MAGNAVOX
DGPS 12 CHANNEL
TECHNICAL REFERENCE
MANUAL

Prepared by

Leica, *Torrance*
23820 Hawthorne Blvd., Suite #200
Torrance, California 90505

Printed in the United States of America
1994

TABLE OF CONTENTS

ILLUSTRATIONS

TABLES

FOREWORD

This manual contains programming information about the MX 9212 DGPS Navigator, the MX 9012R DGPS Reference Station and the MX 9112 Navigator/Reference Station. The characteristics and capabilities of these equipments are detailed in the PC Controller User's Guide identified in Section 1.2, References. The information in this manual will enable you to develop your own applications software.

The Global Positioning System (GPS) satellites that furnish the DGPS Receivers with orbital time and range data are experimental, and will continue to be so for the next few years. The United States Government may modify or deactivate the operation of the satellites at any time. For these reasons, Leica reserves the right to change the capabilities and specifications of the MX 9212, MX 9012R and the MX 9112 without notice.

SECTION I

INTRODUCTION

The MX 9212 is a 12 channel DGPS Navigator which processes measurements transmitted from GPS satellites to produce three dimensional position and time. Differential (DGPS) corrections, transmitted from the Reference Station, are received on the DGPS/RTCM port and are applied to the satellite measurements to refine the calculated GPS position.

The MX 9012R DGPS Reference Station produces differential GPS position corrections which can be transmitted to DGPS navigators.

The MX 9112 functions as either a 12 channel DGPS Navigator or Reference Station as configured by the user. When functioning as a Navigator, the MX 9112 accepts DGPS corrections on the DGPS/RTCM port. As a Reference Station, the MX 9112 computes DGPS corrections and transmits them on the DGPS/RTCM port.

Although the MX 9212, MX 9012R, and the MX 9112 have different capabilities, they all share the same basic command and control structure. Four (4) serial interface ports are used for command and control, output of measurement data, output or receipt of differential data, and output of standard NMEA messages to other electronic marine devices. Magnavox has developed a set of proprietary sentences in accordance with the NMEA-0183 standard (for interfacing Marine Electronics Navigation Devices) to command and control these equipment.

This guide is designed to provide programming information to facilitate integration of these equipments in embedded applications. All possible sentences for the MX 9212, MX 9012R and the MX 9112 are described herein. Some sentences may not be used by all of the equipment. The equipment for which the sentence applies is identified at the top of each table. Additionally, any differences are identified in the highlighted box.

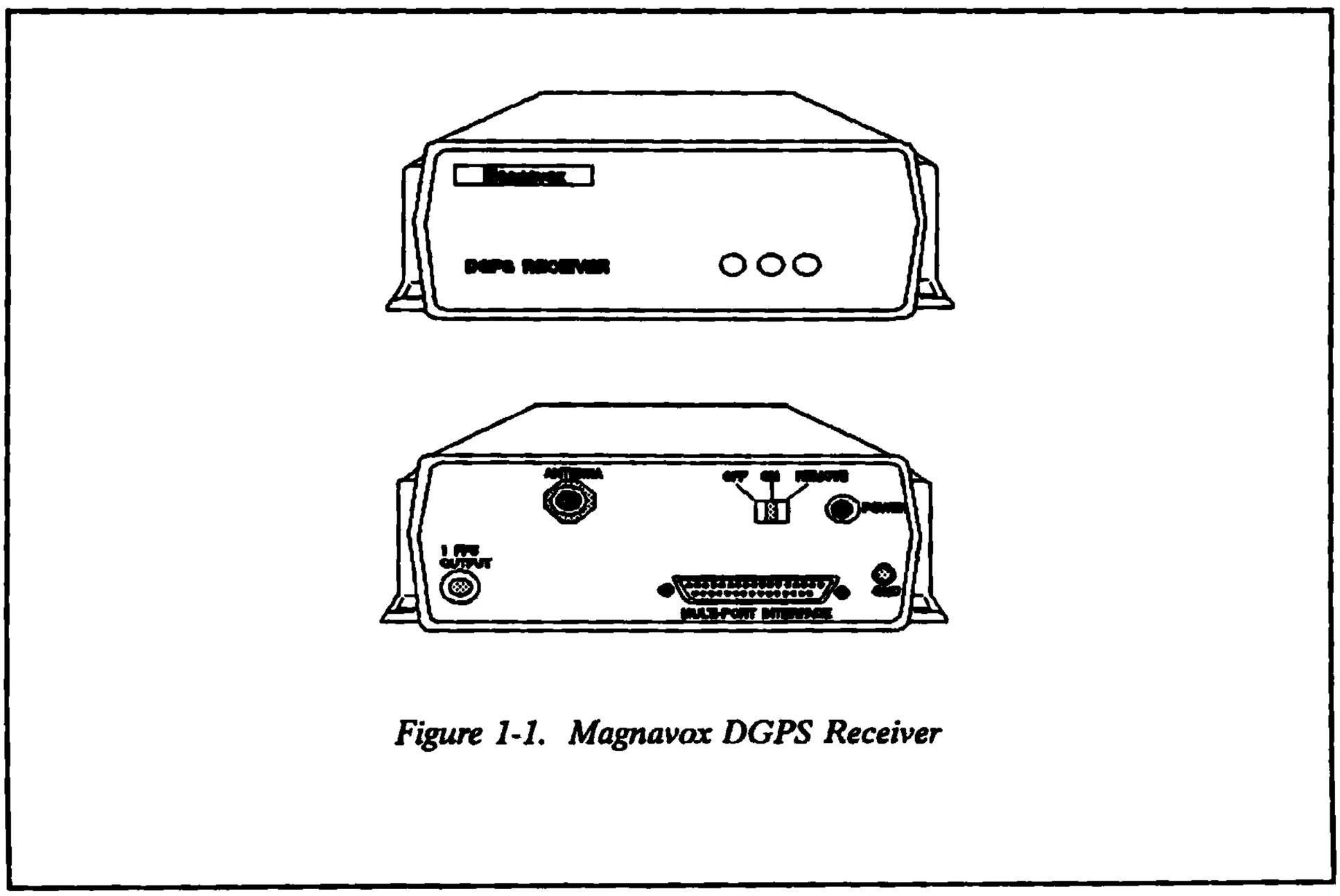


Figure 1-1. Magnavox DGPS Receiver

MANUAL ORGANIZATION

The information in this manual is organized by sections and appendices, so the table of contents will be your basic guide for finding information categories. The alphabetical index at the back of the manual is a more detailed guide for finding specific subjects. The contents are organized as follows:

- SECTION I, Introduction: Describes the organization of this manual and lists supporting documentation.
- SECTION II, The Multi-Port Interface: Defines the operational configuration of the receiver.
- SECTION III, Control Port: Describes the communication protocol and data formats of the Magnavox Proprietary messages; specifies the content definition of the data sentences assigned to the Control Port.
- SECTION IV, Instrumentation/Raw Data Port: Specifies the structure and content definition of the data records assigned to the Instrumentation/Raw Data Port.
- SECTION V, DGPS/RTCM Port: Identifies the format and types of RTCM messages assigned to the DGPS/RTCM Port.
- SECTION VI, Equipment/NMEA Port: Describes the communication protocol and data formats of the standard NMEA-0183 messages assigned to the Equipment/NMEA Port.
- APPENDIX A, Compressed Measurement Format: Structure and content definition of the compressed measurement record (Type 3) assigned to the Instrumentation/Raw Data Port.
- GLOSSARY OF TERMS Definition of terms used in the manual that are applicable to satellite navigation.

The manual contents have been prepared and organized for maximum clarity and reader convenience. We welcome your suggestions for manual improvement by letter, telephone, or the tearout sheet at the back of this manual.

REFERENCED DOCUMENTS

Other documentation that you may find useful for information purposes are identified below:

- Magnavox DGPS 12 Channel Installation and Service Manual, R-7218: Contains procedures for installing and maintaining the Magnavox Navigator. Provides details of the electrical characteristics of the data interfaces.

- Magnavox DGPS 12 Channel Navigator's Operator's Manual, R-7220: Describes how to connect and operate the Magnavox Navigator using the Magnavox developed Control and Display (CDU) program.

- Magnavox DGPS 12 Channel Reference Station Operator's Manual, R-7277: Describes how to connect and operate the Magnavox Reference Station using the Magnavox developed Control and Display (CDU) program.

- NMEA-0183 Specification: Defines the hardware and software requirements for an NMEA-0183 data interface.

- EIA RS-232C Specification: Defines the hardware and software requirements for an RS-232 data interface.

- EIA RS-422 Specification: Defines the hardware and software requirements for an RS-422 data interface.

- RTCM-104 Specification: Defines the record structure for the standard RTCM-104 messages computed by the MX 9012R for differential GPS correction data:

  RTCM Special Committee No. 104, *RTCM Recommended Standards for Differential NAVSTAR GPS Service, Version 2.0* Washington, D.C.; Radio Technical Commission for Maritime Services, 1990

- ICD-GPS-200 Specification: Defines the GPS satellite data format.

SECTION II

THE MULTI-PORT INTERFACE

The multi-port interface gives the user the following capabilities:

- Control of the receiver, using Magnavox proprietary messages
- Output of measurement and processed data for logging and display
- Output of position, track and speed to external equipment that communicates with standard NMEA-0183 messages.
- Receipt of differential corrections transmitted from a DGPS Reference Station (MX 9212, MX 9112 configured as a Navigator).
- Transmission of differential corrections to DGPS Navigators (MX 9012R, MX 9112 configured as a Reference Station)

OPERATIONAL CONFIGURATION

The multi-port interface consists of four serial, bi-directional data ports. The ports can be used for CDU control, measurement output, differential correction I/O, and output of standard NMEA-0183 messages. Users can assign the ports in accordance with their requirements. Figure 2-1 shows the general function of each port.

The default port function assignments are as follows:

PORT 1 (RS-232): PC Control
PORT 2 (RS-422): Instrumentation/Raw Data Output
PORT 3 (RS-232): Differential Correction I/O (DGPS/RTCM)
PORT 4 (RS-422): Equipment/NMEA I/O

PORT FUNCTIONS

The serial data ports are referred to by names that reflect their function as follows:

- Control Port: Used to initialize, monitor and control the receiver. Control Port sentences are detailed in Section III.
- Instrumentation/Raw Data Port: Used to output measurement and processed data from the receiver in a Magnavox defined format. Information such as satellite measurements, position, velocity, ephemeris and almanac are output. Instrumentation/Raw Data Port records are detailed in Section IV and in Appendix A.
- DGPS/RTCM Port: Used to send RTCM-104 differential correction messages to remote DGPS navigators or receive differential corrections from remote DGPS reference stations. This port is typically connected to a modem data link. It can also be used to communicate with an MX-50M Beacon Modulator or MX-50R Beacon Receiver.

- **Equipment/NMEA Port: Used to send position, track and speed information to external equipment that communicates with standard NMEA-0183 messages in addition to all Magnavox proprietary messages.**

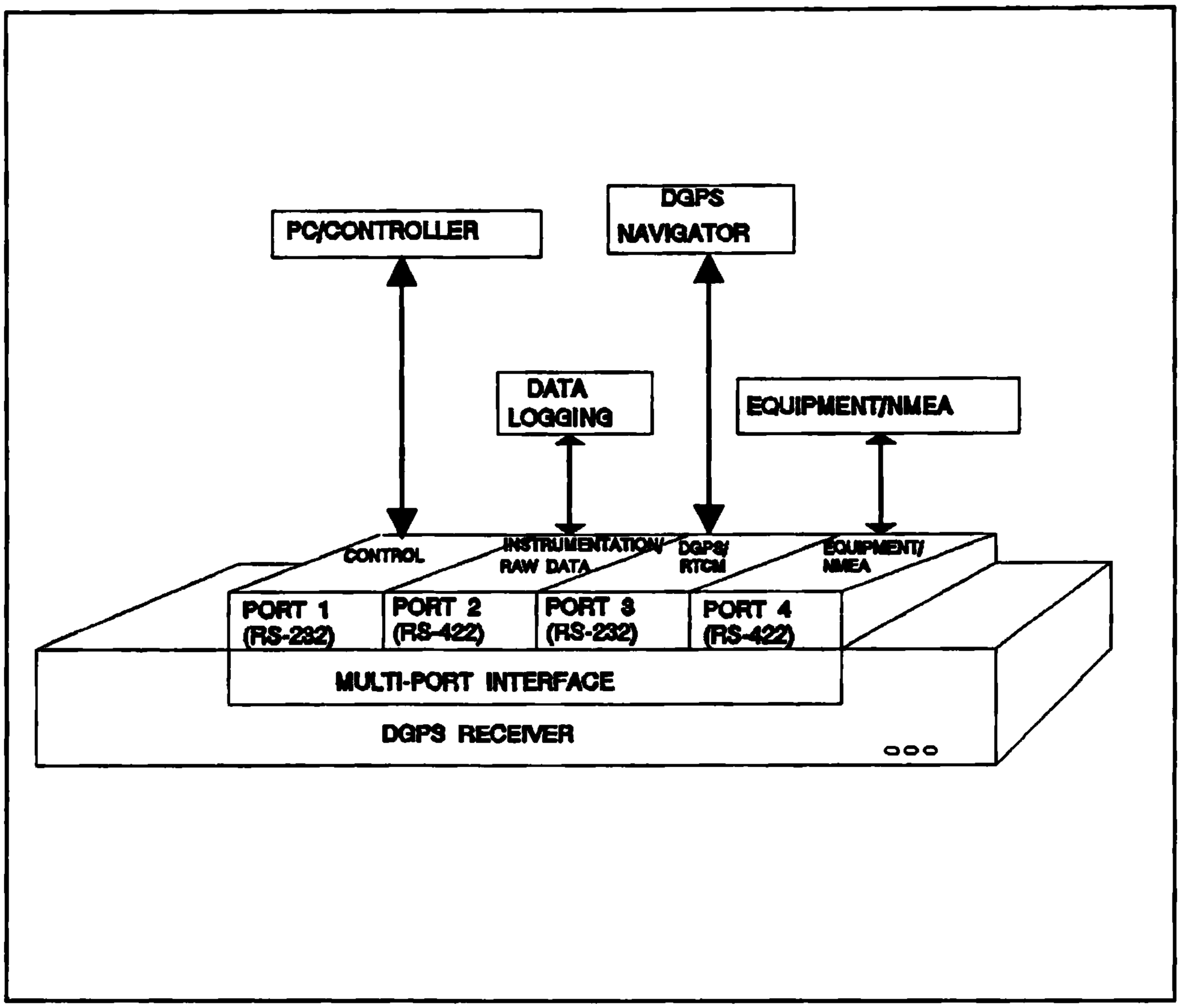


Figure 2-1. Typical Multi-Port Interface Configuration

SECTION III

CONTROL PORT

The Control (or CDU) Port is used to initialize, monitor and control the receiver. The structure of the Control Port sentences is based on the NMEA-0183 Standard for interfacing Marine Electronics Navigation Devices (Version 1.5). For details beyond those provided in this manual, refer to the NMEA-0183 Specification.

Reserved characters are used to indicate the beginning and the end of records in the data stream, and to delimit data fields within a sentence. Only printable ASCII characters (Hex 20 through 7F) may be used in the sentences. Table 3-1 lists the reserved characters and defines their usage. Figure 3-1 illustrates the general Magnavox proprietary NMEA sentence format.

Table 3-1. NMEA Sentence Reserved Characters

Character	Hex Value	Usage
$	24	Start of Sentence Identifier
{CR}{LF}	0D 0A	End of Sentence Identifier
,	2C	Sentence Field Delimiter
*	2A	Optional Checksum Field Delimiter

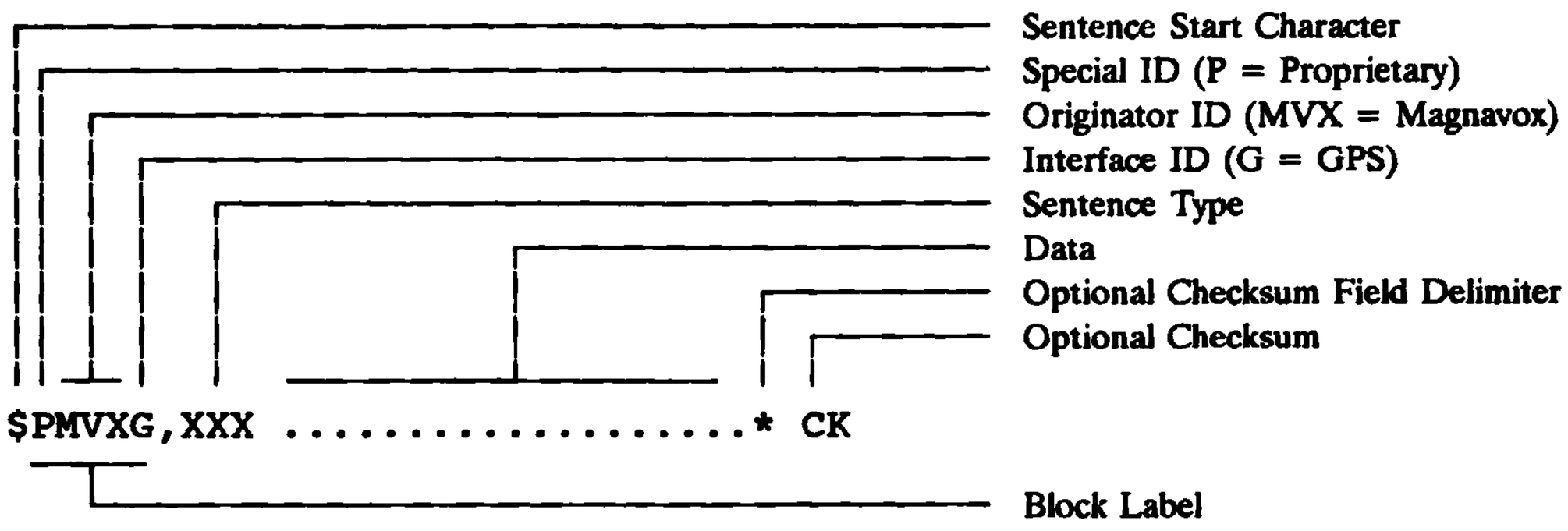


Figure 3-1. Magnavox Proprietary NMEA Sentence Format

Following the start character ($), are five characters which constitute the block label of the sentence. For the Magnavox proprietary sentences, this label is always PMVXG. The next field after the block label is the sentence type, consisting of the three decimal digits.

The data, delimited by commas, follows the sentence type. The data is defined for each record in the Control Port I/O tables. Note that the receivers use a free-format parsing algorithm, so you need not send the exact number of characters shown in the examples. You will need to use the commas to determine how many bytes of data need to be retrieved.

The notation CK, shown in Figure 3-1, symbolically indicates the optional checksum in the examples. The checksum is computed by exclusive 'ORing all of the bytes between the $ and the * characters. The $, * and the checksum are not included in the checksum computation.

Checksums are optional for Control Port input sentences, but are highly recommended to limit the effects of communication errors. The MX 9212, MX 9012R, and the MX 9112 always generate checksums for Control Port output sentences.

ASCII data characters are transmitted in the following format:

- Data Bits 8 (msb always 0)
- Parity None
- Stop Bits 1

NULL fields are fields which do not contain any data. They would appear as two commas together in the sentence format, except for the final field. Some Magnavox proprietary sentences require that the format contain NULL fields. NULL fields in the following formats are identified in the highlighted boxes, and by an '*' next to the respective field.

CONTROL PORT SENTENCES

Tables 3-2 and 3-3 give a complete list of the Control Port sentences used by the MX 9212, the MX 9012R, and the MX 9112. An 'X' beneath the equipment name identifies whether that message is used by that device. In the case of the MX 9112, attention must be paid to the configuration mode; i.e. whether the MX 9112 is configured as a navigator or as a reference station.

