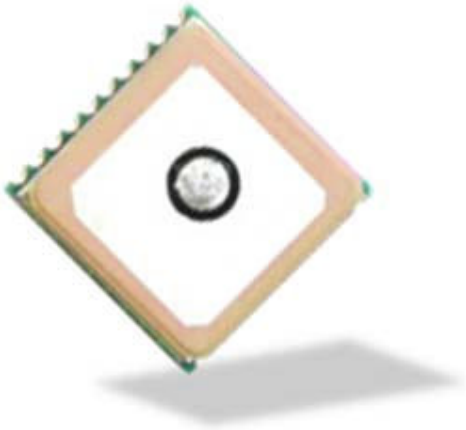


66-channel GPS Engine Board
Smart Antenna

ROBOKITS GPS 02

Description

The ROBOKITS GPS 02 is a revision of PA6 POT (Patch On Top) GPS Module with an extra embedded function for external antenna I/O and comes with **automatic antenna switching function** and short circuit protection. This POT GPS receiver uses internal patch antenna and will automatically detect and switch over to external antenna for GPS reception once a connection to external antenna is made. In addition, the module itself is protected from short circuits to the external antenna. PA6E is high in position and speed accuracy as well as being high in sensitivity with excellent tracking capabilities in urban conditions. The GPS chipset inside the module is powered by MediaTek Inc., and can support up to 66 channels. The module is suitable for every GPS-related application such as:

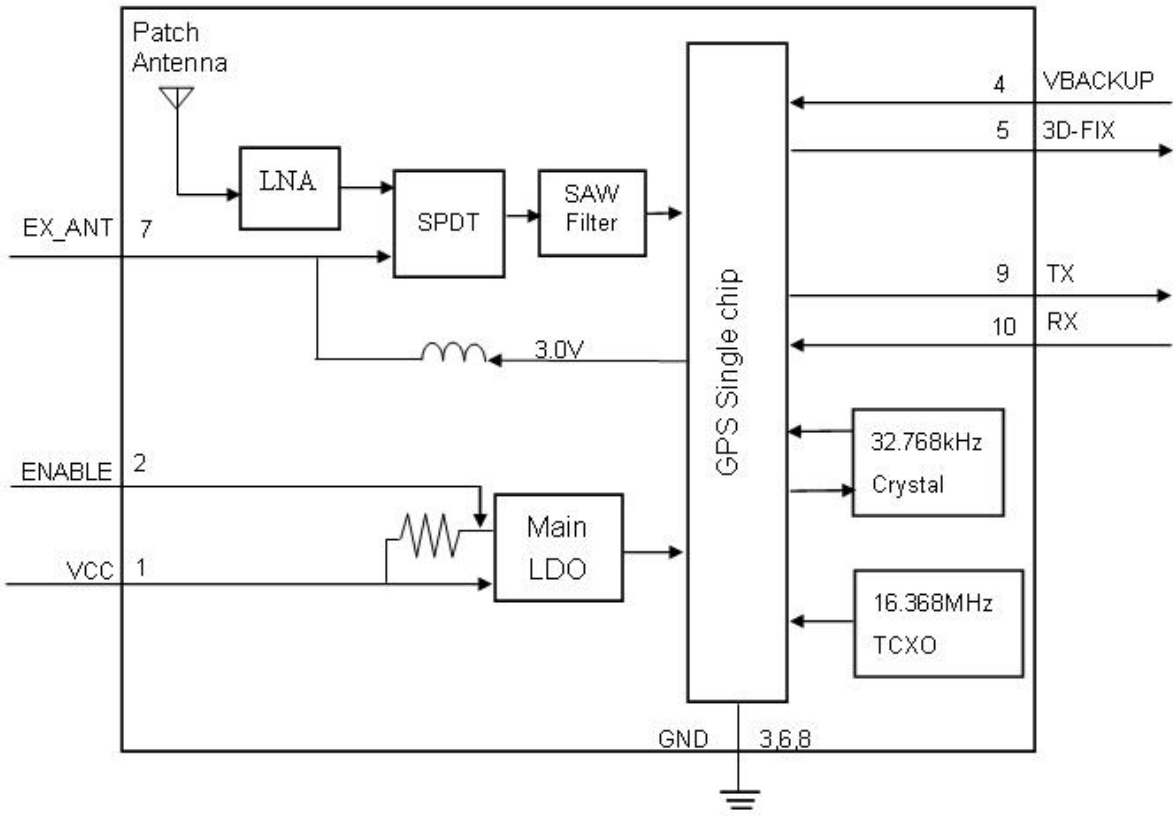
- Fleet Management/Asset Tracking
- LBS (location-base service) and AVL system
- Security system
- Hand-held device for personal positioning and travel navigation

