EVK-M102

Evaluation kit

User guide

Abstract

This document describes the structure and use of the EVK-M102 evaluation kit and provides information for evaluating u-blox M10 positioning technology.

Document information

Title	**EVK-M102**	
Subtitle	Evaluation kit	
Document type	User guide	
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This document applies to the following products:

Product name	Type number	FW version	IN/PCN reference
EVK-M102	EVK-M102-00-00	SPG 5.20 and later	
EVK-M102	EVK-M102-00-00	SPG 5.30 and later	

Contents

1 Evaluation Kit overview

The EVK-M102 evaluation kit supports evaluating the low power consumption of u-blox M10 positioning technology.

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

Figure 1: EVK-M102 evaluation kit

1.1 Platform description

The EVK-M102 evaluation kit is specifically designed to support testing of two distinct firmware variants: one optimized for wearable applications, and the other tailored for asset, pet, people, and vehicle tracking, all based on the u-blox M10 GNSS platform. It supports GPS, Galileo, BeiDou, QZSS, and SBAS and provides a robust navigation solution even in scenarios with a weak GNSS antenna reception.

The EVK operates in two power modes: full-power and power-saving mode, providing exceptional positioning accuracy while consuming minimal power.

Evaluation kit	Market	Related M10 products	Supported firmwares
EVK-M102	Wearables	UBX-M10150-CC	EXT SPG 5.20 and later
	Asset, pet, people, and vehicle trackers	UBX-M10150-KB	EXT SPG 5.30 and later
		MAX-M10N	

Table 1: EVK-M102 supported firmwares and related products

1.2 Kit content

The delivery package is supplied in a C5-format carton box and includes the following contents:

- Compact 105 x 64 x 26 mm evaluation kit in metal housing
- Active GNSS antenna with 3 m cable and SMA connector [12]
- 1-meter USB 2.0 Type-C to Type-A cable
- EVK welcome card

Figure 2: EVK, GNSS antenna, and USB cable included in the kit

1.3 System requirements

Evaluation of the EVK-M102 in u-center 2 requires:

- PC with USB 2.0 interface
- Microsoft Windows 8.1 onwards (x86 and x64 versions)
- Internet connection for the first-time use to download the required Windows drivers and to download and log in u-center 2.

1.4 Safety precautions

EVK-M102 must be supplied by a PS1 class limited power source. See IEC 62368-1 [9] 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-M102, including interfaces and antennas. See IEC 62368-1 [9] for more information on the ES1 class.

2 Getting started

Figure 3: Connecting the EVK for communication

To connect the EVK-M102 with a PC, do as follows:

1. Set the interface switch in the EVK front panel to mode 0, as shown in Figure 4.

Figure 4: Interface switch in the front panel

2. Connect the EVK to a PC with the USB cable provided in the kit. Once the EVK has been connected to the PC, the Windows OS automatically downloads the drivers needed. Ensure that you have internet connection.
3. Connect the GNSS antenna to the RF IN SMA jack and place it in a location with clear sky view.
4. Download u-center 2 from the u-blox website https://www.u-blox.com/en/product/u-center and install it.
5. Once the installation has successfully completed, open u-center 2. Enter your u-blox support portal account credentials when logging in for the first time.
6. Click **Data sources > Add data source**. From the drop down menu, select the u-blox EVK-M102 UART COM port.

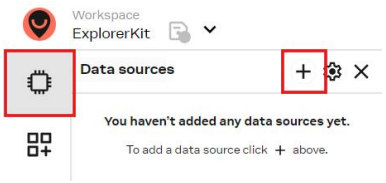

Figure 5: Adding a new data source in u-center 2

7. When the communication has been established, the data view displays the coordinates and the map view shows the position.

For more information on using u-center 2, refer to the u-center 2 User guide [10].

3 Device configuration

The EVK-M102 can be configured using the device configuration interface of the u-center 2 evaluation tool, as shown in Figure 6.

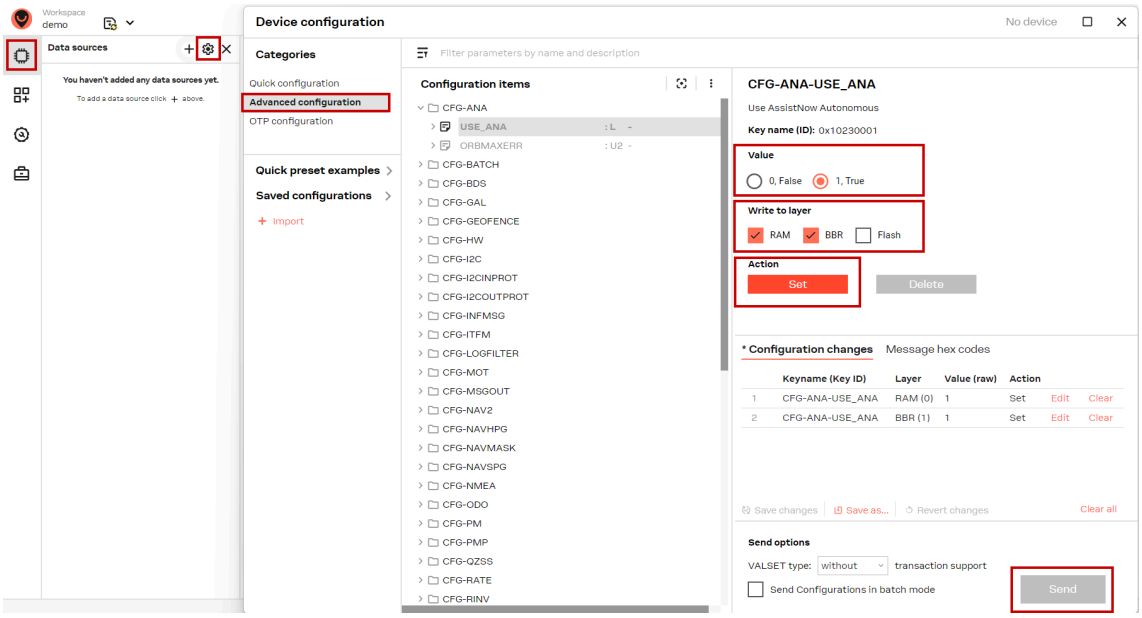

Figure 6: EVK-M102 receiver configuration view

The configuration can be saved in the RAM memory, in the battery-backed RAM (BBR), and in the available flash memory. The RAM configuration content is cleared after the power supply is disconnected, the Reset button is pressed, or the receiver enters any of the backup modes. Therefore, it is recommended saving 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.

☞ Pressing the Reset button clears all data in the RAM and BBR layers, including any configuration stored.

☞ The EVK-M102 supports multiple firmware images. To ensure proper evaluation, verify that the receiver is running the intended firmware variant with the *Data source* panel in u-center 2, as shown in Figure 7, or by polling the message `UBX-MON-VER`. If not, refer to the Uploading the firmware for instructions on flashing the EVK with a different firmware image.

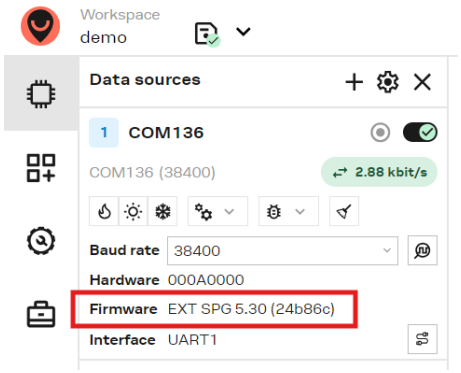

Figure 7: Data source panel in u-center 2 indicating the firmware variant

3.1 Configuring GNSS constellations

The configuration group CFG-SIG-* allows for GNSS configuration, including the selection of GNSS systems as well as the individual signals broadcast by each system.

