



*“While I had the J-Mate running, I performed a solar observation for orientation. That was about the sweetest execution I could imagine. I see so much potential here.”*

*John Evers, PLS*

## Introduction

Let’s set the record straight: J-Mate is not a total-station. **J-Mate and TRIUMPH-LS** together make the “**Total Solution**” which is a combination of GNSS, encoder and laser range measurements that **together do a lot more than a total station**. For long distances you use GNSS and for short distances (maximum of 100 meters) you use the J-Mate along with the TRIUMPH-LS. Together they provide RTK level accuracy (few centimeters) in ranges **from zero to infinity**.

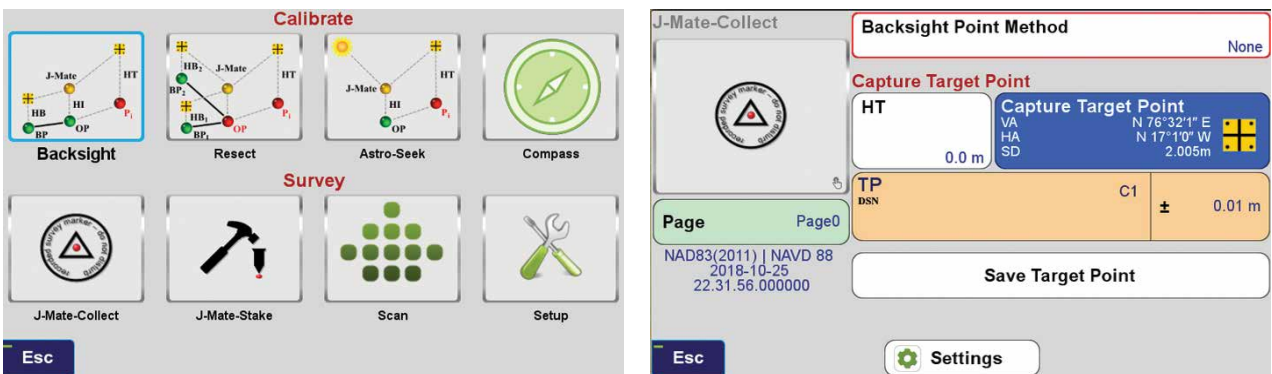
As with the TRIUMPH-LS, with the J-Mate we also provide software improvement updates regularly and free of charge. Download the J-Mate update in your TRIUMPH-LS and then inject it to the J-Mate. The J-Mate SSID will be in this format JMatexxx, where xxx is your J-Mate’s serial number. After a Wi-Fi connection is established, click the J-Mate icon and then click Setup. When you are prompted to connect to the J-Mate, click yes and then follow the remaining prompts.

## Connecting the TRIUMPH-LS to the J-Mate

TRIUMPH-LS communicates with the J-Mate through Wi-Fi. Turn on both the TRIUMPH-LS and the J-Mate. Click the Wi-Fi icon on the TRIUMPH-LS Home screen to connect to the J-Mate, much the same way as you connect TRIUMPH-LS to your Wi-Fi access point.

