# EVK-M101, EVK-M101C

## Evaluation kit

### User guide


**Abstract**

This document describes the structure and use of the EVK-M101 and the EVK-M101C evaluation kits and provides information for evaluating u-blox M10 positioning technology.

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# Document information

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This document applies to the following products:

| Product name | Type number | FW version | IN/PCN reference |
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| EVK-M101 | EVK-M101-00-02 | SPG 5.10 | UBX-22038390 |
| EVK-M101C | EVK-M101C-00-02 | SPG 5.10 | N/A |

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# Contents

# 1 Product description

## 1.1 Overview

The EVK-M101 and the EVK-M101C evaluation kits make evaluating the high performance and low power consumption of u-blox M10 positioning technology simple (see an overview of u-blox M10 features on www.u-blox.com/m10).

The built-in USB interface provides both power supply and USB-to-Serial communication to the receiver, keeping the possibility to also connect through a 14-pin connector or a dedicated RS-232 port. The versatile interfaces and measurement points enable advanced evaluation needs.

u-blox evaluation kits are compact, and their user-friendly interface and power supply make them ideally suited for use in laboratories or vehicles. Furthermore, they can be used with a desktop or a laptop, making them the perfect companion through all stages of design-in projects.

| Evaluation kit | Description | Related products |
|---|---|---|
| EVK-M101 | u-blox M10 evaluation kit with TCXO | u-blox UBX-M10050-KB chips [1]<br>MAX-M10S module [2]<br>MIA-M10Q module[1] [4] |
| EVK-M101C | u-blox M10 evaluation kit with crystal | u-blox UBX-M10050-KB chips [1]<br>MAX-M10M module [3]<br>MIA-M10C module[1] |

**Table 1: EVK-M101/C supported products**

## 1.2 Kit contents

The delivery package contains:

- Compact 105 x 64 x 26 mm EVK-M101/C unit
- An active GNSS antenna with 3 m cable.
- A USB 2.0 cable (Type-C).
- An EVK Welcome card

## 1.3 System requirements

- PC with USB 2.0 or RS-232 interface
- Operating system: Microsoft Windows 8.1 onwards (x86 and x64 versions)
- Internet connection for the first-time use to download the required Windows drivers. See section Installing u-center 2 software for details.

[1] There are differences in the products with regards to performance and current measument values. Please refer to the respective datasheets for the product specifications.

# 2 Specifications

| Parameter | Specification |
|---|---|
| Serial interfaces | 1 USB 2.0 Type-C<br>1 UART, max baud rate 921600 baud (using 14-pin connector)<br>RS-232 +/- 5.0 V level<br>14 pin, 3.3 V logic<br>1 I2C, max 400 kHz<br>1 SPI, max SPI CLK 5.5 MHz |
| Timing interfaces | 1 time pulse output |
| Dimensions | 105 x 64 x 26 mm |
| Power supply | 5.0 V via USB or powered via external power supply pin 14 (5V_IN) and pin 1 (GND) |
| Normal operating temperature | -40 °C to +65 °C |

**Table 2: EVK-M101/C specifications**

## 2.1 Safety precautions

EVK-M101/C must be supplied by a PS1 class limited power source. See section 6.2.2.4 of IEC 62368-1:2018 [5] for more information on the PS1 class.

In addition to a limited power source, only ES1 class circuits are to be connected to the EVK-M101/C, including interfaces and antennas. See section 5.2.1.1 of IEC 62368-1:2018 [5] for more information on the ES1 class.

# 3 Getting started

## 3.1 Installing u-center 2 software

u-center 2, the u-blox interactive evaluation software tool is required for configuration, testing, visualization and data analysis of u-blox GNSS receivers as well as EVKs. The EVK user guide together with the u-center 2 evaluation tool provide useful assistance during all phases of a system integration project. To install the u-center 2 evaluation software tool, follow the steps available on www.u-blox.com/product/u-center. For more information on how to use the u-center 2 evaluation software tool, refer to the u-center 2 User guide [6].

The required Windows drivers for the FTDI FT4232H USB-to-UART converter that is used in the EVK are available from the Microsoft Windows Update service. To ensure that the latest FTDI drivers are installed automatically from Windows Update, check and uninstall the previously installed FTDI drivers. The Windows system driver search mechanism will download and install the FTDI drivers automatically from the Microsoft Windows Update service. If the automatic installation fails, contact u-blox support to get the FTDI drivers and install manually.

## 3.2 Installing hardware

1. Before connecting the interface cable to the EVK, select the interface that you are using for the connection by sliding the interface switch to the correct position:

| Interface cable | Mode |
|---|---|
| USB-C | 0 for UART<br>2 for I2C/UART |
| UART or RS-232 | 0 for UART<br>2 for I2C/UART |
| SPI/I2C | 1 for SPI<br>2 for I2C/UART |

**Table 3: EVK-M101/C interface switch modes**

   Refer to Figure 2 to see these interface positions.

   Use UART mode 0 if the internal SPI flash memory is in use.

   **CAUTION** Changing the interface switch position while the EVK is powered on may damage the GNSS receiver chip. Power off the EVK before changing the interface switch setting.

   Refer to section Device description for more information on the interfaces.
2. Power the device on, either via USB on the back or through the 5V_IN input on the front of the EVK.
3. Connect the provided GNSS antenna to the evaluation unit and place the antenna in a location with clear sky view.
4. Start the u-center 2 evaluation tool and select corresponding COM port and baud rate as shown in the u-center User guide [6].

## 3.3 Interface default configuration

| Parameter | Description | Remark |
|---|---|---|
| UART, Input | UBX and NMEA protocol at 38400 baud | |

| Parameter | Description | Remark |
|---|---|---|
| UART, Output | UBX and NMEA protocol at 38400 baud | Only NMEA messages are activated by default |
| SPI / I2C, Input | UBX and NMEA protocol | |
| SPI / I2C, Output | UBX and NMEA protocol | Only NMEA messages are activated by default |

**Table 4: Default configuration**

☞ The SPI, I2C and UART interfaces on the 14-pin connector are available for debugging and design-in purposes.

# 4 Device description

EVK-M101/C evaluation kit contains u-blox M10 GNSS receiver, RTC, SPI flash memory, DC-DC converter, LNA, SAW filter, and external TCXO or crystal depending on the EVK variant. In addition, the EVK includes I2C current sensors that provide an option for current measurements through the on-board FTDI USB-to-I2C interface as shown in Figure 6.

## 4.1 Interface connection

The EVK-M101/C supports UART, I2C and SPI communication interfaces. To connect the EVK to a PC, use a standard SUBD-9 cable or the included USB cable depending on the interface in use. The EVK also includes an on-board USB-to-Serial converter for USB-to-UART communication with the receiver. For current measurements and to evaluate the available digital interfaces, additional measurement equipment and devices can be connected to the 14-pin connector on the front side of the EVK unit. The EVK design allows the front side pins to be used simultaneously with the other ports.

Do not drive any of the IO pins when the EVK is not connected to a power supply.

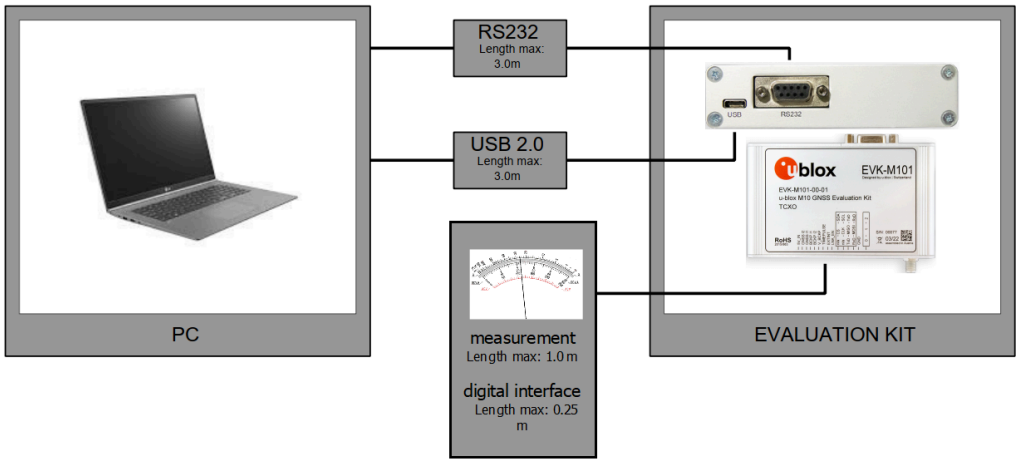


**Figure 1: Connecting the EVK-M101/C unit for power supply and communication**

Figure 2 shows the front and back of the EVK-M101/C evaluation unit.

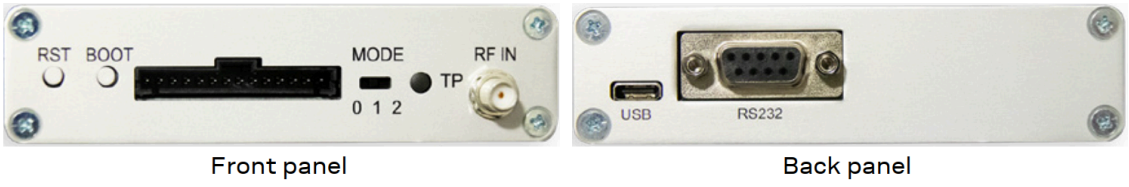


**Figure 2: EVK-M101/C front and back side**

### 4.1.1 Interface switch

Use the interface switch on the front side to choose between I2C/UART, SPI communication with the receiver and using the internal SPI flash memory. You must reset the EVK unit by pressing the RST button after the interface switch setting is changed.

