# LE910Cx/ME910C1/ML865C1/NE910C1/A-GPS

## Application Note

80529NT11738A Rev. 3 – 2021-09-27

Telit Technical Documentation

# CONTENTS

# APPLICABILITY TABLE

| PRODUCTS |
|---|
| ME910C1 Series |
| NE910C1 Series |
| ML865C1 Series |
| LE910C1/C4 Series |

# 1. INTRODUCTION

## 1.1. Scope

This document provides guidelines for using the Assisted GPS (A-GPS) functionality provided by Telit's ME910 family of modules. This document also includes information on the Secure User Plane Location (SUPL) standard created by the OMA standardization body.

## 1.2. Audience

This document is intended for Telit customers, who need to develop applications that use the Location Service (LCS).

## 1.3. Contact Information, Support

For general contact, technical support services, technical questions and report of documentation errors contact Telit Technical Support at:

- *TS-EMEA@telit.com*
- *TS-AMERICAS@telit.com*
- *TS-APAC@telit.com*
- *TS-SRD@telit.com*
- *TS-ONEEDGE@telit.com*

Alternatively, use:

*https://www.telit.com/contact-us*

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

*https://www.telit.com*

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

Telit appreciates the user feedback on our information.

## 1.4. Symbol Conventions

| | |
|---|---|
| | **Danger:** This information MUST be followed or catastrophic equipment failure or personal injury may occur. |
| | **Warning:** Alerts the user on important steps about the module integration. |
| | **Note/Tip:** Provides advice and suggestions that may be useful when integrating the module. |
| | **Electro-static Discharge:** Notifies the user to take proper grounding precautions before handling the product. |

*Table 1: Symbol Conventions*

All dates are in ISO 8601 format, that is 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. GPS- Global Positioning System

The GPS system is based on a constellation of 24 satellites that are evenly spread across six circular orbital planes with a height of around 20200 km. Orbits in this height are referred to as medium earth orbit (MEO).

Each satellite has an atomic clock and follows a known orbit: GPS receivers use the time information regularly transmitted by the satellites and the time elapsed for receiving this signal from each satellite to compute their positions.

