A7600 Series_GNSS _Application Note_V1.00

LTE Module

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About Document

Version History

Version	Date	Owner	What is new
1.00	2020.09.02	jian.ni/Tao.huang	New version

Scope

This document can apply to A7600 Series, currently only supported A7600C1-MNSE.

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Contents

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1 Introduction

1.1 Purpose of the document

This document describes the usage of the GNSS module, and describes some NMEA format statements.

1.2 Related documents

[1] A7600 Series_AT Command Manual

1.3 Conventions and abbreviations

In this document, the GNSS engines are referred to as following terms:

- GP/GPS (Global navigation system);
- BD/BDS (BEIDOU global navigation system);
- GL/GLNASS (GLONASS global navigation system);
- GN/GNSS (All kinds of global navigation system, include GPS, BDS and GLNASS);
- GNSS (Global Navigation Satellite System);

- GGA (Global positioning system fix data)
- GSA (GPS DOP and active satellites)
- GSV (GPS satellites in view)
- RMC (recommended minimum specific GPS/TRANSIT data)
- VTG (Track made good and ground speed)
- GLL (geographic position)

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2 GNSS Introduction

2.1 Overview

Customer can get useful information about A7600 GNSS functions quickly through this document. GNSS function could be easily realized by AT command interface provided in A7600 module.

A7600 GNSS features:

- Support GPS, GLONASS and BEIDOU satellite system.
- Support standalone mode.
- Support cold start and hot start.
- Support a subset of the NMEA-0183 standard.
- Support NMEA sentences output in NMEA port .
- Support GNSS starts automatically when module powers on.
- Support maximum positioning update rate up to 10Hz.

2.2 GNSS

The working principle is the positioning principle. GPS positioning is divided into single-point positioning (absolute positioning) and relative positioning (differential positioning). Using the precise position of each GPS satellite and the navigation information generated by the continuously transmitted on-board atomic clock to obtain the time difference of arrival from the satellite to the receiver.

The basic principle of BD work is to measure the distance between a satellite with a known position and a user receiver, and then integrate the data of multiple satellites to know the specific position of the receiver. Due to technical reasons, GPS can use the atomic clock on each satellite for precise positioning, but BD is different. Due to the limited technology, China still cannot reach every satellite with an atomic clock, so the development of BD-1 Soon, the accuracy is much lower. And GPS is active positioning, which means that GPS can use 4 satellites to observe and position, while BD-1 is passive positioning and 3 satellites to position, so the accuracy is relatively low. The current working principle of BD-2 is similar to that of GPS, both are single-point positioning (absolute positioning) and relative positioning

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3 NMEA Messages

3.1 Standard NMEA Output Messages

Message	Description	Possible Talker Identifiers
GGA	Time, position and fix type data	GP,GN,GL,BD
GSA	GNSS receiver operating mode, satellites used in the position solution, and DOP values	GP, GL,BD
GSV	Number of GNSS satellites in view satellite ID numbers, elevation, azimuth, & SNR values	GP,GL,BD
RMC	Time, date, position, course and speed data	GP,GN,GL,BD
VTG	Course and speed information relative to the ground	GP,GN,GL,BD
GLL	Latitude, longitude, UTC time of position fix and status	GP,GN,BD
ZDA	PPS timing message (synchronized to PPS)	GP,GN, BD

NOTE

- The prefix "GP" refers to the GPS global navigation system;
- The prefix "GN" refers to the GNSS global navigation system(All kinds of global navigation systems);
- The prefix "GL" refers to the GLONASS global navigation system;
- The prefix "BD" refers to the BEIDOU global navigation system.

A full description of the listed NMEA messages is provided in the following sections.

3.2 Message ID GGA: Global Positioning System Fixed Data

Example:
$GPGGA,091926.000,3113.3166,N,12121.2682,E,1,09,0.9,36.9,M,7.9,M,,0000*56<CR><LF>

Name	Example	Unit	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	091926.000		hhmmss.sss

Latitude	3113.3166		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12121.2682		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Position Fix Indicator	1		See Table 2.4
Satellites Used	09		Range 0 to 12
HDOP	0.9		Horizontal Dilution of Precision
MSL Altitude	36.9	meters	
Units	M	meters	
Geoid Separation	7.9	meters	Geoid-to-ellipsoid separation. Ellipsoid altitude = MSL Altitude + Geoid Separation.
Units	M	meters	
Age of Diff. Corr.		sec	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*56		Xor check results
<CR><LF>			End of message termination

Table 2.4 Position Fix Indicator

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

NOTE

- A valid status is derived from all the parameters set in the software. This includes the minimum number of satellites required, any DOP mask setting, presence of DGPS corrections, etc. If the default or current software setting requires that a factor is met, then if that factor is not met, the solution will be marked as invalid.

