# EVK-R6 and EVK-L6

## LARA-R6 and LARA-L6 series cellular evaluation kits

### User guide

**Abstract**

This guide explains how to set up the u-blox EVK-R6 and EVK-L6 evaluation kits to begin evaluating the LARA-R6 series cellular modules supporting LTE Cat 1 / 3G / 2G radio access technologies and the LARA-L6 series cellular modules supporting LTE Cat 4 / 3G / 2G radio access technologies.

# Document information

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This document applies to the following products:

| Product name | Type number |
|---|---|
| EVK-R6001 | EVK-R6001-00B-00 |
| EVK-R6401 | EVK-R6401-00B-00 |
| EVK-R6801 | EVK-R6801-00B-00 |
| EVK-L6004 | EVK-L6004-00B-00 |
| EVK-L6004D | EVK-L6004D-00B-00 |

# Contents

# 1   Starting up

## 1.1   EVK-R6 and EVK-L6 overview

The u-blox EVK-R6 and EVK-L6 kits are powerful and easy-to-use tools that simplifies the evaluation of the LARA-R6 series multimode LTE Cat 1 / 3G / 2G cellular modules and the evaluation of the LARA-L6 series multimode LTE Cat 4 / 3G / 2G cellular modules.

The following evaluation kits are available (see Figure 1):

- EVK-R6001 evaluation kit is for evaluation of LARA-R6001 modules
- EVK-R6401 evaluation kit is for evaluation of LARA-R6401 modules
- EVK-R6801 evaluation kit is for evaluation of LARA-R6801 modules
- EVK-L6004 evaluation kit is for evaluation of LARA-L6004 modules
- EVK-L6004D evaluation kit is for evaluation of LARA-L6004D modules

All the EVK-R6001, EVK-R6401, EVK-R6801, EVK-L6004 and EVK-L6004D evaluation kits are herein identified as EVK-R6 and EVK-L6.

☞ See the LARA-R6 series data sheet [2], the LARA-L6 series data sheet [3], and the LARA-R6 / LARA-L6 series system integration manual [4] for the features supported by the u-blox LARA-R6 and LARA-L6 series cellular modules.
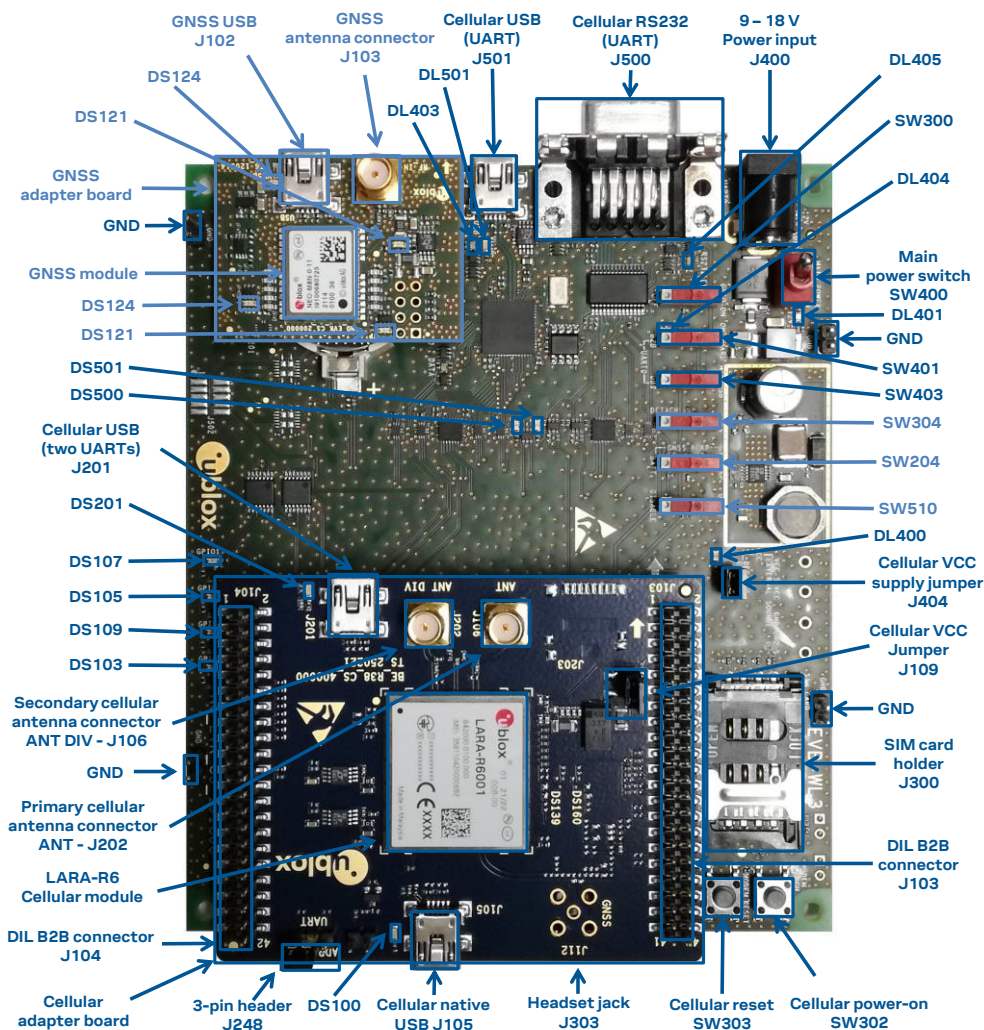


**Figure 1: Overview of EVK-R6 and EVK-L6 evaluation kit for LARA-R6 and LARA-L6 modules**

## 1.2 EVK-R6 and EVK-L6 block diagram and basic description

Figure 2 shows the main interfaces and internal connections of EVK-R6 and EVK-L6 evaluation kits:
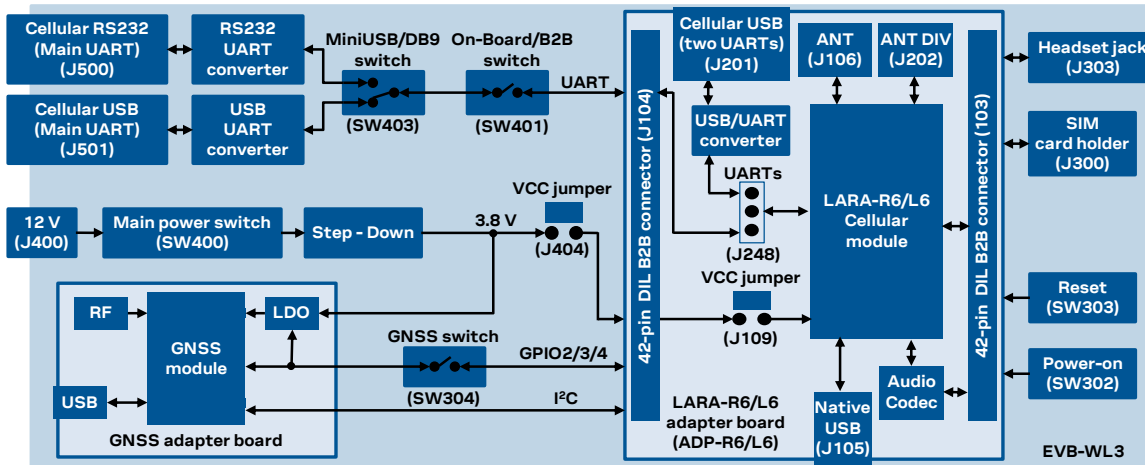


**Figure 2: Block diagram of EVK-R6 and EVK-L6 for LARA-R6 and LARA-L6 modules**

The EVK-R6 and EVK-L6 is formed by three boards:

- The lower one, called EVB-WL3 or simply EVB, contains the power supply and other peripherals for the cellular module (such as SIM card holder, reset button and power-on button).
- The cellular adapter board, called ADP-R6 / ADP-L6, contains the LARA-R6 / LARA-L6 cellular module, the cellular antenna connectors (ANT / ANT DIV), the USB "native" connector (J105), the USB "two UARTs" connector (J201), the UARTs routing switch (J248), the VCC jumper (J109) and an audio codec.
- The GNSS adapter board, called ADP-GNSS, contains the u-blox GNSS module, the GNSS antenna connector and the USB connector for the GNSS module.

The cellular and the GNSS adapter boards (ADP-R6/L6 and ADP-GNSS respectively) are connected by means of male header board-to-board connectors provided on the bottom of the adapter boards and their corresponding female connectors provided on top of the lower board (EVB-WL3).

The USB interface of the cellular module is available on the native USB connector (J105) on the cellular adapter board (ADP-R6 / ADP-L6).

