

OptConnect ema™

Getting Started

V1.2 Updated January 2020



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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 is executing the latest *GettingStartedWithemaVx.x* demonstration project. The latest version of this project is available at <http://optconnect.com/emaPlay> . For instructions on how to update ema:Play’s on-board MCU (U16) firmware, reference the *OptConnect ema™ ema:Play User Guide*, section 4.1.3 .

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™ emaLink AT Command Manual
- ema:Play User Guide

1.5 Activation

If ema is not activated/registered upon receipt, please visit <https://summit.optconnect.com/ema> to activate/register ema.

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. ema:Play ships with the *Getting Started with ema* demonstration project and its hardware is pre-configured to run this project.

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

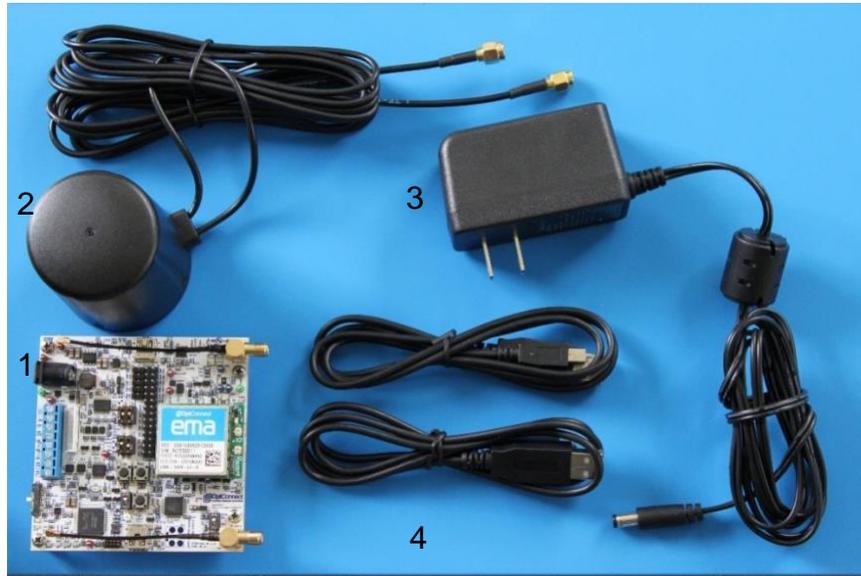


Figure 1

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 aligned 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.

Note: If the antenna adaptor cables are to be removed, it is highly recommended to use an antenna removal tool to avoid damaging the antenna connectors. Sample tool p/n: [Hirose U.FL-LP-N-2](#)

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*. The following conditions can be observed and validate that the demonstration project is successfully running:
 - Green ema:Play power LEDs ON; 4V0, 3V3
 - Blue ema:Play LEDs signal array is scrolling; D14-D17

