uAvionix truFYX NMEA ICD

Rev L

October 10th, 2019

Contents

1 Revision History

Revision	Date	Comments
A	6/15/2018	Initial release
B	6/21/2018	Add PUAVVER, PUAVOK, PUAVERR sentences
C	7/9/2018	Add PUAVALT sentence
D	8/31/2018	Changed defaults
E	10/29/2018	PUAVVV sentences
F	12/3/2018	PUAVSTAT sentence
G	12/4/2018	Add uptime to PUAVSTAT sentence
H	12/26/2018	Add PUAVCFG sentence, enable PUAVNOM persistence, add PUAVRST factory reset
I	2/8/2019	Add TSO-145d/e compliance option to PUAVCFG and expand SBAS PRN Identifiers
J	3/29/2019	Add heater control to PUAVCFG and require checksum for PUAVCFG, PUAVNOM and PUAVRST commands Add NMEA 0183 sentence details Clarify electrical specification
K	4/26/2019	Rename document from "pingGNSS NMEA ICD" to "truFYX NMEA ICD"
L	10/10/2019	Add "Signal ID" field to GPGSV sentence

2 Introduction

This document describes the uAvionix truFYX NMEA data interface implementation. The interface is an adaptation of and extension to the NMEA 0183 Interface Standard.

2.1 NMEA 0183

The NMEA 0183 standard can be found here:

http://www.nmea.org/content/nmea_standards/nmea_0183_v_410.asp

2.2 Electrical Interface

NMEA 0183 is a combined electrical and data specification. The truFYX NMEA interface does not adhere to the NMEA 0183 electrical specification. The truFYX device instead communicates over serial with the following line characteristics:

Rate:	115,200 bps
Data Length:	8 bits
Parity:	None
Stop Bits:	1 bit
Flow Control:	None
Signal Level:	Device specific (TTL or RS-232)

2.3 Data Interface

NMEA uses ASCII data transmitted in sentences. Refer to the NMEA 0183 standard for more information on structure, including delimiters and checksums.

Data is bidirectional.

Sentences are nominally transmitted at 5 Hz, although some sentences may be noted as being transmitted at different rates.

2.4 PRN Identifiers

Satellite PRN identifiers used in NMEA sentences are as follows:

- GPS from 1 to 32
- SBAS from 33 to 70

2.5 Sentences

The following sentence is transmitted at startup:

- PUAVVER

By default, the following sentences are transmitted during normal operation, in this order:

- GPRMC
- GPGGA

- GPGSA
- GPGSV
- GPGLL
- GPVTG
- GPZDA
- RAIM
- PUAVALT
- PUAVVV

The following sentences are not transmitted by default:

- PUAVSBMC
- PUAVPRM
- PUAVSTAT

The PUAVNOM message can be used to adjust the output NMEA sentence mask. By default, adjusting the output sentence mask is volatile, and the mask will be reset after device power cycle.

2.5.1 GPRMC

Description: Recommended minimum specific GPS data

Rate: 5 Hz

Direction: Device to host

Example:

$GPRMC,214821.00,A,4158.37295,N,08741.37695,W,0.271,109.44,291116,0.0,E,D,V*62

Field	Definition
Timestamp	UTC time of position fix, hhmmss.ss
Status	A = Data valid V = Navigation receiver warning
Latitude	Latitude in degrees, DDMM.MMMMM
Latitude Direction	N = North S = South
Longitude	Longitude in degrees, DDDMM.MMMMM
Longitude Direction	E = East W = West
Velocity	Velocity over ground, knots
Course	Course over ground, degrees true
Date	Date of position fix, ddmmyy
Magnetic Variation	Magnetic variation, degrees *Note: Not currently implemented – returns 0.0*
Magnetic Variation Direction	E = East W = West *Note: Not currently implemented – returns E*
Mode	Positioning system mode

	N = No fix A = Autonomous, non-differential mode position fix D = Differential mode position fix (SBAS)

2.5.2 GPGGA

Description: GPS fix data

Rate: 5 Hz

Direction: Device to host

Example:

