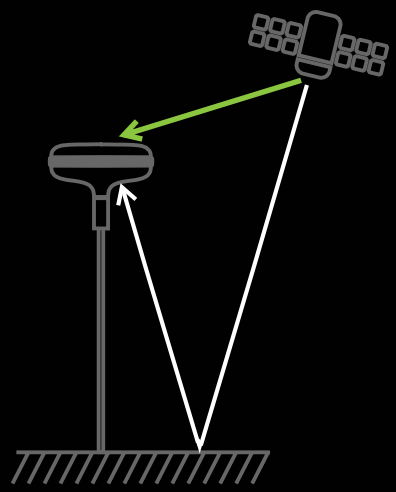
MULTIPATH BUSTERS



Multipath appears like a **ghost signal** that degrades the accuracy of your shots. We **detect and bust** these ghosts by sophisticated signal processing techniques in our **TRIUMPH** chip. We also show the **signature** of these ghosts that we bust. Below are two screen shots from the TRIUMPH-LS.

SAT	EL	AZ	L1	P1	P2	L2C	L5
GPS2	29↑	154	7	7	2	--	--
GPS6	44↑	98	11	9	2	2	-13
GPS12	70↑	282	7	8	-2	-2	--
GPS14	25^	302	5	8	-4	--	--
GPS17	23↓	58	6	9	-6	-2	--
GPS24	53↓	196	1	4	13	1	-12
GPS25	30↑	282	4	8	7	1	-32
GLN1	10↑	34	1	4	-15	-23	--
GLN8	16↓	344	12	15	17	25	--
GLN9	32↑	316	0	2	-3	-6	--
GLN15	31↓	142	5	5	0	1	--
GLN16	84↑	266	2	2	-11	-18	--
GLN17	39↓	44	-1	-4	-12	-10	--
GLN18	69↑	188	-1	3	-1	-6	--
GAL12	68^	108	0	-26	0	--	-14
SB127	25^	160	7	--	--	--	-4
SB128	15^	130	9	--	--	--	-11
QZ193	13↑	68	-3	-1	--	1	-19
BDU2	16^	132	-7	--	--	--	-17
BDU5	25^	154	-4	--	--	--	-7
BDU8	25↓	54	-10	--	--	--	-20

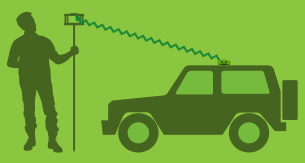
SAT	EL	AZ	L1	P1	P2	L2C	L5
BDU11	75↑	158	-6	--	--	--	-5
BDU12	36↓	60	-6	--	--	--	-14
GPS3	10	26	--	--	--	--	--
GPS29	3	229	--	--	--	--	--
GPS32	3	346	--	--	--	--	--
GLN7	3	297	--	--	--	--	--
GLN19	12	210	--	--	--	--	--

In each column the relative amount of multipath ghosts that has been detected and busted from each signal **carrier phase** is shown (in millimeters). In the carrier phase it is up to a **quarter of a cycle** (wavelength).

SAT	EL	L1	P1	P2	L2C	L5
GPS2	29↑	273	281	-76	--	--
GPS6	44↑	55	201	-60	-5	189
GPS12	70↑	183	190	-90	-94	--
GPS14	25^	281	317	-97	--	--
GPS17	23↓	332	364	-74	6	--
GPS24	53↓	117	566	67	-64	124
GPS25	30↑	243	218	-42	-50	-34
GLN1	10↑	305	229	-126	-404	--
GLN8	16↓	26	87	-484	-617	--
GLN9	32↑	359	301	-246	55	--
GLN15	31↓	276	203	-93	-2	--
GLN16	84↑	235	309	-133	-109	--
GLN17	39↓	52	-84	-156	-52	--
GLN18	69↑	190	168	-177	-184	--
GAL12	68^	680	-121	246	--	32
SB127	25^	469	--	--	--	319
SB128	15^	206	--	--	--	322
QZ193	13↑	550	513	--	56	55
BDU2	16^	299	--	--	--	275
BDU5	25^	269	--	--	--	230
BDU8	25↓	145	--	--	--	143

SAT	EL	L1	P1	P2	L2C	L5
BDU11	75↑	362	--	--	--	305
BDU12	36↓	288	--	--	--	200
GPS3	10	--	--	--	--	--
GPS29	3	--	--	--	--	--
GPS32	3	--	--	--	--	--
GLN7	3	--	--	--	--	--
GLN19	12	--	--	--	--	--

In each column the relative amount of multipath ghost that has been detected and busted from each signal **Code phase** (range) is shown (in centimeters). In the code phase it is approximately **several meters**.



