EVK-M8F-0-00

Evaluation Kit
time and frequency reference products
User Guide

Abstract

This document describes the structure and use of the EVK-M8F-0-00 evaluation kit and provides information for evaluating and testing u-blox M8 time and frequency reference technology.

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Document Information

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Document status explanation

Objective Specification	Document contains target values. Revised and supplementary data will be published later.
Advance Information	Document contains data based on early testing. Revised and supplementary data will be published later.
Early Production Information	Document contains data from product verification. Revised and supplementary data may be published later.
Production Information	Document contains the final product specification.

This document applies to the following products:

Product name	Type number	Hardware Version	ROM/FLASH version	PCN reference
EVK-M8F	EVK-M8F-0-00	A	ROM 2.01/ FLASH FW2.20 FTS1.01	N/A

Preface

Using this guide

This guide assumes, the user has basic computer skills and is familiar with the Windows Graphical User Interface (GUI) and GNSS receiver environments.

The following symbols are used in the document to highlight information:

⚠ **A warning symbol indicates actions that could negatively impact or damage the device.**

☞ An index finger points out key information pertaining to device operation and performance.

Warnings and certifications

CAUTION! IN THE UNLIKELY EVENT OF A FAILURE IN THE INTERNAL PROTECTION CIRCUITRY THERE IS A RISK OF AN EXPLOSION WHEN CHARGING FULLY OR PARTIALLY DISCHARGED BATTERIES. REPLACE THE BATTERY IF IT NO LONGER HAS SUFFICIENT CHARGE FOR UNIT OPERATION. CHECK THE BATTERY BEFORE USING IF THE DEVICE HAS NOT BEEN OPERATED FOR AN EXTENDED PERIOD OF TIME.

Products marked with this lead-free symbol on the product label comply with the "Directive 2002/95/EC of the European Parliament and the Council on the Restriction of Use of certain Hazardous Substances in Electrical and Electronic Equipment" (RoHS).

EVK-M8F evaluation kit is RoHS compliant and green (no halogens).

Contents

1 Product description

1.1 Overview

The EVK-M8F-0-00 evaluation kit makes evaluating the high performance u-blox M8 time and frequency reference products simple. The built-in USB interface provides both power supply and high-speed data transfer, and eliminates the need for an external power supply. Additionally, the dedicated EXTENSION connector in the EVK-M8F-0-00 provides access to time and frequency interface signals. u-blox evaluation kits are compact, and their user friendly interface and power supply make them ideally suited for use in laboratories, vehicles and outdoor locations. Furthermore, they can be used with a PDA or a notebook PC, making them the perfect companion through all stages of design-in projects.

Evaluation Kit	Description	Suitable for
EVK-M8F-0-00	u-blox M8 Evaluation Kit time and frequency reference products	LEA-M8F UBX-M8030-KT-FT

Table 1: Applicability

1.2 Kit includes

- Evaluation unit
- USB cable
- Active GPS / GLONASS / BeiDou antenna with 3 m cable
- Quick Start card

1.3 Software and documentation

The EVK installation software (and documentation) package can be downloaded from the Web; see the Quick Start card for the URL.

1.3.1 u-center GNSS evaluation software

The installation software includes u-center, 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.

1.4 System requirements

- PC with USB interface
- Operating system: Windows Vista onwards (x86 and x64 versions)
- USB drivers are provided in the evaluation kit installation software

2 Specifications

Parameter	Specification
Serial Interfaces	1 USB V2.0
	1 RS232, max. baud rate 921,6 kBd DB9: PC compatible
	1 DDC (I^{2}C compatible) max. 400 kHz
	1 SPI – clock signal max. 5,5 MHz – SPI DATA max. 1 Mbit/s
Timing Interfaces	1 DDC (I^{2}C compatible) master to control external VCTCXO via DAC 2 Frequency/Phase timing measurement inputs 1 Low noise frequency reference output 1 Timepulse output
Dimensions	105 x 64 x 26 mm
Power Supply	5V via USB or external powered via extra power supply through front connector pin 14 (V5_IN) 13 (GND)
Normal Operating temperature	-40°C to +65°C

Table 2: EVK-M8F-0-00 Specifications

3 Getting Started

3.1 Software installation

☞   Installation of the EVK-M8 software and documentation requires Internet access.

