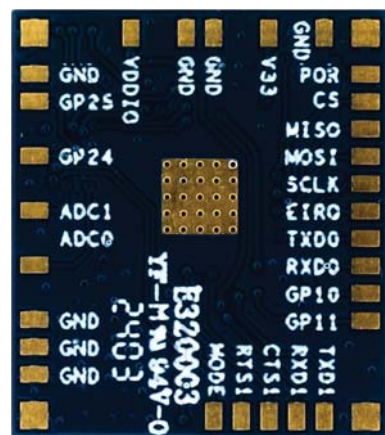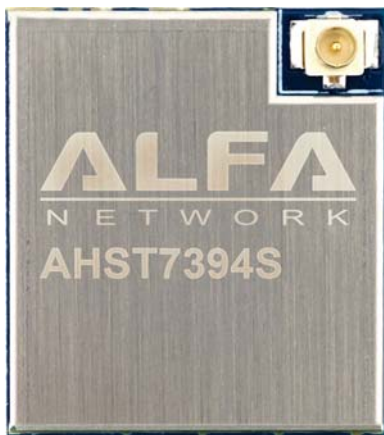# AHST7394S

User Manual
V.1

AHST7394S Overview

AHST7394S is world's leading WiFi HaLow™ solder down module

The AHST7394S allows building long range, ultra-low power WiFi networks in sub 1 GHz license-exempt bands, utilizing compact form factor.
The AHST7394S data rate up to 15 Mbps which better than LoRa 38.4 Kbps with the high-speed data rate, it enables connectivity for many IoT applications, including sensors, weather stations, industrial monitoring, medical patient monitoring, agriculture monitoring, surveillance camera.
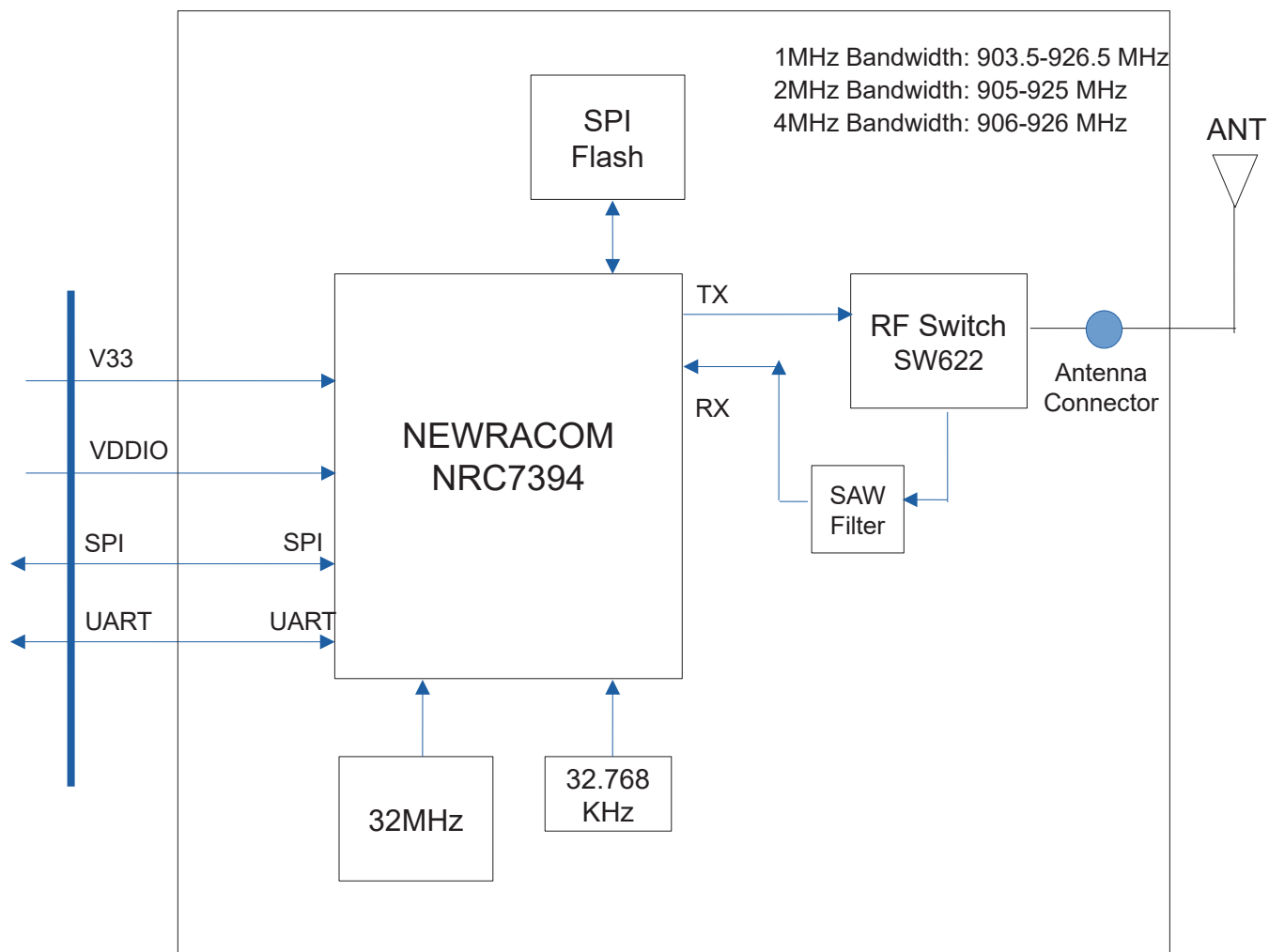
AHST7394S Hardware Specification
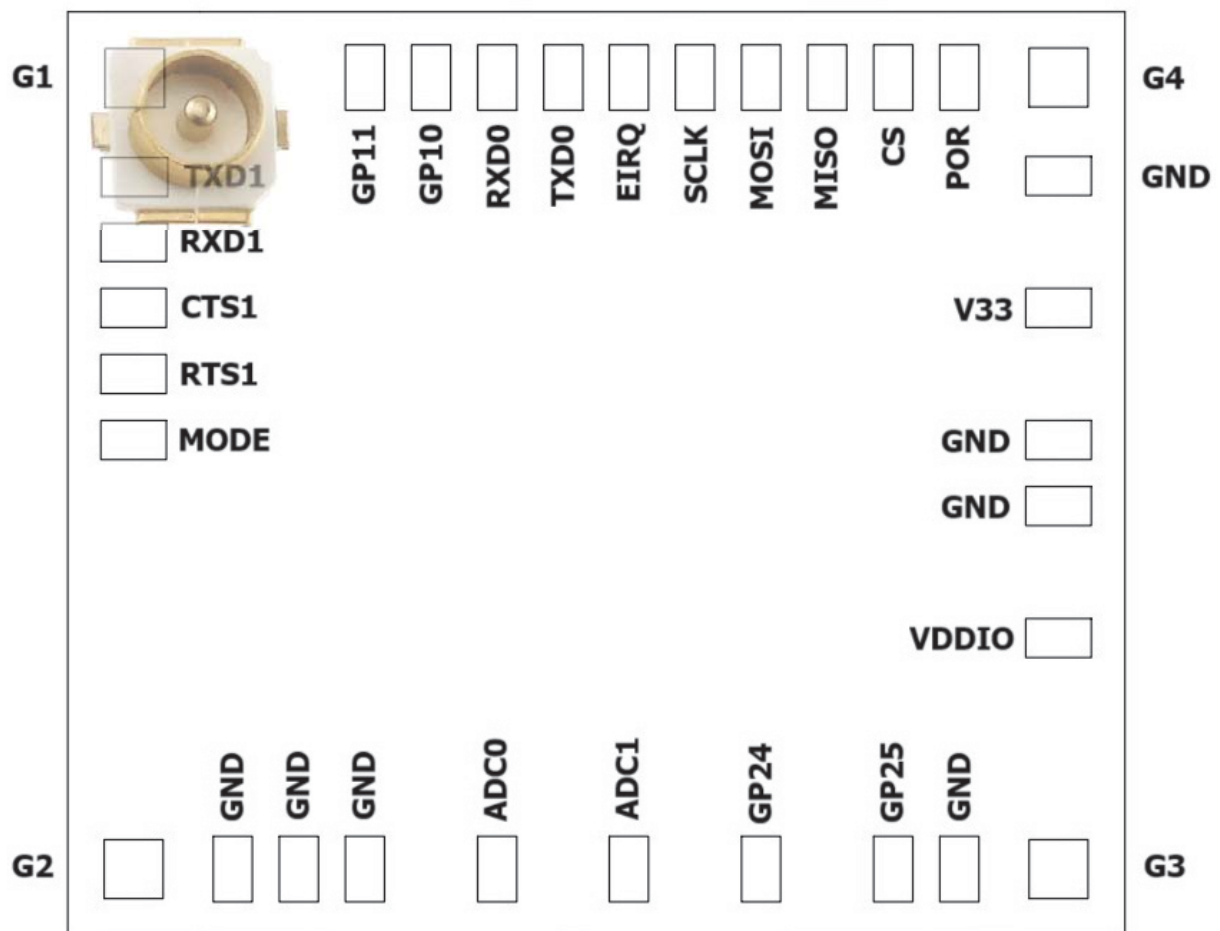
- ## Hardware General

