LV1b Downlink Packet Definitions

Version Tracking

Date	Notes
10/04/00	Broke off SRAM packets to a separate document, LV1b_SRAM_Packet_Defns.doc
10/01/00	Created as separate document, added CRC values.
09/15/00	Fixed GPS packet definition.

Discussion

LV1b sends it's collected data and status information down a 19.2kbps "downlink" to the ground in real time. The system uses a commercially available 900MHz FSK "Linx" transmitter module with a Motorola power amplifier on the rocket, and "Linx" receiver module on the ground.

Data is clumped into "packets" in order to better identify and synchronize the data coming down from the rocket, which will invariably have noise in the form of bit flips, dropouts and spurious additions.

Downlink Packet Types

There are 6 packet types, some with packet subtypes:

```
0x10    GPS Packet
0x20    Status Packet
0x30    INS Packet (NOT IMPLEMENTED)
0x4n    Message packet, where n is the number of message 0x0 - 0xF corresponding to 1 - 16 messages.
0x5n    Low pass filtered IMU data packet, where n = 0 is the full 12bit data and n = 2 is delta
         encoded data
0x60    Null packet
```

Downlink Packet Structure

All packets have the following structure:

```
0x00    Packet Header
PT      Packet Type: 0x10 - 0x60
<D>     Data (length dependent on Packet Type)
CRCH    CRC-16 high byte
CRCL    CRC-16 low byte
0xFF    Footer
```

Downlink Packet Frequencies

The 19.2kbps is really 1.92kBps given that each byte sent is 10bits (1 start + 8 data + 1 stop). Normally, every second will consist of 1 GPS packet, 10 Status packets, 0 message packets (that's not exact because messages do occur, but it's rare on the second to second time scale), and 10 full IMU packets send after the 10 status packets. That's:

1x76 + 10x28 + 10x19 = 546 bytes / second

That gives a left over bit rate of:

1.92kBps - 546Bps = 1.374kBps

Which means we can send a maximum of:

1.374kBps / 12bytes/delta encoded IMU packet =	114.5 delta encoded IMU packets per second
1.374kBps / 19bytes/Full IMU packet =	72 full IMU packets per second

Assuming the flight will be mostly smooth, and the occasional message packet, we should be sending something like 100 IMU packets a second.

Downlink Calibration Mode

In "Downlink Calibration Mode" - when pin RA2 is held low - several changes occur to the downlink packet stream:

- The downlink is initialized to 38.4kbps
- Only full IMU packets are sent down the downlink (all other packets are turned off)
- The data loaded into the IMU data is the raw sample data (the digital low pass filtering algorithm is bypassed)

When in calibration mode, the downlink stream becomes:

3.84kBps / 19 bytes per full IMU packet = 202.1 full IMU packets per second

Downlink Packet Type 1: GPS Data (1Hz, 76 bytes long, No encoding)

