

RA6M5 Group

RYZ024A PMOD LTE Connectivity with
RA6M5 MCU
Quick Start Guide

Renesas RA Family
RA6 Series

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1. Precaution against Electrostatic Discharge (ESD)

A strong electrical field, when exposed to a CMOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop the generation of static electricity as much as possible, and quickly dissipate it when it occurs. Environmental control must be adequate. When it is dry, a humidifier should be used. This is recommended to avoid using insulators that can easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors must be grounded. The operator must also be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions must be taken for printed circuit boards with mounted semiconductor devices.

2. Processing at power-on

The state of the product is undefined at the time when power is supplied. The states of internal circuits in the LSI are indeterminate and the states of register settings and pins are undefined at the time when power is supplied. In a finished product where the reset signal is applied to the external reset pin, the states of pins are not guaranteed from the time when power is supplied until the reset process is completed. In a similar way, the states of pins in a product that is reset by an on-chip power-on reset function are not guaranteed from the time when power is supplied until the power reaches the level at which resetting is specified.

3. Input of signal during power-off state

Do not input signals or an I/O pull-up power supply while the device is powered off. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Follow the guideline for input signal during power-off state as described in your product documentation.

4. Handling of unused pins

Handle unused pins in accordance with the directions given under handling of unused pins in the manual. The input pins of CMOS products are generally in the high-impedance state. In operation with an unused pin in the open-circuit state, extra electromagnetic noise is induced in the vicinity of the LSI, an associated shoot-through current flows internally, and malfunctions occur due to the false recognition of the pin state as an input signal become possible.

5. Clock signals

After applying a reset, only release the reset line after the operating clock signal becomes stable. When switching the clock signal during program execution, wait until the target clock signal is stabilized. When the clock signal is generated with an external resonator or from an external oscillator during a reset, ensure that the reset line is only released after full stabilization of the clock signal. Additionally, when switching to a clock signal produced with an external resonator or by an external oscillator while program execution is in progress, wait until the target clock signal is stable.

6. Voltage application waveform at input pin

Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between V_{IL} (Max.) and V_{IH} (Min.) due to noise, for example, the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between V_{IL} (Max.) and V_{IH} (Min.).

7. Prohibition of access to reserved addresses

Access to reserved addresses is prohibited. The reserved addresses are provided for possible future expansion of functions. Do not access these addresses as the correct operation of the LSI is not guaranteed.

8. Differences between products

Before changing from one product to another, for example to a product with a different part number, confirm that the change will not lead to problems. The characteristics of a microprocessing unit or microcontroller unit products in the same group but having a different part number might differ in terms of internal memory capacity, layout pattern, and other factors, which can affect the ranges of electrical characteristics, such as characteristic values, operating margins, immunity to noise, and amount of radiated noise. When changing to a product with a different part number, implement a system-evaluation test for the given product.

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Precautions

This Evaluation Kit is only intended for use in a laboratory environment under ambient temperature and humidity conditions. A safe separation distance should be used between this and any sensitive equipment. Its use outside the laboratory, classroom, study area, or similar such area invalidates conformity with the protection requirements of the Electromagnetic Compatibility Directive and could lead to prosecution.

The product generates, uses, and can radiate radio frequency energy and may cause harmful interference to radio communications. There is no guarantee that interference will not occur in a particular installation. If this equipment causes harmful interference to radio or television reception, which can be determined by turning the equipment off or on, you are encouraged to try to correct the interference by one or more of the following measures:

- Ensure attached cables do not lie across the equipment.
- Reorient the receiving antenna.
- Increase the distance between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that which the receiver is connected.
- Power down the equipment when not in use.
- Consult the dealer or an experienced radio/TV technician for help.

Note: It is recommended that wherever possible shielded interface cables are used.

The product is potentially susceptible to certain EMC phenomena. To mitigate against them it is recommended that the following measures be undertaken:

- The user is advised that mobile phones should not be used within 10 m of the product when in use.
- The user is advised to take ESD precautions when handling the equipment.

The Evaluation Kit does not represent an ideal reference design for an end product and does not fulfill the regulatory standards for an end product.

Renesas RA Family

RYZ024A PMOD with EK-RA6M5
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1. Introduction

This Quick Start Guide (QSG) provides:

- An overview of the RYZ024A PMOD example project for the EK-RA6M5 board.
- Instructions for running the RYZ024A PMOD example project on the EK-RA6M5 board.
- Instructions for flashing the RYZ024A PMOD example project code using Renesas Flash Programmer.

1.1 Assumptions and Advisory Notes

1. Tool experience: It is assumed that the user has prior experience in using a serial terminal emulation program such as Tera Term.
2. Subject knowledge: It is assumed that the user has basic knowledge about microcontrollers, embedded systems, LTE communication and AT commands.
3. The screen shots provided throughout this document are for reference. The actual screen content may differ depending on the version of software and development tools used.

2. Kit Contents

The following components are required:

1. RYZ024A PMOD board with external antenna ([RTKYZ024A0B00000BE](#))
2. EK-RA6M5 board (renesas.com/ra/ek-ra6m5)
3. 2 x Micro USB device cables (micro-B)
4. Truphone SIM card ([RTKYZ024A0B00000BE](#))

3. EK-RA6M5 Kit Setup

First, disconnect the micro USB power cable (connector J11) from the board. The RYZ024A PMOD board should be connected to PMOD2 (connector J25) with the external antenna attached (see Figure 1). The included SIM card must be inserted in the card slot on the underside of the RYZ024A PMOD board. Connect the second micro USB cable to RYZ024A board (connector CN4) for external powering of PMOD and the other end of cable to a PC USB port. You may now reconnect the micro USB power cable (connector J11) to a PC USB port.

