



RAPTOR CLAMP™ DIVERTER INSTALLATION SYSTEM

USING THE DJI M300/M350 DRONE

INSTALLATION INSTRUCTIONS

IMPORTANT SAFETY INFORMATION

READ AND COMPLETELY UNDERSTAND ALL INSTRUCTIONS BEFORE INSTALLING PRODUCT. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN DAMAGE TO THE AIRCRAFT, PERSONAL INJURY, OR DEATH.

This product is intended for use by trained operators only. This product should not be used by anyone who is not familiar with and not trained to use it. When working in the area of energized lines, extra care should be taken to prevent accidental electrical contact. Be sure to wear proper safety equipment per your company protocol. These instructions are not intended to supersede any company construction or safety standards. These instructions are offered only to illustrate safe installation for the individual. PLP products are intended for the specified application only. Do not modify this product under any circumstances. Do not reuse or reinstall any PLP product unless that capability is expressly indicated in the product’s Installation Instructions. For proper performance and personal safety, be sure to select the proper PLP product before installation. PLP products are precision devices. To ensure proper performance, they should be stored in cartons under cover and handled carefully.

REFER TO YOUR DRONE USER MANUAL FOR DRONE-SPECIFIC SAFETY CONSIDERATIONS. THIS KIT IS MODIFYING THE AIRCRAFT AND ITS PERFORMANCE CAN BE DETERIORATED WITH INSTALLATION OF THIS KIT. BY USING THIS INSTALLATION SYSTEM, YOU ACCEPT FULL LIABILITY FOR ALL ACTIONS PERFORMED IN ACCORDANCE HEREWITH.

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INTRODUCTION

This system is designed to install PLP® RAPTOR CLAMP Diverters on overhead lines using a drone. The core component is a custom-designed RAPTOR CLAMP Diverter Installation System that easily attaches to a DJI M300/M350 drone (**purchased separately**). This system is designed to allow the pilot and other operator personnel to remain safely on the ground while installing bird diverters, significantly reducing the risks involved when compared to other types of installations. The installation system can carry up to three** RAPTOR CLAMP Diverters at a time in order to maximize the number of devices that can be installed per flight. As such, the diverters are installed at a much faster rate than ground-based installation methods such as using a bucket truck, and at a rate similar to helicopter installations at a significantly reduced cost. Overall, this system is designed to allow the RAPTOR CLAMP Diverters to be quickly installed while also minimizing potential risk to overhead lines and utility personnel.

**As tested at 700 ft. above sea level. Flights at higher altitudes will reduce flight time and may require reducing the number of RAPTOR CLAMP Diverters carried per flight.

A high-altitude propeller kit is available through DJI.

AIRCRAFT SPECIFICATION AND PERFORMANCE CHARACTERISTICS

Parameter	Value (Imperial) (Metric)
Approximate Takeoff Weight (ATOW)	20 lb (9 kg)
Attachment System Weight	5 lb (2.3 kg)
Overall Dimensions with Guards Installed	53 in x 50 in x 16 in (134 cm x 127 cm x 41 cm)
Total Height with Vertical Standoff Installed	66 in (168 cm)
RAPTOR CLAMP Diverters Carried per Flight	3**
Recommended Main Camera	DJI Zenmuse H20 with Integrated Gimble
Service Ceiling*	10,000 ft MSL (3000 m MSL)
Nominal Flight Time**	~ 20 minutes
Practical Crosswind Limitation	10 mph (4.5 m/s)
Turbulence Rating	Light
Recommended Line Angle	0 - 25 degrees
Operating Temperature Range*	-4 - 122 degrees F
Shipping Container Size	58" x 19" x 11" (H x W x D) (1.47 x 0.48 x 0.28 m)
Shipping Container Weight	50 lb

* Based on stock M300/350 performance specifications

** As tested at 700 ft. above sea level. Flights at higher altitudes will reduce flight time and may require reducing the number of clamps carried per flight. A high-altitude propeller kit is available through DJI.

