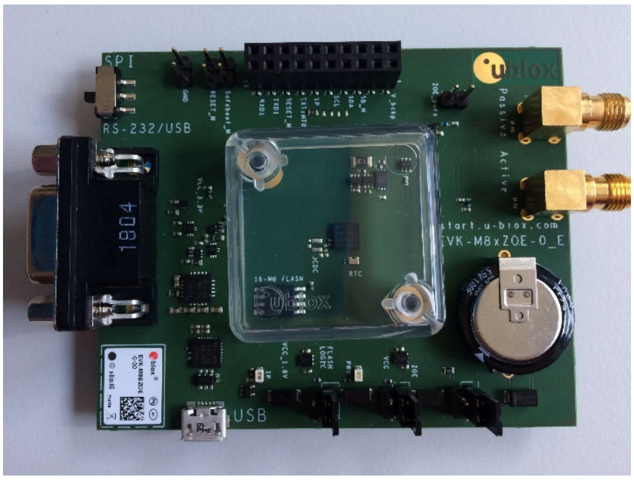
EVK-M8BZOE

Evaluation Kit

User Guide



Abstract

This document describes the structure and use of the EVK-M8BZOE evaluation kit and provides information for evaluating and testing the u-blox ZOE-M8B ultra small super low power GNSS SiP.

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In Development / Prototype	Objective Specification	Target values. Revised and supplementary data will be published later.
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European Union regulatory compliance
EVK-M8BZOE complies with all relevant requirements for RED 2014/53/EU. The EVK-M8BZOE Declaration of Conformity (DoC) is available at www.u-blox.com within Support --> Product Resources --> Conformity Declaration.

This document applies to the following products:

Product name	Type number	Hardware version	ROM/FLASH version	PCN reference
EVK-M8BZOE	EVK-M8BZOE-0-00	E	ROM SPG 3.51	N/A

Contents

1 Product description

1.1 Overview

The EVK-M8BZOE evaluation kit simplifies the evaluation of ZOE-M8B, the u-blox ultra small super low power M8 concurrent GNSS S-LGA SiP (System-in-Package). The built-in USB interface provides both power supply and high-speed data transfer, and eliminates the need for an external power supply. The 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 PDA or a notebook PC, making them the perfect companion through all stages of design-in projects.

1.1.1 Evaluation kit versions

Evaluation Kit	Description	Suitable for
EVK-M8BZOE (PCB version E)	u-blox M8 low power GNSS evaluation kit with ZOE-M8B SiP	ZOE-M8B

Table 1: List of available evaluation kit

The version identification of the evaluation kit is printed on the PCB board.

1.1.2 Features

- Supports GNSS performance evaluation with simulator and active antenna
  - 2 SMA connectors; one for simulator use case, one for external active antenna use case
- Populated optional flash
  - Configuration can be saved permanently
  - Logging can be done
  - AssistNow™ Offline data can be saved
  - Optimal performance of AssistNow™ Autonomous
- Current measurement shunt resistors and corresponding measurement pins
  - 1 Ω shunt resistor makes it easy to convert measured voltage to actual power consumption
  - Set of jumpers to bypass these shunt resistors for more advanced power measurements
- RTC crystal and backup supply to evaluate backup, hot start, and warm start functions
  - 100 Ω shunt resistor to measure backup power consumption
  - Super capacitor of 1 F for backup supply
- USB 2.0 connector for both power supply and data transfer
  - ZOE-M8B SiP does not support USB connection. For this reason the EVK-M8BZOE board contains a separate Silicon Labs CP2102 USB to UART Bridge
- RS-232 DB9 connector and digital connector for easy interfacing with UART, SPI and DDC (I^2C) and for evaluating other advanced scenarios

1.2 Kit includes

- EVK-M8BZOE evaluation board
- Active GNSS antenna with a 3 m cable
- USB cable

☞ A plastic cap is attached on the top of the ZOE-M8B GNSS S-LGA SiP in EVK-M8BZOE. The purpose of the cap is to prevent air flow at ZOE-M8B.

1.3 Software and documentation

The EVK-M8BZOE installation software and documentation is available at https://www.u-blox.com/en/evaluation-kits.

EVK-M8xZOE Quick Start Guide [5] is available at start.u-blox.com

u-center GNSS evaluation software and Windows driver for the evaluation board are available from web. See Section 3.1 for details.

For more ZOE-M8B related documentation, see the ZOE-M8B Data Sheet [1], the ZOE-M8B System Integration Manual [2] and the u-blox 8 / u-blox M8 Receiver Description including Protocol Specification [3].

1.4 u-center GNSS evaluation software

The installation software includes u-center, which is an interactive tool for configuration, testing, visualization and data analysis of GNSS receivers. It provides useful assistance during all phases of a system integration project.

1.5 System requirements

- PC with USB or RS-232 interface
- Operating system: Windows 7 onwards (x86 and x64 versions)
- The EVK board includes Silicon Labs CP2102 USB to UART Bridge. Windows drivers for this interface are available from Microsoft Windows Update service. See section 3.1 for details.

2 Specifications

Parameter	Specification
Serial Interfaces	1 USB V2.0
	1 RS232, max. baud rate 460.8 kBd DB9: PC compatible
	1 DDC (I^2C compatible) max. 400 kHz
	1 SPI , max. clock 1 MHz, max. data 125 kbytes/second
	1 UART , max. baud rate 460.8 kBd
Dimensions	83 x 67 x 20 mm
Power Supply	5 V via micro USB connector or external powered via extra power supply pin 2 (V5_IN) and pin 18 (GND) on digital connector
Normal Operating temperature	-20°C to +70°C

Table 2: EVK-M8BZOE specification

2.1 Safety precautions

EVK-M8BZOE must be supplied by an external limited power source in compliance with the clause 2.5 of the standard IEC 60950-1. This power source must be a Safety Extra-Low Voltage (SELV) circuit, and only SELV circuits are to be connected to the evaluation kit interfaces and antennas.

☞ For more information about SELV circuits see section 2.2 in Safety standard IEC 60950-1 [6]

3 Getting Started

3.1 Software installation

☞ Installation of the EVK-M8BZOE software and documentation requires internet access.

Download and install the u-center GNSS evaluation software from the u-blox website at

https://www.u-blox.com/en/product/u-center-windows.

Once the zip file is downloaded, unzip it and double-click the extracted exe file. The u-center software will be installed on your system and placed under the "u-blox" folder in the "Start → Programs" menu.

Windows drivers for the Silicon Labs CP210x USB to UART Bridge of the EVK are available from Microsoft Windows Update service. The Windows system driver search mechanism can download and install the USB drivers automatically from Microsoft Windows Update service. If the automatic install fails, or if the PC already has an old version of the drivers installed, the correct version of the driver can be downloaded and installed manually from Silicon Labs at http://www.silabs.com/products/mcu/pages/usbtouartbridgevcpdrivers.aspx.

Make sure you select the driver version that does not include "Serial Enumeration" functionality.

3.2 Hardware installation

This section describes the evaluation board connectors and configuration settings that are required to get started. Figure 1 shows an overview of EVK-M8BZOE board and its connectors.

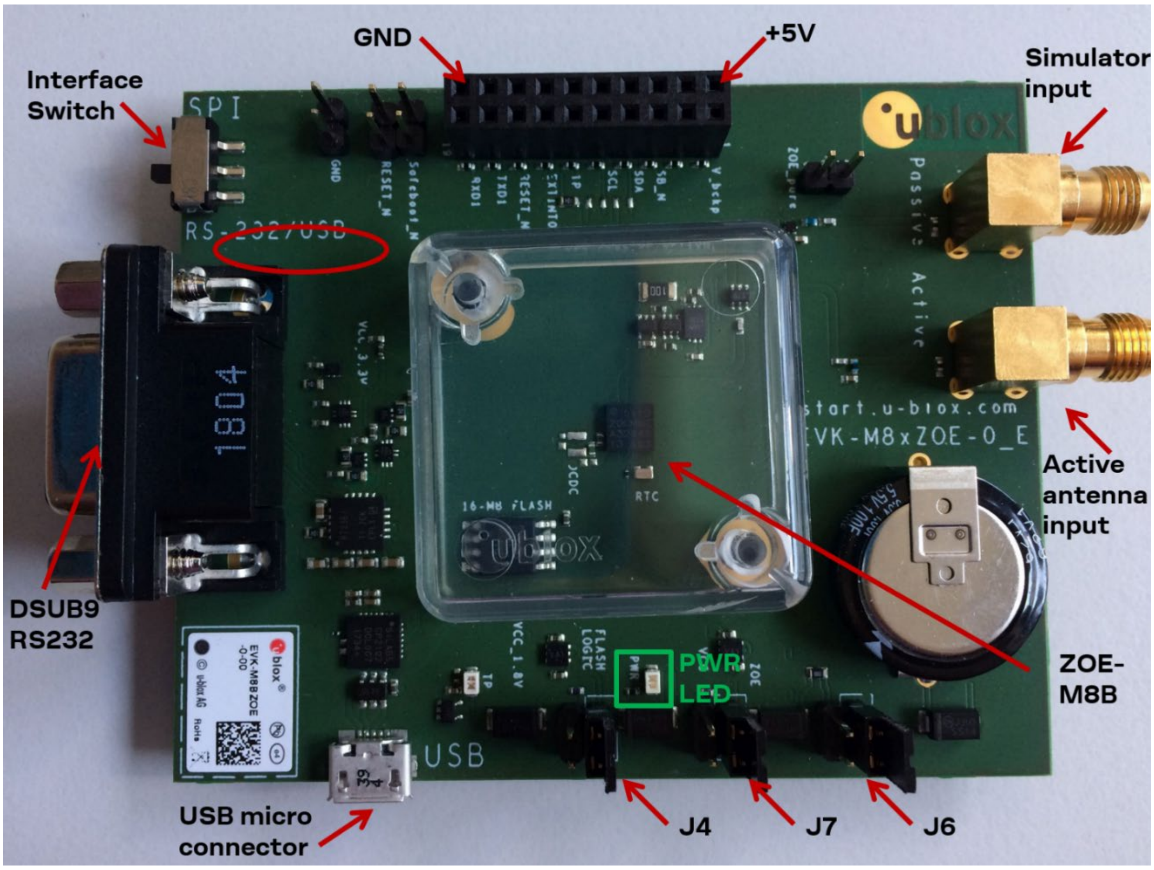

Figure 1: Getting started overview

1. Make sure the "Interface Switch" is at RS-232 / USB side (and not SPI side).
2. Connect the jumpers J4, J7 and J6 as above (There is a white box drawn around the pins of these jumpers).
3. Connect the evaluation board to a PC by micro USB cable and / or RS-232.
   - If a USB cable is used the device is powered by the USB cable.
     - A USB connection creates a virtual COM port to the PC.
   - If an RS-232 interface is used, the device can be powered by USB cable or by the digital connector connecting 5 V to pin 2 and GND to pin 18.
   - The green LED ("PWR LED" in Figure 1) is turned on when power supply is connected.
4. Connect the active antenna to the "Active" (Active antenna input) or the simulator to the "Passive" input (Simulator input).
5. Start the u-center GNSS Evaluation Software and select the corresponding COM port and baud rate, 9600 Bd by default (refer to the u-center User Guide [4] for more information).

