Uplynx
AT Command GUI
and
EasyAT Users Manual
(RCZ345)

Elite Semiconductor Memory Technology Inc.

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Revision Control

Ver.	Date	Description of Change	Approved
1.0	05/10/2018	First Release	Charles Lee

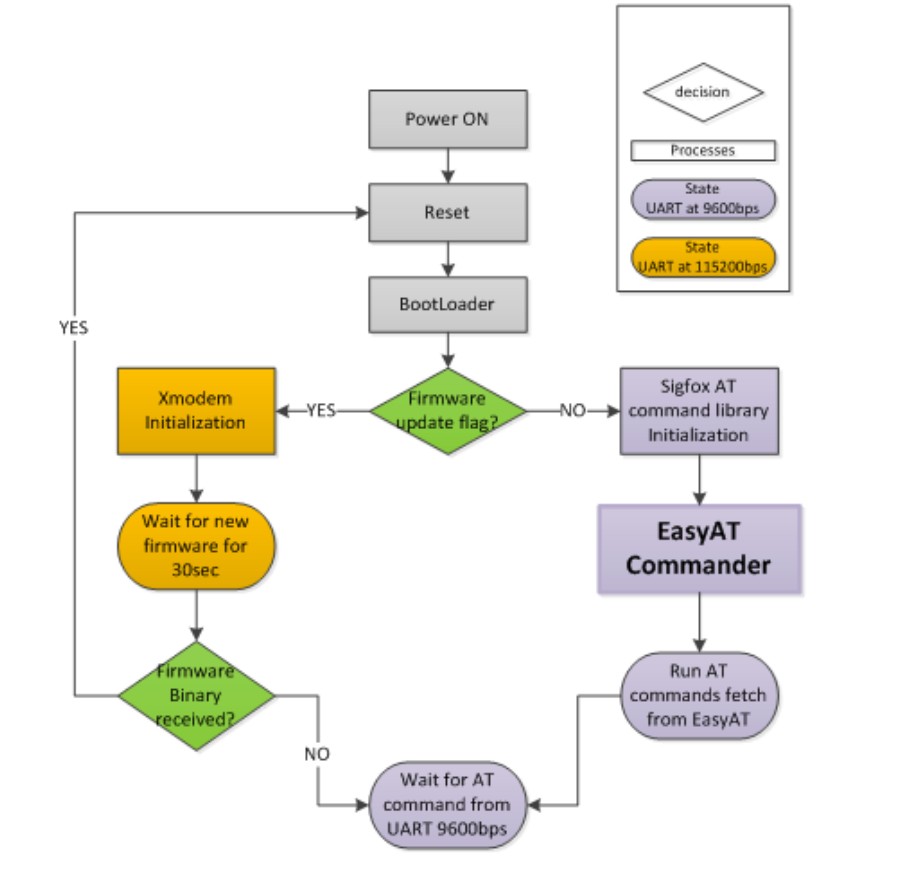
Table of Contents

1 *Document Overview*

The M2COMM's flagship Uplynx M2C8001 and M2C8001-T SOCs are designed for Sigfox uplink communications, ensuring high performance and low cost at the same time.

The Uplynx M2C8001 and M2C8001-T support RCZ1 thru RCZ5 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™ 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 users understand the Sigfox specific AT command interface and operation of the Uplynx-M-RCZ345 module, M2COMM has implemented an intuitive GUI that is integrated with all the essential features provided by Uplynx-M-RCZ345 module.

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

M2COMM GUI version: v2.0

2 *Uplynx Preloaded Software*

The Uplynx-M-RCZ345 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 20180518_145028
SIGFOX library version: V2.3.1_FDL

2.1 *Sigfox Verified™ AT Command*

The Uplynx-M-RCZ345 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-RCZ345 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, EasyAT and Engineering commands are supported.

Command	Description	Value
AT$302?	Get current TX power	Return Current transmission power setting
AT$302=pwr	Set Tx power	pwr = Tx power [14 to 22]
AT$400?	Inquire the Sigfox configuration words	
AT$400=v1,v2,v3,v4	Set Sigfox configuration word for RCZ345 settings	v1 = config_words_0 v2 = config_words_1 v3 = config_words_2 v4 = default FCC Channel
AT$410?	Get Public Key state	0: disable; 1: enable
AT$410=mode	Enable Public Key for emulator mode	mode: 0-normal mode; 1- Public key enabled (emulator mode)

Command	Description	Value
AT$ALU=op,m,i,v	Provides basic arithmetic operation (EasyAT Commander related)	op: operator; op = 0 – 4 where 0: “+” operator 1: “-“ operator 2: “*” operator 3: “/” operator 4: “%” operator Results will be stored in temporary register, index i m: mode, m = 0/1 where 0: operand is immediate value 1: operand is the content of temporary register, index i i: index of temporary register; i = 0 – 9 v: immediate value or value of temporary register
AT$BLK=blk	Get configuration data which is stored in flash memory (For engineering use)	blk: block index; blk = 0 - 15
AT$CM= packetlength	Test mode with random data packet at fixed frequency (For engineering use)	packetlength = number of bytes to be transmitted (1 - 26)
AT$CSOFF=off	LBT disable (for RCZ3 & RCZ5 LBT bypass mode) (For engineering use)	off: 1 (LBT Disable) off: 2 (LBT Enable)
AT$CW= freq, mode	Test mode with continuous wave emission (For engineering use)	freq: 868000000 mode: 0-disable; 1-enable
AT$DLY=count	No operation delay (EasyAT Commander related)	count: number of 100ms delays
AT$EOFF=ena	Turn off echo message	ena: 1: off; 0: on
AT$FEAT=page	Erase flash page (EasyAT Commander related)	page: 0 - 13

Command	Description	Value
AT$FOR=start,end,p	For loop condition; For(i=start;i<end;i++) Page(p) (EasyAT Commander related)	start: start value end: total count p: flash page of EasyAT store area; page = 0 - 13
AT$FW=mode	Firmware update mode (For engineering use)	mode: 0/1 where 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$GD	Get current Sigfox configuration data (For engineering use)	
AT$GPI=gpio	Return GPIO value	gpio = 1-GPIO0; 2-GPIO1; … , 6-GPIO5
AT$GPIINT=gpio,ena	Set GPIO INT mode (EasyAT Commander related)	gpio: gpio number; gpio = 0 – 5 ena: 0/1 where 0: Enable INT 1: Disable INT
AT$GPO=gpio, val	Set GPIO output high or output low	gpio = 1-GPIO0; 2-GPIO1; … , 6-GPIO5 val: 0(output low)/1(output high)
AT$GPIODIR=gpio, val	Set GPIO pin direction.	gpio = 1-GPIO0; 2-GPIO1; … , 6-GPIO5 val: 0-input (weak pull high); 1-output (input float)
AT$GTO=degC	Compute the temperature sensor calibration value for AT$TO command	degC= indoor temperature
AT$ID?	Get device ID	return ID
AT$IF?	Inquire current frequency setting	Return frequency in Hz
AT$IF=freq	Set transmission frequency in Hz	e.g. 868000000

Command	Description	Value
AT$IFELIF=m,i,v,tp,fp	Provide “if else” operational condition (EasyAT Commander related)	m: 0 – 6 where 0: Tmp_Reg[i] > v 1: Tmp_Reg[i] < v 2: Tmp_Reg[i] ≥ v 3: Tmp_Reg[i] ≤ v 4: Tmp_Reg[i] ! = v 5: Tmp_Reg[i] == v 6: Tmp_Reg[i] (GPI) == v i: the content of temporary register, index i = Tmp_Teg[i] v: constant value tp: page number, if condition is true then AT command stored on flash memory page tp will run; tp = 0 – 13 fp: page number, if condition is false then AT command stored on flash memory page fp will run; fp = 0 – 13
AT$IFVTH=voltage	Set battery detection voltage threshold (EasyAT Commander related)	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
AT$JUMP=page	Jump to EasyAT flash page (EasyAT Commander related)	page: flash page of EasyAT storage area; page = 0 - 13
AT$O?	Inquire Sigfox API library open or not	Mode: 1 to load Sigfox library standard: 0(EU)/1(US)/2(JP)/3(US)/4(KOR)
AT$O=mode, standard	Open Sigfox API library	mode: 1 to load Sigfox library standard: 1-RCZ1; 2-RCZ2; 3-RCZ3; 4-RCZ4; 5-RCZ5

