IstarGPS Installation and Operations Manual

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For an electronic version of this manual, Firmware updates and revision histories please see the download page at

http://www.istargps.com/

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Introduction

Congratulations on your choice of the IstarGPS Global Positioning System sensor. Your GPS is designed and constructed to meet the rigorous demands of the marine environment. However, no machine can perform its intended function unless installed, operated and maintained properly. Please read this document carefully and follow the recommended procedures for installation, operation, and maintenance.

We would appreciate hearing from you about whether we are achieving our goal of delivering the highest quality and most connected GPS sensor on the market.

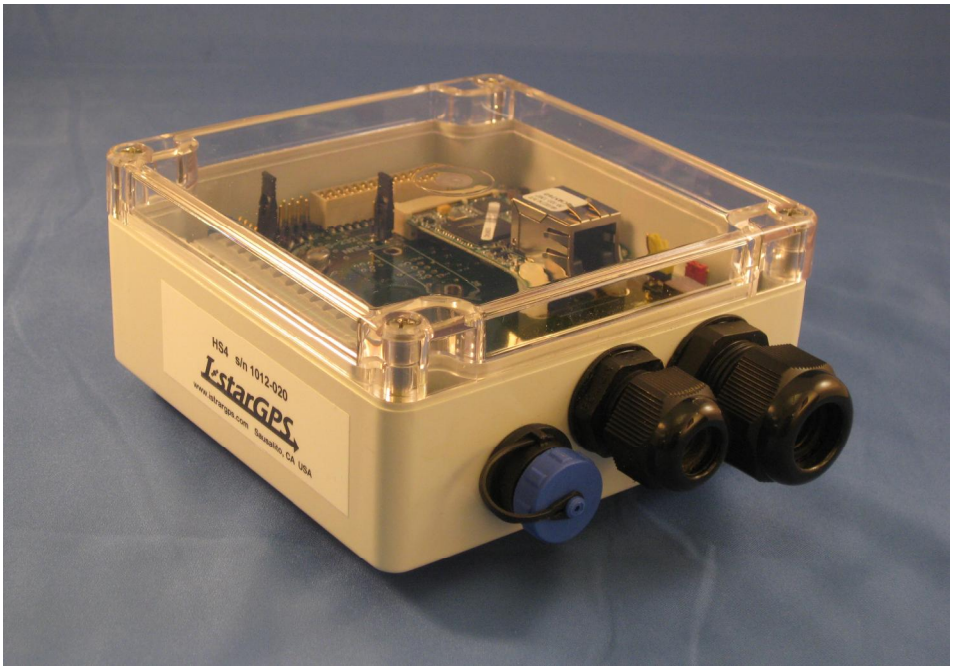

Figure 1 IstarGPS HS4

IstarGPS Overview

IstarGPS has been developed to address the needs of the marine market, specifically for high performance vessels that require high speed sensors.

Recent advancements in GPS technology have greatly improved the Course Over Ground (COG) and Speed Over Ground (SOG) data by using Doppler of the GPS carrier wave signal. Using Doppler, the Cog/Sog data can be as fast to react as data generated from speed and heading transducers.

HM4 Product Features

- High speed Antaris4 GPS engine, up to 4Hz update rates and 115k baud.
- Four NMEA data outputs to drive twelve or more listeners (depending on listener load).
- NMEA outputs are completely independent, capable of varied sentences and baud rates.
- Ethernet 10/100 port, use a web browser for configuration and position data via UDP.
- Four UDP channels for up to 40 ports.
- IP, UDP and NMEA ports.
- Precision barometer sensor outputting NMEA XDR sentence
- MOB functions with support for external contact closure
- Optional active antenna sharing enabling multiple GPS units to use a single antenna.
- 9 to 30vdc input voltage.

System Integration

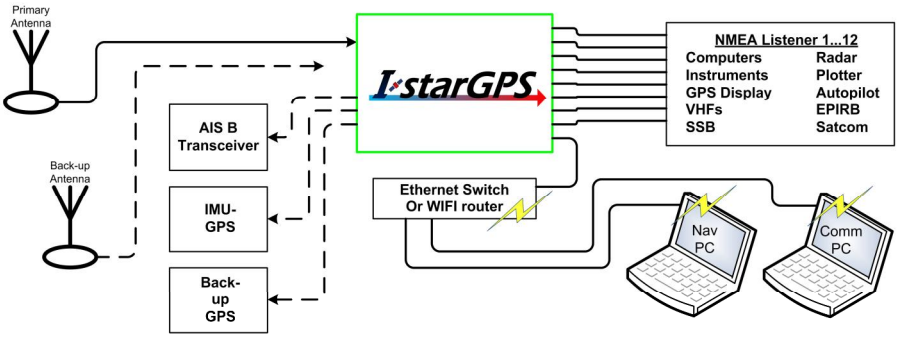

Figure 2 System Integration Drawing

Construction

The IstarGPS is a “black box” GPS sensor with no alphanumeric display. The primary user interface is via a computer and web browser. Alternatively, status information is available via LEDs on the main board. The enclosure is gray polycarbonate rated IP65 with IP68 water tight cable entries, one TNC and (optional) three SMA antenna connectors. One water tight cable entry is large enough to accommodate a RJ45 to pass through and still clamp to common CAT5 wire.

The antenna is a coax fed active element with 26db of gain. Several antenna styles are available (Appendix A).

SBAS (Satellite Based Augmentation Systems)

SBAS (Satellite Based Augmentation System) is an augmentation technology for GPS, which calculates GPS integrity and correction data with RIMS (Ranging and Integrity Monitoring Stations) on the ground and uses geostationary satellites (GEOs) to broadcast GPS integrity and correction data to GPS users. The correction data is transmitted on the GPS L1 frequency (1575.42 MHz), and therefore there is no additional receiver required to make use of the correction- and integrity data.

IstarGPS is delivered enabled to support several compatible SBAS systems available or in development worldwide:

- WAAS (Wide Area Augmentation System) for Northern America.
- EGNOS (European Geostationary Navigation Overlay Service) for Europe.
- MSAS (Multi-Functional Satellite Augmentation System) for Asia.

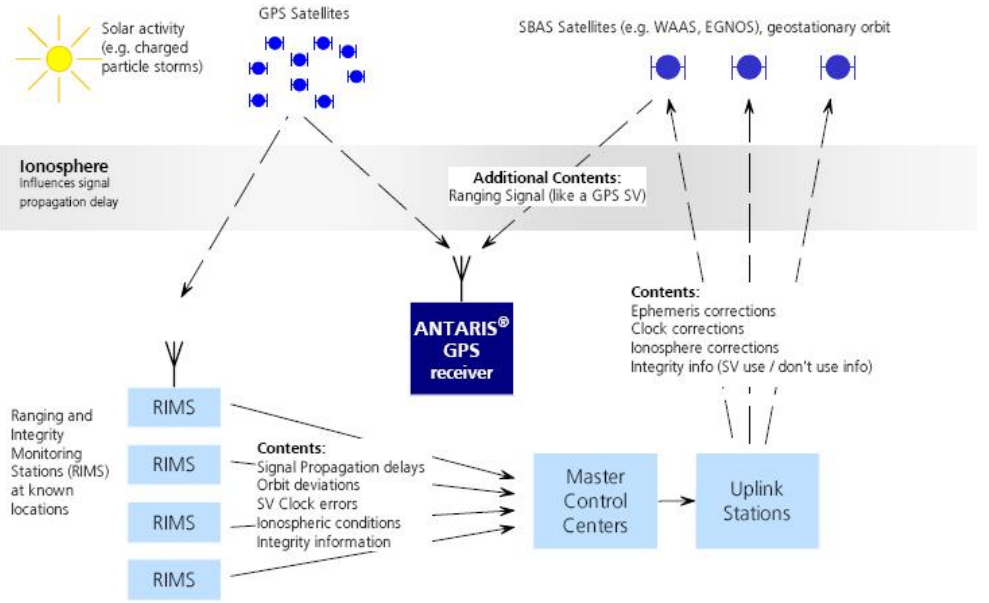

Figure 3 SBAS Flow Diagram

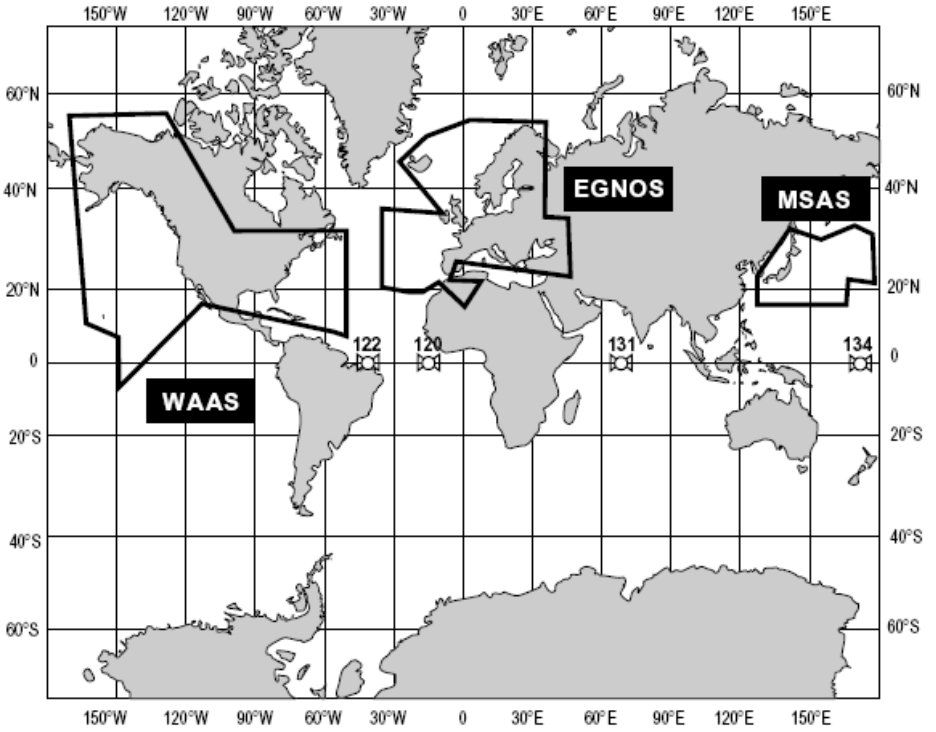

Figure 4 SBAS Coverage Areas

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Installation

Mount the IstarGPS sensor (enclosure) in an environmentally protected non-corrosive area where cables can be safely routed into the enclosure. The preferred orientation for the enclosure is with the cable glands pointing down.

The antenna should be mounted in an area of the vessel that has a clear view of the sky with at least 1 meter separation from satellite communications antennas.

If mounting in the transom area, it is highly recommended to mount the antenna above the side decks of the vessel.