3.3 Interface default configuration

Parameter	Description	Remark
RS-232, Input	UBX and NMEA protocol at 9'600 Bd	
RS-232, Output	UBX and NMEA protocol at 9'600 Bd	Only NMEA messages are activated by default
USB, Input	UBX and NMEA protocol	
USB, Output	UBX and NMEA protocol	Only NMEA messages are activated by default

Table 3: Default configuration

☞ There is also SPI, DDC and UART interface available for debugging and design-in purposes on the digital connector J1.

4 Device description

4.1 Power supply

4.1.1 5V main power supply

The EVK-M8BZOE board must be supplied either by the micro USB connector or by an external 4.5 V – 5.5 V power supply connected to digital connector pin 2 and GND to pin 18, see Figure 1.

The interface circuitry and other logic on the board relies on the 5 V power supply to always work properly. A green LED on EVK-M8BZOE indicates the 5 V supply voltage is available.

In the default setup this 5 V main power supply is connected to the low-dropout linear voltage regulators (LDOs) that provide the 1.8 V **VCC** voltage of ZOE-M8B.

Power consumption of a ZOE-M8B based design can however be easily calculated by measuring the voltage drop over the **VCC** current measurement shunt resistor and then multiplying the resulting values by the 1.8 V power supply voltage. For more information about current measurement of ZOE-M8B, see section 6.1.

4.1.2 Backup power supply

The backup supply (**V_BCKP**) of ZOE-M8B is used to supply the ZOE-M8B and the optional RTC crystal during hardware backup mode (main supply removed). This enables hot start and warm start capabilities.

The EVK-M8BZOE includes a super capacitor to supply the V_BCKP of ZOE-M8B.

In normal operation, when the main supply of ZOE-M8B (**VCC**) is present, the backup domain in ZOE-M8B is supplied by the main supply. **V_BCKP** supplies the backup domain of ZOE-M8B only when the main supply **VCC** is removed.

4.1.2.1 Super Capacitor

The capacity of the super capacitor is 1 F and provides backup power over a 100 Ω shunt resistor to the ZOE-M8B (**V_BCKP**). When this 1 F capacitor is fully charged to 3.3 V, it can provide backup power for about 35 hours (t=C*U/I=1*(3.3-1.4)/15uA=126’666 sec. -> ~35 hours).

As soon as the EVK-M8BZOE is supplied, the super capacitor gets charged.

When evaluating very long backup periods, the backup supply can be supplied by the digital connector J1 pin 1 (2.5 V…3.6 V).

4.2 Interfaces

The EVK-M8BZOE supports all three communication interfaces of ZOE-M8B: UART, DDC (I^2C) and SPI. The ZOE-M8B SiP itself does not have a USB interface. There is a USB to UART converter on EVK-M8BZOE which allows communication to ZOE-M8B by USB.

The UART interface of ZOE-M8B is available on USB, RS232 and on digital connector J1. Only use one of them to communicate. The SPI and the DDC (I^2C) interface are only supported on digital connector J1, see section 4.4.

4.2.1 Interface Switch

The Interface Switch has to be set according if either the UART (RS232/USB) and DDC (I²C) or the SPI interface is used. See Figure 1 for location of interface switch.

☞ Only if SPI communication interface on digital connector is used, the interface switch has to be switched to SPI marking. For all other communication interfaces it has to be set at RS-232 / USB marking.

4.2.2 USB 2.0 micro connector

The USB 2.0 micro B connector on the evaluation board can be used for both power supply and communication. On the EVK-M8BZOE there is a USB to UART converter to UART interface of ZOE-M8B.

The easiest way to evaluate the EVK-M8BZOE operation is to connect the board to a PC by a micro USB cable and then to use the u-center to configure and monitor the GNSS function.

When the board is connected to the PC, Windows creates a virtual COM port to the PC. This newly created virtual COM port needs then to be selected on the u-center application.

The UART communication speed is by default set to 9’600 Bd. Speeds up to 460’800 Bd are supported by ZOE-M8B.

4.2.3 RS-232 connector

The RS-232 serial port interface can be used to connect the EVK-M8BZOE board to a PC or to other evaluation host system.

Connect using a straight RS-232 serial cable with male and female connectors. The maximum cable length is 3 meters. To configure the RS-232 port, use the CFG-PRT command in the u-center application. The maximum supported operating baud rate is 460’800 Bd. 8 data bits, 1 stop bit, and no parity is used. Neither handshaking signals nor hardware flow control signals are available. The serial port operates in asynchronous mode.

The 9-pin D-SUB female connector is assigned as listed in Table 4.

Pin Nr.	Assignment	Remarks
1, 7	Timepulse	Not supported by ZOE-M8B firmware.
4	EXTINT0	Can be used for aiding purposes
2	TXD, GNSS Transmit Data, serial data to EVK	
3	RXD, GNSS Receive Data, serial data from EVK	
5	GND	
6, 8, 9	not connected	

Table 4: SUB-D9 Connector pin description for EVK-M8BZOE

If the RS-232 interface is used, the device must be powered either by USB cable or by the digital connector J1 connecting 5V to pin 2 and GND to pin 18.

The UART communication speed is by default set to 9’600 Bd. Speeds up to 460’800 Bd can be used if the host PC system can reliably support those. Please note that the RS232 of many PCs can only support up to 115’200 Bd.

4.2.4 UART

The UART RX and TX of ZOE-M8B are available on the digital connector J1 with 1.8 V levels, see section 4.4 for more information. The UART communication speed is by default set to 9’600 Bd. ZOE-M8B SiP supports speeds up to 460’800 Bd.

4.2.5 SPI

The SPI interface pins are available on digital connector J1, see section 4.4 for more information.

☞ If using SPI interface, the slide switch has to be set accordingly.

4.2.6 DDC (I²C)

The digital connector J1 contains pins for evaluating DDC (I²C) bus communication. For such evaluation the interface switch must be in correct position: RS-232 / USB.

Additional pull-ups on DDC lines to 1.8 V can be installed on the EVK-M8BZOE if needed, see R4 and R6 in Figure 14.

4.3 GNSS signal inputs

The EVK-M8BZOE has two RF inputs for GNSS signals. The purpose is to have optimal performance for “no gain” and “high gain” use cases, i.e., for passive antenna designs and active antenna designs.

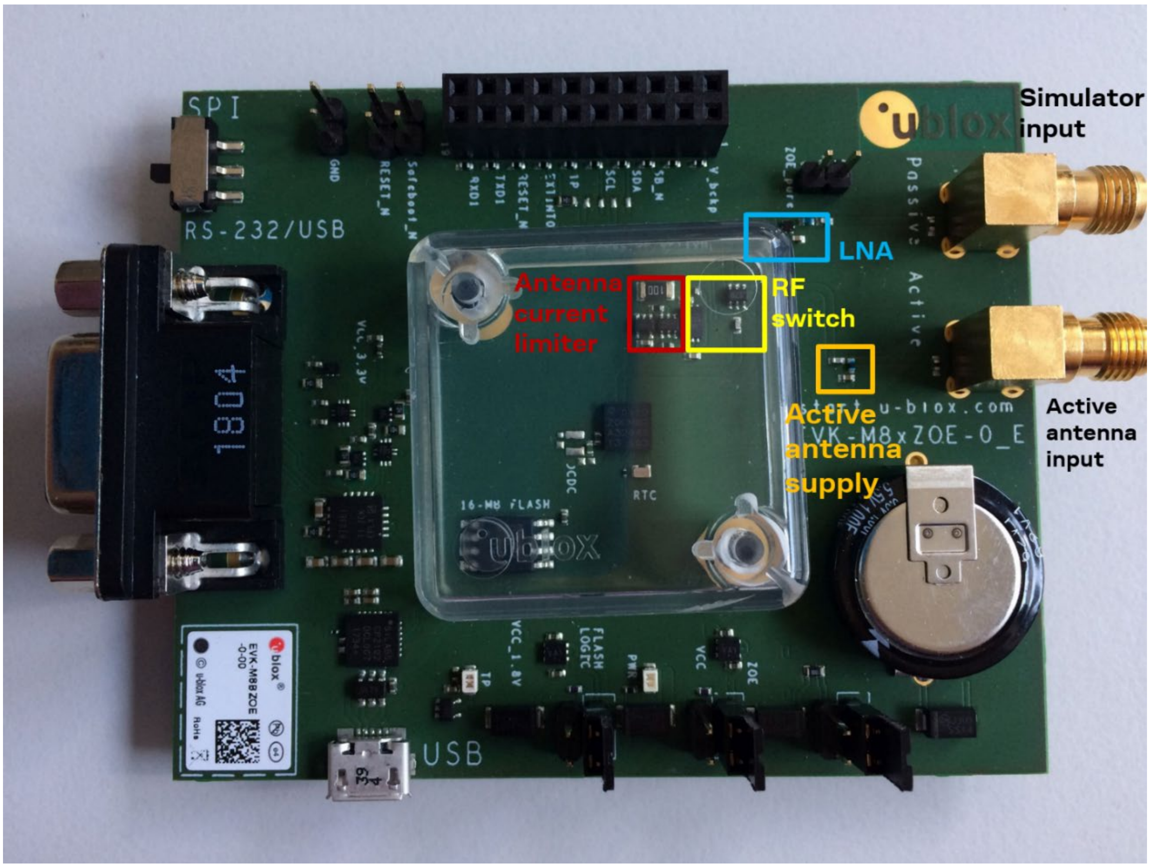

Figure 2: GNSS signal inputs

☞ Do not use both GNSS inputs at the same time. Either use the passive (simulator) input or use the active antenna input.

