

NRC7292 Evaluation Kit

User Guide

(AT-command)

Ultra-low power & Long-range Wi-Fi

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NEWRACOM, Inc.

NRC7292 Evaluation Kit User Guide (AT-command) Ultra-low power & Long-range Wi-Fi

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1 Overview

This document introduces the NRC7292 AT-command. The NRC7292 AT-command allows users to apply fine controls over the NRC7292 modules such as: checking the modem status, scanning, connecting to an AP, opening sockets, and exchanging data.

2 Basic Setup

The AT-command package with a custom firmware binary to enable AT-command feature is required along with the firmware download tool. Users need to download the firmware binary onto the flash on the NRC7292 module to enable AT-command communication via UART or SPI.

2.1 Hardware connection

Figure 2.1 shows an NRC7292 evaluation board (EVB). The AT-command communication is achieved via the UART or SPI interface between an external host and the EVB.

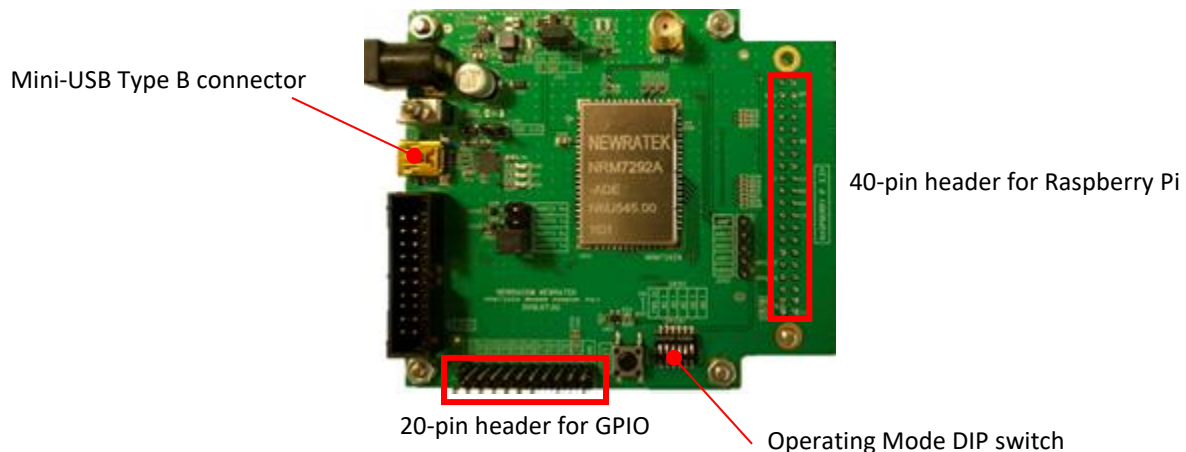
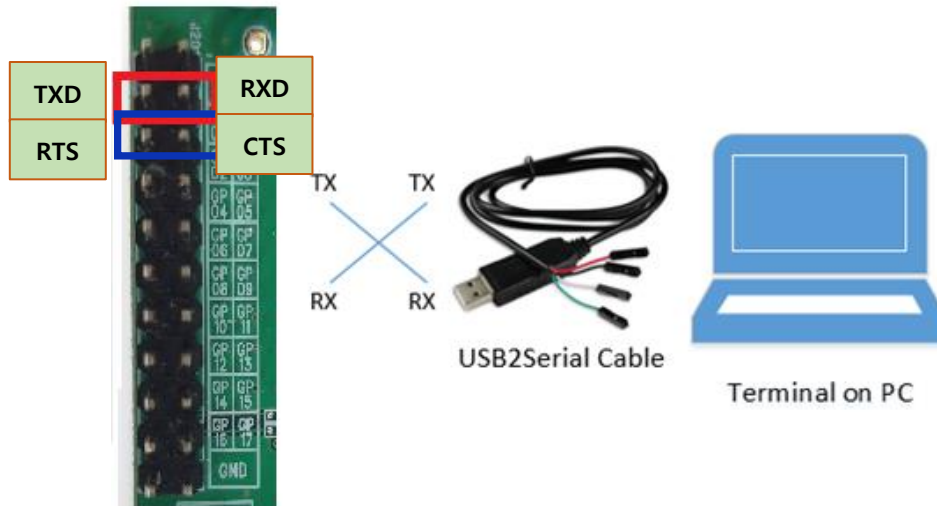


Figure 2.1 NRC7292 evaluation board

IMPORTANT: If the EVB is mounted on a Raspberry Pi host, detach the board from the Raspberry Pi host first before proceeding. The EVB must be used as a standalone for stable AT communication.

1) UART

The AT-command uses UART channel 2. The TX and RX of UART channel 2 are placed in a 20-pin header for GPIO.



**Module-to-Host Connection
(with flow control)**

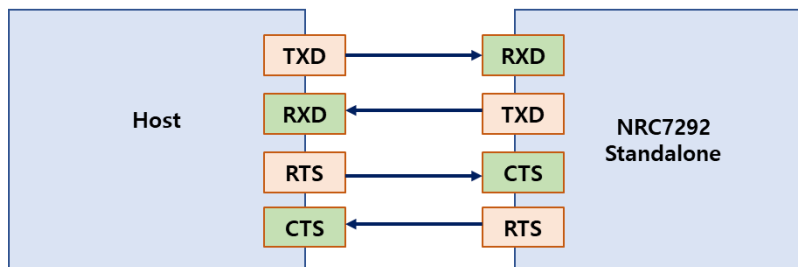


Figure 2.2 UART connection between EVK and external host

The GP00 and GP01 pins on the 20-pin header correspond to TX and RX of UART channel 2, respectively.

※ (Optional) GP02 and GP03 pins correspond to RTS and CTS of UART channel 2 for HW Flow Control

2) HSPI

The NRC7292 has a dedicated SPI slave controller for high speed. The SPI signals are placed in a 40-pin header for Raspberry Pi. The CLI application described in chapter 8 is available to perform AT-command communication via the SPI on Raspberry Pi.

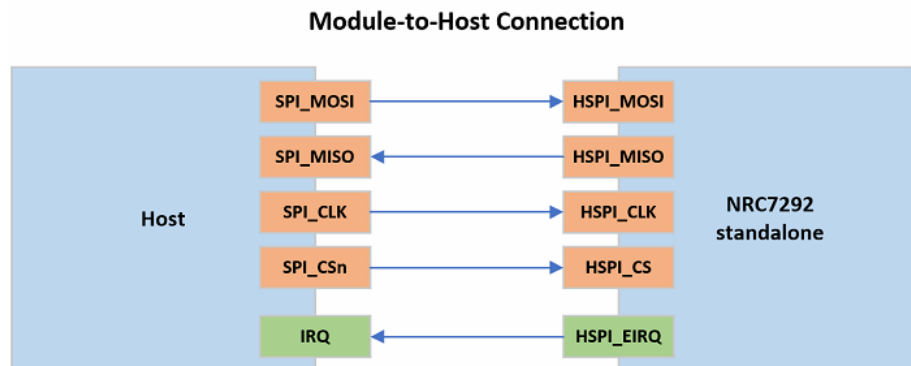
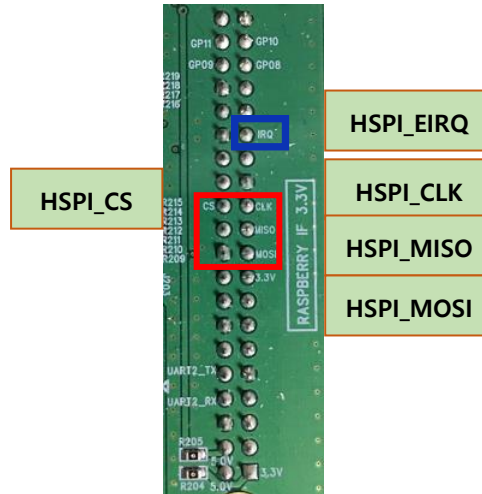


Figure 2.3 SPI connection between EVK and external host

To perform AT command communication through SPI on Raspberry Pi, spidev of Raspberry Pi3 must be enabled.

1. Modify /boot/config.txt and enable spi hardware interface configuration

```
# Uncomment some or all of these to enable the optional hardware interfaces
#dtparam=i2c_arm=on
#dtparam=i2c=on
dtparam=spi=on

# Uncomment this to enable the lirc-rpi module
#dtoverlay=lirc-rpi

# Additional overlays and parameters are documented /boot/overlays/README

# Enable audio (loads snd_bcm2835)
dtparam=audio=on
enable_uart=1
dtoverlay=pi3-disable-bt
dtoverlay=pi3-disable-wifi
#dtoverlay=pi3-disable-spidev
```

