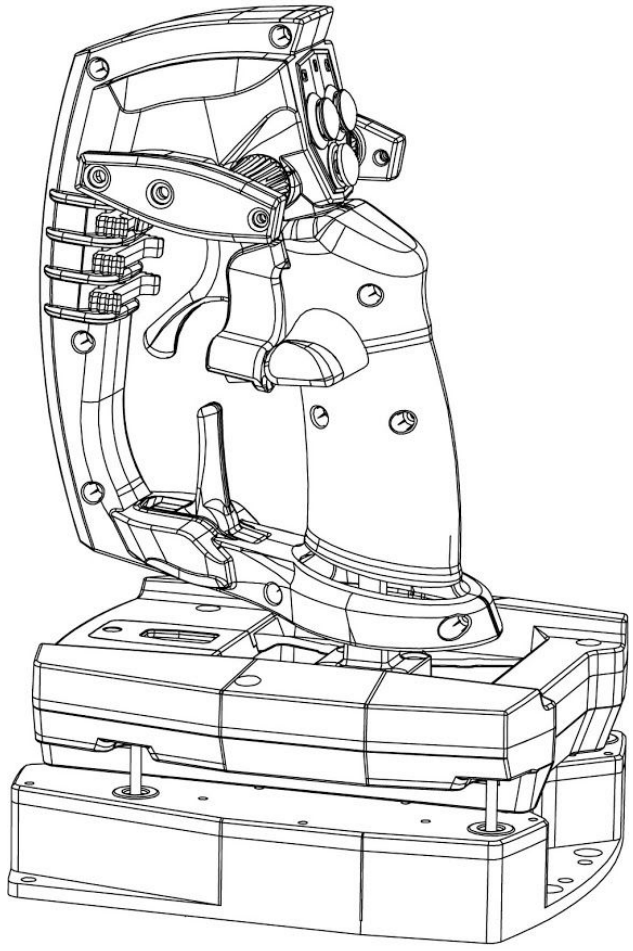
sublight dynamics



6DOF Joystick
Early Access 2020

User Guide

User Guide Sublight 6DOF (Early Access)

Revised Aug. 29, 2020

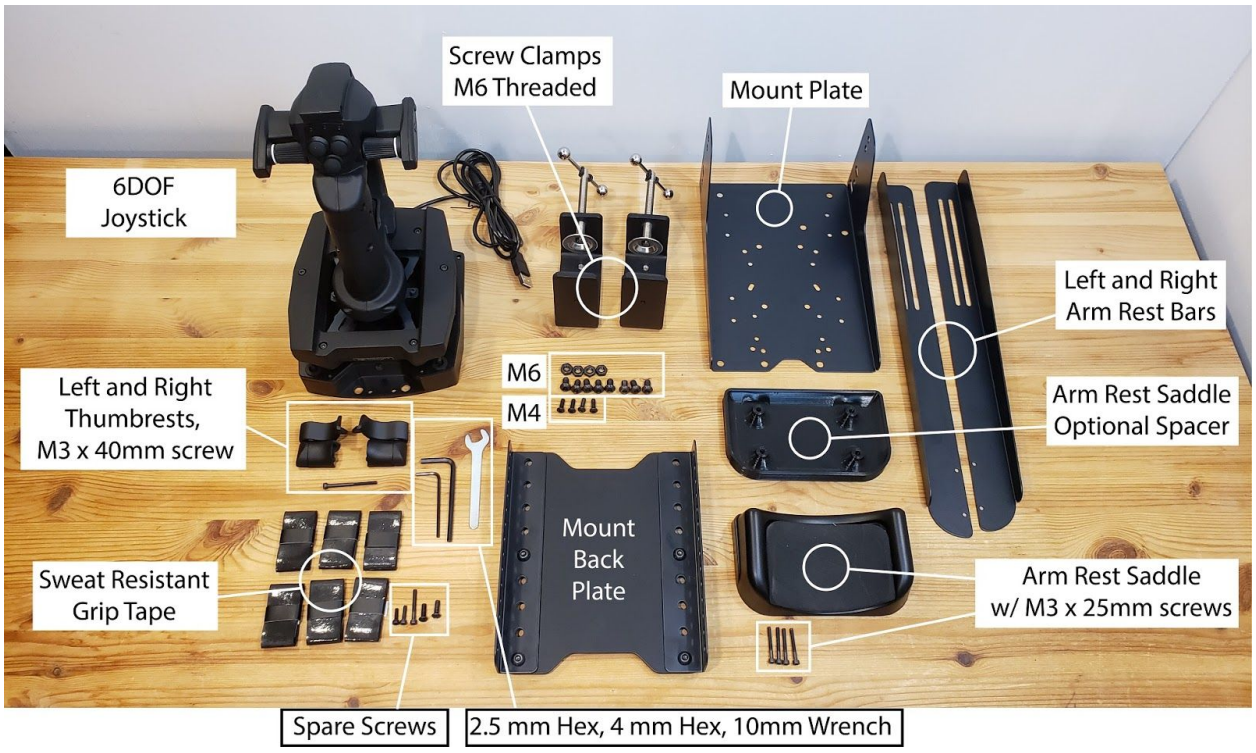
For software instructions, see the document “Using the Sublight Settings Software (Early Access)”

For troubleshooting, see the document “Troubleshooting and Repair Guide (Early Access)”

These instructions can be downloaded from the Resources tab of the Sublight Dynamics website, https://sublightdynamics.com.

