

Mark's MobileMapper 120, ProMark 120, ProMark 220 Notes

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All of the MobileMapper and ProMark products, software and accessories are listed at:

http://www.igage.com/mp/mm100_pm200/MM1x00_PM1x0_PM2x0.htm

Summary

In late 2010, I billed the MobileMapper 100 receiver as 'The Breakthrough in Handheld Accuracy' and it has lived up to every expectation.

Initially the only close accuracy competition (at over twice the price) was the GeoXH and the MM100 trumped the XH on acquisition time and post-processed accuracy. After six months Trimble MGIS released the 6000 series which nearly approximated the MM100 performance, but at a heavy price penalty.

In the ensuing two years, Ashtech has been acquired by Spectra Precision (a division of Trimble) and the MobileMapper 110 is now offered (painted yellow and black) as the Geo5 receiver by Trimble dealers.

In November 2012 the MM100, PM100, PM200 line was updated with these enhancements:

- Possibility to track L1 + L2 + G1 + G2, Z-Blade
- All PM120 receivers include RTK and NTRIP/DIP Options
- Updated OS to 'Windows Embedded Handheld 6.5 Pro'

The updated family members are now called the MM120, PM120 and PM220.

There is little difference between the MM100 and MM120. And there is little difference between the PM100 and PM120. The primary enhancement is Z-Blade (if the GLONASS option is purchased) which allows the receivers to fix without US satellites.

ProMark 220 are significantly better than ProMark 200 because the PM220 now tracks L1+L2+G1+G2. ProMark 200's only track L1+L2.

The entire family still offers ¼ meter real-time WAAS accuracy (European users will get ½ meter accuracy with EGNOS.)

Post-processed static accuracy is 5 mm, Stop & Go accuracy is 12 mm.

RTK accuracy is 10 mm, the same as the ProMark 800 and most competing RTK devices.

These accuracies are even available with the internal antenna in open-sky environments.

Optional GLONASS won't make much difference for real-time work in open sky. But under tree canopy and in urban environments it makes a huge difference.

For post-processed (static and Stop & Go) applications, GLONASS will greatly reduce the required time on point, plus will allow static jobs under moderate/heavy canopy.

For real-time data collection, GLONASS will allow you to work where other receiver's won't even get a position.

Scalability: MM120 -> PM120 -> PM220

The **MobileMapper 120** receiver is the base hardware for a family of three 'Kit' configurations:

- **MobileMapper 120** targeted at GIS and handheld mapping applications
- **ProMark 120** targeted at Static and Stop-N-Go, post-processed sub-centimeter and L1 RTK, survey applications
- **ProMark 200** targeted at Dual Frequency network (NTRIP,DIP) survey and mobile mapping applications

There is no difference between the hardware receivers for the MobileMapper 120 Kit, ProMark 120 Kit and ProMark 220 Kit other than loaded applications, accessories and the background image displayed on the receiver's boot screen.

The receivers are differentiated by the software options which are installed:

Device	Bag, Cradle	Ext Antenna	NTRIP DIP	RTK	GLONASS	L2	FAST 20Hz
MobileMapper 120			\$695	\$,1495	\$1,250	\$,1995	\$1,495
ProMark 120	✓	660 L1* +\$1000 L1/L2	✓	✓	\$1,250	\$,1995	\$1,495
ProMark 220	✓	661 L1/L2	✓	✓	✓	✓	\$1,495

✓ = Included

* The ProMark 120 receiver is shipped with an L1 only GNSS antenna. If you plan to upgrade to Dual Frequency (for running OPUS compatible occupations) consider purchasing the L1/L2 dual-frequency antenna initially.

MobileMapper 120

The **MobileMapper 120** is targeted at GIS and Mapping Grade users. Receivers are available from iGage Mapping Corporation with:

No software (presumably for users with ArcPad site licenses or applications with another Windows Mobile application)

Spectra Precision's MobileMapper Field program (excellent choice!)

ESRI ArcPad bundled

FAST Survey (Ashtech's House Brand of Carlson SurvCE, more on this later...)

