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EVK-F9T-20 User guide

Evaluation kit

User guide

Abstract

This document describes the structure and use of the EVK-F9T evaluation kit and provides information for evaluating and testing u-blox F9 positioning technology for timing and raw data applications.

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1 Product description

1.1 Overview

The EVK-F9T evaluation kit simplifies the evaluation of the high-performance u-blox F9 Timing products. 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, vehicles, and outdoor locations. Furthermore, they can be used with a notebook PC, making them the perfect companion through all stages of design-in projects.

Evaluation Kit	Description	Suitable for
EVK-F9T	u-blox F9 high accuracy timing module with L1/L2/L5/E5a bands	ZED-F9T-20B, LEA-F9T-10B, LEA-F9T-20B

Table 1: List of products supported by EVK-F9T evaluation kit

1.2 Kit contents

The delivered package contains:

- Compact EVK-F9T evaluation unit
- Micro USB cable
- ANN-MB2 all-band (L1/L2/L5/E6/B3/L) active GNSS antenna with 5 m cable
- EVK Welcome card

1.3 Software and documentation

The product evaluation software and documentation are available on the u-blox website.

1.3.1 u-center GNSS evaluation software

u-center evaluation software 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. Use the latest version of u-center.

1.4 System requirements

- PC with USB interface (compatible with USB 2.0)
- Operating system: Microsoft Windows 7 onwards (x86 and x64 versions)
- Internet connection for the first time use

2 Specifications

Parameter	Specification
Serial interfaces	1 micro–USB V2.0
	1 RS232, max baud rate 921,6 kBd DB9 +/- 12 V level 14 pin, 3.3 V logic
	1 DDC (I2C compatible) max 400 kHz
	1 SPI – clock signal max 5,5 MHz – SPI DATA max 1 Mbit/s
Timing interfaces	2 time pulse outputs through main connector PINs
	1 time pulse output through SMA
	1 time pulse output through RS232
	2 external interrupt inputs
Dimensions	105 x 64 x 26 mm
Power supply	5 V via USB or powered via external power supply pin 14 (V5_IN) and pin 13 (GND)
Normal operating temperature	-40 °C to +65 °C

Table 2: EVK-F9T specifications

2.1 Safety precautions

EVK-F9T must be supplied by a PS1 class limited power source. See section 6.2.2.4 of IEC 62368-1:2018 [5] 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-F9T, include interfaces and antennas. See section 5.2.1.1 of IEC 62368-1:2018 [5] for more information on the ES1 class.

2.1.1 Certifications

EVK-F9T is designed to comply with the essential requirements and other relevant provisions of Radio Equipment Directive (RED) 2014/53/EU.

EVK-F9T complies with the Directive 2011/65/EU (EU RoHS 2) and its amendment Directive (EU) 2015/863 (EU RoHS 3).

Declaration of Conformity (DoC) is available on the u-blox website.

3 Device description

3.1 Interface connection and measurement

EVK-F9T supports several communication interfaces, including USB and UART. To connect the EVK to a PC, use the included Micro-USB cable. Alternatively, a standard SUBD-9 cable can also be used. Additional measurement equipment and devices can be connected to the 14-pin connector on the front side of the EVK unit. The EVK design allows the front side pins to be used simultaneously with other ports.

☞ Do not drive any of the IO pins when the EVK is not connected to the power supply.

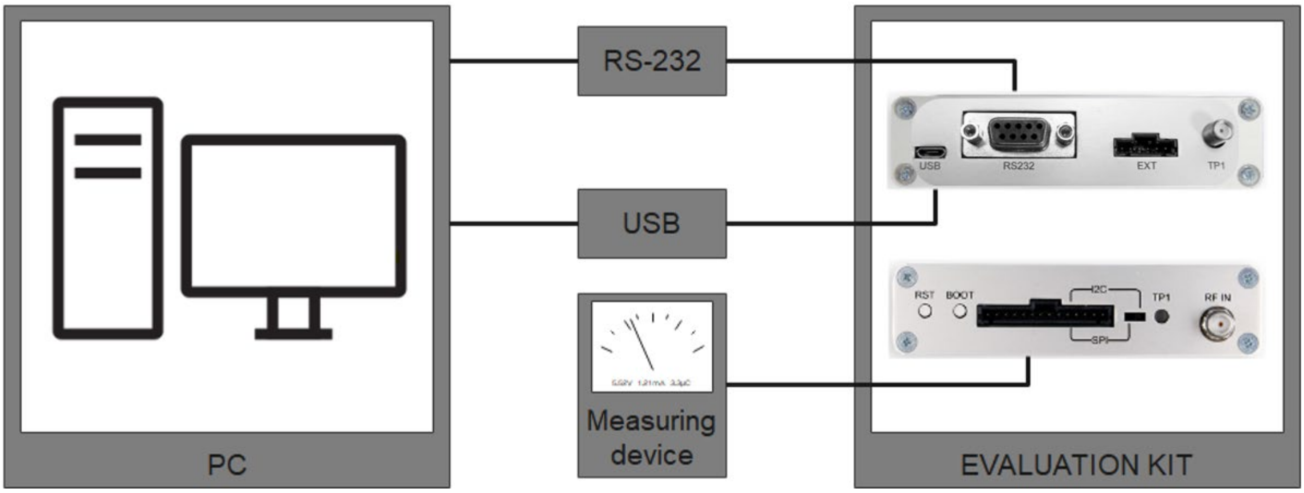

Figure 1: Connecting the unit for power supply and communication

3.2 Active antenna

The EVK-F9T evaluation kit includes an ANN-MB2 all-band (L1/L2/L5/E6/B3/L) active GNSS antenna with a 5-meter cable and an SMA connector.