The main UART and the auxiliary UART interfaces of the cellular module can be routed as follows, by means of the 3-way UARTs' routing switch (J248) available on the cellular adapter board (ADP-R6 / ADP-L6) as illustrated in Figure 3:

- EVB position (pin 1-2 of J248 shorted by jumper socket): main UART routed as 8-wire interface to the lower EVB-WL3 board by the means of dual-in-line male board-to-board connectors mounted on the bottom of the adapter board ADP-R6/L6. According to the mini-USB / DB9 switch (SW403) setting on the EVB-WL3, the main 8-wire UART interface can be accessed on the USB connector (J501) or on the RS232 DB9 connector (J500) on the EVB-WL3, with the on-board / B2B switch (SW401) on the EVB-WL3 set to "on-board". The auxiliary UART interface is not available.
- ADP position (pin 2-3 of J248 shorted by jumper socket): main UART and auxiliary UART routed as 4-wire interfaces to the USB two UARTs connector (J201) mounted on the adapter board, with the on-board / B2B switch (SW401) on the EVB-WL3 board is set to "B2B".
- No position (no jumper socket on J248): main 8-wire UART interface or main 4-wire UART with auxiliary 4-wire UART interfaces, routed to the dual-in-line male header connectors mounted on the top of the adapter board ADP-R6/L6, allowing a connection to an external compatible device with the on-board / B2B switch (SW401) on the EVB-WL3 board set to "B2B".
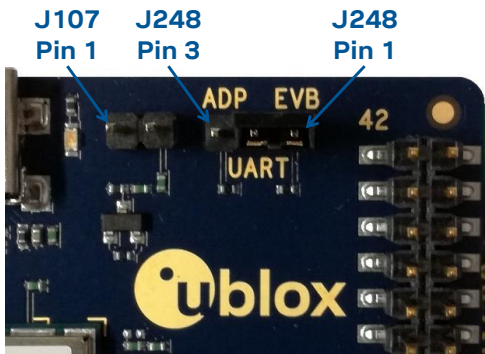
**Figure 3: 3-pin header J248 available to set the routing of the UART interfaces on the EVK for LARA-R6 / LARA-L6 modules**

The other peripherals of the cellular module are available on the dual-in-line male header connectors (J103 / J104) provided on the top layer of the cellular adapter board ADP-R6 / ADP-L6.

The lower board is designed to also be used with other u-blox cellular adapter boards. It contains additional switches, jumpers, connectors, LEDs and parts that are partially described in Figure 1 or in this document, because they are intended for use only with other u-blox cellular modules. It is recommended to leave any additional connector unconnected, and to leave any additional switch in its default configuration.

## 1.3 Switches, jumpers and buttons

| Function | Description | Name | Board |
|---|---|---|---|
| Main power switch | Power on / off the whole evaluation kit | SW400 | EVB |
| Cellular VCC | Jumper socket to provide the 3.8 V supply to the cellular module VCC input | J404 | EVB |
| Cellular power-on | Push button to switch-on the cellular module | SW302 | EVB |
| Cellular reset | Push button to reset the cellular module | SW303 | EVB |
| Cellular UART detach | Slide switch to attach / detach cellular module UART from USB / RS232 connectors: when detached, UART signals available only on DIL B2B connector on ADP board | SW401 | EVB |
| Cellular UART routing | Slide switch to select cellular module main UART routing on USB or on RS232 connector | SW403 | EVB |
| Cellular GPIO detach | Slide switch to attach / detach the cellular module GPIOs from peripherals: when detached, the signals are available only on the DIL B2B connector on ADP-R6/L6 | SW300 | EVB |
| Cellular GNSS detach | Slide switch to attach / detach the cellular module to the GNSS module (GPIO2-3-4): when detached, signals are available only on DIL B2B connector on ADP-R6/L6 | SW304 | EVB |
| GNSS V_BCKP | Slide switch to connect / disconnect backup battery to V_BCKP pin of the GNSS module | SW204 | EVB |
| Cellular VCC | Jumper socket to provide the 3.8 V supply to the cellular module VCC input | J109 | ADP-R6 ADP-L6 |
| Cellular UARTs routing | Jumper to route cellular module UART interfaces to USB two UARTs connector (both Main and Auxiliary UART) or to lower board by the means of Dual-In-Line male Board-to-Board connectors (only Main UART) | J248 | ADP-R6 ADP-L6 |

**Table 1: EVK-R6 and EVK-L6 switch and button descriptions**

## 1.4 LEDs

| Function | Description | LED # | Board | Color |
|---|---|---|---|---|
| Main power | Power supply plugged in the **9 - 18 V Power Input** | DL401 | EVB | |
| Cellular VCC | Cellular module supplied. **Main power switch** must be switched on | DL400 | EVB | |
| Cellular native USB | USB cable plugged in the **Cellular native USB** connector | DS100 | ADP-R6/L6 | |
| Cellular two UARTs USB | USB cable plugged in the Cellular two UARTs USB connector | DS201 | ADP-R6/L6 | |
| Cellular USB | USB cable plugged in the Cellular USB connector for UART access | DL501 | EVB | |

| Function | Description | LED # | Board | Color |
|---|---|---|---|---|
| Cellular USB / UART | Green light is activated when UART is routed to the cellular USB connector<br>Red light blinks at UART TX or RX data on the Cellular USB connector | DL403 | EVB | 🟥🟩 |
| Cellular UART detach | UART signals are available only on the DIL connector on ADP-R6/L6 board | DL404 | EVB | 🟩 |
| Cellular RS232 / UART | Green light is activated when UART is routed to Cellular RS232 connector<br>Red light blinks at UART TX or RX data on the Cellular RS232 connector | DL405 | EVB | 🟥🟩 |
| Cellular RI indicator | RI line turns ON (active low) | DS501 | EVB | 🟥 |
| Cellular CTS indicator | CTS line turns ON (active low) | DS500 | EVB | 🟩 |
| Cellular GPIO1 indicator | Green light is activated when cellular GPIO1 is high | DS107 | EVB | 🟩 |
| Cellular GPIO2 indicator | Green light is activated when cellular GPIO2 is high | DS105 | EVB | 🟩 |
| Cellular GPIO3 indicator | Green light is activated when cellular GPIO3 is high | DS109 | EVB | 🟩 |
| Cellular GPIO4 indicator | Green light is activated when cellular GPIO4 is high | DS103 | EVB | 🟩 |
| GNSS VCC supply | GNSS module supply is turned ON | DS118 | ADP-GNSS | 🟩 |
| GNSS USB | USB cable plugged in GNSS USB connector | DS124 | ADP-GNSS | 🟦 |
| GNSS time pulse | Pulses at 1 Hz when valid GNSS fix | DS121 | ADP-GNSS | 🟩 |
| Cellular / GNSS I2C | Cellular / GNSS module communication over the I$^2$C interface | DS132 | ADP-GNSS | 🟧 |

**Table 2: EVK-R6 and EVK-L6 LED descriptions**

# 1.5   Connectors

| Function | Description | Name | Board |
|---|---|---|---|
| 9 - 18 V Power Input | Connector for the AC / DC power adapter of the EVK<br>AC: 100-240 V, 0.8 A, 50-60 Hz / DC: +12 V, 2.5 A     ☐ IEC 60417-5172 Class II equipment | J400 | EVB |
| SIM card holder | SIM card holder | J300 | EVB |
| Primary cellular antenna | SMA connector for the cellular module primary antenna (ANT1, Tx/Rx) | J106 | ADP-R6/L6 |
| Secondary cellular antenna | SMA connector for the cellular module secondary antenna (ANT2, Rx) | J202 | ADP-R6/L6 |
| Cellular native USB | Mini USB connector for the cellular module native USB interface | J105 | ADP-R6/L6 |
| Cellular two UARTs USB | Mini USB connector for the cellular module main and auxiliary USB interfaces | J201 | ADP-R6/L6 |
| Cellular USB (UART) | Mini USB connector for the cellular module UART interface converted as USB interface | J501 | EVB |
| Cellular RS232 (UART) | DB9 connector for the cellular module UART interface converted as RS232 interface | J500 | EVB |
| DIL B2B headers | Dual-In-Line Board-to-Board connectors for cellular module interfaces | J103-J104 | ADP-R6/L6 |
| Cellular headset | Audio headset jack connector for the cellular module audio interface | J303 | EVB |
| GNSS antenna | SMA connector for the GNSS module antenna (GNSS antenna) | J208 | ADP-GNSS |
| GNSS USB | Mini USB connector for the GNSS module USB interface | J102 | ADP-GNSS |
| GNSS backup battery | Backup battery socket for the GNSS module (under GNSS adapter board) | BT200 | EVB |
| GND | Ground terminals for the probe reference | J402, J403 J405, J406 | EVB |

**Table 3: EVK-R6 and EVK-L6 connector descriptions**

⚠ Caution! In the unlikely event of a failure in the internal protection circuitry, there is a risk of an explosion when charging a fully or partially discharged battery. Replace the battery when it no longer has a sufficient charge for unit operation. Control the battery before use if the device has not been used for an extended period of time.

