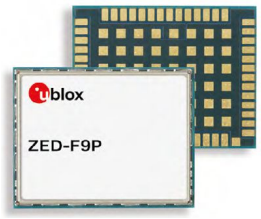
# ZED-F9P

## u-blox F9 high precision GNSS receiver

Interface Description




**Abstract**
This document describes the interface (version 27.12) of the ZED-F9P, a multi-band GNSS module with integrated RTK offering centimeter level accuracy.

**www.u-blox.com**

UBX-18010854 - R08

# Document information

| | | |
|---|---|---|
| **Title** | **ZED-F9P** | |
| **Subtitle** | u-blox F9 high precision GNSS receiver | |
| **Document type** | Interface Description | |
| **Document number** | UBX-18010854 | |
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| **Document status** | Early production information | |

This document applies to the following products:

| Product name | Type number | Firmware version | PCN reference |
|---|---|---|---|
| ZED-F9P | ZED-F9P-02B-00 | HPG 1.13 | N/A |

# Contents

# 1 General information

## 1.1 Document overview

This document describes the interface of the u-blox F9 high precision GNSS receiver. The interface consists of the following parts:

- NMEA protocol
- UBX protocol
- RTCM protocol
- Configuration interface

See also Related documents.

☞ This document describes features that are common to many different u-blox GNSS and correction data receivers. Some of these features may not be available in ZED-F9P, and some may require specific configurations to be enabled. See the Data sheet of your specific product for availability and the Integration manual for instructions for enabling the features.

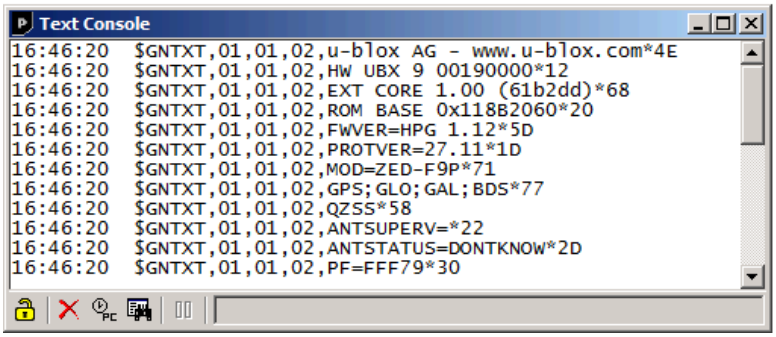
☞ Previous versions of u-blox receiver documentation combined general receiver description and interface specification. In the current documentation the receiver description is included in the Integration manual.

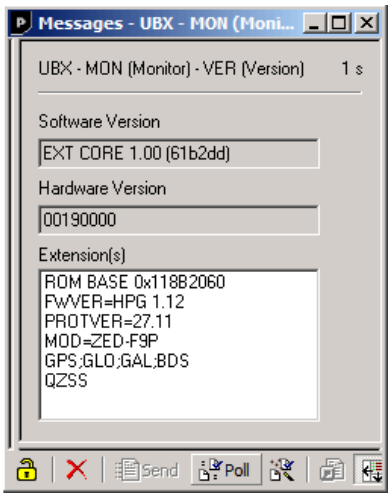
## 1.2 Firmware and protocol versions

u-blox receivers execute firmware from internal ROM and from internal code-RAM. The firmware image is loaded into the code-RAM by a boot loader executed from ROM. The boot loader loads the firmware into the code-RAM either from a connected flash memory or from the host processor.

The location and the version of the boot loader and the currently running firmware can be found in the boot screen and in the UBX-MON-VER message. If the firmware has been loaded from a connected flash or from the host processor, it is indicated by text "EXT". When the receiver is started, the boot screen is output automatically in UBX-INF-NOTICE or NMEA-Standard-TXT messages if configured using CFG-INFMSG. The UBX-MON-VER message can be polled using the UBX polling mechanism.

The following u-center screenshots show an example of a u-blox receiver running firmware loaded from flash:



The following information is available (✓) from the boot screen (**B**) and the UBX-MON-VER message (**M**):

| B | M | Example | Information |
|---|---|---|---|
| ✓ | | `u-blox AG - www.u-blox.com` | Start of the boot screen. |
| ✓ | | `HW UBX 9 00190000` | Hardware version of the u-blox receiver. |
| | ✓ | `00190000` | |
| ✓ | ✓ | `EXT CORE 1.00 (61b2dd)` | Base (CORE) firmware version and revision number, loaded from external memory (EXT). |
| | | `EXT LAP 1.00 (12a3bc)` | Product firmware version and revision number, loaded from external memory (EXT). Available only in some firmware versions. See below for a list of product acronyms. |
| ✓ | ✓ | `ROM BASE 0x118B2060` | Revision number of the underlying boot loader firmware in ROM. |
| ✓ | ✓ | `FWVER=HPG 1.12` | Product firmware version number, where:<br>• `SPG` = Standard precision GNSS product<br>• `HPG` = High precision GNSS product<br>• `ADR` = Dead reckoning product<br>• `TIM` = Time sync product<br>• `LAP` = Lane accurate positioning product<br>• `HPS` = High precision sensor fusion product |
| ✓ | ✓ | `PROTVER=27.11` | Supported protocol version. |
| ✓ | ✓ | `MOD=ZED-F9P` | Module name (if available). |
| ✓ | ✓ | `GPS;GLO;GAL;BDS` | List of supported major GNSS (see GNSS identifiers). |
| ✓ | ✓ | `SBAS;QZSS` | List of supported augmentation systems (see GNSS identifiers). |
| ✓ | | `ANTSUPERV=AC SD PDoS SR` | Configuration of the antenna supervisor (if available), where:<br>• `AC` = Active antenna control enabled<br>• `SD` = Short circuit detection enabled<br>• `OD` = Open circuit detection enabled<br>• `PDoS` = Short circuit power down logic enabled<br>• `SR` = Automatic recovery from short state enabled |
| ✓ | | `PF=FFF79` | Product configuration. |

☞ The "FWVER" product firmware version indicates which firmware is currently running. This is referred to as "firmware version" in this and other documents.

☞ The revision numbers should only be used to identify a known firmware version. They are not necessarily numeric nor are they guaranteed to increase with newer firmware versions.

☞ Similarly, firmware version numbers can have additional non-numeric information appended, such as in "1.00B03".

☞ Not every entry is output by all u-blox receivers. The availability of some of the information depends on the product, the firmware location and the firmware version.

The product firmware version and the base firmware version relate to the protocol version:

| Product firmware version | Base firmware version | Protocol version |
|---|---|---|
| HPG 1.00B03 | EXT CORE 1.00 (554da8) | 27.00 |
| HPG 1.00 | EXT CORE 1.00 (61ce84) | 27.00 |
| HPG 1.10 | EXT CORE 1.00 (eba0dc) | 27.10 |
| HPG 1.11 | EXT CORE 1.00 (94e56e) | 27.10 |
| HPG 1.12 | EXT CORE 1.00 (61b2dd) | 27.11 |

| Product firmware version | Base firmware version | Protocol version |
|---|---|---|
| HPG 1.13 | EXT CORE 1.00 (f10c36) | 27.12 |

## 1.3 Receiver configuration

u-blox positioning receivers are fully configurable with UBX protocol messages. The configuration used by the receiver during normal operation is called the "current configuration". The current configuration can be changed during normal operation by sending UBX-CFG-VALSET messages over any I/O port (except UART2). The receiver will change its current configuration immediately after receiving a configuration message. The receiver will always use the current configuration only.

The current configuration is loaded from permanent configuration hard-coded in the receiver firmware (the defaults) and from non-volatile memory (user configuration) on startup of the receiver. Changes made to the current configuration at run-time will be lost when there is a power cycle, a hardware reset or a (complete) controlled software reset (see Configuration reset behavior).

See Configuration interface for a detailed description of the receiver configuration system, the explanation of the configuration concept and its principles and interfaces.

☞ The configuration interface has changed from earlier u-blox positioning receivers. There is some backwards compatibility provided in UBX-CFG configuration messages. Users are strongly advised to only use the Configuration interface. See also Legacy UBX message fields reference.

☞ See the Integration manual for a basic receiver configuration most commonly used.

## 1.4 Naming

Message names are written in full with the parts of the name separated by hyphens ("-"). The full message name consists of the protocol name (e.g., *UBX)*, the class name (e.g. *NAV*) and the message name (e.g. *PVT*). For example the receiver software version information message is referred to as *UBX-MON-VER*. Similarly, the *NMEA-Standard-GGA* is the NMEA standard message (sentence) with the global positioning fix data.

References to fields of the message add the field name separated by a dot ("."), e.g. *UBX-MON-VER.swVersion*.

Some messages use a fourth level of naming, called the message version. One example is the *UBX-MGA-GPS* message for GPS assistance data, which exists in versions for ephemerides (*UBX-MGA-GPS-EPH*) and almanacs (*UBX-MGA-GPS-ALM*).

Names of configuration items are of the form *CFG-GROUP-ITEM*. For example, *CFG-NAVSPG-DYNMODEL* refers to the navigation dynamic platform model the receiver uses. Constants add a fourth level to the item name, such as *CFG-NAVSPG-DYNMODEL-AUTOMOT* for the automotive platform model. In the context of describing an item's value, only the last part of the constant name can be used (e.g. "set *CFG-NAVSPG-DYNMODEL* to *PORT* for portable applications").

## 1.5 GNSS, satellite and signal identifiers

### 1.5.1 Overview

The UBX protocol messages use two different numbering schemes. Some messages use a one-byte (type U1) field for the satellite identifier (normally named `svid`). This uses numbering similar to the "extended" NMEA scheme and is merely an extension of the scheme in use for previous generations of u-blox receivers.

With the ever increasing numbers of GNSS satellites, this scheme has been phased out in recent u-blox positioning receivers (as numbers greater than 255 would have become necessary). Consequently, newer messages use a more sophisticated, flexible and future-proof approach. This involves having a separate `gnssId` field to identify which GNSS the satellite is part of and a simple `svId` (SV for space vehicle) field that indicates which number the satellite is in that system. In nearly all cases, this means that the *svId* is the natural number associated with the satellite. For example the GLONASS SV4 is identified as *gnssId 6, svId 4*, while the GPS SV4 is *gnssId 0, svId 4*.

Signal identifiers are used where different signals from a GNSS satellite need to be distinguished (e.g. in the UBX-NAV-SIG message). A separate `sigId` field is used. These identifiers are only valid when combined with a GNSS identifier (`gnssId` field).

The NMEA protocol (version 4.10) identifies GNSS satellites with a one-digit system ID and a two-digit satellite number. u-blox receivers support this method in their NMEA output when "strict" SV numbering is selected. In most cases this is the default setting, but it can be checked or changed using the Configuration interface (see also NMEA GNSS, satellite and signal numbering).

In order to support some GNSS (e.g. BeiDou, Galileo, QZSS), which are not supported by some or all NMEA protocol versions, an "extended" SV numbering scheme can be enabled. This uses the NMEA-defined numbers where possible but adds other number ranges to support other GNSS. Note however that these non-standard extensions require 3-digit numbers, which may not be supported by some NMEA parsing software. For example, QZSS satellites use numbers in the range 193 to 202.

The NMEA standard defines signal identifiers to distinguish different signals sent by a single GNSS satellite (e.g. L2 CL and CM). u-blox positioning receivers use those identifiers for signal identification, as far as the corresponding standard is supported in a particular product.

☞ Note that the following sections are a generic overview for different u-blox positioning receivers. A particular product may not support all of the described GNSS identifiers, satellite numbers, signal identifiers or combinations thereof.

### 1.5.2 GNSS identifiers

The following table lists each GNSS along with the GNSS identifiers (UBX protocol), the system IDs (NMEA protocol), and abbreviations used in this document:

| GNSS | Abbreviations | | UBX gnssId | NMEA system ID | | |
|---|---|---|---|---|---|---|
| | | | | 2.3 - 4.0 | 4.10 | 4.11 |
| GPS | GPS | G | 0 | 1 | 1 | 1 |
| SBAS | SBAS | S | 1 | 1 | 1 | 1 |
| Galileo | GAL | E | 2 | n/a | 3 | 3 |
| BeiDou | BDS | B | 3 | n/a | (4)[1] | 4 |
| IMES | IMES | I | 4 | n/a | n/a | n/a |
| QZSS | QZSS | Q | 5 | n/a | (1)[1] | 5 |
| GLONASS | GLO | R | 6 | 2 | 2 | 2 |

Other values will be added when support for other GNSS types will be enabled in u-blox receivers.

[1] While not defined by NMEA 4.10, u-blox receivers in this mode will use system ID 4 for BeiDou and, if extended satellite numbering is enabled, system ID 1 for QZSS.

See also NMEA Talker ID.

### 1.5.3 Satellite identifiers

A summary of all the satellite numbering schemes used in the NMEA protocol and the UBX protocol is provided in the following table.

| | | UBX Protocol | | NMEA Protocol 2.3 - 4.0 | | NMEA Protocol 4.10 | | NMEA Protocol 4.11 | |
|---|---|---|---|---|---|---|---|---|---|
| **GNSS** | **SV Range** | **gnssId:svId** | **single svId** | **(strict)** | **(extended)** | **(strict)** | **(extended)** | **(strict)** | **(extended)** |
| GPS | G1-G32 | 0:1-32 | 1-32 | 1-32 | 1-32 | 1-32 | 1-32 | 1-32 | 1-32 |
| SBAS | S120-S158 | 1:120-158 | 120-158 | 33-64 | 33-64, 152-158 | 33-64 | 33-64, 152-158 | 33-64 | 33-64, 152-158 |
| Galileo | E1-E36 | 2:1-36 | 211-246 | - | 301-336 | 1-36 | 1-36 | 1-36 | 1-36 |
| BeiDou | B1-B37 | 3:1-37 | 159-163, 3-64 | - | 401-437 | 1-37 | 1-37 | 1-37 | 1-37 |
| IMES | I1-I10 | 4:1-10 | 173-182 | n/a | 173-182 | n/a | 173-182 | n/a | 173-182 |
| QZSS | Q1-Q10 | 5:1-10 | 193-202 | n/a | 193-202 | n/a | 193-202 | 1-10 | 1-10 |
| GLONASS | R1-R32, R? | 6:1-32, 6:255 | 65-96, 255 | 65-96, null | 65-96, null | 65-96, null | 65-96, null | 65-96, null | 65-96, null |

Note that GLONASS satellites can be tracked before they have been identified. In UBX messages such unknown satellites will be reported with svId 255. In NMEA messages they will be null (empty) fields. Product-related documentation and u-center will use R? to label unidentified GLONASS satellites.

### 1.5.4 Signal identifiers

A summary of all the signal identification schemes used in the NMEA protocol and the UBX protocol is provided in the following table.

| | UBX Protocol | | NMEA Protocol 4.10 | | NMEA Protocol 4.11 | |
|---|---|---|---|---|---|---|
| **Signal** | **gnssId** | **sigId** | **System ID** | **Signal ID** | **System ID** | **Signal ID** |
| GPS L1C/A[2] | 0 | 0 | 1 | 1 | 1 | 1 |
| GPS L2 CL | 0 | 3 | 1 | 6 | 1 | 6 |
| GPS L2 CM | 0 | 4 | 1 | 5 | 1 | 5 |
| SBAS L1C/A[2] | 1 | 0 | 1 | 1 | 1 | 1 |
| Galileo E1 C[2] | 2 | 0 | 3 | 7 | 3 | 7 |
| Galileo E1 B[2] | 2 | 1 | 3 | 7 | 3 | 7 |
| Galileo E5 bI | 2 | 5 | 3 | 2 | 3 | 2 |
| Galileo E5 bQ | 2 | 6 | 3 | 2 | 3 | 2 |
| BeiDou B1I D1[2] | 3 | 0 | (4)[3] | (1)[4] | 4 | 1 |
| BeiDou B1I D2[2] | 3 | 1 | (4)[3] | (1)[4] | 4 | 1 |
| BeiDou B2I D1 | 3 | 2 | (4)[3] | (3)[4] | 4 | 11 |
| BeiDou B2I D2 | 3 | 3 | (4)[3] | (3)[4] | 4 | 11 |

[2] UBX messages that do not have an explicit `sigId` field contain information about the subset of signals marked.

[3] While not defined by NMEA 4.10, u-blox receivers in this mode will use system ID 4 for BeiDou and, if extended satellite numbering is enabled, system ID 1 for QZSS.

[4] BeiDou and QZSS signal ID are not defined in the NMEA protocol version 4.10. Values shown in the table are only valid for u-blox products and, for QZSS signal ID, if extended satellite numbering is enabled.

| Signal | UBX Protocol | | NMEA Protocol 4.10 | | NMEA Protocol 4.11 | |
|---|---|---|---|---|---|---|
| | gnssId | sigId | System ID | Signal ID | System ID | Signal ID |
| QZSS L1C/A[2] | 5 | 0 | (1)[3] | (1)[4] | 5 | 1 |
| QZSS L1S | 5 | 1 | (1)[3] | (4)[4] | 5 | 4 |
| QZSS L2 CM | 5 | 4 | (1)[3] | (5)[4] | 5 | 5 |
| QZSS L2 CL | 5 | 5 | (1)[3] | (6)[4] | 5 | 6 |
| GLONASS L1 OF[2] | 6 | 0 | 2 | 1 | 2 | 1 |
| GLONASS L2 OF | 6 | 2 | 2 | 3 | 2 | 3 |

## 1.6 Message types

The following message types are defined:

| Message type | Description |
|---|---|
| Input | Messages that are input to the receiver and never output. E.g. UBX-MGA-GPS-EPH. |
| Output | Messages that are output by the receiver in no particular interval and never input. E.g. UBX-ACK-ACK. |
| Input/output | Messages that can be output by or input to the receiver. E.g. UBX-MGA-DBD-DATA0. |
| Periodic | Messages that are output in regular intervals but cannot be polled. E.g. UBX-NAV-EOE. |
| Periodic/polled | Messages that are output in regular intervals and can be polled. E.g. UBX-NAV-PVT. |
| Command | Messages that are a command to the receiver. Similar to type *Input* these are input-only. E.g. UBX-CFG-RST. |
| Set | Input-only configuration or command messages. E.g. UBX-CFG-VALDEL. |
| Get/set | Input/output configuration or command messages. |
| Polled | Non-periodic messages that can only be polled. E.g. UBX-MON-VER. |
| Poll request | Poll request. E.g. UBX-MGA-DBD-POLL. |

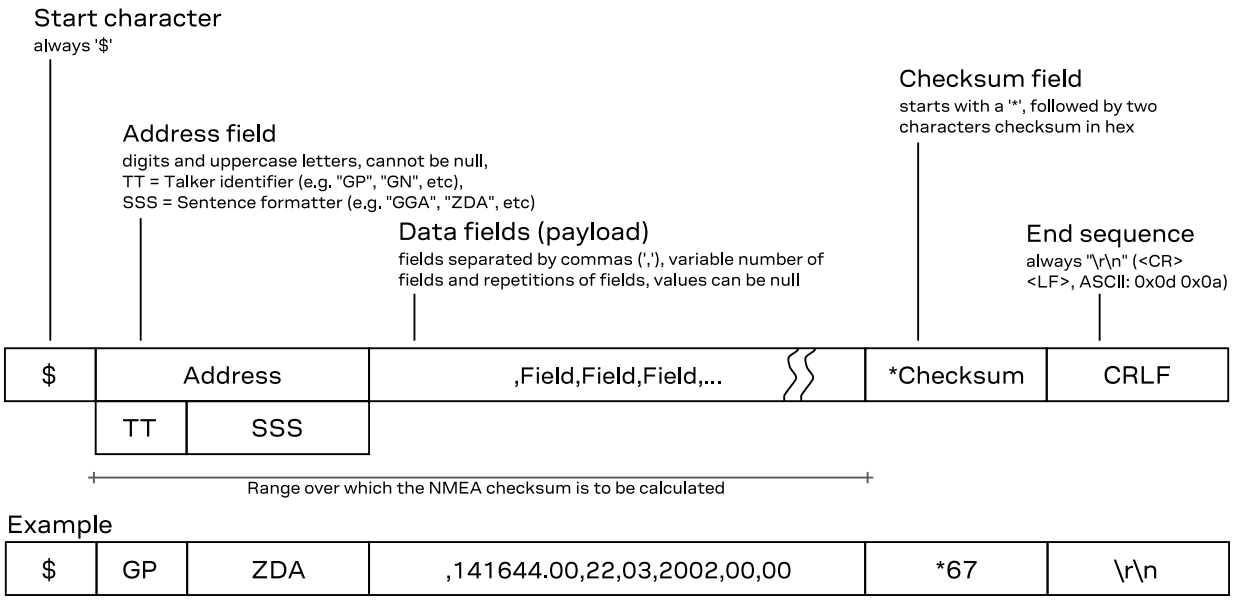
# 2 NMEA protocol

The following sections give an overview of the NMEA messages used by u-blox positioning receivers.

By default, the NMEA messages sent by u-blox positioning receivers are based on the NMEA 0183 version 4.10 standard. For further information on the NMEA standard, refer to the *NMEA 0183 Standard for Interfacing Marine Electronic Devices*, Version 4.10 June, 2012 which is available on http://www.nmea.org/.

## 2.1 NMEA frame structure

The following figure shows the structure of a NMEA protocol message (called "sentences" in the standard).




## 2.2 NMEA protocol configuration

The NMEA protocol on u-blox receivers can be configured for customer applications by using the Configuration interface (CFG-NMEA-* items).

There are five NMEA standards supported. The default NMEA version is 4.10. Alternatively versions 4.11, 4.00, 2.3, and 2.1 can be enabled. See CFG-NMEA-PROTVER to configure the version. See NMEA multi-GNSS operation and NMEA data fields for details on how this affects the output.

The following filtering flags can be used to configure the output of some NMEA message fields:

| Filter | Configuration Item | Description |
|---|---|---|
| Position filtering | CFG-NMEA-OUT_INVFIX | Enable to permit positions from failed or invalid fixes to be reported (with the "V" status flag to indicate that the data is not valid). |
| Valid position filtering | CFG-NMEA-OUT_MSKFIX | Enable to permit positions from invalid fixes to be reported (with the "V" status flag to indicate that the data is not valid). |
| Time filtering | CFG-NMEA-OUT_INVTIME | Enable to permit the receiver's best knowledge of time to be output, even though it might be wrong. |
| Date filtering | CFG-NMEA-OUT_INVDATE | Enable to permit the receiver's best knowledge of date to be output, even though it might be wrong. |

| Filter | Configuration Item | Description |
|---|---|---|
| GPS-only filtering | CFG-NMEA-OUT_ONLYGPS | Enable to restrict output to only report GPS satellites. |
| Track filtering | CFG-NMEA-OUT_FROZENCOG | Enable to permit course over ground (COG) to be reported even when it would otherwise be frozen. |

The following filtering flags can be used to configure the output of some NMEA message flags:

| Mode | Configuration Item | Description |
|---|---|---|
| Compatibility mode | CFG-NMEA-COMPAT | Some older NMEA applications expect the NMEA output to be formatted in a specific way, for example, they will only work if the latitude and longitude have exactly four digits behind the decimal point. u-blox receivers offer a compatibility mode to support these legacy applications. |
| Consideration mode | CFG-NMEA-CONSIDER | u-blox receivers use a sophisticated signal quality detection scheme, in order to produce the best possible position output. This algorithm considers all SV measurements, and may eventually decide to only use a subset thereof, if it improves the overall position accuracy. If consideration mode is enabled, all satellites, which were considered for navigation, are communicated as being used for the position determination. If consideration mode is disabled, only those satellites which after the consideration step remained in the position output are marked as being used. |
| Limit length mode | CFG-NMEA-LIMIT82 | Enabling this mode will limit the NMEA sentence length to a maximum of 82 characters. |
| High precision mode | CFG-NMEA-HIGHPREC | Enabling this mode increases precision of the position output. Latitude and longitude then have seven digits after the decimal point, and altitude has three digits after the decimal point. Note: The high precision mode cannot be set in conjunction with either compatibility mode or Limit82 mode. |

The following extended configuration options are available:

| Option | Configuration Item(s) | Description |
|---|---|---|
| GNSS to filter | CFG-NMEA-FILT_GPS etc. | Filters satellites based on the GNSS they belong to. |
| Satellite numbering | CFG-NMEA-SVNUMBERING | This field configures the display of satellites that do not have an NMEA-defined value. Note: this does not apply to satellites with an unknown ID. See also Satellite identifiers. |
| Main Talker ID | CFG-NMEA-MAINTALKERID | By default the main Talker ID (i.e. the Talker ID used for all messages other than GSV) is determined by the GNSS assignment of the receiver's channels (see configuration items CFG-SIGNAL-*). This field enables the main Talker ID to be overridden. See also NMEA Talker ID. |
| GSV Talker ID | CFG-NMEA-GSVTALKERID | By default the Talker ID for GSV messages is GNSS-specific (as defined by NMEA). This field enables the GSV Talker ID to be overridden. |
| BDS Talker ID | CFG-NMEA-BDSTALKERID | By default the Talker ID for BeiDou is "GB". This field enables the BeiDou Talker ID to be overridden. |

## 2.3 NMEA-proprietary messages

The NMEA standard allows for proprietary, manufacturer-specific messages to be added. These shall be marked with a manufacturer mnemonic. The mnemonic assigned to u-blox is UBX and is used for all non-standard messages. These proprietary NMEA messages therefore have the address field set to PUBX. The first data field in a PUBX message identifies the message number with two digits.

## 2.4 NMEA multi-GNSS operation

Many applications that process NMEA messages assume that only a single GNSS is active. However, when multiple GNSS are configured, the NMEA specification requires the output to change in the following ways:

**Main Talker ID** The main NMEA Talker ID will be "GN" (e.g. instead of "GP" for a GPS-only receiver).

**GSV Talker IDs** The GSV message reports the signal strength of the visible satellites. However, the Talker ID it uses is specific to the GNSS it is reporting information for, so for a multi-GNSS receiver it will not be the same as the main Talker ID. While other messages use the "GN" Talker ID, the GSV message will use GNSS-specific Talker IDs. See also NMEA protocol configuration.

**Multiple GSA and GRS messages** Multiple GSA and GRS messages are output for each fix, one for each GNSS. This may confuse applications that assume they are output only once per position fix (as is the case for a single GNSS receiver).

**GGA Talker IDs** The NMEA specification indicates that the GGA message is GPS-specific. However, u-blox receivers support the output of a GGA message for each of the Talker IDs.

**BeiDou and Galileo** Only NMEA version 4.10 and later have support for these systems.

**QZSS** Only NMEA version 4.11 and later have support for this system.

**Extended satellite numbering** In order to support some GNSS (e.g. BeiDou, Galileo, QZSS) that are not supported by some or all NMEA protocol versions, an "extended" SV numbering scheme can be enabled. This uses the NMEA-defined numbers where possible, but adds other number ranges to support other GNSS. Note however that these non-standard extensions require 3-digit numbers, which may not be supported by some NMEA parsing software. For example, QZSS satellites use numbers in the range 193 to 202. See NMEA protocol configuration and Satellite identifiers.

## 2.5 NMEA data fields

Various data fields in NMEA messages depend on NMEA protocol configuration or require a definition for their interpretation.

### 2.5.1 NMEA Talker ID

One of the ways the NMEA standard differs depending on the GNSS is by using a two-letter message identifier, the "Talker ID". The specific Talker ID used by a u-blox receiver will depend on the product and its configuration. The table below shows the Talker ID that will be used for various GNSS configurations by default.

| GNSS | Talker ID | Comments |
|---|---|---|
| GPS, SBAS | GP | NMEA 2.3+ |
| GLONASS | GL | NMEA 2.3+ |
| Galileo | GA | NMEA 4.10+ |
| BeiDou | GB | NMEA 4.10+ (official NMEA only since 4.11) |
| QZSS | GQ | NMEA 4.11+ (GP for NMEA 2.3 - 4.10) |
| Any combination of GNSS | GN | |

### 2.5.2 NMEA extra fields

The following extra fields are available in NMEA 4.10 and later.

| Message | Extra fields |
|---|---|
| NMEA-Standard-GBS | `systemId` and `signalId` |
| NMEA-Standard-GNS | `navStatus` |
| NMEA-Standard-GRS | `systemId` and `signalId` |
| NMEA-Standard-GSA | `systemId` |
| NMEA-Standard-GSV | `signalId` |
| NMEA-Standard-RMC | `navStatus` |

### 2.5.3 NMEA latitude and longitude format

According to the NMEA standard, latitude and longitude are output in the format *degrees, minutes and (decimal) fractions of minutes*. To convert to *degrees and fractions of degrees*, or *degrees, minutes, seconds and fractions of seconds*, the *minutes* and *fractional minutes* parts need to be converted. For example:

| Format | Latitude | Longitude |
|---|---|---|
| Receiver output | `$GNRMC,014230.00,A,4722.80340,N,00831.68218,E,0.000,,120477,,,A,V*14` | |
| (d)ddmm.mmmmm | 4722.80340 North | 00831.68218 East |
| Degrees and minutes | 47 degrees, 22.80340 minutes | 8 degrees, 31.68218 minutes |
| Degrees | 47.38005667 degrees | 8.52803633 degrees |
| Degrees, minutes and seconds | 47 degrees, 22 minutes, 48.2040 seconds | 8 degrees, 31 minutes, 40.9308 seconds |

### 2.5.4 NMEA GNSS, satellite and signal numbering

See GNSS, satellite and signal identifiers for details on how GNSS, satellites and signals are numbered in the NMEA protocol.

NMEA defines satellite numbering systems for some, but not all GNSS. The exact behavior depends on the configured NMEA protocol version and ("extended" or "strict") mode. See NMEA protocol configuration for details.

### 2.5.5 NMEA position fix flags

This section shows how u-blox positioning receivers implement the NMEA protocol and the conditions determining how flags are set.

The following flags are used in NMEA 4.10 and later.

| NMEA Message | GLL, RMC | GGA | GLL, VTG | RMC, GNS |
|---|---|---|---|---|
| **Field** | **status**[5] | **quality**[6] | **posMode**[7] | **posMode**[7] |
| No position fix (at power-up, after losing satellite lock) | V | 0 | N | N |
| GNSS fix, but user limits exceeded | V | 0 | N | N |
| Dead reckoning fix, but user limits exceeded | V | 6 | E | E |
| Dead reckoning fix | A | 6 | E | E |
| RTK float | A | 5 | D | F |
| RTK fixed | A | 4 | D | R |

5 Possible *status* values: V = data invalid, A = data valid

6 Possible values for *quality*: 0 = No fix, 1 = autonomous GNSS fix, 2 = differential GNSS fix, 4 = RTK fixed, 5 = RTK float, 6 = estimated/dead reckoning fix

7 Possible values for *posMode*: N = No fix, E = estimated/dead reckoning fix, A = autonomous GNSS fix, D = differential GNSS fix, F = RTK float, R = RTK fixed

| NMEA Message | GLL, RMC | GGA | GLL, VTG | RMC, GNS |
|---|---|---|---|---|
| **Field** | **status**[5] | **quality**[6] | **posMode**[7] | **posMode**[7] |
| 2D GNSS fix | A | 1 / 2 | A / D | A / D |
| 3D GNSS fix | A | 1 / 2 | A / D | A / D |
| Combined GNSS/dead reckoning fix | A | 1 / 2 | A / D | A / D |

In high precision GNSS (HPG) products it is recommended to select NMEA version 4.10 or above. Earlier versions do not support the float RTK (F) and real time kinematic (R) mode indicator flags in all messages.

The following flags are used in NMEA 2.3 - 4.0.

| NMEA Message | GLL, RMC | GGA | GSA | GLL, VTG, RMC, GNS |
|---|---|---|---|---|
| **Field** | **status**[8] | **quality**[9] | **navMode**[10] | **posMode**[11] |
| No position fix (at power-up, after losing satellite lock) | V | 0 | 1 | N |
| GNSS fix, but user limits exceeded | V | 0 | 1 | N |
| Dead reckoning fix, but user limits exceeded | V | 6 | 2 | E |
| Dead reckoning fix | A | 6 | 2 | E |
| 2D GNSS fix | A | 1 / 2 | 2 | A / D |
| 3D GNSS fix | A | 1 / 2 | 3 | A / D |
| Combined GNSS/dead reckoning fix | A | 1 / 2 | 3 | A / D |

The flags in NMEA 2.1 and earlier are the same as NMEA 2.3 but with the following differences:

- The *posMode* field is not output for GLL, RMC and VTG messages (each message has one field less).
- The GGA *quality* field is set to 1 (instead of 6) for both types of dead reckoning fix.

### 2.5.6 NMEA output of invalid or unknown data

By default the receiver will not output invalid data. In such cases, it will output empty fields. See NMEA protocol configuration for options to adjust this behavior.

A valid position fix is reported as follows:

```
$GPGLL,4717.11634,N,00833.91297,E,124923.00,A,A*6E
```

An invalid position fix (but valid time) is reported as follows:

```
$GPGLL,,,,,124924.00,V,N*42
```

If the time is unknown (e.g. during a cold start):

```
$GPGLL,,,,,,V,N*64
```

Unlike the NMEA standard behavior to invalid data, dead reckoning products always report a position. It is marked as invalid (V) when the user limits are exceeded or valid (A) if the user limits are met.

8 Possible values for *status*: V = data invalid, A = data valid

9 Possible values for *quality*: 0 = no fix, 1 = autonomous GNSS fix, 2 = differential GNSS fix, 4 = RTK fixed, 5 = RTK float, 6 = estimated/dead reckoning fix

10 Possible values for *navMode*: 1 = No fix, 2 = 2D fix, 3 = 3D fix

11 Possible values for *posMode*: N = No fix, E = estimated/dead reckoning fix, A = autonomous GNSS fix, D = differential GNSS fix

## 2.6 NMEA messages overview

| Message | Class/ID | Description (Type) |
|---|---|---|
| **NMEA-Standard – Standard NMEA messages** | | |
| NMEA-Standard-DTM | 0xf0 0x0a | • Datum reference (Output) |
| NMEA-Standard-GAQ | 0xf0 0x45 | • Poll a standard message (Talker ID GA) (Poll request) |
| NMEA-Standard-GBQ | 0xf0 0x44 | • Poll a standard message (Talker ID GB) (Poll request) |
| NMEA-Standard-GBS | 0xf0 0x09 | • GNSS satellite fault detection (Output) |
| NMEA-Standard-GGA | 0xf0 0x00 | • Global positioning system fix data (Output) |
| NMEA-Standard-GLL | 0xf0 0x01 | • Latitude and longitude, with time of position fix and status (Output) |
| NMEA-Standard-GLQ | 0xf0 0x43 | • Poll a standard message (Talker ID GL) (Poll request) |
| NMEA-Standard-GNQ | 0xf0 0x42 | • Poll a standard message (Talker ID GN) (Poll request) |
| NMEA-Standard-GNS | 0xf0 0x0d | • GNSS fix data (Output) |
| NMEA-Standard-GPQ | 0xf0 0x40 | • Poll a standard message (Talker ID GP) (Poll request) |
| NMEA-Standard-GQQ | 0xf0 0x47 | • Poll a standard message (Talker ID GQ) (Poll request) |
| NMEA-Standard-GRS | 0xf0 0x06 | • GNSS range residuals (Output) |
| NMEA-Standard-GSA | 0xf0 0x02 | • GNSS DOP and active satellites (Output) |
| NMEA-Standard-GST | 0xf0 0x07 | • GNSS pseudorange error statistics (Output) |
| NMEA-Standard-GSV | 0xf0 0x03 | • GNSS satellites in view (Output) |
| NMEA-Standard-RLM | 0xf0 0x0b | • Return link message (RLM) (Output) |
| NMEA-Standard-RMC | 0xf0 0x04 | • Recommended minimum data (Output) |
| NMEA-Standard-TXT | 0xf0 0x41 | • Text transmission (Output) |
| NMEA-Standard-VLW | 0xf0 0x0f | • Dual ground/water distance (Output) |
| NMEA-Standard-VTG | 0xf0 0x05 | • Course over ground and ground speed (Output) |
| NMEA-Standard-ZDA | 0xf0 0x08 | • Time and date (Output) |
| **NMEA-PUBX – u-blox proprietary NMEA messages** | | |
| NMEA-PUBX-CONFIG | 0xf1 0x41 | • Set protocols and baud rate (Set) |
| NMEA-PUBX-POSITION | 0xf1 0x00 | • Poll a PUBX,00 message (Poll request)<br>• Lat/Long position data (Output) |
| NMEA-PUBX-RATE | 0xf1 0x40 | • Set NMEA message output rate (Set) |
| NMEA-PUBX-SVSTATUS | 0xf1 0x03 | • Poll a PUBX,03 message (Poll request)<br>• Satellite status (Output) |
| NMEA-PUBX-TIME | 0xf1 0x04 | • Poll a PUBX,04 message (Poll request)<br>• Time of day and clock information (Output) |

## 2.7 Standard messages

Standard NMEA messages as defined by the NMEA 0183 standard. See NMEA protocol for details.

### 2.7.1 DTM

#### 2.7.1.1 Datum reference

| Message | NMEA-Standard-DTM<br>Datum reference |
|---|---|
| *Type* | Output |
| *Comment* | This message gives the difference between the current datum and the reference datum.<br>The current datum is set to WGS84 by default. |

| | |
|---|---|
| | The reference datum cannot be changed and is always set to WGS84. |
| *Information* | *Class/ID:* 0xf0 0x0a *Number of fields:* 11 |
| *Structure* | `$xxDTM,datum,subDatum,lat,NS,lon,EW,alt,refDatum*cs\r\n` |
| *Examples* | `$GPDTM,W84,,0.0,N,0.0,E,0.0,W84*6F\r\n`<br>`$GPDTM,999,,0.08,N,0.07,E,-47.7,W84*1C\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | `xxDTM` | string | - | $GPDTM | DTM Message ID (xx = current Talker ID, see NMEA Talker IDs table) |
| 1 | `datum` | string | - | W84 | Local datum code: W84 = WGS84, P90 = PZ90, 999 = user-defined |
| 2 | `subDatum` | string | - | - | A null field (or a string describing the currently selected datum for protocol versions less than 14.00) |
| 3 | `lat` | numeric | min | 0.08 | Offset in Latitude |
| 4 | `NS` | character | - | S | North/South indicator |
| 5 | `lon` | numeric | min | 0.07 | Offset in Longitude |
| 6 | `EW` | character | - | E | East/West indicator |
| 7 | `alt` | numeric | m | -2.8 | Offset in altitude |
| 8 | `refDatum` | string | - | W84 | Reference datum code: W84 (WGS 84, fixed field) |
| 9 | `cs` | hexadecimal | - | *67 | Checksum |
| 10 | `CRLF` | character | - | - | Carriage return and line feed |

## 2.7.2 GAQ

### 2.7.2.1 Poll a standard message (Talker ID GA)

| ***Message*** | **NMEA-Standard-GAQ**<br>**Poll a standard message (Talker ID GA)** |
|---|---|
| *Type* | Poll request |
| *Comment* | Polls a standard NMEA message if the current Talker ID is GA. |
| *Information* | *Class/ID:* 0xf0 0x45 *Number of fields:* 4 |
| *Structure* | `$xxGAQ,msgId*cs\r\n` |
| *Example* | `$EIGAQ,RMC*2B\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | `xxGAQ` | string | - | $EIGAQ | GAQ Message ID (xx = Talker ID of the device requesting the poll) |
| 1 | `msgId` | string | - | RMC | Message ID of the message to be polled |
| 2 | `cs` | hexadecimal | - | *2B | Checksum |
| 3 | `CRLF` | character | - | - | Carriage return and line feed |

## 2.7.3 GBQ

### 2.7.3.1 Poll a standard message (Talker ID GB)

| ***Message*** | **NMEA-Standard-GBQ**<br>**Poll a standard message (Talker ID GB)** |
|---|---|
| *Type* | Poll request |

| | |
|---|---|
| *Comment* | Polls a standard NMEA message if the current Talker ID is GB |
| *Information* | *Class/ID:* 0xf0 0x44 *Number of fields:* 4 |
| *Structure* | `$xxGBQ,msgId*cs\r\n` |
| *Example* | `$EIGBQ,RMC*28\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | `xxGBQ` | string | - | $EIGBQ | GBQ Message ID (xx = Talker ID of the device requesting the poll) |
| 1 | `msgId` | string | - | RMC | Message ID of the message to be polled |
| 2 | `cs` | hexadecimal | - | *28 | Checksum |
| 3 | `CRLF` | character | - | - | Carriage return and line feed |

## 2.7.4 GBS

### 2.7.4.1 GNSS satellite fault detection

| ***Message*** | **NMEA-Standard-GBS**<br>**GNSS satellite fault detection** |
|---|---|
| *Type* | Output |
| *Comment* | This message outputs the results of the Receiver Autonomous Integrity Monitoring Algorithm (RAIM).<br>• The fields **errLat**, **errLon** and **errAlt** output the standard deviation of the position calculation, using all satellites that pass the RAIM test successfully.<br>• The fields **errLat**, **errLon** and **errAlt** are only output if the RAIM process passed successfully (i.e. no or successful edits happened). These fields are never output if 4 or fewer satellites are used for the navigation calculation (because, in such cases, integrity cannot be determined by the receiver autonomously).<br>• The fields **prob**, **bias** and **stdev** are only output if at least one satellite failed in the RAIM test.<br>If more than one satellites fail the RAIM test, only the information for the worst satellite is output in this message. |
| *Information* | *Class/ID:* 0xf0 0x09 *Number of fields:* 13 |
| *Structure* | `$xxGBS,time,errLat,errLon,errAlt,svid,prob,bias,stddev,systemId,signalId*cs\r\n` |
| *Examples* | `$GPGBS,235503.00,1.6,1.4,3.2,,,,,,*40\r\n`<br>`$GPGBS,235458.00,1.4,1.3,3.1,03,,-21.4,3.8,1,0*5B\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | `xxGBS` | string | - | $GPGBS | GBS Message ID (xx = current Talker ID, see NMEA Talker IDs table) |
| 1 | `time` | hhmmss.ss | - | 235503.00 | UTC time to which this RAIM sentence belongs. See the section UTC representation in the Integration manual for details. |
| 2 | `errLat` | numeric | m | 1.6 | Expected error in latitude |
| 3 | `errLon` | numeric | m | 1.4 | Expected error in longitude |
| 4 | `errAlt` | numeric | m | 3.2 | Expected error in altitude |
| 5 | `svid` | numeric | - | 03 | Satellite ID of most likely failed satellite |
| 6 | `prob` | numeric | - | - | Probability of missed detection: null (not supported, fixed field) |
| 7 | `bias` | numeric | m | -21.4 | Estimated bias of most likely failed satellite (a priori residual) |
| 8 | `stddev` | numeric | m | 3.8 | Standard deviation of estimated bias |

| | | | | | |
|---|---|---|---|---|---|
| 9 | systemId | numeric | - | 1 | NMEA-defined GNSS system ID, see Signal Identifiers table (only available in NMEA 4.10 and later) |
| 10 | signalId | numeric | - | - | NMEA-defined GNSS signal ID, see Signal Identifiers table (only available in NMEA 4.10 and later) |
| 11 | cs | hexadecimal | - | *5B | Checksum |
| 12 | CRLF | character | - | - | Carriage return and line feed |

## 2.7.5 GGA

### 2.7.5.1 Global positioning system fix data

| ***Message*** | **NMEA-Standard-GGA**<br>**Global positioning system fix data** |
|---|---|
| *Type* | Output |
| *Comment* | Time and position, together with GPS fixing-related data (number of satellites in use, and the resulting HDOP, age of differential data if in use, etc.).<br>☞ The output of this message is dependent on the currently selected datum (default: WGS84). The NMEA specification indicates that the GGA message is GPS-specific. However, when the receiver is configured for multi-GNSS, the GGA message contents will be generated from the multi-GNSS solution. For multi-GNSS use, it is recommended that the NMEA-GNS message is used instead. |
| *Information* | *Class/ID:* 0xf0 0x00 *Number of fields:* 17 |
| *Structure* | `$xxGGA,time,lat,NS,lon,EW,quality,numSV,HDOP,alt,altUnit,sep,sepUnit,diffAge,diffSta ↵ tion*cs\r\n` |
| *Example* | `$GPGGA,092725.00,4717.11399,N,00833.91590,E,1,08,1.01,499.6,M,48.0,M,,*5B\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | xxGGA | string | - | $GPGGA | GGA Message ID (xx = current Talker ID, see NMEA Talker IDs table) |
| 1 | time | hhmmss.ss | - | 092725.00 | UTC time. See the section UTC representation in the Integration manual for details. |
| 2 | lat | ddmm.mmmmm | - | 4717.11399 | Latitude (degrees and minutes), see format description |
| 3 | NS | character | - | N | North/South indicator |
| 4 | lon | dddmm.mmmmm | - | 00833.91590 | Longitude (degrees and minutes), see format description |
| 5 | EW | character | - | E | East/West indicator |
| 6 | quality | digit | - | 1 | Quality indicator for position fix, see position fix flags description |
| 7 | numSV | numeric | - | 08 | Number of satellites used (range: 0-12) |
| 8 | HDOP | numeric | - | 1.01 | Horizontal Dilution of Precision |
| 9 | alt | numeric | m | 499.6 | Altitude above mean sea level |
| 10 | altUnit | character | - | M | Altitude units: M (meters, fixed field) |
| 11 | sep | numeric | m | 48.0 | Geoid separation: difference between ellipsoid and mean sea level |
| 12 | sepUnit | character | - | M | Geoid separation units: M (meters, fixed field) |
| 13 | diffAge | numeric | s | - | Age of differential corrections (null when DGPS is not used) |
| 14 | diffStation | numeric | - | - | ID of station providing differential corrections (null when DGPS is not used) |

| | | | | | |
|---|---|---|---|---|---|
| 15 | cs | hexadecimal | - | *5B | Checksum |
| 16 | CRLF | character | - | - | Carriage return and line feed |

## 2.7.6 GLL

### 2.7.6.1 Latitude and longitude, with time of position fix and status

| ***Message*** | **NMEA-Standard-GLL**<br>**Latitude and longitude, with time of position fix and status** |
|---|---|
| *Type* | Output |
| *Comment* | ☞ The output of this message is dependent on the currently selected datum (default: WGS84) |
| *Information* | *Class/ID:* 0xf0 0x01 *Number of fields:* 10 |
| *Structure* | `$xxGLL,lat,NS,lon,EW,time,status,posMode*cs\r\n` |
| *Example* | `$GPGLL,4717.11364,N,00833.91565,E,092321.00,A,A*60\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | xxGLL | string | - | $GPGLL | GLL Message ID (xx = current Talker ID, see NMEA Talker IDs table) |
| 1 | lat | ddmm.mmmmm | - | 4717.11364 | Latitude (degrees and minutes), see format description |
| 2 | NS | character | - | N | North/South indicator |
| 3 | lon | dddmm.mmmmm | - | 00833.91565 | Longitude (degrees and minutes), see format description |
| 4 | EW | character | - | E | East/West indicator |
| 5 | time | hhmmss.ss | - | 092321.00 | UTC time. See the section UTC representation in the Integration manual for details. |
| 6 | status | character | - | A | Data validity status, see position fix flags description |
| 7 | posMode | character | - | A | Positioning mode, see position fix flags description (only available in NMEA 2.3 and later) |
| 8 | cs | hexadecimal | - | *60 | Checksum |
| 9 | CRLF | character | - | - | Carriage return and line feed |

## 2.7.7 GLQ

### 2.7.7.1 Poll a standard message (Talker ID GL)

| ***Message*** | **NMEA-Standard-GLQ**<br>**Poll a standard message (Talker ID GL)** |
|---|---|
| *Type* | Poll request |
| *Comment* | Polls a standard NMEA message if the current Talker ID is GL |
| *Information* | *Class/ID:* 0xf0 0x43 *Number of fields:* 4 |
| *Structure* | `$xxGLQ,msgId*cs\r\n` |
| *Example* | `$EIGLQ,RMC*3A\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | xxGLQ | string | - | $EIGLQ | GLQ Message ID (xx = Talker ID of the device requesting the poll) |
| 1 | msgId | string | - | RMC | Message ID of the message to be polled |

| | | | | | |
|---|---|---|---|---|---|
| 2 | cs | hexadecimal | - | *3A | Checksum |
| 3 | CRLF | character | - | - | Carriage return and line feed |

## 2.7.8 GNQ

### 2.7.8.1 Poll a standard message (Talker ID GN)

| ***Message*** | **NMEA-Standard-GNQ**<br>**Poll a standard message (Talker ID GN)** |
|---|---|
| *Type* | Poll request |
| *Comment* | Polls a standard NMEA message if the current Talker ID is GN |
| *Information* | *Class/ID:* 0xf0 0x42 *Number of fields:* 4 |
| *Structure* | `$xxGNQ,msgId*cs\r\n` |
| *Example* | `$EIGNQ,RMC*3A\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | xxGNQ | string | - | $EIGNQ | GNQ Message ID (xx = Talker ID of the device requesting the poll) |
| 1 | msgId | string | - | RMC | Message ID of the message to be polled |
| 2 | cs | hexadecimal | - | *3A | Checksum |
| 3 | CRLF | character | - | - | Carriage return and line feed |

## 2.7.9 GNS

### 2.7.9.1 GNSS fix data

| ***Message*** | **NMEA-Standard-GNS**<br>**GNSS fix data** |
|---|---|
| *Type* | Output |
| *Comment* | Time and position, together with GNSS fixing-related data (number of satellites in use, and the resulting HDOP, age of differential data if in use, etc.).<br>☞ The output of this message is dependent on the currently selected datum (default: WGS84) |
| *Information* | *Class/ID:* 0xf0 0x0d *Number of fields:* 16 |
| *Structure* | `$xxGNS,time,lat,NS,lon,EW,posMode,numSV,HDOP,alt,sep,diffAge,diffStation,navStatus*cs\r\n` |
| *Examples* | `$GNGNS,103600.01,5114.51176,N,00012.29380,W,ANNN,07,1.18,111.5,45.6,,,V*00\r\n`<br>`$GNGNS,122310.2,3722.425671,N,12258.856215,W,DAAA,14,0.9,1005.543,6.5,,,V*0E\r\n`<br>`$GPGNS,122310.2,,,,,,07,,,,5.2,23,V*02\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | xxGNS | string | - | $GPGNS | GNS Message ID (xx = current Talker ID, see NMEA Talker IDs table) |
| 1 | time | hhmmss.ss | - | 091547.00 | UTC time. See the section UTC representation in the Integration manual for details. |
| 2 | lat | ddmm.mmmmm | - | 5114.50897 | Latitude (degrees and minutes), see format description |
| 3 | NS | character | - | N | North/South indicator |
| 4 | lon | dddmm.mmmmm | - | 00012.28663 | Longitude (degrees and minutes), see format description |
| 5 | EW | character | - | E | East/West indicator |

| | | | | | |
|---|---|---|---|---|---|
| 6 | posMode | character | - | AAAA | Positioning mode, see position fix flags description. First character for GPS, second character for GLONASS, third character for Galileo, fourth character for BeiDou |
| 7 | numSV | numeric | - | 10 | Number of satellites used (range: 0-99) |
| 8 | HDOP | numeric | - | 0.83 | Horizontal Dilution of Precision |
| 9 | alt | numeric | m | 111.1 | Altitude above mean sea level |
| 10 | sep | numeric | m | 45.6 | Geoid separation: difference between ellipsoid and mean sea level |
| 11 | diffAge | numeric | s | - | Age of differential corrections (null when DGPS is not used) |
| 12 | diffStation | numeric | - | - | ID of station providing differential corrections (null when DGPS is not used) |
| 13 | navStatus | character | - | V | Navigational status indicator: V (Equipment is not providing navigational status information, fixed field, only available in NMEA 4.10 and later) |
| 14 | cs | hexadecimal | - | *71 | Checksum |
| 15 | CRLF | character | - | - | Carriage return and line feed |

## 2.7.10 GPQ

### 2.7.10.1 Poll a standard message (Talker ID GP)

| ***Message*** | **NMEA-Standard-GPQ**<br>**Poll a standard message (Talker ID GP)** |
|---|---|
| *Type* | Poll request |
| *Comment* | Polls a standard NMEA message if the current Talker ID is GP |
| *Information* | *Class/ID:* 0xf0 0x40 *Number of fields:* 4 |
| *Structure* | $xxGPQ,msgId*cs\r\n |
| *Example* | $EIGPQ,RMC*3A\r\n |
| *Payload:* | |

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | xxGPQ | string | - | $EIGPQ | GPQ Message ID (xx = Talker ID of the device requesting the poll) |
| 1 | msgId | string | - | RMC | Message ID of the message to be polled |
| 2 | cs | hexadecimal | - | *3A | Checksum |
| 3 | CRLF | character | - | - | Carriage return and line feed |

## 2.7.11 GQQ

### 2.7.11.1 Poll a standard message (Talker ID GQ)

| ***Message*** | **NMEA-Standard-GQQ**<br>**Poll a standard message (Talker ID GQ)** |
|---|---|
| *Type* | Poll request |
| *Comment* | Polls a standard NMEA message if the current Talker ID is GQ |
| *Information* | *Class/ID:* 0xf0 0x47 *Number of fields:* 4 |
| *Structure* | $xxGQQ,msgId*cs\r\n |
| *Example* | $EIGQQ,RMC*3A\r\n |
| *Payload:* | |

| Field | Name | Format | Unit | Example | Description |
|---|---|---|---|---|---|
| 0 | xxGQQ | string | - | $EIGQQ | GQQ Message ID (xx = Talker ID of the device requesting the poll) |
| 1 | msgId | string | - | RMC | Message ID of the message to be polled |
| 2 | cs | hexadecimal | - | *3A | Checksum |
| 3 | CRLF | character | - | - | Carriage return and line feed |

## 2.7.12 GRS

### 2.7.12.1 GNSS range residuals

| ***Message*** | **NMEA-Standard-GRS**<br>**GNSS range residuals** |
|---|---|
| *Type* | Output |
| *Comment* | If less than 12 SVs are available, the remaining fields are output empty. If more than 12 SVs are used, only the residuals of the first 12 SVs are output, in order to remain consistent with the NMEA standard.<br>**In a multi-GNSS system this message will be output multiple times, once for each GNSS.**<br>☞ This message relates to associated GGA and GSA messages. |
| *Information* | *Class/ID:* 0xf0 0x06 *Number of fields:* 19 |
| *Structure* | `$xxGRS,time,mode{,residual},systemId,signalId*cs\r\n` |
| *Examples* | `$GNGRS,104148.00,1,2.6,2.2,-1.6,-1.1,-1.7,-1.5,5.8,1.7,,,,,1,1*52\r\n`<br>`$GNGRS,104148.00,1,,0.0,2.5,0.0,,2.8,,,,,,,1,5*52\r\n` |

*Payload:*

| Field | Name | Format | Unit | Example | Description |
|---|---|---|---|---|---|
| 0 | xxGRS | string | - | $GPGRS | GRS Message ID (xx = current Talker ID, see NMEA Talker IDs table) |
| 1 | time | hhmmss.ss | - | 082632.00 | UTC time of associated position fix. See the section UTC representation in the Integration manual for details. |
| 2 | mode | digit | - | 1 | Computation method used:<br>• 1 = Residuals were recomputed after the GGA position was computed (fixed) |
| *Start of repeated group (12 times)* | | | | | |
| 3 + n | residual | numeric | m | 0.54 | Range residuals for SVs used in navigation. The SV order matches the order from the GSA sentence |
| *End of repeated group (12 times)* | | | | | |
| 15 | systemId | numeric | - | 1 | NMEA-defined GNSS system ID, see Signal Identifiers table (only available in NMEA 4.10 and later) |
| 16 | signalId | numeric | - | - | NMEA-defined GNSS signal ID, see Signal Identifiers table (only available in NMEA 4.10 and later) |
| 17 | cs | hexadecimal | - | *70 | Checksum |
| 18 | CRLF | character | - | - | Carriage return and line feed |

## 2.7.13 GSA

### 2.7.13.1 GNSS DOP and active satellites

| ***Message*** | **NMEA-Standard-GSA**<br>**GNSS DOP and active satellites** |
|---|---|
| *Type* | Output |
| *Comment* | The GNSS receiver operating mode, satellites used for navigation, and DOP values. |

- If less than 12 SVs are used for navigation, the remaining fields are left empty. If more than 12 SVs are used for navigation, only the IDs of the first 12 are output.
- The SV numbers (fields 'svid') are in the range of 1 to 32 for GPS satellites, and 33 to 64 for SBAS satellites (33 = SBAS PRN 120, 34 = SBAS PRN 121, and so on)

**In a multi-GNSS system this message will be output multiple times, once for each GNSS.**

| | | | | | |
|---|---|---|---|---|---|
| *Information* | *Class/ID:* 0xf0 0x02 | | *Number of fields:* 21 | | |
| *Structure* | `$xxGSA,opMode,navMode{,svid},PDOP,HDOP,VDOP,systemId*cs\r\n` | | | | |
| *Example* | `$GPGSA,A,3,23,29,07,08,09,18,26,28,,,,,1.94,1.18,1.54,1*0D\r\n` | | | | |
| *Payload:* | | | | | |
| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
| 0 | `xxGSA` | string | - | $GPGSA | GSA Message ID (xx = current Talker ID, see NMEA Talker IDs table) |
| 1 | `opMode` | character | - | A | Operation mode:<br>• M = Manually set to operate in 2D or 3D mode<br>• A = Automatically switching between 2D or 3D mode |
| 2 | `navMode` | digit | - | 3 | Navigation mode, see position fix flags description |
| *Start of repeated group (12 times)* | | | | | |
| 3 + n | `svid` | numeric | - | 29 | Satellite number |
| *End of repeated group (12 times)* | | | | | |
| 15 | `PDOP` | numeric | - | 1.94 | Position dilution of precision |
| 16 | `HDOP` | numeric | - | 1.18 | Horizontal dilution of precision |
| 17 | `VDOP` | numeric | - | 1.54 | Vertical dilution of precision |
| 18 | `systemId` | numeric | - | 1 | NMEA-defined GNSS system ID, see Signal Identifiers table (only available in NMEA 4.10 and later) |
| 19 | `cs` | hexadecimal | - | *0D | Checksum |
| 20 | `CRLF` | character | - | - | Carriage return and line feed |

## 2.7.14 GST

### 2.7.14.1 GNSS pseudorange error statistics

| ***Message*** | **NMEA-Standard-GST**<br>**GNSS pseudorange error statistics** | | | | |
|---|---|---|---|---|---|
| *Type* | Output | | | | |
| *Comment* | This message reports statistical information on the quality of the position solution. | | | | |
| *Information* | *Class/ID:* 0xf0 0x07 | | *Number of fields:* 11 | | |
| *Structure* | `$xxGST,time,rangeRms,stdMajor,stdMinor,orient,stdLat,stdLong,stdAlt*cs\r\n` | | | | |
| *Example* | `$GPGST,082356.00,1.8,,,,1.7,1.3,2.2*7E\r\n` | | | | |
| *Payload:* | | | | | |
| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
| 0 | `xxGST` | string | - | $GPGST | GST Message ID (xx = current Talker ID, see NMEA Talker IDs table) |
| 1 | `time` | hhmmss.ss | - | 082356.00 | UTC time of associated position fix. See the section UTC representation in the Integration manual for details. |
| 2 | `rangeRms` | numeric | m | 1.8 | RMS value of the standard deviation of the ranges |
| 3 | `stdMajor` | numeric | m | - | Standard deviation of semi-major axis |
| 4 | `stdMinor` | numeric | m | - | Standard deviation of semi-minor axis |

| | | | | | |
|---|---|---|---|---|---|
| 5 | orient | numeric | deg | - | Orientation of semi-major axis |
| 6 | stdLat | numeric | m | 1.7 | Standard deviation of latitude error |
| 7 | stdLong | numeric | m | 1.3 | Standard deviation of longitude error |
| 8 | stdAlt | numeric | m | 2.2 | Standard deviation of altitude error |
| 9 | cs | hexadecimal | - | *7E | Checksum |
| 10 | CRLF | character | - | - | Carriage return and line feed |

## 2.7.15 GSV

### 2.7.15.1 GNSS satellites in view

| ***Message*** | **NMEA-Standard-GSV**<br>**GNSS satellites in view** |
|---|---|
| *Type* | Output |
| *Comment* | The number of satellites in view, together with each SV ID, elevation azimuth, and signal strength (C/No) value. Only four satellite details are transmitted in one message.<br>**In a multi-GNSS system sets of GSV messages will be output multiple times, one set for each GNSS.** |
| *Information* | *Class/ID:* 0xf0 0x03 *Number of fields:* 7 + [1..4]·4 |
| *Structure* | `$xxGSV,numMsg,msgNum,numSV{,svid,elv,az,cno},signalId*cs\r\n` |
| *Examples* | `$GPGSV,3,1,09,09,,,17,10,,,40,12,,,49,13,,,35,1*6F\r\n`<br>`$GPGSV,3,2,09,15,,,44,17,,,45,19,,,44,24,,,50,1*64\r\n`<br>`$GPGSV,3,3,09,25,,,40,1*6E\r\n`<br>`$GPGSV,1,1,03,12,,,42,24,,,47,32,,,37,5*66\r\n`<br>`$GAGSV,1,1,00,2*76\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | xxGSV | string | - | $GPGSV | GSV Message ID (xx = GSV Talker ID, see NMEA Talker IDs table). Talker ID GN shall not be used. |
| 1 | numMsg | digit | - | 3 | Number of messages, total number of GSV messages being output (range: 1-9) |
| 2 | msgNum | digit | - | 1 | Number of this message (range: 1-numMsg) |
| 3 | numSV | numeric | - | 10 | Number of known satellites in view regarding both the talker ID and the signalId |
| *Start of repeated group (1...4 times)* | | | | | |
| 4 + n·4 | svid | numeric | - | 23 | Satellite ID |
| 5 + n·4 | elv | numeric | deg | 38 | Elevation (range: 0-90) |
| 6 + n·4 | az | numeric | deg | 230 | Azimuth (range: 0-359) |
| 7 + n·4 | cno | numeric | dBHz | 44 | Signal strength (C/N0, range: 0-99), null when not tracking |
| *End of repeated group (1...4 times)* | | | | | |
| 4 + N·4 | signalId | numeric | - | - | NMEA-defined GNSS signal ID, see Signal Identifiers table (only available in NMEA 4.10 and later) |
| 5 + N·4 | cs | hexadecimal | - | *7F | Checksum |
| 6 + N·4 | CRLF | character | - | - | Carriage return and line feed |

## 2.7.16 RLM

### 2.7.16.1 Return link message (RLM)

| ***Message*** | **NMEA-Standard-RLM**<br>**Return link message (RLM)** |
|---|---|
| *Type* | Output |
| *Comment* | The RLM sentence is used to transfer a Return link message from a Cospas-Sarsat recognized Return link service provider (RLSP).<br>The RLM sentence supports communications to an emitting beacon once a distress alert has been detected, located and confirmed. The communications may include acknowledgement of the alert to the emitting beacon as well as optional text messages, and may also include remote beacon configuration and testing. |
| *Information* | *Class/ID:* 0xf0 0x0b *Number of fields:* 7 |
| *Structure* | `$xxRLM,beacon,time,code,body*cs\r\n` |
| *Examples* | `$GARLM,00000078A9FBAD5,083559.00,3,C45B*57\r\n`<br>`$GARLM,F7129D41BC6A78C,034433.02,3,B63CA732AFD419D2*57\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | `xxRLM` | string | - | $GARLM | RLM message ID (xx = current Talker ID, see NMEA Talker IDs table) |
| 1 | `beacon` | hexadecimal | - | 00000078A9FBAD5 | Beacon ID, identifies beacon intended to receive this message (fixed length 15 hexadecimal character field) |
| 2 | `time` | hhmmss.ss | - | 083559.00 | Time of reception field to indicate RLM timestamp in UTC. See the section UTC representation in the Integration manual for details. |
| 3 | `code` | character | - | 3 | Message code field to identify type of RLM Message Service:<br>• 0 = Reserved for future RLM services<br>• 1 = Acknowledgement service RLM<br>• 2 = Command service RLM<br>• 3 = Message service RLM<br>• 4-E = Reserved for future RLM services<br>• F = Test service RLM (currently used only by the Galileo program) |
| 4 | `body` | hexadecimal | - | C45B | Message body encapsulates the data parameters provided by the RLSP into hexadecimal format. |
| 5 | `cs` | hexadecimal | - | *57 | Checksum |
| 6 | `CRLF` | character | - | - | Carriage return and line feed |

## 2.7.17 RMC

### 2.7.17.1 Recommended minimum data

| ***Message*** | **NMEA-Standard-RMC**<br>**Recommended minimum data** |
|---|---|
| *Type* | Output |
| *Comment* | The recommended minimum sentence defined by NMEA for GNSS system data.<br>☞ The output of this message is dependent on the currently selected datum (default: WGS84) |
| *Information* | *Class/ID:* 0xf0 0x04 *Number of fields:* 16 |
| *Structure* | `$xxRMC,time,status,lat,NS,lon,EW,spd,cog,date,mv,mvEW,posMode,navStatus*cs\r\n` |
| *Example* | `$GPRMC,083559.00,A,4717.11437,N,00833.91522,E,0.004,77.52,091202,,,A,V*57\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 0 | xxRMC | string | - | $GPRMC | RMC Message ID (xx = current Talker ID, see NMEA Talker IDs table) |
| 1 | time | hhmmss.ss | - | 083559.00 | UTC time. See the section UTC representation in the Integration manual for details. |
| 2 | status | character | - | A | Data validity status, see position fix flags description |
| 3 | lat | ddmm.mmmmm | - | 4717.11437 | Latitude (degrees and minutes), see format description |
| 4 | NS | character | - | N | North/South indicator |
| 5 | lon | dddmm.mmmmm | - | 00833.91522 | Longitude (degrees and minutes), see format description |
| 6 | EW | character | - | E | East/West indicator |
| 7 | spd | numeric | knots | 0.004 | Speed over ground |
| 8 | cog | numeric | deg | 77.52 | Course over ground |
| 9 | date | ddmmyy | - | 091202 | Date in day, month, year format. See the section UTC representation in the Integration manual for details. |
| 10 | mv | numeric | deg | - | Magnetic variation value |
| 11 | mvEW | character | - | - | Magnetic variation E/W indicator |
| 12 | posMode | character | - | A | Mode Indicator, see position fix flags description (only available in NMEA 2.3 and later) |
| 13 | navStatus | character | - | V | Navigational status indicator: V (Equipment is not providing navigational status information, fixed field, only available in NMEA 4.10 and later) |
| 14 | cs | hexadecimal | - | *57 | Checksum |
| 15 | CRLF | character | - | - | Carriage return and line feed |

## 2.7.18 TXT

### 2.7.18.1 Text transmission

| ***Message*** | **NMEA-Standard-TXT**<br>**Text transmission** |
|---|---|
| *Type* | Output |
| *Comment* | This message outputs various information on the receiver, such as power-up screen, software version etc. This message can be configured using the CFG-INFMSG configuration group. |
| *Information* | *Class/ID:* 0xf0 0x41 *Number of fields:* 7 |
| *Structure* | `$xxTXT,numMsg,msgNum,msgType,text*cs\r\n` |
| *Examples* | `$GPTXT,01,01,02,u-blox ag - www.u-blox.com*50\r\n`<br>`$GPTXT,01,01,02,ANTARIS ATR0620 HW 00000040*67\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | xxTXT | string | - | $GPTXT | TXT Message ID (xx = current Talker ID, see NMEA Talker IDs table) |
| 1 | numMsg | numeric | - | 01 | Total number of messages in this transmission (range: 1-99) |
| 2 | msgNum | numeric | - | 01 | Message number in this transmission (range: 1-numMsg) |

| | | | | | |
|---|---|---|---|---|---|
| 3 | msgType | numeric | - | 02 | Text identifier (u-blox receivers specify the type of the message with this number):<br>• 00 = Error<br>• 01 = Warning<br>• 02 = Notice<br>• 07 = User |
| 4 | text | string | - | www.u-blox.com | Any ASCII text |
| 5 | cs | hexadecimal | - | *67 | Checksum |
| 6 | CRLF | character | - | - | Carriage return and line feed |

## 2.7.19 VLW

### 2.7.19.1 Dual ground/water distance

| ***Message*** | **NMEA-Standard-VLW**<br>**Dual ground/water distance** |
|---|---|
| *Type* | Output |
| *Comment* | The distance traveled, relative to the water and over the ground. This message relates to the odometer feature detailed in the Integration manual. |
| *Information* | *Class/ID:* 0xf0 0x0f *Number of fields:* 11 |
| *Structure* | `$xxVLW,twd,twdUnit,wd,wdUnit,tgd,tgdUnit,gd,gdUnit*cs\r\n` |
| *Example* | `$GPVLW,,N,,N,15.8,N,1.2,N*06\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | xxVLW | string | - | $GPVLW | VLW Message ID (xx = current Talker ID, see NMEA Talker IDs table) |
| 1 | twd | numeric | nmi | - | Total cumulative water distance: null (fixed field) |
| 2 | twdUnit | character | - | N | Total cumulative water distance units: N (nautical miles, fixed field) |
| 3 | wd | numeric | nmi | - | Water distance since reset: null (fixed field) |
| 4 | wdUnit | character | - | N | Water distance since reset units: N (nautical miles, fixed field) |
| 5 | tgd | numeric | nmi | 15.8 | Total cumulative ground distance (only available in NMEA 4.00 and later) |
| 6 | tgdUnit | character | - | N | Total cumulative ground distance units: N (nautical miles, fixed field, only available in NMEA 4.00 and later) |
| 7 | gd | numeric | nmi | 1.2 | Ground distance since reset (only available in NMEA 4.00 and later) |
| 8 | gdUnit | character | - | N | Ground distance since reset units: N (nautical miles, fixed field, only available in NMEA 4.00 and later) |
| 9 | cs | hexadecimal | - | *06 | Checksum |
| 10 | CRLF | character | - | - | Carriage return and line feed |

## 2.7.20 VTG

### 2.7.20.1 Course over ground and ground speed

| ***Message*** | **NMEA-Standard-VTG**<br>**Course over ground and ground speed** |
|---|---|
| *Type* | Output |
| *Comment* | Velocity is given as course over ground (COG) and speed over ground (SOG). |
| *Information* | *Class/ID:* 0xf0 0x05 *Number of fields:* 12 |
| *Structure* | `$xxVTG,cogt,cogtUnit,cogm,cogmUnit,sogn,sognUnit,sogk,sogkUnit,posMode*cs\r\n` |
| *Example* | `$GPVTG,77.52,T,,M,0.004,N,0.008,K,A*06\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | `xxVTG` | string | - | $GPVTG | VTG Message ID (xx = current Talker ID, see NMEA Talker IDs table) |
| 1 | `cogt` | numeric | degrees | 77.52 | Course over ground (true) |
| 2 | `cogtUnit` | character | - | T | Course over ground units: T (degrees true, fixed field) |
| 3 | `cogm` | numeric | degrees | - | Course over ground (magnetic) |
| 4 | `cogmUnit` | character | - | M | Course over ground units: M (degrees magnetic, fixed field) |
| 5 | `sogn` | numeric | knots | 0.004 | Speed over ground |
| 6 | `sognUnit` | character | - | N | Speed over ground units: N (knots, fixed field) |
| 7 | `sogk` | numeric | km/h | 0.008 | Speed over ground |
| 8 | `sogkUnit` | character | - | K | Speed over ground units: K (kilometers per hour, fixed field) |
| 9 | `posMode` | character | - | A | Mode indicator, see position fix flags description (only available in NMEA 2.3 and later) |
| 10 | `cs` | hexadecimal | - | *06 | Checksum |
| 11 | `CRLF` | character | - | - | Carriage return and line feed |

## 2.7.21 ZDA

### 2.7.21.1 Time and date

| ***Message*** | **NMEA-Standard-ZDA**<br>**Time and date** |
|---|---|
| *Type* | Output |
| *Comment* | UTC, day, month, year and local time zone. |
| *Information* | *Class/ID:* 0xf0 0x08 *Number of fields:* 9 |
| *Structure* | `$xxZDA,time,day,month,year,ltzh,ltzn*cs\r\n` |
| *Example* | `$GPZDA,082710.00,16,09,2002,00,00*64\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | `xxZDA` | string | - | $GPZDA | ZDA Message ID (xx = current Talker ID, see NMEA Talker IDs table) |
| 1 | `time` | hhmmss.ss | - | 082710.00 | UTC Time. See the section UTC representation in the Integration manual for details. |
| 2 | `day` | dd | day | 16 | UTC day (range: 1-31) |
| 3 | `month` | mm | month | 09 | UTC month (range: 1-12) |
| 4 | `year` | yyyy | year | 2002 | UTC year |

| | | | | | |
|---|---|---|---|---|---|
| 5 | ltzh | xx | - | 00 | Local time zone hours (fixed field, always 00) |
| 6 | ltzn | zz | - | 00 | Local time zone minutes (fixed field, always 00) |
| 7 | cs | hexadecimal | - | *64 | Checksum |
| 8 | CRLF | character | - | - | Carriage return and line feed |

# 2.8 PUBX messages

Proprietary NMEA messages for u-blox positioning receivers. See also NMEA-proprietary messages.

