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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

2.1 Hardware

The AT-command communication is achieved via the UART or SPI interface between the NRC7292 and an external host. The NRM7292 evaluation board (EVB) use the Raspberry Pi 3 B/B+ as a host.

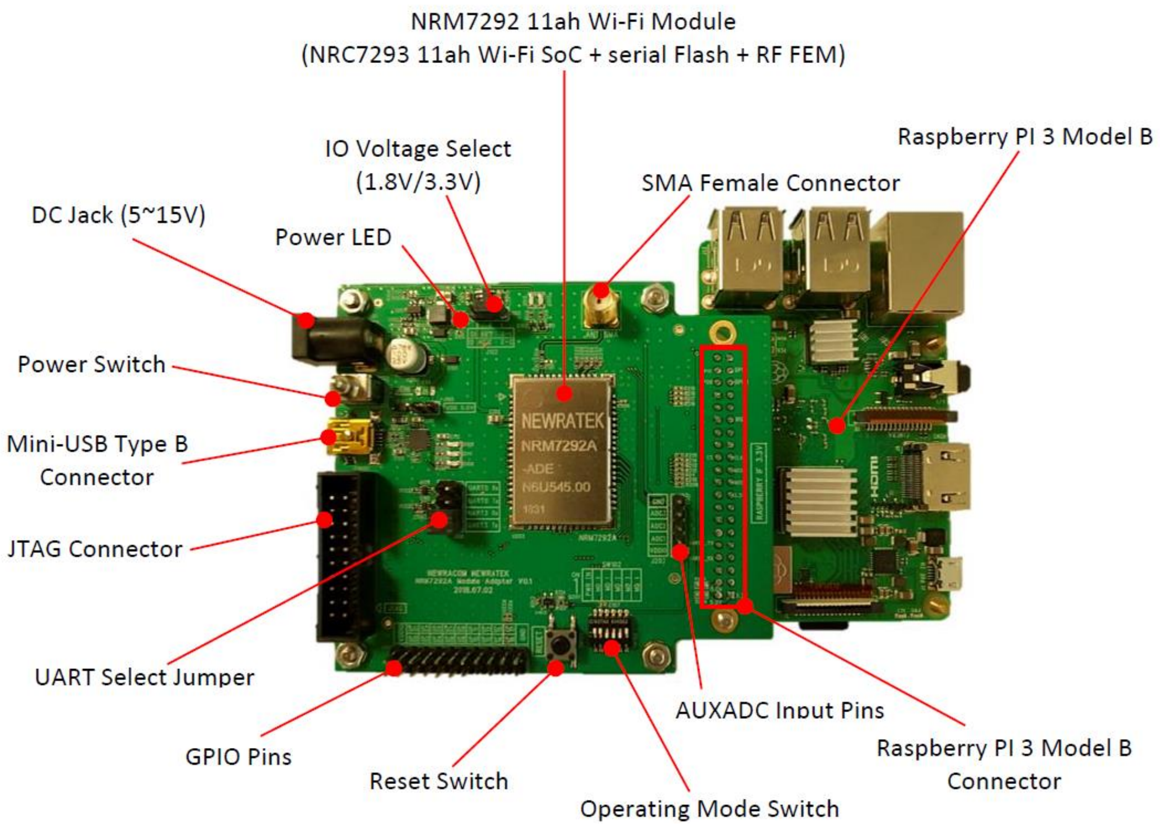
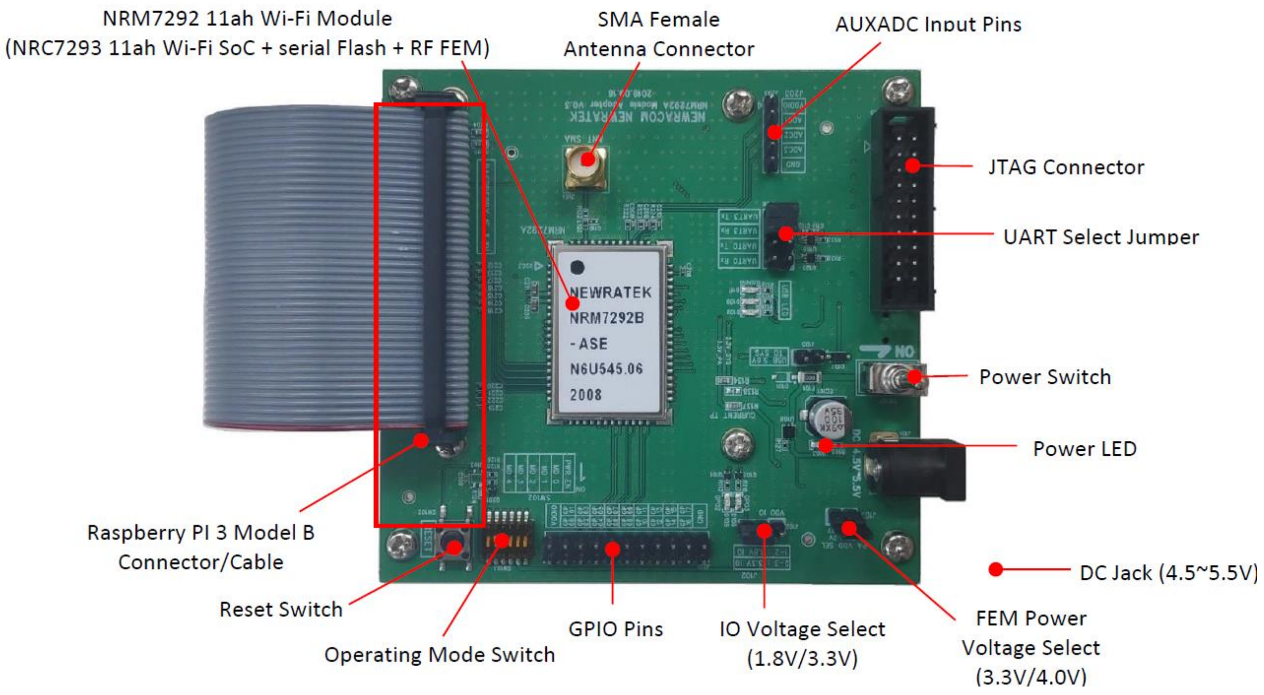


Figure 2.1 NRC7292 evaluation board v0.2



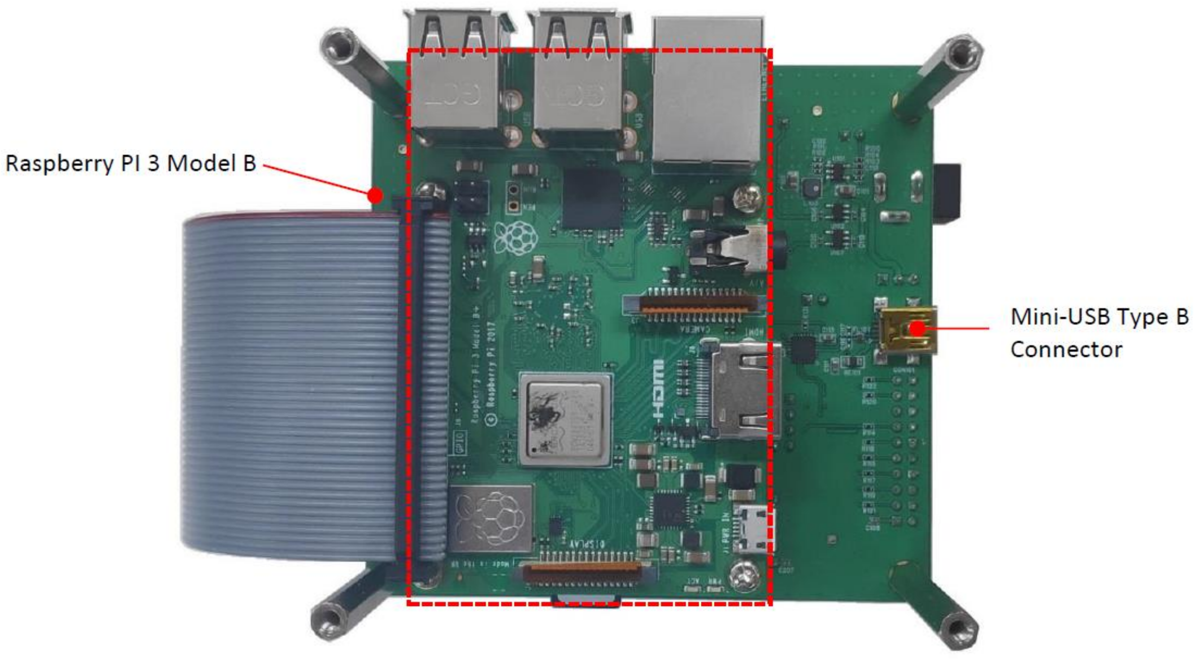


Figure 2.2 NRC7292 evaluation board v0.5

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.

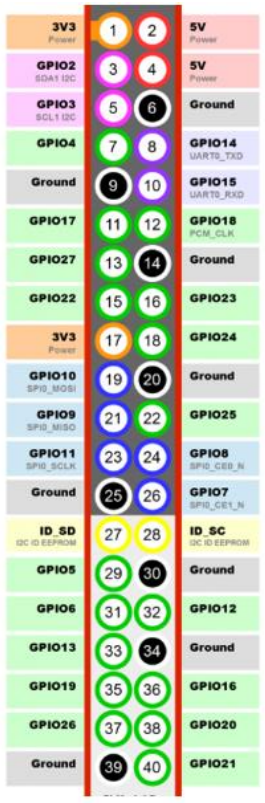

3V3 Power 1 2 5V Power
GPIO2 SDA1 I2C 3 4 5V Power
GPIO3 SCL1 I2C 5 6 Ground
GPIO4 7 8 GPIO14 UART0_TXD
Ground 9 10 GPIO15 UART0_RXD
GPIO17 11 12 GPIO18 PCM_CLK
GPIO27 13 14 Ground
GPIO22 15 16 GPIO23
3V3 Power 17 18 GPIO24
GPIO10 SPI0_MOSI 19 20 Ground
GPIO9 SPI0_MISO 21 22 GPIO25
GPIO11 SPI0_SCLK 23 24 GPIO8 SPI0_CE0_N
Ground 25 26 GPIO7 SPI0_CE1_N
ID_SD I2C ID EEPROM 27 28 ID_SC I2C ID EEPROM
GPIO5 29 30 Ground
GPIO6 31 32 GPIO12
GPIO13 33 34 Ground
GPIO19 35 36 GPIO16
GPIO26 37 38 GPIO20
Ground 39 40 GPIO21

Figure 2.3 Pin map of 40-pin header for Raspberry Pi 3 B/B+

The NRM7292 EVB and Raspberry Pi board is connected as shown in the Figure 2.4.

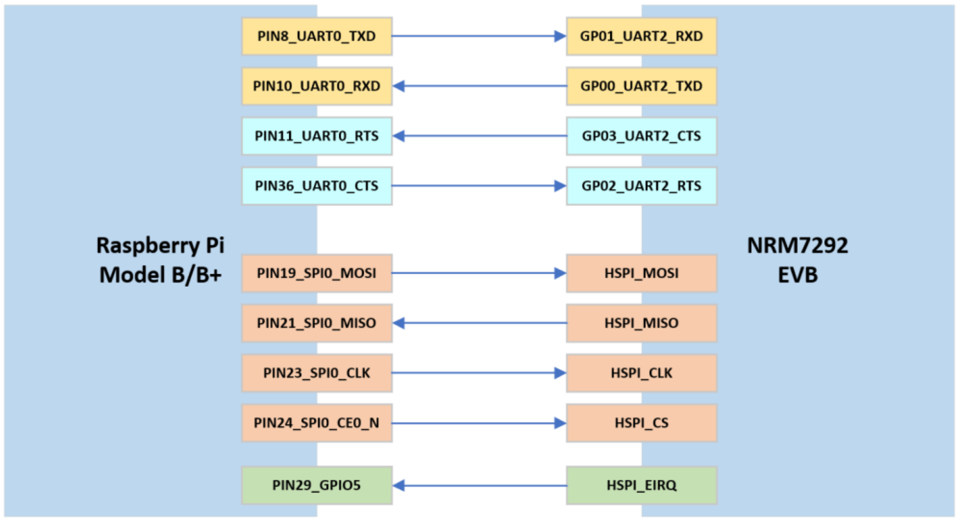
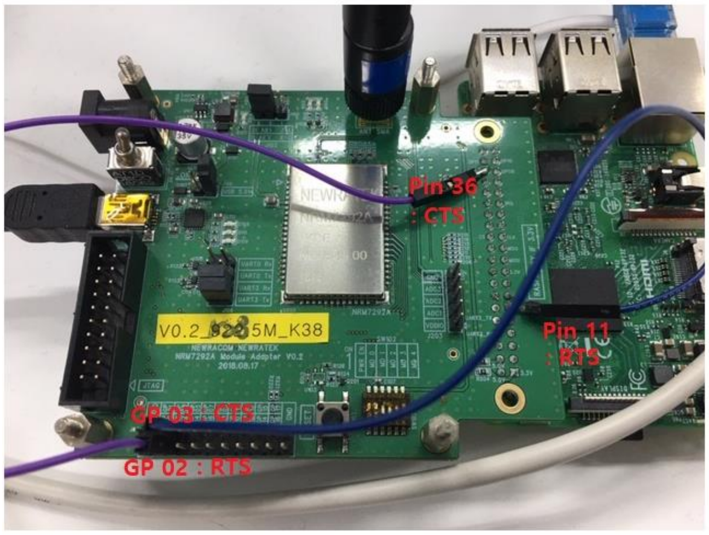

Raspberry Pi Model B/B+
NRM7292 EVB
PIN8_UART0_TXD → GP01_UART2_RXD
PIN10_UART0_RXD ← GP00_UART2_TXD
PIN11_UART0_RTS ← GP03_UART2_CTS
PIN36_UART0_CTS → GP02_UART2_RTS
PIN19_SPI0_MOSI → HSPI_MOSI
PIN21_SPI0_MISO ← HSPI_MISO
PIN23_SPI0_CLK → HSPI_CLK
PIN24_SPI0_CE0_N → HSPI_CS
PIN29_GPIO5 ← HSPI_EIRQ

Figure 2.4 Connection between NRM7292 EVB and Raspberry Pi

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 v0.2 by a jumper wire.



The NRM7292 EVB v0.5 can use the hardware flow control on the UART without a jumper wire.

NOTE:

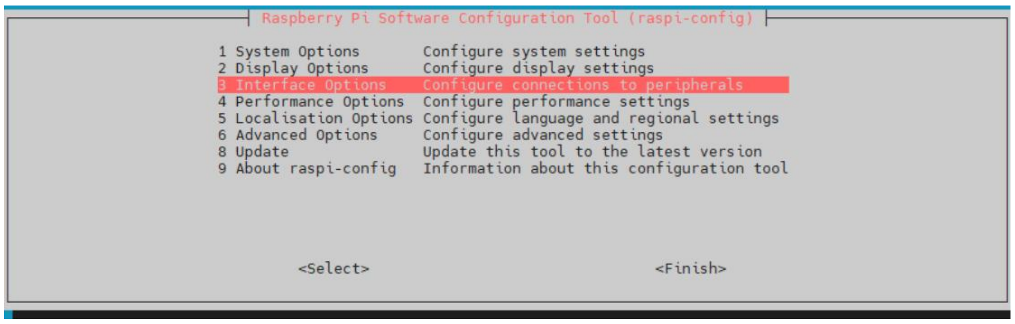
If the host is connected with a 20-pin header, detach the Raspberry Pi board from the EVB first before proceeding. The EVB must be used as a standalone for stable AT communication.

2.1.1 UART

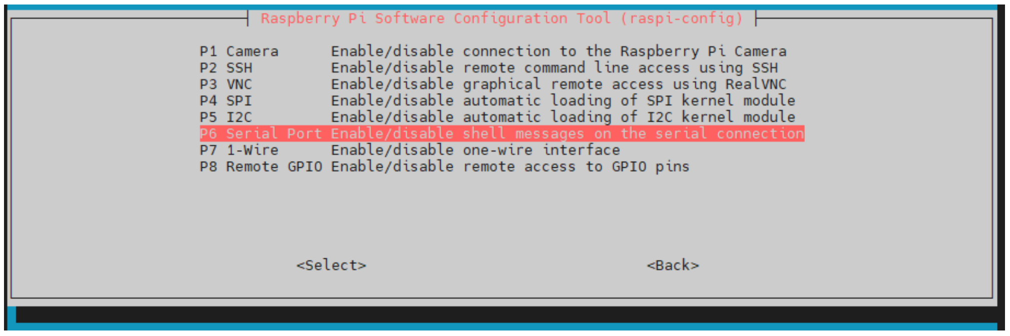
The NRC7292 AT command firmware uses UART channel 2. RTS/CTS is optional and is required to use baudrate greater than 115,200 bps.

To perform AT command communication through UART on Raspberry Pi, Serial Port must be enabled in the Raspberry Pi configuration tool.