Carlson SurvCE (Direct from Carlson)

As in previous products, it may save hundreds of dollars to purchase the receiver with an application bundled:

Application	Bundled	Separately
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ArcPad	+\$545	+\$700
MobileMapper Field	+\$300	+\$395
ProMark Field		+\$395
Fast Survey (Int GPS)		+\$1,000
Fast Survey (Int & Ext GPS)	+\$700	+\$1,250
Carlson SuvCE		+\$1,250

Customers are cautioned to evaluate software needs prior to purchase as the bundled price can not be offered once equipment is delivered.

MobileMapper Field V3 is an excellent field data collection tool. It natively generates shapefiles, is easy to learn to use, supports optional post-processing, supports GEOIDs for converting ellipsoid heights to orthometric heights and has built-in transformations from WAAS ITRF2005 framed real-time results to NAD83-CORS96.

ProMark 120

The **ProMark 120** is bundled with an external L1 antenna (ASH-660), brackets and the MobileMapper Field application with the Post-Processing option for collecting Static and Stop-N-Go data.

The PM120 is a step up from the ProMark 120 receiver because

Every receiver includes the RTK and NTRIP/DIP option!

This means you can add radios or connect to an existing network and get 10 mm accurate, fixed, RTK results! L1 performance is excellent for short baselines and the receivers will fix in VRS networks. Long baselines result in longer times-to-fix. GLONASS will help considerably when running L1 only RTK with moderate canopy.

In addition, the RTK option allows the PM120 used as a base to generate any of the supported correction formats: "

Unlike the ProMark 3 receivers which were bundled in pairs, the PM120 receivers are sold individually.

Dual-frequency can be added to a static only ProMark 120 receiver at the time by:

Purchasing the L1/L2 option key

Swapping the 660 antenna for a L1/L2 661 antenna

This makes a very cost effective base that will generate RINEX for OPUS solutions. Again, you need to make this decision before you take delivery on your instruments.

Upgrading a ProMark 120 to ProMark 220 or OPUS Ready Receiver

Potential ProMark 120 customers who think they may update a receiver to a ProMark 220 should consider purchasing the receiver with the L1/L2 661 antenna. Purchasing initially will save \$995 per receiver:



PM120 with L1 (660) Antenna	\$3,950
PM120 with L2 (661) Antenna	\$4,950
661 Antenna (purchased separately)	\$1,995

How Much Extra Does it Cost to Purchase a ProMark 120 Then Upgrade it to a ProMark 220 a-la-carte?

If initially purchased with **L1 only 660 Antenna**:

ProMark 120 PN 990664-01	\$ 3,950
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Later purchase:

661 Antenna	\$ 1,995
L2 Option PN 680607	\$ 1,995
GLONASS PN 680603	\$ 1,250
FAST Survey Internal PN 990645	\$ 1,000

Total	\$10,190
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Penalty for purchasing a-la-carte	\$ 1,240
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If initially purchased with **L2 661 Antenna**:

ProMark 120 PN 990664-11	\$ 4,950
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Later purchase:

L2 Option PN 680607	\$ 1,995
GLONASS PN 680603	\$ 1,250
FAST Survey Internal PN 990645	\$ 1,000

Total	\$ 9,195
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Penalty for purchasing a-la-carte	\$ 245
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PM120 customers doing the upgrade should give us a call, we can make the penalty

What is the Minimum Configuration that Supports OPUS?

To record L1/L2 data you will need a L1/L2 661 Antenna and the L2 Tracking option on a ProMark 120:

ProMark 120 w/ L1/L2 661 Antenna PN 990664-11	\$ 4,950
L2 Option PN 680607	\$ 1,995

Total	\$ 6,945
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ProMark 220

The ProMark 220 includes all the possible options and FAST Survey Internal.

The ProMark 220 is a great GSM/GPRS Network L1/L2 Rover. The Time-to-First-Fix is as good as any rover Ashtech has ever produced; accuracy is identical to the ProMark 800

receiver. Cabled to an external antenna on a pole, the ProMark 220 is lightweight and reasonably priced network rover.

GIS users will be happy that the ProMark 220 Network Rover is 100% compatible with ArcPad 10! So you can connect to your local correction network, benefit from fast L1/L2 fixes with centimeter real-time accuracy and collect data in the industry standard ArcPad mobile product.