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

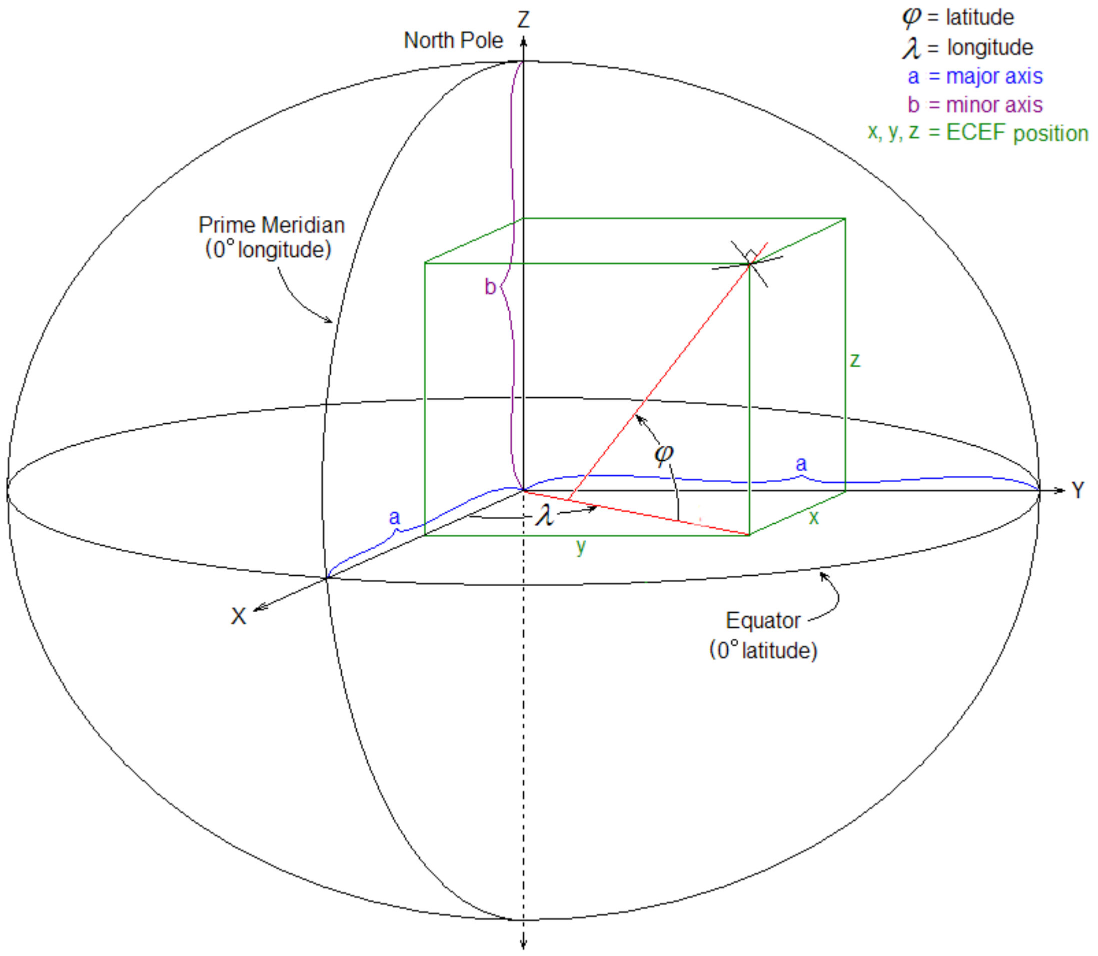


*Figure 1: ECEF Coordinate System*

As shown in the above figure, Telit GPS receivers defaults to 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.

WGS-84 provides a worldwide common grid system that can be translated into local coordinate systems or map datums. Many different reference ellipsoids are used around 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 the best fit to the local shape of the earth and are not universally applicable.

## 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 similar to those of the GPS systems described in the previous section.

When the system has global coverage, it is referred to as Global Navigation Satellite System (GNSS).

Galileo (European Union), BeiDou (China), GPS (USA), and 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, and so on).

## 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”).

To provide an accurate position, GNSS receivers use the following data sets:

- Satellite signals
- Timing information (for example, GPS time)
- Almanac data
- Ephemeris data

When a GNSS device is switched off for an extended time, the acquired information can expire and, when it is switched 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 (for example, 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 also refer to other constellations (for example, GLONASS predictions).

A "cold" start is when the GNSS receiver must receive all data before starting navigation, which can take several minutes.

A "warm" start is when the GNSS has most of the data it needs in memory and will start quickly, within a minute or less.

A "hot" start is when 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, using A-GPS allows the device to start in a condition similar to "warm" and "hot", thus shortening 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 without the use of network data. The GNSS receiver estimates position directly from satellites (GPS, GLONASS, and so on) in line of sight.

To set up the GNSS receiver in standalone mode, follow the steps outlined below. Although modern cellular modules integrate a GNSS receiver rather than a GPS receiver, the AT commands still refer to GPS for legacy reasons.

1. To start from a known GNSS setting, switch on/off the module and restore the default GNSS parameters.

   AT$GPSRST

   OK

2. Delete the GPS information stored in NVM. It is the history buffer interfacing the GPS receiver to the module.

   AT$GPSNVRAM=15,0

   OK

**Note:** This step is optional and should be performed only if the buffer needs to be cleaned.

3. Verify that no GNSS information is available after history buffer cleaning.

   AT$GPSACP

   $GPSACP

   OK

4. Start the GNSS receiver in standalone mode.

   AT$GPSP=1

   OK

5. To enable 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 reserves the AT interface port for the NMEA stream only.

After a time interval based on the environmental characteristic of the location where the GNSS receiver operates (outside, inside, city, and so on), the continuous streaming of RMC sentences becomes populated.

