PRODUCT SPECIFICATION

GPS Module

GP39-1513

1. Product Information

Product Name

GP39-1513

Product Description

GP39-1513 features high sensitivity, low power and ultra small form factor. The module is powered by MediaTek. It can provide you with superior sensitivity and performance even in urban canyon and dense foliage environment. The miniature size makes the module easy to integrate into portable device like mobile phone, PDAs, camera and vehicle locators.

This module supports hybrid ephemeris prediction to achieve faster cold start. One is self-generated ephemeris prediction that is no need of both network assistance and host CPU's intervention. This is valid for up to 3 days and updates automatically from time to time when GPS module is powered on and satellites are available. The other is server-generated ephemeris prediction that gets from an internet server. This is valid for up to 14 days. Both ephemeris predictions are stored in the on-board flash memory and perform a cold start time less than 15 seconds.

GP39-1513 is suitable for the following applications:

- Automotive navigation
- Personal positioning
- Fleet management
- Mobile phone navigation
- Marine navigation

Product Features

- MediaTek high sensitivity solution
- Support 66-channel GPS
- Ultra low power consumption
- Fast TTFF at low signal level
- Built-in 12 multi-tone active interference canceller

- Free hybrid ephemeris prediction to achieve faster cold start
- Built-in data logger
- Built-in DC/DC converter to save power
- Up to 10 Hz update rate
- ±11ns high accuracy time pulse (1PPS)
- Capable of SBAS (WAAS, EGNOS, MSAS, GAGAN)
- Support Japan QZSS
- Indoor and outdoor multi-path detection and compensation
- Small form factor 15.0 * 13.0 * 2.2 mm
- SMD type with stamp holes
- RoHS compliant

Product Specifications

GNSS Receiver

GPS Receiver		
Chip	MediaTek MT3339 Chipset (with Flash)	
Frequency	L1 1575.42MHz, C/A code	
Channels	Support 66 channels	
Update rate	1Hz default, up to 10Hz	
Sensitivity	Tracking	-162dBm, up to -165dBm (with external LNA)
	Cold Start	-143.5dBm, up to -148dBm (with external LNA)
Acquisition Time	Hot start (Open Sky)	< 1s (typical)
	Hot start (Indoor)	< 30s
	Cold Start (Open Sky)	32s (typical) without AGPS
		< 15s (typical) with AGPS (hybrid ephemeris prediction)
Position Accuracy	Autonomous	3m (2D RMS)
	SBAS	2.5m (depends on accuracy of correction data)

Max. Altitude	< 50,000 m	
Max. Velocity	< 515 m/s	
Protocol Support	NMEA 0183 ver 4.01	9600 bps, 8 data bits, no parity, 1 stop bits (default) 1Hz: GGA, GLL, GSA, GSV, RMC, VTG
Physical Characteristic		
Type	22 pin stamp holes	
Dimensions	15.0mm * 13.0 mm * 2.2mm ±0.2mm	

DC Electrical Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage	VCC	Iout = 0	3.0	3.3	4.3	V
Input Backup Battery Voltage	V_BAT		2.0		4.3	V
Supply Current	Iss	VIN = 3.3V, Iout = 0, Peak Acquisition Tracking Standby		 14 12(1) 150	66	 mA mA mA uA
Backup Battery Current	I_{bat}	VCC = 0V		6		uA
High Level Input Voltage	V_{IH}		2.0		3.6	V
Low Level Input Voltage	V_{IL}		-0.3		0.8	V
High Level Input Current	I_{IH}	no pull-up or down	-1		1	uA
Low Level Input Current	I_{IL}	no pull-up or down	-1		1	uA
High Level Output Voltage	V_{OH}		2.4			V
Low Level Output Voltage	V_{OL}				0.4	V
High Level Output Current	I_{OH}			2		mA
Low Level Output Current	I_{OL}			2		mA

