Uplynx

AT Command GUI

and

EasyAT Users Manual

Elite Semiconductor Memory Technology Inc.

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Revision Control

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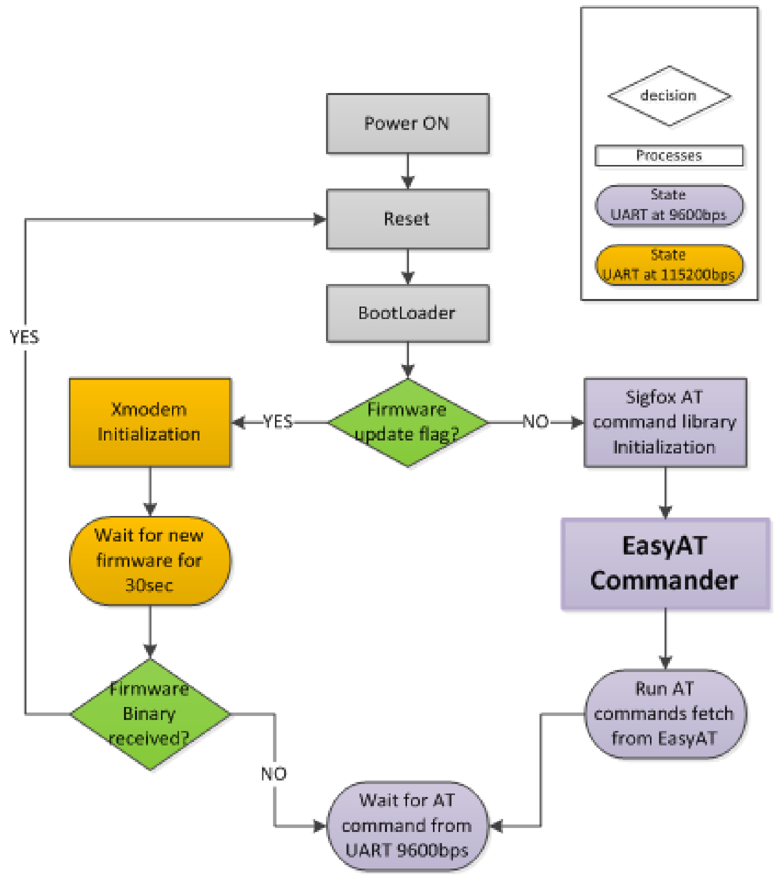
Table of Contents

1 *Document Overview*

The M2COMM's flagship Uplynx M2C8001 SOC is designed for Sigfox uplink communications, ensuring high performance and low cost at the same time.

The Uplynx M2C8001 supports RCZ1 and RCZ2/4 deployment at a minimal BOM cost due to its high efficiency embedded power amplifier which delivers up to 23dBm across the band.

The 128kB flash is preloaded with the Sigfox Ready^{TM} AT command interface and an innovative simple AT command application named EasyAT commander. This ensures minimal development effort without the user having to worry about a development platform, compiler tool-chain and flash burner. This enables fast and easy development of applications for simple Sigfox products.



Bootup Sequence of M2C8001

To help the user understand the Sigfox specific AT command interface and operation of the Uplynx-M-RCZx modules, M2COMM has implemented an intuitive GUI that is integrated with all the essential features provided by Uplynx-M-RCZ1 and Uplynx-M-RCZ24 modules.

This document will describe the functions and operation of the GUI and the EasyAT commander operation.

M2COMM GUI version: v1.1.3

2 *Uplynx Preloaded Software*

The Uplynx-M-RCZx is loaded with the following software prior shipping:

1. Sigfox Verified™ Application
2. Bootloader
3. Device ID, KEY and Portable Access Code (PAC)

The firmware version that was certified by Sigfox:
Firmware Version 20170109_101451
SIGFOX library version: UDL1-1.8.9

2.1 *Sigfox Verified™ AT Command*

The Uplynx-M-RCZx is designed to be compliant with the Sigfox uplink specification. The Sigfox Verified™ AT command set is a standard deliverable and is used to access the network. For API interface request, please contact our sales representatives.

The Uplynx-M-RCZx communicates with the host MCU over a UART interface. The UART interface is configured at 9600bps baud rate, 8-bit data, no parity bit, 1 stop bit and no flow control. When the AT command interface is running at startup, the pin STATUS will be pulled high.

The following AT commands are supported.

Command	Description	Value
AT$302=pwr	Set Tx power	Pwr = Tx power [14 to 22]
AT$302?	Get current TX power	Return Current transmission power setting
AT$400=v1,v2,v3,v4	Set Sigfox configuration word for RCZ2 and RCZ4 settings	v1 = config_words_0 v2 = config_words_1 v3 = config_words_2 v4 = default FCC Channel
AT$400?	Inquire the Sigfox configuration words	
AT$410=mode	Enable Public Key for emulator mode	Mode: 0-normal mode; 1- Public key enabled (emulator mode)
AT$SB=bitvalue	Send a bit value of 0 or 1	Bitvalue = 0/1
AT$SF=frame	Send payload data, 1 to 12 bytes	Frame: data bytes (0,1,2,3…C,D,E,F) to be sent, 12 byte maximum
AT$RC	SIGFOX_API_reset	
AT$ID?	Get device ID	return ID
AT$PAC?	Get device PAC	return PAC
AT$IF=freq	Set transmission frequency in Hz	e.g. 868000000
AT$IF?	Inquire current frequency setting	Return frequency in Hz

Command	Description	Value
AT$CW= freq, mode	Test mode with continuous wave emission	Freq: 868000000 mode: 0-disable; 1-enable
AT$CM= packetlength	Test mode with random data packet at fixed frequency	Packet length = number of bytes to be transmitted (1~26)
AT$V?	Read firmware information	
AT$O=mode, standard	Open Sigfox API library	Mode: 1 to load Sigfox library Standard: 1-RCZ1; 2-RCZ2; 4-RCZ4
AT$RCZ=standard	Sigfox library regional setting	Standard: 1-RCZ1; 2-RCZ2; 4-RCZ4
AT$RCZ?	Inquire Sigfox library regional setting	Standard: 1-RCZ1; 2-RCZ2; 4-RCZ4
AT$O?	Inquire Sigfox API library open or not	Mode: 1 to load Sigfox library standard: 0(EU)/1(US)
AT$OOB?	Get operation condition	Return values: [Battery voltage before active transmission in mV] [Battery voltage during active transmission in mV] [10x silicon temperature] e.g. 2650 [battery voltage 2.65V before transmission] 2550 [battery voltage 2.55V during transmission] 270 [27C silicon temperature]
AT$FW=mode	Firmware update mode	0: normal mode 1: update firmware with UART at 115200 After asserting the command, the device needs to be rebooted into XMODEM mode with UART speed of 115200bps. New binary can be loaded via XMODEM protocol over UART.
AT$GPIODIR=gpio, val	Set GPIO pin direction.	gpio = 1-GPIO0; 2-GPIO1; … , 6-GPIO5 val: 0-input (weak pull high); 1-output (input float)
AT$GPI=gpio	Return GPIO value	gpio = 1-GPIO0; 2-GPIO1; … , 6-GPIO5
AT$GPO=gpio, val	Set GPIO output high or output low	gpio = 1-GPIO0; 2-GPIO1; … , 6-GPIO5 val: 0(output low)/1(output high)

Command	Description	Value
AT$FEAT=page	Erase flash page	Page: 0 ~ 13 [EasyAT Commander related]
AT$SIO=port	Scan GPIO input values and execute relevant flash page	Port: 6-bit input for GPIO0 to GPIO5. A “1” represents the relevant GPIO input will be scanned. [EasyAT Commander related] e.g. port = “100000”, GPIO0 value is scanned and either GPIO0_Input(High) or GPIO0_input(Low) flash page will be executed [EasyAT Commander related]
AT$IFVTH=voltage	Set battery detection voltage threshold	Voltage supply is measured and the AT command on page 12 or page 13 will be executed if the voltage is lower and higher than the threshold respectively [EasyAT Commander related]
AT$DLY=count	No operation delay	Count: number of 100ms delays
AT$RFENA	Turns off the internal ADC after AT$OOB? and AT$IFVTH are used to minimize system current consumption	Value: 0 – Disable internal ADC
AT$SAVE	Saves all settings to flash, values will be retained after power off	

2.2 *Bootloader*

The preloaded bootloader allows the user to reprogram the flash in the SOC. To enter the firmware update mode, user can

I. Pull pin 16 low at startup (i.e. the STATUS pin of module)
On start up, the bootloader polls the module “STATUS” pin which is pin 16 of the SOC. If the pin is logically low, the UART on the SOC is configured as 115200bps and the bootloader is waiting for firmware via XMODEM. User can then upload the application binary file to the SOC via XMODEM. The application will be stored at the application startup address and be uploaded after the system is rebooted. Details can be found in the “Uplynx Software Development Kit User Guide”. Since the “STATUS” pin is an output pin at normal operation, it is important to ensure the pin is NOT pulled down by the application circuit during normal startup.

II. Enter AT$FW=1 when the Sigfox verified AT command interface is uploaded, the module enters XMODEM mode after the AT$FW command is asserted. The speed of UART is configurable to 115200bps. The new firmware is to be transmitted via XMODEM protocol over UART and will be installed automatically. Upon successful update, the new firmware will be uploaded on the next reboot.

2.3 *Device ID, KEY and Portable access code*

As part of the Sigfox operation requirements, each Sigfox device must be assigned a unique identification number (ID), encryption key (KEY) and portable access code (PAC). This information is preloaded in the module and only the ID and PAC can be read via AT command.

