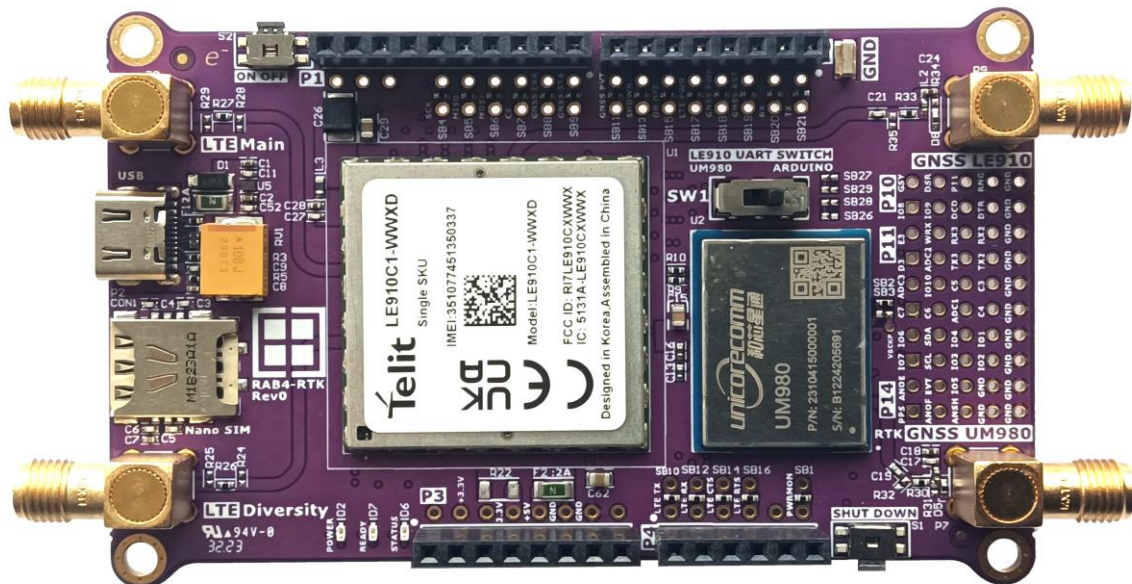


RAB4-RTK User Manual



Versions

Version	Date	Rationale
0.1	November 11, 2023	First draft. Author: GDR
1.0	December 22, 2023	New chapters and template. Author: KOA

Legal Disclaimer

The evaluation board is for testing purposes only and, because it has limited functions and limited resilience, is not suitable for permanent use under real conditions. If the evaluation board is nevertheless used under real conditions, this is done at one's responsibility;
any liability of Rutronik is insofar excluded.

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Overview

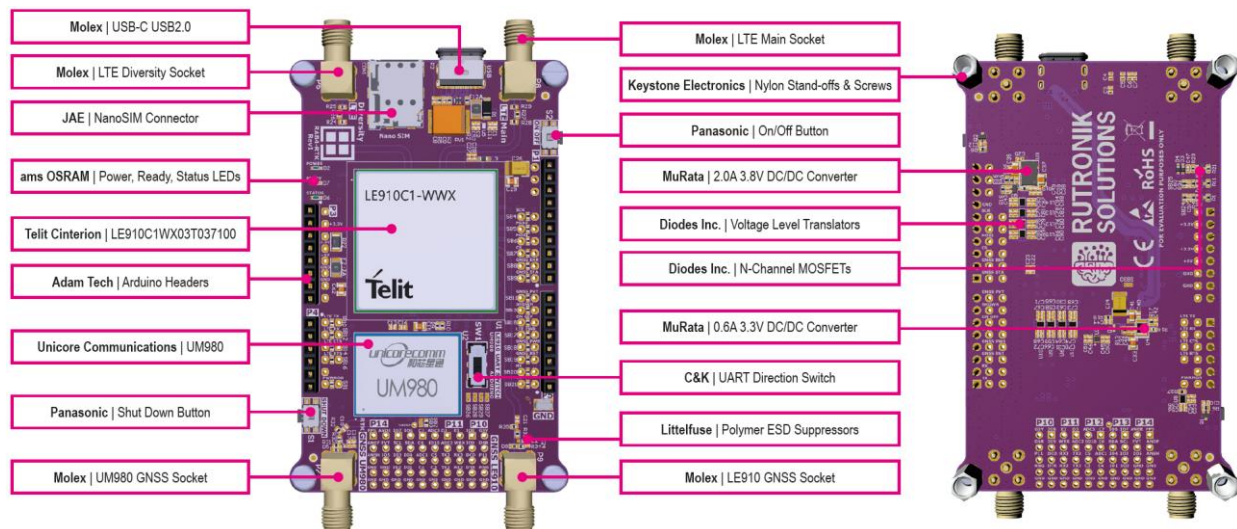
Features

The RAB4-RTK is an evaluation board featuring the Telit LE910C1-WWxD LTE-Cat.1 and Unicore UM980 RTK GNSS.

Key features of RTK:

- LE910C1WX03T037100 – Telit Cinterion LTE C1 ThreadX GNSS Module with 2G/3G Fallback.
- UM980 - Unicore Communications RTK GNSS All-constellation Multi-frequency Module.
- 2J6924Ma – Phoenix Cellular 4G LTE/3G/2G MIMO IP67 IP69 Magnetic Mount Antenna from 2J included.
- 2J7C01MC2F – High Precision GPS/GNSS/SBAS/RTK/L1/L2 Dome Magnetic Mount Antenna from 2J included.
- 2J7C01MC3F - High Precision GPS/ GLONASS/ BeiDou/ QZSS/ Galileo/ IRNSS/ L1/L5 Dome Antenna from 2J included.
- Dual-Purpose Design – the LE910C1 may be used as a host of the UM980 RTK GNSS as well as a slave together with UM980 may be controlled by the external host device.
- All the LE910C1WX03T037100 and UM980 GPIOs are accessible via onboard headers.
- SF72S006VBDR2500 - Push-Push Insertion NanoSIM Card Connector from JAE.
- Part No.: 2130830005 - USB-C 2.0 Waterproof Connector from Molex.
- Part No.: 73391-0083 - SMA Female Right-Angle Connectors from Molex.
- MYRGM080200X41RA and MYRGP080060W21RF - Inductor Built-in Step-Down DC/DC Converters from MuRata.
- AP7354-33FS4-7 - 150mA Ultra-Low Quiescent Current LDO with Enable from Diodes Inc.
- 74LVC1T45FZ4-7 - Single Bit Voltage Level Translators from Diodes Inc.
- DMG1012T-7 - N-Channel MOSFETs from Diodes Inc.
- EVQPUA02K - Panasonic Right-angled ON/OFF and SHUT DOWN switches.
- JS202011JCQN - C&K Slider switch for UART direction control.
- PESD0402-140 - Low-capacitance Polymer ESD Suppressors from Littelfuse.
- Passive components from Samsung EM, Yageo, AVX and ASJ.