See the Quick Start card for the URL where the EVK files are located. Choose the "Software only" or "Software and documentation" installation package from the u-blox website. Once the zip file is downloaded, unzip the file in Tools folder and double-click the extracted exe file.

The software components will be installed on your system and placed under the "u-blox" folder in the "Start → Programs" menu.

3.2 Hardware installation

1. Connect the unit to a PC running Microsoft Windows. Options:

   - USB: Connect via USB port.
   - UART: Connect via RS232. Set slide switch to I^{2}C.
   - SPI / I^{2}C compliant DDC: Connect corresponding pins (see Table 5 for pin description). Set slide switch accordingly to SPI or I^{2}C.

NOTE: Press the RST button after changing the switch.

2. The device must always have power, either via USB on the back or the V5_IN input on the front.
3. Connect the GNSS antenna to the evaluation unit and place the antenna in a location with good sky view.
4. Start the u-center GNSS Evaluation Software and select corresponding COM port and baud rate. (Refer to the *u-center User Guide* [6] for more information.)

3.3 Serial port default configuration

Parameter	Description	Remark
UART Port 1, Input	UBX and NMEA protocol at 9'600 Bd	
UART Port 1, Output	UBX and NMEA protocol at 9'600 Bd	Only NMEA messages are activated
USB, Input	UBX and NMEA protocol	
USB, Output	UBX and NMEA protocol	Only NMEA messages are activated

Table 3: Default configuration

4 Device description

4.1 Interface connection and measurement

For connecting the EVK to a PC, use a standard SUBD-9 cable and the included USB cable.
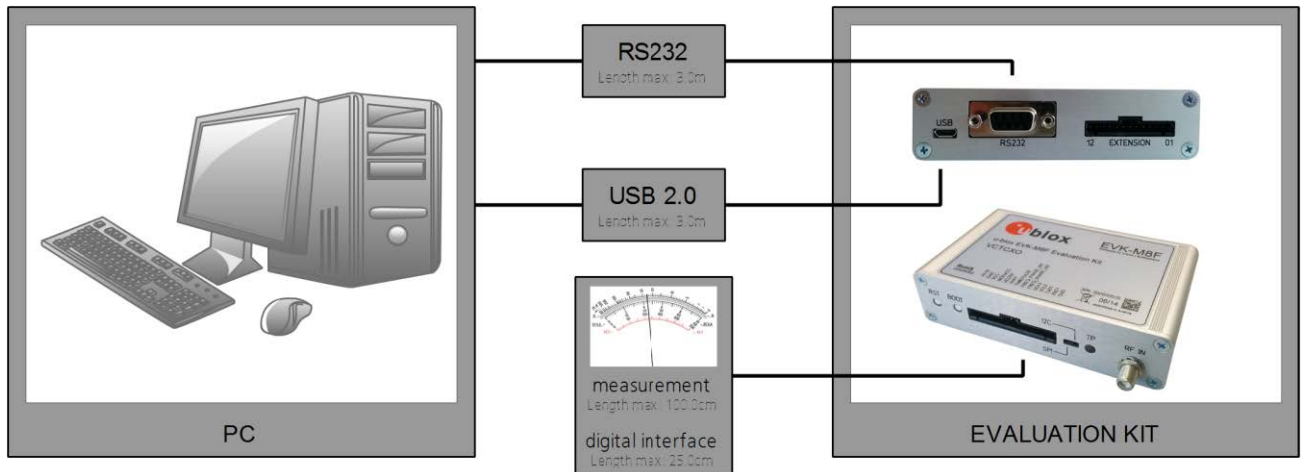Additional measurement equipment can be connected to the front connector.

Figure 1: Connecting the unit for power supply and communication

4.2 Active antenna

EVK-M8F-0-00 evaluation kit includes a GPS / GLONASS / BeiDou antenna with a 3 m cable. It is possible to connect various active and passive GNSS antennas with SMA connectors to the evaluation unit.

The recommended maximum antenna supply current for active antennas is 30 mA.

4.3 Evaluation unit

Figure 2 shows the front and the rear panels of the EVK-M8F-0-00 evaluation unit.

Front panel

Rear panel

Figure 2: EVK-M8F-0-00 evaluation unit – front and rear panels

4.3.1 Antenna connector

An SMA female jack is available on the front side (see RF IN in Figure 2) of the evaluation unit for connecting an active or passive antenna. The DC voltage at the RF input is then 3.3 V. The internal short circuit protection limits the maximum current to 60 mA. Please note that the 30 mA maximum supply current for active antenna stays the same. The RF input connector is also ESD protected.