Alternatively, u-center 2 provides an intuitive interface for easy configuration, as shown in Figure 8.

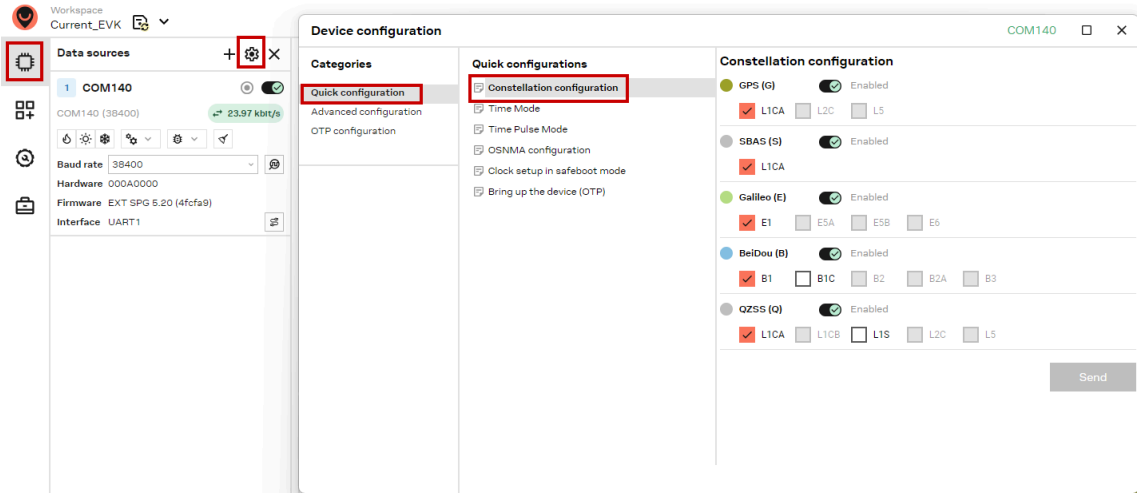

Figure 8: EVK-M102 Quick GNSS configuration interface in u-center 2

3.2 Configuring the communication interfaces

The EVK-M102 provides three communication interfaces for connecting to a host controller: UART, I2C, and SPI. Each interface can be configured within their respective configuration group.

Interface	Input protocol/s	Output protocol/s	Configuration key group
UART	UBX and NMEA protocol at 38400 baud	NMEA messages at 38400 baud	CFG-UART1-*
SPI	UBX and NMEA protocol	NMEA messages	CFG-SPI-*
I2C	UBX and NMEA protocol	NMEA messages	CFG-I2C-*

Table 2: Default configuration

☞ The SPG 5.30 firmware also supports RTCM 3.4 input data.

For more information on setting the communication interfaces, refer to the section Interface switch.

3.3 Configuring navigation rate

The navigation rate can be changed using the configuration key CFG-RATE-MEAS. The navigation rate value is defined in milliseconds, where 500 ms corresponds to a 2 Hz navigation rate. The maximum navigation rate depends on the operation mode and the number of GNSS systems enabled, as specified in the product data sheets.

☞ If setting high navigation rates, consider increasing the baud rate to avoid output buffer overflow.

3.4 Configuring the internal LNA mode

The u-blox M10 receiver offers three internal LNA modes to optimize performance and power consumption based on the gain of the external antenna used. The appropriate LNA mode can be configured using the CFG-HW-RF_LNA_MODE configuration key, as shown in Figure 9.

- **NORMAL:** The internal LNA of the receiver is set to high gain. Combined with the onboard LNA in the EVK RF path and the external antenna gain, this configuration may cause receiver saturation. Therefore, this mode is not recommended for use with the EVK.
- **LOWGAIN:** The internal LNA is configured to low-gain mode. This mode is suitable for use with both passive and active antennas, and is also appropriate when a GNSS simulator is connected to the EVK. It is the default mode on the EVK-M102 and is recommended for use with the antenna provided in the EVK package.
- **BYPASS:** The internal LNA is bypassed. Use this mode to save power when using a high-gain active antenna, such as the one included with the EVK.

☞ 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 flash memory, reset the EVK by pressing the RST button on the front panel. If the configuration is saved in BBR, the reset can be performed via command by sending the UBX-CFG-RST message withh resetMode 0x01. Pressing the RST button erases all content in the RAM and BBR memory.

When changing the internal LNA mode and after the correct reset, the parameter AGC Monitor of the UBX-MON-RF message changes automatically.

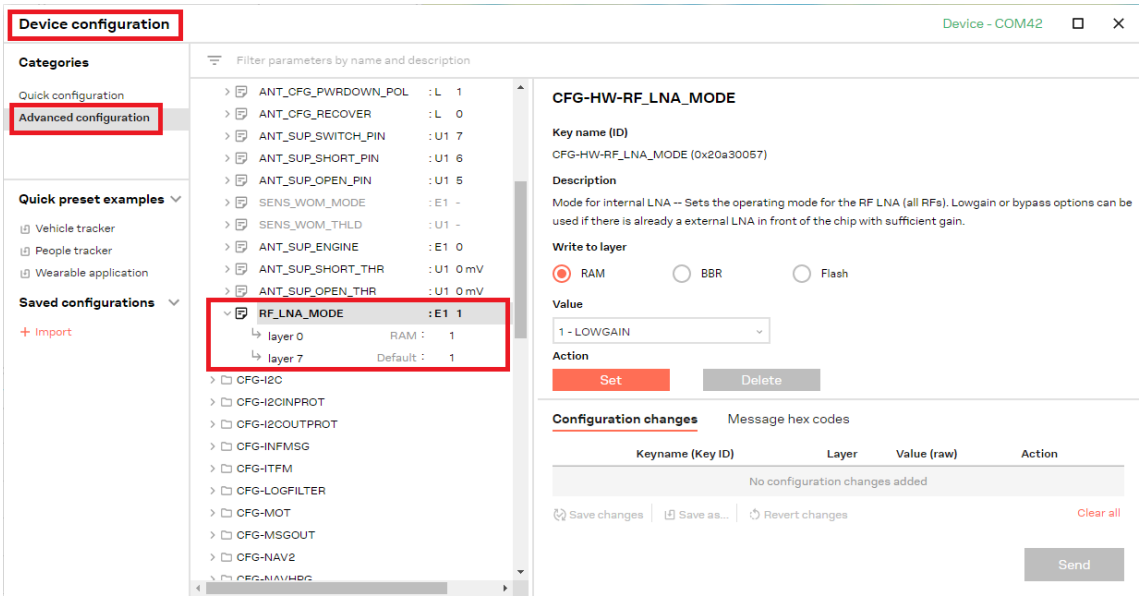

Figure 9: EVK-M102 receiver internal LNA mode configuration

3.5 Setting the LNA output signal

The output signal LNA_EN can be used to control an external LNA. This feature provides significant power savings at the system level, especially in LEAP mode, where the LNA is toggled ON/OFF during continuous operation, resulting in up to 60% power savings compared to normal operation. The LNA_EN signal also disables the external LNA during backup modes.

The LNA_EN signal can be monitored via the 14-pin connector. For more information on configuring this signal, see section LNA control switch.