⚠ Caution! Risk of explosion if battery is replaced with an incorrect type. Dispose of used batteries according to the instructions!

## 1.6   EVK-R6 and EVK-L6 pin out

| LARA-R6/L6 series | | DIL B2B | LARA-R6/L6 series | | DIL B2B | LARA-R6/L6 series | | DIL B2B |
|---|---|---|---|---|---|---|---|---|
| Pin N° | Name | Name / Pin N° | Pin N° | Name | Name / Pin N° | Pin N° | Name | Name / Pin N° |
| 1 | GND | J104 pins 7-10 | 24 | GPIO3 | J104 pin 31 | 47 | RSVD | Not present |
| 2 | RSVD | Not present | 25 | GPIO4 | J104 pin 26 | 48 | RSVD | Not present |
| 3 | GND | J104 pins 7-10 | 26 | SDA | J103 pin 22 | 49 | RSVD | Not present |
| 4 | V_INT | J104 pin 35 | 27 | SCL | J103 pin 19 | 50 | GND | J104 pins 7-10 |
| 5 | GND | J104 pins 7-10 | 28 | USB_D- | Not present | 51 | VCC | J103 pins 8-10 |
| 6 | DSR | J104 pin 17 | 29 | USB_D+ | Not present | 52 | VCC | J103 pins 8-10 |
| 7 | RI | J104 pin 18 | 30 | GND | J104 pins 7-10 | 53 | VCC | J103 pins 8-10 |
| 8 | DCD | J104 pin 12 | 31 | RSVD | Not present | 54 | GND | J104 pins 7-10 |
| 9 | DTR | J104 pin 11 | 32 | GND | J104 pins 7-10 | 55 | GND | J104 pins 7-10 |
| 10 | RTS | J104 pin 14 | 33 | RSVD | Not present | 56 | ANT1 | Not present |
| 11 | CTS | J104 pin 13 | 34 | I2S_WA | Not present | 57 | GND | J104 pins 7-10 |
| 12 | TXD | J104 pin 16 | 35 | I2S_TXD | Not present | 58 | GND | J104 pins 7-10 |
| 13 | RXD | J104 pin 15 | 36 | I2S_CLK | Not present | 59 | ANT_DET | Not present |
| 14 | GND | J104 pins 7-10 | 37 | I2S_RXD | Not present | 60 | GND | J104 pins 7-10 |
| 15 | PWR_ON | J104 pin 30 | 38 | SIM_CLK | J103 pin 16 | 61 | GND | J104 pins 7-10 |
| 16 | GPIO1 | J104 pin 34 | 39 | SIM_IO | J103 pin 13 | 62 | ANT2 | Not present |
| 17 | VUSB_DET | Not present | 40 | SIM_RST | J103 pin 15 | 63 | GND | J104 pins 7-10 |
| 18 | RESET_N | J103 pin 25 | 41 | VSIM | J103 pin 14 | 64 | GND | J104 pins 7-10 |
| 19 | GPIO6 | J104 pin 23 | 42 | GPIO5 | J104 pin 24 | 65-96 | GND | J104 pins 7-10 |
| 20 | GND | J104 pins 7-10 | 43 | GND | J104 pins 7-10 | 97 | RFCTRL1[1] | J103 pin 5 |
| 21 | GND | J104 pins 7-10 | 44 | RSVD | Not present | 98 | RFCTRL2[1] | J103 pin 6 |
| 22 | GND | J104 pins 7-10 | 45 | RSVD | Not present | 99 | RSVD | Not present |
| 23 | GPIO2 | J104 pin 32 | 46 | RSVD | Not present | 100 | RSVD | Not present |

**Table 4: Interfaces of LARA-R6/L6 modules, as routed on the 42-pin dual-in-line board-to-board connectors (J103, J104) available on the adapter board ADP-R6/L6 of the EVK-R6 and EVK-L6 evaluation kits**

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[1] LARA-R6401 and LARA-R6401D only. Pin reserved for future use (RSVD) otherwise.

| Dual-in-line board-to-board connector J104 | | | | Dual-in-line board-to-board connector J103 | | | |
|---|---|---|---|---|---|---|---|
| Signal name | Pin N° | Pin N° | Signal name | Signal name | Pin N° | Pin N° | Signal name |
| Not connected | 1 | 2 | GND | Not connected | 1 | 2 | GND |
| Not connected | 3 | 4 | Not connected | Not connected | 3 | 4 | Not connected |
| Not connected | 5 | 6 | Not connected | RFCTRL1[2] | 5 | 6 | RFCTRL2[2] |
| GND | 7 | 8 | GND | Not connected | 7 | 8 | VCC |
| GND | 9 | 10 | GND | VCC | 9 | 10 | VCC |
| DTR | 11 | 12 | DCD | Not connected | 11 | 12 | Not connected |
| CTS | 13 | 14 | RTS | SIM_IO | 13 | 14 | VSIM |
| RXD | 15 | 16 | TXD | SIM_RST | 15 | 16 | SIM_CLK |
| DSR | 17 | 18 | RI | Not connected | 17 | 18 | Not connected |
| Not connected | 19 | 20 | Not connected | SCL | 19 | 20 | Not connected |
| Not connected | 21 | 22 | Not connected | Not connected | 21 | 22 | SDA |
| GPIO6 | 23 | 24 | GPIO5 | Not connected | 23 | 24 | Not connected |
| Not connected | 25 | 26 | GPIO4 | RESET_N | 25 | 26 | Not connected |
| Not connected | 27 | 28 | Not connected | Not connected | 27 | 28 | Not connected |
| Not connected | 29 | 30 | PWR_ON | Not connected | 29 | 30 | Not connected |
| GPIO3 | 31 | 32 | GPIO2 | Not connected | 31 | 32 | Not connected |
| Not connected | 33 | 34 | GPIO1 | Not connected | 33 | 34 | Not connected |
| V_INT | 35 | 36 | Not connected | Not connected | 35 | 36 | Not connected |
| Not connected | 37 | 38 | Not connected | Not connected | 37 | 38 | Not connected |
| Not connected | 39 | 40 | Not connected | Not connected | 39 | 40 | Not connected |
| GND | 41 | 42 | Not connected | GND | 41 | 42 | Not connected |

**Table 5: Pin-out of the 42-pin dual-in-line board-to-board connectors (J103, J104) available on the adapter board ADP-R6/L6 of the EVK-R6 and EVK-L6 evaluation kits for LARA-R6/L6 series modules**

☞ The pins / interfaces that are not supported by a specific LARA-R6 / LARA-L6 product version should not be driven by an external device (see the LARA-R6 series data sheet [2], the LARA-L6 series data sheet [3] and the LARA-R6 / LARA-L6 series system integration manual [4] for the features supported by each LARA-R6 / LARA-L6 product version).

## 1.7  Software installation

The LARA-R6 and LARA-L6 USB drivers for Windows OS are available with the EVK-R6 and EVK-L6. Download the executable file from https://www.u-blox.com/en/product/evk-r6 and save it to any location on the computer. Start the installation by running the executable.

[2] LARA-R6401 and LARA-R6401D only. Pin reserved for future use (RSVD) otherwise.

## 1.8 Board setup

1. Insert a SIM card into the **SIM card holder** (J300 on the EVB).

2. Connect a cellular antenna provided with the EVK-R6 and EVK-L6 evaluation kit box to the **Primary cellular antenna** SMA connector on the ADP-R6 / ADP-L6 (ANT, RF input/output for transmission and reception of LTE/3G/2G RF signals)

3. Connect a cellular antenna provided with the EVK-R6 and EVK-L6 evaluation kit box to the **Secondary cellular antenna** SMA connector on the ADP-R6 / ADP-L6 (ANT DIV, RF input for the reception of the LTE / 3G RF signals as per Down-Link Rx diversity and/or MIMO 2x2). Place the secondary cellular antenna far enough from the primary cellular antenna (more than 20 cm).

4. If the GNSS functionality is required, connect the GNSS antenna provided with the evaluation kit to the **GNSS antenna** SMA connector on the ADP-GNSS. Keep the cellular GNSS detach switch (SW304) in "GNSS" position. Place the GNSS antenna in a location with a good view of the sky.

5. Connect the AC / DC +12 V power adapter provided with the evaluation kit box to the **9 – 18 V Power Input** connector (J400 on the EVB). LED DL401 lights blue.

6. Be sure to provide a jumper socket on the **Cellular VCC supply jumper** (J404 on the EVB) and to **Cellular VCC supply jumper** (J109 on the ADP-R6 / ADP-L6). These provide the connection from the 3.8 V output of the supply circuit from the EVB to the VCC input of the cellular module.

7. To enable the board power supply, turn the **Main power switch** (SW400 on the EVB) to the ON position. LED DL400 lights green. The cellular module is powered but still switched off.

