GPS/GNSS

EVK-M5Q

u-blox concurrent GNSS Evaluation Kit

User Guide

Abstract

This document describes the structure and use of the EVK-M5Q evaluation kits and provides information for evaluating and testing u-blox concurrent MAX-M5Q GNSS module.

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This document applies to the following products:

Name	Type number	ROM/FLASH version	PCN reference
EVK-M5Q	EVK-M5Q-0-00	FLASH FW320H-UBX.3163	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 GPS/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. CONTROL 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).

u-blox EVK-M5Q evaluation kits are RoHS compliant.

Contents

1 Product description

1.1 Overview

EVK-M5Q Evaluation Kit makes evaluating the high performance of u-blox concurrent MAX-M5Q GNSS modules simple. 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 MAX-M5Q concurrent GNSS Evaluation Kit is compact, and its user friendly interface and power supply make it ideally suited for use in laboratories, vehicles and outdoor locations. Furthermore, it can be used with a PDA or a notebook PC, making it the perfect companion through all stages of design-in projects.

Evaluation Kit	Suitable for
EVK-M5Q: u-blox concurrent GNSS Evaluation Kit with TCXO	MAX-M5Q concurrent GNSS module with TCXO

Table 1: EVK-M5Q evaluation kit

1.2 Kit includes

- Evaluation unit
- USB cable
- Active GPS/GLONASS antenna with 3 m cable
- Extra Battery RENATA CR2450
- Quick Start Guide

1.3 Workbench GPS/GNSS evaluation software

Workbench is recommended as the default evaluation software for EVK-M5Q. The Workbench 5 Installer can be downloaded from the u-blox website http://www.u-blox.com/evk-downloads.html. The installer includes Fastrax Workbench 5 (version 5.22), an interactive tool for configuration, testing, visualization and data analysis of GPS/GNSS receivers. It provides useful assistance during all phases of a system integration project.

Although u-center can be used for MAX-M5Q evaluation as well, the Workbench 5 has a convenient dialog interface for giving MAX-M5Q specific proprietary NMEA commands starting with $PMTK.

1.4 System requirements

• PC with USB interface
• Operating system: Microsoft® Windows 8 (Intel version platform), Windows 7, Windows Vista or Windows XP
• Internet connection (for Windows automatic USB driver installation)

2 Specifications

Parameter	Specification
Serial Interfaces	1 USB V2.0
	1 RS232, max. baud rate 921,6 kBd - DB9: PC compatible - 14-pin connector: 3.3 V level
Dimensions	105 x 64 x 26 mm
Power Supply	5V via USB or external powered via extra power supply pin 14 (V5_IN) 13 (GND)
Normal Operating temperature	-40°C to +65°C
Extended temperature range - only for use with restricted service access	-40°C to +85°C

Table 2: EVK-M5Q specifications

3 Getting Started

3.1 Software installation

☞ Installation of the EVK-M5Q evaluation software requires Internet access.

- Download the Workbench 5 installer and unzip the executable installation software package from the u-blox website http://www.u-blox.com/evk-downloads.html. The installer requires internet access for installing the most up-to-date components on your system; these will be placed under the "Fastrax" folder in the Start → Programs menu.

3.2 Hardware installation

1. Make sure you have internet access when you connect EVK-M5Q to a PC for the first time. (The PC operating system requires this to get the USB driver from the Windows update server.)
2. Connect the unit to a PC running Microsoft Windows by one of these means:
   - USB: Connect via USB port. Set slide switch to USB.
   - UART: Connect via RS232. Set slide switch to RS232.

☞ Press the RST button after changing the switch.

3. The device must always have power, either via USB on the back or the V5_IN input on the front.
4. Connect the GPS/GNSS antenna to the evaluation unit and place the antenna in a location with good sky view.
5. Start the Workbench GPS/GNSS Evaluation Software and select the corresponding COM port and baud rate. (The default baud rate is 115'200 Bd for EVK-M5Q.)

3.3 Serial port default configuration

Parameter	Description
UART Port 1, Input	Proprietary NMEA protocol at 115'200 Bd
UART Port 1, Output	NMEA protocol at 115'200 Bd
USB, Input	Proprietary NMEA protocol
USB, Output	NMEA protocol

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-Mini cable.

