sUAS Transported Disruptor

Operation & Maintenance Manual

Revision A

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SYSTEM OVERVIEW

The Public Safety Bomb Technician (PSBT) and military Explosive Ordnance Disposal (EOD) communities are faced with constantly evolving threats and seek emerging technologies to neutralize, disrupt, or destroy improvised explosive devices.

The sUAS Transported Disruptor System consists of a ready-to-fly, heavy-lift Hexacopter and a Carbon Fiber RTS remote disruptor turret. The Hexacopter is equipped with a winch and gripper/release mechanism to deliver the RTS to a remote threat devise.

The hexacopter comes from the manufacturer with only the gripper/release mechanism installed on the payload mounting plate. It is strongly recommended that the user trains with the aircraft before installing the winch, as a suspended payload causes inherent stability issues.

The sUAS comes pre-calibrated and tuned, so it is ready-to-fly. This manual guides you through unpacking, completing your first flight, troubleshooting, and maintenance operations. The latest version of the manual as well as links to subsystem and software manuals are available for download at http://www.impact-rt.com/sUAS/manuals.html.
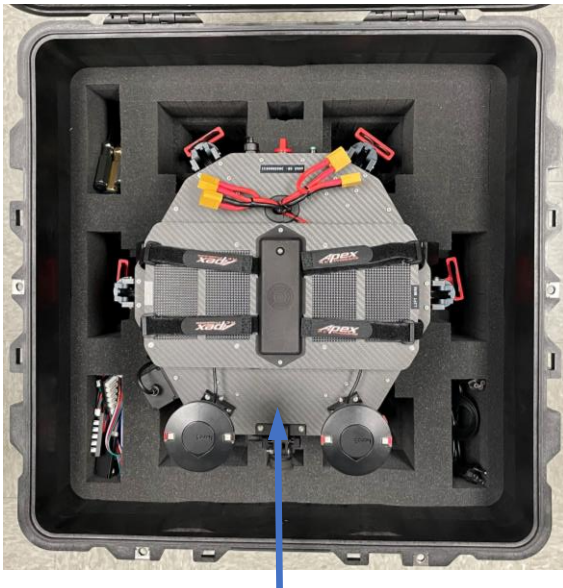
UNPACKING INSTRUCTIONS
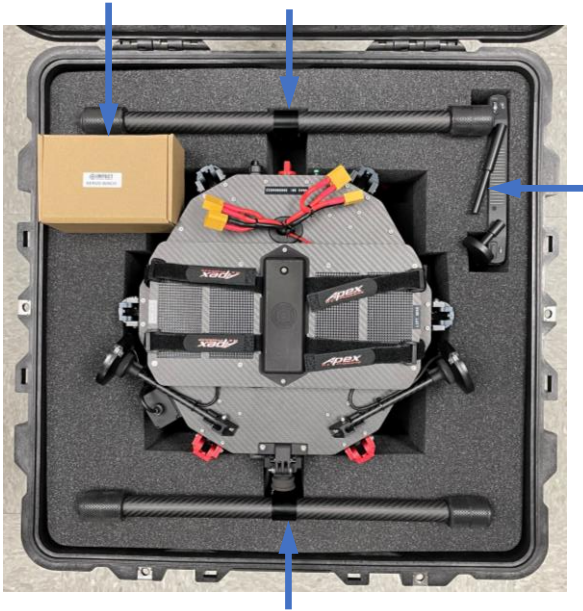
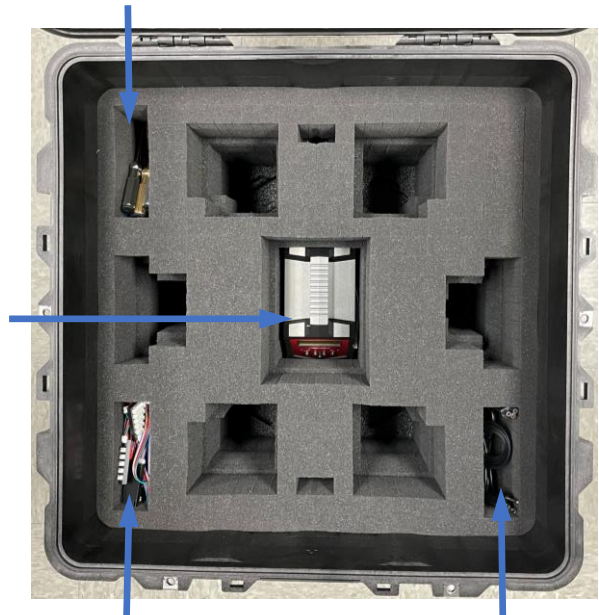1. Remove Controller, Landing Skids & Winch. Raise both GPS masts to vertical.
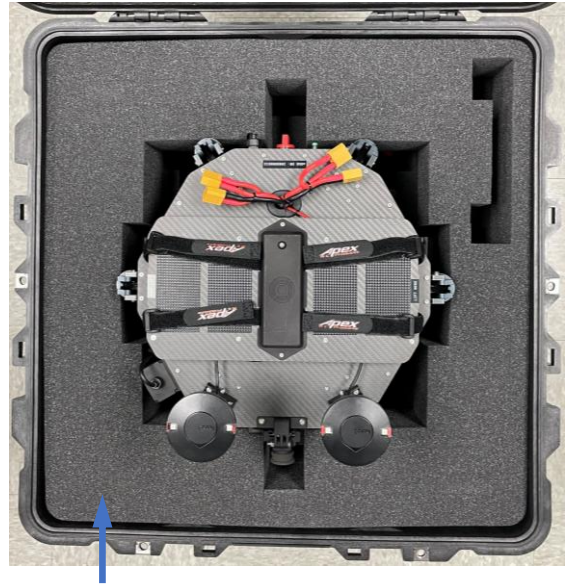
2. Carefully remove the top layer of Foam Packing.