8. For communication via the cellular module's USB interface, connect a USB cable to the **Cellular native USB** (J105) connector (on ADP-R6 / ADP-L6). LED DS100 on ADP-R6 / ADP-L6 lights blue.

   Once the switch-on of the cellular module is triggered (see point 11), the COM ports listed in the Table 6 are enabled by the Windows USB driver after the end of the module boot (details as the numbering of the ports can be seen via the Windows Device Manager)[3]:

| Parameter | Type | Remarks |
|---|---|---|
| u-blox Modem USB1 AT and Data | Modems | AT command interface and data communication |
| u-blox Modem USB2 AT and Data | Modems | AT command interface and data communication |
| u-blox Modem USB3 AT and Data | Modems | AT command interface and data communication |
| u-blox Modem USB0 Diagnostics Log | Ports (COM & LPT) | Diagnostic purpose |

**Table 6: Cellular USB interface configuration**

Run an AT terminal application (such as u-blox m-center), selecting an AT port with these settings:

o Data rate: 115,200 bit/s
o Data bits: 8
o Parity: N
o Stop bits: 1
o Flow control: HW

See appendix A for how to configure the u-blox m-center AT terminal for Windows.

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[3] A message of "driver installation fail" may appear on Windows if the USB cable has been connected before the end of the module boot, but this can be ignored as the normal operating functionality of the module will be available anyway after the end of the module boot.

9. For communication via the cellular module's UART interfaces, the following connections are allowed and can be alternatively enabled in a mutually exclusive way (see Table 7 for the switch position and LED status, and see Figure 1 and Figure 3 for the location of the related connectors, slide switches and the 3-way UARTs' routing switch J248):

   a. Connect a USB cable to the mini-USB connector (**Cellular USB Main UART**, J501 on EVB). The LED DL501 lights blue. When a USB cable is connected to this mini-USB connector, two COM ports are enabled in Windows. The main 8-wire UART interface of the cellular module is available over the first COM port opened by the driver after the end of the module boot, once the switch-on of the cellular module is triggered (see point 11).

   b. Connect an RS232 cable to the DB9 connector (**Cellular RS232 Main UART**, J500 on EVB): the main 8-wire UART interface of the cellular module is available over RS232 after the end of the module boot, once the switch-on of the cellular module is triggered (see point 11).

   c. Connect a USB cable to the mini-USB connector (**Cellular USB two UARTs**, J201 on ADP-R6 / ADP-L6). The LED DS201 lights blue. The two 4-wire UART interfaces of the cellular module are respectively available over the two numbered COM ports opened by the driver after the end of the module boot, once the switch-on of the module is triggered (see point 11). (To enable two UART interfaces, see the AT commands manual [1], the +USIO AT command.)

| Type of connections | SW401 | SW403 | J248 | LED |
|---|---|---|---|---|
| Access to the main UART interface over the **Cellular USB** (Main UART) mini-USB connector on EVB-WL3 (J501) | ON BOARD | MINIUSB | Jumper socket on pins 1-2 | DL403 DL501 |
| Access to the main UART interface over the **Cellular RS232** (Main UART) DB9 connector on EVB-WL3 (J500) | ON BOARD | DB9 | Jumper socket on pins 1-2 | DL405 |
| Access to the two UART interfaces over the **Cellular USB** (Two UARTs) mini-USB connector on ADP-R6/L6 (J201) | B2B | Do not care | Jumper socket on pins 2-3 | DL404 DS201 |
| Access to UART(s) interface(s) over the **DIL B2B header** on the top of the adapter board (J104) | B2B | Do not care | No jumper socket | DL404 |

**Table 7: UART serial interfaces configuration**

Run an AT terminal application (e.g., the u-blox m-center tool) selecting an AT port, with these settings:

- Data rate: 115,200 bit/s
- Data bits: 8
- Parity: N
- Stop bits: 1
- Flow control: HW

See appendix A for how to configure the u-blox m-center AT terminal for Windows.

10. If the audio functionality is required, connect the headset provided with the evaluation kit box to the **Headset jack** connector (J303 on EVB).

11. Press the **Cellular power-on** button (SW302 on the EVB) to switch on the cellular module mounted on the APD-R6.

## 1.9   Enabling error result codes

| Command sent by DTE (user) | DCE response (module) | Description |
| --- | --- | --- |
| AT+CMEE=2 | OK | Enables the cellular module to report verbose error result codes. |

## 1.10 PIN code insertion (when required)

| Command sent by DTE (user) | DCE response (module) | Description |
| --- | --- | --- |
| AT+CPIN="8180" | OK | Enter the PIN code, if needed (enter the PIN of the SIM card – 8180 is written here as an example). |
| AT+CLCK="SC",0,"8180" | OK | Unlock the PIN at power-on (the last parameter is the PIN of the SIM card – 8180 is written here as an example). |
| AT+CLCK="SC",1,"8180" | OK | Lock the PIN at power-on (the last parameter is the PIN of the SIM card – 8180 is written here as an example). |

## 1.11 Registration on a cellular network

| Command sent by DTE (user) | DCE response (module) | Description |
| --- | --- | --- |
| AT+CREG? | +CREG: 0,1<br>OK | Verify the network registration. |
| AT+COPS=0 | OK | Register the module on the network.<br>The cellular module automatically registers itself on the cellular network. This command is necessary only if the automatic registration failed (AT+CREG? returns 0,0). |
| AT+COPS? | +COPS: 0,0,"I TIM",7<br>OK | Read the operator name and radio access technology (RAT). |

See appendix C for further AT command examples describing how to define the initial default bearer for connectivity, how to set up a data connection using internal TCP/IP stack, how to open a TCP socket, or how to open a UDP socket.

## 1.12 Switching off the EVK-R6 and EVK-L6

To switch off the cellular module in the EVK-R6 and EVK-L6, send the +CPWROFF AT command. Make sure to use this command before switching off the main power, otherwise settings and configuration parameters may not be saved in the internal non-volatile memory of the cellular module.

# Appendix

# A   Setting up AT terminal applications for communication with EVK-R6 and EVK-L6

The u-blox m-center tool is a powerful platform for evaluating, configuring and testing u-blox cellular products. m-center includes an AT commands terminal for communication with the device and can be downloaded free-of-charge from our website (https://www.u-blox.com/en/product/m-center).

1. Follow the board setup instructions in section 1.8 to provide all the required connections and switching on the cellular module.

2. Run the m-center tool: after the m-center start-up, the **Home** page appears.

3. On the **Home** page, set up the AT COM port; for the setting values see section 1.8.

   Check with the Windows Device Manager to find out which COM port is being used by the EVK-R6 and EVK-L6.

4. Enable the connection to u-blox cellular module by clicking on the **Connect** button.

5. Retrieve the module and network information by clicking on the **Get Info** button.
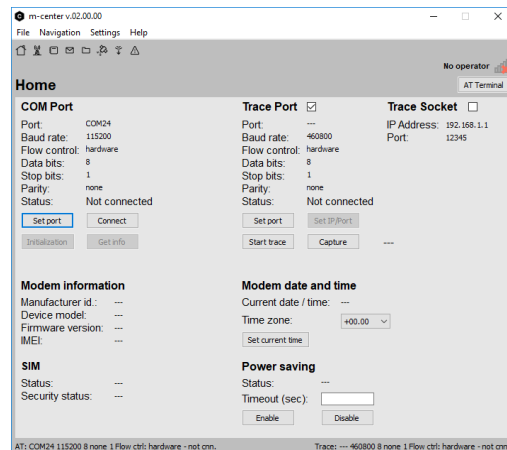


Figure 4: "Home" page

6. The module information is retrieved and displayed on the **Home** page.

7. Click on the **AT Terminal** button, found at the upper right of the **Home** page. A new window opens and the AT-command terminal is now ready for communication with the EVK-R6 and EVK-L6.

8. The AT terminal is ready to use.

   For the complete list of AT commands supported by the modules and their syntax, see the u-blox AT commands manual [1].
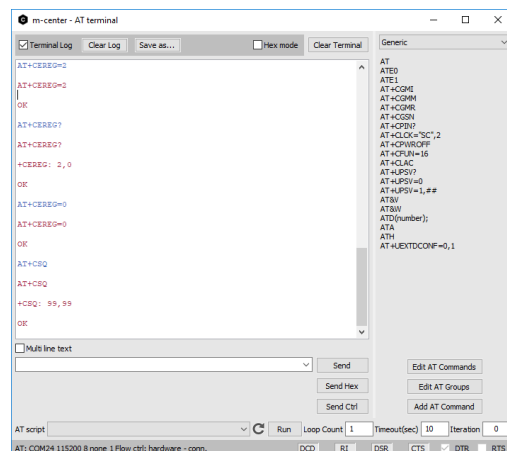


Figure 5: AT Terminal window

For more information on using the u-blox m-center cellular module evaluation tool, press the F1 key on the keyboard to open the m-center help window on the computer.