Command	Description	Value
AT$OOB?	Get operation condition	Return values: [Battery voltage before active transmission in mV] [Battery voltage during active transmission in mV] [10x silicon temperature] e.g. 2650 [battery voltage 2.65V before transmission] 2550 [battery voltage 2.55V during transmission] 270 [27°C silicon temperature]
AT$PAC?	Get device PAC	return PAC
AT$RC	SIGFOX_API_reset	
AT$RCZ?	Inquire Sigfox library regional setting	Standard: 1-RCZ1; 2-RCZ2; 3-RCZ3; 4-RCZ4; 5-RCZ5
AT$RCZ=standard	Sigfox library regional setting	standard: 1-RCZ1; 2-RCZ2; 3-RCZ3; 4-RCZ4; 5-RCZ5
AT$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$RST	System Soft Reset	
AT$SADC=ch	Convert voltage on ADC Channel 1 or 2 to mV	ch: 0 (CH1) ch: 1 (CH2)
AT$SAVE	Saves all settings to flash, values will be retained after power off	
AT$SB=bitvalue	Send a bit value of 0 or 1	bitvalue = 0/1
AT$SF=frame	Send payload data, 1 to 12 bytes	frame: data bytes (0,1,2,3…C,D,E,F) to be sent, 12 byte maximum
AT$SIO=port	Scan GPIO input values and execute relevant flash page (EasyAT Commander related)	port: 6-bit input for GPIO0 to GPIO5. A “1” represents the relevant GPIO input will be scanned. e.g. port = “100000”, GPIO0 value is scanned and either GPIO0_Input(High) or GPIO0_input(Low) flash page will be executed

Command	Description	Value
AT$SLP=m,v	Run sleep mode procedure	m: mode; m = 0/1/2 where 0: wake up source is wait timer, here v = sleep time (in seconds, v<180) e.g. AT$SLP=0,3 (wake up after 3 seconds) 1: wake up source is GPI interrupt, here v = GPI pin number; v = 0 – 5 e.g. AT$SLP=1,2 (wake up by GPIO2 interrupt) 2: wake up source is UART_RX, v does not matter
AT$STORE=m,i,v	Provide 10 temporary registers to store value on system run time (EasyAT Commander related)	m: mode; m = 0/1/2 where 0: store word to temporary register 1: store GPI level to temporary register 2: print value of 10 temporary registers (i, v don't matter) i: index of temporary register; I = 0 -9 v: immediate value
AT$TO?	Get temperature sensor calibration value	Return temperature sensor calibration value
AT$TO=offset	Set temperature sensor calibration value, retrieve by AT$GTO=degC	offset = temperature sensor calibration value
AT$V?	Read firmware information	
AT$XO?	Get frequency offset in Hz	Return frequency offset in Hz
AT$XO=freqoffset	Set frequency offset in Hz	freqoffset = frequency in Hz

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.

2.4 *RC Zones, Frequencies and Power*

SERIAL	ZONE (STANDARD)	FREQUENCY (Hz)	POWER (dBm)
RCZ1	EU	868130000	14
RCZ2	US	902200000	22
RCZ3c	JP	923200000	13
RCZ4	US	902200000	22
RCZ5	KOR	923250000	13

3 *Uplynx Sigfox AT command GUI*

3.1 *Getting Connected*

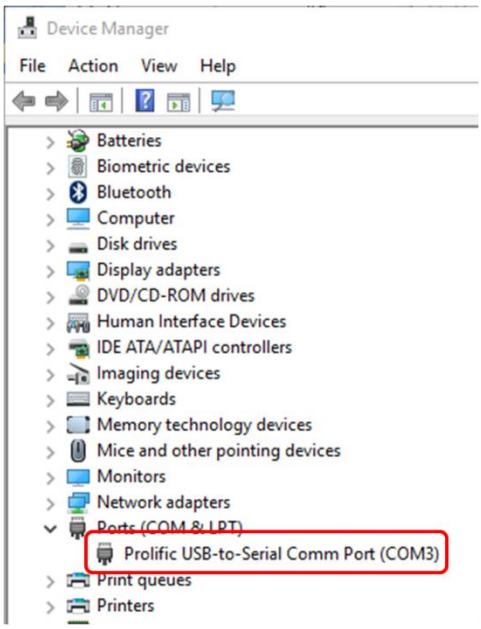
Uplynx is preloaded with the Sigfox Ready™ application. The Sigfox AT command can be passed from host processor via the UART interface. The UART interface on Uplynx is connected to a USB-UART interface IC Prolific PL2303.

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.

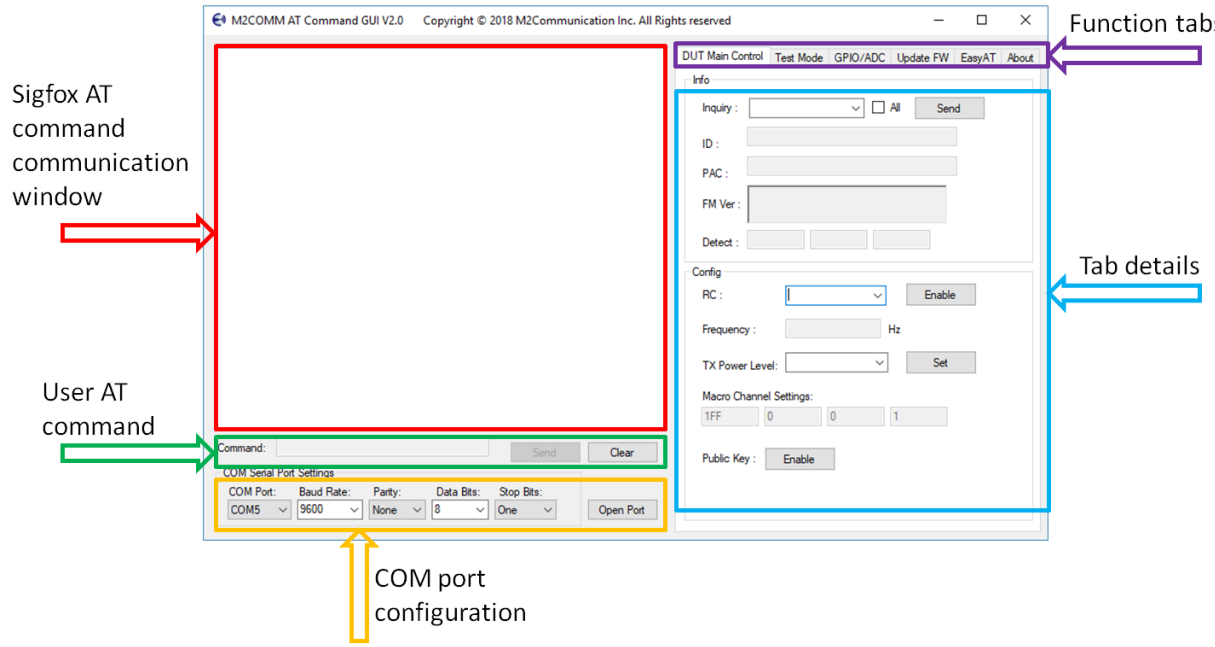


3.2 *Getting Started*

Download the M2COMM GUI interface from the following location:

[Contact M2COMM FAE for download instructions]

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/M2C8001-T 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.

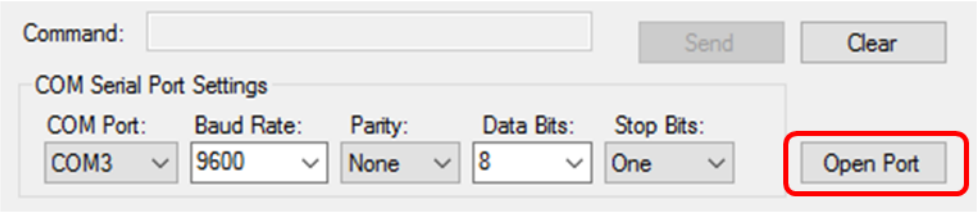
- Function Tabs:

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

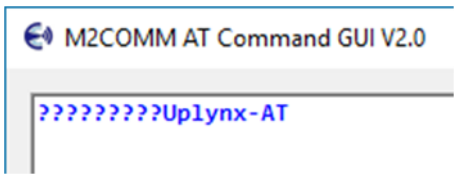
  DUT Main Control
  Test Mode
  GPIO/ADC
  Update FW
  EasyAT
  About (GUI information, e.g. Firmware version)

- 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:

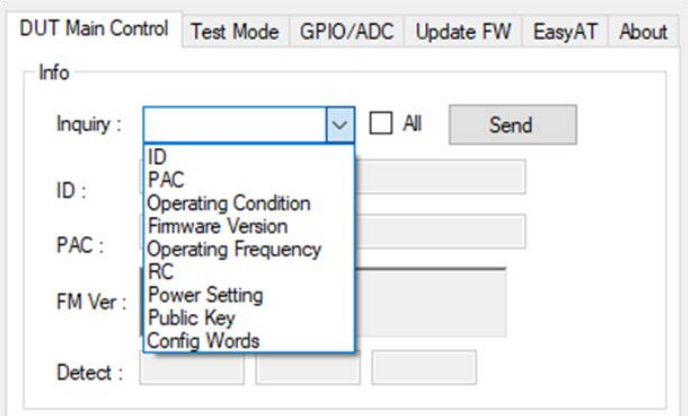


If “Uplynx-AT” is not shown, it is advised to hit the RESET button on the hardware or the evaluation board.