3 *Uplynx Sigfox AT command GUI*

3.1 *Getting Connected*

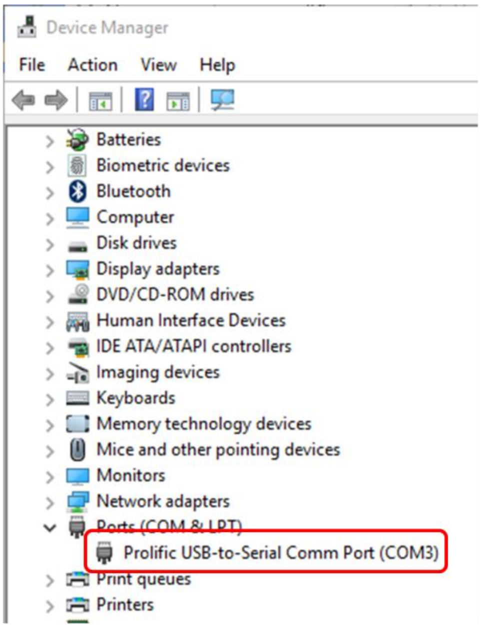
Uplynx is preloaded with the Sigfox Ready[TM] application. The Sigfox AT command can be passed from host processor via the UART interface. The UART interface on Uplynx is connected to a USB-UART interface IC Prolific PL2303.

To access the UART port on Uplynx from a computer, the corresponding driver must be installed.

Instructions and drivers can be downloaded from the "Prolific" website:

http://www.prolific.com.tw/US/ShowProduct.aspx?p_id=225&pcid=41

The driver installation wizard will be initiated when the Uplynx evaluation board is plugged into the USB port on the computer. After the installation is complete, a Profilic USB-to-Serial Comm Port will appear in the Windows device manager as shown below. The COM Port index is also indicated just after "COM". In this case, the device is attached to COM3.



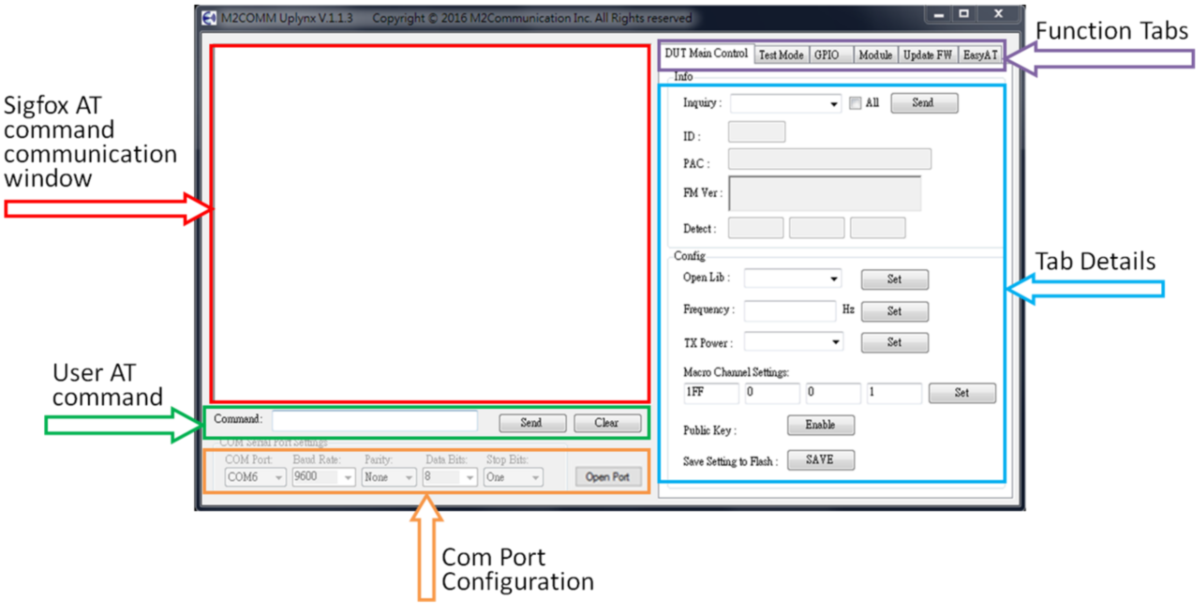
3.2 *Getting Started*

Download the M2COMM GUI interface from the following location:

ftp://118.99.219.153/

Username: user
Password: m2comm

On running the application "M2C_Uplynx_vx.x.x.exe", the main window will open as shown below:



The GUI provides easy access to all the features of M2COMM's Sigfox AT command application.

The GUI is divided into several key sections:

- Sigfox AT command communication window:

  This window displays a record of the AT command communications between the GUI and either an Uplynx-M-RCZx module or an Uplynx M2C8001 SOC when they are connected via the COM port. A simple button push within the GUI allows users to match specific actions with their corresponding AT commands. The AT commands can be copied directly from the communication window to the development platform, ensuring that the module or SOC are configured the same way.
- User AT command box:

  Allows user to key in the required AT command directly in the space provided, clicking on the "***Send***" button will transfer command directly to the module or SOC.
  Command is cleared by clicking on the "***Clear***" button
- COM port configuration

  Allows user to configure the COM port through which the module or SOC communicates with the computer. If the user plugs the evaluation kit into the USB port and has installed the USB-COM drivers, the correct COM port will be preset. The M2COMM Sigfox AT command application communicates via the UART port at 9600bps, no parity bit, 8 data bits and 1 stop bit.

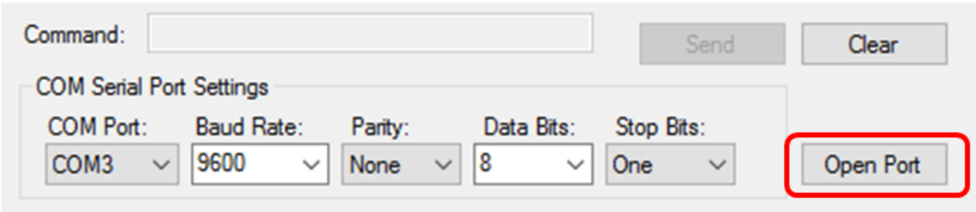
- Function Tabs:

  The function tabs give the user access to the following features;

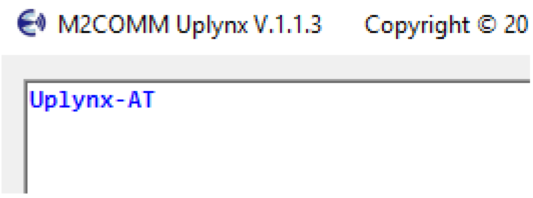
  DUT Main Control
  Test Mode
  GPIO
  Module
  Update FW
  EasyAT

- Function tab details

  Allows user access to the configuration details of the module or SOC for each of the above listed feature tabs.



On the GUI, the connection is made by selecting “Open Port”. The COM port index should be filled in automatically (if the COM port is not shown then use your computers device manager to identify the correct port). A connection is made when “Uplynx-AT” is shown in the Sigfox AT command communication window:

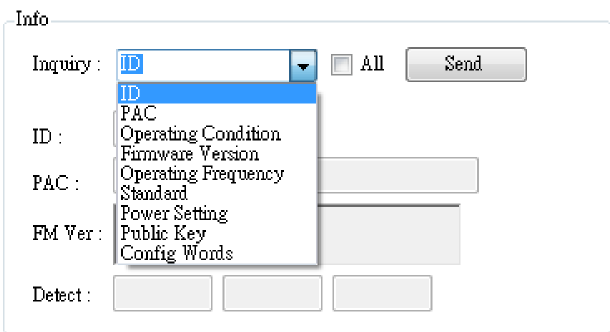


If “Uplynx-AT” is not shown, it is advised to hit the RESET button on the hardware or the evaluation board.

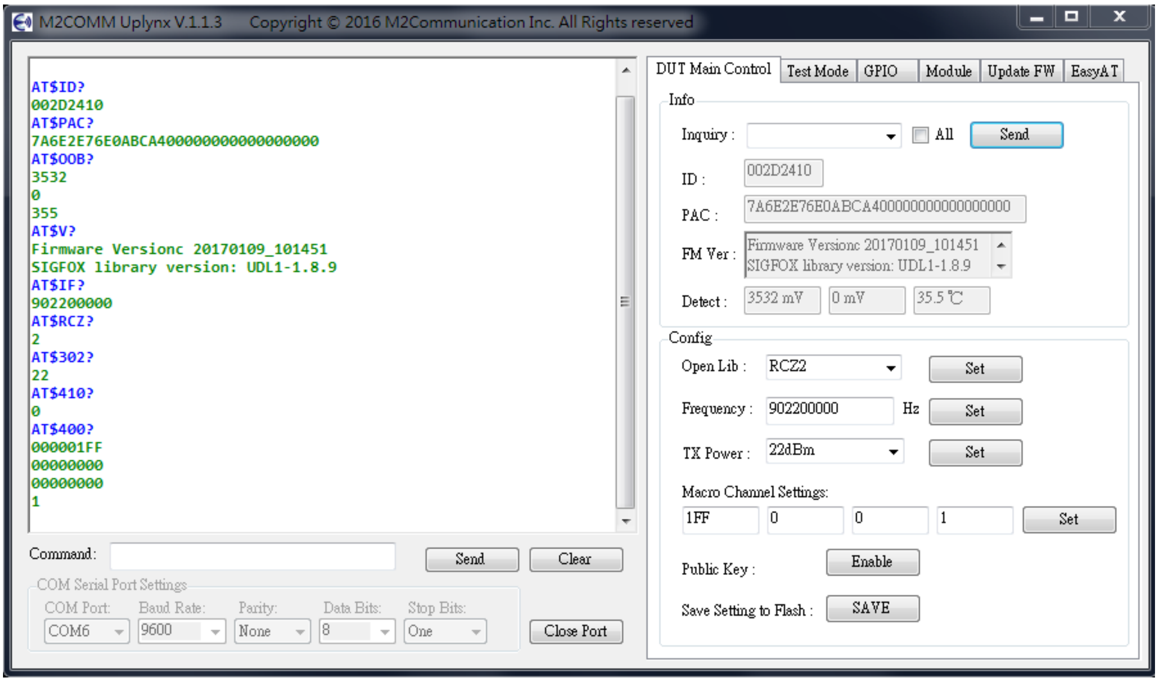
3.2.1 GUI Interface - DUT Main Control

Under the DUT (device under test) main control window, user can access most of the configuration of the M2C8001.