Chipset	NEWRACOM NRC7394
Frequency	1MHz Bandwidth: 903.5-926.5 MHz 2MHz Bandwidth: 905-925 MHz 4MHz Bandwidth: 906-926 MHz
Modulation	OFDM with BPSK, QPSK, 16QAM, 64QAM
Date rate	Up to 15 Mbps (Max. Phy rate)
Channel bandwidth	1/2/4 MHz
Antenna connector	HaLow IPEX/U.FL antenna connector
Host interface	SPI, UART
Form factor	Solder down module
Dimensions	20.32(L) × 17.78(W) x 2.8(H) mm (Includes shielding case)
Operating temperature	-40°C to +85°C (-40°F to 185°F)
Software & SDK	https://github.com/newracom

AHST7394S Block Diagram

SPI
Flash

1MHz Bandwidth: 903.5-926.5 MHz
2MHz Bandwidth: 905-925 MHz
4MHz Bandwidth: 906-926 MHz

ANT

NEWRACOM
NRC7394

V33

VDDIO

SPI   SPI

UART   UART

TX

RX

RF Switch
SW622

Antenna
Connector

SAW
Filter

32MHz

32.768
KHz

Pin Definition - Pin Map

IPEX connector is on the top layer here

AHST7394S Pin Map (Top View)

Pin Definition - Pin Description

| Pin No.	Definition	Description	Voltage	Type
1	TXD1	UART1_TXD (UART channel1 Tx data)		O
2	RXD1	UART1_RXD (UART channel1 Rx data)		I
3	CTS1	UART1_CTS (UART channel1 clear to send)		I
4	RTS1	UART1_RTS (UART channel1 request to send)		O
5	MODE	Boot mode (0: ROM boot, 1: XIP boot)		I
6	GND	GROUND		GND
7	GND	GROUND		GND
8	GND	GROUND		GND
9	ADC0	Auxiliary ADC channel 0		I
10	ADC1	Auxiliary ADC channel 1		I
11	GP24	General purpose I/O		I/O
12	GP25	General purpose I/O		I/O
13	GND	GROUND		GND
14	VDDIO	VDD_IO (NRC7394 I/O power input)	1.8V-3.3V	Power
15	GND	GROUND		GND
16	GND	GROUND		GND
17	V33	VBATT_33 (NRC7394 PMS, RF/PA power input)	3.3V	Power
18	GND	GROUND		GND
19	POR	NRC7394 reset input (active low) POR reset output (internal pull-up)		I/O
20	CS	Host SPI – chip select (active low)		I
21	MISO	Host SPI – master in slave out		O
22	MOSI	Host SPI – master out slave in		I
23	SCLK	Host SPI – clock		I
24	EIRQ	Host SPI – interrupt (active high)		O
25	TXD0	UART0_TXD (UART channel0 Tx data)		O
26	RXD0	UART0_RXD (UART channel0 Rx data)		I
27	GP10	General purpose I/O		I/O
28	GP11	General purpose I/O		I/O
	G1, G2, G3, G4	GROUND		GND

Mode Pin Setting

MODE pin is provided for boot mode selection to offer flexible and configurable boot options as shown in Table M1.
In the case of XIP boot, it is necessary to change to XIP boot mode after FW upload, so users need to install a switch that can control the mode pins on the board.

| MODE pin	Description
VDD	**XIP boot mode (Standalone mode)** F/W should be downloaded in external flash memory before power-up. The start address for boot is remapped to the start address of flash memory.
GND	**ROM boot mode (Host mode)** Boot from internal ROM code and wait for external command via HSPI or UART. The start address for boot is remapped to the start address of ROM memory.
	FW upload mode Firmware upgrade to external flash memory or upload to internal SRAM via UART0

