Sequans Monarch Go and Go-GPS Starter Kit User Manual

Application Note

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Document Revision History

Revision	Date	Description
1	September 2019	First edition
2	October 2019	Added Monarch Go-GPS

Table of Contents

Document Revision History 3
Table of Contents 4
Introduction 5
1. Starter Kit presentation 5
1.1. Starter Kit contents 5
1.2. Starter Kit software dependencies 5
1.3. Starter Kit connectors 6
2. Getting started 7
2.1. Board preparation 7
2.2. Drivers installation 7
2.3. Verifying your installation 7
2.4. Overview of the COM ports 8
2.5. Using the kit in a wired environment 9
3. Using the Starter Kit 9
3.1. Sending AT Commands 9
3.2. Connecting the Starter Kit to Verizon network 11
3.3. Connecting the Starter Kit to a test equipment 12
3.4. Checking the Signal Strength 12
3.5. Sending data to a cloud 13
4. Troubleshooting Issues 14
4.1. Most common issues 14
5. Annex 14

Introduction

This document provides an overview of the Monarch Go and Go-GPS Starter Kit, its basic installation procedures and a quick startup reference to use the kit with a PC. It also includes a section to perform prototyping with an external MCU. Video are also available from Sequans support team.

1. Starter Kit presentation

1.1. Starter Kit contents

Out of the box, the Starter Kit is delivered with

- The interface board with Monarch Go and Go-GPS
- One USB type A to MiniUSB type B cable
- One Flex cable for board-to-board connection
- One screw driver

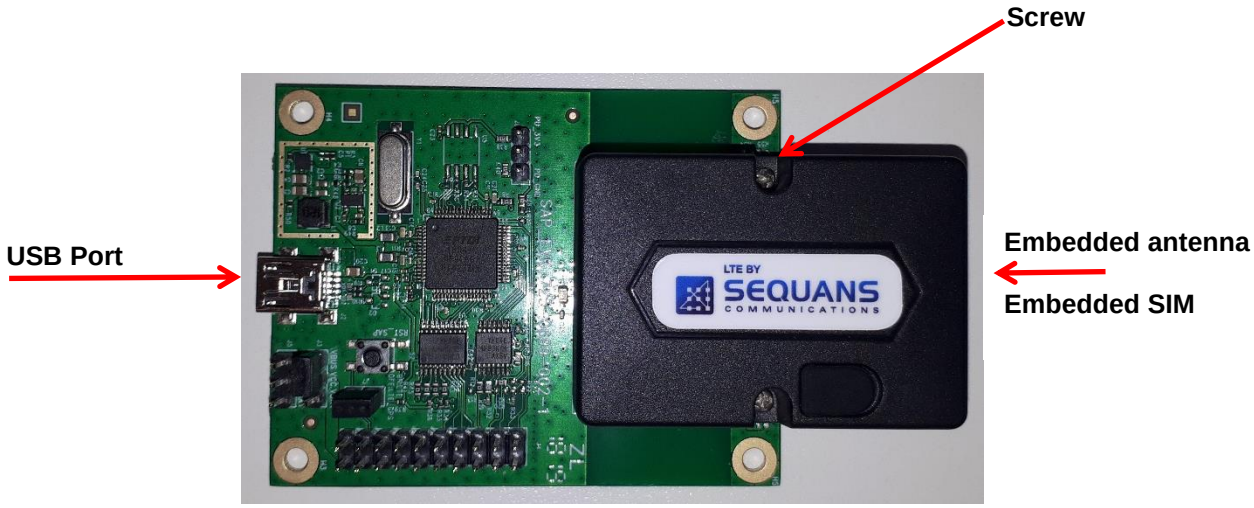
Note: the cellular (LTE-M) SIM card is pre-installed in Monarch Go and Go-GPS.
If you need to change the SIM card pre-installed in Monarch Go and Go-GPS device, a video is available under NDA-Design Ressources/Video – howto/NDA-Monarch Go-video-replacing SIM card.avi.

1.2. Starter Kit software dependencies

The Starter Kit requires external Software to help you performing some operations

- **Mandatory**
  - **Serial Terminal Emulator** under Windows, necessary to interact with the Starter Kit through AT Commands. The examples illustrated in this document are based on Tera Term Software

1.3. Starter Kit connectors



For jumpers and headers default settings please refer to the Annex

You can also connect the board-to-board flex cable:

The use of board-to-board flex cable is optional (for more details on how to connect it check the Annex)

Annex

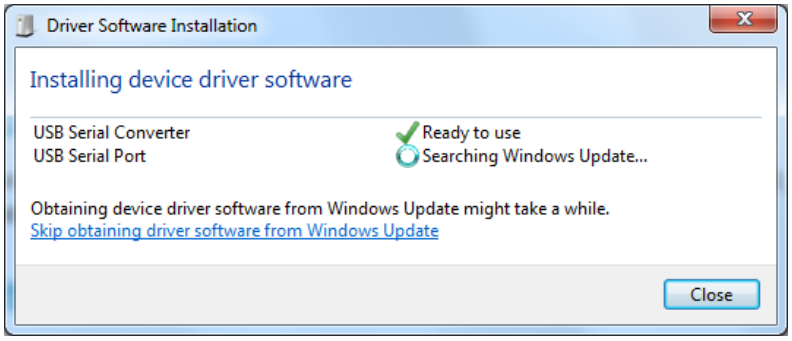
2. Getting started

2.1. Board preparation

- Plug the mini-USB cable from your PC to the interface board USB Port

2.2. Drivers installation

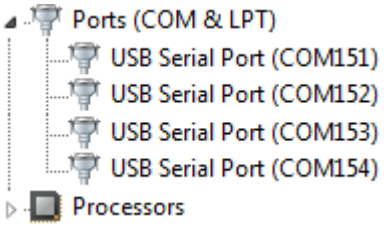
- When you plug the USB connector for the first time in your PC, you need to wait for about one minute, the time to allow the drivers to be auto-installed on windows
- The USB connects the on-board UART-USB bridge IC to provide ACM interfaces (virtual COM) in order to access the board through UART
- You should see a window popping up with the following information



- If for some reasons, the driver fails to auto-install on windows, you can always install them manually from http://www.ftdichip.com/Drivers/VCP.htm FTDI driver labelled UART/USB
- After driver installation, it is safer to unplug the Starter Kit and reboot your PC

2.3. Verifying your installation

- After completing the drivers' installation, whenever you plug the USB cable you should be able to see the following, under Windows Control Panel, Device Manager



- Port enumeration can be different on your PC from the given example, depending on your local settings (example COM23, COM24…)

2.4. Overview of the COM ports

- The following table summarizes the COM ports under Windows and their mapping and configuration to the Starter Kit

We will work with Main UART 1 all along the process

Port Enumeration	Board Mapping	Usage	Baudrate	Data Bits	Flow Control	Parity	Stop
COMa ex COM14	**Main UART 1**	**AT Command**	115200	8	Hardware	None	1

You can check the annex if you are interested in connecting the serial terminal to the COM Port mapped to debug UARTs:

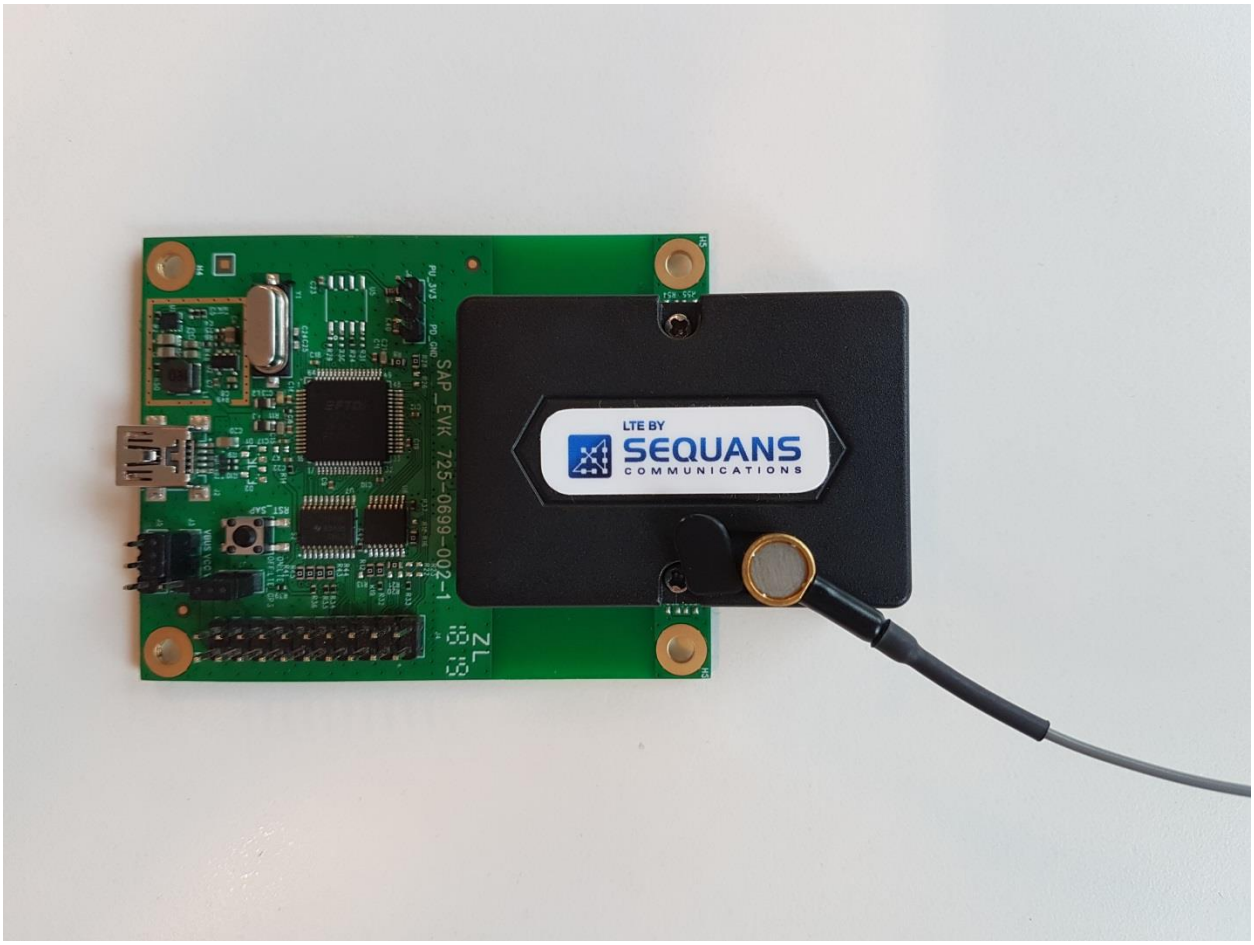
Port Enumeration	Board Mapping	Usage	Baudrate	Data Bits	Flow Control	Parity	Stop
COMb ex COM15	**Debug UART 2**	**Console**	115200	**8**	None	None	1
COMc ex COM16	**Debug UART 0**	**AT Command**	921600	**8**	Hardware	None	1
COMd ex COM17	**UNUSED**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

WARNING: COM ports cannot be shared between two different applications at the same time. If you try to do this, one of the applications will be in error.

