Garmin Proprietary NMEA 0183 Sentences TECHNICAL SPECIFICATIONS

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RECORD OF REVISIONS

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1 INTRODUCTION

1.1 GARMIN PROPRIETARY NMEA SENTENCES

- Garmin Proprietary NMEA sentences are designed for use with Garmin GPS sensors and GPS units in order to interface with external devices for data interpretation and recording. Refer to your Garmin Product Owner's Manual to determine the specific sentences supported by your product.
- **NOTE:** Not all Garmin GPS units support NMEA interfaces.

  For those devices that do not support NMEA 0183, refer to the *Garmin Device Interface SDK* for specific information about the Garmin Protocol. The Garmin Device Interface SDK is located on the Garmin Web site at http://www.garmin.com/support/ commProtocol.html.

2 GPS RECEIVER SOFTWARE INTERFACE

The interface protocol design of most Garmin products is based on the National Marine Electronics Association's NMEA 0183 ASCII interface specification. This standard is fully defined in *NMEA 0183, Version 2.30*. Copies may be obtained from NMEA, http://www.nmea.org/.

In addition to the standard NMEA 0183 sentences, Garmin GPS receivers may transmit or receive information over their serial interface using NMEA 0183 compliant Garmin proprietary sentences. These proprietary sentences begin with the characters, "$PGRM", instead of the characters "$G" that are typical of the standard NMEA 0183 sentences. The characters "$P" indicate that the sentence is a proprietary implementation and the characters and "GRM" indicate that it is Garmin's proprietary sentence. The letter (or letters) that follow the characters "$PGRM" uniquely identifies that particular Garmin proprietary sentence.

2.1 RECEIVED NMEA 0183 SENTENCES

The following paragraphs define the sentences that can be received on a GPS unit's port. Null fields in the configuration sentence indicate no change in the particular configuration parameter. All sentences received by the GPS unit must be terminated with <CR><LF>, the ASCII characters for carriage return (0D hexadecimal) and line feed (0A hexadecimal). The checksum *hh is used for parity checking data and is not required, but is recommended for use in environments containing high electromagnetic noise. It is generally not required in normal PC environments. When used, the parity bytes (hh) are the ASCII representation of the exclusive-or (XOR) sum of all the characters between the "$" and "*" characters, non-inclusive. Any letters used in the hex representation must be capitalized, such as 3D instead of 3d. Sentences may be truncated by <CR><LF> after any data field and valid fields up to that point will be acted on by the GPS unit.

2.1.1 Sensor Initialization Information (PGRMI)

The $PGRMI sentence provides information used to initialize the GPS sensor's set position and time used for satellite acquisition. Receipt of this sentence by the GPS sensor causes the software to restart the satellite acquisition process. If there are no errors in the sentence, it will be echoed upon receipt. If an error is detected, the echoed PGRMI sentence contains the current default values. Current PGRMI defaults (with the exception of the Receiver Command, which is a command rather than a mode) can also be obtained by sending $PGRMIE to the GPS sensor.

$PGRMI,<1>,<2>,<3>,<4>,<5>,<6>,<7>*hh<CR><LF>

<1>	Latitude, ddmm.mmm format (leading zeros must be transmitted)
<2>	Latitude hemisphere, N or S
<3>	Longitude, dddmm.mmm format (leading zeros must be transmitted)
<4>	Longitude hemisphere, E or W
<5>	Current UTC date, ddmmyy format
<6>	Current UTC time, hhmmss format
<7>	Receiver Command, A = Auto Locate, R = Unit Reset

2.1.2 Sensor Configuration Information (PGRMC)

The $PGRMC sentence provides information used to configure a GPS sensor's operation. Configuration parameters are stored in non-volatile memory and retained between power cycles. The GPS sensor will echo this sentence upon its receipt if no errors are detected. If an error is detected, the echoed PGRMC sentence contains the current default values. Current default values can also be obtained by sending $PGRMCE to the GPS sensor.