**CAUTION** Changing the interface switch position while the EVK is powered on may damage the GNSS receiver chip. Power off the EVK before changing the interface switch setting.

1. **Mode 0, UART** – In this selection, the EVK communicates with the receiver through the UART interface and allows the use of the internal SPI flash memory.
2. **Mode 1, SPI** – In this selection, the EVK communicates with the receiver only through the SPI interface. RS-232 is switched off.
3. **Mode 2, I2C / UART** – In this selection, communication via 3.3 V I2C interface is available and the EVK can also communicate with the receiver through the UART interface (via USB or RS-232 – back side or the 3.3 V level TXD/MISO, RXD/MOSI pins at the front side).

### 4.1.2 14-pin connector

The EVK-M101/C front side has a 14-pin connector that provides programmable input/output signals, communication interfaces and supply options. All these pins are ESD protected. The 14-pin connector can be used for communicating with the receiver through the UART, SPI and I2C interfaces. In addition, the 14-pin connector provides flexibility for evaluating other advanced scenarios.

| Pin no. | Pin name | I/O | Level | Description |
|---|---|---|---|---|
| 14 | 5V_IN | I | 4.75 - 5.25 V | Power input – can be used instead of USB. |
| 13 | GNSS I2 | O | 3.3 V | Supply current measurement (total current) node 2. See pin 12 description. |
| 12 | GNSS I1 | O | 3.3 V | Supply current measurement (total current) node 1. Current measured from voltage over a 0.1 Ω 1% resistor between pins 12 (GNSS I1) and 13 (GNSS I2). Pin 12 (GNSS I1) is at higher potential. NOTE: the total current includes the V_CORE, V_RF, and V_IO current consumption [2]. |
| 11 | BCKP I1 | O | 3.3 V | Backup supply current measurement node 1. Connected to backup supply (super capacitor). Current measured from voltage over a 100 Ω 1% resistor between pins 11 (BCKP I1) and 10 (BCKP I2). Pin 11 (BCKP I1) is at higher potential. |
| 10 | BCKP I2 | O | 3.3 V | Backup supply current measurement node 2. See pin 11 description. |
| 9 | VBCKP | I | 3.3 V | Backup power supply input – optional input for testing backup operation. |
| 8 | TIMEPULSE | O | 3.3 V | Time pulse signal (50 Ω output). Can also be used as generic input/output (PIO4). The time pulse signal can be re-assigned as LNA_EN signal for controlling the external LNA. In this configuration, the LNA_EN jumper on the EVK board should be left open (i.e. not connected). |
| 7 | EXTINT | I | 3.3 V | External interrupt signal. Can be used for time mark feature, time aiding, and wakeup from power save modes. |
| 6 | LNA_EN | I/O | 3.3 V | LNA enable signal that controls the external LNA.<br>When this pin is used as an input, the LNA_EN jumper on the EVK board should be left open (i.e. not connected).<br>When this pin is used as an output, the LNA_EN jumper on the EVK board can be open or connected. |
| 5 | SDA/CS | I/O | 3.3 V | If the interface switch slide is on I2C mode 2, then the I2C interface is selected; Function: data input / output.<br>If the interface switch slide is on SPI mode 1, then the SPI interface is selected; Function: chip select input (ACTIVE LOW). |
| 4 | SCL/SCK | I | 3.3 V | Clock input for I2C and SPI interfaces. |

[2] V_IO is connected to 3.3 V supply. V_CORE and V_RF power domains are connected to 1.0 V. See section Measuring GNSS current on the 14-pin connector for more details.

| Pin no. | Pin name | I/O | Level | Description |
|---|---|---|---|---|
| 3 | TxD/MISO | O | 3.3 V | Serial port transmit or SPI slave transmit, operation selected by interface switch. |
| 2 | RxD/MOSI | I | 3.3 V | Serial port receive or SPI slave receive, operation selected by interface switch. |
| 1 | GND | I | - | Recommended common ground pin. |

**Table 5: EVK-M101/C 14-pin connector pin description**


**Figure 3: EVK-M101/C 5.0 V DC power supply example**

Use a maximum 25 cm cable when using the 3.3 V digital interfaces with your application (e.g. SPI or I2C).

### 4.1.3 USB

The USB connector in the evaluation kit can be used for both power supply and communication. The easiest way to evaluate the EVK-M101/C operation is to connect the EVK to a PC with the USB cable and then to use the u-center 2 tool to configure and monitor the GNSS functions. The USB connector is internally connected to a USB-to-Serial converter that connects to the UART interface of the u-blox M10 receiver on the EVK. This allows the USB connector to be used for communication as well. Interface switch modes 0 and 2 can be used for USB communication with the receiver.

When the EVK is connected to the PC, Windows creates a virtual COM port to the PC. This newly created virtual COM port needs to be selected in the u-center 2 evaluation tool for communicating with the receiver. EVK-M101/C supports USB-to-UART communication speeds up to 921600 baud.

### 4.1.4 UART

The EVK unit includes two options for the UART connection, via the RS-232 serial port or the 14-pin connector. By default, the UART communication speed is set to 38400 baud and EVK-M101/C supports speeds up to 921600 baud (through the 14-pin connector).

The following Interface switch options are available for UART communication:

- **Mode 0:** when the internal SPI flash memory is used.
- **Mode 2:** when the internal SPI flash memory is not used.

#### 4.1.4.1 RS-232

The EVK can be connected to a PC using a maximum 3 m straight RS-232 serial cable with male and female connectors. The RS-232 port needs to be configured to connect to the PC. To do this, use the UBX-CFG-VALSET command and select the CFG-UART1 Configuration group in the u-center 2 evaluation tool. The maximum operating baud rate is 230400 baud. Note, if a USB-to-RS-232

adapter cable is used, it can be connected directly to the RS-232 port of the evaluation kit. The RS-232 port also provides a TIMEPULSE output signal and supports evaluation of EXTINT functions such as time mark, time aiding, and wakeup from power save modes.

The 9-pin RS-232 female connector is assigned as listed below:

| Pin no. | Assignment |
|---|---|
| 1 & 6 | Time pulse |
| 2 | TXD/SPI_MISO (GNSS Transmit Data, serial data to external device) |
| 3 | RXD/SPI_MOSI (GNSS Receive Data, serial data from external device) |
| 4 | EXTINT |
| 5 | GND |
| 7, 8 & 9 | not connected |

**Table 6: EVK-M101/C RS-232 connector pin description**

#### 4.1.4.2 UART through 14-pin connector

The EVK also provides UART communication through the 14-pin connector on pins TxD and RxD. The maximum operating baud rate is 921600 baud. See section 14-pin connector for more information.

### 4.1.5 SPI

The SPI interface pins are available on the 14-pin connector, see section 14-pin connector for more information.

☞ If the SPI interface is used for communication with the receiver, the Interface switch must be set to SPI mode 1.

### 4.1.6 I2C

The 14-pin connector contains pins for evaluating I2C bus communication. If the I2C interface is used, the Interface switch must be set to I2C mode 2.

By default, the optional I2C pull-up resistors are not populated on the EVK board. The u-blox M10 GNSS receiver already contains internal pull-up resistors for normal use. If fast communication speed with long cable length is needed, the optional pull-up resistors can be placed to the reserved location on the EVK board.

## 4.2 GNSS input signal

To evaluate the GNSS reception, the GNSS signal must be supplied to the antenna input SMA connector of the evaluation kit. EVK-M101/C evaluation kit includes a GPS / Galileo / GLONASS / BeiDou antenna with a 3.0 m cable. It is possible to connect various active and passive GNSS antennas with SMA connectors or provide a signal from a recorded or simulated GNSS RF source to the antenna input. Also, an external SAW filter can be connected to the RF input connector, for evaluating an SAW-LNA-SAW improved immunity performance.

### 4.2.1 Antenna connector

For connecting an active or a passive antenna, an SMA female connector is available on the front side of the EVK unit (see Figure 2). The RF path on EVK-M101/C contains an LNA and an SAW filter having 3.3 V DC voltage in the RF input. The EVK provides 3.3 V bias supply for the external antenna and the recommended maximum antenna supply current for active antennas is 30 mA. This pin is also ESD protected.

☞ Avoid having a short at the RF input because there is no short circuit detection or antenna supervisor feature on the EVK-M101/C.

## 4.3 Time pulse

u-blox receivers include a time pulse function that provides pulses with a configurable pulse period, pulse length and polarity (rising or falling edge). The u-center 2 evaluation tool can be used to configure the time pulse parameters. The time pulse signal is available at the 14-pin and RS-232 connectors. In addition, the time pulse signal is inverted and connected to the LED on the front side of the EVK.

☞ The time pulse signal from the 14-pin connector has 50 ohms output and thus, no fast slope output signal is possible.

## 4.4 Reset button

The RST button on the front side resets the u-blox M10 receiver.

## 4.5 Safe boot button

This button is used to set the receiver into safeboot mode. In this mode, the receiver executes only the minimal functionality.

☞ The safeboot mode is not recommended in EVK-M101/C because the u-blox M10 receiver is using a ROM-based firmware and thus, it is not necessary to go into safe boot mode.

