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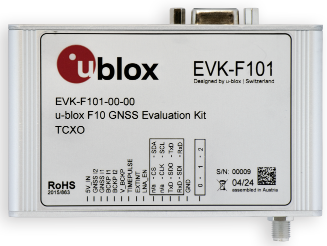
EVK-F101

Evaluation kit

User guide



Abstract
This document describes the structure and use of the EVK-F101 evaluation kit and provides information for evaluating u-blox F10 dual-band positioning technology.

Note! GPS L5 signals are pre-operational and not used by default. Refer to the Overview section for more information.

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Contents

1 Product description

1.1 Overview

The EVK-F101 evaluation kit makes it simple to evaluate the high performance and low-power u-blox F10 L1/L5 dual-band GNSS technology.

⚠ At the time of writing, the GPS L5 signals remain pre-operational and are set as unhealthy until sufficient monitoring capability is established. This is an operational issue concerning the satellites / space segment and not a limitation of u-blox products.

⚠ Due to the pre-operational status, the GPS L5 signals are not used for the navigation solution by default. However, it is possible to evaluate the GPS L5 signals before they become fully operational by changing the receiver configuration to override the GPS L5 health status. Refer to the section Using GPS L5 signals for evaluation for details.

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 capabilities.

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 PC or a laptop, making them the perfect companion through all stages of design-in projects.

Evaluation kit	Description	Related products
EVK-F101	u-blox F10 evaluation kit with TCXO	u-blox UBX-F10050-KB chip [1] MAX-F10S module [2] MIA-F10Q module [3]

Table 1: EVK-F101 supported products

1.2 Kit contents

The delivery package contains:

- Compact 105 x 64 x 26 mm EVK-F101 unit
- Active, dual-band ANN-MB5 [8] GNSS antenna with 3 m cable [1]
- USB 2.0 cable (Type-C)
- EVK welcome card
- GPS L5 information card

1.3 System requirements

- PC with USB 2.0 or RS-232 interface
- Operating system: Microsoft Windows 10 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] L1/L5 dual-band antenna that supports GPS, Galileo, BeiDou, and NavIC

2 Specifications

Parameter	Specification
Serial interfaces	1 USB 2.0 Type-C 1 UART, max baud rate 921600 baud (using 14-pin connector) RS-232 +/- 5.0 V level 14 pin, 3.3 V logic 1 I2C, max 320 kHz 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-F101 specifications

2.1 Safety precautions

EVK-F101 must be supplied by a PS1 class limited power source. See section 6.2.2.4 of IEC 62368-1:2018 [4] 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-F101, including interfaces and antennas. See section 5.2.1.1 of IEC 62368-1:2018 [4] 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 is required for configuration, testing, visualization and data analysis of u-blox GNSS receivers as well as EVKs. u-center 2 also includes a current measurement tool for monitoring the current consumption of u-blox 10 receivers. 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 [5].

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 2 for I2C/UART
UART or RS-232	0 for UART 2 for I2C/UART
SPI/I2C	1 for SPI 2 for I2C/UART

Table 3: EVK-F101 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** Risk of device damage. 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 mode.

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 Connecting the EVK with a PC and also in the u-center 2 User guide [5].

3.3 Default interface 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

The EVK-F101 evaluation kit contains u-blox F10 L1/L5 dual-band GNSS receiver, RTC, SPI flash memory, DC-DC converter, LNA, SAW diplexer filter, and external TCXO. 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-F101 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 includes an on-board USB-to-Serial converter for USB-to-UART communication with the receiver. Additional measurement equipment and devices can be connected to the 14-pin connector on the front side of the EVK for current measurement and accessing the available digital interfaces. 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.

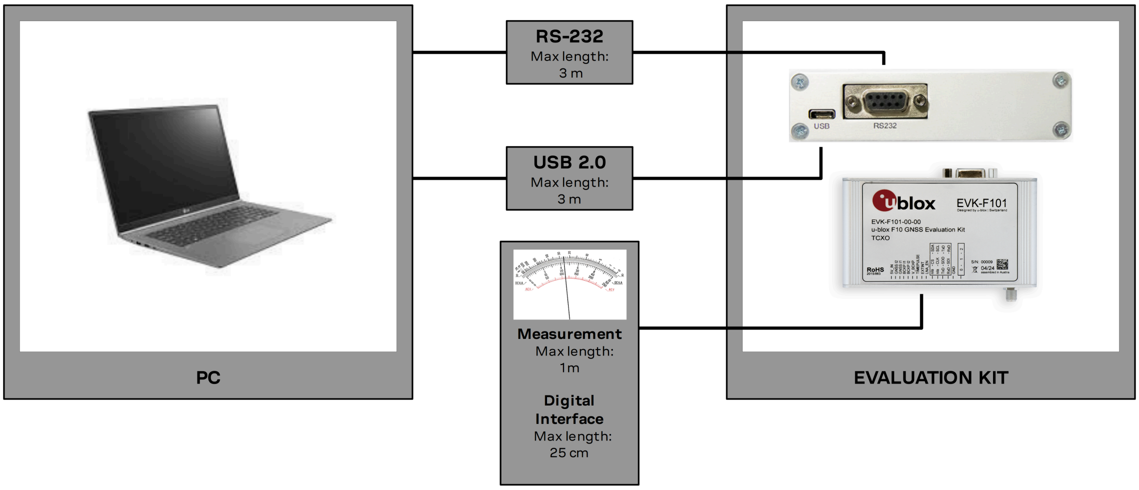

Figure 1: Connecting the EVK-F101 unit for power supply and communication

Figure 2 shows the front and back of the EVK-F101 evaluation unit.

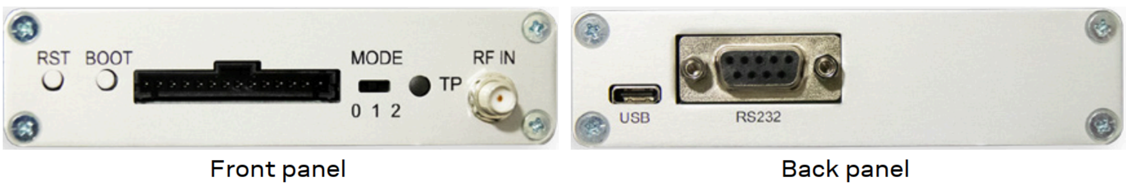

Figure 2: The front and back of EVK-F101

4.1.1 Interface switch

Use the interface switch in the front of the unit 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 mode is changed.

⚠ **CAUTION** CAUTION. Risk of device damage. 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 mode.

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/SDO, RXD/SDI pins at the front side).

4.1.2 14-pin connector

The EVK-F101 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. This 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 a voltage drop over a 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. It can be used for time mark feature and time aiding.
6	LNA_EN	I/O	3.3 V	LNA enable signal that controls the external LNA. When this pin is used as an input, the LNA_EN jumper on the EVK board should be left open (i.e. not connected). 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. 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/SDO	O	3.3 V	Serial port transmit or SPI SDO, operation selected by interface switch.
2	RxD/SDI	I	3.3 V	Serial port receive or SPI SDI, operation selected by interface switch.
1	GND	I	-	Recommended common ground pin.