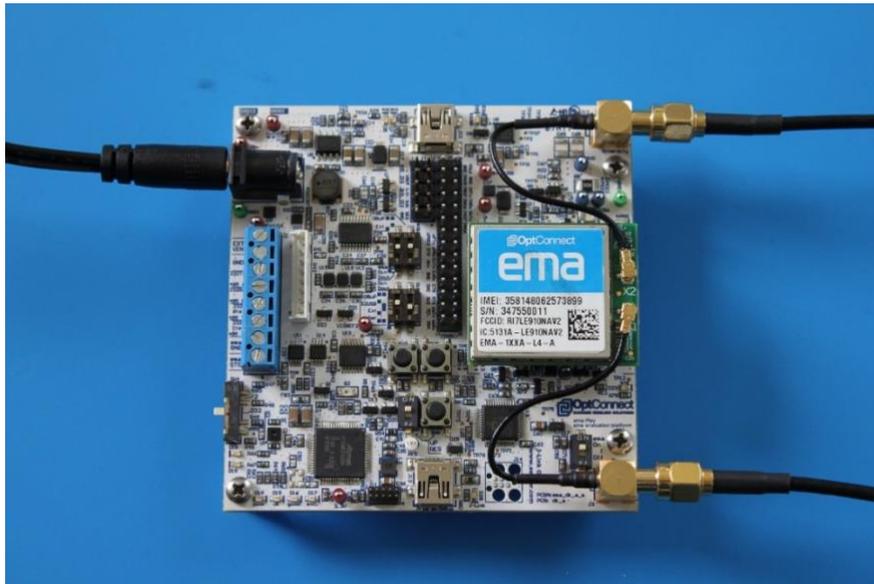


Figure 6

2. Press and hold button SW7 (shown in *Figure 7*) for about 2 seconds or until the LED signal array changes to D14 blinking. The following conditions can be observed and validate that ema is connected and communicating on the cellular network. Allow up to 30 seconds for these conditions to occur.
 - Amber ema:Play status LED ON; STS
 - Green ema status LED ON; D1

- Green ema:Play ema power LED ON; 4VMOD
- Blue LEDs signal array showing current signal strength; D14-D17

| D14 – D17 LED State | Description |
|-------------------------|---|
| Scrolling left to right | Idle, waiting for user input (hold SW7 for 2 seconds) |
| D14 Flashing | Searching for cellular network and/or acquiring signal bars |
| All Flashing | An error has occurred |
| 1 – 4 LEDs ON solid | Indicating current signal quality |

D14 – D17 LED State Reference Table

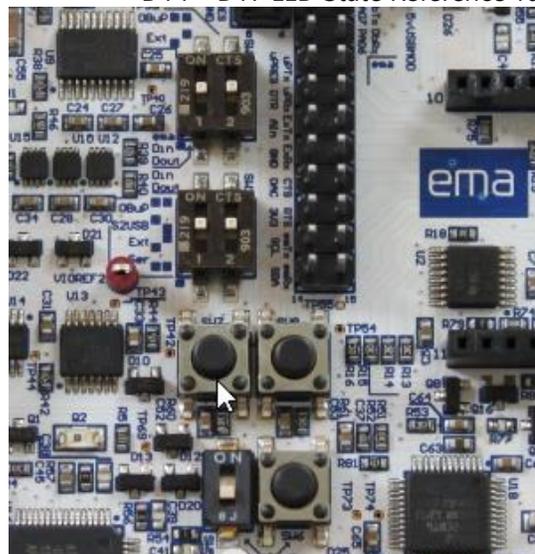


Figure 7

3. OptConnect Summit Portal

3.1 Overview

The OptConnect Summit portal is an online tool that allows users to manage and monitor their entire fleet of OptConnect cellular devices, and is included with the purchase of any OptConnect device. This section describes how to use the Summit portal for basic ema monitoring and management. This section assumes that the users' Summit account has been setup successfully, and the user can login to the Summit portal. For questions regarding Summit account creation and login credentials, refer to section 1.2.

3.2 Login and Find ema

1. Continuing from section 2.5, confirm that ema:Play and ema are powered ON.

- Navigate to <https://summit.optconnect.com/login> and login to the portal. The landing page should look similar to *Figure 8*. All of the OptConnect cellular devices associated with this account will be qualified by the categories shown.