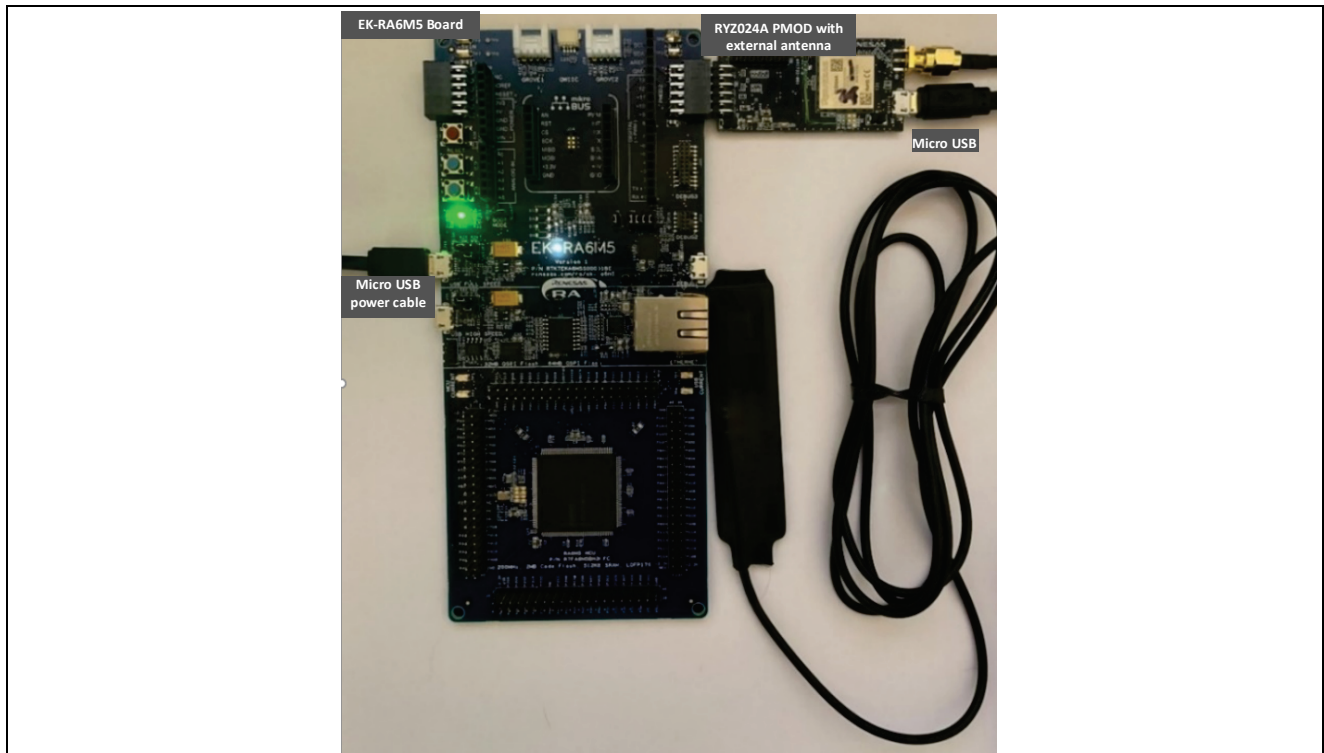


Figure 1. EK-RA6M5 Setup with RYZ024A PMOD Board Connected

4. Overview of the RYZ024A PMOD Example Project

The RYZ024A PMOD example project allows the user to test a RYZ024A PMOD module and SIM card connectivity through a serial terminal menu.

When the EK-RA6M5 board running the RYZ024A PMOD example project is connected to a host PC via USB as a Full Speed CDC Device, the kit and RYZ024A PMOD information can be viewed, and the included SIM card activation can be validated.

5. Running the RYZ024A PMOD Example Project

This section lists the requirements and instructions to power up the EK-RA6M5 board, flash the EK-RA6M5 board, and run the RYZ024A PMOD example project.

Hardware Requirements

- EK-RA6M5 board
- 2 x Micro USB device cables
- A PC with at least 2 USB ports
- RYZ024A PMOD board with external antenna.

Software Requirements

- Windows® 10 operating system
- Tera Term (or similar) serial terminal console application V4.106
- Renesas Flash Programmer V3.10.00
- RYZ024A PMOD example project Hex File (located in `r21qs0007euxxx-ryz024a-ek-ra6m5.zip > ryz024a_quickstart_ek_ra6m5/ ryz024a_quickstart_ek_ra6m5.srec` file).

5.1 Flashing the Example Program on the EK-RA6M5 Board

1. Connect the micro USB end of the micro USB device cable to the micro-AB DEBUG port (J10) of the EK-RA6M5 board.
2. Open Renesas Flash Programmer and create a new project by using the **File** menu and selecting **New Project**.
3. In the **Create a New Project** window (Figure 2), select the **RA** family from the Microcontroller drop-down menu. Next, enter a desired project name and select **J-link** for the communication tool. Click **Connect**.

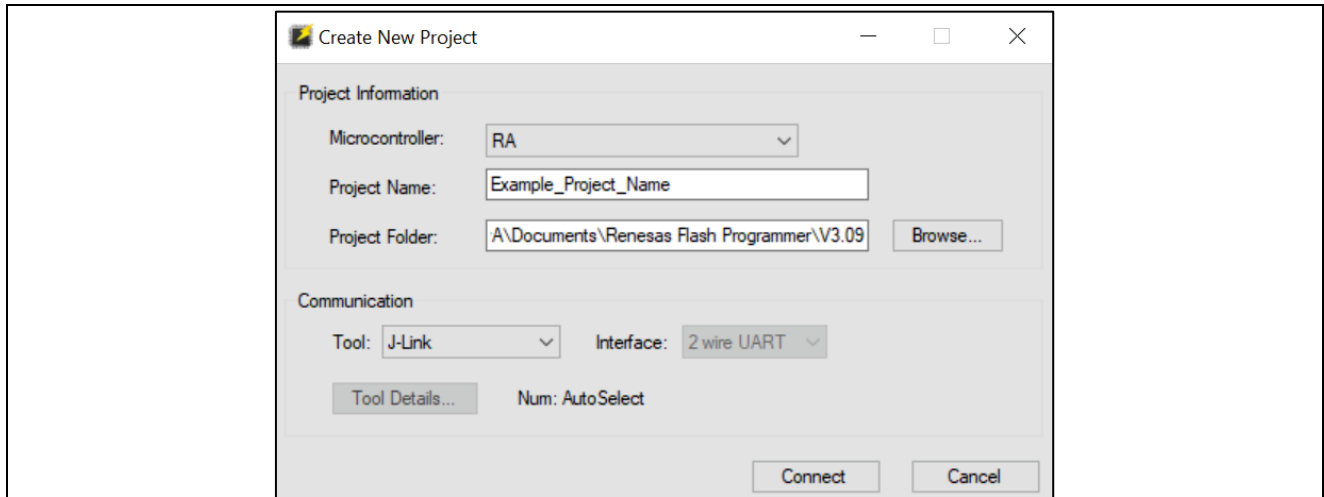


Figure 2. Creating a New Project on Renesas Flash Programmer

4. An authentication window may appear. If it does, then enable **Auto Authentication** and click **OK**.
5. Verify that the message **Operation completed** is printed in the main window after clicking **Connect**. Under Program file, click **Browse** to choose the program file that will be flashed onto the board (Figure 3). Using the file explorer window, navigate to the example project's **Hex File** (located in **r21qs0007euxxx-ryz024a-ek-ra6m5.zip > ryz024a_quickstart_ek_ra6m5/ryz024a_quickstart_ek_ra6m5.srec** file) and click **Open**.