Component Placement



Delivery Set

The delivery set of the RAB4-RTK includes:

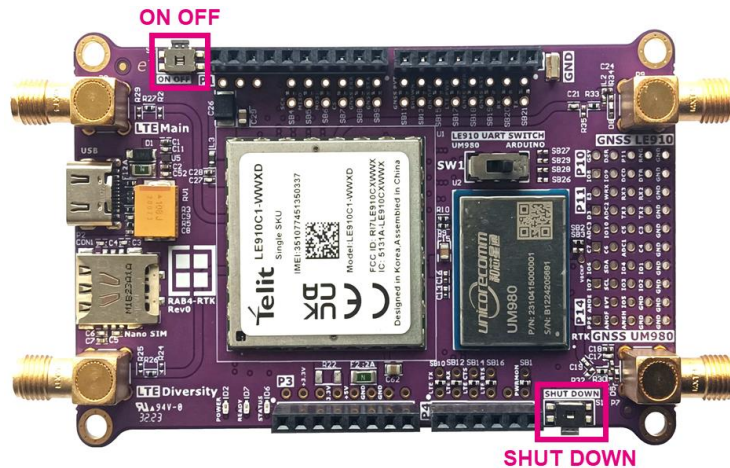
- RAB4-RTK Development board.
- USB 2.0 Cable A Male to C Male for the connection with a PC.
- 2J6924Ma Cellular 4G LTE/3G/2G Antenna.
- 2J7C01MC2F GPS/GNSS/SBAS/RTK/L1/L2 Antenna.
- 2J7C01MC3F GPS/GLONASS/BeiDou/QZSS/Galileo/IRNSS/L1/L5 Antenna.
- Telit nano SIM card.

RAB4-RTK Board	USB 2.0 A to USB-C Cable	Telit nano SIM card
		
2J6924Ma Antenna	2J7C01MC3F L1/L5 Antenna	2J7C01MC2F L1/L2 Antenna
		

Hardware

Turning your Telit Cinterion LE910C1-WWxD ON & OFF

Two buttons are residing on the RAB4-RTK adapter board.



S1 and S2 buttons on the RAB4-RTK

Unconditional SHUTDOWN of LE910C1 Module

The S1 „SHUT DOWN“ button functions as the unconditional shutdown for the LE910C1 module. Hold the S1 „SHUT DOWN“ button at least for 200ms and the module will be turned off immediately.

Turn ON the LE910C1 Module

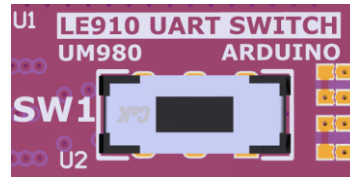
The S2 „ON OFF“ button turns on or off the module. Please push and hold the „ON OFF“ button at least for 1 second and then release it. The Module will boot up and will be ready in approximately 20 seconds.

Turn OFF the LE910C1 Module

To turn off the module, please press and hold the S2 „ON OFF“ button at least 2.5 seconds and then release it. The complete shutdown will be achieved in more than 15 seconds.

UART Direction Select

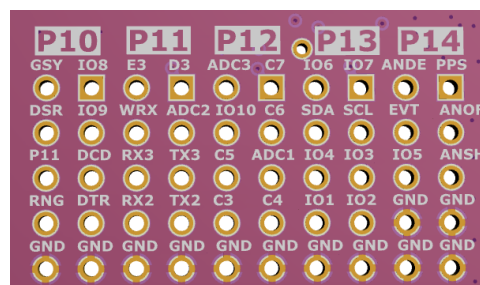
The LE910C1 module may function as a host device on RAB4-RTK board. Therefore, the UM980 can be connected directly with LE910C1 UART simply by switching SW1 to “UM980” position as it is shown in the figure below.



By default, the switch is in “ARDUINO” position which means LE910C1 and UM980 modules are ready for communications over Arduino headers.

Spare GPIOs

All the GPIOs of LE910C1 and UM980 modules are available at sockets P10, P11, P12, P13 and P14 including the Arduino Headers P1, P3, P4, P5.



Spare GPIOs

Socket P10 Pinout				Socket P11 Pinout			
Pin No.	Name	Name	Pin No.	Pin No.	Name	Name	Pin No.
1	GPIO08	GSY	2	1	D3	E3	2
3	GPIO09	DSR	4	3	ADC2	WCI_RX	4
5	DCD	P11	6	5	TX3	RX3	6
7	DTR	RNG	8	7	RX2	TX2	8
9	GND	GND	10	9	GND	GND	10

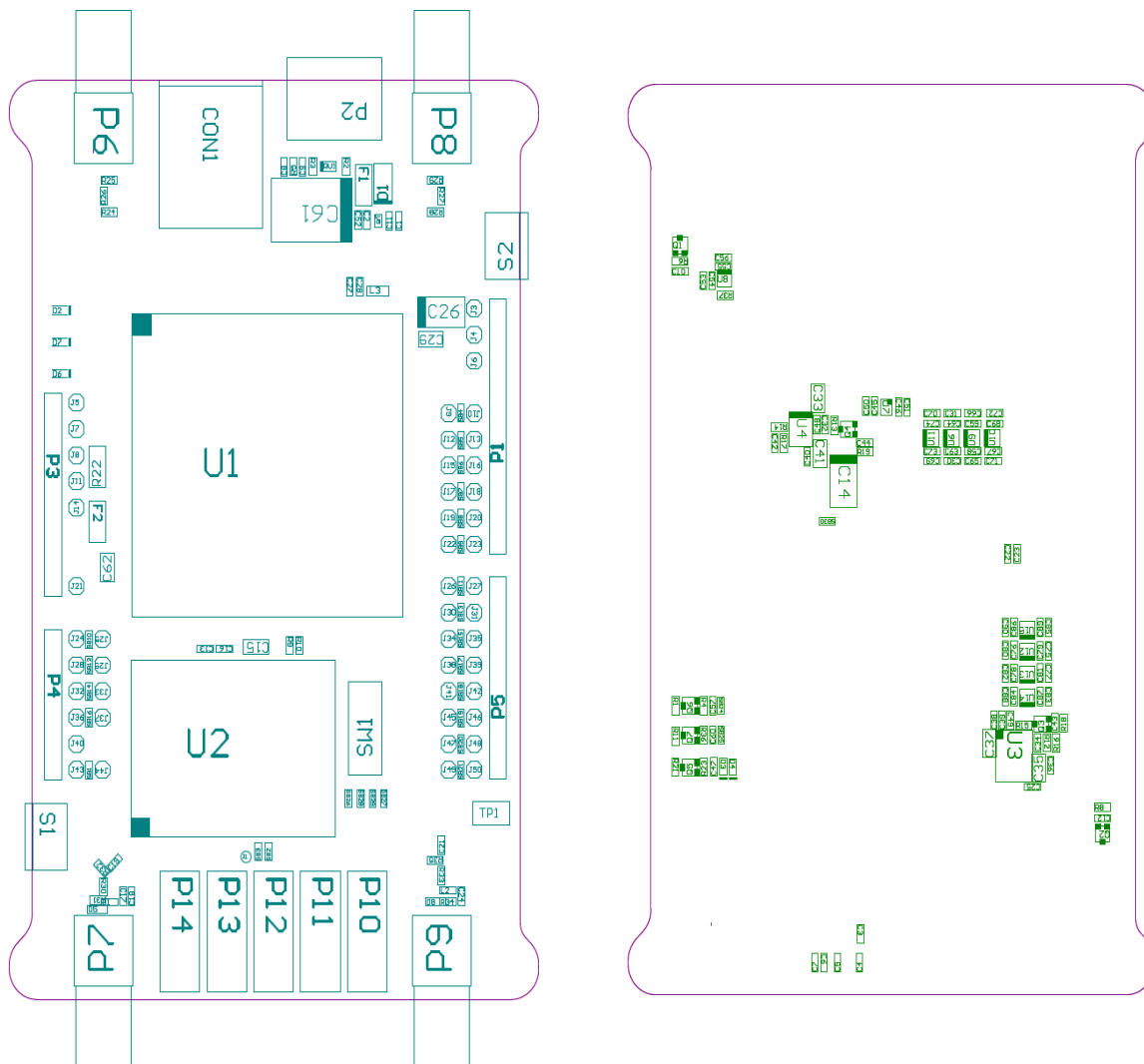
Socket P12 Pinout				Socket P13 Pinout			
Pin No.	Name	Name	Pin No.	Pin No.	Name	Name	Pin No.
1	C7	ADC3	2	1	GPIO7	GPIO6	2
3	C6	GPIO10	4	3	SCL	SDA	4
5	ADC1	C5	6	5	GPIO03	GPIO04	6
7	C4	C3	8	7	GPIO02	GPIO01	8
9	GND	GND	10	9	GND	GND	10