☞ A jumper must be fitted between VCC_RF and VANT on the front panel connector (J4) to power an active antenna. The jumper is delivered with the EVK-M8F kit as shown in Figure 2.

⚠ **The Antenna connector is only to be used with a GNSS antenna or simulator. Do not connect this equipment to cable distribution systems.**

4.3.2 USB

A USB V2.0 compatible serial port is featured for data communication and power supply.

4.3.3 UART

The evaluation unit includes an RS232 port for serial communication that is compatible with PC serial ports.

Connect using a straight RS232 serial cable with male and female connectors to the port on your PC. The maximum cable length is 3 meters. To configure the RS232 port, use the CFG_PRT command in the u-center application. The maximum operating baud rate is 921.6 kBd.

If you are using a USB to RS232 adaptor cable, you can connect it directly to the evaluation kit RS232 port.

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

Pin Nr.	Assignment
1	not connected
2	TXD, GNSS Transmit Data, serial data to DTE
3	RXD, GNSS Receive Data, serial data from DTE
4	not connected
5	GND
6-9	not connected

Table 4: SUB-D9 Connector pin description

4.3.4 RST button

The RST button on the front panel resets the unit. To avoid an inadvertent reset, the button is recessed.

4.3.5 Safe boot button

This is used to set the unit in safe boot mode. In this mode the receiver executes only the minimal functionality, such as updating new firmware into the SQI flash. In order to set the receiver in safe boot mode please follow these steps.

1. Press the BOOT button and keep holding
2. Press the RST button
3. Release the RST button
4. Release the BOOT button
5. If the UART interface has to be used, the training sequence has to be sent to the receiver. The training sequence is a transmission of 0x55 55 at the baud rate of 9600 Bd. Wait for at least 100 milliseconds before the interface is ready to accept commands.

4.3.6 Slide Switch

Use the slide switch on the front panel to choose between I2C (and RS232) and SPI communication ports. You must reset the unit by pressing the RST button when the slide switch has been changed.

1. I^2C – In this selection the EVK operates with the RS232 (DB9 – rear panel) or the 3.3 V level TxD (MISO), RxD (MOSI) at the front panel. Also the communication via 3.3 V DDC interface (I^2C) is selected.
2. *SPI* – In this selection the EVK operates only with the SPI interface. RS232 (DB9) is switched off.

☞ For more information about specification and usage of SPI interface see the *LEA-M8F Data Sheet* [2] and the *LEA-M8F Hardware Integration Manual* [4].

4.3.7 Test Connector

This 14-pin test-connector provides additional functionality to the EVK, allowing access to the interface pins and an ability to measure the current used by the EVK. All pins are ESD protected.

For accurate measurements, it is recommended to use a cable of at most 1 meter in length. Figure 3 shows an example of a power supply connected to the test connector by using standard adapter cables from the manufacture Hirschmann. Figure 4 shows an example for overall current measurement. When connecting the 3.3 V digital interfaces RS232, SPI and DDC to your application, a cable length less than 25 cm is recommended.
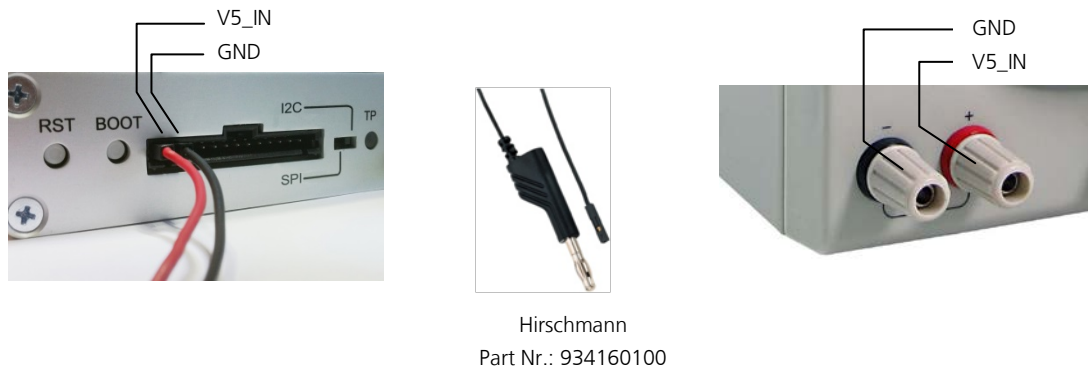