3. Remove Hexacopter by lifting straight up by sides of Battery Tray.

4. Remove the Battery Charger, Cables & Tools.

5. Inspect all wires, screws and connectors for proper installation, tightness, and wear. Do not over-tighten screws. Snug plus 1/4 turn is recommended.

BATTERY CHARGING

Set-Up

1. Plug the charging and LiPo balance cables into the charger.

2. Attach a batteries to the Channels 1-4 cable sets. Both cables from a single channel must be connected to the same battery.

3. Plug the Charger into a 110V outlet with the included power cord.

Charging

1. Verify that LiPo Charge, 7.0A, and 22.2V(6S) are displayed as shown. If not, refer to the charger user manual to change the settings. The red LED indicates the current channel.

2. Long press START. The charger will perform a battery check.

3. When prompted, short press ENTER to initiate charging.

4. Press CHANNEL to switch to the next battery and repeat Steps 2 and 3 to initiate charging.

5. Repeat Step 4 until all 4 batteries are charging simultaneously.

6. The charger will Beep as each battery becomes fully charged.
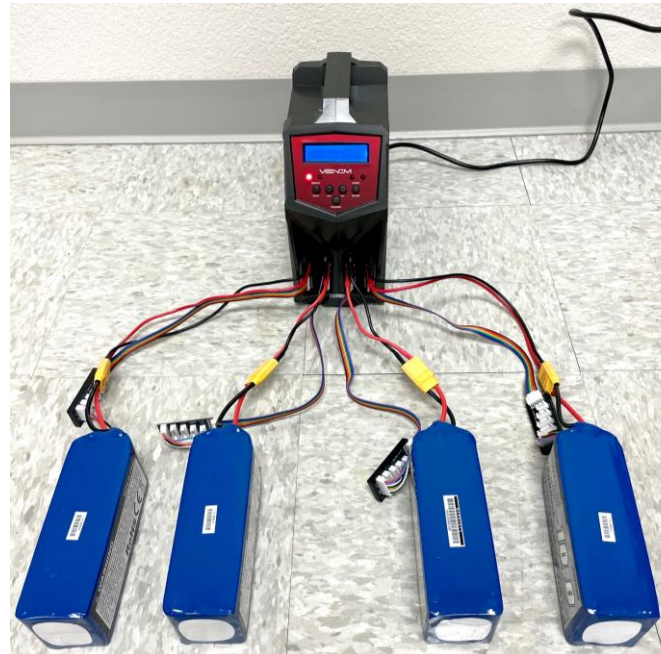
Controller - **The controller is charged via the micro USB port on the bottom of the unit. Pressing the Home button displays charging progress.**

AIRCRAFT ASSEMBLY

Landing Gear

1. Insert the Right-Side Landing Gear tube into the Right-Side Mount on the bottom of the aircraft while pressing the Locking Pin.

2. Rotate until the Locking Pin clicks in place, securing the Landing Gear.

3. Inspect the Landing Gear for excessive play. If necessary, slightly tighten the clamping screws to reduce play.

4. Repeat for the Left-Side Landing Gear.
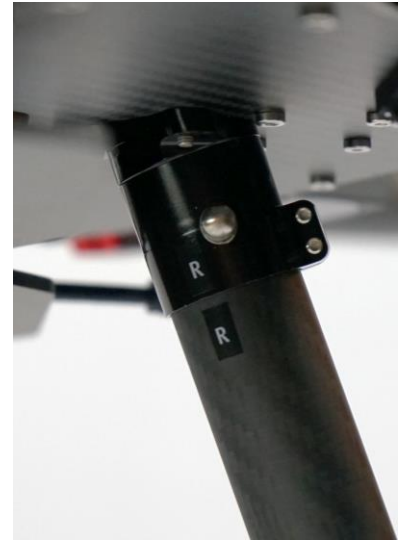
GPS

Rotate the two (2) GPS masts until they snap into their upright positions as shown.

GPS

AIRCRAFT ASSEMBLY (CONT.)

