K3 series Power Modes Application Note

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APPLICABILITY TABLE

PRODUCTS[1]

- SC872-A
- SE868-A
- SE868K3-A/AL
- SL869-V2/SL869L-V2
- SL871/SL871L

[1] Modules with LDO or additional LNA have higher power consumption

CONTENTS

1. INTRODUCTION

1.1. Scope

The scope of this document is to give an overview about the use of low power modes for tracking applications. The document focuses on the solutions offered by Telit GNSS modules mounting Mediatek MT3333 chipset. A comparison of tracking and power consumption performances for the different modes is presented.

1.2. Audience

This document is intended for clients or internal staff interested in using the low power modes offered by Telit GNSS modules for tracking applications and/or devices.

1.3. Contact Information, Support

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

- TS-EMEA@telit.com
- TS-AMERICAS@telit.com
- TS-APAC@telit.com

Alternatively, use:

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

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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

- NMEA Reference Guide (CS-129435-MA8)
- Telit MT GNSS Software User Guide

2. BACKGROUND INFORMATION

GNSS devices are often used on the field and in adverse conditions, where power supply is limited but accurate tracking is essential.

Power consumption and accuracy are thus critical factors in considering a device performance, and a tradeoff between the two is often necessary. For example, the use of a powered antenna improves the quality of the signal at the receiver, at the cost of a higher power consumption.

To find the best tradeoff for every GNSS application, each manufacturer has developed power saving profiles that can be tailored depending on the user-case.

Telit modules based on Mediatek MT3333 chipset were tested as an example in this document. MT3333 offers several low power modes options. These solutions are broadly divided in continuous and periodic modes: the former mode acquire and provide positioning information every second; while the latter periodically turn-off (or better, backup) the device for a certain amount of time and no information is available during this period. Periodic ON-OFF cycles can be fine-tuned to match the final application requirements.

2.1. Power Modes Overview

MT3333 modules can take advantage of the GNSS Low Power (GLP) mode, that consists of a sub-second duty cycle, reducing the time the module is working in full power without reducing the update rate (continuous mode). This mode offers a good tradeoff and does not require the client interaction as the power management is totally autonomous. In addition, MT3333 chipset allows the user to select a periodic mode for powers savings: the device alternates between backup/hibernate and full power states for user-assigned timeframes. This mode requires the client to estimate in advance and with good precision the user-case to find the optimal ON-OFF time settings.

In all cases, a good understanding of each mode's working principles and of the user-case scenario for each device is mandatory to choose the correct settings and achieve the desired results.

3. POWER MODE OVERVIEW

3.1. GLP

GLP stands for *GNSS Low Power* and works on duty cycle of 1 second to achieve the overall power saving. Once this mode is enabled, the MTK chipset automatically switches between GLP and Full Power depending on the latest conditions.

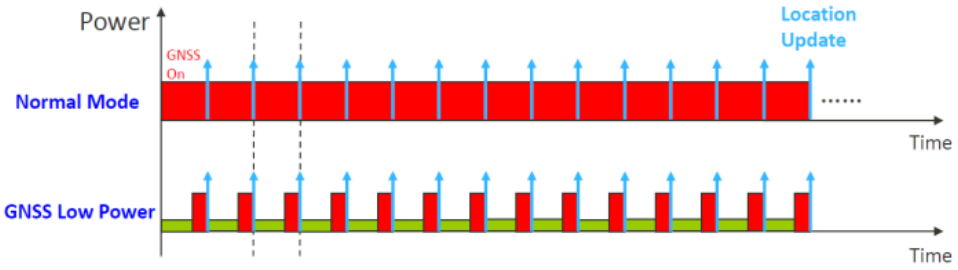

Figure 3-1 GNSS Low Power (GLP) vs Normal Mode power consumption

The image below shows in detail how the GLP algorithm works. Telit suggests to activate the GLP low power mode only after the module has acquired a valid fix.

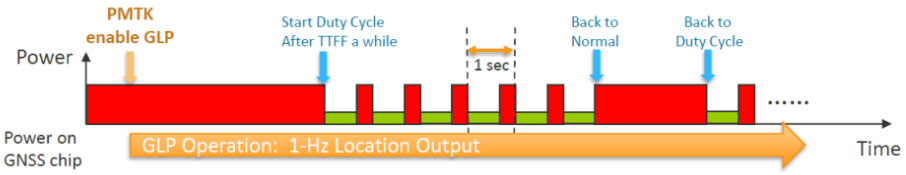

Figure 3-2 GLP Operational phases and power consumption

3.2. Periodic Mode

With periodic modes, the user can set the device to alternate between normal mode (ON) and standby or backup mode (in this section called “SLEEP”) to save power. The time maintained in each state can be preset and, if secondary temporal intervals are assigned, the module uses the second profile if a valid fix is not acquired during the ON time.