Byte #	GPS Word #	Name	Units	Range	Res.
0	-	Packet Header 0x00	-	-	-)
1	-	Packet Type (1) + No Encoding (0)	-	-	-
2	1000.22	UTC Hours	hours	0 - 23	
3	1000.23	UTC Minutes	minutes	0 - 59	
4	1000.24	UTC Seconds	seconds	0 - 59	
5	1000.10&11	Navigation Solution Validity and Type: 4.0 Soln Inv - Altitude used 4.1 Soln Type - Propagated Solution 4.2 Soln Inv - Not Enough Sat.s 4.3 Soln Inv - Exceeded Maximum EHPE 4.4 Soln Inv - Exceeded Maximum EVPE 4.5 Soln Type - Altitude Used	(Bits)	1 = True	
6	1000.12	Number of Measurements Used in Solution		0 - 12	# sat?
7	1000.27.B0	Latitude0	radians	+- 0 - PI/2	10e-8
8	1000.27.B1	Latitude1	radians	+- 0 - PI/2	10e-8
9	1000.28.B0	Latitude2	radians	+- 0 - PI/2	10e-8
10	1000.28.B1	Latitude3	radians	+- 0 - PI/2	10e-8
11	1000.29.B0	Longitude0	radians	+- 0 - PI/4	10e-8
12	1000.29.B1	Longitude1	radians	+- 0 - PI/4	10e-8
13	1000.30.B0	Longitude2	radians	+- 0 - PI/4	10e-8
14	1000.30.B1	Longitude3	radians	+- 0 - PI/4	10e-8
15	1000.31.B0	Height0	meters	+- 0 - 40000	10e-2
16	1000.31.B1	Height1	meters	+- 0 - 40000	10e-2
17	1000.32.B0	Height2	meters	+- 0 - 40000	10e-2
18	1000.32.B1	Height3	meters	+- 0 - 40000	10e-2
19	1009.10.B0	ECEF Position - X0	meters	+- 0 - 9000000	10e-2
20	1009.10.B1	ECEF Position - X1	meters	+- 0 - 9000000	10e-2
21	1009.11.B0	ECEF Position - X2	meters	+- 0 - 9000000	10e-2
22	1009.11.B1	ECEF Position - X3	meters	+- 0 - 9000000	10e-2
23	1009.12.B0	ECEF Position - Y0	meters	+- 0 - 9000000	10e-2
24	1009.12.B1	ECEF Position - Y1	meters	+- 0 - 9000000	10e-2
25	1009.13.B0	ECEF Position - Y2	meters	+- 0 - 9000000	10e-2
26	1009.13.B1	ECEF Position - Y3	meters	+- 0 - 9000000	10e-2
27	1009.14.B0	ECEF Position - Z0	meters	+- 0 - 9000000	10e-2
28	1009.14.B1	ECEF Position - Z1	meters	+- 0 - 9000000	10e-2
29	1009.15.B0	ECEF Position - Z2	meters	+- 0 - 9000000	10e-2
30	1009.15.B1	ECEF Position - Z3	meters	+- 0 - 9000000	10e-2
31	1009.16.B0	ECEF Velocity - X0	meters/sec	+- 0 - 1000	10e-2
32	1009.16.B1	ECEF Velocity - X1	meters/sec	+- 0 - 1000	10e-2
33	1009.17.B0	ECEF Velocity - X2	meters/sec	+- 0 - 1000	10e-2
34	1009.17.B1	ECEF Velocity - X3	meters/sec	+- 0 - 1000	10e-2
35	1009.18.B0	ECEF Velocity - Y0	meters/sec	+- 0 - 1000	10e-2
36	1009.18.B1	ECEF Velocity - Y1	meters/sec	+- 0 - 1000	10e-2
37	1009.19.B0	ECEF Velocity - Y2	meters/sec	+- 0 - 1000	10e-2
38	1009.19.B1	ECEF Velocity - Y3	meters/sec	+- 0 - 1000	10e-2
39	1009.20.B0	ECEF Velocity - Z0	meters/sec	+- 0 - 1000	10e-2
40	1009.20.B1	ECEF Velocity - Z1	meters/sec	+- 0 - 1000	10e-2
41	1009.21.B0	ECEF Velocity - Z2	meters/sec	+- 0 - 1000	10e-2
42	1009.21.B1	ECEF Velocity - Z3	meters/sec	+- 0 - 1000	10e-2
43	1000.40	EHPE0	meters	0 - 320000000	10e-2
44	1000.40	EHPE1	meters	0 - 320000000	10e-2
45	1000.41	EHPE2	meters	0 - 320000000	10e-2
46	1000.41	EHPE3	meters	0 - 320000000	10e-2
47	1000.42	EVPE0	meters	0 - 250000	10e-2
48	1000.42	EVPE1	meters	0 - 250000	10e-2
49	1000.43	EVPE2	meters	0 - 250000	10e-2
50	1000.43	EVPE3	meters	0 - 250000	10e-2
51	1000.44	ETE0	meters	0 - 300000000	10e-2
52	1000.44	ETE1	meters	0 - 300000000	10e-2
53	1000.45	ETE2	meters	0 - 300000000	10e-2
54	1000.45	ETE3	meters	0 - 300000000	10e-2
55	1000.46	EHVE0	meters/sec	0 - 10000	10e-2
56	1000.46	EHVE1	meters/sec	0 - 10000	10e-2
57	1000.47	Clock Bias 0	meters	+- 0 - 9000000	10e-2
58	1000.47	Clock Bias 1	meters	+- 0 - 9000000	10e-2
59	1000.48	Clock Bias 2	meters	+- 0 - 9000000	10e-2
60	1000.48	Clock Bias 3	meters	+- 0 - 9000000	10e-2
61	1000.49	Clock Bias SD 0	meters	+- 0 - 9000000	10e-2
62	1000.49	Clock Bias SD 2	meters	+- 0 - 9000000	10e-2
63	1000.50	Clock Bias SD 3	meters	+- 0 - 9000000	10e-2
64	1000.50	Clock Bias SD 4	meters	+- 0 - 9000000	10e-2
65	1000.51	Clock Drift 0	meters/sec	+- 0 - 1000	10e-2
66	1000.51	Clock Drift 1	meters/sec	+- 0 - 1000	10e-2
67	1000.52	Clock Drift 2	meters/sec	+- 0 - 1000	10e-2
68	1000.52	Clock Drift 3	meters/sec	+- 0 - 1000	10e-2
69	1000.53	Clock Drift SD 0	meters/sec	+- 0 - 1000	10e-2
70	1000.53	Clock Drift SD 1	meters/sec	+- 0 - 1000	10e-2
71	1000.54	Clock Drift SD 2	meters/sec	+- 0 - 1000	10e-2
72	1000.54	Clock Drift SD 3	meters/sec	+- 0 - 1000	10e-2
73		CRC-16 High Byte			
74		CRC-16 Low Byte			
75		Packet Footer 0xFF			