3.6 Setting the EXTINT input signal

The EVK-M102 allows external interrupts through the EXTINT pin. The EXTINT input signal can be enabled on GPIO5, which is accessible via the 14-pin connector. The EXTINT signal can be used for functions such as accurate external frequency assistance, time assistance, time mark reporting, and as a wake-up source from software backup mode.

The EXTINT pin also enables external control for host-controlled on/off operation of the receiver. For more information, refer to the CFG-PM-EXTINT* configuration keys in the Integration manual [3], [4].

By default, PIO5 in the EVK-M102 is configured as the LNA_EN signal. To test the EXTINT feature, disable this function by setting CFG-HW-ANT_CFG_VOLTCTRL = 0. The EXTINT function is automatically assigned to PIO5 when no other functionality is configured for it.

⚠ **CAUTION** Ensure that the LNA control switch is set to 1 when testing the EXTINT feature.

3.7 Configuring operation modes

The EVK-M102 supports two operation modes, the full-power mode and the LEAP (Low Energy Accurate Positioning) mode. The operation mode can be set in both cases with the configuration key CFG-PM-OPERATEMODE.

By default, the SPG 5.20 operates in LEAP mode (CFG-PM-OPERATEMODE = 2), while the SPG 5.30 in full-power mode (CFG-PM-OPERATEMODE = 0).

3.8 Setting backup modes

The EVK-M102 supports two backup modes: hardware backup mode and software standby mode.

The **hardware backup** mode can be tested by simply disconnecting the main power supply. The internal supercapacitor can power the backup domain for approximately 2 days when fully charged. It charges automatically whenever power is supplied, either through the USB connector or the 14-pin connector. Alternatively, for testing longer backup periods, the backup domain can be externally powered via the 14-pin connector on the front panel.

The **software standby** mode can be tested by sending the UBX-RXM-PMREQ. The u-center 2 interface allows you to generate this message with various options, such as specifying the backup duration in milliseconds and selecting wake-up sources like EXTINT, SPI CS, and/or UART RxD input signals.

☞ To keep the software standby mode active until a wake-up signal is detected, set the duration to 0 in the UBX-RXM-PMREQ message.

☞ The RAM memory is cleared when entering any of the backup modes. This means the firmware image must be uploaded either from flash memory or from the host. To ensure configuration is restored at startup, save it to the BBR or permanently to the Flash layer.

3.9 Using AssistNow: GNSS assistance

u-center 2 provides an intuitive interface for evaluating the benefits of using AssistNow. AssistNow is a service offered by u-blox that supplies GNSS assistance data to u-blox receivers. This assistance results in significantly improved TTFF, enhanced position accuracy, and power savings.

The AssistNow service offers download of both **Live orbit** and **Predictive orbit** data. The service is free of charge for u-blox EVK-M102.

For more information on using AssistNow in u-center 2, refer to the u-center 2 User guide [10], section *Tools and Services*. For guidance on future implementation in a customer application, refer to the Integration manual [3], [4].

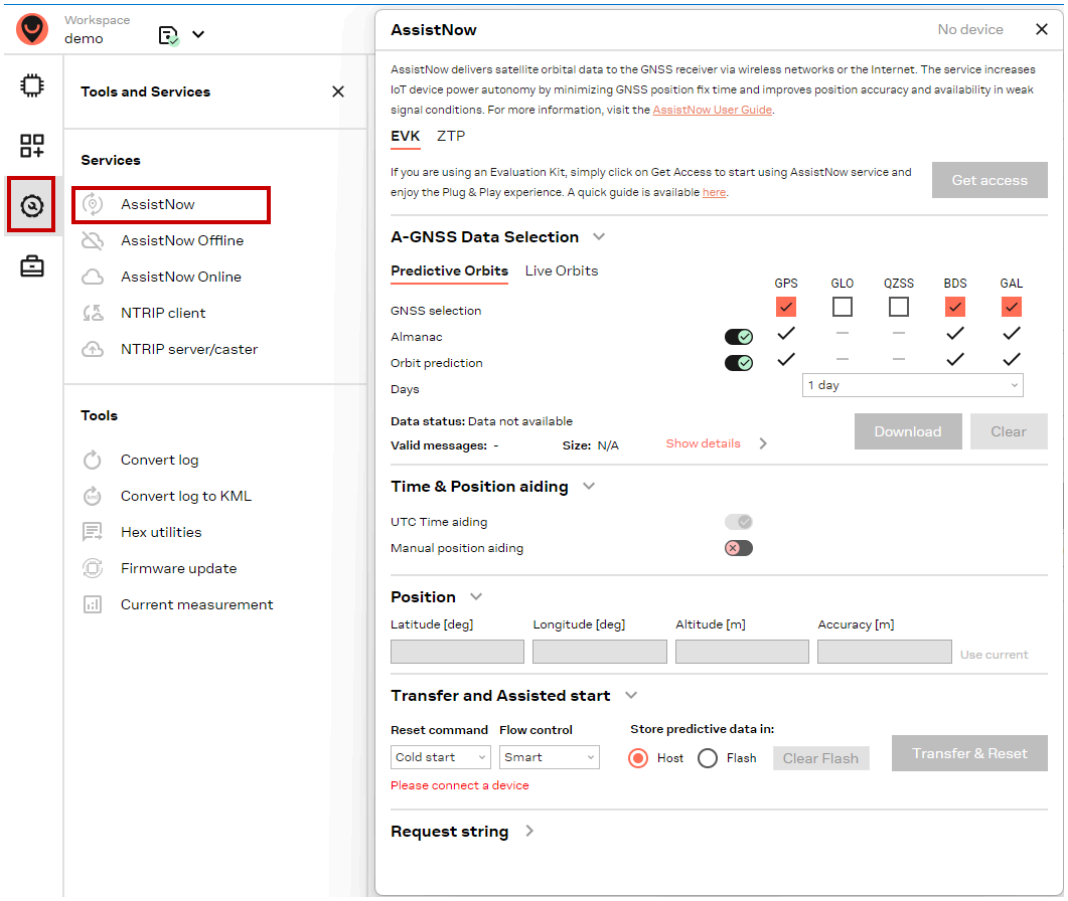

Figure 10: AssitNow interface in u-center 2

3.10 Uploading the firmware

The EVK-M102 is preloaded with the EXT SPG 5.30 firmware in its onboard flash memory. However, users may choose to evaluate alternative supported firmware variants or upgrade to the latest available version to access enhanced features or performance improvements. The Platform description section outlines the intended use cases for each supported firmware variant

u-center 2 includes a firmware update tool that allows uploading the firmware image to the appropriate memory, depending on the hardware configuration:

- If flash memory is attached (Interface switch set to mode 0), the image is uploaded to flash memory. Once uploaded, the FW image is automatically transfered to the receiver RAM at every start.

- If no flash memory is attached (Interface switch set to mode 1 or 2), the image is uploaded directly to the receiver RAM.

