BATHYMETRIC DATA MESSAGES

FILE FORMAT DESCRIPTION

0014932_REV_D

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ABOUT THIS DOCUMENT

Purpose of this Document

This document defines the Bathymetric Data Messages contained within an EdgeTech JSF file. It is to be used in conjunction with the EdgeTech-supplied header files, *BathymetricMessages.h* (or *InterfaceMessages.h*) and *JSFdefs.h*, along with the *JSF Data File Description* to decode all the important messages produced by an EdgeTech bathymetric system (i.e. side scan records, auxiliary data messages, etc.).

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Revision History

REV	DESCRIPTION	DATE	APPROVAL
D	Reformatted to abide by new document template, corrected grammatical errors, and removed Appendix.	03/2016	LNB
C	Added 3005 Status Message to include tide and GPS status information in the JSF file data stream. See Section 8 for more information.	10/2015	LNB
B	Added Range and Angle Uncertainties to the JSF data stream, as well as a TVG function for the bathymetric data	8/2014	LNB
A	Release to Production	5/2013	LNB

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1.0 OVERVIEW

The JSF file has been extended to support data produced by EdgeTech's bathymetric systems and products. These new extensions, called the Bathymetric Data Messages, consist of the 300X family of messages used for the time stamped bathymetric data and supporting information such as position, motion, heading, etc. This document describes this set of messages and provides a definition of the essential calculations used by the bathymetry system.

Please note, in October of 2015 the 3005, or **StatusMessageType**, message was added to the JSF data stream in order to incorporate RTK Tide and GPS status information. Please see **7.0 StatusMessageType** for more information.

2.0 BathymetricDataMessageType

Message ID: 3000

BathymetricDataMessageType is a source for bathymetry data.

This is the primary message sent from the Bathymetry System. For each ping, there is one message for the port side, and one for the starboard side. This message contains the *time delay*, *angle* and *amplitude* of each assumed seafloor echo. Multiple messages of this type are interspersed throughout the data file or data stream. This message consists of a header, followed by a number of bathymetric samples (*numberOfSamples*), one corresponding to each sounding point.

2.1 Header Description

Use these data to derive the raw *X* and *Z* data samples prior to any motion correction. The header contains information static to each ping as follows:

BYTE OFFSET	DATA FIELD DESRIPTION	UNITS	USAGE	SIZE
0-3	Time Since 1/1/1970	Seconds	Essential	UINT32
4-7	Nanosecond Supplement to Time	Nanoseconds	Essential	UINT32
8-11	Ping Number		Essential	UINT32
12-13	Number of BathymetricSampleType Entries		Essential	UINT16
14	Channel (0 – port, 1 – starboard)			Byte
15	Algorithm Type			Byte
16	Number of Pulses			Byte
17	Pulse Phase			Byte
18-19	Pulse Length	Milliseconds		UINT16
20-23	Transmit Pulse Amplitude (0 to 1)			Single
24-27	Chirp Start Frequency	Hertz		Single
28-31	Chirp End Frequency	Hertz		Single
32-35	Mixer Frequency	Hertz		Single
36-39	Sample Rate	Hertz		Single
40-43	Offset to First Sample	Nanoseconds	Essential	UINT32
44-47	Time Delay Uncertainty	Seconds	Essential, see Section 3.2.1	Single
48-51	Time Scale Factor	Seconds	Essential	Single
52-55	Time Scale Accuracy	Percent	Essential	Single

BYTE OFFSET	DATA FIELD DESRIPTION	UNITS	USAGE	SIZE
56-59	Angle Scale Factor	Degrees	Essential	UINT32
60-63	Reserved			UINT32
64-67	Time to First Bottom Return	Nanoseconds	Essential	UINT32
68	Format Revision Level (0 to 4)		Essential, see Section 3.2.2	Byte
69	Binning Flag (0 to 2)		Essential, see Section 3.2.3	Byte
70	TVG	dB/100m	See Notes Below	Byte
71	Reserved			Byte
72-75	Span	Meter or Degrees	See Section 3.2.4	Single
76-79	Reserved			UINT32

