



LE910Cx/ME910C1/ML865C1/NE910C1 A-GPS Application Note

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APPLICABILITY TABLE

PRODUCTS

- ■ ME910C1 SERIES
- ■ NE910C1 SERIES
- ■ ML865C1 SERIES
- ■ LE910C1/C4 SERIES

CONTENTS

NOTICE	2
COPYRIGHTS	2
COMPUTER SOFTWARE COPYRIGHTS	2
USAGE AND DISCLOSURE RESTRICTIONS	3
I. License Agreements	3
II. Copyrighted Materials	3
III. High Risk Materials	3
IV. Trademarks	3
V. Third Party Rights	3
APPLICABILITY TABLE	4
CONTENTS	5
1. INTRODUCTION	6
2. BACKGROUND INFORMATION	9
2.1. A Brief GPS Introduction	9
2.2. GNSS – Global Navigation Satellite System	10
2.3. Time to First Fix (TTFF)	10
3. GNSS SOLUTION	11
3.1. Standalone GNSS	11
3.2. A-GPS – Secure User Plane Location (SUPL) – Ms-Based	12
4. GLOSSARY AND ACRONYMS	17
5. DOCUMENT HISTORY	18

1. INTRODUCTION

The present document provides the reader with a guideline concerning the use of the Assisted GPS (A-GPS) provided by the Telit's Modules of the ME910 family.

1.1. Scope

The Application Note covers the Secure User Plane Location (SUPL) standard created by the OMA standardization body.

1.2. Audience

This document is intended for those users that need to develop applications dealing with LoCation Service (LCS).

1.3. Contact Information, Support

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Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates feedback from the users of our information.

1.4. Text Conventions



Danger – This information **MUST** be followed or catastrophic equipment failure or bodily injury may occur.



Caution or Warning – Alerts the user to important points about integrating the module, if these points are not followed, the module and end user equipment may fail or malfunction.



Tip or Information – Provides advice and suggestions that may be useful when integrating the module.

All dates are in ISO 8601 format, i.e. YYYY-MM-DD.

1.5. Related Documents

- [1] *ME910C1 Quick Start Guide*, 80529NT11661A
- [2] *ME910C1/NE910C1/ML865C1 AT Commands Reference Guide*, 80529ST10815A
- [3] *LE910Cx AT Command Reference Guide 80502ST10950A*

2. BACKGROUND INFORMATION

2.1. A Brief GPS Introduction

The detailed description of the GPS system is beyond the scope of this document.

The reader that is interested in deepening this topic should refer to the dedicated literature; hereafter only the basic concepts are mentioned. GPS system is based on a constellation of 24 satellites distributed equally among six circular orbital planes; the height of the orbits is about 20200 km. Orbits in this height are referred to as medium earth orbit (MEO).

Each satellite moves along a known orbit and is equipped with an atomic clock: GPS receivers use the time information regularly transmitted by the satellites and the time elapsed for receiving this signal from each satellite to calculate their positional information.