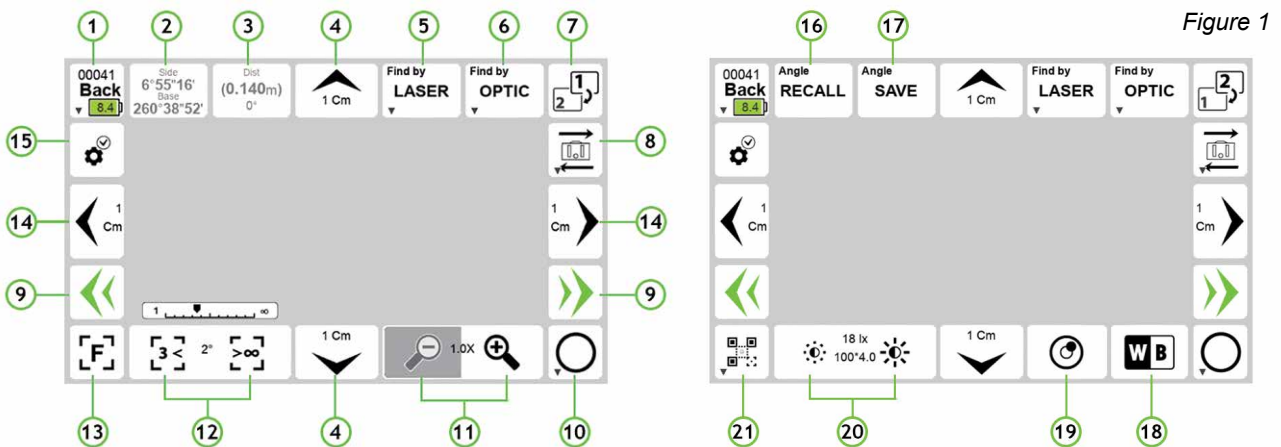


After connection, click the J-Mate icon on the TRIUMPH-LS Home screen and then J-Mate/J-Mate Collect/Capture Target Point to get familiar with the Main J-Mate screen.



## Main J-Mate Screen

This is the Main J-Mate Screen. Click button "7" in Figure 1 to switch some controls as shown above. Below are explanations of some buttons of these screens.

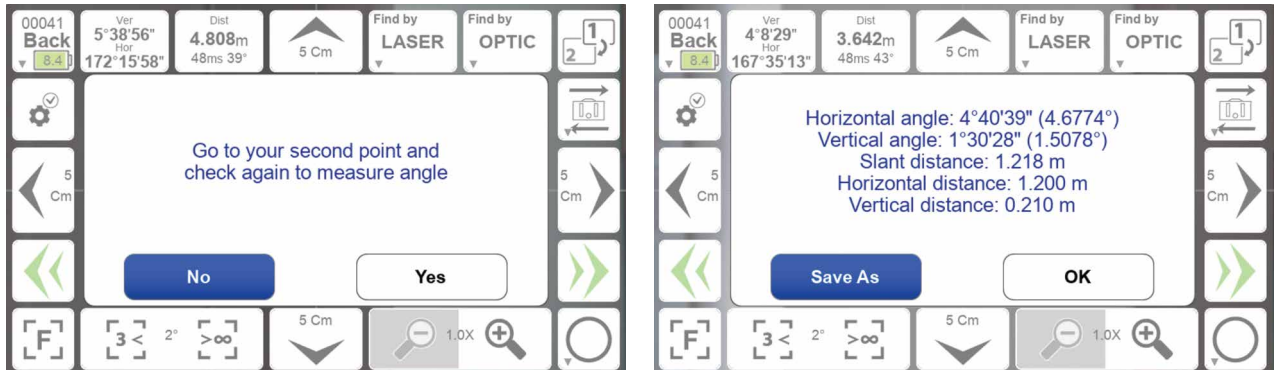


## Aiming at targets manually

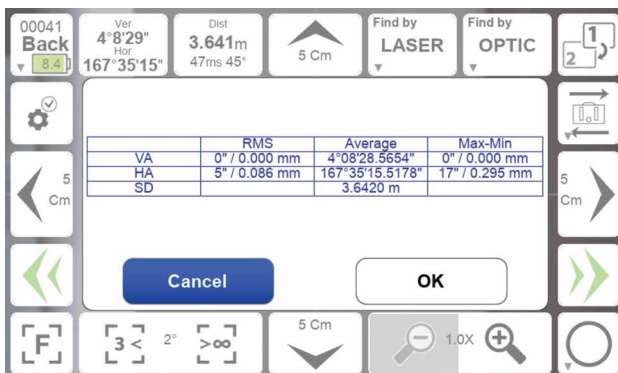
You can find targets manually or automatically.

## Measure angles between two points:

Aim at the first point and click button “2” of Fig. 1. Then Aim to the second point and click this button again. You will see the horizontal angles between the two points. You can save the measured angles in clip boards and use it elsewhere when you need.



## Taking a point



Aim at your target and click “10”. J-Mate will take 10 readings and average them. The average, RMS and spread of the ten readings are shown. Optionally, you can specify four points around the target point to be measured too, to ensure that you have aimed at the desired target. To specify the distance of the four points around the target, hold “10”.

Instantaneous angular and range measurements are shown in boxes “2” and “3” in Fig. 1.

