



Eclipse OEM Board Integrator Guide

Part No. 875-0275-000 Rev E1



This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

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Chapter 1: Introduction

Eclipse OEM Board Options

What's Included

Eclipse Integration

Common Features of All Eclipse Boards

Message Interface

Using PocketMax to Communicate with the Eclipse

This manual does not cover receiver operation, the PocketMax™ utility, or commands and messages (NMEA 0183, NMEA2000® or HGPS proprietary). For information on these subjects refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon).

Eclipse OEM Board Options

The Eclipse™ OEM board is available in two form factors (Eclipse II and miniEclipse™) as shown in Table 1-1.

Table 1-1: Eclipse board options

Model	GNSS Systems	Compatibility	L-Band Support
<i>Eclipse II OEM board</i>			
P320™	L1/L2 GPS and GLONASS	Hemisphere GPS' standard pinout configuration (34-pin)	Yes - with optional Hemisphere GPS LX-2™ OEM board
<i>miniEclipse OEM boards</i>			
P200™	L1/L2 GPS	Hemisphere GPS' standard pinout configuration (34-pin)	Yes - with optional Hemisphere GPS LX-2 OEM board
P201™	L1/L2 GPS	Compatible with popular aftermarket products (20-pin)	No
P202™	L1 GPS and GLONASS	Hemisphere GPS' standard pinout configuration (34-pin)	Yes - with optional Hemisphere GPS LX-2 OEM board
P203™	L1 GPS and GLONASS	Compatible with popular aftermarket products (20-pin)	No
P300™	L1/L2 GPS and GLONASS	Hemisphere GPS' standard pinout configuration (34-pin)	Yes - with optional Hemisphere GPS LX-2 OEM board
P301™	L1/L2 GPS and GLONASS	Compatible with popular aftermarket products (20-pin)	No
P302™	L1/L2 GPS and GLONASS	Hemisphere GPS' standard pinout configuration (34-pin)	Yes - with optional Hemisphere GPS LX-2 OEM board
P303™	L1/L2 GPS and GLONASS	Compatible with popular aftermarket products (20-pin)	No

Note: This manual covers all Eclipse OEM boards. When referring to all boards this manual uses the term Eclipse. When referring to either Eclipse family of boards this manual uses the family name (Eclipse II OEM board or miniEclipse OEM board).

What's Included

The Eclipse is available in two configurations:

- Eclipse OEM board only - designed for integrators who are familiar with Eclipse board integration
- Eclipse OEM board and Universal Development Kit - designed for integrators who are new to Eclipse board integration

The Universal Development Kit is designed to work with various Hemisphere GPS OEM boards and includes an enclosure with carrier board, adapter boards, and various cables.

For more information on the Universal Development Kit visit www.hemispheregps.com and navigate to the OEM Products page or contact your local dealer.

Eclipse Integration

Successful integration of the Eclipse within a system requires electronics expertise that includes:

- Power supply design
- Serial port level translation
- Reasonable radio frequency competency
- An understanding of electromagnetic compatibility
- Circuit design and layout

The Eclipse GPS engine is a low-level module intended for custom integration with the following general integration requirements:

- Regulated power supply input (3.3 VDC \pm 3%) and 300 mA continuous
- Low-level serial port (3.3 V CMOS) and USB port communications
- Radio frequency (RF) input to the engine from a GPS antenna is required to be actively amplified (10 to 40 dB gain)
- GPS antenna is powered with a separate regulated voltage source up to 15 VDC maximum
- Antenna input impedance is 50 Ω

Common Features of All Eclipse Boards

Common features of all Eclipse boards include:

- 12-channel GPS engine (2 channels dedicated to SBAS tracking)
- Sub-meter horizontal accuracy 95%
- Raw measurement output (via documented binary messages)
- Position and heading update rates of 20 Hz max
- COAST™ technology that provides consistent performance with correction data
- e-Dif®-ready - a base station-free way of differentially positioning

- L-Dif™-ready – Local differential is a proprietary Hemisphere GPS method where a specialized set of messages are relayed between two Eclipse receivers
- Quick times to first fix
- Four full-duplex serial ports
- USB ports
 - USB device port only (P200, P201, P202, P203)
 - USB host and USB device ports (P300, P301, P302, P303, P320)
- 1 PPS timing output
- Event marker input

Note: For complete specifications of all Eclipse boards see Appendix C, “Technical Specifications.”

Message Interface

The Eclipse uses a NMEA 0183 interface, allowing you to easily make configuration changes by sending text-type commands to the receiver.

The Eclipse also supports a selection of binary messages. There is a wider array of information available through the binary messages, plus binary messages are inherently more efficient with data. If the application has a requirement for raw measurement data, this information is available only in a binary format.

For more information on NMEA 0183 commands and messages as well as binary messages refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon).

Using PocketMax to Communicate with the Eclipse

Hemisphere’s PocketMax is a free utility program that runs on your Windows PC or Windows mobile device. Simply connect your Windows device to the Eclipse via the COM port and open PocketMax. The screens within PocketMax allow you to easily interface with the Eclipse to:

- Select the internal SBAS, external beacon, or RTCM correction source and monitor reception (beacon optional)
- Configure GPS message output and port settings
- Record various types of data
- Monitor the Eclipse’s status and function

PocketMax is available for download from the Hemisphere GPS website (www.hemispheregps.com).



Chapter 2: Board Overview

Eclipse II OEM Board Key Features

miniEclipse OEM Board Key Features

Mechanical Layout

Connectors

Mounting Options

Header Layouts and Pinouts

Signals

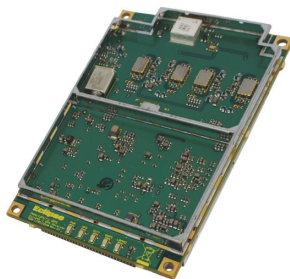
Shielding

Receiver Mounting

Thermal Concerns

Eclipse II OEM Board Key Features

The Eclipse II OEM board offers low power consumption, fast output rates of up to 20 Hz, and L-band support. Offering full scalability and expandability from L1 GPS through L1/L2 GNSS and combined with advanced multipath mitigation techniques, this feature-rich multi-frequency GNSS board is a cost-effective, multi-GNSS solution compatible with other GNSS products.



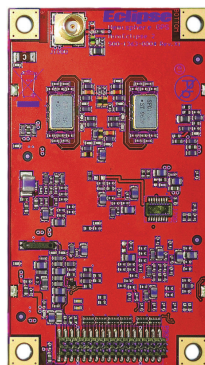
Improved RTK performance based on Hemisphere GPS' patented SureTrack® technology is scalable with Eclipse II, allowing you to achieve centimeter-level accuracy with L1/L2 GPS or improve performance and reliability with L1/L2 GLONASS signals. SureTrack ensures that the RTK rover receiver makes use of every satellite it is tracking, even satellites not tracked at the base. Additional benefits include fewer RTK dropouts in congested environments, faster requisitions and more robust solutions due to better cycle slip detection, and the ability to process GNSS data from various manufacturers. Even if the base supports only GPS, SureTrack processes GLONASS signals at the rover to deliver complete GNSS performance.

miniEclipse OEM Board Key Features

With its small form factor, low power consumption, and simple onboard firmware miniEclipse is an ideal solution for integrators, offering scalability and expandability from L1 GPS with SBAS to L1/L2 GPS and GLONASS (with RTK capability).

miniEclipse is offered in two common industry form factors:

- P200, P202, P300, and P302 are drop-in replacements for Hemisphere GPS' Crescent® receiver (34-pin) and provide L-band support with the optional Hemisphere GPS LX-2™ OEM board
- P201, P203, P301, and P303 have a mechanical design compatible with popular aftermarket products (20-pin)



The reliable positioning performance of miniEclipse is further enhanced through Eclipse RTK and COAST DGPS technology.

With miniEclipse, RTK performance is scalable. Utilize the same centimeter-level accuracy in either L1-only mode, or employ the full performance of fast RTK performance over long distances with L1/L2 GPS signals. Hemisphere GPS' SureTrack technology provides peace of mind knowing the RTK rover is making use of every satellite it is tracking, even satellites not tracked at the base. Benefit from fewer RTK dropouts in congested environments, faster reacquisitions, and more robust solutions due to better cycle slip detection.

Patented COAST software enables select Hemisphere GPS receivers to utilize aging DGPS correction data during times of interference, signal blockage, and weak signal. The receiver will coast and continue to maintain sub-meter positioning for 40 minutes or more without a DGPS signal.

Mechanical Layout

Figure 2-1 shows the mechanical layout for the Eclipse II P320 OEM board, Figure 2-2 shows the mechanical layout for the miniEclipse P200/P202/P300/P302 OEM boards, and Figure 2-3 shows the mechanical layout for the miniEclipse P201/P203/P301/P303 OEM boards. Dimensions are in millimeters (inches) for all three layouts.