6. To stop the NMEA stream enter the following escape sequence:

   +++

```
Sent>> AT$GPSNMUN=3,0,0,0,0,1,0

CONNECT

$GPRMC,,V,,,,,,,,,,N*53
$GPRMC,,V,,,,,,,,,,N*53
$GPRMC,,V,,,,,,,,,,N*53
$GPRMC,,V,,,,,,,,,,N*53
$GPRMC,133730.59,A,3913.660425,N,00904.126908,E,0.0,,090119,0.1,W,A*03
$GPRMC,133731.99,A,3913.660437,N,00904.126912,E,0.0,,090119,0.1,W,A*06
$GPRMC,133733.00,A,3913.659701,N,00904.127000,E,0.0,0.0,090119,0.1,W,A*2D

Sent>> +++
```

*Figure 2: Escape Sequence for Stopping NMEA Stream*

7. To enable additional NMEA sentences containing information on other constellations (for example, GLONASS or GALILEO), refer to the following commands described in [2]:

   AT$GPSGLO

   AT$GPSNMUN

   AT$GPSNMUNEX

8. Poll 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, which is 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. 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 calculates its position using data from the SLP Server.

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.

Following are some of the assumptions:

- Module is powered off;
- 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; and
- APN is already set.

1. To begin, turn on the cellular module.
2. Delete the GNSS information stored in NVM, if required. It is the history buffer between the GNSS device and the module.

   AT$GPSR=0

   AT$GPSNVRAM=15,0

**Note:** This step is optional and should be performed only if the buffer needs to be cleaned.

3. Verify that no GNSS information is available after history buffer cleaning (command response should be empty and have no location information).

   AT$GPSACP

   $GPSACP

4. Set the SUPL version support to 2.0.

   AT$SUPLV=2

5. 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

6. 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

7. Enable SUPL TLS.

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

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

8. Lock <cid> for SUPL use.

   AT$LCSLK=1,<cid>

   For example:

   AT$LCSLK=1,1

9. Activate the PDP context.

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

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

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

    OK

11. Poll the acquired position using the 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:**

```
AT$GPSR=0
OK
AT$GPSNVRAM=15,0
OK
AT$SUPLV=2
OK
AT$GPSQOS=50,50,150,0
OK
AT$LCSSLP=1,"supl.google.com",7276
OK
AT$LCSTER=1,,,0
OK
AT$LCSLK=1,1
OK
AT#SGACT=1,1

#SGACT: 10.88.11.226

OK
AT$GPSSLSR=1,1,,,,,1
OK
AT$GPSACP
$GPSACP: ,,,,,1,,,,,

OK
AT$GPSACP
$GPSACP: ,,,,,1,,,,,

OK
AT$GPSACP
$GPSACP: ,,,,,1,,,,,

OK
AT$GPSACP
$GPSACP: ,,,,,1,,,,,

OK
AT$GPSACP
$GPSACP: 091351.008,3913.6931N,00904.1553E,1.4,18.2,3,0.0,0.0,0.0,221119,08
```

*Figure 3: Full Test Sequence Non-Secure Mode*

- **Full Test Sequence Secure Mode:**

```
AT$GPSR=0
OK
AT$GPSNVRAM=15,0
OK
AT$SUPLV=2
OK
AT$GPSQOS=50,50,150,0
OK
AT$LCSSLP=1,"supl.google.com",7275
OK
AT$LCSTER=1,,,1
OK
AT$LCSLK=1,1
OK
AT#SGACT=1,1

#SGACT: 10.88.11.226

OK
AT$GPSSLSR=1,1,,,,,1
OK
AT$GPSACP
$GPSACP: ,,,,,1,,,,,

OK
AT$GPSACP
$GPSACP: ,,,,,1,,,,,

OK
AT$GPSACP
$GPSACP: ,,,,,1,,,,,

OK
AT$GPSACP
$GPSACP: ,,,,,1,,,,,

OK
AT$GPSACP
$GPSACP: 091751.008,3913.6942N,00904.1525E,1.4,18.2,3,0.0,0.0,0.0,221119,08
```