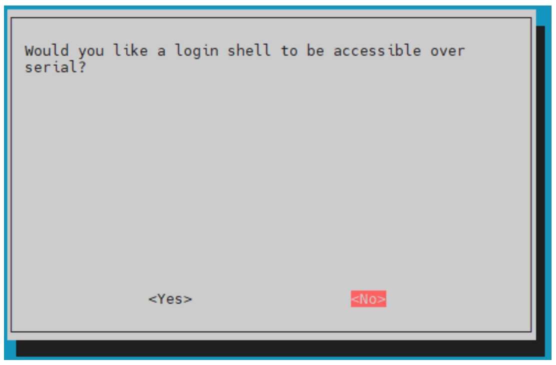
```
# sudo raspi-config
```



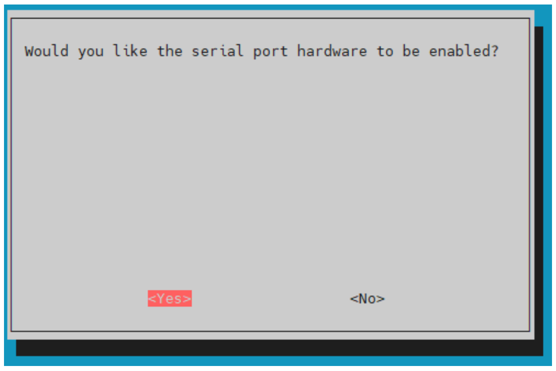
```
Raspberry Pi Software Configuration Tool (raspi-config)

1 System Options       Configure system settings
2 Display Options      Configure display settings
3 Interface Options    Configure connections to peripherals
4 Performance Options  Configure performance settings
5 Localisation Options Configure language and regional settings
6 Advanced Options     Configure advanced settings
8 Update               Update this tool to the latest version
9 About raspi-config   Information about this configuration tool

         <Select>                         <Finish>
```



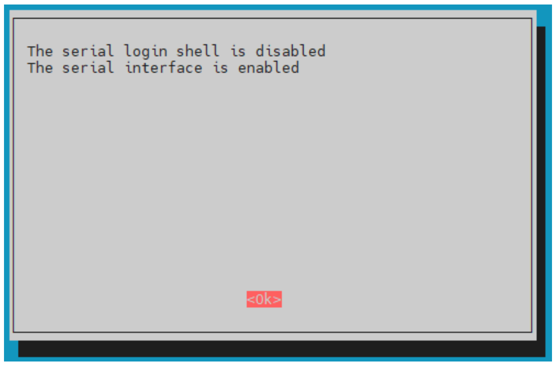
```
Raspberry Pi Software Configuration Tool (raspi-config)

P1 Camera      Enable/disable connection to the Raspberry Pi Camera
P2 SSH         Enable/disable remote command line access using SSH
P3 VNC         Enable/disable graphical remote access using RealVNC
P4 SPI         Enable/disable automatic loading of SPI kernel module
P5 I2C         Enable/disable automatic loading of I2C kernel module
P6 Serial Port Enable/disable shell messages on the serial connection
P7 1-Wire      Enable/disable one-wire interface
P8 Remote GPIO Enable/disable remote access to GPIO pins

           <Select>                        <Back>
```



```
Would you like a login shell to be accessible over
serial?

              <Yes>                   <No>
```



```
Would you like the serial port hardware to be enabled?

            <Yes>                    <No>
```



```
The serial login shell is disabled
The serial interface is enabled

                    <Ok>
```

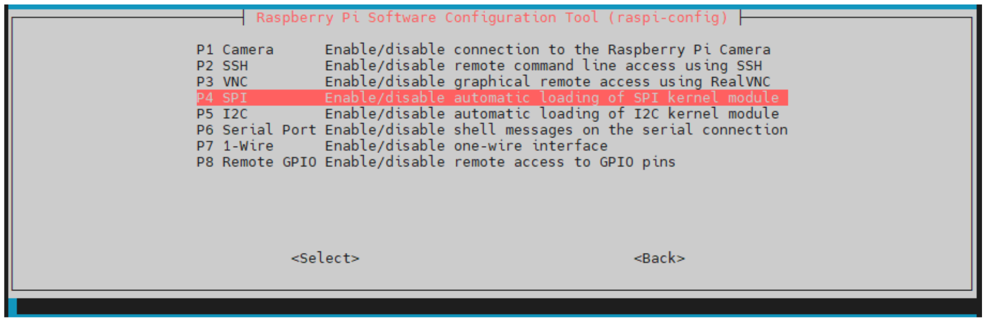
2.1.2 HSPI

The NRC7292 has a dedicated SPI slave controller for high speed. HSPI_EIRQ is optional.

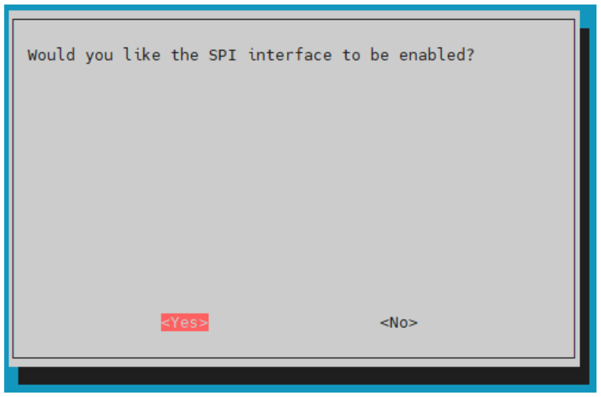
To perform AT command communication through SPI on Raspberry Pi, spidev (User mode SPI device driver) must be enabled.

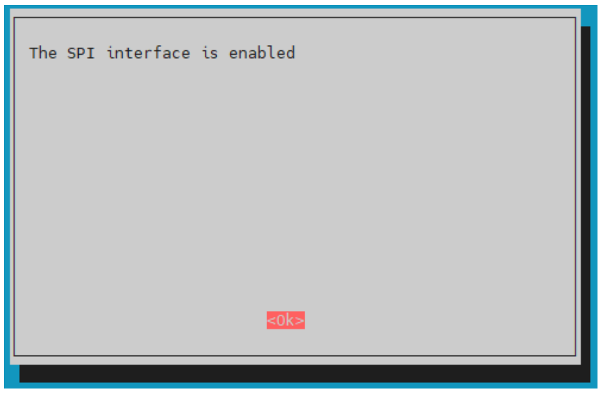
First, SPI interface must be enabled in the Raspberry Pi configuration tool.

```
# sudo raspi-config
```

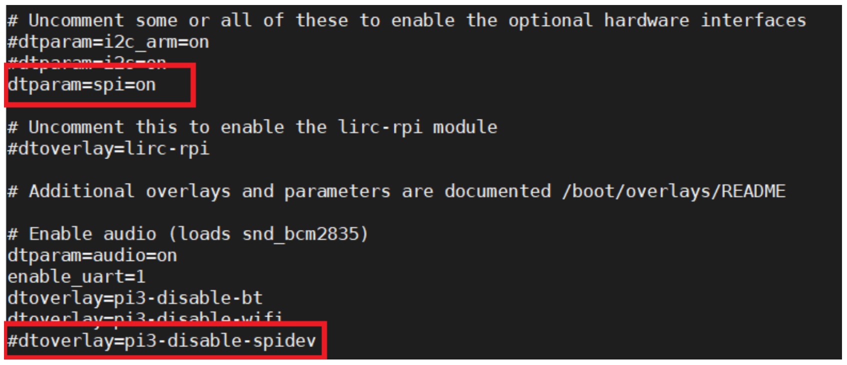


```
Raspberry Pi Software Configuration Tool (raspi-config)

P1 Camera      Enable/disable connection to the Raspberry Pi Camera
P2 SSH         Enable/disable remote command line access using SSH
P3 VNC         Enable/disable graphical remote access using RealVNC
P4 SPI         Enable/disable automatic loading of SPI kernel module
P5 I2C         Enable/disable automatic loading of I2C kernel module
P6 Serial Port Enable/disable shell messages on the serial connection
P7 1-Wire      Enable/disable one-wire interface
P8 Remote GPIO Enable/disable remote access to GPIO pins

            <Select>                        <Back>
```

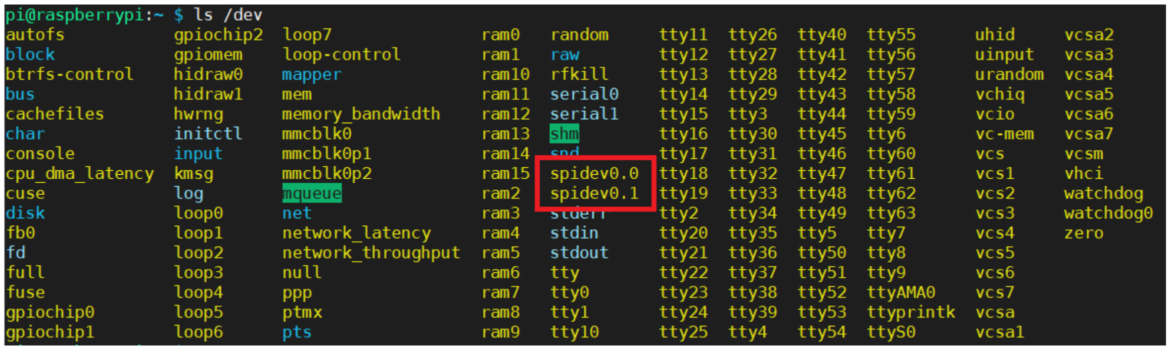

Would you like the SPI interface to be enabled?


The SPI interface is enabled

If spidev0.0 and spidev0.1 are not created under /dev directory, open and check the /boot/config.txt.


```
# 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
```

After rebooting the Raspberry Pi, 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  snd         tty17  tty31  tty46  tty60      vcs      vcsm
cpu_dma_latency  kmsg       mmcblk0p2          ram15  spidev0.0   tty18  tty32  tty47  tty61      vcs1     vhci
cuse             log        mqueue             ram2   spidev0.1   tty19  tty33  tty48  tty62      vcs2     watchdog
disk             loop0      net                ram3   stderr      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  ttyS0      vcsa1
```

2.2 Software

Users need to download the firmware binary onto the flash on the NRC7292 module to enable AT-command communication via UART or SPI.

Refer to the user guide **UG-7292-004-Standalone SDK.pdf** for instructions on how to download the firmware binary. (3 How to download compiled binaries)

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>** OR **AT+<CMD>=<X1,X2,....>**	**Run with no argument.** OR **Set or run with the given arguments.**
GET	**AT+<CMD>?** OR **AT+<CMD>?=<X1,X2,…>**	**Query the current values with no argument.** 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 Command

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+FWUPDATE	Set the information required for firmware update.
AT+FWBINDL	Download the firmware binary data to RAM and write it to FLASH.
+BEVENT	Asynchronously raised event messages.

5.1 AT

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

5.2 ATE

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

5.3 ATZ

Command	ATZ
Response	
Description	Reset the hardware and restart the firmware.
Example	ATZ

5.4 AT+VER

Command	**GET** AT+VER?
Response	**GET** +VER: <SDK>,<ATCMD>

	OK
Parameters	**<SDK>** SDK version **<ATCMD>** AT Command Set version
Description	Fetch the version information of current firmware.
Example	AT+VER? +VER:"1.4.0","1.23.5" OK

5.5 AT+UART

Command	**SET** AT+UART=<baud_rate>,<HFC> **GET** AT+UART?
Response	**SET** OK **GET** +UART:<baud_rate>,<data_bits>,<stop_bits>,<parity>,<HFC> OK
Parameters	**<baud rate>** 9600, 19200, 38400, 57600, 115200*, 230400, 460800, 500000, 576000, 921600, 1000000, 1152000, 1500000, 2000000 **<data bits>** Always 8 (8-bit)* **<stop bits>** Always 1 (1-bit)* **<parity>** Always 0 (None)*

	<HFC> 0 : disable RTS/CTS* 1 : enable RTS/CTS
Description	Configure the baud rate and hardware flow control for the UART. NOTE : For higher baud rates, it is recommended to enable hardware flow control. When hardware flow control is disabled, the AT+SSEND command can only set synchronous send mode.
Example	AT+UART=115200,1 OK AT+UART? +UART:115200,8,1,0,1 OK

5.6 AT+GPIOCONF

Command	**SET** AT+GPIOCONF=<number>,<direction>,<pull-up> **GET** AT+GPIOCONF? AT+GPIOCONF?=<number>
Response	**SET** OK **GET** +GPIOCONF=<number>,<direction>,<pull-up> : OK
Parameters	**<number>** GPIO pin number. (8, 9, 10, 11, 12, 13, 14, 15, 16, 17) **<direction>** 0 : input 1 : output

	<pull-up> (input pin only) 0 : pull-down 1 : pull-up
Description	Configure the GPIO pin direction and pull-up option.
Example	AT+GPIOCONF? +GPIOCONF:8,1,0 +GPIOCONF:9,1,0 +GPIOCONF:10,1,0 +GPIOCONF:11,1,0 +GPIOCONF:12,1,0 +GPIOCONF:13,1,0 +GPIOCONF:14,1,0 +GPIOCONF:15,1,0 +GPIOCONF:16,1,0 +GPIOCONF:17,1,0 OK AT+GPIOCONF=10,0,1 OK AT+GPIOCONF?=10 +GPIOCONF:10,0,1 OK

5.7 AT+GPIOVAL

Command	**SET** AT+GPIOVAL=<number>,<level> **GET** AT+GPIOVAL? AT+GPIOVAL?=<number>
Response	**SET** OK **GET** +GPIOVAL:<number>,<level> OK

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

5.8 AT+FWUPDATE

Command	**RUN** AT+FWUPDATE **SET** AT+FWUPDATE=<length>[,<crc32>] **GET** AT+FWUPDATE?
Response	**RUN**

	OK **SET** OK **GET** +FWUPDATE:<length>,<crc32> OK
Parameters	**<length>** Total length of firmware binary data. **<crc32>** A 32-bit hexadecimal value, prefixed with '0x' and calculated using the CRC-32 algorithm to detect data corruption. To determine the CRC value of the 'newFW.bin' file, you can use the 'crc.py' script located in the 'package\standalone\atcmd\host\python-http-server\python' directory. Simply run the command 'python crc.py newFW.bin' and add the '0x' prefix to the result. (ex) python crc.py newFW.bin 97cb8611
Description	Set the information required for firmware update. The SET command sets the data length and CRC value before downloading the firmware binary data with the AT+FWBINDL command. The AT+FWUPDATE=0 command resets previous settings to 0. The RUN command is required after completing the download with the AT+FWBINDL command and before resetting the system. A system reset can be performed with the ATZ command. Replacing the old firmware with a new one is performed by the bootloader after a system reset.
Example	AT+FWUPDATE=0 OK AT+FWUPDATE=915320,0xDAE06D27 OK AT+FWUPDATE? +FWUPDATE: 915320,0xDAE06D27 OK

	!!! Download the firmware binary data with the AT+FWBINDL SET command !!! AT+FWUPDATE OK ATZ

5.9 AT+FWBINDL

Command	**SET** AT+FWBINDL=<offset>,<length> **GET** AT+FWBINDL?
Response	**SET** OK **GET** +FWBINDL:<total_length>,<done_length> OK
Parameters	**<offset>** Zero-based offset of the data to download. **<length>** Length of data to download. **<total_length>** Total length of firmware binary data. **<done_length>** The data length written to flash memory after downloading.
Description	Download the firmware binary data to RAM and write it to FLASH. Firmware binary data can be downloaded with multiple SET commands. After receiving the OK message for the SET command, data can be downloaded up to 4KB at a time. If no data is downloaded for 1 second, the FWBINDL_IDLE event is raised. At this time, the download can be canceled with the "AT\r\n" command without downloading the remaining data.

	+BEVENT:"FWBINDL_IDLE",<offset>,<length>,<count> When a download is cancelled, the FWBINDL_DROP event is raised. However, the data downloaded with the previous SET command remains, so canceled data can be downloaded again. +BEVENT:"FWBINDL_DROP", <offset>,<length> If data is downloaded without cancellation, the FWBINDL_DONE event is raised. After the FWBINDL_DONE event, the next data can continue to be downloaded with the SET command. +BEVENT:"FWBINDL_DONE", <offset>,<length>
Example	AT+FWUPDATE=915320,0xDAE06D27 OK AT+FWBINDL? +FWBINDL:915320,0 OK AT+FWBINDL=0,4096 OK < data > +BEVENT:"FWBINDL_DONE",0,4096 AT+FWBINDL=4096,4096 OK < data > +BEVENT:"FWBINDL_DONE",4096,4096 AT+FWBINDL=8192,4096 OK < data > +BEVENT:"FWBINDL_DONE",8192,4096 : : AT+FWBINDL=909312,4096 OK < data > +BEVENT:"FWBINDL_DONE",909312,4096 AT+FWBINDL=913408,1912 OK

	< data > +BEVENT:"FWBINDL_DONE",913408,1912 AT+FWBINDL? +FWBINDL:915320,915320 OK

5.10 +BEVENT

Response	+BEVENT:<event>[,<parameter 1>,…,<parameter N>]
Parameters	**<event>** ”FWBINDL_IDLE”,<offset>,<length>,<count> ”FWBINDL_DROP”, <offset>,<length> ”FWBINDL_DONE”, <offset>,<length>
Description	Asynchronously raised event messages.
Example	+BEVENT:"FWBINDL_IDLE",102400,4096,1024 +BEVENT:"FWBINDL_DROP",102400,4096 +BEVENT:"FWBINDL_DONE",909312,4096

6 Wi-Fi AT Commands

Commands	Description
AT+WMACADDR	Read the MAC address.
AT+WCOUNTRY	Configure the Wi-Fi country code
AT+WTXPOWER	Set 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	Set the MCS index.
AT+WDUTYCYCLE	Configure duty cycle operation.
AT+WCCATHRESHOLD	Set CCA threshold.
AT+WTXTIME	Set carrier sense time and pause time.
AT+WTSF	Read the elapsed TSF timer duration.
AT+WBI	Get the beacon interval of the connected AP in STA mode.
AT+WLI	Set the listen interval in STA mode.
AT+WSCAN	Perform Wi-Fi scanning.
AT+WSCANSSID	Perform Wi-Fi scanning with probe request frames that specify full SSID.
AT+WCONN	Connect to a new AP.
AT+WDISCONN	Disconnect from the AP or abort an on-going connection process.
AT+WSOFTAP	Run as the AP mode.
AT+WSOFTAPSSID	Set how to specify the SSID in the beacon frame.
AT+WBSSMAXIDLE	Configure the BSS Max idle service for SoftAP.
AT+WSTAINFO	Get information of associated STAs on AP mode.
AT+WMAXSTA	Set the maximum number of STAs allowed in AP mode.
AT+WIPADDR	Configure the IPv4 address.
AT+WDNS	Configure the IP address for the DNS server.
AT+WDHCP	Request dynamic IP allocation from the DHCP server.

AT+WDHCPS	Run the DHCP sever in SoftAP mode.
AT+WPING	Send ICMP ECHO_REQUEST to network hosts with IPv4 address.
AT+WDEEPSLEEP	Configure deep-sleep mode to save power.
AT+WFOTA	Enable or disable Firmware Over-the-Air (FOTA).
AT+WCTX	Send dummy data frames for continuous TX without connecting to AP.
AT+WTIMEOUT	Configure the response timeout for the specified command.
+WEVENT	Asynchronously raised Wi-Fi event messages.

6.1 AT+WMACADDR

Command	**GET** AT+WMACADDR?
Response	**GET** +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+WCOUNTRY

Command	**SET** AT+WCOUNTRY="<country code>" **GET** AT+WCOUNTRY?
Response	**SET** OK **GET** +WCOUNTRY="<country code>" OK
Parameters	**<country code>** - AU : Australia - CN : China - EU : Europe - JP : Japan - NZ : New Zealand - TW : Taiwan - US : United States - K1 : Korea USN - K2 : Korea MIC
Description	Configure the Wi-Fi country code.

	NOTE: The country code may need to be set after booting.
Example	AT+ WCOUNTRY =”US” OK AT+WCOUNTRY? +WCOUNTRY:”US” OK

6.3 AT+WTXPOWER

Command	**SET** AT+WTXPOWER=<txpower> **GET** AT+WTXPOWER?
Response	**SET** OK **GET** +WTXPOWER:<txpower>
Parameters	**<tx power>** Transmission Power Level (unit : dBm) - 0 : AUTO mode - 1 .. 30 : FIXED mode
Description	Set or get the transmission power level. Default mode is AUTO. In AUTO mode, TX power is set automatically according to MCS. And the value obtained by GET command is the TX power in the last transmission. NOTE: Depending on the country and channel frequency, the maximum allowed TX power may be limited to less than 30 dBm.
Example	AT+WTXPOWER? +WTXPOWER:16 <--- TX power for the last transmission. OK

	< FIXED mode > AT+WTXPOWER=10 OK AT+WTXPOWER? +WTXPOWER:10 OK **< AUTO mode >** AT+WTXPOWER=0 OK AT+WTXPOWER? +WTXPOWER:10 <--- TX power for the last transmission. OK

6.4 AT+WRXSIG

Command	**SET** AT+WRXSIG =<time> **GET** AT+WRXSIG?
Response	**SET** +WRXSIG:<RSSI>,<SNR> … +WRXSIG:<RSSI>,<SNR> OK **GET** +WRXSIG:<RSSI>,<SNR> OK
Parameters	**<time>** Monitoring duration in seconds.
Description	Fetch or monitor the RSSI (dBm) and SNR (dB) values.
Example	AT+WRXSIG? +WRXSIG:-68,31 OK AT+WRXSIG=10

	+WRXSIG:-68,31 +WRXSIG:-68,30 +WRXSIG:-68,32 +WRXSIG:-68,32 +WRXSIG:-68,32 +WRXSIG:-68,32 +WRXSIG:-68,30 +WRXSIG:-68,31 +WRXSIG:-68,32 +WRXSIG:-68,32 OK

6.5 AT+WRATECTRL

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

	OK

6.6 AT+WMCS

Command	**SET** AT+WMCS=<index> **GET** AT+WMCS?
Response	**SET** OK **GET** +WMCS=<index> OK
Parameters	**<index>** Modulation Coding Scheme index (0, 1, 2, 3, 4, 5, 6, 7 and 10)
Description	Set or get the MCS index. NOTE: The MCS index can only be set when rate control is disabled.
Example	AT+WRATECTRL? +WRATECTRL:1 OK AT+WMCS? +WMCS:7 <--- MCS index for the last transmission. OK AT+WMCS=0 ERROR AT+WRATECTRL=0 OK AT+WRATECTRL? +WRATECTRL:0 OK AT+WMCS?

	+WMCS:7 OK AT+WMCS=0 OK AT+WMCS? +WMCS:0 OK

6.7 AT+WDUTYCYCLE

Command	**SET** AT+WDUTYCYCLE=<window>[,<duration>[,<margin>]] **GET** AT+WDUTYCYCLE?
Response	**SET** OK **GET** +WDUTYCYCLE=<window>,<duration>,<margin> OK
Parameters	**<window>** Duty cycle window in microseconds **<duration>** TX duration in microseconds allowed within duty cycle window **<margin>** Duty margin in microseconds
Description	Configure duty cycle operation.
Example	AT+WDUTYCYCLE? +WDUTYCYCLE:0,0,0 OK AT+WDUTYCYCLE=1000000,100000 AT+WDUTYCYCLE? +WDUTYCYCLE:1000000,100000,0

	OK AT+WDUTYCYCLE=0 OK AT+WDUTYCYCLE? +WDUTYCYCLE:0,0,0 OK

6.8 AT+WCCATHRESHOLD

Command	**SET** AT+WCCATHRESHOLD=<threshold> **GET** AT+WCCATHRESHOLD?
Response	**SET** OK **GET** +WCCATHRESHOLD=<threshold> OK
Parameters	**<threshold>** CCA threshold.(unit: dBm) (-100 ~ -35)
Description	Set CCA threshold.
Example	AT+WCCATHRESHOLD? +WCCATHRESHOLD:-75 OK AT+WCCATHRESHOLD=-80 OK AT+WCCATHRESHOLD? +WCCATHRESHOLD:-80 OK

6.9 AT+WTXTIME

Command	**SET** AT+WTXTIME=<cs_time>,<pause_time> **GET** AT+WTXTIME?
Response	**SET** OK **GET** +WTXTIME:<cs_time>,<pause_time> OK
Parameters	**<cs_time>** Carrier sensing time in microseconds (0 ~ 13260) **<pause_time>** Tx pause time in microseconds
Description	Set carrier sense time and pause time for Listen Before Talk.
Example	AT+WTXTIME? +WTXTIME:0,0 OK AT+WTXTIME=128,2000 OK AT+WTXTIME? +WTXTIME:128,2000 OK

6.10 AT+WTSF

Command	**GET** AT+WTSF?
Response	**GET** +WTSF:<time> OK
Parameters	**<time>**

	Elapsed TSF timer duration in microseconds.
Description	Read the elapsed TSF timer duration.
Example	AT+WTSF? +WTSF:44142384 OK

6.11 AT+WBI

Command	**GET** AT+WBI?
Response	**GET** +WBI:<beacon_interval> OK
Parameters	**<beacon_interval>** Beacon interval expressed in Time Unit (TU) *1TU = 1024us
Description	Get the beacon interval of the connected AP in STA mode. The beacon Interval indicates the time between beacon frames transmitted by an AP. Since it is expressed in TU, the beacon interval time is calculated as follows. Beacon Interval Time (us) = <beacon_interval> x 1024 NOTE: If there is no connected AP, an ERROR message is returned.
Example	AT+WBI? ERROR AT+WCONN="halow_atcmd_open" OK AT+WBI? +WBI:100 OK

6.12 AT+WLI

Command	**SET** AT+WLI=<listen_interval> **GET** AT+WLI?
Response	**SET** OK **GET** +WLI:<listen_interval> OK
Parameters	**<listen_interval>** Listen interval expressed in Beacon Interval (BI)
Description	Set the listen interval in STA mode. The listen interval indicates how often the STA will wake to hear a beacon that includes a Traffic Indication Map (TIM) information element. Since it is expressed in BI, the listen interval time is calculated as follows. Listen Interval Time (us) = <listen_interval> x Beacon Interval Time = <listen_interval> x <beacon_interval> x 1024 If BSS MAX IDLE service is enabled in AP, the listen interval time should be less than BSS MAX IDLE time to avoid association-reject. NOTE: The listen interval can only be set before the AT+WCONN command. While connected to the AP, the SET command returns an ERROR message.
Example	AT+WLI? +WLI:0 OK AT+WLI=1000 OK AT+WLI?

	+WLI:1000 OK AT+WCONN="halow_atcmd_open" OK AT+WLI? +WLI:1000 OK AT+WLI=100 ERROR

6.13 AT+WSCAN

Command	**RUN** AT+WSCAN **SET** AT+WSCAN=[{+|-}]<freq>[@<bandwidth>][,<freq>[@<bandwidth>] ...] **GET** AT+WSCAN?
Response	**RUN** +WSCAN:<bssid>,<freq>,<sig_level>,<flags>,<ssid> : OK **SET** OK **GET** +WSCAN:<bandwidth>,<freq>[,<freq> ...] : OK
Parameters	**<bssid>** The BSSID of the AP. **<freq>** The center frequency of the channel. (MHz)

	<bandwidth> The bandwidth of the channel. (1/2/4 MHz) **<sig_level>** The RSSI (Received Signal Strength Indicator) in dBm. **<flags>** Service set flags. **<ssid>** The SSID of the AP.
Description	**<u>RUN</u>** Perform Wi-Fi scanning. **<u>SET/GET</u>** Set the frequencies of the channel to scan or get a list of them. In the SET command, if the first frequency value has a ‘+’ or ‘-‘ prefix, a new frequency is added or a specific frequency is excluded. “AT+WSCAN=0” command resets the scan frequency list to scan all supported channels. NOTE: The SET command cannot be used while connected to the AP and responds with ERROR. After “AT+WCOUNTRY” and “AT+WDISCONN” commands, the scan frequency list is reset to scan all supported channels.
Example	AT+WCOUNTRY=”US” OK AT+WSCAN? +WSCAN:1,902.5,903.5,904.5,905.5,906.5,907.5,908.5,909.5,910.5,911.5 +WSCAN:1,912.5,913.5,914.5,915.5,916.5,917.5,918.5,919.5,920.5,921.5 +WSCAN:1,922.5,923.5,924.5,925.5,926.5,927.5 +WSCAN:2,903.0,905.0,907.0,909.0,911.0,913.0,915.0,917.0,919.0,921.0 +WSCAN:2,923.0,925.0,927.0

