# Trimble ASCII Interface Protocol (TAIP)



Trimble ASCII Interface Protocol (TAIP) is a Trimble-specified digital communication interface based on printable ASCII characters over a serial data link. TAIP was designed specifically for vehicle tracking applications but has become common in a number of other applications because of its ease of use. TAIP supports both scheduled and polled responses.

TAIP messages may be scheduled for output at a user specified rate starting on a given epoch from top of the hour. For communication robustness, the protocol optionally supports checksums on all messages. It also provides the user with the option of tagging all messages with the unit's user specified identification number (ID). This greatly enhances the functional capability of the unit in a network environment.

Additionally, given the printable ASCII format of all communication, TAIP is ideal for use with mobile data terminals, seven bit modems and portable computers. Although, sensors incorporating this protocol are shipped from the factory with a specific serial port setting, the port characteristics are fully programmable through TAIP messages.

This appendix is designed for easy reference to TAIP message formats and describes all the TAIP messages defined at the time of printing. Some of the defined TAIP messages are not supported by the SVeeSix receiver. The SVeeSix supports the following TAIP messages:

SVeeSix Supported TAIP Messages

| | |
|---|---|
| AL | Altitude/Vertical Velocity |
| AP | Auxiliary Port Characteristic |
| CP | Compact Position Solution |
| DC | Differential Corrections (DGPS ready units only) |
| DD | Delta Differential Corrections (DGPS ready units only) |
| ID | Vehicle ID |
| IP | Initial Position |
| LN | Long Navigation Message |
| PT | Port Characteristic |
| PV | Position/Velocity Solution |
| RM | Reporting Mode |
| ST | Status |
| TM | Time/Date |
| VR | Version Number |

## Message Format

All TAIP communication uses printable, uppercase ASCII characters. The interface provides the means to configure the unit to output various sentences in response to query or on a scheduled basis. Each sentence has the following general format:

>*ABB*{*C*}[;ID=*DDDD*][;**FF*]<

where:

| | |
|---|---|
| > | start of new message, |
| *A* | message qualifier, |
| *B B* | a two character message identifier, |
| *C* | data string, |
| *DDDD* | optional 4 character vehicle ID, |
| *FF* | optional 2 character checksum, |
| < | the delimiting character. |

Notation:

| | |
|---|---|
| {*x*} | signifies that x can occur any number of times. |
| [*x*] | signifies that x may optionally occur once. |

### Start of new message

The '>' character (ASCII code 62 decimal) is used to specify the start of a new sentence.

### Message Qualifier

A one character message qualifier is used to describe the action to be taken on the message. The following table lists the valid qualifiers:

| Qualifier | Action |
|---|---|
| Q | Query for a single sentence (sent to GPS sensor). |
| R | Response to a query or a scheduled report (from the sensor) |
| F | Schedule reporting frequency interval in seconds |
| S | Set command to download time to the GPS receiver |
| D | Specify a minimum distance traveled and a minimum and maximum time interval for the next report |

Details on the use of message qualifiers are given in the last section of this appendix, *Communication Using TAIP.*

◆ NOTE: *All TAIP message characters must be in uppercase.*

**Message Identifier**

A unique two character message identifier consisting of letters of alphabet is used to identify different type messages.

**Data String**

The format and length of the data string are dictated by the message qualifier and the message identifier. It can consist of any printable ASCII character with the exception of the '>', '<', and ';' characters. A detailed descriptions of each message format is given later. Most messages are length sensitive and unless otherwise specified, field separators including space are not used.

**Vehicle ID**

A vehicle identification(ID) may optionally be used in all the communications with the sensor. Each sensor in the fleet may be assigned a four character alpha-numeric ID and be forced to output that ID in all messages. The default is: ID set to '0000' and the ID Flag set to 'F' (false).

The sensor will check all incoming messages for ID. If no ID is specified, the sensor will accept the message. If the ID is included in messages but does not compare with the ID previously set, the message will be ignored. This applies even when the ID Flag is turned off.

**Checksum**

The checksum field provides for an optional two digit hex checksum value, which is computed as XOR of *all characters* from the beginning of the sentence up to and including the '*' character. If provided, the checksum is always the last element of the sentence before the message delimiter. The default mode of operation is to include checksum in sentences. The use of checksums can help in instances where the communication channel is noisy.

**Example**

The following message to set the vehicle ID flag on includes checksum.

```
>SRM;ID_FLAG=T;*6F<
```

The checksum (6F) was generated by XOR'ing the ASCII codes for '>' and 'S' then XOR'ing that result with the ASCII code for 'R' and so forth, up to and including the '*' character.

