1 ZODIAC DATA TYPES AND MESSAGE FORMATS

This document describes the formats of the two types of messages that can be communicated across the serial data interface for the zodiac Global Positioning System(GPS) receiver engine. The structure and contents of each binary message is described in Section 2. The structure and contents of each National Marine Electronics Association (NMEA) message is described in Section 3.

1.1 Binary Message Format And Word Structure

1.1.1 Binary Message Format. The input/output binary data stream format is a low byte/high byte pattern. Each byte is output with its Least Significant Bit (LSB) first, followed by its higher order bits, ending with the Most Significant Bits (MSB) of the data byte.

The binary message format is nearly identical to that used by the previous Nav Core/Micro Tracker series of receivers, except that all floating point integer numbers with explicit or implied scale factors.

Each binary message consits of a header portion and a data portion, each with its own checksum. Each message will have a header, but some message may not have data. Message acknowledgements are in the form of a header , and message requests are made using headers as well. Table Ⅰ-1 shows the data types used to define the elements of the binary interface messages.

1.1.2 Word Structure. An integer is defined as 16 bits. While offsets are incorporated in the message description tables, the most convenient specification of memory layout in application implementation is likely to be a structure definition.

If the item is a fixed point quantity, the value of the LSB of the integer is given. To convert a fixed point item to a floating point variable, the integer representation is floated and multiplied by the resolution. When converting to float,

Table I-1. Binary Message Data Types

TYPE	ABBREVIATION	WORDS(Note1)	BITS	MAXIMUM RANGE
Bit (Note 2)	Bit	N/A	0 to 15	0 to 1
Character (Note 3)	C	N/A	8	ASCII 0 to 255
Integer	I	1	16	-32768 to +32767
Double Integer	DI	2	32	-2147483648 to +2147483647
Triple Integer	TI	3	48	-140737488355328 to +140737488355327
Unsigned Integer	UI	1	16	0 to 65535
Unsigned Double Integer	UDI	2	32	0 to 4294967295
Unsigned Triple Integer	UTI	3	48	0 to 281474976710656

Note1:
The term “word” is used throughout this document to specify a quantity which occupies 16 bits of storage.

Note2:
Data items using bit storage are specified with a format of w.b, where w is the word number and b is the bit number (0-15,0 LSB) within the word. Multiple-bit items (bit fields) are indicated by a range of ‘word.bit’ values (e.g., 8.4-8.7).

Note3:
Although the AAMP2 processor and C compiler use 16-bit character representations, this data interface will use the more common 8-bit representation. The Zodiac receiver software will pack/unpack the character data internally as needed.

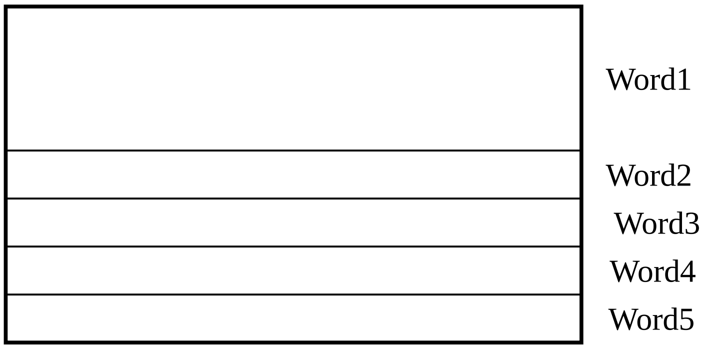

Figure 1-1. Binary Message Header Format

consideration must be given to the range and resolution of the item to ensure that the type of float selected for the conversion has an adequate mantissa length to preserve the accuracy of the data item. Triple word items may require scaling portions of the variable separately and then adding them in floating point form.

Composite words may have independent definitions for each bit field in the word. Flag bits are either zero (false) or one (true). All bits that are designated as reserved within the bit descriptions of binary data have undefined values for outputs and must be set to zero for inputs.

1.2 Binary Message Header

The binary message header format has been modified slightly from the NavCore V format to accommodate message logging requests. The format of the new message header is shown in Figure 1-1.

1.2.1Message Header Word 1. Each input/output message starts with a synchronization word of the form 0xFF81$_{HEX}$ with DEL(255 decimal) occupying the first eight bits followed by the Start Of Header (SOH) (129 decimal) occupying the second eight bits of the synchronization word.

1.2.2 Message Header Word 2. Word2 contains the numeric message ID. For example, Word 2 for Message ID 1000 would be:

High byte		Low Byte	
0000	0011	1110	1000
MSB	LSB	MSB	LSB

Or 0x03E8 $_{HEX.}$

1.2.3 Message Header Word 3. Word 3 contains the word count for the data portion of the message. The word count does not include the data checksum word. A zero data word count indicates a “header-only” message.

1.2.4 Message Header Word 4. The fourth word of the message header is a 16-bit field allocated to protocol and message related flags. These flag bits extend control over ACK/NAK requests and implement message logging requests. The zeroes represented in the word 4 field shown in Figure 1-1 are reserved bits and should be set to zero within this word..

The ACK/NAK control mechanism gives the user the ability to request either ACK or NAK, or both, independently for each message request. The user sets the request (R) bit and either the acknowledge (A) bit or negative acknowledge (N) bit, or both, to select the proper acknowledge behavior. With this approach, the user can configure requests only to be NAKed, alerting the user when a problem arises without incurring the overhead necessary to continuously process ACKs.

The lower six bits of the flags word can be used as an additional input identifier. This identifier is not explicitly processed by the receiver; it is echoed back, in the same location, as part of the header in ACK/NCK responses. This feature allows the user to uniquely distinguish which input message an acknowledgement corresponds to when multiple

Trigger (on time, on update)	Word6
Interval(sec)	Word7
Offset(set)	Word8
Data Checksum	Word9

Figure 1-2. Standard Log Request Message Format (Data Portion)

input message with the same message ID were processed during a particular period of time.

The flags word now supports message logging requests. The connect (C) and disconnect (D) bits are used to enable and disable, respectively, message outputs , and can be used either independently or in conjunction with the log request bits. A header-only message, with a Message ID and the connect bit set, enables the specified message with existing timing characteristics. Likewise, a header-only message, with Message ID and the disconnect bit set, disables the specified message. A message with both connect and disconnect bit is ignored. Note that enabling and disabling a message does not modify its timing characteristics (trigger, interval, or offset). A log request with the connect bit set will set up the message's timing characteristics and then enable the message. Similarly, for a combined log and disable request, the message will be disabled after the timing characteristics are set. To disable all messages, set the message ID to $FFFF_{HEX}$(all bits set) and set the disconnect (D) bit.

Setting the query (Q) request bit will output the message specified by the message ID one time during the next output interval. Standard log requests will be accepted if the log (L) bit is set and if the required data parameters are present in the data portion of the request message.

1.2.5 Message Header Word 5. Word 5 of the message header is the data checksum, used to validate the header portion of the message. It is computed by summing (modulo 2^{16}) all words (including the word containing DEL and SOH) contained in the header and then performing a two's complement on the sum.

The computation of the header checksum may be expressed mathematically as:

$$SUM = Mod\ 2^{16} \quad \Sigma^{4}_{i=1} Word(i)$$

If sum = -32768, Header checksum = SUM; else Header Checksum = -SUM

Where:

a. Unary negation is computed as the two's complement of a 16-bit data word.
b. Mod 2^{16} indicates the least 16 bits of an arithmetic process. That is carry bits from bit position 16 are ignored.
c. The summation is the algebraic binary sum of the words indicated by the subscript i.
d. The –32768 sum value must be treated as a special case since it cannot be negated.

1.2.6 Log Request Messages. Figure 1-2 shows the format of the data portion of standard log request messages. The ranges for words 6, 7, and 8 of these messages are as follows:

Trigger 0 = on time, 1 = on update

Interval 0 to 65535 seconds (an interval of zero produces a query as if the query bit [Q] in word 4 of the message header has been set).

Offset 0 to 60 seconds (an offset of zero specifies an initial output relative to the current time. An offset of 60 specifies an initial output relative to the next even minute [zero seconds into the next minute]).

When the Trigger field is set to “on time”(integer value 0), the first output will occur at the next Offset seconds into the minute, and will repeat every Interval seconds thereafter. When the trigger field is set to “on update,” the specified message will be output only when the data is updated (e.g., when satellite almanac is collected).

1.3 Binary Message Data

The data portion of a binary message, if it exists, can be variable in length, as specified by the data word count found in the header. The Data Checksum follows the data and is not included in the data word count.

The Data Checksum is a 16-bit word used to validate the data portion of the message. It is transmitted as the last word of any message containing data (Figure 1-2 or Figure 1-3).

When the Word Count field is zero, the Data Checksum does not exist. It is computed by summing (modulo 2^{16}) all words it the data portion of the message and then complementing that sum. The mathematical expression for the Data Checksum is:

$$\mathbf{SUM = Mod\ 2^{16}}\ \sum_{i=6}^{5+N} Word\ (i)$$

If sum = -32768, Data Checksum = SUM; else Data Checksum = -SUM

where:

a. Unary negation is computed as the two’s complement of a 16-bit data word.
b. Mod 2^{16} indicates the least 16 bits of an arithmetic process. That is, carry bits from bit position 16 are ignored.
c. The summation is the algebraic binary sum of the words indicated by the subscript (i).
d. The –32768 sum value must be treated as a special case since it cannot be negated.

Data elements identified as “Reserved” must be set to zero for input messages and are undefined for output messages. All data storage which is not explicitly defined should be handled as if it were marked “Reserved.”

Unless otherwise stated, the resolution of each numeric data item is one integer unit, as specified by that item in the “Units” field.

2 ZODIAC BINARY DATA MESSAGES

This section describes the binary data messages of the Zodiac GPS receiver. All of the output and input binary messages are listed in Table II-1 together with their corresponding message IDs. Power-up default messages are also identified.

Binary mode is selected according to the logic described in the hardware interface section of the Zodiac GPS Receiver Family Designer's Guide. Binary messages are transmitted and received across the host port serial I/O interface (RS-232) with the following default communications parameters:

- 9600 bps
- 8 data bits
- no parity
- 1 stop bit

All of the output binary messages are described in detail in section 2.1 All of the input binary messages are described in detail in section 2.2

Table II-1 Zodiac Binary Data Messages

Output Message name	Message ID	Input Message Name	Message ID
Geodetic Position Status Output (*)	1000	Geodetic Position and Velocity Initialization	1200
ECEF Position Status Output	1001	User-Defined Datum Definition	1210
Channel Summary (*)	1002	Map Datum Select	1211
Visible Satellites	1003	Satellite Elevation Mask Control	1212
Differential GPS Status	1005	Satellite Candidate Select	1213
Channel Measurement	1007	Differential GPS Control	1214
Receiver ID (**)	1011	Cold Start Control	1216
User-Settings Output	1012	Solution Validity Criteria	1217
Built - In Test Results	1100	Antenna Type Select	1218
Measurement Time Mark	1102	User-Entered Altitude Input	1219
UTC Time Mark Pulse Output	1108	Application Platform Control	1220
Serial Port Communication Parameters in Use	1130	Nav Configuration	1221
EEPROM Update	1135	Perform Built- In Test Command	1300
EEPROM Status	1136	Restart Command	1303
		Serial Port Communications Parameters	1330
		Message Protocol Control	1331
		Raw DGPS RTCM SC-104 Data	1351
(*) Enable by default at power-up (**)Once at power-up/reset			

2.1 Output Message Descriptions

2.1.1 Geodetic Position Status Output (Message 1000). This message outputs the receiver's estimate of position, ground speed, course over ground, climb rate, and map datum. A solution status indicates whether or not the solution is valid (based on the solution validity criteria) and also the type of solution. The number of measurements used to compute the solution is also included.

The Polar Navigation flag is used to indicate that the solution estimate is too close to the North or South Pole to estimate longitude. When this flag is true, the longitude and true course outputs are invalid and are not updated. Users operating near the poles should use the ECEF Position Status Output message.

The contents of the Geodetic Position Status Output Message are described in Table II-2.