```
+WSCAN:4,906.0,910.0,914.0,918.0,922.0,926.0
OK

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"
+WSCAN:"8c:0f:fa:00:28:1f",906.0,-54,"[WPA3-SAE-CCMP][ESS]","halow_sae"
+WSCAN:"8c:0f:fa:00:29:46",921.0,-75,"[WPA3-SAE-CCMP][ESS]","halow_sae2"
OK

AT+WSCAN=922.5
OK
AT+WSCAN?
+WSCAN:1,922.5
OK
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

AT+WSCAN=+906,921
OK
AT+WSCAN?
+WSCAN:1922.5
+WSCAN:2,921.0
+WSCAN:4,906.0
OK
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"
+WSCAN:"8c:0f:fa:00:28:1f",906.0,-54,"[WPA3-SAE-CCMP][ESS]","halow_sae"
+WSCAN:"8c:0f:fa:00:29:46",921.0,-75,"[WPA3-SAE-CCMP][ESS]","halow_sae2"
OK

AT+WSCAN=-921,922.5
OK
AT+WSCAN?
```

	+WSCAN:4,906.0 OK AT+WSCAN +WSCAN:"8c:0f:fa:00:28:1f",906.0,-54,"[WPA3-SAE-CCMP][ESS]","halow_sae" OK AT+WSCAN=0 OK AT+WSCAN? +WSCAN:1,902.5,903.5,904.5,905.5,906.5,907.5,908.5,909.5,910.5,911.5 +WSCAN:1,912.5,913.5,914.5,915.5,916.5,917.5,918.5,919.5,920.5,921.5 +WSCAN:1,922.5,923.5,924.5,925.5,926.5,927.5 +WSCAN:2,903.0,905.0,907.0,909.0,911.0,913.0,915.0,917.0,919.0,921.0 +WSCAN:2,923.0,925.0,927.0 +WSCAN:4,906.0,910.0,914.0,918.0,922.0,926.0 OK AT+WSCAN=922.5 OK 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 AT+WCONN=”halow_open” OK AT+WSCAN? +WSCAN=1,922.5 OK AT+WSCAN=+906,921 ERROR AT+WDISCONN OK AT+WSCAN? +WSCAN:1,902.5,903.5,904.5,905.5,906.5,907.5,908.5,909.5,910.5,911.5 +WSCAN:1,912.5,913.5,914.5,915.5,916.5,917.5,918.5,919.5,920.5,921.5 +WSCAN:1,922.5,923.5,924.5,925.5,926.5,927.5

```
+WSCAN:2,903.0,905.0,907.0,909.0,911.0,913.0,915.0,917.0,919.0,921.0
+WSCAN:2,923.0,925.0,927.0
+WSCAN:4,906.0,910.0,914.0,918.0,922.0,926.0
OK

------------------------------------------------------------------------------------------------------------

AT+WCOUNTRY="JP"
OK
AT+WSCAN?
+WSCAN:1,921.0,923.0,924.0,925.0,926.0,927.0
+WSCAN:2,923.5,924.5,925.5,926.5
+WSCAN:4,924.5,925.5
OK

AT+WSCAN=926,923,923.5,925.5
OK
AT+WSCAN?
+WSCAN:1,923.0,926.0
+WSCAN:2,923.5,925.5
OK

AT+WSCAN=926,923,926.5,925.5@2,925.5@4,924.5@2
OK
AT+WSCAN?
+WSCAN:1,923.0,926.0
+WSCAN:2,924.5,925.5,926.5
+WSCAN:4,925.5
OK

