

# LEA-M8T-0-01 to LEA-M8T-0-10 Migration Guide

## Functional changes from FW2.30 to FW3.01

### Application Note

#### Abstract

This document identifies the major Software feature differences for u-blox LEA-M8T based timing modules when changing between FW2.30 TIMRAW 1.02 to FW3.01 TIM 1.10

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Product name	Type number	ROM/FLASH version	PCN reference
LEA-M8T	LEA-M8T-0-10	Flash FW3.01 TIM1.10	UBX-16004907

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# 1 Introduction

This document provides important software-related information for customers when migrating from a u-blox LEA-M8T-0-01 to the new LEA-M8T-0-10. The improved product introduces a number of new features and improvements over the existing generation. These changes are reflected in alteration or addition to the u-blox message protocol and NMEA sentences.

The LEA-M8T-0-10 is a FW3.01 based device that inherits the existing features from the earlier FW2.30 based product plus those introduced or changed with this generation firmware. Note that the LEA-M8T-0-01 module hardware design remains similar to the LEA-M8T-0-10 as described in [1]. The major software and operational changes are listed below:

- Operation with the Galileo constellation including S&R Return link message
- Improved Beidou cold start sensitivity
- GeoFence capability
- UBX message signature security mechanism
- A new wrist mounted platform dynamical model for arm-swing mitigation
- New Power Save Modes
- Anti spoofing measures
- Multi-GNSS Assistance (MGA) extensions for Beidou and Galileo
- Operation with the Japanese Indoor MESSaging System (IMES)

This document lists the basic message updates and then expands on information directed at timing customers migrating from the LEA-M8T-0-01 to LEA-M8T-0-10. It concludes with a brief description of the other more general improvements. For a detailed explanation of the message structure and prescribed data, refer to the u-blox M8 Receiver Description Including Protocol Specification [2].

## 2 New or changed UBX Messages

This section provides a quick reference to all the messages changed or introduced with the LEA-M8T-0-10 running on FW3.01 TIM 1.10.

Message	Status	Remarks
UBX-CFG-DYNSEED	New	Feature for signing selected UBX messages using a dynamic key value
UBX-CFG-FIXSEED	New	Signature generated to sign UBX messages with a fixed key value
UBX-CFG-GEOFENCE	New	Geographic area initialization for the Geofence function
UBX-CFG-GNSS	Changed	Altering configuration will now provoke a navigation system restart
UBX-CFG-NAV5	Changed	New 'wrist' dynamical motion model for sports applications added
UBX-CFG-PM2	Changed	New parameter fields added ( <code>maxStartupStateDur</code> , <code>extIntInactivityMs</code> )
UBX-CFG-PMS	New	Simpler configuration message for popular Power Save Mode profiles
UBX-CFG-TP5	Changed	Time base now can be changed to Galileo Time
UBX-MGA-BDS	New	New MGA messages for delivering Beiou assistance information
UBX-MGA-GAL	New	New MGA messages for delivering Galileo assistance information
UBX-MON-GNSS	Changed	All changes now provoke a Navigation restart
UBX-NAV-EOE	New	Marks end of NAV message collection within one epoch
UBX-NAV-GEOFENCE	New	Outputs the state of geofences for current epoch
UBX-NAV-STATUS	New	Added spoofing state to NAV status
UBX-NAV-TIMEGAL	New	Provides precise Galileo time from latest nav fix
UBX-NAV-TIMEGLO	New	Provides precise Glonass time from latest nav fix
UBX-NAV-TIMELS	New	Provides info on up-coming leap second
UBX-RXM-IMES	New	IMES beacon information (replacement for UBX-NAV-IMES)
UBX-RXM-PMREQ	Changed	New states allowed in back-up mode
UBX-RXM-RLM	New	Galileo RLM messages (short and long)
UBX-RXM-SFRBX	New	Was a 'RAW' only feature, now available on all variants
UBX-SEC-SIGN	New	Message signature of previously sent message
UBX-SEC-UNIQID	New	Allows retrieval of a unique chip ID code

**Table 1 New/changed messages from LEA-M8T-0-1 (FW2.30 TIMRAW 1.02) to LEA-M8T-0-10 (FW3.01 TIM 1.10)**

## 3 Functional Changes: Timing

The table above gives an overview for this new FW introduction. This section provides information about the new features relevant to current LEA-M8T timing customers. In summary the changes made with respect to the previous LEA-M8T-0-01 module are:

- Hardware compatibility with LEA-M8T-0-01
- Receiver Firmware based on FW3.01
- Survey-in and multi-constellation timing support as LEA-M8T-0-01
- Similar message and configuration structure to LEA-M8T-0-01
- Improved BeiDou cold-start acquisition sensitivity to at least -142dBm
- Addition of Galileo as a timing source

These points are explained below using the current LEA-M8T.