Table 2-1: Header Description

NOTES:

- *As of May 2014 bytes 18-19, 44-47, 60-63, and 70 have been modified.*
- *Nonessential entries can be safely disregarded. They are used for information only.*
- *If the unit field is empty, then that particular parameter is unitless.*
- *The TVG field (byte 70) is the particular value that has been applied to the bathymetry datagrams during data collection. This TVG does not apply to the side scan records.*

2.2 Important Data Fields

There are a number of important data fields contained within the 3000 message that need to be interpreted in order to properly understand the bathymetric format. This section provides a description for each.

2.2.1 Uncertainty Estimates

Each bathymetric measurement is composed of a vector from the sonar to a measurement point on the seafloor. The vector is defined by the time (and hence range) at which the measurement is made and the received angle relative to nadir of the acoustic return at that instant. Each of these components (the range and angle) has some finite measurement uncertainty. The sonar captures these measurement values and provides an estimate for each.

The *Time Delay Uncertainty Estimate* (bytes 44-47, **TABLE 2-1**) is the potential acoustic uncertainty of the true delay to each detected echo. This field is used to compute the range uncertainty, in meters, for each sample in the data packet and is expressed at the 2-sigma level. For more information see section **2.3.1.3**.

The *Angle Uncertainty* (**TABLE 2-2**) is also computed and reported for each sounding. For more information see SECTION **2.3.1.6**.

2.2.2 Format Revision Level

The *Format Revision Level* (byte 68, **TABLE 2-1**) may have a value between 0 and 4. The revision number affects the interpretation of the data fields listed in **TABLE 2-1**, as well as the N x 4 sample sets described in subsection **2.3**, and includes the additional information for binned data. Revisions 0 through 2 only provide information for interferometric data, whereas Revision 3 and 4 supports the interferometric and pseudo multibeam data formats. Even though the latest *Format Revision Level* supports interferometric output, it is rarely used and should not be implemented unless absolutely necessary.

The latest *Format Revision Level* is 4 and described in subsection **2.3**.

2.2.3 Binning Flag

The *Binning Flag* (byte 69, **TABLE 2-1**) specifies the type of binning output and may have a value between 0 and 2. A value of 0 indicates that no binning has been carried out and the data output is purely interferometric, a value of 1 indicates the data have been binned based on a user defined equidistant across track bin size to produce multibeam-like data, and a value of 2 indicates that the data have been binned based on a user defined equiangular beam size to produce an alternate form of multibeam-like data.

When this binning process is carried out, the data are filtered (or cleaned of outliers) as much as possible prior to binning so that each local estimate is not corrupted by surface or wake artifacts. A median estimate, as opposed to an average, is also used to reduce the effects of outliers on the local estimates.

As of July 2014 the DISCOVER BATHYMETRIC Acquisition Software no longer supports the interferometric output and only binned data are provided. This change affects the *Flag Interpretation Fields* described in subsection **2.3.1.7**.

2.2.4 Span

Span (bytes 72-75, **TABLE 2-1**) states the number of samples returned per side, per ping. This parameter can be specified in meters or in degrees and depends on the binning type selected in byte 69.

The correlation between *Binning* and *Span* is defined below.

If *Binning* = 0, then *Span* =	Maximum processing range defined in the bathymetric processing parameters (in meters).
If *Binning* = 1, then *Span* =	Number of bins x bin size (in meters).
If *Binning* = 2, then *Span* =	Number of beams x beam size (in degrees).

Therefore, the final data set would be computed as *Span* x 2;

2.3 Format Revision Level = 4 (Latest)

Following the **BathymetricDataMessageType** header (or 3000 message header) are N sample sets (N being derived from bytes 12 – 13, appropriately labeled *numberOfSamples*) with each having the 16-bit integer fields described below. Note the third set of 16 bits is broken down into the amplitude and angle uncertainty fields, whereas the last 16 bits compose the flag, SNR, and quality components.