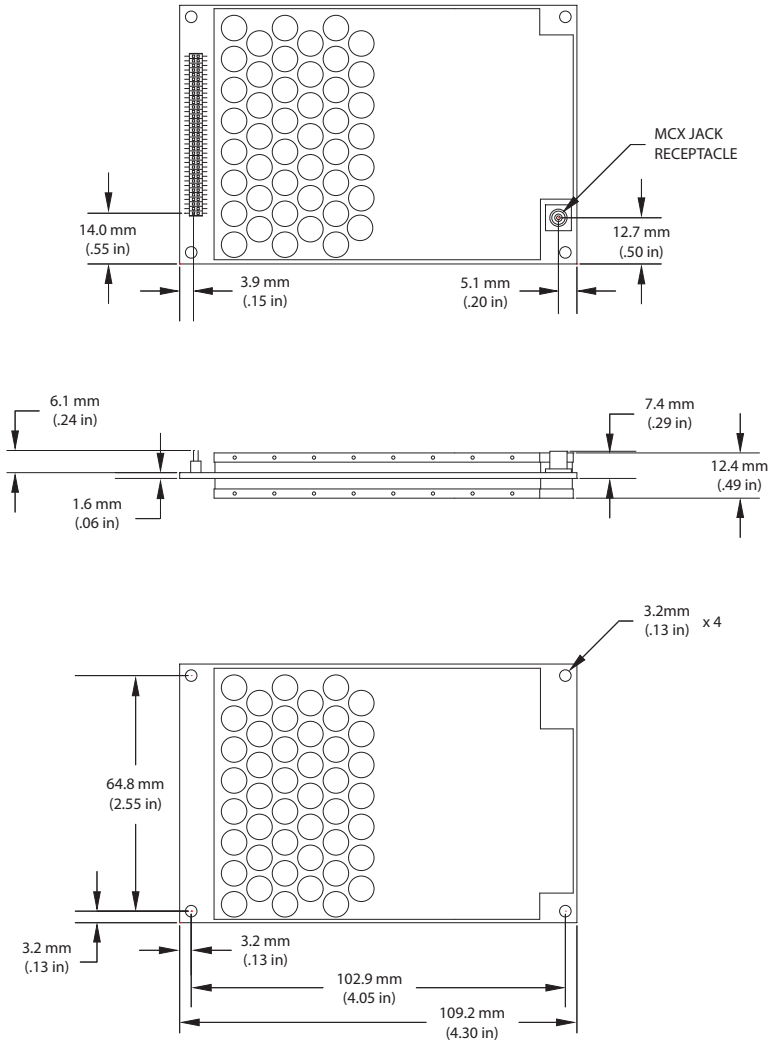


Figure 2-1: Eclipse II P320 mechanical layout

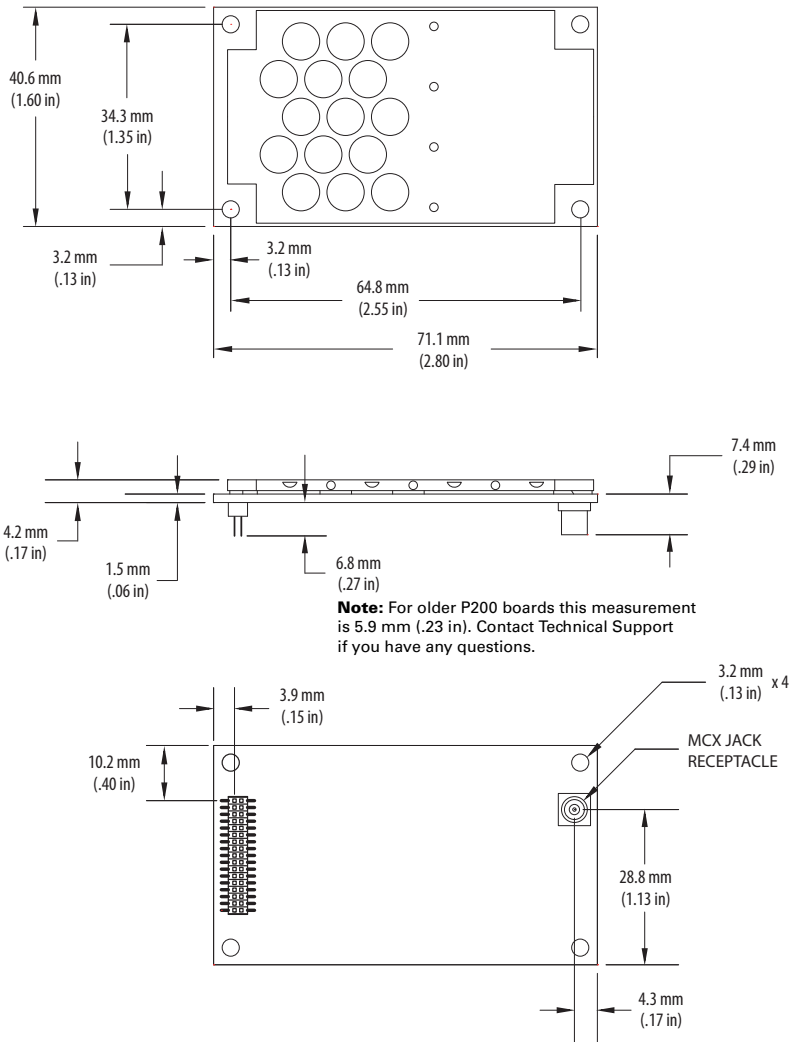


Figure 2-2: miniEclipse P200/P202/P300/P302 mechanical layout

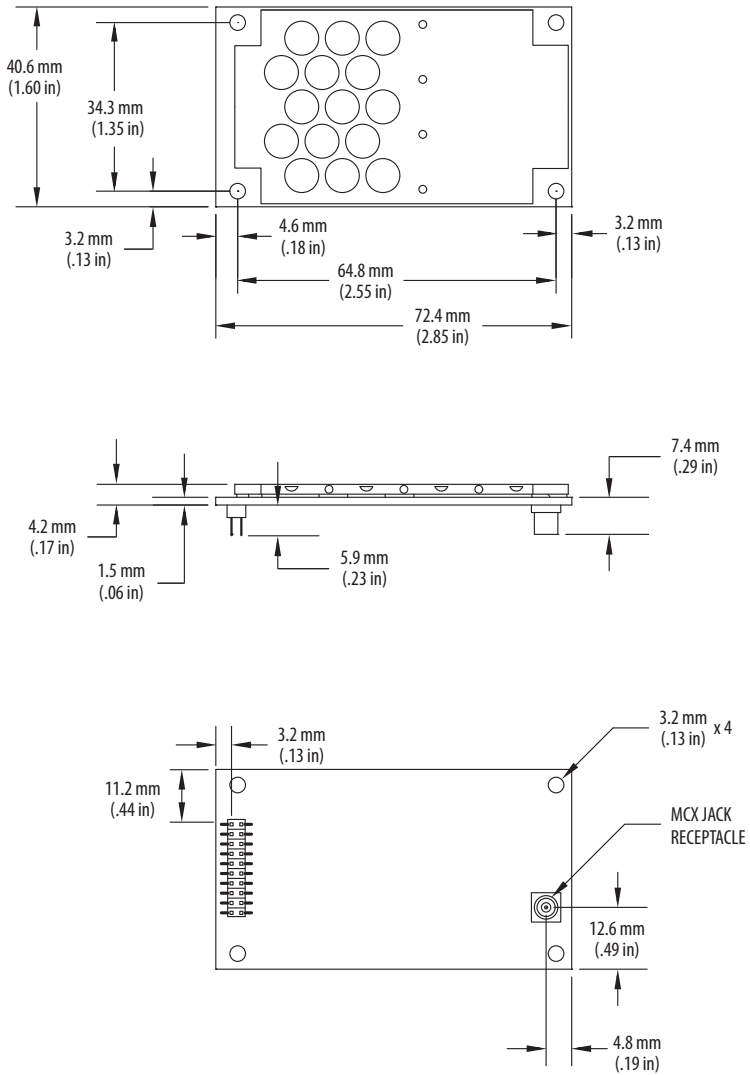


Figure 2-3: miniEclipse P201/P203/P301/P303 mechanical layout

Connectors

Table 2-1 describes Eclipse connectors and mating connectors. You can use different compatible connectors; however, the requirements may be different. The antenna input impedance is 50 Ω .

Note: Some parts in Table 2-1 have changed between board versions. For example, the Samtec SMT connector for the P320 is different for earlier boards compared to newer boards. Contact Hemisphere GPS Technical Support if you have any questions (see the front of this manual for Technical Support contact information).

Table 2-1: Eclipse connectors

Eclipse Board and Connector Type		Eclipse SMT Connector	Mating Connector
Eclipse II (P320)	RF	MCX, female straight jack Emerson (Johnson) 133-3711-202	MCX, male straight plug Samtec RSP-127824-01
	Power/ data	70-pin (35x2) male header, 0.05 in (1.27 mm) pitch Samtec FTSH-135-01-L-DV (older P320 boards) Samtec FTSH-135-04-L-DV (newer P320 boards)	35x2 female SMT header socket, 0.05 in (1.27 mm) pitch Samtec FLE-135-01-G-DV
miniEclipse (P200, P202, P300, P302)	RF	MCX, female straight jack Emerson (Johnson) 133-3711-202	MCX, male straight plug Samtec RSP-127824-01
	Power/ data	34-pin (17x2) male header, 0.05 in (1.27 mm) pitch Samtec FTSH-117-01-L-DV (older P200 boards) Samtec FTSH-117-04-L-DV (new P200 boards and all P202/P300/ P302 boards)	17x2 female SMT header socket, 0.05 in (1.27 mm) pitch Samtec FLE-117-01-G-DV
miniEclipse (P201, P203, P301, P303)	RF	MCX, female straight jack Emerson (Johnson) 133-3711-202	MCX, male straight plug Samtec RSP-127824-01
	Power/ data	20-pin (10x2) male header, 0.08 in (2 mm) pitch Samtec TMM-110-01-T-D-SM	10x2 female SMT header socket, 0.08 in (2 mm) pitch Samtec TLE-110-01-G-DV
<i>Note: For the Samtec FTSH headers, '-01' indicates 0.120" posts and '-04' indicates 0.150" posts.</i>			

Mounting Options

There are two options for mounting the Eclipse:

- Direct Electrical Connection method
- Indirect Electrical Connection (Cable) method

Direct Electrical Connection Method

Place an RF connector, heading connector, and mounting holes on the carrier board and then mount the Eclipse on the standoffs and RF and header connectors. This method is very cost effective as it does not use cable assemblies to interface the Eclipse.

Note: Be aware of the GPS RF signals present on the carrier board and ensure the correct standoff height to avoid any flexural stresses on the board when you fasten it down.

The Eclipse uses a standoff height of 7.9 mm (0.3125 in). With this height there should be no washers between either the standoff and the Eclipse or the standoff and the carrier board; otherwise, you must make accommodations. You may need to change the standoff height if you select a different header connector.

If you want to use a right angle MCX connector, use a taller header than the Samtec part number suggested in this guide. This will provide clearance to have a right angle cable-mount connector and reduce the complexity by not having the carrier board handle the RF signals. See Table 2-1 on page 10 for Eclipse connector information.

The mounting holes of the Eclipse have a standard inner diameter of 3.2 mm (0.125 in).

Indirect Electrical Connection (Cable) Method

The second method is to mount the Eclipse mechanically so you can connect a ribbon power/data cable to the Eclipse. This requires cable assemblies and there is a reliability factor present with cable assemblies in addition to increased expense.

Header Layouts and Pinouts

The Eclipse use a dual-row header connector to interface with power, communications, and other signals.

To identify the first header pin orient the board so the diamond is to the upper left of the pins; the first pin is on the left directly below the diamond (see Figure 2-4). The pins are then sequentially numbered per row from top to bottom.

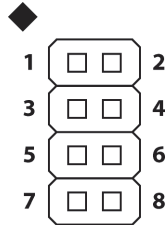


Figure 2-4: Identifying the first pin on the header connector

Eclipse II P320 Header Layout/Pinout

The P320 board has a 70-pin header. Figure 2-5 shows the header layout and Table 2-2 provides the header pinout.

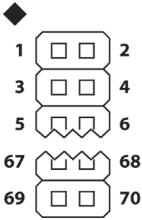


Figure 2-5: Eclipse II P320 70-pin header layout

Table 2-2: Eclipse II P320 70-pin header pinout

Pin	Name	Type	Description
1	3.3 V	Power	Receiver power supply, 3.3 V
2	3.3 V	Power	Receiver power supply, 3.3 V
3	3.3 V	Power	Receiver power supply, 3.3 V
4	3.3 V	Power	Receiver power supply, 3.3 V
5	GND	Power	Receiver ground
6	GND	Power	Receiver ground
7	Antenna Pwr	Power	Antenna power, DC, 15 V max
8	Batt Backup	Power	Power, 2.7 to 4.5 V, 500 nA typical
9	n/c	n/c	n/c
10	n/c	n/c	n/c
11	n/c	n/c	n/c
12	Reset	Open collector	Reset, open collector, 3.3 V typical, not required
13	GND	Power	Receiver ground
14	GND	Power	Receiver ground
15	n/c	n/c	n/c
16	USB-DVBS	Input	Device USB bus power monitor
17	Manual Mark	Input	Active low, falling edge, 3.3 V CMOS
18	1 PPS	Output	Active high, rising edge, 3.3 V CMOS
19	Speed Output	Output	0 - 3 V variable clock output
20	Speed Ready	Output	Active low, speed valid indicator, 3.3 V CMOS
21	n/c	n/c	n/c
22	n/c	n/c	n/c
23	GND	Power	Receiver ground