HS4 Motherboard Layout

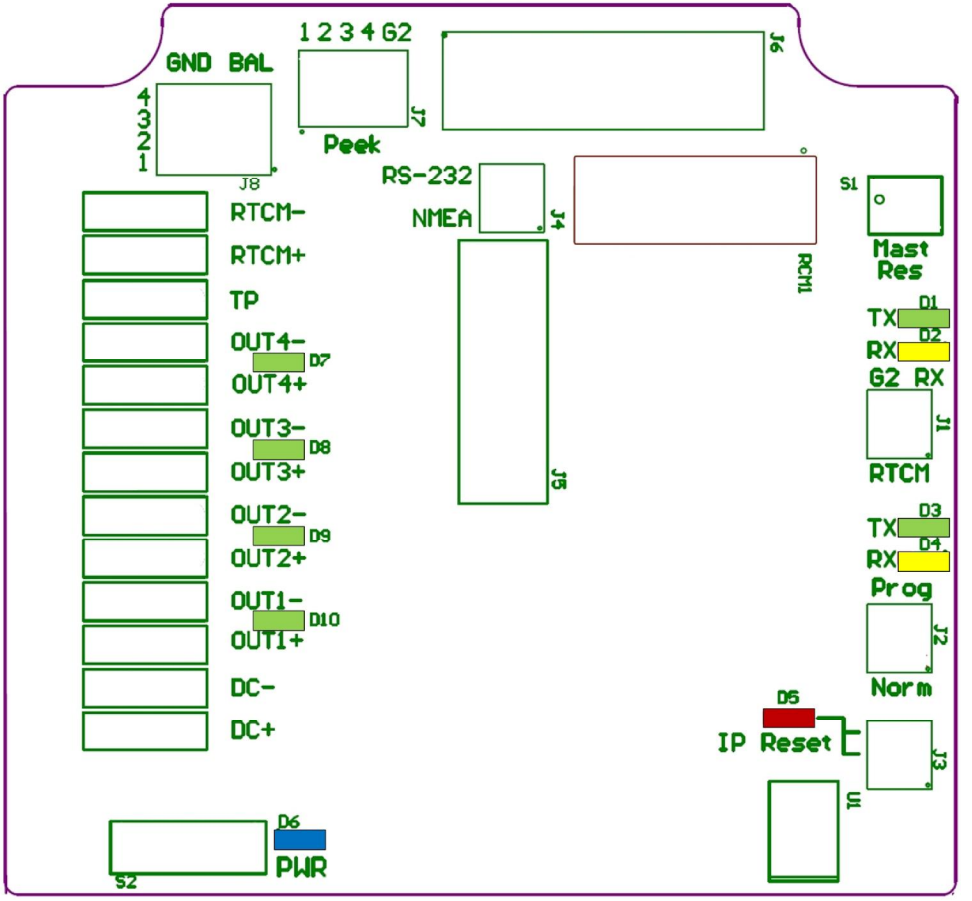


Figure 5

Power Input

Supply the system with **10 to 30v** DC on the terminals labeled Power + and Power -.

Also see Power over Ethernet Appendix C.

A switch adjacent to the terminal strip toggles power on and off; a blue LED will illuminate when the internal power supplies are operating properly.

The IstarGPS incorporates a resettable fuse. If there is an overload from reverse polarity or a hardware failure, the fuse will open circuit. Allow the fuse to cool for 2 minutes before applying power again.

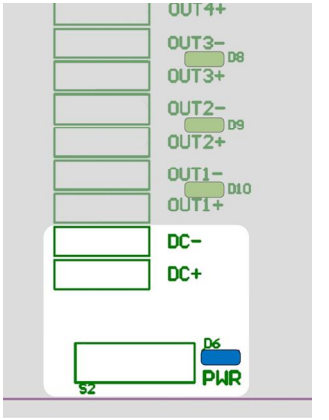


Figure 6 DC Power

Hardware Interfacing

Four independent NMEA 0183 data outputs are supplied on the cage clamp terminal strip. The terminal strip connectors can accommodate multiple conductors to the equivalent of 16 gauge wire.

NMEA 0183 data outputs are active within 8 seconds of powering the IstarGPS and the NMEA status LEDs will start flashing. GPS time and barometric pressure are typically valid within 30 seconds. Once the IstarGPS gains a position fix (less than 3 minutes from cold start), the position sentences will contain valid data.

All NMEA 0183 ports default to 4800 baud, 8, n, 1 with GGA, GLL, RMC and VTG enabled at 1Hz. Output parameters can be configured for higher bauds and update rates via the Browser interface – see section Operation.

Configure NMEA 0183 ports up to 115k baud with sentences up to 4hz. See Browser interface section – Operation.

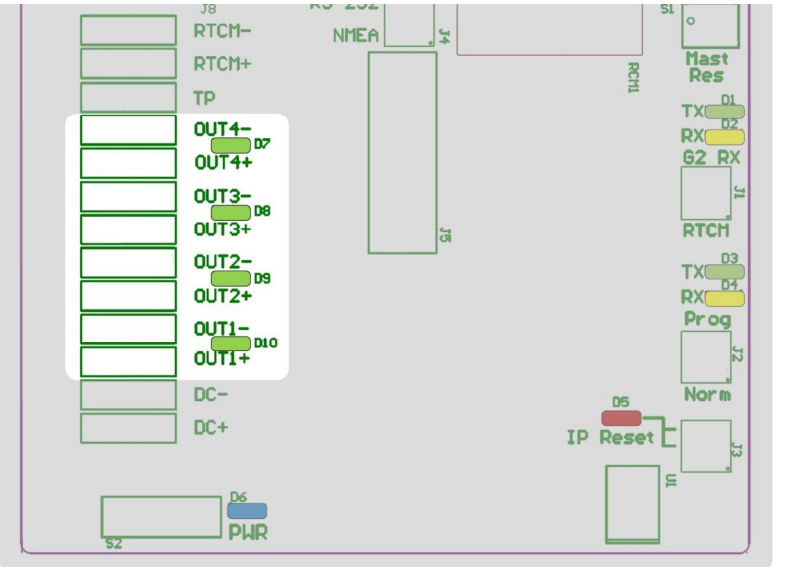


Figure 7 NMEA outputs and status LEDs

NMEA Output Electrical Selection

The IstarGPS NMEA outputs may be configured for two electrical methodologies, 1) balanced EIA-422 or 2) unbalanced "single ended" - also known as "data high referenced to ground".

The NMEA 0183 standard calls for Talkers to conform to EIA-422 (RS-422) which is a balanced circuit. However, most current production NMEA transmitters (Talker) use the single ended method, which is satisfactory due to opto isolators or similar circuits used in the receiving equipment (Listener). Figure 8 represents the output circuit and waveform of the single ended output configuration.

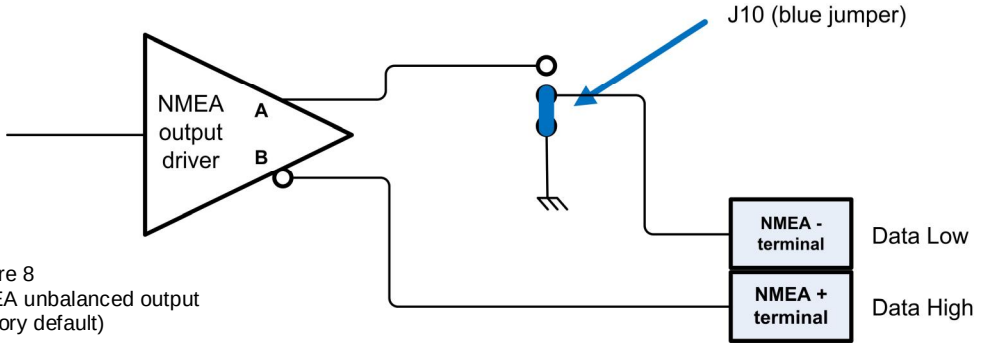


Figure 8
NMEA unbalanced output
(factory default)

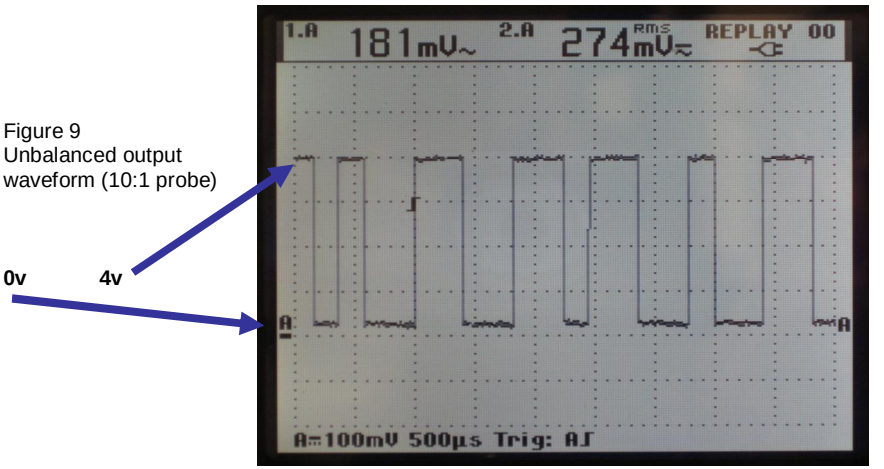


Figure 9
Unbalanced output
waveform (10:1 probe)

IstarGPS is shipped in the single ended configuration.

If a Listener requires receiving a balanced signal, if the data environment is very noisy or if the data is to be sent hundreds or thousands of feet, the balanced output can be selected by moving the appropriate jumper (J10).

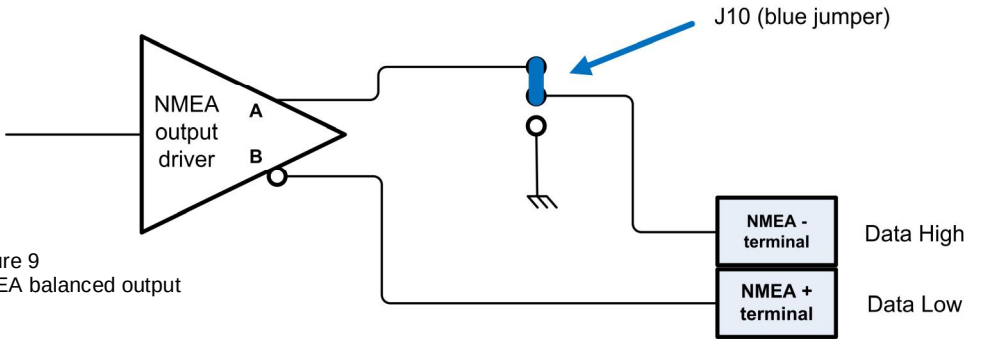


Figure 9
NMEA balanced output

NOTE! When Balanced is selected, the labels on the terminal strip are reversed! NMEA + becomes Data Low, NMEA – becomes Data High. There is no risk of damage if connected backwards but data will not flow.

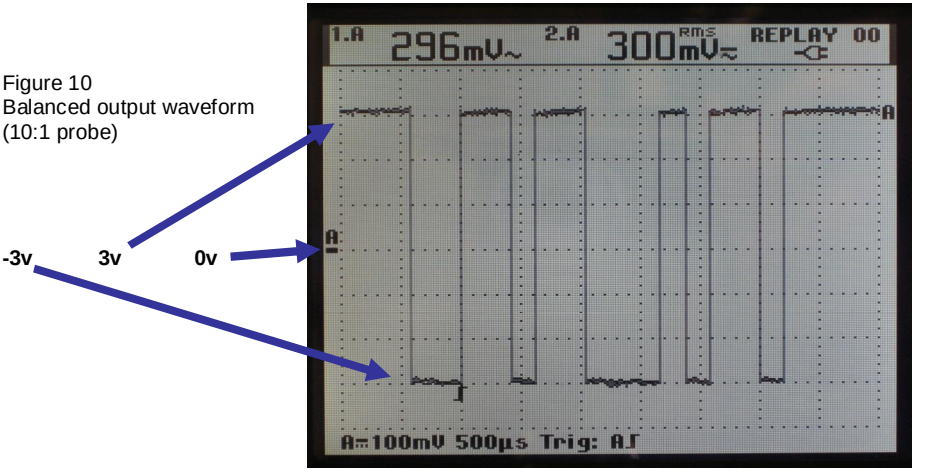


Figure 10
Balanced output waveform
(10:1 probe)

Ethernet Connections

10baseT Ethernet is available via an RJ-45 connector for connection to the ships LAN or direct to a PC over standard Cat5 or Cat6 cable. The factory **default IP address is 192.168.1.152**.