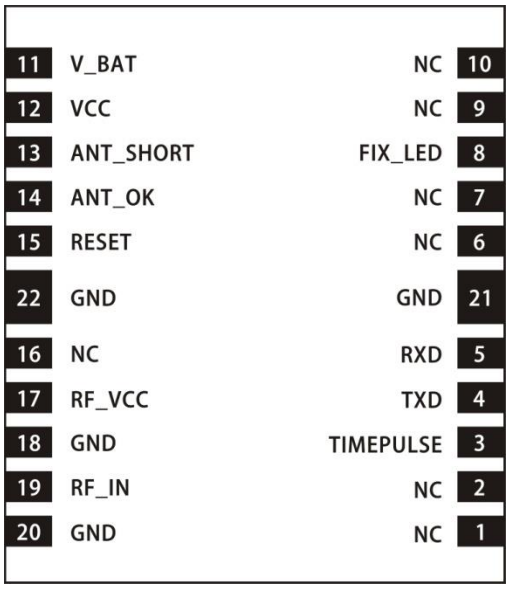
Note 1: Measured when position fix (1Hz) is available, input voltage is 3.3V and the function of self-generated ephemeris prediction is inactive. For different input voltage, the current consumption is as below chart. This is because GP39-1513 is built-in DC/DC converter.

Temperature characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units
Operating Temperature	Topr	-40		85	℃
Storage Temperature	Tstg	-40	25	85	℃

2. Technical Information

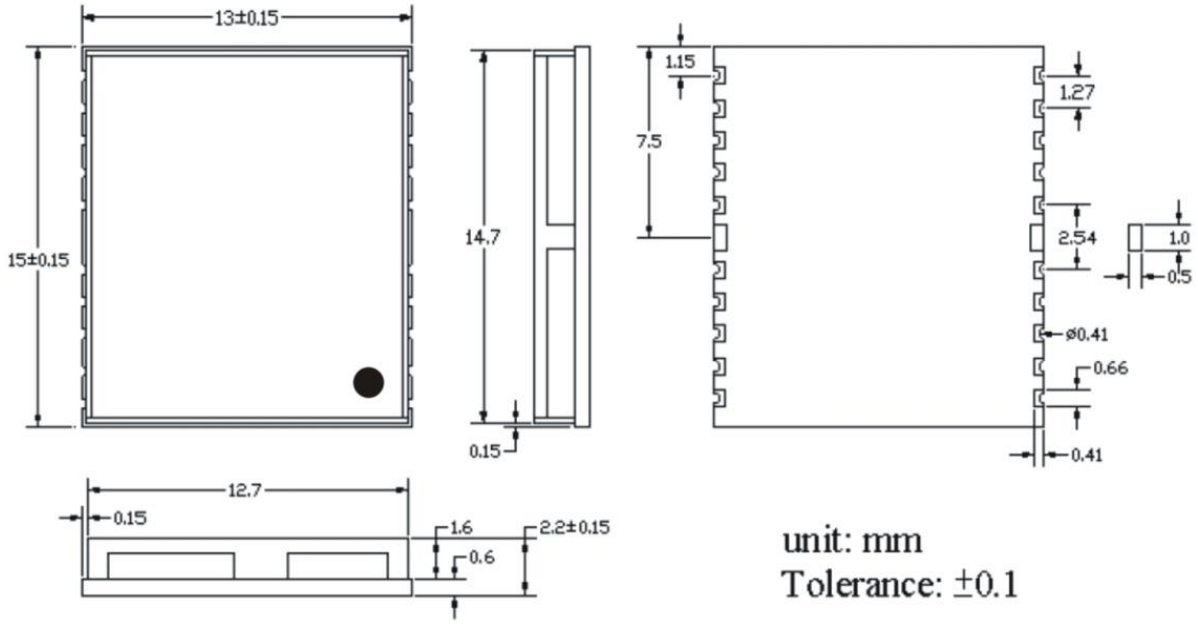
Module Pin Assignment



Pin NO.	Pin Name	I/O	Remark
1.	NC		NC
2.	NC		NC
3.	TIMEPULSE		1pps
4.	TXD		This is the main transmits channel for outputing navigation and measurement data to user's navigation software or user written software,Output TTL level,0V~2.85V.
5.	RXD		This is the main receive channel for receiving software commands to the engine board from demo software or from user written software.
6.	NC		NC
7.	NC		NC
8.	FIX_LED		