$GPGGA,214821.00,4158.37295,N,08741.37695,W,2,08,1.0,186.24,M,,M,,*59

Field	Definition
Timestamp	UTC time of position fix, hhmmss.ss
Latitude	Latitude in degrees, DDMM.MMMMM
Latitude Direction	N = North S = South
Longitude	Longitude in degrees, DDDMM.MMMMM
Longitude Direction	E = East W = West
GPS Quality	0 = No fix 1 = GPS 2 = Differential GPS
Satellites in Use	Number of satellites in use
HDOP	Horizontal Dilution of Precision
Altitude	Height above ellipsoid *Note: Height above geoid not provided*
Altitude Units	M = Meters
Geoidal Separation	Geoidal separation *Note: Not currently implemented – returns 0.0*
Geoidal Separation Units	M = Meters
Differential Age	Age of differential data *Note: Not currently implemented – returns empty*
Differential Reference	Differential reference station ID *Note: Not currently implemented – returns empty*

2.5.3 GPGSA

Description: GPS DOP and active satellites

Rate: 5 Hz

Direction: Device to host

Example:

$GPGSA,A,3,14,18,12,25,31,10,32,24,,,,,1.71,0.96,1.42,1*1C

Field	Definition
Mode	M = Manual A = Auto 2D/3D
Current Mode	1 = No fix 2 = 2D 3 = 3D
Satellite PRNs [1..12]	List of satellite PRNs used in position fix, maximum of 12
PDOP	Position Dilution of Precision
HDOP	Horizontal Dilution of Precision
VDOP	Vertical Dilution of Precision

2.5.4 GPGSV

Description: GPS satellites in view

Note: Satellite information may require the transmission of multiple sentences

Rate: 5 Hz

Direction: Device to host

Example:

```
$GPGSV,3,1,10,32,73,346,35,10,67,128,40,14,56,284,30,31,36,206,40,0*7B
$GPGSV,3,2,10,18,35,131,35,25,25,117,23,12,24,074,34,01,19,317,0,*78
$GPGSV,3,3,10,11,17,296,23,24,13,044,22,,,,,,,,,0*76
```

Field	Definition
Total Sentences	Total number of sentences, 1 to 9
Sentence Number	This sentence number, 1 to 9
Satellites in View	Total number of satellites in view
Satellite X [1..5] PRN	PRN of satellite X
Satellite X [1..5] Elevation	Elevation of satellite X, degrees
Satellite X [1..5] Azimuth	Azimuth of satellite X, degrees true
Satellite X [1..5] C/N0	Carrier to Noise Ratio of satellite X, dB-Hz
Signal ID	0 = All Signals 1 = L1 C/A 2 = L1 P(Y) 3 = LA M 4 = L2 P(Y) 5 = L2C-M 6 = L2C-L 7 = L5-I 8 = L5-Q 9-F = Reserved

2.5.5 GPGLL

Description: Geographic position, latitude/longitude and time

Rate: 5 Hz

Direction: Device to host

Example:

$GPGLL,4158.37295,N,08741.37695,W,214821.00,A,D*74

Field	Definition
Latitude	Latitude in degrees, DDMM.MMMMM
Latitude Direction	N = North S = South
Longitude	Longitude in degrees, DDDMM.MMMMM
Longitude Direction	E = East W = West
Timestamp	UTC time of position fix, hhmmss.ss
Status	A = Data valid V = Data not valid
Mode	Positioning system mode N = No fix A = Autonomous, non-differential mode position fix D = Differential mode position fix (SBAS)

2.5.6 GPVTG
Description: Track made good and ground speed

Rate: 5 Hz

Direction: Device to host

Example:

$GPVTG,109.44,T,,M,0.271,N,0.502,K,D*33

Field	Definition
Course, True	True course over ground, degrees
Course, True Reference	T = True
Course, Magnetic	Magnetic course over ground, degrees *Note: Not currently implemented – returns empty*
Course, Magnetic Reference	M = Magnetic
Velocity, Knots	Velocity over ground, knots
Velocity, Knots Units	N = Knots
Velocity, km/h	Velocity over ground, kilometers per hour
Velocity, km/h Units	K = kilometers per hour
Mode Indicator	N = No fix A = Autonomous, non-differential mode position fix D = Differential mode position fix (SBAS)