Batteries

1. Center two (2) batteries between the straps on each side of the battery tray with the battery cables toward the rear of the aircraft.

2. Align the front faces of the batteries to the front edge of the battery tray to ensure maximum support and to maintain the aircraft's center of balance.

3. Secure the four (4) Velcro straps by threading the outer straps through the buckles on the inner straps, pulling tight, and securing the Velcro.

4. **DO NOT PLUG THE BATTERIES INTO THE BATTERY CABLES AT THIS TIME.**

ALIGN

Arms & Blades

1. Rotate each arm upward until it locks in the horizontal position.

2. Remove the red blade retention clips and straighten the propellers as shown.

Inspection

Inspect all wires, screws and connectors for proper installation, tightness, and wear. **Do not over-tighten screws. Snug plus 1/4 turn is recommended.**

Note: The sUAS is shipped with three unconnected auxiliary power cables for future use. The two 5V and one 12V cables are located next to the forward-facing FPV camera. There is also an unconnected winch connection cable on the bottom of the airframe.

CONTROLLER OVERVIEW

1080P Touch Screen

Land Flight Mode

Gripper Control Thumb Wheel

Throttle (up/down) Rotation (left/right)

Pitch (up/down) Roll (left/right)

Pos-Hold Flight Mode

Winch Up

Winch Down

Alt-Hold Flight Mode

RTL Flight Mode

Power

Pre-programmed Flight Mode Buttons (See page 13 for Flight Mode descriptions):

1. **Short press A: Pos-hold**
2. **Long press A: Auto**
3. **Short press B: Alt-Hold**
4. **Long press HOME: RTL**
5. **Short press right shoulder button: Land**

POWER-UP

Aircraft Flight Controller & Accessories

1. Place aircraft in an open area with no overhead obstructions.

2. Ensure that the MOTOR PWR switch is in the OFF position to prevent sparking when the batteries are connected.

3. Connect the 4 batteries to the aircraft's battery cables.

4. Press and hold the green CPU ON/OFF button until the aircraft's flight controller and fan power on.

Controller – Press and hold the power button to start the controller

Start-up Screen

Select Solex TX

With the aircraft powered up, select "Connect" to pair the controller with the sUAS

Once paired with the sUAS, select the airplane button to enter the flight control screen
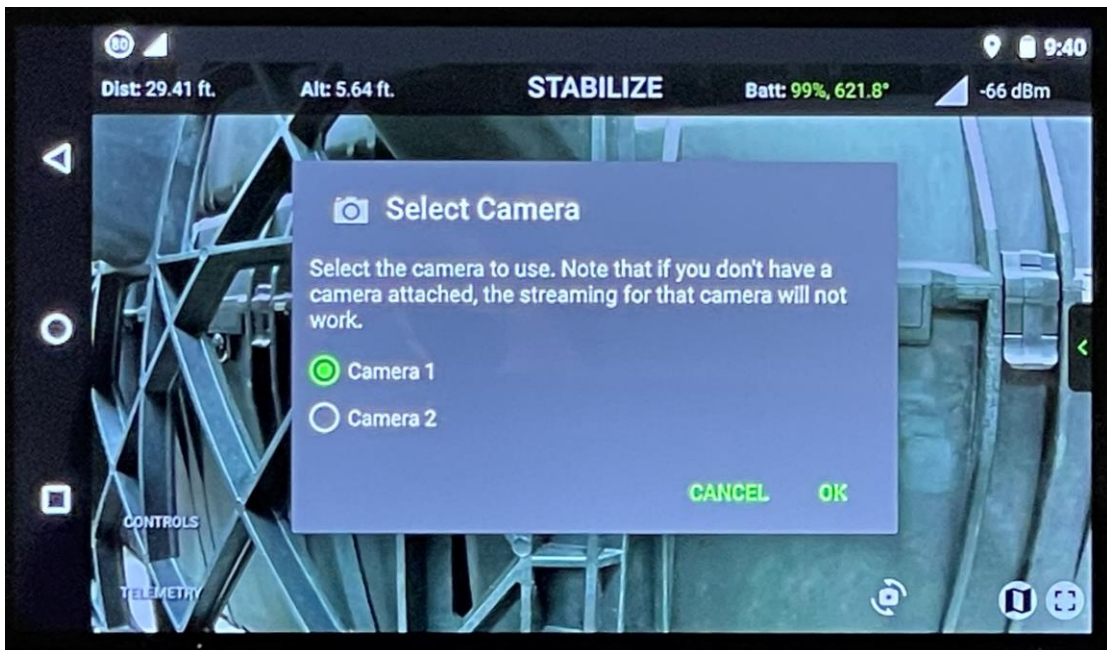
POWER-UP (CONT.)