What is the difference between a ProMark 220 and a ProMark 800?

The PM800 additionally tracks Galileo and L5;

The PM800 tracks 120 channels while ProMark 220 tracks 45

Is 45 channels enough? Probably, but to evaluate channel count we need to understand the relationship between channels and tracked satellites.

When a PM220 tracks a satellite, it tracks 3 signals

CA, P1(Y) and P2(Y)

Each signal delivers pseudo-range observables C1, P1 and P2. Signals P1(Y) and P2(Y) also deliver 3 additional observables:

S1 and S2: strength

L1 and L2: carrier

D1 and D2: Doppler

So the GPS receiver tracks 3-signals (channels) producing 9 observables for each tracked satellite:

L1 L2 C1 P1 P2 D1 D2 S1 S2

I believe that 45-channels will support:

3 SBAS
14 Satellites

Where the Z-Blade engine chooses the best 14 satellites (optimizing geometry and S/N) from the available constellation.

Is 14 satellites enough? For most applications, I think so. I have heard it argued that tracking more than 14 satellites does not improve the solution. And I can tell you that when I am collecting points with 14 SV's, it really is an enjoyable day.

Is it worth \$13,500 for more channels? Well, that is the \$4,500 question! The ProMark 220 receiver fixes extremely quickly under moderate and heavy canopy and holds a fix well under dynamic conditions. It is very difficult or impossible to see any difference when compared to higher channel count receivers.

ArcPad 10 on the MM120/PM120/PM220

ArcPad 10 runs great on the MobileMapper 120. The fast processor, lots of static and flash memory and dedicated graphics processor make the MM120/PM120/PM220 a nice platform for ArcPad.

MobileMapper Field (and ArcPad) vs. ProMark Field

Data collected in MobileMapper Field and ArcPad is post-processed in MobileMapper Office for MM6 / MM120 (MMO). This provides single or multiple baseline processing with a drop-dead simple interface.

Data collected in MobileMapper Field is processed in GNSS Solutions which provides for very short baseline processing against VRS solutions. This VRS approach dependably generates fixed vectors in situations where the nearest reference stations are a long way away.

If you are going to be collecting high accuracy data in the middle of Montana, you will want to use ProMark Field. If you are lucky enough to be able to work in RTK mode with real-time corrections, then you won't need to post-process and all data collection options will enjoy similar accuracies.

Survey Pro on ProMark 220

Survey Pro is the flagship data collection software from Spectra Precision. *Survey Pro's* vast COGO feature set is unmatched in its capabilities and is one of the reasons *Survey Pro* has been a top choice of surveyors for more than 20 years.

ProMark 220 receivers are available with *Survey Pro GNSS* which includes:

- Complete Mechanical Instrument Support
- All data collection features
- Basic point stakeout
- Basic COGO including Inverses, Intersections, Manual Traverse, Area and much more
- Basic Curve Solutions
- All the fundamental features required to properly manage a survey job
- Advanced COGO and Curve Solutions including station offsets, average points, and spiral tools
- Advanced Stakeout including offset staking, slope staking and stake to a DTM
- Road Layout - Complete road layout and staking tool set
- Everything contained in Survey Pro plus complete GPS/GNSS instrument support
- Extensive data collection routines with easy to use, step-by-step setup features
- Extensive support for projections and calibrations
- All GNSS staking routines are supported
- Support for RTK, Network RTK, static and PPK surveys

The availability of *Survey Pro* on the ProMark 220 allows surveyors from the rich *Survey Pro* background to be immediately productive with the ProMark 220 receiver.

FAST Survey on ProMark 120

FAST Survey is the Ashtech 'House Brand' of Carlson SurvCE and is available in two flavors for the MobileMapper 120, ProMark 120, ProMark 220 family:

FAST Survey GNSS Internal Only	990645	\$1,000.00
Fast Survey Int/Ext GNSS	990618	\$1,245.00

The first flavor (990645) runs the internal MM120/PM120/PM220 GPS only. The second flavor (990618) will run external GPS receivers.

