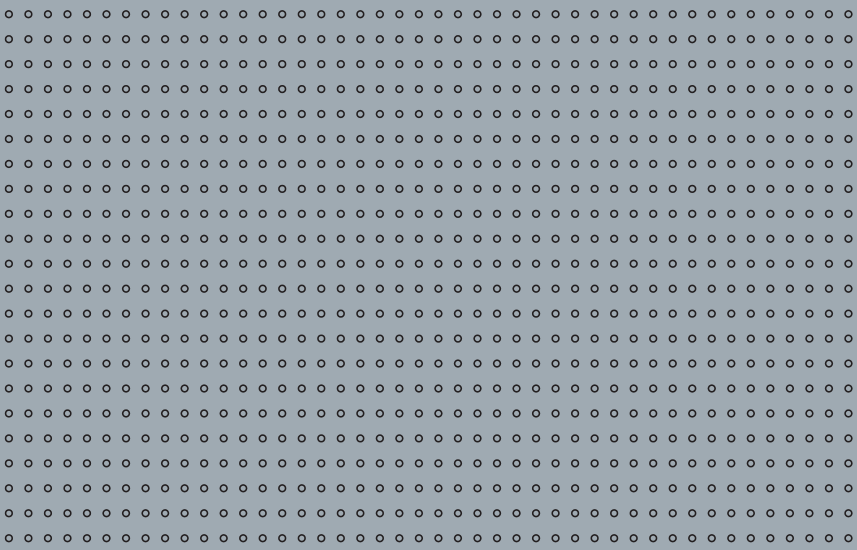
SIMRAD

Master the Elements

Manual

Simrad MX521/MX521A/MX521B GPS/DGPS Sensor

English



Manual

Simrad MX521/MX521A/MX521B GPS/DGPS Sensor

English

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The original language for this document is English. In the event of any discrepancy between translated versions and the English version of this document, the English document will be the official version.

To the best of our knowledge, the content in this publication was correct at the time of printing.

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IMPORTANT NOTICE!

THE MX521 GPS/DGPS SENSOR IS AN AID TO NAVIGATION ONLY. Under no circumstances should it be used in lieu of authorized government charts. Its accuracy can be affected by many factors such as equipment defects, environmental conditions, or improper operation. The user is responsible for safe navigation of the vessel. This includes consulting authorized government charts and exercising common prudence and navigational judgement at all times.

Disclaimer

As Navico is continuously improving this product, we retain the right to make changes to the product at any time which may not be reflected in this version of the manual. Please contact your nearest distributor if you require any further assistance.

It is the owner's sole responsibility to install and use the equipment in a manner that will not cause accidents, personal injury or property damage. The user of this product is solely responsible for observing safe boating practices.

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Warranty

The warranty card is supplied as a separate document.

In case of any queries, refer to the our website:
www.navico.com/commercial or
www.simrad-yachting.com

Contents

1 General

This manual describes the operation and installation of the MX521 antenna sensor.

They were designed to work either interactively with MX Control and Display Unit (MX CDU) or as a stand-alone positioning device for other non-MX applications.

The MX521 smart DGPS antennas can achieve better than 2-meter DGPS accuracy in areas with good beacon differential coverage and autonomous GPS accuracy better than 5 meters.

When connected to an MX-CDU (i.e. MX61x or MX51x), the MX521 can be controlled to function in several modes, namely;

- GPS only
- Differential correction search mode in Auto, Database or Manual
- WAAS* (Wide Area Augmentation System-US system)
- EGNOS* (European Geostationary Overlay System)
- RAIM (Receiver Autonomous Integrity Monitoring)

The MX521 sensors were designed to be used as:

- Source of GPS/DGPS positioning for MX CDUs including MX61x & MX51x series CDUs
- Retrofit of IMO compliant GPS and AIS installation
- Source of position for ECDIS and other charting software

Before installing the MX521 smart antenna, please read this manual carefully to ensure proper installation and operation of the unit.

*Not yet recognized by IMO as official differential correction system

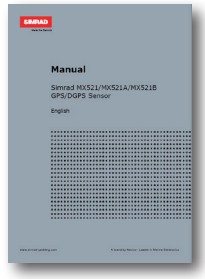
Supplied Equipment

The following items are supplied with the MX521 Kit:

Description	Part Number
MX521B GPS smart antenna with GLONASS	000-11641-001
or,	
MX521B DGPS smart antenna with GLONASS	000-11640-001

The antenna cable assembly is not included and must be ordered separately. Please specify the cable length required. Below are available lengths in stock:

20 meters	3508 102 70170
40 meters	3508 102 70180
60 meters	3508 102 70640
80 meters	3508 102 70185



MX521 Kit

2 Operation

General

This manual covers the MX521, MX521A and MX521B antenna models and will be generally called MX521. The MX521 and MX521A antenna models are D/GPS smart antenna sensor while the MX521B is a combined DGPS/GLONASS smart antenna sensor. They are fully automatic and do not require initialization or user intervention. They will automatically search for available satellites and make a position fix shortly after power is applied.

The internal 2-channel beacon receiver, in the DGPS version, initiates an Auto-matic Beacon Search (ABS) on power on. The primary channel will lock-on to the nearest beacon station, while the second channel searches for other available beacon signals. Should it find a superior signal, it will automatically switch the primary channel to the new station.

The beacon receiver can be controlled by a Control Display Unit (CDU) like the MX420, MX500, MX51x, GN70 or MX61x series, to operate in Automatic Beacon Search, Manual Tune or Database modes. The Database mode allows the beacon receiver to store the almanac of 10 stations that are closest to its present position. This feature complies with the IEC 61108-4 specifications. The combined performance of the high-precision GPS and GPS/GLONASS receivers and 2-channel smart beacon receiver provides a more accurate position fix, usually within 1 meter or less.

Satellite Based Augmentation System (SBAS)

In areas where land-based Coast Guard beacon stations are not available, the MX521 can be controlled to track the Satellite Based Augmentation Systems (SBAS) like the WAAS (US), EGNOS (European) and MSAS (Japan) satellites. These satellites transmit DGPS correction data (just like the Coast Guard stations) using the same GPS frequency of 1575.00 MHz. Refer to the MX CDU Operator Manual for more details. Turning this feature on in the MX CDU will initiate the MX521 to listen for and track any

SBAS satellites that are in view.

