

smart  
positioning



REV 1.7

## ***NMEA Manual for Fastrax IT500 Series GPS receivers***

NMEA command manual for modules based on MediaTek  
chipset

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Fastrax Ltd.

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## CHANGE LOG

| Rev. | Notes   | Date       |
|------|---|------------|
| 1.0  | Initial revision  | 2009-06-02 |
| 1.1  | Added chapters 2.9.1 and 2.9.2. Fixed some typos. Added notes to 2.14.2 and 2.14.3  | 2009-06-09 |
| 1.2  | Added numbering into command title. Removed chapter 2.14.2 and 2.14.3   | 2009-09-15 |
| 1.3  | Added description of default output messages  | 2009-10-09 |
| 1.4  | Some changes to command 300 text  | 2009-11-20 |
| 1.5  | Addition to GGA message status field.<br>Added clear EPO and query EPO status commands.<br>Integrated reply messages to configuration commands. | 2010-02-17 |
| 1.6  | GGA message fix valid indicator values updated.<br>Note for enabling SBAS with PMTK313.<br>Added note about supported NMEA messages.            | 2010-04-18 |
| 1.7  | Added datums. Fixed PMTK30x responses   | 2010-07-21 |

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## COMPLEMENTARY READING

The following reference documents are complementary reading for this document:

| Ref. # | File name | Document name          |
|--------|-----------|------------------------|
| 1      |           | NMEA0183 specification |
|        |           |                        |
|        |           |                        |
|        |           |                        |
|        |           |                        |
|        |           |                        |
|        |           |                        |

# 1 NMEA OUTPUT

Standard NMEA0183 messages that are supported by IT500 series receivers

In default configuration outputted messages are GGA, RMC, GSV and GSA messages. Receiver can be configured to have user defined set of output messages by command PMTK314 described in chapter 2.12.

Outputted messages are utilized in GPS Workbench 4 to visualize the GPS data. Default output messages can cover most of the applications.

## 1.1 GGA - Global Positioning System Fix Data

Time, position and fix related data for a GPS receiver.

### Example:

```
$GPGGA,114353.000,6016.3245,N,02458.3270,E,1,10,0.81,35.2,M,19.5,M,,*50
```

### Format:

```
$GPGGA,hhmmss.dd,xxmm.dddd,<N|S>,yyymm.dddd,<E|W>,v,ss,d.d,h.h,M,g.g,M,a.a,xxxx*hh<CR><LF>
```

|            |   |
|------------|---|
| hhmmss.dd  | UTC time of the fix.<br>hh = hours<br>mm = minutes<br>ss = seconds<br>dd = decimal part of seconds  |
| xxmm.dddd  | Latitude coordinate.<br>xx = degrees<br>mm = minutes<br>dddd = decimal part of minutes  |
| <N/S>      | Character denoting either N = North or S =South.  |
| yyymm.dddd | Longitude coordinate.<br>yyy = degrees<br>mm = minutes<br>dddd = decimal part of minutes  |
| <E/W>      | Character denoting either E = East or W = West.   |
| v          | Fix valid indicator<br>1 = GPS fix (SPS)<br>2 = DGPS fix<br>3 = PPS fix<br>4 = Real Time Kinematic<br>5 = Float RTK<br>6 = estimated (dead reckoning) (2.3 feature)<br>7 = Manual input mode<br>8 = Simulation mode |
| ss         | Number of satellites used in position fix, 00-12. Notice: Fixed length field of two letters.  |
| d.d        | HDOP - Horizontal Dilution Of Precision.  |
| h.h        | Altitude (mean-sea-level, geoid)  |
| M          | Letter M.   |
| g.g        | Difference between the WGS-84 reference ellipsoid surface and the mean-sea-level altitude.  |
| M          | Letter M.   |

|      |   |
|------|---|
| a.a  | - |
| xxxx | - |

## 1.2 RMC - Recommended Minimum Specific GNSS Data.

Time, date, position, course and speed data.

### Example:

```
$GPRMC,114353.000,A,6016.3245,N,02458.3270,E,0.01,0.00,121009,,A*69
```

### Format:

```
$GPRMC,hhmmss.dd,S,xxmm.dddd,<N|S>,yyym.ddd,<E|W>,s.s,h,h,ddmmy,d,d,<E|W>,M*hh<CR><LF>
```

|           |  |
|-----------|--|
| hhmmss.dd | UTC time of the fix.<br>hh = hours<br>mm = minutes<br>ss = seconds<br>dd = decimal part of seconds |
| S         | Status indicator<br>A = valid<br>V = invalid   |
| xxmm.dddd | Latitude coordinate.<br>xx = degrees<br>mm = minutes<br>dddd = decimal part of minutes             |
| <N S>     | Character denoting either N = North or S = South.  |
| yyym.ddd  | Longitude coordinate<br>yyy = degrees<br>mm = minutes<br>ddd = decimal part of minutes             |
| <E W>     | Character denoting either E = East or W = West.  |
| s.s       | Speed in knots.  |
| h.h       | Heading  |
| ddmmy     | UTC Date of the fix.<br>dd = day of month<br>mm = month<br>yy = year                               |
| d.d       | Magnetic variation in degrees, not supported   |
| <E W>     | Letter denoting direction of magnetic variation. Either E = East or W = West. Not supported        |
| M         | Mode indicator<br>A=autonomous<br>N=data not valid   |

## 1.3 GSV - Satellites in view

Number of satellites in view, satellite ID (PRN) numbers, elevation, azimuth, and SNR value. The information for four satellites is a maximum per one message, additional messages up to maximum of eight are sent if needed. The satellites are in PRN number order.