Table M1: MODE description

Reference Design – UART (Standalone mode)
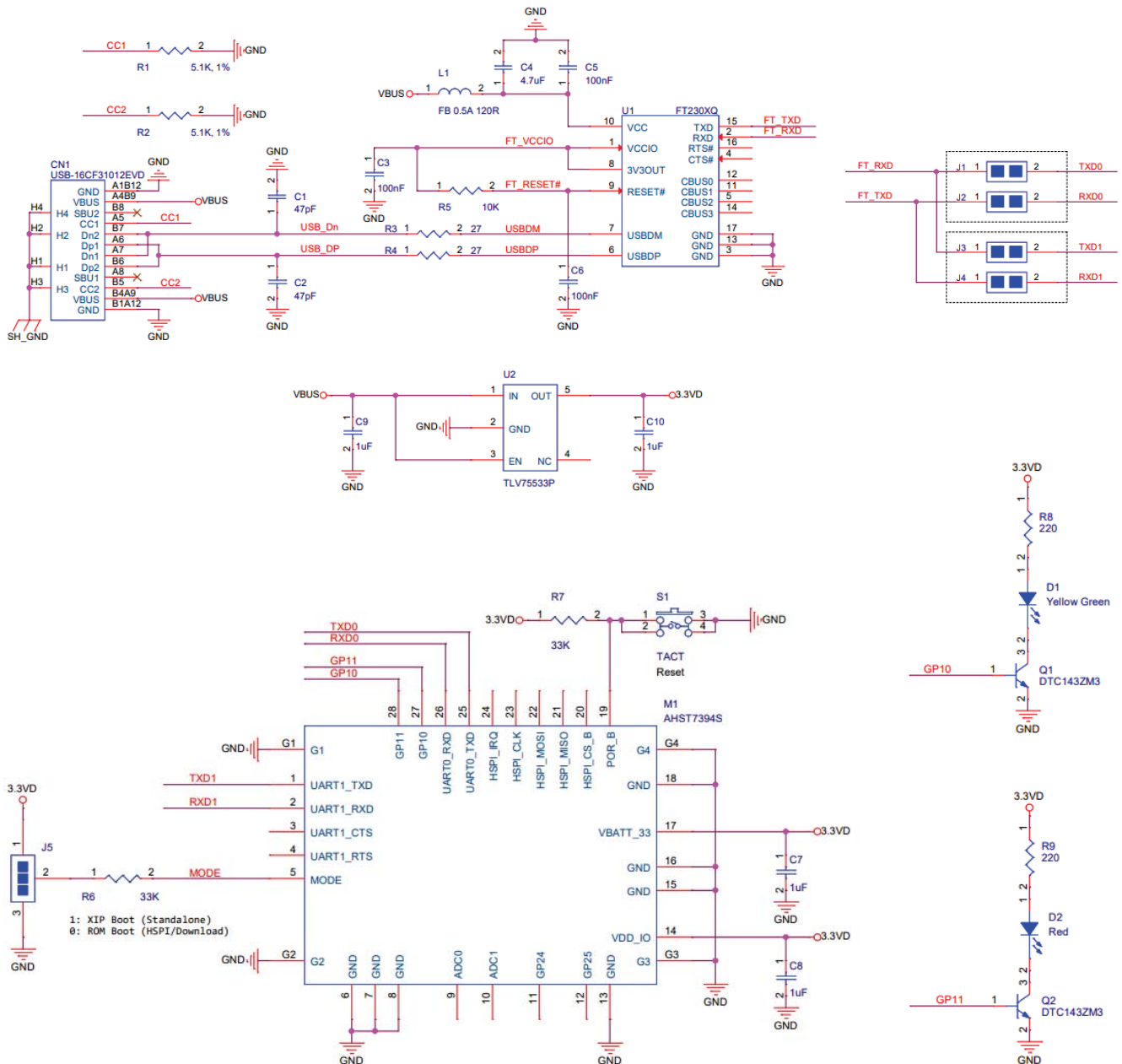
HSPI and UART1 are the general interfaces used for external host MCU. The HSPI is a specially designed SPI for high-speed data transfer.

UART0 is used for uploading test firmware or monitoring the firmware logs.

Reference Design – HSPI (Host mode)
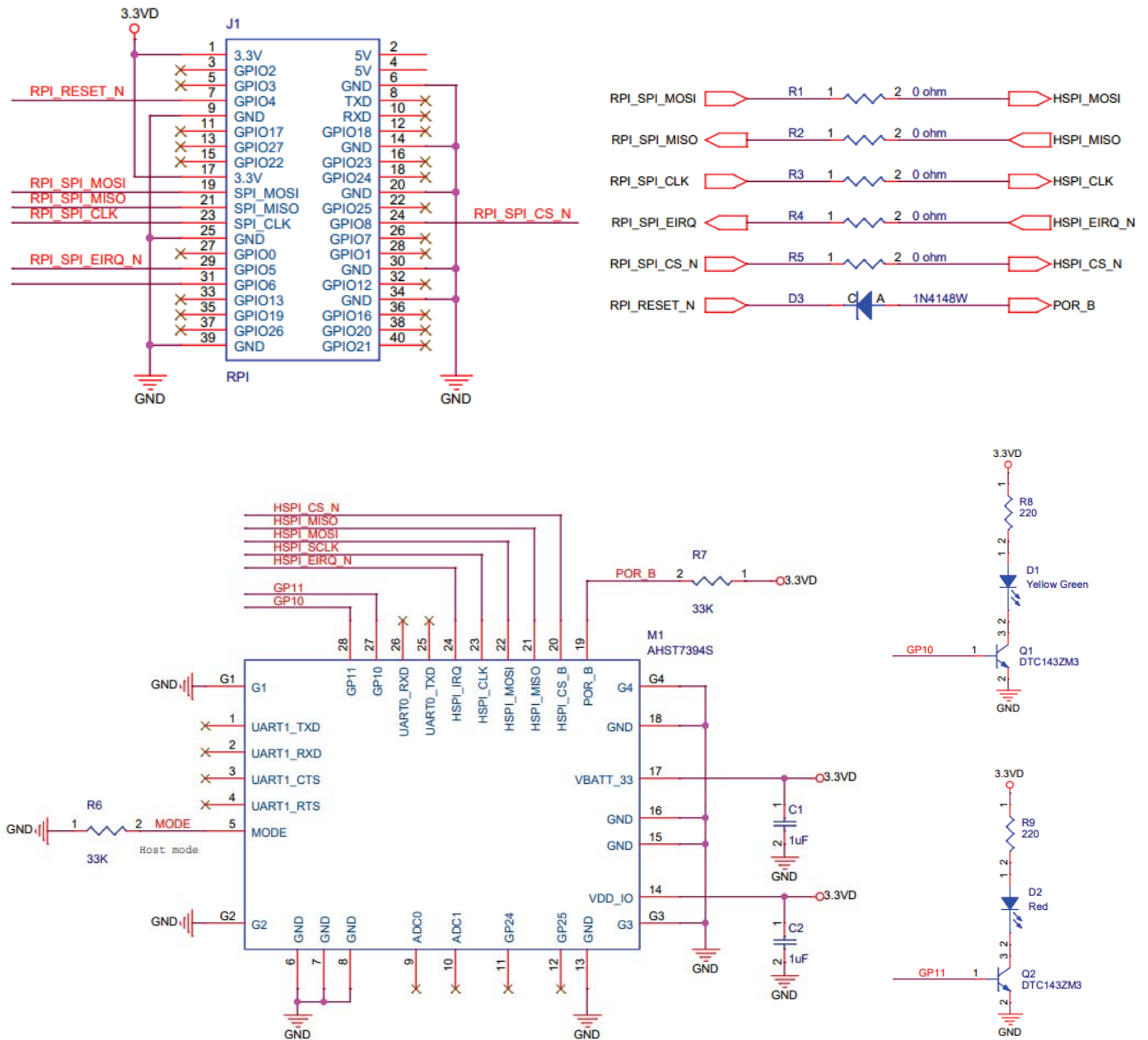
HSPI and UART1 are the general interfaces used for external host MCU. The HSPI is a specially designed SPI for high-speed data transfer.