Hirschmann
Part Nr.: 934160100

Figure 3: Example 5V DC power supply

PIN Nr.	PIN NAME	I/O	LEVEL	DESCRIPTION
14	V5 IN	I	4.75 V – 5.25 V	Power input – can be used instead of USB
13	GND	I	-	Common ground pin
12	VCC	O	3.3 V	Power output – max. current supply 100 mA 1Ω 5% resistor for over-all current measurement to pin 11
11	MODVCC	O		Second connection for over-all current measurement (see section 5)
10	VCCRF	O	3.3 V	Filtered VCC supply output for active antennas
9	VANT	I		VCC supply input to supply an active antenna through the RF connector (link to VCCRF with a jumper if required)
8	TIMEPULSE	O	3.3 V	Timepulse output
7	FREQ_PHASE_IN1	I	3.3 V	Frequency/phase measurement input
6	FREQ_PHASE_IN2	I	3.3 V	Frequency/phase measurement input
5	SDA2	I/O	3.3 V	If slide switch on I2C, then DDC interface selected; Function: data input / output If slide switch on SPI, then SPI interface selected; Chip select input – LOW ACTIVE
4	SCL2	I/O	3.3 V	Clock input / output
3	TXD1	O	3.3 V	UART inverted logic-level interface
2	RXD1	I/O	3.3 V	UART inverted logic-level interface
1	GND	I	-	Common ground pin

Table 5: Test connector pin description (pins numbered from right to left on the front panel)

☞ VCC_RF and VANT pins should be fitted with jumper (as shown in front panel of Figure 2) in order to power an active antenna. The jumper is delivered with the EVK-M8F kit as shown in Figure 2.

4.3.8 Timing Interface Connector (EXTENSION)

This 12-pin EXTENSION-connector (J5) provides access to additional signals specific to the time and frequency reference products. Each signal pin has a neighboring ground pin allowing connections to be made readily by short twisted pairs.

The supported interfaces are

- Master interface for a DDC (I^2C compatible) DAC for controlling an additional external voltage-controlled oscillator
- Two frequency/phase measurement inputs for use with external sources of synchronization or for feedback from an external voltage-controlled oscillator
- The timepulse output
- The low-noise disciplined reference frequency output at 30.72 MHz

The pin functions are itemized below.

PIN Nr.	PIN NAME	I/O	LEVEL	DESCRIPTION
12	GND	-	-	Ground pin
11	SCL_DAC	O	3.3 V	DDC master clock for external DAC
10	GND	-	-	Ground pin
9	SDA_DAC	O	3.3 V	DDC master data for external DAC
8	GND	-	-	Ground pin
7	FREQ_PHASE_IN2	I	3.3 V	Frequency/phase measurement input
6	GND	-	-	Ground pin
5	FREQ_PHASE_IN1	I	3.3 V	Frequency/phase measurement input
4	GND	-	-	Ground pin
3	Timepulse	O	3.3 V	Time-pulse output (buffered)
2	GND	-	-	Ground pin
1	FREQ_EXT	O	3.3 V	Low noise 30.72 MHz reference frequency output

Table 6: EXTENSION connector pin description (pins numbered from right to left on the rear panel)

4.3.9 LED

On the front panel of the unit, a single blue LED shows the time pulse signal. Depending on time-pulse output configuration, the LED starts flashing one pulse per second once accurate time has been derived (e.g. from a GNSS fix). In the default configuration the time-pulse and LED return to a static state on expiry of hold-over.

4.3.10 GNSS Configuration

The EVK-M8F supports GPS, QZSS, GLONASS, and BeiDou.