Table 5: EVK-F101 14-pin connector pin description

Figure 3: EVK-F101 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-F101 operation is to connect the EVK to a PC with the USB cable and 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 F10 receiver in the EVK. This allows the USB connector to be used for UART 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-F101 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 baud and EVK-F101 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. 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 maximum operating baud rate is 230400 baud.

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 software standby mode .

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

Pin number.	Assignment
1 & 6	Time pulse
2	TXD /SPI_SDO (GNSS Transmit Data , serial data to external device)
3	RXD /SPI_SDI (GNSS Receive Data , serial data from external device)
4	EXTINT
5	GND
7, 8 and 9	not connected

Table 6: EVK-F101 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 F10 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-F101 evaluation kit includes an ANN-MB5 dual band L1/L5 antenna for GPS, Galileo, and BeiDou constellations 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.

For evaluating with an external antenna, use the correct mode of the internal LNA as per the external antenna gain. By default, EVK-F101 operates in the low gain mode. The possible maximum external antenna gain corresponding to the different internal LNA modes are listed below:

Maximum external antenna gain	Internal LNA mode	Example antenna to use
25 dB	Normal mode	
35 dB	Low gain mode	u-blox ANN-MB5 [8]
45 dB	Bypass mode	u-blox ANN-MB1 [7]

Table 7: EVK-F101 maximum external antenna gain limits

When using the EVK-F101 in environments with high RF interference, for optimal performance, it is advisable to select a high-immunity, high-gain antenna, such as u-blox ANN-MB1 [7]. Before connecting a high-immunity antenna like ANN-MB1 to EVK-F101, ensure that the internal LNA mode is set to bypass mode. For configuration guidelines on adjusting the internal LNA mode, see Configuring internal LNA mode.

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-F101 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.

☞ EVK-F101 has no antenna supervisor or short circuit detection feature. The short-circuit protection limits the current to 50 mA.

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 F10 receiver, including any data or configuration stored in the RAM and BBR layers.

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.

4.6 LED

LED	Description
Solid blue LED	Time pulse signal, no GNSS fix, Power on
Flashing blue LED	The LED flashes one pulse per second during a GNSS fix

Table 8: EVK-F101 timepulse LED state

4.7 Flash memory

EVK-F101 has a 16-Mbit SPI flash that is connected to the u-blox F10 receiver. By default, it can be used to:

- Store the current configuration permanently.
- Save data logging results.
- Store 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 for downloading AssistNow™ Offline. Refer to the u-center 2 User guide [5] 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-F101 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-F101 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.

☞ The super capacitor requires about 200 seconds to charge to 2.0 V and about 1000 seconds to charge fully to 3.3 V. Due to this, avoid doing a hot start for a few minutes after connecting the power supply (from USB or from the 14-pin connector).

The V_BCKP power supply can provide power for an extended time while evaluating very long backup periods.

4.9 External interrupt

On the EVK-F101, the external interrupt (EXTINT) signal is available on the 14-pin connector. 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 software standby mode. See section 14-pin connector for more information.

5 Measuring current

5.1 Measuring GNSS current on the 14-pin connector

The receiver starts up in the acquisition state to search for available satellites and download GNSS orbital data, i.e. ephemeris and almanac. After downloading the data, the receiver switches to the tracking mode and typically stays in it during continuous operation, reducing the current consumption. The time required to enter tracking mode can be reduced by downloading aiding data from the AssistNow™ Online service.

On EVK-F101, the main supply voltage for the u-blox F10 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-F101, 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-F101.
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 it to current (1 mV equals 1 mA).

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 product data sheet [1].

5.2 Measuring current with u-center 2

☞ The current measurement feature is available in EVK-F101-00-00, 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 EVK-F101 to a PC with the USB cable and configure the correct communication port with u-center 2, as shown in Connecting the EVK with a PC.
2. Once the device has been successfully added, go to **Tools and Services > Tools > Current measurement >** as shown below:

[3] The TCXO on EVK-F101 consumes around 1 to 1.5 mA.

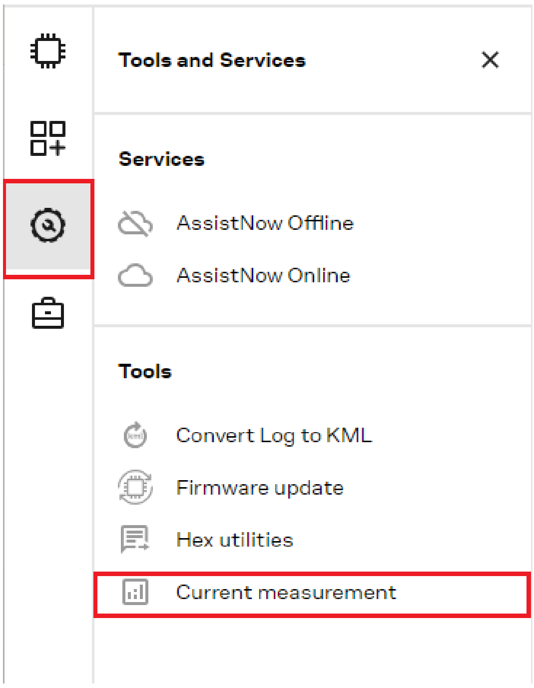

Figure 4: u-center 2 current measurement option in Tools and Services section

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.

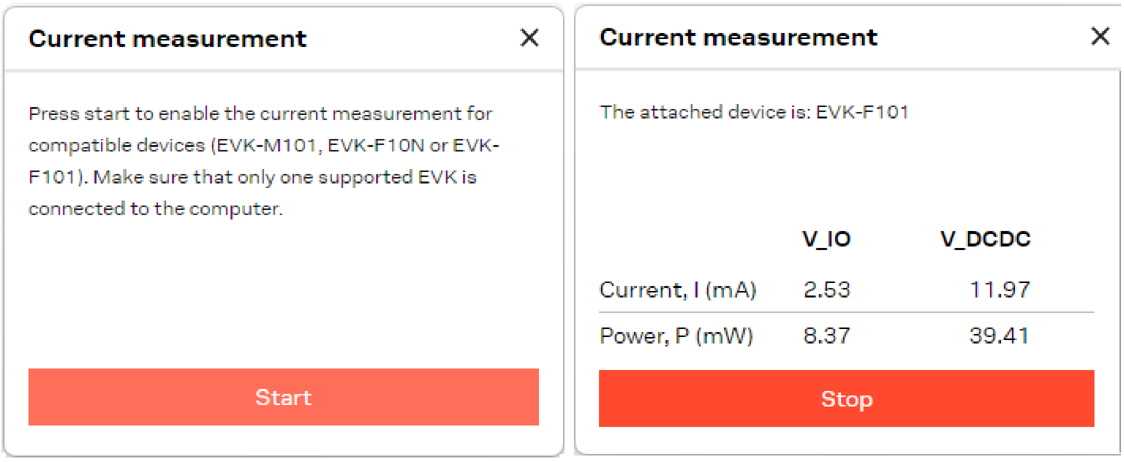

Figure 5: u-center 2 current measurement window

☞ The DC-DC has an average efficiency of 85 %, resulting in a higher power consumption than the values defined in the product data sheet [1].

u-center 2 measures the V_IO and DC-DC currents at 3.3 V.

