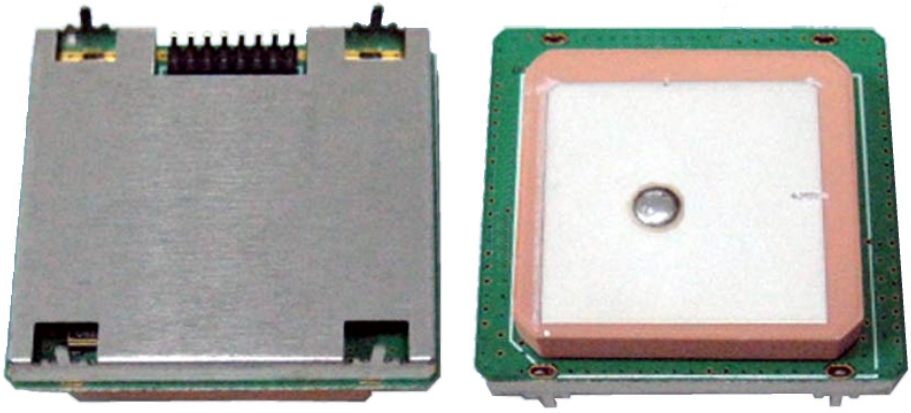
# SkyTraq Venus 6 GPS Module
# ST32-AM

## Datasheet



**Revision History**

| Revision | Date | Change |
|---|---|---|
| V2.1 | 06/01/2012 | Updated technical drawings, pin-out, packaging. Notes for soldering and cleaning. |
| V2.2 | 11/19/2012 | Added wave soldering parameters, changed moisture sensitivity level to 1, correction of supply voltage range in “Key Features” section. |


**Table of Contents**

## 1. Overview

The ST32 is a compact size GPS module with high sensitivity and very low power consumption. It is based on Skytraq's VENUS634 baseband processor and is equipped with a matched patch antenna to provide a modular solution. The ST32 interfaces to the application system via TTL level or RS232 serial port with NMEA protocol. This allows an easy integration in all kinds of navigation applications or products.

The GPS receiver's -161dBm tracking sensitivity allows continuous position coverage in nearly all application environments. Its high performance search engine is capable of testing 8,000,000 time-frequency hypotheses per second, offering industry-leading signal acquisition and TTFF speed.

Dedicated massive-correlator signal parameter search engine within the baseband enables rapid search of all the available satellites and acquisition of very weak signal. An advanced track engine allows weak signal tracking and positioning in harsh environments such as urban canyons and under deep foliage.

## 2. Key Features

- SkyTraq chipset with 65 channels "All-in-View" tracking.
- Cold/Warm/Hot start time: 29/28/1 sec. (average)
- Maximum update rate: 10Hz (default 1Hz)
- High sensitivity: -161 dBm
- Large voltage supply range: 3.3-5.5V
- Low power consumption: 25mA tracking, 50mA acquisition, 70mA enhanced acquisition.
- Support of SBAS (WAAS / EGNOS)
- Size 32 x 32 x 8mm (with patch antenna)
- RS232 and TTL UART communication interface (option)
- Integrated backup battery (option)
- Cost efficient

## 3. Options

| Name | Integrated Backup Battery | TTL (LV) UART | RS232 interface | USB interface | Flash Memory | Antenna |
|---|---|---|---|---|---|---|
| ST32-02 | No | Yes | No | No | No | 4mm |