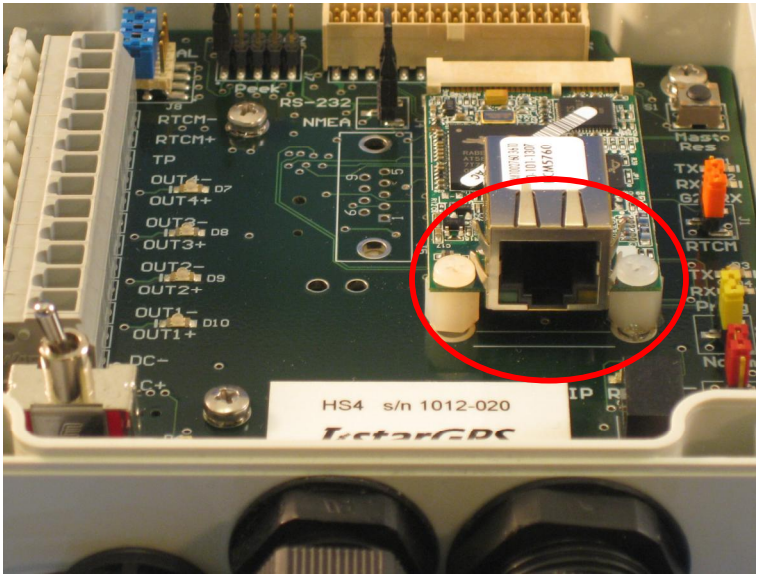


Figure 11 RJ45 Ethernet connection

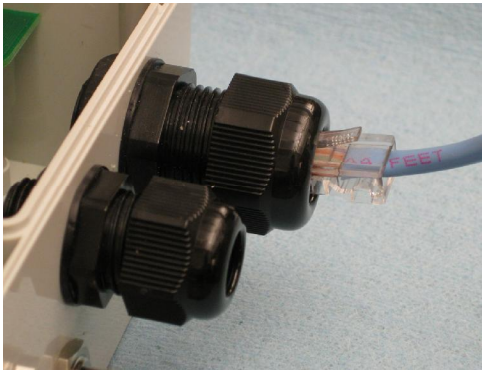


Figure 12

Large cable gland
for RJ45 connector

IP address and IP Reset Jumper

The IP and subnet may be changed to suit the network LAN settings (see Set-up & Status page). The IstarGPS is shipped with a factory default IP address of 192.168.1.152 and subnet 255.255.255.0.

If communications over Ethernet is lost due to an incorrect IP address or subnet, a connection can always be re-established by invoking an IP reset via J7.

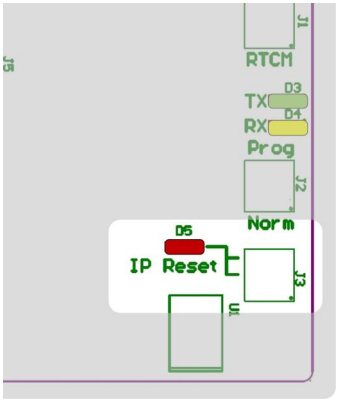


Figure 13
IP Reset

In the event the IP or subnet needs to be restored to the factory settings, do the following:

1. Move the IP Reset jumper to the Reset position.
2. Power cycle the IstarGPS
3. Move the IP Reset jumper back to the storage position.

The IstarGPS will now be at the factory default IP setting, IP 192.168.1.152, subnet 255.255.255.0.

The IP Reset LED (red) will be on whenever factory IP settings are active (192.168.1.152 / 255.255.255.0)

Monitor / Flash Programming USB Port

The USB connector serves five functions

- Direct electrical monitoring of NMEA outputs 1 through 4
- Flash programming the system co-processor (see Flash Programming section)

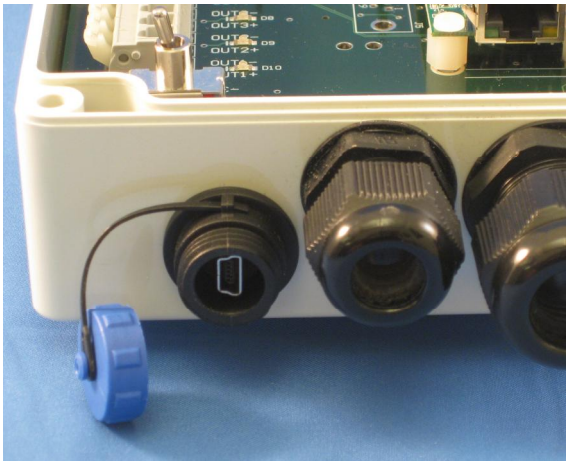
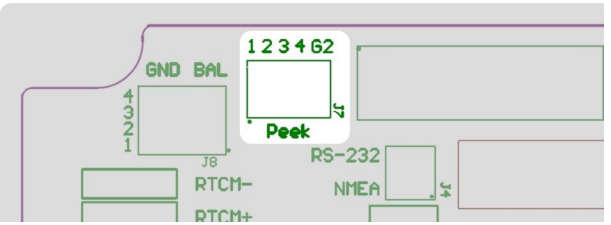


Figure 14
USB connector

The function of the USB connector is controlled by the J7 jumper setting.

Figure 15
USB output selection



J7 Jumper

Position the 2 pin black jumper (J7, Fig 15) in one of the four NMEA positions to monitor the desired NMEA channel via the USB connection.

Figure 16
2 pin jumper

Monitoring Description

The NMEA "PEEK" connects the USB connector in parallel to the NMEA + output terminal (on terminal strip). This selection will add additional minimal load to the NMEA output port.

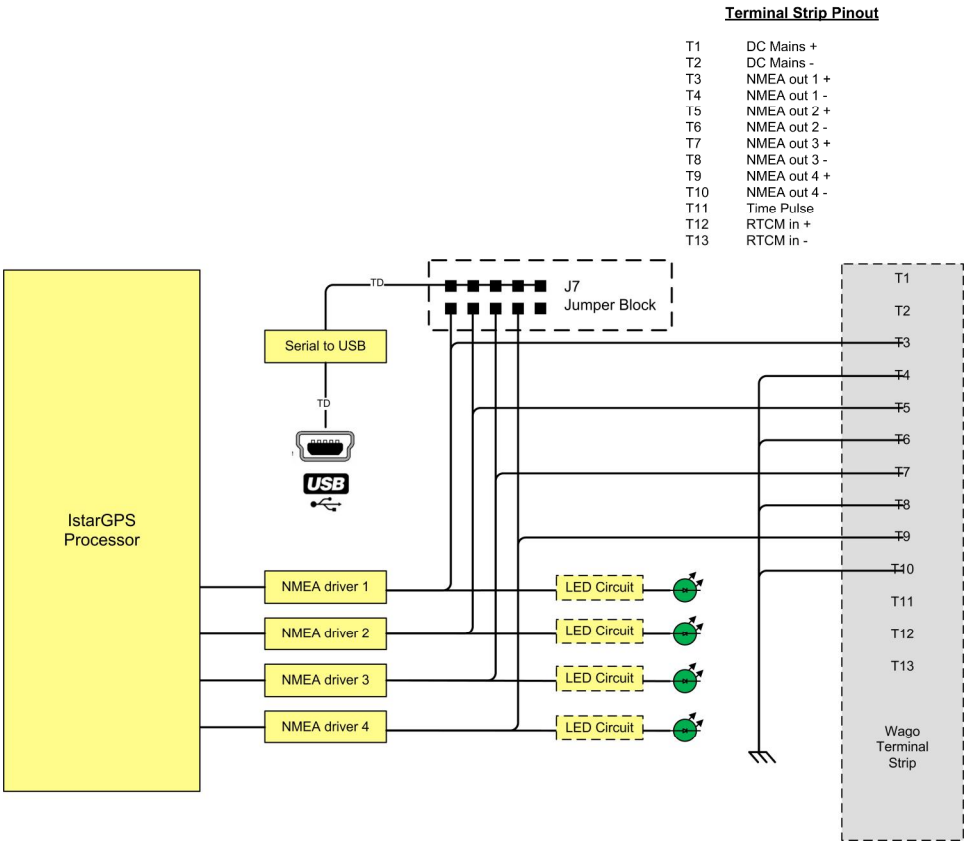


Figure 17 Serial to USB data output signal flow
(shown in unbalanced output configuration)

Master Reset

Reset the IstarGPS to factory default settings by depressing and holding the “Master Reset” switch for 5 second while power is being applied.

NOTE: ALL USER ENTERED CONFIGURATION DATA WILL BE ERASED.

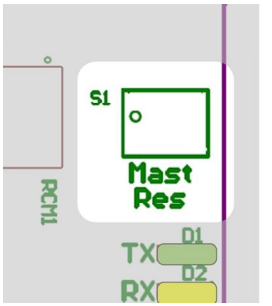


Figure 18
Master Reset

Differential Beacon Receiver (RTCM Input)

IstarGPS accepts RTCM-104 position corrections from an external Differential Beacon Receiver via the RTCM + and RTCM – terminals at **4800 or 9600 baud**. **Jumper J1 must be in the RTCM position.** D2 will flash when data is being received.

See Operation section for software settings.

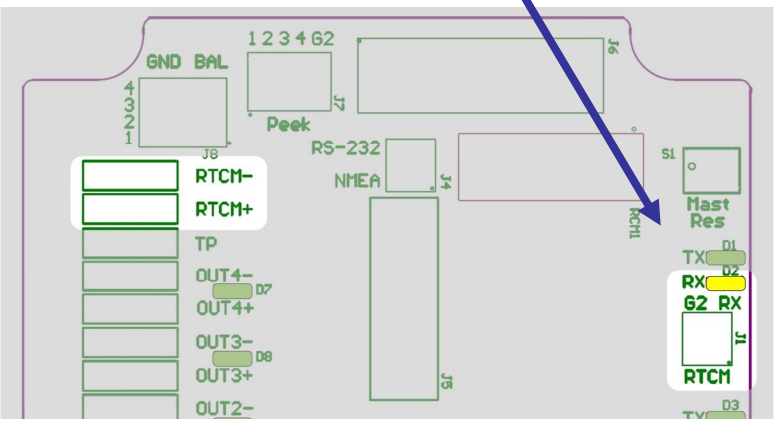


Figure 19 Differential Beacon Receiver connection and Status LED

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Operation

Viewing the status and control options of the GPS require a computer, a common web browser (Internet Explorer, Firefox, Chrome etc.) and connecting the computer to the IstarGPS over Ethernet. **This requires the computer to be on the same IP block as the IstarGPS.**

Configuring the IstarGPS

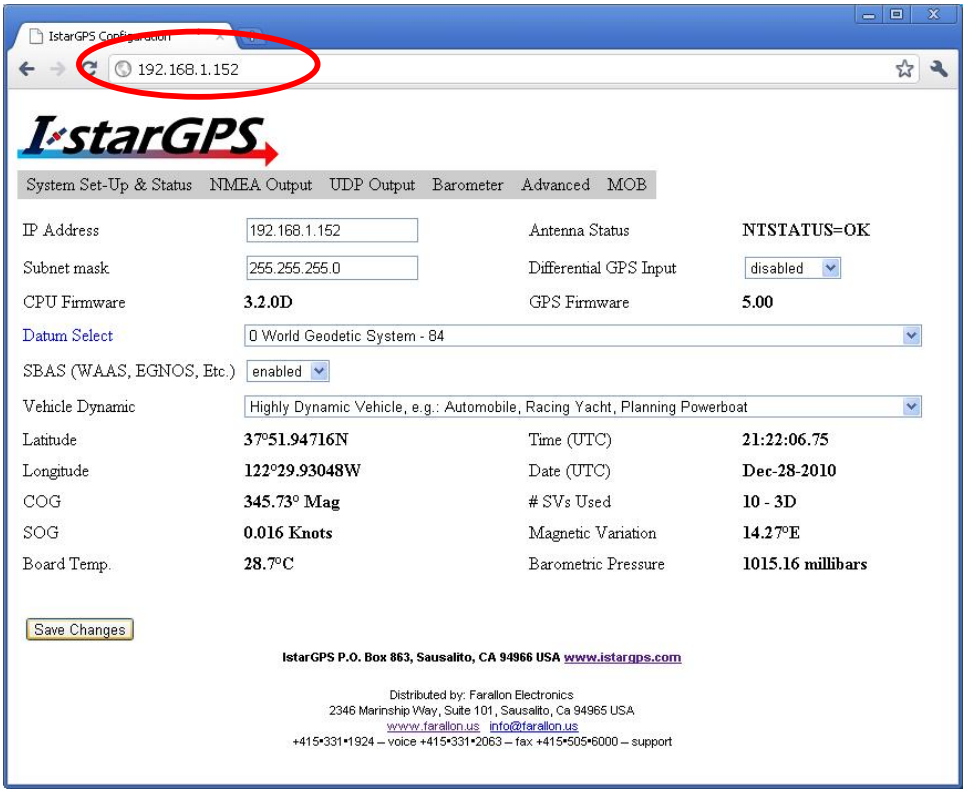


Figure 20 IstarGPS System Set-Up and Status Page

To view the home page for the first time, type the default IP address into the address bar of your browser – **192.168.1.152 - hit enter** (fig 20).

