A22X with Microhard L400 Radio

These Supplemental Release Notes apply to the following Hemisphere GPS products:

- A220 Smart Antenna •
- A221 Smart Antenna

Both the A220 and the A221 (A22X when referred to together) offer a versatile, portable solution with centimeter-level accuracy powered by the Hemisphere GPS Eclipse™ dual-frequency GPS receiver in a rugged, all-in-one enclosure.

These Supplemental Release Notes provide information on using the Microhard L400 long-range radio in an RTK environment where the A221 is the base station and the A220 is a rover. The A221 base station with an integrated L400 radio is designed to broadcast RTK correction messages to compatibly-configured A220 rovers with an integrated L400 radio. Depending on the setup and installation environment you can achieve reliable RTK coverage over distances of up to 30 km (see "Typical Distance Performance" on page 13).

AWARNING: You must obtain a valid radio license for your jurisdiction before using the A22X with L400 radio. Only set the radio to the frequency and power you are licensed to use at your location. See "Obtaining a License" on page 17 for more information.

These Supplemental Release Notes cover the following topics:

- "What's Included in Your Kit" on page 2
- "Installing the A22X" on page 4
- "Configuring the A22X Radio" on page 5
- "Typical Distance Performance" on page 13
- "Displaying and Editing A220 L400 Information via the Outback S3" on page 15
- "Obtaining a License" on page 17



What's Included in Your Kit

There are two kits available:

- A220 L400 kit •
- A221 L400 kit ٠

A220 L400 Kit

Figure 1 shows some of the parts included in the A220 L400 kit and Table 1 lists all the parts in the kit.



Figure 1: A220 L400 kit

Figure Item	Part No.	Description	Qty
А	804-0064-000#	Antenna, Outback A220	1
В	150-1008-000#	400 MHz whip antenna, shipped separately	1
Not shown	808-1010-000	L400 rover radio kit, pre-installed	1
С	051-0236-000#	Data/power cable with power switch	1
D	051-0067-005#	CAN/power adapter cable	1
Not shown	478-0013-000#	Mag mount, pre-installed	1
Not shown	601-1136	Antenna plate	1
Not shown	677-2002	Tie straps, 7"	6
E	875-0243-000	Outback A220 User Guide	1
Not shown	875-0244-000	Outback A220 Quick Reference Guide	1

Table 1: A220 kit parts list



A221 L400 Kit

Figure 2 shows some of the parts included in the A221 L400 kit and Table 2 lists all the parts in the kit.



Figure 2: A221 L400 kit

Table 2: A221 kit parts list

Figure Item	Part No.	Description	Qty
А	804-0065-000#	Antenna, Outback A221	1
В	602-1099-000	A221 fixed base mounting bracket	1
<u>_</u>	676-1071-000	5/8″ nut	1
L	676-0029-000#	5/8" mounting stem	1
	675-0137-000	Pipe clamp 3 ½"	1
D	675-0138-000	Pipe clamp 4 ½"	1
E 054-0136-000# AC powe		AC power adapter	1
F	F 150-0024-000# 450MHz omnidirectional antenna		1
Not shown	051-006x-xxx	Coax LMR400 cable, optional length	1
Not shown	054-0119-000#	12 VDC power adapter, battery clips	1
Not shown	808-1008-000	L400 3W radio kit, pre-installed	1
G 875-0245-000 Outback A221 User Guide		Outback A221 User Guide	1
Not shown	875-0246-000	Outback A221 Quick Reference Guide	1



Installing the A22X

Installing the A220 Rover

For instructions on installing the A220 Rover on your vehicle, refer to the Outback A220 User Guide.

Note: For repeatable accuracy, the A220 must remain in the same position on the vehicle between operations. Any movement in physical installation location will result in an error.