UART0 is used for uploading test firmware or monitoring the firmware logs.

AT CMD Example Description

(1).This example uses the AHST7394S evaluation kit, uses the Standalone mode of the NRC7394, and issues AT commands through UART (this evaluation version is RS-485) and AT Command Tool.

(2).One AHST7394S evaluation kit will be set to AP mode, and the other one AHST7394S evaluation kit will be set to STA mode (Client mode) to establish a connection through WiFi HaLow.

List of devices used

(1).ACBST7394 – NRC7394 Evaluation Board x 2

(2).ACBPW-12 – Power interface board x 2

    (Please bring your own connection cable)

(3).HW-143 – USB to UART(RS-485) converter x 2

    (Please bring your own USB to UART converter)

    (Please bring your own connection cable)

(4).WiFi HaLow antenna + IPEX to SMA RF cable x 2

(5).DC12V/1A power supply x 2

(6).Notebook Computer x 2
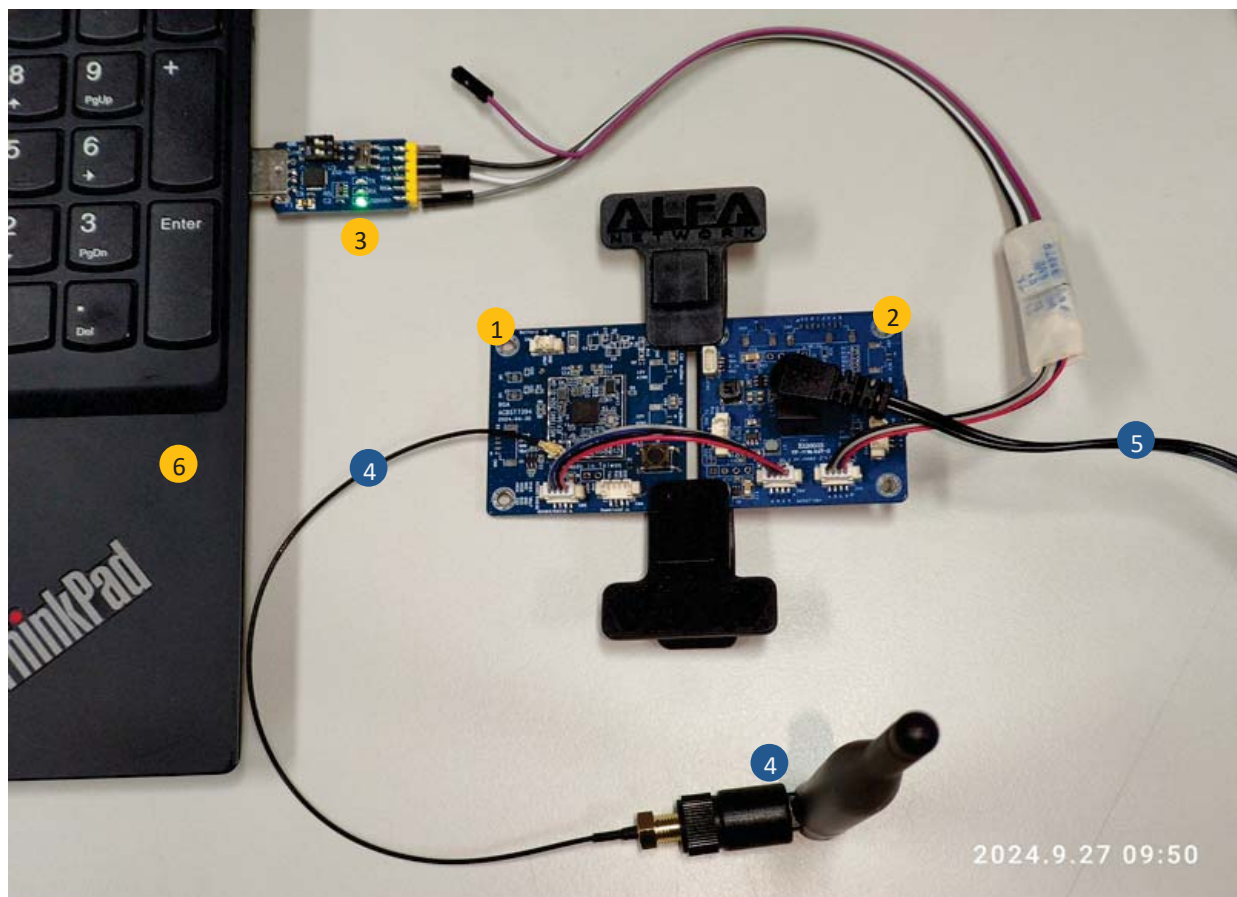
Hardware Overview

(1).ACBST7394 – NRC7394 There are two power supply methods, please choose one.
  (1-1).Use DC3.3V battery module.(Please keep the voltage stable)
 (1-2).Use ACBPW-12 – Power interface board can use DC12V/1A power supply.