As shown in Figure 11, the tool provides several options, including:

- Setting the upload baud rate
- Erasing only the flash memory content
- Transferring the image only to RAM
- Erasing flash memory before uploading the image
- Uploading the image after entering Safeboot mode

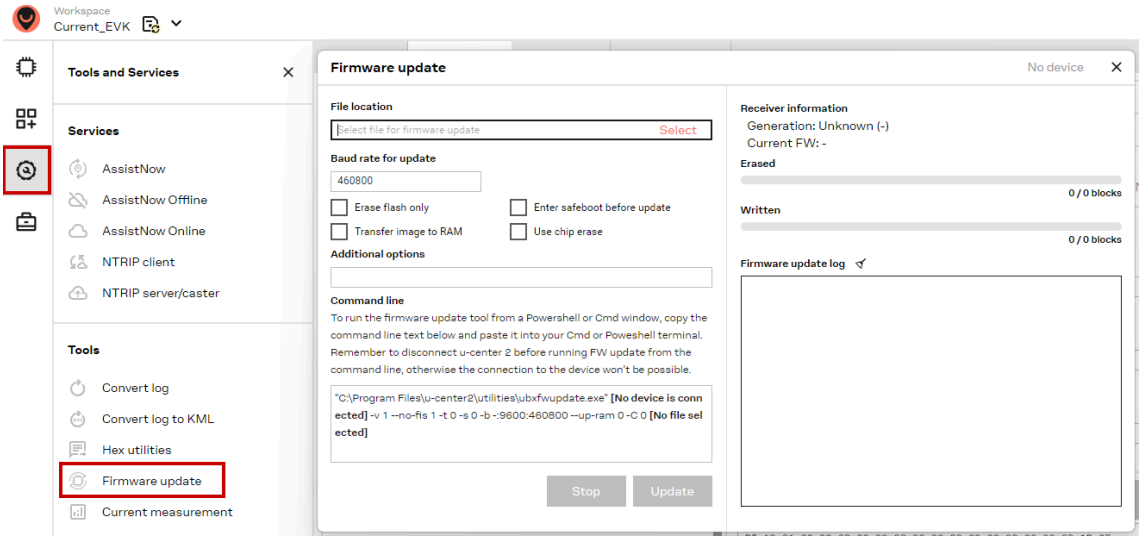

Figure 11: Firmware update tool in u-center2

In addition, the tool provides the command-line instruction that can be tested using PowerShell or the Command Prompt (CMD). Note that certain parameter combinations may conflict with each other, so review the options before execution. For more information on using the Firmware update tool, refer to the u-center 2 User guide [10], section *Tools and Services*.

4 Device description

The EVK features various connectors, switches, and buttons that serve as the user interface. These are presented in Figure 12 and described in the next sections.

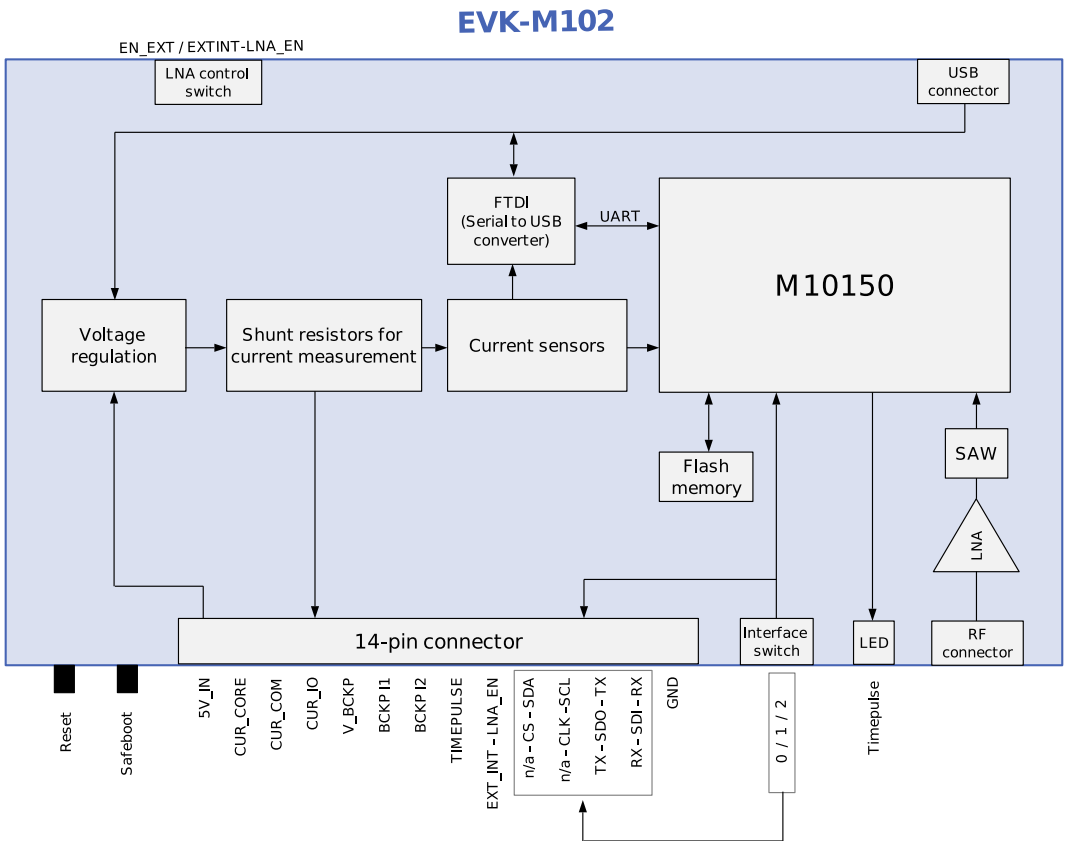

Figure 12: EVK-M102 block diagram

4.1 14-pin connector

The 14-pin connector in the front panel, see Figure 13, provides pin access to several current measurement points, communication interfaces, programmable IO signals, and device supply.

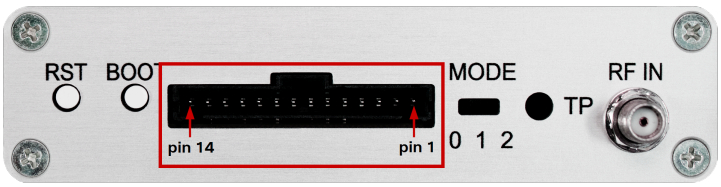

Figure 13: 14-pin connector in the front panel

Pin no.	Pin name	I/O	Level	Description
14	V5_IN	I	4.75 - 5.25 V	Supply voltage input. This is an alternative supply input to the USB connector.

Pin no.	Pin name	I/O	Level	Description
13	CUR_CORE	O	1.8 V	Current measurement node for the core domain. Current measured from a voltage drop over a 1 Ω 5% resistor between pins 13 (CUR_CORE) and 12 (CUR_COM). Pin 12 (CUR_COM) is at higher potential. For more details, see Measuring power consumption on the 14-pin connector.
12	CUR_COM	O	1.8 V	Common current measurement node for the core and IO domains.
11	CUR_IO	O	1.8 V	Current measurement node for the IO domain. Current measured from a voltage drop over a 1 Ω 5% resistor between pins 11 (CUR_IO) and 12 (CUR_COM). Pin 12 (CUR_COM) is at higher potential. For more details, see Measuring power consumption on the 14-pin connector.
10	V_BCKP	I	3.3 V	Backup power supply input. Optional input to test backup operation for periods longer than the internal battery life.
9	BCKP I1	O	3.3 V	Backup supply current measurement node 1. Connected to backup supply (super capacitor). Current measured from a voltage drop over a 100 Ω 0.1% resistor between pins 9 (BCKP I1) and 8 (BCKP I2). Pin 9 (BCKP I1) is at higher potential. For more details, see Measuring power consumption on the 14-pin connector.
8	BCKP I2	O	3.3 V	Backup supply current measurement node 2.
7	TIMEPULSE	O	1.8 V	Time pulse signal. Can also be used as generic input/output (PIO4).
6	EXTINT - LNA_EN	O	1.8 V	PIO configured as LNA_EN signal by default. EXTINT functionality also available. See LNA control switch state.
5	CS / SDA	I /O	1.8 V	Communication pin. SPI chip select or I2C data transfer function depending on the Interface switch state.
4	CLK / SCL	I		Communication pin. Clock input for I2C or SPI interface depending on the Interface switch state.
3	TxD / SDO	O	1.8 V	Communication pin. Serial port transmit or SPI data output depending on the Interface switch state.
2	RxD / SDI	I	1.8 V	Communication pin. Serial port receive or SPI data input depending on the Interface switch state.
1	GND	I	-	Common ground pin

Table 3: EVK-M102 14-pin connector pin description

4.2 Interface switch

The interface switch on the front panel, see Figure 14, sets the communication interface with the receiver.