Make more **money** and have **fun** too >>>
Park, RTK, DPOS-It/Reverse-Shift-It

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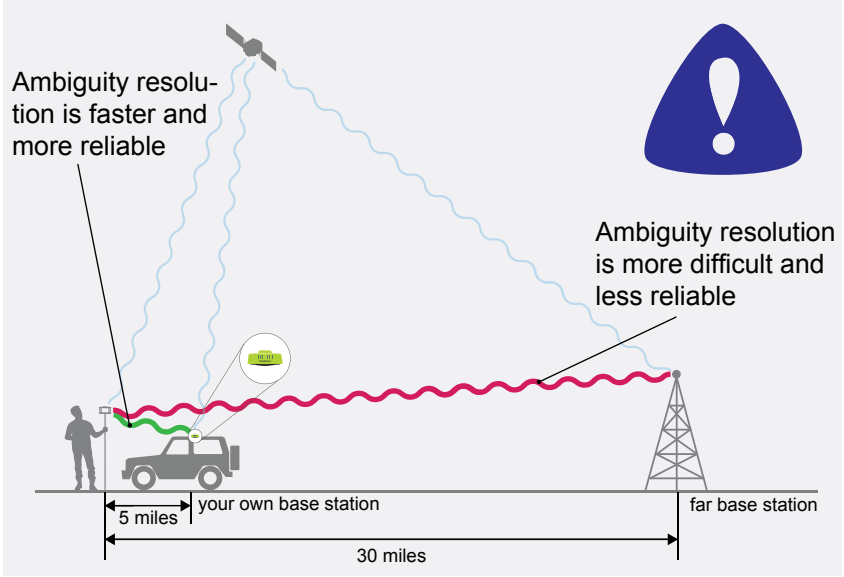
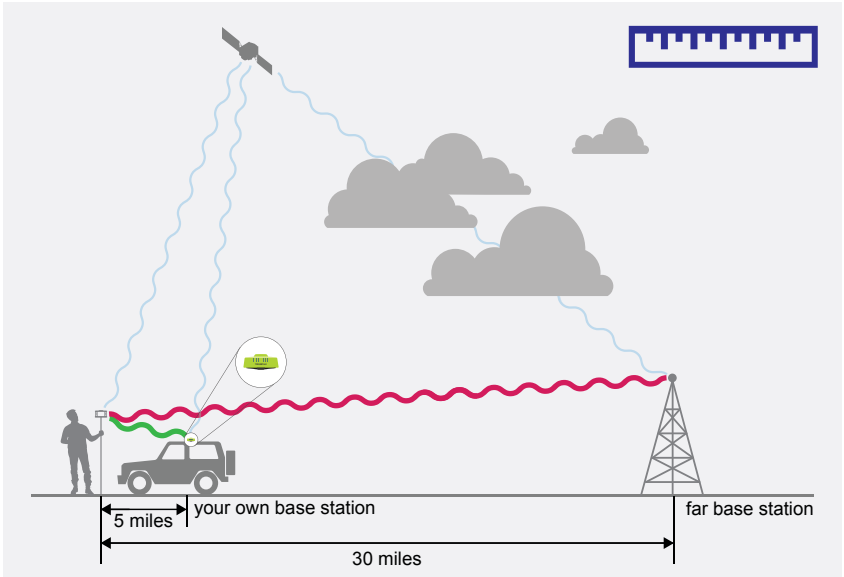
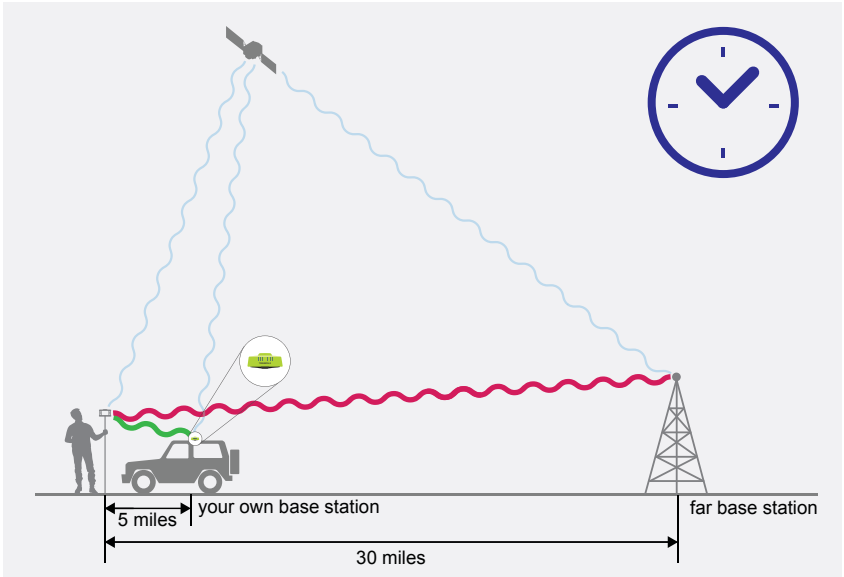
Advantages of your own base station...