Typical DC current consumption of the ANN-MB2 antenna is 15mA at 5V.

3.3 Evaluation unit

Figure 2 shows the front and the rear panels of the EVK-F9T evaluation unit. The front panel provides reset and safe boot buttons (RST and BOOT), 14-pin connector, slide switch, LED(TP1) and antenna connector (RF IN), while the rear panel provides micro-USB, DB9 (RS232), 6-pin connector (EXT) and a Time pulse connector (TP1).

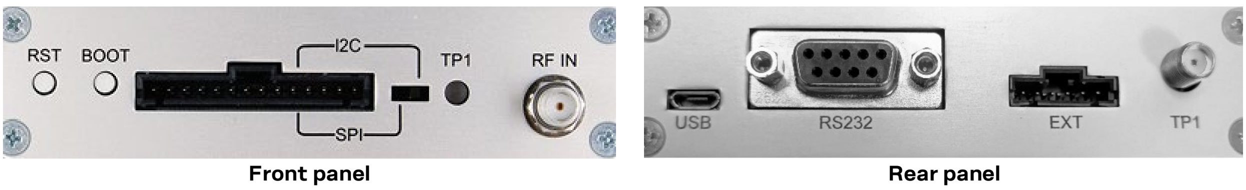

Figure 2: EVK-F9T evaluation unit front and rear panels

3.3.1 Antenna connector (RF IN)

⚠ **CAUTION** Risk of equipment damage. Connecting this equipment to cable distribution systems may damage the EVK. Use the connector only with a GNSS antenna or a GNSS simulator.

An SMA female jack is available on the front side of the evaluation unit for connecting an active GNSS antenna (see Figure 2). A DC voltage of 3.3 V is provided to power the active antenna. The internal short circuit protection limits the maximum current to 60 mA. This pin is also ESD protected.

3.3.2 USB connector

A USB v2.0 compatible serial port is featured for data communication and power supply. For the receiver configuration details, see the Interface description [2].

3.3.3 DB9 connector (RS232)

The evaluation unit includes an RS-232 serial communication port which is compatible with PC serial ports.

Connect a straight RS-232 serial cable with male and female connectors to the port on your PC. The maximum cable length is 3 meters. To configure the RS-232 port, use the CFG-UART1 command in the u-center application. The maximum operating baud rate is 921.6 kBaud. If you are using a USB to RS-232 adaptor cable, you can connect it directly to the evaluation kit RS-232 port.

The 9-pin D-SUB female connector is assigned as listed in Table 3:

Pin Nr.	Assignment
1	Time pulse 1 output (RS-232 levels)
2	TXD, GNSS Transmit Data, serial data to DTE
3	RXD, GNSS Receive Data, serial data from DTE
4	Optional time-mark input (RS-232 levels) using EXTINT0 (internal jumper J6 fitment required)
5	GND
6	Time pulse 1 output (RS-232 levels)
7	Not connected
8, 9	Not connected

Table 3: SUB-D9 connector pin description for EVK-F9T

3.3.4 UART1 through 14-pin connector

The EVK also provides UART1 communication through the 14-pin connector on TxD and RxD pins. See section 14-pin connector for more information.

3.3.5 Reset button

The reset button (RST) on the front panel resets the unit.

⚠ **CAUTION** Risk of data loss. The RST button deletes all information from the volatile memory and triggers a cold start. Reset the system only as a recovery option.

3.3.6 Safe boot button

The safe boot button (BOOT) is used to set the unit in safe boot mode. In this mode, the receiver executes only minimal functionality, such as updating new firmware into the flash memory. To set the receiver in safe boot mode:

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

3.3.7 Slide switch

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

1. **I2C** – In this selection, the EVK operates with the 3.3 V DDC interface (I2C compatible) with the UART (TxD and RxD) via the front panel and the UART1 via the RS-232 (DB9 port).
2. **SPI** – In this selection, the EVK operates only with the SPI interface while the UART communication via front panel (TxD and RxD) and the RS-232 (DB9) port is disabled.

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

3.3.8 14-pin connector

This 14-pin connector provides additional functionality to the EVK, allowing access to the interface pins and an ability to measure the current used by the ZED-F9T module. All pins are ESD protected.

Pin no.	Name	I/O	Level	Description
14	V5_IN	I	4.75 - 5.25 V	Power input. This can be used instead of USB
13	GND	-	-	Common ground pin
12	CUR GPS1	O	5.0 V	Supply current measurement (Module current consumption) node 1. Current is measured over a 1Ω 1% tolerance resistor between pins 12 and 11. Pin 12 (CUR_GPS1) is at higher potential.
11	CUR GPS2	O	5.0 V	Supply current measurement (Module current consumption) node 2. See description for pin 12.
10	NC	-	-	Reserved (the pin is reserved for floating, and the customer should not connect any input to the pin)
9	EXTINT2	O		External interrupt 2 or time-mark 2 input (connected directly to the module pins)
8	TP1	O	3.3V	Output signal for the timepulse1 signal
7	EXTINT	I	3.3 V	External interrupt or time-mark input (connected directly to the module pins)
6	TP2	O	3.3 V	Output signal for the timepulse2 signal
5	SDA / CS	I/O	3.3 V	If slide switch on I2C, the DDC interface is selected; Function: data input / output If slide switch on SPI, the SPI interface is selected; chip select input – LOW ACTIVE
4	SCL / SCK	I/O	3.3 V	Clock input / output (signals are pulled up and then straight to the module)
3	TxD / SDO[1]	I/O	3.3 V	If slide switch on I2C, the DDC interface is selected / UART TxD (3.3 V level) If slide switch on SPI, the SPI interface is selected; Serial Data Out (SDO)
2	RxD / SDI[1]	I/O	3.3 V	If slide switch on I2C, the DDC interface is selected / UART RxD (3.3V Level) If slide switch on SPI, the SPI interface is selected; Serial Data In (SDI)
1	GND	-	-	Common ground pin