**Message Delimiter**

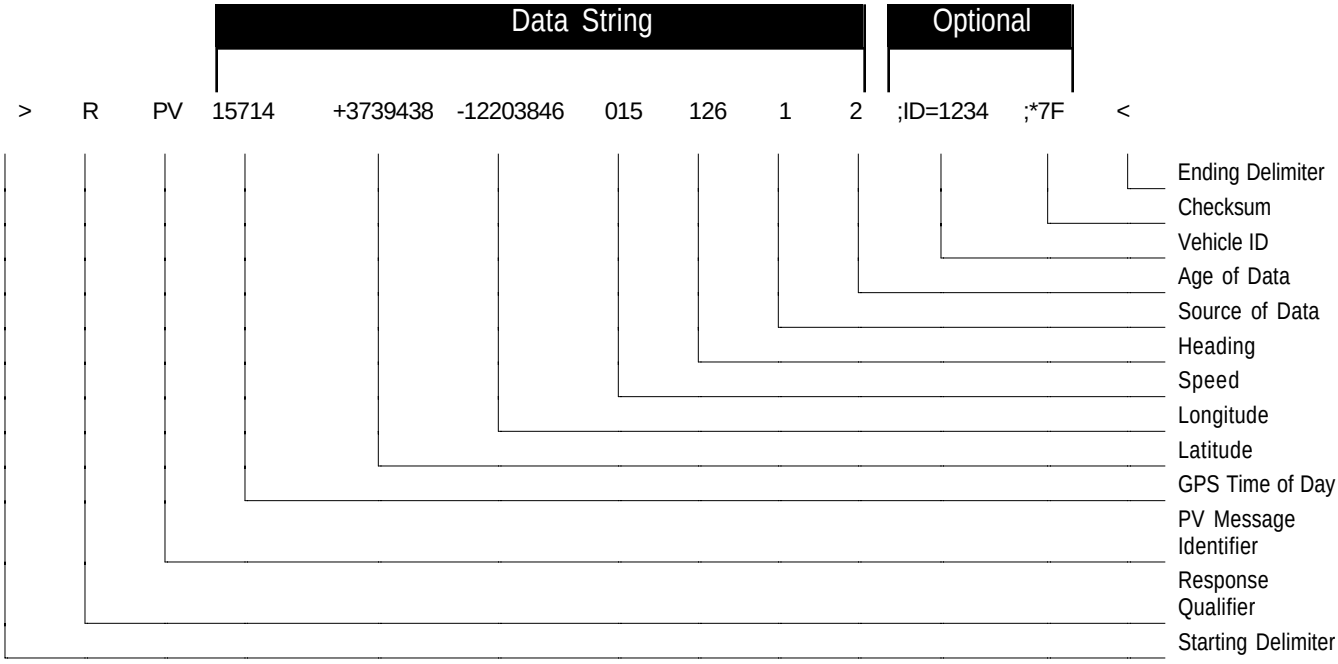
The '<' character signifies end of a sentence and is used as the message delimiter.

## Sample PV Message

The Position/Velocity Solution (PV) message is one of the more commonly used TAIP messages and most sensors using TAIP are set by default to output the PV message once every 5 seconds.

The following analysis of a typical PV message is provided to further explain the TAIP message protocol.

**>RPV15714+3739438-1220384601512612;ID=1234;*7F<**




## Data String Information

| | |
|---|---|
| GPS Time of Day : | 15714 seconds, 04:21:54 GPS (time of last fix) |
| Latitude: | +37.39438 degrees |
| Longitude: | -122.03846 degrees |
| Speed: | 15 MPH |
| Heading: | 126 degrees |
| Source of Data: | 3D GPS |
| Age of Data: | Fresh (<10 seconds) |

- NOTE: *Refer to the discussion of the PV message data string for more detail on how this message is interpreted.*

## Time and Distance Reporting

The "D" message qualifier allows you to specify a minimum distance traveled as well as a minimum and maximum time interval for the next report. Units that are stationed at a fixed location can be programmed to report only when the unit moves "off station" or after a certain elapsed time since last report, but no more often than the specified minimum time interval.

The message format used with the D qualifier is shown below:

>DAABBBBCCCCEEEEFFFF[;ID=GGGG][;*HH]<

| ID | Meaning |
|---|---|
| > | start of message delimiter |
| D | the Distance message qualifier |
| *AA* | message to report (i.e. PV means Position Velocity message) |
| *BBBB* | minimum time (seconds) interval between reports ($T_{interval}$) |
| *CCCC* | report epoch (number of seconds from top of the hour) |
| *EEEE* | delta distance (meters) from last reported distance |
| *FFFF* | maximum time (seconds) interval between reports ($T_{max}$) |
| *GGGG* | optional vehicle identification number (user selected) |
| *HH* | optional checksum |
| < | End of message delimiter |

◆ Note that if BBBB = 0, then the message output is disabled. If FFFF = 0, maximum time feature is disabled (the unit will only report if current position is greater than or equal to the delta distance specified in EEEE).

For example, when the message: >DPV0030000505000900;ID=0105< is sent to the GPS receiver, it specifies that vehicle number 105 (*GGGG* = 0105) is to report the Position Velocity message (*AA* = PV) whenever its current position differs from the previously reported position by at least 500 meters (*EEEE* = 0500), but no more often than every 30 seconds (*BBBB* = 0030) or less often than every 15 minutes (*FFFF* = 0900 seconds). The minimum and maximum time-out reports are to be issued with a 5 second offset (*CCCC* = 0005) from the top of the hour. The optional checksum was not used in this example. The square brackets, [. . .], shown in the format description above are used to indicate optional data. The brackets themselves are never included in the actual TAIP message string.

## Latitude and Longitude Conversion

The TAIP protocol reports latitude as positive north decimal degrees and longitude as positive east decimal degrees, using the WGS-84 datum. For your application, you may wish to convert to degrees, minutes and seconds. The following example illustrates the conversion of decimal degrees to degrees, minutes and seconds.