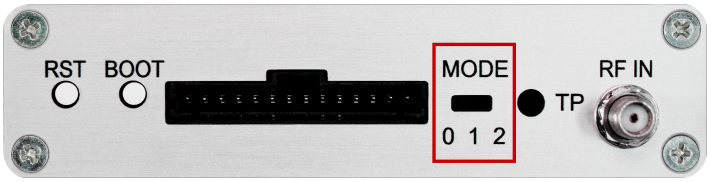

Figure 14: Interface switch in the front panel

⚠ **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 switch position.

The communication interface/s enabled and other additional information in each mode are summarized in the Table 4.

	Mode 0	Mode 1	Mode 2
Communication interface/s	UART	SPI	I2C and UART
Flash memory	Yes	Not connected. FW upload is required at every startup	Not connected. FW upload is required at every startup
Communication over USB connector	Yes	No	Yes
Communication over the 14-pin Connector	Pins 2, 3	Pins 2, 3, 4, 5	Pins 2, 3 (UART), and 4, 5 (I2C)
Additional notes	• The flash memory can be used for FW loading, configuration saving, and features like Save on Shutdown • Communication over the USB connector is via onboard FTDI USB-UART	• FW upload is required at every startup and after resume from a backup mode • USB can still be used to power the EVK	• FW upload is required at every startup and after resume from a backup mode • Communication over the USB connector is via onboard FTDI USB-UART • USB can still be used to power the EVK

Table 4: Communication interfaces enabled with the interface switch

4.3 LNA control switch

The switch on the back panel, as in Figure 15, sets the pin controlling the onboard LNA in the EVK.

Figure 15: LNA control switch on the back panel

⚠ **CAUTION** Risk of device damage. Changing the mode switch position while the EVK is powered on may damage the GNSS receiver chip. Power off the EVK before changing the switch position.

In **mode 1**, the receiver EN_EXT pin controls the LNA. It switches OFF the LNA when the receiver enters hardware backup mode or software standby mode, saving power during the backup periods.

This option also allows setting the PIO5 to the EXTINT feature, which must be configured by setting `CFG-HW-ANT_CFG_VOLTCTRL` = 0 (false), and is accessible through the 14-pin connector. Remember to revert this configuration to test the other mode.

In **mode 2**, the receiver PIO5 controls the LNA. Enabling this mode results in significant power savings for the LNA when operating in the LEAP mode (`CFG-PM-OPERATEMODE` = 2). In this configuration, the LNA is power-cycled every second with an adaptive duty cycle depending on the receiver GNSS conditions. The LNA power savings can be visualized on u-center 2, as explained in Measuring power consumption with u-center 2. Note that the PIO5 is by default configured as LNA_EN signal.

Both modes are represented in Figure 16.

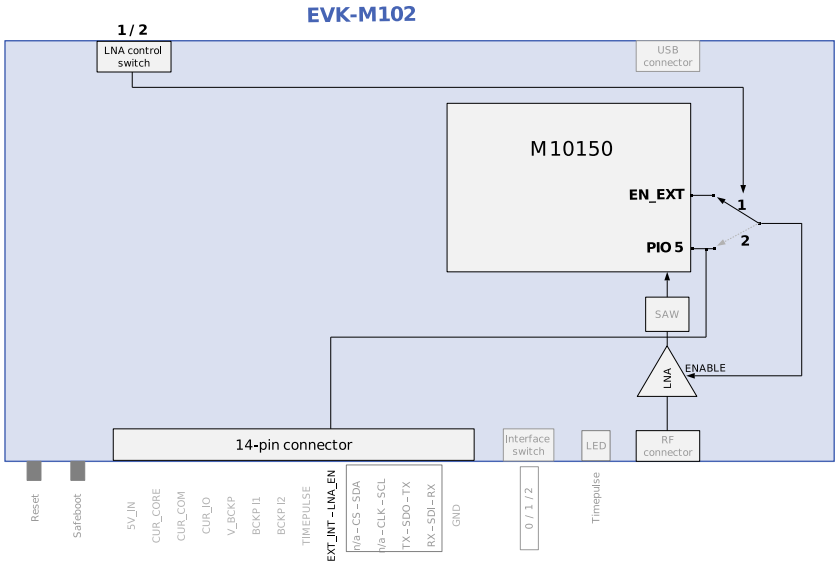

Figure 16: Switch modes to control the onboard LNA

The internal pin and the configuration required for each option are summarized in the Table 5.

Mode	Pin	Functionality assigned to PIO5	Configuration required
1	EN_EXT	LNA_EN	CFG-HW-ANT_SUP_SWITCH_PIN = 5 (default) CFG-HW-ANT_CFG_VOLTCTRL = 1 (default) CFG-HW-ANT_CFG_PWRDOWN_POL = 0 (default)
		EXTINT	CFG-HW-ANT_CFG_VOLTCTRL = 0
2	GPIO5	LNA_EN	CFG-HW-ANT_SUP_SWITCH_PIN = 5 (default) CFG-HW-ANT_CFG_VOLTCTRL = 1 (default) CFG-HW-ANT_CFG_PWRDOWN_POL = 0 (default)
		EXTINT	Not configurable

Table 5: Pin assignment and configuration for each LNA control mode

4.4 RF connector

To evaluate the GNSS performance, a GNSS signal must be provided through the SMA connector on the front panel, as in Figure 17.

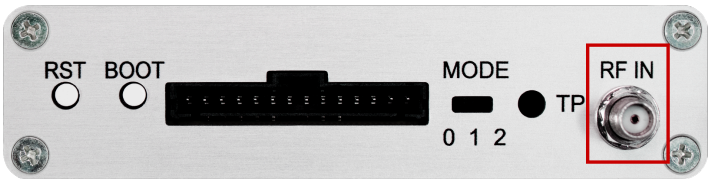

Figure 17: RF connector on the front panel

The EVK kit package includes a GNSS L1 antenna that allows reception of GPS, Galileo, GLONASS, and BeiDou. The EVK provides 3.3 V supply for the external antenna and the recommended maximum antenna supply current for active antennas is 30 mA. This pin is also ESD protected.

Nevertheless, it is possible to connect various active and passive GNSS antennas or provide a signal from a recorded or simulated GNSS RF source to the antenna input. As the internal RF front-end includes an LNA and a SAW filter, ensure that the external gain does not exceed 30 dB.

To evaluate an improved jamming immunity, an external SAW filter can be connected to the RF input connector, resulting on an SAW-LNA-SAW RF front-end design.

4.5 USB connector

The USB connector, as seen in Figure 18, can be used for both power supply and communication.

Figure 18: USB connector in the back panel

This connection is the easiest way to evaluate the receiver performance as described in Getting started.

The connector is internally connected to a USB-to-Serial converter that connects to the UART interface of the receiver. Therefore, communication over the USB connector is only possible with the Interface switch set to 0 or 2.