1. Shorter baselines provide significantly better **reliability** because the ambiguities are much easier to resolve and the correct ambiguity solution has an obvious contrast.



2. Shorter baseline has better **accuracy** because most of errors (like atmospheric and tropospheric effects) are common and cancel.



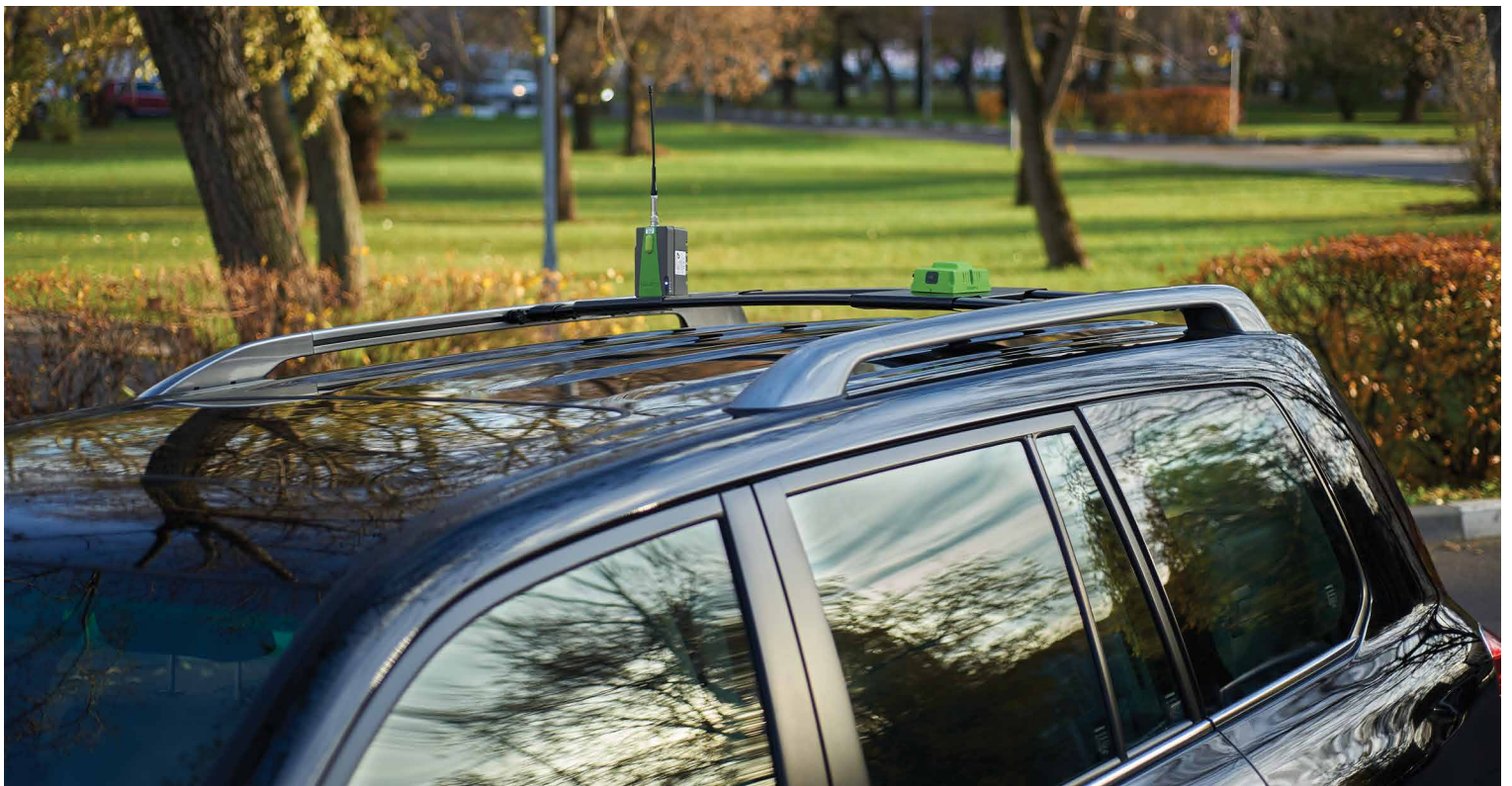
3. Shorter baseline ambiguities are resolved much **faster**. In longer baselines, incorrect ambiguities may pose as being correct in the statistical evaluations and it takes longer to isolate incorrect ambiguities.