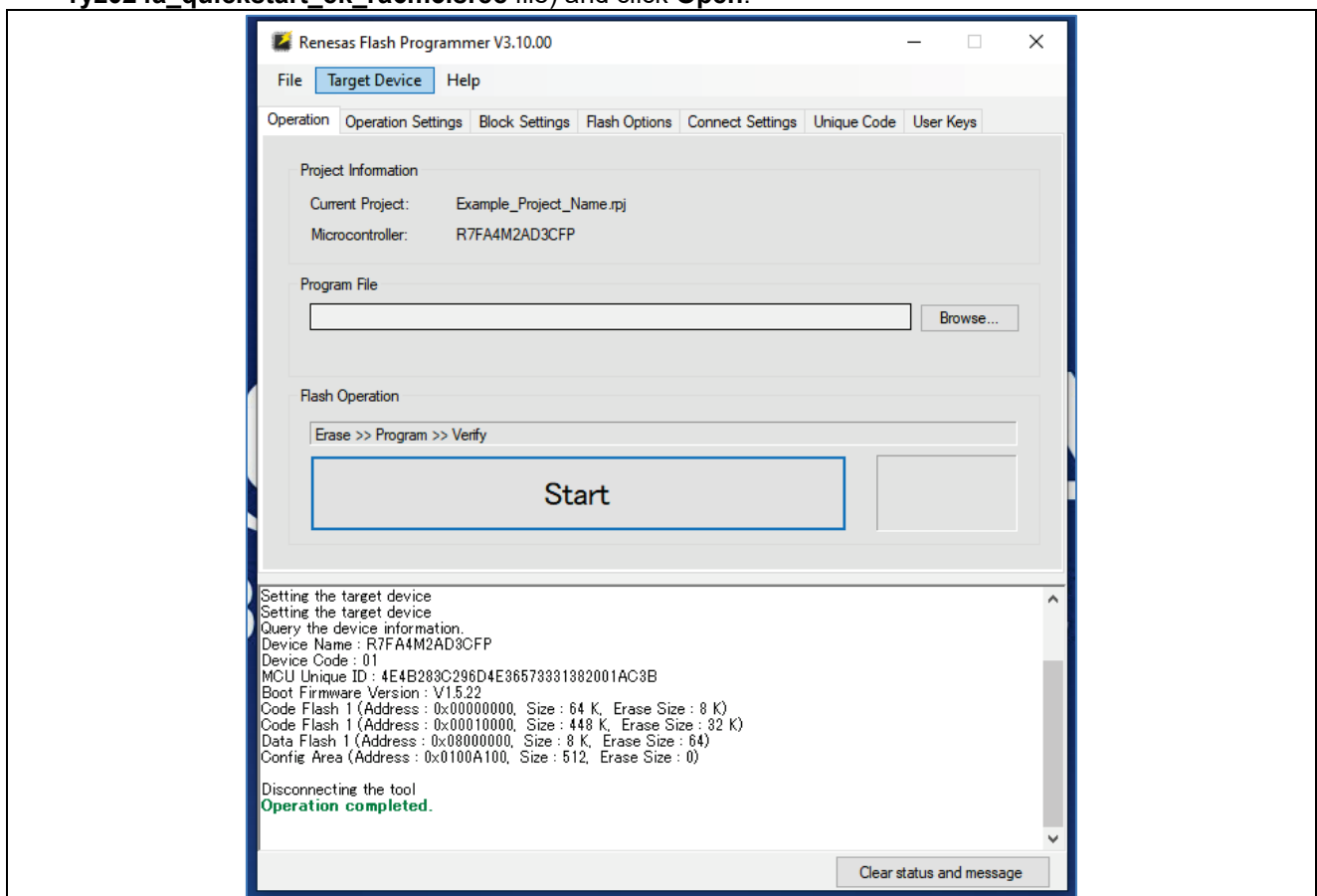


Figure 3. Main Window of Renesas Flash Programmer After Creating a New Project

6. Click **Start** to begin flashing the example project code onto the board. Once completed, the message **Operation completed** should be printed and the status **OK** should be displayed.
7. Disconnect the micro USB device cable from the debug port of the EK-RA6M5 board.

5.2 Connecting and Powering Up the EK-RA6M5 Board

1. Check that J12 is set to link pins 2-3 and that J15 link is closed.
2. Connect one of the micro USB cables to RYZ024A (connector CN4) for external powering of PMOD and the other end of cable to a PC USB port.
3. Connect the second micro USB end of the micro USB device cable to the micro-AB USB Full Speed port (J11) of the EK-RA6M5 board.
4. Connect the other end of this cable to the USB port of the host PC. Power LED (LED4) on the EK-RA6M5 board lights up white, indicating that the EK-RA6M5 board is powered on.

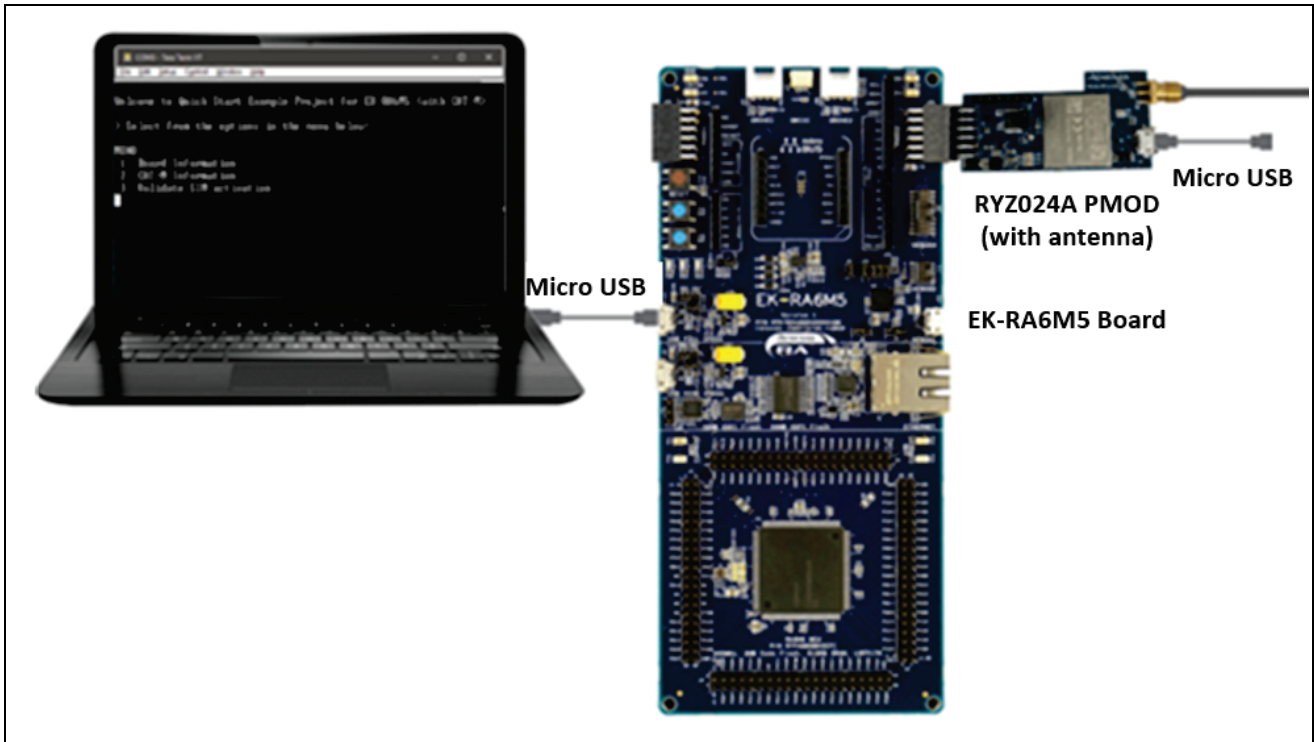


Figure 4. Connecting the EK-RA6M5 Board to the Host PC via USB Full Speed Port

5.3 Running the RYZ024A PMOD Example Project

To run the RYZ024A PMOD example project, use the following instructions:

1. On the host PC, open Windows Device Manager. Expand **Ports (COM & LPT)**, locate **USB Serial Device (COMxx)** and note the COM port number for reference in the next step.