Installing the A221 Base Station

Keep the following points in mind when installing the A221 base station:

- Install the A221 base station with a clear view of the sky. As a general rule a good location for the receiver antenna is 10 m (33.3 ft) horizontally from an obstruction for every 1 m (3.3 ft) of height the obstruction rises vertically above the top of the receiver.
- The A221 base station kit includes a mounting bracket and stem that you can clamp to a round pipe or bolt directly to the mounting structure of your choice. You must install the base station on a structure that cannot move over time with wind or other environmental conditions. Movements in the base station position will cause error in the rover accuracy.
- Consider your power source for your base station installation. You can power the A221 base station with the supplied AC adapter cable for household power access or with a 12 VDC power supply using the battery adapter cable.
- Although service needs for the A221 base station are minimal, there may be times when you will want to change a configuration or update software via one of the communication ports on the bottom of the unit. Consider access to these ports when installing the base station.
- You should install the radio antenna as high in the air as possible to achieve the best possible range (see "Typical Distance Performance" on page 13). The radio antenna is supplied with mounting brackets so you can attach it to a round tube or bolt it to the structure of your choice.
- Radio antenna cable length will gradually degrade range performance as the length increases. Striking a balance between GNSS receiver installation location and radio antenna location is an important part of optimizing your A221 base station installation.



Configuring the A22X Radio

You can configure the A22X through a simple user interface to set the following:

- Radio mode of operation
- Channel (frequency)
- Power

Note: The radio mode and channel of the A220 rover must match that of the A221 base station for the A220 rover to successfully receive the broadcasted RTK messages.

Additionally, you can encrypt RTK data using the Microhard radio static mask.

Setting the Radio Mode of Operation

The radio mode refers to a Hemisphere GPS-proprietary mode or a number of industry-standard compatible modes—see Table 3 on page 6 for more information on supported radio modes.

Note: The following procedure shows how to use the Remote Control software to set the mode. Follow the same procedure if using the actual menu on the A221 to set its mode.

Complete the following steps to set the radio mode:





Table 3 describes the two available radio modes. Pac Crest provides configuration tool that allows you to view the parameters in the Description column; therefore, select the mode you need based on these parameters (PC1 and PC3 differ only by the FEC parameter: ON or OFF).

Note: Hemisphere GPS recommends PC1 for most applications. You should only use PC3 if your are trying to maintain compatibility with an existing Pac Crest network.

Table 3: Radio modes

Mode	Description	n Comment		
PC1	9600 bps link rate, GMSK, FEC ON, Scrambling ON	Compatible with Pac Crest and Satel. This is the most common mode of operation and generally provides best distance performance. Throughput is limited to about 5600 bits/second.		
PC2	Future mode, currently not supported			
PC3	9600 bps link rate, GMSK, FEC OFF, Scrambling ONCompatible with Pac Crest. This mode will give slightly inferior distance performance compared with PC1, but provides better throughput of roughl 8300 bits/second.			
PC4	Future mode, currently not supported			
HGPS	Future mode, currently not supported			

Setting the Channel (Frequency)

Each A221 base station and A220 rover in a network must be configured to operate on the same channel (frequency).

You can set the frequency to any value between 410 MHz and 480 MHz. The channel frequency must be a multiple of 0.0125 MHz (12.5 kHz). If you enter an invalid channel, it will be rejected with an "INVALID" error.

Note: The following procedure shows how to use the Remote Control software to set the channel (frequency). Follow the same procedure if using the actual menu on the A221 to set its channel.

Complete the following steps to set the channel (frequency):









Setting the Power

Note: The following procedure shows how to use the Remote Control software to set the power. Follow the same procedure if using the actual menu on the A221 to set its power.

Complete the following steps to set the power:



Step	Base Station Screen Item	Rover Screen Item	
 Use the Up Arrow and Down Arrow buttons to display the desired power and press Enter to select the power. 		Remote Control Image: Station Decorrect Remote Control Premote CCD User Radio Power 27d Bin Freq > 461.02500 RSSI: -55d Bin Power 27d Bin Prover 27d Bin Freq > 461.02500 Image: Station RSSI: -55d Bin Power Image: Station Power 27d Dialog Power Image: Station Power -55d Bin Power Image: Station Power -55d Bin Power -7 Power -7	

The A221 is capable transmitting at an output power ranging from 0.1 W (20 dBm) up to 5 W (37 dBm) in 1 dB increments. Hemisphere GPS recommends that you set the power to the highest level allowable by your license.