Table 2-2: Eclipse II P320 70-pin header pinout

Pin	Name	Type	Description
24	USB-HVBS	Input	Host USB bus power monitor
25	PATX	Output	Port A serial output, 3.3 V CMOS, idle high
26	PARX	Input	Port A serial input, 3.3 V CMOS, idle high
27	PBTX	Output	Port B serial output, 3.3 V CMOS, idle high
28	PBRX	Input	Port B serial input, 3.3 V CMOS, idle high
29	PCTX	Output	Port C serial output, 3.3 V CMOS, idle high
30	PCRX	Input	Port C serial input, 3.3 V CMOS, idle high
31	PDTX	Output	Port D serial output, 3.3 V CMOS, idle high
32	PDRX	Input	Port D serial input, 3.3 V CMOS, idle high
33	n/c	n/c	n/c
34	n/c	n/c	n/c
35	GND	Power	Receiver ground
36	GND	Power	Receiver ground
37	USB HOST+	I/O	USB host data +
38	USB DEV+	I/O	USB device data +
39	USB HOST-	I/O	USB host data -
40	USB DEV-	I/O	USB device data -
41	GND	Power	Receiver ground
42	n/c	n/c	n/c
43	n/c	n/c	n/c
44	n/c	n/c	n/c
45	n/c	n/c	n/c
46	GND	Power	Receiver ground
47	n/c	n/c	n/c
48	n/c	n/c	n/c
49	n/c	n/c	n/c
50	n/c	n/c	n/c
51	GND	Power	Receiver ground
52	n/c	n/c	n/c
53	GPIO0	I/O	General purpose input/output
54	GPIO1	I/O	General purpose input/output
55	GPIO2	I/O	General purpose input/output
56	GPIO3	I/O	General purpose input/output
57	GPS Lock	Output	Status indicator, 3.3 V CMOS, active low
58	n/c	n/c	n/c

Table 2-2: Eclipse II P320 70-pin header pinout

Pin	Name	Type	Description
59	Diff Lock	Output	Status indicator, 3.3 V CMOS, active low
60	n/c	n/c	n/c
61	DGPS Lock	Output	Status indicator, 3.3 V CMOS, active low
62	n/c	n/c	n/c
63	GND	Power	Receiver ground
64	GND	Power	Receiver ground
65	GND	Power	Receiver ground
66	n/c	n/c	n/c
67	n/c	n/c	n/c
68	GND	Power	Receiver ground
69	GND	Power	Receiver ground
70	n/c	n/c	n/c
Note: <ul style="list-style-type: none"> • Pins are not 5 V tolerant. The pin voltage range is 0 to 3.3 VDC, unless otherwise noted. • Leave any data or I/O pins that will not be used unconnected. 			

miniEclipse 34-Pin Header Layout/Pinout

The P200/202/300/302 boards have a 34-pin header. Figure 2-6 shows the header layout and Table 2-3 provides the header pinout.

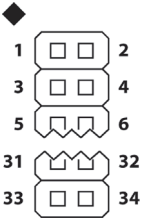


Figure 2-6: miniEclipse 34-pin header layout

Table 2-3: miniEclipse 34-pin header pinout

Pin	Name	Type	Description
1	3.3 V	Power	Receiver power supply, 3.3 V
2	3.3 V	Power	Receiver power supply, 3.3 V
3	Antenna Pwr	Power	Antenna power, DC, 15 V max
4	Batt Backup	Power	Power, 1.5 to 5.5 V, 500 nA typical
5	USB DEV+	I/O	USB device data +
6	USB DEV-	I/O	USB device data -
7	GND	Power	Receiver ground
8	GND	Power	Receiver ground
9	PATX	Output	Port A serial output, 3.3 V CMOS, idle high
10	PARX	Input	Port A serial input, 3.3 V CMOS, idle high
11	PBTX	Output	Port B serial output, 3.3 V CMOS, idle high
12	PBRX	Input	Port B serial input, 3.3 V CMOS, idle high
13	PDTX	Output	Port D serial output, 3.3 V CMOS, idle high
14	PDRX	Input	Port D serial input, 3.3 V CMOS, idle high
15	1 PPS	Output	Active high, rising edge, 3.3 V CMOS
16	Manual Mark	Input	Active low, falling edge, 3.3 V CMOS
17	GPS Lock	Output	Status indicator, 3.3 V CMOS, active low
18	Diff Lock	Output	Status indicator, 3.3 V CMOS, active low
19	DGPS Lock	Output	Status indicator, 3.3 V CMOS, active low
20	n/c	n/c	n/c
21	GPIO0	I/O	General purpose input/output
22	GPIO1	I/O	General purpose input/output
23	GPIO2	I/O	General purpose input/output

Table 2-3: miniEclipse 34-pin header pinout (continued)

Pin	Name	Type	Description
24	GPIO3	I/O	General purpose input/output
25	Speed Output	Output	0 - 3 V variable clock output
26	Speed Ready	Output	Active low, speed valid indicator, 3.3 V CMOS
27	GND	Power	Receiver ground
28	GND	Power	Receiver ground
29	n/c	n/c	n/c
30	n/c	n/c	n/c
31	PCTX	Output	Port C serial output, 3.3 V CMOS, idle high
32	PCRX	Input	Port C serial input, 3.3 V CMOS, idle high
33	L-Band Enable	Output	Reserved
34	Reset	Open collector	Reset, open collector, 3.3 V typical, not required
Note: <ul style="list-style-type: none"> • Pins are not 5 V tolerant. The pin voltage range is 0 to 3.3 VDC, unless otherwise noted. • Leave any data or I/O pins that will not be used unconnected. 			

miniEclipse 20-Pin Header Layout/Pinout

The P201/203/301/303 boards have a 20-pin header. Figure 2-7 shows the header layout and Table 2-4 provides the header pinout.

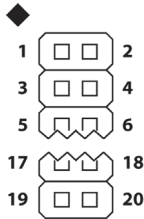


Figure 2-7: miniEclipse 20-pin header layout

Table 2-4: miniEclipse 20-pin header pinout

Pin	Name	Type	Description
1	Antenna Pwr	Power	Antenna power, DC, 15 V max
2	3.3 V	Power	Receiver power supply, 3.3 V
3	USB DEV-	I/O	USB device data -
4	USB DEV+	I/O	USB device data +
5	Reset	Open collector	Reset, open collector, 3.3 V typical, not required
6	PCR _X	Input	Port C serial input, 3.3 V CMOS, idle high
7	PCT _X	Output	Port C serial output, 3.3 V CMOS, idle high
8	PDR _X	Input	Port D serial input, 3.3 V CMOS, idle high
9	PDT _X	Output	Port D serial output, 3.3 V CMOS, idle high
10	GND	Power	Receiver ground
11	PAT _X	Output	Port A serial output, 3.3 V CMOS, idle high
12	PAR _X	Input	Port A serial input, 3.3 V CMOS, idle high
13	GND	Power	Receiver ground
14	PBT _X	Output	Port B serial output, 3.3 V CMOS, idle high
15	PBR _X	Input	Port B serial input, 3.3 V CMOS, idle high
16	GND	Power	Receiver ground
17	Manual Mark	Input	Active low, falling edge, 3.3 V CMOS
18	GND	Power	Receiver ground
19	1 PPS	Output	Active high, rising edge, 3.3 V CMOS
20	Position Valid Indicator	Output	Status indicator, 3.3 V CMOS, active low
<div>Note:<ul style="list-style-type: none">Pins are not 5 V tolerant. The pin voltage range is 0 to 3.3 VDC, unless otherwise noted.Leave any data or I/O pins that will not be used unconnected.</div>			

Signals

This section provides information on the signals available via connectors.

RF Input

The Eclipse is designed to work with active GPS antennas with an LNA gain range of 10 to 40 dB. The purpose of the range is to accommodate for losses in the cable system. Essentially, there is a maximum cable loss budget of 30 dB for a 40 dB gain antenna. Depending on the chosen antenna, the loss budget will likely be lower (a 24 dB gain antenna would have a 14 dB loss budget).

When designing the internal and external cable assemblies and choosing the RF connectors, do not exceed the loss budget; otherwise, you will compromise the tracking performance of the Eclipse.

Serial Ports

The Eclipse has four serial communication ports:

- Port A, Port B, Port C - main ports
- Port D - Exclusively used to interface with the SBX beacon board or an external corrections source. This port will not output normal GPS-related NMEA messages. When communicating into either Port A, B, or C, a virtual connection may be established to the device on Port D using the \$JCONN command. See "Communication Port D" below for more information on Port D.

The Eclipse serial ports' 3.3 V CMOS signal level can be translated to interface to other devices. For example, if serial Ports A, B, and/or C are used to communicate to external devices (such as PCs) you must translate the signal level from 3.3 V CMOS to RS-232.

Communication Port D

Port D is exclusively for external DGPS correction input to the Eclipse, such as from Hemisphere GPS' SBX beacon board.

USB Ports

The Eclipse has both a USB host port and a USB device port (P300, P301, P302, P303, P320) or just a USB device port (P200, P201, P202, P203), where:

- USB device port (data communication) shown in Figure 2-8 on page 20 serves as a high speed data communications port, such as for a PC
- USB host port (data storage) shown in Figure 2-9 on page 21 serves as a data storage port, such as with a USB flash drive

The USB data lines are bidirectional and are differential pairs. The USB data lines should be laid out on printed wire board (PWB) with $90\ \Omega \pm 15\%$ differential impedance. The traces should be over a solid continuous ground plane. Maintain parallel traces and symmetry. There shall be no traces or breaks in the ground plane underneath the D+ and D- traces. It is also recommended to leave a minimum 20 mil spacing between USB signals and other signals. Treat the data lines as if they are RF signals.

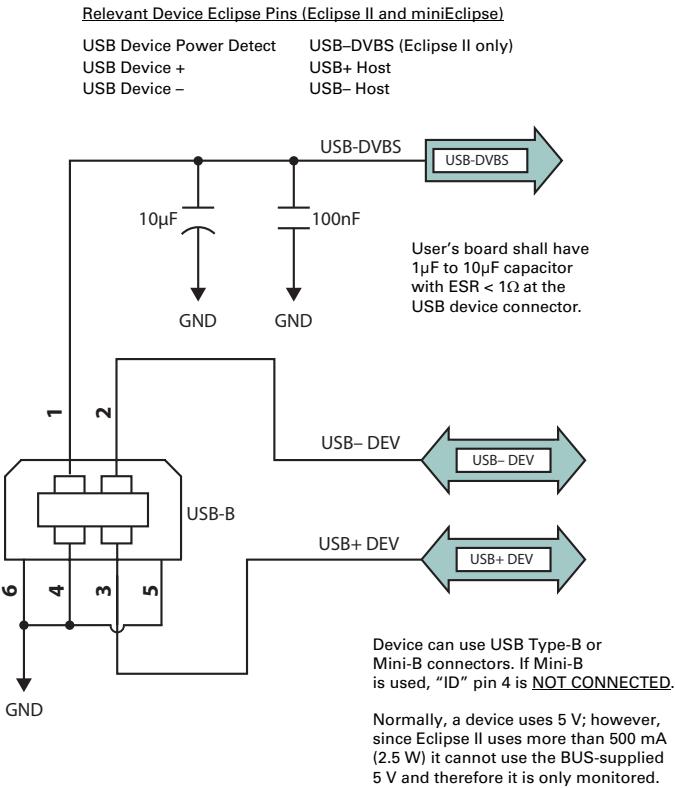


Figure 2-8: Eclipse USB device design example

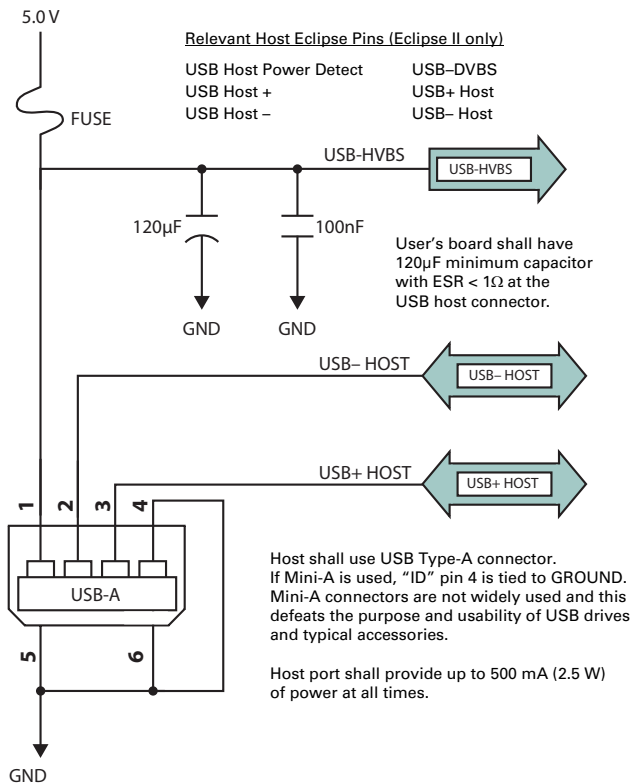


Figure 2-9: Eclipse USB host design example

LED Indicators

The Eclipse features the following surface-mounted diagnostic LEDs that indicate board status (see Figure 2-10):

- PWR - Power
- GPS - GPS lock
- DIFF - Differential lock
- DGPS - DGPS position
- L-BAND - L-band lock

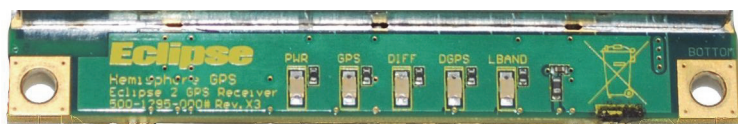


Figure 2-10: Onboard LEDs

With the exception of the power LED the signals that drive the LEDs are available via the header connector. Refer to Table 2-2 through Table 2-4 for pin number descriptions for the Eclipse.