AT+WSCAN=-926.5,925.5@2
OK
AT+WSCAN?
+WSCAN:1,923.0,926.0
+WSCAN:2,924.5
+WSCAN:4,925.5
OK
```

	AT+WSCAN=+924.5@4,925 OK AT+WSCAN? +WSCAN:1,923.0,925.0,926.0 +WSCAN:2,924.5 +WSCAN:4,924.5,925.5 OK

6.14 AT+WSCANSSID

Command	**SET** AT+WSCANSSID=”<ssid>”
Response	**SET** +WSCANSSID:”<bssid>”,<freq>,<sig_level>,”<flags>”,”<ssid>” OK
Parameters	**<ssid>** The SSID of the AP
Description	Perform Wi-Fi scanning with probe request frame that specify full SSID.
Example	AT+WSCANSSID="halow_atcmd_open" +WSCANSSID:"8c:0f:fa:00:28:16",902.5,-74,"[ESS]","halow_atcmd_open" OK AT+WSCANSSID="halow_atcmd_sae" +WSCANSSID:"8c:0f:fa:00:28:16",906.0,-71,"[WPA3-SAE-CCMP][ESS]","halow_atcmd_sae" OK

6.15 AT+WCONN

Command	**SET** AT+WCONN=”<ssid|bssid>”[,”<security>”[,”<password>”]] **GET** AT+WCONN?
Response	**SET** OK **GET**

	+WCONN=”<ssid>”,”<bssid>”,”<security>”,”<password>”,”<state>” OK
Parameters	**<ssid>** The SSID of the AP. **<bssid>** The BSSID of the AP. **<security>** open*, wpa2-psk (or psk), wpa3-owe (or owe), wpa3-sae (or sae) **<password> (wpa2/wpa3-sae security option only)** The password when wpa2/wpa3-sae security option is used. (length : 8 ~ 63) **<state>** State indicator: “connecting”, “connected”, “disconnecting” or ”disconnected”
Description	Connect to a new AP or retrieves information about the current AP. NOTE: 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”.
Example	**OPEN :** AT+WSCAN +WSCAN:"8c:0f:fa:00:2b:a1",922.0,-13,"[ESS]","halow_ap” OK AT+WCONN="halow_ap” OK AT+WCONN? +WCONN:”halow_ap”,”8C:0F:FA:00:2B:A1”,”open”,””,”connected” OK **WPA2-PSK :** AT+WSCAN +WSCAN:"8c:0f:fa:00:2b:a1",922.0,-14,"[WPA2-PSK-CCMP][ESS]","halow_ap" OK AT+WCONN="halow_ap","wpa2-psk","12345678"

	OK AT+WCONN? +WCONN:”halow_ap”,”8C:0F:FA:00:2B:A1”,”wpa2-psk”,”12345678”,”connected” OK **WPA3-OWE :** AT+WSCAN +WSCAN:"8c:0f:fa:00:2b:a1",922.0,-13,"[WPA2-OWE-CCMP][ESS]","halow_ap” OK AT+WCONN="halow_ap”,"wpa3-owe" OK AT+WCONN? +WCONN:”halow_ap”,”8C:0F:FA:00:2B:A1”,”wpa3-owe”,””,”connected” OK **WPA3-SAE :** AT+WSCAN +WSCAN:"8c:0f:fa:00:2b:a1",922.0,-14,"[WPA2-SAE-CCMP][ESS]","halow_ap" OK AT+WCONN="halow_ap","wpa3-sae","12345678" OK AT+WCONN? +WCONN:”halow_ap”,”8C:0F:FA:00:2B:A1”,”wpa3-sae”,”12345678”,”connected” OK

6.16 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

6.17 AT+WSOFTAP

Command	**SET** AT+WSOFTAP=<frequency>[@<bandwidth>],”<ssid>”[,”<security>”[,”<password>”]] **GET** AT+WSOFTAP?
Response	**SET** OK **GET** +WSOFTAP=<frequency>[@<bandwidth>],”<ssid>”,”<security>”,”<password>”[,”dhcp”] OK
Parameters	**<frequency>** S1G channel frequency (MHz) **<bandwidth>** S1G channel bandwidth (1/2/4 MHz) **<ssid>** The SSID of the AP. **<security>** open*, wpa2-psk (or psk) **<password> (wpa2 security option only)** The password when wpa2 security option is used. (length : 8 ~ 63) **<dhcp>** Only included when the DHCP server is running.
Description	Run as the AP mode or retrieves information about the current settings. NOTE: The system should be reset to exit the AP mode. Software Reset is possible with the ATZ command.
Example	AT+WCOUNTRY=”JP” OK AT+WSCAN? +WSCAN:923.5,924.5,925.5,926.5,921.0,923.0,924.0,925.0,926.0,927.0

	+WSCAN:924.5,925.5 OK AT+WSOFTAP=925.5@4,"halow_softap_psk","psk","12345678" OK AT+WSOFTAP? +WSOFTAP:4,925.5,"halow_softap_psk","wpa2-psk","12345678" OK AT+WDHCPS +WDHCPS:192.168.200.27,255.255.255.0,192.168.200.1 OK AT+WSOFTAP? +WSOFTAP:4,925.5,"halow_softap_psk","wpa2-psk","12345678","dhcp" OK

6.18 AT+WSOFTAPSSID

Command	**SET** AT+WSOFTAPSSID=<type> **GET** AT+WSOFTAPSSID?
Response	**SET** OK **GET** +WSOFTAPSSID:<type> OK
Parameters	**<type>** 0 : Full SSID* 1 : Empty SSID (length=0) 2 : Clear SSID
Description	Set how to specify the SSID in the beacon frame. Empty SSID or Clear SSID is used to hide the SSID on the network. NOTE: Set the SSID type before starting the AP with the AT+WSOFTAP command.

Example	AT+WSOFTAPSSID? +WSOFTAPSSID:0 OK AT+WSOFTAPSSID=1 OK AT+WSOFTAPSSID? +WSOFTAPSSID:1 OK AT+WSOFTAP=925,"halow_atcmd_open" OK AT+WSOFTAPSSID? +WSOFTAPSSID:1 OK AT+WSOFTAPSSID=2 ERROR

6.19 AT+WBSSMAXIDLE

Command	**SET** AT+WBSSMAXIDLE=<period>[,<retry>] **GET** AT+WBSSMAXIDLE?
Response	**SET** OK **GET** +WBSSMAXIDLE:<period>,<retry> OK
Parameters	**<period>** BSS MAX IDLE period in 1000TU (1 ~ 65535, default: 0) *TU : Time Unit (1024 us) **<retry>** retry count for receiving keep alive packet from STA (3 ~ 100, default: 3)

Description	Configure the BSS MAX IDLE service for SoftAP. SoftAP disconnects STA that is inactive for BSS MAX IDLE time. If the AP does not receive a keep alive packet from the STA for BSS MAX IDLE time, it is determined that the STA is in an inactive state. The listen interval time should be less than BSS MAX IDLE time to avoid association-reject. Example: - period = 1800 TU, retry count = 5 - BSS MAX IDLE time = 1800 x (1000 x 1024) = 1843.2 secs - Total BSS MAX IDLE time = 5 x 1843.2 = 9216 secs If the period is set 0, the service is disabled.
Example	AT+WBSSMAXIDLE? +WBSSMAXIDLE:0,3 OK AT+WBSSMAXIDLE=1800 OK AT+WBSSMAXIDLE? +WBSSMAXIDLE:1800,3 OK AT+WSOFTAP=918.5,"halow_softap_wpa2","wpa2-psk","12345678" OK AT+WDHCPS +WDHCPS:"192.168.50.1","255.255.255.0","192.168.50.1" OK AT+WBSSMAXIDLE=1800,5 OK AT+WBSSMAXIDLE? +WBSSMAXIDLE:1800,5 OK AT+WBSSMAXIDLE=0

	OK AT+WBSSMAXIDLE? +WBSSMAXIDLE:0,3 OK

6.20 AT+WSTAINFO

Command	**SET** AT+WSTAINFO=<aid> **GET** AT+WSTAINFO?
Response	+WSTAINFO=<aid>,"<mac_address>",<rssi>,<snr>,<mcs_index> OK
Parameters	**<aid>** Association ID **<mac_address>** Hardware address of associated station **<rssi>** Received Signal Strength indication **<snr>** Signal to Noise Ratio **<mcs_index>** Modulation Coding Scheme index
Description	Get information of associated STAs when the device is in AP mode.
Example	AT+WSOFTAP=918.5,"halow_softap","wpa2-psk","12345678" OK AT+WIPADDR="192.168.1.1","255.255.255.0","192.168.1.1" OK AT+WDHCPS +WDHCPS:"192.168.1.1","255.255.255.0","192.168.1.1" OK Wait for one or more stations to be associated … AT+WSTAINFO?

	+WSTAINFO:1,"8c:0f:fa:00:2b:a1",-34,31,7 +WSTAINFO:2,"8c:0f:fa:00:2b:a2",-45,34,7 +WSTAINFO:3,"8c:0f:fa:00:2b:a3",-16,21,7 OK AT+WSTAINFO=1 +WSTAINFO:1,"8c:0f:fa:00:2b:a1",-33,34,7 OK

6.21 AT+WMAXSTA

Command	**SET** AT+WMAXSTA=<max_num_sta> **GET** AT+WMAXSTA?
Response	**SET** OK **GET** +WMAXSTA=<max_num_sta> OK
Parameters	**<max_num_sta>** maximum number of STAs
Description	Set the maximum number of STAs allowed in AP mode. NOTE: The maximum number of STAs must be set before starting AP mode with the AT+WSOFTAP SET command.
Example	AT+WMAXSTA? +WMAXSTA:10 OK AT+WMAXSTA=1 OK AT+WSOFTAP=925,"halow_softap_psk","psk","12345678" OK AT+WMAXSTA? +WMAXSTA:1

	OK

6.22 AT+WIPADDR

Command	**SET** AT+WIPADDR=”<address>”,”<netmask>”,”<gateway>” **GET** AT+WIPADDR?
Response	**SET** OK **GET** +WIPADDR=”<address>”,”<netmask>”,”<gateway>” OK
Parameters	**<address>,<netmask>,<gateway>** IPv4 address
Description	Configure the IPv4 address.
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

6.23 AT+WDNS

Command	**SET** AT+WDNS=”<DNS1>”[,”<DNS2>”] **GET** AT+WDNS?
Response	**SET** OK **GET** +WDNS=”<DNS1>”,”<DNS2>” OK
Parameters	**<DNS1>,<DNS2>** IPv4 address

Description	Configure the IP address of the DNS server.
Example	AT+WDNS? +WDNS=”192.168.200.1”,”0.0.0.0” OK AT+WDNS=”8.8.8.8” OK AT+WDNS? +WDNS=”8.8.8.8”,”0.0.0.0” OK AT+WDNS=”8.8.8.8”,”8.8.4.4” OK AT+WDNS? +WDNS=”8.8.8.8”,”8.8.4.4” OK

6.24 AT+WDHCP

Command	**RUN** AT+WDHCP **SET** AT+WDHCP=<mode> **GET** AT+WDHCP?
Response	**RUN** +WDHCP:”<address>”,”<netmask>”,”<gateway>” OK **SET** OK **GET** +WDHCP:{0|1} OK
Parameters	**<address>, <netmask>** and **<gateway>** IPv4 Address

	<mode> 0 : run manually after connection 1 : run automatically connection or reconnection
Description	Request dynamic IP allocation from the DHCP server. NOTE: Wi-Fi connection must be established before using this command.
Example	AT+WCONN="halow_ap","wpa3-sae","12345678" OK AT+WDHCP +WDHCP:”192.168.200.20”,”255.255.255.0”,”192.168.200.1” OK AT+WDISCONN OK AT+WDHCP? +WDHCP:0 OK AT+WDHCP=1 OK AT+WCONN="halow_ap","wpa3-sae","12345678" OK +WEVENT:"DHCP_RUN" +WEVENT:"DHCP_SUCCESS","192.168.200.18","255.255.255.0","192.168.200.1" +WEVENT:"DISCONNECT","","halow_ap","wpa3-sae" +WEVENT:"CONNECT_SUCCESS","","halow_ap","wpa3-sae" +WEVENT:"DHCP_RUN" +WEVENT:"DHCP_SUCCESS","192.168.200.18","255.255.255.0","192.168.200.1"

6.25 AT+WDHCPS

Command	**RUN** AT+WDHCPS
Response	**RUN** +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

6.26 AT+WPING

Command	**SET** AT+WPING="<remote address>"[,<time>] **GET** AT+WPING?
Response	**SET** +WPING:<size>,"<remote address>",<sequence number>,<TTL>,<elapsed time> : +WPING:<size>,"<remote address>",<sequence number>,<TTL>,<elapsed time> OK **GET** +WPING:"<remote address>",<time>
Parameters	**<remote address>** The remote IPv4 address of the recipient. **<time>** Monitoring duration in seconds. (Default: 5) **<sequence number>** ICMP sequence number. **<TTL>** Time to leave (TTL). **<elapsed time>** Time since the start of the session in seconds.

Description	Send ICMP ECHO_REQUEST to network hosts with IPv4 address. - Interval Time : 1 sec - Packet Size : 64-bytes
Example	AT+WPING =”192.168.200.1”,10 +WPING:64,”192.168.200.1”,1,64,4 +WPING:64,”192.168.200.1”,2,64,4 : +WPING:64,”192.168.200.1”,9,64,4 +WPING:64,”192.168.200.1”,10,64,4 OK

6.27 AT+WDEEPSLEEP

Command	**SET** AT+WDEEPSLEEP=<timeout>[,<gpio>]
Response	**SET** OK
Parameters	**<timeout>** Time in milliseconds. 0 for TIM mode. **<gpio>** GPIO number to use as external signal input. Available GPIO numbers are between 8 and 17.
Description	Configure deep-sleep mode to save power. Deep sleep mode powers off most peripherals to use minimal power. The RTC and retention RAM are always powered. The CPU is powered only in TIM mode to run the uCode stored in the retention RAM. And the GPIO may be powered for external signal input. In TIM mode, the NRC7292 wakes up when there are frames to receive. However, in Non-TIM mode, it cannot be woken up until a timeout. If there are frames to send, the NRC7292 can only be woken up via the GPIO input. The GPIO input level should be low in active mode. If it is high in deep sleep mode, the NRC7292 wakes up.

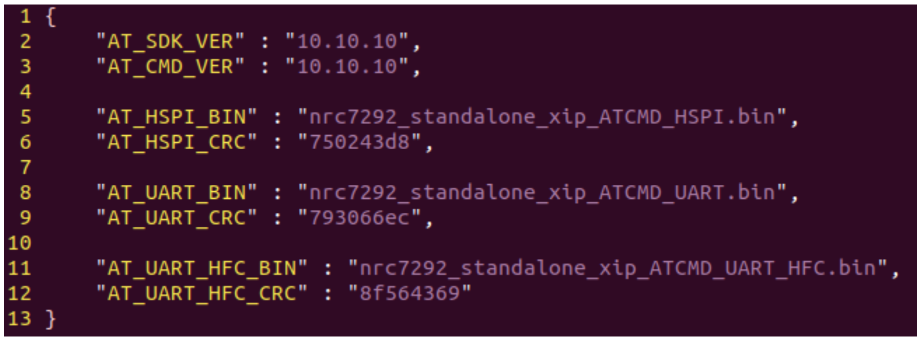
	After waking up, the CPU resets and the firmware reboots. When the firmware reboot is finished, the host application or terminal program will receive a "DEEPSLEEP_WAKEUP" event message.
Example	**< Deep Sleep, TIM mode >** AT+WCONN="halow_ap","wpa2-psk","12345678" OK AT+WDHCP +WDHCP:"192.168.200.18","255.255.255.0","192.168.200.1" OK AT+WDEEPSLEEP=0,11 OK +WEVENT:”DEEPSLEEP_WAKEUP” AT+WCONN="halow_ap","wpa2-psk","12345678" OK AT+WDHCP +WDHCP:"192.168.200.18","255.255.255.0","192.168.200.1" OK AT+WPING=”192.168.200.1”,2 +WEVENT:"PING",64,"192.168.200.1",1,64,5 +WEVENT:"PING",64,"192.168.200.1",2,64,4 OK **< Deep Sleep, Non-TIM mode >** AT+WCONN="halow_ap","wpa2-psk","12345678" OK AT+WDHCP +WDHCP:"192.168.200.18","255.255.255.0","192.168.200.1" OK AT+WDEEPSLEEP=5000,11 OK +WEVENT:”DEEPSLEEP_WAKEUP” AT+WCONN="halow_ap","wpa2-psk","12345678"

	OK AT+WDHCP +WDHCP:"192.168.200.18","255.255.255.0","192.168.200.1" OK AT+WPING="192.168.200.1",2 +WEVENT:"PING",64,"192.168.200.1",1,64,6 +WEVENT:"PING",64,"192.168.200.1",2,64,4 OK

6.28 AT+WFOTA

Command	**SET** AT+WFOTA=<check_time>[,\"<server_url>\"] AT+WFOTA=<check_time>[,\"<server_url>\",\"<bin_name>\",<bin_crc32>] **GET** AT+WFOTA? **RUN** AT+WFOTA
Response	**SET** OK **GET** +WFOTA:<check_time>,"<server_url>","<bin_name>",<bin_crc32> OK **RUN** OK
Parameters	**<check_time>** Interval time in seconds to get new firmware information from the server. Set to 0 to stop the getting or get manually. Set to -1 to disable FOTA operation. **<server_url>** HTTP or HTTPS Server URL **<bin_name>** Firmware binary name with extension .bin. **<bin_crc32>**

	A 32-bit hexadecimal value, prefixed with '0x' and calculated using the CRC-32 algorithm to detect data corruption.
	To determine the CRC value of the 'newFW.bin' file, you can use the 'crc.py' script located in the 'package\standalone\atcmd\host\python-http-server\python' directory. Simply run the command 'python crc.py newFW.bin' and add the '0x' prefix to the result.
	`(ex) python crc.py newFW.bin`
	`97cb8611`

Description	FOTA(Firmware Over-the-Air) is enabled with the SET command and disabled by AT+WFOTA=-1 command.
	When FOTA is enabled, the current firmware starts checking for new firmware on the server. The server check interval can be controlled through the <check_time> parameter.
	To check for new firmware, the current firmware downloads the fota.json file from the server. The server should have a fota.json file as well as firmware binary. The contents of the fota.json file are as follows.
	
	`{`
	`    "AT_SDK_VER" : "10.10.10",`
	`    "AT_CMD_VER" : "10.10.10",`
	
	`    "AT_HSPI_BIN" : "nrc7292_standalone_xip_ATCMD_HSPI.bin",`
	`    "AT_HSPI_CRC" : "750243d8",`
	
	`    "AT_UART_BIN" : "nrc7292_standalone_xip_ATCMD_UART.bin",`
	`    "AT_UART_CRC" : "793066ec",`
	
	`    "AT_UART_HFC_BIN" : "nrc7292_standalone_xip_ATCMD_UART_HFC.bin",`
	`    "AT_UART_HFC_CRC" : "8f564369"`
	`}`
	After getting information about new firmware from the server, the current firmware sends a FOTA_VERSION event to the terminal or host.
	+WEVENT:"FOTA_VERSION","<sdk_version>","<atcmd_version>"
	After receiving the FOTA_VERSION event, the terminal or host can use the RUN command to download new firmware from the server.
	If there is no fota.json file on the server, the firmware information to be downloaded can be set with the bin_name and bin_crc32 parameters. And the

terminal or host can use the RUN command without receiving the FOTA_VERSION event.

The terminal or host can check the download process through FOTA_BINARY and FOTA_DOWNLOAD events from the current firmware.

```
+WEVENT: “FOTA_BINARY”,”<binary_name>”
+WEVENT: “FOTA_DOWNLOAD”,<total_size>,<download_size>
```

When the download is complete and ready to update, the terminal or host will receive a FOTA_UPDATE event from the current firmware.

```
+WEVENT: “FOTA_UPDATE”
```

If an error occurs during the above process, the terminal or host will receive a FOTA_FAIL event from the current firmware.

```
+WEVENT: “FOTA_FAIL”
```

And FOTA will be automatically disabled.

If there are no errors, the current firmware will be replaced with the new firmware after a software reset. A software reset is possible with the ATZ command. Firmware replacement will take about 10 seconds or more.

If an error occurs while accessing the flash memory for firmware replacement, the current firmware cannot be restored. If the error still occurs after a hardware reset, the firmware can only be restored through the download tool.

NOTE:

Whether or not the firmware in the server is the latest version can be determined by comparing the version confirmed by the AT+VER command and the FOTA_VERSION event.

EVENT:

Name	Description
FOTA_VERSION	The version of new firmware on the server. - User SDK version - AT Command Set version

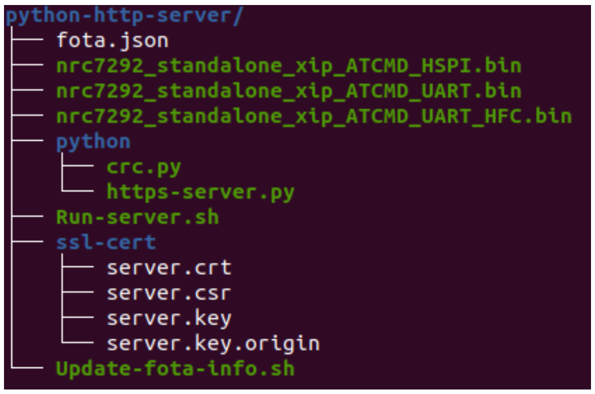
FOTA_BINARY	The binary name of new firmware to download from the server.
FOTA_DOWNLOAD	The binary size of new firmware being downloaded from the server. - Total size - Downloaded size
FOTA_UPDATE	The current firmware is ready to be replaced with the new firmware.
FOTA_FAIL	An error occurred during the FOTA process.

TEST:

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

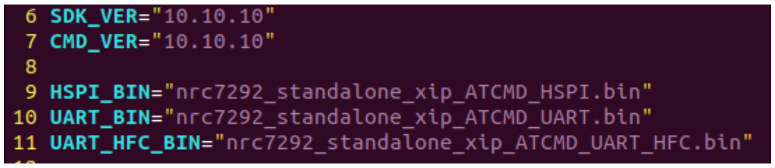
Path : atcmd/host/python-http-server

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



```
python-http-server/
├── fota.json
├── 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
└── Update-fota-info.sh
```

Shell Script	Description
Run-sever.sh	Run HTTP or HTTPS server. Usage: $ ./Run-server.sh http $ ./Run-server.sh https

		Update-fota-info.sh	Calculate the CRC value of firmware binaries and update the fota.json file.
			Usage:
			`$ ./Update-fota-info.sh [options]`
			Firmware version and binary name can be set by editing this file.
			
			`SDK_VER="10.10.10"`
			`CMD_VER="10.10.10"`
			
			`HSPI_BIN="nrc7292_standalone_xip_ATCMD_HSPI.bin"`
			`UART_BIN="nrc7292_standalone_xip_ATCMD_UART.bin"`
			`UART_HFC_BIN="nrc7292_standalone_xip_ATCMD_UART_HFC.bin"`
			Alternatively, it can be set as options when executing the script. Available options can be checked with the -h or --help option. Values set as options overwrite values set in the file.
			If a binary is replaced with a new one, the fota.json should be updated by Update-fota-info.sh.

Example	AT+VER? +VER:"1.5.0","1.23.5" OK AT+WFOTA? +WFOTA:0,"","",0x0 OK **< Get new firmware information from fota.json file >** AT+WFOTA=10,"https://192.168.200.1:4443" AT+WFOTA=10,"https://192.168.200.1:4443" OK AT+WFOTA? +WFOTA:10,"https://192.168.200.1:4443","",0x0 OK +WEVENT:"FOTA_VERSION","10.10.10","10.10.10" +WEVENT:"FOTA_VERSION","10.10.10","10.10.10" +WEVENT:"FOTA_VERSION","10.10.10","10.10.10" *Stop the getting to switch manually. AT+WFOTA=0 OK		

	AT+WFOTA=0 OK +WEVENT:"FOTA_VERSION","10.10.10","10.10.10" **< Set new firmware information without fota.json file >** AT+WFOTA=0,"https://192.168.200.1:4443","nrc7292_atcmd_hspi.bin",0x3e47cf92 OK AT+WFOTA? +WEVENT:0,"https://192.168.200.1:4443","nrc7292_atcmd_hspi.bin",0x3E47CF92 OK **< Download the firmware binary >** AT+WFOTA OK +WEVENT:"FOTA_BINARY","nrc7292_atcmd_hspi.bin" +WEVENT:"FOTA_DOWNLOAD",897632,90112 +WEVENT:"FOTA_DOWNLOAD",897632,180224 +WEVENT:"FOTA_DOWNLOAD",897632,270336 : +WEVENT:"FOTA_DOWNLOAD",897632,720896 +WEVENT:"FOTA_DOWNLOAD",897632,811008 +WEVENT:"FOTA_DOWNLOAD",897632,897632 +WEVENT:"FOTA_UPDATE" **< Reset and update >** ATZ

6.29 AT+WCTX

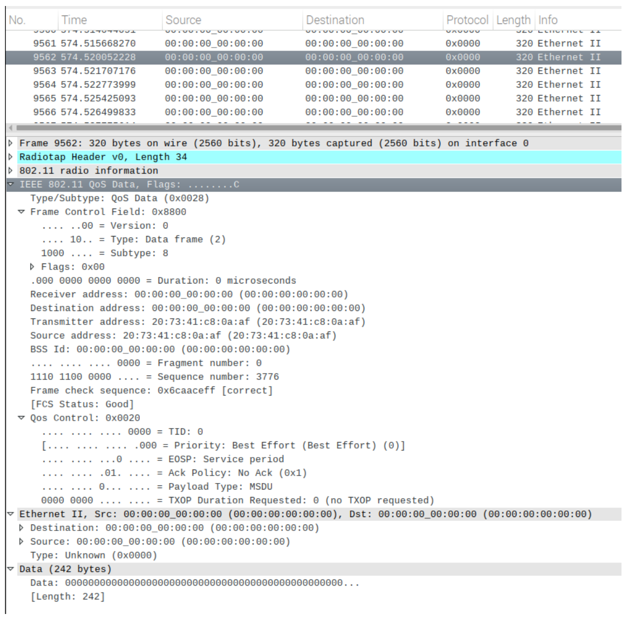
Command	**RUN** AT+WCTX **SET** AT+WCTX=<frequency>,<bandwidth>,<mcs>,<txpower> **GET** AT+WCTX?
Response	**RUN/SET** OK

	<u>GET</u> +WCTX: <frequency>,<bandwidth>,<mcs>,<txpower> OK
Parameters	**<frequency>** Channel frequency in units of 100 KHz **<bandwidth>** S1G channel bandwidth (1, 2 and 4 MHz) **<mcs>** Modulation Coding Scheme index (0, 1, 2, 3, 4, 5, 6, 7 and 10) **<txpower>** Transmission Power Level (1 ~ 30 dBm)

Description

Send dummy data frames for continuous TX without connecting to AP.

Dummy data frame captured with Wireshark :