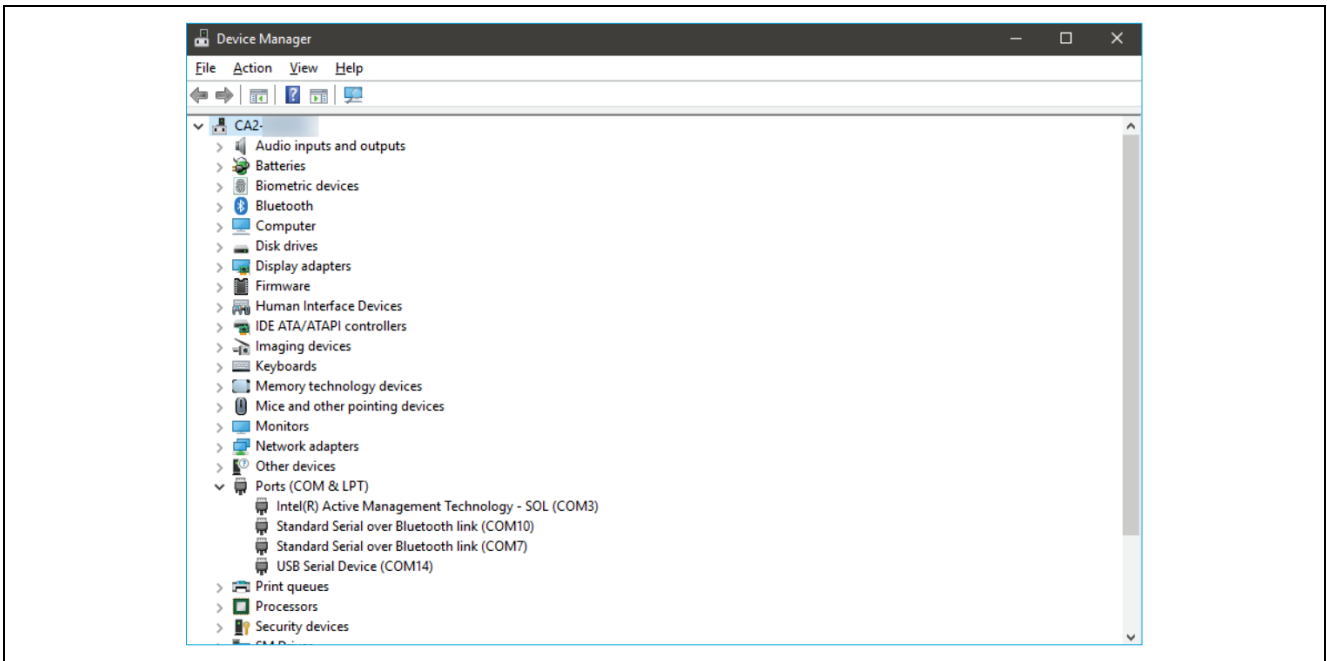


Figure 5. USB Serial Device in Windows Device Manager

2. Open Tera Term, select **Serial** and **COMxx: USB Serial Device (COMxx)** and click **OK**.

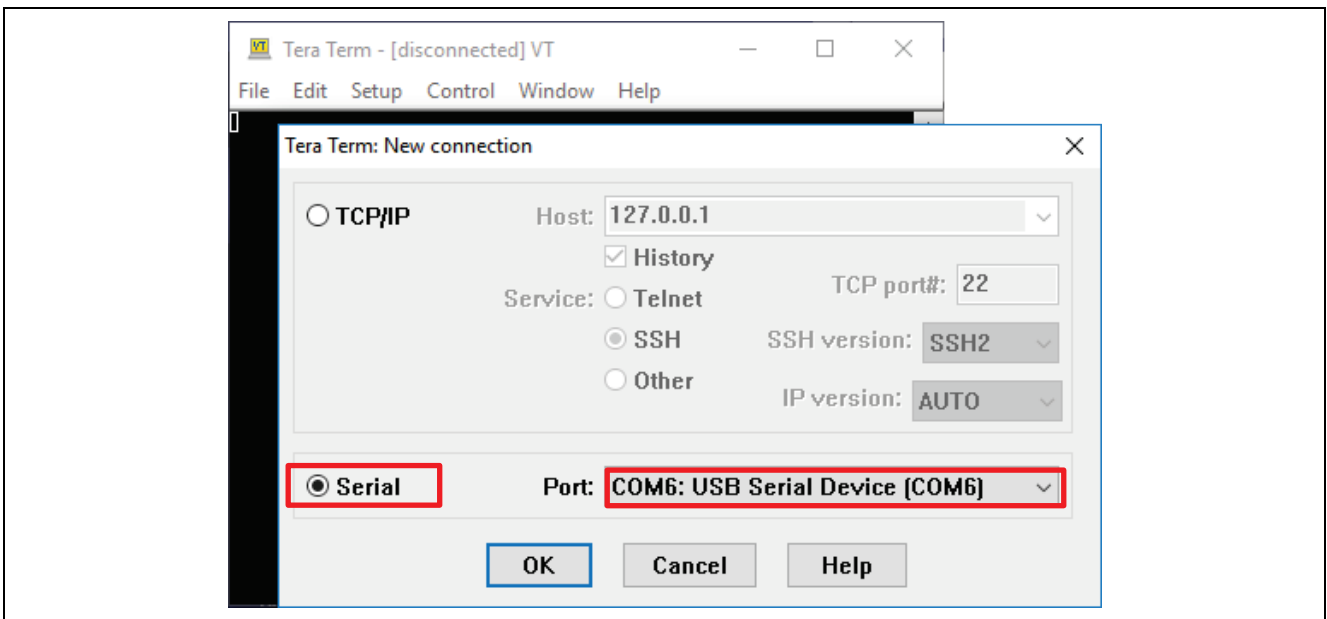


Figure 6. Selecting the Serial Port on Tera Term

- Using the **Setup** menu pull-down, select **Serial port...** and ensure that the speed is set to **115200**, as shown in Figure 7.