Note: Each signal pin can offer only 1 mA of current and is active low. Since 1 mA of current may be inadequate for the application, you may want to transistor-buffer these signals to provide more current capacity for acceptable LED luminance.

1PPS Timing Signal

The one pulse per second (1 PPS) timing signal is used in applications where devices require time synchronization.

Note: 1 PPS is typical of most GPS boards but not essential to normal receiver operation. Do not connect this pin if you do not need this function.

The 1 PPS signal is 3.3 V CMOS, active high with rising edge synchronization. The 1 PPS signal is capable of driving a load impedance greater than 10 k Ω in parallel with 10 pF. The pulse is approximately 1 ms.

Event Marker Input

A GPS solution may need to be forced at a particular instance, not synchronized with GPS time depending on the application, such as indicating to the GPS receiver when a photo is taken from a camera used for aerial photography.

Note: Event marker input is typical of most GPS boards but not essential to normal receiver operation. Do not connect this pin if you do not need this function.

The event marker input is 3.3 V CMOS, active low with falling edge synchronization. The input impedance and capacitance is higher than 10 k Ω and 10 pF respectively, with a threshold of lower than 0.7 V required to recognize the input.

Grounds

You must connect all grounds together when connecting the ground pins of the Eclipse. These are not separate analog and digital grounds that require separate attention. Refer to Table 2-2 through Table 2-4 for pinout ground information for the Eclipse.

Speed Radar Output

Note: Speed radar output is not essential to normal receiver operation. Do not connect these pins if you do not need this function.

The following two pins on the Eclipse relate to the Speed Radar.

- **Speed Radar Pulse** - Outputs a square wave with 50% duty cycle. The frequency of the square wave varies directly with speed. 97 Hz represents a speed of 1 m/s (3.28 ft/s).
- **Speed Radar Ready Signal** - Indicates when the speed signal on the *Speed Radar Pulse* pin is valid. In static situations, such as when the vehicle has stopped, the GPS position may still have slight variations from one moment to the next. During these instances, the signal on the *Speed Radar Ready Signal* pin is 'high' or +Vcc, indicating the speed coming out of the *Speed Radar Pulse* pin is erroneous and not truly indicative of the GPS receiver's actual speed. **Therefore, it should not be referred to or be used.** Once the vehicle starts moving again and meets a minimum threshold speed, the output on the *Speed Radar Ready Signal* pin will go 'low,' indicating valid speed information is present on the *Speed Radar Pulse* pin.

Table 2-5 provides the location of the Speed Radar Pulse and Speed Radar Ready Signal on the Eclipse.

Table 2-5: Eclipse speed radar output availability

Eclipse Board	Speed Radar Pulse	Speed Radar Ready Signal
Eclipse II (P320)	Pin 19	Pin 20
miniEclipse (P200/P202/P300)	Pin 25	Pin 26
miniEclipse (P201/P301)	N/A	N/A

Note: Neither pin (19 or 20 for P320, 25 or 26 for miniEclipse) has any form of isolation or surge protection. If utilizing the Speed Radar Pulse output, Hemisphere GPS strongly recommends incorporating some form of isolation circuitry into the supporting hardware. Contact Hemisphere GPS Customer Support for an example of an optically isolated circuit.

Shielding

The Eclipse is a sensitive instrument. When integrated into an enclosure, the Eclipse requires shielding from other electronics to ensure optimal operation. The Eclipse shield design consists of a thin piece of metal with specific diameter holes, preventing harmful interference from penetrating, while still allowing air circulation for cooling.

Receiver Mounting

The Eclipse is a precision instrument. To ensure optimal operation, consider mounting the receiver in a way to minimize vibration and shock.

When mounting the Eclipse immediately adjacent to the GPS antenna, Hemisphere GPS highly recommends shielding the board from the LNA of the antenna. This step can be more complex than some integrators initially estimate. Attempt to confirm the operation in your application as early in the project as possible.

Thermal Concerns

The Eclipse receiver consumes a few watts of power, which ultimately will generate heat. Since this may raise the ambient temperature inside an enclosure consider managing the heat inside the enclosure to ensure the internal temperature does not exceed the maximum operating temperature for the Eclipse. Some suggestions for heat management are heat sinks, heat conductive foam, or using a small cooling fan possibly using a thermal switch. Air moving over the Eclipse removes heat very effectively.

Note: Thermal design may only be a concern if the integrated product's maximum design temperature is expected to be close to that of the Eclipse.



Chapter 3: Operation

Powering the Eclipse

Communicating with the Eclipse

Configuring the Eclipse

Firmware

Configuring the Data Message Output

Saving the Eclipse Configuration

Using Port D for RTCM Input

Configuration Defaults

This chapter provides Eclipse operation information, such as communicating with the Eclipse, firmware, and configuration defaults.

Note: Install the antenna outdoors so it has a clear view of the entire sky. If you place the antenna indoors near a window, for example, you will likely not track a sufficient number of satellites. With a properly installed antenna the Eclipse provides a position within approximately 60 sec.

Powering the Eclipse

The Eclipse is powered by a 3.3 VDC power source. Once you connect appropriate power the Eclipse is active. Although the Eclipse proceeds through an internal startup sequence upon application of power, it is ready to communicate immediately.

Communicating with the Eclipse

The Eclipse features three primary serial ports (Port A, Port B, Port C) that you can configure independently from each other. You can configure the ports for any combination of NMEA 0183, binary, and RTCM SC-104 data. The usual data output is limited to NMEA data messages as these are industry standard.

Note: You may use the three serial ports to separate the different data types and output different rates. If the Eclipse is required to output different data types simultaneously, ensure data logging and the processing software used can correctly parse the different data from a single stream.

Configuring the Eclipse

You can configure all aspects of Eclipse operation through any serial port using proprietary commands. For information on these commands refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon).

You can configure the following:

- Select one of the two firmware applications
- Set communication port baud rates
- Select which messages to output on the serial ports and the update rate of each message
- Set various receiver operating parameters

For a complete lists of commands and messages refer to the Hemisphere GPS Technical Reference.

To issue commands to the Eclipse you will need to connect it to a terminal program such as HyperTerminal or either of Hemisphere GPS' software applications (SLXMon or PocketMax). See "What is the best software tool to use to communicate with the Eclipse and configure it?" on page 33 for descriptions of HyperTerminal, SLXMon, and PocketMax.

Firmware

The software that runs the Eclipse is often referred to as firmware since it operates at a low level. You can upgrade the firmware in the field through any serial port as new versions become available.

You can have two firmware applications loaded on the receiver; however, you can only operate one at a time.

The Eclipse currently ships with the rover RTK application and the base RTK/SBAS application. Refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon) for information on the \$JAPP command, which you use to change between the two Eclipse applications.

Configuring the Data Message Output

The Eclipse features three primary bidirectional ports (Ports A, B and C) and a differential-only port (Port D). You can configure messages for all ports by sending proprietary commands to the Eclipse through any port. For a complete lists of commands and messages refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon).

‘THIS’ Port and the ‘OTHER’ Port

Both Port A and Port B use the phrases “THIS” and “OTHER” when referring to themselves and each other in NMEA messages.

‘THIS’ port is the port you are currently connected to for inputting commands. To output data through the same port (‘THIS’ port) you do not need to specify ‘THIS’ port. For example, when using Port A to request the GPGGA data message be output at 5 Hz on the same port (Port A), issue the following command:

```
$JASC,GPGGA,5<CR><LF>
```

The ‘OTHER’ port is either Port A or Port B, whichever one you are not using to issue commands. If you are using Port A to issue commands, then Port B is the ‘OTHER’ port, and vice versa. To specify the ‘OTHER’ port for the data output you need to include ‘OTHER’ in the command. For example, if you use Port A to request the GPGGA data message be output at 5 Hz on Port B, issue the following command:

```
$JASC,GPGGA,5,OTHER<CR><LF>
```

When using Port A or Port B to request message be output on Port C, you must specifically indicate (by name) you want the output on Port C. For example, if you use Port A to request the GPGLL data message be output at 10 Hz on Port C, issue the following command:

```
$JASC,GPGLL,10,PORTC<CR><LF>
```


Saving the Eclipse Configuration

Each time you change the Eclipse's configuration you may want to save the configuration so you do not have to reconfigure the receiver each time you power it on. To save the configuration, issue the \$JSAVE command to the Eclipse using a terminal program such as HyperTerminal or either of Hemisphere GPS' applications (SLXMon or PocketMax). The Eclipse will take approximately five seconds to save the configuration to non-volatile memory and will indicate when the configuration has been saved. Refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon) for more information on the \$JSAVE command.

Using Port D for RTCM Input

Port D has been optimized to interface with Hemisphere GPS' SBX-4 beacon board and operates at 9600 baud (8 data bits, no parity and 1 stop bit – 8-N-1).

To configure the Eclipse to use Port D, issue the following command:

```
$JDIFF, BEACON<CR><LF>
```

To return to using SBAS as the correction source, send the following command to the Eclipse:

```
$JDIFF, WAAS<CR><LF>
```

For a complete lists of commands and messages refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon).

Configuration Defaults

Below is the standard configuration for the Eclipse. For more information on these commands refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon).

```
$JOFF, PORTA
$JOFF, PORTB
$JOFF, PORTC
$JBAUD, 19200, PORTA
$JBAUD, 19200, PORTB
$JBAUD, 19200, PORTC
$JAGE, 2700
$JLIMIT, 10.0
$JMASK, 5
$JDIFF, WAAS
$JPOS, 51.0, -114.0
$JSMOOTH, LONG900
$JAIR, AUTO
$JALT, NEVER
$JNP, 7
$JWAASPRN, AUTO
$JTAU, COG, 0.00
$JTAU, SPEED, 0.00
$JSAVE
```



Appendix A: Frequently Asked Questions

Integration
Support and Repair
Power, Communication, and Configuration
GPS Reception and Performance
SBAS Reception and Performance
External Corrections
Installation

Integration

Do I need to use the 1 PPS and event marker?