2.5. Using the kit in a wired environment

Antennas are included in the Monarch Go and Go-GPS products. It is possible to bypass them and perform test in a conducted environment.

The recommended RF cable to be used is the Murata connector MXHQ87WA3000. This cable is not provided in the starter kit package, it can be ordered from online distributors.



A video showing how to connect the RF cable is available in NDA-Design Ressources/Video – howto/NDA-Monarch Go-video- plugging RF cable.avi

3. Using the Starter Kit

3.1. Sending AT Commands

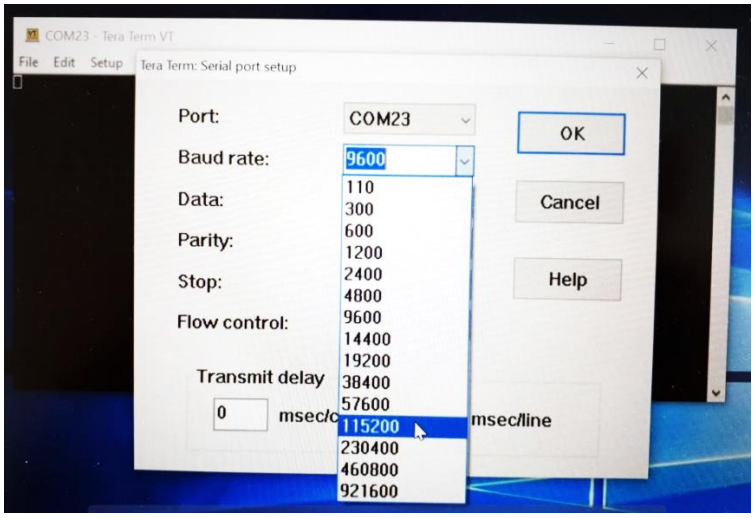
- The Starter Kit configuration and usage is done through AT Commands

- In order to send AT Commands to the board, you need to use a Serial Terminal program under Windows. Example, TeraTerm freeware
- To send an AT command to the board, you need to connect your Serial Terminal to the ”Main UART 1” port–please refer to the table in 2.4 to determine the exact COM port

➡ Overview of the COM ports ⬅

- Under Setup, Serial Port, choose the right configuration according to table 2.4

➡ Overview of the COM ports ⬅



- Once the correct setting is done, you should be able to start sending AT Commands and receiving their corresponding output. Please make sure to turn on “Local echo” by going to the Setup menu and selecting “Terminal”.

- **Note**: You can access the latest version of the AT Command Reference Manual through the same channel where you obtained this document – this reference manual describes the complete list of AT commands supported by Monarch Go and Go-GPS firmware. You can also get examples on AT commands usage in our Module AT Command User Guide.

3.2. Connecting the Starter Kit to Verizon network

Pre-requisite: you need to be located in USA.

If you have access to Verizon LTE-M 4G network, the test kit will connect to the network as soon as the USB cable is plugged to the laptop.

- From the Terminal, enter: AT+CMEE=2
  - This command will allow getting verbose error messages from AT commands

- To check the SIM card state, enter AT+CPIN? from the terminal
  - Response will be
    - +CPIN: <***code***>
      - <***code***> = Ready : SIM card is present and unlocked
      - <***code***>=SIM PIN : Modem is waiting SIM PIN to be entered
      - <***code***>= SIM PUK : Modem is waiting SIM PUK to be given
    - or ERROR, when SIM is not inserted or not detected

- When the modem will start to scan for the network, you can get any of the following URCs
  - +CEREG=<stat>
    - ***<stat>=0*** : Modem is not registered and is not currently searching an operator to register to.
      - Possible cause: SIM card error or registration ongoing
    - ***<stat>=1*** : Modem is registered on network –board connected–
    - ***<stat>=2*** : Modem is not registered, but is currently trying to attach or is searching for an operator to register to.
      - Possible causes:
        - No network available
        - Available networks have bad coverage
        - PLMN available but the registration is rejected
    - ***<stat>= 3*** : Registration denied
      - Possible causes:
        - Illegal mobile equipment
        - IMSI unknown at HLR
        - PLMN not allowed
        - Location area not allowed
        - Roaming not allowed in this location area
        - Network failure
        - Network congestion
    - ***<stat>= 4*** : Unknown. Transitory value

- ***<stat>= 5*** : Modem Registered in roaming mode

- Once you receive the +CEREG 1 URC, you can send a ping to check the network connectivity with
  - AT+PING=www.sequans.com

3.3. Connecting the Starter Kit to a test equipment

If you don't have access to Verizon Live network, you can use an Amarisoft equipment as eNb emulator (Please see Partner _ Amarisoft_Callbox_mini-1.pdf)

Please note that you should configure the Amarisoft tester in band 13 and that the UE will connect to PDN 3 by default.

3.4. Checking the Signal Strength

- When your board is connected to a network, you can check the signal strength and characteristics through the following AT Command
  - AT+CSQ
  - Response will be

    +CSQ:<***rssi***>,<***ber***>

    where <rssi> represents the signal strength at the antenna and <ber> is the bit error rate in %.

<rssi> Conversion Table

<rssi> Parameter	Signal Description with RSSI Value Range
0-9	Marginal: -113 dBm to -95 dBm
10-14	OK: -93 dBm to -85 dBm
15-19	Good: -83 dBm to -75 dBm
20-30	Excellent: -73 dBm to -53 dBm
31	Excellent: -51 dBm or greater
99	Unknown or not detectable

<ber> Conversion Table

<ber> Parameter	Bit Error Rate (in %)
0	Less than 0.2%
1	0.2% to 0.4%
2	0.4% to 0.8%
3	0.8% to 1.6%
4	1.6% to 3.2%
5	3.2% to 6.4%

6	6.4% to 12.8%
7	More than 12.8%
99	Unknown or not detectable

3.5. Sending data to a cloud

- When your board is connected to a network, you can send and receive data
- To perform this operation, please refer to the commands listed in the “MQTT AT user guide”.

Note: Sequans will release soon another document “AT command user guide” and the section “DATA over UART” will describe how to send data through UDP, TCP …

4. Troubleshooting Issues

4.1. Most common issues

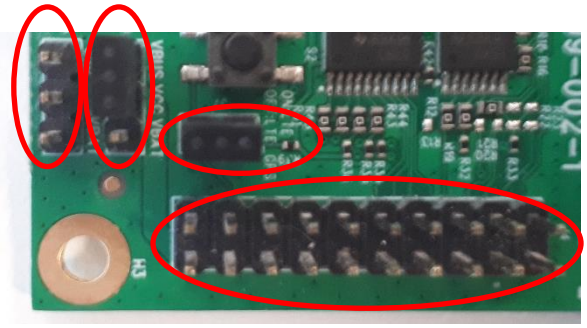
The following is a list of common issues and some possible ways to fix it

Symptom	Solution
The board doesn't boot up	Check your USB cable connection
No RF signal	Check network coverage
Weak LTE signal	Check network coverage
No eNB detected	Check network coverage

The UE finds the cell but doesn't attach due to SIM	Check the SIM card status with AT+CPIN? ; if ERROR is returned it could be a HW issue (voltage or SIM wrongly/not inserted) ; if PIN is returned, the SIM needs to enter a PIN CODE to be unlocked.
The UE finds the cell but doesn't attach due to eNB sending a NAS Attach Reject message	Check the APN settings: name, IP type and authentication
eDRX or PSM is not enabled	Check that eDRX or PSM is enabled on network and UE side
The UE cannot enter IDLE	Check there is no undesirable UL or DL traffic Verify Windows chatty services

5. Annex

- Here below is the default jumper setting for the Monarch Go and Go-GPS Starter Kit. It is setup from the factory, However, if a jumper was knocked off during shipment or when invited by the support to change some setting during maintenance session, here is a diagram for the proper jumper settings:

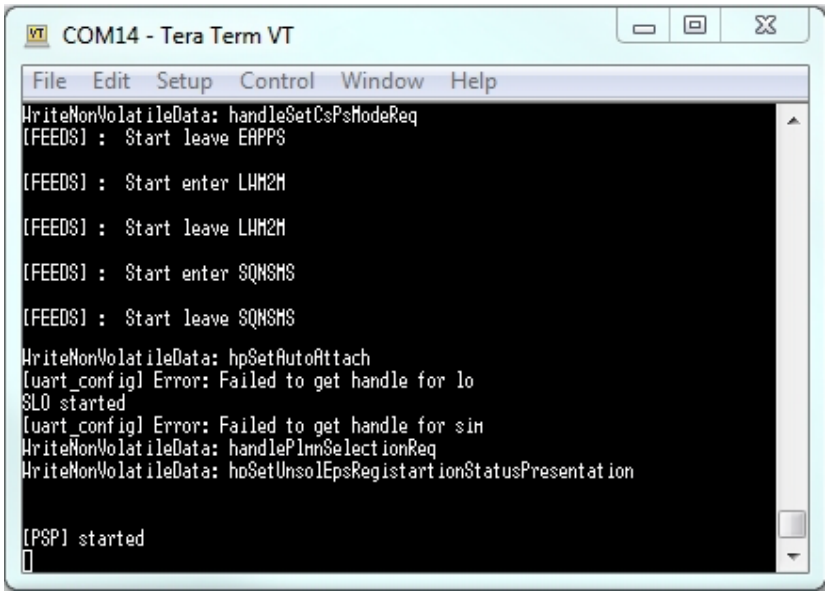


- Monarch Go and Go-GPS can be unscrewed from the interface board with the screw driver provided as part of the Starter Kit content. Once unscrewed, the board-to-board flex cable can be connected between interface board and Monarch Go and Go-GPS.