```
No.    Time            Source              Destination         Protocol Length Info
 9561 574.515668270   00:00:00_00:00:00   00:00:00_00:00:00   0x0000     320 Ethernet II
 9562 574.520052228   00:00:00_00:00:00   00:00:00_00:00:00   0x0000     320 Ethernet II
 9563 574.521707176   00:00:00_00:00:00   00:00:00_00:00:00   0x0000     320 Ethernet II
 9564 574.522773999   00:00:00_00:00:00   00:00:00_00:00:00   0x0000     320 Ethernet II
 9565 574.525425093   00:00:00_00:00:00   00:00:00_00:00:00   0x0000     320 Ethernet II
 9566 574.526499833   00:00:00_00:00:00   00:00:00_00:00:00   0x0000     320 Ethernet II

▷ Frame 9562: 320 bytes on wire (2560 bits), 320 bytes captured (2560 bits) on interface 0
▷ Radiotap Header v0, Length 34
▷ 802.11 radio information
▽ IEEE 802.11 QoS Data, Flags: ........C
    Type/Subtype: QoS Data (0x0028)
  ▽ Frame Control Field: 0x8800
      .... ..00 = Version: 0
      .... 10.. = Type: Data frame (2)
      1000 .... = Subtype: 8
    ▷ Flags: 0x00
    .000 0000 0000 0000 = Duration: 0 microseconds
    Receiver address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Destination address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Transmitter address: 20:73:41:c8:0a:af (20:73:41:c8:0a:af)
    Source address: 20:73:41:c8:0a:af (20:73:41:c8:0a:af)
    BSS Id: 00:00:00_00:00:00 (00:00:00:00:00:00)
    .... .... .... 0000 = Fragment number: 0
    1110 1100 0000 .... = Sequence number: 3776
    Frame check sequence: 0x6caaceff [correct]
    [FCS Status: Good]
  ▽ Qos Control: 0x0020
      .... .... .... 0000 = TID: 0
      [.... .... .... .000 = Priority: Best Effort (Best Effort) (0)]
      .... .... ...0 .... = EOSP: Service period
      .... .... .01. .... = Ack Policy: No Ack (0x1)
      .... .... 0... .... = Payload Type: MSDU
      0000 0000 .... .... = TXOP Duration Requested: 0 (no TXOP requested)
▽ Ethernet II, Src: 00:00:00_00:00:00 (00:00:00:00:00:00), Dst: 00:00:00_00:00:00 (00:00:00:00:00:00)
  ▷ Destination: 00:00:00_00:00:00 (00:00:00:00:00:00)
  ▷ Source: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Type: Unknown (0x0000)
▽ Data (242 bytes)
    Data: 000000000000000000000000000000000000000000000000...
    [Length: 242]
```

NOTE:
 This command is for testing purposes only.

Example	AT+WCOUNTRY=”US” OK **< Set parameters for continuous TX >**

	AT+WCTX=9180,4,7,17 OK AT+WCTX? +WCTX:9180,4,7,17 OK **< Start continuous TX >** AT+WCTX OK **< Stop continuous TX >** AT+WCTX=0 OK

6.30 AT+WTIMEOUT

Command	**SET** AT+WTIMEOUT="<command>",<timeout> **GET** AT+WTIMEOUT?
Response	**SET** OK **GET** +WTIMEOUT:"<command>",<timeout> … OK
Parameters	**<command>** "WCONN", "WDISCONN", "WDHCP" **<timeout>** Timeout in seconds. (0: no timeout)
Description	Configure the response timeout for the specified command. Default timeout : - WCONN : 60 secs - WDISCONN : 60 secs - WDHCP : 60 secs

Example	AT+WTIMEOUT? +WTIMEOUT:"WCONN",60 +WTIMEOUT:"WDISCONN",60 +WTIMEOUT:"WDHCP",60 OK AT+WTIMEOUT="WCONN",120 OK AT+WTIMEOUT? +WTIMEOUT:"WCONN",120 +WTIMEOUT:"WDISCONN",60 +WTIMEOUT:"WDHCP",60 OK

6.31 +WEVENT

Response	+WEVENT:<event>[,<parameter 1>,…,<parameter N>]
Parameters	**<event>** "CONNECT_SUCCESS", "<bssid>","<ssid>","<security>" "DISCONNECT", "<bssid>","<ssid>" ,"<security>" "DHCP_START" "DHCP_STOP" "DHCP_BUSY" "DHCP_FAIL" "DHCP_SUCCESS","<address>","<netmask>","<gateway>" "DHCP_TIMEOUT",<time> "STA_CONNECT","<mac_addr>" "STA_DISCONNECT","<mac_addr>" "FOTA_VERSION","<sdk_version>","<atcmd_version>" "FOTA_BINARY","<binary_name>"

	“FOTA_DOWNLOAD”,”total_size”,”download_size” “FOTA_UPDATE” “FOTA_FAIL” “DEEPSLEEP_WAKEUP”
Description	Asynchronously raised Wi-Fi event messages.
Example	+WEVENT:"CONNECT_SUCCESS","8c:0f:fa:00:2b:a1","halow_sae","wpa3-sae" +WEVENT:"DISCONNECT","8c:0f:fa:00:2b:a1","halow_sae","wpa3-sae" +WEVENT:"DHCP_START" +WEVENT:"DHCP_STOP" +WEVENT:"DHCP_BUSY" +WEVENT:"DHCP_FAIL" +WEVENT:"DHCP_SUCCESS","192.168.200.18","255.255.255.0","192.168.200.1" +WEVENT:"DHCP_TIMEOUT",60 +WEVENT:"STA_CONNECT","8C:0F:FA:00:39:0D" +WEVENT:"STA_DISCONNECT","8C:0F:FA:00:39:0D" +WEVENT:"FOTA_VERSION","10.10.10","10.10.10" +WEVENT:"FOTA_BINARY","nrc7292_atcmd_hspi.bin" +WEVENT:"FOTA_DOWNLOAD",897632,90112 +WEVENT:"FOTA_UPDATE" +WEVENT:"FOTA_FAIL" +WEVENT:”DEEPSLEEP_WAKEUP”

7 Socket AT Commands

Commands	Description
AT+SOPEN	Create a TCP/UDP socket for IPv4 domain.
AT+SCLOSE	Close an existing socket.
AT+SLIST	List all currently open sockets.
AT+SSEND	Send data through a socket.
AT+SRECV	Read buffered data from the network stack (lwip).
AT+SRECVMODE	Configures how data is read from the network stack (lwip).
AT+SRECVINFO	Configure the information level of “+RXD” message.
AT+SADDRINFO	Check the IP address from the domain name.
AT+STCPKEEPALIVE	Enable or disable TCP keepalive.
AT+STCPNODELAY	Enable or disable TCP Nagle’s algorithm.
AT+STIMEOUT	Configure the response timeout for the specified socket command.
+SEVENT	Asynchronously raised socket event messages.
+RXD	An event log for a received packet with payload.

7.1 AT+SOPEN

Command	**SET** AT+SOPEN=”udp”,<local_port>[,<reuse_addr>] AT+SOPEN=”tcp”,<local_port>[,<reuse_addr>] AT+SOPEN=”tcp”,”<server address>”,<server port>[,<reuse_addr>]
Response	**SET** +SOPEN=<socket ID> OK
Parameters	**<local_port> (UDP)** The outgoing local port. **<local_port> (TCP Server)** Local port to listen on. **<server address>,<server port> (TCP Client)** The IPv4 address and port number of the TCP server. **<reuse_addr>** SO_REUSEADDR option (0:disable, 1:enable) **<socket ID>** The ID allocated to the socket.
Description	Create a TCP/UDP socket for IPv4 domain. A socket for TCP server will listen on the given port in the background and asynchronously raise the event CONNECT to notify incoming connections.
Example	AT+SOPEN=”UDP”,60000 +SOPEN=0 OK AT+SOPEN=”TCP”,50000 +SOPEN=1 OK +SEVENT: “CONNECT”,2 AT+SOPEN=”TCP”,”192.168.200.100”,5001 +SOPEN=3

	OK

7.2 AT+SCLOSE

Command	**SET** AT+SCLOSE=<socket ID> **RUN** AT+SCLOSE
Response	**SET** +SCLOSE:<socket ID> OK **RUN** +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:2 +SCLOSE:3 OK

7.3 AT+SLIST

Command	**GET** AT+SLIST?
Response	**GET** +SLIST:<socket ID>,"<protocol>","<remote address>",<remote port>,<local port> :

	+SLIST:<socket ID>,”<protocol>”,”<remote address>”,<remote port>,<local port> OK
Parameters	**<socket ID>** The ID allocated to the socket. **<protocol>** TCP or UDP **<remote address>,<remote port>**,**<local port>** The remote address, remote port and local port associated with the socket.
Description	List all currently open sockets.
Example	AT+SLIST? +SLIST:0,”UDP”,”0.0.0.0”,0,60000 +SLIST:1,”TCP”,”0.0.0.0”,0,50000 +SLIST:2,”TCP”,”192.168.200.100”,55354,0 +SLIST:3,”TCP”,”192.168.200.100”,5001,52433 OK

7.4 AT+SSEND

Command	**SET** AT+SSEND =<ID>[,<length>[,<done_event>]] AT+SSEND =<ID>,”<remote host>”, <remote port>[,<length>[,<done_event>]]
Response	**SET** OK
Parameters	**<ID>** The ID allocated to the socket. **<remote host> (UDP only)** IPv4 address or domain name of the UDP server/client. **<remote port> (UDP only)** Port number of the UDP server/client. **<length>** Number of raw bytes to send. **<done_event>**

	SEND_DONE event. (0:disable, 1:enable)
Description	Send data through a socket. Data can be sent in one of the following modes when the return message is OK. 1. Synchronous Send Synchronous send mode is set when the length parameter has a positive number. The length parameter indicates the length of data sent with one AT+SSEND command. Data can be sent up to 4096 bytes at a time. 2. (Buffered) Passthrough Send Data can be continuously sent with one AT+SSEND command. Passthrough send mode is set when the length parameter is 0 or omitted. Data is copied to the TCP/IP stack by the socket send function without buffering, and the length of the copied data is variable. Buffered passthrough send mode is set when the length parameter has a negative number. The length parameter indicates the length of the buffer. The maximum length of the buffer is 4096 bytes. If the length parameter is -2048, data is buffered up to 2048 bytes. The maximum length of data copied to the TCP/IP stack by the socket send function is equal to the buffer length. To exit (buffered) passthrough send mode and send a new AT command, the following is required: ① Wait at least 1 second after sending the last data. ② Send the EXIT command "AT\r\n" when SEND_IDLE event is raised. ③ Send a new AT command after SEND_EXIT event is raised. If an error occurs before the data is copied to the TCP/IP stack, SEND_ERROR event is raised. If the done_event parameter is set to 1, SEND_DONE event is raised when data is successfully copied to the TCP/IP stack. NOTE: If the host interface is UART and hardware flow control is disabled, the (buffered) passthrough send mode is not available. Data can only be sent in synchronous

	send mode, and it is recommended to set the done_event parameter to 1 and send the next data after checking the SEND_DONE event.
Example	**[Synchronous Send : done_event=0]** AT+SSEND=0,6 OK Hello! **[Synchronous Send : done_event=1]** AT+SSEND=0,6,1 OK Hello! +SEVENT:"SEND_DONE",6 **[Passthrough Send : done_event=0]** AT+SSEND=0 OK Hello, World! Goodbye, World! */* If no data is sent for more than 1 second, the SEND_IDLE event is raised. */* +SEVENT:"SEND_IDLE",0,28,0,0 */* Send the EXIT command "AT\r\n" to exit the passthrough send mode. */* AT OK +SEVENT:"SEND_EXIT",0,28,0 **[Buffered Passthrough Send : done_event=1]** AT+SSEND=0,-8,1 OK TEST0001 +SEVENT:"SEND_DONE",8 TEST0002 +SEVENT:"SEND_DONE",8 TEST0003

	+SEVENT:"SEND_DONE",8 */* Wait for the SEND_IDLE event without sending any data to exit the buffered passthrough send mode. */* +SEVENT:"SEND_IDLE",0,24,0,0 AT OK +SEVENT:"SEND_EXIT",0,24,0

7.5 AT+SRECV

Command	**SET** AT+SRECV=<socket ID>[,<length>] **GET** AT+SRECV? AT+SRECV?=<socket ID>
Response	**SET** OK **GET** +SRECV:<socket_ID>,<bufferd_length> … OK
Parameters	**<socket ID>** The ID allocated to the socket. **<length>** The maximum number of raw bytes to read *If omitted or set to 0, it is set to the maximum value supported by the firmware. **<bufferd_length>** The number of raw bytes currently buffered
Description	Read buffered data from the network stack (lwip). NOTE: 1) AT+SRECV command can be used only when passive mode is set with AT+SRECVMODE command. 2) If it is UDP data, it will be lost when the buffer is full.

Example	AT+SLIST? +SLIST:0,"TCP","192.168.200.1",50000,0 +SLIST:1,"UDP","0.0.0.0",0,60001 OK +SEVENT:"RECV_READY",0,1024 +SEVENT:"RECV_READY",1,1024 AT+SRECV? +SRECV:0,7168 +SRECV:1,7168 OK AT+SRECV=0 +RXD:0,4096,"192.168.200.1",50000 OK AT+SRECV=1 +RXD:1,1024,"192.168.200.1",60000 OK +SEVENT:"RECV_READY",0,3072 +SEVENT:"RECV_READY",1,6144 AT+SRECV?=0 +SRECV:0,3072 OK AT+SRECV?=1 +SRECV:1,6144 OK

7.6 AT+SRECVMODE

Command	**SET** AT+SRECVMODE=<mode>[,<event>] **GET** AT+SRECVMODE?
Response	**SET** OK **GET** +SRECVMODE:<mode>,<event>

	OK
Parameters	**<mode>** 0 : active* 1 : passive **<event>** 0 : ready event disable 1 : ready event enable*
Description	Configures how data is read from the network stack (lwip). If the event parameter is set to 1 in passive mode, a RECV_READY event occurs when there is buffered data. The event does not occur again until the buffered data is read with the AT+SRECV command.
Example	AT+SRECVMODE=1 OK AT+SRECVMODE? +SRECVMODE:1,0 OK AT+SRECVMODE=1,1 OK AT+SRECVMODE? +SRECVMODE:1,1 OK AT+SRECVMODE=0 OK AT+SRECVMODE? +SRECVMODE:0,0 OK

7.7 AT+SRECVINFO

Command	**SET** AT+SRECVINFO=<mode> **GET** AT+SRECVINFO?

Response	**SET** OK **GET** +SRECVINFO:<mode> OK
Parameters	**<mode>** 0 : terse* 1 : verbose
Description	Configure the information level of "+RXD" message. NOTE: The AT+SRECVINFO command is the same as the previous AT+SRXLOGLEVEL command. Only the command name is different.
Example	AT+SRECVINFO =1 OK AT+SRECVINFO? + SRECVINFO:1 OK

7.8 AT+SADDRINFO

Command	**SET** AT+SADDRINFO="<domain_name>"
Response	**SET** +SADDRINFO:"<address>" OK
Parameters	**<domain_name>** Domain name **<address>** IPv4 address
Description	Check the IP address from the domain name.
Example	AT+SADDRINFO ="www.google.com" +SADDRINFO:"142.250.199.100"

	OK

7.9 AT+STCPKEEPALIVE

Command	**SET** AT+STCPKEEPALIVE=<socket ID>,<keepalive>[,<keepidle>,<keepcnt>,<keepintvl>] **GET** AT+STCPKEEPALIVE? AT+STCPKEEPALIVE?=<socket ID>
Response	**SET** OK **GET** +STCPKEEPALIVE:<socket_ID>,<keepalive>,<keepidle>,<keepcnt>,<keepintvl> : OK
Parameters	**<socket ID>** The ID allocated to the socket for TCP client. **<keepalive>** 0 : disable 1 : enable **<keepidle>** The time to wait before sending out the first probe in seconds. (default : 7200) **<keepcnt>** The number of probes that are sent and unacknowledged. (default : 9) **<keepintvl>** The interval between subsequent keepalive probes in seconds. (default : 75)
Description	Enable or disable TCP keepalive.
Example	**< TCP Server >** AT+SOPEN=”TCP”,50000 +SOPEN=0 OK +SEVENT:”CONNECT”,1 AT+SLIST? +SLIST:0,”TCP”,”0.0.0.0”,0,50000 +SLIST:1,”TCP”,”192.168.200.2”,52432,0 OK AT+STCPKEEPALIVE?

	+STCPKEEPALIVE:1,0,7200,9,75 OK AT+STCPKEEPALIVE=1,0,60,5,30 OK AT+STCPKEEPALIVE? +STCPKEEPALIVE:1,0,60,5,30 OK AT+STCPKEEPALIVE=1,1 OK AT+STCPKEEPALIVE? +STCPKEEPALIVE:1,1,60,5,30 OK **< TCP Client >** AT+SOPEN=”TCP”,”192.168.200.1”,50000 +SOPEN:0 OK AT+SLIST? +SLIST:0,”TCP”,”192.168.200.1”,50000,0 OK AT+STCPKEEPALIVE? +STCPKEEPALIVE:0,0,7200,9,75 OK AT+STCPKEEPALIVE=0,1,60,5,30 OK AT+STCPKEEPALIVE?=0 +STCPKEEPALIVE:0,1,60,5,30 OK

7.10 AT+STCPNODELAY

Command	**SET**
	AT+STCPNODELAY=<socket ID>,{0|1}
	GET
	AT+STCPNODELAY?

Response	**SET** OK

	GET +STCPNODELAY:<socket_ID>,<status> OK
Parameters	**<socket ID>** The ID allocated to the socket. **<status>** 0 : disable 1 : enable
Description	Enable or disable TCP Nagle's algorithm.
Example	**< TCP Server >** AT+SOPEN="TCP",50000 +SOPEN=0 OK +SEVENT:"CONNECT",1 AT+SLIST? +SLIST:0,"TCP","0.0.0.0",0,50000 +SLIST:1,"TCP","192.168.200.2",52432,0 OK AT+STCPNODELAY? +STCPNODELAY:1,0 OK AT+STCPNODELAY=1,1 OK AT+STCPNODELAY? +STCPNODELAY:1,1 OK **< TCP Client >** AT+SOPEN="TCP","192.168.200.1",50000 +SOPEN:0 OK AT+SLIST? +SLIST:0,"TCP","192.168.200.1",50000,0 OK AT+STCPNODELAY? +STCPNODELAY:0,0 OK AT+STCPNODELAY=0,1

	OK AT+STCPNODELAY? +STCPNODELAY:0,1 OK

7.11 AT+STIMEOUT

Command	**SET** AT+STIMEOUT="<command>",<timeout> **GET** AT+STIMEOUT?
Response	**SET** OK **GET** +STIMEOUT:"<command>",<timeout> … OK
Parameters	**<command>** "SOPEN", "SSEND" **<timeout>** Timeout in seconds. (0 : no timeout)
Description	Configure the response timeout for the specified socket command. Default timeout : - SOPEN : 30 secs - SSEND : 1 sec
Example	AT+STIMEOUT? +STIMEOUT:"SOPEN",30 +STIMEOUT:"SSEND",1 OK AT+STIMEOUT="SOPEN",60 OK AT+STIMEOUT="SSEND",3 OK AT+STIMEOUT? +STIMEOUT:"SOPEN",60

	+STIMEOUT:"SSEND",3 OK

7.12 +SEVENT

Response	+SEVENT:<event>,<socket ID>[,<parameter 1>,…,<parameter N>]
Parameters	**<event>** "CONNECT",<socket ID> "CLOSE",<socket ID>,<error>,"<description>" "SEND_DONE",<socket ID>,<done> "SEND_DROP",<socket ID>,<drop> "SEND_IDLE",<socket ID>,<done>,<drop>,<wait> "SEND_EXIT",<socket ID>,<done>,<drop> "SEND_ERROR",<socket ID>,<error>,"<description>" "RECV_READY",<socket ID>,<length> "RECV_ERROR",<socket ID>,<error>,"<description>" **<socket ID>** Socket ID **<done>** The length of the sent payload. **<drop>** The length of the dropped payload. **<wait>** The length of the buffered payload. **<length>** The length of the receivable payload. **<error>** error code

	<description> string describing the error code NOTE: The error code may not match the POSIX error code. The error code defined in the errno.h file included in the ARM Toolchain is different from the POSIX error code.
Description	Asynchronously raised socket event messages.
Example	+SEVENT:”CONNECT”,1 +SEVENT:”CLOSE”,1,128,"Socket is not connected" +SEVENT:”SEND_DONE”,1,152 +SEVENT:”SEND_DROP”,1,152 +SEVENT:”SEND_IDLE”,1,1500,152,200 +SEVENT:”SEND_EXIT”,1,1700,152 +SEVENT:”SEND_ERROR”,1,104,”Connection reset by peer” +SEVENT:”RECV_READY”,1,1488 +SEVENT:”RECV_ERROR”,1,128,”Socket is not connected”

7.13 +RXD

Response	**RX Log Level (Terse)** +RXD:<socket ID>,<actual read length> <raw bytes> **RX Log Level (Verbose)** +RXD:<socket ID>,<actual read length>,”<remote IP>”,<remote port> <raw bytes>
Parameters	**<socket ID>** The ID allocated to the socket. **<max read length>** The maximum number of bytes to read. (Max: 2048) **<actual read length>** Actual number of bytes read.

	<remote IP>,<remote port> The remote IP and port. **<raw bytes>** The received raw bytes (0x00~0xFF) payload.
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	**RX Log Level (Terse)** +RXD=0,15 ABCDE12345,.?=+ **RX Log Level (Verbose)** +RXD=0,12,"192.168.200.1",5025 HELLO,WORLD!

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.

8.1.1 Source files

File	Description
common.h	Common header file
main.c	CLI related functions.
Makefile	Make file for building.
nrc-atcmd.c nrc-atcmd.h	AT command handler
nrc-hspi.c nrc-hspi.h	Protocol driver for HSPI. ***Refer to this file to communicate with the ATCMD firmware via HSPI.**
nrc-iperf.c nrc-iperf.h	Iperf server/client
raspi-hif.c raspi-hif.h	Wrapper for user mode driver.
raspi-eirq.c	User mode driver for GPIO EIRQ.
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

8.1.2 Build

Copy the “atcmd/host/raspi-atcmd-cli” directory to the Raspberry Pi's home directory. And build the CLI application with the make command.