No, these are not necessary for Eclipse operation.

What should I do with the 1 PPS signal if I do not want to use it?

This signal will be strobing at 1 Hz, so it should not be connected.

What should I do with the manual mark input if I am not going to use it?

Do not connect the pin because this signal is active low.

Do I need to use the lock indicators?

No, these are present for applications where it is desirable to have an LED visible to the user. These signals need to be transistor-buffered, as these lines can only offer 1 mA. Depending on the product and the application, LEDs can be very useful to the end user. These signals are active low.

Do I need to use a shield-can for the Eclipse?

Not necessarily...but you may need to if there are RF interference issues, such as if the Eclipse interferes with other devices. A shield-can would be a good start in terms of investigating the benefit. If you are designing a smart antenna system, one is likely needed. Hemisphere GPS recommends that you always conduct an RF prescan when integrating OEM boards.

If my company wishes to integrate this product, what type of engineering resources will I need to do this successfully?

Hemisphere GPS recommends you have sufficient engineering resources with the appropriate skills in and understanding of the following:

- Electronic design (including power supplies and level translation)
- RF implications of working with GPS equipment
- Circuit design and layout
- Mechanical design and layout

What type of assistance can I expect from Hemisphere GPS when integrating the Eclipse?

Integration of a GPS board has such benefits as:

- Lower system cost
- Improved branding (rather than relabeling an existing product)
- Better control of system design among others

As an integrator, you are responsible for ensuring that the correct resources are in place to technically complete it. Hemisphere GPS will provide reasonable assistance. However, Hemisphere GPS does not have dedicated engineering resources for in-depth integration support. Hemisphere GPS will do its best to provide support as necessary, but you should expect to have reasonable expertise to use this Integrators Guide.

Support and Repair

How do I solve a problem I cannot isolate?

Hemisphere GPS recommends contacting the dealer first. With their experience with this product, and other products from Hemisphere GPS, they should be able to help isolate a problem. If the issue is beyond the capability or experience of the dealer, Hemisphere GPS Technical Support is available from 8:00 AM to 5:00 PM Mountain Standard Time, Monday through Friday.

See “Technical Support” on page i (just before the Contents page) for Technical Support contact information.

What do I do if I cannot resolve a problem after trying to diagnose it myself?

Contact your dealer to see if they have any information that may help to solve the problem. They may be able to provide some in-person assistance. If this is not viable or does not solve the problem, Hemisphere GPS Technical Support is available from 8:00 AM to 5:00 PM Mountain Standard Time, Monday through Friday.

See “Technical Support” on page i (just before the Contents page) for Technical Support contact information.

Can I contact Hemisphere GPS Technical Support directly regarding technical problems?

Yes, however, Hemisphere GPS recommends speaking to the dealer first as they would be the local support. They may be able to solve the problem quickly, due to their closer location and experience with our equipment.

Power, Communication, and Configuration

My Eclipse system does not appear to be communicating. What do I do?

This could be one of a few issues:

- Examine the Eclipse cables and connectors for signs of damage or offset.
- Ensure the Eclipse system is properly powered with the correct voltage.
- Ensure there is a good connection to the power supply since it is required to terminate the power input with the connector.
- Check the documentation of the receiving device, if not a PC, to ensure the transmit line from the Eclipse is connected to the receive line of the other device. Also, ensure the signal grounds are connected.
- If the Eclipse is connected to a custom or special device, ensure the serial connection to it does not have any incompatible signal lines present that prevent proper communication.
- Make sure the baud rate of the Eclipse matches the other device. The other device must also support an 8 data bit, 1 stop bit, no parity port configuration (8-N-1). Some devices support different settings that may be user configurable. Ensure the settings match.
- Consult the troubleshooting section of the other device's documentation to determine if there may be a problem with the equipment.

Am I able to configure two serial ports with different baud rates?

Yes, all the ports are independent. For example, you may set one port to 4800 and another port to 19200.

Am I able to have the Eclipse output different NMEA messages through multiple ports?

Yes, different NMEA messages can be sent to the serial ports you choose. These NMEA messages may also be at different update rates.

A high enough baud rate is needed to transmit all the data; otherwise, some data may not be transmitted.

How can I determine the current configuration of the Eclipse?

The \$JSHOW command will request the configuration information from the Eclipse. The response will be similar to:

```
$>JSHOW,BAUD,19200
$>JSHOW,BIN,1,5.0
$>JSHOW,BAUD,4800,OTHER
$>JSHOW,ASC,GPGGA,1.0,OTHER
$>JSHOW,ASC,GPVTG,1.0,OTHER
$>JSHOW,ASC,GPGSA,1.0,OTHER
```

How can I be sure the configuration will be saved for the subsequent power cycle?

Query the receiver to make sure the current configuration is correct by issuing a \$JSHOW command. If not, make the necessary changes and reissue the \$JSHOW command. Once the current configuration is acceptable, issue a \$JSAVE command and wait for the receiver to indicate the save is complete. Do not power off the receiver until the "save complete" message appears.

How do I change the baud rate of a port from that port?

Connect at the current baud rate of the Eclipse port and then issue a \$JBAUD command to change the port baud rate to the desired rate. Now change the baud rate in your application to the desired rate.

What is the best software tool to use to communicate with the Eclipse and configure it?

Hemisphere GPS uses three different software applications:

- HyperTerminal™ - Available on all Windows® 95, 98, ME, and XP. This tool allows you to configure the Eclipse by directly typing commands into the terminal window. The output from the Eclipse is simultaneously shown. When using HyperTerminal, ensure it is configured to use the correct PC communication port and baud rate, and that the local echo feature is on (to see what is being typed).
- SLXMon - Available at www.hemispheregps.com. This application is a very useful tool for graphically viewing tracking performance and position accuracy, and for recording data. It can also configure message output and port settings. SLXMon runs on Windows 95 or higher.
- PocketMax - Available at www.hemispheregps.com. Similar to SLXMon, you can use this application to graphically view tracking performance and position accuracy, record data, and configure message output and port settings. PocketMax runs on multiple Windows platforms using the Windows .NET framework.

GPS Reception and Performance

How do I know what the Eclipse is doing?

The Eclipse supports standard NMEA data messages. The \$GPGSV and Bin99 data messages contain satellite tracking and SNR information. If available, the computed position is contained in the \$GPGGA message. Additionally, the Eclipse has surface-mounted status LEDs that indicate receiver status.

Do I have to be careful when using the Eclipse to ensure it tracks properly?

For best performance, the Eclipse's antenna must have a clear view of the sky for satellite tracking. The Eclipse can tolerate a certain amount of signal blockage because redundant satellites are often available. Only four satellites are required for a position; however, the more satellites that are used, the greater the positioning accuracy.

SBAS Reception and Performance

How do I know if the Eclipse has acquired an SBAS signal?

The Eclipse outputs the \$RD1 message that contains the SBAS Bit Error Rate (BER) for each SBAS channel. The BER value describes the rate of errors received from SBAS. Ideally, this should be zero. However, the Eclipse performs well up to 150 BER. The SLXMon and PocketMax utilities provide this information without needing to use NMEA commands.

How do I know if the Eclipse is offering a differentially-corrected or RTK-corrected position?

The Eclipse outputs the \$GPGGA message as the main positioning data message. This message contains a quality fix value that describes the GPS status. If this value is 2, the position is differentially corrected; if this value is 5, the position is RTK-corrected. The SLXMon and PocketMax utilities provide this information without needing to use NMEA commands.

How do I select an SBAS satellite?

By default the Eclipse will automatically attempt to track the appropriate SBAS satellites. If multiple satellites are available, the one with the lowest BER value is selected to be used to decode the corrections.

You can manually select which SBAS satellites to track—refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon) for more information; however, this is not recommended.

Should I be concerned if the Eclipse is frequently losing lock on SBAS due to obstructions or low satellite elevation angles at my geographic location?

No, provided the receiver is receiving a full set of corrections relatively often. Using COAST technology, the Eclipse is able to perform well for 40 minutes or more with aging correction data. Similar to DGPS corrections, accuracy degrades over time and distance. To obtain a full set of corrections the Eclipse antenna receives the ionospheric map over a period of a few minutes. This is the minimum amount of time required to get a full set of corrections for SBAS operation. After this, the receiver can coast until the next set of corrections have been received.

Accuracy is a function of correction age and current ionospheric activity, which will increase in the coming years.

Do I need a dual frequency antenna for SBAS?

Hemisphere GPS recommends using a dual frequency antenna with the Eclipse. While some receiver function is possible with an L1-only antenna, full receiver performance will only be realized with a dual frequency antenna.

External Corrections

My Eclipse system does not appear to be using DGPS or RTK corrections from an external correction source. What could be the problem?

This could be due to a number of factors. To isolate the issue:

- Make sure DGPS corrections are RTCM v2.3 protocol.
- Make sure RTK corrections are either ROX, RTCM v3, CMR, or CMR+ protocol.
- Verify the baud rates used by the Eclipse match that of the external correction source.
- The external correction should be using an 8 data bit, no parity, 1 stop bit (8-N-1) serial port configuration.
- Inspect the cable connection to ensure there is no damage.
- Check the pinout information for the cables to ensure the transmit line of the external correction source is connected to the receive line of the Eclipse's serial port and that the signal grounds are connected.
- Make sure the Eclipse has been set to receive external corrections by issuing the \$JDIFF command. Refer to the Hemisphere GPS Technical Reference (go to www.hemispheregps.com and click the GPS Reference icon) for more information.

Installation

Does it matter where I mount the Eclipse's antenna?

Yes, the mounting location must provide a clear view of the sky for satellite tracking. Additionally, the position that it computes is based on the center of the antenna. It should be placed in the location for which the user would like a position. Often antennas are mounted on the centerline of a vehicle or on a pole-mount for georeference.

How will the antenna selection and mounting affect Eclipse performance?

For best results select a multipath-resistant antenna. Ensure the antenna tracks all the available signals for the receiver.

Mount the antenna:

- With the best possible view of the sky
- In a location with the lowest possible multipath

Using a magnetic mount for the antenna will not affect performance.



Appendix B: Troubleshooting

Use the following checklist to troubleshoot anomalous Eclipse operation. Table B-1 provides a list of issues with possible solutions. Refer to Appendix C, “Technical Specifications” if necessary.