## 2.8.1 CONFIG (PUBX,41)

### 2.8.1.1 Set protocols and baud rate

| ***Message*** | **NMEA-PUBX-CONFIG**<br>**Set protocols and baud rate** |
|---|---|
| *Type* | Set |
| *Comment* | |
| *Information* | *Class/ID:* 0xf1 0x41 *Number of fields:* 9 |
| *Structure* | $PUBX,41,portId,inProto,outProto,baudrate,autobauding*cs\r\n |
| *Example* | $PUBX,41,1,0007,0003,19200,0*25\r\n |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | PUBX | string | - | $PUBX | Message ID, UBX protocol header, proprietary sentence |
| 1 | msgId | numeric | - | 41 | Proprietary message identifier |
| 2 | portId | numeric | - | 1 | ID of communication port. See the section Communication ports in the Integration manual for details. |
| 3 | inProto | hexadecimal | - | 0007 | Input protocol mask. Bitmask, specifying which protocols(s) are allowed for input. See the section Communication ports in the Integration manual for details. |
| 4 | outProto | hexadecimal | - | 0003 | Output protocol mask. Bitmask, specifying which protocols(s) are allowed for input. See the section Communication ports in the Integration manual for details. |
| 5 | baudrate | numeric | bits/s | 19200 | Baud rate |
| 6 | autobauding | numeric | - | - | Autobauding: 1=enable, 0=disable (not supported on u-blox 5, set to 0) |
| 7 | cs | hexadecimal | - | *25 | Checksum |
| 8 | CRLF | character | - | - | Carriage return and line feed |

## 2.8.2 POSITION (PUBX,00)

### 2.8.2.1 Poll a PUBX,00 message

| ***Message*** | **NMEA-PUBX-POSITION**<br>**Poll a PUBX,00 message** |
|---|---|
| *Type* | Poll request |
| *Comment* | A PUBX,00 message is polled by sending the PUBX,00 message without any data fields. |
| *Information* | *Class/ID:* 0xf1 0x00 *Number of fields:* 4 |

| | |
|---|---|
| *Structure* | `$PUBX,00*33\r\n` |
| *Example* | `$PUBX,00*33\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | `PUBX` | string | - | $PUBX | Message ID, UBX protocol header, proprietary sentence |
| 1 | `msgId` | numeric | - | 00 | Set to 00 to poll a PUBX,00 message |
| 2 | `cs` | hexadecimal | - | *33 | Checksum |
| 3 | `CRLF` | character | - | - | Carriage return and line feed |

### 2.8.2.2 Lat/Long position data

| ***Message*** | **NMEA-PUBX-POSITION**<br>**Lat/Long position data** |
|---|---|
| *Type* | Output |
| *Comment* | This message contains position solution data. The datum selection may be changed using the message UBX-CFG-DAT.<br>☞ The output of this message is dependent on the currently selected datum (default: WGS84). |
| *Information* | *Class/ID:* 0xf1 0x00 *Number of fields:* 23 |
| *Structure* | `$PUBX,00,time,lat,NS,long,EW,altRef,navStat,hAcc,vAcc,SOG,COG,vVel,diffAge,HDOP,VDOP ↲ ,TDOP,numSvs,reserved,DR,*cs\r\n` |
| *Example* | `$PUBX,00,081350.00,4717.113210,N,00833.915187,E,546.589,G3,2.1,2.0,0.007,77.52,0.007 ↲ ,,0.92,1.19,0.77,9,0,0*5F\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | `PUBX` | string | - | $PUBX | Message ID, UBX protocol header, proprietary sentence |
| 1 | `msgId` | numeric | - | 00 | Proprietary message identifier: 00 |
| 2 | `time` | hhmmss.ss | - | 081350.00 | UTC time. See the section UTC representation in the Integration manual for details. |
| 3 | `lat` | ddmm.mmmmm | - | 4717.113210 | Latitude (degrees and minutes), see format description |
| 4 | `NS` | character | - | N | North/South Indicator |
| 5 | `long` | dddmm.mmmmm | - | 00833.915187 | Longitude (degrees and minutes), see format description |
| 6 | `EW` | character | - | E | East/West indicator |
| 7 | `altRef` | numeric | m | 546.589 | Altitude above user datum ellipsoid |
| 8 | `navStat` | string | - | G3 | Navigation Status:<br>• NF = No Fix<br>• DR = Dead reckoning only solution<br>• G2 = Stand alone 2D solution<br>• G3 = Stand alone 3D solution<br>• D2 = Differential 2D solution<br>• D3 = Differential 3D solution<br>• RK = Combined GPS + dead reckoning solution<br>• TT = Time only solution |
| 9 | `hAcc` | numeric | m | 2.1 | Horizontal accuracy estimate |
| 10 | `vAcc` | numeric | m | 2.0 | Vertical accuracy estimate |
| 11 | `SOG` | numeric | km/h | 0.007 | Speed over ground |
| 12 | `COG` | numeric | deg | 77.52 | Course over ground |
| 13 | `vVel` | numeric | m/s | 0.007 | Vertical velocity (positive downwards) |

| | | | | | |
|---|---|---|---|---|---|
| 14 | diffAge | numeric | s | - | Age of differential corrections (blank when DGPS is not used) |
| 15 | HDOP | numeric | - | 0.92 | HDOP, Horizontal Dilution of Precision |
| 16 | VDOP | numeric | - | 1.19 | VDOP, Vertical Dilution of Precision |
| 17 | TDOP | numeric | - | 0.77 | TDOP, Time Dilution of Precision |
| 18 | numSvs | numeric | - | 9 | Number of satellites used in the navigation solution |
| 19 | reserved | numeric | - | - | Reserved, always set to 0 |
| 20 | DR | numeric | - | - | DR used |
| 21 | cs | hexadecimal | - | *5B | Checksum |
| 22 | CRLF | character | - | - | Carriage return and line feed |

## 2.8.3 RATE (PUBX,40)

### 2.8.3.1 Set NMEA message output rate

| ***Message*** | **NMEA-PUBX-RATE**<br>**Set NMEA message output rate** |
|---|---|
| *Type* | Set |
| *Comment* | Set/Get message rate configuration (s) to/from the receiver.<br>• Send rate is relative to the event a message is registered on. For example, if the rate of a navigation message is set to 2, the message is sent every second navigation solution. |
| *Information* | *Class/ID:* 0xf1 0x40 *Number of fields:* 11 |
| *Structure* | `$PUBX,40,msgId,rddc,rus1,rus2,rusb,rspi,reserved*cs\r\n` |
| *Example* | `$PUBX,40,GLL,1,0,0,0,0*5D\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | PUBX | string | - | $PUBX | Message ID, UBX protocol header, proprietary sentence |
| 1 | ID | numeric | - | 40 | Proprietary message identifier |
| 2 | msgId | string | - | GLL | NMEA message identifier |
| 3 | rddc | numeric | cycles | 1 | output rate on DDC<br>• 0 disables that message from being output on this port<br>• 1 means that this message is output every epoch |
| 4 | rus1 | numeric | cycles | 1 | output rate on USART 1<br>• 0 disables that message from being output on this port<br>• 1 means that this message is output every epoch |
| 5 | rus2 | numeric | cycles | 1 | output rate on USART 2<br>• 0 disables that message from being output on this port<br>• 1 means that this message is output every epoch |
| 6 | rusb | numeric | cycles | 1 | output rate on USB<br>• 0 disables that message from being output on this port<br>• 1 means that this message is output every epoch |
| 7 | rspi | numeric | cycles | 1 | output rate on SPI<br>• 0 disables that message from being output on this port<br>• 1 means that this message is output every epoch |

| | | | | | |
|---|---|---|---|---|---|
| 8 | reserved | numeric | - | - | Reserved: always fill with 0 |
| 9 | cs | hexadecimal | - | *5D | Checksum |
| 10 | CRLF | character | - | - | Carriage return and line feed |

## 2.8.4 SVSTATUS (PUBX,03)

### 2.8.4.1 Poll a PUBX,03 message

| ***Message*** | **NMEA-PUBX-SVSTATUS**<br>**Poll a PUBX,03 message** |
|---|---|
| *Type* | Poll request |
| *Comment* | A PUBX,03 message is polled by sending the PUBX,03 message without any data fields. |
| *Information* | *Class/ID:* 0xf1 0x03 *Number of fields:* 4 |
| *Structure* | $PUBX,03*30\r\n |
| *Example* | $PUBX,03*30\r\n |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | PUBX | string | - | $PUBX | Message ID, UBX protocol header, proprietary sentence |
| 1 | msgId | numeric | - | 03 | Set to 03 to poll a PUBX,03 message |
| 2 | cs | hexadecimal | - | *30 | Checksum |
| 3 | CRLF | character | - | - | Carriage return and line feed |

### 2.8.4.2 Satellite status

| ***Message*** | **NMEA-PUBX-SVSTATUS**<br>**Satellite status** |
|---|---|
| *Type* | Output |
| *Comment* | The PUBX,03 message contains satellite status information. |
| *Information* | *Class/ID:* 0xf1 0x03 *Number of fields:* 5 + n·6 |
| *Structure* | $PUBX,03,GT{,sv,s,az,el,cno,lck},*cs\r\n |
| *Example* | $PUBX,03,11,23,-,,,45,010,29,-,,,46,013,07,-,,,42,015,08,U,067,31,42,025,10,U,195,33 ↲<br>,46,026,18,U,326,08,39,026,17,-,,,32,015,26,U,306,66,48,025,27,U,073,10,36,026,28,U, ↲<br>089,61,46,024,15,-,,,39,014*0D\r\n |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | PUBX | string | - | $PUBX | Message ID, UBX protocol header, proprietary sentence |
| 1 | msgId | numeric | - | 03 | Proprietary message identifier: 03 |
| 2 | n | numeric | - | 11 | Number of GNSS satellites tracked |
| *Start of repeated group (n times)* | | | | | |
| 3 + n·6 | sv | numeric | - | 23 | Satellite ID according to UBX svId mapping (see Satellite Numbering) |
| 4 + n·6 | s | character | - | - | Satellite status:<br>• - = Not used<br>• U = Used in solution<br>• e = Ephemeris available, but not used for navigation |
| 5 + n·6 | az | numeric | deg | - | Satellite azimuth (range: 0-359) |
| 6 + n·6 | el | numeric | deg | - | Satellite elevation (range: 0-90) |

| | | | | | |
|---|---|---|---|---|---|
| 7 + n·6 | cno | numeric | dBHz | 45 | Signal strength (C/N0, range 0-99), blank when not tracking |
| 8 + n·6 | lck | numeric | s | 010 | Satellite carrier lock time (range: 0-64)<br>• 0 = code lock only<br>• 64 = lock for 64 seconds or more |
| *End of repeated group (n times)* | | | | | |
| 3 + n·6 | cs | hexadecimal | - | *0D | Checksum |
| 4 + n·6 | CRLF | character | - | - | Carriage return and line feed |

## 2.8.5 TIME (PUBX,04)

### 2.8.5.1 Poll a PUBX,04 message

| ***Message*** | **NMEA-PUBX-TIME**<br>**Poll a PUBX,04 message** |
|---|---|
| *Type* | Poll request |
| *Comment* | A PUBX,04 message is polled by sending the PUBX,04 message without any data fields. |
| *Information* | *Class/ID:* 0xf1 0x04 *Number of fields:* 4 |
| *Structure* | `$PUBX,04*37\r\n` |
| *Example* | `$PUBX,04*37\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | PUBX | string | - | $PUBX | Message ID, UBX protocol header, proprietary sentence |
| 1 | msgId | numeric | - | 04 | Set to 04 to poll a PUBX,04 message |
| 2 | cs | hexadecimal | - | *37 | Checksum |
| 3 | CRLF | character | - | - | Carriage return and line feed |

### 2.8.5.2 Time of day and clock information

| ***Message*** | **NMEA-PUBX-TIME**<br>**Time of day and clock information** |
|---|---|
| *Type* | Output |
| *Comment* | |
| *Information* | *Class/ID:* 0xf1 0x04 *Number of fields:* 12 |
| *Structure* | `$PUBX,04,time,date,utcTow,utcWk,leapSec,clkBias,clkDrift,tpGran,*cs\r\n` |
| *Example* | `$PUBX,04,073731.00,091202,113851.00,1196,15D,1930035,-2660.664,43,*3C\r\n` |

*Payload:*

| *Field* | *Name* | *Format* | *Unit* | *Example* | *Description* |
|---|---|---|---|---|---|
| 0 | PUBX | string | - | $PUBX | Message ID, UBX protocol header, proprietary sentence |
| 1 | msgId | numeric | - | 04 | Proprietary message identifier: 04 |
| 2 | time | hhmmss.ss | - | 073731.00 | UTC time. See the section UTC representation in the Integration manual for details. |
| 3 | date | ddmmyy | - | 091202 | UTC date, day, month, year. See the section UTC representation in the Integration manual for details. |
| 4 | utcTow | numeric | s | 113851.00 | UTC time of week |
| 5 | utcWk | numeric | - | 1196 | UTC week number, continues beyond 1023 |

| | | | | | |
|---|---|---|---|---|---|
| 6 | leapSec | numeric/ text | s | 15D | Leap seconds (not supported for protocol versions less than 13.01)<br>The number is marked with a *D* if the value is the firmware default value. If the value is not marked it has been received from a satellite. |
| 7 | clkBias | numeric | ns | 1930035 | Receiver clock bias |
| 8 | clkDrift | numeric | ns/s | -2660.664 | Receiver clock drift |
| 9 | tpGran | numeric | ns | 43 | Time pulse granularity, the quantization error of the TIMEPULSE pin |
| 10 | cs | hexadecimal | - | *3C | Checksum |
| 11 | CRLF | character | - | - | Carriage return and line feed |

# 3 UBX protocol

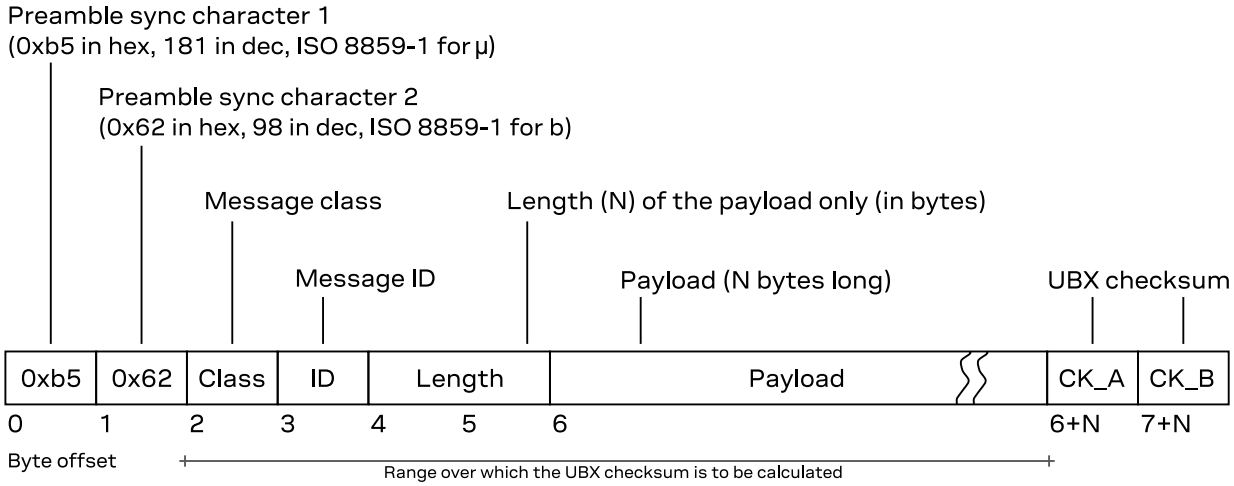
## 3.1 UBX protocol key features

u-blox receivers support a u-blox-proprietary protocol to communicate with a host computer. This protocol has the following key features:

- Compact – uses 8-bit binary data.
- Checksum protected – uses a low-overhead checksum algorithm
- Modular – uses a two-stage message identifier (Class and Message ID)

## 3.2 UBX frame structure

The structure of a basic UBX frame is shown in the following diagram.




- Every *frame* starts with a 2-byte *preamble* consisting of two synchronization characters: `0xb5` and `0x62`.
- A 1-byte *message class* field follows. A class is a group of messages that are related to each other.
- A 1-byte *message ID* field defines the message that is to follow.
- A 2-byte *length* field follows. The length is defined as being that of the payload only. It does not include the preamble, message class, message ID, length, or UBX checksum fields. The number format of the length field is an unsigned little-endian 16-bit integer (a "U2" in UBX data types).
- The *payload* field contains a variable number (= *length*) of bytes.
- The two 1-byte *CK_A* and *CK_B* fields hold a 16-bit checksum whose calculation is defined in UBX checksum section. This concludes the frame.

## 3.3 UBX payload definition rules

This section contains the rules and guidelines for UBX message payloads. See also UBX message example.

### 3.3.1 UBX structure packing

Values are placed in such an order that structure packing is not a problem. This means that two-byte values shall start on offsets that are a multiple of two; four-byte values shall start at a multiple of four; and so on.

### 3.3.2 UBX reserved elements

Some messages contain reserved fields or bits to allow for future expansion. The contents of these elements should be ignored in output messages and must be set to zero in input messages. Where a message is output and subsequently returned to the receiver as an input message, reserved elements can either be explicitly set to zero or left with whatever value they were output with.

For fields in a bitfield the same rules apply. Note that bits not described are automatically reserved and are not explicitly stated (see UBX message example).

### 3.3.3 UBX undefined values

The description of some fields provide specific meanings for specific values. For example, the field `gnssId` appears in many UBX messages and uses 0 to indicate GPS, 1 for SBAS and so on (see GNSS identifiers for details); however it is usually stored in a byte with far more possible values than the handful currently defined. All such undefined values are reserved for future expansion and therefore should not be used.

### 3.3.4 UBX conditional values

Some UBX messages use validity flag fields to indicate whether the values of some value fields are valid. For example the UBX-NAV-PVT message has the `validDate` and `validTime` fields that indicate whether the date (`year`, `month` and `day` fields), and, respectively, the time (`hour`, `min` and `sec` fields) are valid. This means that these value fields will only contain meaningful data if the corresponding flag field is set (has the value 1).

### 3.3.5 UBX data types

The following data types (number formats) are defined.

| Name | Type | Size (Bytes) | Range | Resolution |
|---|---|---|---|---|
| U1 | unsigned 8-bit integer | 1 | $0...2^8-1$ | 1 |
| I1 | signed 8-bit integer, two's complement | 1 | $-2^7...2^7-1$ | 1 |
| X1 | 8-bit bitfield | 1 | n/a | n/a |
| U2 | unsigned little-endian 116-bit integer | 2 | $0...2^{16}-1$ | 1 |
| I2 | signed little-endian 16-bit integer, two's complement | 2 | $-2^{15}...2^{15}-1$ | 1 |
| X2 | 16-bit little-endian bitfield | 2 | n/a | n/a |
| U4 | unsigned little-endian 32-bit integer | 4 | $0...2^{32}-1$ | 1 |
| I4 | signed little-endian 32-bit integer, two's complement | 4 | $-2^{31}...2^{31}-1$ | 1 |
| X4 | 32-bit little-endian bitfield | 4 | n/a | n/a |

| Name | Type | Size (Bytes) | Range | Resolution |
|---|---|---|---|---|
| R4 | IEEE 754 single (32-bit) precision | 4 | $-2^{127}...2^{127}$ | ~ value·$2^{-24}$ |
| R8 | IEEE 754 double (64-bit) precision | 8 | $-2^{1023}...2^{1023}$ | ~ value·$2^{-53}$ |
| CH | ASCII / ISO 8859-1 char (8-bit) | 1 | n/a | n/a |
| $U_{:n}$ | unsigned bitfield value of *n* bits width | var. | variable | variable |
| $I_{:n}$ | signed (two's complement) bitfield value of *n* bits width | var. | variable | variable |
| $S_{:n}$ | signed bitfield value of *n* bits width, in sign (most significant bit) and magnitude (remaining bits) notation | var. | variable | variable |

### 3.3.6 UBX fields scale and unit

Fields in UBX messages can have a unit defined. Whenever possible, SI units and symbols are used (e.g. "m" for meters, "s" for seconds). For civil (UTC) time representation units of years (y), months (month), days (d), hours (h), minutes (min) and seconds (s) are used.

Fields in UBX messages can have a scale factor defined. Unity (factor 1) is assumed if no scale is specified. For integer type fields this is often combined with a unit. When a scale is combined with a unit, the scale represents the smallest storage unit. For example, if meters (m) are expressed (stored) in centimeters the scale would be 0.01 (or 1e-2). This is equivalent of specifying a unit of centimeters (cm) and no scale.

### 3.3.7 UBX repeated fields

There are two types of repetitions in UBX messages. The first type specifies that a single field is repeated a constant number of times. This repetition is defined in the type of the field. For example, the UBX message example can specify a field `data` of type *U1[5]*. In this case the `data` field should be interpreted as an array of five U1 values.

The second type of repetition in messages is referred to as *repeated groups*, which groups one or more fields into a block of payload data. There are several types of repetition:

- The number of repetitions of *variable-by-field group* is indicated by another, earlier field in the same message. The number of repetitions can be zero or more, depending on the value of the referenced field.
- A *constant group* has a constant number of repetitions.
- An *optional group* is repeated zero or one times, depending on the available payload data. That is, the fields are present in the message only if the payload of the message is large enough to cover the whole group of fields.
- The number of repetitions of a *variable-by-size* group is given by the available payload size. The group will repeat until there is not enough payload data left to cover the whole group of fields another time.

Note that only some combinations of repeated groups of fields are possible in a single message. See also UBX payload decoding.

### 3.3.8 UBX payload decoding

UBX message payloads are designed so that the data (fields) can be extracted by a single pass through the payload from start to end. Fixed-size messages are the trivial case where the offset of all fields is unambiguously defined. Variable-size messages have variable number of repetitions of one or multiple groups of fields. For groups where the number of repetitions is given by the value of another field, that field can always be found at a fixed offset in the message payload before the respective group of fields. Groups whose number of repetitions depend on the payload size can only

be the last group of fields in a message and only one such group may exist in a message. See also UBX repeated fields.

## 3.4 UBX checksum

The checksum is calculated over the message, starting and including the class field up until, but excluding, the checksum fields (see the figure UBX frame structure).

The checksum algorithm used is the 8-bit Fletcher algorithm, which is used in the TCP standard RFC 1145). This algorithm works as follows:

- `Buffer[N]` is an array of bytes that contains the data over which the checksum is to be calculated.
- The two `CK_A` and `CK_A` values are 8-bit unsigned integers, only! If implementing with larger-sized integer values, make sure to mask both `CK_A` and `CK_B` with the value `0xff` after both operations in the loop.
- After the loop, the two *U1* values contain the checksum, transmitted after the message payload, which concludes the frame.

```
1 CK_A = 0, CK_B = 0
2 For (I = 0; I < N; I++)
3 {
4     CK_A = CK_A + Buffer[I]
5     CK_B = CK_B + CK_A
6 }
```

## 3.5 UBX message flow

There are certain features associated with the messages being sent back and forth:

### 3.5.1 UBX acknowledgement

When messages from the class CFG are sent to the receiver, the receiver will send an "acknowledge" (UBX-ACK-ACK) or a "not acknowledge" (UBX-ACK-NAK) message back to the sender, depending on whether or not the message was processed correctly.

Some messages from other classes also use the same acknowledgement mechanism.

### 3.5.2 UBX polling mechanism

All messages that are output by the receiver in a periodic manner (i.e. messages in classes UBX-MON, UBX-NAV and UBX-RXM) and Get/Set type messages, such as the configuration messages in the UBX-CFG class, can also be polled.

The UBX protocol is designed so that messages can be polled by sending the message required to the receiver but without a payload (or with just a single parameter that identifies the poll request). The receiver then responds with the same message with the payload populated.

## 3.6 GNSS, satellite and signal numbering

See GNSS, satellite and signal identifiers for details on how GNSS, satellites and signals are numbered in the UBX protocol.

## 3.7 UBX message example

This is an example of the definition of UBX messages as shown in the following sections.

| | | | | | | |
|---|---|---|---|---|---|---|
| ***Message*** ❶ | **UBX-DEMO-EXAMPLE**<br>**Example demo message** | | | | | |
| *Type* ❷ | Periodic/polled | | | | | |
| *Comment* ❸ | This is a comment that describes the use of the demo example message.<br>There can be references to other sections in the documentation (such as: UBX protocol).<br>☞ Note that there can be important remarks here. | | | | | |
| *Message* ❹ | *Header* | *Class ID* | | *Length (bytes)* | *Payload* | *Checksum* |
| *Structure* | 0xb5 0x62 | 0x01 | 0x07 | 16 + numRepeat*4 | *see below* | CK_A CK_B |

*Payload description:* ❺

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | `aField` | - | - | a field that contains an unsigned integer with no particular scale or unit |
| 4 | I4 | `anotherField` | 1e-2 | m | a field that contains a length in meters (m) with a scale of 1e-2 (= 0.01), i.e. a length in centimeters |
| 8 | X2 | `bitfield` ❻ | - | - | this field contains flags or values smaller than one byte, whose definition follows below (bits not described are reserved) |
| bit 0 | U:1 | `aFieldValid` | - | - | the first bit in `bitfield` indicates whether the `aField` is valid or not (see UBX conditional values) |
| bit 1 | U:1 | `someFlag` | - | - | the second bit is a flag (1 = true, 0 = false) |
| bits 5...2 | U:4 | `aBitFieldValue` | - | - | a 4-bits value (range: 0...15) |
| 10 | U1[5] ❼ | `reserved0` | - | - | a reserved field, whose value shall be ignored (in output messages) or set to 0 (in input messages) |
| 15 | U1 | `numRepeat` | - | - | number of repetitions in the group of fields below |
| *Start of repeated group (`numRepeat` times)* ❽ | | | | | |
| 16 + n*4 | I2 | `someValue` | - | - | a signed value in a repeated group of fields |
| 18 + n*4 | U2 | `anotherValue` | - | - | another value in a repeated group of fields |
| *End of repeated group (`numRepeat` times)* | | | | | |

❶ The first line shows the message name (see Naming). The second line shows a short description of the message.

❷ The message type (see Message types).

❸ This section contains comments that describe the message. Often links to other related sections in the documentation or other related messages are found here.

❹ The message structure gives the parameters for the UBX frame structure, notably the message class and message ID values and the payload length. For many messages the payload length is a fixed number (of bytes). Messages that contain repeated blocks of information (fields) have a variable payload (see UBX repeated fields).

❺ The message payload definition is given as a list of fields and their parameters. Each field starts at a specified offset (in bytes) in the payload (see also UBX structure packing), is of a specific type

(see UBX data types), has a unique name (within the message), and a description. Optionally, fields can have a scale and/or a unit (see UBX fields scale and unit).

❻ Bitfields ("X" types) are broken down into smaller parts. Each part can be one or more bits wide. Values that are two or more bits wide can be unsigned or one of two signed value representation (see UBX data types). Note that the ten unused bits 15...6 are not explicitly stated as UBX reserved elements.

❼ Fields can be arrays of values of the same type (see UBX repeated fields).

❽ Groups of fields can be repeated in the payload. The number of repetitions can be given by another field in the message (this example), a constant number, zero or one times (known as "optional group"), or derived from the remaining payload size (labeled as "repeated N times"). See also UBX repeated fields and UBX payload decoding.

## 3.8 UBX messages overview

| *Message* | *Class/ID* | *Description (Type)* |
|---|---|---|
| **UBX-ACK – Acknowledgement and negative acknowledgement messages** | | |
| UBX-ACK-ACK | 0x05 0x01 | • Message acknowledged (Output) |
| UBX-ACK-NAK | 0x05 0x00 | • Message not acknowledged (Output) |
| **UBX-CFG – Configuration and command messages** | | |
| UBX-CFG-ANT | 0x06 0x13 | • Antenna control settings (Get/set) |
| UBX-CFG-CFG | 0x06 0x09 | • Clear, save and load configurations (Command) |
| UBX-CFG-DAT | 0x06 0x06 | • Set user-defined datum (Set)<br>• Get currently defined datum (Get) |
| UBX-CFG-DGNSS | 0x06 0x70 | • DGNSS configuration (Get/set) |
| UBX-CFG-GEOFENCE | 0x06 0x69 | • Geofencing configuration (Get/set) |
| UBX-CFG-GNSS | 0x06 0x3e | • GNSS system configuration (Get/set) |
| UBX-CFG-INF | 0x06 0x02 | • Poll configuration for one protocol (Poll request)<br>• Information message configuration (Get/set) |
| UBX-CFG-ITFM | 0x06 0x39 | • Jamming/interference monitor configuration (Get/set) |
| UBX-CFG-LOGFILTER | 0x06 0x47 | • Data logger configuration (Get/set) |
| UBX-CFG-MSG | 0x06 0x01 | • Poll a message configuration (Poll request)<br>• Set message rate(s) (Get/set)<br>• Set message rate (Get/set) |
| UBX-CFG-NAV5 | 0x06 0x24 | • Navigation engine settings (Get/set) |
| UBX-CFG-NAVX5 | 0x06 0x23 | • Navigation engine expert settings (Get/set) |
| UBX-CFG-NMEA | 0x06 0x17 | • Extended NMEA protocol configuration V1 (Get/set) |
| UBX-CFG-ODO | 0x06 0x1e | • Odometer, low-speed COG engine settings (Get/set) |
| UBX-CFG-PRT | 0x06 0x00 | • Polls the configuration for one I/O port (Poll request)<br>• Port configuration for UART ports (Get/set)<br>• Port configuration for USB port (Get/set)<br>• Port configuration for SPI port (Get/set)<br>• Port configuration for I2C (DDC) port (Get/set) |
| UBX-CFG-PWR | 0x06 0x57 | • Put receiver in a defined power state (Set) |
| UBX-CFG-RATE | 0x06 0x08 | • Navigation/measurement rate settings (Get/set) |
| UBX-CFG-RINV | 0x06 0x34 | • Contents of remote inventory (Get/set) |
| UBX-CFG-RST | 0x06 0x04 | • Reset receiver / Clear backup data structures (Command) |
| UBX-CFG-SBAS | 0x06 0x16 | • SBAS configuration (Get/set) |

| Message | Class/ID | Description (Type) |
|---|---|---|
| UBX-CFG-TMODE3 | 0x06 0x71 | • Time mode settings 3 (Get/set) |
| UBX-CFG-TP5 | 0x06 0x31 | • Time pulse parameters (Get/set) |
| UBX-CFG-USB | 0x06 0x1b | • USB configuration (Get/set) |
| UBX-CFG-VALDEL | 0x06 0x8c | • Delete configuration item values (Set)<br>• Delete configuration item values (with transaction) (Set) |
| UBX-CFG-VALGET | 0x06 0x8b | • Get configuration items (Poll request)<br>• Configuration items (Polled) |
| UBX-CFG-VALSET | 0x06 0x8a | • Set configuration item values (Set)<br>• Set configuration item values (with transaction) (Set) |
| **UBX-INF – Information messages** | | |
| UBX-INF-DEBUG | 0x04 0x04 | • ASCII output with debug contents (Output) |
| UBX-INF-ERROR | 0x04 0x00 | • ASCII output with error contents (Output) |
| UBX-INF-NOTICE | 0x04 0x02 | • ASCII output with informational contents (Output) |
| UBX-INF-TEST | 0x04 0x03 | • ASCII output with test contents (Output) |
| UBX-INF-WARNING | 0x04 0x01 | • ASCII output with warning contents (Output) |
| **UBX-LOG – Logging messages** | | |
| UBX-LOG-CREATE | 0x21 0x07 | • Create log file (Command) |
| UBX-LOG-ERASE | 0x21 0x03 | • Erase logged data (Command) |
| UBX-LOG-FINDTIME | 0x21 0x0e | • Find index of a log entry based on a given time (Input)<br>• Response to FINDTIME request (Output) |
| UBX-LOG-INFO | 0x21 0x08 | • Poll for log information (Poll request)<br>• Log information (Output) |
| UBX-LOG-RETRIEVE | 0x21 0x09 | • Request log data (Command) |
| UBX-LOG-RETRIEVEPOS | 0x21 0x0b | • Position fix log entry (Output) |
| UBX-LOG-RETRIEVEPOSEXTRA | 0x21 0x0f | • Odometer log entry (Output) |
| UBX-LOG-RETRIEVESTRING | 0x21 0x0d | • Byte string log entry (Output) |
| UBX-LOG-STRING | 0x21 0x04 | • Store arbitrary string in on-board flash (Command) |
| **UBX-MGA – GNSS assistance (A-GNSS) messages** | | |
| UBX-MGA-ACK | 0x13 0x60 | • Multiple GNSS acknowledge message (Output) |
| UBX-MGA-BDS | 0x13 0x03 | • BeiDou ephemeris assistance (Input)<br>• BeiDou almanac assistance (Input)<br>• BeiDou health assistance (Input)<br>• BeiDou UTC assistance (Input)<br>• BeiDou ionosphere assistance (Input) |
| UBX-MGA-DBD | 0x13 0x80 | • Poll the navigation database (Poll request)<br>• Navigation database dump entry (Input/output) |
| UBX-MGA-GAL | 0x13 0x02 | • Galileo ephemeris assistance (Input)<br>• Galileo almanac assistance (Input)<br>• Galileo GPS time offset assistance (Input)<br>• Galileo UTC assistance (Input) |
| UBX-MGA-GLO | 0x13 0x06 | • GLONASS ephemeris assistance (Input)<br>• GLONASS almanac assistance (Input)<br>• GLONASS auxiliary time offset assistance (Input) |
| UBX-MGA-GPS | 0x13 0x00 | • GPS ephemeris assistance (Input)<br>• GPS almanac assistance (Input)<br>• GPS health assistance (Input)<br>• GPS UTC assistance (Input)<br>• GPS ionosphere assistance (Input) |

| Message | Class/ID | Description (Type) |
|---|---|---|
| UBX-MGA-INI | 0x13 0x40 | • Initial position assistance (Input)<br>• Initial time assistance (Input)<br>• Initial clock drift assistance (Input)<br>• Initial frequency assistance (Input) |
| UBX-MGA-QZSS | 0x13 0x05 | • QZSS ephemeris assistance (Input)<br>• QZSS almanac assistance (Input)<br>• QZSS health assistance (Input) |
| **UBX-MON – Monitoring messages** | | |
| UBX-MON-COMMS | 0x0a 0x36 | • Communication port information (Periodic/polled) |
| UBX-MON-GNSS | 0x0a 0x28 | • Information message major GNSS selection (Polled) |
| UBX-MON-HW | 0x0a 0x09 | • Hardware status (Periodic/polled) |
| UBX-MON-HW2 | 0x0a 0x0b | • Extended hardware status (Periodic/polled) |
| UBX-MON-HW3 | 0x0a 0x37 | • I/O pin status (Periodic/polled) |
| UBX-MON-IO | 0x0a 0x02 | • I/O system status (Periodic/polled) |
| UBX-MON-MSGPP | 0x0a 0x06 | • Message parse and process status (Periodic/polled) |
| UBX-MON-PATCH | 0x0a 0x27 | • Installed patches (Polled) |
| UBX-MON-RF | 0x0a 0x38 | • RF information (Periodic/polled) |
| UBX-MON-RXBUF | 0x0a 0x07 | • Receiver buffer status (Periodic/polled) |
| UBX-MON-RXR | 0x0a 0x21 | • Receiver status information (Output) |
| UBX-MON-SPAN | 0x0a 0x31 | • Signal characteristics (Periodic/polled) |
| UBX-MON-TXBUF | 0x0a 0x08 | • Transmitter buffer status (Periodic/polled) |
| UBX-MON-VER | 0x0a 0x04 | • Receiver and software version (Polled) |
| **UBX-NAV – Navigation solution messages** | | |
| UBX-NAV-CLOCK | 0x01 0x22 | • Clock solution (Periodic/polled) |
| UBX-NAV-DOP | 0x01 0x04 | • Dilution of precision (Periodic/polled) |
| UBX-NAV-EOE | 0x01 0x61 | • End of epoch (Periodic) |
| UBX-NAV-GEOFENCE | 0x01 0x39 | • Geofencing status (Periodic/polled) |
| UBX-NAV-HPPOSECEF | 0x01 0x13 | • High precision position solution in ECEF (Periodic/polled) |
| UBX-NAV-HPPOSLLH | 0x01 0x14 | • High precision geodetic position solution (Periodic/polled) |
| UBX-NAV-ODO | 0x01 0x09 | • Odometer solution (Periodic/polled) |
| UBX-NAV-ORB | 0x01 0x34 | • GNSS orbit database info (Periodic/polled) |
| UBX-NAV-POSECEF | 0x01 0x01 | • Position solution in ECEF (Periodic/polled) |
| UBX-NAV-POSLLH | 0x01 0x02 | • Geodetic position solution (Periodic/polled) |
| UBX-NAV-PVT | 0x01 0x07 | • Navigation position velocity time solution (Periodic/polled) |
| UBX-NAV-RELPOSNED | 0x01 0x3c | • Relative positioning information in NED frame (Periodic/polled) |
| UBX-NAV-RESETODO | 0x01 0x10 | • Reset odometer (Command) |
| UBX-NAV-SAT | 0x01 0x35 | • Satellite information (Periodic/polled) |
| UBX-NAV-SBAS | 0x01 0x32 | • SBAS status data (Periodic/polled) |
| UBX-NAV-SIG | 0x01 0x43 | • Signal information (Periodic/polled) |
| UBX-NAV-SLAS | 0x01 0x42 | • QZSS L1S SLAS status data (Periodic/polled) |
| UBX-NAV-STATUS | 0x01 0x03 | • Receiver navigation status (Periodic/polled) |
| UBX-NAV-SVIN | 0x01 0x3b | • Survey-in data (Periodic/polled) |
| UBX-NAV-TIMEBDS | 0x01 0x24 | • BeiDou time solution (Periodic/polled) |
| UBX-NAV-TIMEGAL | 0x01 0x25 | • Galileo time solution (Periodic/polled) |
| UBX-NAV-TIMEGLO | 0x01 0x23 | • GLONASS time solution (Periodic/polled) |

| Message | Class/ID | Description (Type) |
|---|---|---|
| UBX-NAV-TIMELS | 0x01 0x26 | • Leap second event information (Periodic/polled) |
| UBX-NAV-TIMEQZSS | 0x01 0x27 | • QZSS time solution (Periodic/polled) |
| UBX-NAV-TIMEUTC | 0x01 0x21 | • UTC time solution (Periodic/polled) |
| UBX-NAV-VELECEF | 0x01 0x11 | • Velocity solution in ECEF (Periodic/polled) |
| UBX-NAV-VELNED | 0x01 0x12 | • Velocity solution in NED frame (Periodic/polled) |
| **UBX-RXM – Receiver manager messages** | | |
| UBX-RXM-MEASX | 0x02 0x14 | • Satellite measurements for RRLP (Periodic/polled) |
| UBX-RXM-PMREQ | 0x02 0x41 | • Power management request (Command) |
| UBX-RXM-RAWX | 0x02 0x15 | • Multi-GNSS raw measurements (Periodic/polled) |
| UBX-RXM-RLM | 0x02 0x59 | • Galileo SAR short-RLM report (Output)<br>• Galileo SAR long-RLM report (Output) |
| UBX-RXM-RTCM | 0x02 0x32 | • RTCM input status (Output) |
| UBX-RXM-SFRBX | 0x02 0x13 | • Broadcast navigation data subframe (Output) |
| **UBX-SEC – Security messages** | | |
| UBX-SEC-UNIQID | 0x27 0x03 | • Unique chip ID (Output) |
| **UBX-TIM – Timing messages** | | |
| UBX-TIM-TM2 | 0x0d 0x03 | • Time mark data (Periodic/polled) |
| UBX-TIM-TP | 0x0d 0x01 | • Time pulse time data (Periodic/polled) |
| UBX-TIM-VRFY | 0x0d 0x06 | • Sourced time verification (Periodic/polled) |
| **UBX-UPD – Firmware update messages** | | |
| UBX-UPD-SOS | 0x09 0x14 | • Poll backup restore status (Poll request)<br>• Create backup in flash (Command)<br>• Clear backup in flash (Command)<br>• Backup creation acknowledge (Output)<br>• System restored from backup (Output) |

# 3.9 UBX-ACK (0x05)

The messages in the UBX-ACK class are used to indicate acknowledgement or rejection (i.e. negative acknowledgement) of input messages, such as UBX-CFG messages.

## 3.9.1 UBX-ACK-ACK (0x05 0x01)

### 3.9.1.1 Message acknowledged

| *Message* | **UBX-ACK-ACK**<br>**Message acknowledged** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | Output upon processing of an input message. A UBX-ACK-ACK is sent as soon as possible but at least within one second. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x05 | 0x01 | 2 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `clsID` | - | - | Class ID of the Acknowledged Message |

| | | | | | |
|---|---|---|---|---|---|
| 1 | U1 | msgID | - | - | Message ID of the Acknowledged Message |

### 3.9.2 UBX-ACK-NAK (0x05 0x00)

#### 3.9.2.1 Message not acknowledged

| ***Message*** | **UBX-ACK-NAK**<br>**Message not acknowledged** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | Output upon processing of an input message. A UBX-ACK-NAK is sent as soon as possible but at least within one second. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x05 | 0x00 | 2 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | clsID | - | - | Class ID of the Not-Acknowledged Message |
| 1 | U1 | msgID | - | - | Message ID of the Not-Acknowledged Message |

## 3.10 UBX-CFG (0x06)

The messages in the UBX-CFG class are used to configure the receiver and poll current configuration values as well as for sending commands to the receiver. Unless stated otherwise, any message in this class sent to the receiver is either acknowledged (by a UBX-ACK-ACK message) if processed successfully or rejected (with a UBX-ACK-NAK message) if processed unsuccessfully.

### 3.10.1 UBX-CFG-ANT (0x06 0x13)

#### 3.10.1.1 Antenna control settings

| ***Message*** | **UBX-CFG-ANT**<br>**Antenna control settings** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>This message allows the user to configure the antenna supervisor.<br>The antenna supervisor can be used to detect the status of an active antenna and control it. It can be used to turn off the supply to the antenna in the event of a short cirquit (for example) or to manage power consumption in power save mode.<br>Refer to antenna supervisor configuration in the Integration manual for more information regarding the behavior of the antenna supervisor.<br>Refer to UBX-MON-HW for a description of the fields in the message used to obtain the status of the antenna.<br>Note that not all pins can be used for antenna supervisor operation, it is recommended that you use the default pins, consult the Integration manual if you need to use other pins. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x13 | 4 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | X2 | flags | - | - | Antenna flag mask |
| bit 0 | U:1 | svcs | - | - | Enable antenna supply voltage control signal |
| bit 1 | U:1 | scd | - | - | Enable short circuit detection |

| | | | | | | |
|---|---|---|---|---|---|---|
| | bit 2 | U:1 | ocd | - | - | Enable open circuit detection |
| | bit 3 | U:1 | pdwnOnSCD | - | - | Power down antenna supply if short circuit is detected. (only in combination with bit 1) |
| | bit 4 | U:1 | recovery | - | - | Enable automatic recovery from short state |
| 2 | | X2 | pins | - | - | Antenna pin configuration |
| | bits 4...0 | U:5 | pinSwitch | - | - | PIO-pin used for switching antenna supply |
| | bits 9...5 | U:5 | pinSCD | - | - | PIO-pin used for detecting a short in the antenna supply |
| | bits 14...10 | U:5 | pinOCD | - | - | PIO-pin used for detecting open/not connected antenna |
| | bit 15 | U:1 | reconfig | - | - | if set to one, and this command is sent to the receiver, the receiver will reconfigure the pins as specified. |

## 3.10.2 UBX-CFG-CFG (0x06 0x09)

### 3.10.2.1 Clear, save and load configurations

| ***Message*** | **UBX-CFG-CFG**<br>**Clear, save and load configurations** |
|---|---|
| *Type* | Command |
| *Comment* | See Receiver configuration for a detailed description on how receiver configuration should be used. The behavior of this message has changed for protocol versions greater than 23.01. Use UBX-CFG-VALSET and UBX-CFG-VALDEL with the appropriate layers instead. These new messages support selective saving and clearing to retain the behavior removed from this message. The three masks which were used to clear, save and load a subsection of configuration have lost their meaning. It is no longer possible to save or clear a subsection of the configuration using this message. The behavior of the masks is now:<br>• if any bit is set in the clearMask: all configuration in the selected non-volatile memory is deleted<br>• if any bit is set in the saveMask: all current configuration is stored (copied) to the selected layers<br>• if any bit is set in the loadMask: The curerent configuration is discarded and rebuilt from all the lower layers<br>Note that commands can be combined. The sequence of execution is clear, save, then load.<br>☞ This message is deprecated in protocol versions greater than 23.01. Use UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL instead. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x06 | 0x09 | 12 + [0,1] | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | X4 | clearMask | - | - | Mask for configuration to clear |
| bits 31...0 | U:32 | clearAll | - | - | Clear all saved configuration from the selected non-volatile memory if any bit is set |
| 4 | X4 | saveMask | - | - | Mask for configuration to save |
| bits 31...0 | U:32 | saveAll | - | - | Save all current configuration to the selected non-volatile memory if any bit is set |
| 8 | X4 | loadMask | - | - | Mask for configuration to load |
| bits 31...0 | U:32 | loadAll | - | - | Discard current configuration and rebuilt it from lower non-volatile memory layers if any bit is set |
| *Start of optional group* | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 12 | X1 | deviceMask | - | - | Mask which selects the memory devices for saving and/or clearing operation<br>Note that if a deviceMask is not provided, the receiver defaults the operation requested to battery-backed RAM (BBR) and Flash (if available) |
| bit 0 | U:1 | devBBR | - | - | Battery-backed RAM |
| bit 1 | U:1 | devFlash | - | - | Flash |
| bit 2 | U:1 | devEEPROM | - | - | EEPROM (only supported for protocol versions less than 14.00) |
| bit 4 | U:1 | devSpiFlash | - | - | SPI Flash (only supported for protocol versions less than 14.00) |
| *End of optional group* | | | | | |

## 3.10.3 UBX-CFG-DAT (0x06 0x06)

### 3.10.3.1 Set user-defined datum

| ***Message*** | **UBX-CFG-DAT**<br>**Set user-defined datum** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x06 | 44 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | R8 | majA | - | m | Semi-major axis ( accepted range = 6,300,000.0 to 6,500,000.0 meters ). |
| 8 | R8 | flat | - | - | 1.0 / flattening ( accepted range is 0.0 to 500.0 ). |
| 16 | R4 | dX | - | m | X axis shift at the origin ( accepted range is +/- 5000.0 meters ). |
| 20 | R4 | dY | - | m | Y axis shift at the origin ( accepted range is +/- 5000.0 meters ). |
| 24 | R4 | dZ | - | m | Z axis shift at the origin ( accepted range is +/- 5000.0 meters ). |
| 28 | R4 | rotX | - | s | Rotation about the X axis ( accepted range is +/- 20.0 milli-arc seconds ). |
| 32 | R4 | rotY | - | s | Rotation about the Y axis ( accepted range is +/- 20.0 milli-arc seconds ). |
| 36 | R4 | rotZ | - | s | Rotation about the Z axis ( accepted range is +/- 20.0 milli-arc seconds ). |
| 40 | R4 | scale | - | ppm | Scale change ( accepted range is 0.0 to 50.0 parts per million ). |

### 3.10.3.2 Get currently defined datum

| ***Message*** | **UBX-CFG-DAT**<br>**Get currently defined datum** |
|---|---|
| *Type* | Get |

| | |
|---|---|
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>Returns the parameters of the currently defined datum. If no user-defined datum has been set, this will default to WGS84. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x06 | 0x06 | 52 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U2 | datumNum | - | - | Datum number: 0 = WGS84, 0xFFFF = user-defined (extra values are defined for protocol versions less than 13.00) |
| 2 | CH[6] | datumName | - | - | ASCII string: WGS84 or USER (extra values are defined for protocol versions less than 13.00) |
| 8 | R8 | majA | - | m | Semi-major axis ( accepted range = 6,300,000.0 to 6,500,000.0 meters ). |
| 16 | R8 | flat | - | - | 1.0 / flattening ( accepted range is 0.0 to 500.0 ). |
| 24 | R4 | dX | - | m | X axis shift at the origin ( accepted range is +/- 5000.0 meters ). |
| 28 | R4 | dY | - | m | Y axis shift at the origin ( accepted range is +/- 5000.0 meters ). |
| 32 | R4 | dZ | - | m | Z axis shift at the origin ( accepted range is +/- 5000.0 meters ). |
| 36 | R4 | rotX | - | s | Rotation about the X axis ( accepted range is +/- 20.0 milli-arc seconds ). |
| 40 | R4 | rotY | - | s | Rotation about the Y axis ( accepted range is +/- 20.0 milli-arc seconds ). |
| 44 | R4 | rotZ | - | s | Rotation about the Z axis ( accepted range is +/- 20.0 milli-arc seconds ). |
| 48 | R4 | scale | - | ppm | Scale change ( accepted range is 0.0 to 50.0 parts per million ). |

## 3.10.4 UBX-CFG-DGNSS (0x06 0x70)

### 3.10.4.1 DGNSS configuration

| ***Message*** | **UBX-CFG-DGNSS**<br>**DGNSS configuration** |
|---|---|
| *Type* | Get/set |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>This message allows the user to configure the DGNSS configuration of the receiver. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x06 | 0x70 | 4 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 0 | U1 | dgnssMode | - | - | Specifies differential mode:<br>• 2 = RTK float: No attempts are made to fix ambiguities.<br>• 3 = RTK fixed: Ambiguities are fixed whenever possible. |
| 1 | U1[3] | reserved0 | - | - | Reserved |

## 3.10.5 UBX-CFG-GEOFENCE (0x06 0x69)

### 3.10.5.1 Geofencing configuration

| ***Message*** | **UBX-CFG-GEOFENCE**<br>**Geofencing configuration** |
|---|---|
| *Type* | Get/set |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>Gets or sets the geofencing configuration.<br>If the receiver is sent a valid new configuration, it will respond with a UBX-ACK-ACK message and immediately change to the new configuration. Otherwise the receiver will reject the request, by issuing a UBX-ACK-NAK and continuing operation with the previous configuration.<br>Note that the acknowledge message does not indicate whether the PIO configuration has been successfully applied (pin assigned), it only indicates the successful configuration of the feature. The configured PIO must be previously unoccupied for successful assignment. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x06 | 0x69 | 8 + numFences·12 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | version | - | - | Message version (0x00 for this version) |
| 1 | U1 | numFences | - | - | Number of geofences contained in this message. Note that the receiver can only store a limited number of geofences (currently 4). |
| 2 | U1 | confLvl | - | - | Required confidence level for state evaluation. This value times the position's standard deviation (sigma) defines the confidence band.<br>• 0 = no confidence required<br>• 1 = 68%<br>• 2 = 95%<br>• 3 = 99.7%<br>• 4 = 99.99% |
| 3 | U1 | reserved0 | - | - | Reserved |
| 4 | U1 | pioEnabled | - | - | 1 = Enable PIO combined fence state output, 0 = disable |
| 5 | U1 | pinPolarity | - | - | PIO pin polarity. 0 = Low means inside, 1 = Low means outside. Unknown state is always high. |
| 6 | U1 | pin | - | - | PIO pin number |
| 7 | U1 | reserved1 | - | - | Reserved |
| *Start of repeated group (numFences times)* | | | | | |
| 8 + n·12 | I4 | lat | 1e-7 | deg | Latitude of the geofence circle center |
| 12 + n·12 | I4 | lon | 1e-7 | deg | Longitude of the geofence circle center |
| 16 + n·12 | U4 | radius | 1e-2 | m | Radius of the geofence circle |

*End of repeated group (`numFences` times)*

## 3.10.6 UBX-CFG-GNSS (0x06 0x3e)

### 3.10.6.1 GNSS system configuration

| ***Message*** | **UBX-CFG-GNSS**<br>**GNSS system configuration** |
|---|---|
| *Type* | Get/set |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>Gets or sets the GNSS system channel sharing configuration.<br>If the receiver is sent a valid new configuration, it will respond with a UBX-ACK-ACK message and immediately change to the new configuration. Otherwise the receiver will reject the request, by issuing a UBX-ACK-NAK and continuing operation with the previous configuration.<br>Configuration requirements:<br>• It is necessary for at least one major GNSS to be enabled, after applying the new configuration to the current one.<br>• It is also required that at least 4 tracking channels are available to each enabled major GNSS, i.e. `maxTrkCh` must have a minimum value of 4 for each enabled major GNSS.<br>• The number of tracking channels in use must not exceed the number of tracking channels available in hardware, and the sum of all reserved tracking channels needs to be less than or equal to the number of tracking channels in use.<br>Notes:<br>• To avoid cross-correlation issues, it is recommended that GPS and QZSS are always both enabled or both disabled.<br>• Polling this message returns the configuration of all supported GNSS, whether enabled or not; it may also include GNSS unsupported by the particular product, but in such cases the enable flag will always be unset.<br>• See section Satellite Numbering for a description of the GNSS IDs available.<br>• Configuration specific to the GNSS system can be done via other messages (e.g. **UBX-CFG-SBAS**). |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x06 | 0x3e | 4 + numConfigBlocks·8 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `msgVer` | - | - | Message version (0x00 for this version) |
| 1 | U1 | `numTrkChHw` | - | - | Number of tracking channels available in hardware (read only) |
| 2 | U1 | `numTrkChUse` | - | - | (Read only for protocol versions greater than 23.00) Number of tracking channels to use. Must be > 0, <= numTrkChHw. If 0xFF, then number of tracking channels to use will be set to numTrkChHw. |
| 3 | U1 | `numConfig Blocks` | - | - | Number of configuration blocks following |
| *Start of repeated group (`numConfigBlocks` times)* | | | | | |
| 4 + n·8 | U1 | `gnssId` | - | - | System identifier (see Satellite Numbering) |
| 5 + n·8 | U1 | `resTrkCh` | - | - | (Read only for protocol versions greater than 23.00) Number of reserved (minimum) tracking channels for this system. |

| | | | | | |
|---|---|---|---|---|---|
| 6 + n·8 | U1 | maxTrkCh | - | - | (Read only for protocol versions greater than 23.00) Maximum number of tracking channels used for this system. Must be > 0, >= resTrkChn, <= numTrkChUse and <= maximum number of tracking channels supported for this system. |
| 7 + n·8 | U1 | reserved0 | - | - | Reserved |
| 8 + n·8 | X4 | flags | - | - | Bitfield of flags. At least one signal must be configured in every enabled system. |
| bit 0 | U:1 | enable | - | - | Enable this system |
| bits 23...16 | U:8 | sigCfgMask | - | - | Signal configuration mask<br>When gnssId is 0 (GPS)<br>• 0x01 = GPS L1C/A<br>• 0x10 = GPS L2C<br>When gnssId is 1 (SBAS)<br>• 0x01 = SBAS L1C/A<br>When gnssId is 2 (Galileo)<br>• 0x01 = Galileo E1 (not supported for protocol versions less than 18.00)<br>• 0x20 = Galileo E5b<br>When gnssId is 3 (BeiDou)<br>• 0x01 = BeiDou B1I<br>• 0x10 = BeiDou B2I<br>When gnssId is 4 (IMES)<br>• 0x01 = IMES L1<br>When gnssId is 5 (QZSS)<br>• 0x01 = QZSS L1C/A<br>• 0x04 = QZSS L1S<br>• 0x10 = QZSS L2C<br>When gnssId is 6 (GLONASS)<br>• 0x01 = GLONASS L1<br>• 0x10 = GLONASS L2 |
| *End of repeated group (numConfigBlocks times)* | | | | | |

## 3.10.7 UBX-CFG-INF (0x06 0x02)

### 3.10.7.1 Poll configuration for one protocol

| | | | | | | |
|---|---|---|---|---|---|---|
| ***Message*** | **UBX-CFG-INF**<br>**Poll configuration for one protocol** | | | | | |
| *Type* | Poll request | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x02 | 1 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 0 | U1 | protocolID | - | - | Protocol identifier, identifying the output protocol for this poll request. The following are valid protocol identifiers:<br>• 0: UBX protocol<br>• 1: NMEA protocol<br>• 2-255: Reserved |

### 3.10.7.2 Information message configuration

| ***Message*** | **UBX-CFG-INF**<br>**Information message configuration** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>The value of infMsgMask[x] below is formed so that each bit represents one of the INF class messages (bit 0 for ERROR, bit 1 for WARNING and so on). For a complete list, see the Message class INF. Several configurations can be concatenated to one input message. In this case the payload length can be a multiple of the normal length. Output messages from the module contain only one configuration unit.<br>Note that:<br>• I/O ports 1 and 2 correspond to serial ports 1 and 2.<br>• I/O port 0 is I2C (DDC).<br>• I/O port 3 is USB.<br>• I/O port 4 is SPI.<br>• I/O port 5 is reserved for future use. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x02 | [0..n]·10 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| *Start of repeated group (N times)* | | | | | |
| 0 + n·10 | U1 | protocolID | - | - | Protocol identifier, identifying for which protocol the configuration is set/get. The following are valid protocol identifiers:<br>• 0: UBX protocol<br>• 1: NMEA protocol<br>• 2-255: Reserved |
| 1 + n·10 | U1[3] | reserved0 | - | - | Reserved |
| 4 + n·10 | X1[6] | infMsgMask | - | - | A bit mask, saying which information messages are enabled on each I/O port |
| bit 0 | U:1 | ERROR | - | - | enable ERROR |
| bit 1 | U:1 | WARNING | - | - | enable WARNING |
| bit 2 | U:1 | NOTICE | - | - | enable NOTICE |
| bit 3 | U:1 | TEST | - | - | enable TEST |
| bit 4 | U:1 | DEBUG | - | - | enable DEBUG |
| *End of repeated group (N times)* | | | | | |

## 3.10.8 UBX-CFG-ITFM (0x06 0x39)

### 3.10.8.1 Jamming/interference monitor configuration

| ***Message*** | **UBX-CFG-ITFM**<br>**Jamming/interference monitor configuration** |
|---|---|
| *Type* | Get/set |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item. | | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x39 | 8 | | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | X4 | config | - | - | Interference config word |
| bits 3...0 | U:4 | bbThreshold | - | - | Broadband jamming detection threshold |
| bits 8...4 | U:5 | cwThreshold | - | - | CW jamming detection threshold |
| bits 30...9 | U:22 | algorithmBits | - | - | Reserved algorithm settings - should be set to 0x16B156 in hex for correct settings |
| bit 31 | U:1 | enable | - | - | Enable interference detection |
| 4 | X4 | config2 | - | - | Extra settings for jamming/interference monitor |
| bits 11...0 | U:12 | generalBits | - | - | General settings - should be set to 0x31E in hex for correct setting |
| bits 13...12 | U:2 | antSetting | - | - | Antenna setting, 0=unknown, 1=passive, 2=active |
| bit 14 | U:1 | enable2 | - | - | Set to 1 to scan auxiliary bands (u-blox 8 / u-blox M8 only, otherwise ignored) |

## 3.10.9 UBX-CFG-LOGFILTER (0x06 0x47)

### 3.10.9.1 Data logger configuration

| ***Message*** | **UBX-CFG-LOGFILTER**<br>**Data logger configuration** | | | | | | |
|---|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>This message can be used to configure the data logger, i.e. to enable/disable the log recording and to get/set the position entry filter settings.<br>Position entries can be filtered based on time difference, position difference or current speed thresholds. Position and speed filtering also have a minimum time interval. A position is logged if any of the thresholds are exceeded. If a threshold is set to zero it is ignored. The maximum rate of position logging is 1 Hz.<br>The filter settings will be configured to the provided values only if the 'applyAllFilterSettings' flag is set. This allows the recording to be enabled/disabled independently of configuring the filter settings.<br>Configuring the data logger in the absence of a logging file is supported. By doing so, once the logging file is created, the data logger configuration will take effect immediately and logging recording and filtering will activate according to the configuration. | | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x47 | 12 | | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | version | - | - | Message version (0x01 for this version) |
| 1 | X1 | flags | - | - | Flags |
| bit 0 | U:1 | recordEnabled | - | - | 1 = enable recording, 0 = disable recording |
| bit 1 | U:1 | psmOncePer WakupEnabled | - | - | 1 = enable recording only one single position per PSM on/off mode wake-up period, 0 = disable once per wake-up |

| | | | | | |
|---|---|---|---|---|---|
| bit 2 | U:1 | applyAllFilterSettings | - | - | 1 = apply all filter settings, 0 = only apply recordEnabled |
| 2 | U2 | minInterval | - | s | Minimum time interval between logged positions (0 = not set). **This is only applied in combination with the speed and/or position thresholds.** If both minInterval and timeThreshold are set, minInterval must be less than or equal to timeThreshold. |
| 4 | U2 | timeThreshold | - | s | If the time difference is greater than the threshold, then the position is logged (0 = not set). |
| 6 | U2 | speedThreshold | - | m/s | If the current speed is greater than the threshold, then the position is logged (0 = not set). minInterval also applies. |
| 8 | U4 | positionThreshold | - | m | If the 3D position difference is greater than the threshold, then the position is logged (0 = not set). minInterval also applies. |

## 3.10.10 UBX-CFG-MSG (0x06 0x01)

### 3.10.10.1 Poll a message configuration

| ***Message*** | **UBX-CFG-MSG**<br>**Poll a message configuration** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Poll request | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x01 | 2 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | msgClass | - | - | Message class |
| 1 | U1 | msgID | - | - | Message identifier |

### 3.10.10.2 Set message rate(s)

| ***Message*** | **UBX-CFG-MSG**<br>**Set message rate(s)** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>Get/set message rate configuration (s) to/from the receiver.<br>• Send rate is relative to the event a message is registered on. For example, if the rate of a navigation message is set to 2, the message is sent every second navigation solution. For configuring NMEA messages, the section NMEA Messages Overview describes class and identifier numbers used. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x01 | 8 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | msgClass | - | - | Message class |
| 1 | U1 | msgID | - | - | Message identifier |

| | | | | | |
|---|---|---|---|---|---|
| 2 | U1[6] | rate | - | - | Send rate on I/O port (6 ports) |

### 3.10.10.3 Set message rate

| ***Message*** | **UBX-CFG-MSG**<br>**Set message rate** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>Set message rate configuration for the current port. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x01 | 3 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | msgClass | - | - | Message class |
| 1 | U1 | msgID | - | - | Message identifier |
| 2 | U1 | rate | - | - | Send rate on current port |

## 3.10.11 UBX-CFG-NAV5 (0x06 0x24)

### 3.10.11.1 Navigation engine settings

| ***Message*** | **UBX-CFG-NAV5**<br>**Navigation engine settings** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x24 | 36 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | X2 | mask | - | - | Parameters bitmask. Only the masked parameters will be applied. |
| bit 0 | U:1 | dyn | - | - | Apply dynamic model settings |
| bit 1 | U:1 | minEl | - | - | Apply minimum elevation settings |
| bit 2 | U:1 | posFixMode | - | - | Apply fix mode settings |
| bit 3 | U:1 | drLim | - | - | Reserved (apply DR limit settings, only applicable for protocol versions less than 14.00) |
| bit 4 | U:1 | posMask | - | - | Apply position mask settings |
| bit 5 | U:1 | timeMask | - | - | Apply time mask settings |
| bit 6 | U:1 | staticHoldMask | - | - | Apply static hold settings |
| bit 7 | U:1 | dgpsMask | - | - | Apply DGPS settings<br>(not supported for protocol versions less than 13.00) |
| bit 8 | U:1 | cnoThreshold | - | - | Apply CNO threshold settings (cnoThresh, cnoThreshNumSVs)<br>(not supported for protocol versions less than 14.00) |
| bit 10 | U:1 | utc | - | - | Apply UTC settings |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | (not supported for protocol versions less than 16.00) |
| 2 | U1 | dynModel | - | - | Dynamic platform model:<br>• 0 = portable<br>• 2 = stationary<br>• 3 = pedestrian<br>• 4 = automotive<br>• 5 = sea<br>• 6 = airborne with <1g acceleration<br>• 7 = airborne with <2g acceleration<br>• 8 = airborne with <4g acceleration<br>• 9 = wrist-worn watch (not supported for protocol versions less than 18.00)<br>• 10 = bike (supported for protocol versions 19.20) |
| 3 | U1 | fixMode | - | - | Position fixing mode:<br>• 1 = 2D only<br>• 2 = 3D only<br>• 3 = auto 2D/3D |
| 4 | I4 | fixedAlt | 0.01 | m | Fixed altitude (mean sea level) for 2D fix mode |
| 8 | U4 | fixedAltVar | 0.0001 | m^2 | Fixed altitude variance for 2D mode |
| 12 | I1 | minElev | - | deg | Minimum elevation for a GNSS satellite to be used in NAV |
| 13 | U1 | drLimit | - | s | Reserved (maximum time to perform dead reckoning (linear extrapolation) in case of GPS signal loss, only applicable for protocol versions less than 14.00) |
| 14 | U2 | pDop | 0.1 | - | Position DOP mask to use |
| 16 | U2 | tDop | 0.1 | - | Time DOP mask to use |
| 18 | U2 | pAcc | - | m | Position accuracy mask |
| 20 | U2 | tAcc | - | m | Time accuracy mask |
| 22 | U1 | staticHoldThresh | - | cm/s | Static hold threshold |
| 23 | U1 | dgnssTimeout | - | s | DGNSS timeout<br>(not supported for protocol versions less than 13.00) |
| 24 | U1 | cnoThreshNumSVs | - | - | Number of satellites required to have C/N0 above cnoThresh for a fix to be attempted<br>(not supported for protocol versions less than 14.00) |
| 25 | U1 | cnoThresh | - | dBHz | C/N0 threshold for deciding whether to attempt a fix<br>(not supported for protocol versions less than 14.00) |
| 26 | U1[2] | reserved0 | - | - | Reserved |
| 28 | U2 | staticHoldMaxDist | - | m | Static hold distance threshold (before quitting static hold)<br>(not supported for protocol versions less than 15.00) |

| | | | | | |
|---|---|---|---|---|---|
| 30 | U1 | utcStandard | - | - | UTC standard to be used:<br>• 0 = Automatic; receiver selects based on GNSS configuration (see GNSS time bases)<br>• 3 = UTC as operated by the U.S. Naval Observatory (USNO); derived from GPS time<br>• 5 = UTC as combined from multiple European laboratories; derived from Galileo time<br>• 6 = UTC as operated by the former Soviet Union (SU); derived from GLONASS time<br>• 7 = UTC as operated by the National Time Service Center (NTSC), China; derived from BeiDou time<br>(not supported for protocol versions less than 16.00) |
| 31 | U1[5] | reserved1 | - | - | Reserved |

## 3.10.12 UBX-CFG-NAVX5 (0x06 0x23)

### 3.10.12.1 Navigation engine expert settings

| ***Message*** | **UBX-CFG-NAVX5**<br>**Navigation engine expert settings** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x23 | 40 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U2 | version | - | - | Message version (0x0002 for this version) |
| 2 | X2 | mask1 | - | - | First parameters bitmask. Only the flagged parameters will be applied, unused bits must be set to 0. |
| bit 2 | U:1 | minMax | - | - | 1 = apply min/max SVs settings |
| bit 3 | U:1 | minCno | - | - | 1 = apply minimum C/N0 setting |
| bit 6 | U:1 | initial3dfix | - | - | 1 = apply initial 3D fix settings |
| bit 9 | U:1 | wknRoll | - | - | 1 = apply GPS weeknumber rollover settings |
| bit 10 | U:1 | ackAid | - | - | 1 = apply assistance acknowledgement settings |
| bit 13 | U:1 | ppp | - | - | 1 = apply usePPP flag |
| bit 14 | U:1 | aop | - | - | 1 = apply aopCfg (useAOP flag) and aopOrbMaxErr settings (AssistNow Autonomous) |
| 4 | X4 | mask2 | - | - | Second parameters bitmask. Only the flagged parameters will be applied, unused bits must be set to 0. |
| bit 6 | U:1 | adr | - | - | Apply ADR/UDR sensor fusion on/off setting (useAdr flag) |
| bit 7 | U:1 | sigAttenComp | - | - | Only supported on certain products |
| 8 | U1[2] | reserved0 | - | - | Reserved |
| 10 | U1 | minSVs | - | #SVs | Minimum number of satellites for navigation |
| 11 | U1 | maxSVs | - | #SVs | Maximum number of satellites for navigation |
| 12 | U1 | minCNO | - | dBHz | Minimum satellite signal level for navigation |

| | | | | | |
|---|---|---|---|---|---|
| 13 | U1 | reserved1 | - | - | Reserved |
| 14 | U1 | iniFix3D | - | - | 1 = initial fix must be 3D |
| 15 | U1[2] | reserved2 | - | - | Reserved |
| 17 | U1 | ackAiding | - | - | 1 = issue acknowledgements for assistance message input |
| 18 | U2 | wknRollover | - | - | GPS week rollover number; GPS week numbers will be set correctly from this week up to 1024 weeks after this week. Setting this to 0 reverts to firmware default. |
| 20 | U1 | sigAttenCompMode | - | dBHz | Only supported on certain products |
| 21 | U1 | reserved3 | - | - | Reserved |
| 22 | U1[2] | reserved4 | - | - | Reserved |
| 24 | U1[2] | reserved5 | - | - | Reserved |
| 26 | U1 | usePPP | - | - | 1 = use Precise Point Positioning (only available with the PPP product variant) |
| 27 | U1 | aopCfg | - | - | AssistNow Autonomous configuration |
| bit 0 | U:1 | useAOP | - | - | 1 = enable AssistNow Autonomous |
| 28 | U1[2] | reserved6 | - | - | Reserved |
| 30 | U2 | aopOrbMaxErr | - | m | Maximum acceptable (modeled) AssistNow Autonomous orbit error (valid range = 5..1000, or 0 = reset to firmware default) |
| 32 | U1[4] | reserved7 | - | - | Reserved |
| 36 | U1[3] | reserved8 | - | - | Reserved |
| 39 | U1 | useAdr | - | - | Only supported on certain products |

## 3.10.13 UBX-CFG-NMEA (0x06 0x17)

### 3.10.13.1 Extended NMEA protocol configuration V1

| ***Message*** | **UBX-CFG-NMEA**<br>**Extended NMEA protocol configuration V1** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>Get/set the NMEA protocol configuration. See section NMEA Protocol Configuration for a detailed description of the configuration effects on NMEA output.<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x17 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | X1 | filter | - | - | filter flags |
| bit 0 | U:1 | posFilt | - | - | Enable position output for failed or invalid fixes |
| bit 1 | U:1 | mskPosFilt | - | - | Enable position output for invalid fixes |
| bit 2 | U:1 | timeFilt | - | - | Enable time output for invalid times |
| bit 3 | U:1 | dateFilt | - | - | Enable date output for invalid dates |
| bit 4 | U:1 | gpsOnlyFilter | - | - | Restrict output to GPS satellites only |

| | | | | | | |
|---|---|---|---|---|---|---|
| | bit 5 | U:1 | trackFilt | - | - | Enable COG output even if COG is frozen |
| 1 | | U1 | nmeaVersion | - | - | • 0x4b = NMEA version 4.11 (not available in all products)<br>• 0x41 = NMEA version 4.10 (not available in all products)<br>• 0x40 = NMEA version 4.0 (not available in all products)<br>• 0x23 = NMEA version 2.3<br>• 0x21 = NMEA version 2.1 |
| 2 | | U1 | numSV | - | - | Maximum number of SVs to report per TalkerId.<br>• 0 = unlimited<br>• 8 = 8 SVs<br>• 12 = 12 SVs<br>• 16 = 16 SVs |
| 3 | | X1 | flags | - | - | flags |
| | bit 0 | U:1 | compat | - | - | enable compatibility mode.<br>This might be needed for certain applications when customer's NMEA parser expects a fixed number of digits in position coordinates. |
| | bit 1 | U:1 | consider | - | - | enable considering mode. |
| | bit 2 | U:1 | limit82 | - | - | enable strict limit to 82 characters maximum. |
| | bit 3 | U:1 | highPrec | - | - | enable high precision mode.<br>This flag cannot be set in conjunction with either compatibility mode or Limit82 mode (not supported for protocol versions less than 20.01). |
| 4 | | X4 | gnssToFilter | - | - | Filters out satellites based on their GNSS. If a bitfield is enabled, the corresponding satellites will be not output. |
| | bit 0 | U:1 | gps | - | - | Disable reporting of GPS satellites |
| | bit 1 | U:1 | sbas | - | - | Disable reporting of SBAS satellites |
| | bit 2 | U:1 | galileo | - | - | Disable reporting of Galileo satellites |
| | bit 4 | U:1 | qzss | - | - | Disable reporting of QZSS satellites |
| | bit 5 | U:1 | glonass | - | - | Disable reporting of GLONASS satellites |
| | bit 6 | U:1 | beidou | - | - | Disable reporting of BeiDou satellites |
| 8 | | U1 | svNumbering | - | - | Configures the display of satellites that do not have an NMEA-defined value.<br>Note: this does not apply to satellites with an unknown ID.<br>• 0 = Strict - Satellites are not output<br>• 1 = Extended - Use proprietary numbering (see Satellite Numbering) |

| | | | | | |
|---|---|---|---|---|---|
| 9 | U1 | mainTalkerId | - | - | By default the main Talker ID (i.e. the Talker ID used for all messages other than GSV) is determined by the GNSS assignment of the receiver's channels (see UBX-CFG-GNSS).<br>This field enables the main Talker ID to be overridden.<br>• 0 = Main Talker ID is not overridden<br>• 1 = Set main Talker ID to 'GP'<br>• 2 = Set main Talker ID to 'GL'<br>• 3 = Set main Talker ID to 'GN'<br>• 4 = Set main Talker ID to 'GA' (not supported for protocol versions less than 15.00)<br>• 5 = Set main Talker ID to 'GB' (not supported for protocol versions less than 15.00)<br>• 6 = Set main Talker ID to 'GQ' (available in NMEA 4.11 or later) |
| 10 | U1 | gsvTalkerId | - | - | By default the Talker ID for GSV messages is GNSS-specific (as defined by NMEA).<br>This field enables the GSV Talker ID to be overridden.<br>• 0 = Use GNSS-specific Talker ID (as defined by NMEA)<br>• 1 = Use the main Talker ID |
| 11 | U1 | version | - | - | Message version (0x01 for this version) |
| 12 | CH[2] | bdsTalkerId | - | - | Sets the two characters that should be used for the BeiDou Talker ID. If these are set to zero, then the default BeiDou Talker ID will be used. |
| 14 | U1[6] | reserved0 | - | - | Reserved |

## 3.10.14 UBX-CFG-ODO (0x06 0x1e)

### 3.10.14.1 Odometer, low-speed COG engine settings

| ***Message*** | **UBX-CFG-ODO**<br>**Odometer, low-speed COG engine settings** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>☞ This feature is not supported for the FTS product variant. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x1e | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | version | - | - | Message version (0x00 for this version) |
| 1 | U1[3] | reserved0 | - | - | Reserved |
| 4 | U1 | flags | - | - | Odometer/Low-speed COG filter flags |
| bit 0 | U:1 | useODO | - | - | Odometer-enabled flag |
| bit 1 | U:1 | useCOG | - | - | Low-speed COG filter enabled flag |
| bit 2 | U:1 | outLPVel | - | - | Output low-pass filtered velocity flag |
| bit 3 | U:1 | outLPCog | - | - | Output low-pass filtered heading (COG) flag |
| 5 | X1 | odoCfg | - | - | Odometer filter settings |

| | | | | | |
|---|---|---|---|---|---|
| bits 2...0 | U:3 | profile | - | - | Profile type (0=running, 1=cycling, 2=swimming, 3=car, 4=custom) |
| 6 | U1[6] | reserved1 | - | - | Reserved |
| 12 | U1 | cogMaxSpeed | 1e-1 | m/s | Speed below which course-over-ground (COG) is computed with the low-speed COG filter |
| 13 | U1 | cogMaxPosAcc | - | m | Maximum acceptable position accuracy for computing COG with the low-speed COG filter |
| 14 | U1[2] | reserved2 | - | - | Reserved |
| 16 | U1 | velLpGain | - | - | Velocity low-pass filter level, range 0..255 |
| 17 | U1 | cogLpGain | - | - | COG low-pass filter level (at speed < 8 m/s), range 0..255 |
| 18 | U1[2] | reserved3 | - | - | Reserved |

## 3.10.15 UBX-CFG-PRT (0x06 0x00)

### 3.10.15.1 Polls the configuration for one I/O port

| ***Message*** | **UBX-CFG-PRT**<br>**Polls the configuration for one I/O port** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Poll request | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>Sending this message with a port ID as payload results in having the receiver return the configuration for the specified port. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x00 | 1 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | PortID | - | - | Port identifier number (see the other versions of CFG-PRT for valid values) |

