



OriginIoT™ Application Kit

USER GUIDE

OriginGPS.com

TABLE OF CONTENTS

1.	General.....	1
1.1.	Introduction.....	1
1.2.	Purpose and Scope.....	1
2.	System Overview.....	2
2.1.	OriginIoT™ System Description	2
2.2.	OriginIoT™ Application Kit Description	2
3.	Getting Started.....	3
3.1.	OriginIoT™ Application Kit Contents	3
3.2.	Equipment Required to Set-Up	3
3.3.	Download the FTDI Driver	4
3.4.	Connecting the APK to a PC	4
4.	Connecting to a Server	9
4.1.	Mobile Network Parameters	9
4.2.	Editing Mobile-Network Parameters - GSM/LTE Authentication Command	11
5.	Ordering Information	13
5.1.	P/N 2: Application Kit	13
	Appendix A. Firmware Upload (Flashing)	21
	Appendix B. Sensor Configuration	26

LIST OF FIGURES

Figure 1. OriginIoT™ Application Kit Contents.....	3
Figure 2. VCP CP210X Driver	4
Figure 3. Connecting the Antennas and SIM Card	5
Figure 4. Connecting the OriginIoT™ Add-on.....	5
Figure 5. Connecting the Console Debug USB.....	6
Figure 6. Connecting the Expander Cable to the FTDI USB	6
Figure 7. Selecting the Serial Port in Tera Term	7
Figure 8. Serial Port Setup in Tera Term.....	7
Figure 9. Connection to the Debug Console	8
Figure 10. OriginIoT™ System Help List	8
Figure 11. OriginIoT™ System Configuration Example	9
Figure 12. Setting up the Network Configuration with the Debug Console.....	10
Figure 13. GSM Authentication Command – Output.....	11
Figure 14. Setting up Authentication Credentials.....	11
Figure 15. GSM Authentication Process	12
Figure 16. Firmware Upload	21
Figure 17. Connector Pins	22
Figure 18. STM32 ST-LINK Utility Window	23
Figure 19. Connecting with the STM32 ST-LINK Utility.....	24
Figure 20. Program and Verify in the STM32 ST-LINK Utility	24
Figure 21. Download Window	25
Figure 22. Successful Firmware Download Window	25

LIST OF TABLES

Table 1. Wireless Connection to Application Board	22
Table 2. Sensor Configuration	26

TABLE OF REVISIONS

Ver. #	Description	Author/s	Date
1.0	First Edition		May 26, 2020
1.1	Updated Table 2 in Appendix B		June 11, 2020
1.2	Added FDTI driver instructions for Windows and Mac operating systems		March 29, 2021
1.3	Updated APN command		June 16, 2021
1.4	Updated to include only APK-related info		May 17, 2023

ABBREVIATIONS

Abbreviation	Description
APN	Access Point Network
ADC	Analog-to-Digital Converter
APK	Application Kit
DHCP	Dynamic Host Configuration Protocol
ESD	Electronic Sensitive Device
FTDI	Future Technology Devices International
GNSS	Global Navigation Satellite System
GPIO	General-Purpose Input/Output
GSM	Global System for Mobile Communications
GUI	Graphical User Interface
I2C	Inter-Integrated Circuit
IMEI	International Mobile Equipment Identity
IMS	IP Multimedia Subsystem
IoT	Internet of Things
LTE	Long-Term Evolution – a standard for wireless broadband communication for mobile devices and data terminals
OriginIoT™ System	Cellular IoT system to accelerate IoT product development
OriginSmart™	Web-based GUI to configure and manage OriginIoT™ systems
RF	Radio Frequency
SMA	Subminiature version A (RF connector)
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver Transmitter
UID	Unique Identifier

RELATED DOCUMENTATION

#	Document Name
1	OriginIoT™ System Datasheet
2	OriginIoT™ System Web API
3	OriginSmart Web Specification

SCOPE

This document describes the features and specifications of the OriginIoT™ Application Kit.

DISCLAIMER

All trademarks are properties of their respective owners.

Performance characteristics listed in this document do not constitute a warranty or guarantee of product performance. OriginGPS assumes no liability or responsibility for any claims or damages arising out of the use of this document, or from the use of integrated circuits based on this document. OriginGPS assumes no liability or responsibility for unintentional inaccuracies or omissions in this document. OriginGPS reserves the right to make changes in its products, specifications, and other information at any time without notice.

OriginGPS reserves the right to conduct, from time to time, and at its sole discretion, firmware upgrades.

As long as those FW improvements have no material change on end customers, PCN may not be issued.

OriginGPS navigation products are not recommended to use in life saving or life sustaining applications.

SAFETY INFORMATION

Improper handling and use can cause permanent damage to the product.

ESD SENSITIVITY

This product is ESD sensitive device and must be handled with care.



CONTACT INFORMATION

contactus@origingps.com

www.origingps.com

1. GENERAL

1.1. Introduction

Welcome to the OriginIoT™ Application Kit (APK) User Guide. The APK is a compact development and evaluation tool for use with the OriginIoT™ system. The APK enables users to interactively configure their OriginIoT™ systems according to their project requirements. The APK enables the quick and easy configuration of the IoT module through an interactive debug console, and also enables debugging commands to be sent to the module.

The OriginIoT™ system is a miniature cellular IoT system that enables the speedy development of IoT projects without writing embedded code and without knowledge of RF engineering. This guide assumes the reader has basic software and hardware knowledge.