  Picture with board-to-board flex cable connecting interface board to Monarch Go and Go-GPS:

- Connecting a serial terminal to the COM port mapped on a “Debug UART” of the Starter Kit, will allow you to access to the Starter Kit console. The console is a maintenance window, not necessary for regular operations, however it is useful to have it during maintenance phases, such as Firmware

upgrade or to observe the boot messages after hitting the reset button.



Console Window

Sequans Monarch Go-GPS

Datasheet
and
Hardware Integration Guide

Application Note

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Document Revision History

Revision	Date	Description
1.2	October 2019	First edition
1.3	November 2019	Section 1.5: corrected Orderable Part Number table

Table of Contents

Document Revision History 3
Table of Contents 4
Introduction 5
1. Product Datasheet 5
1.1. General Description 5
1.2. Applications 5
1.3. System Architecture 5
1.4. Mechanical Overview 6
1.5. Product Characteristics 7
1.6. Digital board-to-board connector 9
1.7. Electrical 10
1.8. Environmental 10
1.9. Mechanical drawings 11
1.10. Certifications 12
1.11. Export Control Certification Number (ECCN) 12
2. Integration guideline 14
2.1. Digital connector 14
2.2. Physical integration 16
2.2.1. Placement without flex cable 16
2.2.2. Placement with flex cable 17
2.3. Functional testing 17
2.4. Configuration 18
3. VzW SIM sign-up procedure 19
4. Troubleshooting 26
4.1. Replacing the SIM card 26
4.1. Connecting a RF cable to LTE connector 27

Introduction

This application note is intended to help customers to successfully integrate and test their product based on Monarch Go-GPS. It presents the datasheet of Monarch Go-GPS device and the integration guidelines for:

- All interface requirements of Monarch Go-GPS with customer's host board and device
- Tips and "how-to"s for testing and troubleshooting

This document summarizes product datasheet and proposes a development process aiming at reaching optimal performance and quality of customer's design. It is recommended to follow the steps in the order presented in this document.

This document is divided in three sections:

- Product datasheet
- Hardware and software design guidelines
- Bring-up verification and test

1. Product Datasheet

1.1. General Description

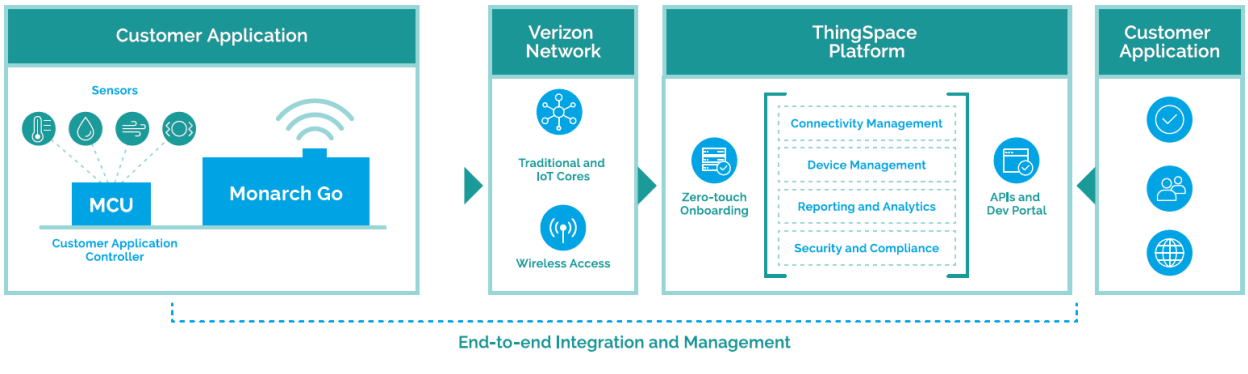
Monarch Go-GPS connected by Verizon is a comprehensive modem component offering device makers the shortest possible route to market and lowest total cost of ownership (TCO) to develop a cellular-IoT connected device. Unlike traditional cellular modules, it is certified by Verizon as an end-device avoiding costly lab testing while improving time-to-market thanks to a reduced effort for board design. It completely removes the need to design and tune a cellular antenna as it embeds an optimized LTE antenna, saving months of design effort and lab testing. Monarch Go-GPS comes with a pre-installed ThingSpace IoT SIM and gives device makers the simplest, easiest, and most cost-effective solution for developing IoT devices for operation on Verizon's network --- simply plug it in and go.

1.2. Applications

Monarch Go-GPS is perfectly suited for a broad range of IoT applications, including telemetry, vending machines, agriculture sensor applications, asset and transportation trackers, hardware tools, and home security monitoring applications

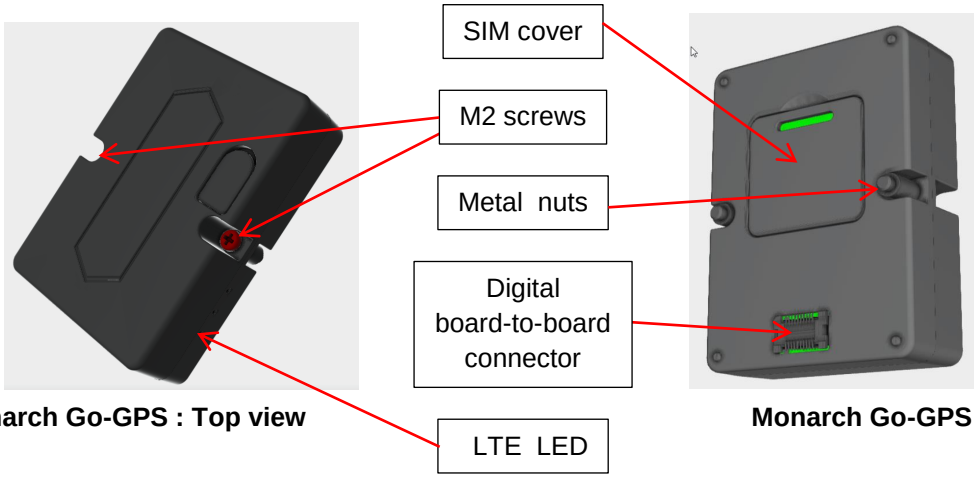
1.3. System Architecture

Customer IoT devices are typically designed with a MCU and a set of sensors. This MCU connects to Monarch Go-GPS through a serial UART interface and can exchange data with a cloud server using Verizon LTE network. The cloud server and the MCU are where the customer application runs. The lifecycle of the LTE cellular connectivity is managed through Verizon ThingSpace platform.



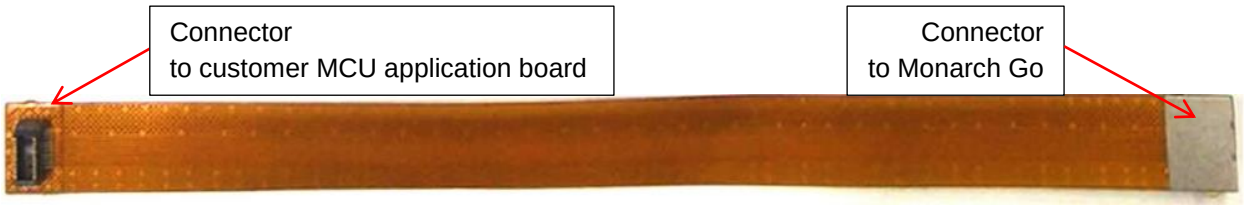
1.4. Mechanical Overview

- Monarch Go-GPS dimensions: 35 mm (1.38”) x 50 mm (1.97”) x 14.95 mm (0.59”)
- Plastic enclosure, black colour
- Fixable with two M2 screws and two metal nuts soldered on customer’s PCB
- Verizon ThingSpace SIM pre-installed (3FF)
- Embedded LTE & GNSS antenna
- LED for modem activity
- Low profile 20-pin digital board-to-board connector to connect customer MCU application controller
- Optional board-to-board flex cable 150 mm (5.9“) between Monarch Go-GPS and customer MCU application board. Orderable separately
- 16 g weight



Monarch Go-GPS : Top view

Monarch Go-GPS : Bottom view



Board-to-board flex cable (optional)