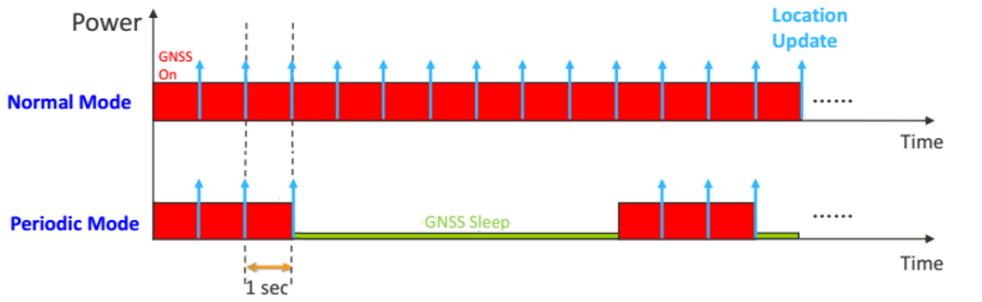

Figure 3-3 Periodic mode vs Normal mode power consumption

4. METHODOLOGY

For evaluating the advantages of the low power modes, a comparison under the same conditions between two identical units, each with a different power profile enabled, was performed.

A dual channel amperemeter was used to record the current consumption of two identical units at the same time. Channels A and B of the meter were connected to the VCC jumper on each DUT, and the measuring resolution set to 100 mA. The time resolution was ~40ms (~25 Hz). When more convenient or practical, a single channel meter, with a time resolution of ~20ms, was used instead.

A GNSS simulator coupled with a signal divider provided GPS+GLONASS signal to each device. A mixed environment (urban and extra-urban) Scenario file was used for this task. These settings resulted in an average C/No of about 36 dB-Hz in open-sky condition and of 30dB-Hz in urban environment.

The DUTs were also connected to a computer for power supply and Telit View was used for logging the data and controlling the units.

For the test, the scenario was started and the correct satellites acquisition and tracking for both DUTs verified. After a few minutes in open sky, current measurement on the meter was started. It is assumed that this time is sufficient for the module to calculate predictions of the satellites (i.e. EASY). At the end of the scenario, the measurement was halted.