1 Equip your car

Mount the TRIUMPH-2 and radio on top of your car or truck. You can use either **UHF or FHSS** (Frequency Hopping Spread Spectrum) radios. You may want to bolt them down in your car for everyday use. FHSS does not need a license but its range is limited to a couple of miles. UHF has a longer range (up to 50 miles with a 35 Watt amplifier) but it needs a license. FHSS is particularly helpful in connection with our Beast Mode RTK which provides corrections from a TRIUMPH-2 near your job site. Use an appropriate long whip UHF/FHSS for longer range transmission.

HPT401BT, 1W UHF Radio

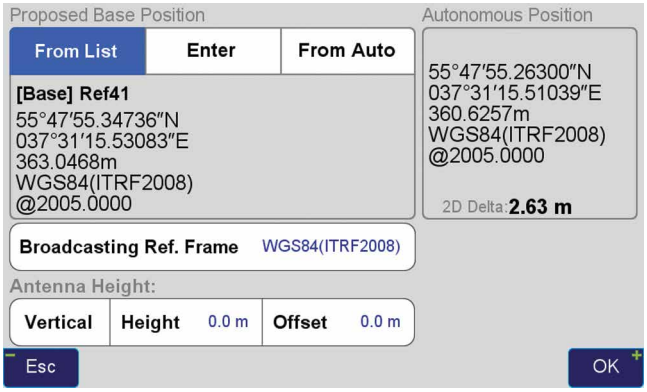