Table 4: Connector pin description for EVK-F9T (pins numbered from right to left on the front panel)

For power supply, use a max 1m cable. Figure 3 shows an example of a power supply connected to the test connector by using standard adapter cables from the manufacturer Hirschmann. Table 4 shows an example for overall current measurement. When connecting the 3.3 V UART, SPI and DDC digital interfaces to your application, use a maximally 25 cm long cable.

[1] The signal names and related terms have been replaced with new terminology in this document.

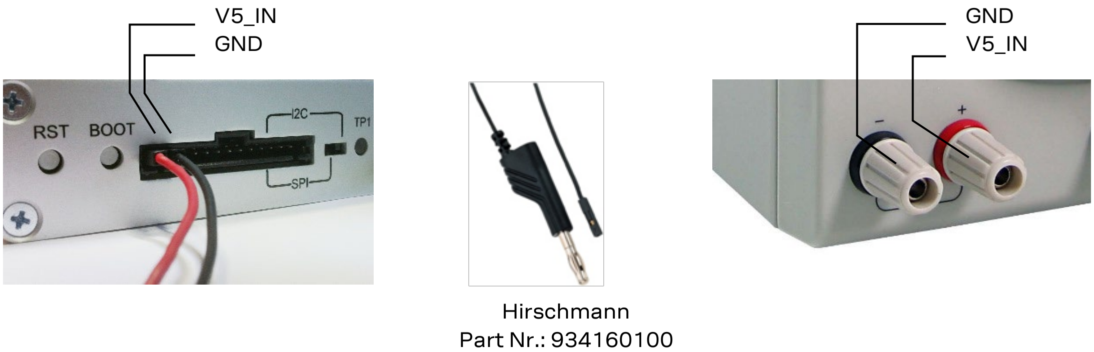

Figure 3: EVK-F9T 5.0V DC power supply example

3.3.9 LED (TP1)

On the front panel of the EVK unit, a single blue LED shows the time pulse 1 signal. In the default configuration, the time pulse LED has following functionality:

LED	Description
Solid blue LED	The device is powered on with no GNSS fix.
Flashing blue LED	The LED flashes one pulse per second during a GNSS fix.

Table 5: LED description

The time pulse signal is configurable, see the Interface description[2] for details.

3.3.10 Time pulse connector (TP1)

The evaluation board includes a time pulse function providing clock pulses with a configurable pulse period, pulse length and polarity (rising or falling edge). Check the ZED-F9T Data sheet [1] for detailed specifications of configurable values.

An SMA female jack is available on the rear side (see Figure 2) of the evaluation unit which provides a buffered timepulse1 signal for driving laboratory equipment.

☞ J7 jumper can be shorted to allow higher output current when driving low impedance loads. User must open the evaluation kit to access the J7 jumper as shown in Figure 4.

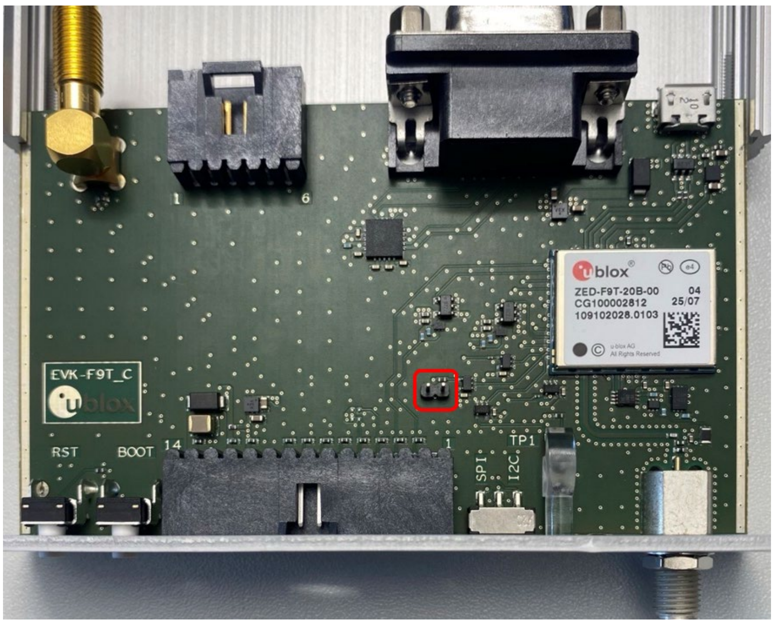

Figure 4 EVK-F9T-20 evaluation unit PCB layout

3.3.11 EXT connector

This is a 6-pin connector in which pin 2 is connected directly to the GEOFENCE_STAT signal. Pin 4 and pin 5 are connected directly from RXD2 and TXD2 of the module, respectively. TXD2 and RXD2 (UART2) can be used for correction data and NMEA messages. Pins 3 and 6 are connected to GND.

☞ Geofence support has been removed in TIM 2.25.