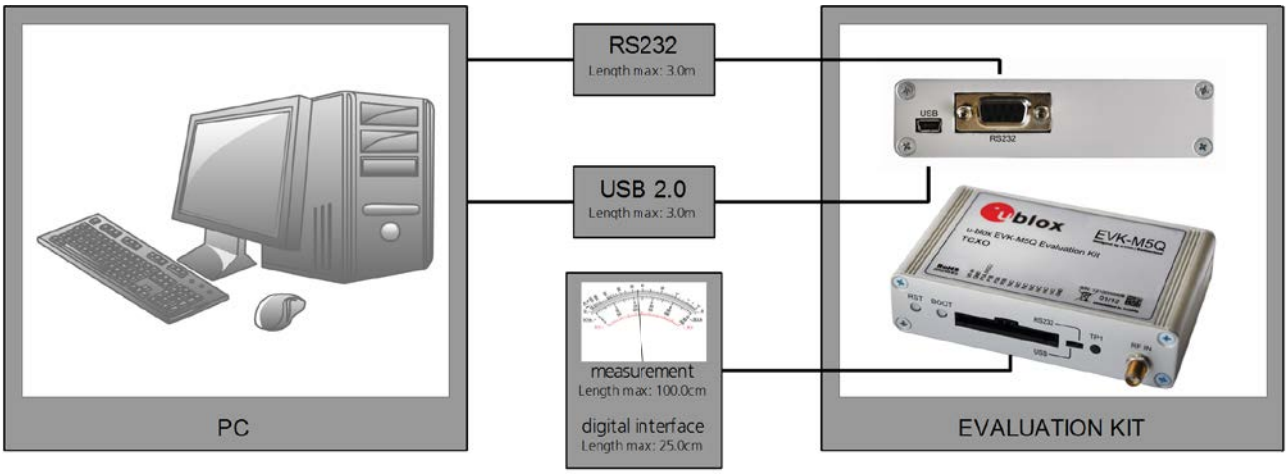


Figure 1: Connecting the unit for power supply and communication

4.2 Active antenna

The EVK-M5Q evaluation kit includes a GPS/GLONASS antenna with a 3 m cable. It is possible to connect various active and passive GPS/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 panel of the EVK-M5Q evaluation unit.

Front panel **Rear panel**

Figure 2: EVK-M5Q evaluation unit - front and rear panels

4.3.1 Antenna connector

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

The connector is only to be used with a GPS/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. In addition to the RS232 communication port, the time pulse 1 signal is available on the DB9 connector (Pin 1; 6).

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. Serial data rates are configurable from 4,800 baud to 921,600 baud by using the proprietary PMTK251command. For more information, refer to the *MAX-M5Q Receiver Description including Protocol Specification* [3].

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	GPS/GNSS time pulse output
2	TXD, GPS/GNSS Transmit Data, serial data to DTE
3	RXD, GPS/GNSS Receive Data, serial data from DTE
4	not connected
5	GND
6	GPS/GNSS time pulse output
7-9	not connected

Table 4: SUB-D9 Connector pin description for EVK-M5Q

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

Safe boot mode is not supported by EVK-M5Q evaluation kit.

4.3.6 Slide Switch

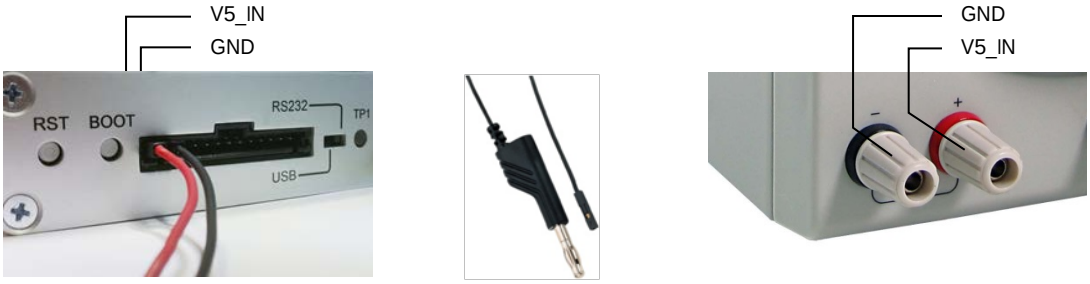
Use the slide switch on the front panel to choose between RS232 and USB communication ports. You must reset the unit by pressing the RST button when the slide switch has been changed.

1. *RS232* – In this selection the EVK operates with the RS232 (DB9 – rear panel).
2. *USB* – In this selection the EVK operates only with the USB interface. RS232 (DB9) is switched off.

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 to connect a power supply to the test connector by using standard adapter cables from the manufacture Hirschmann. Figure 4 shows an example for over all current measurement.