Contents

1. Parts



Included with the Sublight 6DOF Joystick is the following:
1 x Left Side Thumb Rest and Button Lever
1 x Right Side Thumb Rest and Button Lever
1 x M3 x 40mm Screw for Thumb Rest Attachment
2 x Screw Clamps for Mounting
1 x Mount Plate with holes for a variety of joysticks
1 x Left Arm Rest Bar
1 x Right Arm Rest Bar
1 x Arm Rest Saddle Optional Spacer
1 x Arm Rest Saddle
4 x M3 x 25mm screws for Saddle Attachment
1 x Mount Back Plate
1 x 2.5 mm Hex Wrench
1 x 4 mm Hex Wrench
1 x 10 mm Wrench
6 x Sweat Resistant Grip Tape
Spare M3 Screws
Spare M4 Screws

2. Setup

2.1. Assembling Armrest

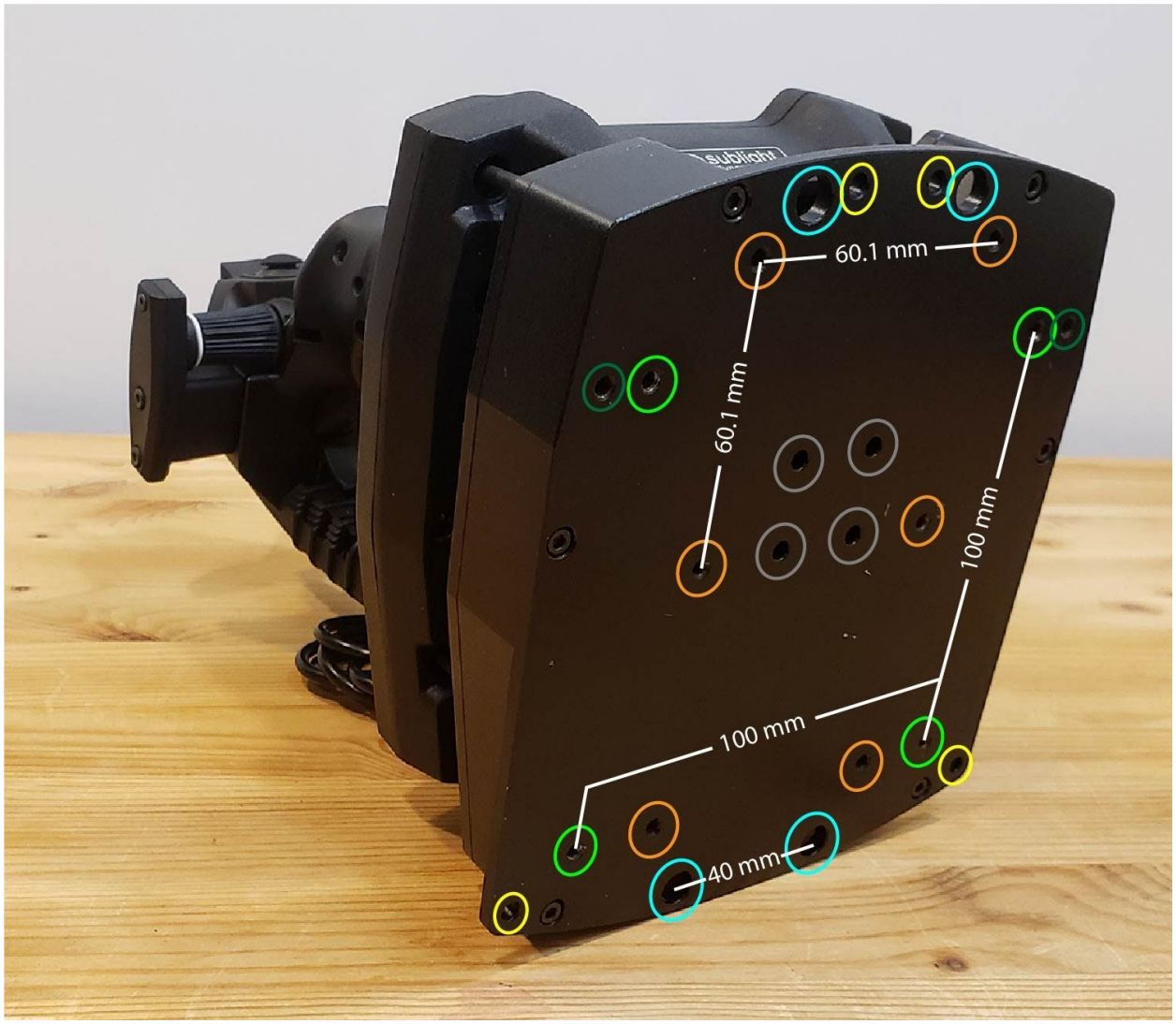
The arm rest included with the 6DOF joystick is recommended, as it provides a consistent, useful fulcrum point for the arm to act on, helping to prevent fatigue. The two steel arm rest bars have slots and small holes in them. The slots align with the 100 x 100 mm pattern M4 threaded holes on the underside of the joystick base. The small holes align with the arm rest saddle, and arm rest saddle optional spacer.

To assemble, loosely screw the arm rest saddle to the two bars using the four M3 x 25mm screws. If a taller height for the saddle rest is preferred, the optional spacer can be added underneath the arm rest saddle to increase height by 0.75 inches.

