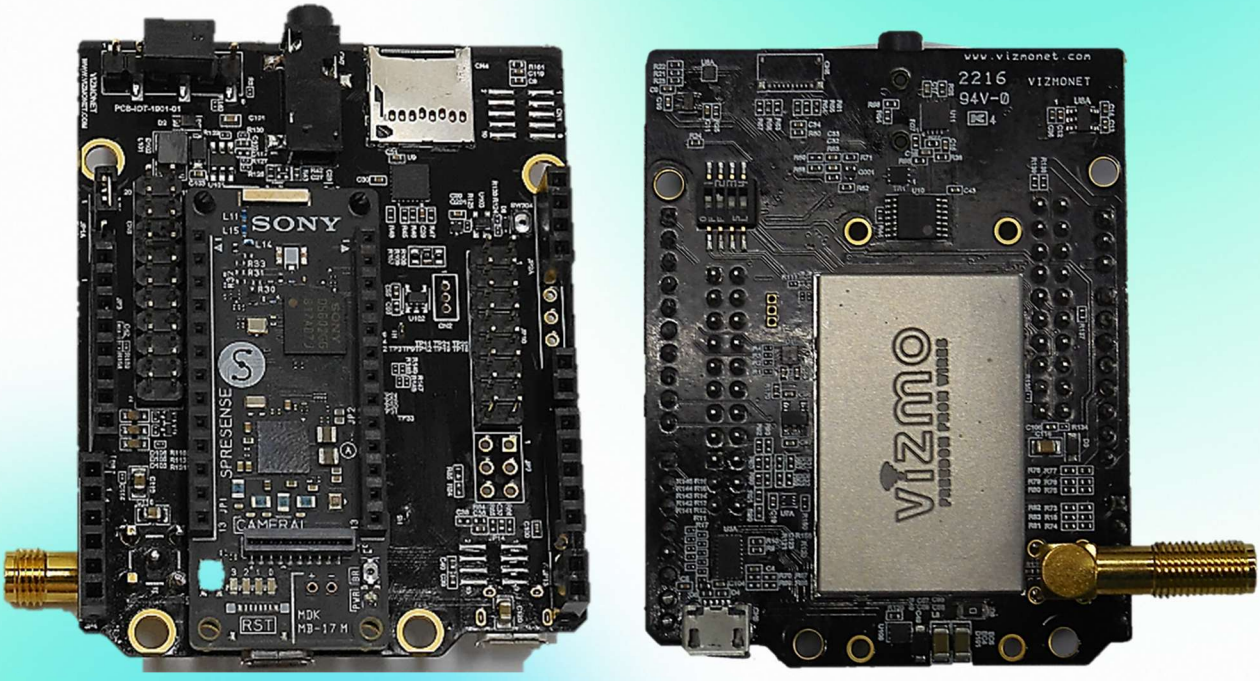
vizmo
FREEDOM FROM WIRES

ahSP1

USER GUIDE



HW Rev# 04.00

Last updated: Nov-03-25

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1. Introduction

The Wi-HaLow board is powered by the NRC7292-industry's first system on a chip (SoC) that is compliant with the IEEE 802.11ah Wi-HaLow standard. Wi-HaLow is optimized Wi-Fi solution for internet of things (IoT) devices. Operating in the Sub 1GHz license-exempt band, it offers a much greater range and material penetration when compared to 2.4GHz and 5GHz technologies. It can support low data rate sensors up to high data rate surveillance camera applications. The protocol's power-saving mechanisms greatly reduce power consumption and increase battery life.

This module is compatible with Sony's SPRESENSE main board which is an IoT board computer that combines low power consumption with a GPS reception function and a high-resolution audio codec. This module has the interfaces of microphone input, headphone output, and microSD card slot to use with the SPRESENSE

2. PROCEDURE

This document details the information on how to use this Wi-HaLow board along with Sony's SPRESENSE main board and how to configure them as either an Access Point or the Station and transfer the data between them.

2.1 PRE-REQUISITES

Please prepare the SPRESENSE board with required bootloader and nuttx spk files

Please follow the below link to install the loader and nuttx.spk in SPRESENSE

Spresense SDK Getting Started Guide (IDE)

Else please refer the Appendix Section 3.2 in this document to program the bootloader/ nuttx.spk

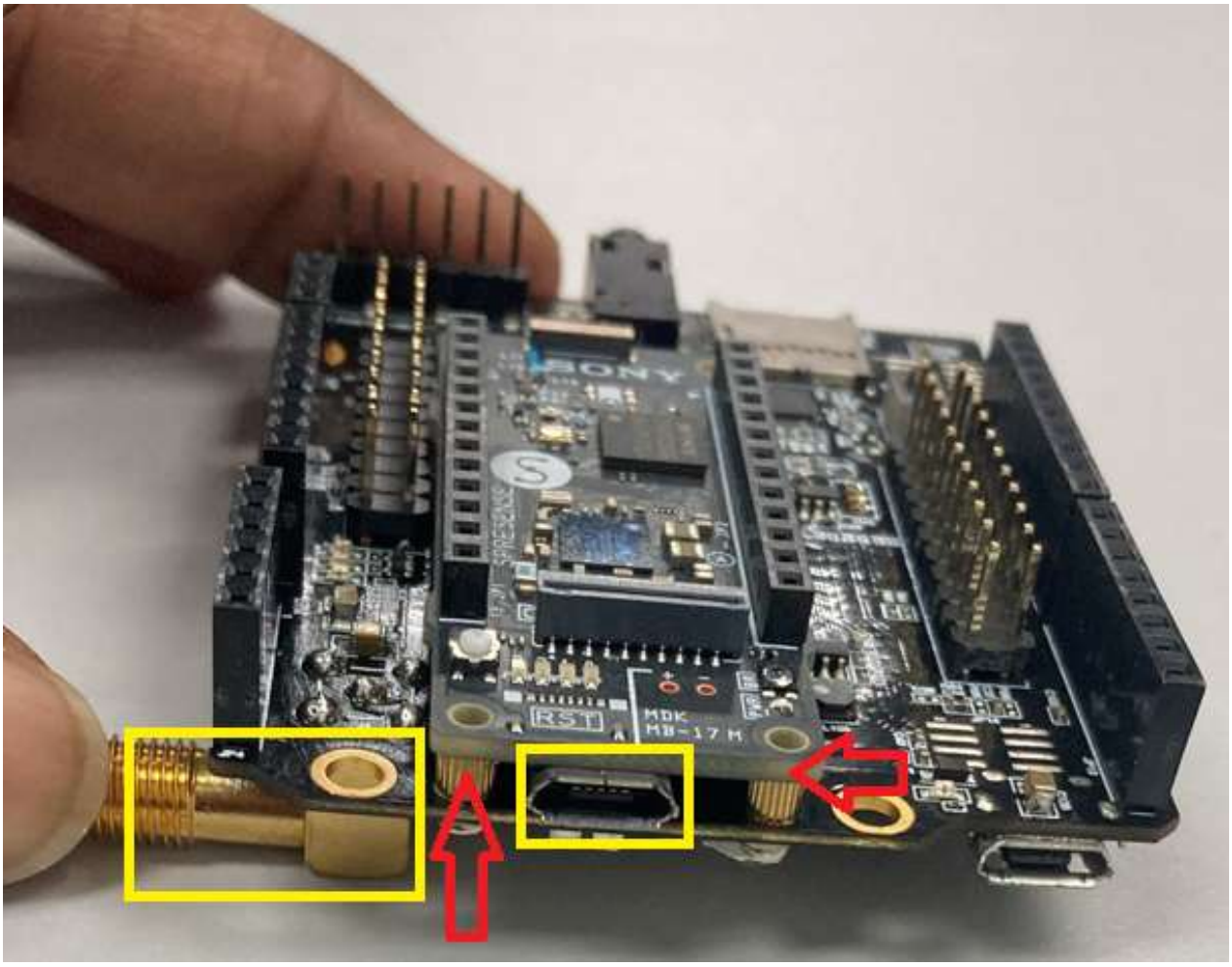
2.2 SETUP

Please insert the Sony SPRESENSE board as shown below

Please align the SPRESENSE's USB port on RF connector side of the Wi-HaLow board (highlighted in Yellow)

Please align the 4 mounting holes on SPRESENSE board on the respective standoffs in the Wi-HaLow card.