**4. Specification**

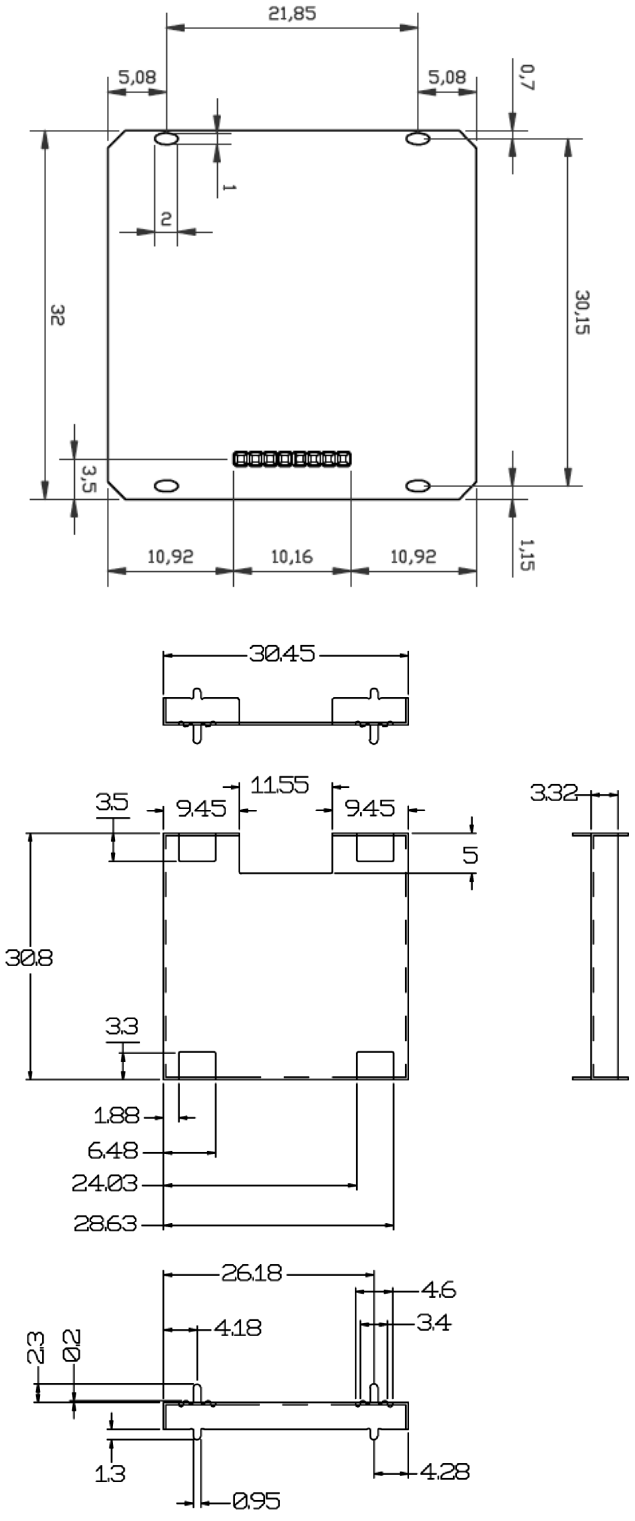
| | |
|---|---|
| Chipset | Skytraq low power VENUS 634 |
| Frequency | L1, 1575.42 MHz |
| C/A Code | 1.023MHz chip rate |
| Channels | 65 |
| Datum | WGS-84 (default), user definable |
| Antenna | Built-in 25x25x4mm patch antenna |
| | |
| Sensitivity | Tracking: -161 dBm<br>Reacquisition: -158 dBm<br>Cold start (autonomous): -148 dBm |
| Time to First Fix (TTFF) | Cold start: 29sec average<br>Warm start: 28sec average<br>Hot start: 1sec average |
| Update rate | 1 Hz – 10Hz (default: 1Hz) |
| Accuracy | Position: 2.5m CEP, 5m 2D RMS<br>Velocity: 0.1m/sec<br>Time: +/-300ns synchronized to GPS time |
| Altitude | Up to 18km |
| Velocity | Up to 500m/s |
| | |
| Current draw | Tracking: 25mA<br>Acquisition:50mA<br>Enhanced acquisition: 70mA |
| Supply | 3.3V – 5.5V DC |
| Backup supply | Optional integrated rechargeable Lithium battery (2 week backup) |
| | |
| Operating temperature | -20 to +60 degrees Celsius (with battery) |
| | -40 to +85 degrees Celsius (without battery) |
| | |
| Device dimensions | 32x32x8mm |
| Device weight | 14 grams |
| Compliance | RoHS |
| | |
| Protocol | 8 data bits, 1 stop bit, no parity<br>NMEA-0183 (GGA, GSA, GSV, RMC, VTG), Skytraq Binary |
| Baud rate | 4800/9600/38400/115200bps (default: 9600) |
| Interface | RS232 or TTL UART |