Changing the IP address and / or Subnet Mask

The IP address and Subnet may be edited to suit your LAN configuration. Edit the IP or Subnet fields on the System Set-Up & Status page, click "Save Changes", this commits the change to memory.

New IP settings will take effect when power is cycled.

When IP settings are different than the factory defaults, the IP Reset LED will be extinguished.

Changing Differential GPS Input

If an external Differential Beacon Receiver is connected, select the appropriate Baud rate and click Save Changes.

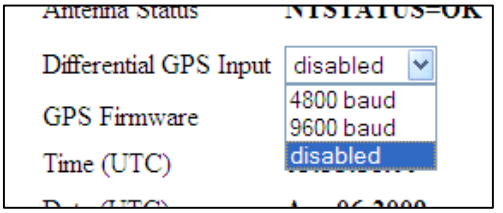


Figure 21 Setting Differential GPS input

Jumper J1 must be in the RTCM position.
See Differential Beacon Receiver Input p.20.

Leave this function "disabled" if no Beacon Receiver is connected!

Datum Selection

IstarGPS supports over 200 map datums. Selection is made on the System Set-Up & Status page (Fig. 21). Refer to Appendix D for the list of datums.

Select the desired datum with the drop down box, hit Save Changes button. The datum in use is shown as Current Datum.

WGS84 is the default datum. To change the datum, make a selection in the datum drop-down box and click Save Changes.

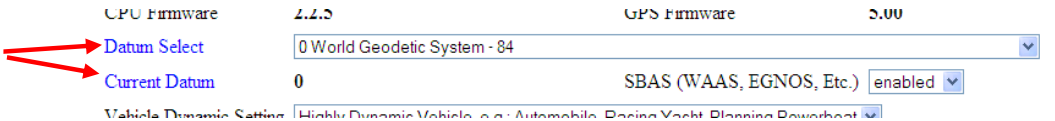


Figure 22 Setting Map Datum

SBAS Enable / Disable

The default setting has SBAS enabled. If for some reason SBAS is not functioning properly (e.g. system outage), the user may disable SBAS (WAAS, EGNOS, etc.) by selecting Disable in the SBAS dropdown box and clicking Save Changes.

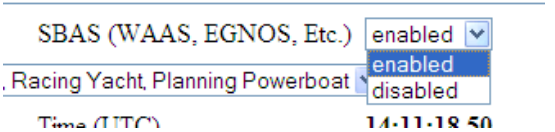


Figure 23 Enable / Disable SBAS

Vehicle Dynamic

The processing filters in the IstarGPS are adjustable depending on the platform the system is mounted to. Two selections are available, 1) Highly Dynamic and 2) Slower Moving.

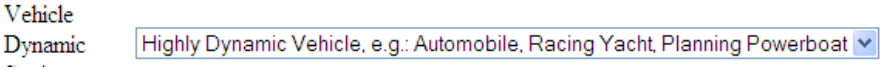


Figure 24 Vehicle Dynamic setting

Configuring the NMEA Channels

Not fully implemented with v.3.0 firmware

Each of the four NMEA channels has its own configuration page for setting Baud rate and output sentences.

Baud rates: 1200 to 115K
NMEA sentences:

- *DTM - Datum Reference (0.5hz)*
- *GBS - GNSS Satellite Fault Detection (0.5hz)*
- GGA - Global positioning system fix data (0.1 – 4hz)
- GLL - Geographic position - latitude/longitude (0.1 – 4hz)
- GSA - GNSS DOP and active satellites (0.1 – 4hz)
- GSV - GNSS satellites in view (0.1 – 4hz)
- RMC - Recommended minimum specific GNSS data (0.1 – 4hz)
- VTG - Course over ground and ground speed (0.1 – 4hz)
- *GRS - GNSS range residuals (0.1 – 4hz)*
- *GST - GNSS pseudo range error statistics (0.1 – 4hz)*
- *TXT – Text messages (0.5hz)*
- ZDA - Time and date (0.1 – 4hz)

Figure 25 NMEA configuration page

To change Baud or the sentence output rate:

- Click the appropriate drop down box(es) and make your selection.
- Click “Save Changes”.
- You will be taken to the System Set-Up and Status page signifying your changes have been made.

All NMEA channels come from the factory at 4800 Baud with GGA, GLL, RMC enabled at 1hz (once per second) and VTG at 4hz (four times per second).

Error - Exceeding Channel Bandwidth

If the output selections exceed the amount of data capable of being sent at the selected Baud rate, you will receive an error message.

Correct this by: 1) INCREASE your Baud rate, 2) REDUCE sentence update rates or 3) turn off sentences.

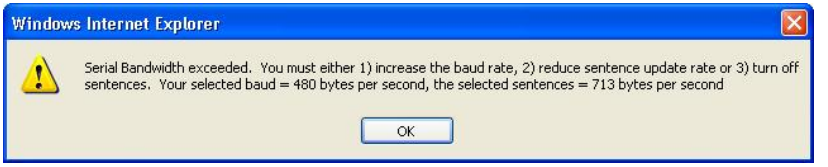


Figure 26 Bandwidth error message

UDP Broadcast

There are four configurable UDP channels. UDP transmits NMEA data via a TCP/IP port for compatible software applications to receive. This facility removes the need for traditional serial port connection to a PC.

Baud rate settings do not apply with UDP.

UDP Destination default = 192.168.1.255
UDP Port defaults Channel 1 through 4 = 4321, 4322, 4323, 4324

It is suggested that the port number not be changed unless it conflicts with other equipment.

Up to 10 UDP ports per channel may be entered separated by a comma (see fig. 27) for a maximum of 40 ports.

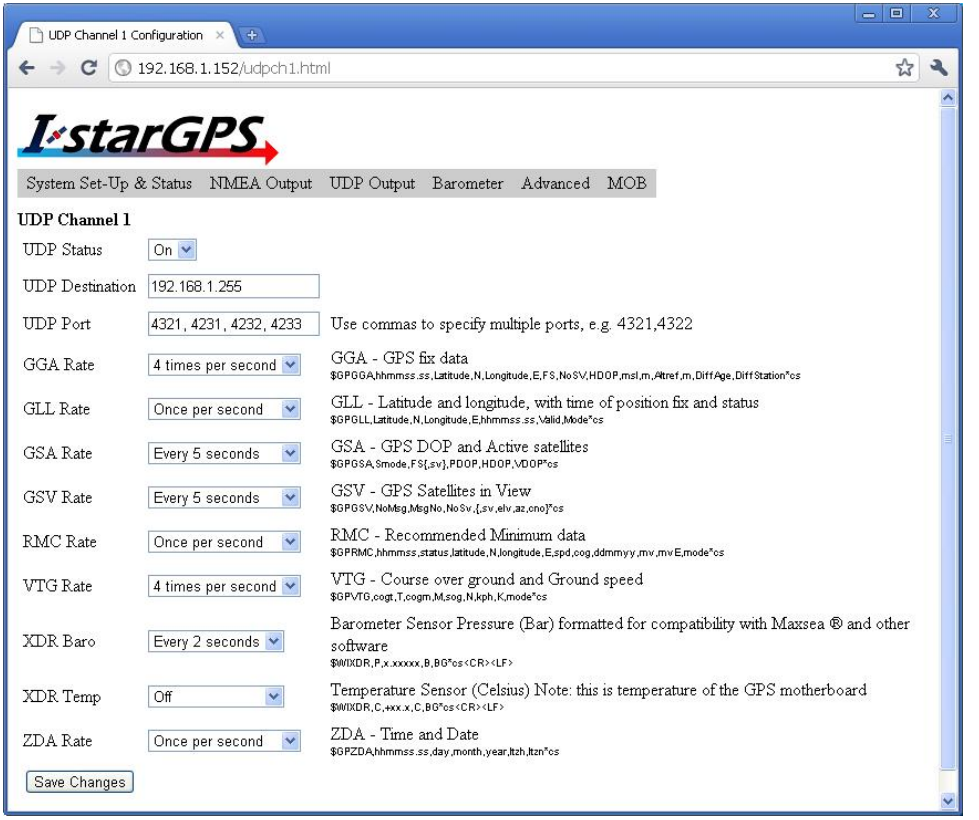


Figure 27 UDP Set-Up page

The high bandwidth of Ethernet allows for maximum sentence output rates. Sentences may be changed or deselected:

- Click the appropriate drop down box(es) and make your selection.
- Click “Save Changes”.
- You will be taken to the System Set-Up and Status page signifying your changes have been made.

Expedition UDP Reception

From the main menu bar select

- Instruments > Connections…
- Select a Network tab
- Enter the IstarGPS UDP port number

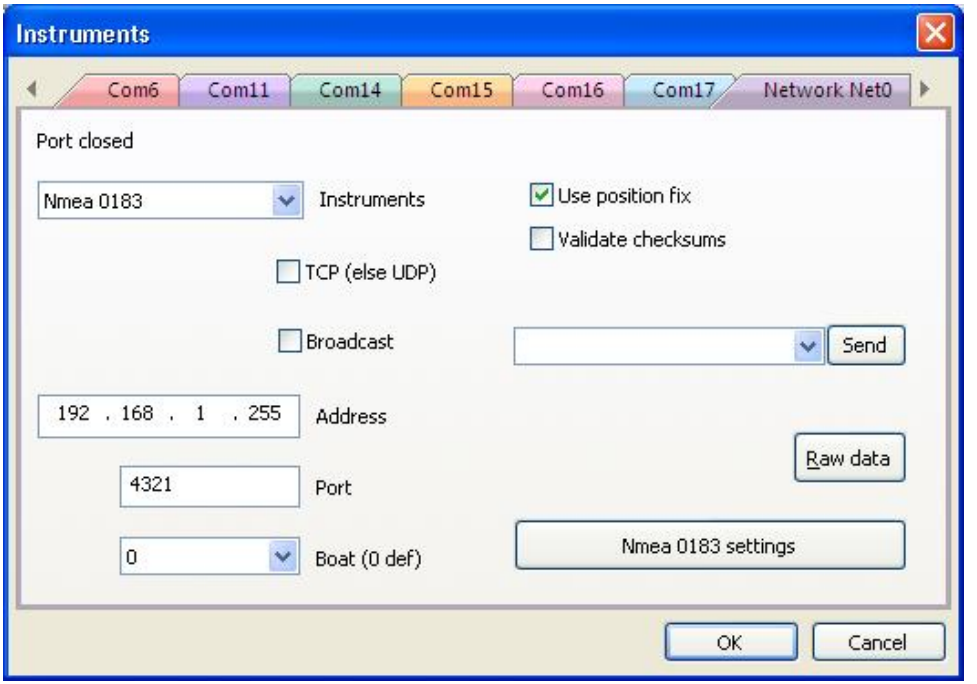


Figure 28 Expedition UDP Set-Up page

Airmail2000 UDP Reception

Consult the Airmail2000 help to enable the Position Reporting module.

