Vectron GNSSDO NMEA Reference Manual

Rev. A, 07-27-18

Vectron™
a Microchip company

Revision History

Revision	Date	Description
A	07-27-18	• First Release

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Chapter 1
Introduction

1.1 Purpose

Vectron GNSS Disciplined Oscillator (GNSSDO) modules embed a Global Navigation Satellite System (GNSS) receiver which, given a sufficiently high-quality signal, provide timing and position data to the user. Timing information is used by the module to discipline the onboard high-stability oscillator. This information, along with position and navigation data, is forwarded to the user via the module's serial port in the form of ASCII NMEA-0183 Standard Sentences. This document outlines which standard sentences are available, and provides details for each.

1.2 Notice

Each satellite system is operated by their respective country, Vectron cannot guarantee and is not liable for degradation of performance due to factors outside of the module's or Vectron's control. This includes, but is not limited to, degradation of satellite system performance due to changes or upgrades by the system operator, and poor signal quality at the module's antenna port. The user is expected to be familiar with the implementation, limitations, and risks associated with GNSS solutions, and is responsible for providing and properly implementing any necessary external electronics and conditions, such as: antenna location, antenna quality, cable quality, transmission lines, matching, signal levels, avoiding multi-path interference, shielding from both internal and external noise sources, etc.

Information herein related to the NMEA-0183 protocol is for reference only. This protocol is defined by the National Marine Electronics Association in the document:
"NMEA 0183 STANDARD FOR INTERFACING MARINE ELECTRONIC DEVICES Version 4.10"
(NATIONAL MARINE ELECTRONICS ASSOCIATION, June, 2012)

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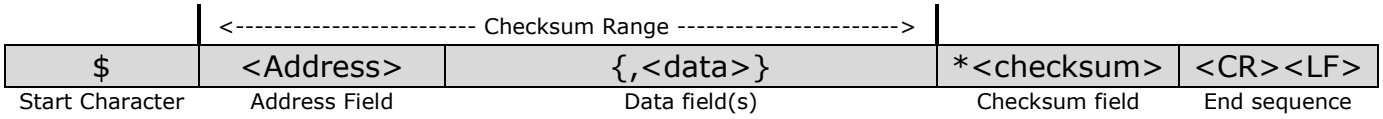
Chapter 2
NMEA-0183 Standard Sentences

2.1 Standard NMEA Protocol



Notes

1) All characters are transmitted in ASCII format
2) The start character is always '$'
3) The address field is subdivided into two subfields: <TT><SSS>, where:
    a. <TT> is the Talker Identifier. It is always:
        i. Gx for GNSS messages (See Talker Identifiers Section)
        ii. P for proprietary messages
    b. <SSS> is the Sentence formatter, which defines the message content
4) Data fields are delimited by a comma ','. Field length can vary, if no data is available for a particular field, it will be left empty (null).
5) The checksum starts with an asterisk '*' and consists of two characters containing the hexadecimal 8-bit exclusive OR of all characters between '$' and '*'.
6) The end sequence is always a carriage return and a line feed <CR><LF>.

2.2 NMEA Talker Identifiers

Standard NMEA Sentences reported by the GNSS receiver may use one of a several possible talker IDs depending on the state of the receiver and its current fix. For example, a module with a view of only GPS satellites will fix to GPS and report information using the "GP" identifier. If this same module later obtains enough GLONASS satellites in view, it may switch to a multi-GNSS fix and begin reporting information using the "GN" identifier.

When using multiple constellations, the user must ensure that their system is able to receive and process these messages under all possible identifiers. Table 2.1-1 contains all identifiers currently implemented (at the time of writing) by Vectron GNSSDO products. The user should be prepared to handle these identifiers if GNSS information is needed in their application.

Table 2.2-1, GNSS System Talker IDs

Talker Identifier	Description
GN	Any combination of 2 or more GNSS systems
GP	Global Positioning System (USA), QZSS (Japan)
GL	GLONASS (Russia)
GA	Galileo (EU)

2.3 Available Sentences List

Vectron GNSSDO module support up to 8 of the following standard NMEA output sentences, defined by the NMEA Standard 0183 Version 4.10 (June, 2012). The descriptions in the following chapter are for reference only, as these sentence formats are defined exclusively by the copyrighted document from the NMEA.