Receiver Autonomous Integrity Monitoring (RAIM)

RAIM is a special software algorithm in the MX521 program which gives the operator timely warnings when the GPS system accuracy is questionable. This feature requires a minimum of five GPS satellites to operate properly. If the position solution error exceeds a preset limit a "RAIM Unsafe (R-)" or "RAIM Caution (R?) alarm will be indicated in the MX CDU. This means that the accuracy of the position cannot be guaranteed to be very accurate. The operator is advised to use the GPS cautiously for navigation until the RAIM indicator switches to (R+) denoting safe RAIM condition. Position errors may be caused by unhealthy satellites, incorrect pseudoranges, poor satellite geometry, excessive atmospheric interference and problems at particular reference stations.

GLONASS Overview (MX521B only)

GLONASS is a global satellite navigation system developed by the Soviet Union, providing real-time position and velocity determination for military and civilian users. The GLONASS satellites are located in orbits at 25,510 km altitude with a 64.8 degree inclination. GLONASS' orbit makes it especially suited for use in high latitudes (north or south), where getting a GPS signal can be problematic. The constellation operates in three orbital planes, with 8 evenly spaced satellites on each plane. A fully operational constellation with global coverage consists of 24 satellites. To get a position fix the receiver must be in the range of at least four satellites.

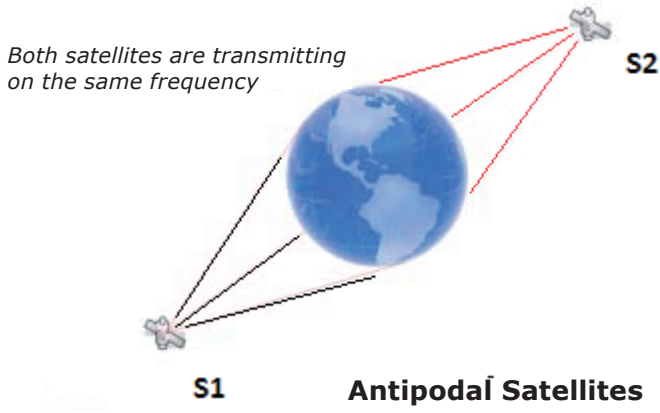
Space Segment

There are 21 satellites that are being used for navigation with 3 spare satellites. All GLONASS satellites are operating using the same code but on slightly different frequencies (L1 signals at 1598.0625 to 1609.3825 while the L2 at 1242.9375-1251.6875 MHz). This is

a modulation technique known as FDMA (Frequency Deviation Multiple Access). They have the same polarization as the GPS signals and have comparable signal strength.

The signal of the GLONASS satellite includes the Satellite ID, Positioning, velocity, acceleration, satellite health, time and time offset and almanac of all GLONASS satellites.

The GLONASS system is based on 24 satellites using 12 different frequencies. This was made possible by using the same frequency on antipodal satellites. These are satellites that are in the same orbital plane but are separated by 180°.



Antipodal Satellites

GPS and GLONASS

Combining the GPS and GLONASS system provides the following advantages:

- Better signal acquisition times
- Better position and time accuracy
- Reduces the physical blocking of signal in urban cities where tall buildings are the norms
- Better satellite geometry resulting in better HDOP

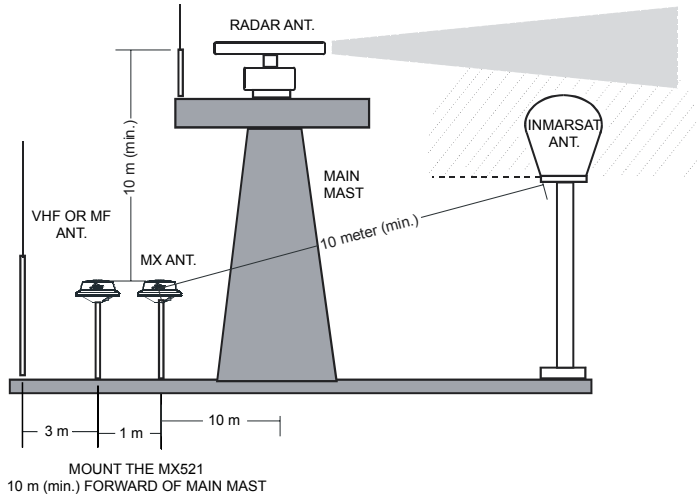
3 Installation

MX521 Antenna Mounting Guidelines

The MX521 antenna housing is weather-resistant and must be located outside where it will have a good view of the sky around it. Use a standard 1”-14 TPI bracket for mounting.

- Install the MX521 antenna where it has a clear view of the sky around it.
- Locate the antenna for easy access and maintenance.
- Stay away from high-power energy sources such as radar, SSB, INMARSAT and other transmitting radio antennas by 5 meters or more.
- Locate the antenna at least 10 meters away from and out of the transmitting beam of radar, INMARSAT and other high-power transmitters.
- Mount the antenna low to avoid excessive position and speed errors while underway.
- Mount the antenna as far away as possible from large metal structures.
- Mount the antenna about 1 meter away from the compass.

If you are not sure if the chosen location is appropriate, you can mount the antenna temporarily and operate it with the CDU. Monitor the operation of the MX521 while you turn on other on-board electronic equipment. Move the antenna around until the MX521 operates satisfactorily then mount it permanently.



MX521 Connector

The 10-pin male connector located at the underside of the antenna unit provides the means to connect to external power and the data interface. Please refer to the chart below for the pin numbers, wire colors codes and signal assignments.

Pin #	Wire Color	MX521 DGPS Antenna	MX521 GPS Antenna
1	BLK	Negative Ground	
2	RED	+9 - 32 VDC	
3	BLU	MX Proprietary Message (MPM In (-)	
4	BRN	MX Proprietary Message (MPM In (+)	
5	ORG	GPS Out (-)	
6	GRN	GPS Out (+)	
7	YEL	Beacon Status Out (-)	Not used
8	WHT	Beacon Status Out (+)	Not used
9	PRPL	RTCM IN (+)	
10	PRPL/ GRY	RTCM IN (-)	

•

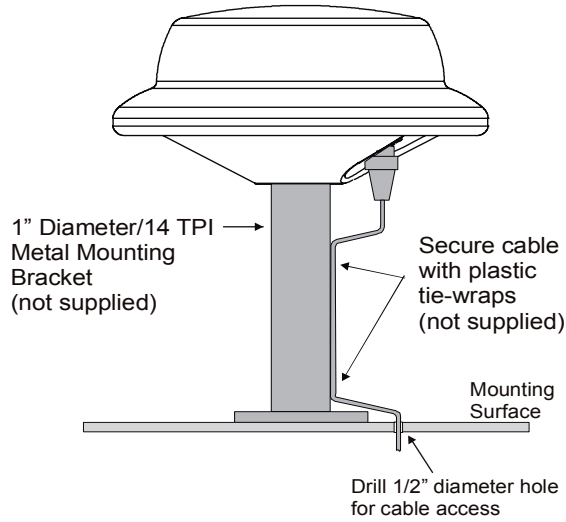
Antenna Mounting

Bracket Mount

The MX521 mounting thread is an industry standard fitting for VHF antenna mounting (1inch, 14 TPI). This enables the antenna to be mounted on a wide range of mounting brackets, including the swivel joints, commonly used for angled surface. Refer to the figure below for bracket mounting illustration.