Pin Nr.	Assignment
1	Common ground pin
2	GEOFENCE_STAT
3	GND
4	RXD2
5	TXD2
6	GND

Table 6: EXT connector pin details

4 Getting started

4.1 u-center installation

u-center, the u-blox interactive evaluation software tool is required for configuration, testing, visualization and data analysis of u-blox GNSS receivers as well as EVKs. The EVK user guide together with the u-center evaluation tool provide useful assistance during all phases of a system integration project. To install the u-center evaluation software tool, follow the steps available on www.u-blox.com/product/u-center. For more information on how to use the u-center evaluation software tool, refer to the u-center user guide [4].

The required Microsoft driver for Windows 10/11 USB interface is available from the Microsoft Windows Update service. The Windows system driver search mechanism downloads and installs the USB driver automatically from the Microsoft Windows Update service. To evaluate with the Windows 7 and 8 operating systems, the u-blox GNSS standard driver (x64bit) is needed which can be found in the u-center package.

4.2 Installing hardware

⚠ **CAUTION** Changing the slide switch position while the EVK is powered on may damage the GNSS receiver chip. Power off the EVK before changing the slide switch setting.

1. Before connecting the interface cable to the EVK, select the interface that you are using by sliding the interface switch to the correct position:
   - Slide the switch to I2C to use UART1 via RS-232 and I2C complaint DDC interface.
   - Slide the switch to SPI to use the SPI interface.
   - The micro-USB interface is independent from the slide switch.
2. Connect the corresponding interface pin on the 14-pin connector (see Table 4 for details).
3. Power the device on, either via USB on the back or through the 5V_IN input on the front of the EVK.
4. Connect the GNSS antenna to the RF_IN SMA jack and place the antenna in a good sky view.
5. Start the u-center evaluation tool and select the corresponding COM port and baud rate.

☞ Refer to the u-center User Guide [4] for more information.

4.3 Default interface settings

Parameter	Description
UART Port 1, input	38400 baud, 8 bits, no parity bit, 1 stop bit. UBX, NMEA and RTCM 3.3 input protocols are enabled by default.
UART Port 1, output	38400 baud, 8 bits, no parity bit, 1 stop bit. NMEA protocol with **GGA, GLL, GSA, GSV, RMC, VTG, TXT, ZDA** messages are output by default. UBX and RTCM 3.3 protocols are enabled by default, but no output messages are enabled by default.
USB	Default messages activated as in UART1. Input/output protocols available as in UART1.
I2C	Compatible with the I2C industry standard, available for communication with an external host CPU or u-blox cellular modules, operated in peripheral mode only. Default messages activated as in UART1. Input/output protocols available as in UART1. Maximum bit rate 400 kb/s.
SPI	Allow communication to a host CPU, operated in peripheral mode only. Default messages activated as in UART1. Input/output protocols available as in UART1. SPI is not available unless D_SEL pin is set to low.

Table 6: Default configuration

☞ Refer to the ZED-F9T Integration manual [3] for more information.

5 Measuring current

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

To measure the total GNSS supply current with EVK-F9T, follow these steps:

1. Place the antenna connected to the EVK in clear sky view and perform the test with good signals to ensure that the receiver can acquire the satellite signals.
2. Power up EVK-F9T.
3. Connect a true RMS voltmeter across CUR GPS1 (pin 12) and CUR GPS2 (pin 11) of the 14-pin connector.
4. Read the voltage (and average if necessary) on the voltmeter and convert it to current (1 mV equals 1 mA).

☞ For accurate supply current measurements, use a max 1 m cable.

☞ When connecting the 3.3 V RS-232, SPI and DDC digital interfaces to your application, use a max 25 cm cable.

☞ The total GNSS current includes the internal LNA, SPI flash and TCXO.

For more details, see the schematic in Figure 8.

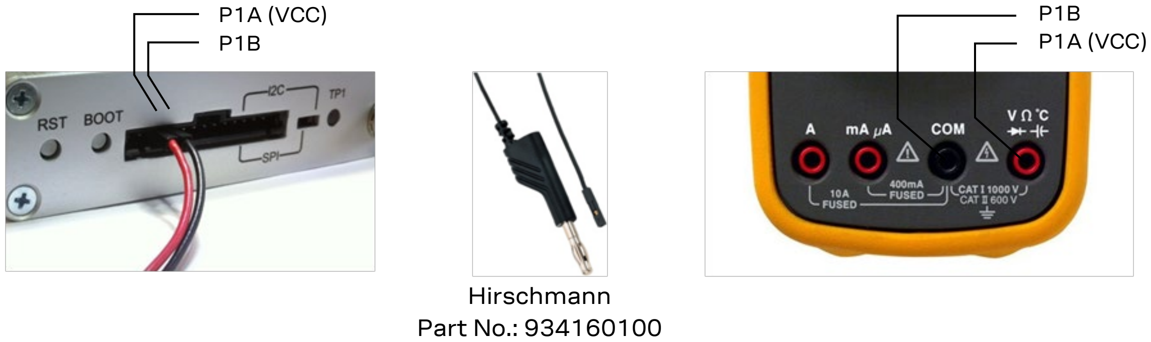

Figure 5: Example – tracking current measurement

6 Block diagram

Figure 6 shows the main interfaces and internal connections of the evaluation kit for the EVK-F9T:

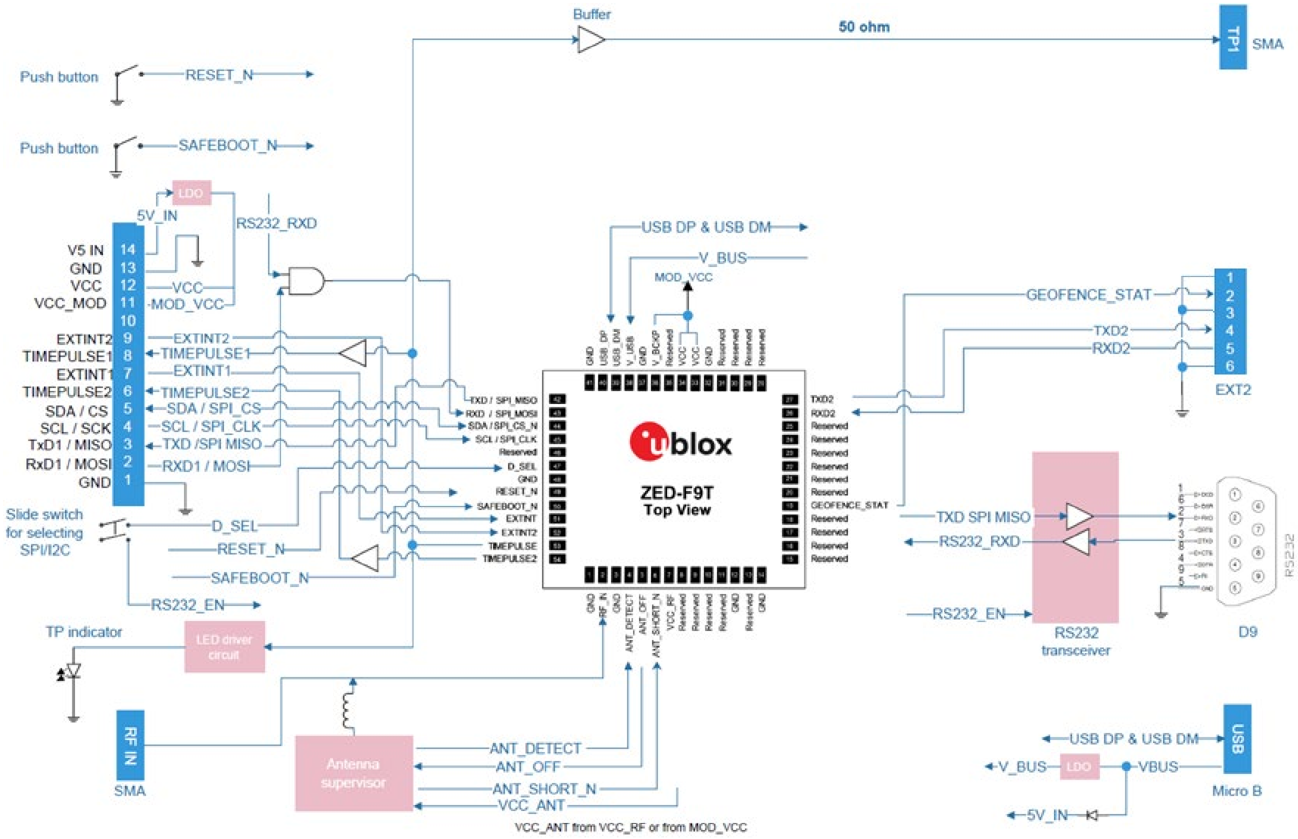

Figure 6: EVK-F9T block diagram

7 Board layout

Figure 7 shows the EVK-F9T board layout. See Table 7 for the component list of the EVB.

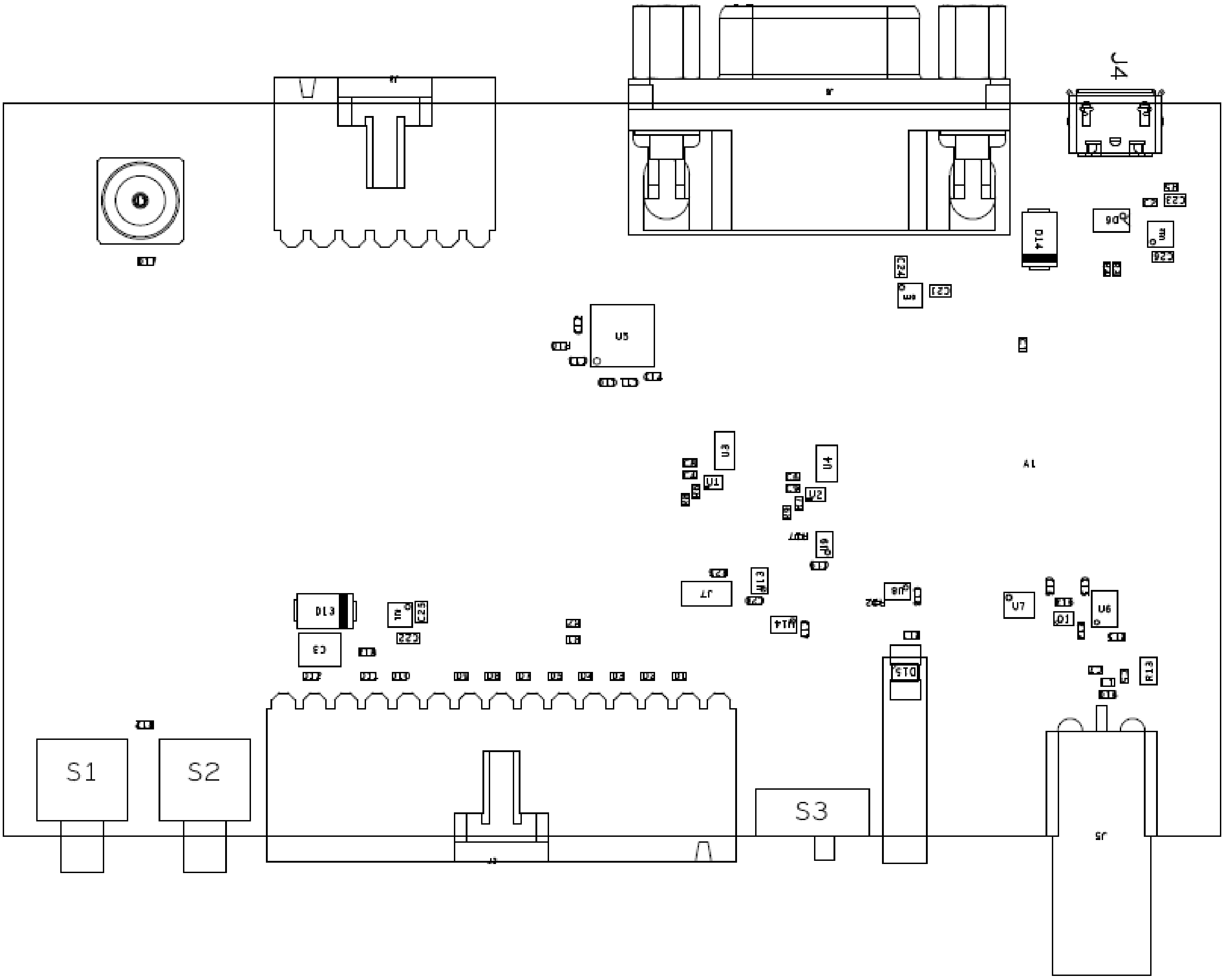

Figure 7: EVB-F9T layout

Part	Description
A1	GNSS RECEIVER U-BLOX ZED-F9T-20B -40/+85C
C1 C2 C4 C6 C8 C9	CAP CER X5R 0402 TY 1U0 10% 6.3V
C3	CAP CER X5R 1210 10U 10% 10V
C5	CAP CER X7R 0402 10N 10% 16V -55/+125C
C7	CAP CER COG 0402 47P 5% 25V
C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20	CAP CER X5R 0402 100N 10% 50V
C21 C22 C23	CAP CER X7R 0603 6.3V -55/+125 1U 10% 6.3V -55/+125C
C24 C25 C26	CAP CER X5R 0603 10U 20% 6.3V
D1 D2 D3 D4 D5 D7 D8 D9 D10 D11 D12	VARISTOR BOURNS MLE SERIES CG0402MLE-18G 18V
D6	USB DATA LINE PROTECTION ST USBLC6-2SC6 SOT23-6

D13 D14	SURFACE MOUNT SCHOTTKY BARRIER RECTIFIER SS14 1A -55/+125C
D15	LED OSRAM HYPER MINI TOPLED LB M673-L1N2-35 BLUE 0.02A
D16 D17	ESD PROTECTION FOR HIGH-SPEED LINES, TYCO, 0.25PF, PESD0402-140 -55/+125C
J1	CON SMA THT RIGHT ANGLE JACK 18MM LENGTH
J2	14PIN 90° 2.54MM PITCH DISCONNECTABLE CRIMP CONNECTOR -40/+85C
J3	6PIN 90° 2.54MM PITCH DISCONNECTABLE CRIMP CONNECTOR -40/+85C
J4	CON USB RECEPTACLE MICRO B TYPE SMD-MOLEX 47346-0001-TID60001597 30V 1A
J5	CON SMA SMD STRAIGHT JACK 11.4MM HEIGHT WITHOUT WASHER AND NUT
J6	9 POLE SUBD CONNECTOR FEMALE
J7	1-ROWS TH-PCB CONNECTOR 2MM GRID 2PINS 0.50MM SQUARE 3.50MM
L1	IND MURATA LQG15H 0402 47N 5% 0.2A
Q1	COMPLEMENTARY N- AND P-CHANNEL 20V (D-S) MOSFET VISHAY Si1016 SC89-6
R3 R4	RES THICK FILM CHIP 0402 27R 5% YAGEO 27R 5% 0.063W -55/+155C
R5	RES THICK FILM CHIP 0402 10K 5% 0.1W
R6 R7 R8 R9 R10 R15 R16	RES THICK FILM CHIP 0402 100K 1% 0.063W
R11 R12	RES THICK FILM CHIP 0402 100R 5% 0.1W
R13	RES THICK FILM CHIP 0805 10R 5% 0.125W -55/+155C
R14	RES THICK FILM CHIP 0402 1K0 1% 0.063W
R17 R22	RES THICK FILM CHIP 0201 51R 1% 0.05W
R18	RES THICK FILM CHIP 0402 CURRENT SENSE 1R 1% 1.1V -55/+125C
R25	RES THICK FILM CHIP 0402 39R 5% 0.063W -55/+125C
S1 S2	SWITCH SPST ON 1POL TYCO -40/+85C
S3	2 WAY SUB-MINIATURE SLIDE SWITCH SMD JS SERIES - SPDT -40/+85C
U1 U2	TINY LOGIC ULP-A 2-INPUT AND GATE 1.45X1.0 6-LEAD MICROPAK -40/+85C
U3 U4	TINY LOGIC UHS BUFFER OE ACTIVE HIGH FAIRCHILD NC7SZ126 SOT23-5
U5	RS-232 TRANSCEIVER 1MBIT 3-5,5VOLT TRSF3223 - VQFN20 5.5V 5.5V -40/+85C
U6	PRECISION RAIL TO RAIL OP AMP LINEAR LT6000 DCB
U7	TRIPLE BUFFER WITH OPEN-DRAIN OUTPUT 74LVC3G07 -40/+125C
U8 U9 U13 U14	TINY LOGIC UHS BUFFER OE_N ACTIVE LOW FAIRCHILD NC7SZ125 SC70
U10 U11 U12	LOW DROPOUT REGULATOR ON SEMI NCV8705 WDFN6 0.5A 3.3V