2.5.7 GPZDA
Description: UTC time and date

Rate: 5Hz

Direction: Device to host

Example:

```
$GPZDA,214821.00,29,11,2016,,*64
```

Field	Definition
Timestamp	UTC time of position fix, hhmmss.ss
Day	Day of month (1 to 31)
Month	Month (1 to 12)
Year	Year
Local Zone Hours	*Note: Not currently implemented – returns empty*
Local Zone Minutes	*Note: Not currently implemented – returns empty*

2.5.8 RAIM

Description: Protection limits, figures of merit, and uncertainty

Rate: 5 Hz

Direction: Device to host

Example:

```
$RAIM,016933,009032,003383,000939,048034,013294,000000,000000,010,5,00111111*37
```

Field	Definition							
HPL	6 digits of Horizontal Protection Limit, cm							
VPL	6 digits of Vertical Protection Limit, cm							
HFOM	6 digits of Horizontal Figure of Merit, cm							
VFOM	6 digits of Vertical Figure of Merit, cm							
VHFOM	6 digits of Velocity Horizontal Figure of Merit, m/s * 10000							
VVFOM	6 digits of Velocity Vertical Figure of Merit, m/s * 10000							
HUL	6 digits of Horizontal Uncertainty Limit, cm *Note: Not currently implemented – returns 000000*							
VUL	6 digits of Vertical Uncertainty Limit, cm *Note: Not currently implemented – returns 000000*							
Version	3 digits of Version Number							
State	Nav State 0 = Invalid 2 = 2D 3 = 3D 4 = RAIM (with barometric aiding) 5 = RAIM (without barometric aiding)							
Validity Flags	8 digits of data Validity Flags							
	7	6	5	4	3	2	1	0
	VUL	HUL	VVFOM	VHFOM	VFOM	HFOM	VPL	HPL

2.5.9 PUAVSBMC

Description: SBAS message counts

Note: Not enabled by default

Rate: 5 Hz for each tracked SBAS satellite

Direction: Device to host

Example:

$PUAVSBMC,133,4,1,0,3,4,0,0,0,1,0,0,0,3,2,0,2,20*3E

Field	Definition
PRN	Satellite PRN
MT0	Count of MT0 subframes received
MT1	Count of MT1 subframes received
MT2	Count of MT2 subframes received
MT3	Count of MT3 subframes received
MT4	Count of MT4 subframes received
MT5	Count of MT5 subframes received
MT6	Count of MT6 subframes received
MT7	Count of MT7 subframes received
MT9	Count of MT9 subframes received
MT17	Count of MT17 subframes received
MT18	Count of MT18 subframes received
MT24	Count of MT24 subframes received
MT25	Count of MT25 subframes received
MT26	Count of MT26 subframes received
MT27	Count of MT27 subframes received
MT28	Count of MT28 subframes received
Total	Count of total subframes received

2.5.10   PUAVPRM

Description: Pseudorange and observable data

               Note: Not enabled by default

Rate: 5 Hz for each tracked satellite

Direction: Device to host

Example:

$PUAVPRM,17,17802342.971858,93551879.058097,-215.698227,40*4B

Field	Definition
PRN	Satellite PRN
Pseudorange	Pseudorange, m
Carrier Phase	Carrier phase, cycles
Doppler	Doppler, Hz
CN0	Carrier to noise ratio (C/N$_0$), dBHz

2.5.11   PUAVNOM

Description: NMEA Output Messages

Sets NMEA output message mask (persistent or non-persistent)

NMEA checksum required on host to device sentence with parameters

Responds with PUAVNOM or PUAVERR

Direction: Host to device

Example: Enable RMC, GGA, GSA, GSV, GLL, VTG, ZDA, and RAIM, non-persistently

Read Configuration

[TX] $PUAVNOM

[RX] $PUAVNOM,00000CFF*01

Write Configuration (non-persistent)

[TX] $PUAVNOM,000000FF*72

[RX] $PUAVNOM,000000FF*72

Write Configuration (persistent)

[TX] $PUAVNOM,000000FF,1*6F

[RX] $PUAVNOM,000000FF*72

Field	Definition
Mask	32-bit bitwise selection of enabled messages, transmitted in hex MSB first