## 4.6 LED

On the front side of the EVK unit, a single blue LED shows the time pulse signal as well as the status that the device is powered on. The LED starts flashing one pulse per second during a GNSS fix. If there is no GNSS fix, the LED will only be lit, without flashing.

## 4.7 Flash memory

EVK-M101/C has a 16-Mbit SPI flash that is connected to the u-blox M10 receiver. By default it can be used to:

- Store the current configuration permanently.
- Save data logging results.
- Hold AssistNow™ Offline and AssistNow™ Autonomous data.

☞ Only the UART interface mode 0 is available for communication with the receiver when the flash is in use. See section Interface switch for more information.

☞ A token is required to be able to download AssistNow™ Offline. Refer to the u-center 2 User guide [6] for more information.

## 4.8 Super capacitor

The evaluation kit board includes a 1.0 F super capacitor to supply the backup power domain of the EVK-M101/C and is charged whenever there is a power supply available, either via USB or through the 14-pin connector. The super capacitor provides backup power directly to the EVK-M101/C V_BCKP power input of the GNSS receiver in case no other V_BCKP power supply is provided. The super capacitor allows more than 12 hours of backup power, when it is fully charged to 3.3 V.

☞ Avoid doing a hot start before having applied the power supply (from USB or from the 14-pin connector) for few minutes because the super capacitor requires about 200 seconds to charge to 2.0 V and about 1000 seconds to charge fully to 3.3 V.

The V_BCKP power supply can be used to provide power for any desired period of time while evaluating for very long backup periods.

## 4.9 External interrupt

On the EVK-M101/C, the external interrupt (EXTINT) signal is available on the 14-pin connector and on the RS-232 port. The EXTINT signal can be used for time mark and time aiding features of the receiver, as well as for waking up the receiver from power save modes. See section 14-pin connector and RS-232 for more information.

# 5 Measuring current

## 5.1 Measuring GNSS current on the 14-pin connector

At startup, the receiver starts in acquisition mode to search for available satellites and to download GNSS orbital data, i.e., ephemeris and almanac. Once the data has been downloaded, the receiver enters tracking mode. In continuous operation, the receiver typically remains in tracking mode once entering it. The current consumption reduces when the receiver enters the tracking mode. The time required to enter tracking mode can be reduced by downloading aiding data from the AssistNow™ Online service.

On EVK-M101/C, the main supply voltage for the u-blox M10 GNSS receiver is 3.3 V. The EVK contains an internal 3.3 V to 1.0 V DC-DC converter to reduce power consumption from the core and RF power domains of the receiver. To measure the total GNSS supply current with EVK-M101/C, follow these steps:

1. Before starting the test, make sure you have good signals and clear sky view to ensure that the receiver can acquire the satellite signals.
2. Power up EVK-M101/C.
3. Connect a true RMS voltmeter across GNSS I1 (pin 12) and GNSS I2 (pin 13) of the 14-pin connector.
4. Read the voltage (and average if necessary) on the voltmeter and convert to current (1 mV equals 1 mA).

☞ Earlier hardware versions of the EVK-M101/C, identified by the type number on the product label, used different shunt resistor values.

The total GNSS current ($I_{VCC}$) shows the current consumption of the DC-DC converter and V_IO power domain. The $I_{V\_IO}$ current includes the contribution from the clock oscillator current[3]. The total current consumption from the core and RF domain of the receiver are measured at the input of the DC-DC converter.

☞ The DC-DC has an average efficiency of 85 %, resulting in a higher power consumption than the values defined in the M10050-KB data sheet.

## 5.2 Measuring current with u-center 2

☞ The current measurement feature is available in EVK-M101-00-02, resp. EVK-M101C-00-02, and later.

The total GNSS current ($I_{VCC}$) is made up of current consumption from the DC-DC converter ($I_{V\_DCDC}$) and the V_IO domain ($I_{V\_IO}$). The separate current contribution from $I_{V\_IO}$ and $I_{V\_DCDC}$ can be measured from the current measurement tool in u-center 2. To do so, follow these steps:

1. Connect the EVK-M101/C to a PC with the USB cable and then use the u-center 2 tool to configure the correct communication port as shown in Communication ports, where the UART port is selected.

[3] The TCXO on EVK-M101 consumes around 1 to 1.5 mA, the XTAL on EVK-M101C consumes around 0.5 to 1 mA.

2. Once the device is successfully added, go to **Tools and Service > Tools > Current measurement >** as shown below:

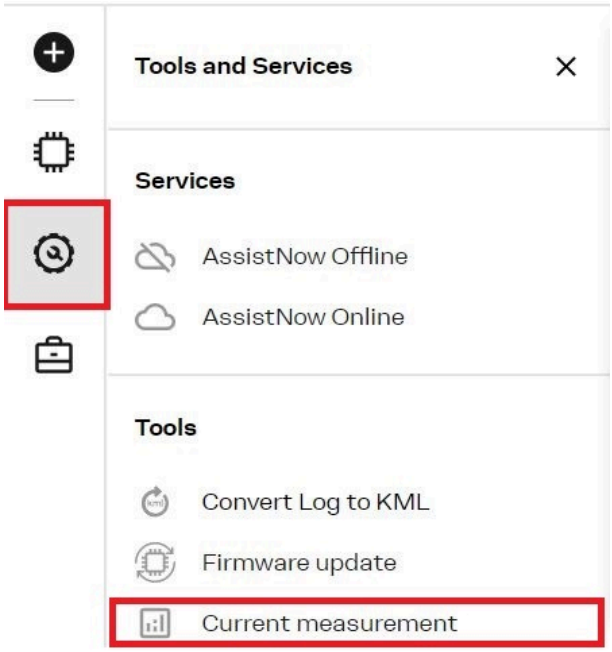


**Figure 4: u-center 2 current measurement setup**

3. To start the current measurement, press the **Start** button as depicted on the left-hand side of Figure 5. The **Current measurement** window continuously updates the V_IO and DC-DC converter input current values. To finish the continuous current measurement, press the **Stop** button.

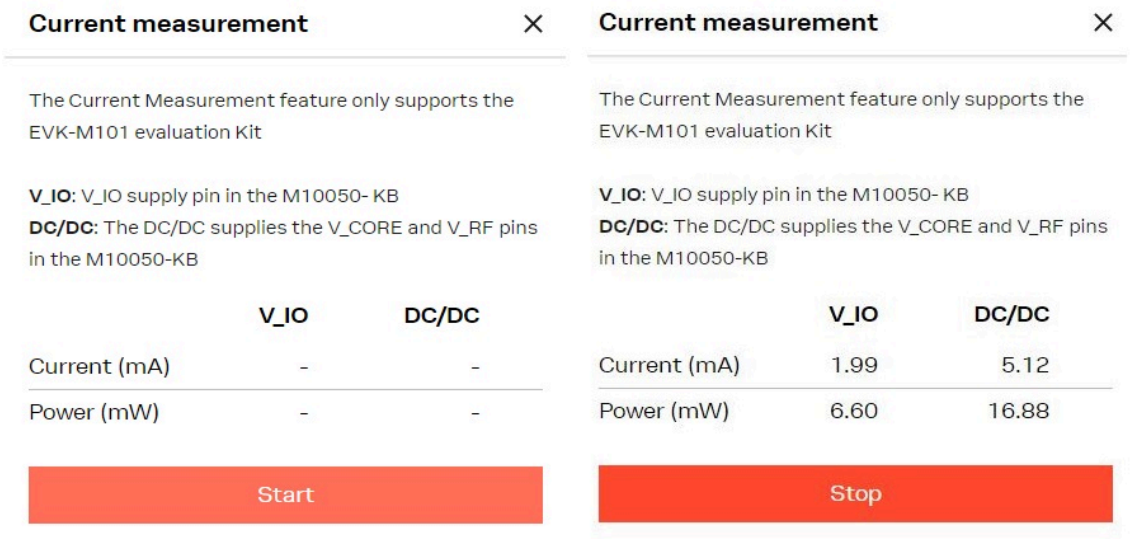


**Figure 5: u-center 2 current measurement example**

The DC-DC has an average efficiency of 85 %, resulting in a higher power consumption than the values defined in the M10050-KB data sheet.

u-center measures the V_IO and DC/DC currents at 3.3V.

To manually measure $I_{V\_IO}$ and $I_{V\_DCDC}$ current contribution, connect a true RMS voltmeter to the test points available on the EVK board. The test points are connected to the I2C current sensors on the EVK board, as shown in Figure 6.

## 5.3 Measuring backup current

To measure the backup current ($I_{BCKP}$) with EVK-M101/C, follow these steps:

1. Connect a true RMS voltmeter across BCKP I1 (pin 11) and BCKP I2 (pin 10) of the 14-pin connector.
2. Remove power supply (USB cable or other external power supply from the 14-pin connector).
3. Read the voltage (and average if necessary) on the voltmeter and convert to current (1 mV equals 10 µA).

# 6 Block diagram

EVK-M101/C block diagram provides an overview on supply voltages, current measurement and communication interfaces as shown in Figure 6.