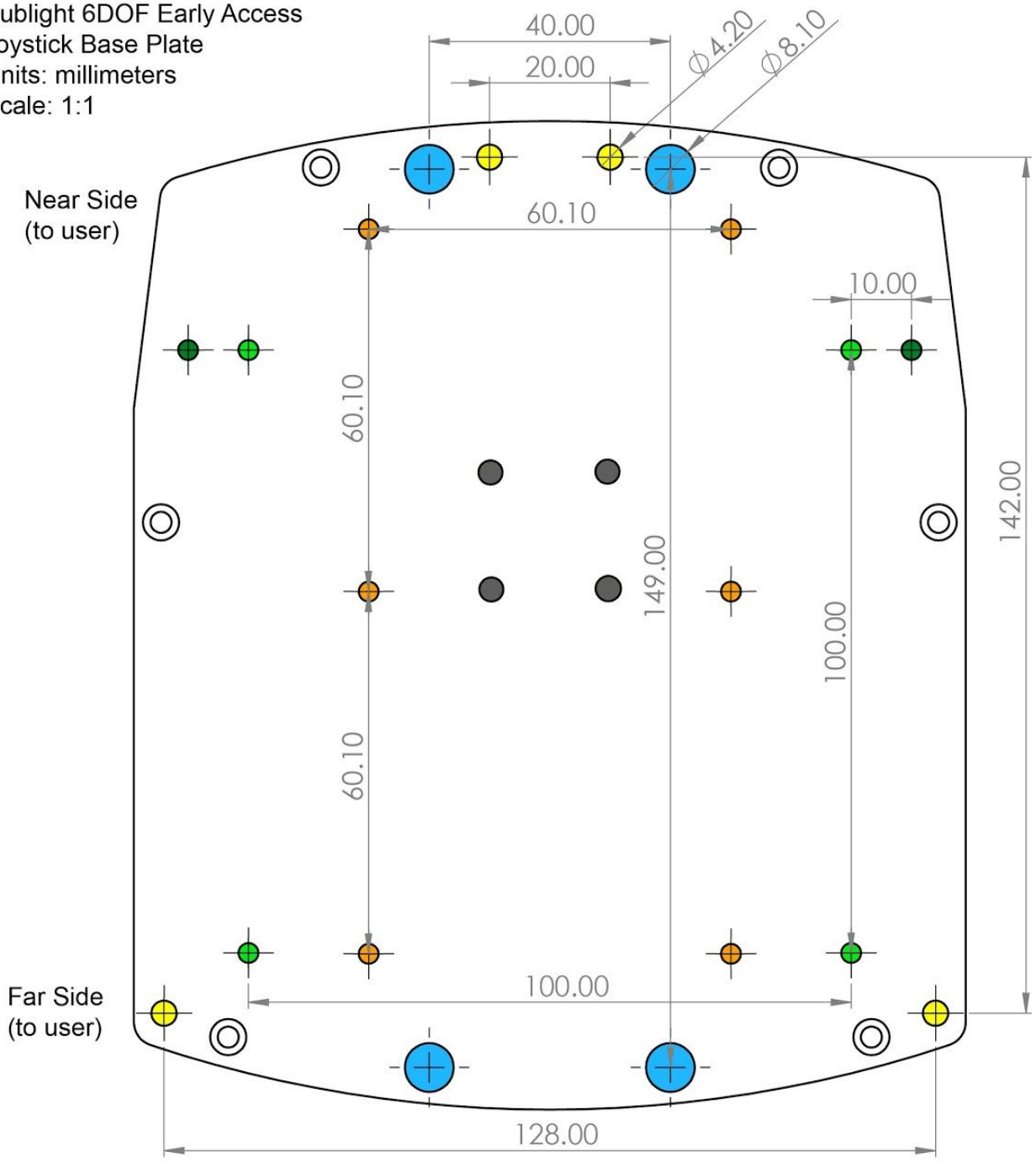
Before tightening the arm rest saddle screws the rest of the way, rest the joystick base on top of the slots, and align the arm rest bars with the sides of the base. Tightening the screws before aligning the bars could make aligning the long slots with mounting holes more difficult later.

The long slots will allow the arm rest some adjustability forward and back. This adjustment is best made once the stick is mounted in its final resting place.

2.2. Clamp/Mounting Holes and Assembling the Mount



Sublight 6DOF Early Access
Joystick Base Plate
Units: millimeters
Scale: 1:1



Aluminum Extrusion Hole Pattern (compatible with 80/20 40 Series profile)

Plain Through Holes, 4.2 mm diameter

M4 Threaded 60.1x60.1 mm Hole Patterns (compatible with Warthog mounts)

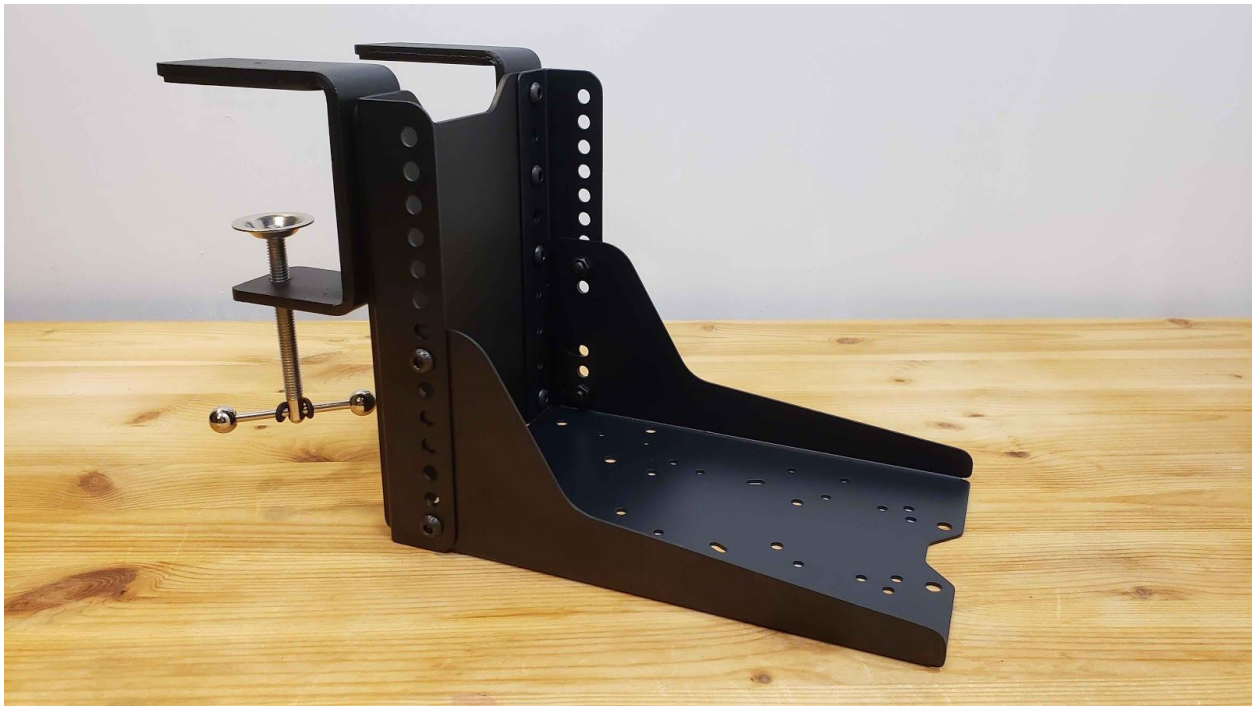
M4 Threaded 100x100 mm Hole Patterns
(VESA standard compatible, matches slots in Arm Rest Bars)

M4 Threaded Holes, Extra (matches slots in Arm Rest Bars)

Through Holes For Reaching Handle M3 Attachment Screws

The joystick should be fixed in place to function optimally. There are a large number of M4 threaded and unthreaded holes on the base of the joystick for accomplishing this, seen in the images above.