VBATT 3.3V   **GND**

RS-485
A B G V

Download UART0
TX RX G NC

DC12V/1A

RS-485
A B G V
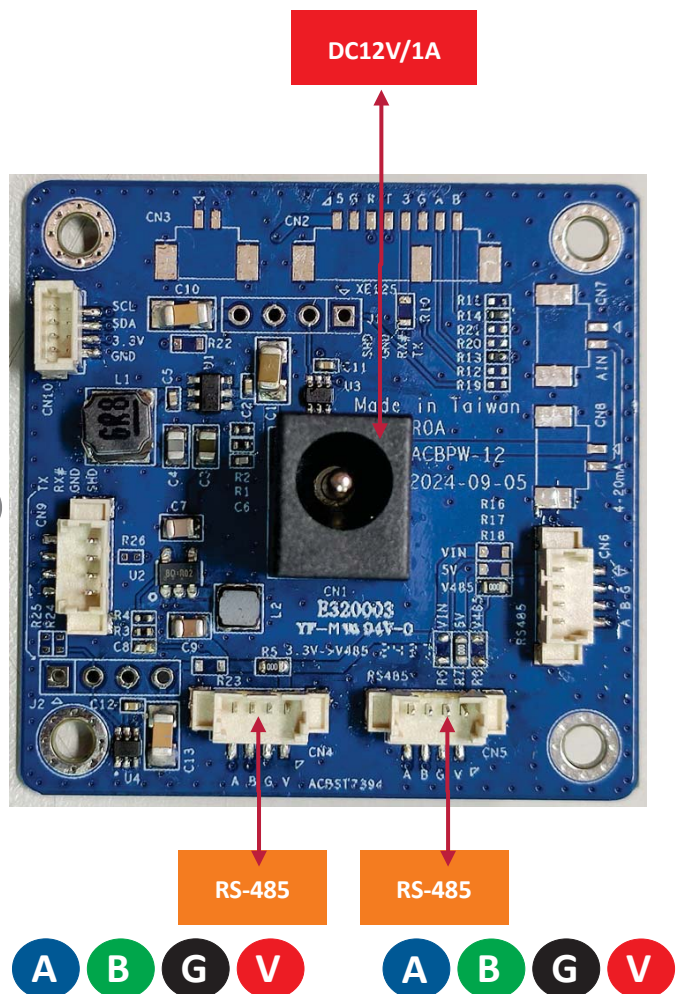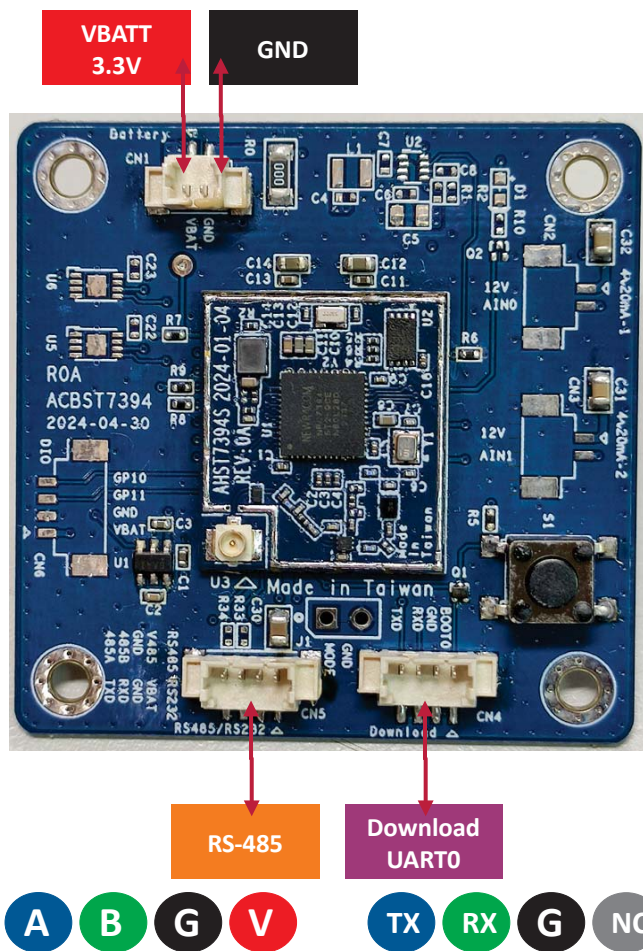
RS-485
A B G V

HW-143 – USB to UART converter

(1).HW-143 – USB to UART converter is a multi-functional converter,
and the wiring method is as follows.

(2).Please check whether the switch position of HW-143 – USB to UART
(RS-485/RS-232) converter is correct.
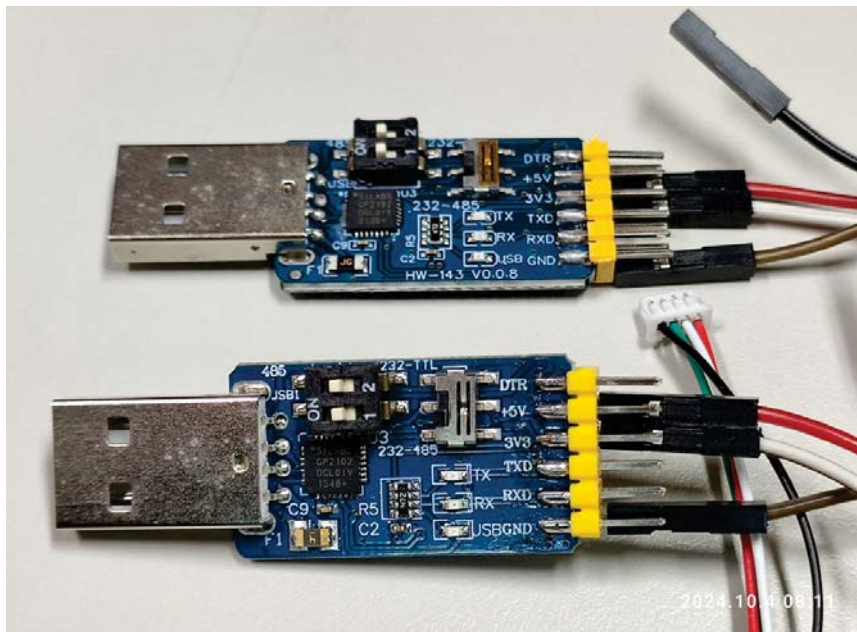
Software and hardware initial settings

(1). Plug the USB to UART converter into the computer and use device manager to check the COM number. And adjust the Baudrate to 115200 bits per second.