- Check “Data input Enabled”
- Click “Setup…” button. New window will appear
- Check “GPS/NMEA Port Enabled”
- In the dropdown box where Com ports are shown, enter the IstarGPS UDP port number

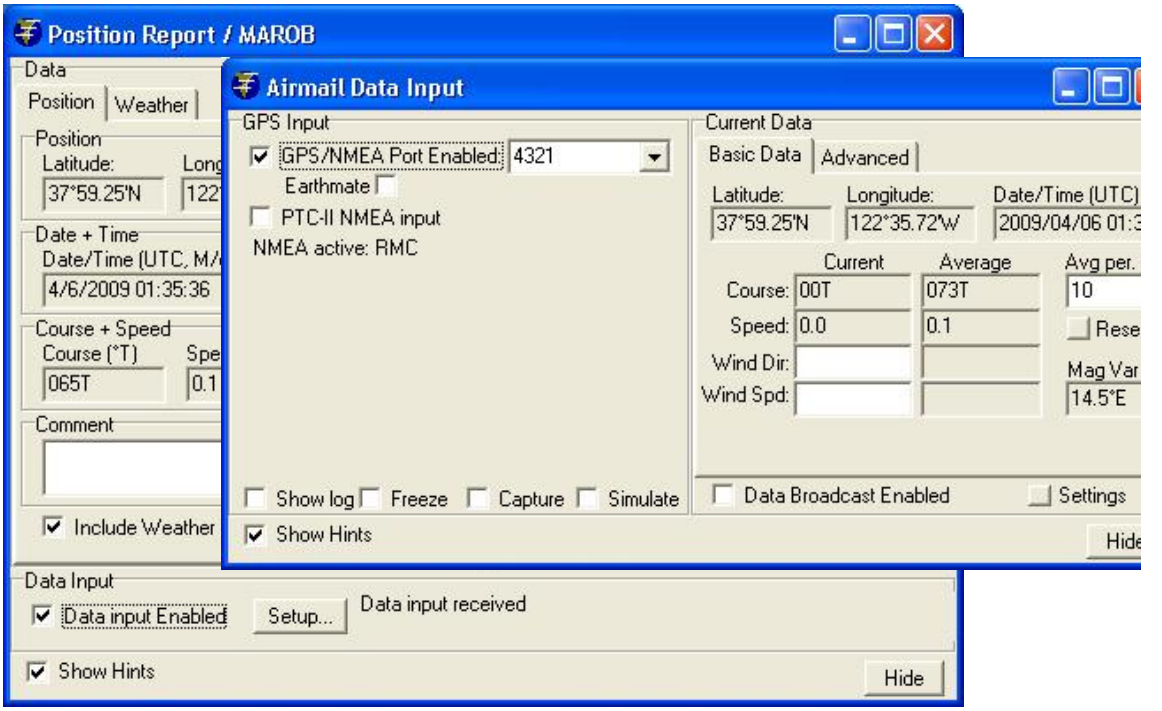


Figure 29 Airmail2000 UDP Set-Up pages

Barometer and Temperature

Measurement units are selected on this page. Selections **only affect the units displayed on IstarGPS browser pages.** Transmitted NMEA data is always formatted in Bar (pressure) and Celsius.

The temperature sensor is on the IstarGPS motherboard and is used to calibrate the barometer. Temp will not represent atmospheric conditions.

Figure 30 Barometer and Temperature page

Advanced

The Advanced tab allows direct viewing and control of the GPS core enabling access to all modes of the GPS. For core module message information, refer to the *"ANTARIS4 Modules SIM"* and *"ANTARIS Protocol Specification"* which can be obtained by contacting IstarGPS support.

The normal high performance operation of the IstarGPS does NOT require use of the Advanced tab. Only users familiar with GPS core messaging should use the Advanced feature.

The GPS core accepts ASCII and Binary messages, which to use depends on the function required. ASCII messages start with "24", binary start with "B5". Messages will be retained in memory and sent whenever the IstarGPS is booted.

Message Log – A "boxcar" buffer showing the last 256 characters sent to the GPS core.

ASCII User Messages – format the ASCII message desired, hit "Send and Save" to send the message and commit to memory.

Binary User Messages – format the Binary message desired, hit "Send and Save" to send the message and commit to memory.

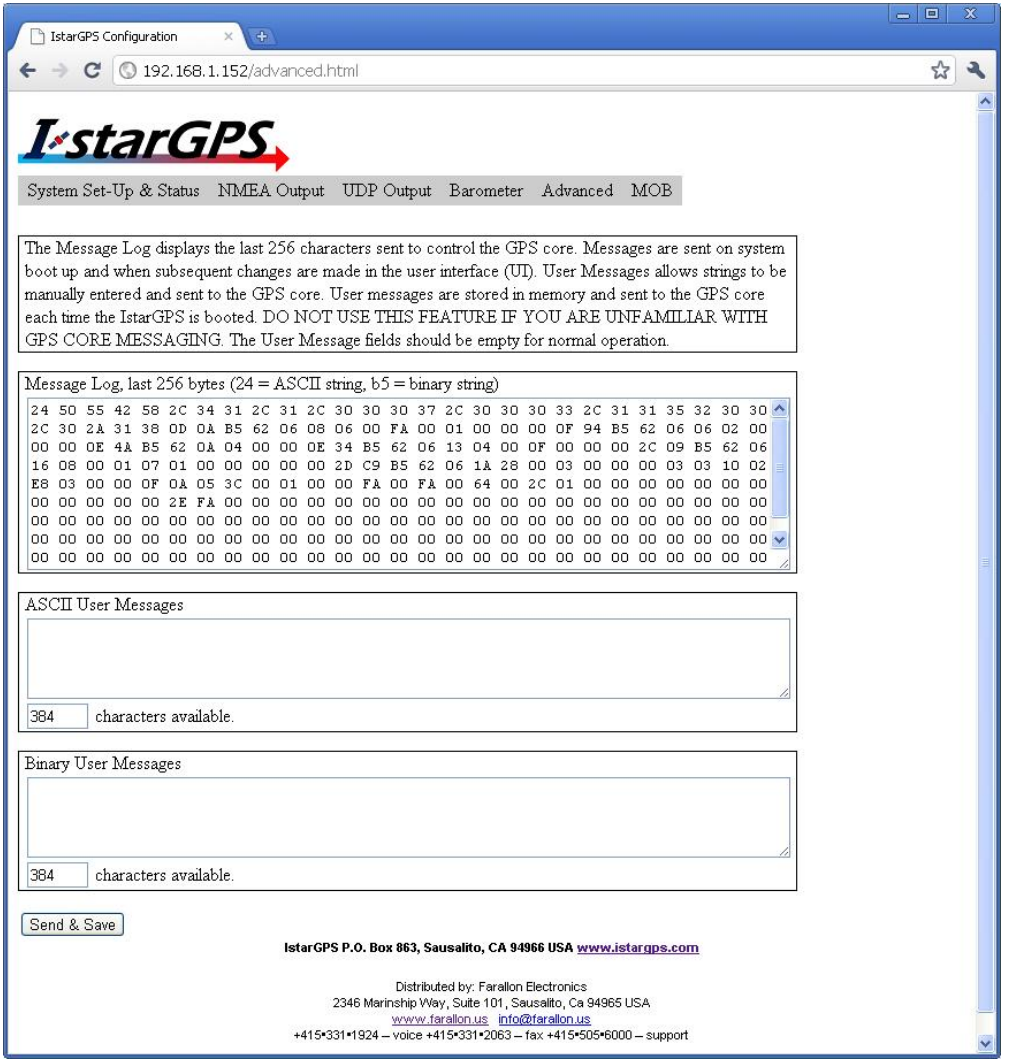


Figure 31 Advanced Tab

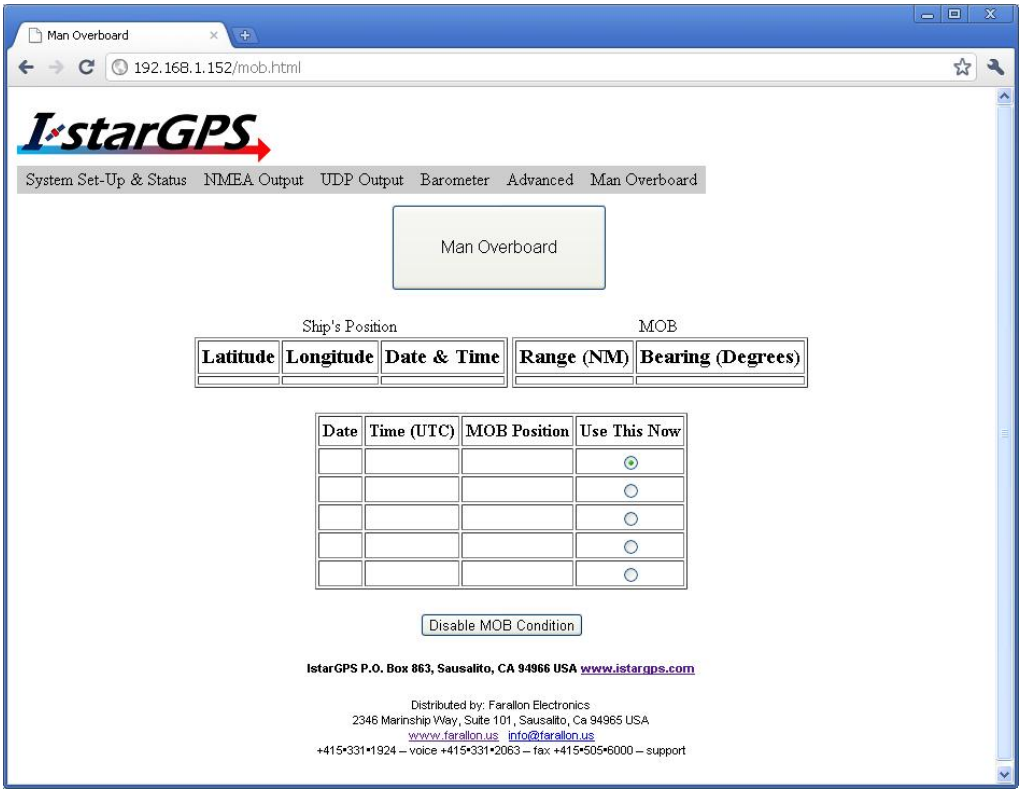
Man Overboard

The Man Overboard (MOB) feature triggers a position to be saved in memory and relevant navigation data to be generated.

Triggering the MOB can be done in two ways:

1. Click the larger “Man Overboard” button on the IstarGPS MOB page
2. Use a remote contact closure wired to the supplied connector for J6 – contact closure must be made for 3 seconds or more.