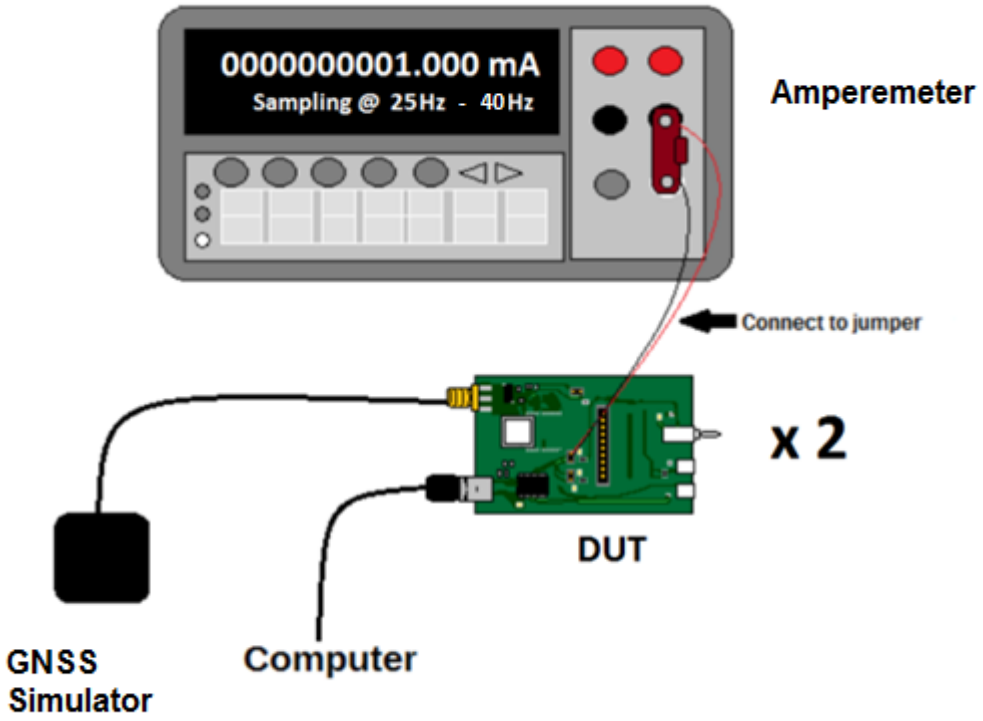

Figure 5-1 test setup

The drive test has been performed in Highway environment in order to assess the accuracy of different low power modes. Two identical modules have been tested in parallel. By coupling them to a passive GNSS antenna with a signal divider, GPS+GLONASS signal to each device has been provided.
The RF setup has been tuned to guarantee an average C/N0 of 35dB-Hz in open sky.

4.1. MTK Test Setup

The tested modules were two SL871 EVKs (2nd Gen) equipped with a firmware release v13-2.2.0-STD-3.8.13-N96.

The test method will also be valid for later firmware release.

The same procedure can be applied to all modules in the applicability table, but consumption may differ for modules with LDO or additional LNA.

For a meaningful comparison, one unit had firmware default configuration (full power mode), while the second one was given the command to enable low power profile of choice. In turns, GNSS Low Power (GLP) and periodic mode were tested.
For the GLP mode the command is:

```
$PMTK262,3
```

For the periodic mode, three cycles were chosen for testing:

2s full power – 5s sleep;

5s full power – 30s sleep;

10s full power – 300s sleep;

The command is as follows, having ***time_on*** and ***time_sleep*** expressed in milliseconds:

```
$PMTK225,1,time_on,time_sleep
```

No other commands were given to the units under testing.

5. POWER CONSUMPTION

This section presents the average power consumption for the tested low power compared with the full power consumption modes for the Mediatek based modules.

The periodic modes offer the highest power reduction and they are recommended for applications where position update rate is not important.

5.1. Power Consumption Comparison

The table below compares the power consumption (in mW) for the different continuous and periodic mode. GNSS LOW POWER (GLP) mode has the advantage of being continuous (1Hz rate) and allows a power reduction of about 38% compared to full power in a mixed environment (urban and extra-urban).

PROFILE - @3,3V	POWER CONSUMPTION (mW)
FULL POWER	66,8
GNSS LOW POWER	41,3
2 SEC FULL POWER / 5 SEC SLEEP	30,6
5 SEC FULL POWER / 30 SEC SLEEP	13,9
10 SEC FULL POWER / 300 SEC SLEEP	6,0

Table 6-1 Power consumption table summary

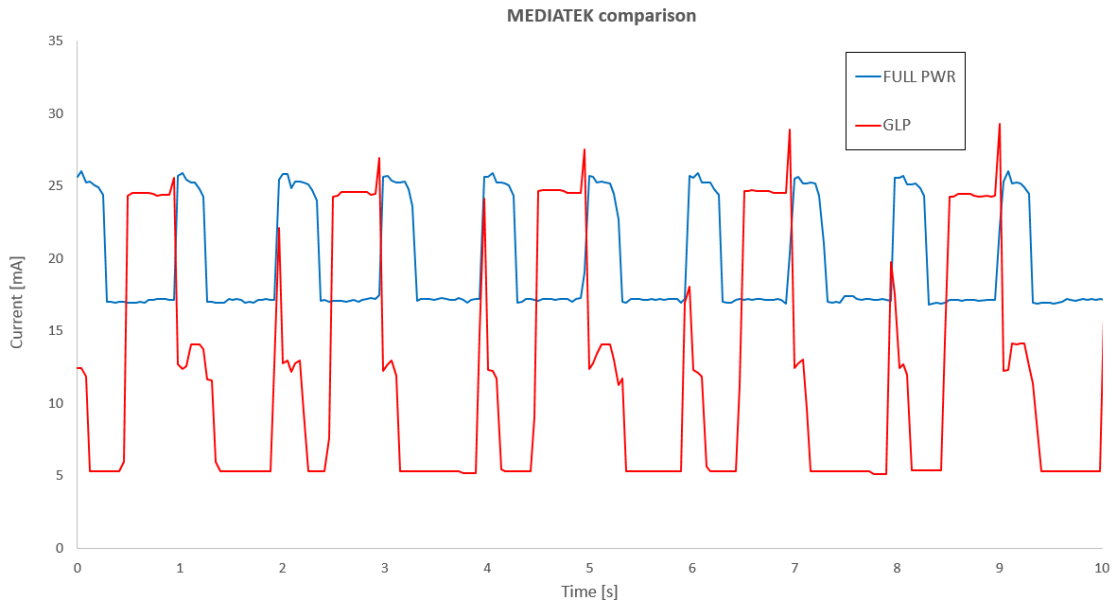

Figure 6-1 Comparison of MTK GLP mode with full power consumption.

