LIVE at www.javad.com

G’day, Mate!

And all components fit in this small carrying case.

Redefining Total Stations and GNSS workflow. The **“Total Solution”**

From the company who brought you the best GNSS receiver on the planet, our latest innovation will allow you to break away from decades-old methods of measurement and positioning. Why employ a workflow designed for yesterday’s gear?

*We plan to ship by **September 2018**.*

See details inside >>>

The encyclopedia of Jamming and Spoofing.

All you nee to know about them.

There is absolutely no way that we can be spoofed or jammed without our knowledge. We will immediately recognize them and take corrective action.

>>> 4 pages inside

JAVAD
www.javad.com

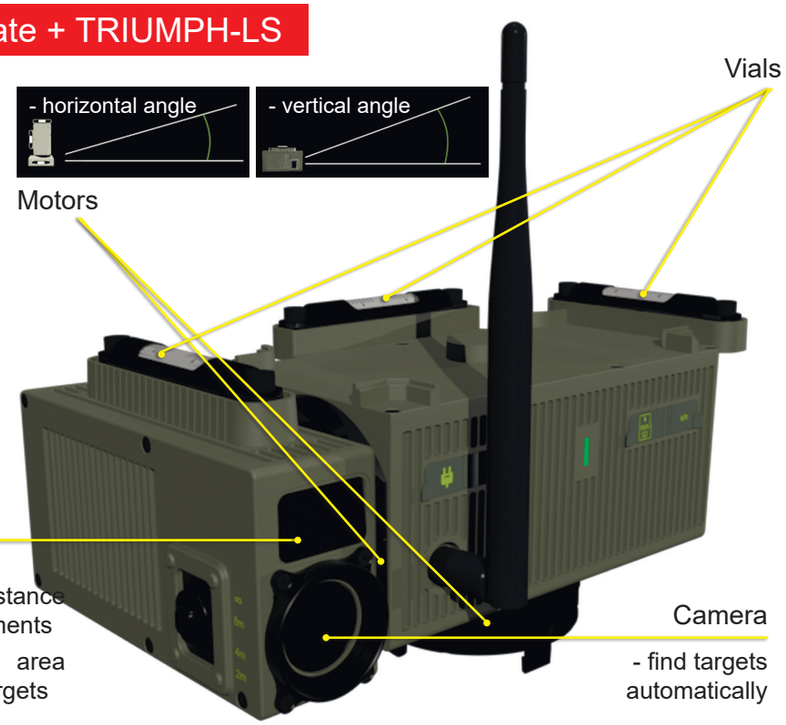
Why follow a workflow designed for yesterday’s equipment?

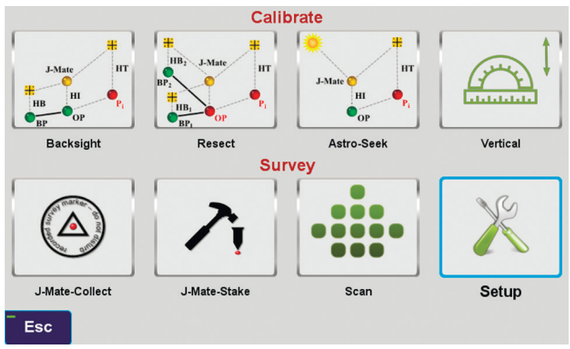
This is J-Mate

J-Mate features a **camera** that can also find targets automatically, and a **laser module** for accurate distance measurements. It scans and examines the area around the intended target to ensure reliable identification. Two **precision encoders** measure vertical and horizontal angles to the target. Three **precision vials** allow a visual check on levelness of the instrument.

Take control with J-Mate + TRIUMPH-LS

Similar to using conventional total stations, to use the J-Mate you need first to 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 establish your occupied position via three different ways: 1) Backsight; 2) Resection; or 3) our new Astro-Seek (more of that later).

When you click the Setup icon of the J-Mate screen you get access to parameters that tunes J-Mate to your desire.