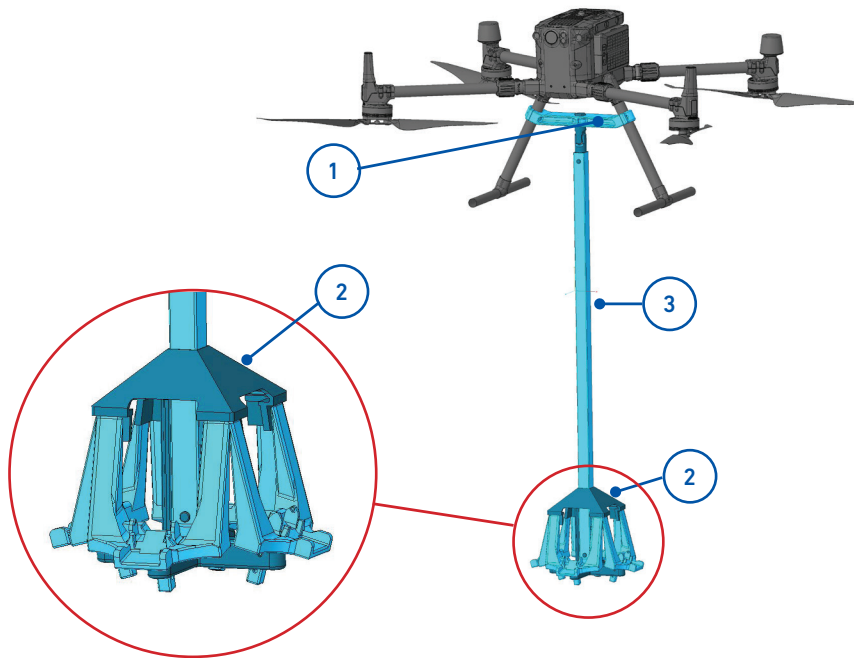
GENERAL OPERATIONAL PROCEDURES

The operator begins by assembling the guard and clamp carrier systems onto the drone (detailed in the following sections) at the desired installation location. The operator then loads the desired number of RAPTOR CLAMP Diverters into the clamp carriers. Then, an experienced, licensed drone pilot and secondary observer fly the system up to conductor height. Using the main camera for assistance, the pilot slowly maneuvers the drone so that the conductor contacts the vertical arm of the installation system somewhere between the drone body and RAPTOR CLAMP Diverter. The secondary observer can help guide the pilot to the correct installation location by viewing the drone and clamp locations using Litchi software on a secondary controller. Once in position, the pilot flies directly upward, guiding the conductor into the clamp triggering mechanism. When triggered,

the clamp automatically locks onto the line while simultaneously disengaging from the drone. The secondary observer can call this action out to aid the pilot. At this point, the pilot slowly backs the drone away from the line and uses the drone camera to verify the clamp is correctly installed on the line. Then, the pilot proceeds to fly the drone to the next installation position and install the remaining diverters. Once all the diverters are installed, the pilot lands the drone to reload additional RAPTOR CLAMP Diverters and the process is repeated until all devices are installed. To land the aircraft, the pilot descends until the vertical arm touches the ground. Once the bottom of the carrier holder touches the ground, the pilot flies slightly forward and down, folding the vertical arm until the drone landing gear is on the ground, at which point the propellers can be stopped.

COMPONENTS

PART A - CLAMP CARRIER SYSTEM



PART B - PROPELLER GUARD SYSTEM

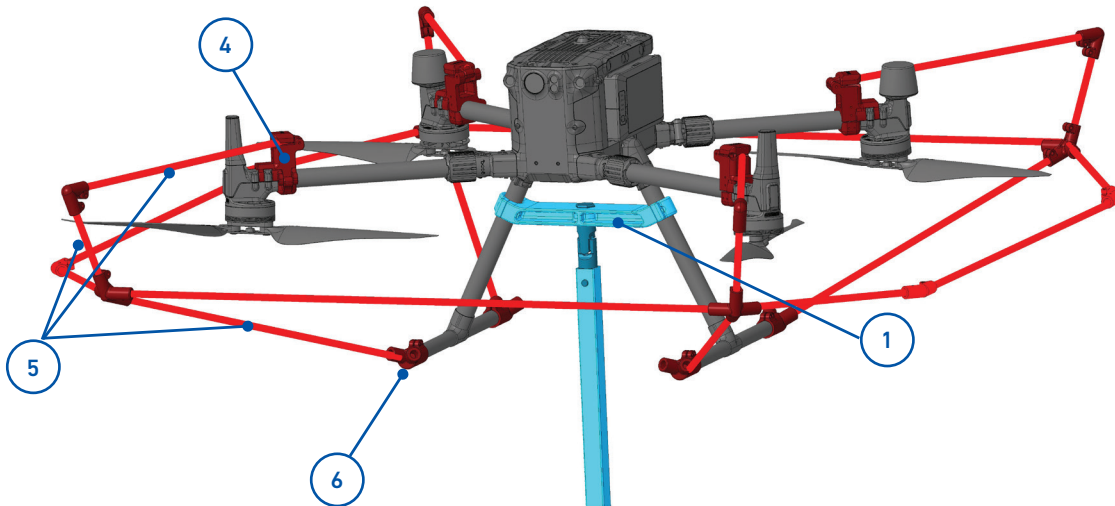
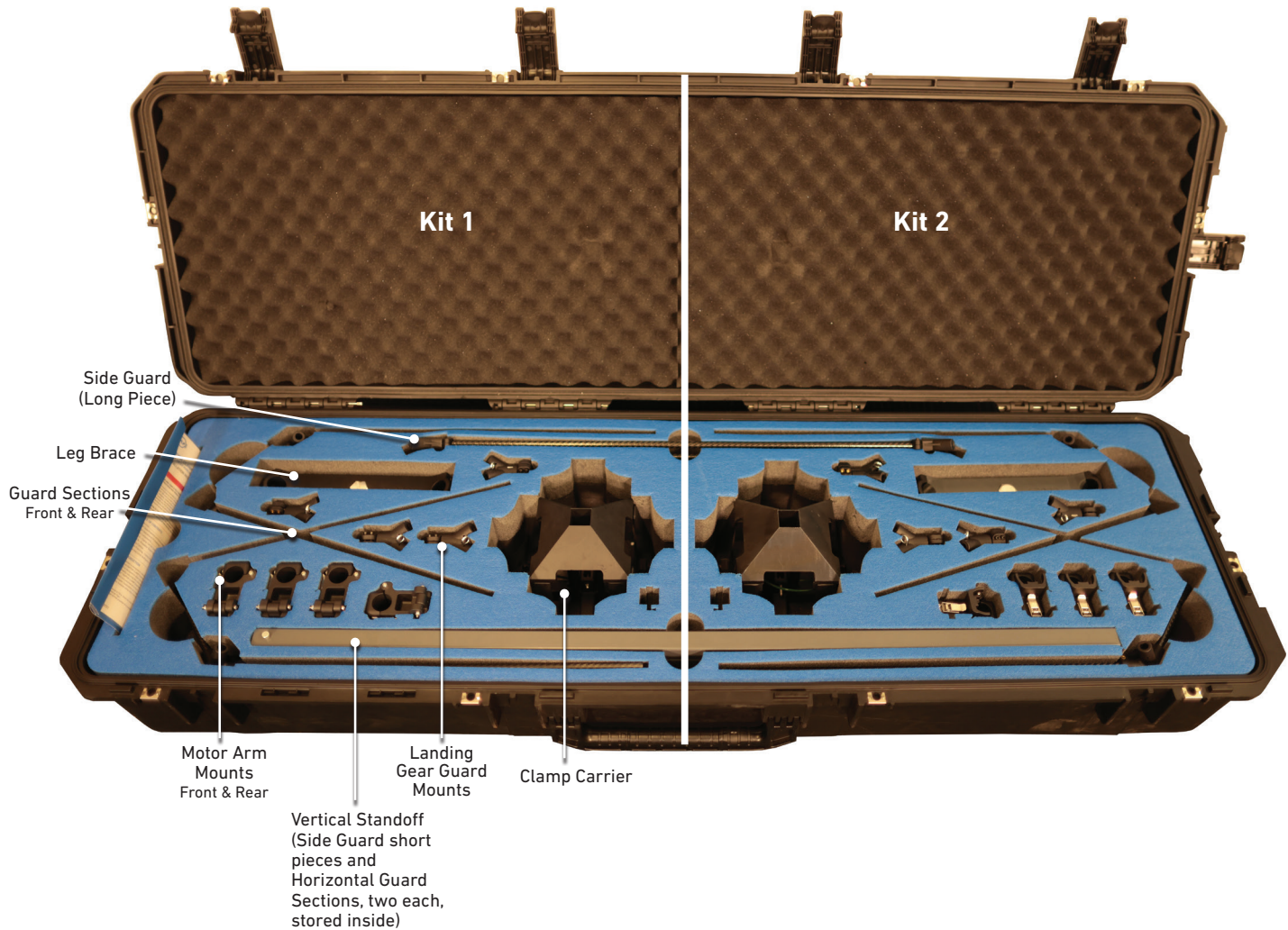