Then firmly press the main board down thus SPRESENSE mates with Wi-HaLow card

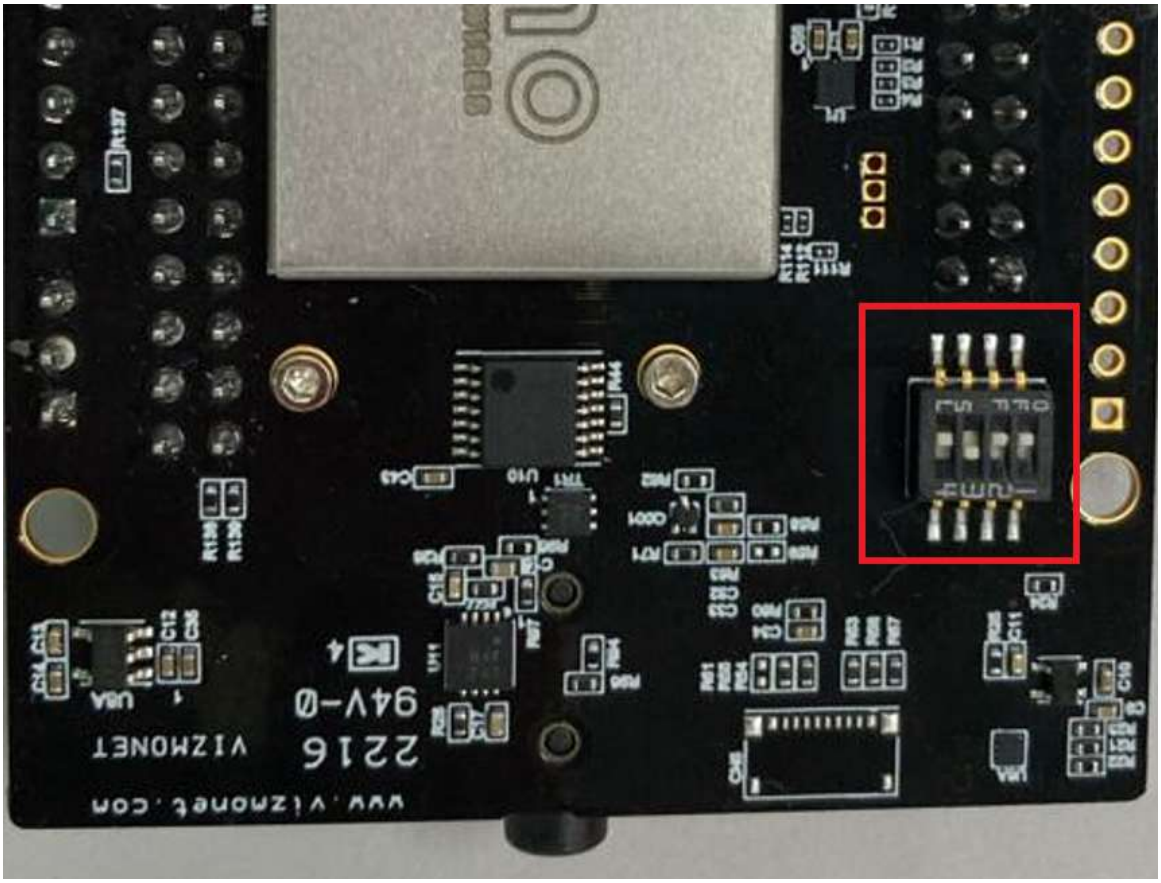


Please ensure the Wi-HaLow board is in the ATCMD mode by keeping the switch position to below

Pin1=OFF

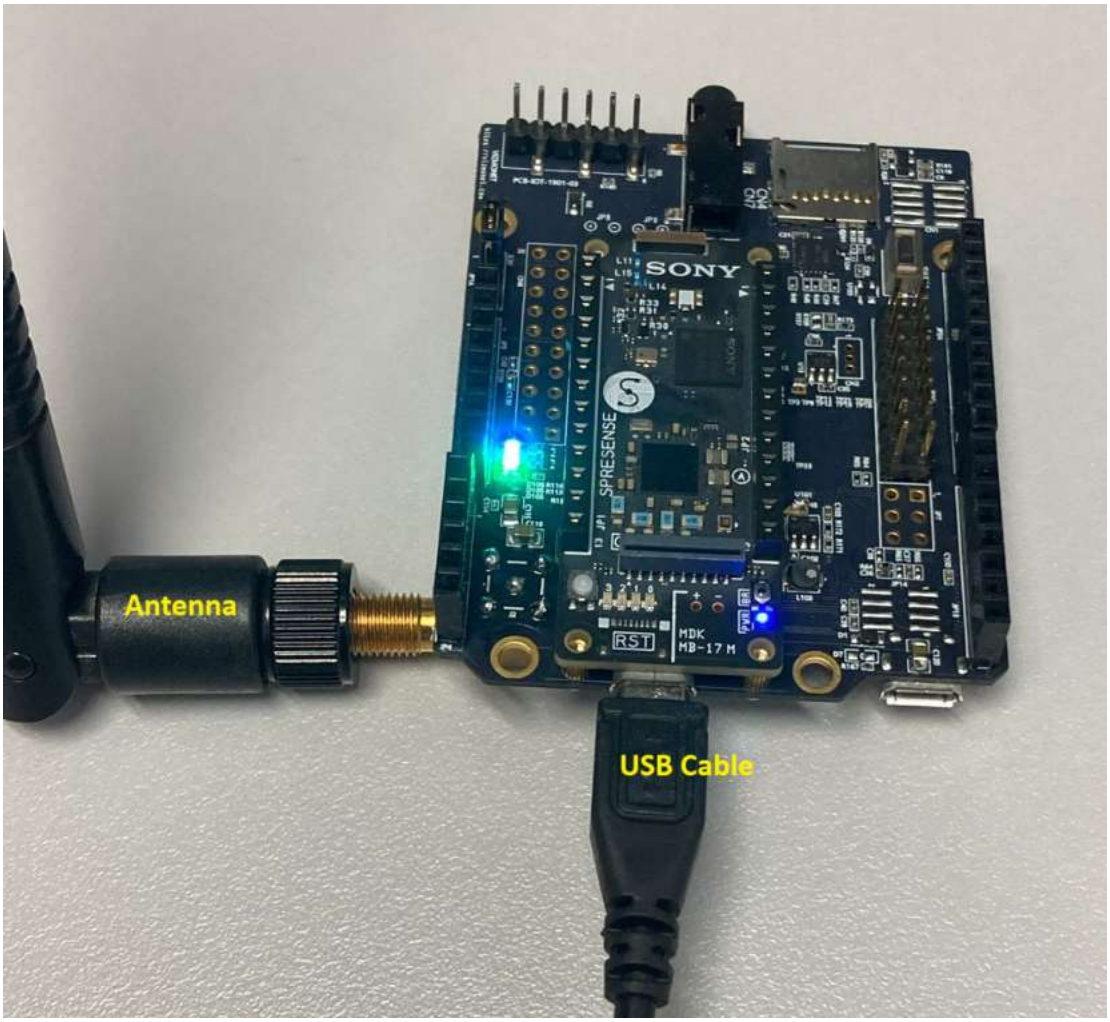
Pin2=OFF

Pin3=ON



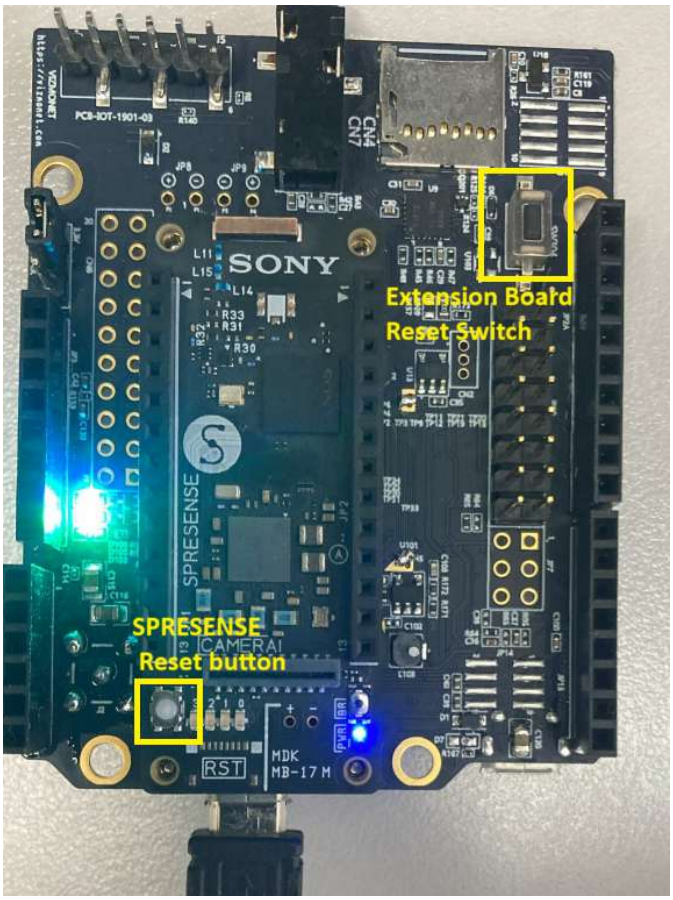
Please connect the Antenna with RF output connector of Wi-HaLow board as shown in below figure

Please Power ON the module by connecting the USB cable with the Sony Spresense Main board it as shown in below figure (This USB cable will act as power cable as well as console for the this module)



This USB console cable in this figure will be used to communicate with Sony SPRESENSE board which will be issuing the AT commands to the Wi-HaLow card through the SPI lines.

