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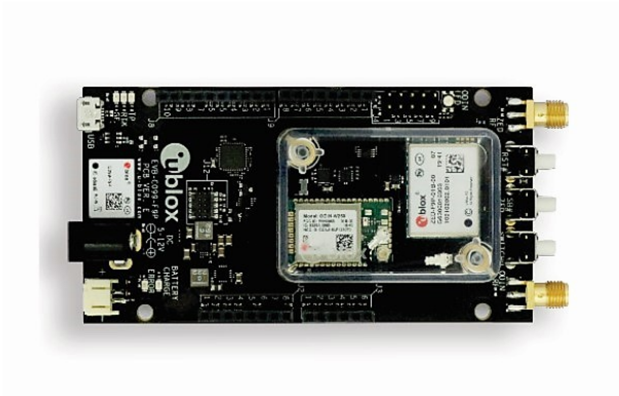
C099-F9P

Application board (rev. E), ODIN-W2 Mbed™ firmware

User guide



Abstract

The C099-F9P board enables customers to evaluate RTK operation with the ZED-F9P high precision GNSS receiver. The board provides short-range wireless connection via Bluetooth® or Wi-Fi for receiving correction data and logging via wireless connectivity.

Document information

Title	**C099-F9P**
Subtitle	Application board (rev. E), ODIN-W2 Mbed™ firmware
Document type	User guide
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This document applies to the following products:

Product name	Type numbers	Firmware version	PCN reference	Product status
C099-F9P	C099-F9P-0-03 C099-F9P-1-03 C099-F9P-2-03	FW 1.00 HPG 1.13 c099mbed3_v2.0.0	N/A	Production ready

Contents

1 Introduction

The C099-F9P board is a convenient tool that allows customers to become familiar with the u-blox ZED-F9P high precision GNSS module. The board provides facilities for evaluating the product and demonstrating its key features. The C099-F9P application board offers:

- A ZED-F9P module for use as an RTK rover or reference station
- An ODIN-W2 short-range module with Arm® Mbed™ firmware[1] tailored for C099-F9P usage to provide untethered operation using Bluetooth and Wi-Fi which are configurable via a command line interface (CLI)[2]
- Power supply options comprising a USB connection, Li-Po (lithium polymer) cell with recharging ability, and 6-12 V DC input[3]
- Small, lightweight board (110 x 55 mm) with Arduino R3/Uno shield connections for host expansion

This User guide describes the following use cases:

1. Base and rover operation via serial connectivity
2. Rover operation via Bluetooth Classic (with ODIN-W2 Mbed FW)
3. Rover operation via Wi-Fi (with ODIN-W2 Mbed FW)
4. Base and rover operation via Wi-Fi (with ODIN-W2 Mbed FW)

This user guide is split into several useful sections, including:

- Section 2: C099-F9P quick start provides information on how to get C099-F9P up and running straight out of the box.
- Section 3: C099-F9P description identifies the board's facilities.
- Section 4: Using the C099-F9P provides a comprehensive guide for in-depth usage.
- Section 5: Rover operation using NTRIP shows different ways of connecting to an NTRIP service.
- Section 6: Wireless communication describes the use case of connecting base and rover boards.
- Section 7: Firmware update provides instructions for updating the firmware of the ZED-F9P high precision GNSS module as well as the ODIN-W2 short-range module.
- Section 8: Arduino header connections provides mechanical specifications for Arduino R3/Uno.
- The sections in the Appendix provide information on how to upload the ODIN-W2 firmware via JTAG, C099-F9P antenna schematics, and C099-F9P mechanical board dimensions and schematics.

[1] The Mbed FW shall be used only with a C099-F9P kit.
[2] S-center usage is not required nor supported by the CLI.
[3] The C099-F9P kit does not contain a battery or mains power adapter.

1.1 Package contents

The delivered package contains:

- C099-F9P board (rev. E)
- u-blox ANN-MB-00 multi-band GNSS antenna and ground plane
- Wi-Fi/Bluetooth antenna
- USB interconnect cable
- Quick start guide
- USB-to-DC plug adapter cable

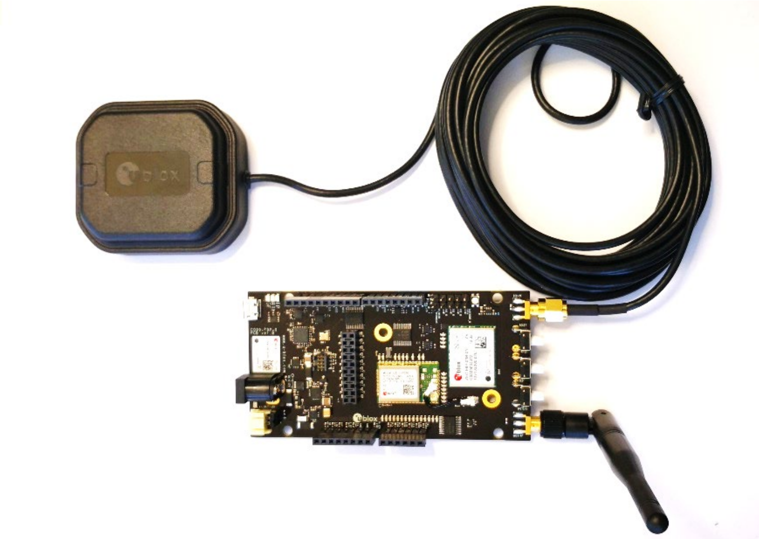


Figure 1: C099-F9P board and antennas

1.2 Additional sources of information

Prior to using the board, it is useful to download the appropriate evaluation software and keep handy the documents listed in the Related documents section.

2 C099-F9P quick start

This section provides some quick steps to enable ZED-F9P operation before exploring the more complex configurations described later.

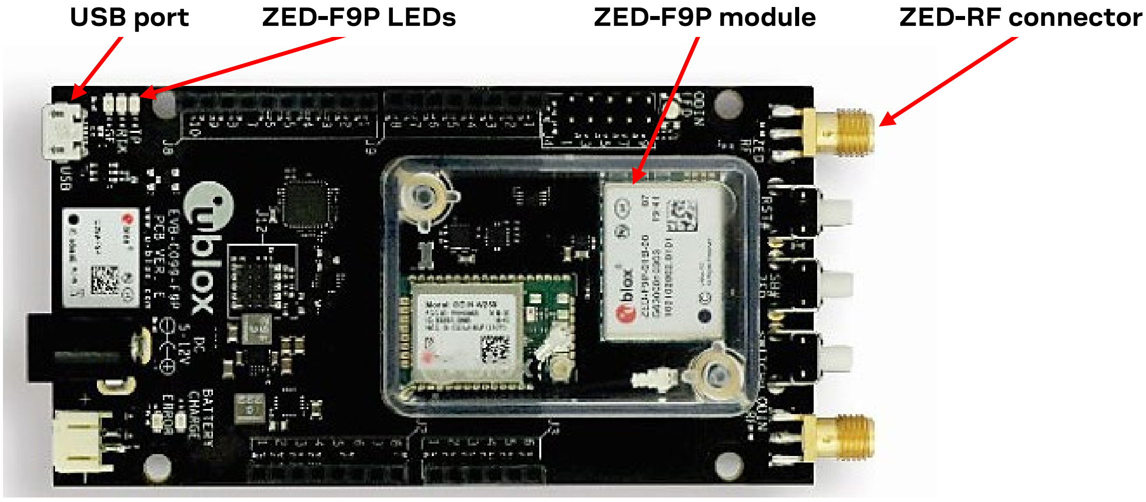


Figure 2: Basic C099-F9P overview with details needed for quick start

2.1 Starting up

- Connect the supplied multi-band GNSS antenna to the ZED-RF SMA connector. Ensure good signal reception.
- Connect the USB to a Windows PC; this will power the board. The FTDI and USB drivers will be installed automatically[4] from Windows Update when the user connects the board for the first time. Note that the board has current limitation functionality on USB. Thus, ZED-F9P and ODIN-W2 modules will power up after the drivers have been successfully installed and the USB enumeration is completed.
- Start u-center and connect to the COM port identified as **C099 application board, ZED-F9P** using Device Manager. Set the baud rate to 460800 baud. See section 4.3.1 for detailed instructions.
- The time pulse LED on the C099-F9P board will blink in blue once the ZED-F9P has obtained valid time information. Figure 3 below shows a typical u-center view with active satellite signal levels.

To operate the ZED-F9P in RTK mode, the GNSS antenna must be placed in an open environment and the unit must be connected to an RTK correction service. Where available, the evaluation kit comes with a free trial of the SmartNet correction service. Consult the leaflet included with the kit for information on how to register for the service and how to obtain mount point and user connection details before moving to the next steps.

RTK corrections can be applied using a u-center built-in NTRIP client. To use the C099-F9P board with a correction service follow these next steps:

- In u-center, click on the **Receiver** menu item.
- Select **NTRIP Client**…
- Fill in the settings for the **NTRIP caster**, **username** and **password**.
- Click **Update source table** and select the recommended NTRIP mount point.
- Click **OK** to close the dialog and connect to the service.
- In the **Data View** of u-center, the **Fix Mode** should change from **3D** to **3D/DGNSS** when RTCM corrections are received. The RTK LED will blink in green.

[4] For manual driver installation, check GNSS Sensor and VCP Device Driver User guide in Related documents

- Eventually, the status will change to **3D/DGNSS/FIXED** and the RTK LED will show a steady green light.

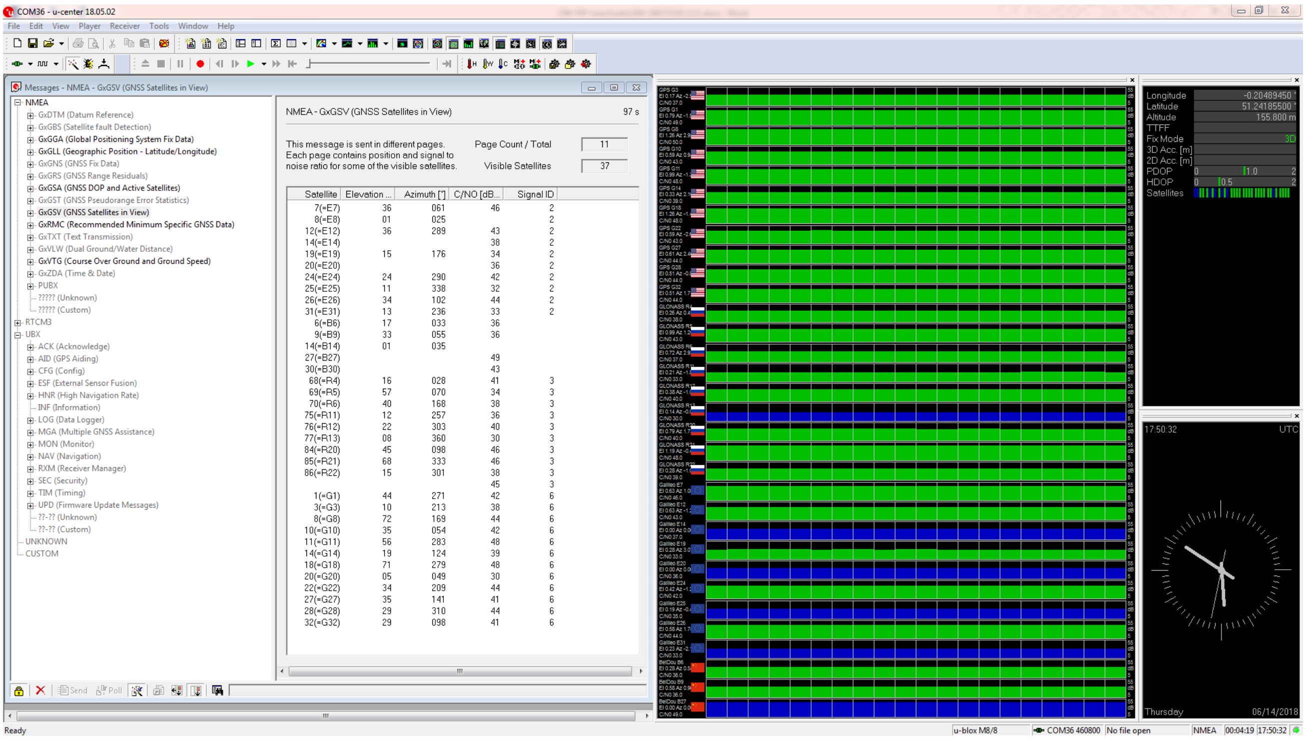


Figure 3: u-center showing a view of the ZED-F9P default operation

3 C099-F9P description

3.1 Component overview

The C099-F9P houses the ZED-F9P RTK high precision positioning module and an ODIN-W2 module for wireless short-range communications. An FTDI component provides dedicated COM port connections with the ZED-F9P and ODIN-W2 via a USB connector.

The board can be powered by USB, a DC supply socket, or by a Li-Po (lithium polymer) battery. The board has been designed using an Arduino form factor with the modules' serial ports routed to the shield headers. Note that a secondary USB power source is available via the USB-to-DC plug adapter cable.

The block diagram in Figure 4 shows the logical signal flow between the individual parts.

