

The following input and output data fields contain binary data that can be interpreted as scaled floating point or integer data. The field width and appropriate scale factors for each parameter are described in the individual I/O message format descriptions. Polarity of the data is described via the two's complement presentation. Input commands may be of the type that enable or disable the output of data or status messages. These output status messages include those that the external controller will use for obtaining position, velocity, time, and status data.

Immediately following this page are listings of the input commands in alphabetic order by function and by binary command. Cross references for page numbers and PC controller software commands are also listed. Refer to Chapter 7 for descriptions of the PC controller commands.

# I/O COMMAND LIST INDEX

Table 6.1: Input Commands Listed by Function

## GT & UT Oncore

Function	Description	Binary Command	Controller Command	User Guide Page #
Time	GMT Offset	@@Ab	gmt	6.4
Time	Time Mode	@@Aw	utc	6.6
Time	Date	@@Ac	date	6.8
Time	Time of Day	@@Aa	time	6.10
Position	Latitude	@@Ad	lat	6.12
Position	Longitude	@@Ae	lon	6.14
Position	Height	@@Af	hgt	6.16
Position	Position/Status/Data Message	@@Ea	ps8	6.18
Satellite	Set Mask Angle	@@Ag	mask	6.22
Satellite	Visible Satellite Status Message	@@Bb	vis	6.24
Setup	Leap Second Pending Status	@@Bj	leapsec	6.26
Setup	Atmospheric Correction Mode	@@Aq	ion	6.28
Setup	Set User Datum	@@Ap	udatum	6.30
Setup	Select Datum	@@Ao	datum	6.32
Almanac	Almanac Data Input	@@Cb	almin	6.34
Almanac	Almanac Data Output	@@Be	almout	6.36
Receiver	System Power-on Failure Message	@@Sz	n/a	6.38
Receiver	Receiver ID	@@Cj	id	6.40
Receiver	Self-Test	@@Fa	selftest8	6.42
Receiver	Set-to-Defaults	@@Cf	default	6.44

## GT Oncore Only

Function	Description	Binary Command	Controller Command	User Guide Page #
Position	ASCII Position Message	@@Eq	as8	6.46
Setup	Altitude-Hold Height	@@Au	ahp	6.51
Setup	Altitude-Hold Mode	@@Av	ah	6.52
Setup	Velocity Filter	@@AN	filter	6.54
Setup	RTCM Port Mode	@@AO	p2baud	6.56
Ephemeris	Ephemeris Data Input	@@Bf	epin	6.58
DGPS	Pseudorange Correction Input	@@Ce	n/a	6.60
NMEA	Switch to NMEA	@@Ci	ioformat	6.62
NMEA	8 NMEA Messages	n/a	n/a	6.64

## UT Oncore Only

Function	Description	Binary Command	Controller Command	User Guide Page #
Time	UTC Offset Status Message	@@Bo	utcoff	6.80
1PPS	1PPS Cable Delay	@@Az	ppsdelay	6.82
1PPS	1PPS Offset	@@Ay	ppsoff	6.84
1PPS	Pulse Mode	@@AP	n/a	6.86
1PPS	Position-Hold Position	@@As	ph	6.88
1PPS	Position-Hold Mode	@@At	php	6.90
1PPS	Time RAIM Setup and Status Message	@@En	trstat8	6.92

Table 6.2: Input Commands Listed by Binary Command

**GT & UT Oncore**

Function	Description	Binary Command	Controller Command	User Guide Page #
Time	Time of Day	@@Aa	time	6.10
Time	GMT Offset	@@Ab	gmt	6.4
Time	Date	@@Ac	date	6.8
Position	Latitude	@@Ad	lat	6.12
Position	Longitude	@@Ae	lon	6.14
Position	Height	@@Af	hgt	6.16
Satellite	Set Mask Angle	@@Ag	mask	6.22
Setup	Velocity Filter	@@AN	filter	6.54
Setup	Select Datum	@@Ao	datum	6.32
Setup	RTCM Port Mode	@@AO	p2baud	6.56
Setup	Set User Datum	@@Ap	udatum	6.30
1PPS	Pulse Mode	@@AP	n/a	6.86
Setup	Atmospheric Correction Mode	@@Aq	ion	6.28
1PPS	Position-Hold Position	@@As	ph	6.88
1PPS	Position-Hold Mode	@@At	php	6.90
Setup	Altitude-Hold Height	@@Au	ahp	6.51
Setup	Altitude-Hold Mode	@@Av	ah	6.52
Time	Time Mode	@@Aw	utc	6.6
1PPS	1PPS Offset	@@Ay	ppssoff	6.84
1PPS	1PPS Cable Delay	@@Az	ppsdelay	6.82
Satellite	Visible Satellite Status Message	@@Bb	vis	6.24
Almanac	Almanac Data Output	@@Be	almout	6.36
Ephemeris	Ephemeris Data Input	@@Bf	ephin	6.58
Time	Leap Second Pending Status	@@Bj	leapsec	6.26
Time	UTC Offset Status Message	@@Bo	utcoff	6.80
Almanac	Almanac Data Input	@@Cb	almin	6.34
DGPS	Pseudorange Correction Input	@@Ce	n/a	6.60
Receiver	Set-to-Defaults	@@Cf	default	6.44
NMEA	Switch to NMEA	@@Ci	ioformat	6.62
NMEA	8 NMEA Messages	n/a	n/a	6.64
Receiver	Receiver ID	@@Cj	id	6.40
Position	Position/Status/Data Message	@@Ea	ps8	6.18
1PPS	Time RAIM Setup and Status Message	@@En	trstat8	6.92
Position	ASCII Position Message	@@Eq	n/a	6.46
Receiver	Self-Test	@@Fa	selftest8	6.42
Receiver	System Power-on Failure Message	@@Sz	n/a	6.38

## GMT OFFSET

This command changes the offset between GMT and local time. The GPS receiver computes local time from GMT and the offset using the following equation:

Local Time = GMT + GMT Offset.

The minutes offset is provided for those locations in the world that do not use an even offset of hours between GMT and local time. If it is desired to operate on GMT, the offset is set to 0 hours, 0 minutes and the time set in the **Time of Day** parameter must be entered in GMT.

Range:           Hours:   -23 .. 23  
                  Minutes:  00 .. 59

Default value:   00:00 (no GMT offset)

## GMT OFFSET

*Motorola Binary Format*

### Input Command

- Poll current GMT Offset:

**@@AbxxxC<CR><LF>**

xxx            3 out of range bytes \$ffffff

C              checksum

Message length: 10 bytes

- Change current GMT Offset:

**@@AbshnC<CR><LF>**

s              sign              00 = positive  
   ff = negative

h              hours              0 .. 23

m              minutes              0 .. 59

C              checksum

Message length: 10 bytes

### Response Message

- To either command:

**@@AbshnC<CR><LF>**

s              sign              00 = positive  
   ff = negative

h              hours              0 .. 23

m              minutes              0 .. 59

C              checksum

Message length: 10 bytes

## TIME MODE

This command selects the type of time (either GPS or UTC) to be output in the **Position/Status/Data Message** and to be used as the synchronization point for the 1PPS timing pulse for timing receivers. See **Time RAIM Setup and Status Message**.

Note that if the receiver does not have the UTC parameters portion of the almanac, then UTC will be output as being equal to GPS time. The receiver will have the UTC parameters once an almanac has been downloaded from the satellites.

Default Value: UTC

## TIME MODE

*Motorola Binary Format*

### Input Command

- Poll current Time Mode:

**@@AwxC<CR><LF>**

x                    1 out of range byte    \$ff

C                    checksum

Message length: 8 bytes

- Change current Time Mode:

**@@AwmC<CR><LF>**

m                    mode                    0 = GPS

1 = UTC

C                    checksum

Message length: 8 bytes

### Response Message

- To either command:

**@@AwmC<CR><LF>**

m                    mode                    0 = GPS

1 = UTC

C                    checksum

Message length: 8 bytes

## DATE

This input command changes the current date in the GPS receiver real-time clock (RTC) to the date specified in the command. The **GMT Offset** should be set before the **Date** is set.

The date in the GPS receiver will normally be correct if the internal RTC has been powered. It is not necessary for the user to enter the current date if the RTC power is removed, however the TTFF will be reduced if the date is initialized. The GPS receiver corrects the date data in the RTC with date information decoded from the satellite broadcast data as soon as one satellite is tracked.

The GPS receiver uses the satellite data to set the RTC, hence the **Date** command is ignored if the GPS receiver is tracking at least one satellite. If the RTC has not been backup powered, then it is initialized at 1/1/98 at power up. Note that the Oncore receiver will automatically handle the rollover in GPS time that will happen in August 1999 as well as the year 2000 rollover.

Range:                      Month: 1..12  
                                 Day: 1..31  
                                 Year: 1998..2018

Default value:              Date from RTC if no satellite tracked  
                                 Date from satellite if at least one satellite tracked



## DATE

*Motorola Binary Format*

### Input Command

- Poll current **Date**:

**@@AcxxxxC<CR><LF>**

xxxx            4 out of range bytes \$ffffff

C                checksum

Message length: 11 bytes

- Change current **Date**:

**@@AcmdyyC<CR><LF>**

m               month            1 .. 12

d               day               1 .. 31

yy              year              1998 .. 2018

C               checksum

Message length: 11 bytes

### Response Message

- To either command:

**@@AcmdyyC<CR><LF>**

m               month            1 .. 12

d               day               1 .. 31

yy              year              1998 .. 2018

C               checksum

Message length: 11 bytes

## TIME OF DAY

This input command changes the current time in the GPS receiver to the time specified in the command. The **GMT Offset** and the **Time Mode** should be specified before the **Time of Day** is set.