Features

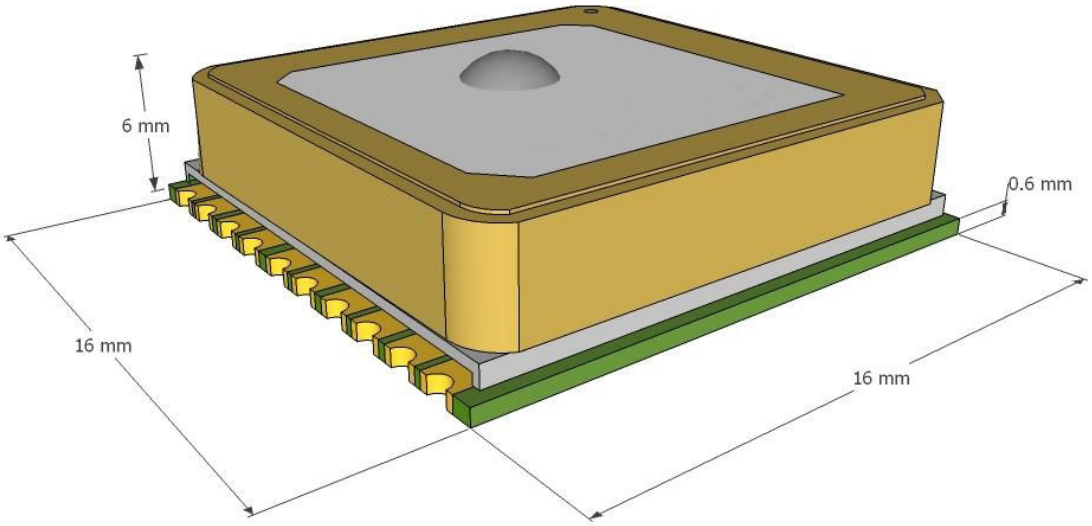
- MediaTek MT3329 Single Chip
- L1 Frequency, C/A code, 66 channels
- Support up 210 PRN channels
- Jammer detection and reduction
- Multi-path detection and compensation
- External Antenna I/O interface
- Automatic External / Internal Antenna Switching
- Dimension: 16mm x 16mm x 6mm / Patch Antenna Size: 15mm x 15mm x 4mm
- High Sensitivity: Up to -165 dBm tracking, superior urban performances[1]
- Low Power Consumption: 48mA @ acquisition, 37mA @ tracking
- Low Shut-Down Power Consumption: 15uA, typical
- DGPS(WAAS/EGNOS/MSAS/GAGAN) support (Default: Enable)
- Max. Update Rate: up to 10Hz (Configurable by firmware)
- Protection from Short Circuits to External Antenna (3V power supply or lower)
- FCC E911 compliance
- RoHS compliant