2. After rebooting the Raspberry Pi3, spidev0.0 and spidev0.1 could be accessible from the userspace.

```
pi@raspberrypi:~$ ls /dev
autofs          gpiochip2  loop7      ram0        random     tty11      tty26      tty40      tty55      uhid        vcsa2
block           gpiomem   loop-control ram1         raw         tty12      tty27      tty41      tty56      uinput      vcsa3
btrfs-control  hidraw0    mapper     ram10        rfkill      tty13      tty28      tty42      tty57      urandom     vcsa4
bus            hidraw1    mem        ram11        serial0     tty14      tty29      tty43      tty58      vchiq       vcsa5
cachefiles     hwrng     memory_bandwidth ram12        serial1     tty15      tty3       tty44      tty59      vcio        vcsa6
char           initctl   mmcblk0    ram13        shm         tty16      tty30      tty45      tty6       vc-mem      vcsa7
console        input     mmcblk0p1  ram14        sd          tty17      tty31      tty46      tty60      vcs         vcs8
cpu_dma_latency kmsg      mmcblk0p2  ram15        spidev0.0   tty18      tty32      tty47      tty61      vcs1        vchi
cuse          log       mqueue     ram2          spidev0.1   tty19      tty33      tty48      tty62      vcs2        watchdog
disk          loop0     net         ram3          sderr       tty2       tty34      tty49      tty63      vcs3        watchdog0
fb0           loop1    network_latency ram4          stdin       tty20      tty35      tty5       tty7       vcs4        zero
fd            loop2    network_throughput ram5          stdout      tty21      tty36      tty50      tty8       vcs5
full          loop3    null        ram6          tty         tty22      tty37      tty51      tty9       vcs6
fuse          loop4    ppp         ram7          tty0        tty23      tty38      tty52      ttyAMA0    vcs7
gpiochip0     loop5    ptmx        ram8          tty1        tty24      tty39      tty53      ttyprintk  vcsa
gpiochip1     loop6    pts         ram9          tty10       tty25      tty4       tty54      tty50      vcsa1
```

2.2 Building the firmware

Refer to the user guide **UG-7292-004-Standalone SDK.pdf** for instructions on how to build the firmware binary. (2. Setup S/W build environment)

1. **HSPI mode:**
 - make select target=nrc7292.sdk.release APP_NAME=ATCMD_HSPI
2. **UART mode (without hardware flow control):**
 - make select target=nrc7292.sdk.release APP_NAME=ATCMD_UART
3. **UART mode (with hardware flow control):**
 - make select target=nrc7292.sdk.release APP_NAME=ATCMD_UART_HFC

2.3 Downloading the firmware and starting the module

Refer to the user guide **UG-7292-004-Standalone SDK.pdf** for instructions on how to download the firmware binary. (3.2 Download the unified binary)

3 AT Command Type

There are four types of AT-commands: HELP, GET, SET and RUN.

Type	Format	Description
HELP	AT+<CMD>=?	List the input argument format and description.
SET or RUN	AT+<CMD>	Run with no argument.
	OR AT+<CMD>=<X1,X2,...>	OR Set or run with the given arguments.
GET	AT+<CMD>?	Query the current values with no argument.
	OR AT+<CMD>?=<X1,X2,...>	OR Query the current values with the given arguments.

Table 3.1 AT-command type

- String input parameter values must be enclosed between double quotation marks (“”).
- Parameters enclosed between a pair of square brackets ‘[]’ indicate optional parameters.
- Optional parameters may be nested.
- All AT commands must be in upper-case letters and terminated by CR-LF.
- Default optional values in the parameter descriptions are indicated by the asterisk ‘*’ characters.

4 Return for Commands

Return Message	Description
OK	The operation for command completes successfully.
ERROR	The command is not supported.
+<CMD>:1 ERROR	The parameter for command is not valid.
+<CMD>:2 ERROR	The previous operation for command is in progress.
+<CMD>:3 ERROR	The operation for command failed with some error.
+<CMD>:4 ERROR	The operation for command is still in progress after the specified time.

5 Basic AT Commands

Commands	Description
AT	Check the AT serial interface status.
ATE	Enable or disable echo.
ATZ	Reset the hardware and restart the firmware.
AT+VER	Fetch the AT firmware version and software package version.
AT+UART	Configure the serial UART parameters.
AT+GPIOCONF	Configure the GPIO pin mode, direction and pull-up option.
AT+GPIOVAL	Read or write the output GPIO pin level.
AT+ADC	Fetch the ADC value at the selected ADC channel index.

5.1AT

Command	AT
Response	OK
Description	Check the AT serial interface status.
Example	AT OK

5.2ATE

Command	ATE0 or ATE1	
Response	OK	
Description	Enable (ATE1) or disable (ATE0) echo. (default: disable) NOTE: Echo should typically be enabled for manual communication via a terminal.	
Example	ATE1 OK	ATE0 OK

5.3ATZ

Command	ATZ
Response	
Description	Reset the hardware and restart the firmware. (restarting time : 3 secs)
Example	ATZ

5.4AT+VER

Command	<u>GET</u> AT+VER?
Response	<u>GET</u> +VER: <S/W package version>,<AT firmware version> OK
Description	Fetch the AT firmware version and software package version.

Example	AT+VER? +VER:"1.3.1","1.15.3" OK
----------------	--

5.5 AT+UART

Command	<u>SET</u> AT+UART=<baud rate>,<HFC> <u>GET</u> AT+UART?	
Response	<u>SET</u> OK <u>GET</u> +UART:<baud rate>,<data bits>,<stop bits>,<parity>,<HFC> OK	
Parameters	<baud rate> 19200, 38400, 57600, 115200*, 230400, 380400, 460800, 500000, 576000, 921600, 1000000, 1152000, 1500000 or 2000000 <data bits> Always 8 (8-bit)* <stop bits> Always 1 (1-bit)* <parity> Always 0 (None)* <HFC> 0 (RTS/CTS disabled)* or 1 (RTS/CTS enabled)	
Description	Configure the baud rate and HFC for the UART.	
Example	AT+UART=115200,1 OK	AT+UART? +UART:115200,8,1,0,1 OK

5.6 AT+GPIOCONF

Command	<u>SET</u> AT+GPIOCONF=<index>,<direction>[,<pull-up>] <u>GET</u> AT+GPIOCONF? AT+GPIOCONF?=<index>
Response	<u>SET</u> OK <u>GET</u> +GPIOCONF=<index>,<direction>,<pull-up> OK
Parameters	<p><index> The GPIO pin index. (8, 9, 10, 11, 12, 13, 14, 15, 16, 17)</p> <p><direction> 0 (input)*, 1 (output)</p> <p><pull-up> (input pin only) 0 (floating)*, 1 (pull-up)</p>
Description	Configure the GPIO pin direction and pull-up option.
Example	<div> AT+GPIOCONF=8,1 OK </div> <div> AT+GPIOCONF=11,0,0 OK </div> <div> AT+GPIOCONF=17,0,1 OK </div> <div> AT+GPIOCONF? +GPIOCONF:8,1,0 : +GPIOCONF:11,0,0 : +GPIOCONF:17,0,1 OK AT+GPIOCONF?=13 +GPIOCONF:13,0,0 OK </div>

5.7 AT+GPIOVAL

Command	<u>SET</u> AT+GPIOVAL=<index>,<level> <u>GET</u> AT+GPIOVAL? AT+GPIOVAL?=<index>	
Response	<u>SET</u> OK <u>GET</u> +GPIOVAL:<index>,<level> OK	
Parameters	<GPIO pin index> The GPIO pin index. (8, 9, 10, 11, 12, 13, 14, 15, 16, 17) <GPIO pin level> 0 (low)*, 1 (high)	
Description	Read or write the output GPIO pin level.	
Example	AT+GPIOVAL=8,1 OK AT+GPIOVAL=13,1 OK AT+GPIOVAL=17,0 OK	AT+GPIOVAL? +GPIOVAL:8,1 : +GPIOVAL:17,0 OK AT+GPIOVAL?=13 +GPIOVAL:13,1 OK

5.8 AT+ADC

Command	<u>SET</u> AT+ADC=<ADC channel index>
Response	<u>SET</u> +ADC:<ADC channel index>,<ADC value> OK

Parameters	<ADC channel index> 1, 2, 3 <ADC value> 0 ~ 511
Description	Fetch the ADC value at the selected ADC channel index.
Example	AT+ADC=1 +ADC:1,23 OK

5.9 AT+SLEEP

Command	<u>SET</u> AT+SLEEP=<rtc>[,<gpio>]
Response	<u>SET</u> OK
Parameters	<rtc> Use RTC interrupt to wake up from deep sleep by TIM in beacon frame. 0 : disable 1 : enable <gpio> Use GPIO interrupt to wake up from deep sleep. Available GPIO numbers : 8 ~ 17
Description	Configure deep sleep mode. In deep sleep mode, retention RAM and 32.768KHz OSC are powered on. And the others are powered off.
Example	AT+SLEEP=1 OK AT+SLEEP=1,15 OK

6 Wi-Fi AT Commands

Commands	Description
AT+WMACADDR	Read the MAC address.
AT+WOUNTRY	Configure the Wi-Fi country code
AT+WTXPOWER	Configure the transmission power level.
AT+WRXSIG	Fetch or monitor the RSSI (dBm) and SNR (dB) values.
AT+WRATECTRL	Toggle the MCS rate control option.
AT+WMCS	Configure the MCS index.
AT+WTSF	Read the elapsed TSF timer duration.
AT+WIPADDR	Configure the IP address, netmask and gateway.
AT+WDHCP	Request dynamic IP allocation from the DHCP server.
AT+WSCAN	Perform Wi-Fi scanning.
AT+WCONN	Connect to a new AP.
AT+WDISCONN	Disconnect from the AP or abort an on-going connection process.
AT+WPING	Initiate a ping session.
AT+WROAM	Enable or disable Wi-Fi roaming.
AT+WSOFTAP	Run as the AP mode.
AT+WFOTA	Enable or disable Firmware Over-the-Air (FOTA).
AT+WTIMEOUT	Configure the response timeout for the specified command.
+WEVENT	Asynchronously raised Wi-Fi event logs.