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	P1A (VCC)	O	3.3 V	Power output – max. current supply 100 mA 1Ω 1% resistor for over-all current measurement to pin 11 (P1B) *NOTE: the current includes also SQI Flash, LNA*
11	P1B	O		second connection for over-all current measurement (see Figure 5)
10	P2A	O	3.0 V	battery output (unloaded) 100 Ω 1% resistor for battery backup current measurement to pin 9 (P2B) *NOTE: There is a current protection to 3 mA. See circuit in figure 7 (D2, D4, R29)*
9	P2B	O		second junction for battery backup current measurement
8	NC	-	-	not connected
7	NC	-	-	not connected
6	NC	-	-	not connected
5	NC	-	-	not connected
4	NC	-	-	not connected
3	NC	-	-	not connected
2	NC	-	-	not connected
1	GND	I	-	common ground pin

Table 5: Connector pin description for EVK-M5Q

4.3.8 LED

On the front panel of the unit a single blue LED shows the time pulse 1 signal. The LED starts flashing one pulse per second during a GPS/GNSS fix. If there is no GPS/GNSS fix, the LED will only light, without flashing.

4.3.9 Backup Battery

There is a backup battery in the unit. This is necessary to store orbital information between operations and to enable faster start-up. It is a RENATA 3.0 V Li / MnO^2 battery of the type CR2450. The battery has a rated capacity of 540 mAh. The operating temperature range is -40° C to +85° C.

CAUTION! RISK OF EXPLOSION IF BATTERY IS REPLACED BY AN INCORRECT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO THE INSTRUCTIONS!

4.3.10 GNSS Configuration

Multi-GNSS EVK-M5Q evaluation kit supports GPS, GLONASS, Galileo (by future firmware update) and QZSS. Default operation mode of EVK-M5Q is parallel GPS/GLONASS. The GNSS operation modes can be configured

on Workbench by proprietary PMTK353 commands (e.g. change to GPS only or GLONASS only operation mode). For more information, refer to the *MAX-M5Q Receiver Description including Protocol Specification* [3].

5 Measuring tracking current

To measure the tracking current with EVK-M5Q, follow these steps:

1. Connect a true rms multimeter across P1A (VCC) and P1B of the front connector. (see Table 4)
2. Wait 12 minutes to download all GPS/GNSS orbital data.
3. Read the voltage (and average if necessary) on the multimeter 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 also includes the internal SQI flash.

For more details see the circuit in Figure 7.

Figure 4: Example – tracking current measurement

6 Testing Power Save Mode

u-blox MAX-M5Q technology offers a power-optimized architecture with built-in autonomous power saving functions to minimize power consumption at any given time. Supported Power Save Modes are Standby, Periodic and AlwaysLocate™.

☞ For more information about EVK-M5Q Power Save Modes and relevant PMTK commands for power management, see *MAX-M5Q Data Sheet* [1] and *MAX-M5Q Receiver Description including Protocol Specification* [3].

When testing Power Save Modes with EVK-M5Q, pay attention to the following points:

- The MAX-M5Q module can control the embedded VCC power switch autonomously only after the MAX-M5Q is set to Periodic or to AlwaysLocate™ mode by a PMTK command.
- The first fix position accuracy can be somewhat degraded in Power Save Modes when compared to Full Power operation. The user can improve the position accuracy by taking the 2nd or 3rd fix after waking up.
- The user can exit low power modes to Full Power by sending a PMTK command just after the module wakes up from its previous sleep cycle.