The GNSS to be used can be configured on u-center (View → Messages View then UBX-CFG-GNSS). For more information, refer to the *u-center User Guide* [6] and *u-blox M8 Receiver Description including Protocol Specification* [5].
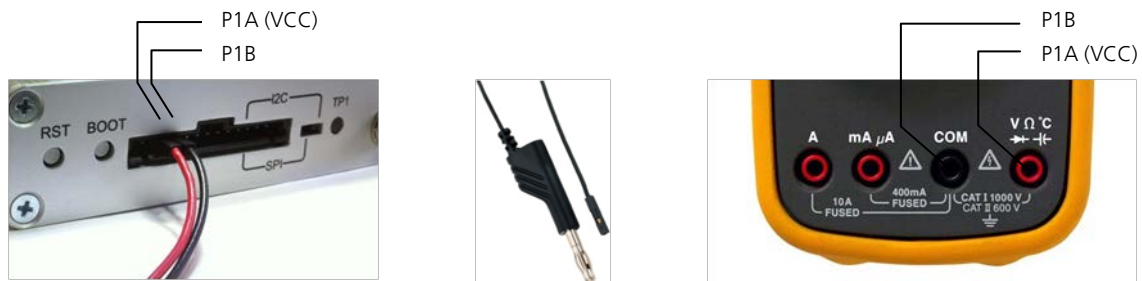
5 Measuring tracking current

To measure the tracking current with EVK-M8F, follow these steps:

1. Connect a voltmeter capable of measuring average current across VCC and MODVCC of the front connector. (see Figure 4)
2. Wait 12 minutes to download all GNSS orbital data, or download all the Aiding Data via the AssistNow Online service
3. Read the voltage (and average if necessary) on the voltmeter and convert to current (1 mV equals 1 mA)
4. Perform the test with good signals and clear sky view to ensure that the receiver can acquire the satellite signals.

☞ The overall current measurement is consistent with the consumption of a LEA-M8F module and representative of designs using 3.3 V Flash and high-performance VCTCXO.

For more details see the circuit in Figure 6.

Hirschmann
Part Nr.: 934160100

Figure 4: Example – tracking current measurement

☞ VCC_RF and VANT pins should be fitted with jumper (as shown in front panel of Figure 2) in order to power an active antenna. The jumper is delivered with the EVK-M8F kit as shown in Figure 2.

6 Board layout

Figure 5 shows the board layout of EVK-M8F-0-00. See Table 7 for the component list of the EVB.
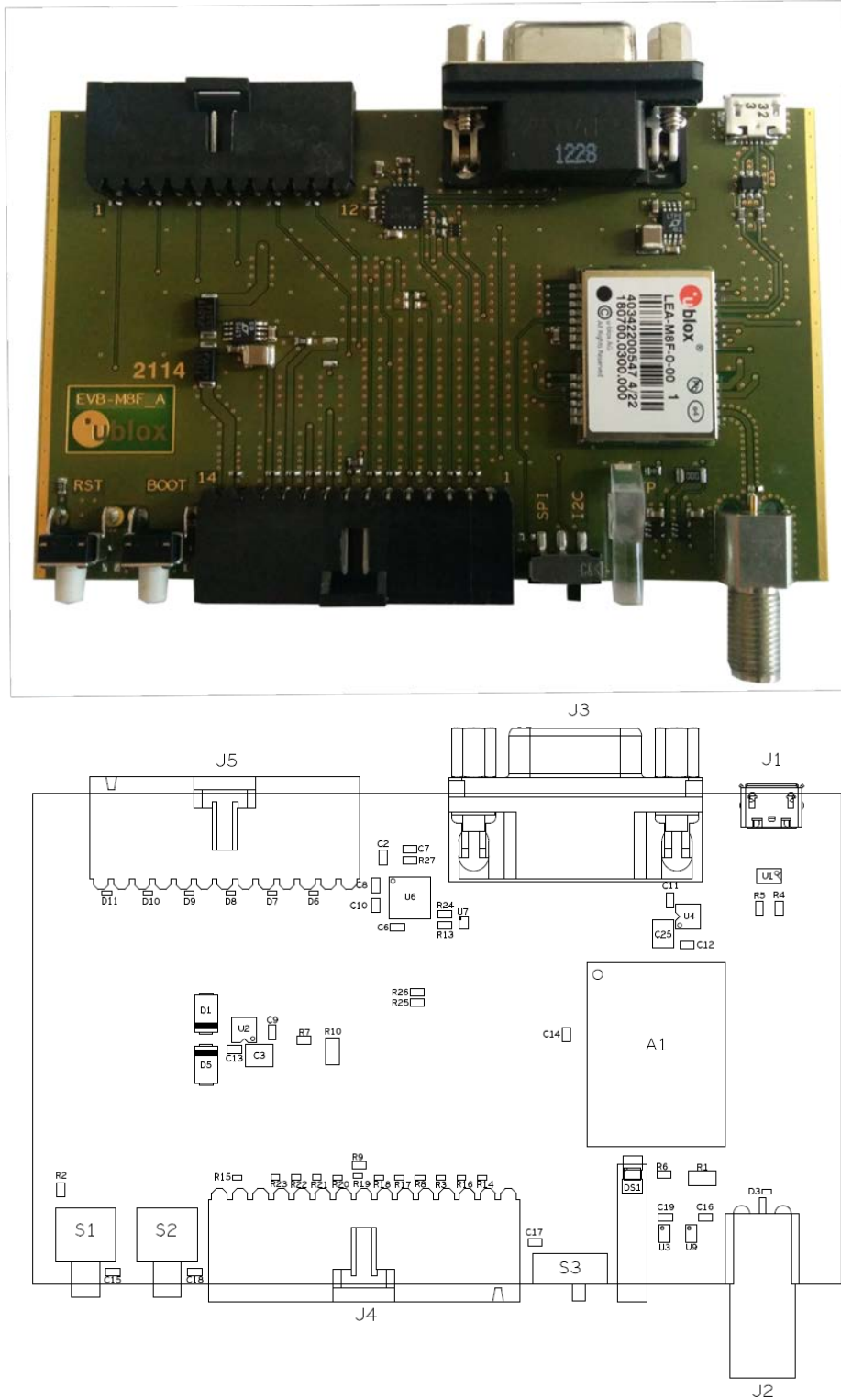