Hand-tighten the antenna onto the bracket until snug. Do not overtighten.

A 10-pin (male) plastic connector is mounted at the underside of the antenna for power and data connection.



MX521 Bracket Mounting

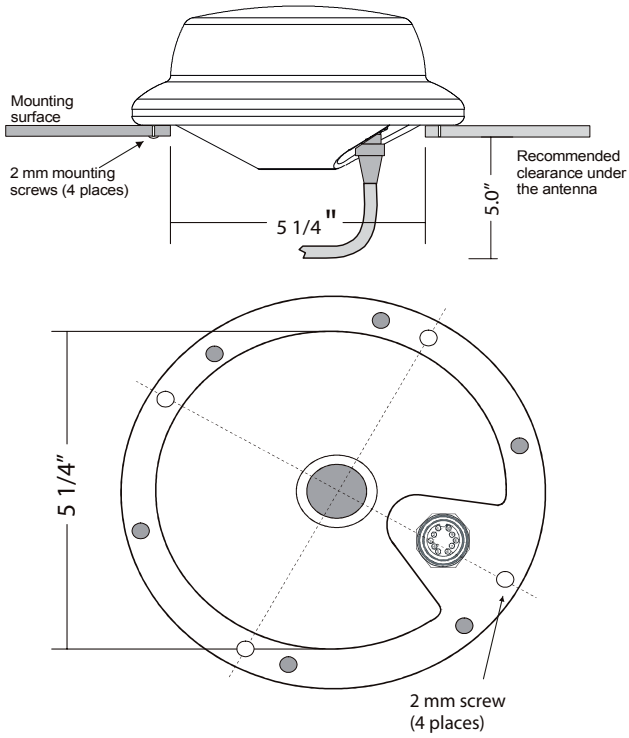
Surface Mount

The MX521 can also be surface-mounted. Make sure there is at least 5-inch clearance underneath the mounting surface to accommodate the lower section of the MX521 housing, connector and cable. Refer to the figure below for surface mounting considerations. Cut a 5

1/4 inch diameter hole on a horizontal mounting surface and drill the four mounting screw holes as shown.

Fasten the antenna by using 2-mm size stainless steel metric screws (4 places). Use a marine grade caulking compound to seal between the mounting surface and the bottom of the antenna housing.

Choose a location for the antenna that has a clear view of the sky. Make sure there are no major obstructions or metal fixtures in the immediate proximity to the antenna. The GPS antenna relies on direct 'line-of-sight' signal reception. If you are unsure if the chosen location is suitable, it is advisable to mount the antenna in a temporary manner to verify correct operation.



MX521 Surface Mount

Antenna Cable Selection

The antenna cable assembly for the MX521 antenna is not included in the kit and must be ordered separately. Several cable lengths are available in stock. To assist you in ordering the correct cable length, please refer to the antenna cable list below for cable description and part number.

Antenna Cable with One 10-Pin Connector (for all models):

Part Number	Description
3508 102 70170	20 meter
3508 102 70180	40 meter
3508 102 70640	60 meter
3508 102 70185	80 meter

Antenna Cable with both ends terminated with 10-Pin Connectors (for direct connection to MX5xx Series CDU):

Part Number	Description
500 100 1006	20 meter
500 100 1007	40 meter

Power Requirement

External power supplied to the MX521 must be within 10.5-32 VDC for best operation. To protect the circuitry in the MX521, the voltage level must be within these limits. Negative grounding is required. The MX521 draws less than 300 mA. at 12 VDC. An in-line fuse or circuit breaker rated at 2 amp. is recommended for overload protection.

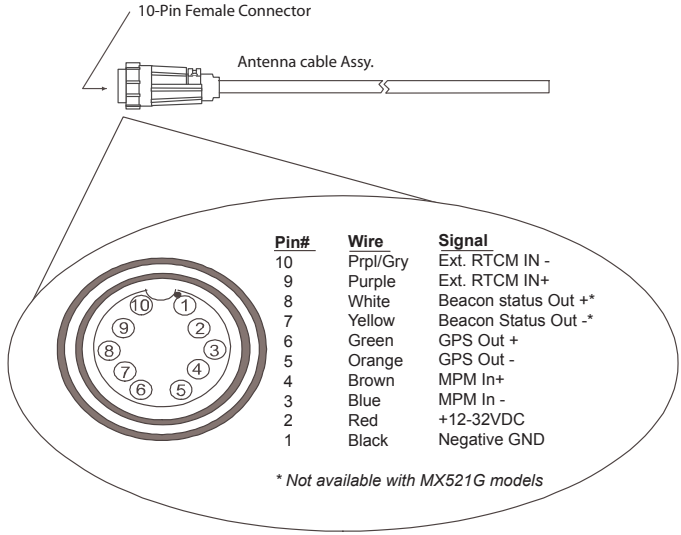
When the MX521 is connected to an MX control and display unit (CDU), the 12 VDC antenna power is supplied by the CDU unit.

The red wire connects to the (+) DC power, while the black wire is the negative return. Although the MX521 has a reverse polarity protection, it is prudent to make sure that proper polarity is observed before making the connection.

Reverse polarity connection may damage the unit.