### Example

Given latitude and longitude in decimal degrees,

Latitude: +37.39438 degrees

Longitude: -122.03846 degrees

Convert latitude by multiplying the decimal fraction of degrees by 60 to convert to minutes,

0.39438 x 60 = 23.6628 minutes

Retain the integer (23) portion as the minutes then multiply the decimal fraction by 60 to convert to seconds,

0.6628 x 60 = 39.768 seconds

Since the sign of the latitude in this example is positive the result is:

Latitude: N 37$^{o}$ 23' 39.77"

The longitude is converted in the same fashion:

Longitude: W 122$^{o}$ 02' 18.46"

- NOTE: *at the earth's equator, one degree of latitude and longitude represents 68.7 miles; therefore, 0.00001 degrees represents approximately 3.6 feet or 1.1 meters. Each second represents approximately 100.76 ft (30.7 m).*

## Message Data Strings

The following table lists all the TAIP messages currently defined and comments regarding their application:

| Message Identifier | Message Name | *Comments* |
|---|---|---|
| AL | Altitude/Vertical Velocity | |
| AM | Alarm | Placer™ GPS/DR only |
| AP | Auxiliary Port Characteristic | dual port units only |
| CP | Compact Position Solution | |
| DC | Differential Corrections | DGPS units only |
| DD | Delta Differential Corrections | DGPS units only |
| ID | Vehicle ID | |
| IP | Initial Position | |
| LN | Long Navigation Message | |
| PT | Port Characteristic | |
| PV | Position/Velocity Solution | |
| RM | Reporting Mode | |
| ST | Status | |
| TM | Time/Date | |
| VR | Version Number | |
| X1 | Extended Diagnostics Message 1 | Placer™ GPS/DR only |

The data string format of each message is described in the following pages.

- NOTES: *Your Trimble GPS sensor may not support all the message types. Please refer to page 1 of this appendix for a list of the messages your sensor supports.*

  *All TAIP message characters must be in uppercase.*

## AL Altitude/Up Velocity

Data String Format:

*AAAAABBBBBBCCCCDE*

| Item | # of Char | UNITS | Format (Value) |
|---|---|---|---|
| GPS Time of day | 5 | Sec | *AAAAA* |
| Altitude | 6 | Meters | *BBBBBB* |
| Vertical Velocity | 4 | MPH | *CCCC* |
| Source | 1 | n/a | *D* (0 = 2D GPS)<br>(1 = 3D GPS)<br>(2 = 2D DGPS)<br>(3 = 3D DGPS)<br>(6 = DR)<br>(8 = Degraded DR)<br>(9 = Unknown) |
| Age of Data Indicator | 1 | n/a | *E* (2 = Fresh, <10 sec)<br>(1 = Old, ≥10 sec)<br>(0 = Not available) |
| Total | 17 | | |

Altitude is above mean sea level in WGS-84. The GPS time of day is the time of fix rounded to the nearest second. This message contains data obtained from the last 3 dimensional fix and my not be current.

◆ NOTE: *The data in this message is to be considered invalid and should not be used, if the "Age of Data Indicator" is equal to 0 (signifying data not available).*

## AM Alarm

Data String Format:

*AAAAABBBCCCCCDDDDEEEEEFFFGGGHIJKK{L}*

| Item | # of Char | UNITS | Format (Value) |
|---|---|---|---|
| GPS Time of day | 5 | Sec | *AAAAA* |
| Latitude | 8 | Deg | *BBB.CCCCC* |
| Longitude | 9 | Deg | *DDDD.EEEEE* |
| Speed | 3 | MPH | *FFF* |
| Heading | 3 | Deg | *GGG* |
| Alarm Code | 1 | n/a | *H* (U =User generated) |
| Source | 1 | n/a | *I* (0 = 2D GPS)<br>(1 = 3D GPS)<br>(2 = 2D DGPS)<br>(3 = 3D DGPS)<br>(6 = DR)<br>(8 = Degraded DR)<br>(9 = Unknown) |
| Age of Data Indicator | 1 | n/a | *J* (2 = Fresh, <10 sec)<br>(1 = Old, ≥10 sec)<br>(0 = Not available) |
| Length of Optional String (n) | 2 | n/a | *K K* |
| Optional String | n | n/a | *{L}* |
| Total | 33 + Length of Optional String | | |

This message is generated when an alarm condition is present. The Alarm Code indicates the reason for the generated alarm message. The frequency of the message output is system dependent. In some systems, once an alarm condition is present, this message is output periodically until the alarm is "acknowledged" by sending the unit the appropriate frequency message, setting the frequency of output for AM to zero (>FAM000<).

Position is in latitude (positive north) and longitude (positive east) WGS-84. Heading is in degrees from True North increasing eastwardly. The 'GPS time of day' is the time of fix rounded to the nearest second.

- NOTE: *The AM message applies only to the Placer GPS/DR sensor. The SVeeSix does not support the AM message.*

## AP Auxiliary Port Characteristic

Data String Format:

*AAAA,B,C,D,E,F*

| Item | # of Char | UNITS | Format | (Value) |
|---|---|---|---|---|
| Baud Rate | 4 | n/a | *AAAA* | (9600, 4800, 2400, 1200, *or* 0300) |
| # of data bits | 1 | n/a | *B* | (7 or 8) |
| # of stop bits | 1 | n/a | *C* | (1 or 2) |
| Parity | 1 | n/a | *D* | (N = None) (O = Odd) (E = Even) |
| Auxiliary Port Number | 1 | n/a | *E* | ( 1 ) |
| Reserved | 1 | n/a | *F* | ( 0 ) |
| Total | 14 (including commas) | | | |

This message defines the characteristics for the auxiliary port. The auxiliary port is usually the RTCM input port on differential ready sensors.