BYTE OFFSET	DESCRTIPTION	UNITS	BITS
	Time Delay	See Time Scale Factor (TABLE 2-1, Bytes 48-51)	UINT16
	Angle	See Angle Scale Factor (TABLE 2-1, Bytes 56-59)	INT16
	Amplitude	dB	Byte
	Angle Uncertainty	Degrees, 2-sigma level	Byte
	Flag	N/A	Byte
0-4	SNR	dB	5, unsigned
5-7	Quality	Percent	3, unsigned

Table 2-2: Format Revision Level = 4 (Latest)

CAUTION!

Use the angle as a signed value! Please refer to sub-section **2.3.1.4** *for further information.*

2.3.1 Essential Calculations / Definitions

The following calculations and definitions are essential to understanding and using the bathymetric message format:

2.3.1.1 Echo Time

The Echo Time is the total time it takes to receive an echo from the seafloor, in seconds:

$$EchoTime = \left(\frac{timeToFirstSample}{1 \times 10^9} + (time\_delay \times timeScaleFactor) \right)$$

Equation 2-1

2.3.1.2 Nominal Slant Range to Echo

The Slant Range to Echo is the slant range to each sample, in meters:

$$Slant\ Range = \left(\frac{soundVelocity}{2} \right) \times EchoTime$$

Equation 2-2

Where *soundVelocity* must be in meters per second and should be acquired from the 3002 message, or **PressureMessageType**, described in **4.0 PRESSUREMESSAGETYPE**.

2.3.1.3 Range Uncertainty Estimate

The Range Uncertainty Estimate is the potential acoustic uncertainty of the range for each sample in the data packet. It is specified in meters at the 2-sigma level.

$$2\sigma_R = \left(\frac{soundVelocity}{2} \right) \times timeDelayUncertainty$$

Equation 2-3

2.3.1.4 Angle from Nadir for Each Sample

Angles, reported in degrees, are measured positive from Nadir of the Sonar Head and increase outwards from both port and starboard. If data for a specific channel, such as for the port side, falls behind Nadir then these correspond to negative angles.

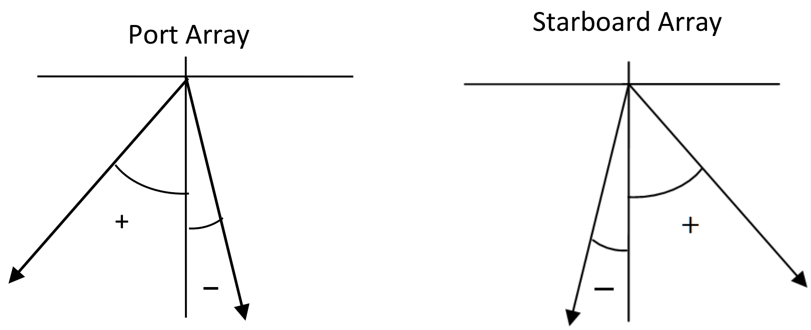

Figure 2-1: Angles per side, as reported from Nadir

When both port and starboard data sets are computed and rendered together in the same frame of reference, negative angles are plotted on the port side and positive angles are plotted on the starboard side. This relationship is defined by the equation below, where *Channel* = 0 for port, or 1 for starboard.

$$AngleFromNadir = (-1)^{(Channel+1)} \times angle \times angleScale\ Factor \qquad \text{Equation 2-4}$$

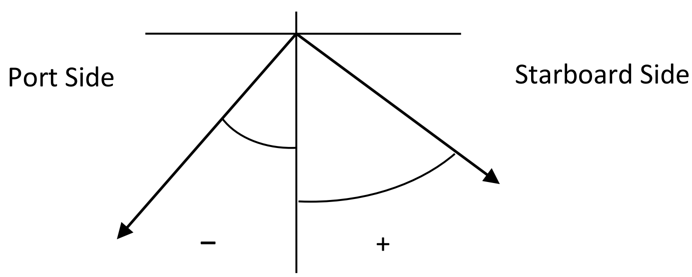

Figure 2-2: Angles shown as a single reference frame

2.3.1.5 Amplitude

Amplitude is a fundamental attribute that is used to trim invalid data points from the final data set and primarily excludes weak echoes, such as the water column or very weak backscatter, based on some minimum threshold. Typically good seafloor echoes are above 25 dB to 30 dB depending on bottom type; values less than 20 dB are typically not bottom echoes (i.e. noise).