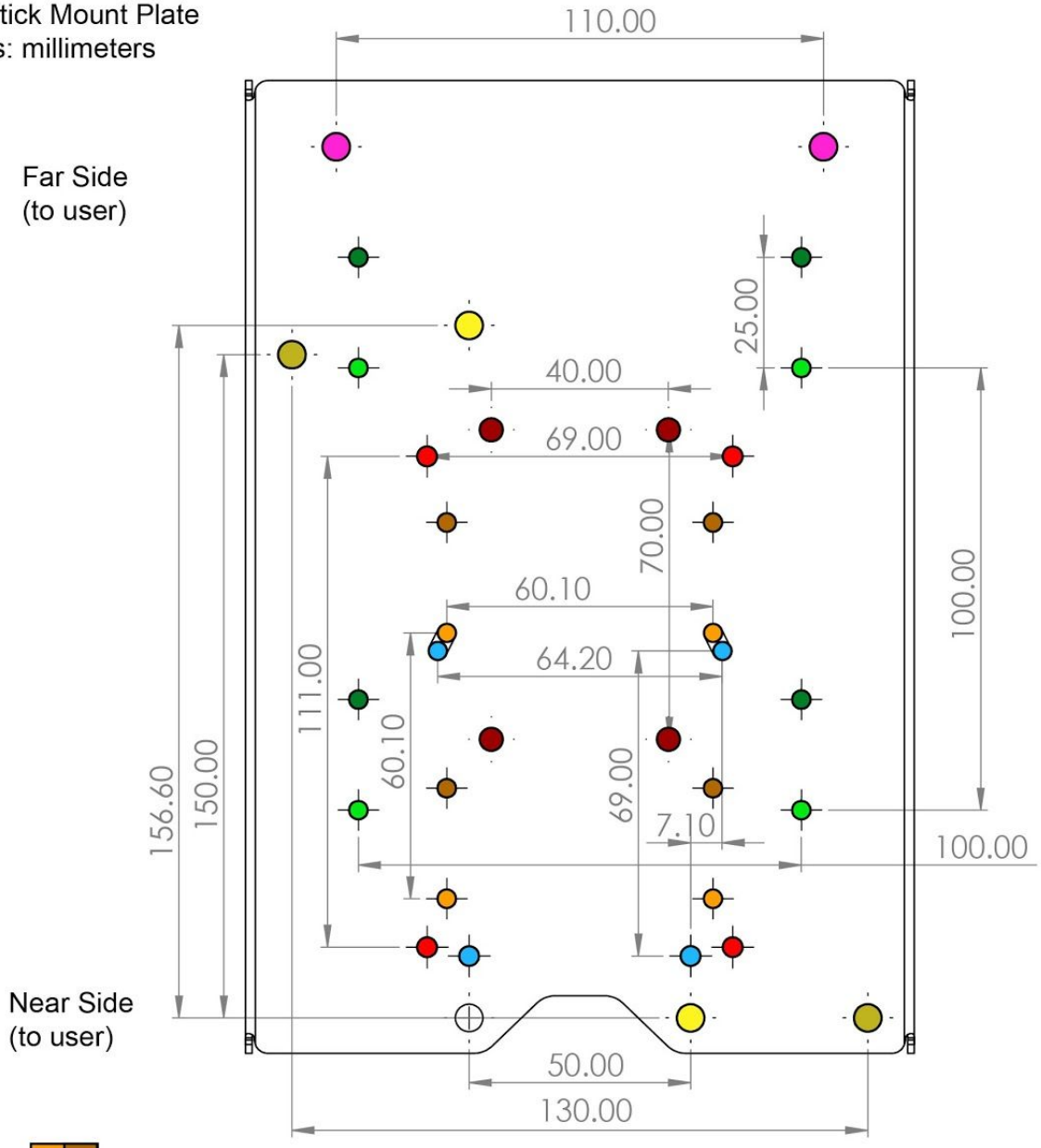
With the included mount hardware, the joystick can be clamped to a desk, either at or below desk height. The most comfortable, strong height for the controller is generally near to the top surface of the user's lap, so that the elbow is close to the body, and isn't forcing the elbow too high. However, this generally requires the use of a large mounting setup, so for lightweight setups, the clamps can be used separately from the mount for a desktop configuration.



To finish, use the last four of the M6 screws and the 4 mm hex wrench to attach the screw clamps to the mount back plate as displayed in the image above. There is an extra threaded hole in the screw clamps spaced at 50 mm which is not used; just use the 40 mm spaced threaded holes.

The mount plate has a large variety of holes in it which match a variety of common controllers. On the next page is a color coded drawing key for each hole pattern. The holes which can be used by the Sublight 6DOF Joystick are highlighted in green, and orange. There are two sets of patterns for the Sublight 6DOF Joystick, to allow the controller to be mounted 25 mm forward or backward. For best results, use the brighter colored green or brighter orange hole patterns, as this puts the joystick nearer to the user, and allows the handle grip the most motion freedom.