To manually measure the current consumption, 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-F101, 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 the power supply by disconnecting the USB cable from the PC or other external power supply from the 14-pin connector.
3. Read the voltage (and average if necessary) on the voltmeter and convert it to current (1 mV equals 10 µA).

6 Block diagram

EVK-F101 block diagram provides an overview on supply voltages, current measurement and communication interfaces as shown in Figure 6.

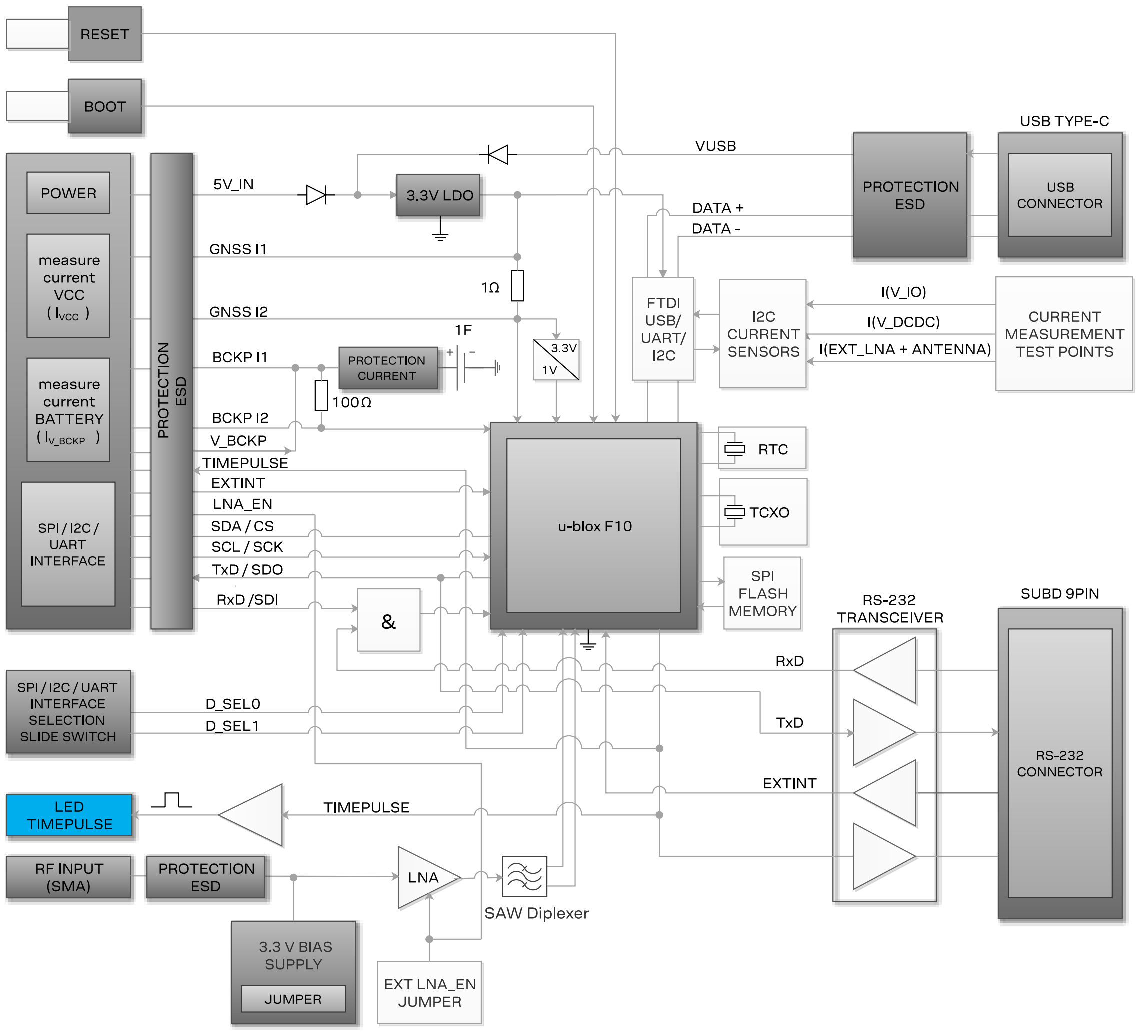

Figure 6: EVK-F101 block diagram

7 Board layout

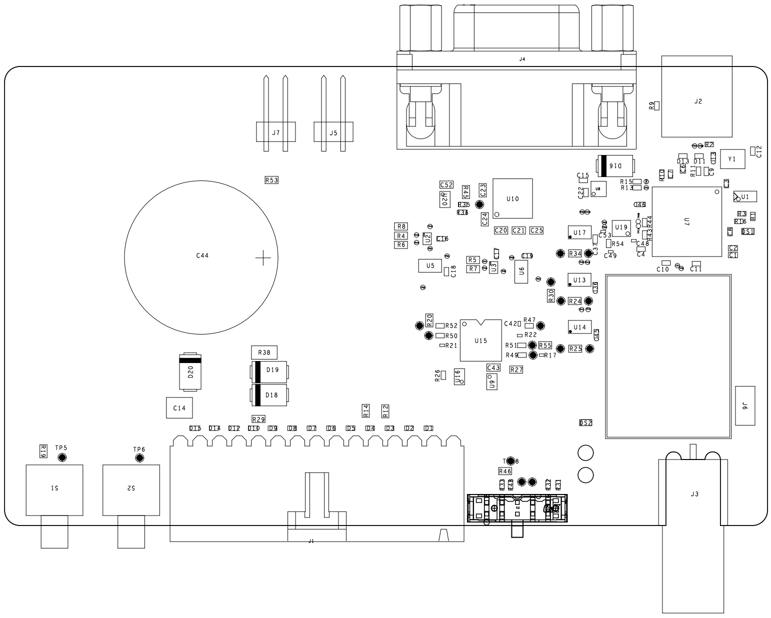

Figure 7: EVK-F101 board layout

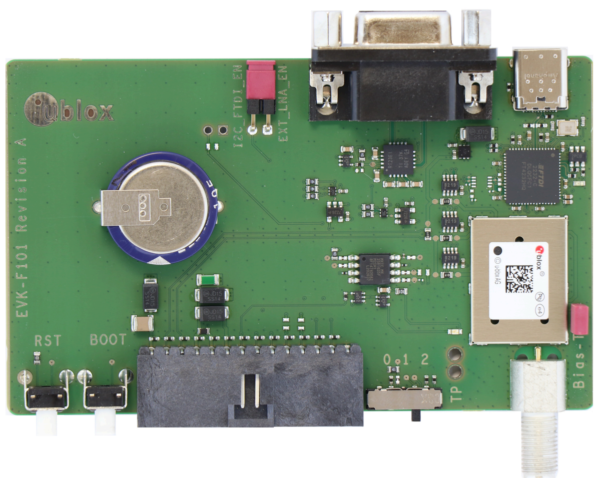

Figure 8: EVK-F101 PCB

8 Configuring the device

This chapter shows how to configure and evaluate the EVK-F101 key features related to power modes, GNSS constellations, and navigation rate of the receiver. The receiver can be configured with the configuration keys using the u-center 2 evaluation tool in the Device configuration -> Advanced configuration view, as shown in Figure 9.