Downlink Packet Type 2: Status (10Hz, 28 bytes long, No Encoding)

Byte #	Name	Value(s), Description & Units
0	Header	0x00
1	Packet Type (2) + No Encoding (0)	0x20
2	FCS (Flight Computer Status)	0x00 = NOT_ARMED 0x01 = ARMED 0x02 = LAUNCH 0x04 = FLIGHT 0x08 = APOGEE 0x16 = RECOVERY
3	Local Clock Hours	00 - 23 (if GPS, it's the GPS' hours)
4	Local Clock Minutes	00 - 60 (if GPS, it's the GPS' minutes)
5	Local Clock seconds	00 - 60 (if GPS, it's the GPS' seconds)
6	Local Clock tenths of seconds	Incremented on 10HzClk
7	FCFlg0	Flight Computer Flag Byte (8 bit flags)
8	FCFlg1	Flight Computer Flag Byte (8 bit flags)
9	FCFlg2	Flight Computer Flag Byte (8 bit flags)
10	FCFlg3	Flight Computer Flag Byte (8 bit flags)
11	FCFlg4	Flight Computer Flag Byte (8 bit flags)
12	FCFlg5	Flight Computer Flag Byte (8 bit flags)
13	FCFlg6	Flight Computer Flag Byte (8 bit flags)
14	FCFlg7	Flight Computer Flag Byte (8 bit flags)
15	FCFlg8	Flight Computer Flag Byte (8 bit flags)
16	FCFlg9	Flight Computer Flag Byte (8 bit flags)
17	Atmospheric Pressure High Byte	0x00 - 0x0F
18	Atmospheric Pressure Low Byte	0x00 - 0xFF in k*kPa (12bit value)
19	Separation Igniter Resistance	0x00 - 0xFF: ADC conversion value (01 - 06 = ok)
20	Shroud Igniter Resistance	0x00 - 0xFF: ADC conversion value (01 - 06 = ok)
21	IMU Temperature High Byte	0x00 - 0x03
22	IMU Temperature Low Byte	0x00 - 0xFF in k*° (10bit value)
23	External Temperature High Byte	0x00 - 0x03
24	External Temperature Low Byte	0x00 - 0xFF in k*° (10bit value)
25	CRC-16 High Byte	
26	CRC-16 Low Byte	
27	Footer	0xFF