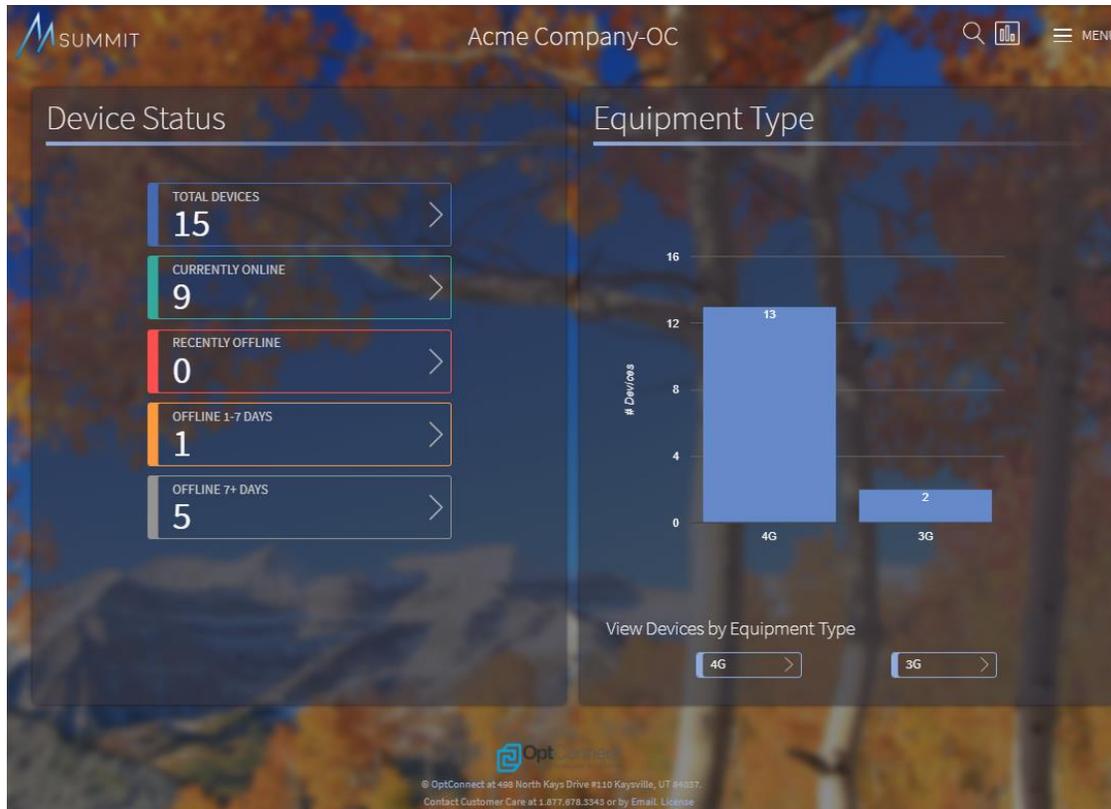


Figure 8

- Click the "CURRENTLY ONLINE" button. The view will switch and list all OptConnect cellular devices associated with this account that are currently online. Locate the ema in question by serial number. Click on the serial number to monitor ema as shown in *Figure 9*.