The data points measured by the system can have an amplitude value between 0 – 127.5dB and is reported in 0.5dB increments.

2.3.1.6 Angle Uncertainty Estimate

The Angle Uncertainty Estimate is reported at the 2-sigma level and can vary between 0 and 5.1 degrees, reported in 0.02 degree increments. Any angle uncertainty larger than 5.1 degrees is clamped to 5.1 degrees.

2.3.1.7 Flag Interpretation

These flags are used for data cleaning and if set to 1 indicate data which have been deemed as invalid points by the processing algorithm. A description of these flags is listed below.

> **NOTE:** *As of July 2014 the DISCOVER BATHYMETRIC Acquisition Software no longer supports the interferometric output, therefore bits 0 through 4 can be safely disregarded, unless parsing interferometric data is required.*
>
> *Bit 5, however, is essential to interpreting the binned data correctly (Binning Flag = 1 or 2). If it is not, then there will be a false sounding reported at the sonar head's location (0, 0).*

Bit 0: *Outlier Removal Flag* – if set the processing algorithm deems these data points as having excessive deviations from the norm.

Bit 1: *Water Column Flag* – if set the processing algorithm deems these data points as water column and are not used in determining the seafloor estimates.

Bit 2: *Amplitude* – if set the processing algorithm deems these data points as invalid based on the calculated threshold. This fundamental attribute is used primarily to exclude weak echo points, such as the water column returns and very weak backscatter amplitudes.

Bit 3: *Quality* – if set the processing algorithm deems these data points as invalid based on angle uncertainty. This filter is used to eliminate points whose phase differences are greater than some specified tolerance.

Bit 4: *SNR* – if set the processing algorithm deems these data points as invalid based on the SNR. This filter is very useful in trimming data points where the angle estimation quality is low due to noise and multipath effects.

Bit 5: *Null Content Binned Data* – if set the binned data contains null content and should be excluded from all processing (i.e. if the total across track extent is too large for the depth, then some bins may be empty and will be deemed as null). This bit is <u>only</u> valid when the data are binned. (*See caution on following page.*)

Bit 6 - 7: Reserved

> **CAUTION!**
>
> *Null bins may or may not have null or 0 values for the **Time Delay**, **Angle**, or **Amplitude** fields in* **TABLE 2-2** *so Bit 5 must be used and is essential in removing invalid data points.*

2.3.1.8 Coherent SNR

Coherent SNR is a very useful statistic that is used to trim invalid data points where the angle noise is high due to multipath effects. When estimating the primary (largest amplitude) angle of arrival the process also returns an estimate of the power in this angle. This power is compared to the total power in the signal at that instant and so a coherent Signal (primary echo) to Noise (noise plus all multipath echoes) can be estimated. In practice the true noise component of this is very small over the useful range of the bathymetry data and is almost all due to multipath interference echoes.

SNR values greater than 20dB are excellent in terms of angle estimation quality, while less than 10dB are quite poor. Useful thresholds are between 10-20 dB, depending on the desire to have maximum swath (more noise) or lower noise and narrower swath widths.

This metric is described by a 5 bit value that ranges between 0 and 31dB in 1dB increments. Any value higher than 31dB is limited to 31dB.

