

OptConnect ema™

Getting Started

V1.1 Update September 2019



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1. Introduction

1.1 Scope

This document serves as a guide on how to get started using the OptConnect ema™ cellular modem. For demonstration purposes, OptConnect's ema:Play Evaluation Kit will be used as the host system throughout this document. Furthermore, it is assumed that ema:Play's on-board MCU (U16) firmware has not been modified and is executing code that was shipped with the unit; *GettingStartedWithemaV1.0.zip*

Included in this document are instructions for driver installation on Windows operating systems and AT commands for basic device configuration and setup.

It is recommended that all OptConnect ema™ users familiarize themselves with the material contained in this document before continuing on to other application notes.

1.2 Contact Information

For more information regarding OptConnect ema™ contact OptConnect Sales at 1.877.678.3343 ext. 2020 during normal business hours. For technical support contact OptConnect Customer Care Center at 1.877.678-3343 ext. 2021 from 8 am till 9 pm MST Monday through Saturday.

1.3 Orderable Part Numbers

Orderable Device	Modem Firmware Revision	Operating Temperature	LTE Bands	3G UMTS	Network	Region
EMA-L4-1-XX-A-A	20.00.005	-40 to +85°C	FDD B2, B4, B5, B12, B13	B2, B5	AT&T, Verizon	North America
EMA-L4-1-US-B-A	20.00.005	-40 to +85°C	FDD B2, B4, B5, B12, B13	B2, B5	AT&T, Verizon	United States

Unless instructed otherwise EMA-L4-1-XX-A-A will utilize AT&T as the primary carrier and Verizon as the secondary carrier. Unless instructed otherwise, EMA-L4-1-US-B-A will utilize Verizon as the primary carrier and AT&T as the secondary carrier.

Orderable Device	Description	Operating Temperature	Region
EMA-ZZ-1-XX-Z-B	ema:Play Evaluation Kit, OptConnect ema™ evaluation platform	-40 to +85°C	North America
EMA-L4-1-XX-A-B	ema:Play Evaluation Kit, OptConnect ema™ evaluation platform, EMA-L4-1-XX-A-A ema modem included	-40 to +85°C	North America
EMA-L4-1-US-B-B	ema:Play Evaluation Kit, OptConnect ema™ evaluation platform, ema EMA-L4-1-US-B-A ema modem included	-40 to +85°C	United States

1.4 Additional Resources

OptConnect ema™ is supported by a full range of documentation; including User Guides and Application Notes as well as an ema:Play User Guide and related code samples. The latest versions of these resources can be found at <http://optconnect.com/ema> . Suggested prerequisites for this document are the following:

- OptConnect ema™ Hardware Guide
- OptConnect ema™ Management UART AT Command Manual
- ema:Play User Guide

2. ema:Play Setup

2.1 Overview

This section describes how to properly install ema into ema:Play and overall evaluation kit setup. It is critical to follow the steps detailed in this section to avoid potential damage to ema and/or ema:Play as a result of improper installation.

2.2 Unpack ema:Play

Carefully unpack ema:Play from its box. The contents of the kit should include the following as shown in *Figure 1*:

1. ema:Play Evaluation Kit with/without ema installed (see section 1.3 for device p/n's)
2. OptConnect Gemini MIMO Antenna
3. 5VDC Power Supply
4. 2 x USB cables