Antenna Cable Assembly

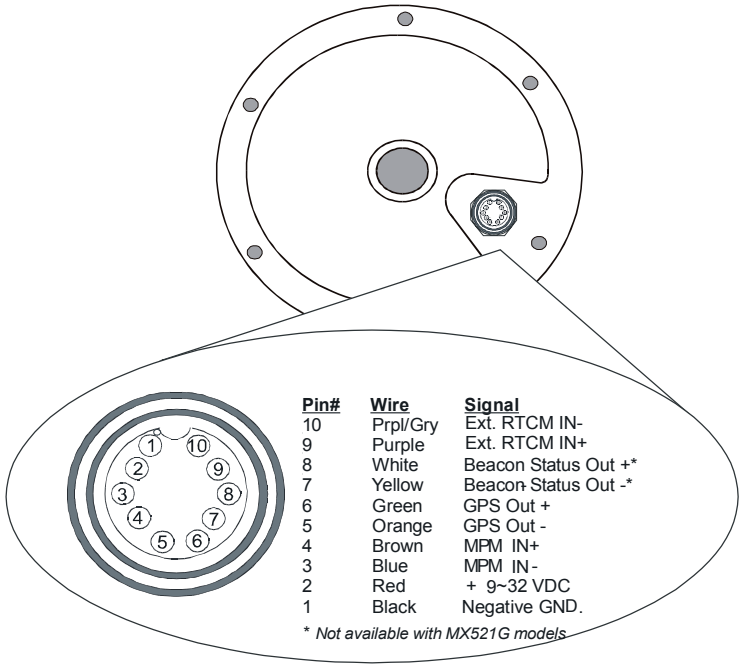
Below is a diagram showing the pins and wire color-coding of the antenna cable assembly.



Power/Data Cable Assembly

MX521 Connector Configuration

Refer to the diagram below for the POWER-DATA connector located at the underside of the MX521A:



MX521 POWER-DATA Connector

Where:

Pins 1 & 2: Negative GND and +12 VDC power input.

Pins 3 & 4: MX proprietary message (MPM) input port.

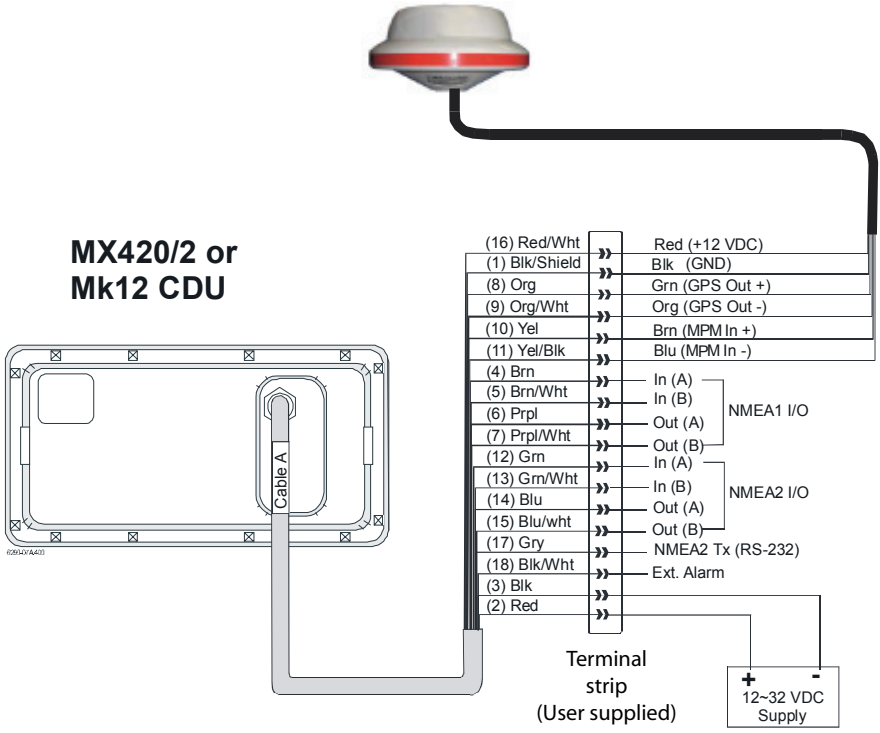
Pins 5 & 6: GPS output to the MX420 or other NMEA 0183 compatible devices.

Pins 7 & 8: Beacon monitoring signal output. Sends the SNR, Signal and Frequency to the CDU. Connects to Cable B of the MX420/8 CDU.

Pins 9 & 10: External RTCM Correction (Input).

Data Interface to MX420/2 or MK12 CDU

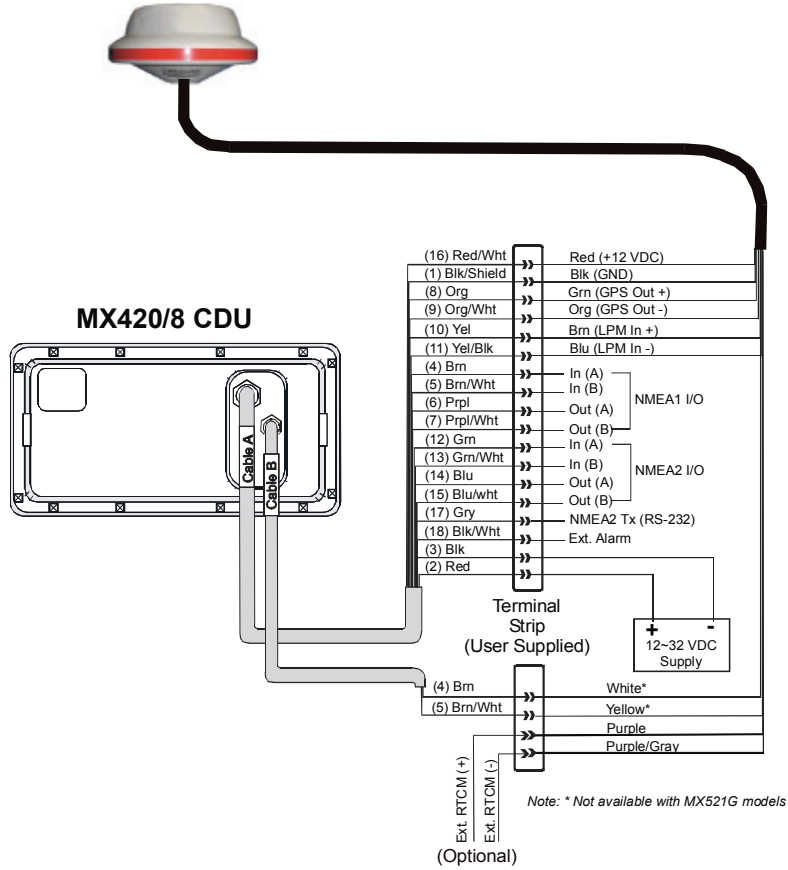
Use the diagram below to interface the MX521A to an MX420/2 or MK12 CDU.