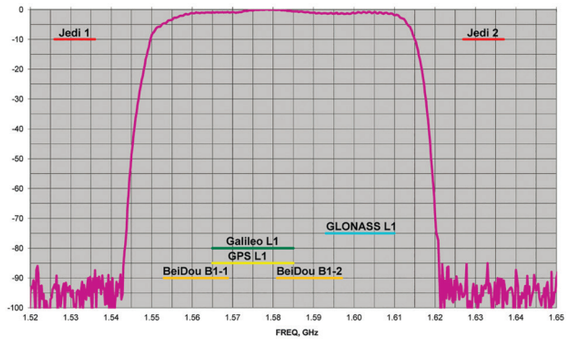
After the J-Mate is calibrated, you can proceed with your work as normal via the Collect or Stake icon.

LIVE video at www.javad.com

These are ways that we defend against jammers and spoofers and inform users of details.

J-Shield Filter
and Near Band Interference

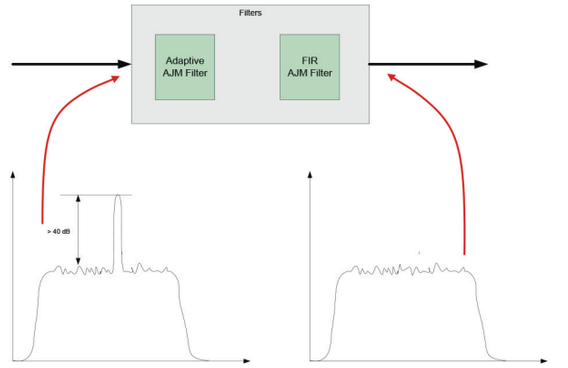
J-Shield is a robust filter in our antennas that blocks out-of-band interference. In particular signals that are near the GNSS bands like the LightSquared signals. The graph on the right shows the protection characteristics of our J-Shield filters. It has a sharp 10dB/KHz skirt which provides up to 100 dB of protection. It makes the precious near band spectrums available for other usages and protects GNSS bands now and in the future.



FIR (Digital Filter)
and In-Band Interference

Our In-Band protection digital filter protects against in-band interference like harmonics of TV and radio stations when you get close to them, or against illegitimate in-band transmissions. Our in-band interference protection is based on the 16 adaptive 80th-order filters. AJM-filters can be combined in pairs for complex signal processing. This filter can simultaneously suppress several interference signals.

The 16 FIR AJM-filters can be combined in any number in chain. Each filter is a 255 order FIR-filter. It can be used to suppress the stationary interference signal in programmable (in compare with adaptive AJM-filter) area or for spectrum shaping. To have more suppressing areas or more aggressive suppressing one can combine FIR_AJM serial.



In-Band noise
Measurement

This figure-of-merit number shows the level of interference as percentage of noise above the normal condition. The first row of the first screenshot shows the condition in a clean environment. 8 GPS satellites were visible (according to the almanac). 8 C/A, 6 P1, 6 P2, 6 L2c and 2 L5 GPS signals were tracked. The noise level is 2% on C/A and L5, and 0% on P1,P2,and L2C. The screenshot below that, shows 290% noise in GPS C/A and %121 on Galileo E1. Only one of 8 GPS C/A code and none of 5 Galileo E1 signals were tracked.

This typical screenshot shows details of each signal. In the last column (T) indicates the signal was tracked by the main channels, (Q) by the Fast Acquisition Channels and (U) signal was used in position calculations. The SN color coded column shows the signal-to-noise ratio of tracked signals. Blue is perfect, green is 3 dB down, and red is 6 or more dB down. Percentage numbers show the percentage of interference above the normal level. We explain other columns later.

No jammer can escape our figure-of-merit test.

Spectrum Shape

We have a very powerful spectrum analyzer within our GNSS TRIUMPH chip. Each spectrum shows the power and the shape of the interfering signals and jammers. This is more powerful and more efficient than having a $30,000 commercial spectrum analyzer to evaluate the environment. The screenshot on the right shows the shape of the GPS L1 band spectrum when the band is not jammed. The GPS C/A code peak at the 2-MHz center of the L1 band is visible.
The height of the spectrum is 11.2 dB.

This is an example of GPS L1 spectrum with a commercial $30,000 spectrum analyzer.