Table B-1: Troubleshooting

Issue	Possible Solution
<p>What do I do initially if I have a problem with the operation of the Eclipse?</p>	<p>Try to isolate the source of the problem. Problems are likely to fall within one of the following categories:</p> <ul style="list-style-type: none"> • Power, communication, and configuration • GPS reception and performance • Beacon reception and performance • SBAS reception and performance • External corrections • Installation • Shielding and isolating interference <p>It is important to review each category in detail in order to eliminate it as a problem.</p>
<p>Receiver fails to power</p>	<ul style="list-style-type: none"> • Verify polarity of power leads • Check 1.0 A in-line power cable fuse connection • Check integrity of power cable connections • Check power input voltage • Check current restrictions imposed by power source (minimum available should be > 1.0 A)
<p>No data from the Eclipse</p> <ol style="list-style-type: none"> 1. No communication 2. No valid data 	<ul style="list-style-type: none"> • (1) Check receiver power status (this may be done with an ammeter) • (2) Verify Eclipse is locked to a valid DGPS signal (this can often be done on the receiving device or by using SLXMon) • (2) Verify that Eclipse is locked to GPS satellites (this can often be done on the receiving device or by using SLXMon) • (2) Check integrity and connectivity of power and data cable connections
<p>Random binary data from the Eclipse</p>	<ul style="list-style-type: none"> • Verify that the RCTM or Bin messages are not being accidentally output (send a \$JSHOW command) • Verify that the baud rate settings of Eclipse and remote device match • Potentially, the volume of data requested to be output by the Eclipse could be higher than the current baud rate supports. Try using 19200 or higher for the baud rate for all devices

Table B-1: Troubleshooting

Issue	Possible Solution
No GPS lock	<ul style="list-style-type: none"> • Check integrity of antenna cable • Verify antenna's view of the sky • Verify the lock status and signal to noise ratio of GPS satellites (this can often be done on the receiving device or by using SLXMon)
No SBAS	<ul style="list-style-type: none"> • Check antenna cable integrity • Verify antenna's view of the sky, especially towards that SBAS satellites, south in the northern hemisphere • Verify the bit error rate and lock status of SBAS satellites (this can often be done on the receiving device or by using SLXMon - monitor BER value)
No DGPS position in external RTCM mode	<ul style="list-style-type: none"> • Verify that the baud rate of the RTCM input port matches the baud rate of the external source • Verify the pinout between the RTCM source and the RTCM input port (the "ground" pin and pinout must be connected, and from the "transmit" from the source must connect to the "receiver" of the RTCM input port).
Non-DGPS output	<ul style="list-style-type: none"> • Verify Eclipse SBAS and lock status (or external source is locked)



Appendix C: Technical Specifications

P200 Specifications

P201 Specifications

P202 Specifications

P203 Specifications

P300 Specifications

P301 Specifications

P302 Specifications

P303 Specifications

P320 Specifications

P200 Specifications

Table C-1 through Table C-5 provide specifications for the P200.

Table C-1: P200 sensor specifications

Item	Specification												
Receiver type	GPS L1 and L2 RTK with carrier phase												
Channels	12 L1CA GPS 12 L1P GPS 12 L2P GPS* 12 L2C GPS* 3 SBAS or 3 additional L1CA GPS * with subscription code <i>Note: L-band support available with optional Hemisphere GPS LX-2 OEM board.</i>												
GPS sensitivity	-142 dBm												
SBAS tracking	3-channel, parallel tracking												
Update rate	1 Hz standard, 10 Hz and 20 Hz available												
Horizontal accuracy	<table><tr><td></td><td>RMS (67%)</td><td>2DRMS (95%)</td></tr><tr><td>RTK^{1,2}</td><td>10 mm + 1 ppm</td><td>20 mm + 2 ppm</td></tr><tr><td>SBAS (WAAS)¹</td><td>0.3 m</td><td>0.6 m</td></tr><tr><td>Autonomous, no SA¹</td><td>1.2 m</td><td>2.5 m</td></tr></table>		RMS (67%)	2DRMS (95%)	RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm	SBAS (WAAS) ¹	0.3 m	0.6 m	Autonomous, no SA ¹	1.2 m	2.5 m
	RMS (67%)	2DRMS (95%)											
RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm											
SBAS (WAAS) ¹	0.3 m	0.6 m											
Autonomous, no SA ¹	1.2 m	2.5 m											
Timing (1PPS) accuracy	20 ns												
Cold start time	< 60 s typical (no almanac or RTC)												
Warm start time	< 30 s typical (almanac and RTC)												
Hot start time	< 10 s (almanac, RTC, and position)												
Maximum speed	1,850 kph (999 kts)												
Maximum altitude	18,288 m (60,000 ft)												
Differential options	SBAS, Autonomous, External RTCM v2.3, RTK v3												

Table C-2: P200 communication specifications

Item	Specification
Serial ports	4 full-duplex 3.3 V CMOS (3 main serial ports, 1 differential-only port)
Baud rates	4800 - 115200
Data I/O protocol	NMEA 0183, Hemisphere GPS binary
Correction I/O protocol	Hemisphere GPS' ROX, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+ ⁴
Timing output	1 PPS CMOS, active high, rising edge sync, 10 k Ω , 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 k Ω , 10 pF load
USB	1 USB Device

Table C-3: P200 power specifications

Item	Specification
Input voltage	3.3 VDC +/- 5%
Power consumption	< 1.35 W nominal (L1/L2 RTK) < 1.25 W nominal (L1 SBAS)
Current consumption	410 mA nominal (L1/L2 RTK) 380 mA nominal (L1 SBAS)
Antenna voltage input	15 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 40 dB
Antenna input impedance	50 Ω

Table C-4: P200 environmental specifications

Item	Specification
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when installed in an enclosure)
Shock and vibration ⁵	Vibration: EP455 Section 5.15.1 Random Mechanical Shock: EP455 Section 5.14.1 Operational (when mounted in an enclosure with screw mounting holes utilized)
EMC ⁵	CE (IEC 60945 Emissions and Immunity) FCC Part 15, Subpart B CISPR22

Table C-5: P200 mechanical specifications

Item	Specification
Dimensions	71.1 L x 40.6 W x 10.1 H mm (2.81 L x 1.60 W x 0.40 H in)
Weight	< 20 g (< 0.7 oz)
Status indication (LED)	Power, GPS lock, Differential lock, DGPS position
Power/Data connector	34-pin (17x2) male header 0.05" (1.27 mm) pitch
Antenna connector	MCX, female, straight

P201 Specifications

Table C-6 through Table C-10 provide specifications for the P201.

Table C-6: P201 sensor specifications

Item	Specification		
Receiver type	GPS L1 and L2 RTK with carrier phase		
Channels	12 L1CA GPS 12 L1P GPS 12 L2P GPS* 12 L2C GPS* 3 SBAS or 3 additional L1CA GPS <i>* with subscription code</i>		
GPS sensitivity	-142 dBm		
SBAS tracking	3-channel, parallel tracking		
Update rate	1 Hz standard, 10 Hz and 20 Hz available		
Horizontal accuracy		RMS (67%)	2DRMS (95%)
	RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm
	SBAS (WAAS) ¹	0.3 m	0.6 m
	Autonomous, no SA ¹	1.2 m	2.5 m
Timing (1PPS) accuracy	20 ns		
Cold start time	< 60 s typical (no almanac or RTC)		
Warm start time	< 30 s typical (almanac and RTC)		
Hot start time	< 10 s (almanac, RTC, and position)		
Maximum speed	1,850 kph (999 kts)		
Maximum altitude	18,288 m (60,000 ft)		
Differential options	SBAS, Autonomous, External RTCM v2.3, RTK v3		

Table C-7: P201 communication specifications

Item	Specification
Serial ports	4 full-duplex 3.3 V CMOS (3 main serial ports, 1 differential-only port)
Baud rates	4800 - 115200
Data I/O protocol	NMEA 0183, Hemisphere GPS binary
Correction I/O protocol	Hemisphere GPS' ROX, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+ ⁴
Timing output	1 PPS CMOS, active high, rising edge sync, 10 k Ω , 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 k Ω , 10 pF load
USB	1 USB Device

Table C-8: P201 power specifications

Item	Specification
Input voltage	3.3 VDC +/- 5%
Power consumption	< 1.35 W nominal (L1/L2 RTK) < 1.25 W nominal (L1 SBAS)
Current consumption	410 mA nominal (L1/L2 RTK) 380 mA nominal (L1 SBAS)
Antenna voltage input	15 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 40 dB
Antenna input impedance	50 Ω

Table C-9: P201 environmental specifications

Item	Specification
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when installed in an enclosure)
Shock and vibration ⁵	Vibration: EP455 Section 5.15.1 Random Mechanical Shock: EP455 Section 5.14.1 Operational (when mounted in an enclosure with screw mounting holes utilized)
EMC ⁵	CE (IEC 60945 Emissions and Immunity) FCC Part 15, Subpart B CISPR22

Table C-10: P201 mechanical specifications

Item	Specification
Dimensions	72.4 L x 40.6 W x 10.1 H mm (2.85 L x 1.60 W x 0.40 H in)
Weight	< 20 g (< 0.7 oz)
Status indication (LED)	Power, GPS lock, Differential lock, DGPS position
Power/Data connector	20-pin (10x2) male header 0.08" (2 mm) pitch
Antenna connector	MCX, female, straight

P202 Specifications

Table C-11 through Table C-15 provide specifications for the P202.

Table C-11: P202 sensor specifications

Item	Specification												
Receiver type	GNSS L1 RTK with carrier phase												
Channels	12 L1CA GPS 12 L1P GPS 12 L1 GLONASS 3 SBAS or 3 additional L1CA GPS <i>Note: L-band support available with optional Hemisphere GPS LX-2 OEM board.</i>												
GPS sensitivity	-142 dBm												
SBAS tracking	3-channel, parallel tracking												
Update rate	1 Hz standard, 10 Hz and 20 Hz available												
Horizontal accuracy	<table><tr><td></td><td>RMS (67%)</td><td>2DRMS (95%)</td></tr><tr><td>RTK^{1,2}</td><td>10 mm + 1 ppm</td><td>20 mm + 2 ppm</td></tr><tr><td>SBAS (WAAS)¹</td><td>0.3 m</td><td>0.6 m</td></tr><tr><td>Autonomous, no SA¹</td><td>1.2 m</td><td>2.5 m</td></tr></table>		RMS (67%)	2DRMS (95%)	RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm	SBAS (WAAS) ¹	0.3 m	0.6 m	Autonomous, no SA ¹	1.2 m	2.5 m
	RMS (67%)	2DRMS (95%)											
RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm											
SBAS (WAAS) ¹	0.3 m	0.6 m											
Autonomous, no SA ¹	1.2 m	2.5 m											
Timing (1PPS) accuracy	20 ns												
Cold start time	< 60 s typical (no almanac or RTC)												
Warm start time	< 30 s typical (almanac and RTC)												
Hot start time	< 10 s (almanac, RTC, and position)												
Maximum speed	1,850 kph (999 kts)												
Maximum altitude	18,288 m (60,000 ft)												
Differential options	SBAS, Autonomous, External RTCM v2.3, RTK v3												

Table C-12: P202 communication specifications

Item	Specification
Serial ports	4 full-duplex 3.3 V CMOS (3 main serial ports, 1 differential-only port)
Baud rates	4800 - 115200
Data I/O protocol	NMEA 0183, Hemisphere GPS binary
Correction I/O protocol	Hemisphere GPS' ROX, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+ ⁴
Timing output	1 PPS CMOS, active high, rising edge sync, 10 k Ω , 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 k Ω , 10 pF load
USB	1 USB Device

Table C-13: P202 power specifications

Item	Specification
Input voltage	3.3 VDC +/- 5%
Power consumption	
Current consumption	
Antenna voltage input	15 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 40 dB
Antenna input impedance	50 Ω

Table C-14: P202 environmental specifications

Item	Specification
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when installed in an enclosure)
Shock and vibration ⁵	Vibration: EP455 Section 5.15.1 Random Mechanical Shock: EP455 Section 5.14.1 Operational (when mounted in an enclosure with screw mounting holes utilized)
EMC ⁵	CE (IEC 60945 Emissions and Immunity) FCC Part 15, Subpart B CISPR22

Table C-15: P202 mechanical specifications

Item	Specification
Dimensions	71.1 L x 40.6 W x 10.1 H mm (2.81 L x 1.60 W x 0.40 H in)
Weight	< 20 g (< 0.7 oz)
Status indication (LED)	Power, GPS lock, Differential lock, DGPS position
Power/Data connector	34-pin (17x2) male header 0.05" (1.27 mm) pitch
Antenna connector	MCX, female, straight

P203 Specifications

Table C-16 through Table C-20 provide specifications for the P203.