MX521 Interface to MX420/2 or MK12 CDUs

Data Interface to MX420/8 or MX420/ AIS CDU

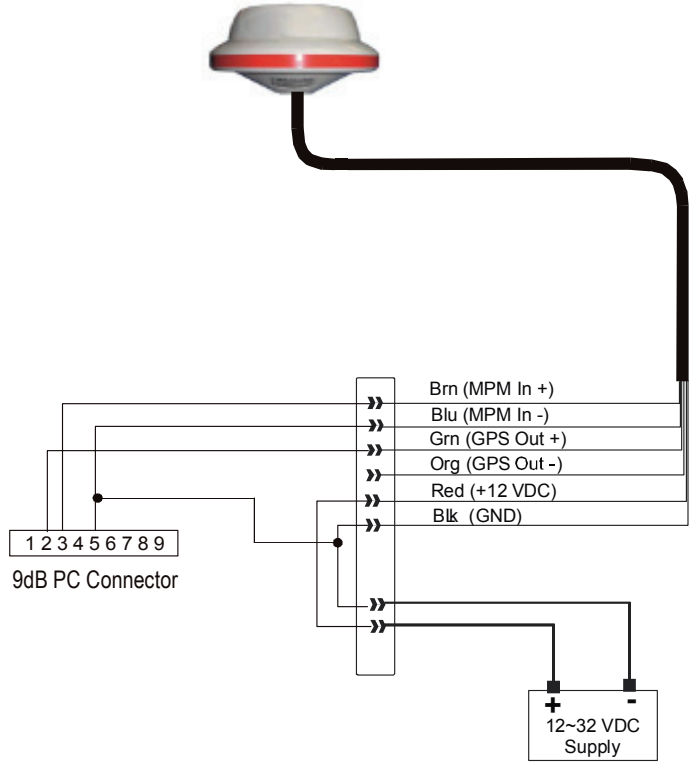
Use the diagram below to interface the MX521A to an MX420/8 or MX420/AIS CDU. The external RTCM connection is optional.



MX521 Interface to MX420/8 or MX420/AIS CDUs

Data Interface to PC or Other Navigation Systems

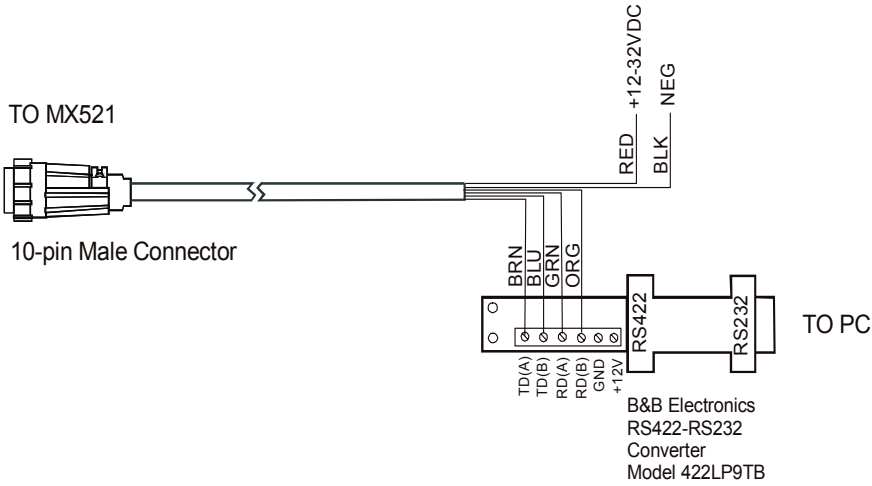
The figure below shows the power and data output connections to the serial port of a PC or other navigation systems using a dB9 connector and a terminal strip (user supplied items).



MX521 Interface to Other Navigation Systems

MX521 Programming Cable

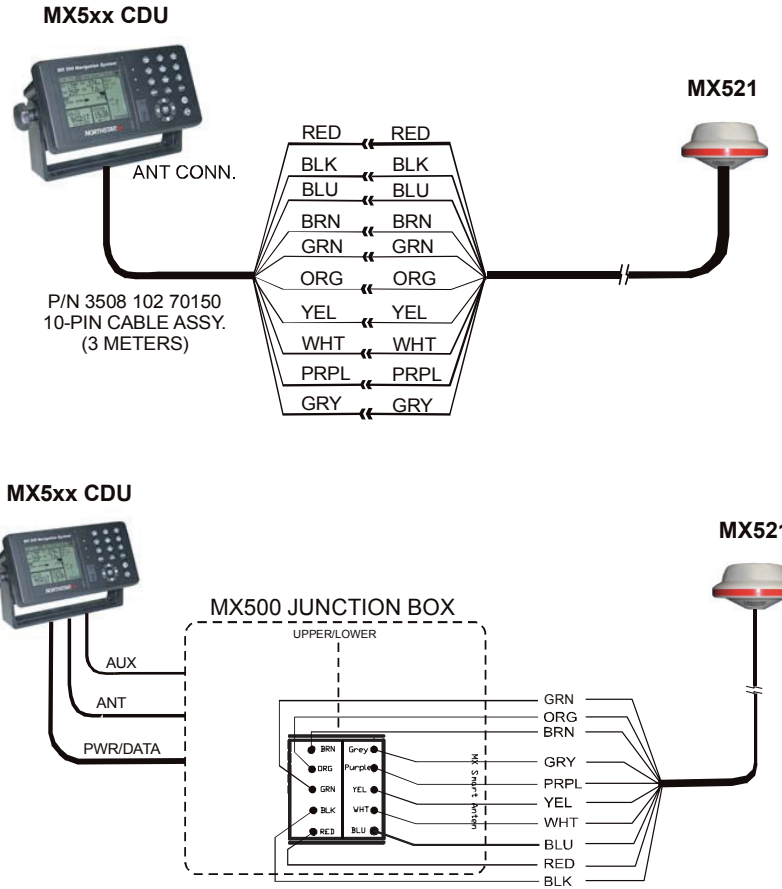
The programming cable is used for upgrading the software of the GPS and Beacon PCBs inside the MX521 smart antenna. The figure below shows the programming cable diagram and equipment setup. Please note that external 12 volt DC is required to power up the MX521. Connect the red wire to +12 VDC and Black wire to negative GND. The RS422-RS232 converter may be powered from the PC serial port or from an external 12 volt power supply.