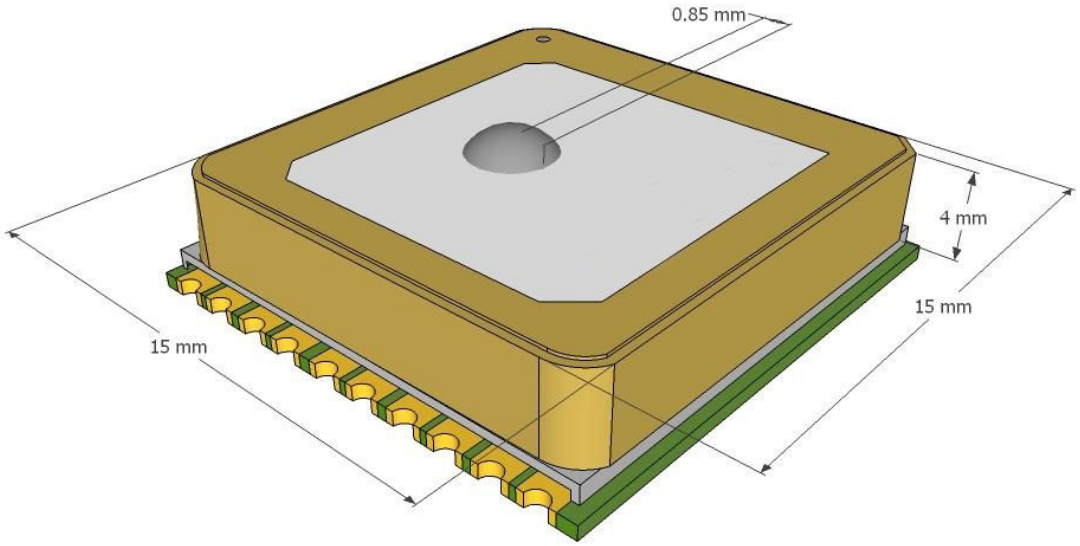
[1] Reference to GPS chipset specification