Socket P14 Pinout			
Pin No.	Name	Name	Pin No.
1	PPS	AN_DE	2
3	AN_OF	EVT	4
5	AN_SH	GPIO05	6
7	GND	GND	8
9	GND	GND	10

Solder Bridges

Name	Circuit	Default
SB1	Arduino P4 pin6 with U1 PWRMON 3.3V Signal	Closed
SB2	3.3V power supply with U2 Backup supply	Closed
SB3	U2 Backup supply external input J1	Opened
SB4	Arduino P1 pin6 with U1 SPI CLK	Closed
SB5	Arduino P1 pin5 with U1 SPI MISO	Closed
SB6	Arduino P1 pin4 with U1 SPI MOSI	Closed
SB7	Arduino P1 pin3 with U1 SPI CS	Closed
SB8	Arduino P1 pin2 with U2 ERR_STAT Output	Closed
SB9	Arduino P1 pin1 with U2 RTK_STAT Output	Closed
SB10	Arduino P4 pin1 with U1 UART TX Output	Closed
SB11	Arduino P5 pin8 with U2 PVT STAT Output	Closed
SB12	Arduino P4 pin2 with U1 UART RX Input	Closed
SB13	Arduino P5 pin7 with U1 Shut Down Control Input	Closed
SB14	Arduino P4 pin3 with U1 CTS Input	Closed
SB15	Arduino P5 pin6 with U1 ON OFF Control Input	Closed
SB16	Arduino P4 pin4 with U1 RTS Output	Closed
SB17	Arduino P5 pin5 with U1 Power Supply Disable Input	Closed
SB18	Arduino P5 pin4 with U2 Power Supply Disable Input	Closed
SB19	Arduino P5 pin3 with U2 RESET_N Input	Closed
SB20	Arduino P5 pin2 with U2 UART RX1 Input	Closed
SB21	Arduino P5 pin1 with U2 UART TX1 Output	Closed
SB24	U1 GPIO01 output with STAT_LED D6 Control Input	Closed
SB25	U1 GPIO02 output with SW_RDY D7 Control Input	Closed

SB26	U1 UART TX with Arduino RX – P5 pin1	Opened
SB27	U1 UART RX with Arduino TX – P5 pin2	Opened
SB28	U1 UART TX with Arduino TX – P5 pin2 (U2 UART RX1)	Opened
SB29	U1 UART RX with Arduino RX – P5 pin1 (U2 UART TX1)	Opened
SB30	U1 VIO_1V8 with RESERVED_D13	Opened



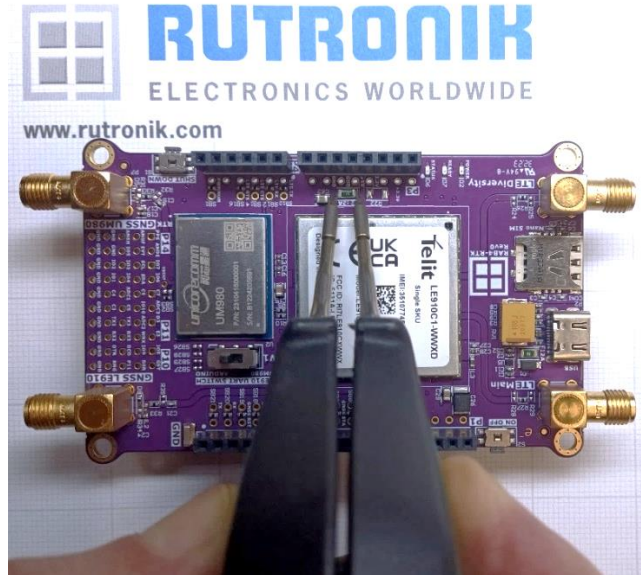
Location of solder bridges [SBxx]
(please check the [assembly document](#) to see in detail)

Fuses

The RAB4-RTK board has two 2A fast-acting fuses F1, and F2 in a 1206 package; Part No: CC12H2A-TR „Eaton“.

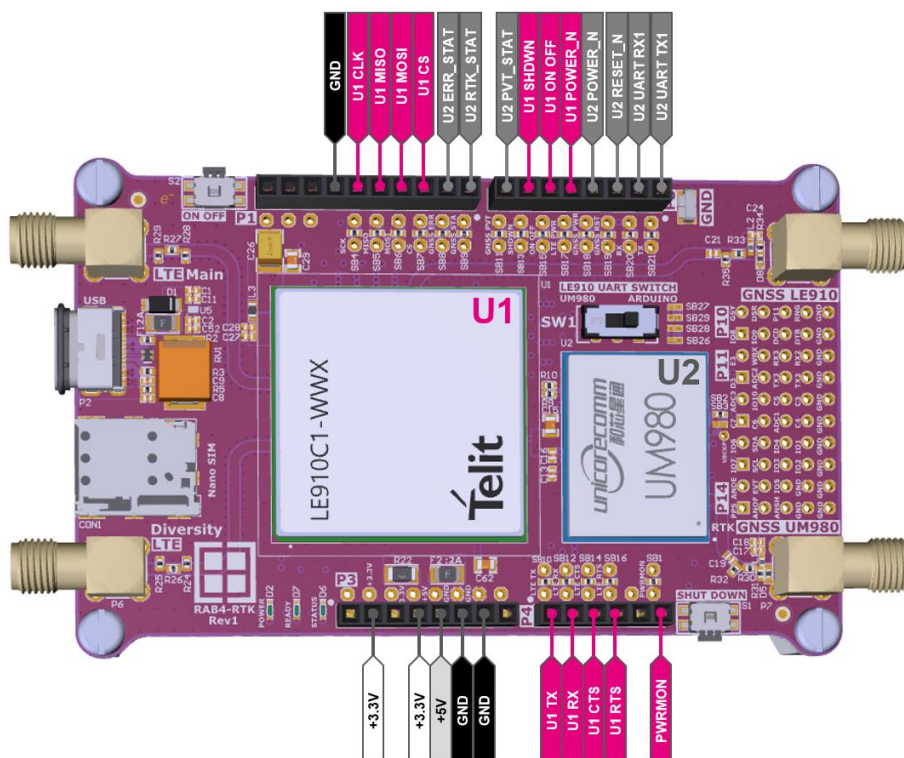
Changing the Fuses or Solder Bridges

The SMD „Chipping Tool“ is recommended for use for SMD solder bridges or fuses soldering on the RAB4-RTK development board.