NOT IMPLEMENTED: Packet Type 3a: INS (1Hz, 39 bytes long, Full data)

Byte #	Name	Value	Units	Range	Res.
0	Header	0x00	-	-	-
1	Packet Type (3) + Full data (0)	0x30	-	-	-
2	X position 3				
3	X position 2				
2	X position 1				
3	X position 0				
4	Y position 3				
5	Y position 2				
6	Y position 1				
7	Y position 0				
8	Z position 3				
9	Z position 2				
10	Z position 1				
11	Z position 0				
12	Phi Attitude 3				
13	Phi Attitude 2				
14	Phi Attitude 1				
15	Phi Attitude 0				
16	Psy Attitude 3				
17	Psy Attitude 2				
18	Psy Attitude 1				
19	Psy Attitude 0				
20	Theta Attitude 3				
21	Theta Attitude 2				
22	Theta Attitude 1				
23	Theta Attitude 0				
24	X Velocity 3				
25	X Velocity 2				
26	X Velocity 1				
27	X Velocity 0				
28	Y Velocity 3				
29	Y Velocity 2				
30	Y Velocity 1				
31	Y Velocity 0				
32	Z Velocity 3				
33	Z Velocity 2				
34	Z Velocity 1				
35	Z Velocity 0				
36	Status?				
37	Status?				
38	Footer	0xFF	-	-	-

NOT IMPLEMENTED: Packet Type 3b: INS (10Hz, 22 bytes long, Δ encoding)

Byte #	Name	Value	Units	Range	Res.
0	Header	0x00	-	-	-
1	Packet Type (3) + Delta encoding (2)	0x32	-	-	-
2	X position H				
3	X position L				
4	Y position H				
5	Y position L				
6	Z position H				
7	Z position L				
8	Phi Attitude H				
9	Phi Attitude L				
10	Psy Attitude H				
11	Psy Attitude L				
12	Theta Attitude H				
13	Theta Attitude L				
14	X Velocity H				
15	X Velocity L				
16	Y Velocity H				
17	Y Velocity L				
18	Z Velocity H				
19	Z Velocity L				
20	Status?				
21	Status?				
22	Footer	0xFF	-	-	-

Downlink Packet Type 4: Messages (low frequ., 7 - 22 bytes long, Encoding = # of Messages)

Byte #	Name	Value	Units	Range	Res.
0	Header	0x00	-	-	-
1	Packet Type: 0x40 | (# messages 0 - F)	-	-	0x40 - 0x4F	-
2	Serial # (incremental for new pkts)	-	-	0x00 - 0xFF	
3	Message #00	-	-	0 - 255	-
{ 4}	Message #01 (Optional)	-	-	0 - 255	-
{ 5}	Message #02 (Optional)	-	-	0 - 255	-
{ 6}	Message #03 (Optional)	-	-	0 - 255	-
{ 7}	Message #04 (Optional)	-	-	0 - 255	-
{ 8}	Message #05 (Optional)	-	-	0 - 255	-
{ 9}	Message #06 (Optional)	-	-	0 - 255	-
{10}	Message #07 (Optional)	-	-	0 - 255	-
{11}	Message #08 (Optional)	-	-	0 - 255	-
{12}	Message #09 (Optional)	-	-	0 - 255	-
{13}	Message #10 (Optional)	-	-	0 - 255	-
{14}	Message #11 (Optional)	-	-	0 - 255	-
{15}	Message #12 (Optional)	-	-	0 - 255	-
{16}	Message #13 (Optional)	-	-	0 - 255	-
{17}	Message #14 (Optional)	-	-	0 - 255	-
{18}	Message #15 (Optional)	-	-	0 - 255	-
4 {19}	CRC-16 High Byte				
5 {20}	CRC-16 Low Byte				
6 {21}	Footer	0xFF	-	-	-

Downlink Packet Type 5a IMU (10Hz and as necessary, 19 bytes long, Full data)

