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SIM33EAU GPS Module (#28504)

Parallax's SIM33EAU GPS Module embeds the capable SIM33EAU GPS device in a project-friendly board. Ultra compact, the SIM33EAU device has a built-in low-noise amplifier and patch antenna so there is no need for an extra antenna on the board.

The SIM33EAU GPS device gives your project the ability to read its position on the earth—given a clear view of the sky—using global navigation satellite systems such as GPS, GLONASS, Galileo or QZSS. 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 re-configure these settings for specific needs.

Parallax's module makes the SIM33EAU device easily accessible to students, hobbyists, and developers. An onboard voltage regulator and buffer circuitry provide signal conditioning for use with 3.3 V or 5 V microcontrollers. Power and satellite fix LEDs let you know when your GPS module is ready and receiving data. A supercapacitor preserves almanac data for up to 4 hours if power is disconnected. The breadboard-friendly 7-pin header and mounting holes make for quick, solder-free integration into a project.

Features

- Ready for use with 3.3 V or 5 V microcontrollers
- Supported with Propeller C & BlocklyProp code examples
- Power and satellite fix LEDs for quick visual status
- Supercapacitor preserves almanac data for
- Supports PMTK and NMEA 0183 standard protocols
- Receiver supports GPS, GLONASS, GALILEO, QZSS, SBAS ranging (WAAS/EGNOS/MSAS/GAGAN), AGPS, and EASY/EPO orbit prediction
- 33 tracking & 99 acquisition channels with jamming elimination
- Indoor and outdoor multi-path detection and compensation
- Configurable time pulse signal

Application Ideas

- Robot navigation
- Fleet tracking
- Heading and speed measurements
- Weather balloon tracking

Key Specifications

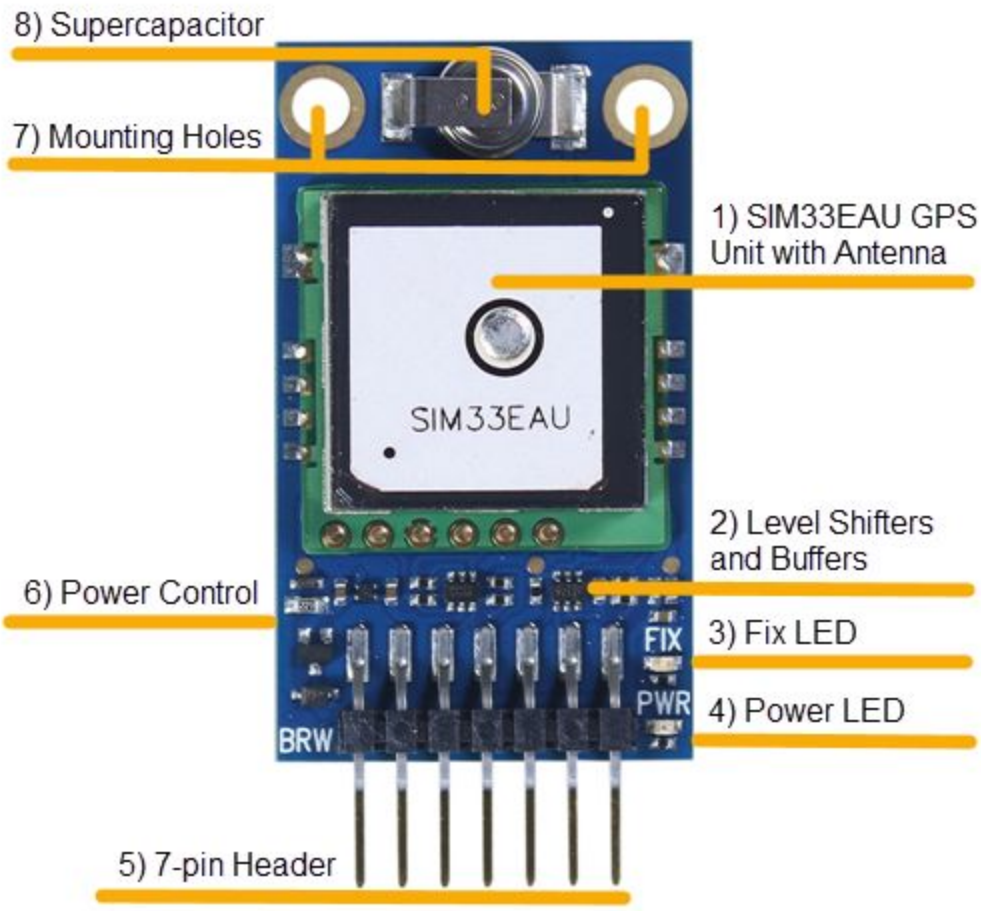
- Power: 3.3 V – 5 V, 60 mA max (typically 45 mA)
- Standby power: Typically 1.5 mA at 3.3 VIN
- Supercapacitor data preservation time for hot start: 4 hours
- Channels: 33 tracking, 99 acquisition
- Typical TTFF (Time to first fix): Cold 31 s, Warm 26 s, Hot < 1 s, EPO Assist 13 s
- Protocols: NMEA and PMTK
- Communication: TTL Asynchronous Serial UART 4800–115200 bps, 9600 default
- Digital I/O: Enable, 3D-Fix and Timemark (1 PPS - Pulse Per Second)
- Navigation update rate: up to 10 Hz
- Horizontal position accuracy: 2.5 meter CEP (Circular Error Probable)
- Speed accuracy: 0.1 meter/second
- Operating temperature range: -40 to +185 °F (-40° to +85° C)
- Maximum altitude: 80 km (~50 mi); upper mesosphere
- Dimensions: 1.0 x 1.7 x 0.36 in (25.4 x 43.2 x 9.1 mm)