If battery life is a concern, you may want to start with the highest allowable power setting on the A221 base station and back it off to the lowest level that still provides adequate RF coverage for your location.

The radio is the main contributor to battery drain. Therefore, backing off on the transmit power allows for significantly longer discharge times. Table 4 lists typical A221 power consumption.

Radio TX Power Setting	Typical Total A221 Power Consumption	Typical Battery Discharge Time of 18Ah SLA Battery	
20 dBm (0.1 W)	7.2 W	31 hours	
27 dBm (0.5 W)	9.0 W	25.0 hours	
30 dBm (1 W)	10.4 W	21.5 hours	
33 dBm (2 W)	12.6 W	17.5 hours	
35 dBm (3 W)	14.1 W	15.5 hours	
Receive Mode Only	5.7 W	39 hours	

Table 4: Typical A221 power consumption

Encrypting RTK Data Using the Microhard Radio Static Mask

When configuring a Microhard radio you can set the static mask to encrypt (require a password to access) RTK data. The default static mask for the 400 MHz L400 radio is blank (no static mask).

Before you set the static mask, make sure you are running the latest A-series controller software. To obtain the latest version of this software, visit www.outbackguidance.com and navigate to the Precision software downloads page (follows steps 1 - 3 below to display the software downloads page).



You can either connect to the A-series receiver with a terminal program or via the Remote Control application.

Setting the Static Mask Using Remote Control

- 1. Connect to the receiver on Port A.
- 2. Start Remote Control.

ntrol		
JHF Radio Base Stati	ion	
MICROHARD Versio	on v5.167-PC,L400	Advanced Save
er (dBm) 35 PC1		
-	440.500000 MH	z
	UNTROL JHF Radio Base Stat MICROHARD Versiv er (dBm) 35 PC1	UNTROL JHF Radio Base Station MICROHARD Version v5.167.PC.L400 er (dBm) 35 PC1 440.500000 MH



3. On the UHF Radio tab click the Advanced button. This takes the radio offline, passes through to the radio data port, and presents the current radio configuration (shown at right).

The static mask is parameter S107 and is shown in the output as:

S107=**** Static Mask

4. Type ATS107=xxxxxxx in the drop-down box and then press Enter (or click SEND) to change the static mask, where xxxxxxxx represents the static mask you want to use.

If successfully set, the radio will reply with OK.

- 5. Send the command AT&W to save the settings.
- 6. Click QUIT to return to normal operating mode.

Setting the Static Mask Using a Terminal Window

- 1. Connect to the receiver on Port A.
- 2. Start the terminal program on your PC.
- 3. Send the command \$JRELAY, PORTC, \$MENUREPLY, A
- 4. Send the command \$JRELAY, PORC, \$JRADIO, PROGRAMMODE to take the radio offline, pass through to the radio data port, and present the current radio configuration.

The static mask is parameter S107 and is shown in the output as:

Static Mask S107=****

5. Type ATS107=xxxxxxx to change the static mask:

where xxxxxxx represents the static mask you want to use. If successfully set, the radio will reply with OK.

- 6. Send the command AT&W to save the settings.
- 7. Type QUIT (uppercase) to return to normal operating mode.

Disconnect NO CARRIER OK AT&W MHX920A Microhard Systems, Inc.	<u> </u>
NO CARRIER OK AT&V MHX920A Microhard Systems, Inc.	<u>_</u>
v4.604 Aug 31 2010 14:18:20 S/N: 007-1048527 E1 DCD &C1 DTR &D0 Handshaking &K0 DSR &S1 Operating Mode S101=0 Static Mask S107=**** Not Mark Size S103=0 Dop Interval S102=1 Network Address S104=102 Output Power(dBm) S108=30 Dop Interval S109=19 Data Expenditure S110=1 Packet Retransmissions S113=1 Repeat Interval S12=30/A Network Address S110=10 Data Expenditure S116=10 Average RSSI(dBm) S123=N/A Network Type S133=0 Destination Address S140=65535 Serial Channel Mode S12=0 Sniff timeout, hops S237=10 Sleep mode S143=0 Siff Search Sleep S169=100 Sniff Search Sleep S169=00 Sniff Search Sleep S129=100	
	QUIT