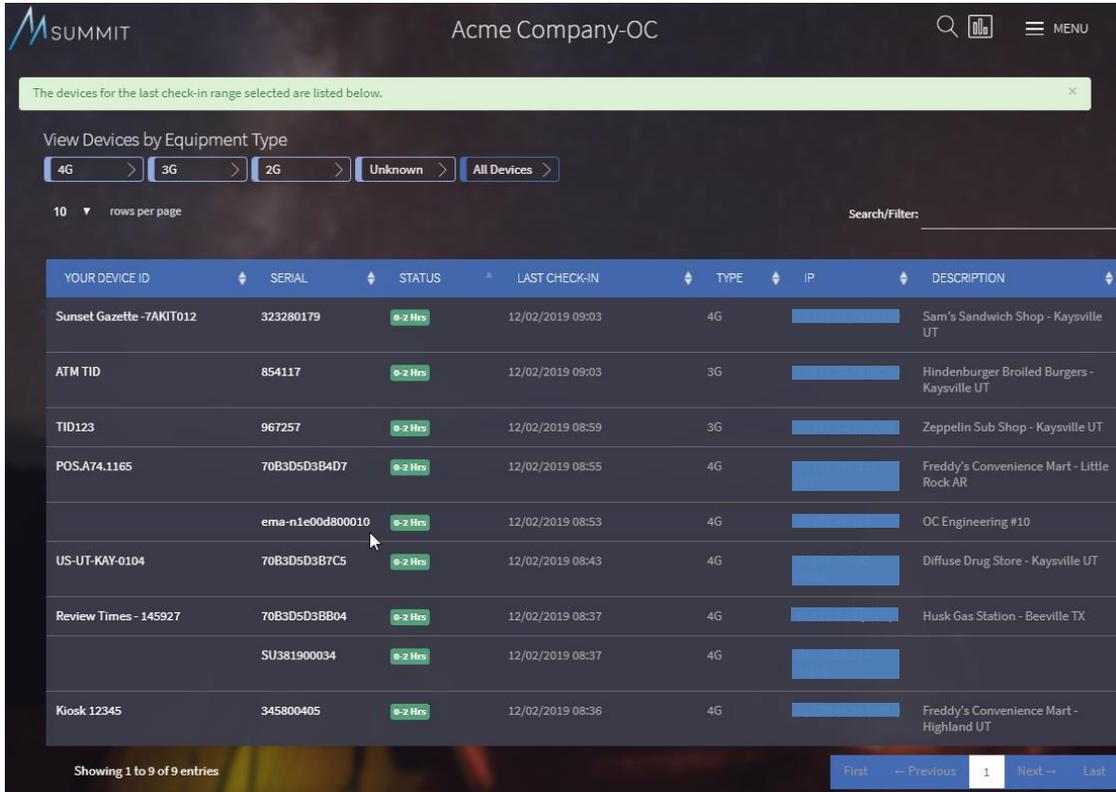


Figure 9

3.3 Device Attributes and Location

1. The "DEVICE ATTRIBUTES" section can be used to investigate ema's Board ID, IP address, Last check-in, etc. Certain fields (Device ID, and Description) can also be edited accordingly. Reference *Figure 10*.

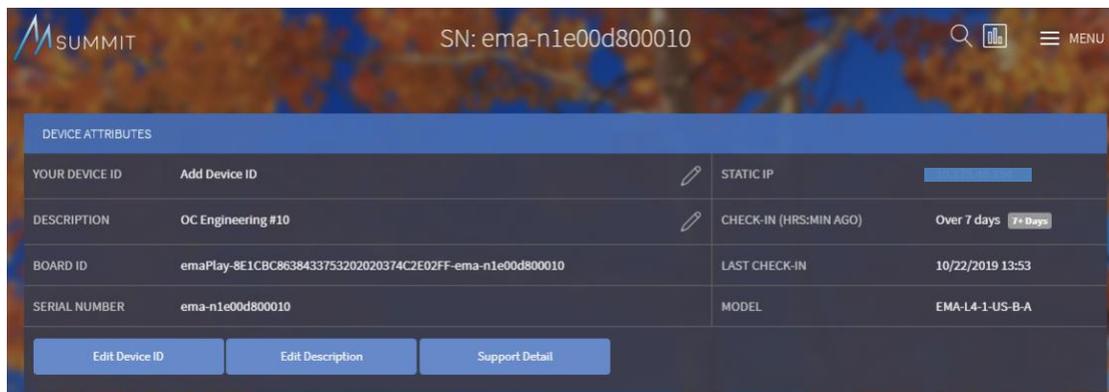


Figure 10

- The "APPROXIMATE DEVICE LOCATION" section can be used to view ema's location. Reference *Figure 11*.

