



MX521 GPS/DGPS Sensor

Installation Manual



Leica



MX521

GPS/DGPS Sensor

INSTALLATION MANUAL

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.

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Unlike many other consumer electronics industries which only sell consumer electronic devices, your marine dealer is often your best advisor for installation and service of your new GPS receiver. MX Marine strongly encourages you to utilize the knowledge and experience of your sales and service dealer.

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General

This manual describes the operation and installation of the MX521G smart GPS and MX521 DGPS antenna sensors.

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

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

The models covered in this manual are:

MX521G - GPS only smart antenna

MX521 - DGPS smart antenna

When connected to an MX-CDU (i.e. MX420), the MX521 can be controlled to function in several modes, namely;

- GPS only
- Auto or manual DGPS mode using the Coast Guard beacon stations*
- 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 an MX420 CDU (software V2.0 or higher)
- 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 available in MX521G

MX521 DGPS Beacon Operation*

The MX521 sensor is an integrated GPS and beacon receiver unit that is fully automatic and usually does not require user intervention in most cases. It will automatically search for available satellites as soon as power is applied. The internal 2-channel beacon receiver in the MX521 continuously monitors all beacon signals available in a particular location. The first channel tracks the primary station while the second channel searches for other available beacons. Should it find a superior signal it will automatically switch the primary channel to the new station. The combined performance of the high-precision 12-channel GPS and 2-channel beacon receiver provides a more accurate position fix, usually within 6 feet or less.

The MX521 DGPS can either automatically tune to the beacon signals or can be controlled by an MX420 CDU to manually tune to a specific beacon frequency.

Satellite Based Augmentation System (SBAS)

In areas where land-based Coast Guard beacon stations are not available, the MX521 can be controlled (using the MX420 CDU) 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 GPS frequency. Refer to the MX420 Operator Manual for more details. Turning this feature ON in the MX420 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 system should not be used for navigation. This feature requires at least five or more 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 can not be guaranteed at that point in time. The operator is advised not to use the GPS for navigation until the RAIM indicator switches to (R+) denoting safe RAIM condition.

Position errors may be caused by unhealthy satellites, incorrect pseudoranges, poor DGPS corrections, excessive atmospheric interference and problems at particular reference stations.

Note: The MX CDU requires a special RAIM "license" to activate the RAIM feature in the MX521 DGPS smart antenna. Refer to the MX CDU Operator Manual for RAIM setup procedure.

* Not available with MX521G models.

MX521 Mounting

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.

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 (-)	

Supplied Equipment

The following items are supplied with the MX521 Kit:

<u>Description</u>	<u>Part Number</u>
MX521G GPS Sensor only	727027
or,	
MX521 DGPS Sensor	727010
Installation Manual	727011

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 (special order only)	3508 102 70185

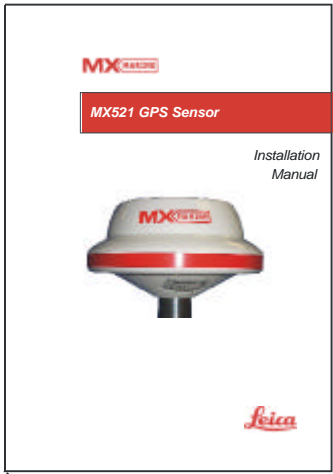
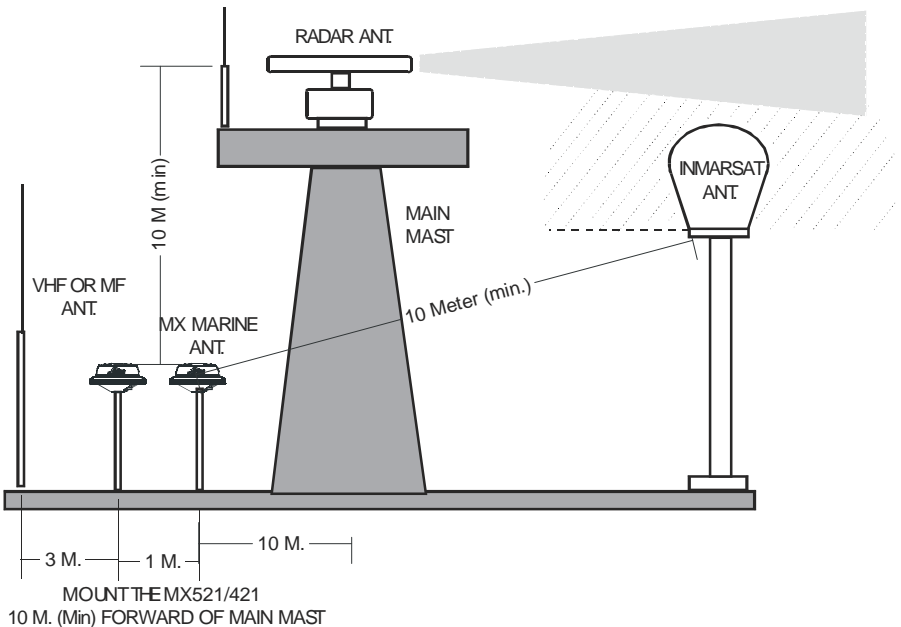