Typical Distance Performance

Distance performance is dependent on several factors including:

- Base station antenna height
- Base station antenna gain
- Cable losses
- Base station transmit power
- Rover antenna gain
- Rover antenna height
- Receiver (rover) sensitivity
- Terrain

Hemisphere GPS provides a very high performance 400 MHz radio solution, which, when properly installed, can provide up to 30 km of RTK coverage from one base station location. Figure 3 provides a rough idea of what kind of distance performance the user can expect.



Figure 3: Typical RTK distance performance vs. base station antenna height above ground

The expected range is based on the following assumptions:

- Gently rolling hills
- Medium to low vegetation
- High quality, low loss RF cables at base station
- Base station uses Hemisphere-recommended 5 dBi antenna
- Base station Tx power is set to 3 W
- Rover antenna height is 3 m above ground level
- Frequency of operation is 450 MHz
- Mode of operation is PC1 (9600 bps GMSK, FEC ON)



As can be seen in Figure 3, Base Station antenna height is key to RTK performance. When installing your Base Station, find a location on a structure, preferably at the highest elevation available.

At 2m (6ft) base antenna height above ground, typical RTK distance performance is approximately 8 km (5 mi). However, as you raise the Base Station antenna, this range improves dramatically. At 20 m (65 ft) above ground level, Rovers can expect to typically receive RTK corrections at distances up to about 28 km (17 mi).

It is important to use high quality RF cable at the Base Station. Hemisphere GPS provides high-quality RF cables in standard lengths of 15, 30, and 45 m.

Normally, the A221 will be located close to ground level, while the 400 MHz UHF antenna will be mounted on a structure several meters above ground. This requires a fairly long run of cable. Figure 4 illustrates the typical degradation in distance performance (for four different Base Station antenna heights) as you use longer runs of RF cable.



Figure 4: Typical RTK distance performance vs. RF cable length at base station for four base station antenna heights above ground



Displaying and Editing A220 L400 Information via the Outback S3

The Outback S3 provides an easy-to-use interface that allows you to select a radio within an A220 and set that radio's mode of operation and frequency.

Note: You must connect the A220 to the S3 and power on the A220 before accessing the setup menu within the S3.

Step	Screen Item (when applicable)
1. Power on the S3.	
On the main screen press the GPS screen tab. The GPS Details screen appears.	0s -• 1 3d
Time CPS Status DM Age 0.23:4994 Warming Up 0-9 34 00000 Centre Time STDEV 1:200000 CPS Firmware Stata Trached 1:200000 CPS Firmware Sets Trached 0.00 md Seriel Number 0 0.00 md Seriel Number 0 0.00 md Beff Freework BER 0.00 md Beff Freework BER 0.00 md Beff Freework BER 0.00 md Sile Status Denils	
3. Press Setup . The GPS Setup screen appears.	Setup
Local Time 6.50 hrs GPS Source Image: CPS Source ▼ ▲ Image: CPS Application Setup SIAAS 1: AUTO Choose GPS Application Setup Image: CPS Application SIAAS 2: AUTO ▲ 23.399/ASPTIN.135.138.AUTO MetEA Image: CPS Application ▼ ▲ 23.399/ASPTIN.135.138.AUTO MetEA Image: CPS Application Image: CPS Application ▼ ▲ 23.399/ASPTIN.135.138.AUTO Image: CPS Application Image: CPS Application Image: CPS Application ▼ ▲ 23.399/ASPTIN.135.138.AUTO Image: CPS Application Image: CPS Application Image: CPS Application ▼ ▲ Image: CPS Application Image: CPS Application Image: CPS Application Image: CPS Application ▼ ▲ Image: CPS Application Image: CPS Applicatio	
 Under GPS Sources press A220. The Radio button appears along the right side of the screen. 	A220
Local Time 6.50 hrs CPS Source CPS Source SEAS 1: AUTO SEAS 2: AUTO SEAS 2: AUTO Choose GPS Application PTK PTK Padlo Details Choose GPS Application Choose GPS Application PTK PTK Padlo Details Choose GPS Application PTK PTK PTK PTK Padlo Details PTK PTK PTK PTK PTK PTK PTK PTK	