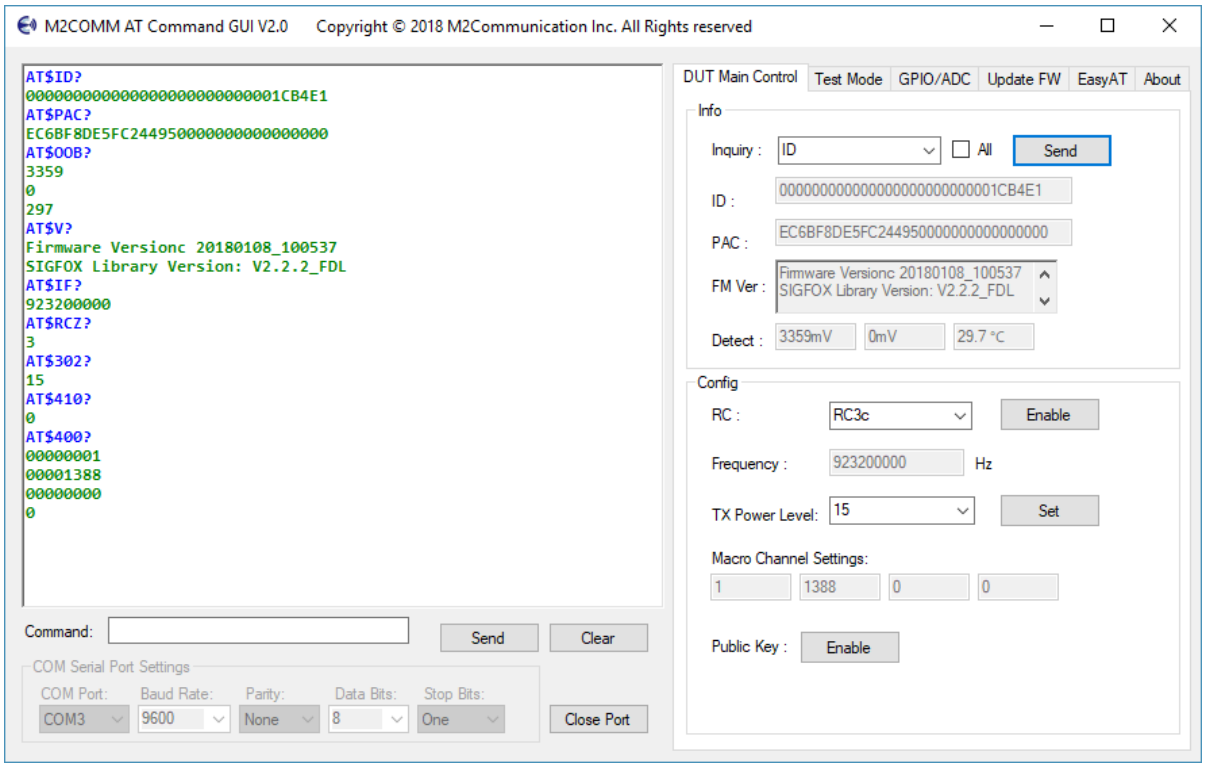
3.3 *GUI Interface - DUT Main Control*

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

- Info

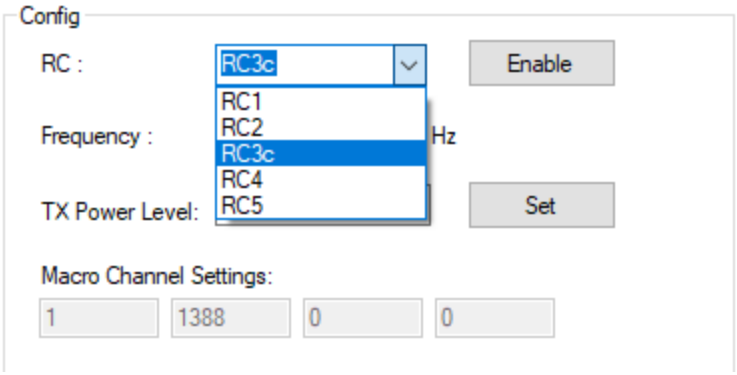


The pull down menu shows all the items available for query. The specific info will be shown by clicking “Send”. With the checkbox “All” checked, all the information will be retrieved by clicking “Send”. The corresponding AT command can be seen in the command window. AT commands are in BLUE while the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

- Config



To simplify the device opening procedure, users can specify which RCZ they wish to open by selecting it from the pull down menu, this will auto populate the Frequency, Tx Power Level and Macro Channel fields with the default settings.

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

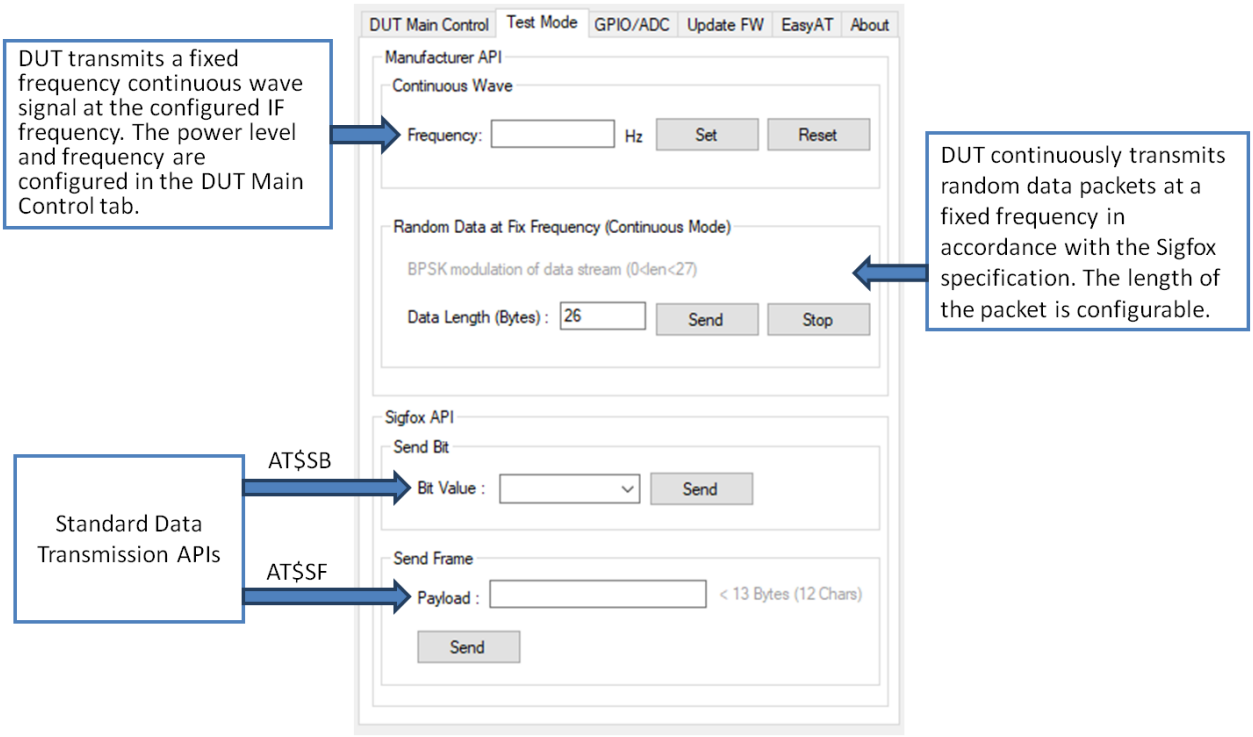
AT$O=1,RCZ is the key Sigfox library AT command for loading the firmware. It will automatically load all the settings from the current setup, (i.e. Operating Frequency, Public Key enable, Transmission power, Macro Channel Setting). Any new setting will be ignored after AT$O=1,RCZ is executed.

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

- 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”.