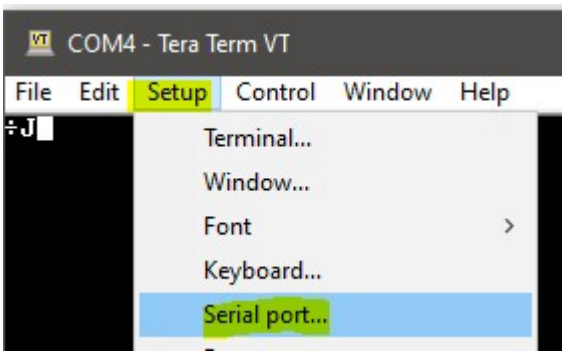
There are two reset switches, one for Wi-HaLow board and one for Sony Spresense as shown in figure. If required, they can be used



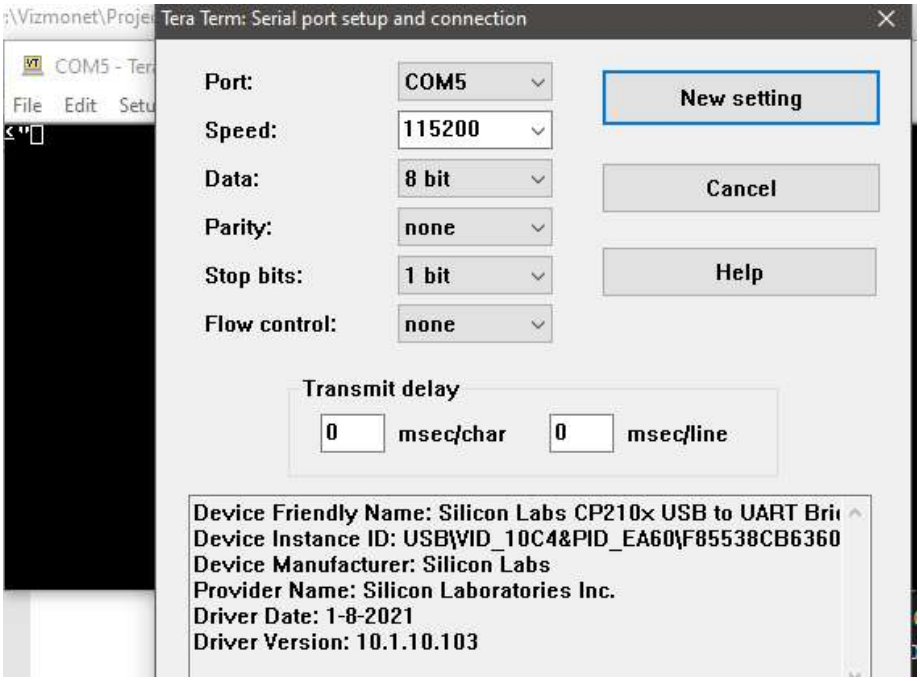
Please open the COM/Console cable window.

Here we show the ***Tera Term COM putty*** as an example.

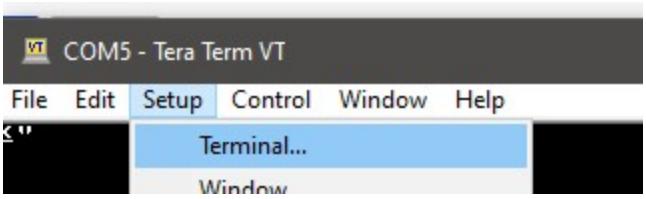
a. Open the Tera Term COM Putty
b. Go to 'Setup' and select 'Serial Port'



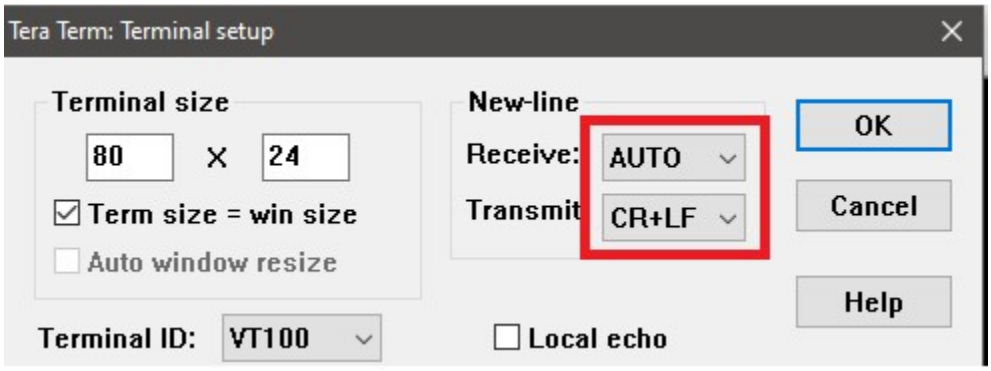
c. Select the Port and Set the baud rate as 115200



d. In the setup –> go to Terminal settings



e. Select the Receive and Transmit as 'Auto' and 'CR+LF' respectively as shown in below figure



Now the messages from Spresense board will be displayed here in the console window as shown below

2.3 WI-HALOW INITIAL CONFIGURATIONS

Please Power ON the board and wait for the nsh> prompt in the console window

```
NuttShell (NSH) NuttX-10.2.0
nsh>
```

Please type wihalo and press the enter button to start the Wi-HaLow, as shown in below figure

```
NuttShell (NSH) NuttX-10.2.0
nsh> wihalo
Starting WiFi HALO service / utility
[mbpro.local-Thu Dec  7 22:17:59 2023]
[01.4.WH1781]
Successfully read configuration
SYS
00 00 92 72 01 00 00 00 00 04 01 00 02 a0 92 72  ¦ ...r...........r

EIRQ
00 04                                            ¦ ..

STAT
00 00 00 00 00 00 00 00 00 20 80 00 00 10        ¦ ......... ....

MSG
4e 52 43 2d 48 53 50 49 00 02 20 00 00 02 20 00  ¦ NRC-HSPI.. ... .


[ HSPI SYS Registers ]
 - Status         : Ready(0), Sleep(0)
 - Chip ID        : 7292
 - Modem ID       : 00000001
 - Software ID : 00010400
 - Board ID       : 7292A002

[ HSPI EIRQ Registers ]
 - mode   : active(low), trigger(level), disable
 - enable : txq(0), rxq(0), ready(1), sleep(0)

[ HSPI STATUS Registers ]
 - latch : 0x00
 - eirq  : txque(0), rxque(0), ready(0), sleep(0)
 - txq   : error(0x00), slot_cnt(0), slot_size(0/0)
 - rxq   : error(0x00), slot_cnt(32), slot_size(128/4096)
Starting wihalo example application
```

Enter the **help** to get the information about those commands

```
help


Help information
help        : Shows help information
exit        : Terminate the NRC test utility
regs        : Read registers and update status
at          : Sends an AT command and receives the response (blocking)
atdelay     : Delay for ATCMD in microseconds

debug       : Enable/Disable debug output
startap     : Starts the access point with default parameters
startsta    : Starts the station with pre-defined parameters
spi         : Sets SPI communications (clock_rate)
cfg         : Sets configuration parameters
listen      : listen udp/tcp port
test        : test sck_id length (num-times)
connect     : connect tcp/udp (remote-ip remote-port)
iperf       : Throughput performance test utility
iperfend    : Terminates iperf procedures
mmr         : MMR
save        : save the current configuration to /mnt/spif/wihalo.cfg
stats       : show and clear stats
bw          : Sets bandwidth spec on some overlapping channels (0/1/2/4)
defaults    : Sets configuration to default values
reset       : Resets the NRC modem
```

To reset the module, please type the **reset** and then press enter.

This will reset the NRC modem (Please note, this command will erase any access point or station setup)

```
reset


Please wait ...Device has been reset
```

To read the hardware version or intended country to use or the maximum target output power, please type **AT+SFSYSUSER=0,108** command and then press enter

```
AT+SFSYSUSER=0,108


OK
+RXD_SFSYSUSER:0,108
{
HW Version: 0300,
Manufacturer: Vizmonet,
Others: ["WiHaLow", "JP", "Target Power=13"]
}
```

To see the existing configuration please follow below steps

Type **cfg show** and then press enter. It will display the existing configuration

```
cfg show

Current Configuration
SPI clock   : 20000000
Country     : JP
DHCP        : ON
Security    : NONE
SSID        : WiHalo-Vizmo
IP Params   : 192.168.1.1,255.255.255.0,192.168.1.1
Flags       : 40000
Channel/bw  : 924.50000004
AT delay    : 0
```

To change/setup the SSID,

Type **cfg ssid 'desired_ssid_name'** and then press enter

```
cfg ssid wihalo-vizmo

Set SSID to wihalo-vizmo
```

If it was successfully set the SSID, then **Set SSID to** message will be displayed

To change/setup the Country ,

(here JP stands for JAPAN, please refer section 3.1 for the country code of other countries)

Type **cfg country JP** and then press enter

```
cfg country JP

Set country code to JP
```

Note: Both Access Point and Station should have same SSID name, Country Code to get connected each other. So please do the steps 5 and 6 on both access point and station boards

To change/setup the Frequency,

Type **cfg frequency 924.5** and then press enter

```
cfg frequency 924.5

Set frequency to 924.500000 Mhz
```

To change/setup the Bandwidth,

Type **bw 4** and then press enter

Note: Please ensure the set BW belongs to the frequency selected. Please refer the Appendix section 3.1 for JP supported frequencies and their corresponding bandwidths.

Once the configuration is changed (either SSID/Country Code/Frequency/BW), then the changes should be saved.