The default settings of the auxiliary port are 1200 baud, 8 data bits, parity none, and 1 stop bit.

### Example

The following command will set the auxiliary port characteristics to 2400 baud, 8 data bits, 1 stop bit and no parity.

```
>SAP2400,8,1,N,1,0<
                  |
                  |_____  Note the inclusion of '0' in the
                          reserved field
```

- NOTES: *The AP command applies only to receivers with dual serial ports.*
  *The SVeeSix is a single port module and does not support the AP command.*
  *The AP command requires commas between data fields.*

## CP Compact Position Solution

Data String Format:

*AAAAABBBCCCCDDDDEEEEFG*

| Item | # of Char | UNITS | Format | (Value) |
|---|---|---|---|---|
| GPS Time of day | 5 | Sec | *AAAAA* | |
| Latitude | 7 | Deg | *BBB.CCCC* | |
| Longitude | 8 | Deg | *DDDD.EEEE* | |
| Source | 1 | n/a | *F* | (0 = 2D GPS)<br>(1 = 3D GPS)<br>(2 = 2D DGPS)<br>(3 = 3D DGPS)<br>(6 = DR)<br>(8 = Degraded DR)<br>(9 = Unknown) |
| Age of Data Indicator | 1 | n/a | *G* | (2 = Fresh, <10 sec)<br>(1 = Old, ≥10 sec)<br>(0 = Not available) |
| Total | 22 | | | |

Position is in latitude (positive north) and longitude (positive east) WGS-84. The GPS time of day is the time of fix rounded to the nearest second.

◆ NOTE: *The data in this message is to be considered invalid and should not be used, if the "Age of Data Indicator" is equal to 0 (signifying data not available).*

## DC Differential Corrections

This message provides the sensor with differential corrections from RTCM-104 record types 1 and 9. The values are numerical values written out in hex format, thus for each byte of data there is a two digit hex number.

The format of the data string is as follows:

*AAAABBCC{DDEEEEFFGG}*

| Item | # of Char | Type | UNITS | Format |
|---|---|---|---|---|
| Modified Z-count | 4 | WORD | .6 sec | *AAAA* |
| Station health | 2 | BYTE | n/a | *BB* |
| Number of SVs | 2 | BYTE | n/a | *CC* |
| *The next 5 bytes (10 characters) are repeated for each SV* | | | | |
| SV PRN & health (UDRE) | 2 | BYTE | n/a | *DD* |
| Range Correction | 4 | WORD | RTCM-104 | *EEEE* |
| Range-rate correction | 2 | BYTE | RTCM-104 | *FF* |
| IODE | 2 | BYTE | n/a | *GG* |

The units and scale factors are as defined by RTCM-104 version 1. The SV PRN and health contains the SV PRN in the lower 5 bits and the health/UDRE/scale factor in the upper 3 bits. Range corrections are scaled by 0.02 meters times 2 raised to the "health" power. Range-rate corrections are scaled by 0.002 meters per second times 2 raised to the "health" power.

- NOTES: *The DC and DD TAIP messages described herein apply only to differential ready sensors and are provided to enclose differential corrections within the TAIP format. Most differential ready SVeeSix family sensors are also equipped with an auxiliary port to receive RTCM-104 formatted differential corrections directly.*
  *Use of DC and DD messages to input corrections requires only one communications channel. Use of the auxiliary port to input RTCM-104 corrections assumes a separate communications channel is available for broadcast and receipt of differential corrections.*
  *The TAIP software toolkit, GPSSK, does not support DC and DD messages.*

## DD Delta Differential Corrections

This message provides the sensor with delta differential corrections from RTCM-104 record type 2. The values are numerical values written out in hex format, thus for each byte of data there is a two digit hex number.

The format of the data string is as follows:

*AAAABB*{*CCDDDD*}

| Item | # of Char | Type | UNITS | Format |
|---|---|---|---|---|
| Modified Z-count | 4 | WORD | .6 sec | *AAAA* |
| Number of SVs | 2 | BYTE | n/a | *BB* |
| *The next 3 bytes (6 characters) are repeated for each SV* | | | | |
| SV PRN | 2 | BYTE | n/a | *CC* |
| Delta Range Correction | 4 | WORD | RTCM-104 | *DDDD* |

The units and scale factors are as defined by RTCM-104 version 1. The health/UDRE/scale factor given for the specific SV in the most recent message "DC" is used. Delta range corrections are scaled by 0.02 meters times 2 raised to the "health" power.

- NOTES: *The DC and DD TAIP messages described herein apply only to differential ready sensors and are provided to enclose differential corrections within the TAIP format. Most differential ready SVeeSix family sensors are also equipped with an auxiliary port to receive RTCM-104 formatted differential corrections directly.*

  *Use of DC and DD messages to input corrections requires only one communications channel. Use of the auxiliary port to input RTCM-104 corrections assumes a separate communications channel is available for broadcast and receipt of differential corrections.*

  *The TAIP software toolkit, GPSSK, does not support DC and DD messages.*

## ID

## Identification Number

Data String Format:

*AAAA*

| Item | # of Char | UNITS | Format |
|---|---|---|---|
| Vehicle ID | 4 | n/a | *AAAA* |
| Total | 4 | | |

This message is used to report or set the vehicle's (or sensor's) unique, four character, alpha-numeric, user assigned ID. The default at cold start is '0000'.