6.1 AT+WMACADDR

Command	<u>GET</u> AT+WMACADDR?
Response	<u>GET</u> +WMACADDR:"<MAC address>" OK
Parameters	<MAC address> The MAC address 'HH:HH:HH:HH:HH:HH' where H is a hexadecimal character.
Description	Read the MAC address.
Example	AT+ WMACADDR? +WMACADDR:"2F:33:4F:65:11:20" OK

6.2 AT+WCCOUNTRY

Command	<u>SET</u> AT+WCCOUNTRY="<country code>" <u>GET</u> AT+WCCOUNTRY?	
Response	<u>SET</u> OK <u>GET</u> +WCCOUNTRY="<country code>" OK	
Parameters	<country code> US, KR*, JP, CN, TW, EU	
Description	Configure the Wi-Fi country code	
Example	AT+ WCCOUNTRY ="US" OK	AT+WCCOUNTRY? +WCCOUNTRY:"US" OK

6.3 AT+WTXPOWER

Command	<u>SET</u> AT+WTXPOWER=<power in dBm> <u>GET</u> AT+WTXPOWER?	
Response	<u>SET</u> OK <u>GET</u> +WTXPOWER:<power in dBm >	
Parameters	<power in dBm> 8, 9, ... ,17*, 18	
Description	Configure the transmission power level.	
Example	AT+WTXPOWER=11 OK	AT+WTXPOWER? +WTXPOWER:11 OK

6.4 AT+WRXSIG

Command	<u>GET</u> AT+WRXSIG? <u>SET</u> AT+WRXSIG =<time>	
Response	<u>GET</u> +WRXSIG:<RSSI>,<SNR> OK <u>SET</u> +WRXSIG:<RSSI>,<SNR> ... +WRXSIG:<RSSI>,<SNR> OK	
Parameters	<time> Monitoring duration in seconds.	
Description	Fetch or monitor the RSSI (dBm) and SNR (dB) values.	
Example	AT+WRXSIG?	AT+WRXSIG=2

	+WRXSIG:-50,25 OK	+WRXSIG:-62,20 +WRXSIG:-82,9 OK
--	----------------------	---------------------------------------

6.5 AT+WRATECTRL

Command	<u>SET</u> AT+WRATECTRL=<mode> <u>GET</u> AT+WRATECTRL?	
Response	<u>SET</u> OK <u>GET</u> +WRATECTRL=<mode> OK	
Parameters	<mode> 0 (disable), 1 (enable)*	
Description	Toggle the MCS rate control option.	
Example	AT+WRATECTRL =1 OK	AT+WRATECTRL? +WRATECTRL:1 OK

6.6 AT+WMCS

Command	<u>SET</u> (Only when the MCS control is enabled) AT+WMCS=<MCS index> <u>GET</u> AT+WMCS?	
Response	<u>SET</u> (Only when the MCS control is enabled) OK <u>GET</u> +WMCS:<value> OK	
Parameters	<MCS index> 0~7, 10	

Description	Configure the MCS index.	
Example	AT+WMCS=7 OK	AT+WMCS? +WMCS:2 OK

6.7 AT+WTSF

Command	<u>GET</u> AT+WTSF?
Response	<u>GET</u> +WTSF:<time> OK
Parameters	<time> Elapsed TSF timer duration in microseconds.
Description	Read the elapsed TSF timer duration.
Example	AT+WTSF? +WTSF:44142384 OK

6.8 AT+WDHCP

Command	<u>RUN</u> AT+WDHCP
Response	<u>RUN</u> +WDHCP:"<IP>","<netmask>","<gateway>" OK
Parameters	<IP> , <netmask> and <gateway> 'A.B.C.D' where A, B, C and D are between 0 and 255, inclusive.
Description	Request dynamic IP allocation from the DHCP server. NOTE: Wi-Fi connection must be established before using this command.
Example	AT+WDHCP +WDHCP:"192.168.200.20","255.255.255.0","192.168.200.1" OK

6.9 AT+WDHCPS

Command	<u>RUN</u> AT+WDHCPS
Response	<u>RUN</u> +WDHCPS:"<IP>","netmask","<gateway>" OK
Parameters	<IP>, <netmask> and <gateway> 'A.B.C.D' where A, B, C and D are between 0 and 255, inclusive.
Description	Run the DHCP sever in SoftAP mode. NOTE: SoftAP must be established before using this command. Refer to chapter 6.15. (AT+WSOFTAP)
Example	AT+WDHCPS +WDHCPS:"192.168.50.1","255.255.255.0","192.168.50.1" OK

6.10 AT+WIPADDR

Command	<u>SET</u> AT+WIPADDR="<IP>","<netmask>","<gateway>" <u>GET</u> AT+WIPADDR?
Response	<u>SET</u> OK <u>GET</u> +WIPADDR="<IP>","<netmask>","<gateway>" OK
Parameters	<IP>,<netmask>,<gateway> 'A.B.C.D' where A, B, C and D are between 0 and 255, inclusive.
Description	Configure the IP address, netmask and gateway.
Example	AT+WIPADDR="192.168.200.20","255.255.255.0","192.168.200.1" OK AT+WIPADDR?

	+WIPADDR="192.168.200.20","255.255.255.0","192.168.200.1" OK
--	---

6.11 AT+WSCAN

Command	<u>RUN</u> AT+WSCAN
Response	<u>RUN</u> +WSCAN:<bssid>,<freq>,<sig_level>,<flags>,<ssid> : OK
Parameters	<p><bssid> The BSSID of the AP.</p> <p><freq> The center frequency of the channel.</p> <p><sig_level> The RSSI (Received Signal Strength Indicator) in dBm.</p> <p><flags> Service set flags.</p> <p><ssid> The SSID of the AP.</p>
Description	Perform Wi-Fi scanning.
Example	AT+WSCAN +WSCAN:"02:00:eb:13:d3:4a",922.5,-39,"[ESS]","halow_open" +WSCAN:"68:27:eb:0e:07:27",922.5,-30,"[WPA2-PSK-CCMP][ESS]","halow_wpa2" OK

6.12 AT+WCONN

Command	<u>SET</u> AT+WCONN="<ssid bssid>","<security>","<password>"] <u>GET</u> AT+WCONN?
----------------	---

Response	<p><u>SET</u> OK</p> <p><u>GET</u> +WCONN="<ssid>","<bssid>","<security>","<password>","<state>" OK</p>
Parameters	<p><ssid> The SSID of the AP.</p> <p><bssid> The BSSID of the AP.</p> <p><security> open*, wpa2</p> <p><password> (wpa2 security option only) The password when wpa2 security option is used.</p> <p><state> State indicator: "connecting", "connected", "disconnecting" or "disconnected"</p>
Description	<p>Connect to a new AP or retrieves information about the current AP.</p> <p>NOTE:</p> <p>Before attempting to connect to the specified AP, the "AT+WSCAN" command should be executed to scan the APs. If the specified AP is not in the scan result list, this command will return an error.</p> <p>If an "ERROR" is returned with the error number INPROGRESS(2) or TIMEOUT(4), the AT-STA needs to be disconnected from the AP with the "AT+WDISCONN" command before a connection is attempted again with "AT+WCONN".</p>
Example	<p>AT+WCONN="demo_ap","wpa2","kds3f3" OK</p> <p>AT+WDISCONN OK</p> <p>AT+WCONN="02:00:A1:45:82:B4","wpa2","kds3f3" OK</p> <p>AT+WCONN? +WCONN:"demo_ap","02:00:A1:45:82:B4","wpa2","kds3f3","connected" OK</p>

6.13 AT+WDISCONN

Command	<u>RUN</u> AT+WDISCONN
Response	<u>RUN</u> OK
Description	Disconnect from the AP or abort an on-going connection process.
Example	AT+WDISCONN OK

6.14 AT+WPING

Command	<u>SET</u> AT+WPING=" <remote IP> "[, <time>]
Response	<u>SET</u> +WPING:<size>,"<remote IP>",<sequence number>,<TTL>,<elapsed time> +WPING:<size>,"<remote IP>",<sequence number>,<TTL>,<elapsed time> OK
Parameters	<p><remote IP> The remote IP of the recipient.</p> <p><time> Monitoring duration in seconds. (Default: 5)</p> <p><sequence number> ICMP sequence number.</p> <p><TTL> Time to leave (TTL).</p> <p><elapsed time> Time since the start of the session in seconds.</p>
Description	Initiate a ping session.
Example	AT+ PING ="192.168.200.1",10

	+PING:64,"192.168.200.1",1,64,11 +PING:64,"192.168.200.1",10,64,12 OK
--	--

6.15 AT+WROAM

Command	<u>SET</u> AT+WROAM=<scan_delay>,<rssi_threshold>,<rssi_level> AT+WROAM=0 <u>GET</u> AT+WROAM?
Response	<u>SET</u> OK <u>GET</u> +WROAM=<scan_delay>,<rssi_threshold>,<rssi_level> OK
Parameters	<u><scan_delay></u> Delay time between scan cycles that is executed to search for nearby APs. (msec) <u><rssi_threshold></u> Current AP's minimum RSSI to move to a new AP. (dBm, -100 ~ 0) <u><rssi_level></u> The minimum signal strength of a new AP to leave the current AP. (dBm, 1 ~ 100)
Description	<p>Enable or disable Wi-Fi roaming.</p> <p>Wi-Fi roaming can be enabled after connecting to the AP with AT+WCONN command and disabled with AT+WROAM=0 command.</p> <p>All APs that is scanned and connected for Wi-Fi roaming have the same SSID and security settings.</p> <p>Conditions for leaving current AP and moving to new AP.</p> <ol style="list-style-type: none"> 1. Current AP's RSSI <= rssi_threshold 2. (New AP's RSSI - Current AP's RSSI) >= rssi_level <p>If it is disconnected from the current AP or the current AP is not scanned, it is connected to a new AP with the highest RSSI value among the scanned APs.</p> <p>When moving to a new AP during the roaming process, the following events occur sequentially.</p> <ol style="list-style-type: none"> 1. +WEVENT:"DISOCNNECT"