Table II-2 Message 1000: Geodetic Position Status Output Message (1 of 3)

Message ID:	1000				
Rate:	Variable; defaults to 1 Hz				
Message Length:	55 Words				
Word No. :	**Name:**	**Type:**	**Units:**	**Range:**	**Res**
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (Note 1)	UDI	10msec ticks	0 to 4294967295	
8	Sequence Number (Note 2)	I		0 to 32767	
9	Satellite Measurement Sequence Number (Note 3)	I		0 to 32767	
Navigation Solution Validity (10.0-10.15)					
10.0	Solution Invalid-Altitude Used (Note 4)	Bit		1 = true	
10.1	Solution Invalid-No Differential GPS (Note 4)	Bit		1 = true	
10.2	Solution Invalid-Not Enough Satellites in Track (Note 4)	Bit		1 = true	
10.3	Solution Invalid-Exceeded Maximum EHPE (Note 4)	Bit		1 = true	
10.4	Solution Invalid-Exceeded Maximum EVPE(Note 4)	Bit		1 = true	
10.5-10.15	Reserved				
Navigation Solution Type (11.0-11.15)					
11.0	Solution type-Propagated Solution (Note 5)	Bit		1=propagated	
11.1	Solution Type-Altitude Used	Bit		1=altitude	
11.2	Solution Type-Differential	Bit		1=differential	
11.3-11.15	Reserved				

Table II-2. Message 1000: Geodetic Position Status Output Message (2 of 3)

Word No:	Name:	Type:	Units:	Range:	Res
12	Number of Measurements Used in Solution	UI		0 to 12	
13	Polar Navigation	Bit		1 = true	
14	GPS Week Number	UI	weeks	0 to 32767	
15-16	GPS Seconds From Epoch	UDI	second	0 to 604799	
17-18	GPS Nanoseconds From Epoch	UDI	nanosec	0 to 999999999	
19	UTC Day	UI	days	1 to 31	
20	UTC Month	UI	months	1 to 12	
21	UTC Year	UI	year	1980 to 2079	
22	UTC Hours	UI	hours	0 to 23	
23	UTC Minutes	UI	minutes	0 to 59	
24	UTC Seconds	UI	seconds	0 to 59	
25-26	UTC Nanoseconds From Epoch	UDI	nanosec	0 to 999999999	
27-28	Latitude	DI	radians	± 0 to $\pi/2$	10^{-8}
29-30	Longitude	DI	radians	± 0 to π	10^{-8}
31-32	Height	DI	meters	± 0 to 50000	10^{-2}
33	Geoidal Separation	I	meters	± 0 to 200	10^{-2}
34-35	Ground Speed	UDI	meters/sec	0 to 1000	10^{-2}
36	True Course	UI	radians	0 to 2π	10^{-3}
37	Magnetic Variation	I	radians	± 0 to $\pi/4$	10^{-4}
38	Climb Rate	I	meters/sec	± 300	10^{-2}
39	Map Datum (Note 6)	UI		0 to 188 and 300 to 304	

Table II-2. Message 1000: Geodetic Position Status Output Message (3 of 3)

Word No:	Name:	Type:	Units:	Range:	Res
40-41	Expected Horizontal Position Error (Note 7)	UDI	meters	0 to 320000000	10^{-2}
42-43	Expected Vertical Position Error (Note 7)	UDI	meters	0 to 250000	10^{-2}
44-45	Expected Time Error (Note 7)	UDI	meters	0 to 300000000	10^{-2}
46	Expected Horizontal Velocity Error (Note 7)	UI	meters/sec	0 to 10000	10^{-2}
47-48	Clock Bias (Note 7)	DI	meters	±0 to 9000000	10^{-2}
49-50	Clock Bias Standard Deviation (Note 7)	DI	meters	±0 to 9000000	10^{-2}
51-52	Clock Drift (Note 7)	DI	m/sec	±0 to 1000	10^{-2}
53-54	Clock Drift Standard Deviation (Note 7)	DI	m/sec	±0 to 1000	10^{-2}
55	Data Checksum				

Note 1:

Set time is an internal 10 millisecond (T10) count since power-on initialization enabled the processor interrupts. It is not used to derive GPS time, but only serves to provide a sequence of events knowledge. The set time or T10 count references the receiver's internal time at which the message was created for output. The T10 range is approximately 71 weeks.

Note 2:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output

Note 3:

The satellite measurement sequence number relates the position solution data to a particular set of satellite measurements found in binary messages 1002 and 1007 (Channel Summary Message and Channel Measurement Message, respectively).

Note 4:

The value of this data item was Initially set using the Solution Validity Criteria Message (Message 1217).

Note 5:

Bit zero of word 11 does not refer to a solution propagated by the navigation software. This bit is used to indicate if the solution was propagated by the serial I/O manager to generate a 1 Hz output message when no new navigation state data was available. This is an error condition potentially caused by a shortage of throughput in one cycle. It is unlikely to occur and is self-correcting. Normal state propagation which occurs within the navigation software with or without measurements available for processing does not cause this bit to be set.

Note 6:

The table in Appendix A contains map datum codes from 0 to 188. Codes 300 to 304 are user-defined

Note 7:

The data displayed by this field is not valid until the receiver is in navigation mode.

2.1.2 ECEF Position Status Output (Message 1001). This message outputs the receiver's estimate of ECEF position and velocity, and map datum. A solution status indicates whether or not the solution is valid (based on the solution validity criteria) and also the type of solution. The number of measurements used to compute the solution is also included.

The contents of the ECEF Position Status Output Message are described in Table II-3.

Table II-3. Message 1001: ECEF Position Status Output Message (1 of 2)

Message ID:	1001				
Rate:	Variable				
Message Length:	54 Words				
Word No.:	**Name:**	**Type:**	**Units:**	**Range:**	**Res**
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (Note 1)	UDI	10msec ticks	0 to 4294967295	
8	Sequence Number (Note 2)	I		0 to 32767	
9	Satellite Measurement Sequence Number (Note 3)	I		0 to 32767	
Navigation Solution Validity (10.0-10.15)					
10.0	Solution Invalid-Altitude Used (Note 4)	Bit		1 = true	
10.1	Solution Invalid-No Differential GPS (Note 4)	Bit		1 = true	
10.2	Solution Invalid-Not Enough Satellites in Track(Note 4)	Bit		1 = true	
10.3	Solution Invalid-Exceeded Maximum EHPE (Note 4)	Bit		1 = true	
10.4	Solution Invalid-Exceeded Maximum EVPE(Note 4)	Bit		1 = true	
10.5-10.15	Reserved	Bit			
Navigation Solution Type (11.0-11.15)					
11.0	Solution type-Propagated Solution (Note 5)	Bit		1=propagated	
11.1	Solution Type-Altitude Used	Bit		1=altused	
11.2	Solution Type-Differential	Bit		1=differential	
11.3-11.15	reserved				
12	Number of Measurements Used in Solution	UI		0 to 12	
13	GPS Week Number	UI	weeks	0 to 32767	
14-15	GPS Seconds Into week	UDI	seconds	0 to 604799	
16-17	GPS Nanoseconds From Epoch	UDI	nanosec	0 to 999999999	
18	UTC Day	UI	days	1 to 31	
19	UTC Month	UI	months	1 to 12	
20	UTC Year	UI	year	1980 to 2079	
21	UTC Hours	UI	hours	0 to 23	
22	UTC Minutes	UI	minutes	0 to 59	

Table II-3. Message 1001: ECEF Position Status Output Message (2 of 2)

Word No:	Name:	Type:	Units:	Range:	Res
23	UTC Seconds	UI	seconds	0 to 59	
24-25	UTC Nanoseconds From Epoch	UDI	nanosec	0 to 999999999	
26-27	ECEF Position – X (Note 7)	DI	meters	±0 to 9000000	10^{-2}
28-29	ECEF Position – Y (Note 7)	DI	meters	±0 to 9000000	10^{-2}
30-31	ECEF Position – Z (Note 7)	DI	meters	±0 to 9000000	10^{-2}
32-33	ECEF Velocity – X (Note 7)	DI	meters/sec	±0 to 1000	10^{-2}
34-35	ECEF Velocity – Y (Note 7)	DI	meters/sec	±0 to 1000	10^{-2}
36-37	ECEF Velocity – Z (Note 7)	DI	meters/sec	±0 to 1000	10^{-2}
38	Map Datum (Note 6)	UI		0 to 188 and 300 to 304	
39-40	Expected Horizontal Position Error (Note 7)	UDI	meters	0 to 1000	10^{-2}
41-42	Expected Vertical Position Error (Note 7)	UDI	meters	0 to 1000	10^{-2}
43-44	Expected Time Error (Note 7)	UDI	meters	0 to 1000	10^{-2}
45	Expected Horizontal Velocity Error (Note 7)	UI	meters/sec	0 to 300	10^{-2}
46-47	Clock Bias (Note7)	DI	meters	±0 to 9000000	10^{-2}
48-49	Clock Bias Standard Deviation (Note 7)	DI	meters	±0 to 9000000	10^{-2}
50-51	Clock Drift (Note 7)	DI	m/sec	±0 to 1000	10^{-2}
52-53	Clock Drift Standard Deviation (Note 7)	DI	m/sec	±0 to 1000	10^{-2}
54	Data Checksum				

Note 1:

Set time is an internal 10 millisecond (T10) count since power-on initialization enabled the processor interrupts. It is not used to derive GPS time, but only serves to provide a sequence of events knowledge. The set time or T10 count references the receiver's internal time at which the message was created for output. The T10 range is approximately 71 weeks.

Note 2:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output

Note 3:

The satellite measurement sequence number relates the position solution data to a particular set of Satellite measurements found in binary messages 1002 and 1007 (Channel Summary Message and Channel Measurement Message, respectively).

Note 4:

The value of this data item was initially set using the Solution Validity Criteria Message (Message 1217).

Note 5:

Bit zero of word 11 does not refer to a solution propagated by the navigation software. This bit is used to indicate if the solution was propagated by the serial I/O manager to generate a 1 Hz output message when no new navigation state data was available. This is an error condition potentially caused by a shortage of throughput in one cycle. It is unlikely to occur and is self-correcting. Normal state propagation which occurs within the navigation software with or without measurements available for processing does not cause this bit to be set.

Note 6:

The table in Appendix A contains map datum codes from 0 to 188. Codes 300 to 304 are user-defined

Note 7:

The data displayed by this field is not valid until the receiver is in navigation mode.

2.1.3 Channel Summary (message 1002). This message provides a summary form of the satellite range measurements and signal tracking information on a per-channel basis. The contents of the Channel Summary Message are described in Table II-4..

Table II-4. Message 1002 : Channel Summary message

Message ID:	1002				
Rate:	Variable; defaults to 1 Hz				
Message Length:	55 Words				
Word No.:	Name:	Type:	Units:	Range:	Res
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (Note 1)	UDI	10msec ticks	0 to 4294967295	
8	Sequence Number (Note 2)	I		0 to 32767	
9	Satellite Measurement Sequence Number (Note 3)	I		0 to 32767	
10	GPS Week Number	UI	weeks	0 to 32767	
11-12	GPS Seconds Into week	UDI	seconds	0 to 604799	
13-14	GPS Nanoseconds From Epoch	UDI	nanosec	0 to 999999999	
Channel Summary Data					
15.0+(3*n)	Measurement Used (Note 4)	Bit		1=used	
15.1+(3*n)	Ephemeris Available	Bit		1=available	
15.2+(3*n)	Measurement Valid	Bit		1=valid	
15.3+(3*n)	DGPS Corrections Available	Bit		1=available	
16+(3*n)	Satellite PRN	UI		0 to 32	
17+(3*n)	C/No	UI	dBHz	0 to 60	
51	Data Checksum				

Note 1:
Set time is an internal 10 millisecond (T10) count since power-on initialization enabled the processor interrupts. It is not used to derive GPS time, but only serves to provide a sequence of events knowledge. The set time or T10 count references the receiver's internal time at which the message was created for output. The T10 range is approximately 71 weeks.

Note 2:
The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output

Note 3:
The satellite measurement sequence number relates the position solution data to a particular set of satellite measurements found in binary messages 1002 and 1007 (Channel Summary Message and Channel Measurement Message, respectively).

Note 4:
n = 0 to 11

2.1.4 Visible Satellites (Message 1003). This message outputs the list of satellites visible to the receiver and their corresponding elevations and azimuths. The best possible $DOP_{s,}$ calculated from this visible list, are also provided. The contents of the Visible Satellites Message are described in Table II-5

Table II-5 Message 1003: Visible Satellites Message

Message ID:	1003				
Rate:	Variable; defaults on update				
Message Length:	51 Words				
Word No.:	**Name:**	**Type:**	**Units:**	**Range:**	**Res**
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (Note 1)	UDI	10msec ticks	0 to 4294967295	
8	Sequence Number (Note 2)	I		0 to 32767	
9	Best Possible GDOP	I		0 to 99	10^{-2}
10	Best Possible PDOP	I		0 to 99	10^{-2}
11	Best Possible HDOP	I		0 to 99	10^{-2}
12	Best Possible VDOP	I		0 to 99	10^{-2}
13	Best Possible TDOP	I		0 to 99	10^{-2}
14	Number of Visible Satellites	UI		1 to 12	
VISIBLE SATELLITE SET (Note 3)					
15.0+(3* j)	Satellite PRN (Note 4)	UI		0 to 32	
16.0+(3*j)	Satellite Azimuth	I	radians	$\pm\pi$	10^{-4}
17.0+(3*j)	Satellite Elevation	I	radians	$\pm\pi/2$	10^{-4}
51	Data Checksum				

Note 1:

Set time is an internal 10 millisecond (T10) count since power-on initialization enabled the processor interrupts. It is not used to derive GPS time, but only serves to provide a sequence of events knowledge. The set time or T10 count references the receiver's internal time at which the message was created for output. The T10 range is approximately 71 weeks.