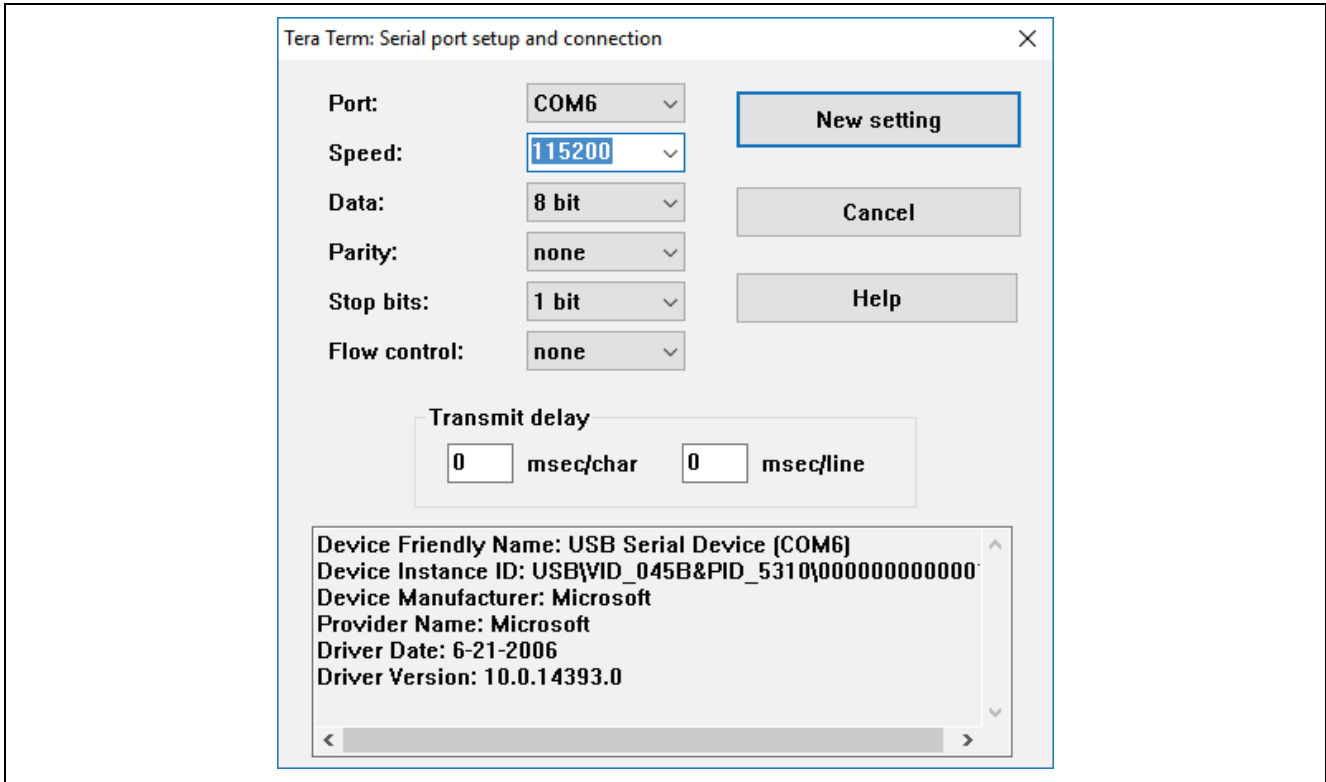


Figure 7. Selecting 115200 on the Speed Pulldown

- Complete the connection. The 'Welcome and Main Menu' screen will be displayed as shown in Figure 8.

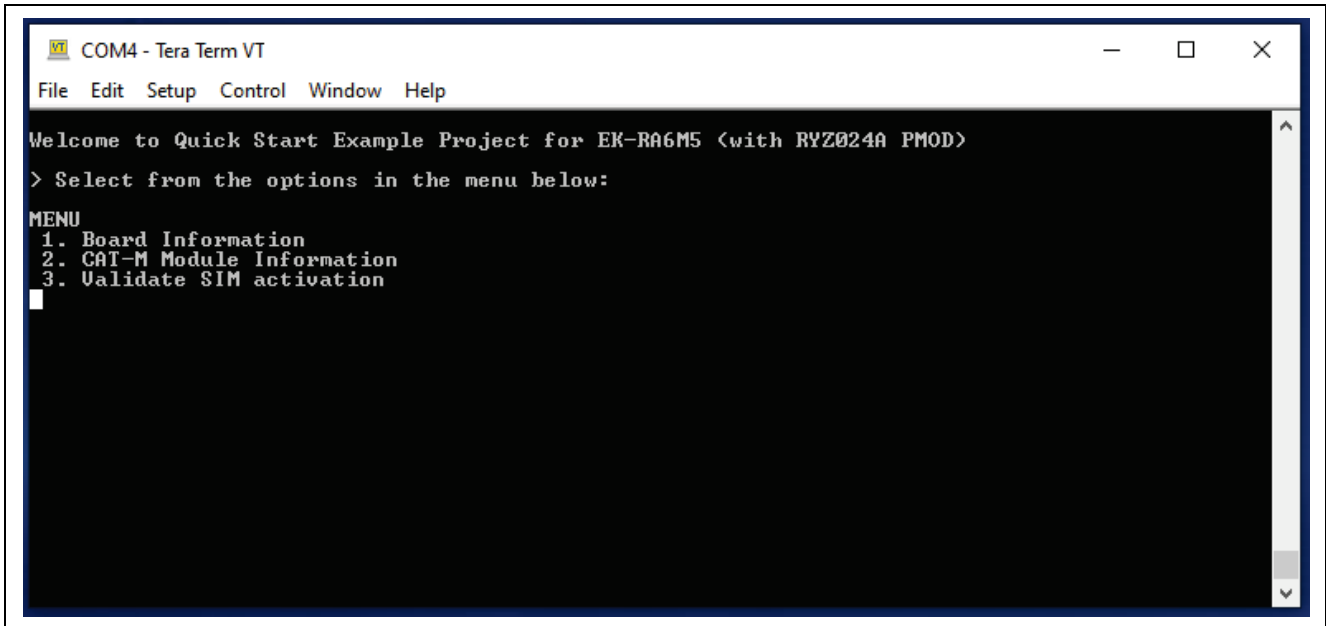
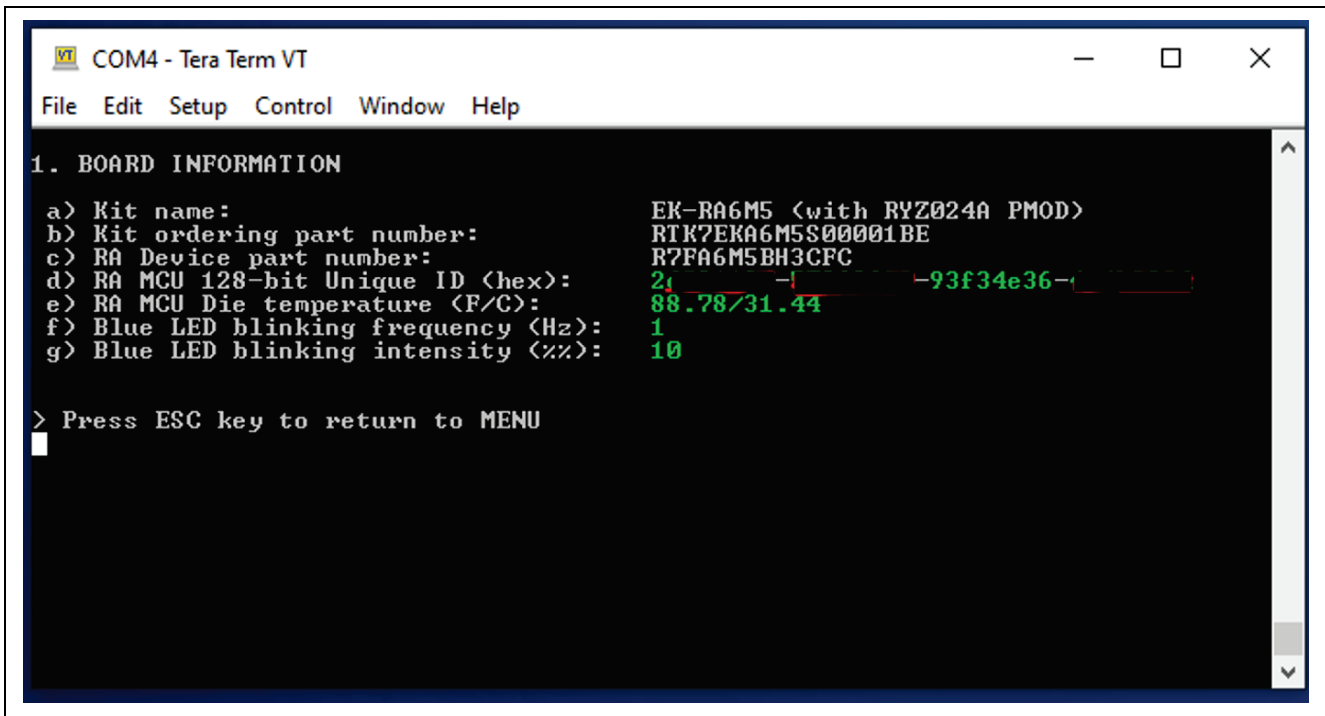