**Example:**

```
$GPGSV,3,1,11,29,68,228,47,30,59,151,47,31,44,284,45,02,38,062,44*7C
$GPGSV,3,2,11,12,28,130,41,10,14,102,35,05,12,110,35,04,11,040,34*70
$GPGSV,3,3,11,21,05,196,29,16,05,297,28,13,02,021,30*4E
```

**Format:**

```
$GPGSV,n,m,ss,xx,ee,aaa,cn,,,,,,,,,,,,,xx,ee,aaa,cn*hh<CR><LF>
```

|     |   |
|-----|---|
| n   | Total number of messages, 1 to 9  |
| m   | Message number, 1 to 9  |
| ss  | Total number of satellites in view  |
| xx  | Satellite ID (PRN) number   |
| ee  | Satellite elevation, degrees 90 max   |
| aaa | Satellite azimuth, degrees True, 000 to 359   |
| ch  | Signal-to-noise ration (C/No) 00-99 dB-Hz. Value of zero means that the satellite is predicted to be on the visible sky but it isn't being tracked. |

## 1.4 GSA - DOP and Active Satellites

GPS receiver operating mode, satellites used in the navigation solution reported by the GGA sentence, and DOP values.

**Example:**

```
$GPGSA,A,3,02,21,30,04,16,05,10,12,31,29,,,1.33,0.81,1.06*02
```

**Format:**

```
$GPGSA,a,b,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,xx,p,p,h,h,v,v*hh<CR><LF>
```

|     |   |
|-----|---|
| a   | Mode:<br>M = Manual, forced to operate in 2D or 3D mode.<br>A = Automatic, allowed to automatically switch 2D/3D. |
| b   | Mode:<br>1 = Fix not available,<br>2 = 2D,<br>3 = 3D  |
| xx  | ID (PRN) numbers of GPS satellites used in solution   |
| p.p | PDOP  |
| h.h | HDOP  |
| v.v | VDOP  |

## 2 NMEA COMMANDS

Nmea commands are used to change or query settings of the module.

### Command Length:

The maximum length of each packet is restricted to **255** bytes

### Commands Contents:

**Preamble:** One byte character.

'\$'

**NMEA ID:** This will identify for the NMEA parser that it is command for MediaTek.

Four bytes character string.

"PMTK"

**Command Number:** Three bytes character string.

From "000" to "999"

An identifier used to tell the decoder how to decode the command

**DataField:** The DataField has variable length depending on the command type.

A comma symbol ',' must be inserted ahead each data filed to help the decoder process the DataField.

\*: 1 byte character.

The star symbol is used to mark the end of DataField.

**CHK1, CHK2:** Two bytes character string.

CHK1 and CHK2 are the checksum of the data between Preamble and '\*'. \*

**CR, LF:** Two bytes binary data.

The two bytes are used to identify the end of a command.

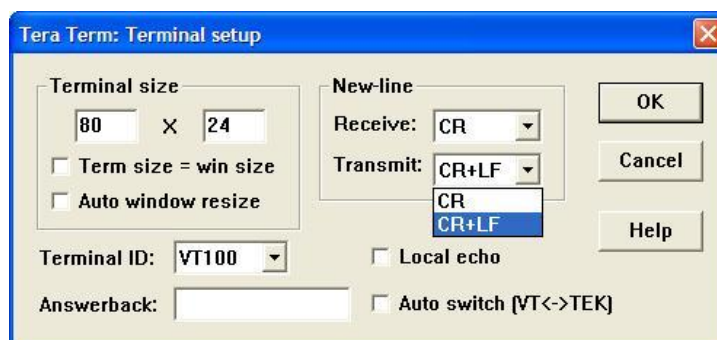
### Sample Command:

```
$PMTK000*32<CR><LF>
```

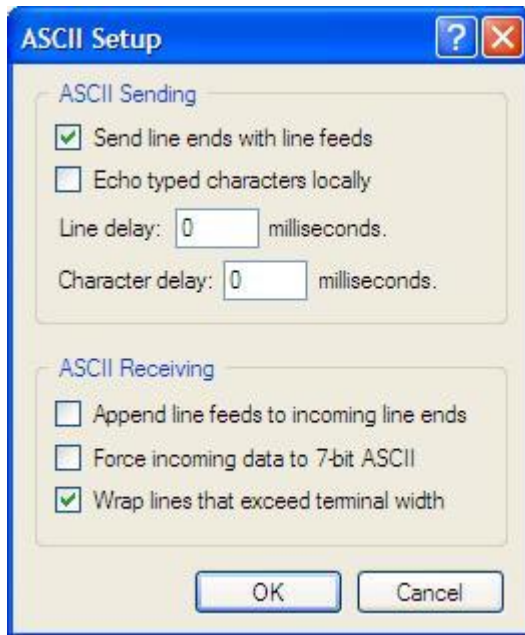
You can use for example TeraTerm as terminal program for giving the commands.

It can be downloaded from e.g. here: <http://en.sourceforge.jp/projects/ttssh2/releases/>

Remember to set the CR+LF for sending the command from terminal program.