### Example

The following message will set the vehicle ID to 101.

```
>SID0101<
```

The following is simply a response to a query for vehicle ID.

```
>RID0101<
```

- NOTE: *The sensor will always check incoming messages for ID and compare with the vehicle ID set in the sensor's memory. If no ID is included in the message, the sensor will assume a match and accept the message. If the message sent to the sensor does contain a vehicle ID but that ID does not match the ID previously set in the sensor, the message will be ignored. This process is followed even when the ID_Flag is turned off (refer to the message RM).*

IP

## Initial Position

Data String Format:

*AAABBBBCCCCC*

| Item | # of Char | UNITS | Format |
|---|---|---|---|
| Initial Latitude | 3 | Deg | *AAA* |
| Initial Longitude | 4 | Deg | *BBBB* |
| Initial Altitude | 5 | 10 Meters | *CCCCC* |
| Total | 12 | | |

This is a very coarse initial position that the user can provide to aid the sensor in obtaining its first fix. This is specially useful with sensors that do not have non-volatile (Battery Backed-up) memory. In such cases, every time the unit is powered up, it goes through a complete cold-start and it has absolutely no knowledge of where it is. Providing this message improves performance by decreasing the time to first fix and enhances the accuracy of the initial two dimensional navigation solutions by providing a reference altitude. In case of units with non-volatile memory, sending this message is only helpful if the unit has moved more than 1,000 miles since its previous fix. In either case, the sensor can initialize itself appropriately without any data from the user; It merely requires more time.

- NOTE: *For all the above values, the first character specifies the sign (+/-).*

Example

The following message will set the initial position to 37º North, 122º West, altitude 10 meters.

```
>SIP+37-122+0001<
```

## LN Long Navigation Message

Data String Format:

*AAAAABBBCCCDDDDDDDEEEEFFFFFFFGGGGGGGHHIIIJKK*
*KKLMMMNOO{PPQQ}RRRRRRRRRST*

| Item | # of Char | UNITS | Format (Value) |
|---|---|---|---|
| GPS Time of day | 8 | Sec | *AAAAA.BBB* |
| Latitude | 10 | Deg | *CCC.DDDDDDD* |
| Longitude | 11 | Deg | *EEEE.FFFFFFF* |
| Altitude above MSL | 9 | Ft | *GGGGGGG.HH* |
| Horizontal Speed | 4 | MPH | *III.J* |
| Vertical Speed | 5 | MPH | *KKKK.L* |
| Heading | 4 | Deg | *MMM.N* |
| Number of SVs used | 2 | n/a | *OO* |
| *The following two entries (4 characters) are repeated for each SV used:* | | | |
| SV Id | 2 | n/a | *PP* |
| IODE (2 digit hex) | 2 | n/a | *QQ* |
| Reserved | 10 | n/a | *RRRRRRRRRR* |
| Source | 1 | n/a | *S* (0 = 2D GPS)<br>(1 = 3D GPS)<br>(2 = 2D DGPS)<br>(3 = 3D DGPS)<br>(6 = DR)<br>(8 = Degraded DR)<br>(9 = Unknown) |
| Age of Data Indicator | 1 | n/a | *T* (2 = Fresh, <10 sec)<br>(1 = Old, ≥10 sec)<br>(0 = Not available) |
| Total | 65 + (Number of SV's used times 4) | | |

Position is in latitude (positive north) and longitude (positive east) WGS-84. Heading is in degrees from True North increasing eastwardly. The GPS time of day is the time of fix rounded to the nearest second.

◆ NOTE: *The data in this message is to be considered invalid and should not be used, if the "Age of Data Indicator" is equal to 0 (signifying data not available).*

## PT Port Characteristic

Data String Format:

*AAAA,B,C,D*

| Item | # of Char | UNITS | Format | (Value) |
|---|---|---|---|---|
| Baud Rate | 4 | n/a | *AAAA* | (9600, 4800, 2400, 1200, *or* 0300) |
| # of data bits | 1 | n/a | *B* | (7 or 8) |
| # of stop bits | 1 | n/a | *C* | (1 or 2) |
| Parity | 1 | n/a | *D* | (N = None)<br>(O = Odd)<br>(E = Even) |
| Total | 10 (including commas) | | | |

This message defines the characteristics for the primary TAIP port.

Most TAIP using sensors use the following default port characteristics (consult the *Installation and Operator's Manual*):

4800 baud

8 data bits

1 stop bit

No parity

◆ NOTES: *The characteristics set by this message will be stored in the sensor's memory. The SVeeSix family of sensors do not include an internal battery but provide a battery back-up input line that may be used to retain memory when main power is removed.*

*If you do not use battery back-up, all port characteristics will reset to the default after power is removed.*

*The PT command uses commas between data fields.*

## PV Position/Velocity Solution

Data String Format:

*AAAAABBBCCCCCDDDDEEEEEFFFGGGHI*

| Item | # of Char | UNITS | Format (Value) |
|---|---|---|---|
| GPS Time of day | 5 | Sec | *AAAAA* |
| Latitude | 8 | Deg | *BBB.CCCCC* |
| Longitude | 9 | Deg | *DDDD.EEEEE* |
| Speed | 3 | MPH | *FFF* |
| Heading | 3 | Deg | *GGG* |
| Source | 1 | n/a | *H* (0 = 2D GPS)<br>(1 = 3D GPS)<br>(2 = 2D DGPS)<br>(3 = 3D DGPS)<br>(6 = DR)<br>(8 = Degraded DR)<br>(9 = Unknown) |
| Age of Data Indicator | 1 | n/a | *I* (2 = Fresh, <10 sec)<br>(1 = Old, ≥10 sec)<br>(0 = Not available) |
| Total | 30 | | |

Position is in latitude (positive north) and longitude (positive east) WGS-84. Heading is in degrees from True North increasing eastwardly. The GPS time of day is the time of fix rounded to the nearest second.