Note 2:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output

Note 3:

Only the satellite sets for the number of satellites reported in word 14 of this message are valid.

Note 4:

J = the number of visible satellites −1 when the number of visible satellites is greater than zero.

2.1.5 Differential GPS Status (Message 1005). This message contains DGPS status information derived from the last set of differential corrections processed by the receiver. The contents of the Differential GPS Status Message are described in Table II-6.

Table II-6 Message 1005: Differential GPS Status Message (1 to 2)

Message ID:	1005				
Rate:	Variable				
Message Length:	25 Words				
Word No.:	Name:	Type:	Units:	Range:	Res
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (Note 1)	UDI	10msec ticks	0 to 4294967295	
8	Sequence Number (Note 2)	I		0 to 32767	
Status (9.0-9.15)					
9.0	Station Health	Bit		1 = station bad	
9.1	User Disabled	Bit		1 = user disabled	
9.2-9.15	Reserved				
10	Station ID	UI		0 to 1023	
11	Age of Last Correction	UI	seconds	0 to 999	
12	Number of Available Corrections	UI		0 to 12	
CORRECTION STATUS PER SATELLITE (Note 3)					
j.0-j.5	Satellite PRN (Note 4)	UI		1 to 32	
j.6	Local Ephemeris	Bit		1 = ephemeris not available	
j.7	RTCM corrections	Bit		1 = corrections not available	
j.8	RTCM UDRE	Bit		1 = UDRE too high	
j.9	Satellite Health	Bit		1 = satellite data indicates bad health	

Table II-6. Message 1005: Differential GPS Status Message (2 of 2)

Word No:	Name:	Type:	Units:	Range:	Res
j.10	RTCM Satellite Health	Bit		1 = RTCM source declares satellite bad	
j.11	Corrections Stale	Bit		1 = received stale corrections	
j.12	IODE Mismatch	Bit		1 = IODE mismatch	
j.13-j.15	Reserved				
25	Data checksum				

Note 1:

Set time is an internal 10 millisecond (T10) count since power-on initialization enabled the Processor interrupts. It is not used to derive GPS time, but only serves to provide a sequence of events knowledge. The set time or T10 count references the receiver's internal time at which the message was created for Output. The T10 range is approximately 71 weeks.

Note 2:

The sequence number is a count that indicates whether the data in a particular binary message has Been Updated or changed since the last message output

Note 3:

Only the correction status words for the number of available corrections reported in word 12 of this message are valid.

Note 4:

The word number, j, ranges from 13 to 24.

2.1.6 Channel Measurement (Message 1007). This message provides measurement and associated data for each of the receiver's 12 channels. The contents of the Channel Measurement Message are described in Table II-7.

Table II-7 Message 1007 : Channel Measurement message

Message ID: 1007					
Rate: Variable					
Message Length: 154 Words					
Word No.:	**Name:**	**Type:**	**Units:**	**Range:**	**Res**
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (Note 1)	UDI	10msec ticks	0 to 4294967295	
8	Sequence Number (Note 2)	I		0 to 32767	
9	Satellite Measurement Sequence Number (Note 3)	I		0 to 32767	
CHANNEL MEASUREMENT DATA					
10+12*j	Pseudo range (Note 4)	TI	meters	$\pm 1.4^{14}$	10^{-3}
13+12*j	Pseudo range Rate	DI	meters/sec	$\pm$21474836	10^{-3}
15+12*j	Carrier Phase	TI	meters	$\pm 1.4^{14}$	10^{-3}
18+12*j	Carrier Phase Bias	TI	meter	$\pm 1.4^{14}$	10^{-3}
21+12*j	Phase Bias Count	UI		0 to 65535	
154	Data Checksum				

Note 1:

Set time is an internal 10 millisecond (T10) count since power-on initialization enabled the processor interrupts. It is not used to derive GPS time, but only serves to provide a sequence of events knowledge. The set time or T10 count references the receiver's internal time at which the message was created for output. The T10 range is approximately 71 weeks.

Note 2:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output

Note 3:

The satellite measurement sequence number relates the position solution data to a particular set of satellite measurements found in binary messages 1002 and 1007 (Channel Summary Message and Channel Message, respectively).

Note 4:

j = 0 to 11

2.1.7 Receiver ID (Message 1011). This message is output automatically at startup after the receiver has completed its initialization. It can be used to determine when the receiver is ready to accept serial input. Manual requests for this message are also honored. This message consists of five 20-byte (two characters per word), null-padded ASCII data fields. The contents of the Receiver ID Message are described in Table II-8.

Table II-8. Message 1011: Receiver ID Message

Message ID:	1011				
Rate:	Variable (see above)				
Message Length:	59 Words				
Word No.:	**Name:**	**Type:**	**Units:**	**Range:**	**Res**
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (Note 1)	UDI	10msec ticks	0 to 4294967295	
8	Sequence Number (Note 2)	I		0 to 32767	
9-18	Number of Channels	C			
19-28	Software Version	C			
29-38	Software Data	C			
39-48	Options List (Note 3)	C			
49-58	Reserved	C			
59	Data Checksum				

Note 1:

Set time is an internal 10 millisecond (T10) count since power-on initialization enabled the Processor interrupts. It is not used to derive GPS time, but only serves to provide a sequence of events knowledge. The set time or T10 count references the receiver's internal time at which the message was created for output. The T10 range is approximately 71 weeks.

Note 2:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output

Note 3:

The options list is a bit-encoded configuration word represented as an ASCII four-digit hexadecimal number

bit0	minimize ROM usage
bit1	minimize RAM usage
bits 2-15	reserved

2.1.8 User-Settings Output (Message 1012). This message Provides a summary of the settings for many of the user-definable parameters, which were set either to default values or to values or to values supplied by the user in input messages. The contents of the User-Settings Output Message are described in Table II-9.

Table II-9. Message 1012: User-Settings Output Message (1 of 2)

Message ID:	1012				
Rate:	Variable				
Message Length:	22 Words				
Word No.:	**Name:**	**Type:**	**Units:**	**Range:**	**Res**
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (Note 1)	UDI	10msec ticks	0 to 2147483647	
8	Sequence Number (Note 2)	I		0 to 32767	
Operational Status (9.0-9.15)					
9.0	Power Management Enabled	Bit		1=enabled	
9.1	Cold Start Disabled	Bit		1=disabled	
9.2	DGPS Disabled	Bit		1=disabled	
9.3	Held Altitude Disabled	Bit		1=disabled	
9.4	Ground Track Smoothing Disabled	Bit		1=disabled	
9.5	Position Pinning Disabled	Bit		1=disabled	
9.6-9.7	Reserved				
9.8	Active Antenna Present	Bit		1=present	
9.9-9.15	Reserved				
10	Cold Start Time-out	UI	seconds	0 to 32767	
11	DGPS Correction Time-out	UI	seconds	0 to 32767	
12	Elevation Mask	I	radians	0 to $\pm\pi/2$	10^{-3}
SELECTED CANDIDATES:					
13.0-14.15	Selected Candidate (Note 3)	Bit		1=include candidate	
SOLUTION VALIDITY CRITERIA (15 – 20)					
15.0	Attitude Not Used	Bit		1=required	
15.1	Differential GPS	Bit		1=required	
15.2-15.15	Reserved				
16	Number of Satellites in Track	UI		0 to 2	

Table II-9 Message 1012: User Settings Output Message (2 of 2)

Word No:	Name:	Type:	Units:	Range:	Res
17-18	Minimum Expected Horizontal Error	UDI	meters	0 to 1000	10^{-2}
19-20	Minimum Expected Vertical Error	UDI	meters	0 to 1000	10^{-2}
21	Application Platform	UI		0=defaut 1=static 2=pedstrian 3=marine (lakes) 4=marine(sea level) 5=land (auto) 6=air	
22	Data Checksum				

Note 1:

Set time is an internal 10 millisecond (T10) count since power-on initialization enabled the processor interrupts. It is not used to derive GPS time, but only serves to provide a sequence of events knowledge. The set time or T10 count references the receiver's internal time at which the message was created for output. The T10 range is approximately 71 weeks.

Note 2:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output

Note 3:

The selected candidate list is a 32-bit flag, each bit representing candidate selection status for one satellite (i.e,bit 0=SV1 status, bit = SV2 status …bit 31 = SV32 status).

2.1.9 Built-In Test (BIT) Results (Message 1100). This message provides detailed test results or the last BIT is commanded since power-up. It is output automatically after the completion of a commanded BIT, but may also be queried manually as needed.Non-zero device failure status indicates failure . The contents of the Built-In Test (BIT) Results Message are described in Table II-10.

Table II-10. Message 1100: Built-In Test Results Message

Message ID:	1100				
Rate:	Variable				
Message Length:	20 Words				
Word No.:	**Name:**	**Type:**	**Units:**	**Range:**	**Res**
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (Note 1)	UDI	10msec ticks	0 to 4294967295	
8	Sequence Number (Note 2)	I		0 to 32767	
9	ROM Failure (Note 3)	UI			
10	RAM Failure (Note 3)	UI			
11	EEPROM Failure (Note 3)	UI			
12	Dual Port RAM Failure (Note 3)	UI			
13	Digital Signal Processor (DSP) Failure (Note 3)	UI			
14	Real – Time Clock (RTC) Failure (Note 3)	UI			
15	Serial Port 1Receive Error Count	UI		0 to 65535	
16	Serial Port 2 Receive Error Count	UI		0 to 65535	
17	Serial Port 1 Receive Byte Count	UI		0 to 65535	
18	Serial Port 2 Receive Byte Count	UI		0 to 65535	
19	Software Version	UI		0.00 to 655.35	0.01
20	Data Checksum				

Note 1:

Set time is an internal 10 millisecond (T10) count since power-on initialization enabled the processor interrupts. It is not used to derive GPS time, but only serves to provide a sequence of events knowledge. The set time or T10 count references the receiver's internal time at which the message was created for output. The T10 range is approximately 71 weeks.

Note 2:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output

Note 3:

A value of zero indicates a test has passed. A non-zero value indicates a device failure. Missing devices will be reported as failures. Therefore, the OEM's BIT pass/fail should ignore words for components that are not in the are not in the system under test. Note that the Dual Port RAM Failure test is currently not implemented. Therefore, word 12 will report a value of zero.

2.1.10 Measurement Time Mark (Message 1102). This message provides raw measurement and associated data. The contents of the Measurement Time Mark Message are described in Table II-11.