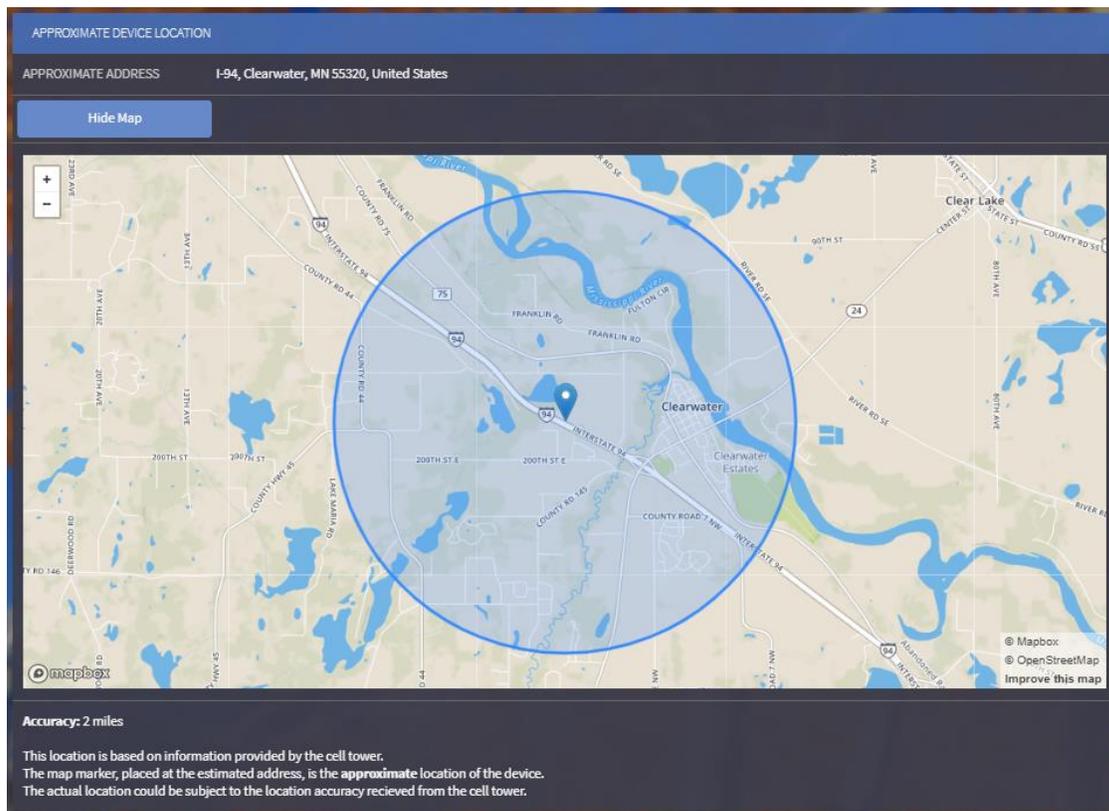


Figure 11

3.4 Events, Usage and Analytics

- The "EMA EVENTS" section can be used to closely monitor ema's behavior over time. Reference *Figure 12*.

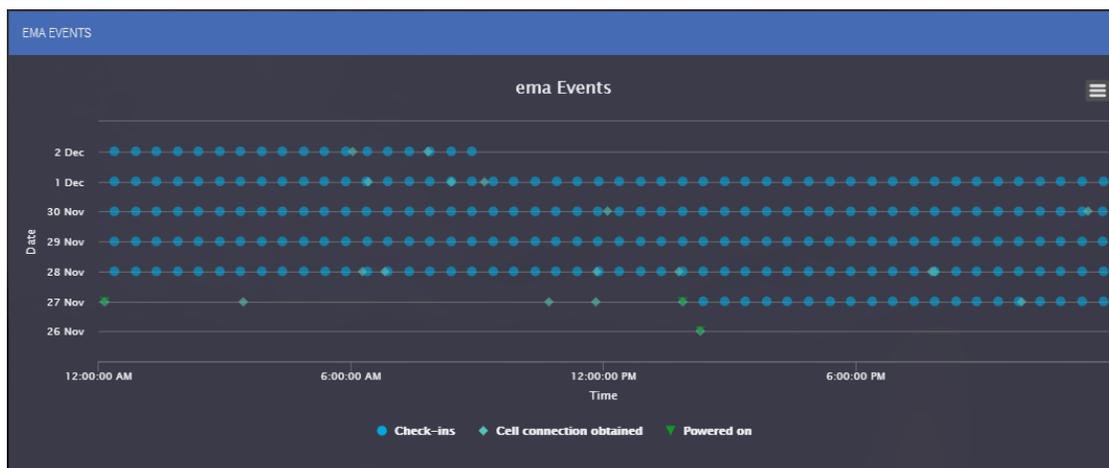


Figure 12

- The "DATA USAGE HISTORY" and "SIGNAL ANALYTICS" sections can be used to monitor ema's usage and signal data. Reference *Figure 13*.