### 3.1 BeiDou Sensitivity Improvement

With FW3.01 the BeiDou sensitivity has been raised to give significant improvement in cold start sensitivity over previous firmware. This provides a cold start sensitivity increase from -138dBm to better than -142dBm.

### 3.2 Galileo Operation

New UBX messages are added to allow operation with the Galileo constellation. Whilst this feature is fully implemented in FW3.01, it is confined to Flash FW operation only with the following caveats:

- The Galileo ICD is not final
- Not enough SV's to do a proper 3D fix
- Galileo reception is disabled by default (use `UBX-CFG-GNSS` to enable)

u-blox will keep the Galileo signal in space status under review during introduction of the constellation for any material changes that will affect our customers.

### 3.3 GNSS Configuration:

`UBX-CFG-GNSS` :

Applying this message with any changes will always provoke a receiver restart. This is to increase the FW robustness and hence simply ramping up and down SV channels cannot be used to fade in and out wanted and unwanted constellations. Please contact u-blox support team for guidance on selective use of constellations.

### 3.4 Time Pulse output:

`UBX-CFG-TP5`:

This message has been expanded to allow Time pulse synchronization to Galileo time. Note that if the time pulse is enabled prior to GNSS lock then the TIM-TP output message should be used as an indicator that the time-pulse is valid and in the 'locked' state. In most cases, the time-pulse will be enabled after the first complete sub-frame has been received (6s for GPS). Note that the the default time base is set to UTC time.

### 3.5 Assistance:

The following new messages cater for constellations supported by the LEA-M8T-0-10. This is echoed in the u-blox services for AssistNowOn /Offline that have been extended to provide assistance for these satellite systems.

### 3.5.1 UBX-MGA-BDS:

New messages are available to enable the delivery of BeiDou assistance data to a receiver .

UBX-MGA-BDS-EPH , UBX-MGA-BDS-ALM , UBX-MGA-BDS-TIMEOFF , UBX-MGA-BDS-HEALTH , UBX-MGA-BDS-UTC , UBX-MGA-BDS-IONO .

### 3.5.2 UBX-MGA-GAL:

As for BeiDou a similar set of messages have been added for delivery of Galileo Assistance data to the receiver.

UBX-MGA-GAL-EPH , UBX-MGA-GAL-ALM , UBX-MGA-GAL-TIMEOFF , UBX-MGA-GAL-HEALTH , UBX-MGA-GAL-UTC .

## 3.6 Spoofing

Spoofing is a process whereby someone (or something) tries to control reported position out of a device. This may take the form of reporting incorrect positioning, velocity or time. FW3.01 includes some anti-spoofing measures so that if a PVT measurement is suspected of being altered then a flag is set in the UBX-NAV-STATUS message. Note that this flag is a **warning** only when signals appear to be suspicious.

## 3.7 New Navigation Messages

### 3.7.1 Leap second event information

UBX-NAV-TIMELS :

This message provides information pertaining to leap second handling and provides the following information to the user:-

- Source of the current number of leap second information.
- Current number of leap seconds since start of GPS time (Jan 6, 1980)
- Future leap second change if one is scheduled.
- Number of seconds until the next leap second event
- GPS week number (WN) of the next leap second
- GPS day of week number (DN) for the next leap second event

### 3.7.2 Galileo Time

UBX-NAV-TIMEGAL :

This message reports the precise Galileo time for the most recent navigation solution.

### 3.7.3 End of Epoch

UBX-NAV-EOE :

This message delimits the end of navigation messages output over one epoch period. Use this as a marker to collect all navigation messages within an epoch. It is output after all the enabled NAV class messages (except NAV-HNR) and after all enabled NMEA messages.

### 3.7.4 RAW output data messages

With the FW 3.01 TIM1.10 firmware users should be aware that the TOW time provided in UBX-RXM-RAWX are no longer identical to the TOW time given in UBX-NAV-PVT. This was the case with earlier firmware but has since changed with FW 3.01 TIM1.10 to make increased update rates available for the RAW output. Even with identical rates, the messages are processed at independently times reflected in their own reported TOW.