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 3	Reserved							

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 2	Reserved							

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Reserved			STAT	VV	ALT	PRM	SBMC

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0	RAIM	ZDA	VTG	GLL	GSV	GSA	GGA	RMC

Field	Definition
Persist Configuration	0 = Do not persist, reset on power-cycle (default) 1 = Persist

2.5.12   PUAVRST

Description: Reset receiver

Performs receiver reset, clearing data as appropriate

NMEA checksum required on host to device sentence with parameters

Responds with PUAVOK

Direction: Host to device

Example: Warm start

[TX] $PUAVRST,W*3C

[TX] $PUAVOK*16

Field	Definition
Reset Type	W = Warm Start (reset ephemeris, ionospheric, and SBAS corrections) C = Cold Start (reset position, almanac, ephemeris, ionospheric, and SBAS corrections) F = Factory Reset (do not perform without understanding implications of doing so)

2.5.13   PUAVVER

Description: Version information

NMEA checksum optional on host to device sentence

Rate: One shot on startup, or in response to $PUAVVER

Direction: Device to host and host to device

Example:

[TX] $PUAVVER

[RX] $PUAVVER,01,00,01,0000,0021,7F584003*2B

Field	Definition
FW Major	Firmware Version Major (2 digits decimal)
FW Minor	Firmware Version Minor (2 digits decimal)
FW Build	Firmware Version Build (2 digits decimal)
FW ID	Firmware Identifier (4 digit hex)
HW ID	Hardware Identifier (4 digit hex)
CRC	Application CRC (8 digits hex)

2.5.14   PUAVOK

Description: Input command accepted

Direction: Device to host

Example:

$PUAVOK*16

2.5.15 PUAVERR

Description: Input command error

Direction: Device to host

Example:

```
$PUAVERR*57
```

2.5.16 PUAVALT

Description: Barometric pressure altitude data

Rate: 5 Hz

Direction: Device to host

Example:

```
$PUAVALT,902.486267,34.292629,965.346741*41
```

Field	Definition
Pressure	Barometric pressure, mbar
Temperature	Temperature, °C
Pressure Altitude	Pressure altitude at 1013.25 mbar or 29.92 inHg (meters)

2.5.17 PUAVVV

Description: Vertical velocity data

Rate: 5 Hz

Direction: Device to host

Example:

```
$PUAVVV,2.54,*0F
```

Field	Definition
Geometric vertical velocity	Geometric vertical velocity, positive when altitude increasing, m/s
Barometric vertical velocity	Barometric vertical velocity (if available), positive when altitude increasing, m/s

2.5.18 PUAVSTAT

Description: Status

Rate: 5 Hz

Direction: Device to host

Example:

```
$PUAVSTAT,34.3,0,854*3F
```

Field	Definition
Temperature	Device temperature, °C Blank if not available
Heater State	0=Disabled, 1=Enabled (below -20C)
Uptime	Device uptime, sec

2.5.19 PUAVCFG

Description: Device configuration

Reads or sets persistent device configuration information

Provide no parameters to read current configuration

Provide values only for fields to be written

NMEA checksum required on host to device sentence with parameters

Rate: In response to $PUAVCFG

Direction: Device to host and host to device

Example:

Read Configuration

```
[TX] $PUAVCFG

[RX] $PUAVCFG,N,M,5.0,0,1,0021,D,1*0F
```

Write Configuration (set elevation mask to 10.0 degrees and disable SBAS ranging)

```
[TX] $PUAVCFG,,,10.0,,0*53

[RX] $PUAVCFG,N,M,10.0,0,0,0021,D,1*3A
```

Field	Definition
COM1 TX Protocol	N = NMEA (default) M = MAVLink
COM2 TX Protocol	N = NMEA M = MAVLink (default)
Elevation Mask	Elevation mask in degrees (default 5.0)
Min CN0	Minimum CN0 in integer dB-Hz (default 0)
SBAS Ranging	0=Disabled, 1=Enabled (default 1)
HW ID	Hardware ID, up to 4 hex digits
TSO-145 Compliance	D = TSO-145d E = TSO-145e (default)
Heater	0=Disabled, 1=Enabled (default 1)