1.5. Product Characteristics

LTE	Release 13 Cat-M1, 375 kbps uplink and 300 kbps downlink (peak)	
Internal antenna	band13 (700c)	TRP: 16dBm(1) TIS: -99dBm(1)
	band 4 (1700/2100 AWS)	TRP: 18dBm(1) TIS: -100dBm(1)
	radiation pattern	Omnidirectional
	polarization	Linear
PSM	default value	Disabled
eDRX	default value	Disabled
RRC Idle	default value	Set by network - 1.28s cycle
cDRX	disabled	
SMS	send and receive SMS in RRC Idle, eDRX and PSM mode.	
APN	default value	Set by network IPV4V6
SUPL (2)	e-CID supported with Verizon SUPL-ECID assistance server or third party ECID servers A-GNSS assisted by Verizon LBS/aGPS SUPL server: <5m accuracy	
Verizon Thingspace	Supported services	LWM2M(3): FOTA, Diagnostics
Roaming	default value	Disabled
Modem control from external MCU	support for UDP, TCP, TFTP, FTP, HTTP, HTTPS, MQTT or MQTTS through AT commands	
SIM	Verizon ThingSpace IoT SIM card pre-installed, 3FF	
LED	default value	LTE activity. Disabled
Digital interfaces (1.8V)	Main interface	UART1 4-wires interface (RXD, TXD, RTS, CTS) is the main interface for controlling Monarch Go-GPS from an external processor, typically a MCU, with AT commands. The default baudrate is 115200kbps with hardware flow control (RTS/CTS)
		RING signals the availability of URC from Monarch Go-GPS modem and can be used to wake-up the MCU on the host board
		Optional: WAKE : this signal can be used to wake-up Monarch Go-GPS from the MCU on the host board. This function is disabled by default
		Optional: POWER_STATUS : this signal indicates to the Host Board that Monarch Go-GPS is in low power mode (sleep mode or deep sleep mode) when signal is low
	Debug interface	UART2 2-wires interface (RXD/TXD) with default baudrate of 115200kbps for console port. Hardware flow control RTS/CTS is disabled by default. UART0 4-wires (RXD/TXD/RTS/CTS) with default baudrate of 921600kbps configured for AT commands.

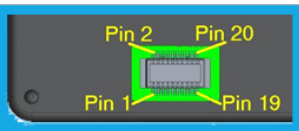
Notes:

(1) TIS/TRP performance is met when design recommendations are followed for optimal antenna placement. These values are applicable to A2 hardware version.

(2) Additional charges might apply. Contact Verizon or third party server vendor for commercial offer.
(3) Not supported with GM01Q-Go-A1

Orderable Part Number	**Item description**	**Hardware version**	**UE software version**	**Product status**
GM01Q-Go-GPS-A2	Monarch Go-GPS Starter Kit	REV2	SR1.2.0.0-LTE-10400	Engineering samples
GM01Q-Go-GPS-A2	Monarch Go-GPS Starter Kit	REV3	Will be provided in a future edition of the document.	Volume production
GGA2NAZQZZ	Monarch Go-GPS	REV3	Will be provided in a future edition of the document.	Volume production
Will be provided in a future edition of the document	150mm flex cable	REV2	Not applicable	Volume production

1.6. Digital board-to-board connector

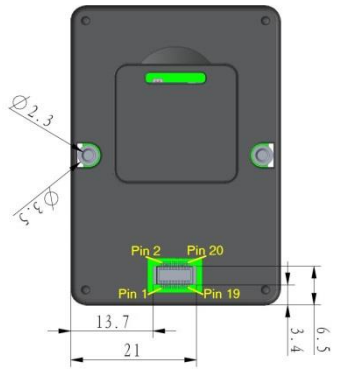


Monarch Go board-to-board connector
reference: MOLEX 53916-0208

number (1)	Direction	Pin name	Function	Description	Power group	State @reset	Pull-up on host board (2)
1	IN	VCC	Power supply	Voltage level 3.1V to 5.5V	n/a	n/a	
2	IN	GND	Ground		n/a	n/a	
3	IN	GND	Ground		n/a	n/a	
4	IN	nRESET	Reset	Reset signal. Active low.	3.1V	In, PU	
5	IN	UART1_TXD	Main UART1 TXD	Main UART: Host board sends data to Monarch Go.	1.8V	In, PU	
6	OUT	UART1_RXD	Main UART1 RXD	Main UART: Monarch Go sends data to Host board.	1.8V	In, PU	
7	IN	UART1_RTS	Main UART1 RTS	Main UART: Hardware flow control signals. Active low.	1.8V	In, PU	
8	OUT	UART1_CTS	Main UART1 CTS		1.8V	In, PU	
9	OUT	RING	RING signal	This signal indicates a URC from Monarch Go and shall be read by host board. Active low.	1.8V	In, PU	
10	IN	WAKE	Wake-up signal	Optional: wake-up Monarch Go from host board. Not set as a wake-up source by default. When enabled by AT command, active high or low level with minimum 100us period.	1.8V	In, PD	
11	OUT	POWER_STATUS	Power Saving Status	Power Saving status of Monarch Go: a high level indicates that Monarch Go is in active mode. A low level indicates that Monarch Go is in low power modes (sleep mode or deep sleep mode) to minimize power consumption.	1.8V	In, PD	
12	IN	UART2_TXD	Debug UART2 TXD	Debug UART2. Data to Monarch Go. Connect to headers.	1.8V	In, PU	
13	OUT	UART2_RXD	Debug UART2 RXD	Debug UART2. Data from Monarch Go. Connect to headers.	1.8V	In, PU	
14	IN	UART2_RTS	Debug UART2 RTS	Debug UART2: Hardware flow control signals. Active low. Connect to headers.	1.8V	In, PU	
15	OUT	UART2_CTS	Debug UART2 CTS		1.8V	In, PU	
16	OUT	GPS_UART1_RXD	Debug GPS UART1 RXD (3)	GPS debug UART1, data for GPS console . Connect to headers.	3.1V	In, PU	
17	IN	GPS_UART1_TXD	Debug GPS UART1 TXD (3)		3.1V	In, PU	
18	na	DNC18	Internal signal (3)	Internal signal; Do not connect.	1.8V	In, HiZ	
19	OUT	GPS_UART2_RXD	Debug GPS UART2 RXD (3)	GPS debug UART2. Connect to headers.	3.1V	In, PU	
20	IN	GPS_UART2_TXD	Debug GPS UART2 TXD (3)		3.1V	In, PU	

Notes :

(1) The pin number “1” is located on the side nearest the outer edge of the plastic case as described below:



(2) "Y" in this column means that a pull-up to an always-on 1.8V voltage supply with typical 100kOhm resistor is mandatory on host board as Monarch Go-GPS pin will become high impedance when Monarch Go-GPS is in low power mode. Not soldering this pull-up resistor on host board will lead to non-functional behavior, such as loss of UART serial communication.

(3) The functions of the pin number “16” to “20” have been changed vs. the digital board-to-board connector of the Monarch GO (LTE Only).

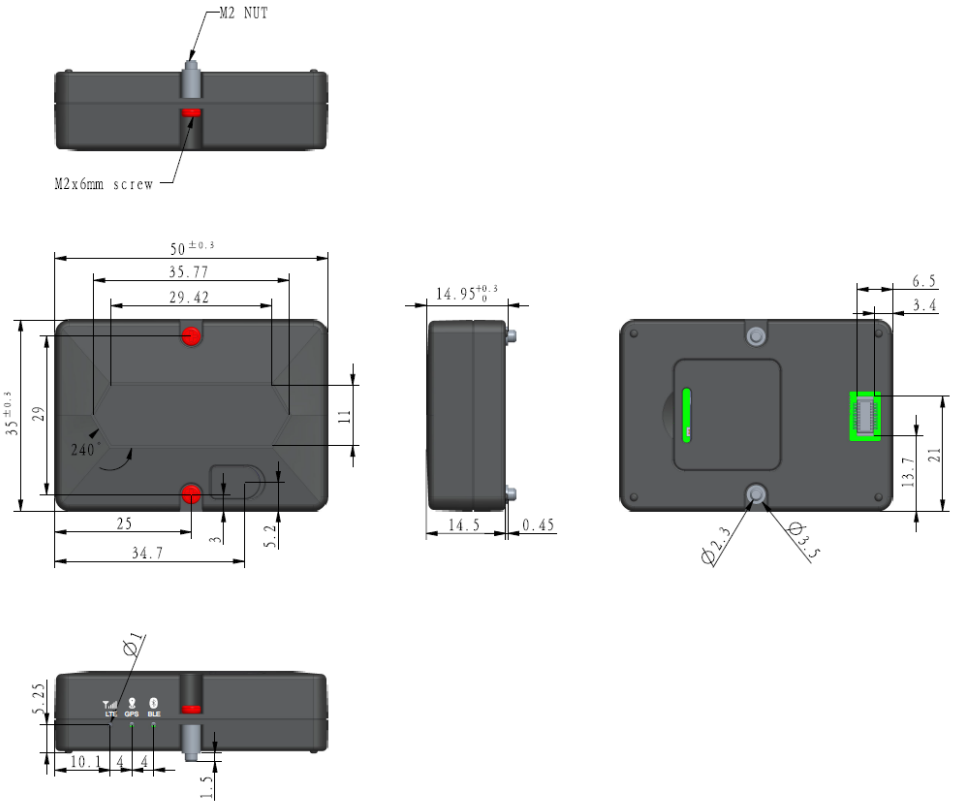
1.7. Electrical

- VCC:
  - operating voltage supply — min 3.1 V - max 5.5 V
  - VCC power supply dimensioning — peak 2.0 W
- DC characteristics for digital I/O1.8V power group (UARTs and other signals)
  - V_{IH} Input High Voltage — min 1.26 V - max 3.6V
  - V_{OH} Output High Voltage — min 1.35 V - max 1.8V
- Power Consumption (typical, VCC=3.8 V)
  - Deep sleep mode, PSM — 1uA
  - eDRX 81.92s — 300uA
  - RRC Idle 1.28s — 2.1mA
  - Receive, max throughput — 150mA
  - Transmit, max throughput, +23dBm — 230mA