	<p>2. +WEVENT:"CONNECT_SUCCESS"</p> <p>3. +WEVENT:"ROAMING","<ssid>","<bssid>"</p> <p>At this time, the TCP connection may be disconnected and the TCP socket may be closed.</p>
Example	<pre> AT+WSCAN +WSCAN:"02:00:eb:3a:a3:b4",922.5,-43,"[WPA2-PSK-CCMP][ESS]","wifi_roaming" +WSCAN:"02:00:eb:ee:9a:87",918.5,-35,"[WPA2-PSK-CCMP][ESS]","wifi_roaming" +WSCAN:"02:00:48:32:58:42",920.5,-59,"[WPA2-PSK-CCMP][ESS]","wifi_roaming" OK AT+WCONN="wifi_roaming","wpa2","12345678" OK AT+WCONN? +WCONN:"wifi_roaming","02:00:eb:ee:9a:87","wpa2","12345678","connected" OK AT+WROAM=10000,-30,10 OK AT+WROAM? +WROAM:10000,-30,10 OK +WEVENT:"DISCONNECT" +WEVENT:"CONNECT_SUCCESS" +WEVENT:"ROAMING","wifi_roaming","02:00:48:32:58:42" +WEVENT:"DISCONNECT" +WEVENT:"CONNECT_SUCCESS" +WEVENT:"ROAMING","wifi_roaming","02:00:eb:3a:a3:b4" AT+WROAM=0 OK </pre>

6.16 AT+WSOFTAP

Command	<p>SET</p> <p>AT+WSOFTAP=<frequency>,"<ssid>","<security>","<password>"]</p> <p>GET</p>
---------	---

	AT+WSOFTAP?
Response	<p><u>SET</u></p> <p>OK</p> <p><u>GET</u></p> <p>+WSOFTAP=<frequency>,"<ssid>","<security>","<password>":["dhcp"]</p> <p>OK</p>
Parameters	<p><frequency> S1G channel frequency (MHz)</p> <p><ssid> The SSID of the AP.</p> <p><security> open*, wpa2</p> <p><password> (wpa2 security option only) The password when wpa2 security option is used.</p> <p><dhcp> Only included when the DHCP server is running.</p>
Description	<p>Run as the AP mode or retrieves information about the current settings.</p> <p>NOTE:</p> <p>The system should be reset to exit the AP mode.</p> <p>Software Reset is possible with the ATZ command.</p>
Example	<pre>AT+WSOFTAP=918.5,"halow_softap","wpa2","kds3f3" OK AT+WIPADDR="192.168.1.1","255.255.255.0","192.168.1.1" OK AT+DHCP +WDHCP:"192.168.1.1","255.255.255.0","192.168.1.1" OK AT+WSOFTAP? +WCONN:918.5,"halow_softap","wpa2","kds3f3","dhcp" OK</pre>

6.17 AT+WFOTA

Command	<p>SET AT+WFOTA=<check_time>[,"<server_url>"]</p> <p>GET AT+WFOTA?</p> <p>RUN AT+WFOTA</p>
Response	<p>SET OK</p> <p>GET +WFOTA=<check_time>,"<server_url>" OK</p> <p>RUN OK</p>
Parameters	<p><check_time> Interval time to periodically check new firmware on the server. Set to 0 to stop checking.</p> <p><server_url> HTTP or HTTPS Server URL</p>
Description	<p>Enable or disable Firmware Over-the-Air (FOTA). FOTA is enabled with the SET command and it is disabled by AT+WFOTA=-1 command.</p> <p>When FOTA is enabled, ATCMD firmware starts to check new firmware on the server. Checking the server can be controlled through the <check_time> parameter.</p> <p>To check new firmware, ATCMD firmware downloads the fota.info file from the server. The server should have the fota.info file as well as the new firmware binaries. The fota.info file should be updated along with new firmware binaries. The contents of the fota.info file are as follows.</p> <pre> 1 AT_SDK_VER: 1.3.2 2 AT_CMD_VER: 1.16.0 3 4 AT_HSPI_BIN: nrc7292_standalone_xip_ATCMD_HSPI.bin 5 AT_HSPI_CRC: b05b8c63 6 7 AT_UART_BIN: nrc7292_standalone_xip_ATCMD_UART.bin 8 AT_UART_CRC: 1d203eac 9 10 AT_UART_HFC_BIN: nrc7292_standalone_xip_ATCMD_UART_HFC.bin 11 AT_UART_HFC_CRC: 4614293e </pre> <p>ATCMD firmware compares the versions and sends an event to the terminal or host if the firmware version on the server is higher.</p> <p>+WEVENT:"FOTA","<sdk_version>","<atcmd_version>"</p> <p>After receiving the event, the terminal or host can download a new firmware from the server with the RUN command. After the download is complete, the current</p>

firmware is replaced with the new firmware. If the replacement is successful, the new firmware will run after the software reset.

NOTE:

The AT+WFOTA command can only be tested using the python-http-server package in the SDK.

Path : sdk/apps/atcmd/host/python-http-server

This package has the shell and python scripts to run HTTP/HTTPS server.

```
python-http-server/
├── fota.info
├── Get-bin-crc.sh
├── nrc7292_standalone_xip_ATCMD_HSPI.bin
├── nrc7292_standalone_xip_ATCMD_UART.bin
├── nrc7292_standalone_xip_ATCMD_UART_HFC.bin
├── python
│   ├── crc.py
│   ├── https-server.py
│   └── Run-server.sh
├── ssl-cert
│   ├── server.crt
│   ├── server.csr
│   ├── server.key
│   └── server.key.origin
```

Shell Script	Description	Usage
Get-bin-crc.sh	Calculate the CRC value of firmware binaries.	\$./Get-bin-crc.sh
Run-sever.sh	Run HTTP or HTTPS server.	\$./Run-server.sh http \$./Run-server.sh https

Example

```
AT+WSCAN
+WSCAN:"02:00:eb:fa:49:99",921.5,-10,"[WPA2-PSK-CCMP][ESS]","halow_demo"
OK
AT+WCONN="halow_demo","wpa2","12345678"
OK
AT+WDHCP
+WDHCP:"192.168.200.10","255.255.255.0","192.168.200.1"
OK
AT+WFOTA=5,"https://192.168.200.1:4443"
OK
AT+WFOTA?
+WFOTA:10,"https://192.168.200.1:4443"
OK
+WEVENT:"FOTA","1.3.2","1.16.0"
+WEVENT:"FOTA","1.3.2","1.16.0"
+WEVENT:"FOTA","1.3.2","1.16.0"
```


	AT+WFOTA=0 OK AT+WFOTA OK
--	------------------------------------

6.18 AT+WTIMEOUT

Command	<u>SET</u> AT+WTIMEOUT="<command>",<timeout> <u>GET</u> AT+WTIMEOUT?	
Response	<u>SET</u> OK <u>GET</u> +WTIMEOUT:"<command>",<timeout> OK	
Parameters	<command> "WSCAN", "WCONN", "WDISCONN" <timeout> Timeout in seconds. (0: no timeout, default: 0)	
Description	Configure the response timeout for the specified command. A timeout event will trigger a Wi-Fi event notification "+WEVENT".	
Example	AT+WTIMEOUT="WCONN",30 OK	AT+WTIMEOUT? +WTIMEOUT:"WSCAN",0 +WTIMEOUT:"WCONN",30 +WTIMEOUT:"WDISCONN",0 OK

6.19 +WEVENT

Response	+WEVENT:<event>
Parameters	<event> "SCAN_DONE" "CONNECT_SUCCESS" "CONNECT_FAIL" "DISCONNECT"

	"ROAMING","<ssid>","<bssid>" "FOTA","<sdk_version>","<atcmd_version>"
Description	Asynchronously raised Wi-Fi event logs.
Example	+WEVENT: "CONNECT_SUCCESS"

7 Socket AT Commands

Commands	Description
AT+SOPEN	Create a TCP/UDP socket.
AT+SCLOSE	Close an existing socket.
AT+SLIST	List all currently open sockets.
AT+SRXLOGLEVEL	Configure the received packet event log level for +RXD.
AT+SSEND	Send data through a socket.
AT+STIMEOUT	Configure the response timeout for the specified socket command.
+SEVENT	Asynchronously raised socket event logs.
+RXD	An event log for a received packet with payload.