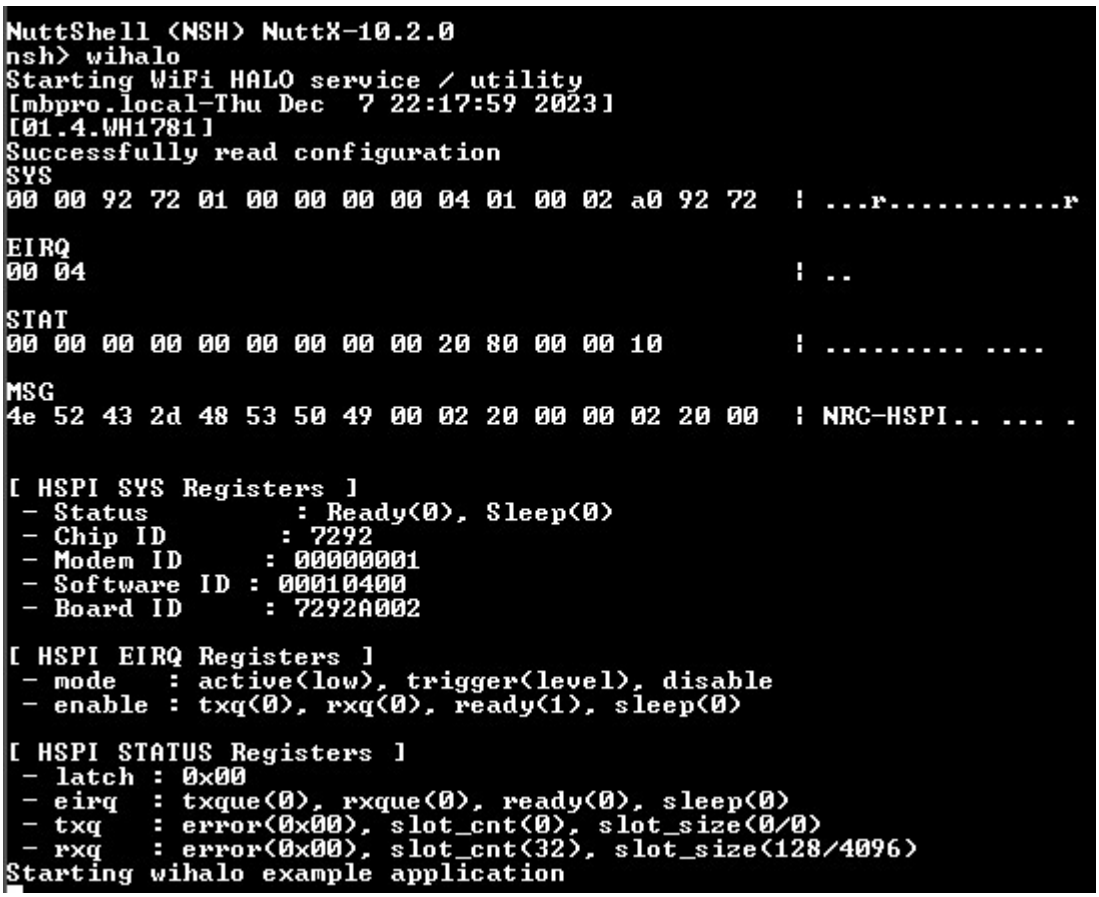
Type **save** and then press enter

Then please **power OFF and then ON the board**, for the new saved configurations to take effect

2.4 ACCESS POINT AND STATION SETUP

1. We need two DUTs, one for Access point, let's called as DUT1.
   Another DUT for Station, let's called as DUT2
2. Please follow section 2.3 for both DUTs to configure the initial WiHaLow settings
3. Please Power ON the DUT and wait for the **nsh>** prompt in the console window

   Please do this step for both DUT1 and DUT2
4. Please type ***wihalo*** and press the **enter** button to start the Wi-HaLow, as shown in below figure



   Please do this step for both DUT1 and DUT2

5. Enter **startap** to start the access point with DUT1
   And it will display below message

```
startap

Configuring NRC device
Device has been reset
Started the access point
Setting IP parameters
Started DHCP server
IP address : 192.168.1.1
Listening on port 88
```

6. Enter **startsta** to start the station on DUT2
   And it will display below message

```
startsta

Connecting..
Device has been reset
Connected to the network
```

2.5 SERVER AND CLIENT SETUP

1. Please set one DUT as access point and another DUT as station by following the procedures in Section 2.4
2. To set one DUT as server, enter **iperf -s -P** on DUT (DUT1 here for an example)

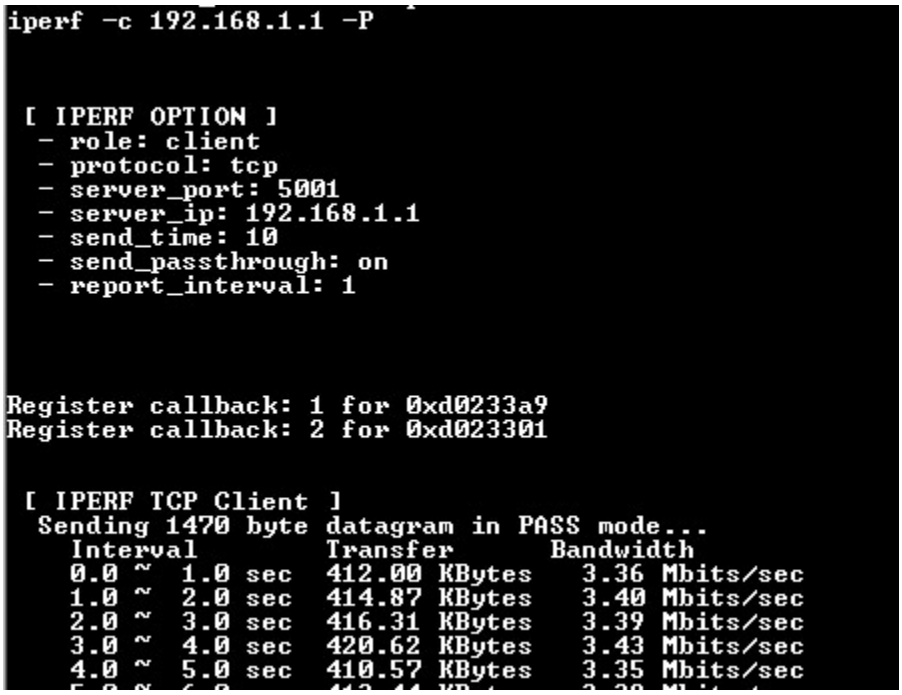
```
iperf -s -P


 [ IPERF OPTION ]
  - role: server
  - protocol: tcp
  - server_port: 5001
  - report_interval: 1




 [ IPERF TCP Server ]
    Interval          Transfer        Bandwidth
```

3. To set another DUT as client, enter **iperf –c 'DUT1's IP address ' -P** on the second DUT (DUT2 here)
   Example: **iperf –c 192.168.1.1 -P**

```
iperf -c 192.168.1.1 -P
```

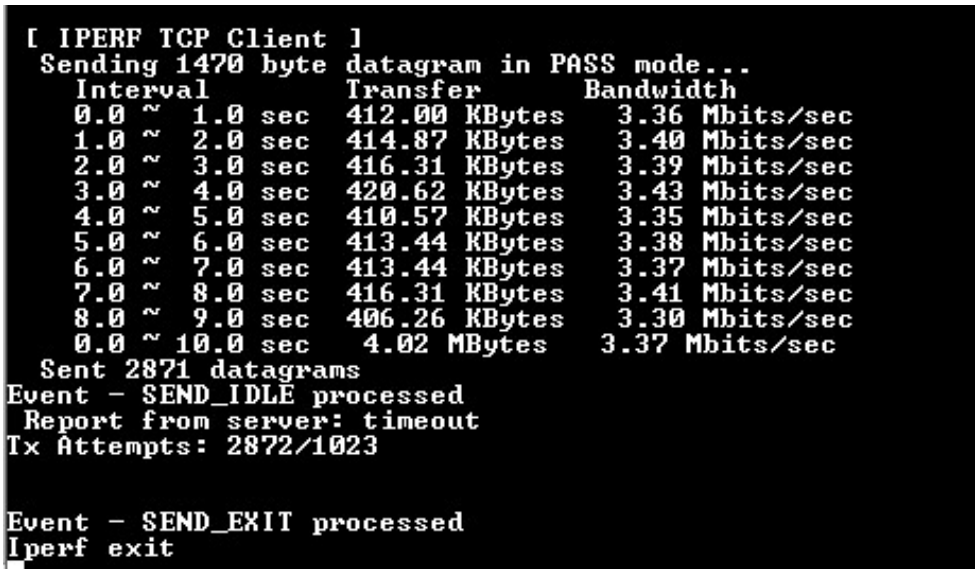
(Note: Access Point's IP address is 192.168.1.1 which is DUT1 and also configured as server here and the station's IP address is 192.168.1.2 which is DUT2 configured as client here)

4. Now the communication starts between the server and client and throughput is displayed on the client side as shown in below figure.