1.2. Purpose and Scope

The purpose of this guide is to explain, step by step, how to use the OriginIoT™ Application Kit. It is intended to provide all the necessary information to configure and test new cellular IoT projects and development innovations. This guide includes a description of the system functions and capabilities, contingencies and alternate modes of operation, and step-by-step procedures for setting up, configuring, and using the OriginIoT™ Application Kit.

2. SYSTEM OVERVIEW

2.1. OriginIoT™ System Description

The OriginIoT™ system is a miniature cellular IoT system with a GNSS tracker and interfaces to peripheral sensors and devices. The data is transferred through cellular communication, stored in a remote server (cloud), and displayed on a Web GUI.

The system communicates through a GSM or LTE interface (2G, 3G, Cat1, CatM, or NB-IoT) through a cloud-based application.

The OriginIoT™ system functions as a multi-purpose IoT sensor platform and can accommodate sensors and other peripheral devices using UART, I2C, or GPIO with superior positional accuracy of a stand-alone GNSS. Data is configured over a Web interface and embedded firmware development is not required by the user. The ease and flexibility of developing a vast array of applications based on the OriginIoT™ system dramatically improves time to market while minimizing the size of your IoT sensor device.

2.2. OriginIoT™ Application Kit Description

The OriginIoT™ Application Kit is a development and evaluation tool for use with the OriginIoT™ system. With the OriginIoT™ Application Kit, users can see live results of the configurations of the OriginIoT™ system according to their project requirements while using a debug console.

The OriginIoT™ Application Kit may be used for the following activities:

- Connecting the OriginIoT™ system to a server
- Testing the functionality of the add-on
- Connecting and configuring new sensors
- Debugging and configuring the OriginIoT™ system locally

3. GETTING STARTED

3.1. OriginIoT™ Application Kit Contents

The OriginIoT™ Application Kit package includes the following items:

- OriginIoT™ system
- OriginIoT™ Add-on board
- GNSS antenna 12x12x4.3 mm with a W.FL connector
- Penta-band GSM antenna with a U.FL connector
- ST-LINK and FTDI USBs
- Cable from USBs to add-on board
- Cable to connect battery (not shown)
- Nano SIM card with optional data package



Figure 1. OriginIoT™ Application Kit Contents

3.2. Equipment Required to Set-Up

The following items are required to set up and start working with the OriginIoT™ Application Kit:

- Nano SIM card with data package
- Server:
 - ♦ **Option A:** OriginGPS provides customers a cloud server for evaluation purposes.
 - ♦ **Option B:** Users can develop their own server tailored to their project's requirements based on OriginSmart™ open-source code, provided with the purchase of the OriginIoT™ system.
- PC with terminal emulator (ex. Tera Term, a free, open-source software, downloadable [here](#))
- USB power source with output 5V / 1A

3.3. Download the FTDI Driver

To download the FTDI driver, execute the following steps:

1. For Windows, click on the following link:

<https://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers>

For a Mac, click on the following link:

<https://www.macupdate.com/app/mac/31352/coolterm>

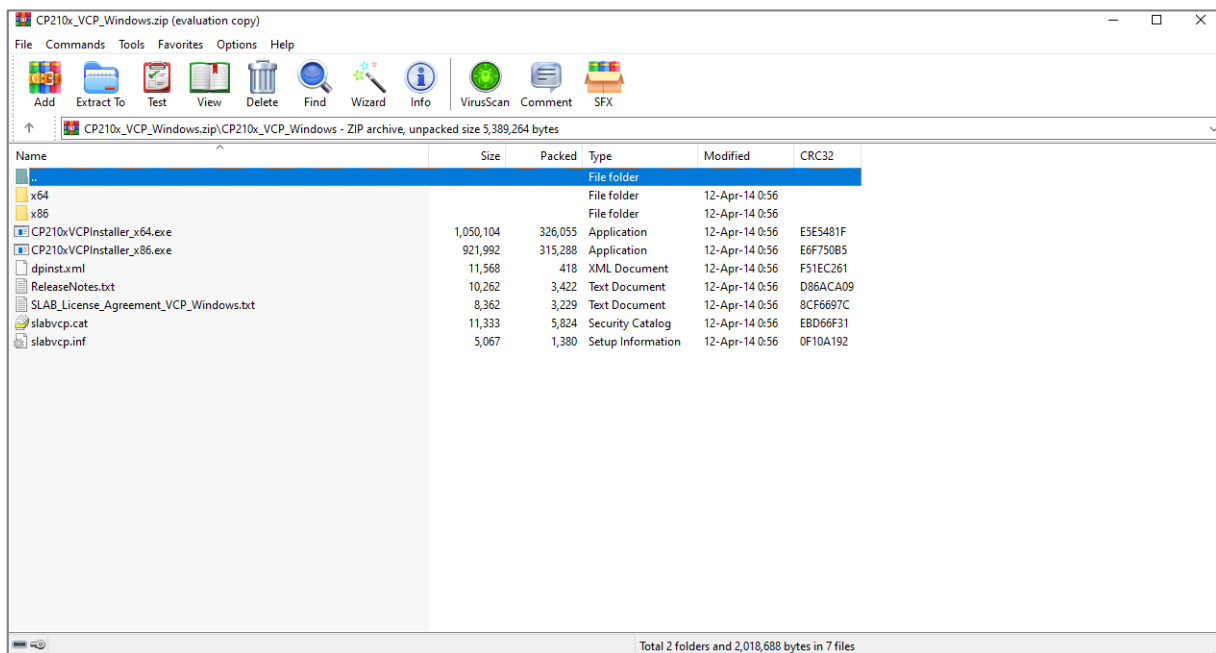


Figure 2. VCP CP210X Driver

2. Navigate to the Downloads section and select your required VCP CP210X driver installation.
3. After the ZIP file has downloaded, open the ZIP folder, and then double-click on the *CP210xVCPInstaller_x86.exe* file.
4. Click on **YES** button to install it.
5. Restart the PC.