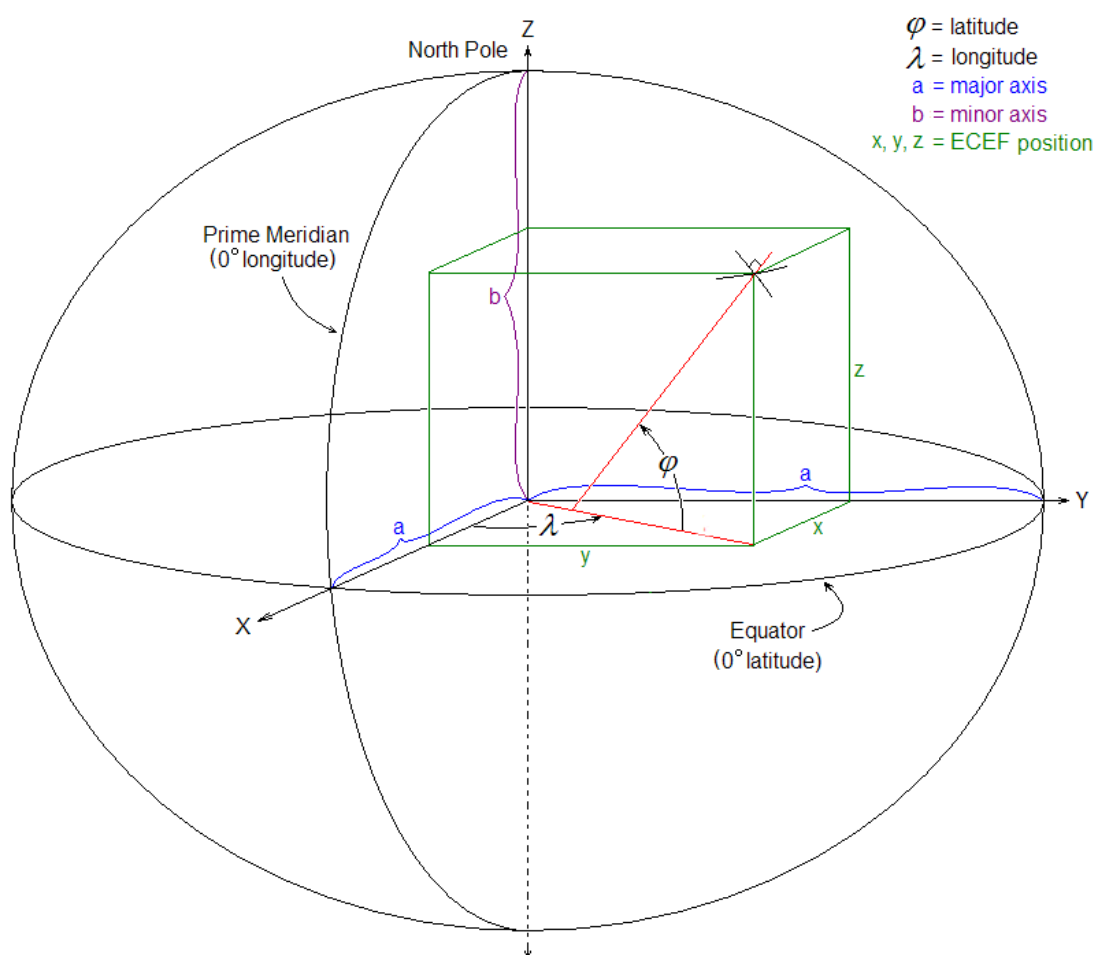


Figure 2-1 ECEF coordinate system [source: <https://en.wikipedia.org>]

Telit GPS receivers use as default the geodetic reference (datum) WGS-84, an ECEF (Earth Centered, Earth Fixed) coordinate system that consists in an ellipsoid approximating the total mass of the Earth, as shown in Fig. 2-1.

WGS-84 provides a worldwide common grid system that may be translated into local coordinate systems or map datums. Many reference ellipsoids are used throughout the world: a specific reference is chosen to minimize the local differences between the geoid

and the ellipsoid separation or other mapping distortions. Local map datums are a best fit to the local shape of the earth and are not valid worldwide.

2.2. GNSS – Global Navigation Satellite System

In addition to the GPS constellation, other satellite navigation systems are currently in operation or under development. The working principles of these systems are analogous to the GPS' ones presented in the previous section.

When the system has global coverage, it may be termed Global Navigation Satellite System (**GNSS**).

Galileo (European Union), **BeiDou** (China), **GPS** (USA), **GLONASS** (Russia) are the GNSSs currently in operation, although Galileo and Beidou are not yet fully operational. Furthermore, additional regional navigation and augmentation systems are under development (**QZSS**, **NAVIC**, etc.).

2.3. Time to First Fix (TTFF)

One of the parameters characterizing the performance of a GNSS receiver is the Time to First Fix (TTFF). TTFF indicates the time required for a GNSS device to get and process adequate satellite signals and data to provide accurate positional information (a “fix”).

GNSS receivers use the following sets of data to provide accurate position

- Satellite signals,
- Timing information (e.g. GPS time),
- Almanac data,
- Ephemeris data.

If a GNSS device has been turned off for a long period of time the acquired information can expire and, when it is turned on again, it will take longer to re-acquire these data sets, resulting in a longer "Time to First Fix". One way to speed up the TTFF is to use the Assisted-GPS (A-GPS) Positioning Technique.

A-GPS is based on the use of a data connection (e.g. a cellular network) to provide predicted satellite information from an A-GPS server to the GNSS receiver. With the help of this data, the receiver is usually able to achieve a positional fix faster than using live-data only. Although the term “A-GPS” is commonly used, the server-based data can refer to other constellations as well (e.g. GLONASS predictions).

A "cold" start indicates the scenario in which the GNSS receiver must get all data in order to start navigation and may take up to several minutes.

A "warm" start indicates the scenario in which the GNSS has most of the data it needs in memory, and will start quickly, a minute or less.

A “hot” start refers to the scenario in which the receiver has all the data from the satellites (time, almanac, ephemeris) and only needs to calculate the positional solution. The fix is usually acquired in few seconds.