When the EVK is connected to the PC, Windows creates a virtual COM port to the PC called u-blox EVK-M102 UART. This newly created virtual COM port needs to be selected in the u-center 2 for communicating with the receiver.

4.6 Reset button

The reset button is accessible on the front panel, as in Figure 19.

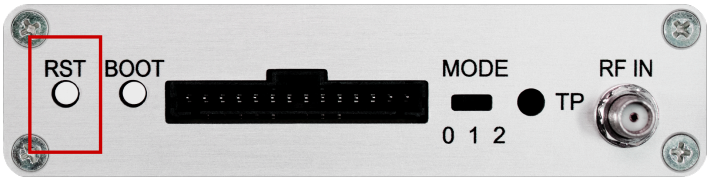

Figure 19: Reset button on the front panel

Pressing the reset button triggers a device reset, as it pulls the reset pin on the receiver low. Once released, the receiver restarts.

Risk of data loss. Triggering a hardware reset erases all the data in the RAM and BBR layers. As a result, the FW image must be transferred to the code RAM to run the GNSS operation again. Only when the interface switch is set to mode 0 and there is a valid FW image stored in the onboard flash memory, this is not necessary.

4.7 Safeboot button

The safeboot button, as seen in Figure 20, can be used to enter the safeboot mode during the receiver startup. In this mode, the receiver runs only minimal functionality before uploading the firmware image.

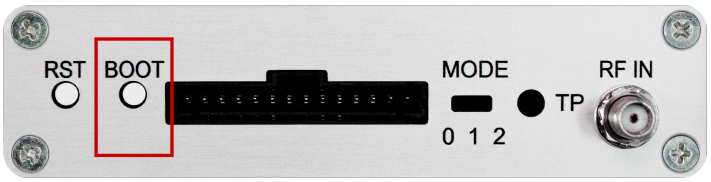

Figure 20: Safeboot button in the front panel

To enter the safeboot mode, do as follows:

1. Press and hold the reset button
2. Press and hold the safeboot button
3. Release the reset button
4. Release the safeboot button. Now the receiver is in safeboot mode.
5. For UART communication, set the baudrate to 9600, and send the training sequence 0x55 0x55.
6. Verify the safeboot state by polling the `UBX-MON-HW3` message, and check that the `safeBoot` parameter is 1 (active).

4.8 LED

The LED on the front panel, as seen in Figure 21 serves as time pulse indicator.

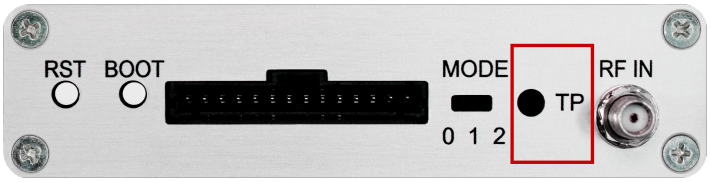

Figure 21: Timepulse LED on the front panel

The LED is controlled by PIO4 on the receiver, where the signal is generated. In the default configuration, the time pulse LED has following functionality:

LED	Description
OFF	The receiver does not have a valid 3D position fix.

LED	Description
Blinking blue	The LED flashes one pulse per second during a valid 3D fix.

Table 6: Timepulse LED state

The LED and the time pulse signal on the 14-pin connector are syncronized. The time pulse signal is configurable. For details, see the SPG 5.20 Interface description [5] or the SPG 5.30 Interface description [6].

☞ In the SPG 5.20 firmware, the time pulse is disabled by default.

5 Measuring power consumption

The M10 chip has three independent supply pins: $V_{CORE/RF}$, V_{IO}, and V_{BCKP}.

The $V_{CORE/RF}$ is the main power consumer, while the V_{IO} supplies the digital domains. In the absence of V_{IO}, the V_{BCKP} supplies the backup domain, for a quick 3D fix after restart.

EVK-M102 allows evaluation of the total power consumption of the M10 chip, either using the 14-pin connector on the front panel or the u-center 2 software.

5.1 Measuring power consumption on the 14-pin connector

The 14-pin connector allows connecting a voltmeter to the EVK to measure the current draw at each supply chip.

Measuring total power consumption in normal operation

To measure the core power consumption at the M10 chip, connect a voltmeter to the EVK's **CUR_COM** and **CUR_CORE** pins, and measure the voltage drop, V_1 as shown in Figure 22. These two pins are internally connected through a 1 Ω resistor and consequently, the conversion to current is direct (1mV equals 1mA).

Note that the EVK can be supplied either using the pin **5V_IN** on the pin header, or simply by connecting it to a PC with the USB cable.

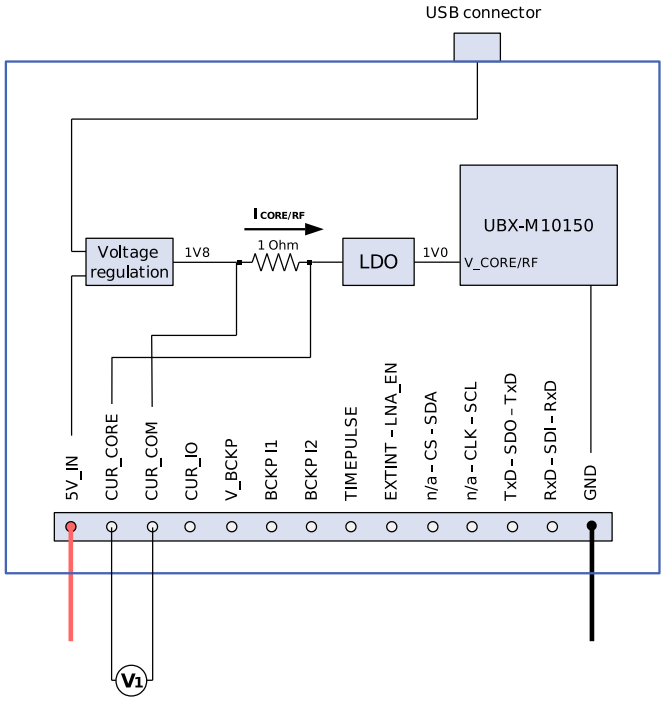

Figure 22: Connection to measure power consumption at V_CORE/RF

To measure the M10 chip **V_IO** power consumption, connect the voltmeter to the EVK's **CUR_COM** and **CUR_IO** pins as shown in Figure 23. These two pins are internally connected through a 1 Ω resistor and the conversion to current is also direct (1mV equals 1mA).

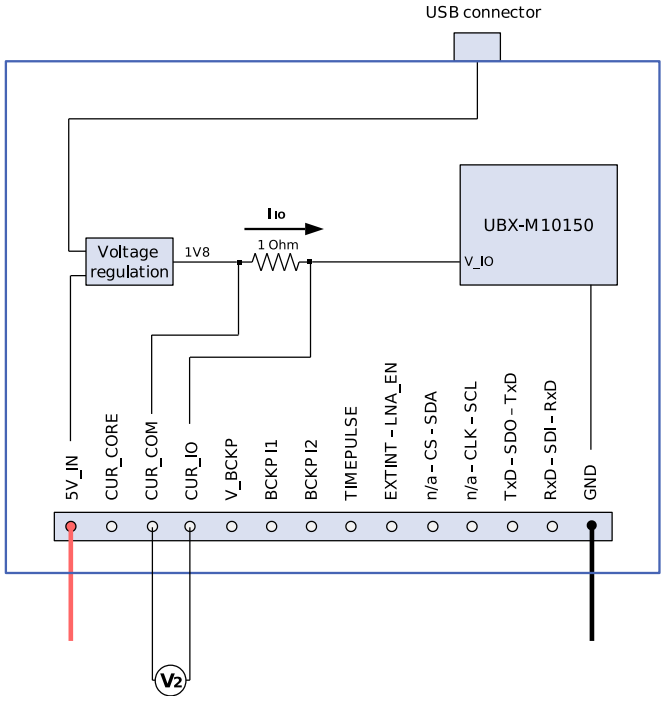

Figure 23: Connection to measure power consumption at V_IO

As an example, if the voltage drop read by the voltmeter is V_2 = 0.9 mV, the I_{IO} = 0.9 mA.