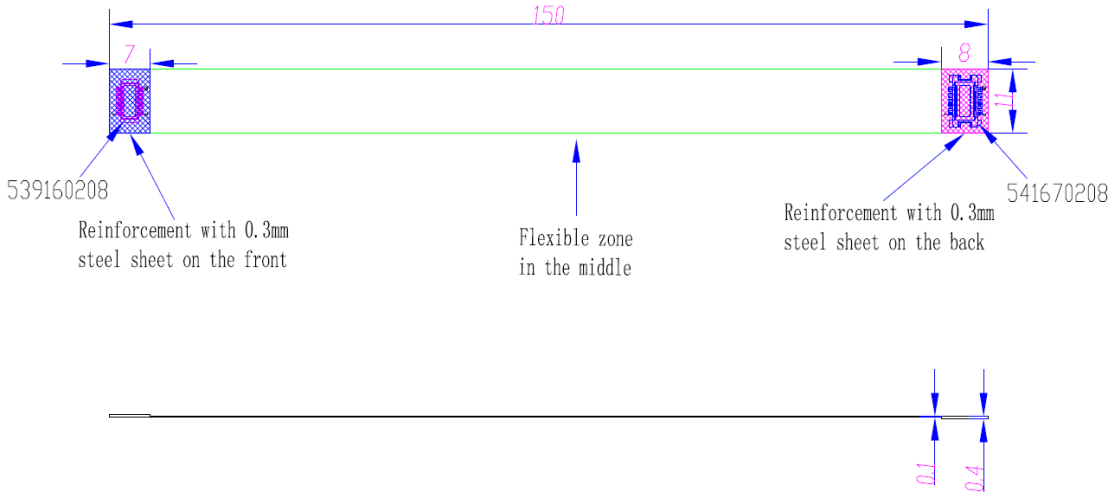
1.8. Environmental

- Compliant with RoHS directive EU 2015/863
- Temperature
  - Operating (board) — -40° C to +80° C
  - RF compliant (ambient) — -30° C to +60° C
  - Storage — -40° C to +85° C
- Humidity
  - Operating — 10% to 85% (non condensing)
  - Storage — 5% to 85% (non condensing)

1.9. Mechanical drawings



Monarch Go-GPS - A1 hardware version
(dimension in mm)



150mm flex cable - A1 hardware version
(dimension in mm)

1.10. Certifications

The certifications will apply to Monarch Go-GPS – A2 hardware version.
The A1 hardware version is for engineering samples and will not pass certifications.

Verizon certification	Verizon Open Development Device Certification LTE cat-M1, band 13 and band 4(*) Certification ID: it will added in future version
Regulatory approval	FCC part 15 / ISED LTE band 13 and band 4 FCC-ID: 2AAGMGMQGOA IC: 12732A-GMQGOA

(*) Initial certification is band 13 only. Band 4 will be available with a software upgrade.

1.11. Regulatory Approval

1.11.1. FCC statement

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

RF exposure safety

This device complies with the FCC RF exposure limits and has been evaluated in compliance with **mobile** exposure conditions.

The equipment must be installed and operated with minimum distance of 20 cm of the human body.

Class B device notice

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

—Reorient or relocate the receiving antenna.
—Increase the separation between the equipment and receiver.
—Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
—Consult the dealer or an experienced radio/TV technician for help.

1.11.2. IC Industry Canada Statement

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Les changements ou modifications non expressément approuvés par la partie responsable de la conformité peuvent annuler le droit de l'utilisateur à utiliser l'équipement.

This device complies with ISED license-exempt RSS(s). Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Cet appareil est conforme aux RSS exempts de licence d'ISDE. Son fonctionnement est soumis aux deux conditions suivantes: (1) Cet appareil ne doit pas provoquer d'interférences nuisibles et (2) cet appareil doit accepter toute interférence reçue, y compris les interférences susceptibles de provoquer un fonctionnement indésirable.

Permitted Antenna

This radio transmitter has been approved by the ISED to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet émetteur radio a été approuvé par l'ISDE pour fonctionner avec les types d'antennes listés ci-dessous avec le gain maximum autorisé indiqué. Les types d'antennes non inclus dans cette liste, ayant un gain supérieur au gain maximum indiqué pour ce type, sont strictement interdits pour une utilisation avec cet appareil.

RF exposure safety

This device complies with ISED RF exposure limits and has been evaluated in compliance with **mobile** exposure conditions.

Cet appareil est conforme aux limites d'exposition RF d'ISDE et a été évalué conformément aux conditions d'exposition mobile.

The equipment must be installed and operated with minimum distance of 20 cm of the human body.

L'équipement doit être installé et utilisé à une distance minimale de 20 cm du corps humain.

CAN ICES-003 (B)

This Class B digital apparatus complies with Canadian ICES-003

Cet appareil numérique de classe B est conforme à la norme ICES-003 du Canada

1.12. Export Control Certification Number (ECCN)

ECCNs are five character alpha-numeric designations used on the Commerce Control List (CCL) to identify dual-use items for export control purposes. An ECCN categorizes items based on the nature of the product, i.e. type of commodity, software, or technology and its respective technical parameters.

- ECCN of Monarch Go-GPS is 5A992.c. CCATS number is G175554.

The following comment from licensing officer is reported on the license information:

- This encryption item is described in paragraph B to note 3 (mass market note) of category 5 part 2. It is authorized for export and re-export under section 740.17(B)(3) of the export administration regulations (EAR).

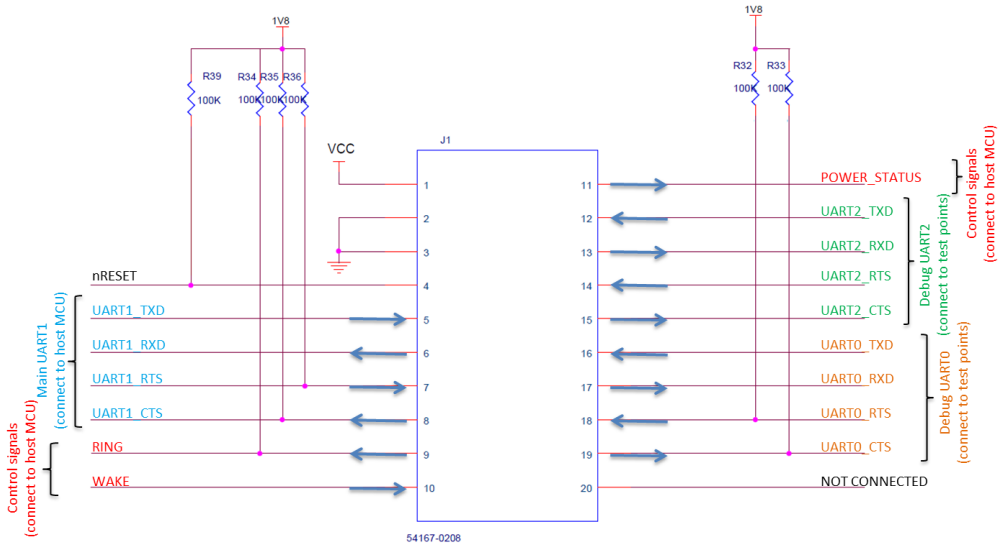
2. Integration guideline

2.1. Digital connector

Monarch Go-GPS device will interface to the Host Board through a board-to-board digital connector :

- Customer shall design a host board with the connector part number 54167-0208 from Molex as described in below figure. The datasheet can be obtained searching Molex web site (https://www.molex.com) with this part number.
- Monarch Go-GPS is shipped with a digital connector, its part number is 53916-0208 from Molex

It is mandatory to add pull-up resistors on host board as per below figure:



Example schematic of host board with connector to connect Monarch Go-GPS

The mandatory electrical interfaces between Monarch Go-GPS and the host board are:

- Supply (VCC) min 3.1 V - max 5.5 V. The supply shall support up to 2 Watts peak even if the average power consumption is significantly lower.

- Ground
- nReset: Monarch Go-GPS device will reset every time this signal goes low. The host board shall maintain this signal high (min 1.26V and max 3.6V) during Monarch Go-GPS operation
- UART1 4-wires interface (RXD, TXD, RTS, CTS) is the main interface for controlling Monarch Go-GPS from an external processor, typically a MCU. The default configuration is:
    - Baud rate : 115200
    - Data : 8 bit
    - Parity : None
    - Stop : 1 bit
    - Flow control : hardware (RTS/CTS)
- RING signals the availability of URC from Monarch Go-GPS modem and can be used to wake-up the MCU on the host board

Warning: The host board shall be compliant with below voltage levels:

- V_{IH} Input High Voltage (UART1 TXD/RTS) min 1.26 V - max 3.6V
- V_{OH} Output High Voltage (UART1 RXD/CTS and RING) min 1.35 V - max 1.8V

If the MCU on host board is capable of 3V only but not 1.8V, level shifters shall be added on UART1 RXD/TXD/RTS/CTS and RING.

The optional electrical interfaces between Monarch Go-GPS and the host board are:

- WAKE : this signal can be used to wake-up Monarch Go-GPS from the MCU on the host board. This function is disabled by default and can be enabled with AT command. Its polarity is also programmable:
    - AT+SQNHWCFG:"wake0", 0, 0 : enabled, active low level
    - AT+SQNHWCFG:"wake0", 0, 1 : enabled, active high level
    - AT+SQNHWCFG:"wake0", 1 : disabled.
- POWER_STATUS : this signal indicates to the Host Board that Monarch Go-GPS is in low power mode (sleep mode or deep sleep mode) when signal is low.

Warning: the host board shall be compliant with below voltage levels:

- V_{IH} Input High Voltage (WAKE) min 1.26 V - max 3.6V
- V_{OH} Output High Voltage (POWER_STATUS) min 1.35 V - max 1.8V

If the MCU on host board is capable of 3V only but not 1.8V, level shifters shall be added on WAKE and POWER_STATUS.

