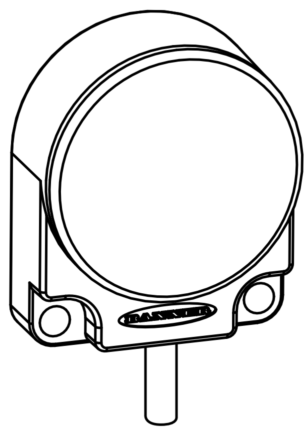
GPS Module

more sensors, more solutions

Datasheet



- Positional accuracy (CEP50) autonomous positional error less than 2.5 meters
- GPS chip: u-blox MAX-M8
- Satellite-based augmentation systems: WAAS, EGNOS, MSAS, GAGAN
- High sensitivity navigation engine (PVT) tracks as low as –166 dBm
- Modbus slave device; RS-485 half-duplex serial communications
- Internal GPS updates once every second
- Environmental rating: IP69K per DIN 40050
- Operating temperature of –40 °C to +80 °C (–40 °F to +176 °F)
- Available with a 2 meter integral cable with flying leads

Models

Model	Power Requirements	Features
GPS50M	5 V DC to 30 V DC	Modbus protocol on RS-485 serial. Latitude, longitude, altitude (meters), time, and date in signed integer and floating point formats

Modbus Registers for the GPS Module

The GPS module only responds to 16-bit Modbus holding register commands. Most GPS data fields require two 16-bit registers to access the entire data value. These 32-bit values are stored as signed integers or floating point values.

By default, the Modbus Slave ID is set to 1.

The GPS device may take a few minutes to achieve a satellite fix, depending on the signal quality and environment.

GPS Location Registers

The Banner GPS unit uses 10 Modbus registers to store the GPS readings for latitude, longitude, altitude (in meters), date, and time. Read the data from the GPS using one of two formats: 32-bit signed integer or 32-bit floating point. Because Modbus registers are only 16-bits per register, two registers are used for every GPS value. Modbus registers 1 through 10 contain the 32-bit signed integer value. Modbus registers 101 through 110 contain the 32-bit floating point value.

Table 1: GPS location registers

GPS Modbus Registers				Definition	Description
Signed		Floating Point			
Upper	Lower	Upper	Lower		
1	2	101	102	Latitude	0 to ±90° From the equator north(+) or south(–) position of a point on the Earth's surface. Integer value is fixed at 7 decimal points
3	4	103	104	Longitude	0 to ±180° From the Prime Meridian east(+) or west(–) position of a point on the Earth's surface. Integer value is fixed at 7 decimal points
5	6	105	106	Altitude	Calculated altitude above sea level in meters(±). Integer value is fixed at 5 decimal points.
7	8	107	108	UTC Time	HHMMSS (Hour, Minute, Second) of UTC time
9	10	109	110	Date	DDMMYY (Day, Month, Year)

GPS Satellite Registers

The GPS accuracy is based on the number of satellites tracked, their positions and whether DGPS (Differential Global Positioning System) is available for use. The Signal Quality register defines if the receiver has achieved DGPS (WAAS for North America), GPS fix or no fix. A DGPS fix is the most accurate.

The DOP (Dilution of Precision) registers help quantify the quality of the fix the receiver has achieved.

Table 2: GPS satellite registers

Modbus Register	Description	Value	Definition
2005–2006	Signal Quality	0	Invalid
		1	GPS fix
		2	DGPS fix
2007–2008	Number of Satellites Being Tracked	1 through 12	Satellite PRN, elevation, azimuth, and signal strength is saved in the satellite data table.
2009–2010	Time (in seconds) Since the Last DGPS Update		

2D/3D Fix Registers

Modbus registers 2103 and 2104 (ASCII) contain a decimal code in ASCII that defines the level of satellite fix.