- NOTE: *The data in this message is to be considered invalid and should not be used, if the "Age of Data Indicator" is equal to 0 (signifying data not available).*

## RM

## Reporting Mode

Data String Format:

[;ID_FLAG=*A*][;CS_FLAG=*B*][;EC_FLAG=*C*] [;FR_FLAG=*D*]
[;CR_FLAG=E]

| Item | # of Char | UNITS | Format (Value) |
|---|---|---|---|
| ID Flag | 1 | n/a | *A* (T = True, F = False) |
| CS Flag | 1 | n/a | *B* (T = True, F = False) |
| EC Flag | 1 | n/a | *C* (T = True, F = False) |
| FR Flag | 1 | n/a | *D* (T = True, F = False) |
| CR Flag | 1 | n/a | *E* (T = True, F = False) |

ID Flag dictates whether the unit is to include the vehicles ID with each report.

CS Flag dictates whether the unit is to include a checksum as part of each message.

EC Flag , when set, will cause the unit to echo back all complete and properly formatted set commands, except for DC and DD, with a "Response" qualifier. This provides an easy way to verify that the unit did in fact receive the intended data.

FR Flag indicates whether the unit is to report messages automatically per their individually scheduled frequency. When set to false, the unit will only respond when queried for a specific message.

CR Flag, when set to True, will cause the sensor to append a carriage return and line feed [CR] [LF] to the end of each message output. This is useful when viewing the unencoded sensor responses on a terminal or a PC.

The default value at start-up for ID flag and the CR flag is false; the default for CS, EC and FR flags is true.

### Example

The following command will turn checksums off and carrage return on:

```
>SRM;CS_FLAG=F;CR_FLAG=T<
```

Note the use of semicolon before the flag name.

## ST Status

Data String Format:

*AABCDDEFGG*

◆ NOTE: *This message provides information about the satellite tracking status and the operational health of the sensor. This information is contained in five status bytes which are output as five 2 digit hexadecimal values. The data format and the meanings of the hex characters are given in the following tables.*

| Item | # of Char | UNITS | Format | |
|---|---|---|---|---|
| Tracking Status Code | 2 | n/a | *AA* | (see table below) |
| Error Codes - Nibble 1 | 1 | n/a | *B* | (see table below) |
| Error Codes - Nibble 2 | 1 | n/a | *C* | (see table below) |
| Machine ID | 2 | n/a | *DD* | |
| Error Codes - Nibble 3 | 1 | n/a | *E* | (not currently used) |
| Error Codes - Nibble 4 | 1 | n/a | *F* | (see table below) |
| (reserved) | 2 | n/a | *GG* | (not currently used) |

Tracking Status Code

| Value of *AA* | Meaning |
|---|---|
| 00 | Doing position fixes |
| 01 | Don't have GPS time yet |
| 02 | Not used |
| 03 | PDOP is too high |
| 08 | No usable satellites |
| 09 | Only 1 usable satellite |
| 0A | Only 2 usable satellites |
| 0B | Only 3 usable satellites |
| 0C | 6-Ch units only: the chosen satellite is unusable. |

## ST Status (continued)

◆ NOTE: *In the tables below, an X in a column means that fault is being reported.*

### Error Codes – Nibble 1

| Value of *B* | Meaning | |
|---|---|---|
| | No Problems | Reported |
| 0 | | |
| 1 | | X |
| 2 | X | |
| 3 | X | X |

Antenna feedline fault (Note 2)

Excessive ref freq error (Note 3)

### Error Codes – Nibble 2

| Value of *C* | Meaning | | | |
|---|---|---|---|---|
| | No Problems | | Reported | |
| 0 | | | | |
| 1 | | | | X |
| 2 | | | X | |
| 3 | | | X | X |
| 4 | | X | | |
| 5 | | X | | X |
| 6 | | X | X | |
| 7 | | X | X | X |
| 8 | X | | | |
| 9 | X | | | X |
| A | X | | X | |
| B | X | | X | X |
| C | X | X | | |
| D | X | X | | X |
| E | X | X | X | |
| F | X | X | X | X |

Battery back-up failed (Note 1)

Signal Processor error (Note 1)

Alignment error, channel or chip 1, (Note 1)

Alignment error, channel or chip 2, (Note 1)

## ST Status (continued)

### Error Codes – Nibble 4

| Value of *F* | Meaning | | | |
|---|---|---|---|---|
| 0 | No Problems | Reported | | |
| 1 | | | | X |
| 2 | | | X | |
| 3 | | | X | X |
| 4 | | X | | |
| 5 | | X | | X |
| 6 | | X | X | |
| 7 | | X | X | X |
| 8 | X | | | |
| 9 | X | | | X |
| A | X | | X | |
| B | X | | X | X |
| C | X | X | | |
| D | X | X | | X |
| E | X | X | X | |
| F | X | X | X | X |

Synthesizer Fault

Battery Powered Timer/Clock Fault

A - to - D Converter Fault

The stored almanac is not complete or current.