7 Block diagram

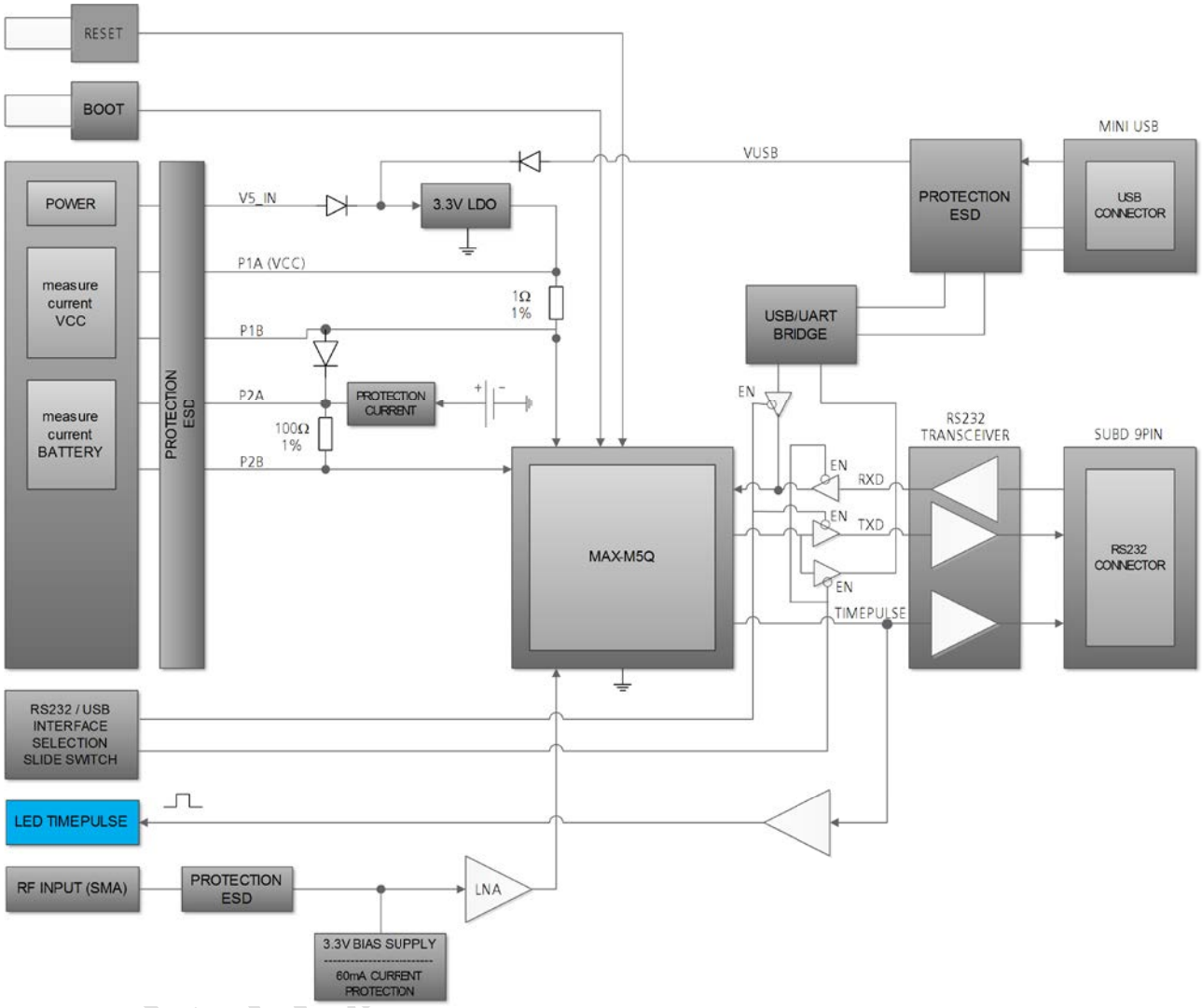


Figure 5: EVK-M5Q block diagram

8 Board layout

Figure 6 shows the EVK-M5Q board layout – the EVB-M5Q. See Table 6 for the component list of the EVB-M5Q.