$PGRMC,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>,<12>,<13>,<14>*hh<CR><LF>

<1>	Fix mode, A = automatic, 2 = 2D exclusively (host system must supply altitude), 3 = 3D exclusively
<2>	Altitude above/below mean sea level, -1500.0 to 10000.0 meters
<3>	Earth datum index. If the user datum index (96) is specified, fields <4> through <8> must contain valid values. Otherwise, fields <4> through <8> must be null. Refer to your Appendix A for a list of earth datums and the corresponding earth datum index.
<4>	User earth datum semi-major axis, 6360000.000 to 6380000.000 meters (.001 meters resolution)
<5>	User earth datum inverse flattening factor, 285.0 to 310.0 (10^{-9} resolution)
<6>	User earth datum delta x earth centered coordinate, -5000.0 to 5000.0 meters (1 meter resolution)
<7>	User earth datum delta y earth centered coordinate, -5000.0 to 5000.0 meters (1 meter resolution)
<8>	User earth datum delta z earth centered coordinate, -5000.0 to 5000.0 meters (1 meter resolution)
<9>	Differential mode, A = automatic (output DGPS data when available, non-DGPS otherwise), D = differential exclusively (output only differential fixes)
<10>	NMEA 0183 Baud rate, 1 = 1200, 2 = 2400, 3 = 4800, 4 = 9600, 5 = 19200, 6 = 300, 7 = 600
<11>	Velocity filter, 0 = No filter, 1 = Automatic filter, 2-255 = Filter time constant (e.g., 10 = 10 second filter)
<12>	Not used
<13>	Not used
<14>	Dead reckoning valid time 1-30 (sec)

All configuration changes take effect after receipt of a valid value except baud rate. Baud rate change takes effect on the next power cycle or an external reset event.

2.1.3 Additional Sensor Configuration Information (PGRMC1)

The $PGRMC1 sentence provides additional information used to configure the GPS sensor operation. Configuration parameters are stored in non-volatile memory and retained between power cycles. The GPS sensor echos this sentence upon its receipt if no errors are detected. If an error is detected, the echoed PGRMC1 sentence contains the current default values. Current default values can also be obtained by sending $PGRMC1E to the GPS sensor.

$PGRMC1,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>,<12>*hh<CR><LF>

<1>	NMEA 0183 output time 1-900 (sec)
<2>	Binary Phase Output Data, 1 = Off, 2 = On.
<3>	Automatic Position Averaging when Stopped, 1 = Off, 2 = On
<4>	No Effect (DGPS beacon frequency – 0.0, 283.5 – 325.0 kHz in 0.5 kHz steps)
<5>	No Effect (DGPS beacon bit rate – 0, 25, 50, 100, or 200 bps)
<6>	No Effect (DGPS beacon scanning, 1 = Off, 2 = On)
<7>	NMEA 0183 version 2.30 mode indicator, 1 = Off, 2 = On
<8>	DGPS mode, W = WAAS Only, N = None (DGPS disabled)
<9>	Power Save Mode for GPS, P = Power Save mode, N = Normal
<10>	Adaptive Transmission Enabled, 1 = Off, 2 = On
<11>	Auto Power Off, 1 = Off, 2 = On
<12>	Power On with External Charger, 1 = Off, 2 = On

Configuration changes take effect immediately, with the exception of Binary Phase Output Data, which takes effect on the next power cycle or a reset event. A reset can be commanded by sending the sentence "$PGRMI,,,,,,,R" (refer to Section 2.1.1 Sensor Initialization Information (PGRMI)). If the GPS sensor is in the Binary data mode, it is necessary to send the following eight-byte data stream to temporarily change

the data format to NMEA 0183. Then follow by sending a PGRMC1 sentence that turns off the Binary Phase Output Data format:

10 0A 02 26 00 CE 10 03 (Hexadecimal)

2.1.4 Output Sentence Enable/Disable (PGRMO)

The $PGRMO sentence provides the ability to enable and disable specific output sentences.