Figure 5: Board layout

| PART	DESCRIPTION
A1	GNSS RECEIVER
C10 C14 C16 C19 C2 C6 C7 C8	CAP CER X7R 0603 100N 10% 10V
C11 C13	CAP CER X5R 0603 1U0 10% 6.3V
C12 C9	CAP CER X7R 0603 10N 10% 25V
C25 C3	CAP CER X5R 1210 10U 10% 10V
D1 D5	SURFACE MOUNT SCHOTTKY BARRIER RECTIFIER SS14 1A -55/+125C
D10 D11 D6 D7 D8 D9 R14 R15 R19 R3 R8	VARISTOR BOURNS MLE SERIES CG0402MLE-18G 18V
D3 R16 R17 R18 R20 R21 R22 R23	ESD PROTECTION FOR HIGH SPEED LINES, TYCO, 0.25PF, PESD0402-140 -55/+125C
DS1	LED OSRAM HYPER MINI TOPLED LB M673-L1N2-35 BLUE 0.02A
J1	CON USB RECEPTACLE MICRO B TYPE SMD – MOLEX 47346-0001 – TID60001597 30V 1A
J2	CON SMA SMD STRAIGHT JACK 11.4MM HEIGHT WITHOUT WASHER AND NUT
J3	9 POLE SUBD CONNECTOR FEMALE
J4	14PIN 90\xB0 2.54MM PITCH DISCONNECTABLE CRIMP CONNECTOR -40/+85C
J5	12PIN 90\xB0 2.54MM PITCH DISCONNECTABLE CRIMP CONNECTOR -40/+85C
R1	RES THICK FILM CHIP 1206 0R 0 2A -55/+125C
R13 R24 R27	RES THICK FILM CHIP 0603 100K 5% 0.1W
R2 R6	RES THICK FILM CHIP 0603 100R 5% 0.1W
R4 R5	RES THICK FILM CHIP 0603 22R 5% 0.1W -55/+125C
R7	RES THICK FILM CHIP 0603 1R0 5% 0.1W
R9	RES THICK FILM CHIP 0603 51R 1% 0.063W
S1 S2	SWITCH SPST ON 1POL TYCO -40/+85C
S3	2 WAY SUB-MINIATURE SLIDE SWITCH SMD JS SERIES – SPDT -40/+85C
U1	USB DATA LINE PROTECTION ST USBLC6-2SC6 SOT23-6
U2 U4	LOW DROPOUT REGULATOR LINEAR LT1962 MS8 3.3V 0.3A
U3 U9	TINY LOGIC UHS BUFFER OE_N ACTIVE LOW FAIRCHILD NC7SZ125 SC70
U6	RS-232 TRANSCEIVER 1MBIT 3-5,5VOLT TRSF3223 – VQFN20 5.5V 5.5V -40/+85C
U7	TINY LOGIC ULP-A 2-INPUT AND GATE 1.45X1.0 6-LEAD MICROPAK -40/+85C