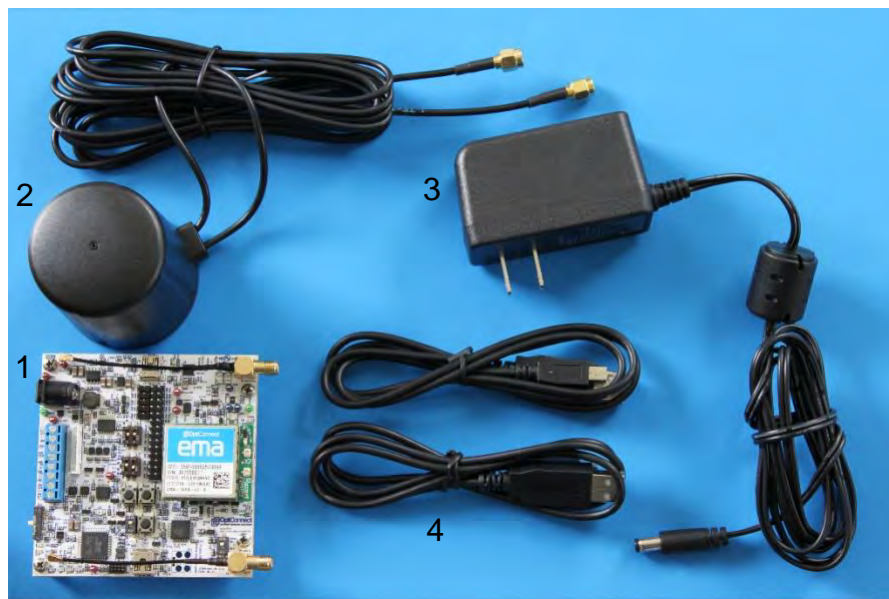


Figure 1

2.3 Insert ema Into ema:Play

If ema:Play includes an ema (see section 1.3 for device p/n's), this section can be skipped.



To avoid damage to ema and/or ema:Play, take precautions to correctly insert ema into the modem socket. Double check pin alignment before applying power.

Follow this procedure to correctly insert ema into ema:Play.

1. Orient ema so that it's label is lined up with the ema logo that is printed on the ema:Play PCB as shown below in *Figure 2*.
2. Firmly press ema into the socket as shown in *Figure 3*.

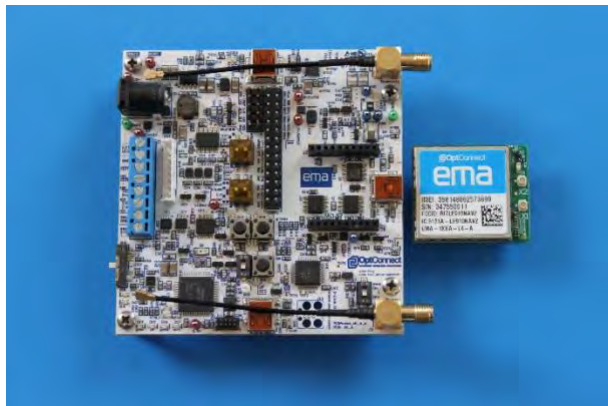


Figure 2

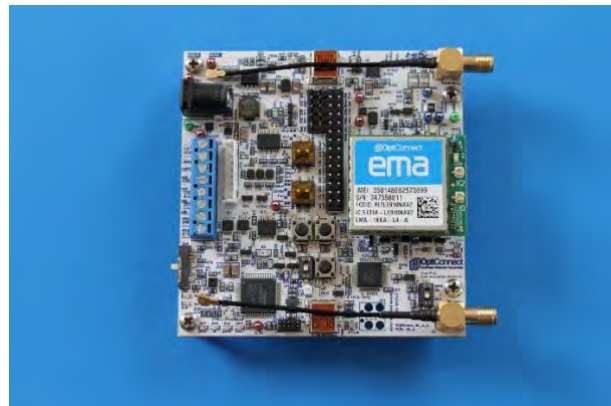


Figure 3

2.4 Attach Antenna(s)

ema:Play includes two SMA to U.FL adaptors located at J3 and J12. These accommodate both a primary antenna and a diversity antenna. The U.FL ends of these adaptors connects to ema's X1 and X2 connectors. The SMA ends of these adaptors connect to the OptConnect Gemini antenna cables or other antennas. If ema:Play includes an ema (see section 1.3 for device p/n's), then the adaptors(J3, J12) should already be connected to ema as shown in *Figure 4*.