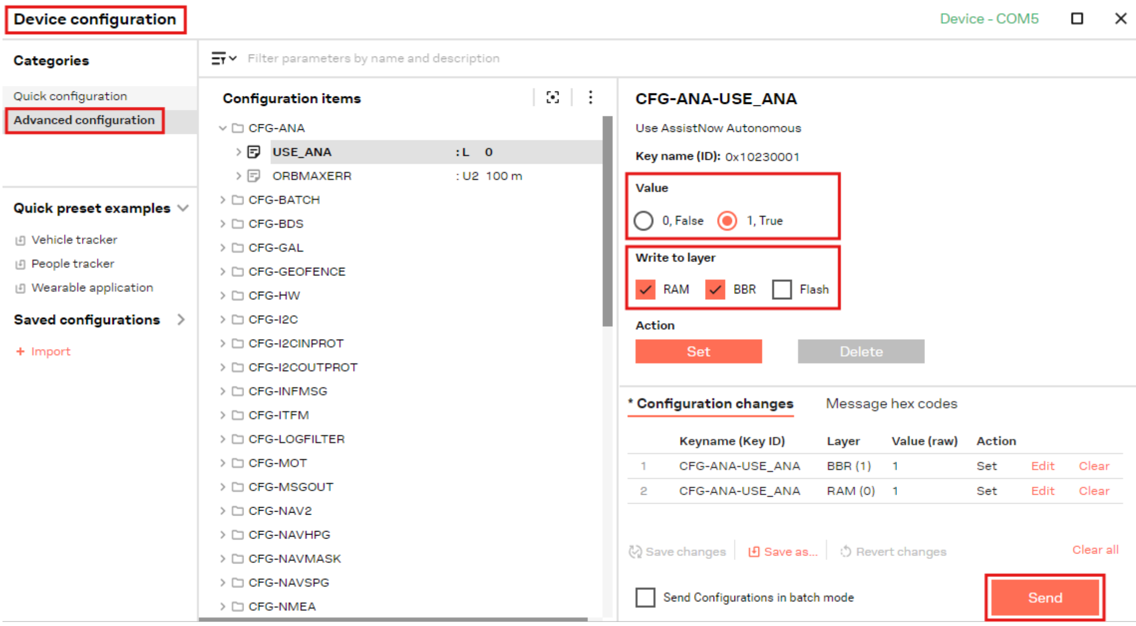

Figure 9: EVK-F101 receiver configuration view

The receiver configuration can be saved to the receiver RAM, battery-backed RAM (BBR), or to the available SPI flash memory. The RAM content is cleared after the power supply is disconnected, in the software standby mode. Therefore, it is recommended to save the receiver configuration to RAM and BBR or permanently in the Flash memory. 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 Connecting the EVK with a PC

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.

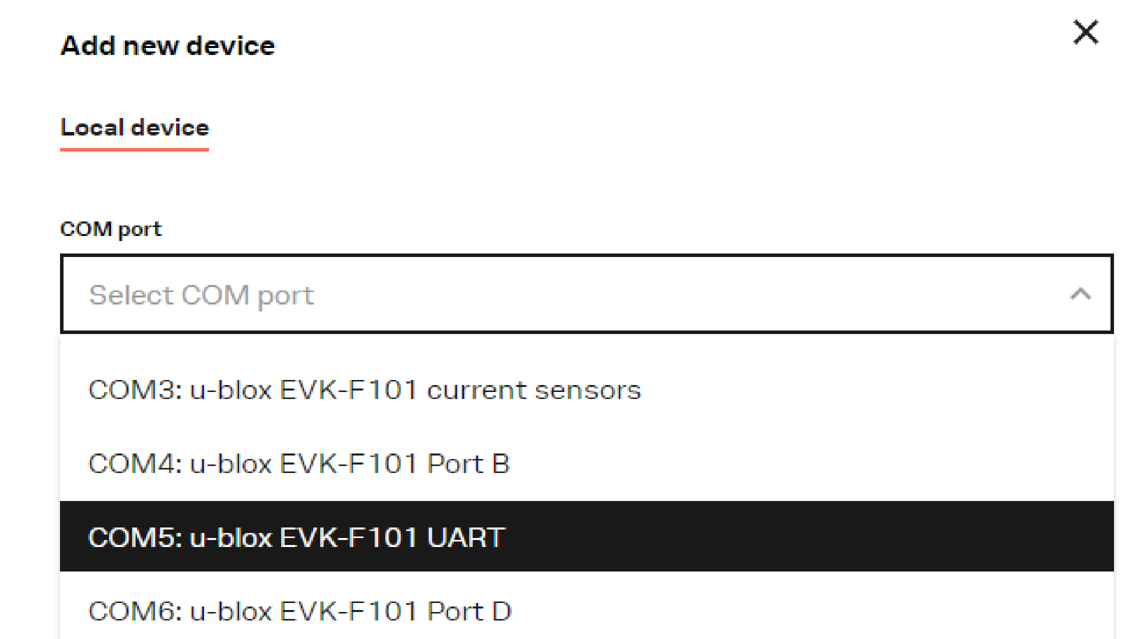

Figure 10: EVK-F101 communication ports identification on Windows

The identification of EVK-F101 on Windows machines has been improved to provide descriptive names to each virtual communication (COM) port as below.

- **u-blox EVK-F101 current sensors:** do not use this COM port.
- **u-blox EVK-F101 Port B:** do not use this COM port.
- **u-blox EVK-F101 UART:** use this COM port for UART communication with the receiver via the FTDI USB-to-UART interface.
- **u-blox EVK-F101 Port D:** do not use this COM port.

8.2 Configuring UART baud rate

The baud rate for the UART communication to the receiver can be configured in the **CFG-UART1-BAUDRATE** configuration key. The default baud rate is set to 38400 as shown in Figure 11, and the maximum baud rate is 921600.