Figure 8. Welcome and Main Menu

- Press **1** to display the **Board Information** including the kit name, part number, MCU ID, MCU die temperature, and the user LED's current intensity.

A screenshot of a terminal window titled "COM4 - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". The terminal content shows a menu with "1. BOARD INFORMATION" and options a) through g). Option a) is selected, and the following information is displayed: Kit name: EK-RA6M5 (with RYZ024A PMOD); Kit ordering part number: RTK7EKA6M5S00001BE; RA Device part number: R7FA6M5BH3CFC; RA MCU 128-bit Unique ID (hex): 21...-93f34e36-...; RA MCU Die temperature (F/C): 88.78/31.44; Blue LED blinking frequency (Hz): 1; Blue LED blinking intensity (%): 10. At the bottom, it says "> Press ESC key to return to MENU" with a cursor on the next line.

```
COM4 - Tera Term VT
File Edit Setup Control Window Help

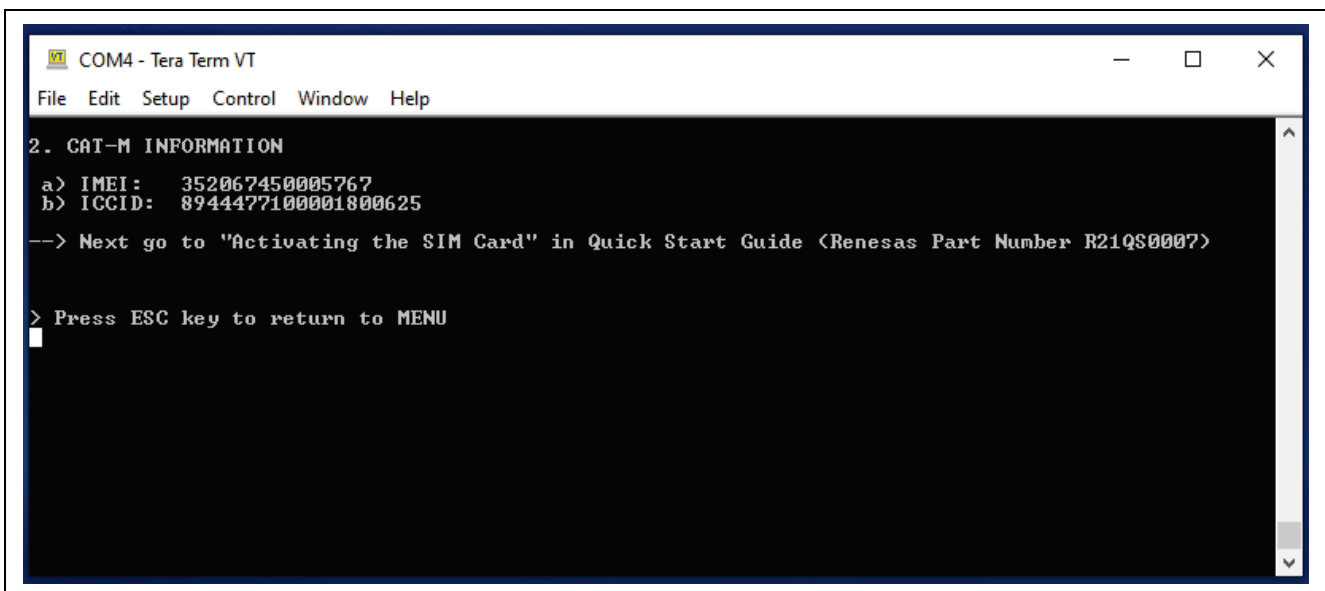
1. BOARD INFORMATION

a) Kit name: EK-RA6M5 (with RYZ024A PMOD)
b) Kit ordering part number: RTK7EKA6M5S00001BE
c) RA Device part number: R7FA6M5BH3CFC
d) RA MCU 128-bit Unique ID (hex): 21...-93f34e36-...
e) RA MCU Die temperature (F/C): 88.78/31.44
f) Blue LED blinking frequency (Hz): 1
g) Blue LED blinking intensity (%): 10

> Press ESC key to return to MENU
█
```

Figure 9. Board Information

- Press **ESC** to return to the 'Welcome and Main Menu' screen.
- Press **2** to display **CAT-M Information**. This menu will communicate with the RYZ024A PMOD module to obtain the ICCID value needed for activating the SIM card. Upon success, the IMEI and ICCID values will be displayed on the terminal screen. The program will continue to attempt to communicate with the RYZ024A PMOD module until it has successfully connected or timed out. After obtaining the ICCID value, go to Truphone truphone.com/connectit to activate the SIM card (see section **Activating the SIM card**).