Figure 31 MOB page

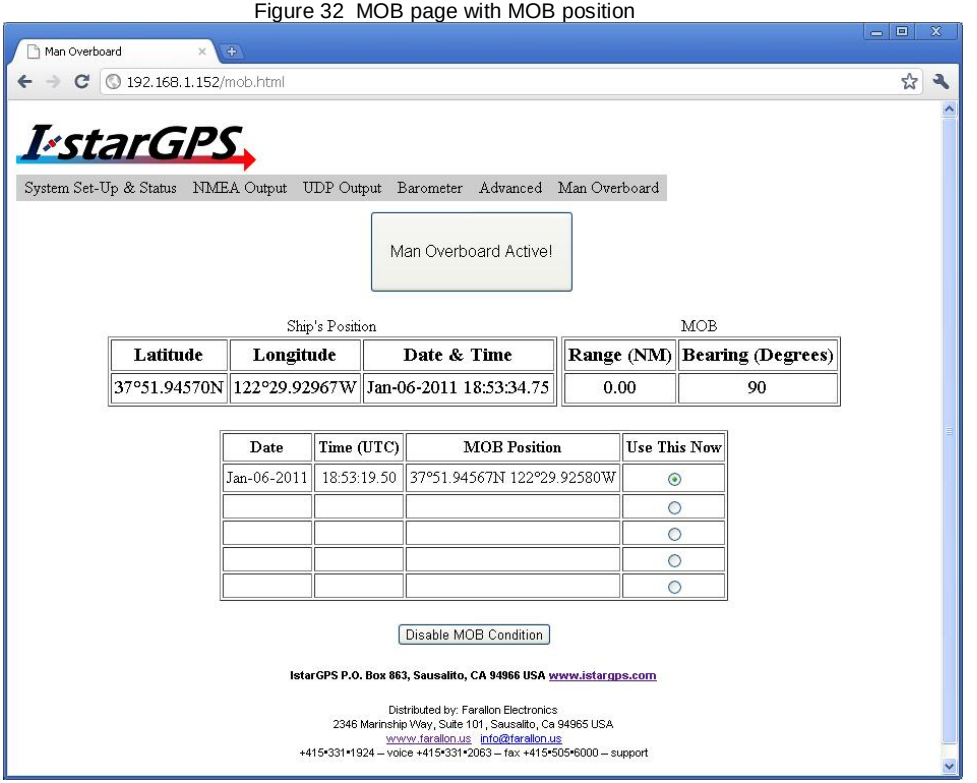


After Triggering the MOB

Several features are available after triggering the MOB

1. The MOB page displays an entry in a table with the Date, Time and Position of the MOB.
2. Display of Range and Bearing from the ship to the MOB position.
3. The ships current position, date and time.
4. Output via the NMEA and UDP channels Bearing to Waypoint – Great Circle (BWC) and Waypoint Location (WPL).

Figure 32 MOB page with MOB position



Selecting Successive MOB Entries

The five most recent MOB positions are saved in the webpage table. If there are five saved entries and MOB is triggered again, the oldest entry is discarded.

Under "Use This Now" any of the five entries may be selected to navigate to by clicking the adjacent radio button. Range and bearing data will change accordingly on the webpage and out the NMEA/UDP ports.

Figure 33 "Use This Now" Radio Button

Disabling MOB

The MOB condition can be disabled by clicking the "Disable MOB Condition" button on the MOB webpage. Disabling permanently clears all MOB entries.

Diagnostics

G2 TX LED – Motherboard Green LED

D1 LED indicates activity of the core GPS module regardless of satellite reception. Within 5 seconds of powering on the IstarGPS, the G2 TX LED should flash rapidly.

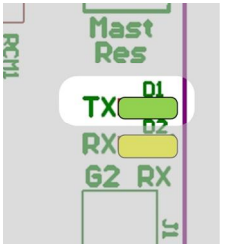


Figure 34 G2 TX LED

Antenna Status - System Set-Up and Status Page

Antenna Status which indicates one of three conditions:

- OK
- Open
- Shorted

Open or Shorted would indicate a problem with the coax, a connector or the antenna itself.

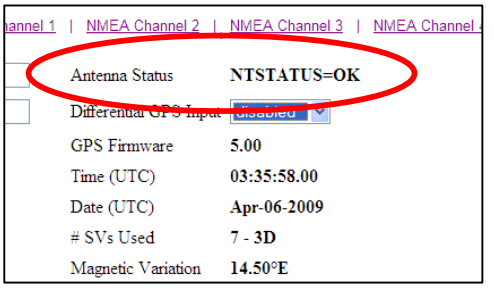


Figure 35 Antenna Status message

NMEA Port Boot-Up Diagnostic Message

Not fully implemented with v.3.0 firmware

At boot-up, the first lines of text transmitted from an NMEA port indicate:

- IP address, subnet
- *CPU firmware version, GPS firmware version*
- *Differential Disabled, 4800 or 9600*
- *NMEA 1 Baud, sentence enabled, update rate in Hz*
- *NMEA 2 Baud, sentence enabled, update rate in Hz*
- *NMEA 3 Baud, sentence enabled, update rate in Hz*
- *NMEA 4 Baud, sentence enabled, update rate in Hz*
- *NMEA UDP, IP address, port , sentence enabled, update rate in Hz*
- *Barometer and Temp units*

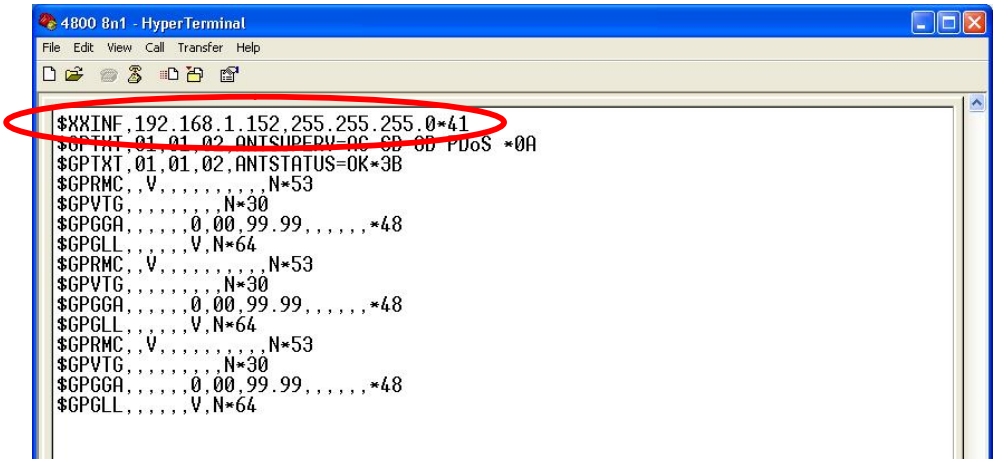


Figure 36 NMEA Port Boot Diagnostics Message

Firmware Flash Programming

The IstarGPS firmware is updated via the USB connector and a Windows PC.

Moving the “Prog / Norm” jumper to the “Prog” position enables the programming function when the IstarGPS is restarted. In this configuration, the USB connector may only be used for programming.

GPS functions will not operate properly when in the Program mode!

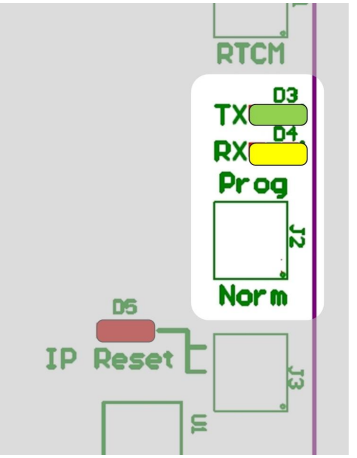


Figure 37 Flash Programming Jumper location, J2

Step by Step Programming Instructions

Download http://www.istargps.com/updaterHS4.zip (~1.7Mb)

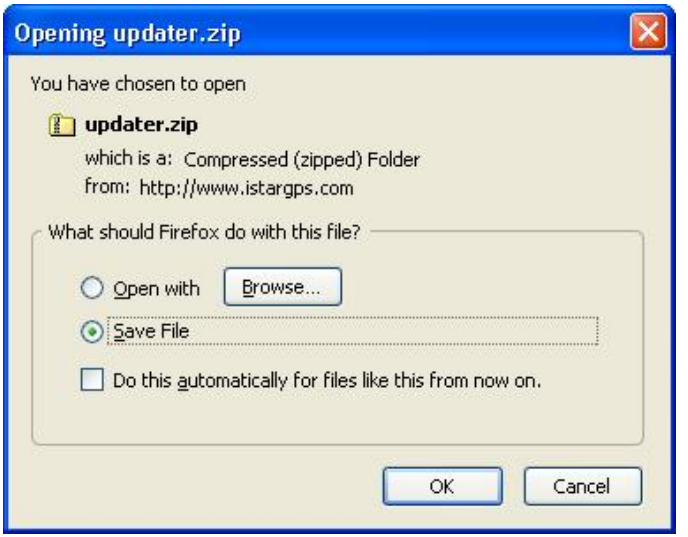


Figure 38 Update utility downloading .zip file

1. Locate the downloaded file (updaterHS4.zip), double click to open a window containing the directory (folder) "IstarGPS HS4 Flash Utilities".
2. **Copy the IstarGPS HS4 Flash Utilities directory to your desktop.** The directory structure of the utility is dependent on a desktop installation
3. Close the window "updaterHS4.zip"
4. Power off the IstarGPS.
5. Move the J2 jumper to the "Prog" position.
6. Connect the IstarGPS USB connector to a Windows PC. If needed, install the USB drivers.
7. Open the IstarGPS HS4 Flash Utilities directory (folder) you copied to your desktop in step 2.

8. Double click **“IstarGPS HS4 Update Utility.exe”**
9. Select the Com port the IstarGPS has created on your PC

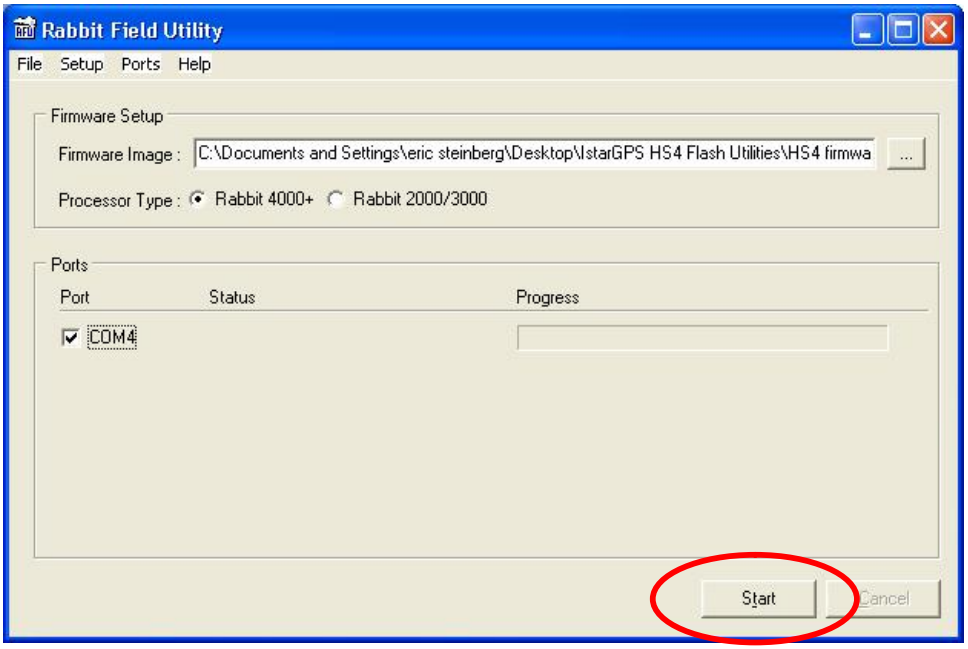
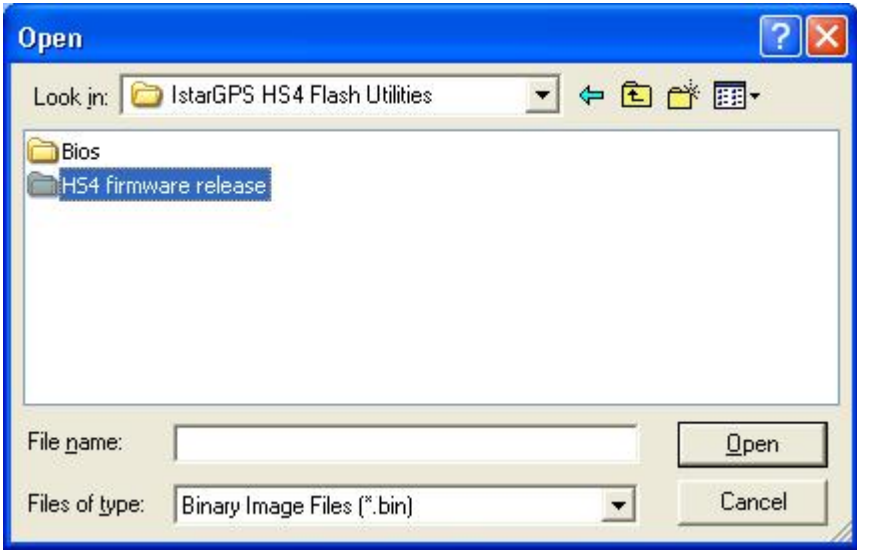


Figure 39 Update Utility com settings

10. Select a firmware image to send to the IstarGPS:
    - File > Load Flash Image...
    - Select the new firmware **for your model** located in the IstarGPS HS4Update Utility directory:

Figure 40
Selecting firmware



Select the file: *modelnumber_version*.bin EXAMPLE: HS4_v3.1.9.bin

11. After selecting the file, press Start (fig 39), updating will start and status will be indicated. The update takes ~30 seconds.