Table II-11. Message 1102 : Measurement Time Mark Message (1 of 3)

Message ID:	1102				
Rate:	Variable				
Message Length:	253 Words				
Word No.:	**Name:**	**Type:**	**Units:**	**Range:**	**Res**
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (Note 1)	UDI	10msec ticks	0 to 4294967295	
8	Sequence Number (Note 2)	I		0 to 32767	
9-12	GPS Measurement Time: Integer portion (Note 3) Fractional portion (Note 4)	 DI DI	 seconds seconds	 0 to 604799.98 0 to ±0.02	 20ms 2^{-29} /50
GPS Time Status (13.0-13.15)					
13.0	Reserved				
13.1	Reserved				
13.2	Hand-Over Word Decoded Flag (Note 5)	BIT		1=Hand-Over Word decoded	
13.3-13.15	Reserved				
14-24	Reserved				
PER CHANNEL OUTPUT					
n	Data Word Subframe Index (Note 6)	UI		0 to 9	1
Channel Status Word One :					
(n+1).0	Weak Signal (Note 7)	Bit		0 to 1	
(n+1).1	High $\triangle\theta$ (Note 8)	Bit		0 to 1	
(n+1).2	Parity Error(s) (Note 9)	Bit		0 to 1	
(n+1).3	Reserved				
(n+1).4	Reserved				
(n+1).5	Bit Sync Flag	Bit		1=bit sync unknown	
(n+1).6	Frame Sync Flag	Bit		1=frame sync unknown	
(n+1).7	Z Count Flag	Bit		1=z count unknown	

Table II-11. Message 1102 : Measurement Time Mark Message (2 of 3)

Word No.:	**Name:**	**Type:**	**Units:**	**Range:**	**Res**
(n+1).8 to (n+1).15	Reserved				
Channel Status Word Two:					
(n+2).0 to (n+2).4	Pre-Detection Interval(PDI)	UI		1 to 20	
(n+2).5 to (n+2).15	Reserved				
SATELLITE MEASUREMENTS					
n+3	Satellite Pseudorandom Noise Number (PRN) (Note10)	I		0 to 32	1
n+4	C/No (Note 11)	I	dBHz	0 to ± 128	2^{-8}
n+5	Code Phase Measurement (Note 12)	UTI	seconds	0 to 0.16	$2^{-45}/5$
n+8	Carrier Phase Measurement (Note 13)	UTI	seconds	0 to 0.16	$2^{-45}/5$
n+11	Carrier Velocity Measurement	DI	sec/sec	0 to $\pm 2^{-14}$	2^{-45}
n+13	Code Phase Standard Deviation	UI	seconds	0 to 0.0025	$2^{-19}/50$
n+14	Carrier Phase Standard Deviation	UI	seconds	0 to 0.0025	$2^{-19}/50$
Channel Data Word One (Note 14):					
(n+15).0 to (n+15).29	SV Data Word One (Note 15)				
(n+15).30	Validity			0=Invalid (unused) 1=Valid(used)	
(n+15).31	Parity Error (Note 16)			0=Correct 1=Error	
Channel Data Word Two (Note 14):					
(n+17).0 to (n+17).29	SV Data Word Two (Note 15)				
(n+17).30	Validity			0=Invalid (unused) 1=Valid(used)	
(n+17).31	Parity Error (Note 16)			0=Correct 1=Error	
253	Data Checksum				

Note 1:

Set time is an internal 10 millisecond (T10) count since power-on initialization enabled the processor interrupts. It is not used to derive GPS time, but only serves to provide a sequence of events knowledge. The set time or T10 count references the receiver's internal time at which the message was created for output. The T10 range is approximately 71 weeks.

Note 2:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output

Note 3:

The GPS time associated with the valid satellite measurement data. The integer portion is the GPS second count from the start of week.

Table II-11. Message 1102: Measurement Time Mark Message (3 of 3)

Note 4:
The fractional portion of the solution measurement time is the offset from the GPS second count.

Note 5:
The Measurement Engine has decoded and applied at least one Hand-Over Word.

Note 6:
Indication of the position of subframe data word one within the GPS satellite's 50 bps telemetry data stream. For example, a value of 0 indicates that subframe data word one represents the first word of a particular telemetry data subframe. The data word subframe index is repeated once for each channel n = 25+(j*19), where j=0 to 11

Note 7:
1 = the signal strength fell below a threshold.

Note 8:
1=a carrier phase change exceeded a threshold.

Note 9:
1= carrier cycle slips may have affected this measurement or the previous measurement.

Note 10:
PRN equal to 0 is used to indicate an unused channel.

Note 11:
C/No observed for this measurement interval.

Note 12:
Code phase (pseudorange) at the measurement epoch. The physical range value in meters is obtained by scaling by $c(2^{-45}/50)$, where c is the WGS-84 value of the speed of light. The factor of 50 results from the 50 Hz accumulation of code phase.

Note 13:
Continuously integrated carrier phase at the measurement epoch.

Note 14:
If channel data word one is unused, so is channel data word two. Channel data word one is indexed into the telemetry subframe by the Data word Frame Index.

Note 15:
30-bit subframe data word from the 50 bps satellite telemetry data stream.

Note 16:
Parity is computed based on the six parity bits found at the end of each 30-bit subframe data word. Parity is computed based on the parity algorithm given in the Global Positioning System Standard Positioning Service Signal Specification (November 5,1993)

2.1.11 UTC Time Mark Pulse Output (Message 1108). This message provides the UTC seconds into week associated with the UTC synchronized Time Mark pulse. This message is output approximately 400 milliseconds before the Time Mark pulse strobe signal. The contents of the UTC Time Mark Pulse Output Message are described below.

Table II-2 Message 1108: UTC Time Mark Pulse Output Message

Message ID:	1108				
Rate:	1Hz				
Message Length:	20 Words				
Word No.:	**Name:**	**Type:**	**Units:**	**Range:**	**Res**
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (Note 1)	UDI	10msec ticks	0 to 4294967295	
8	Sequence Number (Note 2)	I		0 to 32767	
UTC TIME					
9-13	Reserved				
14-15	UTC Seconds Of Week	UDI		0 to 604799	1 sec
16	GPS to UTC Time Offset (integer part)	I		0 to 604799	1 sec
17-18	GPS to UTC Time Offset (fractional part)	UDI		0to999999999	1 nse
UTC TIME VALIDITY (19.0-19.15)					
19.0	Time Mark Validity	Bit		1=True	
19.1	GPS/UTC Sync	Bit		0=GPS 1=UTC	
19.2-19.15	Reserved				
20	Data Checksum				

Note 1:

Set time is an internal 10 millisecond (T10) count since power-on initialization enabled the processor interrupts. It is not used to derive GPS time, but only serves to provide a sequence of events knowledge. The set time or T10 count references the receiver's internal time at which the message was created for output. The T10 range is approximately 71 weeks.

Note 2:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.

2.1.12 Serial Port Communication Parameters In Use (Message 1130). This message contains the communication parameters for the receiver's two serial ports. The contents of the Serial Port Communication Parameters in Use Message are described in Table II-13.

Table II-13. Message 1130: Serial Port Communication Parameters In Use Message (1 of 2)

Message ID: 1130					
Rate: Variable					
Message Length: 21 Words					
Word No.:	**Name:**	**Type:**	**Units:**	**Range:**	**Res**
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (Note 1)	UDI	10msec ticks	0 to 4294967295	
8	Sequence Number (Note 2)	I		0 to 32767	
Port 1 Communication Parameters (9.0-11)					
9	Port 1 Character Width	Bit		0=7 bits 1=8 bits	
10	Port 1 Stop Bits	Bit		0=1 1=2	
11	Port 1 Parity	Bit		0= no parity 1= odd parity 2= even parity	
12	Port 1 bps Rate (Note 3)	Bit		0=custom 1=300 2=600 3=1200 4=2400 5=4800 6=9600 7=19200 8=38400 9=57600 10=76800 11=115200	
13	Port 1 Pre-Scale (Note 3)	UI		0 to 255	
14	Port 1 Post-Scale (Note 3)	UI		0 to 7	

Table II-13. Message 1130: Serial Port Communication Parameters In use Message (2 of 2)

Word No.:	Name:	Type:	Units:	Range:	Res
Port 2 Communication Parameters (12.0 – 14)					
15	Port 2 Character Width	Bit		0=7 bits 1=8 bits	
16	Port 2 Stop Bits	Bit		0=1 1=2	
17	Port 2 Parity	Bit		0= no parity 1= odd parity 2= even parity	
18	Port 2 bps Rate (Note 3)	Bit		0=custom 1=300 2=600 3=1200 4=2400 5=4800 6=9600 7=19200 8=38400 9=57600 10=76800 11=115200	
19	Port 2 Pre-Scale (Note 3)	UI		0 to 255	
20	Port 2 Post-Scale (Note 3)	UI		0 to 7	
21	Data Checksum				

Note 1:

Set time is an internal 10 millisecond (T10) count since power-on initialization enabled the processor interrupts. It is not used to derive GPS time, but only serves to provide a sequence of events knowledge. The set time or T10 count references the receiver’s internal time at which the message was created for output. The T10 range is approximately 71 weeks.

Note 2:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output

Note 3:

When a custom bits-per-second (bps) rate is selected, the bps rate is equal to:

CPU clock /(16 x pre-scale x $2^{post\text{-}scale}$)

2.1.13 EEPROM Update (Message 1135). This message provides dynamic status notification for EEPROM writes. It contains the data block ID for the last set of data which was written to EEPROM. This message is most useful when configured for output on update (the default), as it will provide a notification of all stored configuration changes as they occur. The contents of the EEPROM Update Message are described in Table II-14.

Table II 14. Message 1135 : EEPROM Update Message

Message ID:	1135				
Rate:	Variable; default on update				
Message Length:	10 Words				
Word No.:	**Name:**	**Type:**	**Units:**	**Range:**	**Res**
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (Note 1)	UDI	10msec ticks	0 to 4294967295	
8	Sequence Number (Note 2)	I		0 to 32767	
9.0-9.7	Data ID (Note 3)	Bit		0 to 25	
9.8-9.15	Satellite PRN (Note 4)	Bit		0 to 32	
10	Data Checksum				

Note 1:

Set time is an internal 10 millisecond (T10) count since power-on initialization enabled the processor interrupts. It is not used to derive GPS time, but only serves to provide a sequence of events knowledge. The set time or T10 count references the receiver's internal time at which the message was created for output. The T10 range is approximately 71 weeks.

Note 2:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output

Note 3:

0= Status
1= Position
2= UTC/lono
3= Frequency standard cubic parameters
4= Host port communication configuration
5= Auxiliary port communication configuration
6= Memory options
7= Solution validity criteria
8= Power management selections
9= Selected datum
10= Platform class
11= Cold start control
12= Elevation mask angle
13 = Satellite candidate list
14= Antenna selection
15= User entered altitude
16= DGPS control
17= Host port protocol selection
18= Auxiliary port protocol selection
19= Host port enabled messages
20= Reserved (auxiliary port enabled messages)
21= User datums
22= Frequency/Temperature table
23= Almanac
24= Frequency standard calibration data
25= Nav configuration data

Note 4:

This field is only valid when the Data ID = 23 (Almanac).

2.1.14 EEPROM Status (Message 1136). This message provides failure and storage status information for the EEPROM. Bits set in the failure words represent write failures during attempts to update the corresponding blocks of data. Bits set in the status words indicate that those data blocks have been updated at least once in the EEPROM. The contents of the EEPROM Status Message are described in Table II-15.

Table II-15 Message 1136 : EEPROM Status Message

Message ID:	1136				
Rate:	Variable				
Message Length:	18 Words				
Word No.:	**Name:**	**Type:**	**Units:**	**Range:**	**Res**
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (Note 1)	UDI	10msec ticks	0 to 4294967295	
8	Sequence Number (Note 2)	I		0 to 32767	
9.0	Device Not Present	Bit		1 = not present	
9.1-9.15	Reserved				
10-11	Almanac Failure (Note 3)	Bit			
12-13	Failure (Note 4)	Bit		0 to 31	
14-15	Almanac Status (Note 3)	Bit			
16-17	Status (Note 4)	Bit		0 to 31	
18	Data Checksum				

Note 1:

Set time is an internal 10 millisecond (T10) count since power-on initialization enabled the processor interrupts. It is not used to derive GPS time, but only serves to provide a sequence of events knowledge. The set time or T10 count references the receiver's internal time at which the message was created for output. The T10 range is approximately 71 weeks.

Note 2:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output

Note 3:

The Almanac Failure and Almanac Status words are 32-bit bit maps where the LSB = PRN 1 and the MSB = PRN 32.

Note 4:

The Failure and Status words are bit maps with values as follows:

0= Status
1= Position
2= UTC/Iono
3= Frequency standard cubic parameters
4= Host port communication configuration
5= Auxiliary port communication configuration
6= Memory options
7= Solution validity criteria
8= Power management selections
9= Selected datum
10= Platform class
11= Cold start control
12= Elevation mask angle
13 = Satellite candidate list
14= Antenna selection
15= User entered altitude
16= DGPS control
17= Host port protocol selection
18= Auxiliary port protocol selection
19= Host port enabled messages
20= Reserved(auxiliary port enabled messages)
21= User datums
22= Frequency/Temperature table
23= Reserved
24= Frequency standard calibration data
25= Nav configuration data
26-30= Reserved
31= Data is being updated

2.2 Input Message Descriptions

2.2.1 Geodetic Position and Velocity Initialization (Message 1200) . This message allows the user to initialize the receiver with the specified geodetic position , ground speed , course over ground , and climb rate . The course may be either true or magnetic , as indicated by the Magnetic Course field. The GPS/UTC time represents the time at which the solution was computed and , if present , will be used to propagate the solution to the current time. The contents of the Geodetic Position and Velocity Initialization Message are described in Table Ⅱ-16.