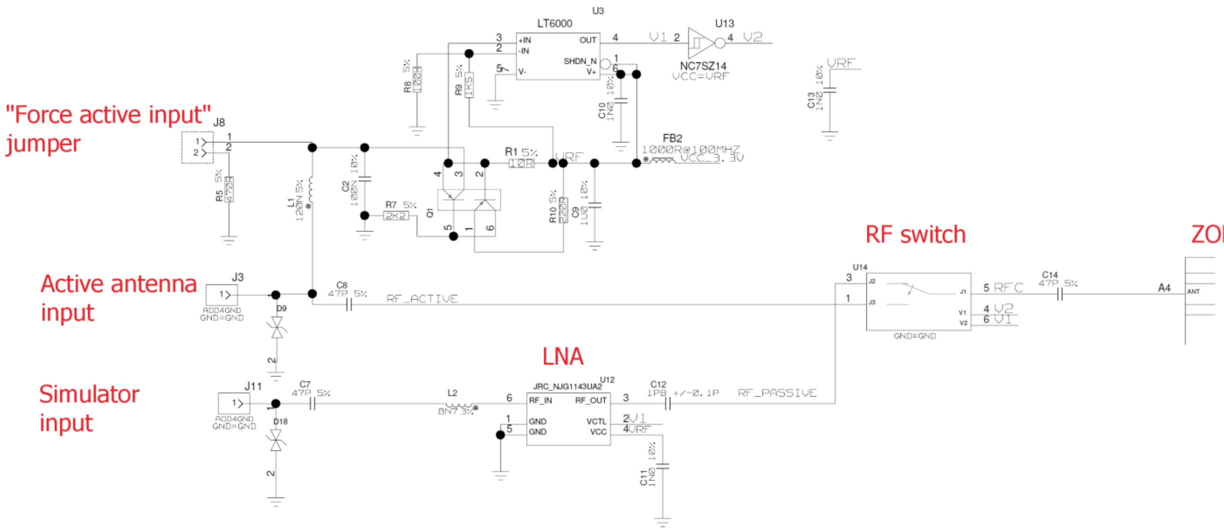

Figure 3: EVK-M8BZOE schematic of GNSS inputs

The RF switch (U14) allows only one of the two GNSS signal inputs to reach the ZOE-M8B.

4.3.1 Active antenna input

The active antenna input provides 3.3 V supply for active antenna. There is a current limiter circuitry which limits the maximum current to about 50 mA. Beside the current limiter there is also a current detector circuit which has the threshold at 5 mA. That is how the RF switch (U14) is set if the active antenna Input goes to ZOE-M8B or the Simulator input.

☞ Only if current drawn at active antenna input is more than 5 mA, it can be used.

4.3.1.1 Direct ZOE-M8B GNSS performance

There is also an option to have the active antenna input available without connecting an active antenna. In that case jumper J8 has to be populated, see Figure 2 and Figure 3. Having jumper J8 populated ensures a current draw at active antenna input and thus the RF switch will still stay at the active antenna input.

Thus a passive antenna or simulator can be connected and performance can be verified when there is no external LNA in front of ZOE-M8B SiP.

☞ There is DC at the active antenna input, so consider to use a DC block.

4.3.2 Simulator input

At Simulator input there is an external LNA (U12) used in front of ZOE-M8B to show optimal GNSS performance. This allows verifying datasheet values of ZOE-M8B SiP with a GNSS simulator.

☞ Only if NO current is drawn at the active antenna input (< 5 mA), can the simulator input be used. Ensure no active antenna is connected to the active antenna input and that Jumper J8 is not populated.

4.4 Digital Connector

There is a 20-pin connector on EVK-M8BZOE. It provides several PIO's, interfaces and supply options. All these pins are ESD protected.

PIN Nr.	PIN NAME	I/O	LEVEL	DESCRIPTION
1	V_BCKP	I	2.5V…3.6V	Backup supply
2	V5_IN	I	4.5V…5.5V	Main Supply
3	NC			
4	GND	-		GND
5	SAFEBOOT_N	I	1.8 V	
6	GND	-		GND
7	SDA / SPI CS_N	I/O	1.8V	DDC SDA or SPI CS_N, depends on interface switch
8	GND	-		GND
9	SCL / SPI SCK	I/O	1.8V	DDC SCL or SPI SCK, depends on interface switch
10	GND	-		GND
11	TIMEPULSE1	O	1.8V	Timepulse not supported by ZOE-M8B firmware.
12	GND	-		GND
13	EXTINT0	I	1.8V	External input, can be used for time aiding.
14	GND	-		GND
15	RESET_N	I	1.8V	RESET input
16	GND	-		GND
17	TXD / SPI MISO	O	1.8 V	UART TX or SPI MISO, depends on interface switch
18	GND	-		GND
19	RXD / SPI MOSI	I	1.8 V	UART RX or SPI MOSI, depends on interface switch
20	GND	-	-	GND

Table 5: Connector pin description for EVK-M8BZOE

4.5 Flash

EVK-M8BZOE has an SQI flash connected to ZOE-M8B SiP. By default it can be used to:

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

4.6 RESET_N and SAFEBOOT_N

RESET_N and SAFEBOOT_N are available on jumpers (J5 and J10) as well as on digital connector J1, see section 4.4 for more information.

4.7 EXTINT

On the EVK-M8BZOE the EXTINT signal of ZOE-M8B is available on digital connector J1 (see section 4.4), and on RS-232 connector (see section 4.2.3).

☞ If EXTINT0 on RS-232 is used, ensure the EXTINT signal available at digital connector J1 is connected to 1.8 V.

5 Testing Super-E mode

This section contains a brief description of main configuration options for optimizing Super-E mode performance and power consumption using the Messages view of the u-center evaluation software. Refer to the ZOE-M8B Data Sheet [1], ZOE-M8B System Integration Manual [2] and u-blox 8 / u-blox M8 Receiver Description including Protocol Specification [3] for full descriptions of all available configuration options.

5.1 Power Mode Setup message UBX-CFG-PMS

Power Mode Setup message UBX-CFG-PMS shown in Figure 4 is used to select the power mode. Continuous or Super-E mode can be selected. There are three predefined power mode setups for Super-E mode including 1 Hz (default), 2 Hz and 4 Hz update rates. The 1 Hz update rate is a good compromise between position accuracy vs. power consumption. For demanding applications, 2 Hz update rate provides high performance at some compromise in power consumption.

For lowest power consumption, Super-E mode supports continuous tracking with update periods up to 10 s. To set update periods longer than 1 s, select default Super-E mode (1 Hz) and use Extended Power Management message UBX-CFG-PM2 to set the update period.

☞ u-blox recommends using the predefined power mode settings for Super-E mode, except where users have very specific power saving requirements.

☞ When selecting a mode using CFG-PMS, always save the configuration by checking the “save configuration” box in u-center, otherwise the configuration will be lost.

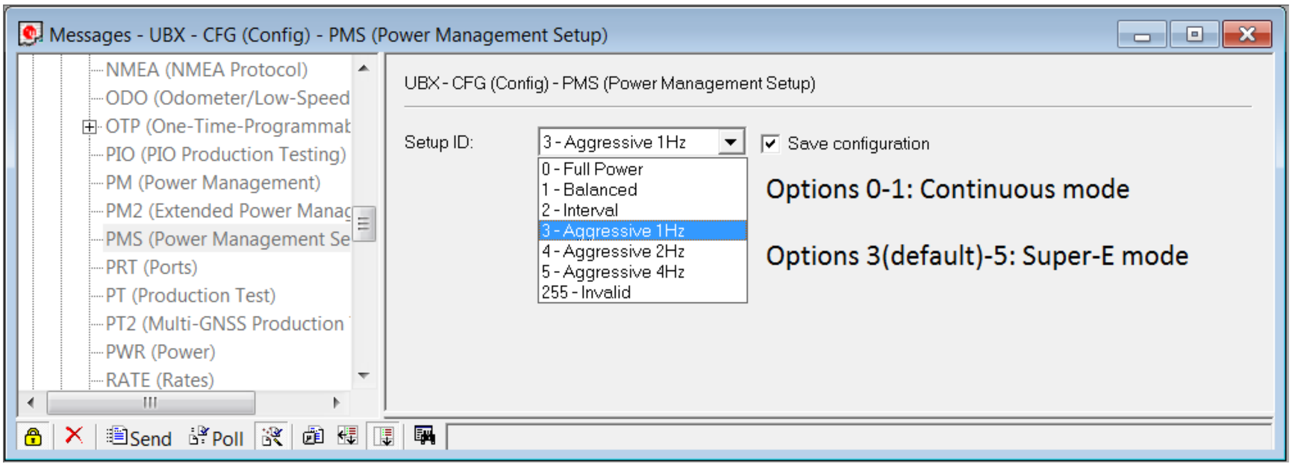

Figure 4: Power Mode Setup message UBX-CFG-PMS. Super-E mode with a desired update rate (1 Hz, 2 Hz or 4 Hz) can be selected with Options 3(default)-5. Options 0-1 are for Continuous mode settings.

5.2 Extended Power Management message UBX-CFG-PM2

The Extended Power Management message UBX-CFG-PM2, which is shown in Figure 5, offers additional options for Super-E configuration. The main use is to set update periods longer than 1 s, adjust the initial acquisition period, and to select the Super-E optTarget.