- Info



The pull down menu shows all the items available for query. The specific info will be shown by clicking “Send”. With the checkbox “All” checked, all the information will be retrieved by clicking “Send”. The corresponding AT command can be seen in the command window. AT commands are in BLUE while the responses are in GREEN and the corresponding fields are updated.

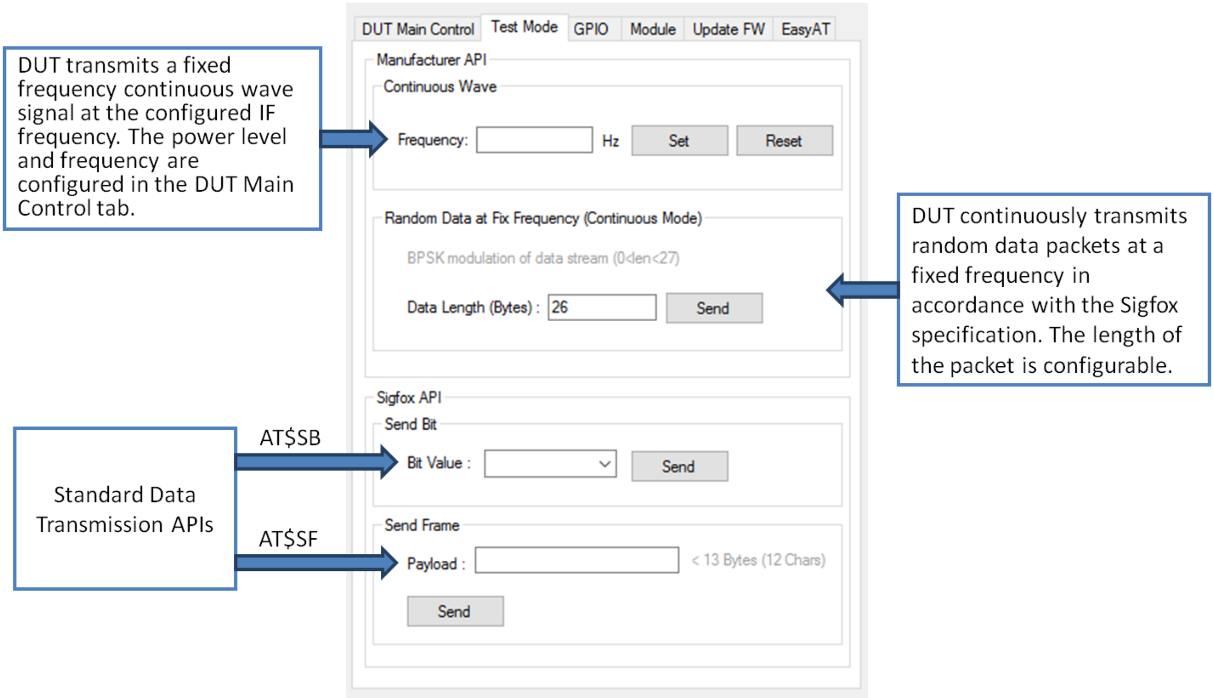


All the information that is shown in the DUT Main control tab is stored in Flash. The corresponding parameter can be set using “Set” button. The new value will be stored and retained even after reset and power down. The information returned for “Detect” are the idle supply voltage, the supply voltage during the last transmission and the silicon temperature in degree.

3.2.1.1 *DUT Main control: Emulator mode for SNEK*

Sigfox connectivity can be checked using a SNEK USB dongle. To allow communication through SNEK, a public key is used instead of the unique private key stored in each module or SOC by enabling “Public Key”.

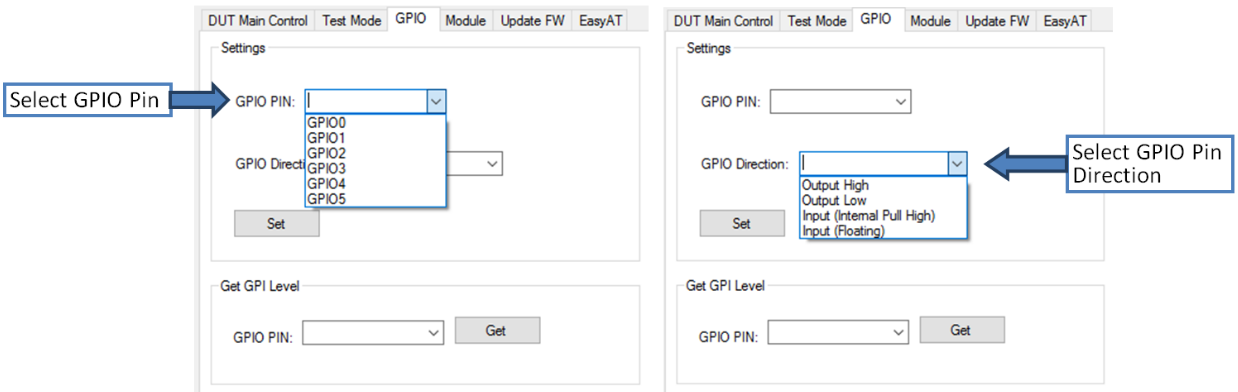
3.2.2 GUI Interface - Test Mode



When the DUT is placed in test mode (either continuous wave or continuous packet), the DUT must be reset before it can receive any new AT commands. These two functions will be needed for FCC and other regulatory test.

The AT$SB and AT$SF are the standard function to send information to Sigfox network.

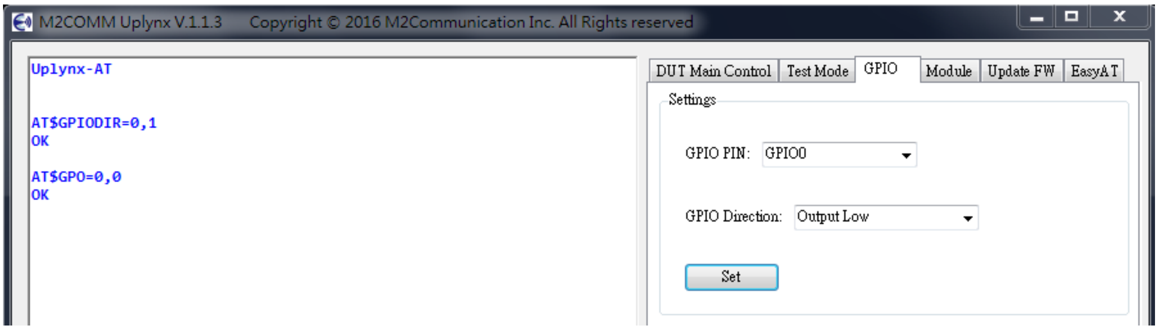
3.2.3 GUI Interface – GPIO



There are 6 GPIOs on the module and the SOC which are supported through AT commands.

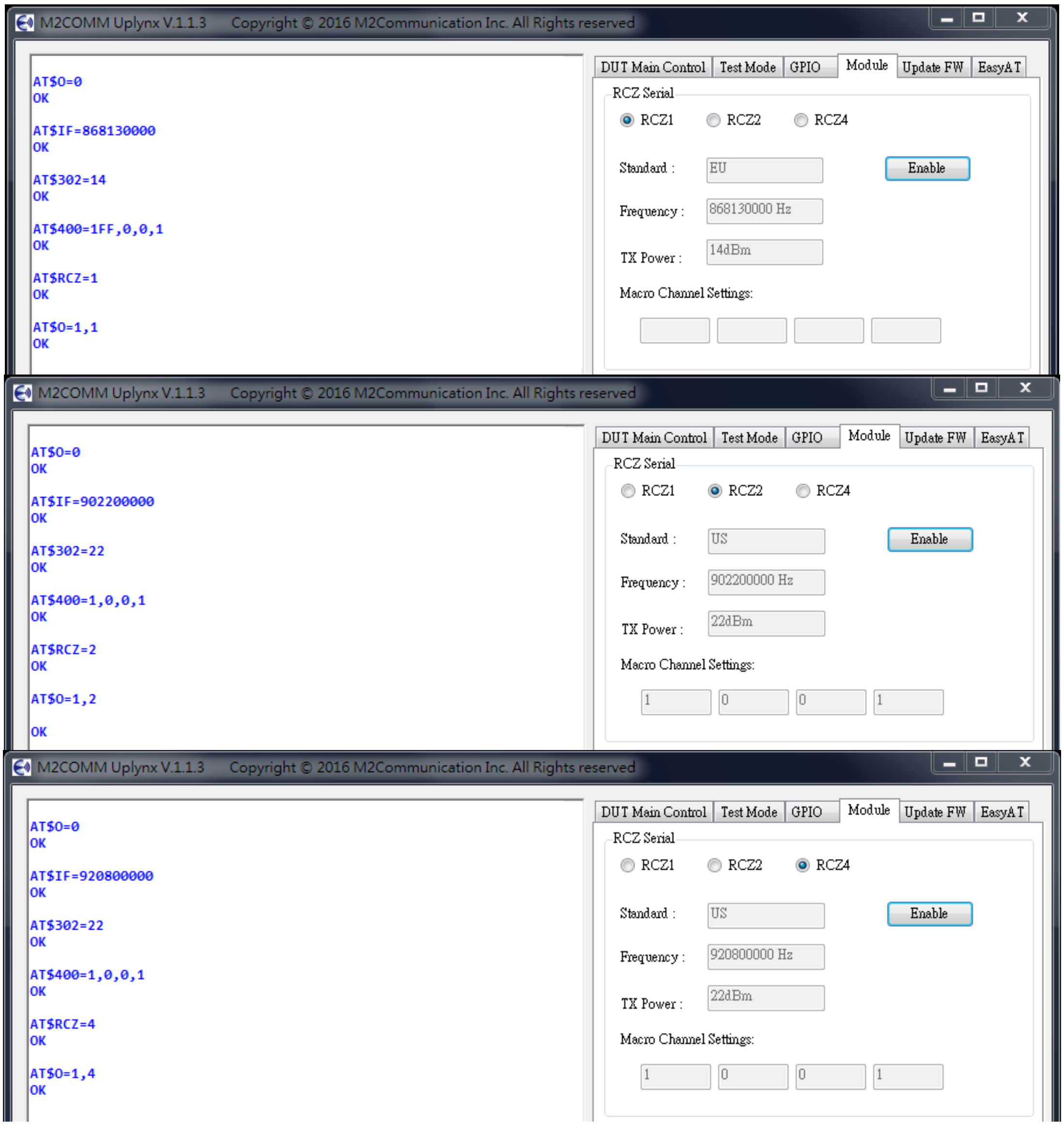
Each of the GPIOs can be configured into input mode (internally pull high 40kΩ), input mode (floating), output mode (to high VDD or low GND).