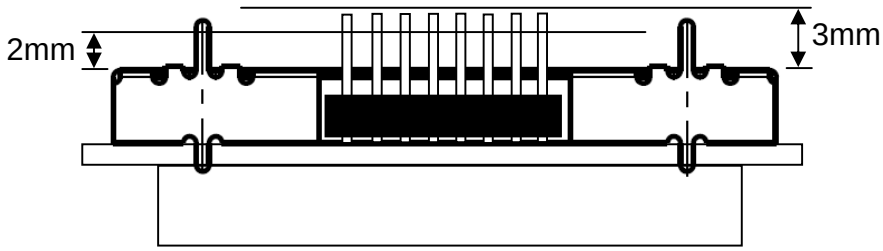
UART logic levels

| Signal | Min | Max |
|---|---|---|
| TX0 High | 2.9V | - |
| TX0 Low | - | 0.4V |
| RX0 High | 2.3V | - |
| RX0 Low | - | 0.6V |

Specification can change without notice. All values are preliminary.

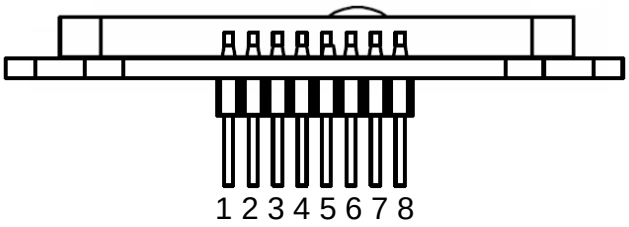
**5. Mechanical Dimensions**






Pin length is between 2 and 3mm above shielding.