(2). Execute AT-CMD_Test_Tool. If Java Runtime is required, please install Java Runtime as required.
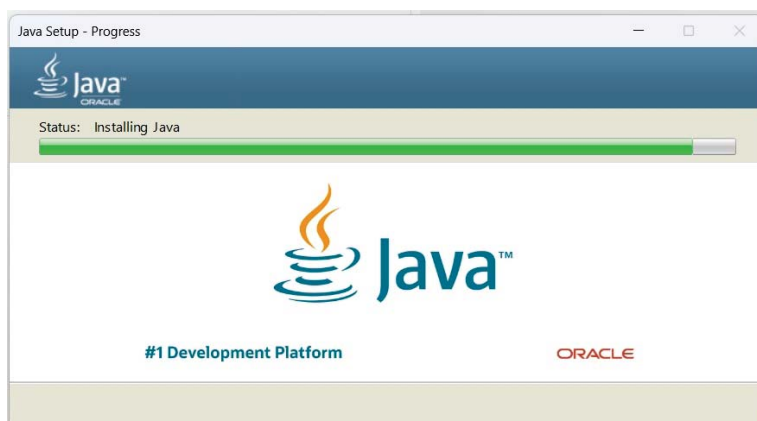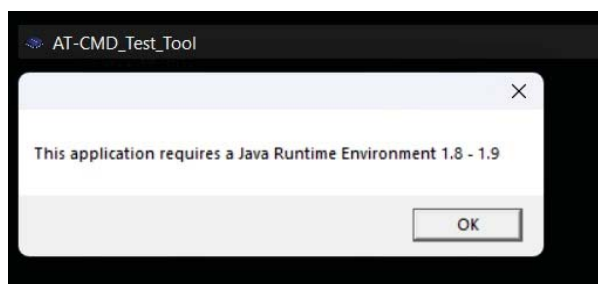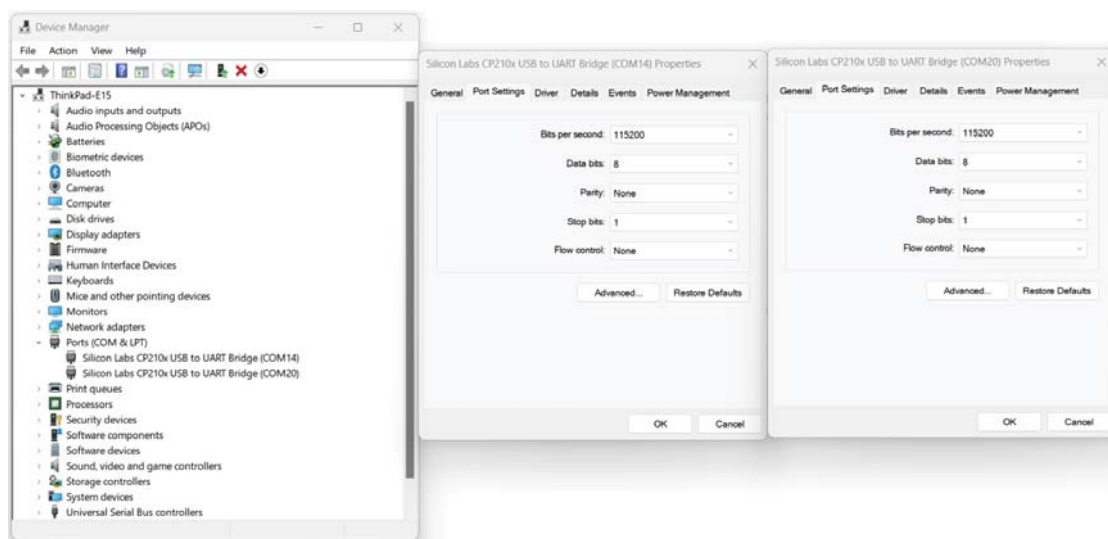
Set to AP mode

(1).Select the correct COM port and press Connect.

(2).You can use the UI preset buttons to enter instructions.
   You can also enter commands in the Custom Command field.