# B   Setting up cellular packet data connection

☞ To set up high data rate connection on EVK-L6, see LARA-L6 series Linux integration guide [5].

This section describes how to set up a packet data connection on Windows 10 and Linux using the operating system's TCP/IP stack and EVK-R6 and EVK-L6. This is also referred to as a dial-up connection (PPP), which is not ideal in the throughput performance perspective but it may be good enough for many applications that do not require high data rate connection.

The following examples describe how to install and configure two different kinds of modems on Windows:

1. Low data rate modem: via the UART interface of the cellular module connected to the Windows PC by the **Cellular USB** connector (J501 on EVB) or the **Cellular RS232** connector (J500 on EVB)

2. Higher data rate modem: via the native USB interface of the cellular module connected to the Windows PC by the **Cellular Native USB** connector (J105 on the ADP-R6 / ADP-L6)

3. Higher data rate modem: via the native USB interface of the cellular module connected to Linux Ubuntu 22.04 by the **Cellular Native USB** connector (J105 on the ADP-R6 / ADP-L6)

## B.1   Install and configure a low data rate modem connection on Windows

This example describes how to install and configure a low data rate packet data connection on a PC with the Windows 10 operating system. This uses the TCP/IP stack of the PC over the UART interface of the cellular module connected to the Windows PC by the Cellular USB connector (J501 on EVB) or the Cellular RS232 connector (J500 on EVB).

1. From **Control Panel,** select **Phone and Modem** > **Modems** > **Add**.
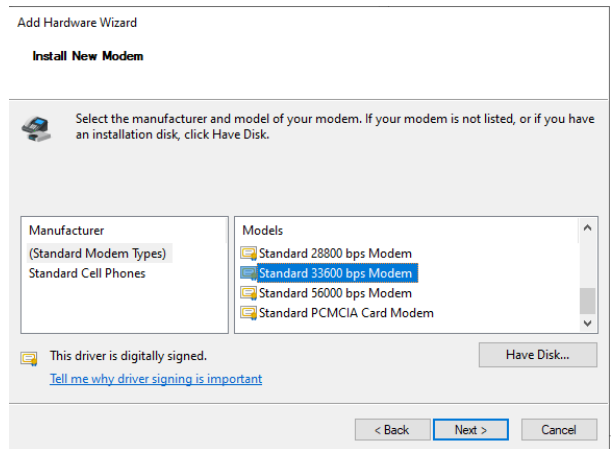
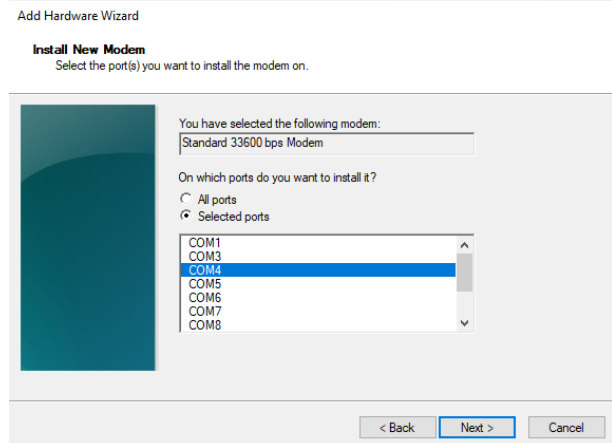   This opens the Add Hardware Wizard.
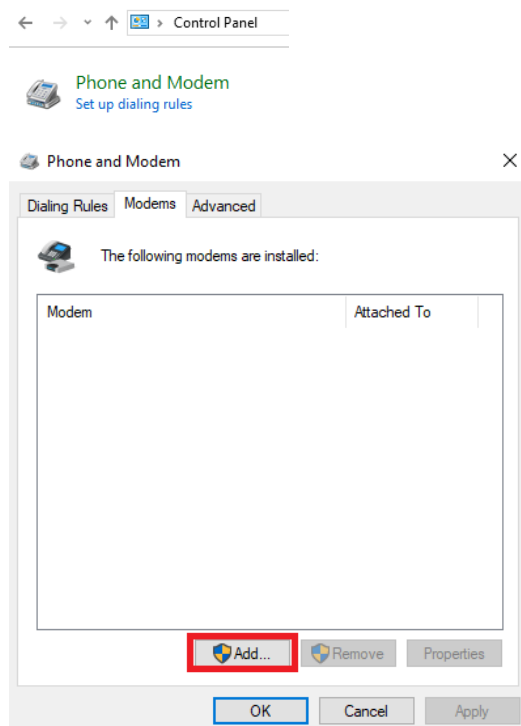
2. Tick "Don't detect my modem" checkbox. Then click **Next**.
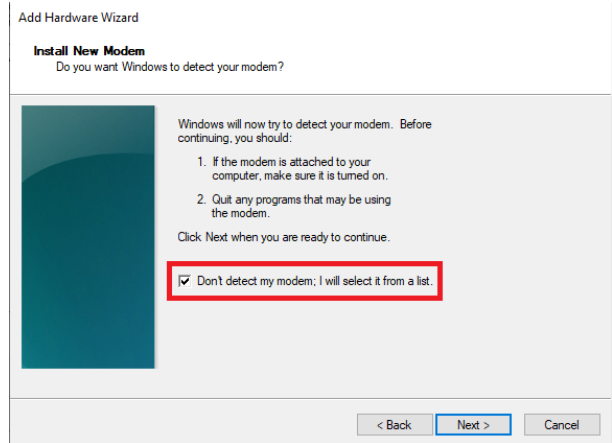
3. Select **Standard 33600 bps Modem** and click **Next**.

4. Select the COM port to use for data communication and click **Next**. This is the COM port on which the modem will be installed.

5. In the next step, click **Finish** to complete the modem installation.

6. Now the new modem is visible in **Control Panel**, under **Phone and Modem** > **Modems**.

Any extra initialization AT command (e.g., to set a specific APN name) can be entered by selecting **Properties** and filling in **Advanced** > **Extra initialization commands** text box.
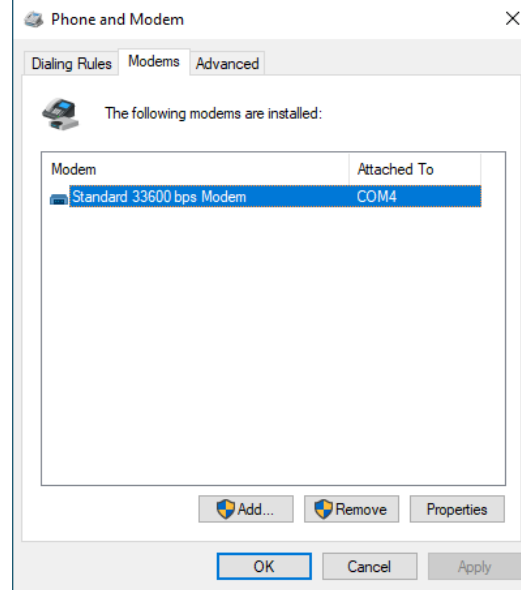
Now the module is ready, and the connection can be configured.

The modem configuration can also be edited in **Device Manager**, by clicking on the modem name.