3.4. Connecting the APK to a PC

To configure the OriginIoT™ system to establish a connection between the GSM/LTE network and Web server, the module using the debug port connection to the PC must be configured according to the following steps:

1. Insert a Nano SIM card to the dedicated slot on the OriginIoT™ system. This step is not required with the ORG2101-NMGL-E model, which includes an integrated, embedded SIM card.
2. Connect the GSM/LTE cellular antenna to the U.FI connector on the OriginIoT™ (Figure 3).

3. Connect the GNSS antenna to the W.Fl connector on the OriginIoT™ system (Figure 3). This step is only required when evaluating GNSS functionality.

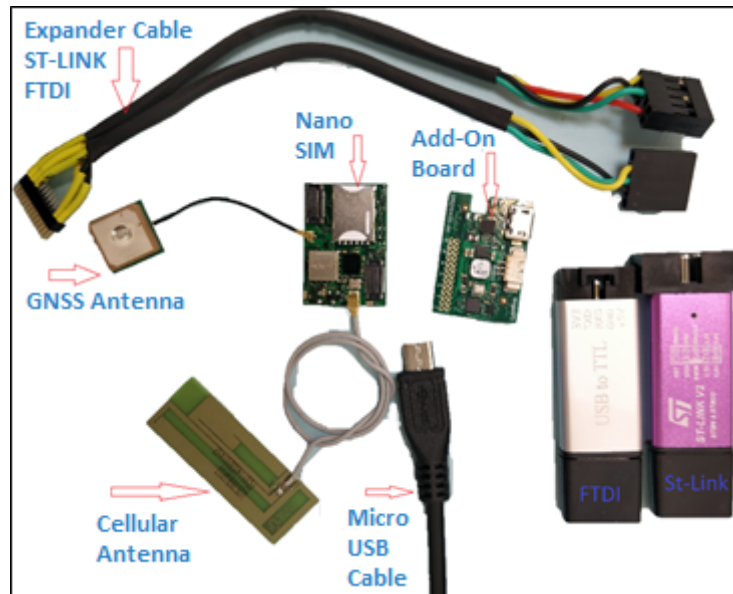


Figure 3. Connecting the Antennas and SIM Card

4. Connect the OriginIoT™ system to the add-on board using the micro-USB cable (Figure 4).

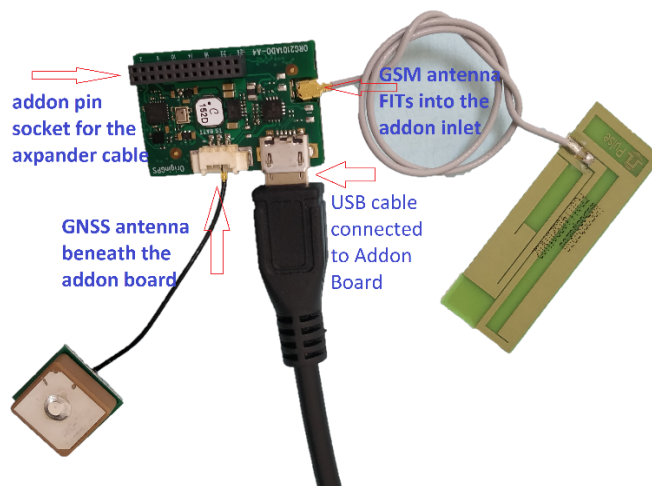


Figure 4. Connecting the OriginIoT™ Add-on

5. Connect the console debug USB (Figure 5)



Figure 5. Connecting the Console Debug USB

6. Connect the expander cable according to
7. Figure 6. The FTDI connector is used for the debug console, whereas the ST-LINK is used for flashing the IoT module. Make sure to connect the FTDI connector to a USB port.



Figure 6. Connecting the Expander Cable to the FTDI USB

7. To connect to the OriginIoT™ COM port: In the Tera Term application, go to: **Setup** → **Serial Port** (Figure 7), select the relevant COM from the port drop list, and set the baud rate to 921600 bps (
8. Figure 8).
9. Click **OK**.