Once selected use the “**Set**” button to send data to the Sigfox AT command communication window



3.2.4 GUI Interface - Module

To simplify the device opening procedure, users can specify which RCZ they wish to open, see examples below.



Once the required RCZ has been enabled; users can perform send bit and send frame instructions (i.e. AT$SB and AT$SF).

AT$O=1,RCZ is the key Sigfox library AT command for loading the firmware. It will automatically load all the settings from the current setup, (i.e. Operating Frequency, Public Key enable, Transmission power, Macro Channel Setting). Any new setting will be ignored after AT$O=1,RCZ is executed.

To unload the AT command application, user must enter AT$O=0 or reset the module or SoC.

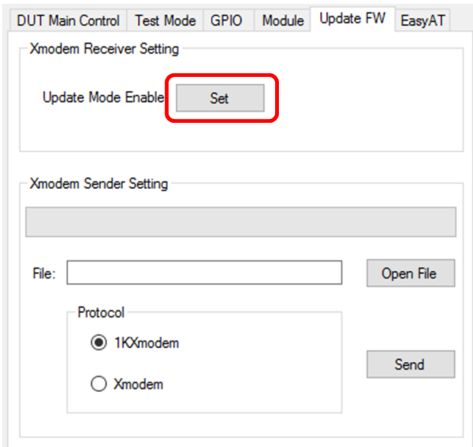
3.2.5 GUI Interface - Update FW

Each M2C8001 is preloaded with a bootloader, Sigfox AT command application and a device ID/PAC/KEY.

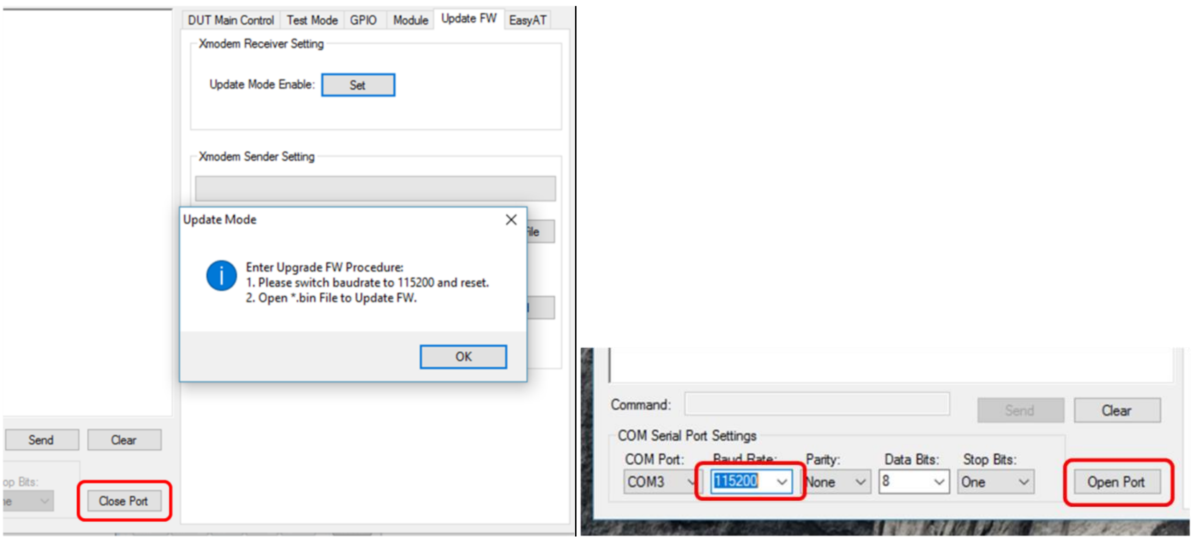
The bootloader supports firmware updates via XMODEM at 115200bps UART interface.

To initiate the firmware update;

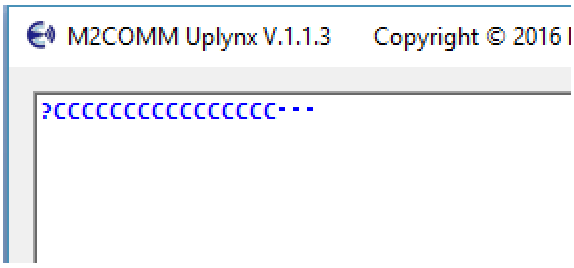
Step 1: Initiate FW update mode



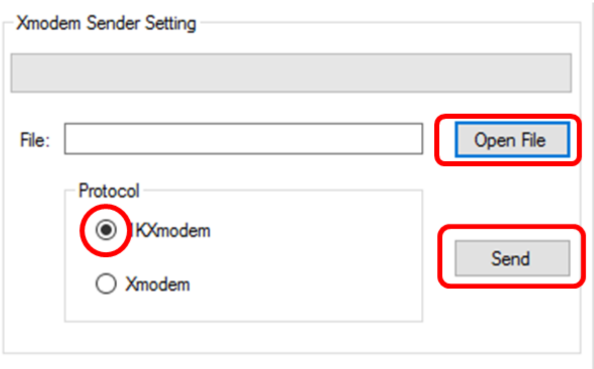
Step 2: Select “Close Port” and reopen at 115200bps



Step 3: Device is waiting for new firmware when "CCCC…" appears in the Sigfox AT command communication window



Step 4: Browse for new firmware, select 1KXmodem and "Send"



The firmware will upload automatically and will then reset the device automatically. Once the update is done, close the port and reopen it at 9600bps. It should see "Uplynx_AT" and the new version of firmware can be checked using the function at "DUT Main Control" tap.

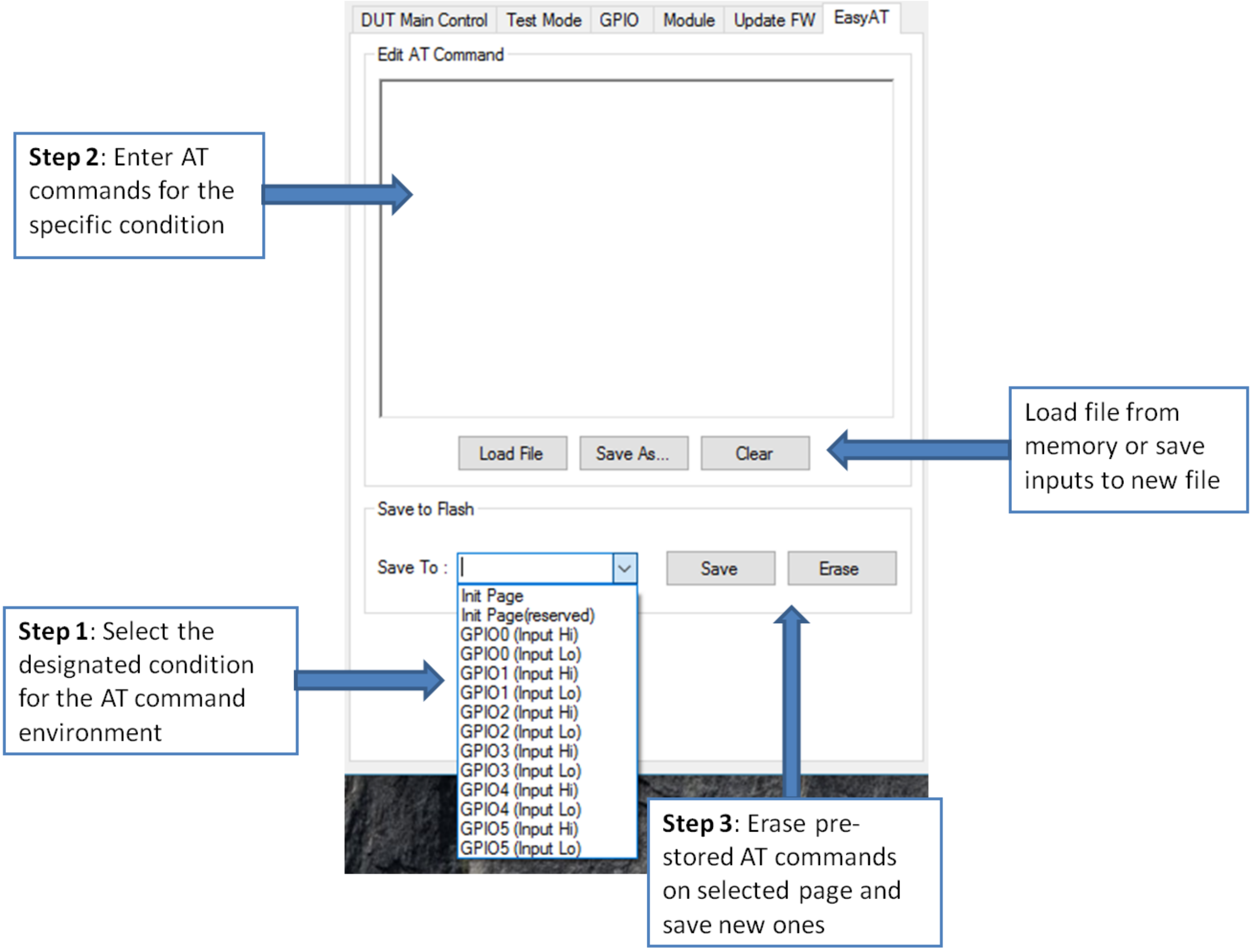
3.2.6 GUI Interface - EasyAT Commander

The EasyAT commander is an AT command recorder and player application which allows users to store AT commands for specific conditions. For example, a set of AT commands will be executed if GPIO is high or low or the battery voltage drops below a certain threshold.