```
$ cd $HOME

$ cd raspi-atcmd-cli
```

$ make clean

```
removed 'raspi-atcmd-cli'
```

$ make

```
cc -g -o raspi-atcmd-cli raspi-spi.c raspi-uart.c raspi-eirq.c raspi-hif.c nrc-hspi.c nrc-atcmd.c nrc-iperf.c main.c
-pthread -Wall    -lpthread
```

8.1.3 Run

- **Help**

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

```
raspi-atcmd-cli version 1.3.3
Copyright (c) 2019-2023    <NEWRACOM LTD>

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

UART/SPI:
   -D, --device #          Specify the device. (default: /dev/spidev0.0, /dev/ttyAMA0)
   -s, --script #          Specify the script file.
   -n, --noexit #          Do not exit the script when the AT command responds with an error.

SPI:
   -S    --spi             Use the SPI to communicate with the target.
   -E, --eirq #            Use EIRQ mode for the SPI. (0:low, 1:high, 2:falling, 3:rising)
   -c, --clock #           Specify the clock frequency for the SPI. (default: 20000000 Hz)

UART:
   -U    --uart            Use the UART to communicate with the target.
   -f    --flowctrl        Enable RTS/CTS signals for the hardware flow control on the UART. (default: off)
   -b, --baudrate #        Specify the baudrate for the UART. (default: 115200 bps)

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

- **SPI**

The maximum clock frequency is 20MHz.

$ sudo ./raspi-atcmd-cli **-S [-D <device>] [-E <trigger>] [-c <clock>] [-s <script> [-n]]**

```
$ sudo ./raspi-atcmd-cli -S -c 20000000 -E 2

  [ SPI ]
    - device: /dev/spidev0.0
    - clock: 20000000 Hz
    - eirq: falling


#
```

- **UART**

  The maximum baud rate is 115,200bps without the hardware flow control.

  $ sudo ./raspi-atcmd-cli **-U [-D <device>] [-b <baudrate>] [-s <script> [-n]]**

```
$ sudo ./raspi-atcmd-cli -U -b 115200

  [ UART ]
    - device: /dev/ttyAMA0
    - baudrate : 115200


#
```

- **UART_HFC**

  If the baud rate setting is more than 115,200bps, the hardware flow control needs to be enabled with -f option on the UART.

  $ sudo ./raspi-atcmd-cli **-U -f [-D <device>] [-b <baudrate>] [-s <script> [-n]]**

```
$ sudo ./raspi-atcmd-cli -U -f -b 2000000

  [ UART_HFC ]
    - device: /dev/ttyAMA0
    - baudrate : 2000000


#
```

- **Examples**

  Getting the informations.

```

# AT
  SEND: AT
  RECV: OK

# AT+VER?
  SEND: AT+VER?
  RECV: +VER:"1.5.0","1.23.5"
  RECV: OK

# AT+WMACADDR?
  SEND: AT+WMACADDR?
  RECV: +WMACADDR:"8c:0f:fa:00:29:43"
  RECV: OK

# AT+WCOUNTRY?
  SEND: AT+WCOUNTRY?
  RECV: +WCOUNTRY:"US"
  RECV: OK

# AT+WTXPOWER?
  SEND: AT+WTXPOWER?
  RECV: +WTXPOWER:17
  RECV: OK

# AT+WRATECTRL?
  SEND: AT+WRATECTRL?
  RECV: +WRATECTRL:1
  RECV: OK

# AT+WIPADDR?
  SEND: AT+WIPADDR?
  RECV: +WIPADDR:"0.0.0.0","0.0.0.0","0.0.0.0"
  RECV: OK
```

Connecting to an AP.

```
# AT+WCONN?
  SEND: AT+WCONN?
  RECV: +WCONN:"halow","00:00:00:00:00:00","open","","disconnected"
  RECV: OK

# AT+WSCAN
  SEND: AT+WSCAN
  RECV: +WSCAN:"8c:0f:fa:00:28:1f",906.0,-39,"[WPA3-SAE-CCMP][ESS]","halow_atcmd_sae"
  RECV: +WSCAN:"8c:0f:fa:00:28:11",925.0,-68,"[WPA3-OWE-CCMP][ESS]","halow_fota"
  RECV: +WSCAN:"8c:0f:fa:00:28:1e",903.5,-93,"[ESS]","halow_s1g_demo_open"
  RECV: OK

# AT+WCONN="halow_atcmd_sae","sae","12345678"
  SEND: AT+WCONN="halow_atcmd_sae","sae","12345678"
  RECV: OK
```

```
# AT+WCONN?
  SEND: AT+WCONN?
  RECV: +WCONN:"halow_atcmd_sae","8c:0f:fa:00:28:1f","wpa3-sae","12345678","connected"
  RECV: OK

# AT+WDHCP
  SEND: AT+WDHCP
  RECV: +WDHCP:"192.168.200.18","255.255.255.0","192.168.200.1"
  RECV: OK

# AT+WIPADDR?
  SEND: AT+WIPADDR?
  RECV: +WIPADDR:"192.168.200.18","255.255.255.0","192.168.200.1"
  RECV: OK

# AT+WPING="192.168.200.1"
  SEND: AT+WPING="192.168.200.1"
  RECV: +WPING:64,"192.168.200.1",1,64,5
  RECV: +WPING:64,"192.168.200.1",2,64,5
  RECV: +WPING:64,"192.168.200.1",3,64,149
  RECV: +WPING:64,"192.168.200.1",4,64,4
  RECV: +WPING:64,"192.168.200.1",5,64,5
  RECV: OK
```

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

```
# AT+SOPEN="TCP","192.168.200.1",50000
  SEND: AT+SOPEN="TCP","192.168.200.1",50000
  RECV: +SOPEN:0
  RECV: OK

# AT+SLIST?
  SEND: AT+SLIST?
  RECV: +SLIST:0,"TCP","192.168.200.1",50000,52432
  RECV: OK

# AT+SSEND=0,10
  SEND: AT+SSEND=0,10
  RECV: OK

# ABCDEFGHIJKLMNOPQRSTUVWXYZ
  SEND: DATA 10

#    RECV: +RXD:0,10

# AT+SSEND=0
  SEND: AT+SSEND=0
  RECV: OK
```

```
# DAJFKDAJFKDAJFDKAJFAKFJDK
  SEND: DATA 25

#    RECV: +RXD:0,25
  RECV: +SEVENT:"SEND_IDLE",0,25,0,0


# DKAJFKDAJFEKJAFKDJFADKJFAKDJFAKEJFKADJFAKEJFKAJDFKDJAFDKJFADK
  SEND: DATA 61

#    RECV: +RXD:0,61
  RECV: +SEVENT:"SEND_IDLE",0,86,0,0


# AT
  SEND: AT
  RECV: OK

#    RECV: +SEVENT:"SEND_EXIT",0,86,0
```

Closing all sockets.

```

# AT+SLIST?
  SEND: AT+SLIST?
  RECV: +SLIST:0,"TCP","192.168.200.1",50000,52432
  RECV: OK

# AT+SCLOSE
  SEND: AT+SCLOSE
  RECV: +SCLOSE:0
  RECV: OK

# EXIT
```

8.1.4 Run with a script

CLI application provides the option to run the script file. (-s/--script)

```
UART/SPI:
    -s, --script #              Specify the script file.
    -n, --noexit #              Do not exit the script when the AT command responds with an error.
```

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

Command	Description	Example

CALL <script_file>	Read and 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
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
ECHO "<message>"	Print a message.	ECHO "AT Command"
TIME	Print current time.	TIME
HOLD	Pause until there is keyboard input.	ECHO "Run an AP in open mode" HOLD
EXIT	Exit script.	EXIT

Users can refer to the script files under the "raspi-atcmd-cli/scripts" directory.

```
raspi-atcmd-cli/scripts/
 ├─── socket-tcp-client-send
 ├─── socket-tcp-client-send-passthrough
 ├─── socket-tcp-client-send-passthrough-buffered
 ├─── socket-tcp-server
 ├─── socket-tcp-server-send
 ├─── socket-tcp-server-send-passthrough
 ├─── socket-tcp-server-send-passthrough-buffered
 ├─── socket-udp-client-send
 ├─── socket-udp-client-send-passthrough
 ├─── socket-udp-client-send-passthrough-buffered
 ├─── socket-udp-server
 ├─── socket-udp-server-send
 ├─── socket-udp-server-send-passthrough
 ├─── socket-udp-server-send-passthrough-buffered
 ├─── softap-tcp-client-send-normal
 ├─── softap-tcp-client-send-passthrough
```

```
├──── softap-tcp-server
├──── softap-udp-client-send-normal
├──── softap-udp-client-send-passthrough
├──── softap-udp-server
├──── sta-tcp-client-send-normal
├──── sta-tcp-client-send-passthrough
├──── sta-tcp-server
├──── sta-udp-client-send-normal
├──── sta-udp-client-send-passthrough
├──── sta-udp-server
├──── wifi-connect-open-dhcp-auto-kr-mic
├──── wifi-connect-open-dhcp-auto-us
├──── wifi-connect-open-dhcp-kr-mic
├──── wifi-connect-open-dhcp-kr-usn
├──── wifi-connect-open-dhcp-us
├──── wifi-connect-wpa2-psk-dhcp-auto-kr-mic
├──── wifi-connect-wpa2-psk-dhcp-auto-us
├──── wifi-connect-wpa2-psk-dhcp-kr-mic
├──── wifi-connect-wpa2-psk-dhcp-us
├──── wifi-connect-wpa3-owe-dhcp-auto-kr-mic
├──── wifi-connect-wpa3-owe-dhcp-auto-us
├──── wifi-connect-wpa3-owe-dhcp-kr-mic
├──── wifi-connect-wpa3-owe-dhcp-us
├──── wifi-connect-wpa3-sae-dhcp-auto-kr-mic
├──── wifi-connect-wpa3-sae-dhcp-auto-us
├──── wifi-connect-wpa3-sae-dhcp-kr-mic
├──── wifi-connect-wpa3-sae-dhcp-us
├──── wifi-softap-open-dhcps-kr-mic
├──── wifi-softap-open-dhcps-kr-usn
├──── wifi-softap-open-dhcps-us
├──── wifi-softap-wpa2-psk-dhcps-kr-mic
└──── wifi-softap-wpa2-psk-dhcps-us
```

8.1.5 Iperf

The CLI application supports the iperf2 command used for network performance measurement. However, the available options are limited as shown below.

# iperf {-h|--help}

```
Usage: iperf {-s}|{-c <host>} [options]

  Client/Server:
    -i, --interval #          seconds between periodic bandwidth reports (default: 1 sec)
    -p, --port #                 server port to listen on/connect to (default: 5001)
    -u, --udp                      use UDP rather than TCP

  Server specific:
    -s, --server                 run in server mode

  Client specific:
    -c, --client <host>      run in client mode, connecting to <host>
    -t, --time #                 time in seconds to transmit for (default: 10 sec)
    -P, --passthrough         transmit in passthrough mode
    -N, --negative              use negative length for buffered passthrough mode (always negative in UDP)
    -D, --done_vent             enable SEND_DONE event

  Miscellaneous:
    -h, --help                     print this message and quit
```

The iperf command can be run after completing the Wi-Fi connection and IP setup.

Wi-Fi connection and IP setup can be done in one of two ways:

- Enter AT command in the CLI application.

```
# AT+WSCAN
  SEND: AT+WSCAN
  RECV: +WSCAN:"8c:0f:fa:00:28:1f",914.0,-38,"[WPA3-SAE-CCMP][ESS]","halow_atcmd_sae"
  RECV: OK

# AT+WCONN="halow_atcmd_sae","sae","12345678"
  SEND: AT+WCONN="halow_atcmd_sae","sae","12345678"
  RECV: OK

# AT+WDHCP
  SEND: AT+WDHCP
  RECV: +WDHCP:"192.168.200.18","255.255.255.0","192.168.200.1"
  RECV: OK
```

- Specify a script file containing AT command with the -s option when running the CLI application.