### 3.10.15.2 Port configuration for UART ports

| ***Message*** | **UBX-CFG-PRT**<br>**Port configuration for UART ports** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>Several configurations can be concatenated to one input message. In this case the payload length can be a multiple of the normal length (see the other versions of CFG-PRT). Output messages from the module contain only one configuration unit.<br>Note that this message can affect baud rate and other transmission parameters. Because there may be messages queued for transmission there may be uncertainty about which protocol applies to such messages. In addition a message currently in transmission may be corrupted by a protocol change. Host data reception parameters may have to be changed to be able to receive future messages, including the acknowledge message resulting from the CFG-PRT message. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x00 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| Byte offset | Type | Name | Scale | Unit | Description |
|---|---|---|---|---|---|
| 0 | U1 | portID | - | - | Port identifier number (see Integration manual for valid UART port IDs) |
| 1 | U1 | reserved0 | - | - | Reserved |
| 2 | X2 | txReady | - | - | TX ready PIN configuration (not supported for protocol versions less than 13.01) |
| bit 0 | U:1 | en | - | - | Enable TX ready feature for this port |
| bit 1 | U:1 | pol | - | - | Polarity<br>• 0 High-active<br>• 1 Low-active |
| bits 6...2 | U:5 | pin | - | - | PIO to be used (must not be in use by another function) |
| bits 15...7 | U:9 | thres | - | - | Threshold<br>The given threshold is multiplied by 8 bytes.<br>The TX ready PIN goes active after >= thres*8 bytes are pending for the port and going inactive after the last pending bytes have been written to hardware (0-4 bytes before end of stream).<br>• 0x000 no threshold<br>• 0x001 8byte<br>• 0x002 16byte<br>• ...<br>• 0x1FE 4080byte<br>• 0x1FF 4088byte |
| 4 | X4 | mode | - | - | A bit mask describing the UART mode |
| bits 7...6 | U:2 | charLen | - | - | Character length<br>• 00 5bit (not supported)<br>• 01 6bit (not supported)<br>• 10 7bit (supported only with parity)<br>• 11 8bit |
| bits 11...9 | U:3 | parity | - | - | • 000 Even parity<br>• 001 Odd parity<br>• 10X No parity<br>• X1X Reserved |
| bits 13...12 | U:2 | nStopBits | - | - | Number of Stop bits<br>• 00 1 Stop bit<br>• 01 1.5 Stop bit<br>• 10 2 Stop bit<br>• 11 0.5 Stop bit |
| 8 | U4 | baudRate | - | Bits/s | Baud rate in bits/second |
| 12 | X2 | inProtoMask | - | - | A mask describing which input protocols are active.<br>Each bit of this mask is used for a protocol. Through that, multiple protocols can be defined on a single port. |
| bit 0 | U:1 | inUbx | - | - | UBX protocol |
| bit 1 | U:1 | inNmea | - | - | NMEA protocol |
| bit 2 | U:1 | inRtcm | - | - | RTCM2 protocol |
| bit 5 | U:1 | inRtcm3 | - | - | RTCM3 protocol (not supported for protocol versions less than 20.00) |
| 14 | X2 | outProtoMask | - | - | A mask describing which output protocols are active.<br>Each bit of this mask is used for a protocol. Through that, multiple protocols can be defined on a single port. |
| bit 0 | U:1 | outUbx | - | - | UBX protocol |

| | | | | | | |
|---|---|---|---|---|---|---|
| | bit 1 | U:1 | outNmea | - | - | NMEA protocol |
| | bit 5 | U:1 | outRtcm3 | - | - | RTCM3 protocol (not supported for protocol versions less than 20.00) |
| 16 | | X2 | flags | - | - | Flags bit mask |
| | bit 1 | U:1 | extendedTx Timeout | - | - | Extended TX timeout: if set, the port will time out if allocated TX memory >=4 kB and no activity for 1.5 s. If not set the port will time out if no activity for 1.5 s regardless on the amount of allocated TX memory (not supported for protocol versions less than 13.01). |
| 18 | | U1[2] | reserved1 | - | - | Reserved |

### 3.10.15.3 Port configuration for USB port

| ***Message*** | **UBX-CFG-PRT**<br>**Port configuration for USB port** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>Several configurations can be concatenated to one input message. In this case the payload length can be a multiple of the normal length (see the other versions of CFG-PRT). Output messages from the module contain only one configuration unit. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x00 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | portID | - | - | Port identifier number (= 3 for USB port) |
| 1 | U1 | reserved0 | - | - | Reserved |
| 2 | X2 | txReady | - | - | TX ready PIN configuration (not supported for protocol versions less than 13.01) |
| bit 0 | U:1 | en | - | - | Enable TX ready feature for this port |
| bit 1 | U:1 | pol | - | - | Polarity<br>• 0 High-active<br>• 1 Low-active |
| bits 6...2 | U:5 | pin | - | - | PIO to be used (must not be in use by another function) |
| bits 15...7 | U:9 | thres | - | - | Threshold<br>The given threshold is multiplied by 8 bytes.<br>The TX ready PIN goes active after >= thres*8 bytes are pending for the port and going inactive after the last pending bytes have been written to hardware (0-4 bytes before end of stream).<br>• 0x000 no threshold<br>• 0x001 8byte<br>• 0x002 16byte<br>• ...<br>• 0x1FE 4080byte<br>• 0x1FF 4088byte |
| 4 | U1[8] | reserved1 | - | - | Reserved |
| 12 | X2 | inProtoMask | - | - | A mask describing which input protocols are active.<br>Each bit of this mask is used for a protocol. Through that, multiple protocols can be defined on a single port. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | bit 0 | U:1 | inUbx | - | - | UBX protocol |
| | bit 1 | U:1 | inNmea | - | - | NMEA protocol |
| | bit 2 | U:1 | inRtcm | - | - | RTCM2 protocol |
| | bit 5 | U:1 | inRtcm3 | - | - | RTCM3 protocol (not supported for protocol versions less than 20.00) |
| 14 | | X2 | outProtoMask | - | - | A mask describing which output protocols are active.<br>Each bit of this mask is used for a protocol. Through that, multiple protocols can be defined on a single port. |
| | bit 0 | U:1 | outUbx | - | - | UBX protocol |
| | bit 1 | U:1 | outNmea | - | - | NMEA protocol |
| | bit 5 | U:1 | outRtcm3 | - | - | RTCM3 protocol (not supported for protocol versions less than 20.00) |
| 16 | | U1[2] | reserved2 | - | - | Reserved |
| 18 | | U1[2] | reserved3 | - | - | Reserved |

### 3.10.15.4 Port configuration for SPI port

| ***Message*** | **UBX-CFG-PRT**<br>**Port configuration for SPI port** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>Several configurations can be concatenated to one input message. In this case the payload length can be a multiple of the normal length. Output messages from the module contain only one configuration unit. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x00 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | portID | - | - | Port identifier number (= 4 for SPI port) |
| 1 | U1 | reserved0 | - | - | Reserved |
| 2 | X2 | txReady | - | - | TX ready PIN configuration (not supported for protocol versions less than 13.01) |
| bit 0 | U:1 | en | - | - | Enable TX ready feature for this port |
| bit 1 | U:1 | pol | - | - | Polarity<br>• 0 High-active<br>• 1 Low-active |
| bits 6...2 | U:5 | pin | - | - | PIO to be used (must not be in use by another function) |
| bits 15...7 | U:9 | thres | - | - | Threshold<br>The given threshold is multiplied by 8 bytes.<br>The TX ready PIN goes active after >= thres*8 bytes are pending for the port and going inactive after the last pending bytes have been written to hardware (0-4 bytes before end of stream).<br>• 0x000 no threshold<br>• 0x001 8byte<br>• 0x002 16byte<br>• ...<br>• 0x1FE 4080byte<br>• 0x1FF 4088byte |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | | X4 | mode | - | - | SPI Mode Flags |
| | bits 2...1 | U:2 | spiMode | - | - | • 00 SPI Mode 0: CPOL = 0, CPHA = 0<br>• 01 SPI Mode 1: CPOL = 0, CPHA = 1<br>• 10 SPI Mode 2: CPOL = 1, CPHA = 0<br>• 11 SPI Mode 3: CPOL = 1, CPHA = 1 |
| | bits 13...8 | U:6 | ffCnt | - | - | Number of bytes containing 0xFF to receive before switching off reception. Range: 0 (mechanism off) - 63 |
| 8 | | U1[4] | reserved1 | - | - | Reserved |
| 12 | | X2 | inProtoMask | - | - | A mask describing which input protocols are active.<br>Each bit of this mask is used for a protocol. Through that, multiple protocols can be defined on a single port.<br>(The bitfield inRtcm3 is not supported for protocol versions less than 20.00) |
| | bit 0 | U:1 | inUbx | - | - | |
| | bit 1 | U:1 | inNmea | - | - | |
| | bit 2 | U:1 | inRtcm | - | - | |
| | bit 5 | U:1 | inRtcm3 | - | - | |
| 14 | | X2 | outProtoMask | - | - | A mask describing which output protocols are active.<br>Each bit of this mask is used for a protocol. Through that, multiple protocols can be defined on a single port.<br>(The bitfield outRtcm3 is not supported for protocol versions less than 20.00) |
| | bit 0 | U:1 | outUbx | - | - | |
| | bit 1 | U:1 | outNmea | - | - | |
| | bit 5 | U:1 | outRtcm3 | - | - | |
| 16 | | X2 | flags | - | - | Flags bit mask |
| | bit 1 | U:1 | extendedTx Timeout | - | - | Extended TX timeout: if set, the port will time out if allocated TX memory >=4 kB and no activity for 1.5 s.<br>(not supported for protocol versions less than 13.01) |
| 18 | | U1[2] | reserved2 | - | - | Reserved |

### 3.10.15.5 Port configuration for I2C (DDC) port

| ***Message*** | **UBX-CFG-PRT**<br>**Port configuration for I2C (DDC) port** |
|---|---|
| *Type* | Get/set |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>Several configurations can be concatenated to one input message. In this case the payload length can be a multiple of the normal length (see the other versions of CFG-PRT). Output messages from the module contain only one configuration unit. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x06 | 0x00 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | portID | - | - | Port identifier number (= 0 for I2C (DDC) port) |
| 1 | U1 | reserved0 | - | - | Reserved |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | | X2 | txReady | - | - | TX ready PIN configuration (not supported for protocol versions less than 13.01) |
| | bit 0 | U:1 | en | - | - | Enable TX ready feature for this port |
| | bit 1 | U:1 | pol | - | - | Polarity<br>• 0 High-active<br>• 1 Low-active |
| | bits 6...2 | U:5 | pin | - | - | PIO to be used (must not be in use by another function) |
| | bits 15...7 | U:9 | thres | - | - | Threshold<br>The given threshold is multiplied by 8 bytes.<br>The TX ready PIN goes active after >= thres*8 bytes are pending for the port and going inactive after the last pending bytes have been written to hardware (0-4 bytes before end of stream).<br>• 0x000 no threshold<br>• 0x001 8byte<br>• 0x002 16byte<br>• ...<br>• 0x1FE 4080byte<br>• 0x1FF 4088byte |
| 4 | | X4 | mode | - | - | I2C (DDC) Mode Flags |
| | bits 7...1 | U:7 | slaveAddr | - | - | Slave address<br>Range: 0x07 < slaveAddr < 0x78. Bit 0 must be 0 |
| 8 | | U1[4] | reserved1 | - | - | Reserved |
| 12 | | X2 | inProtoMask | - | - | A mask describing which input protocols are active.<br>Each bit of this mask is used for a protocol. Through that, multiple protocols can be defined on a single port.<br>(The bitfield inRtcm3 is not supported for protocol versions less than 20.00) |
| | bit 0 | U:1 | inUbx | - | - | |
| | bit 1 | U:1 | inNmea | - | - | |
| | bit 2 | U:1 | inRtcm | - | - | |
| | bit 5 | U:1 | inRtcm3 | - | - | |
| 14 | | X2 | outProtoMask | - | - | A mask describing which output protocols are active.<br>Each bit of this mask is used for a protocol. Through that, multiple protocols can be defined on a single port.<br>(The bitfield outRtcm3 is not supported for protocol versions less than 20.00) |
| | bit 0 | U:1 | outUbx | - | - | |
| | bit 1 | U:1 | outNmea | - | - | |
| | bit 5 | U:1 | outRtcm3 | - | - | |
| 16 | | X2 | flags | - | - | Flags bit mask |
| | bit 1 | U:1 | extendedTx Timeout | - | - | Extended TX timeout: if set, the port will time out if allocated TX memory >=4 kB and no activity for 1.5 s (not supported for protocol versions less than 13.01). |
| 18 | | U1[2] | reserved2 | - | - | Reserved |

## 3.10.16 UBX-CFG-PWR (0x06 0x57)

### 3.10.16.1 Put receiver in a defined power state

| ***Message*** | **UBX-CFG-PWR**<br>**Put receiver in a defined power state** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Set | | | | | |
| *Comment* | ☞ This message is deprecated in protocol versions greater than 17. Use UBX-CFG-RST for GNSS start/stop and UBX-RXM-PMREQ for software backup. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x57 | 8 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `version` | - | - | Message version (0x01 for this version) |
| 1 | U1[3] | `reserved0` | - | - | Reserved |
| 4 | U4 | `state` | - | - | Enter system state<br>• 0x52554E20 = GNSS running<br>• 0x53544F50 = GNSS stopped<br>• 0x42434B50 = Software backup. USB interface will be disabled, other wakeup source is needed. |

## 3.10.17 UBX-CFG-RATE (0x06 0x08)

### 3.10.17.1 Navigation/measurement rate settings

| ***Message*** | **UBX-CFG-RATE**<br>**Navigation/measurement rate settings** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>This message allows the user to alter the rate at which navigation solutions (and the measurements that they depend on) are generated by the receiver. The calculation of the navigation solution will always be aligned to the top of a second zero (first second of the week) of the configured reference time system.<br>(Navigation period is an integer multiple of the measurement period for protocol versions greater than 17.00).<br>• Each measurement triggers the measurements generation and, if available, raw data output.<br>• The navRate value defines that every nth measurement triggers a navigation epoch.<br>• The update rate has a direct influence on the power consumption. The more fixes that are required, the more CPU power and communication resources are required.<br>• For most applications a 1 Hz update rate would be sufficient.<br>• When using power save mode, measurement and navigation rate can differ from the values configured here. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x08 | 6 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U2 | `measRate` | - | ms | The elapsed time between GNSS measurements, which defines the rate, e.g. 100 ms => 10 Hz, 1000 ms => 1 Hz, 10000 ms => 0.1 Hz. Measurement rate should be greater than or equal to 25 ms. (Measurement rate should be greater than or equal to 50 ms for protocol versions less than 24.00). |

| | | | | | |
|---|---|---|---|---|---|
| 2 | U2 | navRate | - | cycles | The ratio between the number of measurements and the number of navigation solutions, e.g. 5 means five measurements for every navigation solution. Maximum value is 127. (This parameter is ignored and the navRate is fixed to 1 for protocol versions less than 18.00). |
| 4 | U2 | timeRef | - | - | The time system to which measurements are aligned:<br>• 0 = UTC time<br>• 1 = GPS time<br>• 2 = GLONASS time (not supported for protocol versions less than 18.00)<br>• 3 = BeiDou time (not supported for protocol versions less than 18.00)<br>• 4 = Galileo time (not supported for protocol versions less than 18.00) |

## 3.10.18 UBX-CFG-RINV (0x06 0x34)

### 3.10.18.1 Contents of remote inventory

| ***Message*** | **UBX-CFG-RINV**<br>**Contents of remote inventory** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>If *N* is greater than 30, the excess bytes are discarded.<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x34 | 1 + [0..n] | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | X1 | flags | - | - | Flags |
| bit 0 | U:1 | dump | - | - | Dump data at startup. Does not work if flag binary is set. |
| bit 1 | U:1 | binary | - | - | Data is binary. |
| *Start of repeated group (N times)* | | | | | |
| 1 + n | U1 | data | - | - | Data to store/stored in remote inventory. |
| *End of repeated group (N times)* | | | | | |

## 3.10.19 UBX-CFG-RST (0x06 0x04)

### 3.10.19.1 Reset receiver / Clear backup data structures

| ***Message*** | **UBX-CFG-RST**<br>**Reset receiver / Clear backup data structures** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Command | | | | | |
| *Comment* | Do not expect this message to be acknowledged by the receiver.<br>• Newer FW version will not acknowledge this message at all.<br>• Older FW version will acknowledge this message but the acknowledge may not be sent completely before the receiver is reset. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x04 | 4 | *see below* | CK_A CK_B |

| *Payload description:* | | | | | |
|---|---|---|---|---|---|
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | X2 | navBbrMask | - | - | BBR sections to clear. The following special sets apply:<br>• 0x0000 Hot start<br>• 0x0001 Warm start<br>• 0xFFFF Cold start |
| bit 0 | U:1 | eph | - | - | Ephemeris |
| bit 1 | U:1 | alm | - | - | Almanac |
| bit 2 | U:1 | health | - | - | Health |
| bit 3 | U:1 | klob | - | - | Klobuchar parameters |
| bit 4 | U:1 | pos | - | - | Position |
| bit 5 | U:1 | clkd | - | - | Clock drift |
| bit 6 | U:1 | osc | - | - | Oscillator parameter |
| bit 7 | U:1 | utc | - | - | UTC correction + GPS leap seconds parameters |
| bit 8 | U:1 | rtc | - | - | RTC |
| bit 15 | U:1 | aop | - | - | Autonomous orbit parameters |
| 2 | U1 | resetMode | - | - | Reset Type<br>• 0x00 = Hardware reset (watchdog) immediately<br>• 0x01 = Controlled software reset<br>• 0x02 = Controlled software reset (GNSS only)<br>• 0x04 = Hardware reset (watchdog) after shutdown<br>• 0x08 = Controlled GNSS stop<br>• 0x09 = Controlled GNSS start |
| 3 | U1 | reserved0 | - | - | Reserved |

## 3.10.20 UBX-CFG-SBAS (0x06 0x16)

### 3.10.20.1 SBAS configuration

| ***Message*** | **UBX-CFG-SBAS**<br>**SBAS configuration** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>This message configures the SBAS receiver subsystem (i.e. WAAS, EGNOS, MSAS).<br>See the SBAS configuration settings description in the Integration manual for a detailed description of how these settings affect receiver operation. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x16 | 8 | *see below* | CK_A CK_B |

| *Payload description:* | | | | | |
|---|---|---|---|---|---|
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | X1 | mode | - | - | SBAS mode |
| bit 0 | U:1 | enabled | - | - | SBAS enabled (1) / disabled (0) - This field is deprecated; use UBX-CFG-GNSS to enable/disable SBAS operation |
| bit 1 | U:1 | test | - | - | SBAS testbed: Use data anyhow (1) / Ignore data when in test mode (SBAS msg 0) |
| 1 | X1 | usage | - | - | SBAS usage |

| | | | | | | |
|---|---|---|---|---|---|---|
| | bit 0 | U:1 | range | - | - | Use SBAS GEOs as a ranging source (for navigation) |
| | bit 1 | U:1 | diffCorr | - | - | Use SBAS differential corrections |
| | bit 2 | U:1 | integrity | - | - | Use SBAS integrity information. If enabled, the receiver will only use GPS satellites for which integrity information is available. |
| 2 | | U1 | maxSBAS | - | - | Maximum number of SBAS prioritized tracking channels (valid range: 0 - 3) to use (obsolete and superseded by UBX-CFG-GNSS for protocol versions 14.00+). |
| 3 | | X1 | scanmode2 | - | - | Continuation of scanmode bitmask below |
| | bit 0 | U:1 | PRN152 | - | - | |
| | bit 1 | U:1 | PRN153 | - | - | |
| | bit 2 | U:1 | PRN154 | - | - | |
| | bit 3 | U:1 | PRN155 | - | - | |
| | bit 4 | U:1 | PRN156 | - | - | |
| | bit 5 | U:1 | PRN157 | - | - | |
| | bit 6 | U:1 | PRN158 | - | - | |
| 4 | | X4 | scanmode1 | - | - | Which SBAS PRN numbers to search for (bitmask).<br>If all bits are set to zero, auto-scan (i.e. all valid PRNs) are searched.<br>Every bit corresponds to a PRN number. |
| | bit 0 | U:1 | PRN120 | - | - | |
| | bit 1 | U:1 | PRN121 | - | - | |
| | bit 2 | U:1 | PRN122 | - | - | |
| | bit 3 | U:1 | PRN123 | - | - | |
| | bit 4 | U:1 | PRN124 | - | - | |
| | bit 5 | U:1 | PRN125 | - | - | |
| | bit 6 | U:1 | PRN126 | - | - | |
| | bit 7 | U:1 | PRN127 | - | - | |
| | bit 8 | U:1 | PRN128 | - | - | |
| | bit 9 | U:1 | PRN129 | - | - | |
| | bit 10 | U:1 | PRN130 | - | - | |
| | bit 11 | U:1 | PRN131 | - | - | |
| | bit 12 | U:1 | PRN132 | - | - | |
| | bit 13 | U:1 | PRN133 | - | - | |
| | bit 14 | U:1 | PRN134 | - | - | |
| | bit 15 | U:1 | PRN135 | - | - | |
| | bit 16 | U:1 | PRN136 | - | - | |
| | bit 17 | U:1 | PRN137 | - | - | |
| | bit 18 | U:1 | PRN138 | - | - | |
| | bit 19 | U:1 | PRN139 | - | - | |
| | bit 20 | U:1 | PRN140 | - | - | |
| | bit 21 | U:1 | PRN141 | - | - | |
| | bit 22 | U:1 | PRN142 | - | - | |

| | | | | |
|---|---|---|---|---|
| bit 23 | U:1 | PRN143 | - | - |
| bit 24 | U:1 | PRN144 | - | - |
| bit 25 | U:1 | PRN145 | - | - |
| bit 26 | U:1 | PRN146 | - | - |
| bit 27 | U:1 | PRN147 | - | - |
| bit 28 | U:1 | PRN148 | - | - |
| bit 29 | U:1 | PRN149 | - | - |
| bit 30 | U:1 | PRN150 | - | - |
| bit 31 | U:1 | PRN151 | - | - |

## 3.10.21 UBX-CFG-TMODE3 (0x06 0x71)

### 3.10.21.1 Time mode settings 3

| ***Message*** | **UBX-CFG-TMODE3**<br>**Time mode settings 3** |
|---|---|
| *Type* | Get/set |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item.<br>Configures the receiver to be in Time Mode. The position referred to in this message is that of the Antenna Reference Point (ARP).<br>Note that using UBX-CFG-TMODE3 to set the receiver mode to Survey In or to Fixed Mode, will set automatically the dynamic platform model (CFG-NAVSPG-DYNMODEL) to Stationary. Note that using UBX-CFG-TMODE3 to set the receiver mode to Disabled, will set automatically the dynamic platform model (CFG-NAVSPG-DYNMODEL) to Portable. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x06 | 0x71 | 40 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | version | - | - | Message version (0x00 for this version) |
| 1 | U1 | reserved0 | - | - | Reserved |
| 2 | X2 | flags | - | - | Receiver mode flags |
| bits 7...0 | U:8 | mode | - | - | Receiver Mode:<br>• 0 Disabled<br>• 1 Survey In<br>• 2 Fixed Mode (true ARP position information required)<br>• 3-255 Reserved |
| bit 8 | U:1 | lla | - | - | Position is given in LAT/LON/ALT (default is ECEF) |
| 4 | I4 | ecefXOrLat | - | cm_or_deg*1e-7 | WGS84 ECEF X coordinate (or latitude) of the ARP position, depending on flags above |
| 8 | I4 | ecefYOrLon | - | cm_or_deg*1e-7 | WGS84 ECEF Y coordinate (or longitude) of the ARP position, depending on flags above |
| 12 | I4 | ecefZOrAlt | - | cm | WGS84 ECEF Z coordinate (or altitude) of the ARP position, depending on flags above |

| | | | | | |
|---|---|---|---|---|---|
| 16 | I1 | ecefXOrLatHP | - | 0.1_mm_or_deg *1e-9 | High-precision WGS84 ECEF X coordinate (or latitude) of the ARP position, depending on flags above. Must be in the range -99..+99.<br>The precise WGS84 ECEF X coordinate in units of cm, or the precise WGS84 ECEF latitude in units of 1e-7 degrees, is given by<br>ecefXOrLat + (ecefXOrLatHP * 1e-2) |
| 17 | I1 | ecefYOrLonHP | - | 0.1_mm_or_deg *1e-9 | High-precision WGS84 ECEF Y coordinate (or longitude) of the ARP position, depending on flags above. Must be in the range -99..+99.<br>The precise WGS84 ECEF Y coordinate in units of cm, or the precise WGS84 ECEF longitude in units of 1e-7 degrees, is given by<br>ecefYOrLon + (ecefYOrLonHP * 1e-2) |
| 18 | I1 | ecefZOrAltHP | - | 0.1_mm | High-precision WGS84 ECEF Z coordinate (or altitude) of the ARP position, depending on flags above. Must be in the range -99..+99.<br>The precise WGS84 ECEF Z coordinate, or altitude coordinate, in units of cm is given by<br>ecefZOrAlt + (ecefZOrAltHP * 1e-2) |
| 19 | U1 | reserved1 | - | - | Reserved |
| 20 | U4 | fixedPosAcc | - | 0.1_mm | Fixed position 3D accuracy |
| 24 | U4 | svinMinDur | - | s | Survey-in minimum duration |
| 28 | U4 | svinAccLimit | - | 0.1_mm | Survey-in position accuracy limit |
| 32 | U1[8] | reserved2 | - | - | Reserved |

## 3.10.22 UBX-CFG-TP5 (0x06 0x31)

### 3.10.22.1 Time pulse parameters

| ***Message*** | **UBX-CFG-TP5**<br>**Time pulse parameters** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 27. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x31 | 32 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | tpIdx | - | - | Time pulse selection (0 = TIMEPULSE, 1 = TIMEPULSE2) |
| 1 | U1 | version | - | - | Message version (0x01 for this version) |
| 2 | U1[2] | reserved0 | - | - | Reserved |
| 4 | I2 | antCableDelay | - | ns | Antenna cable delay |
| 6 | I2 | rfGroupDelay | - | ns | RF group delay |
| 8 | U4 | freqPeriod | - | Hz_or_us | Frequency or period time, depending on setting of bit 'isFreq' |
| 12 | U4 | freqPeriodLock | - | Hz_or_us | Frequency or period time when locked to GNSS time, only used if 'lockedOtherSet' is set |

| | | | | | | |
|---|---|---|---|---|---|---|
| 16 | | U4 | pulseLenRatio | - | us_or_2^-32 | Pulse length or duty cycle, depending on 'isLength' |
| 20 | | U4 | pulseLenRatioLock | - | us_or_2^-32 | Pulse length or duty cycle when locked to GNSS time, only used if 'lockedOtherSet' is set |
| 24 | | I4 | userConfigDelay | - | ns | User-configurable time pulse delay |
| 28 | | X4 | flags | - | - | Configuration flags |
| | bit 0 | U:1 | active | - | - | If set enable time pulse; if pin assigned to another function, other function takes precedence.<br>Must be set for FTS variant. |
| | bit 1 | U:1 | lockGnssFreq | - | - | If set, synchronize time pulse to GNSS as soon as GNSS time is valid. If not set, or before GNSS time is valid, use local clock.<br>This flag is ignored by the FTS product variant; in this case the receiver always locks to the best available time/frequency reference (which is not necessarily GNSS).<br>This flag can be unset only in Timing product variants. |
| | bit 2 | U:1 | lockedOtherSet | - | - | If set the receiver switches between the timepulse settings given by 'freqPeriodLocked' & 'pulseLenLocked' and those given by 'freqPeriod' & 'pulseLen'. The 'Locked' settings are used where the receiver has an accurate sense of time. For non-FTS products, this occurs when GNSS solution with a reliable time is available, but for FTS products the setting syncMode field governs behavior. In all cases, the receiver only uses 'freqPeriod' & 'pulseLen' when the flag is unset. |
| | bit 3 | U:1 | isFreq | - | - | If set 'freqPeriodLock' and 'freqPeriod' are interpreted as frequency, otherwise interpreted as period. |
| | bit 4 | U:1 | isLength | - | - | If set 'pulseLenRatioLock' and 'pulseLenRatio' interpreted as pulse length, otherwise interpreted as duty cycle. |
| | bit 5 | U:1 | alignToTow | - | - | Align pulse to top of second (period time must be integer fraction of 1s).<br>Also set 'lockGnssFreq' to use this feature.<br>This flag is ignored by the FTS product variant; it is assumed to be always set (as is lockGnssFreq). Set maxSlewRate and maxPhaseCorrRate fields of **UBX-CFG-SMGR** to 0 to disable alignment. |
| | bit 6 | U:1 | polarity | - | - | Pulse polarity:<br>• 0 = falling edge at top of second<br>• 1 = rising edge at top of second |
| | bits 10...7 | U:4 | gridUtcGnss | - | - | Timegrid to use:<br>• 0 = UTC<br>• 1 = GPS<br>• 2 = GLONASS<br>• 3 = BeiDou<br>• 4 = Galileo (not supported for protocol versions less than 18.00)<br>This flag is only relevant if 'lockGnssFreq' and 'alignToTow' are set.<br>Note that configured GNSS time is estimated by the receiver if locked to any GNSS system. If the receiver has a valid GNSS fix it will attempt to steer the TP |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | to the specified time grid even if the specified time is not based on information from the constellation's satellites. To ensure timing based purely on a given GNSS, restrict the supported constellations in UBX-CFG-GNSS. |
| bits 13...11 | U:3 | syncMode | - | - | Sync Manager lock mode to use:<br>• 0 = switch to 'freqPeriodLock' and 'pulseLenRatioLock' as soon as Sync Manager has an accurate time, never switch back to 'freqPeriod' and 'pulseLenRatio'<br>• 1 = switch to 'freqPeriodLock' and 'pulseLenRatioLock' as soon as Sync Manager has an accurate time, and switch back to 'freqPeriod' and 'pulseLenRatio' as soon as time gets inaccurate<br>This field is only relevant for the FTS product variant.<br>This field is only relevant if the flag 'lockedOtherSet' is set. |

## 3.10.23 UBX-CFG-USB (0x06 0x1b)

### 3.10.23.1 USB configuration

| ***Message*** | **UBX-CFG-USB**<br>**USB configuration** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Get/set | | | | | |
| *Comment* | **This message is deprecated in protocol versions greater than 23.01. Use** UBX-CFG-VALSET, UBX-CFG-VALGET, UBX-CFG-VALDEL **instead.**<br>See the Legacy UBX Message Fields Reference for the corresponding configuration item. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x06 | 0x1b | 108 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U2 | vendorID | - | - | Vendor ID. This field shall only be set to registered Vendor IDs. Changing this field requires special Host drivers. |
| 2 | U2 | productID | - | - | Product ID. Changing this field requires special Host drivers. |
| 4 | U1[2] | reserved0 | - | - | Reserved |
| 6 | U1[2] | reserved1 | - | - | Reserved |
| 8 | U2 | power Consumption | - | mA | Power consumed by the device |
| 10 | X2 | flags | - | - | various configuration flags |
| bit 0 | U:1 | reEnum | - | - | force re-enumeration |
| bit 1 | U:1 | powerMode | - | - | self-powered (1), bus-powered (0) |
| 12 | CH[32] | vendorString | - | - | String containing the vendor name. 32 ASCII bytes including 0-termination. |
| 44 | CH[32] | productString | - | - | String containing the product name. 32 ASCII bytes including 0-termination. |

| | | | | | |
|---|---|---|---|---|---|
| 76 | CH[32] | serialNumber | - | - | String containing the serial number. 32 ASCII bytes including 0-termination.<br>Changing the String fields requires special Host drivers. |

## 3.10.24 UBX-CFG-VALDEL (0x06 0x8c)

### 3.10.24.1 Delete configuration item values

| ***Message*** | **UBX-CFG-VALDEL**<br>**Delete configuration item values** |
|---|---|
| *Type* | Set |
| *Comment* | Overview:<br>• This message can be used to delete saved configuration to effectively revert the item values to defaults.<br>• This message can delete saved configuration from the flash configuration layer and the BBR configuration layer. The changes will not be effective until these layers are loaded into the RAM layer.<br>• This message is limited to containing a maximum of 64 keys up for deletion; i.e. N is a maximum of 64.<br>• This message can be used multiple times and every time the result will be applied immediately. To send this message multiple times with the result being applied at the end, see version 1 of UBX-CFG-VALDEL that supports transactions.<br>• This message does not check if the resulting configuration is valid.<br>• See Receiver configuration for details.<br>This message returns a UBX-ACK-NAK and no configuration is applied:<br>• if any key is unknown to the receiver FW<br>• if the layer's bitfield does not specify a layer to delete a value from.<br>Notes:<br>• If a key is sent multiple times within the same message, then the value is effectively deleted only once.<br>• Attempting to delete items that have not been set before, or that have already been deleted, is considered a valid request. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x06 | 0x8c | 4 + [0..n]·4 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | version | - | - | Message version (0x00 for this version) |
| 1 | X1 | layers | - | - | The layers where the configuration should be deleted from |
| bit 1 | U:1 | bbr | - | - | Delete configuration from the BBR layer |
| bit 2 | U:1 | flash | - | - | Delete configuration from the Flash layer |
| 2 | U1[2] | reserved0 | - | - | Reserved |
| *Start of repeated group (N times)* | | | | | |
| 4 + n·4 | U4 | keys | - | - | Configuration key IDs of the configuration items to be deleted |
| *End of repeated group (N times)* | | | | | |

### 3.10.24.2 Delete configuration item values (with transaction)

| ***Message*** | **UBX-CFG-VALDEL**<br>**Delete configuration item values (with transaction)** |
|---|---|
| *Type* | Set |
| *Comment* | Overview:<br>• This message can be used to delete saved configuration to effectively revert them to defaults.<br>• This message can delete saved configuration from the flash configuration layer and the BBR configuration layer. The changes will not be effective until these layers are loaded into the RAM layer. |

- This message is limited to containing a maximum of 64 keys up for deletion; i.e. N is a maximum of 64.
- This message can be used multiple times with the result being managed within a transaction.
- This message does not check if the resulting configuration is valid.
- See Receiver configuration for details.
- See version 0 of UBX-CFG-VALDEL for simplified version of this message.

This message returns a UBX-ACK-NAK, cancels any started transaction, and no configuration is applied:

- if any key within a transaction is unknown to the receiver FW
- if an invalid transaction state transition is requested
- if the layer's bitfield changes within a transaction
- if the layer's bitfield does not specify a layer to delete a value from.

Notes:

- Any request for another UBX-CFG- message type (including UBX-CFG-VALSET and UBX-CFG-VALGET) will cancel any started transaction, and no configuration is applied.
- This message can be sent with no keys to delete for the purposes of managing the transaction state transition.
- If a key is sent multiple times within the same message or within the same transaction, then the value is effectively deleted only once.
- Attempting to delete items that have not been set before, or that have already been deleted, is considered a valid request.

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x06 | 0x8c | 4 + [0..n]·4 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `version` | - | - | Message version (0x01 for this version) |
| 1 | X1 | `layers` | - | - | The layers where the configuration should be deleted from |
| bit 1 | $U_{:1}$ | `bbr` | - | - | Delete configuration from the BBR layer |
| bit 2 | $U_{:1}$ | `flash` | - | - | Delete configuration from the Flash layer |
| 2 | X1 | `transaction` | - | - | Transaction action to be applied: |
| bits 1...0 | $U_{:2}$ | `action` | - | - | Transaction action to be applied:<br>• 0 = Transactionless UBX-CFG-VALDEL: In the next UBX-CFG-VALDEL, it can be either 0 or 1. If a transaction has not yet been started, the incoming configuration is applied. If a transaction has already been started, cancels any started transaction and the incoming configuration is applied.<br>• 1 = (Re)Start deletion transaction: In the next UBX-CFG-VALDEL, it can be either 0, 1, 2 or 3. If a transaction has not yet been started, a transaction will be started. If a transaction has already been started, restarts the transaction, effectively removing all previous non-applied UBX-CFG-VALDEL messages.<br>• 2 = Deletion transaction ongoing: In the next UBX-CFG-VALDEL, it can be either 0, 1, 2 or 3.<br>• 3 = Apply and end a deletion transaction: In the next UBX-CFG-VALDEL, it can be either 0 or 1. |
| 3 | U1 | `reserved0` | - | - | Reserved |
| *Start of repeated group (N times)* | | | | | |
| 4 + n·4 | U4 | `keys` | - | - | Configuration key IDs of the configuration items to be deleted |
| *End of repeated group (N times)* | | | | | |

## 3.10.25 UBX-CFG-VALGET (0x06 0x8b)

### 3.10.25.1 Get configuration items

| ***Message*** | **UBX-CFG-VALGET**<br>**Get configuration items** |
|---|---|
| *Type* | Poll request |
| *Comment* | Overview:<br>• This message is used to get configuration values by providing a list of configuration key IDs, which identify the configuration items to retrieve.<br>• This message can specify the configuration layer where the values of the specified configuration items are retrieved from.<br>• This message is limited to containing a maximum of 64 key IDs.<br>• See Receiver configuration for details.<br>This message returns a UBX-ACK-NAK:<br>• if any key is unknown to the receiver FW<br>• if the layer field specifies an invalid layer to get the value from<br>• if the keys array specifies more than 64 key IDs.<br>Notes:<br>• If a value is requested multiple times within the same poll request, then the reply will contain it multiple times.<br>• The provided keys can be complete key values (group and item specifiers) or wild-card specifications. A complete key value will constitute a request for one key-value pair. A key value that has a valid group specifier and 0xffff in the item part of the key value (bits 0-15) constitutes a request for all items in the specified group. A key with a value of 0xfff in the group part of the key value (bits 16-27) is a request for all items known to the receiver in all groups.<br>• The response message is limited to containing a maximum of 64 key-value pairs. If there are wild-card specifications then there may be more than 64 possible responses. In order to handle this, the 'position' field can specify that the response message should skip this number of key-value pairs before it starts constructing the message. This allows a large set of values to be retrieved 64 at a time. If the response contains less than 64 key-value pairs then all values have been reported, otherwise there may be more to read.<br>• It is not possible to retrieve configuration values for the same configuration item from multiple configuration layers. Separate poll requests must be made for each desired layer. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x06 | 0x8b | 4 + [0..n]·4 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 1 | U1 | `layer` | - | - | The layer from which the configuration items should be retrieved:<br>• 0 - RAM layer<br>• 1 - BBR layer<br>• 2 - Flash layer<br>• 7 - Default layer |
| 2 | U2 | `position` | - | - | Skip this many key values before constructing output message |
| *Start of repeated group (N times)* | | | | | |
| 4 + n·4 | U4 | `keys` | - | - | Configuration key IDs of the configuration items to be retrieved |
| *End of repeated group (N times)* | | | | | |

### 3.10.25.2 Configuration items

| ***Message*** | **UBX-CFG-VALGET**<br>**Configuration items** |
|---|---|
| *Type* | Polled |
| *Comment* | This message is output by the receiver to return requested configuration data (key and value pairs). |

See Receiver configuration for details.

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x06 | 0x8b | 4 + [0..n] | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `version` | - | - | Message version (0x01 for this version) |
| 1 | U1 | `layer` | - | - | The layer from which the configuration item was retrieved:<br>• 0 - RAM layer<br>• 1 - BBR<br>• 2 - Flash<br>• 7 - Default |
| 2 | U2 | `position` | - | - | Number of configuration items skipped in the result set before constructing this message (mirrors the equivalent field in the request message) |
| *Start of repeated group (N times)* | | | | | |
| 4 + n | U1 | `cfgData` | - | - | Configuration data (key and value pairs) |
| *End of repeated group (N times)* | | | | | |

## 3.10.26 UBX-CFG-VALSET (0x06 0x8a)

### 3.10.26.1 Set configuration item values

| ***Message*** | **UBX-CFG-VALSET**<br>**Set configuration item values** |
|---|---|
| *Type* | Set |
| *Comment* | Overview:<br>• This message is used to set a configuration by providing configuration data (a list of key and value pairs), which identify the configuration items to change, and their new values.<br>• This message is limited to containing a maximum of 64 key-value pairs.<br>• This message can be used multiple times and every time the result will be applied immediately. To send this message multiple times with the result being applied at the end, see version 1 of UBX-CFG-VALSET that supports transactions.<br>• See Receiver configuration for details.<br>This message returns a UBX-ACK-NAK and no configuration is applied:<br>• if any key is unknown to the receiver FW<br>• if the layer's bitfield does not specify a layer to save a value to<br>• if the requested configuration is not valid. The validity of a configuration is checked only if the message requests to apply the configuration to the RAM configuration layer.<br>Notes:<br>• If a key is sent multiple times within the same message, then the value eventually being applied is the last sent. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x06 | 0x8a | 4 + [0..n] | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 1 | X1 | `layers` | - | - | The layers where the configuration should be applied |
| bit 0 | U:1 | `ram` | - | - | Update configuration in the RAM layer |
| bit 1 | U:1 | `bbr` | - | - | Update configuration in the BBR layer |
| bit 2 | U:1 | `flash` | - | - | Update configuration in the Flash layer |

| | | | | | |
|---|---|---|---|---|---|
| 2 | U1[2] | reserved0 | - | - | Reserved |
| *Start of repeated group (N times)* | | | | | |
| 4 + n | U1 | cfgData | - | - | Configuration data (key and value pairs) |
| *End of repeated group (N times)* | | | | | |

### 3.10.26.2 Set configuration item values (with transaction)

| | |
|---|---|
| ***Message*** | **UBX-CFG-VALSET**<br>**Set configuration item values (with transaction)** |
| *Type* | Set |
| *Comment* | Overview:<br>• This message is used to set a configuration by providing configuration data (a list of key and value pairs), which identify the configuration items to change, and their new values.<br>• This message is limited to containing a maximum of 64 key-value pairs.<br>• This message can be used multiple times with the result being managed within a transaction. Within a transaction there is no limit on the number key-value pairs; a transaction is effectively limited to the number of known keys.<br>• See Receiver configuration for details.<br>• See version 0 of UBX-CFG-VALSET for simplified version of this message.<br>This message returns a UBX-ACK-NAK, cancels any started transaction, and no configuration is applied:<br>• if any key within a transaction is unknown to the receiver FW<br>• if an invalid transaction state transition is requested<br>• if the layer's bitfield changes within a transaction<br>• if the layer's bitfield does not specify a layer to save a value to<br>This message returns a UBX-ACK-NAK, and no configuration is applied:<br>• if the requested configuration is not valid. While in a transaction context, only the last message that requests to apply the transaction returns a UBX-ACK-NAK. The validity of a configuration is checked only if the message requests to apply the configuration to the RAM configuration layer. This also applies to a transactionless request.<br>Notes:<br>• Any request for another UBX-CFG-message type (including UBX-CFG-VALDEL and UBX-CFG-VALGET) will cancel any started transaction, and no configuration is applied.<br>• This message can be sent with no key/values to set for the purposes of managing the transaction state transition.<br>• If a key is sent multiple times within the same message or within the same transaction, then the value eventually being applied is the last sent. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x06 | 0x8a | 4 + [0..n] | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | version | - | - | Message version (0x01 for this version) |
| 1 | X1 | layers | - | - | The layers where the configuration should be applied |
| bit 0 | U:1 | ram | - | - | Update configuration in the RAM layer |
| bit 1 | U:1 | bbr | - | - | Update configuration in the BBR layer |
| bit 2 | U:1 | flash | - | - | Update configuration in the Flash layer |
| 2 | U1 | transaction | - | - | Transaction action to be applied |
| bits 1...0 | U:2 | action | - | - | Transaction action to be applied:<br>• 0 = Transactionless UBX-CFG-VALSET: In the next UBX-CFG-VALSET, it can be either 0 or 1. If a transaction has not yet been started, the incoming configuration is applied (if valid). If a transaction has already been started, cancels any started transaction and the incoming configuration is applied (if valid). |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | • 1 = (Re)Start set transaction: In the next UBX-CFG-VALSET, it can be either 0, 1, 2 or 3. If a transaction has not yet been started, a transaction will be started. If a transaction has already been started, restarts the transaction, effectively removing all previous non-applied UBX-CFG-VALSET messages.<br>• 2 = Set transaction ongoing: In the next UBX-CFG-VALSET, it can be either 0, 1, 2 or 3.<br>• 3 = Apply and end a set transaction: In the next UBX-CFG-VALSET, it can be either 0 or 1. |
| 3 | U1 | `reserved0` | - | - | Reserved |
| *Start of repeated group (N times)* | | | | | |
| 4 + n | U1 | `cfgData` | - | - | Configuration data (key and value pairs) |
| *End of repeated group (N times)* | | | | | |

# 3.11 UBX-INF (0x04)

Messages in the UBX-INF class are used to output strings from the firmware or application code. All messages have an associated type to indicate the nature or priority of the message.

## 3.11.1 UBX-INF-DEBUG (0x04 0x04)

### 3.11.1.1 ASCII output with debug contents

| ***Message*** | **UBX-INF-DEBUG**<br>**ASCII output with debug contents** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | This message has a variable length payload, representing an ASCII string. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x04 | 0x04 | [0..n] | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| *Start of repeated group (N times)* | | | | | |
| 0 + n | CH | `str` | - | - | ASCII Character |
| *End of repeated group (N times)* | | | | | |

## 3.11.2 UBX-INF-ERROR (0x04 0x00)

### 3.11.2.1 ASCII output with error contents

| ***Message*** | **UBX-INF-ERROR**<br>**ASCII output with error contents** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | This message has a variable length payload, representing an ASCII string. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x04 | 0x00 | [0..n] | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| *Start of repeated group (N times)* | | | | | |
| 0 + n | CH | `str` | - | - | ASCII Character |

| |
|---|
| *End of repeated group (N times)* |

## 3.11.3 UBX-INF-NOTICE (0x04 0x02)

### 3.11.3.1 ASCII output with informational contents

| ***Message*** | **UBX-INF-NOTICE**<br>**ASCII output with informational contents** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | This message has a variable length payload, representing an ASCII string. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x04 | 0x02 | [0..n] | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| *Start of repeated group (N times)* | | | | | |
| 0 + n | CH | `str` | - | - | ASCII Character |
| *End of repeated group (N times)* | | | | | |

## 3.11.4 UBX-INF-TEST (0x04 0x03)

### 3.11.4.1 ASCII output with test contents

| ***Message*** | **UBX-INF-TEST**<br>**ASCII output with test contents** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | This message has a variable length payload, representing an ASCII string. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x04 | 0x03 | [0..n] | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| *Start of repeated group (N times)* | | | | | |
| 0 + n | CH | `str` | - | - | ASCII Character |
| *End of repeated group (N times)* | | | | | |

## 3.11.5 UBX-INF-WARNING (0x04 0x01)

### 3.11.5.1 ASCII output with warning contents

| ***Message*** | **UBX-INF-WARNING**<br>**ASCII output with warning contents** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | This message has a variable length payload, representing an ASCII string. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x04 | 0x01 | [0..n] | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| *Start of repeated group (N times)* | | | | | |
| 0 + n | CH | `str` | - | - | ASCII Character |

*End of repeated group (N times)*

# 3.12 UBX-LOG (0x21)

The messages in the UBX-LOG class are used to configure and report status information of the logging and data batching features.

## 3.12.1 UBX-LOG-CREATE (0x21 0x07)

### 3.12.1.1 Create log file

| ***Message*** | **UBX-LOG-CREATE**<br>**Create log file** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Command | | | | | |
| *Comment* | This message is used to create an initial logging file and activate the logging subsystem.<br>UBX-ACK-ACK or UBX-ACK-NAK are returned to indicate success or failure.<br>This message does not handle activation of recording or filtering of log entries (see UBX-CFG-LOGFILTER). | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x21 | 0x07 | 8 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 1 | X1 | `logCfg` | - | - | Config flags |
| bit 0 | $U_{:1}$ | `circular` | - | - | Log is circular (new entries overwrite old ones in a full log) if this bit set |
| 2 | U1 | `reserved0` | - | - | Reserved |
| 3 | U1 | `logSize` | - | - | Indicates the size of the log:<br>• 0 (maximum safe size) = Ensures that logging will not be interrupted and enough space will be left available for all other uses of the filestore<br>• 1 (minimum size) =<br>• 2 (user-defined) = See 'userDefinedSize' below |
| 4 | U4 | `userDefinedSize` | - | bytes | Sets the maximum amount of space in the filestore that can be used by the logging task.<br>This field is only applicable if logSize is set to user-defined. |

## 3.12.2 UBX-LOG-ERASE (0x21 0x03)

### 3.12.2.1 Erase logged data

| ***Message*** | **UBX-LOG-ERASE**<br>**Erase logged data** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Command | | | | | |
| *Comment* | This message deactivates the logging system and erases all logged data.<br>UBX-ACK-ACK or UBX-ACK-NAK are returned to indicate success or failure. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x21 | 0x03 | 0 | *see below* | CK_A CK_B |
| *Payload* | This message has no payload. | | | | | |

## 3.12.3 UBX-LOG-FINDTIME (0x21 0x0e)

### 3.12.3.1 Find index of a log entry based on a given time

| ***Message*** | **UBX-LOG-FINDTIME**<br>**Find index of a log entry based on a given time** |
|---|---|
| *Type* | Input |
| *Comment* | This message can be used for a time-based search of a log. It can find the index of the first log entry with time equal to the given time, otherwise the index of the most recent entry with time less than the given time. This index can then be used with the UBX-LOG-RETRIEVE message to provide time-based retrieval of log entries.<br>Searching a log is effective for a given time later than the base date (January 1st, 2004). Searching a log for a given time earlier than the base date will result in an 'entry not found' response. (Searching a log for a given time earlier than the base date will result in a UBX-ACK-NAK message for protocol versions less than 18.00).<br>Searching a log for a given time greater than the last recorded entry's time will return the index of the last recorded entry. (If the logging has stopped due to lack of file space, such a search will result in a UBX-ACK-NAK message for protocol versions less than 18.00). |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x21 | 0x0e | 12 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 1 | U1 | `type` | - | - | Message type, 0 for request |
| 2 | U1[2] | `reserved0` | - | - | Reserved |
| 4 | U2 | `year` | - | - | Year (1-65635) of UTC time |
| 6 | U1 | `month` | - | - | Month (1-12) of UTC time |
| 7 | U1 | `day` | - | - | Day (1-31) of UTC time |
| 8 | U1 | `hour` | - | - | Hour (0-23) of UTC time |
| 9 | U1 | `minute` | - | - | Minute (0-59) of UTC time |
| 10 | U1 | `second` | - | - | Second (0-60) of UTC time |
| 11 | U1 | `reserved1` | - | - | Reserved |

### 3.12.3.2 Response to FINDTIME request

| ***Message*** | **UBX-LOG-FINDTIME**<br>**Response to FINDTIME request** |
|---|---|
| *Type* | Output |
| *Comment* | |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x21 | 0x0e | 8 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `version` | - | - | Message version (0x01 for this version) |
| 1 | U1 | `type` | - | - | Message type, 1 for response |
| 2 | U1[2] | `reserved0` | - | - | Reserved |
| 4 | U4 | `entryNumber` | - | - | Index of the first log entry with time = given time, otherwise index of the most recent entry with time < given time. If 0xFFFFFFFF, no log entry found with time <= given time. The indexing of log entries is zero-based. |

## 3.12.4 UBX-LOG-INFO (0x21 0x08)

### 3.12.4.1 Poll for log information

| ***Message*** | **UBX-LOG-INFO**<br>**Poll for log information** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Poll request | | | | | |
| *Comment* | Upon sending of this message, the receiver returns UBX-LOG-INFO as defined below. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x21 | 0x08 | 0 | *see below* | CK_A CK_B |
| *Payload* | This message has no payload. | | | | | |

### 3.12.4.2 Log information

| ***Message*** | **UBX-LOG-INFO**<br>**Log information** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | This message is used to report information about the logging subsystem.<br>Note:<br>• The reported maximum log size will be smaller than that originally specified in LOG-CREATE due to logging and filestore implementation overheads.<br>• Log entries are compressed in a variable length fashion, so it may be difficult to predict log space usage with any precision.<br>• There may be times when the receiver does not have an accurate time (e.g. if the week number is not yet known), in which case some entries will not have a timestamp. This may result in the oldest/newest entry time values not taking account of these entries. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x21 | 0x08 | 48 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `version` | - | - | Message version (0x01 for this version) |
| 1 | U1[3] | `reserved0` | - | - | Reserved |
| 4 | U4 | `filestore Capacity` | - | bytes | The capacity of the filestore |
| 8 | U1[8] | `reserved1` | - | - | Reserved |
| 16 | U4 | `currentMaxLog Size` | - | bytes | The maximum size the current log is allowed to grow to |
| 20 | U4 | `currentLogSize` | - | bytes | Approximate amount of space in log currently occupied |
| 24 | U4 | `entryCount` | - | - | Number of entries in the log.<br>Note: for circular logs this value will decrease when a group of entries is deleted to make space for new ones. |
| 28 | U2 | `oldestYear` | - | - | Oldest entry UTC year (1-65635) or zero if there are no entries with known time |
| 30 | U1 | `oldestMonth` | - | - | Oldest month (1-12) |
| 31 | U1 | `oldestDay` | - | - | Oldest day (1-31) |
| 32 | U1 | `oldestHour` | - | - | Oldest hour (0-23) |
| 33 | U1 | `oldestMinute` | - | - | Oldest minute (0-59) |
| 34 | U1 | `oldestSecond` | - | - | Oldest second (0-60) |
| 35 | U1 | `reserved2` | - | - | Reserved |
| 36 | U2 | `newestYear` | - | - | Newest year (1-65635) or zero if there are no entries with known time |

| | | | | | | |
|---|---|---|---|---|---|---|
| 38 | | U1 | newestMonth | - | - | Newest month (1-12) |
| 39 | | U1 | newestDay | - | - | Newest day (1-31) |
| 40 | | U1 | newestHour | - | - | Newest hour (0-23) |
| 41 | | U1 | newestMinute | - | - | Newest minute (0-59) |
| 42 | | U1 | newestSecond | - | - | Newest second (0-60) |
| 43 | | U1 | reserved3 | - | - | Reserved |
| 44 | | X1 | status | - | - | Log status flags |
| | bit 3 | U:1 | recording | - | - | Log entry recording is currently turned on |
| | bit 4 | U:1 | inactive | - | - | Logging system not active - no log present |
| | bit 5 | U:1 | circular | - | - | The current log is circular |
| 45 | | U1[3] | reserved4 | - | - | Reserved |

## 3.12.5 UBX-LOG-RETRIEVE (0x21 0x09)

### 3.12.5.1 Request log data

| ***Message*** | **UBX-LOG-RETRIEVE** | | | | | |
|---|---|---|---|---|---|---|
| | **Request log data** | | | | | |
| *Type* | Command | | | | | |
| *Comment* | This message is used to request logged data (log recording must first be disabled, see UBX-CFG-LOGFILTER).<br>Log entries are returned in chronological order, using the messages UBX-LOG-RETRIEVEPOS and UBX-LOG-RETRIEVESTRING. If the odometer was enabled at the time a position was logged, then message UBX-LOG-RETRIEVEPOSEXTRA will also be used. The maximum number of entries that can be returned in response to a single UBX-LOG-RETRIEVE message is 256. If more entries than this are required the message will need to be sent multiple times with different startNumbers. The retrieve will be stopped if any UBX-LOG message is received. The speed of transfer can be maximized by using a high data rate and temporarily stopping the GPS processing (see UBX-CFG-RST). | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x21 | 0x09 | 12 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | startNumber | - | - | Index of first log entry to be transferred. If it is larger than the index of the last available log entry, then the first log entry to be transferred is the last available log entry. The indexing of log entries is zero-based. |
| 4 | U4 | entryCount | - | - | Number of log entries to transfer in total including the first entry to be transferred. If it is larger than the log entries available starting from the first entry to be transferred, then only the available log entries are transferred followed by a UBX-ACK-NAK. The maximum is 256. |
| 8 | U1 | version | - | - | Message version (0x00 for this version) |
| 9 | U1[3] | reserved0 | - | - | Reserved |

## 3.12.6 UBX-LOG-RETRIEVEPOS (0x21 0x0b)

#### 3.12.6.1 Position fix log entry

| ***Message*** | **UBX-LOG-RETRIEVEPOS**<br>**Position fix log entry** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | This message is used to report a position fix log entry | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x21 | 0x0b | 40 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | `entryIndex` | - | - | The index of this log entry |
| 4 | I4 | `lon` | 1e-7 | deg | Longitude |
| 8 | I4 | `lat` | 1e-7 | deg | Latitude |
| 12 | I4 | `hMSL` | - | mm | Height above mean sea level |
| 16 | U4 | `hAcc` | - | mm | Horizontal accuracy estimate |
| 20 | U4 | `gSpeed` | - | mm/s | Ground speed (2-D) |
| 24 | U4 | `heading` | 1e-5 | deg | Heading |
| 28 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 29 | U1 | `fixType` | - | - | Fix type:<br>• 0x01 = Dead Reckoning only<br>• 0x02 = 2D-Fix<br>• 0x03 = 3D-Fix<br>• 0x04 = GNSS + Dead Reckoning combined |
| 30 | U2 | `year` | - | - | Year (1-65635) of UTC time |
| 32 | U1 | `month` | - | - | Month (1-12) of UTC time |
| 33 | U1 | `day` | - | - | Day (1-31) of UTC time |
| 34 | U1 | `hour` | - | - | Hour (0-23) of UTC time |
| 35 | U1 | `minute` | - | - | Minute (0-59) of UTC time |
| 36 | U1 | `second` | - | - | Second (0-60) of UTC time |
| 37 | U1 | `reserved0` | - | - | Reserved |
| 38 | U1 | `numSV` | - | - | Number of satellites used in the position fix |
| 39 | U1 | `reserved1` | - | - | Reserved |

## 3.12.7 UBX-LOG-RETRIEVEPOSEXTRA (0x21 0x0f)

#### 3.12.7.1 Odometer log entry

| ***Message*** | **UBX-LOG-RETRIEVEPOSEXTRA**<br>**Odometer log entry** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | This message is used to report an odometer log entry | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x21 | 0x0f | 32 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | `entryIndex` | - | - | The index of this log entry |
| 4 | U1 | `version` | - | - | Message version (0x00 for this version) |

| | | | | | |
|---|---|---|---|---|---|
| 5 | U1 | reserved0 | - | - | Reserved |
| 6 | U2 | year | - | - | Year (1-65635) of UTC time. Will be zero if time not known |
| 8 | U1 | month | - | - | Month (1-12) of UTC time |
| 9 | U1 | day | - | - | Day (1-31) of UTC time |
| 10 | U1 | hour | - | - | Hour (0-23) of UTC time |
| 11 | U1 | minute | - | - | Minute (0-59) of UTC time |
| 12 | U1 | second | - | - | Second (0-60) of UTC time |
| 13 | U1[3] | reserved1 | - | - | Reserved |
| 16 | U4 | distance | - | - | Odometer distance traveled since the last time the odometer was reset by a UBX-NAV-RESETODO |
| 20 | U1[12] | reserved2 | - | - | Reserved |

## 3.12.8 UBX-LOG-RETRIEVESTRING (0x21 0x0d)

### 3.12.8.1 Byte string log entry

| ***Message*** | **UBX-LOG-RETRIEVESTRING**<br>**Byte string log entry** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | This message is used to report a byte string log entry | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x21 | 0x0d | 16 + byteCount | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | entryIndex | - | - | The index of this log entry |
| 4 | U1 | version | - | - | Message version (0x00 for this version) |
| 5 | U1 | reserved0 | - | - | Reserved |
| 6 | U2 | year | - | - | Year (1-65635) of UTC time. Will be zero if time not known |
| 8 | U1 | month | - | - | Month (1-12) of UTC time |
| 9 | U1 | day | - | - | Day (1-31) of UTC time |
| 10 | U1 | hour | - | - | Hour (0-23) of UTC time |
| 11 | U1 | minute | - | - | Minute (0-59) of UTC time |
| 12 | U1 | second | - | - | Second (0-60) of UTC time |
| 13 | U1 | reserved1 | - | - | Reserved |
| 14 | U2 | byteCount | - | - | Size of string in bytes |
| *Start of repeated group (byteCount times)* | | | | | |
| 16 + n | U1 | bytes | - | - | The bytes of the string |
| *End of repeated group (byteCount times)* | | | | | |

## 3.12.9 UBX-LOG-STRING (0x21 0x04)

#### 3.12.9.1 Store arbitrary string in on-board flash

| ***Message*** | **UBX-LOG-STRING**<br>**Store arbitrary string in on-board flash** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Command | | | | | |
| *Comment* | This message can be used to store an arbitrary byte string in the on-board flash memory. The maximum length that can be stored is 256 bytes. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x21 | 0x04 | [0..n] | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| *Start of repeated group (N times)* | | | | | |
| 0 + n | U1 | `bytes` | - | - | The string of bytes to be logged (maximum 256) |
| *End of repeated group (N times)* | | | | | |

# 3.13 UBX-MGA (0x13)

The messages in the UBX-MGA class are used for sending GNSS assistance (A-GNSS, aiding) information to the receiver as well as backing up the navigation database from the receiver to a host.

## 3.13.1 UBX-MGA-ACK (0x13 0x60)

#### 3.13.1.1 Multiple GNSS acknowledge message

| ***Message*** | **UBX-MGA-ACK-DATA0**<br>**Multiple GNSS acknowledge message** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | This message is sent by a u-blox receiver to acknowledge the receipt of an assistance message.<br>Acknowledgments are enabled by setting the CFG-NAVSPG-ACKAIDING item.<br>See the section Flow control in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x60 | 8 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `type` | - | - | Type of acknowledgment:<br>• 0 = The message was not used by the receiver (see infoCode field for an indication of why)<br>• 1 = The message was accepted for use by the receiver (the infoCode field will be 0) |
| 1 | U1 | `version` | - | - | Message version (0x00 for this version) |

| | | | | | |
|---|---|---|---|---|---|
| 2 | U1 | infoCode | - | - | Provides greater information on what the receiver chose to do with the message contents:<br>• 0 = The receiver accepted the data<br>• 1 = The receiver does not know the time so it cannot use the data (To resolve this a UBX-MGA-INI-TIME_UTC message should be supplied first)<br>• 2 = The message version is not supported by the receiver<br>• 3 = The message size does not match the message version<br>• 4 = The message data could not be stored to the database<br>• 5 = The receiver is not ready to use the message data<br>• 6 = The message type is unknown |
| 3 | U1 | msgId | - | - | UBX message ID of the acknowledged message |
| 4 | U1[4] | msgPayload Start | - | - | The first 4 bytes of the acknowledged message's payload |

## 3.13.2 UBX-MGA-BDS (0x13 0x03)

### 3.13.2.1 BeiDou ephemeris assistance

| ***Message*** | **UBX-MGA-BDS-EPH**<br>**BeiDou ephemeris assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of BeiDou ephemeris assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x03 | 88 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x01 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | U1 | svId | - | - | BeiDou satellite identifier (see Satellite Numbering) |
| 3 | U1 | reserved0 | - | - | Reserved |
| 4 | U1 | SatH1 | - | - | Autonomous satellite Health flag |
| 5 | U1 | IODC | - | - | Issue of Data, Clock |
| 6 | I2 | a2 | 2^-66 | s/s^2 | Time polynomial coefficient 2 |
| 8 | I4 | a1 | 2^-50 | s/s | Time polynomial coefficient 1 |
| 12 | I4 | a0 | 2^-33 | s | Time polynomial coefficient 0 |
| 16 | U4 | toc | 2^3 | s | Clock data reference time |
| 20 | I2 | TGD1 | 0.1 | ns | Equipment Group Delay Differential |
| 22 | U1 | URAI | - | - | User Range Accuracy Index |
| 23 | U1 | IODE | - | - | Issue of Data, Ephemeris |
| 24 | U4 | toe | 2^3 | s | Ephemeris reference time |
| 28 | U4 | sqrtA | 2^-19 | m^0.5 | Square root of semi-major axis |
| 32 | U4 | e | 2^-33 | - | Eccentricity |

| | | | | | |
|---|---|---|---|---|---|
| 36 | I4 | omega | 2^-31 | semi-circles | Argument of perigee |
| 40 | I2 | Deltan | 2^-43 | semi-circles/s | Mean motion difference from computed value |
| 42 | I2 | IDOT | 2^-43 | semi-circles/s | Rate of inclination angle |
| 44 | I4 | M0 | 2^-31 | semi-circles | Mean anomaly at reference time |
| 48 | I4 | Omega0 | 2^-31 | semi-circles | Longitude of ascending node of orbital of plane computed according to reference time |
| 52 | I4 | OmegaDot | 2^-43 | semi-circles/s | Rate of right ascension |
| 56 | I4 | i0 | 2^-31 | semi-circles | Inclination angle at reference time |
| 60 | I4 | Cuc | 2^-31 | semi-circles | Amplitude of cosine harmonic correction term to the argument of latitude |
| 64 | I4 | Cus | 2^-31 | semi-circles | Amplitude of sine harmonic correction term to the argument of latitude |
| 68 | I4 | Crc | 2^-6 | m | Amplitude of cosine harmonic correction term to the orbit radius |
| 72 | I4 | Crs | 2^-6 | m | Amplitude of sine harmonic correction term to the orbit radius |
| 76 | I4 | Cic | 2^-31 | semi-circles | Amplitude of cosine harmonic correction term to the angle of inclination |
| 80 | I4 | Cis | 2^-31 | semi-circles | Amplitude of sine harmonic correction term to the angle of inclination |
| 84 | U1[4] | reserved1 | - | - | Reserved |

### 3.13.2.2 BeiDou almanac assistance

| ***Message*** | **UBX-MGA-BDS-ALM**<br>**BeiDou almanac assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of BeiDou almanac assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x03 | 40 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x02 for this version) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | U1 | svId | - | - | BeiDou satellite identifier (see Satellite Numbering) |
| 3 | U1 | reserved0 | - | - | Reserved |
| 4 | U1 | Wna | - | week | Almanac Week Number |
| 5 | U1 | toa | 2^12 | s | Almanac reference time |
| 6 | I2 | deltaI | 2^-19 | semi-circles | Almanac correction of orbit reference inclination at reference time |
| 8 | U4 | sqrtA | 2^-11 | m^0.5 | Almanac square root of semi-major axis |
| 12 | U4 | e | 2^-21 | - | Almanac eccentricity |

| | | | | | |
|---|---|---|---|---|---|
| 16 | I4 | omega | 2^-23 | semi-circles | Almanac argument of perigee |
| 20 | I4 | M0 | 2^-23 | semi-circles | Almanac mean anomaly at reference time |
| 24 | I4 | Omega0 | 2^-23 | semi-circles | Almanac longitude of ascending node of orbit plane at computed according to reference time |
| 28 | I4 | omegaDot | 2^-38 | semi-circles/s | Almanac rate of right ascension |
| 32 | I2 | a0 | 2^-20 | s | Almanac satellite clock bias |
| 34 | I2 | a1 | 2^-38 | s/s | Almanac satellite clock rate |
| 36 | U1[4] | reserved1 | - | - | Reserved |

### 3.13.2.3 BeiDou health assistance

| ***Message*** | **UBX-MGA-BDS-HEALTH**<br>**BeiDou health assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of BeiDou health assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x03 | 68 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x04 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | U1[2] | reserved0 | - | - | Reserved |
| 4 | U2[30] | healthCode | - | - | Each two-byte value represents a BeiDou SV (1-30). The 9 LSBs of each byte contain the 9 bit health code from subframe 5 pages 7,8 of the D1 message, and from subframe 5 pages 35,36 of the D1 message. |
| 64 | U1[4] | reserved1 | - | - | Reserved |

### 3.13.2.4 BeiDou UTC assistance

| ***Message*** | **UBX-MGA-BDS-UTC**<br>**BeiDou UTC assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of BeiDou UTC assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x03 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x05 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | U1[2] | reserved0 | - | - | Reserved |
| 4 | I4 | a0UTC | 2^-30 | s | BDT clock bias relative to UTC |
| 8 | I4 | a1UTC | 2^-50 | s/s | BDT clock rate relative to UTC |

| | | | | | |
|---|---|---|---|---|---|
| 12 | I1 | dtLS | - | s | Delta time due to leap seconds before the new leap second effective |
| 13 | U1 | reserved1 | - | - | Reserved |
| 14 | U1 | wnRec | - | week | BeiDou week number of reception of this UTC parameter set (8-bit truncated) |
| 15 | U1 | wnLSF | - | week | Week number of the new leap second |
| 16 | U1 | dN | - | day | Day number of the new leap second |
| 17 | I1 | dtLSF | - | s | Delta time due to leap seconds after the new leap second effective |
| 18 | U1[2] | reserved2 | - | - | Reserved |

#### 3.13.2.5 BeiDou ionosphere assistance

| ***Message*** | **UBX-MGA-BDS-IONO**<br>**BeiDou ionosphere assistance** | | | | |
|---|---|---|---|---|---|
| *Type* | Input | | | | |
| *Comment* | This message allows the delivery of BeiDou ionospheric assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x03 | 16 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x06 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | U1[2] | reserved0 | - | - | Reserved |
| 4 | I1 | alpha0 | 2^-30 | s | Ionospheric parameter alpha0 |
| 5 | I1 | alpha1 | 2^-27 | s/pi | Ionospheric parameter alpha1 |
| 6 | I1 | alpha2 | 2^-24 | s/pi^2 | Ionospheric parameter alpha2 |
| 7 | I1 | alpha3 | 2^-24 | s/pi^3 | Ionospheric parameter alpha3 |
| 8 | I1 | beta0 | 2^11 | s | Ionospheric parameter beta0 |
| 9 | I1 | beta1 | 2^14 | s/pi | Ionospheric parameter beta1 |
| 10 | I1 | beta2 | 2^16 | s/pi^2 | Ionospheric parameter beta2 |
| 11 | I1 | beta3 | 2^16 | s/pi^3 | Ionospheric parameter beta3 |
| 12 | U1[4] | reserved1 | - | - | Reserved |

### 3.13.3 UBX-MGA-DBD (0x13 0x80)

#### 3.13.3.1 Poll the navigation database

| ***Message*** | **UBX-MGA-DBD**<br>**Poll the navigation database** | | | | |
|---|---|---|---|---|---|
| *Type* | Poll request | | | | |
| *Comment* | Poll the whole navigation data base. The receiver will send all available data from its internal database. The receiver will indicate the finish of the transmission with a UBX-MGA-ACK. The msgPayloadStart field of the UBX-MGA-ACK message will contain a U4 representing the number of UBX-MGA-DBD-DATA* messages sent. | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x80 | 0 | *see below* | CK_A CK_B |
| *Payload* | This message has no payload. | | | | |

#### 3.13.3.2 Navigation database dump entry

| ***Message*** | **UBX-MGA-DBD**<br>**Navigation database dump entry** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input/output | | | | | |
| *Comment* | Navigation database entry. The data fields are firmware-specific. Transmission of this type of message will be acknowledged by UBX-MGA-ACK messages, if acknowledgment has been enabled.<br>See the section AssistNow online in Integration manual for details.<br>The maximum payload size for firmware 2.01 onwards is 164 bytes (which makes the maximum message size 172 bytes).<br>☞ UBX-MGA-DBD messages are only intended to be sent back to the same receiver that generated them. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x80 | 12 + [0..n] | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1[12] | `reserved0` | - | - | Reserved |
| *Start of repeated group (N times)* | | | | | |
| 12 + n | U1 | `data` | - | - | firmware-specific data |
| *End of repeated group (N times)* | | | | | |

## 3.13.4 UBX-MGA-GAL (0x13 0x02)

#### 3.13.4.1 Galileo ephemeris assistance

| ***Message*** | **UBX-MGA-GAL-EPH**<br>**Galileo ephemeris assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of Galileo ephemeris assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x02 | 76 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `type` | - | - | Message type (0x01 for this type) |
| 1 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 2 | U1 | `svId` | - | - | Galileo Satellite identifier (see Satellite Numbering) |
| 3 | U1 | `reserved0` | - | - | Reserved |
| 4 | U2 | `iodNav` | - | - | Ephemeris and clock correction Issue of Data |
| 6 | I2 | `deltaN` | 2^-43 | semi-circles/s | Mean motion difference from computed value |
| 8 | I4 | `m0` | 2^-31 | semi-circles | Mean anomaly at reference time |
| 12 | U4 | `e` | 2^-33 | - | Eccentricity |
| 16 | U4 | `sqrtA` | 2^-19 | m^0.5 | Square root of the semi-major axis |
| 20 | I4 | `omega0` | 2^-31 | semi-circles | Longitude of ascending node of orbital plane at weekly epoch |
| 24 | I4 | `i0` | 2^-31 | semi-circles | Inclination angle at reference time |

| | | | | | |
|---|---|---|---|---|---|
| 28 | I4 | omega | 2^-31 | semi-circles | Argument of perigee |
| 32 | I4 | omegaDot | 2^-43 | semi-circles/s | Rate of change of right ascension |
| 36 | I2 | iDot | 2^-43 | semi-circles/s | Rate of change of inclination angle |
| 38 | I2 | cuc | 2^-29 | radians | Amplitude of the cosine harmonic correction term to the argument of latitude |
| 40 | I2 | cus | 2^-29 | radians | Amplitude of the sine harmonic correction term to the argument of latitude |
| 42 | I2 | crc | 2^-5 | radians | Amplitude of the cosine harmonic correction term to the orbit radius |
| 44 | I2 | crs | 2^-5 | radians | Amplitude of the sine harmonic correction term to the orbit radius |
| 46 | I2 | cic | 2^-29 | radians | Amplitude of the cosine harmonic correction term to the angle of inclination |
| 48 | I2 | cis | 2^-29 | radians | Amplitude of the sine harmonic correction term to the angle of inclination |
| 50 | U2 | toe | 60 | s | Ephemeris reference time |
| 52 | I4 | af0 | 2^-34 | s | SV clock bias correction coefficient |
| 56 | I4 | af1 | 2^-46 | s/s | SV clock drift correction coefficient |
| 60 | I1 | af2 | 2^-59 | s/s squared | SV clock drift rate correction coefficient |
| 61 | U1 | sisaIndexE1E5b | - | - | Signal-In-Space Accuracy index for dual frequency E1-E5b |
| 62 | U2 | toc | 60 | s | Clock correction data reference Time of Week |
| 64 | I2 | bgdE1E5b | - | - | E1-E5b Broadcast Group Delay |
| 66 | U1[2] | reserved1 | - | - | Reserved |
| 68 | U1 | healthE1B | - | - | E1-B Signal Health Status |
| 69 | U1 | dataValidityE1B | - | - | E1-B Data Validity Status |
| 70 | U1 | healthE5b | - | - | E5b Signal Health Status |
| 71 | U1 | dataValidityE5b | - | - | E5b Data Validity Status |
| 72 | U1[4] | reserved2 | - | - | Reserved |

### 3.13.4.2 Galileo almanac assistance

| ***Message*** | **UBX-MGA-GAL-ALM**<br>**Galileo almanac assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of Galileo almanac assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x02 | 32 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x02 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |

| | | | | | |
|---|---|---|---|---|---|
| 2 | U1 | svId | - | - | Galileo Satellite identifier (see Satellite Numbering) |
| 3 | U1 | reserved0 | - | - | Reserved |
| 4 | U1 | ioda | - | - | Almanac Issue of Data |
| 5 | U1 | almWNa | - | week | Almanac reference week number |
| 6 | U2 | toa | 600 | s | Almanac reference time |
| 8 | I2 | deltaSqrtA | 2^-9 | m^0.5 | Difference with respect to the square root of the nominal semi-major axis (29 600 km) |
| 10 | U2 | e | 2^-16 | - | Eccentricity |
| 12 | I2 | deltaI | 2^-14 | semi-circles | Inclination at reference time relative to i0 = 56 degree |
| 14 | I2 | omega0 | 2^-15 | semi-circles | Longitude of ascending node of orbital plane at weekly epoch |
| 16 | I2 | omegaDot | 2^-33 | semi-circles/s | Rate of change of right ascension |
| 18 | I2 | omega | 2^-15 | semi-circles | Argument of perigee |
| 20 | I2 | m0 | 2^-15 | semi-circles | Satellite mean anomaly at reference time |
| 22 | I2 | af0 | 2^-19 | s | Satellite clock correction bias 'truncated' |
| 24 | I2 | af1 | 2^-38 | s/s | Satellite clock correction linear 'truncated' |
| 26 | U1 | healthE1B | - | - | Satellite E1-B signal health status |
| 27 | U1 | healthE5b | - | - | Satellite E5b signal health status |
| 28 | U1[4] | reserved1 | - | - | Reserved |

