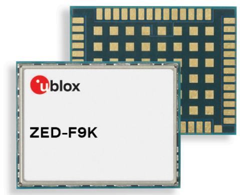
P

ZED-F9K

High Precision ADR with 3D sensors

Data Sheet



Abstract

This data sheet describes the ZED-F9K high precision module with 3D sensors and a multi-band GNSS receiver. The module provides lane-accurate positioning under the most challenging conditions, decimeter level accuracy for automotive mass markets, and it is ideal for ADAS, V2X and head-up display. It provides low-risk multi-band RTK turnkey solution with built-in inertial sensors and lag-free displays with up to 30 Hz real-time position update rate.

www.u-blox.com

UBX-17061422 - R02

Document Information

Title	**ZED-F9K**
Subtitle	High Precision ADR with 3D sensors
Document type	Data Sheet
Document number	UBX-17061422
Revision and date	R02 25-Feb-2019
Document status	Objective Specification – Confidential

Product status	Corresponding content status	
In Development / Prototype	Objective Specification	Target values. Revised and supplementary data will be published later.
Engineering Sample	Advance Information	Data based on early testing. Revised and supplementary data will be published later.
Initial Production	Early Production Information	Data from product verification. Revised and supplementary data may be published later.
Mass Production / End of Life	Production Information	Document contains the final product specification.

This document applies to the following products:

Product name	Type number	Firmware version	PCN reference
ZED-F9K	ZED-F9K-00B-00	TBD	N/A

Contents

1 Functional description

1.1 Overview

The ZED-F9K module features the u-blox F9 multi-band L1/L2 GNSS receiver with rapid convergence time within seconds. This mass-market component provides decimeter-level positioning with high availability, while making use of all 4 GNSS constellations simultaneously.

It is the first dead-reckoning module with an integrated Inertial Measurement Unit (IMU) capable of high precision positioning. The sophisticated built-in algorithms fuse the IMU data, GNSS measurements, wheel ticks, and vehicle dynamics model to provide lane accurate positioning where GNSS alone would fail. The module operates under open-sky motorways, in the wooded countryside, in difficult urban environments, and even in tunnels and underground parking. In modern automotive applications, such as Advanced Driver Assistance System (ADAS) where availability can improve the safety of our roads, ZED-F9K is the ultimate solution.

The device is a turnkey solution eliminating the technical risk of integrating third party libraries, precise positioning engines, and the multi-faceted hardware engineering aspects of radio frequency design and digital design. The u-blox approach provides a transparent evaluation of the positioning solution and clear lines of responsibility for design support while reducing supply chain complexity during production.

ZED-F9K is ideal for innovative automotive architecture designs with limited space and power. The module provides accurate location services to the increasing number of intelligent Electronic Control Units (ECU) such as telematics control unit, navigation system, infotainment and V2X safety systems.

The module reaches a high navigation output rate of up to 30 Hz. The on-board processor augments fused GNSS position with additional IMU-based position estimates. Drivers experience responsive, lag-free user interfaces. ZED-F9K can output raw IMU and raw GNSS data for advanced applications.

The module supports a range of leading correction services. ZED-F9K comes with built-in support for RTCM 3.3 formatted OSR-type corrections, and in a future release, SSR-type corrections. SSR-based techniques use data sparingly and are suitable for both IP-based cellular networks and broadcast-based satellite connectivity. This unique combination ensures the reliable distribution of correction services scalable to millions of vehicles using mobile networks in populated areas and satellites for remote areas.

ZED-F9K modules are manufactured in ISO/TS 16949 certified sites and are fully tested on a system level. Qualification tests are performed as stipulated in the ISO 16750 standard: “Road vehicles– Environmental conditions and testing for electrical and electronic equipment.”

1.2 Performance

Parameter	Specification	
Receiver type	Multi-band GNSS high precision receiver	
Accuracy of time pulse signal	RMS 99%	30 ns 60 ns
Frequency of time pulse signal		0.25 Hz to 10 MHz (configurable)

Parameter	Specification	
Operational limits[1]	Dynamics Altitude Velocity	≤ 4 g 50,000 m 500 m/s
Position error during GNSS loss[2]	3D Gyro + 3D accelerometer + speed pulse	2%
High Navigation Rate output[3]		30 Hz
Max navigation update rate (RTK)[3 4]		5 Hz
Velocity accuracy[5]		0.05 m/s
Dynamic heading accuracy[5]		0.3 deg
Max sensor measurement output rate		100 Hz

GNSS		GPS+GLO+GAL+BDS
Acquisition[6]	Cold start	24 s
	Hot start	2 s
	Aided starts[7]	2 s
Convergence time[8]	RTK	TBD
Sensitivity[9]	Tracking and Nav.	-151 dBm
	Reacquisition	-151 dBm
	Cold start	-147 dBm
	Hot start	-151 dBm
Horizontal pos. accuracy	RTK[8 10 11]	0.2 m
Vertical pos. accuracy	RTK[8 10 11]	0.4 m

Table 1: ZED-F9K performance in different GNSS modes

☞ BDS B2I is not enabled by default.

1.3 Supported GNSS constellations

The ZED-F9K GNSS modules are concurrent GNSS receivers that can receive and track multiple GNSS constellations. Owing to the multi-band RF front-end architecture, all four major GNSS constellations (GPS, GLONASS, Galileo and BeiDou) plus QZSS satellites can be received concurrently. All satellites in view can be processed to provide an RTK navigation solution when used with correction data. If power consumption is a key factor, the receiver can be configured for a sub-set of GNSS constellations.

1 Assuming Airborne 4 g platform
2 Typical error incurred without GNSS as a percentage of distance travelled, applicable to four wheel road vehicle
3 Configured the receiver for 2 Constellations only
4 Rates with QZSS enabled for > 98% fix report rate under typical conditions
5 50% @ 30 m/s for dynamic operation
6 All satellites at -130 dBm
7 Dependent on the speed and latency of the aiding data connection, commanded starts.
8 Depends on atmospheric conditions, baseline length, GNSS antenna, multipath conditions, satellite visibility and geometry.
9 Demonstrated with a good external LNA
10 Measured using 1 km baseline and patch antennas with good ground planes. Does not account for possible antenna phase center offset errors. ppm limited to baselines up to 20 km.
11 Targeted performance

All satellites in view can be processed to provide an RTK navigation solution when used with correction data; the highest positioning accuracy will be achieved when the receiver is tracking signals on both bands from multiple satellites, and is provided with corresponding correction data.

The QZSS system shares the same L1 and L2 frequency bands as GPS and can always be processed in conjunction with GPS.

To take advantage of multi-band signal reception, dedicated hardware preparation must be made during the design-in phase. See the ZED-F9K Integration Manual [1] for u-blox design recommendations.

The ZED-F9K supports the GNSS and their signals as shown in Table 2.

GPS	GLONASS	Galileo	BeiDou
L1C/A (1575.42 MHz)	L1OF (1602 MHz + k*562.5 kHz, k = –7,..., 5, 6)	E1-B/C (1575.42 MHz)	B1I (1561.098 MHz)
L2C (1227.60 MHz)	L2OF (1246 MHz + k*437.5 kHz, k = –7,..., 5, 6)	E5b (1207.140 MHz)	B2I (1207.140 MHz)

Table 2: Supported GNSS and signals on ZED-F9K

☞ BeiDou B2I is not enabled by default.

The following GNSS assistance services can be activated on ZED-F9K:

AssistNow™ Online	AssistNow™ Offline	AssistNow™ Autonomous
Supported	-	-

Table 3: Supported Assisted GNSS (A-GNSS) Services

1.4 Supported GNSS augmentation systems

1.4.1 QZSS

The Quasi-Zenith Satellite System (QZSS) is a regional navigation satellite system that transmits additional GPS L1 C/A and L2C signals for the Pacific region covering Japan and Australia. The ZED-F9K high precision receiver is able to receive and track these signals concurrently with GPS L1 C/A and L2C signals, resulting in better availability especially under challenging signal conditions, e.g. in urban canyons.

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

1.4.2 Differential GNSS (DGNSS)

When operating in RTK mode, RTCM version 3.3 messages are required and the module supports DGNSS according to RTCM 10403.3. ZED-F9K can decode the following RTCM 3.3 messages:

Message Type	Description
RTCM 1001	L1-only GPS RTK observables
RTCM 1002	Extended L1-only GPS RTK observables
RTCM 1003	L1/L2 GPS RTK observables
RTCM 1004	Extended L1/L2 GPS RTK observables
RTCM 1005	Stationary RTK reference station ARP
RTCM 1006	Stationary RTK reference station ARP with antenna height
RTCM 1007	Antenna descriptor
RTCM 1009	L1-only GLONASS RTK observables
RTCM 1010	Extended L1-only GLONASS RTK observables

Message Type	Description
RTCM 1011	L1/L2 GLONASS RTK observables
RTCM 1012	Extended L1/L2 GLONASS RTK observables
RTCM 1033	Receiver and Antenna Description
RTCM 1074	GPS MSM4
RTCM 1075	GPS MSM5
RTCM 1077	GPS MSM7
RTCM 1084	GLONASS MSM4
RTCM 1085	GLONASS MSM5
RTCM 1087	GLONASS MSM7
RTCM 1094	Galileo MSM4
RTCM 1095	Galileo MSM5
RTCM 1097	Galileo MSM7
RTCM 1124	BeiDou MSM4
RTCM 1125	BeiDou MSM5
RTCM 1127	BeiDou MSM7
RTCM 1230	GLONASS code-phase biases

Table 4: Supported input RTCM 3.3 messages

1.5 Broadcast navigation data and satellite signal measurements

The ZED-F9K high precision receiver can output all the GNSS broadcast data upon reception from tracked satellites. This includes all the supported GNSS signals plus the augmentation service QZSS. The UBX-RXM-SFRBX message contains this information. The receiver also makes available the tracked satellite signal information, i.e. raw code phase and Doppler measurements, in a form aligned to the Radio Resource LCS Protocol (RRLP) [3]. For the UBX-RXM-SFRBX message specification, see the u-blox ZED-F9K Interface Description [2].

1.5.1 Carrier-phase measurements

The ZED-F9K 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 the u-blox ZED-F9K Interface Description [2].

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

1.6 Supported protocols

The ZED-F9K supports the following protocols:

Protocol	Type
UBX	Input/output, binary, u-blox proprietary
NMEA	Input/output, ASCII
RTCM 3.3	Input, binary

Table 5: Supported Protocols

For specification of the protocols, see the u-blox ZED-F9K Interface Description [2].

1.7 Automotive Dead Reckoning

u-blox's proprietary Automotive Dead Reckoning (ADR) solution uses a 3D inertial measurement unit (IMU) included within the module and speed pulses from the vehicle's wheel tick sensor. Alternatively, the vehicle speed data can be provided as messages via a serial interface. Sensor data and GNSS signals are processed together, achieving 100% coverage, with highly accurate and continuous positioning even in GNSS hostile environments (e.g. urban canyons) or in case of GNSS signal absence (e.g. tunnels and parking garages).

Wheel tick or speed sensor rate variations are calibrated automatically and continuously by the module, accommodating, for example, vehicle tire wear automatically.

☞ For more details, see the ZED-F9K Integration Manual[1].

The ZED-F9K combines GNSS and dead-reckoning measurements and computes a position solution at rates of up to 5 Hz[3]. These solutions are reported in standard NMEA, UBX-NAV-PVT and similar messages. High Navigation Rate output message (UBX-HNR-PVT) extends these results with IMU-only data to deliver accurate, low latency position measurements at rates up to 30 Hz.

Dead reckoning allows navigation to commence as soon as power is applied to the module (i.e. before a GNSS fix has been established) under the following conditions:

- the vehicle has not been moved while the module is switched off
- at least a dead-reckoning fix was available when the vehicle was last used
- a back-up supply has been available for the module since the vehicle was last used

☞ Save-on-Shutdown feature can be used in case of no back-up supply is available. All information necessary will be saved to flash and read from flash upon restart.

2 System description

2.1 Block diagram

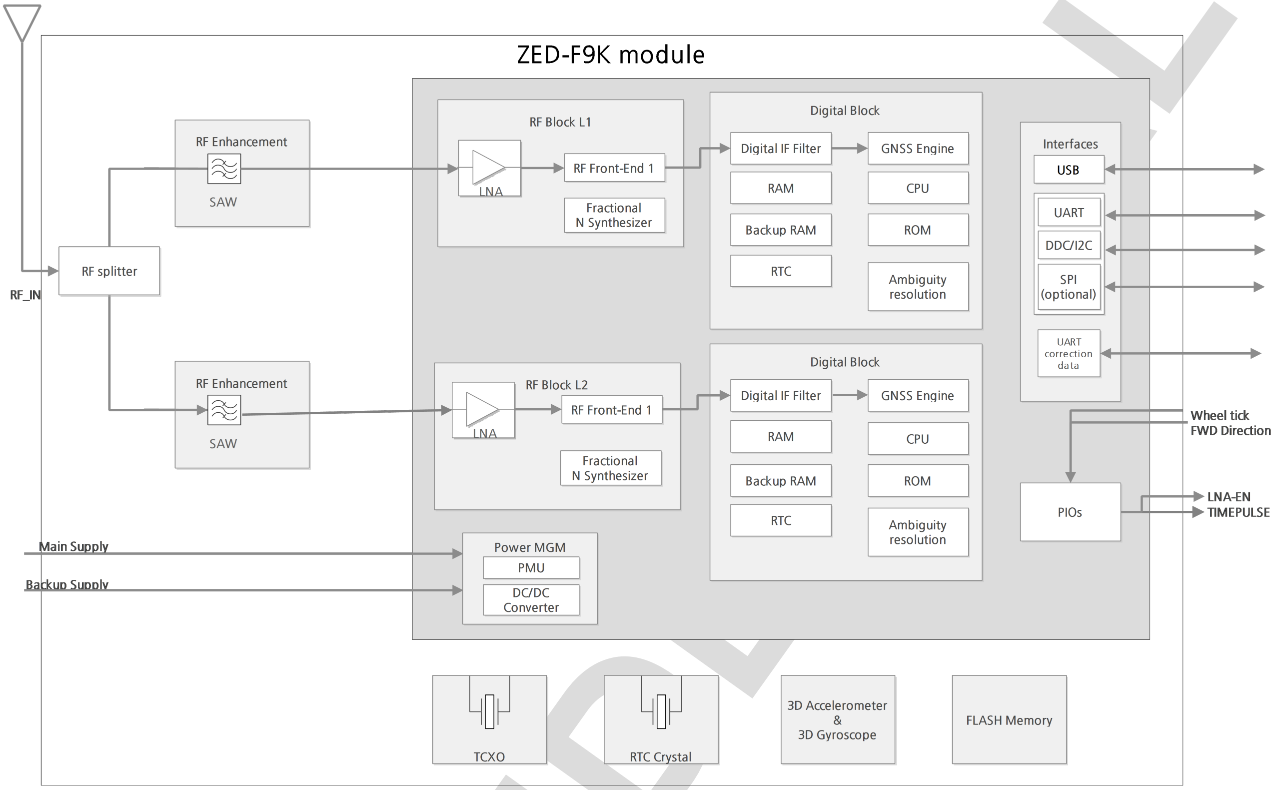


Figure 1: ZED-F9K block diagram

3 Pin definition

3.1 Pin assignment

The pin assignment of the ZED-F9K module is shown in Figure 2. The defined configuration of the PIOs is listed in Table 6.

☞ The ZED-F9K is an LGA package with the I/O on the outside edge and central ground pads.

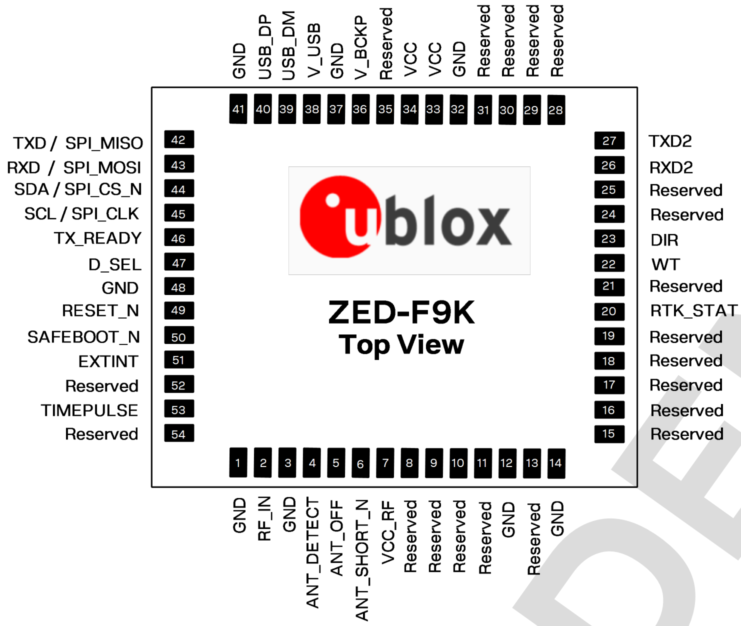


Figure 2: ZED-F9K pin assignment

Pin No	Name	I/O	Description
1	GND	I	Ground
2	RF_IN	I	RF input
3	GND	I	Ground
4	ANT_DETECT	I	Active Antenna Detect
5	ANT_OFF	O	External LNA disable
6	ANT_SHORT_N	O	Active antenna short detect
7	VCC_RF	O	Voltage for external LNA
8	Reserved	-	Reserved
9	Reserved	-	Reserved
10	Reserved	-	Reserved
11	Reserved	-	Reserved
12	GND	I	Ground
13	Reserved	-	Reserved
14	GND	I	Ground
15	Reserved	-	Reserved
16	Reserved	-	Reserved
17	Reserved	-	Reserved

Pin No	Name	I/O	Description
18	Reserved	-	Reserved
19	Reserved	-	Reserved
20	RTK_STAT	O	RTK status 0 – Fixed, blinking – receiving RTCM data, 1 – no corrections
21	Reserved	-	Reserved
22	WT	I	Wheel Ticks
23	DIR	I	Direction
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	I	Ground
33	VCC	I	Voltage supply
34	VCC	I	Voltage supply
35	Reserved	-	Reserved
36	V_BCKUP	I	Backup supply voltage
37	GND	I	Ground
38	V_USB	I	USB Power input
39	USB_DM	I/O	USB Data
40	USB_DP	I/O	USB Data
41	GND	I	Ground
42	TXD / SPI_MISO	O	Serial Port if D_SEL =1(or open). SPI MISO if D_SEL = 0
43	RXD / SPI_MOSI	I	Serial Port if D_SEL =1(or open). SPI MOSI if D_SEL = 0
44	SDA / SPI_CS_N	I/O	DDC Data if D_SEL =1 (or open). SPI Chip Select if D_SEL = 0
45	SCL / SPI_CLK	I/O	DDC Clock if D_SEL =1(or open). SPI Clock if D_SEL = 0
46	TX_READY	O	TX_Buffer full and ready for TX of data
47	D_SEL	I	Interface select
48	GND	I	Ground
49	RESET_N	I	RESET_N
50	SAFEBOOT_N	I	SAFEBOOT_N (for future service, updates and reconfiguration, leave OPEN)
51	EXT_INT	I	External Interrupt Pin
52	Reserved	-	Reserved
53	TIMEPULSE	O	Time Pulse
54	Reserved	-	Reserved

Table 6: ZED-F9K pin assigment

4 Electrical specification

☞ The limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only. Operation of the device at these or at any other conditions above those given below is not implied. Exposure to limiting values for extended periods may affect device reliability.

☞ Where application information is given, it is advisory only and does not form part of the specification.

4.1 Absolute maximum ratings

Parameter	Symbol	Condition	Min	Max	Units
Power supply voltage	VCC		-0.5	3.6	V
Backup battery voltage	V_BCKP		-0.5	3.6	V
Input pin voltage	Vin		-0.5	VCC+0.5	V
DC current through any digital I/O pin (except supplies)	Ipin			TBD	mA
VCC_RF output current	ICC_RF			100	mA
Input power at RF_IN	Prfin	source impedance = 50 Ω, continuous wave		10	dBm
Storage temperature	Tstg		-40	+85	°C

Table 7: Absolute maximum ratings

⚠ **Attention** The product is not protected against overvoltage or reversed voltages. If necessary, voltage spikes exceeding the power supply voltage specification, given in the table above, must be limited to values within the specified boundaries by using appropriate protection diodes.

4.2 Operating conditions

☞ All specifications are at an ambient temperature of 25°C. Extreme operating temperatures can significantly impact specification values. Applications operating near the temperature limits should be tested to ensure the specification.

Parameter	Symbol	Min	Typical	Max	Units	Condition
Power supply voltage	VCC	2.7	3.0	3.6	V	
Backup battery voltage	V_BCKP	1.65		3.6	V	
Backup battery current	I_BCKP		40		µA	
SW backup current	I_SWBCKP		1.4		mA	
Input pin voltage range	Vin	0		VCC	V	
Digital IO pin low level input voltage	Vil	0		0.8	V	
Digital IO pin high level input voltage	Vih	2		VCC+0.3	V	
Digital IO pin low level output voltage	Vol			0.4	V	Iol = 2 mA
Digital IO pin high level output voltage	Voh	VCC – 0.4			V	Ioh = 2 mA
VCC_RF voltage	VCC_RF		VCC - 0.1		V	
VCC_RF output current	ICC_RF			50	mA	
Receiver chain noise figure[12]	NFtot		9.5		dB	

12 Only valid for the GPS L1 band

Parameter	Symbol	Min	Typical	Max	Units	Condition
Operating temperature	Topr	-40		85	°C	

Table 8: Operating conditions

☞ Operation beyond the specified operating conditions can affect device reliability.

4.3 Indicative power requirements

Table 9 lists examples of the total system supply current including RF and baseband section for a possible application.

☞ Values in Table 9 are provided for customer information only, as an example of typical current requirements. Values are characterized on samples with a commanded cold start – actual power requirements can vary depending on FW version used, external circuitry, number of SVs tracked, signal strength, type and time of start, duration, and conditions of test.

Symbol	Parameter	Conditions	GPS+GLO +GAL+BDS	GPS	Unit
I_{PEAK}	Peak current	Acquisition	130	120	mA
I_{VCC}[13]	VCC current	Acquisition	90	75	mA
I_{VCC}[13]	VCC current	Tracking	85	68	mA

Table 9: Currents to calculate the indicative power requirements

All values in Table 9 are measured at 25°C ambient temperature.

13 Simulated signal

5 Communications interfaces

There are several communications interfaces including UART, SPI, I2C and USB.

5.1 UART interface

There are two UART interfaces: UART1 and UART2. UART1 and UART2 operate up to and including a speed of 921600 baud. No hardware flow control on UART1 and UART2 is supported.

UART1 is the primary host communications interface while UART2 is dedicated for RTCM 3.3 corrections and NMEA. No UBX protocol is supported on UART 2.

UART1 is enabled by default if D_SEL = 1 or unconnected.

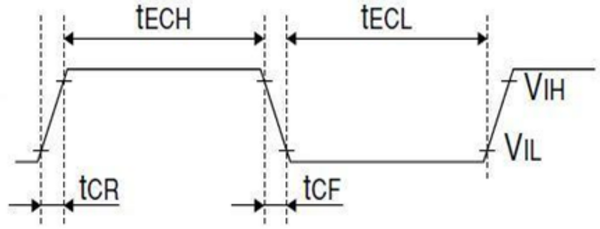


Figure 3: ZED-F9K high precision receiver UART timing specifications

Symbol	Parameter	Min	Max	Unit
V_{IL}	LOW-level input voltage	0	0.2VCC	V
V_{IH}	HIGH-level input voltage	0.7VCC	VCC+0.3	V
t_{ECH}	HIGH period of external data input	0	0.4	µs
t_{ECL}	LOW period of external data input	TBA	TBA	µs
R_u	Baudrate	9600	921600	bps
t_{CR}	Rise time of data		5	ns
t_{CF}	Fall time of data		5	ns

Table 10: ZED-F9K UART timings and specifications

5.2 SPI interface

The ZED-F9K has an SPI slave interface that can be selected by setting D_SEL = 0. The SPI slave interface is shared with UART1. The SPI pins available are: SPI_MISO (TXD), SPI_MOSI (RXD), SPI_CS_N, SPI_CLK. The SPI interface is designed to allow communication to a host CPU. The interface can be operated in slave mode only. Note that SPI is not available in the default configuration because its pins are shared with the UART and DDC interfaces. The maximum transfer rate using SPI is 125 kB/s and the maximum SPI clock frequency is 5.5 MHz.

This section provides SPI timing values for the ZED-F9K slave operation. Timing specific A, B, C, D and E are presented visually in Figure 4. The following tables present timing values under different capacitive loading conditions. Default SPI configuration is CPOL = 0 and CPHA = 0.

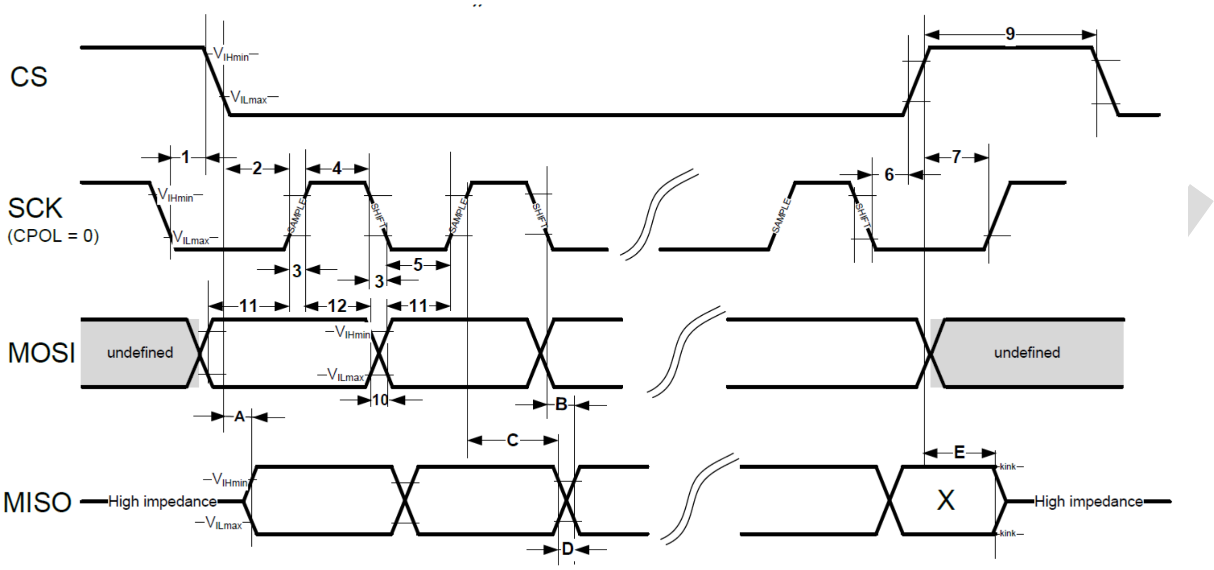


Figure 4: ZED-F9K high precision receiver SPI specification Mode 1: CPHA=0 SCK = 5.33 MHz

☞ Timings 1 - 12 are not specified here.

Timing value @ 2 pF load	Min (ns)	Max (ns)
"A" - MISO data valid time (CS)	14	38
"B" - MISO data valid time (SCK) weak driver mode	21	38
"C" - MISO data hold time	114	130
"D" - MISO rise/fall time, weak driver mode	1	4
"E" - MISO data disable lag time	20	32

Table 11: ZED-F9K SPI timings @ 2pF load

Timing value @ 20 pF load	Min (ns)	Max (ns)
"A" - MISO data valid time (CS)	19	52
"B" - MISO data valid time (SCK) weak driver mode	25	51
"C" - MISO data hold time	117	137
"D" - MISO rise/fall time, weak driver mode	6	16
"E" - MISO data disable lag time	20	32

Table 12: ZED-F9K SPI timings @ 20pF load

Timing value @ 60 pF load	Min (ns)	Max (ns)
"A" - MISO data valid time (CS)	29	79
"B" - MISO data valid time (SCK) weak driver mode	35	78
"C" - MISO data hold time	122	152
"D" - MISO rise/fall time, weak driver mode	15	41
"E" - MISO data disable lag time	20	32

Table 13: ZED-F9K SPI timings @ 60pF load

5.3 Slave I²C interface

An I²C compliant DDC interface is available for communication with an external host CPU. The interface can be operated in slave mode only. The DDC protocol and electrical interface are fully compatible with Fast-Mode of the I^2C industry standard. Since the maximum SCL clock frequency is 400 kHz, the maximum bit rate is 400 kbit/s. The interface stretches the clock when slowed down while serving interrupts, therefore the real bit rates may be slightly lower.

☞ The I^2C interface is only available with the UART default mode. If the SPI interface is selected by using D_SEL = 0, the I^2C interface is not available.

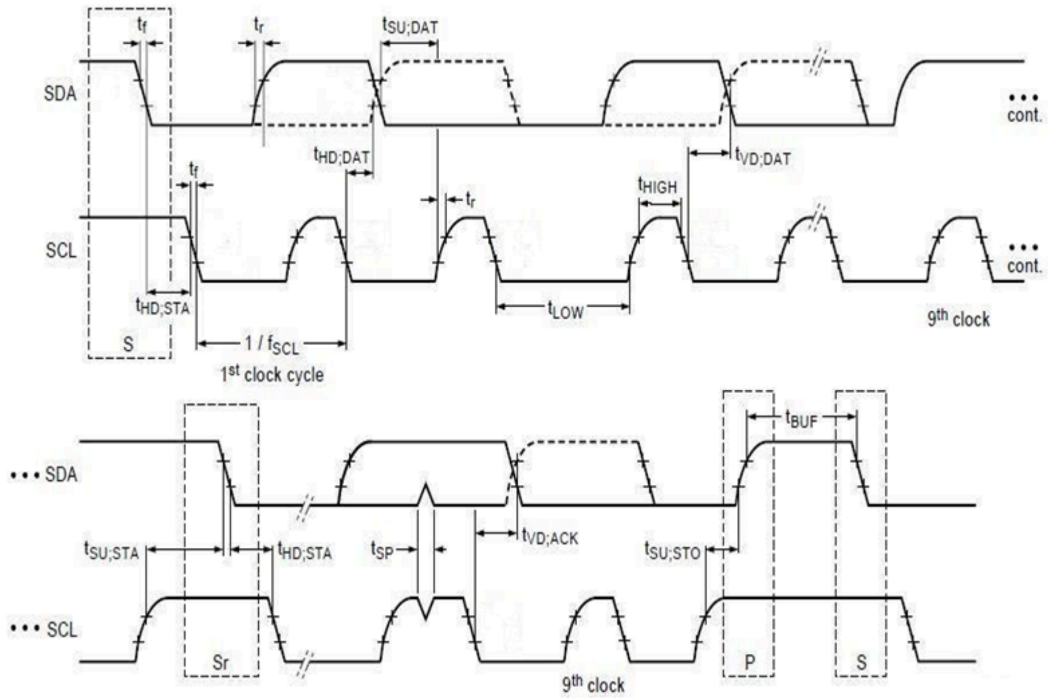


Figure 5: ZED-F9K high precision receiver I^2C slave specification

Symbol	Parameter	Min	Max	Unit
V_{IL}	LOW-level input voltage	VSS-0.3	0.3VCC	V
V_{IH}	HIGH-level input voltage	0.7VCC	VCC+0.3	V
V_{OL}	LOW-level output voltage		0.4	V
V_{OH}	HIGH-level output voltage	VCC-0.4		V
f_{SCL}	SCL clock frequency	0	400	kHz
$t_{HD;STA}$	Hold time (repeated) START condition	4.0/1	-	µs
t_{LOW}	LOW period of the SCL clock	5/2	-	µs
t_{HIGH}	HIGH period of the SCL clock	4.0/1	-	µs
$t_{SU;STA}$	Set-up time for a repeated START condition	5/1	-	µs
$t_{HD;DAT}$	Data hold time	0/0	-	µs
$t_{SU;DAT}$	Data set-up time	250/100		µs
t_r	Rise time of both SDA and SCL signals	-	1000/300 (for C 400pF)	µs
t_f	Fall time of both SDA and SCL signals	-	300/300 (for C 400pF)	µs
$t_{SU;STO}$	Set-up time for STOP condition	4.0/1	-	µs
t_{BUF}	Bus free time between a STOP and START condition	5/2	-	µs
$t_{VD;DAT}$	Data valid time	-	4/1	µs

Symbol	Parameter	Min	Max	Unit
$t_{VD;ACK}$	Data valid acknowledge time	-	4/1	µs
V_{nL}	Noise margin at the LOW level	0.1VCC	-	V
V_{nH}	Noise margin at the HIGH level	0.2VCC	-	V

Table 14: ZED-F9K I^2C Slave timings and specifications

5.4 USB interface

A USB interface, which is compatible to USB version 2.0 FS (Full Speed, 12 Mbit/s), can be used for communication as an alternative to the UART. The VDD_USB pin supplies the USB interface.

5.5 WT (wheel-tick) and DIR (Forward/reverse indication) inputs

ZED-F9K pin 22 (WT) is available as a wheel-tick input. Pin 23 (DIR) is available as a direction input (forward/reverse indication).

By default the wheel-tick count is derived from the rising edges of the WT input.

For optimal performance the wheel-tick resolution should be less than 5 cm.

The DIR input shall indicate whether the vehicle is moving forwards or backwards.

Alternatively, the vehicle WT (or speed) and DIR inputs can be provided via one of the communication interfaces with UBX-ESF-MEAS messages.

☞ For more details, see the ZED-F9K Integration Manual[1].

5.6 Default interface settings

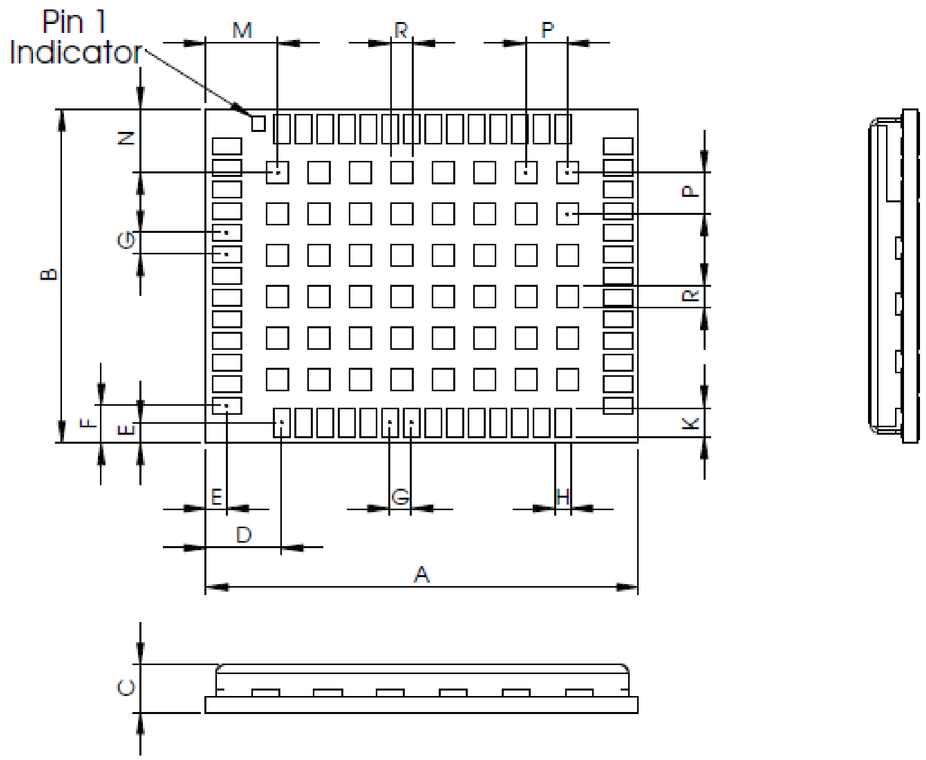
Interface	Settings
UART1 Output	38400 Baud, 8 bits, no parity bit, 1 stop bit. NMEA **GGA, GLL, GSA, GSV, RMC, VTG, TXT** (and no UBX) messages are output by default.
UART1 Input	38400 Baud, 8 bits, no parity bit, 1 stop bit. UBX, NMEA and RTCM 3.3 messages are enabled by default.
UART2 Output	38400 Baud, 8 bits, no parity bit, 1 stop bit. **No host interface support.** Output disabled by default
UART2 Input	38400 Baud, 8 bits, no parity bit, 1 stop bit. **No Host interface support.** RTCM 3.3 enabled by default
USB Output	NMEA **GGA, GLL, GSA, GSV, RMC, VTG, TXT** (and no UBX) messages are output by default.
USB Input	UBX, NMEA, RTCM 3.3 protocols enabled by default.
DDC	Fully compatible with the I^2C industry standard, available for communication with an external host CPU or u-blox cellular modules, operated in slave mode only. Default messages activated as in UART1. Input/output protocols available as in UART1. Maximum bit rate 400 kb/s.
SPI	Allows communication to a host CPU, operated in slave mode only. Default messages activated as in UART1. Input/output protocols available as in UART1. SPI is not available unless the D_SEL interface is set up accordingly (see D_SEL interface).

Table 15: Default interface settings

UART2 can be configured as an RTCM interface. RTCM 3.3 is the default input protocol. UART2 may also be configured for NMEA output, typically NMEA GGA output for use with VRS correction services.

By default the ZED-F9K outputs NMEA 4.10 messages that include satellite data for all GNSS bands being received. This results in a higher NMEA output load than u-blox M8 for each navigation period. Please ensure the UART1 baud rate being used is sufficient for the set navigation rate and the amount of GNSS signals being received.

6 Mechanical specification



Symbol	Min. (mm)	Typ. (mm)	Max. (mm)
A	21.80	22.00	22.35
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
R	0.88	1.10	1.32
Weight		1.85g	

Figure 6: ZED-F9K mechanical drawing

7 Reliability tests and approvals

All u-blox modules are based on AEC-Q100 qualified GNSS chips.

Tests for product family qualifications are according to ISO 16750 "Road vehicles – environmental conditions and testing for electrical and electronic equipment", and appropriate standards.

7.1 Approvals

The product is designed to in compliance with the essential requirements and other relevant provisions of Radio Equipment Directive (RED) 2014/53/EU.

Products marked with this lead-free symbol on the product label comply with the Restriction of the use of certain hazardous substances Directive (RoHS) 2015/863/EU.

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

8 Labeling and ordering information

8.1 Product labeling

The labeling of the ZED-F9K modules provides product information and revision information. For more information contact sales.

8.2 Explanation of product codes

Three different product code formats are used. The **Product Name** is used in documentation such as this data sheet and identifies all u-blox products, independent of packaging and quality grade. The **Ordering Code** includes options and quality, while the **Type Number** includes the hardware and firmware versions. Table 16 below details these three different formats.

Format	Structure
Product Name	ZED-F9K
Ordering Code	ZED-F9K-00B
Type Number	ZED-F9K-00B-00

Table 16: Product code formats

8.3 Ordering codes

Ordering No.	Product
ZED-F9K-00B	u-blox ZED-F9K

Table 17: Product ordering codes

☞ Product changes affecting form, fit or function are documented by u-blox. For a list of Product Change Notifications (PCNs) see our website at: https://www.u-blox.com/en/product-resources.

9 Related documents

[1] ZED-F9K Integration Manual, Docu. No. UBX-18047567

[2] ZED-F9K Interface Description, Docu. No. UBX-19000811

[3] 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 (http://www.u-blox.com).

10 Revision history

Revision	Date	Name	Status / Comments
R01	19-Feb-2019	ssid	Objective Specification
R02	25-Feb-2019	ssid	Objective Specification

Contact

For complete contact information visit us at www.u-blox.com.

u-blox Offices

North, Central and South America

u-blox America, Inc.
Phone: +1 703 483 3180
E-mail: info_us@u-blox.com

Regional Office West Coast
Phone: +1 408 573 3640
E-mail: info_us@u-blox.com

Technical Support
Phone: +1 703 483 3185
E-mail: support_us@u-blox.com

Headquarters

Europe, Middle East, Africa

u-blox AG
Phone: +41 44 722 74 44
E-mail: info@u-blox.com
Support: support@u-blox.com

Documentation Feedback
Email: docsupport@u-blox.com

Asia, Australia, Pacific

u-blox Singapore Pte. Ltd.
Phone: +65 6734 3811
E-mail: info_ap@u-blox.com
Support: support_ap@u-blox.com

Regional Office Australia
Phone: +61 2 8448 2016
E-mail: info_anz@u-blox.com
Support: support_ap@u-blox.com

Regional Office China (Beijing)
Phone: +86 10 68 133 545
E-mail: info_cn@u-blox.com
Support: support_cn@u-blox.com

Regional Office China (Chongqing)
Phone: +86 23 6815 1588
E-mail: info_cn@u-blox.com
Support: support_cn@u-blox.com

Regional Office China (Shanghai)
Phone: +86 21 6090 4832
E-mail: info_cn@u-blox.com
Support: support_cn@u-blox.com

Regional Office China (Shenzhen)
Phone: +86 755 8627 1083
E-mail: info_cn@u-blox.com
Support: support_cn@u-blox.com

Regional Office India
Phone: +91 80 4050 9200
E-mail: info_in@u-blox.com
Support: support_in@u-blox.com

Regional Office Japan (Osaka)
Phone: +81 6 6941 3660
E-mail: info_jp@u-blox.com
Support: support_jp@u-blox.com

Regional Office Japan (Tokyo)
Phone: +81 3 5775 3850
E-mail: info_jp@u-blox.com
Support: support_jp@u-blox.com

Regional Office Korea
Phone: +82 2 542 0861
E-mail: info_kr@u-blox.com
Support: support_kr@u-blox.com

Regional Office Taiwan
Phone: +886 2 2657 1090
E-mail: info_tw@u-blox.com
Support: support_tw@u-blox.com