Figure 4

Follow this procedure to correctly connect the adaptor's U.FL end to ema if required:

1. Insert ema into ema:Play as shown in section 2.3.
2. Carefully bend the adaptor cables into position over ema's antenna connectors (X1, X2) as shown in *Figure 4* above.
3. With extreme care, press the U.FL ends of the adaptor cables onto ema's antenna connectors (X1, X2). When correctly connected, there should be a subtle click/snap.
4. Confirm the connection by holding the adaptor cable close to ema's antenna connectors (X1, X2) and gently rotating the adaptor cable back and forth while it is connected to ema. It should rotate freely in a flat planar fashion.

Follow this procedure to correctly connect the OptConnect Gemini antenna to ema:Play:

1. On the Gemini antenna, locate the cable labeled "LTE-1". Finger tighten this cable onto ema:Play at connector J3, labeled "Primary" as shown in *Figure 5*.
2. The other cable is labeled "LTE-2", and should be finger tightened onto ema:Play at connector J12 labeled "Diversity" as shown in *Figure 5*.

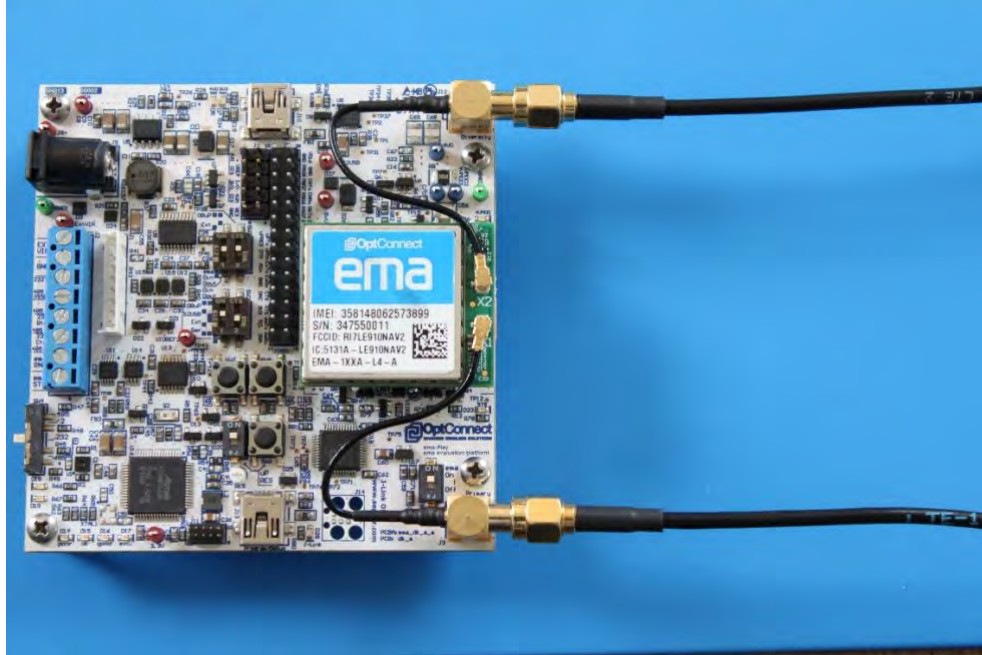


Figure 5

2.5 Apply Power to ema:Play

1. Apply power to ema:Play and ema by plugging in the provided power supply at connector J9 as shown in Figure 6. Confirm the following conditions can be observed:
 - Green power LEDs ON; 4V0, 3V3, 4VMOD
 - Blue LED is flashing; D14