## B.2 Install and configure a high data rate modem connection on Windows

This example describes how to install and configure a high data rate packet data connection on a PC with the Windows 10 operating system, using the TCP/IP stack of the PC, over the native USB interface of the cellular module connected to the Windows PC by the Cellular Native USB connector (J105 on the ADP-R6 / ADP-L6).
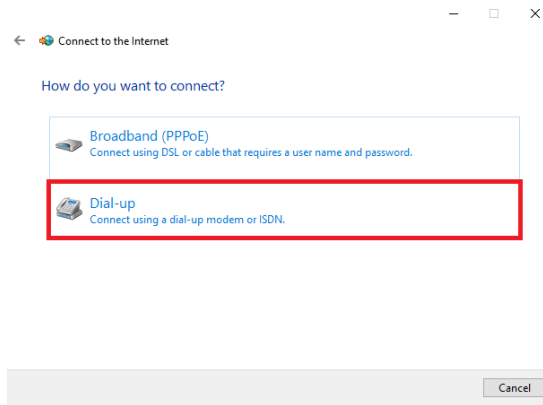
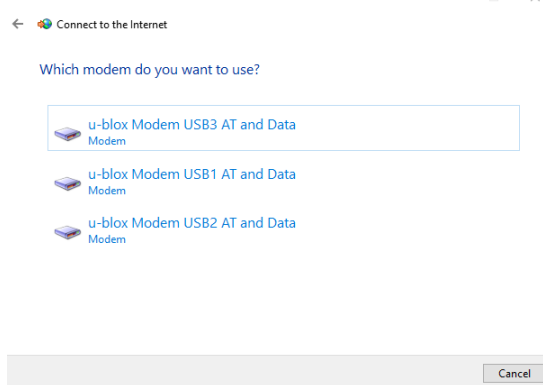1. From **Control Panel**, select **Network and Sharing Center** > **Set up a new connection or network**".
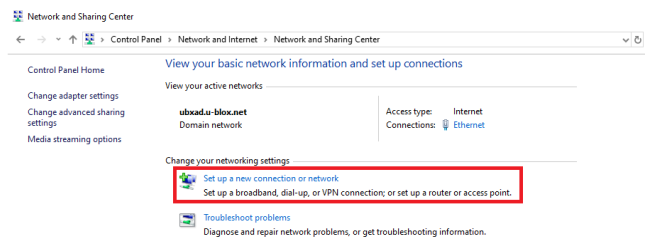
2. Click **Connect to the Internet** and then **Next**.
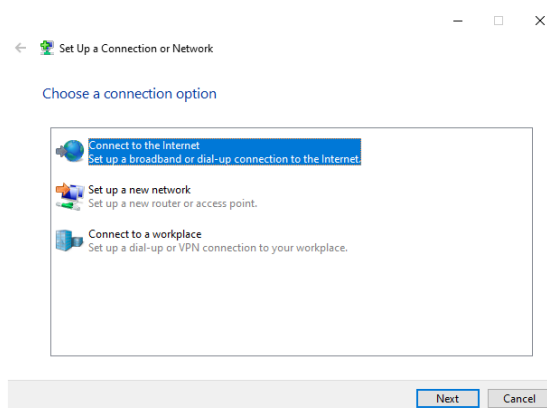
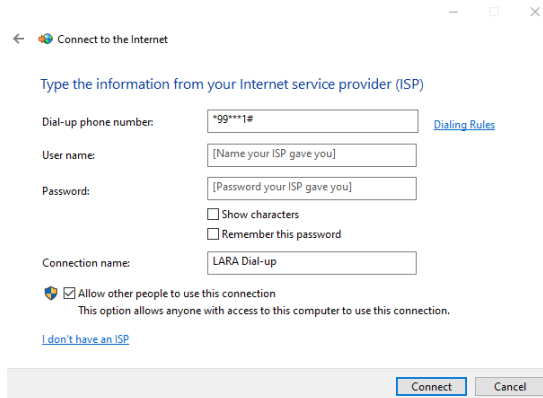3. Select **Dial-up** and, if requested, the modem previously installed.

4. Select one of the two AT commands ports.

5. Enter the parameters for the dial-up connection:

   o The module telephone number: *99***1#

     (change if using a PDP context different from 1)

   o The specific account information for the network operator

   o A name for the connection (e.g., "R6 Dial-up")

The packet data connection is now ready to be used with EVK-R6 and EVK-L6. Click "Connect" to start the connection, then start a browser to check internet connectivity.

Consult the cellular network operator for username and password. In most cases, they can be left empty.
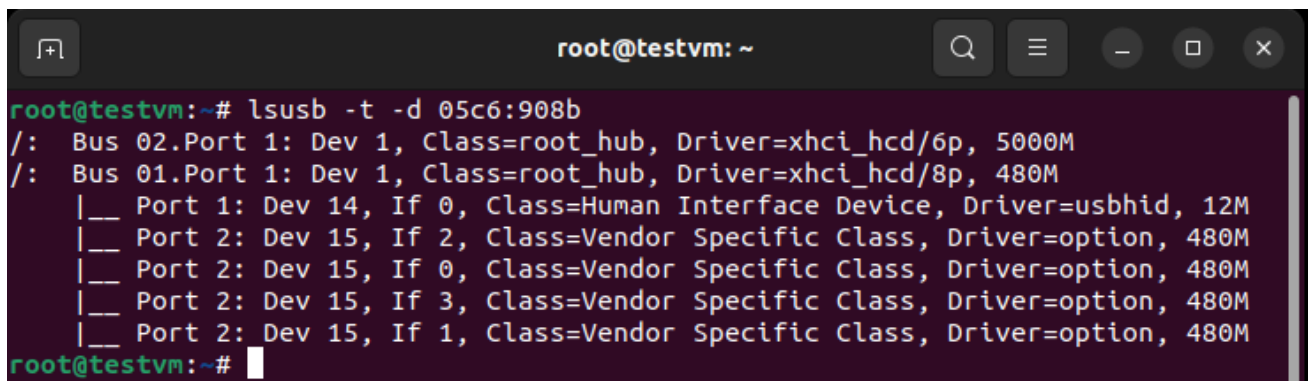
## B.3   Setting up cellular packet data connection on Linux

This section describes how to set up a packet data connection on Linux (reference OS: Ubuntu 22.04) on a PC connected with EVK-R6 and EVK-L6 over the USB interface of the modules. Follow the board setup instructions described in section 1.8 to provide communication via the USB interface of the modules. Use minicom or similar program to send AT commands via USB.

1.   LARA-R6 and LARA-L6 use a non-standard USB specific class (Vendor Specific USB class). To enumerate correctly on Linux hosts, use **option** driver:

   `/lib/modules/<kernel_version>/kernel/drivers/usb/serial/option.c`.
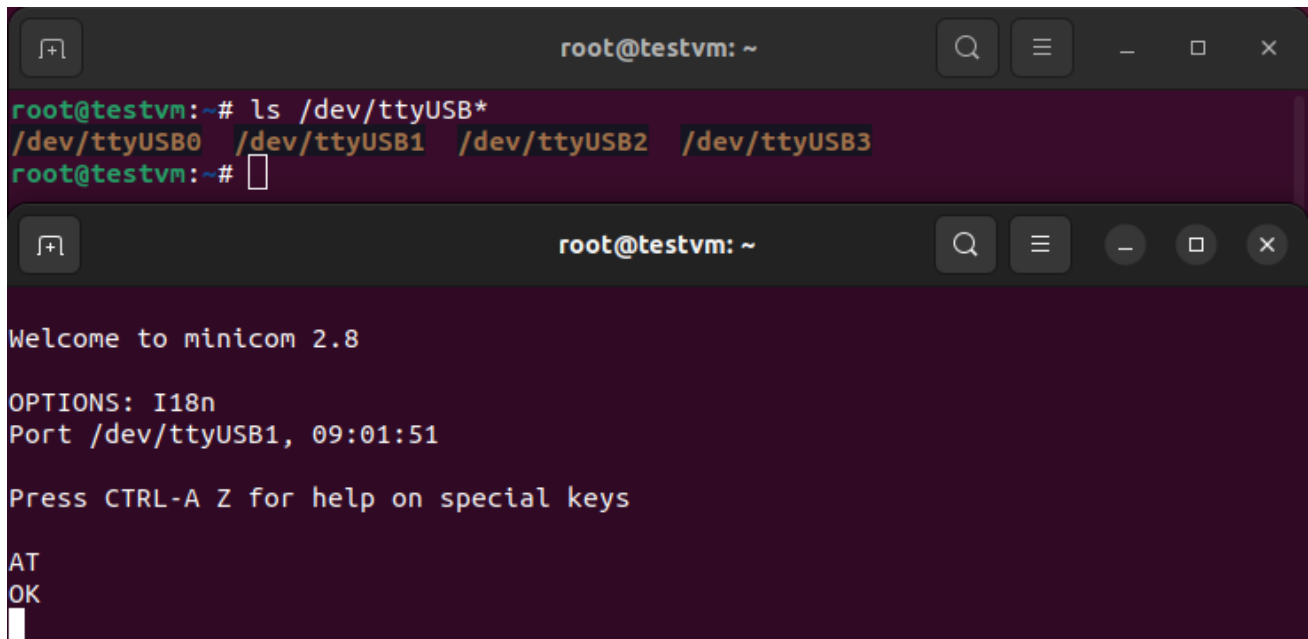
   To check if the module is correctly enumerated, for LARA-R6 use `lsusb -t -d 05c6:908b;`  for LARA-L6 in default mode, use `lsusb -t -d 1546:1341`.



2.   Identify the **ttyUSB\*** ports by `ls /dev/ttyUSB*` and then launch minicom to use this port. LARA-R6 enumerates the port as ttyUSB0: diagnostic, ttyUSB1/ttyUSB2: AT interface, ttyUSB3: GNSS tunneling/AT interface varying on the +USIO configuration. In the example below, **ttyUSB1** is used.