7.1 AT+SOPEN

Command	<u>SET</u> AT+SOPEN="udp",<local_port> AT+SOPEN="tcp",<local_port> AT+SOPEN="tcp","<remote IP>",<remote port>
Response	<u>SET</u> +SOPEN=<socket ID> OK
Parameters	<local_port> (UDP) Optional argument to specify the outgoing local port. <local_port> (TCP Server) Local port to listen on. <remote IP>,<remote port> (TCP Client) The remote IP and remote port of the server.
Description	Create a TCP/UDP socket. For TCP, the server socket will listen on the given port in the background and asynchronously raise the event TCP_CONNECT to notify incoming connections.
Example	AT+ SOPEN ="TCP","192.168.100.109",8088 +SOPEN=0 OK AT+ SOPEN ="TCP",8088 +SOPEN=1 OK +SEVENT: "TCP_CONNECT",2 AT+ SOPEN ="UDP",8088 +SOPEN=3 OK

7.2 AT+SCLOSE

Command	<u>SET</u> AT+SCLOSE=<socket ID> <u>RUN</u> AT+SCLOSE
Response	<u>SET</u> +SCLOSE:<socket ID> OK <u>RUN</u> +SCLOSE:<socket ID> : +SCLOSE:<socket ID> OK
Parameters	<socket ID> The ID allocated to the socket.
Description	Close an existing socket. To close all existing sockets, run a command without the parameter <socket ID>. If a server socket is closed, all client sockets connected to the server socket will close automatically.
Example	AT+SCLOSE=1 +SCLOSE:1 OK AT+SCLOSE +SCLOSE:0 : +SCLOSE:3 OK

7.3 AT+SLIST

Command	<u>GET</u> AT+SLIST?
Response	<u>GET</u> +SLIST:<socket ID>,"<tcp-udp>","<remote IP>",<remote port>,<local port> : +SLIST:<socket ID>,"<tcp-udp>","<remote IP>",<remote port>,<local port> OK

Parameters	<p><socket ID> The ID allocated to the socket.</p> <p><tcp-udp> TCP, UDP</p> <p><remote IP>,<remote port>,<local port> The remote IP, remote port and local port associated with the socket.</p>
Description	List all currently open sockets.
Example	<p>AT+SLIST?</p> <p>+SLIST:1,"UDP","0.0.0.0",0,8088</p> <p>+SLIST:3,"TCP", "192.168.100.109",8089,6000</p> <p>OK</p>

7.4 AT+SRXLOGLEVEL

Command	<p><u>SET</u> AT+SRXLOGLEVEL=<mode></p> <p><u>GET</u> AT+SRXLOGLEVEL?</p>						
Response	<p><u>SET</u> +SRXLOGLEVEL:<mode></p> <p>OK</p> <p><u>GET</u> OK</p>						
Parameters	<p><mode> 0 (terse)*, 1 (verbose)</p>						
Description	Configure the received packet event log level for +RXD.						
Example	<table border="0"> <tr> <td>AT+SRXLOGLEVEL =1</td> <td>AT+SRXLOGLEVEL?</td> </tr> <tr> <td>OK</td> <td>+ SRXLOGLEVEL:1</td> </tr> <tr> <td></td> <td>OK</td> </tr> </table>	AT+SRXLOGLEVEL =1	AT+SRXLOGLEVEL?	OK	+ SRXLOGLEVEL:1		OK
AT+SRXLOGLEVEL =1	AT+SRXLOGLEVEL?						
OK	+ SRXLOGLEVEL:1						
	OK						

7.5 AT+SSEND

Command	<p><u>SET</u> AT+SSEND =<socket ID>[,<length>]</p>
----------------	---

	AT+SSEND =<socket ID>,"<remote IP>",<remote port>[,<length>]
Response	<u>SET</u> OK
Parameters	<p><socket ID> The ID allocated to the socket.</p> <p><remote IP>,<remote port> (UDP only) The IP and port of the remote UDP server.</p> <p><length> The number of raw bytes to send. (Max: 2048) In normal mode, the payload length must be explicitly provided. In passthrough mode, the payload length must NOT be provided.</p>
Description	<p>Send data through a socket.</p> <p>In normal mode, the <length> must be explicitly provided. The byte sequence of <length> bytes must be directly followed by "AT+SSEND=<socket ID>,<length>\r\n". The byte sequence does not have to be followed by "\r" or "\n".</p> <p>In passthrough mode, the module enters the continuous transmission state when the "AT+SSEND=<socket ID>\r\n" command is used without the length argument. Once the module enters the continuous transmission state, any byte sequence fed into the UART input stream will be copied in real-time to the corresponding socket stream.</p> <p>There should be no additional "AT+SSEND=<socket ID>\r\n" prefix fed into the UART input stream except for the very first one for state transition, as the prefix characters themselves will be treated as actual data bytes.</p> <p>To leave the continuous transmission state and return to the regular state in which AT-commands can be handled again, wait for SSEND timeout duration (See AT+STIMEOUT) without feeding any bytes to the UART input stream.</p> <p>And feed the magic bytes "AT\r\n" to exit the continuous transmission state after +SEVENT:"SEND_IDLE" notification is received.</p> <p>Exiting the state will trigger the +SEVENT:"SEND_EXIT" notification, at which point the module is ready to receive and handle AT-commands again.</p> <p>NOTE:</p> <p>The data payload should be transmitted to the module after receiving OK in response to the AT+SSEND command.</p> <p>The passthrough mode is not supported for UART without H/W flow control.</p>

<p>Example</p>	<p>[Normal Mode] AT+SSEND=0,6 OK Hello!</p> <p>[Passthrough mode] AT+SSEND=0 OK Hello! Nice to meet you.</p> <p>[Wait for SSEND timeout duration to change the internal state to receive magic bytes and exit the continuous transmission state]</p> <p>+SEVENT:"SEND_IDLE",0,23 AT OK +SEVENT:"SEND_EXIT",0,23</p> <p>[Normal Mode] AT+SSEND=0,6 OK Hello!</p>
-----------------------	---

7.6 AT+STIMEOUT

<p>Command</p>	<p><u>SET</u> AT+STIMEOUT="<command>",<timeout></p> <p><u>GET</u> AT+STIMEOUT?</p>
<p>Response</p>	<p><u>SET</u> OK</p> <p><u>GET</u> +STIMEOUT:"<command>",<timeout> OK</p>
<p>Parameters</p>	<p><command> "SOPEN", "SSEND"</p> <p><timeout> Timeout in seconds. (default: [SOPEN=30, SSEND=1], disable: 0)</p>
<p>Description</p>	<p>Configure the response timeout for the specified socket command.</p>

	A timeout event will trigger a socket event notification "+SEVENT".	
Example	AT+STIMEOUT="SOPEN",60 OK	AT+STIMEOUT? +STIMEOUT:"SOPEN",60 +STIMEOUT:"SSEND",1 OK

7.7+SEVENT

Response	+SEVENT:<event>,<socket ID>[,<parameter 1>,...,<parameter N>]														
Parameters	<p><event> "CONNECT",<socket ID> "CLOSE",<socket ID> "SEND_IDLE",<socket ID>,<length> "SEND_DROP",<socket ID>,<length> "SEND_EXIT",<socket ID>,<length> "SEND_ERROR",<socket ID>,<length>,<error> "RCV_ERROR",<socket ID>,<error></p> <p><socket ID> Socket ID</p> <p><length> The total length of the payload sent over the socket. The SEND_DROP event indicates the length of the dropped payload.</p> <p><error> POSIX error code. If the SEND_ERROR and RCV_ERROR events occur due to the following errors, the corresponding socket is closed by the firmware.</p> <table border="1"> <thead> <tr> <th>Event Name</th><th>Error Value</th><th>Description</th></tr> </thead> <tbody> <tr> <td rowspan="2">SEND_ERROR</td><td>-107</td><td>Transport endpoint is not connected. (ENOTCONN)</td></tr> <tr> <td>-104</td><td>Connection reset by peer. (ECONNRESET)</td></tr> <tr> <td rowspan="2">RCV_ERROR</td><td>-107</td><td>Transport endpoint is not connected. (ENOTCONN)</td></tr> <tr> <td>-111</td><td>Connection refused. (ECONNREFUSED)</td></tr> </tbody> </table>		Event Name	Error Value	Description	SEND_ERROR	-107	Transport endpoint is not connected. (ENOTCONN)	-104	Connection reset by peer. (ECONNRESET)	RCV_ERROR	-107	Transport endpoint is not connected. (ENOTCONN)	-111	Connection refused. (ECONNREFUSED)
Event Name	Error Value	Description													
SEND_ERROR	-107	Transport endpoint is not connected. (ENOTCONN)													
	-104	Connection reset by peer. (ECONNRESET)													
RCV_ERROR	-107	Transport endpoint is not connected. (ENOTCONN)													
	-111	Connection refused. (ECONNREFUSED)													
Description	Asynchronously raised socket event logs.														

Example	+SEVENT:"CONNECT",1 +SEVENT:"SEND_INIT",1,1500 +SEVENT:"SEND_ERROR",1,1000,-103
----------------	---

7.8+RXD

Response	<p><u>RX mode (Terse)</u> +RXD:<socket ID>,<actual read length>,<raw bytes></p> <p><u>RX mode (Verbose)</u> +RXD:<socket ID>,<actual read length>,"<remote IP>",<remote port>,<raw bytes></p>
Parameters	<p><socket ID> The ID allocated to the socket.</p> <p><max read length> The maximum number of bytes to read. (Max: 2048)</p> <p><actual read length> Actual number of bytes read.</p> <p><remote IP>,<remote port> The remote IP and port.</p> <p><raw bytes> The received raw bytes (0x00~0xFF) payload.</p>
Description	An event log for a received packet with payload. Upon receiving packets, +RXD event logs will automatically appear on the terminal output. Note that there will be no 'OK' message following the event log.
Example	<p><u>RX mode (Terse)</u> +RXD=0,15,ABCDE12345,.?+=</p> <p><u>RX mode (Verbose)</u> +RXD=0,12,"192.168.200.1",5025,HELLO,WORLD!</p>