In other words, the use of A-GPS allows the device to start in a condition similar to “warm” and “hot”, hence speeding up the TTFF.

3. GNSS SOLUTION

3.1. Standalone GNSS

Standalone (or autonomous) GNSS mode is a feature that allows the GNSS receiver, installed on the cellular module, to perform First Fixing activity without assistance data coming from the network. The GNSS receiver estimates position directly from satellites (GPS, GLONASS, etc.) in line of sight.

To set up the GNSS receiver in standalone mode the user should go through the following steps provided as example. It should be noted that, although modern cellular modules integrate a GNSS receiver rather than a GPS one, the AT commands still refer to GPS for legacy reasons.

Switch off/on the module and restore the default GNSS parameters in order to start from a known GNSS setting.

AT\$GPSRST

OK

Delete the GPS information stored in NVM. It is the history buffer interfacing the GPS receiver to the module. This action is not mandatory; it should be performed only if you need to clean the buffer:

AT\$GPSNVRAM=15,0

OK

Check that after history buffer cleaning no GPS information is available

AT\$GPSACP

\$GPSACP:

OK

Start the GNSS receiver in standalone mode:

AT\$GPSP=1

OK

For enabling unsolicited messages of GNSS data in NMEA format, refer to [2]. In this example, only RMC sentence is enabled:

AT\$GPSNMUN=3,0,0,0,0,1,0

OK

This command enables the GNSS data stream format and reserve the AT interface port for the NMEA stream only.

After a time-interval depending from the environmental characteristic of the location where the GNSS receiver operates (outside, inside, city, etc.), the continuous streaming of RMC sentences becomes populated.

To stop the NMEA stream enter the following escape sequence:

+++

```

1 Sent>> AT$GPSNMUN=3,0,0,0,0,1,0
2
3 CONNECT
4
5 $GPRMC,,V,,,,,,,,,N*53
6 $GPRMC,,V,,,,,,,,,N*53
7 $GPRMC,,V,,,,,,,,,N*53
8 $GPRMC,,V,,,,,,,,,N*53
9 $GPRMC,133730.59,A,3913.660425,N,00904.126908,E,0.0,,090119,0.1,W,A*03
10 $GPRMC,133731.99,A,3913.660437,N,00904.126912,E,0.0,,090119,0.1,W,A*06
11 $GPRMC,133733.00,A,3913.659701,N,00904.127000,E,0.0,0.0,090119,0.1,W,A*2D
12
13 Sent>> +++

```

Figure 3-1 Enabling the NMEA stream, RMC sentence only

For enabling additional NMEA sentences containing information on other constellations (e.g. GLONASS or GALILEO), refer to the following commands described in [2]:

AT\$GPSGLO

AT\$GPSNMUN

AT\$GPSNMUNEX

Finally, for polling the current location:

AT\$GPSACP

\$GPSACP:152324.000,4542.8396N,01344.2874E,3.00,310.0,3,000.00,0.00,0.00,200412,05

OK

3.2. A-GPS – Secure User Plane Location (SUPL)

As mentioned in previous sections, Assisted GPS mode is a feature that allows the GNSS receiver to perform its First Fix faster using assistance data, usually provided over the cellular network.

The LE910Cx/ME910C1/ML865C1/NE910C1 series supports the following type of A-GPS

- Secure User Plane Location (SUPL) was proposed by OMA

3.2.1.1. MS-Based mode

In MS-Based mode, the module requires assistance data to the SLP Server. The A-GPS receiver, installed on the module, receives the signals from the visible satellites and with the help of the data received from the SLP Server calculates its position.

For the MS-Based mode, an example is provided below. It should be noted that in this configuration an example of SUPL Server is provided: however, it is responsibility of the user to select the appropriate server fitting their needs.

The following assumptions have been made:

- the module is powered off;
- the GNSS antenna is connected and placed in sight of satellites (must be able to receive GNSS signal);
- cellular antenna is connected;
- SIM card is inserted;
- APN is already set.

Firstly, turn on the cellular module.

If required, delete the GNSS information stored in NVM. It is the history buffer between the GNSS device and the module. This action is not mandatory and should be performed only if cleaning the buffer is needed:

AT\$GPSR=0

AT\$GPSNVRAM=15,0

Check that after history buffer cleaning no GNSS information are available (command response should be empty and have no location information)

AT\$GPSACP

\$GPSACP:

Set the SUPL version support to 2.0

AT\$SUPLV=2

Set the location's Quality of Service (QoS). AT\$GPSSAV command can be used to save GPS parameters into NVM.