3.  In AT terminal, enter the following AT commands to set the **PDP_type** and the **APN**.

| Command sent by DTE (user) | DCE response (module) | Description |
|---|---|---|
| `AT+CFUN=4` | `OK` | Set the module in airplane mode. The module will deregister from the network and both RF Tx and RF Rx will be disabled. |
| `AT+CGDCONT=1,"IP","ibox.tim.it"` | `OK` | Define a PDP context with preferred APN: in this example, the "ibox.tim.it" APN is selected. |
| `AT+CFUN=1` | `OK` | Set the module to full functionality. The module starts the automatic network registration. |
| `AT+CPIN?` | `+CPIN: READY`<br>`OK` | Check the SIM PIN status and act accordingly. |
| `AT+COPS?` | `+COPS: 0,0,"I TIM",7`<br>`OK` | Check the +COPS <AcT> parameter to see if the module is registered to the network. |

4. Use **pppd** in Linux as PPP daemon. The following configuration scripts can be used to start a PPP connection through the module.

```
root@testvm:~# cat /etc/chatscripts/example.chat
# Abort conditions
ABORT 'BUSY'
ABORT 'NO CARRIER'
ABORT 'NO DIALTONE'
ABORT 'ERROR'
ABORT 'NO ANSWER'

# Default timeout
TIMEOUT 30

# Configurations
'' 'AT'
OK 'ATZ'
OK 'ATQ0 V1 E1 &S0 &C1 &D2'

# Configure the APN
#OK 'AT+CFUN=4'
#OK 'AT+CGDCONT=1,"IP","apn_name"'
#OK 'AT+CFUN=1'

# Dial out
OK 'ATD*99***1#'
CONNECT
root@testvm:~#
```

```
root@testvm:~# cat /etc/ppp/peers/example_exe
file /etc/ppp/example_options
connect "/usr/sbin/chat -v -t15 -f /etc/chatscripts/example.chat"
root@testvm:~#
```

```
root@testvm:~# cat /etc/ppp/example_options
/dev/ttyUSB2
115200
asyncmap 0
noauth
lock
lcp-echo-interval 30
lcp-echo-failure 4
noipx
usepeerdns
debug
root@testvm:~#
```

5.  Start the PPP with `pon example_exe` command and check with `ifconfig` command if the PPP interface (in the example `ppp0`). Now it is possible to browse the Internet.

```
root@testvm:~# pon example_exe
root@testvm:~# ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.0.2.15  netmask 255.255.255.0  broadcast 10.0.2.255
        inet6 fe80::97e4:a88f:1cc0:971a  prefixlen 64  scopeid 0x20<link>
        ether 08:00:27:29:3f:0c  txqueuelen 1000  (Ethernet)
        RX packets 335  bytes 167891 (167.8 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 456  bytes 65836 (65.8 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 42  bytes 4254 (4.2 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 42  bytes 4254 (4.2 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

ppp0: flags=4305<UP,POINTOPOINT,RUNNING,NOARP,MULTICAST>  mtu 1500
        inet 10.44.21.188  netmask 255.255.255.255  destination 10.64.64.64
        ppp  txqueuelen 3  (Point-to-Point Protocol)
        RX packets 5  bytes 62 (62.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 9  bytes 143 (143.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

root@testvm:~# ping -I ppp0 8.8.8.8
PING 8.8.8.8 (8.8.8.8) from 10.44.21.188 ppp0: 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=112 time=192 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=112 time=44.6 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=112 time=39.5 ms
64 bytes from 8.8.8.8: icmp_seq=4 ttl=112 time=37.1 ms
64 bytes from 8.8.8.8: icmp_seq=5 ttl=112 time=37.7 ms
^C
--- 8.8.8.8 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4007ms
rtt min/avg/max/mdev = 37.073/70.178/191.989/60.961 ms
root@testvm:~#
```

6.  To stop the ppp, type `poff example_exe`.

# C Examples of AT commands

For the complete description and syntax of the AT commands supported by LARA-R6 / LARA-L6 series modules, see the u-blox AT commands manual [1].

## C.1 Define the initial default bearer for connectivity

To change the PDN settings for the initial default EPS bearer established during LTE attach, edit the <cid>=1 PDN by means of the +CGDCONT AT command.

| Command sent by DTE (user) | DCE response (module) | Description |
|---|---|---|
| AT+COPS? | +COPS: 2<br>OK | The module is not registered. |
| AT+CEREG=2;+CGEREP=1,1 | OK | Enable a set of registration URCs. |
| AT+CGDCONT? | +CGDCONT: 1,"IPV4V6","","0.0.0.0 0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0", 0,0,0,2,0,0,0,0,0,0<br>OK | Read IP type and APN for EPS attach bearer. |
| AT+CGDCONT=1,"IPV4V6","broadband" | OK | Set the APN name ("broadband" for example) and the PDP type ("IPV4V6" for example) for EPS attach bearer. |
| AT+COPS=0 | OK<br><br>+CEREG: 1,"0001","01a2d001",7<br>+CGEV: ME PDN ACT 1 | Trigger a network registration and wait for attach complete. |

The same procedure can also be applied for the PDP context associated with <cid>=1 in 2G and 3G RAT. During the LTE attach, the initial default EPS bearer is automatically activated by the network, while in 2G and 3G RAT, it is necessary to manually activate the PDP context by means of +CGACT AT command.

| Command sent by DTE (user) | DCE response (module) | Description |
|---|---|---|
| AT+CGACT=1,1 | OK | Activate the PDP context associated with <cid>=1. |

It is possible to verify the status of the initial default EPS bearer or a PDP context by the means of the +CGDCONT and +CGCONTRDP AT commands.

| Command sent by DTE (user) | DCE response (module) | Description |
|---|---|---|
| AT+CGDCONT? | +CGDCONT: 1,"IP","default.mnc321. mcc654.gprs","192.168.20.6",0,0,0 ,2,0,0,0,0,0,0<br>OK | Read IP type and APN for EPS attach bearer.<br>Context <cid>=1 has IP type "IP" and APN "default.mnc321.mcc654.gprs". |
| AT+CGCONTRDP=1 | +CGCONTRDP: 1,5,"default.mnc321.m cc654.gprs","192.168.20.6.255.255 .255.0","192.168.20.1","185.215.1 95.114","","","",0,0,1500,0,0<br>OK | Read context <cid>=1 dynamic parameters.<br><cid>=1 is currently active with IPv4 address 192.168.20.6/24, gateway 192.168.20.1 and DNS server 185.215.195.114. |

## C.2 Data connection using internal TCP/IP stack

The internal TCP/IP stack is automatically mapped, configured, and activated to the initial default EPS bearer established during LTE attach or to the first activated PDP context in 2G or 3G RAT. Consequently the +UPSD and +UPSDA commands are no longer required to perform these tasks manually.

## C.3   Opening a TCP socket

| Command sent by DTE (user) | DCE response (module) | Description |
| --- | --- | --- |
| AT+CMEE=2 | OK | Enables the cellular module to report verbose error result codes. |
| AT+CGATT? | +CGATT: 1<br>OK | Verifies the  module is attached to the network. |
| AT+CEREG? | +CEREG: 0,1<br>OK | Verify the network registration status. |
| AT+COPS=0 | OK | Register the module on the network. The cellular module automatically registers itself on the cellular network. This command is necessary only if the automatic registration failed (AT+CREG? returns 0,0). |
| AT+COPS? | +COPS: 0,0,"Verizon Wireless",7<br>OK | Read the operator name and radio access technology (RAT). |
| AT+USOCR=6 | +USOCR: 0<br>OK | Create a TCP socket. |
| AT+USOCO=0,"echo.u-blox.com",7 | OK | Connect to the server. |
|  | +UUSORD: 0,32 | Greeting message. |
| AT+USORD=0,32 | +USORD: 0,32,"u-blox AG TCP/UDP test service"<br>OK | Retrieving the message. |
| AT+USOCL=0 | OK | Closing the socket. |

## C.4   Opening a UDP socket

| Command sent by DTE (user) | DCE response (module) | Description |
| --- | --- | --- |
| AT+CMEE=2 | OK | Enables the cellular module to report verbose error result codes. |
| AT+CGATT? | +CGATT: 1<br>OK | Verifies the  module is attached to the network. |
| AT+CEREG? | +CEREG: 0,1<br>OK | Verify the network registration status. |
| AT+COPS=0 | OK | Register the module on the network. The cellular module automatically registers itself on the cellular network. This command is necessary only if the automatic registration failed (AT+CREG? returns 0,0). |
| AT+COPS? | +COPS: 0,0,"Verizon Wireless",7<br>OK | Read the operator name and radio access technology (RAT). |
| AT+USOCR=17 | +USOCR: 0<br>OK | Create a UDP socket. |
| AT+USOST=0,"echo.u-blox.com",7,13,"TestNumberOne" | +USOST: 0,13<br>OK | Connecting and storing text on the server. |
|  | +UUSORF: 0,13 | Echo server returning the message. |
| AT+USORF=0,13 | +USORF: 0,"185.215.195.137",7,13,"TestNumberOne"<br>OK | Reading the message from the server. |
| AT+USOCL=0 | OK | Closing the socket. |

# C.5   Configure audio interface for earphones

The audio interface has to be configured by selecting among the available settings a combination supported by the used audio codec.