Select "CONTROLS"

Current flight mode. Press to change flight modes

Press to change video feed between forward and downward-facing cameras

Camera 1: Forward-Facing FPV

Camera 2: Downward-Facing

FLIGHT MODES

The default flight mode at boot-up for the ArduCopter flight control software is Stabilize. **We do not recommend operating the aircraft in this flight mode, and it must be changed to either Pos-Hold or Alt-Hold prior to arming the aircraft.**

Approved flight Modes are:

1. Alt-Hold – Altitude Hold maintains altitude and stability when throttle is centered. Position and flight speed is controlled manually.

2. Pos-Hold – Position Hold maintains altitude, stability, and position when both controller sticks are centered. The aircraft will automatically correct for disturbances that force it from its held position.

3. Auto – Auto mode executes preplanned missions. **Caution: Always verify that the loaded mission plan is applicable to your location and flight plan. An unexecuted mission plan from a previous operator will remain loaded until its either deleted or executed. If a mission is inadvertently executed, immediately change the flight mode to AltHold or PosHold to retake control of the aircraft.**

4. RTL – Return to Launch automatically takes the aircraft to a pre-specified safe altitude, then returns and lands at the takeoff location. **This flight mode automatically executed when communication between the controller and aircraft is disrupted.**

5. Land – Automatically lands the aircraft at its current location.

FIRST FLIGHT

Power Motors

Rotate the MOTOR PWR knob 90 degrees clockwise to the on Position. The propellers will chirp and twitch, but they will not spin until the aircraft is Armed with the Controller.

Arm Aircraft

Press the Arming button. The motors will stop chirping and emit a long tone to indicate proper electronic speed controller (ESC) calibration, but they will not spin until the Controller is also armed.

Prior to Arming the Controller, ensure that the GPS has acquired and locked in satellites. This is indicated by a Solid Green LED on the GPS.

The aircraft will operate in GPS-denied environments, but the Auto and Return to Launch (RTL) flight modes cannot be used.

Arming Button

Arm Controller/Start Motors

1. Change Flight Mode – The default Flight Mode is Stabilize at boot-up. Short press the "A" button on the controller to change the Flight Mode to Pos-Hold.

2. Ensure that the aircraft and takeoff area are clear of obstructions.

3. Click the Arm/Disarm symbol on controller touch screen's left toolbar. The controller will audibly announce that the Aircraft is armed, and the propellers will begin to spin at idle.

Arm/Disarm   **Current flight mode**
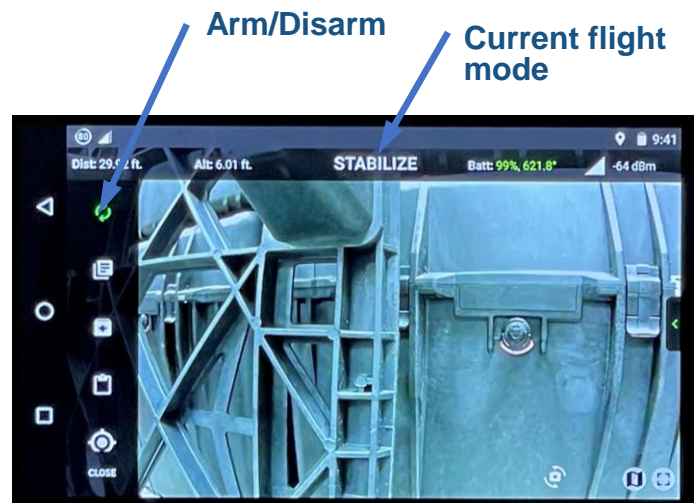
FIRST FLIGHT (CONT.)

Take-off

Ensure that the aircraft and takeoff area are clear of obstructions. Slowly raise the throttle stick until the aircraft reaches 1-2 meters above the ground and release the throttle. The aircraft will maintain it's current altitude, position and orientation by making subtle corrections when forced from its position by wind or other forces.

Throttle (up/down)
Rotation (left/right)

Pitch (up/down)
Roll (left/right)

Flight

1. Apply throttle to raise the aircraft to a safe altitude.

2. Use the right control stick to move the aircraft laterally in the direction of the stick movement.

3. Move the left control stick side-to-side to rotate the aircraft.

Auto Land

Auto Land Mode is recommended due to the aircraft's long landing gear and high center of gravity. Excess speed or lateral movement during touchdown may cause the aircraft to roll over.

1. Ensure that the landing area is clear of obstructions.

2. Short press the right shoulder button to LAND. The aircraft will slowly descend, land and disarm. The propellers will stop, and the controller will audibly announce that the aircraft is disarmed. It is now safe to approach the aircraft.

Land

POST-FLIGHT

Power Down Aircraft

WARNING: The power to the motors must be turned off before powering down the flight controller. Failure to do so may result in a power surge which could spin the propellers.

1. Once the aircraft is disarmed and the propellers have stopped, rotate the MOTOR PWR switch counter-clockwise to the OFF position

2. Press and hold the green CPU ON/OFF button until the aircrafts flight controller and fan power off.

3. Disconnect all four (4) batteries from the aircraft's battery cables. The aircraft is now SAFE.

Power Down Controller

Press and hold the controller's power button, then select Power Off to shut down the controller.