Table C-16: P203 sensor specifications

Item	Specification		
Receiver type	GNSS L1 RTK with carrier phase		
Channels	12 L1CA GPS 12 L1P GPS 12 L1 GLONASS 3 SBAS or 3 additional L1CA GPS		
GPS sensitivity	-142 dBm		
SBAS tracking	3-channel, parallel tracking		
Update rate	1 Hz standard, 10 Hz and 20 Hz available		
Horizontal accuracy		RMS (67%)	2DRMS (95%)
	RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm
	SBAS (WAAS) ¹	0.3 m	0.6 m
	Autonomous, no SA ¹	1.2 m	2.5 m
Timing (1PPS) accuracy	20 ns		
Cold start time	< 60 s typical (no almanac or RTC)		
Warm start time	< 30 s typical (almanac and RTC)		
Hot start time	< 10 s (almanac, RTC, and position)		
Maximum speed	1,850 kph (999 kts)		
Maximum altitude	18,288 m (60,000 ft)		
Differential options	SBAS, Autonomous, External RTCM v2.3, RTK v3		

Table C-17: P203 communication specifications

Item	Specification
Serial ports	4 full-duplex 3.3 V CMOS (3 main serial ports, 1 differential-only port)
Baud rates	4800 - 115200
Data I/O protocol	NMEA 0183, Hemisphere GPS binary
Correction I/O protocol	Hemisphere GPS' ROX, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+ ⁴
Timing output	1 PPS CMOS, active high, rising edge sync, 10 k Ω , 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 k Ω , 10 pF load
USB	1 USB Device

Table C-18: P203 power specifications

Item	Specification
Input voltage	3.3 VDC +/- 5%
Power consumption	< 1.35 W nominal (L1/L2 RTK) < 1.25 W nominal (L1 SBAS)
Current consumption	410 mA nominal (L1/L2 RTK) 380 mA nominal (L1 SBAS)
Antenna voltage input	15 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 40 dB
Antenna input impedance	50 Ω

Table C-19: P203 environmental specifications

Item	Specification
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when installed in an enclosure)
Shock and vibration ⁵	Vibration: EP455 Section 5.15.1 Random Mechanical Shock: EP455 Section 5.14.1 Operational (when mounted in an enclosure with screw mounting holes utilized)
EMC ⁵	CE (IEC 60945 Emissions and Immunity) FCC Part 15, Subpart B CISPR22

Table C-20: P203 mechanical specifications

Item	Specification
Dimensions	72.4 L x 40.6 W x 10.1 H mm (2.85 L x 1.60 W x 0.40 H in)
Weight	< 20 g (< 0.7 oz)
Status indication (LED)	Power, GPS lock, Differential lock, DGPS position
Power/Data connector	20-pin (10x2) male header 0.08" (2 mm) pitch
Antenna connector	MCX, female, straight

P300 Specifications

Table C-21 through Table C-25 provide specifications for the P300.

Table C-21: P300 sensor specifications

Item	Specification												
Receiver type	GPS L1 and L2 RTK with carrier phase												
Channels	12 L1CA GPS 12 L1P GPS 12 L2P GPS* 12 L2C GPS* 12 L1 GLONASS 12 L2 GLONASS* 3 SBAS or 3 additional L1CA GPS * with subscription code <i>Note: L-band support available with optional Hemisphere GPS LX-2 OEM board.</i>												
GPS sensitivity	-142 dBm												
SBAS tracking	3-channel, parallel tracking												
Update rate	1 Hz standard, 10 Hz and 20 Hz available												
Horizontal accuracy	<table><tr><td></td><td>RMS (67%)</td><td>2DRMS (95%)</td></tr><tr><td>RTK^{1,2}</td><td>10 mm + 1 ppm</td><td>20 mm + 2 ppm</td></tr><tr><td>SBAS (WAAS)¹</td><td>0.3 m</td><td>0.6 m</td></tr><tr><td>Autonomous, no SA¹</td><td>1.2 m</td><td>2.5 m</td></tr></table>		RMS (67%)	2DRMS (95%)	RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm	SBAS (WAAS) ¹	0.3 m	0.6 m	Autonomous, no SA ¹	1.2 m	2.5 m
	RMS (67%)	2DRMS (95%)											
RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm											
SBAS (WAAS) ¹	0.3 m	0.6 m											
Autonomous, no SA ¹	1.2 m	2.5 m											
Timing (1PPS) accuracy	20 ns												
Cold start time	< 60 s typical (no almanac or RTC)												
Warm start time	< 30 s typical (almanac and RTC)												
Hot start time	< 10 s (almanac, RTC, and position)												
Maximum speed	1,850 kph (999 kts)												
Maximum altitude	18,288 m (60,000 ft)												
Differential options	SBAS, Autonomous, External RTCM v2.3, RTK v3												

Table C-22: P300 communication specifications

Item	Specification
Serial ports	4 full-duplex 3.3 V CMOS (3 main serial ports, 1 differential-only port)
Baud rates	4800 - 115200
Data I/O protocol	NMEA 0183, Hemisphere GPS binary
Correction I/O protocol	Hemisphere GPS' ROX, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+ ⁴
Timing output	1 PPS CMOS, active high, rising edge sync, 10 k Ω , 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 k Ω , 10 pF load
USB	1 USB Host, 1 USB Device

Table C-23: P300 power specifications

Item	Specification
Input voltage	3.3 VDC +/- 5%
Power consumption	< 1.35 W nominal (L1/L2 RTK) < 1.25 W nominal (L1 SBAS)
Current consumption	550 mA nominal GPS (L1/L2) and GLONASS (L1/L2)
Antenna voltage input	15 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 40 dB
Antenna input impedance	50 Ω

Table C-24: P300 environmental specifications

Item	Specification
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when installed in an enclosure)
Shock and vibration ⁵	Vibration: EP455 Section 5.15.1 Random Mechanical Shock: EP455 Section 5.14.1 Operational (when mounted in an enclosure with screw mounting holes utilized)
EMC ⁵	CE (ISO 14982 Emissions and Immunity) FCC Part 15, Subpart B CISPR22

Table C-25: P300 mechanical specifications

Item	Specification
Dimensions	71.1 L x 40.6 W x 10.1 H mm (2.81 L x 1.60 W x 0.40 H in)
Weight	< 20 g (< 0.7 oz)
Status indication (LED)	Power, GPS lock, Differential lock, DGPS position
Power/Data connector	34-pin (17x2) male header 0.05" (1.27 mm) pitch
Antenna connector	MCX, female, straight

P301 Specifications

Table C-26 through Table C-30 provide specifications for the P301.

Table C-26: P301 sensor specifications

Item	Specification												
Receiver type	GPS L1 and L2 RTK with carrier phase												
Channels	12 L1CA GPS 12 L1P GPS 12 L2P GPS* 12 L2C GPS* 12 L1 GLONASS 12 L2 GLONASS* 3 SBAS or 3 additional L1CA GPS * with subscription code <i>Note: L-band support available with optional Hemisphere GPS LX-2 OEM board.</i>												
GPS sensitivity	-142 dBm												
SBAS tracking	3-channel, parallel tracking												
Update rate	1 Hz standard, 10 Hz and 20 Hz available												
Horizontal accuracy	<table><tr><td></td><td>RMS (67%)</td><td>2DRMS (95%)</td></tr><tr><td>RTK^{1,2}</td><td>10 mm + 1 ppm</td><td>20 mm + 2 ppm</td></tr><tr><td>SBAS (WAAS)¹</td><td>0.3 m</td><td>0.6 m</td></tr><tr><td>Autonomous, no SA¹</td><td>1.2 m</td><td>2.5 m</td></tr></table>		RMS (67%)	2DRMS (95%)	RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm	SBAS (WAAS) ¹	0.3 m	0.6 m	Autonomous, no SA ¹	1.2 m	2.5 m
	RMS (67%)	2DRMS (95%)											
RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm											
SBAS (WAAS) ¹	0.3 m	0.6 m											
Autonomous, no SA ¹	1.2 m	2.5 m											
Timing (1PPS) accuracy	20 ns												
Cold start time	< 60 s typical (no almanac or RTC)												
Warm start time	< 30 s typical (almanac and RTC)												
Hot start time	< 10 s (almanac, RTC, and position)												
Maximum speed	1,850 kph (999 kts)												
Maximum altitude	18,288 m (60,000 ft)												
Differential options	SBAS, Autonomous, External RTCM v2.3, RTK v3												

Table C-27: P301 communication specifications

Item	Specification
Serial ports	4 full-duplex 3.3 V CMOS (3 main serial ports, 1 differential-only port)
Baud rates	4800 - 115200
Data I/O protocol	NMEA 0183, Hemisphere GPS binary
Correction I/O protocol	Hemisphere GPS' ROX, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+ ⁴
Timing output	1 PPS CMOS, active high, rising edge sync, 10 k Ω , 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 k Ω , 10 pF load
USB	1 USB Host, 1 USB Device

Table C-28: P301 power specifications

Item	Specification
Input voltage	3.3 VDC +/- 5%
Power consumption	< 1.35 W nominal (L1/L2 RTK) < 1.25 W nominal (L1 SBAS)
Current consumption	550 mA nominal GPS (L1/L2) and GLONASS (L1/L2)
Antenna voltage input	15 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 40 dB
Antenna input impedance	50 Ω

Table C-29: P301 environmental specifications

Item	Specification
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when installed in an enclosure)
Shock and vibration ⁵	Vibration: EP455 Section 5.15.1 Random Mechanical Shock: EP455 Section 5.14.1 Operational (when mounted in an enclosure with screw mounting holes utilized)
EMC ⁵	CE (ISO 14982 Emissions and Immunity) FCC Part 15, Subpart B CISPR22

Table C-30: P301 mechanical specifications

Item	Specification
Dimensions	72.4 L x 40.6 W x 10.1 H mm (2.85 L x 1.60 W x 0.40 H in)
Weight	< 20 g (< 0.7 oz)
Status indication (LED)	Power, GPS lock, Differential lock, DGPS position
Power/Data connector	20-pin (10x2) male header 0.08" (2 mm) pitch
Antenna connector	MCX, female, straight

P302 Specifications

Table C-21 through Table C-25 provide specifications for the P302.