See the SIM33EAU GPS manufacturer's documentation for complete device specifications.

Resources and Downloads

Check for the latest version of this document, SIM33EAU GPS manufacturer's documentation, and example programs from the SiM33EAU GPS Module product page. Just go to www.parallax.com and search 28504.

Feature Descriptions



1) SIM33EAU GPS Unit with Antenna

The SIM33EAU can track a signal as low as -165 dBm and has excellent low power consumption characteristics (acquisition 38 mA, tracking 32 mA), making this an ideal module for battery powered applications.

The SIM33EAU supports various location and navigation applications, including autonomous GPS, GLONASS, GALILEO, QZSS, SBAS ranging (WAAS, EGNOS, GAGAN, MSAS), and A-GPS.

See the SIM33EAU manufacturer documentation on the 28504 product page at www.parallax.com for complete information about the SIM33EAU device.

2) Level Shifters and Buffers

To ensure maximum compatibility with a wide range of 3.3V and 5V microcontrollers and development boards, the Parallax GPS module includes voltage level shifters and buffers to set

the logic voltage levels at the SIP header to the VIN voltage level. If you supply 3.3 V to VIN, then the IO pins logic voltage level will be 3.3 V. If you supply 5 V to VIN, then the IO pins logic voltage level will be 5 V.

The Parallax GPS module level shifting circuits include 100 kΩ resistors pulled up to VIN for the TXD and RXD pins, and push-pull buffers for the FIX and PPS pins.

3) Fix LED

The FIX LED by default will light blue whenever the GPS module is locked onto a satellite with at least a 3D fix. The behaviour can be customised.

4) Power LED

The PWR LED indicates that the device is receiving power. It will light green when power is supplied to VIN and the EN "enable" pin is left unconnected or set high. If the enable pin is pulled low then the PWR LED will go off, and the GPS module will powered off.

5) 7-pin Header

The 7-pin header is a 0.1" spaced SIP (single inline package) male header, suitable for plugging directly into a breadboard. It will accept a wide range of header cables (for example, Parallax items #800-00120, #800-00048, #751-00010).

The simplest way to connect to the GPS module is to use only the first three pins: GND, VIN, TXD. These are compatible with the 3-pin ports/servo headers found on Parallax development boards, such as Propeller Activity Board WX (#32912). When connected to a power source, the GPS module will automatically begin transmitting serial NMEA data out of the TXD pin, once per second.

For more advanced features, use additional header cables with the remaining pins: RXD, PPS, FIX and EN.

6) Power Control

The power section of the module includes reverse power protection, a low noise regulator, and a supercapacitor charging circuit. The regulator is specially selected so that the module will be able to operate from noisy power sources, including switching regulators and supplies which are also powering servo motors.

7) Mounting Holes

The two plated mounting holes are attached to the ground plane. See the Module Dimensions section for mounting hole size and spacing.

8) Supercapacitor

An onboard supercapacitor preserves the GPS device's almanac data for up to 4 hours if power is disconnected temporarily, such as when changing your project's batteries or for low power use with occasional GPS queries.

The supercapacitor is automatically charged when power is connected to the Parallax GPS module VIN pin, and will reach greater than a 95% charge capacity in about a minute. This stored energy will provide at least 4 hours of backup time for the GPS module satellite information and real-time clock (RTC).

The benefit of this is that when the GPS module is started, the GPS fix can be obtained more quickly based on the last-known data. This is known as a "Hot Start" and the impact on start-up time and potential power-saving can be considerable.