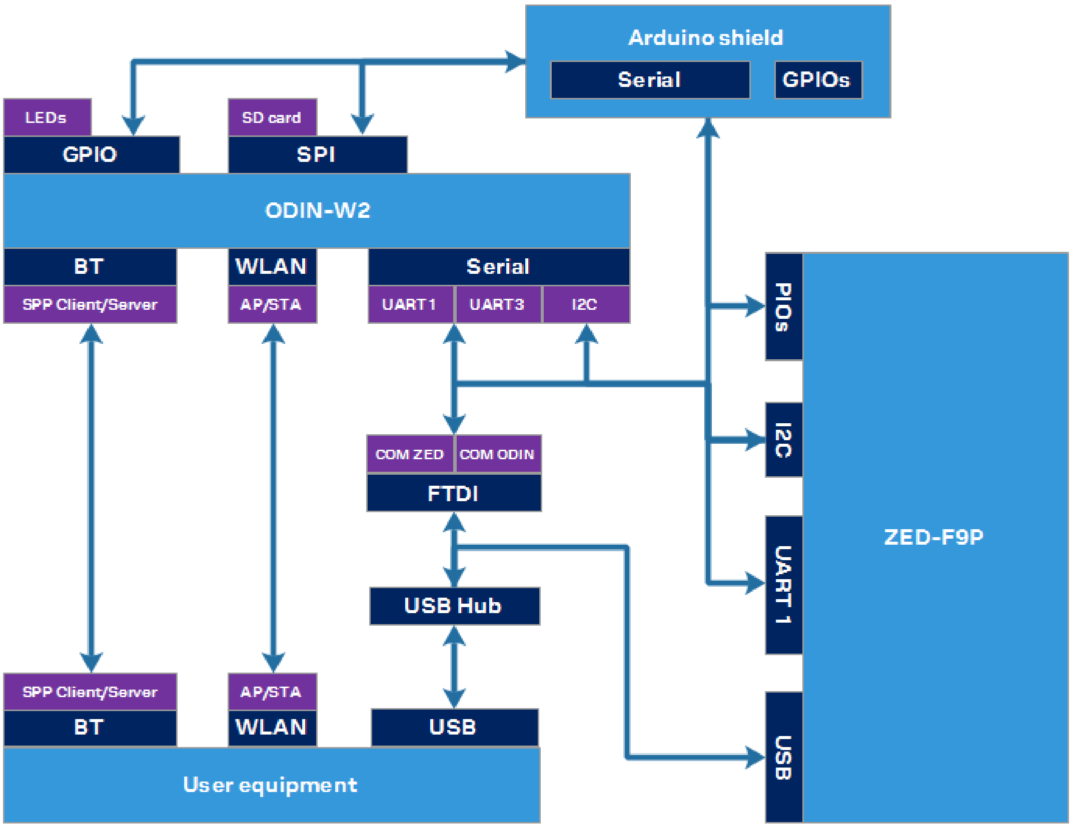


Figure 4: C099-F9P block diagram

3.2 Component identification

The following images show the position of major parts and user interfaces.

- Main components – Figure 5.
- Switches and LEDs – Figure 6.

Their functions are described later on in this section.

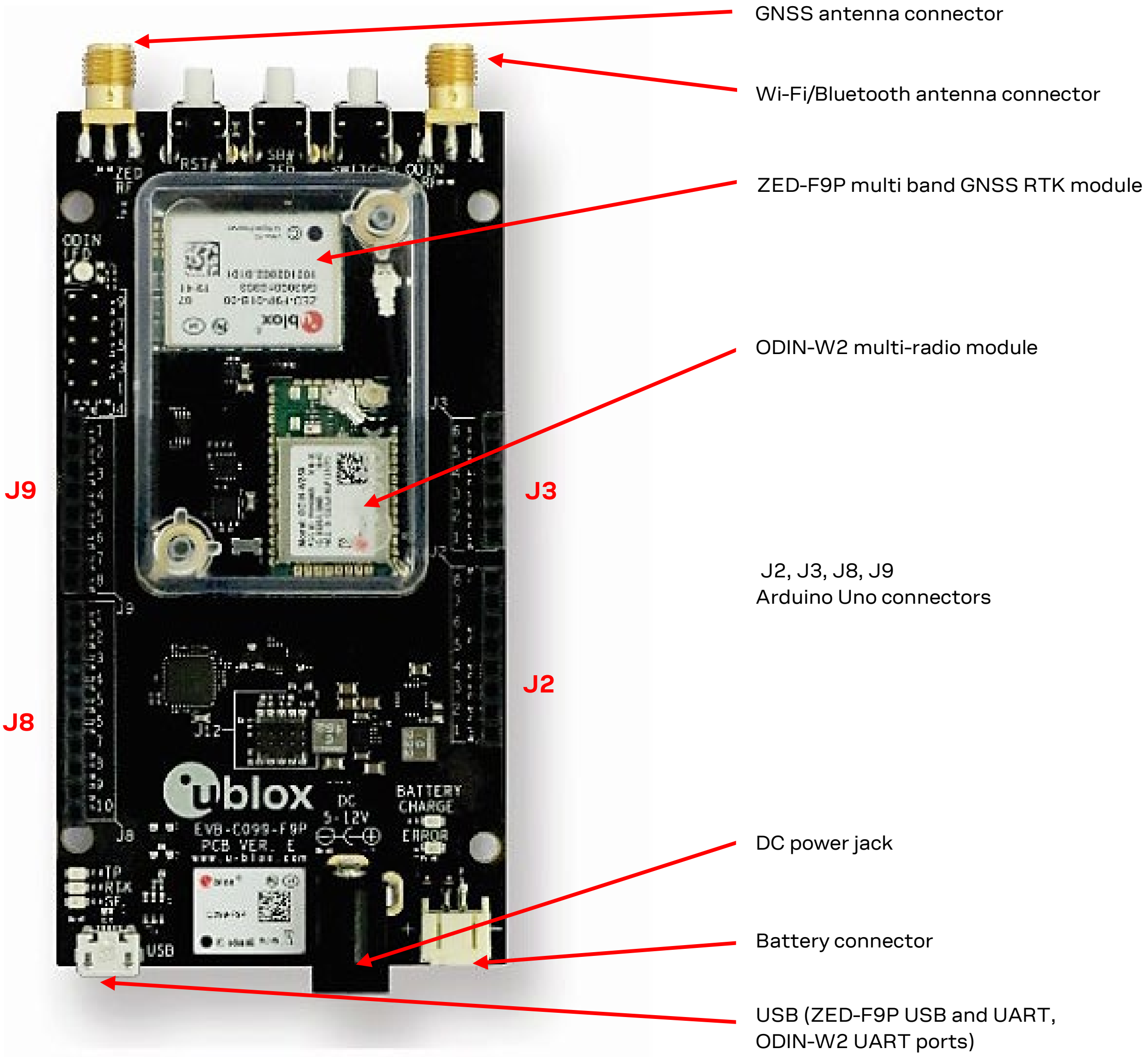


Figure 5: Main components and USB ports

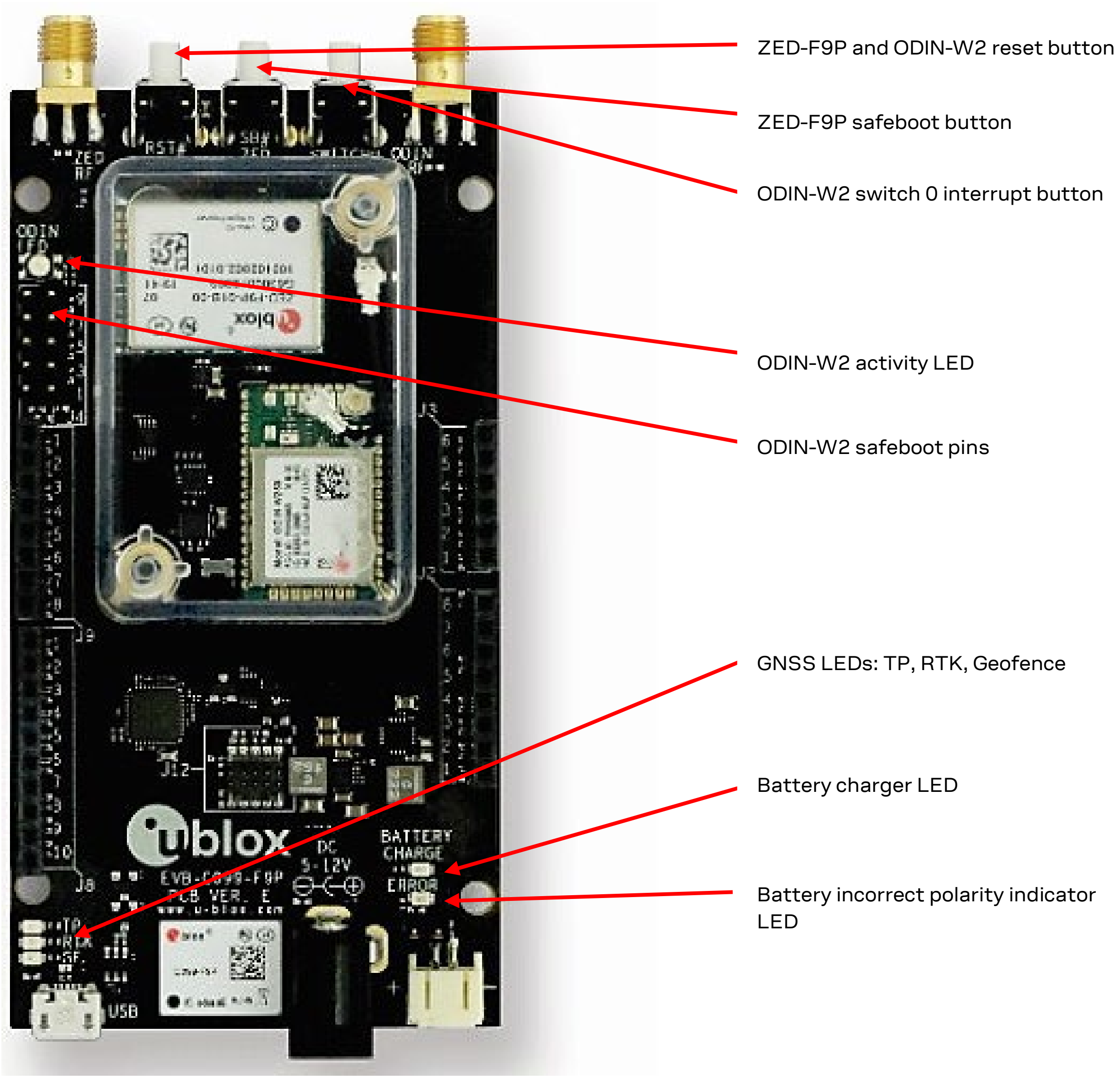


Figure 6: Switches and LEDs

☞ The microSD card functionality is not supported by the currently released Mbed firmware for ODIN-W2.

3.2.1 ZED-F9P status LEDs

The board provides three LEDs to show the ZED-F9P status. The location of the LEDs is shown in Figure 7 below.

The RTK status LED provides an indication of the state of the ZED-F9P module RTK-STAT pin.

- At start-up the LED is off.
- When a valid stream of RTCM messages is being received and utilized, but no RTK fixed mode has been achieved, the yellow LED flashes.
- When in RTK fixed mode, the yellow LED is turned on.

The blue time pulse LED will flash at the default 1 Hz rate when the time solution is valid.

If activated, the Geofence status LED indicates the current Geofence status, i.e. in or outside a designated area.

See the ZED-F9P Interface description [2] for help with configuring the time pulse output or activating the Geofence pin.

Figure 7: ZED-F9P LEDs

3.2.2 ODIN-W2 activity LED

The ODIN-W2 module uses a multi-colored LED to show particular activity status. This is positioned adjacent to the ZED-F9P and ODIN-W2 reset switch and shown below in Figure 8. The activity status is summarized in Table 1 below.

Status	LED color	Remark
Successful start-up, Bluetooth radio initialized	Green	
Bluetooth serial port profile (SPP) connection created	Blue	Connection initiated and accepted
Successful SPP data packet transmission	Blinking blue	
Failed SPP data packet transmission	Blinking red	Weak signal, Bluetooth SPP connection failure
Wi-Fi access point and station (AP and STA) ready	Yellow	Ready to accept incoming Wi-Fi STA connection
Wi-Fi STA connected to AP	Purple	Ready to accept incoming UDP client connection
Successful UDP packet transmission over Wi-Fi	Blinking purple	UDP packet reception is not indicated
ODIN-W2 in safeboot mode	LED off	Safeboot is triggered during start-up. Requires the safeboot jumper to be connected.

Table 1: ODIN-W2 Mbed FW LED activity states and colors

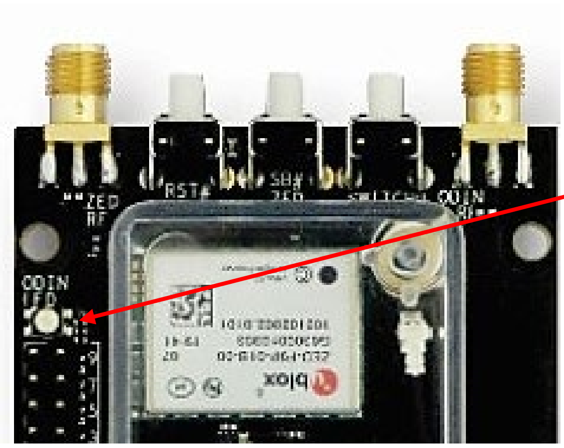


Figure 8: ODIN-W2 activity LED position on C099-F9P board

4 Using the C099-F9P

The ZED-F9P is shipped with the latest HPG firmware. Check the latest ODIN-W2 Mbed FW availability and information on the FW update procedures in section 7 Firmware update.

4.1 Powering the board

The board can be powered from a variety of sources:

- The USB connection,
- A 3.7 V Li-Po Battery via a JST connector,
- An external 6-12 V DC source via a 2.1 mm connector; center pin V+. Also, the included USB-to-DC plug adapter cable can be used to provide an additional USB power source.