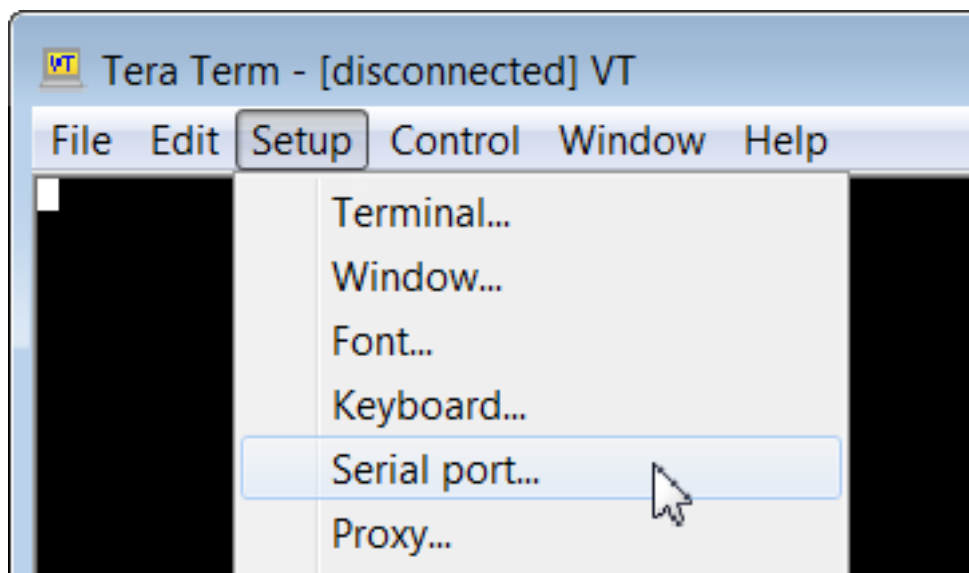


Figure 7. Selecting the Serial Port in Tera Term

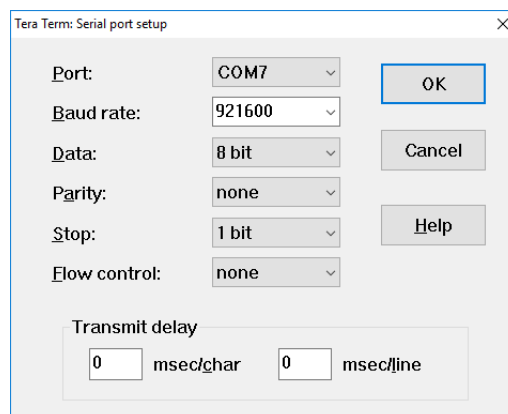


Figure 8. Serial Port Setup in Tera Term

10. When the OriginIoT™ system is connected to a power source, a welcome message and GSM/LTE start-up messages is displayed on your PC.
11. While the OriginIoT™ system is connected to your PC, press **Enter** in the terminal, and the prompt line **ORG>** is displayed in the terminal window (Figure 9).

```

COM7 - Tera Term VT
File Edit Setup Control Window Help
00001095 [INFO] <main:170> Restart Reason: Watchdog
----- Welcome to the OriginIoT Debug Console Version: 1.1
00001203 [INFO] <gpsTurnDeviceOn:554> GPS Turn Device On
00002003 [INFO] <gsmPowerOnSequence:665> Cellular Module ON
00002704 [INFO] <GSM_MainTask:2061> Cellular module starting ...
ORG>

```

Figure 9. Connection to the Debug Console

The system may now be accessed through the debug console.

12. Enter **'help'** in the Tera Term terminal to see a list of available commands (Figure 10).

```

COM3:321600baud - Tera Term VT
File Edit Setup Control Window Help
ORG> help
adc      adc <instance> <start|stop|read>
dac      dac <instance> <show|start> ...
cls      cls clear the screen
fs        fs <write|erase|read|write|tbRead|tbErase|show> ...
gpio      gpio <display|set> ...
gps       gps <instance> <defconfig|msg|print|show|toggle> ...
gsm       gsm <instance> <console|info|network|pins|save|set|stats|txpwr|rxpwr>...
help      this helpful list
i2c       i2c <instance> <config|get|Probe|set|show> ...
mcu       mcu <debug>...
ota       ota
reset     reset <reason|gps|gsm|mcu> ...
show      show <console|fs|gsm|gps|lpuart|iwdg|stack|troubleblock> ...
debug     debug <at|...> ...
uart      uart <device id> <config|read|save|show|write>
uptime    uptime
sysinfo    System configuration
echomode   echomode <instance> <state>

Where:
<> are parameters
() parameter range
[] means they are optional
... more parameters for specific commands
ORG>

```

Figure 10. OriginIoT™ System Help List

4. CONNECTING TO A SERVER

4.1. Mobile Network Parameters

The OriginIoT™ system can send data over a mobile network following initial cellular APN configuration. This configuration is performed automatically once a SIM card is inserted and includes the following SIM parameters from your mobile network operator's properties on your SIM card:

- **APN** – Access Point Network

```
ORG> gsm 0 network
00124449 [INFO] (gsmDebugShowNetwork:4935) APN : datamobile.ag
00124470 [INFO] (gsmDebugShowNetwork:4936) Server IP : 18.184.85.107
00124491 [INFO] (gsmDebugShowNetwork:4937) Server Port : 31000
00124512 [INFO] (gsmDebugShowNetwork:4938) Connected : true
00124533 [INFO] (gsmDebugShowNetwork:4940) Network IP : 10.7.192.83
```