$PGRMO,<1>,<2>*hh<CR><LF>

<1>	Target sentence description (e.g., PGRMT, GPGSV, etc.)
<2>	Target sentence mode, where: 0 = disable specified sentence 1 = enable specified sentence 2 = disable all output sentences 3 = enable all output sentences (except GPALM) 4 = restore factory default output sentences

The following notes apply to the PGRMO input sentence:

1. If the target sentence mode is '2' (disable all), '3' (enable all), or '4' (restore defaults), the target sentence description is not checked for validity. In this case, an empty field is allowed (e.g., $PGRMO,,3), or the mode field may contain from 1 to 5 characters.
2. If the target sentence mode is '0' (disable) or '1' (enable), the target sentence description field must be an identifier for one of the sentences that can be output by the GPS sensor.
3. If either the target sentence mode field or the target sentence description field is not valid, the PGRMO sentence will have no effect.
4. $PGRMO,GPALM,1 causes the GPS sensor to transmit all stored almanac information. All other NMEA 0183 sentence transmission will be suspended temporarily.
5. $PGRMO,,G causes the COM port to change to Garmin Data Transfer format for the duration of the power cycle. The Garmin mode is required for GPS 10, GPS 15L, GPS 15H, GPS 16, GPS 17, and GPS 18 series product software updates.

2.1.5 Additional Waypoint Information (PGRMW)

The $PGRMW sentence provides the ability to update a waypoint's symbol, altitude, and comment.

$PGRMW,<1>,<2>,<3>,<4>*hh<CR><LF>

<1>	Waypoint identifier
<2>	Altitude in meters
<3>	Symbol number in Hexadecimal up to FFFF. Uses the enumerated values as defined for symbol_type.
<4>	Comment string

The following notes apply to the PGRMW input sentence:

1. The waypoint identifier must exactly match an existing waypoint on the unit. If the unit cannot find a waypoint that matches the given identifier, the rest of the sentence will be ignored.
2. See Garmin Device Interface Specification 001-0063-00 for enumerated values of symbol_type.
3. If the comment string contains more characters than the unit supports, the unit will ignore any characters beyond the size allotted for comments.
4. Not all units support this sentence.

2.2 TRANSMITTED NMEA 0183 SENTENCES

The subsequent paragraphs define the sentences that can be transmitted.

2.2.1 Sentence Transmission Rate

Sentences are transmitted with respect to the user selected baud rate.

The GPS unit transmits each sentence (except where noted in particular transmitted sentence descriptions) at a periodic rate based on the user selected baud rate and user selected output sentences. The GPS unit transmits the selected sentences contiguously. The length of the transmission can be determined by the following equation and Tables 2 and 3:

$$\text{length of transmission} = \frac{\text{total characters to be transmitted}}{\text{characters transmitted per second}}$$

Sentence	Output Rate	Maximum Characters
GPRMC	Once per record*	74
GPGGA	Once per record*	82
GPGSA	Once per record*	66
GPGSV	Once per record*	70
PGRME	Once per record*	35
GPGLL	Once per record*	44
GPVTG	Once per record*	42
PGRMV	Once per record*	32
PGRMF	Once per record*	82
PGRMB	Once per record*	40
PGRMT	Once per minute*	50

***if enabled**

Table 1: NMEA 0183 Output Sentence Order and Size

Baud	Characters per Second
300	30
600	60
1200	120
2400	240
4800	480
9600	960
19200	1920
38400	3840

Table 2: Characters per Second for Available Baud Rates

The maximum number of fields allowed in a single sentence is 82 characters including delimiters. Values in the table include the sentence start delimiter character "$" and the termination delimiter <CR><LF>. The factory set defaults result in a once per second transmission at the NMEA 0183 specification transmission rate of 4800 baud.

Some Garmin products implement a one-pulse-per-second output, the rising edge of which is aligned to the UTC second boundary to within one microsecond for all conditions in which the receiver has reported a valid and accurate position for at least the previous four seconds.

Regardless of the selected baud rate, the information transmitted by the GPS sensor is referenced to the one-pulse-per-second output pulse immediately preceding the GPRMC sentence, or whichever sentence is output first in the burst (see Table 2 above). NMEA 0183 sentences are listed in order of their occurrence within a record.