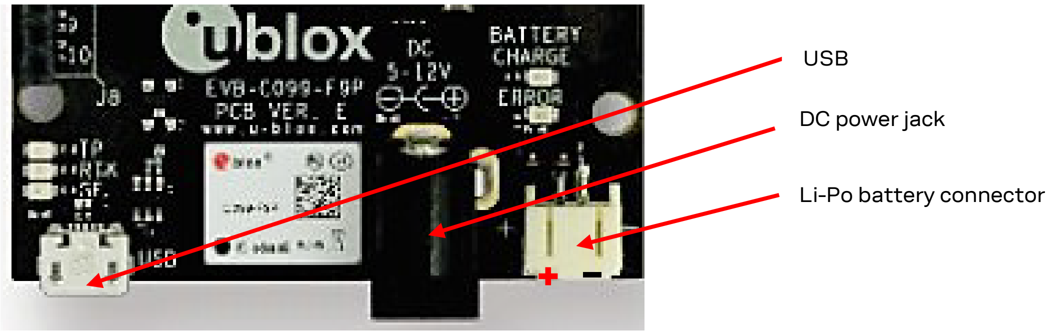


Figure 9: Power connections

Figure 10: Typical single cell 3.7 V Li-Po battery with JST connector

⚠ Follow all published safety advice for using bare cell Li-Po batteries while charging. Protect the batteries from mechanical damage. Fire risk can occur if the advice is not followed.

⚠ Ensure correct polarity on the JST battery connector. In case of an incorrect polarity, the incorrect polarity LED will be on. Due to the polarity protection feature, the supply rails will not be powered.

All supply connections are fed via a Schottky diode to the main supply bus to allow multiple sources to be connected in parallel. The Li-Po battery will be charged from either the DC power source or the

USB power source. The charging status is indicated by a red LED which is on during charging and turned off when fully charged.

When less than 500 mA is available from the USB host, ensure sufficient extra supply via the DC power jack. Note that due to the higher current consumption caused by the battery charging it is not recommended to charge the battery via USB only.

☞ Supplying through the USB port requires the power source (USB host) to support the USB enumeration process. If the power source is not capable of enumeration, you may use the provided USB-to-DC adapter cable and connect it to the DC plug. There is no current limitation for the DC supply.

Figure 11: Battery charge status LED

4.1.1 Non-wireless operation

For use-case scenarios where non-wireless data link is needed the ODIN-W2 can be disabled. In order to disable the ODIN-W2, connect the safeboot jumper which forces the ODIN-W2 into safeboot mode during the device start-up. See Figure 6 to locate the safeboot pins.

On average, the ODIN-W2 consumes less current when started in the safeboot mode. In addition, the safeboot mode ensures that no intentional radiation originates from the 2.4 GHz antenna connector.

4.2 GNSS RF input

The C099-F9P board should be used with the antenna supplied with the kit. If another active antenna is used, be aware that the RF input has a bias output designed to supply 3.3 V DC with a 70 mA maximum current load. A DC block is advisable if the board is connected to a signal distribution scheme or GNSS simulator to prevent any potential shorting of the antenna bias.

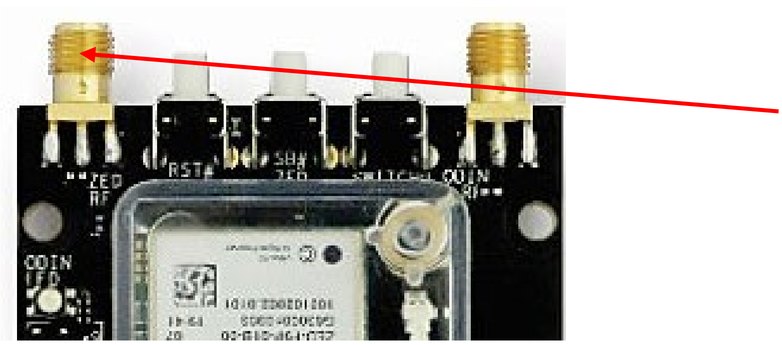


Figure 12: GNSS antenna connector

When using the supplied antenna it is advisable to use the ground plane provided. Otherwise ensure that there is an adequate ground plane, e.g. by mounting in the center of a metallic car roof.

Figure 13: The supplied GNSS multi-band antenna

4.3 User interfaces

The C099-F9P has a number of fixed connection options besides the wireless modes. There is also an additional Arduino R3 / Uno interface for external host connection.

The USB connector on the board provides connection via an on-board hub providing:

- An FTDI USB bridge to ZED-F9P UART1 and ODIN-W2 UART COM ports.
- Dedicated connection to the ZED-F9P USB port.

4.3.1 FTDI USB bridge

When the USB cable from the user's PC is connected, a driver will load and set up two virtual serial ports, as shown below in Figure 14. Additionally, a further serial VCP will be created to provide a direct connection with the ZED-F9P USB port.

☞ Ensure that the PC is connected to the internet to load the drivers from Windows Update.

The first of these is connected to the ZED-F9P serial port and should be selected with u-center. The second serial device is for the ODIN-W2 module when using s-center. In Figure 14, the ODIN-W2 connection is the first port (COM 62) and the ZED-F9P connection is the second port (COM 64). Port numbering can be different between individual PCs, but the same arrangement applies.

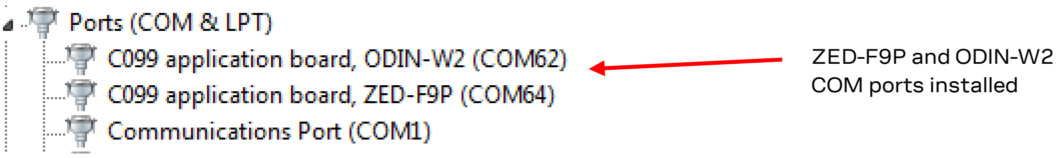


Figure 14: Windows Device Manager COM port view

In addition, a third VCP will be created corresponding to the ZED-F9P USB port. Windows 10 users will see a new VCP device in the Device Manager window when it loads a built-in driver. With older Windows installations, a driver will be loaded via Windows Update. In this case the device will be identified as a u-blox GNSS device in the Device Manager window.

Open u-center (V18.12 or later), select the ZED-F9P serial port, and set the baud rate to 460800 to match the ZED-F9P default UART setting. Once connected, u-center shows typical received signal levels from multiple GNSS bands, see Figure 15 below.

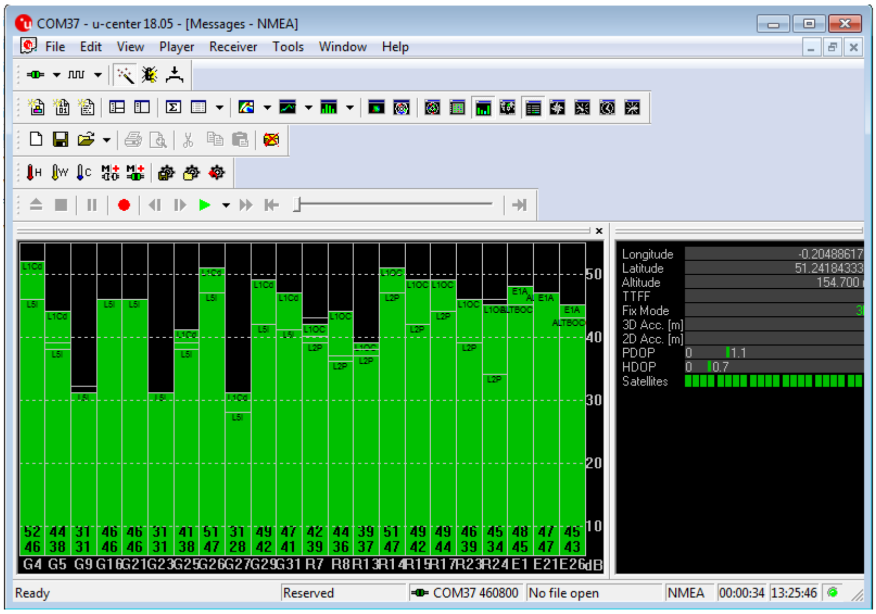


Figure 15: u-center view with ZED-F9P connected

Additional UBX protocol messages can be enabled to view additional information in u-center. For example, the following are typical messages the user can poll or enable for periodic update.

- UBX-NAV-HPPOSLLH
- UBX-NAV-RELPOSNED
- UBX-NAV-SIG
- UBX-NAV-PVT
- UBX-NAV-STATUS
- UBX-NAV-SVIN

☞ For help with the Message view, see u-center User guide [3].

4.3.2 Command line interface of ODIN-W2

The user controls the ODIN-W2 through a command line interface (CLI) which supports Remote Procedure Call syntax as described below:

```
/<function_name>/run <argument 1> <argument 2> …
```

To access the ODIN-W2 CLI use the following default serial settings:

- Baud rate: 460800
- Serial frame: 8 bits, 1 stop bit, no parity
- Flow control: None

Prior to connecting to the ODIN-W2 CLI check the below terminal settings:

☞ Putty (**Settings – Terminal**)

  - local echo force off
  - implicit CR in every LF off
  - implicit LF in every CR off

☞ Tera Term (**Setup – Terminal**)

  - newline receive CR and transmit CR
  - local echo disabled
  - terminal ID VT100

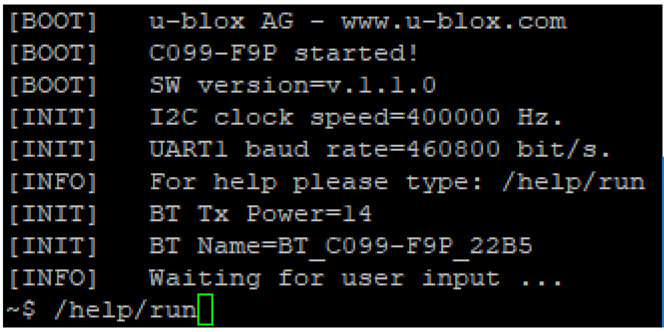


Figure 16: CLI help command

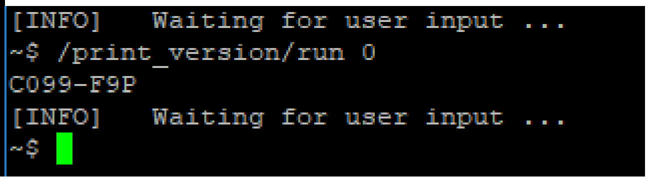


Figure 17: Example RPC syntax

By typing the help command as in Figure 16, the ODIN-W2 will display all available user commands with a short description. The CLI embodies character echo with limited text edit functions. Misspelled commands are replied to with a list of supported commands. Note that ODIN-W2 features I/O-related functions for diagnostic purposes. These functions are listed by the CLI but are not documented in this User guide.

4.4 Persistent ODIN-W2 settings

By default the ODIN-W2 starts in Bluetooth initiator role, and the ODIN-W2 UART1 is configured to use a 460800 baud rate. However, some user settings can be stored in the non-volatile data storage (flash) in the ODIN-W2 and applied after a power cycle.

The user settings are saved into the flash memory via the following CLI command:

```
/mem_store/run <argument 1> <argument 2>
```

4.4.1 Revert to factory default

Factory default settings can be set by one of the two methods:

1. `/mem_erase/run` (via CLI)
2. Press down the SW0 button for more than 3 seconds.

During the next re-start of the ODIN-W2, the factory default settings will be applied.

5 Rover operation using NTRIP

This section shows how the ZED-F9P is used as a rover using correction information provided over the internet using NTRIP. This is usually provided by a host from a single reference station or as a Network RTK Virtual Reference Service (VRS).

A suitable host is a PC with internet access. A host runs an NTRIP client and streams RTCM corrections to the C099-F9P through a UART or Bluetooth connection. Messages transmitted through a Bluetooth or Wi-Fi link are forwarded to I2C bus and vice versa. The user is advised to enable desired messages in both UART and I2C interfaces in ZED-F9P.

5.1 PC hosting via u-center

The u-center application includes an NTRIP client for PC hosting. The u-center User guide [3] provides help when setting NTRIP service connections. Users can connect via Bluetooth for wireless operation or directly via a serial COM port. Once the service is active, RTCM corrections are sent over the connection and data can be logged as usual with u-center.

The u-center User guide [3] provides more information concerning NTRIP connections. Enter the required connection settings using the client setting window shown below.

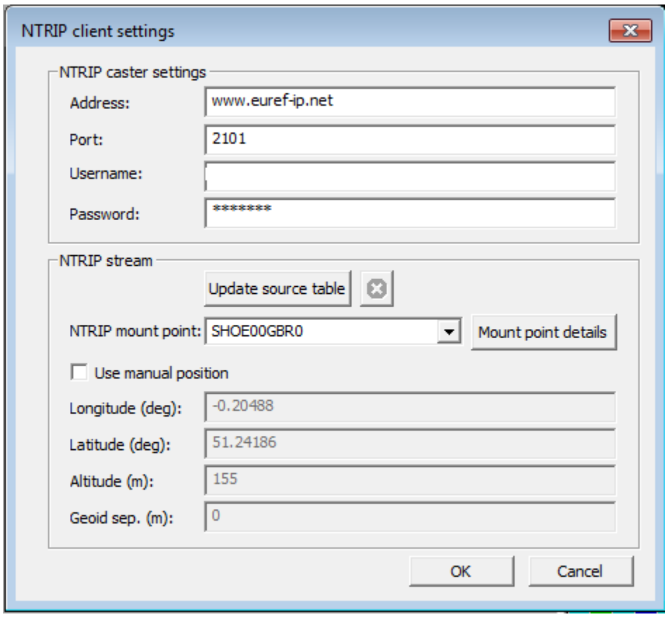


Figure 18: u-center NTRIP client view

Ensure that the NTRIP client connection icon is green. This indicates a successful NTRIP connection and that RTCM data is transferred to the C099-F9P.