Soldering the RAB4-RTK's fuse

Arduino Headers Pinout



Software and Firmware

Getting Started

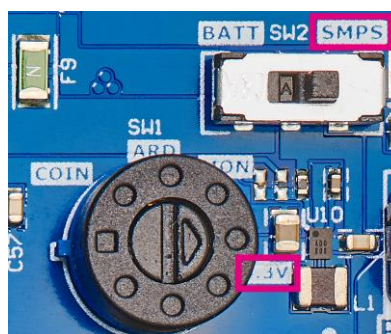
1. This chapter and [Running a Demo](#) one describe the steps to be followed for running a **RDK2 UM980 Rover Mode** example. Please obtain RDK2 development kit for it.

If you have RDK3 or RDK4 only, please start with [RDK2, RDK3, RDK4 ModusToolbox USB UART Examples](#). If you do not have any of these development kits, you may start from [AppZone USB UART Tunnel](#) demo and use UPrecise software for UM980 evaluation.

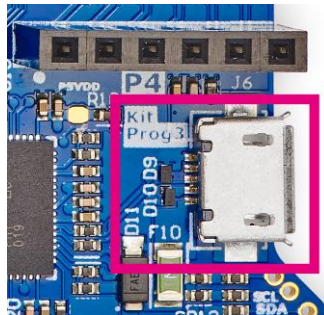
2. Register or/and log in at [Infineon](#) website (myInfineon tab). License generation takes up to several days.
3. Download and install the latest version of [ModusToolbox™](#) software.
4. Mount the RAB4-RTK board on Arduino headers of RDK2.
5. Place the 2JC01MC3F antenna so that interference from the building is minimal (for example, on a windowsill or outdoors).
6. Connect the antenna to RTK via GNSS UM980 socket.



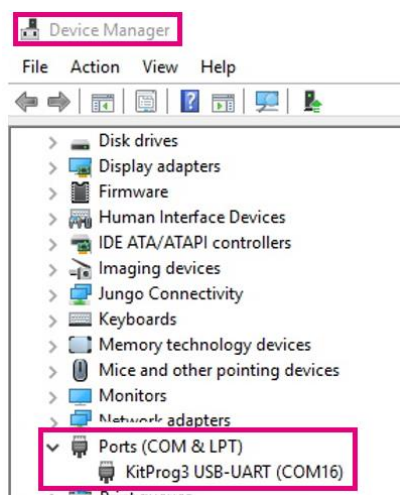
7. Ensure the switch SW1 of RDK2 is set to "3.3V" and SW2 is set to "SMPS".



8. Connect the “KitProg3” connector of RDK2 with a PC using the Micro USB cable (A to Micro B).



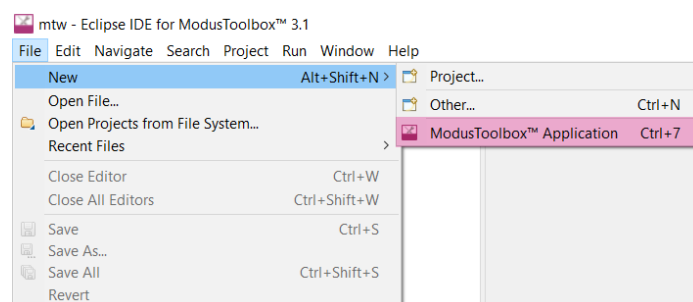
9. The “KitProg3” port must be seen in the MS Windows Device Manager window.



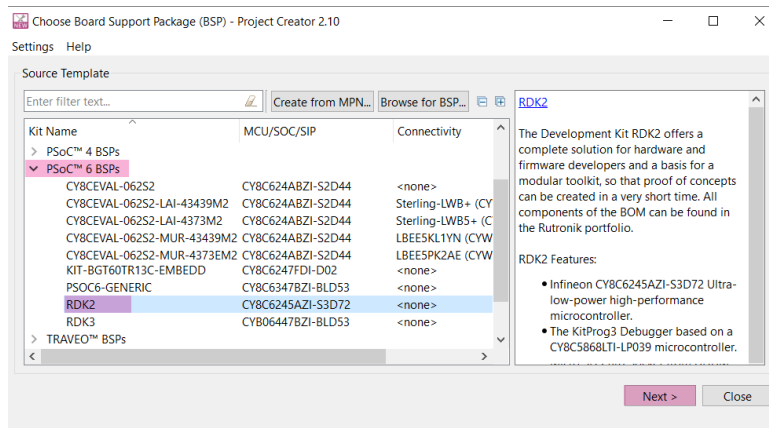
Running a Demo

The next steps explain how to use RDK2 in a combination with RAB4-RTK to read the position (latitude, longitude, and height) of the antenna.

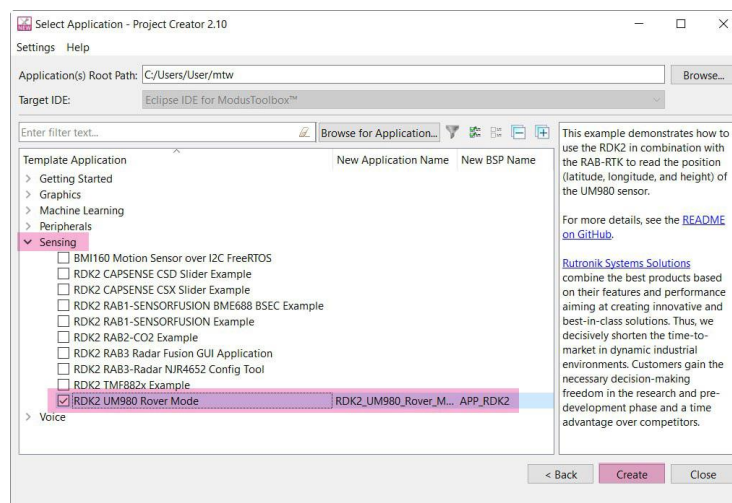
1. Run the **Modus Toolbox** application.
2. Go **File - New – Modus Toolbox Application** and wait for a while.



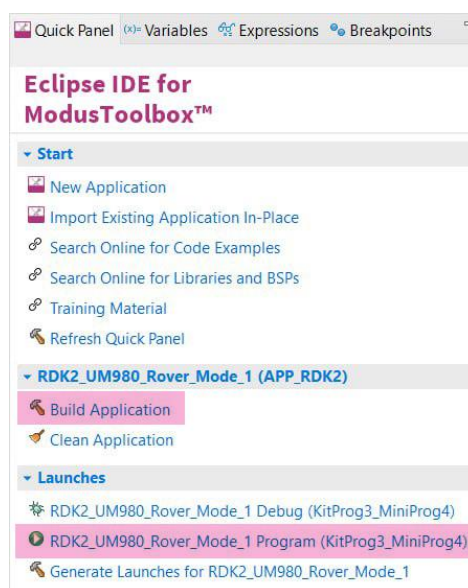
3. Open the **PSoC 6** block, select **RDK2** and press **Next**.