3.4 *GUI Interface - Test Mode*

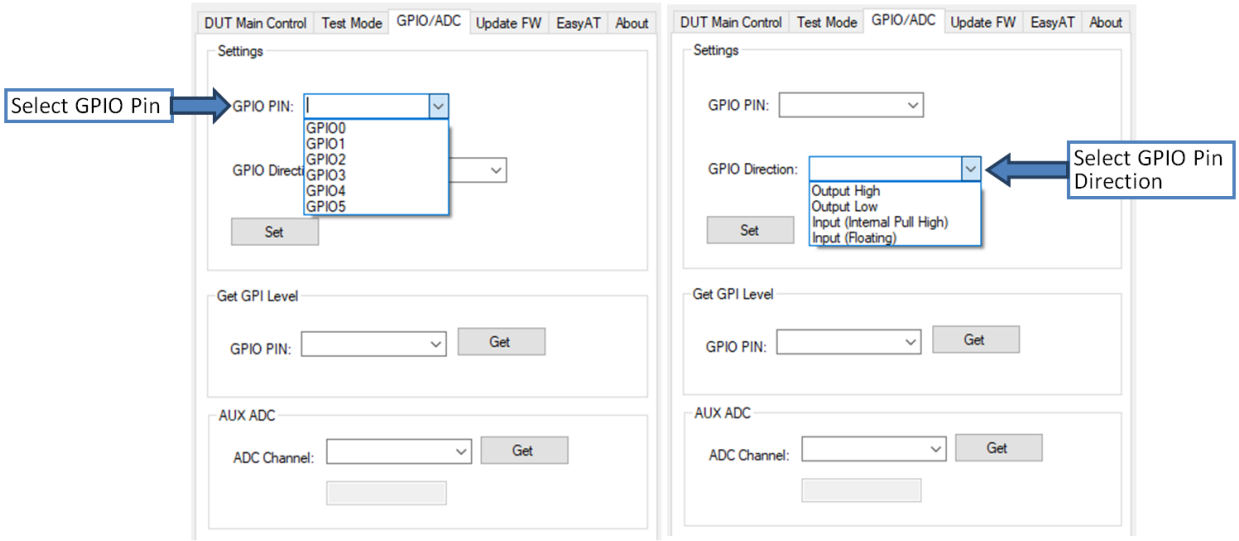


When the DUT is placed in test mode (either continuous wave or continuous packet), the DUT must be reset before it can receive any new AT commands. These two functions will be needed for FCC and other regulatory test.

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

3.5 *GUI Interface – GPIO/ADC*

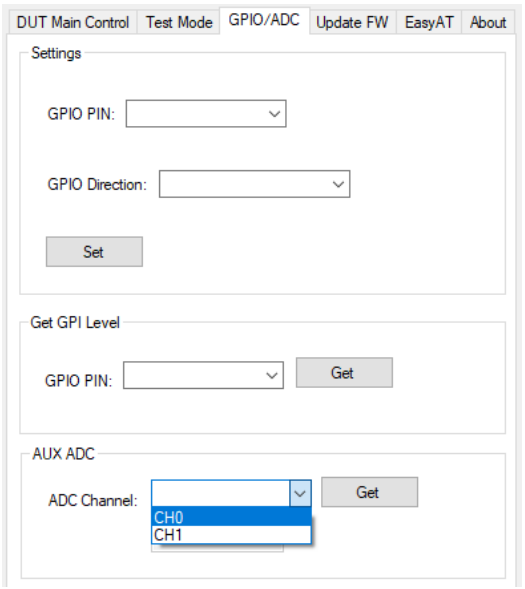
- GPIO



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).

- ADC



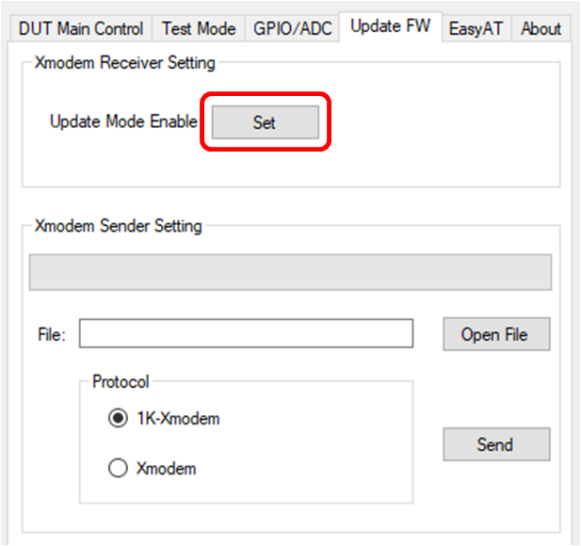
There are 2 ADC Channels on the module and the SOC that will return the value of external voltage rails in mV when queried.

3.6 *GUI Interface - Update FW*

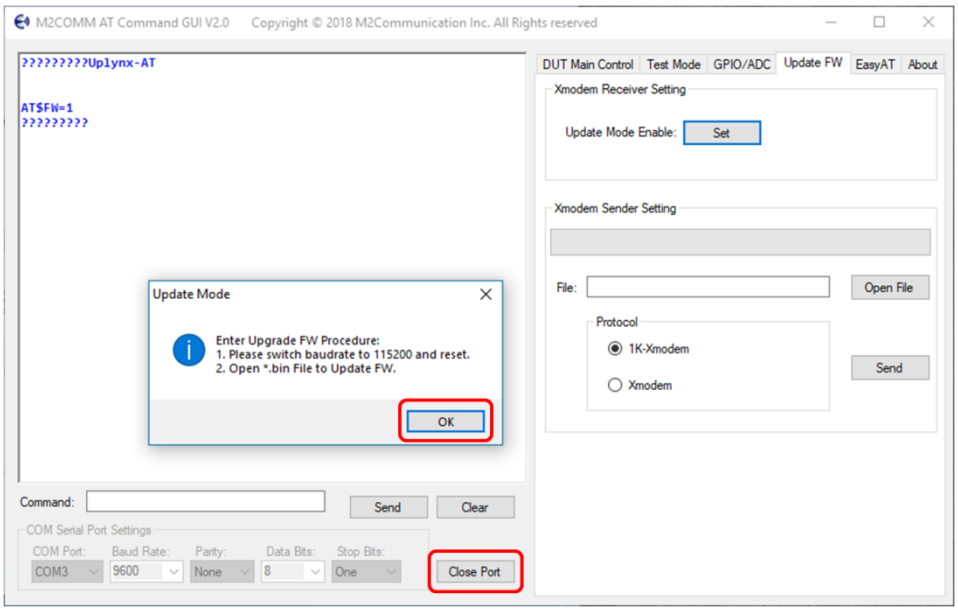
Each M2C8001/M2C8001-T is preloaded with a bootloader, Sigfox AT command application and a device ID/PAC/KEY.

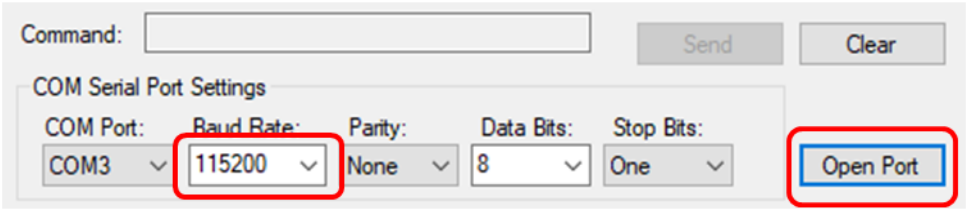
The bootloader supports firmware update over XMODEM at 115200bps.

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

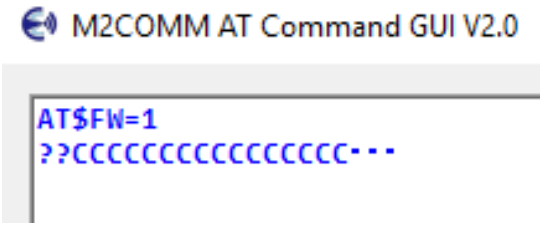


Step 3: Select “Close Port” and then reopen it at 115200bps

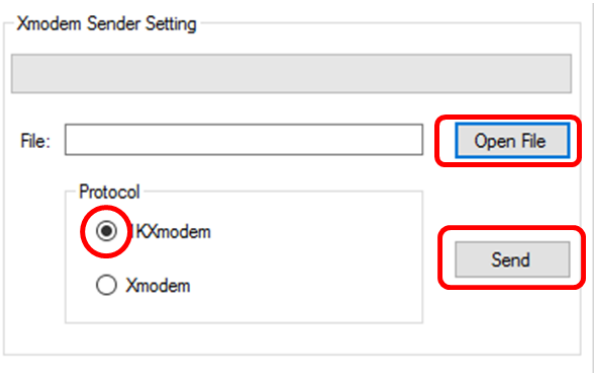




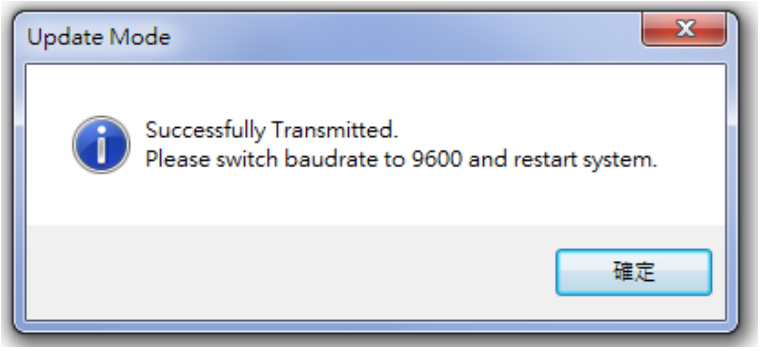
Step 4: Your device is ready to receive the new firmware when “CCCC…” appears in the Sigfox AT command communication window; if it does not appear, press the “RESET” button on the evaluation board.



Step 5: Browse for the 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.