## Camera operation and settings

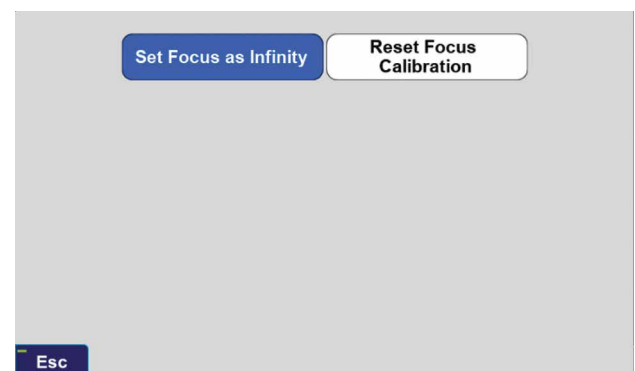
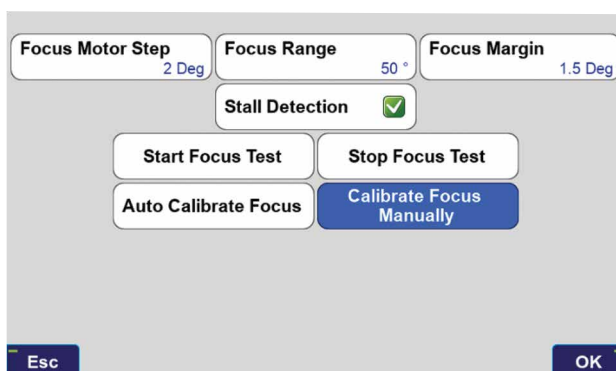
**White balancing** the J-Mate camera when the light setting changes: 1)Put a white paper in front of the J-Mate camera about few meters away, such that it covers at least half of the viewing angle of the camera. 2) Click “18” to start white balancing. It will take about 10 seconds to finish.

**Zoom** buttons: “11”

**Contrast/Brightness** buttons: “20”

**Focus:** use buttons “12” to focus manually. Click “13” for autofocus on the subject.

Occasionally you may need to calibrate the Focus motor. Click Setup “15” → “Focus” → “Auto Calibrate Focus” or “Calibrate Focus Manually”. In Manual focus, 1)click “Rest Focus Calibration”, 2) using “12” buttons, focus to infinity, 3) Click “Set Focus as Infinity”.



## Searching and finding objects by laser and Object types

The image shows two screenshots of the J-Mate software interface. The left screenshot is the 'Select Target' screen, featuring a 'J-Target' button at the top. Below it are several input fields: 'Distance' (3.0 m), 'Tolerance' (5 %), 'Horizontal Limit' (15.0), and 'Vertical Limit' (15.0). There are also checkboxes for 'EDM timeout' (300), 'Pointer' (checked), 'Keep Fixed Height' (checked), 'Repeat' (Never), 'Stop on Error' (unchecked), 'Pause' (None), and 'Report' (unchecked). At the bottom, there are 'Screenshot' and 'Recall' buttons, and 'Esc' and 'OK' keys. The right screenshot shows the 'J-Target' selection screen with a grid of options: 'J-Target' (checked), 'J-Target Custom' (unchecked), 'Triumph-LS Back' (unchecked), 'Search Tube' (unchecked), 'Measure Tube' (unchecked), 'Corner' (unchecked), 'SNAP' (unchecked), 'SCAN' (unchecked), 'Side Flaps' (checked), 'Top Flaps' (unchecked), 'Bottom Flaps' (unchecked), 'Measure to Bottom' (unchecked), 'Width' (0.166 m), 'Height' (0.166 m), 'Wing Span' (0.226 m), and 'Wing Depth' (0.025 m). At the bottom, there is a 'Save' button and 'Esc' and 'OK' keys.

Hold the Laser button (“5”) to see the setup screen for laser target selection and parameters. If you know the approximate distance to the target, click the check box and enter the distance and accuracy percentage. This will help J-Mate to ignore targets that are outside the range.

**Horizontal and Vertical Limits** are the limits that J-Mate will search around the starting point to find targets. In this example is 15 degrees on left and right, and 5 degrees up and down.

“**Keep Fixed Height**” check box, scans horizontally on fixed target height. You may rarely need to use this feature. It will reduce the scanning speed by a factor of 2.

In Target Selection screen, the following targets are defined:

- **J-Target** is a printed pattern glued to 166x166 mm plywood of about 25 mm thick. It can be attached to a 226x226 mm plywood of 10 mm which provides flaps around the pattern. Select check boxes related to Sides, Top and Bottom flaps, if they exist and you want J-Mate to consider the depth of the flap (about 25 mm).
- If the J-Target is not sitting on another object and its bottom boundary is clear, then check the box Measure to Bottom. If not checked, J-Mate will measure to the top and will come down half of the height to aim at center. This feature applies to other target types too.
- In laser scanning and finding, the pattern on the J-Target has no effect.