The time in the GPS receiver will be correct if the internal real-time clock (RTC) has been powered. It is not necessary for the user to enter the current time of day if the RTC power is removed, however the TTFF will be reduced if the time is initialized. The GPS receiver corrects the time data in the RTC with time information decoded from the satellite broadcast data as soon as one satellite is tracked.

The GPS receiver uses the satellite data to set the RTC, hence the **Time of Day** command is ignored if the GPS receiver is tracking at least one satellite. If the RTC has not been backup powered, then it is initialized at 12:00:00 at power up.

Time is stored as local time or GMT depending on the setting of the **GMT Offset** parameter. The GPS receiver automatically compensates for leap-second corrections, thus the seconds field in the message will indicate 60 when a leap second is inserted. Leap seconds are inserted approximately once per year. See **Leap Second Pending Status**.

Range: 00:00:00 to 23:59:59

Default value: Time from RTC if no satellite tracked  
Time from satellite if at least one satellite tracked

## TIME OF DAY

### *Motorola Binary Format*

#### Input Command

- Poll current Time of Day:

**@@Aa**xxx**C**<CR><LF>

xxx            3 out of range bytes \$ffffff

C              checksum

Message length: 10 bytes

- Change current Time of Day:

**@@Aa**hms**C**<CR><LF>

h            hours            0 .. 23

m            minutes          0 .. 59

s            seconds          0 .. 59

Message length: 10 bytes

#### Response Message

- To either command:

**@@Aa**hms**C**<CR><LF>

h            hours            0 .. 23

m            minutes          0 .. 59

s            seconds          0 .. 60

C            checksum

Message length: 10 bytes

## LATITUDE

The following three parameters (latitude, longitude, and height) are used to establish the initial position of the GPS receiver. The initial position estimate provides the GPS receiver with a starting point to begin the satellite acquisition process. It is not necessary for the user to initialize the coordinates with a position estimate, however the TTFF will be minimized by providing an estimate that is close (within one degree is sufficient) to the user's position.

Latitude is measured in degrees north (+) or degrees south (-) of the earth's equator. The datum for the latitude is WGS 84. This input command sets the initial latitude coordinate only if the GPS receiver is not yet computing a position fix. If the GPS receiver is already computing a fix, then the latitude is not changed. See **Longitude** and **Height**.

Range:               -90° (South Pole) .. 90° (North Pole)  
Default value:      0° (Equator)  
Units:                milliarcseconds (mas) (1° = 3,600,000 mas)

## LATITUDE

*Motorola Binary Format*

### Input Command

- Poll current **Latitude**:

**@@AdxxxxC<CR><LF>**

xxxx            4 out of range bytes    \$99999999

C                checksum

Message length: 11 bytes

- Change current **Latitude**:

**@@AdddddC<CR><LF>**

dddd            latitude in mas        -324,000,000 .. 324,000,000 (-90° to 90°)

C                checksum

Message length: 11 bytes

### Response Message

- To either command:

**@@AdddddC<CR><LF>**

dddd            latitude in mas        -324,000,000 ..324,000,000 (-90° to 90°)

C                checksum

Message length: 11 bytes

**NOTE:** 1 degree of latitude equals 3,600 arcseconds or 3,600,000 milliarcseconds (mas).

## LONGITUDE

Longitude is measured in degrees east (+) or degrees west (-) of the Greenwich Meridian. The datum for the longitude is WGS 84. This input command sets the initial longitude coordinate only if the GPS receiver is not yet computing a position fix. If the GPS receiver is already computing a fix, then the longitude is not changed. See **Latitude** and **Height**.

Range:           -180° .. 180°  
Default value:   0° (Greenwich Meridian)  
Units:           milliarcseconds (mas) ( $1^\circ = 3,600,000$  mas)

## LONGITUDE

*Motorola Binary Format*

### Input Command

- Poll current **Longitude**:

**@@Ae**xxxxC<CR><LF>

xxxx            4 out of range bytes    \$99999999

C                checksum

Message length: 11 bytes

- Change current **Longitude**:

**@@Ae**ddddC<CR><LF>

dddd            longitude in mas    -648,000,000 .. 648,000,000 (-180° to 180°)

C                checksum

Message length: 11 bytes

### Response Message

- To either command:

**@@Ae**ddddC<CR><LF>

dddd            longitude in mas    -648,000,000 .. -648,000,000 (-180° to 180°)

C                checksum

Message length: 11 bytes

**NOTE:** 1 degree of longitude equals 3,600 arcseconds or 3,600,000 milliarcseconds (mas).

## HEIGHT

Height is measured with respect to the GPS reference ellipsoid (WGS84), and the units are in meters. This input command sets the initial height coordinate only if the GPS receiver is not yet computing a position fix. If the GPS receiver is already computing a fix, then the height is not changed. See **Latitude** and **Height**.

Range: -1,000.00 .. 18,000.00 m

Default value: 0.00 m (GPS)

Resolution: 0.01 m



## HEIGHT

*Motorola Binary Format*

### Input Command

- Poll current **Height**:

**@@AfxxxxxC<CR><LF>**

xxxx              5 out of range bytes \$9999999999  
 C                  checksum  
 Message length: 12 bytes

- Change current **Height**:

**@@AfhhhtC<CR><LF>**

hhhh              height in cm          -100,000 .. 1,800,000  
    (-1,000.00 .. 18,000.00 m)  
 t                  height type             0 = GPS ellipsoid height  
 C                  checksum  
 Message length: 12 bytes

### Response Message

- To either command:

**@@AfhhhmmmmC<CR><LF>**

hhhh              ellipsoid height in cm -100,000 .. 1,800,000  
    (-1,000.00 to 18,000.00 m)  
 mmmm              not used                   0  
 C                  checksum  
 Message length: 15 bytes

## POSITION/STATUS/DATA MESSAGE

This input command sets the rate that the position/status/data information in the response message is output. The mode parameter (m) in the input message instructs the GPS receiver to either output this message one time (polled), or to output this message at the indicated update rate (continuously). Once the GPS receiver is set to continuous output, the continuous message flow can be stopped by sending a one-time output request. The GPS receiver will output the message one more time, then terminate any further message outputs.

The state of the rate byte is stored in RAM. If the GPS receiver was continuously outputting the position/status/data output when turned off and backup power is applied, then it will begin to output this message continuously (at the selected update rate) again when the main power is reapplied. If backup power is not applied during power down, then the GPS receiver will start up in polled only mode.

The position/status/data output is explained in the response message section. Refer to **Date**, **Time of Day**, **Latitude**, **Longitude**, and **Height** for more details on the formats of these parameters. Refer to the glossary for definitions of the DOP values.

The number of satellites visible is computed using the current date, time, position, almanac, and a mask angle of zero degrees, representing the horizon. The receiver will attempt to track the eight satellites that are highest in the sky. If a current almanac is unavailable, this number will be zero. This condition will not prevent satellites from being tracked.

In order for a satellite to be used for positioning, the satellite mode must reach eight, indicating that the ephemeris for that satellite has been acquired. Once the ephemeris is available, the satellite can be used for positioning in modes five through eight. Refer to page 3.42 for a description of the carrier to noise density ratio.

**NOTE:** United States export laws prohibit GPS receivers from outputting valid data if the altitude is greater than 18,000 meters and the velocity is greater than 514 meters per second. If the GPS receiver is used above both these limits, the height and velocity outputs are clamped to the maximum values. In addition, the latitude and longitude data will be incorrect.

Default mode: Polled

## POSITION/STATUS/DATA MESSAGE

### Motorola Binary Format

#### Input Command

- Request Position/Status/Data Message:

**@@EamC**<CR><LF>

m	mode	0 = output response message once (polled) 1..255 = response message output at indicated rate (continuous) 1 = once per second 2 = once every two seconds 255 = once every 255 seconds
---	------	---

C checksum  
Message length: 8 bytes

#### Response Message

- To above command:

**@@Eamdyyhmsffffaaaaoohhhmmmmvvhddtntimsdmsd  
imsdmsdmsdmsdmsdmsdsC**<CR><LF>

Date		
m	month	1 .. 12
d	day	1 .. 31
yy	year	1998 .. 2018

Time		
h	hours	0 .. 23
m	minutes	0 .. 59
s	seconds	0 .. 60
fff	fractional second	0 .. 999,999,999 (0.0 .. 0.999999999)

Position		
aaaa	latitude in mas	-324,000,000 .. 324,000,000 (-90° .. 90°)
oooo	longitude in mas	-648,000,000 .. 648,000,000 (-180° .. 180°)
hhhh	ellipsoid height in cm	-100,000 .. 1,800,000 (-1000.00 .. 18,000.00 m)*
mmmm	not used	0

Velocity		
vv	velocity in cm/s	0 .. 51,400 (0 .. 514.00 m/s)*
hh	heading	0 .. 3,599 (0.0 .. 359.9°) (true north res 0.1°)

\* The upper limit of one of these two ranges may be exceeded as long as the other is below the limit as described in the note on the previous page.

Continued on the next page.