Figure 1 - MX521 DGPS Sensor Kit

MX521 Antenna Mounting Guidelines

- 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 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.

Note: *If you are not sure if the chosen location is appropriate, you can mount the antenna temporarily and operate it with the MX420 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.*



Installation Procedure

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 Figure 2 for bracket mounting illustration.

Note: Hand-tighten the antenna onto the bracket until snug. Do not over-tighten.

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

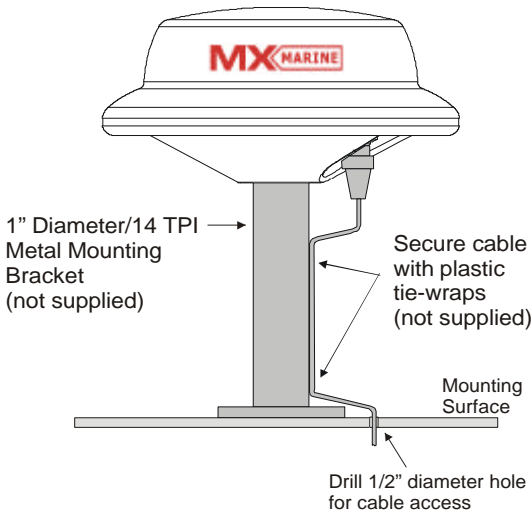


Figure 2 - MX521 Bracket Mounting

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 Figure 3 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 in Figure 3.

Fasten the antenna by using 4-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.

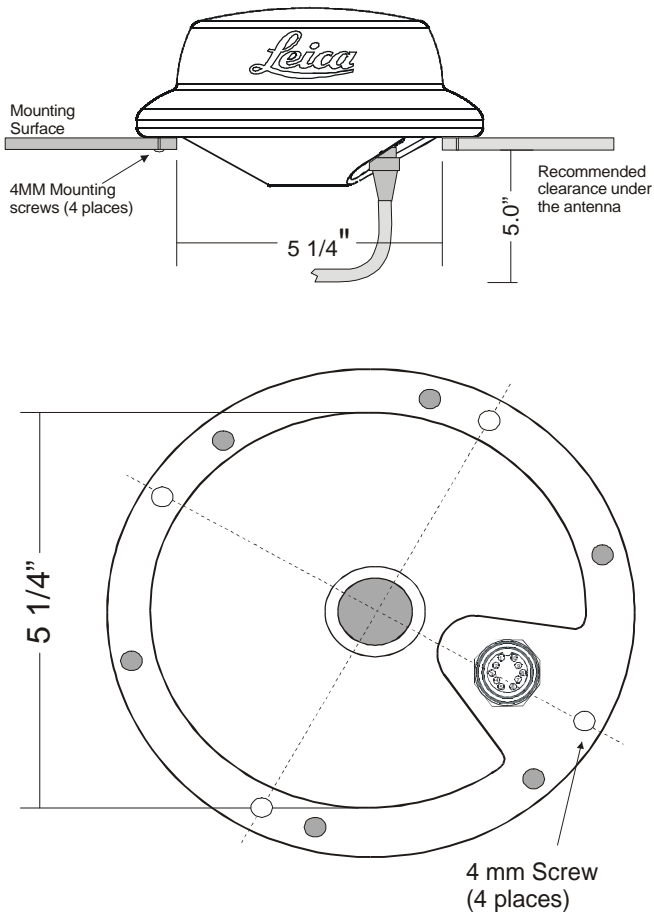


Figure 3 - MX521 Surface Mount

Antenna Cable Selection

The antenna cable assembly (with the 10-pin connector) 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. STP stands for Shielded Twisted Pair.