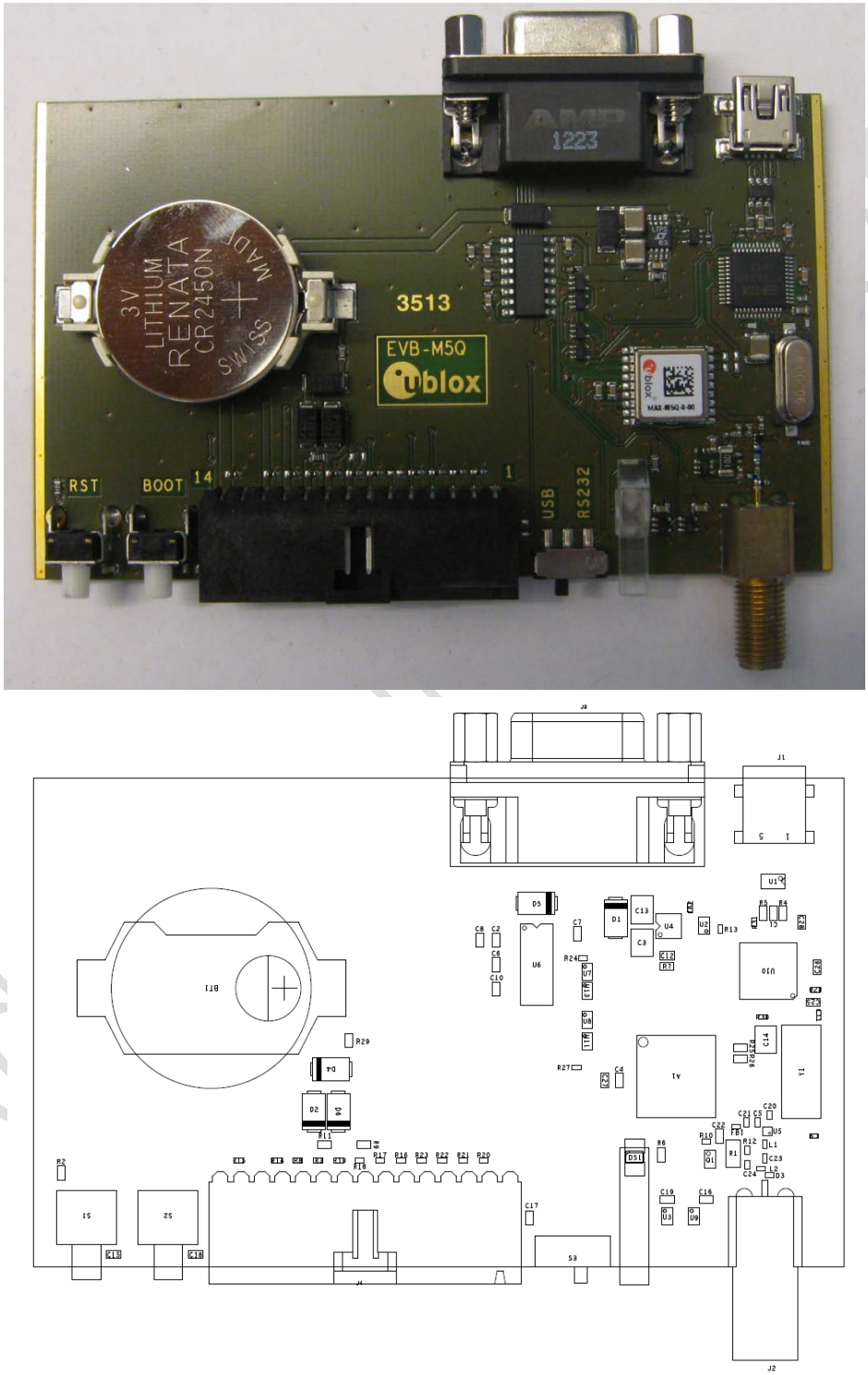


Figure 6: EVB-M5Q layout

PART	DESCRIPTION
A1	Multi-GNSS RECEIVER U-BLOX MAX-M5Q-0 -40/+85° C
BT1	BATTERY HOLDER RENATA CR2450N 3 V
C1 C16 C19 C25 C28 C7	CAP CER X7R 0603 100N 10% 10 V
C10 C2 C22 C6 C8	CAP CER X5R 0603 1U0 10% 6.3 V
C11 C9	CAP CER COG 0402 27P 5% 25 V
C12 C15	CAP CER X7R 0603 10N 10% 10 V
C13 C14 C3	CAP CER X5R 1210 10U 10% 10 V
C20	CAP CER COG 0402 1P8 +/-0.1P 25 V
C21	CAP CER COG 0402 22P 5% 25 V
C23	CAP CER COG 0402 47P 5% 25 V
C24	CAP CER X5R 0402 100N 10% 10 V
C26	CAP CER X7R 0603 33N 10% 25 V
C27 C4	CAP CER X5R 0603 4U7 10% 6.3 V
C5	CAP CER X7R 0402 1N0 10% 16 V
D1 D2 D4 D5 D6	SURFACE MOUNT SCHOTTKY BARRIER RECTIFIER SS14 1A -55/+125° C
D3 R17 R18 R20 R21 R22 R23	ESD PROTECTION FOR HIGH SPEED LINES, TYCO, 0.25PF, PESD0402-140 -55/+125° C
DS1	LED OSRAM HYPER MINI TOPLED LB M673-L1N2-35 BLUE 0.02 A
FB1 FB2	FERRITE BEAD MURATA BLM15HD 0402 1000R@100 MHZ
J1	CON MINI USB RECEPTABLE B TYPE SMD CERTIFIED -40/+85° C
J2	CON SMA SMD STRAIGHT JACK 11.4 MM HEIGHT WITHOUT WASHER AND NUT
J3	9 POLE SUBD CONNECTOR FEMALE
J4	14PIN 90DEGREE 2.54MM PITCH DISCONNECTABLE CRIMP CONNECTOR -40/+85° C
L1	IND MURATA LQW15A 0402 8N7 3% 0.54A -55/+125° C