Table 3: 2D/3D fix registers

Modbus Register	Description	Value	Definition
2103–2104	2D/3D Fix	1 (ASCII 49)	No fix
		2 (ASCII 50)	3 satellites
		3 (ASCII 51)	4 or more satellites

Dilution of Precision Registers

Positional Dilution of Precision (PDOP)—The Positional Dilution of Precision (PDOP) is a result of the HDOP and VDOP where $PDOP^2 = HDOP^2 + VDOP^2$. Generally, the more satellites used in the solution, the smaller the DOP values, which result in smaller solution error. Larger Dilution of Precision values occur when the set of satellites used in the position fix are not spatially diverse (spread out across the sky) from each other. To reduce this error, place the module and its antenna so that it has a clear view of as much of the sky as possible.

Horizontal Dilution of Precision Registers (HDOP)—This number represents the horizontal component of the dilution of precision. This is a geometric factor that, when multiplied by measurement and other input error, gives the error in position.

Vertical Dilution of Precision Registers(VDOP)—This number represents the vertical component of the dilution of precision. This is a geometric factor that, when multiplied by measurement and other input error, gives the error in position.

PDOP, HDOP, and VDOP valures are only valid after the receiver has achieved a position fix.

Table 4: Dilution of prevision (DOP) registers

Modbus Register	Description	Value	Definition
2129–2130	Positional Dilution of Precision (PDOP)	0.0 to 14.4	The smaller the number, the more accurate the readings.
2131–2132	Horizontal Dilution of Precision (HDOP)	0.0 to 10.2	
2133–2134	Vertical Dilution of Precision (VDOP)	0.0 to 10.2	

Speed and Direction Registers

These Modbus registers store the speed and direction as 32-bit floating point values. Since Modbus registers are defined to be 16-bit, a host system is required to read two consecutive registers for each floating point value. The GPS unit must be moving to create valid readings for these fields.

- Speed is stored as a floating point value in knots. To convert to miles per hour, multiply by 1.151.
- Direction is stored as degrees (0 through 359) from true (geodetic) north.

Table 5: Speed and direction registers

Modbus Register	Description	Register Format	Definition
2207–2208	Speed	Floating point	Speed, in knots
2209–2210	Direction	Floating point	Direction from true north, 0–359 degrees.

GPS Satellite Table Data Registers

The GPS tracks up to 12 satellites to calculate position. The Modbus register table below identifies each satellite by the PRN number, position, and signal strength.

- PRN (pseudo random noise) is a unique identifier for each satellite

- Elevation in degrees; 90 maximum
- Azimuth, clockwise in degrees from true north; 000 to 359
- Signal to Noise Ratio; 00–99 dB (null when not tracking)

Table 6: GPS satellite Modbus registers (unsigned integer)

	Satellite PRN	Elevation (Degrees)	Azimuth (Degrees)	Signal Strength
Tracking Satellite 1	2307-2308	2309-2310	2311-2312	2313-2314
Tracking Satellite 2	2315-2316	2317-2318	2319-2320	2321-2322
Tracking Satellite 3	2323-2324	2325-2326	2327-2328	2329-2330
Tracking Satellite 4	2331-2332	2333-2334	2335-2336	2337-2338
Tracking Satellite 5	2407-2408	2409-2410	2411-2412	2413-2414
Tracking Satellite 6	2415-2416	2417-2418	2419-2420	2421-2422
Tracking Satellite 7	2423-2424	2425-2426	2427-2428	2429-2430
Tracking Satellite 8	2431-2432	2433-2434	2435-2436	2437-2438
Tracking Satellite 9	2507-2508	2509-2510	2511-2512	2513-2514
Tracking Satellite 10	2515-2516	2517-2518	2519-2520	2521-2522
Tracking Satellite 11	2523-2524	2525-2526	2527-2528	2529-2530
Tracking Satellite 12	2531-2532	2533-2534	2535-2536	2537-2538

GPS Configuration Registers

Use the configuration registers to change the factory default for the communications interface. The factory default is 19.2 k baud, no parity, and Modbus Slave ID = 1. After you change the Modbus register values, cycle power to the device to activate the new parameters.