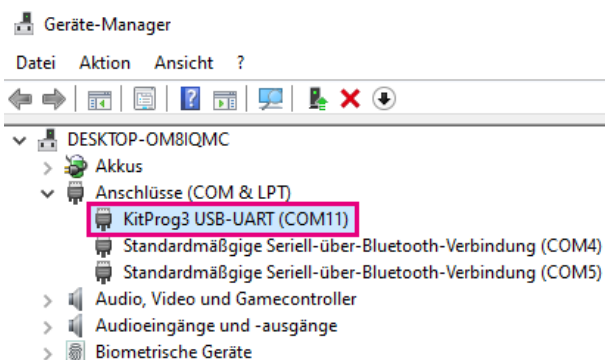
4. Open the **Sensing** block, check **RDK2 UM980 Rover Mode** and press **Create**.



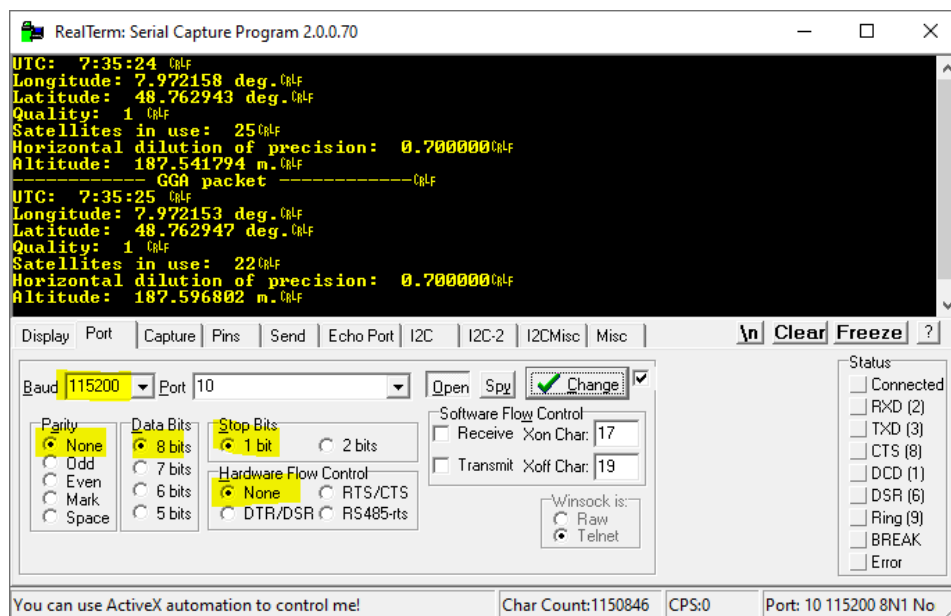
5. Press **Build Application** and then ***Program (KitProg3_MiniProg4)**.



6. Check the number of KitProg3 COM ports in Windows **Device Manager** (COM11 at the picture below), you'll need it in the next step.



10. Using a serial terminal on your computer, monitor the serial port (115200 bauds, Parity: None, Data bits: 8, Stop Bits: 1). The sensor data is refreshed every second in the terminal window.



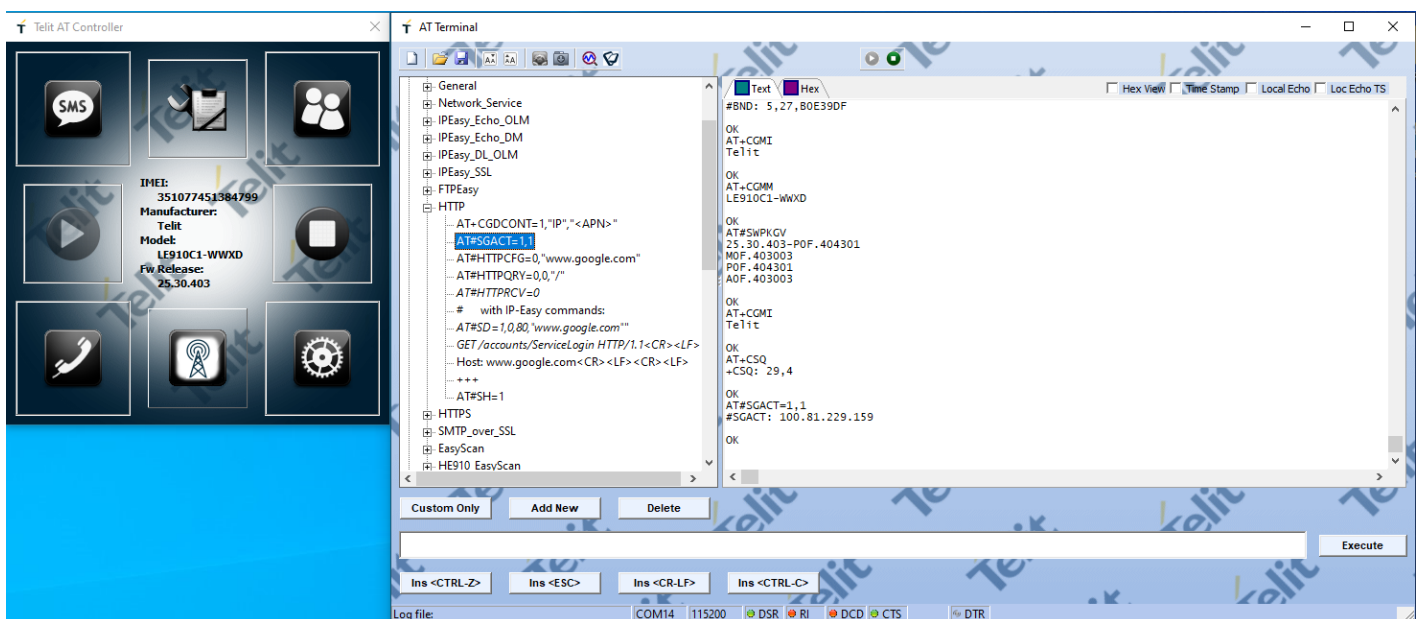
Supported Firmware and Software Examples

Telit AT Controller

LE910C1-WWxD module can be used with **Telit AT Controller** software without any additional setup. The software allows you to easily execute AT commands.

Please follow the next steps to use it:

1. Register or log in to [Telit Cinterion Download Zone](#).
2. Find the supported material for the LE910C1-WWxD Cellular Module.
3. Download and install Telit AT Controller software.
4. Connect the 2J6924Ma LTE antenna cables to RAB4-RTK board “LTE Main P8” and “LTE Diversity P6” SMA sockets.
5. Insert your Nano SIM card into the Nano SIM connector (optional).
6. Connect the RAB4-RTK to your PC using the USB cable.
7. Load the software, select the right port, and start testing the commands.