**Power Button**

WINCH & GRIPPER INSTALLATION

Remove The Payload Mounting Plate

1. Carefully unplug the micro-HDMI cable from the downward-facing camera on the underside of the sUAS.

2. Disconnect the downward-facing camera's power cable.

3. Remove the four (4) M4 corner screws securing the payload mounting plate and remove the plate from the aircraft.

4. If previously installed, remove the servo gripper from the mounting plate.
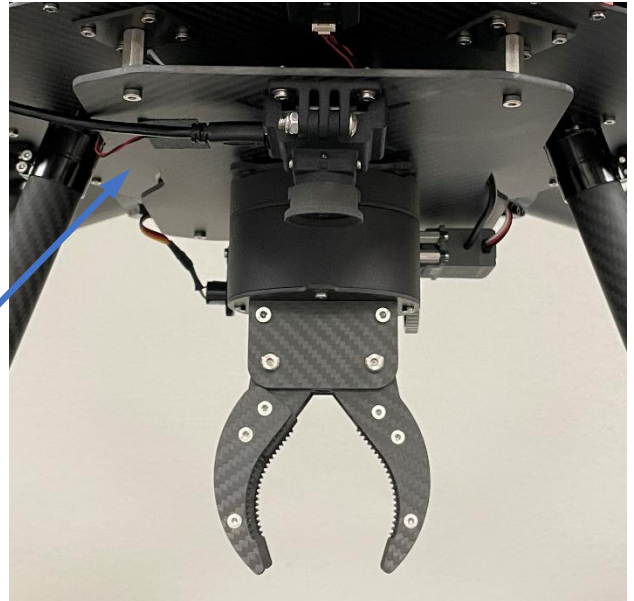

Install the Servo Winch

1. Install the servo winch to the bottom side of the mounting plate as shown, using the four (4) M4x12 screws provided with the winch. Do not over tighten the screws. We recommend using blue Loctite medium thread locker and tightening the screws snug plus 1/4 turn.

2. Install the limit switch to the top side of the mounting plate as shown, using the two (2) m3x8 screws provided with the winch.
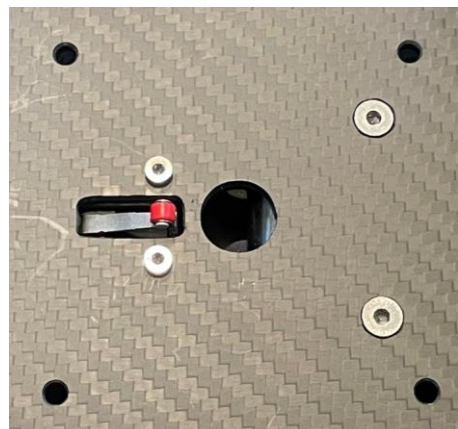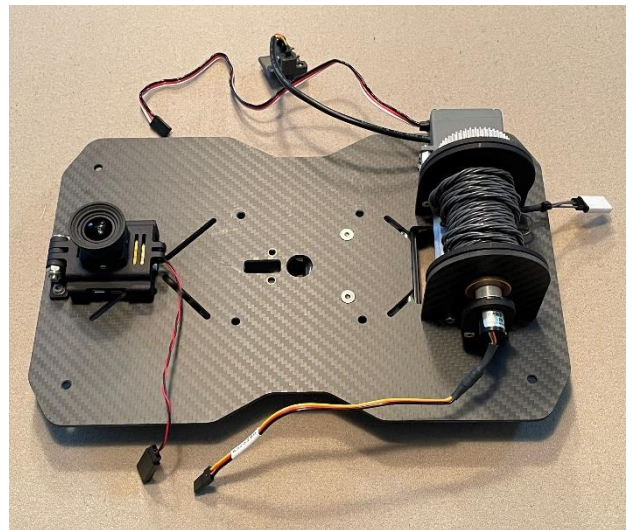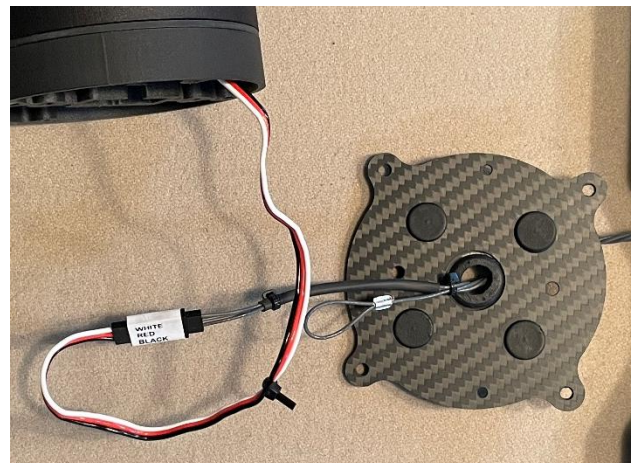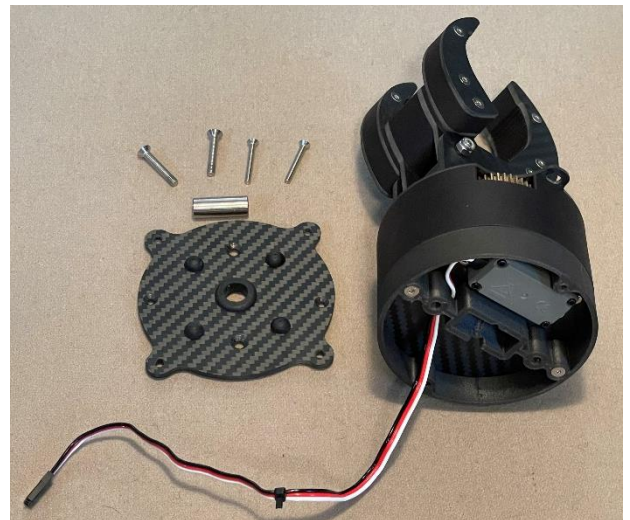
WINCH & GRIPPER INSTALLATION (CONT.)