Table Ⅱ-16. Message 1200:Geodetic Position and Velocity Initialization Message (1 of 2)

Message ID:	1200				
Rate:	As required-maximum rate is 1Hz				
Message Length:	27 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	1		0 to 32767	
Initialization Control (7.0-7.15)					
7.0	Force Time	Bit		0=normal 1=forced	
7.1	GPS Time Valid	Bit		1=valid	
7.2	UTC Time Valid	Bit		1=valid	
7.3	Lat / Lon Valid	Bit		1=valid	
7.4	Altitude Valid	Bit		1=valid	
7.5	Speed / Course Valid	Bit		1=valid	
7.6	Magnetic Course	Bit		1=magnetic	
7.7	Climb Rate Valid	Bit		1=valid	
7.8-7.15	Reserved				
8	GPS Week Number	UI	Weeks	0 to 32767	
9-10	GPS Seconds Into Week	UDI	Seconds	0 to 604799	
11	UTC Day	UI	days	1 to 31	

Table Ⅱ-16. Message 1200:Geodetic Position and Velocity Initialization Message (2 of 2)

12	UTC Month	UI	months	1 to 12	
13	UTC Year	UI	year	1980 to2079	
14	UTC Hours	UI	hours	0 to 23	
15	UTC Minutes	UI	minutes	0 to 59	
16	UTC Seconds	UI	seconds	0 to 59	
17-18	Latitude	DI	radians	± 0 to $\pi/2$	10^{-9}
19-20	Longitude	DI	radians	± 0 to π	10^{-9}
21-22	Altitude	DI	meters	± 0 to 50000	10^{-2}
23-24	Ground Speed	DI	meters/sec	0 to 1000	10^{-2}
25	Course	UI	radians	0 to 2π	10^{-3}
26	Climb Rate	I	meters/sec	± 300	10^{-2}
27	Data Checksum				

Note 1:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.

2.2.2 User-Defined Datum Definition (Message 1210). This message allows the user to define a datum to be used by the receiver to transform its position solution. Up to five user-defined datums may be stored. Storage of these parameters requires EEPROM. The contents of the User-Defined Datum Definition Message are described in Table Ⅱ-17.Note that datum definition does not imply datum use. Message 1211 is used to specify the "Datum In Use" for the navigation function. Also, any Message 1210 that contains an undefined datum code is ignored.

Table Ⅱ-17. Message 1210:User-Defined Datum Definition Message

Message ID:	1210				
Rate:	As required-maximum rate is 1Hz				
Message Length:	20 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
7	User Datum ID	UI		300-304	
8-9	Semi-Major Axis-Integer Part	UDI	Meters	6300000 to 640000	
10	Semi-Major Axis-Fractional Part	UI	Meters	0 to 9999	10^{-4}
11	Inverse Flattening-Integer Part	UI		280 to 320	
12-13	Inverse Flattening-Fractional Part	UDI		0 to 999999999	10^{-9}
14-15	WGS-84 Datum Offset-dX	DI	Meters	0 to ±9000000	10^{-2}
16-17	WGS-84 Datum Offset-dY	DI	Meters	0 to ±9000000	10^{-2}
18-19	WGS-84 Datum Offset-dZ	DI	meters	0 to ±9000000	10^{-2}
20	Data Checksum				
Note 1: The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.					

2.2.3 Map Datum Select (Message 1211). This message allows the user to select a datum to be used by the receiver to transform its position solution.

The contents of the Map Datum Select Message are described in Table Ⅱ-18.

Table Ⅱ-18. Message 1211:Map Datum Select Message

Message ID:	1211				
Rate:	As required-maximum rate 1Hz				
Message Length:	8 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
7	Datum ID(Note 2)	UI		0 to 188 and 300 to 304	
8	Data Checksum				

Note 1:
The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.

Note 2:
The table in Appendix C contains map datum codes from 0 to 188.Codes 300 to 304 are user-defined.

2.2.4 Satellite Elevation Mask Control (Message 1212). This message allows the user to set the elevation mask angle used by the receiver to select visible satellites. Storage of the Elevation Mask Angle parameter requires EEPROM. The contents of the Satellite Elevation Mask Control Message are described in Table Ⅱ-19.

Table Ⅱ-19. Message 1212:Satellite Elevation Mask Control Message

Message ID:	1212				
Rate:	As required-maximum rate 1Hz				
Message Length:	8 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
7	Elevation Mask Angle	UI	Radians	0 to $\pm\pi/2$	10^{-3}
8	Data Checksum				

Note 1:
The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.

2.2.5 Satellite Candidate Select (Message 1213). This message allows the user to construct the list of satellites which will be considered for selection by the receiver. The contents of the Satellite Candidate Select Message are described in Table Ⅱ-20.

Table Ⅱ-20. Message 1213:Satellite Candidate Select Message

Message ID:	1213				
Rate:	As required-maximum rate 1Hz				
Message Length:	10 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
7.0	Satellite PRN#1	Bit		1=included	
•					
•					
•					
7.15	Satellite PRN#16	Bit		1=included	
8.0	Satellite PRN#17	Bit		1=included	
•					
•					
•					
8.15	Satellite PRN#32	Bit		1=included	
9.0	Non-Volatile Storage Select	Bit		1=store in non-volatile memory	
9.1-9.15	Reserved				
10	Data Checksum				
Note 1: The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.					

2.2.6 Differential GPS Control(Message 1214). This message allows the user to control the behavior of the receiver's differential capability. Storage of this message's parameters requires EEPROM. The contents of the Differential GPS Control Message are described in Table Ⅱ-21.

Table Ⅱ-21. Message 1214:Differential GPS Control Message

Message ID:	1214				
Rate:	As required-maximum rate 1Hz				
Message Length:	9 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
7.0	DGPS Disable	Bit		1=disable	
7.1	Correction Data Base Reset	Bit		1=reset	
7.2-7.15	Reserved				
8	Correction Time-out	UI		0 to 32767	
9	Data Checksum				
Note 1: The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.					

2.2.7 Cold Start Control (Message 1216). This message allows the user to disable the Cold Start acquisition mode of the receiver. Normal operation is to leave cold start enabled. However, in certain enclosed situations (e.g., parking garages, houses, office buildings, etc.), faster acquisitions may be achieved with cold start disabled. Storage of the Cold Start Disable parameter requires EEPROM. The contents of the Cold Start Control Message are described in Table Ⅱ-22.

Table Ⅱ-22. Message 1216:Cold Start Control Message

Message ID:	1216				
Rate:	As required-maximum rate 1Hz				
Message Length:	9 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
7.0	Cold Start Disable	Bit		1=disable	
7.1-7.15	Reserved				
8	Cold Start Time-out	UI	sec	0 to 32767	
9	Data Checksum				
Note 1: The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.					

2.2.8 Solution Validity Criteria (Message 1217). The receiver will always output the best position solution it can attain , depending on the number and quality of available measurements. The Solution Validity Criteria Message allows the user to define the criteria for setting the position validity status specified in the position output messages. The status will be set to 'invalid' if any of the specified requirements are not met. Storage of this message's parameters requires EEPROM. The contents of the Solution Validity Criteria Message are described in Table Ⅱ-23.

Table Ⅱ-23. Message 1217:Solution Validity Criteria Message

Message ID:	1217				
Rate:	As required-maximum rate is 1Hz				
Message Length:	13 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
7.0	Altitude Not Used	Bit		1=required	
7.1	Differential GPS	Bit		1=required	
7.2-7.15	Reserved				
8	Minimum Number of Satellites Used	UI		0 to 12	
9-10	Maximum Expected Horizontal Position Error	UDI	meters	0 to 1000	10^{-2}
11-12	Maximum Expected Vertical Position Error	UDI	meters	0 to 1000	10^{-2}
13	Data Checksum				

Note 1:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.

2.2.9 Antenna Type Select (Message 1218). This message allows the user to specify the type of antenna which is being used with the receiver. Selecting 'Active Antenna Present' will raise the floor on the receiver's expected signal level to reduce sideband correlations. Deselecting it indicates use of a passive antenna, allowing the receiver to be more sensitive to low signal levels and preventing it from searching "hot" signals. Storage for the Active Antenna Present parameter requires EEPROM. The contents of the Antenna Type Select Message are described in Table Ⅱ-24.

Table Ⅱ-24. Message 1218:Antenna Type Select Message

Message ID:	1218				
Rate:	As required-maximum rate 1Hz				
Message Length:	8 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
7.0	Antenna Type	Bit		0=passive 1=active	
7.1-7.15	Reserved				
8	Data Checksum				

Note 1:
The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.

2.2.10 User-Entered Altitude Input (Message 1219). This message allows the user to enter an altitude to be used for altitude hold during 2-D navigation. If the Force Use field is not set , the receiver may ignore the altitude input if it thinks it has a better estimate. Setting the Clear field will clear out the last estimate of altitude which the receiver uses for altitude hold. Setting the MSL Select field allows entry of mean-sea-level altitude. A standard deviation can be specified to indicate the uncertainty associated with the entered altitude. The receiver will weight the altitude measurement according to this uncertainty. As a special case, a zero standard deviation indicates that the quality of the altitude is not known. The contents of the User-Entered Altitude Input Message are described in Table Ⅱ-25.

Table Ⅱ-25. Message 1219:User-Entered Altitude Input Message

Message ID:	1219				
Rate:	As required-maximum rate is 1Hz				
Message Length:	12 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
Altitude Input Control (7.0-7.15)					
7.0	Force Use	Bit		1=force	
7.1	MSL Select	Bit		1=MSL	
7.2	Store (RAM)(Note 2)	Bit		1=store	
7.3	Store (EEPROM)(Note 2)	Bit		1=store	
7.4	Clear(RAM)	Bit		1=clear	
7.5	Clear(EEPROM)	Bit		1=clear	
7.6-7.15	Reserved				
8-9	Altitude	DI	meters	±0 to50000	10^{-2}
10	Altitude Standard Deviation	UDI	meters	0 to 10000	10^{-2}
11	Data Checksum				

Note 1:
The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.

Note 2:
For an altitude sensor that is supplying data in real-time, the OEM must ensure that bits 7.2 and 7.3 are set to zero so the altitude value will not be stored continuously. In memory(RAM or EEPROM).

2.2.11 Application Platform Control (Message 1220). This message allows the user to adjust the receiver's dynamics based on the type of application in which the receiver is being used. Storage for the Platform parameter requires EEPROM. The contents of the Application Platform Control Message are described in Table Ⅱ-26.

Table Ⅱ-26. Message 1220:Application Platform Control Message

Message ID:	1220				
Rate:	As required-maximum rate is 1Hz				
Message Length:	8 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
7	Platform	UI		0=default 1=static 2=pedestrian 3=marine (lakes) 4=marine (sea level) 5=land(auto) 6=air	
8	Data Checksum				
Note 1: The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.					

2.2.12 Nav Configuration (Message 1221). This message allows the user to control various features in the navigation processing. The held altitude disable bit controls the use of stored GPS-based altitude to aid the receiver when the vertical geometry deteriorates. The ground track smoothing bit controls the use of satellite range bias estimates to minimize the position shifts resulting from SA and constellation changes. The position pinning bit controls the use of a horizontal speed test to pin the position reported by the receiver and eliminate the wander associated with SA when static. Ground track smoothing and position pinning are not used when DGPS corrections are in use. The contents of the Nav Configuration Message are described in Table Ⅱ-27.

Table Ⅱ-27. Message 1221:Nav Configuration Message

Message ID:	1221				
Rate:	As required-maximum rate is 1Hz				
Message Length:	15 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
Nav Configuration Word(7.0-7.15)					
7.0	Held Altitude Disable (default = enabled)	Bit		0=Enabled 1=Disabled	
7.1	Ground Track Smoothing Disable (default = enabled)	Bit		0=Enabled 1=Disabled	
7.2	Position Pinning Disable (default = enable)	Bit		0=Enabled 1=Disabled	
7.3	Measurement Filtering	Bit		0=Enabled 1=Disabled	
7.4-7.15	Reserved (must be zeroed out)	Bit			
8-14	Reserved (must be zeroed out)	UI			
15	Data Checksum				

Note 1:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.

2.2.13 Perform Built-In Test Command (Message 1300). This message instructs the receiver to immediately execute its Built-In Test (BIT). Results of the BIT are available in the Built-In Test Results message. Note that this message contains no data. The contents of the Perform Built-In Test Command Message are described in Table Ⅱ-28.

Table Ⅱ-28. Message 1300:Perform Built-In Test Command Message

Message ID:	1300				
Rate:	As required-maximum rate approximately 0.1Hz				
Message Length:	8 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
7	Reserved				
8	Data Checksum				
Note 1: The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.					

2.2.14 Restart Command (Message 1303). This message commands a full restart each time it is received. The contents of the Restart Command Message are described in Table Ⅱ-29.