Response Message  
(Continued)

POSITION/STATUS/DATA MESSAGE  
*Motorola Binary Format*

Geometry

dd	current DOP (0.1 res)	0 .. 999 (0.0 to 99.9 DOP) (0 = not computable, position-hold, or position propagate)
t	DOP type (msb)	Bit 7: antenna undercurrent * Bit 6: antenna overcurrent * Bit 5: automatic survey mode Bit 4: not used Bit 3: not used Bit 2: not used Bit 1: not used
	(lsb)	Bit 0: set = HDOP (2D) clear = PDOP (3D)

Satellite visibility and tracking status

n	num of visible sats	0 .. 12
t	num of satellites tracked	0 .. 8

For each of eight receiver channels

i	sat ID	0 .. 37
m	channel tracking mode	0 .. 8
	0 = code search	5 = message sync detect
	1 = code acquire	6 = satellite time available
	2 = AGC set	7 = ephemeris acquire
	3 = preq acquire	8 = avail for position
	4 = bit sync detect	
s	carrier to noise density ratio (C/No)	0 .. 255 dB-Hz
d	channel status flag	
	Each bit represents one of the following:	
	(msb)	Bit 7: using for position fix Bit 6: satellite momentum alert flag Bit 5: satellite anti-spoof flag set Bit 4: satellite reported unhealthy Bit 3: satellite reported inaccurate (> 16 m) Bit 2: spare Bit 1: using for time solution Bit 0: parity error
	(lsb)	

End of channel dependent data

s	receiver status flag	
	Each bit represents one of the following:	
	(msb)	Bit 7: position propagate mode Bit 6: poor geometry (DOP > 12) Bit 5: 3D fix Bit 4: 2D fix Bit 3: acquiring satellites/position hold Bit 2: differential fix Bit 1: insufficient visible satellites (< 3) Bit 0: bad almanac
	(lsb)	

C checksum  
Message length: 76 bytes

\* Refer to page 6.43 for the meaning of the antenna sense bits.



## **SATELLITE MASK ANGLE**

The GPS receiver will attempt to track satellites for which the elevation angle is greater than the satellite mask angle. This parameter allows the user to control the elevation angle that was used for this decision.

Range: 0 to 89 degrees

Default value: 0 degrees

## SATELLITE MASK ANGLE

### *Motorola Binary Format*

#### Input Command

- Poll current mask angle:

**@@AgxC<CR><LF>**

x \$ff (one byte, hex ff)

C checksum

Message length: 8 bytes

- Change current mask angle:

**@@AgdC<CR><LF>**

d degrees 0 .. 89

C checksum

Message length: 8 bytes

#### Response Message

- To either command:

**@@AgdC<CR><LF>**

d degrees 0 .. 89

C checksum

Message length: 8 bytes

## VISIBLE SATELLITE STATUS MESSAGE

This command requests the results of the most current satellite alert computation. The response message gives a summary of the satellite visibility status showing the number of visible satellites, the Doppler frequency and the location of the currently visible satellites (up to 12 satellites). The reference position for the most recent satellite alert is the current position coordinates. Note that these coordinates may not compare to the GPS receiver's actual position when initially turned on, since the GPS receiver may have moved a great distance since it was last used.

Default mode: Polled



**VISIBLE SATELLITE STATUS MESSAGE**  
*Motorola Binary Format*

**Input Command**

- Request Visible Satellite Status Message:

**@@BbmC**<CR><LF>

m            mode            0 = output response message once (polled)  
   1 = output response message when visibility data changes

C            checksum  
Message length: 8 bytes

**Response Message**

- To above command:

**@@Bbniddeaasiddeaasiddeaasiddeaasiddeaasidde**  
**aasiddeaasiddeaasiddeaasiddeaasiddeaasC**<CR><LF>

n    number of visible sats    0 .. 12  
For each visible satellite, up to n fields contain the following valid data

i    satellite ID                1 .. 32  
dd   Doppler in Hz             -5000 .. 5000  
e    elevation in degrees       0 .. 90  
aa   azimuth in degrees        0 .. 359  
s    satellite health            0 = healthy & not removed  
   1 = healthy & removed  
   2 = unhealthy & not removed  
   3 = unhealthy & removed

C    checksum  
Message length: 92 bytes

## LEAP SECOND PENDING STATUS

This command causes the receiver to send a message to the user indicating the status of any pending leap second correction to UTC due at the end of the current month. If a leap second is pending, its direction is also indicated. This is a polled-only output message.

Leap seconds are occasionally inserted in UTC and generally occur on midnight UTC June 30 or midnight UTC December 31. The GPS control segment notifies GPS users of pending leap second insertions to UTC several weeks before the event via a special broadcast message in the satellite downlink message. The receiver decodes this data and then inserts the time correction in the appropriate one second time bin.

Note that a leap second pending may not apply to the end of the current month.

When a leap second is inserted, the **Time of Day** will show a value of 60 in the seconds field. When a leap second is removed, the date will roll over at 58 seconds. See **Time of Day**.

## LEAP SECOND PENDING STATUS

### *Motorola Binary Format*

#### Input Command

- Poll current Leap Second Status:

**@@Bj**mC<CR><LF>

m            mode            0 = output response message once (polled)

C            checksum

Message length: 8 bytes

#### Response Message

- To above command:

**@@Bj**mC<CR><LF>

m            status            0 = no leap second pending

1 = addition of one second pending

2 = subtraction of one second pending

C            checksum

Message length: 8 bytes

## ATMOSPHERIC CORRECTION MODE

The user has the flexibility of turning the GPS ionospheric and/or tropospheric correction models on or off. The models do a reasonable job of taking out the range error induced by the earth's ionosphere and troposphere by using algorithms and parameters transmitted to the users by the satellites. For some applications, such as differential systems, the atmospheric models should be disabled since the differential corrections include the atmospheric errors.

Default modes:    Ionospheric model enabled  
                         Tropospheric model disabled

## ATMOSPHERIC CORRECTION MODE

### *Motorola Binary Format*

#### Input Command

- Poll current Atmospheric Correction Mode:

**@@Aqx**C<CR><LF>

x            1 out of range byte    \$ff

C            checksum

Message length: 8 bytes

- Change current Atmospheric Correction Mode:

**@@Aqs**C<CR><LF>

s            selection            0 = both models disabled  
                                 1 = ionospheric model only enabled  
                                 2 = tropospheric model only enabled  
                                 3 = both models enabled

C            checksum

Message length: 8 bytes

#### Response Message

- To either command:

**@@Aqs**C<CR><LF>

s            selection            0 = both models disabled  
                                 1 = ionospheric model only enabled  
                                 2 = tropospheric model only enabled  
                                 3 = both models enabled

C            checksum

Message length: 8 bytes

## SET USER DATUM

The GPS receiver has one user defined datum stored as ID number 50. The **User Datum** command allows the user to define the constants used for a custom datum. A datum is defined by a semi-major axis, an inverse flattening constant, and an offset from the center of mass of the earth given as delta-X, delta-Y, and delta-Z parameters.

Default values: WGS-84 parameters

## SET USER DATUM

### Motorola Binary Format

#### Input Command

- Output current user defined datum parameters:

```
@@ApdxxxxxxxxxxxxxxxxxxxxxC<CR><LF>
```

d	desired user datum	50
xxxxxxxxxxxxxxxxxxxx	17 bytes	all hex 00
C	checksum	

Message length: 25 bytes

- Change current user defined datum parameters:

```
@@Apdsssf fiiff fxyyzzC<CR><LF>
```

d	datum ID	50
sssf	semi-major axis (m)	
sss	integer part	6,000,000 .. 7,000,000
ff	fractional part	0 .. 999 (0.0 .. 0.999)
iiff	inverse flattening	
ii	integer part	285 .. 305
fff	fractional part	0 .. 999,999,999 (0.0 .. 0.999999999)
xx	delta X (0.1 m)	-32,768 .. 32,767 (-3276.8 .. 3276.7)
yy	delta Y (0.1 m)	-32,768 .. 32,767 (-3276.8 .. 3276.7)
zz	delta Z (0.1 m)	-32,768 .. 32,767 (-3276.8 .. 3276.7)
C	checksum	

Message length: 25 bytes

#### Response Message

- To either command:

```
@@Apdsssf fiiff fxyyzzC<CR><LF>
```

d	datum ID	50
sssf	semi-major axis (m)	
sss	integer part	6,000,000 .. 7,000,000
ff	fractional part	0 .. 999 (0.0 .. 0.999)
iiff	inverse flattening	
ii	integer part	285 .. 305
fff	fractional part	0 .. 999,999,999 (0.0 .. 0.999999999)
xx	delta X (0.1 m)	-32,768 .. 32,767 (-3276.8 .. 3276.7)
yy	delta Y (0.1 m)	-32,768 .. 32,767 (-3276.8 .. 3276.7)
zz	delta Z (0.1 m)	-32,768 .. 32,767 (-3276.8 .. 3276.7)
C	checksum	

Message length: 25 bytes

## SELECT DATUM

The GPS receiver has one predefined datum in its internal memory and one user definable datum. The datums are referenced by an ID number. The predefined datum is number 49 and the user defined datum is number 50. The user instructs the GPS receiver which datum to use by sending the **Select Datum** command. The command contains the ID number of the desired datum and the GPS receiver returns the response message which gives the user the ability to validate that the input command was accepted. The user can instruct the GPS receiver to use the user defined datum by sending the **Select Datum** command set to 50.

Default datum:      WGS-84 (ID code 49)



## SELECT DATUM *Motorola Binary Format*

### Input Command

- Output current datum ID code:

**@@AoxC<CR><LF>**

x            1 out of range byte    \$ff

C            checksum

Message length: 8 bytes

- Change current datum ID code:

**@@AodC<CR><LF>**

d            datum ID                    49 or 50

C            checksum

Message length: 8 bytes

### Response Message

- To either command:

**@@ApdsssffiiffffxyyzzC<CR><LF>**

d            datum ID                    49 or 50

sssff       semi-major axis (m)

sss        integer part                6,000,000 .. 7,000,000

ff         fractional part             0 .. 999 (0.0 .. 0.999)

iiffff     inverse flattening

ii         integer part                285 .. 305

ffff       fractional part             0 .. 999,999,999 (0.0 .. 0.999999999)

xx         delta X (0.1 m)            -32,768 .. 32,767 (-3276.8 .. 3276.7)

yy         delta Y (0.1 m)            -32,768 .. 32,767 (-3276.8 .. 3276.7)

zz         delta Z (0.1 m)            -32,768 .. 32,767 (-3276.8 .. 3276.7)

C            checksum

Message length: 25 bytes

## ALMANAC DATA INPUT

This input data command loads an almanac into the receiver's random access memory (RAM) via the serial port. The entire almanac data message consists of 34 unique formatted messages that correspond to the subframe and page number of the almanac data (see GPS-ICD-200 for format description).