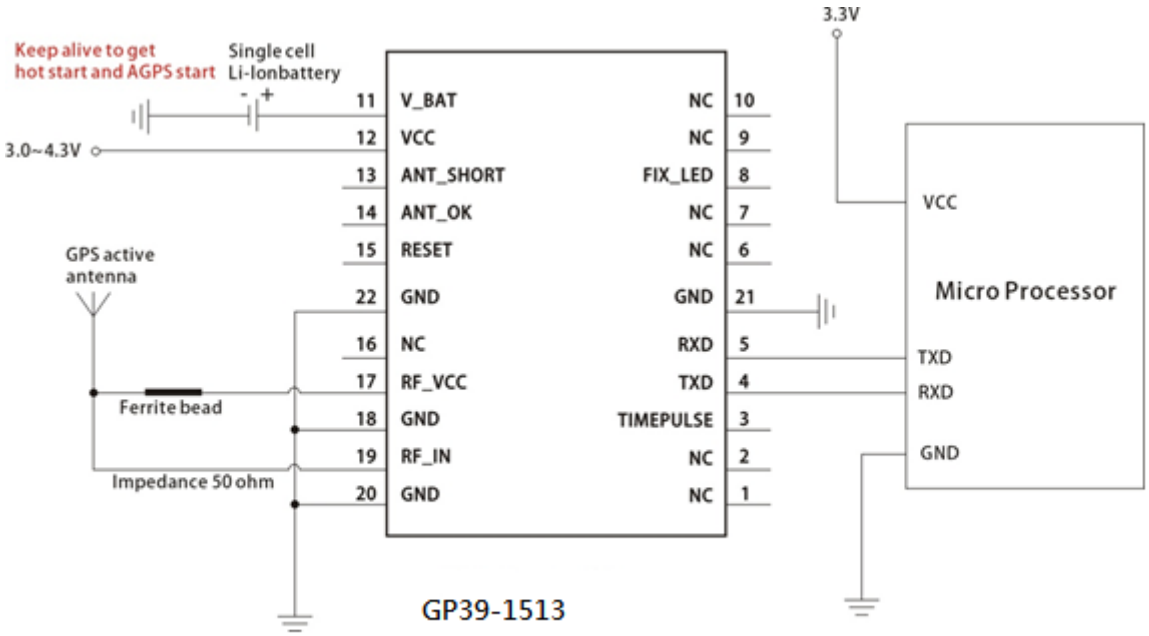
9.	NC		NC
10.	NC		NC
11.	V_BAT	P	Apply2.8~4.3V DC for RTC & SRAM. This pin must be powered to enable the module.
12.	VCC	P	Apply 3.3V±5% DC for ARM and RF.(Main power)
13.	ANT_SHORT	I/O	
14.	ANT_OK	I/O	
15.	RESET		
16.	NC		NC
17.	RF_VCC	P	Apply 3.3V±5% DC for RF
18.	GND	G	Ground.
19.	RF_IN		Connect to Patch Antenna or Connect to External Active Antenna
20.	GND	G	Ground.
21.	GND	G	Ground.
22.	GND	G	Ground.

Dimensions



3. Application Circuit

Typical application circuit that uses active antenna



4. Software Interface

NMEA output message

Table 1-1 NMEA output message

NMEA	Description
GGA	Global positioning system fixed data
GLL	Geographic position - latitude/longitude
GSA	GNSS DOP and active satellites
GSV	GNSS satellites in view
RMC	Recommended minimum specific GNSS data
VTG	Course over ground and ground speed

GGA--- Global Positioning System Fixed Data

Table 1-2 contains the values for the following example:

$GPGGA,060406.000,2503.7148,N,12138.7451,E,2,17,0.71,116.7,M,15.3,M,0000,0000*6D

Table 1- 2 GGA Data Format

Name	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	060406.000		hhmmss.sss
Latitude	2503.7148		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	12138.7451		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	2		See Table 1-3
Satellites Used	17		Range 0 to 33
HDOP	0.71		Horizontal Dilution of Precision
MSL Altitude	116.7	mters	
Units	M	mters	
Geoid Separation	15.3	mters	
Units	M	mters	
Age of Diff. Corr.	0000	second	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*6D		
<CR> <LF>			End of message termination

Table 1-3 Position Fix Indicators

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3-5	Not supported
6	Dead Reckoning Mode, fix valid

GLL--- Geographic Position – Latitude/Longitude

Table 1-4 contains the values for the following example:
$GNGLL,2503.7148,N,12138.7451,E,060406.000,A,D*46

Table 1-4 GLL Data Format

Name	Example	Units	Description
Message ID	$GNGLL		GLL protocol header (GPGLL or GNGLL; GP indicates the device receives GPS satellites signal only and GN indicates the position is calculated with BEIDOU satellite signal)
Latitude	2503.7148		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	12138.7451		dddmm.mmmm
E/W indicator	E		E=east or W=west
UTC Time	060406.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	D		A=autonomous, D=DGPS, E=DR, N=Data not valid, R=Coarse Position, S=Simulator
Checksum	*46		
<CR> <LF>			End of message termination