Install the Servo Winch (Cont.)

3. Uncoil about 1-ft of winch cable and feed the end up through the rectangular opening, over the guide rollers, and back down through the hole in the center of the mounting plate as shown.
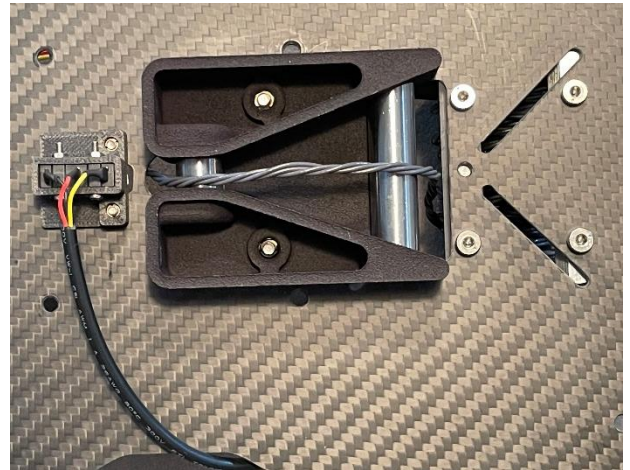

Connect the servo gripper

1. Remove the four (4) screws securing the top cover of the servo gripper and remove the cover and steel roller as shown.

2. Feed the end of the winch cable through the gripper cover as shown.

3. Connect the gripper's servo connector to the mating connector on the end of the winch cable.
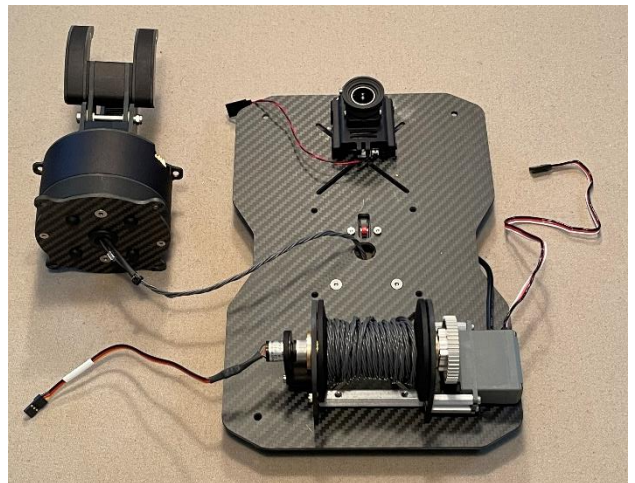
WINCH & GRIPPER INSTALLATION (CONT.)

Connect the servo gripper (Cont.)

4. Secure the winch cable to the gripper by inserting the steel roller pin through the cable loop and installing the roller into the gripper as shown.
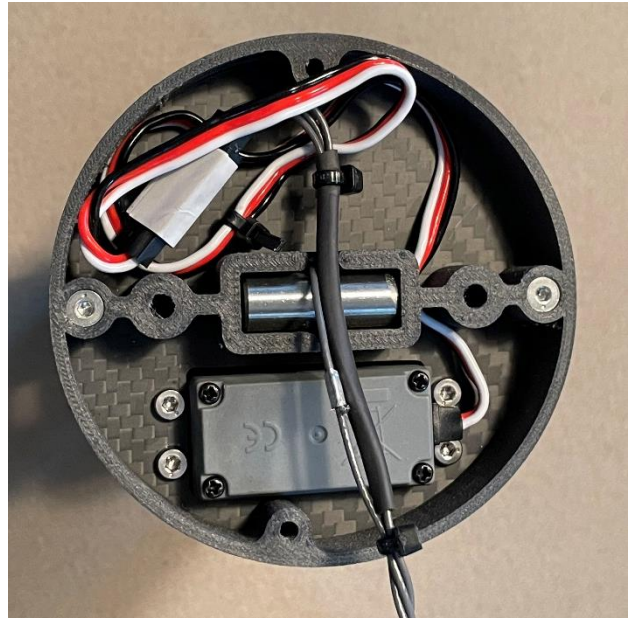

5. Carefully reinstall the gripper cover, ensuring that the lifting and servo cables do not get pinched.

WINCH & GRIPPER INSTALLATION (CONT.)