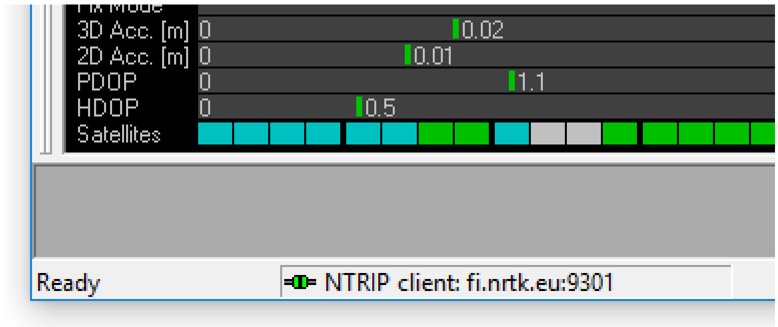


Figure 19: u-center NTRIP Client connection icon in the status bar of u-center

Confirm that the rover has obtained RTK fixed mode in the u-center Data view:

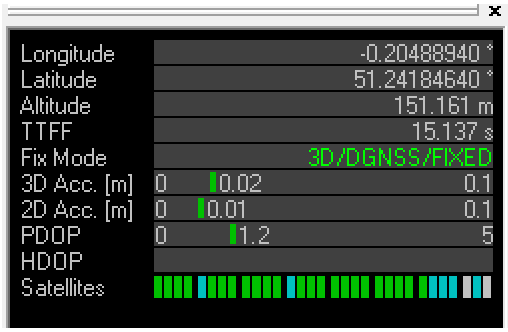


Figure 20: u-center Data view RTK FIXED indication

5.2 Mobile hosting

A portable rover option is offered by an Android application which utilizes Bluetooth connection to a single C099-F9P. An example application is provided by Lefebure and it is available from Google Play Store: https://play.google.com/store/apps/details?id=com.lefebure.ntripclient.

The application integrates an NTRIP client which forwards corrections received from a cellular or a wireless network to Bluetooth interface. In addition, the application logs the incoming NMEA messages from the C099-F9P into the phone memory.

Prior to usage, the following steps are required:

1. Pair an Android phone with C099-F9P (see section 6.1.1 ODIN-W2 as pairing responder).
2. Insert the necessary credentials for the NTRIP service through the application settings.
3. Configure the desired NMEA messages to I2C interface in ZED-F9P via the UART 1 interface.

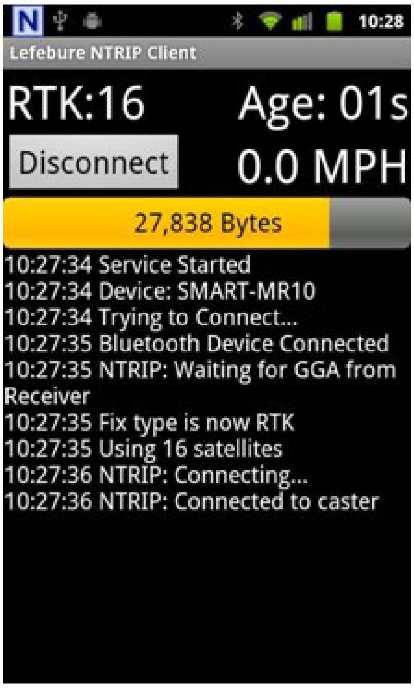


Figure 21: Lefebure Android NTRIP client

6 Wireless communication

6.1 Bluetooth pairing

Prior to operation, the user is requested to pair the ODIN-W2 with a host device. Pairing is the process for creating one or more shared secret keys and is required only once for a pair of devices. The ODIN-W2 can be paired with one of the two alternatives:

1. The host initiates, ODIN-W2 responds.
2. ODIN-W2 initiates, the host responds.

6.1.1 ODIN-W2 as pairing responder

Once verified that the terminal connection is available, use the following command to make the ODIN-W2 visible and connectable:

```
/bt_visible/run
```

ODIN-W2 will acknowledge a successful reception of the command and inform once it is ready to respond to a pairing request.

Next, perform Bluetooth scan to find the C099-F9P. Every C099-F9P has a predefined unique Bluetooth name of type BT_C099-F9P_XYZW as shown in Figure 22.

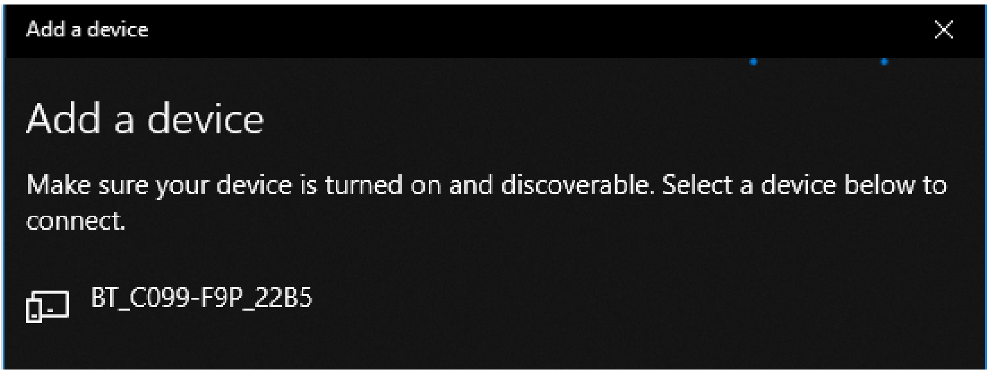


Figure 22: Windows 10 menu for adding a Bluetooth device

6.1.2 ODIN-W2 as pairing initiator

Once you have verified a working CLI connection, use the following command to scan any nearby Bluetooth devices. Prior to that, enable Bluetooth visibility at the host device.

```
/bt_inquiry/run
```

The C099-F9P will list the nearby Bluetooth devices, their Bluetooth addresses ("MAC") and the corresponding RSSI values. To ensure sufficient radio link quality, check that the RSSI level of the host device is well above -80 dBm. Weak signal levels can result in connection losses and limited range.

Once the host device has been found by the C099-F9P, the following command starts the pairing process:

```
/bt_bond/run <MAC address>
```

ODIN-W2 will wait until the user has accepted the pairing request on the host device. Note that the pairing request will fail if an internal timeout is reached. Typically, you can accept an incoming pairing request in the host Bluetooth menu. Finally, the host and ODIN-W2 will permanently store their exchanged link keys for future connections.

6.2 Bluetooth serial port

C099-F9P supports incoming and outgoing Bluetooth serial connections. In order to find the corresponding Bluetooth COM ports refer to Bluetooth options as indicated in Figure 23.

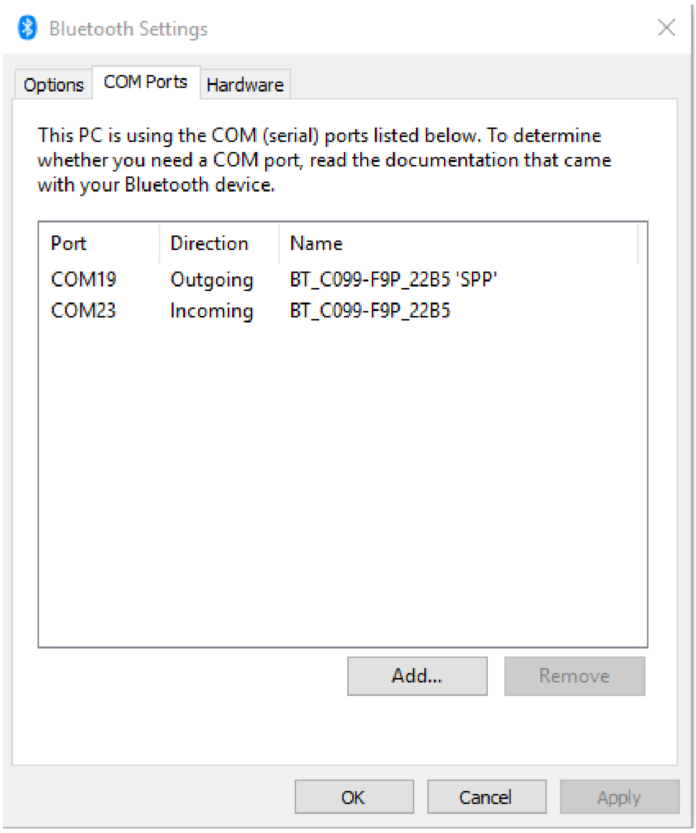


Figure 23: Bluetooth COM ports

Typically Windows hosts will automatically set the corresponding COM ports if the pairing process was initiated at the host, as described in 6.1.1 ODIN-W2 as pairing responder. Often, the user is requested to add incoming and outgoing ports manually if the pairing process was initiated at C099-F9P, as described in 6.1.2 ODIN-W2 as pairing initiator.

6.2.1 Server SPP connection

In order to use the server port (incoming port) at the host PC, connect to the incoming COM port at u-center prior to the CLI command on the C099-F9P:

```
/bt_sppcli/run <MAC address>
```

After a successful connection the C099-F9P starts to stream data from ZED-F9P to the Bluetooth COM port. Note that you can ignore the baud rate of the Bluetooth serial port at the host PC.

6.2.2 Client SPP connection

In order to use the outgoing port (client port) at the host PC, set the C099-F9P in server mode by issuing the following command:

```
/bt_visible/run
```

After selecting the client port (outgoing port) at u-center, the C099-F9P will be automatically requested to open a data stream between the ZED-F9P and the Bluetooth COM port. Note that u-center has default COM port behavior resulting in connection failures or non-listed outgoing Bluetooth COM ports. As a workaround it is recommended to change the default COM port enumeration in u-center as shown in Figure 24.

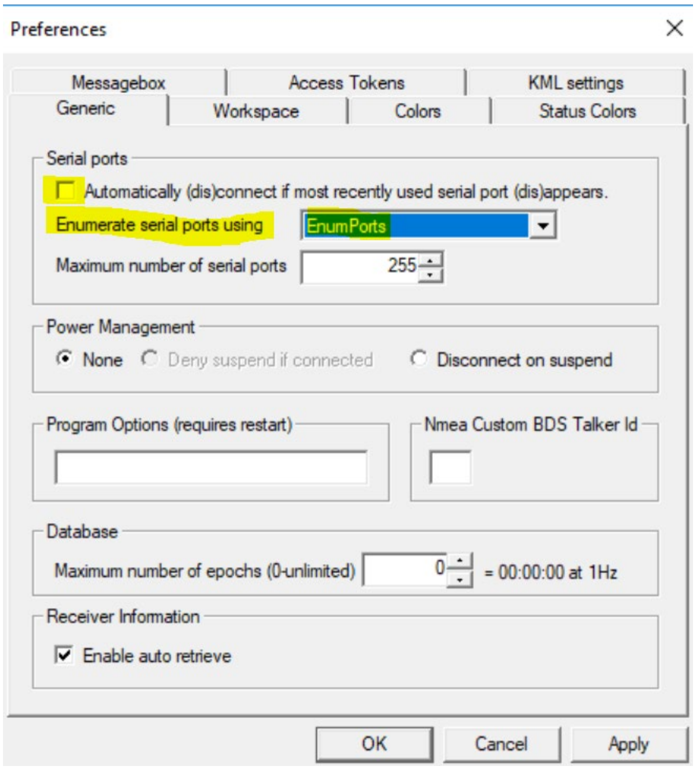


Figure 24: u-center COM port enumeration

To force the C099-F9P to start in Bluetooth SPP server mode at the next device restart, use the following CLI command:

```
/mem_store/run bt 1
```

You can later revert to default start-up settings by erasing the memory content, which is described in section 4.4.1 Revert to factory default.

6.3 Wi-Fi connectivity

The C099-F9P can be operated in Wi-Fi mode to enable longer communication range, higher wireless link throughput and interconnection between base and rover boards. The on-board ZED-F9P and ODIN-W2 are interconnected via I2C bus, as in the Bluetooth operation. Hence, ensure that the desired ZED-F9P messages are enabled for the I2C interface.

	Base	**Rover**
Wi-Fi access point / UDP server	✓	✓
Wi-Fi station / UDP client	N/A	✓

Table 2: ODIN-W2 Wi-Fi modes

6.3.1 Wi-Fi access point and UDP server

The C099-F9P RTK base can be set to operate as a Wi-Fi access point and UDP server to deliver RTCM corrections via a Wi-Fi link. For rover operation, the C099-F9P can be configured either to Wi-Fi STA or Wi-Fi AP mode. The latter configuration is suitable for a single rover connected to a u-center UDP client. Refer to section 4.3.2 Command line interface of ODIN-W2 to recap the required terminal settings for the command line interface.

6.3.1.1 Base operation in Wi-Fi AP mode

Follow the steps below to configure the ODIN-W2 in Wi-Fi AP mode and to redirect incoming rover data to the ODIN-W2 UART1 port (remote logging) as depicted in Figure 25. The UART1 and USB ports on the rover ZED-F9P remain as optional logging interfaces.

1. Configure the C099-F9P to Wi-Fi AP mode by using the CLI command in terminal:

   `/mem_store/run wifi_ap`

2. Set the C099-F9P Wi-Fi and I2C interfaces to support base operation[5]:

   `/mem_store/run base`

3. Re-start the C099-F9P to apply the Wi-Fi AP settings.

   ☞ The ODIN-W2 waits until a Wi-Fi STA (rover) connects to it before streaming any data over the wireless link. See section 6.3.1.3 Rover operation in Wi-Fi STA mode for rover configurations.

4. Apply ZED-F9P base settings through u-center by connecting to ZED-F9P UART 1 port.

   ☞ Any RTCM messages sent over the Wi-Fi link shall be configured for ZED-F9P I2C interface as depicted in Figure 25.