Table 3-2. Control Port Input Sentences

Type $PMVXG,	Description	MX 9212	MX 9012R	MX 9112 Nav	MX 9112 Ref Stn
000	Receiver Initialization - Part A	X	X	X	X
001	Receiver Initialization - Part B	X	X	X	X
002	Satellite Health Control	X	X	X	X
007	Control Port Output Control	X	X	X	X
018	Restart Control	X	X	X	X
019	Oscillator Fit Parameters	X	X	X	X
020	Self-Test Control	X	X	X	X
023	Time Recovery Configuration	X	X	X	X
024	Instrumentation/Raw Data Port Output Selection	X	X	X	X
026	Equipment/NMEA Port Output Control	X	X	X	X
027	Instrumentation/Raw Data Port Output Settings	X	X	X	X
029	Constellation Selection Control	X	X	X	X
032	Tepid Start Limit	X	X	X	X
034	Beacon Receiver Configuration Control	X		X	
035	Reference Station/Navigator Selection			X	X
036	Self Survey Control	X		X	
041	User Entered Beacon Almanac	X	X	X	X
050	Differential Output Control		X		X
051	Send DGPS/RTCM Message		X		X
053	Differential Input Control	X		X	
060	MX-50M Control		X		X
062	MX-50M Reset		X		X
070	Serial Port Configuration	X	X	X	X
071	Serial Port Selection	X	X	X	X
074	Instrumentation/Raw Data Port Output Selection	X	X	X	X
YYY	Query From Remote Device to Output Sentence	X	X	X	X

Table 3-3. Control Port Output Sentences

Type $PMVXG,	Description	MX 9212	MX 9012R	MX 9112 Nav	MX 9112 Ref Stn
000	Receiver Status	X	X	X	X
001	Position and altitude	X	X	X	X
003	DOPs	X	X	X	X
004	Operating Mode	X	X	X	X
006	Satellite Health Status	X	X	X	X
011	Speed and Heading	X	X	X	X
014	MX-50R Beacon Status	X		X	
015	RTCM Input Port Statistics	X		X	
020	Self-Test Results	X	X	X	X
021	Position, Height and Velocity	X	X	X	X
022	Nav Constellation	X	X	X	X
023	Position, Height, COG and SOG	X	X	X	X
027	RTCM Type 16 Message	X		X	
030	Software Configuration	X	X	X	X
031	Almanac Collection Status	X	X	X	X
033	RTCM Type 3 Message	X	X	X	X
034	MX-50R Configuration	X		X	
035	Software Configuration	X	X	X	X
036	Self Survey Results	X		X	
037	GGA/GLL Configuration	X	X	X	X
039	Magnavox Maintenance Message	X	X	X	X
040	Broadcast Beacon Almanac	X	X	X	X
041	User Entered Beacon Almanac	X	X	X	X
050	Differential Output Control		X		X
052	Oscillator Offset	X	X	X	X
053	Differential Configuration	X		X	
060	MX-50M Configuration		X		X
061	MX-50M Failure		X		X
070	Serial Port Configuration	X	X	X	X
071	Serial Port Assignment	X	X	X	X
074	Instrumentation/Raw Data Port Output Records	X	X	X	X
100	GPS Channel Status	X	X	X	X
101	Control Sentence Accept/Reject	X	X	X	X
121	Predicted Position, Height, Velocity	X	X	X	X
123	Predicted Position, Ht, COG & SOG	X	X	X	X
500	CDU Position and Altitude	X	X	X	X
502	Almanac and Ephemeris Health	X	X	X	X
523	Time Recovery Configuration	X	X	X	X
524	Instrumentation/Raw Data Port Output Records	X	X	X	X
532	Tepid Hold-off	X	X	X	X
533	GPS Date	X	X	X	X
671	RTCM Type 1 Differential Corrections		X		X
672	RTCM Type 2 Differential Corrections		X		X
830	Time Recovery Results	X	X	X	X

Sentence Type - **$PMVXG,000**

Description: Receiver Initialization - Part A

This message initializes time, position, and antenna height. For Reference Stations, the position contained in this message must be the surveyed coordinates of the Reference Station antenna. For navigators which are not currently navigating, this position is used as the system position. The altitude used here is the value which will be used for all 2D navigation except when Altitude Hold Selection is set to COAST (refer to input sentence $PMVXG,001 for additional information).

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Day		Int	1 - 31 Default = None
2	Month		Int	1 - 12 Default = None
3	Year (last 2 digits)		Int	0 - 99 Default = None
4	GMT Time	HHMMSS	Int	HH: 0 - 23 MM: 0 - 59 SS: 0 - 59 Default = None
5	WGS-84 Latitude	Deg, Min	Float	Deg: 0 - 89 Min: 0 - 59.99 Default = 00 00.00
6	North/South Indicator		Char	N, S Default = N
7	WGS-84 Longitude	Deg, Min	Float	Deg: 0 - 179 Min: 0 - 59.99 Default = 00 00.00
8	East/West Indicator		Char	E, W Default = E
9	Altitude (WGS-84 ellipsoid or MSL as specified in field #13)	Meters	Float	±99999.0 Default = 0.0
10	Altitude Reference Selection		Int	0 = WGS-84 Ellipsoid 1 = MSL (Geoid) Default = 0

Example:

$PMVXG,000,10,03,1993,100000,,,,,*49
$PMVXG,000,,,,,3350.50004,N,11820.20000,W,46.01,1*71

Sentence Type - $PMVXG,001

Description: Receiver Initialization - Part B

This message initializes the altitude hold mode, horizontal and vertical acceleration constants, the maximum HDOP, VDOP and elevation limits, the time output mode, and the local time offset.

IMPORTANT
Fields marked with an 'X' must be set to NULL for the MX 9012R and for the MX 9112 when configured as a Reference Station.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
*1	Altitude Hold Selection - Auto and Coast modes transition to 2D when tracking < than 4 sats.		Int	0 = 3D Only 1 = Auto (use operator entered value) 2 = 2D Only 3 = Coast (use last altitude computed) Default = 3
2	Reserved			
*3	Horizontal Acceleration Constant	m/sec^2	Float	Default = 0.01
*4	Vertical Acceleration Constant	m/sec^2	Float	Default = 0.00
*5	VDOP Limit		Int	>1 Default = 10
*6	HDOP Limit		Int	>1 Default = 10
7	Elevation Limit (sat is not used if elevation angle exceeds limit)	Deg	Int	0 - 90 Default Navigator = 5° Default Reference Sta. = 0°
8	Time Output Selection		Char	U = UTC L = Local Default = U
9	Local Time Offset From GMT	HHMM	Int	HH: ± 0 - 23 MM: 0 - 59 Default = 0

Example:

$PMVXG,001,1,,1.00,0.10,7,5,7,,*61
$PMVXG,001,3,,0.10,0.01,10,10,5,L,-0800*0A

Sentence Type - **$PMVXG,002**

Description: Satellite Health Control

This message allows the user to change or restore the default health status for a particular satellite. The health code may be forced healthy, unhealthy, or restored to the default contained in the almanac or ephemeris (referred to as the 'natural' state).

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	PRN of Satellite		Int	1 - 32 99 = Set All 32 Sats to Status Defined Below Default = None
2	Health Control Code		Char	N = Natural Health + = Force Healthy - = Force Unhealthy Default = None

Example:

$PMVXG,002,05,+*64
$PMVXG,002,06,+*67
$PMVXG,002,07,-*60
$PMVXG,002,08,-*6F
$PMVXG,002,20,N*06

Sentence Type - $PMVXG,007

Description: Control Port Output Control

This message enables or disables output of the specified sentence and defines the output rate. The user sends this message for each sentence that the receiver is to output.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Control Port Output Block		Char	Default = None
2	Clear Current Output List		Int	0 = No 1 = Yes Default = None
3	Add/Delete Sentence From List		Int	1 = Append Sentence to Output List 2 = Delete Sentence From Output List Default = None
4	Reserved			
5	Sentence Output Rate	Sec	Int	1 - 9999 Default = None
6	Speed/Position Precision for GGA and GLL sentences (# of places to the right of the decimal point)		Int	2 = 2 Digits 3 = 3 Digits 4 = 4 Digits Default = 2
7	NMEA Version for GGA & GLL Output		Int	1 = Version 1 2 = Version 2 Default = 1
8	Reserved			

Example:

$PMVXG,007,533,,1,,10,,,*4A
$PMVXG,007,015,,1,,10,,,*4B
$PMVXG,007,015,,2,,,,,*49

Sentence Type - **$PMVXG,018**

Description: Restart Control

This message causes the receiver to terminate operation and restart in either the warm, cold, tepid or oscillator + cold states, as specified.

WARM: The receiver will restart using the current values entered by the operator (same as power fail).

COLD: The receiver will clear memory of all changes and revert to the factory defaults in ROM. All navigation information will be lost and the receiver will restart in Search the Sky mode.

TEPID: An intermediate startup between a warm start and a cold start. It is reverted to when there is an almanac, but the time and position are unknown.

OSCILLATOR + COLD: The receiver will perform all cold start functions and additionally, will erase the oscillator parameters located in the EEROM.

IMPORTANT
The receiver contains battery backed up memory. Values that are changed will stay changed until a cold start message is sent.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Restart Selection		Char	C = Cold W = Warm T = Tepid O = Oscillator + Cold Default = None

Example:

$PMVXG,018,C

Sentence Type - $PMVXG,019

Description: Oscillator Fit Parameters

This message allows the user to modify the oscillator temperature/frequency model coefficients in the RAM and EEROM memory. These are the coefficients to the cubic equation used to compute the oscillator frequency offset at a given temperature.

IMPORTANT
This message should not be used without Magnavox direction.

Equipment: MX 9212, MX 9012R				
Field	**Description**	**Units**	**Format**	**Range**
1	Constant term of the cubic equation given in reference oscillator Hz. For example, if the curve has a 12 Hz bias from nominal, enter 10230012.0 as the constant term (nominal = 10230000.0)	Hz	Float	Default = 10230000
2	1st order term of the cubic frequency model	Hz/°C	Float	Default = 1.31923
3	2nd order term of the cubic frequency model	$Hz/°C^2$	Float	Default = -0.073775
4	3rd order term of the cubic frequency model	$Hz/°C^3$	Float	Default = 0.000955
5	Reserved			NULL

Example:

Sentence Type - **$PMVXG,020**

Description: Self-Test Control

This message is used to activate a particular type of test in the receiver. Field 1 contains the test type to be performed. Fields 2 and 3 are parameters which will be used in the various tests, if required. Refer to output type $PMVXG,020 for a description of the results returned.

Equipment: MX 9212, MX 9012R, MX 9112			
Test Type (field #1)	Description	Test Parameter #1 (field #2)	Test Parameter #2 (field #3)
1	Self-Test	N/A	N/A

Example:

$PMVXG,020,1

Sentence Type - **$PMVXG,023**

Description: Time Recovery Configuration & Predicted Position Output Control

This message allows the user to configure the Time Recovery feature of the receiver.

IMPORTANT
Fields containing an '*' must be set to NULL for Reference Stations.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
*1	Time Recovery Mode Dynamic = solve for position, altitude and time while moving; Static = solve for position, altitude and time while stationary; Known Position = solve for time only; No Time Recovery = disable clock synchronization, navigation is dynamic;		Char	D = Dynamic S = Static K = Known Position N = No Time Recovery Default = D
2	Time Synchronization		Char	U = UTC, G = GPS Default = G
3	Time Mark Mode		Char	A = Always, V = Valid Pulses Only Default = V
4	Maximum Time Error - the maximum error for which a time mark will be considered valid.	Nsec	Int	50 - 1000 Default Navigator = 100 Default Reference Sta.= 1000
5	User Time Bias - external bias.	Nsec	Int	±99999 Default = 0
6	Time Recovery Message Control (830) & Predicted Position Output Control (121 & 123) ** Note: 121 and 123 are exclusive and cannot be on at the same time.		Int	Bits 1 & 0: **Output 830** 00 = No Output, 01 = Control Port 10 = Equipment, 11 = Raw Data Bits 3 & 2: **Output 121** 00 = No Output, 01 = Control Port 10 = Equipment, 11 = Raw Data Bits 5 & 4: **Output 123** 00 = No Output, 01 = Control Port 10 = Equipment, 11 = Raw Data Default = 0
7	Position Known PRN		Int	1 - 32, 0 = Track All Sats Default = 0

Example:

$PMVXG,023,K,U,A,50,500,5,0*0F
$PMVXG,023,K,G,V,100,0,0,*0E

Sentence Type - **$PMVXG,024**

Description: Instrumentation/Raw Data Port Output Selection*

This message controls which raw data records are output on the Instrumentation/Raw Data Port. The list below indicates which record types are affected by each selection. For a complete description of the contents of these sentence types, refer to Section IV, Instrumentation/Raw Data Port Records.

Input sentence type $PMVXG,027 provides additional control for the format of the Measurements record and the request to output Almanac and Ephemeris data once, when commanded.

Selection	Record Type
Nav Results	8, 308, 310
Measurements	1, 3, 311, 321, 331, 351
Almanac & Ephemeris	100 - 150, 200 - 203
Constellation	401, 411 - 422
Time Recovery	969
Full Debug	Various
Partial Debug	Various

Equipment: MX 9212, MX 9012R, MX 9112

Field	Description	Units	Format	Range
1	Nav Results		Char	- = Disable Output + = Enable Output Default = +
2	Measurements		Char	- = Disable Output + = Enable Output Default = +
3	Almanac & Ephemeris		Char	- = Disable Output + = Enable Output Default = +
4	Constellation Information		Char	- = Disable Output + = Enable Output Default = -
5	Time Recovery		Char	- = Disable Output + = Enable Output Default = -
6	Full Debug Diagnostics		Char	- = Disable Output + = Enable Output Default = -
7	Partial Debug		Char	- = Disable Output + = Enable Output Default = -

NOTE:
* This sentence (and input sentence $PMVXG,027) have been replaced by input sentence $PMVXG,074.

Example:

$PMVXG,024,+,+,+,+,+,+,+*49

Sentence Type - **$PMVXG,026**

Description: Equipment/NMEA Port Output Control

This message enables/disables output of the specified sentence to the Equipment/NMEA port and defines the output rate. The user sends this message for each sentence that the receiver is to output. Either standard NMEA or Magnavox Proprietary messages may be output to the Equipment/NMEA Port.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Equipment Port Output Block		Char	Default = None
2	Clear Current List		Int	0 = No 1 = Yes Default = None
3	Add/Delete Sentence From List		Int	1 = Append Sentence to Output List 2 = Delete Sentence From Output List Default = None
4	Sentence Output Rate	Sec	Int	1 - 9999 Default = None
5	Position Precision (number of decimal units in position output)		Int	2-4
5	NMEA Version for GGA & GLL Output		Int	1 = Use NMEA Version 1 2 = Use NMEA Version 2

Example:

$PMVXG,026,021,0,1,1,2,2

Sentence Type - **$PMVXG,027**

Description: Instrumentation/Raw Data Port Output Control.*

This sentence is used in conjunction with input sentence $PMVXG,024. The Instrumentation/Raw Data Port defines in which format measurement data is output and whether to output almanac and ephemeris data once (now).

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Instrumentation/Raw Data Port Baud Rate		Int	3 = 150 4 = 300 5 = 600 6 = 1200 8 = 2400 9 = 4800 11 = 9600 12 = 19200 Default = 11
2	Reserved			NULL
3	Reserved			NULL
4	Raw Measurement Record Compression Control		Int	0 = ASCII 1 = Compressed Only 2 = Both Default = 1
5	Almanac/Ephemeris Request		Int	0 = Output Almanac Data Now 1 = Output Ephemeris Data Now 2 = Output Almanac and Ephemeris Data Now Default = None

Note:

*** This sentence (and input sentence $PMVXG,024) have been replaced by input sentence $PMVXG,074.**

Example:

$PMVXG,027,,,,1,*50

Sentence Type - $PMVXG,029

Description: Constellation Selection Control

This sentence sets the criteria by which the receiver will select the satellites to track.

Equipment: MX 9212, MX 9012R, MX 9112

Field	Description	Units	Format	Range
1	Constellation Selection Mode*		Int	0 = Best DOP 1 = Best DOP Using at least 4 Sats Above 30° Elevation 2 = Highest Elevation 12 Sats 3 = Same Sat On All Channels (test mode) Default = 2
2	Constellation Selection PRN		Int	0 = Use Highest Sat In Mode 3, Above 1 - 32 = Sat to Use In Mode 3, Above Default = 0

Note:

* If 12 or fewer satellites are visible, modes 0-2 are identical.

Example:

$PMVXG,029,2,0

Sentence Type - **$PMVXG,032**

Description: Tepid Start Limit

This sentence sets the maximum period of time during a warm start the receiver will wait to find at least two satellites before automatically transitioning to a tepid start.

		Equipment:		
Field	**Description**	**Units**		**Range**
1	Hold Off Period - (the amount of time the receiver will wait before commencing with tepid start)	Min	Int	0 - 999 Default = 30

Example:

$PMVXG,032,15*61
$PMVXG,032,31*67

Sentence Type - **$PMVXG,034**

Description: Beacon Receiver Configuration Control

This sentence configures the MX-50R Beacon Receiver to accept and decode the differential information sent from a Beacon Transmitter. The configuration of the receiver must match that of the transmitter.

IMPORTANT
The MX 9112 must be configured as a Navigator to accept this message.

Equipment: MX 9212, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	MX-50R Enable		Int	0 = Disabled 1 = Enabled Default = 0
2	Beacon Logging - when enabled, a type 799 record is output to the Instrumentation/Raw Data Port every minute.*		Int	0 = Disabled 1 = Enabled Default = 0
3	Reserved			0
4	Manual Tune Frequency**	KHz	Float	283.5 - 325.0 Default = 0.0
5	Manual Bit Rate**	Bits/Sec	Int	0 = 25 1 = 50 2 = 100 3 = 200 Default = 0
6	Manual EDAC Enable**		Int	0 = Disabled 1 = Enabled Default = 0
7	Reserved			
8	Reserved			
9	Reserved			

Notes:

* Beacon logging may be enabled without the MX-50R enabled, however the output will contain 0 for beacon data.

** If Manual Tune Frequency, Bit Rate, and EDAC are supplied, the MX-50R is immediately tuned to the supplied values. (Automatic selection, if enabled, will resume one minute later. This feature is not currently implemented).

Example:

$PMVXG,034,,,,325.0,1,1,,,*49
$PMVXG,034,,1,,,,,,*52
$PMVXG,034,,0,1,,,,,*62

Sentence Type - $PMVXG,035

Description: Reference Station/Navigator Selection

This sentence configures the operating mode of the MX 9112.

		MX 9112		
Field	**Description**	**Units**	**Format**	**Range**
1	MX 9112 Operating Mode		Int	0 = Navigator 1 = Reference Station Default = 0
2	Reserved			
3	Reserved			
4	Reserved			

Example:

$PMVXG,035,0,,,*7E

Sentence Type - **$PMVXG,036**

Description: Self Survey Control

This sentence enables the Self Survey mode of the receiver, and specifies whether the Self Survey results are to be used as the known position.

IMPORTANT
The MX 9112 must be configured as a Navigator to accept this message.

Equipment: MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Self Survey Enable		Int	0 = Disabled 1 = Enabled Default = 0
2	Self Survey Results Enable		Int	0 = Don't use Results 1 = Use results as Known Position Default = 0
3	Reserved			NULL

Example:
$PMVXG,036,1,,*50

Sentence Type - **$PMVXG,041**

Description: User-Entered Beacon Almanac

This message enables the user to enter almanac data for 1 to 10 beacons. When interfaced to a Reference Station, this sentence causes the receiver to buffer this information in the RTCM Type 7 message. (Refer to Section V for additional information regarding the RTCM messages.)

When interfaced to a Navigator, this sentence defines the user-entered Beacon Almanac which may optionally be used to automatically tune an attached MX-50R. (Refer to input sentence $PMVXG,034, Auto Beacon Selection field for usage.)

Note: The Auto Beacon Selection function is not currently implemented.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Number of Almanacs		Int	1 - 10 0 = Clear Almanac data Default = None
2	Beacon #1 - 10 hex-ASCII almanac. Each entry is 18 bytes of hex-ASCII data representing the 9 bytes of binary data defined in RTCM-104 version 2, type 7 record without header or parity.		Char	111111111111111112222222222222222233333333333333334444444444444445555555555555555566666666666666666777777777777778888888888888888999999999999999aaaaaaaaaaaa Where 1..a are the 18 hex-ASCII data for beacons 1 - 10. Default = None

Example:

$PMVXG,041,,301CABD9FA151819D0*34

Sentence Type - **$PMVXG,050**

Description: Differential Output Control

This message controls the operation of the reference station's RTCM port.

IMPORTANT
The MX 9112 must be configured as a Reference Station to accept this message.

Equipment: MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Differential Output		Int	0 = Disabled 1 = RTCM Data 2 = Record Type 671 Default = 1
2	RTCM Version			2
3	RTCM Data Bits/Bytes			6
4	Average Data Rate	Bits/Sec	Int	0 = No Limit, 1 - 9600 Default = 9600
5	Log RTCM 6XX Records on Instrumentation/Raw Data Port. The XX represents the RTCM message type. Refer to Section V for additional information.		Int	0 = No Logging 1 = Hex Format (Type 601 - 664) 2 = Real Format (Type 665) 3 = Hex and Real Formats Default = 1
6	Add CR/LF		Int	0 = No, 1 = Yes Default = 0
7	Acc♦Q♦Point Pacing		Int	0 = Use all RTCM Messages 1 = Use only RTCM Type 1 Messages Default = 0
8	Reference Station Identifier		Int	0 - 1023; Default = 0
9	RTCM Type 3 Output Interval	Sec	Int	0 - 9999; Default = 900
10	RTCM Type 7 Output Interval	Sec	Int	0 - 9999; Default = 660
11*	Sentence Type 671 Output Interval	Sec	Int	0 - 9999; Default = 0
12*	Sentence Type 671 Output Port Selection		Char	0 = Control Port 1 = RTCM Port 2 = Equipment Port Default = 1
13*	Proprietary Smoothing Output Interval - (refer to RTCM messages, Section V for additional information).	Sec	Int	0 - 99 Default = 0

* These fields MUST be NULL when connected to an MX 9012R.