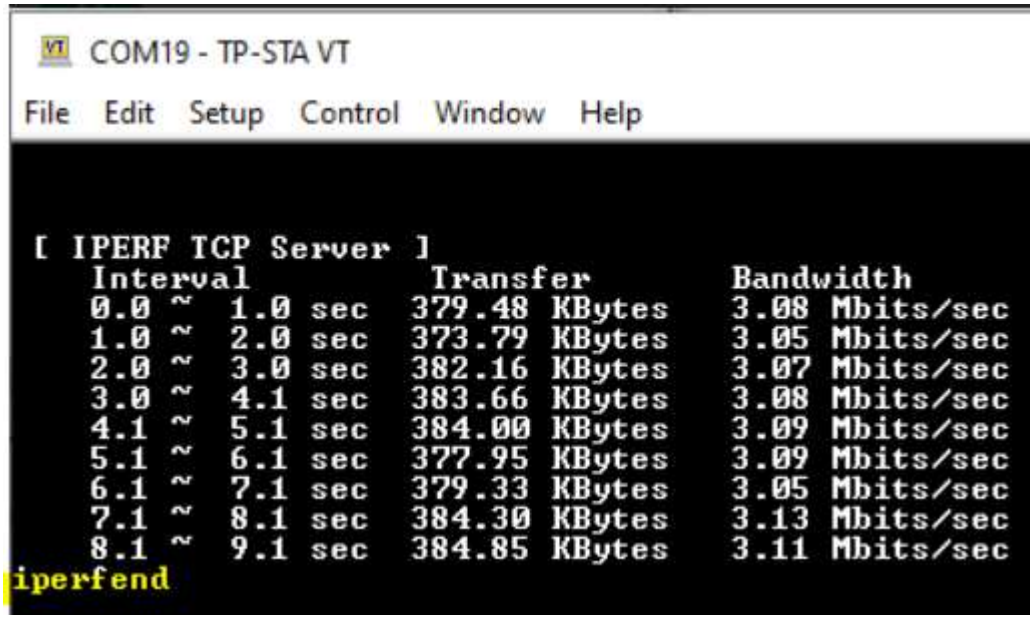
It is 3.36 Mbps here in the picture.

5. After completing 10 iterations, iperf end automatically on client side (DUT2 here).



6. On the server side(DUT1 here) please enter below command

   Iperfend



7. If you want to restart the iperf, please go to step 2

2.6 MESSAGE TRANSFER TEST

8. Please set one DUT as access point and another DUT as station by following the procedures in Section 2.4
9. Please enable the pass-through mode by entering **cfg bit 4 0** on both DUTs

10. Please enter **save** to save the settings done in step 2

11. On the access point DUT side , please enter the command **test** (here on DUT1 as access point)

12. On the station DUT side (here DUT2), please enter the command **test 'Access Point's IP address'**

    Example: **test 192.168.1.1**

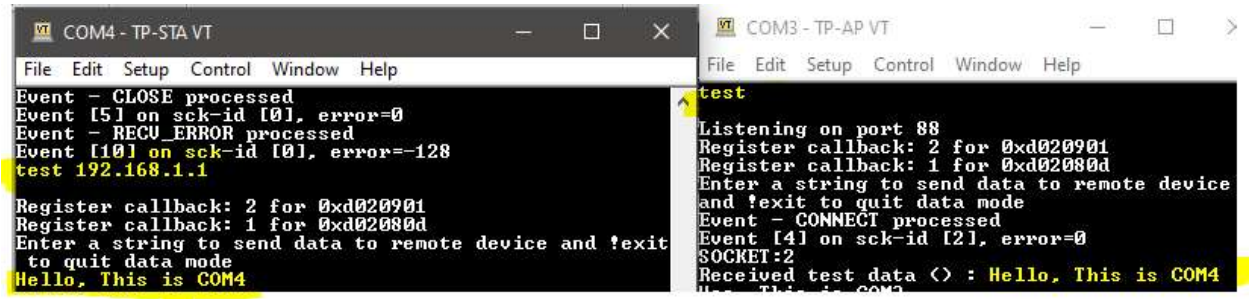
```
test 192.168.1.1

Register callback: 2 for 0xd020901
Register callback: 1 for 0xd02080d
Enter a string to send data to remote device and !exit to quit data mode
```

    (Note: Access Point's IP address is 192.168.1.1 which is DUT1 and the station's IP address is 192.168.1.2 which is DUT2 here)

13. Now you can enter any message on either side (access point or station). It will be sent to corresponding opposite DUT and will be displayed there

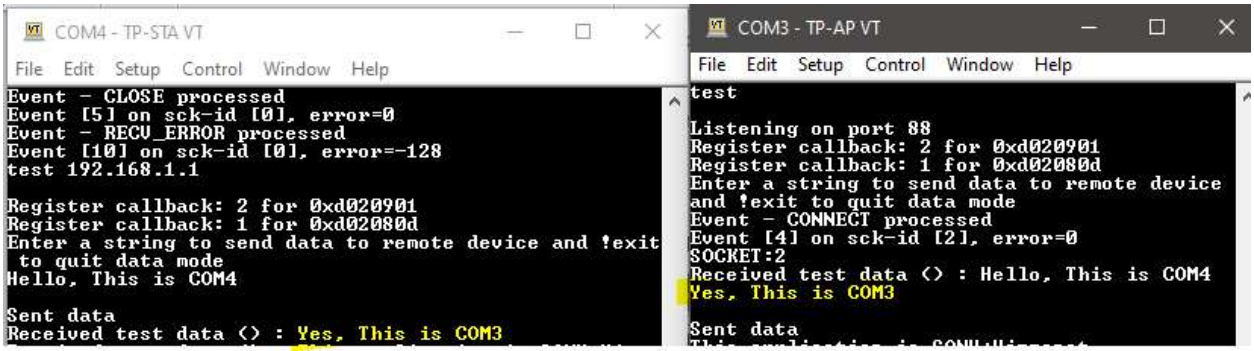
    Example: Hello, This is COM4 is entered in station DUT's COM4

    It is received and displayed by access point DUT's COM3



    Example: Yes, This is COM3 is entered in access point DUT's COM3

    It is received and displayed by station DUT's COM3



14. Enter **!exit** on both (station first and then access point) DUTs to terminate this message transfer

```
!exit

Exit test mode
```

3. Appendix

3.1 WI-HALOW BANDS FOR DIFFERENT COUNTRY

The 802.11 standard's frequency index (channel numbers) are mapped to Wi-HaLow band. The below tables shows the frequency band index (from 802.11) and the corresponding mapped Wi-HaLow frequency band and bandwidths that is supported with this module.

JAPAN (Country Code: JP)

Available frequency band index	Bandwidth (MHz)	Sub-1GHz frequency	2.4 / 5G frequency
40 (Default)	1	921.0	5200
42	1	923.0	5210
43	1	924.0	5215
44	1	925.0	5220
45	1	926.0	5225
46	1	927.0	5230
36	2	923.5	5180
37	2	924.5	5185
38	2	925.5	5190
39	2	926.5	5195
47	4	924.5	5235
48	4	925.5	5240

EUROPE (Country Code: EU)

Available frequency band index	Bandwidth (MHz)	Sub-1GHz frequency	2.4 / 5G frequency
36	1	863.5	5180
37	1	864.5	5185
38	1	865.5	5190
39	1	866.5	5195
40	1	867.5	5200

North America (County Code: US)

Available frequency band index	Bandwidth (MHz)	Sub-1GHz frequency	2.4 / 5G frequency
1	1	902.5	2412
3	1	903.5	2422
5	1	904.5	2432
7	1	905.5	2442
9	1	906.5	2452
11	1	907.5	2462
36	1	908.5	5180
37	1	909.5	5185
38	1	910.5	5190
39	1	911.5	5195
40	1	912.5	5200
41	1	913.5	5205
42	1	914.5	5210
43	1	915.5	5215
44	1	916.5	5220
45	1	917.5	5225
46	1	918.5	5230
47	1	919.5	5235
48	1	920.5	5240
149	1	921.5	5745
150	1	922.5	5750
151	1	923.5	5755
152	1	924.5	5760
100	1	925.5	5500
104	1	926.5	5520
108	1	927.5	5540
2	2	903	2417
6	2	905	2437
10	2	907	2457
153	2	909	5765
154	2	911	5770
155	2	913	5775
156	2	915	5780
157	2	917	5785
158	2	919	5790
159	2	921	5795
160	2	923	5800
161 (Default)	2	925	5805
112	2	927	5560
8	4	906	2447
162	4	910	5810
163	4	914	5815
164	4	918	5820
165	4	922	5825
116	4	926	5580

Australia (County Code: AU)

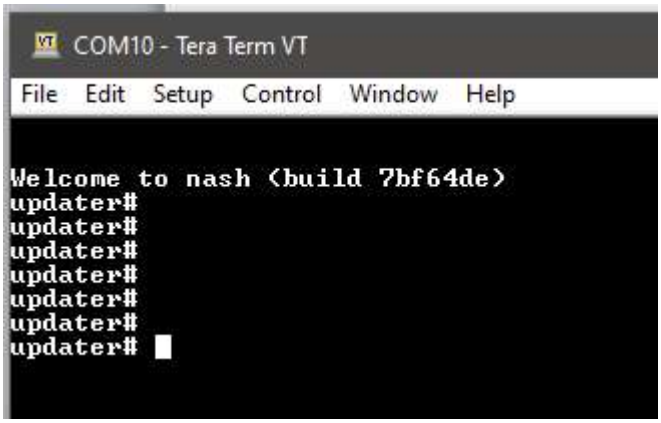
Available frequency band index	Bandwidth (MHz)	Sub-1GHz frequency	2.4 / 5G frequency
36 (Default)	1	915.5	5180
37	1	916.5	5185
38	1	917.5	5190
39	1	918.5	5195
40	1	919.5	5200
41	1	920.5	5205
42	1	921.5	5210
43	1	922.5	5215
44	1	923.5	5220
45	1	924.5	5225
46	1	925.5	5230
47	1	926.5	5235
48	1	927.5	5240
153	2	917.0	5765
154	2	919.0	5770
155	2	921.0	5775
156	2	923.0	5780
157	2	925.0	5785
158	2	927.0	5790
162	4	918.0	5810
163	4	922.0	5815
164	4	926.0	5820

