AGPS Application Note

GPS_AN02_V1.02

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Version History

Date	Version	Description of change	Author
2008-05-06	1.01	Origin	Tanshi
2008-06-18	1.02	Edit the default value of AT+GPSREF Update the return value of AT+GPSSTART Modify the input scale of AT+GPSTIME Remove the command AT+GPSLAST	Yuechuan

Scope of the document

This document is intended for the following versions of the SIMCom modules: SIM548C & SIM508 / SIM548.

1 Introduction

This document provides information that can be used to implement your AGPS application solutions by the GPS&GSM module. The methods provided will cover the module's circuit connection and how to manage the various accesses to the location data by AT command.

Assisted GPS (AGPS) can improve the performance of GPS receivers by providing them with data that they would ordinarily have to download from the GPS satellites such as navigation data. With the assisted data, GPS receivers can operate faster and more reliably. AGPS can shorter the wait of TTFF because the receiver no longer has the task of decoding the navigation data bits, a task that takes tens of seconds. AGPS can improve acquire sensitivity so that it can use signal strengths below the conventional thresholds to make range measurements.

The AGPS system, consisting of the integrated GPS receiver and network components, has advanced performance beyond that of the same receiver in a standalone mode. The GPS&GSM module have integrated a GSM module and a GPS module, so you can use GSM network to get AGPS data easily.

We use LPL(1.16.6) in terminal, which follows SUPL Version 1.0 and RRLP Version 3GPP TS44.031V5.13.0 2 in AGPS solution.

1.1 Related documents

Table 1: Related documents

SN	Document name	Remark
[1]	3GPP TS 44.031	Location Services (LCS); Mobile Station (MS) – Serving Mobile Location Center (SMLC) Radio Resource LCS Protocol (RRLP)
[2]	3GPP TS 22.071	Location Services (LCS); Service description; Stage 1
[3]	3GPP TS 23.271	Functional stage 2 description of LCS
[4]	3GPP TS 25.171	Requirements for support of AGPS
[5]	3GPP TS 34.108	Common test environments for User Equipment (UE) conformance testing
[6]	3GPP TS 34.171	Terminal conformance specification; Assisted Global Positioning System
[7]	OMA-TS-ULP-V1_0	User Plane Location Protocol

1.2 Terms and abbreviations

Table 2: Terms and abbreviations

Abbreviation	Description
3GPP	The 3rd Generation Partnership Project
AGPS	Assisted GPS
BS	Base Station
Cell-ID	Cell Identity
LCS	Location Services
GIS	Geography Information System
GPS	Global Positioning System
HDOP	Horizontal Dilution of Precision
LBS	Location Based Service
LPL	Location Protocol Library
MS	Mobile Station
MSA	Mobile Station Assisted
MSB	Mobile Station Based
OMA	Open Mobile Alliance
OMNA	Open Mobile Naming Authority
PRN	Pseudo Random Noise
SET	SUPL Enabled Terminal
SLC	SUPL Location Center
SMLC	Serving Mobile Location Center
SMS	Short Message Service
SP	Service Provider
SUPL	Secure User Plane Location
TLS	Transport Layer Security
TTFF	Time To First Fix
VDOP	Vertical Dilution of Precision
WDP	Wireless Datagram Protocol

2 SUPL Location Services

Secure User Plane Location (SUPL) is an Enabler which utilizes existing standards where available and possible, to transfer assistance data and positioning data over a User Plane bearer, such as IP, to aid network and SET based positioning technologies in the calculation of a SET's position. SUPL includes but is not limited to the definition of a Location User Plane reference point and corresponding interface between the SUPL network and SET, security functions, charging functions, roaming functions, and privacy function.

The SUPL Location Services can be categorized into Network initiated and SET initiated services.

2.1 SET-INIT

SET Initiated Services are services, which originate from the SET. For these services the SUPL Agent resides within the SET.

2.2 NET-INIT

Network Initiated Services are services, which originate from within the SUPL network. For these services the SUPL Agent resides in the Network.

SUPL INIT Message of NET-INIT is over WAP PUSH which includes 3 parts they are WDP, WSP and SUPL INIT msg.