☞ u-center v8.29 or later displays the optTarget options correctly.

Update periods longer than 1 s are set with the field updatePeriod. The UBX-CFG-PMS message sets this field automatically for 1-4 Hz update rates, but needs to be adjusted for longer update periods. For example, for a 3 s update period, set the updatePeriod field to 3000 ms. The maximum value for updatePeriod is 10000 ms , i.e., 10 s.

At start-up, the receiver runs at full power and decodes satellite data (ephemeris, almanac). This initial acquisition period is by default 300 s to enable receiver to find a sufficient number of satellites also under weak-signal conditions. If needed, the initial acquisition period can be adjusted with the minAcqTime field given in seconds. The initial acquisition period can be reduced or even removed if AssistNow™ service is used to provide the satellite information for the receiver. Use of AssistNow™ improves receiver performance and reduces power consumption and is strongly recommended with Super-E mode.

Super-E mode has two settings for power optimization targets. The optimization target is set with optTarget field and is used with any update rate selected. The “performance” (default) provides an optimum compromise between position accuracy vs. power consumption. Additional power savings up to 15-20% can be achieved with the “power save” setting, but at the expense of position accuracy.

☞ When configuring the receiver in Super-E mode, it is recommended to always first send UBX-CFG-PMS message followed by UBX-CFG-PM2. This ensures consistent receiver configuration.

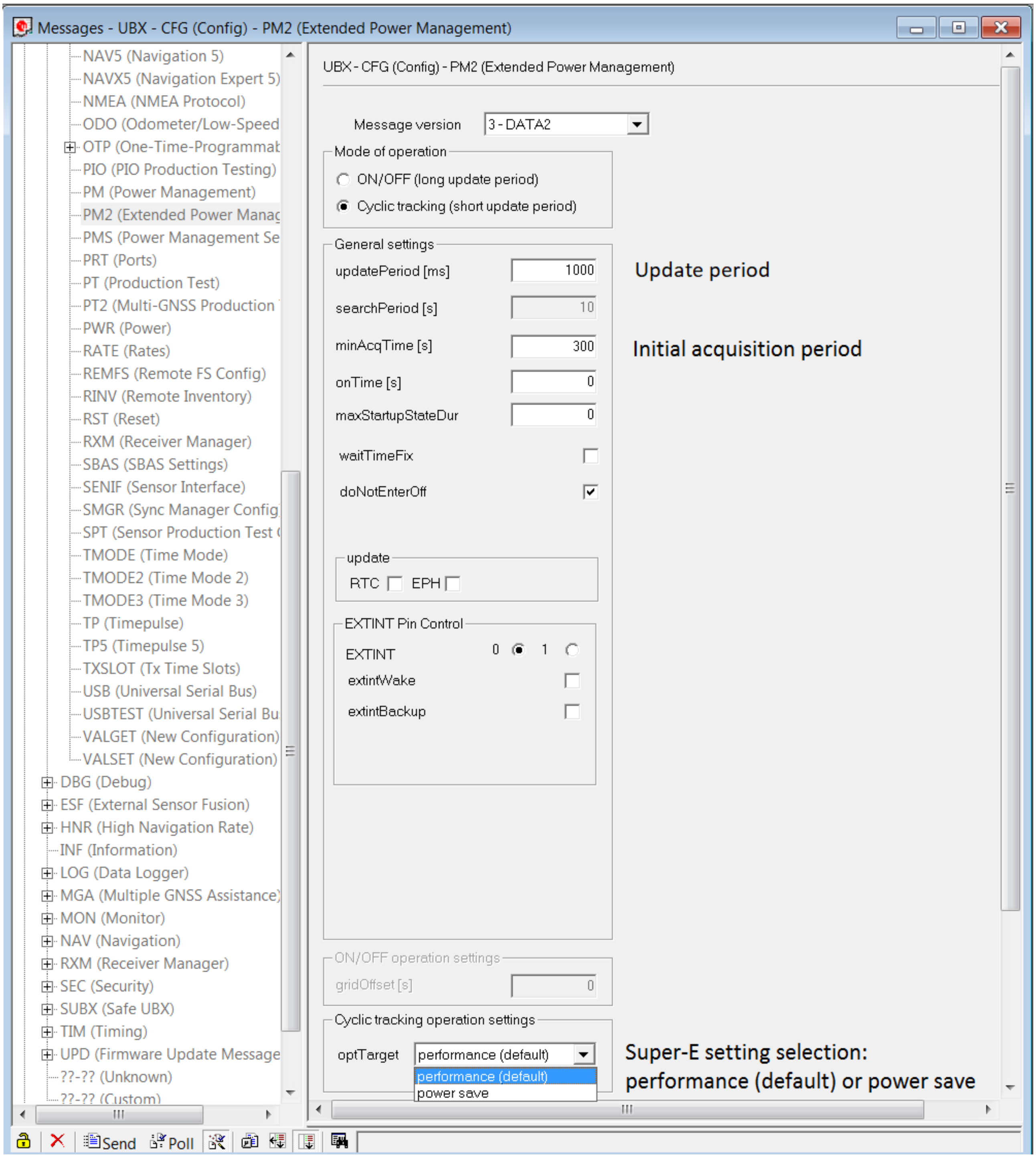

Figure 5: Extended Power Management message UBX-CFG-PM2.

5.3 Other useful messages

Super-E mode has three different states: acquisition, tracking, and power-optimized tracking. The power-optimized tracking state is the low-power state of the Super-E mode. Acquisition and tracking states are used during initial acquisition phase or in case fix is lost or satellite data for new satellites needs to be decoded. In most cases, after initial acquisition phase the receiver spends all or most of the time in power-optimized tracking state. Information on the Super-E state is given in the UBX-NAV-PVT message shown in Figure 6. In addition to time, position and velocity information, the message contains a field indicating receiver state.

The messages UBX-CFG-PMS and UBX-CFG-PM2 set the navigation update rate for the power-optimized tracking state of Super-E mode. The update rate for both the acquisition and tracking state is set by the message UBX-CFG-RATE shown in Figure 7. The message UBX-CFG-RATE also sets the navigation update rate for the continuous mode. To set a uniform update rate regardless of the Super-E state, the same update rate should be used for UBX-CFG-PMS/UBX-CFG-PM2 and UBX-CFG-RATE. For low update rates (e.g. 10 s update period) for the power-optimized tracking state, it is recommended to use 1 Hz update rate for acquisition and tracking states to speed up the time for the receiver to return to power-optimized tracking state.

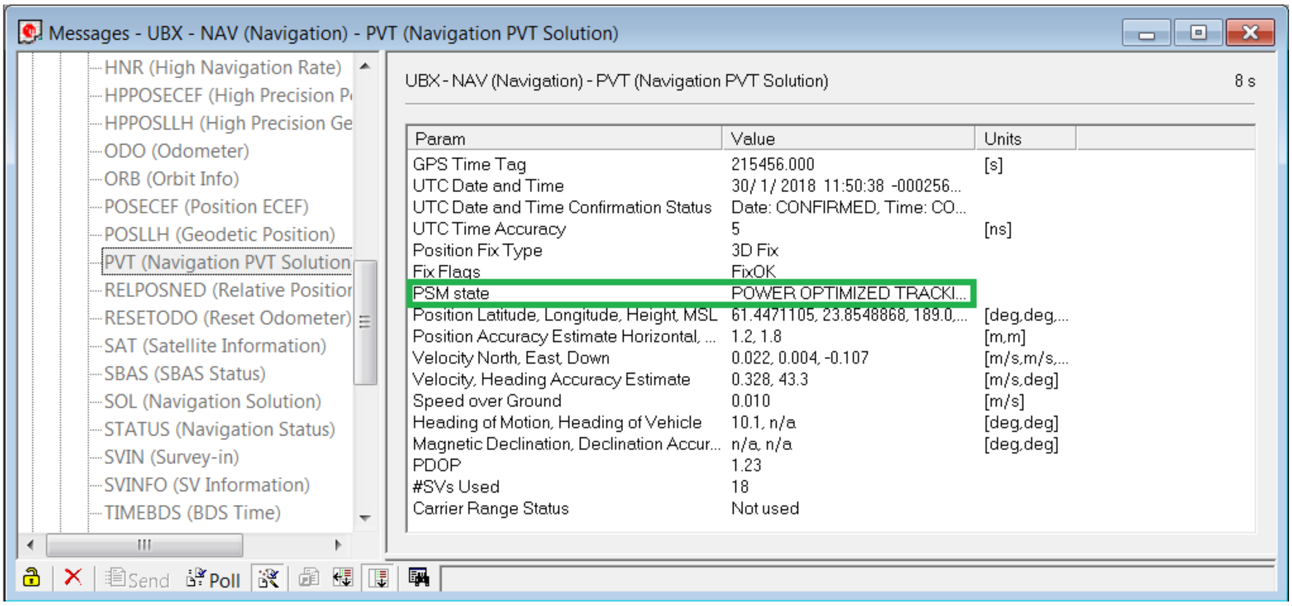

Figure 6: Navigation information is found in UBX-NAV-PVT message. The PSM state "Power optimized tracking" is the low-power state of Super-E mode.