3.3 Message ID GLL: Geographic Position - Latitude/Longitude

Example:
$GPGLL,3113.3157,N,12121.2684,E,094051.000,A,A*59<CR><LF>

Name	Example	Unit	Description
Message ID	$GPGLL		GLL protocol header
Latitude	3113.3157		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12121.2684		dddmm.mmmm
E/W Indicator	E		E=east or W=west
UTC Time	094051.000		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	A		A=Autonomous, D=DGPS,
Checksum	*59		Xor check results
<CR><LF>			End of message termination

NOTE

- Position was calculated based on one or more of the SVs having their states derived from almanac parameters, as opposed to ephemerides.

3.4 Message ID GSA: GNSS DOP and Active Satellites

Example:
$GPGSA,A,3,07,02,26,27,09,04,15, , , , , ,1.8,1.0,1.5*33<CR><LF>

Name	Example	Unit	Description
Message ID	$GPGSA		GGA protocol header
Mode 1	A		Table 2.6.1
Mode 2	3		Table 2.6.2
Satellite Used [1]	07		SV on Channel 1
Satellite Used [1]	02		SV on Channel 2
....			....
Satellite Used [1]			SV on Channel 12
PDOP[2]	1.8		Position Dilution of Precision
HDOP[2]	1.0		Horizontal Dilution of Precision
VDOP[2]	1.5	meters	Vertical Dilution of Precision
Checksum	*33		Xor check results
<CR><LF>			End of message termination

NOTE

- Satellite used in solution.
- Maximum DOP value reported is 50. When value 50 is reported, the actual DOP may be much larger.

Table 2.6.1 Mode1

Value	Description
M	Manual – Forced to operate in 2D or 3D mode
A	2D Automatic – Allowed to automatically switch 2D/3D

Table 2.6.2 Mode2

Value	Description
1	Fix not available
2	2D (<4 SVs used)
3	3D (>3 SVs used)

3.5 Message ID GSV: GNSS Satellites in View

Example:
$GPGSV,3,1,11,26,68,023,37,15,64,251,33,05,45,058,34,29,33,253,33*75<CR><LF>
$GPGSV,3,2,11,27,32,164,30,21,25,315,29,02,24,140,31,08,19,048,29*70<CR><LF>
$GPGSV,3,3,11,09,16,180,25,18,08,284,27,10,08,085,18*4E<CR><LF>

Name	Example	Unit	Description
Message ID	$GPGSV		GSV protocol header
Number of Messages [1]	2		Total number of GSV messages to be sent in this group
Message Number[1]	1		Message number in this group of GSV messages
Satellites in View[1]	11		
Satellite ID	26		Channel 1 (Range 1 to 32)
Elevation	68	degrees	Channel 1 (Maximum 90)
Azimuth	023	degrees	Channel 1 (True, Range 0 to 359)
SNR (C/N0)	37	dBHz	Range 0 to 99, null when not tracking
....			....
Satellite ID	29		Channel 4 (Range 1 to 32)
Elevation	33	degrees	Channel 4 (Maximum 90)
Azimuth	253	degrees	Channel 4 (True, Range 0 to 359)
SNR (C/N0)	33	dBHz	Range 0 to 99, null when not tracking

Checksum	*75		Xor check results
<CR><LF>			End of message termination

NOTE

- Depending on the number of satellites tracked, multiple messages of GSV data may be required. In some software versions, the maximum number of satellites reported as visible is limited to 12, even though more may be visible.