Table 2.3-1, Available NMEA Standard Sentences

Sentence Formatter	Description
GGA	Global Positioning System Fix Data
GLL	Geographic Position – Latitude/Longitude
GNS	GNSS Fix Data
GSA	GNSS DOP and Active Satellites
GSV	GNSS Satellites in View
RMC	Recommended Minimum Navigation Information
VTG	Course Over Ground and Ground Speed
ZDA	Time & Date

Table 2.3-2, Information in NMEA Sentences

Formatter	Fix Data	Date	Time	Position	Navigation
GGA	X[1]		X	X	
GLL			X	X	
GNS	X		X	X	
GSA	X				
GSV	X				
RMC			X	X	X
VTG					X
ZDA		X	X		

Note: 1) GGA is specific to GPS fix data only

Please note that some modules may not support all the above talker identifiers or sentences. Proprietary report messages (where the talker id is 'P') may also be reported by the module. Individual sentences may be enabled or disabled by the user, and the rate at which they are reported may also be modified. Check the device-specific reference manual and appropriate proprietary protocol user's guide for more details.

Chapter 3
NMEA-0183 Standard Sentence Details

3.1 Introduction

This section provides details for each available NMEA Standard Sentence.
These formats are defined by the NMEA 0183 Standard Version 4.10 (June, 2012) - the descriptions and information provided in this section are for reference only. Vectron modules may not populate all fields as described by the NMEA specification, and in this case, these fields are marked "Not Supported".

3.2 GGA: Global Positioning System Fix Data

Message Structure:

$XXGGA,hhmmss.sss,ddmm.mmmm,a,dddmm.mmmm,a,x,xx,x.x,x.x,M,x.x,M,,*cs<CR><LF>

Example:

$GPGGA,020418.127,4048.4894,N,7720.2754,W,1,8,1.5,42.0,M,33.8,M,,*XX

#	Name	Format	Example	Description
1	UTC	hhmmss.sss	020418.127	"hh" hour, "mm" minute, "ss.sss" second
2	Latitude	ddmm.mmmm	4048.4894	Latitude Degrees and Minutes
3	Lat. N/S	a	N	Latitude North or South
4	Longitude	dddmm.mmmm	7720.2754	Longitude Degrees and Minutes
5	Long. E/W	a	W	Longitude East or West
6	Fix Quality	x	1	"0" Fix Invalid, "1" Fix Valid
7	Satellites[1]	xx	8	Number of GPS satellites used in current fix
8	HDOP[2]	x.x	1.5	Horizontal Dilution of precision
9	Altitude	x.x	42.0	Altitude above/below mean sea level
10	Altitude Unit	M	M	Unit of Altitude (meter)
11	Geoidal Height	xxx	33.8	Geoidal Height
12	Geoidal Height Unit	M	M	Unit of Geoidal Height (meter)
13	Not Supported			Field will be empty
14	Not Supported			Field will be empty

Notes:

1) This field counts GPS, QZSS, and SBAS satellites only. Other GNSS satellites are not included. Maximum number is 12.
2) The HDOP field may be null if a valid fix is not available

3.3 GLL: Geographic Position – Latitude/Longitude

Message Structure:

$XXGLL,ddmm.mmmm,a,dddmm.mmmm,a,hhmmss.sss,a,a*cs<CR><LF>

Example:

$GPGLL,4048.4894,N,7720.2754,W,020418.127,A,A*XX

#	Name	Format	Example	Description
1	Latitude	ddmm.mmmm	4048.4894	Latitude Degrees and Minutes
2	Lat. N/S	a	N	Latitude North or South
3	Longitude	dddmm.mmmm	7720.2754	Longitude Degrees and Minutes
4	Long. E/W	a	W	Longitude East or West
5	UTC	hhmmss.sss	020418.127	“hh” hour, “mm” minute, “ss.sss” second
6	Status	a	A	“A” Data Valid, “V” Data Invalid
7	Position Mode	a	A	“A” Autonomous, “N” Data Invalid