New Zealand (County Code: NZ)

Available frequency band index	Bandwidth (MHz)	Sub-1GHz frequency	2.4 / 5G frequency
36 (Default)	1	915.5	5180
37	1	916.5	5185
38	1	917.5	5190
39	1	918.5	5195
40	1	919.5	5200
41	1	920.5	5205
42	1	921.5	5210
43	1	922.5	5215
44	1	923.5	5220
45	1	924.5	5225
46	1	925.5	5230
47	1	926.5	5235
48	1	927.5	5240
153	2	917.0	5765
154	2	919.0	5770
155	2	921.0	5775
156	2	923.0	5780
157	2	925.0	5785
158	2	927.0	5790
162	4	918.0	5810
163	4	922.0	5815
164	4	926.0	5820

3.2 PROGRAM THE IMAGE ON SONY SPRESENSE

1. Once power ON the board, below will be displayed in the COM port of the SONY SPRESENSE for the brand new SPRESENSE Main board.



To make it work, we have to program the bootloader and nuttx.spk.

2. If PC does not have MSYS2 tool, then please download the tool 'msys2-x86_64-20220603.exe' from the MSYS2 website and install the MSYS software. This software is used to program the flash in nuttx/linux environment from the windows PC.
3. Copy the loader.espk and nuttx.spk into the 'SPRESENSE' folder of the Spresense-mainboard.
   Attached the zip files with required files in place, but please get the latest nuttx.spk file. Please download and extract below attachment.

SPRESENSE.zip

4. Open the MSYS window and go to that 'SPRESENSE' directory as shown on below figure.

```
gokul@GOKUL MSYS ~
$ cd D:/Vizmonet/Projects/IOT-1901/VZ/VER-2/SW/SPRESENSE
```

5. Execute below command to flash the boot loader (If already bootloader installed, please skip this step)
   tools/flash.sh –c COM6 loader.espk

```
gokul@GOKUL MSYS /d/Vizmonet/Projects/IOT-1901/VZ/VER-2/SW/SPRESENSE
$ tools/flash.sh -c COM6 loader.espk
/usr/bin/env: 'python3': No such file or directory
>>> Install files ...
install -b 115200
Install loader.espk
|0%----------------------------50%----------------------------100%|
##################################################################

129968 bytes loaded.
Package validation is OK.
Saving package to "loader"
updater# sync
updater# Restarting the board ...
reboot
```

6. Execute below command to flash the nuttx ATCMD application.
   tools/flash.sh –c COM6 nuttx.spk

```
gokul@GOKUL MSYS /d/Vizmonet/Projects/IOT-1901/VZ/VER-2/SW/SPRESENSE
$ tools/flash.sh -c COM6 nuttx.spk
/usr/bin/env: 'python3': No such file or directory
>>> Install files ...
install -b 115200
Install nuttx.spk
|0%----------------------------50%----------------------------100%|
##################################################################

205648 bytes loaded.
Package validation is OK.
Saving package to "nuttx"
updater# sync
updater# Restarting the board ...
reboot
```

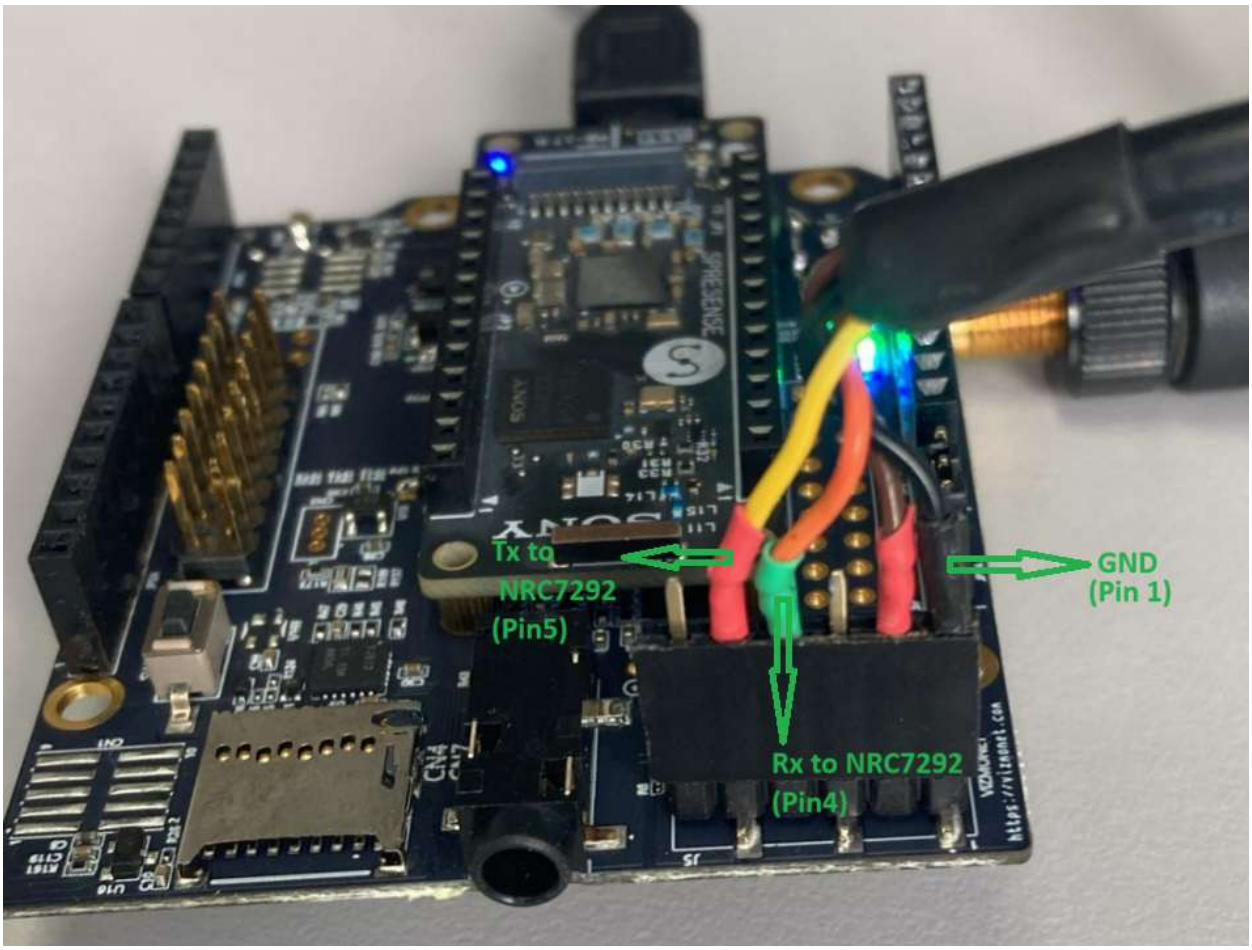
3.3 WI-HALOW CARD CONSOLE

1. There is one console cable header (6-pins header out of which 4 pins are used) for Wi-HaLow card for debug purpose. It can be used if required.

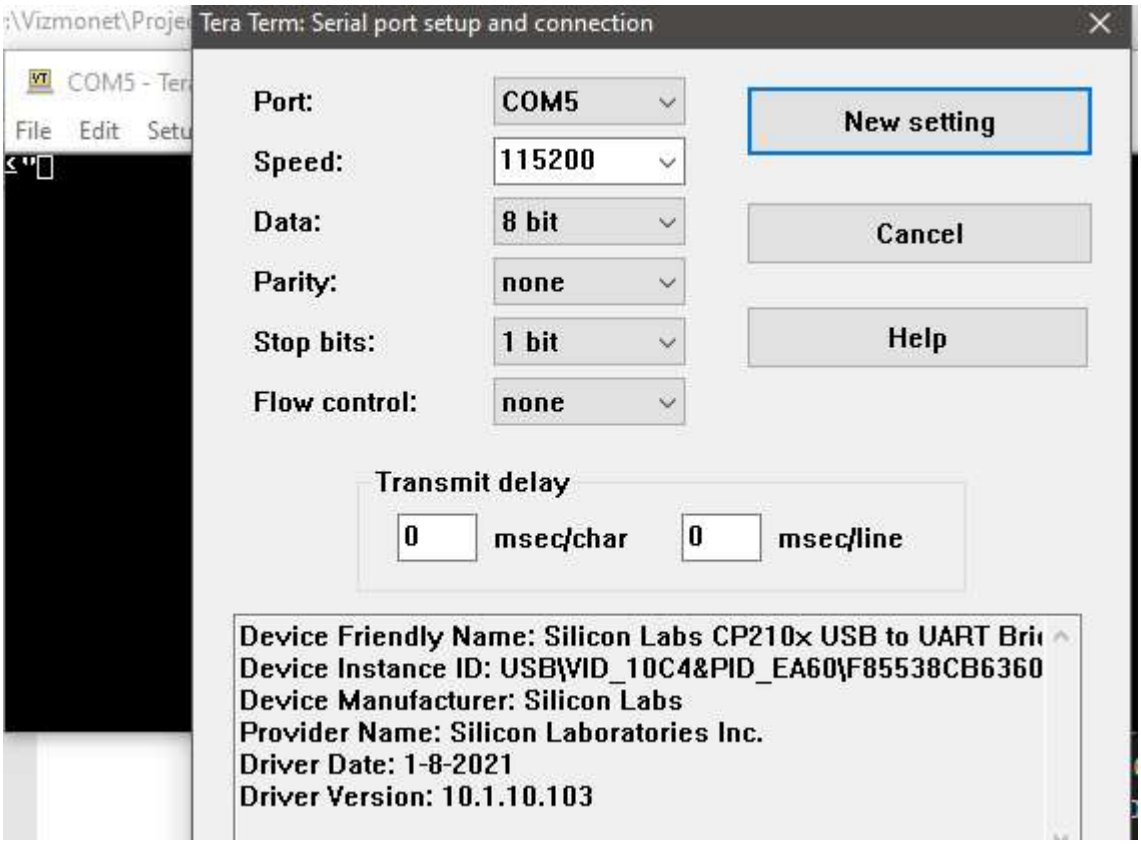
(Please remove the Red (power) and green or blue wires from the default USB console cable before connecting with this header)