A screenshot of a terminal window titled "COM4 - Tera Term VT". The window has a menu bar with "File", "Edit", "Setup", "Control", "Window", and "Help". The terminal content shows a menu with "2. CAT-M INFORMATION" and options a) and b). Option a) is selected, and the following information is displayed: IMEI: 352067450005767; ICCID: 8944477100001800625. Below this, it says "--> Next go to 'Activating the SIM Card' in Quick Start Guide (Renesas Part Number R21QS0007)". At the bottom, it says "> Press ESC key to return to MENU" with a cursor on the next line.

```
COM4 - Tera Term VT
File Edit Setup Control Window Help

2. CAT-M INFORMATION

a) IMEI: 352067450005767
b) ICCID: 8944477100001800625

--> Next go to "Activating the SIM Card" in Quick Start Guide (Renesas Part Number R21QS0007)

> Press ESC key to return to MENU
█
```

Figure 10. RYZ024A PMOD Information

8. Press **ESC** to return to the ‘Welcome and Main Menu’ screen.

Press **3** to enter the **Validate SIM activation** screen. The program will attempt to ping the Quad9 server (IP address 9.9.9.9) for a response to determine whether the SIM card has been activated with access to the LTE Network. Upon success, the text “** SIM card active! **” will be displayed on the terminal screen. If the PING response returns a time out condition “+PING: 1,9.9.9.9,-1,-1”, keep in mind it can take up to 15 minutes for the card to be activated after performing **Activating the SIM Card** to obtain LTE Network access. In this case, wait 15 minutes and repeat step 8. If SIM card validation continues to fail, follow the **Troubleshooting** section.

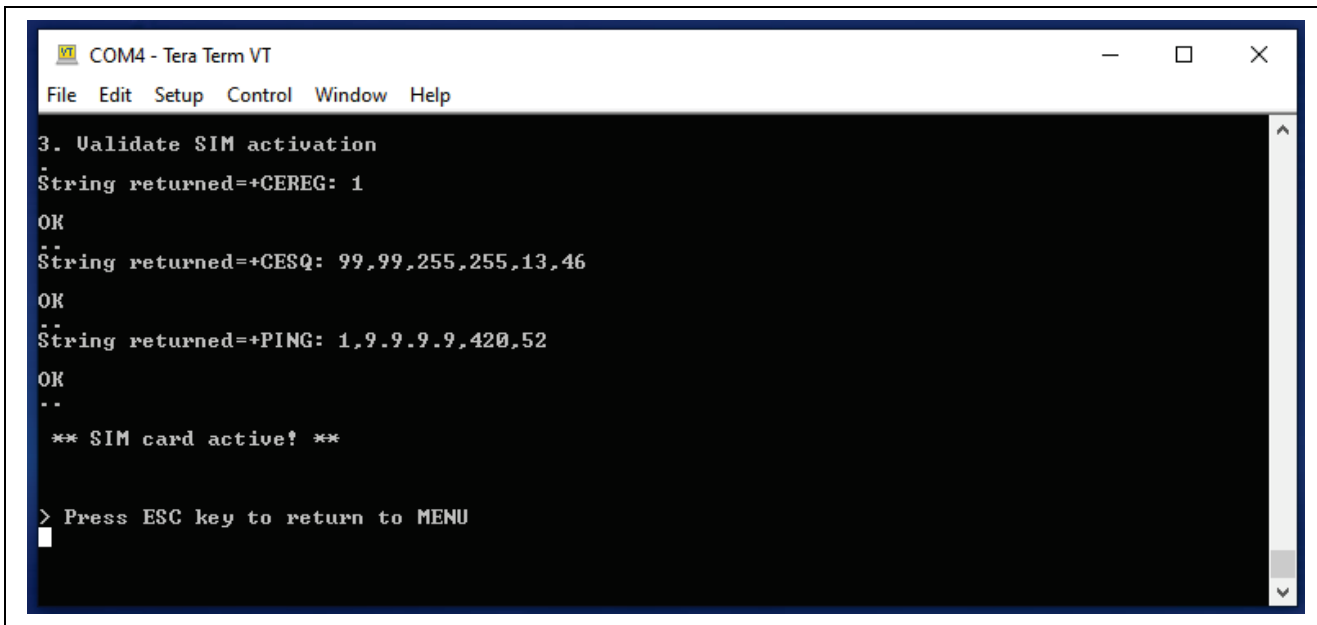


Figure 11. Validating SIM Activation – SIM Card Active

9. Press **ESC** to return to the ‘Welcome and Main Menu’ screen.

6. Activating the SIM Card

To activate the included SIM card, please visit the Truphone SIM Activation platform at truphone.com/connectit and use the following steps:

1. On the **Business** page, click **Start activation** button under **IoT SIM Activation**.

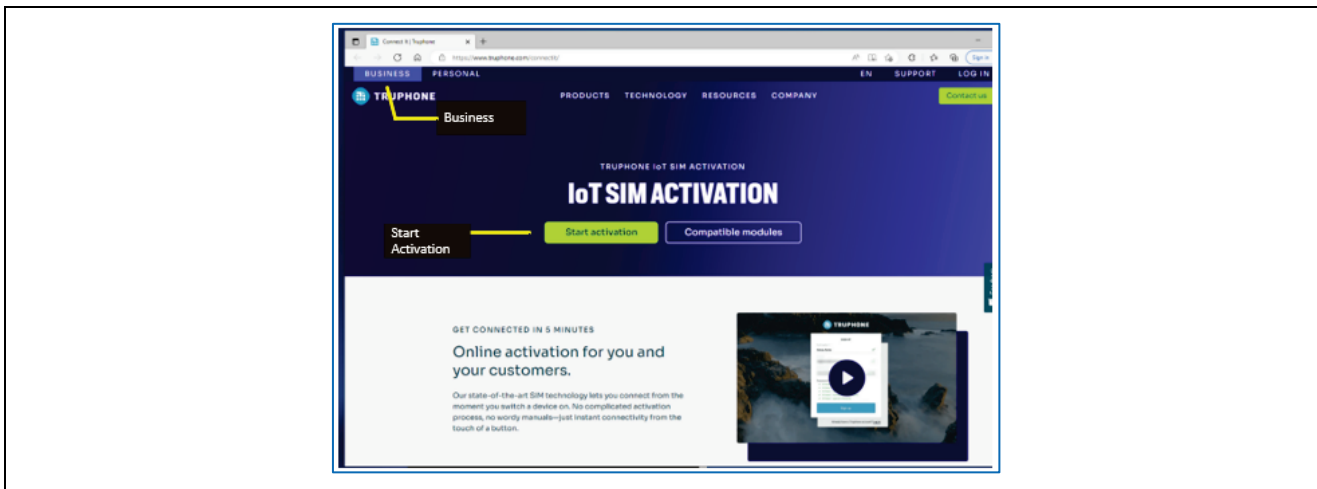


Figure 12. Activating the SIM Card

2. Create a new Truphone Account by selecting **Sign up** (next to **Don't have an account yet?**) and Fill-in your Full name, Email, and a Password. Then click **Sign up** to create a new account.
3. Select **Personal** as the account type.
4. Select **Get Started**.
5. Verify your email by entering the activation code sent to your email account.
6. Complete the **Profile information** form – then select **Create account**.
7. Select **Activate SIMS** to activate your individual SIM by **ICCID**.
8. Enter the **ICCID** value obtained from the **Running the RYZ024A PMOD example project** section. See the **ICCID** value in Figure 10, RYZ024A PMOD Information. Fill other fields as needed.
9. You will receive email confirmation when the SIM card activation is complete.
10. Insert the SIM card in the RYZ024A PMOD. Follow **Running the RYZ024A PMOD example project** section step 8 by using **Menu 3 Validate SIM activation** to verify that the SIM card is activated. The SIM card should be activated on the Truphone SIM Activation platform after 15 minutes and can be validated on the Tera Term terminal as shown in Figure 11. The time for the SIM card to be activated by Truphone can vary depending on their system demand. In most cases, if PING Response fails, wait a few more minutes and repeat **Menu 3 Validate SIM activation**.