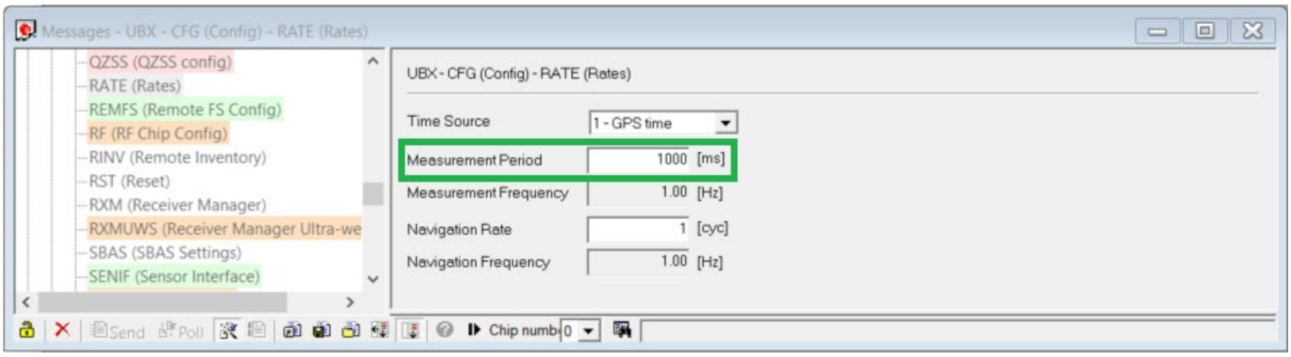

Figure 7: The message UBX-CFG-RATE sets the navigation update rate for the acquisition and tracking state of Super-E mode and the continuous mode.

The default constellations used by the receiver are GPS, GLONASS and QZSS. The constellations used can be selected with the UBX-CFG-GNSS message shown in Figure 8. Depending on region, it may be beneficial to configure the receiver to use GPS, BeiDou and QZSS. Note however that AssistNow™ Offline service currently supports GPS and GLONASS but not BeiDou. For absolute lowest power consumption, the receiver can be configured to receive only GPS and QZSS satellites. This may affect the availability of satellites resulting in reduced performance and is not recommended unless power saving is critical.

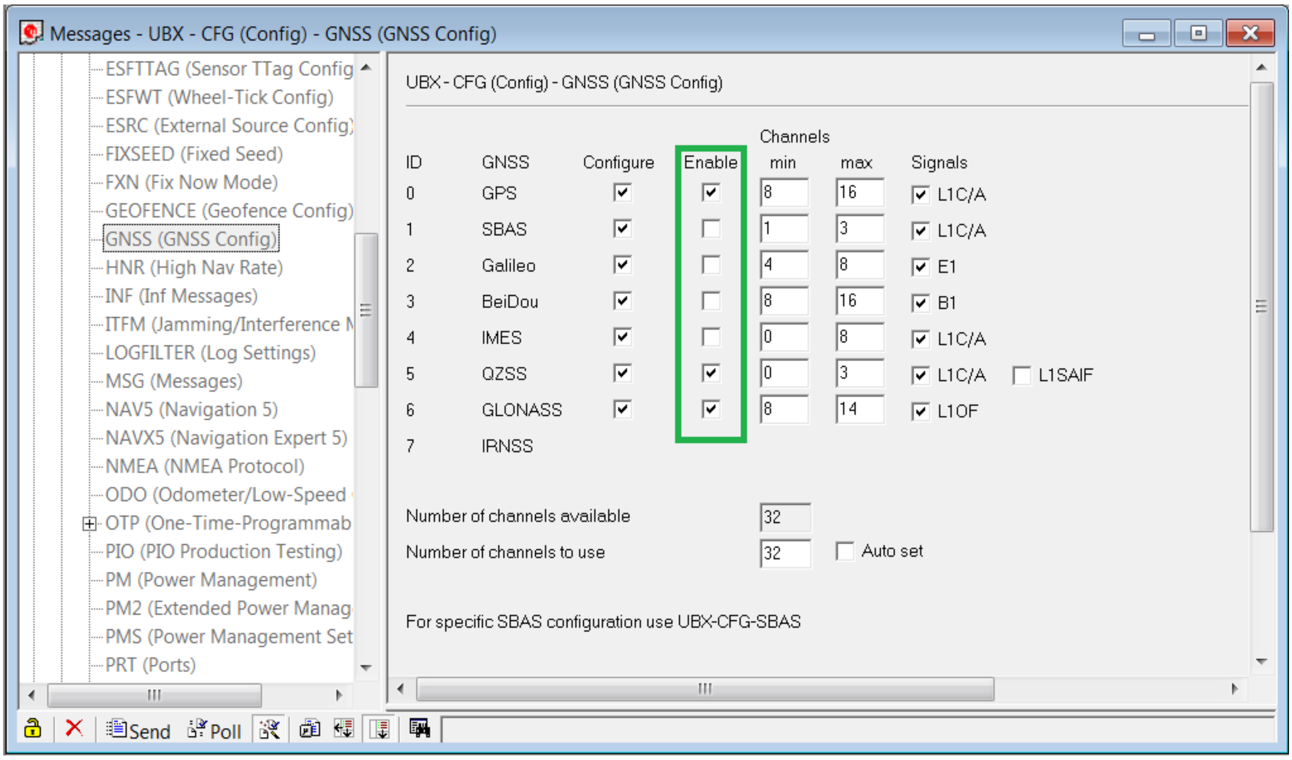

Figure 8: Constellations used can be selected with UBX-CFG-GNSS message. For absolute lowest-power applications, current consumption can be further reduced by disabling GLONASS.

6 Measuring current consumption

6.1 Basic measurements with the shunt resistors

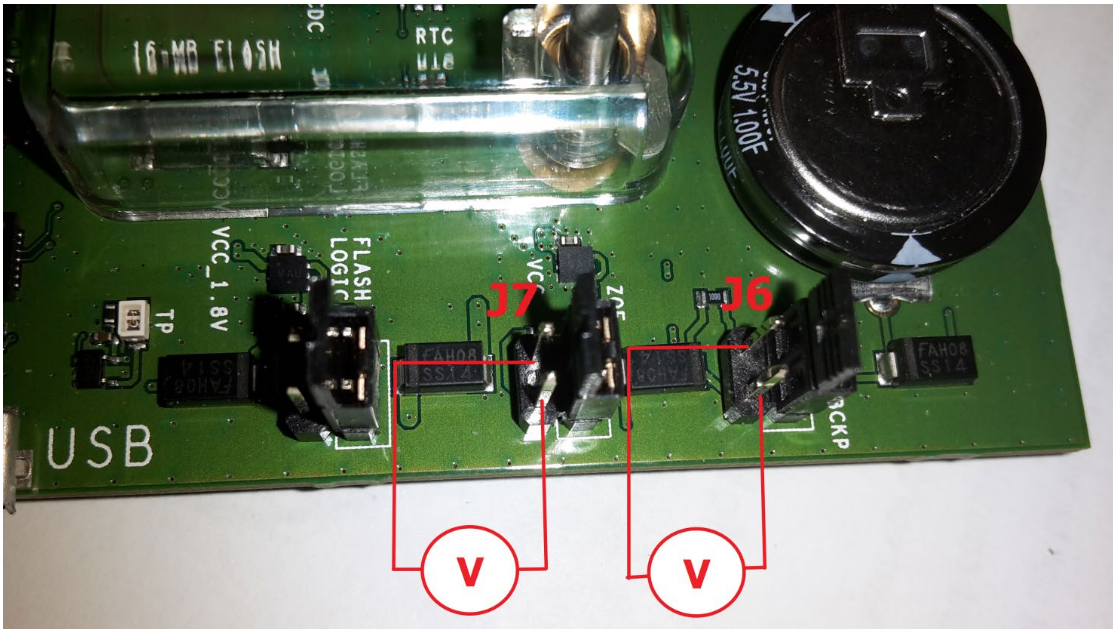

Figure 9: EVK-M8BZOE board measuring the ZOE-M8B VCC current

On the EVK-M8BZOE there is a 1.8 V LDO supplying the ZOE-M8B main supply (**VCC**). At the input of that LDO is a 1 Ω current measurement shunt resistor placed in between J7 pin 1 and pin 2, see Figure 9.

A super capacitor charged to 3.3 V supplies the V_BCKP for ZOE-M8B. In between the super capacitor and **V_BCKP** there is a 100 Ω current measurement shunt resistor placed in between J6 pin 1 and pin 2.

6.1.1 ZOE-M8B VCC current

To measure the acquisition and tracking power consumption with the EVK-M8BZOE, follow the below steps. A picture of the setup can be seen in Figure 10.

1. Connect a voltmeter to J7 pin 1 and pin 2 to see the voltage over the 1 Ω current measurement shunt resistor in the **VCC** supply.
2. Do a cold reset for the GNSS engine e.g. with u-center software.
3. Read the voltage (and average for a while if necessary) on the voltmeter and convert to current. 1 mV equals 1 mA.
   - Average current consumption from power on to first fix will give you the Acquisition current consumption as mentioned in the ZOE-M8B Data Sheet [1].
   - After the first fix, the receiver continues to operate in full-power mode. After some minutes when it has acquired a sufficient number of satellites, it enters the Super-E power save mode. Average current consumption in this state with a good signal level is less than 10 mA.

See Figure 10 as an example where 0.0407 V in average is measured by multimeter over 1 Ω VCC shunt resistor. This corresponds (1 mV equals 1 mA) to 40.7 mA average current typical in acquisition phase. In power-optimized tracking state, the average current consumption can be of the order of 10 mA.

Figure 10: Setup to measure the VCC current consumption of ZOE-M8B on EVK-M8BZOE

6.1.2 ZOE-M8B V_BCKP current

To measure the backup current consumption for **V_BCKP** of ZOE-M8B follow the below steps, a picture of the setup can be seen at Figure 11:

1. Connect a voltmeter to J6 pin 1 and pin 2 to see the voltage over the 100 Ω current measurement shunt resistor in the **V_BCKP** supply.
2. Disconnect the main supply.
3. Read the voltage on the voltmeter and convert to current. 1 mV equals 10 uA.

See Figure 11 for an example where 0.0016 V is measured by multimeter over 100 Ω V_BCKP shunt resistor. This corresponds (1 mV equals 10 uA) to 16 uA backup current.

Figure 11: Setup to measure the V_BCKP current consumption of ZOE-M8B on EVK-M8BZOE

6.1.3 ZOE-M8B optional Flash and logic current

If the optional Flash is used e.g. for logging purposes, the current consumption of that can be measured using J4; see schematic in Section 8.

6.2 Measurement with an external current measuring power supply

If customers have their own current measurement setup, they can also measure the current consumption of **VCC** and **V_BCKP** of ZOE-M8B with an external current measuring power supply.