8 Test Application

8.1 Command Line Interface (raspi-atcmd-cli)

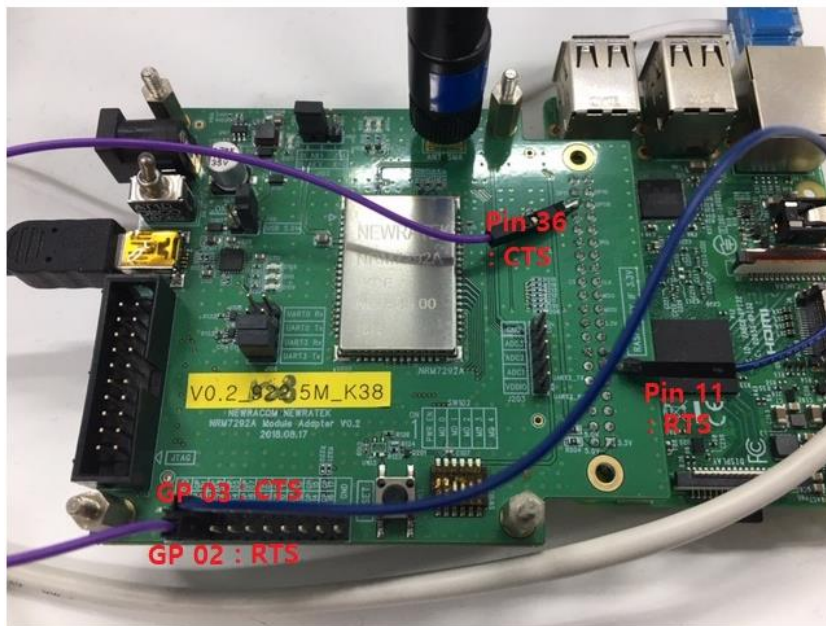
CLI application is a Linux program running on Raspberry Pi for AT-command communication via UART or SPI. In the CLI application, as in terminal program via UART, the user can enter the AT command and check the response to the command.

The NRM7292 EVB can use the Raspberry Pi as a host. The Raspberry Pi board is connected to the NRM7292 EVB through a 40-pin header. The 40-pin header has signals for UART and SPI.



Figure 8.1 Pin map of 40-pin header for Raspberry Pi

The NRM7292 EVB and Raspberry Pi board is connected as shown in the Figure 8.2. Both PIN11_UART0_RTS and PIN36_UART0_CTS used for hardware flow control on the UART needs to be directly connected to a 20-pin header in the NRM7292 EVB by a jumper wire.



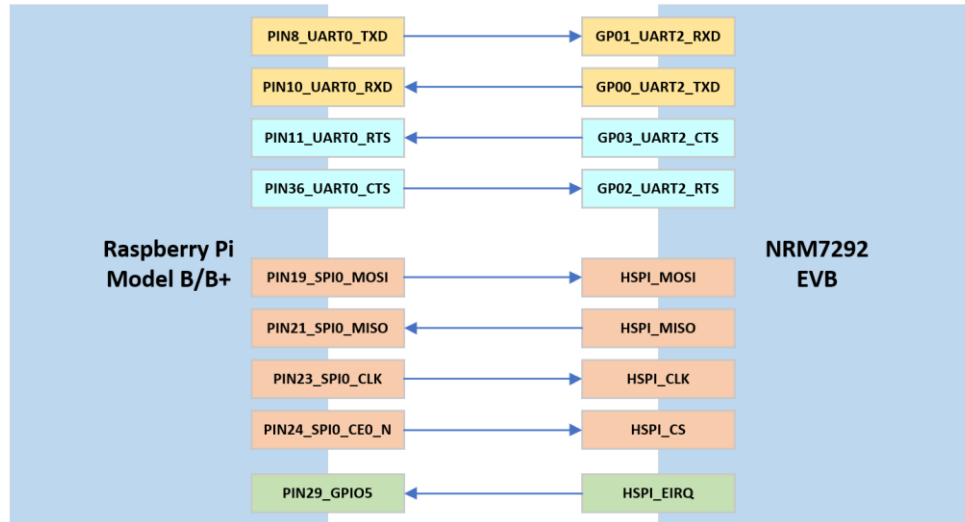


Figure 8.2 Connection between NRM7292 EVB and Raspberry Pi

1) Source files

```

├── main.c
├── Makefile
├── nrc-hspi.c
├── nrc-hspi.h
├── raspi-atcmd-cli
├── raspi.h
├── raspi-hif.c
├── raspi-spi.c
├── raspi-uart.c
├── scripts
│   ├── examples
│   └── test-case

```

File	Description
main.c	CLI related functions.
Makefile	Make file for building.
nrc-hspi.c/h	Protocol driver for HSPI. *Refer to this file to communicate with the ATCMD firmware via SPI from the host.
raspi.h	Common header file for Raspberry Pi.
raspi-hif.c	Wrapper for user mode driver.
raspi-spi.c	User mode driver for SPI.
raspi-uart.c	User mode driver for UART.
scripts/	Script files

Table 8.1 raspi-atcmd-cli source files

2) Build

Copy all source files from standalone/sdk/apps/atcmd/host to the Raspberry Pi's home directory. And build the CLI application with the make command.

```
$ cd $HOME
$ cd host/raspi-atcmd-cli
$ make [clean]
```

```
pi@raspberrypi:~/host/raspi-atcmd-cli $ make clean
removed 'raspi-atcmd-cli'
pi@raspberrypi:~/host/raspi-atcmd-cli $ make
cc -g -o raspi-atcmd-cli main.c raspi-hif.c raspi-spi.c raspi-uart.c nrc-hspi.c -pthread
-Wall -Wno-unused-function -lpthread
```

3) Run

A. It needs be executed on Raspberry Pi3 or Host which can use AT command through UART or SPI

Run the CLI application using a raspi-atcmd-cli file. And enter the AT command as in Terminal program.

● Help

```
$ ./raspi-atcmd-cli [-h|--help]
```

```
pi@raspberrypi:~/host/raspi-atcmd-cli $ ./raspi-atcmd-cli --help
raspi-atcmd-cli version 1.0.0
Copyright (c) 2019-2020 <NEWRACOM LTD>

Usage:
$ ./raspi-atcmd-cli -U [-D <device>] [-b <baudrate>] [-d] [-f] [-s <script>]
$ ./raspi-atcmd-cli -S [-D <device>] [-c <clock>] [-s <script>]

UART/SPI:
-D, --device #          specify the device. (default: /dev/ttyAMA0, /dev/spidev0.0)

UART:
-U --uart               use the UART to communicate with the target.
-b, --baudrate #        specify the baudrate for the UART. (default: 38,400 bps)
-f --flowctrl           enable RTS/CTS signals for the hardware flow control on the UART. (default: disable)

SPI:
-S --spi               use the SPI to communicate with the target.
-c, --clock #          specify the clock frequency for the SPI. (default: 16,000,000 Hz)

Script:
-s, --script #         specify the script file.

Miscellaneous:
-v, --version          print version information and quit.
-h, --help             print this message and quit.
```

- **SPI**

A clock of the SPI master is up to 20MHz. The clock default setting is 16 MHz.

\$ sudo ./raspi-atcmd-cli -S [-c <clock>]

```
pi@raspberrypi:~/host/raspi-atcmd-cli $ sudo ./raspi-atcmd-cli -S -c 16000000
[RPI]
[RPI] [ SPI ]
[RPI] - device: /dev/spidev0.0
[RPI] - clock: 16000000 Hz
[RPI]
```

- **UART**

A default setting for baud rate is 115200bps without the hardware flow control.

\$ sudo ./raspi-atcmd-cli -U [-b <baudrate>]

```
pi@raspberrypi:~/host/raspi-atcmd-cli $ sudo ./raspi-atcmd-cli -U -b 115200
[RPI]
[RPI] [ UART ]
[RPI] - device: /dev/ttyAMA0
[RPI] - baudrate : 115200
[RPI]
```

If the baud rate setting is more than 115200bps, the hardware flow control needs to be enabled on the UART.

\$ sudo ./raspi-atcmd-cli -U [-b <baudrate>] -f

```
pi@raspberrypi:~/host/raspi-atcmd-cli $ sudo ./raspi-atcmd-cli -U -b 115200 -f
[RPI]
[RPI] [ UART_HFC ]
[RPI] - device: /dev/ttyAMA0
[RPI] - baudrate : 115200
[RPI]
```

- Log

Getting the informations.

```
AT
[RPI] SEND: AT
[RPI] RECV: OK

AT+VER?
[RPI] SEND: AT+VER?
[RPI] RECV: +VER:"1.7.1","1.3.0"
[RPI] RECV: OK

AT+UART?
[RPI] SEND: AT+UART?
[RPI] RECV: +UART:38400,8,1,0,1
[RPI] RECV: OK

AT+WCCOUNTRY?
[RPI] SEND: AT+WCCOUNTRY?
[RPI] RECV: +WCCOUNTRY:"KR"
[RPI] RECV: OK

AT+WTXPOWER?
[RPI] SEND: AT+WTXPOWER?
[RPI] RECV: +WTXPOWER:17
[RPI] RECV: OK

AT+WMACADDR?
[RPI] SEND: AT+WMACADDR?
[RPI] RECV: +WMACADDR:"02:00:eb:59:dd:99"
[RPI] RECV: OK

AT+WIPADDR?
[RPI] SEND: AT+WIPADDR?
[RPI] RECV: +WIPADDR:"0.0.0.0","0.0.0.0","0.0.0.0"
[RPI] RECV: OK

AT+WCONN?
[RPI] SEND: AT+WCONN?
[RPI] RECV: +WCONN:"hallow","open","", "disconnected"
[RPI] RECV: OK
```