GSA---GNSS DOP and Active Satellites

Table 1-5 contains the values for the following example:
$GNGSA,A,3,22,21,18,12,24,25,14,15,193,,,,1.18,0.71,0.95*2C
$GNGSA,A,3,205,207,210,202,201,203,209,208,,,,,1.18,0.71,0.95*1C

Table 1-5 GSA Data Format

Name	Example	Units	Description
Message ID	$GNGSA		GSA protocol header (GNGSA or GPGSA; GP indicates the device receives GPS satellites signal only and GN indicates the position is calculated with BEIDOU satellite signal).First row of GSA message contains GPS & QZSS satellites and second row of GSA message contains BEIDOU satellites.
Mode 1	A		See Table 1-6
Mode 2	3		See Table 1-7

ID of satellite used	22		Sv on Channel 1
ID of satellite used	21		Sv on Channel 2
….			….
ID of satellite used			Sv on Channel 12
PDOP	1.18		Position Dilution of Precision
HDOP	0.71		Horizontal Dilution of Precision
VDOP	0.95		Vertical Dilution of Precision
Checksum	*2C		
<CR> <LF>			End of message termination

Table 1-6 Mode 1

Value	Description
M	Manual- forced to operate in 2D or 3D mode
A	Automatic-allowed to automatically switch 2D/3D

Table 1-7 Mode 2

Value	Description
1	Fix not available
2	2D
3	3D

GSV---GNSS Satellites in View

Table 1-8 contains the values for the following example:
$GPGSV,6,1,21,18,78,169,36,209,72,273,36,22,63,309,38,207,63,328,38*7B
$GPGSV,6,2,21,203,58,205,39,25,56,138,39,201,55,141,34,206,50,168,*45
$GPGSV,6,3,21,210,49,282,34,12,48,076,39,204,39,118,,14,38,322,37*77
$GPGSV,6,4,21,193,37,180,34,202,36,246,29,24,23,041,34,31,21,244,*71
$GPGSV,6,5,21,21,17,198,33,205,16,258,28,15,12,092,33,208,09,169,30*7B
$GPGSV,6,6,21,51,,,*7E

Table 1-8 GSV Data Format

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header

Total number of messages1	6		Range 1 to 6
Message number1	1		Range 1 to 6
Satellites in view	21		
Satellite ID	18		Channel 1 (Range 01 to 237), GPS Satellites ID : 01~32,SBAS Satellites ID : 33~64, QZSS Satellites ID:193~196, &BEIDOU Satellites ID : 201~214
Elevation	78	degrees	Channel 1 (Range 00 to 90)
Azimuth	169	degrees	Channel 1 (Range 000 to 359)
SNR (C/No)	36	dB-Hz	Channel 1 (Range 00 to 99, null when not tracking)
….	….	….	….
Satellite ID	207		Channel 4 (Range 01 to 237) , GPS Satellites ID : 01~32,SBAS Satellites ID : 33~64, QZSS Satellites ID:193~196, &BEIDOU Satellites ID : 201~214
Elevation	63	degrees	Channel 4 (Range 00 to 90)
Azimuth	328	degrees	Channel 4 (Range 000 to 359)
SNR (C/No)	38	dB-Hz	Channel 4 (Range 00 to 99, null when not tracking)
Checksum	*7B		
<CR> <LF>			End of message termination

Depending on the number of satellites tracked multiple messages of GSV data may be required.

RMC---Recommended Minimum Specific GNSS Data

Table 1-9 contains the values for the following example:
$GNRMC,060406.000,A,2503.7148,N,12138.7451,E,0.01,0.00,180313,,,D*78

Table 1-9 RMC Data Format

Name	Example	Units	Description
Message ID	$GNRMC		RMC protocol header (GNRMC or GPRMC; GP indicates the device receives GPS satellites signal only and GN indicates the position is calculated with BEIDOU satellite signal)
UTC Time	060406.000		hhmmss.sss
Status	A		A=data valid or V=data not valid

Latitude	2503.7148		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12138.7451		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed over ground	0.01	knots	True
Course over ground	0.00	degrees	
Date	180313		ddmmyy
Magnetic variation		degrees	
Variation sense			E=east or W=west (Not shown)
Mode	D		A=autonomous, D=DGPS, E=DR, N=Data not valid,R=Coarse Position, S=Simulator
Checksum	*78		
<CR> <LF>			End of message termination