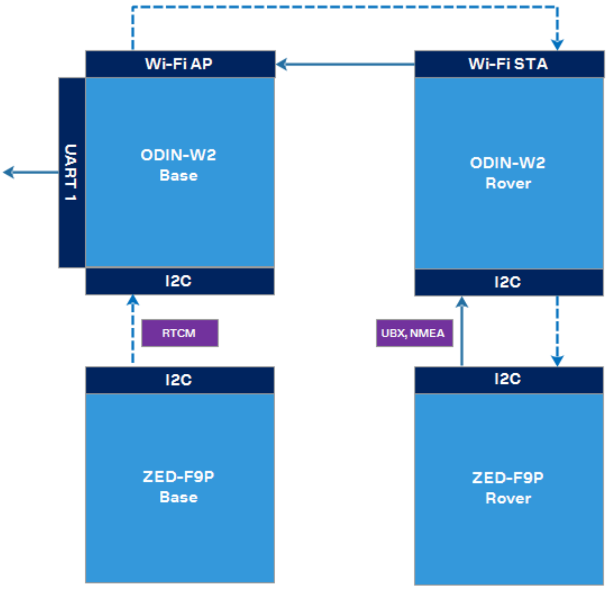


Figure 25: Wi-Fi base and rover setup

6.3.1.2 Rover operation in Wi-Fi AP mode

In order to connect to a C099-F9P rover via a Wi-Fi link, follow the configuration steps below:

1. Configure the C099-F9P to Wi-Fi AP mode by using the CLI command in terminal:

   `/mem_store/run wifi_ap`

2. Set the C099-F9P to operate as a rover:

   `/mem_store/run rover`

3. Re-start the C099-F9P to apply the Wi-Fi AP settings.
4. Connect the host PC's Wi-Fi to the Wi-Fi AP of C099-F9P:

   "C099-F9P" is the default SSID
   "123456789" is the default WPA2 passphraseWi-Fi Station and UDP Client

[5] ZED-F9P I2C output port is enabled for RTCM messages. Disabled for UBX and NMEA protocols.

6.3.1.3 Rover operation in Wi-Fi STA mode

Typically the Wi-Fi STA mode is applicable when two C099-F9Ps (base and rover) interconnect via a Wi-Fi link. Firstly, it is recommended to configure the base as instructed in section 6.3.1.1 Base operation in Wi-Fi AP mode. Secondly, the rover C099-F9P is set up to function in Wi-Fi STA and rover mode:

1. Configure the C099-F9P to Wi-Fi STA mode by using the CLI command in terminal:

```
/mem_store/run wifi_sta
```

2. Set the C099-F9P to operate as a rover:

```
/mem_store/run rover
```

3. Re-start the C099-F9P to apply the Wi-Fi STA settings.
4. The rover C099-F9P will automatically connect to the C099-F9P base.

The AP and STA use the default pre-stored SSID “C099-F9P”. You can set a new SSID and read the current SSID by the following commands:

1. Read the current SSID setting:

```
/wifi_getssid/run
```

2. Set and store a new SSID:

```
/wifi_setssid/run <your_SSID>
```

☞ Wi-Fi connectivity between base and rover requires matching SSID.

6.4 Host UDP client

6.4.1 Client UDP connection

Follow the below steps to start monitoring the ZED-F9P output and to feed in RTCM correction data:

1. Navigate to **Receiver** > **Connection**> **Network Connection** menu at u-center and connect to the C099-F9P via a UDP client socket:

```
udp://192.168.0.1:5555
```

2. After a successful UDP connection, the NTRIP connection can be started as described in section 5.1. RTCM messages will be automatically forwarded to the active UDP socket when the **Current connection** option is used on the NTRIP menu.

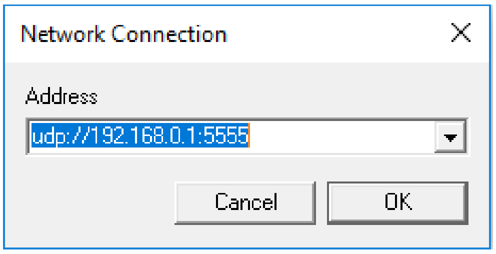


Figure 26: UDP client connection

6.5 Wireless link limitations

6.5.1 Data throughput

The system throughput of the Bluetooth and Wi-Fi links is dominated by the effective I2C and Bluetooth SPP or Wi-Fi data rates, respectively. The user is recommended to limit the average byte load from ZED-F9P to 17 kB/sec. The following examples approximate the output load of the default configuration of ZED-F9P firmware:

- 1 Hz navigation rate: NMEA, UBX-NAV-RELPOSNED, UBX-NAV-PVT enabled < 2.4 kB/sec
- 5 Hz navigation rate: NMEA, UBX-NAV-RELPOSNED, UBX-RXM-RTCM enabled < 17 kB/sec
- 10 Hz navigation rate: NMEA, UBX-RXM-RTCM enabled < 14 kB/sec

The ODIN-W2 outputs an error message upon too high I2C bus load. In such situations some messages may get dropped. To avoid that, the user is recommended to adjust the enabled messages on the ZED-F9P I2C interface.

6.5.2 Link loss

6.5.2.1 Bluetooth Classic

During a Bluetooth transmission failure (red LED blinking), check the system for typical root causes:

- Bluetooth SPP COM port on the host device stalled or disconnected.
- Insufficient signal quality between the host device and C099-F9P.

Recover the system by re-starting the ODIN-W2. Reset can be done by pressing down the reset button.

If ZED-F9P is configured through a Bluetooth link, e.g. using UBX-CFG messages, it is recommended to apply all configurations manually at u-center. Uploading a large configuration file may fail due to the limited link bandwidth.

6.5.2.2 Wi-Fi 2.4 GHz

A Wi-Fi disconnection is reported by a CLI message from ODIN-W2 UART1 interface and the LED indication (yellow LED). If the disconnection is not intended, check the Wi-Fi interface at the host PC.

Wi-Fi channel congestion can be avoided by changing the Wi-Fi AP channel on C099-F9P. Typically, channel congestion is experienced when the Wi-Fi connection indicators (e.g. LEDs) are OK but no data is received. Use the following commands to set and read the current channel stored in the ODIN-W2 RAM:

1. /wifi_setch/run <integer number 1-11>
2. /wifi_getch/run

Then, continue with the Wi-Fi connectivity settings, refer to section 6.3 Wi-Fi connectivity. Ensure the C099-F9P is rebooted to apply the new channel.

6.5.3 Windows OS issues with Bluetooth SPP

There are some known issues with the Windows Bluetooth serial port profile (SPP) implementation for Windows 7-10. The symptoms include the Bluetooth Virtual COM port not installing or applications not connecting to the Bluetooth virtual COM port. In other cases Windows might crash or become un-responsive. This is not related to the ODIN-W2 Bluetooth implementation that uses the Bluetooth standard SPP.

Figure 27: ASUS USB-BT400

A known industry fix is to not use the Windows Bluetooth stack and PC Bluetooth hardware. This is done by using a USB Bluetooth adapter that uses its own Bluetooth stack. A device that is known to work is the ASUS USB-BT400 (USB 2.0). Once installed, use the Bluetooth virtual COM port assigned to this device and not the built-in Bluetooth interface.

7 Firmware update

This section shows how to update the GNSS and Wi-Fi/Bluetooth modules' firmware, if required.

The board is delivered with the latest versions of firmware running on the ZED-F9P and ODIN-W2 modules. However, newer versions may become available during the lifetime of the product.

7.1 ZED-F9P firmware update

This section shows how to update the firmware and re-enable the configuration settings required for the C099-F9P. The user has two possible serial communication channels to update ZED-F9P: UART1 and USB2.0 ports.

To update the ZED-F9P, connect to u-center via USB to the COM port identified as the ZED-F9P and poll MON-VER to view the installed firmware: see Figure 14 for the Device Manager COM port view. To download a new firmware follow the sequence detailed below.

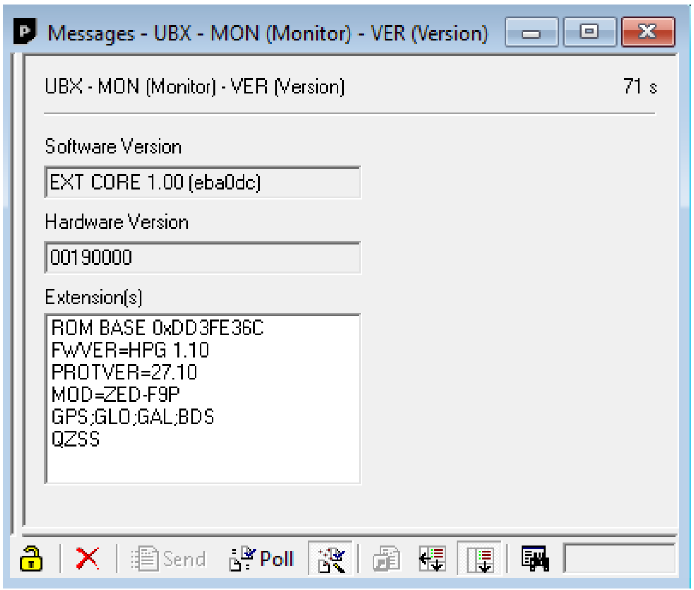


Figure 28: MON-VER poll response for a receiver with firmware version HPG 1.10

To begin updating the firmware, select **Tools** > **Firmware Update**…

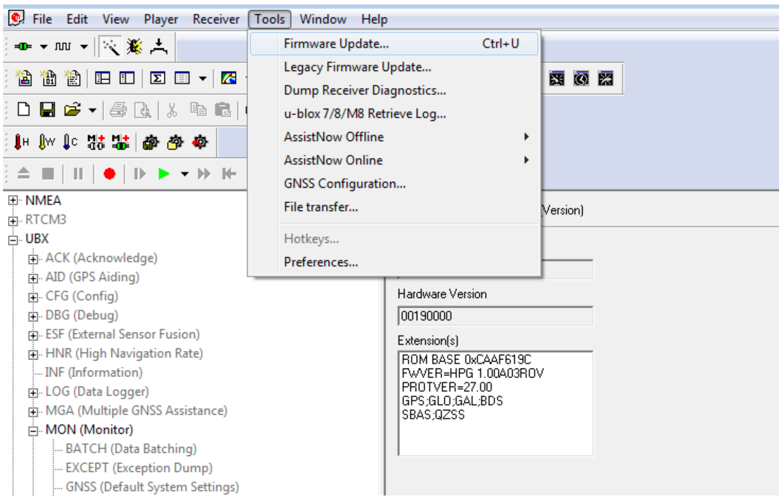


Figure 29: Selecting u-center Firmware Update mode

The following **Firmware image** update window will appear:

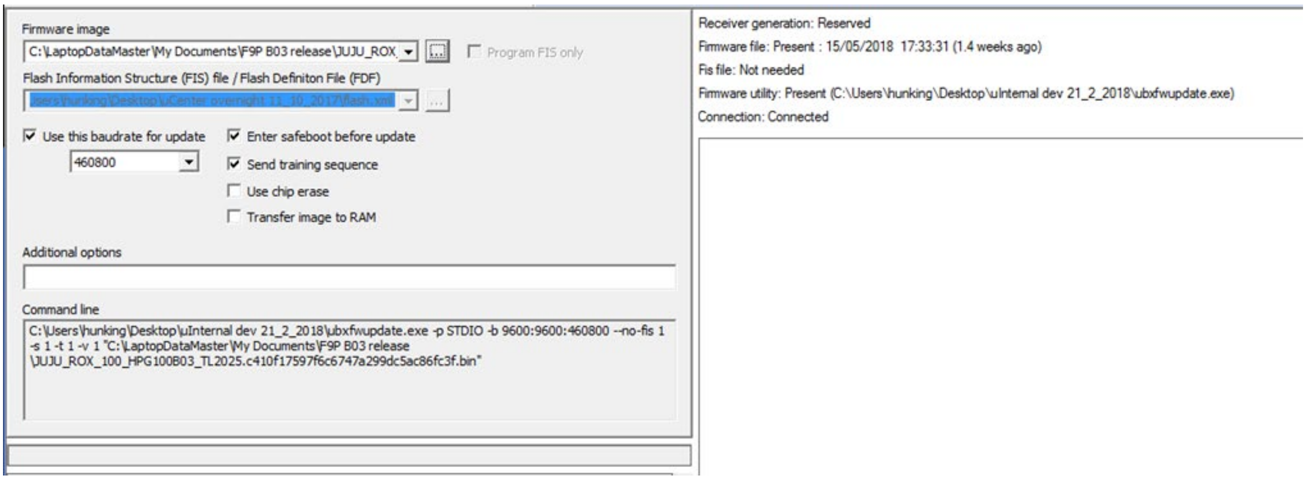


Figure 30: Selecting u-center Firmware image folder

At the top is the **Firmware image** file selection window. Click on the button on the right of the window. This allows you to select the folder and file. Select the new firmware image bin file.

Set the **Enter safeboot before update** and **Send training sequence** options. Set the **Use this baudrate for update** option and select e.g. 460800 from the pull-down list. This is shown in Figure 32 below.

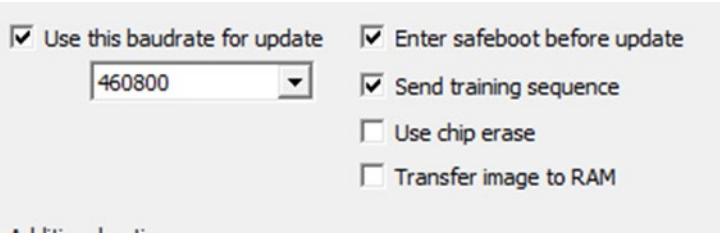


Figure 31: Setting the required baud rate, safeboot and training sequence options

Then click the **GO** button at the bottom left corner of the window to begin the download.

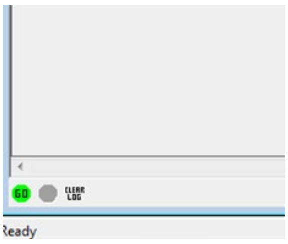


Figure 32: Click GO for firmware update

The firmware update progress indication is shown adjacent to the input window.

When programming is complete, the module will start up in a default configuration in which the ZED-F9P serial port is set to 38400 baud. This requires changing to 460800 baud to provide sufficient data bandwidth and work correctly with the ODIN-W2 module. In order to make the baud rate change persistent, make the selections shown in Figure 34.