Table 7: EVB-M8F-0-00 component list

7 Schematic
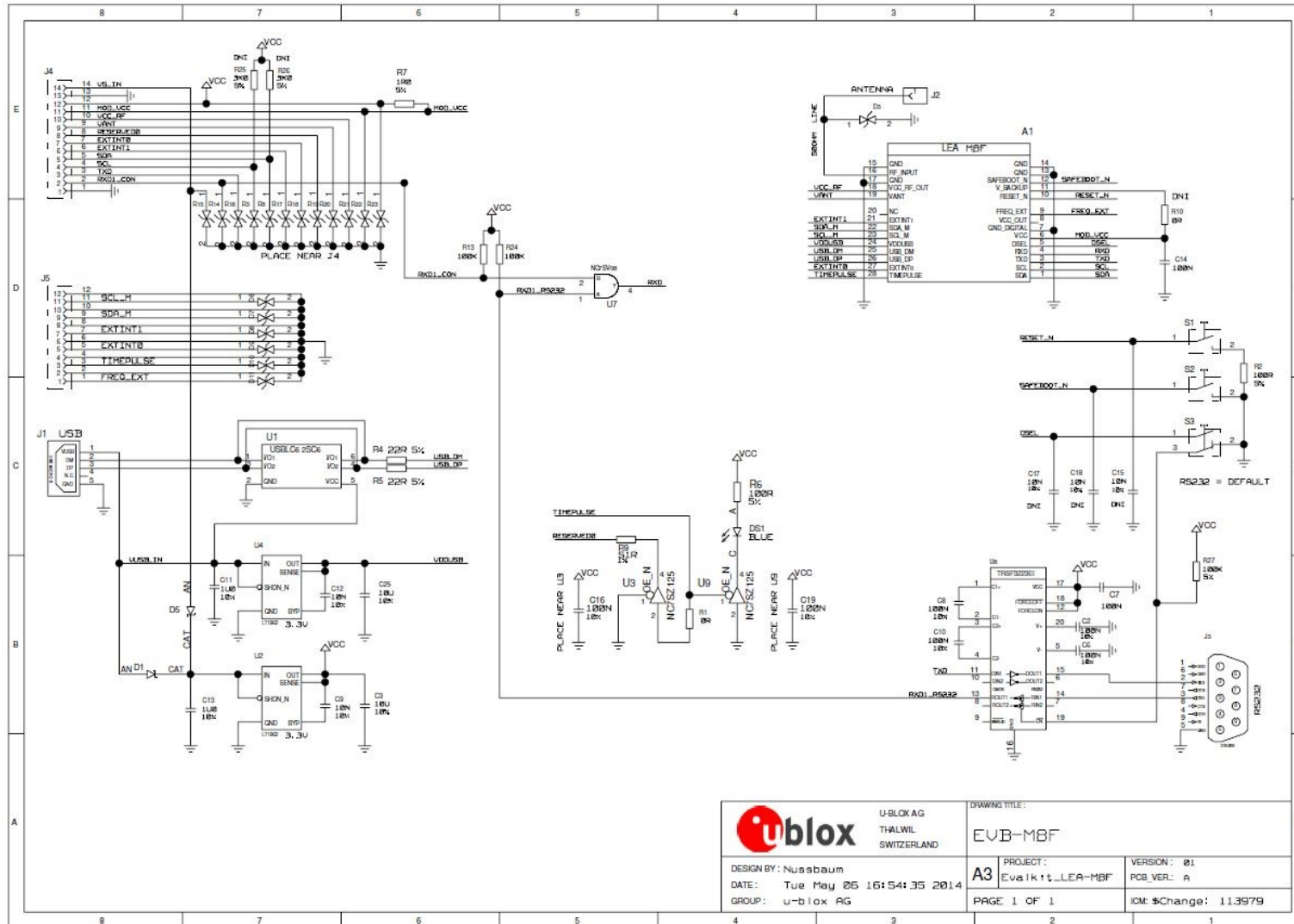
Figure 6: Schematic EVK-M8F-0-00: DNI=TRUE in the schematic means: Component not installed

8 Troubleshooting

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

Check whether the blue LED on the evaluation unit is blinking. Also 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, the GNSS receiver 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 positioning technology 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 panel is set to I2C and not SPI. In SPI Mode the RS232 pins on the DB9 connector are switched off and the RxD and TxD output at the front panel are used for SPI (MISO, MOSI).