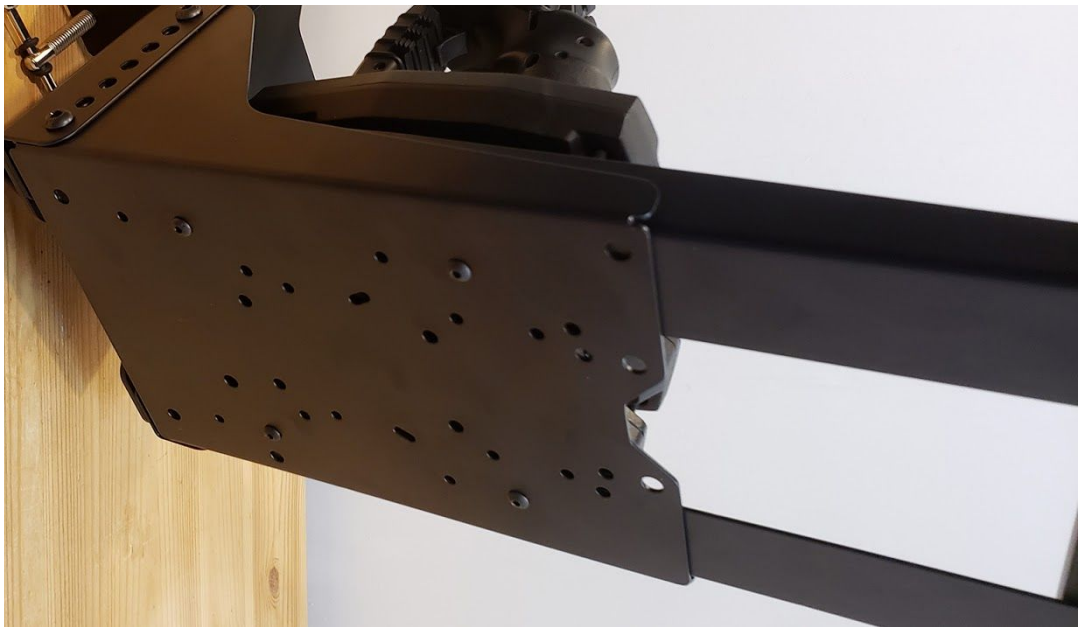
Sublight 6DOF Early Access
Joystick Mount Plate
Units: millimeters



- Sublight 60.1x60.1 mm (M4) (compatible with TM Warthog)
- Sublight 100x100 mm (M4) (VESA standard compatible, matches slots in Arm Rest Bars)
- TM T16000M Joystick (M6)
- TM T16000M Throttle (M6)
- TM Warthog Throttle (M6)
- VPC Warbird and MT-50CM2 (M4)
- VPC MT-50 CM2 Throttle (M5)
- VKB Gunfighter (M4)

In order to use some of these hole patterns for other controllers, for instance to use the T16000M joystick, the mount plate must be mounted upside down to allow for the wider base to not interfere with the folded wings of the plate.

To attach the Sublight joystick with the armrest, the arm rest should be sandwiched between the mounting surface and the joystick base. The M4 screw will pass through the mounting surface holes, through the slots in the arm rests, and thread into the joystick base. In the images below, the joystick is shown attached to the full mount with the arm rests.

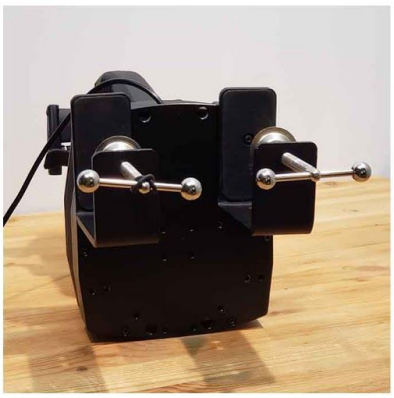


The joystick can also be attached above desk height more simply by attaching directly to the screw clamps, as shown in the images below.

When mounting at desk height using just the clamps, many different configurations are possible: forward, back, side, and corner desk. Some of these configurations are shown in the following images. In the side configuration, it may be possible to attach to some sturdy chair arm rests.