L2	IND MURATA LQW15A 0402 120N 5% 0.64A -55/+125° C
Q1	MBT3906DW1T1G DUAL GENERAL PURPOSE TRANSISTOR 0.2A 0.15W -40/+125° C
R1	RES THICK FILM CHIP 1206 10R 5% 0.25 W
R10	RES THICK FILM CHIP 0402 220R 5% 0.1 W
R11 R2 R6	RES THICK FILM CHIP 0603 100R 5% 0.1 W
R12	RES THICK FILM CHIP 0402 2K2 5% 0.1 W
R13	RES THICK FILM CHIP 0402 10K 5% 0.1 W
R14 R15 R19 R3 R8	VARISTOR BOURNS MLE SERIES CG0402MLE-18G 18 V
R24 R27	RES THICK FILM CHIP 0402 100K 5% 0.1 W
R28	RES THICK FILM CHIP 0402 10K 1% 0.063 W
R29	RES THICK FILM CHIP 0603 1K0 5% 0.1 W
R30	RES THICK FILM CHIP 0402 470R 5% 0.1 W
R31	RES THICK FILM CHIP 0402 1K5 5% 0.1 W
R4 R5	RES THICK FILM CHIP 0603 27R 5% 0.1 W
R7	RES THICK FILM CHIP 0603 1R0 5% 0.1 W
S1 S2	SWITCH SPST ON 1POL TYCO 40/+85° C
S3	2 WAY SUB-MINIATURE SLIDE SWITCH SMD JS SERIES – SPDT -40/+85° C
U1	USB DATA LINE PROTECTION ST USBLC6-2SC6 SOT23-6
U10	DUAL USB TO SERIAL BRIDGE CONTROLLER FT2232D
U11 U13 U2 U3 U7 U8 U9	TINY LOGIC UHS BUFFER OE_N ACTIVE LOW FAIRCHILD NC7SZ125 SC70

U4	LOW DROPOUT REGULATOR LINEAR LT1962 MS8 3.3V 0.3 A
U5	LOW NOISE AMPLIFIER GAAS MMIC 1.575 GHZ 1.5V-3.6V JRC EPFFP6-A2 3.6V -40/+85° C
U6	RS-232 TRANSCEIVER MAXIM MAX3232 SO16 -40/+85° C
Y1	CRYSTAL CL=18PF CITIZEN HCM49 6.0000MHZ 50PPM