TRIUMPH-2, GPS+GLONASS, L1/L2

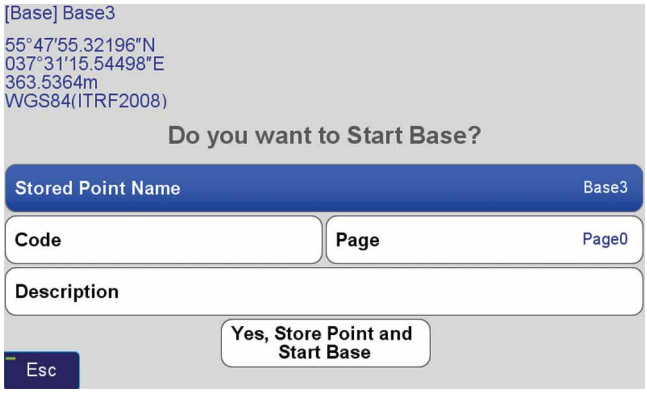


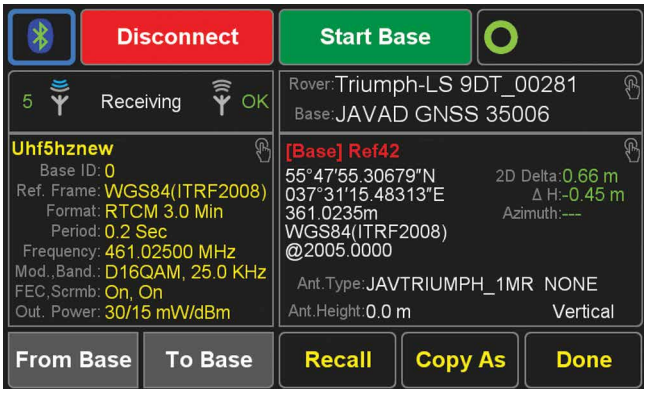
2 Park your car, Start Base

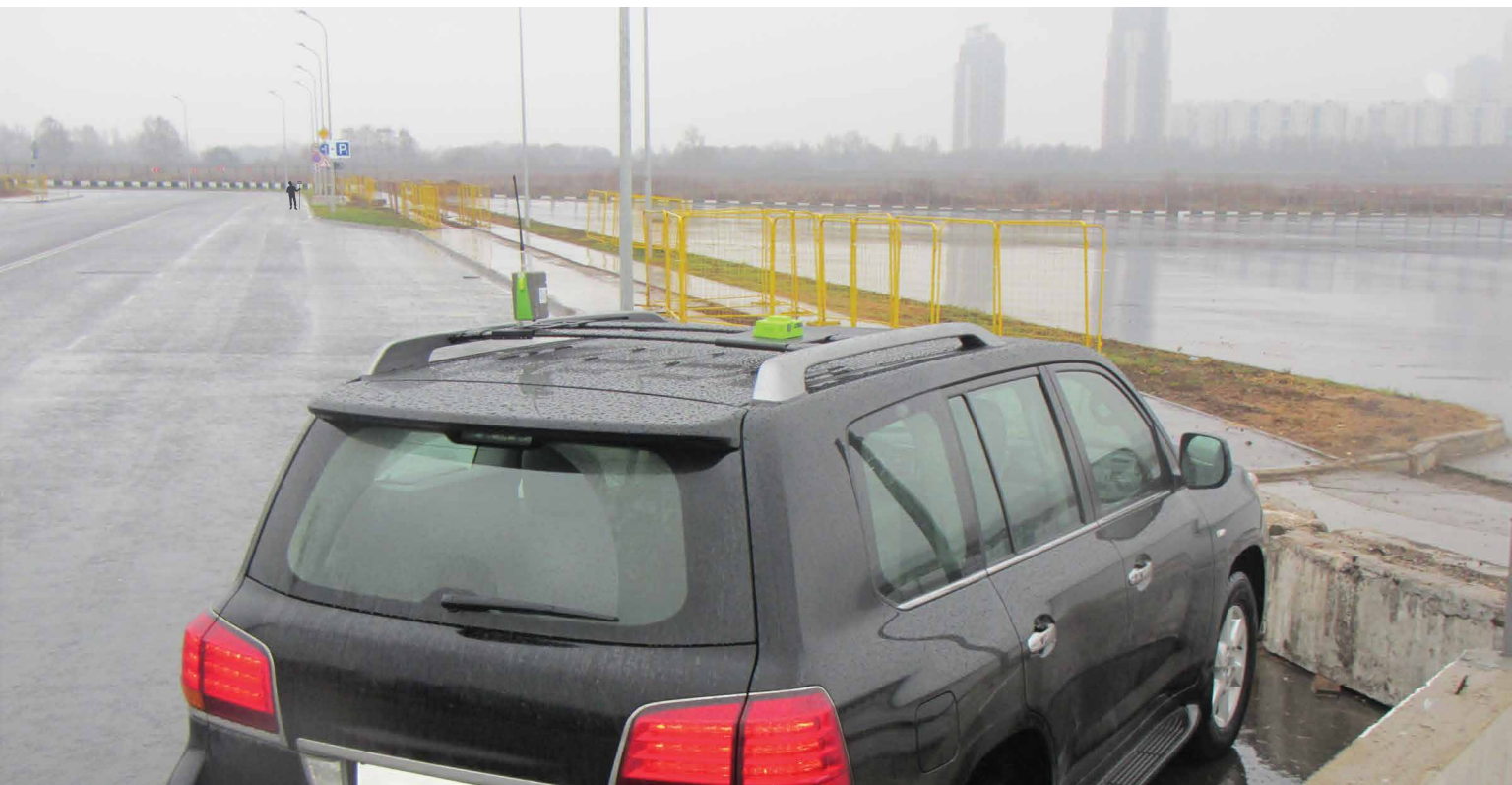
Park your car in an open area near your job site. It may be even in the middle of your site job. Engage all the brakes and ensure the car will not move. The Base/ Rover Setup screen makes it easy to configure the base and rover with the same parameters.

Use “**Auto**” for the base coordinate. “Auto” will use an autonomous solution as the base coordinates which may be off by several meters (this will be corrected later). Then click **Start Base**.