Part Number	Description
3508 102 70170	20 meter cable STP
3508 102 70180	40 meter cable STP
3508 102 70640	60 meter cable STP (Special order only)
3508 102 70185	80 meter cable STP

Note: *The maximum antenna cable length allowable for the MX521 is 80 meters. Exceeding this maximum length will degrade its operation.*

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 Marine control 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.

Note: 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.

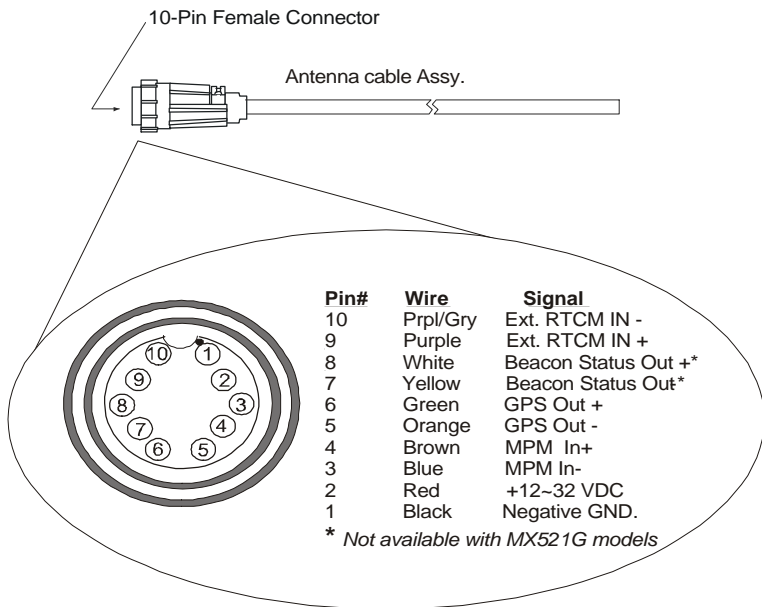


Figure 4 - Power/Data Cable Assembly

MX521 Connector Configuration

Refer to the diagram below for the POWER-DATA connector located at the underside of the MX521 :

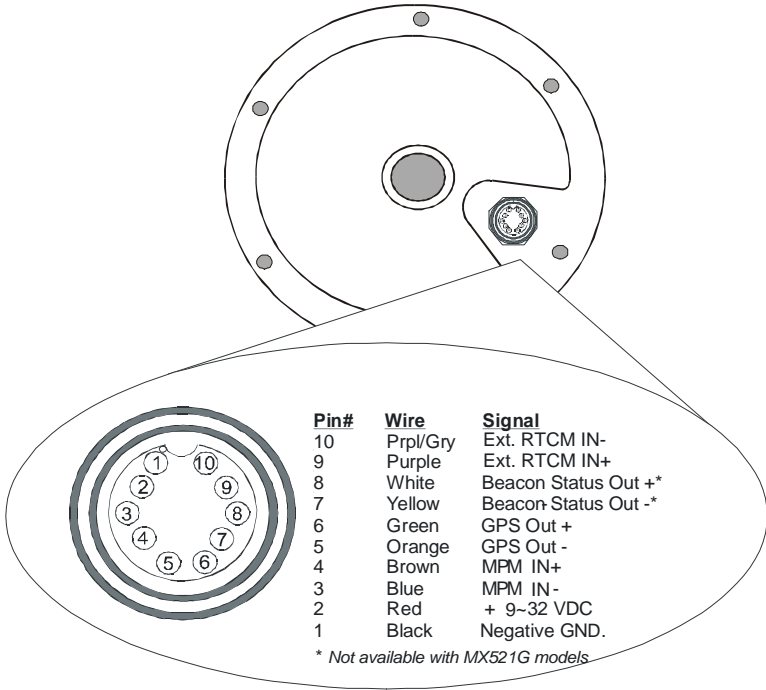


Figure 5 - MX521 POWER-DATA Connector

Where:

- Pins 1 & 2: Negative GND and +12 VDC power input.
- Pins 3 & 4: MX Marine 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 MX420/8 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 in Figure 6 to interface the MX521 to an MX420/2 or MK12 CDU.