### 3.13.4.3 Galileo GPS time offset assistance

| ***Message*** | **UBX-MGA-GAL-TIMEOFFSET**<br>**Galileo GPS time offset assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of Galileo time to GPS time offset.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x02 | 12 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x03 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | U1[2] | reserved0 | - | - | Reserved |
| 4 | I2 | a0G | 2^-35 | s | Constant term of the polynomial describing the offset |
| 6 | I2 | a1G | 2^-51 | s/s | Rate of change of the offset |
| 8 | U1 | t0G | 3600 | s | Reference time for GGTO data |
| 9 | U1 | wn0G | - | weeks | Week Number of GGTO reference |
| 10 | U1[2] | reserved1 | - | - | Reserved |

#### 3.13.4.4 Galileo UTC assistance

| ***Message*** | **UBX-MGA-GAL-UTC**<br>**Galileo UTC assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of Galileo UTC assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x02 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `type` | - | - | Message type (0x05 for this type) |
| 1 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 2 | U1[2] | `reserved0` | - | - | Reserved |
| 4 | I4 | `a0` | 2^-30 | s | First parameter of UTC polynomial |
| 8 | I4 | `a1` | 2^-50 | s/s | Second parameter of UTC polynomial |
| 12 | I1 | `dtLS` | - | s | Delta time due to current leap seconds |
| 13 | U1 | `tot` | 3600 | s | UTC parameters reference time of week (Galileo time) |
| 14 | U1 | `wnt` | - | weeks | UTC parameters reference week number (the 8-bit WNt field) |
| 15 | U1 | `wnLSF` | - | weeks | Week number at the end of which the future leap second becomes effective (the 8-bit WNLSF field) |
| 16 | U1 | `dN` | - | days | Day number at the end of which the future leap second becomes effective |
| 17 | I1 | `dTLSF` | - | s | Delta time due to future leap seconds |
| 18 | U1[2] | `reserved1` | - | - | Reserved |

## 3.13.5 UBX-MGA-GLO (0x13 0x06)

#### 3.13.5.1 GLONASS ephemeris assistance

| ***Message*** | **UBX-MGA-GLO-EPH**<br>**GLONASS ephemeris assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of GLONASS ephemeris assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x06 | 48 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `type` | - | - | Message type (0x01 for this type) |
| 1 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 2 | U1 | `svId` | - | - | GLONASS Satellite identifier (see Satellite Numbering) |
| 3 | U1 | `reserved0` | - | - | Reserved |
| 4 | U1 | `FT` | - | - | User range accuracy |
| 5 | U1 | `B` | - | - | Health flag from string 2 |

| | | | | | |
|---|---|---|---|---|---|
| 6 | U1 | M | - | - | Type of GLONASS satellite (1 indicates GLONASS-M) |
| 7 | I1 | H | - | - | Carrier frequency number of navigation RF signal, Range=(-7 .. 6), -128 for unknown |
| 8 | I4 | x | 2^-11 | km | X component of the SV position in PZ-90.02 coordinate System |
| 12 | I4 | y | 2^-11 | km | Y component of the SV position in PZ-90.02 coordinate System |
| 16 | I4 | z | 2^-11 | km | Z component of the SV position in PZ-90.02 coordinate System |
| 20 | I4 | dx | 2^-20 | km/s | X component of the SV velocity in PZ-90.02 coordinate System |
| 24 | I4 | dy | 2^-20 | km/s | Y component of the SV velocity in PZ-90.02 coordinate System |
| 28 | I4 | dz | 2^-20 | km/s | Z component of the SV velocity in PZ-90.02 coordinate System |
| 32 | I1 | ddx | 2^-30 | km/s^2 | X component of the SV acceleration in PZ-90.02 coordinate System |
| 33 | I1 | ddy | 2^-30 | km/s^2 | Y component of the SV acceleration in PZ-90.02 coordinate System |
| 34 | I1 | ddz | 2^-30 | km/s^2 | Z component of the SV acceleration in PZ-90.02 coordinate System |
| 35 | U1 | tb | 15 | minutes | Index of a time interval within current day according to UTC(SU) |
| 36 | I2 | gamma | 2^-40 | - | Relative carrier frequency deviation |
| 38 | U1 | E | - | days | Ephemeris data age indicator |
| 39 | I1 | deltaTau | 2^-30 | s | Time difference between L2 and L1 band |
| 40 | I4 | tau | 2^-30 | s | SV clock bias |
| 44 | U1[4] | reserved1 | - | - | Reserved |

### 3.13.5.2 GLONASS almanac assistance

| ***Message*** | **UBX-MGA-GLO-ALM**<br>**GLONASS almanac assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of GLONASS almanac assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x06 | 36 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x02 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | U1 | svId | - | - | GLONASS Satellite identifier (see Satellite Numbering) |
| 3 | U1 | reserved0 | - | - | Reserved |
| 4 | U2 | N | - | days | Reference calender day number of almanac within the four-year period (from string 5) |
| 6 | U1 | M | - | - | Type of GLONASS satellite (1 indicates GLONASS-M) |

| | | | | | |
|---|---|---|---|---|---|
| 7 | U1 | C | - | - | Unhealthy flag at instant of almanac upload (1 indicates operability of satellite) |
| 8 | I2 | tau | 2^-18 | s | Coarse time correction to GLONASS time |
| 10 | U2 | epsilon | 2^-20 | - | Eccentricity |
| 12 | I4 | lambda | 2^-20 | semi-circles | Longitude of the first (within the N-day) ascending node of satellite orbit in PC-90.02 coordinate system |
| 16 | I4 | deltaI | 2^-20 | semi-circles | Correction to the mean value of inclination |
| 20 | U4 | tLambda | 2^-5 | s | Time of the first ascending node passage |
| 24 | I4 | deltaT | 2^-9 | s/orbital-period | Correction to the mean value of Draconian period |
| 28 | I1 | deltaDT | 2^-14 | s/orbital-period^2 | Rate of change of Draconian period |
| 29 | I1 | H | - | - | Carrier frequency number of navigation RF signal, Range=(-7 .. 6) |
| 30 | I2 | omega | - | - | Argument of perigee |
| 32 | U1[4] | reserved1 | - | - | Reserved |

### 3.13.5.3 GLONASS auxiliary time offset assistance

| ***Message*** | **UBX-MGA-GLO-TIMEOFFSET**<br>**GLONASS auxiliary time offset assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of auxiliary GLONASS assistance (including the GLONASS time offsets to other GNSS systems) to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x06 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x03 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | U2 | N | - | days | Reference calendar day number within the four-year period of almanac (from string 5) |
| 4 | I4 | tauC | 2^-27 | s | Time scale correction to UTC(SU) time |
| 8 | I4 | tauGps | 2^-31 | s | Correction to GPS time relative to GLONASS time |
| 12 | I2 | B1 | 2^-10 | s | Coefficient to determine delta UT1 |
| 14 | I2 | B2 | 2^-16 | s/msd | Rate of change of delta UT1 |
| 16 | U1[4] | reserved0 | - | - | Reserved |

## 3.13.6 UBX-MGA-GPS (0x13 0x00)

### 3.13.6.1 GPS ephemeris assistance

| ***Message*** | **UBX-MGA-GPS-EPH**<br>**GPS ephemeris assistance** |
|---|---|
| *Type* | Input |
| *Comment* | This message allows the delivery of GPS ephemeris assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. |

| Message structure | Header | Class | ID | Length (Bytes) | Payload | Checksum |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x13 | 0x00 | 68 | *see below* | CK_A CK_B |

*Payload description:*

| Byte offset | Type | Name | Scale | Unit | Description |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x01 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | U1 | svId | - | - | GPS Satellite identifier (see Satellite Numbering) |
| 3 | U1 | reserved0 | - | - | Reserved |
| 4 | U1 | fitInterval | - | - | Fit interval flag |
| 5 | U1 | uraIndex | - | - | URA index |
| 6 | U1 | svHealth | - | - | SV health |
| 7 | I1 | tgd | 2^-31 | s | Group delay differential |
| 8 | U2 | iodc | - | - | IODC |
| 10 | U2 | toc | 2^4 | s | Clock data reference time |
| 12 | U1 | reserved1 | - | - | Reserved |
| 13 | I1 | af2 | 2^-55 | s/s squared | Time polynomial coefficient 2 |
| 14 | I2 | af1 | 2^-43 | s/s | Time polynomial coefficient 1 |
| 16 | I4 | af0 | 2^-31 | s | Time polynomial coefficient 0 |
| 20 | I2 | crs | 2^-5 | m | Crs |
| 22 | I2 | deltaN | 2^-43 | semi-circles/s | Mean motion difference from computed value |
| 24 | I4 | m0 | 2^-31 | semi-circles | Mean anomaly at reference time |
| 28 | I2 | cuc | 2^-29 | radians | Amplitude of cosine harmonic correction term to argument of latitude |
| 30 | I2 | cus | 2^-29 | radians | Amplitude of sine harmonic correction term to argument of latitude |
| 32 | U4 | e | 2^-33 | - | Eccentricity |
| 36 | U4 | sqrtA | 2^-19 | m^0.5 | Square root of the semi-major axis |
| 40 | U2 | toe | 2^4 | s | Reference time of ephemeris |
| 42 | I2 | cic | 2^-29 | radians | Amplitude of cos harmonic correction term to angle of inclination |
| 44 | I4 | omega0 | 2^-31 | semi-circles | Longitude of ascending node of orbit plane at weekly epoch |
| 48 | I2 | cis | 2^-29 | radians | Amplitude of sine harmonic correction term to angle of inclination |
| 50 | I2 | crc | 2^-5 | m | Amplitude of cosine harmonic correction term to orbit radius |
| 52 | I4 | i0 | 2^-31 | semi-circles | Inclination angle at reference time |
| 56 | I4 | omega | 2^-31 | semi-circles | Argument of perigee |
| 60 | I4 | omegaDot | 2^-43 | semi-circles/s | Rate of right ascension |
| 64 | I2 | idot | 2^-43 | semi-circles/s | Rate of inclination angle |

| | | | | | |
|---|---|---|---|---|---|
| 66 | U1[2] | reserved2 | - | - | Reserved |

### 3.13.6.2 GPS almanac assistance

| ***Message*** | **UBX-MGA-GPS-ALM**<br>**GPS almanac assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of GPS almanac assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x00 | 36 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x02 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | U1 | svId | - | - | GPS Satellite identifier (see Satellite Numbering) |
| 3 | U1 | svHealth | - | - | SV health information |
| 4 | U2 | e | 2^-21 | - | Eccentricity |
| 6 | U1 | almWNa | - | week | Reference week number of almanac (the 8-bit WNa field) |
| 7 | U1 | toa | 2^12 | s | Reference time of almanac |
| 8 | I2 | deltaI | 2^-19 | semi-circles | Delta inclination angle at reference time |
| 10 | I2 | omegaDot | 2^-38 | semi-circles/s | Rate of right ascension |
| 12 | U4 | sqrtA | 2^-11 | m^0.5 | Square root of the semi-major axis |
| 16 | I4 | omega0 | 2^-23 | semi-circles | Longitude of ascending node of orbit plane |
| 20 | I4 | omega | 2^-23 | semi-circles | Argument of perigee |
| 24 | I4 | m0 | 2^-23 | semi-circles | Mean anomaly at reference time |
| 28 | I2 | af0 | 2^-20 | s | Time polynomial coefficient 0 (8 MSBs) |
| 30 | I2 | af1 | 2^-38 | s/s | Time polynomial coefficient 1 |
| 32 | U1[4] | reserved0 | - | - | Reserved |

### 3.13.6.3 GPS health assistance

| ***Message*** | **UBX-MGA-GPS-HEALTH**<br>**GPS health assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of GPS health assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x00 | 40 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x04 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |

| | | | | | |
|---|---|---|---|---|---|
| 2 | U1[2] | reserved0 | - | - | Reserved |
| 4 | U1[32] | healthCode | - | - | Each byte represents a GPS SV (1-32). The 6 LSBs of each byte contains the 6 bit health code from subframes 4/5 page 25. |
| 36 | U1[4] | reserved1 | - | - | Reserved |

### 3.13.6.4 GPS UTC assistance

| ***Message*** | **UBX-MGA-GPS-UTC**<br>**GPS UTC assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of GPS UTC assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x00 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x05 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | U1[2] | reserved0 | - | - | Reserved |
| 4 | I4 | utcA0 | 2^-30 | s | First parameter of UTC polynomial |
| 8 | I4 | utcA1 | 2^-50 | s/s | Second parameter of UTC polynomial |
| 12 | I1 | utcDtLS | - | s | Delta time due to current leap seconds |
| 13 | U1 | utcTot | 2^12 | s | UTC parameters reference time of week (GPS time) |
| 14 | U1 | utcWNt | - | weeks | UTC parameters reference week number (the 8-bit WNt field) |
| 15 | U1 | utcWNlsf | - | weeks | Week number at the end of which the future leap second becomes effective (the 8-bit WNLSF field) |
| 16 | U1 | utcDn | - | days | Day number at the end of which the future leap second becomes effective |
| 17 | I1 | utcDtLSF | - | s | Delta time due to future leap seconds |
| 18 | U1[2] | reserved1 | - | - | Reserved |

### 3.13.6.5 GPS ionosphere assistance

| ***Message*** | **UBX-MGA-GPS-IONO**<br>**GPS ionosphere assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of GPS ionospheric assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x00 | 16 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x06 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | U1[2] | reserved0 | - | - | Reserved |
| 4 | I1 | ionoAlpha0 | 2^-30 | s | Ionospheric parameter alpha0 [s] |

| | | | | | |
|---|---|---|---|---|---|
| 5 | I1 | ionoAlpha1 | 2^-27 | s/semi-circle | Ionospheric parameter alpha1 [s/semi-circle] |
| 6 | I1 | ionoAlpha2 | 2^-24 | s/(semi-circle^2) | Ionospheric parameter alpha2 [s/semi-circle^2] |
| 7 | I1 | ionoAlpha3 | 2^-24 | s/(semi-circle^3) | Ionospheric parameter alpha3 [s/semi-circle^3] |
| 8 | I1 | ionoBeta0 | 2^11 | s | Ionospheric parameter beta0 [s] |
| 9 | I1 | ionoBeta1 | 2^14 | s/semi-circle | Ionospheric parameter beta1 [s/semi-circle] |
| 10 | I1 | ionoBeta2 | 2^16 | s/(semi-circle^2) | Ionospheric parameter beta2 [s/semi-circle^2] |
| 11 | I1 | ionoBeta3 | 2^16 | s/(semi-circle^3) | Ionospheric parameter beta3 [s/semi-circle^3] |
| 12 | U1[4] | reserved1 | - | - | Reserved |

## 3.13.7 UBX-MGA-INI (0x13 0x40)

### 3.13.7.1 Initial position assistance

| ***Message*** | **UBX-MGA-INI-POS_XYZ**<br>**Initial position assistance** |
|---|---|
| *Type* | Input |
| *Comment* | This message allows the delivery of initial position assistance to a receiver in cartesian ECEF coordinates. This message is equivalent to the UBX-MGA-INI-POS_LLH message, except for the coordinate system.<br>See the section AssistNow online in Integration manual for details.<br>☞ Supplying position assistance that is inaccurate by more than the specified position accuracy, may lead to substantially degraded receiver performance. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x13 | 0x40 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x00 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | U1[2] | reserved0 | - | - | Reserved |
| 4 | I4 | ecefX | - | cm | WGS84 ECEF X coordinate |
| 8 | I4 | ecefY | - | cm | WGS84 ECEF Y coordinate |
| 12 | I4 | ecefZ | - | cm | WGS84 ECEF Z coordinate |
| 16 | U4 | posAcc | - | cm | Position accuracy (stddev) |

### 3.13.7.2 Initial position assistance

| ***Message*** | **UBX-MGA-INI-POS_LLH**<br>**Initial position assistance** |
|---|---|
| *Type* | Input |
| *Comment* | This message allows the delivery of initial position assistance to a receiver in WGS84 lat/long/alt coordinates. This message is equivalent to the UBX-MGA-INI-POS_XYZ message, except for the coordinate system.<br>See the section AssistNow online in Integration manual for details.<br>☞ Supplying position assistance that is inaccurate by more than the specified position accuracy, may lead to substantially degraded receiver performance. |

| Message structure | Header | Class | ID | Length (Bytes) | Payload | Checksum |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x13 | 0x40 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| Byte offset | Type | Name | Scale | Unit | Description |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x01 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | U1[2] | reserved0 | - | - | Reserved |
| 4 | I4 | lat | 1e-7 | deg | WGS84 Latitude |
| 8 | I4 | lon | 1e-7 | deg | WGS84 Longitude |
| 12 | I4 | alt | - | cm | WGS84 Altitude |
| 16 | U4 | posAcc | - | cm | Position accuracy (stddev) |

### 3.13.7.3 Initial time assistance

| ***Message*** | **UBX-MGA-INI-TIME_UTC**<br>**Initial time assistance** |
|---|---|
| *Type* | Input |
| *Comment* | This message allows the delivery of UTC time assistance to a receiver. This message is equivalent to the UBX-MGA-INI-TIME_GNSS message, except for the time base.<br>See the section AssistNow online in Integration manual for details.<br>☞ Supplying time assistance that is inaccurate by more than the specified time accuracy, may lead to substantially degraded receiver performance. |

| Message structure | Header | Class | ID | Length (Bytes) | Payload | Checksum |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x13 | 0x40 | 24 | *see below* | CK_A CK_B |

*Payload description:*

| Byte offset | Type | Name | Scale | Unit | Description |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x10 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | X1 | ref | - | - | Reference to be used to set time |
| bits 3...0 | U:4 | source | - | - | • 0 = none, i.e. on receipt of message (will be inaccurate!)<br>• 1 = relative to pulse sent to EXTINT0<br>• 2 = relative to pulse sent to EXTINT1<br>• 3-15 = reserved |
| bit 4 | U:1 | fall | - | - | use falling edge of EXTINT pulse (default rising) - only if source is EXTINT |
| bit 5 | U:1 | last | - | - | use last EXTINT pulse (default next pulse) - only if source is EXTINT |
| 3 | I1 | leapSecs | - | s | Number of leap seconds since 1980 (or 0x80 = -128 if unknown) |
| 4 | U2 | year | - | - | Year |
| 6 | U1 | month | - | - | Month, starting at 1 |
| 7 | U1 | day | - | - | Day, starting at 1 |
| 8 | U1 | hour | - | - | Hour, from 0 to 23 |
| 9 | U1 | minute | - | - | Minute, from 0 to 59 |
| 10 | U1 | second | - | s | Seconds, from 0 to 59 |
| 11 | U1 | reserved0 | - | - | Reserved |

| | | | | | |
|---|---|---|---|---|---|
| 12 | U4 | ns | - | ns | Nanoseconds, from 0 to 999,999,999 |
| 16 | U2 | tAccS | - | s | Seconds part of time accuracy |
| 18 | U1[2] | reserved1 | - | - | Reserved |
| 20 | U4 | tAccNs | - | ns | Nanoseconds part of time accuracy, from 0 to 999,999,999 |

### 3.13.7.4 Initial time assistance

| ***Message*** | **UBX-MGA-INI-TIME_GNSS**<br>**Initial time assistance** |
|---|---|
| *Type* | Input |
| *Comment* | This message allows the delivery of time assistance to a receiver in a chosen GNSS timebase. This message is equivalent to the UBX-MGA-INI-TIME_UTC message, except for the time base.<br>See the section AssistNow online in Integration manual for details.<br>☞ Supplying time assistance that is inaccurate by more than the specified time accuracy, may lead to substantially degraded receiver performance. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x13 | 0x40 | 24 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x11 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | X1 | ref | - | - | Reference to be used to set time |
| bits 3...0 | U:4 | source | - | - | • 0 = none, i.e. on receipt of message (will be inaccurate!)<br>• 1 = relative to pulse sent to EXTINT0<br>• 2 = relative to pulse sent to EXTINT1<br>• 3-15 = reserved |
| bit 4 | U:1 | fall | - | - | use falling edge of EXTINT pulse (default rising) - only if source is EXTINT |
| bit 5 | U:1 | last | - | - | use last EXTINT pulse (default next pulse) - only if source is EXTINT |
| 3 | U1 | gnssId | - | - | Source of time information. Currently supported:<br>• 0 = GPS time<br>• 2 = Galileo time<br>• 3 = BeiDou time<br>• 6 = GLONASS time: week = 834 + ((N4-1)*1461 + Nt)/7, tow = (((N4-1)*1461 + Nt) % 7) * 86400 + tod |
| 4 | U1[2] | reserved0 | - | - | Reserved |
| 6 | U2 | week | - | - | GNSS week number |
| 8 | U4 | tow | - | s | GNSS time of week |
| 12 | U4 | ns | - | ns | GNSS time of week, nanosecond part from 0 to 999,999,999 |
| 16 | U2 | tAccS | - | s | Seconds part of time accuracy |
| 18 | U1[2] | reserved1 | - | - | Reserved |
| 20 | U4 | tAccNs | - | ns | Nanoseconds part of time accuracy, from 0 to 999,999,999 |

### 3.13.7.5 Initial clock drift assistance

| ***Message*** | **UBX-MGA-INI-CLKD**<br>**Initial clock drift assistance** |
|---|---|
| *Type* | Input |
| *Comment* | This message allows the delivery of clock drift assistance to a receiver.<br>See the section AssistNow online in Integration manual for details.<br>☞ Supplying clock drift assistance that is inaccurate by more than the specified accuracy, may lead to substantially degraded receiver performance. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x13 | 0x40 | 12 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `type` | - | - | Message type (0x20 for this type) |
| 1 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 2 | U1[2] | `reserved0` | - | - | Reserved |
| 4 | I4 | `clkD` | - | ns/s | Clock drift |
| 8 | U4 | `clkDAcc` | - | ns/s | Clock drift accuracy |

### 3.13.7.6 Initial frequency assistance

| ***Message*** | **UBX-MGA-INI-FREQ**<br>**Initial frequency assistance** |
|---|---|
| *Type* | Input |
| *Comment* | This message allows the delivery of external frequency assistance to a receiver.<br>See the section AssistNow online in Integration manual for details.<br>☞ Supplying external frequency assistance that is inaccurate by more than the specified accuracy, may lead to substantially degraded receiver performance. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x13 | 0x40 | 12 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `type` | - | - | Message type (0x21 for this type) |
| 1 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 2 | U1 | `reserved0` | - | - | Reserved |
| 3 | X1 | `flags` | - | - | Frequency reference |
| bits 3...0 | $U_{:4}$ | `source` | - | - | • 0 = frequency available on EXTINT0<br>• 1 = frequency available on EXTINT1<br>• 2-15 = reserved |
| bit 4 | $U_{:1}$ | `fall` | - | - | use falling edge of EXTINT pulse (default rising) |
| 4 | I4 | `freq` | 1e-2 | Hz | Frequency |
| 8 | U4 | `freqAcc` | - | ppb | Frequency accuracy |

## 3.13.8 UBX-MGA-QZSS (0x13 0x05)

### 3.13.8.1 QZSS ephemeris assistance

| ***Message*** | **UBX-MGA-QZSS-EPH**<br>**QZSS ephemeris assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of QZSS ephemeris assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x05 | 68 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `type` | - | - | Message type (0x01 for this type) |
| 1 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 2 | U1 | `svId` | - | - | QZSS Satellite identifier (see Satellite Numbering), Range 1-5 |
| 3 | U1 | `reserved0` | - | - | Reserved |
| 4 | U1 | `fitInterval` | - | - | Fit interval flag |
| 5 | U1 | `uraIndex` | - | - | URA index |
| 6 | U1 | `svHealth` | - | - | SV health |
| 7 | I1 | `tgd` | 2^-31 | s | Group delay differential |
| 8 | U2 | `iodc` | - | - | IODC |
| 10 | U2 | `toc` | 2^4 | s | Clock data reference time |
| 12 | U1 | `reserved1` | - | - | Reserved |
| 13 | I1 | `af2` | 2^-55 | s/s squared | Time polynomial coefficient 2 |
| 14 | I2 | `af1` | 2^-43 | s/s | Time polynomial coefficient 1 |
| 16 | I4 | `af0` | 2^-31 | s | Time polynomial coefficient 0 |
| 20 | I2 | `crs` | 2^-5 | m | Crs |
| 22 | I2 | `deltaN` | 2^-43 | semi-circles/s | Mean motion difference from computed value |
| 24 | I4 | `m0` | 2^-31 | semi-circles | Mean anomaly at reference time |
| 28 | I2 | `cuc` | 2^-29 | radians | Amp of cosine harmonic corr term to arg of lat |
| 30 | I2 | `cus` | 2^-29 | radians | Amp of sine harmonic corr term to arg of lat |
| 32 | U4 | `e` | 2^-33 | - | eccentricity |
| 36 | U4 | `sqrtA` | 2^-19 | m^0.5 | Square root of the semi-major axis A |
| 40 | U2 | `toe` | 2^4 | s | Reference time of ephemeris |
| 42 | I2 | `cic` | 2^-29 | radians | Amp of cos harmonic corr term to angle of inclination |
| 44 | I4 | `omega0` | 2^-31 | semi-circles | Long of asc node of orbit plane at weekly epoch |
| 48 | I2 | `cis` | 2^-29 | radians | Amp of sine harmonic corr term to angle of inclination |
| 50 | I2 | `crc` | 2^-5 | m | Amp of cosine harmonic corr term to orbit radius |
| 52 | I4 | `i0` | 2^-31 | semi-circles | Inclination angle at reference time |
| 56 | I4 | `omega` | 2^-31 | semi-circles | Argument of perigee |

| | | | | | |
|---|---|---|---|---|---|
| 60 | I4 | omegaDot | 2^-43 | semi-circles/s | Rate of right ascension |
| 64 | I2 | idot | 2^-43 | semi-circles/s | Rate of inclination angle |
| 66 | U1[2] | reserved2 | - | - | Reserved |

### 3.13.8.2 QZSS almanac assistance

| ***Message*** | **UBX-MGA-QZSS-ALM**<br>**QZSS almanac assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of QZSS almanac assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x05 | 36 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | type | - | - | Message type (0x02 for this type) |
| 1 | U1 | version | - | - | Message version (0x00 for this version) |
| 2 | U1 | svId | - | - | QZSS Satellite identifier (see Satellite Numbering), Range 1-5 |
| 3 | U1 | svHealth | - | - | Almanac SV health information |
| 4 | U2 | e | 2^-21 | - | Almanac eccentricity |
| 6 | U1 | almWNa | - | week | Reference week number of almanac (the 8-bit WNa field) |
| 7 | U1 | toa | 2^12 | s | Reference time of almanac |
| 8 | I2 | deltaI | 2^-19 | semi-circles | Delta inclination angle at reference time |
| 10 | I2 | omegaDot | 2^-38 | semi-circles/s | Almanac rate of right ascension |
| 12 | U4 | sqrtA | 2^-11 | m^0.5 | Almanac square root of the semi-major axis A |
| 16 | I4 | omega0 | 2^-23 | semi-circles | Almanac long of asc node of orbit plane at weekly |
| 20 | I4 | omega | 2^-23 | semi-circles | Almanac argument of perigee |
| 24 | I4 | m0 | 2^-23 | semi-circles | Almanac mean anomaly at reference time |
| 28 | I2 | af0 | 2^-20 | s | Almanac time polynomial coefficient 0 (8 MSBs) |
| 30 | I2 | af1 | 2^-38 | s/s | Almanac time polynomial coefficient 1 |
| 32 | U1[4] | reserved0 | - | - | Reserved |

### 3.13.8.3 QZSS health assistance

| ***Message*** | **UBX-MGA-QZSS-HEALTH**<br>**QZSS health assistance** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Input | | | | | |
| *Comment* | This message allows the delivery of QZSS health assistance to a receiver.<br>See the section AssistNow online in Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x13 | 0x05 | 12 | *see below* | CK_A CK_B |

| *Payload description:* | | | | | |
|---|---|---|---|---|---|
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `type` | - | - | Message type (0x04 for this type) |
| 1 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 2 | U1[2] | `reserved0` | - | - | Reserved |
| 4 | U1[5] | `healthCode` | - | - | Each byte represents a QZSS SV (1-5). The 6 LSBs of each byte contains the 6 bit health code from subframes 4/5, data ID = 3, SV ID = 51 |
| 9 | U1[3] | `reserved1` | - | - | Reserved |

# 3.14 UBX-MON (0x0a)

The messages in the UBX-MON class are used to report the receiver status, such as hardware status or I/O subsystem statistics.

## 3.14.1 UBX-MON-COMMS (0x0a 0x36)

### 3.14.1.1 Communication port information

| ***Message*** | **UBX-MON-COMMS**<br>**Communication port information** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | Consolidated communications information for all ports. The size of the message is determined by the number of ports that are in use on the receiver. A port is only included if communication, either send or receive, has been initiated on that port. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x0a | 0x36 | 8 + nPorts·40 | *see below* | CK_A CK_B |

| *Payload description:* | | | | | |
|---|---|---|---|---|---|
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 1 | U1 | `nPorts` | - | - | Number of ports included |
| 2 | X1 | `txErrors` | - | - | TX error bitmask |
| bit 0 | $U_{:1}$ | `mem` | - | - | Memory Allocation error |
| bit 1 | $U_{:1}$ | `alloc` | - | - | Allocation error (TX buffer full) |
| 3 | U1 | `reserved0` | - | - | Reserved |
| 4 | U1[4] | `protIds` | - | | The identifiers of the protocols reported in the msgs array. 0: UBX, 1: NMEA, 2: RTCM2, 5: RTCM3, 0xFF: No protocol reported. |
| *Start of repeated group (`nPorts` times)* | | | | | |
| 8 + n·40 | U2 | `portId` | - | - | Unique identifier for the port. See section Communications ports in Integration manual for details. |
| 10 + n·40 | U2 | `txPending` | - | bytes | Number of bytes pending in transmitter buffer |
| 12 + n·40 | U4 | `txBytes` | - | bytes | Number of bytes ever sent |
| 16 + n·40 | U1 | `txUsage` | - | % | Maximum usage transmitter buffer during the last sysmon period |
| 17 + n·40 | U1 | `txPeakUsage` | - | % | Maximum usage transmitter buffer |
| 18 + n·40 | U2 | `rxPending` | - | bytes | Number of bytes in receiver buffer |

| | | | | | |
|---|---|---|---|---|---|
| 20 + n·40 | U4 | rxBytes | - | bytes | Number of bytes ever received |
| 24 + n·40 | U1 | rxUsage | - | % | Maximum usage receiver buffer during the last sysmon period |
| 25 + n·40 | U1 | rxPeakUsage | - | % | Maximum usage receiver buffer |
| 26 + n·40 | U2 | overrunErrs | - | - | Number of 100 ms timeslots with overrun errors |
| 28 + n·40 | U2[4] | msgs | - | msg | Number of successfully parsed messages for each protocol. The reported protocols are identified through the protIds field. |
| 36 + n·40 | U1[8] | reserved1 | - | - | Reserved |
| 44 + n·40 | U4 | skipped | - | bytes | Number of skipped bytes |
| *End of repeated group (nPorts times)* | | | | | |

## 3.14.2 UBX-MON-GNSS (0x0a 0x28)

### 3.14.2.1 Information message major GNSS selection

| ***Message*** | **UBX-MON-GNSS**<br>**Information message major GNSS selection** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Polled | | | | | |
| *Comment* | This message reports major GNSS selection. It does this by means of bit masks in U1 fields. Each bit in a bit mask corresponds to one major GNSS. Augmentation systems are not reported. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x0a | 0x28 | 8 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | version | - | - | Message version (0x01for this version) |
| 1 | X1 | supported | - | - | A bit mask showing the major GNSS that can be supported by this receiver |
| bit 0 | U:1 | GPSSup | - | - | GPS is supported |
| bit 1 | U:1 | GlonassSup | - | - | GLONASS is supported |
| bit 2 | U:1 | BeidouSup | - | - | BeiDou is supported |
| bit 3 | U:1 | GalileoSup | - | - | Galileo is supported |
| 2 | X1 | defaultGnss | - | - | A bit mask showing the default major GNSS selection. If the default major GNSS selection is currently configured in the efuse for this receiver, it takes precedence over the default major GNSS selection configured in the executing firmware of this receiver. |
| bit 0 | U:1 | GPSDef | - | - | GPS is default-enabled |
| bit 1 | U:1 | GlonassDef | - | - | GLONASS is default-enabled |
| bit 2 | U:1 | BeidouDef | - | - | BeiDou is default-enabled |
| bit 3 | U:1 | GalileoDef | - | - | Galileo is default-enabled |
| 3 | X1 | enabled | - | - | A bit mask showing the current major GNSS selection enabled for this receiver |
| bit 0 | U:1 | GPSEna | - | - | GPS is enabled |
| bit 1 | U:1 | GlonassEna | - | - | GLONASS is enabled |
| bit 2 | U:1 | BeidouEna | - | - | BeiDou is enabled |
| bit 3 | U:1 | GalileoEna | - | - | Galileo is enabled |

| | | | | | |
|---|---|---|---|---|---|
| 4 | U1 | simultaneous | - | - | Maximum number of concurrent major GNSS that can be supported by this receiver |
| 5 | U1[3] | reserved0 | - | - | Reserved |

## 3.14.3 UBX-MON-HW (0x0a 0x09)

### 3.14.3.1 Hardware status

| ***Message*** | **UBX-MON-HW**<br>**Hardware status** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | **This message is deprecated in this protocol version. Use** UBX-MON-HW3 **and** UBX-MON-RF **instead.**<br>Status of different aspect of the hardware, such as antenna, PIO/peripheral pins, noise level, automatic gain control (AGC) | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x0a | 0x09 | 60 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | X4 | pinSel | - | - | Mask of pins set as peripheral/PIO |
| 4 | X4 | pinBank | - | - | Mask of pins set as bank A/B |
| 8 | X4 | pinDir | - | - | Mask of pins set as input/output |
| 12 | X4 | pinVal | - | - | Mask of pins value low/high |
| 16 | U2 | noisePerMS | - | - | Noise level as measured by the GPS core |
| 18 | U2 | agcCnt | - | - | AGC monitor (counts SIGHI xor SIGLO, range 0 to 8191) |
| 20 | U1 | aStatus | - | - | Status of the antenna supervisor state machine (0=INIT, 1=DONTKNOW, 2=OK, 3=SHORT, 4=OPEN) |
| 21 | U1 | aPower | - | - | Current power status of antenna (0=OFF, 1=ON, 2=DONTKNOW) |
| 22 | X1 | flags | - | - | Flags |
| bit 0 | U:1 | rtcCalib | - | - | RTC is calibrated |
| bit 1 | U:1 | safeBoot | - | - | Safeboot mode (0 = inactive, 1 = active) |
| bits 3...2 | U:2 | jammingState | - | - | Output from jamming/interference monitor (0 = unknown or feature disabled, 1 = ok - no significant jamming, 2 = warning - interference visible but fix OK, 3 = critical - interference visible and no fix) |
| bit 4 | U:1 | xtalAbsent | - | - | RTC xtal has been determined to be absent (not supported for protocol versions less than 18.00) |
| 23 | U1 | reserved0 | - | - | Reserved |
| 24 | X4 | usedMask | - | - | Mask of pins that are used by the virtual pin manager |
| 28 | U1[17] | VP | - | - | Array of pin mappings for each of the 17 physical pins |
| 45 | U1 | jamInd | - | - | CW jamming indicator, scaled (0 = no CW jamming, 255 = strong CW jamming) |
| 46 | U1[2] | reserved1 | - | - | Reserved |
| 48 | X4 | pinIrq | - | - | Mask of pins value using the PIO Irq |
| 52 | X4 | pullH | - | - | Mask of pins value using the PIO pull high resistor |

| | | | | | |
|---|---|---|---|---|---|
| 56 | X4 | pullL | - | - | Mask of pins value using the PIO pull low resistor |

## 3.14.4 UBX-MON-HW2 (0x0a 0x0b)

### 3.14.4.1 Extended hardware status

| ***Message*** | **UBX-MON-HW2**<br>**Extended hardware status** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | **This message is deprecated in this protocol version. Use** UBX-MON-HW3 **and** UBX-MON-RF **instead.**<br>Status of different aspects of the hardware such as Imbalance, Low-Level Configuration and POST Results.<br>The first four parameters of this message represent the complex signal from the RF front end. The following rules of thumb apply:<br>• The smaller the absolute value of the variable ofsI and ofsQ, the better.<br>• Ideally, the magnitude of the I-part (magI) and the Q-part (magQ) of the complex signal should be the same. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x0a | 0x0b | 28 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | I1 | ofsI | - | - | Imbalance of I-part of complex signal, scaled (-128 = max. negative imbalance, 127 = max. positive imbalance) |
| 1 | U1 | magI | - | - | Magnitude of I-part of complex signal, scaled (0 = no signal, 255 = max. magnitude) |
| 2 | I1 | ofsQ | - | - | Imbalance of Q-part of complex signal, scaled (-128 = max. negative imbalance, 127 = max. positive imbalance) |
| 3 | U1 | magQ | - | - | Magnitude of Q-part of complex signal, scaled (0 = no signal, 255 = max. magnitude) |
| 4 | U1 | cfgSource | - | - | Source of low-level configuration<br>(114 = ROM, 111 = OTP, 112 = config pins, 102 = flash image) |
| 5 | U1[3] | reserved0 | - | - | Reserved |
| 8 | U4 | lowLevCfg | - | - | Low-level configuration (obsolete for protocol versions greater than 15.00) |
| 12 | U1[8] | reserved1 | - | - | Reserved |
| 20 | U4 | postStatus | - | - | POST status word |
| 24 | U1[4] | reserved2 | - | - | Reserved |

## 3.14.5 UBX-MON-HW3 (0x0a 0x37)

### 3.14.5.1 I/O pin status

| ***Message*** | **UBX-MON-HW3**<br>**I/O pin status** |
|---|---|
| *Type* | Periodic/polled |
| *Comment* | This message contains information specific to each HW I/O pin, for example whether the pin is set as Input or Output.<br>For the antenna supervisor status and other RF status information, see the UBX-MON-RF message. |

| Message structure | Header | Class | ID | Length (Bytes) | Payload | Checksum |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x0a | 0x37 | 22 + nPins·6 | *see below* | CK_A CK_B |

*Payload description:*

| Byte offset | Type | Name | Scale | Unit | Description |
|---|---|---|---|---|---|
| 0 | U1 | version | - | - | Message version (0x00 for this version) |
| 1 | U1 | nPins | - | - | The number of I/O pins included |
| 2 | X1 | flags | - | - | Flags |
| bit 0 | U:1 | rtcCalib | - | - | RTC is calibrated |
| bit 1 | U:1 | safeBoot | - | - | Safeboot mode (0 = inactive, 1 = active) |
| bit 2 | U:1 | xtalAbsent | - | - | RTC xtal has been determined to be absent |
| 3 | CH[10] | hwVersion | - | - | Zero-terminated hardware version string (same as that returned in the UBX-MON-VER message) |
| 13 | U1[9] | reserved0 | - | - | Reserved |
| *Start of repeated group (nPins times)* | | | | | |
| 22 + n·6 | U2 | pinId | - | - | Identifier for the pin, including both external and internal pins. |
| 24 + n·6 | X2 | pinMask | - | - | Pin mask |
| bit 0 | U:1 | periphPIO | - | - | Pin is set to peripheral or PIO? 0=Peripheral 1=PIO |
| bits 3...1 | U:3 | pinBank | - | - | Bank the pin belongs to, where 0=A 1=B 2=C 3=D 4=E 5=F 6=G 7=H |
| bit 4 | U:1 | direction | - | - | Pin direction? 0=Input 1=Output |
| bit 5 | U:1 | value | - | - | Pin value? 0=Low 1=High |
| bit 6 | U:1 | vpManager | - | - | Used by virtual pin manager? 0=No 1=Yes |
| bit 7 | U:1 | pioIrq | - | - | Interrupt enabled? 0=No 1=Yes |
| bit 8 | U:1 | pioPullHigh | - | - | Using pull high resistor? 0=No 1=Yes |
| bit 9 | U:1 | pioPullLow | - | - | Using pull low resistor 0=No 1=Yes |
| 26 + n·6 | U1 | VP | - | - | Virtual pin mapping |
| 27 + n·6 | U1 | reserved1 | - | - | Reserved |
| *End of repeated group (nPins times)* | | | | | |

## 3.14.6 UBX-MON-IO (0x0a 0x02)

### 3.14.6.1 I/O system status

| ***Message*** | **UBX-MON-IO**<br>**I/O system status** |
|---|---|
| *Type* | Periodic/polled |
| *Comment* | **This message is deprecated in this protocol version. Use** UBX-MON-COMMS **instead.**<br>The size of the message is determined by the number of ports 'N' the receiver supports, i.e. on u-blox 5 the number of ports is 6. |

| Message structure | Header | Class | ID | Length (Bytes) | Payload | Checksum |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x0a | 0x02 | [0..n]·20 | *see below* | CK_A CK_B |

*Payload description:*

| Byte offset | Type | Name | Scale | Unit | Description |
|---|---|---|---|---|---|
| *Start of repeated group (N times)* | | | | | |
| 0 + n·20 | U4 | rxBytes | - | bytes | Number of bytes ever received |

| | | | | | |
|---|---|---|---|---|---|
| 4 + n·20 | U4 | txBytes | - | bytes | Number of bytes ever sent |
| 8 + n·20 | U2 | parityErrs | - | - | Number of 100 ms timeslots with parity errors |
| 10 + n·20 | U2 | framingErrs | - | - | Number of 100 ms timeslots with framing errors |
| 12 + n·20 | U2 | overrunErrs | - | - | Number of 100 ms timeslots with overrun errors |
| 14 + n·20 | U2 | breakCond | - | - | Number of 100 ms timeslots with break conditions |
| 16 + n·20 | U1[4] | reserved0 | - | - | Reserved |
| *End of repeated group (N times)* | | | | | |

## 3.14.7 UBX-MON-MSGPP (0x0a 0x06)

### 3.14.7.1 Message parse and process status

| ***Message*** | **UBX-MON-MSGPP**<br>**Message parse and process status** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | **This message is deprecated in this protocol version. Use** UBX-MON-COMMS **instead.** | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x0a | 0x06 | 120 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U2[8] | msg1 | - | msgs | Number of successfully parsed messages for each protocol on port0 |
| 16 | U2[8] | msg2 | - | msgs | Number of successfully parsed messages for each protocol on port1 |
| 32 | U2[8] | msg3 | - | msgs | Number of successfully parsed messages for each protocol on port2 |
| 48 | U2[8] | msg4 | - | msgs | Number of successfully parsed messages for each protocol on port3 |
| 64 | U2[8] | msg5 | - | msgs | Number of successfully parsed messages for each protocol on port4 |
| 80 | U2[8] | msg6 | - | msgs | Number of successfully parsed messages for each protocol on port5 |
| 96 | U4[6] | skipped | - | bytes | Number skipped bytes for each port |

## 3.14.8 UBX-MON-PATCH (0x0a 0x27)

### 3.14.8.1 Installed patches

| ***Message*** | **UBX-MON-PATCH**<br>**Installed patches** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Polled | | | | | |
| *Comment* | This message reports information about patches installed and currently enabled on the receiver. It does not report on patches installed and then disabled. An enabled patch is considered active when the receiver executes from the code space where the patch resides on. For example, a ROM patch is reported active only when the system runs from ROM. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x0a | 0x27 | 4 + nEntries·16 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 0 | U2 | version | - | - | Message version (0x0001 for this version) |
| 2 | U2 | nEntries | - | - | Total number of reported patches |
| *Start of repeated group (nEntries times)* | | | | | |
| 4 + n·16 | X4 | patchInfo | - | - | Status information about the reported patch |
| bit 0 | U:1 | activated | - | - | 1: the patch is active, 0: otherwise |
| bits 2...1 | U:2 | location | - | - | Indicates where the patch is stored. 0: eFuse, 1: ROM, 2: BBR, 3: file system |
| 8 + n·16 | U4 | comparator Number | - | - | The number of the comparator |
| 12 + n·16 | U4 | patchAddress | - | - | The address that is targeted by the patch |
| 16 + n·16 | U4 | patchData | - | - | The data that is inserted at the patchAddress |
| *End of repeated group (nEntries times)* | | | | | |

## 3.14.9 UBX-MON-RF (0x0a 0x38)

### 3.14.9.1 RF information

| ***Message*** | **UBX-MON-RF**<br>**RF information** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | Information for each RF block. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x0a | 0x38 | 4 + nBlocks·24 | *see below* | CK_A CK_B |
| *Payload description:* | | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* | |
| 0 | U1 | version | - | - | Message version (0x00 for this version) | |
| 1 | U1 | nBlocks | - | - | The number of RF blocks included | |
| 2 | U1[2] | reserved0 | - | - | Reserved | |
| *Start of repeated group (nBlocks times)* | | | | | | |
| 4 + n·24 | U1 | blockId | - | - | RF block ID | |
| 5 + n·24 | X1 | flags | - | - | Flags | |
| bits 1...0 | U:2 | jammingState | - | - | output from Jamming/Interference Monitor (0 = unknown or feature disabled, 1 = ok - no significant jamming, 2 = warning - interference visible but fix OK, 3 = critical - interference visible and no fix) | |
| 6 + n·24 | U1 | antStatus | - | - | Status of the antenna supervisor state machine (0x00=INIT, 0x01=DONTKNOW, 0x02=OK, 0x03=SHORT, 0x04=OPEN) | |
| 7 + n·24 | U1 | antPower | - | - | Current power status of antenna (0x00=OFF, 0x01=ON, 0x02=DONTKNOW) | |
| 8 + n·24 | U4 | postStatus | - | - | POST status word | |
| 12 + n·24 | U1[4] | reserved1 | - | - | Reserved | |
| 16 + n·24 | U2 | noisePerMS | - | - | Noise level as measured by the GPS core | |
| 18 + n·24 | U2 | agcCnt | - | - | AGC Monitor (counts SIGHI xor SIGLO, range 0 to 8191) | |
| 20 + n·24 | U1 | jamInd | - | - | CW jamming indicator, scaled (0=no CW jamming, 255 = strong CW jamming) | |

| | | | | | |
|---|---|---|---|---|---|
| 21 + n·24 | I1 | ofsI | - | - | Imbalance of I-part of complex signal, scaled (-128 = max. negative imbalance, 127 = max. positive imbalance) |
| 22 + n·24 | U1 | magI | - | - | Magnitude of I-part of complex signal, scaled (0 = no signal, 255 = max.magnitude) |
| 23 + n·24 | I1 | ofsQ | - | - | Imbalance of Q-part of complex signal, scaled (-128 = max. negative imbalance, 127 = max. positive imbalance) |
| 24 + n·24 | U1 | magQ | - | - | Magnitude of Q-part of complex signal, scaled (0 = no signal, 255 = max.magnitude) |
| 25 + n·24 | U1[3] | reserved2 | - | - | Reserved |
| *End of repeated group (nBlocks times)* | | | | | |

## 3.14.10 UBX-MON-RXBUF (0x0a 0x07)

### 3.14.10.1 Receiver buffer status

| ***Message*** | **UBX-MON-RXBUF**<br>**Receiver buffer status** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | **This message is deprecated in this protocol version. Use** UBX-MON-COMMS **instead.** | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x0a | 0x07 | 24 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U2[6] | pending | - | bytes | Number of bytes pending in receiver buffer for each target |
| 12 | U1[6] | usage | - | % | Maximum usage receiver buffer during the last sysmon period for each target |
| 18 | U1[6] | peakUsage | - | % | Maximum usage receiver buffer for each target |

## 3.14.11 UBX-MON-RXR (0x0a 0x21)

### 3.14.11.1 Receiver status information

| ***Message*** | **UBX-MON-RXR**<br>**Receiver status information** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | The receiver ready message is sent when the receiver changes from or to backup mode. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x0a | 0x21 | 1 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | X1 | flags | - | - | Receiver status flags |
| bit 0 | $U_{:1}$ | awake | - | - | not in backup mode |

## 3.14.12 UBX-MON-SPAN (0x0a 0x31)

### 3.14.12.1 Signal characteristics

| ***Message*** | **UBX-MON-SPAN**<br>**Signal characteristics** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | This message is to be used as a basic spectrum analyzer, where it displays one spectrum for each of the receiver's existing RF paths. The spectrum is conveyed with the following parameters: The frequency span in MHz, the frequency bin resolution in MHz, the center frequency in MHz, and 256 bins with amplitude data. Additionally, in order to give further insight on the signal captured by the receiver, the current gain of the internal programmable gain amplifier (PGA) is provided.<br>**This message gives information for comparative analysis rather than absolute and precise spectrum overview. Users should not expect highly accurate spectrum amplitude.**<br>Note that the PGA gain is not included in the spectrum data but is available as a separate field. Neither the spectrum, nor the PGA gain considers the internal fixed LNA gain or an external third-party LNA.<br>The center frequency at each bin, assuming a zero-based bin count, can be computed as<br>*f(i) = center + span * (i - 128) / 256* | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x0a | 0x31 | 4 + numRfBlocks·272 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 1 | U1 | `numRfBlocks` | - | - | Number of RF blocks included |
| 2 | U1[2] | `reserved0` | - | - | Reserved |
| *Start of repeated group (`numRfBlocks` times)* | | | | | |
| 4 + n·272 | U1[256] | `spectrum` | - | dB | Spectrum data (number of points = span/res) |
| 260 + n·272 | U4 | `span` | - | Hz | Spectrum span |
| 264 + n·272 | U4 | `res` | - | Hz | Resolution of the spectrum |
| 268 + n·272 | U4 | `center` | - | Hz | Center of spectrum span |
| 272 + n·272 | U1 | `pga` | - | dB | Programmable gain amplifier |
| 273 + n·272 | U1[3] | `reserved1` | - | - | Reserved |
| *End of repeated group (`numRfBlocks` times)* | | | | | |

## 3.14.13 UBX-MON-TXBUF (0x0a 0x08)

### 3.14.13.1 Transmitter buffer status

| ***Message*** | **UBX-MON-TXBUF**<br>**Transmitter buffer status** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | **This message is deprecated in this protocol version. Use** UBX-MON-COMMS **instead.** | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x0a | 0x08 | 28 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U2[6] | `pending` | - | bytes | Number of bytes pending in transmitter buffer for each target |
| 12 | U1[6] | `usage` | - | % | Maximum usage transmitter buffer during the last sysmon period for each target |
| 18 | U1[6] | `peakUsage` | - | % | Maximum usage transmitter buffer for each target |

| | | | | | | |
|---|---|---|---|---|---|---|
| 24 | | U1 | tUsage | - | % | Maximum usage of transmitter buffer during the last sysmon period for all targets |
| 25 | | U1 | tPeakusage | - | % | Maximum usage of transmitter buffer for all targets |
| 26 | | X1 | errors | - | - | Error bitmask |
| | bits 5...0 | U:6 | limit | - | - | Buffer limit of corresponding target reached |
| | bit 6 | U:1 | mem | - | - | Memory Allocation error |
| | bit 7 | U:1 | alloc | - | - | Allocation error (TX buffer full) |
| 27 | | U1 | reserved0 | - | - | Reserved |

### 3.14.14 UBX-MON-VER (0x0a 0x04)

#### 3.14.14.1 Receiver and software version

| ***Message*** | **UBX-MON-VER** | | | | | |
|---|---|---|---|---|---|---|
| | **Receiver and software version** | | | | | |
| *Type* | Polled | | | | | |
| *Comment* | | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x0a | 0x04 | 40 + [0..n]·30 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | CH[30] | swVersion | - | - | Nul-terminated software version string. |
| 30 | CH[10] | hwVersion | - | - | Nul-terminated hardware version string |
| *Start of repeated group (N times)* | | | | | |
| 40 + n·30 | CH[30] | extension | - | - | Extended software information strings.<br>A series of nul-terminated strings. Each extension field is 30 characters long and contains varying software information. Not all extension fields may appear.<br>Examples of reported information: the software version string of the underlying ROM (when the receiver's firmware is running from flash), the firmware version, the supported protocol version, the module identifier, the flash information structure (FIS) file information, the supported major GNSS, the supported augmentation systems.<br>See Firmware and protocol versions for details. |
| *End of repeated group (N times)* | | | | | |

## 3.15 UBX-NAV (0x01)

The messages in the UBX-NAV class are used to output navigation results and data, such as position, altitude and velocity in a number of formats, and status flags and accuracy estimate figures, or satellite and signal information. The messages are generated with the configured navigation rate.

### 3.15.1 UBX-NAV-CLOCK (0x01 0x22)

#### 3.15.1.1 Clock solution

| ***Message*** | **UBX-NAV-CLOCK**<br>**Clock solution** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x22 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | `iTOW` | - | ms | GPS time of week of the navigation epoch. See the section Navigation epochs in Integration manual for details.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | I4 | `clkB` | - | ns | Clock bias |
| 8 | I4 | `clkD` | - | ns/s | Clock drift |
| 12 | U4 | `tAcc` | - | ns | Time accuracy estimate |
| 16 | U4 | `fAcc` | - | ps/s | Frequency accuracy estimate |

## 3.15.2 UBX-NAV-DOP (0x01 0x04)

#### 3.15.2.1 Dilution of precision

| ***Message*** | **UBX-NAV-DOP**<br>**Dilution of precision** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | • DOP values are dimensionless.<br>• All DOP values are scaled by a factor of 100. If the unit transmits a value of e.g. 156, the DOP value is 1.56. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x04 | 18 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | `iTOW` | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | U2 | `gDOP` | 0.01 | - | Geometric DOP |
| 6 | U2 | `pDOP` | 0.01 | - | Position DOP |
| 8 | U2 | `tDOP` | 0.01 | - | Time DOP |
| 10 | U2 | `vDOP` | 0.01 | - | Vertical DOP |
| 12 | U2 | `hDOP` | 0.01 | - | Horizontal DOP |
| 14 | U2 | `nDOP` | 0.01 | - | Northing DOP |
| 16 | U2 | `eDOP` | 0.01 | - | Easting DOP |

## 3.15.3 UBX-NAV-EOE (0x01 0x61)

#### 3.15.3.1 End of epoch

| ***Message*** | **UBX-NAV-EOE**<br>**End of epoch** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic | | | | | |
| *Comment* | This message is intended to be used as a marker to collect all navigation messages of an epoch. It is output after all enabled NAV class messages (except UBX-NAV-HNR) and after all enabled NMEA messages. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x61 | 4 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | `iTOW` | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |

## 3.15.4 UBX-NAV-GEOFENCE (0x01 0x39)

#### 3.15.4.1 Geofencing status

| ***Message*** | **UBX-NAV-GEOFENCE**<br>**Geofencing status** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | This message outputs the evaluated states of all configured geofences for the current epoch's position.<br>See the section Geofencing in Integration manual for feature details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x39 | 8 + numFences·2 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | `iTOW` | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 5 | U1 | `status` | - | - | Geofencing status<br>• 0 - Geofencing not available or not reliable<br>• 1 - Geofencing active |
| 6 | U1 | `numFences` | - | - | Number of geofences |
| 7 | U1 | `combState` | - | - | Combined (logical OR) state of all geofences<br>• 0 - Unknown<br>• 1 - Inside<br>• 2 - Outside |
| *Start of repeated group (`numFences` times)* | | | | | |
| 8 + n·2 | U1 | `state` | - | - | Geofence state<br>• 0 - Unknown<br>• 1 - Inside<br>• 2 - Outside |
| 9 + n·2 | U1 | `id` | - | - | Geofence ID (0 = not available) |
| *End of repeated group (`numFences` times)* | | | | | |

## 3.15.5 UBX-NAV-HPPOSECEF (0x01 0x13)

### 3.15.5.1 High precision position solution in ECEF

| ***Message*** | **UBX-NAV-HPPOSECEF**<br>**High precision position solution in ECEF** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | See important comments concerning validity of position given in section Navigation output filters in Integration manual. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x13 | 28 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 1 | U1[3] | `reserved0` | - | - | Reserved |
| 4 | U4 | `iTOW` | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 8 | I4 | `ecefX` | - | cm | ECEF X coordinate |
| 12 | I4 | `ecefY` | - | cm | ECEF Y coordinate |
| 16 | I4 | `ecefZ` | - | cm | ECEF Z coordinate |
| 20 | I1 | `ecefXHp` | 0.1 | mm | High precision component of ECEF X coordinate. Must be in the range of -99..+99. Precise coordinate in cm = ecefX + (ecefXHp * 1e-2). |
| 21 | I1 | `ecefYHp` | 0.1 | mm | High precision component of ECEF Y coordinate. Must be in the range of -99..+99. Precise coordinate in cm = ecefY + (ecefYHp * 1e-2). |
| 22 | I1 | `ecefZHp` | 0.1 | mm | High precision component of ECEF Z coordinate. Must be in the range of -99..+99. Precise coordinate in cm = ecefZ + (ecefZHp * 1e-2). |
| 23 | X1 | `flags` | - | - | Additional flags |
| bit 0 | $U_{:1}$ | `invalidEcef` | - | - | 1 = Invalid ecefX, ecefY, ecefZ, ecefXHp, ecefYHp and ecefZHp |
| 24 | U4 | `pAcc` | 0.1 | mm | Position Accuracy Estimate |

## 3.15.6 UBX-NAV-HPPOSLLH (0x01 0x14)

### 3.15.6.1 High precision geodetic position solution

| ***Message*** | **UBX-NAV-HPPOSLLH**<br>**High precision geodetic position solution** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | See important comments concerning validity of position given in section Navigation output filters in Integration manual.<br>This message outputs the Geodetic position in the currently selected ellipsoid. The default is the WGS84 Ellipsoid, but can be changed with the message CFG-NAVSPG-USE_USRDAT. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x14 | 36 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 1 | U1[2] | `reserved0` | - | - | Reserved |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | | X1 | flags | - | - | Additional flags |
| | bit 0 | U:1 | invalidLlh | - | - | 1 = Invalid lon, lat, height, hMSL, lonHp, latHp, heightHp and hMSLHp |
| 4 | | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 8 | | I4 | lon | 1e-7 | deg | Longitude |
| 12 | | I4 | lat | 1e-7 | deg | Latitude |
| 16 | | I4 | height | - | mm | Height above ellipsoid. |
| 20 | | I4 | hMSL | - | mm | Height above mean sea level |
| 24 | | I1 | lonHp | 1e-9 | deg | High precision component of longitude. Must be in the range -99..+99. Precise longitude in deg * 1e-7 = lon + (lonHp * 1e-2). |
| 25 | | I1 | latHp | 1e-9 | deg | High precision component of latitude. Must be in the range -99..+99. Precise latitude in deg * 1e-7 = lat + (latHp * 1e-2). |
| 26 | | I1 | heightHp | 0.1 | mm | High precision component of height above ellipsoid. Must be in the range -9..+9. Precise height in mm = height + (heightHp * 0.1). |
| 27 | | I1 | hMSLHp | 0.1 | mm | High precision component of height above mean sea level. Must be in range -9..+9. Precise height in mm = hMSL + (hMSLHp * 0.1) |
| 28 | | U4 | hAcc | 0.1 | mm | Horizontal accuracy estimate |
| 32 | | U4 | vAcc | 0.1 | mm | Vertical accuracy estimate |

## 3.15.7 UBX-NAV-ODO (0x01 0x09)

### 3.15.7.1 Odometer solution

| ***Message*** | **UBX-NAV-ODO**<br>**Odometer solution** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | This message outputs the traveled distance since last reset (see UBX-NAV-RESETODO) together with an associated estimated accuracy and the total cumulated ground distance (can only be reset by a cold start of the receiver). | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x09 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | version | - | - | Message version (0x00 for this version) |
| 1 | U1[3] | reserved0 | - | - | Reserved |
| 4 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 8 | U4 | distance | - | m | Ground distance since last reset |
| 12 | U4 | totalDistance | - | m | Total cumulative ground distance |
| 16 | U4 | distanceStd | - | m | Ground distance accuracy (1-sigma) |

## 3.15.8 UBX-NAV-ORB (0x01 0x34)

### 3.15.8.1 GNSS orbit database info

| ***Message*** | **UBX-NAV-ORB**<br>**GNSS orbit database info** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | Status of the GNSS orbit database knowledge. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x34 | 8 + numSv·6 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | `iTOW` | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | U1 | `version` | - | - | Message version (0x01 for this version) |
| 5 | U1 | `numSv` | - | - | Number of SVs in the database |
| 6 | U1[2] | `reserved0` | - | - | Reserved |
| *Start of repeated group (`numSv` times)* | | | | | |
| 8 + n·6 | U1 | `gnssId` | - | - | GNSS ID |
| 9 + n·6 | U1 | `svId` | - | - | Satellite ID |
| 10 + n·6 | X1 | `svFlag` | - | - | Information Flags |
| bits 1...0 | U:2 | `health` | - | - | SV health:<br>• 0 = unknown<br>• 1 = healthy<br>• 2 = not healty |
| bits 3...2 | U:2 | `visibility` | - | - | SV health:<br>• 0 = unknown<br>• 1 = below horizon<br>• 2 = above horizon<br>• 3 = above elevation mask |
| 11 + n·6 | X1 | `eph` | - | - | Ephemeris data |
| bits 4...0 | U:5 | `ephUsability` | - | - | How long the receiver will be able to use the stored ephemeris data from now on:<br>• 31 = The usability period is unknown<br>• 30 = The usability period is more than 450 minutes<br>• 30 > n > 0 = The usability period is between (n-1)*15 and n*15 minutes<br>• 0 = Ephemeris can no longer be used |
| bits 7...5 | U:3 | `ephSource` | - | - | • 0 = not available<br>• 1 = GNSS transmission<br>• 2 = external aiding<br>• 3-7 = other |
| 12 + n·6 | X1 | `alm` | - | - | Almanac data |
| bits 4...0 | U:5 | `almUsability` | - | - | How long the receiver will be able to use the stored almanac data from now on:<br>• 31 = The usability period is unknown<br>• 30 = The usability period is more than 30 days<br>• 30 > n > 0 = The usability period is between n-1 and n days<br>• 0 = Almanac can no longer be used |
| bits 7...5 | U:3 | `almSource` | - | - | • 0 = not available |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | • 1 = GNSS transmission<br>• 2 = external aiding<br>• 3-7 = other |
| 13 + n·6 | X1 | otherOrb | - | - | Other orbit data available |
| bits 4...0 | U:5 | anoAop Usability | - | - | How long the receiver will be able to use the orbit data from now on:<br>• 31 = The usability period is unknown<br>• 30 = The usability period is more than 30 days<br>• 30 > n > 0 = The usability period is between n-1 and n days<br>• 0 = Data can no longer be used |
| bits 7...5 | U:3 | type | - | - | Type of orbit data:<br>• 0 = No orbit data available<br>• 1 = AssistNow Offline data<br>• 2 = AssistNow Autonomous data<br>• 3-7 = Other orbit data |
| *End of repeated group (numSv times)* | | | | | |

## 3.15.9 UBX-NAV-POSECEF (0x01 0x01)

### 3.15.9.1 Position solution in ECEF

| ***Message*** | **UBX-NAV-POSECEF**<br>**Position solution in ECEF** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | See important comments concerning validity of position given in section Navigation output filters in Integration manual. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x01 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | I4 | ecefX | - | cm | ECEF X coordinate |
| 8 | I4 | ecefY | - | cm | ECEF Y coordinate |
| 12 | I4 | ecefZ | - | cm | ECEF Z coordinate |
| 16 | U4 | pAcc | - | cm | Position Accuracy Estimate |

## 3.15.10 UBX-NAV-POSLLH (0x01 0x02)

### 3.15.10.1 Geodetic position solution

| ***Message*** | **UBX-NAV-POSLLH**<br>**Geodetic position solution** |
|---|---|
| *Type* | Periodic/polled |
| *Comment* | See important comments concerning validity of position given in section Navigation output filters in Integration manual.<br>This message outputs the Geodetic position in the currently selected ellipsoid. The default is the WGS84 Ellipsoid, but can be changed with the message CFG-NAVSPG-USE_USRDAT. |

| Message structure | Header | Class | ID | Length (Bytes) | Payload | Checksum |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x01 | 0x02 | 28 | *see below* | CK_A CK_B |

*Payload description:*

| Byte offset | Type | Name | Scale | Unit | Description |
|---|---|---|---|---|---|
| 0 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | I4 | lon | 1e-7 | deg | Longitude |
| 8 | I4 | lat | 1e-7 | deg | Latitude |
| 12 | I4 | height | - | mm | Height above ellipsoid |
| 16 | I4 | hMSL | - | mm | Height above mean sea level |
| 20 | U4 | hAcc | - | mm | Horizontal accuracy estimate |
| 24 | U4 | vAcc | - | mm | Vertical accuracy estimate |

## 3.15.11 UBX-NAV-PVT (0x01 0x07)

### 3.15.11.1 Navigation position velocity time solution

| ***Message*** | **UBX-NAV-PVT**<br>**Navigation position velocity time solution** |
|---|---|
| *Type* | Periodic/polled |
| *Comment* | This message combines position, velocity and time solution, including accuracy figures.<br>Note that during a leap second there may be more or less than 60 seconds in a minute.<br>See the description of leap seconds in the Integration manual for details. |

| Message structure | Header | Class | ID | Length (Bytes) | Payload | Checksum |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x01 | 0x07 | 92 | *see below* | CK_A CK_B |

*Payload description:*

| Byte offset | Type | Name | Scale | Unit | Description |
|---|---|---|---|---|---|
| 0 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | U2 | year | - | y | Year (UTC) |
| 6 | U1 | month | - | month | Month, range 1..12 (UTC) |
| 7 | U1 | day | - | d | Day of month, range 1..31 (UTC) |
| 8 | U1 | hour | - | h | Hour of day, range 0..23 (UTC) |
| 9 | U1 | min | - | min | Minute of hour, range 0..59 (UTC) |
| 10 | U1 | sec | - | s | Seconds of minute, range 0..60 (UTC) |
| 11 | X1 | valid | - | - | Validity flags |
| bit 0 | U:1 | validDate | - | - | 1 = valid UTC Date (see section Time validity in Integration manual for details) |
| bit 1 | U:1 | validTime | - | - | 1 = valid UTC time of day (see section Time validity in Integration manual for details) |
| bit 2 | U:1 | fullyResolved | - | - | 1 = UTC time of day has been fully resolved (no seconds uncertainty). Cannot be used to check if time is completely solved. |
| bit 3 | U:1 | validMag | - | - | 1 = valid magnetic declination |
| 12 | U4 | tAcc | - | ns | Time accuracy estimate (UTC) |

| | | | | | | |
|---|---|---|---|---|---|---|
| 16 | | I4 | nano | - | ns | Fraction of second, range -1e9 .. 1e9 (UTC) |
| 20 | | U1 | fixType | - | - | GNSSfix Type:<br>• 0 = no fix<br>• 1 = dead reckoning only<br>• 2 = 2D-fix<br>• 3 = 3D-fix<br>• 4 = GNSS + dead reckoning combined<br>• 5 = time only fix |
| 21 | | X1 | flags | - | - | Fix status flags |
| | bit 0 | U:1 | gnssFixOK | - | - | 1 = valid fix (i.e within DOP & accuracy masks) |
| | bit 1 | U:1 | diffSoln | - | - | 1 = differential corrections were applied |
| | bits 4...2 | U:3 | psmState | - | - | Power save mode state (see Power management section in Integration Manual for details.<br>• 0 = PSM is not active<br>• 1 = Enabled (an intermediate state before Acquisition state<br>• 2 = Acquisition<br>• 3 = Tracking<br>• 4 = Power Optimized Tracking<br>• 5 = Inactive |
| | bit 5 | U:1 | headVehValid | - | - | 1 = heading of vehicle is valid, only set if the receiver is in sensor fusion mode |
| | bits 7...6 | U:2 | carrSoln | - | - | Carrier phase range solution status:<br>• 0 = no carrier phase range solution<br>• 1 = carrier phase range solution with floating ambiguities<br>• 2 = carrier phase range solution with fixed ambiguities<br>(not supported for protocol versions less than 20.00) |
| 22 | | X1 | flags2 | - | - | Additional flags |
| | bit 5 | U:1 | confirmedAvai | - | - | 1 = information about UTC Date and Time of Day validity confirmation is available (see section Time validity in Integration manual for details)<br>This flag is only supported in Protocol Versions 19.00, 19.10, 20.10, 20.20, 20.30, 22.00, 23.00, 23.01, 27 and 28. |
| | bit 6 | U:1 | confirmedDate | - | - | 1 = UTC Date validity could be confirmed (see section Time validity in Integration manual for details) |
| | bit 7 | U:1 | confirmedTime | - | - | 1 = UTC Time of Day could be confirmed (see section Time validity in Integration manual for details) |
| 23 | | U1 | numSV | - | - | Number of satellites used in Nav Solution |
| 24 | | I4 | lon | 1e-7 | deg | Longitude |
| 28 | | I4 | lat | 1e-7 | deg | Latitude |
| 32 | | I4 | height | - | mm | Height above ellipsoid |
| 36 | | I4 | hMSL | - | mm | Height above mean sea level |
| 40 | | U4 | hAcc | - | mm | Horizontal accuracy estimate |
| 44 | | U4 | vAcc | - | mm | Vertical accuracy estimate |
| 48 | | I4 | velN | - | mm/s | NED north velocity |
| 52 | | I4 | velE | - | mm/s | NED east velocity |
| 56 | | I4 | velD | - | mm/s | NED down velocity |

| | | | | | | |
|---|---|---|---|---|---|---|
| 60 | | I4 | gSpeed | - | mm/s | Ground Speed (2-D) |
| 64 | | I4 | headMot | 1e-5 | deg | Heading of motion (2-D) |
| 68 | | U4 | sAcc | - | mm/s | Speed accuracy estimate |
| 72 | | U4 | headAcc | 1e-5 | deg | Heading accuracy estimate (both motion and vehicle) |
| 76 | | U2 | pDOP | 0.01 | - | Position DOP |
| 78 | | X1 | flags3 | - | - | Additional flags |
| | bit 0 | $U_{:1}$ | invalidLlh | - | - | 1 = Invalid lon, lat, height and hMSL |
| 79 | | U1[5] | reserved0 | - | - | Reserved |
| 84 | | I4 | headVeh | 1e-5 | deg | Heading of vehicle (2-D), this is only valid when headVehValid is set, otherwise the output is set to the heading of motion |
| 88 | | I2 | magDec | 1e-2 | deg | Magnetic declination. Only supported in ADR 4.10 and later. |
| 90 | | U2 | magAcc | 1e-2 | deg | Magnetic declination accuracy. Only supported in ADR 4.10 and later. |

## 3.15.12 UBX-NAV-RELPOSNED (0x01 0x3c)

### 3.15.12.1 Relative positioning information in NED frame

| ***Message*** | **UBX-NAV-RELPOSNED**<br>**Relative positioning information in NED frame** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | This message contains the relative position vector from the reference station to the rover, including accuracy figures, in the local topological system defined at the reference station.<br>☞ The NED frame is defined as the local topological system at the reference station. The relative position vector components in this message, along with their associated accuracies, are given in that local topological system. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x3c | 64 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | version | - | - | Message version (0x01 for this version) |
| 1 | U1 | reserved0 | - | - | Reserved |
| 2 | U2 | refStationId | - | - | Reference station ID. Must be in the range 0..4095. |
| 4 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 8 | I4 | relPosN | - | cm | North component of relative position vector |
| 12 | I4 | relPosE | - | cm | East component of relative position vector |
| 16 | I4 | relPosD | - | cm | Down component of relative position vector |
| 20 | I4 | relPosLength | - | cm | Length of the relative position vector |
| 24 | I4 | relPosHeading | 1e-5 | deg | Heading of the relative position vector |
| 28 | U1[4] | reserved1 | - | - | Reserved |

| | | | | | |
|---|---|---|---|---|---|
| 32 | I1 | relPosHPN | 0.1 | mm | High-precision North component of relative position vector.<br>Must be in the range -99 to +99.<br>The full North component of the relative position vector, in units of cm, is given by<br>relPosN + (relPosHPN * 1e-2) |
| 33 | I1 | relPosHPE | 0.1 | mm | High-precision East component of relative position vector.<br>Must be in the range -99 to +99.<br>The full East component of the relative position vector, in units of cm, is given by<br>relPosE + (relPosHPE * 1e-2) |
| 34 | I1 | relPosHPD | 0.1 | mm | High-precision Down component of relative position vector.<br>Must be in the range -99 to +99.<br>The full Down component of the relative position vector, in units of cm, is given by<br>relPosD + (relPosHPD * 1e-2) |
| 35 | I1 | relPosHP Length | 0.1 | mm | High-precision component of the length of the relative position vector.<br>Must be in the range -99 to +99.<br>The full length of the relative position vector, in units of cm, is given by<br>relPosLength + (relPosHPLength * 1e-2) |
| 36 | U4 | accN | 0.1 | mm | Accuracy of relative position North component |
| 40 | U4 | accE | 0.1 | mm | Accuracy of relative position East component |
| 44 | U4 | accD | 0.1 | mm | Accuracy of relative position Down component |
| 48 | U4 | accLength | 0.1 | mm | Accuracy of length of the relative position vector |
| 52 | U4 | accHeading | 1e-5 | deg | Accuracy of heading of the relative position vector |
| 56 | U1[4] | reserved2 | - | - | Reserved |
| 60 | X4 | flags | - | - | Flags |
| bit 0 | $U_{:1}$ | gnssFixOK | - | - | A valid fix (i.e within DOP & accuracy masks) |
| bit 1 | $U_{:1}$ | diffSoln | - | - | 1 if differential corrections were applied |
| bit 2 | $U_{:1}$ | relPosValid | - | - | 1 if relative position components and accuracies are valid and, in moving base mode only, if baseline is valid |
| bits 4...3 | $U_{:2}$ | carrSoln | - | - | Carrier phase range solution status:<br>• 0 = no carrier phase range solution<br>• 1 = carrier phase range solution with floating ambiguities<br>• 2 = carrier phase range solution with fixed ambiguities |
| bit 5 | $U_{:1}$ | isMoving | - | - | 1 if the receiver is operating in moving base mode |
| bit 6 | $U_{:1}$ | refPosMiss | - | - | 1 if extrapolated reference position was used to compute moving base solution this epoch. (Flag set for protocol versions 27.10, and 27.11, and 31.11) |
| bit 7 | $U_{:1}$ | refObsMiss | - | - | 1 if extrapolated reference observations were used to compute moving base solution this epoch. (Flag set for protocol versions 27.10, and 27.11, and 31.11) |
| bit 8 | $U_{:1}$ | relPosHeading Valid | - | - | 1 if relPosHeading is valid |

| | | | | | |
|---|---|---|---|---|---|
| bit 9 | U:1 | relPos Normalized | - | - | 1 if the components of the relative position vector (including the high-precision parts) are normalized |

## 3.15.13 UBX-NAV-RESETODO (0x01 0x10)

### 3.15.13.1 Reset odometer

| ***Message*** | **UBX-NAV-RESETODO**<br>**Reset odometer** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Command | | | | | |
| *Comment* | This message resets the traveled distance computed by the odometer (see UBX-NAV-ODO).<br>UBX-ACK-ACK or UBX-ACK-NAK are returned to indicate success or failure. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x10 | 0 | *see below* | CK_A CK_B |
| *Payload* | This message has no payload. | | | | | |