A good example of how the supercapacitor helps would be for battery powered applications, such as periodic remote logging in a balloon, boat or robot.

The GPS module can be held in low-power mode, and enabled occasionally to log it's position. This strategy will significantly increase the battery life for two reasons:

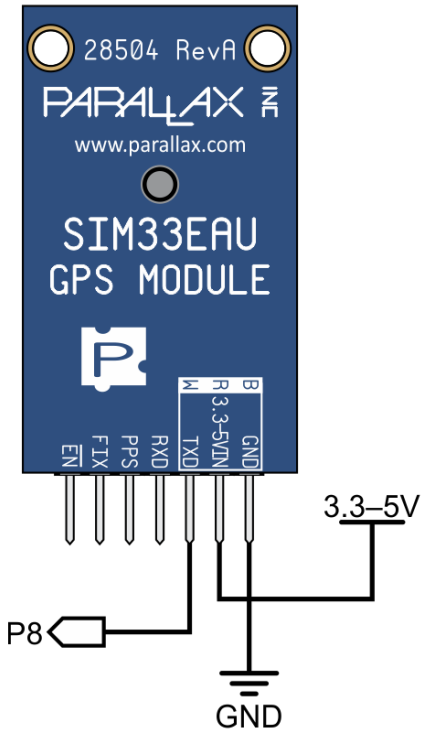
1) Hot Start can take less than 1 second, compared to >30 seconds for a Cold Start.
2) The GPS module typically consumes 45 mA when searching for satellites, but only 1.5 mA when in standby mode.

Quick-Start Guide

The SIM33EAU 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, VIN 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.

Note that the SIM33EAU Module is compatible with Parallax 3-pin extension cables and the 3-pin ports/servo headers on Parallax development boards. The GPS module is marked BRW to indicate the three connections for the black, red, and white pins. A single 3-pin cable between the Parallax GPS module and one of the 5V servo headers on the Parallax Propeller Activity Board (#32912) is all you need to get started.



Example wiring information and BlocklyProp code can be found at learn.parallax.com, in the BlocklyProp Block Reference. Find the link on the 28504 product page at www.parallax.com. For Propeller C, use Learn folder Simple Libraries .07.0292019 or later.

WARNING ! Do not power from VIN when using 3-pin ports/servo headers on Parallax boards. ALWAYS double-check the voltage selection pin is in the correct position for 5V operation before attaching the cable! The Parallax GPS module requires the 5V setting; the VIN voltage will cause damage to the GPS module.

Voltage Supply and Signaling Levels

You can power the module at TTL voltage levels, between 3.3 V and 5.0 V. The module's voltage supply and communication voltage level is provided by the VIN pin. The module's onboard regulator and buffer circuitry automatically adjust the incoming and outgoing communication signals to the supply voltage. So, output signals will be matched to VIN's voltage, and input signals will be conditioned to match internal voltages, so as not to damage the SIM33EAU GPS device.

The SIM33EAU module's TXD pin's output high voltage has a series 100K resistor, so it is safe to use with 3.3V Propeller microcontroller I/O pins when the module is powered by 5V at VIN. This means the module is compatible with the servo headers on the Propeller Activity Board WX (#32912), when the voltage selection pin is set to 5V.

WARNING! The PPS and FIX pins do not have series resistors. When VIN is connected to 5V, these pins should not be connected directly to an I/O pin on the Propeller microcontroller, but may be connected through an external series resistor that is 3.9 KΩ, or higher.

NOTE! When VIN is connected to 5V, connect a series diode between VIN and 5V to enable the PPS and FIX output pins. Use a common diode such as 1N4001, 1N4148 or 1N5818. Connect the Anode to your 5V supply and the Cathode to the GPS module VIN pin.

Default Settings

The device comes pre-configured with these default settings. See the sections that follow for further details. Full information about configurable options can be found in the SIM33EAU manufacturer's datasheet.

Default Settings	
Output Data	0183 NMEA standard sentences: RMC, VTG, GGA, GSA, GSV, GLL
Update Rate	1 Hz
Navigation Mode	Continuous
Time Pulse Output	1 Hz time pulse output on PPS pin, synchronized at rising edge, pulse length 100ms
Communication Protocol	URAT: 9600 baud, 8 data bits, no parity, 1 stop bit

Output Data

By default, the SIM33EAU GPS Module outputs a NMEA 0183 protocol sentence each second. As soon as the module is powered, the following NMEA sentences are transmitted as ASCII strings from the module's TXD pin:

- 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 optionally be turned on or off, by issuing specific PMTK commands to the module. See the Communication Protocol section for more information.