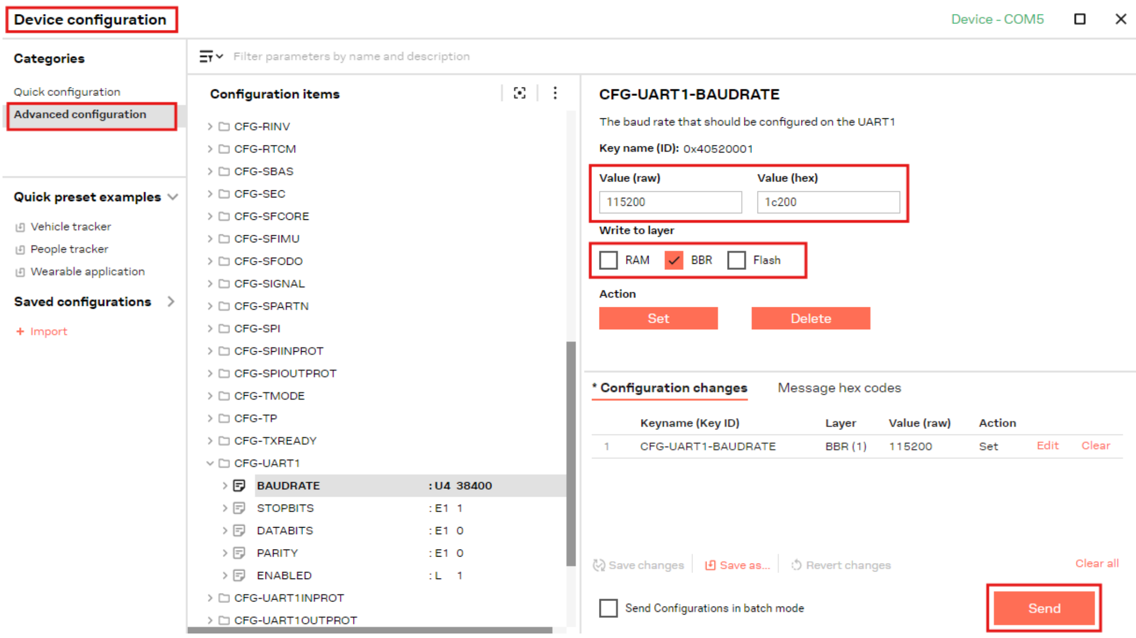

Figure 11: EVK-F101 UART baud rate configuration

☞ 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 in u-center 2 to resume communication with the host and apply the remaining configuration items.

8.3 Configuring GNSS constellations

The default GNSS constellations that are enabled on the receiver are GPS, Galileo, BeiDou, SBAS, and QZSS. The receiver GNSS configuration can be updated by selecting the constellations in the Device configuration -> Quick configuration -> Constellation configuration view as shown in Figure 12.

☞ u-blox receivers do not use GPS L5 signals by default. Refer to Using GPS L5 signals for evaluation to evaluate the GPS L5 signals.

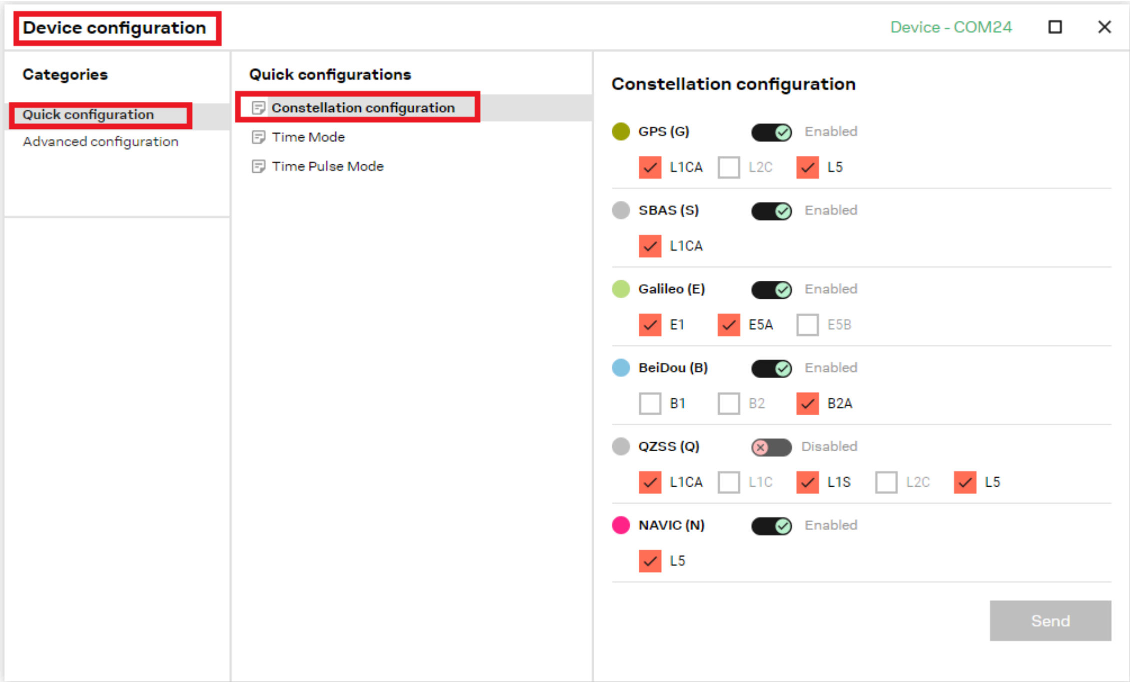

Figure 12: EVK-F101 receiver GNSS configuration

8.4 Using GPS L5 signals for evaluation

EVK-F101 supports both GPS L1 C/A and L5 signals. Broadcasting of Civil Navigation (CNAV) messages on the L5 signal began in April 2014. At the time of writing, GPS L5 signals remain pre-operational. They are set as unhealthy until sufficient monitoring capability is established and as such are not used by u-blox receivers by default.

To evaluate GPS L5 signals before they become fully operational, the receiver can be configured to ignore the GPS L5 health status by overriding it with the respective GPS L1 C/A signal status.

To ignore the GPS L5 signal health status and override it with the respective GPS L1 signal health status, send the configuration string given in Table 9 by navigating to Tools and Services -> Hex utilities -> Send raw data as shown in Figure 13.

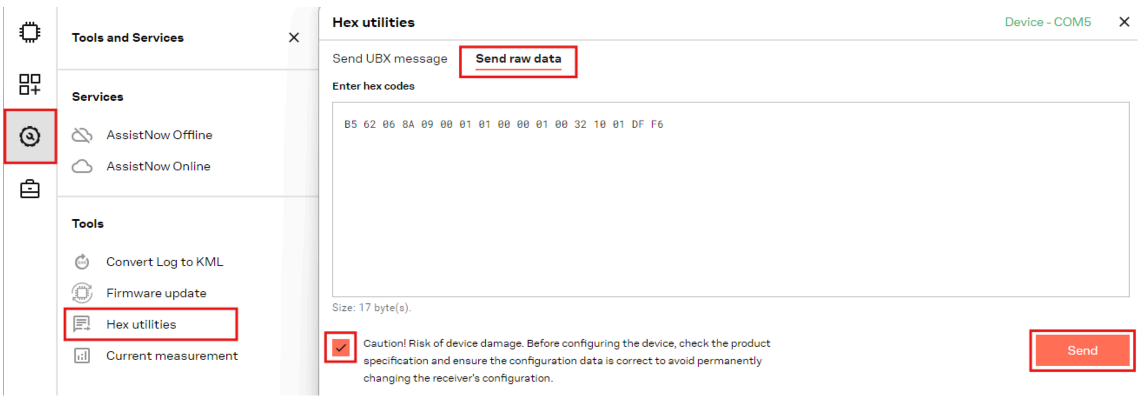

Figure 13: EVK-F101 GPS L5 health status configuration

The configuration can be stored in RAM, BBR and flash layers. If stored in the RAM layer, the device returns the UBX-ACK-ACK message if the configuration is sent successfully and it is applied immediately without a configuration reset. To apply the configuration stored in the BBR and flash layers, send the UBX-CFG-RST message with resetMode 0x01 as shown in Figure 14.