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. AT Command should display “Uplynx_AT” and the new version of firmware can be checked using the function on the “DUT Main Control” tab.

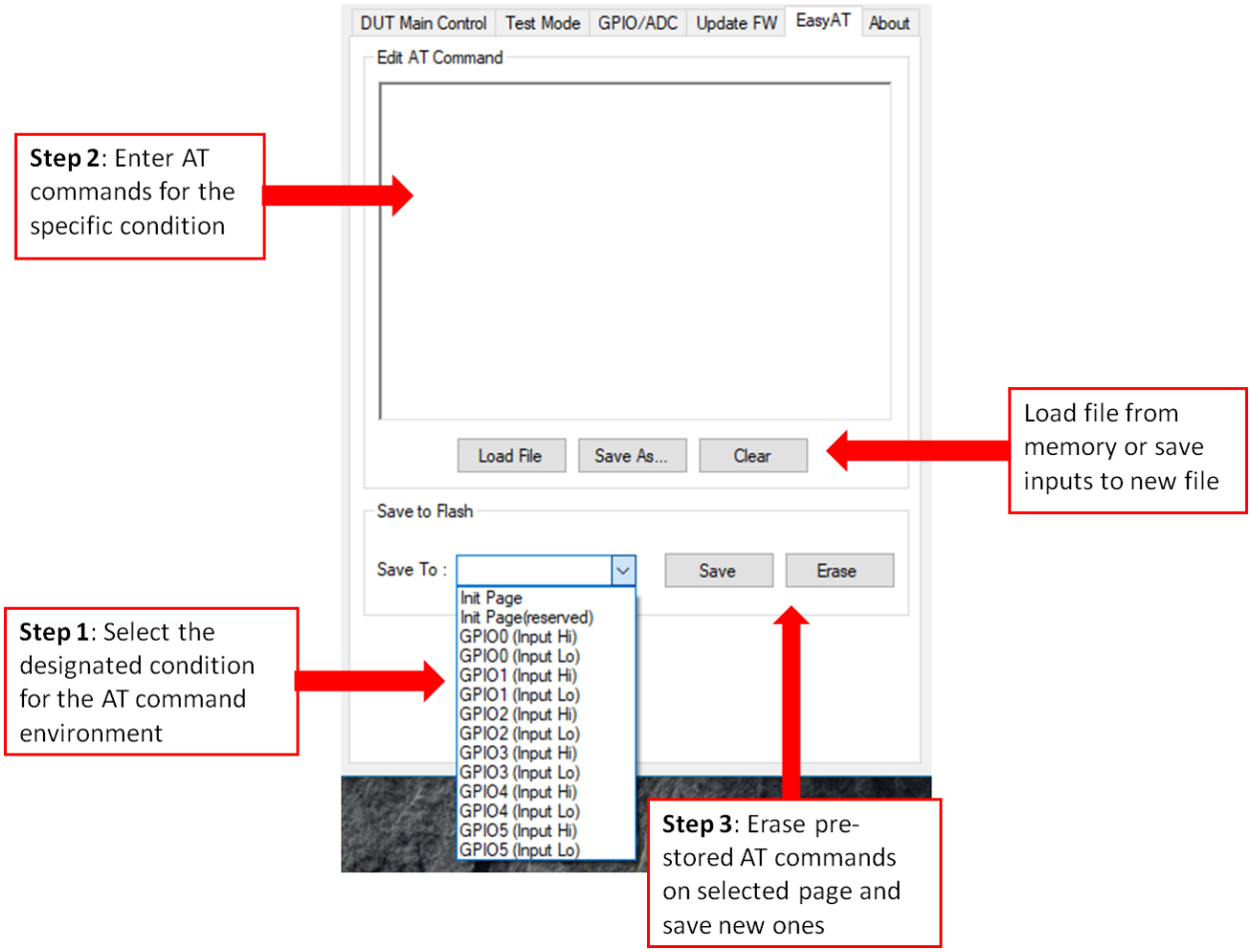
3.7 *GUI Interface - EasyAT Commander*

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/M2C8001-T 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:

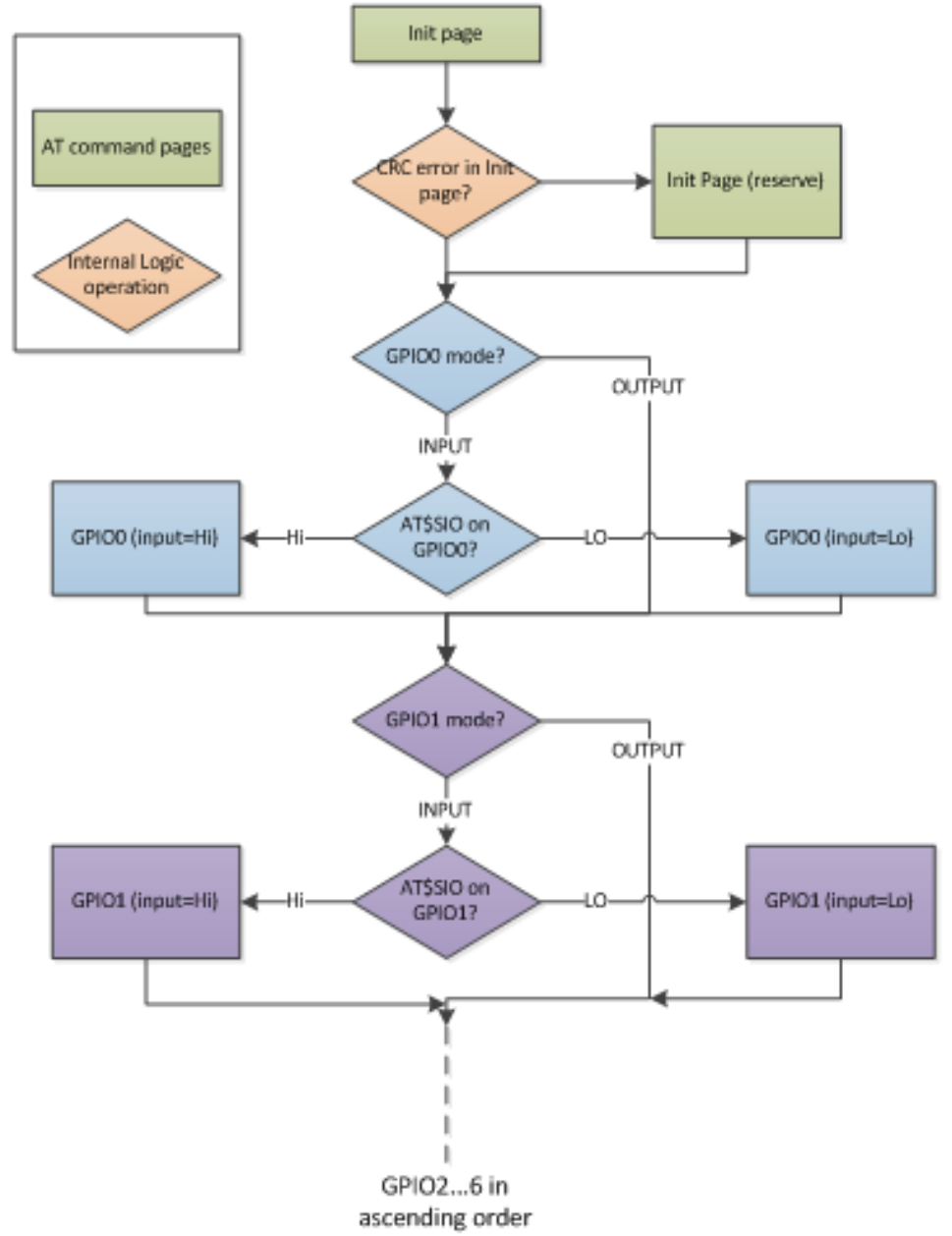
Initialization and actions required for each GPIO and/or voltage level. The firmware supports GPIO and low voltage actions.