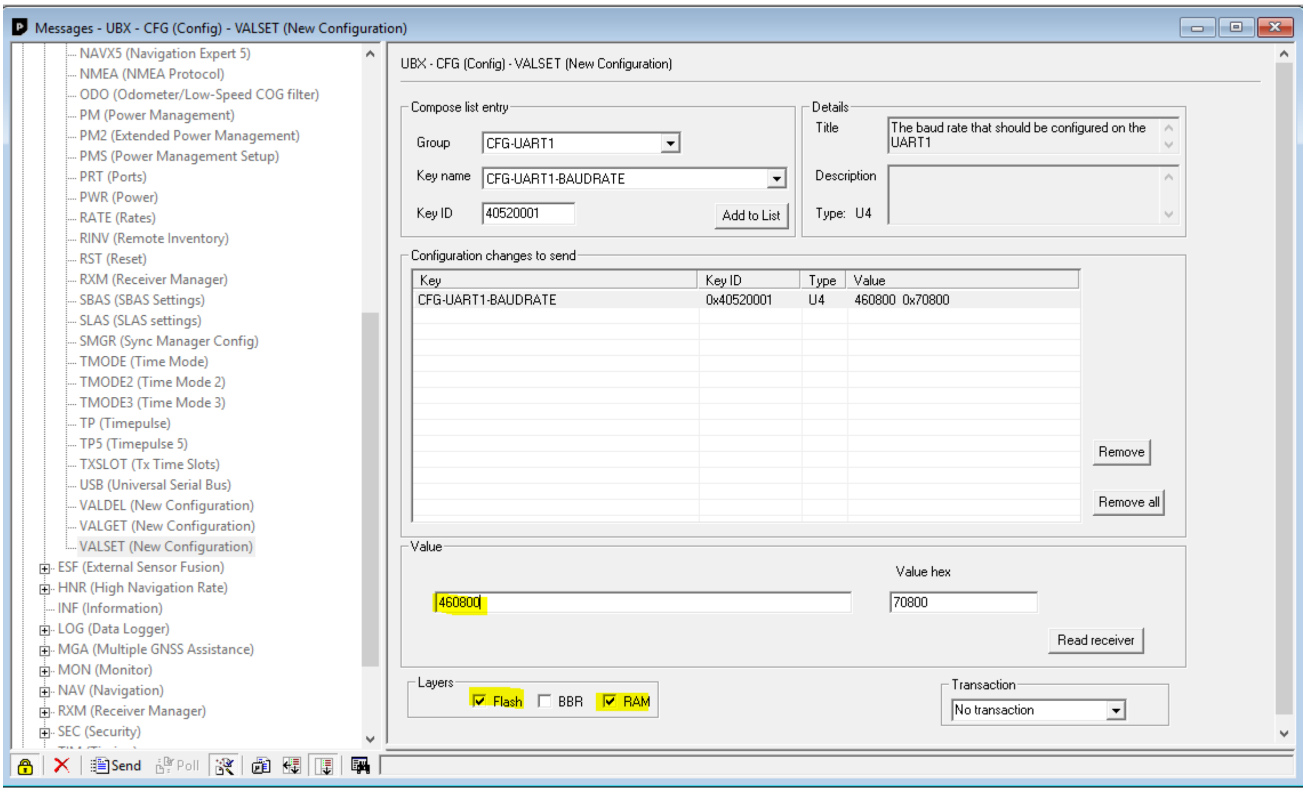


Figure 33: Setting ZED-F9P UART1 back to 460800 baud and saving it to flash memory

7.2 ODIN-W2 firmware update

Users have a choice to run two distinct firmware variants in ODIN-W2. By factory default the ODIN-W2 on a C099-F9P runs a dedicated Mbed application firmware.

7.2.1 Mbed OS 3 application firmware

The latest released binary is available via the u-blox git-hub repository:

https://github.com/u-blox/ublox-C099_F9P-mbed-3

Firmware update on ODIN-W2 is possible by the following tool set:

- Through ODIN-W2 UART1 by using stm32flash.exe

It is recommended to download the stm32flash.exe command line tool from STM website or from Sourceforge: https://sourceforge.net/projects/stm32flash/

Place the downloaded stm32flash executable in the same folder with the FW binary and check for a correct ODIN-W2 COM port number in the Device Manager (Windows users).

To ensure no settings persist over the firmware versions, it is recommended to revert to factory default before uploading a new firmware. Instructions can be found in section 4.4.1 Revert to factory default.

Prior to firmware upload, the ODIN-W2 must be started in safeboot mode. Proceed by placing a safeboot jumper and reboot C099-F9P. Location of the safeboot pin header and the reset button is depicted in Figure 6. To confirm the ODIN-W2 started in safeboot mode the ODIN-W2 activity LED remains off. Use the following command structure in power shell or command prompt to start the FW upload:

```
.\stm32flash.exe -b 115200 -w <c099mbed3.bin> -S 0x8000000 COM<port number>
```

To confirm a successful FW upload remove the safeboot jumper and restart the device. The ODIN-W2 activity LED lights up.

Windows PowerShell

```
PS C:\> .\stm32flash.exe -b 115200 -w c099mbed3_v1.1.0.bin -S 0x8000000 COM7
stm32flash 0.5

http://stm32flash.sourceforge.net/

Using Parser : Raw BINARY
Interface serial_w32: 115200 8E1
Version      : 0x31
Option 1     : 0x00
Option 2     : 0x00
Device ID    : 0x0419 (STM32F42xxx/43xxx)
- RAM        : 192KiB  (12288b reserved by bootloader)
- Flash      : 2048KiB (size first sector: 1x16384)
- Option RAM : 65552b
- System RAM : 30KiB
Write to memory
Erasing memory
Wrote address 0x08078500 (40.33%)
```

Figure 34: Power shell capture of FW upload

7.2.2 u-connectXpress software

In order to utilize the standard ODIN-W2 connectivity stack a firmware update is required. The latest u-blox u-connectXpress software and documentation is available via u-blox.com:

https://www.u-blox.com/en/product/odin-w2-series

The software upload procedure consists of two consecutive phases. Firstly, a bootloader is required to be uploaded:

```
.\stm32flash.exe -b 115200 -w <ODIN-W2-BOOT.bin> -S 0x8000000 COM<port number>
```

After a succesful bootloader upload, the actual u-connectXpress software shall be uploaded while incrementing the memory index as shown below

```
.\stm32flash.exe -b 115200 -w <ODIN-W26X-SW.bin> -S 0x8010000 COM<port number>
```

Instructions of connectivity configurations of ODIN-W2 running the u-connectXpress SW are available in C099-F9P User guide [5].

Windows PowerShell

```
PS C:\> .\stm32flash.exe -b 115200 -w ODIN-W2-BOOT-v0.8.2.bin -S 0x8000000 COM7
stm32flash 0.5

http://stm32flash.sourceforge.net/

Using Parser : Raw BINARY
Interface serial_w32: 115200 8E1
Version      : 0x31
Option 1     : 0x00
Option 2     : 0x00
Device ID    : 0x0419 (STM32F42xxx/43xxx)
- RAM        : 192KiB  (12288b reserved by bootloader)
- Flash      : 2048KiB (size first sector: 1x16384)
- Option RAM : 65552b
- System RAM : 30KiB
Write to memory
Erasing memory
Wrote address 0x08002914 (100.00%) Done.

PS C:\>
```

Figure 35: Power shell capture of bootloader upload

Windows PowerShell

```
PS C:\> .\stm32flash.exe -b 115200 -w ODIN-W26X_FW5.0.1-002.bin -S 0x8010000 COM7
stm32flash 0.5

http://stm32flash.sourceforge.net/

Using Parser : Raw BINARY
Interface serial_w32: 115200 8E1
Version      : 0x31
Option 1     : 0x00
Option 2     : 0x00
Device ID    : 0x0419 (STM32F42xxx/43xxx)
- RAM        : 192KiB  (12288b reserved by bootloader)
- Flash      : 2048KiB (size first sector: 1x16384)
- Option RAM : 65552b
- System RAM : 30KiB
Write to memory
Erasing memory
Wrote address 0x0804a100 (15.78%)
```

Figure 36: Power shell capture of u-connectXpresssoftware upload

8 Arduino header connections

The board size and the four connectors comply with the Arduino R3/Uno mechanical specification. The functions of each I/O align as much as possible to the Arduino-specified functions. Check the pin functions and electrical compatibility before using with an Arduino R3/Uno - see Figure 39 below. All the pin functions besides power are 3.3 V compliant.

Figure 37: C099-F9P Arduino connectors

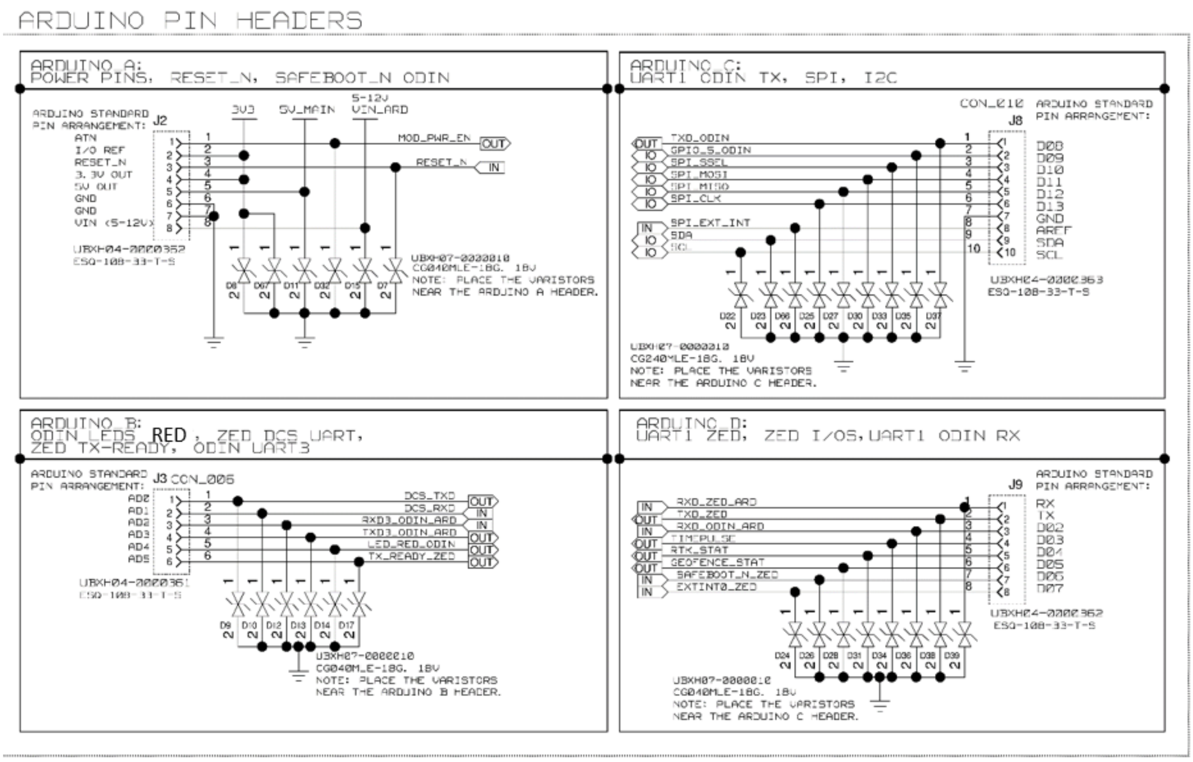


Figure 38: C099-F9P Arduino R3 connections

Appendix

A Glossary

Abbreviation	Definition
CLI	Command line interface
FW	Firmware
LiPo	Lithium polymer
NTRIP	Networked transport of RTCM via internet protocol
NVDS	Non-volatile data storage
RTK	Real time kinematic
UART	Universal asynchronous receiver transmitter
UDP	User datagram protocol
USB	Universal serial bus
UTC	Coordinated universal time
VCP	Virtual COM port
Wi-Fi AP	Wi-Fi access point
Wi-Fi STA	Wi-Fi station

Table 3: Explanation of the abbreviations and terms used

B C099-F9P antenna specification

B.1 Wi-Fi/Bluetooth antenna specification

EX-IT WLAN RPSMA / Ex-IT WLAN SMA	
Manufacturer	ProAnt
Type	½ wave dipole dual-band antenna
Polarization	Vertical
Gain	+3 dBi
Impedance	50 Ω
Size	107 mm (straight)
Type	Monopole
Connector	• Reverse polarity SMA plug (inner thread and pin receptacle) • SMA plug (inner thread and pin)
Comment	To be mounted on the U.FL to SMA or reverse polarity SMA adapter cable
Approval	FCC, IC, RED, MIC, NCC, KCC*, ANATEL, and ICASA

Table 4: Wi-Fi/Bluetooth antenna

☞ The variant included in the the C099-F9P kit is with an SMA connector and has to be mounted on the corresponding antenna connector of the C099-F9P board if you wish to use Wi-Fi or Bluetooth connectivity.

C ODIN-W2 firmware upload via JTAG

ODIN-W2 firmware upload is possible through the 10-pin JTAG connector by using the STM Link Utility SW and ST LINK V2 debugger device. STM Link Utility software can be found on

https://www.st.com/en/development-tools/stsw-link004.html

Check the availability of ST LINK V2 debugger device with local STM distributors.