Figure 11. OriginIoT™ System Configuration Example

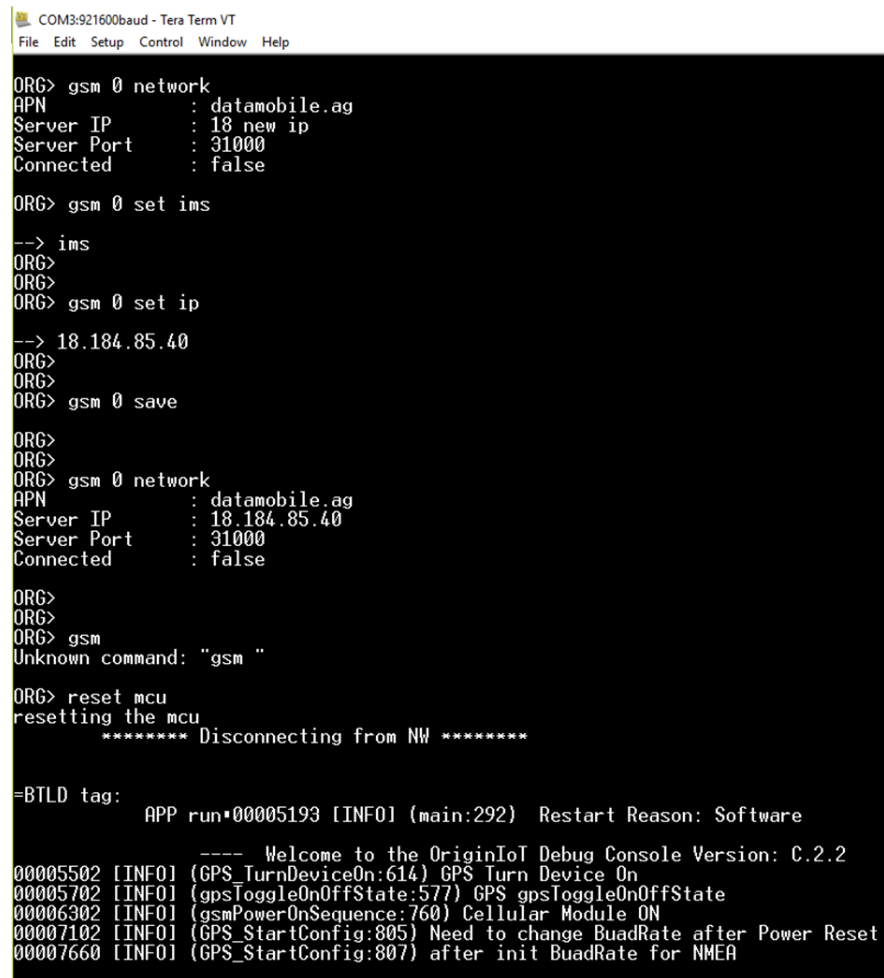
Key to Figure 11:

- **APN:** SIM card provider's network.
- **Server IP:** Hostname or IP address of cloud-based application—the server to which the module connects.
- **Server Port:** Port used by a cloud application to receive messages from the OriginIoT™ system .
- **Connected:** Set to '**true**' when GSM/LTE is connected to the access portal, '**false**' if otherwise.
- **Network IP:** (Shown only when connected) provided to the system by the Internet provider's Dynamic Host Configuration Protocol (DHCP) servers and is not configurable.

To set these fields, use the command:

1. **gsm 0 set <apn|ip|port> ...**
2. Save the changes to flash memory using the command:
gsm 0 save
3. Reset the MCU using this command to implement these changes:
reset mcu

Examples of the above commands are shown in Figure 12:



```

COM3:921600baud - Tera Term VT
File Edit Setup Control Window Help

ORG> gsm 0 network
APN          : datamobile.ag
Server IP    : 18 new ip
Server Port  : 31000
Connected    : false

ORG> gsm 0 set ims
--> ims
ORG>
ORG> gsm 0 set ip
--> 18.184.85.40
ORG>
ORG> gsm 0 save

ORG>
ORG>
ORG> gsm 0 network
APN          : datamobile.ag
Server IP    : 18.184.85.40
Server Port  : 31000
Connected    : false

ORG>
ORG>
ORG> gsm
Unknown command: "gsm "

ORG> reset mcu
resetting the mcu
***** Disconnecting from NW *****

=BTLD tag:
APP run*00005193 [INFO] (main:292) Restart Reason: Software
----- Welcome to the OriginIoT Debug Console Version: C.2.2
00005502 [INFO] (GPS_TurnDeviceOn:614) GPS Turn Device On
00005702 [INFO] (gpsToggleOnOffState:577) GPS gpsToggleOnOffState
00006302 [INFO] (gsmPowerOnSequence:760) Cellular Module ON
00007102 [INFO] (GPS_StartConfig:805) Need to change BuadRate after Power Reset
00007660 [INFO] (GPS_StartConfig:807) after init BuadRate for NMEA
  
```

Figure 12. Setting up the Network Configuration with the Debug Console

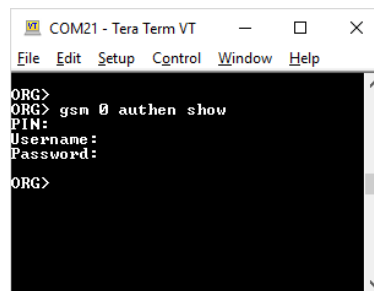
4.2. Editing Mobile-Network Parameters - GSM/LTE Authentication Command

You may skip this section if your SIM card does not require authentication (username and password).

To configure your SIM card, use the **'authen'** command in the debug console.

To see the current configuration, use the command **gsm 0 authen show**.

The following output is displayed:



```
COM21 - Tera Term VT
File Edit Setup Control Window Help
ORG>
ORG> gsm 0 authen show
PIN:
Username:
Password:
ORG>
```

Figure 13. GSM Authentication Command – Output

The OriginIoT™ System is shipped without authentication settings, so these settings are displayed as empty fields here.