*Figure 4: Full Test Sequence Secure Mode*

# 4. PRODUCT AND SAFETY INFORMATION

## 4.1. Copyrights and Other Notices

**SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE**

Although reasonable efforts have been made to ensure the accuracy of this document, Telit assumes no liability resulting from any inaccuracies or omissions in this document, or from the use of the information contained herein. The information contained in this document has been carefully checked and is believed to be reliable. Telit reserves the right to make changes to any of the products described herein, to revise it and to make changes from time to time without any obligation to notify anyone of such revisions or changes. Telit does not assume any liability arising from the application or use of any product, software, or circuit described herein; neither does it convey license under its patent rights or the rights of others.

This document may contain references or information about Telit's products (machines and programs), or services that are not announced in your country. Such references or information do not necessarily mean that Telit intends to announce such Telit products, programming, or services in your country.

### 4.1.1. Copyrights

This instruction manual and the Telit products described herein may include or describe Telit copyrighted material, such as computer programs stored in semiconductor memories or other media. The laws in Italy and in other countries reserve to Telit and its licensors certain exclusive rights for copyrighted material, including the exclusive right to copy, reproduce in any form, distribute, and make derivative works of the copyrighted material. Accordingly, any of Telit's or its licensors' copyrighted material contained herein or described in this instruction manual, shall not be copied, reproduced, distributed, merged, or modified in any way without the express written permission of the owner. Furthermore, the purchase of Telit products shall not be deemed to grant in any way, neither directly nor by implication, or estoppel, any license.

### 4.1.2. Computer Software Copyrights

Telit and the Third Party supplied Software (SW) products, described in this instruction manual may include Telit's and other Third Party's copyrighted computer programs stored in semiconductor memories or other media. The laws in Italy and in other countries reserve to Telit and other Third Party, SW exclusive rights for copyrighted

## 4.2. Usage and Disclosure Restrictions

### 4.2.1. License Agreements

The software described in this document is owned by Telit and its licensors. It is furnished by express license agreement only and shall be used exclusively in accordance with the terms of such agreement.

### 4.2.2. Copyrighted Materials

The Software and the documentation are copyrighted materials. Making unauthorized copies is prohibited by the law. The software or the documentation shall not be reproduced, transmitted, transcribed, even partially, nor stored in a retrieval system, nor translated into any language or computer language, in any form or by any means, without prior written permission of Telit.

### 4.2.3. High Risk Materials

Components, units, or third-party goods used in the making of the product described herein are NOT fault-tolerant and are NOT designed, manufactured, or intended for use as on-line control equipment in the following hazardous environments requiring fail-safe controls: operations of Nuclear Facilities, Aircraft Navigation or Aircraft Communication Systems, Air Traffic Control, Life Support, or Weapons Systems ("High Risk Activities"). Telit and its supplier(s) specifically disclaim any expressed or implied warranty of fitness eligibility for such High-Risk Activities.

### 4.2.4. Trademarks

TELIT and the Stylized T-Logo are registered in the Trademark Office. All other product or service names are property of their respective owners.

### 4.2.5. Third Party Rights

The software may include Third Party's software Rights. In this case the user agrees to comply with all terms and conditions imposed in respect of such separate software rights. In addition to Third Party Terms, the disclaimer of warranty and limitation of liability provisions in this License, shall apply to the Third-Party Rights software as well.

TELIT HEREBY DISCLAIMS ANY AND ALL WARRANTIES EXPRESSED OR IMPLIED FROM ANY THIRD PARTY REGARDING ANY SEPARATE FILES, ANY THIRD-PARTY MATERIALS INCLUDED IN THE SOFTWARE, ANY THIRD PARTY MATERIALS FROM WHICH THE SOFTWARE IS DERIVED (COLLECTIVELY "OTHER CODES"), AND THE USE OF ANY OR ALL OTHER CODES IN CONNECTION WITH THE SOFTWARE, INCLUDING (WITHOUT LIMITATION) ANY WARRANTIES OF SATISFACTORY QUALITY OR FITNESS FOR A PARTICULAR PURPOSE.