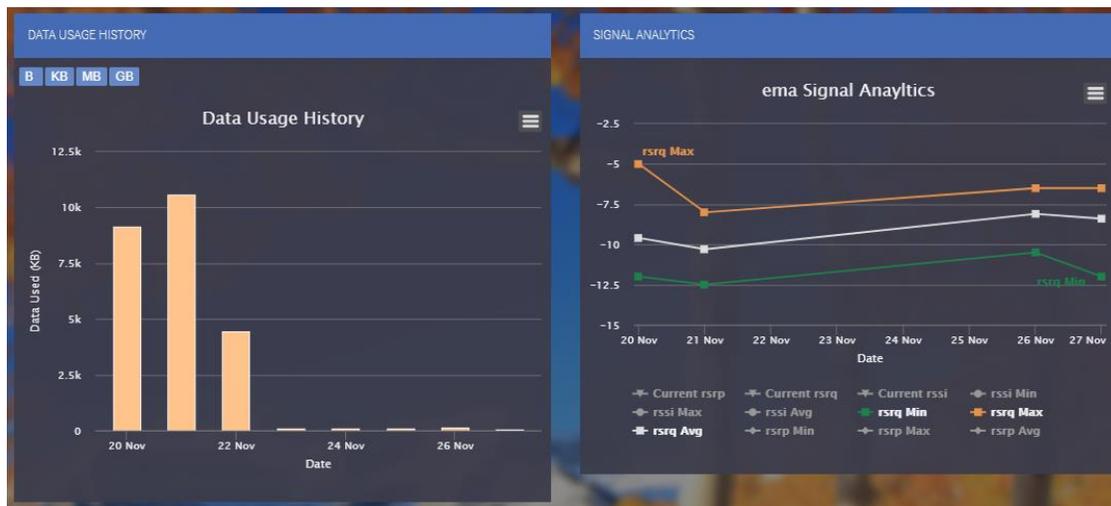


Figure 13

4. Banyan Hills Canopy™ IoT Platform

Every purchase of an OptConnect ema:Play Evaluation Kit includes a trial of Banyan Hills Canopy™ enterprise IoT platform. Its real-time dashboard, advanced features and configurable KPIs give you complete visibility into your network of data. Manage the overall health of your devices, address service issues before problems arise and delight customers with entirely new experiences. Canopy™ is coupled with Banyan Hills Leaf Agent, running on ema:Play's Demonstration project, and using ema as the internet connection. This allows for a simple device to cloud round trip relationship utilizing ema:Play's onboard sensors, digital inputs, and digital outputs. For more information and detailed usage examples, reference the *ema:Play User Guide*.

5. ema Modem UART Test

5.1 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.

5.2 Configure ema:Play for S2USB

- Continuing from section 2.5, confirm that ema:Play and ema are powered ON.
- Hold ema:Play's on-board MCU (U16) in RESET by moving SW5 to the ON position as shown in *Figure 14*.

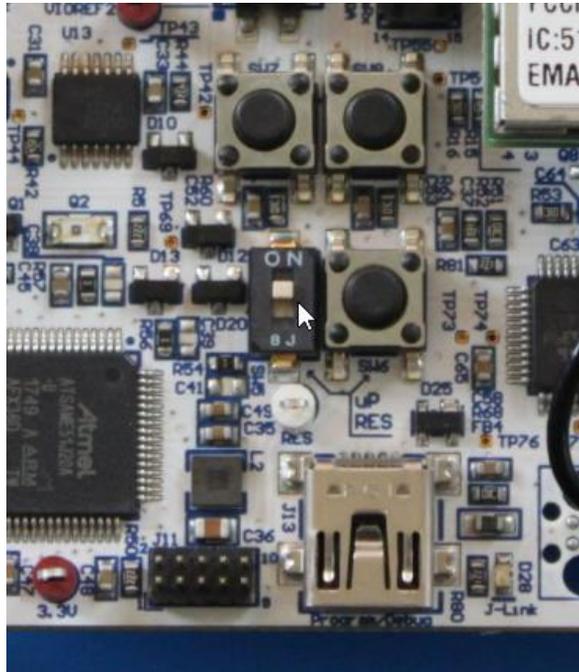


Figure 14

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 15.