Using the previous examples, the instant power consumption of the whole chip at the time of the reading is calculated in Table 7.

Supply pin	Voltage, V (V)	Current, I (mA)	Power consumption, P = V*I (mW)
V_CORE/RF	1	8	8
V_IO	1.8	0.9	1.62
		TOTAL	**9.62**

Table 7: Calculation of the total power consumption

Measuring V_BCKP power consumption in hardware backup mode

To measure the M10 chip **V_BCKP** power consumption, connect the voltmeter to EVK's **BCKP I1** and **BCKP I2** as shown in Figure 24. These two pins are internally connected through a 100 Ω resistor and the conversion to current is calculated by dividing by 100 (1mV equals 0.01mA).

In normal operation, the **V_BCKP** power consumption is close to zero. To read a meaningful current value, enter the hardware backup mode by removing the main supply, or enter the software backup mode by sending the `UBX-RXM-PMREQ` message to the receiver.

Note that the M10 chip **V_BCKP** can be either supplied using the EVK's **V_BCKP** pin on the pin header or by the 3V3 supercapacitor inside the EVK. In the case of using the internal supercapacitor, measure V_4 as well, as the level may have discharged.

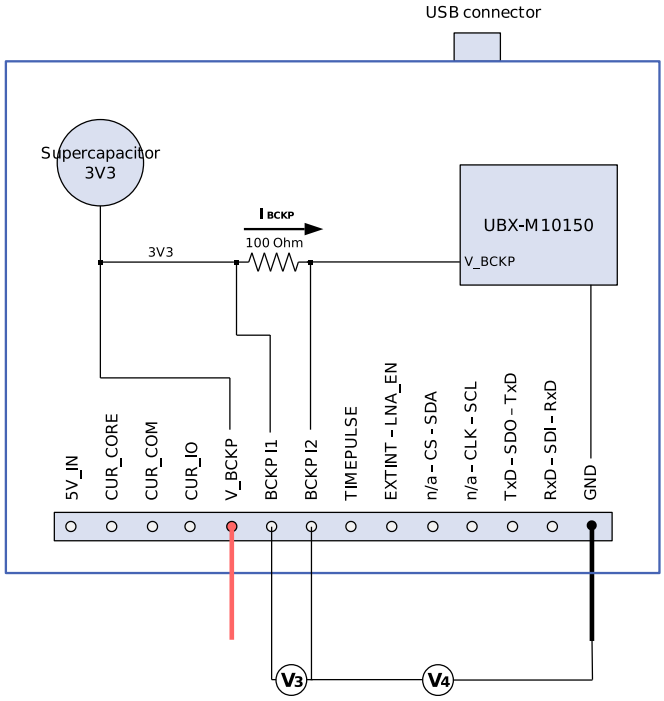

Figure 24: Connection to measure power consumption at V_BCKP

As an example, after disconnecting the main supply, the inner battery supplies the M10 chip **V_BCKP** pin. If the voltage drop read by the voltmeter is V_3 = 4 mV, the I_{BCKP} = 0.04 mA. Table 8 shows the power consumption calculation for this example.

Supply pin	Voltage, V (V)	Current, I (mA)	Power consumption, P = V*I (mW)
V_BCKP	3	0.04	0.12

Table 8: Calculation of the V_BCKP power consumption

5.2 Measuring power consumption with u-center 2

U-center 2 integrates a current measurement tool to monitor instant power consumption. Figure 25 represents the internal components to measure of the $I_{CORE/RF}$ and I_{IO} of the chip, and I_{LNA} of the onboard LNA.

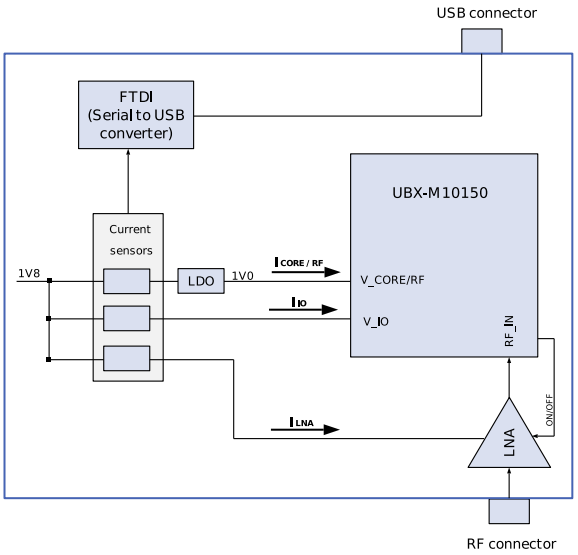

Figure 25: Current measurement block diagram on the EVK-M102

As the onboard LNA is controlled by the M10 chip, the power savings at the system level are remarkable when the GPIO5 is set as LNA_EN signal (default). Note that the LNA control switch on the back panel must be set as **2** and the receiver must be running in power optimized tracking mode.

The current measurement tool in u-center2 can be opened by clicking in **Tools and services > Current measurement** as seen in Figure 26.

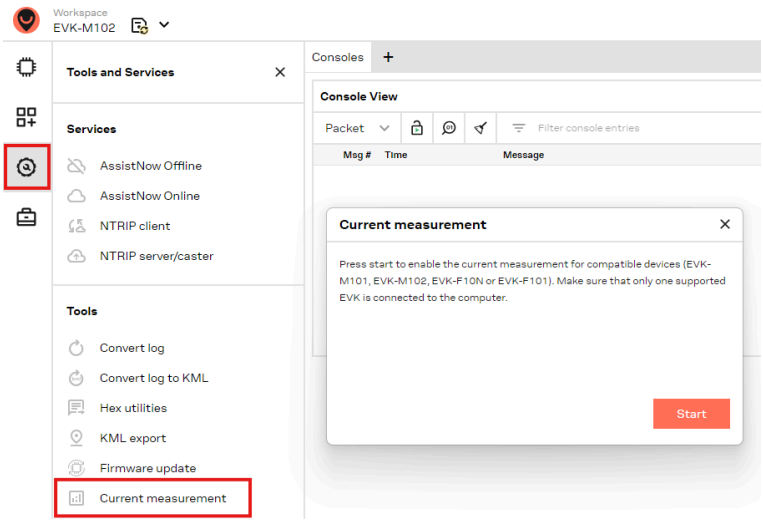

Figure 26: Opening the current measurement tool in u-center 2

For more information on using the current measurement tool, refer to the u-center 2 User guide [10].