Example:
$PMVXG,050,2,2,6,09600,1,0,0,0000,0900,0660,001,0,000*61

Sentence Type - **$PMVXG,051**

Description: Send DGPS/RTCM Message

This message contains the text of an RTCM Type 16 message. The RTCM Type 16 message is immediately transmitted on the DGPS/RTCM Port when this sentence is received. In order to comply with the NMEA-0183 standard, this sentence cannot contain the characters $,*.

IMPORTANT
The MX 9112 must be configured as a Reference Station to accept this message

Equipment: MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Message Text		Char	ASCII Text <= 93 Characters Default = None

Example:

$PMVXG,051,this is a test*2B

Sentence Type - $PMVXG,053

Description: Differential Input Control

This sentence enables or disables receipt of differential corrections on the DGPS/RTCM Port and defines the format of the RTCM data. The configuration of the RTCM data must be identical to that at the Reference Station.

IMPORTANT
The MX 9112 must be configured as a Navigator to accept this message.

Equipment: MX 9212, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Differential Control		Int	0 = Disabled 1 = Enabled 2 = Auto Default = 0
2	Maximum Data Age	Sec	Int	1 - 999 Default = 30
3	Output Control - log RTCM 7XX records on Instrumentation/Raw Data Port. The XX represents the RTCM message type. Refer to Section V for additional information.		Int	0 = None 1 = Hex Format (Type 701 - 764) 2 = Real Format (Type 765) 3 = Both Hex & Real Default = 1
4	Reserved			NULL
5	RTCM Data	Bits/Byte	Int	6
6	Reference Station Selection		Int	0 = Use Any Reference Station 1 - 1023 = Use Corrections From Station Identified Default = 0
7	Proprietary High Accuracy Control (RTCM Type 59)		Int	0 = Disabled 1 = Enabled Default = 0
8	Reserved			NULL
9	Reserved			NULL
10	Reserved			NULL

Example:

$PMVXG,053,0,30,,,,,,,*7D
$PMVXG,053,,31,1,0,6,0,0,,,*7B

Sentence Type - $PMVXG,060

Description: MX-50M Control

This message configures the MX-50M Beacon Modulator. Output sentence $PMVXG,061 (MX-50M failure code) is enabled when MX-50M Present is set to YES. The Beacon Receiver must have the identical configuration specified here.

IMPORTANT
The MX 9112 must be configured as a Reference Station to accept this message.

Equipment: MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	MX-50M Present		Int	0 = No 1 = Yes Default = 0
2	Configuration Message: CD414141CEaaaaCFbbbbccddeeff ggF4 Where: aaaa = Frequency #1 bbbb = Frequency #2 cc = Channel #1 Control dd = Channel #2 Control ee = Bit Rate ff = Default Fill Value gg = EDAC Control	 100 Hz 100 Hz Bits/Sec	Hex	aaaa: 0B13 - 0CB2 bbbb: 0B13 - 0CB2 cc: D0 = Disabled D1 = Enabled dd: D2 = Disabled D3 = Enabled ee: D4 = 24 D5 = 50 D6 = 100 D7 = 200 ff: D9 = Mark DA = Space DB = Park DC = Alternate I/O gg: F0 = Disabled F1 = Enabled Default = None

Example:

$PMVXG,060,0,*7E

Sentence Type - **$PMVXG,062**

Description: MX-50M Reset

This message causes the Reference Station to transmit a 'break' to the MX-50M Beacon Modulator, thus causing a hardware reset. A break is defined as a 'space' condition that lasts for at least 150 milliseconds. Note that this sentence is accepted and processed even if field #1 of input sentence $PMVXG,060 (MX-50M Present) is set to 0.

IMPORTANT
The MX 9112 must be configured as a Reference Station to accept this message.

Equipment: MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
No Fields Required				

Example:

$PMVXG,062*4C

Sentence Type - $PMVXG,070

Description: Serial Port Configuration

This message sets the transmission rate, number of data bits, and parity convention for each of the serial interface ports. The selection of low baud rates for either the Control or Instrumentation/Raw Data ports is not recommended as this could result in data loss. The Magnavox CDU program supports baud rates of 2400 and above.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Port 1 Baud Rate	Bits/Sec	Int	150, 300, 600, 1200, 2400, 4800, 9600, 19200 Default = 9600
2	Port 1 Parity		Char	N = None
3	Port 1 Data Bits		Int	8
4	Port 2 Baud Rate	Bits/Sec	Int	150, 300, 600, 1200, 2400, 4800, 9600, 19200 Default = 9600
5	Port 2 Parity		Char	N = None
6	Port 2 Data Bits		Char	8
7	Port 3 Baud Rate	Bits/Sec	Int	150, 300, 600, 1200, 2400, 4800, 9600, 19200 Default = 9600
8	Port 3 Parity		Char	N = None
9	Port 3 Data Bits		Int	8
10	Port 4 Baud Rate	Bits/Sec	Int	150, 300, 600, 1200, 2400, 4800, 9600, 19200 Default = 9600
11	Port 4 Parity		Char	N = None
12	Port 4 Data Bits		Int	8

Example:

$PMVXG,070,9600,N,8,9600,N,8,9600,N,8,9600,N,8*4F

Sentence Type - **$PMVXG,071**

Description: Serial Port Selection

This message assigns a function to each of the serial interface ports. If a field is NULL, the port retains its current assignment.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Control Port Selection		Int	1
2	Instrumentation/Raw Data Port Selection		Int	1 - 4 Default = 2
*3	RTCM Output Port Selection - this port cannot be assigned to the same port as any other function.		Int	2 - 4 Default = 3
**4	RTCM Input Port Selection - this port cannot be assigned to the same port as any other function.		Int	2 - 4 Default = 3
5	Equipment/NMEA Port Selection			2 - 4 Default = 4
6	Reserved			NULL
7	Reserved			NULL
8	Reserved			NULL

Notes:

* Applicable for Reference Stations
** Applicable for Navigators

Example:

$PMVXG,071,1,2,3,3,4,,,*79

Sentence Type - **$PMVXG,074**

Description: Instrumentation/Raw Data Port Output Selection

This message controls which raw data records are output on the Instrumentation/Raw Data Port. For a complete description of the contents of these sentence types, refer to Section IV, Instrumentation/Raw Data Port Records and Appendix A, Compressed Measurement Format.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Nav Results Types: 8, 9, 308, 310		Int	0 = Disable Output 1 = Type 8 Records 2 = Type 9 Records Default = 2
2	Measurements Types: 1, 3, 311, 321, 331, 351		Int	0 = Disable Output 1 = ASCII (Type 1) 2 = Compressed (Type 3) 3 = Both (Type 1 and Type 3) Default = 2
3	Almanac & Ephemeris Types: 100 - 150, 200 - 203		Int	0 = Disable Output 1 = Enable Output Default = 1
4	Constellation Information Types: 401, 411 - 422		Int	0 = Disable Output 1 = Enable Output Default = 0
5	Time Recovery Types: 969		Int	0 = Disable Output 1 = Enable Output Default = 1
6	Full Debug Diagnostics Types: Various		Int	0 = Disable Output 1 = Enable Output Default = 0
7	Partial Debug Bitmap - bits 0 - 3 are set to 1 to turn on partial debug messages 4 - 1, respectively.		Int	Bits 0 = Enable Beacon Debug 1 = Enable Debug #3 2 = Enable Debug #2 3 = Enable Debug #1 Default = 0000
8	Almanac/Ephemeris Request		Int	0 = Output Ephemeris Now 1 = Output Almanac Now 2 = Output Both Now Default = None
9	Reserved			NULL
10	Reserved			NULL
11	Reserved			NULL

Example:

$PMVXG,074,1,3,0,1,0,0,0,,,,*54

Sentence Type - **$PMVXG,GPQ**

Description: Query From Remote Device/Request To Output of Sentence

This message enables the user to request a one-time transmission of a specific block label. To output messages at a periodic rate, refer to input sentence $PMVXG,007.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Block Label (YYY) If YYY = all numbers, then a Magnavox proprietary sentence is requested, otherwise a standard NMEA sentence is assumed.		Char	See Table 3-3, and 6-2

Example:

$CDGPQ,004*59

Sentence Type - $PMVXG,000

Description: Receiver Status

This sentence gives the current status of the receiver including the operating mode (navigating, tracking, providing corrections, search-the-sky, etc.), the number of satellites visible, and the number of satellites being tracked.

IMPORTANT
The various operating modes of the receiver are a function of the equipment type. 'COR' is for reference stations only (MX 9012R and MX 9112 configured as a reference station) and 'NAV' is only for navigators (MX 9212 and MX 9112 configured as a navigator).

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Receiver Status		Char	ACQ = Reacquisition ALT = Initialization Rqst'd COR = Providing Corrections ** IAC = Initial Acquisition IDL = Idle, No Satellites NAV = Navigating *** STS = Search-the-sky TRK = Tracking
2	# of Satellites That Should Be Visible		Int	0 - 12
3	# of Satellites Tracked		Int	0 - 12
4*	Time Since Last Navigation (if not currently navigating)	HHMM		HH: 0 - 23 MM: 0 - 59
5	Initialization Status		Int	0 = Waiting for Initialization 1 = Initialization Completed

Notes:

* This field is a NULL for Reference Stations.

** COR status is for Reference Stations since only Reference Stations can output differential corrections.

*** NAV status is for Navigators since only Navigators can 'navigate'.

Example:

$PMVXG,000,NAV,8,5,0000,0*00
$PMVXG,000,NAV,7,6,0000,1*0D

Sentence Type - **$PMVXG,001**

Description: Position and Altitude

This sentence gives the time, position and altitude of the receiver.

Equipment: MX 9212, MX 9012R, MX 9112

Field	Description	Units	Format	Range
1	Time of Position Update	HHMMSS	Int	HH: 0 - 23 MM: 0 - 59 SS: 0 - 59
2	WGS-84 Latitude	Deg, Min	Float	Deg: 0 - 89 Min: 0 - 59.99999
3	North/South Indicator		Char	N, S
4	WGS-84 Longitude	Deg, Min	Float	Deg: 0 - 179 Min: 0 - 59.99999
5	East/West Indicator		Char	E, W
6	Altitude (WGS-84 ellipsoid or MSL as shown in field #9)	Meters	Float	±999999.99
7	Position Source		Int	0 = Not Navigating 2 = 2D Nav 3 = 3D Nav 4 = 2D Differential Nav 5 = 3D Differential Nav 6 = Static 8 = Position Known - Reference Station 9 = Position Known - Navigator
8	Time Output Mode		Int	0 = UTC 1 = Local
9	Altitude Reference		Int	0 = WGS-84 Ellipsoid 1 = MSL (Geoid)

Example:

$PMVXG,001,142923,3350.52297,N,11820.22028,W,000079.61,3,1,1*59

Sentence Type - **$PMVXG,003**

Description: DOPs

The DOPs in this sentence correspond to the optimum constellation selected by the receiver. These DOPs may not correspond to the actual satellites being used for navigation. Output sentence $PMVXG,022 contains the DOPs for the satellites actually used for navigation.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	East DOP (EDOP)		Float	
2	North DOP (NDOP)		Float	
3	Vertical DOP (VDOP)		Float	
4	Horizontal DOP (HDOP)		Float	

Example:

$PMVXG,003,000.6,001.2,001.2,001.3*4F

Sentence Type - **$PMVXG,004**

Description: Operating Mode

This sentence defines the operating mode and criteria for acceptable navigation for the receiver.

IMPORTANT
The fields identified with an '*' are output as NULL for reference stations.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
*1	Constrain Altitude Mode		Int	0 = Auto - automatically transition to 2D Nav when fewer than 4 good satellites are available. 1 = 2D - always navigate in 2D mode 2 = 3D - Always navigate in 3D mode; navigation is suspended when fewer than 4 good satellites are available 3 = Coast - when fewer than 4 satellites are available, use the last computed value for altitude during 2D nav
2	Altitude Reference		Int	0 = Ellipsoid 1 = Geoid (MSL)
*3	Differential Navigation Control		Int	0 = Disabled 1 = Enabled 2 = Auto
*4	Horizontal Acceleration Constant	m/sec^2	Float	
*5	Vertical Acceleration Constant	m/sec^2	Float	
6	Tracking Elevation Limit	Deg	Int	
*7	HDOP Limit		Int	
*8	VDOP Limit		Int	
9	Time Output Mode		Char	U = UTC L = Local Time
10	Local Time Offset	Min	Int	±9999

Notes:
* These fields are output as NULL for reference stations.

Example:
$PMVXG,004,0,0,1,0.10,0.01,05,0010,0010,U,00000*1D
$PMVXG,004,0,1,0,0.11,0.02,06,0011,0011,L,-0480*14

Sentence Type - **$PMVXG,006**

Description: Satellite Health Status

This sentence gives the health status of the satellites.

Equipment: MX 9212, MX 9012R, MX 9112

Field #	Description	Units	Format	Range
1	Health Status of PRN #1	Char	H = Healthy (natural) U = Unhealthy (natural) + = Healthy (forced) - = Unhealthy (forced)	
2	Health Status of PRN #2	Char	H = Healthy (natural) U = Unhealthy (natural) + = Healthy (forced) - = Unhealthy (forced)	
		Char	H = Healthy (natural) U = Unhealthy (natural) + = Healthy (forced) - = Unhealthy (forced)	
		Char	H = Healthy (natural) U = Unhealthy (natural) + = Healthy (forced) - = Unhealthy (forced)	
32	Health Status of PRN #32	Char	– + = - =	

Example:

$PMVXG,006,H,H,H,U,U,U,U,U,U,U,H,H,H,H,H,H,H,H,H,H,H,U,H,H,H,H,H,H,H,U,U,U*53

Sentence Type - $PMVXG,011

Description: Speed and Heading

This sentence gives the speed over ground and course over ground.

Equipment: MX 9212, MX 9012R, MX 9112

Field #	Description	Units	Format	Range
*1	Course Over Ground	Deg	Float	
*2	Speed Over Ground	Kts	Float	
3	Reserved			NULL
4	Reserved			NULL
5	Reserved			NULL
6	Reserved			NULL
7	Reserved			NULL
8	Reserved			NULL
9	Reserved			NULL
10	Reserved			NULL

Notes:

*These fields will be 0 when output from a Reference Station.

Example:

$PMVXG,011,204.9,000.3,,,,,,,*44

Sentence Type - **$PMVXG,039**

Description: Magnavox Maintenance Message

This message is for Magnavox use only.

Example:

$PMVXG,039,5,1,1,0,0000,1,1,0,,*77

Sentence Type - **$PMVXG,037**

Description: GGA/GLL Configuration

This sentence reports the configuration of the NMEA GGA and GLL messages.

		Equipment:	
Field	**Description**	**Units**	**Format**	**Range**
1	Position Precision Used for GGA & GLL Messages	Int	2 - 4
2	NMEA Version	Int	1 = Version 1 2 = Version 2
3	Reserved		NULL
4	Reserved		NULL

Example:

$PMVXG,037,4,2,,*4A

Sentence Type - $PMVXG,014

Description: MX-50R Beacon Status

This sentence reports the status of the MX-50R Beacon Receiver.

IMPORTANT
The MX 9112 must be configured as a Navigator to output this message.

Equipment: MX 9212, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Signal Strength	dB μV/m	Int	0 = MX-50R Not Configured 1 = MX-50R Not Tracking 2-63 = Signal Strength
2	Signal/Noise	dB	Int	0 - 63
3	Tuned Frequency	Khz	Float	283.5 - 325.0
4	Bit Rate	Bits/Sec	Int	0 = 25 1 = 50 2 = 100 3 = 200
5	EDAC Enable		Int	0 = Disabled 1 = Enabled
6	Software Version		Int	1 - 63 0 = MX-50R Not Connected
7	EDAC Code Words Received		Int	0 - 262143
8	EDAC Code Words Corrected		Int	0 - 262143
9	Reserved			NULL
10	Reserved			NULL

Example:

$PMVXG,014,047,28,294.0,3,0,08,000000,000000,,*5E

Sentence Type - **$PMVXG,015**

Description: RTCM Input Port Statistics

This sentence reports the accumulated statistics on the data received from the RTCM input port.

IMPORTANT
The MX 9112 must be configured as a Navigator to output this message.

Equipment: MX 9212, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Total # of RTCM Messages Received		Int	
2	# of Parity Failures		Int	
3	RTCM Version Number		Int	2
4	Reserved			NULL
5	Reserved			NULL

Example:

$PMVXG,015,0155955,0000,2,,*6A

Sentence Type - **$PMVXG,022**

Description: Nav Constellation

This sentence reports the DOP values actually used in the measurement processing corresponding to the satellites listed. The satellites are listed in receiver channel order.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	UTC Measurement Time	Seconds into the week	Float	0 - 604800.00
2	East DOP (EDOP)		Float	
3	North DOP (NDOP)		Float	
4	Vertical DOP (VDOP)		Float	
5	PRN on Channel #1		Int	1 - 32; 00 = Not Tracking
6	PRN on Channel #2		Int	1 - 32; 00 = Not Tracking
7	PRN on Channel #3		Int	1 - 32; 00 = Not Tracking
8	PRN on Channel #4		Int	1 - 32; 00 = Not Tracking
9	PRN on Channel #5		Int	1 - 32; 00 = Not Tracking
10	PRN on Channel #6		Int	1 - 32; 00 = Not Tracking
11	PRN on Channel #7		Int	1 - 32; 00 = Not Tracking
12	PRN on Channel #8		Int	1 - 32; 00 = Not Tracking
13	PRN on Channel #9		Int	1 - 32; 00 = Not Tracking
14	PRN on Channel #10		Int	1 - 32; 00 = Not Tracking
15	PRN on Channel #11		Int	1 - 32; 00 = Not Tracking
16	PRN on Channel #12		Int	1 - 32; 00 = Not Tracking

Example:

$PMVXG,022,321087.00,01.0,01.0,02.1,00,25,00,18,00,29,00,15,14,00,00,00*70
$PMVXG,022,340136.00,00.8,01.5,01.4,00,00,02,27,00,00,19,11,15,26,00,00*7D

Sentence Type - **$PMVXG,021**

Description: Position, Height, Velocity

This sentence gives the receiver position, height, navigation mode, and velocity north/east. ***This sentence is intended for post-analysis applications.***

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	UTC Measurement Time	Seconds into the Week	Float	0 - 604800.00
2	WGS-84 Latitude	Deg, Min	Float	Deg: 0 - 89 Min: 9 - 59.9999
3	North/South Indicator		Char	N, S
4	WGS-84 Longitude	Deg, Min	Float	Deg: 0 - 179 Min: 0 - 59.9999
5	East/West Indicator		Char	E, W
6	Altitude (MSL)	Meters	Float	
7	Geoidal Height	Meters	Float	
8	Velocity East	M/Sec	Float	
9	Velocity North	M/Sec	Float	
10	Navigation Mode		Int	Navigating 1 = Position From Remote Device 2 = 2D 3 = 3D 4 = 2D Differential 5 = 3D Differential 6 = Static 8 = Position Known - Reference Station 9 = Position Known - Navigator Not Navigating 51 = Too Few Satellites 52 = DOPs Too Large 53 = Position STD Too Large 54 = Velocity STD Too Large 55 = Too Many Iterations for Velocity 56 = Too Many Iterations for Position 57 = 3 Sat Startup Failed 58 = Commanded Abort

Example:

$PMVXG,021,340217.00,3350.5163,N,11820.2232,W,00083.5,-032.3,-000.1,-000.1,03*62

Sentence Type - **$PMVXG,020**

Description: Self-Test Results

This sentence contains the results of the test performed in field #1. The table below identifies the contents of each of the remaining fields for each type of test. A '0' in fields 2 - 8 indicates that the test identified passed, a '1' indicates failed.