Byte #	Name	Value(s), Description & Units
0	Header	0x00
1	Packet Type (5) + Full Data (0)	0x50
2	X axis accelerometer High Byte	0x00 – 0x0F
3	X axis accelerometer Low Byte	0x00 – 0xFF k*g
4	Y axis accelerometer High Byte	0x00 – 0x0F
5	Y axis accelerometer Low Byte	0x00 – 0xFF k*g
6	Z axis accelerometer High Byte	0x00 – 0x0F
7	Z axis accelerometer Low Byte	0x00 – 0xFF k*g
8	Q axis accelerometer High Byte	0x00 – 0x0F
9	Q axis accelerometer Low Byte	0x00 – 0xFF k*g
10	Phi (pitch) axis accelerometer High Byte	0x00 – 0x0F
11	Phi (pitch) axis accelerometer Low Byte	0x00 – 0xFF k*°/s
12	Psi (yaw) axis accelerometer High Byte	0x00 – 0x0F
13	Psi (yaw) axis accelerometer Low Byte	0x00 – 0xFF k*°/s
14	Theta (roll) axis accelerometer High Byte	0x00 – 0x0F
15	Theta (roll) axis accelerometer Low Byte	0x00 – 0xFF k*°/s
16	CRC-16 High Byte	
17	CRC-16 Low Byte	
18	Footer	0xFF

Note: all IMU data in this packet has been low pass filtered

Downlink Packet Type 5b IMU (As fast as possible (100Hz?), 12 bytes long, Δ encoded)

Byte #	Name	Value(s), Description & Units
0	Header	0x00
1	Packet Type (5) + Delta Encoding (2)	0x52
2	X axis accelerometer Δ encoding	0x00 – 0xFF: 0x7F (127) to 0x80 (–128) k*g
3	Y axis accelerometer Δ encoding	0x00 – 0xFF: 0x7F (127) to 0x80 (–128) k*g
4	Z axis accelerometer Δ encoding	0x00 – 0xFF: 0x7F (127) to 0x80 (–128) k*g
5	Q axis accelerometer Δ encoding	0x00 – 0xFF: 0x7F (127) to 0x80 (–128) k*g
6	φ axis rate gyroscope Δ encoding	0x00 – 0xFF: 0x7F (127) to 0x80 (–128) k*°/s
7	ψ axis rate gyroscope Δ encoding	0x00 – 0xFF: 0x7F (127) to 0x80 (–128) k*°/s
8	θ axis rate gyroscope Δ encoding	0x00 – 0xFF: 0x7F (127) to 0x80 (–128) k*°/s
9	CRC-16 High Byte	
10	CRC-16 Low Byte	
11	Footer	0xFF

Note: all IMU data in this packet has been low pass filtered

Downlink Packet Type 6: Null Packet Data (5 bytes long, No encoding)

Byte #	Name	Value	Units	Range	Res.
0	Header	0x00	–	–	–
1	Packet Type + Encoding	0x60	–	–	–
2	CRC-16 High Byte				
3	CRC-16 Low Byte				
4	Footer	0xFF	–	–	–

Appendix: Rockwell GPS Message Information

Here are the GPS packet formats that come directly from the Rockwell Jupiter GPS board (which are then parsed into the regular FCOS GPS Packets (type 0x10) in the FCOS GPS routines). Yellow rows are data parsed into the FCOS GPS Packets.