1. The WDP part (User Data Header)
   06 05 04 0B 84 23 F0
   Where:
   06 - length of UDH
   05 - UDH information element identifier (05 = application port addressing scheme, 16-bit address)
   04 - information element length
   0B84 – push destination port (Decimal: 2948)
   23F0 – push source port (Decimal: 9200)

2. The WSP part
   1E 06 04 03 12 AF 10
   Where:
   1E: TID
   06: PDU Type: push
   04: length of content type + length of application id
   03 12: content type should be encoded as the OMNA registered WSP content type (0x312) or the
           NULL terminated string:"application/vnd.omaloc-supl-init"
   AF: X-Wap-Application-Id is assigned to 0x2F, coding: 0x80+0x2F = 0xAF
   10: X-Wap-Application-Id value should be encoded as the OMNA registered number (0x10) or the
           NULL terminated string:"x-oma-application:ulp.ua"

3. SUPL INIT message
   SUPL INIT is the initial message from the SLP to the SET in Network initiated cases.

3 Positioning methods of AGPS

AGPS solution supports three positioning methods. These three methods can be set by AT command.

3.1 Autonomous Positioning

When AGPS server can't response the MS request, the MS can't obtain the assisted data, the receiver has to obtain the ephemeris data from the satellite constellation, the GPS antenna must has a clear view of the sky in order to obtain a signal with higher strength and provide GPS location data
In Autonomous Positioning, MS will refresh GPS info continually when locating successfully.

3.2 MS-Based Positioning

MS is assisted with GPS navigation data from the AGPS server .MS computes the final MS position and returns position result to the AGPS Server (LCS).   In this mode, by using the assisted data, MS can accurately detect its position in lower signal strength areas such as buildings. This mode can also speed up Time to First Fix (TTFF).
In MS-Based Positioning, MS will refresh GPS info continually when locating successfully.
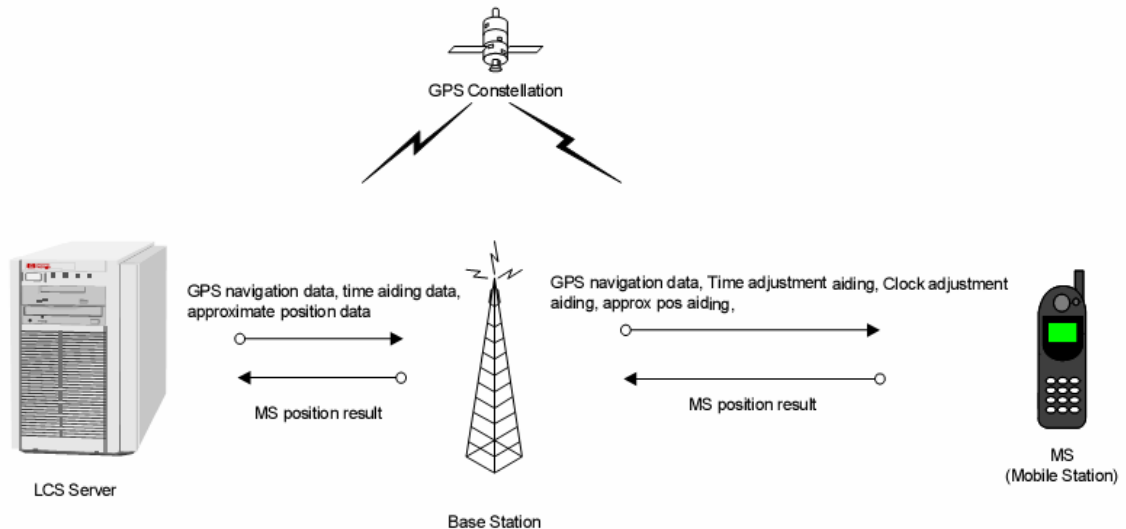
Figure 1: MS-Based positioning

3.3 MS-Assisted Positioning

MS is assisted with coarse acquisition data from the AGPS Server and MS returns coarse acquisition result to the AGPS Server. The AGPS Server computes the final MS position by using coarse acquisition result. In this mode MS can also speed up TTFF and acquire the satellite constellation in lower strength signal area.

In MS-Assisted Positioning, MS will get GPS info only once.

