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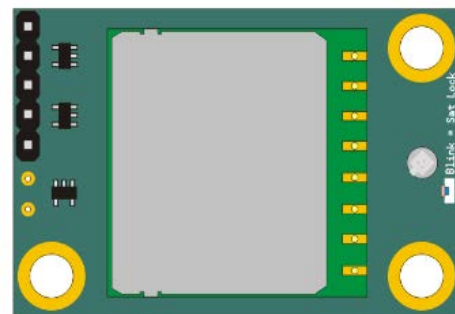


PAM-7Q GPS Module (#28509)

Parallax's PAM-7Q GPS Module embeds the very capable uBlox PAM-7Q GPS device in a project-friendly module.

The PAM-7Q GPS device gives your project the ability to understand its position anywhere on the earth, as long as it has a clear view of the sky. It does this by using a Global Navigation Satellite System (GNSS), such as GPS. Its default settings provide all the capabilities you would expect from a GPS receiver – location fix, speed, heading, altitude measurements, and atomic date and time. Advanced users can reconfigure these settings for specific needs.

Parallax's module makes the PAM-7Q device even more user-friendly by providing a breadboard-friendly 5-pin header and mounting holes for quick, solder-free integration into your project. An onboard voltage regulator and buffer circuitry provides bidirectional signal conditioning for ready use with 5 V microcontrollers. A dual-purpose power/satellite lock LED lets you know when your GPS module is powered on and receiving data. As a final touch, an onboard super-cap preserves the GPS device's almanac data for up to 30 minutes if power is disconnected temporarily, such as when changing your project's batteries. Whether your project needs positional accuracy, high speed movement estimations, high altitude measurements, fast update rates, or just plain ease of use, the PAM-7Q GPS Module has you covered.



PAM-7Q Features

- NMEA 0183 v2.3 standard protocol
- 56 separate tracking channels
- Up to 10 Hz max navigation update rate
- <2.0 meter horizontal position accuracy (2.5 m worst case)
- Configurable time pulse signal (0.25 Hz to 1 kHz)
- Buffered UART serial communication (3.3 V/5V safe)
- 50 km (~ 31 mi) maximum altitude (upper stratosphere)
- Super-capacitor aided start battery backup

Key Specifications

- Power requirements: 3.3 V – 5 V, 55 mA max (typically 35 mA)
- Communication: TTL Asynchronous Serial (UART), Optional I²C
- Operating temperature range: -40 to +185 °F (-40° to +85° C)
- Dimensions: 1.0 x 1.5 x 0.5 in (25.4 x 38.1 x 12.7 mm)

Application Ideas

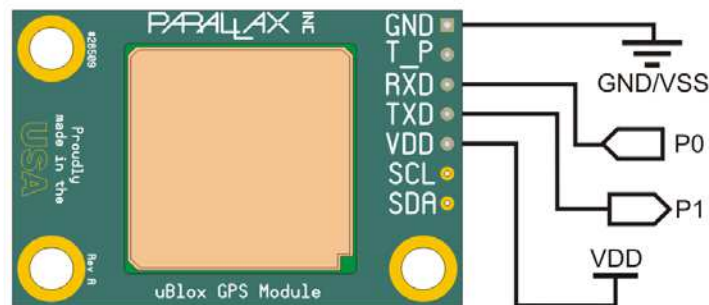
- Robo-Magellan projects
- Fleet tracking
- Heading and speed measurements
- Weather balloon tracking
- Electronic pet tracking collar

Pin Definitions and Ratings

| Pin | Name | Function |
|-----|------|--|
| 1 | GND | Ground Reference (VSS) -> 0 V |
| 2 | T_P | Time Pulse |
| 3 | RXD | Device UART Receive |
| 4 | TXD | Device UART Transmit |
| 5 | VDD | Voltage Input (3.3 V – 5.0 V) |
| 6 | SCL | Optional I ² C Serial Clock |
| 7 | SDA | Optional I ² C Serial Data |

| Symbol | Quantity | Minimum | Typical | Maximum | Units |
|----------------------|---------------------------------|-----------|---------|------------|-------|
| VDD | Supply Voltage | 3.0 | 3.3 | 5.2 | V |
| GND | Ground reference connection | | 0 | | V |
| I _{DD(Ave)} | Average active supply current | | 35 | | mA |
| I _{DD(PK)} | Peak instantaneous current | | | 55 | mA |
| VOH | Signal high transmit (TXD, T_P) | VDD × 0.9 | VDD | VDD + 0.5 | V |
| VOL | Signal low transmit (TXD, T_P) | GND - 0.3 | GND | VDD × 0.15 | V |
| VIH | Signal high receive (RXD) | 1.5 | VDD | 40 | V |
| VIL | Signal low receive (RXD) | - 0.3 | GND | 0.7 | V |
| V _{SCL} | I ² C Clock Signal | 0 | | 3.3 | V |
| V _{SDA} | I ² C Data Signal | 0 | | 3.3 | V |