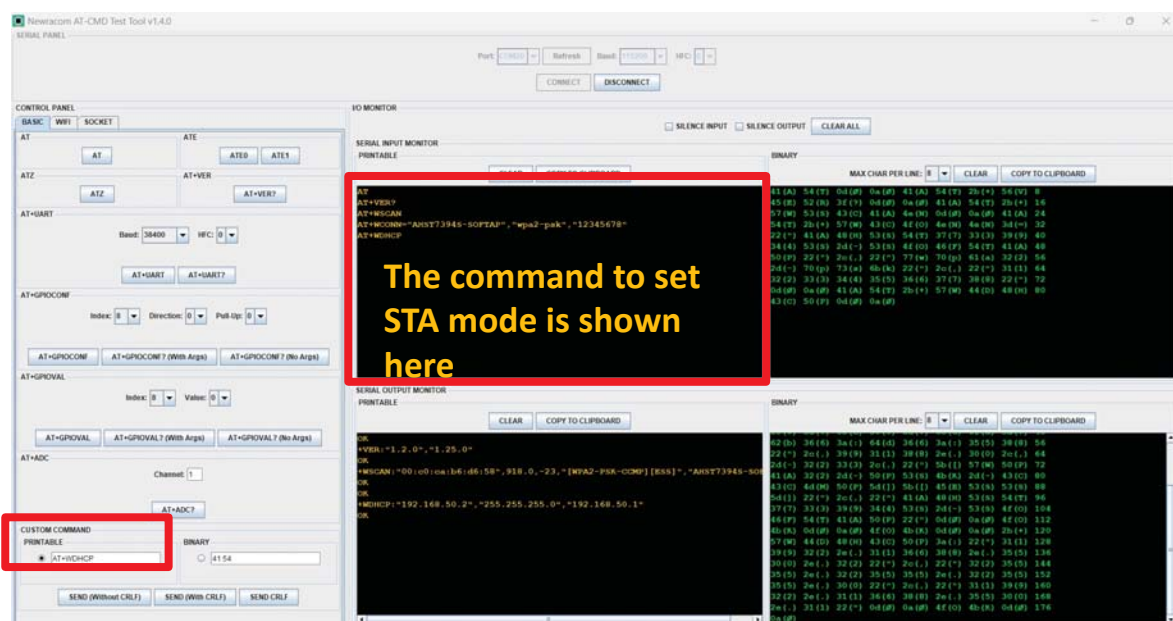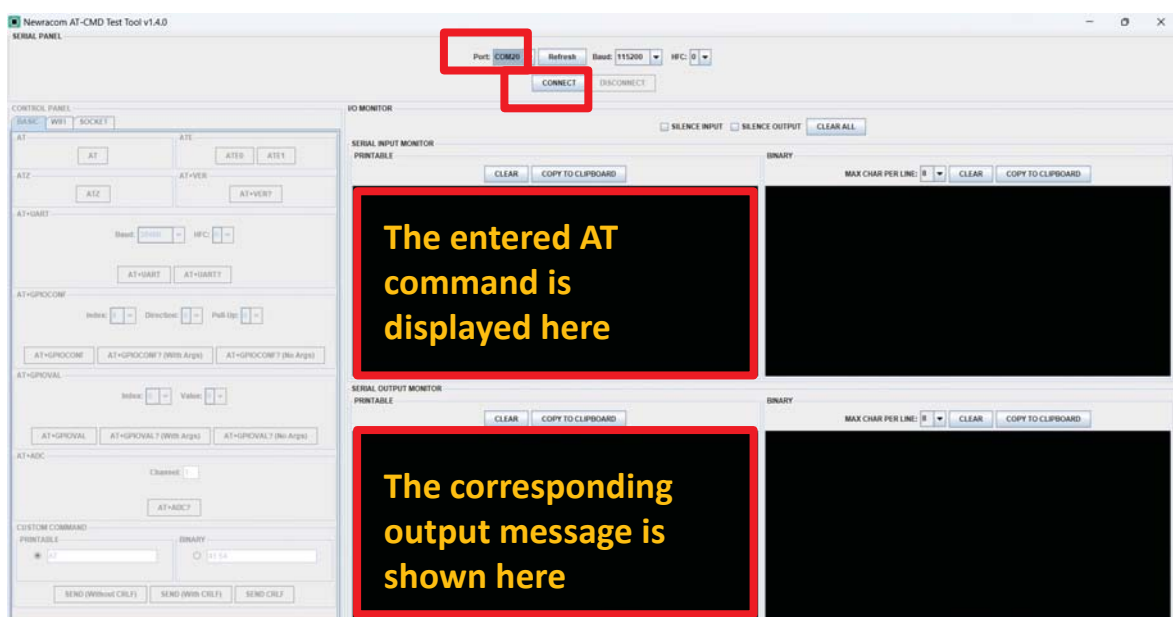(3).This example sets the AT command of AP mode, as shown in the window.
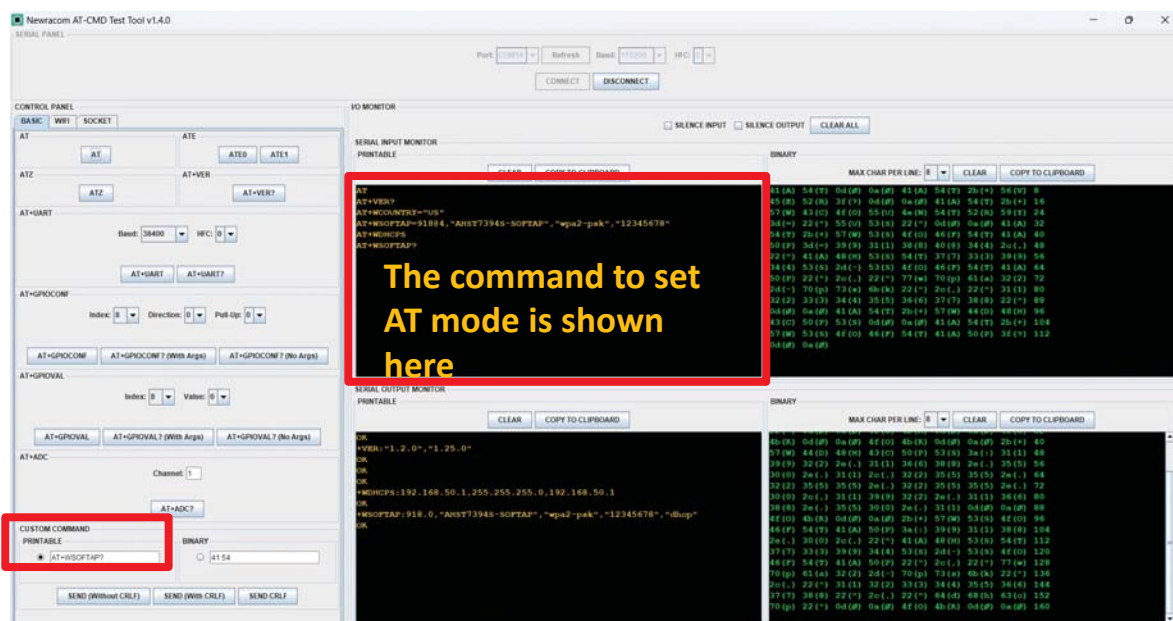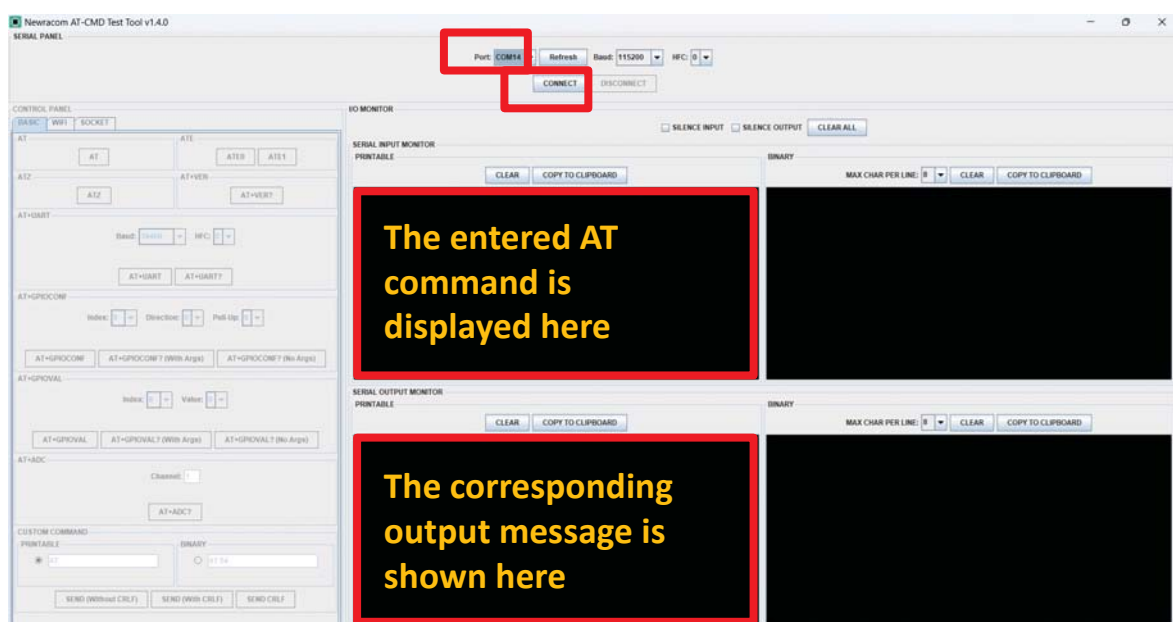
Set to STA mode

(1).Select the correct COM port and press Connect.
(2).You can use the UI preset buttons to enter instructions.
   You can also enter commands in the Custom Command field.
(3).This example sets the AT command in STA mode, as shown in the window.