3.6 Message ID RMC: Recommended Minimum Specific GNSS Data

Example:
$GPRMC,094330.000,A,3113.3156,N,12121.2686,E,0.51,193.93,171210,,,A*68<CR><LF>

Name	Example	Unit	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	094330.000		hhmmss.sss
Status [1]	A		A=data valid or V=data not valid
Latitude	3113.3156		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12121.2686		dddmm.mmmm
E/W Indicator	E		E=east or W=west
Speed Over Ground	0.51	knots	
Course Over Ground	193.93	degrees	True
Date	171210		ddmmyy
Magnetic Variation [2]		degrees	E=east or W=west
East/West Indicator[2]			E=east
Mode	A		A=Autonomous, D=DGPS
Checksum	*68		Xor check results
<CR><LF>			End of message termination

NOTE

- A valid status is derived from all the parameters set in the software. This includes the minimum number of satellites required, any DOP mask setting, presence of DGPS corrections, etc. If the default or current software setting requires that a factor is met, then if that factor is not met, the

solution will be marked as invalid.

- Does not support magnetic declination. All "course over ground" data are geodetic WGS84 directions relative to true North.

3.7 Message ID GSA: GNSS DOP and Active Satellites

Example:
$GPVTG,83.37,T,,M,0.00,N,0.0,K,A*32<CR><LF>

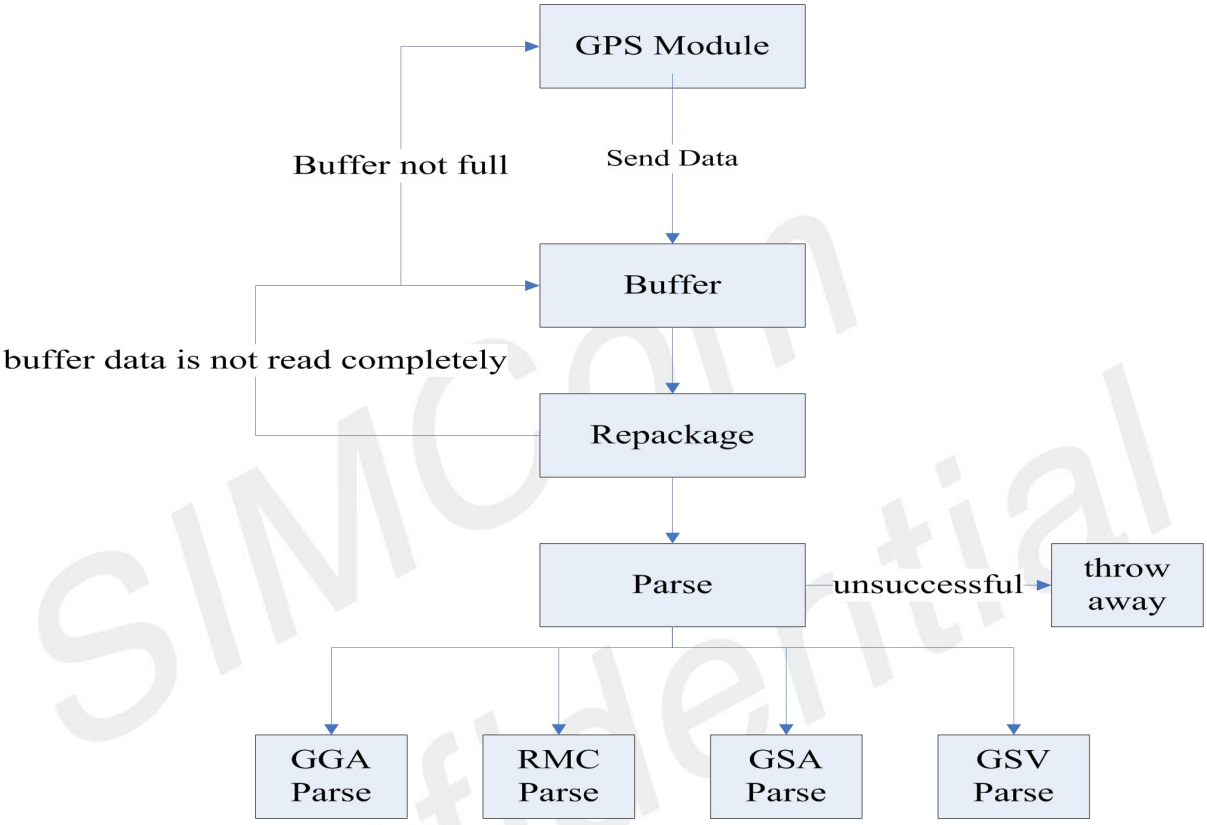
Name	Example	Unit	Description
Message ID	$GPVTG		VTG protocol header
Course	83.37	degrees	Measured heading
Reference	T		True
Course		degrees	Measured heading
Reference	M		Magnetic1 [1]
Speed	0.00	knots	Measured horizontal speed
Units	N		Knots
Speed	0.0	km/hr	Measured horizontal speed
Units	K		Kilometers per hour
Mode	A		A=Autonomous D=DGPS
Checksum	*32		Xor check results
<CR><LF>			End of message termination