Equipment: MX 9212, MX 9012R, MX 9112								
Field 1	**Description**	**Field 2**	**Field 3**	**Field 4**	**Field5**	**Field 6**	**Field 7**	**Field 8**
1	Full	RAM	ROM	NULL	NULL	NULL	NULL	NULL

Example:

$PMVXG,020,1,0,0,,,,,*7B

Sentence Type - **$PMVXG,023**

Description: Position, Height, COG and SOG

This sentence gives the position, height, COG, and SOG of the receiver. ***This sentence is intended for post-analysis applications.***

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Current Time (either UTC or Local)	HHMMSS	INT	HH = 0 - 23, MM = 0 - 59, SS = 0 - 59
2	WGS-84 Latitude	Deg,Min	Float	Deg = 0 - 89, Min = 0 - 59.99999
3	North/South Indicator		Char	N or S
4	WGS-84 Longitude	Deg, Min	Float	Deg = 0 - 179, Min = 0 - 59.99999
5	East/West Indicator		Char	E or W
6	Altitude (refer to field #13 for Altitude Reference)	Meters	Float	±99999.9
7	COG (Course Over Ground)	Deg	Float	0 - 359.9
8	SOG (Speed Over Ground)	Kts	Float	999.9
9	Navigation Mode			Navigating 1 = Position From Remote Device 2 = 2D, 3 = 3D, 4 = 2D DGPS 5 = 3D DGPS, 8 = Pos Kwn Ref Stn 9 = Pos Kwn Nav, 10 = 2D P-DGPS 11 = 3D P-DGPS Not Navigating 51 = Too Few Satellites 52 = DOPs Too Large 53 = Position STD Too Large 54 = Velocity STD Too Large 55 = Too Many Iterations for Velocity 56 = Too Many Iterations for Position 57 = 3 Sat Startup Failed 58 = Commanded Abort
10	Last Fix Time (UTC or LOCAL)	HHMMSS	Int	HH = 0 - 23, MM = 0 - 59, SS = 0 - 59
11	Last Fix Navigation Mode		Int	See Field #9
12	Nav Flag		Int	0 = No Nav, 1 = Nav
13	Altitude Reference		Int	0 = WGS-84 Ellipsoid 1 = MSL (geoid)

Example:

$PMVXG,023,171125,3350.51805,N,11820.22154,W,00006.0,296.4,000.0,05,171124,05,1,0*6B
$PMVXG,023,142851,3350.52377,N,11820.22131,W,00074.0,083.9,000.3,03,142850,03,1,1*69

Sentence Type - **$PMVXG,027**

Description: RTCM Type 16 Message

This sentence contains one RTCM Type 16 Message (Operator Input). The navigator retains the last 3 Type 16 messages it received from the Reference Station and saves them in a circular buffer. The user should request this message three times to retrieve all of the information. The most current message can be determined by the time and GPS week fields.

IMPORTANT
The MX 9112 must be configured as a Navigator to output this message.

Equipment: MX 9212, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Message Index		Char	A, B, or C
2	Message Time	Seconds Into the Week	Int	0 - 604800
3	GPS Week of Message	Week Since Jan 1980	Int	0 - 9999
4	Message Length	Characters	Int	1 - 90
5	Message		ASCII	

Example:

$PMVXG,027,A,000000,0000,00,*20

Sentence Type - **$PMVXG,030**

Description: Software Configuration

This sentence contains the navigation processor and baseband firmware version numbers.

Equipment: MX 9212, MX 9012R, MX 9112				
Field #	**Description**	**Units**	**Format**	**Range**
1	Nav Processor Version Number		Char	
2	Baseband Firmware Version Number		Char	

Example:

$PMVXG,030,T_09,3.5*61

Sentence Type - **$PMVXG,031**

Description: Almanac Collection Status

This sentence reports whether the receiver has collected a full almanac as well as some debug information which can be used to determine how many more subframes are needed to complete almanac collection.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Almanac Complete		Int	0 = No 1 = Yes
2	Subframe 5 Collection Record - this is a number that, when converted to binary, notes which pages of subframe 5 have been collected. When all 25 LSB's = 1, the entire subframe has been collected.		Int	0 - 33554431
3	Subframe 4 Collection Record - this is a number that when converted to binary, notes which pages of subframe 4 have been collected. When all 25 LSB's = 1, the entire subframe has been collected.		Int	0 - 33554431
4	Reserved			NULL

Example:

$PMVXG,031,1,000000000,000000000,*7B

Sentence Type - $PMVXG,033

Description: RTCM Type 3 Message

This sentence gives the contents of the RTCM Type 3 message, Reference Station Parameters.

Equipment: MX 9212, MX 9012R, MX 9112

Field	Description	Units	Format	Range
1	Reference Station Latitude	Deg,Min	Float	Deg = 0 - 89 Min = 0 - 59.9999
2	North/South Indicator		Char	N or S
3	Reference Station Longitude	Deg,Min	Float	Deg = 0 - 179 Min = 0 - 59.999
4	East/West Indicator		Char	E or W
5	Altitude Above the Ellipsoid	Meters	Float	± 9999.9
6	Reference Station Identifier		Int	0 - 1023
7	Correction Age	Sec	Int	0 = < 12 1 = 12 < 18 2 = 18 < 24 3 = 24 < 48 4 = 48 < 96 5 = ≥ 96 6 = See Type 16 Message 7 = Not Operational
8	Reserved			NULL

Example:

$PMVXG,033,3350.5248,N,11820.2170,W,00002.6,1000,0,*7A

Sentence Type - $PMVXG,036

Description: Self Survey Control

This sentence enables the Self Survey mode of the receiver, and specifies whether the Self Survey results are to be used as the known position.

IMPORTANT
The MX 9112 must be configured as a Navigator to output this message.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Current Time (either UTC or Local)	HHMMSS	INT	HH = 0 - 23, MM = 0 - 59, SS = 0 - 59
2	WGS-84 Latitude	Deg,Min	Float	Deg = 0 - 89, Min = 0 - 59.99999
3	North/South Indicator		Char	N or S
4	WGS-84 Longitude	Deg, Min	Float	Deg = 0 - 179, Min = 0 - 59.99999
5	East/West Indicator		Char	E or W
6	Altitude (refer to field #13 for Altitude Reference)	Meters	Float	±99999.9
7	Number of Samples		Int	0 - 999999
8	Duration of Self Survey	Sec	Int	0 - 999999
9	Self Survey Mode		Int	0 = Disabled 1 = Enabled

Example:

$PMVXG,036,185709,3348.54948,N,11820.96826,W,-0000.86,000002,000003,2*75

Sentence Type - $PMVXG,035

Description: Software Configuration

This sentence reports the version numbers for the navigator processor and the baseband firmware. The model number of the receiver, number of channels, and the receiver function (navigator or reference station) are also returned.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Nav Processor Version #		Char	
2	Baseband Firmware Version #		Float	
3	Receiver Type		Char	9012, 9112, 9212
4	Reserved			NULL
5	Navigator/Reference Station Function		Int	0 = Navigator 1 = Reference Station
6	# of Receiver Channels		Int	12
7	Reserved			NULL
8	Reserved			NULL
9	Reserved			NULL

Example:

$PMVXG,035,T_09,3.5,9112,,0,12,,,*70

Sentence Type - **$PMVXG,034**

Description: MX-50R Configuration

This sentence gives the operational status of the MX-50R and the navigator.

IMPORTANT
The MX 9112 must be configured as a Navigator to output this message.

Equipment: MX 9212, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	MX-50R Attached		Int	0 = No 1 = Yes
2	Beacon Logging - output Type 799 records to Instrumentation/Raw Data Port every minute.		Int	0 = Disabled 1 = Enabled
3	Auto Beacon Selection Mode		Int	0 = Disabled 1 = Use Received Almanac 2 = Use User-entered Almanac
4	Manual Tune Frequency	Khz	Float	283.5 - 325.0
5	Manual Tune Bit Rate	Bits/Sec	Int	0 = 25 1 = 50 2 = 100 3 = 200
6	Manual EDAC Enable		Int	0 = Off 1 = On
7	Reserved			NULL
8	Reserved			NULL
9	Reserved			NULL

Example:

$PMVXG,034,1,0,0,294.0,3,0,,,*70

Sentence Type - **$PMVXG,040**

Description: Broadcast Beacon Almanac

This is the Beacon Almanac which was received in an RTCM Type 7 message.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Reserved			0
2	Broadcast Beacon Almanac Beacon #1 - 10 hex-ASCII almanac. Each entry contains 18 bytes of hex-ASCII data representing the 9 bytes of binary data defined in the RTCM-104 version 2, type 7 record without header or parity.		Char	111111111111111111 222222222222222222 333333333333333333 444444444444444444 555555555555555555 666666666666666666 777777777777777777 888888888888888888 999999999999999999 aaaaaaaaaaaaaaaaaa Where 1..a are the 18 hex-ASCII data for beacons 1 - 10.

Example:

$PMVXG,040,0,301CABD905D04203E8000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000

Sentence Type - **$PMVXG,052**

Description: Oscillator Offset

This sentence reports the offset of the reference oscillator from the GPS time standard.

Equipment: MX 9212, MX 9012R, MX 9112

Field #	Description	Units	Format	Range
1	Frequency Offset	PPM	Float	
2	Reserved			NULL

Example:

$PMVXG,052, 0.4780,*5A
$PMVXG,052, 0.4568,*5E

Sentence Type - **$PMVXG,050**

Description: Differential Output Control

This sentence gives the configuration of the differential information output from the Reference Station.

> **IMPORTANT**
> **The MX 9112 must be configured as a Reference Station to output this message.**

Equipment: MX 9012R, MX 9112				
Field #	**Description**	**Units**	**Format**	**Range**
1	Differential Output		Int	0 = Disabled 1 = RTCM Data 2 = Record Type 671
2	RTCM Version		Int	2
3	Data Bits/Byte		Int	6
4	Average Data Rate	Bits/Sec	Int	
5	Log RTCM 6XX to Instrumentation/Raw Data Port		Int	0 = No Logging 1 = Hex Format 2 = Real Format 3 = Both Hex and Real
6	Add CR/LF		Int	0 = No 1 = Yes
7	Acc♦Q♦Point Pacing		Int	0 = Use all RTCM Messages 1 = Use only RTCM Type 1 Messages
8	Reference Station ID		Int	0 - 1023
9	RTCM Type 3 Output Interval	Sec	Int	0 - 9999
10	RTCM Type 7 Output Interval	Sec	Int	0 - 9999
11	Record Type 671 Output Interval	Sec	Int	0 - 9999
12	Sentence Type 671 Output Port Selection		Char	0 = Control Port 1 = RTCM Port 2 = Equipment Port
13	Proprietary Smoothing Output Interval	Sec	Int	0 - 99

Example:

$PMVXG,050,1,2,6,09600,1,0,0,0000,0900,0660,000,C,000*10

Sentence Type - $PMVXG,041

Description: User-Entered Beacon Almanac

This sentence gives the contents of the user-entered Beacon Almanac. For Reference Stations this information is transmitted in RTCM type 7 messages. For Navigators, this information is used for automatic Beacon selection.

Equipment: MX 9212, MX 9012, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Number of Almanacs found in field #2.			1 - 10
2	Beacon #1 - 10 hex-ASCII almanac. Each entry contains 18 bytes of hex-ASCII data representing the 9 bytes of binary data defined in the RTCM-104 version 2, type 7 record without header or parity.		Char	111111111111111111 222222222222222222 333333333333333333 444444444444444444 555555555555555555 666666666666666666 777777777777777777 888888888888888888 999999999999999999 aaaaaaaaaaaaaaaaaa Where 1..a are the 18 hex-ASCII data for beacons 1 - 10.

Example:

$PMVXG,041,1,301CABD905D04203E8*7A

Sentence Type - **$PMVXG,053**

Description: Differential Configuration

This sentence reports the configuration of the differential input control used by the Navigator.

IMPORTANT
The MX 9112 must be configured as a Navigator to output this message.

Equipment: MX 9212, MX 9112

Field #	Description	Units	Format	Range
1	Differential Mode		Int	0 = Disabled 1 = Enabled 2 = Auto
2	Correction Age Limit - the amount of time a previous correction will be applied to new measurements.	Sec	Int	
3	Differential Logging Format		Int	0 = None 1 = Hex 2 = Real 3 = Both Hex & Real
4	Reserved			NULL
5	Number of Bits/Byte		Int	6 = 6 of 8 Format
6	Reference Station ID		Int	0 = Use Any Reference Station 1 - 1023 = Use Corrections From Station Identified
7	Proprietary High Accuracy Control		Int	0 = Disabled 1 = Enabled
8	Reserved			NULL
9	Reserved			NULL
10	Reserved			NULL

Example:

$PMVXG,053,1,030,1,,6,0000,0,,,*7B

Sentence Type - $PMVXG,060

Description: MX-50M Configuration

This sentence reports the configuration of the Beacon Modulator. If field #1 of this sentence is 0 (MX-50M not present), field #2 will be NULL.

If the MX-50M is defined as present, and a request for this sentence is processed, either by a GPQ or $PMVXG,007 sentence, the receiver sends a request byte to the MX-50M. The actual transmission of this sentence is triggered by the status returned from the MX-50M. If the MX-50M fails to respond, this sentence will not be output.

IMPORTANT
This MX 9112 must be configured as a Reference Station to output this message.

Equipment: MX 9012R, MX 9112

Field #	Description	Units	Format	Range
1	MX-50M Present		Int	0 = No 1 = Yes
2	MX-50M Configuration Message: aaaaaaaabbbbbbbbccddeeffgg Where: aaaaaaaa = Frequency #1 bbbbbbbb = Frequency #2 cc = Bit Rate dd = Modulation Enable ee = EDAC Enable ff = Default Fill Type gg = Modulator Version Number	 100 Hz 100 Hz Bits/Sec	 Hex Hex Hex Hex Hex Hex Hex	aaaaaaaa: bbbbbbbb: cc: 19 = 25 32 = 50 64 = 100 C8 = 200 dd: 00 = None 01 = Channel #1 Only 02 = Channel #2 Only 03 = Both Channels ee: 00 = Disabled 01 = Enabled ff: 00 = Space 01 = Mark 02 = Alternate I/O 03 = Park gg:

Example:

$PMVXG,060,1,32393430333130303C803000304*0D

Sentence Type - **$PMVXG,061**

Description: MX-50M Failure

This sentence is output when a failure code is received from the MX-50M. It is sent only if field #1 in input sentence $PMVXG,050 (MX-50M present) is set to 1.

IMPORTANT
This MX 9112 must be configured as a Reference Station to output this message

Equipment: MX 9012R, MX 9112				
Field #	**Description**	**Units**	**Format**	**Range**
1	Failure Type		Int	1 = Data Underrun 2 = EEROM Failure 3 = EPROM Failure

Example:

$PMVXG,061,1*52

Sentence Type - $PMVXG,070

Description: Serial Port Configuration

This sentence gives the transmission rate, number of data bits, and parity convention for the 4 serial interface ports of the receiver.

Equipment: MX 9212, MX 9012R, MX 9112				
Field #	**Description**	**Units**	**Format**	**Range**
1	Port 1 Baud Rate	Bits/Sec	Int	150, 300, 600, 1200, 2400, 4800, 9600, 19200
2	Port 1 Parity		Char	N = None
3	Port 1 Data Bits		Int	8
4	Port 2 Baud Rate	Bits/Sec	Int	150, 300, 600, 1200, 2400, 4800, 9600, 19200
5	Port 2 Parity		Char	N = None
6	Port 2 Data Bits		Int	8
7	Port 3 Baud Rate	Bits/Sec	Int	150, 300, 600, 1200, 2400, 4800, 9600, 19200
8	Port 3 Parity		Char	N = None
9	Port 3 Data Bits		Int	8
10	Port 4 Baud Rate	Bits/Sec	Int	150, 300, 600, 1200, 2400, 4800, 9600, 19200
11	Port 4 Parity		Char	N = None
12	Port 4 Data Bits		Int	8

Example:

$PMVXG,070, 9600,N,8, 9600,N,8, 9600,N,8, 9600,N,8*4F

Sentence Type - **$PMVXG,071**

Description: Serial Port Assignment

This sentence identifies the port assignments and their respective function.

Equipment: MX 9212, MX 9012R, MX 9112				
Field #	**Description**	**Units**	**Format**	**Range**
1	Control Port Selection		Int	1
2	Instrumentation/Raw Data Port Selection		Int	1 - 4
3	DGPS/RTCM Output Port Selection		Int	2 - 4
4	DGPS/RTCM Input Port Selection		Int	2 - 4
5	Equipment/NMEA Port Selection		Int	1 - 4
6	Reserved			NULL
7	Reserved			NULL
8	Reserved			NULL

Example:

$PMVXG,071,1,2,3,3,4,,,*79

Sentence Type - $PMVXG,074

Description: Instrumentation/Raw Data Port Output Records

The sentence indicates which records have been selected for output on the Instrumentation/Raw Data Port.

Selection	Record Type
Nav Results	8, 9, 308, 310
Measurements	1, 3, 311, 321, 331, 351
Almanac & Ephemeris	100 - 150, 200 - 203
Constellation	401, 411 - 422
Time Recovery	969
Full Debug	Various
Partial Debug	Various

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Nav Results		Int	0 = Disabled 1 = Type 8 2 = Type 9
2	Measurements		Int	0 = Disabled 1 = ASCII (Type 1) 2 = Compressed (Type 3) 3 = Both (Types 1 and 3)
3	Almanac & Ephemeris		Int	0 = Disabled 1 = Enabled
4	Constellation Information		Int	0 = Disabled 1 = Enabled
5	Time Recovery		Int	0 = Disabled 1 = Enabled
6	Full Debug		Int	0 = Disabled 1 = Enabled
7	Partial Debug Bitmap		Int	0 = Disabled Bits 0 = Partial Beacon Messages 1 = Partial Debug #3 2 = Partial Debug #2 3 = Partial Debug #1
8	Reserved			NULL
9	Reserved			NULL
10	Reserved			NULL
11	Reserved			NULL

Example:

$PMVXG,074,2,2,1,0,1,0, 0,,,,*57

Sentence Type - $PMVXG,100

Description: GPS Channel Status

When this sentence is requested, the receiver actually outputs 12 $PMVXG,100 sentences, one for each channel. Idle channels are indicated in field #2 by the PRN set to 0, with subsequent fields set to NULL.

For Reference Stations, the correction age is the difference between the last measurement time and the last time that a correction was queued for output.

For Navigators, the correction age is the time since the correction was computed at the Reference Station.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Channel Number		Int	1 - 12
2	Satellite PRN		Int	1 - 32
3	Azimuth	Deg	Int	0 - 359
4	Elevation	Deg	Int	0 - 89
5	C/N0	dB/Hz	Int	
6	Correction	Meters	Float	
7	Correction Rate	M/Sec	Float	
8	Correction Age	Sec	Int	
9	IODE		Int	
10	Channel Status		Char	+ = Measurements Available SRCH = Searching for Sat FRAM = Waiting for Framing Sync EPH = Waiting for 1st Ephemeris REAQ = Lost Satellite Signal
11	Measurement Residual	Meters	Float	± 9999.999
*12	Correction Latency	Sec	Float	0 - 99.9
13	Reserved			NULL
14	Reserved			NULL

Notes:

* This field is a NULL when output from a Reference Station.

Example:

$PMVXG,100,09,14,321,72,49,00023.36,0000.320,001,1E, + ,0000.604,01.8,,*3D
$PMVXG,100,01,16,265,14,43,00000.00,0000.000,999,C4,FRAM,0030.725,,,*37

Sentence Type - $PMVXG,101

Description: Control Sentence Accept/Reject

This sentence is returned (on the Control Port) for every $PMVXG and $XXGPQ sentence that is received.