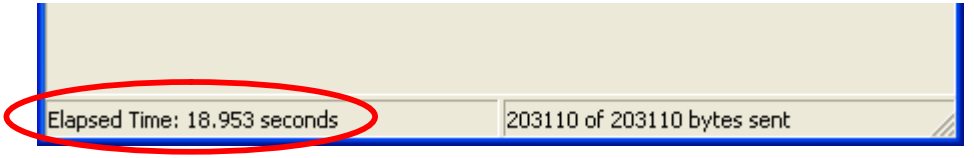


Figure 41 Elapsed time example

12. Turn off power to the IstarGPS.
13. Move jumper J2 to the “Norm” position.

14. Turn on power to the IstarGPS.
15. Verify new firmware was loaded successfully by browsing to the Status page of the IstarGPS. The firmware version is displayed in the "CPU Firmware" field.

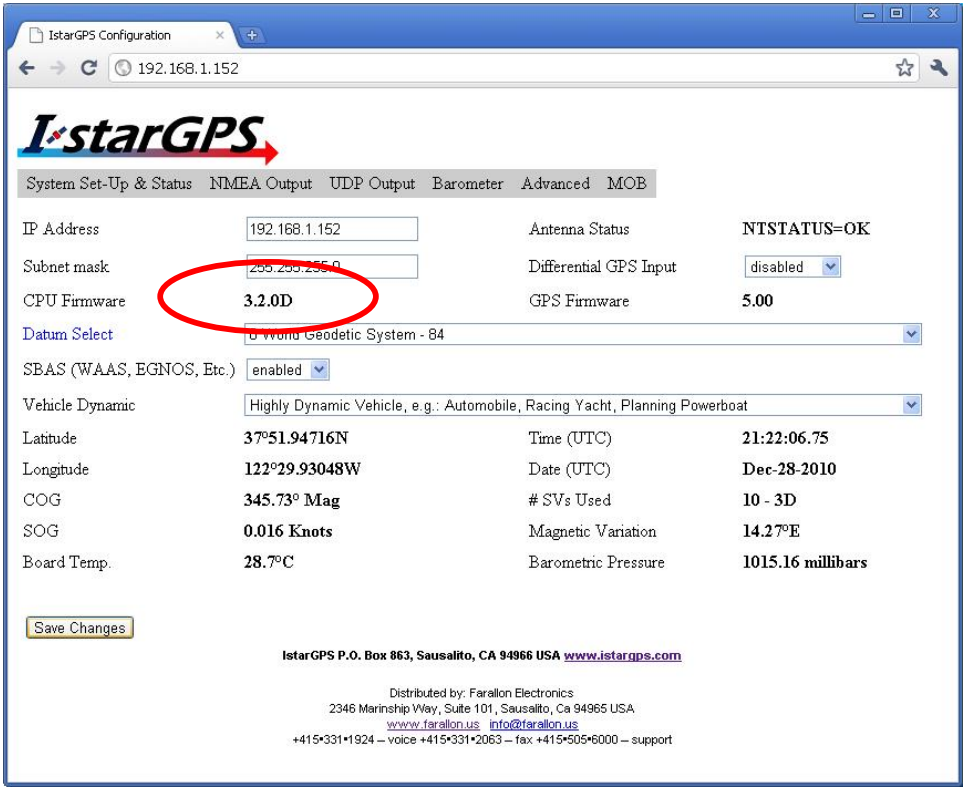


Figure 42 Status page showing CPU version

Warranty

IstarGPS products are warranted for one year (12 months) from the date of sale, to be free of defects in materials and workmanship. The IstarGPS warranty covers a unit that has failed in use during normal operation conforming to the installation guidelines and limitations set fourth in this manual.

If an IstarGPS has failed within the warranty period and warranty service is expected, the customer must initiate technical support with the company the unit was purchased from (Dealer) or contact IstarGPS directly. Contact should be via phone, fax or email and include a detailed description of the failure.

IstarGPS or the Dealer will, at their discretion, either require the unit be returned for evaluation, send an exchange circuit board (PCB) or send a complete advance replacement unit for the customer to exchange on site. The IstarGPS warranty is an "at the factory" warranty meaning that there is no allowance for warranty labor reimbursement for field or in-house services by a Dealer.

IstarGPS will ship replacement parts to a Dealer or customer via UPS 3 Day service or UPS ground, which ever is faster. If a faster shipping method is required, the Dealer or customer will be billed the difference in shipping cost. Shipments outside the United States will be billed at 100% of cost. The customer is responsible for freight and insurance costs to return a defective unit for repair or, if an advance replacement has been provided, return the exchange PCB or exchange unit.

This warranty applies only to products in normal use. It does not apply to units or circuit boards defective due to improper installation, physical damage, tampering, lightning or other electrical discharge or any form of water intrusion / water damage from fresh or salt water. Any unit with an altered serial number will be returned without being repaired.

The foregoing are the only warranties expressed or implied. No other warranties exist. IstarGPS assumes no responsibility for any consequential losses or damages of any nature with respect to any products or services sold, rendered or delivered.

IstarGPS Non-Warranty Repair Policy

When a unit fails after the warranty period, the unit is eligible for a non-warranty repair at a flat fee. Repair charges are based upon the anniversary date of the sale printed on the invoice from IstarGPS or its Dealer. The date of sale may also be verified with a canceled check or credit card receipt in conjunction with the purchase invoice.

Repair Charge Guidelines

- 13th to 36th month - 15% of published list price at time of purchase
- 37th to 60th month - 40% of published list price at time of purchase
- 61st + months - 65% of published list price at time of purchase

Charges are based upon a unit's ability to be repaired subject to parts availability and condition of the unit being repaired. The non-warranty repair policy applies only to products in normal use. Charges for a non-warranty repair may exceed the Repair Charge Guidelines in cases where a unit is extremely damaged. Repair Charge Guidelines do not apply to units or circuit boards defective due to improper installation, physical damage, tampering, lightning or other electrical discharge, unauthorized field repair or any form of water intrusion or water damage from fresh or salt water. Any unit with an altered or missing serial number may be returned without being repaired. All repairs and associated charges are to be authorized by the customer or Dealer prior to repair. Repairs are subject to the discretion of IstarGPS.

Shipping

The customer is responsible for freight and insurance costs to return a unit for repair and for a repaired unit to be return shipped to the customer. IstarGPS will return ship via UPS Ground service or equivalent unless specified otherwise by the customer. International shipping will be via UPS or similar common carrier. Shipping is invoiced at a cost plus basis.

Support Contact Information

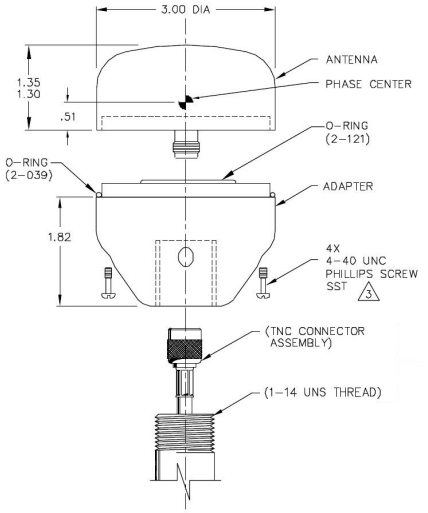
All repairs should be shipped to:

Farallon Electronics
2346 Marinship Way, Suite 101
Sausalito, Ca 94965 USA
www.farallon.us
info@farallon.us

+415•331•1924 – voice
+415•331•2063 – fax
+415•505•6000 – support

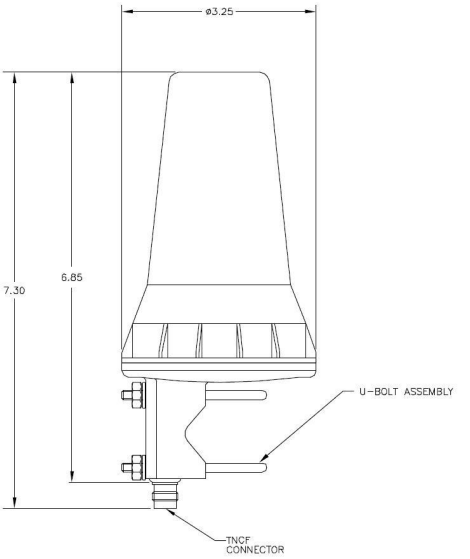
IstarGPS
P.O. Box 863
Sausalito, CA 94966 USA
www.istargps.com

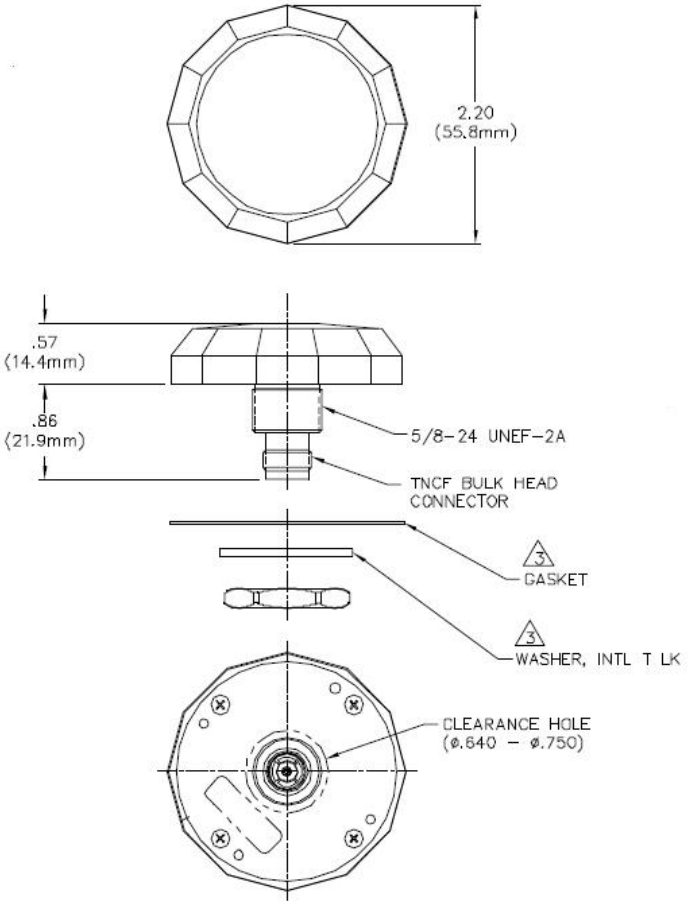
Appendix A – Antenna Options



-ST - Standard marine mount with 1x14 thread base

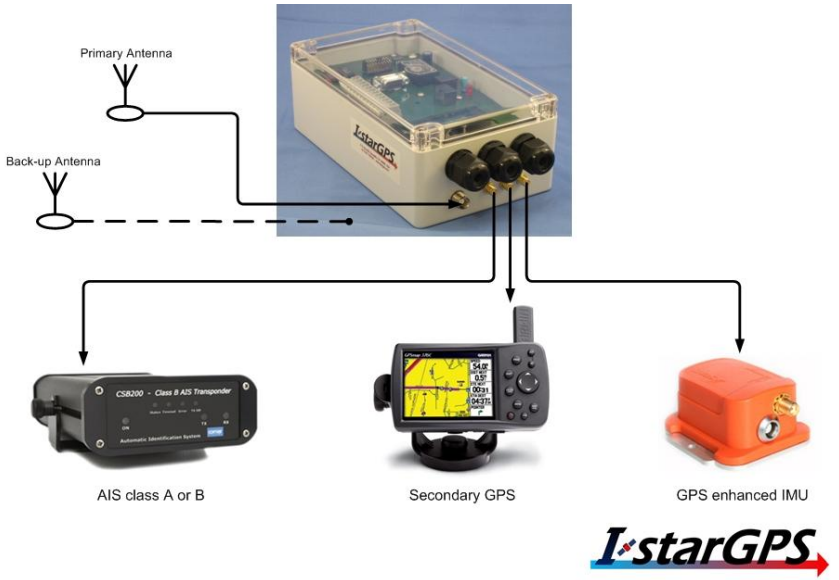
-PM - Pole mount horizontal or vertical pipe, 0.75 to 1.0”





-SM - Surface mount

Appendix B – Optional Antenna Sharing



The antenna sharing module enables a single antenna to feed multiple devices. The sharing module may be ordered built into the HS4 (above), or as an external device (below).