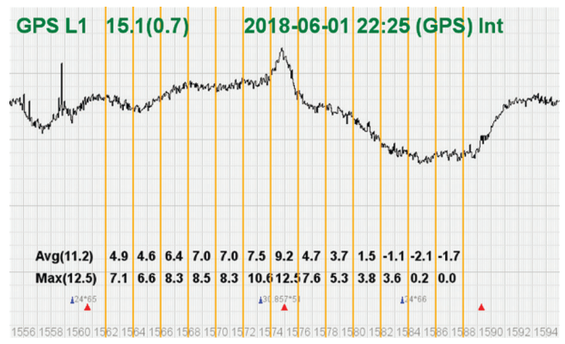
Our integrated spectrum analyzer has the advantage that it monitors the spectrum inside the chip where it matters. It has effective bandwidth of 1 KHz.

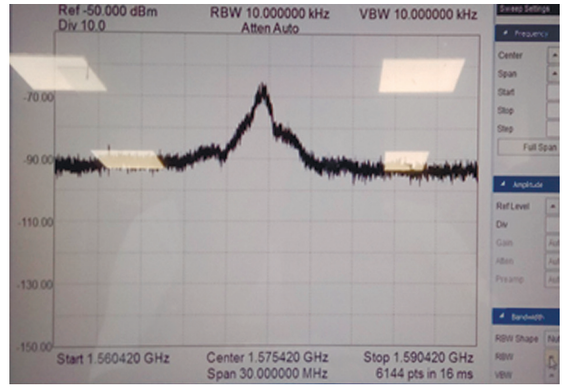
Our embedded spectrum analyzer also has the advantage that it can be programmed to automatically record the spectrum (and other information) periodically or according to the set conditions, and monitor the environment continuously.

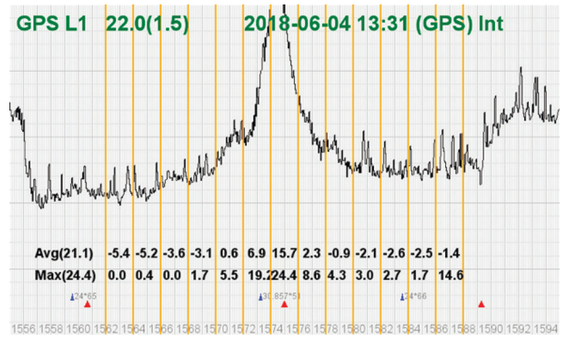
This is the spectrum example of a GPS L1 band when it is jammed. There is a huge peak in the center where the C/A code is. The number on the bottom left is the height of the peak.

The height of the spectrum is 21.1 dB, which compared to the calm 11.2 dB, indicates about 10dB of jammer.

Although we label the bands as three GPS and 3 GLONASS bands, but they represent all bands of all GNSS signals, because bands are shared by all GNSS signals.







AGC
Automatic Gain Control

In addition to the spectrum, we also keep record of Automatic Gain Control which is another indicator of external signals.

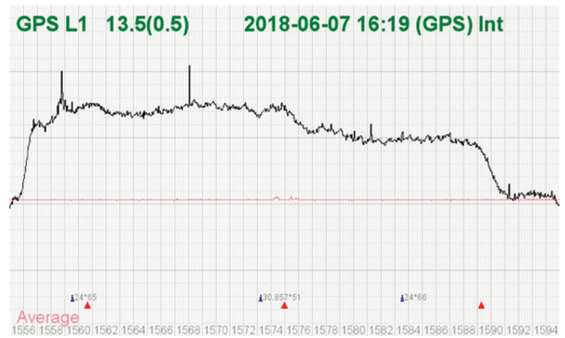
The AGC monitors the environment and adjusts the gain to keep the voltage at a certain level. The change in AGC is an indicator of interference existence.

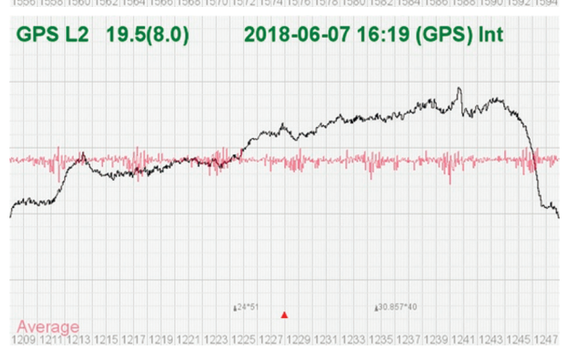
The narrow orange line in the middle of the band in this screenshot shows a quiet AGC.

AGC in this screenshot shows there are activities in this band which our AGC was able to defend against it.