MX521 Programming Cable Diagram

Data Interface to MX5xx CDU

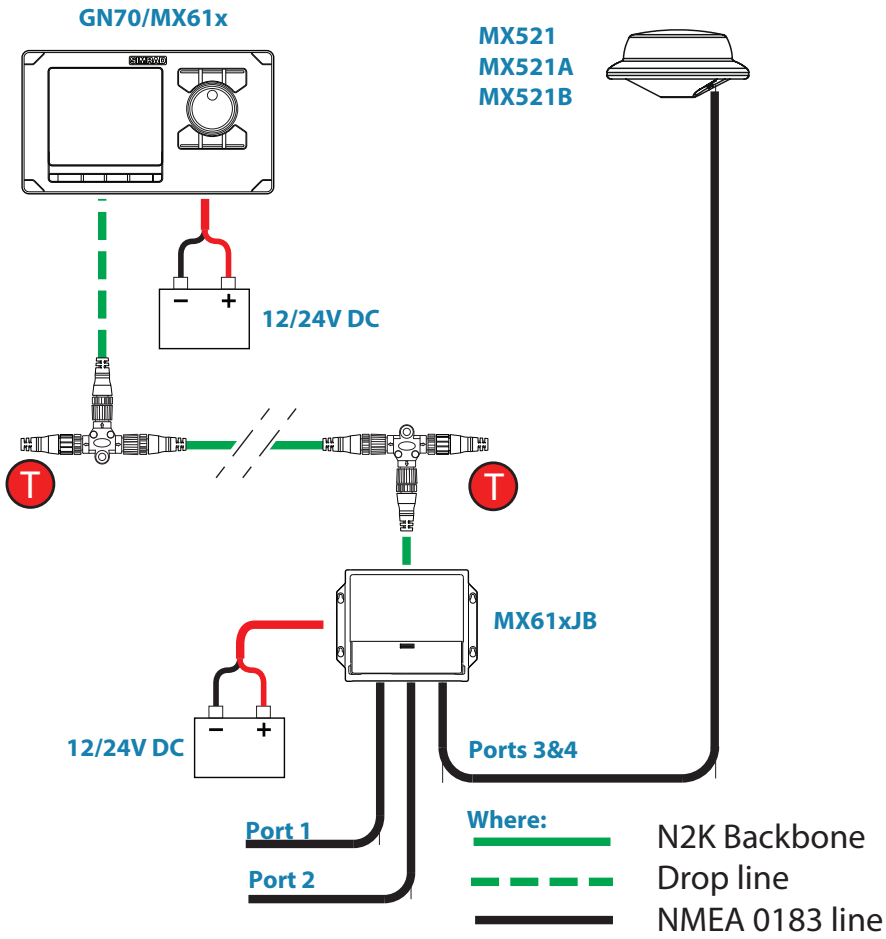
Use the diagram below to interface the MX521 to an MX500, MX510 or MX512 CDU. Antenna cable assembly with two 10-Pin connectors are available in 3, 20 and 40 meter lengths.



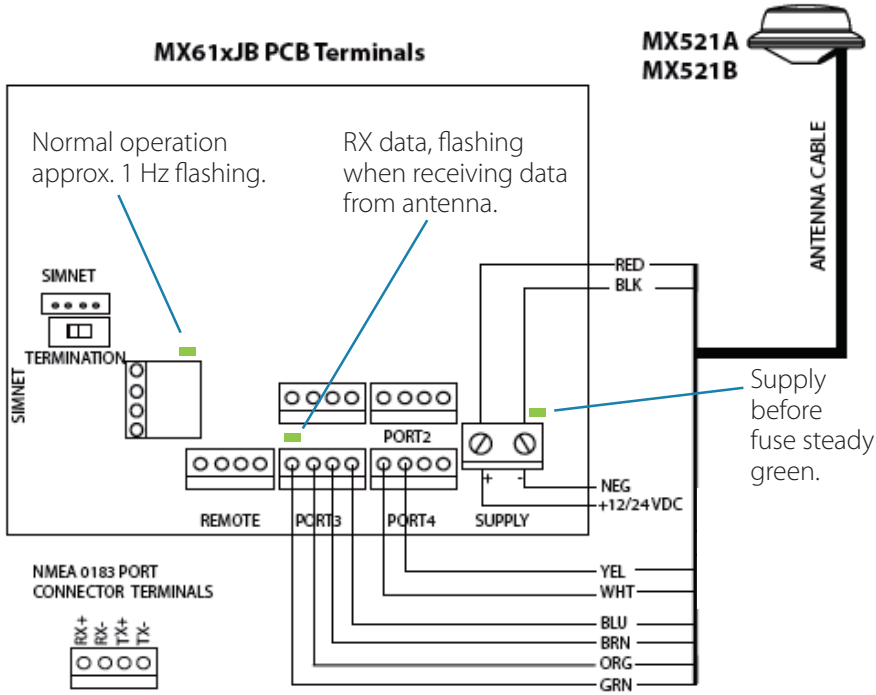
MX5xx Antenna Interface to MX521

Data Interface to MX61x Junction Box

Use the diagram below to interface the MX521 to GN70/ MX61x CDU via MX61x JB.



GN70/MX61x, MX61xJB and MX521 diagram



MX521 to MX61xJB wiring diagram

4 Specifications

GPS Receiver MX521A

Type: ..... L1, C/A Code (SPS) with carrier phase smoothing

Frequency: ..... 1575.42 MHz

Channels: .....12 Channels, parallel tracking

Update rate: ..... 1 Hz

RTCM Input: ..... RTCM SC-104 format

Satellite measurement use: ..... 12 channel parallel automatic selection

Antenna type: ..... Ceramic Patch

Dynamic Range: ..... 90 dB

Time to first fix:

Cold start (no almanac or RTCM): ..... 60 second (typical)

Reacquisition..... <10 second (typical)

Position accuracy:

With differential corrections from:

Beacon Stations: <1 meters (2D-RMS) typical depending on distance from differential base station.

Without differential corrections <3 m (2D-RMS) (with S/A off)

Serial Ports:..... 2 duplex NMEA 0183 ports

Baud Rates: .....4800 (default), 9600, 19200

Data I/O Protocol: ..... NMEA 0183 V3.0

Correction I/O Protocol: .....RTCM SC-104

Datum:..... WGS84

NMEA messages: GGA, GRS, GSA, GSV, GST, RMC, VTG, ZDA & PMVXG,GBS (MX Marine proprietary)

Beacon Receiver (MX521 DGPS model only)

Frequency: ..... 283.5 to 325.0 kHz. 2-channel Auto or Manual selection (500 Hz steps)

Sensitivity: .....2.5 uV/m for 6dB SNR @ 200 bps

Operating Modes: ..... Automatic, Manual or Database

Dynamic Range: .....100 dB

Adjacent Channel Rejection: .....61 dB @ f $\pm$ 400 Hz

Channel spacing: .....500 Hz

Frequency offset tolerance: ..... ± 5 Hz

Antenna type: ..... H-Field

MSK rates:.....50, 100 and 200 bps

Environmental

Operating temperature:..... -30 to +70 °C

Storage Temperature: .....-40 to 85 °C

Humidity: ..... "Exposed Category" (IEC 60945)

Mechanical

Dimensions:

Height ..... 102 mm (4.0 in.)

