NMEA-0183 Messages

Guide for *Ag*GPS Receivers

Trimble

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Release Notice

This is the February 2004 release (Revision A) of the *NMEA-0183 Messages Guide for AgGPS receivers.*

Contents

Introduction

Trimble® *Ag*GPS® receivers use National Marine Electronic Association (NMEA) messages to transfer GPS position data between electronic equipment. Information on the NMEA-0183 communication standard for GPS receivers is available at www.trimble.com.

This document describes the NMEA-0183 standard messages that are configured using Trimble Standard Interface Protocol (TSIP) command packets.

Other message types are supported only when specific Trimble options are installed on the receiver. Messages beginning with PTNL are Trimble proprietary messages.

NMEA-0183 Message Structure

NMEA-0183 messages are strings of comma-delimited text. Figure 1 shows the structure of an NMEA-0183 message.

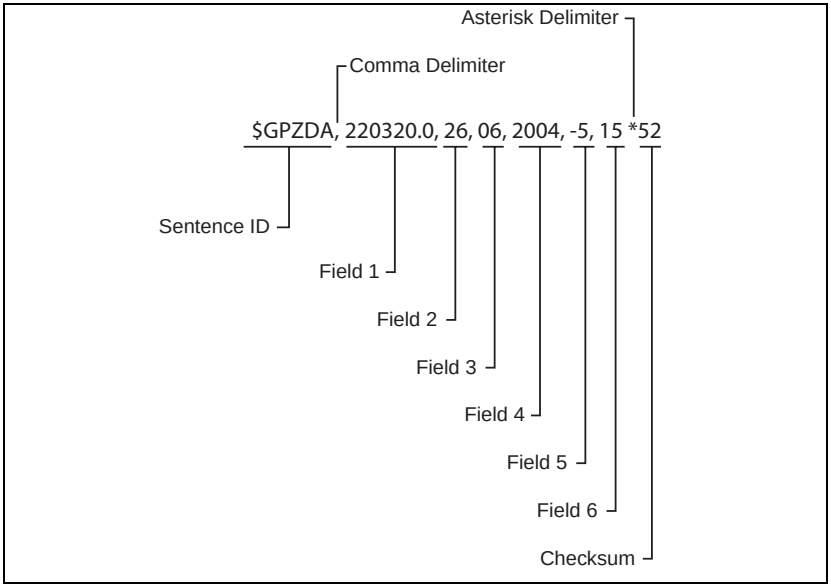

Figure 1 Example showing NMEA-0183 message structure — ZDA

Each NMEA message includes:

- an identifier to distinguish it from other messages in the data stream
- one or more fields of data, separated by a comma
- a checksum (preceded by *) to validate the data

Table 1 explains the fields in the ZDA example shown in Figure 1.

Table 1 Fields in an NMEA-0183 message — ZDA

Field	Data	Description
1	220320.0	Time in UTC
2	26	Day (01 to 31)
3	06	Month (01 to 12)
4	2004	Year
5	-5	Local time zone offset from GMT (in hours 00 to ±13 hours)
6	15	Local time zone offset from GMT (in minutes)

Fields 5 and 6 together give the total offset. Local time is 5 hours and 15 minutes earlier than GMT.

Symbols and delimiters

All messages follow the NMEA-0183 Version 2.1 format, in which symbols and delimiters identify or separate the message data.

NMEA-0183 messages always:

- begin with a dollar sign ($) followed by a talker ID code (for example, GP) and a message ID code (for example, ZDA)
- end with a carriage return and line feed

Checksum values

Newer Trimble receivers conform to the NMEA-0183 Version 2.1 format, in which checksums are mandatory for all messages.

The checksum is calculated from all characters in the message, including commas but excluding the “$” and “*” delimiters. The hexadecimal result is converted to two ASCII characters (0–9, A–F), of which the most significant appears first.

Field formats

The data values output by Trimble *Ag*GPS receivers meet the NMEA-0183 Version 2.1 standard.

Null fields

If a message contains a fixed number of fields, null (empty) fields are included if no data is available. These fields are usually reserved for data that is transmitted on a periodic or irregular basis.