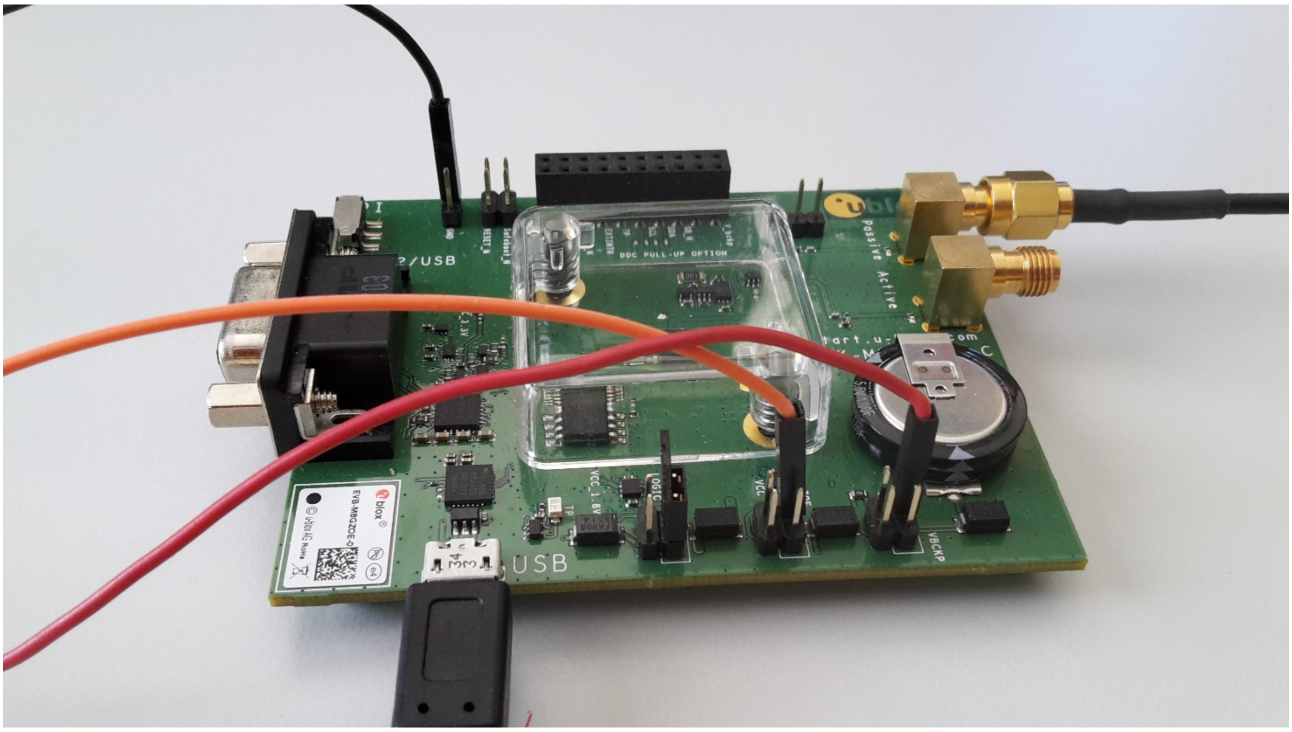

Figure 12: Measuring power consumption with external power supply

In Figure 12 the **VCC** and **V_BCKP** power supply circuitry have been disconnected from the main power supply and Gold Capacitor (J6 and J7 removed). The LDOs are supplied by separate external power supplies. The jumpers for normal shunt resistor use have been disconnected and the power is supplied to the LDO connection pins. For the jumpers J12, J13, and J11, the leftmost pin is connected to the main supply and the rightmost pin is connected to the corresponding LDO. The J14 GND pins can be used to provide the ground for these external power supplies.

J6 pin 4 (red cable in Figure 12) directly supplies **V_BCKP** of ZOE-M8B. The voltage level must be within 1.4 V to 3.6 V.

The J7 pin 4 (orange cable in Figure 12) supplies the LDO which makes the 1.8 V for **VCC** of ZOE-M8B. The voltage level must be within 2.5 V to 5.5 V.

7 Board assembly

Figure 13 shows the EVK-M8BZOE assembly. See Table 6 for the component list.

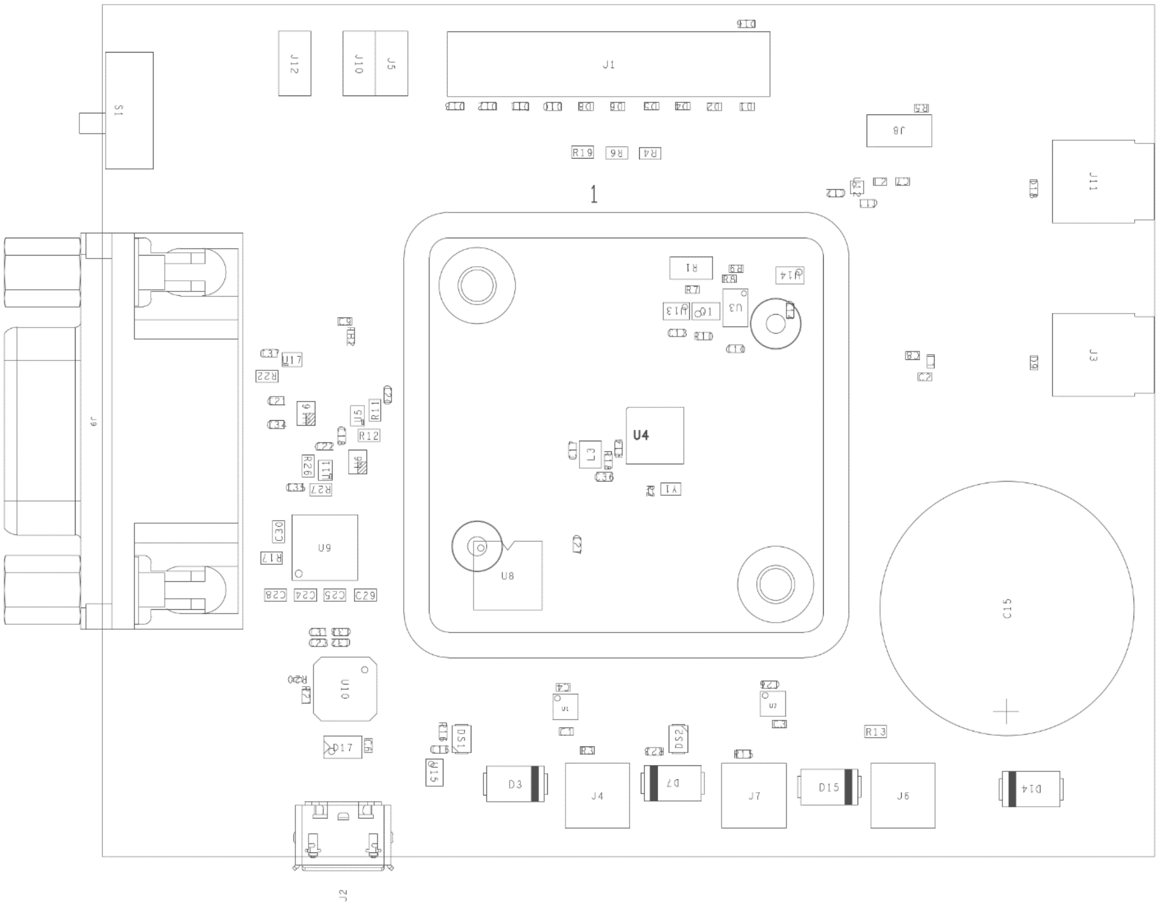

Figure 13: EVK-M8BZOE Assembly

PART	DESCRIPTION
C1 C3 C4 C6 C9 C18 C20 C21 C22 C23 C26 C27 C34 C35 C37	CAP CER X5R 0402 TY 1U0 10% 6.3V
C2 C16 C31 C33	CAP CER X7R 0402 100N 10% 16V -55/+125C
C7 C8 C14	CAP CER COG 0402 47P 5% 25V
C10 C11 C13	CAP CER X7R 0402 1N0 10% 50V
C12	CAP CER COG 0402 1P8 +/-0.1P 25V
C15	CAP ELECTRIC DOUBLE LAYER THT PANASONIC SERIES SG 1F 30% 5.5V
C24 C25 C28 C29 C30	CAP CER X7R 0603 100N 10% 10V
C32	CAP CER X5R 0402 4U7 20% 6.3V
D1 D2 D4 D5 D6 D8 D10 D11 D12 D13 D16	VARISTOR BOURNS MLE SERIES CG0402MLE-18G 18V
D3 D7 D14 D15	SURFACE MOUNT SCHOTTKY BARRIER RECTIFIER SS14 1A -55/+125C
D9 D18	ESD PROTECTION FOR HIGH SPEED LINES, TYCO, 0.25PF, PESD0402-140 -55/+125C
D17	USB DATA LINE PROTECTION ST USBLC6-2SC6 SOT23-6
DS1	LED OSRAM HYPER MINI TOPLED LB M673-L1N2-35 BLUE 0.02A