  $ sudo ./raspi-atcmd-cli -S -s scripts/example/wifi-connect-wpa3-sae-dhcp

```
CALL: scripts/examples/wifi-connect-wpa3-sae-dhcp

  SEND: AT
  RECV: OK
  SEND: AT+WDISCONN
  RECV: OK

  ECHO: Run an AP in WPA3-SAE.
  ECHO:    - SSID : halow_atcmd_sae
  ECHO:    - Password : 12345678
  ECHO:    - IP : 192.168.200.1
  ECHO:    - DHCP Server
  HOLD: Press ENTER to continue.

  SEND: AT+WSCAN
  RECV: +WSCAN:"8c:0f:fa:00:28:1f",906.0,-39,"[WPA3-SAE-CCMP][ESS]","halow_atcmd_sae"
  RECV: OK
  SEND: AT+WDISCONN
  RECV: OK
  SEND: AT+WCONN="halow_atcmd_sae","wpa3-sae","12345678"
  RECV: OK
  SEND: AT+WCONN?
  RECV: +WCONN:"halow_atcmd_sae","8c:0f:fa:00:28:1f","wpa3-sae","12345678","connected"
  RECV: OK
  SEND: AT+WDHCP
  RECV: +WDHCP:"192.168.200.18","255.255.255.0","192.168.200.1"
  RECV: OK


DONE: scripts/examples/wifi-connect-wpa3-sae-dhcp
```

- **Iperf TCP Client/Server**

```
# iperf -c 192.168.200.1

  [ IPERF OPTION ]
    - role: client
    - protocol: tcp
    - server_port: 5001
    - server_ip: 192.168.200.1
    - send_length: 1440
    - send_time: 10
    - send_passthrough: off
  - send_done_event: 0
  - report_interval: 1


 [ IPERF TCP Client ]
  Sending 1440 byte datagram ...
      Interval              Transfer          Bandwidth
      0.0 ~    1.0 sec    187.03 KBytes     1.53 Mbits/sec
      1.0 ~    2.0 sec    192.66 KBytes     1.57 Mbits/sec
      2.0 ~    3.0 sec    191.25 KBytes     1.56 Mbits/sec
      3.0 ~    4.0 sec    194.06 KBytes     1.59 Mbits/sec
      4.0 ~    5.0 sec    191.25 KBytes     1.56 Mbits/sec
      5.0 ~    6.0 sec    194.06 KBytes     1.58 Mbits/sec
      6.0 ~    7.0 sec    195.47 KBytes     1.59 Mbits/sec
      7.0 ~    8.0 sec    192.66 KBytes     1.57 Mbits/sec
      8.0 ~    9.0 sec    191.25 KBytes     1.56 Mbits/sec
      9.0 ~ 10.0 sec    187.03 KBytes     1.58 Mbits/sec
      0.0 ~ 10.0 sec      1.87 MBytes     1.57 Mbits/sec
  Sent 1363 datagrams
  Done


# iperf -c 192.168.200.1 -P

 [ IPERF OPTION ]
  - role: client
  - protocol: tcp
  - server_port: 5001
  - server_ip: 192.168.200.1
  - send_length: 1440
  - send_time: 10
  - send_passthrough: on
  - send_done_event: 0
  - report_interval: 1


 [ IPERF TCP Client ]
  Sending 1440 byte datagram ...
      Interval              Transfer          Bandwidth
      0.0 ~    1.0 sec    426.09 KBytes     3.47 Mbits/sec
      1.0 ~    2.0 sec    407.81 KBytes     3.34 Mbits/sec
      2.0 ~    3.0 sec    406.41 KBytes     3.32 Mbits/sec
      3.0 ~    4.0 sec    412.03 KBytes     3.37 Mbits/sec
      4.0 ~    5.0 sec    403.59 KBytes     3.30 Mbits/sec
      5.0 ~    6.0 sec    414.84 KBytes     3.40 Mbits/sec
      6.0 ~    7.0 sec    403.59 KBytes     3.29 Mbits/sec
      7.0 ~    8.0 sec    405.00 KBytes     3.31 Mbits/sec
      8.0 ~    9.0 sec    405.00 KBytes     3.31 Mbits/sec
      9.0 ~ 10.0 sec    409.22 KBytes     3.39 Mbits/sec
      0.0 ~ 10.0 sec      4.00 MBytes     3.35 Mbits/sec
  Sent 2911 datagrams
```

```
   Done


# iperf -c 192.168.200.1 -P -N

  [ IPERF OPTION ]
   - role: client
   - protocol: tcp
   - server_port: 5001
   - server_ip: 192.168.200.1
   - send_length: 1440
   - send_time: 10
   - send_passthrough: on (-)
   - send_done_event: 0
   - report_interval: 1


  [ IPERF TCP Client ]
   Sending 1440 byte datagram ...
       Interval              Transfer          Bandwidth
       0.0 ~    1.0 sec    348.75 KBytes     2.85 Mbits/sec
       1.0 ~    2.0 sec    343.12 KBytes     2.79 Mbits/sec
       2.0 ~    3.0 sec    340.31 KBytes     2.77 Mbits/sec
       3.0 ~    4.0 sec    334.69 KBytes     2.74 Mbits/sec
       4.0 ~    5.0 sec    337.50 KBytes     2.76 Mbits/sec
       5.0 ~    6.0 sec    336.09 KBytes     2.75 Mbits/sec
       6.0 ~    7.0 sec    330.47 KBytes     2.70 Mbits/sec
       7.0 ~    8.0 sec    337.50 KBytes     2.76 Mbits/sec
       8.0 ~    9.0 sec    341.72 KBytes     2.79 Mbits/sec
       9.0 ~ 10.0 sec    330.47 KBytes     2.77 Mbits/sec
       0.0 ~ 10.0 sec      3.30 MBytes     2.77 Mbits/sec
   Sent 2404 datagrams
   Done


# iperf -s

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


  [ IPERF TCP Server ]
   Connected with client: 192.168.200.1 port 52174
       Interval              Transfer          Bandwidth
       0.0 ~    1.0 sec    415.77 KBytes     3.41 Mbits/sec
       1.0 ~    2.0 sec    424.22 KBytes     3.47 Mbits/sec
       2.0 ~    3.0 sec    428.46 KBytes     3.51 Mbits/sec
       3.0 ~    4.0 sec    435.53 KBytes     3.57 Mbits/sec
```

```
        4.0 ~   5.0 sec   425.39 KBytes     3.48 Mbits/sec
        5.0 ~   6.0 sec   424.46 KBytes     3.48 Mbits/sec
        6.0 ~   7.0 sec   439.77 KBytes     3.60 Mbits/sec
        7.0 ~   8.0 sec   418.56 KBytes     3.43 Mbits/sec
        8.0 ~   9.0 sec   425.63 KBytes     3.49 Mbits/sec
        9.0 ~ 10.0 sec   416.91 KBytes     3.42 Mbits/sec
        0.0 ~ 10.0 sec     4.15 MBytes     3.49 Mbits/sec
    Done

Press ENTER to continue or type "quit" : quit


#
```

Remote Iperf TCP Server/Client

```
$ iperf -s -i 1
------------------------------------------------------------
Server listening on TCP port 5001
TCP window size: 85.3 KByte (default)
------------------------------------------------------------
[   4] local 192.168.200.1 port 5001 connected with 192.168.200.43 port 52432
[ ID] Interval           Transfer        Bandwidth
[   4]    0.0- 1.0 sec      187 KBytes    1.53 Mbits/sec
[   4]    1.0- 2.0 sec      193 KBytes    1.58 Mbits/sec
[   4]    2.0- 3.0 sec      190 KBytes    1.56 Mbits/sec
[   4]    3.0- 4.0 sec      194 KBytes    1.59 Mbits/sec
[   4]    4.0- 5.0 sec      191 KBytes    1.57 Mbits/sec
[   4]    5.0- 6.0 sec      193 KBytes    1.58 Mbits/sec
[   4]    6.0- 7.0 sec      194 KBytes    1.59 Mbits/sec
[   4]    7.0- 8.0 sec      191 KBytes    1.57 Mbits/sec
[   4]    8.0- 9.0 sec      191 KBytes    1.57 Mbits/sec
[   4]    9.0-10.0 sec      193 KBytes    1.58 Mbits/sec
[   4]    0.0-10.0 sec    1.87 MBytes    1.57 Mbits/sec
[   5] local 192.168.200.1 port 5001 connected with 192.168.200.43 port 52433
[   5]    0.0- 1.0 sec      408 KBytes    3.34 Mbits/sec
[   5]    1.0- 2.0 sec      405 KBytes    3.32 Mbits/sec
[   5]    2.0- 3.0 sec      408 KBytes    3.34 Mbits/sec
[   5]    3.0- 4.0 sec      412 KBytes    3.37 Mbits/sec
[   5]    4.0- 5.0 sec      400 KBytes    3.28 Mbits/sec
[   5]    5.0- 6.0 sec      418 KBytes    3.42 Mbits/sec
[   5]    6.0- 7.0 sec      402 KBytes    3.30 Mbits/sec
[   5]    7.0- 8.0 sec      403 KBytes    3.30 Mbits/sec
[   5]    8.0- 9.0 sec      406 KBytes    3.32 Mbits/sec
[   5]    9.0-10.0 sec      413 KBytes    3.39 Mbits/sec
[   5] 10.0-11.0 sec    18.2 KBytes      149 Kbits/sec
[   5]    0.0-11.3 sec    4.00 MBytes    2.98 Mbits/sec
[   4] local 192.168.200.1 port 5001 connected with 192.168.200.43 port 52434
[   4]    0.0- 1.0 sec      336 KBytes    2.75 Mbits/sec
[  4]  1.0- 2.0 sec    340 KBytes  2.78 Mbits/sec
[  4]  2.0- 3.0 sec    339 KBytes  2.78 Mbits/sec
[  4]  3.0- 4.0 sec    333 KBytes  2.73 Mbits/sec
[  4]  4.0- 5.0 sec    338 KBytes  2.77 Mbits/sec
[  4]  5.0- 6.0 sec    333 KBytes  2.72 Mbits/sec
[  4]  6.0- 7.0 sec    334 KBytes  2.73 Mbits/sec
[  4]  7.0- 8.0 sec    337 KBytes  2.76 Mbits/sec
[  4]  8.0- 9.0 sec    339 KBytes  2.78 Mbits/sec
[  4]  9.0-10.0 sec    338 KBytes  2.77 Mbits/sec
[  4] 10.0-11.0 sec   15.2 KBytes   124 Kbits/sec
[  4]  0.0-11.3 sec   3.30 MBytes  2.46 Mbits/sec


$ iperf -c 192.168.200.43 -i 1
------------------------------------------------------------
Client connecting to 192.168.200.43, TCP port 5001
TCP window size: 43.8 KByte (default)
------------------------------------------------------------
[  3] local 192.168.200.1 port 52174 connected with 192.168.200.43 port 5001
[ ID] Interval       Transfer     Bandwidth
[  3]  0.0- 1.0 sec    512 KBytes  4.19 Mbits/sec
[  3]  1.0- 2.0 sec    384 KBytes  3.15 Mbits/sec
[  3]  2.0- 3.0 sec    512 KBytes  4.19 Mbits/sec
[  3]  3.0- 4.0 sec    384 KBytes  3.15 Mbits/sec
[  3]  4.0- 5.0 sec    384 KBytes  3.15 Mbits/sec
[  3]  5.0- 6.0 sec    512 KBytes  4.19 Mbits/sec
[  3]  6.0- 7.0 sec    384 KBytes  3.15 Mbits/sec
[  3]  7.0- 8.0 sec    384 KBytes  3.15 Mbits/sec
[  3]  8.0- 9.0 sec    512 KBytes  4.19 Mbits/sec
[  3]  9.0-10.0 sec    384 KBytes  3.15 Mbits/sec
[  3]  0.0-10.2 sec   4.25 MBytes  3.51 Mbits/sec
```

NOTE:

When sending data in passthrough mode with the -P option, the socket can only be closed after receiving the SEND_IDLE event. It takes more than 1 second after sending the last data. So, the remote iperf tcp server stops after 1 second.

- **Iperf UDP Client/Server**

```
# iperf -c 192.168.200.1 -u

 [ IPERF OPTION ]
  - role: client
  - protocol: udp
  - server_port: 5001
  - server_ip: 192.168.200.1
  - send_length: 1470
```

```
   - send_time: 10
   - send_passthrough: off
   - send_done_event: 0
   - report_interval: 1


  [ IPERF UDP Client ]
   Sending 1470 byte datagrams ...
       Interval             Transfer          Bandwidth
       0.0 ~    1.0 sec    215.33 KBytes     1.76 Mbits/sec
       1.0 ~    2.0 sec    216.77 KBytes     1.77 Mbits/sec
       2.0 ~    3.0 sec    222.51 KBytes     1.82 Mbits/sec
       3.0 ~    4.0 sec    219.64 KBytes     1.79 Mbits/sec
       4.0 ~    5.0 sec    222.51 KBytes     1.81 Mbits/sec
       5.0 ~    6.0 sec    222.51 KBytes     1.82 Mbits/sec
       6.0 ~    7.0 sec    216.77 KBytes     1.77 Mbits/sec
       7.0 ~    8.0 sec    213.90 KBytes     1.75 Mbits/sec
       8.0 ~    9.0 sec    215.33 KBytes     1.76 Mbits/sec
       9.0 ~ 10.0 sec    206.72 KBytes     1.74 Mbits/sec
       0.0 ~ 10.0 sec      2.12 MBytes     1.78 Mbits/sec
   Sent 1513 datagrams
   Done


# iperf -c 192.168.200.1 -u -P

  [ IPERF OPTION ]
   - role: client
   - protocol: udp
   - server_port: 5001
   - server_ip: 192.168.200.1
   - send_length: 1470
   - send_time: 10
   - send_passthrough: on (-)
   - send_done_event: 0
   - report_interval: 1


  [ IPERF UDP Client ]
   Sending 1470 byte datagrams ...
       Interval             Transfer          Bandwidth
       0.0 ~    1.0 sec    480.91 KBytes     3.94 Mbits/sec
       1.0 ~    2.0 sec    467.99 KBytes     3.83 Mbits/sec
       2.0 ~    3.0 sec    469.42 KBytes     3.84 Mbits/sec
       3.0 ~    4.0 sec    467.99 KBytes     3.83 Mbits/sec
       4.0 ~    5.0 sec    469.42 KBytes     3.83 Mbits/sec
       5.0 ~    6.0 sec    470.86 KBytes     3.83 Mbits/sec
       6.0 ~    7.0 sec    467.99 KBytes     3.83 Mbits/sec
       7.0 ~    8.0 sec    467.99 KBytes     3.83 Mbits/sec
       8.0 ~    9.0 sec    466.55 KBytes     3.82 Mbits/sec
       9.0 ~ 10.0 sec    462.25 KBytes     3.84 Mbits/sec
```

```
      0.0 ~ 10.0 sec      4.58 MBytes      3.84 Mbits/sec
    Sent 3268 datagrams
    Done


# iperf -c 192.168.200.1 -u -P -N

  [ IPERF OPTION ]
    - role: client
    - protocol: udp
    - server_port: 5001
    - server_ip: 192.168.200.1
    - send_length: 1470
    - send_time: 10
    - send_passthrough: on (-)
    - send_done_event: 0
    - report_interval: 1


  [ IPERF UDP Client ]
    Sending 1470 byte datagrams ...
      Interval              Transfer          Bandwidth
      0.0 ~    1.0 sec    483.78 KBytes     3.96 Mbits/sec
      1.0 ~    2.0 sec    467.99 KBytes     3.82 Mbits/sec
      2.0 ~    3.0 sec    470.86 KBytes     3.84 Mbits/sec
      3.0 ~    4.0 sec    467.99 KBytes     3.83 Mbits/sec
      4.0 ~    5.0 sec    469.42 KBytes     3.83 Mbits/sec
      5.0 ~    6.0 sec    470.86 KBytes     3.84 Mbits/sec
      6.0 ~    7.0 sec    470.86 KBytes     3.83 Mbits/sec
      7.0 ~    8.0 sec    467.99 KBytes     3.83 Mbits/sec
      8.0 ~    9.0 sec    470.86 KBytes     3.85 Mbits/sec
      9.0 ~ 10.0 sec    455.07 KBytes     3.84 Mbits/sec
      0.0 ~ 10.0 sec      4.59 MBytes      3.85 Mbits/sec
    Sent 3271 datagrams
    Done


# iperf -s -u

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


  [ IPERF UDP Server ]
    Connected with client: 192.168.200.1 port 56129
      Interval               Transfer           Bandwidth            Jitter        Lost/Total Datagrams
      0.0 ~    1.0 sec    482.34 KBytes     3.95 Mbits/sec    0.964 ms         0/    336 (0%)
      1.0 ~    2.0 sec    490.96 KBytes     4.02 Mbits/sec    0.393 ms         0/    342 (0%)
    2.0 ~   3.0 sec    490.96 KBytes      4.02 Mbits/sec     0.276 ms         0/    342 (0%)
    3.0 ~   4.0 sec    489.52 KBytes      4.01 Mbits/sec     0.509 ms         0/    341 (0%)
    4.0 ~   5.0 sec    486.65 KBytes      3.98 Mbits/sec     0.280 ms         0/    339 (0%)
    5.0 ~   6.0 sec    486.65 KBytes      3.99 Mbits/sec     0.544 ms         0/    339 (0%)
    6.0 ~   7.0 sec    490.96 KBytes      4.02 Mbits/sec     0.454 ms         0/    342 (0%)
    7.0 ~   8.0 sec    489.52 KBytes      4.01 Mbits/sec     0.301 ms         0/    341 (0%)
    8.0 ~   9.0 sec    488.09 KBytes      3.99 Mbits/sec     0.607 ms         0/    340 (0%)
    9.0 ~ 10.0 sec    489.52 KBytes      4.01 Mbits/sec     0.807 ms         0/    341 (0%)
    0.0 ~ 10.0 sec      4.77 MBytes      4.00 Mbits/sec     0.807 ms         0/ 3403 (0%)
  Done: 3403/3403

Press ENTER to continue or type "quit" :

[ IPERF UDP Server ]
  Connected with client: 192.168.200.1 port 51030
    Interval                 Transfer            Bandwidth            Jitter        Lost/Total Datagrams
    0.0 ~   1.0 sec    496.70 KBytes      4.07 Mbits/sec     0.477 ms         0/    346 (0%)
    1.0 ~   2.0 sec    501.01 KBytes      4.10 Mbits/sec     0.454 ms         0/    349 (0%)
    2.0 ~   3.0 sec    499.57 KBytes      4.09 Mbits/sec     0.550 ms         0/    348 (0%)
    3.0 ~   4.0 sec    499.57 KBytes      4.09 Mbits/sec     0.747 ms         0/    348 (0%)
    4.0 ~   5.0 sec    501.01 KBytes      4.10 Mbits/sec     0.507 ms         0/    349 (0%)
    5.0 ~   6.0 sec    501.01 KBytes      4.10 Mbits/sec     0.694 ms         0/    349 (0%)
    6.0 ~   7.0 sec    502.44 KBytes      4.12 Mbits/sec     0.448 ms         0/    350 (0%)
    7.0 ~   8.0 sec    499.57 KBytes      4.09 Mbits/sec     0.428 ms         0/    348 (0%)
    8.0 ~   9.0 sec    501.01 KBytes      4.10 Mbits/sec     0.588 ms         0/    349 (0%)
    9.0 ~ 10.0 sec    505.31 KBytes      4.12 Mbits/sec     1.007 ms         0/    352 (0%)
    0.0 ~ 10.0 sec      4.89 MBytes      4.10 Mbits/sec     1.007 ms         0/ 3488 (0%)
  Done: 3488/3488

Press ENTER to continue or type "quit" :

 [ IPERF UDP Server ]
  Connected with client: 192.168.200.1 port 39813
    Interval                 Transfer            Bandwidth            Jitter        Lost/Total Datagrams
    0.0 ~   1.0 sec    492.39 KBytes      4.03 Mbits/sec     0.633 ms         3/    346 (0.87%)
    1.0 ~   2.0 sec    502.44 KBytes      4.11 Mbits/sec     0.402 ms         8/    358 (2.2%)
    2.0 ~   3.0 sec    503.88 KBytes      4.12 Mbits/sec     0.486 ms         7/    358 (2%)
    3.0 ~   4.0 sec    501.01 KBytes      4.10 Mbits/sec     0.627 ms         8/    357 (2.2%)
    4.0 ~   5.0 sec    501.01 KBytes      4.10 Mbits/sec     0.773 ms         7/    356 (2%)
    5.0 ~   6.0 sec    503.88 KBytes      4.13 Mbits/sec     0.404 ms         8/    359 (2.2%)
    6.0 ~   7.0 sec    502.44 KBytes      4.11 Mbits/sec     0.383 ms         7/    357 (2%)
    7.0 ~   8.0 sec    501.01 KBytes      4.10 Mbits/sec     0.487 ms         8/    357 (2.2%)
    8.0 ~   9.0 sec    499.57 KBytes      4.09 Mbits/sec     0.550 ms         8/    356 (2.2%)
    9.0 ~ 10.0 sec    515.36 KBytes      4.16 Mbits/sec     1.931 ms         7/    367 (1.9%)
    0.0 ~ 10.0 sec      4.91 MBytes      4.11 Mbits/sec     1.931 ms        72/ 3573 (2%)
  Done: 3500/3573

Press ENTER to continue or type "quit" : quit

#
```