Diagram Number	Catalog Number	Description	Tools Required
1	LANDING GEAR BRACE ASSEM	Leg Brace Assembly with Pivot Joint (1)	2.5 mm Allen wrench (1) 3 mm Allen wrench (1)
2	CLAMP CARRIER ASSEM	3-Position Clamp Carrier Assembly (1)	
3	VERTICAL ROD KIT	Vertical Standoff Rod Kit 42 in (1)	
4	UPPER GUARD SYS MOUNT	Motor Arm Guard System Mounting Kit (4 guard mounts)	
5	GUARD SYSTEM	Prop Collision Guard System (1)	
6	LOWER GUARD SYS MOUNT	Landing Gear Guard System Mounting Kit (4 guard mounts)	
M300/350 RAPTOR INST KIT		RAPTOR CLAMP Diverter Drone Installation Single System	
M300/350 RAPTOR INST DBL		RAPTOR CLAMP Diverter Drone Installation Double System	
RAPTOR CLMP INST SYS CASE (Not Shown)		M300 RAPTOR CLAMP Diverter Installation System Case	

PART A – CLAMP CARRIER SYSTEM

These system installation steps are required to install the clamp carrier system onto an off-the-shelf DJI M300/M350 Drone. The clamp carrier system is designed to securely hold multiple RAPTOR CLAMP Diverters for installation onto overhead lines. It consists of a main carrier body and a large dielectric vertical standoff that helps to guide the overhead line into the clamp triggering mechanism.



1

Begin by bolting the leg brace onto the M300/M350 frame. Ensure that the brace is sitting level relative to the main drone body before fully tightening the mounting screws.

NOTE: The pivot joint and vertical standoff adapter are pre-installed in the leg brace.

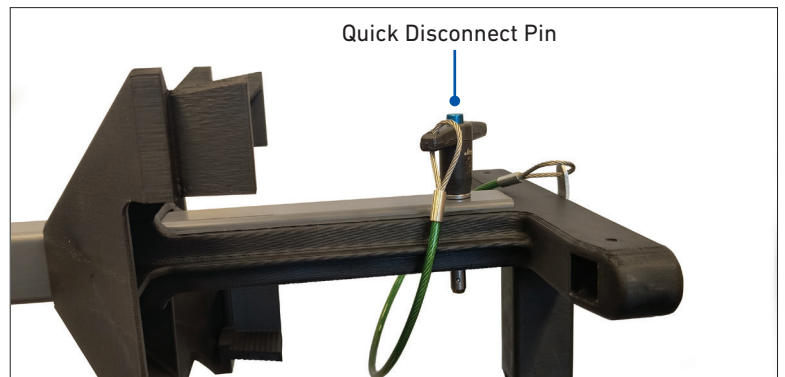


- 3 Inspect the clamp carrier holder to ensure that the clamp carriers are firmly attached.