It is not necessary to input an almanac at power up. If backup power has been applied, the almanac will be retained in RAM. If the almanac is not available, it will be downloaded from the satellites. This can take anywhere from 15 to 30 minutes if satellites are tracked continuously. Manually loading an almanac will reduce the TTFF.

The GPS receiver echoes the input almanac data subframe and page numbers of messages received so the user can validate that each almanac slice has been accepted. It is not necessary nor is it recommended to wait for an echo before sending the next data page. The Oncore GPS receiver will collect an entire almanac in local storage, then check the almanac for validity. The receiver will update the internal almanac data with the new user-supplied almanac upon completion of the receipt of a valid almanac.

Any single input message that has an invalid subframe (i.e., not 4 or 5) will reset the almanac collection software so that the local collection of almanac data can begin fresh. Subframe 5 page 1 marks the beginning message and resets the collection process. The data for subframe 5 page 1 must appear first in the string of 34 commands that make up the total almanac input data. The order for the remaining data is not important.

At 9600 baud, the user can insert up to about 1K of data per second into the serial port. Consequently, the user should be aware that the 34 total messages (of 33 bytes each) that make up the almanac data will take longer than one second to input into the receiver.

## ALMANAC DATA INPUT

### *Motorola Binary Format*

#### Input Command

- Input one almanac data page:

**@@Cb**spxxx . . . xxxC<CR><LF>

sp	subframe/page	subframe 5 / pages 1 – 25, or subframe 4 / pages 2 – 5, 7 – 10, 25
xxx...xxx	data words	words 3 – 10, each word is 3 bytes long (format per ICD-GPS-200)
C	checksum	

Message length: 33 bytes

#### Response Message

- To above command:

**@@Ch**spC<CR><LF>

sp	subframe/page	subframe 5 / pages 1 – 25, or subframe 4 / pages 2 – 5, 7 – 10, 25
C	checksum	

Message length: 9 bytes

## ALMANAC DATA OUTPUT

This command is used to output the almanac data. The user has the option of requesting the almanac data output one time (polled), or each time the almanac data changes (continuously).

The state of the mode parameter is stored in RAM. If the GPS receiver was continuously outputting the almanac data when turned off, and backup power is applied, then it will begin to output this message continuously again when the main power is reapplied. If backup power is not applied during power down, then the GPS receiver will start up in polled only mode.

Almanac data for the GPS satellites is transmitted in words 3 through 10 of subframe 5 (pages 1 through 25), and words 3 through 10 of subframe 4 (pages 2 through 5, 7 through 10, and 25) of the satellite broadcast data message. The user is directed to the ICD-GPS-200 for specifics on the format of the almanac data.

The GPS receiver outputs the almanac data through a series of output messages, each of which is identified by the particular subframe and page numbers. The data fields of each individual message correspond to words 3 through 10 of the broadcast data. Each word contains 24 data bits.

The entire almanac data output consists of 34 output response messages corresponding to the 25 pages of subframe 5 and the 9 pages in subframe 4 that contain almanac data (pages 2 through 5, 7 through 10, and 25). The total message output for one output request is 1122 bytes including the @@Be prefix and the checksum, carriage return, and line feed for each output. The output message begins with subframe 5 page 1.

The GPS receiver will output about 750 bytes of message data for each one second output opportunity. If selected, the almanac response message is output until the total number of bytes sent in a one-second epoch exceeds 750. The remainder of the almanac message is sent in the next one-second epoch (up to the 750 byte limit per second) until all of the almanac data is output.

If the user issues this command and the GPS receiver does not contain an almanac, then the GPS receiver returns one response message with the subframe and page bytes equal to zero.

Default: Polled

## ALMANAC DATA OUTPUT

### Motorola Binary Format

#### Input Command

- Request Almanac Data:

**@@BemC<CR><LF>**

m	mode	0 = output response message once (polled) 1 = output response message when almanac data changes (continuous)
C	checksum	

Message length: 8 bytes

#### Response Message

- To above command:

**@@Cbspxxxxx...xxxxC<CR><LF>**

sp	subframe/page	subframe 5 / pages 1 – 25, or subframe 4 / pages 2 – 5, 7 – 10, 25
xxx...xxx	data words	words 3 - 10, each word is 3 bytes long (format per ICD-GPS-200)
C	checksum	

Message length: 33 bytes

**NOTE:** If an almanac is present in the GPS receiver, then the receiver outputs all of the almanac pages. Otherwise, it returns one output message with all of the message bytes set to zero.

## **SYSTEM POWER-ON FAILURE MESSAGE**

Immediately after power-up, the Oncore's ROM is tested. If this test does not pass, the Oncore firmware will not execute its positioning algorithms. Rather, it will continuously output this message at a 10 second rate. Receipt of this message indicates that the receiver will need to be repaired and/or reprogrammed. This feature keeps the receiver from being utilized when the ROM is, for some reason, compromised and therefore, unreliable. This feature helps to protect the integrity of the application.

**SYSTEM POWER-ON FAILURE MESSAGE**  
*Motorola Binary Format*

**Output Message**

**@@Sz**cC<CR><LF>

c            constant equal to 0

C            checksum

Message length: 8 bytes

## **RECEIVER ID**

The GPS receiver outputs an ID message upon request. The information contained in the ID string is self-explanatory. The model number can be used to determine the type of receiver installed.



**RECEIVER ID**  
*Motorola Binary Format*

**Input Command**

- Poll Receiver ID string:

**@@cjC<CR><LF>**

C                    checksum

Message length: 7 bytes

**Response Message**

To above command:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
@	@	C	j	(cr)	(lf)	C	O	P	Y	R	I	G	H	T		1	9	9	1	-	1	9	9	x	1
		M	O	T	O	R	O	L	A		I	N	C	.	(cr)	(lf)	S	F	T	W		P	/	N	2
#		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	(cr)	(lf)	S	O	F	T	W	A	3
R	E		V	E	R		#		X	X	X	X	X	X	X	X	(cr)	(lf)	S	O	F				4
T	W	A	R	E		R	E	V		#		X	X	X	X	X	X	X	(cr)	(lf)					5
S	O	F	T	W	A	R	E		D	A	T	E			X	X	X	X	X	X	X	X	X	X	6
X	(cr)	(lf)	M	O	D	E	L		#					X	X	X	X	X	X	X	X	X	X	X	7
X	X	X	X	(cr)	(lf)	H	D	W	R		P	/	N		#		X	X	X	X	X	X	X	X	8
X	X	X	X	X	X	(cr)	(lf)	S	E	R	I	A	L		#				X	X	X	X	X	X	9
X	X	X	X	X	X	X	X	X	X	(cr)	(lf)	M	A	N	U	F	A	C	T	U	R		D	A	10
T	E		X	X	X	X	X	X	X	X	(cr)	(lf)	O	P	T	I	O	N	S		L	I			11
S	T					X	X	X	X	X	X	X	X	X	X	C	(cr)	(lf)							12

Message length: 294 bytes

## SELF-TEST

The GPS receiver user has the ability to perform an extensive self-test. The tests that are accomplished during the commanded self-test are as follows:

Antenna connection

RTC communication and time

Temperature sensor

RAM

ROM

Correlator IC

SCI communication is verified operational if the RS-232 port is active

The output of the self-test command is a 16-bit field, where each bit of the field represents the go/no-go condition of the particular item tested.

When the self-test is initiated, the next output message may not be the response. The self-test may take up to ten seconds to execute. Once the self-test is complete, the acquisition process starts all over as if the receiver were first powered on. The date, time, position, almanac, and ephemeris information is all retained.

## SELF-TEST

### Motorola Binary Format

#### Input Command

- Initiate **Self-Test**:

**@@FaC**<CR><LF>

C                    checksum

Message length: 7 bytes

#### Response Message

- To above command:

**@@FaxxC**<CR><LF>

xx                    self test results in two bytes as detailed below:

Bit 15: (msb)	antenna undercurrent
Bit 14:	antenna overcurrent
Bit 13:	RTC comm & time
Bit 12:	temperature sensor
Bit 11:	spare
Bit 10:	RAM
Bit 9:	ROM
Bit 8:	1 KHz presence
Bit 7:	channel 8 correlation test
Bit 6:	channel 7 correlation test
Bit 5:	channel 6 correlation test
Bit 4:	channel 5 correlation test
Bit 3:	channel 4 correlation test
Bit 2:	channel 3 correlation test
Bit 1:	channel 2 correlation test
Bit 0: (lsb)	channel 1 correlation test

C                    checksum

Message length: 9 bytes

**NOTE:** Each bit is zero for pass and one for failure. The antenna undercurrent and overcurrent should be interpreted together as follows:

Bit 15	Bit 14	Meaning
0	0	antenna properly connected
0	1	short
1	0	open (antenna not connected)
1	1	short

## **SET-TO-DEFAULTS**

This command sets all of the GPS receiver parameters to their default values. Performance of this utility results in all continuous messages being reset to polled only output, and clears the almanac and ephemeris data. The time and date stored in the internal real-time clock are not changed by the execution of this utility.