The ground polarity and the cable orientations are as shown in below figure.

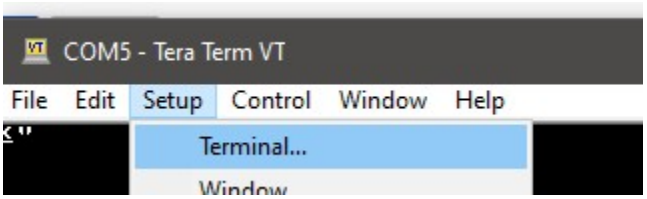
Pins 3 and 6 are no connection from right as in below figure, Pin2 is not used

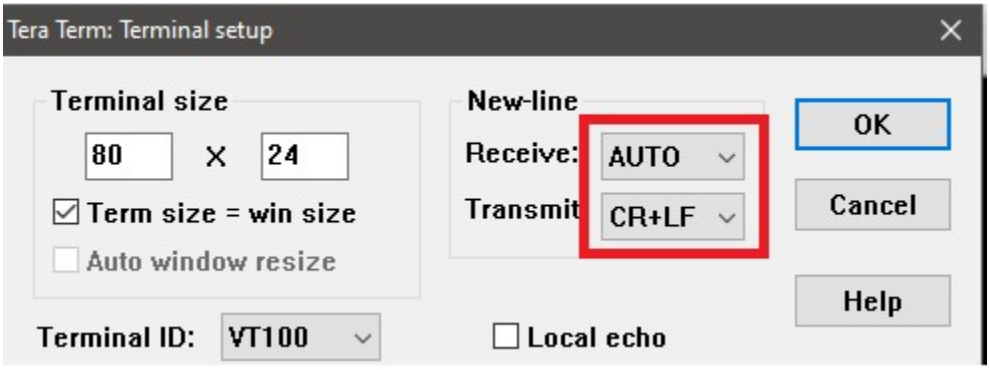


2. Please set the baud rate as 115200

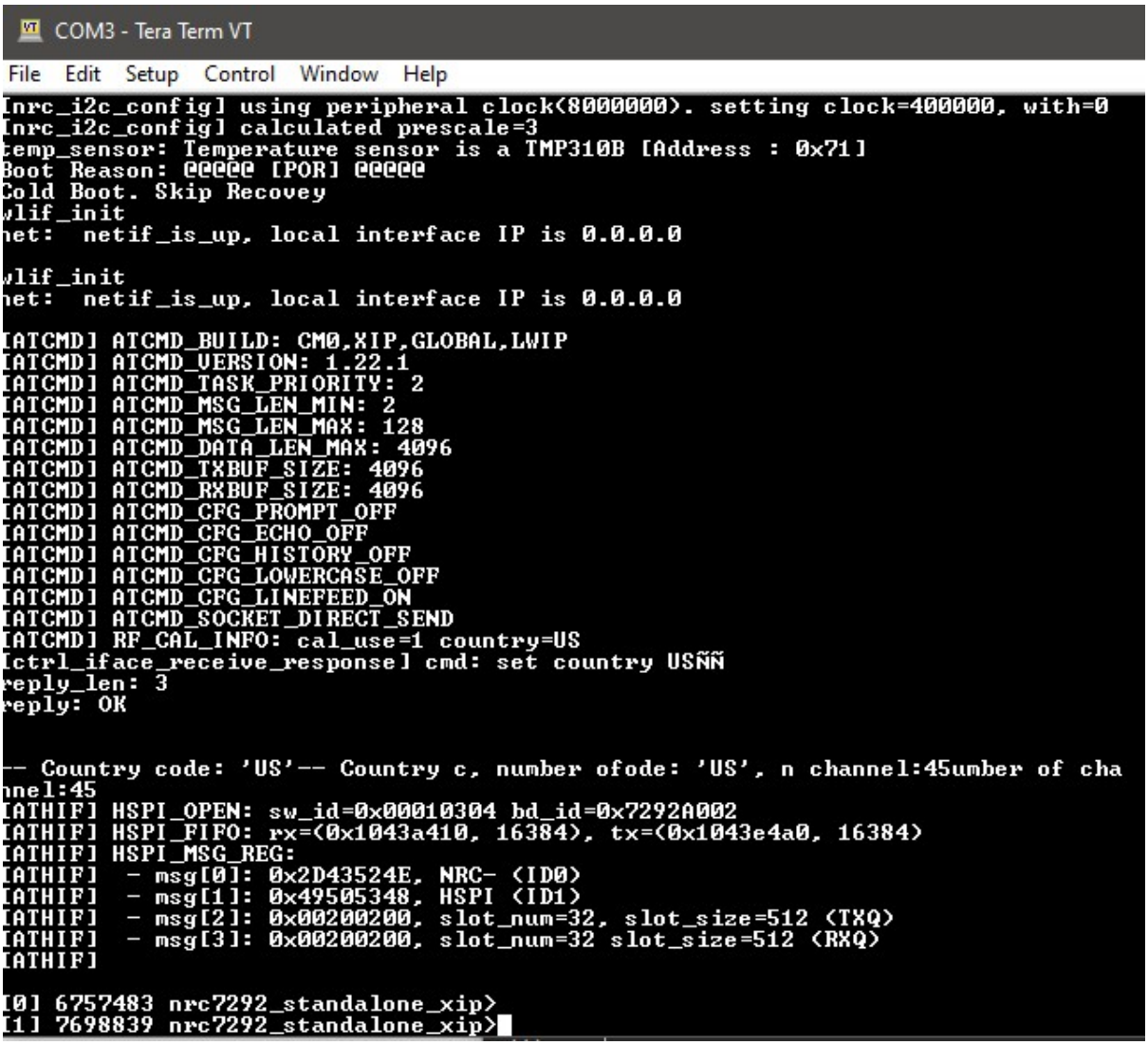


3. In the setup –>Terminal settings, select the Receive and Transmit as 'Auto' and 'CR+LF' respectively as shown in below figure