Diameter .....182 mm (7 1/8 in)

Weighs: (MX521 DGPS) ..... 820 grams (1.8 lbs.) (without cable)

(MX521G) ..... 600 grams (1.3 lbs.) (without cable)

Mount: ..... 1"-14 TPI pole mount. Surface mounting 5 1/4 " hole

Electrical

Operating voltage range:..... 10.5 to 32 VDC

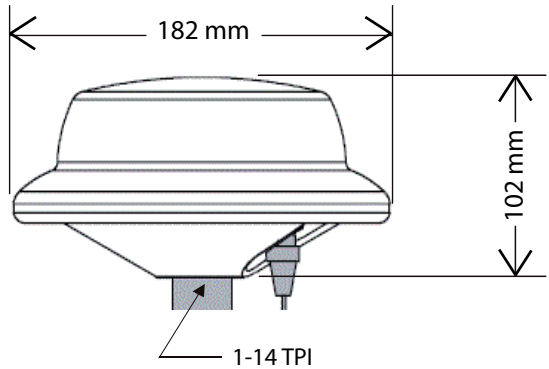
Operating current: .....< 230 mA at 12.0 VDC,

Power Consumption: ..... <3 Watts

Certifications

96/98 EC as amended by directive (EU) 2015/559

CE and FCC compliant



MX521B D/GNSS Receiver

Key features:

- IMO type approved
- Flexibility for easy integration into NMEA 0183 interfaces
- More satellite tracking for better geometry
- Maintain position lock when more of the sky is blocked
- COAST technology maintains differentially-corrected positioning for 40 minutes or more after loss of differential signal

GNSS Sensor Specifications

Receiver Type: ..... GNSS L1 Receiver

Signals Received: ..... GPS, GLONASS

Channels: 270

GPS Sensitivity: ..... -142 dBm

SBAS Tracking: ..... 2-channel, parallel tracking

Update Rate: ..... 1 Hz standard (20 Hz optional)

Positioning Accuracy:

RMS (67%):	Horizontal	Vertical
Single Point: [1]	1.2 m	2.5 m
SBAS (WAAS): [2]	0.3 m	0.6 m
Code Differential DGPS: [3]	0.3 m	0.6 m

Compass Safe

Distance: ..... 75 cm (with enclosure) [4]

Cold Start: ..... 60 s (no almanac or RTC)

Warm Start: ..... 20 s typical (almanac and RTC)

Hot Start: ..... 1 s typical (almanac, RTC and position)

Maximum Speed: ..... 1,850 mph (999 kts)

Maximum Altitude: ..... 18,288 m (60,000 ft)

Beacon Sensor Specifications

Channels: ..... 2-channel, parallel tracking

Frequency Range: ..... 283.5 to 325 kHz

Operating Modes: ..... Manual, automatic and database

Compliance: ..... IEC 61108-4 beacon standard

Communications

Baud Rates: ..... 4800 - 115200

Correction I/O Protocol: ..... RTCM v2.3 (DGPS)

Data I/O Protocol: ..... NMEA 0183

Power

Input Voltage: ..... 10.5 to 32 VDC

Power Consumption: ..... 4.3 W nominal (GPS L1 + GLONASS L1)

4.6 W nominal (GPS L1 + GLONASS L1 + Beacon)

Current Consumption: .. 0.36 A nominal (GPS L1 + GLONASS L1)

0.38 A nominal (GPS L1 + GLONASS L1 + Beacon)

Power Isolation: ..... Isolated to enclosure

Reverse Polarity Protection: ..... Yes

Environmental

Operating Temperature: ..... -30°C to + 70°C (-22°F to + 158°F)

Storage Temperature: ..... -40°C to + 85°C (-40°F to + 185°F)

Humidity: ..... 95% non-condensing

Shock and Vibration: .... Mechanical Shock: EP455 Section 5.14.1

Vibration: EP455 Section 5.15.1 Random

EMC: ..... CE (IEC 60945 Emissions and Immunity)

FCC Part 15, Subpart B CISPR22

IMO Wheelmark Certification: ..... Yes [6]

Mechanical

Power/Data Connector: ..... 10-pin, environmentally sealed

1 *Depends on multipath environment, number of satellites in view, satellite geometry, no SA, and ionospheric activity*

2 *Depends on multipath environment, number of satellites in view, WAAS coverage and satellite geometry*

3 *Based on a 40 second time constant*

4 *This is the minimum safe distance measured when the product is placed in the vicinity of the steering magnetic compass. The ISO 694 defines "vicinity" relative to the compass as within 5 m (16.4 ft) separation*

6 *NMEA 0183 only*

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5 Data Output

The MX521 data output conforms to the NMEA 0183 V3.0 at 4800 baud. Below is a list of the NMEA sentences output:

GGA, GSA, GSV, GST, RMC, VTG and PMVXG,GBS (an MX proprietary sentence used for RAIM)

NMEA 0183 Data Output Sentences

(1) **GGA** - Global Positioning System Fix Data

Time, position and fix related data for a GPS receiver.

$GPGGA,hhmmss,llll.llll,a,yyyyy.yyyy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh<CR><LF

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Notes:

1 ----- UTC of position

2,3 --- Latitude - N/S

4,5 --- Longitude - E/W

6 ----- GPS Quality Indicator:

- 0 = Fix not available or invalid
- 1 = GPS SPS Mode, fix valid
- 2 = Differential GPS, SPS Mode, fix valid
- 3 = GPS PPS Mode, fix valid

7 -----Number of Satellites in use, 00-12, may be different from the number in view

8 -----Horizontal Dilution of Precision (HDOP)

9 ---- Antenna altitude/mean-sea-level (geoid)

10---- Units of antenna altitude, Meters

11,12- Geoidal Height, Meters

13---- Age of Differential GPS Data

14 --- Differential Reference Station ID

(2) **GRS** - GNSS Range Residual

This message is used to support RAIM.

$GPGRS,hhmmss,x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x,x.x*hh<CR><LF>

1 2 3

Notes: 1 ---- UTC time of GGA or GNS fix associated with this sentence

2 ---- Mode 0 = residuals were used to calculate the position given in the matching GGA or GNS.