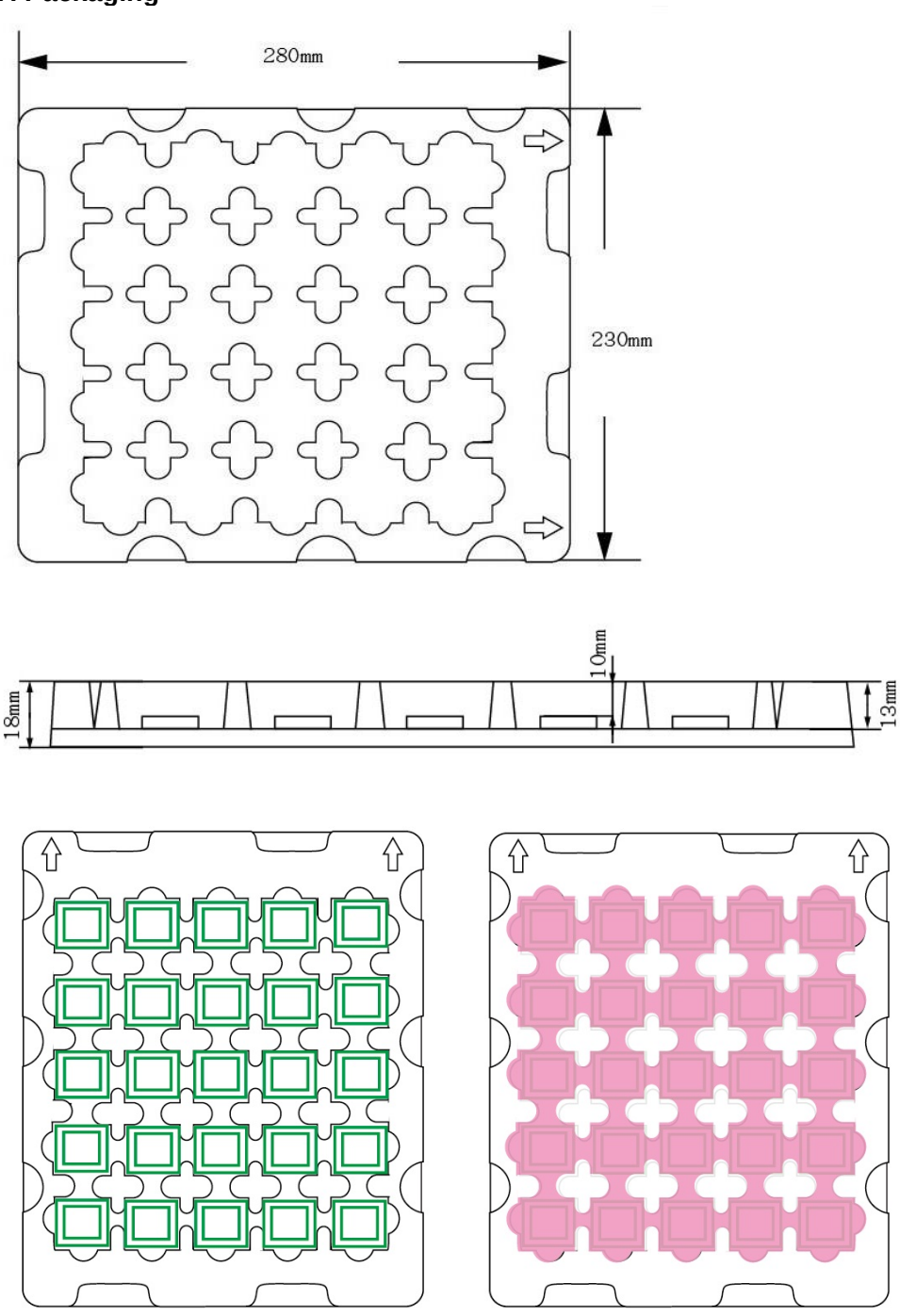
**6. Pinout**




Connector type: pin header 1.27mm x 8 pins

| Pin | Name | Description |
|---|---|---|
| 1 | TXD0 | UART Serial data output |
| 2 | RXD0 | UART Serial data input (only if RS232 is disabled) |
| 3 | TXD1 | RS232 Serial data output (Optional) |
| 4 | RXD1 | RS232 Serial data input (Optional) |
| 5 | VIN | Voltage supply |
| 6 | GND | Ground |
| 7 | NC | |
| 8 | VBAK | Standby supply |

**7. Packaging**




25 modules per tray, foam layer on top, sealed in bag for moisture protection.

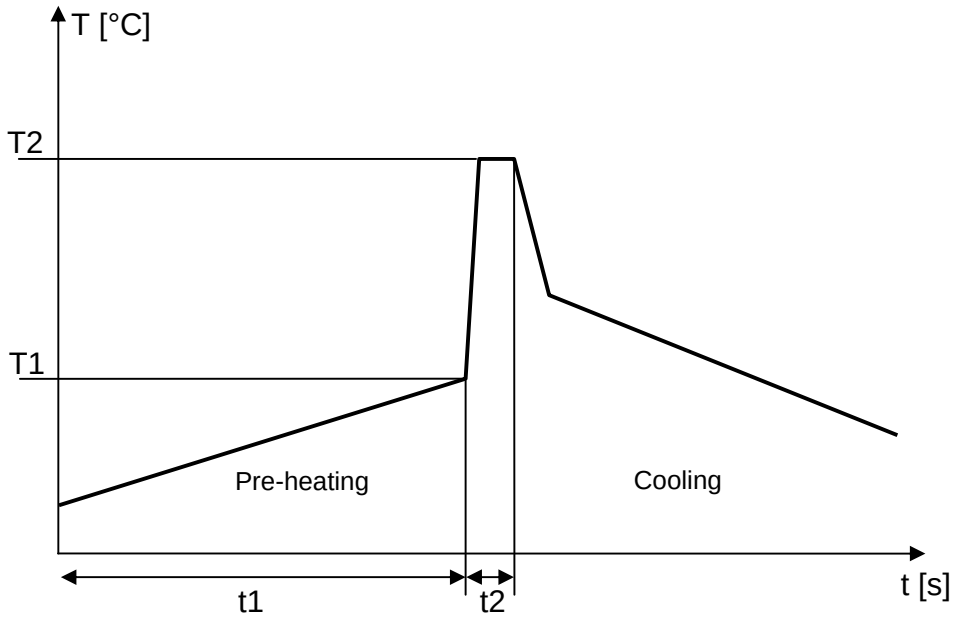
**8. Handling & Soldering**

Device is sensitive to electrostatic discharge. Proper precautions must take place for handling.