Equipment: MX 9212, MX 9012R, MX 9112

Field #	Description	Units	Format	Range
1	Sentence ID		Char	
2	Accept/Reject Status		Int	0 = Sentence Accepted 1 = Bad Checksum 2 = Illegal Value 3 = Unrecognized ID 4 = Wrong # of Fields 5 = Required Data Field Missing 6 = Requested Sentence Unavailable (GPQ only)
3	Bad Field Index		Int	
4	Requested Sentence Id (if field #1 = GPQ)		Char	

Example:

$PMVXG,101,GPQ,0,,034*09
$PMVXG,101,007,0,,*4F

Sentence Type - **$PMVXG,121**

Description: Predicted Position, Height, Velocity

This sentence gives the predicted position, height, navigation mode, and velocity north/east within a few milliseconds of measurement receipt time (synchronized to the 1PPS output). The predicted position is determined by extrapolating the previous set of GPS measurements forward to the next measurement receipt time. The measurements currently received are used in the fix computation found in the type $PMVXG,021 and $PMVXG,023 sentences which are output sometime before the next measurement capture cycle, and will be extrapolated forward to produce the 'predicted' position found in the $PMVXG,121 and $PMVXG,123 sentences. *This sentence is intended for real-time applications.*

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	UTC Measurement Time	Seconds into the Week	Float	0 - 604800.00
2	WGS-84 Latitude	Deg, Min	Float	Deg: 0 - 89 Min: 9 - 59.9999
3	North/South Indicator		Char	N, S
4	WGS-84 Longitude	Deg, Min	Float	Deg: 0 - 179 Min: 0 - 59.9999
5	East/West Indicator		Char	E, W
6	Altitude (MSL)	Meters	Float	
7	Geoidal Height	Meters	Float	
8	Velocity East	M/Sec	Float	
9	Velocity North	M/Sec	Float	
10	Navigation Mode		Int	Navigating 1 = Position From Remote Device 2 = 2D, 3 = 3D, 4 = 2D Differential 5 = 3D Differential, 6 = Static 8 = Position Known - Ref. Station 9 = Position Known - Navigator Not Navigating 51 = Too Few Satellites 52 = DOPs Too Large 53 = Position STD Too Large 54 = Velocity STD Too Large 55 = Too Many Iters. for Vel. 56 = Too Many Iters. for Pos. 57 = 3 Sat Startup Failed 58 = Commanded Abort

Example:

$PMVXG,121,325457.00,3350.4971,N,11820.2190,W,-0000.6,-032.3,0000.0,0000.3,03*75

Sentence Type - $PMVXG,123

Description: Predicted Position, Height, COG and SOG

This sentence gives the predicted position, height, COG and SOG within a few milliseconds of measurement receipt time (synchronized to the 1PPS output). The predicted position is determined by extrapolating the previous set of GPS measurements forward to the next measurement receipt time. The measurements currently received are used in the fix computation found in the type $PMVXG,021 and $PMVXG,023 sentences which are output sometime before the next measurement capture cycle, and will be extrapolated forward to produce the 'predicted' position found in the $PMVXG,121 and $PMVXG,123 sentences. *This sentence is intended for real-time applications.*

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Current Time (either UTC or Local)	HHMMSS	INT	HH = 0 - 23, MM = 0 - 59, SS = 0 - 59
2	WGS-84 Latitude	Deg,Min	Float	Deg = 0 - 89, Min = 0 - 59.99999
3	North/South Indicator		Char	N or S
4	WGS-84 Longitude	Deg, Min	Float	Deg = 0 - 179, Min = 0 - 59.99999
5	East/West Indicator		Char	E or W
6	Altitude (refer to field #13 for Altitude Reference)	Meters	Float	±99999.9
7	COG (Course Over Ground)	Deg	Float	0 - 359.9
8	SOG (Speed Over Ground)	Kts	Float	
9	Navigation Mode			Navigating 1 = Position From Remote Device 2 = 2D, 3 = 3D, 4 = 2D DGPS 5 = 3D DGPS, 8 = Pos Kwn ● Ref. Stn 9 = Position Known - Navigator 10 = 2D P-DGPS, 11 = 3D P-DGPS Not Navigating 51 = Too Few Satellites 52 = DOPs Too Large 53 = Position STD Too Large 54 = Velocity STD Too Large 55 = Too Many Iterations for Velocity 56 = Too Many Iterations for Position 57 = 3 Sat Startup Failed 58 = Commanded Abort
10	Last Fix Time (UTC or LOCAL)	HHMMSS	Int	HH = 0 - 23, MM = 0 - 59, SS = 0 - 59
11	Last Fix Navigation Mode		Int	See Field #9
12	Nav Flag		Int	0 = No Nav, 1 = Nav
13	Altitude Reference		Int	0 = WGS-84 Ellipsoid 1 = MSL (geoid)

Example:

$PMVXG,123,182644,3350.52427,N,11820.21701,W,00002.00,175.4,000.0,05,182643,05,1,0*5C

Sentence Type - **$PMVXG,500**

Description: CDU Position and Altitude

This sentence gives the time, position and altitude of the receiver when interfaced to a Magnavox CDU. Refer to output sentence $PMVXG,001 for a complete description of the format.

Example:

$PMVXG,500,143207,3350.51423,N,11820.21766,W,000075.15,3,1,1*5A

Sentence Type - **$PMVXG,502**

Description: Almanac and Ephemeris Health

This sentence reports the almanac and ephemeris health status for all 32 satellites.

Equipment: MX 9212, MX 9012R, MX 9112

Field #	Description	Units	Format	Range
1	Almanac Health (for 32 satellites)		Char	+ = Healthy - = Unhealthy 0 = Not in Almanac
2	Ephemeris Health (for 32 satellites)		Char	+ = Healthy - = Unhealthy 0 = No Ephemeris Collected

Example:

$PMVXG,502,+++0000000++++++++++++-+++++++000,000000000000+000++0000+00+++000*52

$PMVXG,502,+++0000000++++++++-+++-+++++++000,0+00000000+000++00+000000++00000*54

Sentence Type - **$PMVXG,523**

Description: Time Recovery Configuration

This sentence contains the configuration of the time recovery function of the receiver.

MX 9212, MX 9012R, MX 9112

	Description	Units	Format	Range
1	Time Recovery Mode		Char	D = Dynamic; solve for position and time while moving S = Static; solve for position and time while stationary K = Known Position; solve for time only N = No Time Recovery
2	Time Synchronization		Char	U = UTC Time G = GPS Time
3	Time Mark Mode		Char	A = Always Output Time Pulse V = Only When Time is Valid (as determined by Maximum Time Error)
4	Maximum Time Error - the maximum time for which a time mark will be considered valid.	Nsec	Int	
5	User Time Bias - external bias.	Nsec	Int	
6	Time Message Control			0 = No Time Recovery Message Output 1 = Output Time Recovery Message (#830) to Control Port 2 = Output Time Recovery Message (#830) to Equipment Port
7	Reserved			NULL
8	Position Known PRN		Int	1 - 32

Example:

$PMVXG,523,D,G,V,0100,000000,0,,*28
$PMVXG,523,D,U,A,0101,000010,1,,*2C

Sentence Type - **$PMVXG,524**

Description: Instrumentation/Raw Data Port Output Records

The sentence indicates which records have been selected for output on the Instrumentation/Raw Data Port.

Selection	Record Type
Nav Results	8, 308, 310
Measurements	1, 3, 311, 321, 331, 351
Almanac & Ephemeris	100 - 150, 200 - 203
Constellation	401, 411, 422
Time Recovery	969
Full Debug	Various
Partial Debug	Various

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Nav Results		Char	- = Disabled + = Enabled
2	Measurements		Char	- = Disabled + = Enabled
3	Almanac & Ephemeris		Char	- = Disabled + = Enabled
4	Constellation Information		Char	- = Disabled + = Enabled
5	Time Recovery		Char	- = Disabled + = Enabled
6	Full Debug		Char	- = Disabled + = Enabled
7	Partial Debug		Char	- = Disabled + = Enabled
8	Reserved			NULL

Example:

$PMVXG,524,+,+,+,-,-,-,-,*60

Sentence Type - $PMVXG,527

Description: Instrumentation/Raw Data Output Configuration*

This sentence reports the configuration of the Instrumentation/Raw Data Port as setup in input sentence $PMVXG,027.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Instrumentation/Raw Data Port Baud Rate		Int	150, 300, 600, 1200, 2400, 4800, 9600, 19200
2	Raw Measurement Record Compression Control		Int	0 = ASCII 1 = Compressed Only 2 = Both
3	Almanac/Ephemeris Request		Int	0 = Output Almanac Now 1 = Output Ephemeris Now 2 = Output Both
4	Reserved			NULL

NOTE:

* This sentence (and output sentence $PMVXG,524) have been replaced by $PMVXG,074.

Example:

$PMVXG,527,09600,1,1,*77

Sentence Type - **$PMVXG,532**

Description: Tepid Hold-off

This sentences reports the tepid hold-off period used by the receiver.

Field	Description	Equipment Units	Format	Range
1	Tepid Hold-off Period	Min	Int	0 -
2	Reserved			NULL
3	Reserved			NULL
4	Reserved			NULL
5	Reserved			NULL
6	Reserved			NULL
7	Reserved			NULL

Example:

$PMVXG,532,0030,,,,,*63
$PMVXG,532,0031,,,,,*62

Sentence Type - **$PMVXG,533**

Description: GPS Date

This sentences returns the current GPS date.

		Equipment:		2
Field	**Description**	**Units**	**Format**	**Range**
1	Day of the Month		Int	0 - 31
2	Month of the Year		Int	1 - 12
3	Year		Int	1993 -
4	Reserved			NULL
5	Reserved			NULL
6	Reserved			NULL

Example:

$PMVXG,533,10,03,1993,,,*4D

Sentence Type - **$PMVXG,671**

Description: RTCM Type 1 Corrections

This sentence returns the differential correction data in the RTCM hex-ASCII format.

IMPORTANT
This MX 9112 must be configured as a Reference Station to output this message.

Equipment: MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Hours in the Week	Hours Into the Week	Hex	00 - A8
2	Number of Satellites Containing Correction Data		Hex	0 - F
3	Seconds in the Hour - format = LSB MSB	Seconds	Hex	0000 - 100E
4	Correction for Satellite #1 - data is in the RTCM Version 2.0 format, 40 bits per satellite including prn, correction, correction rate, scale bits, and iode.		Hex	0000000000 - FFFFFFFFFF

Example:

$PMVXG,671,5D,6,B708,98FFD4F748,0CFE63C64E,0DFF1DD2CF,9BFF54EE2F,82FFCB0F1E,
1AF6B06E25*50

Sentence Type - $PMVXG,672

Description: RTCM Type 2 Corrections

This sentence returns the differential correction data in the RTCM hex-ASCII format.

IMPORTANT
This MX 9112 must be configured as a Reference Station to output this message.

Equipment: MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Hours in the Week	Hours Into the Week	Hex	00 - A8
2	Number of Satellites Containing Correction Data		Hex	0 - F
3	Seconds in the Hour - format = LSB MSB	Seconds	Hex	0000 - 100E
4	Correction for Satellite #1 - data is in the RTCM Version 2.0 format, 40 bits per satellite including prn, correction, correction rate, scale bits, and iode.		Hex	0000000000 - FFFFFFFFFF

Example:

Sentence Type - **$PMVXG,830**

Description: Time Recovery Results

This sentence is output approximately 1 second preceding the 1PPS output. It indicates the exact time of the next pulse, whether or not the time mark will be valid (based on the operator specified error tolerance), the time to which the pulse is synchronized, the receiver operating mode, and the time error of the last 1PPS output.

Equipment: MX 9212, MX 9012R, MX 9112				
Field	**Description**	**Units**	**Format**	**Range**
1	Time Mark Valid		Char	T = Valid F = Not Valid
2	Year		Int	1993 -
3	Month		Int	1 - 12
4	Day		Int	1 - 31
5	Time	HH:MM:SS	Int	HH = 0 - 23 MM = 0 - 59 SS = 0 - 59
6	Time Synchronization		Char	U = UTC G = GPS
7	Operating Mode		Char	D = Dynamic S = Static K = Known Position
8	Oscillator Offset - the filter's estimate of the oscillator frequency error.	PPB	Int	
9	Time Mark Error - the computed error of the last pulse output.	Nsec	Int	
10	User Time Bias - operator specified bias.	Nsec	Int	
11	Leap Second Flag - indicates that a leap second will occur. This value is usually zero, except during the week prior to the leap second occurrence, when this value will be set to ±1. A value of +1 indicates that GPS time will be 1 second further ahead of UTC time.		Int	±1

Example:

$PMVXG,830,F,1993,03,11,18:45:47,U,D,000436,-0029,000000,00*15
$PMVXG,830,T,1993,03,17,22:28:52,U,D,000456,-0005,000010,00*0E

SECTION IV

INSTRUMENTATION/RAW DATA PORT

The Instrumentation/Raw Data Port (default Port 2) is an output-only, RS-422 port which provides detailed GPS data. The data is available in either an ASCII character format or a compressed, binary format.

Table 4-1 lists the data records output on the Instrumentation/Raw Data port. The controller enables and/or disables output of each record individually (see input sentence $PMVXG,074). The format of the compressed measurement data record (type 3) is detailed in Appendix A.

Table 4-1. Instrumentation/Raw Data Port Records

Record Type	Type of Information	Lines/ Set	Output Interval
1	ASCII Measurement Data	1/sat	1/second
3	Compressed Measurement Data	1	1/second
8	Position and Velocity	1	1/second
9	Position and Velocity (Extended Precision)	1	1/second
100-150	Almanac Data	51	Every 2 hours
200-203	Satellite Ephemeris	4/sat	As changed
308	Nav Failure Record	1	1/Failure
310	Filter Cycle Delay	1	1/Delay
311	Measurement Data with Invalid Status	1	1/second when condition exists
321	Measurement Data Not Used in Filter	1	1/second when condition exists
331	Measurement Data Used for DGPS Corrections but not in Clock Filter		
351	Satellite Found	1	Whenever channel locks onto a satellite
401	Dilution of Precision	1	1/minute
411-422	Satellite Geometry	1/sat	1/minute
601-664	Reference Station RTCM Logging		
665	Reference Station Pseudorange Corrections	1	1/second
701 - 764	Navigator RTCM Logging		
765	Navigator Pseudorange Corrections		
799	Beacon Logging	1	1/minute
969	Time Recovery	1	1/second
Debug	ASCII Messages		

Instrumentation/Raw Data Port Records

The raw data records consist of printable ASCII characters terminated by a carriage return/line feed. Each record begins with a four-character record type field. Except for the diagnostic and special status messages, the record type is a decimal integer in the range 1 to 9999, right-justified within the record type field, left filled with leading blanks. The record type defines the format of the subsequent data items in the record.

Records with the same ID are always the same length and have the same fixed format, with the following exceptions: record types 601, 607, 616 and 665 may vary in length.

Record Type 1

Description: Raw Satellite Data

A type 1 record is output once a second for each satellite being tracked when the user has enabled 'Measurement' outputs (see input sentence $PMVXG,074). It contains the raw measurements in the same format as reported from the receiver baseband processing firmware. The following is a detailed explanation of the important elements used in the record.

USER_MS: User Time Milliseconds: This is the time of the measurement based on the local receiver clock, in milliseconds. All twelve (12) channels process the same samples since the sampling is done in the analog section of the receiver that is common to all channels. Note that USER_MS is 322325 msec for all measurements taken during this 2 Hz user time epoch. Because the code and carrier reconstruction within the digital receiver is done in the local time frame (that is, the feedback from the microcontroller loops is referenced to the local clock of the receiver), we refer to the receiver as a "user time" receiver. Any measurement error caused by the receiver's reference oscillator is common to all the measurements and can be easily solved for in the navigation solution.

CHNL_MS: This is the time of transmission from the satellite in milliseconds. Channel time is the code phase of the GPS signal precision to 1/256 of a cycle at the time of transmission from the satellite, as captured by the receiver time tick as defined by receiver time. The code sequence is precisely 1 week long and transmission starts at midnight Sunday - time zero. By locating precisely where in the code sequence the time of transmission occurred, we know what time it is. The CHNL_MS is the millisecond portion of this channel time. By adding the raw code measurement (initial code synchronization error) plus the carrier cycles and portions of carrier cycles (the accumulated number of whole cycles and fractional cycles caused by satellite and vehicle dynamics and receiver oscillator error), we determine channel time precisely.

PHI: This is the integrated carrier phase in whole cycles.

CODE: This is the raw code offset. It is the difference between the satellite message epoch and the receiver time epoch. It includes the initial code synchronization error, slow moving ionospheric effects, multipath, and contribution of the code tracking loop after vehicle dynamics have been removed by carrier aided tracking.

TIME: This is GPS time as solved for in the Kalman filter. It is current time synchronous with satellite GPS time. The clock error reported in record type 969 is the difference in seconds between receiver time and GPS time in seconds. This value is used in the filter to solve for TIME as output in record type 8. In time recovery mode, this clock error will approach zero less any static receiver delays (from cable, for example). In this case, time in record type 8 and USER_MS in record type 1 will be the same.

The pseudorange will be negative if the receiver time is less than the channel time. In a "user time" receiver, this is a valid condition and is solved for in the navigation filter. In time recovery mode, this would not happen because the user time is driven into synchronization with GPS time.

Record Type 1 (continued)

Byte	Description	Units	Range
1 - 4	Record Type		1
6 - 7	Receiver Channel Number [CHNL]		1 - 6
9 - 10	Satellite PRN [PRN]		1 - 32
12 - 20	User Time of Measurement [USER_MS]	Msec	0 - 604,799,999
22 - 30	Channel Time of Measurement [CHNL_ML]	Msec	0 - 604,799,799
32 - 41	Integrated Carrier Phase [PHI]	L1 Wavelengths	
43 - 48	Raw Code Offset [CODE]	L1 Wavelengths	
50 - 53	Integrated Carrier Phase [PHI_FRAC]	1/256 L1 Wavelengths	-128 - 127
55 - 58	Costas Ratio - provides a measure of the maximum phase error in the measurement. Phase error = 45°*(1-CR/128). [CR]		-128 - 127
60 - 63	Signal-to-Noise Ratio at 1 Hz Bandwidth [SNR]	dB Hz	25 - 53
65	Half-cycle Phase Ambiguity Indicator. The ? indicates that the phase ambiguity is unknown. The + or - signs do not mean anything by themselves. They are only important when they change, giving a better resolution of the phase of the measurement.		(-,+,?)

Because the GPS receiver is a user time receiver, measurements for all satellites being tracked are taken simultaneously at the same user clock time, once a second. The following FORTRAN code segment shows how to convert the raw user-time measurements to double-precision pseudorange and phase values, in meters. The associated channel time for the message is also computed.

Record Type 1 (continued)

FORTRAN CODE SEGMENT TO CONVERT USER TIME MEASUREMENTS TO PSEUDORANGE AND PHASE VALUES

```
INTEGER*2       ID, CHNL, PRN, PHI_FRAC, CR, SNR
INTEGER*4       USER_MS, CHANL_MS, PHI
REAL*8              PSEUDORANGE, PHASE, CHANNEL_TIME
REAL*8              C,L1FREQ
PARAMETER           (C=299792458.D0, L1FREQ=15759012R00.D0)

**  Compute user time and channel time in seconds
**  Compute pseudorange and phase in meters.

USER_TIME = DBLE(USER_MS)/1000.D0
    + (DBLE(PHI)+DBLE(PHI_FRAC)/256.D0)/L1FREQ+CODE/L1FREQ

PSEUDORANGE = (USER_TIME - CHANNEL_TIME)*C

PHASE = -(DBLE(PHI)+DBLE(PHI_FRAC)/256.D0)*C/L1FREQ
```

Example:

```
1         10        20        30        40        50        60        70
|---------|---------|---------|---------|---------|---------|---------|
  1  1  2 243610000 243610001    -387819      0    65   127    44 -
  1  2 18 243610000 243610016    -370259     18    42   127    49 -
  1  3 29 243610000 243610011    -642520    -12   -25   126    48 +
  1  4 16 243610000 243610000    -998648      6    30   125    42 +
  1  7 14 243610000 243610000    -165896    -13    30   123    40 +
  1  8 27 243610000 243610008    -645566     -3    59   127    48 +
  1  9 11 243610000 243610001    -771955     27    -2   125    43 ?
  1 11 19 243610000 243610014    -476275    -18   -93   126    48 -
```

Record Type 3

Description: Compressed Measurement Data For 12 Satellites

A type 3 record is output once a second when the user has enabled 'Compressed Measurements' (refer to input sentence $PMVXG,074). For a detailed description of the contents of this record, refer to Appendix A.

Item	Description	Units	# of bits
1	User Time of Measurement Set	Msec	30
2	Channel Time (SV time) Base Value	Msec	30
3	Time Recovery Clock Shift	Clock Cycles	22

Sum = 82 bits

Items 4 - 13 are repeated 12 times, once per receiver channel

Item	Description	Units	# of bits
4	Data Valid Flag	True/False	1
5	Satellite PRN		6
6	Channel Time (SV time) Delta Value	Msec	5
7	Integrated Phase, sub-ms part	L1 Cycles	21
8	Integrated Phase, fractional part	1/256 L1 Cycles	8
9	Raw Code Offset	L1 Cycles	10
10	Carrier Smoothed Code Offset	L1 Cycles	10
11	Costas Ratio		4
12	Signal Strength (C/NO)	dB	5
13	Half Cycle Ambiguity Resolution		2

Sum = 72 bits

Total data bits = 82 + 12*72 = 946

Total data bytes (7 of 8) = 136
+ 1 Checksum byte
137 bytes total
+ 5 Record type header
142 Total Bytes

Example:

```
1        10        20        30        40        50        60        70
|--------|---------|---------|---------|---------|---------|---------|
  3 B*-ë,FK-áijL/->,çA1%dtswgKBKz)uL¥|P]¥IXâHPóÆ%-if8i2'D/%pà)3+%E)3%)%&V0e,1(nà
P&ƒLtrábçÆ,1,ÉÇóeTép*i9Jó+òáù,.5%lèà)%fè@uççI\ûƒDa%s-ñMo%?93%p
```

Record Type 8

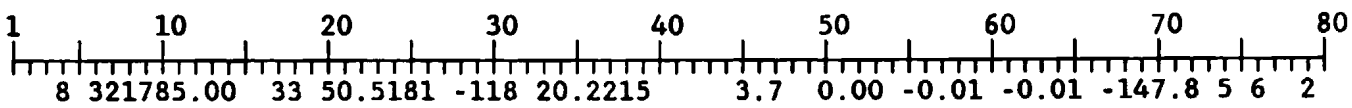
Description: Position and Velocity

This record is output once a second when the receiver is navigating and the user has enabled 'Nav Results' for output (refer to input sentence $PMVXG,074). This record is suspended when too few satellites are available for navigation. It contains the user's position and height relative to the WGS-84 ellipsoid; the north, east and up components of velocity; the navigation mode; and dilution of precision.