2.3.1.9 EdgeTech Bathymetric Quality Factor

The EdgeTech Bathymetric Quality Factor is a metric used to identify how well the interstave phase measurements agree. The array used to determine the angles has 10 x ½ wavelength spaced elements. This allows the estimation of 9 interstave phase estimates. In the most ideal case (no errors, no noise, no interfering multipath) these would all agree. In practice this is not the case and interstave phases may either agree quite well (+/- 5 – 10 degrees) or not at all (up to +/- 90 deg). This metric is described by a 3 bit value and has been broken down into 8 discrete numbers associated with each:

0 – quality < 50%
1 – 50% <= quality < 60%
2 – 60% <= quality < 70%
3 – 70% <= quality < 75%
4 – 75% <= quality < 80%
5 – 80% <= quality < 85%
6 – 85% <= quality < 90%
7 – 90% <= quality

> **NOTE:** *For most cases, any data with a Quality Factor less than 50% should be discarded. High quality data is considered to be anything above 70-80%. The quality factor can be set quite high (90%) in most cases, especially when the sea floor is very flat.*

2.3.1.10 Nadir Depth (or Depth below Sounder)

The system incorporates a single beam echo sounder mode with a 15 degree beam width. This depth is reported for each ping and is independent of any bathymetric calculations or principles (see **5.0 ALTITUDEMESSAGETYPE**). The value is specified in meters and is defined as:

$$DepthBelowSounder = \left(\frac{soundVelocity}{2}\right) \times timeToFirstBottomreturn$$

Equation 2-5

Where *soundVelocity* must be in meters per second and acquired from the 3002 message, or **PressureMessageType** described in **4.0 PRESSUREMESSAGETYPE**.

This parameter is used in the calculation for the *Water Column Filter*. This filtering metric is effective at trimming water column data but may also trim data from close up targets such as dock walls, sharp banks, etc., so caution should be taken when surveying next to steep slopes. This filter can also be turned off in such cases where the water column filter is too aggressive or if it is desired to retain objects in the water column, such as a mast of a shipwreck.

2.3.1.11 Seafloor Samples

The seafloor samples are computed as raw *X* and *Z* values, reported in meters, and are calculated as:

$$x = SlantRange \times sin(AngleFromNadir)$$

Equation 2-6

$$z = SlantRange \times cos(AngleFromNadir)$$

Equation 2-7

Once these data points are rendered, a median filter is run over the data to exclude data points whose *Z* values deviate significantly from the local median value. This filter, known as the *Outlier Removal Filter*, is effective when equidistant across track binning is used. However, it is not used when equiangle binning is implemented allowing large vertical structures to be retained.

2.3.1.12 Binning

Currently there are two types of binning schemes the processor can utilize.

The first scheme uses equidistant sections and does a good job at plotting most seafloor topographies. The user must only specify the bin size, whereas the other two parameters are automatically calculated by the DISCOVER BATHYMETRIC Acquisition Software. The maximum number of bins is 800. This relationship is defined below.

$$TotalSwath = NumberOfBins \times BinSize$$

Equation 2-8

This method, however, cannot plot vertical objects very well, as it inherently collapses the data within a single bin.

The second scheme uses equiangular bins and is very effective at plotting vertical objects. The user only has to specify the bin (or beam) size. The total field of view is set to a constant 200 deg and the maximum number of bins is 800. This relationship is described below.

$$200^{\circ} = NumberOfBeams \times BeamSize$$

Equation 2-9

This method, however, does not provide an evenly distributed seafloor profile like the equidistant method described above. Instead it provides dense soundings near nadir and fewer soundings as the angle increases from nadir which could result in poor object detection at the extremities.

3.0 AttitudeMessageType

Message ID: 3001

AttitudeMessageType is a source for roll, pitch, heave, and heading data. Yaw is not used. Some or all of these fields may be valid (or set to 1) depending on which type(s) of sensor is (are) used.