AT\$GPSQOS=50,50,150,0

Set the selected SLP address and port number

AT\$LCSSLP=<slp_address_type>,<slp_address>,<port number>

For example:

```
AT$LCSSLP=1,"ExampleSUPLwebsite.com",7276
```

Enable SUPL TLS

```
AT$LCSTER=1,,0 // non-secure mode
```

```
AT$LCSTER=1,,1 // secure mode
```

Lock <cid> for SUPL use:

```
AT$LCSLK=1,<cid>
```

For example:

```
AT$LCSLK=1,1
```

Activate the PDP context

```
AT#SGACT=1,1 //returns a list of IP addresses for the specified context
```

Start the SET Initiated Session using the MS-Based mode:

```
AT$GPSSLSR=1,1,,,,,1
```

```
OK
```

Now poll the acquired position through AT\$GPSACP command until location information is returned.

```
AT$GPSACP
```

```
$GPSACP:152324.000,4542.8396N,01344.2874E,3.00,310.0,3,000.00,0.00,0.00,200412,05
```

```
OK
```

It must be returned within few seconds (less than ten seconds)

Full test sequence non-secure Mode:

```
1 AT$GPSR=0
2 OK
3 AT$GPSNVRAM=15,0
4 OK
5 AT$SUPLV=2
6 OK
7 AT$GPSQOS=50,50,150,0
8 OK
9 AT$LCSSLP=1,"supl.google.com",7276
10 OK
11 AT$LCSTER=1,,0
12 OK
13 AT$LCSLK=1,1
14 OK
15 AT#SGACT=1,1
16
17 #SGACT: 10.88.11.226
18
19 OK
20 AT$GPSSLSR=1,1,,,,,1
21 OK
22 AT$GPSACP
23 $GPSACP: ,,,,,1,,,,
24
25 OK
26 AT$GPSACP
27 $GPSACP: ,,,,,1,,,,
28
29 OK
30 AT$GPSACP
31 $GPSACP: ,,,,,1,,,,
32
33 OK
34 AT$GPSACP
35 $GPSACP: ,,,,,1,,,,
36
37 OK
38 AT$GPSACP
39 $GPSACP: 091351.008,3913.6931N,00904.1553E,1.4,18.2,3,0.0,0.0,0.0,221119,08
```

Full test sequence secure Mode:

```
1 AT$GPSR=0
2 OK
3 AT$GPSNVRAM=15,0
4 OK
5 AT$SUPLV=2
6 OK
7 AT$GPSQOS=50,50,150,0
8 OK
9 AT$LCSSLP=1,"supl.google.com",7275
10 OK
11 AT$LCSTER=1,,1
12 OK
13 AT$LCSLK=1,1
14 OK
15 AT#SGACT=1,1
16
17 #SGACT: 10.88.11.226
18
19 OK
20 AT$GPSLSR=1,1,,,,,1
21 OK
22 AT$GPSACP
23 $GPSACP: ,,,,,1,,,,
24
25 OK
26 AT$GPSACP
27 $GPSACP: ,,,,,1,,,,
28
29 OK
30 AT$GPSACP
31 $GPSACP: ,,,,,1,,,,
32
33 OK
34 AT$GPSACP
35 $GPSACP: ,,,,,1,,,,
36
37 OK
38 AT$GPSACP
39 $GPSACP: 091751.008,3913.6942N,00904.1525E,1.4,18.2,3,0.0,0.0,0.0,221119,08
```


4. GLOSSARY AND ACRONYMS

	Description
3GPP	Third Generation Partnership Project
A-GPS	Assisted-Global Positioning System
C-Plane	Network Control Plane Network
DTE	Data Terminal Equipment
ECEF	Earth-Centered Earth-Fixed
GMLC	Gateway Mobile Location Center
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
LCS	LoCation Service
MO-LR	Mobile Originated-Location Request
MS	Mobile Station
MT-LR	Mobile Terminated-Location Request
NMEA	National Marine Electronics Association
NVM	Non-Volatile Memory
OMA	Open Mobile Alliance
PDP	Packet Data Protocol
SET	SUPL Enable Terminal
S-GNSS	Standalone-Global Navigation Satellite System
S-GPS	Standalone-Global Positioning System
SLP	SUPL Location Platform
SMLC	Serving Mobile Location Center
SMS	Short Message Service
SSL	Secure Socket Layer
SUPL	Secure User Plane Location
TTFF	Time to First Fix
UART	Universal Asynchronous Receiver Transmitter
URC	Unsolicited Result Code

5. DOCUMENT HISTORY

Revision	Date	Changes
0	2019-02-14	First issue
1	2019-07-08	Updated applicability table
2	2019-11-22	Added example and configuration secure mode



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