Appendix C – Supported Datums

World Geodetic System - 84 (WGS84)

World Geodetic System - 72 (WGS72)
Earth-90 - GLONASS Coordinate system
Adindan - Mean Solution (Ethiopia & Sudan)
Adindan - Burkina Faso
Adindan - Cameroon
Adindan - Ethiopia
Adindan - Ma l i
Adindan - Senegal
Adindan - Sudan
Afgooye - Somalia
ARC 1950 - Mean (Botswana, Lesotho, Malawi, Swaziland, Zaire, Zambia, Zimbabwe)
ARC 1950 - Botswana
ARC 1950 - Burundi
ARC 1950 - Lesotho
ARC 1950 - Malawi
ARC 1950 - Swaziland
ARC 1950 - Zaire
ARC 1950 - Zambia
ARC1950 - Zimbabwe
ARC 1960 - Mean (Kenya, Tanzania)
Ayabelle Lighthouse - Djibouti
Bissau - Guinea-Bissau
Cape - South Africa
Carthage - Tunisia
Dabola - Guinea
Leigon - Ghana
Liberia 1964
Massawa - Eritrea (Ethiopia)
Merchich - Morocco
Minna - Cameroon
Minna - Nigeria
M'Poraloko - Gabon
North Sahara 1959 - Algeria
Old Egyptian 1907 - Egypt
Point 58 - Mean Solution (Burkina Faso & Niger)
Pointe Noire 1948 - Congo
Schwarzeck - Namibia
Voirol 1960 - Algeria
Ain El Abd 1970 - Bahrain Island
Ain El Abd 1970 - Saudi Arabia
Djakarta (Batavia) - Sumatra (Indonesia)
Hong Kong 1963 - Hong Kong
Hu-Tzu-San - Taiwan
Indian - Bangladesh
Indian - India & Nepal
Indian 1954 - Thailand
Indian 1960 - Vietnam (near 16N)
Indian 1960 - Con Son Island (Vietnam)

Indian 1975 - Thailand
Indonesian 1974
Kandawala - Sri Lanka
Kartau 1948 - West Malaysia & Singapore
Nahrwan - Masirah Island (Oman)
Nahrwan - United Arab Emirates
Nahrwan - Saudi Arabia
Oman
Qatar National - Qatar
South Asia - Singapore
Timbalai 1948 - Brunei & East Malaysia (Sarawak & Sabah)
Tokyo - Mean Solution (Japan,Okinawa & South Korea)
Tokyo - Japan
Tokyo - Okinawa
Tokyo - South Korea
Australian Geodetic1966 - Australia & Tasmania
Australian Geodetic 1984 - Australia & Tasmania
European 1950 - Mean (AU, B, DK, FN, F, G, GER, I, LUX, NL, N, P, E, S, CH)
European 1950 - Western Europe (AU, DK, FR, GER, NL, CH)
European 1950 - Cyprus
European 1950 - Egypt
European 1950 - England, Wales, Scotland &Channel Islands
European 1950 - England, Wales, Scotland & Ireland
European 1950 - Greece
European 1950 - Iran
European 1950 - Italy - Sardinia
European 1950 - Italy - Sicily
European 1950 - Malta
European 1950 - Norway & Finland
European 1950 - Portugal & Spain
European 1950 - Tunisia
European 1979 - Mean Solution (AU, FN, NL, N, E, S, CH)
Hjorsey 1955 - Iceland
Ireland 1965
Ordnance Survey of GB 1936 - Mean (E, IoM, S, ShI, W)
Ordnance Survey of GB 1936 - England
Ordnance Survey of GB 1936 - England, Isle of Man & Wales
Ordnance Survey of GB 1936 - Scotland & Shetland Isles
Ordnance Survey of GB 1936 - Wales
Rome 1940 - Sardinia Island
S-42 (Pulkovo 1942) - Hungary
S-JTSK Czechoslavakia (prior to 1 Jan 1993)
Cape Canaveral - Mean Solution (Florida & Bahamas)
N. American 1927 - Mean Solution (CONUS)
N. American 1927 - Western US
N. American 1927 - Eastern US
N. American 1927 - Alaska (excluding Aleutian Islands)
N. American 1927 - Aleutian Islands, East of180W

N. American 1927 - Aleutian Islands, West of 180W
N. American 1927 - Bahamas (excluding SanSalvador Island)
N. American 1927 - San Salvador Island
N. American 1927 - Canada Mean Solution (including Newfoundland)
N. American 1927 - Alberta & British Columbia
N. American 1927 - Eastern Canada (Newfoundland, New Brunswick, Nova Scotia & Quebec)
N. American 1927 - Manitoba & Ontario
N. American 1927 - Northwest Territories & Saskatchewan
N. American 1927 - Yukon
N. American 1927 - Canal Zone
N. American 1927 - Caribbean
N. American 1927 - Central America
N. American 1927 - Cuba
N. American 1927 - Greenland (Hayes Peninsula)
N. American 1927 - Mexico
N. American 1983 - Alaska (excluding Aleutian Islands)
N. American 1983 - Aleutian Islands
N. American 1983 - Canada
N. American 1983 - Mean Solution (CONUS)
N. American 1983 - Hawaii
N. American 1983 - Mexico & Central America
Bogota Observatory - Colombia
Campo Inchauspe 1969 - Argentina
Chua Astro - Paraguay
Corrego Alegre - Brazil
Prov S. American 1956 - Mean Solution (Bol, Col, Ecu, Guy, Per & Ven)
Prov S. American 1956 - Bolivia
Prov S. American 1956 - Northern Chile (near 19S)
Prov S. American 1956 - Southern Chile (near 43S)
Prov S. American 1956 - Colombia
Prov S. American 1956 - Ecuador
Prov S. American 1956 - Guyana
Prov S. American 1956 - Peru
Prov S. American 1956 - Venezuela
Prov South Chilean 1963
South American 1969 - Mean Solution (Arg, Bol, Bra, Chi, Col, Ecu, Guy, Par, Per, Tri & Tob, Ven)
South American 1969 - Argentina
South American 1969 - Bolivia
South American 1969 - Brazil
South American 1969 - Chile
South American 1969 - Colombia
South American 1969 - Ecuador (excluding Galapagos Islands)
South American 1969 - Baltra, Galapagos Islands
South American 1969 - Guyana
South American 1969 - Paraguay
South American 1969 - Peru
South American 1969 - Trinidad & Tobago
South American 1969 - Venezuela

Zanderij - Suriname
Antigua Island Astro 1943 - Antigua, Leeward Islands
Ascension Island 1958
Astro Dos 71/4 - St Helena Island
Bermuda 1957 - Bermuda Islands
Deception Island, Antarctica
Fort Thomas 1955 - Nevis, St Kitts, Leeward Islands
Graciosa Base SW 1948 - Faial, Graciosa, Pico, Sao Jorge, Terceira Islands (Azores)
ISTS 061 Astro 1968 - South Georgia Islands
L.C. 5 Astro 1961 - Cayman Brac Island
Montserrat Island Astro 1958 - Montserrat Leeward Islands
Naparima, BWI - Trinidad & Tobago
Observatorio Meteorologico 1939 - Corvo and Flores Islands (Azores)
Pico De Las Nieves - Canary Islands
Porto Santo 1936 - Porto Santo and Madeira Islands
Puerto Rico - Puerto Rico & Virgin Islands
Qornoq - South Greenland
Sao Braz - Soa Miguel, Santa Maria Islands (Azores)
Sapper Hill 1943 - East Falkland Island
Selvagem Grande 1938 - Salvage Islands
Tristan Astro 1968 - Tristan du Cunha
Anna 1 Astro 1965 - Cocos Islands
Gandajika Base 1970 - Republic of Maldives
ISTS 073 Astro 1969 - Diego Garcia
Kerguelen Island 1949 - Kerguelen Island
Mahe 1971 - Mahe Island
Reunion - Mascarene Islands
American Samoa 1962 - American Samoa Islands
Astro Beacon E 1945 - Iwo Jima
Astro Tern Island (Frig) 1961 - Tern Island
Astronomical Station 1952 - Marcus Island
Bellevue (IGN) - Efate and Erromango Islands
Canton Astro 1966 - Phoenix Islands
Chatham Island Astro 1971 - Chatham Island (New Zeland)
DOS 1968 - Gizo Island (New Georgia Islands)
Easter Island 1967 - Easter Island
Geodetic Datum 1949 - New Zealand
Guam 1963 - Guam Island
GUX 1 Astro - Guadalcanal Island
Indonesian 1974 - Indonesia
Johnston Island 1961 - Johnston Island
Kusaie Astro 1951 - Caroline Islands, Fed States of Micronesia
Luzon - Philippines (excluding Mindanao Island)
Luzon - Mindanao Island (Philippines)
Midway Astro 1961 - Midway Islands
Old Hawaiian - Mean Solution
Old Hawaiian - Hawaii
Old Hawaiian - Kauai

Old Hawaiian - Maui
Old Hawaiian - Oahu
Pitcairn Astro 1967 - Pitcairn Island
Santo (Dos) 1965 - Espirito Santto Island
Viti Levu 1916 Viti Levu Island (Fiji Islands)
Wake-Eniwetok 1960 - Marshall Islands
Wake Island Astro 1952 - Wake Atoll
Bukit Rimpah - Bangka and Belitung Islands (Indonesia)
Camp Area Astro McMurdo Area, Antarctica
European 1950 - Iraq, Israel, Jordan, Kuwait, Lebanon, Saudi Arabia & Syria
Gunung Segara - Kalimantan (Indonesia)
Herat North - Afghanistan
Indian - Pakistan
Pulkovo 1942 Russia
Tananarive Observatory 1925 - Madagascar
Yacare - Uruguay
Krassovsky 1942 - Russia
Lommel Datum 1950 - Belgium & Luxembourg
Reseau National Belge 1972 - Belgium
NTF - Nouvelle Triangulation de la France
Netherlands 1921 - Netherlands
European Datum 1987, IAG RETrig Subcommision.
Swiss Datum 1903+ (LV95)

Appendix D - Packing List

The following items are supplied with an IstarGPS HS4:

Qty 1 IstarGPS sensor
Qty 1 Antenna sensor
Qty 1 Antenna cable, 50 ohm RG58, 50’
Qty 1 TNC connector, crimp for RG58
Qty 1 TNC connector 90 degree, crimp for RG58
Qty 1 3’ (.91m) Cat5 cable, straight through
Qty 1 Connector pigtail for MOB switch
Qty 1 CD with update utilities, USB drivers, PDF of manual