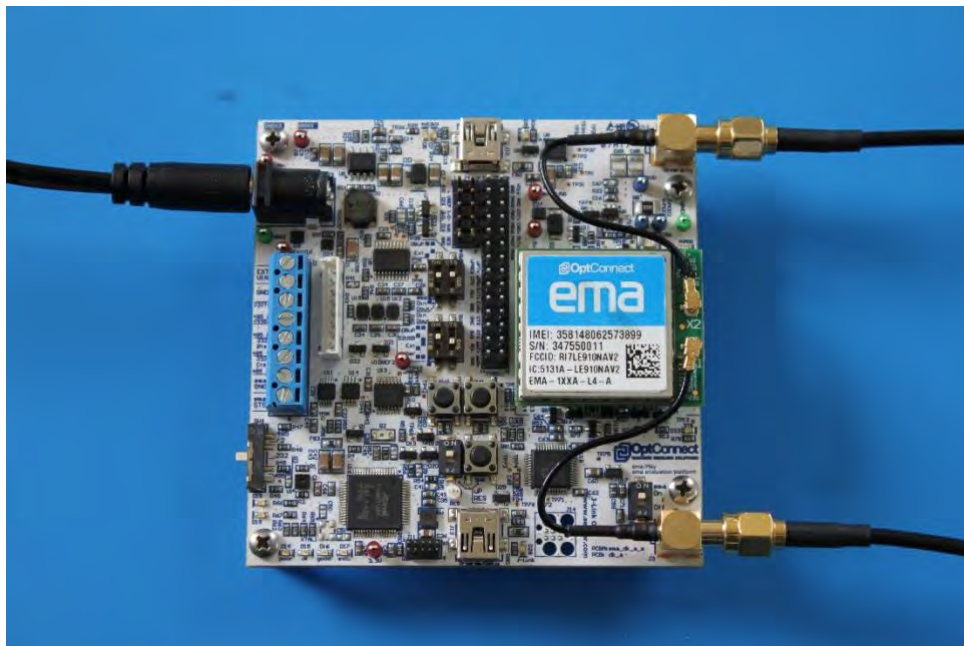


Figure 6

2. Turn ema ON by moving SW1 to the ON position as shown in *Figure 7*. Confirm the following conditions exist within 15 seconds:
 - Amber Status LED ON; STS
 - Green ema status LED; Blinking, 1 second on, 2 seconds off

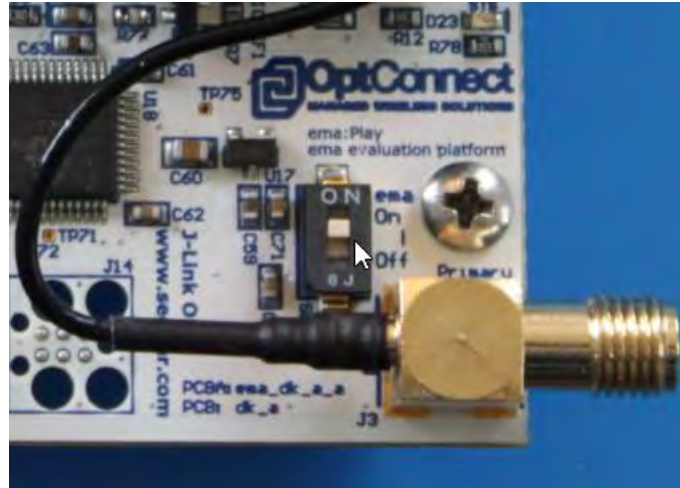


Figure 7

3. ema Modem UART Test

3.1 Overview

Section 3 describes how to properly configure and test ema communications using ema:Play's built in dual Serial to USB (S2USB) port to access the ema modem UART interface using a standard USB port on any Windows computer. This will allow the user to send and receive AT commands to ema's cellular module. The S2USB port will enumerate as two unique Virtual COM ports on the computer.

3.2 Configure ema:Play for S2USB

1. Continuing from section 2.5, confirm that ema:Play and ema are powered ON.
2. Hold ema:Play's on-board MCU (U16) in RESET by moving SW5 to the ON position as shown in *Figure 8*.