**J-Target Custom:** This option allows you to build your custom J-Target type.

**TRIUMPH-LS Back:** searching for an object similar to the back of TRIUMPH-LS.

**Search Tube:** Searches to find a tube with given diameter and height. If Measure to Bottom is not checked, it will go to the top of the tube and then come down half of the specified height, irrespective of the actual height of the tube.

**Measure Tube:** Searches for a tube that has the given width and then it measures the tube depth.

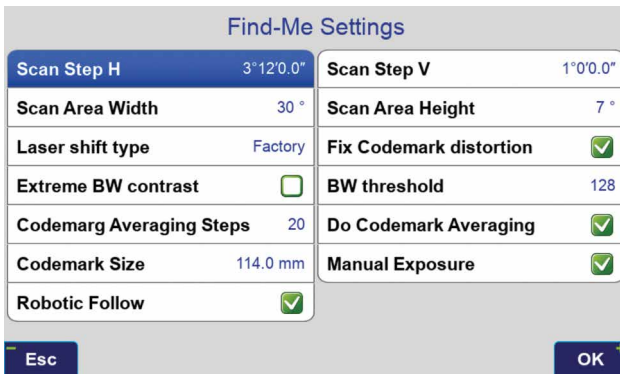
**Corner** identifies an abrupt change on a flat surface.

**Snap:** scans with the resolution given in “Step” and stops when range changes by “Edge Depth”.

**Scan:** Scans according with the resolution given in “Step” and saves the scanned files if the box is checked. The scanned files can be viewed in the Main screen / File icon.

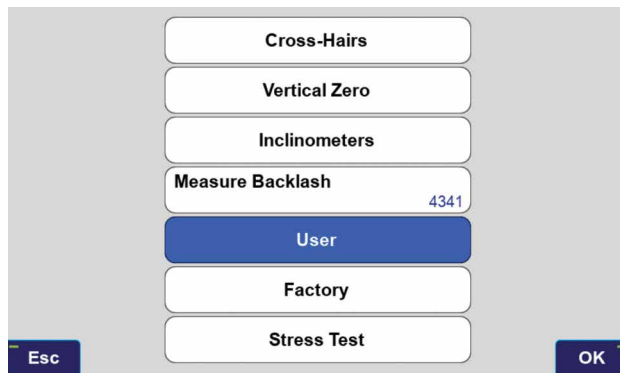
Selected objects and their parameters can be saved and recalled by “**Save**” button on this and “**Recall**” button of the previous screen.

## Follow me and robotic operation



box, you can make the Zebra Cylinder of any height and J-Mate will aim half of the specified “Target Height” from the top of the cylinder. The Zebra Cylinder is omnidirectional and you can hold it in any direction towards the J-Mate.

## Calibrating the J-Mate laser and camera offset.



1. Select an area where range changes between 2 to 10 meters when J-Mate rotates.
2. Hold “15”, select “Advanced” → “Calibration” → “User Calibration” and click “Start”. It will take about 10 minutes to finish calibration. This will be adjust the laser cross hair identification to where it should be.

## Saving and recalling orientation of J-Mate

Click “17” to save the current orientation of the J-Mate to a scratch pad.

Click “16” and select the scratch pad orientation that you want to orient to.

## Laser time limit

The time that it takes for a laser measurement depends on the reflective surface of the target and weather conditions (dust and moisture in the air).

On a good white reflective surface and in clean air, it takes about 50 milliseconds to have a laser reading. If there is no reflective surface, or the reflective surface is black, it may take up to 4 seconds to have a laser reading.

If the surface of the object that you want to scan is a good reflective surface, limit the laser time to a fraction of a second. This will cause the laser to skip points that do not reflect enough energy in the time limit that you specified. This will significantly increase the scan speed and will ignore points that are not possibly your target and reduces the chance of identifying a wrong object.