Moisture Sensitivity Level: 1

Pre-Conditioning: Bake if moisture sensitivity level floor time or conditions exceeded

Soldering profile: Wave soldering/double wave soldering according to EN61760-1:2006 with parameters as listed below.




| Symbol | Parameter | Target | Max |
|---|---|---|---|
| T1 | Pre-heating temperature | 110 °C | 120°C |
| t1 | Pre-heating duration | 80s | 80s |
| T2 | Wave soldering temperature | 260°C | 280°C |
| t2 | Wave soldering time | 2s | 5s |
| | Pre-heating gradient | | +2°C/s |
| | Cooling gradient | | -4°C/s |

Cleaning solvent: IEC 60068-2-45:1980, 3.1.2, Isopropyl alcohol recommended
**No ultrasonic supported cleaning permitted !**

**9. Baud Rate Adjustment**

During application the baud rate can be easily changed by software using the Skytraq binary protocol (please see application note AN0003 from Skytraq). The software setting will override the hardware pre-set.

Example:
To switch the baud rate to 38400 send the following hexadecimal bytes to the receiver:
`A0 A1 00 04 05 00 03 01 07 0D 0A`

Note: the above shown bytes are in hexadecimal format, do not send as text string.

**10. Update Rate Adjustment**

The position update rate can be adjusted via configuration commands (see app Note AN0003). For higher update rates the default baud rate is too low and need to be increased at least to 38400 bps. After this the update rate can be increased.

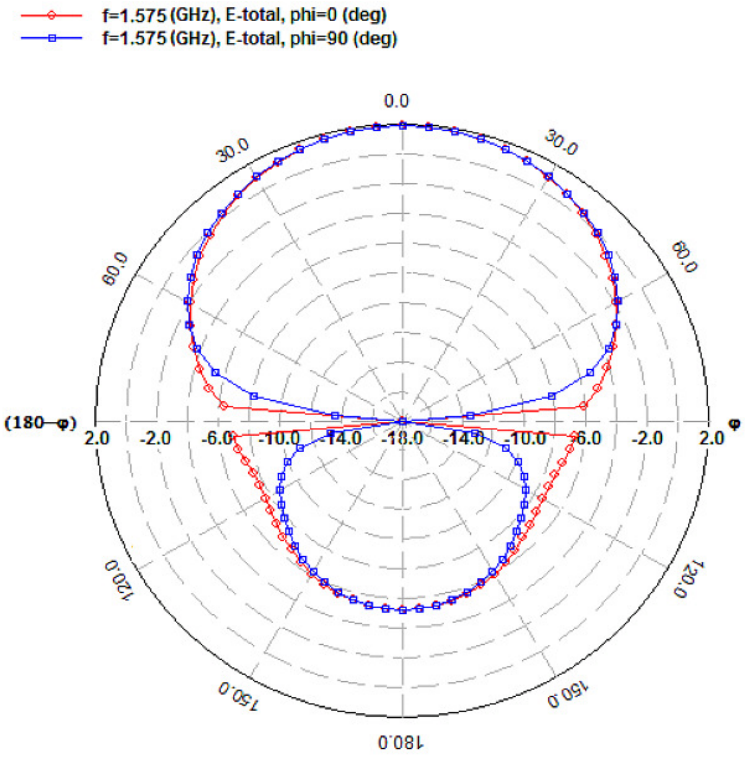
Example:
To switch to 10Hz position update rate the following hex bytes are send to the receiver:
`A0 A1 00 03 0E 0A 01 05 0D 0A`

Please note that only the NMEA messages GGA and RMC will update at the select speed. All other messages will not.

**11. Filter Modes**

Two position filter modes can be selected using Skytraq binary protocol (see App. Note AN0003). Default mode is “car”. Using “pedestrian” will reduce the filter impact and provide a more sensitive position but also more noise in case of low signal reception conditions.