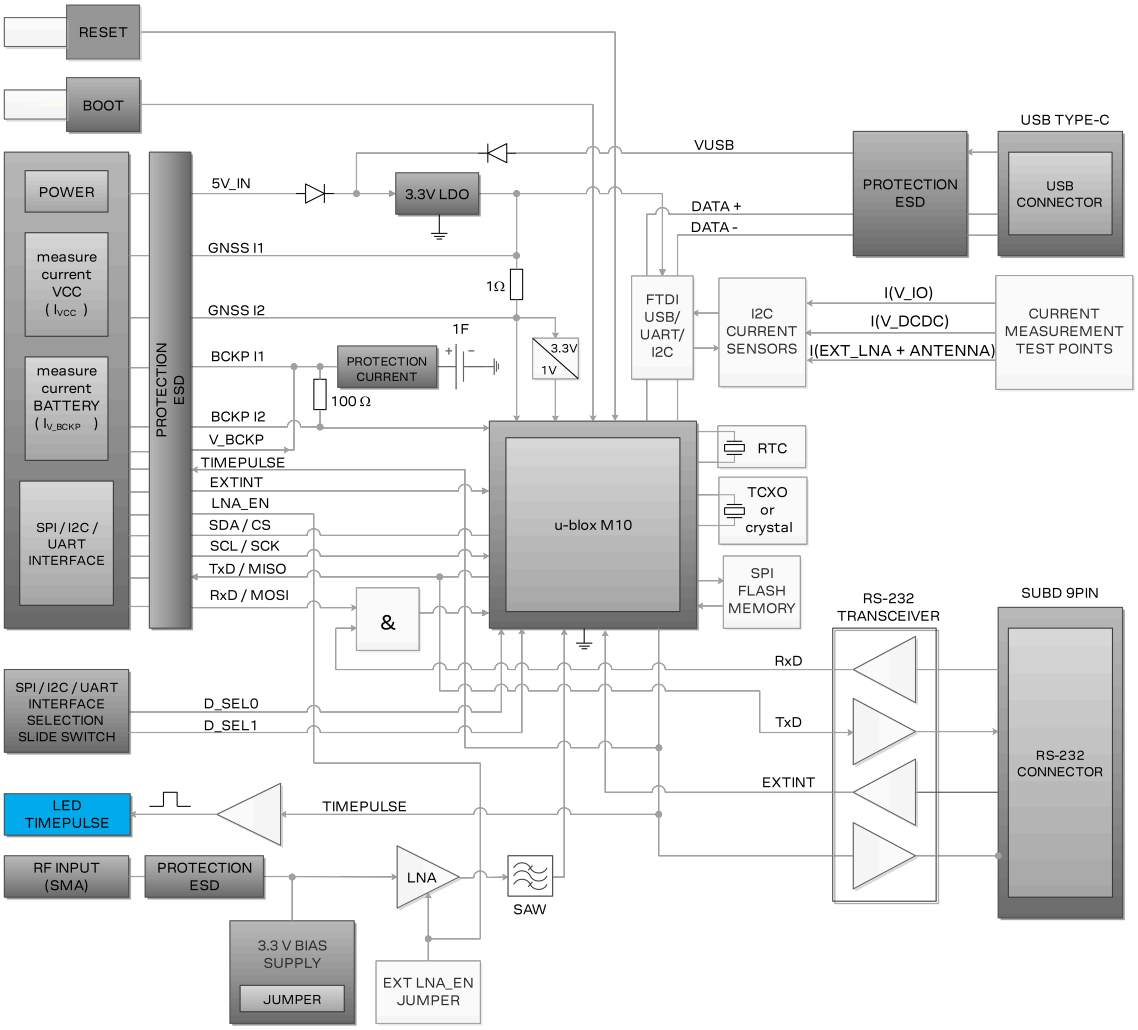


**Figure 6: EVK-M101/C block diagram**

# 7 Board layout

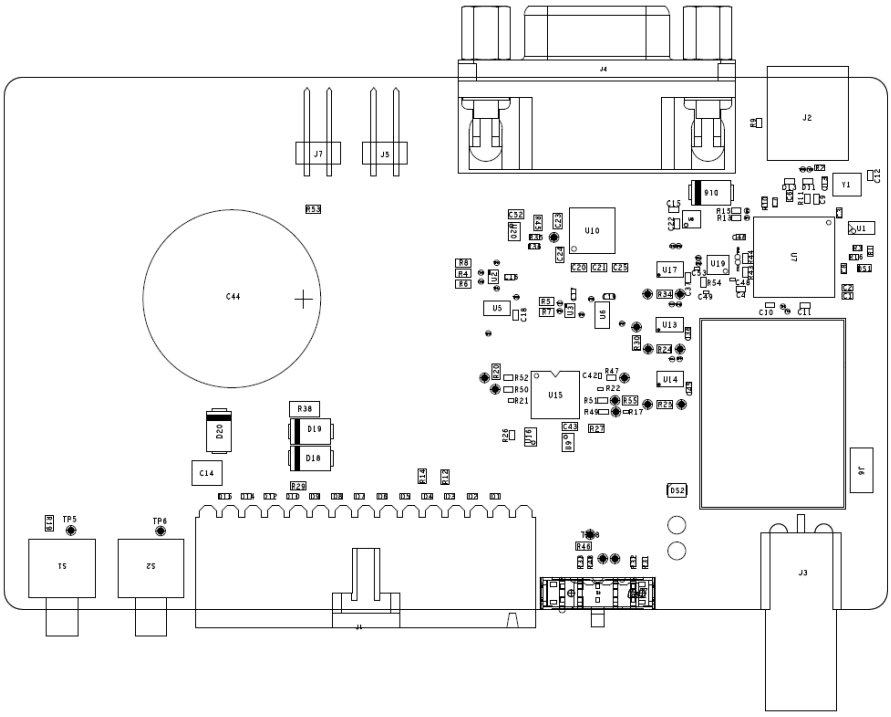

**Figure 7: EVK-M101/C board layout**

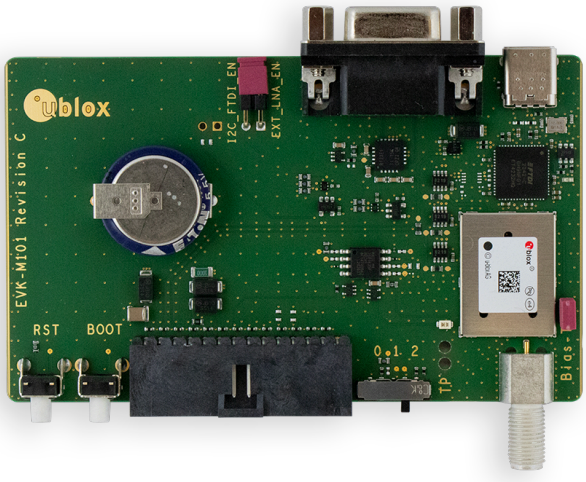


**Figure 8: EVK-M101/C PCB**

# 8 Device configuration

This section shows how to configure and evaluate some important receiver features on EVK-M101/C related to power modes, GNSS constellations, navigation rate and internal LNA modes of the receiver. In addition, the receiver can be configured with the Advanced Configuration View of the u-center 2 evaluation tool as shown in Figure 9.

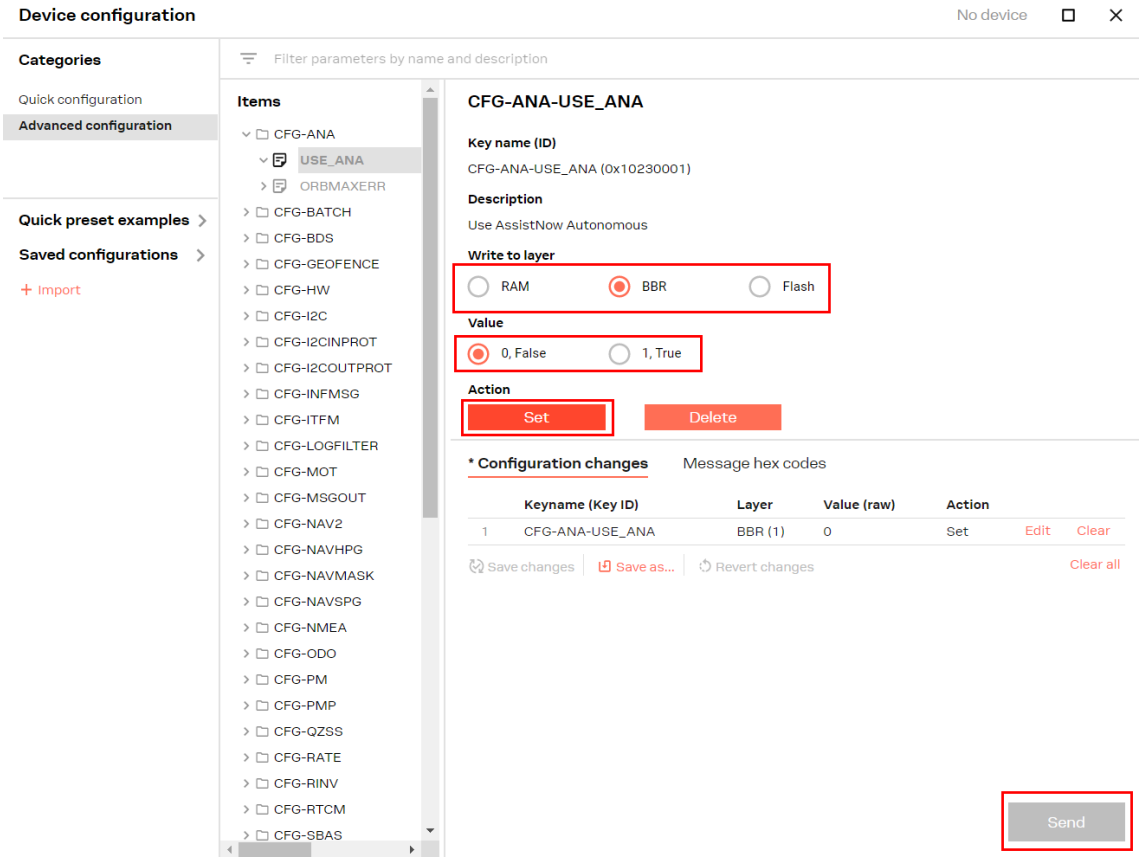


**Figure 9: EVK-M101/C receiver configuration view**

The receiver configuration can be saved to the receiver RAM, or to the battery-backed RAM (BBR), or to the available SPI flash memory. The RAM content is cleared after the power supply is disconnected or in software standby mode and the off state of On/Off power save mode (PSMOO). Therefore, it is recommended to save the receiver configuration to RAM and BBR or permanently in Flash. The BBR content is maintained as long as the backup battery supply is available. The content of the flash memory is preserved between power cycles and thus, it is the preferred option for long-term storage of the receiver configuration.