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 below:



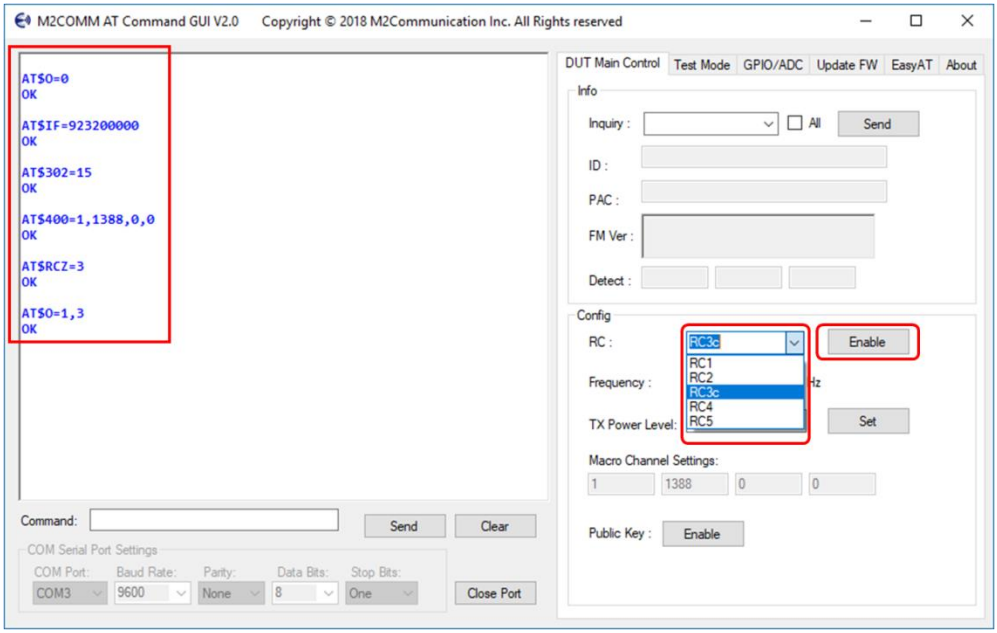
EasyAT Commander Operation Flow

4 *Operational Examples*

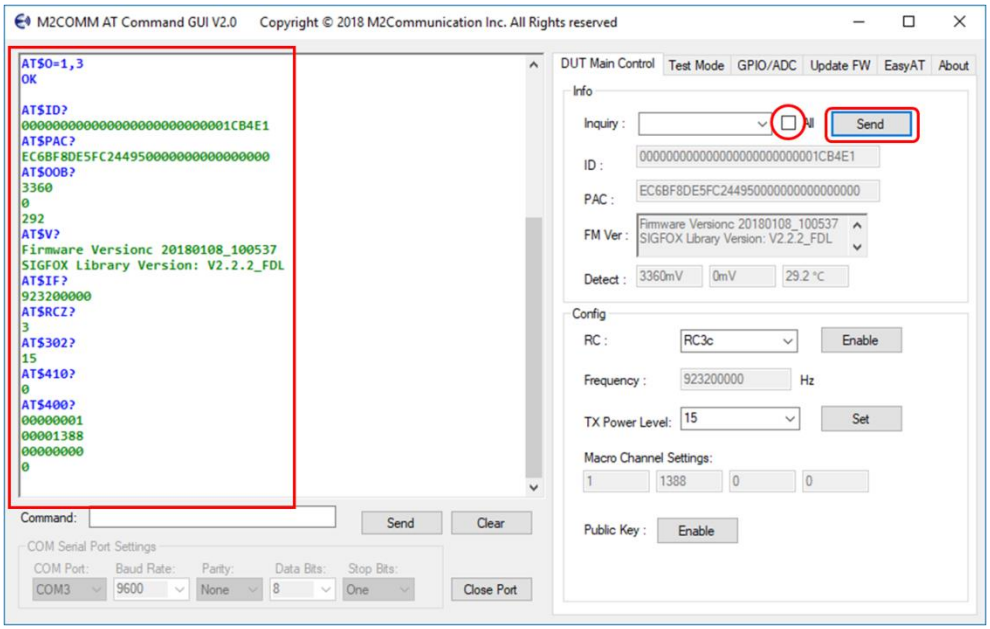
In this section we will walk through several commonly executed operations step by step. For each operation the user will be able to see the resultant AT Command list, these same commands can then be transferred to the MCU programming.

4.1 *Configure M2C8001/M2c8001-T (zone RCZ1 thru 5) and send a bit or frame.*

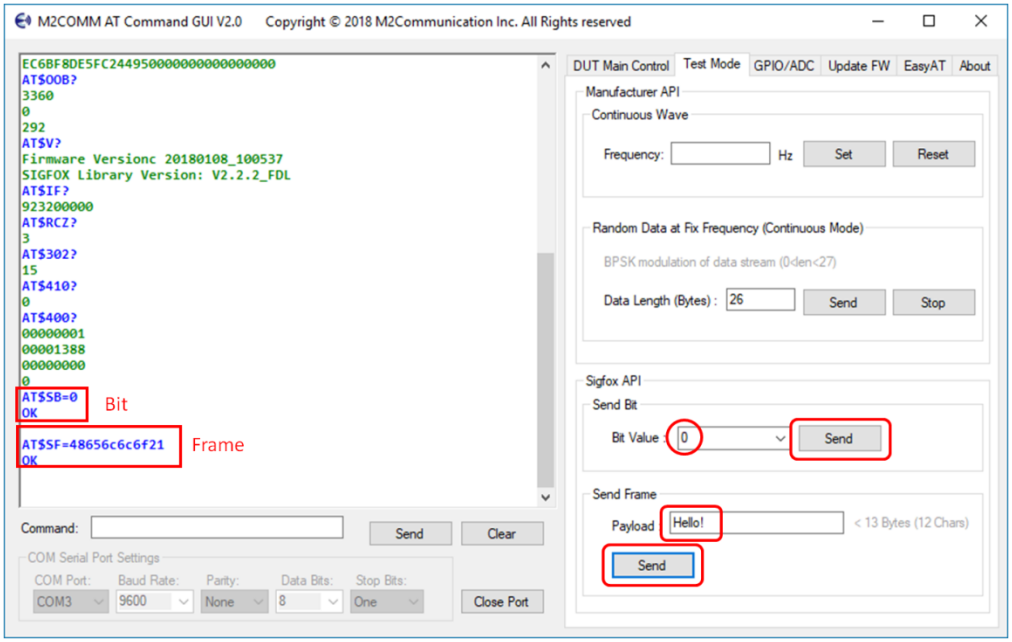
Step 1: Go to the “DUT Main Control” tab and select the required zone from the Config pane, then “Enable”, the AT Command Communication pane will display the basic details for the zone selected.



Step 2: Still in the “DUT Main Control” tab, inquire all info by checking “ALL” and then “Send”. Check the firmware version



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



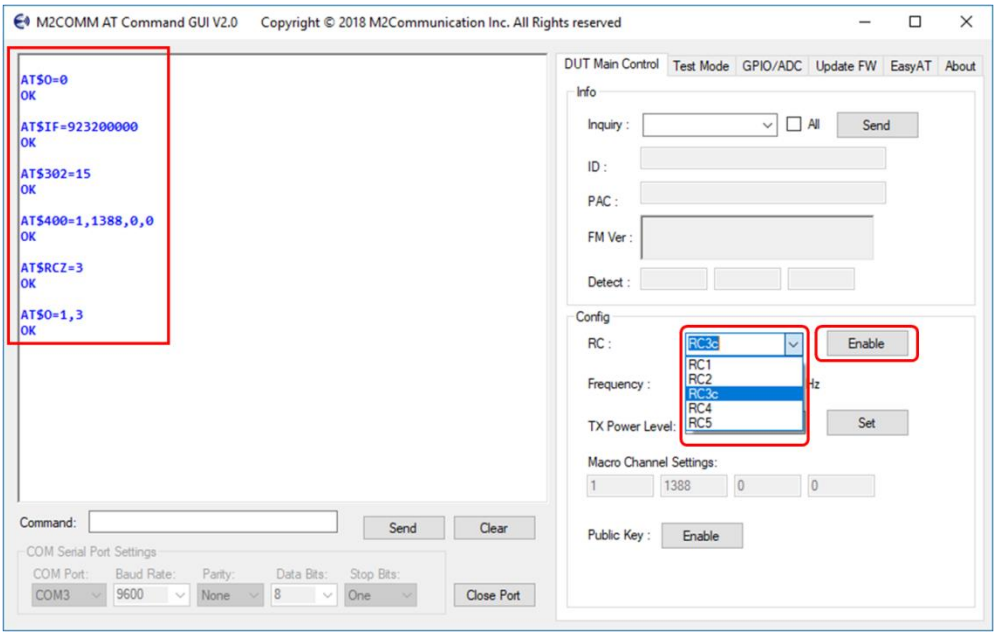
The send frame function carries the hexadecimal representation of the ACSII code input to the GUI. The ACSII text is not transmitted directly. In the example, ACSII “H” is transmitted as 0x48 and so “Hello!” is transmitted as 0x48 0x65 0x6c 0x6c 0x6f 0x21.