The **'authen'** command enables the operator to set the following fields:

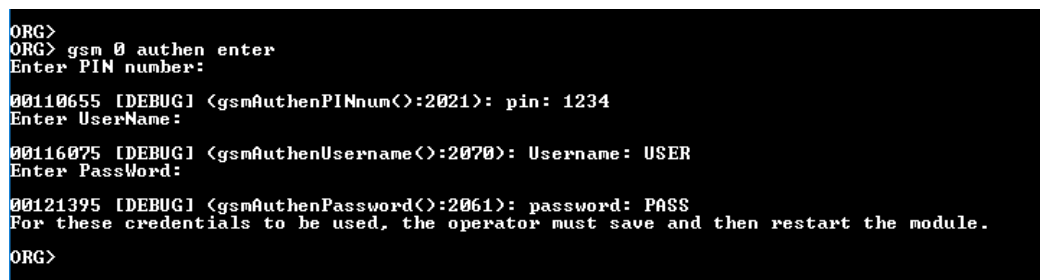
- PIN (4 to 8-digit number provided with the SIM card)
- Username
- Password

Note: Fields that the operator does not set are shown as empty.

To set these fields use the command:

gsm 0 authen enter

The operator is then prompted for each of the fields. If a field is not required, type **Enter** to exit the field.



```
ORG>
ORG> gsm 0 authen enter
Enter PIN number:
00110655 [DEBUG] <gsmAuthenPINnum():2021>: pin: 1234
Enter UserName:
00116075 [DEBUG] <gsmAuthenUsername():2070>: Username: USER
Enter Password:
00121395 [DEBUG] <gsmAuthenPassword():2061>: password: PASS
For these credentials to be used, the operator must save and then restart the module.
ORG>
```

Figure 14. Setting up Authentication Credentials

Verify the fields are correct, then save them to flash using the following command:

gsm 0 authen save

The next time the system boots, these fields are used for the wireless network connectivity.

The GSM authentication process should look like the following figure (Figure 15):

```

ORG> gsm 0 authen show
PIN          :
Username     :
Password     :

ORG> gsm 0 authen enter
Enter PIN number:

00546272 [DEBUG] (gsmAuthenPINnum():3490): pin: 12
Enter UserName:

00555390 [DEBUG] (gsmAuthenUsername():3539): Username: 12
Enter PassWord:

00562350 [DEBUG] (gsmAuthenPassword():3530): password: 12345678
For these credentials to be used, the operator must save and then restart the module.

ORG> gsm 0 authen save

ORG> gsm 0 authen show
PIN          : 12
Username     : 12
Password     : 12345678

ORG> reset mcu
resetting the mcu
***** Disconnecting from NW *****

=BTLD tag:
APP run*00005193 [INFO] (main:292) Restart Reason: Software
----- Welcome to the OriginIoT Debug Console Version: C.2.2
00005502 [INFO] (GPS_TurnDeviceOn:614) GPS Turn Device On
00005702 [INFO] (gpsToggleOnOffState:577) GPS gpsToggleOnOffState
00006302 [INFO] (gsmPowerOnSequence:760) Cellular Module ON
00007102 [INFO] (GPS_StartConfig:805) Need to change BaudRate after Power Reset
00007660 [INFO] (GPS_StartConfig:807) after init BaudRate for NMEA

```

Figure 15. GSM Authentication Process

5. ORDERING INFORMATION

The ordering information for an OriginIoT™ Application Kit must be formatted according to the following template.

5.1. P/N 2: Application Kit

O	R	G	2	1	0	1	-	X	X	X	X	-	X	-	A	P	K	-	X	
								1				2								3

1. Cellular Module Option
2. SIM Card Type
 - a. **E** – Embedded Sim card
 - b. **T** – Traditional SIM card
3. SIM Card Option
 - a. **S** – Supply SIM card
 - b. **N** – Do not supply SIM card

Notes:

1. The SIM card included in the OriginIoT™ Application Kit supports LTE and 2G networks. When other SIM cards are used, support for LTE will be enabled, but be sure to set-up the APN to enable 2G support.
2. For OriginIoT™ System and OriginIoT™ Add-on ordering information, please refer to the *OriginIoT™ System Datasheet* found on our website, origingps.com.

Appendix A. Firmware Upload (Flashing)

The OriginIoT™ Application Kit includes company proprietary OriginSmart™ firmware, designed to enable codeless configuration of the remote system without performing any firmware changes. This section explains how this firmware can be uploaded.

The equipment required for uploading the firmware includes:

- ST-Link/V2 STM8 & STM32 controller
- STM32-ST-Link Utility – [Link](#) to download the application
 - ♦ There are two options for using the controller to update the firmware.
- Using the USB supplied in the APK, pictured on the left in Figure 16.
 - Note: The pin description labeled on the top of the USB connector. In the case of any discrepancies between the between the connector pins in this guide and those labeled on the USB, refer to the USB connector as the USB connector might vary from kit to kit.
- Using a standard controller ST-LINK/V2 STM8 & STM32, pictured on the right in Figure 16.

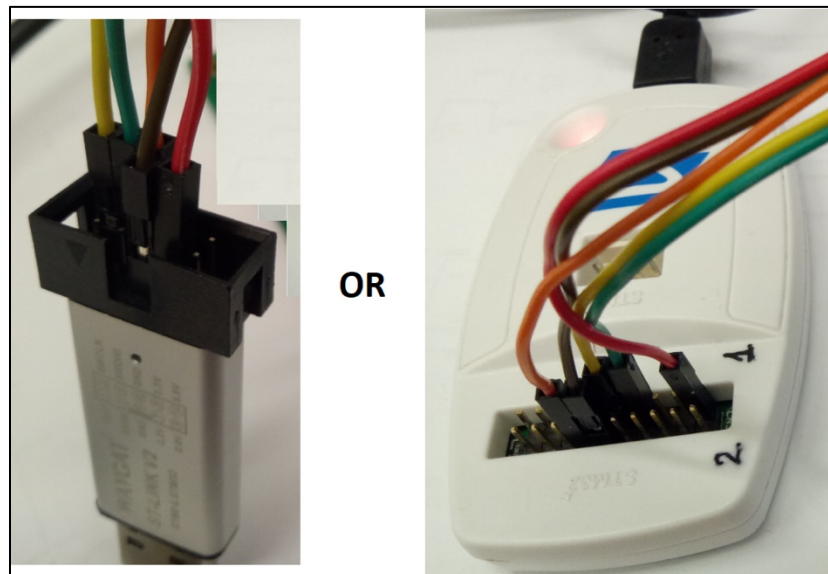


Figure 16. Firmware Upload

To connect the application board to the ST-LINK controller, connect wires to the J5 connector, as depicted in Table 1 and Figure 17 below.