Table 6: EVB-M5Q component list

9 Schematic

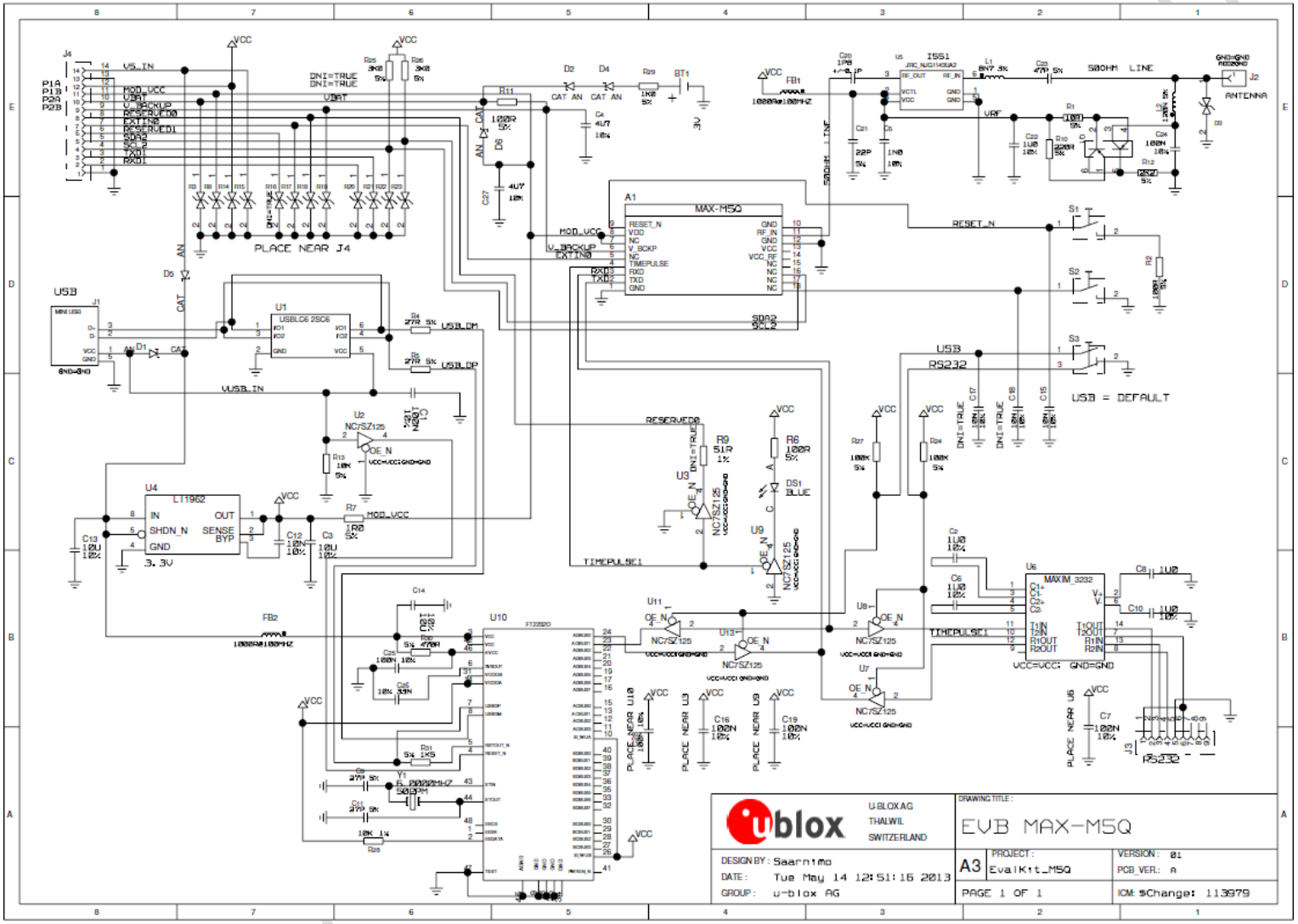


Figure 7: Schematic EVK-M5Q: DNI=TRUE in the schematic means: Component not installed

10 Battery replacement

To replace the battery (Number 5 in Figure 8), open the unit (unscrew four screws on the front panel).