The following signals shall be added to test points on host board for debug purpose:

- UART2 2-wires RXD/TXD is a console port. Default configuration :
    - Baud rate : 115200
    - Data : 8 bit
    - Parity : None
    - Stop : 1 bit
    - Flow control : None (no RTS/CTS)

  Note: hardware flow control (RTS/CTS) is disabled by default even if signals are present on the connector.
- UART0 4-wires RXD/TXD/RTS/CTS is configured for AT commands. Default values:
    - Baud rate : 921600
    - Data : 8 bit
    - Parity : None
    - Stop : 1 bit
    - Flow control : hardware (RTS/CTS)

Warning: the voltage levels for these signals are:

- V_{IH} Input High Voltage (UART2 and UART0 TXD/RTS) min 1.26 V - max 3.6V
- V_{OH} Output High Voltage (UART2 and UART0 RXD/CTS) min 1.35 V - max 1.8V

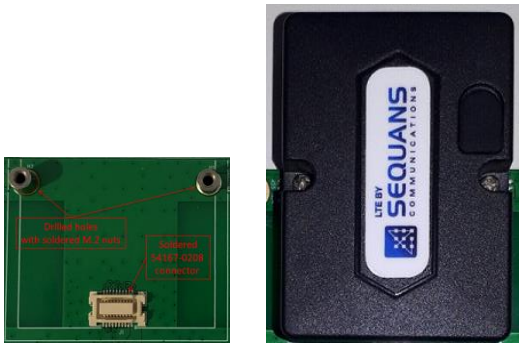
2.2. Physical integration

2.2.1. Placement without flex cable

When Monarch Go-GPS is connected directly on host board, the host board shall be designed with

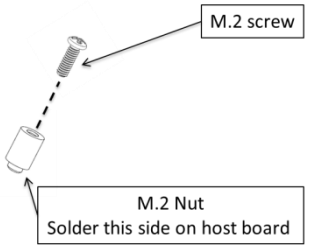
- 2 holes to solder the M.2 nuts
- the board-to-board connector

An example of host board layout is illustrated below:



Host board (top view)
without Monarch Go-GPS (left) and with Monarch Go-GPS (right)

The M.2 nuts are made of metal and are aimed at ensuring physical and grounding connection between the host board and Monarch Go-GPS thanks to two M.2 screws and nuts.



M.2 nut and M.2 screw

The exact position of the drilled holes and the connector on Host Board shall match the dimensions given in document “Monarch Go-GPS Mechanical drawing-2d-enclosure-drawing-0726_A1.pdf”. Placement on Host Board is critical to correctly fit Monarch Go-GPS to the Host Board.

- The dimension of the M.2 nuts are given in document “Monarch Go-GPS Mechanical drawing-2d-SMT-NUT-M2x5_A1.pdf”. The nuts are shipped with Monarch Go-GPS .

- The dimension of the M.2 screws are given in document “Monarch Go-GPS Mechanical drawing-2d-Screw-M2X6-Model_A1.pdf”. The screws are shipped with Monarch Go-GPS .
- The footprint of the connector 54167-0208 is given in Molex datasheet available from their web site.

Note: customer can add anti vibration thread locking adhesive to the 2 screws for higher resistance to vibration.

Warning: In order to get optimal antenna performance, no metal plate shall be located above Monarch Go-GPS embedded LTE antenna as described on this figure:

2.2.2. Placement with flex cable

The optional flex cable can be used between the connector of the Host Board and the connector of Monarch Go-GPS , allowing positioning Monarch Go-GPS away of the host board.

- The position of the connector on the Host Board does not have to follow the guidance of section 2.2.1 when the flex cable is used, it gives more flexibility in Host Board design.
- The M.2 screws shall be screwed into the nuts to ensure that Monarch Go-GPS ’s plastic enclosure will is correctly assemble and can resist to vibration.

In order to get optimal antenna performance, the design shall follow below guidelines:

- It is recommended to solder the nuts to a large PCB with ground plane
- If this is not possible, the nuts shall be soldered to wires connected to ground, or the nuts can be replaced by bolts to connect to a drilled metal plate. The objective is to improve grounding connection between Monarch Go-GPS PCB and an external ground plane, for optimal antenna performance.
- The best position of Monarch Go-GPS device into the end product can be estimated by using AT command AT+CSQ that reports signal strength. The position with lowest value (highest signal strength) is the best one.

Warning: In order to get optimal antenna performance, no metal plate shall be located above Monarch Go-GPS embedded LTE antenna as described on this figure:

2.3. Functional testing

Once Monarch Go-GPS is correctly assembled to the Host Board, the MCU can be used for functional testing. Sending AT command “ATI1” to UART1 will return Monarch Go-GPS software version:

```
UE5.2.0.1
LR5.2.1.0-xxxx
```

This will verify that the UART1 connection between Host Board MCU and Monarch Go-GPS is functional and correctly configured (voltage level, baud rate, hardware flow control).

The next step is to verify connectivity to Verizon network, this can be done typing AT+PING=www.sequans.com command.

2.4. Configuration

The default LTE LED behavior can be changed using AT+SQNLED, this is a persistent setting.

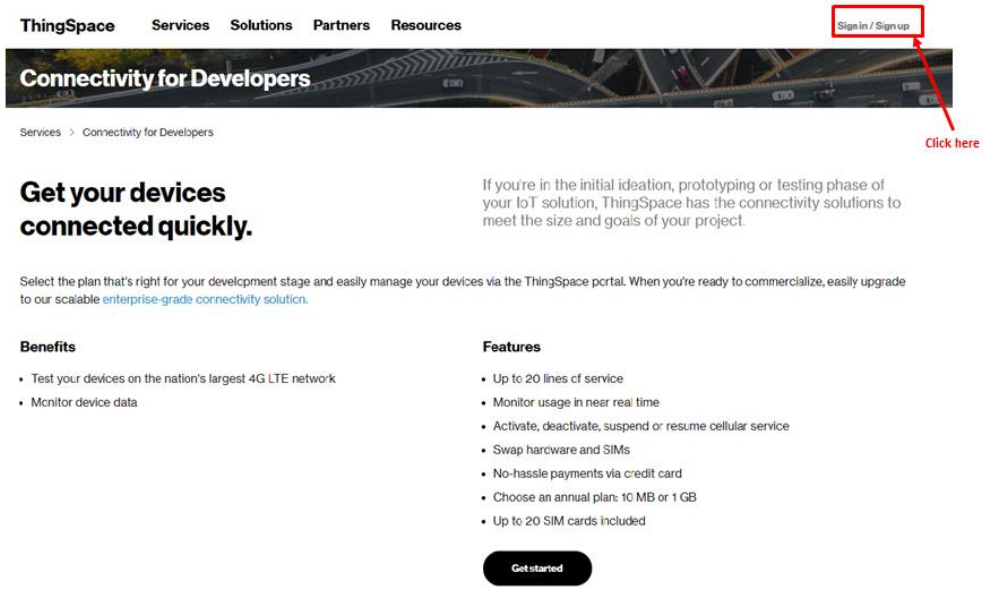
- AT+SQNLED=0 : Set blink mode Off. The LED is switched off.
- AT+SQNLED=1 : Set blink mode On. The LED will blink according to the system state:
    - AT+CFUN=0 or 4. The modem is stopped or in Airplane mode. The LED is permanently turned off.
    - AT+CFUN=1. LTE data transfer. The LED is permanently turned on.
    - AT+CFUN=1. The modem is registered to the network, no data transfer (modem is in RRC Idle). The LED blinks (typically 1280 ms on, 3840 ms off).
    - AT+CFUN=1. Limited Network Service (no SIM, network search). The LED blinks (typically 500 ms on, 500 ms off).
    - AT+CFUN=1. The modem is in sleep or deep sleep mode (eDRX or PSM). The LED is permanently turned off.

3. VzW SIM sign-up procedure

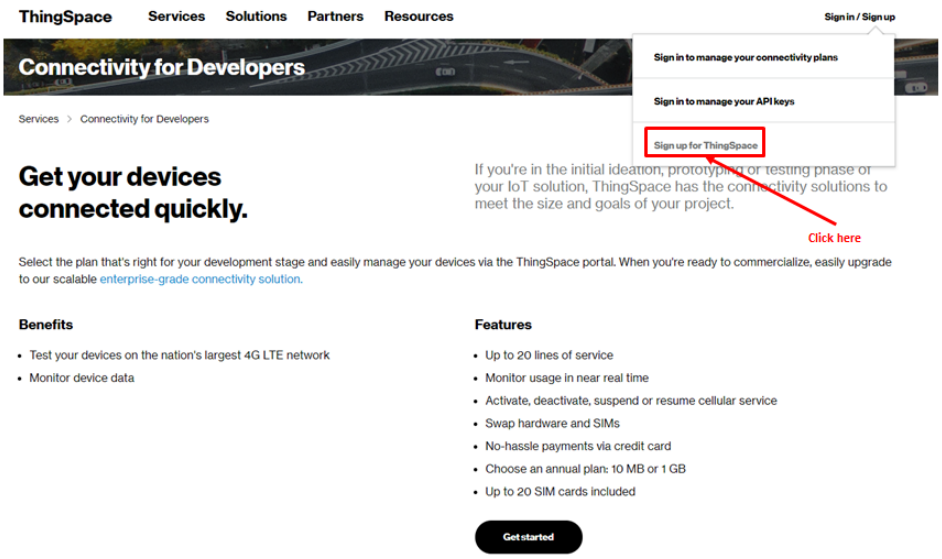
In order to sign-up to the VzW ThingSpace portal, you can go to the web page:
https://thingspace.verizon.com/service/connectivity-for-developers/

Then follow the below procedure.