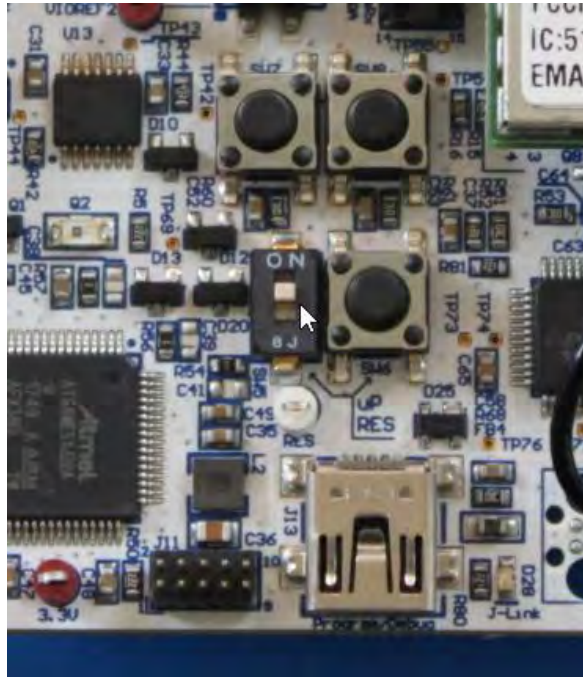


Figure 8

3. Direct ema's modem UART signals (DIN/DOU) to the S2USB port using dip switch SW2, by setting it to the S2USB mode as shown in Figure 9.

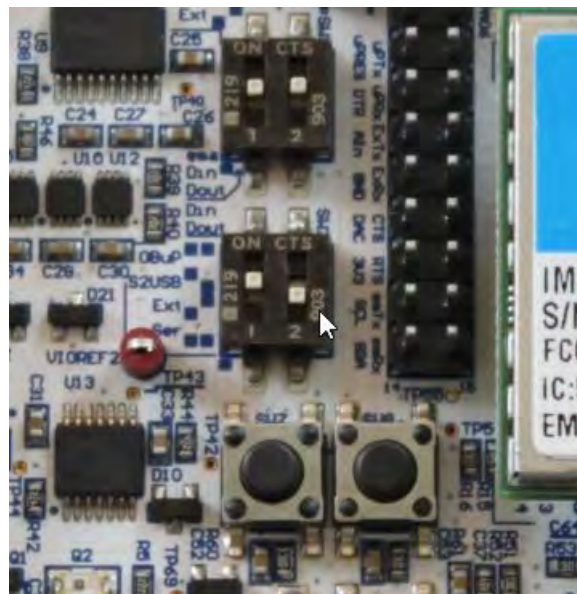


Figure 9

3.3 Configure the S2USB Driver

Before ema:Play's S2USB port can be used with a Windows computer, the computer must have the proper drivers installed.

1. Continuing from section 3.2, plug one end of the provided USB cable into a computer and the other end into the S2USB port at J10 on ema:Play.
 - The S2USB LED should turn ON and ema:Play should enumerate with the computer as two unique COM ports.
 - Confirm driver installation by checking Windows Device Manager. The driver should be listed as shown in *Figure 10*, or similar.

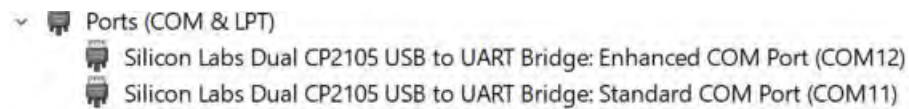


Figure 10

- If the driver is not listed as shown, visit this website to download the drivers: <https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers>

3.4 ema Modem Configuration and Test

The next step is to use AT commands to configure ema using the ema Modem UART via the ema:Play S2USB port and a terminal emulator program. This section details a few useful AT commands, and how to troubleshoot error conditions.

1. Install a terminal emulator Program for Windows, such as Tera Term. It can be downloaded here: <https://ttssh2.osdn.jp/index.html.en>
2. After installing Tera Term, run it. The startup window will look similar to *Figure 11*.