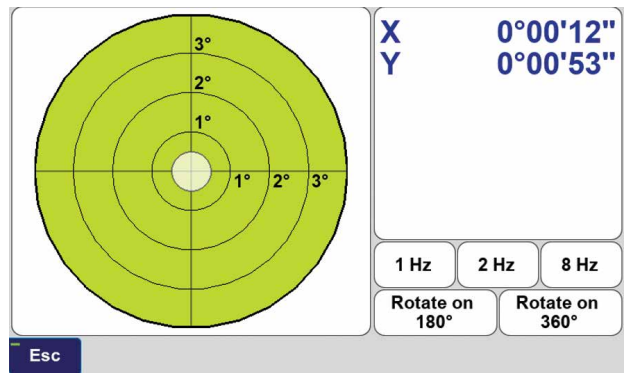
Hold “LASER” (“5”) to set the laser time limit.

J-Mate can search and find the J-Target and robotically follow it. J-Mate also measures the distance to the Target optically, and shows distance and tilt on top and the bottom of the J-Target image.

For J-Mate to follow the J-Target robotically, check the “Follow Me” box in the OPTIC set up (hold 6 to reach its setup).

J-Mate can also optically search and find the “Zebra Cylinder” Target. It will target the center of the Zebra Target (Half the specified height from the top). If you don’t check the “Measure to bottom”

## Viewing the inclinometer



Hold button “8” or click button “19” of Figure 1 to see the embedded 0.001-degree electronic inclinometer of the J-Mate as shown in Figure 3. It updates 10 times per second.

The embedded inclinometer monitors and corrects for tilts automatically.

## Option to Help J-Mate to find you

At Occupation point, click the J-Target icon (“21” of the Figure 1). You will be guided through the following steps for J-Mate to aim at you holding the TRIUMPH-LS with the J-Target, when going to the Backsight, for example.

1. At Occupation point, put the TRIUMPH-LS on top of J-Mate (or slightly above it, but at the same orientation as the J-Mate, to be far from the motor magnets of the J-Mate) and click Next.

This step will transfer the compass reading of the TRIUMPH-LS to the J-Mate encoders.

2. Go to your target, Put the J-Target on top of the TRIUMPH-LS and aim the TRIUMPH-LS towards the J-Mate (with the help of the TRIUMPH-LS camera) and click Next.

This will help the J-Mate to know the general direction to the target and limit its search range. You can go back to previous step to fine tune view of the J-Mate.

3. You will see the J-Mate camera view on the TRIUMPH-LS screen. You can fine tune the J-Mate view by the navigation buttons to make recognition faster.

You can also manually aim at the center of the J-Target panel and take your shot.

4. Click “Optic” if you want the J-Target panel to be searched and centered automatically.

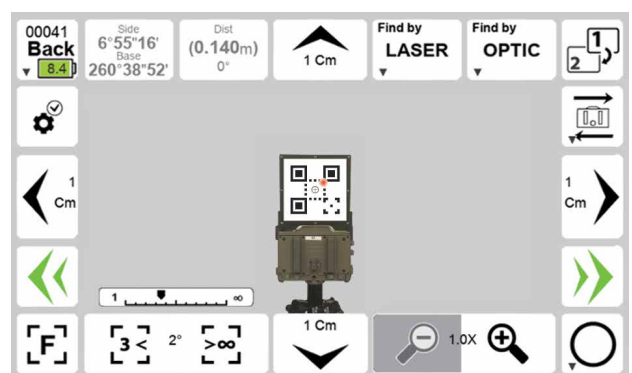
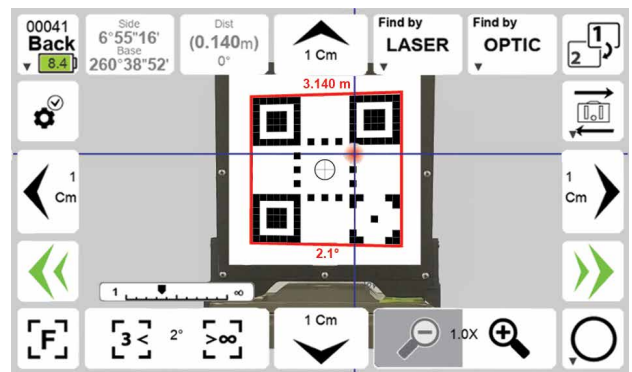
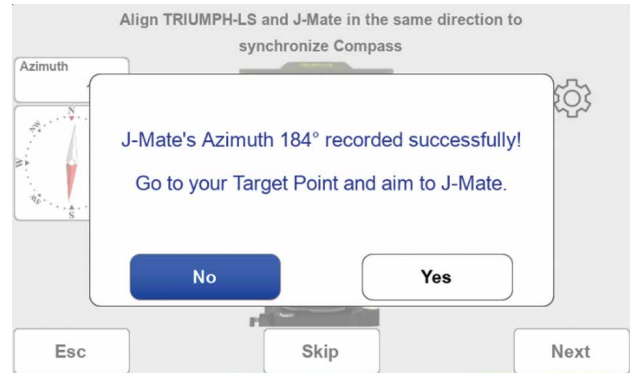
When J-Mate focuses on the center of the J-Target, you can click the “Take” button. You will be asked if you want to record the point.