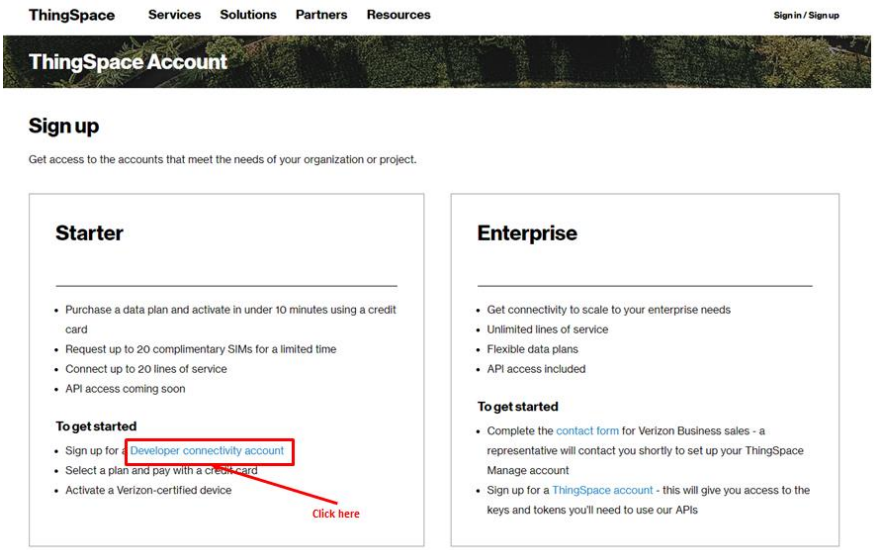
Step 1: Start the Signup procedure



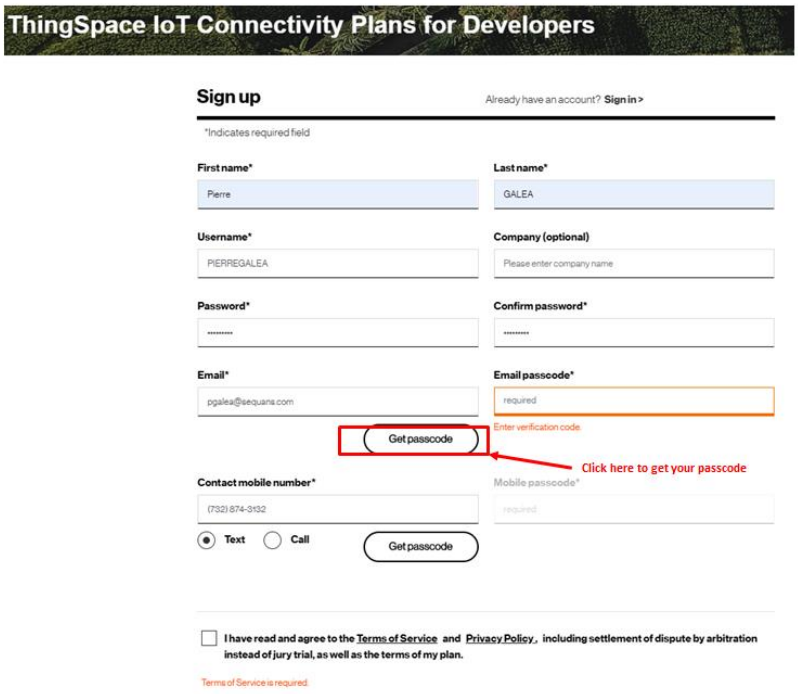
Step 2: select the ThingSpace signup procedure



Step 3: Signup for a developer connectivity account

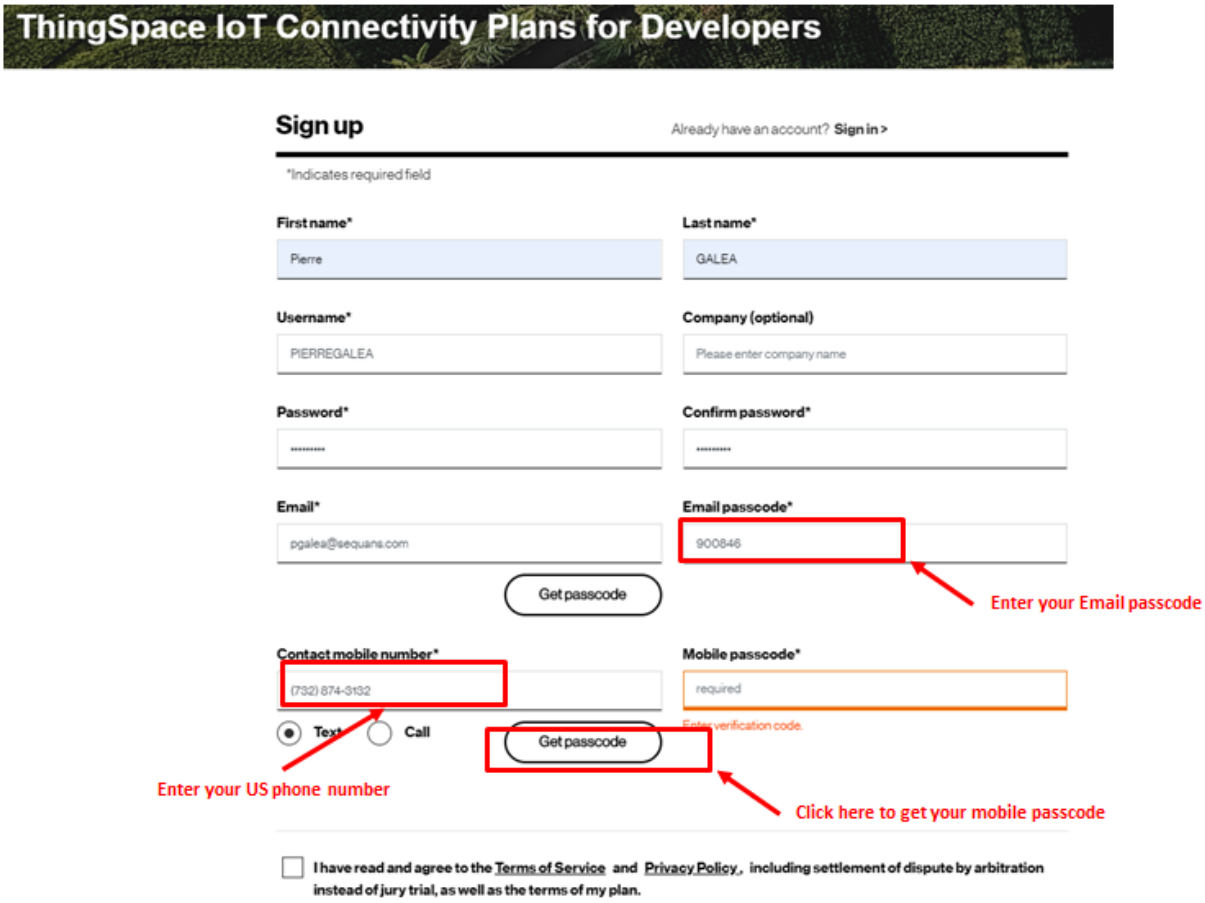


Step 4: Fulfill the required fields with your personal information and get your Email passcode



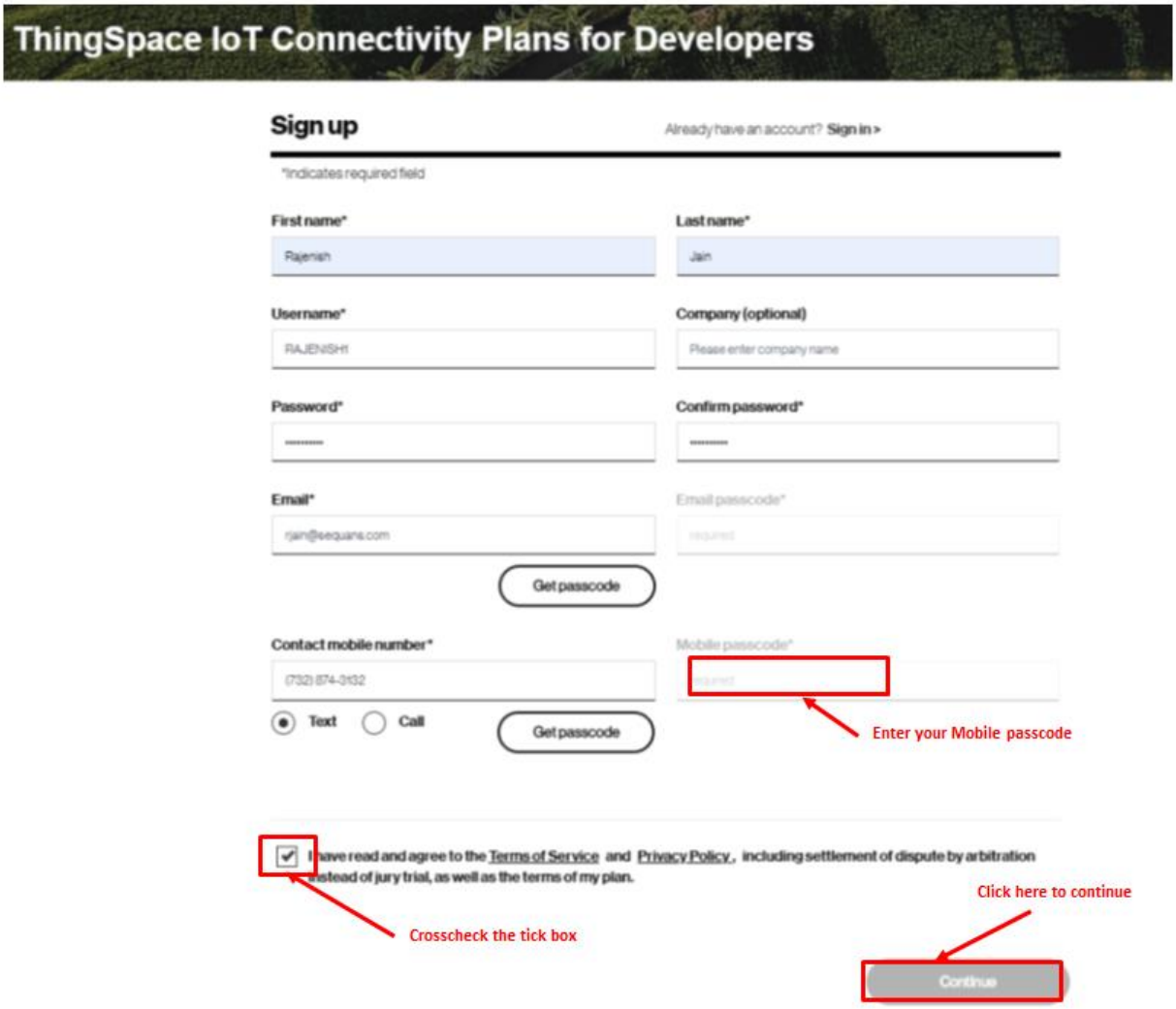
Your Email passcode will be sent to you by Verizon to your Email address.