Table 7: EVB-F9T component list

8 Schematic

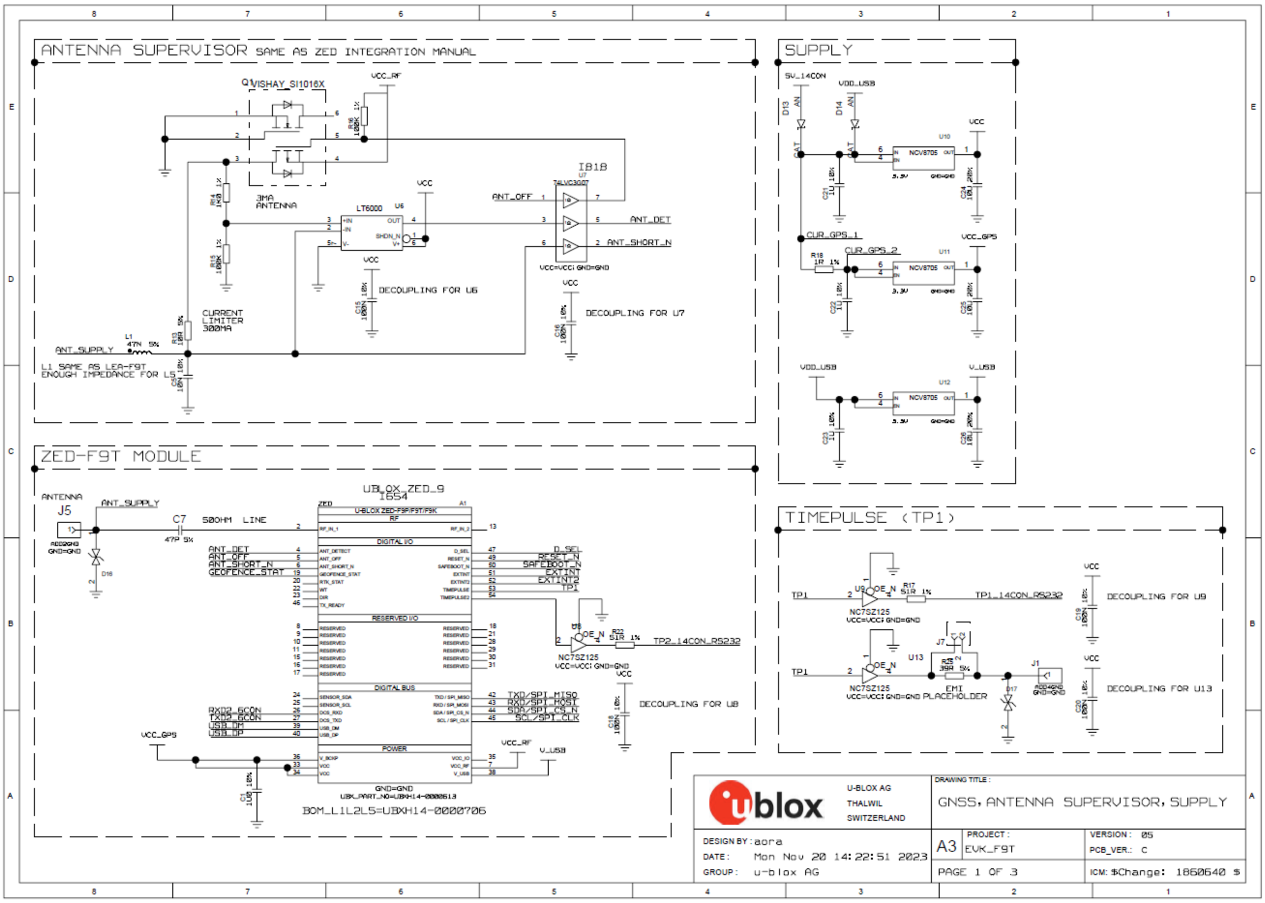

Figure 8: Schematic EVK-F9T: GNSS, Power supply RF path and Antenna supervisor

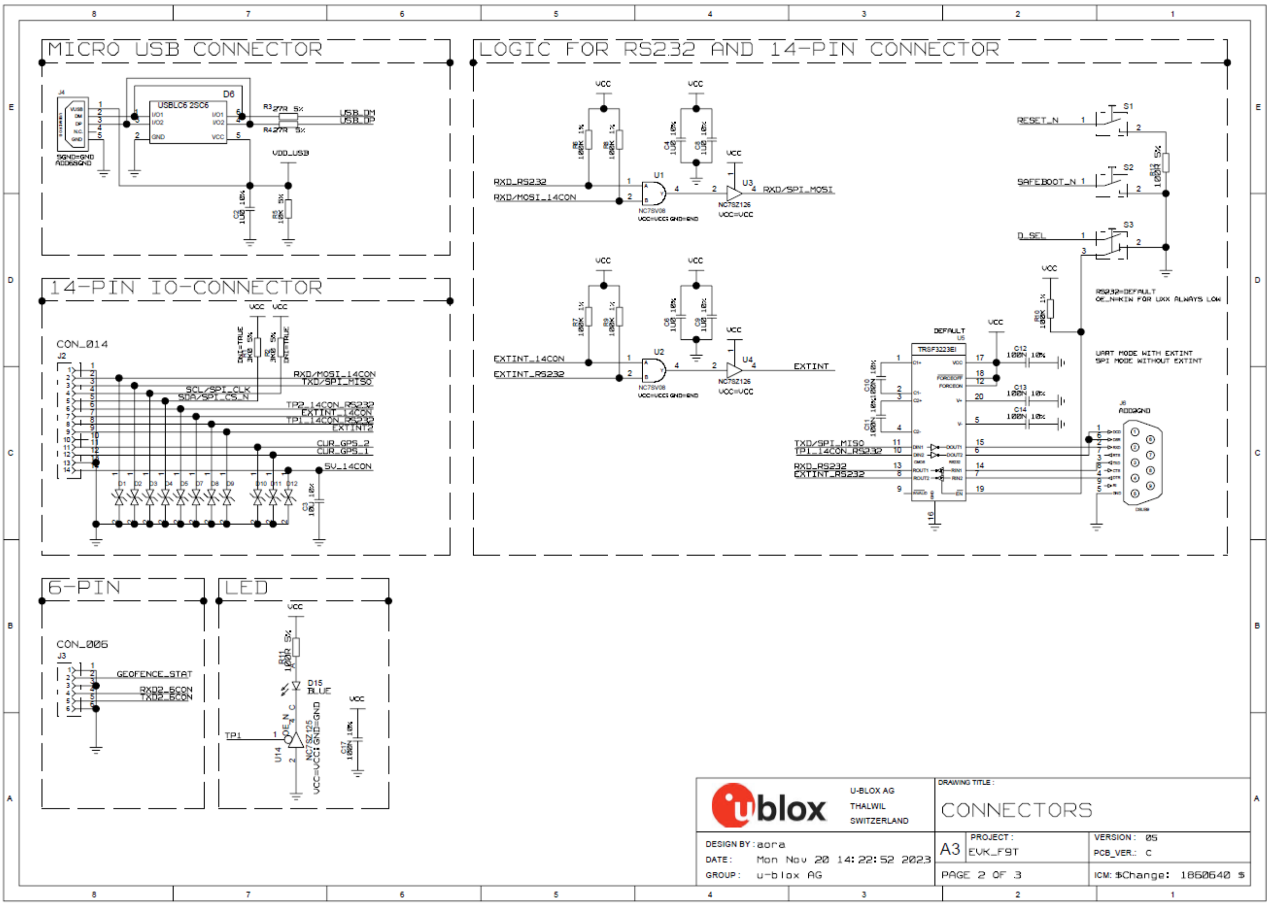

Figure 9: Schematic EVK-F9T: Connectors

9 Troubleshooting

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

- Check that the GNSS antenna is in clear sky view and the antenna cable is connected.
- Check that the slide switch on the front panel of the EVK is set to the communication port that you are using.
- Check the LED on the front panel of the EVK is on. A solid blue or flashing LED indicates the EVK is powered on. If the LED is off, connect the power source either via USB on the rear or through the V5_IN input on the front of the EVK.

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 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 user interface on u-center indicates when the messages are dropped.

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

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

The COM port does not send any messages

Make sure that the slide switch on 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 (SDO, SDI) instead.

⚠ **CAUTION** Changing the slide switch position while the EVK is powered on may damage the GNSS receiver chip. Power off the EVK before changing the slide switch setting.

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 not listed in u-center or u-center is not able to connect to the selected COM port, check if another application running on the computer is using the same port.

The position is off by a few dozen meters

u-blox F9 GNSS technology starts up with the WGS84 standard GNSS datum. If your application expects a different datum, you will most likely find the positions to be off by a few dozen meters. Do not 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 users to filter the position according to their 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 externally shutting down the receiver, check the calibration status in MON-HW ‘Real Time Clock Status’ field. Do not shut down the receiver if the RTC has not been calibrated.