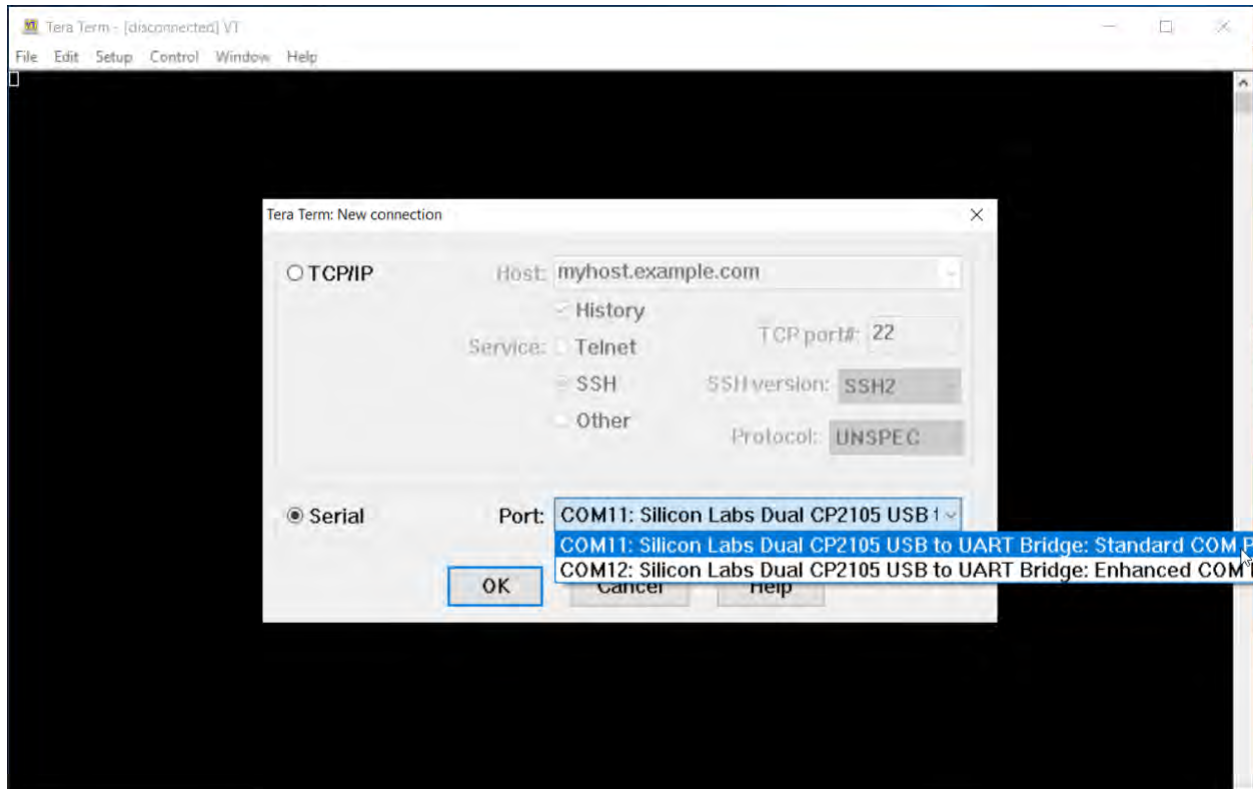


Figure 11

3. Select the "Serial" radio button and using the drop-down menu labeled "Port", select the COM port that corresponds to ema's Modem UART interface. It should be labeled as "Silicon Labs Dual CP2105 USB to UART Bridge: Standard COM PORT" in the menu. Then, click on the "OK" button to open the connection.

Note: The COM port assigned to the ema modem UART will vary from computer to computer, and will not necessarily be COM11, as in the example. The Windows Device Manager can be explored to identify the correct COM port.
4. Configure the Connection Properties. Click on the "Setup" drop down in the menu bar at the top of the Tera Term window, and then select "Serial port...". Configure the settings in the dialogue that opens according to *Figure 12*. Do not change the "Port" setting, as this is already configured properly.