Table 1. Wireless Connection to Application Board

Function	Wire Color	J5 Add-On	ST-LINK USB	ST-LINK Plug
GND	Black	Pin 2	Pin 4	Pin 14
GND	Black	Pin 4	Pin 3	Pin 12
VCC 3.3V	Red	Pin 3	Pin 7	Pin 1
SWCLK	Green	Pin 24	Pin 6	Pin 9
SWDIO	Yellow	Pin 26	Pin 2	Pin 7



Figure 17. Connector Pins

To update the OriginIoT™ firmware, take the following steps:

1. Connect the OriginIoT™ system to the OriginIoT™ Add-on
2. Power-on the OriginIoT™ system using the Micro USB connector
3. Connect the ST-LINK to J5, as shown in Figure 17 above
4. Connect the ST-LINK to a PC

5. Add a DLL file (missing in Windows) with the following link
<https://answers.microsoft.com/en-us/windows/forum/all/missing-mfc140dll/fd263446-82bd-4fdf-8e50-a0a2c0cf8486>.
6. Open the STM32 ST-LINK Utility
7. Click **Target** → **Connect**

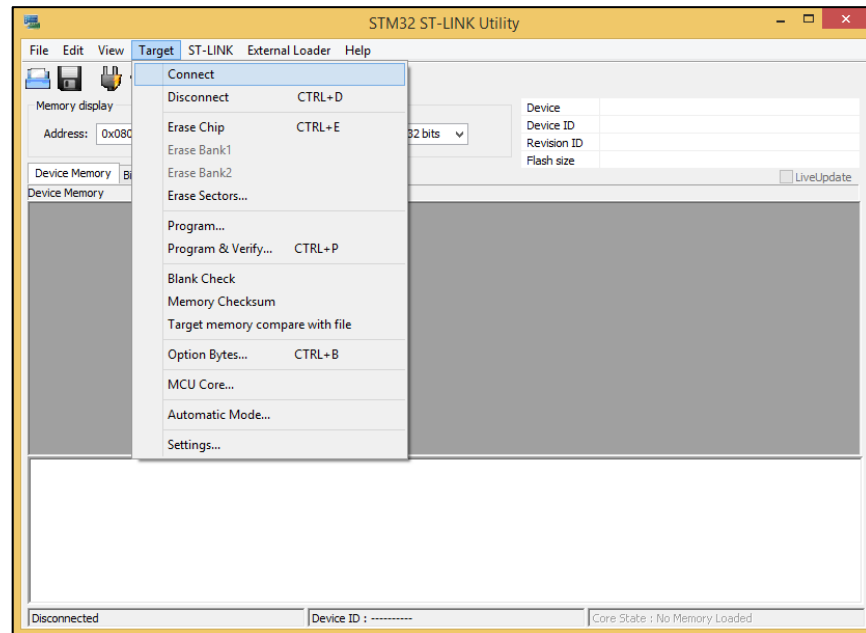


Figure 18. STM32 ST-LINK Utility Window

8. When the connection is established, the following message is shown:
‘Connected via SWD’ (Figure 19).
9. If you are unable to connect, verify that the wires are correctly connected.