Reinstall Payload Mounting Plate

1. Reinstall the four (4) M4 corner screws, securing the payload mounting plate to the posts on the bottom of the airframe. Do not over tighten the screws. We recommend using blue Loctite medium thread locker and tightening the screws snug plus 1/4 turn.

2. Connect The winch and gripper cables to their mating cables on the sUAS.

3. Reconnect the micro-HDMI cable into the downward-facing camera.

4. Reconnect the downward-facing camera's power cable into a black and white 12V power cable on the sUAS.

5. Secure loose cables by tucking them between the airframe and the payload mounting plate and/or by taping them to the aircraft. We recommend cloth gaffer's tape.
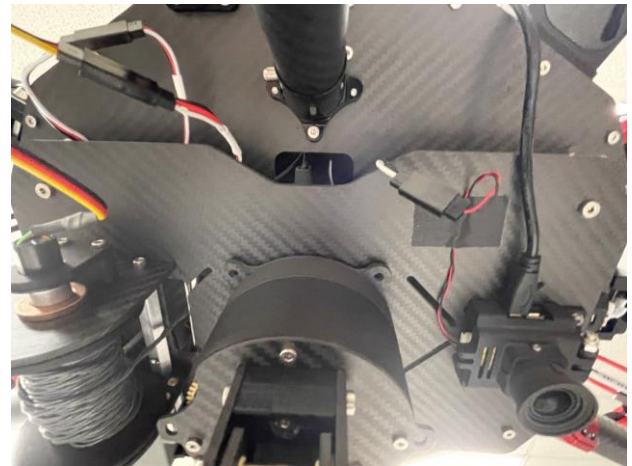
WINCH & GRIPPER OPERATION

Gripper Control Thumb Wheel

1. To LOWER the winch payload, short press the "C" button on the bottom-right corner of the controller. To STOP the winch, long press and release the "C" button.

2. To RAISE the winch payload, short press the "D" button on the bottom-right corner of the controller. To STOP the winch, long press and release the "D" button.

3. Use the thumb wheel on the upper-left shoulder of the controller to open and close the servo gripper. Rotate clockwise (right) to OPEN and counterclockwise (left) to CLOSE the gripper.

Winch Down

Winch Up

Maintenance

Inspection

Inspect all wires, screws and connectors for proper installation, tightness, and wear. **Do not over-tighten screws. Snug plus 1/4 turn is recommended.**

Inspect Lithium Ion (LiPo) batteries. Dispose of and replace any damaged or swollen batteries.

Arm Adjustment

The arms should be adjusted to partially fold downward when the release knobs are pushed in toward the center of the aircraft. The arms should not freefall all the way against the airframe or landing gear. Loosen or tighten the arm bracket pivot screw on each arm to ensure proper adjustment.


Arm Release Knob

Arm Piot Screw
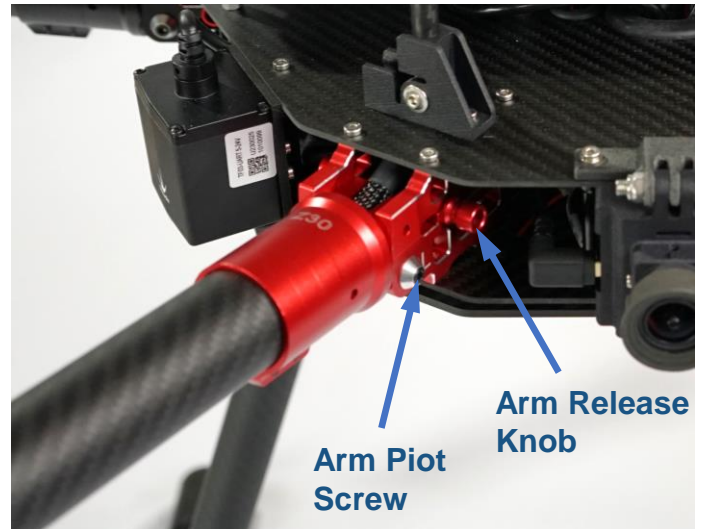
Propeller Replacement

Cracked or broken propellers can cause excessive vibration and should be replaced as soon as possible.

WARNING: Installing any of the six (6) propellers incorrectly will cause the aircraft to flip and result in a crash!