Table Ⅱ-29. Message 1303:Restart Command Message

Message ID:	1303				
Rate:	As required-maximum rate approximately 0.2Hz				
Message Length:	8 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
Invalidation Control (7.0-7.15)					
7.0	Invalidate RAM (Note 2)	Bit		0 to 1	
7.1	Invalidate EEPROM (Note 3)	Bit		0 to 1	
7.2	Invalidate RTC (Note 4)	Bit		0 to 1	
7.3-7.14	Reserved				
7.15	Force Cold Start (Note 5)	Bit		0 to 1	
8	Data Checksum				

Note 1:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.

Note 2:

1 = invalidate all RAM address space before restart.

Note 3:

1 = invalidate all data in the EEPROM device(if present) before restart.

Note 4:

1 = invalidate all data in the RTC device(if present) before restart.

Note 5:

Force a cold start reset by clearing RAM and ignoring but not clearing the stored position in EEPROM. This provides cold start testing with the valid time. If cold start testing without time is desired, then the invalidate RTC bit(7.2) should also be set.

2.2.15 Serial Port Communication Parameters (Message 1330). This message allows the user to set the communication parameters for the receiver's two serial ports. The contents of the Serial Port Communication Parameters Message are described in Table Ⅱ-30.

Table Ⅱ-30. Message 1330:Serial Port Communication Parameters Message(1 of 2)

Message ID:	1330				
Rate:	As required-maximum rate 1Hz				
Message Length:	20 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
PORT CONTROL/VALIDITY DATA					
7.0	Port1 Data Valid	Bit		1 = data valid	
7.1	Port2 Data Valid	Bit		1 = data valid	
7.2-7.15	Reserved				
8	Port1 Character Width	UI		0 = 7 bits 1 = 8 bits	
9	Port1 Stop Bits	UI		0 = 1 1 = 2	
10	Port1 Parity	UI		0 = no parity 1 = odd parity 2 = even parity	
11	Port1 Bits Per Second(bps) Rate	UI		0 = custom 1 = 300 2 = 600 3 = 1200 4 = 2400 5 = 4800 6 = 6900 7 = 19200	
12	Port1 Pre-Scale (Note2)	UI		0 to 255	
13	Port1 Post-Scale (Note2)	UI		0 to 7	
14	Port2 Character Width	Bit		0 = 7 bits 1 = 8 bits	
15	Port2 Stop Bits	Bit		0 = 1 1 = 2	

Table Ⅱ-30. Message 1330:Serial Port Communication Parameters Message(2 of 2)

16	Port2 Parity	Bit		0 = no parity 1 = odd parity 2 = even parity	
17	Port2 bps Rate	Bit		0 = custom 1 = 300 2 = 600 3 = 1200 4 = 2400 5 = 4800 6 = 6900 7 = 19200	
18	Port2 Pre-Scale(Note 2)	UI		0 to 255	
19	Port2 Post-Scale(Note 2)	UI		0 to 7	
20	Data Checksum				

Note 1:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.

Note 2:

Pre-scale and post-scale parameters are used to establish custom bps rates. The bps rate is equal to: CPU clock / (16×pre-scale ×$2^{post\text{-}scale}$)

2.2.16 Message Protocol Control (Message 1331). This message allows the user to set the message format protocol which will be used to communicate information to and from the receiver through the host serial I/O port. Currently, the available protocols are binary (with fixed-point numbers) and NMEA-0183. Storage for the Protocol Type parameter requires EEPROM. The contents of the Message Protocol Control Message are described in Table Ⅱ-31.

Table Ⅱ-31. Message 1331:Message Protocol Control Message

Message ID:	1331				
Rate:	As required-maximum rate 1Hz				
Message Length:	9 words				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
7	Reserved	I			
8	Protocol Type	I		1 = NMEA	
9	Data Checksum				

Note 1:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.

2.2.17 Raw DGPS RTCM SC-104 Data (Message 1351). This input message contains DGPS RTCM SC-104 data. The message is provided for backwards compatibility with the earlier Micro Tracker GPS receiver and may be used in lieu of the auxiliary port data. The contents of the Raw DGPS RTCM SC-104 Data Message are described in Table Ⅱ-32.

Table Ⅱ-32. Message 1351:Raw DGPS RTCM SC-104 Data Message

Message ID:	1351				
Rate:	As required. The maximum allowable rate is once every 100 ms (Note 1)				
Message Length:	Varies with message				
Word No:	**Name:**	**Type:**	**Units:**	**Range:**	**Resolution:**
1-4	Message Header				
5	Header Checksum				
6	Sequence Number (Note 1)	I		0 to 32767	
7 to n-1	Any valid RTCM-104 raw data in multiples of 16 bits, not to exceed 32 16-bit words (Note 3)				
n	Data Checksum(Note 1)				

Note 1:

n must be less than or equal to 39. No more than 32 receiver 16-bit words of RTCM data should be delivered to the receiver with any one message.

Word Description	Number of Words
Header	4
Header Checksum	1
Reserved (Sequence Number)	1
RTCM Data	<=32
Data Checksum	1

Max Number of words	<=39

Note 2:

The sequence number is a count that indicates whether the data in a particular binary message has been updated or changed since the last message output.

Note 3:

Raw demodulated data must conform to the “6 of 8” format described in the RTCM SC-104 standard. The data must also be packed into one or more 16-bit words and should be ordered chronologically from earliest to latest. Specifically, Word7 should represent the earliest data and Word n-1 should represent the latest. Within each word, the most significant bit (bit 15) should represent the latest received bit and the least significant bit (bit 0) should represent the earliest received bit. (Note that according to RTCM “6 of 8” format, bits 6 and 14 should be set marking (1) and bit7 and 15 should be set spacing (0) for each word.) The intent of this bit ordering is to allow the user to pass on the raw RTCM data without modification.

0 WGS 84-Default
1 Adindan - MEAN FOR Ethiopia , Sudan
2 Adindan - Burkina Faso
3 Adindan - Cameroon
4 Adindan - Ethiopia
5 Adindan - Mali
6 Adindan - Senegal
7 Adindan - Sudan
8 Afgooye -Somalia
9 Ain el Abd 1970-Bahrain
10 Ain el Abd 1970-Saudi Arabia
11 Anna 1 Astro 1965-Cocos Islands
12 Antigua Island Astro 1943 Antigua (Leeward Islands)
13 Arc 1950 MEAN FOR Botswana , Lesotho , Malawi, Swaziland ,Zaire, Zambia, Zimbabwe
14 Arc 1950-Botswana
15 Arc 1950-Burundi
16 Arc 1950-Lesotho
17 Arc 1950-Malawi
18 Arc 1950-Swaziland
19 Arc 1950-Zaire
20 Arc 1950-Zambia
21 Arc 1950-Zimbabwe
22 Arc 1960-MEAN FOR Kenya, Tanzania
23 Ascension Island 1958 Ascension Island
24 Astro Beacon E 1945 –Iwo Jima
25 Astro DOS 71/4-St Helena Island
26 Astro Tem Island (FRIG)1961 Tem Island
27 Astronomical Station 1952 Marcus Island
28 Australian Geodetic 1966 Australia & Tasmania
29 Australian Geodetic 1984 Australia & Tasmania
30 Ayabelle Lighthouse-Djibouti
31 Bellevue (IGN) Efate & Erromango Islands
32 Bermuda 1957-Bermuda
33 Bissau-Guinea-Bissau
34 Bogota Observatory-Colombia
35 Bukit Rimpah Indonesia (Bangka & Belitung Islands)
36 Camp Area Astro Antarctica (McMurdo Camp Area)
37 Camp Inchauspe-Argentina
38 Canton Astro 1966-Phoenix Islands
39 Cape-South Africa
40 Cape Canaveral-Bahamas, Florida
41 Carthage-Tunisia
42 Chatham Island Astro 1971 New Zealand (Chatham Island)
43 Chua Astro-Paraguay
44 Corrego Alegre-Brazil
45 Dabola-Guinea
46 Djakarta(Batavia)Indonesia(Sumatra)
47 DOS 1968 New Georgia Islands (Gizo Island)
48 Easter Island 1967-Easter Island
49 European 1950 MEAN FOR Austria,Belgium, Denmark, Finland , France , West Germany, Gibralter, Greece, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland
50 European 1950 MEAN FOR Austria, Denmark, France, West Germany, Netherlands, Switzerland
51 European 1950 MEAN FOR Iraq, Israel, Jordan, Lebanon, Kuwait, Saudi Arabia, Syria
52 European 1950-Cyprus
53 European 1950-Egypt
54 European 1950 England, Channel Islands, Ireland, Scotland, Shetland Islands
55 European 1950-Finland, Norway

56 European 1950-Greece
57 European 1950-Iran
58 European 1950-Italy(Sardinia)
59 European 1950-Italy(Sicily)
60 European 1950-Malta
61 European 1950-Portugal, Spain
62 European 1979 MEAN FOR Austria, Finland, Netherlands, Norway, Spain, Sweden, Switzerland
63 Fort Thomas 1955 Nevis St. Kitts(Leeward Islands)
64 Gan 1970-Republic of Maldives
65 Geodetic Datum 1949-New Zealand
66 Graciosa Base SW 1948 Azores(Faial, Graciosa, Pico, Sao Jorge, Terceira)
67 Guam 1963-Guam
68 Gunung Segara-Indonesia (Kalimantan)
69 GUX 1 Astro-Guadalcanal Island
70 Herat North-Afghanistan
71 Hjorsey 1955-Iceland
72 Hong Kong 1963-Hong Kong
73 Hu- Tzu - Shan- Taiwan
74 Indian-Bangladesh
75 Indian-India, Nepal
76 Indian 1954- Thailand,Vietnam
77 Indian 1975- Thailand
78 Ireland 1965- Ireland
79 ISTS 061 Astro 1968 South Georgia Islands
80 ISTS 073 Astro 1969- Diego Garcia
81 Johnston Island 1961- Johnston Island
82 Kandawala- Sri Lanka
83 Kerguelen Island 1949- Kerguelen Island
84 Kertau 1948- West Malaysia & Singapore
85 Kusaie Astro 1951- Caroline Islands
86 L.C. 5 Astro 1961- Cayman Brac Island
87 Leigon- Ghana
88 Liberia 1964- Liberia
89 Luzon Philippines (Excluding Mindanao)
90 Luzon-Philippines (Mindanao)
91 Mahe 1971-Mahe Island
92 Massawa-Ethiopia(Eritrea)
93 Merchich-Morocco
94 Midway Astro 1961-Midway Islands
95 Minna-Cameroon
96 Minna-Nigeria
97 Montserrat Island Astro 1958 Montserrat (Leeward Islands)
98 M’Poraloko-Gabon
99 Nahrwan-Oman(Masirah Island)
100 Nahrwan-Saudi Arabia
101 Nahrwan-United Arab Emirates
102 Naparima BWI-Trinidad & Tobago
103 North American 1927 MEAN FOR Antigua, Barbados, Barbuda, Caicos Islands, Cuba, Dominican Republic, Grand Cayman, Jamaica, Turks Islands
104 North American 1927 MEAN FOR Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua
105 North American 1927-MEAN FOR Canada
106 North American 1927-MEAN FOR CONUS
107 North American 1927 MEAN FOR CONUS(East of Mississippi River) including Louisiana, Missouri, Minnesota
108 North American 1927 MEAN FOR CONUS (West of Mississippi River)
109 North American 1927-Alaska
110 North American 1927 Bahamas (Except San Salvador Island)
111 North American 1927 Bahamas (San Salvador Island)
112 North American 1927 Canada (Alberta, British Columbia)
113 North American 1927 Canada (Manitoba, Ontario)
114 North American 1927 Canada (New Brunswick, Newfoundland, Nova Scotia, Quebec)