Step	Screen Item (when applicable)
 Press Radio. The Radio screen appears. Microhard L400 appears in the Status field (non-editable). The Display Mode and Frequency fields are editable. 	A220
Radio Mode PC-1 Status Status Frequency PC-1 Status PC-1 PC-1 <th></th>	
6. To set the radio mode:	
a. Press the Radio Mode field.	Radio Mode PC-1
Redo Mode PC-1 Ok PC-1 Ok Image: State of the sta	
b. In the Radio Mode window select the desired mode and press OK .	
7. To set the frequency:	
a. Press the Frequency field.	Frequency 461.0250 MHz
b. In the Edit Microhard L400 Frequency window use the Up and Down	

Obtaining a License

Paperwork varies by country. The following sections provide basic instructions on obtaining and filling in the forms and include sample forms for the US, Canada, and Australia.

U.S. License

AWARNING: You must obtain a valid radio license for your jurisdiction before using the A22X with L400 radio.

To obtain a U.S. license you must first register with the Federal Communications Commission (FCC). You can then login and file your application electronically.

For help on applying for a license, go to http://www.fcc.gov/Forms/Form601/601.html.

Use the following steps as a guideline to register.

St	ep			Screen Item (when applicable)
1.	In a web browser navigate to the http://wireless.fcc.gov/uls/index.l The main Universal Licensing Sy	e Federal Communications website at: htm ystem page appears.		
	CC Universal Licensit For Life Year Higtor CC Universal Licensit Commission Universal Lice Search the FCC: Commission Commission	ng System (ULS) ULS Home - Macilla Firefox y Bockmarks Teol. Lefe ing System (ULS) UL Home Announcing a new FCC.gov Tell us what you think and help shape the Search [SS] Upstates [Effing CC2 + XIIB of ULS Home CC2 + XIIB of ULS + CC2 + CC	Coopie P future > for Sealing For Se	
2.	Click REGISTER .	LERM MORE ONLINE FILING OLOGIN Apply for a new leaner, renew, modify, manage locates and applications. SEARCH OLICENSE Find licenses arrow all services. Other Online Systems Variation States Variation States Variatio Stat	Address for manual address for manual address for manual more for a for manual more for a for a for more for more for a for more for mo	ULS Online Systems All applications are operating properly. NEW USERS REGISTER To use the PCC NEW USERS REGISTER To use the PCC



Step		Screen Item (when applicable)
	ECC.Home I Search Updates E-Filing Initiatives Eor.Consumers End People Commission ECC.Registration	
	<u>PCC > ULB > FCC Repirivelon</u> <u>CCC Registration</u> If you wish to conduct business with the FCC, you must first register through the FCC's COmmission Registration System (CORES), Upon registration, you will be assigned a FCC Registration Number (FRV). This number will be used to uniquely identify you in all transactories with the FCC. News releases related to the FCC Registration Number. <u>Select one of the following:</u> <u>UPDATE</u> <u>SEARCH</u> <u>S</u>	
3. Click REGISTER to st Number (FRN).	Customer Service Presvertix Asked Questions Forms Resuma an FRN Process Statement PCC Home Page FRN Help Line: 6777-480-3201 (HonFri. 6 a.m6 p.m. ET) The FRN Help desk has a dedicated staff of customer service representatives standing by to answer your questions or concerns. You can also grad the FRN Help Line: 662 with your questions and concerns. You can also grad the FRN Help Concerns You can also grad the FRN Help Concerns. You can also grad the FRN Help Concerns. You can also grad the FRN Help Concerns You can also grad the FRN Help Concerns. You can also grad the FRN Help Concerns.	REGISTER A Realying and receive your LRM (• REGISTER
	Communications ECC Home Search Updates E-Filing Initiatives Enc.Consumers End People Communications Communications	
	FCC Registration < rCC Ste. Maa	
4. Select your registration	The FRN Help desk has a dedicated starf of customer service representatives standing by to answer your questions or concerns. You can also <u>small the FRN Help desk</u> with your questions and concerns.	CONTINUE