5. If you also want to find the center of the J-Target by Laser scanning, you can click the “Laser”. If Laser scan is successful, you can click the “Take” button to replace the previous measurement with the current measurement done by laser scanning.

The center of the J-Target is vertically collocated with the GNSS antenna and you don't need to be exactly perpendicular to the J-Mate path.

If light condition is such that camera cannot find the J-Target, chances are better that laser scanner can find it.

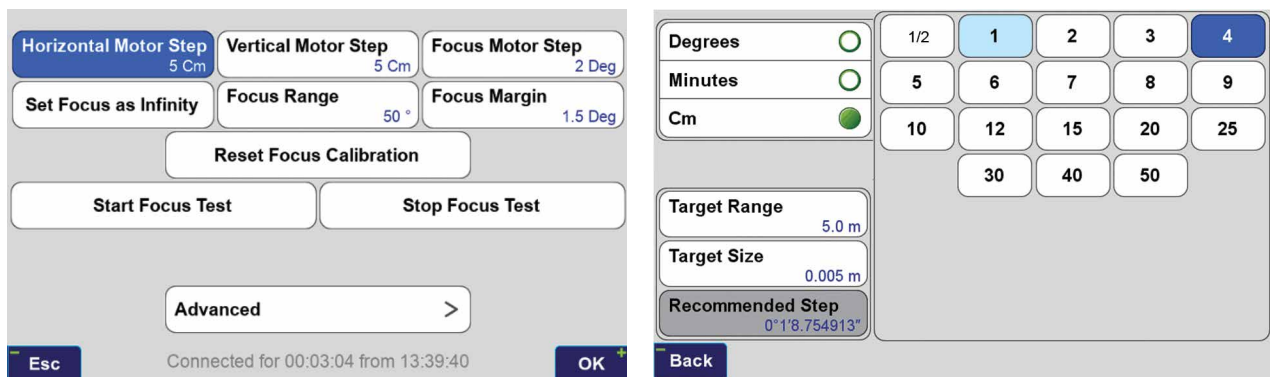
Even after the J-Target is found optically, you can continue the laser search with “On J-Mate” option to measure the J-Target and find its center more accurately by laser.



There are five ways that you can manually aim the J-Mate towards your targets:

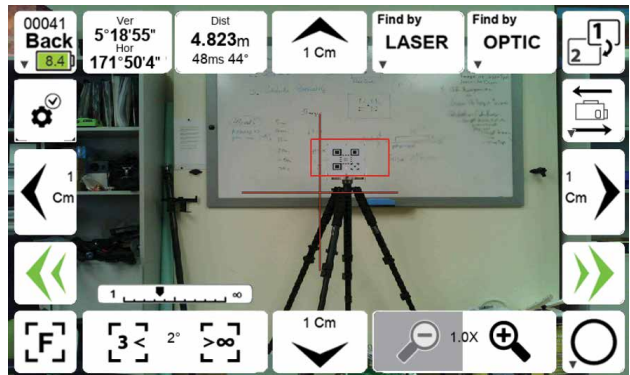
1. Each click of the Left/Right/Up/Down buttons around the screen (“4” and “14”) moves the J-Mate according to the value that you assign to them in the setup screen (“15”), as shown in Figure below (Horizontal and Vertical Motor Step).
2. While holding these buttons “4” and “14”, J-Mate rotates about 5 degrees per second.
3. Buttons “9” are “Fast Motion” buttons. While you hold them the J-Mate rotates about 30 degrees per second.
4. You can point J-Mate towards points by touching points on the screen and by gestures (moving finger on the screen).
5. You can also rotate the J-Mate manually while it is not moving by motors, but limit that to small rotations, not to apply backpressure to motor. Motor manufacturer does not prohibit manual motion, but we think it is better to avoid it as much as possible.