VTG---Course Over Ground and Ground Speed

Table 1-10 contains the values for the following example:
$GPVTG,0.00,T,,M,0.01,N,0.02,K,D*3B

Table 1-10 VTG Data Format

Name	Example	Units	Description
Message ID	$GPVTG		VTG protocol header
Course over ground	0.00	degrees	Measured heading
Reference	T		True
Course over ground		degrees	Measured heading
Reference	M		Magnetic
Speed over ground	0.01	knots	Measured speed
Units	N		Knots
Speed over ground	0.02	km/hr	Measured speed
Units	K		Kilometer per hour

Mode	D		A=autonomous, D=DGPS, E=DR, N=Data not valid,R=Coarse Position, S=Simulator
Checksum	*3B		
<CR> <LF>			End of message termination

Proprietary NMEA input/output message

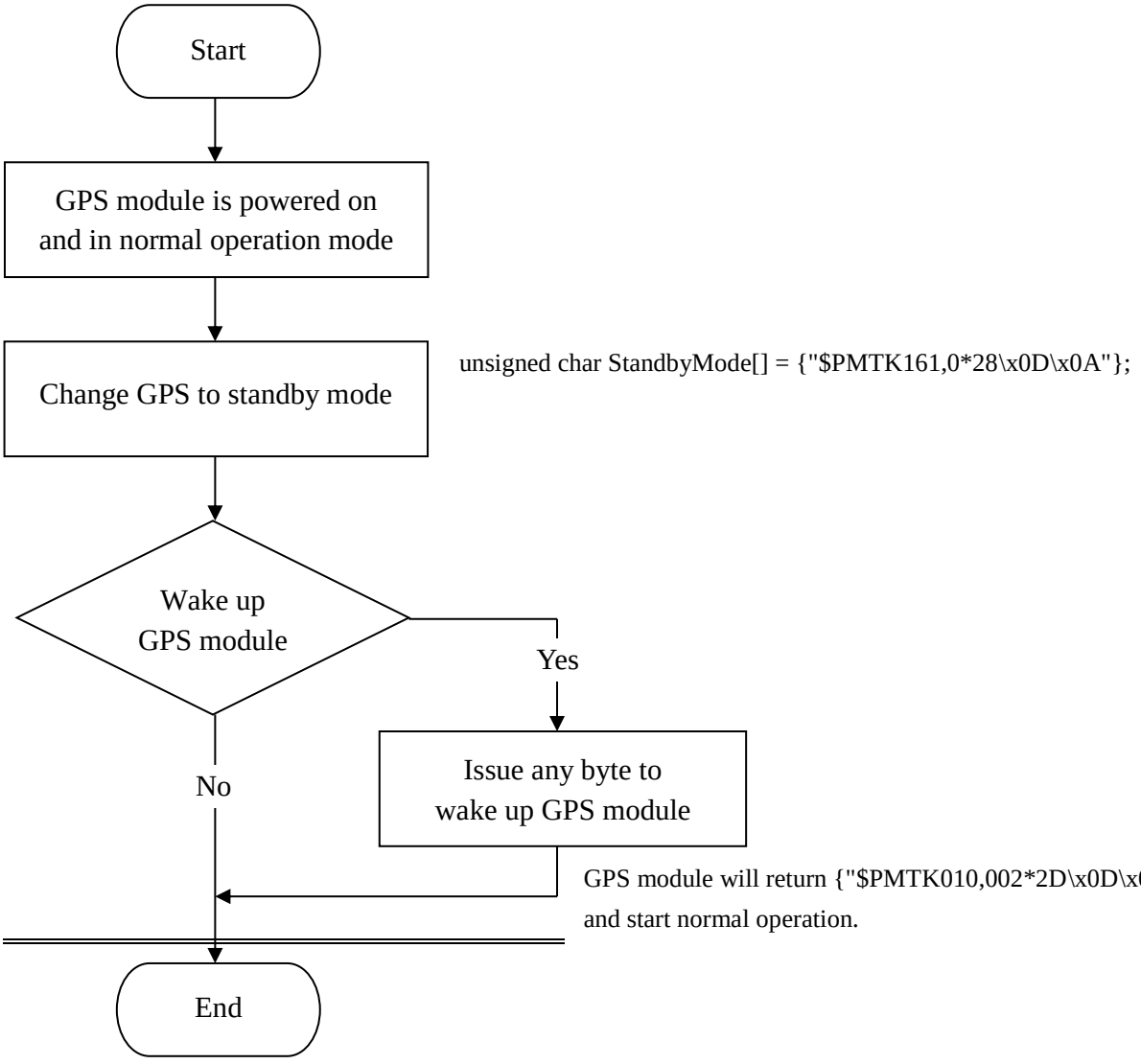
Please refer to MTK proprietary message.