DS2	LED OSRAM HYPER MINI TOPLED LT M673-N1R2-25 GREEN 0.02A
FB2	FERRITE BEAD MURATA BLM15HD 0402 1000R@100MHZ
J1	2-ROWS TH-PCB SOCKET 100MIL GRID 20PINS 0.64MM SQUARE 8.5MM
J2	CON USB RECEPTACLE MICRO B TYPE SMD - MOLEX 47346-0001 - TID60001597 30V 1A
J3 J11	CON SMA THT RIGHT ANGLE JACK
J4 J6 J7	CON 2-ROWS THT 100MIL GRID 4PINS 0.64MM SQUARE 6.1MM HEIGHT
J5 J10 J12	CON 1-ROW THT 100MIL GRID 2PINS 0.64MM SQUARE 6.1MM HEIGHT
J8	1-ROWS TH-PCB SOCKETS 100MIL GRID 2PINS 0.64MM SQUARE POLARIZE
J9	9 POLE SUBD CONNECTOR FEMALE
L1	IND MURATA LQW15A 0402 120N 5% 0.11A -55/+125C
L2	IND MURATA LQW15A 0402 8N7 3% 0.54A -55/+125C
Q1	MBT3906DW1T1G DUAL GENERAL PURPOSE TRANSISTOR 0.2A 0.15W -40/+125C
R1	RES THICK FILM CHIP 1206 10R 5% 0.25W
R2	RES THICK FILM CHIP 0201 220R 5% 0.05W
R3 R15	RES THICK FILM CHIP 0402 CURRENT SENSE 1R 1% 1.1V -55/+125C
R5	RES THICK FILM CHIP 0402 470R 5% 0.1W
R7	RES THICK FILM CHIP 0402 2K2 5% 0.1W
R8	RES THICK FILM CHIP 0402 100K 5% 0.1W
R9	RES THICK FILM CHIP 0402 1K5 5% 0.1W
R10	RES THICK FILM CHIP 0402 220R 5% 0.1W
R11 R12 R17 R19 R22 R26 R27	RES THICK FILM CHIP 0603 100K 5% 0.1W
R13	RES THICK FILM CHIP 0603 100PPM PRO KELVIN 100R 1% 75V 0.1W -55/+125C
R14 R18	RES THICK FILM CHIP 0402 0R 0 0.1W
R16	RES THICK FILM CHIP 0402 100R 5% 0.1W
R20	RES THICK FILM CHIP 0201 4K7 1% 0.05W
R23	RES THICK FILM CHIP 0402 1K8 5% 0.1W
S1	2 WAY SUB-MINIATURE SLIDE SWITCH SMD JS SERIES - SPDT -40/+85C
U1 U7	LOW DROPOUT REGULATOR ON SEMI NCV8705 WDFN6 0.5A 1.8V -40/+125C
U3	PRECISION RAIL TO RAIL OP AMP LINEAR LT6000 DCB
U4	GNSS RECEIVER U-BLOX ZOE-M8B S-LGA51
U5 U11 U17	TINY LOGIC ULP-A 2-INPUT AND GATE 1.45X1.0 6-LEAD MICROPAK -40/+85C
U6 U16	DUAL-BIT DUAL-SUPPLY BUS TRANSCEIVER WITH CONFIGURABLE VOLTAGE TRANSLATION AND 3-STATE OUTPUTS RSW -40/+85C
U8	16MBIT SERIAL QUAD I/O SPI FLASH MEMORY 1.65-3.6V 3.6V -40/+85C
U9	RS-232 TRANSCEIVER 1MBIT 3-5,5VOLT TRSF3223 - VQFN20 5.5V 5.5V -40/+85C
U10	SINGLE-CHIP USB TO UART BRIDGE 5V 0.1A -40/+85C
U12	LOW NOISE AMPLIFIER GAAS MMIC 1.575 GHZ 1.5V-3.6V JRC EPFFP6-A2 3.6V -40/+85C
U13	TINY LOGIC UHS INVERTER WITH SCHMITT TRIGGER 0.9 TO 3.6V FAIRCHILD NC7SV14 SC70
U14	PHEMT SPDT SWITCH 300KHZ-3GHZ SKYWORKS AS179-92 SC70 -40/+85C
U15	TINY LOGIC UHS BUFFER OE_N ACTIVE LOW FAIRCHILD NC7SZ125 SC70
Y1	CRYSTAL CL=7PF MICRO CRYSTAL CM9 GOLD TERMINATION 32.768KHZ 100PPM -40/+85C
1	CLEAR (TRANSPARENT) PLASTIC HOUSING FOR 35X35 MM

Table 6: EVB-M8BZOE component list

8 Schematic

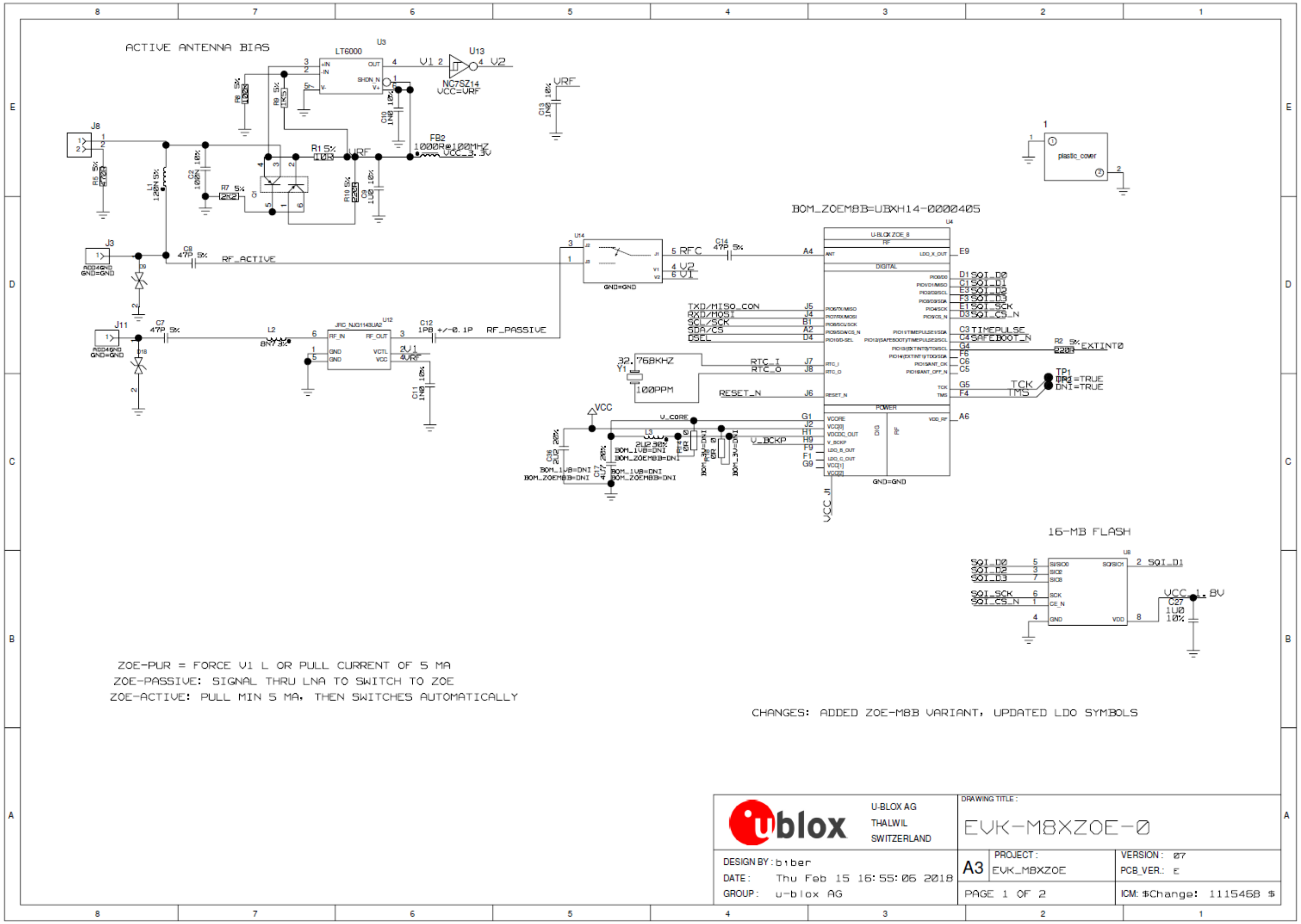

Figure 14: Schematic EVK-M8BZOE Version E, page 1 of 2: DNI=TRUE in the schematic means: Component not installed

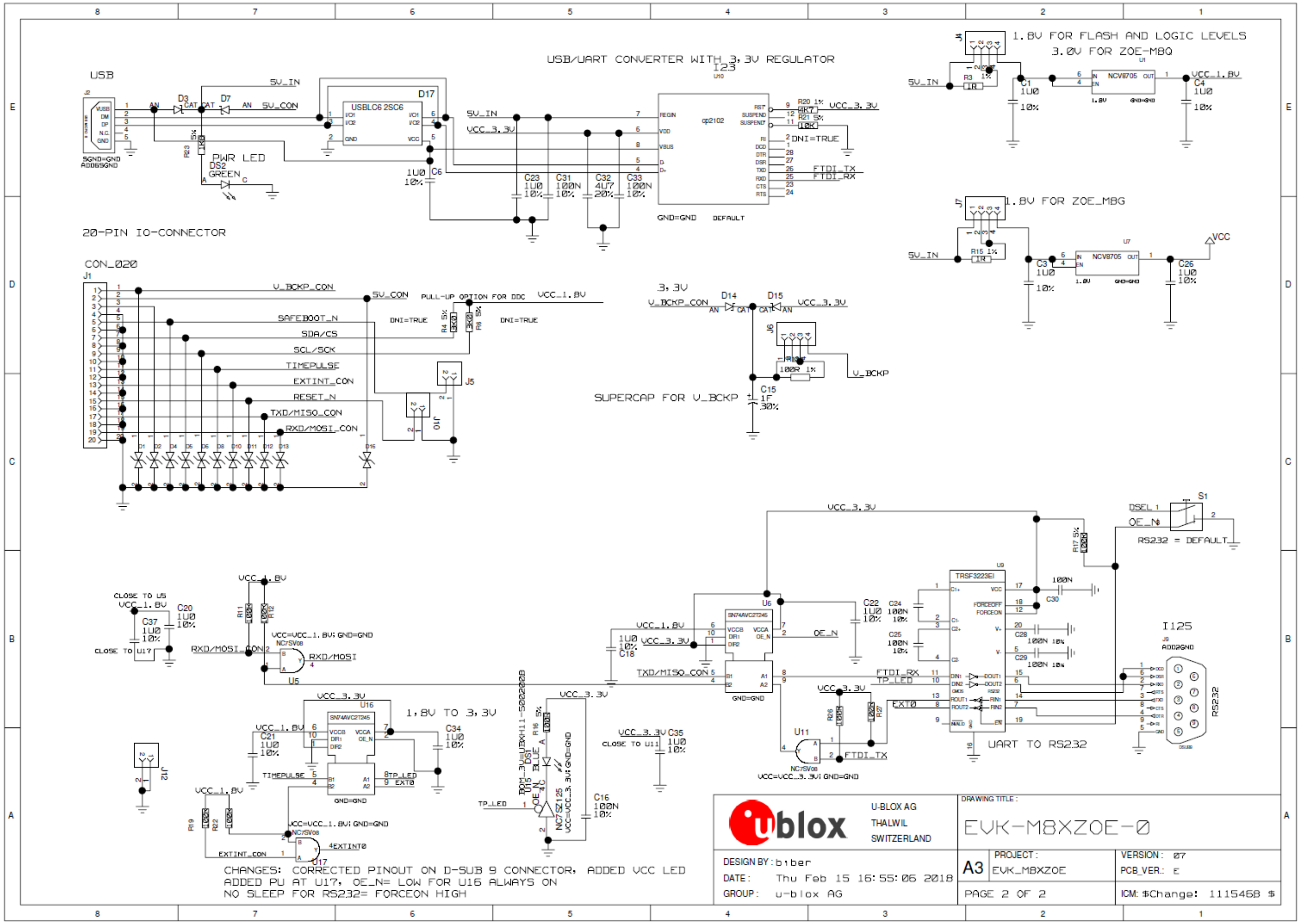

Figure 15: Schematic EVK-M8BZOE Version E, page 2 of 2: DNI=TRUE in the schematic means: Component not installed