Figure 2: MS-Assisted positioning

4 AGPS circuit connection

There are two parts need to take more attention in AGPS application circuit design. One is the serial port connection; the other is the power control connection.
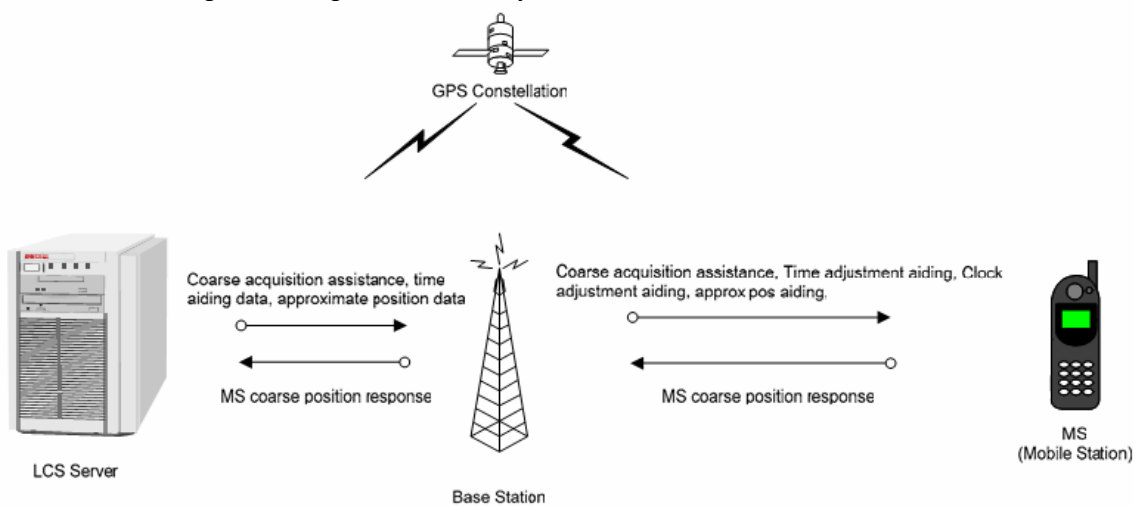
4.1 Serial port connection

For AGPS solution, the GPS UART B exchange AGPS data with GSM network for fast coldstart and GPS UART A output NEMA messages.

DISP_DATA, DISP_D/C   GPS_TXB   and GPS_RXB, these 4 pins are used to exchange AGPS data.

For AGPS application, you must:
Connect DISP_DATA to GPS_RXB
Connect DISP_D/C to GPS_TXB

GPS_TXA and GPS_RXA output NEMA message.
GPS_TXA can be connected to RXD of external MCU
GPS_RXA can be connected to TXD of external MCU

RXD   and TXD is the serial port which used for AT command

The following Figure shows how serial ports are connected for AGPS application. .
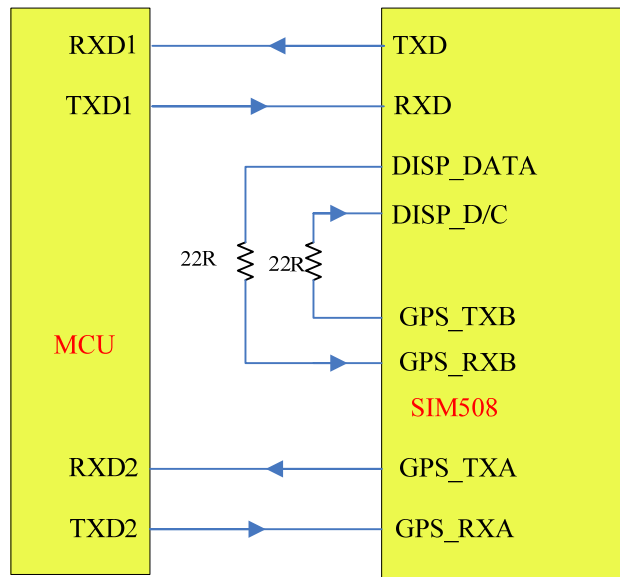
Figure 3: AGPS serial ports connection diagram

4.2 Power control connection

GPIO0 form GSM part must be used to control an external LDO which supplies GPS_VCC power. Please refer the next figure, VMAIN is the input power which must below 10V voltage and