We believe it could be harmonics of GSM cellular phone near our site.

Our AGC mitigates the effect of such interference completely.



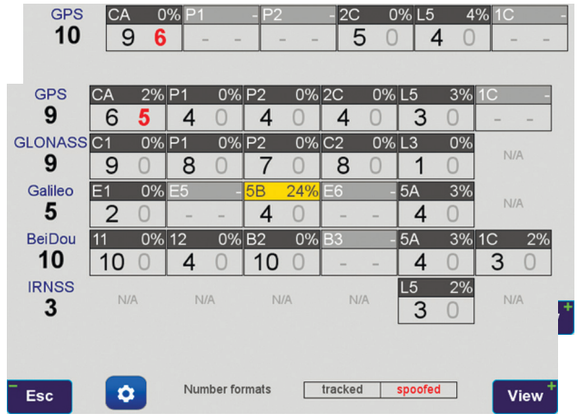


Spoofers & 2 Peaks

Spoofers are quite different from jammers. They don't disturb the environment and the spectrum shape. They broadcast a GNSS-like signal to fool the GNSS receivers to calculate wrong positions.

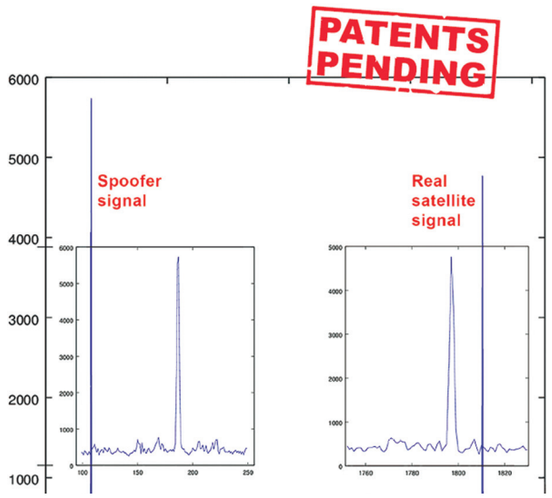
In the top screenshot 10 GPS satellites were visible (according to the Almanac). 6 of the 9 GPS satellites that we tracked were spoofed, as indicated by the red number, while the noise level was 0% in the GPS C/A band.

In the second screenshot, 5 of the 6 GPS C/A signals were spoofed while the noise in the band was only 2%.



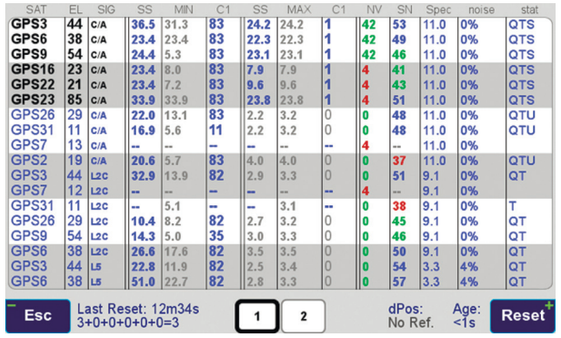
We detect spoofers by digital signal processing. With 864 channels and about 130,000 Quick Acquisition Channels in our TRIUMPH chip, we have resources to assign more than one channel to each satellite to find ALL signals that are transmitted with that GNSS PRN code.

If we detect more than one reasonable and consistent correlation peak for any PRN code, we know that we are being spoofed and can identify the spoofer signals. Figure on the right is an example of two peaks. We isolate and ignore the wrong peak.



The screenshot on the right shows details of each signal. The first six lines in this screenshot show the spoofed signals that we detected as soon as they appeared (numbers "1" in those line). The two section columns represents the characteristics of each peak. Second SS column show if the second peak is a consistent signal.

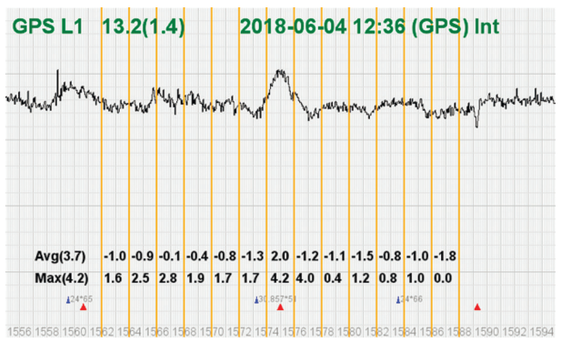
While six satellites were spoofed, there was no indication on the noise level (0%) and no indication on the spectrum shape and level as shown on the screenshot on the right below the chart.