Quick Start Circuit



The PAM-7Q GPS Module can be interfaced with many common microcontrollers or computers, including the Propeller, BASIC Stamp, Arduino, PIC, Raspberry Pi, Beaglebone, and more. At minimum, you can begin receiving data from the module by connecting the power pins, VDD and GND, and by making a connection with the module's transmit pin, TXD. If you want to change any of the module's settings, you will need to connect a signaling pin from your device to the module's receive pin, RXD.

Voltage Supply and Signaling Levels

You can power the module at common TTL voltage levels, between 3.3 V and 5.0 V. The module's voltage supply and communication voltage level is provided by the VDD pin. The module's onboard regulator and buffer circuitry appropriately condition incoming and outgoing communication signals. So, output signals will be matched to VDD's voltage, and input signals will be conditioned to 3.3 V so as not to damage the uBlox GPS device. Note that the optional SCL and SDA lines are not conditioned; see the Other Features and Precautions section, page 5.

Default Settings

The device comes preconfigured with these default settings. See the sections that follow for details about these defaults. Full information about configurable options can be found in the PAM-7Q manufacturer's datasheet.

- Output Data: 0183 NMEA standard sentences
 - RMC
 - VTG
 - GGA
 - GSA
 - GSV
 - GLL
- Update Rate: 1 Hz fix update rate
- Navigation Mode: Continuous
- Time Pulse Output: 1 Hz time pulse output on T_P pin, 10% duty cycle
- Communication Protocol: 9,600 baud TTL Asynchronous Serial (UART) communication
 - True mode (active high)
 - 1 start bit
 - 8 data bits
 - 1 stop bit
 - No parity

Output Data

By default, the PAM-7Q GPS Module outputs NMEA 0183 v2.3 protocol standard sentences. As soon as the module is powered, a series of ASCII strings are sent from the module's TXD pin, representing fix information.

The module will output the following NMEA strings by default:

RMC: Recommended minimum data for GPS

VTG: Vector track and speed over the ground

GGA: Fix information

GSA: Overall satellite data

GSV: Detailed satellite data

GLL: Latitude/Longitude data

These NMEA sentences and others can be turned on or off optionally by issuing special UBX commands to the module. See the Communication Protocol section and uBlox's Receiver Description Protocol Specification document for more information.

At initial power-on, the PAM-7Q GPS module also transmits a set of special messages that describe the GPS device hardware. These messages carry a non-NMEA-standard "TXT" prefix, yet follow the same checksum rules defined by the standard. If your application demands verification of the module, you can parse this information as needed. These strings contain no relevant fix information.

This is an example of the module's power-on hardware summary:

```
$GPTXT,01,01,02,u-blox ag - www.u-blox.com* 50
$GPTXT,01,01,02,HW UBX-G70xx 00070000 EFFFFFFo* 1B
$GPTXT,01,01,02,ROM CORE 1.00 (59842) Jun 27 2012 17:43:52* 59
$GPTXT,01,01,02,PROTVER 14.00* 1E
$GPTXT,01,01,02,ANTSUPERV= AC SD PDoS SR* 20
$GPTXT,01,01,02,ANTSTATUS= DONTKNOW* 33
```

```
$GPTXT,01,01,02,LLC FFFFFFFF-FFFFFFFF-FFFFFFFF-FFFFFFFF-FFFFFFFF79* 21
$GPTXT,01,01,02,ANTSTATUS= INIT* 25
$GPTXT,01,01,02,ANTSTATUS= OK* 3B
```

This is a set of initial empty NMEA sentences before a fix has been established, just after the module has been powered on:

```
$GPRMC,V,,,,,,,,,N* 53
$GPVTG,,,,,,,,,N* 30
$GPGGA,,,,,0,00,99.99,,,,,* 48
$GPGSA,A,1,,,,,,,,,99.99,99.99,99.99* 30
$GPGLL,,,,,V,N* 64
```