## SET-TO-DEFAULTS

*Motorola Binary Format*

### Input Command

- Set the Oncore GPS receiver to default values:

**@@CfC<CR><LF>**

C            checksum

Message length: 7 bytes

### Response Message

- To above command:

**@@CfC<CR><LF>**

C            checksum

Message length: 7 bytes

## **ASCII POSITION MESSAGE**

### *GT Oncore Only*

The ASCII position output message contains the basic information in the Position/Status/Data Message (@@Ea). The ASCII message may be a more convenient interface for certain applications. The units and style of the data is similar to NMEA output.

Default mode: Polled

## ASCII POSITION MESSAGE

### Input Command

- Request ASCII Position Message:

**@@EqmC<CR><LF>**

m	mode	0 = output response message once (polled) 1..255 = response message output at indicated rate (continuous) 1 = once per second 2 = once every two seconds 255 = once every 255 seconds
C	checksum	Message length: 8 bytes

### Response Message

- To above command:

**@@Eq,mm,dd,yy, hh,mm,ss, dd,mm.mmmm,n,ddd,mm.mmmm,w,shhhhh.h,sss.s, hhh.h,m,t, dd.d,nn,rrrr,aa,CCC<CR><LF>**

#### Date

mm	month	01 .. 12
dd	day	01 .. 31
yy	year	98 .. 18

#### UTC Time

hh	hours	00 .. 23
mm	minutes	00 .. 59
ss	seconds	00 .. 60

#### Latitude

dd	degrees	00 .. 90
mm.mmmm	minutes	00 .. 59.9999
n	direction	N - north, S - south

#### Longitude

ddd	degrees	000 .. 180
mm.mmmm	minutes	00 .. 59.9999
w	direction	W - west, E - east

#### Height

s	sign of height	+/-
hhhhh.h	height in meters	-1000.0 .. 18,000.0

#### Velocity

sss.s	speed in knots	000.0 .. 999.9
hhh.h	heading in degrees	000.0 .. 359.9

#### Receiver status

m	fix mode	0 = autonomous 1 = differential
t	fix type	0 = no fix 1 = 2D fix 2 = 3D fix 3 = propagate mode

Continued on the next page.

**ASCII POSITION  
MESSAGE**  
*Continued*

dd.d	dilution of precision (DOP)	00.0...99.9 HDOP if 2D, PDOP if 3D
nn	number of satellites in use	00...37
rrrr	reference station ID	0000..1023
aa	age of differential data in s	00..60
CCC	checksum	000...255

Message length: 96 bytes





## ALTITUDE-HOLD HEIGHT

### *GT Oncore Only*

The user can specify the receiver height for manual altitude-hold applications. Use the **Altitude-Hold Mode** command to enable or disable the altitude-hold feature. The **Altitude-Hold Height** is specified in units of meters to a resolution of 0.01 meters. The height is referenced to the GPS reference ellipsoid. The datum for the height is the one selected using the **Select Datum** command.

Default value: 0 meters

## ALTITUDE-HOLD HEIGHT

*Motorola Binary Format*

### Input Command

- Poll current Altitude-Hold Height

**@@AuxxxxxC<CR><LF>**

xxxx            5 out of range bytes    \$7ffffff

C                checksum

Message length: 12 bytes

- Change current Altitude-Hold Height:

**@@AuhhhhtC<CR><LF>**

hhhh            height in cm            -100,000 .. 1,800,000 (-1000.00 to + 18,000.00 m)

t                height type            0 = GPS reference ellipsoid

C                checksum

Message length: 12 bytes

### Response Message

- To either command:

**@@AuhhhhtC<CR><LF>**

hhhh            height in cm            -100,000 .. 1,800,000 (-1000.00 to + 18,000.00 m)

t                height type            0 = GPS reference ellipsoid

C                checksum

Message length: 12 bytes

## **ALTITUDE-HOLD MODE**

### *GT Oncore Only*

The user can specify a height coordinate for altitude-hold applications. This command allows the user to manually enable or disable the altitude-hold feature. Remember, the GPS receiver automatically holds the altitude to the last known height when the PDOP is greater than 6.0 or when the GPS receiver is tracking only three satellites.

Default value: Disabled

## ALTITUDE-HOLD MODE

*Motorola Binary Format*

### Input Command

- Poll current Altitude-Hold Mode:

**@@AvxC<CR><LF>**

x                    1 out of range byte    Sff

C                    checksum

Message length: 8 bytes

- Change current Altitude-Hold Mode:

**@@AvmC<CR><LF>**

m                    mode                    0 = disabled

1 = enabled

C                    checksum

Message length: 8 bytes

### Response Message

- To either command:

**@@AvmC<CR><LF>**

m                    mode                    0 = disabled

1 = enabled

C                    checksum

Message length: 8 bytes

## VELOCITY FILTER

### *GT Oncore Only*

The **Velocity Filter** command controls the velocity filtering feature. The velocity filter is useful in marine applications to filter out some of the wave motion in the reported velocity.

The filter is a single order alpha filter, where alpha is the value entered by the user ranging from 10 to 100 in increments of one. Alpha is then used in the filtered velocity solution representing 10% to 100% of the last calculated velocity, the remainder of which uses the previously reported velocity. If a value of 10 is entered for alpha, the maximum filtering will be done. An alpha value this low must be used with caution; the reported velocity will have extreme latency. An alpha value of 100 will result in no filtering, which is the default alpha value.

Default value: 100

## VELOCITY FILTER

### *Motorola Binary Format*

#### Input Command

- Poll current Velocity Filter parameter:

**@@ANxC<CR><LF>**

x                    1 out of range byte    \$ff

C                    checksum

Message length: 8 bytes

- Change current Velocity Filter parameter:

**@@ANfC<CR><LF>**

f                    filter parameter    10 .. 100 (max. filtering to no filtering)

C                    checksum

Message length: 8 bytes

#### Response Message

- To either command:

**@@ANfC<CR><LF>**

f                    filter parameter    10 .. 100 (max. filtering to no filtering)

C                    checksum

Message length: 8 bytes

## **RTCM PORT MODE**

### *GT Oncore Only*

This command allows the user to select the baud rate of the RTCM serial input port (pin 5). The allowable baud rates are 2400, 4800, and 9600. The baud rate of this secondary port is independent of the status of the primary serial port.

Default baud rate: 9600 baud



## RTCM PORT MODE

*Motorola Binary Format*

### Input Command

- Poll current RTCM Port Mode:

**@@AO***b***C**<CR><LF>

*x*                    1 out of range byte        Sff

*C*                    checksum

Message length: 8 bytes

- Change current RTCM Port Mode:

**@@AO***b***C**<CR><LF>

*b*                    RTCM port baud rate    0 = 9600

1 = 4800

2 = 2400

*C*                    checksum

Message length: 8 bytes

### Response Message

- To either command:

**@@AO***b***C**<CR><LF>

*b*                    RTCM port baud rate    0 = 9600

1 = 4800

2 = 2400

*C*                    checksum

Message length: 8 bytes

## **EPHEMERIS DATA INPUT**

### *GT Oncore Only*

This command will cause the receiver to accept satellite ephemeris data input via the RS-232 port. The receiver keeps the ephemerides decoded from all satellites in its nonvolatile memory as long as the 5V BATT voltage is applied to the receiver, and the ephemerides are still valid ( $t\text{-toe} < 4$  hours). However, the ephemeris data that the user inputs via the RS-232 port is only remembered until the next time the receiver power is cycled, or until it is replaced as a normal part of decoding new ephemeris data from a satellite. This is true even though the 5V BATT voltage may have been applied during the receiver off period. The ephemeris-hold switch can be used to prevent the receiver from replacing the user input ephemeris with new data decoded from the satellites.

The input format is identical to the format output by the VP Oncore receiver using the output ephemeris command. This allows the same ephemeris output file to be used by the receiver for an ephemeris input file. Note that the GT Oncore does not support ephemeris output. A VP Oncore can be used to obtain ephemeris data. The receiver echoes the input ephemeris data format message so the user can validate the ephemeris data with the new user supplied ephemeris upon completion of the receipt of a valid ephemeris.

## EPHEMERIS DATA INPUT

### *Motorola Binary Format*

#### Input Command

- Input one ephemeris data page:

**@@Bfi**xxx...xxxC<CR><LF>

i	sat ID	1 .. 37
xxx .. xxx	ephemeris	sf 1 – 3/words 3 – 10 (72 bytes per sat; format per ICD-GPS-200)

C           checksum  
Message length: 80 bytes

#### Response Message

- To above command:

**@@Cci**xxx...xxxC<CR><LF>

i	sat ID	1 .. 37
xxx .. xxx	ephemeris	sf 1 – 3/words 3 – 10 (72 bytes per sat; format per ICD-GPS-200)

C           checksum  
Message length: 80 bytes

## **PSEUDORANGE CORRECTION INPUT**

### *GT Oncore Only*

Enabling this option allows the GPS receiver to accept pseudorange correction messages from a differential master site receiver. The input message is structured to accept pseudorange and pseudorange-rate corrections for up to six satellites. The slave receiver uses the corrections in the input message by associating the satellite ID with the corresponding satellite (channel) that the slave is tracking. The user can specify up to 12 satellite corrections through the use of two back-to-back input commands. Back-to-back commands must be input with no time delay in between.

## PSEUDORANGE CORRECTION INPUT

### *Motorola Binary Format*

#### Input Command

- Input pseudorange corrections (for up to six satellites):

```
@@Cetttippprrrdipprrrdipprrrdipprrrdipprrdi  
pprrdC<CR><LF>
```

ttt	GPS time ref	0 .. 6047999 (0.0 .. 604799.9)
i	sat ID	0 .. 37
		0 = not used
		1-37 = sat ID
ppp	pseudorange corr	-1,048,576 .. +1,048,576
		0.01 meter resolution (-10485.76 .. +10485.76)
rr	pseudorange-rate corr	-4096 .. 4096
		0.001 m/s resolution (-4.096 .. 4.096)
d	issue of data ephemeris	0 .. 255
C	checksum	

Message length: 52 bytes

#### Response Message

- To above command:

```
@@CkC<CR><LF>
```

C	checksum	
---	----------	--

Message length: 7 bytes

## **SWITCH TO NMEA**

### *GT Oncore Only*

This command switches the serial data format on the primary port from Motorola binary to NMEA 0183. The baud rate of the port is switched from 9600 to 4800 and input commands are recognized in NMEA format only. Note that the default mode of all of the NMEA output messages is off. To initiate NMEA output, the input commands must be utilized.