NO THIRD PARTY LICENSORS OF OTHER CODES MUST BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING WITHOUT LIMITATION LOST OF PROFITS), HOWEVER CAUSED AND WHETHER MADE UNDER CONTRACT, TORT OR OTHER LEGAL THEORY, ARISING IN ANY WAY OUT OF THE USE OR DISTRIBUTION OF THE OTHER CODES OR THE EXERCISE OF ANY RIGHTS GRANTED UNDER EITHER OR BOTH THIS LICENSE AND THE LEGAL TERMS APPLICABLE TO ANY SEPARATE FILES, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

### 4.2.6. Waiver of Liability

IN NO EVENT WILL TELIT AND ITS AFFILIATES BE LIABLE FOR AY DIRECT, INDIRECT, SPECIAL, GENERAL, INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR EXEMPLARY INDIRECT DAMAGE OF ANY KIND WHATSOEVER, INCLUDING BUT NOT LIMITED TO REIMBURSEMENT OF COSTS, COMPENSATION OF ANY DAMAGE, LOSS OF PRODUCTION, LOSS OF PROFIT, LOSS OF USE, LOSS OF BUSINESS, LOSS OF DATA OR REVENUE, WHETHER OR NOT THE POSSIBILITY OF SUCH DAMAGES COULD HAVE BEEN REASONABLY FORESEEN, CONNECTD IN ANY WAY TO THE USE OF THE PRODUCT/S OR TO THE INFORMATION CONTAINED IN THE PRESENT DOCUMENTATION, EVEN IF TELIT AND/OR ITS AFFILIATES HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES OR THEY ARE FORESEEABLE OR FOR CLAIMS BY ANY THIRD PARTY.

### 4.3. Safety Recommendations

Make sure the use of this product is allowed in your country and in the environment required. The use of this product may be dangerous and has to be avoided in areas where:

- it can interfere with other electronic devices, particularly in environments such as hospitals, airports, aircrafts, etc.
- there is a risk of explosion such as gasoline stations, oil refineries, etc. It is the responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product; any mark of tampering will compromise the warranty validity. We recommend following the instructions of the hardware user guides for correct wiring of the product. The product has to be supplied with a stabilized voltage source and the wiring has to be conformed to the security and fire prevention regulations. The product has to be handled with care, avoiding any contact with the pins because electrostatic discharges may damage the product itself. Same cautions have to be taken for the SIM, checking carefully the instruction for its use. Do not insert or remove the SIM when the product is in power saving mode.

The system integrator is responsible for the functioning of the final product. Therefore, the external components of the module, as well as any project or installation issue, have to be handled with care. Any interference may cause the risk of disturbing the GSM network or external devices or having an impact on the security system. Should there be any doubt, please refer to the technical documentation and the regulations in force. Every module has to be equipped with a proper antenna with specific characteristics. The antenna has to be installed carefully in order to avoid any interference with other electronic devices and has to guarantee a minimum distance from the body (20 cm). In case this requirement cannot be satisfied, the system integrator has to assess the final product against the SAR regulation.

The equipment is intended to be installed in a restricted area location.

The equipment must be supplied by an external specific limited power source in compliance with the standard EN 62368-1:2014.

The European Community provides some Directives for the electronic equipment introduced on the market. All of the relevant information is available on the European Community website:

*https://ec.europa.eu/growth/sectors/electrical-engineering_en*

# 5. GLOSSARY

| | |
|---|---|
| 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 |
| WCDMA | Wideband Code Division Multiple Access |

# 6. DOCUMENT HISTORY

| Revision | Date | Changes |
|---|---|---|
| 3 | 2021-09-27 | Updated document to new Telit Template standards<br>Minor editorial changes |
| 2 | 2019-11-22 | Added example and configuration secure mode |
| 1 | 2019-07-08 | Updated applicability table |
| 0 | 2019-02-14 | First issue |

From Mod.0809 rev.3

Connect to our site and contact our technical support team for any question

www.telit.com