A valid position fix will have NMEA sentences that look something like this:

```
$GPRMC,041845.00,A,3846.50323,N,12115.39233,W,0.264,,040814,,,A* 67
$GPVTG,,T,,M,0.264,N,0.488,K,A* 27
$GPGGA,041845.00,3846.50323,N,12115.39233,W,1,03,7.16,72.5,M,-26.8,M,,* 50
$GPGSA,A,2,18,21,15,,,,,,,,,7.23,7.16,1.00* 0A
$GPGSV,4,1,14,14,18,184,,15,33,055,15,16,19,263,,18,78,009,28* 75
$GPGSV,4,2,14,19,11,320,,21,68,067,29,22,53,256,,24,05,105,* 74
$GPGSV,4,3,14,26,05,033,,27,38,308,14,29,17,156,09,46,36,147,* 79
$GPGSV,4,4,14,48,43,198,,51,43,158,* 78
$GPGLL,3846.50323,N,12115.39233,W,041845.00,A,A* 77
```

Your application can parse these sentences for GPS fix information as needed. Parallax provides some sample programs that parse these NMEA sentences and makes the data available to your application. See the Resources and Downloads section for more information. For more information about NMEA sentences and what information is contained in the fields, check out this website:

<http://www.gpsinformation.org/dale/nmea.htm>

Update Rate

By default, the most up-to-date GPS fix information is transmitted from the module at a rate of 1 Hz, that is, once per second. This rate can be increased up to 10 Hz; see the manufacturer's datasheet for more information.

Navigation Mode

There are two navigation modes, continuous navigation and static hold. In the default continuous navigation mode, the PAM-7Q module uses its position acquisition system to constantly download updated almanac information and track satellites. With this information, the module transmits the most up-to-date fix information to your connected device. Continuous navigation mode is enabled by default so your application will receive constant fix updates, regardless of the speed or distance traveled. When the module is stationary, you may see very minute changes in reported speed.

Atmospheric anomalies cause the precise timing signals received by the module to drift ever so slightly, causing the module's reported location to minimally vary. Tall buildings, trees, and overhead obstructions also contribute to slight shifts in timing measurements from the satellites. Static Hold mode is used to filter out this "noise" while the module is not in motion. Thus, the module will not report position changes unless it has moved several meters. This feature is commonly used in automobile GPS navigation systems.

Time Pulse and Satellite Lock LED

The Time Pulse pin on the PAM-7Q GPS module outputs a pulse that is synchronized with the GPS device's "epoch." By default, the PAM-7Q GPS device's epoch is set to a 1 second period and it is synchronized with the time base received from the network of GPS satellites in orbit. By default, this active high pulse has a 10% duty cycle, or 100 ms. The time pulse is only active at the top of each second and only occurs once the module has acquired a GPS satellite lock. If your application requires it, this signal can serve as an interrupt request.

The blue satellite lock LED on the underside of the module also makes use of this time pulse signal to give you a visual indication of when the GPS module has locked onto a GPS signal. This LED also doubles as a power indicator to the module. As soon as power is applied, the LED will light indicating the presence of power. Once at least one satellite is being tracked, the LED will begin to blink with the module's time pulse.

Communication Protocol

The PAM-7Q GPS Module supports multiple physical communication protocols. The module was designed to communicate primarily through a TTL UART – with the TXD transmit pin and RXD receive pin. This UART operates at a default baud rate of 9,600 bits per second (BPS), eight data bits, one start bit, one stop bit, and no parity (8N1). However, the baud rate and character framing settings can be changed to other standard configurations, up to a maximum of 115,200 baud. If 10 Hz navigation update is required, it is recommended that you change the module's baud rate to a higher setting. This is because at 9,600 baud, there is not enough time to send a full set of NMEA sentences in a 100 ms period.

For convenience, advanced users can take advantage of the optional I²C slave port. As you would expect, this communication will take place on the SCL and SDA pins. Note that the pins have not been populated – this is to prevent damage to the module as the signals are not pre-conditioned. See the Precautions section below for more information.

The PAM-7Q GPS module also supports multiple structured data protocols. By default, the module is set to output NMEA sentences automatically. The module will also respond to other data protocols. uBlox has created two proprietary protocols called PUBX and UBX. The PUBX protocol is similar to the NMEA protocol in that data is communicated in ASCII format. For more compact data transmissions, the UBX protocol exchanges data in a binary format. Most users will not need to configure the module with these protocols, but it is good to be aware of their existence.

Additional information about how to communicate with the module via these special protocols or with I²C can be found in uBlox's "Receiver Description Protocol Specification" document.