## 12. Antenna Pattern



## 13. NMEA Format

The general NMEA format consists of an ASCII string beginning with a '$' character and terminating with a <CR><LF> sequence. NMEA standard messages begin with 'GP' then a 3-letter message identifier.
The message header is followed by a comma delimited list of fields optionally terminated with a checksum consisting of an asterisk '*' and a 2 digit hex value representing the checksum. There is no comma preceding the checksum field. When present, the checksum is calculated as a bitwise exclusive of the characters between the '$' and '*'. As an ASCII representation, the number of digits in each number will vary depending on the number and precision, hence the record length will vary. Certain fields may be omitted if they are not used, in which case the field position is reserved using commas to ensure correct interpretation of subsequent fields.
The tables below indicate the maximum and minimum widths of the fields to allow for buffer size allocation.

### 13.1. NMEA Message $GPGGA

This message transfers global positioning system fix data. Example:
$GPGGA,060932.448,2447.0959,N,12100.5204,E,1,08,1.1,108.7,M,,,,0000*0E<CR><LF>

| Field | Format | Min chars | Max chars | Notes |
|---|---|---|---|---|
| Message ID | $GPGGA | 6 | 6 | GGA protocol header |
| UTC Time | hhmmss.sss | 1,2,2.1 | 2, 2, 2.3 | Fix time to 1ms accuracy |
| Latitude | float | 1,2.1 | 3,2.4 | Degrees * 100+minutes |
| N/S Indicator | char | 1 | 1 | N=North, S=South |
| Longitude | float | 1,2.1 | 3,2.4 | Degrees * 100+minutes |
| E/W Indicator | Char | 1 | 1 | E=East, W=West |
| Position Fix Indicator | Int | 1 | 1 | 0: position fix unavailable<br>1: valid position fix, SPS mode<br>2: valid position fix, differential GPS mode<br>3: GPS PPS Mode, fix valid<br>4: Real Time Kinematic.<br>5: Float RTK<br>6: Estimated (dead reckoning) Mode<br>7: Manual Input Mode<br>8: Simulator Mode |
| Satellites Used | Int | 2 | 2 | Number of satellites used to calculate fix. |
| HDOP | float | 1.1 | 3.1 | Horizontal Dilution of Precision. |
| MSL Altitude | float | 1.1 | 5.1 | Altitude above mean seal level |
| Units | Char | 1 | 1 | M stands for "meters". |
| GeoID Separation | Int | (0) 1 | 4 | Separation from Geoids can be blank. |
| Units | Char | 1 | 1 | M stands for "meters". |
| Age of Differential Corrections | Int | (0) 1 | 5 | Age in seconds. Blank (Null) fields when DGPS is not used. |
| Diff Reference Corrections | Int | 4 | 4 | 0000 |
| Checksum | *xx | (0) 3 | 3 | 2 digits |
| Message terminator | <CR> <LF> | 2 | 2 | ASCII 13, ASCII 10. |

### 13.2. NMEA Message $GPGLL

This message transfers Geographic position, Latitude, Longitude, and time. Example:
$GPGLL,4250.5589,S,14718.5084,E,092204.999,A,A*2D<CR><LF>

The $GPGLL message structure is shown below:

| Field | Format | Min chars | Max chars | Notes |
|---|---|---|---|---|
| Message ID | $GPGLL | 6 | 6 | GLL protocol header |
| Latitude | float | 1,2.1 | 3,2.4 | Degrees * 100+minutes |
| N/S Indicator | char | 1 | 1 | N=North, S=South |
| Longitude | float | 1,2.1 | 3,2.4 | Degrees * 100+minutes |
| E/W Indicator | Char | 1 | 1 | E=East, W=West |
| UTC Time | hhmmss.sss | 1,2,2.1 | 2,2,2.3 | Fix time to 1ms accuracy |
| Status | Char | 1 | 1 | A = Data valid<br>V = Data not valid |
| Mode Indicator | Chat | 1 | 1 | N = Data not valid<br>A = Autonomous mode<br>D = Differential mode<br>E = Estimated mode<br>M = Manual input mode<br>S = Simulator mode |
| Checksum | *xx | (0) 3 | 3 | 2 digits |
| Message terminator | <CR> <LF> | 2 | 2 | ASCII 13, ASCII 10. |