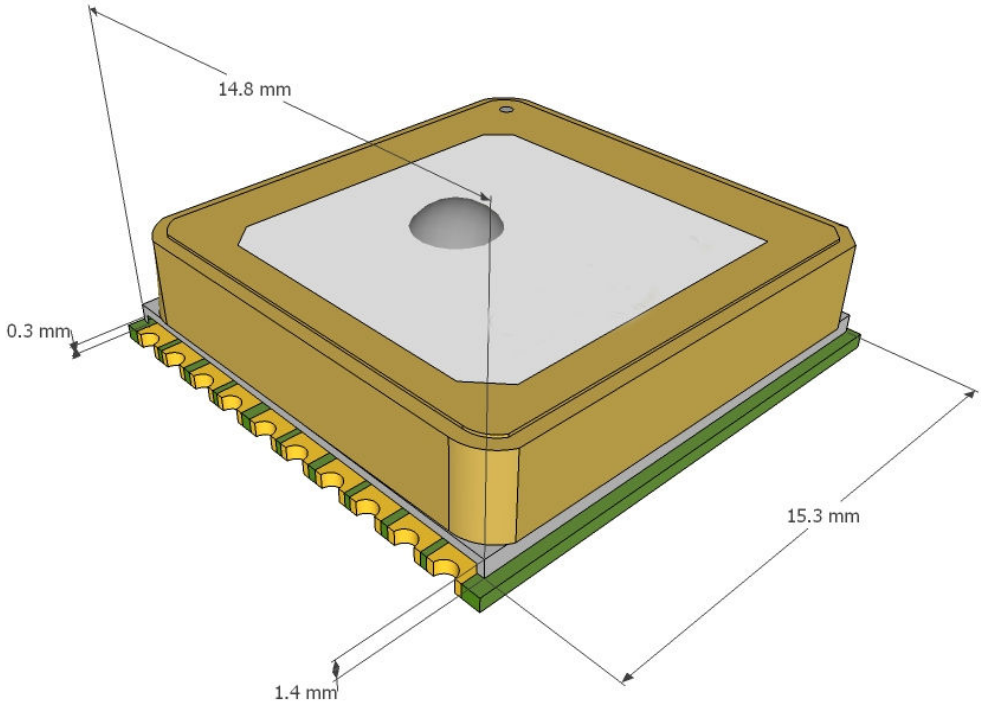
System Block

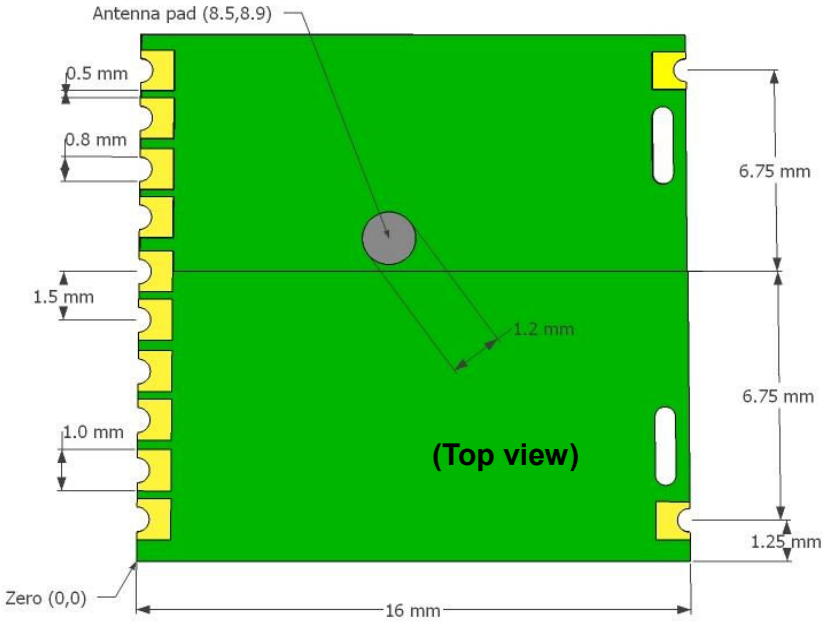


Mechanical



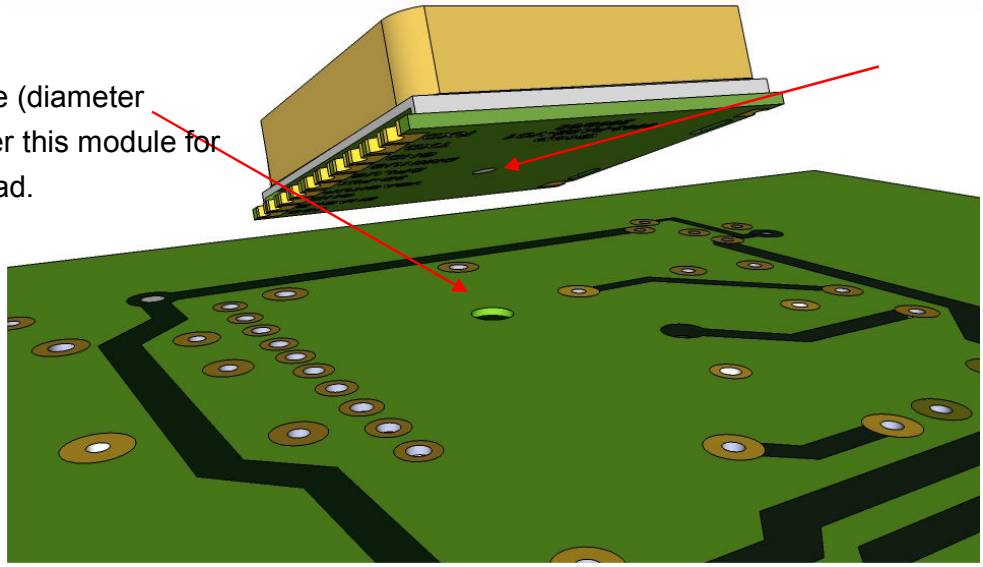



14.8 mm
0.3 mm
15.3 mm
1.4 mm

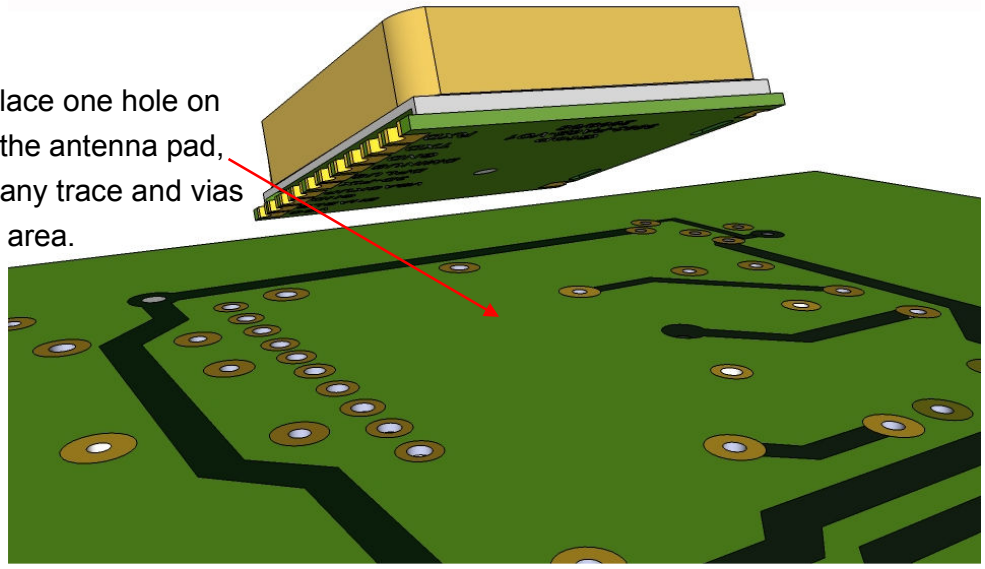

Antenna pad (8.5,8.9)
0.5 mm
0.8 mm
1.5 mm
1.0 mm
1.2 mm
6.75 mm
6.75 mm
1.25 mm
(Top view)
Zero (0,0)
16 mm

Recommend PCB Layout Pad

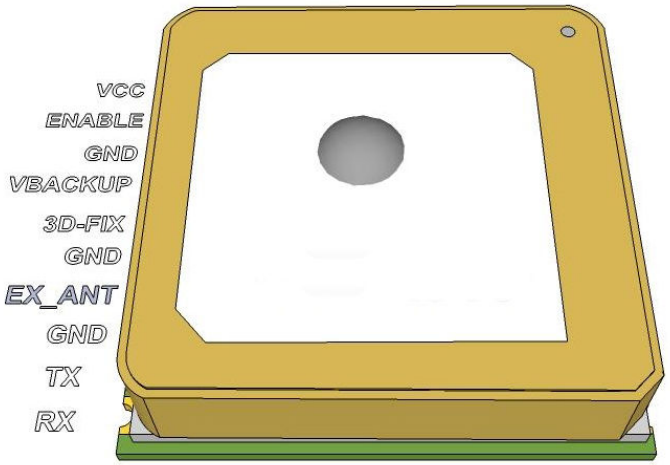
Note.
Place one hole (diameter =3.0mm) under this module for the antenna pad.



Note.
If can't place one hole on PCB for the antenna pad, don't let any trace and vias pass the area.



Pin Configuration



Pin Definition

Pin	Name	I/O	Description
1	VCC	PI	Main DC power input
2	ENABLE	I	High active, or keep floating for normal working
3	GND	P	Ground
4	VBACKUP	PI	Backup power input
5	3D-FIX	O	3D-fix indicator
6	GND	P	Ground
7	EX_ANT	I/O	External Antenna 3.0V input and output for external antenna. The maximum consumption current for the GPS antenna is limited to 30mA. When a 3mA or higher current