Picture 1. TeraTerm: Terminal setup



Picture 2. HyperTerminal setup

## 2.1 PMTK000 TEST

### Command purpose:

Testing the communication between the receiver and host.

**Command number:** 000

### DataField:

None

### Example:

```
$PMTK000*32<CR><LF>
```

**Reply:** see next chapter.

## 2.2 PMTK001 ACK

### Command purpose:

Acknowledge of PMTK000 command

**Command number:** 001

**DataField:**

*PMTK001, Cmd, Flag*

Cmd: The command / packet type the acknowledge responds.

Flag:           0 = Invalid command / packet.

                  1 = Unsupported command / packet type

                  2 = Valid command / packet, but action failed

                  3 = Valid command / packet, and action succeeded

**Example:**

\$PMTK001,604,3\*32<CR><LF>

## 2.3 PMTK010 Startup message

**Command purpose:**

Output system message

**Command number:** 010

**DataField:**

Msg: The system message.

'0': UNKNOWN

'1': STARTUP

**Example:**

\$PMTK010,001\*2E<CR><LF>

## 2.4 PMTK101 CMD HOT START

**Command purpose:**

Hot Restart: Use all available data in the NV Store.

**Command number:** 101

**DataField:**

None

**Example:**

```
$PMTK101*32<CR><LF>
```

## 2.5 PMTK102 CMD WARM START

**Command purpose:**

Warm Restart: Don't use Ephemeris at re-start.

**Command number:** 102

**DataField:**

None

**Example:**

```
$PMTK102*31<CR><LF>
```

## 2.6 PMTK101 CMD COLD START

**Command purpose:**

Cold Restart: Don't use Time, Position, Almanacs and Ephemeris data at re-start.

**Command number:** 101

**DataField:**

None

**Example:**

```
$PMTK103*30<CR><LF>
```

## 2.7 PMTK104 CMD FULL COLD START

**Command purpose:**

Full Cold Restart: It's essentially a Cold Restart, but additionally clear system/user configurations at re-start. That is, reset the receiver to the factory status.

**Command number:** 104

**DataField:**

None

**Example:**

```
$PMTK104*37<CR><LF>
```

## 2.8 PMTK127 CLEAR EPO FILE

**Command purpose:**

Clear predicted Ephemeris file (EPO) from flash memory.

**Command number:** 127

**DataField:**

'0' Clear

**Example:**

```
$PMTK127,0*2A<CR><LF>
```

**Reply:**

```
$PMTK001,127,3*34
```

## 2.9 PMTK251 SET NMEA BAUDRATE

**Command purpose:**

Set NMEA port baudrate

**Command number:** 251

**DataField:**

*PMTK251,Baudrate*

Baudrate: Baudrate setting

0 – default setting

4800

9600

14400

19200

38400

57600

115200

**Example:**

```
$PMTK251,38400*27<CR><LF>
```

## 2.10 PMTK300 API SET FIX CTL

**Command purpose:**

This parameter controls the rate of position fixing activity.

**Command number:** 300

DataField:

```
PMTK300,FixInterval,0,0,0,0
```

FixInterval: Position fix interval [msec].

**Example:**

```
$PMTK300,1000,0,0,0,0*1C<CR><LF>
```

**Reply:**

```
$PMTK001,300,3*33 <CR><LF>
```

### 2.10.1 Setting 5 Hz navigation

For 5 Hz you need to change the baudrate to 38400 in order to handle the increased message load in serial port.

Command for changing the Baud Rate to 38400:

```
$PMTK251,38400*27
```

The output in terminal should show obscured data.

Then you need to change baud rate from terminal program to 38400.

After you can see NMEA sentences again you are ready to give next command.

Command for setting the Fix Rate to 5 Hz:

```
$PMTK300,200,0,0,0,0*2F
```

## 2.10.2 Setting 10 Hz navigation

Note:10 Hz setting works only with IT500 receiver

You can do it wit first giving command PMTK251(baudrate) followed by command PMTK300(fixrate).

Command for changing the Baud Rate to 115200:

```
$PMTK251,115200*1F
```

The output in terminal should show obscured data.

Then you need to change baud rate from terminal program to 115200.

After you can see NMEA sentences again you are ready to give next command.

Command for setting the Fix Rate to 10 Hz:

```
$PMTK300,100,0,0,0,0*2C
```

You can reset the settings by powering off the module and removing the backup battery jumper from application board.

Remember to set the CR+LF for sending the command from terminal program.

e.g. In tera term program setting looks like in picture1.

## 2.11 PMTK301 API SET DGPS MODE

**Command purpose:**

DGPS correction data source mode.



**Command number:** 301

**DataField:**

*PMTK301,Mode*

Mode: DGPS data source mode.

'0': No DGPS source

'1': RTCM

'2': WAAS

**Example:**

\$PMTK301,1\*2D<CR><LF>

**Reply:**

\$PMTK001,301,3\*32

## 2.12 PMTK313 API SET SBAS ENABLED

**Command purpose:**

Enable/Disable search of SBAS satellite.

**Command number:** 313

**DataField:**

Enabled: Enable or disable

'0' = Disable

'1' = Enable

**Example:**

\$PMTK313,1\*2E<CR><LF>

**Reply:**

\$PMTK001,313,3\*31<CR><LF>

Note: SBAS can be used only with 1Hz(Default) output rate!