### 13.3. NMEA Message $GPGSA

This message transfers DOP and active satellites information. Example:
$GPGSA,A,3,01,20,19,13,,,,,,,,,40 .4,24.4,32.2*0A<CR><LF>

The $GPGSA message structure is shown below:

| Field | Format | Min chars | Max chars | Notes |
|---|---|---|---|---|
| Message ID | $GPGSA | 6 | 6 | GSA protocol header |
| Mode | Char | 1 | 1 | M = Manual, forced to operate in selected mode.<br>A = Automatic switching between modes. |
| Mode | Int | 1 | 1 | 1 = Fix not available.<br>2 = 2D position fix.<br>3 = 3D position fix. |
| Satellites Used | Int | 2 | 2 | SV on channel 1 |
| Satellites Used | Int | 2 | 2 | SV on channel 2 |
| … | … | … | … | … |
| Satellites Used | Int | 2 | 2 | SV on channel 12 |
| PDOP | Float | 1.1 | 3.1 | |
| HDOP | Float | 1.1 | 3.1 | |
| VDOP | Float | 1.1 | 3.1 | |
| Checksum | *xx | 0 | 3 | 2 digits |
| Message terminator | <CR> <LF> | 2 | 2 | ASCII 13, ASCII 10. |

### 13.4. NMEA Message $GPGSV

This message transfers information about satellites in view. The $GPGSV message structure is shown below. Each record contains the information for up to 4 channels, allowing up to 12 satellites in view. In the final record of the sequence the unused channel fields are left blank with commas to indicate that a field has been omitted.

Example:
$GPGSV,3,1,09,28,81,225,41,24,66,323,44,20,48,066,43,17,45,336,4 1*78<CR><LF>
$GPGSV,3,2,09,07,36,321,45,04,36,257,39,11,20,050,41,08,18,208,43*77<CR><LF>

| Field | Format | Min chars | Max chars | Notes |
|---|---|---|---|---|
| Message ID | $GPGSV | 6 | 6 | GSV protocol header |
| Number of messages | Int | 1 | 1 | Number of messages in the message sequence from 1 to 3. |
| Message number | Int | 1 | 1 | Sequence number of this message in current sequence, form 1 to 3. |
| Satellites in view | Int | 1 | 2 | Number of satellites currently in view. |
| Satellite ID | Int | 2 | 2 | Satellite vehicle 1. |
| Elevation | Int | 1 | 3 | Elevation of satellite in degrees. |
| Azimuth | Int | 1 | 3 | Azimuth of satellite in degrees. |
| SNR | Int | (0) 1 | 2 | Signal to noise ration in dBHz, null if the SV is not in tracking. |
| Satellite ID | Int | 2 | 2 | Satellite vehicle 2. |
| Elevation | Int | 1 | 3 | Elevation of satellite in degrees. |
| Azimuth | Int | 1 | 3 | Azimuth of satellite in degrees. |
| SNR | Int | (0) 1 | 2 | Signal to noise ration in dBHz, null if the SV is not in tracking. |
| Satellite ID | Int | 2 | 2 | Satellite vehicle 3. |
| Elevation | Int | 1 | 3 | Elevation of satellite in degrees. |
| Azimuth | Int | 1 | 3 | Azimuth of satellite in degrees. |
| SNR | Int | (0) 1 | 2 | Signal to noise ration in dBHz, null if the SV is not in tracking. |
| Satellite ID | Int | 2 | 2 | Satellite vehicle 4. |
| Elevation | Int | 1 | 3 | Elevation of satellite in degrees. |
| Azimuth | Int | 1 | 3 | Azimuth of satellite in degrees. |
| SNR | Int | (0) 1 | 2 | Signal to noise ration in dBHz, null if the SV is not in tracking. |
| Checksum | *xx | 0 | 3 | 2 digits |
| Message terminator | <CR> <LF> | 2 | 2 | ASCII 13, ASCII 10. |

### 13.5. NMEA Message $GPRMC

This message transfers recommended minimum specific GNSS data.