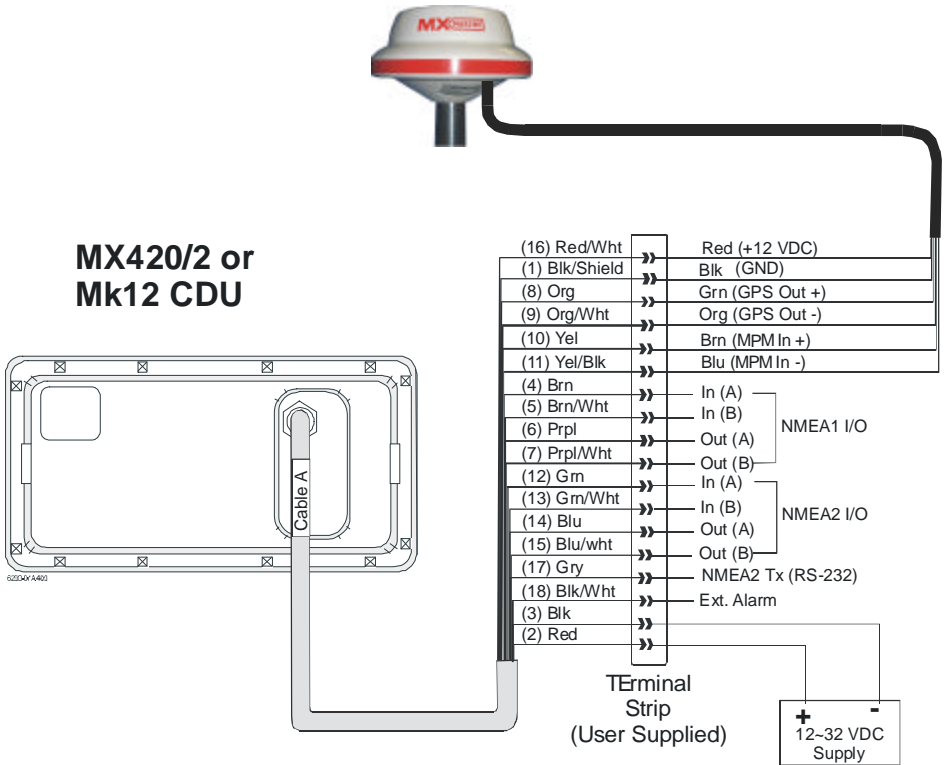


Figure 6 - MX521 Interface to MX420/2 or MK12 CDUs

Data Interface to MX420/8 or MX420/AIS CDU

Use the diagram in Figure 7 to interface the MX521 to an MX420/8 or MX420/AIS CDU. The external RTCM connection is optional.