NOTE: After changing the slide switch, always reset the EVK, otherwise the change will not take place.

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.

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.

The EVK-M8F 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-M8F does not preserve the configuration in case of reset

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).

The EVK-M8F does not work properly when connected with a GNSS simulator

When using an EVK together with a GNSS simulator, please pay attention to proper handling of the EVK. A GNSS receiver is designed for real-life use, i.e. time is always moving forward. 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 the GPS week rollover to 1200 (as indicated in Figure 7), which corresponds to Jan 2003. Then, issue the Cold Start command before every simulator test to avoid receiver confusion due to the time jumps.
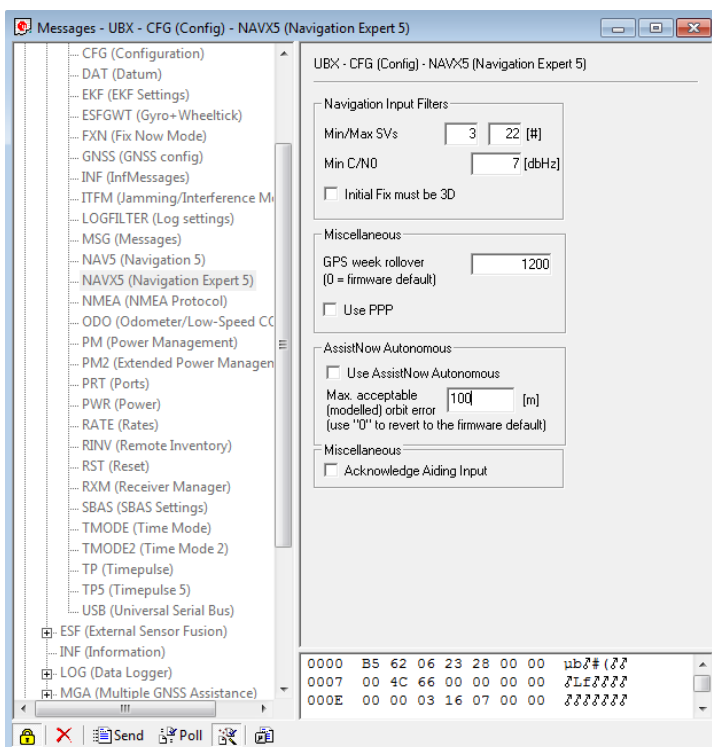

Figure 7: Configuration instruction for using the EVK with a GNSS simulator

The EVK-M8F receives GPS and GLONASS

Use u-center, version 8.11 or newer. Message UBX-CFG-GNSS allows switching on and off the supported GNSS.

9 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; avoid decisions based on unconfirmed numbers from datasheets.

- Try to use identical or at least similar settings when comparing the GNSS performance of different receivers.

- Data, which have 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.

- Momentary measurements cannot be compared directly. GNSS is a non-deterministic system. The satellite constellation changes constantly. Atmospheric effects (particularly at 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) risk 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 the accuracy. One additional satellite can lead to a lower DOP and less position drift.

- When doing reacquisition tests, cover the antenna in order to block the sky view. Do not unplug the antenna since u-blox receivers continuously perform noise calibration on idle channels.

Related documents

[1]   UBX-M8030-KT-FT Data Sheet (NDA version), Docu. No UBX-13005485

[2]   LEA-M8F Data Sheet, Docu. No UBX-14001772

[3]   UBX-M8030-KT-FT Hardware Integration Manual (NDA version), Docu. No UBX-13001708

[4]   LEA-M8F Hardware Integration Manual, Docu. No UBX-14000034

[5]   u-blox M8 Receiver Description including Protocol Specification (Public version), Docu. No UBX-1300322

[6]   u-center – User Guide, Docu. No UBX-13005250

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

Revision history

Revision	Date	Name	Status / Comments
R01	08-Jul- 2014	amil/alnu	Objective Specification
R02	20-Aug-2014	isim	Advance Information. Updated section 1.2 and section 4.3.8 (removed timing interface cable).
R03	07-Oct-2014	julu	Early Production Information
R04	06-Jul-2015	julu	Renamed document as EVK-M8F-0-00 specific

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