## 4 Functional Changes: Generic

This section provides an overview of the general feature improvements made with FW3.01.

### 4.1 Geo-fencing

FW3.01 supports up to four circular Geo-fence areas defined on the Earth's surface using a 2D model.

The Geo-fence feature is activated/deactivated by the UBX message `UBX-CGF-GEOFENCE` in which the Geo-fence areas are defined. Geo-fencing is active when at least one Geo-fence is defined and the current status can be found when polling `UBX-NAV-GEOFENCE`. A PIO pin can be nominated to indicate the status for example, wake up a host on activation.

### 4.2 Signature

New to FW3.01 is a mechanism to prevent third party to interference with the UBX message stream sent from receiver to host. The key elements are:

- Provision of one fixed secret ID set by eFuse in customer production
- Use of a dynamic ID-key set by host
- Attacks can be detected by the host

The mechanism revolves around 'signing' a message nominated via the `UBX-CFG-FIXSEED` message. The signature is provided after the nominated message(s) within the `UBX-SEC-SIGN` message. The signature is compared with one generated by the host to determine if the message data has been altered.

### 4.3 Power save Mode Improvements

Power save modes are now implemented for all GNSS constellations providing less risk of a fall-back to continuous operation. Cyclic mode is operable over the range from 1-10 Hz. A new message (`UBX-CFG-PMS`) is available for pre-selecting common power usage scenarios. This introduction makes PSM easier to configure and includes the following settings:-

- Continuous balanced mode (~8 to 18% improvement compared to FW2.30) - Default option
- Full power: no compromises on power consumption
- A 1Hz Cyclic tracking mode for aggressive power reduction
- A choice of 2 or 4<sup>1</sup> Hz Cyclic tracking modes for typical wearable applications
- ON/OFF interval mode

### 4.4 IMES

Customers can now receive the Japanese Indoor MESSaging System (IMES) information through the new message `UBX-RXM-IMES`. This message replaces the older `UBX-NAV-IMES` message that is no longer supported in FW3.01. NB. This service is authorized and available only in Japan.

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<sup>1</sup> Single GNSS constellation only



## 4.5 NAV dynamic model: wrist

A new navigation dynamical model has been introduced for wrist-mounted receivers. This is to mitigate against coupling of the arm swing period and the navigation update rate. The model is programmed by specifying the 'wrist worn watch model' in `UBX-CFG-NAVX5`. Results show improved position deviation that can be further improved with higher update rates, for example, 4 Hz.

## 4.6 Galileo SAR Return Link Message

The Galileo constellation can receive the output from international maritime distress beacons and relay this on to a control center. To provide a return path from the control center, the Galileo satellites reserve a portion of their broadcast message structure to send a return link message (RLM) to an activated distress beacon. FW3.01 has a new message (`UBX-RXM-RLM`) which supports this function for both the long and short message formats providing:

- Message type
- Distress Beacon ID
- Message code
- Message Parameters
- Sending SV

## 4.7 UART Port Framing Error Response

If an asynchronous serial data stream is applied to the UART port at an incorrect baud rate then the interface will register a frame error and ignore the input character. This can also occur if the UART Rx pin is left grounded. If more than 100 frame errors are detected in a one second period the port is disabled and will not attempt to receive any more characters. At the completion of the 1 second period the interface is reset and re-enabled to accept input data. If this condition occurs an error message is printed after the UART RX is re-enabled.

Users should be cautious when implementing a baud rate change and allow at least 100 ms between sending the baud rate change (`CFG-PRT`) and providing input data at the new rate. Otherwise some input characters may be ignored or the port could be disabled until the interface is able to process at the new baud rate.

## Appendix

### A Glossary

Abbreviation	Definition
FW	Firmware object code
GALILEO	European navigation system
GLONASS	Russian navigation satellite system
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
IMES	Japanese Indoor positioning system
QZSS	Quasi-Zenith Satellite System
SAR	Search and Rescue

Table 2: Explanation of abbreviations used

## Related documents

- [1] LEA-M8S / LEA-M8T Hardware Integration Manual, Doc. No. UBX-15030060
- [2] u-blox 8 / u-blox M8 Receiver Description, Doc. No. UBX-153003221



For regular updates to u-blox documentation and to receive product change notifications, register on our homepage (<http://www.u-blox.com>)

## Revision history

Revision	Date	Name	Comments
R01	18-Aug-2016	byou	Initial release.
R02	11-July-2017	byou	Addition of UART frame error response.

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