BYTE OFFSET	DESCRIPTION	UNITS	SIZE
0-3	Time Since 1/1/1970	Seconds	UINT32
4-7	Nanosecond Supplement to Time	Nanoseconds	UINT32
8-11	Data Valid Flag Bit 0: Heading Bit 1: Heave Bit 2: Pitch Bit 3: Roll Bit 4: Yaw	0 – clear, 1 – set	UINT32
12-15	Heading (0 to 359.9)	Degrees	Single
16-19	Heave	Meters	Single
20-23	Pitch	Degrees	Single
24-27	Roll	Degrees	Single
28-31	Yaw	Degrees	Single

Table 3-1: AttitudeMessageType

The EdgeTech convention is:

- **Roll** is positive port up
- **Pitch** is positive bow up
- **Heave** is positive down
- **Yaw** is positive to starboard

The validity of each field is indicated in the *Data Valid Flag* (bytes 8-11) and it is imperative that this is used to correctly parse the fields. Which fields are populated depend on the device used in conjunction with the sonar system supplying the data.

Since each message has a single unique timestamp, only one input string (or message) supplied from the incorporated device is in this message at any one time. Unused fields are flagged as such (or set to 0) in the *Data Valid Flag* (see examples below).

The time stamp accuracy of this message with respect to the sonar ping emission time is approximately 1 millisecond at 80% and 2 milliseconds at 100% of the samples.

3.1 Example 1

The data source is a TSS CMS attitude sensor and supplies roll, pitch, and heave over a single message (i.e. TSS1). The sensor does not supply yaw or heading. The *Data Valid Flag* would be:

Bit 0: heading = 0
Bit 1: heave = 1
Bit 2: pitch = 1
Bit 3: roll = 1
Bit 4: yaw = 0

3.2 Example 2

The data source is an OCTANS Inertial Navigation System (INS) and supplies roll, pitch, heave, and heading in a single message. The sensor does not supply yaw. The *Data Valid Flag* would be populated as follows:

Data Valid Flags:
Bit 0: heading = 1
Bit 1: heave = 1
Bit 2: pitch = 1
Bit 3: roll = 1
Bit 4: yaw = 0

4.0 PRESSUREMESSAGETYPE

Message ID: 3002

PressureMessageType is a source for sound velocity, and possibly water temperature, salinity, conductivity, and depth.

BYTE OFFSET	DESCRIPTION	UNITS	SIZE
0-3	Time Since 1/1/1970	Seconds	UINT32
4-7	Nanosecond Supplement to Time	Nanoseconds	UINT32
8-11	Data Valid Flag Bit 0: Pressure Bit 1: Water Temperature Bit 2: Salinity Bit 3: Conductivity Bit 4: Sound Velocity Bit 5: Depth	0 – clear, 1 – set	UINT32
12-15	Absolute Pressure	PSI	Single
16-19	Water Temperature	Degrees	Single
20-23	Salinity (PPM)	Parts/Million	Single
24-27	Conductivity	Degrees	Single
28-31	Sound Velocity	Meters/Second	Single
32-35	Depth	Meters	Single

Table 4-1: PressureMessageType

Only on those platforms that are deployed subsea will have a valid *Depth* field (bytes 32-35) as provided by the platform's depth or pressure sensor (such as ROV, ROTV and AUV applications).

The *Sound Velocity* (bytes 28-31) is the sound velocity measured at the sonar head and must be used when calculating *Slant Range* in Message ID 3000, or **BathymetricDataMessageType**.

The time stamp accuracy is 20 milliseconds or better.

The validity of each field is determined as in **3.0 ATTITUDEMESSAGETYPE**. Unused fields are flagged as such (or set to 0) in the *Data Valid Flag* (bytes 8-11).

5.0 ALTITUDEMESSAGETYPE

Message ID: 3003

AltitudeMessageType is a source for altitude and possibly speed, and heading.

BYTE OFFSET	DESCRIPTION	UNITS	SIZE
0-3	Time Since 1/1/1970	Seconds	UINT32
4-7	Nanosecond Supplement to Time	Nanoseconds	UINT32
8-11	Data Valid Flag Bit 0: Altitude Bit 1: Speed Bit 2: Heading	0 – clear, 1 – set	UINT32
12-15	Altitude	Meters	Single
16-19	Speed	Knots	Single
20-23	Heading (0 to 359.9)	Degrees	Single

Table 5-1: AltitudeMessageType

This *Altitude* parameter (bytes 12-15) is reported for each ping and is the value computed from the *Depth Below Sounder* (**2.3.1.10**). This field will always be valid and should be added to the depth field (if available) from Message ID 3002, or **PressureMessageType**, in order to calculate the total water depth.