We reject infected signals and then among all the available GPS, GLONASS, Galileo, BeiDou, IRNSS and QZSS multiple signals we use the healthy ones.

Usually there are over 100 signals available at any given time, and we need only four good signals to compute position. In rare cases that all signals are affected, we inform the user and guide them to use compass and altimeter to get out of the Jammed area.

There is absolutely no way that we can be spoofed without our knowledge. We will immediately recognize and take corrective action.

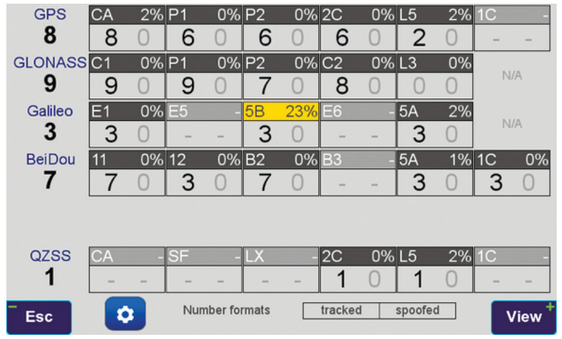


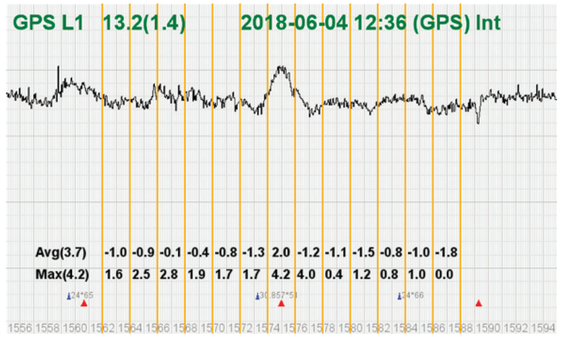
Jamming and Spoofing protection option is available in all of our products and OEM Boards.

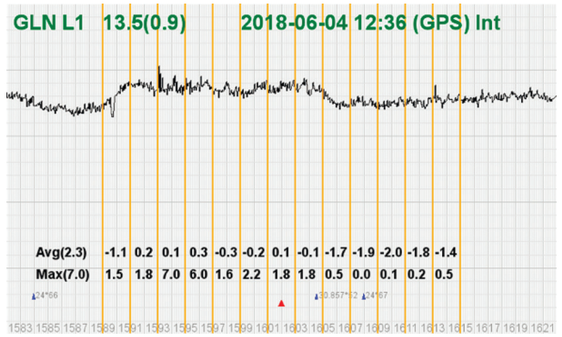
And Examples of when the world is peaceful.

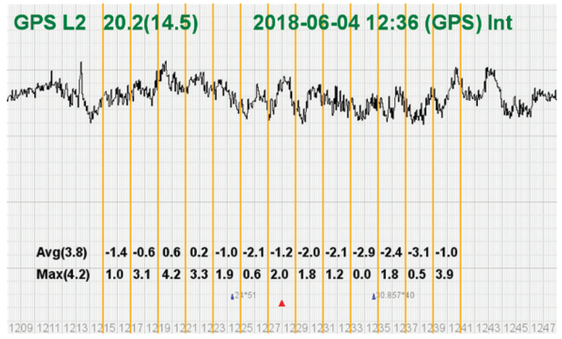
Jamming and Spoofing protection option is available in all of our products and OEM Boards.

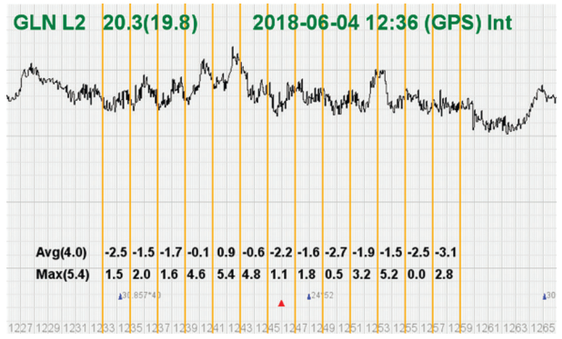
All screenshots are from our TRIUMPH-LS Receiver.