“FAST Survey GNSS” (PN 990618) is available bundled with a ProMark 120 receiver and a pole bracket:

ProMark 120 Data Collector	800981-12-ASH	\$3,995
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This combination is a fantastic solution for staking mining claims, setting crop rows, doing recon for boundary work where the internal WAAS corrected receiver is accurate enough and survey tools benefit the application.

Full support for Total Stations, Roding can be added:

Upgrade to Fast Survey Complete	680670	\$1,250
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Carlson SurvCE vs. FAST Survey on MobileMapper 120

It is also possible to purchase SurvCE from Carlson and load it on a MobileMapper 120.

FAST Survey and SurvCE are essentially exactly the same program, here is a breakdown on cost:

	FAST Survey	SurvCE
Internal GPS Only	990645 \$1,000	Not available
Internal + External GPS	990618 \$1,245	650.003.001 \$1,250
Add Total Station, Robotics and Advanced Roding	680670 \$1,250	\$1,745

There are some subtle differences in the branding options:

Carlson SurvCE does not interface to the internal GNSS engine well. One must set it for NMEA, use the GNSS toolbox to make RTK connections.

SurvCE will not report HRMS or VRMS for measurements made with the internal GPS receiver (this is a big deal.)

FAST Survey is usually updated at the same time new software is released for PM800, PF800, PM120 and PM220. SurvCE updates are not timed to match Ashtech firmware releases. Occasionally SurvCE won't immediately handle the latest Ashtech firmware updates.

For this reason, I strongly recommend that FAST Survey be provisioned instead of Carlson SurvCE on MM120 and PM120 devices.



Accuracy

Real-Time WAAS Corrected Accuracy

The MobileMapper 120 real-time SBAS performance is advertised as 0.5 meters with SBAS worldwide.

In the North American WAAS covered service area, my tests (performed in Browns Park and in the Salt Lake City area) indicate that the MobileMapper 120, with GLONASS enabled, using the internal GPS antenna has a 1-sigma 2DRMS Horizontal error of 0.25 meters. (That is about 0.15 meters CEP.)

My tests were 'real-world' tests performed by repeatedly occupying three adjacent control points, 15-second shots, over a 2½ hour period.

Here are the results for my West control point in Browns Park:

WEST HUB

TRUE	653,026.171	4,527,678.450	1,712.152		
1.7			1,713.852		
	Easting	Northing	Height	dXY	dZ
	653,026.063	4,527,678.316	1,713.858	0.172	0.006
	653,026.024	4,527,678.280	1,713.878	0.225	0.026
	653,026.319	4,527,678.794	1,714.447	0.375	0.595
	653,026.319	4,527,678.760	1,714.412	0.344	0.560
	653,026.288	4,527,678.733	1,714.289	0.306	0.437
	653,026.232	4,527,678.610	1,713.995	0.171	0.143
	653,026.242	4,527,678.585	1,713.944	0.153	0.092
	653,026.249	4,527,678.566	1,713.799	0.140	-0.053
	653,026.203	4,527,678.587	1,713.416	0.141	-0.436
	653,025.992	4,527,678.409	1,713.130	0.183	-0.722
	653,026.034	4,527,678.380	1,712.965	0.154	-0.887
	653,026.184	4,527,678.663	1,713.548	0.213	-0.304
	653,026.186	4,527,678.736	1,713.903	0.286	0.051
	653,026.198	4,527,678.624	1,713.925	0.176	0.073
	653,026.130	4,527,678.733	1,714.577	0.286	0.725
	653,026.110	4,527,678.671	1,714.430	0.229	0.578
	653,026.159	4,527,678.689	1,714.384	0.239	0.532
	653,026.039	4,527,678.791	1,713.562	0.366	-0.290
	653,026.077	4,527,678.761	1,713.603	0.325	-0.249
	653,026.110	4,527,678.831	1,713.656	0.386	-0.196
Avg	653,026.158	4,527,678.626	1,713.886	0.244	0.034
Max	653,026.319	4,527,678.831	1,714.577	0.386	0.725
Min	653,025.992	4,527,678.280	1,712.965	0.140	-0.887
Range	0.327	0.552	1.612	0.247	1.612
Stdev	0.099	0.181	0.447	0.084	0.447
		WEST	2DRMS	0.258	
			CEP	0.152	

Post-Processed Accuracy

MM120 post-processed accuracy, with GLONASS enabled, internal GPS antenna, 1-sigma 2DRMS Horizontal error is less than 0.010 meters.