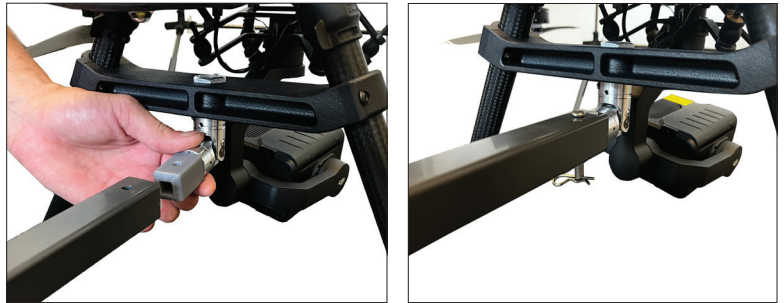


- 2 Next, attach the vertical standoff to the clamp carrier holder using the supplied quick disconnect pin. Make sure to loop the pin lanyard around the inside of the vertical standoff. This is to minimize the chance of the lanyard getting caught on anything.

NOTE: It is common practice to store the long carbon fiber guards inside the vertical standoff. Make sure the rods are removed from the vertical standoff before attaching the vertical standoff to the drone.



- 4 When ready to begin the field installation, attach the clamp carrier assembly to the pivot joint using the supplied pin and cotter key. Ensure the empty side of the clamp carrier will face the rear of the drone when the clamp carrier assembly hangs vertical.



PART B – PROPELLER GUARD SYSTEM

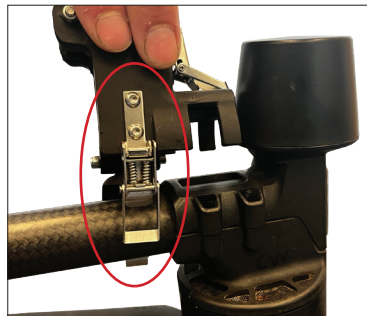
These system installation steps are required to install the propeller guard system onto an off-the-shelf DJI M300/M350 Drone.

The propeller guard system is designed to provide a measure of protection to the rotating propellers during specific flight and landing situations. They may help prevent the propellers from contacting the ground in the event the drone begins to tip over while landing with the vertical installation system.

NOTE: The guard system is not designed to provide 100% protection in all situations.

1

Start by attaching the motor arm mounts to the drone. The two labeled “FRONT” go towards the camera side of the drone, and the ones labeled “REAR” go on the back side of the drone. Simply align the tabs with the geometry of the motors and fasten the lower latch to secure them.

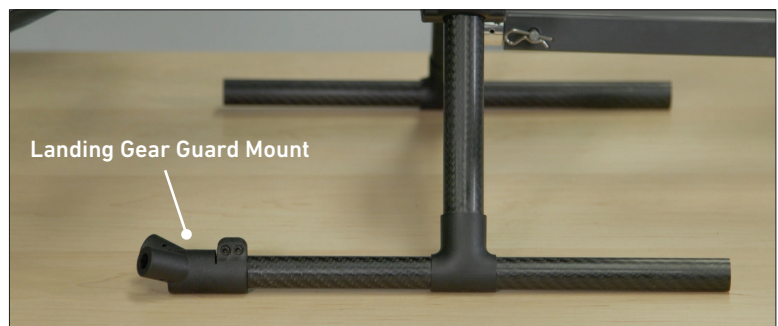


2

Next, install the four landing gear guard mounts on the ends of the landing gear legs. Remove rubber caps from landing gear legs. Loosen pinch bolts and slide the landing gear guard mounts onto the legs ensuring they are fully seated and the holes are facing up. Tighten the pinch bolts to secure them to the landing guards using a 2.5 mm Allen wrench.