The EVK-R6001, EVK-R6401, EVK-R6801 and EVK-L6004 for the LARA-R6 and LARA-L6 modules supporting voice and data mount a Maxim Integrated MAX9860 audio voice codec and the default configuration module already matches with the setting supported by MAX9860. The user only needs to activate the audio codec

| Command sent by DTE (user) | DCE response (module) | Description |
|---|---|---|
| AT+USPM=1,0 | OK | Set the headset profile (default setting)[4]. |
| AT+UI2S=14,1,0,3,0 | OK | Configures the I2S digital audio interface (default setting) ([1]). |
| AT+UGPIOC=34,12 | OK | Configures the GPIO pin 34 (I2S_WA) as I2S digital audio interface (default setting) ([1]). |
| AT+UGPIOC=35,12 | OK | Configures the GPIO pin 35 (I2S_TXD) as I2S digital audio interface (default setting) ([1]). |
| AT+UGPIOC=36,12 | OK | Configures the GPIO pin 36 (I2S_CLK) as I2S digital audio interface (default setting) ([1]). |
| AT+UGPIOC=37,12 | OK | Configures the GPIO pin 37 (I2S_RXD) as I2S digital audio interface (default setting) ([1]). |
| AT+UEXTDCONF=0 | OK | Disable the audio codec and restore the default settings ([1]). |
| AT+UEXTDCONF=0,1 | OK | Defines the settings to be downloaded to the Maxim MAX9860 external audio codec. If it was disabled (as per default setting), it will be enabled and configured properly. In other scenarios, AT+UEXTDCONF=0 shall have to be issued previously. |
| AT+UTGN=440,500,100 | OK <br><br> +UUTGN: 0 | Play a 440 Hz tone, 0.5 s long, volume 0 dB. |

---

[4] optional: this command is not needed if the module audio settings have been not changed and they have the default values.

# D  Current consumption measurement

Measure the current consumption of the cellular module on the EVK-R6 and EVK-L6 by removing the jumper socket from the **Cellular VCC supply jumper** (J109 on the ADP-R6 /L6), described in Figure 6.
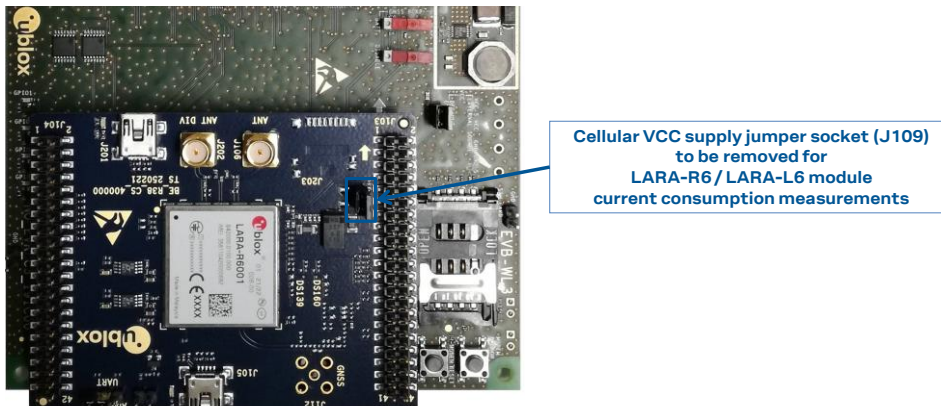


**Figure 6: Jumper socket to be removed for cellular module's current consumption measurement**

A suitable external digital multi-meter (as the Keysight 34465A, 34410A or 34411A) can be used for current consumption measurements: in this case, the 3.8 V supply circuit on the EVB will supply the cellular module, with the digital multi-meter placed in series as illustrated in Figure 7.
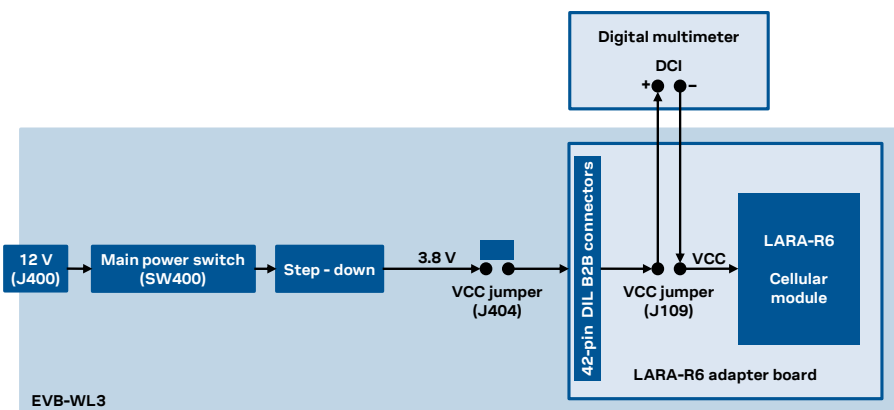


**Figure 7: Block diagram of the setup for cellular module's current consumption measurement using a current meter**

Alternatively, a suitable external DC power supply with the dynamic current measurement capabilities (as for example, the portable and cheap Qoitech Otii Arc, or the more accurate Keysight N6705B, or the models designed for mobile communications Keysight 66319B/D or 66321B/D) can be used for current consumption measurements, acting also as 3.8 V supply source for the cellular module mounted on the adapter board, as illustrated in Figure 8.
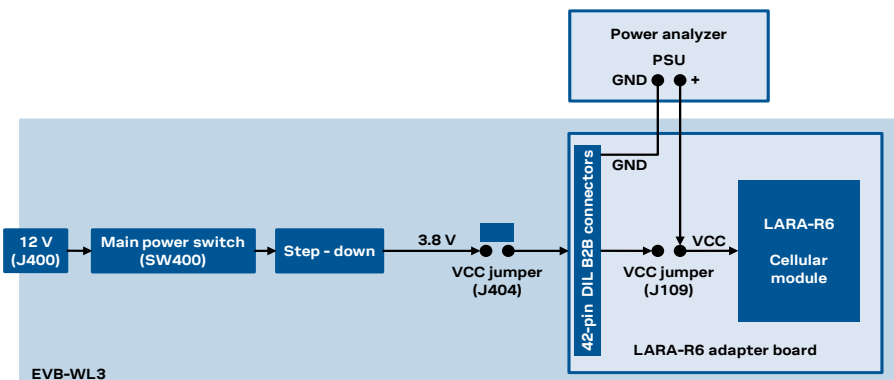


**Figure 8: Block diagram of the setup for cellular module's current consumption measurement using a DC power analyzer**

# E Glossary

| Abbreviation | Definition |
|---|---|
| ADP | Adapter Board |
| APN | Access Point Name |
| AT | AT Command Interpreter Software Subsystem, or attention |
| B2B | Board-To-Board |
| CTS | Clear To Send |
| DCI | Direct Current |
| DIL | Dual In Line |
| EPS | Evolved Packet System |
| EVB | Evaluation Board |
| EVK | Evaluation Kit |
| GND | Ground |
| GNSS | Global Navigation Satellite System |
| GPIO | General Purpose Input Output |
| GPRS | General Packet Radio Service |
| IMS | IP Multimedia Subsystem |
| IP | Internet Protocol |
| LDO | Low Drop-Out |
| LED | Light Emitting Diode |
| LTE | Long Term Evolution |
| NVM | Non-Volatile Memory |
| OS | Operating System |
| PIN | Personal Identification Number |
| PPP | Point-to-Point Protocol |
| PS | Packet Switch |
| PSU | Power Supply Unit |
| RAT | Radio Access Technology |
| RF | Radio Frequency |
| RI | Ring Indicator |
| SIM | Subscriber Identity Module |
| TCP | Transfer Control Protocol |
| UART | Universal Asynchronous Receiver-Transmitter |
| UDP | User Datagram Protocol |
| URC | Unsolicited Result Code |
| USB | Universal Serial Bus |
| VCC | Voltage Common Collector |

# F Declaration of conformities

The equipment is intended for indoor usage. It is the user's duty to verify if further restrictions apply, such as in airplanes, hospitals, or hazardous locations (petrol stations, refineries, etc.).

Any changes or modification made to this equipment will void its compliance to safety requirements.

Maintenance, inspections and repairs of the EVK-R6 and EVK-L6 shall be performed by u-blox AG.

# Related documentation

[1]     u-blox LARA-R6 series AT commands manual, UBX-21046719
[2]     u-blox LARA-R6 series data sheet, UBX-21004391
[3]     u-blox LARA-L6 series data sheet, UBX-21047783
[4]     u-blox LARA-R6 and LARA-L6 series system integration manual, UBX-21010011
[5]     u-blox LARA-L6 series Linux integration manual, UBX-22026570

☞     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 | 25-Jan-2022 | mdem / psca | Initial release |
| R02 | 08-Jul-2022 | mrod | Added section "C.5 Configure audio interface for earphones". References to new echo server. Minor other corrections and clarifications. |
| R03 | 06-Dec-2022 | sses | Extended document applicability to EVK-L6004 and EVK-L6004D |

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