## 2.13 PMTK314 API SET NMEA OUTPUT

### Command purpose:

Set NMEA sentence output frequencies.

**Command number:** 314

### DataField:

There are totally 19 data fields that present output frequencies for the 19 supported NMEA sentences individually.

#### Supported NMEA Sentences

- 0 NMEA\_SEN\_GLL, // GPGLL interval - Geographic Position - Latitude longitude
- 1 NMEA\_SEN\_RMC, // GPRMC interval - Recommended Minimum Specific GNSS Sentence
- 2 NMEA\_SEN\_VTG, // GPVTG interval - Course Over Ground and Ground Speed
- 3 NMEA\_SEN\_GGA, // GPGGA interval - GPS Fix Data
- 4 NMEA\_SEN\_GSA, // GPGSA interval - GNSS DOPS and Active Satellites
- 5 NMEA\_SEN\_GSV, // GPGSV interval - GNSS Satellites in View
- 6 NMEA\_SEN\_GRS, // GPGRS interval - GNSS Range Residuals
- 7 NMEA\_SEN\_GST, // GPGST interval - GNSS Pseudorange Errors Statistics
- 13 NMEA\_SEN\_MALM, // PMTKALM interval - GPS almanac information (not supported)
- 14 NMEA\_SEN\_MEPH, // PMTKEPH interval - GPS ephemeris information (not supported)
- 15 NMEA\_SEN\_MDGP, // PMTKDGP interval - GPS differential correction information (not supported)
- 16 NMEA\_SEN\_MDBG, // PMTKDBG interval – MTK debug information (not supported)
- 17 NMEA\_SEN\_ZDA, // GPZDA interval – Time & Date
- 18 NMEA\_SEN\_MCHN, // PMTKCHN interval – GPS channel status

#### Supported Frequency Setting

- 0 - Disabled or not supported sentence
- 1 - Output once every one position fix
- 2 - Output once every two position fixes
- 3 - Output once every three position fixes
- 4 - Output once every four position fixes
- 5 - Output once every five position fixes

**Example:**

```
$PMTK314,1,1,1,1,1,5,1,1,1,1,1,0,1,1,1,1,1*2C<CR><LF>
```

This command set GLL output frequency to be outputting once every 1 position fix, and RMC to be outputting once every 1 position fix, and so on.

**Reply:**

```
$PMTK001,314,3*36<CR><LF>
```

You can also restore the system default setting via issue:

```
$PMTK314,-1*04<CR><LF>
```

Note: messages ALM, EPH, DGB and DBG are not currently supported.

## 2.14 PMTK330 API SET DATUM

**Command purpose:**

Set default datum.

**Command number:** 330

**DataField:**

*PMTK330,Datum*

Datum: 0: WGS84

1: TOKYO-M

2: TOKYO-A

Support 219 different datums. The total datums list in, **Appendix A**.

**Example:**

```
$PMTK330,0*2E<CR><LF>
```

**Reply:**

```
$PMTK001,330,3*30<CR><LF>
```

## 2.15 PMTK390 API SET USER OPTION

**Command purpose:**

Change default settings of the NMEA output permanently. Write the user setting to the flash to override the default setting. Maximum 8 times without erase the chip.

**Command number:** 390

**DataField:**

*PMTK390, Lock, Update\_Rate, Baud\_Rate, GLL\_Period, RMC\_Period, VTG\_Period, GSA\_Period, GSV\_Period, GGA\_Period, ZDA\_Period, MCHN\_Period, Datum, DGPS\_Mode, RTCM\_Baud\_Rate*

Lock: nonzero: freeze the setting; 0: allow further setting

Update\_Rate: 1~5 (Hz)

Baud\_Rate: 115200, 57600, 38400, 19200, 14400, 9600, 4800

RTCM\_Baud\_Rate: 115200, 57600, 38400, 19200, 14400, 9600, 4800

XXX\_Period: NMEA sentence output period

DGPS\_Mode: 0 (disable), 1 (RTCM), 2 (SBAS)

Datum: We support more than 200 datum. Please refer to Appendix A for the supported datum list.

The typical value is: 0 (WGS84), 1 (Tokyo-M), 2 (Tokyo-A)

**Example:**

```
$PMTK390,1,1,38400,1,1,1,1,1,1,1,0,0,2,9600*0B<CR><LF>
```

**Reply:**

```
$PMTK001,390,3
```

Note: Command PMTK390 settings are stored to non-volatile flash memory. It is restricted to change the settings only 8 times/module. If exceeding the limit, settings cannot be changed until module is re-flashed.

### 2.15.1 Setting 4800 baud rate permanently

Note: This setting is not supported with UP500 AGPS enabled firmware  
5Hz is maximum rate that can be set for navigation with this command

Please note that with default NMEA message mask the 4800 baud rate is not enough in conditions where there is lot of satellites tracked. GSV messages might have four lines and exceed the capacity of 4800 bit/second.

```
$PMTK390,0,1,4800,0,1,0,1,1,1,0,0,0,2,9600*38
```

and back to default 9600:

```
$PMTK390,0,1,9600,0,1,0,1,1,1,0,0,0,2,4800*38
```

Note: Command PMTK390 settings are stored to non-volatile flash memory. It is restricted to change the settings only 8 times/module. If exceeding the limit, settings cannot be changed until module is re-flashed.

### 3 QUERY COMMANDS

These commands are for querying the settings on the receiver.