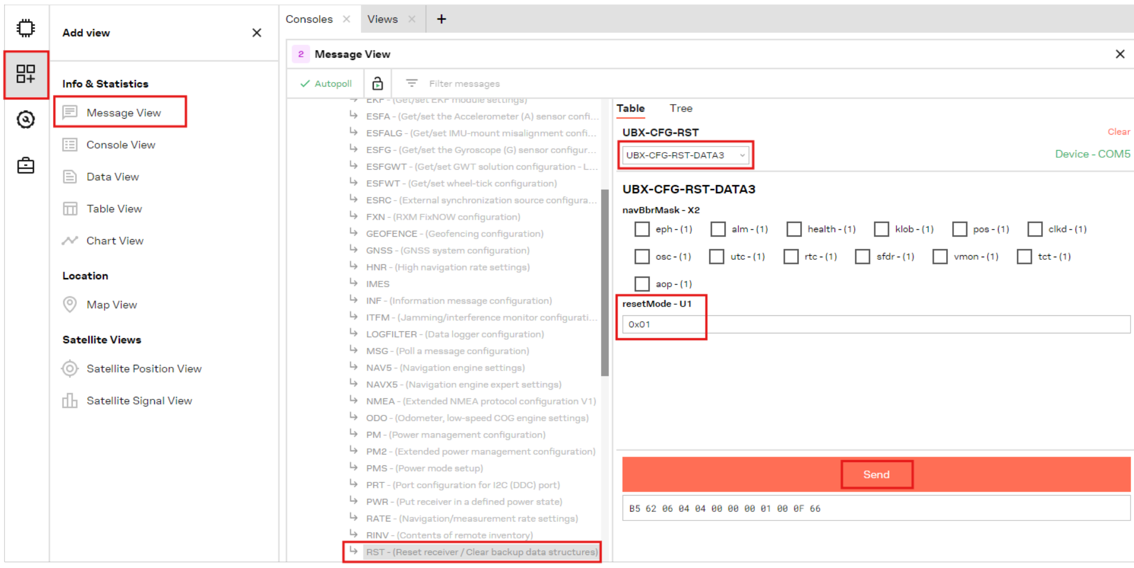

Figure 14: EVK-F101 UBX-CFG-RST message view with reset mode 0x01

To revert to the default configuration, send the configuration string given in Table 10 by navigating to Tools and Services -> Hex utilities -> Send raw data as shown in Figure 13.

The device returns the UBX-ACK-ACK message if the configuration is sent successfully and it is applied immediately without a reset in the RAM layer. To apply the configuration stored in the BBR and flash layers, send the UBX-CFG-RST message with resetMode 0x01 as shown in Figure 14.

Configuration layer	Configuration string
RAM	B5 62 06 8A 09 00 01 01 00 00 01 00 32 10 01 DF F6
BBR	B5 62 06 8A 09 00 01 02 00 00 01 00 32 10 01 E0 FE
FLASH	B5 62 06 8A 09 00 01 04 00 00 01 00 32 10 01 E2 0E

Table 9: UBX binary string to override GPS L5 signal health status with GPS L1 health status

Configuration layer	Configuration string
RAM	B5 62 06 8A 09 00 01 01 00 00 01 00 32 10 00 DE F5
BBR	B5 62 06 8A 09 00 01 02 00 00 01 00 32 10 00 DF FD
FLASH	B5 62 06 8A 09 00 01 04 00 00 01 00 32 10 00 E1 0D

Table 10: UBX binary strings to revert the GPS L5 signal health status monitoring to default

8.5 Configuring navigation update rate

The **CFG-RATE-MEAS** configuration key that is shown in Figure 15 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.

☞ When high navigation update rates are used, increase the communication baud rate and reduce the number of enabled messages. The maximum baud rate of 921600 or 460800 is sufficient for most use cases.

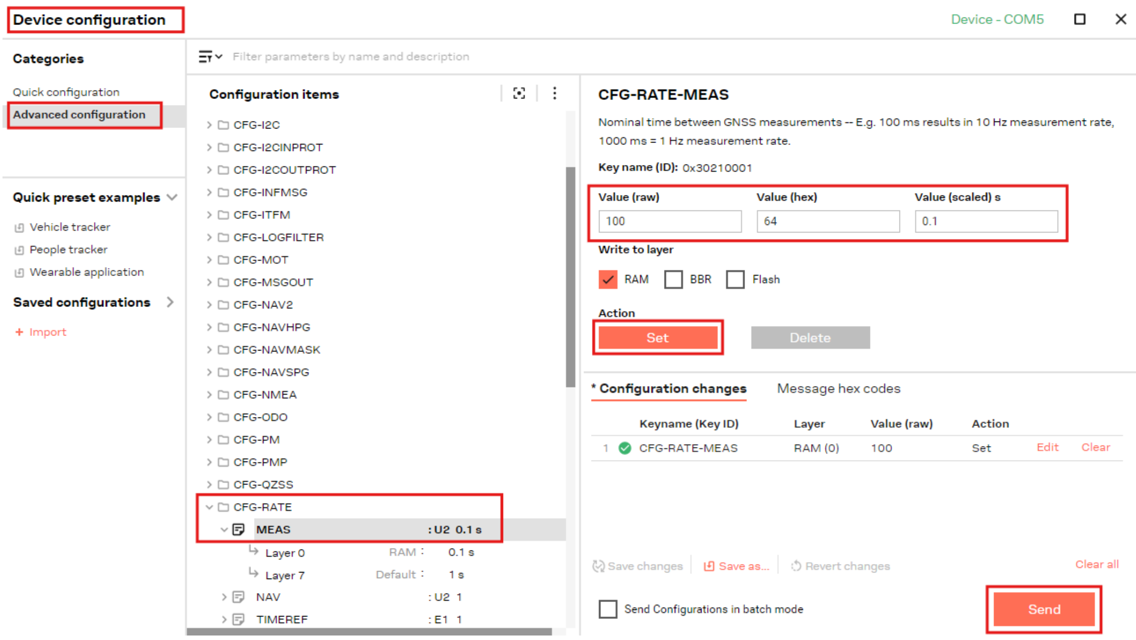

Figure 15: EVK-F101 receiver navigation update rate configuration

8.6 Configuring internal LNA mode

The u-blox F10 receiver provides the following internal LNA modes for optimizing the receiver performance and power consumption based on the gain of the external antenna used. The appropriate LNA mode can be configured with the **CFG-HW-RF_LNA_MODE** configuration key as shown in Figure 16.