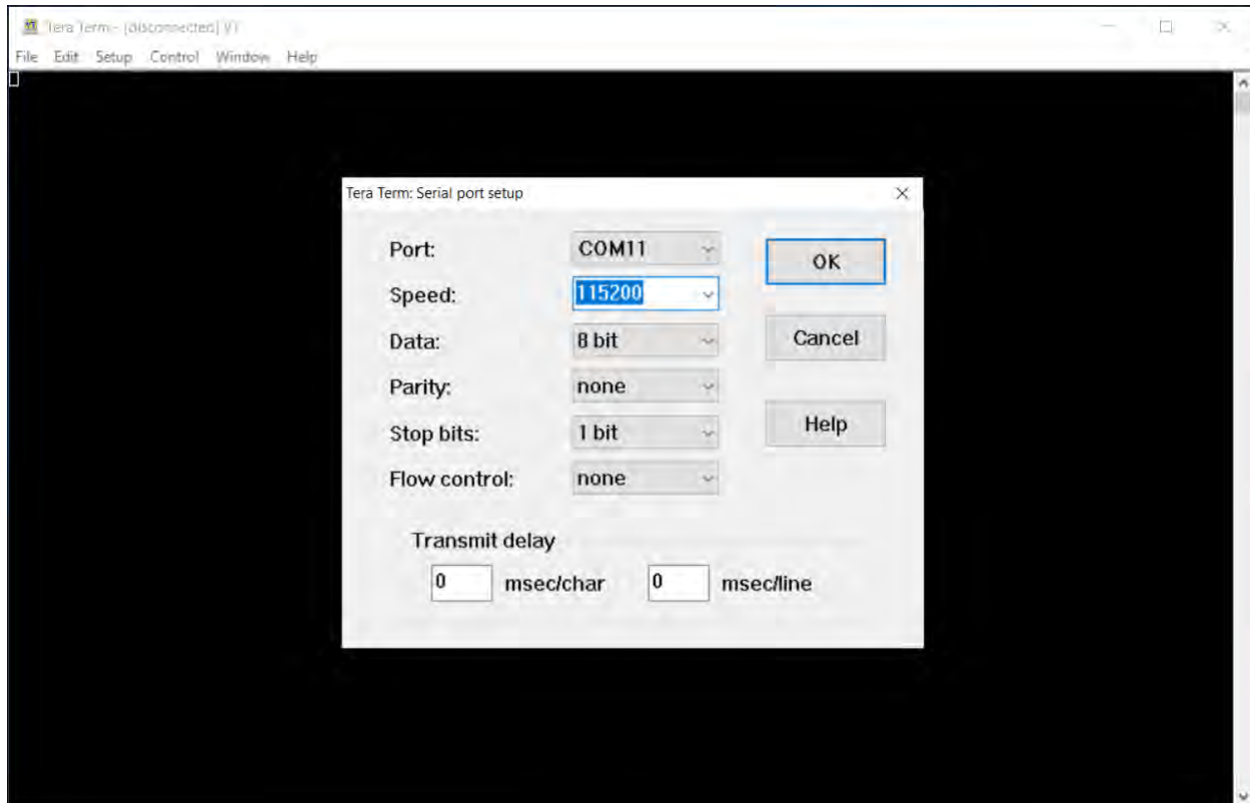


Figure 12

After choosing the configuration settings, Tera Term is now ready for use. However, the configuration settings will not persist after Tera Term is closed.

To save the configuration settings, simply click on "Setup", and then select the "Save setup..." option. This will open a dialogue box that will ask for the path at which to save the configuration file. Configure this path in any way, and then hit the "Save" button.

5. Verify Serial Connectivity. To ensure that the serial connection is established and functioning, issue the following command to ema via the terminal emulator:

AT

ema should respond with:

OK

If ema responds to the above command as described, then the serial connection has been properly established.

6. Verify cellular signal quality. To verify that ema is receiving an acceptable cellular signal, issue the following command:

AT+CESQ

ema will respond in the following format:

+CESQ: aa,bb,ccc,ddd,xx,yy

The important parameters are the last two. **xx** is the Reference Signal Received Quality (RSRQ) and **yy** is the Reference Signal Received Power (RSRP). Typical RSRQ and RSRP values are shown in *Figure 13* and *Figure 14*, respectively.

Values of xx	RSRQ
0	RSRQ < -19.5 dB
1	-19.5 dB ≤ RSRQ < -19 dB
2	-19 dB ≤ RSRQ < -18.5 dB
...	...
32	-4 dB ≤ RSRQ < -3.5 dB
33	-3.5 dB ≤ RSRQ < -3 dB
34	-3 dB ≤ RSRQ
255	Not known or detectable

Figure 13

Values of yy	RSRP
0	RSRP < -140 dBm
1	-140 dBm ≤ RSRP < -139 dBm
2	-139 dBm ≤ RSRP < -138 dBm
...	...
95	-46 dBm ≤ RSRP < -45 dBm
96	-45 dBm ≤ RSRP < -44 dBm
97	-44 dBm ≤ RSRP
255	Not known or not detectable

Figure 14

The following table (Figure 15) lists estimated signal qualities based on RSRQ and RSRP.