Latitude and longitude are output as degrees and minutes. South latitudes and west longitudes are indicated by a minus sign preceding the degrees value.

Byte	Description	Units	Range
1 - 4	Record Type		8
6 - 14	UTC Time	Seconds Into the Week	0 - 604800.00
16 - 26	Latitude	Deg,Min	Deg = ± 0 - 89 Min = 0 - 59.9999
28 - 39	Longitude	Deg,Min	Deg = ± 0 - 179 Min = 0 - 59.9999
41 - 47	Antenna Height Above Ellipsoid	Meters	
49 - 53	Velocity North	M/Sec	0 - 999.9
55 - 59	Velocity East	M/Sec	0 - 999.9
61 - 65	Velocity Up	M/Sec	0 - 999.9
67 - 72	Clock Velocity	M/Sec	0 - 999.9
74	Navigation Mode		0 = Not Navigating 1 = DR Nav 2 = 2D Nav 3 = 3D Nav 4 = 2D Differential Nav 5 = 3D Differential Nav 8 = Position Known - Reference Station 9 = Position Known - Navigator
76	Number of Satellites Used in Navigation Filter		1 - 12
78 - 79	Geometric Dilution of Precision		1 - 99

Example:



Record Type 9

Description: Position and Velocity (Extended Precision)

This record is output once a second when the receiver is navigating and the user has enabled 'Type 9 Nav Results' (refer to input sentence $PMVXG,074). This record is suspended when too few satellites are available for navigation. It contains the user's position and height relative to the WGS-84 ellipsoid; the north, east and up components of velocity; the navigation mode; and dilution of precision.

Latitude and longitude are output as degrees and minutes. South latitudes and west longitudes are indicated by a minus sign preceding the degrees value.

Byte	Description	Units	Range
1 - 4	Record Type		9
6 - 14	UTC time	Seconds Into the Week	0 - 604800
16 - 27	Latitude	Deg,Min	Deg = ± 0 - 89 Min = 0 - 59.99999
29 - 41	Longitude	Deg,Min	Deg = ± 0 - 179 Min = 0 - 59.99999
43 - 49	Antenna Height Above Ellipsoid	Meters	
51 - 55	Velocity North	M/Sec	0 - 999.9
57 - 61	Velocity East	M/Sec	0 - 999.9
63 - 67	Velocity Up	M/Sec	0 - 999.9
69 - 74	Clock Velocity	M/Sec	0 - 999.9
76 - 77	Navigation Mode		0 = Not Navigating 1 = DR 2 = 2D 3 = 3D 4 = 2D DGPS 5 = 3D DGPS 8 = Position Known - Reference Station 9 = Position Known - Navigator 10 = 2D DGPS - Proprietary Smoothing 11 = 3D DGPS - Proprietary Smoothing
79	Number of Satellites Used In Navigation Filter		1 - 12
81 - 84	Geometric Dilution of Precision		1 - 99

Example:

```
1        10        20        30        40        50        60        70        80
|---------|---------|---------|---------|---------|---------|---------|---------|
   9 243933.00   33 50.51827 -118 20.22159      2.7 -0.01  0.02 -0.00 -143.6  4 7
 1.0
```

Record Type 100 - 150

Description: Almanac Data

The group of almanac records is output at startup, if available, when newly collected, or upon request from the user and when 'Almanac and Ephemeris' are enabled for output (refer to input sentence $PMVXG,074). Record type 100 indicates the PRN of the satellite used to collect the almanac data. Types 101-132 contain the almanac data for satellites 1 - 32 respectively. Types 133 - 134 contain the health indicators for satellites 1 - 32. Type 135 contains the ionospheric correction and types 136 - 150 are reserved for special messages, spares and additional data.

Each of these records contains 24 pairs of hex-ASCII digits. Each pair of digits represent one byte of message data. All parity bits are removed, leaving 24 bits (3 bytes) for each GPS word. This results in 8 (words) x 3 (bytes/word) = 24 bytes per subframe.

For a detailed description of the contents of these records, refer to ICD-GPS-200, subframes 4 and 5.

Example:

```
1        10        20        30        40        50        60        70
|---------|---------|---------|---------|---------|---------|---------|
100  14
101 01 1E 90 08 09 22 FD 38 00 A1 0D 71 2F E0 58 D5 3B 65 D8 6A 96 FE 00 0F
102 02 5C CA 08 09 E6 FD 5C 00 A1 0D 3F 83 AA 84 8D 45 59 53 55 8F FE 00 05
103 03 69 CE 08 76 77 FD CB 00 A1 0D 45 BD E4 5E 65 37 91 DB EA 00 B5 FD AD
104 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
105 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
106 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
107 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
108 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
109 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
110 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
111 0B 6E 8E 08 70 A7 FD C3 00 A1 0D 53 BD 59 59 A6 E8 68 47 34 0C FD FF AF
112 0C 6B 8B 08 62 61 FD D6 00 A1 0D 16 65 D0 45 F4 C4 78 BE A2 63 E2 FE 0E
113 0D 25 A1 08 6D D9 FD BE 00 A1 0D 2B BC 9C 14 9B 60 28 FA B1 F6 52 00 11
114 0E 20 94 08 0C 3F FD 61 00 A1 0C 3D 05 98 83 78 D6 E0 18 EB F1 00 00 01
115 0F 38 99 08 0D 95 FD 3F 00 A1 0C BC DB 7B 7D 4C EB AE 74 F2 8B 00 00 16
116 10 07 77 08 0A 59 FD 60 00 A1 0C 81 06 17 D2 86 62 64 AE 1A CA FB 00 16
117 11 38 29 08 0E 7C FD 47 00 A1 0C EB DC D7 8A 41 48 1A DC DC 25 FD 00 17
118 12 2B 0D 08 01 65 FD 30 00 A1 0B FB 2E 5C DF 30 19 AC 21 D3 5F FF 00 14
119 13 09 8F 08 FE A7 FD 36 00 A1 0D 6B 59 84 59 F8 FF D0 2C 9C 81 09 00 31
120 14 22 23 08 0D B2 FD 60 00 A1 0C 3E 83 ED B2 3C 4F 00 44 9C AC 01 00 10
121 15 56 2F 08 08 2E FD 5E 00 A1 0D 0B 04 80 77 68 28 F0 74 4D 00 FE 00 13
122 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
123 17 37 50 08 0A A1 FD 5F 00 A1 0D 55 05 C5 3E 9A F7 3A 57 85 C8 00 00 0D
124 18 26 31 08 10 FE FD 44 00 A1 0D 3F D9 A6 4D A1 D5 42 C7 6A 4C F8 FF FA
125 19 30 82 08 04 F7 FD 3D 00 A1 0D C1 59 5B 35 68 51 C9 11 DD CE 24 00 99
126 1A 40 3E 08 0A FC FD 3A 00 A1 0D 47 2E F1 AB C9 C0 41 33 FA 08 FE 00 12
127 1B 56 47 08 07 66 FD 44 00 A1 0D 22 59 C8 63 57 02 87 B8 92 CD 02 00 04
128 1C 36 EC 08 0F 1D FD 31 00 A1 0D 24 AF 15 43 72 70 DC 9E 87 1D 07 00 2B
129 1D 2A 76 08 08 3F FD 38 00 A1 0C BF 2E 23 09 B7 2C E2 B2 A2 EC 00 00 13
130 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
131 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
132 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
133 33 08 AD 00 00 3F FF FF FF FF F0 00 00 00 00 00 00 00 03 F0 00 AA AA AB
134 3F 11 00 00 00 00 00 01 11 11 11 11 11 11 11 10 00 80 00 00 00 FF FF E9
135 38 16 00 FE 02 3F FE FF FB FF FF E9 00 00 00 11 08 AD 08 8B 03 08 AA AA
136 37 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 A8
137 39 92 80 48 E2 45 E8 7B 8C B7 25 74 16 CE A3 D5 C9 05 01 D7 99 AA AA A9
138 39 92 80 48 E2 45 E8 7B 8C B7 25 74 16 CE A3 D5 C9 05 01 D7 99 AA AA A9
139 39 92 80 48 E2 45 E8 7B 8C B7 25 74 16 CE A3 D5 C9 05 01 D7 99 AA AA A9
140 3E D7 DF 20 7A 90 06 B2 AF FB D5 2D 5F 2B A6 07 F2 06 E9 AA AA AA AA A8
141 34 AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA
142 35 AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA A9
143 36 AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA AA A8
144 39 92 80 48 E2 45 E8 7B 8C B7 25 74 16 CE A3 D5 C9 05 01 D7 99 AA AA A9
145 3A 31 E7 46 0C D4 61 02 1B C0 1A 5A 88 42 6B 5D 95 06 67 AA AA AA AA A9
146 3B AB D4 28 9C 97 77 30 1F 9D 0C 9F EF 38 88 E1 CD 06 92 AA AA AA AA AB
147 39 92 80 48 E2 45 E8 7B 8C B7 25 74 16 CE A3 D5 C9 05 01 D7 99 AA AA A9
148 3C 08 AD 7B B2 5E 81 0B 6B 9F C4 47 1A F1 35 A3 0A 06 B0 AA AA AA AA AA
149 3D DF 4C 5E EB 0D FC 6D 75 DE 6A E2 8E 4C 88 E3 A3 06 CF AA AA AA AA A8
150 3E D7 DF 20 7A 90 06 B2 AF FB D5 2D 5F 2B A6 07 F2 06 E9 AA AA AA AA A8
```

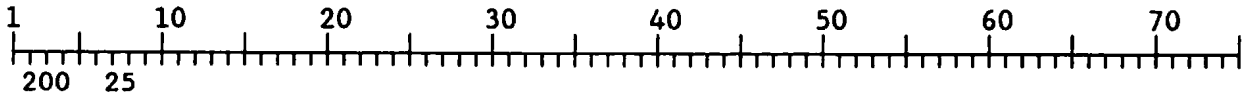
Record Type 200 - 203

Description: Satellite Ephemeris Data

The type 200 records are output once an hour for each satellite being tracked and when 'Almanac and Ephemeris' are enabled for output (refer to input sentence $PMVXG,074). Type 200 records contain the subframe 1, 2 and 3 data for the satellite, in ICD-GPS-200 format.

Each of these records contains 24 pairs of hex-ASCII digits. Each pair of digits represents one byte of message data. All parity bits are removed, leaving 24 bits (3 bytes) for each GPS word. GPS words 1 and 2 (TLM and HOW) are not output in 201, 202, 203 records. This results in 8 (words) x 3 (bytes/word) = 24 bytes per subframe.

Example:




```
200  25
201 AB D7 00 4A 17 D1 53 7D B2 FD B8 40 14 F1 FB C4 4E 1A 00 00 6E 27 85 43
202 C4 03 25 3A 05 CF DD F9 17 02 F7 03 0A 1E 34 04 1E A1 0E 4C 95 4E 1A 54
203 00 09 4F 07 E8 2B FF ED 26 B1 9C 56 29 FB 68 9A E9 09 FF 9F 95 C4 05 F6
```

Record Type 308

Description: Nav Failure Record

A type 308 record is output whenever the navigation filter is run and a position solution is not obtained and 'Nav Results' are enabled for output (refer to input sentence $PMVXG,074). The possible reasons are: too few satellites, DOPs too large, position STD (standard deviation) too large, velocity STD too large, too many iterations for velocity solution, too many iterations for position solution, or three satellite start-up failed.

Byte	Description	Units	Range
1 - 4	Record Type		308
5 - 14	UTC Time	Seconds Into the Week	0 - 604800.00
16 - 17	Differential Mode		0 = Disabled 1 = Always 2 = Auto
19 - 20	Number of Visible Satellites		0 - 12
22 - 23	Number of Measurements Used in Navigation Filter		0 - 12
25 - 29	HDOP of Measurements Used in Navigation Filter		
31 - 32	Position Source		0 = Not Navigating 2 = 2D Nav 3 = 3D Nav 4 = 2D Differential Nav 5 = 3D Differential Nav 6 = Static 8 = Position Known - Reference Station 9 = Position Known - Navigator
33 - 43	Internal Trace Variable		
44 - 46	Reason for Navigation Failure (each bit represents one failure reason)		Bit # 1 = Too Few Satellites 2 = DOPs Too Large 3 = Position STD Too Large 4 = Velocity STD Too Large 5 = Too Many Iterations for Velocity 6 = Too Many Iterations for Position 7 = 3 Sat Start-up Failed 8 = Internal Filter Reset

Example:

```
1        10        20        30        40        50        60        70
|--------|---------|---------|---------|---------|---------|---------|
308 321138.00  1   8   0    1.4 -1       1584    1
```

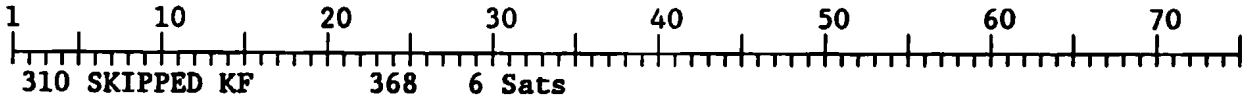
Record Type 310

Description: Filter Cycle Delay

A type 310 record is generated whenever execution of the navigation filter cycle was delayed for any reason and 'Nav Results' are enabled for output (refer to input sentence $PMVXG,074).

Byte Location	Description	Units	Range
1 - 4	Record Type		310
6 - 15	ASCII Message		'SKIPPED KF'
17 - 25	Internal Trace Value		
28 - 29	Number of Satellites Providing Measurement		0 - 12
31 - 34	ASCII Message		'SATS'

Example:



Record Type 311

Description: Raw Satellite Data With Invalid Status

A type 311 record is output whenever the receiver is locked onto a satellite, but the measurement is neither used in the navigation filter nor used to generate a DGPS correction and the user has enabled 'Measurements' for output (refer to input sentence $PMVXG,074). The possible reasons are: parity errors in the data, C/NO < 30, or no ephemeris available.

Byte	Description	Units	Range
1 - 4	Record Type		311
6 - 7	Receiver Channel Number [CHNL]		1 - 6
9 - 10	Satellite PRN [PRN]		1 - 32
12 - 20	User Time of Measurement [USER_MS]	Msec	0 - 604,799,999
22 - 30	Channel Time of Measurement [CHNL_ML]	Msec	0 - 604,799,799
32 - 41	Integrated Carrier Phase [PHI]	L1 Wavelengths	
43 - 48	Raw Code Offset [CODE]	L1 Wavelengths	
50 - 53	Integrated Carrier Phase [PHI_FRAC]	1/256 L1 Wavelengths	-128 - 127
55 - 58	Costas Ratio - provides a measure of the maximum phase error in the measurement. Phase error = 45°*(1-CR/128). [CR]		-128 - 127
60 - 63	Signal-to-Noise Ratio at 1 Hz Bandwidth [SNR]	dB Hz	25 - 53
65	Half-cycle Phase Ambiguity Indicator. The ? indicates that the phase ambiguity is unknown. The + or - signs do not mean anything by themselves. They are only important when they change, giving a better resolution of the phase of the measurement.		(-,+,?)

See record type 1 for the FORTRAN code which shows how to convert the raw user-time measurements to double-precision pseudorange and phase values in meters. The associated channel time for the message is also computed.

Example:

```
1         10        20        30        40        50        60        70
|---------|---------|---------|---------|---------|---------|---------|
311 11 19 243585000      8234    -638125     -19   68  126   48 ?
```

Record Type 321

Description: Raw Satellite Data Not Used In Filter

A type 321 record is output whenever the receiver is locked onto a satellite but the navigation filter is too busy to use the measurement and the user has enabled 'Measurements' for output (refer to input sentence $PMVXG,074).

Byte	Description	Units	Range
1 - 4	Record Type		321
6 - 7	Receiver Channel Number [CHNL]		1 - 6
9 - 10	Satellite PRN [PRN]		1 - 32
12 - 20	User Time of Measurement [USER_MS]	Msec	0 - 604,799,999
22 - 30	Channel Time of Measurement [CHNL_ML]	Msec	0 - 604,799,799
32 - 41	Integrated Carrier Phase [PHI]	L1 Wavelengths	
43 - 48	Raw Code Offset [CODE]	L1 Wavelengths	
50 - 53	Integrated Carrier Phase [PHI_FRAC]	1/256 L1 Wavelengths	-128 - 127
55 - 58	Costas Ratio - provides a measure of the maximum phase error in the measurement. Phase error = 45°*(1-CR/128). [CR]		-128 - 127
60 - 63	Signal-to-Noise Ratio at 1 Hz Bandwidth [SNR]	dB Hz	25 - 53
65	Half-cycle Phase Ambiguity Indicator. The ? indicates that the phase ambiguity is unknown. The + or - signs do not mean anything by themselves. They are only important when they change, giving a better resolution of the phase of the measurement.		(-,+,?)

See record type 1 for the FORTRAN code which shows how to convert the raw user-time measurements to double-precision pseudorange and phase values in meters. The associated channel time of the message is also computed.

Example:

```
1        10        20        30        40        50        60        70
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
 321  1  2 243605000 243605001     -538008     -13  61  126  44 ?
```

Record Type 331

Description: Raw Satellite Data Used for DGPS Corrections But Not In Clock Filter

A type 331 record is output whenever a valid measurement is received and is used to compute differential corrections but is not used in the clock filter solution and the user has enabled 'Measurements' for output (refer to input sentence $PMVXG,074). This could occur as a result of the satellite being marked 'unhealthy' in the almanac or ephemeris.

Byte	Description	Units	Range
1 - 4	Record Type		331
6 - 7	Receiver Channel Number [CHNL]		1 - 6
9 - 10	Satellite PRN [PRN]		1 - 32
12 - 20	User Time of Measurement [USER_MS]	Msec	0 - 604,799,999
22 - 30	Channel Time of Measurement [CHNL_ML]	Msec	0 - 604,799,799
32 - 41	Integrated Carrier Phase [PHI]	L1 Wavelengths	
43 - 48	Raw Code Offset [CODE]	L1 Wavelengths	
50 - 53	Integrated Carrier Phase [PHI_FRAC]	1/256 L1 Wavelengths	-128 - 127
55 - 58	Costas Ratio - provides a measure of the maximum phase error in the measurement. Phase error = 45°*(1-CR/128). [CR]		-128 - 127
60 - 63	Signal-to-Noise Ratio at 1 Hz Bandwidth [SNR]	dB Hz	25 - 53
65	Half-cycle Phase Ambiguity Indicator. The ? indicates that the phase ambiguity is unknown. The + or - signs do not mean anything by themselves. They are only important when they change, giving a better resolution of the phase of the measurement.		(-,+,?)

See record type 1 for the FORTRAN code which shows how to convert the raw user-time measurements to double-precision pseudorange and phase values in meters. The associated channel time of the message is also computed.

Example:

```
1        10        20        30        40        50        60        70
|---------|---------|---------|---------|---------|---------|---------|
331  9 11 243895000 243902917    1440099     94   43  122   38 -
```

Record Type 351

Description: Satellite Found

A type 351 record is output whenever a channel locks onto a satellite and the user has enabled 'Debug' for output (refer to input sentence $PMVXG,074)

Byte		Description	Units	Range
1 - 4	Record Type			351
6 - 7	Satellite PRN			1 - 32
9 - 10	C/N0		dB/Hz	0 - 54
12 - 19	Satellite PRN			1 - 32
21 - 31	Channel #			1 - 12
32 - 37	Acquired Frequency		L1 Hz	

Example:

```
1        10        20        30        40        50        60        70
|        |         |         |         |         |         |         |
351  2 52  SAT   2 CH  8 FOUND -1999
```

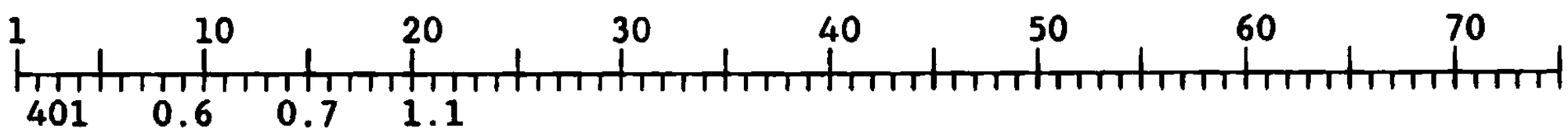
Record Type 401

Description: Dilution Of Precision

A type 401 record is output once each minute when the user has enabled 'Constellation' for output (refer to input sentence $PMVXG,074). The dilution of precision (DOP) values are given in the north, east, and up directions.