## Setup screen



## The two cameras

The viewing angle of the TRIUMPH-LS camera is 60 degrees wide, while that of the J-Mate is about 5 degrees. The viewing area of the J-Mate camera is represented on the TRIUMPH-LS camera by a small red rectangle. While TRIUMPH-LS is sitting on top of the J-Mate, you can view your target on the TRIUMPH-LS camera (Click Button “8” of Fig. 1), bring it to the rectangle by touching the target or using the navigation buttons, and then switch to the J-Mate camera.



To calibrate the camera of J-Mate with the camera of the TRIUMPH-LS, while TRIUMPH-LS sitting on top of the J-Mate:

1. Click “3” and clear existing Horizontal and Vertical calibration offsets (if non-zero).
2. Aim J-Mate **laser** to the target.
3. Click “2” to set the first position of the offset angle.
4. Click “8” to switch to the TRIUMPH-LS camera and note the small rectangle that represents the J-Mate camera viewing area.
5. Aim the J-Mate to bring that target to the center of the rectangle.
6. Click “2” to finish measuring the offset angles between the laser center and the rectangle.
7. Save them to a location on the scratch pads.
8. Click “3” to recall the measured offsets from the scratch pad that you saved in.

## Backsight point and the Sun

Similar to using conventional total station, to use the J-Mate you need to first establish its accurate position and calibrate its vertical and horizontal encoders. Then proceed to shoot the unknown points. This is similar to using any total station, but we have improved and automated the process.

With J-Mate you can do these in three different ways as shown in the J-Mate screen of the TRIUMPH-LS. Via the J-Mate-Backsight; J-Mate-Resect and J-Mate-Astro-Seek icons.

If GNSS signals are available at the site, click the J-Mate-Backsight icon.

This screen appears which guides you to determine the accurate positions of the Occupation Point and a Backsight Point to establish an azimuth and calibrate the J-Mate angular encoders.

The tripod is setup at the "Occupation Point" (OP). The J-Mate is secured on top of the tripod.

Next, TRIUMPH-LS is put on top of the J-Mate with its legs registered to the matching features on the J-Mate.

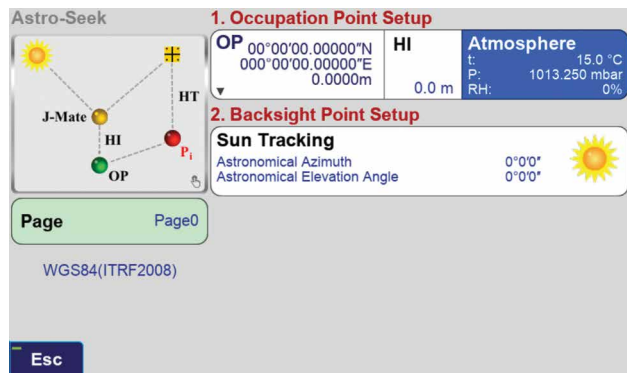
Next Use the RTK Survey feature of the TRIUMPH-LS to quickly determine the accurate location of the Occupation Point. You can use your own base station or any public RTN.

Next, slide the J-Target on top of the TRIUMPH-LS, lift it from the J-Mate and move to the "Backsight Point" (BP). The camera of the J-Mate will search the J-Target. The camera's view is visible from the TRIUMPH-LS screen, which mostly focuses on this J-Target. When at the Backsight Point, its accurate position is determined by the TRIUMPH-LS, and the Azimuth from the Operation Point to the Backsight Point is determined, and the J-Mate is calibrated and ready for use.

After this calibration is complete, if the tripod is disturbed, the red LED on the front of the J-Mate will blink to show that re-calibration is required.

We can now replace the TRIUMPH-LS on top of the J-Mate at the Occupation Point and proceed to shooting as many "Target Points" as the job requires. From now on TRIUMPH-LS is used as a controller and you can hold in your hand too, but it is more convenient to put it on its place to have free hands.

If GNSS signals are not available at the Occupation Point, click the "J-Mate-Resect" icon to shoot two known points to establish its accurate position and calibrate its encoders. Then continue to shoot the unknown points.



## Astro-Seek feature: Sun as the Backsight point!

We have added a new innovative feature to the J-Mate that it can automatically calibrate itself via its automatic Sun Seeking feature.

Attach the Sun filter to the camera of the J-Mate, click the "J-Mate-Astro-Seek" icon and click the "Sun" icon in the screen which appears and J-Mate will automatically find the Sun, and use its position to calibrate the angular encoders automatically.