is detected, the IC will acknowledge the external antenna as being present and uses external antenna for reception. In the event of short circuit occurring at external antenna, the module will limit the drawn current to a safe level.
8	GND	P	Ground
9	TX	O	Serial data output of NMEA
10	RX	I	Serial data input for firmware update

Description of I/O Pin

VCC (Pin1)

The main DC power supply of the module, the voltage should be kept between from 3.2V to 5.0V. The Vcc ripple must be controlled under 50mV$_{pp}$ **(Typical:3.3V)**

ENABLE (Pin2)

Keep open or pull high to Power ON. Pull low to shutdown the module.

Enable (High): 1.8V<= V_{enable}<=VCC

Disable (Low): 0V<= V_{enable}<=0.25V

GND (Pin3)

Ground.

VBACKUP (Pin4)

This is the power for GPS chipset to keep RTC running when main power is removed. The voltage should be kept between 2.0V~4.3V. **(Typical:3.0V)**

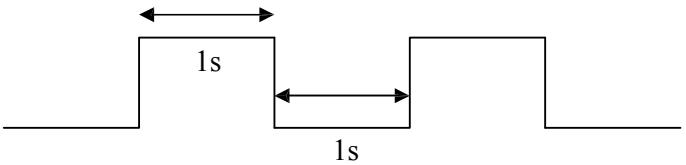
To use the function related to VBackup, this pin must be connected to a power supply.