#### 3.1 PMTK400 API Q FIX CTL

**Command purpose:**

Query Position fix interval

**Command number:** 400

**DataField:**

None

**Return:**

PMTK\_DT\_FIX\_CTL

**Example:**

\$PMTK400\*36<CR><LF>

#### 3.2 PMTK401 API Q DGPS MODE

**Command purpose:**

API\_Query\_Dgps\_Mode

**Command number:** 401

**DataField:**

None

**Return:**

PMTK500 DT DGPS MODE

**Example:**

\$PMTK401\*37<CR><LF>

#### 3.3 PMTK413 API Q SBAS ENABLED

**Command purpose:**

Query SBAS status

**Command number:** 413

**DataField:**

None

**Return:**

PMTK513 DT SBAS ENABLED

**Example:**

\$PMTK413\*34<CR><LF>

### 3.4 PMTK414 API Q NMEA OUTPUT

**Command purpose:**

Query current NMEA sentence output frequencies.

**Command number:** 414

**DataField:**

None

**Return:**

PMTK514 DT NMEA OUTPUT

**Example:**

\$PMTK414\*33<CR><LF>

### 3.5 PMTK430 API Q DATUM

**Command purpose:**

Query default datum

**Command number:** 430

Query default datum

**DataField:**

None

**Return:**

PMTK530 DT DATUM

**Example:**

\$PMTK430\*35<CR><LF>

### 3.6 **PMTK490 API GET USER OPTION**

**Command purpose:**

Returns the current user setting from the flash memory.

**Command number:** 490

**DataField:**

None

**Return:**

PMTK590 DT FLASH USER OPTION

**Example:**

\$PMTK490\*3F<CR><LF>



## 4 FIRMWARE STATUS

### 4.1 PMTK605 QUERY FIRMWARE INFO

**Command purpose:**

Query the firmware release information.

**Command number:** 605

**DataField:**

NONE

**Return:**

PMTK705 DT RELEASE

**Example:**

\$PMTK605\*31<CR><LF>

**Reply:**

\$PMTK705,AXN\_1.30,9156,Fastrax IT500,\*6C

### 4.2 PMTK607 QUERY EPO STATUS

**Command purpose:**

Query the status of EPO file loaded into flash memory.

**Command number:** 607

**DataField:**

'0' Status

**Example:**

\$PMTK607,0\*2F<CR><LF>

**Reply:**

PMTK707,56,1565,345600,1567,324000,1565,367200,1565,367200\*1E

Explanation:

Receive: PMTK\_DT\_EPO\_INFO

Number Epoch:56

First Epoch Week:1565

First Epoch TOW:345600

Final Epoch Week:1567

Final Epoch TOW:324000

Crnt Min Epoch Week:1565

Crnt Min Epoch TOW:388800

Crnt Max Epoch Week:1565

Crnt Max Epoch TOW:388800

## 5 FIX VALID FLAG

Note: This chapter concerns only UP500 antenna module.

It is important to notice that current UP500 receiver firmware output position coordinates in RMC and GGA messages even if the position is flagged as invalid in the NMEA RMC message.

This is contrary to most other GPS receivers and the consequence is that a trace displayed on a map might look inaccurate. The advantage for some applications is that you do get some kind of position even if you know the output is not validated.

This is a feature that can very easily be filtered by monitoring Valid "A" flag and invalid "V" flag in the RMC message.

Here is an example of a NOT VALID output fix:

```
$GPRMC,000040.026,V,6016.3376,N,02458.3604,E,0.00,0.00,060180,,,N*73
```

```
$GPVTG,0.00,T,,M,0.00,N,0.00,K,N*32
```

```
$GPGGA,000041.026,6016.3376,N,02458.3604,E,0,0,,130.5,M,19.5,M,,*42
```

```
$GPGSA,A,1,,,,,,,,,,,,,*1E
```

```
$GPGSV,1,1,00*79
```

And here is an example of a VALID output fix:

```
$GPRMC,065343.000,A,6016.3204,N,02458.3279,E,0.02,0.00,190309,,,A*69
```

```
$GPVTG,0.00,T,,M,0.02,N,0.03,K,A*3C
```

```
$GPGGA,065344.000,6016.3206,N,02458.3278,E,1,7,1.06,29.3,M,19.5,M,,*6A
```

```
$GPGSA,A,3,03,22,16,21,27,06,08,,,,,1.33,1.06,0.81*01
```

```
$GPGSV,3,1,12,06,66,201,48,03,65,236,48,22,56,163,48,21,30,090,42*7E
```

```
$GPGSV,3,2,12,37,21,183,,08,14,331,34,16,13,204,33,27,09,026,33*76
```

```
$GPGSV,3,3,12,07,03,296,30,19,,45,18,,48,15,,37*4C
```