For *Speed* (bytes 16-19) and *Heading* (bytes 20-23), the *Data Valid Flag* (bytes 8-11) should be tested to determine if these fields are usable (or set to 1). The validity of these fields depends on what devices are connected to the sonar system. For example, if there is a device connected to the sonar which supplies heading only (such as a gyroscope) this heading field would be valid.

Again, the validity of each field is determined as in **3.0 ATTITUDEMESSAGETYPE**. Unused fields are flagged as such (or set to 0) in the *Data Valid Flag*.

6.0 POSITIONMESSAGETYPE

Message ID: 3004

PositionMessageType is a source for position (latitude/longitude), heading, speed, and antenna altitude. UTM Zone, Easting, and Northing fields are not typically used.

BYTE OFFSET	DESCRIPTION	UNITS	SIZE
0-3	Time Since 1/1/1970	Seconds	UINT32
4-7	Nanosecond Supplement to Time	Nanoseconds	UINT32
8-9	Data Valid Flag Bit 0: UTM Zone Bit 1: Easting Bit 2: Northing Bit 3: Latitude Bit 4: Longitude Bit 5: Speed Bit 6: Heading Bit 7: Antenna Height	0 – clear, 1 – set	UINT16
10-11	UTM Zone		UINT16
12-19	Easting	Meters	Double
20-27	Northing	Meters	Double
28-35	Latitude	Degrees	Double
36-43	Longitude	Degrees	Double
44-47	Speed	Knots	Single
48-51	Heading (0 to 359.9)	Degrees	Single
52-55	Antenna Height	Meters	Single

Table 6-1: PositionMessageType

The EdgeTech convention is:

- **Latitude** is positive North
- **Longitude** is positive East
- **Heading** is always positive
- **Antenna Height** is positive up

The *Data Valid Flag* (bytes 8-9) must be tested for the presence or absence of data in each field. If a GPS device is connected and it is a dual antenna system supplying heading, then the *Heading* field (bytes 48-51) is also valid (or set to 1).

Antenna Height, or ellipsoid height, (bytes 52-55) may or may not be populated and depends on the GPS device connected. The validity of each field is determined as in section **3.0 ATTITUDEMESSAGETYPE**. Unused fields are flagged as such (or set to 0) in the *Data Valid Flag*.

7.0 StatusMessageType

Message ID: 3005

StatusMessageType is a source for GPS status and quality (i.e. fixed, float, DGPS, etc.). The status includes information such as Number of Satellites and Horizontal Dilution of Precision. The quality indicator is given by its numerical code in the incoming GPS message. EdgeTech reads these status codes and indicates which message structure provided the information. Currently, there are only two sources that can provide the necessary status information: GGA or GGK.

> **NOTE:** *The Talker ID for the incoming GPS messages does not matter (e.g. $GPGGA, $PTNL,GGK, $INGGK, $GPGGK, etc.)*

BYTE OFFSET	DESCRIPTION	UNITS	SIZE
0-3	Time Since 1/1/1970	Seconds	UINT32
4-7	Nanosecond Supplement to Time	Nanoseconds	UINT32
8-9	Data Valid Flag Bit 0: GGA Status Bit 1: GGK Status Bit 2: Number of Satellites Bit 3: Dilution of Precision	0 – clear, 1 – set	UINT16
10	Version		Byte
11	GGA Status		Byte
12	GGK Status		Byte
13	Number of Satellites		Byte
14-15	Reserved		Byte
16-19	Dilution of Precision	Meters	Single
20-63	Reserved		UINT32

Table 7-1: StatusMessageType

The *Data Valid Flag* must be tested for the presence or absence of data in each field. The validity of each field is determined as in **3.0 AttitudeMessageType**. Unused fields are flagged as such (or set to 0) in the *Data Valid Flag*.