Notes:

3.4 GNS: GNSS Fix Data

Message Structure:

$XXGNS,hhmmss.sss,ddmm.mmmm,a,dddmm.mmmm,a,xxx,xx,x.x,x.x,x.x,,,x*cs<CR><LF>

Example:

$GNGNS,020418.127,4048.4894,N,7720.2754,W,AAN,18,1.5,42.0,33.8,,,V*XX

#	Name	Format	Example	Description
1	UTC	hhmmss.sss	020418.127	“hh” hour, “mm” minute, “ss.sss” second
2	Latitude	ddmm.mmmm	4048.4894	Latitude Degrees and Minutes
3	Lat. N/S	a	N	Latitude North or South
4	Longitude	dddmm.mmmm	7720.2754	Longitude Degrees and Minutes
5	Long. E/W	a	W	Longitude East or West
6	Mode Indicator	xxx	AAN	“A” Autonomous, “N” Invalid for each system (GPS, GLONASS, Galileo)
7	Satellite Count	xx	18	Number of satellites used (0-32)
8	HDOP	x.x	1.5	Horizontal Dilution of Precision (0.0-50.0)
9	Altitude	x.x	42.0	Altitude above mean sea-level (geoid)
10	Geoidal Height	x.x	33.8	Geoidal Height
11	Not Supported			
12	Not Supported			
13	Nav. Status	x	V	Navigation Status Indicator “S” Safe, “C” Caution, “U” Unsafe, “V” Not Valid

Notes:

3.5 GSA: GNSS DOP and Active Satellites

Message Structure:

$XXGSA,a,a,xx,xx,xx,…,xx,x.x,x.x,x.x,h*cs<CR><LF>

Example:

$GNGSA,A,3,09,15,26,05,24,21,08,02,29,28,18,10,0.8,0.5,0.5,1*XX
$GNGSA,A,3,79,69,68,84,85,80,70,83,,,,,0.8,0.5,0.5,2*XX

#	Name	Format	Example	Description
1	Operation Mode	a	A	“M” 2D/3D Fixed, “A” 2D/3D Auto-Switching
2	Mode	a	3	“1” No Fix, “2” 2D Fix, “3” 3D Fix
3-14	Satellite Numbers[1]	xx	09	01-99, SVIDs used in fix
15	PDOP	x.x	0.8	Position Dilution of Precision
16	HDOP	x.x	0.5	Horizontal Dilution of Precision
17	VDOP	x.x	1.5	Vertical Dilution of Precision
18	GNSS System ID	h	2	

Notes:

1) Multiple messages may be reported if multiple systems are used for the current fix (GPS, GLONASS, etc.). The identifier will follow the convention of other messages, but field 18 will indicate which system the message is providing information from.
2) SVIDs are numbered as follows:
    a. GPS: 01-32
    b. SBAS: 33-51 (120 to 138)
    c. GLONASS: 65-92 (01 to 28)
    d. QZSS: 93-99 (193 to 199)

3.6 GSV: GNSS Satellites in View

Message Structure:

```
$XXGSV,x,x,x,xx,xx,xxx,xx,xx,xx,xxx,xx,xx,xx,xxx,xx,xx,xx,xxx,xx,…,h*cs<CR><LF>
```

Example:

```
$GPGSV,4,1,14,15,67,319,52,09,63,068,53,26,45,039,50,05,44,104,49,1*XX
$GPGSV,4,2,14,24,42,196,47,21,34,302,46,18,12,305,43,28,11,067,41,1*XX
$GPGSV,4,3,14,08,07,035,38,29,04,237,39,02,02,161,40,50,47,163,44,1*XX
$GPGSV,4,4,14,42,48,171,44,93,65,191,48,,,,,,,,1*XX
$GLGSV,3,1,09,79,66,099,50,69,55,019,53,80,33,176,46,68,28,088,45,1*XX
$GLGSV,3,2,09,70,25,315,46,78,24,031,42,85,18,293,44,84,16,246,41,1*XX
$GLGSV,3,3,09,86,02,338,,,,,,,,,,,,1*XX
```