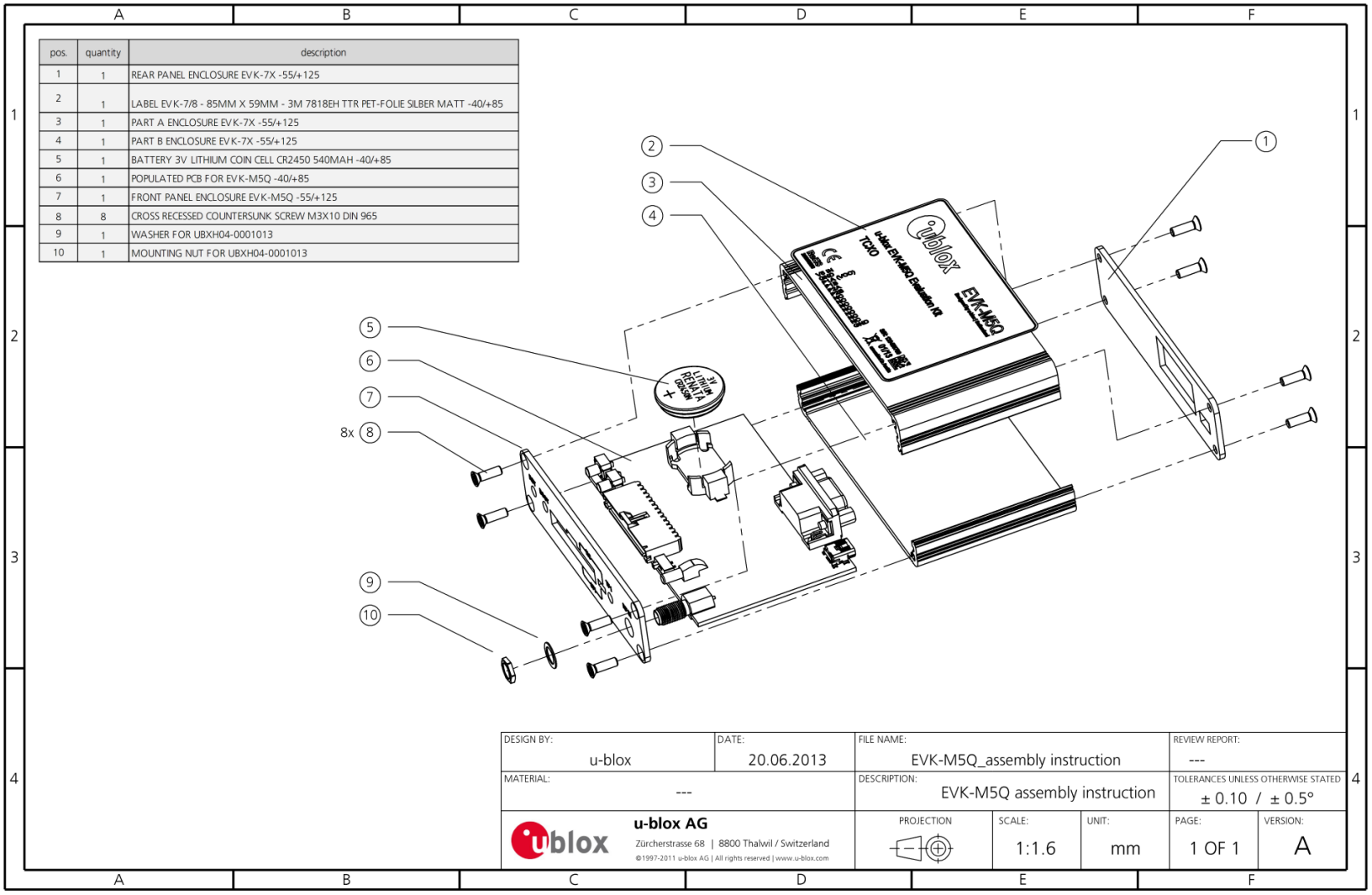


Figure 8: EVK-M5Q battery location

11 Troubleshooting

My application (e.g. Workbench) does not receive anything

Check if the blue LED on the evaluation unit lights up and make sure the USB cable is properly connected to the evaluation unit and the PC. Start Workbench, press connect icon and try automatic port and baud rate settings. You may also try to figure out which virtual serial port number is issued with the USB driver from Windows (Device manager/Ports). By default, the evaluation unit outputs NMEA protocol on Serial Port at 115200 Bd, or on the USB.

My application (e.g. Workbench) does not receive all messages

When using UART, make sure the baud rate is sufficient. If the baud rate is insufficient, GPS/GNSS receivers based on u-blox MAX-M5Q GPS/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 Workbench receives a message, the message will be discarded.

My application (e.g. Workbench) loses the connection to the GPS/GNSS receiver

The connection is lost e.g. during Power save modes when the module enters sleep state. Wait until the module wakes up.

The COM port does not send any messages

Be sure that the slide switch at the front panel is set to RS232 and not USB. In USB Mode the RS232 pins on the DB9 connector are switched off.

☞ 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. Workbench)

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 MAX-M5Q GPS/GNSS technology starts up with the WGS84 standard GPS/GNSS datum. If your application expects a different datum, you'll most likely find the positions to be off by a few dozen meters.

TTFF times at startup are much longer than specified

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

The EVK-M5Q 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.

My configuration of EVK-M5Q is lost

EVK-M5Q does not preserve the configuration in case of backup battery is empty or removed. Replace the battery.

EVK-M5Q receives GPS and GLONASS, GPS only and GLONASS only?

Use Workbench, version 5.22. Command PMTK353 allows configuration of different operation modes.

☞ For more information about relevant PMTK commands, see *MAX-M5Q Receiver Description including Protocol Specification* [3]

12 Common evaluation pitfalls

- Parameter may have the same name but a different definition. GPS/GNSS receivers may have a similar size, price and power consumption but can still have different functionalities (e.g. no support for passive antennas, different temperature range). Also, the definitions of hot, warm, and cold start times may differ between suppliers.
- Verify design-critical parameters; do not base a decision on unconfirmed numbers from datasheets.
- Try to use identical or at least similar settings when comparing the GPS/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. GPS/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 GPS/GNSS/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 the accuracy. One additional satellite can lead to a lower DOP and less position drift.

Related documents

[1] MAX-M5Q Data Sheet, Docu. No UBX-130024951
[2] MAX-M5Q Hardware Integration Manual, Docu. No UBX-13002460
[3] MAX-M5Q Receiver Description including Protocol Specification, Docu. No UBX-13002496

Revision history

Revision	Date	Name	Status / Comments
R01	30-Sep-2013	julu	Objective Specification
R02	13-Nov-2013	julu	Advance Information, Updated layout in cover page and page 2.

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