Values of xx	RSRQ	Values of yy	RSRP	Quality
0	RSRQ < -19.5 dB	0 – 40	RSRP < -100 dBm	Marginal
1 – 9	-19.5 dB ≤ RSRQ < -15 dB	41 – 50	-100 dBm ≤ RSRP < -90 dBm	Fair
10 – 19	-15 dB ≤ RSRQ < -10 dB	51 – 59	-90 dBm ≤ RSRP < -80 dBm	Good
20 – 34	≥ -10 dB	60 – 97	≥ -80 dBm	Excellent

Figure 15

If ema responds with **+CESQ: aa,bb,ccc,ddd,255,255** then there is likely a problem with the antenna connection. Please refer to section 4 for troubleshooting information.

3.5 Packet Data Protocol (PDP) Test

1. **PDP Configuration:** ema will automatically determine and configure the proper PDP context based on the inserted SIM card(s). As such, no further action is required on the part of the user insofar as PDP context configuration is concerned.

Note: ema will configure the PDP context during the boot-up process. Therefore, the PDP context will be ready for use as soon as the AT command interface becomes responsive.

2. **Activate the PDP Context:** Before activating the PDP context, it is important to consider the primary cellular carrier being used for the data connection. AT&T users must activate the first PDP context for data connections, while Verizon users must activate the sixth PDP context.

Be sure to only activate the context number that corresponds to the carrier of the primary SIM card installed in ema.

To activate the PDP context, and establish the network connection, issue the following command:

AT#SGACT=<cid>,1

Where **<cid>** is replaced with **"1"** for AT&T users, and **"6"** for Verizon Users.

ema should respond with the following:

#SGACT: <ip_addr>

Where **<ip_addr>** is replaced with the IP address that ema was assigned by the network.

3. **Disconnecting from the network:** To disconnect from the network, issue the following command:

AT#SGACT=<cid>,0

Where **<cid>** is replaced with **"1"** for AT&T users, and **"6"** for Verizon Users.

Issuing this command will cease any ongoing data connections, and gracefully detach ema from the network.

4. Troubleshooting

4.1 Overview

This section contains troubleshooting information for various errors and difficulties that may occur when setting up ema.

1. **Enabling Verbose Error Reporting.** It is often helpful to enable verbose error reporting after encountering an **"ERROR"** response code for an AT command. A higher level of verbosity will add more detail to the error response code, and can aid in the troubleshooting process.

To enable verbose error reporting, issue the following command:

AT+CMEE=2

For instance, consider an example in which a user instructs ema to activate a PDP context that has already been activated.

Assuming the highest level of error reporting verbosity was enabled, ema would respond with

+CME "ERROR: context already activated"

instead of just

"ERROR"

In this case, the extra information contained in the error response code would help the user determine the exact cause of the problem they were experiencing.

2. **Signal Quality and Antenna Troubleshooting.** If the response to:

AT+CESQ

is:

+CESQ: aa,bb,ccc,ddd,255,255

It is likely that the antenna is not properly connected to either ema at X1/X2 or ema:Play at J3/J12. Check all connections along the antenna path. In this case, check the antenna connections, and retry:

AT+CESQ

5. What's Next?

Now that the user has experienced how to exchange AT commands with the OptConnect ema™ modem and it has been properly set up and connected to the network, it is ready to be used for product development.

OptConnect offers several application notes that demonstrate how to use essential ema features and capabilities. These application notes are available at the following link: <http://optconnect.com/ema> .

6. Revision History

Revision	Date	Description	Author
1.0	6/3/2019	Initial Release	MSV
1.1	9/9/2019	Updated Section 3.4. CSQ->CESQ and tables.	MSV