Remote Iperf UDP Server/Client

```
$ iperf -s -u -i 1
------------------------------------------------------------
Server listening on UDP port 5001
Receiving 1470 byte datagrams
UDP buffer size:    160 KByte (default)
------------------------------------------------------------
[   3] local 192.168.200.1 port 5001 connected with 192.168.200.43 port 50000
[ ID] Interval            Transfer         Bandwidth              Jitter     Lost/Total Datagrams
[   3]    0.0- 1.0 sec      218 KBytes    1.79 Mbits/sec      0.499 ms        0/    152 (0%)
[   3]    1.0- 2.0 sec      215 KBytes    1.76 Mbits/sec      0.465 ms        0/    150 (0%)
[   3]    2.0- 3.0 sec      223 KBytes    1.82 Mbits/sec      0.659 ms        0/    155 (0%)
[   3]    3.0- 4.0 sec      218 KBytes    1.79 Mbits/sec      0.726 ms        0/    152 (0%)
[   3]    4.0- 5.0 sec      221 KBytes    1.81 Mbits/sec      0.606 ms        0/    154 (0%)
[   3]    5.0- 6.0 sec      223 KBytes    1.82 Mbits/sec      0.658 ms        0/    155 (0%)
[   3]    6.0- 7.0 sec      217 KBytes    1.78 Mbits/sec      0.901 ms        0/    151 (0%)
[   3]    7.0- 8.0 sec      214 KBytes    1.75 Mbits/sec      0.799 ms        0/    149 (0%)
[   3]    8.0- 9.0 sec      214 KBytes    1.75 Mbits/sec      0.712 ms        0/    149 (0%)
[   3]    0.0-10.0 sec    2.12 MBytes    1.78 Mbits/sec      0.756 ms        0/ 1513 (0%)
[   4] local 192.168.200.1 port 5001 connected with 192.168.200.43 port 50000
[   4]    0.0- 1.0 sec      468 KBytes    3.83 Mbits/sec      2.071 ms        0/    326 (0%)
[   4]    1.0- 2.0 sec      467 KBytes    3.82 Mbits/sec      2.216 ms        0/    325 (0%)
[   4]    2.0- 3.0 sec      469 KBytes    3.85 Mbits/sec      2.175 ms        0/    327 (0%)
[   4]    3.0- 4.0 sec      468 KBytes    3.83 Mbits/sec      2.077 ms        0/    326 (0%)
[   4]    4.0- 5.0 sec      468 KBytes    3.83 Mbits/sec      2.053 ms        0/    326 (0%)
[   4]    5.0- 6.0 sec      468 KBytes    3.83 Mbits/sec      2.109 ms        0/    326 (0%)
[   4]    6.0- 7.0 sec      467 KBytes    3.82 Mbits/sec      2.329 ms        0/    325 (0%)
[   4]    7.0- 8.0 sec      467 KBytes    3.82 Mbits/sec      2.159 ms        0/    325 (0%)
[   4]    8.0- 9.0 sec      468 KBytes    3.83 Mbits/sec      2.121 ms        0/    326 (0%)
[   4]    9.0-10.0 sec      469 KBytes    3.85 Mbits/sec      2.180 ms        0/    327 (0%)
[   4]    0.0-10.0 sec    4.58 MBytes    3.83 Mbits/sec      2.072 ms        0/ 3268 (0%)
[   3] local 192.168.200.1 port 5001 connected with 192.168.200.43 port 50000
[   3]    0.0- 1.0 sec      469 KBytes    3.85 Mbits/sec      2.106 ms        0/    327 (0%)
[   3]    1.0- 2.0 sec      468 KBytes    3.83 Mbits/sec      2.252 ms        0/    326 (0%)
[   3]    2.0- 3.0 sec      467 KBytes    3.82 Mbits/sec      2.483 ms        0/    325 (0%)
[   3]    3.0- 4.0 sec      469 KBytes    3.85 Mbits/sec      2.064 ms        0/    327 (0%)
[   3]    4.0- 5.0 sec      467 KBytes    3.82 Mbits/sec      2.311 ms        0/    325 (0%)
[   3]    5.0- 6.0 sec      469 KBytes    3.85 Mbits/sec      2.323 ms        0/    327 (0%)
[   3]    6.0- 7.0 sec      468 KBytes    3.83 Mbits/sec      2.198 ms        0/    326 (0%)
[   3]    7.0- 8.0 sec      468 KBytes    3.83 Mbits/sec      2.018 ms        0/    326 (0%)
[   3]    8.0- 9.0 sec      468 KBytes    3.83 Mbits/sec      2.115 ms        0/    326 (0%)
[   3]    9.0-10.0 sec      468 KBytes    3.83 Mbits/sec      2.247 ms        0/    326 (0%)
[   3]    0.0-10.0 sec    4.59 MBytes    3.83 Mbits/sec      2.124 ms        0/ 3271 (0%)


$ iperf -c 192.168.200.43 -u -b 4M -i 1
------------------------------------------------------------
Client connecting to 192.168.200.43, UDP port 5001
Sending 1470 byte datagrams, IPG target: 2940.00 us (kalman adjust)
```

```
UDP buffer size:    160 KByte (default)
------------------------------------------------------------
[  3] local 192.168.200.1 port 56129 connected with 192.168.200.43 port 5001
[ ID] Interval           Transfer       Bandwidth
[  3]   0.0- 1.0 sec     491 KBytes   4.02 Mbits/sec
[  3]   1.0- 2.0 sec     488 KBytes   4.00 Mbits/sec
[  3]   2.0- 3.0 sec     488 KBytes   4.00 Mbits/sec
[  3]   3.0- 4.0 sec     488 KBytes   4.00 Mbits/sec
[  3]   4.0- 5.0 sec     488 KBytes   4.00 Mbits/sec
[  3]   5.0- 6.0 sec     488 KBytes   4.00 Mbits/sec
[  3]   6.0- 7.0 sec     488 KBytes   4.00 Mbits/sec
[  3]   7.0- 8.0 sec     490 KBytes   4.01 Mbits/sec
[  3]   8.0- 9.0 sec     488 KBytes   4.00 Mbits/sec
[  3]   9.0-10.0 sec     488 KBytes   4.00 Mbits/sec
[  3]   0.0-10.0 sec    4.77 MBytes   4.00 Mbits/sec
[  3] Sent 3403 datagrams
[  3] Server Report:
[  3]   0.0-10.0 sec    4.77 MBytes   4.00 Mbits/sec    0.807 ms      0/ 3403 (0%)
```

$ iperf -c 192.168.200.43 -u -b 4.1M -i 1

```
------------------------------------------------------------
Client connecting to 192.168.200.43, UDP port 5001
Sending 1470 byte datagrams, IPG target: 2868.29 us (kalman adjust)
UDP buffer size:    160 KByte (default)
------------------------------------------------------------
[  3] local 192.168.200.1 port 51030 connected with 192.168.200.43 port 5001
[ ID] Interval           Transfer       Bandwidth
[  3]   0.0- 1.0 sec     502 KBytes   4.12 Mbits/sec
[  3]   1.0- 2.0 sec     501 KBytes   4.10 Mbits/sec
[  3]   2.0- 3.0 sec     500 KBytes   4.09 Mbits/sec
[  3]   3.0- 4.0 sec     501 KBytes   4.10 Mbits/sec
[  3]   4.0- 5.0 sec     501 KBytes   4.10 Mbits/sec
[  3]   5.0- 6.0 sec     500 KBytes   4.09 Mbits/sec
[  3]   6.0- 7.0 sec     501 KBytes   4.10 Mbits/sec
[  3]   7.0- 8.0 sec     501 KBytes   4.10 Mbits/sec
[  3]   8.0- 9.0 sec     500 KBytes   4.09 Mbits/sec
[  3]   9.0-10.0 sec     501 KBytes   4.10 Mbits/sec
[  3]   0.0-10.0 sec    4.89 MBytes   4.10 Mbits/sec
[  3] Sent 3488 datagrams
[  3] Server Report:
[  3]   0.0-10.0 sec    4.89 MBytes   4.10 Mbits/sec    1.006 ms      0/ 3488 (0%)
```

$ iperf -c 192.168.200.43 -u -b 4.2M -i 1

```
------------------------------------------------------------
Client connecting to 192.168.200.43, UDP port 5001
Sending 1470 byte datagrams, IPG target: 2800.00 us (kalman adjust)
UDP buffer size:    160 KByte (default)
------------------------------------------------------------
[  3] local 192.168.200.1 port 39813 connected with 192.168.200.43 port 5001
[ ID] Interval           Transfer       Bandwidth
[  3]   0.0- 1.0 sec     515 KBytes   4.22 Mbits/sec
[   3]   1.0- 2.0 sec     512 KBytes   4.20 Mbits/sec
[   3]   2.0- 3.0 sec     512 KBytes   4.20 Mbits/sec
[   3]   3.0- 4.0 sec     512 KBytes   4.20 Mbits/sec
[   3]   4.0- 5.0 sec     512 KBytes   4.20 Mbits/sec
[   3]   5.0- 6.0 sec     512 KBytes   4.20 Mbits/sec
[   3]   6.0- 7.0 sec     512 KBytes   4.20 Mbits/sec
[   3]   7.0- 8.0 sec     514 KBytes   4.21 Mbits/sec
[   3]   8.0- 9.0 sec     512 KBytes   4.20 Mbits/sec
[   3]   9.0-10.0 sec     512 KBytes   4.20 Mbits/sec
[   3]   0.0-10.0 sec   5.01 MBytes   4.20 Mbits/sec
[   3] Sent 3573 datagrams
[   3] Server Report:
[   3]   0.0-10.0 sec   4.91 MBytes   4.11 Mbits/sec    1.930 ms     72/ 3573 (2%)
```

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

A remote server/client application run one server or client. This application is a Linux application and can be executed on Raspberry Pi.

8.2.1 Source files

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

Table 8.2 raspi-atcmd-remote source files

8.2.2 Build

Copy the “atcmd/host/raspi-atcmd-remote” directory to the Raspberry Pi's home directory. And build the remote application with the make command.

```
$ cd $HOME

$ cd raspi-atcmd-remote

$ make clean
```

```
removed 'raspi-atcmd-remote'
```

$ make

```
cc -g -o raspi-atcmd-remote main.c -Wall -Wno-unused-function -DCONFIG_VERBOSE
```

8.2.3 Run

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

```
raspi-atcmd-remote version 1.2.0
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Usage:
    $ ./raspi-atcmd-remote -s [-p <listen_port>] [-u] [-e]
    $ ./raspi-atcmd-remote -c <server_ip> [-p <server_port>] [-u] [-e]

Options:
    -s, --server               run in server mode
    -c, --client #             run in client mode
    -p, --port #               set server port to listen on or connect to (default: 50000)
    -u, --udp                  use UDP
    -e, --echo                 enable echo for received packets (default: off)
    -v, --version              print version information and quit
    -h, --help                 print this message and quit
```

Examples:

Mode	Protocol	Command
Server	TCP	$ ./raspi-atcmd-remote -s -p 50000 [-e]
	UDP	$ ./raspi-atcmd-remote -s -u -p 60000 [-e]
Client	TCP	$ ./raspi-atcmd-remote -c 192.168.200.1 -p 50000 [-e]
	UDP	$ ./raspi-atcmd-remote -c 192.168.200.1 -u -p 60000 [-e]

9 Revision History

Revision No	Date	Comments
1.0	03/28/2019	Initial version for customer release created
1.1	07/02/2019	Sample Applications updated
1.2	08/01/2019	HW Flow Control added
1.3	09/17/2019	Additional AT-commands added
1.4	11/18/2019	Download binary update & remove description wpa security
1.5	02/14/2020	Improved command descriptions
1.6	03/25/2020	SPI connection and CLI application added
1.7	03/31/2020	AT+STXMODE, AT+SRXMODE, AT+SRXAVAIL and AT+SRECV commands removed
1.8	04/07/2020	Socket related events removed and added CLI application updated
1.9	05/15/2020	Ping size parameter removed Test Application added
1.10	05/22/2020	AT+WDHCPS, AT+WSOFTAP commands added
1.11	06/03/2020	AT+SLEEP command added
1.12	07/15/2020	“Chapter 2.2 Building the firmware” added
1.13	08/04/2020	UART default baudrate changed (38400 -> 115200) “4) Run with script file” in chapter 8.1 added
1.14	08/13/2020	BSSID in AT+WCONN command added
1.15	08/24/2020	AT+WROAM command added ROAMING event added
1.16	09/02/2020	AT+WFOTA command added FOTA event added
1.17	10/08/2020	In raspi-atcmd-cli application, Iperf command supported
1.18	11/24/2020	FOTA updated - New events added - Get-bin-crc.sh removed - Update-fota-info.sh added
1.19	06/15/2021	AT+WSTAINFO command added
1.20	06/25/2021	WPA3-OWE/SAE security added
1.21	07/12/2021	AT+WMCS command removed
1.21.1	07/29/2021	Some examples fixed
1.22.0	10/21/2021	AT+SLEEP command removed AT+WSLEEP command added DEEPSLEEP_WAKEUP event added
1.22.1	11/12/2021	Country code added (AU, NZ)
1.22.2	12/16/2021	AT+WFOTA command updated - fota.json file in JSON format that describes new firmware

		- bin_name and bin_crc32 parameters to set new firmware - description and example
1.22.3	02/03/2022	Added setting form enable serial port Change event name from TCP CONNECT to CONNECT
1.22.4	02/25/2022	SCAN_DONE event removed ROAMING event removed CONNECT_SUCCESS event changed CONNECT_FAIL event changed DISCONNECT event changed
1.22.5	03/08/2022	SEND_IDLE event changed SEND_DROP event changed SEND_EXIT event changed SEND_ERROR event changed
1.22.6	03/16/2022	AT+WMCS command added AT+WTXTIME command added AT+WDUTYCYCLE command added AT+WCCATHRESHOLD command added AT+WBSSMAXIDLE command added
1.22.7	03/28/2022	AT+WSCAN SET/GET command added
1.22.8	04/22/2022	AT+WCONN command updated AT+WTIMEOUT command updated AT+SSEND command updated
1.22.9	08/08/2022	AT+WDNS command added AT+SOPEN command updated AT+SSEND command updated AT+SRECV command added AT+SRECVMODE command added AT+SRXLOGLEVEL command removed AT+SRECVINFO command added AT+SADDRINFO command added RECV_READY event added
1.23.0	01/13/2023	AT+WDHCP SET/GET command added DHCP related events added Country code “K1” and “K2” added Test Application updated
1.23.1	03/10/2023	AT+STCPNODELAY command added
1.23.2	03/31/2023	AT+WROAM command removed CONNECT_FAIL event removed STA_CONNECT/STA_DISCONNECT events added
1.23.3	05/04/2023	AT+WCCATHRESHOLD command updated - CCA threshold range changed
1.23.4	06/30/2023	Country code “K0” added

		AT+WTXPOWER command updated AT+WSOFTAP command updated AT+WSLEEP command removed AT+WDEEPSLEEP command added AT+SOPEN command updated AT+SSEND command updated SEND_ERROR/RECV_ERROR events updated SEND_DONE event added
1.24	08/31/2023	AT+UART command updated AT+ADC command removed AT+WTXPOWER command updated AT+WMCS command updated AT+WSCAN command updated AT+WFOTA command updated AT+WBI command added AT+WLI command added AT+WMAXSTA command added AT+WCTX command added AT+STCPKEEPALIVE command added +SEVENT:”CLOSE” event updated +SEVENT:”SEND_ERROR” event updated +SEVENT:”RECV_ERROR” event updated
1.25	10/20/2023	AT+FWUPDATE command added AT+FWBINDL command added AT+WBSSMAXIDLE command updated AT+SSEND command updated AT+WSCANSSID command added AT+WSOFTAPSSID command added AT+SRECV command updated