## 6 APPENDIX A

### Map datums

| No | Datum                    | Region  |
|----|--------------------------|---|
| 0  | WGS1984                  | International   |
| 1  | Tokyo                    | Japan   |
| 2  | Tokyo                    | Mean For Japan, South Korea, Okinawa                                  |
| 3  | User Setting             | User Setting  |
| 4  | Adindan                  | Burkina Faso  |
| 5  | Adindan                  | Cameroon  |
| 6  | Adindan                  | Ethiopia  |
| 7  | Adindan                  | Mali  |
| 8  | Adindan                  | Mean For Ethiopia, Sudan  |
| 9  | Adindan                  | Senegal   |
| 10 | Adindan                  | Sudan   |
| 11 | Afgooye                  | Somalia   |
| 12 | Ain El Abd1970           | Bahrain   |
| 13 | Ain El Abd1970           | Saudi Arabia  |
| 14 | American Samoa1962       | American Samoa Islands  |
| 15 | Anna 1 Astro1965         | Cocos Island  |
| 16 | Antigua Island Astro1943 | Antigua(Leeward Islands)  |
| 17 | Arc1950                  | Botswana  |
| 18 | Arc1950                  | Burundi   |
| 19 | Arc1950                  | Lesotho   |
| 20 | Arc1950                  | Malawi  |
| 21 | Arc1950                  | Mean For Botswana, Lesotho, Malawi, Swaziland, Zaire,Zambia, Zimbabwe |

|    |                               |                                    |
|----|-------------------------------|------------------------------------|
| 22 | Arc1950                       | Swaziland                          |
| 23 | Arc1950                       | Zaire                              |
| 24 | Arc1950                       | Zambia                             |
| 25 | Arc1950                       | Zimbabwe                           |
| 26 | Arc1960                       | Mean For Kenya Tanzania            |
| 27 | Arc1960                       | Kenya                              |
| 28 | Arc1960                       | Tanzania                           |
| 29 | Ascension Island1958          | Ascension Island                   |
| 30 | Astro Beacon E 1945           | Iwo Jima                           |
| 31 | Astro Dos 71/4                | St Helena Island                   |
| 32 | Astro Tern Island (FRIG) 1961 | Tern Island                        |
| 33 | Astronomical Station 1952     | Marcus Island                      |
| 34 | Australian Geodetic 1966      | Australia, Tasmania                |
| 35 | Australian Geodetic 1984      | Australia, Tasmania                |
| 36 | Ayabelle Lighthouse           | Djibouti                           |
| 37 | Bellevue (IGN)                | Efate and Erromango Islands        |
| 38 | Bermuda 1957                  | Bermuda                            |
| 39 | Bissau                        | Guinea-Bissau                      |
| 40 | Bogota Observatory            | Colombia                           |
| 41 | Bukit Rimpah                  | Indonesia(Bangka and Belitung Ids) |
| 42 | Camp Area Astro               | Antarctica(McMurdi Camp Area)      |
| 43 | Campo Inchauspe               | Argentina                          |
| 44 | Canton Astro1966              | Phoenix Island                     |
| 45 | Cape                          | South Africa                       |
| 46 | Cape Canaveral                | Bahamas, Florida                   |

|    |                               |  |
|----|-------------------------------|--|
| 47 | Carthage                      | Tunisia  |
| 48 | Chatham Island Astro1971      | New Zealand(Chatham Island)  |
| 49 | Chua Astro                    | Paraguay   |
| 50 | Corrego Alegre                | Brazil   |
| 51 | Dabola                        | Guinea   |
| 52 | Deception Island              | Deception Island, Antarctica   |
| 53 | Djakarta (Batavia)            | Indonesia(Sumatra)   |
| 54 | Dos 1968                      | New Georgia Islands (Gizo Island)  |
| 55 | Easter Island 1967            | Easter Island  |
| 56 | Estonia Coordinate System1937 | Estonia  |
| 57 | European 1950                 | Cyprus   |
| 58 | European 1950                 | Egypt  |
| 59 | European 1950                 | England, Channel Islands, Scotland, Shetland Islands   |
| 60 | European 1950                 | England, Ireland, Scotland, Shetland Islands   |
| 61 | European 1950                 | Finland, Norway  |
| 62 | European 1950                 | Greece   |
| 63 | European 1950                 | Iran   |
| 64 | European 1950                 | Italy (Sardinia)   |
| 65 | European 1950                 | Italy (Sicily)   |
| 66 | European 1950                 | Malta  |
| 67 | European 1950                 | Mean For Austria, Belgium,Denmark, Finland, France, W Germany, Gibraltar, Greece, Italy, Luxembourg, Netherlands, Norway, Portuga,l Spain, Sweden, Switzerland |
| 68 | European 1950                 | Mean For Austria, Debnmark,France, W Germany, Netherland ,<br>Switzerland  |
| 69 | European 1950                 | Mean For Irag, Israel, Jordan, Lebanon, Kuwait, Saudi Arabia, Syria  |

|    |                      |  |
|----|----------------------|--|
|    |                      |  |
| 70 | European 1950        | Portugal, Spain  |
| 71 | European 1950        | Tunisia,   |
| 72 | European 1979        | Mean For Austria, Finland ,Netherlands ,Norway, Spain, Sweden, Switzerland |
| 73 | Fort Thomas 1955     | Nevis St Kitts (Leeward Islands)   |
| 74 | Gan 1970             | Republic Of Maldives   |
| 75 | Geodetic Datum 1970  | New Zealand  |
| 76 | Graciosa Base SW1948 | Azores (Faial, Graciosa, Pico, Sao, Jorge, Terceria)                       |
| 77 | Guam1963             | Guam   |
| 78 | Gunung Segara        | Indonesia (Kalimantan)   |
| 79 | Gux I Astro          | Guadalcanal Island   |
| 80 | Herat North          | Afghanistan  |
| 81 | Hermannskogel Datum  | Croatia-Serbia, Bosnia-Herzegovina   |
| 82 | Hjorsey 1955         | Iceland  |
| 83 | Hongkong 1963        | Hongkong   |
| 84 | Hu Tzu Shan          | Taiwan   |
| 85 | Indian               | Bangladesh   |
| 86 | Indian               | India,Nepal  |
| 87 | Indian               | Pakistan   |
| 88 | Indian 1954          | Thailand   |
| 89 | Indian 1960          | Vietnam (Con Son Island)   |
| 90 | Indian 1960          | Vietnam (Near 16 deg N)  |
| 91 | Indian 1975          | Thailand   |
| 92 | Indonesian 1974      | Indonesian   |
| 93 | Ireland 1965         | Ireland  |
| 94 | ISTS 061 Astro 1968  | South Georgia Islands  |