The entered AT command is displayed here

The corresponding output message is shown here

The command to set STA mode is shown here
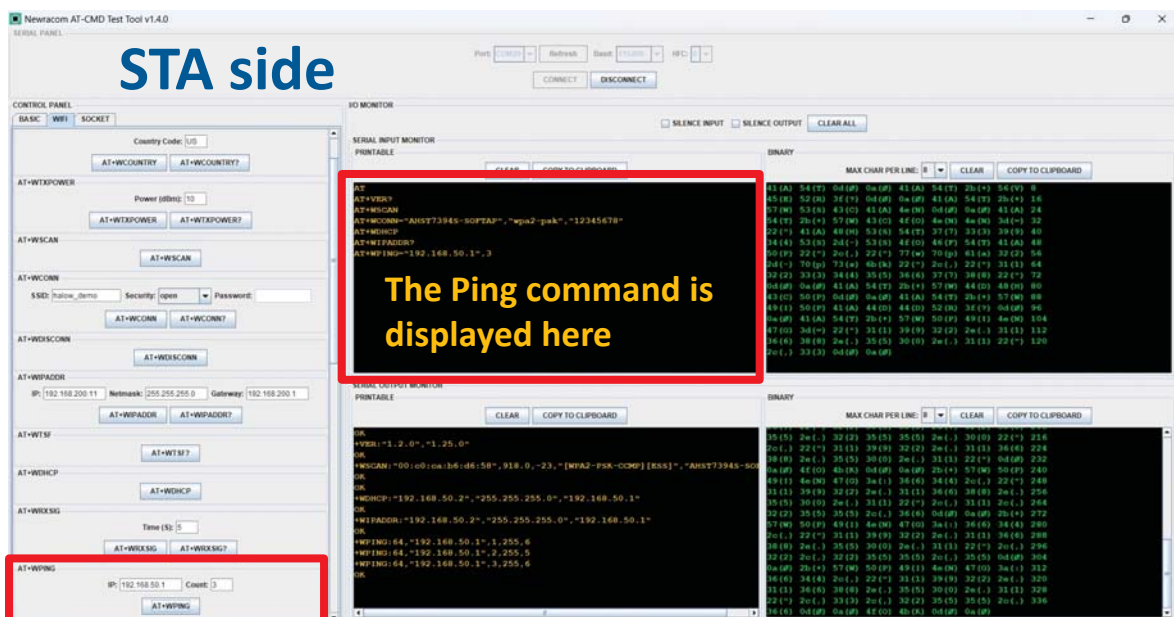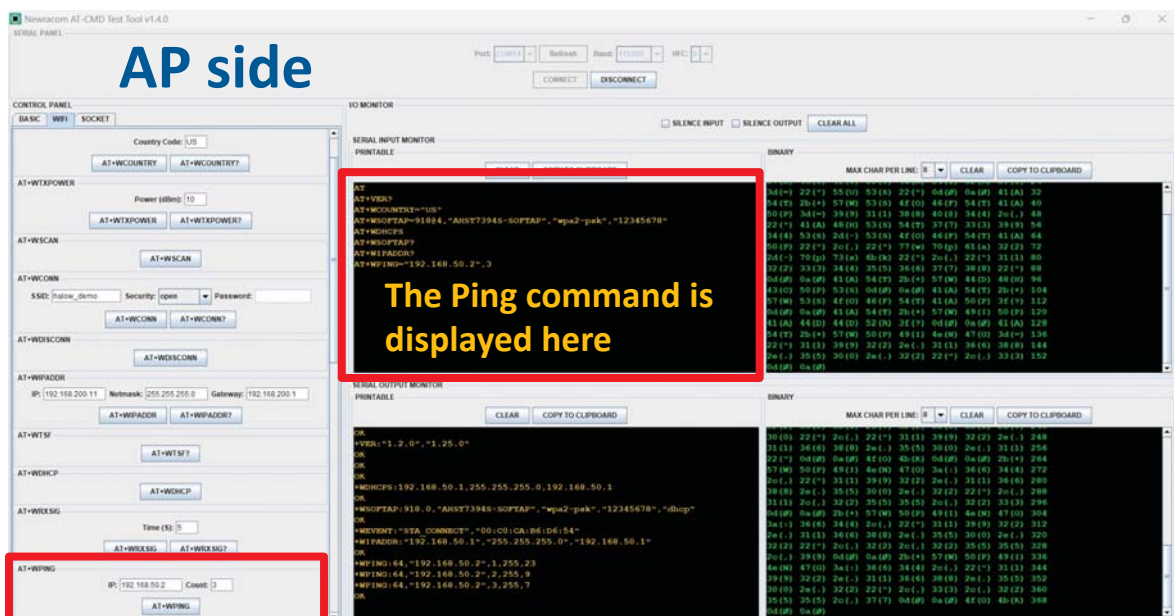
AP/STA Ping Test

(1). AP and STA can ping each other.
    Please issue the Ping command in the respective AT-CMD_Test_Tool.
(2). You can check the status of Ping in the message output window.

Federal Communications Commission Statement

Any 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:

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

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.

List of applicable FCC rules

CFR 47 FCC PART 15 SUBPART C has been investigated. It is applicable to the modular.

Specific operational use conditions

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system.

Limited module procedures Not applicable

Trace antenna designs Not applicable

RF exposure considerations

To maintain compliance with FCC's RF Exposure guidelines, this equipment should be installed and operated with minimum distance of 20cm from your body.

Antennas

This radio transmitter FCC ID: 2AB877394 has been approved by Federal Communications Commission to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Antenna type	Maximum Antenna gain
Dipole Antenna	2dBi

Label and compliance information

The final end product must be labeled in a visible area with the following " Contains FCCID:2AB877394"

Information on test modes and additional testing requirements
Host manufacturer is strongly recommended to confirm compliance with FCC requirements for the transmitter when the module is installed in the host.

Additional testing, Part 15 Subpart B disclaimer
Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B.