Modbus Register	Description	Value	Definition
6101	Serial Baud Rate	0	9.6 k
		1	19.2 k (default)
		2	38.4 k
6102	Parity	0	None (default)
		1	Odd
		2	Even
6103	Modbus Slave ID (default = 1)	1 through 247	

Wiring the Cable to the GPS Module

Connect the GPS module using the cable to 5 V DC to 30 V DC power, ground, and the RS-485 serial lines to a Modbus master device according to the wiring/pin diagram shown. After connecting the GPS module, the user may change the communications parameters using Modbus registers on the device. WARNING: After communications parameters are changed, the GPS module will only respond to the new parameters.

The default communications parameters are: 19.2 k baud, no parity, and Modbus Slave ID = 1.

Wire Color	Sensor Connection (Male)
Brown	Power IN (+), 5 V DC to 30 V DC
White	RS-485 / D1 / B / +
Blue	Ground (–)
Black	RS-485 / D0 / A / –
Gray	Reserved

Specifications

Supply Voltage
5 V DC to 30 V DC

Current
Maximum: < 0.5 W
Typical Average: 10 mA at 24 V DC

Indicators
Green flashing: Power ON
Amber flashing: Modbus communication active

Communication
Interface: RS-485 serial
Baud rates: 9.6k, 19.2k (default), or 38.4k
Data format: 8 data bits, no parity (default), 1 stop bit (even or odd parity available)
Protocol: Modbus RTU

Operating Temperature
–40 °C to +80 °C (–40 °F to +176 °F) [1]

Shock and Vibration
All models meet IEC 60068-2-6 and IEC 60068-2-27 testing criteria
Shock: 30G 11 ms duration, half sine wave per IEC 60068-2-27
Vibration: 10 Hz to 55 Hz, 0.5 mm peak-to-peak amplitude per IEC 60068-2-6

Certifications

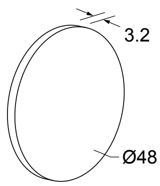
CE — **Banner Engineering Europe** Park Lane, Culliganlaan 2F bus 3, 1831 Diegem, BELGIUM

UK CA — **Turck Banner LTD** Blenheim House, Blenheim Court, Wickford, Essex SS11 8YT, Great Britain

Accessories

ACC-WL50F-MAG

- Magnet mount



Banner Engineering Corp. Limited Warranty

Banner Engineering Corp. warrants its products to be free from defects in material and workmanship for one year following the date of shipment. Banner Engineering Corp. will repair or replace, free of charge, any product of its manufacture which, at the time it is returned to the factory, is found to have been defective during the warranty period. This warranty does not cover damage or liability for misuse, abuse, or the improper application or installation of the Banner product.

THIS LIMITED WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED (INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE), AND WHETHER ARISING UNDER COURSE OF PERFORMANCE, COURSE OF DEALING OR TRADE USAGE.

This Warranty is exclusive and limited to repair or, at the discretion of Banner Engineering Corp., replacement. **IN NO EVENT SHALL BANNER ENGINEERING CORP. BE LIABLE TO BUYER OR ANY OTHER PERSON OR ENTITY FOR ANY EXTRA COSTS, EXPENSES, LOSSES, LOSS OF PROFITS, OR ANY INCIDENTAL, CONSEQUENTIAL OR SPECIAL DAMAGES RESULTING FROM ANY PRODUCT DEFECT OR FROM THE USE OR INABILITY TO USE THE PRODUCT, WHETHER ARISING IN CONTRACT OR WARRANTY, STATUTE, TORT, STRICT LIABILITY, NEGLIGENCE, OR OTHERWISE.**

Banner Engineering Corp. reserves the right to change, modify or improve the design of the product without assuming any obligations or liabilities relating to any product previously manufactured by Banner Engineering Corp. Any misuse, abuse, or improper application or installation of this product or use of the product for personal protection applications when the product is identified as not intended for such purposes will void the product warranty. Any modifications to this product without prior express approval by Banner Engineering Corp will void the product warranties. All specifications published in this document are subject to change; Banner reserves the right to modify product specifications or update documentation at any time. Specifications and product information in English supersede that which is provided in any other language. For the most recent version of any documentation, refer to: www.bannerengineering.com.

For patent information, see www.bannerengineering.com/patents.

[1] Operating the devices at the maximum operating conditions for extended periods can shorten the life of the device.

more sensors, more solutions