2.2.2 Estimated Error Information (PGRME)

$PGRME,<1>,M,<2>,M,<3>,M*hh<CR><LF>

<1>	Estimated horizontal position error (HPE), 0.0 to 999.9 meters
<2>	Estimated vertical position error (VPE), 0.0 to 999.9 meters
<3>	Estimated position error (EPE), 0.0 to 999.9 meters

2.2.3 GPS Fix Data Sentence (PGRMF)

$PGRMF,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>,<10>,<11>,<12>,<13>,<14>,<15>*hh<CR><LF>

<1>	GPS week number (0 - 1023)
<2>	GPS seconds (0 - 604799)
<3>	UTC date of position fix, ddmmyy format
<4>	UTC time of position fix, hhmmss format
<5>	GPS leap second count
<6>	Latitude, ddmm.mmmm format (leading zeros will be transmitted)
<7>	Latitude hemisphere, N or S
<8>	Longitude, dddmm.mmmm format (leading zeros will be transmitted)
<9>	Longitude hemisphere, E or W
<10>	Mode, M = manual, A = automatic
<11>	Fix type, 0 = no fix, 1 = 2D fix, 2 = 3D fix
<12>	Speed over ground, 0 to 1051 kilometers/hour
<13>	Course over ground, 0 to 359 degrees, true
<14>	Position dilution of precision, 0 to 9 (rounded to nearest integer value)
<15>	Time dilution of precision, 0 to 9 (rounded to nearest integer value)

2.2.4 Aviation Height and VNAV Data (PGRMH)

$PGRMH,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>hh<CR><LF>

<1>	Data status: A = data valid, v = data unusable
<2>	Vertical speed, feet per minute: negative = down, positive = up
<3>	VNAV profile error, feet: -999 ft (below VNAV profile) to 999 ft (above VNAV profile)
<4>	Vertical speed to VNAV target, feet per minute: negative = down, positive = up
<5>	Vertical speed to next waypoint, feet per minute: negative = down, positive = up
<6>	Approximate height above terrain, feet (rounded to next lowest 100 feet)
<7>	Desired track, degrees true
<8>	Course of next route leg after active waypoint, degrees true

2.2.5 Map Datum (PGRMM)

$PGRMM,<1> *hh<CR><LF>

<1>	Current map datum (variable length field, for example, “WGS 84”)

2.2.6 Sensor Status Information (PGRMT)

The Garmin Proprietary sentence $PGRMT gives information concerning the status of a GPS sensor. This sentence is transmitted once per minute regardless of the selected baud rate.

$PGRMT,<1>,<2>,<3>,<4>,<5>,<6>,<7>,<8>,<9>*hh<CR><LF>

<1>	Product, model and software version (variable length field, e.g., “GPS 10 SW VER 2.01 BT VER 1.27 764”)
<2>	ROM checksum test, P = pass, F = fail
<3>	Receiver failure discrete, P = pass, F = fail
<4>	Stored data lost, R = retained, L = lost
<5>	Real time clock lost, R = retained, L = lost
<6>	Oscillator drift discrete, P = pass, F = excessive drift detected
<7>	Data collection discrete, C = collecting, null if not collecting
<8>	GPS sensor temperature in degrees C
<9>	GPS sensor configuration data, R = retained, L = lost

2.2.7 3D velocity Information (PGRMV)

$PGRMV,<1>,<2>,<3>*hh<CR><LF>

<1>	True east velocity, 514.4 to 514.4 meters/second
<2>	True north velocity, 514.4 to 514.4 meters/second
<3>	Up velocity, 999.9 to 9999.9 meters/second