## 8.1 Communication ports

The FTDI USB-to-UART converter generates four virtual communication (COM) ports as shown in Figure 10. The third COM port based on the COM port ID is the correct port to use. For example, if the generated COM ports are COM1, COM2, COM3, and COM4, then the port to use is COM3.

☞ If the RS-232 port is also connected to the same PC, there will be an additional COM port for the RS-232 serial connection.

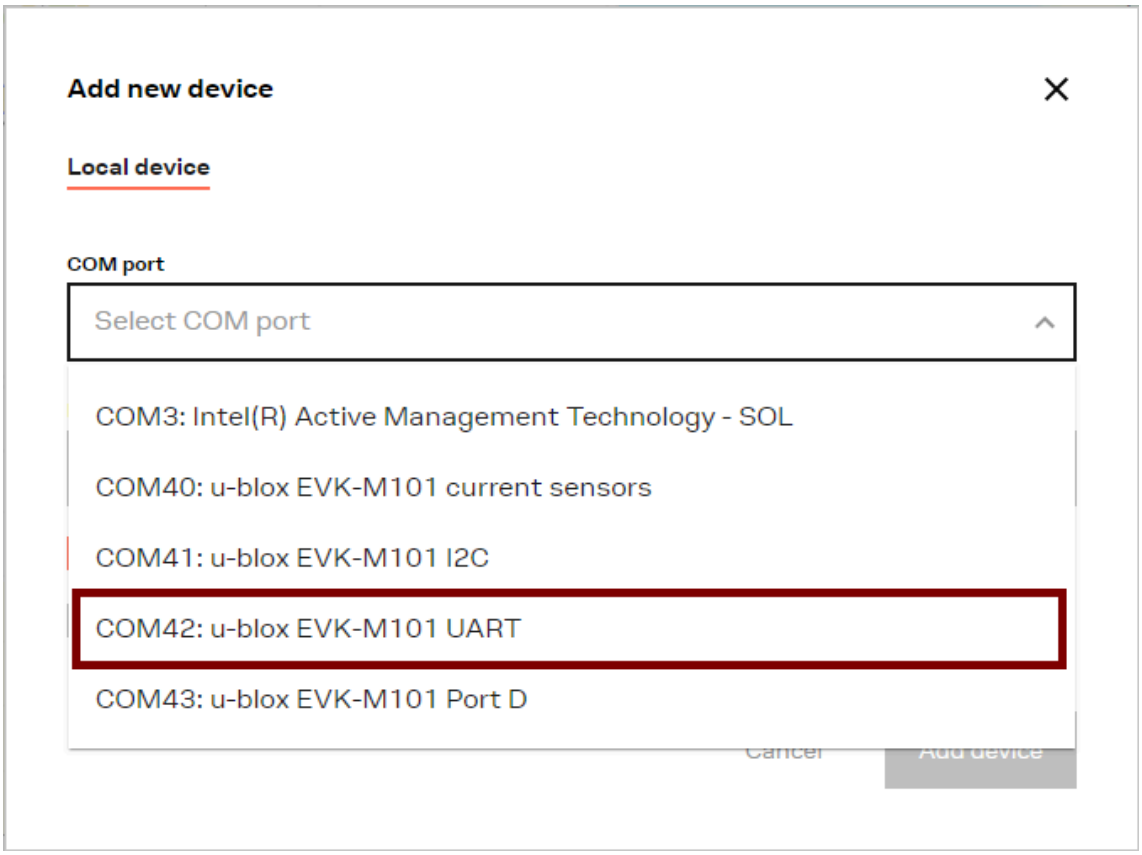


**Figure 10: EVK-M101/C communication ports**

The identification of EVK-M101/C on Windows machines has been improved to provide descriptive names to each virtual communication (COM) port as shown in Figure 11.

- **EVK-M101 current sensors:** Do not use this COM port.
- **EVK-M101 I2C:** Do not use this COM port.
- **EVK-M101 UART:** Use this COM port for UART communication with the receiver via the FTDI USB-to-UART interface.
- **EVK-M101 port D:** Do not use this COM port.

☞ The COM ports may appear differently in different Windows versions.

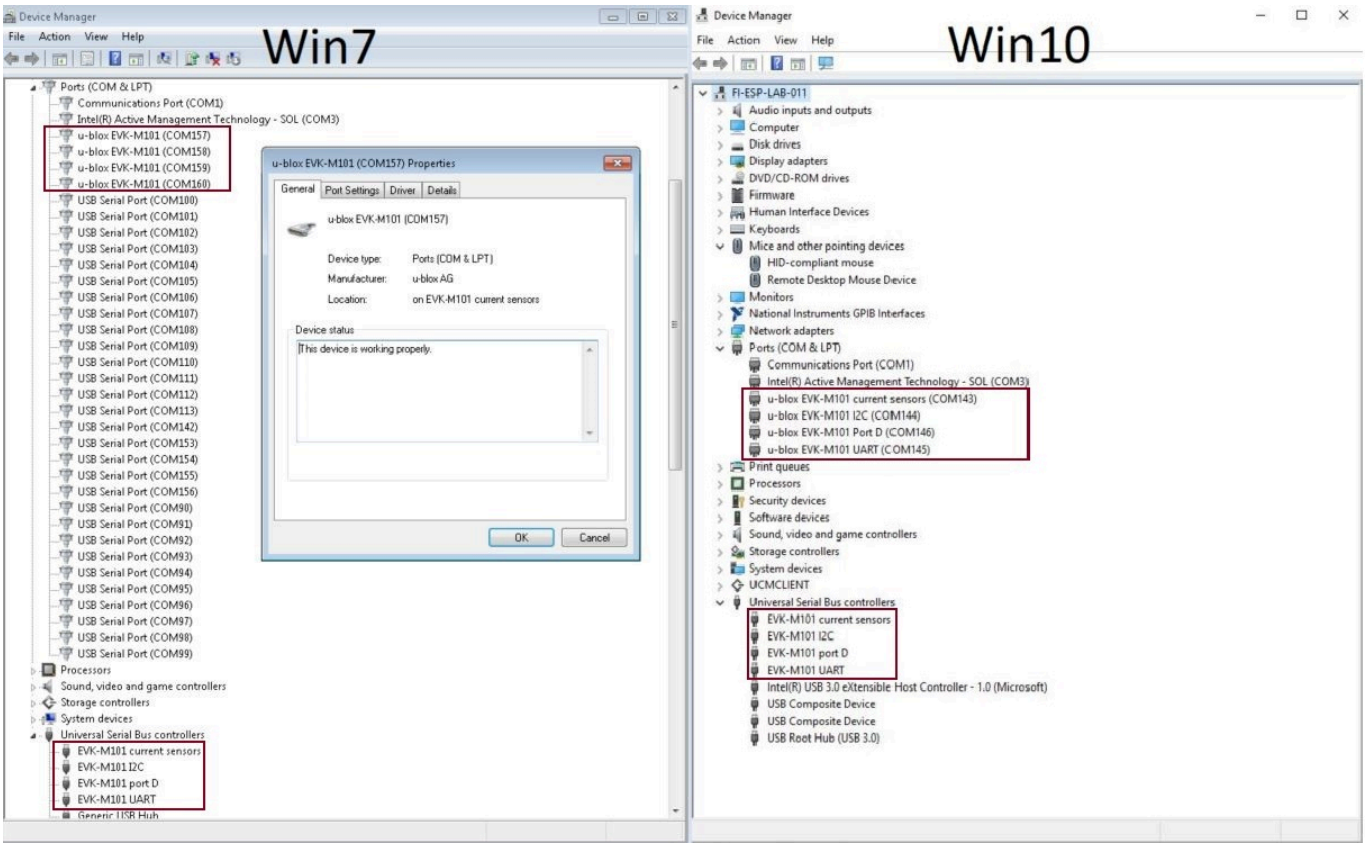


**Figure 11: EVK-M101/C communication ports identification on Windows**

### 8.1.1 UART baud rate configuration

The baud rate for the UART communication to the receiver can be configured in the **CFG-UART1-BAUDRATE** configuration key or in the CFG-UART2-BAUDRATE configuration key depending on the UART interface that is in use. The default baud rate is set to 38400 as shown in Figure 12, and the maximum baud rate is 921600.