Talker ID codes

Talker ID code identifies the source of the data (for example, GPS, Loran C, or Sounder). Table 2 describes the Talker ID codes that are available for NMEA-0183 output from most Trimble receivers.

Table 2 Supported Talker ID codes

Code	Description
GP	GPS
LG	Loran C/ GPS
LC	Loran C
II	Integrated Instrumentation

Latitude and longitude values

The latitude and longitude values in NMEA-0183 messages are presented in degrees, minutes, and decimal minutes, in a single field:

- latitude (ddmm.mmmm)
- longitude (dddmm.mmmm)

Latitude and longitude direction values are sent in a separate field as N, S, E, or W.

Time values

Time values in Universal Time Coordinated (UTC) are presented in hhmmss.ss format, where hh is hours (00–23), mm is minutes, and ss.ss is seconds and fractions of seconds.

Reading NMEA string format

NMEA strings can vary in length, depending on how the receiver is configured. Trimble recommends comma delimited parsing.

NMEA Message Summary

Table 3 describes the NMEA-0183 message set that is supported by the *Ag*GPS receivers.

Note – *Some messages are supported only when specific Trimble options are installed on the receiver.*

Messages beginning with PTNL are Trimble proprietary messages.

Table 3 NMEA message summary

Message	Message Contents
GGA (GPS Fix Data)	Time, position, and fix related data
GLL (Position Data)	Position fix, time of position fix, and status
GRS (GPS Range Residuals)	GPS range residuals
GSA (GPS DOP and Active Satellites)	GPS position fix mode, SVs used for navigation, and DOP values
GST (GPS PRN)	GPS Pseudorange Noise (PRN) statistics
GSV (GPS Satellites in View)	Number of SVs visible, PRN numbers, elevation, azimuth, and SNR values
MSS (Beacon Receiver Signal Status)	Signal strength, signal-to-noise ratio, beacon frequency, and beacon bit rate

Table 3 NMEA message summary (continued)

Message	Message Contents
RMC (Recommended Minimum Specific GPS Data)	UTC time, status, latitude, longitude, speed over ground (SOG), date, and magnetic variation of the position fix
VTG (Course Over Ground and Ground Speed)	Actual track made good and speed over ground
XTE (Cross-Track Error)	Cross-track error
ZDA (Time and Date)	UTC time, day, month, and year, local zone number, and local zone minutes
PTNLDG Proprietary (Trimble DGPS Receiver Status)	Beacon channel strength, channel SNR, channel frequency, channel bit rate, channel number, channel tracking status, RTCM source, and channel performance indicator
PTNLEV Proprietary (Event Marker)	Time, event number, and event line state for time-tagging change of state on an event input line
PTNL,GGK (Time, Position, Position Type, and DOP)	Time, Position, Position Type, and DOP values
PTNLID Proprietary (Trimble Receiver ID)	Receiver machine ID, product ID, major and minor release numbers, and firmware release date
PTNLSM Proprietary (RTCM Special)	Reference Station Number ID and the contents of the Special Message included in valid RTCM Type 16 records
PFUGDP (Fugro-encrypted Message)	Encrypted message for use with Fugro equipment

All messages in this document are presented in the format shown in Table 1. In each example, the structure is shown in the paragraph before the table.

GGA (GPS Fix Data)

The GGA message contains the time, position, and fix related data.

The GGA message structure is:

$GPGGA,151924,3723.454444,N,12202.269777,
W,2,09,1.9,–17.49,M,–25.67,M,1,0000*57

Table 4 describes these fields.

Table 4 GGA message fields

Field	Description
1	UTC of position fix in HHMMSS.SS format
2	Latitude in DD MM,MMMM format (0-7 decimal places)
3	Direction of latitude N: North S: South
4	Longitude in DDD MM,MMMM format (0-7 decimal places)
5	Direction of longitude E: East W: West
6	GPS Quality indicator 0: fix not valid 1: GPS fix 2: DGPS fix 4: Real-time kinematic, fixed integers 5: Real-time kinematic, float integers
7	Number of SVs in use, 00-12
8	HDOP
9	Antenna height, MSL reference
10	“M” indicates that the altitude is in meters
11	Geoidal separation
12	“M” indicates that the geoidal separation is in meters
13	Correction age of GPS data record, Type 1; Null when DGPS not used
14	Base station ID, 0000-1023

GLL (Position Data)

The GLL message specifies the position fix, time of position fix, and status.