#	Name	Format	Example	Description
1	Number of Messages	x	4	Total number of messages
2	Message Number	x	1	Message number in this sequence
3	Number of Satellites	x	14	Satellites in line-of-sight
4	1st SV ID	xx	15	Satellite ID Number
5	1st SV Elevation	xx	67	Satellite Elevation Angle (degree)
6	1st SV Azimuth	xxx	319	Satellite Azimuth Angle (degree)
7	1st SV SNR	xx	52	Satellite Signal-to-Noise Ratio (SNR) (dB)
8-11	2nd SV Details			
12-15	3rd SV Details			
16-19	4th SV Details			
20	Signal ID	h	1	

Notes:

1) Each message contains fields for 4 satellites, multiple messages may be reported per each GNSS system, enough to indicate all satellites in line-of-sight. If less than 4 satellites are reported by a message, the extra fields will be null.
2) If a satellite is in line-of-sight but is not able to be used in the fix, the SNR field is left null. A situation where this may be observed is if a satellite is predicted by the almanac to be visible, but is obscured or masked by an SNR mask or elevation mask.
3) The 'GN' talker identifier is not used for GSV, as a GSV message or group of messages is reported for each system which is enabled and satellites are visible.
4) SVIDs are numbered as follows:
    a. GPS: 01-32
    b. SBAS: 33-51 (120 to 138)
    c. GLONASS: 65-92 (01 to 28)
    d. QZSS: 93-99 (193 to 199)

3.7 RMC: Recommended Minimum Navigation Information

Message Structure:

$XXRMC,hhmmss.sss,ddmm.mmmm,a,dddmm.mmmm,a,x.x,x.x,ddmmyy,x.x,a,a,a*cs<CR><LF>

Example:

$GNRMC,020418.127,4048.4894,N,7720.2754,W,0.00,0.00,180116,,,A,V*XX

#	Name	Format	Example	Description
1	UTC	hhmmss.sss	020418.127	“hh” hour, “mm” minute, “ss.sss” second
2	Latitude	ddmm.mmmm	4048.4894	Latitude Degrees and Minutes
3	Latitude N/S	a	N	Latitude North or South
4	Longitude	dddmm.mmmm	7720.2754	Longitude Degrees and Minutes
5	Longitude E/W	a	W	Longitude East or West
6	Speed	x.x	0.00	Speed in knots
7	True Course	x.x	0.00	Course in degrees
8	Date	ddmmyy		UTC Date
9	Not Supported			
10	Not Supported			
11	Positioning Mode	a	A	“A” Autonomous, “N” Invalid
12	Nav. Status	a	V	Navigation Status Indicator “S” Safe, “C” Caution, “U” Unsafe, “V” Not Valid

Notes:

3.8 VTG: Course Over Ground and Ground Speed

Message Structure:

$XXVTG,x.x,T,x.x,M,x.x,N,x.x,K,a*cs<CR><LF>

Example:

$GNVTG,0.00,T,,M,0.00,N,0.00,K,D*XX

#	Name	Format	Example	Description
1-2	True Course	x.x,T	0.00,T	True Coarse (degrees)
3-4	Not Supported	x.x,M	,M	
5-6	Speed – kts	x.x,N	0.00,N	Speed in knots
7-8	Speed – km/h	x.x,K	0.00,K	Speed in km/h
9	Positioning Mode	a	A	“A” Autonomous, “N” Invalid

Notes:

3.9 ZDA: Time & Date

Message Structure:

$XXZDA,hhmmss.sss,xx,xx,xxxx,xxx,xx*cs<CR><LF>

Example:

$GPZDA,014811.000,13,09,2013,+00,00*XX

#	Name	Format	Example	Description
1	UTC	hhmmss.sss	020418.127	“hh” hour, “mm” minute, “ss.sss” second
	UTC: Day	xx	13	Day of month
	UTC: Month	xx	09	Month
	UTC: Year	xxxx	2013	Year
	Local Zone Hours	xxx	+00	(+/-) 00 – 23
	Local Zone Minutes	xx	00	00 – 59

Notes: