XPLR-HPG-2

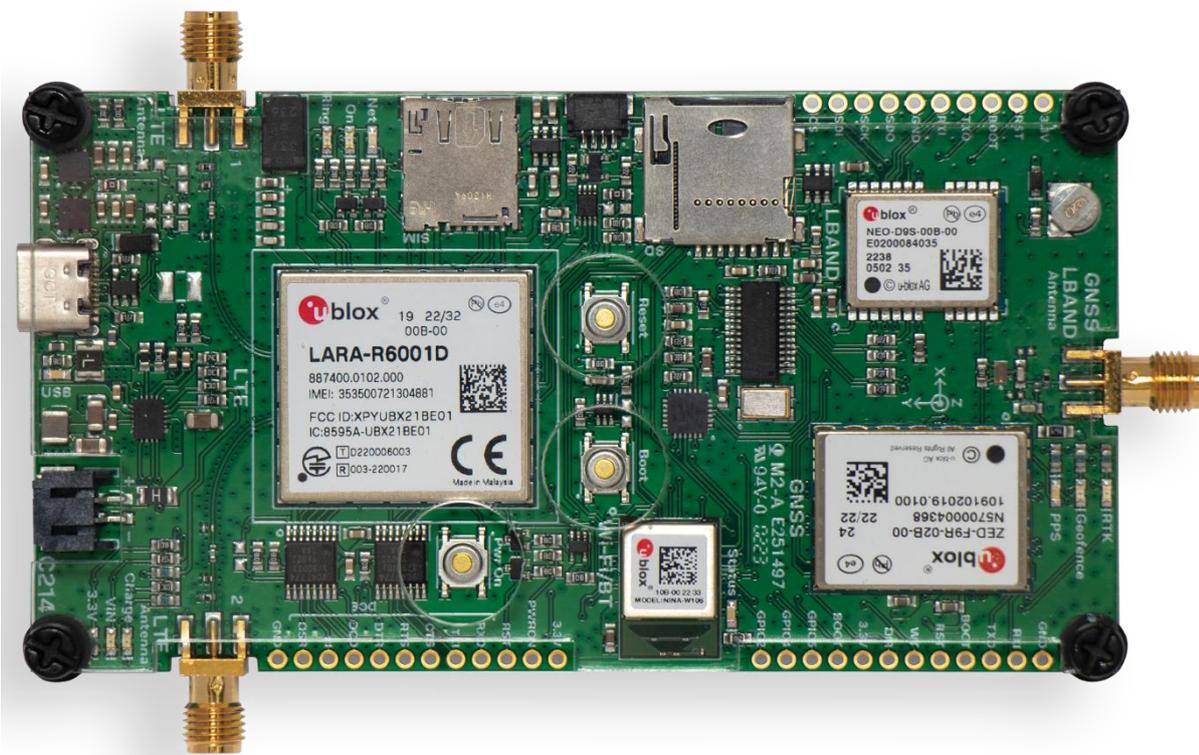## High-precision GNSS evaluation platform
User guide

Abstract

This document describes the XPLR-HPG-2 explorer kit used for evaluating and prototyping of high-precision GNSS solutions. Describing the positioning, cellular and short-range radio modules hosted on the C214 host application board, this document explains the various module configurations and related use cases that can be explored using the kit. It also provides a quick start guide to get XLPR-HPG-2 up and running as quickly as possible.

www.u-blox.com

Document information

Title	**XPLR-HPG-2**	
Subtitle	High-precision GNSS evaluation platform	
Document type	User guide	
Document number	UBX-22039292	
Revision and date	R01	7-Jun-2023
Disclosure restriction	C1-Public	

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	Ordering code	Firmware version	Application version	PCN reference	Product status
XPLR-HPG-2	-	-		N/A	In development/Prototype

Contents

1 Product description

The XPLR-HPG-2 explorer kit provides a compact platform for the evaluation and prototyping of the ublox solution for high-precision GNSS. Comprising integrated GNSS, cellular, and short-range radio modules, the platform accesses correction data from satellite broadcasts using an L-band satellite GNSS receiver or through IP connectivity using Wi-Fi or LTE. The correction data, which compensates for satellite and atmospheric errors, is provided by the u-blox PointPerfect GNSS augmentation service and delivered through the Thingstream IoT service delivery platform. The platform topology and data communication between each of the component systems is shown in Figure 1.
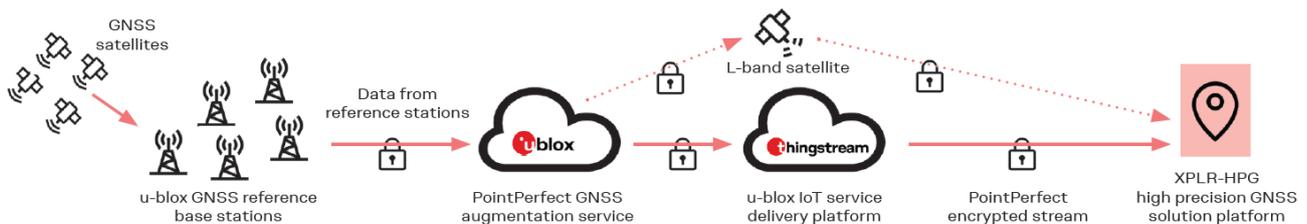

Figure 1: XPLR-HPG-2 platform topology

1.1 Module integration

XPLR-HPG-2 integrates the following positioning, cellular, and short-range radio modules:

- ZED-F9R high precision dead reckoning module [6]: Global navigation satellite system (GNSS) for high-precision GNSS positioning in challenging environments, including:
  - o Multi-band GNSS receiver delivers centimeter-level accuracy
  - o Native support for PointPerfect GNSS augmentation service
- NEO-D9S correction data L-band receiver module [9]: Processes the correction data necessary for correcting satellite and atmospheric errors. The module processes external corrections to compensate for various imperfections called GNSS errors, with:
  - o Access to centimeter-level GNSS corrections globally
  - o Freedom to select GNSS correction data delivery channel
  - o Allows selection of desired L-band GNSS correction service
- LARA-R6 single or multi-mode LTE Cat 1 cellular module [12]: Modem for Internet of Things (IoT) and Machine to Machine (M2M) applications, including:
  - o Secure Cloud
  - o Universal connectivity and reliable performance in smallest form factor
  - o Reduced logistics complexity, with three regional product variants and extensive certifications from the mobile network operator (MNO)
  - o Any region, any band, any technology for simple roaming anywhere in the world
  - o World's smallest LTE Cat 1 module - used for cellular applications - with global coverage, ideal for size-constrained devices (LTE CAT-1 = medium speed wireless communication standard specifically designed for Internet of Things (IoT) and Machine to Machine (M2M) use cases).
  - o Receive-diversity for reliable performance in difficult conditions
  - o Secure by design to always keep your device running and updated
- NINA-W106 stand-alone multiradio module [3], including:
  - o Wi-Fi 802.11b/g/n and dual-mode Bluetooth v4.2 radio connectivity
  - o Powerful open CPU for advanced customer applications
  - o Small footprint and multiple antenna options

1.2   Kit includes

The XPLR-HPG-2 kit is suitable to develop applications that require high-precision GNSS positioning devices feature real-time kinematics, dead reckoning, cellular, Wi-Fi, and Bluetooth communication. The purchase of the kit includes:

- C214 high-precision GNSS demo board hosting the GNSS and communications modules
- 2x LTE antennas
- 1x GNSS high precision patch antenna that includes L-band
- 2x protective plexiglass sheets
- Screws and standoffs
- USB cable
- Thingstream promo code that provides one month of free access to the PointPerfect IP service
- Application software example in source code
- PointPerfect GNSS augmentation service (Trial version)
- AssistNow location services

☞   XPLR-HPG-2 is shipped as a fully assembled product that includes two protective plexiglass sheets over each side the PCB. Customers need only connect the antennas before configuring and using the platform.

2 Hardware

XPLR-HPG-2 comprises four u-blox modules:

- NINA-W106 short range radio as the controller and for Wi-Fi/Bluetooth connectivity
- ZED-F9R GNSS receiver
- NEO-D9S L-BAND receiver
- LARA-R6001D LTE Cat 1 module

See also Module integration.

2.1 C214 application board

The C214 application board hosts the L-band, GNSS, LTE, and multiradio modules together with the following component items:

- USB-C connector (J1) connected to a 4-port USB hub that facilitates the direct communication of all the modules to an external PC
- MicroSD connector (J10), which can be used for logging and persistent memory
- Li-ion battery charger capable of charging and powering the board by a single-cell Li-ion battery, which makes evaluation in the field much easier. The charger connects to the USB-C connector for power.
- QWIIC® connector for evaluating external sensors
- LEDs for presenting the status of the board
- Three buttons:
  - o Power On: Press to power up the LARA-R6 LTE module
  - o Reset: Press to reset the NINA-W106 module
  - o Boot: Press and hold for five seconds to erase user credentials
- Three pin headers (J2, J5 and J10) that usefully expose the modules IOs
- I2C (J4) pin header for connecting external modules or devices through the QWIIC connector
- JTAG (J11) pin header that can be used to debug the NINA-W106 module
- One SMA connector for GNSS and L-band receiver antenna
- Two SMA connectors for LTE Cat 1 modem antennas

☞ The schematics and other project resources can be found on the Altium XPLR-HPG hardware repository [16] under the XPLR-HPG-2 folder.

Figure 2 shows the top side of the C214 application board and the physical location of the main component items.
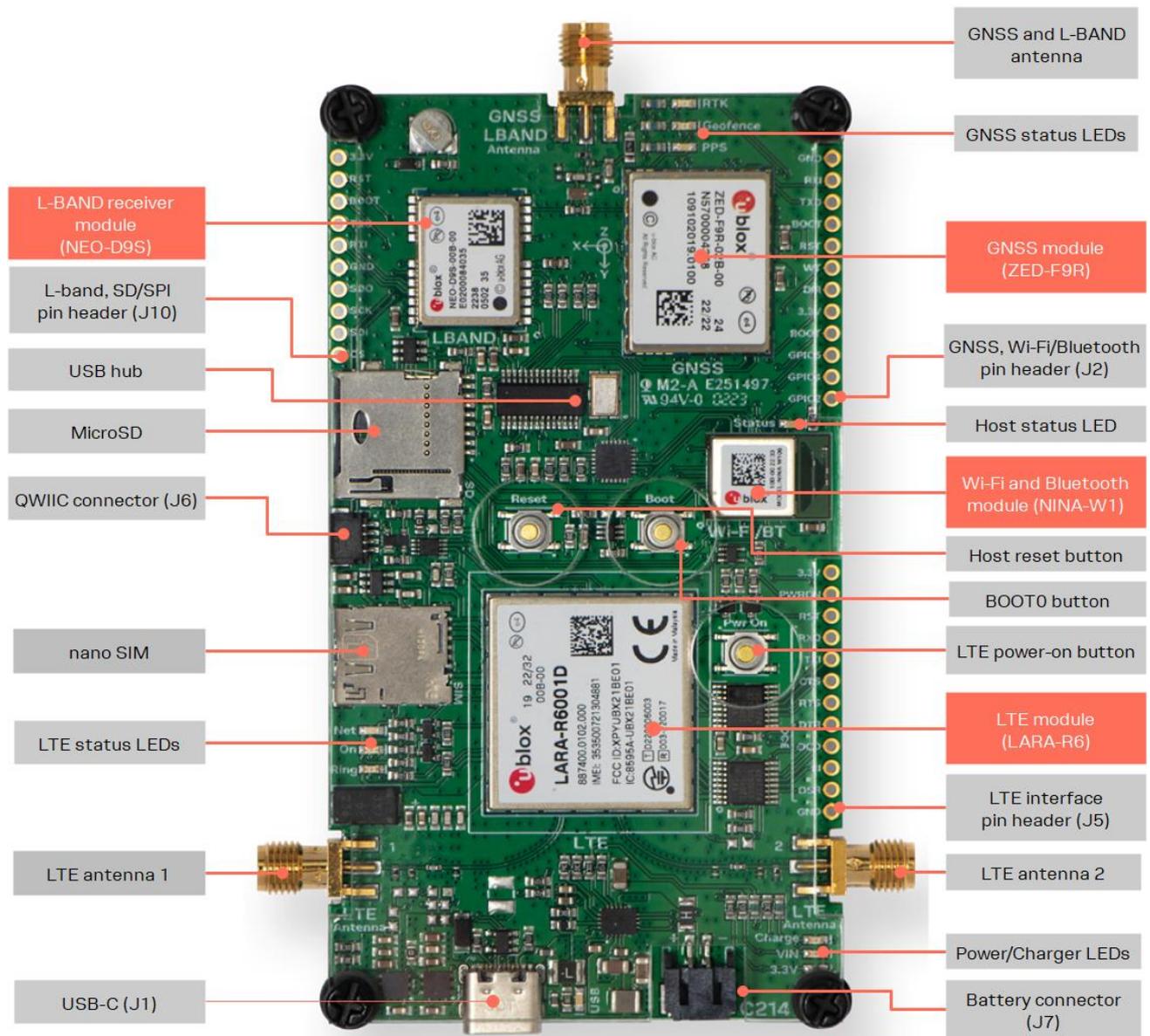

Figure 2: C214 board description (top side)

Figure 3 shows the bottom side of the C214 application board and the physical location of the pin headers.

Figure 3: C214 board description (bottom side)

2.2 Control and communication

The NINA-W106 multiradio module runs the high precision GNSS application and controls the communications between the ZED-F9R GNSS module and NEO-D9S L-band receiver module over the I2C bus. NINA-W106 also connects to the LARA-R6 LTE Cat 1 modem through a 4-pin UART interface, as shown in Figure 4Figure 4.

Figure 4: XPLR-HPG-2 modules connections

2.3 Correction data

XPLR-HPG-2 can receive GNSS correction data over Wi-Fi, through the GNSS and L-band antenna, or either of the LTE antennas (1 and 2). The NINA-W106 module provides the Wi-Fi interface and manages the decryption keys and receipt of GNSS correction data and between the three modules. In this case, the XPLR-HPG-2 can work in three different modes of operation – described in the following sub-sections as use cases:

- Use case #1: Correction data through L-band receiver
- Use case #2: Correction data through LTE Cat 1 modem
- Use case #3: Correction data through Wi-Fi connection

2.3.1   Use case #1: Correction data through L-band receiver

L-band represents the range of frequencies in the radio spectrum from 1 2 GHz to 2 GHz, which is the top end of the ultra-high frequency (UHF) band and the lower end of the microwave range.

In this use case #1, the NEO-D9S module receives correction data through LBAND and the NINA-W106 module gets the correction data from NEO-D9S through the I2C bus. NINA-W106 forwards the correction data to ZED-F9R through the same I2C bus.

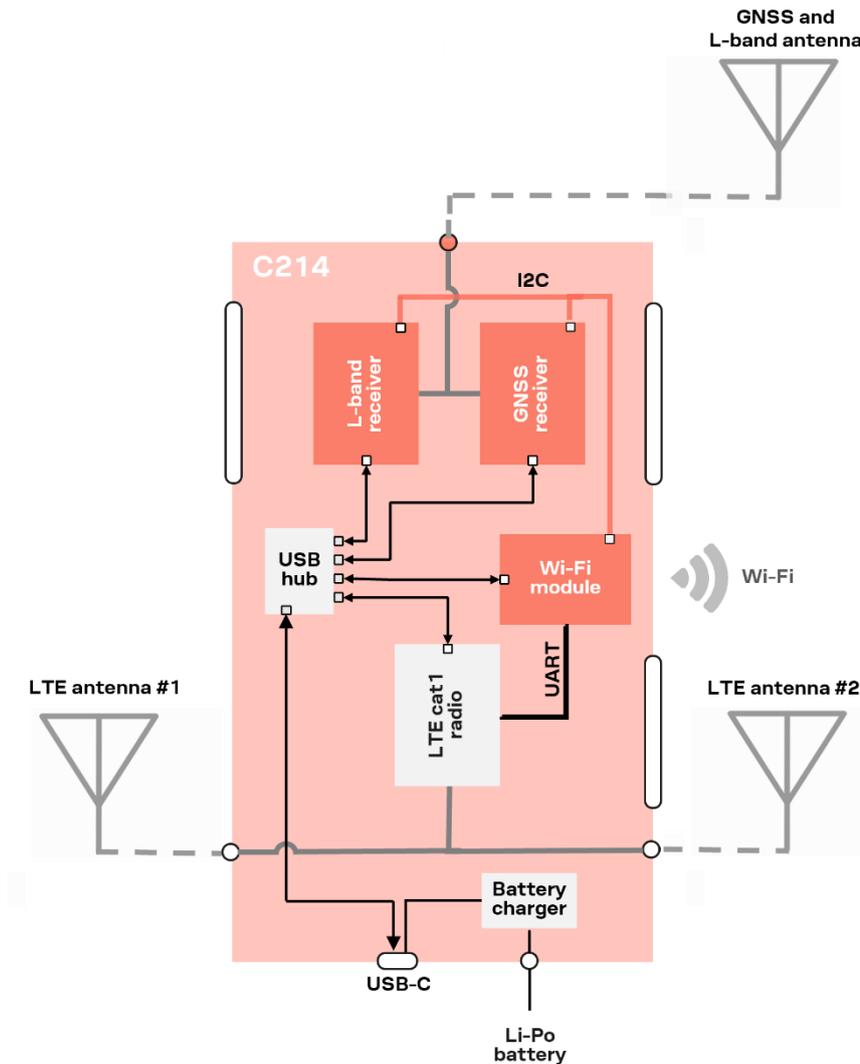The active components in this use case are shown in Figure 5.

Figure 5: Correction data flow (L-band)

☞   NINA-W106 also forwards the decryption keys for the correction data packages to ZED-F9R. The decryption keys (changed monthly) can be downloaded from the internet over a NINA-W106 Wi-Fi connection or LARA-R6 LTE Cat 1 connection, using the MQTT messaging protocol.

☞   For library references, code examples, build instructions, macro and component definitions related to this use case, see also the GitHub example: "Correction data via NEO-D9S LBAND module to ZED-F9R with the help of MQTT – using certificates" [25].

2.3.2 Use case #2: Correction data through LTE Cat 1 modem

In this scenario, the correction data flow stars when the LTE Cat 1 modem (LARA-R6) receives the correction data and the decryption keys through the cellular network using an MQTT connection to the cloud based Thingstream delivery platform for IoT services. After that, the NINA-W106 module reads the correction data through the 4-pin UART interface and forwards the data and the decryption keys to the GNSS module (ZED F9R) over the I2C bus.

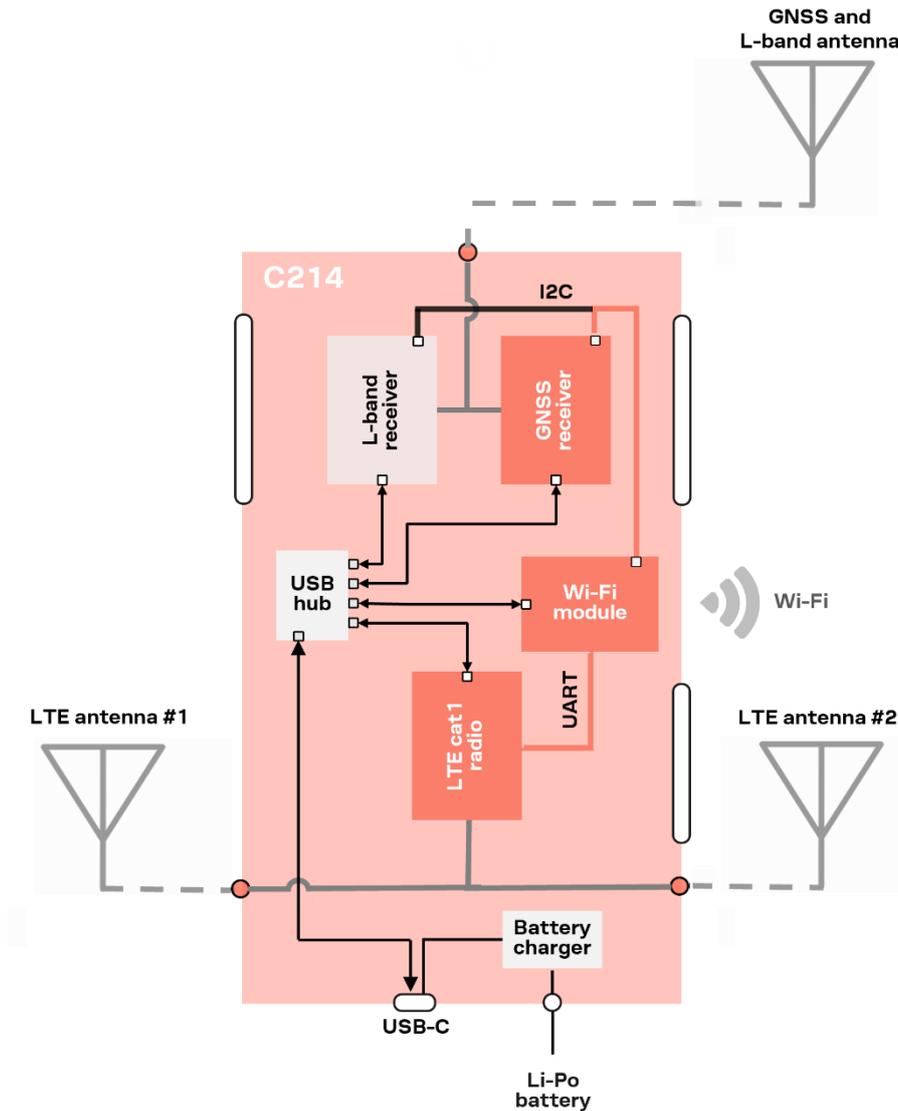The active components in this use case are shown in Figure 6.

Figure 6: Correction data flow (LTE Cat 1 modem)

☞ For library references, code examples, build instructions, macro and component definitions related to this use case, see also the XPLR-HPG GitHub example "Correction Data over MQTT from Thingstream Point Perfect Service" [26].

2.3.3 Use case #3: Correction data through Wi-Fi connection

In this scenario, the NINA-W106 functions as a Wi-Fi host and receives the correction data and the decryption keys through a Wi-Fi network using an MQTT connection. This data is then forwarded to the GNSS module (ZED-F9R) over the I2C bus. NINA-W106 then forwards the decryption keys for the correction data packages to ZED-F9R. [27].

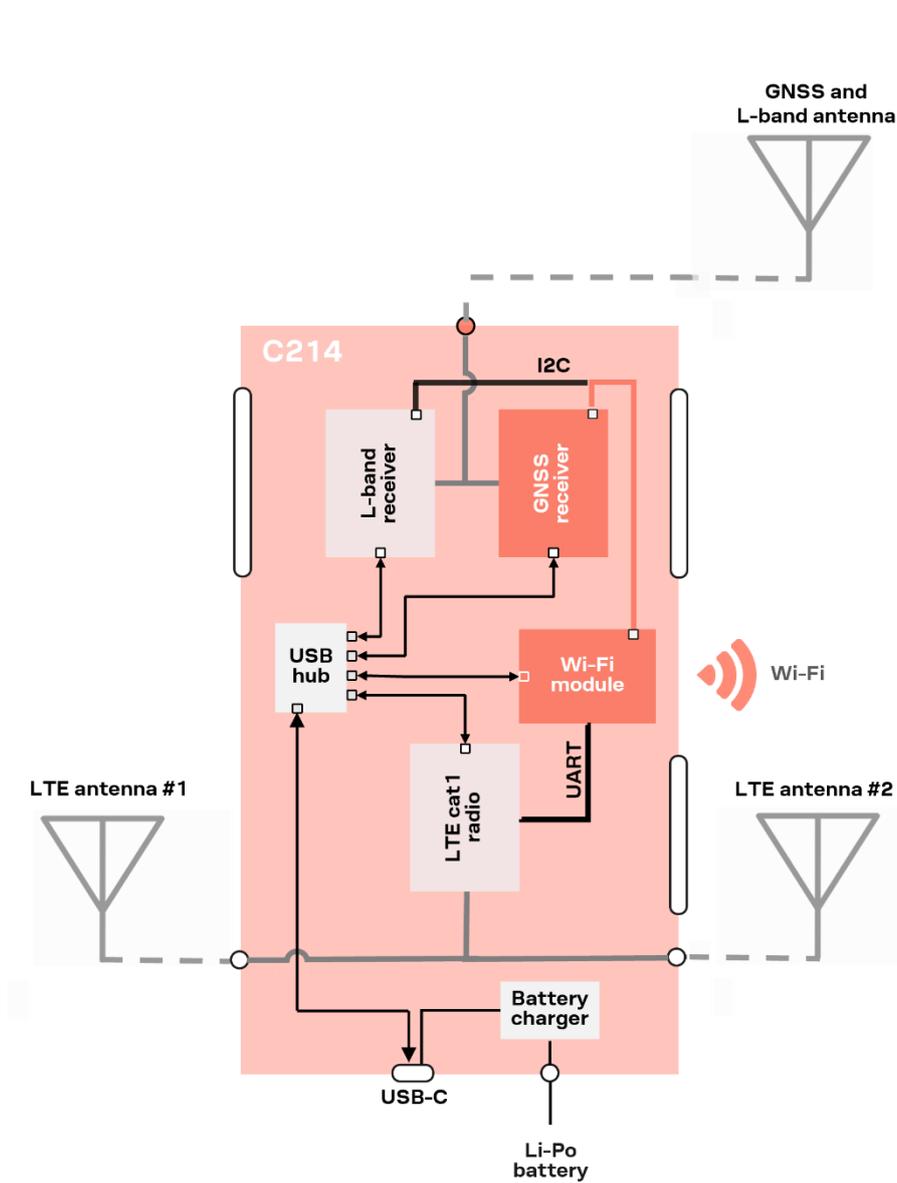The active components in this use case are shown in Figure 7.

Figure 7: Correction data flow (Wi-Fi)

☞ For library references, code examples, build instructions, macro and component definitions related to this use case, see also the XPLR-HPG GitHub example "Correction data via Wi-Fi MQTT to ZED-F9R using certificates" [27].

2.4 Power subsystem

XPLR-HPG-2 supports multiple power options, where:

- USB-C connector (J1) supplies power directly to the board from the connected device
- Battery connector (J7) supplies power from an externally connected single-cell Li-ion battery
- MP2617H switch-mode battery charger (U12) manages power supply to the board through both the USB-C connector (J1) and Li-ion battery.

In situations where the USB-C connector provides excessive power, the power path management functionality offered by the latter battery charger option adjusts power to the XPLR-HPG-2 board and charges the battery simultaneously. Conversely, the battery compensates for the power deficiency if the USB-C connector provides insufficient power. A Li-ion battery can be connected to XPLR-HPG-2 through the (2-pin, 2 mm pitch, JST type) connector J7 .

⚠️ Use a suitable single-cell, Li-ion type battery (like the Sparkfun PRT-13855) with the same polarity connections shown in Figure 8.

The output of the battery charger is connected to two Onsemi NCP690MNxx, 1 A, linear regulators (U7 and U8). One regulator has a 3.3 V fixed output and the other has an adjustable output (set to 3.75 V). The 3.3 V regulator supplies the complete board except for the LTE modem, which is supplied by the adjustable output.

Three LEDs indicate the power state of the device:

- Charge – indicates that the battery is being charged.
- VIN – powered by the charger output. Lit when the supply voltage is applied to the linear regulators.
- 3.3V – powered by the output of the 3.3 V linear regulator.

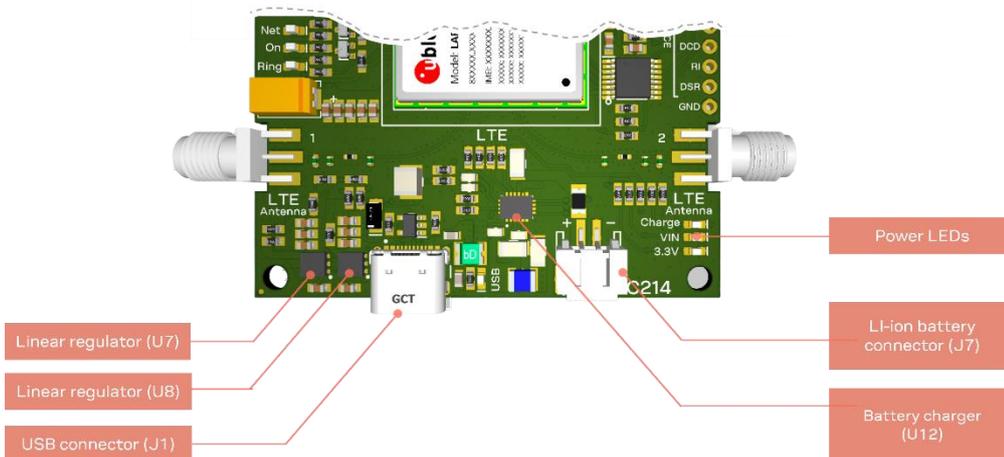The location of the power LEDs on the C214 board is shown in Figure 8.

Figure 8: Power system components – showing battery connector polarity

2.5 USB subsystem

XPLR-HPG-2 incorporates a 4-port USB 2.0 hub that connect to the various u-blox modules through the USB port that is used for monitoring, setup, and programming. NINA-W106 UART is connected to the USB hub through a Silicon Labs CP2102N USB to UART chip (U2).

3   Software

HPG software operates autonomously, configures all the modules, handles the different correction data sources, and provides the correction data to the GNSS module. This is possible with the HPG library [18] built on top of ubxlib for high-precision GNSS tailored projects.

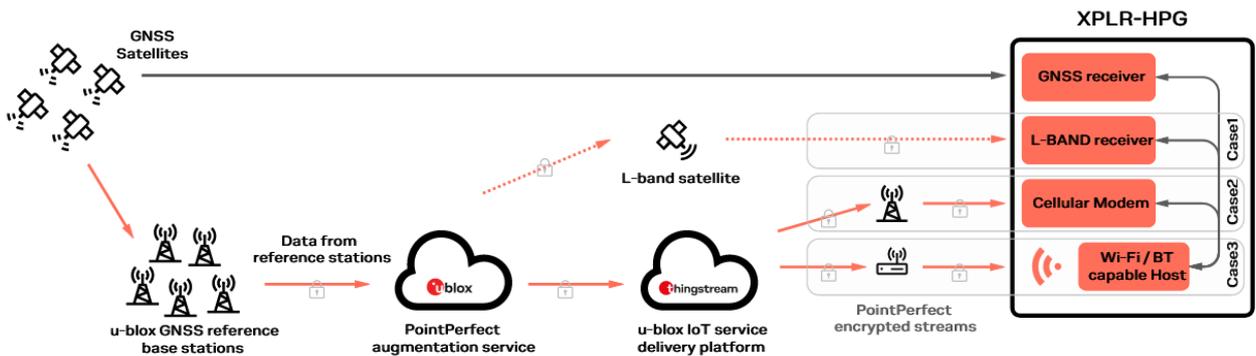Figure 9 shows the HPG data topology for each of the HPG use case examples.

Figure 9: HPG data topology showing use case configuration examples

3.1   HPG use case examples

In addition to the HPG library [18], the HPG software includes several examples that demonstrate the handling of correction data from the u-blox modules in realistic scenarios and use cases, such as:

* Case 1: Achieving High Precision GNSS via LBand Satellite correction data
* Case 2: Achieving High Precision GNSS via correction data from Thingstream, using Cellular
* Case 3: Achieving High Precision GNSS via correction data from Thingstream, using WiFi

For further information about these and other use cases, see the Examples summary [17].

3.2 u-blox library (ubxlib)

HPG software makes use of open-source u-blox library (ubxlib), which provides C libraries for connecting the various u-blox modules and building embedded applications easily. The goal of ubxlib is to deliver a single tested solution, with examples, which provides uniform easy-to-use APIs across several u-blox products. Releases of ubxlib [23] are tested automatically for all configurations on multiple boards in a test farm.

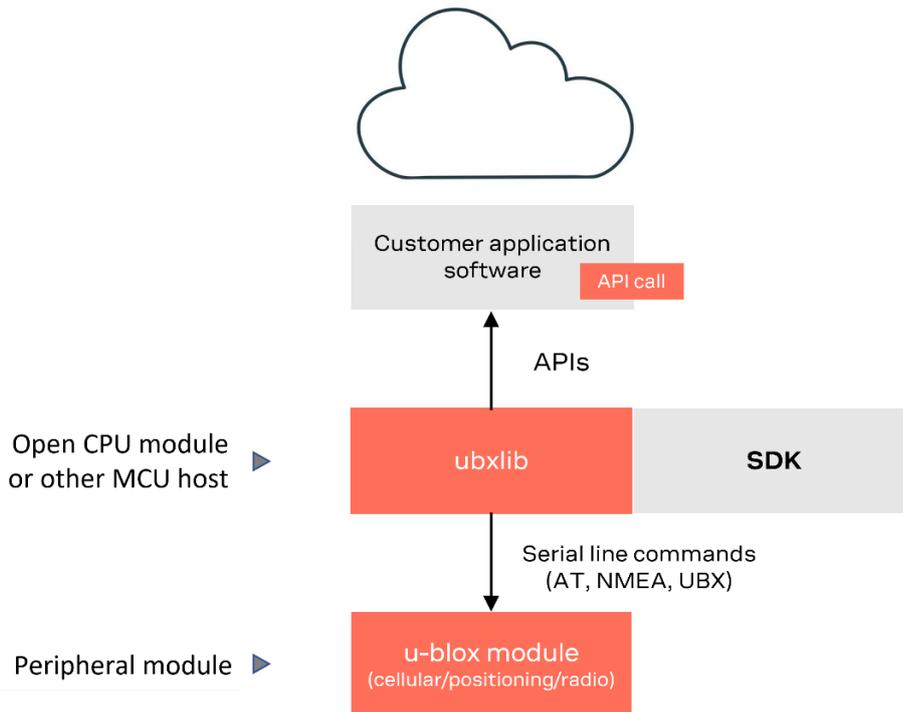Figure 10 shows how ubxlib on the MCU host handles peripheral modules using serial line commands.

Figure 10: ubxlib MCU host and peripheral configuration

ubxlib interfaces with most common host SDKs and RTOS to simplify the development of embedded applications for u-blox products and services. The ubxlib repository [23] is hosted on GitHub.

The library provides portable, high-level, C libraries that expose the available APIs for handling u-blox short-range radio (Bluetooth/Wi-Fi), positioning (GNSS), and cellular (2G/3G/4G) modules.

ubxlib runs on the most common embedded platforms, including u-blox open CPU, stand-alone modules like NORA-B1. For the full list of supported host platforms, refer to the GitHub ubxlib repository [23].

4 Module configuration

XPLR-HPG-2 comprises four u-blox modules:

- NINA-W106 short range radio as the controller and for Wi-Fi/Bluetooth connectivity
- ZED-F9R GNSS receiver
- NEO-D9S L-BAND receiver
- LARA-R6001D LTE Cat 1 module

See also Module integration.

4.1 NINA-W106 short range radio

NINA-W106 is the controller of the XPLR-HPG-2 kit and connects to ZED-F9R and NEO-D9S through an I2C bus and LARA-R6 through an UART bus. It can be programmed by the user with one of the examples available on the XPLR-HPG-2 repository [16].

4.1.1 Configuring the I2C bus

NINA-W106 connects to ZED-F9R and NEO-D9S through the I2C bus and assumes the role of the bus master. This I2C bus is also accessible through the QWIIC® connector (J6), which is suitable for connecting additional 3.3 V sensor and devices.

The triple solder jumper (JP3) can be cut to disable the onboard 2.2 kΩ pull-up resistors, as shown in Figure 11. This procedure should become necessary if the user connects an external device with pull-up resistors to use the I2C bus.
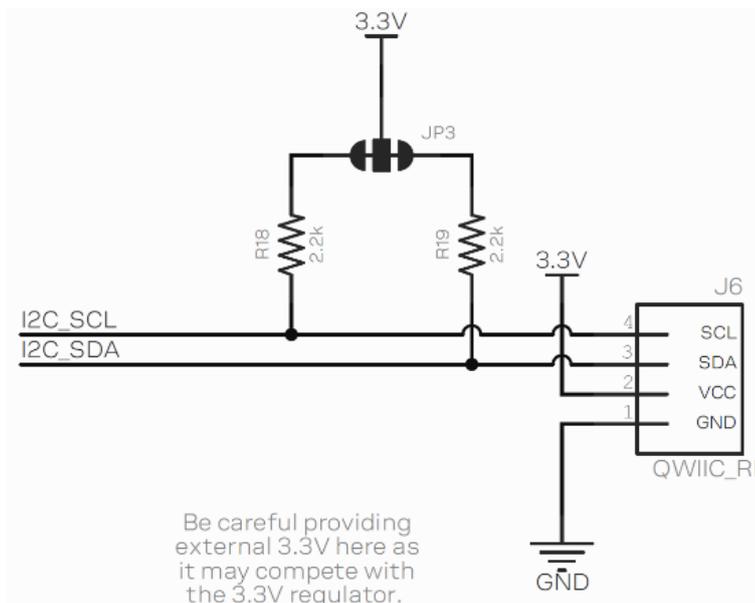

Figure 11: Schematic circuit showing I2C pull-up resistors

NINA-W106 also connects to LARA-R6 through a 4- to 8-pin UART and additional GPIOs for monitoring status information. Moreover, it can be connected to a microSD card using single SPI communication through the microSD card socket. See also Figure 12.
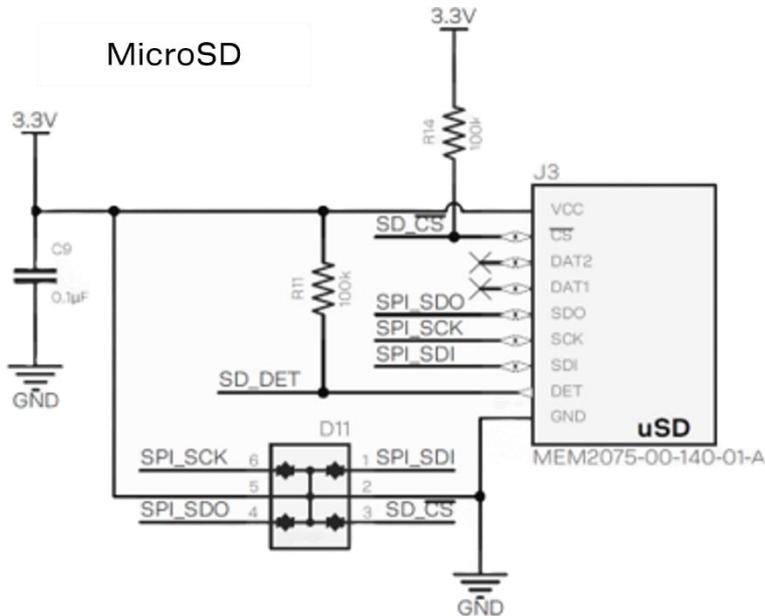

Figure 12: microSD card socket signals

4.1.2 GPIO pin-out

Table 1 describes the function of the GPIO pins used in the NINA-W106 module. Some pins are accessible from the J2, J5, J10 pin headers. Others are available from the three-pin header (J4) that exposes the I2C bus (available on the bottom side of the board), the QWIIC® connector (J6), and the 10-pin 0.05" pitch JTAG header (J11) located on the bottom side of the connector.

NINA-W106 pin	ESP32 GPIO	Signal function	Available from	Notes
1	GPIO23	uSD_SDI / COPI	J10-2	SPI COPI connected to microSD.
2	GPI34	LTE_RXO	J5-9	UART to LTE. See also USB subsystem
4	GPI36	LTE_CTS	J5-7	UART to LTE. See also USB subsystem
5	GPIO33	LTE_RESET	J5-10	Resets the LTE modem, active LOW. See also USB subsystem
7	GPIO32	uSD_CS	J10-1	SPI chip select (used by the microSD)
8	GPIO21	I2C_SDA	J4-2, J6-3 (QWIIC connector)	I2C SDA signal. NINA-W106 is the I2C controller that connects to GNSS and L-band
11	GPI37	LTE_ON	-	Input to NINA-W106. Signals that the LTE modem has powered on. Also connected to LTE status LED "On". See also USB subsystem
15	GPI38	uSD_DET	-	Input to NINA-W106. Signals that the microSD card is inserted.
16	GPIO25	LTE_TXI	J5-8	UART to LTE. See also USB subsystem
17	GPIO26	LTE_PWR_ON	J5-11	Command to LTE to power on, active HIGH. Different pulse duration for power on/off. See also USB subsystem
18	GPIO27	LTE_RTS	J5-6	UART to LTE. See also USB subsystem
19	RESET_N	RESET	J11-10 (unpopulated JTAG, bottom side)	NINA-W106 Reset
20	GPIO22	I2C_SCL	J4-3, J6-4 (QWIIC connector)	I2C SCL signal. NINA-W106 is the I2C controller, connects to GNSS and L-band
21	GPIO19	uSD_SDO / CIPO	J10-4	SPI CIPO connected to microSD

NINA-W106 pin	ESP32 GPIO	Signal function	Available from	Notes
22	GPIO1	CDC_TX	-	USB CDC RX
23	GPIO3	CDC_RX	-	USB CDC TX
24	GPIO4	GPIO4 / CAN_RX	J2-2	Needs external CAN transceiver
25	GPIO2	LED / GPIO2	J2-1	Host status LED (blue)
27	GPIO0	BOOT / GPIO0	J2-4	BOOT button, USB CDC RTS/CTS. See also Auto reset circuit.
28	GPIO5	GPIO5 / CAN_TX	J2-3	Needs external CAN transceiver.
29	GPIO18	uSD_SCK / SCK	J10-3	SPI CLK connected to microSD.
31	GPIO14	LTE_DCD	J5-4, J11-2 (unpopulated JTAG, bottom side)	UART to LTE. See LARA-R6001D LTE cat 1 modem. JTAG JTMS. See JTAG connector
32	GPIO15	LTE_DTR	J5-5, J11-6 (unpopulated JTAG, bottom side)	UART to LTE. See LARA-R6001D LTE cat 1 modem JTAG JTDO. See JTAG connector.
34	ADC34/GPI35	SYS_OUT_MON	-	Analog input, relative to SYS_OUT/Battery Voltage.
35	GPIO13	LTE_DSR	J5-2, J11-4 (unpopulated JTAG, bottom side)	UART to LTE. See LARA-R6001D LTE cat 1 modem JTAG JTCLK. See JTAG connector.
36	GPIO12	LTE_RI	J5-3, J11-8 (unpopulated JTAG, bottom side)	UART to LTE. See LARA-R6001D LTE cat 1 modem JTAG JTDI. See JTAG connector.

Table 1: NINA-W106 pinout

For further information, see also the NINA-W10 data sheet [1] and system integration manual [2].

4.1.3 Auto reset circuit

XPLR-HPG-2 board includes a typical auto reset circuit that connects to the **BOOT0** and **RESET** pins of NINA-W106, as shown in Figure 13. The circuit enables the programming tools (like `esptool.py`) to assert the DTR and RTS control lines of the USB to Serial converter (CP2102N) and set NINA-W106 on the serial bootloader mode. More information can be found in the Espressif Automatic Bootloader documentation [14].
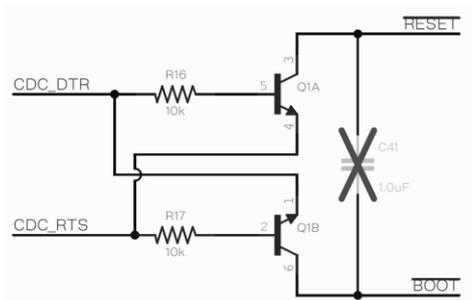

Figure 13: Auto reset circuit

☞ Capacitor C41 is not mounted on the C214 board but can be added in the application design – if needed.

4.1.4 JTAG connector

The bottom side of the C214 board includes the footprint for a 10-pin 0.05" pitch JTAG connector (J11), as shown in Figure 14. Four of these connectors are shared with the LTE as part of the 8-pin UART connections, as shown in Figure 15.
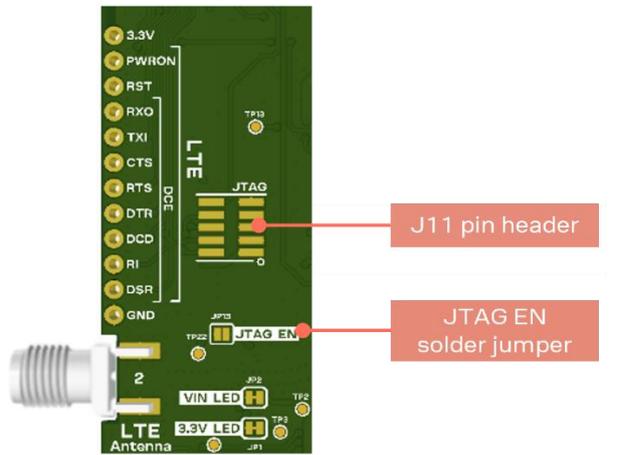

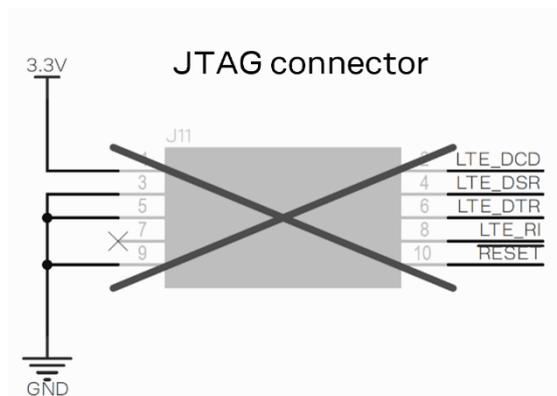**Figure 14: JTAG Enable solder jumper and 10-pin JTAG footprint**

Figure 15: JTAG connector (J11) pinout

☞ The JTAG connector is not mounted on the C14 board but can be added in the application design – if needed.

Bridging the **JTAG_EN** solder jumper (JP13), disables the voltage level translator and allows the signals to be used for the JTAG connector, as shown in Figure 16.

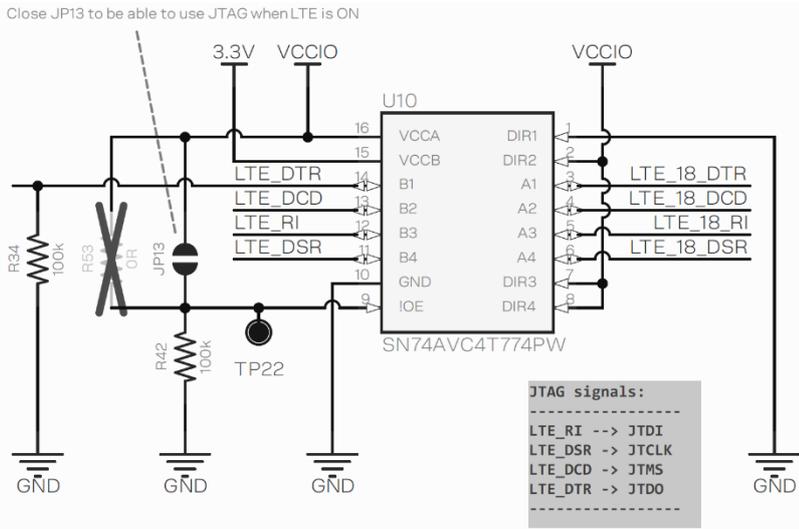**Figure 16: JTAG_EN (JP13) and level translator**

☞ Jumper JP13 is not mounted on the C214 board but can be added in the application design – if needed.

4.2   ZED-F9R – GNSS receiver

ZED-F9R is an F9 high-precision dead reckoning module with 3D sensors and a multi-band GNSS receiver. It provides a reliable multi-band, Real-time kinematic positioning (RTK), turnkey solution that supports full GNSS carrier raw data and real-time positioning update rate of up to 30 Hz.

ZED-F9R is powered with a 3.3 V linear regulator and communicates with the NINA-W106 stand-alone multiradio module over the I2C bus using the address 0x42.

Several ZED-F9R pins are exposed on the J2 pin header, as shown in Table 2 and Figure 17.

ZED-F9R pin no.	Signal name	Header pin	Notes
43	ZED_RX1	J2-11	UART1 RX
42	ZED_TX1	J2-10	UART1 TX
50	ZED_SAFEBOOT#	J2-9	SAFEBOOT pin
49	ZED_RESET#	J2-8	Reset pin, active Low
22	ZED_WT	J2-7	Odometry Wheel tick signal. See also the ZED-F9R data sheet [5]
23	ZED_DIR	J2-6	Odometry Direction signal See also the ZED-F9R data sheet [5]

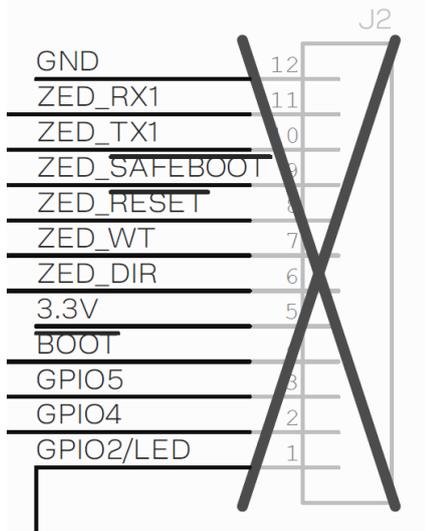**Table 2: ZED-F9R signal availability**

Figure 17: J2 signals

☞ The connector J2 is not mounted on the C214 board but can be added in the application design – if needed.

ZED-F9R UART2 is connected directly to the UART2 of the L-band correction data module, NEO-D9S. The two modules share correction data directly without host intervention. To disable this direct connection, cut J2-7 and J2-8 shown in Figure 18.
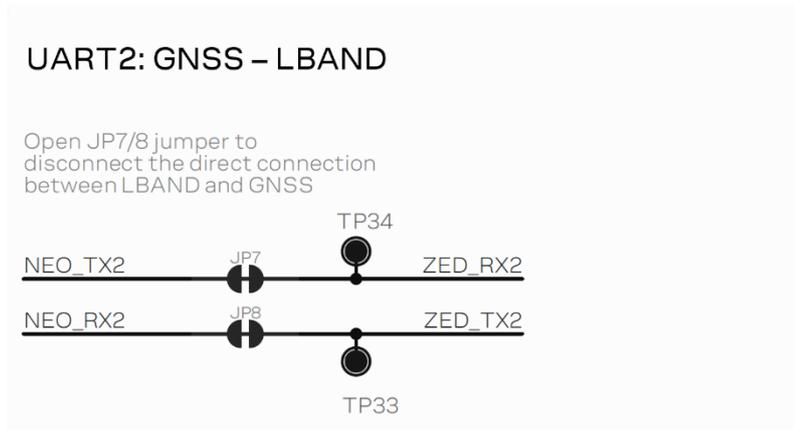

Figure 18: ZED - NEO UART 2 solder jumpers

☞ For direct correction data from NEO-D9S to ZED-F9R additional setup is needed on both modules. For more information, see the respective data sheets [7] [4] and integration manuals [8] [5].

Table 3 describes the pin connections to the status LEDs on ZED-F9R. The LEDs, shown in Figure 19, provide a visual display of the RTK, GNSS signal reception, and geofence signal status.

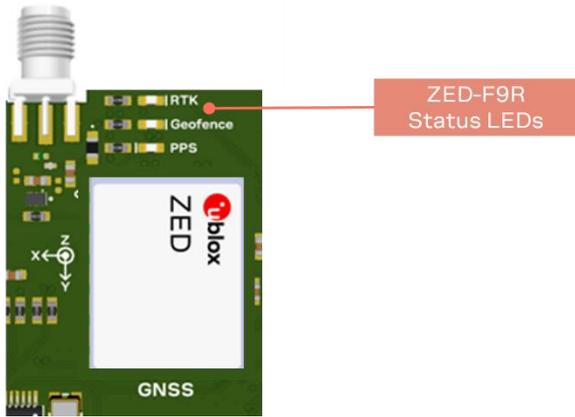| ZED-F9R pin no.	Signal name	LED name – color	Notes
19	GEOFENCE _STAT	Geofence – Red	Geofence status, user defined
20	RTK_STAT	RTK – Green	RTK status: LED on – RTK fixed LED blinking – receiving and using corrections LED off – no corrections
53	ZED_PPS	PPS – Blue	Time pulse

Table 3: ZED-F9R status LEDs

Figure 19: ZED-F9R status LED locations

To disable the LEDs for reduced power consumption, cut the JP4-6 solder jumpers located on the bottom side of XPLR-HPG-2, as shown in Figure 20.
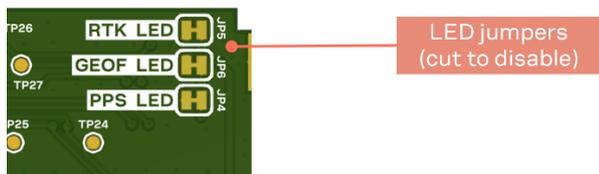

Figure 20: Disable ZED-F9R status LEDs

ZED-F9R USB is connected to the 4-port USB hub IC and is available for connection through the J1 USB connector.

4.3   NEO-D9S L-band receiver

NEO-D9S is an L-BAND correction data receiver module. It provides global and easy access to satellite L-band GNSS correction data.

The module is powered from the 3.3 V linear regulator and connects to the host through the I2C bus with address 0x43.

Several NEO-D9S pins are exposed on J10 pin header, as shown in Table 4 and Figure 21.

NEO-D9S pin no.	Signal name	Available at	Notes
21	NEO_RX1	J10-6	UART1 RX
20	NEO_TX1	J10-7	UART1 TX
1	NEO_SAFEBOOT	J10-8	SAFEBOOT pin
8	NEO_RESET	J10-9	Reset pin, active Low

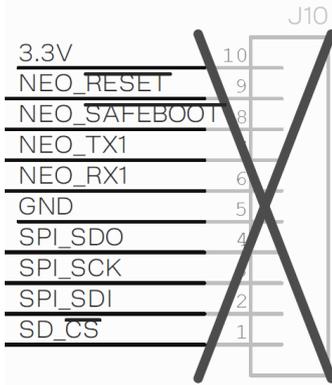**Table 4: NEO-D9S signal availability**

Figure 21: J10 signals

☞ Jumper J10 is not mounted on the C214 board but can be added in the application design – if needed.

NEO-D9S UART2 is connected directly to ZED-F9R UART2. This allows the two modules to share correction data directly – without any intervention from NINA-W106.

NEO-D9S USB is connected to the 4-port USB hub IC and is available for connection through the J1 USB connector.

4.4   LARA-R6001D LTE cat 1 modem

The LARA-R6 series comprises multi-band and multi-mode modules that support LTE Cat 1 FDD and LTE Cat 1 TDD radio access technology with 3G UMTS/HSPA and 2G GSM/GPRS/EGPRS fallback, which makes LARA-R6 the ideal solution for global and multi-regional coverage.

LARA-R6 is powered from the 3.75 V linear regulator and all IOs are referenced at 1.8 V voltage level (powered by the **V_INT** pin). As a result, the level translators are used for all signals shared with the host.

LARA-R6 is connected to the host through the 8-wire serial port (data lines, hardware flow control lines and modem status and control lines). LARA-R6 uses DCE notation.

Table 5 and Figure 22 show the UART signals and their availability on the J5 pin header. See also the LARA-R6/L6 series system integration manual, [11].

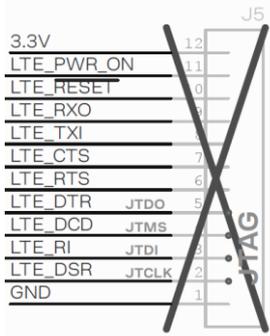| LARA-R6 pin no.	Signal name	Translated to	Available at	Notes
13	LTE_18_RXO	LTE_RXO	J5-9	UART data output
12	LTE_18_TXI	LTE_TXI	J5-8	UART data input
11	LTE_18_CTS	LTE_CTS	J5-7	UART clear to send output
10	LTE_18_RTS	LTE_RTS	J5-6	UART ready to send input
6	LTE_18_DSR	LTE_DSR	J5-2	UART data set ready output
7	LTE_18_RI	LTE_RI	J5-3	UART ring indicator output
9	LTE_18_DTR	LTE_DTR	J5-5	UART data terminal ready input
8	LTE_18_DCD	LTE_DCD	J5-4	UART data carrier detect output

Table 5: LARA-R6 UART pins

Figure 22: J5 signals

☞ Jumper J5 is not mounted on the C214 board but can be added in the application design – if needed.

Several control signals are either connected to host or the status LEDs, as described on Table 6.

LARA-R6 pin no.	Signal name	Available at	Notes
15	LTE_PWR_ON	J5-11, Pwr On button	Power-on input. 0.15s low to trigger switch on. 1.5s low to graceful switch off.
-	LTE_ON	On LED (Green)	High when V_INT is on, which indicates that LARA-R6 is switched on
18	LTE_RESET	J5-10	External reset input
16	LTE_18_NI	Net LED (Blue)	Network status indication
7	LTE_RI	Ring LED (Red)	Ring indicate status

Table 6: LARA-R6 pins

XPLR-HPG-2 supports a nano SIM card holder (J9) that is connected to the LTE modem, as shown in Figure 23.

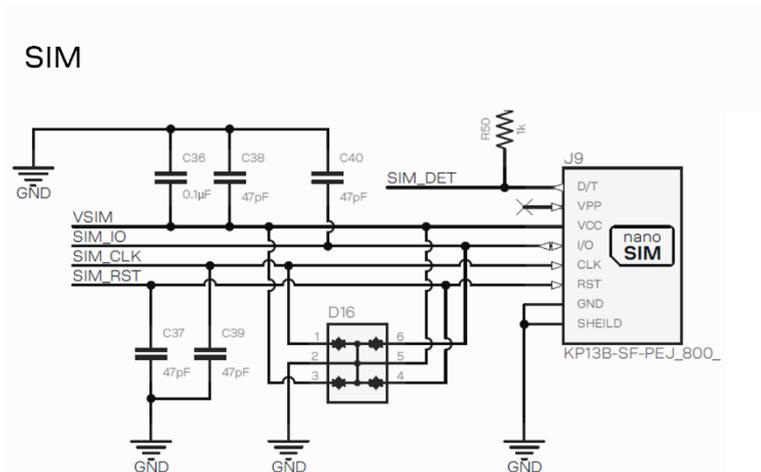**Figure 23: nano SIM card holder (J9)**

5   Quick start guide

Referencing the components shown in Figure 24, follow this procedure to get started with XPLR-HPG-2.
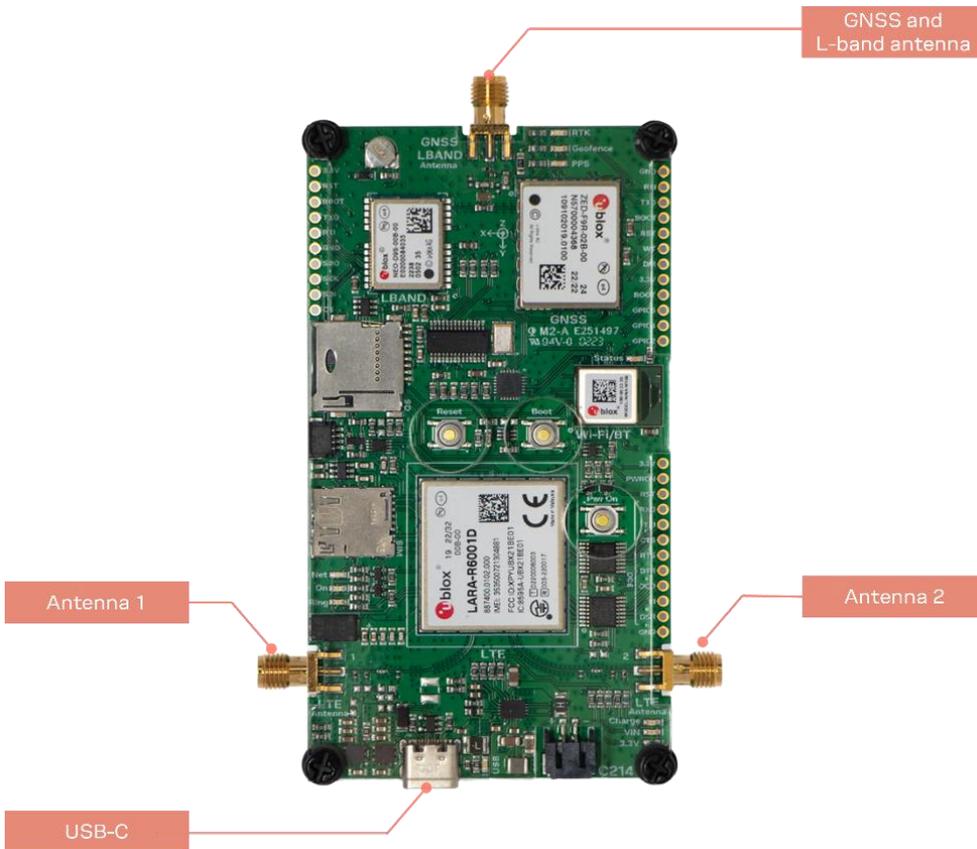

Figure 24: C214 application board showing antennas and USB-C connector

1. Plug in the GNSS and L-band antenna.
2. Plug in the two LTE antennas.
3. Connect the XPLR-HPG-2 to a computer through the USB-C connector. The VIN, 3.3V and USB LEDs on XPLR-HPG-2 are lit when the kit is connected.

   ☞ When connecting the XPLR-HPG-2 through the USB, the following devices are enumerated:

   - CP2102: USB to UART bridge (connected to NINA)
   - 2x "u-blox GNSS receiver" (NEO and ZED)
   - 4x UARTs from the LARA-R6 (only enumerated if LTE Power is ON)

   The ZED-F9R and NEO-D9S modules are enumerated as a USB Serial Device and both modules are described as a u-blox GNSS receiver in the device settings. The UART communication between the computer and the NINA-W106 module is established through the Silicon Labs CP210x USB to UART Bridge driver (U2).

4. Optionally, connect a 4G LTE SIM card with an active data plan on nano SIM card holder (J9). This is necessary if the LTE is to be used.
5. Use the appropriate u-blox evaluation software to communicate with the different modules:
   - Use u-center [19] to communicate with ZED-F9R and NEO-D9S. Both modules enumerate as "u-blox AG" serial interfaces. See also the respective integration manuals [5] [8].
   - Use m-center [20] to communicate with LARA-R6. USB drivers are needed as indicated for the LARA-R6001D LTE cat 1 modem.

6. Select one of the three equivalent "u-blox Modem USBx AT and Data" modem interfaces for communication. See also the LARA-R6/L6 series system integration manual, [11].

☞   LARA-R6 by default is not powered on but can be either by the NINA-W106 through code or by the "**Pwr On"** button. NINA-W106 should be available to load code through the "Silicon Labs CP210x UART Bridge" serial interface.

7. Proceed with the steps described in the README.md file [15].

☞ A USB driver for LARA-R6 is needed for communication through the USB connector (for example when using LARA-R6 with m-center software). The LARA-R6 USB driver can be downloaded from the LARA-R6 product page [13]. LARA-R6 USB drivers are not needed for communication with LARA-R6 through the NINA-W106 module, and ZED-F9R and NEO-D9S modules do not need additional drivers for Windows PC.

Appendix

A Glossary

Abbreviation	Definition
3G	3rd Generation Cellular Technology (UMTS, HSDPA, HSUPA)
DCE	Data Circuit-terminating Equipment* / Data Communication Equipment*
EGPRS	Enhanced General Packet Radio System
FDD	Frequency Division Duplexing
GNSS	Global Navigation Satellite System
GPIO	General Purpose Input Output
GPRS	General Packet Radio Service
GSM	Global System for Mobile communication
HPG	High Precision GNSS
HSPA	High Speed Packet Access
I2C	Inter-Integrated Circuit
IC	Integrated circuit
IO	Input Output
JTAG	Joint Test Action Group
LED	Light Emitting Diode
LTE	4G Long Term Evolution
MQTT	Message Queuing Telemetry Transport protocol
PCB	Printed Circuit Board
PCBA	Printed Circuit Board Assembly
PPS	(1) Pulse Per Second
RTK	Real Time Kinematic positioning
SMA	Sub-miniature A connector
SPI	Serial Peripheral Interface
TDD	Time Division Duplexing
UART	Universal Asynchronous Receiver Transmitter
UMTS	Universal Mobile Telecommunications System
USB	Universal Serial Bus
uSD	micro Secure Digital card

Table 7: Explanation of the abbreviations and terms used

Related documentation

[1] NINA-W10 data sheet, UBX-17065507
[2] NINA-W1 system integration manual, UBX-17005730
[3] NINA-W10 product summary, UBX-17051775
[4] ZED-F9R data sheet, UBX-22024085
[5] ZED-F9R integration manual, UBX-20039643
[6] ZED-F9R product summary, UBX-19048775
[7] NEO-D9S data sheet, UBX-18012996
[8] NEO-D9S integration manual, UBX-19026111
[9] NEO-D9S product summary, UBX-17010946
[10] LARA-R6 data sheet, UBX-21004391
[11] LARA-R6/L6 series system integration manual, UBX-21010011
[12] LARA-R6 product summary, UBX-20048923
[13] LARA-R6 product and services, product and services
[14] Espressif ESP32 documents: Automatic bootloader
[15] GitHub XPLR-HPG software repository: read.me
[16] GitHub XPLR-HPG hardware repository: design files
[17] GitHub XPLR-HPG software repository: examples summary
[18] GitHub XPLR-HPG software repository: HPG library
[19] u-blox s-center
[20] u-blox m-center
[21] Tagoglas GNSS antenna, datasheet
[22] PointPerfect, product summary, UBX-21024758
[23] GitHub repository: ubxlib
[24] Thingstream | u-blox: https://www.u-blox.com/en/product/thingstream
[25] Correction data via NEO-D9S LBAND module to ZED-F9R with the help of MQTT (using certificates): positioning example 02_hpg_gnss_lband_correction
[26] Correction Data over MQTT from Thingstream Point Perfect Service (manual): cellular example 02_hpg_cell_mqtt_correction_certs
[27] Correction data via Wi-Fi MQTT to ZED-F9R using certificates: shortrange example 03_hpg_wifi_mqtt_correction_certs

☞ For product change notifications and regular updates of u-blox documentation, register on our website, www.u-blox.com.

Revision history

Revision	Date	Name	Comments
R01	07-Jun-2023	tcha	Initial release

Contact

u-blox AG

Address: Zürcherstrasse 68
8800 Thalwil
Switzerland

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