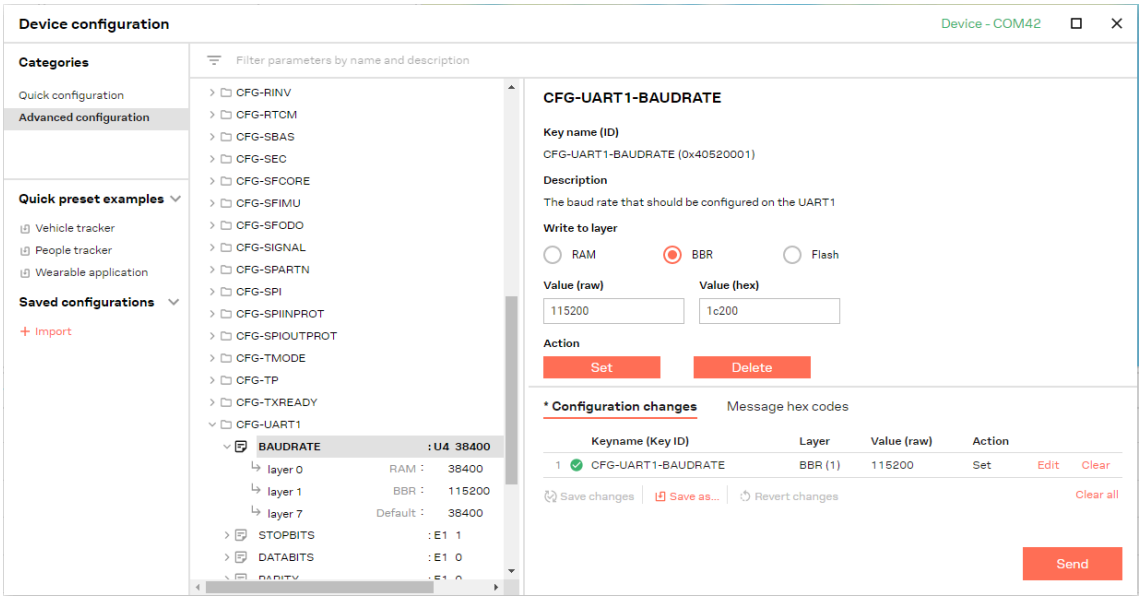


**Figure 12: EVK-M101/C UART baud rate configuration**

Setting a different baud rate will interrupt communication. If other configuration keys were set after, these will not be applied. Therefore, the new baud rate needs to be selected manually to resume communication and apply the remaining configuration items.

## 8.2 GNSS configuration

The default GNSS constellations that are enabled on the receiver are GPS, Galileo, SBAS and QZSS. The receiver GNSS configuration can be updated by selecting the constellations in the GNSS Configuration View as shown in Figure 13.

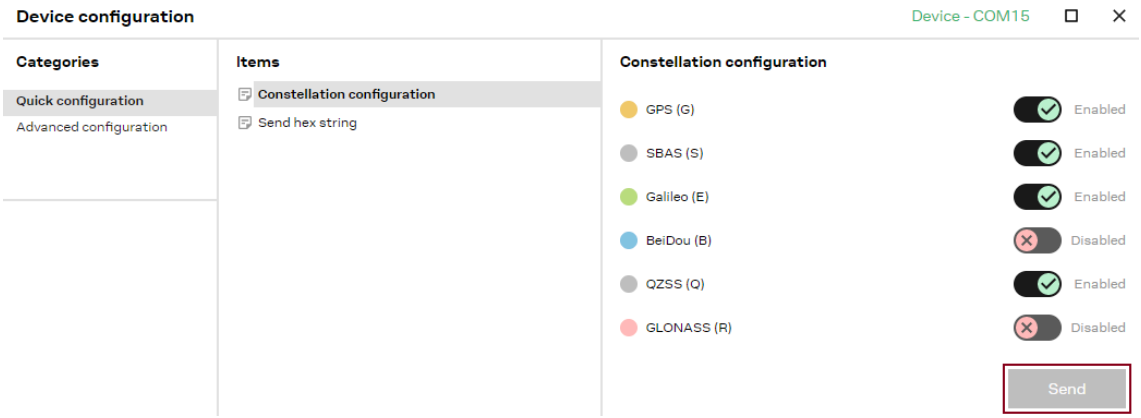


**Figure 13: EVK-M101/C receiver GNSS configuration**

## 8.3 Navigation update rate

The **CFG-RATE-MEAS** configuration key that is shown in Figure 14 can be used to configure the navigation update rate. The navigation update rate value is defined in ms, where 100 ms corresponds to 10 Hz. The default update rate is 1000 ms which corresponds to 1 Hz. The default 1 Hz update rate is a good tradeoff between position accuracy and power consumption. Certain applications require faster update rates for high performance but this will increase the receiver power consumption.

Increase the communication baud rate and reduce the number of messages that are enabled when high navigation update rates are used. The maximum baud rate of 921600 or 460800 baud rate should be sufficient for most use cases.

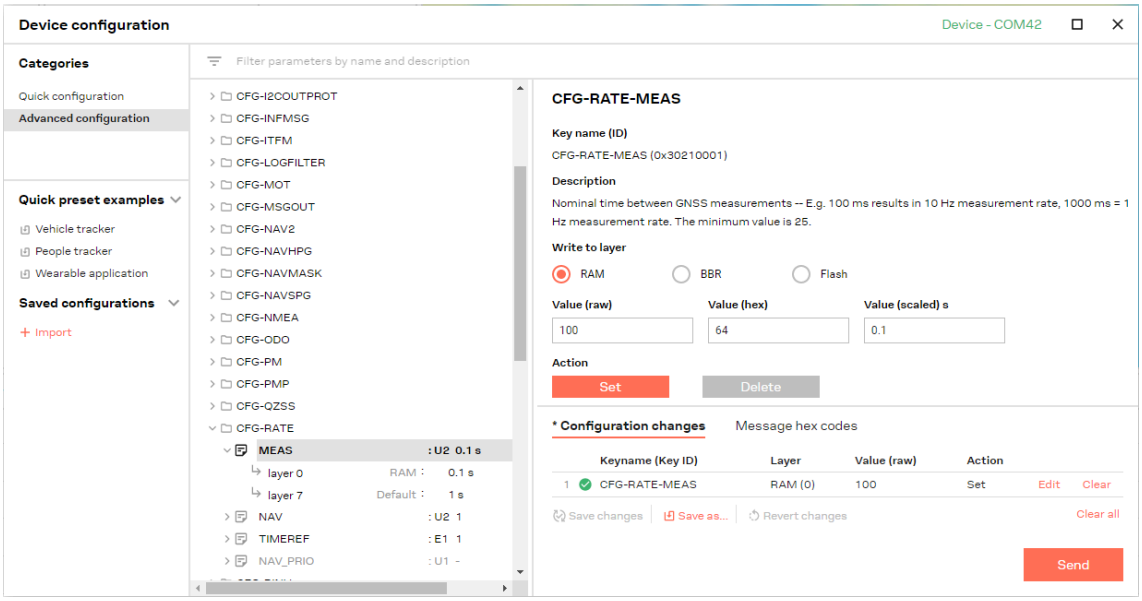


**Figure 14: EVK-M101/C receiver navigation update rate configuration**

## 8.4 Internal LNA mode configuration

The u-blox M10 receiver provides the following internal LNA modes for optimizing the receiver performance and power consumption based on the available external gain from the selected RF front-end and active antenna. The appropriate LNA mode can be configured with the **CFG-HW-RF_LNA_MODE** configuration key as shown in Figure 15.

- **NORMAL:** The internal LNA of the receiver is configured to high-gain mode. Due to the external LNA on the RF path of the EVK, this mode is not recommended to be used on the EVK.
- **LOWGAIN:** The internal LNA of the receiver is configured to low-gain mode. This mode can be used on the EVK with a passive or an active antenna. This mode is also suitable when a GNSS simulator is connected to the EVK. This is the default mode on EVK-M101/C.
- **BYPASS:** The internal LNA of the receiver is bypassed. Consider using this mode to save power if an active antenna with high gain is used like the antenna included in the EVK package.

Changing the internal LNA mode requires a reset or power-cycle of the receiver for the new configuration to take effect. The reset can be done by pressing the RST button on the EVK front panel if the configuration is saved in Flash. Otherwise, power-cycle the receiver if the configuration is saved to BBR.