## SWITCH TO NMEA

*Motorola Binary Format*

### Input Command

- Switch to NMEA format:

**@@Ci**mC<CR><LF>

m            format            1 = NMEA

C            checksum

Message length: 8 bytes

### Response Message

- There is no response message to this input command.

## **GPGGA (GPS FIX DATA)**

### *GT Oncore Only*

This command enables the GPGGA GPS Fix Data message and determines the rate at which the information is transmitted. The periodic rate field (yyyy) instructs the receiver either to output this message once (polled), or to output this message at the indicated update rate (continuously). Once the receiver is set to continuous output, the continuous flow can be stopped by sending a one-time (polled) output request. The receiver will output the response one final time, and then terminate any further message outputs. The value of the periodic rate is retained through a power cycle only if battery backup power is applied.

If the receiver has just powered up and has yet to compute a position fix (GPS quality indicator field (q) is zero), then the time (hhmmss.ss) and HDOP (y.y) fields will be nulled. If the receiver is not currently computing a position fix sometime after the first fix, (GPS quality indicator field (q) is zero), the time field (hhmmss.ss) will be frozen and the HDOP field (y.y) will be nulled. If the receiver is not using differential GPS (GPS quality indicator field (q) is not two), then the age of differential data (t.t) and differential reference station ID (iiii) fields will be nulled.

NOTE: The geoidal separation field (g.g) will always be zero since the GT Oncore does not have this information.

Default value: Message disabled



## GPGGA (GPS FIX DATA)

### NMEA-0183 Format

#### Input Command

- Set response message rate:

```
$PMOTG,GGA,yyyyCC<CR><LF>
```

yyyy	update rate	0 .. 9999 seconds
CC	optional checksum	

#### Response Message

- Response to above command at selected rate:

```
$GPGGA,hhmmss.ss,ddmm.mmmm,n,dddmm.mmmm,e,q,ss,y,a,a,z,g,g,z,t,t,  
iiii*CC<CR><LF>
```

hhmmss.ss	UTC of position fix	
hh	hours	00 .. 24
mm	minutes	00 .. 59
ss.ss	seconds	00.00 .. 59.99
ddmm.mmmm,n	latitude	
dd	degrees	00 .. 90
mm.mmmm	minutes	00.0000 .. 59.9999
n	direction	N = north S = south
dddmm.mmmm,e	longitude	
ddd	degrees	000 .. 180
mm.mmmm	minutes	00.0000 .. 59.9999
e	direction	E = east W = west
q	GPS status indicator	0 = GPS not available 1 = GPS available 2 = GPS differential fix
ss	number of sats being used	0 .. 12
y.y	HDOP	
a.a,z	antenna height	
a.a	height	
z	units	M = meters
g.g,z	geoidal separation	
g.g	height	
z	units	M = meters
t.t	age of differential data	
iiii	differential reference	0000 .. 1023
	station ID	
CC	checksum	

## **GPGLL (GEOGRAPHIC POSITION-LATITUDE/LONGITUDE)** *GT Oncore Only*

This command enables the GPGLL Geographic Position-Latitude/Longitude message and determines the rate at which the information is transmitted. The periodic rate field (yyyy) instructs the receiver either to output this message once (polled), or to output this message at the indicated update rate (continuously). Once the receiver is set to continuous output, the continuous flow can be stopped by sending a one-time (polled) output request. The receiver will output the response one final time, and then terminate any further message outputs. The receiver will output the response one final time, and then terminate any further message outputs. The value of the periodic rate is retained through a power cycle only if battery backup power is applied.

If the receiver has just powered up and has yet to compute a position fix (GPS quality indicator (q) is zero), then the time field (hhmmss.ss) will be nulled. If the receiver is not computing a position fix sometime after the first fix (GPS quality indicator (q) is zero), then the time field (hhmmss.ss) will be frozen.

Default value:           Message disabled

## GPGLL (GEOGRAPHIC POSITION-LATITUDE/LONGITUDE) NMEA-0183 Format

### Input Command

- Set response message rate:

```
$PMOTG, GLL, yyyyCC<CR><LF>
```

yyyy	update rate	0 .. 9999 seconds
CC	optional checksum	

### Response Message

- Response to above command at selected rate:

```
$GPGLL, ddm. mmm, n, ddd. mmm, e, hhmmss. ss, a*CC<CR><LF>
```

ddm. mmm, n	latitude	
dd	degrees	00 .. 90
mm. mmm	minutes	00.0000 .. 59.9999
n	direction	N = north S = south
ddd. mmm, e	longitude	
ddd	degrees	00 .. 180
mm. mmm	minutes	00.0000 .. 59.9999
e	direction	E = east W = west
hhmmss. ss	UTC of position fix	
hh	hours	00 .. 24
mm	minutes	00 .. 59
ss. ss	seconds	00.00 .. 59.99
a	status	A = valid V = invalid
CC	checksum	

## **GPGSA (GPS DOP AND ACTIVE SATELLITES)**

### *GT Oncore Only*

This command enables the GPGSA GPS DOP and Active Satellites message and determines the rate at which the information is transmitted. The periodic rate field (yyyy) instructs the receiver either to output this message once (polled), or to output this message at the indicated update rate (continuously). Once the receiver is set to continuous output, the continuous flow can be stopped by sending a one-time (polled) output request. The receiver will output the response one final time, and then terminate any further message outputs. The value of the periodic rate is retained through a power cycle only if battery backup power is applied.

If the receiver is not computing a position fix (mode field (b) is one), then the xDOP fields (p.p, q.q, r.r) will be nulled. If the receiver is computing a 2-D position fix (mode field (b) is two), then the PDOP field (p.p) and the VDOP field (r.r) will be nulled. Only satellite IDs used in the solution are output; the remaining satellite ID fields will be nulled.

Default value:      Message disabled

## GPGSA (GPS DOP AND ACTIVE SATELLITES) NMEA-0183 Format

### Input Command

- Set response message rate:

\$PMOTG,GSA,yyyyCC<CR><LF>

yyyy	update rate	0 .. 9999 seconds
CC	optional checksum	

### Response Message

- Response to above command at selected rate:

\$GPGSA,a,b,cc,dd,ee,ff,gg,hh,ii,jj,kk,mm,nn,oo,p,q,r,r\*CC<CR><LF>

a	sat acquisition mode	M = manual (forced to operate in 2D or 3D mode) A = automatic (auto switch 2D/3D)
b	positioning mode	1 = fix not available 2 = 2D 3 = 3D

cc, dd, ee, ff, gg, hh, ii, jj, kk, mm, nn, oo

sat IDs used in solution (null for unused fields)

p.p	PDOP	1.0 .. 9.9
q.q	HDOP	1.0 .. 9.9
r.r	VDOP	1.0 .. 9.9
CC	checksum	

## **GPGSV (GPS SATELLITES IN VIEW)**

### *GT Oncore Only*

This command enables the GPGSV GPS Satellites in View message and determines the rate at which the information is transmitted. The periodic rate field (yyyy) instructs the receiver either to output this message once (polled), or to output this message at the indicated update rate (continuously). Once the receiver is set to continuous output, the continuous flow can be stopped by sending a one-time (polled) output request. The receiver will output the response one final time, and then terminate any further message outputs.

If the receiver is not tracking the satellite, the SNR field (ss) will be nulled. Further, an entire group — satellite ID field (ii), elevation field (ee), azimuth field (aaa), and SNR field (ss) — will be nulled if not needed.

NOTE: The SNR field (ss) is the same as the C/No value in the **Position/Status/Data Message**.

Default value:      Message disabled

## GPGSV (GPS SATELLITES IN VIEW) NMEA-0183 Format

### Input Command

- Set response message rate:

\$PMOTG,GSV,yyyCC<CR><LF>

yyy update rate

0 .. 9999 seconds

CC optional checksum

### Response Message

- Response to above command at selected rate:

\$GPGSV,t,m,n,ii,ee,aaa,ss,ii,ee,aaa,ss,ii,ee,aaa,ss\*CC<CR><LF>

t number of messages 1 .. 4

m message number 1 .. 4

n total number of satellites in view

For each visible satellite (four groups per message)

ii satellite PRN number

ee elevation (degrees) 0 .. 90

aaa azimuth (degrees True) 0 .. 359

ss SNR (dB) 0 .. 99

CC checksum

## **GPRMC (RECOMMENDED MINIMUM SPECIFIC GPS/TRANSIT DATA)**

### *GT Oncore Only*

This command enables the GPRMC Recommended Minimum Specific GPS/Transit Data message and determines the rate at which the information is transmitted. The periodic rate field (yyyy) instructs the receiver either to output this message once (polled), or to output this message at the indicated update rate (continuously). Once the receiver is set to continuous output, the continuous flow can be stopped by sending a one-time (polled) output request. The receiver will output the response one final time, and then terminate any further message outputs. The value of the periodic rate is retained through a power cycle only if battery backup power is applied.

If the receiver has just powered up and has yet to compute a position fix (status field (a) is invalid), then the time (hhmmss.ss) and date (ddmmyy) fields will be nulled. If the receiver is not computing a position fix sometime after the first fix (status field (a) is invalid), then the time (hhmmss.ss) and date (ddmmyy) fields will be frozen. If the receiver is not computing a position fix (status field (a) is invalid), then the speed over ground (z.z) and track made good (y.y) fields will be nulled.