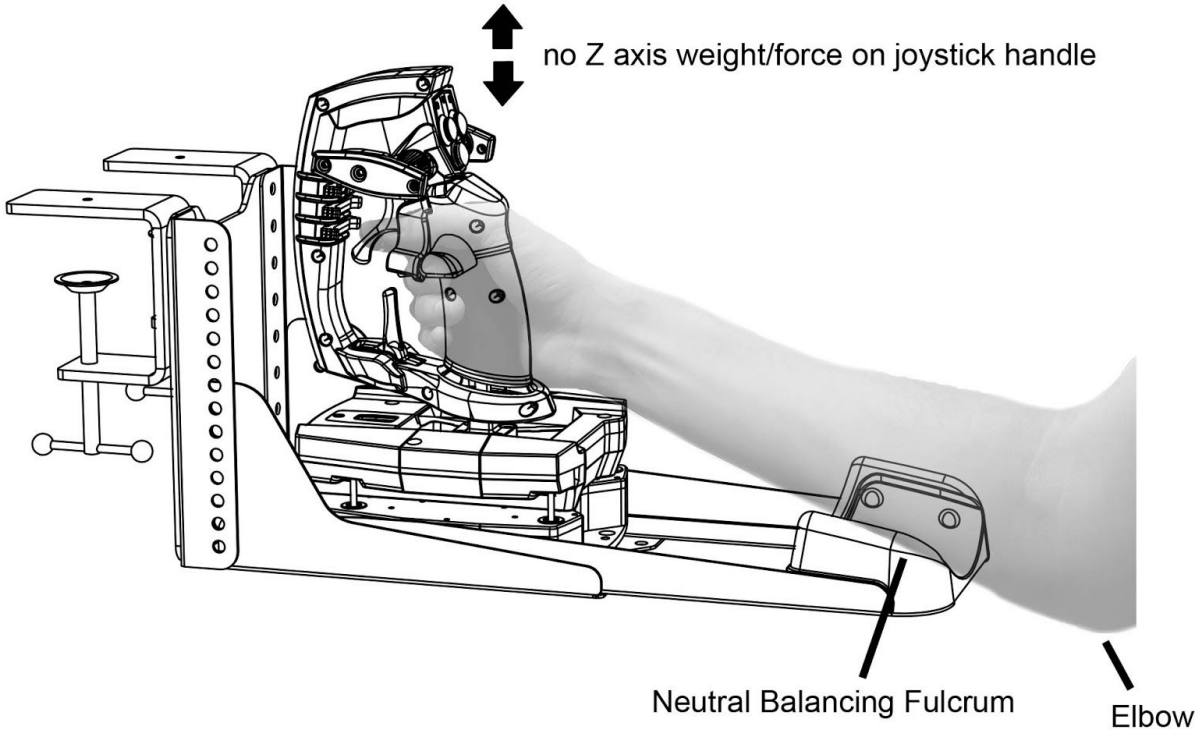




2.3. Adjusting the Armrest

The recommended armrest length to prevent fatigue is that which balances your forearm such that your hand does not produce any downward or upward force on the handle grip at rest, as shown in the following image. This may feel strange at first, as the instinct is to put the rest far back at your elbow. For users who do not wish to use this balance method, the arm rest may

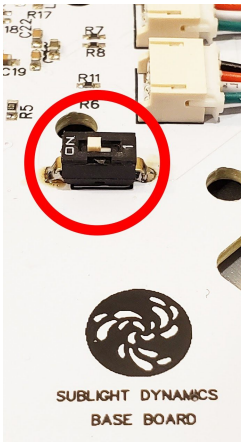
simply be adjusted to elbow length. The arm rest saddle optional spacer may be used to raise and lower the saddle height.



2.4. USB Plug/Calibration & Reset Button

The USB cable is a USB 2.0. The cable is replaceable; the USB micro end is zip-tied inside the joystick base housing.

The controller does not retain zero/calibration values. Treat the controller as an electronic scale, where it zeroes itself each time it is plugged in or reset. Make sure that the stick is still and untouched before pressing the illuminated reset/tare button or plugging the controller in. Wait about 1.5 seconds after plugging in the USB before touching the handle.



The reset/tare button is the illuminated rectangle on the near side of the joystick base housing, shown in the following image. If the stick is ever found to be drifting, pressing the reset button is the fastest way to reset calibration to zero. Resetting is slightly faster than plugging in the USB, as a reset calibration takes almost exactly 1 second. Additionally, the joystick can be tared via the Sublight Settings program. The illumination of the reset button can be turned off by switching the DIP switch on the circuit board inside the base housing, shown in this image on the right.

2.5. Installing/Swapping the Thumb Rest/Lever

There are both left and right handed thumb rests, which also include the thumb button lever. Only one side can be installed at any time. Without a thumb rest/lever installed, button #5, the thumb lever button, cannot be pressed. To attach a thumb rest, insert the M3 x 40 mm socket screw through the handle from the opposite side as the thumb rest is being installed. Use the 2.5 mm hex wrench to tighten it in place. The thumb lever can be temporarily rotated out of the way to allow for stronger thumb grip for extreme maneuvers without unintended thumb button input.

2.6 Applying Grip Tape

The Sublight 6DOF Joystick comes with 6 mini rolls of tennis racket grip tape, cut much shorter than usual to exactly fit the length of the grip. Using the tape is optional, but we've found it to help with grip strength, reduce fatigue, and generally improve control. Any sports grip tape with work, so users can customize their grip.

To apply grip tape, first remove the black finishing tape, but hold onto it for later. Next, cut the squared end with scissors to form an angle mirroring the already angled end of the tape.

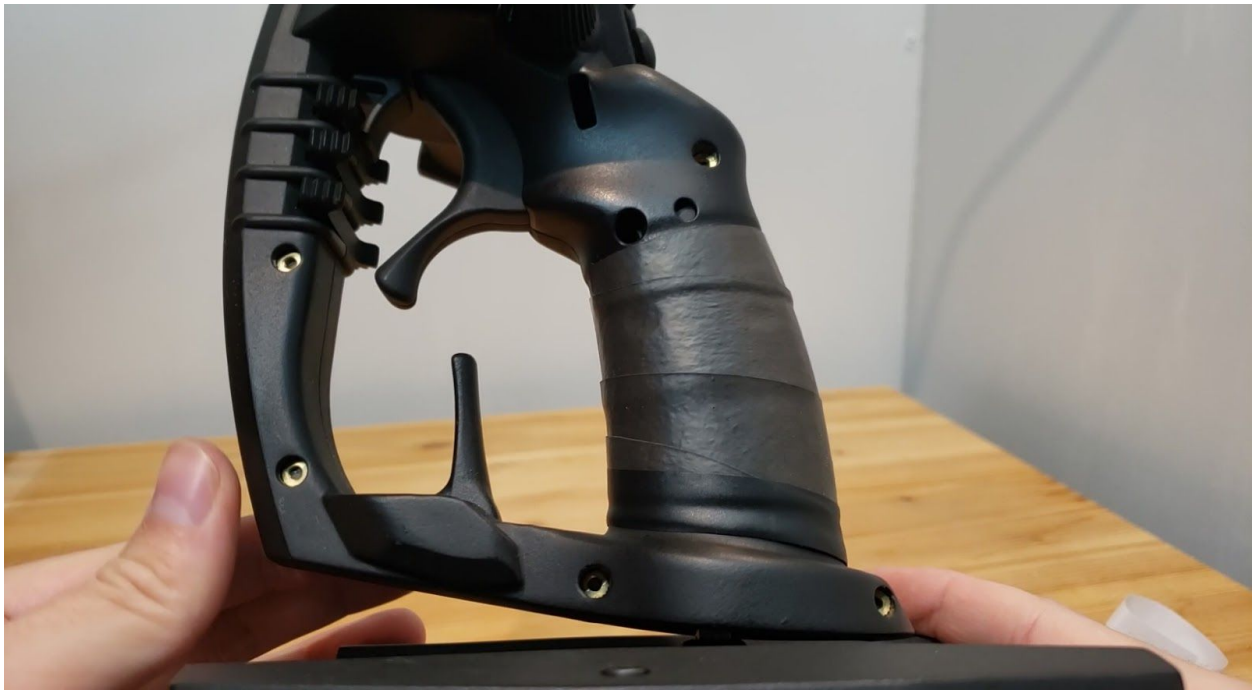
Next, remove the protective clear film over the grip tape.