Table C-31: P302 sensor specifications

Item	Specification												
Receiver type	GPS L1 and L2 RTK with carrier phase												
Channels	12 L1CA GPS 12 L1P GPS 12 L2P GPS* 12 L2C GPS* 12 L1 GLONASS 12 L2 GLONASS* 3 SBAS or 3 additional L1CA GPS * with subscription code <i>Note: L-band support available with optional Hemisphere GPS LX-2 OEM board.</i>												
GPS sensitivity	-142 dBm												
SBAS tracking	3-channel, parallel tracking												
Update rate	1 Hz standard, 10 Hz and 20 Hz available												
Horizontal accuracy	<table><tr><td></td><td>RMS (67%)</td><td>2DRMS (95%)</td></tr><tr><td>RTK^{1,2}</td><td>10 mm + 1 ppm</td><td>20 mm + 2 ppm</td></tr><tr><td>SBAS (WAAS)¹</td><td>0.3 m</td><td>0.6 m</td></tr><tr><td>Autonomous, no SA¹</td><td>1.2 m</td><td>2.5 m</td></tr></table>		RMS (67%)	2DRMS (95%)	RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm	SBAS (WAAS) ¹	0.3 m	0.6 m	Autonomous, no SA ¹	1.2 m	2.5 m
	RMS (67%)	2DRMS (95%)											
RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm											
SBAS (WAAS) ¹	0.3 m	0.6 m											
Autonomous, no SA ¹	1.2 m	2.5 m											
Timing (1PPS) accuracy	20 ns												
Cold start time	< 60 s typical (no almanac or RTC)												
Warm start time	< 30 s typical (almanac and RTC)												
Hot start time	< 10 s (almanac, RTC, and position)												
Maximum speed	1,850 kph (999 kts)												
Maximum altitude	18,288 m (60,000 ft)												
Differential options	SBAS, Autonomous, External RTCM v2.3, RTK v3												

Table C-32: P302 communication specifications

Item	Specification
Serial ports	4 full-duplex 3.3 V CMOS (3 main serial ports, 1 differential-only port)
Baud rates	4800 - 115200
Data I/O protocol	NMEA 0183, Hemisphere GPS binary
Correction I/O protocol	Hemisphere GPS' ROX, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+ ⁴
Timing output	1 PPS CMOS, active high, rising edge sync, 10 k Ω , 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 k Ω , 10 pF load
USB	1 USB Host, 1 USB Device

Table C-33: P302 power specifications

Item	Specification
Input voltage	3.3 VDC +/- 5%
Power consumption	< 1.35 W nominal (L1/L2 RTK) < 1.25 W nominal (L1 SBAS)
Current consumption	550 mA nominal GPS (L1/L2) and GLONASS (L1/L2)
Antenna voltage input	15 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 40 dB
Antenna input impedance	50 Ω

Table C-34: P302 environmental specifications

Item	Specification
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when installed in an enclosure)
Shock and vibration ⁵	Vibration: EP455 Section 5.15.1 Random Mechanical Shock: EP455 Section 5.14.1 Operational (when mounted in an enclosure with screw mounting holes utilized)
EMC ⁵	CE (ISO 14982 Emissions and Immunity) FCC Part 15, Subpart B CISPR22

Table C-35: P302 mechanical specifications

Item	Specification
Dimensions	71.1 L x 40.6 W x 10.1 H mm (2.81 L x 1.60 W x 0.40 H in)
Weight	< 20 g (< 0.7 oz)
Status indication (LED)	Power, GPS lock, Differential lock, DGPS position
Power/Data connector	34-pin (17x2) male header 0.05" (1.27 mm) pitch
Antenna connector	MCX, female, straight

P303 Specifications

Table C-26 through Table C-30 provide specifications for the P303.

Table C-36: P303 sensor specifications

Item	Specification												
Receiver type	GPS L1 and L2 RTK with carrier phase												
Channels	12 L1CA GPS 12 L1P GPS 12 L2P GPS* 12 L2C GPS* 12 L1 GLONASS 12 L2 GLONASS* 3 SBAS or 3 additional L1CA GPS * with subscription code <i>Note: L-band support available with optional Hemisphere GPS LX-2 OEM board.</i>												
GPS sensitivity	-142 dBm												
SBAS tracking	3-channel, parallel tracking												
Update rate	1 Hz standard, 10 Hz and 20 Hz available												
Horizontal accuracy	<table><tr><td></td><td>RMS (67%)</td><td>2DRMS (95%)</td></tr><tr><td>RTK^{1,2}</td><td>10 mm + 1 ppm</td><td>20 mm + 2 ppm</td></tr><tr><td>SBAS (WAAS)¹</td><td>0.3 m</td><td>0.6 m</td></tr><tr><td>Autonomous, no SA¹</td><td>1.2 m</td><td>2.5 m</td></tr></table>		RMS (67%)	2DRMS (95%)	RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm	SBAS (WAAS) ¹	0.3 m	0.6 m	Autonomous, no SA ¹	1.2 m	2.5 m
	RMS (67%)	2DRMS (95%)											
RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm											
SBAS (WAAS) ¹	0.3 m	0.6 m											
Autonomous, no SA ¹	1.2 m	2.5 m											
Timing (1PPS) accuracy	20 ns												
Cold start time	< 60 s typical (no almanac or RTC)												
Warm start time	< 30 s typical (almanac and RTC)												
Hot start time	< 10 s (almanac, RTC, and position)												
Maximum speed	1,850 kph (999 kts)												
Maximum altitude	18,288 m (60,000 ft)												
Differential options	SBAS, Autonomous, External RTCM v2.3, RTK v3												

Table C-37: P303 communication specifications

Item	Specification
Serial ports	4 full-duplex 3.3 V CMOS (3 main serial ports, 1 differential-only port)
Baud rates	4800 - 115200
Data I/O protocol	NMEA 0183, Hemisphere GPS binary
Correction I/O protocol	Hemisphere GPS' ROX, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+ ⁴
Timing output	1 PPS CMOS, active high, rising edge sync, 10 k Ω , 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 k Ω , 10 pF load
USB	1 USB Host, 1 USB Device

Table C-38: P303 power specifications

Item	Specification
Input voltage	3.3 VDC +/- 5%
Power consumption	< 1.35 W nominal (L1/L2 RTK) < 1.25 W nominal (L1 SBAS)
Current consumption	550 mA nominal GPS (L1/L2) and GLONASS (L1/L2)
Antenna voltage input	15 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 40 dB
Antenna input impedance	50 Ω

Table C-39: P303 environmental specifications

Item	Specification
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when installed in an enclosure)
Shock and vibration ⁵	Vibration: EP455 Section 5.15.1 Random Mechanical Shock: EP455 Section 5.14.1 Operational (when mounted in an enclosure with screw mounting holes utilized)
EMC ⁵	CE (ISO 14982 Emissions and Immunity) FCC Part 15, Subpart B CISPR22

Table C-40: P303 mechanical specifications

Item	Specification
Dimensions	72.4 L x 40.6 W x 10.1 H mm (2.85 L x 1.60 W x 0.40 H in)
Weight	< 20 g (< 0.7 oz)
Status indication (LED)	Power, GPS lock, Differential lock, DGPS position
Power/Data connector	20-pin (10x2) male header 0.08" (2 mm) pitch
Antenna connector	MCX, female, straight

P320 Specifications

Table C-41 through Table C-45 provide specifications for the P320.

Table C-41: P320 sensor specifications

Item	Specification		
Receiver type	GNSS L1 & L2 RTK with carrier phase		
Channels	12 L1CA GPS 12 L1P GPS 12 L2P GPS (with subscription code) 12 L2C GPS (with subscription code) 12 L1 GLONASS 12 L2 GLONASS (with subscription code) 3 SBAS or 3 additional L1CA GPS 1 L-Band SBAS		
GPS sensitivity	-142 dBm		
SBAS tracking	3-channel, parallel tracking		
Update rate	10 Hz standard, 20 Hz available		
Horizontal accuracy		RMS (67%)	2DRMS (95%)
	RTK ^{1,2}	10 mm + 1 ppm	20 mm + 2 ppm
	L-band high precision services ^{1,3}	0.1 m	0.2 m
	SBAS (WAAS) ¹	0.3 m	0.6 m
	Autonomous, no SA ¹	1.2 m	2.5 m
Timing (1PPS) accuracy	20 ns		
Cold start time	< 60 s typical (no almanac or RTC)		
Warm start time	< 30 s typical (almanac and RTC)		
Hot start time	< 10 s (almanac, RTC, and position)		
Maximum speed	1,850 kph (999 kts)		
Maximum altitude	18,288 m (60,000 ft)		
Differential options	SBAS, Autonomous, External RTCM, RTK, L-band DGPS service, L-band high precision services, L-band high precision service with GLONASS		

Table C-42: P320 communication specifications

Item	Specification
Serial ports	4 full-duplex 3.3 V CMOS (3 main serial ports, 1 differential-only port)
Baud rates	4800 - 115200
Correction I/O protocol	Hemisphere GPS proprietary, RTCM v2.3 (DGPS), RTCM v3 (RTK), CMR, CMR+ ⁴
Data I/O protocol	NMEA 0183, Hemisphere GPS binary
Timing output	1 PPS CMOS, active high, rising edge sync, 10 k Ω , 10 pF load
Event marker input	CMOS, active low, falling edge sync, 10 k Ω , 10 pF load
USB	1 USB Host, 1 USB Device

Table C-43: P320 power specifications

Item	Specification
Input voltage	3.3 VDC +/- 5%
Power consumption	<2.5 W nominal GPS (L1/L2), GLONASS (L1/L2), and L-Band <1.9 W nominal GPS (L1/L2) and GLONASS (L1/L2)
Current consumption	760 mA nominal GPS (L1/L2), GLONASS (L1/L2), and L-Band 580 mA nominal GPS (L1/L2) and GLONASS (L1/L2)
Antenna voltage input	15 VDC maximum
Antenna short circuit protection	Yes
Antenna gain input range	10 to 40 dB
Antenna input impedance	50 Ω

Table C-44: P320 environmental specifications

Item	Specification
Operating temperature	-40°C to +85°C (-40°F to +185°F)
Storage temperature	-40°C to +85°C (-40°F to +185°F)
Humidity	95% non-condensing (when installed in an enclosure)
Shock and vibration ⁵	Vibration: EP455 Section 5.15.1 Random Mechanical Shock: EP455 Section 5.14.1 Operational (when mounted in an enclosure with screw mounting holes utilized)
EMC ⁵	CE (IEC 60945 Emissions and Immunity) FCC Part 15, Subpart B CISPR22

Table C-45: P320 mechanical specifications

Item	Specification
Dimensions	109.2 L x 71.1 W x 12.7 H mm (4.30 L x 2.81 W x 0.50 H in)
Weight	< 71 g (< 2.5 oz)
Status indication (LED)	Power, GPS lock, Differential lock, DGPS position, L-Band lock
Power/Data connector	70-pin male header, 0.05" pitch
Antenna connector	MCX, female, straight

- ¹ Depends on multipath environment, number of satellites in view, satellite geometry, and ionospheric activity
- ² Depends also on baseline length
- ³ Requires an L-band subscription
- ⁴ Receive only, does not transmit this format
- ⁵ When integrated in conjunction with the recommended shielding and protection as outlined in this manual

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THE PURCHASER IS RESPONSIBLE FOR OPERATING THE VEHICLE SAFELY. The purchaser is solely responsible for the safe operation of the vehicle used in connection with the Product, and for maintaining proper system control settings. UNSAFE DRIVING OR SYSTEM CONTROL SETTINGS CAN RESULT IN PROPERTY DAMAGE, INJURY, OR DEATH. The purchaser is solely responsible for his/her safety and for the safety of others. The purchaser is solely responsible for maintaining control of the automated steering system at all times. THE PURCHASER IS SOLELY RESPONSIBLE FOR ENSURING THE PRODUCT IS PROPERLY AND CORRECTLY INSTALLED, CONFIGURED, INTERFACED, MAINTAINED, STORED, AND OPERATED IN ACCORDANCE WITH HEMISPHERE GNSS' RELEVANT USER'S MANUAL AND SPECIFICATIONS. Hemisphere GNSS does not warrant or guarantee the positioning and navigation precision or accuracy obtained when using Products. Products are not intended for primary navigation or for use in safety of life applications. The potential accuracy of Products as stated in Hemisphere GNSS literature and/or Product specifications serves to provide only an estimate of achievable accuracy based on performance specifications provided by the satellite service operator (i.e. US Department of Defense in the case of GNSS) and differential correction service provider. Hemisphere GNSS reserves the right to modify Products without any obligation to notify, supply or install any improvements or alterations to existing Products.

GOVERNING LAW. This agreement and any disputes relating to, concerning or based upon the Product shall be governed by and interpreted in accordance with the laws of the State of Arizona.

OBTAINING WARRANTY SERVICE. In order to obtain warranty service, the end purchaser must bring the Product to a Hemisphere GNSS approved service center along with the end purchaser's proof of purchase. Hemisphere GNSS does not warrant claims asserted after the end of the warranty period. For any questions regarding warranty service or to obtain information regarding the location of any of Hemisphere GNSS approved service center, contact Hemisphere GNSS at the following address:

Hemisphere GNSS

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