## 3.15.14 UBX-NAV-SAT (0x01 0x35)

### 3.15.14.1 Satellite information

| ***Message*** | **UBX-NAV-SAT**<br>**Satellite information** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | This message displays information about SVs that are either known to be visible or currently tracked by the receiver. All signal related information corresponds to the subset of signals specified in Signal Identifiers. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x35 | 8 + numSvs·12 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | U1 | version | - | - | Message version (0x01 for this version) |
| 5 | U1 | numSvs | - | - | Number of satellites |
| 6 | U1[2] | reserved0 | - | - | Reserved |
| *Start of repeated group (numSvs times)* | | | | | |
| 8 + n·12 | U1 | gnssId | - | - | GNSS identifier (see Satellite Numbering) for assignment |
| 9 + n·12 | U1 | svId | - | - | Satellite identifier (see Satellite Numbering) for assignment |
| 10 + n·12 | U1 | cno | - | dBHz | Carrier to noise ratio (signal strength) |
| 11 + n·12 | I1 | elev | - | deg | Elevation (range: +/-90), unknown if out of range |
| 12 + n·12 | I2 | azim | - | deg | Azimuth (range 0-360), unknown if elevation is out of range |
| 14 + n·12 | I2 | prRes | 0.1 | m | Pseudorange residual |
| 16 + n·12 | X4 | flags | - | - | Bitmask |
| bits 2...0 | U:3 | qualityInd | - | - | Signal quality indicator:<br>• 0 = no signal<br>• 1 = searching signal |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | • 2 = signal acquired<br>• 3 = signal detected but unusable<br>• 4 = code locked and time synchronized<br>• 5, 6, 7 = code and carrier locked and time synchronized |
| bit 3 | U:1 | svUsed | - | - | 1 = Signal in the subset specified in Signal Identifiers is currently being used for navigation |
| bits 5...4 | U:2 | health | - | - | Signal health flag:<br>• 0 = unknown<br>• 1 = healthy<br>• 2 = unhealthy |
| bit 6 | U:1 | diffCorr | - | - | 1 = differential correction data is available for this SV |
| bit 7 | U:1 | smoothed | - | - | 1 = carrier smoothed pseudorange used |
| bits 10...8 | U:3 | orbitSource | - | - | Orbit source:<br>• 0 = no orbit information is available for this SV<br>• 1 = ephemeris is used<br>• 2 = almanac is used<br>• 3 = AssistNow Offline orbit is used<br>• 4 = AssistNow Autonomous orbit is used<br>• 5, 6, 7 = other orbit information is used |
| bit 11 | U:1 | ephAvail | - | - | 1 = ephemeris is available for this SV |
| bit 12 | U:1 | almAvail | - | - | 1 = almanac is available for this SV |
| bit 13 | U:1 | anoAvail | - | - | 1 = AssistNow Offline data is available for this SV |
| bit 14 | U:1 | aopAvail | - | - | 1 = AssistNow Autonomous data is available for this SV |
| bit 16 | U:1 | sbasCorrUsed | - | - | 1 = SBAS corrections have been used for a signal in the subset specified in Signal Identifiers |
| bit 17 | U:1 | rtcmCorrUsed | - | - | 1 = RTCM corrections have been used for a signal in the subset specified in Signal Identifiers |
| bit 18 | U:1 | slasCorrUsed | - | - | 1 = QZSS SLAS corrections have been used for a signal in the subset specified in Signal Identifiers |
| bit 20 | U:1 | prCorrUsed | - | - | 1 = Pseudorange corrections have been used for a signal in the subset specified in Signal Identifiers |
| bit 21 | U:1 | crCorrUsed | - | - | 1 = Carrier range corrections have been used for a signal in the subset specified in Signal Identifiers |
| bit 22 | U:1 | doCorrUsed | - | - | 1 = Range rate (Doppler) corrections have been used for a signal in the subset specified in Signal Identifiers |
| *End of repeated group (`numSvs` times)* | | | | | |

## 3.15.15 UBX-NAV-SBAS (0x01 0x32)

### 3.15.15.1 SBAS status data

| ***Message*** | **UBX-NAV-SBAS**<br>**SBAS status data** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | This message outputs the status of the SBAS sub system | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x32 | 12 + cnt·12 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 0 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the description of iTOW for details. |
| 4 | U1 | geo | - | - | PRN Number of the GEO where correction and integrity data is used from |
| 5 | U1 | mode | - | - | SBAS Mode<br>• 0 Disabled<br>• 1 Enabled integrity<br>• 3 Enabled test mode |
| 6 | I1 | sys | - | - | SBAS System (WAAS/EGNOS/...)<br>• -1 Unknown<br>• 0 WAAS<br>• 1 EGNOS<br>• 2 MSAS<br>• 3 GAGAN<br>• 16 GPS |
| 7 | X1 | service | - | - | SBAS Services available |
| bit 0 | U:1 | Ranging | - | - | GEO may be used as ranging source |
| bit 1 | U:1 | Corrections | - | - | GEO is providing correction data |
| bit 2 | U:1 | Integrity | - | - | GEO is providing integrity |
| bit 3 | U:1 | Testmode | - | - | GEO is in test mode |
| bit 4 | U:1 | Bad | - | - | Problem with signal or broadcast data indicated |
| 8 | U1 | cnt | - | - | Number of SV data following |
| 9 | U1[3] | reserved0 | - | - | Reserved |
| *Start of repeated group (cnt times)* | | | | | |
| 12 + n·12 | U1 | svid | - | - | SV ID |
| 13 + n·12 | U1 | flags | - | - | Flags for this SV |
| 14 + n·12 | U1 | udre | - | - | Monitoring status |
| 15 + n·12 | U1 | svSys | - | - | System (WAAS/EGNOS/...)<br>same as SYS |
| 16 + n·12 | U1 | svService | - | - | Services available<br>same as SERVICE |
| 17 + n·12 | U1 | reserved1 | - | - | Reserved |
| 18 + n·12 | I2 | prc | - | cm | Pseudo Range correction in [cm] |
| 20 + n·12 | U1[2] | reserved2 | - | - | Reserved |
| 22 + n·12 | I2 | ic | - | cm | Ionosphere correction in [cm] |
| *End of repeated group (cnt times)* | | | | | |

## 3.15.16 UBX-NAV-SIG (0x01 0x43)

### 3.15.16.1 Signal information

| ***Message*** | **UBX-NAV-SIG**<br>**Signal information** |
|---|---|
| *Type* | Periodic/polled |
| *Comment* | This message displays information about signals currently tracked by the receiver.<br>On the F9 platform the maximum number of signals is 120. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x01 | 0x43 | 8 + numSigs·16 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | `iTOW` | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 5 | U1 | `numSigs` | - | - | Number of signals |
| 6 | U1[2] | `reserved0` | - | - | Reserved |
| *Start of repeated group (`numSigs` times)* | | | | | |
| 8 + n·16 | U1 | `gnssId` | - | - | GNSS identifier (see Satellite Numbering) for assignment |
| 9 + n·16 | U1 | `svId` | - | - | Satellite identifier (see Satellite Numbering) for assignment |
| 10 + n·16 | U1 | `sigId` | - | - | New style signal identifier (see Signal Identifiers) |
| 11 + n·16 | U1 | `freqId` | - | - | Only used for GLONASS: This is the frequency slot + 7 (range from 0 to 13) |
| 12 + n·16 | I2 | `prRes` | 0.1 | m | Pseudorange residual |
| 14 + n·16 | U1 | `cno` | - | dBHz | Carrier-to-noise density ratio (signal strength) |
| 15 + n·16 | U1 | `qualityInd` | - | - | Signal quality indicator:<br>• 0 = no signal<br>• 1 = searching signal<br>• 2 = signal acquired<br>• 3 = signal detected but unusable<br>• 4 = code locked and time synchronized<br>• 5, 6, 7 = code and carrier locked and time synchronized |
| 16 + n·16 | U1 | `corrSource` | - | - | Correction source:<br>• 0 = no corrections<br>• 1 = SBAS corrections<br>• 2 = BeiDou corrections<br>• 3 = RTCM2 corrections<br>• 4 = RTCM3 OSR corrections<br>• 5 = RTCM3 SSR corrections<br>• 6 = QZSS SLAS corrections |
| 17 + n·16 | U1 | `ionoModel` | - | - | Ionospheric model used:<br>• 0 = no model<br>• 1 = Klobuchar model transmitted by GPS<br>• 2 = SBAS model<br>• 3 = Klobuchar model transmitted by BeiDou<br>• 8 = Iono delay derived from dual frequency observations |
| 18 + n·16 | X2 | `sigFlags` | - | - | Signal related flags |
| bits 1...0 | U:2 | `health` | - | - | Signal health flag:<br>• 0 = unknown<br>• 1 = healthy<br>• 2 = unhealthy |
| bit 2 | U:1 | `prSmoothed` | - | - | 1 = Pseudorange has been smoothed |
| bit 3 | U:1 | `prUsed` | - | - | 1 = Pseudorange has been used for this signal |

| | | | | | |
|---|---|---|---|---|---|
| bit 4 | U:1 | crUsed | - | - | 1 = Carrier range has been used for this signal |
| bit 5 | U:1 | doUsed | - | - | 1 = Range rate (Doppler) has been used for this signal |
| bit 6 | U:1 | prCorrUsed | - | - | 1 = Pseudorange corrections have been used for this signal |
| bit 7 | U:1 | crCorrUsed | - | - | 1 = Carrier range corrections have been used for this signal |
| bit 8 | U:1 | doCorrUsed | - | - | 1 = Range rate (Doppler) corrections have been used for this signal |
| 20 + n·16 | U1[4] | reserved1 | - | - | Reserved |
| *End of repeated group (numSigs times)* | | | | | |

## 3.15.17 UBX-NAV-SLAS (0x01 0x42)

### 3.15.17.1 QZSS L1S SLAS status data

| ***Message*** | **UBX-NAV-SLAS**<br>**QZSS L1S SLAS status data** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | This message outputs the status of the QZSS L1S SLAS sub system | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x42 | 20 + cnt·8 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the description of iTOW for details. |
| 4 | U1 | version | - | - | Message version (0x00 for this version) |
| 5 | U1[3] | reserved0 | - | - | Reserved |
| 8 | I4 | gmsLon | 1e-3 | deg | Longitude of the used ground monitoring station |
| 12 | I4 | gmsLat | 1e-3 | deg | Latitude of the used ground monitoring station |
| 16 | U1 | gmsCode | - | - | Code of the used ground monitoring station according to the QZSS SLAS Interface Specification, available from qzss.go.jp/en/ |
| 17 | U1 | qzssSvId | - | - | Satellite identifier of the QZS/GEO whose correction data is used (see Satellite Numbering) |
| 18 | X1 | serviceFlags | - | - | Flags regarding SLAS service |
| bit 0 | U:1 | gmsAvailable | - | - | 1 = Ground monitoring station available |
| bit 1 | U:1 | qzssSv Available | - | - | 1 = Correction providing QZSS SV available |
| bit 2 | U:1 | testMode | - | - | 1 = Currently used QZSS SV in test mode |
| 19 | U1 | cnt | - | - | Number of pseudorange corrections following |
| *Start of repeated group (cnt times)* | | | | | |
| 20 + n·8 | U1 | gnssId | - | - | GNSS identifier (see Satellite Numbering) |
| 21 + n·8 | U1 | svId | - | - | Satellite identifier (see Satellite Numbering) |
| 22 + n·8 | U1 | reserved1 | - | - | Reserved |
| 23 + n·8 | U1[3] | reserved2 | - | - | Reserved |
| 26 + n·8 | I2 | prc | - | cm | Pseudorange correction |

*End of repeated group (`cnt` times)*

## 3.15.18 UBX-NAV-STATUS (0x01 0x03)

### 3.15.18.1 Receiver navigation status

| ***Message*** | **UBX-NAV-STATUS**<br>**Receiver navigation status** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | See important comments concerning validity of position given in section Navigation output filters in Integration manual. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x03 | 16 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | `iTOW` | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | U1 | `gpsFix` | - | - | GPSfix Type, this value does **not** qualify a fix as valid and within the limits. See note on flag gpsFixOk below.<br>• 0x00 = no fix<br>• 0x01 = dead reckoning only<br>• 0x02 = 2D-fix<br>• 0x03 = 3D-fix<br>• 0x04 = GPS + dead reckoning combined<br>• 0x05 = Time only fix<br>• 0x06..0xff = reserved |
| 5 | X1 | `flags` | - | - | Navigation Status Flags |
| bit 0 | U:1 | `gpsFixOk` | - | - | 1 = position and velocity valid and within DOP and ACC Masks. |
| bit 1 | U:1 | `diffSoln` | - | - | 1 = differential corrections were applied |
| bit 2 | U:1 | `wknSet` | - | - | 1 = Week Number valid (see section Time validity in Integration manual for details) |
| bit 3 | U:1 | `towSet` | - | - | 1 = Time of Week valid (see section Time validity in Integration manual for details) |
| 6 | X1 | `fixStat` | - | - | Fix Status Information |
| bit 0 | U:1 | `diffCorr` | - | - | 1 = differential corrections available |
| bit 1 | U:1 | `carrSolnValid` | - | - | 1 = valid carrSoln |
| bits 7...6 | U:2 | `mapMatching` | - | - | map matching status:<br>• 00: none<br>• 01: valid but not used, i.e. map matching data was received, but was too old<br>• 10: valid and used, map matching data was applied<br>• 11: valid and used, map matching data was applied. In case of sensor unavailability map matching data enables dead reckoning. This requires map matched latitude/longitude or heading data. |
| 7 | X1 | `flags2` | - | - | further information about navigation output |
| bits 1...0 | U:2 | `psmState` | - | - | power save mode state (not supported for protocol versions less than 13.01) |

| | | | | | |
|---|---|---|---|---|---|
| | | | | | • 0 = ACQUISITION [or when psm disabled]<br>• 1 = TRACKING<br>• 2 = POWER OPTIMIZED TRACKING<br>• 3 = INACTIVE |
| bits 4...3 | U:2 | spoofDetState | - | - | Spoofing detection state (not supported for protocol versions less than 18.00)<br>• 0: Unknown or deactivated<br>• 1: No spoofing indicated<br>• 2: Spoofing indicated<br>• 3: Multiple spoofing indications<br>Note that the spoofing state value only reflects the dector state for the current navigation epoch. As spoofing can be detected most easily at the transition from real signal to spoofing signal, this is also where the detector is triggered the most. I.e. a value of *1 - No spoofing indicated* does not mean that the receiver is not spoofed, it simply states that the detector was not triggered in this epoch. |
| bits 7...6 | U:2 | carrSoln | - | - | Carrier phase range solution status:<br>• 0 = no carrier phase range solution<br>• 1 = carrier phase range solution with floating ambiguities<br>• 2 = carrier phase range solution with fixed ambiguities |
| 8 | U4 | ttff | - | ms | Time to first fix (millisecond time tag) |
| 12 | U4 | msss | - | ms | Milliseconds since Startup / Reset |

## 3.15.19 UBX-NAV-SVIN (0x01 0x3b)

### 3.15.19.1 Survey-in data

| ***Message*** | **UBX-NAV-SVIN**<br>**Survey-in data** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | This message contains information about survey-in parameters. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x3b | 40 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | version | - | - | Message version (0x00 for this version) |
| 1 | U1[3] | reserved0 | - | - | Reserved |
| 4 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the description of iTOW for details. |
| 8 | U4 | dur | - | s | Passed survey-in observation time |
| 12 | I4 | meanX | - | cm | Current survey-in mean position ECEF X coordinate |
| 16 | I4 | meanY | - | cm | Current survey-in mean position ECEF Y coordinate |
| 20 | I4 | meanZ | - | cm | Current survey-in mean position ECEF Z coordinate |
| 24 | I1 | meanXHP | - | 0.1_mm | Current high-precision survey-in mean position ECEF X coordinate. Must be in the range -99..+99.<br>The current survey-in mean position ECEF X coordinate, in units of cm, is given by<br>meanX + (0.01 * meanXHP) |

| | | | | | |
|---|---|---|---|---|---|
| 25 | I1 | meanYHP | - | 0.1_mm | Current high-precision survey-in mean position ECEF Y coordinate. Must be in the range -99..+99.<br>The current survey-in mean position ECEF Y coordinate, in units of cm, is given by<br>meanY + (0.01 * meanYHP) |
| 26 | I1 | meanZHP | - | 0.1_mm | Current high-precision survey-in mean position ECEF Z coordinate. Must be in the range -99..+99.<br>The current survey-in mean position ECEF Z coordinate, in units of cm, is given by<br>meanZ + (0.01 * meanZHP) |
| 27 | U1 | reserved1 | - | - | Reserved |
| 28 | U4 | meanAcc | - | 0.1_mm | Current survey-in mean position accuracy |
| 32 | U4 | obs | - | - | Number of position observations used during survey-in |
| 36 | U1 | valid | - | - | Survey-in position validity flag, 1 = valid, otherwise 0 |
| 37 | U1 | active | - | - | Survey-in in progress flag, 1 = in-progress, otherwise 0 |
| 38 | U1[2] | reserved2 | - | - | Reserved |

## 3.15.20 UBX-NAV-TIMEBDS (0x01 0x24)

### 3.15.20.1 BeiDou time solution

| ***Message*** | **UBX-NAV-TIMEBDS**<br>**BeiDou time solution** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | This message reports the precise BDS time of the most recent navigation solution including validity flags and an accuracy estimate. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x24 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | U4 | SOW | - | s | BDS time of week (rounded to seconds) |
| 8 | I4 | fSOW | - | ns | Fractional part of SOW (range: +/-500000000).<br>The precise BDS time of week in seconds is:<br>SOW + fSOW * 1e-9 |
| 12 | I2 | week | - | - | BDS week number of the navigation epoch |
| 14 | I1 | leapS | - | s | BDS leap seconds (BDS-UTC) |
| 15 | X1 | valid | - | - | Validity Flags |
| bit 0 | U:1 | sowValid | - | - | 1 = Valid SOW and fSOW (see section Time validity in Integration manual for details) |
| bit 1 | U:1 | weekValid | - | - | 1 = Valid week (see section Time validity in Integration manual for details) |
| bit 2 | U:1 | leapSValid | - | - | 1 = Valid leap second |

| | | | | | |
|---|---|---|---|---|---|
| 16 | U4 | tAcc | - | ns | Time Accuracy Estimate |

## 3.15.21 UBX-NAV-TIMEGAL (0x01 0x25)

### 3.15.21.1 Galileo time solution

| ***Message*** | **UBX-NAV-TIMEGAL**<br>**Galileo time solution** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | This message reports the precise Galileo time of the most recent navigation solution including validity flags and an accuracy estimate. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x25 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | U4 | galTow | - | s | Galileo time of week (rounded to seconds) |
| 8 | I4 | fGalTow | - | ns | Fractional part of the Galileo time of week (range: +/-500000000).<br>The precise Galileo time of week in seconds is:<br>`galTow + fGalTow * 1e-9` |
| 12 | I2 | galWno | - | - | Galileo week number |
| 14 | I1 | leapS | - | s | Galileo leap seconds (Galileo-UTC) |
| 15 | X1 | valid | - | - | Validity Flags |
| bit 0 | U:1 | galTowValid | - | - | 1 = Valid galTow and fGalTow (see the section Time validity in the Integration manual for details) |
| bit 1 | U:1 | galWnoValid | - | - | 1 = Valid galWno (see the section Time validity in the Integration manual for details) |
| bit 2 | U:1 | leapSValid | - | - | 1 = Valid leapS |
| 16 | U4 | tAcc | - | ns | Time Accuracy Estimate |

## 3.15.22 UBX-NAV-TIMEGLO (0x01 0x23)

### 3.15.22.1 GLONASS time solution

| ***Message*** | **UBX-NAV-TIMEGLO**<br>**GLONASS time solution** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | This message reports the precise GLO time of the most recent navigation solution including validity flags and an accuracy estimate. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x23 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |

| | | | | | |
|---|---|---|---|---|---|
| 4 | U4 | TOD | - | s | GLONASS time of day (rounded to integer seconds) |
| 8 | I4 | fTOD | - | ns | Fractional part of TOD (range: +/-500000000).<br>The precise GLONASS time of day in seconds is:<br>TOD + fTOD * 1e-9 |
| 12 | U2 | Nt | - | days | Current date (range: 1-1461), starting at 1 from the 1st Jan of the year indicated by N4 and ending at 1461 at the 31st Dec of the third year after that indicated by N4 |
| 14 | U1 | N4 | - | - | Four-year interval number starting from 1996 (1=1996, 2=2000, 3=2004...) |
| 15 | X1 | valid | - | - | Validity flags |
| bit 0 | U:1 | todValid | - | - | 1 = Valid TOD and fTOD (see section Time validity in Integration manual for details) |
| bit 1 | U:1 | dateValid | - | - | 1 = Valid N4 and Nt (see section Time validity in Integration manual for details) |
| 16 | U4 | tAcc | - | ns | Time Accuracy Estimate |

## 3.15.23 UBX-NAV-TIMELS (0x01 0x26)

### 3.15.23.1 Leap second event information

| ***Message*** | **UBX-NAV-TIMELS**<br>**Leap second event information** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | Information about the upcoming leap second event if one is scheduled. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x26 | 24 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | U1 | version | - | - | Message version (0x00 for this version) |
| 5 | U1[3] | reserved0 | - | - | Reserved |
| 8 | U1 | srcOfCurrLs | - | - | Information source for the current number of leap seconds.<br>• 0 = Default (hardcoded in the firmware, can be outdated)<br>• 1 = Derived from time difference between GPS and GLONASS time<br>• 2 = GPS<br>• 3 = SBAS<br>• 4 = BeiDou<br>• 5 = Galileo<br>• 6 = Aided data<br>• 7 = Configured<br>• 255 = Unknown |

| | | | | | |
|---|---|---|---|---|---|
| 9 | I1 | currLs | - | s | Current number of leap seconds since start of GPS time (Jan 6, 1980). It reflects how much GPS time is ahead of UTC time. Galileo number of leap seconds is the same as GPS. BeiDou number of leap seconds is 14 less than GPS. GLONASS follows UTC time, so no leap seconds. |
| 10 | U1 | srcOfLsChange | - | - | Information source for the future leap second event.<br>• 0 = No source<br>• 2 = GPS<br>• 3 = SBAS<br>• 4 = BeiDou<br>• 5 = Galileo<br>• 6 = GLONASS |
| 11 | I1 | lsChange | - | s | Future leap second change if one is scheduled. +1 = positive leap second, -1 = negative leap second, 0 = no future leap second event scheduled or no information available. |
| 12 | I4 | timeToLsEvent | - | s | Number of seconds until the next leap second event, or from the last leap second event if no future event scheduled. If > 0 event is in the future, = 0 event is now, < 0 event is in the past. Valid only if validTimeToLsEvent = 1. |
| 16 | U2 | dateOfLsGpsWn | - | - | GPS week number (WN) of the next leap second event or the last one if no future event scheduled. Valid only if validTimeToLsEvent = 1. |
| 18 | U2 | dateOfLsGpsDn | - | - | GPS day of week number (DN) for the next leap second event or the last one if no future event scheduled. Valid only if validTimeToLsEvent = 1. (GPS and Galileo DN: from 1 = Sun to 7 = Sat. BeiDou DN: from 0 = Sun to 6 = Sat.) |
| 20 | U1[3] | reserved1 | - | - | Reserved |
| 23 | X1 | valid | - | - | Validity flags |
| bit 0 | U:1 | validCurrLs | - | - | 1 = Valid current number of leap seconds value. |
| bit 1 | U:1 | validTimeToLsEvent | - | - | 1 = Valid time to next leap second event or from the last leap second event if no future event scheduled. |

## 3.15.24 UBX-NAV-TIMEQZSS (0x01 0x27)

### 3.15.24.1 QZSS time solution

| ***Message*** | **UBX-NAV-TIMEQZSS**<br>**QZSS time solution** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | This message reports the precise QZSS time of the most recent navigation solution including validity flags and an accuracy estimate. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x27 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the description of iTOW for details. |
| 4 | U4 | qzssTow | - | s | QZSS time of week (rounded to seconds) |

| | | | | | |
|---|---|---|---|---|---|
| 8 | I4 | fQzssTow | - | ns | Fractional part of QZSS time of week (range: +/-500000000).<br>The precise QZSS time of week in seconds is:<br>qzssTow + (fQzssTow * 1e-9) |
| 12 | I2 | qzssWno | - | - | QZSS week number of the navigation epoch |
| 14 | I1 | leapS | - | s | QZSS leap seconds (QZSS-UTC) |
| 15 | X1 | valid | - | - | Validity Flags |
| bit 0 | U:1 | qzssTowValid | - | - | 1 = Valid QZSS time of week (qzssTow & fQzssTow, see Time Validity section for details) |
| bit 1 | U:1 | qzssWnoValid | - | - | 1 = Valid QZSS week number (see Time Validity section for details) |
| bit 2 | U:1 | leapSValid | - | - | 1 = Valid QZSS leap seconds |
| 16 | U4 | tAcc | - | ns | Time Accuracy Estimate |

## 3.15.25 UBX-NAV-TIMEUTC (0x01 0x21)

### 3.15.25.1 UTC time solution

| ***Message*** | **UBX-NAV-TIMEUTC**<br>**UTC time solution** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | Note that during a leap second there may be more or less than 60 seconds in a minute.<br>See the description of leap seconds in the Integration manual for details. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x21 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | U4 | tAcc | - | ns | Time accuracy estimate (UTC) |
| 8 | I4 | nano | - | ns | Fraction of second, range -1e9 .. 1e9 (UTC) |
| 12 | U2 | year | - | y | Year, range 1999..2099 (UTC) |
| 14 | U1 | month | - | month | Month, range 1..12 (UTC) |
| 15 | U1 | day | - | d | Day of month, range 1..31 (UTC) |
| 16 | U1 | hour | - | h | Hour of day, range 0..23 (UTC) |
| 17 | U1 | min | - | min | Minute of hour, range 0..59 (UTC) |
| 18 | U1 | sec | - | s | Seconds of minute, range 0..60 (UTC) |
| 19 | X1 | valid | - | - | Validity Flags |
| bit 0 | U:1 | validTOW | - | - | 1 = Valid Time of Week (see section Time validity in Integration manual for details) |
| bit 1 | U:1 | validWKN | - | - | 1 = Valid Week Number (see section Time validity in Integration manual for details) |
| bit 2 | U:1 | validUTC | - | - | 1 = Valid UTC Time |
| bits 7...4 | U:4 | utcStandard | - | - | UTC standard identifier. (Not supported for protocol versions less than 15.00)<br>• 0 = Information not available |

- 1 = Communications Research Labratory (CRL), Tokyo, Japan
- 2 = National Institute of Standards and Technology (NIST)
- 3 = U.S. Naval Observatory (USNO)
- 4 = International Bureau of Weights and Measures (BIPM)
- 5 = European laboratories
- 6 = Former Soviet Union (SU)
- 7 = National Time Service Center (NTSC), China
- 15 = Unknown

## 3.15.26 UBX-NAV-VELECEF (0x01 0x11)

### 3.15.26.1 Velocity solution in ECEF

| ***Message*** | **UBX-NAV-VELECEF**<br>**Velocity solution in ECEF** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | See important comments concerning validity of position given in section Navigation output filters in Integration manual. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x11 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | I4 | ecefVX | - | cm/s | ECEF X velocity |
| 8 | I4 | ecefVY | - | cm/s | ECEF Y velocity |
| 12 | I4 | ecefVZ | - | cm/s | ECEF Z velocity |
| 16 | U4 | sAcc | - | cm/s | Speed accuracy estimate |

## 3.15.27 UBX-NAV-VELNED (0x01 0x12)

### 3.15.27.1 Velocity solution in NED frame

| ***Message*** | **UBX-NAV-VELNED**<br>**Velocity solution in NED frame** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | See important comments concerning validity of position given in section Navigation output filters in Integration manual. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x01 | 0x12 | 36 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | iTOW | - | ms | GPS time of week of the navigation epoch.<br>See the section iTOW timestamps in Integration manual for details. |
| 4 | I4 | velN | - | cm/s | North velocity component |
| 8 | I4 | velE | - | cm/s | East velocity component |

| | | | | | |
|---|---|---|---|---|---|
| 12 | I4 | velD | - | cm/s | Down velocity component |
| 16 | U4 | speed | - | cm/s | Speed (3-D) |
| 20 | U4 | gSpeed | - | cm/s | Ground speed (2-D) |
| 24 | I4 | heading | 1e-5 | deg | Heading of motion 2-D |
| 28 | U4 | sAcc | - | cm/s | Speed accuracy Estimate |
| 32 | U4 | cAcc | 1e-5 | deg | Course / Heading accuracy estimate |

# 3.16 UBX-RXM (0x02)

The messages in the UBX-RXM class are used to output status and result data from the receiver manager as well as sending commands to the receiver manager.

## 3.16.1 UBX-RXM-MEASX (0x02 0x14)

### 3.16.1.1 Satellite measurements for RRLP

| *Message* | **UBX-RXM-MEASX**<br>**Satellite measurements for RRLP** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | The message payload data is, where possible and appropriate, according to the Radio Resource LCS (Location Services) Protocol (RRLP) [1]. One exception is the satellite and GNSS IDs, which here are given according to the Satellite Numbering scheme. The correct satellites have to be selected and their satellite ID translated accordingly [1, tab. A.10.14] for use in a RRLP Measure Position Response Component. Similarly, the measurement reference time of week has to be forwarded correctly (modulo 14400000 for the 24 LSB GPS measurements variant, modulo 3600000 for the 22 LSB Galileo and Additional Navigation Satelllite Systems (GANSS) measurements variant) of the RRLP measure position response to the SMLC.<br>Reference: [1] ETSI TS 144 031 V11.0.0 (2012-10), Digital cellular telecommunications system (Phase 2+), Location Services (LCS), Mobile Station (MS) - Serving Mobile Location Centre (SMLC), Radio Resource LCS Protocol (RRLP), (3GPP TS 44.031 version 11.0.0 Release 11). | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x02 | 0x14 | 44 + numSV·24 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | version | - | - | Message version, currently 0x01 |
| 1 | U1[3] | reserved0 | - | - | Reserved |
| 4 | U4 | gpsTOW | - | ms | GPS measurement reference time |
| 8 | U4 | gloTOW | - | ms | GLONASS measurement reference time |
| 12 | U4 | bdsTOW | - | ms | BeiDou measurement reference time |
| 16 | U1[4] | reserved1 | - | - | Reserved |
| 20 | U4 | qzssTOW | - | ms | QZSS measurement reference time |
| 24 | U2 | gpsTOWacc | 2^-4 | ms | GPS measurement reference time accuracy (0xffff = > 4s) |
| 26 | U2 | gloTOWacc | 2^-4 | ms | GLONASS measurement reference time accuracy (0xffff = > 4s) |
| 28 | U2 | bdsTOWacc | 2^-4 | ms | BeiDou measurement reference time accuracy (0xffff = > 4s) |
| 30 | U1[2] | reserved2 | - | - | Reserved |
| 32 | U2 | qzssTOWacc | 2^-4 | ms | QZSS measurement reference time accuracy (0xffff = > 4s) |

| | | | | | |
|---|---|---|---|---|---|
| 34 | U1 | numSV | - | - | Number of satellites in repeated block |
| 35 | U1 | flags | - | - | Flags |
| bits 1...0 | U:2 | towSet | - | - | TOW set (0 = no, 1 or 2 = yes) |
| 36 | U1[8] | reserved3 | - | - | Reserved |
| *Start of repeated group (numSV times)* | | | | | |
| 44 + n·24 | U1 | gnssId | - | - | GNSS ID (see Satellite Numbering) |
| 45 + n·24 | U1 | svId | - | - | Satellite ID (see Satellite Numbering) |
| 46 + n·24 | U1 | cNo | - | - | carrier noise ratio (0..63) |
| 47 + n·24 | U1 | mpathIndic | - | - | multipath index (according to [1]) (0 = not measured, 1 = low, 2 = medium, 3 = high) |
| 48 + n·24 | I4 | dopplerMS | 0.04 | m/s | Doppler measurement |
| 52 + n·24 | I4 | dopplerHz | 0.2 | Hz | Doppler measurement |
| 56 + n·24 | U2 | wholeChips | - | - | whole value of the code phase measurement (0..1022 for GPS) |
| 58 + n·24 | U2 | fracChips | - | - | fractional value of the code phase measurement (0..1023) |
| 60 + n·24 | U4 | codePhase | 2^-21 | ms | Code phase |
| 64 + n·24 | U1 | intCodePhase | - | ms | Integer (part of the) code phase |
| 65 + n·24 | U1 | pseuRangeRMSErr | - | - | pseudorange RMS error index (according to [1]) (0..63) |
| 66 + n·24 | U1[2] | reserved4 | - | - | Reserved |
| *End of repeated group (numSV times)* | | | | | |

## 3.16.2 UBX-RXM-PMREQ (0x02 0x41)

### 3.16.2.1 Power management request

| ***Message*** | **UBX-RXM-PMREQ**<br>**Power management request** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Command | | | | | |
| *Comment* | This message requests a power management related task of the receiver. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x02 | 0x41 | 8 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | duration | - | ms | Duration of the requested task, set to zero for infinite duration. The maximum supported time is 12 days. |
| 4 | X4 | flags | - | - | task flags |
| bit 1 | U:1 | backup | - | - | The receiver goes into backup mode for a time period defined by duration, provided that it is not connected to USB |

### 3.16.2.2 Power management request

| ***Message*** | **UBX-RXM-PMREQ**<br>**Power management request** |
|---|---|
| *Type* | Command |
| *Comment* | This message requests a power management related task of the receiver. |

| Message structure | Header | Class | ID | Length (Bytes) | Payload | Checksum |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x02 | 0x41 | 16 | *see below* | CK_A CK_B |

*Payload description:*

| Byte offset | Type | Name | Scale | Unit | Description |
|---|---|---|---|---|---|
| 0 | U1 | `version` | - | - | Message version (0x00 for this version) |
| 1 | U1[3] | `reserved0` | - | - | Reserved |
| 4 | U4 | `duration` | - | ms | Duration of the requested task, set to zero for infinite duration. The maximum supported time is 12 days. |
| 8 | X4 | `flags` | - | - | task flags |
| bit 1 | U:1 | `backup` | - | - | The receiver goes into backup mode for a time period defined by duration, provided that it is not connected to USB |
| bit 2 | U:1 | `force` | - | - | Force receiver backup while USB is connected. USB interface will be disabled. |
| 12 | X4 | `wakeupSources` | - | - | Configure pins to wake up the receiver. The receiver wakes up if there is either a falling or a rising edge on one of the configured pins. |
| bit 3 | U:1 | `uartrx` | - | - | Wake up the receiver if there is an edge on the UART RX pin |
| bit 5 | U:1 | `extint0` | - | - | Wake up the receiver if there is an edge on the EXTINT0 pin |
| bit 6 | U:1 | `extint1` | - | - | Wake up the receiver if there is an edge on the EXTINT1 pin |
| bit 7 | U:1 | `spics` | - | - | Wake up the receiver if there is an edge on the SPI CS pin |

## 3.16.3 UBX-RXM-RAWX (0x02 0x15)

### 3.16.3.1 Multi-GNSS raw measurements

| ***Message*** | **UBX-RXM-RAWX**<br>**Multi-GNSS raw measurements** |
|---|---|
| *Type* | Periodic/polled |
| *Comment* | This message contains the information needed to be able to generate a RINEX 3 multi-GNSS observation file (see ftp://ftp.igs.org/pub/data/format/).<br>This message contains pseudorange, Doppler, carrier phase, phase lock and signal quality information for GNSS satellites once signals have been synchronized. This message supports all active GNSS.<br>The only difference between this version of the message and the previous version (**UBX-RXM-RAWX-DATA0**) is the addition of the version field. |

| Message structure | Header | Class | ID | Length (Bytes) | Payload | Checksum |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x02 | 0x15 | 16 + numMeas·32 | *see below* | CK_A CK_B |

*Payload description:*

| Byte offset | Type | Name | Scale | Unit | Description |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 0 | R8 | rcvTow | - | s | Measurement time of week in receiver local time approximately aligned to the GPS time system.<br>The receiver local time of week, week number and leap second information can be used to translate the time to other time systems. More information about the difference in time systems can be found in the RINEX 3 format documentation. For a receiver operating in GLONASS only mode, UTC time can be determined by subtracting the leapS field from GPS time regardless of whether the GPS leap seconds are valid. |
| 8 | U2 | week | - | weeks | GPS week number in receiver local time. |
| 10 | I1 | leapS | - | s | GPS leap seconds (GPS-UTC). This field represents the receiver's best knowledge of the leap seconds offset. A flag is given in the recStat bitfield to indicate if the leap seconds are known. |
| 11 | U1 | numMeas | - | - | Number of measurements to follow |
| 12 | X1 | recStat | - | - | Receiver tracking status bitfield |
| bit 0 | $U_{:1}$ | leapSec | - | - | Leap seconds have been determined |
| bit 1 | $U_{:1}$ | clkReset | - | - | Clock reset applied. Typically the receiver clock is changed in increments of integer milliseconds. |
| 13 | U1 | version | - | - | Message version (0x01 for this version) |
| 14 | U1[2] | reserved0 | - | - | Reserved |
| *Start of repeated group (numMeas times)* | | | | | |
| 16 + n·32 | R8 | prMes | - | m | Pseudorange measurement [m]. GLONASS inter frequency channel delays are compensated with an internal calibration table. |
| 24 + n·32 | R8 | cpMes | - | cycles | Carrier phase measurement [cycles]. The carrier phase initial ambiguity is initialized using an approximate value to make the magnitude of the phase close to the pseudorange measurement. Clock resets are applied to both phase and code measurements in accordance with the RINEX specification. |
| 32 + n·32 | R4 | doMes | - | Hz | Doppler measurement (positive sign for approaching satellites) [Hz] |
| 36 + n·32 | U1 | gnssId | - | - | GNSS identifier (see Satellite Numbering for a list of identifiers) |
| 37 + n·32 | U1 | svId | - | - | Satellite identifier (see Satellite Numbering) |
| 38 + n·32 | U1 | sigId | - | - | New style signal identifier (see Signal Identifiers).(not supported for protocol versions less than 27.00) |
| 39 + n·32 | U1 | freqId | - | - | Only used for GLONASS: This is the frequency slot + 7 (range from 0 to 13) |
| 40 + n·32 | U2 | locktime | - | ms | Carrier phase locktime counter (maximum 64500ms) |
| 42 + n·32 | U1 | cno | - | dBHz | Carrier-to-noise density ratio (signal strength) [dB-Hz] |
| 43 + n·32 | X1 | prStdev | 0.01*2^n | m | Estimated pseudorange measurement standard deviation |
| bits 3...0 | $U_{:4}$ | prStd | - | - | Estimated pseudorange standard deviation |
| 44 + n·32 | X1 | cpStdev | 0.004 | cycles | Estimated carrier phase measurement standard deviation (note a raw value of 0x0F indicates the value is invalid) |
| bits 3...0 | $U_{:4}$ | cpStd | - | - | Estimated carrier phase standard deviation |

| | | | | | |
|---|---|---|---|---|---|
| 45 + n·32 | X1 | doStdev | 0.002*2^n | Hz | Estimated Doppler measurement standard deviation. |
| bits 3...0 | U:4 | doStd | - | - | Estimated Doppler standard deviation |
| 46 + n·32 | X1 | trkStat | - | - | Tracking status bitfield |
| bit 0 | U:1 | prValid | - | - | Pseudorange valid |
| bit 1 | U:1 | cpValid | - | - | Carrier phase valid |
| bit 2 | U:1 | halfCyc | - | - | Half cycle valid |
| bit 3 | U:1 | subHalfCyc | - | - | Half cycle subtracted from phase |
| 47 + n·32 | U1 | reserved1 | - | - | Reserved |
| *End of repeated group (numMeas times)* | | | | | |

## 3.16.4 UBX-RXM-RLM (0x02 0x59)

### 3.16.4.1 Galileo SAR short-RLM report

| ***Message*** | **UBX-RXM-RLM**<br>**Galileo SAR short-RLM report** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | This message contains the contents of any Galileo Search and Rescue (SAR) Short Return Link Message detected by the receiver. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x02 | 0x59 | 16 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | version | - | - | Message version (0x00 for this version) |
| 1 | U1 | type | - | - | Message type (0x01 for Short-RLM) |
| 2 | U1 | svId | - | - | Identifier of transmitting satellite (see Satellite Numbering) |
| 3 | U1 | reserved0 | - | - | Reserved |
| 4 | U1[8] | beacon | - | - | Beacon identifier (60 bits), with bytes ordered by earliest transmitted (most significant) first. Top four bits of first byte are zero. |
| 12 | U1 | message | - | - | Message code (4 bits) |
| 13 | U1[2] | params | - | - | Parameters (16 bits), with bytes ordered by earliest transmitted (most significant) first. |
| 15 | U1 | reserved1 | - | - | Reserved |

### 3.16.4.2 Galileo SAR long-RLM report

| ***Message*** | **UBX-RXM-RLM**<br>**Galileo SAR long-RLM report** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | This message contains the contents of any Galileo Search and Rescue (SAR) Long Return Link Message detected by the receiver. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x02 | 0x59 | 28 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | version | - | - | Message version (0x00 for this version) |

| | | | | | |
|---|---|---|---|---|---|
| 1 | U1 | type | - | - | Message type (0x02 for Long-RLM) |
| 2 | U1 | svId | - | - | Identifier of transmitting satellite (see Satellite Numbering) |
| 3 | U1 | reserved0 | - | - | Reserved |
| 4 | U1[8] | beacon | - | - | Beacon identifier (60 bits), with bytes ordered by earliest transmitted (most significant) first. Top four bits of first byte are zero. |
| 12 | U1 | message | - | - | Message code (4 bits) |
| 13 | U1[12] | params | - | - | Parameters (96 bits), with bytes ordered by earliest transmitted (most significant) first. |
| 25 | U1[3] | reserved1 | - | - | Reserved |

## 3.16.5 UBX-RXM-RTCM (0x02 0x32)

### 3.16.5.1 RTCM input status

| ***Message*** | **UBX-RXM-RTCM**<br>**RTCM input status** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | This message shows info on a received RTCM input message. It is output upon successful parsing of an RTCM input message, irrespective of whether the RTCM message is supported or not by the receiver. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x02 | 0x32 | 8 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | version | - | - | Message version (0x02 for this version) |
| 1 | X1 | flags | - | - | RTCM input status flags |
| bit 0 | $U_{:1}$ | crcFailed | - | - | 0 when RTCM message received and passed CRC check, 1 when failed, in which case refStation and msgType might be corrupted and misleading |
| bits 2...1 | $U_{:2}$ | msgUsed | - | - | 2 = RTCM message used successfully by the receiver, 1 = not used, 0 = do not know |
| 2 | U2 | subType | - | - | Message subtype, only applicable to u-blox proprietary RTCM message 4072 (not available on all products) |
| 4 | U2 | refStation | - | - | Reference station ID:<br>• For RTCM 2.3: Reference station ID of the received RTCM 2 input message. Valid range 0-1023.<br>• For RTCM 3.3: Reference station ID (DF003) of the received RTCM input message. Valid range 0-4095. Reported only for the standard RTCM messages that include the DF003 field and for the u-blox proprietary RTCM messages 4072.x. For all other messages, reports 0xFFFF. |
| 6 | U2 | msgType | - | - | Message type |

## 3.16.6 UBX-RXM-SFRBX (0x02 0x13)

#### 3.16.6.1 Broadcast navigation data subframe

| ***Message*** | **UBX-RXM-SFRBX**<br>**Broadcast navigation data subframe** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | This message reports a complete subframe of broadcast navigation data decoded from a single signal. The number of data words reported in each message depends on the nature of the signal. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x02 | 0x13 | 8 + numWords·4 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `gnssId` | - | - | GNSS identifier (see Satellite Numbering) |
| 1 | U1 | `svId` | - | - | Satellite identifier (see Satellite Numbering) |
| 2 | U1 | `reserved0` | - | - | Reserved |
| 3 | U1 | `freqId` | - | - | Only used for GLONASS: This is the frequency slot + 7 (range from 0 to 13) |
| 4 | U1 | `numWords` | - | - | The number of data words contained in this message (up to 10, for currently supported signals) |
| 5 | U1 | `chn` | - | - | The tracking channel number the message was received on |
| 6 | U1 | `version` | - | - | Message version, (0x02 for this version) |
| 7 | U1 | `reserved1` | - | - | Reserved |
| *Start of repeated group (`numWords` times)* | | | | | |
| 8 + n·4 | U4 | `dwrd` | - | - | The data words |
| *End of repeated group (`numWords` times)* | | | | | |

# 3.17 UBX-SEC (0x27)

The messages in the UBX-SEC class are used for security features of the receiver.

## 3.17.1 UBX-SEC-UNIQID (0x27 0x03)

#### 3.17.1.1 Unique chip ID

| ***Message*** | **UBX-SEC-UNIQID**<br>**Unique chip ID** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Output | | | | | |
| *Comment* | This message is used to retrieve a unique chip identifier (40 bits, 5 bytes). | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x27 | 0x03 | 9 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `version` | - | - | Message version (0x01 for this version) |
| 1 | U1[3] | `reserved0` | - | - | Reserved |
| 4 | U1[5] | `uniqueId` | - | - | Unique chip ID |

# 3.18 UBX-TIM (0x0d)

The messages in the UBX-TIM class are used to output timing information from the receiver, such as time pulse and time mark measurements.

## 3.18.1 UBX-TIM-TM2 (0x0d 0x03)

### 3.18.1.1 Time mark data

| ***Message*** | **UBX-TIM-TM2**<br>**Time mark data** |
|---|---|
| *Type* | Periodic/polled |
| *Comment* | This message contains information for high precision time stamping / pulse counting.<br>The delay figures and timebase given in UBX-CFG-TP5 are also applied to the time results output in this message. |

| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x0d | 0x03 | 28 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | ch | - | - | Channel (i.e. EXTINT) upon which the pulse was measured |
| 1 | X1 | flags | - | - | Bitmask |
| bit 0 | U:1 | mode | - | - | • 0=single<br>• 1=running |
| bit 1 | U:1 | run | - | - | • 0=armed<br>• 1=stopped |
| bit 2 | U:1 | newFallingEdge | - | - | New falling edge detected |
| bits 4...3 | U:2 | timeBase | - | - | • 0=Time base is Receiver time<br>• 1=Time base is GNSS time (the system according to the configuration in UBX-CFG-TP5 for tpIdx=0)<br>• 2=Time base is UTC (the variant according to the configuration in UBX-CFG-NAV5) |
| bit 5 | U:1 | utc | - | - | • 0=UTC not available<br>• 1=UTC available |
| bit 6 | U:1 | time | - | - | • 0=Time is not valid<br>• 1=Time is valid (Valid GNSS fix) |
| bit 7 | U:1 | newRisingEdge | - | - | New rising edge detected |
| 2 | U2 | count | - | - | Rising edge counter |
| 4 | U2 | wnR | - | - | Week number of last rising edge |
| 6 | U2 | wnF | - | - | Week number of last falling edge |
| 8 | U4 | towMsR | - | ms | Tow of rising edge |
| 12 | U4 | towSubMsR | - | ns | Millisecond fraction of tow of rising edge in nanoseconds |
| 16 | U4 | towMsF | - | ms | Tow of falling edge |
| 20 | U4 | towSubMsF | - | ns | Millisecond fraction of tow of falling edge in nanoseconds |
| 24 | U4 | accEst | - | ns | Accuracy estimate |

## 3.18.2 UBX-TIM-TP (0x0d 0x01)

### 3.18.2.1 Time pulse time data

| ***Message*** | **UBX-TIM-TP**<br>**Time pulse time data** | | | | | | |
|---|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | | |
| *Comment* | This message contains information on the timing of the next pulse at the TIMEPULSE0 output. The recommended configuration when using this message is to set both the measurement rate (CFG-RATE) and the timepulse frequency (CFG-TP) to 1 Hz. | | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x0d | 0x01 | 16 | | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U4 | `towMS` | - | ms | Time pulse time of week according to time base |
| 4 | U4 | `towSubMS` | 2^-32 | ms | Submillisecond part of towMS |
| 8 | I4 | `qErr` | - | ps | Quantization error of time pulse. Only available in timing products |
| 12 | U2 | `week` | - | weeks | Time pulse week number according to time base |
| 14 | X1 | `flags` | - | - | Flags |
| bit 0 | $U_{:1}$ | `timeBase` | - | - | • 0 = Time base is GNSS<br>• 1 = Time base is UTC |
| bit 1 | $U_{:1}$ | `utc` | - | - | • 0 = UTC not available<br>• 1 = UTC available |
| bits 3...2 | $U_{:2}$ | `raim` | - | - | (T)RAIM information<br>• 0 = Information not available<br>• 1 = Not active<br>• 2 = Active |
| bit 4 | $U_{:1}$ | `qErrInvalid` | - | - | • 0 = Quantization error valid<br>• 1 = Quantization error invalid |
| 15 | X1 | `refInfo` | - | - | Time reference information |
| bits 3...0 | $U_{:4}$ | `timeRefGnss` | - | - | GNSS reference information. Only valid if time base is GNSS (timeBase=0).<br>• 0 = GPS<br>• 1 = GLONASS<br>• 2 = BeiDou<br>• 3 = Galileo<br>• 15 = Unknown |
| bits 7...4 | $U_{:4}$ | `utcStandard` | - | - | UTC standard identifier. Only valid if time base is UTC (timeBase=1).<br>• 0 = Information not available<br>• 1 = Communications Research Laboratory (CRL), Tokyo, Japan<br>• 2 = National Institute of Standards and Technology (NIST)<br>• 3 = U.S. Naval Observatory (USNO)<br>• 4 = International Bureau of Weights and Measures (BIPM)<br>• 5 = European laboratories<br>• 6 = Former Soviet Union (SU)<br>• 7 = National Time Service Center (NTSC), China<br>• 15 = Unknown |

## 3.18.3 UBX-TIM-VRFY (0x0d 0x06)

#### 3.18.3.1 Sourced time verification

| ***Message*** | **UBX-TIM-VRFY**<br>**Sourced time verification** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Periodic/polled | | | | | |
| *Comment* | This message contains verification information about previous time received via assistance data or from RTC. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x0d | 0x06 | 20 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | I4 | `itow` | - | ms | integer millisecond tow received by source |
| 4 | I4 | `frac` | - | ns | sub-millisecond part of tow |
| 8 | I4 | `deltaMs` | - | ms | integer milliseconds of delta time (current time minus sourced time) |
| 12 | I4 | `deltaNs` | - | ns | Sub-millisecond part of delta time |
| 16 | U2 | `wno` | - | week | Week number |
| 18 | X1 | `flags` | - | - | Flags |
| bits 2...0 | $U_{:3}$ | `src` | - | - | Aiding time source<br>• 0 = no time aiding done<br>• 2 = source was RTC<br>• 3 = source was assistance data |
| 19 | U1 | `reserved0` | - | - | Reserved |

# 3.19 UBX-UPD (0x09)

The messages in the UBX-UPD class are used to download a firmware to the receiver and to update the firmware on the flash.

## 3.19.1 UBX-UPD-SOS (0x09 0x14)

#### 3.19.1.1 Poll backup restore status

| ***Message*** | **UBX-UPD-SOS**<br>**Poll backup restore status** | | | | | |
|---|---|---|---|---|---|---|
| *Type* | Poll request | | | | | |
| *Comment* | Sending this (empty) message to the receiver results in the receiver returning a *System restored from backup* message as defined below. | | | | | |
| *Message structure* | *Header* | *Class* | *ID* | *Length (Bytes)* | *Payload* | *Checksum* |
| | 0xb5 0x62 | 0x09 | 0x14 | 0 | *see below* | CK_A CK_B |
| *Payload* | This message has no payload. | | | | | |

#### 3.19.1.2 Create backup in flash

| ***Message*** | **UBX-UPD-SOS**<br>**Create backup in flash** |
|---|---|
| *Type* | Command |
| *Comment* | The host can send this message in order to save part of the battery-backed memory (BBR) in a file in the flash file system. The feature is designed in order to emulate the presence of the backup battery even if it is not present; the host can issue the save on shutdown command before switching off the device supply. It is recommended to issue a GNSS stop command using UBX-CFG-RST before in order to keep the BBR memory content consistent. |

| Message structure | Header | Class | ID | Length (Bytes) | Payload | Checksum |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x09 | 0x14 | 4 | *see below* | CK_A CK_B |

*Payload description:*

| Byte offset | Type | Name | Scale | Unit | Description |
|---|---|---|---|---|---|
| 0 | U1 | `cmd` | - | - | Command (must be 0) |
| 1 | U1[3] | `reserved0` | - | - | Reserved |

### 3.19.1.3 Clear backup in flash

| ***Message*** | **UBX-UPD-SOS**<br>**Clear backup in flash** |
|---|---|
| *Type* | Command |
| *Comment* | The host can send this message in order to erase the backup file present in flash. It is recommended that the clear operation is issued after the host has received the notification that the memory has been restored after a reset. Alternatively the host can parse the startup string *Restored data saved on shutdown* or poll the UBX-UPD-SOS message for obtaining the status. |

| Message structure | Header | Class | ID | Length (Bytes) | Payload | Checksum |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x09 | 0x14 | 4 | *see below* | CK_A CK_B |

*Payload description:*

| Byte offset | Type | Name | Scale | Unit | Description |
|---|---|---|---|---|---|
| 0 | U1 | `cmd` | - | - | Command (must be 1) |
| 1 | U1[3] | `reserved0` | - | - | Reserved |

### 3.19.1.4 Backup creation acknowledge

| ***Message*** | **UBX-UPD-SOS**<br>**Backup creation acknowledge** |
|---|---|
| *Type* | Output |
| *Comment* | The message is sent from the device as confirmation of creation of a backup file in flash. The host can safely shut down the device after having received this message. |

| Message structure | Header | Class | ID | Length (Bytes) | Payload | Checksum |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x09 | 0x14 | 8 | *see below* | CK_A CK_B |

*Payload description:*

| Byte offset | Type | Name | Scale | Unit | Description |
|---|---|---|---|---|---|
| 0 | U1 | `cmd` | - | - | Command (must be 2) |
| 1 | U1[3] | `reserved0` | - | - | Reserved |
| 4 | U1 | `response` | - | - | • 0 = Not acknowledged<br>• 1 = Acknowledged |
| 5 | U1[3] | `reserved1` | - | - | Reserved |

### 3.19.1.5 System restored from backup

| ***Message*** | **UBX-UPD-SOS**<br>**System restored from backup** |
|---|---|
| *Type* | Output |
| *Comment* | The message is sent from the device to notify the host the BBR has been restored from a backup file in the flash file sysetem. The host should clear the backup file after receiving this message. If the UBX-UPD-SOS message is polled, this message will be resent. |

| Message structure | Header | Class | ID | Length (Bytes) | Payload | Checksum |
|---|---|---|---|---|---|---|
| | 0xb5 0x62 | 0x09 | 0x14 | 8 | *see below* | CK_A CK_B |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `cmd` | - | - | Command (must be 3) |
| 1 | U1[3] | `reserved0` | - | - | Reserved |
| 4 | U1 | `response` | - | - | • 0 = Unknown<br>• 1 = Failed restoring from backup<br>• 2 = Restored from backup<br>• 3 = Not restored (no backup) |
| 5 | U1[3] | `reserved1` | - | - | Reserved |

# 4 RTCM protocol

## 4.1 RTCM introduction

The RTCM (Radio Technical Commission for Maritime Services) protocols are used to supply the GNSS receiver with real-time differential correction data. The RTCM protocol specifications are available from http://www.rtcm.org.

The RTCM 3.x support is implemented according to *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3*.

## 4.2 RTCM 3.x configuration

The configuration of the RTK rover and reference station is explained in section RTK configuration in Integration manual.

The RTCM3 protocol can be disabled/enabled on communication interfaces using the Configuration interface, for example configuration item CFG-UART1OUTPROT-RTCM3X.

## 4.3 RTCM messages overview

| *Message* | *Class/ID* | *Description (Type)* |
|---|---|---|
| **RTCM-3X – RTCM 3.3 messages** | | |
| RTCM-3X-TYPE1001 | 0xf5 0x01 | Message type 1001<br>• L1-only GPS RTK observables (Input) |
| RTCM-3X-TYPE1002 | 0xf5 0x02 | Message type 1002<br>• Extended L1-only GPS RTK observables (Input) |
| RTCM-3X-TYPE1003 | 0xf5 0x03 | Message type 1003<br>• L1/L2 GPS RTK observables (Input) |
| RTCM-3X-TYPE1004 | 0xf5 0x04 | Message type 1004<br>• Extended L1/L2 GPS RTK observables (Input) |
| RTCM-3X-TYPE1005 | 0xf5 0x05 | Message type 1005<br>• Stationary RTK reference station ARP (Input/output) |
| RTCM-3X-TYPE1006 | 0xf5 0x06 | Message type 1006<br>• Stationary RTK reference station ARP with antenna height (Input) |
| RTCM-3X-TYPE1007 | 0xf5 0x07 | Message type 1007<br>• Antenna descriptor (Input) |
| RTCM-3X-TYPE1009 | 0xf5 0x09 | Message type 1009<br>• L1-only GLONASS RTK observables (Input) |
| RTCM-3X-TYPE1010 | 0xf5 0x0a | Message type 1010<br>• Extended L1-Only GLONASS RTK observables (Input) |
| RTCM-3X-TYPE1011 | 0xf5 0xa1 | Message type 1011<br>• L1&L2 GLONASS RTK observables (Input) |
| RTCM-3X-TYPE1012 | 0xf5 0xa2 | Message type 1012<br>• Extended L1&L2 GLONASS RTK observables (Input) |
| RTCM-3X-TYPE1033 | 0xf5 0x21 | Message type 1033<br>• Receiver and antenna descriptors (Input) |
| RTCM-3X-TYPE1074 | 0xf5 0x4a | Message type 1074<br>• GPS MSM4 (Input/output) |
| RTCM-3X-TYPE1075 | 0xf5 0x4b | Message type 1075<br>• GPS MSM5 (Input) |

| Message | Class/ID | Description (Type) |
|---|---|---|
| RTCM-3X-TYPE1077 | 0xf5 0x4d | Message type 1077<br>• GPS MSM7 (Input/output) |
| RTCM-3X-TYPE1084 | 0xf5 0x54 | Message type 1084<br>• GLONASS MSM4 (Input/output) |
| RTCM-3X-TYPE1085 | 0xf5 0x55 | Message type 1085<br>• GLONASS MSM5 (Input) |
| RTCM-3X-TYPE1087 | 0xf5 0x57 | Message type 1087<br>• GLONASS MSM7 (Input/output) |
| RTCM-3X-TYPE1094 | 0xf5 0x5e | Message type 1094<br>• Galileo MSM4 (Input/output) |
| RTCM-3X-TYPE1095 | 0xf5 0x5f | Message type 1095<br>• Galileo MSM5 (Input) |
| RTCM-3X-TYPE1097 | 0xf5 0x61 | Message type 1097<br>• Galileo MSM7 (Input/output) |
| RTCM-3X-TYPE1124 | 0xf5 0x7c | Message type 1124<br>• BeiDou MSM4 (Input/output) |
| RTCM-3X-TYPE1125 | 0xf5 0x7d | Message type 1125<br>• BeiDou MSM5 (Input) |
| RTCM-3X-TYPE1127 | 0xf5 0x7f | Message type 1127<br>• BeiDou MSM7 (Input/output) |
| RTCM-3X-TYPE1230 | 0xf5 0xe6 | Message type 1230<br>• GLONASS L1 and L2 code-phase biases (Input/output) |
| RTCM-3X-TYPE4072_0 | 0xf5 0xfe | Message type 4072, sub-type 0<br>• Reference station PVT (u-blox proprietary) (Input/output) |
| RTCM-3X-TYPE4072_1 | 0xf5 0xfd | Message type 4072, sub-type 1<br>• Additional reference station information (u-blox proprietary) (Output) |

## 4.4 RTCM 3.3 messages

For details see RTCM protocol and the *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* available from http://www.rtcm.org.

### 4.4.1 Message type 1001

#### 4.4.1.1 L1-only GPS RTK observables

| *Message* | **RTCM-3X-TYPE1001**<br>**L1-only GPS RTK observables** |
|---|---|
| *Type* | Input |
| *Comment* | See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. |
| *Information* | *Class/ID:* 0xf5 0x01, *Message Type:* 1001 (0x3e9), *Message Size:* 6 + numData |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | $U_{:10}$ | `numData` | - | - | payload size |
| bits 15...10 | $U_{:6}$ | `res1` | - | - | reserved, all zero |

| | | | | | |
|---|---|---|---|---|---|
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.2 Message type 1002

### 4.4.2.1 Extended L1-only GPS RTK observables

| ***Message*** | **RTCM-3X-TYPE1002**<br>**Extended L1-only GPS RTK observables** | | | | |
|---|---|---|---|---|---|
| *Type* | Input | | | | |
| *Comment* | See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x02, *Message Type:* 1002 (0x3ea), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | U:10 | `numData` | - | - | payload size |
| bits 15...10 | U:6 | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.3 Message type 1003

### 4.4.3.1 L1/L2 GPS RTK observables

| ***Message*** | **RTCM-3X-TYPE1003**<br>**L1/L2 GPS RTK observables** | | | | |
|---|---|---|---|---|---|
| *Type* | Input | | | | |
| *Comment* | See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x03, *Message Type:* 1003 (0x3eb), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | U:10 | `numData` | - | - | payload size |
| bits 15...10 | U:6 | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 3 + numData | U1[3] | crc | - | - | checksum |

## 4.4.4 Message type 1004

### 4.4.4.1 Extended L1/L2 GPS RTK observables

| ***Message*** | **RTCM-3X-TYPE1004**<br>**Extended L1/L2 GPS RTK observables** | | | | |
|---|---|---|---|---|---|
| *Type* | Input | | | | |
| *Comment* | See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x04, *Message Type:* 1004 (0x3ec), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | preamble | - | - | preamble (0xd3) |
| 1 | X2 | bitfield0 | - | - | bitfield |
| bits 9...0 | U:10 | numData | - | - | payload size |
| bits 15...10 | U:6 | res1 | - | - | reserved, all zero |
| *Start of repeated group (numData times)* | | | | | |
| 3 + n | U1 | data | - | - | message payload data |
| *End of repeated group (numData times)* | | | | | |
| 3 + numData | U1[3] | crc | - | - | checksum |

## 4.4.5 Message type 1005

### 4.4.5.1 Stationary RTK reference station ARP

| ***Message*** | **RTCM-3X-TYPE1005**<br>**Stationary RTK reference station ARP** | | | | |
|---|---|---|---|---|---|
| *Type* | Input/output | | | | |
| *Comment* | See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x05, *Message Type:* 1005 (0x3ed), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | preamble | - | - | preamble (0xd3) |
| 1 | X2 | bitfield0 | - | - | bitfield |
| bits 9...0 | U:10 | numData | - | - | payload size |
| bits 15...10 | U:6 | res1 | - | - | reserved, all zero |
| *Start of repeated group (numData times)* | | | | | |
| 3 + n | U1 | data | - | - | message payload data |
| *End of repeated group (numData times)* | | | | | |
| 3 + numData | U1[3] | crc | - | - | checksum |

## 4.4.6 Message type 1006

#### 4.4.6.1 Stationary RTK reference station ARP with antenna height

| ***Message*** | **RTCM-3X-TYPE1006**<br>**Stationary RTK reference station ARP with antenna height** | | | | |
|---|---|---|---|---|---|
| *Type* | Input | | | | |
| *Comment* | See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x06, *Message Type:* 1006 (0x3ee), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | U:10 | `numData` | - | - | payload size |
| bits 15...10 | U:6 | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.7 Message type 1007

#### 4.4.7.1 Antenna descriptor

| ***Message*** | **RTCM-3X-TYPE1007**<br>**Antenna descriptor** | | | | |
|---|---|---|---|---|---|
| *Type* | Input | | | | |
| *Comment* | See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x07, *Message Type:* 1007 (0x3ef), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | U:10 | `numData` | - | - | payload size |
| bits 15...10 | U:6 | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.8 Message type 1009

#### 4.4.8.1 L1-only GLONASS RTK observables

| ***Message*** | **RTCM-3X-TYPE1009**<br>**L1-only GLONASS RTK observables** |
|---|---|
| *Type* | Input |

| | | | | | |
|---|---|---|---|---|---|
| *Comment* | See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x09, *Message Type:* 1009 (0x3f1), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | $U_{:10}$ | `numData` | - | - | payload size |
| bits 15...10 | $U_{:6}$ | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.9 Message type 1010

### 4.4.9.1 Extended L1-Only GLONASS RTK observables

| ***Message*** | **RTCM-3X-TYPE1010**<br>**Extended L1-Only GLONASS RTK observables** | | | | |
|---|---|---|---|---|---|
| *Type* | Input | | | | |
| *Comment* | See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x0a, *Message Type:* 1010 (0x3f2), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | $U_{:10}$ | `numData` | - | - | payload size |
| bits 15...10 | $U_{:6}$ | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.10 Message type 1011

### 4.4.10.1 L1&L2 GLONASS RTK observables

| ***Message*** | **RTCM-3X-TYPE1011**<br>**L1&L2 GLONASS RTK observables** | | | | |
|---|---|---|---|---|---|
| *Type* | Input | | | | |
| *Comment* | See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0xa1, *Message Type:* 1011 (0x3f3), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |

| | | | | | |
|---|---|---|---|---|---|
| 0 | U1 | preamble | - | - | preamble (0xd3) |
| 1 | X2 | bitfield0 | - | - | bitfield |
| bits 9...0 | U:10 | numData | - | - | payload size |
| bits 15...10 | U:6 | res1 | - | - | reserved, all zero |
| *Start of repeated group (numData times)* | | | | | |
| 3 + n | U1 | data | - | - | message payload data |
| *End of repeated group (numData times)* | | | | | |
| 3 + numData | U1[3] | crc | - | - | checksum |

## 4.4.11 Message type 1012

### 4.4.11.1 Extended L1&L2 GLONASS RTK observables

| ***Message*** | **RTCM-3X-TYPE1012**<br>**Extended L1&L2 GLONASS RTK observables** |
|---|---|
| *Type* | Input |
| *Comment* | See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. |
| *Information* | *Class/ID:* 0xf5 0xa2, *Message Type:* 1012 (0x3f4), *Message Size:* 6 + numData |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | preamble | - | - | preamble (0xd3) |
| 1 | X2 | bitfield0 | - | - | bitfield |
| bits 9...0 | U:10 | numData | - | - | payload size |
| bits 15...10 | U:6 | res1 | - | - | reserved, all zero |
| *Start of repeated group (numData times)* | | | | | |
| 3 + n | U1 | data | - | - | message payload data |
| *End of repeated group (numData times)* | | | | | |
| 3 + numData | U1[3] | crc | - | - | checksum |

## 4.4.12 Message type 1033

### 4.4.12.1 Receiver and antenna descriptors

| ***Message*** | **RTCM-3X-TYPE1033**<br>**Receiver and antenna descriptors** |
|---|---|
| *Type* | Input |
| *Comment* | See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. |
| *Information* | *Class/ID:* 0xf5 0x21, *Message Type:* 1033 (0x409), *Message Size:* 6 + numData |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | preamble | - | - | preamble (0xd3) |
| 1 | X2 | bitfield0 | - | - | bitfield |
| bits 9...0 | U:10 | numData | - | - | payload size |
| bits 15...10 | U:6 | res1 | - | - | reserved, all zero |

| | | | | | |
|---|---|---|---|---|---|
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.13 Message type 1074

### 4.4.13.1 GPS MSM4

| ***Message*** | **RTCM-3X-TYPE1074**<br>**GPS MSM4** | | | | |
|---|---|---|---|---|---|
| *Type* | Input/output | | | | |
| *Comment* | Full GPS Pseudoranges and PhaseRanges plus CNR<br>See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x4a, *Message Type:* 1074 (0x432), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | U:10 | `numData` | - | - | payload size |
| bits 15...10 | U:6 | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.14 Message type 1075

### 4.4.14.1 GPS MSM5

| ***Message*** | **RTCM-3X-TYPE1075**<br>**GPS MSM5** | | | | |
|---|---|---|---|---|---|
| *Type* | Input | | | | |
| *Comment* | Full GPS Pseudoranges, PhaseRanges, PhaseRangeRate and CNR<br>See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x4b, *Message Type:* 1075 (0x433), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | U:10 | `numData` | - | - | payload size |
| bits 15...10 | U:6 | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 3 + numData | U1[3] | crc | - | - | checksum |

## 4.4.15 Message type 1077

### 4.4.15.1 GPS MSM7

| ***Message*** | **RTCM-3X-TYPE1077**<br>**GPS MSM7** |
|---|---|
| *Type* | Input/output |
| *Comment* | Full GPS Pseudoranges, PhaseRanges, PhaseRangeRate and CNR (high resolution)<br>See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. |
| *Information* | *Class/ID:* 0xf5 0x4d, *Message Type:* 1077 (0x435), *Message Size:* 6 + numData |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | preamble | - | - | preamble (0xd3) |
| 1 | X2 | bitfield0 | - | - | bitfield |
| bits 9...0 | U:10 | numData | - | - | payload size |
| bits 15...10 | U:6 | res1 | - | - | reserved, all zero |
| *Start of repeated group (numData times)* | | | | | |
| 3 + n | U1 | data | - | - | message payload data |
| *End of repeated group (numData times)* | | | | | |
| 3 + numData | U1[3] | crc | - | - | checksum |

## 4.4.16 Message type 1084

### 4.4.16.1 GLONASS MSM4

| ***Message*** | **RTCM-3X-TYPE1084**<br>**GLONASS MSM4** |
|---|---|
| *Type* | Input/output |
| *Comment* | Full GLONASS Pseudoranges and PhaseRanges plus CNR<br>See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. |
| *Information* | *Class/ID:* 0xf5 0x54, *Message Type:* 1084 (0x43c), *Message Size:* 6 + numData |

*Payload description:*

| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
|---|---|---|---|---|---|
| 0 | U1 | preamble | - | - | preamble (0xd3) |
| 1 | X2 | bitfield0 | - | - | bitfield |
| bits 9...0 | U:10 | numData | - | - | payload size |
| bits 15...10 | U:6 | res1 | - | - | reserved, all zero |
| *Start of repeated group (numData times)* | | | | | |
| 3 + n | U1 | data | - | - | message payload data |
| *End of repeated group (numData times)* | | | | | |
| 3 + numData | U1[3] | crc | - | - | checksum |

## 4.4.17 Message type 1085

#### 4.4.17.1 GLONASS MSM5

| ***Message*** | **RTCM-3X-TYPE1085**<br>**GLONASS MSM5** | | | | |
|---|---|---|---|---|---|
| *Type* | Input | | | | |
| *Comment* | Full GLONASS Pseudoranges, PhaseRanges, PhaseRangeRate and CNR<br>See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x55, *Message Type:* 1085 (0x43d), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | U:10 | `numData` | - | - | payload size |
| bits 15...10 | U:6 | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.18 Message type 1087

#### 4.4.18.1 GLONASS MSM7

| ***Message*** | **RTCM-3X-TYPE1087**<br>**GLONASS MSM7** | | | | |
|---|---|---|---|---|---|
| *Type* | Input/output | | | | |
| *Comment* | Full GLONASS Pseudoranges, PhaseRanges, PhaseRangeRate and CNR (high resolution)<br>See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x57, *Message Type:* 1087 (0x43f), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | U:10 | `numData` | - | - | payload size |
| bits 15...10 | U:6 | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.19 Message type 1094

#### 4.4.19.1 Galileo MSM4

| ***Message*** | **RTCM-3X-TYPE1094**<br>**Galileo MSM4** | | | | |
|---|---|---|---|---|---|
| *Type* | Input/output | | | | |
| *Comment* | Full Galileo Pseudoranges and PhaseRanges plus CNR<br>See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x5e, *Message Type:* 1094 (0x446), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | U:10 | `numData` | - | - | payload size |
| bits 15...10 | U:6 | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.20 Message type 1095

#### 4.4.20.1 Galileo MSM5

| ***Message*** | **RTCM-3X-TYPE1095**<br>**Galileo MSM5** | | | | |
|---|---|---|---|---|---|
| *Type* | Input | | | | |
| *Comment* | Full Galileo Pseudoranges, PhaseRanges, PhaseRangeRate and CNR<br>See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x5f, *Message Type:* 1095 (0x447), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | U:10 | `numData` | - | - | payload size |
| bits 15...10 | U:6 | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.21 Message type 1097

#### 4.4.21.1 Galileo MSM7

| ***Message*** | **RTCM-3X-TYPE1097**<br>**Galileo MSM7** | | | | |
|---|---|---|---|---|---|
| *Type* | Input/output | | | | |
| *Comment* | Full Galileo Pseudoranges, PhaseRanges, PhaseRangeRate and CNR (high resolution)<br>See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x61, *Message Type:* 1097 (0x449), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | U:10 | `numData` | - | - | payload size |
| bits 15...10 | U:6 | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.22 Message type 1124

#### 4.4.22.1 BeiDou MSM4

| ***Message*** | **RTCM-3X-TYPE1124**<br>**BeiDou MSM4** | | | | |
|---|---|---|---|---|---|
| *Type* | Input/output | | | | |
| *Comment* | Full BeiDou Pseudoranges and PhaseRanges plus CNR<br>See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x7c, *Message Type:* 1124 (0x464), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | U:10 | `numData` | - | - | payload size |
| bits 15...10 | U:6 | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.23 Message type 1125

#### 4.4.23.1 BeiDou MSM5

| ***Message*** | **RTCM-3X-TYPE1125**<br>**BeiDou MSM5** | | | | |
|---|---|---|---|---|---|
| *Type* | Input | | | | |
| *Comment* | Full BeiDou Pseudoranges, PhaseRanges, PhaseRangeRate and CNR<br>See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x7d, *Message Type:* 1125 (0x465), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | U:10 | `numData` | - | - | payload size |
| bits 15...10 | U:6 | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.24 Message type 1127

#### 4.4.24.1 BeiDou MSM7

| ***Message*** | **RTCM-3X-TYPE1127**<br>**BeiDou MSM7** | | | | |
|---|---|---|---|---|---|
| *Type* | Input/output | | | | |
| *Comment* | Full BeiDou pseudoranges, PhaseRanges, PhaseRangeRate and CNR (high resolution)<br>See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0x7f, *Message Type:* 1127 (0x467), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | U:10 | `numData` | - | - | payload size |
| bits 15...10 | U:6 | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.25 Message type 1230

### 4.4.25.1 GLONASS L1 and L2 code-phase biases

| ***Message*** | **RTCM-3X-TYPE1230**<br>**GLONASS L1 and L2 code-phase biases** | | | | |
|---|---|---|---|---|---|
| *Type* | Input/output | | | | |
| *Comment* | See *RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3* for a detailed message specification. | | | | |
| *Information* | *Class/ID:* 0xf5 0xe6, *Message Type:* 1230 (0x4ce), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | $U_{:10}$ | `numData` | - | - | payload size |
| bits 15...10 | $U_{:6}$ | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.26 Message type 4072, sub-type 0

### 4.4.26.1 Reference station PVT (u-blox proprietary)

| ***Message*** | **RTCM-3X-TYPE4072_0**<br>**Reference station PVT (u-blox proprietary)** | | | | |
|---|---|---|---|---|---|
| *Type* | Input/output | | | | |
| *Comment* | The `payload` starts with the following RTCM data fields:<br>• uint12 (12 bits unsigned, RTCM data field type D002): message type (0xfe8 for this message)<br>• uint12 (12 bits unsigned, RTCM data field type D002): message sub-type (0x000 for this message) | | | | |
| *Information* | *Class/ID:* 0xf5 0xfe, *Message Type:* 4072 (0xfe8), *Sub-type:* 0 (0x000), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | $U_{:10}$ | `numData` | - | - | payload size |
| bits 15...10 | $U_{:6}$ | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

## 4.4.27 Message type 4072, sub-type 1

### 4.4.27.1 Additional reference station information (u-blox proprietary)

| ***Message*** | **RTCM-3X-TYPE4072_1**<br>**Additional reference station information (u-blox proprietary)** |
|---|---|
| *Type* | Output |

| | | | | | |
|---|---|---|---|---|---|
| *Comment* | The `payload` starts with the following RTCM data fields:<br>• uint12 (12 bits unsigned, RTCM data field type D002): message type (0xfe8 for this message)<br>• uint12 (12 bits unsigned, RTCM data field type D002): message sub-type (0x001 for this message) | | | | |
| *Information* | *Class/ID:* 0xf5 0xfd, *Message Type:* 4072 (0xfe8), *Sub-type:* 1 (0x001), *Message Size:* 6 + numData | | | | |
| *Payload description:* | | | | | |
| *Byte offset* | *Type* | *Name* | *Scale* | *Unit* | *Description* |
| 0 | U1 | `preamble` | - | - | preamble (0xd3) |
| 1 | X2 | `bitfield0` | - | - | bitfield |
| bits 9...0 | $U_{:10}$ | `numData` | - | - | payload size |
| bits 15...10 | $U_{:6}$ | `res1` | - | - | reserved, all zero |
| *Start of repeated group (`numData` times)* | | | | | |
| 3 + n | U1 | `data` | - | - | message payload data |
| *End of repeated group (`numData` times)* | | | | | |
| 3 + numData | U1[3] | `crc` | - | - | checksum |

# 5 Configuration interface

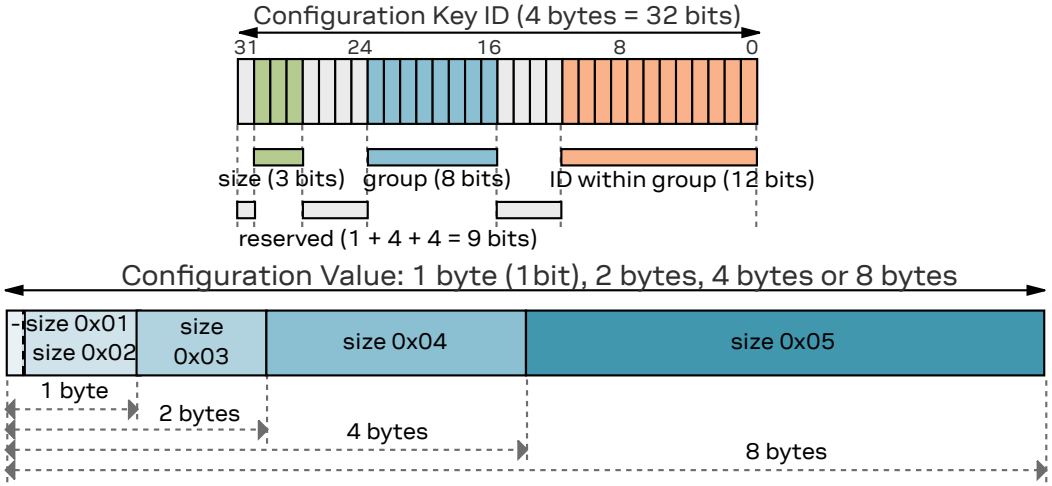
This chapter describes the receiver configuration interface.