The AT commands are stored in the flash and will be automatically fetched and loaded. If no AT command is stored, the Uplynx M2C8001 will enter a normal AT command waiting state.

Although not a full function programming environment, it does allow easy application development using all AT commands.

To access the feature, go to "EasyAT" in the feature tab.



The user needs to divide the software into two main sections:

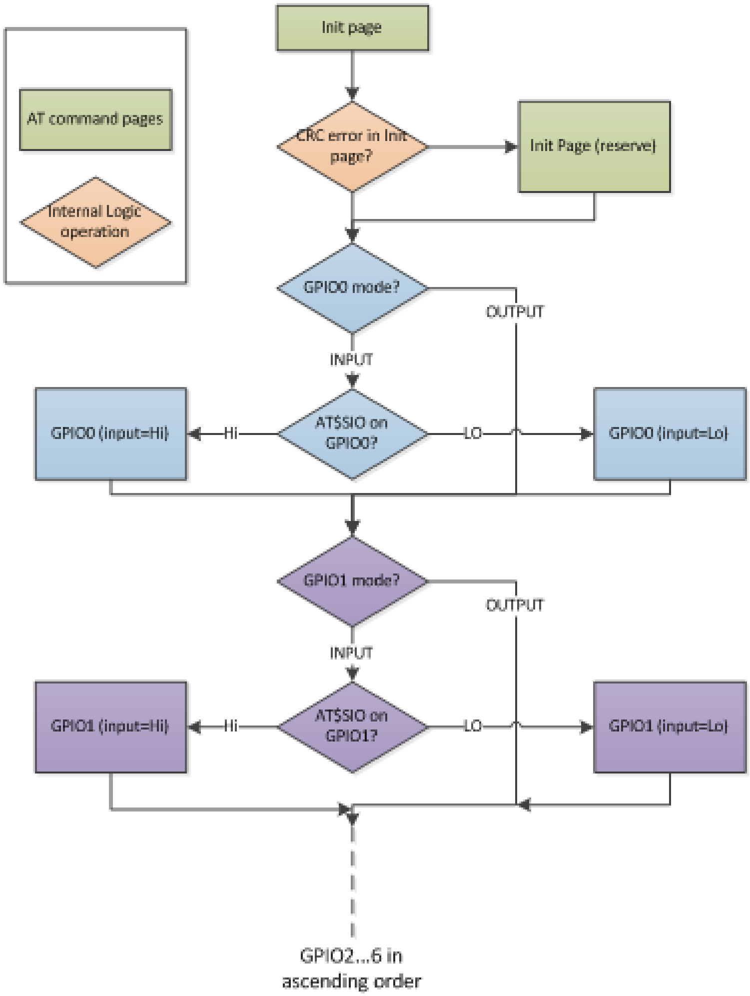
Initialization and actions required for each GPIO and/or voltage level. The firmware supports GPIO and low voltage actions.

A general implementation would be divided into device initiation which defines the direction and mode of operation. These settings should be in the “Init Page”. Then on each page with the corresponding GPIO which is configured as input mode, user can enter the actions to be taken.

For example, user can send data bit 1 if GPIO1 is high by using AT$SB=1 in the page GPIO1 (Input high).

Alternatively, user can configure the action for low voltage detection by using AT$IFVTH=[voltage] to force the engine to detect the battery voltage and decide the following action. The actions for higher than or lower than the threshold voltage are stored in “GPIO5 (Input Hi)” and “GPIO5 (Input Lo)” respectively. In other words, the actions for GPIO5 will not be available.

The operating flow of the EasyAT commander engine is depicted in below:



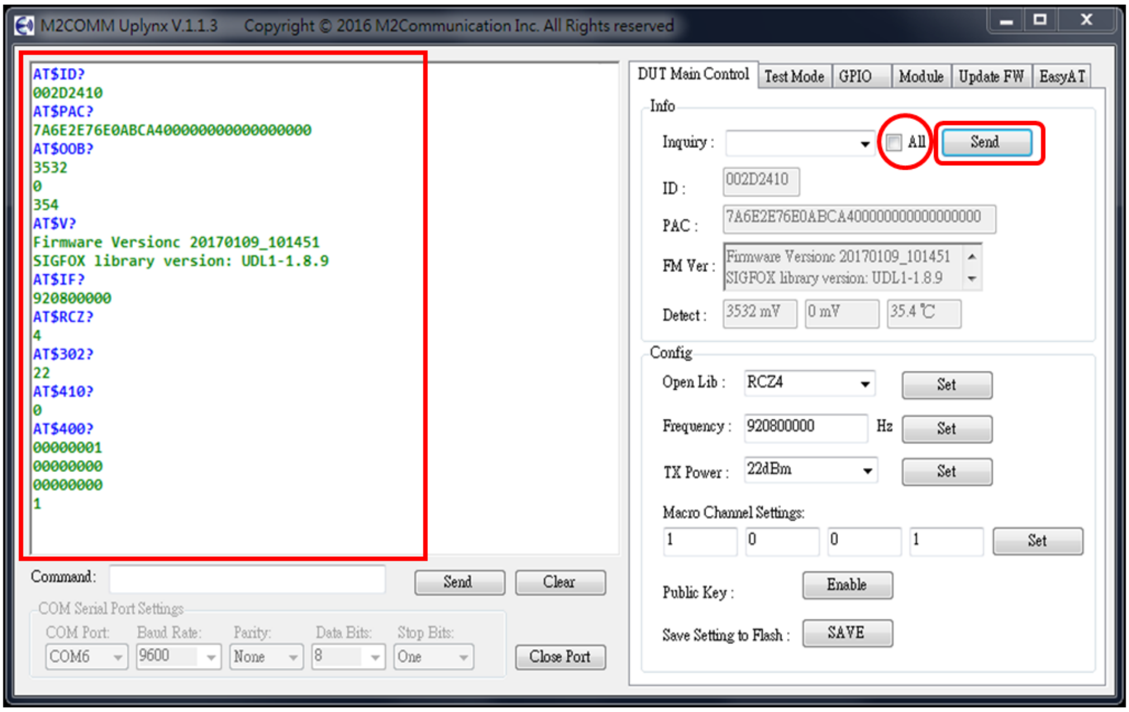
EasyAT Commander Operation Flow

4 *Operation Example*

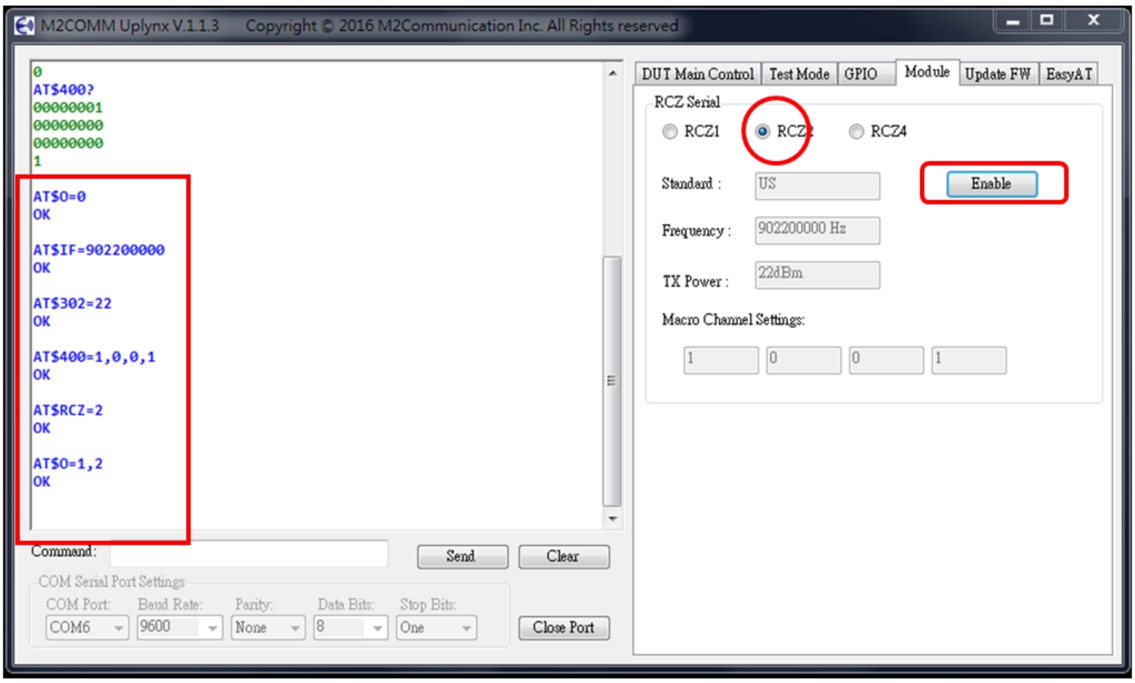
In this section we will walk through several commonly executed operations step by step. For each operation the user will be able to see the resultant AT Command list, these same commands can then be transferred to the MCU programming.