Here is a sample set of occupations (GPS moved between two mounts). Time on point = 30 seconds, internal antenna, baseline to correction 7 km.

	Easting	Northing	Height	dXY	dZ
	428052.202	4508563.849	1336.374	0.006	0.014
	428052.201	4508563.838	1336.373	0.006	0.015
	428052.204	4508563.828	1336.374	0.016	0.015
	428052.202	4508563.839	1336.380	0.005	0.008
	428052.206	4508563.843	1336.368	0.006	0.021
	428052.206	4508563.843	1336.342	0.006	0.046
	428052.196	4508563.836	1336.383	0.009	0.006
	428052.188	4508563.831	1336.391	0.018	-0.003
	428052.201	4508563.853	1336.376	0.009	0.013
	428052.206	4508563.854	1336.371	0.012	0.017
	428052.201	4508563.831	1336.396	0.013	-0.008
	428052.198	4508563.836	1336.399	0.008	-0.010
	428052.200	4508563.838	1336.394	0.006	-0.006
	428052.204	4508563.860	1336.387	0.016	0.001
	428052.199	4508563.852	1336.391	0.008	-0.002
	428052.195	4508563.849	1336.402	0.008	-0.014
	428052.202	4508563.858	1336.388	0.014	0.000
	428052.202	4508563.867	1336.401	0.023	-0.013
	428052.194	4508563.851	1336.394	0.009	-0.006
	428052.196	4508563.838	1336.398	0.007	-0.009
	428052.200	4508563.845	1336.391	0.001	-0.002
	428052.201	4508563.842	1336.406	0.002	-0.018
	428052.200	4508563.838	1336.409	0.006	-0.020
	428052.204	4508563.841	1336.413	0.005	-0.025
	428052.200	4508563.838	1336.409	0.006	-0.020
AVG	428052.200	4508563.844	1336.388	0.009	0.000
MAX	428052.206	4508563.867	1336.413	0.023	0.046
MIN	428052.188	4508563.828	1336.342	0.001	-0.025
RNG	0.018	0.039	0.071	0.022	0.071
STD	0.000	0.072	0.016	0.005	0.016
			2DRMS	0.010	0.016

RTK Accuracy

RTK accuracy, with a VRS base provided by The Utah Reference Network (TURN), internal GPS antenna, 1-sigma 2DRMS Horizontal error is less than 0.010 meters.

With the 661 external antenna, L1/L2 Time-to-Fix is amazingly quick, typically 5 to 20 seconds.

In 200 Fix – Store – Dump iterations under moderate and heavy canopy, I had no bad fixes (errors greater than 3 cm). The PM220 is a dependable production VRS rover.

WiFi

The MobileMapper 120 / ProMark 120 family does not have embedded WiFi. You can insert an SDIO WiFi card for WiFi support however there is no way to seal the SD card slot as the card is longer than a regular SD card.

I am using this card:

Spectec SDW-821 WiFi 802.11b/802.11g 54Mbps SD SDIO Wireless LAN Network Card



It actually works extremely well, you plug in the card and 15-seconds later it is shown in the 'Connections' window and is connected automatically to a known access point.

While the receiver has a built in GSM cell modem, I find that operation with a WiFi connection to a Wireless HotSpot is much more reliable and easier to setup. Here are my thoughts:

- Connectivity to Verizon or other CDMA carriers
- MiFi usually costs less per month than sim-card activation, no taxes on internet only
- The MiFi hotspot supports faster protocols (4G and HSDP)
- You can tell from the front panel of the MiFi if it has internet connectivity
- You can leverage the MiFi for use with laptop, tablet and other devices
- Connection is easier to debug
- Connection is made more quickly

Warranty and Extended Warranty

The MobileMapper 120, ProMark 120 and ProMark 220 are sold with a 12-month warranty.

Extended warranties to three years are available at a reasonable price:

12 Months MM120 / PM120 / PM220 Warranty Extension	W12-802158	\$525.00
24 Months MM120 / PM120 / PM220 Warranty Extension	W24-802158	\$1,050.00