CAUTION

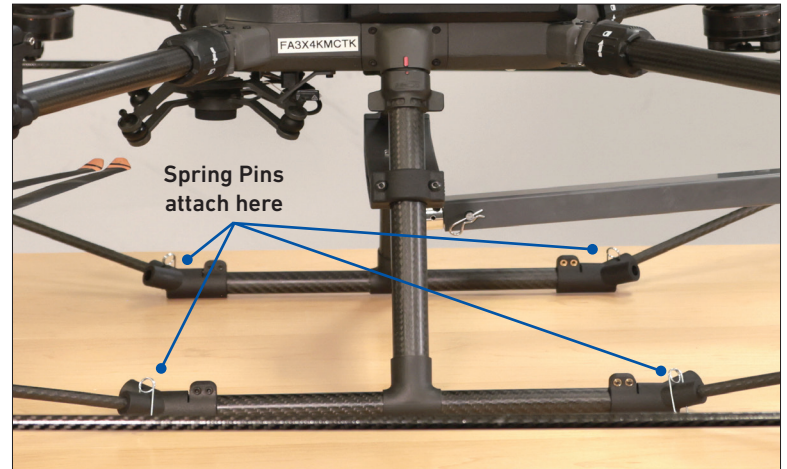
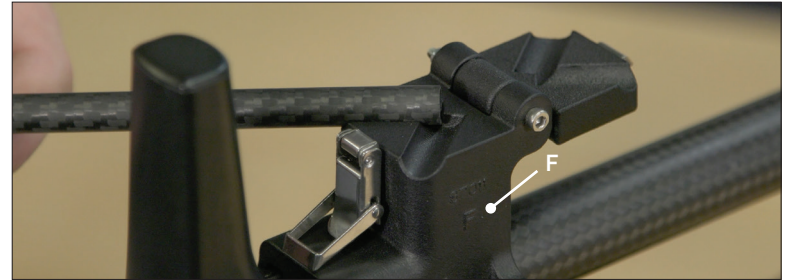
DO NOT OVER-TIGHTEN the mounts as you may damage the plastic.



3

The guard sections are split both front-to-rear and left-to-right. Front/Rear can be differentiated by the **F** and **R** printed on the guards. Left/right can be differentiated by aligning the spring pin holes in the carbon fiber rods and the landing gear guard mounts.

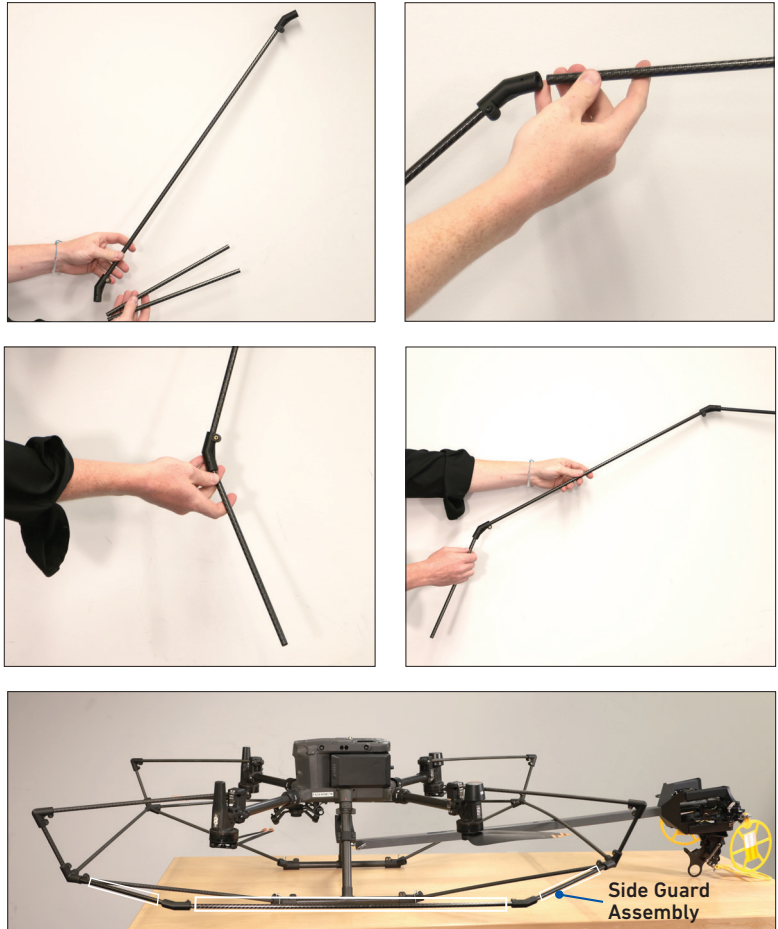
Make sure the top latch of the motor arm mount is open. Slide one of the front carbon fiber guards into the outside hole of the landing gear mount and place the other end in the motor arm mount. Secure the landing gear guard piece using one of the provided spring pins. Then, while ensuring the motor arm guard is fully seated in the motor arm mount, fasten the top latch of the motor arm mount. Repeat for all four landing gear sections.


4

Next, install the two horizontal guard sections at the front and rear of the drone. Slide each end into the previously installed guards.

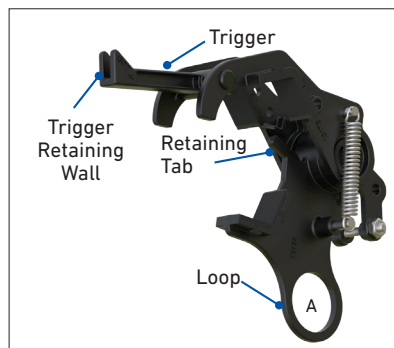


- 5 To install the side guards, insert a short carbon fiber guard rod into each end of the side guard rod to create the side guard assembly. Next, insert each end of the assembly into the remaining open holes on the guards mounted to the motors. Repeat this process on the other side of the drone. If needed, it is ok to open the motor arm mounts to gain some flexibility during final assembly. If this is needed, ensure the motor arm mounts are re-latched after assembling the guards. This completes the guard installation.