Step					Screen Item (when applicable)
FRN Re	gistration				
Beturn to	aturn In SPC Bandstration Mome				
P.	Ponictar a Domastic Ruciness				
Du	siness Type:	Federal Agency -	Subtype:	Administration -	
Bu	siness Name:*				
H.	your business h	as an Employer Identification Numb	er or Taxpaver Identific	cation Number, enter it here:	
II (2)	your business d	oes not have an <u>Employer Identifica</u>	ation Number, select a	reason: 🔹	
Ca	ntact Informati	ion	1		
or	ganization:		Position:*		
Sa	autation:		First Name:		
Mi Su	ddie Initial: ffix:		Last Name:		
Ad	dress Line 1:*		Address Line 2:		
Cit	v:*		State:*		
26	Code:*		Phone:*	ext	
Fa	x:		Email:		
FR	N Password		- Constant		
En	ter a 6- to 15-d k here,	haracter case-sensitive password o	f your choice. <u>For advic</u>	e on how to choose a secure password,	
Pa	ssword:*		Re-enter Password:*	(
Pe	rsonal Security	Question			
Pi ov SD	ase select a Pe in question, ple ace provided.	rsonal Security Question type and p ase select Custom Question Type	provide its correspondi . from the dropdown a	ng answer. If you wish to provide your nd enter your custom question in the	
Pe	rsonal Security		PSQ Answer:*		
Cu Se Qu	stom Personal curity iestion:				
			SVEHIT		
		Asterisks (*) indicate required fields.		
51	wised: April 2005			Form 160 - Approved by OMB 3060-0917	
 Fill out the registration form an fields that are noted with an rec 	d click S I asteris	UBMIT . You are k *.	only requir	ed to fill out those	SUBMIT
You are issued an FCC Registra	tion Nu	Imber (FRN) at 1	this point.	You can now apply	for your license.



Canadian License

AWARNING: You must obtain a valid radio license for your jurisdiction before using the A22X with L400 radio.

In Canada, licensing is administered by Industry Canada. A sample of the application is provided below. Contact Hemisphere GPS for assistance.

Use the following steps as a guideline to obtain a license.

Step		Screen Item (when applicable)
1.	In a web browser navigate to the Industry Canada website at: http://www.ic.gc.ca/eic/site/ic1.nsf/eng/home The main Universal Licensing System page appears.	
	Ele [dis yeer Higtory Boahmak's Tools Help Midulator Canada Set Heren - C	
2.	Click Programs and Services and then from the expanded menu click Radio , Spectrum and Telecommunications . The Radio, Spectrum and Telecommunications page appears.	Industry Canada Programs and Services Information by Radio, Spectrum and Telecommunications











Australian License

AWARNING: You must obtain a valid radio license for your jurisdiction before using the A22X with L400 radio.

To obtain a license in Australia you must complete and submit the following forms:

- ACMA form R057 Application for apparatus licence(s) •
- ACMA form R077 Additional station information •

Both forms are available from the Australian Communications and Media Authority (ACMA) website.

Use the following steps as a guideline to obtain a license:









Step	Screen Item (when applicable)		
3. Scroll down the page and down	oad the appropriate forms (R057 an	d R077) in either Mic	crosoft Word or PDF.
Submission Syste	Spectrum Licensing Current spectrum licence allocations		
	Form Form title	PDF Word	
	Apparatus Licensing		
	R038 Application for licence fee exemption or concession	53kb 338kb	
	R057 Application for apparatus licence(s)	149kb 410kb	
	R058 Application for digital radio multiplex transmitter apparatus licence(s)	164kb 445kb	
	R060 Application for transfer of apparatus licence(s)	117kb 111kb	
	R077 Additional station information	43kb 365kb	
	R078 Additional station information for satellite services	176kb 109kb	
	R110 Frequency assignment certificate	74kb 342kb	
	Appeals and Reviews		
	PART Automation for second of desiring	676b 3436b	