Message ID	Rate	Message Length
1000	Variable (1Hz)	55 Words

Word Num.	Name	Typ	Units	Range	Resolution
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (1)	UDI	10ms ticks	0 - 4294967295	
8	Sequence Number (2)	I		0 - 32767	
9	Satellite Measurement Sequence Number (3)	I		0 - 32767	
10.0	Solution Invalid - Altitude Used (4)	Bit		1 = True	
10.1	Solution Invalid - No Differential GPS (4)	Bit		1 = True	
10.2	Solution Invalid - Not Enough Sat.s in Track (4)	Bit		1 = True	
10.3	Solution Invalid - Exceeded Maximum EHPE (4)	Bit		1 = True	
10.4	Solution Invalid - Exceeded Maximum EVPE (4)	Bit		1 = True	
10.5-10.15	Reserved				
11.0	Solution Type - Propagated Solution (5)	Bit		1 = Propagated	
11.1	Solution Type - Altitude Used	Bit		1 = Alt. Used	
11.2	Solution Type - Differential	Bit		1 = Differential	
11.3-11.15	Reserved				
12	Number of Measurements Used in Solution	UI		0 - 12	# sat?
13	Polar Navigation	Bit		1 = True	
14	GPS Week Number	UI	weeks	0 - 32767	
15-16	GPS Seconds From Epoch	UDI	seconds	0 - 604799	
17-18	GPS Nanoseconds From Epoch	UDI	nseconds	0 - 999999999	
19	UTC Day	UI	days	1 - 31	
20	UTC Month	UI	months	1 - 12	
21	UTC Year	UI	year	1980 - 2079	
22	UTC Hours	UI	hours	0 - 23	
23	UTC Minutes	UI	minutes	0 - 59	
24	UTC Seconds	UI	seconds	0 - 59	
25-26	UTC Nanoseconds From Epoch	UDI	nseconds	0 - 999999999	
27-28	Latitude	DI	radians	+- 0 - PI/2	10e-8
29-30	Longitude	DI	radians	+- 0 - PI/4	10e-8
31-32	Height	DI	meters	+- 0 - 40000	10e-2
33	Geoidal Separation	I	meters	+- 0 - 200	10e-2
34-35	Ground Speed	UDI	meters/sec	0 - 1000	10e-2
36	True Course	UI	radians	0 - 2PI	10e-3
37	Magnetic Variation	I	radians	+- 0 - PI/4	10e-4
38	Climb Rate	I	meters/sec	+-300	10e-2
39	Map Datum (6)	UI	meters	0-188 & 300-304	10e-2
40 - 41	Expected Horizontal Position Error (7)	UDI	meters	0 - 320000000	10e-2
42 - 43	Expected Vertical Position Error (7)	UDI	meters	0 - 250000	10e-2
44 - 45	Expected Time Error (7)	UDI	meters	0 - 300000000	10e-2
46	Expected Horizontal Velocity Error (7)	UI	meters/sec	0 - 10000	10e-2
47 - 48	Clock Bias (7)	DI	meters	+- 0 - 9000000	10e-2
49 - 50	Clock Bias Standard Deviation (7)	DI	meters	+- 0 - 9000000	10e-2
51 - 52	Clock Drift (7)	DI	meters/sec	+- 0 - 1000	10e-2
53 - 54	Clock Drift Standard Deviation (7)	DI	meters/sec	+- 0 - 1000	10e-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 message 1009 (ECEF Position Output Message).

Note 4: The value of this data item was intially 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 neww 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 E 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.

Message ID	Rate	Message Length
1009	Variable	22 Words

Word Num.	Name	Type	Units	Range	Resolution
1-4	Message Header				
5	Header Checksum				
6-7	Set Time (1)	UDI	10 ms ticks	0 - 4294967295	
8	Sequence Number (2)	I		0 - 32767	
9	Sat. Measurement Sequence Number (3)	I		0 - 32767	
10 - 11	ECEF Position - X (4)	DI	meters	+- 0 - 9000000	10e-2
12 - 13	ECEF Position - Y (4)	DI	meters	+- 0 - 9000000	10e-2
14 - 15	ECEF Position - Z (4)	DI	meters	+- 0 - 9000000	10e-2
16 -17	ECEF Velocity - X (4)	DI	meters/sec	+- 0 - 1000	10e-2
18 - 19	ECEF Velocity - Y (4)	DI	meters/sec	+- 0 - 1000	10e-2
20 - 21	ECEF Velocity - Z (4)	DI	meters/sec	+- 0 - 1000	10e-2
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 satellite measurement sequence number relates the position solution data to a particular set of satellite measurements found in binary messages 1000 and 1002 (Geodetic Position Status Output Message and Channel Summary Message, respectively).

Note 4: The data displayed by this field is not valid until the receiver is in navigation mode.