Examples to configure the power mode of GPS module

The module supports different power modes that user can configure by issuing software commands.

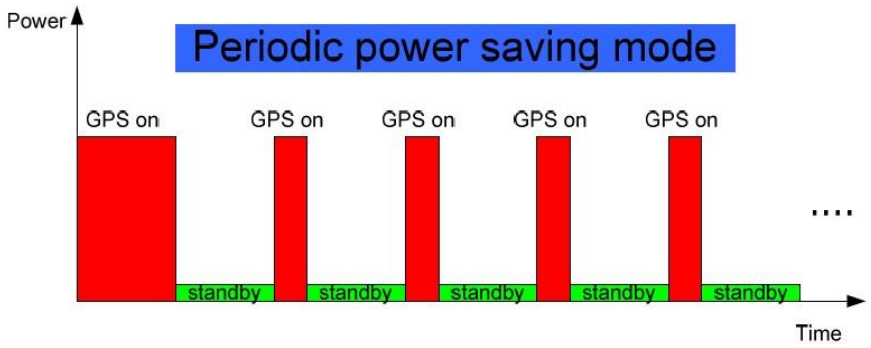
Standby Mode

User can issue software command to make GPS module go into standby mode that consumes less than 200uA current. GPS module will be awaked when receiving any byte. The following flow chart is an example to make GPS module go into standby mode and then wake up.