Byte	Description	Units	Range
1 - 4	Record Type		401
6 - 10	North DOP		0 - 999.9
12 - 16	East DOP		0 - 999.9
18 - 22	Vertical DOP		0 - 999.9

Example:



Record Type 411 - 422

Description: Satellite Geometry

The type 411 - 422 records are output once each minute for each satellite being tracked when the user has enabled 'Constellation' for output (refer to input sentence $PMVXG,074). The azimuth and elevation of the current selected constellation of satellites are contained in these records.

Byte	Description	Units	Range
1 - 4	Record Type: 411 = Channel 1 412 = Channel 2 .. .. .. 421 = Channel 11 422 = Channel 12		411 - 422
6 - 7	Satellite PRN		1 - 32
9 - 11	Azimuth to Satellite	Deg	0 - 359
13 - 17	Elevation of Satellite	Deg	0 - 89.99
19 - 25	GPS Time	Seconds Into the Week	0 - 604800

Example:

```
1        10        20        30        40        50        60        70
|        |         |         |         |         |         |         |
411   1 083   3.56  321098
412  25 044  35.01  321098
413  19 227   1.75  321098
414  18 284  16.28  321098
415   0 000   0.00  321098
416  29 309  48.70  321098
417  13 313   1.96  321098
418  15 209  29.46  321098
419  14 321  73.18  321098
420   0 000   0.00  321098
421   0 000   0.00  321098
422   0 000   0.00  321098
```

Record Type 6XX

Description: Reference Station RTCM Logging

All RTCM messages generated by the Reference Station are logged under record types 601 - 664; that is 600 plus the RTCM message type when the user has enabled 'Hex Format' for RTCM logging (refer to $PMVXG,050). The currently active message types are:

601 Differential Corrections (variable length)
602 Delta Differential Corrections (variable length)
603 Reference Station Parameters
606 Null
607 Beacon Almanac (variable length)
616 Operator Message (variable length)
659 Proprietary Message (variable length)

The RTCM records are composed of binary RTCM data with parity removed, expressed in hex-ASCII format. Each 8-bit byte of the RTCM message is represented by two hex-ASCII digits. Each RTCM word is represented by six hex-ASCII digits containing 24 data bits and 6 parity bits.

IMPORTANT
This message is generated only by Reference Stations (i.e. MX 9012R or MX 9112 configured as a Reference Station).

Byte Location	Description	Units	Range
1 - 4	Record Type		601 - 664
6 - 8	UTC Time of Transmission	Hours into the Week	00 - A8
10 -	RTCM Message (hex-ASCII)		00-FF (each byte)

Example:

```
1       10        20        30        40        50        60        70
|       |         |         |         |         |         |         |
601  93 6604003B213818014ABB480C00D5224E9BFF83F42F9AFF62F825AA
603  93 660C00304E20F0FF2F17E42DD664150D455F
607  93 661C00316000
659  93 66EC003788484D0018FFEA00AB0CFFDDFEF602FFFC00551B000B00551A00670055
```

Record Type 665

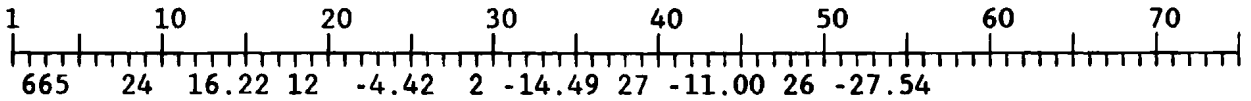
Description: Reference Station Pseudorange Corrections

This record consists of a list of satellite PRNs followed by the pseudorange corrections for each satellite in a readable format when the user has enabled 'Real Format' for RTCM logging (refer to input sentence $PMVXG,050). The satellites included in this record are those being tracked by the receiver.

IMPORTANT
This message is generated only by Reference Stations (i.e. MX 9012R or MX 9112 configured as a Reference Station).

Byte Location	Description	Units	Range
1 - 4	Record Type		665
8+(n-1)*11	Satellite PRN		1 - 32
10+(n-1)*11	Pseudorange Correction - (n = 1...number of satellites being tracked).	Meters	1 - 99999.9

Example:



Record Type 7XX

Description: Navigator RTCM Logging

All RTCM messages received by the Navigator are logged under record types 701 - 764; that is 700 plus the RTCM message type when the user has enabled 'Hex Format' for RTCM Logging (refer to input sentence $PMVXG,053). The currently active message types are:

701 Differential Corrections (variable length)
702 Delta Differential Corrections (variable length)
703 Reference Station Parameters
706 Null
707 Beacon Almanac (variable length)
716 Operator Message (variable length)
759 Proprietary Message (variable length)

The RTCM records are composed of binary RTCM data with parity removed, expressed in hex-ASCII format. Each 8-bit byte of the RTCM message is represented by two hex-ASCII digits. Each RTCM word is represented by six hex-ASCII digits containing 24 data bits and 6 parity bits.

IMPORTANT
This message is generated only by Navigators (i.e. MX 9212 or MX 9112 configured as a Navigator).

Byte Location	Description	Units	Range
1 - 4	Record Type		701 - 764
6 - 13	UTC Time of Transmission	Seconds Into the Week	0 - 604800.0
15 -	RTCM Message (hex-ASCII)		00-FF (each byte)

Example:

```
1        10        20        30        40        50        60        70
701 1F00EFDC1C9BFFD4094E0BFE43D9E892005DF71C9CFFDE08A313F9FEEBC402FC322BAF
10FE67C5601DF9B3E72C70
```

Record Type 765

Description: Navigator Pseudorange Corrections

This record consists of a list of satellite PRNs followed by the pseudorange corrections for each satellite in a readable format when the user has enabled 'Real Format' for RTCM Logging (refer to input sentence $PMVXG,053). The satellites included in this record are those being tracked by the receiver.

IMPORTANT
This message is generated only by Navigators (i.e. MX 9212 or MX 9112 configured as a Navigator).

Byte Location	Description	Units	Range
1 - 4	Record Type		765
6+(n-1)*11	Satellite PRN		1 - 32
9+(n-1)*11	Pseudorange Correction - (n = 1...number of satellites being tracked).	Meters	± 9999.9

Example:

```
1        10        20        30        40        50        60        70        80
|--------|---------|---------|---------|---------|---------|---------|---------|
 765  1   -49.0 14    -4.0 15     4.8 18    -6.7 19   -75.1 22   -35.1 25     2.
4 29     21.6
 765  2    18.1 14   -70.4 16   -28.5 18   -12.5 22  -111.2 27     4.1 28   -15.
6 29    -63.0
```

Record Type 799

Description: Beacon Logging

The type 799 record is generated once a minute when the user has enabled 'Beacon Logging' (refer to input sentence $PMVXG,034). This record contains navigation and beacon related information.

Byte	Description	Units	Range
1 - 4	Record Type		799
6 - 11	UTC Time of Measurement	Seconds Into the Week	0 - 604799
13 - 22	WGS-84 Latitude		
24 - 34	WGS-84 Longitude		
36 - 37	Navigation Mode		Navigating 1 = Position From Remote Device 2 = 2D 3 = 3D 4 = 2D Differential 5 = 3D Differential 8 = Position Known - Ref. Station 9 = Position Known - Navigator Not Navigating 51 = Too Few Satellites 52 = DOPs Too Large 53 = Position STD Too Large 54 = Velocity STD Too Large 55 = Too Many Velocity Iterations 56 = Too Many Position Iterations 57 = 3 Sat Startup Failed 58 = Commanded Abort
39	Beacon Bit Rate	Bits/Sec	1 = 25, 2 = 50, 3 = 100, 4 = 200
41	EDAC		0 = Disabled, 1 = Enabled
43 - 49	Total # of RTCM Messages Received		
51 - 54	# of RTCM Messages with Failures		
56 - 59	Beacon Signal Strength	dB µV/m	
61 - 64	Beacon Signal/Noise Ratio	dB	0 - 63
66 - 70	Beacon Frequency	Khz	283.5 - 325.0

Example:

```
1        10        20        30        40        50        60        70        80
|        |         |         |         |         |         |         |         |
799 150782 N 3350.525 W 11820.217 05 2 0 0000043 0001 0000 0000 00000
```

Record Type 969

Description: Time Recovery

The type 969 record is output each second when the user has enabled 'Time Recovery' outputs (refer to input sentence $PMVXG,074). This record consists of values computed by the navigation filter relating to the receiver clock state.

Byte	Description	Units	Range
*1 - 4	Record Type		969
5 - 17	Clocks Moved Last Measurement Time (divide this by the speed of light to obtain clock moves per second)	Meters	0 - 999999999.999
19 - 23	Oscillator Frequency Offset from Nominal	L1 Hz	0 - 999999
25 - 36	Clock Offset From GPS Time (add this value to user time to obtain GPS time)	Sec	
38 - 42	Error in Last Time Pulse	Local Oscillator Hz	± 99999
43 - 46	A/D Temperature Reading		0 - 1024
48	User Time Valid		T = True; time is within the specified window F = False
50 - 51	Solving For Expected Nav States		0 = No 1 = Yes

Notes:

*The type 969 record type field begins on byte #1.

Example:

```
1        10        20        30        40        50        60        70
|        |         |         |         |         |         |         |
969 146.526128 760 -0.000000670 6 542 T 1
```

SECTION V

DGPS/RTCM Port

The DGPS/RTCM Port (default Port 3) is an RS-232 port used to receive DGPS corrections in the case of a navigator, or to transmit DGPS corrections in the case of a reference station. The information contained in the RTCM messages is listed in Table 5-1.

The differential correction information is in the RTCM-104 format consisting of binary data in a 6 of 8 bit format, Version 2.0.

Table 5-1. DGPS/RTCM Port Records

Record Type	Type of Information	Lines/ Set	Output Interval
1	Differential Corrections	1	The Reference Station computes the corrections at a rate of 1/second. The output rate is a function of the Max Average Data Rate as controlled by the user. Refer to input sentence type $PMVXG,050.
2	Delta Differential Corrections	1	At ephemeris change, and once a minute for 3 more minutes.
3	Reference Station Parameters	1	User selectable rate (refer to input sentence $PMVXG,050). Default = every 15 minutes.
6	Null	1	Every 2 seconds when no other messages are available depending on Max Average Data Rate.
7	Beacon Almanac	1	At operator entry and at user selectable rate (refer to input sentence $PMVXG,050). Default = 11 minutes.
16	Operator Message	1	At operator input.
59	Proprietary Smoothing	1	User selectable rate (refer to input sentence $PMVXG,050). Default = Off

SECTION VI

EQUIPMENT/NMEA PORT

The Equipment/NMEA Port (default Port 4) is an RS-422 bi-directional serial interface port used to transmit standard NMEA sentences to NMEA devices (or external equipment interfacing on the NMEA standard). Data transmission protocol on the Equipment Port is identical to the protocol on the Control Port. Refer to the introductory text in Section III for the port and format specifications. Table 6-1 lists the identifiers of the NMEA devices. Note that the first two characters of the sentences transmitted from the GPS receiver are 'GP'. These characters identify the GPS receiver as the GPS talker.

Magnavox proprietary sentences may also be output on the Equipment Port. Refer to Control Port input sentence $PMVXG,026 to set up the list of messages to be output and their respective output rates.

Table 6-1. NMEA Device Identifiers

ID MNEMONIC	TALKER/LISTENER
AP	Autopilot, Magnet
AG	Autopilot,Gyro
CS	Communications, Satellite
CM	Computer, Memory Data
CC	Computer, Programmer Calc
DE	Decca Navigation
GP	GPS
HE	Gyro, Earth Seeking
HC	Compass, Magnetic
II	Integrated Instrumentation
LA	Loran A
LC	Loran C
MP	Microwave Positioner
OM	Omega System
OS	Distress Alarm
P	Proprietary
RA	Radar
SD	Sonar, Sounder, Depth
SS	Sonar, Sounder, Scanning
TR	Transit Satellite Navigator
VW	Speed Log, Water, Mechanical
VM	Speed Log, Water, Magnetic
YP	Pressure Transducers
YF	Frequency Transducers
YC	Temperature Transducers
YL	Level Transducers
YV	Volume Transducers
YR	Flow Rate Transducers
YT	Tachometer Transducers
ZQ	Quartz Clock
ZC	Chronometer
ZV	Radio Update (WWV or WWVH)
ZA	Atomic Clock

Table 6-2 lists the standard NMEA sentence that the Magnavox GPS receivers transmit to NMEA devices. The sentences contain velocity (speed over ground), track (heading), time and position information.

Table 6-2. Standard NMEA Records Transmitted to External Equipment

Sentence Type	Type of Information
$GPGGA	Past GPS Position
$GPGLL	Geographic Position
$GPVTG	Track and Speed Over Ground

Sentence Type - $GPGGA

Description: GPS Past Position

Field	Description	Units	Format	Range
1	UTC Time When Last Navigating	HHMMSS	Int	HH = 0 - 23 MM = 0 - 59 SS = 0 - 59
2	WGS-84 Latitude	Deg,Min	Float	Deg = 0 - 89 Min = 0 - 59.999
3	North/South Indicator		Char	N or S
4	WGS-84 Longitude	Deg,Min	Float	Deg = 0 - 179 Min = 0 - 59.999
5	East/West Indicator		Char	E or W
6	GPS Quality Indicator		Int	NMEA Version 1 0 = NO 1 = Yes NMEA Version 2 0 = No Fix 1 = Non-DGPS Fix 2 = DGPS Fix
7	Number of Satellites Used in the Fix		Int	0 - 12
8	HDOP		Int Float*	0.0 - 999.9
9	Antenna Height Above the Ellipsoid	Meters	Int Float*	±18000
10	Antenna Height Units		Char	'M'
11	Geoidal Height	Meters	Int Float*	±199
12	Geoidal Height Units		Char	'M'
13**	Age of DGPS Corrections	Sec	Int	0 - 999
14**	DGPS Reference Station ID		Int	0 - 1023

* **Note:** The format for these fields are FLOAT when NMEA Version 2 is selected and INT when Version 1 is selected.

** **Note:** These fields are present only when NMEA Version 2 is selected.

Example:

$GPGGA,182415,3350.4968,N,11820.2190,W,1,8,01,-0001,M,-032,M*4A NMEA Version 1
$GPGGA,182643,3350.5243,N,11820.2170,W,2,8,001.0,00034.3,M,-032.3,M,001,0157*42 NMEA Version 2

Sentence Type - $GPGLL

Description: Geographic Position Fix

Field	Description	Units	Format	Range
1	S-84 Latitude	Deg,Min	Float	Deg = 0 - 89 Min = 0 - 59.999
2	North/South Indicator		Char	N or S
3	WGS-84 Longitude	Deg,Min	Float	Deg = 0 - 179 Min = 0 - 59.999
4	East/West Indicator		Char	E or W
5*	UTC Time of Position	HHMMSS	Int	HH = 0-23 MM = 0 - 59 SS = 0 - 59
6*	Status: Data Valid		Char	A

* **Note:** These fields are present only when NMEA Version 2 is selected.

Example:

$GPGLL,3350.4968,N,11820.2190,W*7F NMEA Version 1
$GPGLL,3350.5243,N,11820.2170,W,182643,A*39 NMEA Version 2

Sentence Type - $GPVTG

Description: Track and Speed Over Ground

Field	Description	Units	Format	Range
1	Heading	Deg	Int	0 - 359
2	True		Char	T
3	Reserved			
4	Reserved			
5	Speed Over Ground	Kts	Float	
6	Knots		Char	N
7	Speed Over Ground	Km/Hr	Float	
8	Km/Hr		Char	K

Example:

$GPVTG,001.6,T,,,000.6,N,001.0,K*2D

APPENDIX A

COMPRESSED MEASUREMENT FORMAT

COMPRESSED MEASUREMENT FORMAT

Satellite measurement data is available in a compressed format on the Instrumentation/Raw Data Port. Record type 3 contains the same information reported in the type 1 measurement data records, except in a more efficient format. Type 3 measurement output formats are controlled using input sentence $PMVXG, 074.

The type 3 records use a mapped, 7 of 8 bit, binary format. The five-character ASCII record header '3' is followed by 136 data characters and one checksum character. Each data character contains seven bits of binary data that have been mapped into a 'printable' subset of the extended ASCII character set. This 7 of 8, mapped binary format was chosen instead of a pure binary format (8 of 8) to avoid special characters such as ENQ, ACK, DC1, DC2, FF, LF and DEL that might cause problems with modems, printers or data communication protocols.

Decoding of the type 3 records is done in two steps. First, each of the data and checksum characters are mapped from their 'printable' ASCII representation back to a 7 of 8 binary format. This mapping is illustrated in the listing of the 'C' function, **unmap78**, shown in Figure A-1. **unmap78** also compares the stored and computed checksums. Following this operation, each of the characters contain values in the range 0x00 to 0x7f; that is, only the least significant seven bits contain information. Note that the value 0xf7 is treated as a special case to avoid the DEL (rubout) character. The stored checksum is computed as the exclusive 'or' of the unmapped data bytes. The five-character ASCII header, '3', is not included in the checksum.

The second step in decoding type 3 records involves unpacking the data bits contained in the unmapped, 7 of 8 binary characters into the separate data items that make up the satellite measurements for each receiver channel. The data items contained in a type 3 record and their bit lengths within the packed 7 of 8 bit stream are shown in Table A-1. The source listing of the 'C' program **read3dat** shown in Figure A-2 illustrates how the data items are unpacked and scaled. **read3dat** calls the function **unpack78** (listing shown in Figure A-3) to strip each successive data item out of the 7 of 8 bit stream. Note that **unpack78** returns a long integer value that is cast to the appropriate data type in **read_dat** as required.

read3dat also contains code, following the **unpack78** calls, that shows how the data items are combined to form the full values of integrated phase, pseudorange and channel time (SV time of transmit).

The unpacked variable labeled *clock_shift* is required for operation in time recovery mode. It is scaled from clock cycles to meters in **read3dat**. It represents the number of clock cycles that have been added to the receiver's (user) clock since the last set of measurements was recorded. The unpacked value in meters should match the value in the first field of the Type 969 Time Recovery record. When time recovery is disabled, this value should be zero.

If the recorded raw measurements are being used as inputs to a navigation solution, the clock shift value should be added (or subtracted depending on the sign convention adopted in the navigation formulas) to the estimated clock offset prior to processing the pseudoranges. If phase measurements are being used, it should also be applied to the previous value of integrated phase before differencing with the current value. Since this value represents how much the user clock was shifted and since the receiver collects measurements at user time epochs, the user time interval between measurements must also be adjusted by the clock shift.