Figure 6-1 shows the current measurements in a 10 seconds' window for the full power and GLP modes. The GLP mode presents a stronger variation in the current during its duty cycle, between ~25 and ~5 mA each second. Full Power mode instead displays a smaller variation (4-5 mA) around the average value of 20 mA.

Periodic power modes (not shown in Figure 6-1) behave like Full Power mode when the device is in the ON state, while the current drops to the microampere range when in the SLEEP state.

6. ACCURACY

This section presents the tracking results for the tested low power modes compared with the full power mode.

The tracking evaluation has been done in both urban and extra-urban environments.

6.1. GLP vs FP

GNSS Low Power (GLP) profile offered by Mediatek chipset is a continuous mode, and its performance are shown in Figures 7-1 to 7-3. The offset from the correct positions for the GLP mode reached 18m and 15m for the presented cases.

Overall, GLP accuracy is close to full-power mode's one in good RF conditions and degrades to a reasonable level for sharp changes of direction (Figure 7-3) and for difficult urban environment (Figures 7-1, 7-2).

Figure 7-1 Full Power (blue) vs GLP (red)

Figure 7-2 Full Power (blue) vs GLP (red)

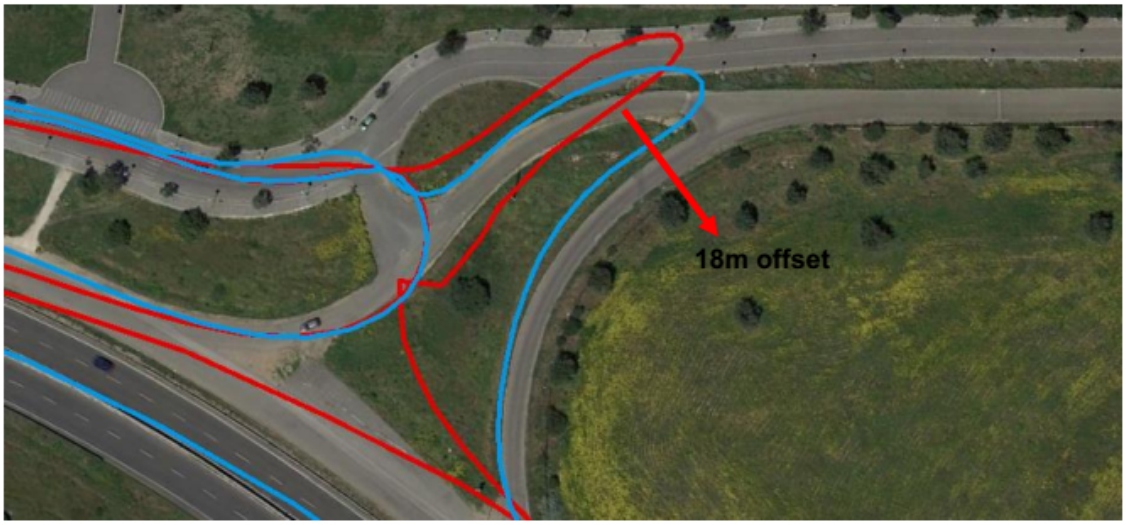

Figure 7-3 Full Power (blue) vs GLP (red)

6.2. MEDIATEK Periodic Mode

Periodic modes with 5s-30s and 10s-300s settings were tested for Mediatek chipset in extra-urban environment, and the results are shown in Figures 7-4 and 7-5.

The observed results demonstrate good accuracy under optimal RF conditions for both modules, but tracking applications are possible with first settings only as seen below in Figure 7-5. In Figure 7-6, the actual tracking path can be used for comparison.

Thus, the better trade-off between update-rate and accuracy is achieved with the first settings (5s_ON-30s_SLEEP).

Figure 7-4 5s_ON-30s_SLEEP (red) vs 10s_ON-300s_SLEEP (green)

Figure 7-5 5s_ON-30s_SLEEP (red) vs 10s_ON-300s_SLEEP (green)

Figure 7-6 Actual Testing-Path

7. DOCUMENT HISTORY

Revision	Date	Changes
0	2017-06-16	First issue

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