1 = residuals were computed after the GGA or GNS position was computed.

3 ---- Range residuals in meters for sat. used in navigation solution. Order must match the order of the satellite ID numbers in GSA. When GRS is used GSA and GSV are generally required.

(3) **GSA** - GPS DOP and Active Satellites

GPS receiver operating mode, satellites used in the navigation solution reported by the $GPGGA sentence, and DOP values.

$GPGSA,a,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,x.x,x.x,x.x*hh<CR><LF>

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

Notes: 1---- Mode: M = Manual, forced to operate in 2D or 3D Mode

A = Automatic, allowed to automatically switch 2D/3D

2 ---- Mode: 1 = Fix not available, 2 = 2D, 3 = 3D

3-14 -PRN numbers of satellites used in solution (null for unused fields)

15 ---PDOP

16 ---HDOP

17 ---VDOP

(4) **GSV** - GPS Satellite in View

Number of satellites (SV) in view, PRN numbers, elevation, azimuth and SNR values. Four satellites maximum per transmission, additional satellite data sent in second or third message. Total number of messages being transmitted and the number of the message transmitted are indicated in the first two fields.

$GPGSV,x,x,xx,xx,xx,xxx,xx,.....,xx,xx,xxx,xx*hh<CR><LF>

1 2 3 4 5 6 7 8 9 10 11 12

Notes: 1 -----Total number of messages, 1 to 3

2 ---- Message number, 1 to 3

3 ---- Total number of satellites in view

4 ----- Satellite PRN number

5 ----- Elevation, degrees, 90 degrees maximum

6 ------Azimuth, degrees True, 000 to 359

7 ------SNR (C/No) 00-99 dB, null when not tracking

8 ------2nd and 3rd SV

9,10,11,12 - 4th SV

(5) **RMC** - Recommended Minimum Specific GPS Data

Time, date, position, course and speed data provided by a GPS navigation receiver. This sentence is transmitted at intervals not exceeding 2 seconds. All data fields must be provided: null fields used only when data is temporarily unavailable.

$GPRMC,hhmmss.ss,A,llll.llll,a,yyyyy.yyyy,a,x.x,x.x,xxxxxx,x.x,a*hh<CR><LF>

1 2 3 4 5 6 7 8 9 10 11

Notes: 1 ---- UTC of Position fix

2 ---- Status: A = data valid

V = Navigation receiver warning

3,4 -- Latitude, N/S

5,6 -- Longitude, E/W

7 ---- Speed over ground, knots

8 ---- Course Over Ground, True

9 ---- Date: dd/mm/yy

10,11 - Magnetic variation, degrees E/W. Easterly variation (E) subtracts from True course, Westerly variation (W) adds to True course.

(6) **GST** - GNSS Pseudorange Error Statistics

This message is used to support Receiver Autonomous Integrity Monitoring (RAIM). Pseudorange measurement error statistics can be translated in the position domain in order to give statistical measures of the quality of the position solution.

If only GPS, GLONASS, etc. is used for the reported position solution, the talker ID is GP, GL, etc., and the error data pertains to the individual system. If satellites from multiple systems are used to obtain the reported position solution, the talker ID is GN and the errors pertain to the combined solution.

$GPGST,hhmmss.ss,x.x,x.x,x.x,x.x,x.x,x.x,x.x*hh<CR><LF>

1 2 3 4 5 6 7 8

Notes: 1 ---- UTC time of the GGA or GNS fix associated with this sentence.

2 ---- RMS value of the standard deviation of the range inputs to the navigation process. Range inputs include preudoranges & DGNSS corrections.

3 ---- Standard deviation of semi-major axis of error ellipse (meters)

4 ---- Standard deviation of semi-minor axis of error ellipse (meters)

5 ---- Orientation of semi-major axis of error ellipse (degrees from true north)

6 ---- Standard deviation of latitude error (meters)

7 ---- Standard deviation of longitude error (meters)

8 ---- Standard deviation of altitude error (meters)

(7) **VTG** - Course Over Ground and Ground Speed

The actual course and speed relative to the ground.

$GPVTG,x.x,T,x.x,M,x.x,N,x.x,K,a*hh<CR><LF>

1 2 3 4 5 6 7 8 9

Notes: 1,2 ---- Course over ground, degrees True

2,3 ---- Course over ground, degrees Magnetic

5,6 ---- Speed over ground, knots

7,8 ---- Speed over ground, km/hr

9 ------ Mode indicator: A = Autonomous mode

D = Differential mode

E = Estimated (DR)

M = Manual input mode

S = Simulator mode

N = Data not valid

(8) **ZDA** -Time and Date

UTC, day, month, year and local time zone

$GPZDA,hhmmss,xx,xx,xxxx,xx,xx*hh<CR><LF>

1 2 3 4 5 6

Notes: 1 --- UTC

2, 3, 4 --- Day, month & year

5 --- Local zone hours, 00 to ± 13 hrs.

6 --- Local zone in minutes, 00 to +59.

(9) **GBS** - GNSS Satellite Fault Detection (Modified MX version)

This message is used to support Receiver Autonomous Integrity Monitoring (RAIM) feature in the MX420 CDU. A special character flag was added for proper RAIM status determination.

$PMVXG,GBS,hhmmss.ss,x.x,x.x,x.x,xx,x.x,x.x,x.x,x*hh<CR><LF>

1 2 3 4 5 6 7 8 9

Notes:
1 ----- UTC time of the GGA or GNS fix associated with this sentence.
2 ----- Expected error in Latitude (meters)
3 ----- Expected error in Longitude (meters)
4 ----- Expected error in Altitude (meters)
5 ----- ID number of most likely failed satellite
6 ----- Probability of missed detection for most likely failed satellite
7 ----- Estimate of bias in meters on most likely failed satellite
8 ----- Standard deviation of bias estimate
9 ----- RAIM status mode; 0=safe, 1=caution, 2=unsafe

List of abbreviations

CDU	Control Display Unit
DGPS	Differential Global Positioning System
FDMA	Frequency Deviation Multiple Access
GLONASS	Global Orbiting Navigation Satellite System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HDOP	Horizontal Dilution Of Precision
IMO	International Maritime Organization
NMEA	National Marine Electronic Association
PDOP	Positional Dilution Of Precision
RAIM	Receiver Autonomous Integrity Monitoring
RTCM	Radio Technical Commission For Maritime
SBAS	Satellite Based Augmentation System
VDOP	Vertical Dilution Of Precision

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