4.1 *Configure M2C8001 to RCZ1, RCZ2 or RCZ4 and send a bit or frame.*

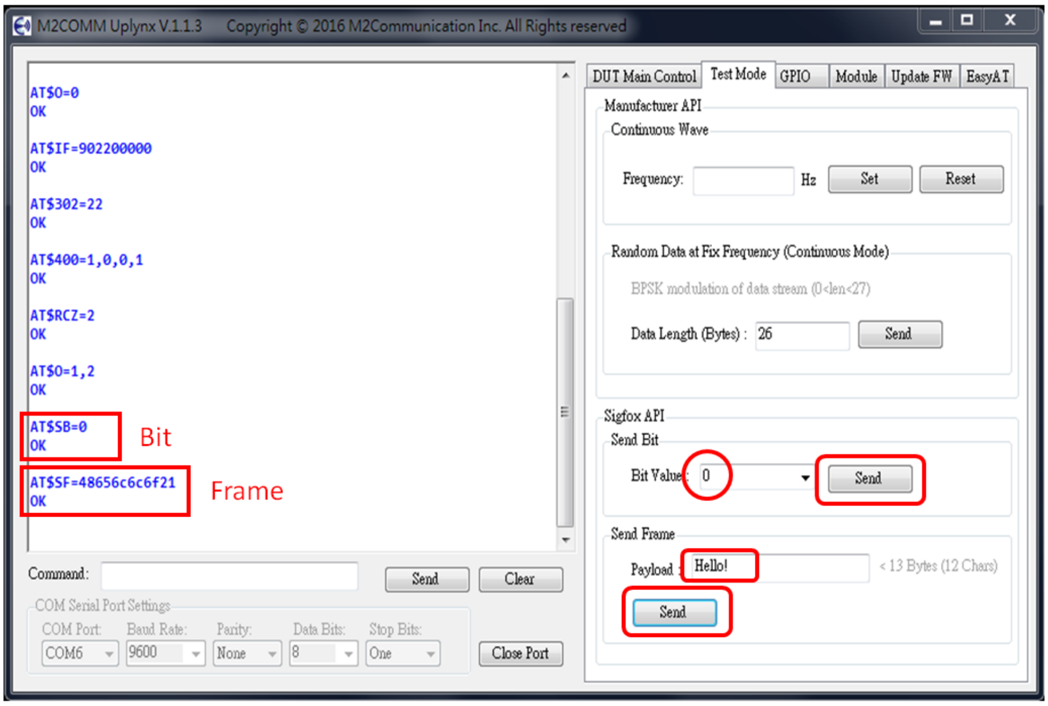
Step 1: Inquire all info by checking "ALL" and then "Send". Check the firmware version



Step 2: Go to the "Module" tab and select the zone then "Enable"

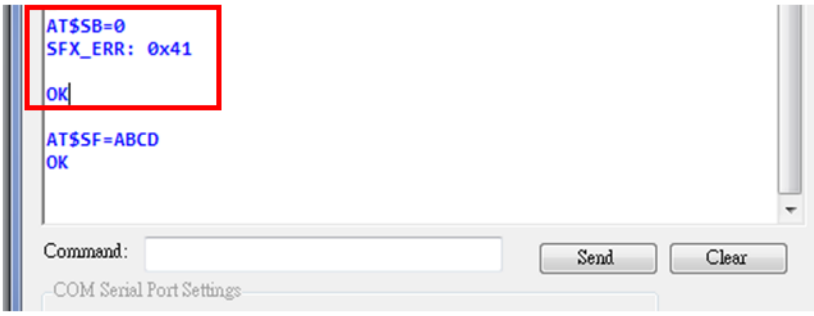


Step 3: Go to the “Test mode” tab and perform either a “Send bit” or “Send Frame” with the corresponding “Send”



The send frame function carries the hexadecimal representation of the ACSII code input to the GUI. The ACSII text is not transmitted directly. In the example, ACSII “H” is transmitted as 0x48 and so “Hello!” is transmitted as 0x48 0x65 0x6c 0x6c 0x6f 0x21.

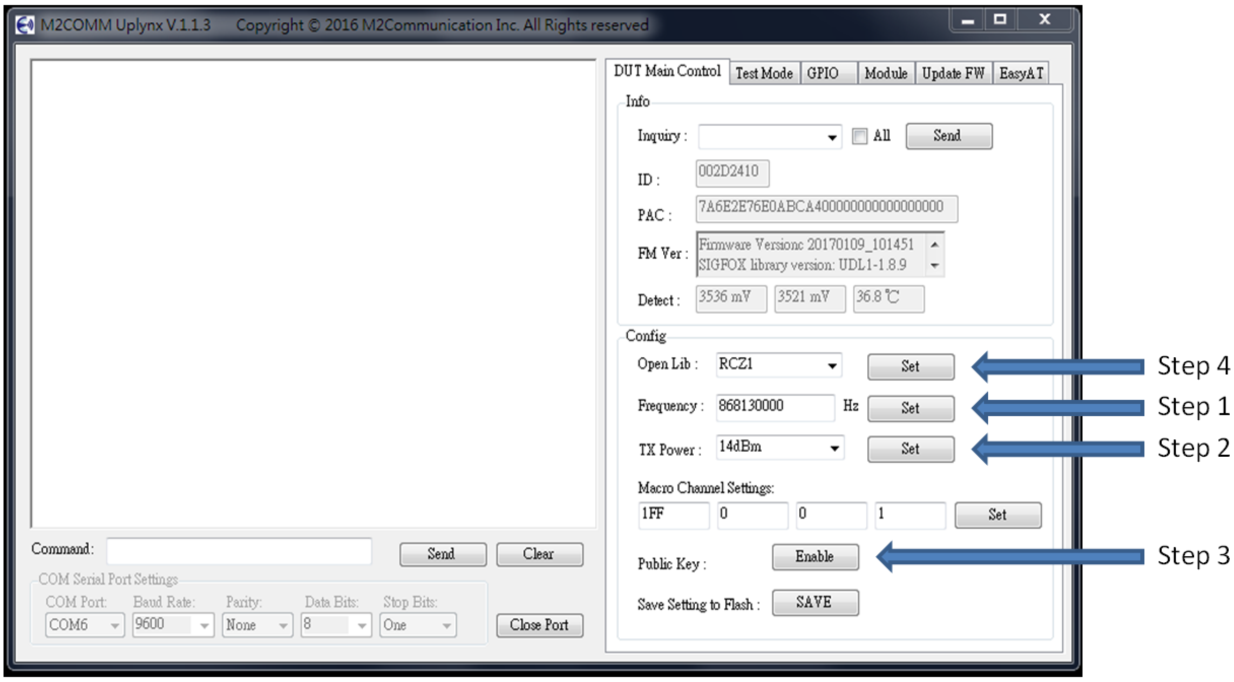
In a following capture, it can be seen that it returns “SFX_ERR:0x41” as below.



This is a library error code for your reference only. M2C8001 will take care of the error automatically and the command is actually executed and returns “OK”.

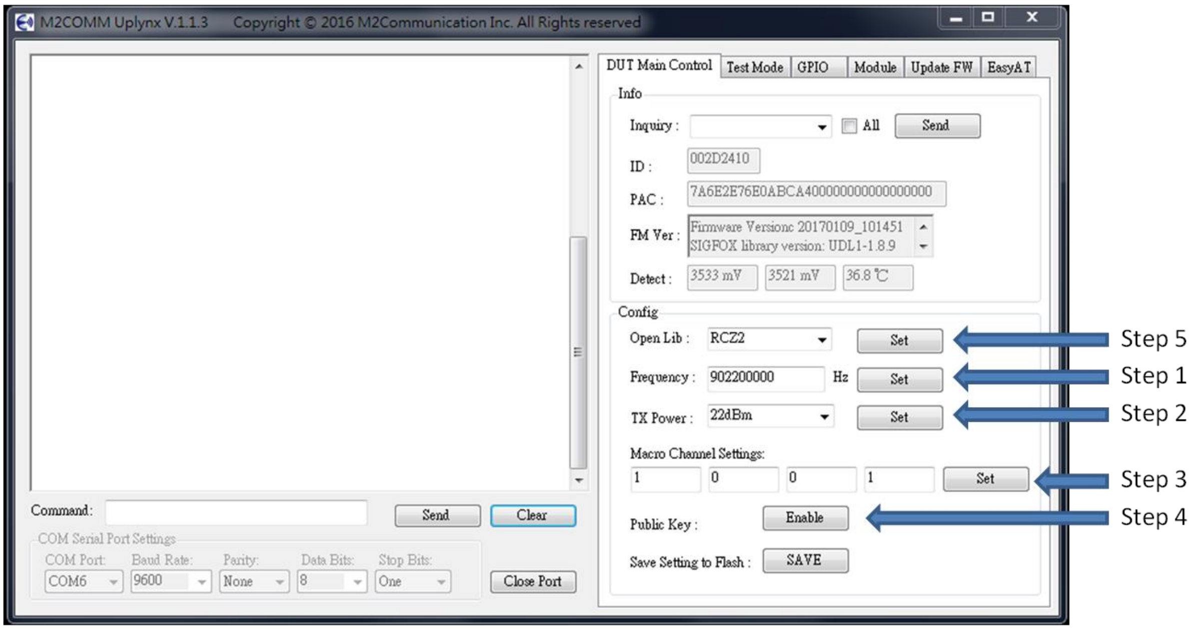
4.2 *Configure M2C8001 to RCZ1, RCZ2 or RCZ4 and send a bit or frame to SNEK*