Step 5: Enter your US phone number and get your Mobile passcode



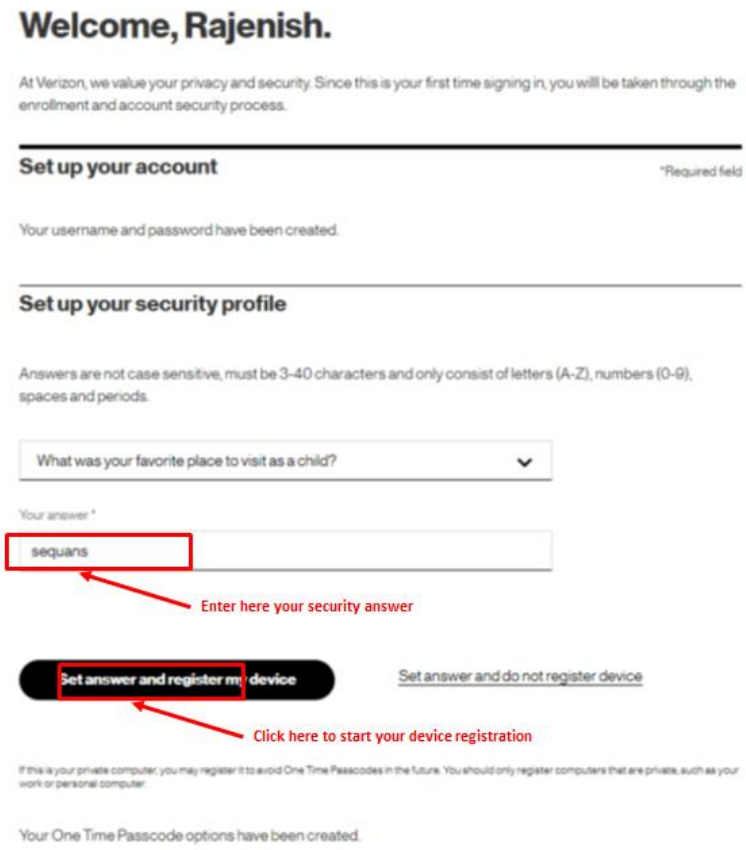
Your Mobile passcode will be sent to you by SMS on your mobile phone.

Step 6: Enter your email passcode and mobile passcode and get your ThingSpace credentials

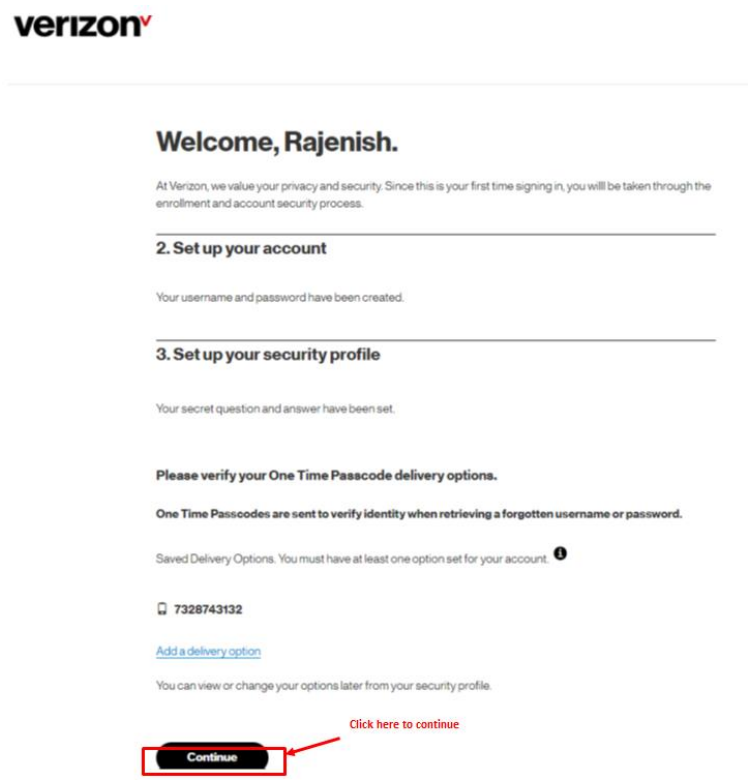


Your ThingSpace credentials will be sent to you by email and SMS.

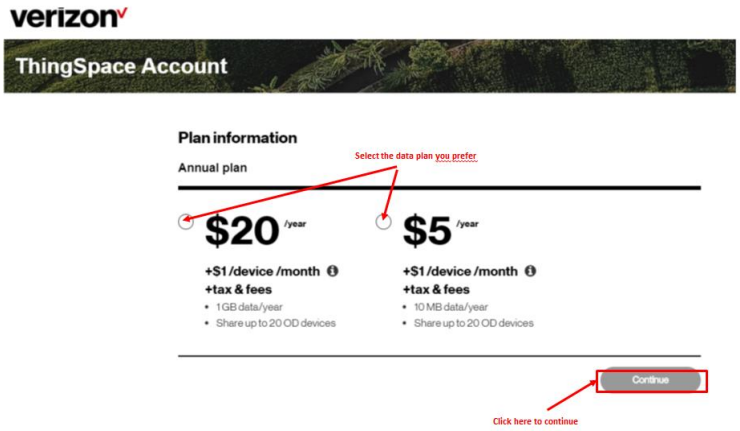
Step 7: create your security profile and launch the registration of your device



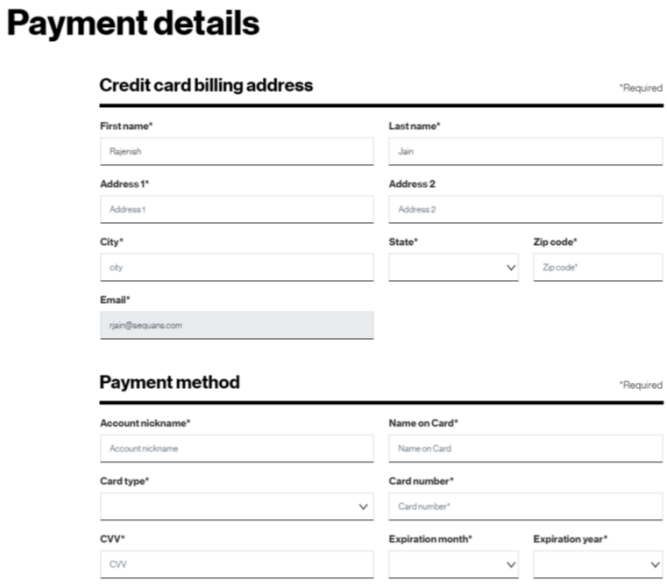
Step 8: Verify and approve your security profile and go ahead



Step 9: Select your preferred data plan



Step 10: provide your payment detailed and get your device register

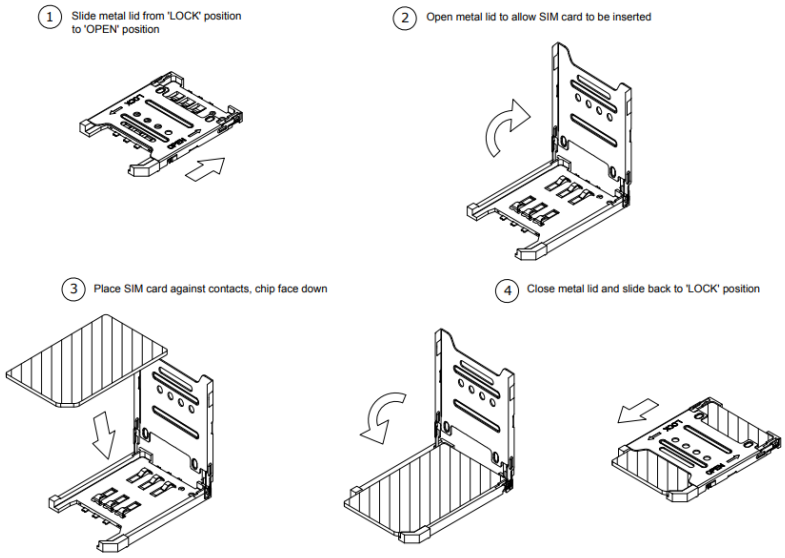


After this step, your device will be register in the Verizon ThingSpace platform, ready to use ThingSpace services.

4. Troubleshooting

4.1. Replacing the SIM card

The SIM card can be removed and replaced after opening Monarch Go-GPS enclosure (bottom). When the SIM connector is visible, follow the below steps:



4.1. Connecting a RF cable to LTE connector

Monarch Go-GPS has an SWG_VE series RF connector for LTE signal. It is located inside the enclosure. Once you remove the mechanical protection (top), you can connect a RF cable reference MXHQ87WA3000 orderable from Murata. This connector can be used for debug purpose. It is not intended to be used in operating mode.