Next, take the white protective film off of the sticky, pre-angle cut end, and apply the angled end to the top of the grip on one side. Make sure not to block the holes for the thumb rest/levers.

Next, wrap the grip tape around the grip, but only overlap by less than ⅛” inch or 2mm, no more.

When the tape is wrapped all the way to the base of the grip, remove the white protective film from the black thin finishing tape, and wrap the loose end of the grip tape at the base of the handle grip.

When the grip tape is successfully applied, it should look like this.



3. Features

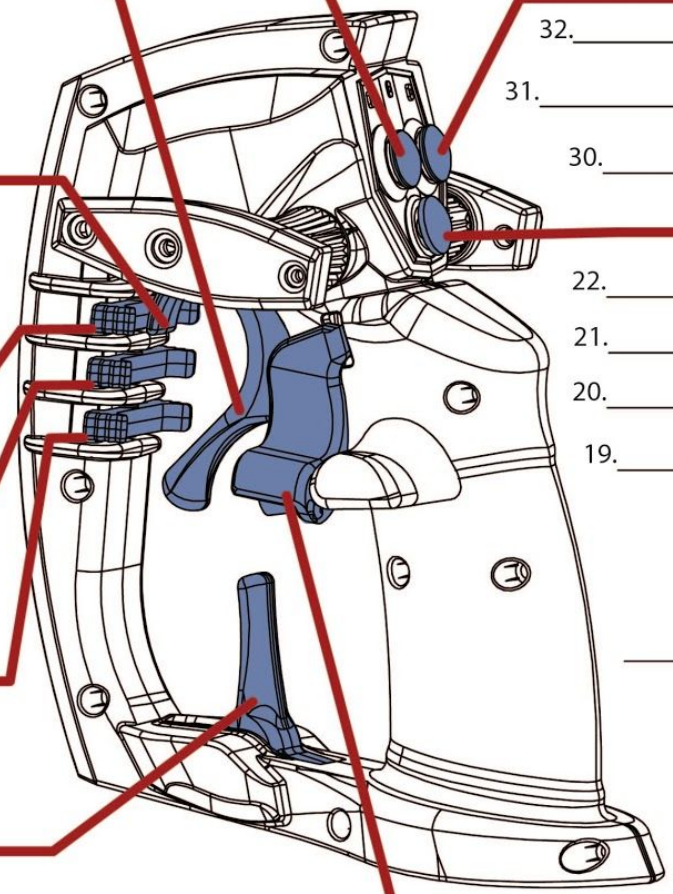
3.1 Finger Controls and Button Map

The following page contains a button map for the digital and analog finger controls on the Early Access unit.

Sublight Dynamics Early Access Unit 2020 Button Map

Application: _____ Hand (L/R): _____

Date: ____/____/____



Main Trigger

1. _____ Primary
2. _____ Secondary
3. _____ Reverse

Bump Trigger

4. _____ Push

Index Levers

Top
8. _____ L (cw)
11. _____ R (ccw)

Middle
9. _____ L (cw)
12. _____ R (ccw)

Bottom
10. _____ L (cw)
13. _____ R (ccw)

Pinkie Lever

6. _____ Push
7. _____ Pull

Thumb Lever

5. _____

Left 5-Button Hat

27. _____
23. _____
26. _____
24. _____
25. _____

Right 5-Button Hat

32. _____
28. _____
31. _____
29. _____
30. _____

Nine-Button Hat

22. _____
14. _____
21. _____
15. _____
20. _____
16. _____
19. _____
17. _____
18. _____

Left Knob _____

Right Knob _____

Settings File: _____

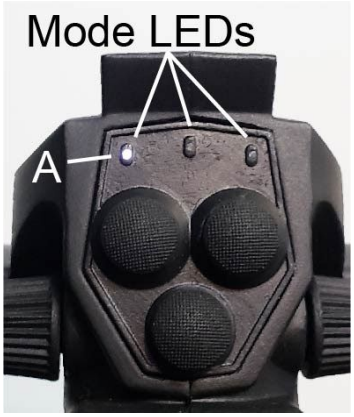
Mode for this page (if applicable): ☐

Mode Buttons (if applicable): A: ____ B: ____ C: ____

Cruise Control Button: ____

Auto-Fire Button: ____ Rate: ____

3.2 Mode Buttons and LEDs



Modes allow for swapping settings in real-time for different situations like landing, combat, cruising, or axis exclusion. When the controller is reset, it defaults to Mode A (1).

The current mode is indicated by the 3 LEDs on the hat switch panel on the top of the handle. Only one mode is used by default. Extra modes can be enabled in our settings customization program, Sublight Settings. The LEDs can be adjusted in brightness and function, in software.

3.3 Throttle Knobs

The two throttle knobs on either side of the hat switch panel come with center detents installed by default. These detents function with a spring loaded, ⅛” ball bearing. The knobs and detent tracks have been lubricated with a very sticky sheer-thickening grease, which may occasionally trap air bubbles and make slight popping noises when rotated.

The center detents can be removed by removing the ball bearing. This will also make the throttle knob rotation much looser. To remove the detent, first loosen the two M3 x 35mm socket screws holding the “wing” structures onto the joystick housing by about 6 mm or ¼ inch. This will allow the throttle knob to pull away slightly from the joystick housing, and expose the ball bearing, as shown in the following pictures. If the ball bearing does not fall out on its own when the wing is unscrewed, reach in with a thin tool and sweep it out.