◆ NOTES: *(1) After this error is detected, its bit remains set until the sensor is reset.*

*(2) The SVeeSix family of OEM modules do not support antenna feed line fault detection.*

*(3) This bit is "1" if the last computed reference frequency error indicated that the reference oscillator is out of tolerance.*

## TM Time/Date

Data String Format:

*AABBCCDDDEEFFGGGGHHIJJKLLLLL*

| Item | # of Char | UNITS | Format (Value) |
|---|---|---|---|
| UTC Time of Day | | | |
| Hours | 2 | Hour | *A A* |
| Minutes | 2 | Min | *B B* |
| Seconds | 5 | Sec | *CC.DDD* |
| Date; Day | 2 | Day | *EE* |
| Date; Month | 2 | Month | *FF* |
| Date; Year | 4 | Year | *GGGG* |
| GPS/UTC Time Offset | 2 | Sec | *H H* |
| Current Fix Source | 1 | n/a | *I* (0 = 2D GPS)<br>(1 = 3D GPS)<br>(2 = 2D DGPS)<br>(3 = 3D DGPS)<br>(6 = DR)<br>(8 = Degraded DR)<br>(9 = Unknown) |
| Number of Usable SVs | 2 | n/a | *JJ* |
| GPS/UTC Offset Flag | 1 | n/a | *K* (1 = Valid)<br>(0 = Invalid) |
| Reserved | 5 | n/a | *LLLLL* |
| Total | 28 | | |

This message outputs the time and date as computed by the GPS sensor. The time is most accurate when the unit is doing fixes. It is less accurate but still usable when the unit is not doing fixes but the 'Number of Usable SVs' is one or more.

◆ NOTE: *GPS/UTC Time Offset is the difference between GPS and UTC time standards in seconds. The 'UTC time of Day' is only valid if the 'GPS/UTC Offset Valid Flag' is indicating valid.*

## TM Time/Date (continued)

The TM mesage is supported under the Set qualifier which allows you to download time to a GPS receiver that does not have a real-time clock. Fields AA through GGGG must be downloaded but the remaining fields may be filled with zeros (0) to create a total data stream of 28 characters. For warm-start performance, downloaded time must only be accurate to ±5 minutes so the entire field may be filled with zeros. However if you wish to specify seconds, use a format such as 08150 to represent 8.15 seconds. The reserved field, *GGGGGGGGGG*, should be filled with zeros.

For example, when the >STM19250000028061994000000000000< message is sent to the GPS receiver, it specifies that the receiver should set its internal time to 19:25 (7:25 PM) UTC, 28 June 1994. The time downloaded to the receiver should be accurate to ±5 minutes (use UTC, not local time) for optimum warm start or hot start acquisition.

## VR Version Number

Data String Format:

*XXXXXXX ;VERSION A.AA(BB/BB/BB); CORE VERSION C.CC (DD/DD/DD); E*

| Item | # of Char | UNITS | Format |
|---|---|---|---|
| Product Name | n | n/a | n/a |
| Major Version number | 4 | n/a | *A.AA* |
| Major Release Date | 8 | n/a | *BB/BB/BB (month/day/year)* |
| Core Version number | 4 | n/a | *C.CC* |
| Core Release Date | 8 | n/a | *DD/DD/DD (month/day/year)* |
| Copyright Text | variable | n/a | |

- NOTE: *The length of this message is variable based upon copyright text string.*

  *The phrase CoreVersion refers to the signal processing firmware version.*

## X1 Extended Diagnostics Message 1; Dead Reckoning

Data String Format:

*,A,BC,DDDDDDD,EF,GG.GGGG,HH.HHHH,II.IIII*

| Item | # of Char | UNITS | Format |
|---|---|---|---|
| Diagnostics sub-message ID | 1 | n/a | *A* |
| Odometer Status 1 | 1 | n/a | *B* (reserved) |
| Odometer Status 2 | 1 | n/a | *C* (see table below) |
| Odometer Scale Factor | 7 | Pulses/Mile | *DDDDDDD* |
| Gyro Status 1 | 1 | n/a | *E* (reserved) |
| Gyro Status 2 | 1 | n/a | *F* (see table below) |
| Gyro Rate Bias | 7 | Deg/Sec | *GG.GGGG* |
| Gyro Left Scale Factor | 7 | n/a | *HH.HHHH* |
| Gyro Right Scale Factor | 7 | n/a | *II.IIII* |
| Total | 40 (Including commas and decimal points) | | |

◆ NOTE: *The X1 message applies only to the Placer GPS/DR sensor. The SVeeSix does not support the X1 message.*

### Odometer Status 2

| Value of *C* | Meaning: No Problems Reported | Back-up light active | Odometer scale factor is out of tolerance | No pulses received from odometer since start-up |
|---|---|---|---|---|
| 0 | | | | |
| 1 | | | | X |
| 2 | | | X | |
| 3 | | | X | X |
| 4 | | X | | |
| 5 | | X | | X |
| 6 | | X | X | |
| 7 | | X | X | X |