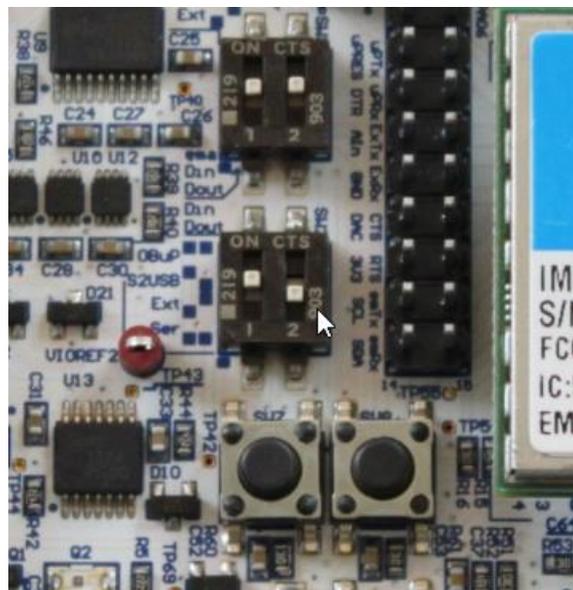


Figure 15

5.3 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 5.2, 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.

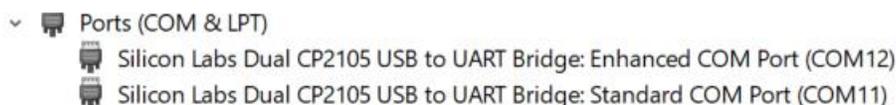


Figure 10

- 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>

5.4 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 16*.

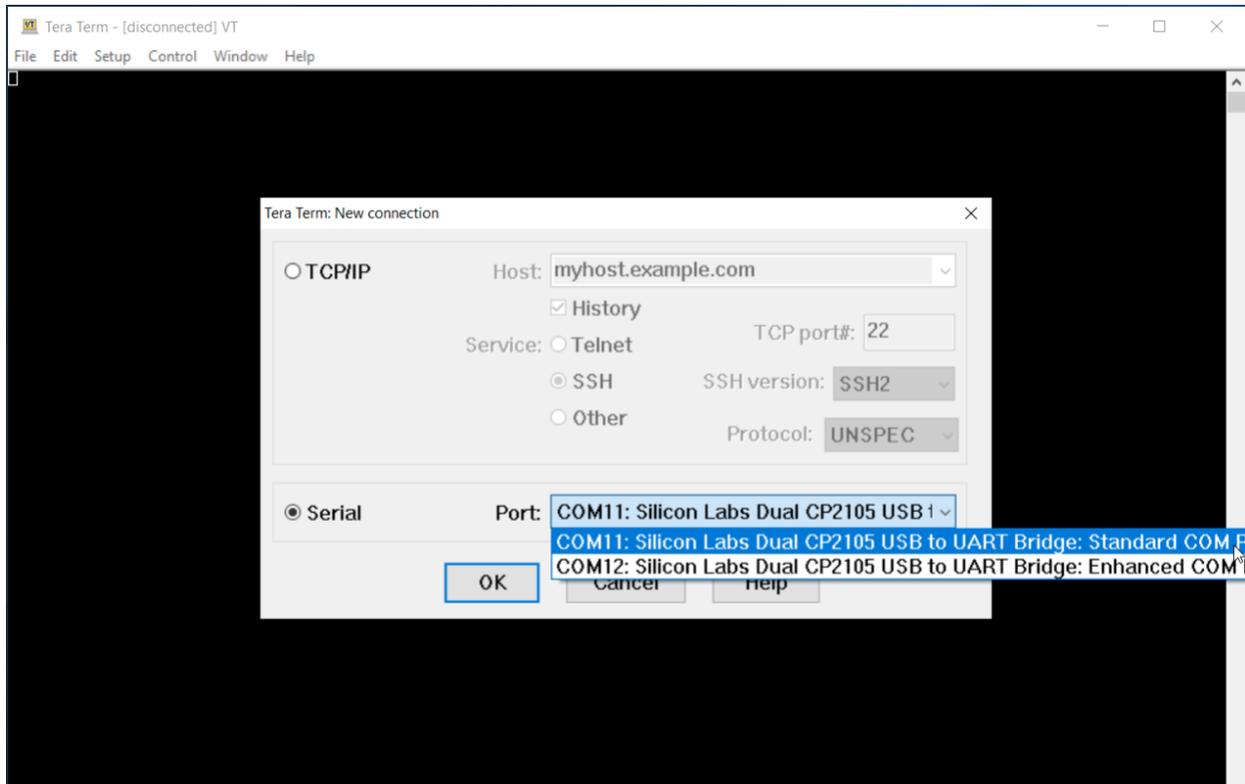


Figure 16

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 17*. Do not change the "Port" setting, as this is already configured properly.