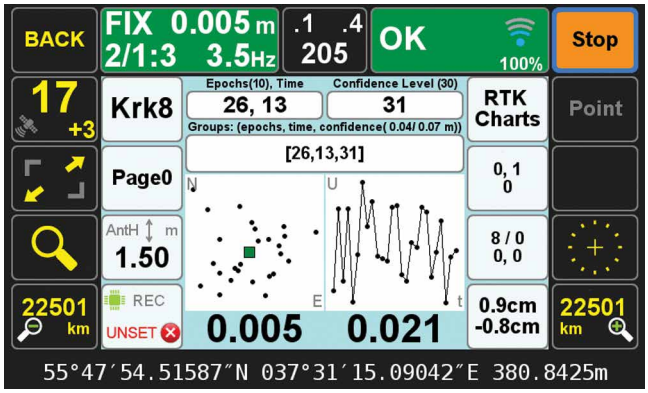




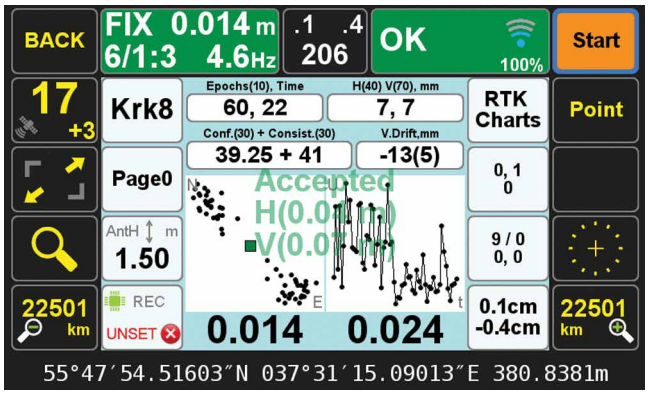


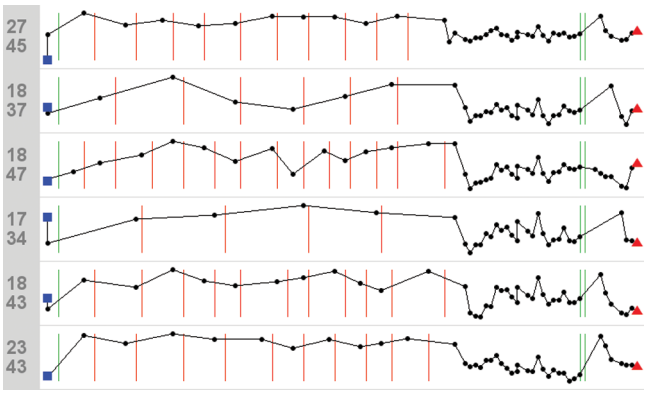
3 RTK Survey

Use your rover to perform your tasks. We have combined UHF and Spread Spectrum Frequency Hopping (FHSS) in the same module in TRIUMPH-LS as an option. The automatic "**Verify**" feature (Phase-1 and Phase-2) ensures that you will never get a wrong solution.



Since your RTK baselines are short, you benefit from all advantages that we discussed earlier BUT all your rover shots are shifted by the offset error of the autonomous base coordinates (up to several meters). "DPOS-It" or "Reverse-Shift-It" to correct for the error from the autonomous position.

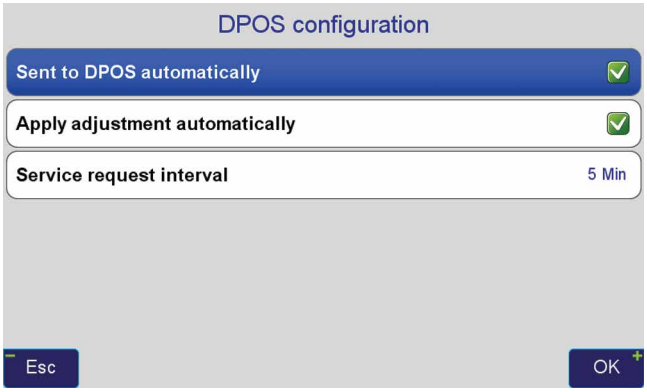


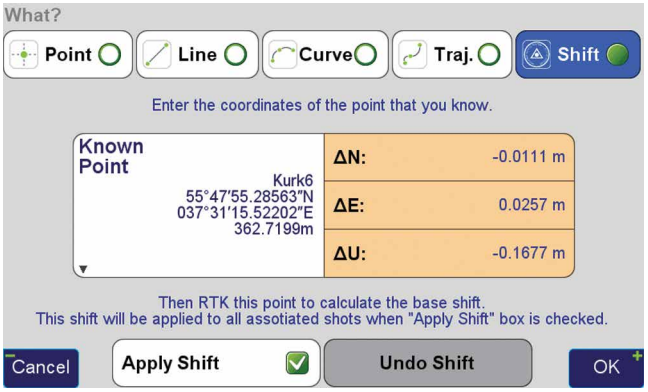


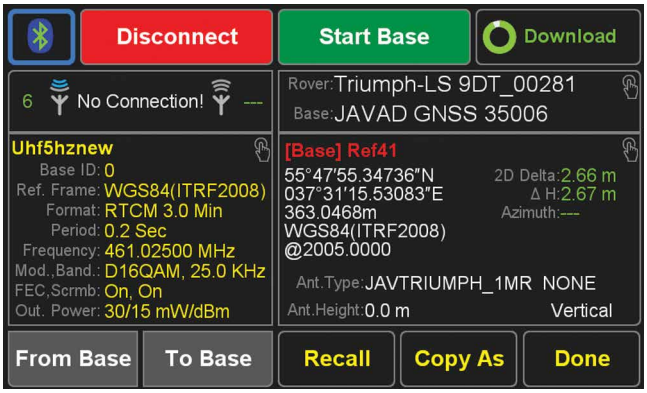
4 DPOS-it or Reverse-Shift-it

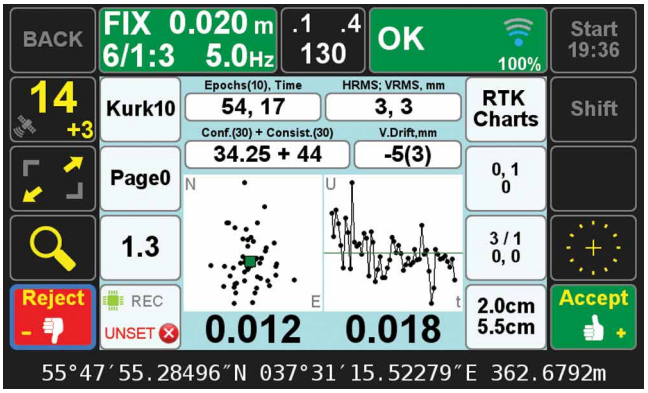
DPOS-it:
Press Stop Base and this will automatically **download** the raw GNSS base data to TRIUMPH-LS and send it to **DPOS** for processing with data from nearby CORS receivers. The TRIUMPH-LS then receives the **correct coordinates** of the base and **shifts** all the rover points accordingly. DPOS, CORS data and J-Field's RTK Verification guarantee your rover solutions.