Connecting to an AP.

```
AT+WSCAN
[RPI] SEND: AT+WSCAN
[RPI] RECV: +WSCAN:"02:00:eb:fa:49:90",921.5,-34,"[WPA2-PSK-CCMP][ESS]","hallow_atcmd_wpa2"
[RPI] RECV: OK

AT+WCONN="hallow_atcmd_wpa2","wpa2","12345678"
[RPI] SEND: AT+WCONN="hallow_atcmd_wpa2","wpa2","12345678"
[RPI] RECV: OK

AT+WDHCP
[RPI] SEND: AT+WDHCP
[RPI] RECV: +WDHCP:"192.168.200.39","255.255.255.0","192.168.200.1"
[RPI] RECV: OK

AT+WIPADDR?
[RPI] SEND: AT+WIPADDR?
[RPI] RECV: +WIPADDR:"192.168.200.39","255.255.255.0","192.168.200.1"
[RPI] RECV: OK

AT+WPING
[RPI] SEND: AT+WPING
[RPI] RECV: +WPING:64,"192.168.200.1",1,64,6
[RPI] RECV: +WPING:64,"192.168.200.1",2,64,7
[RPI] RECV: +WPING:64,"192.168.200.1",3,64,6
[RPI] RECV: +WPING:64,"192.168.200.1",4,64,6
[RPI] RECV: +WPING:64,"192.168.200.1",5,64,6
[RPI] RECV: OK
```


Sending and receiving the data with a socket for TCP client.

```
AT+SOPEN="tcp","192.168.200.1",50000
[RPI] SEND: AT+SOPEN="tcp","192.168.200.1",50000
[RPI] RECV: +SOPEN:0
[RPI] RECV: OK

AT+SLIST?
[RPI] SEND: AT+SLIST?
[RPI] RECV: +SLIST:0,"TCP","192.168.200.1",50000,0
[RPI] RECV: OK

AT+SSEND=0,10
[RPI] SEND: AT+SSEND=0,10
[RPI] RECV: OK

ABCDEFGHIJKLMNOPQRSTUVWXYZ
[RPI] SEND: len=10
[RPI] RECV: +RXD:0,10
[RPI] RECV: ABCDEFGHIJ

AT
[RPI] SEND: AT
[RPI] RECV: OK

AT+SSEND=0
[RPI] SEND: AT+SSEND=0
[RPI] RECV: OK

ABCDEFGHIJKLMNOPQRSTUVWXYZ
[RPI] SEND: len=26
[RPI] RECV: +RXD:0,14
[RPI] RECV: ABCDEFGHIJKLMN
[RPI] RECV: +RXD:0,12
[RPI] RECV: OPQRSTUVWXYZ
[RPI] RECV: +SEVENT:"SEND_IDLE",0,26

0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ
[RPI] SEND: len=36
[RPI] RECV: +RXD:0,14
[RPI] RECV: 0123456789ABCD
[RPI] RECV: +RXD:0,22
[RPI] RECV: EFGHIJKLMNOPQRSTUVWXYZ
[RPI] RECV: +SEVENT:"SEND_IDLE",0,62

AT
[RPI] SEND: AT
[RPI] RECV: OK
[RPI] RECV: +SEVENT:"SEND_EXIT",0,62
```

Sending and receiving the data with a socket for UDP client.

```
AT+SOPEN="udp",60000
[RPI] SEND: AT+SOPEN="udp",60000
[RPI] RECV: +SOPEN:1
[RPI] RECV: OK

AT+SLIST?
[RPI] SEND: AT+SLIST?
[RPI] RECV: +SLIST:0,"TCP","192.168.200.1",50000,0
[RPI] RECV: +SLIST:1,"UDP","0.0.0.0",0,60000
[RPI] RECV: OK

AT+SSEND=1,"192.168.200.1",50000,10
[RPI] SEND: AT+SSEND=1,"192.168.200.1",50000,10
[RPI] RECV: OK

ABCDEFGHIJKLMNOPQRSTUVWXYZ
[RPI] SEND: len=10
[RPI] RECV: +RXD:1,10
[RPI] RECV: ABCDEFGHIJ

AT
[RPI] SEND: AT
[RPI] RECV: OK

AT+SSEND=1,"192.168.200.1",50000
[RPI] SEND: AT+SSEND=1,"192.168.200.1",50000
[RPI] RECV: OK

ABCDEFGHIJKLMNOPQRSTUVWXYZ
[RPI] SEND: len=26
[RPI] RECV: +RXD:1,14
[RPI] RECV: ABCDEFGHIJKLMNOP
[RPI] RECV: +RXD:1,12
[RPI] RECV: OPQRSTUVWXYZ

[RPI] RECV: +SEVENT:"SEND_IDLE",1,26

0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ
[RPI] SEND: len=36
[RPI] RECV: +RXD:1,14
[RPI] RECV: 0123456789ABCD
[RPI] RECV: +RXD:1,14
[RPI] RECV: EFGHIJKLMNOPQR
[RPI] RECV: +RXD:1,8
[RPI] RECV: STUVWXYZ
[RPI] RECV: +SEVENT:"SEND_IDLE",1,62

AT
[RPI] SEND: AT
[RPI] RECV: OK
[RPI] RECV: +SEVENT:"SEND_EXIT",1,62
```

Closing all sockets.

```
AT+SLIST?
[RPI] SEND: AT+SLIST?
[RPI] RECV: +SLIST:0,"TCP","192.168.200.1",50000,0
[RPI] RECV: +SLIST:1,"UDP","0.0.0.0",0,60000
[RPI] RECV: OK

AT+SCLOSE
[RPI] SEND: AT+SCLOSE
[RPI] RECV: +SCLOSE:0
[RPI] RECV: +SCLOSE:1
[RPI] RECV: OK

EXIT
```

4) Run with script file

CLI application provides the option to run the script files.

```
script:
-s, --script #      specify the script file.
```

The script file can be created using the AT command and the following script command.

Command	Description	Example
ECHO "<message>"	Print a message.	ECHO "AT Command"
DATA <length>	Send payload with random value.	DATA 1024
WAIT <time>{s m u}	Wait for the specified time. s: sec m: msec u: usec	WAIT 1s WAIT 1000m WAIT 100u
CALL <script_file>	Run the specified script file.	CALL wifi_connect CALL wifi/connect
LOOP <line> <count>	Repeat next lines. <line>: number of lines to repeat <count>: number of repetitions.	LOOP 2 5 AT+SSEND=0,1024 DATA 1024
HOLD	Pause until there is keyboard input.	ECHO "Run an AP in open mode" HOLD

***) Users can refer to the script files under the scripts directory.**

```
scripts/
├── examples
│   ├── socket-send-passthrough-exit
│   ├── socket-send-tcp-client
│   ├── socket-send-tcp-client-passthrough
│   ├── wifi-connect-open-dhcp
│   ├── wifi-connect-wpa2-dhcp
│   ├── wifi-softap-open-dhcps
│   └── wifi-softap-wpa2-dhcps
└── test-case
    ├── ATCMD_Test_Cases.xlsx
    ├── AT-TC-ALL
    ├── AT-TC-BASIC
    ├── AT-TC-BASIC-01
    ├── AT-TC-BASIC-02
    ├── AT-TC-BASIC-03
    ├── AT-TC-SOCKET
    ├── AT-TC-SOCKET-01
    ├── AT-TC-SOCKET-02
    ├── AT-TC-SOCKET-03
    ├── AT-TC-SOCKET-04
    ├── AT-TC-WIFI
    ├── AT-TC-WIFI-01
    ├── AT-TC-WIFI-02-01
    ├── AT-TC-WIFI-02-02
    ├── AT-TC-WIFI-03-01
    ├── AT-TC-WIFI-03-02
    ├── AT-TC-WIFI-04
    ├── AT-TC-WIFI-AP
    └── AT-TC-WIFI-STA
```

- **SPI**

\$ sudo ./raspi-atcmd-cli -S [-c <clock>] -s <script_file>

(Example) \$sudo ./raspi-atcmd-cli -S -s scripts/test-case/AT-TC-ALL

- **UART**

\$ sudo ./raspi-atcmd-cli -U [-b <baudrate>] -s <script_file>

(Example) \$sudo ./raspi-atcmd-cli -U -s scripts/test-case/AT-TC-ALL

- **UART with H/W flow control**

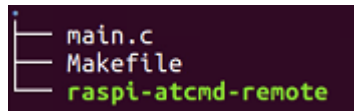
\$ sudo ./raspi-atcmd-cli -U [-b <baudrate>] -f -s <script_file>

(Example) \$sudo ./raspi-atcmd-cli -U -s scripts/test-case/AT-TC-ALL

8.2 Remote Server/Client (raspi-atcmd-remote)

A remote server/client application run one server or client at a time. This application is a Linux application that can be executed on Raspberry Pi. After running the AP, rasp-atcmd-remote must be run on the host running the AP. That is, the AP must run UDP or TCP server / client, and a user can send and receive data using socket-related AT commands through the CLI application(rasp-atcmd-cli).