9 Troubleshooting

My application (e.g. u-center) does not receive anything

Make sure that the USB cable is properly connected to the evaluation unit and the PC. By default, the evaluation unit outputs NMEA protocol on Serial Port 1 at 9600 Bd, or on the USB.

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

When using UART, make sure the baud rate is sufficient. If the baud rate is insufficient, GNSS receivers based on u-blox M8 GNSS technology will skip excessive messages. Some serial port cards/adapters (i.e. USB to RS232 converter) frequently generate errors. If a communication error occurs while u-center receives a message, the message will be discarded.

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

u-blox M8 GNSS receivers and u-center 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 and the GNSS receiver both autonomously try to adjust the baud rate. Do not enable the u-center autobauding feature if the GNSS receiver has the autobauding flag enabled.

The COM port does not send any messages

Be sure that the slide switch at the front side is set to RS-232/USB and not SPI.

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

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, another application running on this computer is using it.

After installing USB driver for the first time by connecting EVK-M8BZOE to PC with USB cable, the cursor on PC starts to jump around the screen

The syndrome is caused when the NMEA 0183 GNSS serial data is misinterpreted as a mouse data by the serial port enumerator (serenum.sys), resulting in erratic mouse cursor activity. This typically happens if the GNSS receiver sends NMEA data at startup of PC. Thus ensure the EVK is not connected to PC when PC starts up.

The position is off by a few dozen meters

u-blox M8 GNSS technology starts up with the WGS84 standard GNSS datum. If your application expects a different datum, you'll most likely find the positions to be off by a few dozen meters. Don't forget to check the calibration of u-center map files.

The position is off by hundreds of meters

Position drift may also occur when almanac navigation is enabled. The satellite orbit information retrieved from an almanac is much less accurate than the information retrieved from the ephemeris. With an almanac only solution, the position will only have an accuracy of a few kilometers but it may start up faster or still navigate in areas with obscured visibility when the ephemeris from one or several satellites have not yet been received. The almanac information is NOT used for calculating a position, if valid ephemeris information is present, regardless of the setting of this flag.

In NMEA protocol, position solutions with high deviation (e.g. due to enabling almanac navigation) can be filtered with the Position Accuracy Mask. UBX protocol does not directly support this since it provides a position accuracy estimation, which allows the user to filter the position according to his requirements. However, the "Position within Limits" flag of the UBX-NAV-STATUS message indicates whether the configured thresholds (i.e. P Accuracy Mask and PDOP) are exceeded.

TTFF times at startup are much longer than specified

At startup (after the first position fix), the GNSS receiver performs an RTC calibration to have an accurate internal time source. A calibrated RTC is required to achieve minimal startup time.

Before shutting down the receiver externally, check the status in MON-HW in field “Real Time Clock Status”. Do not shut down the receiver if the RTC is not calibrated.

The EVK-M8BZOE does not meet the TTFF specification

Make sure the antenna has a good sky view. An obstructed view leads to prolonged startup times. In a well-designed system, the average of the C/No ratio of high elevation satellites should be in the range of 40 dBHz to about 50 dBHz. With a standard off-the-shelf active antenna, 47 dBHz should easily be achieved. Low C/No values lead to a prolonged startup time.

The EVK-M8BZOE does not work properly when connected with a GNSS simulator

There is RF-input for simulator signal (passive).

When using an EVK 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. By using a GNSS simulator, the user can change scenarios, which enables jumping backwards in time. This can have serious side effects on the performance of GNSS receivers.

The solution is to configure GPS week rollover to 1200 (as indicated in Figure 16), which corresponds to Jan 2003. Then, issue the cold start command before every simulator test to avoid receiver confusion due to the time jumps.

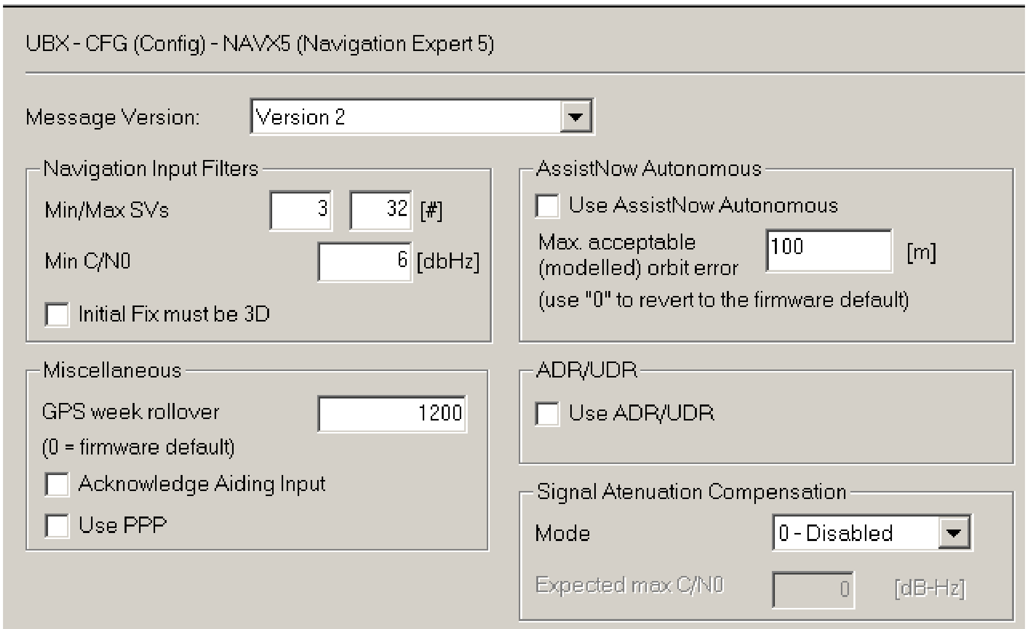

Figure 16: Configuration instruction for using the EVK with a GNSS simulator

The EVK-M8BZOE does not preserve the configuration when power is cut off

u-blox M8 GNSS technology uses a slightly different concept than most other GNSS receivers do. Settings are initially stored to volatile memory. In order to save them permanently, sending a second command is required. This allows testing the new settings and reverting to the old settings by resetting the receiver if the new settings aren’t good. This provides safety, as it is no longer possible to accidentally program a bad configuration (e.g. disabling the main communication port).

10 Common evaluation pitfalls

- Parameter 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, cold start times may differ between suppliers.
- Verify design-critical parameters; do not base a decision on unconfirmed numbers from datasheets.
- Try to use identical or at least similar settings when comparing the GNSS performance of different receivers.
- Data that 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. The average C/No ratio of the high elevation satellites should be between 40 dBHz and about 50 dBHz. A low C/No ratio will result in a prolonged TTFF and more position drift.
- When comparing receivers side by side, make sure that all receivers have the same signal levels. The best way to achieve this is by using a signal splitter. Comparing results measured with different antenna types (with different sensitivity) will lead to incorrect conclusions.
- Try to feed the same signal to all receivers in parallel (i.e. through a splitter); the receivers won't have the same sky view otherwise. Even small differences can have an impact on speed, accuracy, and power consumption. One additional satellite can lead to a lower 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 M8 positioning technology continuously performs a noise calibration on idle channels.

Related documents

[1] ZOE-M8B Data Sheet, Doc. No. UBX-17035164
[2] ZOE-M8B System Integration Manual, Doc. No.UBX-17045131
[3] u-blox 8 / u-blox M8 Receiver Description including Protocol Specification, Doc. No. UBX-13003221 (Public Release)
[4] u-center User Guide, Doc. No. UBX-13005250
[5] EVK-M8xZOE Quick Start Guide, Doc. No. UBX-17013022
[6] Information technology equipment – Safety Standard IEC 60950-1 https://webstore.iec.ch/publication/4024

☞ For regular updates to u-blox documentation and to receive product change notifications, register on our homepage (www.u-blox.com).

Revision history

Revision	Date	Name	Comments
R01	25-Sep-2017	rmak	Objective Specification
R02	31-Jan-2018	rmak	Early Production Information. Added information on RED DoC in European Union regulatory compliance (page 2). Added section 5 (Testing Super-E mode) for configuration options.
R03	23-Feb-2018	rmak	Updated Section 5.2 (Extended Power Management message UBX-CFG-PM2).
R04	17-Apr-2019	rmak	Updated to hardware revision E (LED added for power supply indication). Updated sections 3.2 (Hardware installation), section 4.3 (GNSS signal inputs), section 5.2 (Extended Power Management message UBX-CFG-PM2), section 5.3 (Other useful messages), section 7 (Board assembly) and section 8 (Schematic).

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