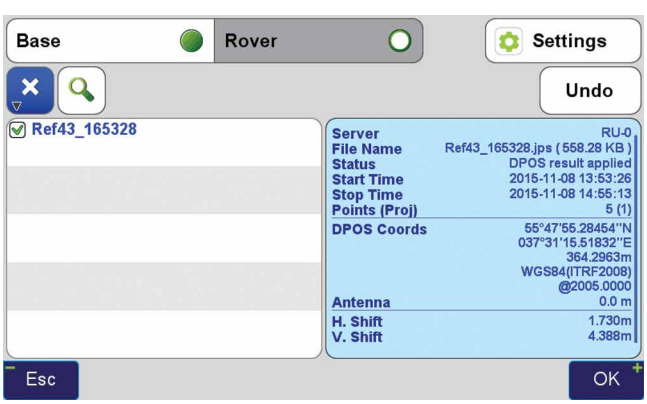
Reverse-Shift-it:
1) Take the TRIUMPH-LS to a **known point** and select the "**Shift**" function in the Setup Advanced screen. 2) Enter the **known coordinates** of that point. 3) Take a **shot** at that point and a base station shift will be **calculated and applied** to all previous and subsequent points surveyed in this session. You can then also use the newly surveyed points as known point for leap frogging during the project.

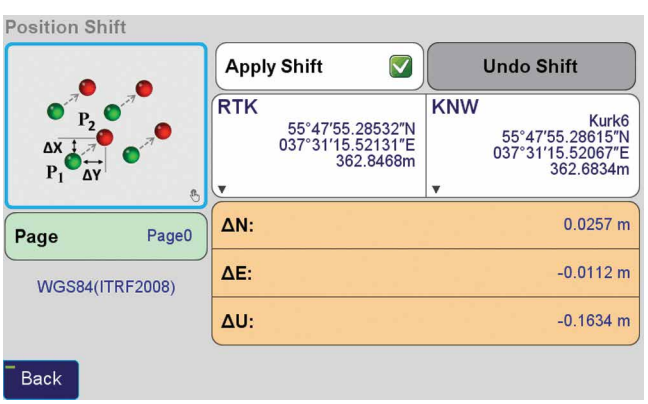






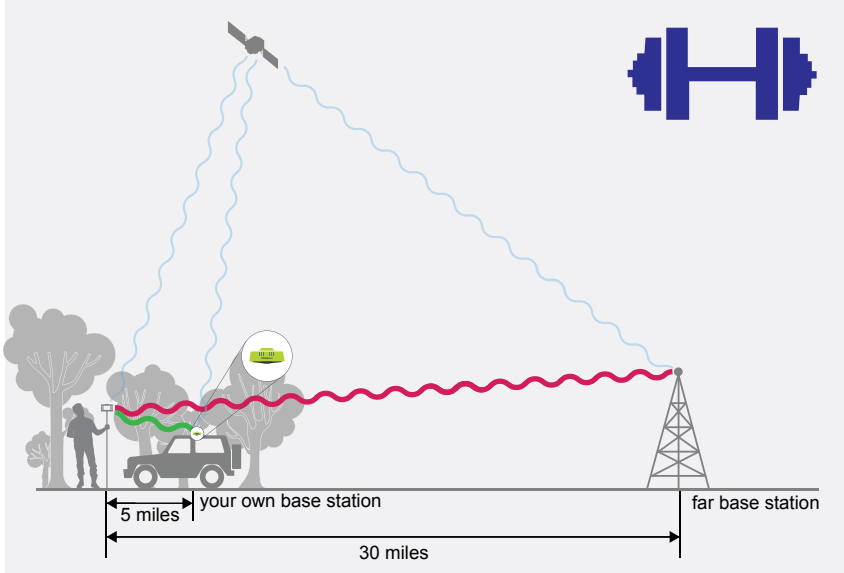




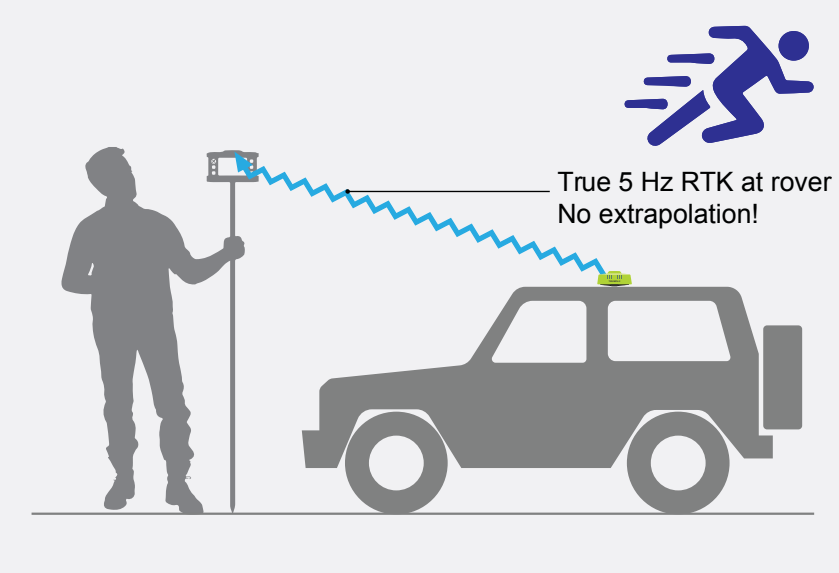


...and short baselines

4. Shorter baselines make it feasible to work in **difficult** areas (under tree canopy and in urban environments) because ambiguities have better contrast and are easier to resolve.



5. **Beast Mode RTK** is available only via our TRIUMPH-2 and TRIUMPH-1M base station. It makes ambiguity resolution up to 5 times faster because base station transmits base data 5 times per second. 5-Hz Beast Mode RTK is totally different from the up to 100-Hz RTK that is done by extrapolating the same 1-Hz data 100 times per second AFTER the ambiguities are fixed. This extrapolation technique does not improve the ambiguity resolution speed and is mainly used in applications like machine control after the ambiguities are fixed.