6 Board layout

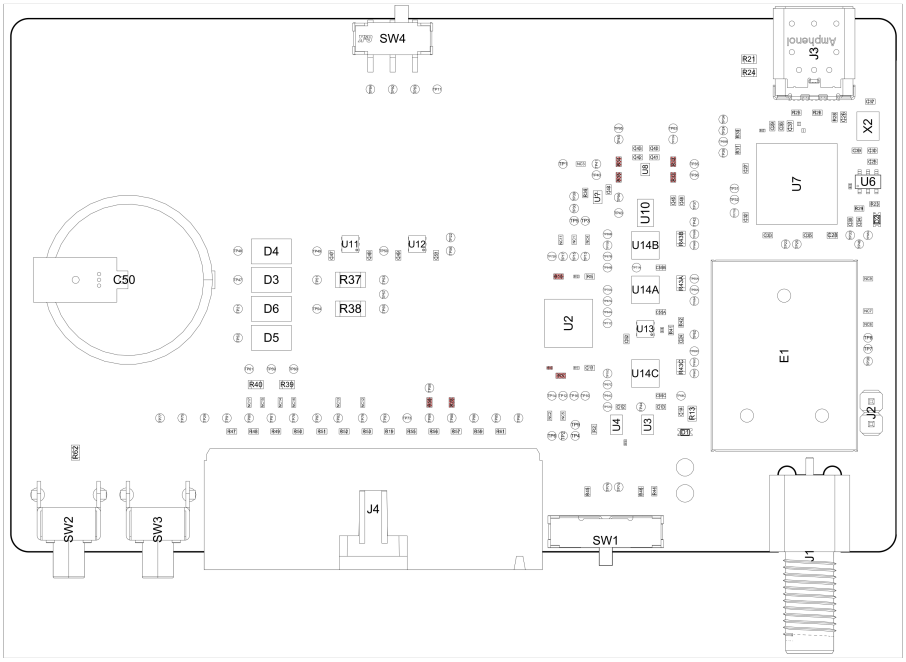

Figure 27: EVK-M102 board layout

7 Troubleshooting

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

If the baud rate is insufficient, the GNSS receiver skips 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 should be sufficient for most use cases. If a communication error occurs while u-center 2 receives a message, the message is discarded.

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.

There is no data received 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.

The EVK does not receive any signal

Ensure that the antenna has been properly connected, there is no damage on the hardware and cable, and that the onboard LNA has been powered on. For more details, see LNA control switch

The time pulse signal cannot be enabled in the SPG 5.20 Firmware

The time pulse can only be enabled in Full power mode (`CFG-PM-OPERATEMODE` = 0). By default, SPG 5.20 operates in LEAP mode (`CFG-PM-OPERATEMODE` = 2). Set the operation mode before enabling the time pulse signal in GPIO4.

The LEAP mode cannot be enabled in the SPG 5.30 Firmware

Disable the Time pulse signal (`CFG-TP-TP1_ENA` = 0) before setting the LEAP mode.

EVK-M102 does not work properly when replaying an old scenario

When using a GNSS simulator scenario or an old recorded 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. In addition, issue a cold start command before every simulator or replay test to avoid receiver confusion due to time jumps. For more information on setting the GPS week number with the u-center 2 GNSS evaluation tool, see Figure 28.

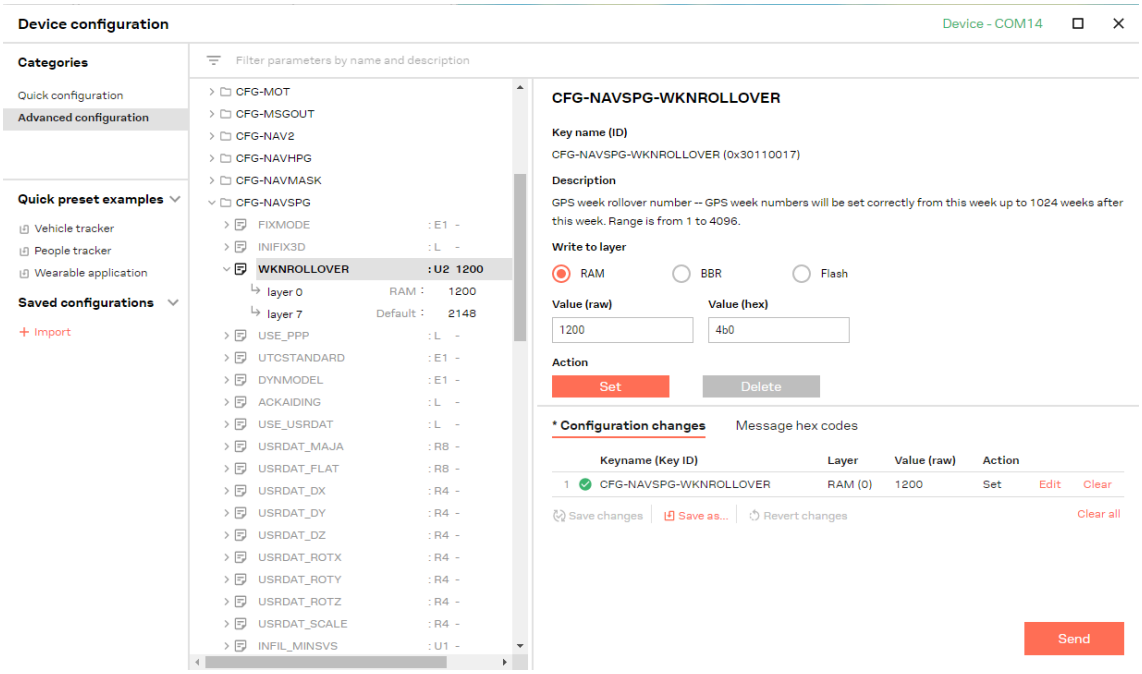

Figure 28: Setting the GPS week number with the u-center 2 GNSS evaluation tool

8 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. **Do not unplug the antenna** since the u-blox positioning technology continuously performs a noise calibration on idle channels.
- **Do not 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. A later power up of the EVK in SPI mode 1 will result in 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.
- **Configure the correct gain of the internal LNA.** By default, EVK-M102 operates in the low gain mode with an active antenna provided with the evaluation kit. If connecting another external antenna with a gain exceeding the limit specified in the RF connector section, and poor performance is observed, or AGC value in the UBX-MON-RF message is low (~below 10%) indicating receiver saturation, switch the internal LNA mode to bypass.
- **Mitigate poor performance in high RF interference areas.** In environments with significant RF interference, such as near cellular networks, instead of the antenna provided in the evaluation kit, use an active antenna with a SAW filter before the LNA, such as the ANN-MB1[11]. If using a passive antenna, add an external SAW filter between the antenna and the RF input to improve the performance.

9 Related documents

1. UBX-M10150-CC Data sheet, UBX-22014825 (NDA required).
2. UBX-M10150-KB Data sheet, UBXDOC-304424225-20108 (NDA required).
3. UBX-M10150-CC Integration manual, UBXDOC-963802114-13067 (NDA required).
4. UBX-M10150-KB Integration manual, UBXDOC-304424225-20458 (NDA required).
5. u-blox M10 SPG 5.20 Interface description, UBXDOC-304424225-20128.
6. u-blox M10 SPG 5.30 Interface description, UBXDOC-304424225-20395.
7. EVK-M102 schematics, UBXDOC-1909086364-10092 (NDA required).
8. EVK-M102 components list, UBXDOC-869164769-894734 (NDA required).
9. Information technology equipment - Safety Standard IEC 62368-1.
10. u-center 2 User guide, www.u-blox.com/en/info/u-center-2-user-guide.
11. ANN-MB1 antenna, https://www.u-blox.com/en/product/ann-mb1-antenna.
12. 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.

10 Revision history

Revision	Date	Status / comments
R01	16-Oct-2025	Initial release

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