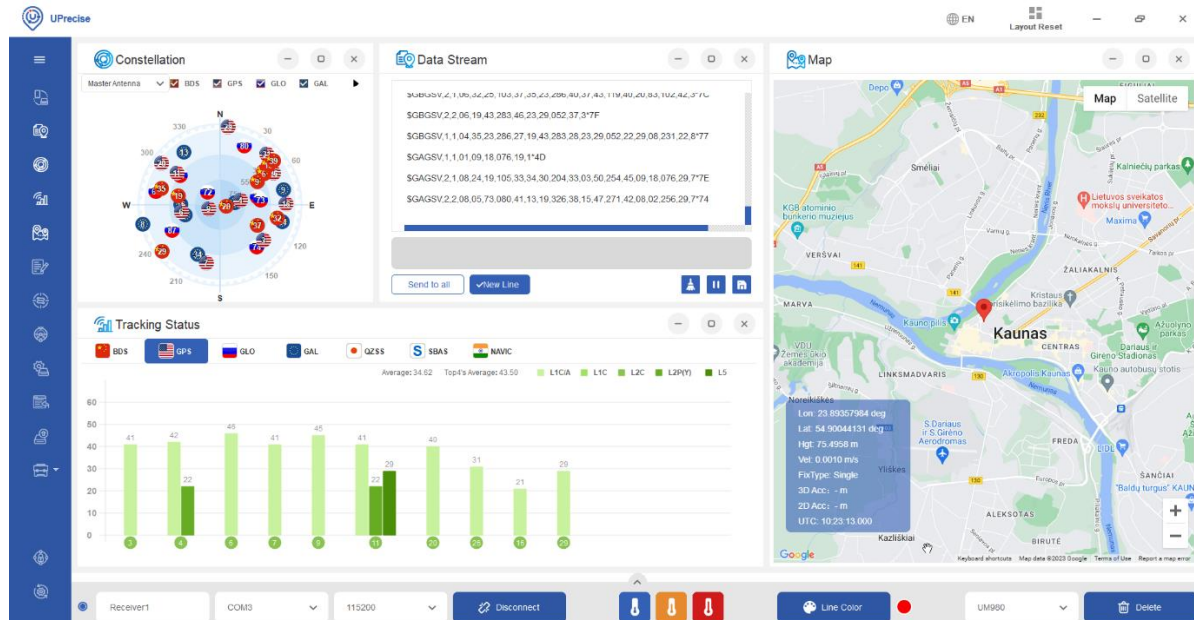


RAB4-RTK runs with Telit AT Controller software

Here you may find the most commonly used AT command examples. Telit LE910Cx AT Commands Reference Guide will need to be referred to for testing more specific functions of the LE910C1-WWxD module.

UPrecise – Visualised Real-Time and Playback Software

UM980 module can be used with **UPrecise** software provided by Unicore Communications Inc. The USB-UART bridge connecting the module and the PC is needed.



RAB4-RTK runs with UPrecise software

The residing onboard LE910C1-WWxD can be programmed using IoT AppZone IDE with the „UART USB Tunnel“ example to act as a USB-UART bridge. See [here](#) for details.

The Rutronik development kits RDK2, RDK3, or RDK4 may be used for that purpose as well, check out [this chapter](#) for details. If you have any of these devkits, you may download and program USB-UART bridge firmware using the ModusToolbox Project Creator tool, then mount the RAB4-RTK on Arduino Headers and use UPrecise software.

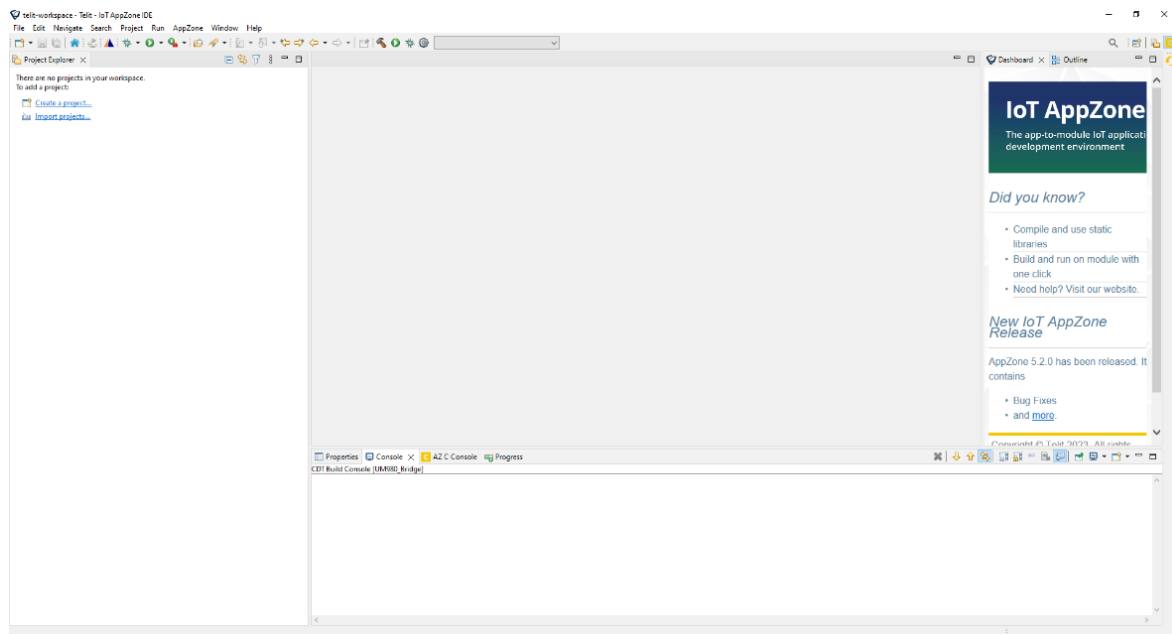
UPrecise may be downloaded from [here](#).

The manual for this software may be also downloaded from the supplier's page [here](#).

Telit IoT AppZone Examples

Telit Cinterion IoT AppZone 5.0 is available for the LE910C1-WWxD module. Telit Cinterion provides all the information on how to start with the development:

<https://www.telit.com/support-tools/telit-iot-app-zone/>.



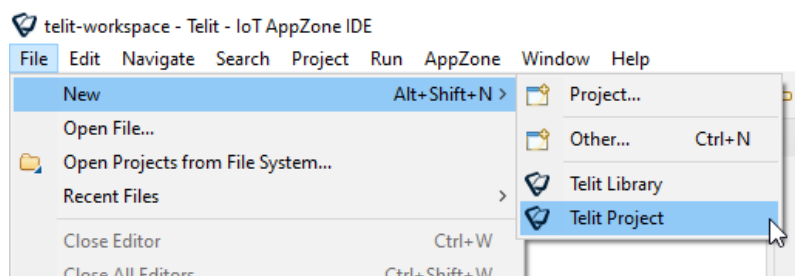
IoT AppZone IDE software

Plenty of examples for LE910C1-WWxD may be tested from IoT AppZone and GitHub:
[IoT-AppZone-SampleApps](#).

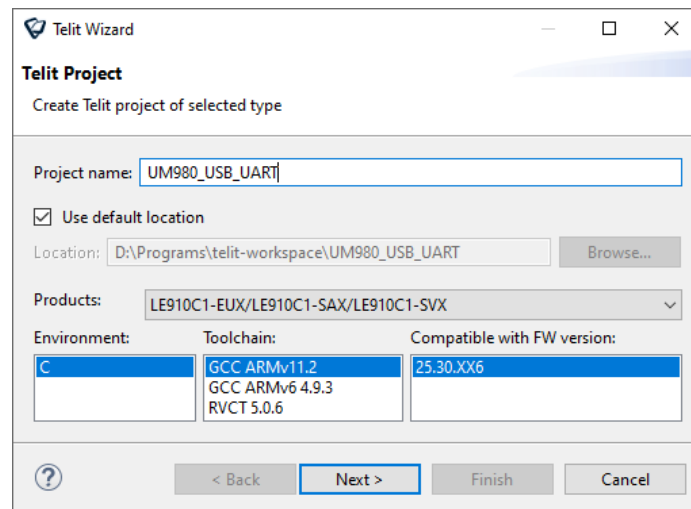
AppZone USB UART Tunnel

For example, you may create a new and useful Telit Project and select a USB UART Tunnel application that may be used for communication with UM980 and Uprecise Software without any additional hardware. The procedure is described in the following steps.