D Mechanical board dimensions

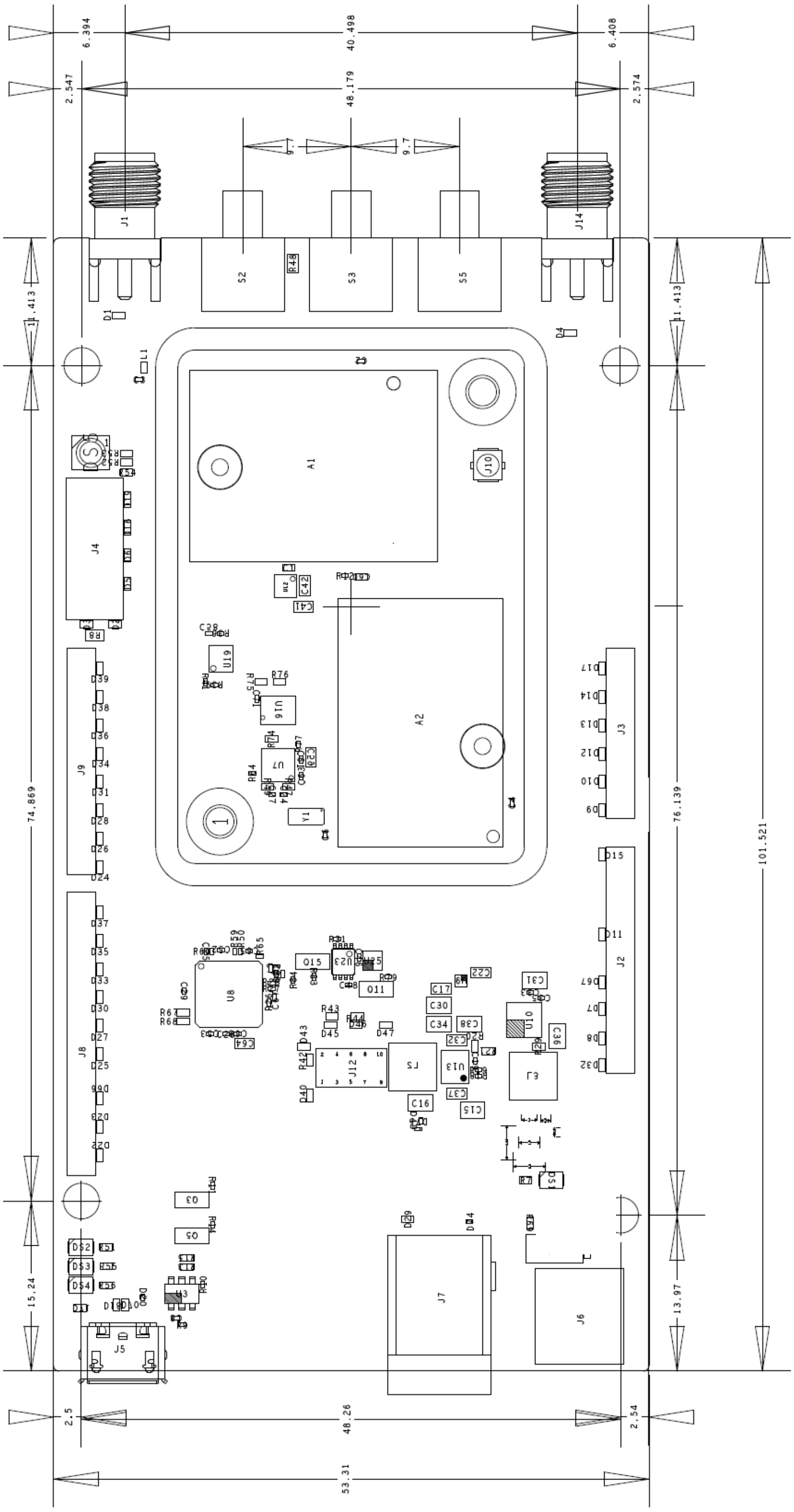
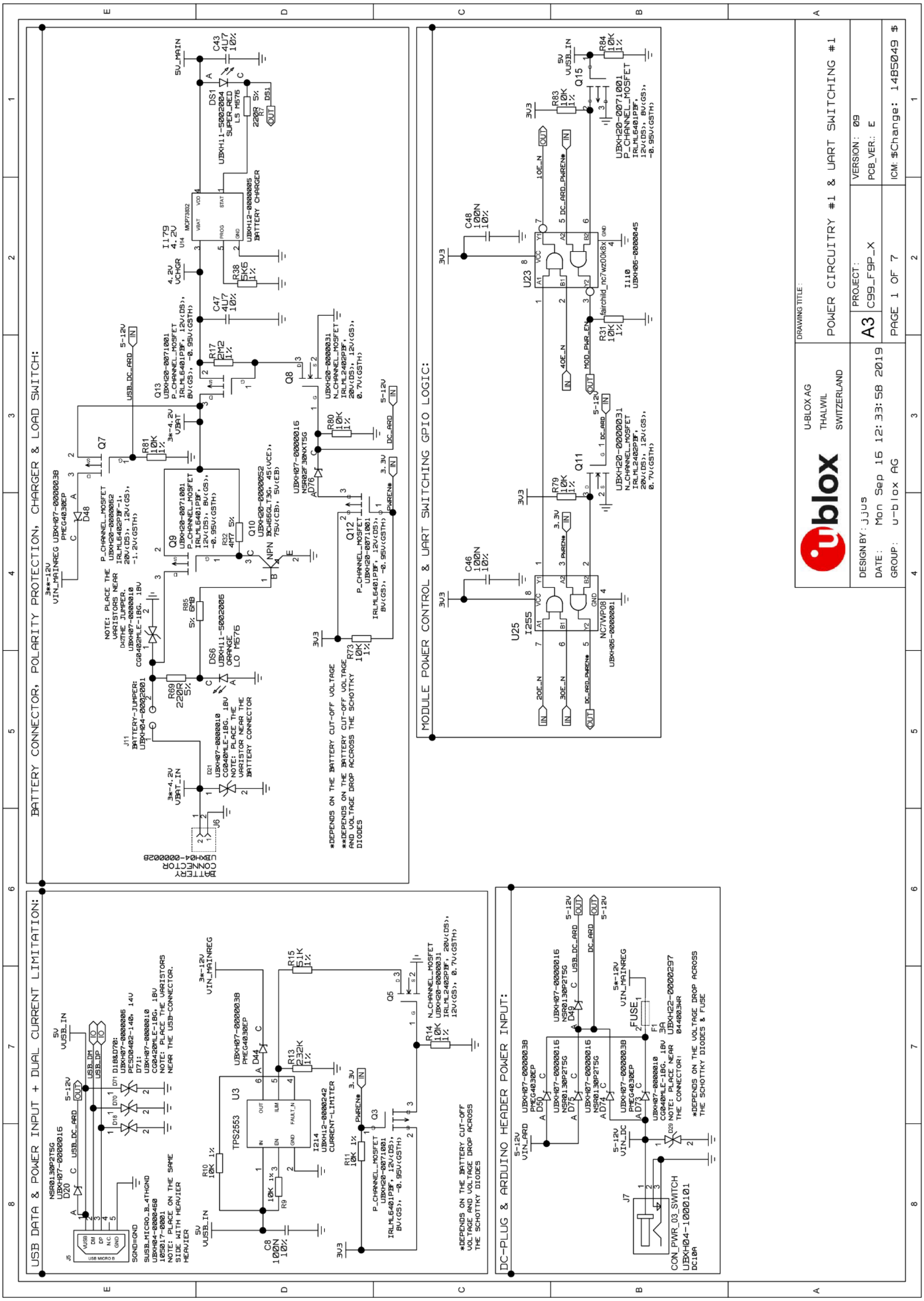
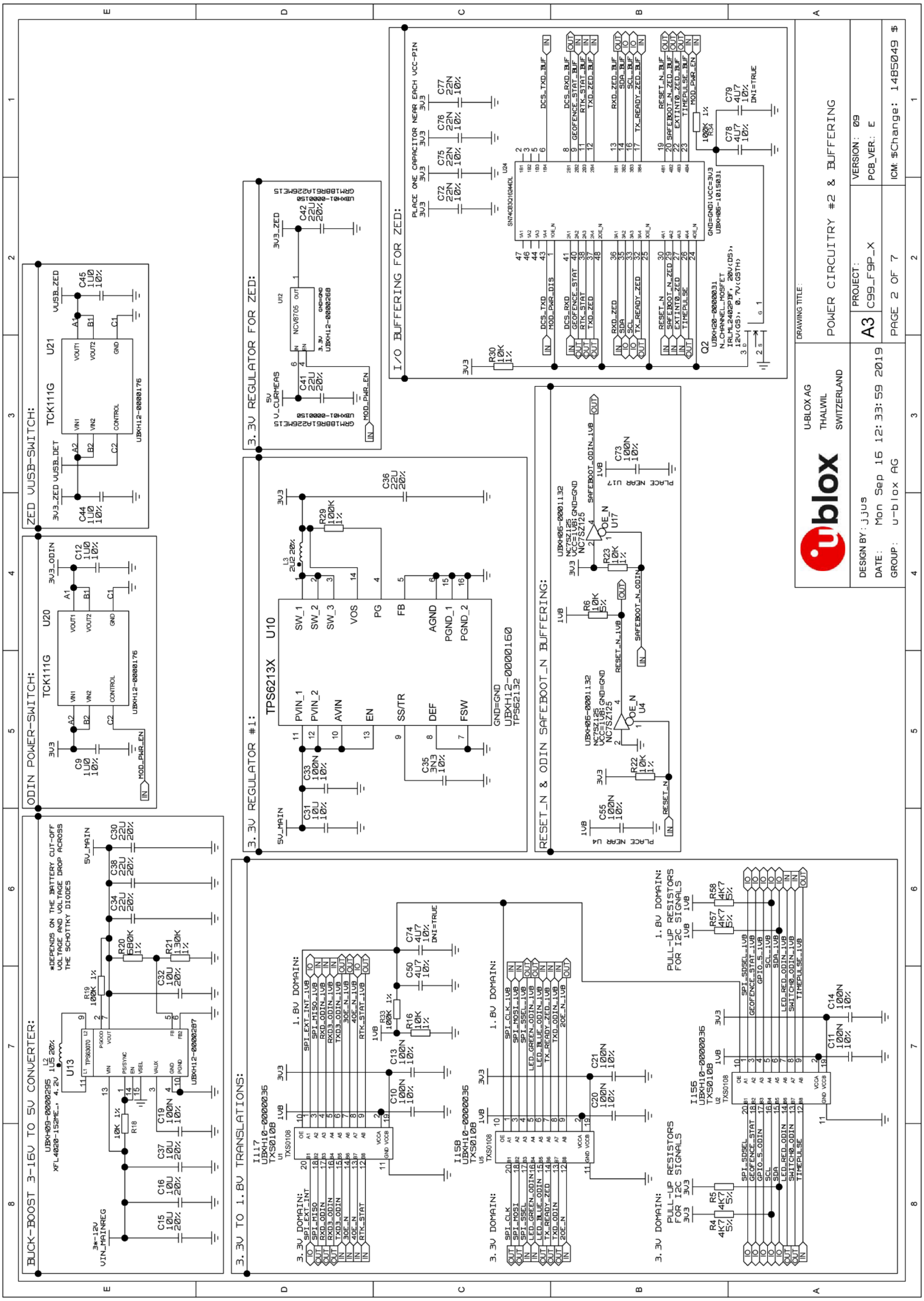