The EVK-F9T 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/N0 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/N0 values lead to a prolonged startup time.

The EVK-F9T does not preserve the configuration in case of reset

u-blox F9 GNSS technology uses a slightly different concept than most other GNSS receivers do. Settings are initially stored in the volatile memory. 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 are not good. This provides safety, as it is no longer possible to accidentally program a bad configuration (e.g. disabling the main communication port).

For configuration details, see the Interface description[2]

The EVK-F9T does not work properly when connected to a GNSS simulator

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). When using a GNSS simulator scenario, the scenario time can be in the past causing the receiver to jump backwards in time. This affects the receiver’s 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 (corresponds to Jan 2003) allows running simulator scenarios taking place after this date. Then, issue the cold start command before every simulator test to avoid receiver confusion due to the time jumps.

Communication does not work with the USB interface in the power save mode

For communication in the power save mode, use the RS232 interface.

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 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 same place, should not be compared. The satellite constellation, the number of visible satellites and 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.
- When comparing side-by-side receivers, 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) 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.

Related documentation

[1] ZED-F9T-20B Data sheet, UBXDOC-963802114-12681

[2] u-blox F9 TIM 2.25 Interface description, UBXDOC-963802114-13231

[3] ZED-F9T Integration manual, UBX-21040375

[4] u-center User guide, UBX-13005250

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

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Revision history

Revision	Date	Comments
R01	11-Dec-2024	Initial revision
R02	13-Mar-2025	Updated product image with trademark.

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