|     |                                 |  |
|-----|---------------------------------|--|
| 95  | ISTS 073 Astro 1969             | Diego Garcia                           |
| 96  | Johnston Island 1961            | Johnston Island                        |
| 97  | Kandawala                       | Sri Lanka                              |
| 98  | Kerguelen Island<br>1949        | Kerguelen Island                       |
| 99  | Kertau 1948                     | West Malaysia and Singapore            |
| 100 | Kusaie Astro 1951               | Caroline Islands                       |
| 101 | Korean Geodetic<br>System       | South Korea                            |
| 102 | LC5 Astro 1961                  | Cayman Brac Island                     |
| 103 | Leigon                          | Ghana                                  |
| 104 | Liberia 1964                    | Liberia                                |
| 105 | Luzon                           | Philippines (Excluding Mindanao)       |
| 106 | Luzon                           | Philippines (Mindanao)                 |
| 107 | M'Poraloko                      | Gabon                                  |
| 108 | Mahe 1971                       | Mahe Island                            |
| 109 | Massawa                         | Ethiopia (Eritrea)                     |
| 110 | Merchich                        | Morocco                                |
| 111 | Midway Astro 1961               | Midway Islands                         |
| 112 | Minna                           | Cameroon                               |
| 113 | Minna                           | Nigeria                                |
| 114 | Montserrat Island<br>Astro 1958 | Montserrat (Leeward Island)            |
| 115 | Nahrwan                         | Oman (Masirah Island)                  |
| 116 | Nahrwan                         | Saudi Arabia                           |
| 117 | Nahrwan                         | United Arab Emirates                   |
| 118 | Naparima BWI                    | Trinidad and Tobago                    |
| 119 | North American<br>1927          | Alaska (Excluding Aleutian Ids)        |
| 120 | North American                  | Alaska (Aleutian Ids East of 180 degW) |



|     |               |          |  |
|-----|---------------|----------|--|
|     | 1927          |          |  |
| 121 | North<br>1927 | American | Alaska (Aleutian Ids West of 180 degW)   |
| 122 | North<br>1927 | American | Bahamas (Except San Salvador Islands)  |
| 123 | North<br>1927 | American | Bahamas (San Salvador Islands)   |
| 124 | North<br>1927 | American | Canada (Alberta, British Columbia)   |
| 125 | North<br>1927 | American | Canada (Manitoba, Ontario)   |
| 126 | North<br>1927 | American | Canada (New Brunswick, Newfoundland, Nova Scotia, Qubec)   |
| 127 | North<br>1927 | American | Canada (Northwest Territories, Saskatchewan)   |
| 128 | North<br>1927 | American | Canada (Yukon)   |
| 129 | North<br>1927 | American | Canal Zone   |
| 130 | North<br>1927 | American | Cuba   |
| 131 | North<br>1927 | American | Greenland (Hayes Peninsula)  |
| 132 | North<br>1927 | American | Mean For Antigua, Barbados, Barbuda, Caicos Islands, Cuba, Dominican, Grand Cayman, Jamaica, Turks Islands |
| 133 | North<br>1927 | American | Mean For Belize, Costa Rica, El Salvador, Guatemala, Honduras,<br>Nicaragua                                |
| 134 | North<br>1927 | American | Mean For Canada  |
| 135 | North<br>1927 | American | Mean For Conus   |
| 136 | North<br>1927 | American | Mean For Conus (East of Mississippi, River Including Louisiana, Missouri, Minnesota)                       |

|     |                                    |   |
|-----|------------------------------------|---|
|     |                                    |   |
| 137 | North American<br>1927             | Mean For Conus (West of Mississippi, Rive Excluding Louisiana, Minnesota, Missouri) |
| 138 | North American<br>1927             | Mexico  |
| 139 | North American<br>1983             | Alaska (Excluding Aleutian Ids)   |
| 140 | North American<br>1983             | Aleutian Ids  |
| 141 | North American<br>1983             | Canada  |
| 142 | North American<br>1983             | Conus   |
| 143 | North American<br>1983             | Hahawii   |
| 144 | North American<br>1983             | Mexico, Central America   |
| 145 | North Sahara 1959                  | Algeria   |
| 146 | Observatorio Meteorologico 1939    | Azores (Corvo and Flores Islands)   |
| 147 | Old Egyptian 1907                  | Egypt   |
| 148 | Old Hawaiian                       | Hawaii  |
| 149 | Old Hawaiian                       | Kauai   |
| 150 | Old Hawaiian                       | Maui  |
| 151 | Old Hawaiian                       | Mean For Hawaii, Kauai, Maui, Oahu  |
| 152 | Old Hawaiian                       | Oahu  |
| 153 | Oman                               | Oman  |
| 154 | Ordnance Survey Great Britian 1936 | England   |
| 155 | Ordnance Survey Great Britian 1936 | England, Isle of Man, Wales   |
| 156 | Ordnance Survey                    | Mean For England ,Isle of Man, Scotland, Shetland Island,                           |