2.2.8 Altitude (PGRMZ)

$PGRMZ,<1>, f, <2>,<3>*hh<CR><LF>

<1>	Current altitude, feet
<2>	Fix type: 1 = no fix, 2 = 2D fix, 3 = 3D fix

2.2.9 DGPS Beacon Information (PGRMB)

$PGRMB,<1>,<2>,<3>,<4>,<5>,K,<6>,<7>*hh<CR><LF>

<1>	Beacon tune frequency, 0.0, 283.5 – 325.0 kHz in 0.5 kHz steps
<2>	Beacon bit rate, 0, 25, 50, 100, or 200 bps
<3>	Beacon SNR, 0 to 31
<4>	Beacon data quality, 0 to 100
<5>	Distance to beacon reference station in kilometers
<6>	Beacon receiver communication status (0 = Check Wiring, 1 = No Signal, 2 = Tuning, 3 = Receiving, 4= Scanning)
<7>	DGPS fix source (R = RTCM, W = WAAS, N = Non-DGPS Fix)
<8>	DGPS mode, A = Automatic, W = WAAS Only, R = RTCM Only, N = None (DGPS disabled)

Important Note: Garmin units equipped with Sirf® technology chipsets do not support this proprietary sentence.

APPENDIX A: EARTH DATUMS

The following is a list of the Garmin GPS 10 Earth datum indices and the corresponding earth datum name (including the area of application). NOTE: New datums are always added at the end of the list found on your Garmin GPS device.

0	ADINDAN - Ethiopia, Mali, Senegal, Sudan
1	AFGOOYE - Somalia
2	AIN EL ABD 1970 - Bahrain Island, Saudi Arabia
3	ANNA 1 ASTRO 1965 - Cocos Island
4	ARC 1950 - Botswana, Lesotho, Malawi, Swaziland, Zaire, Zambia, Zimbabwe
5	ARC 1960 - Kenya, Tanzania
6	ASCENSION ISLAND 1958 - Ascension Island
7	ASTRO BEACON “E” - Iwo Jima Island
8	AUSTRALIAN GEODETIC 1966 - Australia, Tasmania Island
9	AUSTRALIAN GEODETIC 1984 - Australia, Tasmania Island
10	ASTRO DOS 71/4 - St. Helena Island
11	ASTRONOMIC STATION 1952 - Marcus Island
12	ASTRO B4 SOROL ATOLL - Tern Island
13	BELLEVUE (IGN) - Efate and Erromango Islands
14	BERMUDA 1957 - Bermuda Islands
15	BOGOTA OBSERVATORY - Colombia
16	CAMPO INCHAUSPE - Argentina
17	CANTON ASTRO 1966 - Phoenix Islands
10	CAPE CANAVERAL - Florida, Bahama Islands
19	CAPE - South Africa
20	CARTHAGE - Tunisia
21	CHATHAM 1971 - Chatham Island (New Zealand)
22	CHUA ASTRO - Paraguay
23	CORREGO ALEGRE - Brazil
24	DJAKARTA (BATAVIA) - Sumatra Island (Indonesia)
25	DOS 1968 - Gizo Island (New Georgia Islands)
26	EASTER ISLAND 1967 - Easter Island
27	EUROPEAN 1950 - Austria, Belgium, Denmark, Finland, France, Germany, Gibraltar, Greece, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland
28	EUROPEAN 1979 - Austria, Finland, Netherlands, Norway, Spain, Sweden, Switzerland
29	FINLAND HAYFORD 1910 - Finland
30	GANDAJIKA BASE - Republic of Maldives
31	GEODETIC DATUM 1949 - New Zealand
32	ORDNANCE SURVEY OF GREAT BRITAIN 1936 - England, Isle of Man, Scotland, Shetland Islands, Wales
33	GUAM 1963 - Guam Island
34	GUX 1 ASTRO - Guadalcanal Island
35	HJORSEY 1955 - Iceland