Each 3-character NMEA sentence identifier (such as RMC) will always be prefixed with a two digit satellite identification character. This is known as the "talker ID". For GPS satellites the talker ID is "GP", GLONASS is "GL", GALILEO is "GA" and for the combined GNSS system "GN".

The NMEA sentences are terminated with a carriage-return and line-feed and, including the starting symbols ($ or !) and termination, have a maximum total length of 82 characters.

A set of initial empty NMEA sentences before a fix has been established, just after the module has been powered on, based on reception from a GPS satellite, will look something like this:

```
$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,,*5
$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. For more information about NMEA sentences and what information is contained in the fields, check out this website: https://www.gpsinformation.org/dale/nmea.htm

Pin Definitions and Ratings

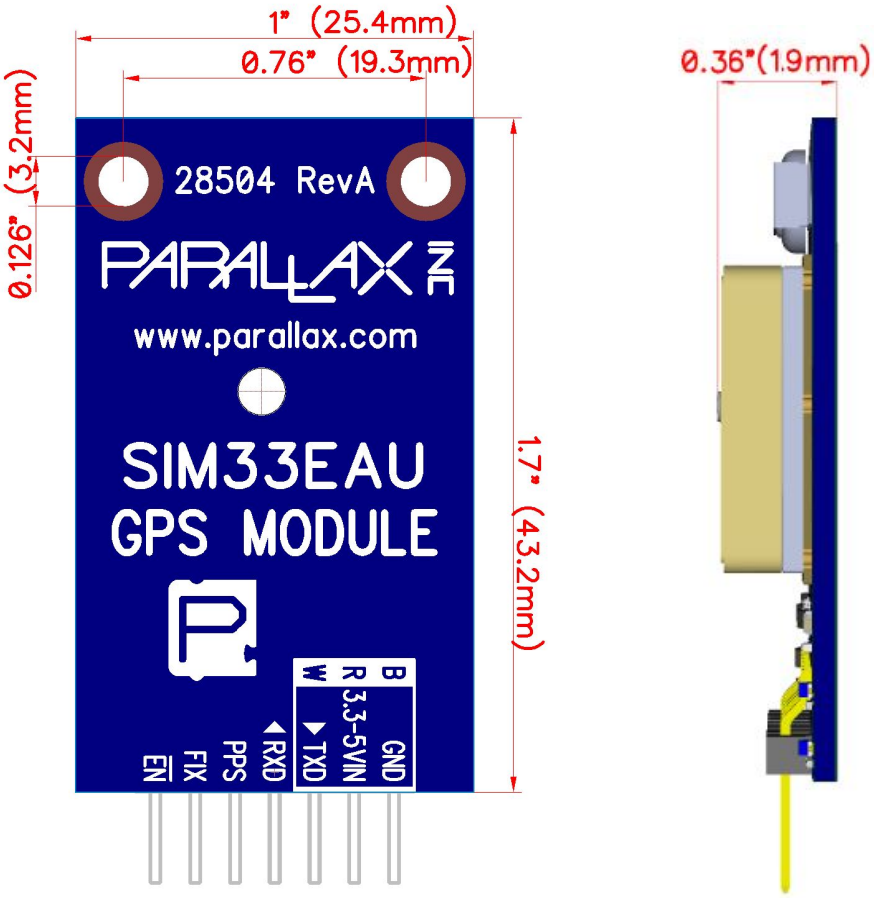
Pin	Type	Function
GND	Ground	Common Ground (0 V supply) must be shared with microcontroller host
3.3-5 VIN	Power	The module operates from 3.3V to 5V DC. The VIN voltage also sets the logic-high level voltage for the signal pins, so match VIN to the microcontroller host VIN within this range..
TXD	Out	TTL Asynchronous Serial Output (UART 9600bps default)
RXD	In	TTL Asynchronous Serial Input (UART 9600bps default)
PPS	Out	Pulse-Per-Second clock output (active high, push-pull) When VIN is connected to 5V, refer to this note to enable this signal output.
FIX	Out	3D GPS Fix obtained indicator (active high, push-pull) When VIN is connected to 5V, refer to this note to enable this signal output.
EN	In	To switch off the module, connect to GND (otherwise leave unconnected or drive with a voltage between VIN and GND). The EN pin is pulled high internally with a 100K resistor to VIN.

Communication Protocol

Full information about the NMEA and PMTK communication protocols can be found in the SIM33EAU message specification guide, available for download from the Parallax website on the 28504 product page:

MT3337 Platform NMEA Message Specification For GPS+GLONASS_V1.00

Module Dimensions



Revision History

Version 1.0: Original release

Version 1.1: Added this note about using the PPS and FIX outputs with 5V supply on Rev A boards; linked to Pin Definitions and Ratings table.