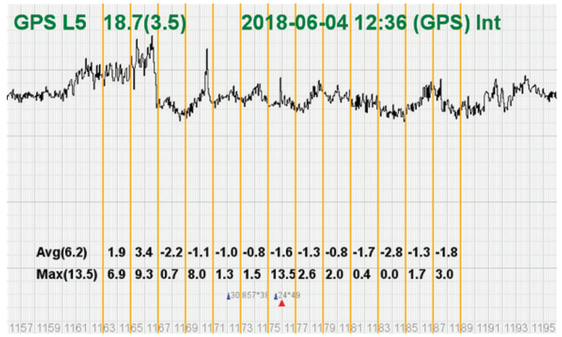


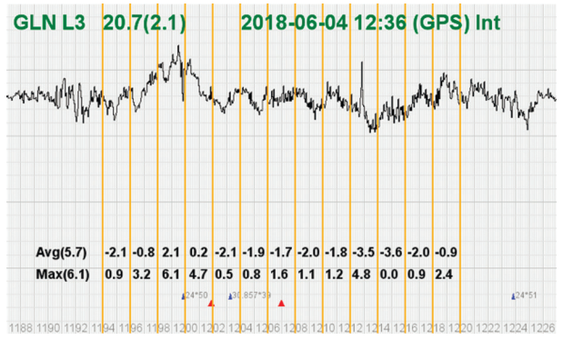






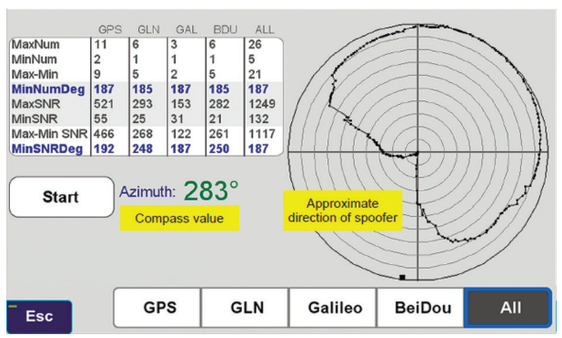






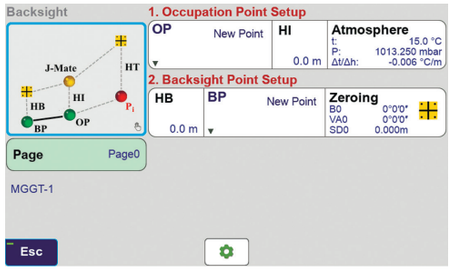
When you detect that spoofers exist, you can also try to find the direction that the spoofing signals are coming from. For this, hold your receiver antenna (e.g. TRIUMPH-LS) horizontally and rotate it slowly (one rotation about 30 seconds) as shown in the picture and find the direction that the satellite energies become minimum. This is the orientation that the spoofer is behind the null point of the antenna reception pattern.

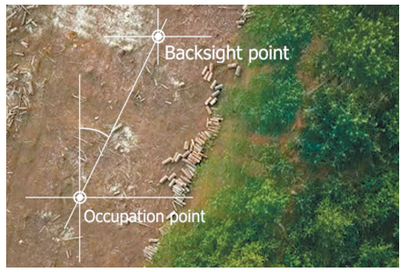
After one or more full rotations observe the resulting graph that shows approximate orientation of the spoofer as shown in figure below.

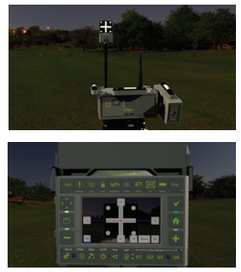


Backsight icon

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



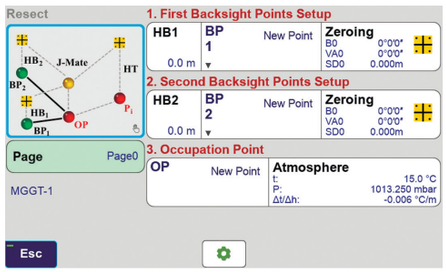


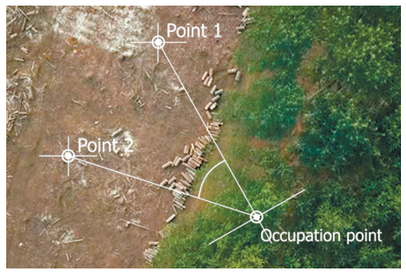


This screen appears which gui-des you to determine the accurate positions of the Occupation Point and the Backsight Point, to establish an azimuth and calibrate the J-Mate angular encoders.