Disclaimer

The activation steps above are provided by SIM Provider Truphone. They are the most current at the time of publishing this application note. If you need help activating your SIM Card, contact Truphone support iot.truphone.com or [Contact Support | Truphone](#).

If you have a SIM card from any other provider then contact the technical support for that provider.

For any other issue that cannot be resolved please Contact Renesas Support at [Technical Support](#).

Note: The SIM card provider for the Quick Start Guide example project is Truphone. If you use any other SIM card provider, you must change the Access Point Name required for the SIM card provider in your global region. Failure to do so could result in the RYZ024A not connecting to the Cellular network.

To set the Access Point Name (APN) for SIM Card provider other than Truphone see `#define CELLULAR_CFG_AP_NAME` in project file `/src/uart_CATM.h`

```
// the default Access Point Name
#define TRUPHONE_SIM_APN // Truphone uses APN = iot.truphone.com
```

7. Troubleshooting

This section includes a common set of issues and how to resolve them. The two types of issues that you may encounter are due to the hardware setup or SIM activation. The steps that follow will help to resolve those types of issues. For any other issue that cannot be resolved please contact Renesas Support at [Technical Support](#).

7.1 Hardware Setup

A first step for any general issue is to verify that the proper connections are made. For example, Executing Menu 2 **CAT-M Information** results in `** RYZ024A init FAILED **`. Refer to Figure 4.

- The RYZ024A PMOD board is plugged into PMOD2 port (J25).
- The RYZ024A PMOD antenna cable is plugged into connector (CN3) RYZ024A PMOD board.
- A micro USB cable is plugged into the USB Full Speed port, connector (J11) and PC.
- The 2nd micro USB cable is plugged into the RYZ024A PMOD connector (CN4) and PC.
- Check to see that the SIM card is fully inserted in the SIM slot (on the underside of the RYZ024A PMOD module). Check for proper SIM card orientation in the slot.

7.2 Power Problem

- If no LEDs illuminate when the USB cable is connected to the PC, power may not be applied. In that case:
 - Check that J12 is set to link pins 2-3.
 - Check that J15 is linked (pins 1-2).

7.3 SIM Card Activation Problem

- If the SIM activation fails, verify that the ICCID number and PUK numbers are correctly entered when activating the SIM Card on Truphone IoT SIM Activation platform truphone.com/connectit.
- If **Menu 3 Validate SIM activation** PING response returns a Ping Failed condition, it can take up to 15 minutes or longer for the card to be activated after performing **Activating the SIM Card** to obtain LTE Network access. In this case, wait at least 15 minutes (or longer) and repeat **Menu 3 Validate SIM activation**.
- SIM cards cannot be activated more than once. To verify whether the SIM card has already been activated, please monitor and manage your SIMs on the Truphone IoT Connectivity Management Platform or contact Truphone support through iot.truphone.com by logging into your account.
- If **Menu 3 Validate SIM activation** PING response continues to return Ping Failed condition, first check the external antenna is connected securely to the RYZ024A PMOD and try again. The CESQ Network Signal Quality (RSSI) could be too low to connect. If the RSSI is 99 then check that the external antenna is connected or no Cell Network Signal could be detected in your area. An RSSI reading with RSSI = 15 or less indicates marginal or poor reception.

+CESQ: 99,99,255,255,15,40 : in this example, RSSI = 15 which is the 5th argument returned.

It may be necessary to move the EK-RA6M5 with PMOD to a different location to improve the Network Signal Quality (RSSI) to get an RSSI value in the range of 16 to 98.

- If **Menu 3 Validate SIM activation** continues to fail, verify that the APN is set for the Global Region where the RYZ024A PMOD is trying to connect. The APN setting and LTE Band List depends on your Global Region and the SIM Card Provider.

To set the Access Point Name (APN) for SIM Card provider other than Truphone
The APN is set in the example project in `/src/uart_CATM.h`
see `#define CELLULAR_CFG_AP_NAME`

```
// the default Access Point Name  
#define TRUPHONE_SIM_APN // Truphone uses APN = iot.truphone.com
```

- For all other SIM Card issues that cannot be resolved with these troubleshooting steps, contact Truphone support through iot.truphone.com by logging into your account.

7.4 Illegible/No Terminal Output (Tera Term)

This could be caused by the setup of the serial terminal connection. To fix this, use the following instructions:

- Please make sure the following settings in the setup of the serial connection are set as follows:
 - Speed: 115200
 - Data: 8 bit
 - Parity: None
 - Stop bits: 1 bit
 - Flow Control: None

7.5 Unable to Read RYZ024A Board Information

If there is a failure to read the RYZ024A PMOD board and SIM information (IMEI and ICCID), check to confirm the following:

- SIM card is fully inserted in the SIM card slot on the underside of the RYZ024A PMOD board.
- RYZ024A PMOD board is plugged into the PMOD2 port (J25) of the EK-RA6M5 board.
- A micro USB cable is plugged into the RYZ024A PMOD connector (CN4) and PC.

7.6 Contact Renesas Support

For Evaluation Kit and RYZ024A PMOD related issues that cannot be resolved with these troubleshooting steps, please contact Renesas Support at renesas.com/support for more help.

8. Next Steps

- RYZ024A PMOD Module
renesas.com/RTKYZ024A0B00000BE
- RYZ024A Module
renesas.com/RYZ024A
- RA6M5
[RA6M5 200MHz Arm Cortex M33 TrustZone](https://renesas.com/RA6M5-200MHz-Arm-Cortex-M33-TrustZone)

To learn how to create a new e² studio project from scratch, refer to *Chapter 2 Starting Development* in the FSP User Manual (renesas.com/ra/fsp). To learn how to use e² studio, refer to the User Manual provided on the e² studio webpage (renesas.com/software-tool/e-studio).

9. Website and Support

Visit the following URLs to learn about the kit and the RA family of microcontrollers, download tools and documentation, and get support.

EK-RA6M5 Resources	renesas.com/ra/ek-ra6m5
RA Kit Information	renesas.com/ra/kits
RA Product Information	renesas.com/ra
RA Product Support Forum	community.renesas.com/mcu-mpu/ra/
RA Videos	renesas.com/ra/videos
RA Kit Feedback and Feature Request	renesas.com/ra/kitfeedback
Renesas Support	renesas.com/support

Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Feb.22.23	—	Initial release
1.01	Jan.22.24	-	Updated to FSP v5.0.0

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Renesas aims to provide the best microcontroller kit experience to help jumpstart customer innovation with RA family of microcontrollers and take products to market faster. The Renesas RA microcontroller kits have been designed with a lot of attention-to-detail and customer-centric thinking at every aspect of design. Renesas aims to exceed customer expectations.

Renesas looks forward to hearing your feedback and knowing how we can enhance your experience. Please share your feedback at renesas.com/ra/kitfeedback.

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