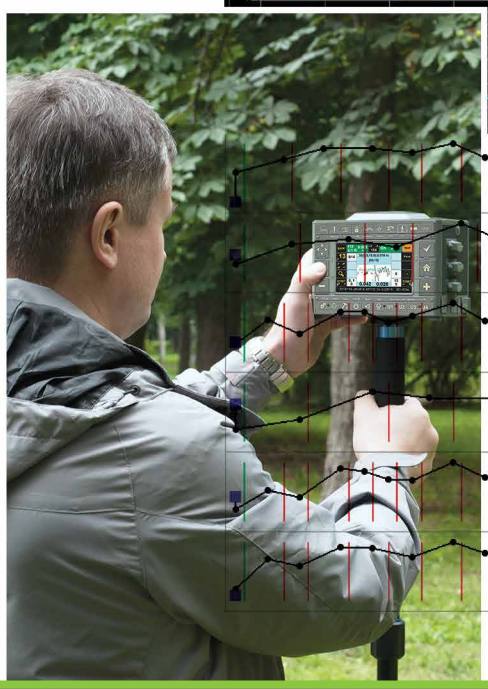
6. In addition to savings due to speed and reliability, it saves you RTN and communication charges. A complete system, Base + Rover + Radio + Controller & Controller Software, starts at $19,990. 0% financing available ($1,537.69 per month for 13 months) to active license US Professional Land Surveyors (PLS). Extended finance terms also available, contact sales@javad.com for details.

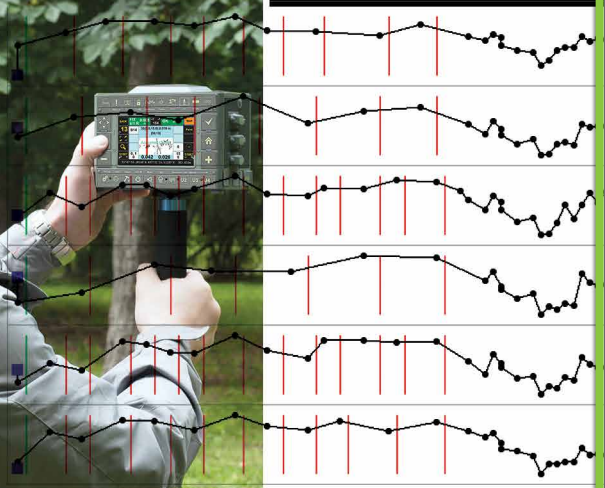
Monitor and record the health of your shots

Verify, Monitor, Record, Present and Defend

RTK is a statistical process by nature and needs **verification**. TRIUMPH-LS has **six different RTK engines** and extensive automatic verification to ensure your shots are 100% reliable (see www.javad.com).

It also has many tools to **document** the process of your shots for **presentation** when you need to **prove** and **defend**. The screen shots on following pages can automatically be recorded and attached to each point and easily **exported to HTML format**.





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