GPS_VCC is the fixed 3.3V output. The LDO must supply 150mA current with an active high control logic. XC6209B332MR from TOREX is recommended. Before using GPS, the software will set GPIO0 high, so the GPS power is on and GPS part is activated. When set GPIO0 low, the GPS power will be turn off. User need not control GPIO0, software does this automatically.
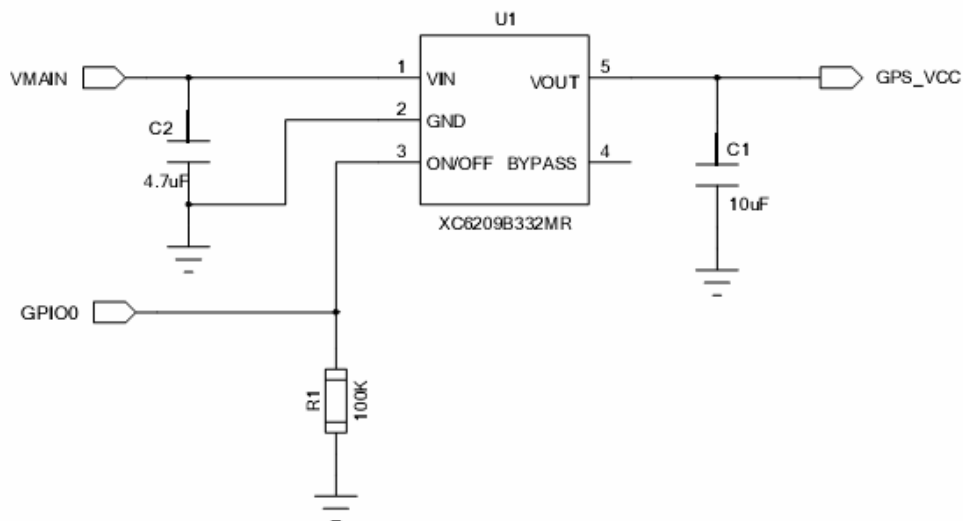
Figure 4: AGPS power control diagram

5 AT commands for AGPS

5.1 Overview

Command	Description
AT+GPSMODE	SET AGPS MODE
AT+GPSSERV	SET AGPS SERVER IP ADDRESS AND PORT
AT+GPSREF	SET AGPS REFERENCE
AT+GPSINFO	GET CURRENT AGPS LOCATION INFO
AT+GPSSTART	START UP AGPS CONNECTION
AT+GPSCLOSE	CLOSE AGPS CONNECTION
AT+GPSRPIN	SET AGPS REPORT INTERVAL
AT+GPSCOLDMODE	ENABLE AGPS COLD START MODE
AT+GPSTIME	SET AGPS LOCATION TIMEOUT

5.2 Detailed Descriptions of Commands

5.2.1 AT+GPSMODE SET AGPS MODE

AT+GPSMODE	SET AGPS MODE
Test Command **AT+GPSMODE** **=?**	Response **+GPSMODE: (1, 2, 4)** **OK**
	Parameters See Write Command
Read Command **AT+GPSMODE?**	Response **+GPSMODE: <mode>** **OK**
	Parameters See Write Command

Write Command
AT+GPSMODE
=<mode>
	Set the AGPS locating mode. This command can't be executed during the AGPS locating process.
	Response
	
	OK
	
	if parameters not correct, TA returns
	+CME ERROR: 780
	if during the AGPS locating process, TA returns
	+CME ERROR: 782
	Parameters
	<mode> a numeric parameter which indicates the mode AGPS used.
	    1 MS_BASED
	    2 MS_ASSISTED
	    4 (Default) AUTONOMOUS

5.2.2 AT+GPSSERV SET AGPS SERVER IP ADDRESS AND PORT

AT+ GPSSERV	SET AGPS SERVER IP ADDRESS AND PORT
Test Command **AT+GPSSERV =?**	Response **+ GPSSERV : "(0,255).(0,255).(0,255).(0,255)",(0,65535)** **OK**
	Parameters See Write Command
Read Command **AT+ GPSSERV?**	Response **+ GPSSERV: <ip_address>,<port>** **OK**
	Parameters See Write Command
Write Command **AT+GPSSERV = <ip_address>,<port>**	Set the AGPS server IP address and port. This command can't be executed during the AGPS locating process. Response **OK** if parameters not correct, TA returns **+CME ERROR: 780** if during the AGPS locating process, TA returns **+CME ERROR: 782** Parameters **<ip_address>** AGPS server ip address **<port>** AGPS server port