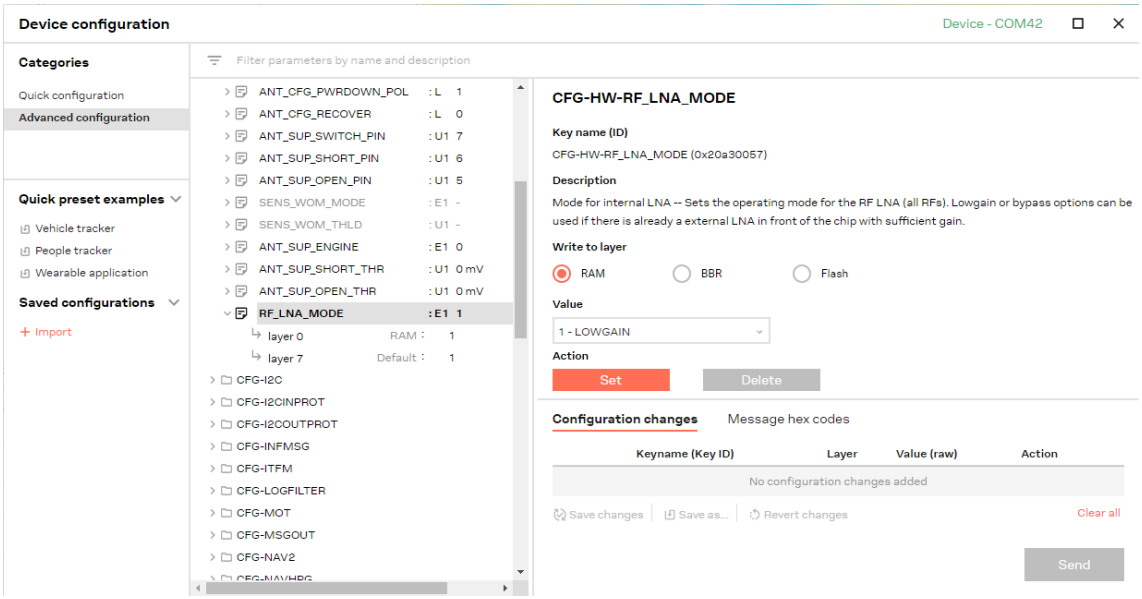


**Figure 15: EVK-M101/C receiver internal LNA mode configuration**

## 8.5 Power modes

EVK-M101/C supports the following power modes and can be configured with the **CFG-PM-OPERATEMODE** configuration key.

- **Continuous mode (FULL):** This is the full power mode and the default mode of the receiver. No power save mode is active in this mode.
- **On/Off mode (PSMOO):** This is a power save mode for reducing the power consumption of the receiver. In this mode, the receiver is configured to be periodically turned on or off for applications that require less frequent position updates. Typically used for update periods longer than 10 seconds.
- **Cyclic tracking mode (PSMCT):** This is also a power save mode for applications that require more frequent position updates. Typically used for short update periods in the range of 0.5 to 10 seconds. In this mode, the receiver does not shut down completely between position fixes, but uses low-power tracking instead.

☞ BeiDou B1C is not supported in power save mode (PSM). Some PSM states clear the RAM memory. Store receiver configuration in BBR to maintain the settings. In addition, it is recommended to disable SBAS because the receiver is unable to download or process any SBAS data in PSM.

Figure 16 shows the configuration window for selecting the receiver power mode and configuring the position update period. For the On/Off power mode, the position update period is defined with the **CFG-PM-POSUPDATEPERIOD**. To maintain the configuration during an inactive state, save it either in the RAM and BBR layers or permanently in the Flash layer.

☞ The CFG-PM-OPERATEMODE configuration is applied last after other required power mode configuration items are defined in the CFG-PM group.

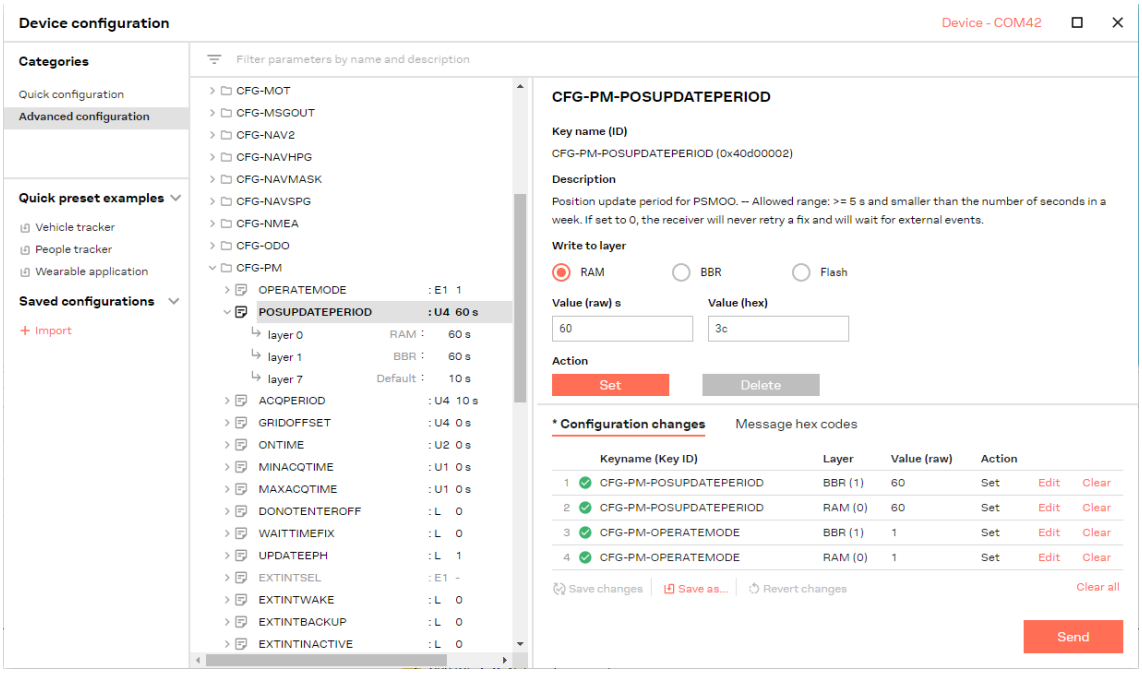


**Figure 16: EVK-M101/C receiver power mode configuration**

### 8.5.1 Backup modes

u-blox M10 receiver supports hardware backup, hardware standby, and software standby modes. The hardware standby mode is not supported on EVK-M101/C.

- **Hardware backup mode:** In this mode, other supplies except the backup supply (V_BCKP) are turned off. On the EVK-M101/C, this is achieved by turning off the main power supply of the EVK either by removing the USB cable or the 5.0 V supply from the 14-pin connector.
- **Software standby mode:** In this mode, the receiver executes little or no system activity. To wake the receiver up from the software standby mode, the wakeup source can be configured in **UBX-RXM-PMREQ** message. The available wakeup sources are EXTINT, SPI CS and UART RxD signals.

The duration in the UBX-RXM-PMREQ message can be set to 0 for putting the receiver to software standby mode indefinitely until a signal is detected from the configured wakeup source. In addition, ensure that the force option is selected.

The RAM memory is cleared in the software standby mode and in the off state of PSMOO. To maintain the configuration during the inactive state, save it either in the RAM and BBR layers or permanently in the Flash layer.

Refer to u-blox M10 interface description for more information on advanced configuration of the receiver [7].

# 9 Approvals

The EVK-M101/C is designed for the presumption of conformity with the essential requirements and other relevant provisions of Radio Equipment Directive (RED) 2014/53/EU.

The EVK-M101/C complies with the Directive 2011/65/EU (EU RoHS 2) and its amendment Directive (EU) 2015/863 (EU RoHS 3).

The Declaration of Conformity (DoC) is available at u-blox website within Support > File Category > Conformity and Certification [8] .

# 10 Troubleshooting

**My application (e.g. u-center 2) does not receive all messages**

When using UART, check that the baud rate is high enough or reduce the number of enabled messages. The maximum baud rate of 921600 or 460800 baud rate should be sufficient for most use cases. If the baud rate is insufficient, GNSS receivers based on u-blox M10 GNSS technology will skip excessive messages. Some serial port cards/adapters (e.g. USB to RS-232 converter) frequently generate errors. If a communication error occurs while u-center 2 receives a message, the message will be discarded.

**My application (e.g. u-center 2) loses the connection to the GNSS receiver**

u-blox M10 positioning technology and u-center 2 have an autobauding feature. If frequent communication errors occur (e.g. due to problems with the serial port), the connection may be lost. This happens because u-center 2 and the GNSS receiver both autonomously try to adjust the baud rate, if the GNSS receiver has the autobauding enabled. Select a suitable baud rate from the available list in u-center 2.

**Some COM ports are not shown in the port list of my application (e.g. u-center 2)**

Only the COM ports that are available on your computer will show up in the COM port drop down list. If a COM port is gray or u-center 2 is not able to connect to the selected COM port, check if there is another application running on the computer that is using the same port.

**There is no data received from the EVK after connecting the EVK to my application.**

Check the interface switch position and ensure that it is set to the communication interface that is in use. For example, set the interface switch to position 0 or 2 for UART communication.

☞ Do not change the interface switch while the EVK is still powered. Turn off the EVK, change the switch position and turn on the receiver.

EXTINT signal is not transmitted when connecting the EVK using an RS-232 cable. Disconnect the RS-232 cable and use the EXTINT signal from the front side of the EVK.

The USB port on the EVK can also be used for UART communication with the on-board FTDI USB-to-UART converter.

**EVK-M101/C is not able to use the available FTDI drivers automatically in Linux environment.**

EVK-M101/C does not officially support Linux and the following configuration is only provided to map the available FTDI drivers to the connected EVK, which should be useful in most cases.

Map the FTDI drivers that are available in the Linux system to the EVK device by saving the following configuration in a new rules file under the `/etc/udev/rules.d/` folder.