4. Tips for Using the joystick

4.1 Ratings and Limitations

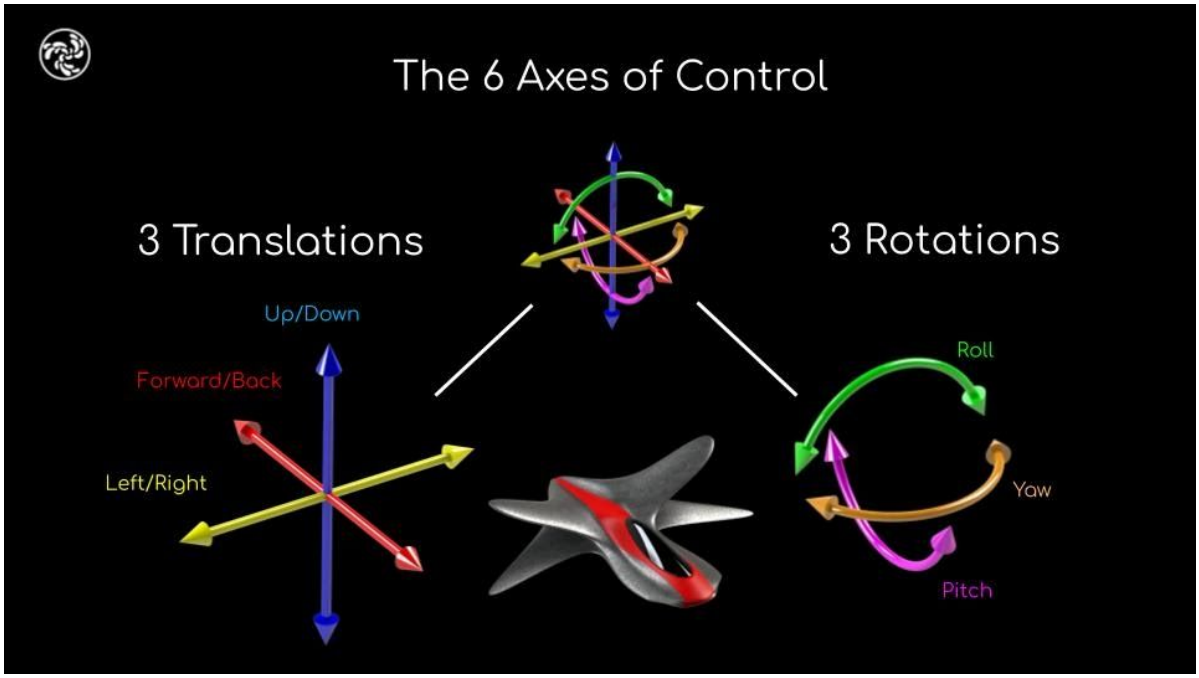
TLDR, avoid applying much more than 12 pounds of force to the handle, or overstressing the 5-button hat switches

The joystick is rated to measure input force up to 13 pounds. We tested the failure point for the sensors, and found that individual sensors began to deform if strained passed 50 pounds. It hasn't happened yet in all the years we've been using them as there are 8 of these working together to distribute the load, but know that there are limits. Setting the vibration feedback motor "constant" setting to kick in at a maximum of 4 times max input could help prevent inadvertent damage.

The 5-button hat switches are rated for 1,000,000 cycles for each input, but can be physically damaged if a large amount of force is applied. This hasn't happened outside of extreme stress testing outside of the housing, but is physically possible with very high finger strength.

There is a slight over-torque risk to the rotational suspension inside the handle in the yaw axis, as straining on sections of the stick that are not the handle grip could provide enough leverage to loosen it. However, we've tested it at over 15 inch-pounds of torque without failure.

4.2 Visualizing The Axes



This joystick controller has 6 axes which can be controlled by the rotation, or translation forces applied by the hand gripping the controller. There are also 2 additional “slider” type axes provided by the two throttle knobs for a total of 8 analog axes.

4.3 Getting The Feel For The Joystick

The six main axes, or “degrees of freedom” of the joystick are controlled with force and torque applied to the joystick handle grip. The joystick uses force sensors, not motion sensors. The joystick is on a 6DOF suspension so that it will move slightly when force is applied. This helps the user intuitively feel the direction and magnitude of force that they're applying.

The center of rotation is in the middle of the joystick handle grip, rather than in a base-mounted gimbal, which can be unusual to users of traditional joysticks. The software-calculated vertical location of this center of rotation can be adjusted in the Sublight Settings program separately for pitch and roll.

It is recommended that if arm fatigue is experienced, that the user practices feeling what the maximum input value for a particular sensitivity setting is. This way the user is not putting too much excess force into the controller. This can be accomplished by enabling the vibration feedback setting in the settings program. In a traditional joystick, there would be hard physical limits to the joystick motion. In the Sublight joystick, a very wide force range can be customized

in settings, so without adequate application feedback, it might take some practice to gauge where the set max output limits are.

Generally, setting the vibration pulse to activate at a value of “1” or the maximum output value of the axes, and the vibration constant output to activate at a value of “2” or two times the max output value of the axes, will provide for a comfortable window for learning where the max output for a given axis is.

One mistake that some first-time users make is to instinctually bracing their hand downward for stability, which causes Z-axis input. Balancing the arm rest such that a resting position does not produce these forces, or increasing the Z-axis base deadzone can help prevent this unwanted input.

5. Summary of the Settings Software

The joystick’s settings are stored in flash memory on the joystick’s base circuit board. The settings program does not need to be running to use this joystick. The settings program is used to change the stored settings, and to run diagnostic tests for troubleshooting.

Some examples of things the settings program can adjust are:
- Axis sensitivity, curves, and dead zones
- Vibration axis feedback settings (off by default, but can be helpful for learning)
- Knob ranges, dead zones, and inversion
- Separate modes to quickly swap between settings
- Handle rotational center balance
- LED functionality
- Button functionality

For full instructions on the settings software, see the document “Using the Sublight Settings Software (Early Access)”