- **NORMAL:** The internal LNA of the receiver is set to high gain. This, along with the gain from the external LNA on the EVK's RF path and the external antenna gain, can lead to receiver saturation. Therefore, this mode is not recommended for use 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. It is also suitable when a GNSS simulator is connected to the EVK. This is the default mode on EVK-F101.This mode is to be used for example with the ANN-MB5 antenna provided with the EVK.
- **BYPASS:** The internal LNA of the receiver is bypassed. Use this mode to save power if using an active antenna with high gain, like the u-blox ANN-MB1 [7].

☞ After changing the internal LNA mode, reset or power-cycle the receiver for the new configuration to take effect. If the configuration is saved in the Flash memory, reset the EVK by pressing the RST button on the front panel. If the configuration is saved in BBR, power-cycle the receiver. The reset can be done by pressing the RST button on the EVK front panel or by sending the UBX-CFG-RST message with resetMode set to 0, 1 or 4. In addition, the resetMode 0x01 should be used if the configuration is saved in BBR, while resetMode 0x00 and 0x04 can be used if the configuration is saved in Flash.

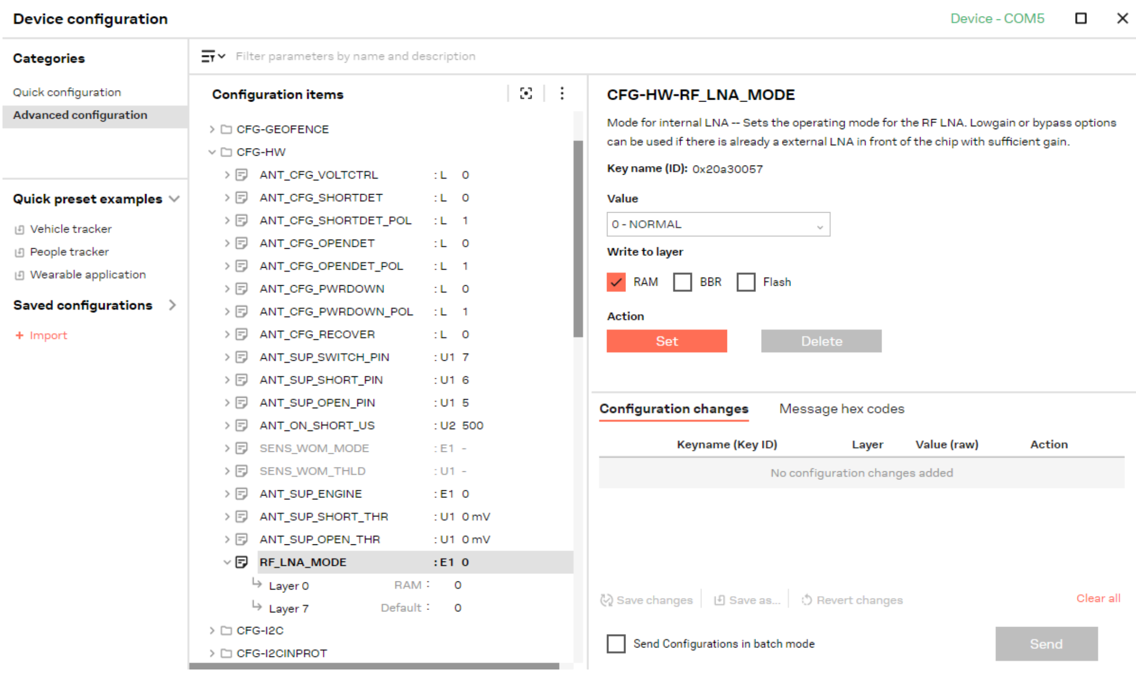

Figure 16: EVK-F101 receiver internal LNA mode configuration

8.7 Configuring power modes

EVK-F101 supports continuous power mode only. This is the full power mode and the default mode of the receiver.

8.7.1 Configuring backup modes

EVK-F101 supports two backup modes: hardware backup mode and software standby mode.

- **Hardware backup mode:** In this mode, only the the backup supply (V_BCKP) is turned on. All other supplies are turned off. To turn on the hardware backup mode on EVK-F101, remove the EVK main power supply either by disconnecting the USB cable from the PC or the 5.0 V supply from the 14-pin connector.
- **Software standby mode:** To turn on the software standby mode, provide the time duration as milliseconds in the duration field and select the UBX-RXM-PMREQ message backup flag, as shown in Figure 17. The receiver wakes up after the provided duration or by selecting the supported wakeup sources in the message field. The available wakeup sources are EXTINT and UART RxD signals.

☞ To keep the software standby mode on until a signal is detected from the configured wakeup source, set the duration to 0 in the UBX-RXM-PMREQ message.

☞ The RAM memory is cleared in the software standby mode. Save the configuration to maintain it during the inactive state.

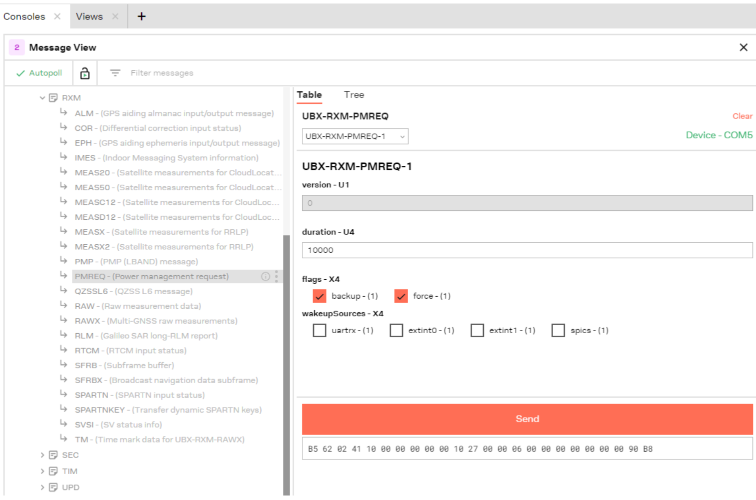

Figure 17: EVK-F101 receiver software standby mode configuration

Refer to u-blox F10 interface description for more information on the advanced receiver configuration [6].

9 Approvals

EVK-F101 complies with the essential requirements and other relevant provisions of the Radio Equipment Directive (RED) 2014/53/EU.

EVK-F101 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.

10 Troubleshooting

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

If the baud rate is insufficient, the GNSS receivers based on u-blox F10 GNSS technology skip excessive 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 is sufficient for most use cases. 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 is discarded.

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

u-blox F10 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 if the GNSS receiver has the autobauding enabled because both u-center 2 and the GNSS receiver try to autonomously adjust the baud rate. Select a suitable baud rate from the list available 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 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 another application running on the computer is using the same port.