## X1 Extended Diagnostics Message 1; Dead Reckoning (continued)

### Gyro Status 2

| Value of *F* | Meaning | | | |
|---|---|---|---|---|
| 0 | No Problems | Reported | | |
| 1 | | | | X |
| 2 | | | X | |
| 3 | | | X | X |
| 4 | | X | | |
| 5 | | X | | X |
| 6 | | X | X | |
| 7 | | X | X | X |
| 8 | X | | | |
| 9 | X | | | X |
| A | X | | X | |
| B | X | | X | X |
| C | X | X | | |
| D | X | X | | X |
| E | X | X | X | |
| F | X | X | X | X |

Gyro hardware failed internal diagnostics

Gyro bias is out of tolerance

Gyro scale factors out of tolerance

Gyro reference voltage is out of tolerance

**Example**

An Odometer Status 2 value of '0' indicates no faults. An Odometer Status 2 value of '4' simply indicates the backup light is active. An Odometer Status 2 value of '2' indicates the odometer scale factor is out of tolerance.

**Example**

A Gyro Status 2 value of '0' indicates no faults. A Gyro Status 2 value of '5' indicates the gyro hardware failed the internal diagnostics and that the scale factors are out of tolerance.

◆ NOTE: *For more information on Dead Reckoning and the meaning of terms used in this message, consult the Placer GPS/DR Installation and Operator's Manual.*

## Communication Using TAIP

Communication with the unit takes place in four different ways. Message qualifiers are used to differentiate between these.

### Query for single sentence

The query(Q) message qualifier is used to query the GPS sensor to respond immediately with a specific message. The format is:

>QAA[;ID=BBBB][;*CC]<

where AA is the requested message identifier. Messages supported by this qualifier are AL, AM, AP, CP, ID, IP, LN, PT, PV, RM, ST, TM, VR, and X1.

### Scheduled reporting frequency interval

The scheduled reporting frequency interval(F) message qualifier is used to tell the unit how often and when to report a specific message. The format is:

>FAABBBBCCCC[;ID=DDDD][;*FF]<

where sending this sentence tells the unit to report message specified by the two digit identifier AA at the time interval of BBBB seconds with time epoch at CCCC seconds from top of the hour. Specifying time interval of 0000 stops scheduled reporting of the message. The default is 0000 time interval for all messages except PV. The output frequency for PV at cold-start is set at once every five seconds, zero seconds from top of the hour. Messages supported by this qualifier are AL, AM, AP, CP, ID, IP, LN, PT, PV, RM, ST, TM, VR, and X1.

Note that what is specified by this qualifier is the timing of the message output and may be different from the time tag of the data in the message.

## Communication Using TAIP (continued)

### The Response to query or scheduled report

The response(R) qualifier carry various types of data between the unit and the user equipment. The format is:

>RAA[{B}][;ID=CCCC][;*DD]<

where AA is the two character message identifier and {B} specifies the data string within the message. For the format of {B}, please refer to the message definitions in the previous section. Messages supported by the response qualifier are AL, AM, AP, CP, ID, IP, LN, PT, PV, RM, ST, TM, VR, and X1.

### The Set qualifier

The set (S) qualifier enables the user equipment to initialize/set-up various types of data in the GPS unit. The format is:

>SAA[{B}][;ID=CCCC][;*DD]<

where AA is the two character message identifier and {B} specifies the data string within the message. For the format of {B}, please refer to the message definitions in the previous section. Note that all the messages have very specific formats and are length dependant. Messages normally supported by the set qualifier are AL, AP, CP, DC, DD, ID, IP, LN, PT, PV, RM and TM (the Placer GPS/DR does not support the set qualifier for the AP message).

The set qualifier may be used with the AL, CP, LN, or PV message to set more precise initial position data into the GPS sensor than can be set with the IP message.

## Communication Using TAIP (continued)

### Sample Communication Session

The following is a sample communication session to illustrate how message qualifiers are used. Query the sensor for version number for the TAIP firmware:

```
>QVR<
```

The sensor responds with a message in the following form:

```
>RVR SVEESIX   D;VERSION 4.06 (5/18/94); CORE VERSION 1.17
(11/21/93); COPYRIGHT (C) 1991, 1992, 1993, 1994 TRIMBLE
NAVIGATION,LTD.;*32<
```

Notice that the sensor identified its product name, firmware version number, core signal processing version number, and release dates, then included the checksum for the message (the default for the CS Flag is TRUE). Also notice that the sensor did respond to our query even though we did not send a checksum.

Query the sensor for its ID number:

```
>QID<
```

The sensor will respond (assuming factory default settings):

```
>RID0000;*70<
```

Set the ID to match the number for a vehicle in your fleet and then tell the sensor to include the Vehicle ID in its responses:

```
>SID1234<
```

```
>SRM;ID_FLAG=T<
```

Most Placer family sensors are set by default to report the PV message once every 5 seconds. (Note that the Placer GPS 400 ID receiver automatically outputs the TAIP LN messages required for IND/IO operations.) To schedule the PV message from vehicle 1234 to respond once every 10 seconds, starting at 5 seconds after the top of the hour, use the following command:

```
>FPV00100005;ID=1234<
```

The sensor will check the ID included in the message for a match with its own and then reschedule the PV message. At the next scheduled time, the sensor will respond with:

```
>RPV15714+3739438-1220384601512612;ID=1234;*7F<
```

Notice that the time given in the message is the time of the last GPS fix (04:21:54 GPS), not necessarily the time of the message response. If the time of last fix is 10 or more seconds old, the age flag will be set to '1'.