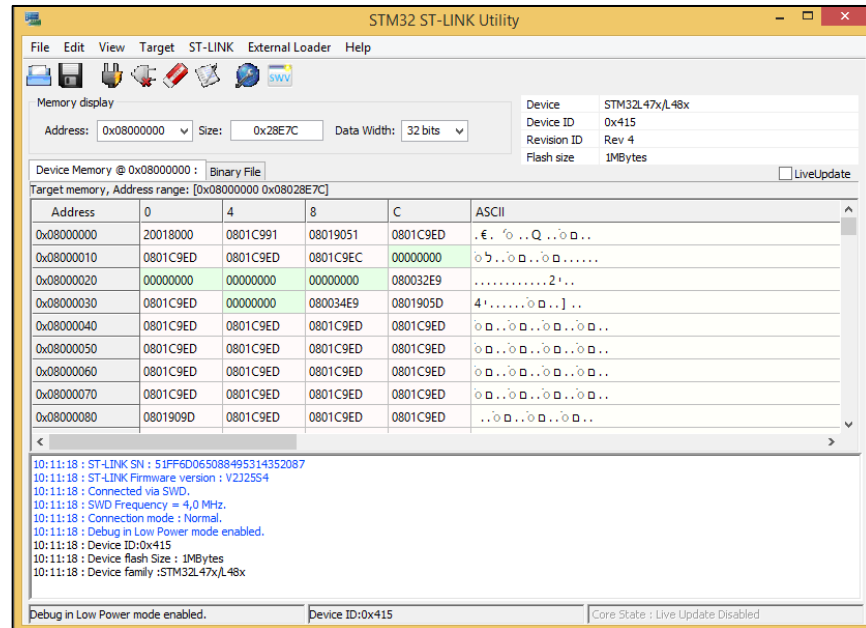


Figure 19. Connecting with the STM32 ST-LINK Utility

9. Click on **Target** → **Program & Verify** (Figure 20).

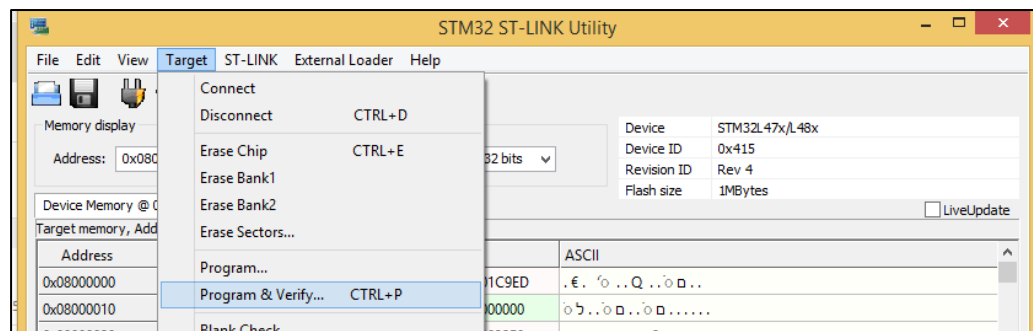


Figure 20. Program and Verify in the STM32 ST-LINK Utility

10. Open the file and a dialog box opens. Select your firmware file - a **.hex** / **.bin** file.
11. After selecting your firmware file, a download window opens.
12. Click **Start**.

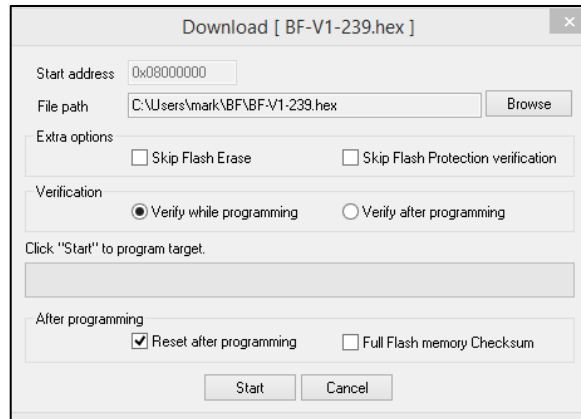


Figure 21. Download Window

13. When the firmware upload is complete, a Verification...OK message is shown (Figure 22).

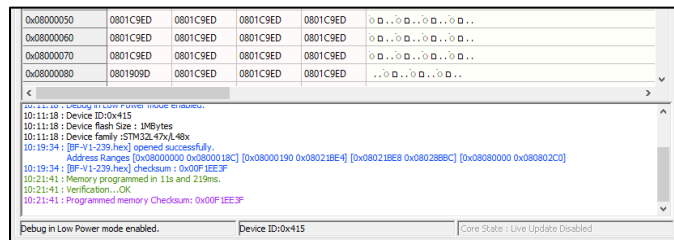


Figure 22. Successful Firmware Download Window

14. To disconnect the system, click **Target** → **Disconnect**.

Appendix B. Sensor Configuration

The add-on board contains six sensors (including the GNSS module on the OriginIoT™ system):

- GNSS module connected through the UART interface
- Temperature sensors connected through the I2C
- Accelerometer connected through the I2C
- Magnetometer connected through the I2C
- Gyroscope connected through the I2C
- Barometer connected through the I2C
- Fuel gauge for battery life through the I2C with dedicated address

All sensors, with the exception of the GNSS module, must be configured (“Committed”) on the device using an IF_PARAM_SET message, specified in the API spec document.

The required parameters for each peripheral device can be found in its respective datasheet. OriginIoT™ system does not restrict devices that can be connected to the module as long as they interface with I2C, UART or GPIO. Each device has parameters that are required in this step. For convenience, Table 2 below lists the parameters required to configure the devices inside the APK.

See the API datasheet for examples on how to configure and use the default sensors on the add-on board.

Table 2. Sensor Configuration

Device	Device P/N	IF_ID	Parameters							
UART Type Interface			Baud Rate	Flow Control	Stop Bit	Parity	Data Bits	Data Ready IF_ID	Data Over Run Action	
GPS	ORG4572	03	4800-230400	Disable	1	None	8	N/A	N/A	
I2C Type Interface			Addressing Mode	Bit Rate	Register Type	Data Ready IF_ID	Data Over Run Action	Device Address (0x)	Register Address (0x)	
Magnetometer (Ecompass)	ICM-20948	05	7-bit	400 kbps	BYTE	N/A	N/A	d0	11H	
Gyroscope	ICM-20948	05	7-bit	400 kbps	BYTE	N/A	N/A	d0	33	
Accelerometer	ICM-20948	05	7-bit	400 kbps	BYTE	N/A	N/A	d0	2d	
Temperature	ICM-20948	05	7-bit	400 kbps	BYTE	N/A	N/A	d0	39	
Barometer	BMP280	05	7-bit	400 kbps	BYTE	N/A	N/A	EC	f7	
Fuel Gauge	LC709203F	05	7-bit	400 kbps	BYTE	N/A	N/A	16*	Note**	

Note: *The Fuel Gauge has a dedicated address and is not subject to change.

**Many different registers are used to configure and receive data from the fuel gauge – see datasheet and/or API specifications for more information.