LOADING CLAMPS

- 1 To load a RAPTOR CLAMP™ Diverter into the carrier system, begin by setting the clamp trigger. To do this, fully open the clamp by grasping the top hooks in one hand and the loop in the other hand and pull the two apart until rotation stops. Using the plastic tab on top of the swinging trigger, rotate the trigger into the set position. While holding the trigger in this position, begin forcing the clamp closed until the bottom jaw tab is resting flat against the trigger.



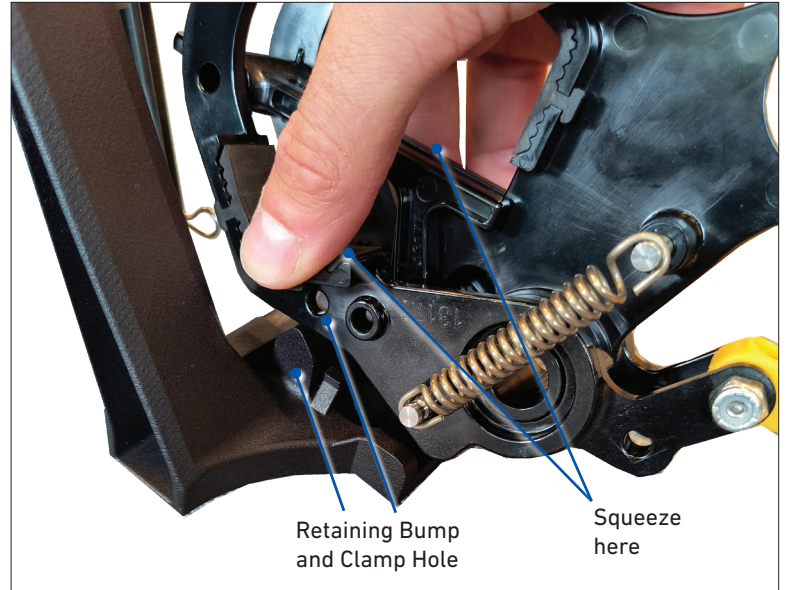
The trigger is set when the tab of the bottom jaw half is resting against the retaining wall.



Watch the RAPTOR CLAMP Diverter installation video.

2

At this point the clamp is set and ready to be inserted into the carrier. The clamp is held by the carrier using two small plastic bumps on the carrier arms. These bumps line up with two holes in the clamp arms. The clamp is simply pressed into the carrier until the bumps click into the clamp arm holes. It is helpful to squeeze the clamp sides inward during the installation to allow the clamp to slide into the carrier easier. Install a RAPTOR CLAMP Diverter in each of the open carrier positions.



MISSION PLANNING - CLAMP PLACEMENT AND FLIGHT CONTROL SOFTWARE

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Ensuring correct clamp placement on a line can be difficult when piloting the drone from a remote location on the ground. Many utilities require a specific clamp spacing distance on a span, typically between 15 ft and 20 ft. To assist with achieving the required spacing, we recommend using Litchi flight control software (**purchased separately**). This software allows the clamp installation locations to be pre-mapped before the flight using a desktop pc or laptop. The Litchi program will allow these maps to be accessed using the built-in drone controller screen. During the flight, the pilot or secondary observer can view the drone's position relative to the pre-mapped clamp locations on the flight control screen. Using this, they can assist the pilot in making sure the drone is positioned at the desired installation locations to ensure the clamps are evenly spaced throughout the installation.

NOTE: While the built-in DJI Pilot 2 software is another option for this application, we have found that Pilot 2 does not allow for accurate clamp placement compared to the Litchi software.

The maps in Pilot 2 do not allow enough zoom level to see the difference between points at installation spacing distances of 25 ft or less.

NOTE: Once installed, a clamp cannot be removed or repositioned using the drone. This means that initial clamp placement is critical to ensure the installed spans meet the utility's requirements.

The Litchi flight control software is available for download on Apple and Android devices. When using a pc, the online version is available at flylitchi.com and is recommended. We recommend downloading and installing the app on all controllers that will be used for the clamp installation process. We recommend missions be planned using a personal computer with the online Litchi version. The larger screen and better interface make it easier to plan missions vs. using a tablet in the field. If needed, points can be plotted or moved using a tablet or controller. Litchi has an intuitive interface, and manuals are available on their website for specific questions. Below is a brief overview of the mission planning process.

INSTALLING THE LITCHI DRONE CONTROL APP ON THE M300/M350 CONTROLLER

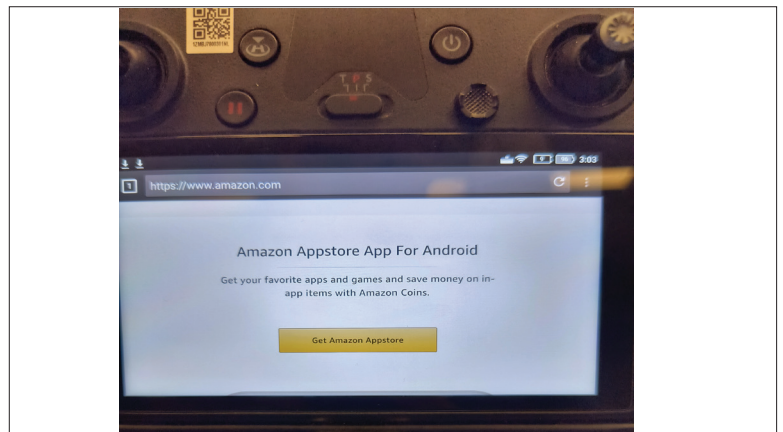
The recommended Litchi drone control app can be installed on both the primary and secondary controllers so that clamps can be accurately placed in the field. Below are the steps required to do this.