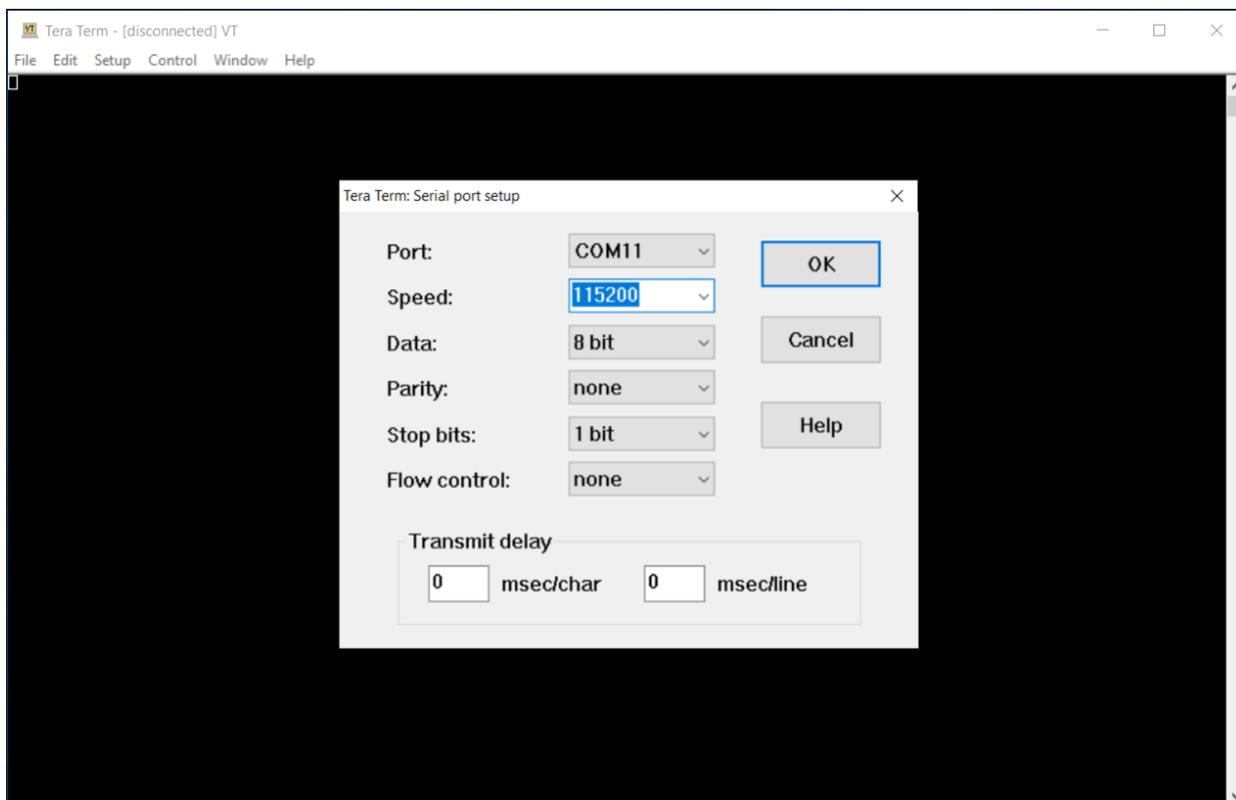


Figure 17

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 18* and *Figure 19*, 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 18

| 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 19

The following table (Figure 20) 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 20

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.

5.5 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.

6. Troubleshooting

6.1 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

7. 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> .

8. 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 |
| 1.2 | 5/11/2020 | Added Sections 1.5, 3, 4. Updated Section 2 per ema:Play demonstration project. | MSV |