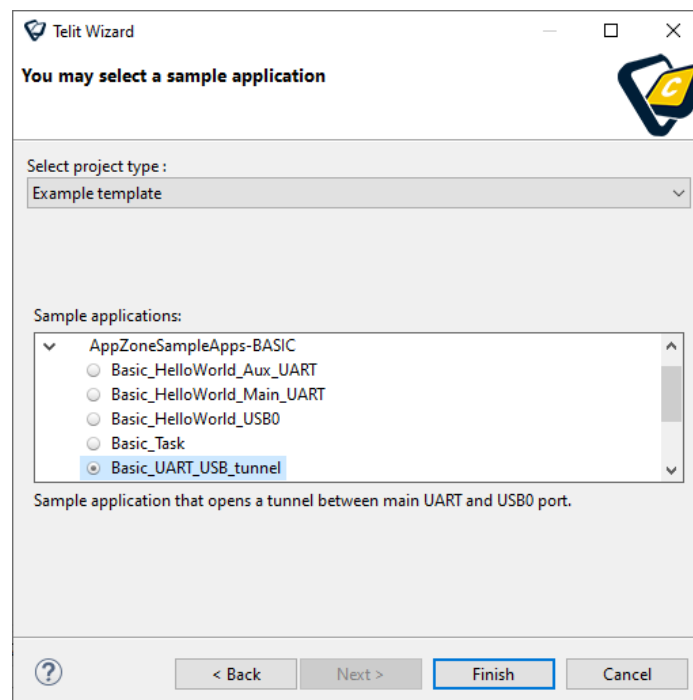
1. Select a **File → New → Telit Project**.



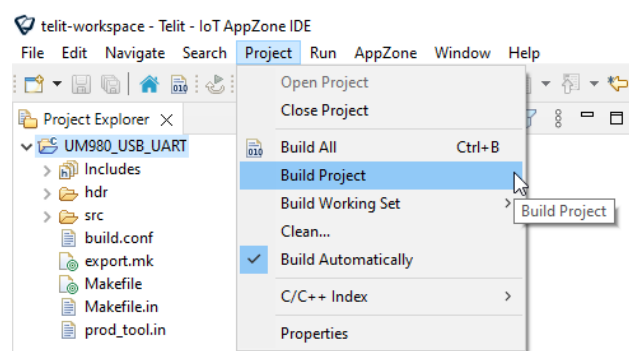
- Set up a project as it is shown below, and press **Next**.



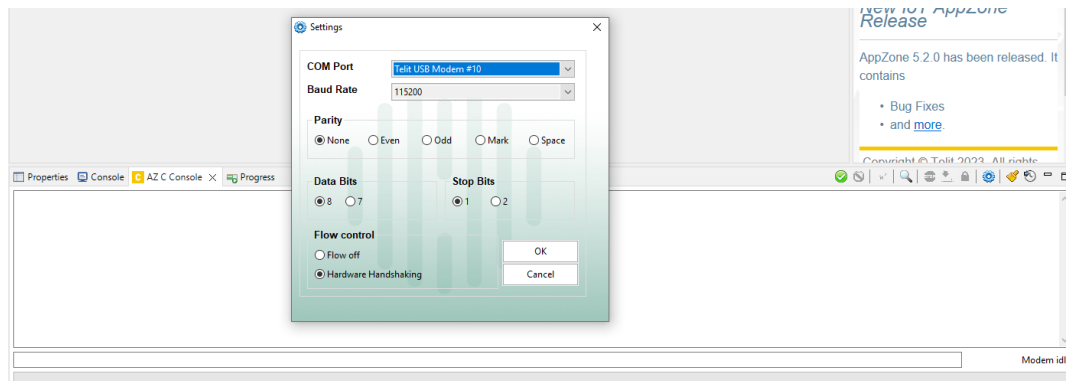
- Select the example **Basic_UART_USB_tunnel** and press **Finish**.



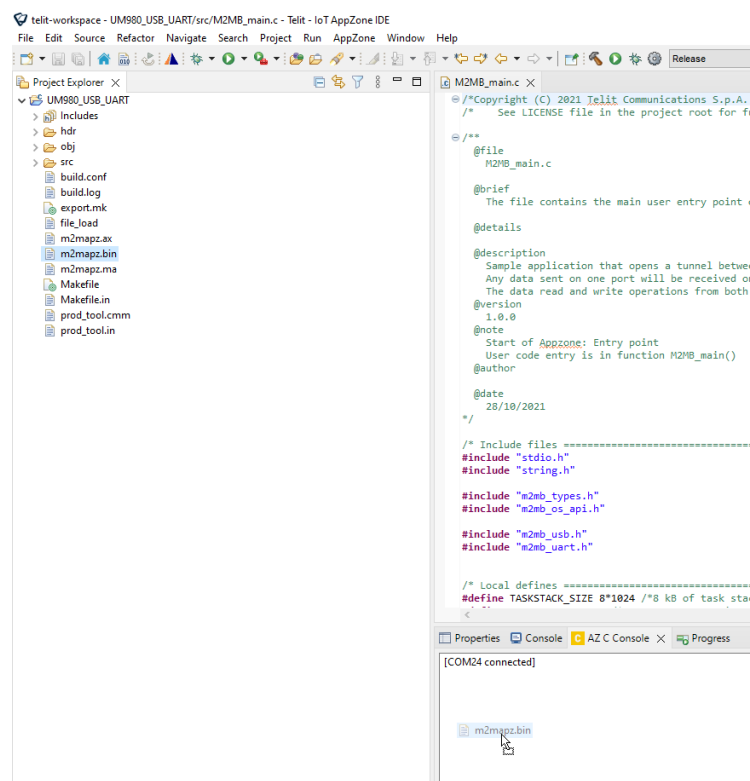
- Build the newly created project.



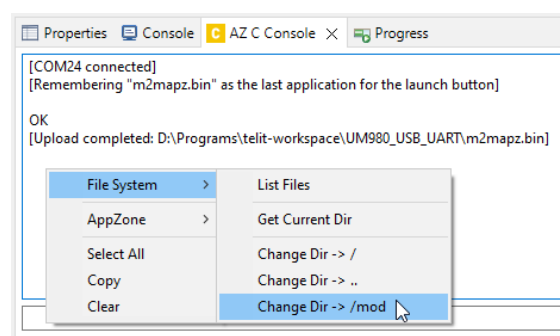
5. Open the **AZ C Console** tab, check  **Settings** and then connect by pressing .



6. Load the binary „m2mapz.bin“ by dragging and dropping it to the **AZ C Console**.

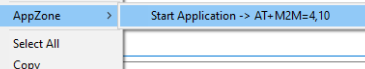


7. Change the working directory with the right-click inside **AZ C Console**.



-



- 
- The screenshot shows the 'AZ C Console' window with the 'Progress' tab selected. The console output displays the following messages:
- ```
[COM24 connected]
[Remembering "m2mapz.bin" as the last application for the launch button]
OK
[Upload completed: D:\Programs\telit-workspace\UM980_USB_UART\m2mapz.bin]
[Directory changed -> /mod]
[File m2mapz.bin: execute permissions set]
```
- Below the console output, a context menu is open over the 'Start Application' button. The menu options are:
- File System
  - AppZone
  - Select All
  - Copy
  - Clear
- The 'Start Application' button itself contains the text: 'Start Application -> AT+M2M=4,10'.