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

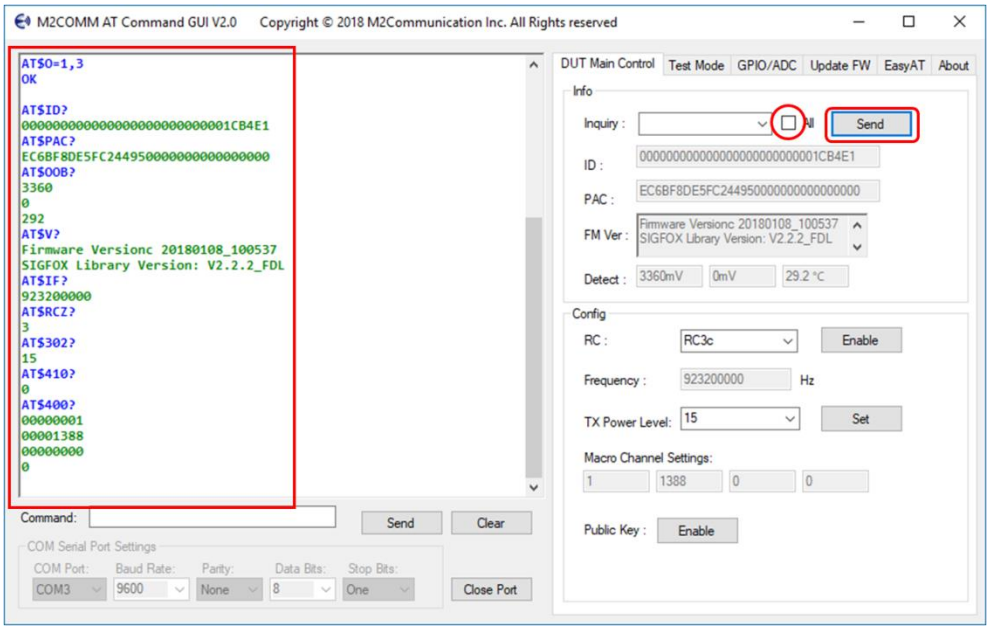
This is a library error code for your reference only. M2C8001/M2C8001-T will take care of the error automatically and the command is actually executed and returns “OK”.

4.2 *Configure M2C8001/M2C8001-T (zone RCZ1 thru 5) and send a bit or frame to SNEK*

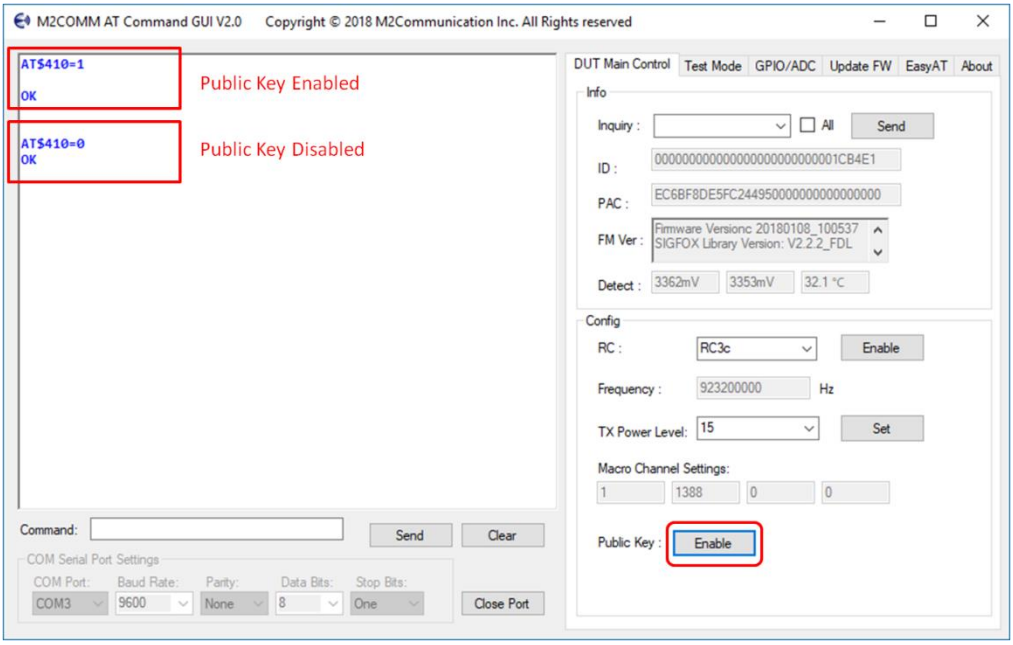
Step 1: Go to the “DUT Main Control” tab and select the required zone from the Config pane, then “Enable”, the AT Command Communication pane will display the basic details for the zone selected.



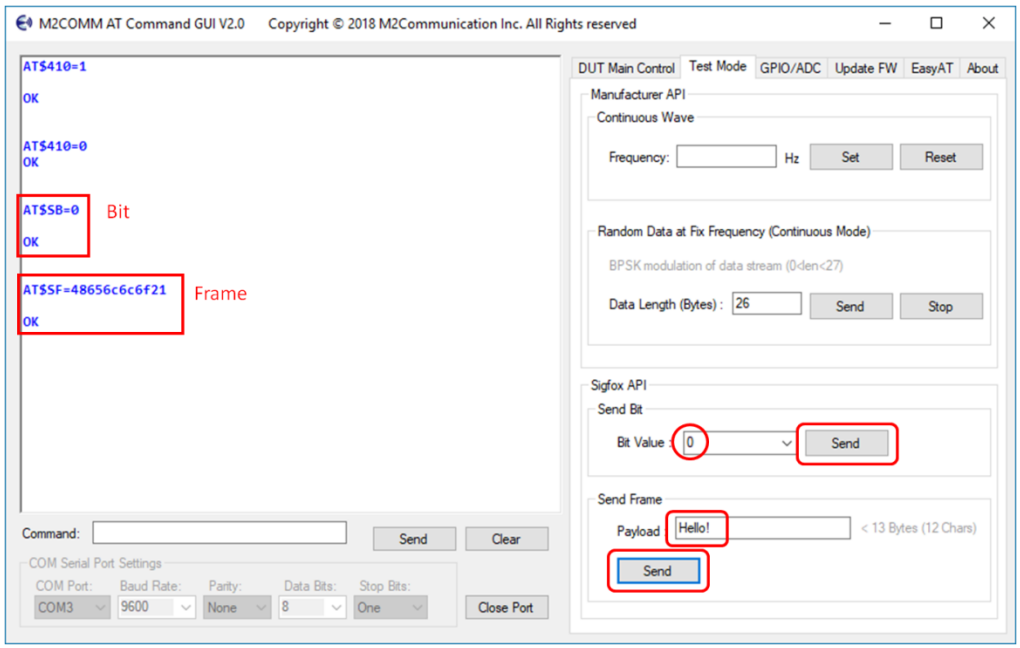
Step 2: Still in the “DUT Main Control” tab, inquire all info by checking “ALL” and then “Send”. Check the firmware version



Step 3: Enable Public Key by clicking “Enable”

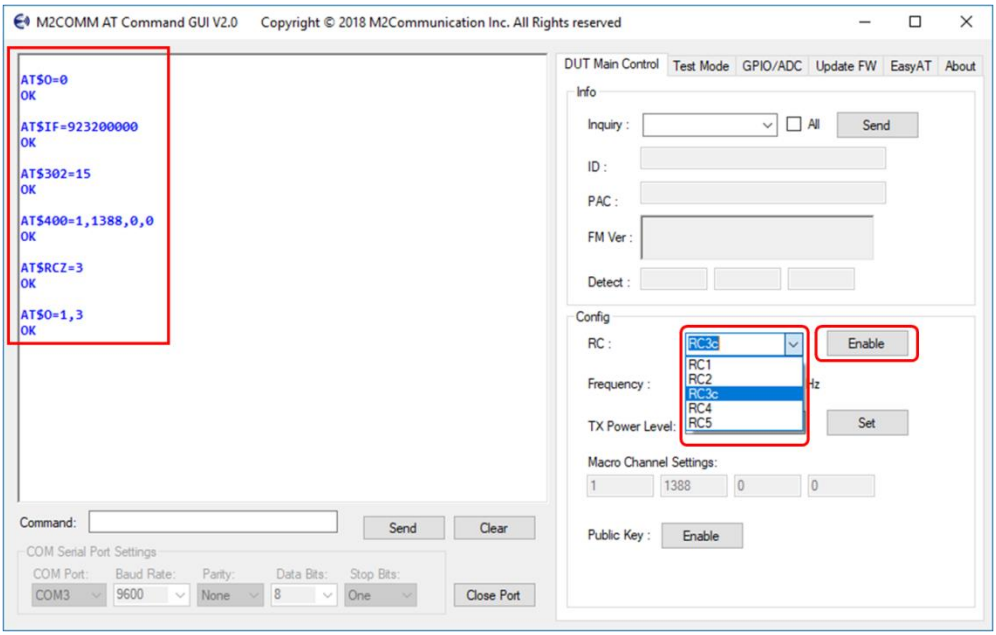


Step 4: Go to “Test mode” tab to send a bit or send a frame.