NOTE

- Does not support magnetic declination. All "course over ground" data are geodetic WGS84 directions.

4 GNSS Parser

Parse to get the correct value:



（1） Receive data from the GPS module and put it in our buffer, Data parse when the buffer is full
（2） Get a field that matches each NEMA field, Loop this operation until the buffer data is read
（3） Data parsing is successful, update global variables, and discard if unsuccessful

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5 AT Command for GNSS

5.1 Start GNSS

the GNSS is self-starting after power on, We can also restart by command:

(1) AT+CGPSCOLD

(2) AT+CGPSHOT

COLD start GNSS:

- When first used;
- Loss of ephemeris information due to battery depletion;
- Move the receiver more than 200 km under shutdown.

HOT start GNSS:

- Boot less than two hours from the last location

NOTE

- AT+CGNSSPWR=1 should be executed to let GNSS module power on firstly.

5.2 Get GPS fixed position information

AT+CGPSINFO:
+CGPSINFO:3113.343286,N,12121.234064,E,250311,072809.3,44.1,0.0,0
OK

Name	Example	Unit	Description
lat	3113.343286		Latitude of current position. Output format is ddmm.mmmmmm.
N/S	N		N/S Indicator, N=north or S=south.
log	12121.234064		Longitude of current position. Output format is dddmm.mmmmmm.
E/W	E		E/W Indicator, E=east or W=west.
date	250311		Date. Output format is ddmmyy.
UTC time	072809.3		UTC Time. Output format is hhmmss.s.

alt	44.1		MSL Altitude. Unit is meters.
speed	0.0	knots	Speed Over Ground. Unit is knots.
course	0		Course. Degrees.

NOTE

- AT+CGNSSPWR=1 should be executed to let GNSS module power on firstly.
- Location information will output to USB AT port after executing AT+CGPSINFO=<time>, scope of time is 0-255, unit is second.
- If not fix information or have no signal,will output null data.

5.3 Get GNSS fixed position information

AT+CGNSSINFO:
2,09,05,00,3113.330650,N,12121.262554,E,131117,091918.0,32.9,0.0,255.0,1.1,0.8,0.7
OK

Name	Example	Unit	Description
mode	2		Fix mode 2=2D fix 3=3D fix
GPS-SVs	09		GPS satellite valid numbers scope: 00-12
GLONASS-SVs	05		GLONASS satellite valid numbers scope: 00-12
BEIDOU-SVs	00		BEIDOU satellite valid numbers scope: 00-12
lat	3113.330650		Latitude of current position. Output format is ddmm.mmmmmm.
N/S	N		N/S Indicator, N=north or S=south.
log	12121.262554		Longitude of current position. Output format is dddmm.mmmmmm.
E/W	E		E/W Indicator, E=east or W=west.
date	131117		Date. Output format is ddmmyy.
UTC-time	091918.0		UTC Time. Output format is hhmmss.s.
alt	32.9	meters	MSL Altitude. Unit is meters.
speed	0.0	knots	Speed Over Ground. Unit is knots.
course	255.0		Course. Degrees.
PDOP	1.1		Position Dilution Of Precision.
HDOP	0.8		Horizontal Dilution Of Precision.
VDOP	0.7		Vertical Dilution Of Precision.

NOTE

- AT+CGNSSPWR=1 should be executed to let GNSS module power on firstly.
- Location information will output to USB AT port after executing AT+CGNSSINFO=<time>, scope of time is 0-255, unit is second.
- If not fix information or have no signal,will output null data.

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