3D-FIX (Pin5)

The 3D-FIX was assigned as fix flag output. If not used, keep floating.

④ Before 2D Fix

The pin should continuously output one-second high-level with one-second low-level signal.



④ After 2D or 3D Fix

The pin should continuously output low-level signal.

GND (Pin6)
Ground

EX_ANT (Pin7)
External Antenna input and Output 3.0V power for external antenna.
The maximum consumption current for the GPS antenna is limited to 30mA.
When a 3mA or higher current is detected, the IC will acknowledge the external antenna as being present and uses external antenna for reception.
In the event of short circuit occurring at external antenna, the module will limit the drawn current to a safe level.

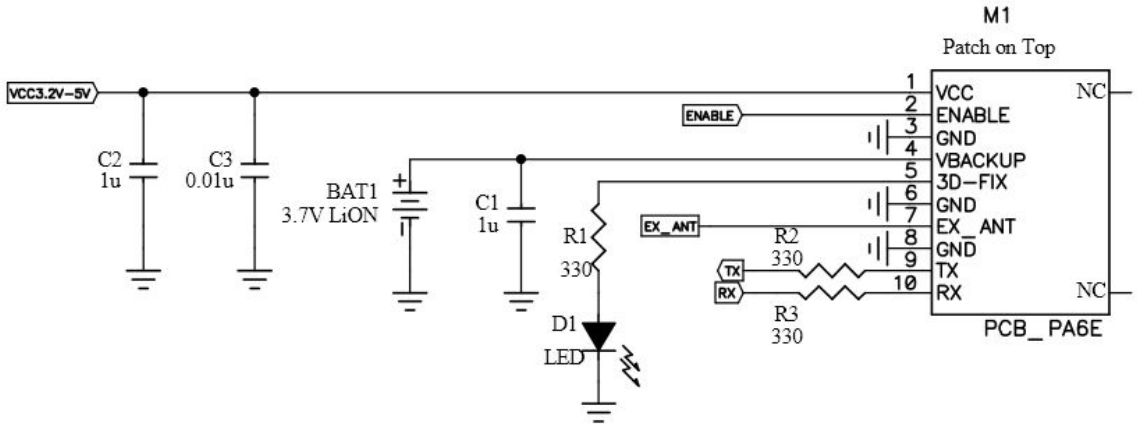
GND (Pin8)
Ground

TX (Pin9)
This is the UART transmitter of the module. It outputs the GPS information for application.

RX (Pin10)
This is the UART receiver of the module. It is used to receive software commands and firmware update.

Reference Design

UART Interface



Specifications

General	
Chipset	MTK MT3329
Frequency	L1, 1575.42MHz
C/A Code	1.023 MHz
Channels	66 channels
SBAS	WAAS, EGNOS,MSAS ,GAGAN Supported(Default: Enable)
Datum	WGS84(Default), Tokyo-M, Tokyo-A, User Define
CPU	ARM7EJ-S
Dimensions	
Length/Width/Height	16*16*6 mm
Weight	6g
Performance Characteristics	
Position Accuracy	Without aid: 3m 2D-RMS DGPS(RTM,SBAS(WAAS,EGNOS,MSAS)):2.5m 2D-RMS
Velocity Accuracy	Without aid:0.1 m/s
	DGPS (SBAS):0.05m/s
Acceleration Accuracy	Without aid:0.1 m/s²
	DGPS (SBAS):0.05m/s²
Timing Accuracy	100 ns RMS
Sensitivity[1]	Acquisition:-148dBm (Cold Start)
	Reacquisition:-160dBm
	Tracking:-165dBm
Update Rate	1Hz (Default)
Acquisition (Open sky, stationary)	
Reacquisition Time[1]	Less than 1 second
Hot start[1]	1.0s (Typical)
Warm start[1]	34s (Typical)
Cold start[1]	35s (Typical)