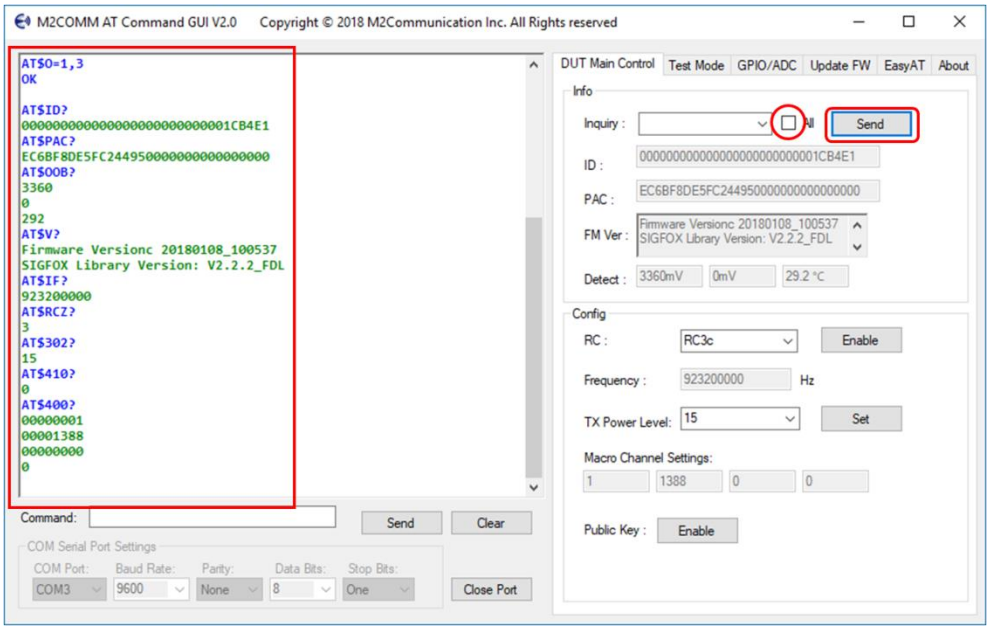


4.3 *Configure M2C8001/M2C8001-T to transmit a Continuous Wave or Packet for RF testing*

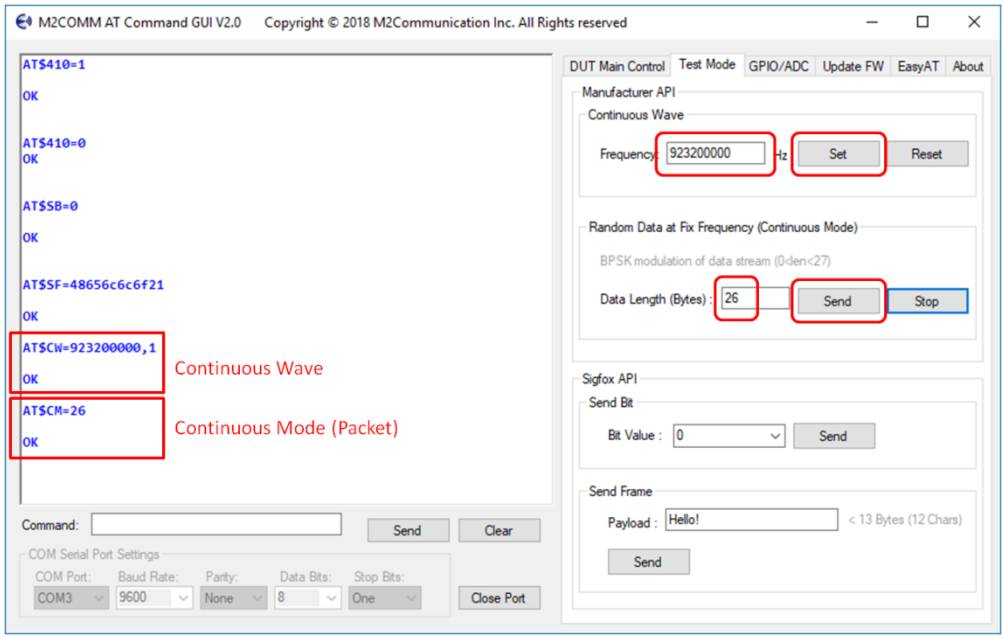
Step 1: Go to the “DUT Main Control” tab and select the required zone from the Config pane, then “Enable”, the AT Command Communication pane will display the basic details for the zone selected.



Step 2: Still in the “DUT Main Control” tab, inquire all info by checking “ALL” and then “Send”. Check the firmware version



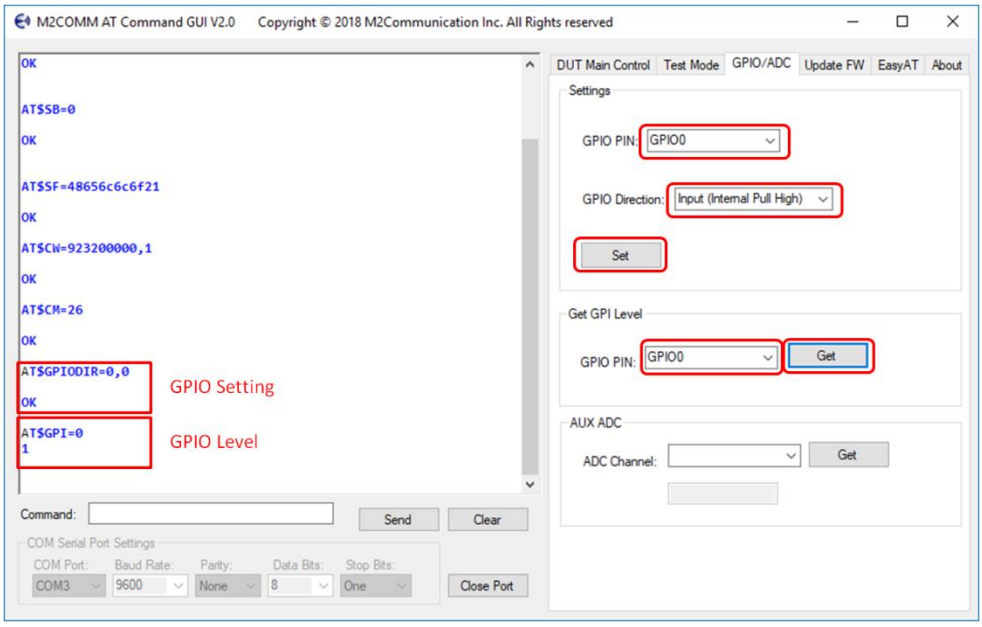
Step 3a (Continuous Wave): Go to “Test mode” tab, enter the Target Frequency and click “Set”, refer to table in Section 2.4 for frequency details.
Step 3b (Continuous Packet): Go to “Test mode” tab, enter the Data Length and click “Send”.



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

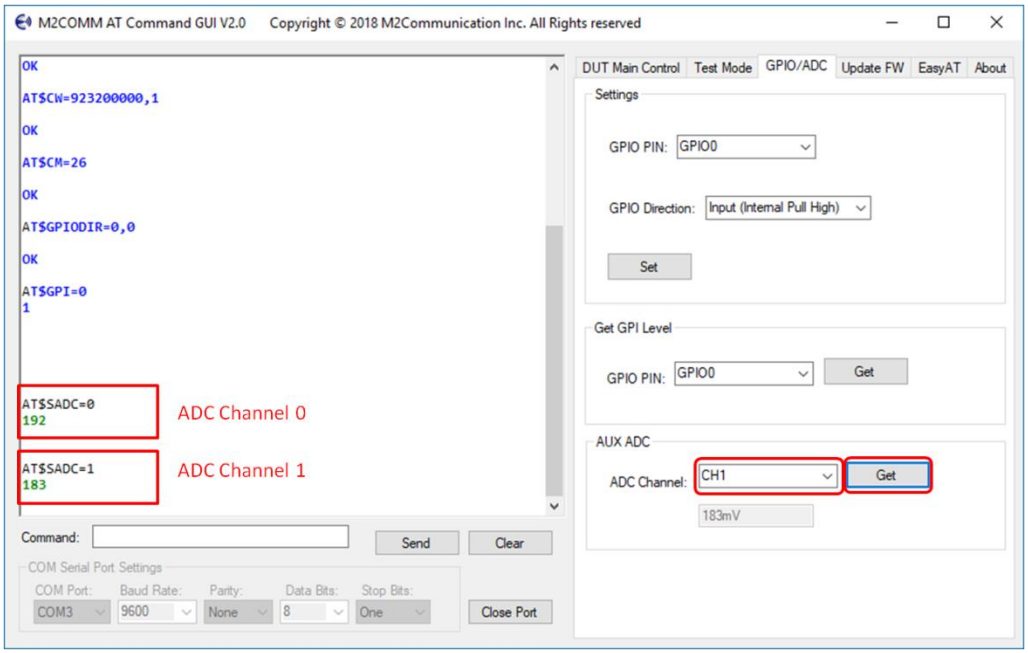
4.4 *Configure M2C8001 GPIO0 to input/output mode and read the input level*

Step 1: Go to the “GPIO/ADC” tab and select the GPIO pin from the pull down menu
Step 2: Select the configuration of the specific IO pin (input/output) from the pull down menu 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”.

4.5 *Measure the M2C8001/M2C8001-T external voltage levels*



Go to the “GPIO/ADC” tab and select the required ADC Channel from the pull down menu then click “Get”, displayed value is in mV.