Resect icon

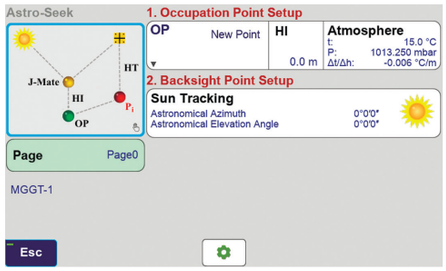
If GNSS signals are not available at the Occupation Point, click the “J-Mate-Resect” icon





Shoot two or more known points to establish an accurate position and calibrate the encoders. Then continue to shoot the unknown points.

Astro-Seek icon

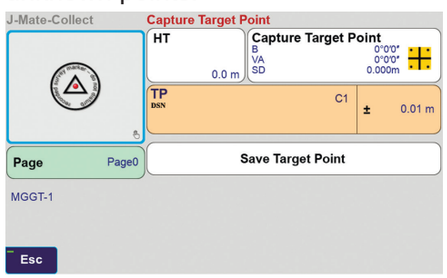


And now our new feature!

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

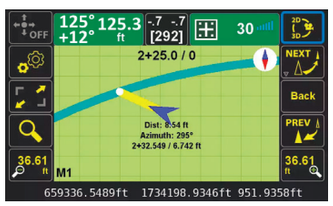
J-Mate-Collect

After calibration is performed, click the J-Mate-Collect icon to shoot the unknown points.



J-Mate-Stake

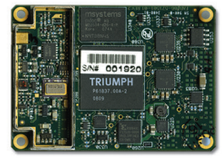
Click the J-Mate-Stake icon to use for stakeout.



The functions and features of the J-Mate stakeout are very similar to our conventional GNSS stakeout: RTK solutions guide you to the stake points. But with the J-Mate the camera follows the “+” sign that you carry and then the encoders and laser measurements (shown on screenshots) provide guidance to the stakeout features. This is similar to Visual Stakeout and other useful and innovative features of our TRIUMPH-LS GNSS RTK stakeout.

OEM boards

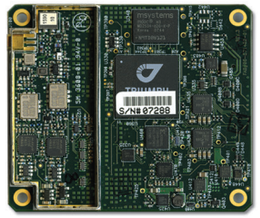
Available in all boards: RAIM; On-Board Power supply; Reduced MinPad; RS232(A) 460 kbaud; USB; Fast acquisition channels; Advanced Multipath Reduction; 1PPS; Event; IRIG A/B; Up to 100 Hz update rate for real time position and raw data



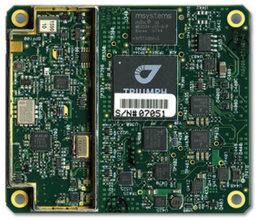
TR-G2
All-in-view
GPS L1; SBAS L1;
Galileo E1; BeiDou B1;
QZSS L1

TRH-G2P
All-in-view GPS L1;
SBAS L1; Galileo E1;
BeiDou B1; QZSS L1;
UART(A) 460 kbaud *

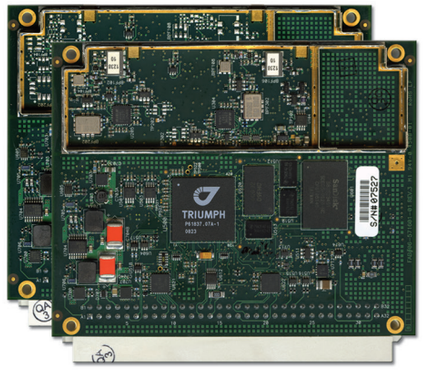
TRH-G2
All-in-view
GPS L1; Galileo E1;
BeiDou B1; QZSS L1;
UART(A) 460 kbaud **