The GLL message structure is:

$GPGLL,3723.4543,N,12202.2696,W,151933,
A*3E

Table 5 describes these fields.

Table 5 GLL message fields

Field	Description
1	Latitude in dd mm,mmmm format (0-7 decimal places)
2	Direction of latitude N: North S: South
3	Longitude in ddd mm,mmmm format (0-7 decimal places)
4	Direction of longitude E: East W: West
5	UTC of position in hhmmss.ss format
6	Fixed text “A” shows that data is valid

GRS (GPS Range Residuals)

The GRS message is used to support the Receiver Autonomous Integrity Monitoring (RAIM).

The GRS message structure is:

$GPGRS,220320.0,0,-0.8,-0.2,-0.1,
-0.2,0.8,0.6,,,,,,*55

Table 6 describes these fields.

Table 6 GRS message fields

Field	Description
1	UTC time of GGA position fix
2	Residuals 0: Residuals used to calculate position given in the matching GGA line 1: Residuals recomputed after the GGA position was computed
3-14	Range residuals for satellites used in the navigation solution, in meters

Note – *Because the contents of this NMEA message do not change significantly during a one-second interval, the receiver outputs this message at a maximum rate of 1 Hz.*

GSA (GPS DOP and Active Satellites)

The GSA message identifies the GPS position fix mode, the Satellite Vehicles (SVs) used for navigation, and the Dilution of Precision (DOP) values.

The GSA message structure is:

$GPGSA,A,3,19,28,14,18,27,22,31,29,,,,,
1.7,1.0,1.3*35

Table 7 describes these fields.

Table 7 GSA message fields

Field	Description
1	Mode M: Manual, forced to operate in 2D or 3D A: Automatic, 3D/2D
2	Mode 1: Fix not available 2: 2D 3: 3D
3–14	IDs of SVs used in position fix (null for unused fields)
15	PDOP
16	HDOP
17	VDOP

GST (GPS PRN)

The GST message is used to support Receiver Autonomous Integrity Monitoring (RAIM).

The GST message structure is:

$GPGST,220320.0,1.3,0.8,0.5,166.1,0.8,0.5,1.6,*4F

Table 8 describes these fields.

Table 8 GST message fields

Field	Description
1	UTC time of GGA fix
2	RMS value of the standard deviation of the range inputs to the navigation process (range inputs include pseudoranges and DGPS corrections)
3	Standard deviation of semi-major axis of error ellipse, in meters
4	Standard deviation of semi-minor axis of error ellipse, in meters
5	Orientation of semi-major axis of error ellipse, in degrees from true north
6	Standard deviation of latitude error, in meters
7	Standard deviation of longitude error, in meters
8	Standard deviation of altitude error, in meters

Note – *Because the contents of this NMEA message do not change significantly during a one-second interval, the receiver outputs this message at a maximum rate of 1 Hz.*

GSV (GPS Satellites in View)

The GSV message identifies the number of SVs in view, the pseudorange noise (PRN) numbers, elevation, azimuth, and signal-to-noise (SNR) values.

The GSV message structure is:

$GPGSV,4,1,13,02,02,213,,03,
-3,000,,11,00,121,,14,13,172,05*67

Table 9 describes these fields.

Table 9 GSV message fields

Field	Description
1	Total number of messages of this type in this cycle
2	Message number
3	Total number of SVs visible
4	SV PRN number
5	Elevation in degrees, 90^0 maximum
6	Azimuth, degrees from true north, 000^0 to 359^0
7	SNR, 00-99 dB (null when not tracking)
8–11	Information about second SV, same format as fields 4–7
12–15	Information about third SV, same format as fields 4–7
16–19	Information about fourth SV, same format as fields 4–7

Note – *Because the contents of this NMEA message do not change significantly during a one-second interval, the receiver outputs this message at a maximum rate of 1 Hz.*

MSS (Beacon Receiver Signal Status)

The MSS message identifies the status of the beacon signal, including the beacon signal strength, beacon SNR, beacon frequency, and beacon bit rate.