Other Features and Precautions

Battery Backup Aided Start Feature

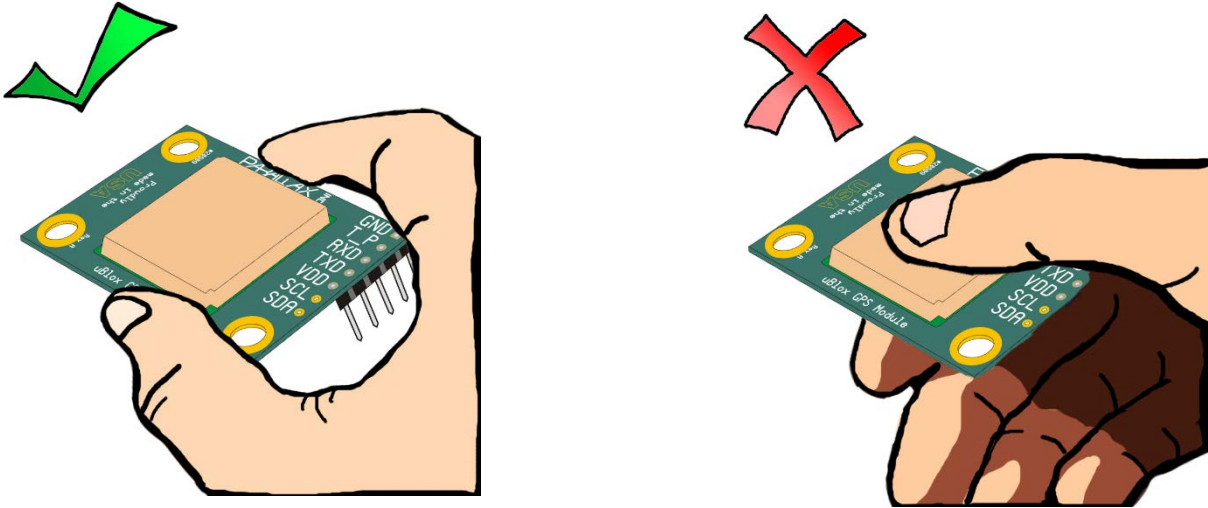
The module is designed with a 30 mF super-cap that acts as a rechargeable battery backup. This allows the GPS module to retain almanac data for more than 30 minutes which aids in quicker Time To Fix (TTF). With this aided start, the module can acquire a valid location fix in as little as 5 seconds.

SCL and SDA Line Precautions

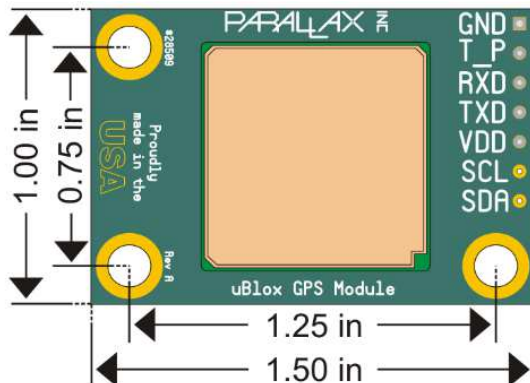
Communication with the PAM-7Q GPS module is intended to happen via the TXD and RXD lines. For advanced users, I²C communication signals are provided as an option. However, there is no signal conditioning present on these lines. Only signal the SCL and SDA lines at 3.3 V. Additionally, the I²C lines are not externally pulled up. If you do decide to communicate via I²C, make sure that the SDA and SCL lines are pulled up to 3.3 V in order to comply with the I²C standard.

Handling Precautions

When handling the PAM-7Q GPS module, handle the module from the edges only. Take special care not to put undue pressure on the GPS antenna from the top-side of the module. As part of the manufacturing process, we have applied epoxy to the GPS antenna to make the module resistant to stress, but excess force could still damage the module.



Module Dimensions



Pin spacing is standard 0.1" for a breadboard friendly design. Mounting holes are spaced by 1.25" and 0.75" center-to-center, with a .125" diameter, and accepts # 4-40 screws.

Resources and Downloads

Check for example programs on Parallax's PAM-7Q product page. Just search for the product number: 28509. Additionally, uBlox publishes detailed datasheets and other technical descriptions on their website. If you want to gain full use of all of the GPS receiver's special features, take a look at uBlox's "Receiver Description Protocol Specification" document. This document is very complete and describes every setting of the PAM-7Q module you can change, as well as the communication protocols the module supports.