RCZ1 SNEK mode: Go to DUT Main Control



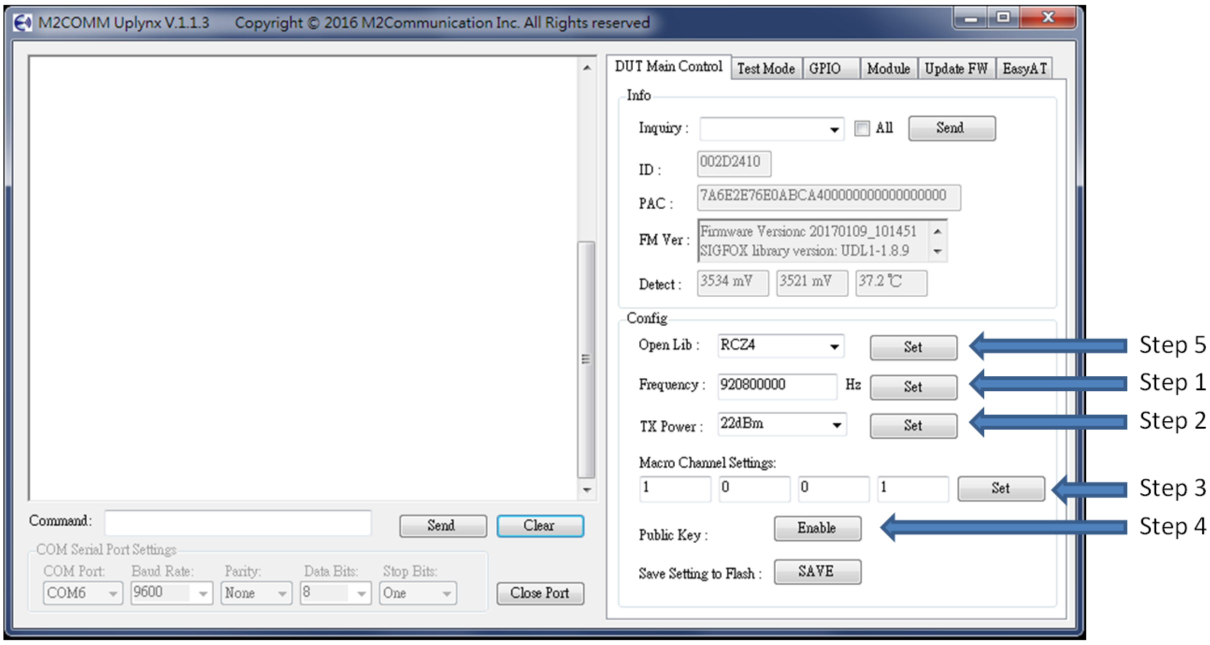
Step 1: Key in the Frequency 868130000 by clicking "Set"
Step 2: Select wanted power level by clicking "Set"
Step 3: Enable Public Key by clicking "Enable"
Step 4: Open RCZ1 library by clicking "Set"
Step 5: Go to "Test mode" tab to send a bit or send a frame.

RCZ2 SNEK mode: Go to DUT Main Control



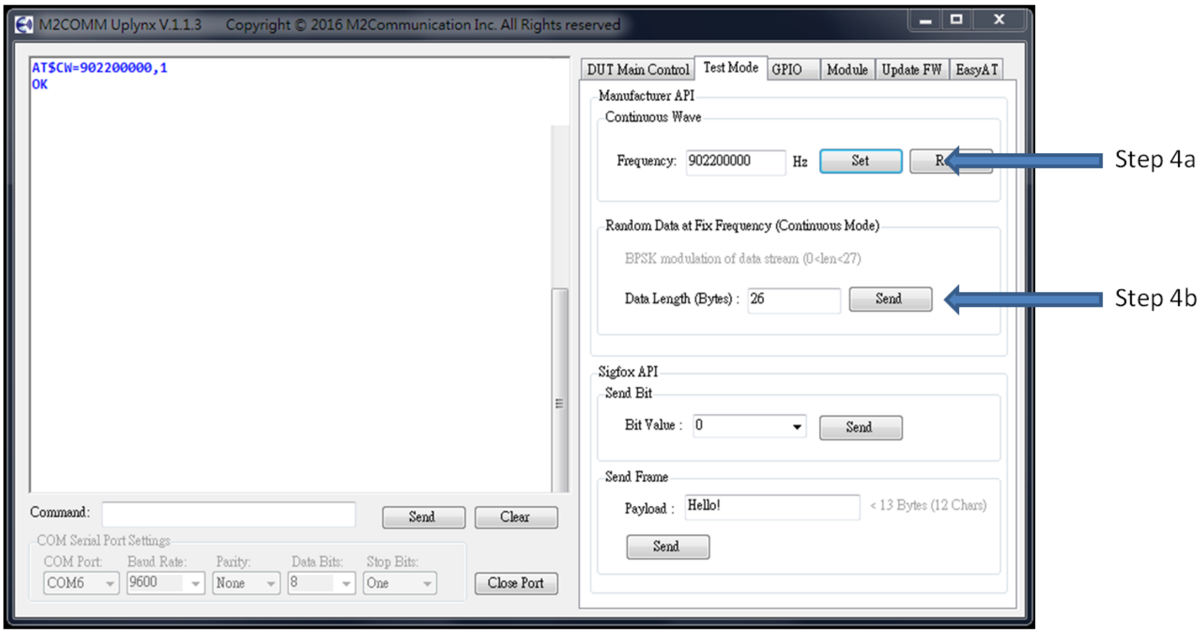
Step 1: Key in the Frequency 902200000 by clicking “Set”
Step 2: Select wanted power level by clicking “Set”
Step 3: Enter 1, 0, 0, 1 into “Macro Channel Setting” and click “Set”
Step 4: Enable Public Key by clicking “Enable”
Step 5: Open RCZ2 library by clicking “Set”
Step 6: Go to “Test mode” tab to send a bit or send a frame.

RCZ4 SNEK mode: Go to DUT Main Control



Step 1: Key in the Frequency 920800000 by clicking "Set"
Step 2: Select wanted power level by clicking "Set"
Step 3: Enter 1, 0, 0, 1 into "Macro Channel Setting" and click "Set"
Step 4: Enable Public Key by clicking "Enable"
Step 5: Open RCZ4 library by clicking "Set"
Step 6: Go to "Test mode" tab to send a bit or send a frame.

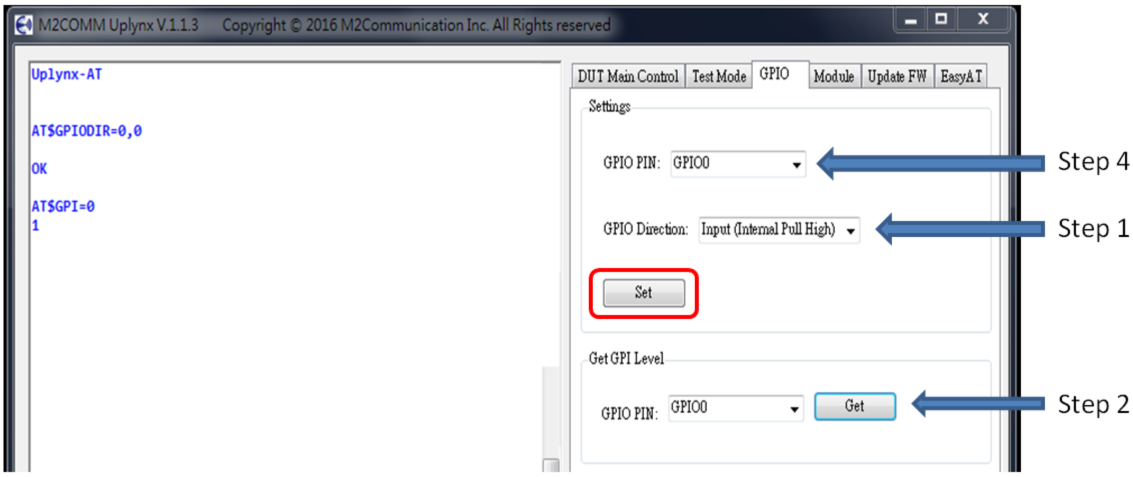
4.3 *Configure M2C8001 to transmit a Continuous Wave or Packet for RF testing*



Step 1: DUT Main Control - Key in the target operating frequency by clicking “Set”
Step 2: DUT Main Control - Select wanted power level by clicking “Set”
Step 3: DUT Main Control - Open RCZ1/2/4 library by clicking “Set”
Step 4a (Continuous Wave): Go to “Test mode” tab, enter the Target Frequency and click “Set”.
Step 4b (Continuous Packet): Go to “Test mode” tab, enter the Data Length and click “Send”.

*Both Continuous wave (AT$CW) and packet (AT$CM) requires a hardware reset to quit.

4.4 *Configure M2C8001 GPIO0 to input/output mode and read the input level*



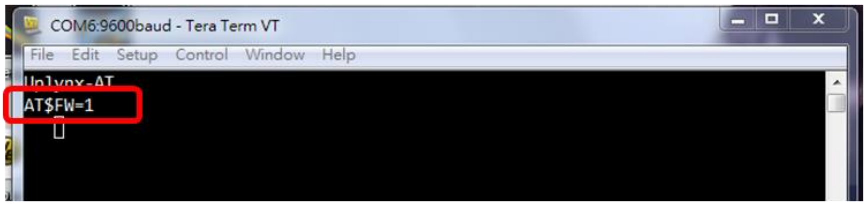
Step 1: Go to the “GPIO” tab and select the GPIO pin from the pull down menu
Step 2: Select the configuration of the specific IO pin (input/output) then click “Set”
Step 3: Select the GPIO to be read in and click “Get”. Since the GPIO0 is set to input mode with internal pull high, the value from the GPIO is “high”.