NOTE: The magnetic variation field (d.d) will always be zero since the GT Oncore does not have this information.

Default value: Message disabled



# GPRMC (RECOMMENDED MINIMUM SPECIFIC GPS/TRANSIT DATA)

## NMEA-0183 Format

### Input Command

- Set response message rate:

```
SPMOTG,RMC,yyyyCC<CR><LF>
```

yyyy	update rate	0 .. 9999 seconds
CC	optional checksum	

### Response Message

- Response to above command at selected rate:

```
$GPRMC,hhmmss.ss,a,ddmm.mmmm,n,dddmm.mmmm,w,z.z,y,y,  
ddmmyy,d,d,v*CC<CR><LF>
```

hhmmss.ss	UTC of position fix	
hh	hours	00 .. 24
mm	minutes	00 .. 59
ss.ss	seconds	00.00 .. 59.99
a	status	A = valid V = invalid
ddmm.mmmm,n	latitude	
dd	degrees	00 .. 90
mm.mmmm	minutes	00.0000 .. 59.9999
n	direction	N = north S = south
dddmm.mmmm,w	longitude	
ddd	degrees	00 .. 180
mm.mmmm	minutes	00.0000 .. 59.9999
w	direction	E = east W = west
z.z	speed over ground (knots)	0.0
y.y	track made good (reference to true north)	0.0 .. 359.9
ddmmyy	UTC date of position fix	
dd	day	01 .. 31
mm	month	01 .. 12
yy	year	00 .. 99
d.d	magnetic variation (degrees)	0.0 .. 180.0
v	variation sense	E = east W = west
CC	checksum	

## **GPVTG (TRACK MADE GOOD AND GROUND SPEED)**

### *GT Oncore Only*

This command enables the GPVTG Track Made Good and Ground Speed message and determines the rate at which the information is transmitted. The periodic rate field (yyyy) instructs the receiver either to output this message once (polled), or to output this message at the indicated update rate (continuously). Once the receiver is set to continuous output, the continuous flow can be stopped by sending a one-time (polled) output request. The receiver will output the response one final time, and then terminate any further message outputs. The receiver will output the response one final time, and then terminate any further message outputs.

If the receiver is not computing a position fix, all numeric fields (a.a, c.c, e.e, g.g) will be nulled.

NOTE: The GT Oncore does not have the information required to compute magnetic track (c.c).

Default value:      Message disabled

## GPVTG (TRACK MADE GOOD AND GROUND SPEED) NMEA-0183 Format

### Input Command

- Set response message rate:

\$PMOTG,VTG,yyyCC<CR><LF>

yyy	update rate	0 .. 9999 seconds
CC	optional checksum	

### Response Message

- Response to above command at selected rate:

\$GPVTG,a.a,b,c.c,d,e.e,f,g.g,h\*CC<CR><LF>

a.a	track	
b	units	T = degrees true
c.c	track	
d	units	M = degrees magnetic
e.e	speed	
f	units	N = knots
g.g	speed	
h	units	K = km/hr
CC	checksum	

## **GPZDA (TIME AND DATE)**

### *GT Oncore Only*

This command enables the GPZDA Time and Date message and determines the rate at which the information is transmitted. The periodic rate field (yyyy) instructs the receiver either to output this message once (polled), or to output this message at the indicated update rate (continuously). Once the receiver is set to continuous output, the continuous flow can be stopped by sending a one-time (polled) output request. The receiver will output the response one final time, and then terminate any further message outputs. The receiver will output the response one final time, and then terminate any further message outputs.

Currently, there is no mechanism to set the local zone description in the NMEA I/O format, and the receiver operates as if the GMT offset is set to 00:00.

Default value:        Message disabled

## GPZDA (TIME AND DATE) NMEA-0183 Format

### Input Command

- Set response message rate:  
\$PMOTG,ZDA,yyyCC<CR><LF>  
    yyy    update rate            0 .. 9999 seconds  
    CC      optional checksum

### Response Message

- Response to above command at selected rate:  
\$GPZDA,hhmmss.ss,dd,mm,yyy,xx,yy\*CC<CR><LF>  
    hhmmss.ss    UTC time  
    hh          hours            0 .. 23  
    mm          minutes          0 .. 59  
    ss.ss       seconds          0 .. 59.99  
    dd          day              1 .. 31  
    mm          month            1 .. 12  
    yyy        year              1998 .. 2018  
    xx          local zone hours  -13 .. 13  
    yy          local zone minutes 0 .. 59  
    CC          checksum

## **SWITCH TO BINARY**

### *GT Oncore Only*

This utility command switches the serial data format on the primary port from NMEA 0183 to Motorola binary. The baud rate of the port is switched from 4800 to 9600 and input commands are recognized in Motorola binary format only.

## SWITCH TO BINARY

### *NMEA-0183 Format*

#### Input Command

- Switch to Binary format:

\$PMOTG, FOR, xCC<CR><LF>

x	format	0 = Motorola binary
CC	optional checksum	

#### Response Message

- There is no response message to this input command.

## UTC OFFSET STATUS MESSAGE

### *UT Oncore Only*

This message allows the user to request the UTC offset that is currently being used in the time solution. The value reported is the integer number of seconds between UTC and GPS time. If the offset is zero, the receiver does not currently have the portion of the almanac that contains the UTC parameters. The UTC parameters are broadcast by the satellites as part of the almanac, which is repeated every 12.5 minutes.

The message can be set to output either once (polled), or any time the UTC offset has been updated or changed from its previous value.

Default mode:      Polled



## UTC OFFSET STATUS MESSAGE

*Motorola Binary Format*

### Input Command

- Request UTC Offset Status Message:

**@@BomC<CR><LF>**

m            mode

0 = output UTC offset once (polled)

1 = output UTC offset every time it is updated

C            checksum

Message length: 8 bytes

### Response Message

- To above command:

**@@BouC<CR><LF>**

u            UTC offset in seconds    -128 .. +127

C            checksum

Message length: 8 bytes

## 1PPS CABLE DELAY

### *UT Oncore Only*

The GPS receiver outputs a 1PPS signal, the rising edge of which is placed at the top of the GPS or UTC one second tic mark epoch as specified by the **Time Mode**. The **1PPS Cable Delay** command allows the user to offset the 1PPS time mark in one nanosecond increments relative to the measurement epoch.

This parameter instructs the GPS receiver to output the 1PPS output pulse earlier in time to compensate for antenna cable delay. Up to one millisecond of equivalent cable delay can be removed. Zero cable delay is set for a zero-length antenna cable. The user should consult a cable data book for the delay per foot for the particular antenna cable used in order to compute the total cable delay needed for a particular installation.

This parameter also allows the user to adjust the position of the 1PPS to compensate for other system delays.

Range:            0.000 to 0.000999999 s  
Default value:   0.000 s  
Resolution:      1 ns

## 1PPS CABLE DELAY

*Motorola Binary Format*

### Input Command

- Poll current 1PPS Cable Delay:

**@@AzxxxxC<CR><LF>**

xxxx            4 out of range bytes \$ffffff

C                checksum

Message length: 11 bytes

- Change current 1PPS Cable Delay:

**@@AzttttC<CR><LF>**

tttt            time offset in ns    0 .. 999,999 ns  
(0.0 to 0.000999999 s)

C                checksum

Message length: 11 bytes

### Response Message

- To either command:

**@@AzttttC<CR><LF>**

tttt            time offset in ns    0 .. 999,999 ns  
(0.0 to 0.000999999 s)

C                checksum

Message length: 11 bytes

## **1PPS OFFSET**

*UT Oncore Only*

The GPS receiver outputs a one pulse-per-second (1PPS) signal with the rising edge placed on top of the GPS/UTC one second tic mark. The **1PPS Offset** command allows the user to offset the 1PPS time mark in one nanosecond increments. This offset can be used to place the 1PPS signal anywhere within the one second epoch.

The resolution of this parameter is one nanosecond. This does not imply that the accuracy of the 1PPS output signal is to this level. The absolute accuracy of the signal is a function of GPS time accuracy, and is subject to degradation due to U.S. Department of Defense policy.

Range: 0.000000000 to 0.999999999 s

Default value: 0.000000000 s

Resolution: 1 ns

## 1PPS OFFSET

*Motorola Binary Format*

### Input Command

- Poll current 1PPS Offset:

**@@AyxxxxC<CR><LF>**

xxxx            4 out of range bytes    \$ffffff

C                checksum

Message length: 11 bytes

- Change current 1PPS Offset:

**@@AyttttC<CR><LF>**

tttt            time offset in ns        0 .. 999,999,999 (0.0 to 0.999999999 s)

C                checksum

Message length: 11 bytes

### Response Message

- To either command:

**@@AyttttC<CR><LF>**

tttt            time offset in ns        0 .. 999,999,999 (0.0 to 0.999999999 s)

C                checksum

Message length: 11 bytes

## **PULSE MODE**

### *UT Oncore Only*

The UT Oncore can output 100PPS instead of 1PPS. The user selects the the pulse output signal using the Pulse Mode command. More information on the characteristics of the 100PPS signal can be found on page 3.13.