- 1 First, turn on the controller. Press the button with four squares in the bottom right-hand corner of the screen to view installed apps on the controller.

Open the “Lightning Browser” app. Type “Amazon App Store” into the top address search bar and press enter. Navigate to Amazon.com and click on “Get Amazon App Store” for android devices. The first download will fail.

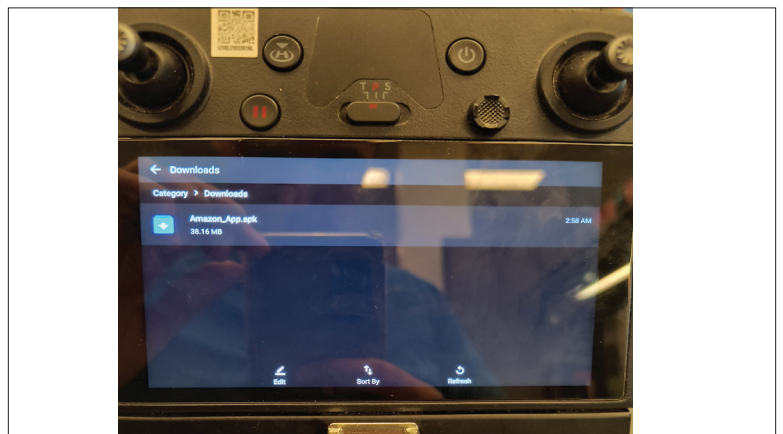


- 2 Click on “retry download” until the file is successfully downloaded as indicated by the download arrow in the top notifications bar.

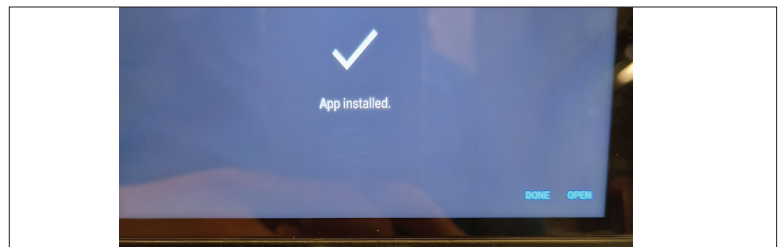


- 3 Using the physical back button located in the upper left hand controller side, exit the lightning browser application and return to the main controller screen.

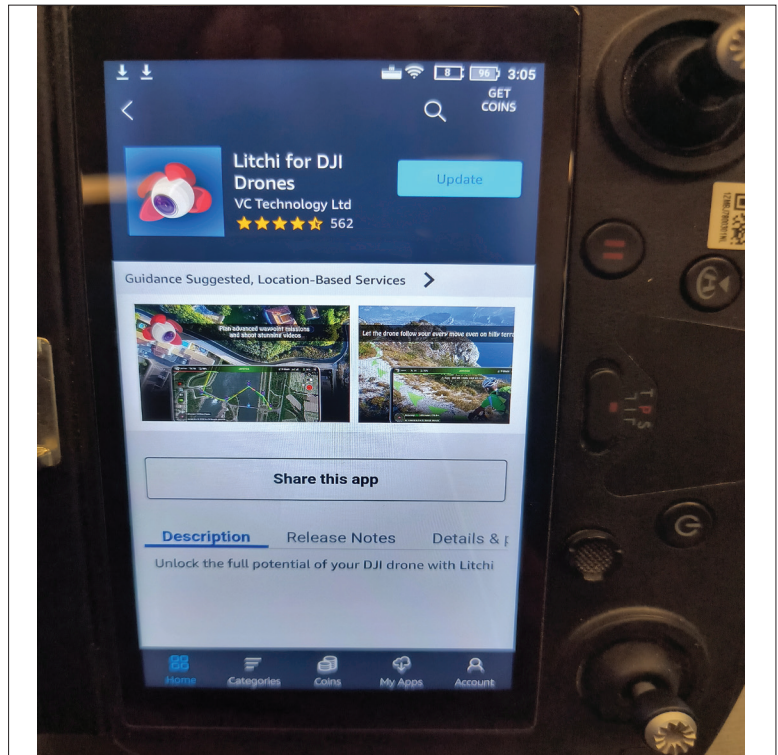
Tap on the “file manager” icon, then tap the “downloads” folder and locate the Amazon.apk file. It should be at the top of the downloads list.



- 4 Tap on the Amazon.apk file and then tap “Install”.