[1] Reference to GPS chipset specification

Dynamic	
Altitude	Maximum 18,000m (60,000 feet)
Velocity	Maximum 515m/s (1000 knots)
Acceleration	Maximum 4G
I/O	
Signal Output	8 data bits, no parity, 1 stop bit
Available Baud Rates	Default:9600bps (4800/9600/38400/57600/115200 bps by customization)
Protocols	NMEA 0183 v3.01 (Default:GGA,GSA,GSV,RMC,VTG) MTK NMEA Command
Data output Interface	
UART Interface	TTL level serial port
Environment	
Operating Temperature	-40 °C to 85 °C
Storage Temperature	-50 °C to 90 °C
Operating Humidity	5% to 95% (no condensing)
Mounting	SMD Type ,10 Pin

GPS External Antenna Specification (Recommended)

It is important that the antenna gets a clear view of the sky and is positioned on a surface level to the horizon for best results. The following specification has to meet for the use reference design.

Characteristic	Specification
Polarization	Right-hand circular polarized
Receive frequency	1.57542GHz +/-1.023MHz
Power supply	3.0V
DC current	<30mA at 3.0V
Total gain	>15dB
Output VSWR	<2.5
Impedance	50ohm
Noise Figure	<1.5dB

ROBOKITS GPS 02 is capable of automatically detecting the presence of external antenna. If no external antenna is connected, it will use its internal patch antenna. Once an external antenna is connected and a 3mA or higher current consumption is detected, it will automatically switch over to external antenna for GPS reception.

In the event of short circuit occurring at external antenna, the module will automatically limit the drawn current to a safe level. This feature is only supported when using a GPS External Antenna with 3.0V or lower power supply.

DC Characteristics

Parameter	Condition	Min.	Typ.	Max.	Unit
Operation supply Voltage	-	3.2	3.3	5.0	V
Operation supply Ripple Voltage	-	-	-	50	mVpp
Backup Battery Voltage	-	2.0	3.0	4.3	V
RX TTL H Level	VCC=3.3V	2.1	-	2.8	V
RX TTL L Level	VCC=3.3V	0	-	0.9	V
TX TTL H Level	VCC=3.3V	2.1	-	2.8	V
TX TTL L Level	VCC=3.3V	0	-	0.8	V
Power Consumption @ 3.3V	Acquisition	43	48	53	mA
	Tracking	32	37	42	mA
Backup Power Consumption@ 3.0V	25°C	-	10	-	uA
Shut-down Power Consumption (via enable pin)	25°C	-	15	-	uA

NMEA Output Sentence

Table-1 lists each of the NMEA output sentences specifically developed and defined by MTK for use within MTK products

NMEA Output Sentence	**Table-1**
Option	**Description**
GGA	Time, position and fix type data.
GSA	GPS receiver operating mode, active satellites used in the position solution, and DOP values.
GSV	The number of GPS satellites in view satellite ID numbers, elevation, azimuth, and SNR values.
RMC	Time, date, position, course and speed data. Recommended Minimum Navigation Information.
VTG	Course and speed information relative to the ground.

GGA—Global Positioning System Fixed Data. Time, Position and fix related data for a GPS receiver

Table-2 contains the values for the following example:

$GPGGA,064951.000,2307.1256,N,12016.4438,E,1,8,0.95,39.9,M,17.8,M,,*65

GGA Data Format **Table-2**

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	064951.000		hhmmss.sss
Latitude	2307.1256		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12016.4438		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	1		See **Table-3**
Satellites Used	8		Range 0 to 14
HDOP	0.95		Horizontal Dilution of Precision
MSL Altitude	39.9	meters	Antenna Altitude above/below mean-sae-level
Units	M	meters	Units of antenna altitude
Geoidal Separation	17.8	meters	
Units	M	meters	Units of geoidal separation
Age of Diff. Corr.		second	Null fields when DGPS is not used
Checksum	*65		
<CR> <LF>			End of message termination

Position Fix Indicator **Table-3**

Value	Description
0	Fix not available
1	GPS fix
2	Differential GPS fix

GSA—GNSS DOP and Active Satellites

Table-4 contains the values for the following example:

$GPGSA,A,3,29,21,26,15,18,09,06,10,,,,,2.32,0.95,2.11*00

GSA Data Format			**Table-4**
Name	**Example**	**Units**	**Description**
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See **Table-5**
Mode 2	3		See **Table-6**
Satellite Used	29		SV on Channel 1
Satellite Used	21		SV on Channel 2
....	….	….	....
Satellite Used			SV on Channel 12
PDOP	2.32		Position Dilution of Precision
HDOP	0.95		Horizontal Dilution of Precision
VDOP	2.11		Vertical Dilution of Precision
Checksum	*00		
<CR> <LF>			End of message termination

Mode 1	**Table-5**
Value	**Description**
M	Manual—forced to operate in 2D or 3D mode
A	2D Automatic—allowed to automatically switch 2D/3D

Mode 2	**Table-6**
Value	**Description**
1	Fix not available
2	2D (< 4 SVs used)
3	3D (≧4 SVs used)

GSV—GNSS Satellites in View

Table-7 contains the values for the following example:

$GPGSV,3,1,09,29,36,029,42,21,46,314,43,26,44,020,43,15,21,321,39*7D

$GPGSV,3,2,09,18,26,314,40,09,57,170,44,06,20,229,37,10,26,084,37*77

$GPGSV,3,3,09,07,,,26*73

GSV Data Format **Table-7**

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Number of Messages	3		Range 1 to 3 *(Depending on the number of satellites tracked, multiple messages of GSV data may be required.)*
Message Number1	1		Range 1 to 3
Satellites in View	09		
Satellite ID	29		Channel 1 (Range 1 to 32)
Elevation	36	degrees	Channel 1 (Maximum 90)
Azimuth	029	degrees	Channel 1 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99, (null when not tracking)
....	….	….	....
Satellite ID	15		Channel 4 (Range 1 to 32)
Elevation	21	degrees	Channel 4 (Maximum 90)
Azimuth	321	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/No)	39	dBHz	Range 0 to 99, (null when not tracking)
Checksum	*7D		
<CR> <LF>			End of message termination

RMC—Recommended Minimum Navigation Information

Table-8 contains the values for the following example:

$GPRMC,064951.000,A,2307.1256,N,12016.4438,E,0.03,165.48,260406, 3.05,W,A*55

RMC Data Format			**Table-8**
Name	**Example**	**Units**	**Description**
Message ID	$GPRMC		RMC protocol header
UTC Time	064951.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	2307.1256		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12016.4438		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed Over Ground	0.03	knots	
Course Over Ground	165.48	degrees	True
Date	260406		ddmmyy
Magnetic Variation	3.05,W	degrees	E=east or W=west
Mode	A		A= Autonomous mode D= Differential mode E= Estimated mode
Checksum	*55		
<CR> <LF>			End of message termination

VTG—Course and speed information relative to the ground.

Table-9 contains the values for the following example:

$GPVTG,165.48,T,,M,0.03,N,0.06,K,A*37

VTG Data Format **Table-9**

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course	165.48	degrees	Measured heading
Reference	T		True
Course		degrees	Measured heading
Reference	M		Magnetic
Speed	0.03	knots	Measured horizontal speed
Units	N		Knots
Speed	0.06	km/hr	Measured horizontal speed
Units	K		Kilometers per hour
Mode	A		A= Autonomous mode D= Differential mode E= Estimated mode
Checksum	*06		
<CR> <LF>			End of message termination

MTK NMEA Command Protocol

Packet Type:

103 PMTK_CMD_COLD_START

Packet Meaning:

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

Example:

$PMTK103*30<CR><LF>

ESD Handling

Please carefully follow the following precautions to prevent severe damage to GPS modules.

GPS modules are sensitive to electrostatic discharges, and thus are Electrostatic Sensitive Devices (ESD). Careful handling of the GPS modules and in particular to its patch antenna (if included) and RF_IN pin, must follow the standard ESD safety practices:

- Unless there is a galvanic coupling between the local GND and the PCB GND, then the first point of contact when handling the PCB shall always be between the local GND and PCB GND.
- Before working with RF_IN pin, please make sure the GND is connected
- When working with RF_IN pin, do not contact any charges capacitors or materials that can easily develop or store charges such as patch antenna, coax cable, soldering iron.
- Please do not touch the mounted patch antenna to prevent electrostatic discharge from the RF input
- When soldering RF_IN pin, please make sure to use an ESD safe soldering iron