## 5.1 Configuration database

The configuration database in the receiver's RAM holds the current configuration, which is used by the receiver at run-time. It is constructed on startup of the receiver from several sources of configuration. These sources are called *Configuration Layers*. The current configuration is called the *RAM Layer*. Any configuration in any layer is organized as *Configuration Items*, where each Configuration Item is referenced to by a unique *Configuration Key ID* and holds a single *Configuration Value*.

## 5.2 Configuration items

The following figure shows the structure of a *Configuration Item*, which consists of a *(Configuration) Key ID* and its *(Configuration) Value*:




A Configuration Key ID is a 32-bit integer value, which is split into the following parts:

- Bit 31: Currently unused. Reserved for future use.
- Bits 30...28: Three bits that indicate the storage size of a Configuration Value (range 0x01-0x05, see below)
- Bits 27...24: Currently unused. Reserved for future use.
- Bits 23...16: Eight bits that define a unique group ID (range 0x01-0xfe)
- Bits 15...12: Currently unused. Reserved for future use.
- Bits 11...0: Twelve bits that define a unique item ID within a group (range 0x001-0xffe)

The entire 32-bit value is the unique Key ID, which uniquely identifies a particular item. The numeric representation of the Key ID uses the lower-case hexadecimal format, such as `0x20c400a1`. An easier, more readable text representation uses the form CFG-*GROUP-ITEM*. This is also referred to as the *(Configuration) Key Name*.

Supported storage size identifiers (bits 30...28 of the Key ID) are:

- 0x01: one bit (the actual storage used is one byte, but only the least significant bit is used)
- 0x02: one byte
- 0x03: two bytes
- 0x04: four bytes

- 0x05: eight bytes

Each Configuration Item is of a certain type, which defines the interpretation of the raw binary data (see also UBX data types):

- U1, U2, U4, U8: unsigned little-endian integers of 8-, 16-, 32- and 64-bit widths
- I1, I2, I4, I8: signed little-endian, two's complement integers of 8-, 16-, 32- and 64-bit widths
- R4, R8: IEEE 754 single (32-bit) and double (64-bit) precision floats
- E1, E2, E4: unsigned little-endian enumeration of 8-, 16-, and 32-bit widths
- X1, X2, X4, X8: unsigned little-endian integers of 8-, 16-, 32- and 64-bit widths for bitfields and other binary data, such as strings
- L: single-bit boolean (true = 1, false = 0), stored as U1

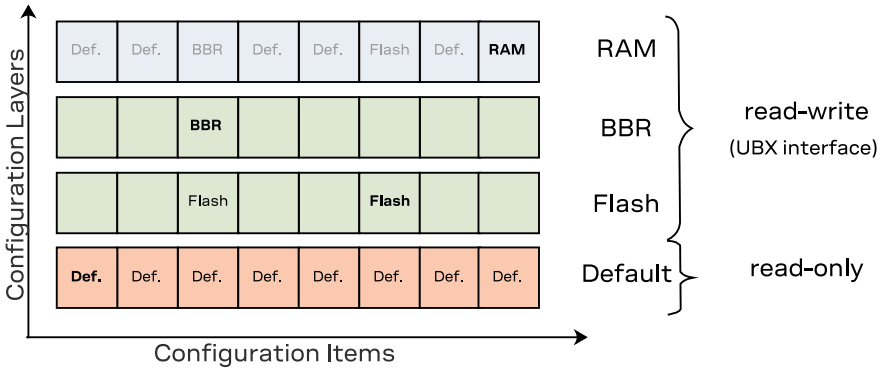
## 5.3 Configuration layers

Several *Configuration Layers* exist. They are separate sources of Configuration Items. Some of the layers are read-only and others are modifiable. Layers are organized in terms of priority. Values in a high-priority layer will replace values stored in low-priority layer. On startup of the receiver all configuration layers are read and the items within each layer are stacked up in order to create the *Current Configuration*, which is used by the receiver at run-time.

The following configuration layers are available (in order of priority, highest priority first):

- **RAM**: This layer contains items stored in volatile RAM. This is the Current Configuration. The value of any item can be set by the user at run-time (see UBX protocol interface) and it will become effective immediately.
- **BBR**: This layer contains items stored in the battery-backed RAM. The contents in this layer are preserved as long as a battery backup supply is provided during off periods. The value of any item can be set by the user at run-time (see UBX protocol interface) and it will become effective upon a restart of the receiver.
- **Flash**: This layer contains items stored permanently in the external flash memory. This layer is only available if there is a usable external flash memory. The value of any item can be set by the user at run-time (see UBX protocol interface) and it will become effective upon a restart of the receiver.
- **Default:** This layer contains all items known to the running receiver software and their hard-coded default values. Data in this layer is not writable.

The stacking of the Configuration Items from the different layers (sources) in order to construct the Current Configuration in the RAM Layer is depicted in the following figure. For each defined item, i.e. for each item in the Default Layer, the receiver software goes through the layers above and stacks all the found items on top. Some items may not be present in every layer. The result is the RAM Layer filled with all Configuration Items given Configuration Values coming from the highest priority layer the corresponding item was present. In the example figure below bold text indicates the source of the value in the Current Configuration (the RAM Layer). Empty boxes mean that the layer can hold the item but that it is not currently stored there. Boxes with text mean that an item is currently stored in the layer.




In the example figure above several items (e.g. the first item) are only set in the Default Layer and hence the default value ends up in Current Configuration in the RAM Layer. The third item is present in the Default, Flash and BBR Layers. The value from the BBR Layer has the highest priority and therefore it ends up in the RAM Layer. On the other hand, the default value of the sixth item is changed by the value in the Flash Layer. The value of the last item is changed in the RAM Layer only, i.e. upon startup the value in the RAM Layer was the value from the Default Layer, but the user has changed the value in the RAM Layer at run-time.

## 5.4 Configuration interface access

The following sections describe the existing interfaces to access the Configuration Database.

### 5.4.1 UBX protocol interface

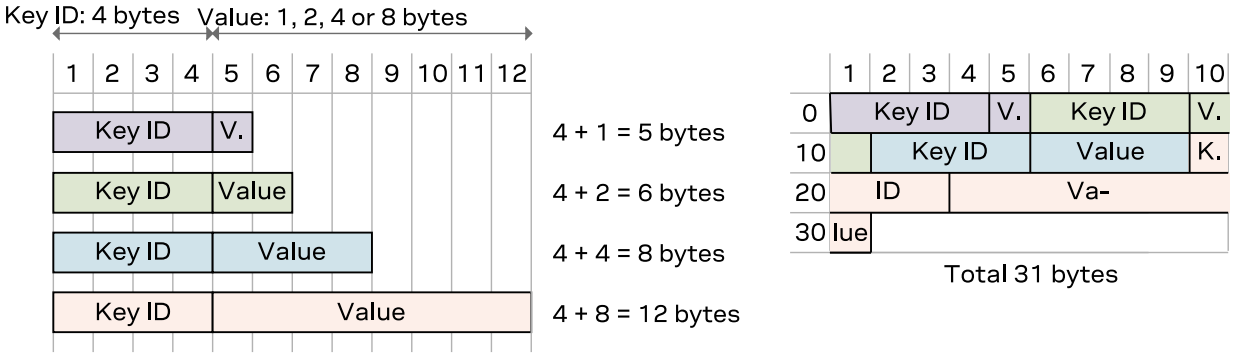
The following UBX protocol messages are available to access the Configuration Database:

- UBX-CFG-VALGET to read Configuration Items from the database
- UBX-CFG-VALSET to set Configuration Items in the database
- UBX-CFG-VALDEL to delete Configuration Items from the database

## 5.5 Configuration data

Configuration data is the binary representation of a list of Key ID and Value pairs. It is formed by concatenating keys (U4 values) and values (variable type) without any padding. This format is used in the UBX-CFG-VALSET and UBX-CFG-VALGET messages.

The figure below shows an example. The four Items (Key ID - Value pairs) on the left use the four fundamental storage sizes: one byte (L, U1, I1, E1 and X1 types), 2 bytes (U2, I2, E2 and X2 types), four byte (U4, I4, E4, X4 and R4 types) and eight bytes (U8, I8, X8 and R8 types). When concatenated (right) the Key IDs and Values are not aligned and there is no padding.



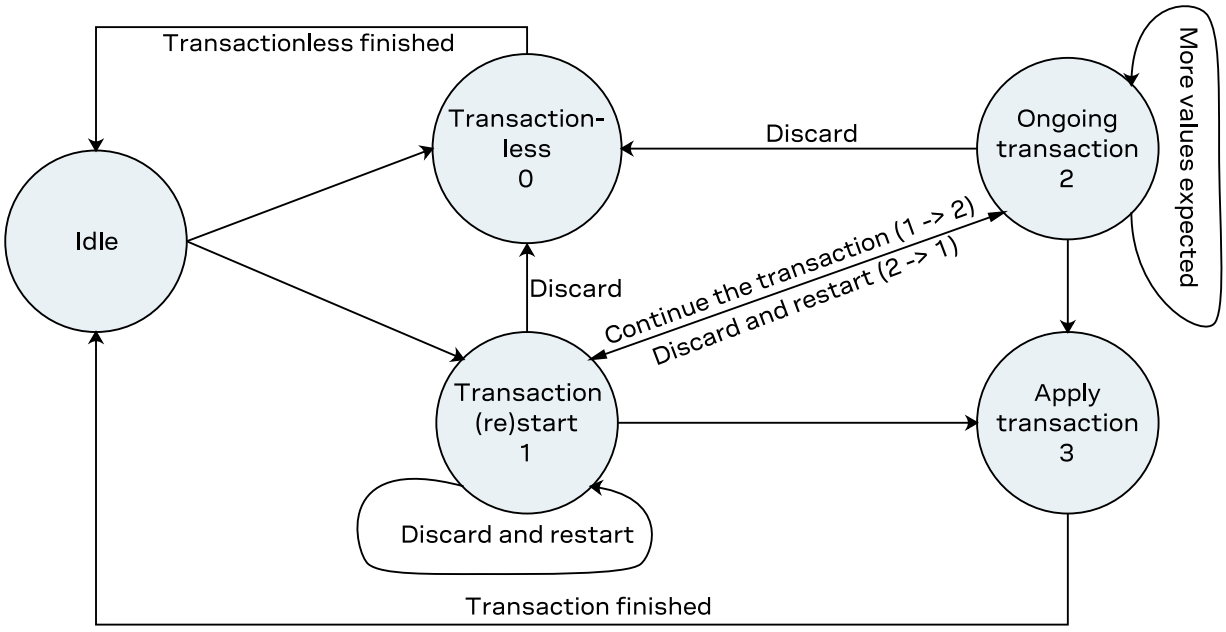
Note that this is an arbitrary example and any number of items of any value storage size can be concatenated the same way.

## 5.6 Configuration transactions

The configuration interface supports two mechanisms of configuration: the first is a transactionless mechanism where sent configuration changes are applied immediately to the configuration layer(s) requested. The second mechanism is a configuration transaction.

A transaction offers a way of queuing multiple configuration changes. It is particularly useful where different configuration keys depend on each other in such a way that sending one before the other can cause the configuration to be rejected. The queued configuration change requests are stored then checked collectively before being applied to the receiver.

A transaction can have the following states described in the figure below.




When starting a transaction, the user must specify the layer(s) the changes will be applied to. This list of configuration layer(s) must be observed throughout the transaction states. Modifying the configuration layer(s) mid-transaction will cause the transaction to be aborted and no queued changes will be applied.

In the start transaction state, the receiver will lock the configuration database so that changes from another entity or message cannot be applied. It is possible to send a configuration key-value pairs with the start transaction state. These will be queued waiting to be applied.

In the ongoing state, a configuration key and value must be sent. The receiver will abort the transaction and not apply any changes if this condition is violated. Key-value pairs sent in the ongoing state will be queued waiting to be applied.

In the apply state, the queued changes will be collectively checked and applied to the requested configuration layer(s). Note that any additional key-value pairs sent within the apply state will be ignored.

Note that a transaction can only come from a single source, a UBX-CFG-VALSET message or a UBX-CFG-VALDEL message. This means that in any given transaction it is not possible to mix a delete

and a save request. Starting a transaction from a different source will abort the current transaction and no queued changes would be applied.

Refer to UBX-CFG-VALSET and UBX-CFG-VALDEL messages for a detailed description of how to set up a configuration transaction, its limitations and conditions that would cause the transaction to be rejected.

## 5.7 Configuration reset behavior

The RAM layer is always rebuilt from the layers below when the chip's processor comes out from reset. When using UBX-CFG-RST the processor goes through a reset cycle with these reset types (`resetMode` field):

- `0x00` hardware reset (watchdog) immediately
- `0x01` controlled software reset
- `0x04` hardware reset (watchdog) after shutdown

See also the section *Forcing a receiver reset* in the Integration Manual.

## 5.8 Configuration overview

| Group | Description |
|---|---|
| CFG-BDS | BeiDou system configuration |
| CFG-GEOFENCE | Geofencing configuration |
| CFG-HW | Hardware configuration |
| CFG-I2C | Configuration of the I2C interface |
| CFG-I2CINPROT | Input protocol configuration of the I2C interface |
| CFG-I2COUTPROT | Output protocol configuration of the I2C interface |
| CFG-INFMSG | Information message configuration |
| CFG-ITFM | Jamming and interference monitor configuration |
| CFG-LOGFILTER | Data logger configuration |
| CFG-MOT | Motion detector configuration |
| CFG-MSGOUT | Message output configuration |
| CFG-NAVHPG | High precision navigation configuration |
| CFG-NAVSPG | Standard precision navigation configuration |
| CFG-NMEA | NMEA protocol configuration |
| CFG-ODO | Odometer and low-speed course over ground filter configuration |
| CFG-QZSS | QZSS system configuration |
| CFG-RATE | Navigation and measurement rate configuration |
| CFG-RINV | Remote inventory |
| CFG-RTCM | RTCM protocol configuration |
| CFG-SBAS | SBAS configuration |
| CFG-SIGNAL | Satellite systems (GNSS) signal configuration |
| CFG-SPI | Configuration of the SPI interface |
| CFG-SPIINPROT | Input protocol configuration of the SPI interface |
| CFG-SPIOUTPROT | Output protocol configuration of the SPI interface |
| CFG-TMODE | Time mode configuration |

| Group | Description |
|---|---|
| CFG-TP | Timepulse configuration |
| CFG-TXREADY | TX ready configuration |
| CFG-UART1 | Configuration of the UART1 interface |
| CFG-UART1INPROT | Input protocol configuration of the UART1 interface |
| CFG-UART1OUTPROT | Output protocol configuration of the UART1 interface |
| CFG-UART2 | Configuration of the UART2 interface |
| CFG-UART2INPROT | Input protocol configuration of the UART2 interface |
| CFG-UART2OUTPROT | Output protocol configuration of the UART2 interface |
| CFG-USB | Configuration of the USB interface |
| CFG-USBINPROT | Input protocol configuration of the USB interface |
| CFG-USBOUTPROT | Output protocol configuration of the USB interface |

# 5.9 Configuration reference

## 5.9.1 CFG-BDS: BeiDou system configuration

Note that enabling and disabling of individual GNSS is done via the CFG-SIGNAL configuration group.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-BDS-USE_PRN_1_TO_5* | 0x10340014 | L | - | - | Use BeiDou geostationary satellites (PRN 1-5) |

**Table 1: CFG-BDS configuration items**

## 5.9.2 CFG-GEOFENCE: Geofencing configuration

See the chapter *Geofencing* in Integration Manual for feature details.

If the receiver is sent a valid new configuration, it will respond with a UBX-ACK-ACK message and immediately change to the new configuration. Otherwise the receiver will reject the request, by issuing a UBX-ACK-NAK and continuing operation with the previous configuration.

Note that the acknowledge message does not indicate whether the PIO configuration has been successfully applied (pin assigned), it only indicates the successful configuration of the feature. The configured PIO must be previously unoccupied for successful assignment.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-GEOFENCE-CONFLVL* | 0x20240011 | E1 | - | - | Required confidence level for state evaluation |
| This value times the position's standard deviation (sigma) defines the confidence band.<br>See Table 3 below for a list of possible constants for this item. | | | | | |
| *CFG-GEOFENCE-USE_PIO* | 0x10240012 | L | - | - | Use PIO combined fence state output |
| *CFG-GEOFENCE-PINPOL* | 0x20240013 | E1 | - | - | PIO pin polarity |
| See Table 4 below for a list of possible constants for this item. | | | | | |
| *CFG-GEOFENCE-PIN* | 0x20240014 | U1 | - | - | PIO pin number |
| *CFG-GEOFENCE-USE_FENCE1* | 0x10240020 | L | - | - | Use first geofence |
| *CFG-GEOFENCE-FENCE1_LAT* | 0x40240021 | I4 | 1e-7 | deg | Latitude of the first geofence circle center |
| *CFG-GEOFENCE-FENCE1_LON* | 0x40240022 | I4 | 1e-7 | deg | Longitude of the first geofence circle center |
| *CFG-GEOFENCE-FENCE1_RAD* | 0x40240023 | U4 | 0.01 | m | Radius of the first geofence circle |
| *CFG-GEOFENCE-USE_FENCE2* | 0x10240030 | L | - | - | Use second geofence |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-GEOFENCE-FENCE2_LAT* | 0x40240031 | I4 | 1e-7 | deg | Latitude of the second geofence circle center |
| *CFG-GEOFENCE-FENCE2_LON* | 0x40240032 | I4 | 1e-7 | deg | Longitude of the second geofence circle center |
| *CFG-GEOFENCE-FENCE2_RAD* | 0x40240033 | U4 | 0.01 | m | Radius of the second geofence circle |
| *CFG-GEOFENCE-USE_FENCE3* | 0x10240040 | L | - | - | Use third geofence |
| *CFG-GEOFENCE-FENCE3_LAT* | 0x40240041 | I4 | 1e-7 | deg | Latitude of the third geofence circle center |
| *CFG-GEOFENCE-FENCE3_LON* | 0x40240042 | I4 | 1e-7 | deg | Longitude of the third geofence circle center |
| *CFG-GEOFENCE-FENCE3_RAD* | 0x40240043 | U4 | 0.01 | m | Radius of the third geofence circle |
| *CFG-GEOFENCE-USE_FENCE4* | 0x10240050 | L | - | - | Use fourth geofence |
| *CFG-GEOFENCE-FENCE4_LAT* | 0x40240051 | I4 | 1e-7 | deg | Latitude of the fourth geofence circle center |
| *CFG-GEOFENCE-FENCE4_LON* | 0x40240052 | I4 | 1e-7 | deg | Longitude of the fourth geofence circle center |
| *CFG-GEOFENCE-FENCE4_RAD* | 0x40240053 | U4 | 0.01 | m | Radius of the fourth geofence circle |

**Table 2: CFG-GEOFENCE configuration items**

| Constant | Value | Description |
|---|---|---|
| *L000* | 0 | No confidence |
| *L680* | 1 | 68% |
| *L950* | 2 | 95% |
| *L997* | 3 | 99.7% |
| *L9999* | 4 | 99.99% |
| *L999999* | 5 | 99.9999% |

**Table 3: Constants for CFG-GEOFENCE-CONFLVL**

| Constant | Value | Description |
|---|---|---|
| *LOW_IN* | 0 | PIO low means inside geofence |
| *LOW_OUT* | 1 | PIO low means outside geofence |

**Table 4: Constants for CFG-GEOFENCE-PINPOL**

## 5.9.3 CFG-HW: Hardware configuration

Hardware configuration settings.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-HW-ANT_CFG_VOLTCTRL* | 0x10a3002e | L | - | - | Active antenna voltage control flag |
| Enable active antenna voltage control flag. Used by EXT and MADC engines. | | | | | |
| *CFG-HW-ANT_CFG_SHORTDET* | 0x10a3002f | L | - | - | Short antenna detection flag |
| Enable short antenna detection flag. Used by EXT and MADC engines. | | | | | |
| *CFG-HW-ANT_CFG_SHORTDET_POL* | 0x10a30030 | L | - | - | Short antenna detection polarity |
| Set to true if polarity of the antenna short detection is active low. Used by EXT engine. | | | | | |
| *CFG-HW-ANT_CFG_OPENDET* | 0x10a30031 | L | - | - | Open antenna detection flag |
| Enable open antenna detection flag. Used by EXT and MADC engines. | | | | | |
| *CFG-HW-ANT_CFG_OPENDET_POL* | 0x10a30032 | L | - | - | Open antenna detection polarity |
| Set to true if polarity of the antenna open detection is active low. Used by EXT engine. | | | | | |
| *CFG-HW-ANT_CFG_PWRDOWN* | 0x10a30033 | L | - | - | Power down antenna flag |
| Enable power down antenna logic in the event of antenna short circuit. CFG-HW-ANT_CFG_SHORTDET must be enabled to use this feature. Used by EXT and MADC engines. | | | | | |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-HW-ANT_CFG_PWRDOWN_POL* | 0x10a30034 | L | - | - | Power down antenna logic polarity |
| Set to true if polarity of the antenna power down logic is active high. Used by EXT and MADC engines. | | | | | |
| *CFG-HW-ANT_CFG_RECOVER* | 0x10a30035 | L | - | - | Automatic recovery from short state flag |
| Enable automatic recovery from short state. Used by EXT and MADC engines. | | | | | |
| *CFG-HW-ANT_SUP_SWITCH_PIN* | 0x20a30036 | U1 | - | - | ANT1 PIO number |
| Antenna Switch (ANT1) PIO number. Used by EXT and MADC engines. | | | | | |
| *CFG-HW-ANT_SUP_SHORT_PIN* | 0x20a30037 | U1 | - | - | ANT0 PIO number |
| Antenna Short (ANT0) PIO number. Used by EXT engine. | | | | | |
| *CFG-HW-ANT_SUP_OPEN_PIN* | 0x20a30038 | U1 | - | - | ANT2 PIO number |
| Antenna Switch (ANT2) PIO number. Used by EXT engine. | | | | | |
| *CFG-HW-ANT_SUP_ENGINE* | 0x20a30054 | E1 | - | - | Antenna supervisor engine selection |
| Select the engine used to evaluate antenna state.<br>See Table 6 below for a list of possible constants for this item. | | | | | |
| *CFG-HW-ANT_SUP_SHORT_THR* | 0x20a30055 | U1 | - | mV | Antenna supervisor MADC engine short detection threshold |
| Threshold above which antenna short is detected. Used by MADC engine. | | | | | |
| *CFG-HW-ANT_SUP_OPEN_THR* | 0x20a30056 | U1 | - | mV | Antenna supervisor MADC engine open detection threshold |
| Threshold below which antenna open/disconnected is detected. Used by MADC engine. | | | | | |

**Table 5: CFG-HW configuration items**

| Constant | Value | Description |
|---|---|---|
| *EXT* | 0 | Uses external comparators for current measurement. |
| *MADC* | 1 | Uses built-in ADC and a shunt for current measurement. |

**Table 6: Constants for CFG-HW-ANT_SUP_ENGINE**

### 5.9.4 CFG-I2C: Configuration of the I2C interface

Settings needed to configure the I2C communication interface.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-I2C-ADDRESS* | 0x20510001 | U1 | - | - | I2C slave address of the receiver (7 bits) |
| *CFG-I2C-EXTENDEDTIMEOUT* | 0x10510002 | L | - | - | Flag to disable timeouting the interface after 1.5 s |
| *CFG-I2C-ENABLED* | 0x10510003 | L | - | - | Flag to indicate if the I2C interface should be enabled |

**Table 7: CFG-I2C configuration items**

### 5.9.5 CFG-I2CINPROT: Input protocol configuration of the I2C interface

Input protocol enable flags of the I2C interface.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-I2CINPROT-UBX* | 0x10710001 | L | - | - | Flag to indicate if UBX should be an input protocol on I2C |
| *CFG-I2CINPROT-NMEA* | 0x10710002 | L | - | - | Flag to indicate if NMEA should be an input protocol on I2C |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-I2CINPROT-RTCM3X* | 0x10710004 | L | - | - | Flag to indicate if RTCM3X should be an input protocol on I2C |

**Table 8: CFG-I2CINPROT configuration items**

### 5.9.6 CFG-I2COUTPROT: Output protocol configuration of the I2C interface

Output protocol enable flags of the I2C interface.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-I2COUTPROT-UBX* | 0x10720001 | L | - | - | Flag to indicate if UBX should be an output protocol on I2C |
| *CFG-I2COUTPROT-NMEA* | 0x10720002 | L | - | - | Flag to indicate if NMEA should be an output protocol on I2C |
| *CFG-I2COUTPROT-RTCM3X* | 0x10720004 | L | - | - | Flag to indicate if RTCM3X should be an output protocol on I2C |

**Table 9: CFG-I2COUTPROT configuration items**

### 5.9.7 CFG-INFMSG: Information message configuration

Information message configuration for the NMEA and UBX protocols.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-INFMSG-UBX_I2C* | 0x20920001 | X1 | - | - | Information message enable flags for the UBX protocol on the I2C interface |
| See Table 11 below for a list of possible constants for this item. | | | | | |
| *CFG-INFMSG-UBX_UART1* | 0x20920002 | X1 | - | - | Information message enable flags for the UBX protocol on the UART1 interface |
| See Table 11 below for a list of possible constants for this item. | | | | | |
| *CFG-INFMSG-UBX_UART2* | 0x20920003 | X1 | - | - | Information message enable flags for the UBX protocol on the UART2 interface |
| See Table 11 below for a list of possible constants for this item. | | | | | |
| *CFG-INFMSG-UBX_USB* | 0x20920004 | X1 | - | - | Information message enable flags for the UBX protocol on the USB interface |
| See Table 11 below for a list of possible constants for this item. | | | | | |
| *CFG-INFMSG-UBX_SPI* | 0x20920005 | X1 | - | - | Information message enable flags for the UBX protocol on the SPI interface |
| See Table 11 below for a list of possible constants for this item. | | | | | |
| *CFG-INFMSG-NMEA_I2C* | 0x20920006 | X1 | - | - | Information message enable flags for the NMEA protocol on the I2C interface |
| See Table 11 below for a list of possible constants for this item. | | | | | |
| *CFG-INFMSG-NMEA_UART1* | 0x20920007 | X1 | - | - | Information message enable flags for the NMEA protocol on the UART1 interface |
| See Table 11 below for a list of possible constants for this item. | | | | | |
| *CFG-INFMSG-NMEA_UART2* | 0x20920008 | X1 | - | - | Information message enable flags for the NMEA protocol on the UART2 interface |
| See Table 11 below for a list of possible constants for this item. | | | | | |
| *CFG-INFMSG-NMEA_USB* | 0x20920009 | X1 | - | - | Information message enable flags for the NMEA protocol on the USB interface |
| See Table 11 below for a list of possible constants for this item. | | | | | |
| *CFG-INFMSG-NMEA_SPI* | 0x2092000a | X1 | - | - | Information message enable flags for the NMEA protocol on the SPI interface |
| See Table 11 below for a list of possible constants for this item. | | | | | |

**Table 10: CFG-INFMSG configuration items**

| Constant | Value | Description |
|---|---|---|
| *ERROR* | 0x01 | Enable ERROR information messages |
| *WARNING* | 0x02 | Enable WARNING information messages |
| *NOTICE* | 0x04 | Enable NOTICE information messages |
| *TEST* | 0x08 | Enable TEST information messages |
| *DEBUG* | 0x10 | Enable DEBUG information messages |

**Table 11: Constants for CFG-INFMSG-UBX_I2C, CFG-INFMSG-UBX_UART1, CFG-INFMSG-UBX_UART2, CFG-INFMSG-UBX_USB, CFG-INFMSG-UBX_SPI, CFG-INFMSG-NMEA_I2C, CFG-INFMSG-NMEA_UART1, CFG-INFMSG-NMEA_UART2, CFG-INFMSG-NMEA_USB, CFG-INFMSG-NMEA_SPI**

### 5.9.8 CFG-ITFM: Jamming and interference monitor configuration

Configuration of jamming and interference monitor.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-ITFM-BBTHRESHOLD* | 0x20410001 | U1 | - | - | Broadband jamming detection threshold |
| *CFG-ITFM-CWTHRESHOLD* | 0x20410002 | U1 | - | - | CW jamming detection threshold |
| *CFG-ITFM-ENABLE* | 0x1041000d | L | - | - | Enable interference detection |
| *CFG-ITFM-ANTSETTING* | 0x20410010 | E1 | - | - | Antenna setting |
| See Table 13 below for a list of possible constants for this item. | | | | | |
| *CFG-ITFM-ENABLE_AUX* | 0x10410013 | L | - | - | Scan auxiliary bands |
| Set to true to scan auxiliary bands.<br>Supported on u-blox 8 / u-blox M8 only, otherwise ignored. | | | | | |

**Table 12: CFG-ITFM configuration items**

| Constant | Value | Description |
|---|---|---|
| *UNKNOWN* | 0 | Unknown |
| *PASSIVE* | 1 | Passive |
| *ACTIVE* | 2 | Active |

**Table 13: Constants for CFG-ITFM-ANTSETTING**

### 5.9.9 CFG-LOGFILTER: Data logger configuration

This group can be used to configure the data logger, i.e. to enable/disable the log recording and to get/set the position entry filter settings.

Position entries can be filtered based on time difference, position difference or current speed thresholds. Position and speed filtering also have a minimum time interval. A position is logged if any of the thresholds are exceeded. If a threshold is set to zero it is ignored. The maximum rate of position logging is 1 Hz.

The filter settings will be configured to the provided values only if the APPLY_ALL_FILTERS flag is set. This allows the recording to be enabled/disabled independently of configuring the filter settings.

It is possible to configure the data logger in the absence of a logging file. By doing so, once the logging file is created, the data logger configuration will take effect immediately and logging recording and filtering will activate according to the configuration.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-LOGFILTER-RECORD_ENA* | 0x10de0002 | L | - | - | Recording enabled |
| Set to true when recording enabled. | | | | | |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-LOGFILTER-ONCE_PER_WAKE_UP_ENA* | 0x10de0003 | L | - | - | Once per wake up |
| Set to true recording only one single position per PSM on/off mode wake-up period is enabled.<br>Note: the value set here does not take effect unless CFG-LOGFILTER-APPLY_ALL_FILTERS is enabled. | | | | | |
| *CFG-LOGFILTER-APPLY_ALL_FILTERS* | 0x10de0004 | L | - | - | Apply all filter settings |
| Set to true when all filter settings are to be applied, not just recording enabling/disabling. | | | | | |
| *CFG-LOGFILTER-MIN_INTERVAL* | 0x30de0005 | U2 | - | s | Minimum time interval between logged positions |
| Minimum time interval between logged positions (0 = not set). **This is only applied in combination with the speed and/or position thresholds.** If both MIN_INTERVAL and TIME_THRS are set, MIN_INTERVAL must be less than or equal to TIME_THRS.<br>Note: the value set here does not take effect unless CFG-LOGFILTER-APPLY_ALL_FILTERS is enabled. | | | | | |
| *CFG-LOGFILTER-TIME_THRS* | 0x30de0006 | U2 | - | s | Time threshold |
| If the time difference is greater than the threshold then the position is logged (0 = not set).<br>Note: the value set here does not take effect unless CFG-LOGFILTER-APPLY_ALL_FILTERS is enabled. | | | | | |
| *CFG-LOGFILTER-SPEED_THRS* | 0x30de0007 | U2 | - | m/s | Speed threshold |
| If the current speed is greater than the threshold then the position is logged (0 = not set). MIN_INTERVAL also applies.<br>Note: value set here does not take effect unless CFG-LOGFILTER-APPLY_ALL_FILTERS is enabled. | | | | | |
| *CFG-LOGFILTER-POSITION_THRS* | 0x40de0008 | U4 | - | m | Position threshold |
| If the 3D position difference is greater than the threshold then the position is logged (0 = not set). MIN_INTERVAL also applies.<br>Note: the value set here does not take effect unless CFG-LOGFILTER-APPLY_ALL_FILTERS is enabled. | | | | | |

**Table 14: CFG-LOGFILTER configuration items**

## 5.9.10 CFG-MOT: Motion detector configuration

The items in this group specify the parameters used for the internal receiver motion detector. The platform motion is assessed by combining the detected motion of different detectors looking at specific data types (i.e. GNSS, gyroscopes, accelerometers, wheel ticks). The decision thresholds of the internal detectors can be specified using the configuration items in this group.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MOT-GNSSSPEED_THRS* | 0x20250038 | U1 | 0.01 | m/s | GNSS speed threshold below which platform is considered as stationary (a.k.a. static hold threshold) |
| Set this parameter to 0 for firmware default value or behavior. | | | | | |
| *CFG-MOT-GNSSDIST_THRS* | 0x3025003b | U2 | - | - | Distance above which GNSS-based stationary motion is exit (a.k.a. static hold distance threshold) |
| Set this parameter to 0 for firmware default value or behavior. | | | | | |

**Table 15: CFG-MOT configuration items**

## 5.9.11 CFG-MSGOUT: Message output configuration

For each message and port a separate output rate (per second, per epoch) can be configured.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-NMEA_ID_DTM_I2C* | 0x209100a6 | U1 | - | - | Output rate of the NMEA-GX-DTM message on port I2C |
| *CFG-MSGOUT-NMEA_ID_DTM_SPI* | 0x209100aa | U1 | - | - | Output rate of the NMEA-GX-DTM message on port SPI |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-NMEA_ID_DTM_UART1* | 0x209100a7 | U1 | - | - | Output rate of the NMEA-GX-DTM message on port UART1 |
| *CFG-MSGOUT-NMEA_ID_DTM_UART2* | 0x209100a8 | U1 | - | - | Output rate of the NMEA-GX-DTM message on port UART2 |
| *CFG-MSGOUT-NMEA_ID_DTM_USB* | 0x209100a9 | U1 | - | - | Output rate of the NMEA-GX-DTM message on port USB |
| *CFG-MSGOUT-NMEA_ID_GBS_I2C* | 0x209100dd | U1 | - | - | Output rate of the NMEA-GX-GBS message on port I2C |
| *CFG-MSGOUT-NMEA_ID_GBS_SPI* | 0x209100e1 | U1 | - | - | Output rate of the NMEA-GX-GBS message on port SPI |
| *CFG-MSGOUT-NMEA_ID_GBS_UART1* | 0x209100de | U1 | - | - | Output rate of the NMEA-GX-GBS message on port UART1 |
| *CFG-MSGOUT-NMEA_ID_GBS_UART2* | 0x209100df | U1 | - | - | Output rate of the NMEA-GX-GBS message on port UART2 |
| *CFG-MSGOUT-NMEA_ID_GBS_USB* | 0x209100e0 | U1 | - | - | Output rate of the NMEA-GX-GBS message on port USB |
| *CFG-MSGOUT-NMEA_ID_GGA_I2C* | 0x209100ba | U1 | - | - | Output rate of the NMEA-GX-GGA message on port I2C |
| *CFG-MSGOUT-NMEA_ID_GGA_SPI* | 0x209100be | U1 | - | - | Output rate of the NMEA-GX-GGA message on port SPI |
| *CFG-MSGOUT-NMEA_ID_GGA_UART1* | 0x209100bb | U1 | - | - | Output rate of the NMEA-GX-GGA message on port UART1 |
| *CFG-MSGOUT-NMEA_ID_GGA_UART2* | 0x209100bc | U1 | - | - | Output rate of the NMEA-GX-GGA message on port UART2 |
| *CFG-MSGOUT-NMEA_ID_GGA_USB* | 0x209100bd | U1 | - | - | Output rate of the NMEA-GX-GGA message on port USB |
| *CFG-MSGOUT-NMEA_ID_GLL_I2C* | 0x209100c9 | U1 | - | - | Output rate of the NMEA-GX-GLL message on port I2C |
| *CFG-MSGOUT-NMEA_ID_GLL_SPI* | 0x209100cd | U1 | - | - | Output rate of the NMEA-GX-GLL message on port SPI |
| *CFG-MSGOUT-NMEA_ID_GLL_UART1* | 0x209100ca | U1 | - | - | Output rate of the NMEA-GX-GLL message on port UART1 |
| *CFG-MSGOUT-NMEA_ID_GLL_UART2* | 0x209100cb | U1 | - | - | Output rate of the NMEA-GX-GLL message on port UART2 |
| *CFG-MSGOUT-NMEA_ID_GLL_USB* | 0x209100cc | U1 | - | - | Output rate of the NMEA-GX-GLL message on port USB |
| *CFG-MSGOUT-NMEA_ID_GNS_I2C* | 0x209100b5 | U1 | - | - | Output rate of the NMEA-GX-GNS message on port I2C |
| *CFG-MSGOUT-NMEA_ID_GNS_SPI* | 0x209100b9 | U1 | - | - | Output rate of the NMEA-GX-GNS message on port SPI |
| *CFG-MSGOUT-NMEA_ID_GNS_UART1* | 0x209100b6 | U1 | - | - | Output rate of the NMEA-GX-GNS message on port UART1 |
| *CFG-MSGOUT-NMEA_ID_GNS_UART2* | 0x209100b7 | U1 | - | - | Output rate of the NMEA-GX-GNS message on port UART2 |
| *CFG-MSGOUT-NMEA_ID_GNS_USB* | 0x209100b8 | U1 | - | - | Output rate of the NMEA-GX-GNS message on port USB |
| *CFG-MSGOUT-NMEA_ID_GRS_I2C* | 0x209100ce | U1 | - | - | Output rate of the NMEA-GX-GRS message on port I2C |
| *CFG-MSGOUT-NMEA_ID_GRS_SPI* | 0x209100d2 | U1 | - | - | Output rate of the NMEA-GX-GRS message on port SPI |
| *CFG-MSGOUT-NMEA_ID_GRS_UART1* | 0x209100cf | U1 | - | - | Output rate of the NMEA-GX-GRS message on port UART1 |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-NMEA_ID_GRS_UART2* | 0x209100d0 | U1 | - | - | Output rate of the NMEA-GX-GRS message on port UART2 |
| *CFG-MSGOUT-NMEA_ID_GRS_USB* | 0x209100d1 | U1 | - | - | Output rate of the NMEA-GX-GRS message on port USB |
| *CFG-MSGOUT-NMEA_ID_GSA_I2C* | 0x209100bf | U1 | - | - | Output rate of the NMEA-GX-GSA message on port I2C |
| *CFG-MSGOUT-NMEA_ID_GSA_SPI* | 0x209100c3 | U1 | - | - | Output rate of the NMEA-GX-GSA message on port SPI |
| *CFG-MSGOUT-NMEA_ID_GSA_UART1* | 0x209100c0 | U1 | - | - | Output rate of the NMEA-GX-GSA message on port UART1 |
| *CFG-MSGOUT-NMEA_ID_GSA_UART2* | 0x209100c1 | U1 | - | - | Output rate of the NMEA-GX-GSA message on port UART2 |
| *CFG-MSGOUT-NMEA_ID_GSA_USB* | 0x209100c2 | U1 | - | - | Output rate of the NMEA-GX-GSA message on port USB |
| *CFG-MSGOUT-NMEA_ID_GST_I2C* | 0x209100d3 | U1 | - | - | Output rate of the NMEA-GX-GST message on port I2C |
| *CFG-MSGOUT-NMEA_ID_GST_SPI* | 0x209100d7 | U1 | - | - | Output rate of the NMEA-GX-GST message on port SPI |
| *CFG-MSGOUT-NMEA_ID_GST_UART1* | 0x209100d4 | U1 | - | - | Output rate of the NMEA-GX-GST message on port UART1 |
| *CFG-MSGOUT-NMEA_ID_GST_UART2* | 0x209100d5 | U1 | - | - | Output rate of the NMEA-GX-GST message on port UART2 |
| *CFG-MSGOUT-NMEA_ID_GST_USB* | 0x209100d6 | U1 | - | - | Output rate of the NMEA-GX-GST message on port USB |
| *CFG-MSGOUT-NMEA_ID_GSV_I2C* | 0x209100c4 | U1 | - | - | Output rate of the NMEA-GX-GSV message on port I2C |
| *CFG-MSGOUT-NMEA_ID_GSV_SPI* | 0x209100c8 | U1 | - | - | Output rate of the NMEA-GX-GSV message on port SPI |
| *CFG-MSGOUT-NMEA_ID_GSV_UART1* | 0x209100c5 | U1 | - | - | Output rate of the NMEA-GX-GSV message on port UART1 |
| *CFG-MSGOUT-NMEA_ID_GSV_UART2* | 0x209100c6 | U1 | - | - | Output rate of the NMEA-GX-GSV message on port UART2 |
| *CFG-MSGOUT-NMEA_ID_GSV_USB* | 0x209100c7 | U1 | - | - | Output rate of the NMEA-GX-GSV message on port USB |
| *CFG-MSGOUT-NMEA_ID_RLM_I2C* | 0x20910400 | U1 | - | - | Output rate of the NMEA-GX-RLM message on port I2C |
| *CFG-MSGOUT-NMEA_ID_RLM_SPI* | 0x20910404 | U1 | - | - | Output rate of the NMEA-GX-RLM message on port SPI |
| *CFG-MSGOUT-NMEA_ID_RLM_UART1* | 0x20910401 | U1 | - | - | Output rate of the NMEA-GX-RLM message on port UART1 |
| *CFG-MSGOUT-NMEA_ID_RLM_UART2* | 0x20910402 | U1 | - | - | Output rate of the NMEA-GX-RLM message on port UART2 |
| *CFG-MSGOUT-NMEA_ID_RLM_USB* | 0x20910403 | U1 | - | - | Output rate of the NMEA-GX-RLM message on port USB |
| *CFG-MSGOUT-NMEA_ID_RMC_I2C* | 0x209100ab | U1 | - | - | Output rate of the NMEA-GX-RMC message on port I2C |
| *CFG-MSGOUT-NMEA_ID_RMC_SPI* | 0x209100af | U1 | - | - | Output rate of the NMEA-GX-RMC message on port SPI |
| *CFG-MSGOUT-NMEA_ID_RMC_UART1* | 0x209100ac | U1 | - | - | Output rate of the NMEA-GX-RMC message on port UART1 |
| *CFG-MSGOUT-NMEA_ID_RMC_UART2* | 0x209100ad | U1 | - | - | Output rate of the NMEA-GX-RMC message on port UART2 |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-NMEA_ID_RMC_USB* | 0x209100ae | U1 | - | - | Output rate of the NMEA-GX-RMC message on port USB |
| *CFG-MSGOUT-NMEA_ID_VLW_I2C* | 0x209100e7 | U1 | - | - | Output rate of the NMEA-GX-VLW message on port I2C |
| *CFG-MSGOUT-NMEA_ID_VLW_SPI* | 0x209100eb | U1 | - | - | Output rate of the NMEA-GX-VLW message on port SPI |
| *CFG-MSGOUT-NMEA_ID_VLW_UART1* | 0x209100e8 | U1 | - | - | Output rate of the NMEA-GX-VLW message on port UART1 |
| *CFG-MSGOUT-NMEA_ID_VLW_UART2* | 0x209100e9 | U1 | - | - | Output rate of the NMEA-GX-VLW message on port UART2 |
| *CFG-MSGOUT-NMEA_ID_VLW_USB* | 0x209100ea | U1 | - | - | Output rate of the NMEA-GX-VLW message on port USB |
| *CFG-MSGOUT-NMEA_ID_VTG_I2C* | 0x209100b0 | U1 | - | - | Output rate of the NMEA-GX-VTG message on port I2C |
| *CFG-MSGOUT-NMEA_ID_VTG_SPI* | 0x209100b4 | U1 | - | - | Output rate of the NMEA-GX-VTG message on port SPI |
| *CFG-MSGOUT-NMEA_ID_VTG_UART1* | 0x209100b1 | U1 | - | - | Output rate of the NMEA-GX-VTG message on port UART1 |
| *CFG-MSGOUT-NMEA_ID_VTG_UART2* | 0x209100b2 | U1 | - | - | Output rate of the NMEA-GX-VTG message on port UART2 |
| *CFG-MSGOUT-NMEA_ID_VTG_USB* | 0x209100b3 | U1 | - | - | Output rate of the NMEA-GX-VTG message on port USB |
| *CFG-MSGOUT-NMEA_ID_ZDA_I2C* | 0x209100d8 | U1 | - | - | Output rate of the NMEA-GX-ZDA message on port I2C |
| *CFG-MSGOUT-NMEA_ID_ZDA_SPI* | 0x209100dc | U1 | - | - | Output rate of the NMEA-GX-ZDA message on port SPI |
| *CFG-MSGOUT-NMEA_ID_ZDA_UART1* | 0x209100d9 | U1 | - | - | Output rate of the NMEA-GX-ZDA message on port UART1 |
| *CFG-MSGOUT-NMEA_ID_ZDA_UART2* | 0x209100da | U1 | - | - | Output rate of the NMEA-GX-ZDA message on port UART2 |
| *CFG-MSGOUT-NMEA_ID_ZDA_USB* | 0x209100db | U1 | - | - | Output rate of the NMEA-GX-ZDA message on port USB |
| *CFG-MSGOUT-PUBX_ID_POLYP_I2C* | 0x209100ec | U1 | - | - | Output rate of the NMEA-GX-PUBX00 message on port I2C |
| *CFG-MSGOUT-PUBX_ID_POLYP_SPI* | 0x209100f0 | U1 | - | - | Output rate of the NMEA-GX-PUBX00 message on port SPI |
| *CFG-MSGOUT-PUBX_ID_POLYP_ UART1* | 0x209100ed | U1 | - | - | Output rate of the NMEA-GX-PUBX00 message on port UART1 |
| *CFG-MSGOUT-PUBX_ID_POLYP_ UART2* | 0x209100ee | U1 | - | - | Output rate of the NMEA-GX-PUBX00 message on port UART2 |
| *CFG-MSGOUT-PUBX_ID_POLYP_USB* | 0x209100ef | U1 | - | - | Output rate of the NMEA-GX-PUBX00 message on port USB |
| *CFG-MSGOUT-PUBX_ID_POLYS_I2C* | 0x209100f1 | U1 | - | - | Output rate of the NMEA-GX-PUBX03 message on port I2C |
| *CFG-MSGOUT-PUBX_ID_POLYS_SPI* | 0x209100f5 | U1 | - | - | Output rate of the NMEA-GX-PUBX03 message on port SPI |
| *CFG-MSGOUT-PUBX_ID_POLYS_ UART1* | 0x209100f2 | U1 | - | - | Output rate of the NMEA-GX-PUBX03 message on port UART1 |
| *CFG-MSGOUT-PUBX_ID_POLYS_ UART2* | 0x209100f3 | U1 | - | - | Output rate of the NMEA-GX-PUBX03 message on port UART2 |
| *CFG-MSGOUT-PUBX_ID_POLYS_USB* | 0x209100f4 | U1 | - | - | Output rate of the NMEA-GX-PUBX03 message on port USB |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-PUBX_ID_POLYT_I2C* | 0x209100f6 | U1 | - | - | Output rate of the NMEA-GX-PUBX04 message on port I2C |
| *CFG-MSGOUT-PUBX_ID_POLYT_SPI* | 0x209100fa | U1 | - | - | Output rate of the NMEA-GX-PUBX04 message on port SPI |
| *CFG-MSGOUT-PUBX_ID_POLYT_UART1* | 0x209100f7 | U1 | - | - | Output rate of the NMEA-GX-PUBX04 message on port UART1 |
| *CFG-MSGOUT-PUBX_ID_POLYT_UART2* | 0x209100f8 | U1 | - | - | Output rate of the NMEA-GX-PUBX04 message on port UART2 |
| *CFG-MSGOUT-PUBX_ID_POLYT_USB* | 0x209100f9 | U1 | - | - | Output rate of the NMEA-GX-PUBX04 message on port USB |
| *CFG-MSGOUT-RTCM_3X_TYPE1005_I2C* | 0x209102bd | U1 | - | - | Output rate of the RTCM-3X-TYPE1005 message on port I2C |
| *CFG-MSGOUT-RTCM_3X_TYPE1005_SPI* | 0x209102c1 | U1 | - | - | Output rate of the RTCM-3X-TYPE1005 message on port SPI |
| *CFG-MSGOUT-RTCM_3X_TYPE1005_UART1* | 0x209102be | U1 | - | - | Output rate of the RTCM-3X-TYPE1005 message on port UART1 |
| *CFG-MSGOUT-RTCM_3X_TYPE1005_UART2* | 0x209102bf | U1 | - | - | Output rate of the RTCM-3X-TYPE1005 message on port UART2 |
| *CFG-MSGOUT-RTCM_3X_TYPE1005_USB* | 0x209102c0 | U1 | - | - | Output rate of the RTCM-3X-TYPE1005 message on port USB |
| *CFG-MSGOUT-RTCM_3X_TYPE1074_I2C* | 0x2091035e | U1 | - | - | Output rate of the RTCM-3X-TYPE1074 message on port I2C |
| *CFG-MSGOUT-RTCM_3X_TYPE1074_SPI* | 0x20910362 | U1 | - | - | Output rate of the RTCM-3X-TYPE1074 message on port SPI |
| *CFG-MSGOUT-RTCM_3X_TYPE1074_UART1* | 0x2091035f | U1 | - | - | Output rate of the RTCM-3X-TYPE1074 message on port UART1 |
| *CFG-MSGOUT-RTCM_3X_TYPE1074_UART2* | 0x20910360 | U1 | - | - | Output rate of the RTCM-3X-TYPE1074 message on port UART2 |
| *CFG-MSGOUT-RTCM_3X_TYPE1074_USB* | 0x20910361 | U1 | - | - | Output rate of the RTCM-3X-TYPE1074 message on port USB |
| *CFG-MSGOUT-RTCM_3X_TYPE1077_I2C* | 0x209102cc | U1 | - | - | Output rate of the RTCM-3X-TYPE1077 message on port I2C |
| *CFG-MSGOUT-RTCM_3X_TYPE1077_SPI* | 0x209102d0 | U1 | - | - | Output rate of the RTCM-3X-TYPE1077 message on port SPI |
| *CFG-MSGOUT-RTCM_3X_TYPE1077_UART1* | 0x209102cd | U1 | - | - | Output rate of the RTCM-3X-TYPE1077 message on port UART1 |
| *CFG-MSGOUT-RTCM_3X_TYPE1077_UART2* | 0x209102ce | U1 | - | - | Output rate of the RTCM-3X-TYPE1077 message on port UART2 |
| *CFG-MSGOUT-RTCM_3X_TYPE1077_USB* | 0x209102cf | U1 | - | - | Output rate of the RTCM-3X-TYPE1077 message on port USB |
| *CFG-MSGOUT-RTCM_3X_TYPE1084_I2C* | 0x20910363 | U1 | - | - | Output rate of the RTCM-3X-TYPE1084 message on port I2C |
| *CFG-MSGOUT-RTCM_3X_TYPE1084_SPI* | 0x20910367 | U1 | - | - | Output rate of the RTCM-3X-TYPE1084 message on port SPI |
| *CFG-MSGOUT-RTCM_3X_TYPE1084_UART1* | 0x20910364 | U1 | - | - | Output rate of the RTCM-3X-TYPE1084 message on port UART1 |
| *CFG-MSGOUT-RTCM_3X_TYPE1084_UART2* | 0x20910365 | U1 | - | - | Output rate of the RTCM-3X-TYPE1084 message on port UART2 |
| *CFG-MSGOUT-RTCM_3X_TYPE1084_USB* | 0x20910366 | U1 | - | - | Output rate of the RTCM-3X-TYPE1084 message on port USB |
| *CFG-MSGOUT-RTCM_3X_TYPE1087_I2C* | 0x209102d1 | U1 | - | - | Output rate of the RTCM-3X-TYPE1087 message on port I2C |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-RTCM_3X_TYPE1087_SPI* | 0x209102d5 | U1 | - | - | Output rate of the RTCM-3X-TYPE1087 message on port SPI |
| *CFG-MSGOUT-RTCM_3X_TYPE1087_UART1* | 0x209102d2 | U1 | - | - | Output rate of the RTCM-3X-TYPE1087 message on port UART1 |
| *CFG-MSGOUT-RTCM_3X_TYPE1087_UART2* | 0x209102d3 | U1 | - | - | Output rate of the RTCM-3X-TYPE1087 message on port UART2 |
| *CFG-MSGOUT-RTCM_3X_TYPE1087_USB* | 0x209102d4 | U1 | - | - | Output rate of the RTCM-3X-TYPE1087 message on port USB |
| *CFG-MSGOUT-RTCM_3X_TYPE1094_I2C* | 0x20910368 | U1 | - | - | Output rate of the RTCM-3X-TYPE1094 message on port I2C |
| *CFG-MSGOUT-RTCM_3X_TYPE1094_SPI* | 0x2091036c | U1 | - | - | Output rate of the RTCM-3X-TYPE1094 message on port SPI |
| *CFG-MSGOUT-RTCM_3X_TYPE1094_UART1* | 0x20910369 | U1 | - | - | Output rate of the RTCM-3X-TYPE1094 message on port UART1 |
| *CFG-MSGOUT-RTCM_3X_TYPE1094_UART2* | 0x2091036a | U1 | - | - | Output rate of the RTCM-3X-TYPE1094 message on port UART2 |
| *CFG-MSGOUT-RTCM_3X_TYPE1094_USB* | 0x2091036b | U1 | - | - | Output rate of the RTCM-3X-TYPE1094 message on port USB |
| *CFG-MSGOUT-RTCM_3X_TYPE1097_I2C* | 0x20910318 | U1 | - | - | Output rate of the RTCM-3X-TYPE1097 message on port I2C |
| *CFG-MSGOUT-RTCM_3X_TYPE1097_SPI* | 0x2091031c | U1 | - | - | Output rate of the RTCM-3X-TYPE1097 message on port SPI |
| *CFG-MSGOUT-RTCM_3X_TYPE1097_UART1* | 0x20910319 | U1 | - | - | Output rate of the RTCM-3X-TYPE1097 message on port UART1 |
| *CFG-MSGOUT-RTCM_3X_TYPE1097_UART2* | 0x2091031a | U1 | - | - | Output rate of the RTCM-3X-TYPE1097 message on port UART2 |
| *CFG-MSGOUT-RTCM_3X_TYPE1097_USB* | 0x2091031b | U1 | - | - | Output rate of the RTCM-3X-TYPE1097 message on port USB |
| *CFG-MSGOUT-RTCM_3X_TYPE1124_I2C* | 0x2091036d | U1 | - | - | Output rate of the RTCM-3X-TYPE1124 message on port I2C |
| *CFG-MSGOUT-RTCM_3X_TYPE1124_SPI* | 0x20910371 | U1 | - | - | Output rate of the RTCM-3X-TYPE1124 message on port SPI |
| *CFG-MSGOUT-RTCM_3X_TYPE1124_UART1* | 0x2091036e | U1 | - | - | Output rate of the RTCM-3X-TYPE1124 message on port UART1 |
| *CFG-MSGOUT-RTCM_3X_TYPE1124_UART2* | 0x2091036f | U1 | - | - | Output rate of the RTCM-3X-TYPE1124 message on port UART2 |
| *CFG-MSGOUT-RTCM_3X_TYPE1124_USB* | 0x20910370 | U1 | - | - | Output rate of the RTCM-3X-TYPE1124 message on port USB |
| *CFG-MSGOUT-RTCM_3X_TYPE1127_I2C* | 0x209102d6 | U1 | - | - | Output rate of the RTCM-3X-TYPE1127 message on port I2C |
| *CFG-MSGOUT-RTCM_3X_TYPE1127_SPI* | 0x209102da | U1 | - | - | Output rate of the RTCM-3X-TYPE1127 message on port SPI |
| *CFG-MSGOUT-RTCM_3X_TYPE1127_UART1* | 0x209102d7 | U1 | - | - | Output rate of the RTCM-3X-TYPE1127 message on port UART1 |
| *CFG-MSGOUT-RTCM_3X_TYPE1127_UART2* | 0x209102d8 | U1 | - | - | Output rate of the RTCM-3X-TYPE1127 message on port UART2 |
| *CFG-MSGOUT-RTCM_3X_TYPE1127_USB* | 0x209102d9 | U1 | - | - | Output rate of the RTCM-3X-TYPE1127 message on port USB |
| *CFG-MSGOUT-RTCM_3X_TYPE1230_I2C* | 0x20910303 | U1 | - | - | Output rate of the RTCM-3X-TYPE1230 message on port I2C |
| *CFG-MSGOUT-RTCM_3X_TYPE1230_SPI* | 0x20910307 | U1 | - | - | Output rate of the RTCM-3X-TYPE1230 message on port SPI |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-RTCM_3X_TYPE1230_UART1* | 0x20910304 | U1 | - | - | Output rate of the RTCM-3X-TYPE1230 message on port UART1 |
| *CFG-MSGOUT-RTCM_3X_TYPE1230_UART2* | 0x20910305 | U1 | - | - | Output rate of the RTCM-3X-TYPE1230 message on port UART2 |
| *CFG-MSGOUT-RTCM_3X_TYPE1230_USB* | 0x20910306 | U1 | - | - | Output rate of the RTCM-3X-TYPE1230 message on port USB |
| *CFG-MSGOUT-RTCM_3X_TYPE4072_0_I2C* | 0x209102fe | U1 | - | - | Output rate of the RTCM-3X-TYPE4072_0 message on port I2C |
| *CFG-MSGOUT-RTCM_3X_TYPE4072_0_SPI* | 0x20910302 | U1 | - | - | Output rate of the RTCM-3X-TYPE4072_0 message on port SPI |
| *CFG-MSGOUT-RTCM_3X_TYPE4072_0_UART1* | 0x209102ff | U1 | - | - | Output rate of the RTCM-3X-TYPE4072_0 message on port UART1 |
| *CFG-MSGOUT-RTCM_3X_TYPE4072_0_UART2* | 0x20910300 | U1 | - | - | Output rate of the RTCM-3X-TYPE4072_0 message on port UART2 |
| *CFG-MSGOUT-RTCM_3X_TYPE4072_0_USB* | 0x20910301 | U1 | - | - | Output rate of the RTCM-3X-TYPE4072_0 message on port USB |
| *CFG-MSGOUT-RTCM_3X_TYPE4072_1_I2C* | 0x20910381 | U1 | - | - | Output rate of the RTCM-3X-TYPE4072_1 message on port I2C |
| *CFG-MSGOUT-RTCM_3X_TYPE4072_1_SPI* | 0x20910385 | U1 | - | - | Output rate of the RTCM-3X-TYPE4072_1 message on port SPI |
| *CFG-MSGOUT-RTCM_3X_TYPE4072_1_UART1* | 0x20910382 | U1 | - | - | Output rate of the RTCM-3X-TYPE4072_1 message on port UART1 |
| *CFG-MSGOUT-RTCM_3X_TYPE4072_1_UART2* | 0x20910383 | U1 | - | - | Output rate of the RTCM-3X-TYPE4072_1 message on port UART2 |
| *CFG-MSGOUT-RTCM_3X_TYPE4072_1_USB* | 0x20910384 | U1 | - | - | Output rate of the RTCM-3X-TYPE4072_1 message on port USB |
| *CFG-MSGOUT-UBX_LOG_INFO_I2C* | 0x20910259 | U1 | - | - | Output rate of the UBX-LOG-INFO message on port I2C |
| *CFG-MSGOUT-UBX_LOG_INFO_SPI* | 0x2091025d | U1 | - | - | Output rate of the UBX-LOG-INFO message on port SPI |
| *CFG-MSGOUT-UBX_LOG_INFO_UART1* | 0x2091025a | U1 | - | - | Output rate of the UBX-LOG-INFO message on port UART1 |
| *CFG-MSGOUT-UBX_LOG_INFO_UART2* | 0x2091025b | U1 | - | - | Output rate of the UBX-LOG-INFO message on port UART2 |
| *CFG-MSGOUT-UBX_LOG_INFO_USB* | 0x2091025c | U1 | - | - | Output rate of the UBX-LOG-INFO message on port USB |
| *CFG-MSGOUT-UBX_MON_COMMS_I2C* | 0x2091034f | U1 | - | - | Output rate of the UBX-MON-COMMS message on port I2C |
| *CFG-MSGOUT-UBX_MON_COMMS_SPI* | 0x20910353 | U1 | - | - | Output rate of the UBX-MON-COMMS message on port SPI |
| *CFG-MSGOUT-UBX_MON_COMMS_UART1* | 0x20910350 | U1 | - | - | Output rate of the UBX-MON-COMMS message on port UART1 |
| *CFG-MSGOUT-UBX_MON_COMMS_UART2* | 0x20910351 | U1 | - | - | Output rate of the UBX-MON-COMMS message on port UART2 |
| *CFG-MSGOUT-UBX_MON_COMMS_USB* | 0x20910352 | U1 | - | - | Output rate of the UBX-MON-COMMS message on port USB |
| *CFG-MSGOUT-UBX_MON_HW2_I2C* | 0x209101b9 | U1 | - | - | Output rate of the UBX-MON-HW2 message on port I2C |
| *CFG-MSGOUT-UBX_MON_HW2_SPI* | 0x209101bd | U1 | - | - | Output rate of the UBX-MON-HW2 message on port SPI |
| *CFG-MSGOUT-UBX_MON_HW2_UART1* | 0x209101ba | U1 | - | - | Output rate of the UBX-MON-HW2 message on port UART1 |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-UBX_MON_HW2_UART2* | 0x209101bb | U1 | - | - | Output rate of the UBX-MON-HW2 message on port UART2 |
| *CFG-MSGOUT-UBX_MON_HW2_USB* | 0x209101bc | U1 | - | - | Output rate of the UBX-MON-HW2 message on port USB |
| *CFG-MSGOUT-UBX_MON_HW3_I2C* | 0x20910354 | U1 | - | - | Output rate of the UBX-MON-HW3 message on port I2C |
| *CFG-MSGOUT-UBX_MON_HW3_SPI* | 0x20910358 | U1 | - | - | Output rate of the UBX-MON-HW3 message on port SPI |
| *CFG-MSGOUT-UBX_MON_HW3_UART1* | 0x20910355 | U1 | - | - | Output rate of the UBX-MON-HW3 message on port UART1 |
| *CFG-MSGOUT-UBX_MON_HW3_UART2* | 0x20910356 | U1 | - | - | Output rate of the UBX-MON-HW3 message on port UART2 |
| *CFG-MSGOUT-UBX_MON_HW3_USB* | 0x20910357 | U1 | - | - | Output rate of the UBX-MON-HW3 message on port USB |
| *CFG-MSGOUT-UBX_MON_HW_I2C* | 0x209101b4 | U1 | - | - | Output rate of the UBX-MON-HW message on port I2C |
| *CFG-MSGOUT-UBX_MON_HW_SPI* | 0x209101b8 | U1 | - | - | Output rate of the UBX-MON-HW message on port SPI |
| *CFG-MSGOUT-UBX_MON_HW_UART1* | 0x209101b5 | U1 | - | - | Output rate of the UBX-MON-HW message on port UART1 |
| *CFG-MSGOUT-UBX_MON_HW_UART2* | 0x209101b6 | U1 | - | - | Output rate of the UBX-MON-HW message on port UART2 |
| *CFG-MSGOUT-UBX_MON_HW_USB* | 0x209101b7 | U1 | - | - | Output rate of the UBX-MON-HW message on port USB |
| *CFG-MSGOUT-UBX_MON_IO_I2C* | 0x209101a5 | U1 | - | - | Output rate of the UBX-MON-IO message on port I2C |
| *CFG-MSGOUT-UBX_MON_IO_SPI* | 0x209101a9 | U1 | - | - | Output rate of the UBX-MON-IO message on port SPI |
| *CFG-MSGOUT-UBX_MON_IO_UART1* | 0x209101a6 | U1 | - | - | Output rate of the UBX-MON-IO message on port UART1 |
| *CFG-MSGOUT-UBX_MON_IO_UART2* | 0x209101a7 | U1 | - | - | Output rate of the UBX-MON-IO message on port UART2 |
| *CFG-MSGOUT-UBX_MON_IO_USB* | 0x209101a8 | U1 | - | - | Output rate of the UBX-MON-IO message on port USB |
| *CFG-MSGOUT-UBX_MON_MSGPP_I2C* | 0x20910196 | U1 | - | - | Output rate of the UBX-MON-MSGPP message on port I2C |
| *CFG-MSGOUT-UBX_MON_MSGPP_SPI* | 0x2091019a | U1 | - | - | Output rate of the UBX-MON-MSGPP message on port SPI |
| *CFG-MSGOUT-UBX_MON_MSGPP_UART1* | 0x20910197 | U1 | - | - | Output rate of the UBX-MON-MSGPP message on port UART1 |
| *CFG-MSGOUT-UBX_MON_MSGPP_UART2* | 0x20910198 | U1 | - | - | Output rate of the UBX-MON-MSGPP message on port UART2 |
| *CFG-MSGOUT-UBX_MON_MSGPP_USB* | 0x20910199 | U1 | - | - | Output rate of the UBX-MON-MSGPP message on port USB |
| *CFG-MSGOUT-UBX_MON_RF_I2C* | 0x20910359 | U1 | - | - | Output rate of the UBX-MON-RF message on port I2C |
| *CFG-MSGOUT-UBX_MON_RF_SPI* | 0x2091035d | U1 | - | - | Output rate of the UBX-MON-RF message on port SPI |
| *CFG-MSGOUT-UBX_MON_RF_UART1* | 0x2091035a | U1 | - | - | Output rate of the UBX-MON-RF message on port UART1 |
| *CFG-MSGOUT-UBX_MON_RF_UART2* | 0x2091035b | U1 | - | - | Output rate of the UBX-MON-RF message on port UART2 |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-UBX_MON_RF_USB* | 0x2091035c | U1 | - | - | Output rate of the UBX-MON-RF message on port USB |
| *CFG-MSGOUT-UBX_MON_RXBUF_I2C* | 0x209101a0 | U1 | - | - | Output rate of the UBX-MON-RXBUF message on port I2C |
| *CFG-MSGOUT-UBX_MON_RXBUF_SPI* | 0x209101a4 | U1 | - | - | Output rate of the UBX-MON-RXBUF message on port SPI |
| *CFG-MSGOUT-UBX_MON_RXBUF_UART1* | 0x209101a1 | U1 | - | - | Output rate of the UBX-MON-RXBUF message on port UART1 |
| *CFG-MSGOUT-UBX_MON_RXBUF_UART2* | 0x209101a2 | U1 | - | - | Output rate of the UBX-MON-RXBUF message on port UART2 |
| *CFG-MSGOUT-UBX_MON_RXBUF_USB* | 0x209101a3 | U1 | - | - | Output rate of the UBX-MON-RXBUF message on port USB |
| *CFG-MSGOUT-UBX_MON_RXR_I2C* | 0x20910187 | U1 | - | - | Output rate of the UBX-MON-RXR message on port I2C |
| *CFG-MSGOUT-UBX_MON_RXR_SPI* | 0x2091018b | U1 | - | - | Output rate of the UBX-MON-RXR message on port SPI |
| *CFG-MSGOUT-UBX_MON_RXR_UART1* | 0x20910188 | U1 | - | - | Output rate of the UBX-MON-RXR message on port UART1 |
| *CFG-MSGOUT-UBX_MON_RXR_UART2* | 0x20910189 | U1 | - | - | Output rate of the UBX-MON-RXR message on port UART2 |
| *CFG-MSGOUT-UBX_MON_RXR_USB* | 0x2091018a | U1 | - | - | Output rate of the UBX-MON-RXR message on port USB |
| *CFG-MSGOUT-UBX_MON_SPAN_I2C* | 0x2091038b | U1 | - | - | Output rate of the UBX-MON-SPAN message on port I2C |
| *CFG-MSGOUT-UBX_MON_SPAN_SPI* | 0x2091038f | U1 | - | - | Output rate of the UBX-MON-SPAN message on port SPI |
| *CFG-MSGOUT-UBX_MON_SPAN_UART1* | 0x2091038c | U1 | - | - | Output rate of the UBX-MON-SPAN message on port UART1 |
| *CFG-MSGOUT-UBX_MON_SPAN_UART2* | 0x2091038d | U1 | - | - | Output rate of the UBX-MON-SPAN message on port UART2 |
| *CFG-MSGOUT-UBX_MON_SPAN_USB* | 0x2091038e | U1 | - | - | Output rate of the UBX-MON-SPAN message on port USB |
| *CFG-MSGOUT-UBX_MON_TXBUF_I2C* | 0x2091019b | U1 | - | - | Output rate of the UBX-MON-TXBUF message on port I2C |
| *CFG-MSGOUT-UBX_MON_TXBUF_SPI* | 0x2091019f | U1 | - | - | Output rate of the UBX-MON-TXBUF message on port SPI |
| *CFG-MSGOUT-UBX_MON_TXBUF_UART1* | 0x2091019c | U1 | - | - | Output rate of the UBX-MON-TXBUF message on port UART1 |
| *CFG-MSGOUT-UBX_MON_TXBUF_UART2* | 0x2091019d | U1 | - | - | Output rate of the UBX-MON-TXBUF message on port UART2 |
| *CFG-MSGOUT-UBX_MON_TXBUF_USB* | 0x2091019e | U1 | - | - | Output rate of the UBX-MON-TXBUF message on port USB |
| *CFG-MSGOUT-UBX_NAV_CLOCK_I2C* | 0x20910065 | U1 | - | - | Output rate of the UBX-NAV-CLOCK message on port I2C |
| *CFG-MSGOUT-UBX_NAV_CLOCK_SPI* | 0x20910069 | U1 | - | - | Output rate of the UBX-NAV-CLOCK message on port SPI |
| *CFG-MSGOUT-UBX_NAV_CLOCK_UART1* | 0x20910066 | U1 | - | - | Output rate of the UBX-NAV-CLOCK message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_CLOCK_UART2* | 0x20910067 | U1 | - | - | Output rate of the UBX-NAV-CLOCK message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_CLOCK_USB* | 0x20910068 | U1 | - | - | Output rate of the UBX-NAV-CLOCK message on port USB |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-UBX_NAV_DOP_I2C* | 0x20910038 | U1 | - | - | Output rate of the UBX-NAV-DOP message on port I2C |
| *CFG-MSGOUT-UBX_NAV_DOP_SPI* | 0x2091003c | U1 | - | - | Output rate of the UBX-NAV-DOP message on port SPI |
| *CFG-MSGOUT-UBX_NAV_DOP_UART1* | 0x20910039 | U1 | - | - | Output rate of the UBX-NAV-DOP message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_DOP_UART2* | 0x2091003a | U1 | - | - | Output rate of the UBX-NAV-DOP message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_DOP_USB* | 0x2091003b | U1 | - | - | Output rate of the UBX-NAV-DOP message on port USB |
| *CFG-MSGOUT-UBX_NAV_EOE_I2C* | 0x2091015f | U1 | - | - | Output rate of the UBX-NAV-EOE message on port I2C |
| *CFG-MSGOUT-UBX_NAV_EOE_SPI* | 0x20910163 | U1 | - | - | Output rate of the UBX-NAV-EOE message on port SPI |
| *CFG-MSGOUT-UBX_NAV_EOE_UART1* | 0x20910160 | U1 | - | - | Output rate of the UBX-NAV-EOE message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_EOE_UART2* | 0x20910161 | U1 | - | - | Output rate of the UBX-NAV-EOE message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_EOE_USB* | 0x20910162 | U1 | - | - | Output rate of the UBX-NAV-EOE message on port USB |
| *CFG-MSGOUT-UBX_NAV_GEOFENCE_I2C* | 0x209100a1 | U1 | - | - | Output rate of the UBX-NAV-GEOFENCE message on port I2C |
| *CFG-MSGOUT-UBX_NAV_GEOFENCE_SPI* | 0x209100a5 | U1 | - | - | Output rate of the UBX-NAV-GEOFENCE message on port SPI |
| *CFG-MSGOUT-UBX_NAV_GEOFENCE_UART1* | 0x209100a2 | U1 | - | - | Output rate of the UBX-NAV-GEOFENCE message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_GEOFENCE_UART2* | 0x209100a3 | U1 | - | - | Output rate of the UBX-NAV-GEOFENCE message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_GEOFENCE_USB* | 0x209100a4 | U1 | - | - | Output rate of the UBX-NAV-GEOFENCE message on port USB |
| *CFG-MSGOUT-UBX_NAV_HPPOSECEF_I2C* | 0x2091002e | U1 | - | - | Output rate of the UBX-NAV-HPPOSECEF message on port I2C |
| *CFG-MSGOUT-UBX_NAV_HPPOSECEF_SPI* | 0x20910032 | U1 | - | - | Output rate of the UBX-NAV-HPPOSECEF message on port SPI |
| *CFG-MSGOUT-UBX_NAV_HPPOSECEF_UART1* | 0x2091002f | U1 | - | - | Output rate of the UBX-NAV-HPPOSECEF message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_HPPOSECEF_UART2* | 0x20910030 | U1 | - | - | Output rate of the UBX-NAV-HPPOSECEF message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_HPPOSECEF_USB* | 0x20910031 | U1 | - | - | Output rate of the UBX-NAV-HPPOSECEF message on port USB |
| *CFG-MSGOUT-UBX_NAV_HPPOSLLH_I2C* | 0x20910033 | U1 | - | - | Output rate of the UBX-NAV-HPPOSLLH message on port I2C |
| *CFG-MSGOUT-UBX_NAV_HPPOSLLH_SPI* | 0x20910037 | U1 | - | - | Output rate of the UBX-NAV-HPPOSLLH message on port SPI |
| *CFG-MSGOUT-UBX_NAV_HPPOSLLH_UART1* | 0x20910034 | U1 | - | - | Output rate of the UBX-NAV-HPPOSLLH message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_HPPOSLLH_UART2* | 0x20910035 | U1 | - | - | Output rate of the UBX-NAV-HPPOSLLH message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_HPPOSLLH_USB* | 0x20910036 | U1 | - | - | Output rate of the UBX-NAV-HPPOSLLH message on port USB |
| *CFG-MSGOUT-UBX_NAV_ODO_I2C* | 0x2091007e | U1 | - | - | Output rate of the UBX-NAV-ODO message on port I2C |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-UBX_NAV_ODO_SPI* | 0x20910082 | U1 | - | - | Output rate of the UBX-NAV-ODO message on port SPI |
| *CFG-MSGOUT-UBX_NAV_ODO_UART1* | 0x2091007f | U1 | - | - | Output rate of the UBX-NAV-ODO message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_ODO_UART2* | 0x20910080 | U1 | - | - | Output rate of the UBX-NAV-ODO message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_ODO_USB* | 0x20910081 | U1 | - | - | Output rate of the UBX-NAV-ODO message on port USB |
| *CFG-MSGOUT-UBX_NAV_ORB_I2C* | 0x20910010 | U1 | - | - | Output rate of the UBX-NAV-ORB message on port I2C |
| *CFG-MSGOUT-UBX_NAV_ORB_SPI* | 0x20910014 | U1 | - | - | Output rate of the UBX-NAV-ORB message on port SPI |
| *CFG-MSGOUT-UBX_NAV_ORB_UART1* | 0x20910011 | U1 | - | - | Output rate of the UBX-NAV-ORB message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_ORB_UART2* | 0x20910012 | U1 | - | - | Output rate of the UBX-NAV-ORB message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_ORB_USB* | 0x20910013 | U1 | - | - | Output rate of the UBX-NAV-ORB message on port USB |
| *CFG-MSGOUT-UBX_NAV_POSECEF_I2C* | 0x20910024 | U1 | - | - | Output rate of the UBX-NAV-POSECEF message on port I2C |
| *CFG-MSGOUT-UBX_NAV_POSECEF_SPI* | 0x20910028 | U1 | - | - | Output rate of the UBX-NAV-POSECEF message on port SPI |
| *CFG-MSGOUT-UBX_NAV_POSECEF_UART1* | 0x20910025 | U1 | - | - | Output rate of the UBX-NAV-POSECEF message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_POSECEF_UART2* | 0x20910026 | U1 | - | - | Output rate of the UBX-NAV-POSECEF message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_POSECEF_USB* | 0x20910027 | U1 | - | - | Output rate of the UBX-NAV-POSECEF message on port USB |
| *CFG-MSGOUT-UBX_NAV_POSLLH_I2C* | 0x20910029 | U1 | - | - | Output rate of the UBX-NAV-POSLLH message on port I2C |
| *CFG-MSGOUT-UBX_NAV_POSLLH_SPI* | 0x2091002d | U1 | - | - | Output rate of the UBX-NAV-POSLLH message on port SPI |
| *CFG-MSGOUT-UBX_NAV_POSLLH_UART1* | 0x2091002a | U1 | - | - | Output rate of the UBX-NAV-POSLLH message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_POSLLH_UART2* | 0x2091002b | U1 | - | - | Output rate of the UBX-NAV-POSLLH message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_POSLLH_USB* | 0x2091002c | U1 | - | - | Output rate of the UBX-NAV-POSLLH message on port USB |
| *CFG-MSGOUT-UBX_NAV_PVT_I2C* | 0x20910006 | U1 | - | - | Output rate of the UBX-NAV-PVT message on port I2C |
| *CFG-MSGOUT-UBX_NAV_PVT_SPI* | 0x2091000a | U1 | - | - | Output rate of the UBX-NAV-PVT message on port SPI |
| *CFG-MSGOUT-UBX_NAV_PVT_UART1* | 0x20910007 | U1 | - | - | Output rate of the UBX-NAV-PVT message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_PVT_UART2* | 0x20910008 | U1 | - | - | Output rate of the UBX-NAV-PVT message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_PVT_USB* | 0x20910009 | U1 | - | - | Output rate of the UBX-NAV-PVT message on port USB |
| *CFG-MSGOUT-UBX_NAV_RELPOSNED_I2C* | 0x2091008d | U1 | - | - | Output rate of the UBX-NAV-RELPOSNED message on port I2C |
| *CFG-MSGOUT-UBX_NAV_RELPOSNED_SPI* | 0x20910091 | U1 | - | - | Output rate of the UBX-NAV-RELPOSNED message on port SPI |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-UBX_NAV_RELPOSNED_UART1* | 0x2091008e | U1 | - | - | Output rate of the UBX-NAV-RELPOSNED message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_RELPOSNED_UART2* | 0x2091008f | U1 | - | - | Output rate of the UBX-NAV-RELPOSNED message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_RELPOSNED_USB* | 0x20910090 | U1 | - | - | Output rate of the UBX-NAV-RELPOSNED message on port USB |
| *CFG-MSGOUT-UBX_NAV_SAT_I2C* | 0x20910015 | U1 | - | - | Output rate of the UBX-NAV-SAT message on port I2C |
| *CFG-MSGOUT-UBX_NAV_SAT_SPI* | 0x20910019 | U1 | - | - | Output rate of the UBX-NAV-SAT message on port SPI |
| *CFG-MSGOUT-UBX_NAV_SAT_UART1* | 0x20910016 | U1 | - | - | Output rate of the UBX-NAV-SAT message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_SAT_UART2* | 0x20910017 | U1 | - | - | Output rate of the UBX-NAV-SAT message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_SAT_USB* | 0x20910018 | U1 | - | - | Output rate of the UBX-NAV-SAT message on port USB |
| *CFG-MSGOUT-UBX_NAV_SBAS_I2C* | 0x2091006a | U1 | - | - | Output rate of the UBX-NAV-SBAS message on port I2C |
| *CFG-MSGOUT-UBX_NAV_SBAS_SPI* | 0x2091006e | U1 | - | - | Output rate of the UBX-NAV-SBAS message on port SPI |
| *CFG-MSGOUT-UBX_NAV_SBAS_UART1* | 0x2091006b | U1 | - | - | Output rate of the UBX-NAV-SBAS message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_SBAS_UART2* | 0x2091006c | U1 | - | - | Output rate of the UBX-NAV-SBAS message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_SBAS_USB* | 0x2091006d | U1 | - | - | Output rate of the UBX-NAV-SBAS message on port USB |
| *CFG-MSGOUT-UBX_NAV_SIG_I2C* | 0x20910345 | U1 | - | - | Output rate of the UBX-NAV-SIG message on port I2C |
| *CFG-MSGOUT-UBX_NAV_SIG_SPI* | 0x20910349 | U1 | - | - | Output rate of the UBX-NAV-SIG message on port SPI |
| *CFG-MSGOUT-UBX_NAV_SIG_UART1* | 0x20910346 | U1 | - | - | Output rate of the UBX-NAV-SIG message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_SIG_UART2* | 0x20910347 | U1 | - | - | Output rate of the UBX-NAV-SIG message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_SIG_USB* | 0x20910348 | U1 | - | - | Output rate of the UBX-NAV-SIG message on port USB |
| *CFG-MSGOUT-UBX_NAV_SLAS_I2C* | 0x20910336 | U1 | - | - | Output rate of the UBX-NAV-SLAS message on port I2C |
| *CFG-MSGOUT-UBX_NAV_SLAS_SPI* | 0x2091033a | U1 | - | - | Output rate of the UBX-NAV-SLAS message on port SPI |
| *CFG-MSGOUT-UBX_NAV_SLAS_UART1* | 0x20910337 | U1 | - | - | Output rate of the UBX-NAV-SLAS message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_SLAS_UART2* | 0x20910338 | U1 | - | - | Output rate of the UBX-NAV-SLAS message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_SLAS_USB* | 0x20910339 | U1 | - | - | Output rate of the UBX-NAV-SLAS message on port USB |
| *CFG-MSGOUT-UBX_NAV_STATUS_I2C* | 0x2091001a | U1 | - | - | Output rate of the UBX-NAV-STATUS message on port I2C |
| *CFG-MSGOUT-UBX_NAV_STATUS_SPI* | 0x2091001e | U1 | - | - | Output rate of the UBX-NAV-STATUS message on port SPI |
| *CFG-MSGOUT-UBX_NAV_STATUS_UART1* | 0x2091001b | U1 | - | - | Output rate of the UBX-NAV-STATUS message on port UART1 |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-UBX_NAV_STATUS_UART2* | 0x2091001c | U1 | - | - | Output rate of the UBX-NAV-STATUS message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_STATUS_USB* | 0x2091001d | U1 | - | - | Output rate of the UBX-NAV-STATUS message on port USB |
| *CFG-MSGOUT-UBX_NAV_SVIN_I2C* | 0x20910088 | U1 | - | - | Output rate of the UBX-NAV-SVIN message on port I2C |
| *CFG-MSGOUT-UBX_NAV_SVIN_SPI* | 0x2091008c | U1 | - | - | Output rate of the UBX-NAV-SVIN message on port SPI |
| *CFG-MSGOUT-UBX_NAV_SVIN_UART1* | 0x20910089 | U1 | - | - | Output rate of the UBX-NAV-SVIN message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_SVIN_UART2* | 0x2091008a | U1 | - | - | Output rate of the UBX-NAV-SVIN message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_SVIN_USB* | 0x2091008b | U1 | - | - | Output rate of the UBX-NAV-SVIN message on port USB |
| *CFG-MSGOUT-UBX_NAV_TIMEBDS_I2C* | 0x20910051 | U1 | - | - | Output rate of the UBX-NAV-TIMEBDS message on port I2C |
| *CFG-MSGOUT-UBX_NAV_TIMEBDS_SPI* | 0x20910055 | U1 | - | - | Output rate of the UBX-NAV-TIMEBDS message on port SPI |
| *CFG-MSGOUT-UBX_NAV_TIMEBDS_UART1* | 0x20910052 | U1 | - | - | Output rate of the UBX-NAV-TIMEBDS message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_TIMEBDS_UART2* | 0x20910053 | U1 | - | - | Output rate of the UBX-NAV-TIMEBDS message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_TIMEBDS_USB* | 0x20910054 | U1 | - | - | Output rate of the UBX-NAV-TIMEBDS message on port USB |
| *CFG-MSGOUT-UBX_NAV_TIMEGAL_I2C* | 0x20910056 | U1 | - | - | Output rate of the UBX-NAV-TIMEGAL message on port I2C |
| *CFG-MSGOUT-UBX_NAV_TIMEGAL_SPI* | 0x2091005a | U1 | - | - | Output rate of the UBX-NAV-TIMEGAL message on port SPI |
| *CFG-MSGOUT-UBX_NAV_TIMEGAL_UART1* | 0x20910057 | U1 | - | - | Output rate of the UBX-NAV-TIMEGAL message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_TIMEGAL_UART2* | 0x20910058 | U1 | - | - | Output rate of the UBX-NAV-TIMEGAL message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_TIMEGAL_USB* | 0x20910059 | U1 | - | - | Output rate of the UBX-NAV-TIMEGAL message on port USB |
| *CFG-MSGOUT-UBX_NAV_TIMEGLO_I2C* | 0x2091004c | U1 | - | - | Output rate of the UBX-NAV-TIMEGLO message on port I2C |
| *CFG-MSGOUT-UBX_NAV_TIMEGLO_SPI* | 0x20910050 | U1 | - | - | Output rate of the UBX-NAV-TIMEGLO message on port SPI |
| *CFG-MSGOUT-UBX_NAV_TIMEGLO_UART1* | 0x2091004d | U1 | - | - | Output rate of the UBX-NAV-TIMEGLO message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_TIMEGLO_UART2* | 0x2091004e | U1 | - | - | Output rate of the UBX-NAV-TIMEGLO message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_TIMEGLO_USB* | 0x2091004f | U1 | - | - | Output rate of the UBX-NAV-TIMEGLO message on port USB |
| *CFG-MSGOUT-UBX_NAV_TIMEGPS_I2C* | 0x20910047 | U1 | - | - | Output rate of the UBX-NAV-TIMEGPS message on port I2C |
| *CFG-MSGOUT-UBX_NAV_TIMEGPS_SPI* | 0x2091004b | U1 | - | - | Output rate of the UBX-NAV-TIMEGPS message on port SPI |
| *CFG-MSGOUT-UBX_NAV_TIMEGPS_UART1* | 0x20910048 | U1 | - | - | Output rate of the UBX-NAV-TIMEGPS message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_TIMEGPS_UART2* | 0x20910049 | U1 | - | - | Output rate of the UBX-NAV-TIMEGPS message on port UART2 |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-UBX_NAV_TIMEGPS_USB* | 0x2091004a | U1 | - | - | Output rate of the UBX-NAV-TIMEGPS message on port USB |
| *CFG-MSGOUT-UBX_NAV_TIMELS_I2C* | 0x20910060 | U1 | - | - | Output rate of the UBX-NAV-TIMELS message on port I2C |
| *CFG-MSGOUT-UBX_NAV_TIMELS_SPI* | 0x20910064 | U1 | - | - | Output rate of the UBX-NAV-TIMELS message on port SPI |
| *CFG-MSGOUT-UBX_NAV_TIMELS_UART1* | 0x20910061 | U1 | - | - | Output rate of the UBX-NAV-TIMELS message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_TIMELS_UART2* | 0x20910062 | U1 | - | - | Output rate of the UBX-NAV-TIMELS message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_TIMELS_USB* | 0x20910063 | U1 | - | - | Output rate of the UBX-NAV-TIMELS message on port USB |
| *CFG-MSGOUT-UBX_NAV_TIMEQZSS_I2C* | 0x20910386 | U1 | - | - | Output rate of the UBX-NAV-TIMEQZSS message on port I2C |
| *CFG-MSGOUT-UBX_NAV_TIMEQZSS_SPI* | 0x2091038a | U1 | - | - | Output rate of the UBX-NAV-TIMEQZSS message on port SPI |
| *CFG-MSGOUT-UBX_NAV_TIMEQZSS_UART1* | 0x20910387 | U1 | - | - | Output rate of the UBX-NAV-TIMEQZSS message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_TIMEQZSS_UART2* | 0x20910388 | U1 | - | - | Output rate of the UBX-NAV-TIMEQZSS message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_TIMEQZSS_USB* | 0x20910389 | U1 | - | - | Output rate of the UBX-NAV-TIMEQZSS message on port USB |
| *CFG-MSGOUT-UBX_NAV_TIMEUTC_I2C* | 0x2091005b | U1 | - | - | Output rate of the UBX-NAV-TIMEUTC message on port I2C |
| *CFG-MSGOUT-UBX_NAV_TIMEUTC_SPI* | 0x2091005f | U1 | - | - | Output rate of the UBX-NAV-TIMEUTC message on port SPI |
| *CFG-MSGOUT-UBX_NAV_TIMEUTC_UART1* | 0x2091005c | U1 | - | - | Output rate of the UBX-NAV-TIMEUTC message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_TIMEUTC_UART2* | 0x2091005d | U1 | - | - | Output rate of the UBX-NAV-TIMEUTC message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_TIMEUTC_USB* | 0x2091005e | U1 | - | - | Output rate of the UBX-NAV-TIMEUTC message on port USB |
| *CFG-MSGOUT-UBX_NAV_VELECEF_I2C* | 0x2091003d | U1 | - | - | Output rate of the UBX-NAV-VELECEF message on port I2C |
| *CFG-MSGOUT-UBX_NAV_VELECEF_SPI* | 0x20910041 | U1 | - | - | Output rate of the UBX-NAV-VELECEF message on port SPI |
| *CFG-MSGOUT-UBX_NAV_VELECEF_UART1* | 0x2091003e | U1 | - | - | Output rate of the UBX-NAV-VELECEF message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_VELECEF_UART2* | 0x2091003f | U1 | - | - | Output rate of the UBX-NAV-VELECEF message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_VELECEF_USB* | 0x20910040 | U1 | - | - | Output rate of the UBX-NAV-VELECEF message on port USB |
| *CFG-MSGOUT-UBX_NAV_VELNED_I2C* | 0x20910042 | U1 | - | - | Output rate of the UBX-NAV-VELNED message on port I2C |
| *CFG-MSGOUT-UBX_NAV_VELNED_SPI* | 0x20910046 | U1 | - | - | Output rate of the UBX-NAV-VELNED message on port SPI |
| *CFG-MSGOUT-UBX_NAV_VELNED_UART1* | 0x20910043 | U1 | - | - | Output rate of the UBX-NAV-VELNED message on port UART1 |
| *CFG-MSGOUT-UBX_NAV_VELNED_UART2* | 0x20910044 | U1 | - | - | Output rate of the UBX-NAV-VELNED message on port UART2 |
| *CFG-MSGOUT-UBX_NAV_VELNED_USB* | 0x20910045 | U1 | - | - | Output rate of the UBX-NAV-VELNED message on port USB |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-UBX_RXM_MEASX_I2C* | 0x20910204 | U1 | - | - | Output rate of the UBX-RXM-MEASX message on port I2C |
| *CFG-MSGOUT-UBX_RXM_MEASX_SPI* | 0x20910208 | U1 | - | - | Output rate of the UBX-RXM-MEASX message on port SPI |
| *CFG-MSGOUT-UBX_RXM_MEASX_UART1* | 0x20910205 | U1 | - | - | Output rate of the UBX-RXM-MEASX message on port UART1 |
| *CFG-MSGOUT-UBX_RXM_MEASX_UART2* | 0x20910206 | U1 | - | - | Output rate of the UBX-RXM-MEASX message on port UART2 |
| *CFG-MSGOUT-UBX_RXM_MEASX_USB* | 0x20910207 | U1 | - | - | Output rate of the UBX-RXM-MEASX message on port USB |
| *CFG-MSGOUT-UBX_RXM_RAWX_I2C* | 0x209102a4 | U1 | - | - | Output rate of the UBX-RXM-RAWX message on port I2C |
| *CFG-MSGOUT-UBX_RXM_RAWX_SPI* | 0x209102a8 | U1 | - | - | Output rate of the UBX-RXM-RAWX message on port SPI |
| *CFG-MSGOUT-UBX_RXM_RAWX_UART1* | 0x209102a5 | U1 | - | - | Output rate of the UBX-RXM-RAWX message on port UART1 |
| *CFG-MSGOUT-UBX_RXM_RAWX_UART2* | 0x209102a6 | U1 | - | - | Output rate of the UBX-RXM-RAWX message on port UART2 |
| *CFG-MSGOUT-UBX_RXM_RAWX_USB* | 0x209102a7 | U1 | - | - | Output rate of the UBX-RXM-RAWX message on port USB |
| *CFG-MSGOUT-UBX_RXM_RLM_I2C* | 0x2091025e | U1 | - | - | Output rate of the UBX-RXM-RLM message on port I2C |
| *CFG-MSGOUT-UBX_RXM_RLM_SPI* | 0x20910262 | U1 | - | - | Output rate of the UBX-RXM-RLM message on port SPI |
| *CFG-MSGOUT-UBX_RXM_RLM_UART1* | 0x2091025f | U1 | - | - | Output rate of the UBX-RXM-RLM message on port UART1 |
| *CFG-MSGOUT-UBX_RXM_RLM_UART2* | 0x20910260 | U1 | - | - | Output rate of the UBX-RXM-RLM message on port UART2 |
| *CFG-MSGOUT-UBX_RXM_RLM_USB* | 0x20910261 | U1 | - | - | Output rate of the UBX-RXM-RLM message on port USB |
| *CFG-MSGOUT-UBX_RXM_RTCM_I2C* | 0x20910268 | U1 | - | - | Output rate of the UBX-RXM-RTCM message on port I2C |
| *CFG-MSGOUT-UBX_RXM_RTCM_SPI* | 0x2091026c | U1 | - | - | Output rate of the UBX-RXM-RTCM message on port SPI |
| *CFG-MSGOUT-UBX_RXM_RTCM_UART1* | 0x20910269 | U1 | - | - | Output rate of the UBX-RXM-RTCM message on port UART1 |
| *CFG-MSGOUT-UBX_RXM_RTCM_UART2* | 0x2091026a | U1 | - | - | Output rate of the UBX-RXM-RTCM message on port UART2 |
| *CFG-MSGOUT-UBX_RXM_RTCM_USB* | 0x2091026b | U1 | - | - | Output rate of the UBX-RXM-RTCM message on port USB |
| *CFG-MSGOUT-UBX_RXM_SFRBX_I2C* | 0x20910231 | U1 | - | - | Output rate of the UBX-RXM-SFRBX message on port I2C |
| *CFG-MSGOUT-UBX_RXM_SFRBX_SPI* | 0x20910235 | U1 | - | - | Output rate of the UBX-RXM-SFRBX message on port SPI |
| *CFG-MSGOUT-UBX_RXM_SFRBX_UART1* | 0x20910232 | U1 | - | - | Output rate of the UBX-RXM-SFRBX message on port UART1 |
| *CFG-MSGOUT-UBX_RXM_SFRBX_UART2* | 0x20910233 | U1 | - | - | Output rate of the UBX-RXM-SFRBX message on port UART2 |
| *CFG-MSGOUT-UBX_RXM_SFRBX_USB* | 0x20910234 | U1 | - | - | Output rate of the UBX-RXM-SFRBX message on port USB |
| *CFG-MSGOUT-UBX_TIM_TM2_I2C* | 0x20910178 | U1 | - | - | Output rate of the UBX-TIM-TM2 message on port I2C |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-MSGOUT-UBX_TIM_TM2_SPI* | 0x2091017c | U1 | - | - | Output rate of the UBX-TIM-TM2 message on port SPI |
| *CFG-MSGOUT-UBX_TIM_TM2_UART1* | 0x20910179 | U1 | - | - | Output rate of the UBX-TIM-TM2 message on port UART1 |
| *CFG-MSGOUT-UBX_TIM_TM2_UART2* | 0x2091017a | U1 | - | - | Output rate of the UBX-TIM-TM2 message on port UART2 |
| *CFG-MSGOUT-UBX_TIM_TM2_USB* | 0x2091017b | U1 | - | - | Output rate of the UBX-TIM-TM2 message on port USB |
| *CFG-MSGOUT-UBX_TIM_TP_I2C* | 0x2091017d | U1 | - | - | Output rate of the UBX-TIM-TP message on port I2C |
| *CFG-MSGOUT-UBX_TIM_TP_SPI* | 0x20910181 | U1 | - | - | Output rate of the UBX-TIM-TP message on port SPI |
| *CFG-MSGOUT-UBX_TIM_TP_UART1* | 0x2091017e | U1 | - | - | Output rate of the UBX-TIM-TP message on port UART1 |
| *CFG-MSGOUT-UBX_TIM_TP_UART2* | 0x2091017f | U1 | - | - | Output rate of the UBX-TIM-TP message on port UART2 |
| *CFG-MSGOUT-UBX_TIM_TP_USB* | 0x20910180 | U1 | - | - | Output rate of the UBX-TIM-TP message on port USB |
| *CFG-MSGOUT-UBX_TIM_VRFY_I2C* | 0x20910092 | U1 | - | - | Output rate of the UBX-TIM-VRFY message on port I2C |
| *CFG-MSGOUT-UBX_TIM_VRFY_SPI* | 0x20910096 | U1 | - | - | Output rate of the UBX-TIM-VRFY message on port SPI |
| *CFG-MSGOUT-UBX_TIM_VRFY_UART1* | 0x20910093 | U1 | - | - | Output rate of the UBX-TIM-VRFY message on port UART1 |
| *CFG-MSGOUT-UBX_TIM_VRFY_UART2* | 0x20910094 | U1 | - | - | Output rate of the UBX-TIM-VRFY message on port UART2 |
| *CFG-MSGOUT-UBX_TIM_VRFY_USB* | 0x20910095 | U1 | - | - | Output rate of the UBX-TIM-VRFY message on port USB |