The MSS message structure is:

$GPMSS,52.5,23.7,287.0,100*4C

Table 10 describes these fields.

Table 10 MSS message fields

Field	Description
1	Signal strength (SS), dB ref: 1 υV/m
2	Signal-to-Noise Ratio (SNR), dB
3	Beacon frequency, 283.5–325.0 kHz
4	Beacon bit rate (25, 50, 100, 200), bits per second
5	Channel number

Note – *Because the contents of this NMEA message do not change significantly during a one-second interval, the receiver outputs this message at a maximum rate of 1 Hz.*

RMC (Recommended Minimum Specific GPS Data)

The RMC message identifies the UTC time, status, latitude, longitude, speed over ground (SOG), date, and magnetic variation of the position fix.

The RMC message structure is:

$GPRMC,184804.00,A,3723.476543,N,
12202.239745,W,000.0,0.0,051196,15.6,E*7C

Table 11 describes these fields.

Table 11 RMC message fields

Field	Description
1	Time: UTC time of the position fix in hhmmss.ss format
2	Status A: Valid V: Navigation Receiver Warning (V is output whenever the receiver indicates something is wrong)
3	Latitude coordinate (the number of decimal places, 0–7, is programmable and determined by the numeric precision selected in TSIP Talker for a RMC message)
4	Latitude direction N = North, S = South
5	Longitude coordinate (the number of decimal places, 0–7, is programmable and determined by the numeric precision selected in TSIP Talker for a RMC message)
6	Longitude direction W: West E: East
7	Speed Over Ground (SOG) in knots (0–3 decimal places)
8	Track Made Good, True, in degrees
9	Date in dd/mm/yy format
10	Magnetic Variation in degrees

Table 11 RMC message fields (continued)

Field	Description
11	Direction of magnetic variation E: Easterly variation from True course (subtracts from True course) W: Westerly variation from True course (adds to True course)
12	Mode indication A: Autonomous D: Differential N: Data not valid

VTG (Course Over Ground and Ground Speed)

The VTG (Velocity True Ground) message identifies the actual track made good and speed over ground.

The VTG message structure is:

$GPVTG,0,T,,,0.00,N,0.00,K*33

Table 12 describes these fields.

Table 12 VTG message fields

Field	Description
1	Track made good
2	Fixed text “T” shows that track made good is relative to true north
3	Not used
4	Not used
5	Speed over ground in knots (0–3 decimal places)
6	Fixed text “N” shows that speed over ground is in knots
7	Speed over ground in kilometers/hour (0–3 decimal places)
8	Fixed text “K” shows that speed over ground is in kilometers/hour

Note – *Because the contents of this NMEA message do not change significantly during a one-second interval, the receiver outputs this message at a maximum rate of 1 Hz.*

XTE (Cross-Track Error)

The XTE message reports the cross-track error of the vehicle.

The XTE message structure is:

$GPXTE,A,A,0.050,L,N*5E

Table 13 describes these fields.

Table 13 XTE message fields

Field	Description
1	A: Valid (fixed)
2	A: Valid (fixed)
3	Cross-track error, in nautical miles
4	Direction to steer L: Left R: Right
5	N: Nautical mile units

ZDA (Time and Date)

The ZDA message identifies UTC time, day, month, and year, local zone number, and local zone minutes.

The ZDA message structure is:

$GPZDA,184830.15,05,11,1996,00,00*66

Table 14 describes these fields.

Table 14 ZDA message fields

Field	Description
1	UTC time
2	Day
3	Month
4	Year
5	Local zone number (– for East Longitude)
6	Local zone minutes

Note – *Because the contents of this NMEA message do not change significantly during a one-second interval, the receiver outputs this message at a maximum rate of 1 Hz.*

PTNLDG Proprietary (Trimble DGPS Receiver Status)

The PTNLDG message is a Trimble proprietary message for identifying the DGPS receiver channel strength, channel SNR, channel frequency, channel bit rate, channel number, channel tracking status, RTCM source, and channel performance indicator for either beacon DGPS or satellite DGPS.

The PTNLDG message structure is:

$PTNLDG,87.0,5.2,1558510.0,1200,2,4,1,25,,,*01

Table 15 describes these fields.