- 

- 
- RealTerm: Serial Capture Program 2.0.0.70
- ```

READY$GNGGA,,0,,~78 tbf
$GPGSR,,1,,~73 tbf
$GNRMC,,0,,N,0~37 tbf
$GPGSU,,1,1.00,,~55 tbf
$GNGGA,,0,,~78 tbf
$GPGSR,,1,,~73 tbf
$GNRMC,,0,,N,0~37 tbf
$GPGSU,,1,1.00,,~55 tbf

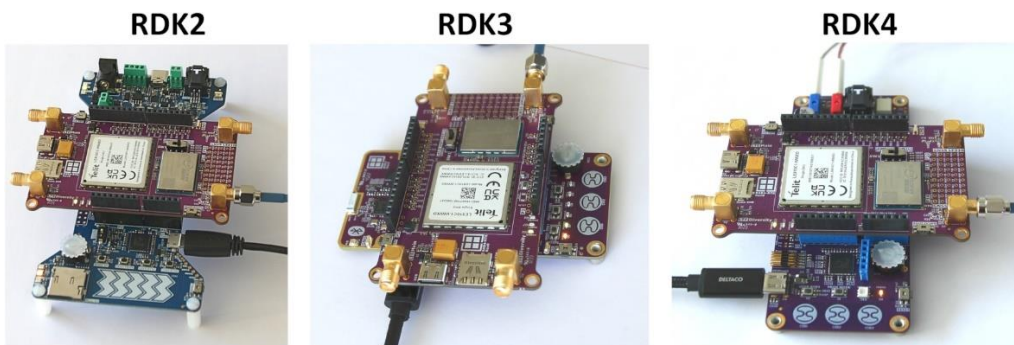
```
- Display Port Capture Pins Send Echo Port I2C I2C-2 I2CMisc Misc
- Baud 115200 Port 7
- Open Spy ☒ Change ☒
- Software Flow Control
☐ Receive Xon Char: 17
☐ Transmit Xoff Char: 19
- Parity: ☐ None ☐ Odd ☐ Even ☐ Mark ☐ Space
 Data Bits: ☐ 8 bits ☐ 7 bits ☐ 6 bits ☐ 5 bits
 Stop Bits: ☐ 1 bit ☒ 2 bits
 Hardware Flow Control: ☒ None ☐ RTS/CTS ☐ DTR/DSR ☐ RS485-rts
- Winsock is:
☐ Raw ☒ Telnet
- Status:
☐ Disconnect
☐ RXD (2)
☐ TXD (3)
☒ CTS (8)
☐ DCD (1)
☒ DSR (6)
☐ Ring (9)
☐ BREAK
☐ Error
- Char Count:222 CPS:0 Port: 7 115200 8N2 None

13. Load the „Uprecise“ software, set up the port and start operating



RDK2, RDK3, RDK4 ModusToolbox USB UART Examples

These are universal code examples that enable the UM980 to communicate with a host PC over the USB. The Rutronik Development Kits RDK2, RDK3, or RDK4 may be used for this purpose together with the Rutronik Adapter Board the RAB4-RTK, and UPrecise software provided by Unicore Com Communications Inc.



USB UART Bridge for the UM980

The examples are accessible using the Infineon [ModusToolbox™](#) software. Every particular example acts as a USB UART Bridge, therefore any software on a host side can be used to read the measurements or send the commands to any device that is interfaced with Arduino UART and communicates at 115200 bit/s of baud rate. The UM980 module can be run with „ModusToolbox™“ software just in a few steps.

1. Register or/and login to the [Infineon website](#), press on the „myInfineon“ tab.
2. Download and install the latest ModusToolbox™ software.
3. Load the ModusToolbox™ software and open the **Project Creator tool**:
File → New → ModusToolbox™ Application.
4. Check RDK2, RDK3, or RDK4 BSP (depending on what platform you are currently working on). It is in PSoC™ 6 and PSoC™ 4 BSPs lists and click on **Next**.
5. Select the example "RDKx-USB-UART-UM980" from the Peripherals category list and click on **Create**.
6. **Built**, and **Program** the example to your development platform (RDK3 must be provisioned).
7. Mount the RAB4-RTK adapter board on the Arduino Headers and start using the example.

RDk3 Android and iOS Smartphone Apps

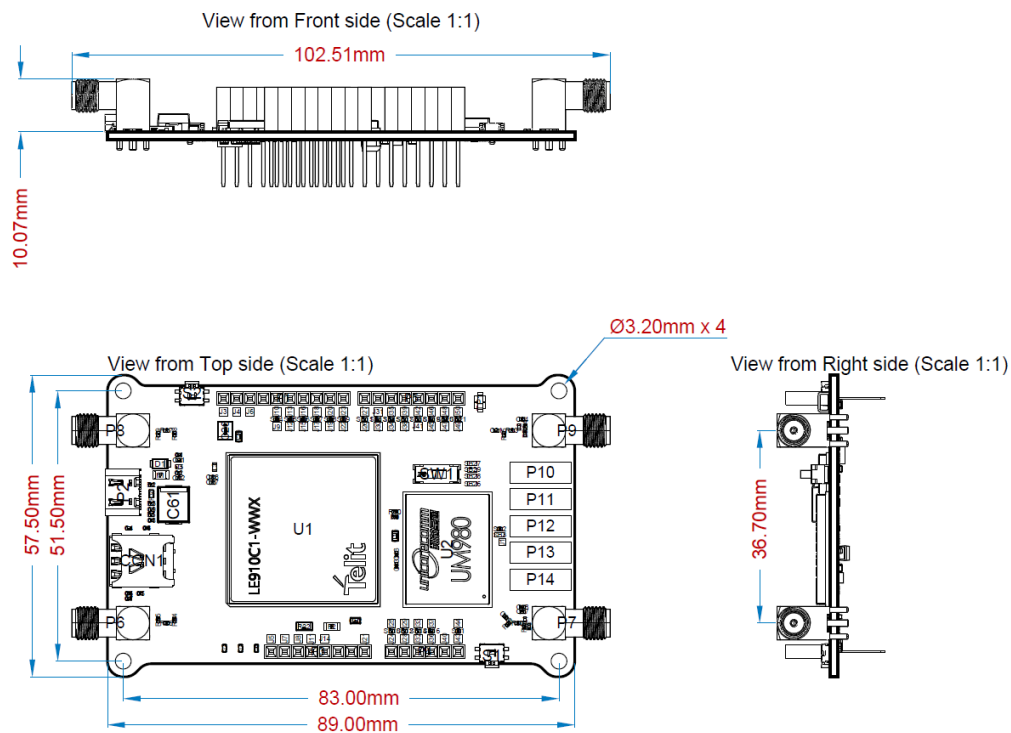
Application note can be found [here](#).

RDk2 UM980 NTRIP Client GUI

Application note can be found [here](#).

Production Data

Mechanical Layout



Schematics

You'll find the schematics of RTK [here](#).

BOM

You'll find the [BOM](#) for RTK here.