FTDI drivers are not automatically mapped in Linux environment

EVK-F101 does not officially support Linux. The following example shows how to map the available FTDI drivers to the connected EVK.

To map the FTDI drivers available in the Linux system to the EVK device, save 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}=="050a",

ATTRS{bInterfaceNumber}=="00", SYMLINK+="ttyUSB-EVK-F101-Current-sensors",

ATTRS{bInterfaceNumber}=="01", SYMLINK+="ttyUSB-EVK-F101-PortB",

ATTRS{bInterfaceNumber}=="02", SYMLINK+="ttyUSB-EVK-F101-UART",

ATTRS{bInterfaceNumber}=="03", SYMLINK+="ttyUSB-EVK-F101-PortD",

RUN+="/sbin/modprobe ftdi_sio"

RUN+="/bin/sh -c 'echo 1546 050a > /sys/bus/usb-serial/drivers/ftdi_sio/
new_id'"

RUN+="/bin/stty -F /dev/ttyUSB-EVK-* -clocal raw ispeed 38400 ospeed 38400"
```

The configuration generates four ports as shown in the example in Figure 18 and the fourth port (ttyUSB2 in the figure) can be used for UART communication with the receiver.

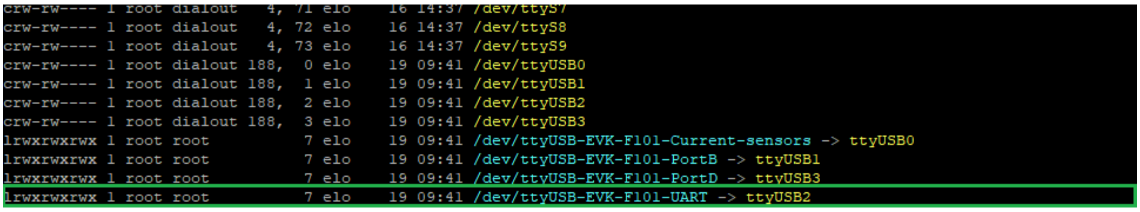

Figure 18: EVK-F101 communication ports in Linux environment

EVK-F101 does not work properly when connected to a GNSS simulator

When using EVK-F101 together with a GNSS simulator, 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 scenario, the scenario time can be in the past causing the receiver to jump backwards in time. This affects the receiver performance.

To avoid this, configure the GPS week rollover value to a week number preceding the date used in the 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. For more information on setting the GPS week number with the u-center 2 GNSS evaluation tool, see Figure 19. In addition, issue a cold start command before every simulator test to avoid receiver confusion due to time jumps.

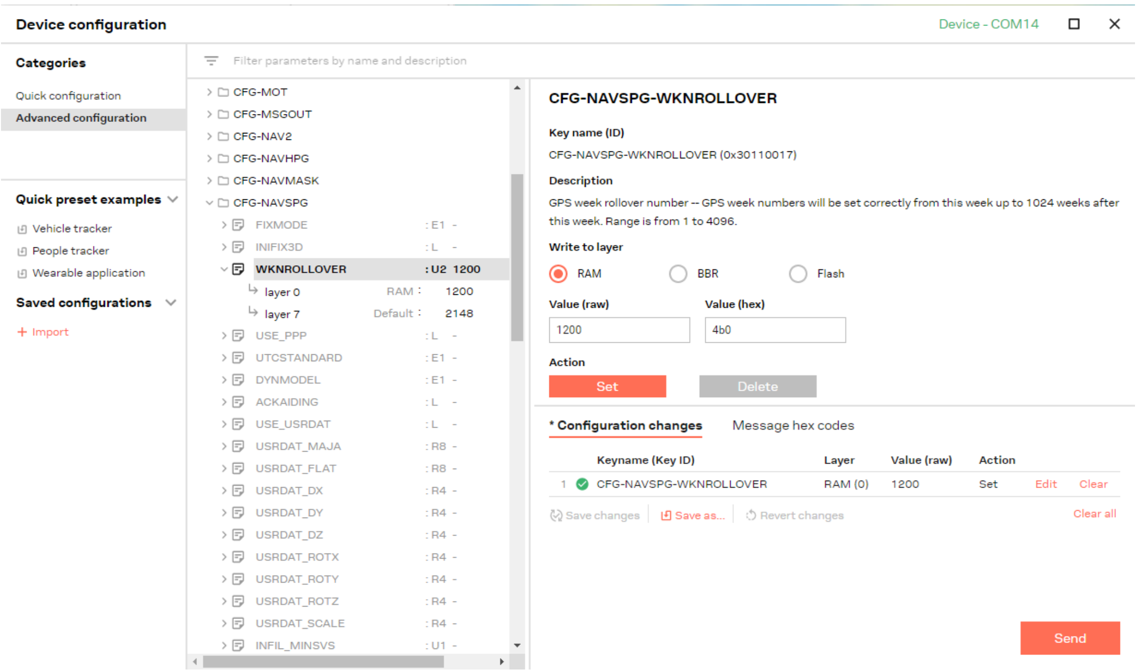

Figure 19: Setting the GPS week number with the u-center 2 GNSS evaluation tool

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 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. Therefore, conduct comparative tests in parallel by using one antenna and a signal splitter. Run statistical tests 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. Otherwise, the receivers do 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 to block the sky view.
- **Configure the correct gain of the internal LNA in EVK-F101.** By default, EVK-F101 operates in the low gain mode with ANN-MB5 provided with the evaluation kit. If connecting EVK-F101 to another external antenna with a gain exceeding the limit specified in GNSS input signal, switch to bypass mode to avoid the receiver going into saturation. If poor performance is observed, or AGC value in the UBX-MON-RF message is low (~below 10%) indicating receiver saturation, adjust the internal LNA gain accordingly.
- **Mitigate poor performance in high RF interference areas.** In environments with significant RF interference, such as near cellular networks, use an active antenna with a SAW filter before the LNA, such as the ANN-MB1. Refer to the guideline in GNSS input signal and Configuring internal LNA mode for required internal LNA configuration. If using a passive antenna, add an external SAW filter between the antenna and the EVK-F101 RF input to improve performance.

Related documents

[1] UBX-F10050-KB Data sheet, UBXDOC-963802114-8749 (NDA required)

[2] MAX-F10S Data sheet, UBXDOC-963802114-12732

[3] MIA-F10Q Data sheet, UBXDOC-963802114-13204 (NDA required)

[4] Information technology equipment - Safety Standard IEC 62368-1:2018

[5] u-center 2 User guide, www.u-blox.com/en/info/u-center-2-user-guide

[6] u-blox F10 SPG 6.00 Interface description, UBX-23002975

[7] ANN-MB1 antenna, https://www.u-blox.com/en/product/ann-mb1-antenna

[8] ANN-MB5 antenna, https://www.u-blox.com/en/product/ann-mb5-antenna

☞ 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	Status / comments
R01	29-Aug-2024	Initial release
R02	18-Dec-2024	Added chapter Approvals Updated chapter Related documents

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