For example: `> nano /etc/udev/rules.d/10-evk.rules`

```
ACTION=="add" \, ATTRS{idVendor}=="1546" \, ATTRS{idProduct}=="0506" \,
SYMLINK+="ttyEVK%n" \,

RUN+="/sbin/modprobe ftdi_sio" \ RUN+="/bin/sh -c 'echo 1546 0506 > /sys/bus/
usb-serial/drivers/ftdi_sio/new_id'"

RUN+="/bin/stty -F /dev/ttyEVK%n -clocal raw ispeed 38400 ospeed 38400"
```

The configuration will generate four ports as shown in the example in Figure 17 and the third port (ttyUSB4 in the figure) can be used for UART communication with the receiver.

```
lrwxrwxrwx.  1 root root           7 Mar  9 16:15 ttyEVK5 -> ttyUSB5
lrwxrwxrwx.  1 root root           7 Mar  9 16:15 ttyEVK4 -> ttyUSB4
lrwxrwxrwx.  1 root root           7 Mar  9 16:15 ttyEVK3 -> ttyUSB3
lrwxrwxrwx.  1 root root           7 Mar  9 16:15 ttyEVK2 -> ttyUSB2
crw-rw----.  1 root dialout 188,   3 Mar  9 16:16 ttyUSB3
crw-rw----.  1 root dialout 188,   5 Mar  9 16:16 ttyUSB5
crw-rw----.  1 root dialout 188,   2 Mar  9 16:16 ttyUSB2
crw-rw----.  1 root dialout 188,   4 Mar  9 17:05 ttyUSB4
crw-rw----.  1 root dialout 166,   1 Mar  9 17:40 ttyACM1
crw-rw----.  1 root dialout 166,   0 Mar  9 17:41 ttyACM0
crw-rw----.  1 root dialout 188,   0 Mar  9 17:47 ttyUSB0
crw-rw----.  1 root dialout 188,   1 Mar  9 17:47 ttyUSB1
```

**Figure 17: EVK-M101/C communication ports in Linux environment**

### EVK-M101/C does not work properly when connected to a GNSS simulator

When using EVK-M101/C together with a GNSS simulator, please pay attention to proper handling of the EVK. A GNSS receiver is designed for real-life use (i.e. time is always moving forward). When using a GNSS simulator scenarios, the scenario time can be in the past resulting in the receiver to jump backwards in time. This can have serious side effects on the performance of GNSS receivers.

The solution is to configure the GPS week rollover value to a week number preceding the date in GNSS simulator scenario. For example, setting the GPS week number to 1200 (corresponding to Jan 2003) allows running simulator scenarios taking place after this date. Please refer to Figure 18 for how to set the GPS week number with u-center 2 GNSS evaluation tool. In addition, always issue a cold start command before every simulator test to avoid receiver confusion due to the time jumps.

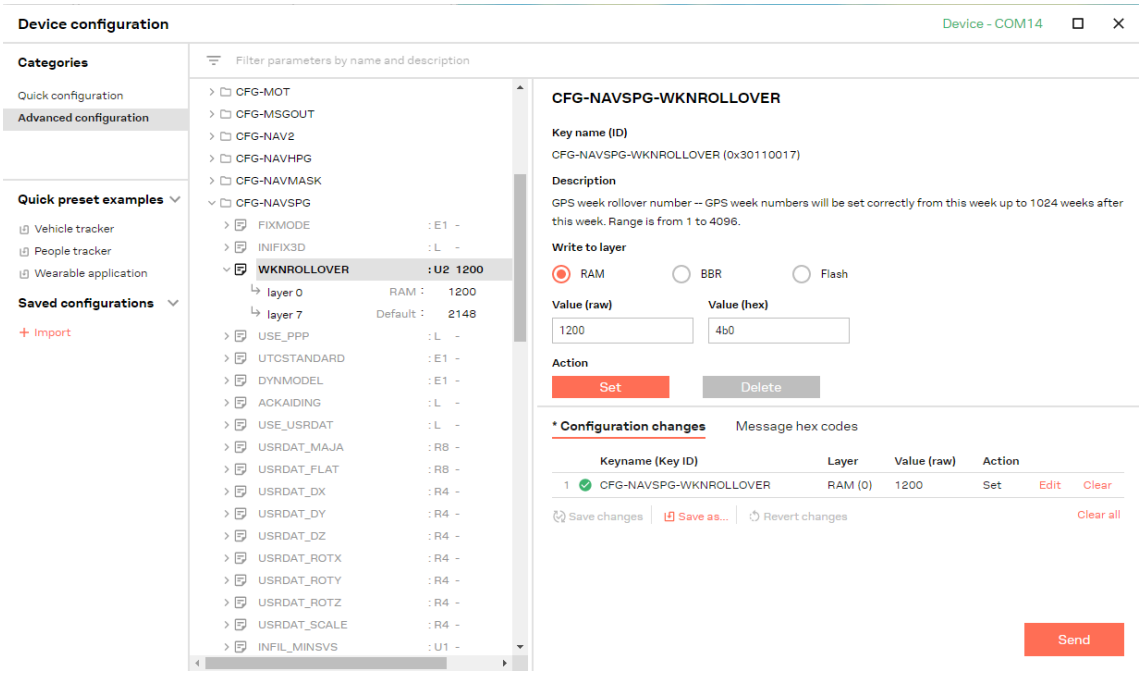


**Figure 18: Setting GPS week number with u-center 2 GNSS evaluation tool**

# 11 Common evaluation pitfalls

- **Parameters may have the same name but a different definition.** GNSS receivers may have a similar size, price and power consumption but can still have different functionalities (e.g. no support for passive antennas, different temperature range). Also, the definitions of Hot, Warm, and Cold Start times may differ between suppliers.
- Verify design-critical parameters. Try to **use identical or at least similar settings when comparing** the GNSS performance of different receivers. Data, which has not been recorded at the same time and the same place, should not be compared. The satellite constellation, the number of visible satellites and the sky view might have been different.
- **Do not compare momentary measurements.** GNSS is a non-deterministic system. The satellite constellation changes constantly. Atmospheric effects (i.e. dawn and dusk) have an impact on signal travel time. The position of the GNSS receiver is typically not the same between two tests. Comparative tests should therefore be conducted in parallel by using one antenna and a signal splitter; statistical tests shall be run for 24 hours.
- **Monitor the carrier-to-noise-ratio (C/N0).** The average C/N0 of the high elevation satellites should be between 40 dBHz and about 50 dBHz. A low C/N0 will result in a prolonged TTFF and more position drift.
- Try to **feed the same signal to all receivers in parallel** (i.e. through a splitter) with identical cable length; the receivers will otherwise not have the same sky view. Even small differences can have an impact on the speed, accuracy, and power consumption. One additional satellite can lead to a lower dilution of precision (DOP), less position drift, and lower power consumption.
- **When doing reacquisition tests,** cover the antenna in order to block the sky view. **Do not unplug the antenna** since the u-blox M10 positioning technology continuously performs a noise calibration on idle channels.
- **Be careful not to disable the communication interface while it is used.** The Interface switch is used to select between UART, I2C or SPI communication interfaces. If the receiver is set to I2C/UART mode 2 and the receiver configuration is saved by sending the UBX-CFG-CFG save command, all input and output protocols for SPI are disabled. Powering up the EVK in SPI mode 1 will result in the receiver starting with all SPI input and output protocols disabled. Since SPI input has also been disabled, it is impossible to recover using the SPI interface. Powering up in I2C/UART mode 2 and sending the UBX-CFG-CFG clear command restores the SPI interface defaults, which makes the SPI interface usable again for communication with the receiver.
- **u-center 2 does not offer the current measurement feature for my EVK.** The current measurement feature is available in EVK-M101-00-02, resp. EVK-M101C-00-02, and later. For the type number, see the product label.

# Related documents

[1] UBX-M10050-KB Data sheet (NDA required)
[2] MAX-M10S Data sheet, UBX-20035208
[3] MAX-M10M Data sheet, UBX-22028884
[4] MIA-M10Q Data sheet, UBX-22015849
[5] Information technology equipment - Safety Standard IEC 62368-1:2018
[6] u-center 2 User guide, www.u-blox.com/en/info/u-center-2-user-guide
[7] u-blox M10 SPG 5.10 Interface description, UBX-21035062, UBX-21035061 (NDA required)
[8] Declaration of Conformity, UBX-22025557

☞ For regular updates to u-blox documentation and to receive product change notifications please register on our homepage https://www.u-blox.com.

# Revision history

| Revision | Date | Name | Status / comments |
|---|---|---|---|
| R01 | 09-Feb-2021 | oola | Initial release |
| R02 | 30-Mar-2021 | oola | Updates for ES release: newer EVK images and COM port identification information. |
| R03 | 06-Apr-2022 | oola | Added SPG 5.10 related updates and replaced references to u-center with u-center 2. Added power save mode configuration. Updated troubleshooting and device configuration sections with u-center 2 images. |
| R04 | 23-Aug-2022 | imar | Added references to the EVK-M10 crystal variant, EVK-M101C.<br>Added section "2.2 Approvals" |
| R05 | 19-Jan-2023 | mban | Added section 5.2 for measuring current using u-center 2.<br>Updated the block diagram (figure 6) with a different shunt resistor value.<br>Added a point stating that the RS232 port supports max 230400 baud. |

# Appendix

## A Glossary

| Abbreviation | Definition |
|---|---|
| BeiDou | Chinese navigation satellite system |
| BBR | Battery-backed RAM |
| EVK | Evaluation kit |
| I2C | Inter-Integrated Circuit bus |
| ESD | Electrostatic discharge |
| Galileo | European navigation satellite system |
| GLONASS | Russian navigation satellite system |
| GND | Ground |
| GNSS | Global Navigation Satellite System |
| GPS | Global Positioning System |
| IEC | International Electrotechnical Commission |
| PCB | Printed circuit board |
| RF | Radio frequency |
| UBX | u-blox |
| QZSS | Quasi-Zenith Satellite System |

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