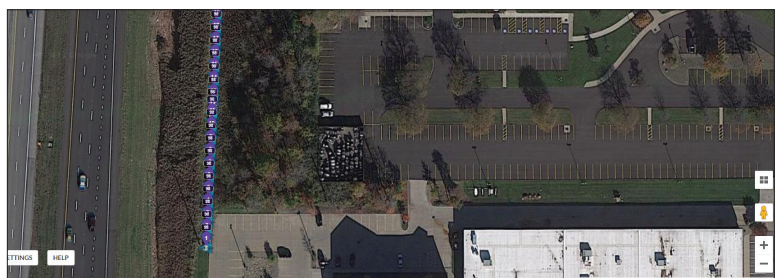


- 5 Once installed, use the physical remote controller back button to return to the main controller home screen.
 Tap on the Amazon App symbol to open the app store. Type the word "Litchi" into the search bar to bring up the Litchi app.
 Click "download" to install the app and follow the screen prompts to complete the install.
 Return to the controller home screen and open the Litchi app and sign in to begin using the clamp placement plotting software.



MISSION PLANNING - CLAMP PLACEMENT AND FLIGHT CONTROL SOFTWARE CONTINUED

- 1 To plan a mission, the basic procedure is to navigate to the mission hub tab in the Litchi program and identify the installation line on the satellite image map.



Sample Installation Way point Setup using flylitchi.com.

- 2 Once the line has been correctly identified, click on the first tower in the span to place a reference marker point. This will be the starting point from which all other points are measured. PLP recommends placing the points slightly offset from the line in the direction of installation rather than directly on top of the line. This will make it easier for the secondary observer or the pilot to line up the drone with the points while flying.



Litchi App pictured on the Drone Control Screen

- 3 Next, click on a location a short distance down the line to create the first clamp installation point. Once created, drag the point along the line until the correct spacing is indicated as referenced from the first point, typically 15-20 ft. The distance is displayed in the app.



- 4 Repeat this procedure for the remainder of the clamp installation points.

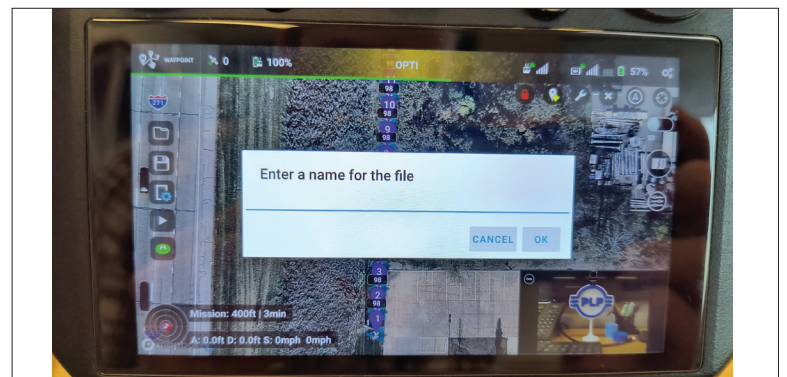
NOTE: It is recommended to only place clamp installation way points along one span per mission. This ensures that the pilot will be able to clearly see the spacing between the points on the flight control screen in the field. When too many points are placed in a single mission, the resolution of the map display screen makes it difficult to distinguish individual points.



- 5 Once complete, click the blue "Missions" button on the bottom of the screen to save the mission.

NOTE: It is good practice to establish a naming convention that incorporates the span number to make identification easier in the field.

Name and save the file.



NOTE: To edit individual points, click on them to bring up individual information on each point. Multiple points can be selected and edited by holding down the Ctrl key while clicking on the desired points. Once in the edit screen, the latitude and longitude values can be used to set the point locations if desired. These are useful to ensure all the points are in a straight line along the power line. Since the automated flight option is not being used, the overall altitude does not need to be set to a specific height. However, you must ensure that all points have the same altitude setting so the distance between points remains correct. The heading setting can be useful to help give a reference point to line up the drone when flying. The heading should be set so that the clamp location marker arrows are all pointing toward the line. When flying, the pilot can line up the drone heading arrow with the clamp installation position arrows to ensure the drone remains perpendicular to the line.

HOW TO USE LITCHI PLACEMENT SOFTWARE IN THE FIELD

1 Once in the field, the pre-planned way point maps can easily be pulled up using the Litchi app on the drone controller screen.

NOTE: In order to pull up pre-planned missions, the Litchi app on the controller needs to be signed into the same account that created the mission.

Simply open the Litchi app and use the file folder icon on the left hand of the screen to open the desired mission. The Litchi app default view is a split screen, allowing the pilot to view the main drone camera as well as the clamp installation way points in the lower right-hand corner of the screen. When flying, the drone position will be displayed on the way point map as an arrow colored differently from the pre-planned clamp installation way points.



2 When installing, the secondary observer or pilot will use the split screen controller view to reference where the drone is, ensuring proper accuracy in the clamp spacing throughout the installation.



- 3 The pilot simply flies the drone so that the drone marker arrow is directly over the clamp installation way point arrow, then flies the final few feet forward to engage the clamp onto the line at that specific location.

The secondary observer can also view the drone way points on the slave controller screen to assist the pilot in ensuring clamps are being installed in their correct positions.



- 4 The secondary observer uses the view from the drone cameras to verify when the clamp has fully engaged the line, at which point the observer can let the main pilot know it is safe to back the drone up and proceed to the next installation position.





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