**Table 16: CFG-MSGOUT configuration items**

## 5.9.12 CFG-NAVHPG: High precision navigation configuration

This group configures items related to the operation of the receiver in high precision, for example Differential correction and other related features.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-NAVHPG-DGNSSMODE* | 0x20140011 | E1 | - | - | Differential corrections mode |
| See Table 18 below for a list of possible constants for this item. | | | | | |

**Table 17: CFG-NAVHPG configuration items**

| Constant | Value | Description |
|---|---|---|
| *RTK_FLOAT* | 2 | No attempts made to fix ambiguities |
| *RTK_FIXED* | 3 | Ambiguities are fixed whenever possible |

**Table 18: Constants for CFG-NAVHPG-DGNSSMODE**

## 5.9.13 CFG-NAVSPG: Standard precision navigation configuration

This group contains configuration items related to the operation of the receiver at standard precision, including configuring postition fix mode, ionospheric model selection and other related items.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-NAVSPG-FIXMODE* | 0x20110011 | E1 | - | - | Position fix mode |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| See Table 20 below for a list of possible constants for this item. | | | | | |
| *CFG-NAVSPG-INIFIX3D* | 0x10110013 | L | - | - | Initial fix must be a 3D fix |
| *CFG-NAVSPG-WKNROLLOVER* | 0x30110017 | U2 | - | - | GPS week rollover number |
| GPS week numbers will be set correctly from this week up to 1024 weeks after this week.<br>Range is from 1 to 4096. | | | | | |
| *CFG-NAVSPG-UTCSTANDARD* | 0x2011001c | E1 | - | - | UTC standard to be used |
| See also the section *GNSS time base* in the Integration manual.<br>See Table 21 below for a list of possible constants for this item. | | | | | |
| *CFG-NAVSPG-DYNMODEL* | 0x20110021 | E1 | - | - | Dynamic platform model |
| See Table 22 below for a list of possible constants for this item. | | | | | |
| *CFG-NAVSPG-ACKAIDING* | 0x10110025 | L | - | - | Acknowledge assistance input messages |
| *CFG-NAVSPG-USE_USRDAT* | 0x10110061 | L | - | - | Use user geodetic datum parameters |
| This must be set together with all CFG-NAVSPG-USERDAT_* parameters. | | | | | |
| *CFG-NAVSPG-USRDAT_MAJA* | 0x50110062 | R8 | - | m | Geodetic datum semi-major axis |
| Accepted range is from 6,300,000.0 to 6,500,000.0 meters<br>This will only be used if CFG-NAVSPG-USE_USERDAT is set. It must be set together with all other CFG-NAVSPG-USERDAT_... parameters. | | | | | |
| *CFG-NAVSPG-USRDAT_FLAT* | 0x50110063 | R8 | - | - | Geodetic datum 1.0 / flattening |
| Accepted range is 0.0 to 500.0.<br>This will only be used if CFG-NAVSPG-USE_USERDAT is set. It must be set together with all other CFG-NAVSPG-USERDAT_... parameters. | | | | | |
| *CFG-NAVSPG-USRDAT_DX* | 0x40110064 | R4 | - | m | Geodetic datum X axis shift at the origin |
| Accepted range is +/- 5000.0 meters.<br>This will only be used if CFG-NAVSPG-USE_USERDAT is set. It must be set together with all other CFG-NAVSPG-USERDAT_... parameters. | | | | | |
| *CFG-NAVSPG-USRDAT_DY* | 0x40110065 | R4 | - | m | Geodetic datum Y axis shift at the origin |
| Accepted range is +/- 5000.0 meters.<br>This will only be used if CFG-NAVSPG-USE_USERDAT is set. It must be set together with all other CFG-NAVSPG-USERDAT_... parameters. | | | | | |
| *CFG-NAVSPG-USRDAT_DZ* | 0x40110066 | R4 | - | m | Geodetic datum Z axis shift at the origin |
| Accepted range is +/- 5000.0 meters.<br>This will only be used if CFG-NAVSPG-USE_USERDAT is set. It must be set together with all other CFG-NAVSPG-USERDAT_.. parameters. | | | | | |
| *CFG-NAVSPG-USRDAT_ROTX* | 0x40110067 | R4 | - | arcsec | Geodetic datum rotation about the X axis |
| Accepted range is +/- 20.0 milli arc seconds.<br>This will only be used if CFG-NAVSPG-USE_USERDAT is set. It must be set together with all other CFG-NAVSPG-USERDAT_... parameters. | | | | | |
| *CFG-NAVSPG-USRDAT_ROTY* | 0x40110068 | R4 | - | arcsec | Geodetic datum rotation about the Y axis () |
| Accepted range is +/- 20.0 milli-arc seconds.<br>This will only be used if CFG-NAVSPG-USE_USERDAT is set. It must be set together with all other CFG-NAVSPG-USERDAT_* parameters. | | | | | |
| *CFG-NAVSPG-USRDAT_ROTZ* | 0x40110069 | R4 | - | arcsec | Geodetic datum rotation about the Z axis |
| Accepted range is +/- 20.0 milli-arc seconds.<br>This will only be used if CFG-NAVSPG-USE_USERDAT is set. It must be set together with all other CFG-NAVSPG-USERDAT_... parameters. | | | | | |
| *CFG-NAVSPG-USRDAT_SCALE* | 0x4011006a | R4 | - | ppm | Geodetic datum scale factor |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| Accepted range is 0.0 to 50.0 parts per million.<br>This will only be used if CFG-NAVSPG-USE_USERDAT is set. It must be set together with all other CFG-NAVSPG-USERDAT_... parameters. | | | | | |
| *CFG-NAVSPG-INFIL_MINSVS* | 0x201100a1 | U1 | - | - | Minimum number of satellites for navigation |
| *CFG-NAVSPG-INFIL_MAXSVS* | 0x201100a2 | U1 | - | - | Maximum number of satellites for navigation |
| *CFG-NAVSPG-INFIL_MINCNO* | 0x201100a3 | U1 | - | dBHz | Minimum satellite signal level for navigation |
| *CFG-NAVSPG-INFIL_MINELEV* | 0x201100a4 | I1 | - | deg | Minimum elevation for a GNSS satellite to be used in navigation |
| *CFG-NAVSPG-INFIL_NCNOTHRS* | 0x201100aa | U1 | - | - | Number of satellites required to have C/N0 above CFG-NAVSPG-INFIL_CNOTHRS for a fix to be attempted |
| *CFG-NAVSPG-INFIL_CNOTHRS* | 0x201100ab | U1 | - | - | C/N0 threshold for deciding whether to attempt a fix |
| *CFG-NAVSPG-OUTFIL_PDOP* | 0x301100b1 | U2 | 0.1 | - | Output filter position DOP mask (threshold) |
| *CFG-NAVSPG-OUTFIL_TDOP* | 0x301100b2 | U2 | 0.1 | - | Output filter time DOP mask (threshold) |
| *CFG-NAVSPG-OUTFIL_PACC* | 0x301100b3 | U2 | - | m | Output filter position accuracy mask (threshold) |
| *CFG-NAVSPG-OUTFIL_TACC* | 0x301100b4 | U2 | - | m | Output filter time accuracy mask (threshold) |
| *CFG-NAVSPG-OUTFIL_FACC* | 0x301100b5 | U2 | 0.01 | m/s | Output filter frequency accuracy mask (threshold) |
| *CFG-NAVSPG-CONSTR_ALT* | 0x401100c1 | I4 | 0.01 | m | Fixed altitude (mean sea level) for 2D fix mode |
| *CFG-NAVSPG-CONSTR_ALTVAR* | 0x401100c2 | U4 | 0.0001 | m^2 | Fixed altitude variance for 2D mode |
| *CFG-NAVSPG-CONSTR_DGNSSTO* | 0x201100c4 | U1 | - | s | DGNSS timeout |

**Table 19: CFG-NAVSPG configuration items**

| Constant | Value | Description |
|---|---|---|
| *2DONLY* | 1 | 2D only |
| *3DONLY* | 2 | 3D only |
| *AUTO* | 3 | Auto 2D/3D |

**Table 20: Constants for CFG-NAVSPG-FIXMODE**

| Constant | Value | Description |
|---|---|---|
| *AUTO* | 0 | Automatic; receiver selects based on GNSS configuration |
| *USNO* | 3 | UTC as operated by the U.S. Naval Observatory (USNO); derived from GPS time |
| *EU* | 5 | UTC as combined from multiple European laboratories; derived from Galileo time |
| *SU* | 6 | UTC as operated by the former Soviet Union (SU); derived from GLONASS time |
| *NTSC* | 7 | UTC as operated by the National Time Service Center (NTSC), China; derived from BeiDou time |

**Table 21: Constants for CFG-NAVSPG-UTCSTANDARD**

| Constant | Value | Description |
|---|---|---|
| *PORT* | 0 | Portable |
| *STAT* | 2 | Stationary |
| *PED* | 3 | Pedestrian |
| *AUTOMOT* | 4 | Automotive |

| Constant | Value | Description |
|---|---|---|
| *SEA* | 5 | Sea |
| *AIR1* | 6 | Airborne with <1g acceleration |
| *AIR2* | 7 | Airborne with <2g acceleration |
| *AIR4* | 8 | Airborne with <4g acceleration |
| *WRIST* | 9 | Wrist-worn watch (not available in all products) |

**Table 22: Constants for CFG-NAVSPG-DYNMODEL**

### 5.9.14 CFG-NMEA: NMEA protocol configuration

This group configures the NMEA protocol. See section NMEA protocol configuration for a detailed description of the configuration effects on NMEA output.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-NMEA-PROTVER* | 0x20930001 | E1 | - | - | NMEA protocol version |
| See Table 24 below for a list of possible constants for this item. | | | | | |
| *CFG-NMEA-MAXSVS* | 0x20930002 | E1 | - | - | Maximum number of SVs to report per Talker ID |
| See Table 25 below for a list of possible constants for this item. | | | | | |
| *CFG-NMEA-COMPAT* | 0x10930003 | L | - | - | Enable compatibility mode |
| This might be needed for certain applications, e.g. for an NMEA parser that expects a fixed number of digits in position coordinates. | | | | | |
| *CFG-NMEA-CONSIDER* | 0x10930004 | L | - | - | Enable considering mode |
| This will affect NMEA output used satellite count. If set, also considered satellites (e.g. RAIMED) are counted as used satellites as well. | | | | | |
| *CFG-NMEA-LIMIT82* | 0x10930005 | L | - | - | Enable strict limit to 82 characters maximum NMEA message length |
| *CFG-NMEA-HIGHPREC* | 0x10930006 | L | - | - | Enable high precision mode |
| This flag cannot be set in conjunction with either CFG-NMEA-COMPAT or CFG-NMEA-LIMIT82 mode. | | | | | |
| *CFG-NMEA-SVNUMBERING* | 0x20930007 | E1 | - | - | Display configuration for SVs that do not have value defined in NMEA |
| Configures the display of satellites that do not have an NMEA-defined value.<br>Note: this does not apply to satellites with an unknown ID.<br>See also Satellite Numbering.<br>See Table 26 below for a list of possible constants for this item. | | | | | |
| *CFG-NMEA-FILT_GPS* | 0x10930011 | L | - | - | Disable reporting of GPS satellites |
| *CFG-NMEA-FILT_SBAS* | 0x10930012 | L | - | - | Disable reporting of SBAS satellites |
| *CFG-NMEA-FILT_GAL* | 0x10930013 | L | - | - | Disable reporting of Galileo satellites |
| *CFG-NMEA-FILT_QZSS* | 0x10930015 | L | - | - | Disable reporting of QZSS satellites |
| *CFG-NMEA-FILT_GLO* | 0x10930016 | L | - | - | Disable reporting of GLONASS satellites |
| *CFG-NMEA-FILT_BDS* | 0x10930017 | L | - | - | Disable reporting of BeiDou satellites |
| *CFG-NMEA-OUT_INVFIX* | 0x10930021 | L | - | - | Enable position output for failed or invalid fixes |
| *CFG-NMEA-OUT_MSKFIX* | 0x10930022 | L | - | - | Enable position output for invalid fixes |
| *CFG-NMEA-OUT_INVTIME* | 0x10930023 | L | - | - | Enable time output for invalid times |
| *CFG-NMEA-OUT_INVDATE* | 0x10930024 | L | - | - | Enable date output for invalid dates |
| *CFG-NMEA-OUT_ONLYGPS* | 0x10930025 | L | - | - | Restrict output to GPS satellites only |
| *CFG-NMEA-OUT_FROZENCOG* | 0x10930026 | L | - | - | Enable course over ground output even if it is frozen |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-NMEA-MAINTALKERID* | 0x20930031 | E1 | - | - | Main Talker ID |
| By default the main Talker ID (i.e. the Talker ID used for all messages other than GSV) is determined by the GNSS assignment of the receiver's channels (see CFG-SIGNAL).<br>This field enables the main Talker ID to be overridden.<br>See Table 27 below for a list of possible constants for this item. | | | | | |
| *CFG-NMEA-GSVTALKERID* | 0x20930032 | E1 | - | - | Talker ID for GSV NMEA messages |
| By default the Talker ID for GSV messages is GNSS-specific (as defined by NMEA).<br>This field enables the GSV Talker ID to be overridden.<br>See Table 28 below for a list of possible constants for this item. | | | | | |
| *CFG-NMEA-BDSTALKERID* | 0x30930033 | U2 | - | - | BeiDou Talker ID |
| Sets the two ASCII characters that should be used for the BeiDou Talker ID.<br>If these are set to zero, the default BeiDou Talker ID will be used. | | | | | |

**Table 23: CFG-NMEA configuration items**

| Constant | Value | Description |
|---|---|---|
| *V21* | 21 | NMEA protocol version 2.1 |
| *V23* | 23 | NMEA protocol version 2.3 |
| *V40* | 40 | NMEA protocol version 4.0 (not available in all products) |
| *V41* | 41 | NMEA protocol version 4.10 (not available in all products) |
| *V411* | 42 | NMEA protocol version 4.11 (not available in all products) |

**Table 24: Constants for CFG-NMEA-PROTVER**

| Constant | Value | Description |
|---|---|---|
| *UNLIM* | 0 | Unlimited |
| *8SVS* | 8 | 8 SVs |
| *12SVS* | 12 | 12 SVs |
| *16SVS* | 16 | 16 SVs |

**Table 25: Constants for CFG-NMEA-MAXSVS**

| Constant | Value | Description |
|---|---|---|
| *STRICT* | 0 | Strict - satellites are not output |
| *EXTENDED* | 1 | Extended - use proprietary numbering |

**Table 26: Constants for CFG-NMEA-SVNUMBERING**

| Constant | Value | Description |
|---|---|---|
| *AUTO* | 0 | Main Talker ID is not overridden |
| *GP* | 1 | Set main Talker ID to 'GP' |
| *GL* | 2 | Set main Talker ID to 'GL' |
| *GN* | 3 | Set main Talker ID to 'GN' |
| *GA* | 4 | Set main Talker ID to 'GA' (not available in all products) |
| *GB* | 5 | Set main Talker ID to 'GB' (not available in all products) |
| *GQ* | 7 | Set main Talker ID to 'GQ' (not available in all products) |

**Table 27: Constants for CFG-NMEA-MAINTALKERID**

| Constant | Value | Description |
|---|---|---|
| *GNSS* | 0 | Use GNSS-specific Talker ID (as defined by NMEA) |

| Constant | Value | Description |
|---|---|---|
| *MAIN* | 1 | Use the main Talker ID |

**Table 28: Constants for CFG-NMEA-GSVTALKERID**

## 5.9.15 CFG-ODO: Odometer and low-speed course over ground filter configuration

The items in this group allow the user to configure the Odometer feature and Low-Speed Course Over Ground Filter.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-ODO-USE_ODO* | 0x10220001 | L | - | - | Use odometer |
| *CFG-ODO-USE_COG* | 0x10220002 | L | - | - | Use low-speed course over ground filter |
| *CFG-ODO-OUTLPVEL* | 0x10220003 | L | - | - | Output low-pass filtered velocity |
| *CFG-ODO-OUTLPCOG* | 0x10220004 | L | - | - | Output low-pass filtered course over ground (heading) |
| *CFG-ODO-PROFILE* | 0x20220005 | E1 | - | - | Odometer profile configuration<br>See Table 30 below for a list of possible constants for this item. |
| *CFG-ODO-COGMAXSPEED* | 0x20220021 | U1 | - | m/s | Upper speed limit for low-speed course over ground filter |
| *CFG-ODO-COGMAXPOSACC* | 0x20220022 | U1 | - | - | Maximum acceptable position accuracy for computing low-speed filtered course over ground |
| *CFG-ODO-VELLPGAIN* | 0x20220031 | U1 | - | - | Velocity low-pass filter level<br>Range is from 0 to 255. |
| *CFG-ODO-COGLPGAIN* | 0x20220032 | U1 | - | - | Course over ground low-pass filter level (at speed < 8 m/s)<br>Range is from 0 to 255. |

**Table 29: CFG-ODO configuration items**

| Constant | Value | Description |
|---|---|---|
| *RUN* | 0 | Running |
| *CYCL* | 1 | Cycling |
| *SWIM* | 2 | Swimming |
| *CAR* | 3 | Car |
| *CUSTOM* | 4 | Custom |

**Table 30: Constants for CFG-ODO-PROFILE**

## 5.9.16 CFG-QZSS: QZSS system configuration

Note that enabling and disabling of individual GNSS is done via the CFG-SIGNAL configuration group.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-QZSS-USE_SLAS_DGNSS* | 0x10370005 | L | - | - | Apply QZSS SLAS DGNSS corrections |
| *CFG-QZSS-USE_SLAS_TESTMODE* | 0x10370006 | L | - | - | Use QZSS SLAS data when it is in test mode (SLAS msg 0) |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-QZSS-USE_SLAS_RAIM_UNCORR* | 0x10370007 | L | - | - | Raim out measurements that are not corrected by QZSS SLAS, if at least 5 measurements are corrected |

**Table 31: CFG-QZSS configuration items**

## 5.9.17 CFG-RATE: Navigation and measurement rate configuration

The configuration items in this group allow the user to alter the rate at which navigation solutions (and the measurements that they depend on) are generated by the receiver. The calculation of the navigation solution will always be aligned to the top of a second zero (first second of the week) of the configured reference time system. The navigation period is an integer multiple of the measurement period.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-RATE-MEAS* | 0x30210001 | U2 | 0.001 | s | Nominal time between GNSS measurements |
| E.g. 100 ms results in 10 Hz measurement rate, 1000 ms = 1 Hz measurement rate. | | | | | |
| *CFG-RATE-NAV* | 0x30210002 | U2 | - | - | Ratio of number of measurements to number of navigation solutions |
| E.g. 5 means five measurements for every navigation solution. The maximum value is 128. | | | | | |
| *CFG-RATE-TIMEREF* | 0x20210003 | E1 | - | - | Time system to which measurements are aligned |
| See Table 33 below for a list of possible constants for this item. | | | | | |

**Table 32: CFG-RATE configuration items**

| Constant | Value | Description |
|---|---|---|
| *UTC* | 0 | Align measurements to UTC time |
| *GPS* | 1 | Align measurements to GPS time |
| *GLO* | 2 | Align measurements to GLONASS time |
| *BDS* | 3 | Align measurements to BeiDou time |
| *GAL* | 4 | Align measurements to Galileo time |

**Table 33: Constants for CFG-RATE-TIMEREF**

## 5.9.18 CFG-RINV: Remote inventory

The remote inventory enables storing user-defined data in the non-volatile memory of the receiver. The data can be either binary or a string of ASCII characters. In the latter case, it can optionally be output at startup after the boot screen.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-RINV-DUMP* | 0x10c70001 | L | - | - | Dump data at startup |
| When true, data will be dumped to the interface on startup, unless CFG-RINV-BINARY is set. | | | | | |
| *CFG-RINV-BINARY* | 0x10c70002 | L | - | - | Data is binary |
| When true, the data is treated as binary data. | | | | | |
| *CFG-RINV-DATA_SIZE* | 0x20c70003 | U1 | - | - | Size of data |
| Size of data to store/be stored in the remote inventory (maximum 30 bytes). | | | | | |
| *CFG-RINV-CHUNK0* | 0x50c70004 | X8 | - | - | Data bytes 1-8 (LSB) |
| Data to store/be stored in remote inventory - max 8 bytes, left-most in LSB, e.g. string ABCD will appear as 0x44434241. | | | | | |
| *CFG-RINV-CHUNK1* | 0x50c70005 | X8 | - | - | Data bytes 9-16 |
| Data to store/be stored in remote inventory - max 8 bytes, left-most in LSB, e.g. string ABCD will appear as 0x44434241. | | | | | |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-RINV-CHUNK2* | 0x50c70006 | X8 | - | - | Data bytes 17-24 |
| Data to store/be stored in remote inventory - max 8 bytes, left-most in LSB, e.g. string ABCD will appear as 0x44434241. | | | | | |
| *CFG-RINV-CHUNK3* | 0x50c70007 | X8 | - | - | Data bytes 25-30 (MSB) |
| Data to store/be stored in remote inventory - max 6 bytes, left-most in LSB, e.g. string ABCD will appear as 0x44434241. | | | | | |

**Table 34: CFG-RINV configuration items**

## 5.9.19 CFG-RTCM: RTCM protocol configuration

Configures the RTCM protocol.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-RTCM-DF003_OUT* | 0x30090001 | U2 | - | - | RTCM DF003 (Reference station ID) output value |
| Value to set in RTCM data field DF003 (Reference station ID) in RTCM output messages containing DF003. The value can be 0..4095. | | | | | |
| *CFG-RTCM-DF003_IN* | 0x30090008 | U2 | - | - | RTCM DF003 (Reference station ID) input value |
| Value to use for filtering out RTCM input messages based on their DF003 data field (Reference station ID) value. To be used in conjunction with CFG-RTCM-DF003_IN_FILTER. The value can be 0..4095. | | | | | |
| *CFG-RTCM-DF003_IN_FILTER* | 0x20090009 | E1 | - | - | RTCM input filter configuration based on RTCM DF003 (Reference station ID) value |
| Configures if and how the filtering out of RTCM input messages based on their DF003 data field (Reference station ID) operates.<br>See Table 36 below for a list of possible constants for this item. | | | | | |

**Table 35: CFG-RTCM configuration items**

| Constant | Value | Description |
|---|---|---|
| *DISABLED* | 0 | Disabled RTCM input filter; all input messages allowed |
| *RELAXED* | 1 | Relaxed RTCM input filter; input messages allowed must contain a DF003 data field matching the CFG-RTCM-DF003_IN value or not contain by specification the DF003 data field |
| *STRICT* | 2 | Strict RTCM input filter; input messages allowed must contain a DF003 data field matching the CFG-RTCM-DF003 value |

**Table 36: Constants for CFG-RTCM-DF003_IN_FILTER**

## 5.9.20 CFG-SBAS: SBAS configuration

This group configures the SBAS receiver subsystem (i.e. WAAS, EGNOS, MSAS). See the *SBAS configuration settings description* in the Integration manual for a detailed description of how these settings affect receiver operation.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-SBAS-USE_TESTMODE* | 0x10360002 | L | - | - | Use SBAS data when it is in test mode (SBAS msg 0) |
| *CFG-SBAS-USE_RANGING* | 0x10360003 | L | - | - | Use SBAS GEOs as a ranging source (for navigation) |
| *CFG-SBAS-USE_DIFFCORR* | 0x10360004 | L | - | - | Use SBAS differential corrections |
| *CFG-SBAS-USE_INTEGRITY* | 0x10360005 | L | - | - | Use SBAS integrity information |
| If enabled, the receiver will only use GPS satellites for which integrity information is available | | | | | |
| *CFG-SBAS-PRNSCANMASK* | 0x50360006 | X8 | - | - | SBAS PRN search configuration |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| This configuration item determines which SBAS PRNs should be searched. Setting it to 0 indicates auto-scanning all SBAS PRNs. For non-zero values the bits correspond to the allocated SBAS PRNs ranging from PRN120 (bit 0) to PRN158 (bit 38), where a bit set enables searching for the corresponding PRN.<br>See Table 38 below for a list of possible constants for this item. | | | | | |

**Table 37: CFG-SBAS configuration items**

| Constant | Value | Description |
|---|---|---|
| *ALL* | 0x0000000000000000 | Enable search for all SBAS PRNs |
| *PRN120* | 0x0000000000000001 | Enable search for SBAS PRN120 |
| *PRN121* | 0x0000000000000002 | Enable search for SBAS PRN121 |
| *PRN122* | 0x0000000000000004 | Enable search for SBAS PRN122 |
| *PRN123* | 0x0000000000000008 | Enable search for SBAS PRN123 |
| *PRN124* | 0x0000000000000010 | Enable search for SBAS PRN124 |
| *PRN125* | 0x0000000000000020 | Enable search for SBAS PRN125 |
| *PRN126* | 0x0000000000000040 | Enable search for SBAS PRN126 |
| *PRN127* | 0x0000000000000080 | Enable search for SBAS PRN127 |
| *PRN128* | 0x0000000000000100 | Enable search for SBAS PRN128 |
| *PRN129* | 0x0000000000000200 | Enable search for SBAS PRN129 |
| *PRN130* | 0x0000000000000400 | Enable search for SBAS PRN130 |
| *PRN131* | 0x0000000000000800 | Enable search for SBAS PRN131 |
| *PRN132* | 0x0000000000001000 | Enable search for SBAS PRN132 |
| *PRN133* | 0x0000000000002000 | Enable search for SBAS PRN133 |
| *PRN134* | 0x0000000000004000 | Enable search for SBAS PRN134 |
| *PRN135* | 0x0000000000008000 | Enable search for SBAS PRN135 |
| *PRN136* | 0x0000000000010000 | Enable search for SBAS PRN136 |
| *PRN137* | 0x0000000000020000 | Enable search for SBAS PRN137 |
| *PRN138* | 0x0000000000040000 | Enable search for SBAS PRN138 |
| *PRN139* | 0x0000000000080000 | Enable search for SBAS PRN139 |
| *PRN140* | 0x0000000000100000 | Enable search for SBAS PRN140 |
| *PRN141* | 0x0000000000200000 | Enable search for SBAS PRN141 |
| *PRN142* | 0x0000000000400000 | Enable search for SBAS PRN142 |
| *PRN143* | 0x0000000000800000 | Enable search for SBAS PRN143 |
| *PRN144* | 0x0000000001000000 | Enable search for SBAS PRN144 |
| *PRN145* | 0x0000000002000000 | Enable search for SBAS PRN145 |
| *PRN146* | 0x0000000004000000 | Enable search for SBAS PRN146 |
| *PRN147* | 0x0000000008000000 | Enable search for SBAS PRN147 |
| *PRN148* | 0x0000000010000000 | Enable search for SBAS PRN148 |
| *PRN149* | 0x0000000020000000 | Enable search for SBAS PRN149 |
| *PRN150* | 0x0000000040000000 | Enable search for SBAS PRN150 |
| *PRN151* | 0x0000000080000000 | Enable search for SBAS PRN151 |
| *PRN152* | 0x0000000100000000 | Enable search for SBAS PRN152 |
| *PRN153* | 0x0000000200000000 | Enable search for SBAS PRN153 |

| Constant | Value | Description |
|---|---|---|
| *PRN154* | 0x0000000400000000 | Enable search for SBAS PRN154 |
| *PRN155* | 0x0000000800000000 | Enable search for SBAS PRN155 |
| *PRN156* | 0x0000001000000000 | Enable search for SBAS PRN156 |
| *PRN157* | 0x0000002000000000 | Enable search for SBAS PRN157 |
| *PRN158* | 0x0000004000000000 | Enable search for SBAS PRN158 |

**Table 38: Constants for CFG-SBAS-PRNSCANMASK**

## 5.9.21 CFG-SIGNAL: Satellite systems (GNSS) signal configuration

The enable items for individual signals are governed by their corresponding constellation enable item. It is necessary that at least one signal from a major GNSS constellation is enabled. See *GNSS signal configuration* in the Integration manual for more details.

Configuration specific to a GNSS system is available in other groups (e.g. CFG-SBAS).

Note that changes to any items within this group will trigger a reset to the GNSS subsystem.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-SIGNAL-GPS_ENA* | 0x1031001f | L | - | - | GPS enable |
| *CFG-SIGNAL-GPS_L1CA_ENA* | 0x10310001 | L | - | - | GPS L1C/A |
| *CFG-SIGNAL-GPS_L2C_ENA* | 0x10310003 | L | - | - | GPS L2C (only on u-blox F9 platform products) |
| *CFG-SIGNAL-SBAS_ENA* | 0x10310020 | L | - | - | SBAS enable |
| *CFG-SIGNAL-SBAS_L1CA_ENA* | 0x10310005 | L | - | - | SBAS L1C/A |
| *CFG-SIGNAL-GAL_ENA* | 0x10310021 | L | - | - | Galileo enable |
| *CFG-SIGNAL-GAL_E1_ENA* | 0x10310007 | L | - | - | Galileo E1 |
| *CFG-SIGNAL-GAL_E5B_ENA* | 0x1031000a | L | - | - | Galileo E5b (only on u-blox F9 platform products) |
| *CFG-SIGNAL-BDS_ENA* | 0x10310022 | L | - | - | BeiDou Enable |
| *CFG-SIGNAL-BDS_B1_ENA* | 0x1031000d | L | - | - | BeiDou B1I |
| *CFG-SIGNAL-BDS_B2_ENA* | 0x1031000e | L | - | - | BeiDou B2I (only on u-blox F9 platform products) |
| *CFG-SIGNAL-QZSS_ENA* | 0x10310024 | L | - | - | QZSS enable |
| *CFG-SIGNAL-QZSS_L1CA_ENA* | 0x10310012 | L | - | - | QZSS L1C/A |
| *CFG-SIGNAL-QZSS_L1S_ENA* | 0x10310014 | L | - | - | QZSS L1S |
| *CFG-SIGNAL-QZSS_L2C_ENA* | 0x10310015 | L | - | - | QZSS L2C (only on u-blox F9 platform products) |
| *CFG-SIGNAL-GLO_ENA* | 0x10310025 | L | - | - | GLONASS enable |
| *CFG-SIGNAL-GLO_L1_ENA* | 0x10310018 | L | - | - | GLONASS L1 |
| *CFG-SIGNAL-GLO_L2_ENA* | 0x1031001a | L | - | - | GLONASS L2 (only on u-blox F9 platform products) |

**Table 39: CFG-SIGNAL configuration items**

## 5.9.22 CFG-SPI: Configuration of the SPI interface

Settings needed to configure the SPI communication interface.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-SPI-MAXFF* | 0x20640001 | U1 | - | - | Number of bytes containing 0xFF to receive before switching off reception. Range: 0 (mechanism off) - 63 |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-SPI-CPOLARITY* | 0x10640002 | L | - | - | Clock polarity select: 0: Active Hight Clock, SCLK idles low, 1: Active Low Clock, SCLK idles high |
| *CFG-SPI-CPHASE* | 0x10640003 | L | - | - | Clock phase select: 0: Data captured on first edge of SCLK, 1: Data captured on second edge of SCLK |
| *CFG-SPI-EXTENDEDTIMEOUT* | 0x10640005 | L | - | - | Flag to disable timeouting the interface after 1.5s |
| *CFG-SPI-ENABLED* | 0x10640006 | L | - | - | Flag to indicate if the SPI interface should be enabled |

**Table 40: CFG-SPI configuration items**

## 5.9.23 CFG-SPIINPROT: Input protocol configuration of the SPI interface

Input protocol enable flags of the SPI interface.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-SPIINPROT-UBX* | 0x10790001 | L | - | - | Flag to indicate if UBX should be an input protocol on SPI |
| *CFG-SPIINPROT-NMEA* | 0x10790002 | L | - | - | Flag to indicate if NMEA should be an input protocol on SPI |
| *CFG-SPIINPROT-RTCM3X* | 0x10790004 | L | - | - | Flag to indicate if RTCM3X should be an input protocol on SPI |

**Table 41: CFG-SPIINPROT configuration items**

## 5.9.24 CFG-SPIOUTPROT: Output protocol configuration of the SPI interface

Output protocol enable flags of the SPI interface.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-SPIOUTPROT-UBX* | 0x107a0001 | L | - | - | Flag to indicate if UBX should be an output protocol on SPI |
| *CFG-SPIOUTPROT-NMEA* | 0x107a0002 | L | - | - | Flag to indicate if NMEA should be an output protocol on SPI |
| *CFG-SPIOUTPROT-RTCM3X* | 0x107a0004 | L | - | - | Flag to indicate if RTCM3X should be an output protocol on SPI |

**Table 42: CFG-SPIOUTPROT configuration items**

## 5.9.25 CFG-TMODE: Time mode configuration

Configuration for operation of the receiver in Time mode. The position referred to in the configuration items is that of the Antenna Reference Point (ARP).

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-TMODE-MODE* | 0x20030001 | E1 | - | - | Receiver mode |
| See Table 44 below for a list of possible constants for this item. | | | | | |
| *CFG-TMODE-POS_TYPE* | 0x20030002 | E1 | - | - | Determines whether the ARP position is given in ECEF or LAT/LON/HEIGHT? |
| See Table 45 below for a list of possible constants for this item. | | | | | |
| *CFG-TMODE-ECEF_X* | 0x40030003 | I4 | - | cm | ECEF X coordinate of the ARP position. |
| This will only be used if CFG-TMODE-MODE=FIXED and CFG-TMODE-POS_TYPE=ECEF. | | | | | |
| *CFG-TMODE-ECEF_Y* | 0x40030004 | I4 | - | cm | ECEF Y coordinate of the ARP position. |
| This will only be used if CFG-TMODE-MODE=FIXED and CFG-TMODE-POS_TYPE=ECEF. | | | | | |
| *CFG-TMODE-ECEF_Z* | 0x40030005 | I4 | - | cm | ECEF Z coordinate of the ARP position. |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| This will only be used if CFG-TMODE-MODE=FIXED and CFG-TMODE-POS_TYPE=ECEF. | | | | | |
| *CFG-TMODE-ECEF_X_HP* | 0x20030006 | I1 | 0.1 | mm | High-precision ECEF X coordinate of the ARP position. |
| Accepted range is -99 to +99. This will only be used if CFG-TMODE-MODE=FIXED and CFG-TMODE-POS_TYPE=ECEF. | | | | | |
| *CFG-TMODE-ECEF_Y_HP* | 0x20030007 | I1 | 0.1 | mm | High-precision ECEF Y coordinate of the ARP position. |
| Accepted range is -99 to +99. This will only be used if CFG-TMODE-MODE=FIXED and CFG-TMODE-POS_TYPE=ECEF. | | | | | |
| *CFG-TMODE-ECEF_Z_HP* | 0x20030008 | I1 | 0.1 | mm | High-precision ECEF Z coordinate of the ARP position. |
| Accepted range is -99 to +99. This will only be used if CFG-TMODE-MODE=FIXED and CFG-TMODE-POS_TYPE=ECEF. | | | | | |
| *CFG-TMODE-LAT* | 0x40030009 | I4 | 1e-7 | deg | Latitude of the ARP position. |
| This will only be used if CFG-TMODE-MODE=FIXED and CFG-TMODE-POS_TYPE=LLH. | | | | | |
| *CFG-TMODE-LON* | 0x4003000a | I4 | 1e-7 | deg | Longitude of the ARP position. |
| This will only be used if CFG-TMODE-MODE=FIXED and CFG-TMODE-POS_TYPE=LLH. | | | | | |
| *CFG-TMODE-HEIGHT* | 0x4003000b | I4 | - | cm | Height of the ARP position. |
| This will only be used if CFG-TMODE-MODE=FIXED and CFG-TMODE-POS_TYPE=LLH. | | | | | |
| *CFG-TMODE-LAT_HP* | 0x2003000c | I1 | 1e-9 | deg | High-precision latitude of the ARP position |
| Accepted range is -99 to +99. This will only be used if CFG-TMODE-MODE=FIXED and CFG-TMODE-POS_TYPE=LLH. | | | | | |
| *CFG-TMODE-LON_HP* | 0x2003000d | I1 | 1e-9 | deg | High-precision longitude of the ARP position. |
| Accepted range is -99 to +99. This will only be used if CFG-TMODE-MODE=FIXED and CFG-TMODE-POS_TYPE=LLH. | | | | | |
| *CFG-TMODE-HEIGHT_HP* | 0x2003000e | I1 | 0.1 | mm | High-precision height of the ARP position. |
| Accepted range is -99 to +99. This will only be used if CFG-TMODE-MODE=FIXED and CFG-TMODE-POS_TYPE=LLH. | | | | | |
| *CFG-TMODE-FIXED_POS_ACC* | 0x4003000f | U4 | 0.1 | mm | Fixed position 3D accuracy |
| *CFG-TMODE-SVIN_MIN_DUR* | 0x40030010 | U4 | - | s | Survey-in minimum duration |
| This will only be used if CFG-TMODE-MODE=SURVEY_IN. | | | | | |
| *CFG-TMODE-SVIN_ACC_LIMIT* | 0x40030011 | U4 | 0.1 | mm | Survey-in position accuracy limit |
| This will only be used if CFG-TMODE-MODE=SURVEY_IN. | | | | | |

**Table 43: CFG-TMODE configuration items**

| Constant | Value | Description |
|---|---|---|
| *DISABLED* | 0 | Disabled |
| *SURVEY_IN* | 1 | Survey in |
| *FIXED* | 2 | Fixed mode (true ARP position information required) |

**Table 44: Constants for CFG-TMODE-MODE**

| Constant | Value | Description |
|---|---|---|
| *ECEF* | 0 | Position is ECEF |

| Constant | Value | Description |
|---|---|---|
| *LLH* | 1 | Position is Lat/Lon/Height |

**Table 45: Constants for CFG-TMODE-POS_TYPE**

## 5.9.26 CFG-TP: Timepulse configuration

Use this group to configure the generation of timepulses.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-TP-PULSE_DEF* | 0x20050023 | E1 | - | - | Determines whether the time pulse is interpreted as frequency or period |
| See Table 47 below for a list of possible constants for this item. | | | | | |
| *CFG-TP-PULSE_LENGTH_DEF* | 0x20050030 | E1 | - | - | Determines whether the time pulse length is interpreted as length[us] or pulse ratio[%] |
| See Table 48 below for a list of possible constants for this item. | | | | | |
| *CFG-TP-ANT_CABLEDELAY* | 0x30050001 | I2 | 1e-9 | s | Antenna cable delay |
| *CFG-TP-PERIOD_TP1* | 0x40050002 | U4 | 1e-6 | s | Time pulse period (TP1) |
| *CFG-TP-PERIOD_LOCK_TP1* | 0x40050003 | U4 | 1e-6 | s | Time pulse period when locked to GNSS time (TP1) |
| Only used if CFG-TP-USE_LOCKED_TP1 is set. | | | | | |
| *CFG-TP-FREQ_TP1* | 0x40050024 | U4 | - | Hz | Time pulse frequency (TP1) |
| This will only be used if CFG-TP-PULSE_DEF=FREQ. | | | | | |
| *CFG-TP-FREQ_LOCK_TP1* | 0x40050025 | U4 | - | Hz | Time pulse frequency when locked to GNSS time (TP1) |
| Only used if CFG-TP-USE_LOCKED_TP1 is set. | | | | | |
| *CFG-TP-LEN_TP1* | 0x40050004 | U4 | 1e-6 | s | Time pulse length (TP1) |
| *CFG-TP-LEN_LOCK_TP1* | 0x40050005 | U4 | 1e-6 | s | Time pulse length when locked to GNSS time (TP1) |
| Only used if CFG-TP-USE_LOCKED_TP1 is set. | | | | | |
| *CFG-TP-DUTY_TP1* | 0x5005002a | R8 | - | % | Time pulse duty cycle (TP1) |
| Only used if CFG-TP-PULSE_LENGTH_DEF=RATIO is set. | | | | | |
| *CFG-TP-DUTY_LOCK_TP1* | 0x5005002b | R8 | - | % | Time pulse duty cycle when locked to GNSS time (TP1) |
| Only used if CFG-TP-PULSE_LENGTH_DEF=RATIO and CFG-TP-USE_LOCKED_TP1 are set. | | | | | |
| *CFG-TP-USER_DELAY_TP1* | 0x40050006 | I4 | 1e-9 | s | User-configurable time pulse delay (TP1) |
| *CFG-TP-TP1_ENA* | 0x10050007 | L | - | - | Enable the first timepulse |
| if pin associated with time pulse is assigned for another function, the other function takes precedence.<br>Must be set for frequency-time products. | | | | | |
| *CFG-TP-SYNC_GNSS_TP1* | 0x10050008 | L | - | - | Sync time pulse to GNSS time or local clock (TP1) |
| If set, sync to GNSS if GNSS time is valid otherwise, if not set or not available, use local clock.<br>Ignored by time-frequency product variants, which will attempt to use the best available time/frequency reference (not necessarily GNSS).<br>This flag can be unset only in Timing product variants. | | | | | |
| *CFG-TP-USE_LOCKED_TP1* | 0x10050009 | L | - | - | Use locked parameters when possible (TP1) |
| If set, use CFG-TP-PERIOD_LOCK_TP1 and CFG-TP-LEN_LOCK_TP1 as soon as GNSS time is valid. Otherwise if not valid or not set, use CFG-TP-PERIOD_TP1 and CFG-TP-LEN_TP1. | | | | | |
| *CFG-TP-ALIGN_TO_TOW_TP1* | 0x1005000a | L | - | - | Align time pulse to top of second (TP1) |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| To use this feature, CFG-TP-USE_LOCKED_TP1 must be set.<br>Time pulse period must be an integer fraction of 1 second.<br>Ignored in time-frequency product variants, where it is assumed always enabled. | | | | | |
| *CFG-TP-POL_TP1* | 0x1005000b | L | - | - | Set time pulse polarity (TP1) |
| false (0) : falling edge at top of second.<br>true (1) : rising edge at top of second. | | | | | |
| *CFG-TP-TIMEGRID_TP1* | 0x2005000c | E1 | - | - | Time grid to use (TP1) |
| Only relevant if CFG-TP-USE_LOCKED_TP1 and ALIGN_TO_TOW_TP1 are set.<br>Note that configured GNSS time is estimated by the receiver if locked to any GNSS system. If the receiver has a valid GNSS fix it will attempt to steer the TP to the specified time grid even if the specified time is not based on information from the constellation's satellites. To ensure timing based purely on a given GNSS, restrict the supported constellations in CFG-SIGNAL-*.<br>See Table 49 below for a list of possible constants for this item. | | | | | |

**Table 46: CFG-TP configuration items**

| Constant | Value | Description |
|---|---|---|
| *PERIOD* | 0 | Time pulse period [us] |
| *FREQ* | 1 | Time pulse frequency [Hz] |

**Table 47: Constants for CFG-TP-PULSE_DEF**

| Constant | Value | Description |
|---|---|---|
| *RATIO* | 0 | Time pulse ratio |
| *LENGTH* | 1 | Time pulse length |

**Table 48: Constants for CFG-TP-PULSE_LENGTH_DEF**

| Constant | Value | Description |
|---|---|---|
| *UTC* | 0 | UTC time reference |
| *GPS* | 1 | GPS time reference |
| *GLO* | 2 | GLONASS time reference |
| *BDS* | 3 | BeiDou time reference |
| *GAL* | 4 | Galileo time reference |

**Table 49: Constants for CFG-TP-TIMEGRID_TP1**

## 5.9.27 CFG-TXREADY: TX ready configuration

Configuration of the TX ready pin.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-TXREADY-ENABLED* | 0x10a20001 | L | - | - | Flag to indicate if TX ready pin mechanism should be enabled |
| *CFG-TXREADY-POLARITY* | 0x10a20002 | L | - | - | The polarity of the TX ready pin: false:high-active, true:low-active |
| *CFG-TXREADY-PIN* | 0x20a20003 | U1 | - | - | Pin number to use for the TX ready functionality |
| *CFG-TXREADY-THRESHOLD* | 0x30a20004 | U2 | - | - | Amount of data that should be ready on the interface before triggering the TX ready pin |
| *CFG-TXREADY-INTERFACE* | 0x20a20005 | E1 | - | - | Interface where the TX ready feature should be linked to |
| See Table 51 below for a list of possible constants for this item. | | | | | |

**Table 50: CFG-TXREADY configuration items**

| Constant | Value | Description |
|---|---|---|
| *I2C* | 0 | I2C interface |
| *SPI* | 1 | SPI interface |

**Table 51: Constants for CFG-TXREADY-INTERFACE**

## 5.9.28 CFG-UART1: Configuration of the UART1 interface

Settings needed to configure the UART1 communication interface.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-UART1-BAUDRATE* | 0x40520001 | U4 | - | - | The baud rate that should be configured on the UART1 |
| *CFG-UART1-STOPBITS* | 0x20520002 | E1 | - | - | Number of stopbits that should be used on UART1<br>See Table 53 below for a list of possible constants for this item. |
| *CFG-UART1-DATABITS* | 0x20520003 | E1 | - | - | Number of databits that should be used on UART1<br>See Table 54 below for a list of possible constants for this item. |
| *CFG-UART1-PARITY* | 0x20520004 | E1 | - | - | Parity mode that should be used on UART1<br>See Table 55 below for a list of possible constants for this item. |
| *CFG-UART1-ENABLED* | 0x10520005 | L | - | - | Flag to indicate if the UART1 should be enabled |

**Table 52: CFG-UART1 configuration items**

| Constant | Value | Description |
|---|---|---|
| *HALF* | 0 | 0.5 stopbits |
| *ONE* | 1 | 1.0 stopbits |
| *ONEHALF* | 2 | 1.5 stopbits |
| *TWO* | 3 | 2.0 stopbits |

**Table 53: Constants for CFG-UART1-STOPBITS**

| Constant | Value | Description |
|---|---|---|
| *EIGHT* | 0 | 8 databits |
| *SEVEN* | 1 | 7 databits |

**Table 54: Constants for CFG-UART1-DATABITS**

| Constant | Value | Description |
|---|---|---|
| *NONE* | 0 | No parity bit |
| *ODD* | 1 | Add an odd parity bit |
| *EVEN* | 2 | Add an even parity bit |

**Table 55: Constants for CFG-UART1-PARITY**

## 5.9.29 CFG-UART1INPROT: Input protocol configuration of the UART1 interface

Input protocol enable flags of the UART1 interface.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-UART1INPROT-UBX* | 0x10730001 | L | - | - | Flag to indicate if UBX should be an input protocol on UART1 |
| *CFG-UART1INPROT-NMEA* | 0x10730002 | L | - | - | Flag to indicate if NMEA should be an input protocol on UART1 |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-UART1INPROT-RTCM3X* | 0x10730004 | L | - | - | Flag to indicate if RTCM3X should be an input protocol on UART1 |

**Table 56: CFG-UART1INPROT configuration items**

## 5.9.30 CFG-UART1OUTPROT: Output protocol configuration of the UART1 interface

Output protocol enable flags of the UART1 interface.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-UART1OUTPROT-UBX* | 0x10740001 | L | - | - | Flag to indicate if UBX should be an output protocol on UART1 |
| *CFG-UART1OUTPROT-NMEA* | 0x10740002 | L | - | - | Flag to indicate if NMEA should be an output protocol on UART1 |
| *CFG-UART1OUTPROT-RTCM3X* | 0x10740004 | L | - | - | Flag to indicate if RTCM3X should be an output protocol on UART1 |

**Table 57: CFG-UART1OUTPROT configuration items**

## 5.9.31 CFG-UART2: Configuration of the UART2 interface

Settings needed to configure the UART2 communication interface.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-UART2-BAUDRATE* | 0x40530001 | U4 | - | - | The baud rate that should be configured on the UART2 |
| *CFG-UART2-STOPBITS* | 0x20530002 | E1 | - | - | Number of stopbits that should be used on UART2 |
| See Table 59 below for a list of possible constants for this item. | | | | | |
| *CFG-UART2-DATABITS* | 0x20530003 | E1 | - | - | Number of databits that should be used on UART2 |
| See Table 60 below for a list of possible constants for this item. | | | | | |
| *CFG-UART2-PARITY* | 0x20530004 | E1 | - | - | Parity mode that should be used on UART2 |
| See Table 61 below for a list of possible constants for this item. | | | | | |
| *CFG-UART2-ENABLED* | 0x10530005 | L | - | - | Flag to indicate if the UART2 should be enabled |
| *CFG-UART2-REMAP* | 0x10530006 | L | - | - | UART2 Remapping |

**Table 58: CFG-UART2 configuration items**

| Constant | Value | Description |
|---|---|---|
| *HALF* | 0 | 0.5 stopbits |
| *ONE* | 1 | 1.0 stopbits |
| *ONEHALF* | 2 | 1.5 stopbits |
| *TWO* | 3 | 2.0 stopbits |

**Table 59: Constants for CFG-UART2-STOPBITS**

| Constant | Value | Description |
|---|---|---|
| *EIGHT* | 0 | 8 databits |
| *SEVEN* | 1 | 7 databits |

**Table 60: Constants for CFG-UART2-DATABITS**

| Constant | Value | Description |
|---|---|---|
| *NONE* | 0 | No parity bit |

| Constant | Value | Description |
|---|---|---|
| *ODD* | 1 | Add an odd parity bit |
| *EVEN* | 2 | Add an even parity bit |

**Table 61: Constants for CFG-UART2-PARITY**

## 5.9.32 CFG-UART2INPROT: Input protocol configuration of the UART2 interface

Input protocol enable flags of the UART2 interface.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-UART2INPROT-UBX* | 0x10750001 | L | - | - | Flag to indicate if UBX should be an input protocol on UART2 |
| *CFG-UART2INPROT-NMEA* | 0x10750002 | L | - | - | Flag to indicate if NMEA should be an input protocol on UART2 |
| *CFG-UART2INPROT-RTCM3X* | 0x10750004 | L | - | - | Flag to indicate if RTCM3X should be an input protocol on UART2 |

**Table 62: CFG-UART2INPROT configuration items**

## 5.9.33 CFG-UART2OUTPROT: Output protocol configuration of the UART2 interface

Output protocol enable flags of the UART2 interface.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-UART2OUTPROT-UBX* | 0x10760001 | L | - | - | Flag to indicate if UBX should be an output protocol on UART2 |
| *CFG-UART2OUTPROT-NMEA* | 0x10760002 | L | - | - | Flag to indicate if NMEA should be an output protocol on UART2 |
| *CFG-UART2OUTPROT-RTCM3X* | 0x10760004 | L | - | - | Flag to indicate if RTCM3X should be an output protocol on UART2 |