5.2.3 AT+GPSREF SET AGPS REFERENCE

AT+GPSREF SET AGPS REFERENCE	
Test Command **AT+GPSREF =?**	Response **+GPSREF: (0-1),"(-180.000000 - 180.000000)","(-90.000000 - 90.000000)"** **OK**
	Parameters See Write Command
Read Command **AT+GPSREF?**	Response **+GPSREF: <use>[,<longitude>,<latitude>]** **OK**
	Parameters See Write Command

Write Command
AT+GPSREF=<use>[,<longitude>,<latitude>]
	Set the AGPS reference local longitude and latitude, the correct value will shorten the AGPS locating time. This command can't be executed during the AGPS locating process.
	When use local longitude and latitude, the longitude and latitude will refresh after AGPS location successful.
	Response
	
	OK
	
	if parameters not correct, TA returns
	+CME ERROR: 780
	if during the AGPS locating process, TA returns
	+CME ERROR: 782
	
	Parameters
	<use> a numeric parameter which indicates whether to use local longitude and latitude
	              0 (default) nonuse the local longitude and latitude
	              1 use the local longitude and latitude
	<longitude> a string parameter which indicates local longitude, when the value is bigger than 0, it indicates the east longitude. Otherwise it indicates the west longitude.
	<latitude> a string parameter which indicates local latitude, when the value is bigger than 0, it indicates the north latitude. Otherwise it indicates the south latitude.

5.2.4 AT+GPSINFO GET CURRENT AGPS LOCATION INFO

AT+GPSINFO GET CURRENT AGPS LOCATION INFO	
Execution Command **AT+GPSINFO**	TA returns the current successful AGPS location info. This command should be executed after the AGPS locating successfully. Response **+GPSINFO: <longitude>,<latitude>,<altitude>,<time>,< TTFF time>, [<aiding time>,< position time>]** **OK** if AGPS locating has not been successful yet, TA returns **+CME ERROR: 783** Parameters **<longitude>**　　　a string parameter which indicates local longitude **<latitude>**　　　 a string parameter which indicates local latitude **<altitude>**　　　 a string parameter which indicates local altitude **<time>**　　　 a string parameter which indicates location successfully time. **<TTFF time>**　 a numeric parameter which indicates the time in seconds for the GPS chip to compute the position once it has all the aiding **<aiding time>**　 a numeric parameter which indicates the time in seconds to get all the aiding from the server inside the GPS chip(MS_ASSISTED and MS_BASED mode only) **<position time>** a numeric parameter which indicates the time in seconds to receive the position from the server after it was computed by the GPS chip (MS_ASSISTED mode only)

5.2.5 AT+GPSSTART START UP AGPS CONNECTION

AT+GPSSTART START UP AGPS CONNECTION	
Execution Command **AT+GPSSTART**	Start the AGPS connection. Response **OK** the AGPS server IP address and port could not be NULL or 0 unless use AUTONOMOUS MODE. The command couldn't execute twice before stop the AGPS locating. if AGPS parameters not correctly, TA returns **+CME ERROR: 780** if use MS_BASED MODE or MS_ASSISTED MODE, TA should bring up wireless connection with GPRS first.(use AT+CSTT, AT+CIICR and AT+CIFSR first) if not bring up GPRS, TA returns **+CME ERROR: 781**
	Unsolicited result code if use MS_BASED MODE or MS_ASSISTED MODE , TA will return **Connecting < ip_address >:<port>** **Connect Successful** **Got Aiding** **Connect Close** **Connect Socket Error: <err>** And if connect socket error, TA will return to AUTONOMOUS mode. **Turn to Autonomous** When the AGPS location successfully finally, an unsolicited result code is returned **Location Successful** If the AGPS task doesn't location successfully, the connection will be closed and an unsolicited result code will be returned. **Location Failed** Parameters **<error>** NETDOWN The network is unavailable ADDRINUSE The socket's local address is already in use ISCONN The socket is already connected (TCP) ALREADY A previous connection attempt has not yet been completed

NOBUFS	There is no buffer space available
BADF	The descriptor is not a socket
NOTSUPP	Invalid address for this socket type
INVAL	The socket is in the listen state, or has already been told to close.
WOULDBLOCK	The connection is pending being established
CONNREFUSED	Remote host rejected the connection
HOSTUNREACH	The remote host is unreachable
TIMEOUT	Connection timed out
UNKNOWN	Other unknown error
Reference SIM300_ATC_V2.00	