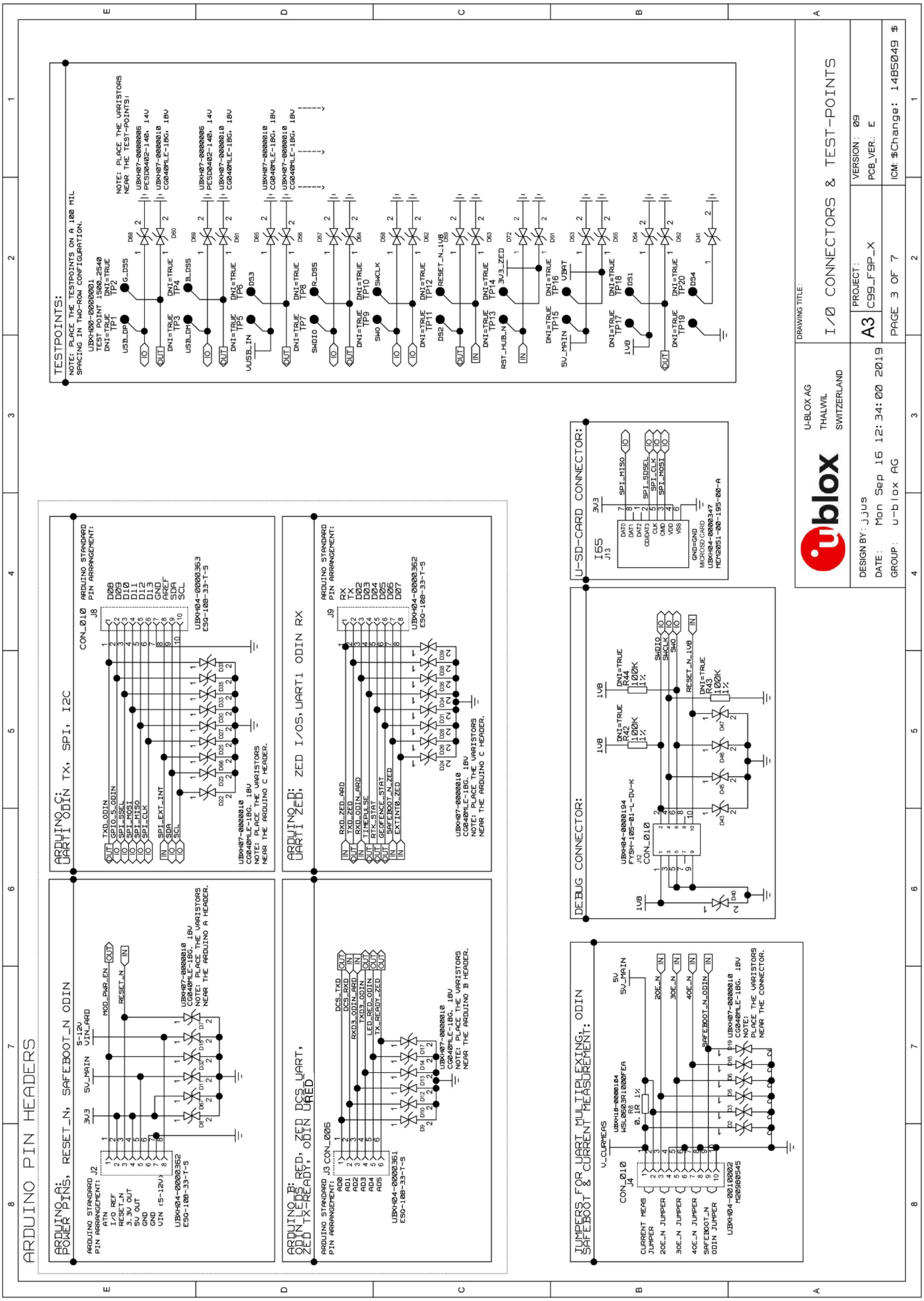
Figure 39: C099-F9P rev. E dimensions

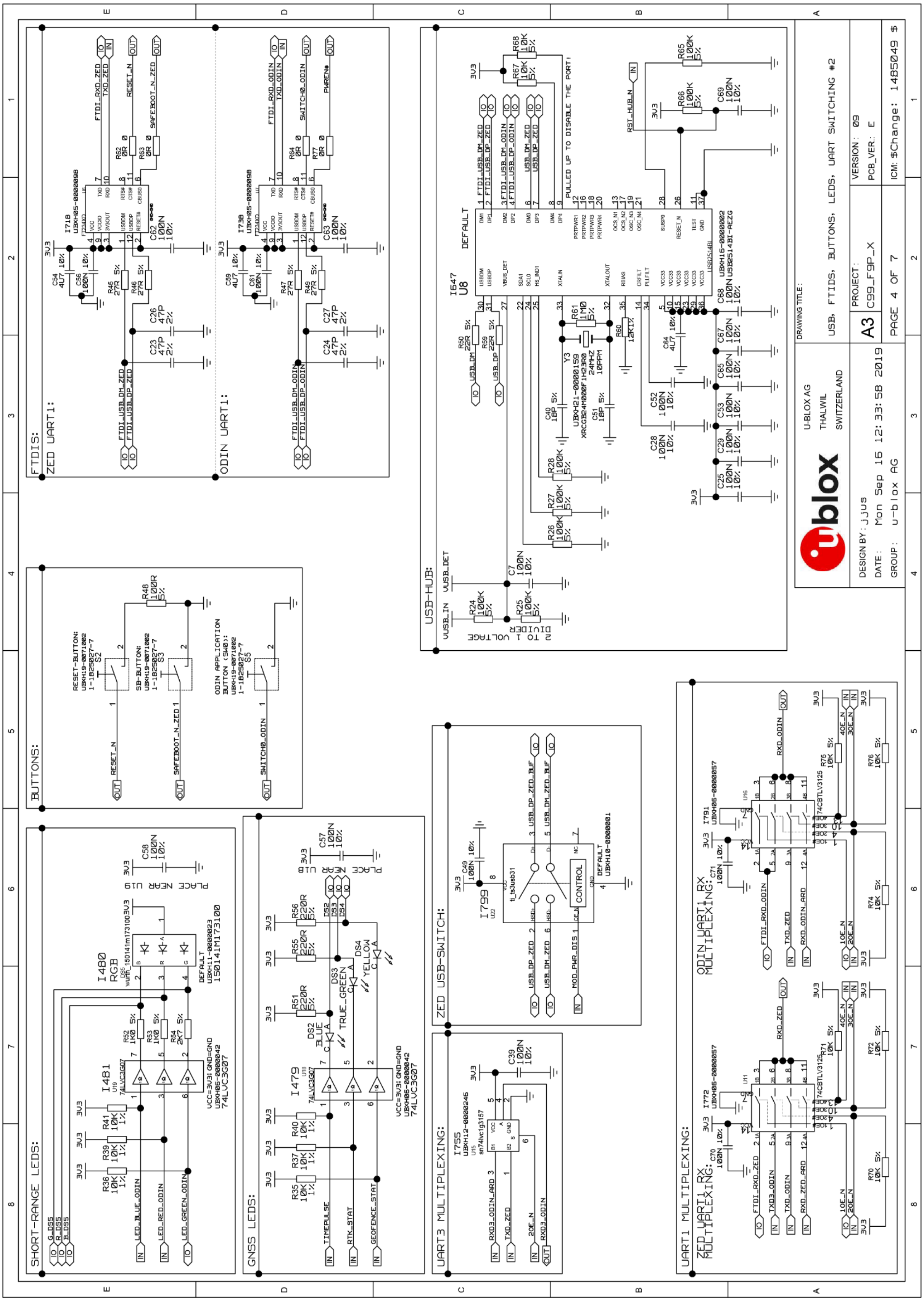
E C099-F9P schematics

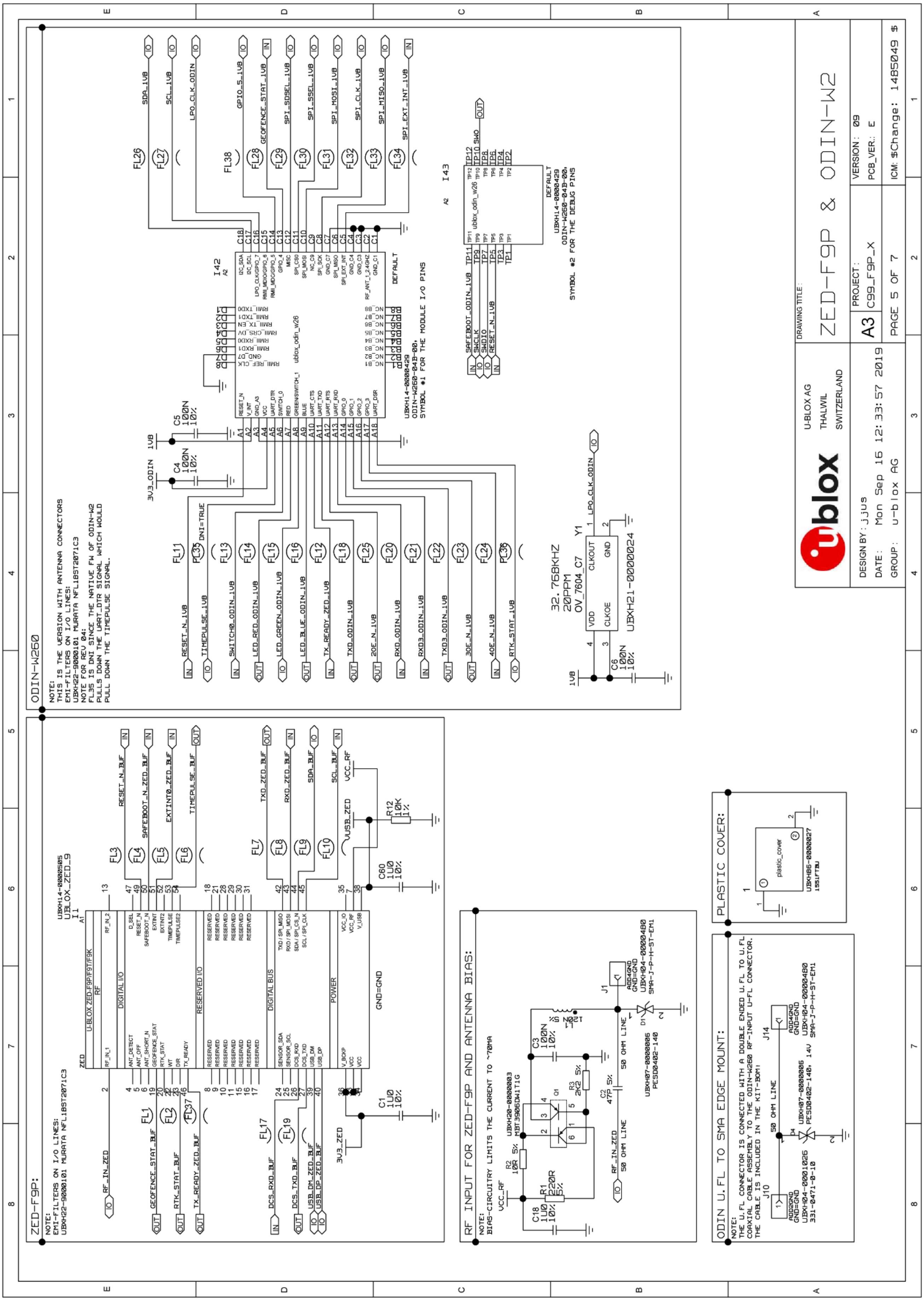
The following pages show the complete schematic for the C099-F9P evaluation board.


BATTERY CONNECTOR, POLARITY PROTECTION, CHARGER & LOAD SWITCH:
MODULE POWER CONTROL & UART SWITCHING GPIO LOGIC:
USB DATA & POWER INPUT + DUAL CURRENT LIMITATION:
DC-PLUG & ARDUINO HEADER POWER INPUT:
U-BLOX AG
THALWIL
SWITZERLAND
DRAWING TITLE:
POWER CIRCUITRY #1 & UART SWITCHING #1
A3
PROJECT: C99_F9P_X
VERSION: 09
PCB_VER.: E
DESIGN BY: jjus
DATE: Mon Sep 16 12:33:58 2019
GROUP: u-blox AG
PAGE 1 OF 7
ICM: $Change: 1485049 $


BUCK-BOOST 3-16V TO 5V CONVERTER:
ODIN POWER-SWITCH:
ZED VUSB-SWITCH:
3.3V REGULATOR FOR ZED:
I/O BUFFERING FOR ZED:
3.3V REGULATOR #1:
RESET_N & ODIN SAFEBOOT_N BUFFERING:
3.3V TO 1.8V TRANSLATIONS:
DRAWING TITLE:
POWER CIRCUITRY #2 & BUFFERING
U-BLOX AG
THALWIL
SWITZERLAND
A3
PROJECT:
C99_F9P_X
PAGE 2 OF 7
VERSION: 09
PCB_VER.: E
DESIGN BY: jjus
DATE: Mon Sep 16 12:33:59 2019
GROUP: u-blox AG


ARDUINO PIN HEADERS
TESTPOINTS:
DEBUG CONNECTOR:
U-SD-CARD CONNECTOR:
JUMPERS FOR UART MULTIPLEXING, ODIN SAFEBOOT & CURRENT MEASUREMENT:
I/O CONNECTORS & TEST-POINTS
U-BLOX AG
THALWIL
SWITZERLAND
DESIGN BY: jjus
DATE: Mon Sep 16 12:34:00 2019
GROUP: u-blox AG
PROJECT: C99_F9P_X
VERSION: 09
PCB_VER.: E
PAGE 3 OF 7
ICM: $Change: 1485049 $


USB, FTDIS, BUTTONS, LEDS, UART SWITCHING #2
A3
PROJECT: C99_F9P_X
PAGE 4 OF 7
VERSION: 09
PCB_VER.: E
U-BLOX AG
THALWIL
SWITZERLAND
DESIGN BY: jjus
DATE: Mon Sep 16 12:33:58 2019
GROUP: u-blox AG
ICM: $Change: 1485049 $
USB-HUB:
ZED USB-SWITCH:
UART3 MULTIPLEXING:
UART1 MULTIPLEXING:
GNSS LEDS:
SHORT-RANGE LEDS:
BUTTONS:
FTDIS:


ZED-F9P & ODIN-W2
DRAWING TITLE:
PROJECT: C99_F9P_X
VERSION: 09
PCB_VER.: E
A3
PAGE 5 OF 7
ICM: $Change: 1485049 $
U-BLOX AG
THALWIL
SWITZERLAND
DESIGN BY: jjus
DATE: Mon Sep 16 12:33:57 2019
GROUP: u-blox AG
ZED-F9P:
ODIN-W260
RF INPUT FOR ZED-F9P AND ANTENNA BIAS:
PLASTIC COVER:
ODIN U.FL TO SMA EDGE MOUNT:

Related documents

[1] ZED-F9P Integration manual, doc. no. UBX-18010802
[2] ZED-F9P Interface description, doc. no. UBX-18010854
[3] u-center User guide, doc. no. UBX-13005250
[4] u-blox GNSS Sensor and VCP Device Driver User guide, doc. no. UBX-15022397
[5] C099-F9P User guide (with ODIN-W2 u-connectXpress SW), doc. no. UBX-18055649
[6] ANN-MB series multi-band GNSS antennas Data sheet, doc.no. UBX-18049862

☞ For regular updates to u-blox documentation and to receive product change notifications, register on our homepage (www.u-blox.com).

Revision history

Revision	Date	Name	Comments
R01	10-Jul-2018	ghun/byou	Initial release
R02	19-Oct-2018	byou	Updates for the C099-F9P rev. B board revision.
R03	8-Nov-2018	olep	Updates for Mbed3 FW in ODIN-W2
R04	1-Feb-2019	olep	Updates for Wi-Fi and NVDS features in ODIN-W2
R05	21-Feb-2019	olep	Updated Arduino J9 schematics. Polarity requirement of the battery connector.
R06	29-Mar-2019	olep	Updates for Wi-Fi AP and STA operation
R07	23-May-2019	olep	Editorial changes
R08	11-June-2019	olep	Updates on Wi-Fi base instructions.
R09	25-Sep-2019	jhak/jjus	Added instructions for non-wireless operation. Updates for the C099-F9P rev. C board revision
R10	12-Nov-2019	jhak	Updates for the C099-F9P rev. E board revision. Connectivity SW renamed to u-connectXpress
R11	5-Dec-2019	mala	Improved the quality of the schematic drawings.
R12	29-June 2020	ghun	Update for HPG 1.13

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