|     |                                       |  |
|-----|---------------------------------------|--|
|     | Great Britian 1936                    | Wales  |
| 157 | Ordnance Survey<br>Great Britian 1936 | Scotland, Shetland Islands   |
| 158 | Ordnance Survey<br>Great Britian 1936 | Wales  |
| 159 | Pico de las Nieves                    | Canary Islands   |
| 160 | Pitcairn Astro 1967                   | Pitcairn Island  |
| 161 | Point 58                              | Mean For Burkina Faso and Niger                                      |
| 162 | Pointe Noire 1948                     | Congo  |
| 163 | Porto Santo 1936                      | Porto Santo, Maderia Islands   |
| 164 | Provisional South<br>American 1956    | Bolovia  |
| 165 | Provisional South<br>American 1956    | Chile (Northern Near 19 deg S)                                       |
| 166 | Provisional South<br>American 1956    | Chile (Southern Near 43 deg S)                                       |
| 167 | Provisional South<br>American 1956    | Colombia   |
| 168 | Provisional South<br>American 1956    | Ecuador  |
| 169 | Provisional South<br>American 1956    | Guyana   |
| 170 | Provisional South<br>American 1956    | Mean For Bolivia Chile,Colombia, Ecuador, Guyana, Peru,<br>Venezuela |
| 171 | Provisional South<br>American 1956    | Peru   |
| 172 | Provisional South<br>American 1956    | Venezuela  |
| 173 | Provisional South<br>Chilean 1963     | Chile (Near 53 deg S) (Hito XVIII)                                   |
| 174 | Puerto Rico                           | Puerto Rico, Virgin Islands  |
| 175 | Pulkovo 1942                          | Russia   |
| 176 | Qatar National                        | Qatar  |

|     |                         |                                      |
|-----|-------------------------|--------------------------------------|
| 177 | Qornoq                  | Greenland (South)                    |
| 178 | Reunion                 | Mascarene Island                     |
| 179 | Rome 1940               | Italy (Sardinia)                     |
| 180 | S-42 (Pulkovo 1942)     | Hungary                              |
| 181 | S-42 (Pulkovo 1942)     | Poland                               |
| 182 | S-42 (Pulkovo 1942)     | Czechoslovakia                       |
| 183 | S-42 (Pulkovo 1942)     | Lativa                               |
| 184 | S-42 (Pulkovo 1942)     | Kazakhstan                           |
| 185 | S-42 (Pulkovo 1942)     | Albania                              |
| 186 | S-42 (Pulkovo 1942)     | Romania                              |
| 187 | S-JTSK                  | Czechoslovakia (Prior 1 Jan1993)     |
| 188 | Santo (Dos) 1965        | Espirito Santo Island                |
| 189 | Sao Braz                | Azores (Sao Miguel, Santa Maria Ids) |
| 190 | Sapper Hill 1943        | East Falkland Island                 |
| 191 | Schwarzeck              | Namibia                              |
| 192 | Selvagem Grande<br>1938 | Salvage Islands                      |
| 193 | Sierra Leone 1960       | Sierra Leone                         |
| 194 | South American<br>1969  | Argentina                            |
| 195 | South American<br>1969  | Bolivia                              |
| 196 | South American<br>1969  | Brazil                               |
| 197 | South American<br>1969  | Chile                                |
| 198 | South American<br>1969  | Colombia                             |
| 199 | South American<br>1969  | Ecuador                              |
| 200 | South American<br>1969  | Ecuador (Baltra, Galapagos)          |

|     |                             |  |
|-----|-----------------------------|--|
| 201 | South American<br>1969      | Guyana   |
| 202 | South American<br>1969      | Mean For Argentina, Bolivia, Brazil,Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Trinidad and Tobago, Venezuela |
| 203 | South American<br>1969      | Paraguay   |
| 204 | South American<br>1969      | Peru   |
| 205 | South American<br>1969      | Trinidad and Tobago  |
| 206 | South American<br>1969      | Venezuela  |
| 207 | South Asia                  | Singapore  |
| 208 | Tananarive Observatory 1925 | Madagascar   |
| 209 | Timbalai 1948               | Brunei, E Malaysia (Sabah Sarawak)   |
| 210 | Tokyo                       | Japan  |
| 211 | Tokyo                       | Mean For Japan, South Korea, Okinawa   |
| 212 | Tokyo                       | Okinawa  |
| 213 | Tokyo                       | South Korea  |
| 214 | Tristan Astro 1968          | Tristam Da Cunha   |
| 215 | Viti Levu 1916              | Fiji (Viti Levu Island)  |
| 216 | Voirol 1960                 | Algeria  |
| 217 | Wake Island Astro 1952      | Wake Atoll   |
| 218 | Wake-Eniwetok 1960          | Marshall Islands   |
| 219 | WGS 1972                    | Global Definition  |
| 220 | WGS 1984                    | Global Definition  |
| 221 | Yacare                      | Uruguay  |
| 222 | Zanderij                    | Suriname   |

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