**Table 63: CFG-UART2OUTPROT configuration items**

## 5.9.34 CFG-USB: Configuration of the USB interface

Settings needed to configure the USB communication interface.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-USB-ENABLED* | 0x10650001 | L | - | - | Flag to indicate if the USB interface should be enabled |
| *CFG-USB-SELFPOW* | 0x10650002 | L | - | - | Self-powered device |
| *CFG-USB-VENDOR_ID* | 0x3065000a | U2 | - | - | Vendor ID |
| *CFG-USB-PRODUCT_ID* | 0x3065000b | U2 | - | - | Vendor ID |
| *CFG-USB-POWER* | 0x3065000c | U2 | - | mA | Power consumption |
| *CFG-USB-VENDOR_STR0* | 0x5065000d | X8 | - | - | Vendor string characters 0-7 |
| *CFG-USB-VENDOR_STR1* | 0x5065000e | X8 | - | - | Vendor string characters 8-15 |
| *CFG-USB-VENDOR_STR2* | 0x5065000f | X8 | - | - | Vendor string characters 16-23 |
| *CFG-USB-VENDOR_STR3* | 0x50650010 | X8 | - | - | Vendor string characters 24-31 |
| *CFG-USB-PRODUCT_STR0* | 0x50650011 | X8 | - | - | Product string characters 0-7 |
| *CFG-USB-PRODUCT_STR1* | 0x50650012 | X8 | - | - | Product string characters 8-15 |
| *CFG-USB-PRODUCT_STR2* | 0x50650013 | X8 | - | - | Product string characters 16-23 |
| *CFG-USB-PRODUCT_STR3* | 0x50650014 | X8 | - | - | Product string characters 24-31 |
| *CFG-USB-SERIAL_NO_STR0* | 0x50650015 | X8 | - | - | Serial number string characters 0-7 |

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-USB-SERIAL_NO_STR1* | 0x50650016 | X8 | - | - | Serial number string characters 8-15 |
| *CFG-USB-SERIAL_NO_STR2* | 0x50650017 | X8 | - | - | Serial number string characters 16-23 |
| *CFG-USB-SERIAL_NO_STR3* | 0x50650018 | X8 | - | - | Serial number string characters 24-31 |

**Table 64: CFG-USB configuration items**

### 5.9.35 CFG-USBINPROT: Input protocol configuration of the USB interface

Input protocol enable flags of the USB interface.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-USBINPROT-UBX* | 0x10770001 | L | - | - | Flag to indicate if UBX should be an input protocol on USB |
| *CFG-USBINPROT-NMEA* | 0x10770002 | L | - | - | Flag to indicate if NMEA should be an input protocol on USB |
| *CFG-USBINPROT-RTCM3X* | 0x10770004 | L | - | - | Flag to indicate if RTCM3X should be an input protocol on USB |

**Table 65: CFG-USBINPROT configuration items**

### 5.9.36 CFG-USBOUTPROT: Output protocol configuration of the USB interface

Output protocol enable flags of the USB interface.

| Configuration item | Key ID | Type | Scale | Unit | Description |
|---|---|---|---|---|---|
| *CFG-USBOUTPROT-UBX* | 0x10780001 | L | - | - | Flag to indicate if UBX should be an output protocol on USB |
| *CFG-USBOUTPROT-NMEA* | 0x10780002 | L | - | - | Flag to indicate if NMEA should be an output protocol on USB |
| *CFG-USBOUTPROT-RTCM3X* | 0x10780004 | L | - | - | Flag to indicate if RTCM3X should be an output protocol on USB |

**Table 66: CFG-USBOUTPROT configuration items**

## 5.10 Legacy UBX message fields reference

The following table lists the legacy UBX message fields and the corresponding configuration item. Note that the mapping from UBX-CFG message fields to configuration items is not necessarily 1:1 and that that some legacy UBX-CFG messages may not be available for certain products.

| UBX message and field | Configuration item(s) |
|---|---|
| **UBX-CFG-ANT** | |
| UBX-CFG-ANT.ocd | CFG-HW-ANT_CFG_OPENDET |
| UBX-CFG-ANT.pdwnOnSCD | CFG-HW-ANT_CFG_PWRDOWN |
| UBX-CFG-ANT.pinOCD | CFG-HW-ANT_SUP_OPEN_PIN |
| UBX-CFG-ANT.pinSCD | CFG-HW-ANT_SUP_SHORT_PIN |
| UBX-CFG-ANT.pinSwitch | CFG-HW-ANT_SUP_SWITCH_PIN |
| UBX-CFG-ANT.recovery | CFG-HW-ANT_CFG_RECOVER |
| UBX-CFG-ANT.scd | CFG-HW-ANT_CFG_SHORTDET |
| UBX-CFG-ANT.svcs | CFG-HW-ANT_CFG_VOLTCTRL |
| **UBX-CFG-DAT** | |
| UBX-CFG-DAT.dX | CFG-NAVSPG-USRDAT_DX |
| UBX-CFG-DAT.dY | CFG-NAVSPG-USRDAT_DY |
| UBX-CFG-DAT.dZ | CFG-NAVSPG-USRDAT_DZ |

| UBX message and field | Configuration item(s) |
|---|---|
| UBX-CFG-DAT.flat | CFG-NAVSPG-USRDAT_FLAT |
| UBX-CFG-DAT.majA | CFG-NAVSPG-USE_USRDAT, CFG-NAVSPG-USRDAT_MAJA |
| UBX-CFG-DAT.rotX | CFG-NAVSPG-USRDAT_ROTX |
| UBX-CFG-DAT.rotY | CFG-NAVSPG-USRDAT_ROTY |
| UBX-CFG-DAT.rotZ | CFG-NAVSPG-USRDAT_ROTZ |
| UBX-CFG-DAT.scale | CFG-NAVSPG-USRDAT_SCALE |
| **UBX-CFG-DGNSS** | |
| UBX-CFG-DGNSS.dgnssMode | CFG-NAVHPG-DGNSSMODE |
| **UBX-CFG-GEOFENCE** | |
| UBX-CFG-GEOFENCE.confLvl | CFG-GEOFENCE-CONFLVL |
| UBX-CFG-GEOFENCE.lat | CFG-GEOFENCE-FENCE1_LAT, CFG-GEOFENCE-FENCE2_LAT, CFG-GEOFENCE-FENCE3_LAT, CFG-GEOFENCE-FENCE4_LAT |
| UBX-CFG-GEOFENCE.lon | CFG-GEOFENCE-FENCE1_LON, CFG-GEOFENCE-FENCE2_LON, CFG-GEOFENCE-FENCE3_LON, CFG-GEOFENCE-FENCE4_LON |
| UBX-CFG-GEOFENCE.numFences | CFG-GEOFENCE-USE_FENCE1, CFG-GEOFENCE-USE_FENCE2, CFG-GEOFENCE-USE_FENCE3, CFG-GEOFENCE-USE_FENCE4 |
| UBX-CFG-GEOFENCE.pin | CFG-GEOFENCE-PIN |
| UBX-CFG-GEOFENCE.pinPolarity | CFG-GEOFENCE-PINPOL |
| UBX-CFG-GEOFENCE.pioEnabled | CFG-GEOFENCE-USE_PIO |
| UBX-CFG-GEOFENCE.radius | CFG-GEOFENCE-FENCE1_RAD, CFG-GEOFENCE-FENCE2_RAD, CFG-GEOFENCE-FENCE3_RAD, CFG-GEOFENCE-FENCE4_RAD |
| **UBX-CFG-GNSS** | |
| UBX-CFG-GNSS.gnssId | CFG-SIGNAL-GPS_ENA, CFG-SIGNAL-SBAS_ENA, CFG-SIGNAL-BDS_ENA, CFG-SIGNAL-QZSS_ENA, CFG-SIGNAL-GLO_ENA |
| **UBX-CFG-INF** | |
| UBX-CFG-INF.infMsgMask | CFG-INFMSG-UBX_I2C, CFG-INFMSG-UBX_UART1, CFG-INFMSG-UBX_UART2, CFG-INFMSG-UBX_USB, CFG-INFMSG-UBX_SPI, CFG-INFMSG-NMEA_I2C, CFG-INFMSG-NMEA_UART1, CFG-INFMSG-NMEA_UART2, CFG-INFMSG-NMEA_USB, CFG-INFMSG-NMEA_SPI |
| UBX-CFG-INF.protocolID | CFG-INFMSG-UBX_UART1, CFG-INFMSG-UBX_UART2, CFG-INFMSG-UBX_USB, CFG-INFMSG-UBX_SPI, CFG-INFMSG-NMEA_I2C, CFG-INFMSG-NMEA_UART1, CFG-INFMSG-NMEA_UART2, CFG-INFMSG-NMEA_USB, CFG-INFMSG-NMEA_SPI |
| **UBX-CFG-ITFM** | |
| UBX-CFG-ITFM.antSetting | CFG-ITFM-ANTSETTING |
| UBX-CFG-ITFM.bbThreshold | CFG-ITFM-BBTHRESHOLD |
| UBX-CFG-ITFM.cwThreshold | CFG-ITFM-CWTHRESHOLD |
| UBX-CFG-ITFM.enable | CFG-ITFM-ENABLE |
| UBX-CFG-ITFM.enable2 | CFG-ITFM-ENABLE_AUX |
| **UBX-CFG-LOGFILTER** | |
| UBX-CFG-LOGFILTER.applyAllFilterSettings | CFG-LOGFILTER-APPLY_ALL_FILTERS |
| UBX-CFG-LOGFILTER.minInterval | CFG-LOGFILTER-MIN_INTERVAL |
| UBX-CFG-LOGFILTER.positionThreshold | CFG-LOGFILTER-POSITION_THRS |

| UBX message and field | Configuration item(s) |
|---|---|
| UBX-CFG-LOGFILTER.psmOncePerWakupEnabled | CFG-LOGFILTER-ONCE_PER_WAKE_UP_ENA |
| UBX-CFG-LOGFILTER.recordEnabled | CFG-LOGFILTER-RECORD_ENA |
| UBX-CFG-LOGFILTER.speedThreshold | CFG-LOGFILTER-SPEED_THRS |
| UBX-CFG-LOGFILTER.timeThreshold | CFG-LOGFILTER-TIME_THRS |
| **UBX-CFG-MOT** | |
| UBX-CFG-MOT.gnssDistThdl | CFG-MOT-GNSSDIST_THRS |
| UBX-CFG-MOT.gnssSpeedThdl | CFG-MOT-GNSSSPEED_THRS |
| **UBX-CFG-NAV5** | |
| UBX-CFG-NAV5.cnoThresh | CFG-NAVSPG-INFIL_CNOTHRS |
| UBX-CFG-NAV5.cnoThreshNumSVs | CFG-NAVSPG-INFIL_NCNOTHRS |
| UBX-CFG-NAV5.dgnssTimeout | CFG-NAVSPG-CONSTR_DGNSSTO |
| UBX-CFG-NAV5.dynModel | CFG-NAVSPG-DYNMODEL |
| UBX-CFG-NAV5.fixMode | CFG-NAVSPG-FIXMODE |
| UBX-CFG-NAV5.fixedAlt | CFG-NAVSPG-CONSTR_ALT |
| UBX-CFG-NAV5.fixedAltVar | CFG-NAVSPG-CONSTR_ALTVAR |
| UBX-CFG-NAV5.minElev | CFG-NAVSPG-INFIL_MINELEV |
| UBX-CFG-NAV5.pAcc | CFG-NAVSPG-OUTFIL_PACC |
| UBX-CFG-NAV5.pDop | CFG-NAVSPG-OUTFIL_PDOP |
| UBX-CFG-NAV5.staticHoldMaxDist | CFG-MOT-GNSSDIST_THRS |
| UBX-CFG-NAV5.staticHoldThresh | CFG-MOT-GNSSSPEED_THRS |
| UBX-CFG-NAV5.tAcc | CFG-NAVSPG-OUTFIL_TACC, CFG-NAVSPG-OUTFIL_FACC |
| UBX-CFG-NAV5.tDop | CFG-NAVSPG-OUTFIL_TDOP |
| UBX-CFG-NAV5.utcStandard | CFG-NAVSPG-UTCSTANDARD |
| **UBX-CFG-NAVX5** | |
| UBX-CFG-NAVX5.ackAiding | CFG-NAVSPG-ACKAIDING |
| UBX-CFG-NAVX5.iniFix3D | CFG-NAVSPG-INIFIX3D |
| UBX-CFG-NAVX5.maxSVs | CFG-NAVSPG-INFIL_MAXSVS |
| UBX-CFG-NAVX5.minCNO | CFG-NAVSPG-INFIL_MINCNO |
| UBX-CFG-NAVX5.minSVs | CFG-NAVSPG-INFIL_MINSVS |
| UBX-CFG-NAVX5.wknRollover | CFG-NAVSPG-WKNROLLOVER |
| **UBX-CFG-NMEA** | |
| UBX-CFG-NMEA.bdsTalkerId | CFG-NMEA-BDSTALKERID |
| UBX-CFG-NMEA.beidou | CFG-NMEA-FILT_BDS |
| UBX-CFG-NMEA.compat | CFG-NMEA-COMPAT |
| UBX-CFG-NMEA.consider | CFG-NMEA-CONSIDER |
| UBX-CFG-NMEA.dateFilt | CFG-NMEA-OUT_INVDATE |
| UBX-CFG-NMEA.galileo | CFG-NMEA-FILT_GAL |
| UBX-CFG-NMEA.glonass | CFG-NMEA-FILT_GLO |
| UBX-CFG-NMEA.gps | CFG-NMEA-FILT_GPS |
| UBX-CFG-NMEA.gpsOnlyFilter | CFG-NMEA-OUT_ONLYGPS |
| UBX-CFG-NMEA.gsvTalkerId | CFG-NMEA-GSVTALKERID |
| UBX-CFG-NMEA.highPrec | CFG-NMEA-HIGHPREC |
| UBX-CFG-NMEA.limit82 | CFG-NMEA-LIMIT82 |
| UBX-CFG-NMEA.mainTalkerId | CFG-NMEA-MAINTALKERID |

| UBX message and field | Configuration item(s) |
|---|---|
| UBX-CFG-NMEA.mskPosFilt | CFG-NMEA-OUT_MSKFIX |
| UBX-CFG-NMEA.nmeaVersion | CFG-NMEA-PROTVER |
| UBX-CFG-NMEA.numSV | CFG-NMEA-MAXSVS |
| UBX-CFG-NMEA.posFilt | CFG-NMEA-OUT_INVFIX |
| UBX-CFG-NMEA.qzss | CFG-NMEA-FILT_QZSS |
| UBX-CFG-NMEA.sbas | CFG-NMEA-FILT_SBAS |
| UBX-CFG-NMEA.svNumbering | CFG-NMEA-SVNUMBERING |
| UBX-CFG-NMEA.timeFilt | CFG-NMEA-OUT_INVTIME |
| UBX-CFG-NMEA.trackFilt | CFG-NMEA-OUT_FROZENCOG |
| **UBX-CFG-ODO** | |
| UBX-CFG-ODO.cogLpGain | CFG-ODO-COGLPGAIN |
| UBX-CFG-ODO.cogMaxPosAcc | CFG-ODO-COGMAXPOSACC |
| UBX-CFG-ODO.cogMaxSpeed | CFG-ODO-COGMAXSPEED |
| UBX-CFG-ODO.outLPCog | CFG-ODO-OUTLPCOG |
| UBX-CFG-ODO.outLPVel | CFG-ODO-OUTLPVEL |
| UBX-CFG-ODO.profile | CFG-ODO-PROFILE |
| UBX-CFG-ODO.useCOG | CFG-ODO-USE_COG |
| UBX-CFG-ODO.useODO | CFG-ODO-USE_ODO |
| UBX-CFG-ODO.velLpGain | CFG-ODO-VELLPGAIN |
| **UBX-CFG-PRT** | |
| UBX-CFG-PRT.en | CFG-TXREADY-ENABLED |
| UBX-CFG-PRT.extendedTxTimeout | CFG-I2C-EXTENDEDTIMEOUT |
| UBX-CFG-PRT.inNmea | CFG-I2CINPROT-NMEA |
| UBX-CFG-PRT.inProtoMask | CFG-I2C-ENABLED |
| UBX-CFG-PRT.inRtcm3 | CFG-I2CINPROT-RTCM3X |
| UBX-CFG-PRT.inUbx | CFG-I2CINPROT-UBX |
| UBX-CFG-PRT.outNmea | CFG-I2COUTPROT-NMEA |
| UBX-CFG-PRT.outProtoMask | CFG-I2C-ENABLED |
| UBX-CFG-PRT.outRtcm3 | CFG-I2COUTPROT-RTCM3X |
| UBX-CFG-PRT.outUbx | CFG-I2COUTPROT-UBX |
| UBX-CFG-PRT.pin | CFG-TXREADY-PIN |
| UBX-CFG-PRT.pol | CFG-TXREADY-POLARITY |
| UBX-CFG-PRT.slaveAddr | CFG-I2C-ADDRESS |
| UBX-CFG-PRT.thres | CFG-TXREADY-THRESHOLD |
| UBX-CFG-PRT.en | CFG-TXREADY-ENABLED |
| UBX-CFG-PRT.extendedTxTimeout | CFG-SPI-EXTENDEDTIMEOUT |
| UBX-CFG-PRT.ffCnt | CFG-SPI-MAXFF |
| UBX-CFG-PRT.inNmea | CFG-SPIINPROT-NMEA |
| UBX-CFG-PRT.inProtoMask | CFG-SPI-ENABLED |
| UBX-CFG-PRT.inRtcm3 | CFG-SPIINPROT-RTCM3X |
| UBX-CFG-PRT.inUbx | CFG-SPIINPROT-UBX |
| UBX-CFG-PRT.outNmea | CFG-SPIOUTPROT-NMEA |
| UBX-CFG-PRT.outProtoMask | CFG-SPI-ENABLED |
| UBX-CFG-PRT.outRtcm3 | CFG-SPIOUTPROT-RTCM3X |

| UBX message and field | Configuration item(s) |
|---|---|
| UBX-CFG-PRT.outUbx | CFG-SPIOUTPROT-UBX |
| UBX-CFG-PRT.pin | CFG-TXREADY-PIN |
| UBX-CFG-PRT.pol | CFG-TXREADY-POLARITY |
| UBX-CFG-PRT.spiMode | CFG-SPI-CPOLARITY, CFG-SPI-CPHASE |
| UBX-CFG-PRT.thres | CFG-TXREADY-THRESHOLD |
| UBX-CFG-PRT.baudRate | CFG-UART1-BAUDRATE, CFG-UART2-BAUDRATE |
| UBX-CFG-PRT.charLen | CFG-UART1-DATABITS, CFG-UART2-DATABITS |
| UBX-CFG-PRT.inNmea | CFG-UART1INPROT-NMEA, CFG-UART2INPROT-NMEA |
| UBX-CFG-PRT.inProtoMask | CFG-UART1-ENABLED, CFG-UART2-ENABLED |
| UBX-CFG-PRT.inRtcm3 | CFG-UART1INPROT-RTCM3X, CFG-UART2INPROT-RTCM3X |
| UBX-CFG-PRT.inUbx | CFG-UART1INPROT-UBX, CFG-UART2INPROT-UBX |
| UBX-CFG-PRT.nStopBits | CFG-UART1-STOPBITS, CFG-UART2-STOPBITS |
| UBX-CFG-PRT.outNmea | CFG-UART1OUTPROT-NMEA, CFG-UART2OUTPROT-NMEA |
| UBX-CFG-PRT.outProtoMask | CFG-UART1-ENABLED, CFG-UART2-ENABLED |
| UBX-CFG-PRT.outRtcm3 | CFG-UART1OUTPROT-RTCM3X, CFG-UART2OUTPROT-RTCM3X |
| UBX-CFG-PRT.outUbx | CFG-UART1OUTPROT-UBX, CFG-UART2OUTPROT-UBX |
| UBX-CFG-PRT.parity | CFG-UART1-PARITY, CFG-UART2-PARITY |
| UBX-CFG-PRT.inNmea | CFG-USBINPROT-NMEA |
| UBX-CFG-PRT.inProtoMask | CFG-USB-ENABLED |
| UBX-CFG-PRT.inRtcm3 | CFG-USBINPROT-RTCM3X |
| UBX-CFG-PRT.inUbx | CFG-USBINPROT-UBX |
| UBX-CFG-PRT.outNmea | CFG-USBOUTPROT-NMEA |
| UBX-CFG-PRT.outProtoMask | CFG-USB-ENABLED |
| UBX-CFG-PRT.outRtcm3 | CFG-USBOUTPROT-RTCM3X |
| UBX-CFG-PRT.outUbx | CFG-USBOUTPROT-UBX |
| **UBX-CFG-RATE** | |
| UBX-CFG-RATE.measRate | CFG-RATE-MEAS |
| UBX-CFG-RATE.navRate | CFG-RATE-NAV |
| UBX-CFG-RATE.timeRef | CFG-RATE-TIMEREF |
| **UBX-CFG-RINV** | |
| UBX-CFG-RINV.data | CFG-RINV-DATA_SIZE, CFG-RINV-CHUNK0, CFG-RINV-CHUNK1, CFG-RINV-CHUNK2, CFG-RINV-CHUNK3 |
| UBX-CFG-RINV.flags | CFG-RINV-DUMP, CFG-RINV-BINARY |
| **UBX-CFG-SBAS** | |
| UBX-CFG-SBAS.diffCorr | CFG-SBAS-USE_DIFFCORR |
| UBX-CFG-SBAS.integrity | CFG-SBAS-USE_INTEGRITY |
| UBX-CFG-SBAS.range | CFG-SBAS-USE_RANGING |
| UBX-CFG-SBAS.scanmode1 | CFG-SBAS-PRNSCANMASK |
| UBX-CFG-SBAS.test | CFG-SBAS-USE_TESTMODE |
| **UBX-CFG-SLAS** | |
| UBX-CFG-SLAS.enabled | CFG-QZSS-USE_SLAS_DGNSS |
| UBX-CFG-SLAS.raim | CFG-QZSS-USE_SLAS_RAIM_UNCORR |
| UBX-CFG-SLAS.test | CFG-QZSS-USE_SLAS_TESTMODE |

| UBX message and field | Configuration item(s) |
|---|---|
| **UBX-CFG-TMODE3** | |
| UBX-CFG-TMODE3.ecefXOrLat | CFG-TMODE-ECEF_X, CFG-TMODE-LAT |
| UBX-CFG-TMODE3.ecefXOrLatHP | CFG-TMODE-ECEF_X_HP, CFG-TMODE-LAT_HP |
| UBX-CFG-TMODE3.ecefYOrLon | CFG-TMODE-ECEF_Y, CFG-TMODE-LON |
| UBX-CFG-TMODE3.ecefYOrLonHP | CFG-TMODE-ECEF_Y_HP, CFG-TMODE-LON_HP |
| UBX-CFG-TMODE3.ecefZOrAlt | CFG-TMODE-ECEF_Z, CFG-TMODE-HEIGHT |
| UBX-CFG-TMODE3.ecefZOrAltHP | CFG-TMODE-ECEF_Z_HP, CFG-TMODE-HEIGHT_HP |
| UBX-CFG-TMODE3.fixedPosAcc | CFG-TMODE-FIXED_POS_ACC |
| UBX-CFG-TMODE3.flags | CFG-TMODE-MODE, CFG-TMODE-POS_TYPE |
| UBX-CFG-TMODE3.svinAccLimit | CFG-TMODE-SVIN_ACC_LIMIT |
| UBX-CFG-TMODE3.svinMinDur | CFG-TMODE-SVIN_MIN_DUR |
| **UBX-CFG-TP5** | |
| UBX-CFG-TP5.active | CFG-TP-TP1_ENA |
| UBX-CFG-TP5.alignToTow | CFG-TP-ALIGN_TO_TOW_TP1 |
| UBX-CFG-TP5.antCableDelay | CFG-TP-ANT_CABLEDELAY |
| UBX-CFG-TP5.freqPeriod | CFG-TP-PERIOD_TP1, CFG-TP-FREQ_TP1 |
| UBX-CFG-TP5.freqPeriodLock | CFG-TP-PERIOD_LOCK_TP1, CFG-TP-FREQ_LOCK_TP1 |
| UBX-CFG-TP5.gridUtcGnss | CFG-TP-TIMEGRID_TP1 |
| UBX-CFG-TP5.isFreq | CFG-TP-PULSE_DEF |
| UBX-CFG-TP5.isLength | CFG-TP-PULSE_LENGTH_DEF |
| UBX-CFG-TP5.lockGnssFreq | CFG-TP-SYNC_GNSS_TP1 |
| UBX-CFG-TP5.lockedOtherSet | CFG-TP-USE_LOCKED_TP1 |
| UBX-CFG-TP5.polarity | CFG-TP-POL_TP1 |
| UBX-CFG-TP5.pulseLenRatio | CFG-TP-LEN_TP1, CFG-TP-DUTY_TP1 |
| UBX-CFG-TP5.pulseLenRatioLock | CFG-TP-LEN_LOCK_TP1, CFG-TP-DUTY_LOCK_TP1 |
| UBX-CFG-TP5.userConfigDelay | CFG-TP-USER_DELAY_TP1 |
| **UBX-CFG-USB** | |
| UBX-CFG-USB.powerConsumption | CFG-USB-POWER |
| UBX-CFG-USB.powerMode | CFG-USB-SELFPOW |
| UBX-CFG-USB.productID | CFG-USB-PRODUCT_ID |
| UBX-CFG-USB.productString | CFG-USB-PRODUCT_STR0, CFG-USB-PRODUCT_STR1, CFG-USB-PRODUCT_STR2, CFG-USB-PRODUCT_STR3 |
| UBX-CFG-USB.serialNumber | CFG-USB-SERIAL_NO_STR0, CFG-USB-SERIAL_NO_STR1, CFG-USB-SERIAL_NO_STR2, CFG-USB-SERIAL_NO_STR3 |
| UBX-CFG-USB.vendorID | CFG-USB-VENDOR_ID |
| UBX-CFG-USB.vendorString | CFG-USB-VENDOR_STR0, CFG-USB-VENDOR_STR1, CFG-USB-VENDOR_STR2, CFG-USB-VENDOR_STR3 |

**Table 67: Legacy UBX message fields and the corresponding configuration items**

# Configuration defaults

The following tables contain the configuration defaults for the product firmware version *HPG 1.13*.

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-BDS-USE_PRN_1_TO_5 | 0x10340014 | L | - | - | 0 (false) |

**Table 68: CFG-BDS configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-GEOFENCE-CONFLVL | 0x20240011 | E1 | - | - | 0 (L000) |
| CFG-GEOFENCE-USE_PIO | 0x10240012 | L | - | - | 0 (false) |
| CFG-GEOFENCE-PINPOL | 0x20240013 | E1 | - | - | 0 (LOW_IN) |
| CFG-GEOFENCE-PIN | 0x20240014 | U1 | - | - | 3 |
| CFG-GEOFENCE-USE_FENCE1 | 0x10240020 | L | - | - | 0 (false) |
| CFG-GEOFENCE-FENCE1_LAT | 0x40240021 | I4 | 1e-7 | deg | 0 |
| CFG-GEOFENCE-FENCE1_LON | 0x40240022 | I4 | 1e-7 | deg | 0 |
| CFG-GEOFENCE-FENCE1_RAD | 0x40240023 | U4 | 0.01 | m | 0 |
| CFG-GEOFENCE-USE_FENCE2 | 0x10240030 | L | - | - | 0 (false) |
| CFG-GEOFENCE-FENCE2_LAT | 0x40240031 | I4 | 1e-7 | deg | 0 |
| CFG-GEOFENCE-FENCE2_LON | 0x40240032 | I4 | 1e-7 | deg | 0 |
| CFG-GEOFENCE-FENCE2_RAD | 0x40240033 | U4 | 0.01 | m | 0 |
| CFG-GEOFENCE-USE_FENCE3 | 0x10240040 | L | - | - | 0 (false) |
| CFG-GEOFENCE-FENCE3_LAT | 0x40240041 | I4 | 1e-7 | deg | 0 |
| CFG-GEOFENCE-FENCE3_LON | 0x40240042 | I4 | 1e-7 | deg | 0 |
| CFG-GEOFENCE-FENCE3_RAD | 0x40240043 | U4 | 0.01 | m | 0 |
| CFG-GEOFENCE-USE_FENCE4 | 0x10240050 | L | - | - | 0 (false) |
| CFG-GEOFENCE-FENCE4_LAT | 0x40240051 | I4 | 1e-7 | deg | 0 |
| CFG-GEOFENCE-FENCE4_LON | 0x40240052 | I4 | 1e-7 | deg | 0 |
| CFG-GEOFENCE-FENCE4_RAD | 0x40240053 | U4 | 0.01 | m | 0 |

**Table 69: CFG-GEOFENCE configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-HW-ANT_CFG_VOLTCTRL | 0x10a3002e | L | - | - | 0 (false) |
| CFG-HW-ANT_CFG_SHORTDET | 0x10a3002f | L | - | - | 0 (false) |
| CFG-HW-ANT_CFG_SHORTDET_POL | 0x10a30030 | L | - | - | 1 (true) |
| CFG-HW-ANT_CFG_OPENDET | 0x10a30031 | L | - | - | 0 (false) |
| CFG-HW-ANT_CFG_OPENDET_POL | 0x10a30032 | L | - | - | 1 (true) |
| CFG-HW-ANT_CFG_PWRDOWN | 0x10a30033 | L | - | - | 0 (false) |
| CFG-HW-ANT_CFG_PWRDOWN_POL | 0x10a30034 | L | - | - | 1 (true) |
| CFG-HW-ANT_CFG_RECOVER | 0x10a30035 | L | - | - | 0 (false) |
| CFG-HW-ANT_SUP_SWITCH_PIN | 0x20a30036 | U1 | - | - | 16 |
| CFG-HW-ANT_SUP_SHORT_PIN | 0x20a30037 | U1 | - | - | 15 |
| CFG-HW-ANT_SUP_OPEN_PIN | 0x20a30038 | U1 | - | - | 8 |
| CFG-HW-ANT_SUP_ENGINE | 0x20a30054 | E1 | - | - | 0 (EXT) |

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-HW-ANT_SUP_SHORT_THR | 0x20a30055 | U1 | - | mV | 0 |
| CFG-HW-ANT_SUP_OPEN_THR | 0x20a30056 | U1 | - | mV | 0 |

**Table 70: CFG-HW configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-I2C-ADDRESS | 0x20510001 | U1 | - | - | 132 |
| CFG-I2C-EXTENDEDTIMEOUT | 0x10510002 | L | - | - | 0 (false) |
| CFG-I2C-ENABLED | 0x10510003 | L | - | - | 1 (true) |

**Table 71: CFG-I2C configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-I2CINPROT-UBX | 0x10710001 | L | - | - | 1 (true) |
| CFG-I2CINPROT-NMEA | 0x10710002 | L | - | - | 1 (true) |
| CFG-I2CINPROT-RTCM3X | 0x10710004 | L | - | - | 1 (true) |

**Table 72: CFG-I2CINPROT configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-I2COUTPROT-UBX | 0x10720001 | L | - | - | 1 (true) |
| CFG-I2COUTPROT-NMEA | 0x10720002 | L | - | - | 1 (true) |
| CFG-I2COUTPROT-RTCM3X | 0x10720004 | L | - | - | 1 (true) |

**Table 73: CFG-I2COUTPROT configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-INFMSG-UBX_I2C | 0x20920001 | X1 | - | - | 0x00 |
| CFG-INFMSG-UBX_UART1 | 0x20920002 | X1 | - | - | 0x00 |
| CFG-INFMSG-UBX_UART2 | 0x20920003 | X1 | - | - | 0x00 |
| CFG-INFMSG-UBX_USB | 0x20920004 | X1 | - | - | 0x00 |
| CFG-INFMSG-UBX_SPI | 0x20920005 | X1 | - | - | 0x00 |
| CFG-INFMSG-NMEA_I2C | 0x20920006 | X1 | - | - | 0x07 (ERROR \| WARNING \| NOTICE) |
| CFG-INFMSG-NMEA_UART1 | 0x20920007 | X1 | - | - | 0x07 (ERROR \| WARNING \| NOTICE) |
| CFG-INFMSG-NMEA_UART2 | 0x20920008 | X1 | - | - | 0x07 (ERROR \| WARNING \| NOTICE) |
| CFG-INFMSG-NMEA_USB | 0x20920009 | X1 | - | - | 0x07 (ERROR \| WARNING \| NOTICE) |
| CFG-INFMSG-NMEA_SPI | 0x2092000a | X1 | - | - | 0x07 (ERROR \| WARNING \| NOTICE) |

**Table 74: CFG-INFMSG configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-ITFM-BBTHRESHOLD | 0x20410001 | U1 | - | - | 3 |
| CFG-ITFM-CWTHRESHOLD | 0x20410002 | U1 | - | - | 15 |
| CFG-ITFM-ENABLE | 0x1041000d | L | - | - | 0 (false) |
| CFG-ITFM-ANTSETTING | 0x20410010 | E1 | - | - | 0 (UNKNOWN) |
| CFG-ITFM-ENABLE_AUX | 0x10410013 | L | - | - | 0 (false) |

**Table 75: CFG-ITFM configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-LOGFILTER-RECORD_ENA | 0x10de0002 | L | - | - | 0 (false) |
| CFG-LOGFILTER-ONCE_PER_WAKE_UP_ENA | 0x10de0003 | L | - | - | 0 (false) |
| CFG-LOGFILTER-APPLY_ALL_FILTERS | 0x10de0004 | L | - | - | 0 (false) |
| CFG-LOGFILTER-MIN_INTERVAL | 0x30de0005 | U2 | - | s | 0 |
| CFG-LOGFILTER-TIME_THRS | 0x30de0006 | U2 | - | s | 0 |
| CFG-LOGFILTER-SPEED_THRS | 0x30de0007 | U2 | - | m/s | 0 |
| CFG-LOGFILTER-POSITION_THRS | 0x40de0008 | U4 | - | m | 0 |

**Table 76: CFG-LOGFILTER configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-MOT-GNSSSPEED_THRS | 0x20250038 | U1 | 0.01 | m/s | 0 |
| CFG-MOT-GNSSDIST_THRS | 0x3025003b | U2 | - | - | 0 |

**Table 77: CFG-MOT configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-MSGOUT-NMEA_ID_DTM_I2C | 0x209100a6 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_DTM_SPI | 0x209100aa | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_DTM_UART1 | 0x209100a7 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_DTM_UART2 | 0x209100a8 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_DTM_USB | 0x209100a9 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GBS_I2C | 0x209100dd | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GBS_SPI | 0x209100e1 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GBS_UART1 | 0x209100de | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GBS_UART2 | 0x209100df | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GBS_USB | 0x209100e0 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GGA_I2C | 0x209100ba | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GGA_SPI | 0x209100be | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GGA_UART1 | 0x209100bb | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GGA_UART2 | 0x209100bc | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GGA_USB | 0x209100bd | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GLL_I2C | 0x209100c9 | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GLL_SPI | 0x209100cd | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GLL_UART1 | 0x209100ca | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GLL_UART2 | 0x209100cb | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GLL_USB | 0x209100cc | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GNS_I2C | 0x209100b5 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GNS_SPI | 0x209100b9 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GNS_UART1 | 0x209100b6 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GNS_UART2 | 0x209100b7 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GNS_USB | 0x209100b8 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GRS_I2C | 0x209100ce | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GRS_SPI | 0x209100d2 | U1 | - | - | 0 |

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-MSGOUT-NMEA_ID_GRS_UART1 | 0x209100cf | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GRS_UART2 | 0x209100d0 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GRS_USB | 0x209100d1 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GSA_I2C | 0x209100bf | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GSA_SPI | 0x209100c3 | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GSA_UART1 | 0x209100c0 | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GSA_UART2 | 0x209100c1 | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GSA_USB | 0x209100c2 | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GST_I2C | 0x209100d3 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GST_SPI | 0x209100d7 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GST_UART1 | 0x209100d4 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GST_UART2 | 0x209100d5 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GST_USB | 0x209100d6 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_GSV_I2C | 0x209100c4 | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GSV_SPI | 0x209100c8 | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GSV_UART1 | 0x209100c5 | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GSV_UART2 | 0x209100c6 | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_GSV_USB | 0x209100c7 | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_RLM_I2C | 0x20910400 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_RLM_SPI | 0x20910404 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_RLM_UART1 | 0x20910401 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_RLM_UART2 | 0x20910402 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_RLM_USB | 0x20910403 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_RMC_I2C | 0x209100ab | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_RMC_SPI | 0x209100af | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_RMC_UART1 | 0x209100ac | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_RMC_UART2 | 0x209100ad | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_RMC_USB | 0x209100ae | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_VLW_I2C | 0x209100e7 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_VLW_SPI | 0x209100eb | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_VLW_UART1 | 0x209100e8 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_VLW_UART2 | 0x209100e9 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_VLW_USB | 0x209100ea | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_VTG_I2C | 0x209100b0 | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_VTG_SPI | 0x209100b4 | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_VTG_UART1 | 0x209100b1 | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_VTG_UART2 | 0x209100b2 | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_VTG_USB | 0x209100b3 | U1 | - | - | 1 |
| CFG-MSGOUT-NMEA_ID_ZDA_I2C | 0x209100d8 | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_ZDA_SPI | 0x209100dc | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_ZDA_UART1 | 0x209100d9 | U1 | - | - | 0 |

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-MSGOUT-NMEA_ID_ZDA_UART2 | 0x209100da | U1 | - | - | 0 |
| CFG-MSGOUT-NMEA_ID_ZDA_USB | 0x209100db | U1 | - | - | 0 |
| CFG-MSGOUT-PUBX_ID_POLYP_I2C | 0x209100ec | U1 | - | - | 0 |
| CFG-MSGOUT-PUBX_ID_POLYP_SPI | 0x209100f0 | U1 | - | - | 0 |
| CFG-MSGOUT-PUBX_ID_POLYP_UART1 | 0x209100ed | U1 | - | - | 0 |
| CFG-MSGOUT-PUBX_ID_POLYP_UART2 | 0x209100ee | U1 | - | - | 0 |
| CFG-MSGOUT-PUBX_ID_POLYP_USB | 0x209100ef | U1 | - | - | 0 |
| CFG-MSGOUT-PUBX_ID_POLYS_I2C | 0x209100f1 | U1 | - | - | 0 |
| CFG-MSGOUT-PUBX_ID_POLYS_SPI | 0x209100f5 | U1 | - | - | 0 |
| CFG-MSGOUT-PUBX_ID_POLYS_UART1 | 0x209100f2 | U1 | - | - | 0 |
| CFG-MSGOUT-PUBX_ID_POLYS_UART2 | 0x209100f3 | U1 | - | - | 0 |
| CFG-MSGOUT-PUBX_ID_POLYS_USB | 0x209100f4 | U1 | - | - | 0 |
| CFG-MSGOUT-PUBX_ID_POLYT_I2C | 0x209100f6 | U1 | - | - | 0 |
| CFG-MSGOUT-PUBX_ID_POLYT_SPI | 0x209100fa | U1 | - | - | 0 |
| CFG-MSGOUT-PUBX_ID_POLYT_UART1 | 0x209100f7 | U1 | - | - | 0 |
| CFG-MSGOUT-PUBX_ID_POLYT_UART2 | 0x209100f8 | U1 | - | - | 0 |
| CFG-MSGOUT-PUBX_ID_POLYT_USB | 0x209100f9 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1005_I2C | 0x209102bd | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1005_SPI | 0x209102c1 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1005_UART1 | 0x209102be | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1005_UART2 | 0x209102bf | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1005_USB | 0x209102c0 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1074_I2C | 0x2091035e | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1074_SPI | 0x20910362 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1074_UART1 | 0x2091035f | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1074_UART2 | 0x20910360 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1074_USB | 0x20910361 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1077_I2C | 0x209102cc | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1077_SPI | 0x209102d0 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1077_UART1 | 0x209102cd | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1077_UART2 | 0x209102ce | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1077_USB | 0x209102cf | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1084_I2C | 0x20910363 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1084_SPI | 0x20910367 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1084_UART1 | 0x20910364 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1084_UART2 | 0x20910365 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1084_USB | 0x20910366 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1087_I2C | 0x209102d1 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1087_SPI | 0x209102d5 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1087_UART1 | 0x209102d2 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1087_UART2 | 0x209102d3 | U1 | - | - | 0 |

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-MSGOUT-RTCM_3X_TYPE1087_USB | 0x209102d4 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1094_I2C | 0x20910368 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1094_SPI | 0x2091036c | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1094_UART1 | 0x20910369 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1094_UART2 | 0x2091036a | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1094_USB | 0x2091036b | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1097_I2C | 0x20910318 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1097_SPI | 0x2091031c | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1097_UART1 | 0x20910319 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1097_UART2 | 0x2091031a | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1097_USB | 0x2091031b | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1124_I2C | 0x2091036d | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1124_SPI | 0x20910371 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1124_UART1 | 0x2091036e | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1124_UART2 | 0x2091036f | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1124_USB | 0x20910370 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1127_I2C | 0x209102d6 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1127_SPI | 0x209102da | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1127_UART1 | 0x209102d7 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1127_UART2 | 0x209102d8 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1127_USB | 0x209102d9 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1230_I2C | 0x20910303 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1230_SPI | 0x20910307 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1230_UART1 | 0x20910304 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1230_UART2 | 0x20910305 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE1230_USB | 0x20910306 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE4072_0_I2C | 0x209102fe | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE4072_0_SPI | 0x20910302 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE4072_0_UART1 | 0x209102ff | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE4072_0_UART2 | 0x20910300 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE4072_0_USB | 0x20910301 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE4072_1_I2C | 0x20910381 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE4072_1_SPI | 0x20910385 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE4072_1_UART1 | 0x20910382 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE4072_1_UART2 | 0x20910383 | U1 | - | - | 0 |
| CFG-MSGOUT-RTCM_3X_TYPE4072_1_USB | 0x20910384 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_LOG_INFO_I2C | 0x20910259 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_LOG_INFO_SPI | 0x2091025d | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_LOG_INFO_UART1 | 0x2091025a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_LOG_INFO_UART2 | 0x2091025b | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_LOG_INFO_USB | 0x2091025c | U1 | - | - | 0 |

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-MSGOUT-UBX_MON_COMMS_I2C | 0x2091034f | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_COMMS_SPI | 0x20910353 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_COMMS_UART1 | 0x20910350 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_COMMS_UART2 | 0x20910351 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_COMMS_USB | 0x20910352 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_HW2_I2C | 0x209101b9 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_HW2_SPI | 0x209101bd | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_HW2_UART1 | 0x209101ba | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_HW2_UART2 | 0x209101bb | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_HW2_USB | 0x209101bc | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_HW3_I2C | 0x20910354 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_HW3_SPI | 0x20910358 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_HW3_UART1 | 0x20910355 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_HW3_UART2 | 0x20910356 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_HW3_USB | 0x20910357 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_HW_I2C | 0x209101b4 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_HW_SPI | 0x209101b8 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_HW_UART1 | 0x209101b5 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_HW_UART2 | 0x209101b6 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_HW_USB | 0x209101b7 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_IO_I2C | 0x209101a5 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_IO_SPI | 0x209101a9 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_IO_UART1 | 0x209101a6 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_IO_UART2 | 0x209101a7 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_IO_USB | 0x209101a8 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_MSGPP_I2C | 0x20910196 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_MSGPP_SPI | 0x2091019a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_MSGPP_UART1 | 0x20910197 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_MSGPP_UART2 | 0x20910198 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_MSGPP_USB | 0x20910199 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_RF_I2C | 0x20910359 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_RF_SPI | 0x2091035d | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_RF_UART1 | 0x2091035a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_RF_UART2 | 0x2091035b | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_RF_USB | 0x2091035c | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_RXBUF_I2C | 0x209101a0 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_RXBUF_SPI | 0x209101a4 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_RXBUF_UART1 | 0x209101a1 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_RXBUF_UART2 | 0x209101a2 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_RXBUF_USB | 0x209101a3 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_RXR_I2C | 0x20910187 | U1 | - | - | 0 |

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-MSGOUT-UBX_MON_RXR_SPI | 0x2091018b | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_RXR_UART1 | 0x20910188 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_RXR_UART2 | 0x20910189 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_RXR_USB | 0x2091018a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_SPAN_I2C | 0x2091038b | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_SPAN_SPI | 0x2091038f | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_SPAN_UART1 | 0x2091038c | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_SPAN_UART2 | 0x2091038d | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_SPAN_USB | 0x2091038e | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_TXBUF_I2C | 0x2091019b | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_TXBUF_SPI | 0x2091019f | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_TXBUF_UART1 | 0x2091019c | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_TXBUF_UART2 | 0x2091019d | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_MON_TXBUF_USB | 0x2091019e | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_CLOCK_I2C | 0x20910065 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_CLOCK_SPI | 0x20910069 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_CLOCK_UART1 | 0x20910066 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_CLOCK_UART2 | 0x20910067 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_CLOCK_USB | 0x20910068 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_DOP_I2C | 0x20910038 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_DOP_SPI | 0x2091003c | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_DOP_UART1 | 0x20910039 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_DOP_UART2 | 0x2091003a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_DOP_USB | 0x2091003b | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_EOE_I2C | 0x2091015f | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_EOE_SPI | 0x20910163 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_EOE_UART1 | 0x20910160 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_EOE_UART2 | 0x20910161 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_EOE_USB | 0x20910162 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_GEOFENCE_I2C | 0x209100a1 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_GEOFENCE_SPI | 0x209100a5 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_GEOFENCE_UART1 | 0x209100a2 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_GEOFENCE_UART2 | 0x209100a3 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_GEOFENCE_USB | 0x209100a4 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_HPPOSECEF_I2C | 0x2091002e | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_HPPOSECEF_SPI | 0x20910032 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_HPPOSECEF_UART1 | 0x2091002f | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_HPPOSECEF_UART2 | 0x20910030 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_HPPOSECEF_USB | 0x20910031 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_HPPOSLLH_I2C | 0x20910033 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_HPPOSLLH_SPI | 0x20910037 | U1 | - | - | 0 |

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-MSGOUT-UBX_NAV_HPPOSLLH_UART1 | 0x20910034 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_HPPOSLLH_UART2 | 0x20910035 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_HPPOSLLH_USB | 0x20910036 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_ODO_I2C | 0x2091007e | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_ODO_SPI | 0x20910082 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_ODO_UART1 | 0x2091007f | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_ODO_UART2 | 0x20910080 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_ODO_USB | 0x20910081 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_ORB_I2C | 0x20910010 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_ORB_SPI | 0x20910014 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_ORB_UART1 | 0x20910011 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_ORB_UART2 | 0x20910012 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_ORB_USB | 0x20910013 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_POSECEF_I2C | 0x20910024 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_POSECEF_SPI | 0x20910028 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_POSECEF_UART1 | 0x20910025 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_POSECEF_UART2 | 0x20910026 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_POSECEF_USB | 0x20910027 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_POSLLH_I2C | 0x20910029 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_POSLLH_SPI | 0x2091002d | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_POSLLH_UART1 | 0x2091002a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_POSLLH_UART2 | 0x2091002b | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_POSLLH_USB | 0x2091002c | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_PVT_I2C | 0x20910006 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_PVT_SPI | 0x2091000a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_PVT_UART1 | 0x20910007 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_PVT_UART2 | 0x20910008 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_PVT_USB | 0x20910009 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_RELPOSNED_I2C | 0x2091008d | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_RELPOSNED_SPI | 0x20910091 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_RELPOSNED_UART1 | 0x2091008e | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_RELPOSNED_UART2 | 0x2091008f | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_RELPOSNED_USB | 0x20910090 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SAT_I2C | 0x20910015 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SAT_SPI | 0x20910019 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SAT_UART1 | 0x20910016 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SAT_UART2 | 0x20910017 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SAT_USB | 0x20910018 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SBAS_I2C | 0x2091006a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SBAS_SPI | 0x2091006e | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SBAS_UART1 | 0x2091006b | U1 | - | - | 0 |

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-MSGOUT-UBX_NAV_SBAS_UART2 | 0x2091006c | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SBAS_USB | 0x2091006d | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SIG_I2C | 0x20910345 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SIG_SPI | 0x20910349 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SIG_UART1 | 0x20910346 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SIG_UART2 | 0x20910347 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SIG_USB | 0x20910348 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SLAS_I2C | 0x20910336 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SLAS_SPI | 0x2091033a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SLAS_UART1 | 0x20910337 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SLAS_UART2 | 0x20910338 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SLAS_USB | 0x20910339 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_STATUS_I2C | 0x2091001a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_STATUS_SPI | 0x2091001e | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_STATUS_UART1 | 0x2091001b | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_STATUS_UART2 | 0x2091001c | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_STATUS_USB | 0x2091001d | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SVIN_I2C | 0x20910088 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SVIN_SPI | 0x2091008c | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SVIN_UART1 | 0x20910089 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SVIN_UART2 | 0x2091008a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_SVIN_USB | 0x2091008b | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEBDS_I2C | 0x20910051 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEBDS_SPI | 0x20910055 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEBDS_UART1 | 0x20910052 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEBDS_UART2 | 0x20910053 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEBDS_USB | 0x20910054 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEGAL_I2C | 0x20910056 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEGAL_SPI | 0x2091005a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEGAL_UART1 | 0x20910057 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEGAL_UART2 | 0x20910058 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEGAL_USB | 0x20910059 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEGLO_I2C | 0x2091004c | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEGLO_SPI | 0x20910050 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEGLO_UART1 | 0x2091004d | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEGLO_UART2 | 0x2091004e | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEGLO_USB | 0x2091004f | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEGPS_I2C | 0x20910047 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEGPS_SPI | 0x2091004b | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEGPS_UART1 | 0x20910048 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEGPS_UART2 | 0x20910049 | U1 | - | - | 0 |

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-MSGOUT-UBX_NAV_TIMEGPS_USB | 0x2091004a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMELS_I2C | 0x20910060 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMELS_SPI | 0x20910064 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMELS_UART1 | 0x20910061 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMELS_UART2 | 0x20910062 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMELS_USB | 0x20910063 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEQZSS_I2C | 0x20910386 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEQZSS_SPI | 0x2091038a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEQZSS_UART1 | 0x20910387 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEQZSS_UART2 | 0x20910388 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEQZSS_USB | 0x20910389 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEUTC_I2C | 0x2091005b | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEUTC_SPI | 0x2091005f | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEUTC_UART1 | 0x2091005c | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEUTC_UART2 | 0x2091005d | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_TIMEUTC_USB | 0x2091005e | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_VELECEF_I2C | 0x2091003d | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_VELECEF_SPI | 0x20910041 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_VELECEF_UART1 | 0x2091003e | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_VELECEF_UART2 | 0x2091003f | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_VELECEF_USB | 0x20910040 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_VELNED_I2C | 0x20910042 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_VELNED_SPI | 0x20910046 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_VELNED_UART1 | 0x20910043 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_VELNED_UART2 | 0x20910044 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_NAV_VELNED_USB | 0x20910045 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_MEASX_I2C | 0x20910204 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_MEASX_SPI | 0x20910208 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_MEASX_UART1 | 0x20910205 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_MEASX_UART2 | 0x20910206 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_MEASX_USB | 0x20910207 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_RAWX_I2C | 0x209102a4 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_RAWX_SPI | 0x209102a8 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_RAWX_UART1 | 0x209102a5 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_RAWX_UART2 | 0x209102a6 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_RAWX_USB | 0x209102a7 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_RLM_I2C | 0x2091025e | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_RLM_SPI | 0x20910262 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_RLM_UART1 | 0x2091025f | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_RLM_UART2 | 0x20910260 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_RLM_USB | 0x20910261 | U1 | - | - | 0 |

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-MSGOUT-UBX_RXM_RTCM_I2C | 0x20910268 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_RTCM_SPI | 0x2091026c | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_RTCM_UART1 | 0x20910269 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_RTCM_UART2 | 0x2091026a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_RTCM_USB | 0x2091026b | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_SFRBX_I2C | 0x20910231 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_SFRBX_SPI | 0x20910235 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_SFRBX_UART1 | 0x20910232 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_SFRBX_UART2 | 0x20910233 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_RXM_SFRBX_USB | 0x20910234 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_TIM_TM2_I2C | 0x20910178 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_TIM_TM2_SPI | 0x2091017c | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_TIM_TM2_UART1 | 0x20910179 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_TIM_TM2_UART2 | 0x2091017a | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_TIM_TM2_USB | 0x2091017b | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_TIM_TP_I2C | 0x2091017d | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_TIM_TP_SPI | 0x20910181 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_TIM_TP_UART1 | 0x2091017e | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_TIM_TP_UART2 | 0x2091017f | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_TIM_TP_USB | 0x20910180 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_TIM_VRFY_I2C | 0x20910092 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_TIM_VRFY_SPI | 0x20910096 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_TIM_VRFY_UART1 | 0x20910093 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_TIM_VRFY_UART2 | 0x20910094 | U1 | - | - | 0 |
| CFG-MSGOUT-UBX_TIM_VRFY_USB | 0x20910095 | U1 | - | - | 0 |

**Table 78: CFG-MSGOUT configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-NAVHPG-DGNSSMODE | 0x20140011 | E1 | - | - | 3 (RTK_FIXED) |

**Table 79: CFG-NAVHPG configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-NAVSPG-FIXMODE | 0x20110011 | E1 | - | - | 3 (AUTO) |
| CFG-NAVSPG-INIFIX3D | 0x10110013 | L | - | - | 0 (false) |
| CFG-NAVSPG-WKNROLLOVER | 0x30110017 | U2 | - | - | 2098 |
| CFG-NAVSPG-UTCSTANDARD | 0x2011001c | E1 | - | - | 0 (AUTO) |
| CFG-NAVSPG-DYNMODEL | 0x20110021 | E1 | - | - | 0 (PORT) |
| CFG-NAVSPG-ACKAIDING | 0x10110025 | L | - | - | 0 (false) |
| CFG-NAVSPG-USE_USRDAT | 0x10110061 | L | - | - | 0 (false) |
| CFG-NAVSPG-USRDAT_MAJA | 0x50110062 | R8 | - | m | 6378137 |
| CFG-NAVSPG-USRDAT_FLAT | 0x50110063 | R8 | - | - | 298.25722356300002502 |
| CFG-NAVSPG-USRDAT_DX | 0x40110064 | R4 | - | m | 0 |

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-NAVSPG-USRDAT_DY | 0x40110065 | R4 | - | m | 0 |
| CFG-NAVSPG-USRDAT_DZ | 0x40110066 | R4 | - | m | 0 |
| CFG-NAVSPG-USRDAT_ROTX | 0x40110067 | R4 | - | arcsec | 0 |
| CFG-NAVSPG-USRDAT_ROTY | 0x40110068 | R4 | - | arcsec | 0 |
| CFG-NAVSPG-USRDAT_ROTZ | 0x40110069 | R4 | - | arcsec | 0 |
| CFG-NAVSPG-USRDAT_SCALE | 0x4011006a | R4 | - | ppm | 0 |
| CFG-NAVSPG-INFIL_MINSVS | 0x201100a1 | U1 | - | - | 3 |
| CFG-NAVSPG-INFIL_MAXSVS | 0x201100a2 | U1 | - | - | 32 |
| CFG-NAVSPG-INFIL_MINCNO | 0x201100a3 | U1 | - | dBHz | 6 |
| CFG-NAVSPG-INFIL_MINELEV | 0x201100a4 | I1 | - | deg | 10 |
| CFG-NAVSPG-INFIL_NCNOTHRS | 0x201100aa | U1 | - | - | 0 |
| CFG-NAVSPG-INFIL_CNOTHRS | 0x201100ab | U1 | - | - | 0 |
| CFG-NAVSPG-OUTFIL_PDOP | 0x301100b1 | U2 | 0.1 | - | 250 |
| CFG-NAVSPG-OUTFIL_TDOP | 0x301100b2 | U2 | 0.1 | - | 250 |
| CFG-NAVSPG-OUTFIL_PACC | 0x301100b3 | U2 | - | m | 100 |
| CFG-NAVSPG-OUTFIL_TACC | 0x301100b4 | U2 | - | m | 350 |
| CFG-NAVSPG-OUTFIL_FACC | 0x301100b5 | U2 | 0.01 | m/s | 150 |
| CFG-NAVSPG-CONSTR_ALT | 0x401100c1 | I4 | 0.01 | m | 0 |
| CFG-NAVSPG-CONSTR_ALTVAR | 0x401100c2 | U4 | 0.0001 | m^2 | 10000 |
| CFG-NAVSPG-CONSTR_DGNSSTO | 0x201100c4 | U1 | - | s | 60 |

**Table 80: CFG-NAVSPG configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-NMEA-PROTVER | 0x20930001 | E1 | - | - | 41 (V41) |
| CFG-NMEA-MAXSVS | 0x20930002 | E1 | - | - | 0 (UNLIM) |
| CFG-NMEA-COMPAT | 0x10930003 | L | - | - | 0 (false) |
| CFG-NMEA-CONSIDER | 0x10930004 | L | - | - | 1 (true) |
| CFG-NMEA-LIMIT82 | 0x10930005 | L | - | - | 0 (false) |
| CFG-NMEA-HIGHPREC | 0x10930006 | L | - | - | 0 (false) |
| CFG-NMEA-SVNUMBERING | 0x20930007 | E1 | - | - | 0 (STRICT) |
| CFG-NMEA-FILT_GPS | 0x10930011 | L | - | - | 0 (false) |
| CFG-NMEA-FILT_SBAS | 0x10930012 | L | - | - | 0 (false) |
| CFG-NMEA-FILT_GAL | 0x10930013 | L | - | - | 0 (false) |
| CFG-NMEA-FILT_QZSS | 0x10930015 | L | - | - | 0 (false) |
| CFG-NMEA-FILT_GLO | 0x10930016 | L | - | - | 0 (false) |
| CFG-NMEA-FILT_BDS | 0x10930017 | L | - | - | 0 (false) |
| CFG-NMEA-OUT_INVFIX | 0x10930021 | L | - | - | 0 (false) |
| CFG-NMEA-OUT_MSKFIX | 0x10930022 | L | - | - | 0 (false) |
| CFG-NMEA-OUT_INVTIME | 0x10930023 | L | - | - | 0 (false) |
| CFG-NMEA-OUT_INVDATE | 0x10930024 | L | - | - | 0 (false) |
| CFG-NMEA-OUT_ONLYGPS | 0x10930025 | L | - | - | 0 (false) |

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-NMEA-OUT_FROZENCOG | 0x10930026 | L | - | - | 0 (false) |
| CFG-NMEA-MAINTALKERID | 0x20930031 | E1 | - | - | 0 (AUTO) |
| CFG-NMEA-GSVTALKERID | 0x20930032 | E1 | - | - | 0 (GNSS) |
| CFG-NMEA-BDSTALKERID | 0x30930033 | U2 | - | - | 0 |

**Table 81: CFG-NMEA configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-ODO-USE_ODO | 0x10220001 | L | - | - | 0 (false) |
| CFG-ODO-USE_COG | 0x10220002 | L | - | - | 0 (false) |
| CFG-ODO-OUTLPVEL | 0x10220003 | L | - | - | 0 (false) |
| CFG-ODO-OUTLPCOG | 0x10220004 | L | - | - | 0 (false) |
| CFG-ODO-PROFILE | 0x20220005 | E1 | - | - | 0 (RUN) |
| CFG-ODO-COGMAXSPEED | 0x20220021 | U1 | - | m/s | 10 |
| CFG-ODO-COGMAXPOSACC | 0x20220022 | U1 | - | - | 50 |
| CFG-ODO-VELLPGAIN | 0x20220031 | U1 | - | - | 153 |
| CFG-ODO-COGLPGAIN | 0x20220032 | U1 | - | - | 76 |

**Table 82: CFG-ODO configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-QZSS-USE_SLAS_DGNSS | 0x10370005 | L | - | - | 1 (true) |
| CFG-QZSS-USE_SLAS_TESTMODE | 0x10370006 | L | - | - | 0 (false) |
| CFG-QZSS-USE_SLAS_RAIM_UNCORR | 0x10370007 | L | - | - | 0 (false) |

**Table 83: CFG-QZSS configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-RATE-MEAS | 0x30210001 | U2 | 0.001 | s | 1000 |
| CFG-RATE-NAV | 0x30210002 | U2 | - | - | 1 |
| CFG-RATE-TIMEREF | 0x20210003 | E1 | - | - | 1 (GPS) |

**Table 84: CFG-RATE configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-RINV-DUMP | 0x10c70001 | L | - | - | 0 (false) |
| CFG-RINV-BINARY | 0x10c70002 | L | - | - | 0 (false) |
| CFG-RINV-DATA_SIZE | 0x20c70003 | U1 | - | - | 22 |
| CFG-RINV-CHUNK0 | 0x50c70004 | X8 | - | - | 0x203a656369746f4e ("Notice: ") |
| CFG-RINV-CHUNK1 | 0x50c70005 | X8 | - | - | 0x2061746164206f6e ("no data ") |
| CFG-RINV-CHUNK2 | 0x50c70006 | X8 | - | - | 0x0000216465766173 ("saved!\0\0") |
| CFG-RINV-CHUNK3 | 0x50c70007 | X8 | - | - | 0x0000000000000000 |

**Table 85: CFG-RINV configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-RTCM-DF003_OUT | 0x30090001 | U2 | - | - | 0 |
| CFG-RTCM-DF003_IN | 0x30090008 | U2 | - | - | 0 |

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-RTCM-DF003_IN_FILTER | 0x20090009 | E1 | - | - | 0 (DISABLED) |

**Table 86: CFG-RTCM configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-SBAS-USE_TESTMODE | 0x10360002 | L | - | - | 0 (false) |
| CFG-SBAS-USE_RANGING | 0x10360003 | L | - | - | 1 (true) |
| CFG-SBAS-USE_DIFFCORR | 0x10360004 | L | - | - | 1 (true) |
| CFG-SBAS-USE_INTEGRITY | 0x10360005 | L | - | - | 0 (false) |
| CFG-SBAS-PRNSCANMASK | 0x50360006 | X8 | - | - | 0x0000000000072bc8 (ALL \| PRN123 \| PRN126 \| PRN127 \| PRN128 \| PRN129 \| PRN131 \| PRN133 \| PRN136 \| PRN137 \| PRN138) |

**Table 87: CFG-SBAS configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-SIGNAL-GPS_ENA | 0x1031001f | L | - | - | 1 (true) |
| CFG-SIGNAL-GPS_L1CA_ENA | 0x10310001 | L | - | - | 1 (true) |
| CFG-SIGNAL-GPS_L2C_ENA | 0x10310003 | L | - | - | 1 (true) |
| CFG-SIGNAL-SBAS_ENA | 0x10310020 | L | - | - | 1 (true) |
| CFG-SIGNAL-SBAS_L1CA_ENA | 0x10310005 | L | - | - | 1 (true) |
| CFG-SIGNAL-GAL_ENA | 0x10310021 | L | - | - | 1 (true) |
| CFG-SIGNAL-GAL_E1_ENA | 0x10310007 | L | - | - | 1 (true) |
| CFG-SIGNAL-GAL_E5B_ENA | 0x1031000a | L | - | - | 1 (true) |
| CFG-SIGNAL-BDS_ENA | 0x10310022 | L | - | - | 1 (true) |
| CFG-SIGNAL-BDS_B1_ENA | 0x1031000d | L | - | - | 1 (true) |
| CFG-SIGNAL-BDS_B2_ENA | 0x1031000e | L | - | - | 1 (true) |
| CFG-SIGNAL-QZSS_ENA | 0x10310024 | L | - | - | 1 (true) |
| CFG-SIGNAL-QZSS_L1CA_ENA | 0x10310012 | L | - | - | 1 (true) |
| CFG-SIGNAL-QZSS_L1S_ENA | 0x10310014 | L | - | - | 0 (false) |
| CFG-SIGNAL-QZSS_L2C_ENA | 0x10310015 | L | - | - | 1 (true) |
| CFG-SIGNAL-GLO_ENA | 0x10310025 | L | - | - | 1 (true) |
| CFG-SIGNAL-GLO_L1_ENA | 0x10310018 | L | - | - | 1 (true) |
| CFG-SIGNAL-GLO_L2_ENA | 0x1031001a | L | - | - | 1 (true) |

**Table 88: CFG-SIGNAL configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-SPI-MAXFF | 0x20640001 | U1 | - | - | 50 |
| CFG-SPI-CPOLARITY | 0x10640002 | L | - | - | 0 (false) |
| CFG-SPI-CPHASE | 0x10640003 | L | - | - | 0 (false) |
| CFG-SPI-EXTENDEDTIMEOUT | 0x10640005 | L | - | - | 0 (false) |
| CFG-SPI-ENABLED | 0x10640006 | L | - | - | 0 (false) |

**Table 89: CFG-SPI configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-SPIINPROT-UBX | 0x10790001 | L | - | - | 1 (true) |
| CFG-SPIINPROT-NMEA | 0x10790002 | L | - | - | 1 (true) |
| CFG-SPIINPROT-RTCM3X | 0x10790004 | L | - | - | 1 (true) |

**Table 90: CFG-SPIINPROT configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-SPIOUTPROT-UBX | 0x107a0001 | L | - | - | 1 (true) |
| CFG-SPIOUTPROT-NMEA | 0x107a0002 | L | - | - | 1 (true) |
| CFG-SPIOUTPROT-RTCM3X | 0x107a0004 | L | - | - | 1 (true) |

**Table 91: CFG-SPIOUTPROT configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-TMODE-MODE | 0x20030001 | E1 | - | - | 0 (DISABLED) |
| CFG-TMODE-POS_TYPE | 0x20030002 | E1 | - | - | 0 (ECEF) |
| CFG-TMODE-ECEF_X | 0x40030003 | I4 | - | cm | 0 |
| CFG-TMODE-ECEF_Y | 0x40030004 | I4 | - | cm | 0 |
| CFG-TMODE-ECEF_Z | 0x40030005 | I4 | - | cm | 0 |
| CFG-TMODE-ECEF_X_HP | 0x20030006 | I1 | 0.1 | mm | 0 |
| CFG-TMODE-ECEF_Y_HP | 0x20030007 | I1 | 0.1 | mm | 0 |
| CFG-TMODE-ECEF_Z_HP | 0x20030008 | I1 | 0.1 | mm | 0 |
| CFG-TMODE-LAT | 0x40030009 | I4 | 1e-7 | deg | 0 |
| CFG-TMODE-LON | 0x4003000a | I4 | 1e-7 | deg | 0 |
| CFG-TMODE-HEIGHT | 0x4003000b | I4 | - | cm | 0 |
| CFG-TMODE-LAT_HP | 0x2003000c | I1 | 1e-9 | deg | 0 |
| CFG-TMODE-LON_HP | 0x2003000d | I1 | 1e-9 | deg | 0 |
| CFG-TMODE-HEIGHT_HP | 0x2003000e | I1 | 0.1 | mm | 0 |
| CFG-TMODE-FIXED_POS_ACC | 0x4003000f | U4 | 0.1 | mm | 0 |
| CFG-TMODE-SVIN_MIN_DUR | 0x40030010 | U4 | - | s | 0 |
| CFG-TMODE-SVIN_ACC_LIMIT | 0x40030011 | U4 | 0.1 | mm | 0 |

**Table 92: CFG-TMODE configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-TP-PULSE_DEF | 0x20050023 | E1 | - | - | 0 (PERIOD) |
| CFG-TP-PULSE_LENGTH_DEF | 0x20050030 | E1 | - | - | 1 (LENGTH) |
| CFG-TP-ANT_CABLEDELAY | 0x30050001 | I2 | 1e-9 | s | 50 |
| CFG-TP-PERIOD_TP1 | 0x40050002 | U4 | 1e-6 | s | 1000000 |
| CFG-TP-PERIOD_LOCK_TP1 | 0x40050003 | U4 | 1e-6 | s | 1000000 |
| CFG-TP-FREQ_TP1 | 0x40050024 | U4 | - | Hz | 1 |
| CFG-TP-FREQ_LOCK_TP1 | 0x40050025 | U4 | - | Hz | 1 |
| CFG-TP-LEN_TP1 | 0x40050004 | U4 | 1e-6 | s | 0 |
| CFG-TP-LEN_LOCK_TP1 | 0x40050005 | U4 | 1e-6 | s | 100000 |
| CFG-TP-DUTY_TP1 | 0x5005002a | R8 | - | % | 0 |
| CFG-TP-DUTY_LOCK_TP1 | 0x5005002b | R8 | - | % | 10 |

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-TP-USER_DELAY_TP1 | 0x40050006 | I4 | 1e-9 | s | 0 |
| CFG-TP-TP1_ENA | 0x10050007 | L | - | - | 1 (true) |
| CFG-TP-SYNC_GNSS_TP1 | 0x10050008 | L | - | - | 1 (true) |
| CFG-TP-USE_LOCKED_TP1 | 0x10050009 | L | - | - | 1 (true) |
| CFG-TP-ALIGN_TO_TOW_TP1 | 0x1005000a | L | - | - | 1 (true) |
| CFG-TP-POL_TP1 | 0x1005000b | L | - | - | 1 (true) |
| CFG-TP-TIMEGRID_TP1 | 0x2005000c | E1 | - | - | 0 (UTC) |

**Table 93: CFG-TP configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-TXREADY-ENABLED | 0x10a20001 | L | - | - | 0 (false) |
| CFG-TXREADY-POLARITY | 0x10a20002 | L | - | - | 0 (false) |
| CFG-TXREADY-PIN | 0x20a20003 | U1 | - | - | 0 |
| CFG-TXREADY-THRESHOLD | 0x30a20004 | U2 | - | - | 0 |
| CFG-TXREADY-INTERFACE | 0x20a20005 | E1 | - | - | 0 (I2C) |

**Table 94: CFG-TXREADY configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-UART1-BAUDRATE | 0x40520001 | U4 | - | - | 38400 |
| CFG-UART1-STOPBITS | 0x20520002 | E1 | - | - | 1 (ONE) |
| CFG-UART1-DATABITS | 0x20520003 | E1 | - | - | 0 (EIGHT) |
| CFG-UART1-PARITY | 0x20520004 | E1 | - | - | 0 (NONE) |
| CFG-UART1-ENABLED | 0x10520005 | L | - | - | 1 (true) |

**Table 95: CFG-UART1 configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-UART1INPROT-UBX | 0x10730001 | L | - | - | 1 (true) |
| CFG-UART1INPROT-NMEA | 0x10730002 | L | - | - | 1 (true) |
| CFG-UART1INPROT-RTCM3X | 0x10730004 | L | - | - | 1 (true) |

**Table 96: CFG-UART1INPROT configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-UART1OUTPROT-UBX | 0x10740001 | L | - | - | 1 (true) |
| CFG-UART1OUTPROT-NMEA | 0x10740002 | L | - | - | 1 (true) |
| CFG-UART1OUTPROT-RTCM3X | 0x10740004 | L | - | - | 1 (true) |

**Table 97: CFG-UART1OUTPROT configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-UART2-BAUDRATE | 0x40530001 | U4 | - | - | 38400 |
| CFG-UART2-STOPBITS | 0x20530002 | E1 | - | - | 1 (ONE) |
| CFG-UART2-DATABITS | 0x20530003 | E1 | - | - | 0 (EIGHT) |
| CFG-UART2-PARITY | 0x20530004 | E1 | - | - | 0 (NONE) |
| CFG-UART2-ENABLED | 0x10530005 | L | - | - | 1 (true) |
| CFG-UART2-REMAP | 0x10530006 | L | - | - | 0 (false) |

**Table 98: CFG-UART2 configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-UART2INPROT-UBX | 0x10750001 | L | - | - | 0 (false) |
| CFG-UART2INPROT-NMEA | 0x10750002 | L | - | - | 0 (false) |
| CFG-UART2INPROT-RTCM3X | 0x10750004 | L | - | - | 1 (true) |

**Table 99: CFG-UART2INPROT configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-UART2OUTPROT-UBX | 0x10760001 | L | - | - | 0 (false) |
| CFG-UART2OUTPROT-NMEA | 0x10760002 | L | - | - | 0 (false) |
| CFG-UART2OUTPROT-RTCM3X | 0x10760004 | L | - | - | 1 (true) |

**Table 100: CFG-UART2OUTPROT configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-USB-ENABLED | 0x10650001 | L | - | - | 1 (true) |
| CFG-USB-SELFPOW | 0x10650002 | L | - | - | 1 (true) |
| CFG-USB-VENDOR_ID | 0x3065000a | U2 | - | - | 5446 |
| CFG-USB-PRODUCT_ID | 0x3065000b | U2 | - | - | 425 |
| CFG-USB-POWER | 0x3065000c | U2 | - | mA | 0 |
| CFG-USB-VENDOR_STR0 | 0x5065000d | X8 | - | - | 0x4120786f6c622d75 ("u-blox A") |
| CFG-USB-VENDOR_STR1 | 0x5065000e | X8 | - | - | 0x2e777777202d2047 ("G - www.") |
| CFG-USB-VENDOR_STR2 | 0x5065000f | X8 | - | - | 0x632e786f6c622d75 ("u-blox.c") |
| CFG-USB-VENDOR_STR3 | 0x50650010 | X8 | - | - | 0x0000000000006d6f ("om\0\0\0\0\0") |
| CFG-USB-PRODUCT_STR0 | 0x50650011 | X8 | - | - | 0x4720786f6c622d75 ("u-blox G") |
| CFG-USB-PRODUCT_STR1 | 0x50650012 | X8 | - | - | 0x656365722053534e ("NSS rece") |
| CFG-USB-PRODUCT_STR2 | 0x50650013 | X8 | - | - | 0x0000000072657669 ("iver\0\0\0") |
| CFG-USB-PRODUCT_STR3 | 0x50650014 | X8 | - | - | 0x0000000000000000 |
| CFG-USB-SERIAL_NO_STR0 | 0x50650015 | X8 | - | - | 0x0000000000000000 |
| CFG-USB-SERIAL_NO_STR1 | 0x50650016 | X8 | - | - | 0x0000000000000000 |
| CFG-USB-SERIAL_NO_STR2 | 0x50650017 | X8 | - | - | 0x0000000000000000 |
| CFG-USB-SERIAL_NO_STR3 | 0x50650018 | X8 | - | - | 0x0000000000000000 |

**Table 101: CFG-USB configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-USBINPROT-UBX | 0x10770001 | L | - | - | 1 (true) |
| CFG-USBINPROT-NMEA | 0x10770002 | L | - | - | 1 (true) |
| CFG-USBINPROT-RTCM3X | 0x10770004 | L | - | - | 1 (true) |

**Table 102: CFG-USBINPROT configuration defaults**

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-USBOUTPROT-UBX | 0x10780001 | L | - | - | 1 (true) |
| CFG-USBOUTPROT-NMEA | 0x10780002 | L | - | - | 1 (true) |

| Configuration item | Key ID | Type | Scale | Unit | Default value |
|---|---|---|---|---|---|
| CFG-USBOUTPROT-RTCM3X | 0x10780004 | L | - | - | 1 (true) |

**Table 103: CFG-USBOUTPROT configuration defaults**

# Related documents

**[1]** ZED-F9P Data sheet, doc. no. UBX-17051259
**[2]** ZED-F9P Integration manual, doc. no. UBX-18010802
**[3]** RTCM Standard 10403.3 Recommended Standards for Differential GNSS (Global Navigation Satellite Systems) Service, Version 3
**[4]** Radio Resource LCS Protocol (RRLP), (3GPP TS 44.031 version 11.0.0 Release 11)
**[5]** NMEA 0183 Standard for Interfacing Marine Electronic Devices, Version 4.10, June, 2012

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# Revision history

| Revision | Date | Name | Status / Comments |
|---|---|---|---|
| R01 | 23-May-2018 | pkeh, jhak | Objective specification |
| R05 | 21-Dec-2018 | jhak | HPG 1.10 advance information |
| R06 | 19-Feb-2019 | jhak | HPG 1.11 early production information |
| R07 | 09-Jul-2019 | gste | HPG 1.12 early production information |
| R08 | 28-May-2020 | dama | HPG 1.13 early production information |

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