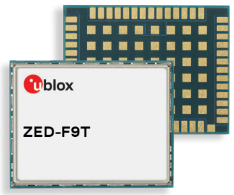
# ZED-F9T-20B

## High accuracy timing module
## Professional grade

Data sheet





### Abstract

This data sheet describes the ZED-F9T timing module with multi-band GNSS receiver and nanosecond-level timing accuracy. ZED-F9T meets the most stringent 5G timing requirements, is ideal for global deployment due to GPS, BeiDou and Galileo reception, and is unaffected by ionospheric errors. The module provides differential timing mode for highly accurate local timing and built-in security for highest robustness against malicious attacks.



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# Document information

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* In the not recommended for new designs (NRND) status, the product is still in production, but it is not recommended for new designs. For the latest product statuses, see the product website or contact u-blox.

This document applies to the following products:

| Product name | Type number | FW version | IN/PCN reference | Product status |
|---|---|---|---|---|
| ZED-F9T | ZED-F9T-20B-00 | TIM 2.25 | UBXDOC-304424225-21294 | Mass production |

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# 1 Functional description

## 1.1 Overview

ZED-F9T-20B is a multi-band GNSS module offering 5 ns (1-sigma) timing accuracy with unparalleled low power consumption.

ZED-F9T-20B incorporates the u-blox F9 multi-band platform in a small surface-mount device with a form factor of 22 x 17 mm.

## 1.2 Performance

| Parameter | Specification | Value |
|---|---|---|
| Receiver type | Multi-band GNSS receiver for timing applications | |
| Accuracy of time pulse signal[1] [2] | Absolute timing mode | 5 ns |
| | Differential timing mode[3] | 2.5 ns |
| Frequency of time pulse signal | | 0.25 Hz to 25 MHz (configurable) |
| Time pulse jitter | | ±4 ns |
| Time-mark resolution | | 8 ns |
| Operational limits[4] | Dynamics | ≤ 4 g |
| | Altitude | 80,000 m |
| | Velocity | 500 m/s |
| Velocity accuracy[2] [5] | | 0.05 m/s |
| Dynamic heading accuracy[2] [5] | | 0.3 deg |

**Table 1: ZED-F9T-20B specifications**

| GNSS | | GPS+BDS+GAL | GPS+GAL | GPS+BDS | GPS |
|---|---|---|---|---|---|
| Acquisition[6] | Cold start | 25 s | 29 s | 28 s | 29 s |
| | Hot start | 2 s | 2 s | 2 s | 2 s |
| | Aided start[7] | 2 s | 2 s | 2 s | 2 s |
| Max navigation update rate[8] | | 10 Hz | 15 Hz | 12 Hz | 20 Hz |

**Table 2: ZED-F9T-20B performance in different GNSS modes**

1 1-sigma, fixed position mode, depends on temperature, atmospheric conditions, GNSS antenna, multipath conditions, satellite visibility and geometry
2 Assumes typical performance of the navigation satellite systems.
3 Depends on baseline length, demonstrated with 20 km baseline
4 Assuming Airborne 4 g platform
5 50% at 30 m/s for dynamic operation
6 Commanded starts. All satellites at -130 dBm. Measured at room temperature. Dual band operation
7 Dependent on the speed and latency of the aiding data connection, commanded starts
8 95% In PVT navigation mode, assumes secondary navigation output disabled (default)



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| GNSS | | GPS+BDS+GAL | GPS+GAL | GPS+BDS | GPS |
|---|---|---|---|---|---|
| Horizontal position accuracy (CEP)[2] | Standalone[9] | 1.5 m | 1.5 m | 1.5 m | 1.5 m |

**Table 3: ZED-F9T-20B position accuracy in different GNSS modes**

☞ To achieve the best absolute timing accuracy, measure the propagation delay of the entire signal path from the antenna to the receiver's time pulse output, and then compensate for this delay using the CFG-TP configuration items.

| GNSS | | GPS+GAL+BDS |
|---|---|---|
| Sensitivity[10] | Tracking and nav. | -167 dBm |
| | Reacquisition | -160 dBm |
| | Cold start | -148 dBm |
| | Hot start | -157 dBm |

**Table 4: ZED-F9T-20B sensitivity**

## 1.3 Supported GNSS constellations

The ZED-F9T-20B GNSS module is a concurrent GNSS receiver that can receive and track multiple GNSS systems. Thanks to the multi-band RF front-end architecture, all major GNSS constellations (GPS, Galileo and BeiDou) as well as NavIC, SBAS, and QZSS satellites can be received concurrently. ZED-F9T-20B can be configured to function as a L1, L2 or L1, L5 dual-band receiver. If low power consumption is a key factor, then the receiver can be configured for a subset of GNSS constellations.

ZED-F9T-20B can receive the NavIC L5 satellite signals that share the same frequency with GPS L5 signals and can be configured to work on its own or in parallel with the other GNSS constellations.

The QZSS system shares the same frequency bands with GPS and can only be processed in conjunction with GPS.

To benefit from multi-band signal reception, dedicated hardware preparation must be made during the design-in phase. See the Integration manual [1] for u-blox design recommendations.

ZED-F9T-20B supports the GNSS and their signals as shown in Table 5. [11]

| GPS / QZSS | Galileo | BeiDou | NavIC |
|---|---|---|---|
| L1C/A (1575.420 MHz) | E1-B/C (1575.420 MHz) | B1I (1561.098 MHz)<br>B1C (1575.420 MHz) | - |
| L2C (1227.600 MHz) | E5b (1207.140 MHz) | B2I (1207.140 MHz) | - |
| L5 (1176.450 MHz) | E5a (1176.450 MHz) | B2a (1176.450 MHz) | SPS-L5 (1176.450 MHz) |

**Table 5: Supported GNSS signals on ZED-F9T-20B**

ZED-F9T-20B can use the AssistNow Live Orbits service which provides GNSS assistance information.

9 Depends on atmospheric conditions, GNSS antenna, multipath conditions, satellite visibility, and geometry

10 Demonstrated with a good external LNA. Measured at room temperature.

11 Only L1, L2 or L1, L5 bands are supported concurrently



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## 1.4 Supported GNSS augmentation systems

### 1.4.1 Quasi-Zenith Satellite System (QZSS)

The Quasi-Zenith Satellite System (QZSS) is a regional navigation satellite system that provides positioning services for the Pacific region covering Japan and Australia. ZED-F9T-20B is able to receive and track QZSS L1 C/A and L5 signals concurrently with GPS signals, resulting in better availability especially under challenging signal conditions, e.g. in urban canyons.

☞ QZSS can be enabled only if the GPS operation is also configured.

### 1.4.2 Satellite-based augmentation system (SBAS)

ZED-F9T-20B supports SBAS (including WAAS in the US, EGNOS in Europe, L1Sb (QZSS SBAS) in Japan and GAGAN in India) to deliver improved location accuracy within the regions covered. However, the additional inter-standard time calibration step used during SBAS reception results in degraded time accuracy overall.

☞ SBAS reception is disabled by default in ZED-F9T-20B.

### 1.4.3 Differential timing mode

To improve timing accuracy locally, ZED-F9T-20B can be used in differential timing mode, in which correction data is sent to neighboring ZED-F9T-20B timing receivers via a communication network.

In differential timing mode ZED-F9T-20B can operate either as a reference station generating the following RTCM 3.4 messages, or as a corrected station using the following RTCM 3.4 messages:

| Message type | Description |
|---|---|
| RTCM 1005 | Stationary RTK reference station ARP |
| RTCM 1077 | GPS MSM7 |
| RTCM 1097 | Galileo MSM7 |
| RTCM 1127 | BeiDou MSM7 |
| RTCM 4072.1 | Additional reference station information (u-blox proprietary RTCM Message) |

**Table 6: Supported RTCM 3.4 messages**

## 1.5 Broadcast navigation data and satellite signal measurements

ZED-F9T-20B can output all the GNSS broadcast data upon reception from tracked satellites. This includes all the supported GNSS signals as well as the QZSS and SBAS augmentation services. The UBX-RXM-SFRBX message provides this information. For the UBX-RXM-SFRBX message specification, see the Interface description [2]. The receiver can provide satellite signal information in a form compatible with the Radio Resource LCS Protocol (RRLP) [4].

### 1.5.1 Carrier-phase measurements

The ZED-F9T-20B modules provide raw carrier-phase data for all supported signals, along with pseudorange, Doppler and measurement quality information. The data contained in the UBX-RXM-RAWX message follows the conventions of a multi-GNSS RINEX 3 observation file. For the UBX-RXM-RAWX message specification, see Interface description [2].

☞ Raw measurement data is available once the receiver has established data bit synchronization and time-of-week.



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## 1.6 Supported protocols

ZED-F9T-20B supports the following protocols:

| Protocol | Type |
|---|---|
| UBX | Input/output, binary, u-blox proprietary |
| NMEA 4.11 (default), 4.10, 4.0, 2.3, and 2.1 | Input/output, ASCII |
| RTCM 3.4 | Input/output, binary |

**Table 7: Supported protocols**

For specification of the protocols, see the Interface description [2].



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# 2 System description

## 2.1 Block diagram

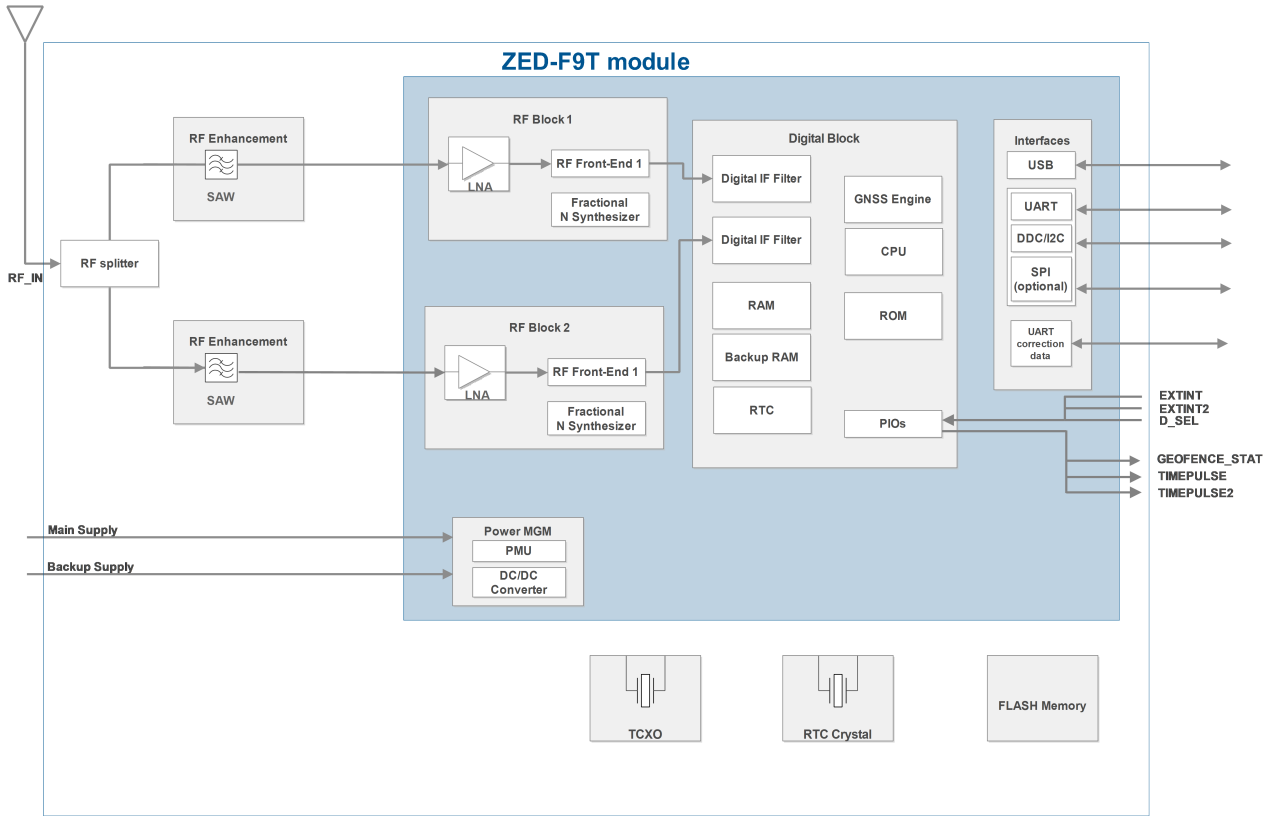



**Figure 1: ZED-F9T-20B block diagram**

☞ An active antenna is mandatory with ZED-F9T-20B. For more information, see the Integration manual [1].



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# 3 Pin definition

## 3.1 Pin assignment

The pin assignment of the ZED-F9T-20B module is shown in Figure 2. The defined configuration of the PIOs is listed in Table 8.

For detailed information on pin functions and characteristics, see the Integration manual [1].

☞ ZED-F9T-20B is an LGA package with the I/O on the outside edge and central ground pads.

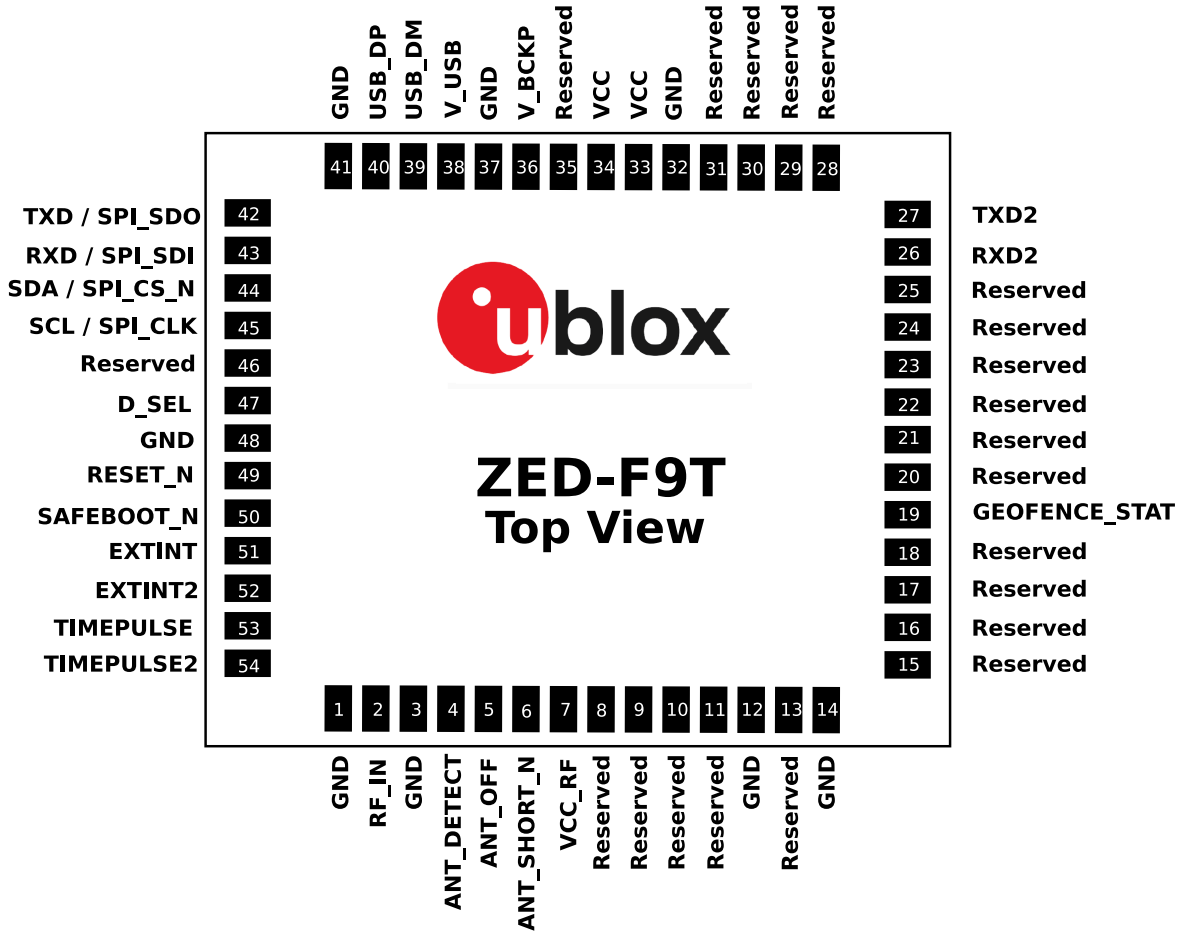



**Figure 2: ZED-F9T-20B pin assignment**

| Pin no. | Name | I/O | Description |
|---|---|---|---|
| 1 | GND | - | Ground |
| 2 | RF_IN | I | RF input |
| 3 | GND | - | Ground |
| 4 | ANT_DETECT | I | Active antenna detect - default active high |
| 5 | ANT_OFF | O | External LNA disable - default active high |
| 6 | ANT_SHORT_N | I | Active antenna short detect - default active low |
| 7 | VCC_RF | O | Voltage for external LNA |
| 8 | Reserved | - | Reserved |



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| Pin no. | Name | I/O | Description |
|---|---|---|---|
| 9 | Reserved | - | Reserved |
| 10 | Reserved | - | Reserved |
| 11 | Reserved | - | Reserved |
| 12 | GND | - | Ground |
| 13 | Reserved | - | Reserved |
| 14 | GND | - | Ground |
| 15 | Reserved | - | Reserved |
| 16 | Reserved | - | Reserved |
| 17 | Reserved | - | Reserved |
| 18 | Reserved | - | Reserved |
| 19 | GEOFENCE_STAT | O | Geofence status, user defined |
| 20 | Reserved | - | Reserved |
| 21 | Reserved | - | Reserved |
| 22 | Reserved | - | Reserved |
| 23 | Reserved | - | Reserved |
| 24 | Reserved | - | Reserved |
| 25 | Reserved | - | Reserved |
| 26 | RXD2 | I | Correction UART input |
| 27 | TXD2 | O | Correction UART output |
| 28 | Reserved | - | Reserved |
| 29 | Reserved | - | Reserved |
| 30 | Reserved | - | Reserved |
| 31 | Reserved | - | Reserved |
| 32 | GND | - | Ground |
| 33 | VCC | I | Voltage supply |
| 34 | VCC | I | Voltage supply |
| 35 | Reserved | - | Reserved |
| 36 | V_BCKP | I | Backup supply voltage |
| 37 | GND | - | Ground |
| 38 | V_USB | I | USB supply |
| 39 | USB_DM | I/O | USB data |
| 40 | USB_DP | I/O | USB data |
| 41 | GND | - | Ground |
| 42 | TXD / SPI_SDO | O | Host UART output if D_SEL = 1(or open). SPI_SDO if D_SEL = 0 |
| 43 | RXD / SPI_SDI | I | Host UART input if D_SEL = 1(or open). SPI_SDI if D_SEL = 0 |
| 44 | SDA / SPI_CS_N | I/O | I2C Data if D_SEL = 1 (or open). SPI Chip Select if D_SEL = 0 |
| 45 | SCL / SPI_CLK | I/O | I2C Clock if D_SEL = 1(or open). SPI Clock if D_SEL = 0 |
| 46 | Reserved | - | Reserved |
| 47 | D_SEL | I | Interface select for pins 42-45 |
| 48 | GND | - | Ground |
| 49 | RESET_N | I | RESET_N |



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| Pin no. | Name | I/O | Description |
|---|---|---|---|
| 50 | SAFEBOOT_N | I | SAFEBOOT_N (If not used, leave open)[12] |
| 51 | EXTINT | I | External interrupt pin |
| 52 | EXTINT2 | I | External interrupt pin 2 |
| 53 | TIMEPULSE | O | Time pulse |
| 54 | TIMEPULSE2 | O | Time pulse 2 |

**Table 8: ZED-F9T-20B pin assignment**

[12] The receiver enters safeboot mode if SAFEBOOT_N pin is low at start up. The SAFEBOOT_N pin is internally connected to TIMEPULSE2 pin through a 1 kΩ series resistor.



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# 4 Electrical specifications

## 4.1 Absolute maximum ratings

⚠ CAUTION. Risk of device damage. Exceeding the absolute maximum ratings may affect the lifetime and reliability of the device or permanently damage it. Do not exceed the absolute maximum ratings.

⚠ This product is not protected against overvoltage or reversed voltages. Use appropriate protection to avoid device damage from voltage spikes exceeding the specified boundaries.

| Parameter | Symbol | Condition | Min | Max | Units |
|---|---|---|---|---|---|
| Power supply voltage | VCC | | –0.5 | 3.6 | V |
| Voltage ramp on VCC[13] | | | 20 | 8000 | µs/V |
| Backup battery voltage | V_BCKP | | –0.5 | 3.6 | V |
| Voltage ramp on V_BCKP[13] | | | 20 | | µs/V |
| Input pin voltage | Vin | VCC ≤ 3.1 V | –0.5 | VCC + 0.5 | V |
| | | VCC > 3.1 V | –0.5 | 3.6 | V |
| VCC_RF output current | ICC_RF | | | 300 | mA |
| Supply voltage USB | V_USB | | –0.5 | 3.6 | V |
| USB signals | USB_DM, USB_DP | | –0.5 | V_USB + 0.5 | V |
| Input power at RF_IN | Prfin | Source impedance = 50 Ω, continuous wave | | 10 | dBm |
| Storage temperature | Tstg | | –40 | +85 | °C |

**Table 9: Absolute maximum ratings**

## 4.2 Operating conditions

☞ Extreme operating temperatures can significantly impact the specified values. If an application operates near the min or max temperature limits, ensure the specified values are not exceeded.

| Parameter | Symbol | Min | Typical | Max | Units | Condition |
|---|---|---|---|---|---|---|
| Power supply voltage | VCC | 2.7 | 3.0 | 3.6 | V | |
| Supply voltage for USB interface | V_USB | 3.0 | | 3.6 | V | |
| V_USB current | I_USB | | 2.0 | | mA | |
| Backup battery voltage | V_BCKP | 1.65 | | 3.6 | V | |
| Backup battery current[14, 15] | I_BCKP | | 45 | | µA | V_BCKP = 3 V, VCC = 0 V |
| SW backup current[15] | I_SWBCKP | | 1.4 | | mA | |
| Input pin voltage range | Vin | 0 | | VCC | V | |
| Digital IO pin low level input voltage | Vil | | | 0.4 | V | |
| Digital IO pin high level input voltage | Vih | 0.8 * VCC | | | V | |
| Digital IO pin low level output voltage | Vol | | | 0.4 | V | Iol = 2 mA |
| TIMEPULSE | | | | | | Iol = 4 mA |

13 Exceeding the ramp speed may permanently damage the device

14 To measure the I_BCKP, the receiver should first be switched on, i.e. VCC and V_BCKP is available. Then set VCC to 0 V while the V_BCKP remains available. Afterward, measure the current consumption at the V_BCKP.

15 The value has been characterized at 25 °C ambient temperature.



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| Parameter | Symbol | Min | Typical | Max | Units | Condition |
|---|---|---|---|---|---|---|
| Digital IO pin high level output voltage<br>TIMEPULSE | Voh | VCC – 0.4 | | | V | Ioh = 2 mA<br>Ioh = 4 mA |
| DC current through any digital I/O pin (except supplies) | Ipin | | | 5 | mA | |
| Pull-up resistance for SCL, SDA | $R_{pu}$ | 7 | 15 | 30 | kΩ | |
| Pull-up resistance for D_SEL, RXD, TXD, SAFEBOOT_N, EXTINT | $R_{pu}$ | 30 | 75 | 130 | kΩ | |
| Pull-up resistance for RESET_N | $R_{pu}$ | 7 | 10 | 13 | kΩ | |
| VCC_RF voltage | VCC_RF | | VCC – 0.1 | | V | |
| VCC_RF output current | ICC_RF | | | 50 | mA | |
| Input impedance at RF_IN | $Z_{in}$ | | 50 | | Ω | |
| Receiver chain noise figure[16] | NFtot | | 9.5 | | dB | |
| External gain (at RF_IN) | Ext_gain | 17 | | 50 | dB | |
| Operating temperature | Topr | –40 | +25 | +85 | °C | |

**Table 10: Operating conditions**

## 4.3 Indicative power requirements

Table 11 provides examples of typical current requirements when using a cold start command. The given values are total system supply current for a possible application including RF and baseband sections.

All values in Table 11 have been measured at 25 °C ambient temperature.

☞ The actual power requirements vary depending on the FW version used, external circuitry, number of satellites tracked, signal strength, type and time of start, duration, and conditions of test.

| Symbol | Parameter | Conditions | GPS+GAL +BDS | GPS | Unit |
|---|---|---|---|---|---|
| $I_{PEAK}$ | Peak current | Acquisition | 130 | 120 | mA |
| $I_{VCC}$[17] | VCC current | Acquisition | 90 | 75 | mA |
| $I_{VCC}$[17] | VCC current | Tracking | 85 | 70 | mA |

**Table 11: Currents to calculate the indicative power requirements**

16 Only valid for GPS

17 Simulated GNSS signal



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# 5 Communications interfaces

ZED-F9T-20B has several communications interfaces, including UART, SPI, I2C and USB.

All the inputs have internal pull-up resistors in normal operation and can be left open if not used. All the PIOs are supplied by VCC, therefore all the voltage levels of the PIO pins are related to VCC supply voltage.

## 5.1 UART

The UART interfaces support configurable baud rates. For further information, see the Integration manual [1].

Hardware flow control is not supported.

The UART1 is enabled if D_SEL pin of the module is left open or "high".

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| $R_u$ | Baud rate | 9600 | 921600 | bit/s |
| $\Delta_{Tx}$ | Tx baud rate accuracy | -1% | +1% | - |
| $\Delta_{Rx}$ | Rx baud rate tolerance | -2.5% | +2.5% | - |

**Table 12: ZED-F9T-20B UART specifications**

## 5.2 SPI

The SPI interface is disabled by default. The SPI interface shares pins with UART and I2C and can be selected by setting D_SEL = 0. The SPI interface can be operated in peripheral mode only. The maximum transfer rate using SPI is 125 kB/s and the maximum SPI clock frequency is 5.5 MHz.

The SPI timing parameters for peripheral operation are defined in Figure 3. Default SPI configuration is CPOL = 0 and CPHA = 0.

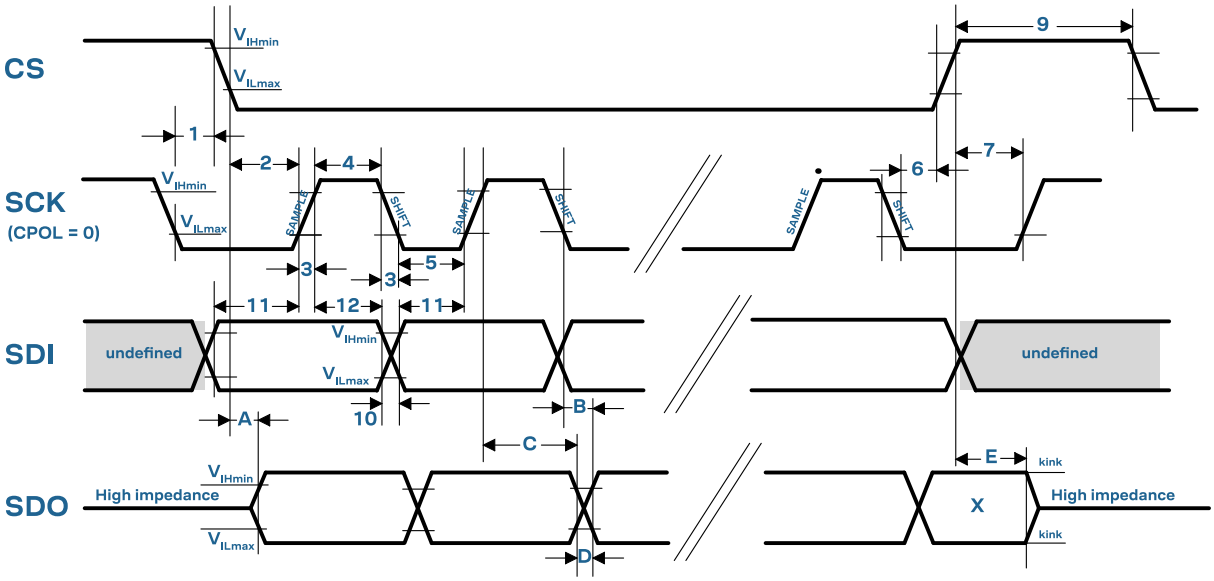



**Figure 3: ZED-F9T-20B SPI specification mode 1: CPHA=0 SCK = 5.33 MHz**

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| 1 | CS deassertion hold time | 23 | - | ns |



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| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| 2 | Chip select time (CS to SCK) | 20 | - | ns |
| 3 | SCK rise/fall time | - | 7 | ns |
| 4 | SCK high time | 24 | - | ns |
| 5 | SCK low time | 24 | - | ns |
| 6 | Chip deselect time (SCK falling to CS) | 30 | - | ns |
| 7 | Chip deselect time (CS to SCK) | 30 | - | ns |
| 9 | CS high time | 32 | - | ns |
| 10 | SDI transition time | - | 7 | ns |
| 11 | SDI setup time | 16 | - | ns |
| 12 | SDI hold time | 24 | - | ns |

**Table 13: SPI peripheral input timing parameters 1 - 12**

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| A | SDO data valid time (CS) | 12 | 40 | ns |
| B | SDO data valid time (SCK), weak driver mode | 15 | 40 | ns |
| C | SDO data hold time | 100 | 140 | ns |
| D | SDO rise/fall time, weak driver mode | 0 | 5 | ns |
| E | SDO data disable lag time | 15 | 35 | ns |

**Table 14: SPI peripheral timing parameters A - E, 2 pF load capacitance**

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| A | SDO data valid time (CS) | 16 | 55 | ns |
| B | SDO data valid time (SCK), weak driver mode | 20 | 55 | ns |
| C | SDO data hold time | 100 | 150 | ns |
| D | SDO rise/fall time, weak driver mode | 3 | 20 | ns |
| E | SDO data disable lag time | 15 | 35 | ns |

**Table 15: SPI peripheral timing parameters A - E, 20 pF load capacitance**

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| A | SDO data valid time (CS) | 26 | 85 | ns |
| B | SDO data valid time (SCK), weak driver mode | 30 | 85 | ns |
| C | SDO data hold time | 110 | 160 | ns |
| D | SDO rise/fall time, weak driver mode | 13 | 45 | ns |
| E | SDO data disable lag time | 15 | 35 | ns |

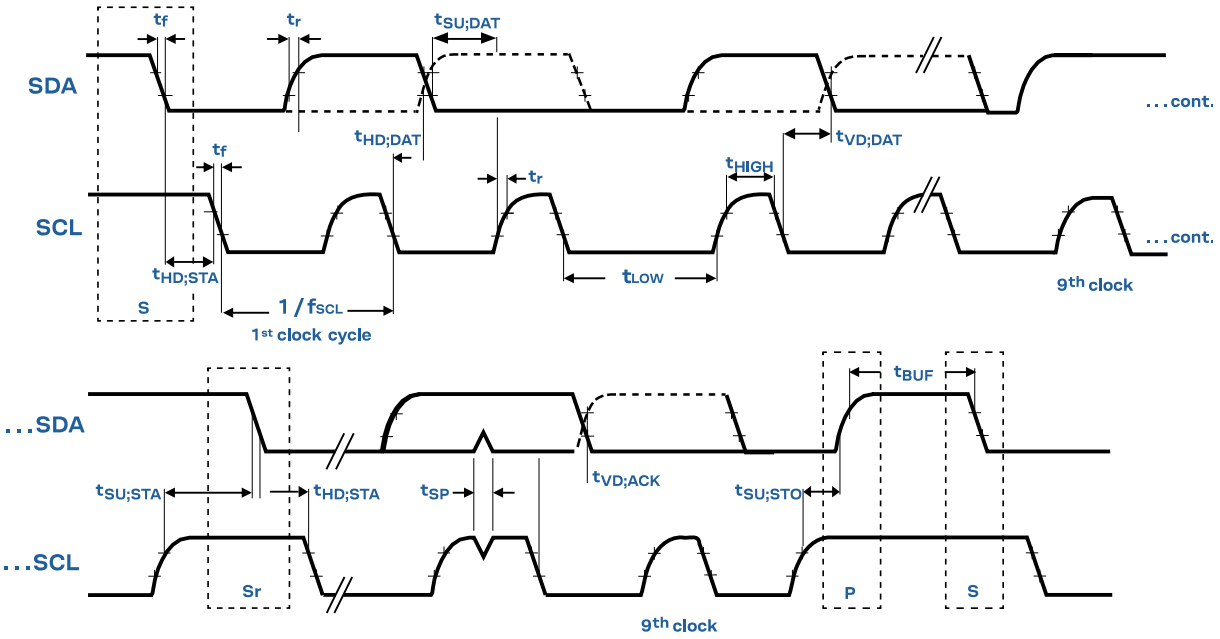
**Table 16: SPI peripheral timing parameters A - E, 60 pF load capacitance**

## 5.3 I2C

An I2C interface is available for communication with an external host CPU in I2C Fast-mode. Backwards compatibility with Standard-mode I2C bus operation is not supported. The interface can be operated only in peripheral mode with a maximum bit rate of 400 kbit/s. The interface can make use of clock stretching by holding the SCL line LOW to pause a transaction. In this case, the bit transfer rate is reduced. The maximum clock stretching time is 20 ms.



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$V_{IL} = 0.3\ V_{DD}$
$V_{IH} = 0.7\ V_{DD}$

**Figure 4: ZED-F9T-20B I2C peripheral specification**

| | | I2C Fast-mode | | |
|---|---|---|---|---|
| **Symbol** | **Parameter** | **Min** | **Max** | **Unit** |
| $f_{SCL}$ | SCL clock frequency | 0 | 400 | kHz |
| $t_{HD;STA}$ | Hold time (repeated) START condition | 0.6 | - | µs |
| $t_{LOW}$ | Low period of the SCL clock | 1.3 | - | µs |
| $t_{HIGH}$ | High period of the SCL clock | 0.6 | - | µs |
| $t_{SU;STA}$ | Setup time for a repeated START condition | 0.6 | - | µs |
| $t_{HD;DAT}$ | Data hold time | 0 [18] | - [19] | µs |
| $t_{SU;DAT}$ | Data setup time | 100 [20] | | ns |
| $t_r$ | Rise time of both SDA and SCL signals | - | 300 (for C = 400pF) | ns |
| $t_f$ | Fall time of both SDA and SCL signals | - | 300 (for C = 400pF) | ns |
| $t_{SU;STO}$ | Setup time for STOP condition | 0.6 | - | µs |
| $t_{BUF}$ | Bus-free time between a STOP and START condition | 1.3 | - | µs |
| $t_{VD;DAT}$ | Data valid time | - | 0.9 [19] | µs |
| $t_{VD;ACK}$ | Data valid acknowledge time | - | 0.9 [19] | µs |
| $V_{nL}$ | Noise margin at the low level | 0.1 VCC | - | V |

18 External device must provide a hold time of at least one transition time (max 300 ns) for the SDA signal (with respect to the min Vih of the SCL signal) to bridge the undefined region of the falling edge of SCL.

19 The maximum $t_{HD;DAT}$ must be less than the maximum $t_{VD;DAT}$ or $t_{VD;ACK}$ with a maximum of 0.9 µs by a transition time. This maximum must only be met if the device does not stretch the LOW period (tLOW) of the SCL signal. If the clock stretches the SCL, the data must be valid by the set-up time before it releases the clock.

20 When the I2C peripheral is stretching the clock, the $t_{SU;DAT}$ of the first bit of the next byte is 62.5 ns.



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| | | I2C Fast-mode | | |
|---|---|---|---|---|
| **Symbol** | **Parameter** | **Min** | **Max** | **Unit** |
| $V_{nH}$ | Noise margin at the high level | 0.2 VCC | - | V |

**Table 17: ZED-F9T-20B I2C peripheral timings and specifications**

☞ The I2C interface is only available with the UART default mode. If the SPI interface is selected by using D_SEL = 0, the I2C interface is not available.

## 5.4 USB

The USB 2.0 FS (full speed, 12 Mbit/s) interface can be used for host communication. Due to the hardware implementation, it may not be possible to certify the USB interface. The V_USB pin supplies the USB interface.

## 5.5 Default interface settings

| Interface | Settings |
|---|---|
| UART1 output | 38400 baud, 8 bits, no parity bit, 1 stop bit.<br>NMEA protocol with **GGA, GLL, GSA, GSV, RMC, VTG, TXT, ZDA** messages are output by default.<br>UBX and RTCM 3.4 protocols are enabled by default but no output messages are enabled by default. |
| UART1 input | 38400 baud, 8 bits, no parity bit, 1 stop bit.<br>UBX, NMEA and RTCM 3.4 input protocols are enabled by default. |
| UART2 output | 38400 baud, 8 bits, no parity bit, 1 stop bit.<br>UBX protocol cannot be enabled.<br>RTCM 3.3 protocol is enabled by default but no output messages are enabled by default.<br>NMEA protocol is disabled by default. |
| UART2 input | 38400 baud, 8 bits, no parity bit, 1 stop bit.<br>UBX protocol cannot be enabled and will not receive UBX input messages.<br>RTCM 3.3 protocol is enabled by default.<br>NMEA protocol is disabled by default. |
| USB | Default messages activated as in UART1. Input/output protocols available as in UART1. |
| I2C | Available for communication in the Fast-mode with an external host CPU 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 (see section D_SEL interface in Integration manual [1]). |

**Table 18: Default interface settings**

☞ Refer to the applicable Interface description [2] for information about further settings.

☞ By default, ZED-F9T-20B outputs NMEA messages that include satellite data for all GNSS bands being received. This results in a high NMEA output load for each navigation period. Make sure the UART baud rate used is sufficient for the selected navigation rate and the number of GNSS signals being received.



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# 6 Mechanical specifications

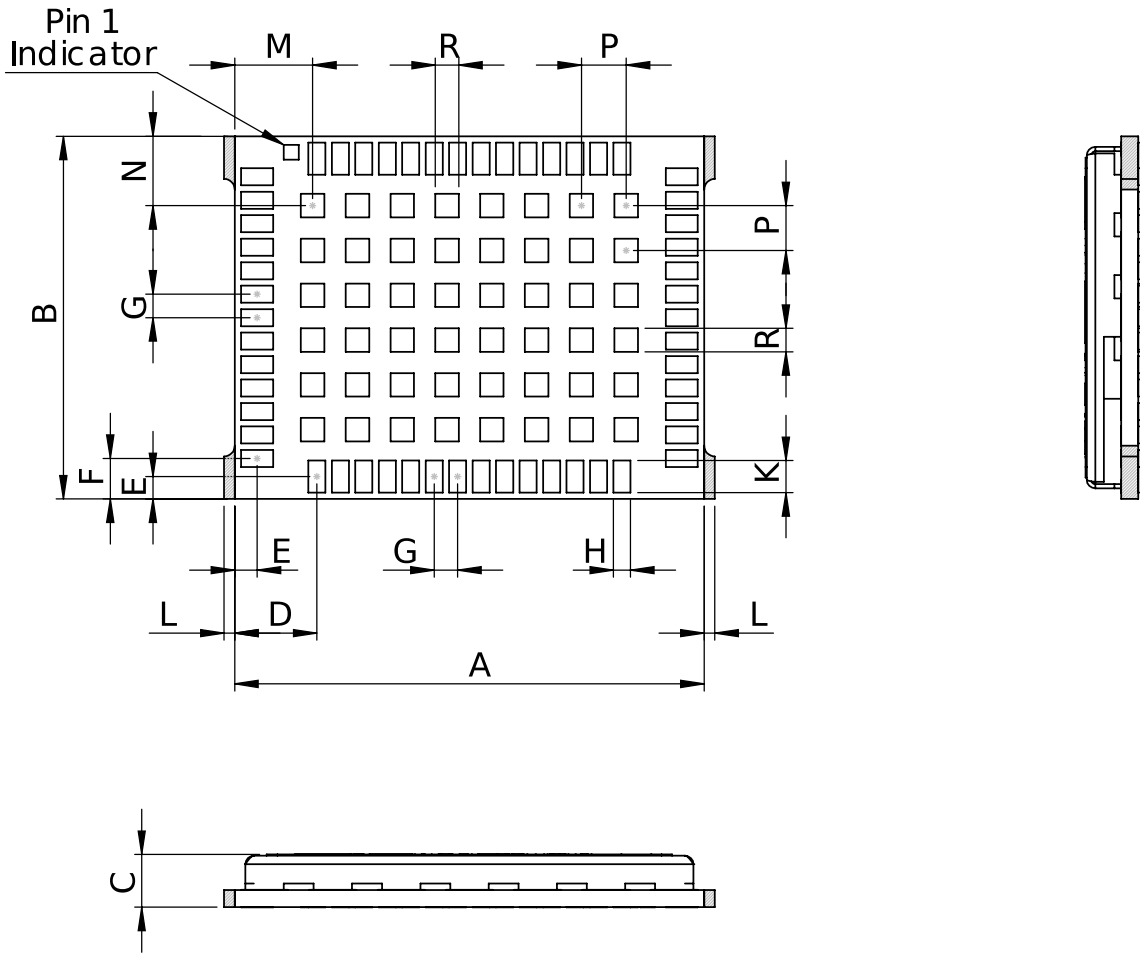



**Figure 5: ZED-F9T-20B mechanical drawing**

| Symbol | Min (mm) | Typical (mm) | Max (mm) |
|---|---|---|---|
| A | 21.80 | 22.00 | 22.20 |
| B | 16.80 | 17.00 | 17.20 |
| C | 2.20 | 2.40 | 2.60 |
| D | 3.65 | 3.85 | 4.05 |
| E | 0.85 | 1.05 | 1.25 |
| F | 1.70 | 1.90 | 2.10 |
| G | 1.05 | 1.10 | 1.15 |
| H | 0.70 | 0.80 | 0.96 |
| K | 1.20 | 1.50 | 1.80 |
| M | 3.45 | 3.65 | 3.85 |
| N | 3.05 | 3.25 | 3.45 |
| P | 2.05 | 2.10 | 2.15 |



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| Symbol | Min (mm) | Typical (mm) | Max (mm) |
|---|---|---|---|
| R | 0.88 | 1.10 | 1.32 |
| L | 0.00 | | 0.30 |
| Weight | | 1.8 g | |

**Table 19: ZED-F9T-20B mechanical dimensions**

☞ The mechanical picture of the de-paneling residual tabs (L) is an approximate representation. The shape and position may vary, but the overall size of the residual tabs remains within the maximum dimensions even when the tab sizes differ.

☞ Take the size of the de-paneling residual tabs into account when designing the component keep-out area.



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# 7 Qualifications and approvals

| | |
|---|---|
| **Quality and reliability** | |
| Product qualification | Qualified according to ISO 16750 |
| Chip qualification | Modules are based on AEC-Q100 qualified GNSS chips |
| Manufacturing | Manufactured at ISO/TS 16949 certified sites |
| **Environmental** | |
| RoHS compliance | Yes |
| Moisture sensitivity level (MSL) [21], [22] | 4 |
| **Type approvals** | |
| European RED certification (CE) | Declaration of Conformity (DoC) is available on the u-blox website. |
| UK conformity assessment (UKCA) | Yes |

**Table 20: Qualifications and approvals**

[21] For the MSL standard, see IPC/JEDEC J-STD-020 and J-STD-033, available on www.jedec.org

[22] For more information regarding moisture sensitivity levels, labelling, storage and drying, see the Product packaging reference guide [3]



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# 8 Product marking and ordering information

This section provides information about product marking and ordering.

## 8.1 Product marking

The product marking provides information on ZED-F9T-20B and its revision, as in Figure 6. For a description of the product marking, see Table 21.

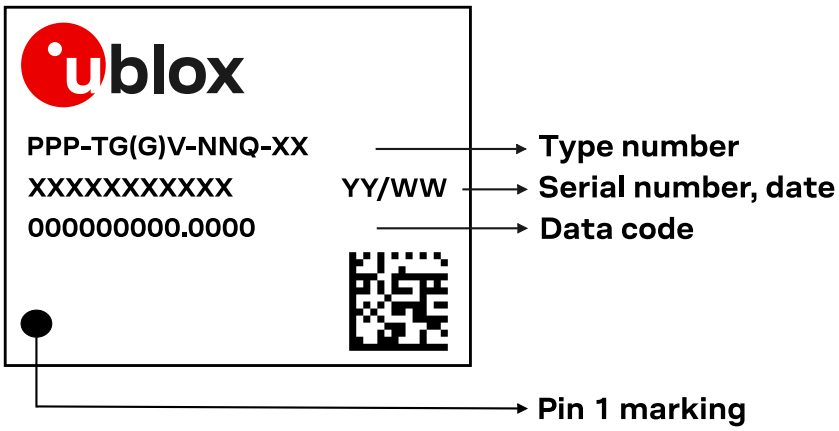



**Figure 6: Example of ZED-F9T-20B product marking**

| Code | Meaning | Example |
|---|---|---|
| PPP | Form factor | ZED |
| TG(G) | Platform | F9 = u-blox F9 |
| V | Variant | T = Timing |
| NN | Major product version | 00, 01, ..., 99 |
| Q | Product grade | A = Automotive, B = Professional, C= Standard |
| XX | Revision | Hardware and firmware revisions |
| YY/WW or YYWW | Production date | Year/week, e.g. 24/04 or 2404 |
| XXXXXXXXXXX | Serial number | Alphanumeric characters, e.g. BN600001181 |
| 000000000.0000 | Data code | Alphanumeric characters |
| Other information | QR code | For internal/technical use. |

**Table 21: Description of product marking**

## 8.2 Product identifiers

The ZED-F9T-20B label features three product identifiers: product name, ordering code, and type number. The product name identifies all u-blox products. It is used in documentation such as this Data sheet and is independent of packaging and product grade. The ordering code indicates the major product version and product grade, and the type number additionally specifies the hardware and firmware revisions.

Table 22 describes the three different product identifiers used in the ZED-F9T-20B label

| Identifier | Format | Example |
|---|---|---|
| Product name | PPP-TG(G)V | ZED-F9T |
| Ordering code | PPP-TG(G)V-NNQ | ZED-F9T-20B |



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| Identifier | Format | Example |
|---|---|---|
| Type number | PPP-TG(G)V-NNQ-XX | ZED-F9T-20B-00 |

**Table 22: Product identifiers**

## 8.3 Ordering codes

| Ordering code | Product | Remark |
|---|---|---|
| ZED-F9T-20B | u-blox ZED-F9T | |

**Table 23: Product ordering codes**

u-blox provides information on product changes affecting the form factor, size or function of the product. For the Product change notifications (PCNs), see our website at https://www.u-blox.com/en/product-resources.



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# Related documents

**[1]** ZED-F9T Integration manual, UBX-21040375
**[2]** TIM 2.25 Interface description, UBXDOC-963802114-13231
**[3]** Product packaging reference guide, UBX-14001652
**[4]** Radio Resource LCS Protocol (RRLP), (3GPP TS 44.031 version 11.0.0 Release 11)

☞ For regular updates to u-blox documentation and to receive product change notifications please register on our homepage https://www.u-blox.com.



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# Revision history

| Revision | Date | Status / comments |
|---|---|---|
| R01 | 28-Aug-2024 | Initial version |
| R02 | 23-Oct-2024 | Updates:<br>• Product status to engineering sample<br>• Firmware to TIM 2.24<br>• Added USB voltages and Pull-up resistance details in table Operating conditions |
| R03 | 03-Jan-2025 | Updates:<br>• Product status to initial production<br>• Firmware to TIM 2.25<br>• Product marking and ordering information section |
| R04 | 28-May-2026 | Updates:<br>• Product status to mass production<br>• RTCM version updated to 3.4<br>• Added input impedance at RF_IN in the Operating conditions table<br>• Product marking section |



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# Contact

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For further support and contact information, visit us at www.u-blox.com/support.



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