5.2.6 AT+GPSCLOSE CLOSE AGPS CONNECTION

AT+GPSCLOSE CLOSE AGPS CONNECTION	
Execution Command **AT+GPSCLOSE**	Close the AGPS connection. The command couldn't be executed after stopped the AGPS locating. Response **OK** if executed after stopped the AGPS locating, TA returns **+CME ERROR: 784** NOTE: this command will not shut up GPRS connection autonomous. Please use command AT+ CIPSHUT to shut up GPRS connection.
Reference SIM300_ATC_V2.00	

5.2.7 AT+GPSRPIN SET AGPS REPORT INTERVAL

AT+GPSRPIN SET AGPS REPORT INTERVAL	
Test Command **AT+GPSRPIN =?**	Response **+GPSRPIN: (0-100)** **OK**
	Parameters See Write Command
Read Command **AT+GPSRPIN ?**	Response **+GPSRPIN: <interval>** **OK**
	Parameters See Write Command
Write Command **AT+GPSRPIN=<interval>**	Set the AGPS report interval. This command can't be executed during the AGPS locating process.This command is no effect when in MS-Assisted Positioning. For in MS-Assisted Positioning, MS just get GPS info once. Response **OK** if parameters not correct, TA returns **+CME ERROR: 780** if during the AGPS locating process, TA returns **+CME ERROR: 782** Parameters **<interval>** a numeric parameter which indicates AGPS report interval time. This parameter would effective after restart the AGPS task if set<interval> to 0 , the AGPS report will be closed. <interval> value unit: minutes. **Unsolicited result code** When arrive the report time, TA will return **+GPSINFO: <longitude>,<latitude>,<altitude>,<time>,< TTFF time>, [<aiding time>,< position time>]**

5.2.8 AT+GPSCOLDMODE ENABLE AGPS COLD START MODE

AT+GPSCOLDMODE ENABLE AGPS COLD START MODE	
Test Command **AT+ GPSCOLDMODE =?**	Response **+ GPSCOLDMODE : (0-1)** **OK**
	Parameters See Write Command
Read Command **AT+ GPSCOLDMODE ?**	Response **+ GPSCOLDMODE: <mode>** **OK**
	Parameters See Write Command

Write Command
**AT+
GPSCOLDMODE
=<mode>**
	Enable the AGPS cold start mode. This command can't be executed during the AGPS locating process.
	Response
	
	OK
	
	if parameters not correct, TA returns
	+CME ERROR: 780
	if during the AGPS locating process, TA returns
	+CME ERROR: 782
	Parameters
	<mode> a numeric parameter which indicates the mode AGPS starting used
	    0 (Default) Disable the AGPS cold start mode
	    1 Enable the AGPS cold start mode

5.2.9 AT+GPSTIME SET AGPS LOCATION TIMEOUT

AT+GPSTIME	SET AGPS LOCATION TIMEOUT
Test Command **AT+GPSTIME =?**	Response **+GPSTIME: (0,30-600)** **OK**
	Parameters See Write Command
Read Command **AT+GPSTIME ?**	Response **+GPSTIME: <time>** **OK**
	Parameters See Write Command

Write Command
AT+GPSTIME=<time>
	Set the AGPS timeout. This command can't be executed during the AGPS locating process.
	
	Response
	
	OK
	
	if parameters not correct, TA returns
	+CME ERROR: 780
	if during the AGPS locating process, TA returns
	+CME ERROR: 782
	
	Parameters
	<time> a numeric parameter which indicates the time in seconds for the AGPS location.
	        When <time> equals 0, this command is useless and user must close the GPS locating manually.
	        The default value of <time> is 180.
	When locating time more than <time>, TA returns
	
	Location Failed

6 Supported unsolicited result codes

6.1 Summary of CME ERROR Codes

Final result code +CME ERROR: <err> indicates an error related to mobile equipment or network. The operation is similar to ERROR result code. None of the following commands in the same Command line is executed. Neither ERROR nor OK result code shall be returned.
<err> values used by common messaging commands:

Code of <err>	Meaning
780	AGPS invalid parameter value
781	AGPS need GPRS network
782	AGPS already run
783	AGPS location not successful
784	AGPS not run yet

The other <err>s is defined in the module ATC document.

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