Table 15 PTNLDG message fields

Field	Description
1	Channel signal strength, in 1 dBuV/m. For beacon, this is the electromagnetic field intensity level. For satellite, this is the ADC input voltage level.
2	Channel signal to noise (SNR) level, in dB
3	Channel frequency, in kHz
4	Channel bit rate, in bits per second (bps)
5	Channel number, 0–99
6	Channel tracking status 0: Channel idle 1: Wideband FFT search 2: Searching for signal 3: Channel has acquired signal 4: Channel has locked on signal 5: Channel disabled
7	Specified channel is used as RTCM source 0: Not used 1: Used
8	Channel tracking performance indicator. For beacon, this is the number of errors in the last 255 words. For satellite, this is the time since last sync, in tenths of seconds ranging from 0–255.

The PTNLDG message fields are defined in free format.

The maximum number of characters in each field is indicated above (for example, 25 bps displayed as *xxx,25,xxx* instead of *xxx,00025,xxx*).

If a channel is disabled, the channel fields can be null fields (showing commas only). If more than one channel is available, the message should be repeated for each channel.

This message can be enabled using TSIP. If enabled, it is output at the NMEA report rate.

Note – *Because the contents of this NMEA message do not change significantly during a one-second interval, the receiver outputs this message at a maximum rate of 1 Hz.*

PTNLEV Proprietary (Event Marker)

The PTNLEV message is a Trimble proprietary message for time-tagging and marking when an event input occurs. If enabled, this event message is output whenever an event is detected.

The PTNLEV message structure is:

$PTNLEV,184804.00,0*XX

Table 16 describes these fields.

Table 16 PTNLEV message fields

Field	Description
1	Time: UTC time of the position fix in hhmmss.ss format
2	Event number, starting with event 0

PTNL,GGK (Time, Position, Position Type, and DOP)

The PTNL,GGK message structure is:

$PTNL,GGK,172814.00,071296,3723.46587704,
N,12202.26957864,W,3,06,1.7,EHT-6.777,M*48

Table 17 describes these fields.

Table 17 PTNL,GGK message fields

Field	Description
1	UTC of position fix, in hhmmss.ss format
2	UTC Date of position, in mmddyy format
3	Latitude, in degrees and decimal minutes (for example, ddmm.mmmmmmm)
4	Direction of latitude N: North S: South
5	Longitude, in degrees and decimal minutes (for example, dddmm.mmmmmmm)
6	Direction of longitude E: East W: West
7	GPS quality indicator 0: Fix not available or invalid 1: Autonomous GPS fix 2: RTK float solution 3: RTK fixed (initialized) solution 4: Differential, code phase only solution (DGPS)
8	Number of satellites used in GPS solution
9	DOP of fix
10	Ellipsoidal height of fix (antenna height above ellipsoid)
11	M: Ellipsoidal height is measured in meters

PTNLID Proprietary (Trimble Receiver ID)

The PTNLID message is a Trimble proprietary message for identifying the receiver machine ID, product ID, major and minor release numbers, and firmware release date.

The PTNLID message structure is:

$PTNLID,097,01,XXX,XXX,DD/MM/YY*XX

Table 18 describes these fields.

Table 18 PTNLID message fields

Field	Description
1	Machine ID
2	Product ID
3	Major firmware release number
4	Minor firmware release number
5	Firmware release date, in dd/mm/yy format

The PTNLID message, if enabled, is output every 30 seconds.

PTNLSM Proprietary (RTCM Special)

The PTNLSM message is a Trimble proprietary message for identifying the Reference Station ID and the ASCII Text message that is included in an RTCM Type 16 Special Message. The PTNLSM message is generated any time an RTCM stream receives a valid Type 16 Special Message.

The PTNLSM message structure is:

$PTNLSM,0022,This is a message,*.XX

Table 19 describes these fields.

Table 19 PTNLSM message fields

Field	Description
1	Reference station ID number, ranging from 0 to 1023. Leading zeros must be added to fill four-digit field.
2	ASCII text message contained within the Type 16 RTCM message.

PFUGDP (Fugro-encrypted Message)

The PFUGDP message is a Fugro-encrypted message for use with Fugro equipment.