5 *Firmware Update*

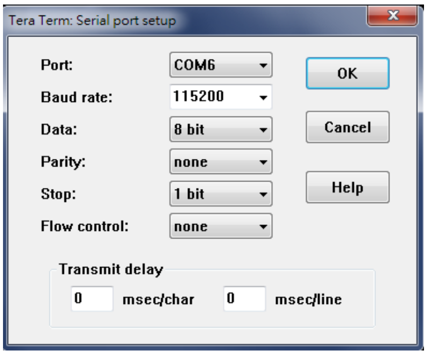
The bootloader supports firmware update over XMODEM at 115200bps. There are several ways to update the firmware:

5.1 *Using a Terminal Emulator (e.g.TeraTerm, Cutecom)*

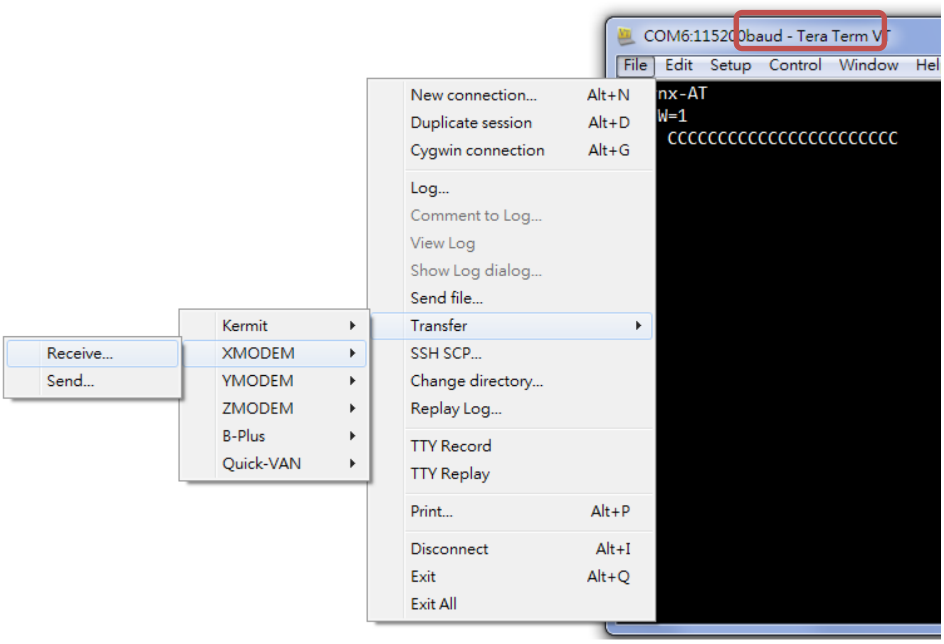
Step 1: Connect the evaluation board to the terminal emulator at 9600bps.
Step 2: Enter firmware update mode by typing “AT$FW=1”



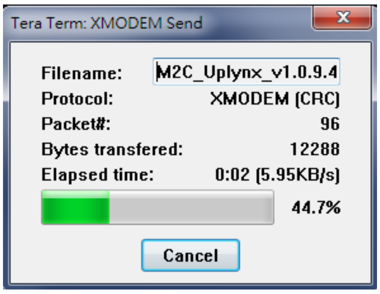
Step 3: Change the terminal connection speed to 115200bps



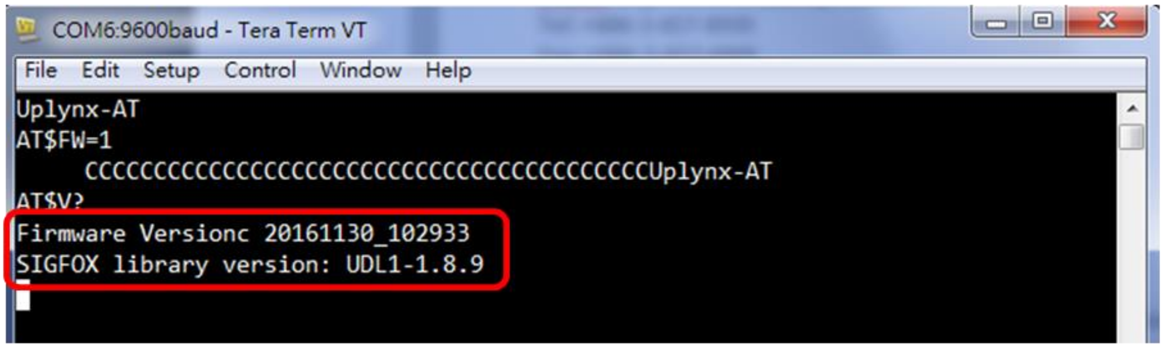
Step 4: Press “RESET” button on the evaluation board and consecutive “C” will be shown every second for 30 seconds while waiting for the firmware image.
Step 5: Activate XMODEM binary transfer:



Step 6: Select the new binary file using Windows Explorer and start transfer:

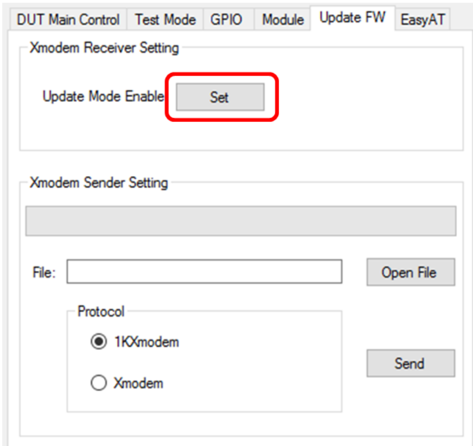


Step 7: The board will reset by itself and the user needs to change the terminal connection speed back to 9600bps.
Step 8: Check the firmware version with “AT$V?”

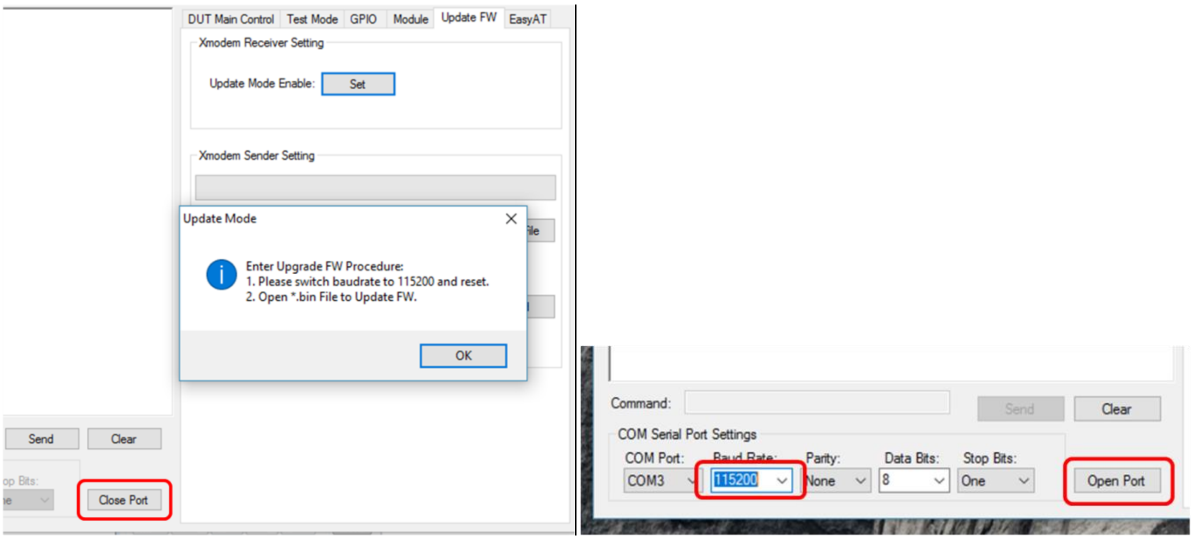


5.2 *Using Uplynx GUI*

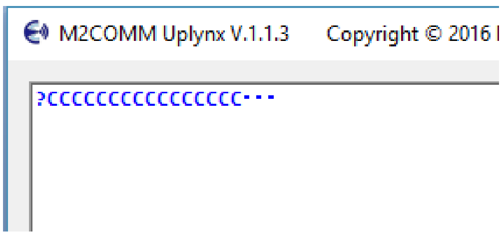
Step 1: Go to Update FW tab
Step 2: Initiate FW update mode by selecting “Set”



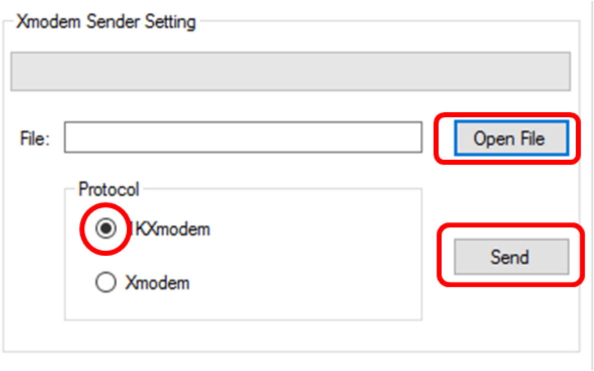
Step 3: Select “Close Port” and reopen at 115200bps



Step 4: Device is waiting for new firmware when “CCCC…” appears in the Sigfox AT command communication window, if not, press the “RESET” button on the evaluation board.



Step 5: Browse for new firmware, select 1KXmodem and “Send”



Step 6: wait for the new firmware to be updated, a message box with “successfully transmitted” will be shown after a successful update. If the message box does not appear, repeat from step 3.