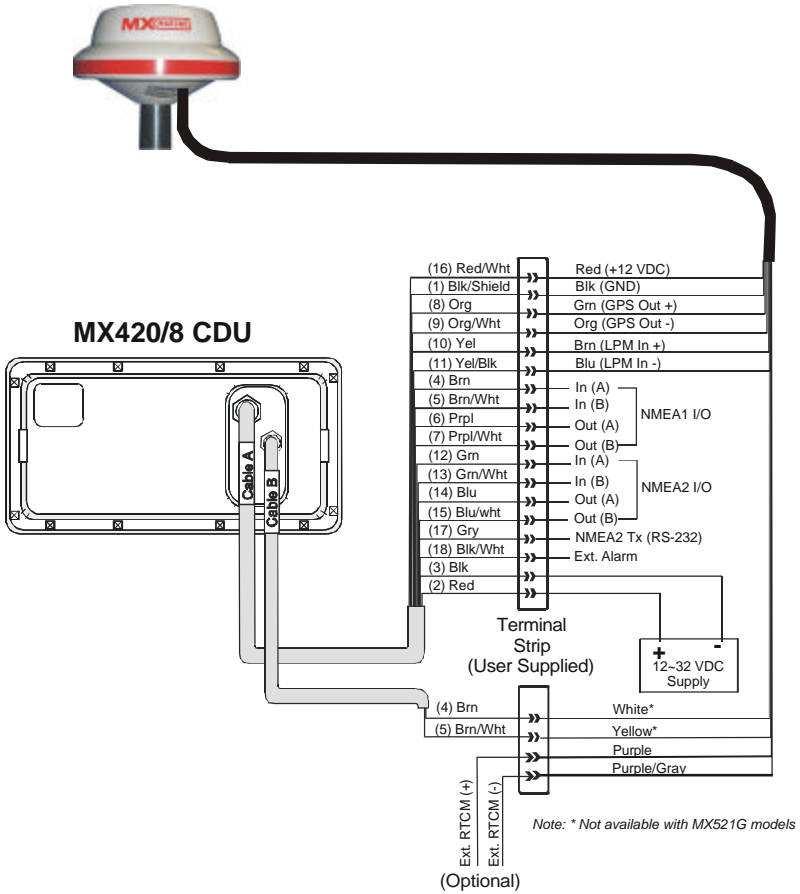


Figure 7 - MX521 Interface to MX420/8 or MX420/AIS CDUs

Data Interface to PC or Other Navigation Systems

Figure 8 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).

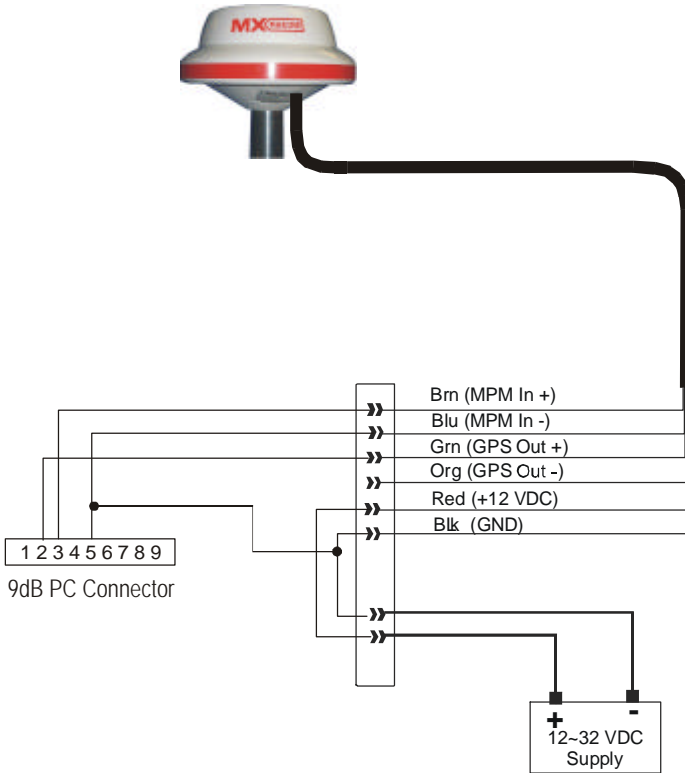


Figure 8 - MX521 Interface to Other Navigation Systems

MX521 Programming Cable

The programming cable is used for upgrading the software of the GPS and Beacon PCBs inside the MX521 smart antenna. Figure 9 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.