36 HONG KONG 1963 - Hong Kong

37 INDIAN - Bangladesh, India, Nepal

38 INDIAN - Thailand, Vietnam

39 IRELAND 1965 - Ireland

40 ISTS O73 ASTRO 1969 - Diego Garcia

41 JOHNSTON ISLAND 1961 - Johnston Island

42 KANDAWALA - Sri Lanka

43 KERGUELEN ISLAND - Kerguelen Island

44 KERTAU 1948 - West Malaysia, Singapore

45 L.C. 5 ASTRO - Cayman Brac Island

46 LIBERIA 1964 - Liberia

47 LUZON - Mindanao Island

48 LUZON - Phillippines (excluding Mindanao Island)

49 MAHE 1971 - Mahe Island

50 MARCO ASTRO - Salvage Islands

51 MASSAWA - Eritrea (Ethiopia)

52 MERCHICH - Morocco

53 MIDWAY ASTRO 1961 - Midway Island

54 MINNA - Nigeria

55 NORTH AMERICAN 1927 - Alaska

56 NORTH AMERICAN 1927 - Bahamas (excluding San Salvador Island)

57 NORTH AMERICAN 1927 - Central America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua)

58 NORTH AMERICAN 1927 - Canal Zone

59 NORTH AMERICAN 1927 - Canada (including Newfoundland Island)

60 NORTH AMERICAN 1927 - Caribbean (Barbados, Caicos Islands, Cuba, Dominican Republic, Grand Cayman, Jamaica, Leeward Islands, Turks Islands)

61 NORTH AMERICAN 1927 - Mean Value (CONUS)

62 NORTH AMERICAN 1927 - Cuba

63 NORTH AMERICAN 1927 - Greenland (Hayes Peninsula)

64 NORTH AMERICAN 1927 - Mexico

65 NORTH AMERICAN 1927 - San Salvador Island

66 NORTH AMERICAN 1983 - Alaska, Canada, Central America, CONUS, Mexico

67 NAPARIMA, BWI - Trinidad and Tobago

68 NAHRWAN - Masirah Island (Oman)

69 NAHRWAN - Saudi Arabia

70 NAHRWAN - United Arab Emirates

71 OBSERVATORIO 1966 - Corvo and Flores Islands (Azores)

72 OLD EGYPTIAN - Egypt

73 OLD HAWAIIAN - Mean Value

74 OMAN - Oman

75 PICO DE LAS NIEVES - Canary Islands

76 PITCAIRN ASTRO 1967 - Pitcairn Island

77 PUERTO RICO - Puerto Rico, Virgin Islands

78 QATAR NATIONAL - Qatar

79 QORNOQ - South Greenland

80 REUNION - Mascarene Island

81 ROME 1940 - Sardinia Island

82 RT 90 - Sweden

83 PROVISIONAL SOUTH AMERICAN 1956 - Bolivia, Chile, Colombia, Ecuador, Guyana, Peru, Venezuela

84 SOUTH AMERICAN 1969 - Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Venezuela, Trinidad and Tobago

85 SOUTH ASIA - Singapore

86 PROVISIONAL SOUTH CHILEAN 1963 - South Chile

87 SANTO (DOS) - Espirito Santo Island

88 SAO BRAZ - Sao Miguel, Santa Maria Islands (Azores)

89 SAPPER HILL 1943 - East Falkland Island

90 SCHWARZECK - Namibia

91 SOUTHEAST BASE - Porto Santo and Madeira Islands

92 SOUTHWEST BASE - Faial, Graciosa, Pico, Sao Jorge, and Terceira Islands (Azores)

93 TIMBALAI 1948 - Brunei and East Malaysia (Sarawak and Sabah)

94 TOKYO - Japan, Korea, Okinawa

95 TRISTAN ASTRO 1968 - Tristan da Cunha

96 User defined earth datum

97 VITI LEVU 1916 - Viti Levu Island (Fiji Islands)

98 WAKE-ENIWETOK 1960 - Marshall Islands

99 WORLD GEODETIC SYSTEM 1972

100 WORLD GEODETIC SYSTEM 1984

101 ZANDERIJ - Surinam

102 CH-1903 - Switzerland

103 Hu - Tzu - Shan

104 Indonesia 74

105 Austria

106 Potsdam

107 Taiwan - modified Hu-Tzu-Shan

108 GDA - Geocentric Datum of Australia

109 Dutch

For the latest free software updates (excluding map data) throughout the life of your Garmin products, visit the Garmin Web site at www.garmin.com.

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