The sUAS hexacopter features alternating clockwise and counterclockwise motors per the diagram to the right. Propellers are also made in clockwise and counter-clockwise models, and the must be properly matched to the motors in the positions shown. Part numbers for the propellers are as follows:
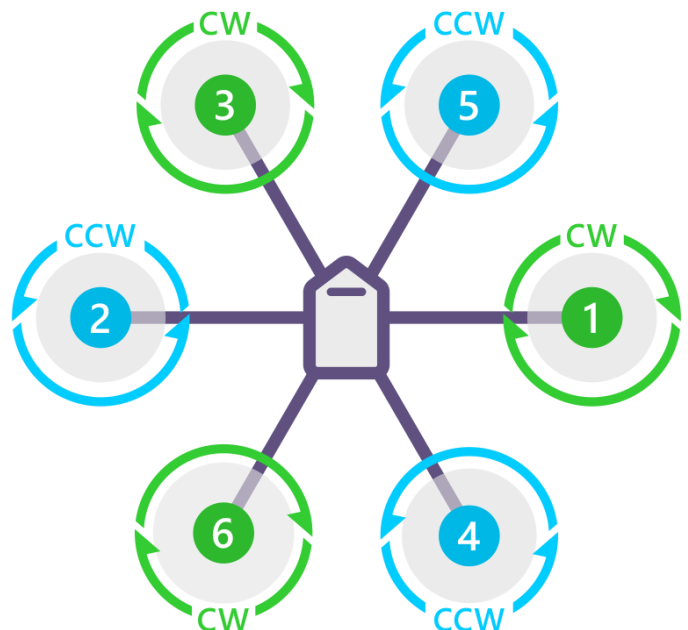
1. Clockwise: T-Motor MF-2211L
2. Counterclockwise: T-Motor MF-2211R

MAINTENANCE (CONT.)

Cleaning

Use only dry wipes when possible, and if necessary, use wipes dampened with water or non-solvent-based cleaners. Avoid spraying cleaners directly on the aircraft or the controller.

Long-Term Storage

The drone and controller should be stored in the provided hard case when not in use.

The drone's lithium-ion (LiPo) batteries should be stored inside a LiPo-safe bags or other fireproof container. If the LiPo batteries are to be stored for a long period of time, they must be charged to a storage charge (about 60%) to ensure long life. Refer to your battery charger's manual for storage charging instructions.

TROUBLESHOOTING

Problem / Warning	Potential Cause	Solution
Excessive Vibration	Loose Hardware	Inspect for and tighten any loose hardware.
	Damaged or dirty propellors	Replace cracked or chipped propellers. Clean dirty propellers.
	Misaligned landing skids	Loosen ground skid T-connector screws and rotate skids to align. Retighten screws.
	Loose payload	Ensure that all payloads are secure before flight.
"Compass Inconsistent"	GPS not deployed	Lock GPS mounts in their upright positions.
"Hardware Safety Switch"	Aircraft not armed	Long press Arm/Safety button on flight controller cover between batteries.
"Waiting for GPS" or "GPS Glitch"	Overhead obstructions	Move aircraft to an outdoor area with a clear view of the sky.
"Heater Temp Low"	Flight controller still warming up	Wait for built-in heater to reach target temperature.
"Throttle too high"	Flight Mode is Stabilize	Change flight mode to Pos-Hold or Alt-Hold.

For preflight warnings not list above, please refer to https://ardupilot.org/copter/

ADDITIONAL REFERENCES

Online Manuals

1. http://www.impact-rt.com/sUAS/manuals.html
2. https://docs.cubepilot.org/user-guides/herelink/herelink-overview
3. https://ardupilot.org/copter/
4. https://solex-app.com/

HEAVY LIFT HEXACOPTER

FEATURES

- US-Built Carbon Fiber Airframe
- US-Made Pixhawk Flight Controller
- Integrated GPS and Compass
- LiDAR and Optical Sensors for Precision Altitude and Position Control in GPS-Denied Environments
- Long-Range HereLink HD Touchscreen Tablet Controller
- Dual HD 1080P Camera Inputs - FPV Camera Included
- Additional Power and Controller Ports for Auxiliary Equipment & Sensor Integration
- Downward Folding Arms
- Quick-Release Landing Gear
- Rugged Travel Case

PAYLOAD DELIVERY SYSTEM

Optional Winch & Gripper for Remote Placement of up to 12-lb Payload from up to 2 meters

SPECIFICATIONS

Weight (no Batteries):	18 lbs
Max Payload:	25 lbs
Max Gross Takeoff Weight:	55 lbs
Aircraft Diameter:	48 in
Ground Clearance:	17 in
Props:	22.5" Folding
Flight Time (unloaded):	40 min
Flight Time (12-lb Payload):	20 min
Batteries:	4X 22.2V 10Ah Lipo
Controller Screen:	5.46" Touchscreen
Video Resolution	1080P @ 30/60 fps
Flight Controller:	US-Made Pixhawk 2.1
Control Frequency:	2.4GHz ISM
Control & Video Range:	12 mi (LOS)