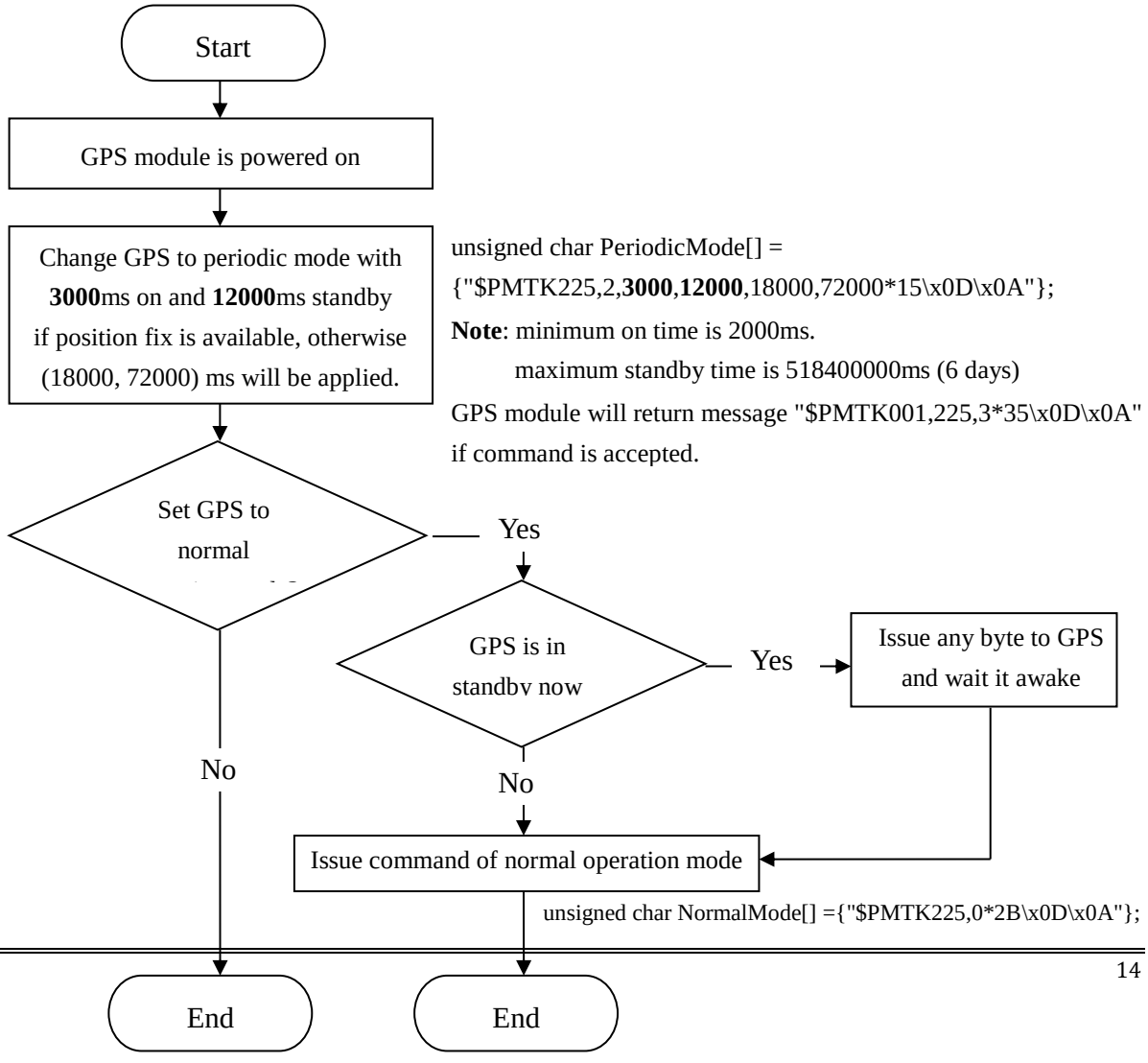


Periodic Mode

When GPS module is commanded to periodic mode, it will be in operation and standby periodically. Its status of power consumption is as below chart.



The following flow chart is an example to make GPS module go into periodic mode and then back to normal operation mode.



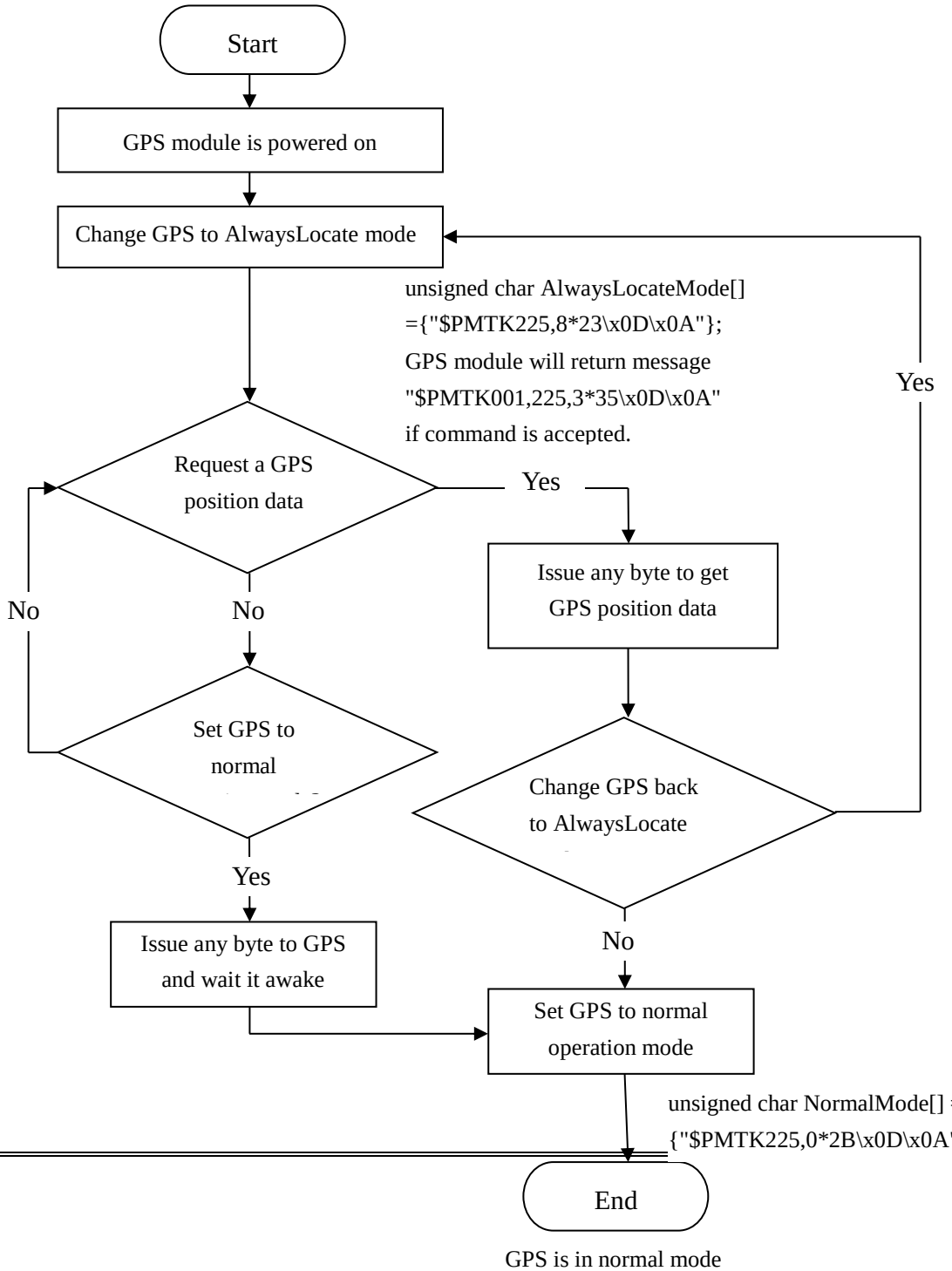
GPS module will return message
"$PMTK001,225,3*35\x0D\x0A"
if command is accepted.