4. Now, the messages from Wi-HaLow card will be displayed here in the window as shown below.

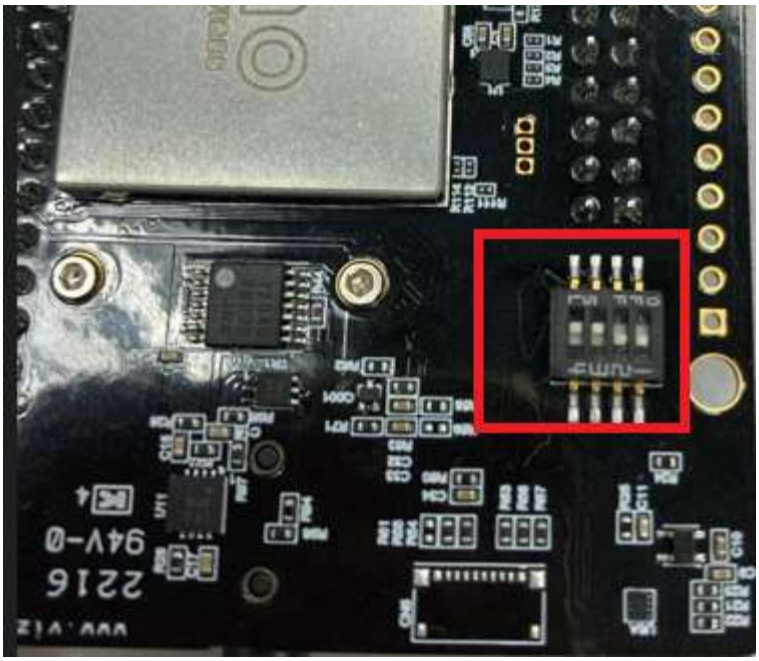

COM3 - Tera Term VT
File Edit Setup Control Window Help
[nrc_i2c_config] using peripheral clock(8000000). setting clock=400000, with=0
[nrc_i2c_config] calculated prescale=3
temp_sensor: Temperature sensor is a TMP310B [Address : 0x71]
Boot Reason: @@@@@ [POR] @@@@@
Cold Boot. Skip Recovey
wlif_init
net: netif_is_up, local interface IP is 0.0.0.0
wlif_init
net: netif_is_up, local interface IP is 0.0.0.0
[ATCMD] ATCMD_BUILD: CM0,XIP,GLOBAL,LWIP
[ATCMD] ATCMD_VERSION: 1.22.1
[ATCMD] ATCMD_TASK_PRIORITY: 2
[ATCMD] ATCMD_MSG_LEN_MIN: 2
[ATCMD] ATCMD_MSG_LEN_MAX: 128
[ATCMD] ATCMD_DATA_LEN_MAX: 4096
[ATCMD] ATCMD_TXBUF_SIZE: 4096
[ATCMD] ATCMD_RXBUF_SIZE: 4096
[ATCMD] ATCMD_CFG_PROMPT_OFF
[ATCMD] ATCMD_CFG_ECHO_OFF
[ATCMD] ATCMD_CFG_HISTORY_OFF
[ATCMD] ATCMD_CFG_LOWERCASE_OFF
[ATCMD] ATCMD_CFG_LINEFEED_ON
[ATCMD] ATCMD_SOCKET_DIRECT_SEND
[ATCMD] RF_CAL_INFO: cal_use=1 country=US
[ctrl_iface_receive_response] cmd: set country USÑÑ
reply_len: 3
reply: OK
-- Country code: 'US'-- Country c, number ofode: 'US', n channel:45umber of cha
nnel:45
[ATHIF] HSPI_OPEN: sw_id=0x00010304 bd_id=0x7292A002
[ATHIF] HSPI_FIFO: rx=(0x1043a410, 16384), tx=(0x1043e4a0, 16384)
[ATHIF] HSPI_MSG_REG:
[ATHIF] - msg[0]: 0x2D43524E, NRC- (ID0)
[ATHIF] - msg[1]: 0x49505348, HSPI (ID1)
[ATHIF] - msg[2]: 0x00200200, slot_num=32, slot_size=512 (TXQ)
[ATHIF] - msg[3]: 0x00200200, slot_num=32 slot_size=512 (RXQ)
[ATHIF]
[0] 6757483 nrc7292_standalone_xip>
[1] 7698839 nrc7292_standalone_xip>

3.4 Program/Upgrade the standalone mode firmware

1. To program a firmware/image in the IOT-1901, please change the switch position to download mode as shown in below figure.
   Pin1=ON

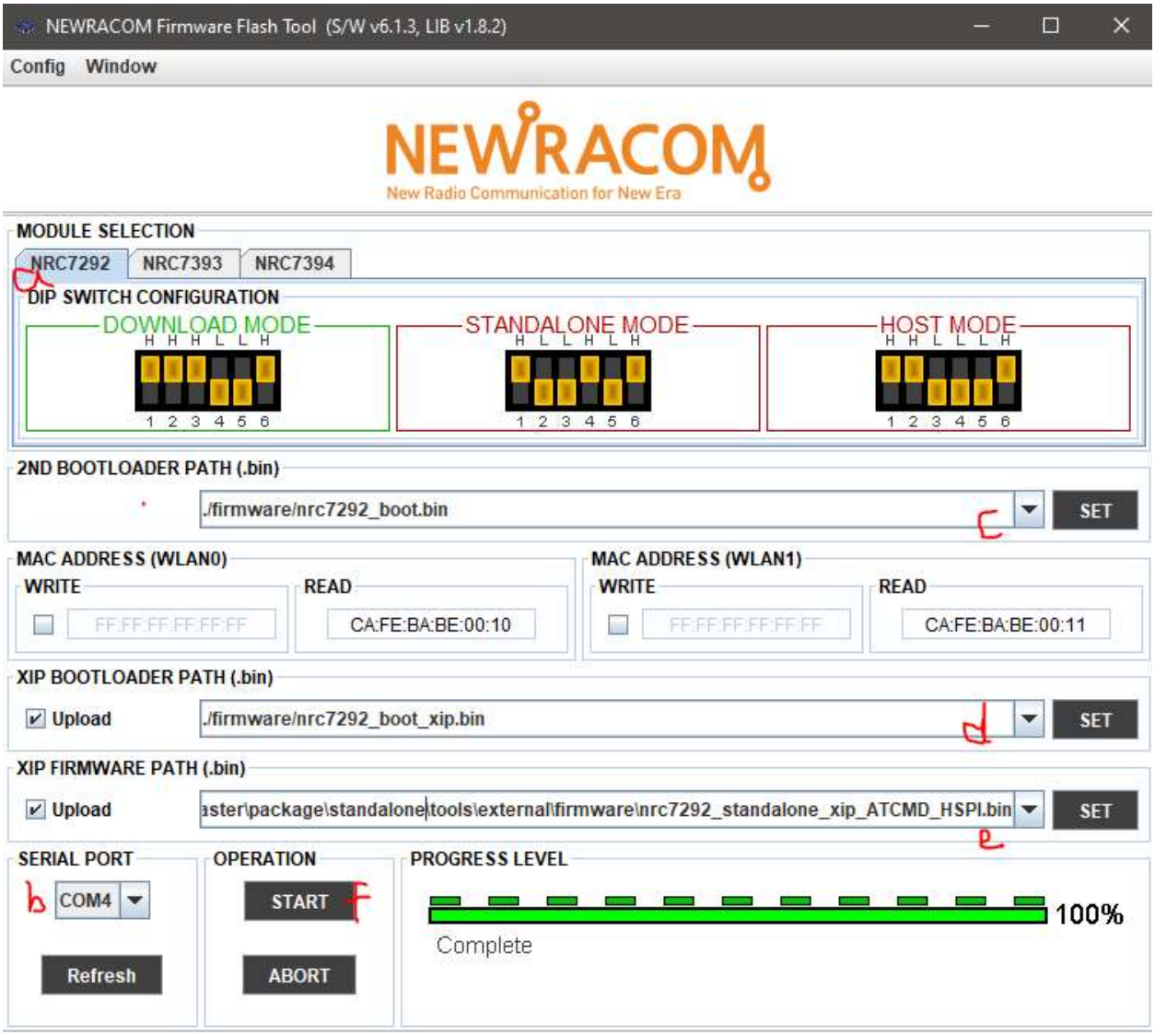
   Pin2=ON

   Pin3=OFF



2. Please connect the console cable as mentioned in the step 1 of section 3.3

3. Open the corresponding 'FirmwareDownloader.exe' tool
   a. Select the NRC7292 tab
   b. Select the serial port of IOT-1901
   c. Set the corresponding 2nd Bootloader path (this is automatic, in case if it's different from desired bin)
   d. Set the corresponding **XIP Bootloader path** (this is automatic, in case if it's different from desired bin)
   *e. Set the required **XIP firmware path** to flash. Please click the 'Set' button to point the desired firmware (**nrc7292_standalone_xip_ATCMD_HSPI.bin**)*
   f. Click 'START' button

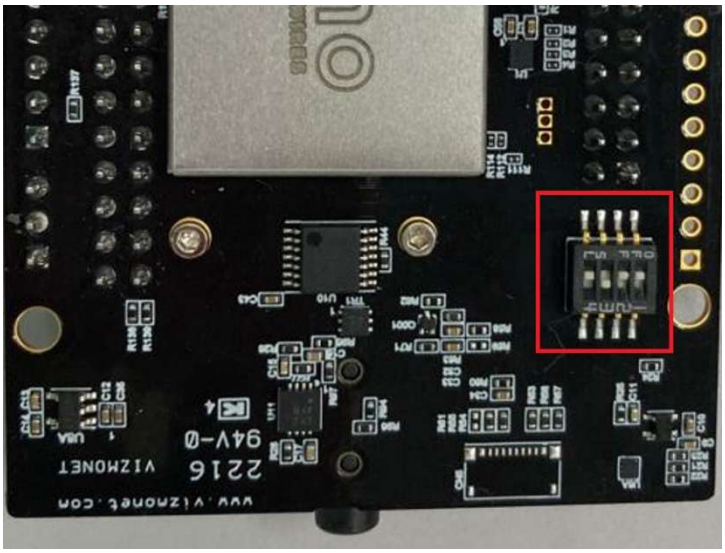


4. Once the programming completed, Please close the 'FirmwareDownloader.exe' tool
5. Power OFF the board
6. Change the switch position to below

   Pin1=OFF

   Pin2=OFF

   Pin3=ON



7. Then open the COM port and do settings as per the **steps 1 to 4 in the** section 3.3
8. Power ON the board
9. Please enter the command **show version** in the COM port and ensure the firmware version is correct what you have programmed in step 3

```
[7] 856355817 nrc7292_standalone_xip>show version
Newracom Firmware Version : 01.06.02
:fd06cf2
Compiled on Oct 23 2024 at 16:25:38
COPYRIGHT(2023)
Board Rev.:7292B
CPU Type:CM3
Description:rc5.c40
OK
[8] 860819335 nrc7292_standalone_xip>
```