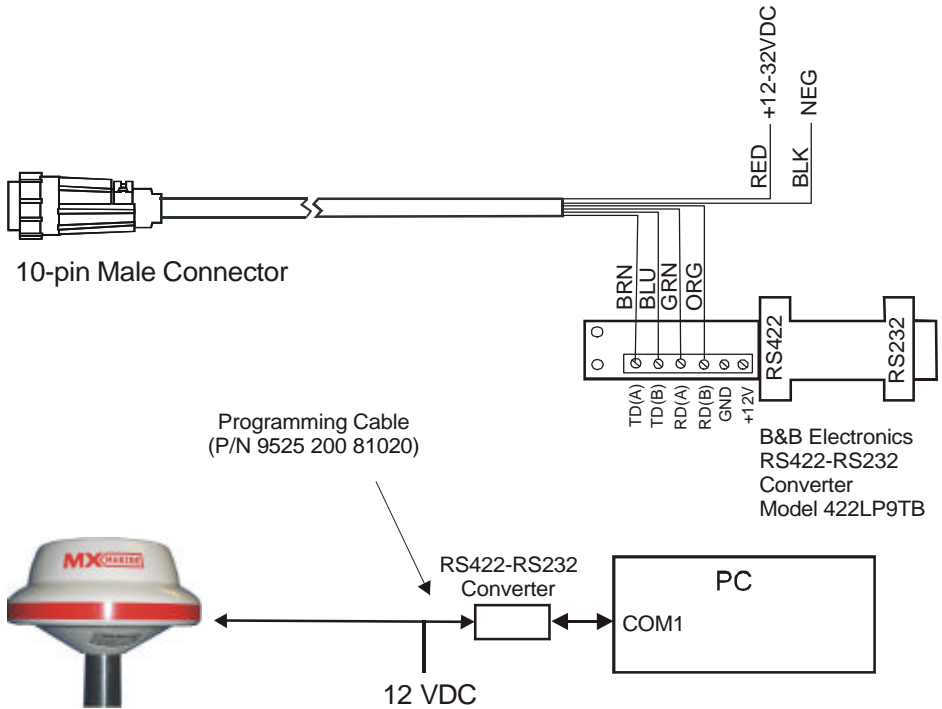


Figure 9 - MX521 Programming Cable Diagram

Specifications

GPS Receiver

Type:	L1, C/A Code (SPS) with carrier phase smoothing
Frequency:	1575.42 MHz
Channels:	12 Channels, parallel tracking
Update rate:	1 Hz (optional 5 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)
Antenna:	Patch
Position accuracy:	
With differential corrections from:	
Beacon Stations:	<2 meters (2D-RMS) typical depending on distance from differential base station.
Without differential corrections	<5 meters (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 or Manual
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 Degrees. C
Storage Temperature: -40 to 85 Degrees C
Humidity: "Exposed Category" (IEC 60945)

Mechanical

Dimensions: Height 4.0 in. (102 mm)
 Diameter 7 1/8 in (182 mm.)
Weights: (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

BSH and Wheelmark approval IMO MSC 112(73)
IEC 60945 ed. 3, CE and FCC compliant



Note: MX Marine reserves the right to make changes in its products and specifications without notice.

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 Marine 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*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.

\$GPGGA,a,x,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,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 pseudoranges & 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 \pm 13 hrs.
6 --- Local zone in minutes, 00 to +59.

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

PRODUCT WARRANTY AND LIMITATION OF LIABILITY

This product is warranted by MX Marine (the “Seller”) to original purchaser (the “buyer”) for use only to be free of all defects in material and workmanship for a period of twelve (12) months from date of purchase by Buyer.

If during the warranty period, this product or parts thereof (“Product”) are found to be defective in material or workmanship, Seller shall repair or replace the defective Product, at the discretion of the Seller.

In order to claim this warranty service, Buyer shall return the defective Product, together with proof of purchase to Seller or its authorized service representative and pay all transportation charges, duties, and taxes associated with the return of the Product to Seller. Seller shall reimburse Buyer for costs of the return to Buyer of Product found to be defective and covered by this warranty. Product which is repaired or replaced under the warranty is covered by this warranty for the remainder of the original warranty period or for a period of ninety (90) days after return shipment to Buyer, whichever is longer.

SELLER’S MAXIMUM LIABILITY ARISING FROM USE OF SELLER’S PRODUCT SHALL NOT EXCEED AND BUYER’S REMEDY IS LIMITED IN ANY EVENT TO REPAIR OR REPLACEMENT AND REIMBURSEMENT FOR COSTS ASSOCIATED WITH THE RETURN OF THE DEFECTIVE PRODUCT AS PROVIDED HEREIN; AND SUCH REMEDY SHALL BE THE BUYER’S ENTIRE AND EXCLUSIVE REMEDY.

This warranty does not apply to failure of any equipment not sold to Buyer by Seller, or to any Product which has been subjected to misuse, lightning, an accident, or improper installation, maintenance or application, nor does it extend to any Product which has been repaired or altered by anybody other than the Seller or its authorized service representative, unless such repair or alteration was authorized in writing by Seller. This warranty also does not apply to batteries and losses or damage due to the batteries. Since the GPS system on which the Product operates is furnished by the U.S.. Government, not Seller, the Seller shall not be responsible for the GPS system or changes in the GPS System availability, coverage or accuracy.

THIS PRINTED LIMITED WARRANTY IS ACCEPTED BY BUYER IN LIEU OF ANY OTHER WARRANTY FOR THE PRODUCT, WHETHER EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

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THIS PRODUCT 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.



How are we doing?

**Please help us to help you and our other
valued customers by**

sending us your evaluation of this manual. We need to know such things as:

- is the manual complete, or do you need more (or less) information?
- can you find the information you need easily?
- is the information easy to understand, or could we be clearer?
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