1) Source files



File	Description
main.c	UDP/TCP server/client related functions
Makefile	Make file for building

Table 8.2 rasp-atcmd-remote source files

2) Build

```
$ cd $HOME
$ cd host/raspi-atcmd-remote
$ make [clean]
```

```
pi@raspberrypi:~/host/raspi-atcmd-remote $ make clean
removed 'raspi-atcmd-remote'
pi@raspberrypi:~/host/raspi-atcmd-remote $ make
cc -g -o raspi-atcmd-remote main.c -Wall -Wno-unused-function
```

3) Run

A. It needs be executed on Raspberry Pi3 running as a Host mode AP.

\$./raspi-atcmd-remote [-h|--help]

```
pi@raspberrypi:~/host/raspi-atcmd-remote $ ./raspi-atcmd-remote
raspi-atcmd-remote version 1.0.0
Copyright (c) 2019-2020 <NEWRACOM LTD>

Usage:
$ ./raspi-atcmd-remote -u [-p <bind_port>] [-e]
$ ./raspi-atcmd-remote -t -s [-p <listen_port>] [-e]
$ ./raspi-atcmd-remote -t -c <server_ip> [-p <server_port>] [-e]

UDP:
-u, --udp          use UDP.

TCP:
-t, --tcp          use TCP
-s, --server       run in server mode
-c, --client #     run in client mode

UDP/TCP:
-p, --port #       set port number (default: 50000)
-e, --echo         enable echo for received packets (default: disable)

-v, --version      print version information and quit.
-h, --help         print this message and quit.
```

Examples:

Mode	Command
UDP Server or Client	\$./raspi-atcmd-remote -u -p 50000 [-e]
TCP Server	\$./raspi-atcmd-remote -t -s -p 50000 [-e]
TCP Client	\$./raspi-atcmd-remote -t -c 192.168.200.39 -p 60000 [-e]

4) Log

UDP Server or Client (\$./raspi-atcmd-remote -u -p 50000 -e)

```
[ UDP ]
- bind_port : 50000
- echo : on
RECV: addr=192.168.200.39 port=60000 len=16
SEND: addr=192.168.200.39 port=60000 len=16
RECV: addr=192.168.200.39 port=60000 len=16
SEND: addr=192.168.200.39 port=60000 len=16
RECV: addr=192.168.200.39 port=60000 len=16
SEND: addr=192.168.200.39 port=60000 len=16
RECV: addr=192.168.200.39 port=60000 len=16
SEND: addr=192.168.200.39 port=60000 len=16
RECV: addr=192.168.200.39 port=60000 len=16
SEND: addr=192.168.200.39 port=60000 len=16
```

TCP Server (\$./raspi-atcmd-remote -t -s -p 50000 -e)

```
[ TCP_SERVER ]
- listen_port : 50000
- echo : on
LISTEN ...
CONNECT: addr=192.168.200.39 port=52433

RECV: addr=192.168.200.39 port=52433 len=16
SEND: addr=192.168.200.39 port=52433 len=16
RECV: addr=192.168.200.39 port=52433 len=16
SEND: addr=192.168.200.39 port=52433 len=16
RECV: addr=192.168.200.39 port=52433 len=16
SEND: addr=192.168.200.39 port=52433 len=16
RECV: addr=192.168.200.39 port=52433 len=16
SEND: addr=192.168.200.39 port=52433 len=16
RECV: addr=192.168.200.39 port=52433 len=16
SEND: addr=192.168.200.39 port=52433 len=16
```

TCP Client (\$./raspi-atcmd-remote -t -c 192.168.200.39 -p 60000 -e)

```
[ TCP_CLIENT ]
- server_ip : 192.168.200.39
- server_port : 60000
- echo : on
CONNECT: addr=192.168.200.39 port=60000

RECV: addr=192.168.200.39 port=60000 len=16
SEND: addr=192.168.200.39 port=60000 len=16
RECV: addr=192.168.200.39 port=60000 len=16
SEND: addr=192.168.200.39 port=60000 len=16
RECV: addr=192.168.200.39 port=60000 len=16
SEND: addr=192.168.200.39 port=60000 len=16
RECV: addr=192.168.200.39 port=60000 len=16
SEND: addr=192.168.200.39 port=60000 len=16
RECV: addr=192.168.200.39 port=60000 len=16
SEND: addr=192.168.200.39 port=60000 len=16
```

9 Examples

9.1 Connect to 11ah AP and Send UDP Data to UDP Server

Configuration

- 11ah AP (IP: 192.168.200.1, SSID: halow_demo, Security: Open, DHCP Server: O)
- UDP Server (Port 8800, IP 192.168.200.10, DHCP Server)
- UDP Client (Port 1000, DHCP Client)

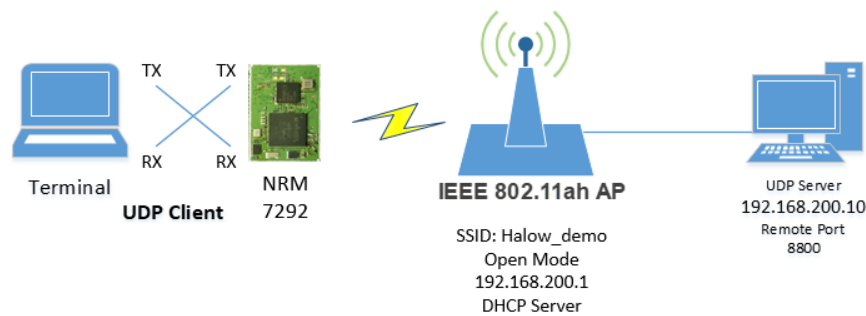


Figure 9.1 Configuration of Example1

[AT Command used for example1]

- 1) Find AP
➔ AT+WSCAN
- 2) Try to connection Wi-Fi AP (SSID: halow_demo, Open Mode)
➔ AT+WCONN="halow_demo"
- 3) Try to DHCP
➔ AT+WDHCP
- 4) Check IP address after connection
➔ AT+WIPADDR?
- 5) Check Connection to AP using PING
➔ AT+WPING="192.168.200.1"
- 6) Create UDP Client Socket to Server (Server Port 8800, Server IP 192.168.200.10)
➔ AT+SOPEN="UDP",1000
- 7) Check UDP Socket

➔ AT+SLIST?

8) Send Data to UDP Server

➔ AT+SSEND=0,"192.168.200.10",8800,10
"0123456789"

9) Close UDP Socket

➔ AT+SCLOSE=0

10) Check UDP Socket

➔ AT+SLIST?

9.2 Connect to 11ah AP and Send TCP Data to TCP Server

Configuration

- 11ah AP (IP: 192.168.200.1, SSID: halow_demo, Security: WPA2, PW:12345678, NO DHCP)
- TCP Server (Port 8098, IP 192.168.200.10)
- TCP Client (IP 192.168.200.20)

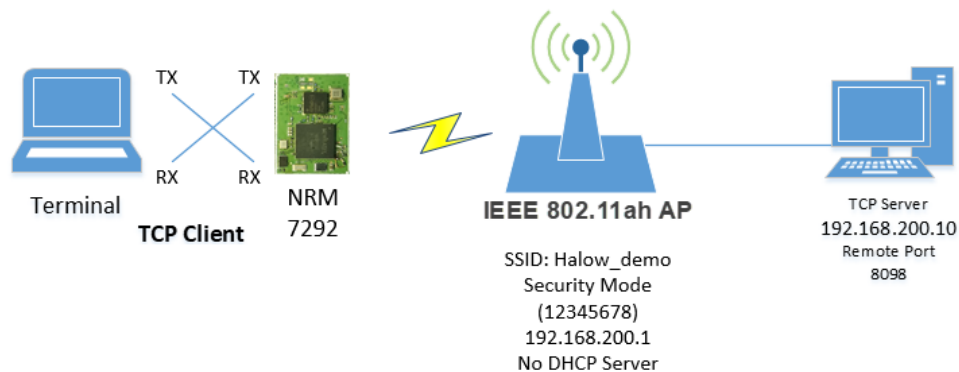


Figure 9.2 Configuration of Example2

[AT Command used for example2]

- 1) Find AP
➔ AT+WSCAN
- 2) Set Static IP
➔ AT+WIPADDR="192.168.200.20","255.255.255.0","192.168.200.1"
- 3) Try to connection Wi-Fi AP (SSID: halow_demo, Security Mode, Static IP)
➔ AT+WCONN="halow_demo","wpa2","12345678"
- 4) Check IP address after connection
➔ AT+WIPADDR?
- 5) Check Connection to AP using PING
➔ AT+WPING="192.168.200.1"
- 6) Create TCP Client Socket to Server (Server Port 8800, Server IP 192.168.200.10)
➔ AT+SOPEN="TCP","192.168.200.10",8098
- 7) Check UDP Socket
➔ AT+SLIST?

8) Send Data to TCP Server

➔ AT+SSEND=0,10
"0123456789"

9) Close TCP Socket

➔ AT+SCLOSE=0

10) Check TCP Socket

➔ AT+SLIST?

10 Revision History

Revision No	Date	Comments
Ver 1.0	03/28/2019	Initial version for customer release created
Ver 1.1	07/02/2019	Sample Applications updated
Ver 1.2	08/01/2019	HW Flow Control added
Ver 1.3	09/17/2019	Additional AT-commands added
Ver 1.4	11/18/2019	Download binary update & remove description wpa security
Ver 1.5	02/14/2020	Improved command descriptions
Ver 1.6	03/25/2020	SPI connection and CLI application added
Ver 1.7	03/31/2020	AT+STXMODE, AT+SRXMODE, AT+SRXAVAIL and AT+SRECV commands removed
Ver 1.8	04/07/2020	Socket related events removed and added CLI application updated
Ver 1.9	05/15/2020	Ping size parameter removed Test Application added
Ver 1.10	05/22/2020	AT+WDHCPS, AT+WSOFTAP commands added
Ver 1.11	06/03/2020	AT+SLEEP command added
Ver 1.12	07/15/2020	"Chapter 2.2 Building the firmware" added
Ver 1.13	08/04/2020	UART default baudrate changed (38400 -> 115200) "4) Run with script file" in chapter 8.1 added
Ver1.14	08/13/2020	BSSID in AT+WCONN command added
Ver1.15	08/24/2020	AT+WROAM command added ROAMING event added
Ver1.16	09/02/2020	AT+WFOTA command added FOTA event added