Example:
$GPRMC,092204.999,A,4250.5589,S,14718.5084,E,0.00,89.68,211200, ,A*25<CR><LF>

| Field | Format | Min chars | Max chars | Notes |
|---|---|---|---|---|
| Message ID | $GPRMC | 6 | 6 | RMC protocol header |
| UTC Time | hhmmss.sss | 1,2,2.1 | 2,2,2.3 | Fix time to 1ms accuracy |
| Status | Char | 1 | 1 | A=Data valid<br>V=Data invalid |
| Latitude | float | 1,2.1 | 3,2.4 | Degrees * 100+minutes |
| N/S Indicator | char | 1 | 1 | N=North, S=South |
| Longitude | float | 1,2.1 | 3,2.4 | Degrees * 100+minutes |
| E/W Indicator | Char | 1 | 1 | E=East, W=West |
| Speed over ground | Float | 1,1 | 5.3 | Speed over ground in knots |
| Course over ground | Float | 1.1 | 3.2 | Course over ground in degrees |
| Date | ddmmyy | 2,2,2 | 2,2,2 | Current date |
| Magnetic variation | Blank | (0) | (0) | Not used |
| E/W indicator | Blank | (0) | (0) | Not used |
| Mode | Char | 1 | 1 | N = Data not valid<br>A = Autonomous mode<br>D = Differential mode<br>E = Estimated (dead reckoning) mode<br>M = Manual input mode<br>S = Simulator mode |
| Checksum | *xx | 0 | 3 | 2 digits |
| Message terminator | <CR> <LF> | 2 | 2 | ASCII 13, ASCII 10. |

### 13.6. NMEA Message $GPVTG

This message transfers velocity, course over ground, and ground speed.

Example:
$GPVTG,89.68,T,,M,0.00,N,0.0,K,A*5F<CR><LF>

The $GPVTG message format is shown below.

| Field | Format | Min chars | Max chars | Notes |
|---|---|---|---|---|
| Message ID | $GPVTG | 6 | 6 | VTG protocol header |
| Course (true) | Float | 1.1 | 3.2 | Measured heading in degrees |
| Reference | Char | 1 | 1 | T=true heading |
| Course (magnetic) | Float | 1.1 | 3.2 | Measured heading |
| Reference | Char | 1 | 1 | M=magnetic heading |
| Speed | Float | 1.1 | 4.2 | Speed in knots |
| Units | Char | 1 | 1 | N=knots |
| Speed | Float | 1.1 | 4.2 | Speed in km/h |
| Units | Char | 1 | 1 | K=km/h |
| Mode | Char | 1 | 1 | N = not valid<br>A = Autonomous mode<br>D = Differential mode<br>E = Estimated (dead reckoning) mode<br>M = Manual input mode<br>S = Simulator mode |
| Checksum | *xx | 0 | 3 | 2 digits |
| Message terminator | <CR> <LF> | 2 | 2 | ASCII 13, ASCII 10. |

### 13.7. NMEA Message $GPZDA

This message transfers UTC Time and Date. Since the latency of preparing and transferring the message is variable, and the time does not refer to a particular position fix, the second precision is reduced to 2 decimal places.
The $GPZDA message format is shown below.

| Field | Format | Min chars | Max chars | Notes |
|---|---|---|---|---|
| Message ID | $GPZDA | 6 | 6 | ZDA protocol header |
| UTC time | hhmmss.ss | 2,2,2.2 | 2,2,2.2 | 00000000.00 to 235959.99 |
| UTC day | dd | 2 | 2 | 01 to 31, day of month |
| UTC month | mm | 2 | 2 | 01 to 12 |
| UTC Year | yyyy | 4 | 4 | 1989-9999 |
| Local zone hours | Int | (-)2 | (-)2 | Offset of local time zone (-13) to 13 |
| Local zone minutes | Unsigned | 2 | 2 | |
| Checksum | *xx | 0 | 3 | 2 digits |
| Message terminator | <CR> <LF> | 2 | 2 | ASCII 13, ASCII 10. |

P.O. Box 383
Anderson, SC 29622
USA

Email: engineering@perthold.de
Web: www.perthold.de