115 North American 1927 Canada (Northwest Territories, Saskatchewan)
116 North American 1927-Canada(Yukon)
117 North American 1927-Canal Zone
118 North American 1927-Cuba
119 North American 1927 Greenland (Hayes Peninsula)
120 North American 1927-Mexico
120 North American 1983 Alaska, Canada,CONUS
122 North American 1983 Central America, Mexico
123 Observatorio Metereo 1939 Azores (Corvo & Flores Islands)
124 Old Egyptian 1907-Egypt
125 Old Hawaiian MEAN FOR Hawaii, Kauai, Maui, Oahu
126 Old Hawaiian-Hawaii
127 Old Hawaiian-Kauai
128 Old Hawaiian-Maui
129 Old Hawaiian-Oahu
130 Oman-Oman
131 Ord. Survey G. Britain 1936 MEAN FOR England, Isle of Man, Scotland, Shetland Islands, Wales
132 Ord. Survey G. Britain 1936-England
133 Ord. Survey G. Britain 1936 England, Isle of Man, Wales
134 Ord. Survey G. Britain 1936 Scotland, Shetland Islands
135 Ord. Survey G. Britain 1936-Wales
136 Pico de las Nieves-Canary Islands
137 Pitcaim Astro 1967-Pitcaim Island
138 Point 58 MEAN FOR Burkina Faso & Niger
139 Pointe Noire 1948-Congo
140 Porto Santo 1936 Porto Santo, Madeira Islands
141 Provisional S. American 1956 MEAN FOR Bolivia, Chile, Colombia, Ecuador, Guyana, Peru, Venezuela
142 Provisional S. American 1956-Bolivia
143 Provisional S. American 1956 Chile (Northem, Near 19° S)
144 Provisional S. American 1956 Chile (Southem, Near 43° S)
145 Provisional S. American 1956 -Colombia
146 Provisional S. American 1956 -Ecuador
147 Provisional S. American 1956 -Guyana
148 Provisional S. American 1956 - Peru
149 Provisional S. American 1956 Venezuela
150 Provisional S. Chilean 1963 Chile (South, Near 53° S)(Hito XⅧ)
151 Puerto Rico Puerto Rico, Virgin Islands
152 Qatar National-Qatar
153 Qomoq-Greenland(South)
154 Reunion-Mascarene Islands
155 Rome 1940-Itlay(Sardinia)
156 Santo(DOS) 1965 Espirito Santa Maria Island
157 Sao Braz Azores (Sao Miguel, Santa Maria Islands)
158 Sapper Hill 1943-East Falkland Island
159 Schwarzeck-Namibia
160 Selvagem Grande-Salvage Islands
161 SGS 85-Soviet Geodetic System 1985
162 South American 1969 MEAN FOR Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Trinidad & Tobago, Venezuela
163 South American 1969-Argentina
164 South American 1969-Bolivia
165 South American 1969-Brazil
166 South American 1969-Chile
167 South American 1969-Colombia
168 South American 1969-Ecuador
169 South American 1969-Ecuador (Baltra, Galapagos)
170 South American 1969-Guyana
171 South American 1969-Paraguay
172 South American 1969-Peru

173 South American 1969-Trinidad & Tobago
174 South American 1969-Venezuela
175 South Asia-Singapore
176 Tananarive Observatory 1925 Madagascar
177 Timbalai 1948 Brunei, East Malaysia (Sabah, Sarawak)
178 Tokyo-MEAN FOR Japan, Korea, Okinawa
179 Tokyo-Japan
180 Tokyo-Korea
181 Tokyo-Okinawa
182 Tristan Astro 1968-Tristan da Cunha
183 Viti Levu 1916 Fiji (Viti Levu Island)
184 Wake-Eniwetok 1960-Marshall Islands
185 Wake Island Astro 1952-Wake Atoll
186 WGS 1972-Global Definition
187 Yacare - Uruguay
188 Zanderij - Suriname

3 ZODIAC NMEA DATA MESSAGES

This section describes the National Marine Electronics Association (NMEA) data messages of the Zodiac GPS receiver. All of the output and input NMEA messages are listed in Table III-1 together with their corresponding message IDs. Power-up default messages are also identified.

NMEA mode is selected according to the logic described in the hardware interface section of the *Zodiac GPS Receiver Family Designer's Guid*e. NMEA messages are transmitted and received across the host port serial I/O interface (RS-232) with the following default communications parameters:

- 4800 bps
- no parity
- 8 data bits
- 1 stop bit

This interface conforms with the NMEA-0183, version 2.01, specification. All of the output NMEA messages are described in detail in section 3.1. All of the input NMEA messages are described in detail in section 3.2.

Table III-1. Zodiac NMEA Data Messages

Output Message Name	**Message ID**
Rockwell Proprietary Built-In Test Results	BIT
GPS Fix Data (*)	GGA
GPS DOP and Active Satellites (*)	GSA
GPS Satellites in View (*)	GSV
Recommended Minimum Specific GPS Data (*)	RMC
Rockwell Proprietary Receiver ID	RID
Rockwell Proprietary Zodiac Channel Status (*)	ZCH
Input Message Name	**Message ID**
Rockwell Proprietary Built-In Test Command	IBIT.
Rockwell Proprietary Log Control Message	ILOG
Rockwell Proprietary Receiver Initialization	INIT
Rockwell Proprietary Protocol Message	IPRO
(*) Default power-up message	

3.1 Output Message Descriptions

3.1.1Rockwell Proprietary Built-In Test (BIT) Results (BIT). This proprietary message provides detailed test results when a BIT is commanded. Non-zero device failure status indicates failure. The contents of the BIT Message are described in Table III-2.

Table III-2. BIT Message: Rockwell Proprietary Built-In Test (BIT) Results Message

Message ID:	**BIT**			
Rate:	**Variable**			
Fields:	**11**			
Field No.:	**Symbol:**	**Field Description:**	**Field Type:**	**Example:**
	$PRWIBIT	Start of sentence and address field (Note 1)		$PRWIBIT
1	ROM_FAIL	ROM failure (Note 2)	hhhh	0001
2	RAM_FAIL	RAM failure (Note 2)	hhhh	0000
3	EEP_FAIL	EEPROM failure (Note 2)	hhhh	0000
4	DPR_FAIL	Dual Port RAM failure (Note 2)	hhhh	0000
5	DSP_FAIL	Digital Signal Processor (DSP) failure (Note 2)	hhhh	0000
6	RTC_FAIL	Real-Time Clock (RTC) failure (Note 2)	hhhh	0000
7	SP1-ERR	Serial Port 1 Receive Error Count	x.x	0
8	SP2_ERR	Serial Port 2 Receive Error Count	x.x	0
9	SP1_RCV	Serial Port 1 Receive Character Count	x.x	15
10	SP2_RCV	Serial Port 2 Receive Character Count	x.x	640
11	SW_VER	Software Version	x.x	01.02
	CKSUM	Checksum	*hh	*75
	<CR><LF>	Sentence terminator		<CR><LF>

Note 1:

$ = NMEA message prefix.
P = Proprietary message indicator.
RWI = Rockwell International mnemonic.
BIT = BIT Results message ID.

Note 2:

A value of zero indicates a test has passed. A non-zero value indicates a device failure. Missing devices will be reported as failures. Therefore, the OEM's BIT pass /fail should ignore words for components that are not in the system under test. Note that the Dual Port RAM failure test is currently not implemented. Therefore, field 4 will report a value of zero.

Sample Message:

$PRWIBIT,0001,0000,0000,0000,0000,0000,0,0,15,640,01.02*75

3.1.2GPS Fix Data (GGA). This message contains time, position, and fix related data for the Zodiac receiver. When a navigation solution passes all of the validity criteria (set using the binary Solution Validity Criteria message), a GGA message is generated automatically. Otherwise, if any of the validity criteria are invalid for the solution, a GGA message is not generated. The contents of the GGA Message are described in Table III-3.

Table III-3. GGA Message: GPS Fix Data Message

Message ID: **GGA (while receiver is in Navigation Mode -- Note 1)**

Rate: **Variable; defaults to 1 Hz**

Fields: **14**

Field No.:	Symbol:	Field Description:	Field Type:	Example:
	$_ _GGA	Start of sentence and address field		$GPGGA
1	POS_UTC	UTC of position (hours, minutes, seconds, decimal seconds)	hhmmss.ss	222435
2	LAT	Latitude	IIII.II	3339.7334
3	LAT_REF	Latitude direction (N = north, S = south)	a	N
4	LON	Longitude	yyyyy.yy	11751.7598
5	LON_REF	Longitude direction (E = east, W = west)	a	W
6	GPS_QUAL	GPS quality indicator (Note 2)	x	2
7	NUM_SATS	Number of satellites in use, 00 to 12 (may be different from the number in view)	xx	06
8	HDOP	Horizontal Dilution of Precision (HDOP)	x.x	1.33
9	ALT_MSL	Antenna altitude above/below meanSea level (geoid) (Note 3)	x.x	27.0
10	M	Units of antenna altitude (meters)	M	M
11	GEOID_SEP	Geoidal separation (Note 4)	x.x	-34.4
12	M	Units of geoidal separation (meters)	M	M
13	DGPS_AGE	Age of differential GPS data (Note 5)	x.x	7
14	STA_ID	Differential reference station ID (0000 to 1023) (Note 6)	xxxx	0000
	CKSUM	Checksum	*hh	*41
	<CR><LF>	Sentence terminator		<CR><LF>

Note 1:

When the navigation solution is invalid, fields 1 through 5 and 8 through 14 are null. Field 7 also has special meaning (see Note 3).

Note 2:

GPS quality indicator:

0 = Fix not available or invalid.

1 = GPS fix.

2 = Differential GPS fix.

Note 3:

The geodetic altitude can be computed from the mean sea level altitude by adding the geoidal separation (word 11).

Note 4:

Geoidal separation is the difference between the WGS-84 Earth ellipsoid and mean sea level (geoid).

Note 5:

Time in seconds since the last SC104 Type 1 or Type 9 update; null field when DGPS is not used.

Note 6:

This field is null when DGPS is not used.

Sample Message:

$GPGGA,222435,3339.7334,N,11751.7598,W,2,06,1.33,27.0,M,4.4,M,7,0000*41

3.1.3GPS DOP and Active Satellites (GSA). This message contains the Zodiac receiver’s operating mode, satellites used for navigation, and DOP values. The contents of the GSA Message are described in Table III-4.

Table III-4. GSA Message: GPS DOP and Active Satellites Message

Message ID:	**GSA**			
Rate:	**Variable**			
Fields:	**17**			
Field No.:	**Symbol:**	**Field Description:**	**Field Type:**	**Example:**
	$_ _GSA	Start of sentence and address field		$GPGSA
1	OP_MODE	Mode (Note 1)	a	A
2	FIX_MODE	Mode (Note 2)	x	3
3-14	SATN	PRNs of satellites used in solution (null for unused fields)	xx,xx,....	04, 16, 09, 24,...
15	PDOP	Position Dilution of Precision (PDOP) (Note 3)	x.x	3.33
16	HDOP	Horizontal Dilution of Precision (HDOP) (Note 3)	x.x	1.96
17	VDOP	Vertical Dilution of Precision (VDOP) (Note 3)	x.x	2.70
	CKSUM	Checksum	*hh	*06
	<CR><LF>	Sentence terminator		<CR><LF>

Note 1:
Mode (operating):
M = Manual, forced to operate in 3-D mode.
A = Automatic, allowed to automatically switch between 2-D and 3-D.

Note 2:
Mode (fix):
1 = Fix not available
2 = 2-D
3 = 3-D

Note 3:
DOPs are based on the set of satellites above the elevation mask angle, which may not be the same set as that used for navigation.

Sample Message:

$GPGSA,A,3,04,16,09,24,,,,,,,,,3.33,1.96,2.70*06

3.1.4 GPS Satellites in View (GSV). This message contains the number of satellites in view, PRN numbers, elevation, azimuth, and Signal-to-Noise Ratio (SNR) values. Each transmission identifies up to four satellites maximum; additional satellite data is sent in a second or third message. The total number of messages being transmitted and the number of the message being transmitted is indicated in the first two fields.

The contents of the GSV Message are described in Table III-5.

Table III-5. GSV Message: GPS Satellites in View Message

Message ID:	**GSV**			
Rate:	**Variable; defaults to 0.5 Hz**			
Fields:	**19**			
Field No.:	**Symbol:**	**Field Description:**	**Field Type:**	**Example:**
	$_ _GSV	Start of sentence and address field		$GPGSV
1	MAX_MSG	Total number of messages (1 to 3)	x	2
2	NUM_MSG	Message number (1 to 3)	x	1
3	NUM_SATS	Total number of satellites in view	xx	07
4	SAT_PRN	Satellite PRN number (Note 1)	xx	24
5	ELEV	Elevation in degrees (90 degrees maximum) (Note 2)	xx	60
6	AZ	Azimuth in True degrees (000 to 359) (Note 2)	xxx	216
7	SNR	SNR (C/No) 00 to 99 dB, null when not tracking	xx	50
8-11	…	2nd satellite PRN number, elevation, azimuth, SNR (Note 1)	xx, xx, xxx, xx	…
12-15	…	3rd satellite PRN number, elevation, azimuth, SNR (Note 1)	xx, xx, xxx, xx	…
16-19	…	4th satellite PRN number, elevation, azimuth, SNR (Note 1)	xx, xx, xxx, xx	…
	CKSUM	Checksum	*hh	*75
	<CR><LF>	Sentence terminator		<CR><LF>

Note 1:
The visible satellites may include one or more that are below the horizon. Since NMEA doesn’t account for negative elevation angles, the elevation field will be null for these satellites.