TR-G3
All-in-view
GPS L1; SBAS L1;
GLONASS L1;
Galileo E1;
BeiDou B1;
QZSS L1

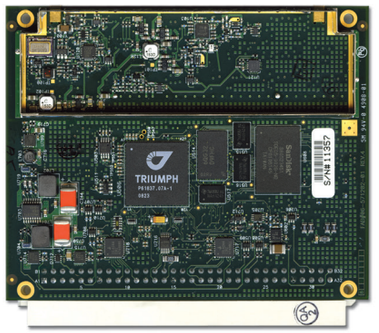


TR-G2T
All-in-view
GPS L1/L2/L5;
SBAS L1/L5;
Galileo E1/E5A;
BeiDou B1;
QZSS L1

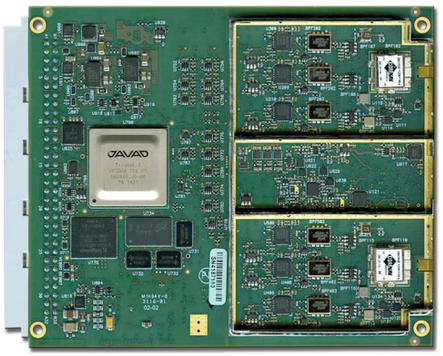


Duo-G2
All-in-view
2 groups of GPS L1; SBAS L1;
Galileo E1; Ethernet;
Up to 50 Hz Heading rate

Duo-G2D
All-in-view
2 groups of GPS L1/L2;
SBAS L1; Galileo E1; Ethernet;
Up to 50 Hz Heading rate

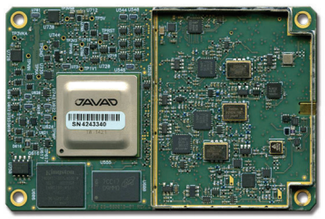


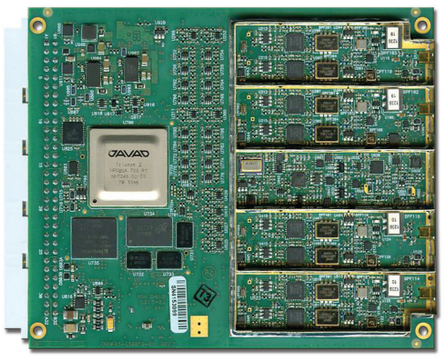
TRE-G2T
All-in-view GPS L1/L2/L5; SBAS L1/L5; Galileo E1/E5A; BeiDou B1; QZSS L1/L2/L5; Ethernet ***



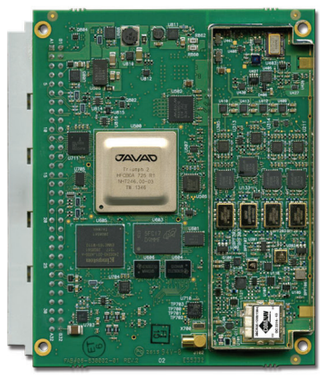
TRE_DUO
All-in-view on 2 antennas
GPS L1/L2/L2C/L5;
Galileo E1/E5A/E5B/AltBoc;
GLONASS L1/L2/L3;
BeiDou B1/B2; QZSS L1/L2/L5

TR-3N
All-in-view GPS L1/L2/L2C/L5;
Galileo E1/E5A/E5B/AltBoc;
GLONASS L1/L2/L3; BeiDou B1/B2;
QZSS L1/L2/L5; SBAS L1/L5





TRE-Quattro
All-in-view on 2 antennas
GPS L1/L2/L2C/L5, Galileo E1/E5A/E5B/AltBoc; GLONASS L1/L2/L3;
BeiDou B1/B2; QZSS L1/L2/L5



TRE-3N
All-in-view GPS L1/L2/L5
Galileo E1/E5A/E5B/AltBoc;
GLONASS L1/L2/L3;
BeiDou B1/B2; SBAS L1/L5;
QSZZ L1/L2/L5/LEX

** Not available in this board: Reduced MinPad; RS232(A) 460 kbaud; USB; Event; IRIG A/B*
*** Not available in this board: Reduced MinPad; RS232(A) 460 kbaud; USB; 1PPS; Event; IRIG A/B*
**** May be not applicable for simultaneous tracking of Galileo and BeiDou*

Spoofer detection available in all of our OEM boards.

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