GPS is in periodic mode GPS is in normal mode

AlwaysLocate Mode

AlwaysLocate™ is an intelligent controller of periodic mode. Depending on the environment and motion conditions, GPS module can adaptively adjust working/standby time to achieve balance of positioning accuracy and power consumption. In this mode, the host CPU does not need to control GPS module until the host CPU needs the GPS position data. The following flow chart is an example to make GPS module go into AlwaysLocate™ mode and then back to normal operation mode.

Note: AlwaysLocate™ is a trade mark of MTK.



Data Logger

The GPS module has internal flash memory for logging GPS data. The configurations include time interval, distance, speed, logging mode, and … etc.

For more information, please contact us.

Examples to configure the update rate of GPS module

The GPS module supports up to 10Hz update rate that user can configure by issuing software commands. Note that the configurations by software commands are stored in the battery-backed SRAM that is powered through V_BAT pin. Once it drains out, the default/factory settings will be applied.

Due to the transmitting capacity per second of the current baud rate, GPS module has to be changed to higher baud rate for high update rate of position fix. The user can use the following software commands to change baud rate.

Baud rate	Software command
Factory default	$PMTK251,0*28<CR><LF>
4800	$PMTK251,4800*14<CR><LF>
9600	$PMTK251,9600*17<CR><LF>
19200	$PMTK251,19200*22<CR><LF>
38400	$PMTK251,38400*27<CR><LF>
57600	$PMTK251,57600*2C<CR><LF>
115200	$PMTK251,115200*1F<CR><LF>

Note: <CR> means Carriage Return, i.e. 0x0D in hexadecimal. <LF> means Line Feed, i.e. 0x0A in hexadecimal.

If the user does not want to change baud rate, you can reduce the output NMEA sentences by the following software commands.

NMEA sentence	Software command
Factory default	$PMTK314,-1*04<CR><LF>
Only GLL at 1Hz	$PMTK314,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only RMC at 1Hz	$PMTK314,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only VTG at 1Hz	$PMTK314,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only GGA at 1Hz	$PMTK314,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only GSA at 1Hz	$PMTK314,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>

Only GSV at 1Hz	$PMTK314,0,0,0,0,0,1,0,0,0,0,0,0,0,0,0,0,0,0,0*29<CR><LF>
Only ZDA at 1Hz	$PMTK314,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0*29<CR><LF>
RMC, GGA, GSA at 1Hz and GSV at 0.2Hz	$PMTK314,0,1,0,1,1,5,0,0,0,0,0,0,0,0,0,0,0,0,0,0*2C<CR><LF>
If the command is correct and executed, GPS module will output message $PMTK001,314,3*36<CR><LF>	

After the GPS module is changed to higher baud rate or reduced NMEA sentence, the user can configure it to high update rate of position fix by the following commands.

Interval of position fix	Software command
Every 100ms (10Hz)(1)	$PMTK220,100*2F<CR><LF>
Every 200ms (5Hz)	$PMTK220,200*2C<CR><LF>
Every 500ms (2Hz)	$PMTK220,500*2B<CR><LF>
Every 1000ms (1Hz)	$PMTK220,1000*1F<CR><LF>
Every 2000ms (0.5Hz)(2)	$PMTK220,2000*1C<CR><LF>
If the command is correct and executed, GPS module will output message $PMTK001,220,3*30<CR><LF>	

Note 1: The minimum interval of position fix is 100ms, i.e. the maximum update rate is 10Hz.
Note 2: The current consumption is the same with the update rate of 1Hz.