All three of these adjustments are illustrated by the C code fragment shown below. The sign conventions and scalings assumed are valid for the receiver basic navigation equations. They may need to be modified depending on the sign convention and scaling adopted in the user implemented navigation solution.

```
nav_clock = nav_clock + clock_shift;
for(i=0;i;i++)old_phase[i] = old_phase[i] + clock_shift;
prev_navtime = prev_navtime - clock_shift/SPEED_OF_LIGHT;]
```

Table C-1. Data Items Contained in Type 3 Record

	Description	Units	No. of Bits
1.	User time of measurement set	milliseconds	30
2.	Channel time (SV time base value	milliseconds	30
3.	Time recovery clock shift	clock cycles	22

Sum = 82 bits

Items 4 - 13 are repeated 12 times, once per receiver channel

	Description	Units	No. of Bits
4.	Data valid flag	true/false	1
5.	Satellite PRN	-	6
6.	Channel time (SV time) delta value	milliseconds	5
7.	Integrated phase, sub-ms part	L1 cycles	21
8.	Integrated phase, fractional part	1/256 L1 cycles	8
9.	Raw code offset	L1 cycles	10
10.	Carrier smoothed code offset	L1 cycles	10
11.	Costas ratio	-	4
12.	Signal strength (c/no)	dB	5
13.	Half cycle ambiguity	-	2

Sum = 72 bits

Total data bits = 82 + 12*72 = 946

Total data bytes (7 of 8) = 136
+ 1 Checksum byte
137 bytes total
+ 5 Record type header
142 Total Bytes

Example:

Figure A-1. Source Listing of 'C' Function unmap78

```
/*
 *  unmap78
 *
 *
 *  Unmap a packed 7 of 8 binary buffer from 'printable' subset of the
 *  extended ASCII code set back to binary.  Compute the binary checksum
 *  and compare it with the one stored in the buffer following the data.
 *
 *  Inputs
 *  ------
 *  char*    buf            ptr to start of packed buffer
 *  int      checksum_index index (subscript) where checksum is stored
 *
 *  Outputs
 *  -------
 *  char*    buf            Unmapped buffer.
 *
 *  Function Value Returned: TRUE if computed and stored checksum match.
 *
 *  NOTE:  Unmapping is done in place, i.e. input and output buffers are
 *         the same
 *
 *  History:
 *      1/18/91  Created for MX4200.  T. Sharpe
 */
int unmap78( char* buf, int checksum_index)
{
        int      i;
        char     checksum;

/*                          <<<<<<<<<<>>>>>>>>>>                          */

checksum = (char)0;

/* Index over all of the packed data bytes and the stored checksum, map them
   back to binary.  Test for special case of rubout/delete.  Compute checksum.
 */
for (i=0; i < checksum_index+1 ; i++)
{
    if (buf[i] == (char)0xf7) buf[i] = (char)0x7f;
    buf[i] -= (char)37;
    checksum  ^= buf[i];
}
if (checksum == 0)
    return(1);
else
    return(0);
}
```

Figure A-2. Source Listing of 'C' Program read3dat

```
/*
 * read3dat
 *
 *
 *  Utility program to read and decode MX 4200 type 2 compressed raw data
 *  records from a recorded MX 4200 raw data file.
 *
 *  Usage:
 *          read3dat [d:][pathname]in_filename [d:][pathname]out_filename
 *
 *                  d:          - optional, drive specification
 *                  pathname    - optional, path specification
 *                  in_filename - name of MX 4200 recorded raw data file
 *                  out_filename - name of output file to receive results
 */

#include <stdio.h>
#include <string.h>

  /*              Function prototypes                     */

int   main(int, char *[]);
int   unmap78( char* buf, int checksum_index);
void  unpack78(char* buf, int num_bits, long* out_value, int* total_num_bits);

main(argc, argv)

int   argc;             /* number of arguments passed into main     */
char *argv[];           /* an array of pointers to argument strings */

{

        /*      Local Constants         */

#define CHANO                   12
#define SPEED_OF_LIGHT          299792458.0
#define L1_CARRIER_FREQUENCY    1575420000.0
#define L1_TO_VEL               (SPEED_OF_LIGHT / L1_CARRIER_FREQUENCY)

        /*      Local Variables         */

FILE    *dat_strm, *out_strm;
```

*Figure A-2. Source Listing of 'C' Function **read3dat** (Continued)*

```
int     total_bits, ch, prn[CHANO], raw_code[CHANO], cas_code[CHANO];
long    long_temp, ch_ms_base, chnl_time_ms[CHANO], sub_ms_phase[CHANO];
char    data_valid[CHANO], phase_fraction[CHANO], costas_ratio[CHANO];
char    inverted_data[CHANO], buf[200], half_cycle;
int     cn0[CHANO], channel;
long    user_time_ms;

double  temp_ms, temp_phase, temp_raw_code, temp_cas_code, clock_shift;
double  integrated_phase[CHANO], raw_pseudorange[CHANO];
double  cas_pseudorange[CHANO], sv_transmit_time[CHANO];

/*              <<<<<<<<<<<<<<<>>>>>>>>>>>>>>>

/* Check if enough arguments were supplied in the run string
 */
if(argc!=3)
{
 printf("\nread2dat [d:][pathname]in_filename [d:][pathname]out_filename\n");
 printf("\n  d:          - optional, drive specification              \n");
 printf("\n  pathname    - optional, path specification                \n");
 printf("\n  in_filename  - name of MX 9012/4212 recorded raw data file \n");
 printf("\n  out_filename - name of output file to receive results     \n");
 return(0);
}

/*  Open the MX 4212 raw data input file.  Bail out if open fails.
 */
if ( !(dat_strm=fopen(argv[1],"rt")) )
{
   printf("\n");
   printf("Unable to open input file. Try again.\n");
   return (0);
}

/*  Open the specified output file.  Bail out if open fails
 */
if( !(out_strm=fopen(argv[2],"wt")) )
{
   printf("\n");
   printf("Unable to open output file. Try again.\n");
   return (0);
}
```

Figure A-2. Source Listing of 'C' Function read3dat (Continued)

```
/*  Read records from the recorded data file until end of file.
    Decode any type 3 records and output their contents.
 */
while(fgets(buf,199, dat_strm))
{
    if ( buf[0]==' ' && buf[1]==' ' && buf[2]==' ' && buf[3]=='3' )
    {
       /*  Unmap the data characters from 'printable' extended ASCII
           back to 7 of 8 binary.  If computed and stored checksum
           don't match (function returns false) then don't decode this
           record  */

if ( !unmap78( buf+5, strlen(buf+5)-2 ) ) break;

/*  Set the total number of bits unpacked so far to zero.  This
    serves as an initialization signal to the unpack routine.
 */
total_bits = 0;

/* Unpack items recorded once for each set
 */
unpack78( buf+5, 30, &user_time_ms, &total_bits);
unpack78( buf+5, 30, &ch_ms_base, &total_bits);
unpack78( buf+5, 22, &long_temp,  &total_bits);
clock_shift =
  (double)(long_temp-(long)2046000) * SPEED_OF_LIGHT/10.23E6;

/* For each channel, unpack and scale the data items.
   If the channel has valid data,  compute the integrated phase,
   pseudorange (raw and smoothed) and channel time (SV time of xmit)
 */
for ( ch = 0; ch < CHANO; ch++ )
{
    unpack78( buf+5,  1, &long_temp, &total_bits );
    data_valid[ch] = (char)long_temp;

    unpack78( buf+5,  6, &long_temp, &total_bits );
    prn[ch] = (int)long_temp;

unpack78( buf+5,  5, &long_temp, &total_bits );
chnl_time_ms[ch] = ch_ms_base + long_temp;

unpack78( buf+5, 21, &long_temp, &total_bits );
sub_ms_phase[ch] = long_temp;
```

Figure A-2. Source Listing of 'C' Function read3dat (Continued)

```
unpack78( buf+5,  8, &long_temp, &total_bits );
phase_fraction[ch] =  (char)long_temp - (char)128;

unpack78( buf+5, 10, &long_temp, &total_bits );
raw_code[ch] = (int)long_temp - 512;

unpack78( buf+5, 10, &long_temp, &total_bits );
cas_code[ch] = (int)long_temp - 512;

unpack78( buf+5,  4, &long_temp, &total_bits );
costas_ratio[ch] = (char)long_temp * (char)16  -  (char)128;

unpack78( buf+5,  5, &long_temp, &total_bits );
cn0[ch] = (int)long_temp + 25;

unpack78( buf+5,  2, &long_temp, &total_bits );
inverted_data[ch] = (char)long_temp;

if ( data_valid[ch] )
{
    temp_ms =
(((double)(user_time_ms - chnl_time_ms[ch]))/1000.)*SPEED_OF_LIGHT;

    temp_phase =
-(((double)sub_ms_phase[ch] + (((double)phase_fraction[ch])/256.)
 ) * L1_TO_VEL );

    temp_raw_code = -((double)raw_code[ch]) * L1_TO_VEL;

    temp_cas_code = -((double)cas_code[ch]) * L1_TO_VEL;

    /* Form the complete integrated phase (meters),
       raw pseudorange (meters), carrier smoothed pseudorange
       (meters) and channel time (SV time of transmit,
       GPS seconds in week) for use in nav solution.
     */
    integrated_phase[ch] = temp_ms + temp_phase;
    raw_pseudorange[ch] = integrated_phase[ch] + temp_raw_code;
    cas_pseudorange[ch] = integrated_phase[ch] + temp_cas_code;
    sv_transmit_time[ch] = (double)user_time_ms/1000. -
                    raw_pseudorange[ch]/SPEED_OF_LIGHT;
```

*Figure A-2. Source Listing of 'C' Function **read3dat** (Continued)*

```
/* Write the decoded type 2 results to the output file
   */
channel = ch + 1;
if      (inverted_data[ch] == 0) half_cycle = '?';
else if (inverted_data[ch] == 1) half_cycle = '+';
else if (inverted_data[ch] == 2) half_cycle = '-';

                    fprintf( out_strm,
                     "   1 %2d %2d %9ld %9ld %10ld %6d %4d %4d %4d %c %4d\n"
                     ,channel, prn[ch], user_time_ms, chnl_time_ms[ch]
                     ,sub_ms_phase[ch], raw_code[ch], phase_fraction[ch]
                     , costas_ratio[ch], cn0[ch], half_cycle, cas_code[ch] );

                } /* End 'if data_valid' */
            } /* End 'for ch =0 to CHANO' */
        } /* End 'if type = 2 ' */
        else
        {
            fprintf( out_strm, "%s", buf );
        }
    } /* End 'while fgets' */
    return(1);
}
```

Figure A-3. Source Listing 'C' function unpack78

```
/*
 *   unpack78
 *
 *
 *   Unpack values from a buffer stored in 7 of 8 binary format
 *
 *   Inputs
 *   ------
 *   char*    buf           ptr to start of packed 7 of 8 binary buffer
 *   int      num_bits      number of bits to be extracted for this value
 *   int*     total_num_bits total number of bits unpacked so far, set to zero
 *                           by calling routine to signal beginning of unpack
 *
 *   Outputs
 *   -------
 *   long     out_value     unpacked value cast as long, right justified
 *   int*     total_num_bits reports total number of bits packed so far
 *
 * NOTE:
 * 1) total_num_bits is used as both an INPUT and OUTPUT as described above.
 * 2) out_value is right justified (LSB of value in LSB of long int)
 *
 *   Globals: NONE
 *
 *   Hardware Interfaces: NONE
 *
 *   Restrictions: NONE
 *
 *   History:
 *       1/18/91  Created for MX4200.   T. Sharpe
 */

void unpack78(char* buf, int num_bits, long* out_value, int* total_num_bits)
{
static   int      bit_index, buf_index;
         int      num_bits_remaining;

/*                  <<<<<<<<<<<<>>>>>>>>>>>>
if( *total_num_bits == 0 )   /* Start on new buffer if caller requests it  */
{
   buf_index = 0;
   bit_index = 6;
}
```

Figure A-3. Source Listing 'C' function unpack78 (continued)

```
num_bits_remaining = num_bits;
*out_value = 0;

while( num_bits_remaining > 0 )
{
    num_bits_remaining--;

    /* Unpack the next bit and 'or' it into the proper bit in the output value
     */
    *out_value = *out_value |
        ((long)((buf[buf_index] >> bit_index) & 1) << num_bits_remaining);

    bit_index--;

    if (bit_index < 0)
    {
        bit_index = 6;
        buf_index++;
    }
}
*total_num_bits += num_bits;
return;
}
```

- A -

Library of coarse satellite orbital characteristics used to calculate satellite rise times, set times, angles of elevation, etc. Almanac data is valid for 181 days.

Antenna height above mean sea level in meters. GPS uses average mean sea level (MSL) as its reference altitude, which is the fixed altitude for marine navigation.

The angular displacement in the horizontal plane between the point of observation and the Greenwich meridian. For GPS satellites, azimuth is measured clockwise from true north.

- B -

The characters in an NMEA data record that define the NMEA data family (class) of records.

A group of 8 bits of binary data or one ASCII character.

- C -

The program supplied by Magnavox on diskette that allows a PC to operate as the receiver controller.

The initial clock offset, plus accumulated integrated clock frequency offset. Clock bias is given in units of displacement by multiplying it by the speed of light.

Difference in frequency between the receiver reference oscillator and the GPS system clock.

The difference between the receiver time and GPS system time.

Receiver startup with all navigation values reset and all constants set at default values.

A group of GPS satellites visible to the receiver. The size of a usable constellation is a minimum of 3 satellites.

- D -

Sending data to a disk file for later observation or printing.

The difference between the computed and observed position at a GPS reference station. The correction is transmitted by the GPS reference station to the remote GPS receiver, where it is incorporated with the remote receiver's own measurements to obtain better accuracy.

A method of improving the accuracy of the GPS positon by applying pseudorange

corrections computed at the GPS reference station.

A measure of quality of the GPS derived position and time estimates, based on the geometry of the satellite constellation. A smaller DOP indicates better geometry which yields a better solution. Generally, the more spread out the satellites, the lower the DOP. The DOP's used for GPS satellite tracking are as follows:

NDOP - Dilution of precision in the North axis.
EDOP - Dilution of precision in the East axis.
VDOP - Dilution of precision in the Vertical axis.
TDOP - Dilution of precision with respect to time.
HDOP - Horizontal dilution of precision (NDOP, EDOP).
PDOP - Position dilution of precision (NDOP, EDOP, VDOP)
GDOP - Geometric dilution of precision (NDOP, EDOP, VDOP, TDOP)

- E -

The angle formed by the line-of-sight range to the satellite and the horizontal plane of the receiver antenna. Thus, the elevation angle is 90 degrees when the satellite is overhead and 0 degrees when it first appears on the horizon.

In geodesy, a mathematical figure formed by revolving an ellipse about its minor axis.

Height of the ellipsoid relative to sea level.

Tabulation of accurate data describing position and health of the satellites over a 2 - 4 hour period. The data is up-loaded to the satellites every 12 hours.

- G -

Position as defined by latitude and longitude (as opposed to grid coordinates).

A mathematical model of the earth's surface with all of the topographical undulations removed so that all points on the model approximate mean sea level.

Height relative to the geoid (approximately mean sea level).

The spacial relationship of the GPS satellites with respect to each other and the receiver.

The NAVSTAR Global Positioning System, consisting of orbiting satellites, a network of ground control stations, and user positioning and navigation equipment. When fully operational, the system will have 21 satellites in six orbital planes about 20,200 kilometers above the earth. Three additional satellites will be strategically stationed in orbit as spares in the event of on-line satellite malfunction.

The GPS receiver located at a precisely known location. This receiver computes the difference between its known position and the computed position, and transmits the differences over a modem link to a GPS navigator.

The 0-degree east/west demarcation line of longitude running through Greenwich, England.

- H -

Status of a satellite whereby it is deemed by the GPS system to be capable of providing reliable position and time data.

A factor in the motion dynamics of a vessel that describes the acceleration vector in the horizontal plane (as in a change of course).

The character in an NMEA data record that defines the equipment receiving the data.

- L -

The identification of a point on the earth's surface located along a parallel plane.

The number of hours by which the local time differs from Universal Time Coordinated (UTC).

The identification of a point on the earth's surface located along a meridan plane.

- M -

Messages sent and received on the Control Port in a proprietary NMEA format.
GPS signal measurement before processing.

- N -

A billionth (10^{-9}) of a second.

A unit of distance used on most maritime charts. In the U.S., 1 nm is equal to 1852 meters (6076.115 feet).

National Maritime Electronics Association.

Data records formatted according to the National Marine Electronics Association 0183 Standard.

- O -

The characters in an NMEA data record that define the equipment requesting the record.

The medium through which one channel of data enters and/or leaves a device. The receiver has four ports accessed through the MULTI-PORT INTERFACE connector.

An identifying number assigned to the pseudorandom noise sequence used to identify each GPS satellite.

As it applies to GPS, the measured distance from an orbiting satellite to a GPS receiver. The pseudorange is calculated by differencing the time of receipt of a satellite signal and the time of transmission; and then multiplying the result by the speed of light.

A GPS receiver located at a precisely known position. The receiver produces corrections to its computed position by differencing the "known" and the "computed" positions. It passes the differential corrections to remote GPS receivers to improve accuracy at the remote location.

- S -

The orbital state of the satellite constellation at a specific time, relative to a GPS user or specific set of GPS users.

Describes the operational status and/or quality of measurement data from a satellite.

Receiver mode where the receiver is attempting to track a satellite that has not been previously tracked.

s Future rise and set times of the GPS satellites.

Receiver mode where the receiver is attempting to track a previously tracked satellite.

Moving the cursor continuously through "pages" of screen data.

Receiver mode where the receiver is scanning satellites to acquiring them (mode code = STS).

The mode in which the receiver is evaluating the signal from a satellite to determine whether or not it will lock onto the signal.

The character in an NMEA data record that defines the record as non-standard.

Speed (in knots) relative to the ocean floor or land.

Position as computed directly from GPS satellite signals (differential corrections are not applied).

- T -

A process that pinpoints the exact time, within 50 nanoseconds, of the navigation solution.

The path that the receiver has taken to reach the current position.

Receiver mode where the receiver is locked onto a satellite and is evaluating its status (mode code = TRK).

Minimum satellite elevation, in degrees, necessary (or desirable) for tracking. Satellites below this elevation will not be selected for tracking by the receiver. This value is normally set between 5 and 10 degrees. The recommended value is 5.

- U -

Status of a satellite whereby it is deemed to be incapable of providing reliable position and time data.

Greenwich mean time corrected for polar motion of the earth and seasonal variation in the earth's rotation.

- V -

A factor in the motion dynamics of a vehicle that describes the acceleration vector of the vehicle in the vertical plane (as in heave).

The position of a satellite whereby it is in uninterrupted line of sight from the receiver antenna.

- W -

Receiver startup using values currently stored in memory.

- 2 -

A navigation mode whereby latitude, longitude and time are computed from three satellites using a fixed value for altitude.

A navigation mode whereby differentially corrected latitude, longitude and time are computed from three satellites using a fixed value for altitude.

- 3 -

A navigation mode whereby latitude, longitude, altitude and time are computed using a minimum of four satellites.

3D DGPS	A navigation mode whereby differentially corrected latitude, longitude, altitude and time are computed using a minimum of four satellites.

'S Seconc ls

Tue	Wed	Thu
172800	259200	345600
176400	262800	349200
180000	266400	352800
183600	270000	356400
187200	273600	360000
190800	277200	363600
194400	280800	367200
198000	284400	370800
201600	288000	374400
205200	291600	378000
208800	295200	381600
212400	298800	385200
216000	302400	388800
219600	306000	392400
223200	309600	396000
226800	313200	399600
230400	316800	403200
234000	320400	406800
237600	324000	410400
241200	327600	414000
244800	331200	417600
248400	334800	421200
252000	338400	424800
255600	342000	428400
259200	345600	432000

Magnavox DGPS 12 Channel Technical Reference Manual	R-7278 B	May 1994
Manual Title	Manual Number	Issue Date

Leica welcomes your evaluation of this manual. Please note errors, suggest additions, or make general comments below. Use extra pages if you like. All comments and suggestions become the property of Leica.

Do not use this form to request purchases, maintenance assistance, or additional publications. Please contact your Leica marketing representative for purchases or additional publications, and your nearest authorized service representative for maintenance assistance.

Thank you.

YOUR NAME:_____

ADDRESS:_____

_____

PHONE: ( )_____

FOLD ON BROKEN LINE AS SHOWN ON OTHER SIDE OF PAGE AND SEAL WITH TAPE.

LEICA, *TORRANCE*
23820 Hawthorne Blvd., Suite #200
Torrance, CA 90505,
USA

Attn: Navigation and Positioning, Dept. 970
Technical Documentation

LIMITED WARRANTY

Refer to the "Standard Condition of Sale" on your Order acknowledgement or Invoice.

REQUEST FOR SERVICE

LEICA IS REPRESENTED BY A WORLDWIDE NETWORK OF SERVICE REPRESENTATIVES WHO ARE AVAILABLE TO SERVICE THE COMPLETE RANGE OF LEICA MARINE AND SURVEY PRODUCTS.

CONTACT LEICA FOR THE LOCATION OF YOUR NEAREST AUTHORIZED SERVICE REPRESENTATIVE

LEICA, *TORRANCE*
23820 Hawthorne Blvd., Suite #200
Torrance, CA 90505
U.S.A.

ATTN: FIELD SERVICE MANAGER

PHONE: (310) 791-2141

FAX: (310) 378-6627

YOU WILL NEED TO KNOW YOUR UNIT'S MODEL AND SERIAL NUMBER WHEN CONTACTING LEICA FOR SERVICE. RECORD THE SERIAL NUMBER BELOW. YOUR MODEL NUMBER IS:

MX 9212 _____ MX 9012R _____ MX 9112 _____

SERIAL NUMBER:_____

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?
- Are there any errors and, if so, where and what are they?

Be sure to reference the title and identification number of this manual:

Magnavox DGPS 12 Channel
Technical Reference Manual R-7278 A

and include your name, address and telephone number. We look forward to finding out how we can improve our information services.

All of your comments and suggestions become the property of Magnavox. Please send them to:

Leica, *Torrance*
23820 Hawthorne Blvd., Suite #200
Torrance, CA 90505
United States of America

Attn: Navigation and Positioning, Dept. 970
Technical Documentation

or write your comments on the READER COMMENT SHEET on the next page and mail it to us.

READER COMMENT SHEET