Note 2:
Azimuth and elevation are null when the satellite is in track, but a visible list is not available.

Sample Message:

$GPGSV,2,1,07,24,60,216,50,20,47,135,47,12,40,020,47,16,36,319,46*75

1.1.5 Recommended Minimum Specific GPS Data (RMC). This message contains time, date, position, course, and speed data. The fields in this message will always contain data even when the receiver is not navigating. This allows user-initialized, stored, or default values to be displayed before a solution is obtained.

The contents of the RMC Message are described in Table III-6.

Table III-6. RMC Message: Recommended Minimum Specific GPS Data Message

Message ID:	**RMC**			
Rate:	**Variable; defaults to 1 Hz**			
Fields:	**11**			
Field No.:	**Symbol:**	**Field Description:**	**Field Type:**	**Example:**
	$_ _RMC	Start of sentence and address field		$GPRMC
1	POS_UTC	UTC of position (hours, minutes, seconds, decimal seconds)	hhmmss.ss	185203
2	POS_STAT	Position status (A = Data valid, V = Data invalid) (Note 1)	a	A
3	LAT	Latitude	IIII.II	3339.7332
4	LAT_REF	Latitude direction (N = north, S = south)	a	N
5	LON	Longitude	yyyyy.yy	11751.7598
6	LON_REF	Longitude direction (E = east, W = west)	a	W
7	SPD	Speed over ground (knots)	x.x	0.000
8	HDG	Heading/track made good (degrees True)	x.x	121.7
9	DATE	Date (dd/mm/yy)	xxxxxx	160496
10	MAG_VAR	Magnetic variation (degrees)	x.x	13.8
11	MAG_REF	Magnetic variation (E = east, W = west) (Note 2)	a	E
	CKSUM	Checksum	*hh	*55
	<CR><LF>	Sentence terminator		<CR><LF>

Note 1:

The position status flag will be set to “V” (data invalid) until the receiver is navigating. at that time, the flag is changed to “A” (data valid) and the information provided in the RMC message will reflect a navigation solution.

Note 2:

Easterly variation (E) subtracts from True course. Westerly variation (W) adds to True course.

Sample Message:

$GPRMC,185203,A,3339.7332,N,11751.7598,W,0.000,121.7,160496,13.8,E*55

1.1.6 Rockwell Proprietary Receiver ID (RID). This message is output automatically at startup after the receiver has completed its initialization. It can be used to determine when the receiver is ready to accept serial input. manual requests for this message are also honored.

The contents of the RID Message are described in Table III-7.

Table III-7. RID Message: Rockwell Proprietary Receiver ID Message

Message ID:	**RID**			
Rate:	**Variable (see above)**			
Fields:	**5**			
Field No.:	**Symbol:**	**Field Description:**	**Field Type:**	**Example:**
	$_ _ _ _RID	Start of sentence and address field		$PRWIRID
1	NUM_CHN	Number of Channels	xx	12
2	SW_VER	Software Version	x.x	00.90
3	SW_DATE	Software Date	cccccccc	12/25/95
4	OPT_LST	Options List (Note 1)	hhhh	0003
5	RES	Reserved		
	CKSUM	Checksum	*hh	*40
	<CR><LF>	Sentence terminator		<CR><LF>

Note 1:
The options list is a bit-encoded configuration word represented as a four-digit hexadecimal number:
bit 0 minimize ROM usage
bit 1 minimize RAM usage
bits 2-15 reserved

Sample Message:

$PRWIRID,12,00.90,12/25/95,0003,*40

1.1.7 Rockwell Proprietary Zodiac Channel Status (ZCH). This message complements the GSV message by providing satellite-to-channel mapping and a status indication for each channel. The contents of the ZCH Message are described in Table III-8.

Table III-8. ZCH Message: Rockwell Proprietary Zodiac Channel Status Message

Message ID:	**ZCH**			
Rate:	**Variable ; defaults to 1 Hz**			
Fields:	**24**			
Field No.:	**Symbol:**	**Field Description:**	**Field Type:**	**Example:**
	$_ _ _ _ZCH	Start of sentence and address field		$PRWIZCH
1-2	SAT_PRN	Channel 1 satellite PRN number (Note 1)	xx	05
2	STATUS	Channel 1 status indication (Note 1)	hh_ _	F
3-4	…	Channel 2 satellite PRN number and status indication	xx,hh_ _	…
5-6	…	Channel 3 satellite PRN number and status indication	xx,hh_ _	…
7-8	…	Channel 4 satellite PRN number and status indication	xx,hh_ _	…
9-10		Channel 5 satellite PRN number and status indication	xx,hh_ _	…
11-12		Channel 6 satellite PRN number and status indication	xx,hh_ _	…
13-14		Channel 7 satellite PRN number and status indication	xx,hh_ _	…
15-16		Channel 8 satellite PRN number and status indication	xx,hh_ _	…
17-18		Channel 9 satellite PRN number and status indication	xx,hh_ _	…
19-20		Channel 10 satellite PRN number and status indication	xx,hh_ _	…
21-22		Channel 11 satellite PRN number and status indication	xx,hh_ _	…
23-24		Channel 12 satellite PRN number and status indication	xx,hh_ _	…
	CKSUM	Checksum	*hh	37
	<CR><LF>	Sentence terminator		<CR><LF>

Note 1:

Channel number (xx) is implied by position in message. Data for all 12 channels is always provided in this message. If a channel is unused, a value of 0 will appear for both channel fields. The status indication (hh_ _) is a one-digit, hexadecimal value which represents four bits as follows:

<y.0> Measurement of the satellite on this channel used in navigation solution.
<y.1> Ephemeris available for the satellite on this channel.
<y.2> Satellite on this channel is in track.
<y.3> DGPS corrections available for the satellite on this channel (NOTE: this bit will never be set whenever the configuration of a particular Zodiac GPS receiver does not support DGPS).

Sample Message:

$PRWIZCH,05,F,20,F,04,F,09,F,16,F,06,F,07,6,00,0,24,F,00,0,00,0,00,0*37

3.2 Input Message Descriptions

3.2.1 Rockwell Proprietary Built-In Test (BIT) Command Message (IBIT). This proprietary message instructs the receiver to immediately execute its BIT. Results of the BIT are available in the Rockwell Proprietary Built-In Test Results message. The data field is reserved and should be left null.

The contents of the IBIT Message are described in Table III-9.

Table III-9. IBIT Message: Rockwell Proprietary Built-In Test (BIT) Command Message

Message ID:	**IBIT**			
Rate:	**As required**			
Fields:	**1**			
Field No.:	**Symbol:**	**Field Description:**	**Field Type:**	**Example:**
	$PRWIIBIT	Start of sentence and address field (Note 1)		$PRWIIBIT
1	RES	Reserved		
	CKSUM	Checksum (optional)	*hh	
	<CR><LF>	Sentence terminator		<CR><LF>

Note 1:
$ = NMEA message prefix.
P = Proprietary message indicator.
RWI = Rockwell International mnemonic.
ILOG = BIT command message ID.

Sample Message:

$PRWIIBIT,

3.2.2 Rockwell Proprietary Log Control Message (ILOG). This proprietary message controls the output of the Zodiac receiver's NMEA messages. The contents of the ILOG Message are described in Table III-10.

Table III-10. ILOG Message: Rockwell Proprietary Log Control Message

Message ID:	**ILOG**			
Rate:	**As required**			
Fields:	**5**			
Field No.:	**Symbol:**	**Field Description:**	**Field Type:**	**Example:**
	$PRWIILOG	Start of sentence and address field (Note 1)		$PRWIILOG
1	MSG_ID	Approved sentence formatter of the data being requested (Note 2)	ccc	RMC
2	ENABLE	Output enable flag (A = enable, V = disable) (Note 3)	a	A
3	TRIG	Output trigger (t = on time, u = on update) (Note 4)	a	T
4	INTERVAL	Output interval (seconds, 0 = once) (Note 4)	x.x	5
5	OFFSET	Initial output offset (seconds from minute mark) (Note 4)	x.x	0
	CKSUM	Checksum (optional)	*hh	
	<CR><LF>	Sentence terminator		<CR><LF>

Note 1:
$ = NMEA message prefix.
P = Proprietary message indicator.
RWI = Rockwell International mnemonic.
ILOG = Log control message ID.

Note 2:
A special form of this field disables all output messages. Use "???" as the message ID as in the following example: $PRWIILOG,???,V,,,

Note 3:
This field may be null to indicate that the previous setting should be left unchanged.

Note 4:
The TRIG, INTERVAL, and OFFSET fields may be null to indicate that the previous setting should be left unchanged.

Sample Message:

$PRWIILOG,RMC,A,T,5,0

3.2.3 Rockwell Proprietary Receiver Initialization Message (INIT). This proprietary message commands the Zodiac receiver to perform a reset, modify its operating mode, or reinitialize itself using specified parameters. The contents of the INIT Message are described in Table III-11.

Table III-11. INIT Message: Rockwell Proprietary Receiver Initialization Message.(1 of 2)

Message ID:		**INIT**		
Rate:		**As required**		
Fields:		**14**		
Field No.:	**Symbol:**	**Field Description:**	**Field Type:**	**Example:**
	$PRWIINIT	Start of sentence and address field (Note 1)		$PRWIINIT
1	RESET	Software reset flag (A = reset, V = don’t reset) (Note 2)	a	V
2	RES_1	Reserved		
3	RES_2	Reserved		
4	LAT	Latitude (Note 2)	IIII.III	3339.650
5	LAT_REF	Latitude direction (N = north, S = south) (Note 2)	a	N
6	LON	Longitude (Note 2)	yyyyy.yy	11751.680
7	LON_REF	Longitude direction (E = east, W = west) (Note 2)	a	W
8	ALT	Altitude (meters) (Note 2)	x.x	64.131
9	SPD	Ground speed (Note 2)	x.x	0.0
10	SPD_TYP	Ground speed units (M = m/sec, N = knots, K = km/hr) (Note 2)	a	M
11	HDG	Heading (0.0 to 360.0 degrees north) (Note 2)	x.x	0.0
12	HDG_TYP	Heading type (T = true, M = magnetic) (Note 2)	a	T
13	TIME	UTC time (hours, minutes, seconds) (Note 2)	hhmmss	162338
14	DATE	UTC date (Note 2)	ddmmyy	190594
	CKSUM	Checksum (optional)	*hh	
	<CR><LF>	Sentence terminator		<CR><LF>

Table III-11. INIT Message: Rockwell Proprietary Receiver Initialization Message.(2 of 2)

Note 1:

$ = NMEA message prefix.
P = Proprietary message indicator.
RWI = Rockwell International mnemonic.
INIT = Initialization message ID.

Note 2:

This function is enabled by default. Each of the fields 1 through 14 may be null to indicate that the previous setting for the data item should be left unchanged. For example, reset may be commanded without specifying the other parameters by issuing the following command:

$PRWIINIT,A, , , , , , , , , , , , ,<CR><LF>

When using null fields, the following restrictions apply:

If a supplied parameter has a corresponding unit specifier or reference indicator, it must also be supplied.

Both latitude and longitude must be provided to specify a valid horizontal position.

Both ground speed and heading must be provided to specify a valid horizontal velocity.

If a magnetic heading is specified, horizontal position (lat/lon), and UTC time and date Must also be provided.

UTC time and date must be provided together.

Sample Message:

$PRWIINIT,V,,,3339.650,N,11751.680,W,64.131,0.0,M,0.0,T,162338,190594

3.2.4 Rockwell Proprietary Protocol Message (IPRO). This proprietary message allows the user to set the message format protocol which will be used to communicate information to and from the receiver through the host serial I/O port. Currently, the available protocols are binary (with fixed-point numbers) and NMEA-0183. Storage for the Protocol Type parameter requires EEPROM.

The contents of the IPRO Message are described in Table III-12.

Message ID:	**IPRO**			
Rate:	**As required**			
Fields:	**2**			
Field No.:	**Symbol:**	**Field Description:**	**Field Type:**	**Example:**
	$PRWIIPRO	Start of sentence and address field (Note 1)		$PRWIIPRO
1	RES	Reserved		
2	PRO_TYPE	Protocol Type (RBIN = Rockwell binary)	cccc	RBIN
	CKSUM	Checksum (optional)	*hh	
	<CR><LF>	Sentence terminator		<CR><LF>

Note 1:

$ = NMEA message prefix.
P = Proprietary message indicator.
RWI = Rockwell International mnemonic.
IPRO = Protocol message ID.

Sample Message:

$PRWIIPRO,,RBIN