Default mode: 1PPS

## PULSE MODE

### *Motorola Binary Format*

#### Input Command

- Output current Pulse Mode:

**@@AP**xC<CR><LF>

x            1 out of range byte    \$ff

C            checksum

Message length: 8 bytes

- Change current Pulse Mode:

**@@AP**mC<CR><LF>

m            mode                    0 = 1PPS output  
   1 = 100PPS output

C            checksum

Message length: 8 bytes

#### Response Message

To either command:

**@@AP**mC<CR><LF>

m            mode                    0 = 1PPS output  
   1 = 100PPS output

C            checksum

Message length: 8 bytes

## POSITION-HOLD POSITION

### *UT Oncore Only*

The user can specify receiver coordinates for timing applications to increase the timing accuracy. This command is used to enter the position to be held. Note that this command will only be executed if the Position-Hold Mode is disabled.

The position to be held is specified in the same units and referenced to the same datum (WGS 84) as the initial position coordinates of latitude, longitude, and height (to the same resolution). The height parameter is referenced to the GPS reference ellipsoid. Note that all three parameters must be specified. The valid ranges of each parameter are the same as those specified in the Latitude, Longitude, and Height commands.

Default values:   Latitude = 0° (Equator)  
                          Longitude = 0° (Greenwich Meridian)  
                          Height = 0 m (GPS)



## POSITION-HOLD POSITION

### Motorola Binary Format

#### Input Command

- Poll current Position-Hold Position:

**@@As**xxxxxxxxxxxxxC<CR><LF>

xxxxxxxxxxxx 13 out of range bytes \$7ffffff7ffffff7ffffff

C checksum

Message length: 20 bytes

- Change current Position-Hold Position:

**@@As**llllloooohhhhtC<CR><LF>

llll latitude in mas -324,000,000 .. 324,000,000 (-90° .. 90°)

oooo longitude in mas -648,000,000 .. 648,000,000 (-180° .. 180°)

hhhh height in cm -100000 .. 1,800,000 (-1,000.00 .. 18,000.00 m)

t height type 0 = GPS ellipsoid height reference

C checksum

Message length: 20 bytes

#### Response Message

- To either command:

**@@As**llllloooohhhhtC<CR><LF>

llll latitude in mas -324,000,000 .. 324,000,000 (-90° .. 90°)

oooo longitude in mas -648,000,000 .. 648,000,000 (-180° .. 180°)

hhhh height in cm -100,000 .. 1,800,000 (-1,000.00 .. 18,000.00 m)

t height type 0 = GPS ellipsoid height reference

C checksum

Message length: 20 bytes

**NOTE:** 1 degree equals 3,600 arcseconds or 3,600,000 milliarseconds (mas)

## POSITION-HOLD MODE

### *UT Oncore Only*

The user can specify a set of position coordinates for timing applications using the **Position-Hold Position** command. The **Position-Hold Mode** enables/disables the position-hold function. The coordinates for the position-hold must be specified before the **Position-Hold Mode** is enabled; the receiver will not use the current position fix coordinates.

This command is also used to initiate the Automatic Site Survey mode (see page 3.13 for more information on this feature). While in the survey mode, a flag will be set in the **Position/Status/Data Message**. When the survey is complete, that flag will clear, the surveyed position will be automatically entered into the **Position-Hold Position** fields, and the **Position-Hold Mode** will be enabled.

Whenever the receiver is in **Position-Hold Mode**, a flag is set in the **Position/Status Data Message**.

**NOTE:** The receiver must be in position-hold mode for the Time RAIM algorithm to isolate and remove bad satellite measurements.

Default value: Disabled

## POSITION-HOLD MODE

*Motorola Binary Format*

### Input Command

- Poll current **Position-Hold Mode**:

**@@AtxC<CR><LF>**

x                    1 out of range byte    \$ff

C                    checksum

Message length: 8 bytes

- Change current **Position-Hold Mode**:

**@@AtmC<CR><LF>**

m                    mode                    0 = disabled

1 = enabled

2 = start automatic site survey

C                    checksum

Message length: 8 bytes

### Response Message

- To either command:

**@@AtmC<CR><LF>**

m                    mode                    0 = disabled

1 = enabled

2 = automatic site survey in progress

C                    checksum

Message length: 8 bytes

## TIME RAIM SETUP AND STATUS MESSAGE

### *UT Oncore Only*

The GPS receiver uses the Time RAIM algorithm to exploit redundancy in the GPS time solution in order to detect, isolate, and remove faulty satellites. The **Time RAIM Setup and Status Message** allows the user to change the update rate, the configuration for the 1PPS output, and the Time RAIM alarm limit.

The rate parameter instructs the GPS receiver to either output this message one-time (polled), or to output this message at the indicated update rate (continuously). If the message rate is the same as the 1PPS rate, then the message and the 1PPS pulse are synchronized. Once the GPS receiver is set to continuous output, the continuous message flow can be stopped by sending a one-time output request. The GPS receiver will output the message one more time, then terminate any further message outputs.

The state of the rate byte is stored in RAM. If the GPS receiver was continuously outputting the message when turned off and backup power is applied, then it will begin to output this message continuously (at the selected update rate) again when the main power is reapplied. If backup power is not applied during power down, then the GPS receiver will start up in polled only mode. The other Time RAIM control parameters are also stored in RAM, so they will be reset to their default values if backup power is not applied during power down.

The pulse generation can be controlled with the 1PPS control mode byte. The pulse can be on all the time, off all the time, on only when the receiver is tracking at least one satellite, or on only when the time solution is within the alarm threshold.

The number of satellites appearing in the table below are the minimum which must be tracked to ensure the detection, isolation, and removal of faulty satellites. The probability of detection and isolation of a faulty satellite is greater than 99.99%, which corresponds to less than one missed detection every 10,000 failures. Given the infrequency of GPS satellite failures, this makes a missed detection virtually impossible. The probability of a false alarm is less than 2.e-4%, which corresponds to less than one false alarm every 5.7 days. Given that lock is maintained on eight satellites, the time alarm can be set as low as 300 ns without compromising performance.

Time Alarm (ns)	SVs needed to detect	SVs needed to isolate
T > 1000	2	3
1000 > T > 700	3	3
700 > T > 500	4	4
500 > T > 300	4	8
300 > T > 250	8*	8*

\*The minimum time required false alarm rate of 2.e-4% cannot be achieved for this time alarm range.

## Input Command

### TIME RAIM SETUP AND STATUS MESSAGE

When the receiver is not in position-hold mode, Time RAIM can only operate in detect mode; isolation and removal are not possible. The receiver must be in position-hold mode for the Time RAIM algorithm to be able to detect, isolate and remove bad satellite measurements.

The **Time RAIM Setup and Status Message** outputs the status of the Time RAIM solution when the algorithm is on. This message also outputs several values relating to the Time RAIM solution.

The 1PPS is synchronized to either UTC or GPS time, as specified by the **Time Mode**.

The receiver can make an estimate of the overall accuracy of the time solution.

The one sigma accuracy estimate is computed using the residuals of the least-squares time solution. This number is a measure of the spread of the observations, not an estimate of the absolute time accuracy.

The underlying noise due to the granularity of the clock generating the 1PPS signal is deterministic on every pulse. The receiver computes and outputs the negative sawtooth residual so that the user can compensate for the error and remove the granularity if desired.

Finally, the time solution of each individual satellite is output.

Default values:	Time RAIM algorithm	off
	Time RAIM alarm limit	1000 ns
	1PPS control mode	setting 1

## TIME RAIM SETUP AND STATUS MESSAGE

### Motorola Binary Format

#### Input Command

- Poll current Time RAIM Setup and Status:

**@@En**XXXXXXXXXXXXXXXXXXXXC<CR><LF>

x	15 out of range bytes	\$ff ff ff...
C	checksum	

Message length: 22 bytes

- Change current Time RAIM Setup:

**@@En**otaapXXXXXXXXXXC<CR><LF>

o	output message rate	0 .. 255 0 = output response message once (polled) 1..255 = response message output at indicated rate (continuous) 1 = once per second 2 = once every two seconds 255 = once every 255 seconds
t	Time RAIM algorithm on/off	0 = off 1 = on
aa	Time RAIM alarm limit in 100s of nanoseconds	3 .. 65535
p	1PPS control mode	0 = 1PPS output pulse is off all the time 1 = 1PPS on all the time 2 = pulse active only when tracking at least one satellite 3 = pulse active only when Time RAIM algorithm confirms time solution error is within the user defined alarm limit
XXXXXXXX	not used	0
C	checksum	

Message length: 22 bytes

#### Response Message

- To either command:

**@@En**otaapXXXXXXXXXXpysreensffffsffffsffffsffffsffffsffffsffffsffffC<CR><LF>

o	output message rate	0 .. 255
t	Time RAIM algorithm on/off	0 = off 1 = on
aa	Time RAIM alarm limit in 100s of nanoseconds	3 .. 65535

## TIME RAIM SETUP AND STATUS MESSAGE

### Motorola Binary Format

#### Response Message Continued

p	1PPS control mode	0 = 1PPS output pulse is off all the time 1 = 1PPS on all the time 2 = pulse active only when tracking at least one satellite 3 = pulse active only when Time RAIM algorithm confirms time solution error is within the user defined alarm limit
xxxxxxx	not used	0
p	pulse status	0 = off 1 = on
y	1PPS pulse sync	0 = pulse referenced to UTC 1 = pulse referenced to GPS time
s	Time RAIM solution status	0 = OK: solution within alarm limits 1 = ALARM: user specified limit exceeded 2 = UNKNOWN: due to ... a) alarm threshold set too low b) Time RAIM turned off c) insufficient satellites being tracked
r	Time RAIM status	0 = detection and isolation possible 1 = detection only possible 2 = neither possible
ee	time solution one sigma accuracy estimate in nanoseconds	0 .. 65535
n	negative sawtooth time error of next 1PPS pulse in nanoseconds	-128 .. 127

For each of eight receiver channels

s	satellite ID	0 .. 37
fff	fractional GPS local time estimate of satellite in nanoseconds	0 .. 99999999

C checksum  
Message length: 69 bytes