NRC7292 Evaluation Kit User Guide

(CLI Application)

Ultra-low power & Long-range Wi-Fi

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NEWRACOM, Inc.

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Ultra-low power & Long-range Wi-Fi

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1 Overview

This document introduces NRC7292 command line interface (CLI) application. The user can utilize the CLI application to check basic information for firmware, monitor channel quality; such as: received signal strength indicator (RSSI), signal to noise ratio (SNR), adjust transmit power, and configure NRC7292 to run in specific operating condition. The source code of this application is offered to user's so users can build an executable file suitable for the host.

1.1 Software structure of CLI application

As shown in Figure 1.1, the CLI application is a user-level application program. The CLI application uses Netlink library to communicate with NRC 11ah driver running on a Linux kernel. The CLI command initiated by the user and goes to the NRC 11ah driver and then to NRC7292 via host serial peripheral interface (HSPI).

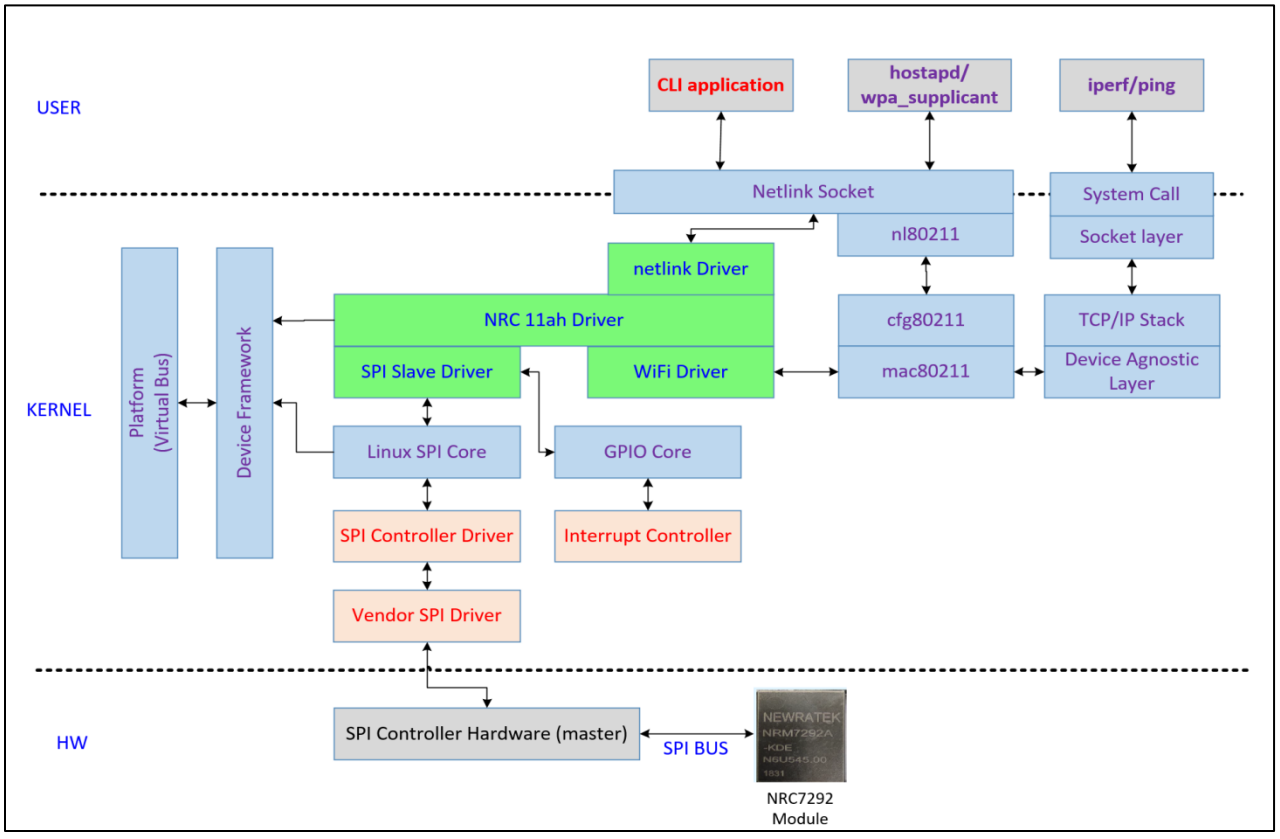


Figure 1.1 Software structure of CLI application

1.2 Build CLI application

A user can build the source code of CLI application with Makefile which is provided along with the source code. Once the user successfully builds it, the user can find "cli_app" executable file in the same directory where the user runs Makefile.

```
pi@raspberrypi:~/cli_app $ make clean; make
rm -f cli_cmd.o cli_netlink.o cli_util.o main.o cli_app
gcc     -c -o cli_cmd.o cli_cmd.c
gcc     -c -o cli_netlink.o cli_netlink.c
gcc     -c -o cli_util.o cli_util.c
gcc     -c -o main.o main.c
gcc cli_cmd.o cli_netlink.o cli_util.o main.o -o cli_app -pthread -lm
```

Figure 1.2 Build CLI application

1.3 Start CLI application

“NRC>” prompt appears if a user executes "cli_app", then the user can enter in a CLI command into the prompt.

```
pi@raspberrypi:~/project/working/NRC_MACSW/host/linux/cli_app $ ./cli_app
=================================================
     Newracom Command Line Application (x.x)
=================================================
NRC>
```

Figure 1.3 Execution of CLI application

"help" is a useful command which displays all the CLI commands with its usages as shown in Figure 1.4.

```
NRC> help
=================================================================================================
 help                                                    :show CLI tree
 exit                                                    :exit program
 show version                                            :show version
 show config [vif_id]                                    :show configuration
 show edca                                               :show EDCA parameters
 show uinfo [vif_id]                                     :show UMAC information
 show ampdu [clear]                                      :show/clear AMPDU count
 show signal [start|stop] [interval] [number]            :show rssi/snr
 show maxagg                                             :show max aggregation
 show duty                                               :show duty cycle
 show autotxgain                                         :show autotxgain
 show cal_use                                            :show cal_use
 show bdf_use                                            :show board data use
 show recovery stats                                     :show recovery
 show detection stats                                    :show detection
 show temp                                               :show temp
 show wakeup_pin                                         :show wakeup pin configuration
 show wakeup_source                                      :show wakeup source configuration
 show stats simple_rx                                    :show received packet information
 show mac clear                                          :clear TX/RX Statistics
 show mac tx stats                                       :show TX Statistics
 show mac tx clear                                       :clear TX Statistics
 show mac rx stats                                       :show RX Statistics
 show mac rx clear                                       :clear RX Statistics
 set gi <short|long|auto>                                :set guard interval
 set maxagg <AC(0-3)> <Max(0-13,0:off)> {size:default=0}:set aggregation
 set config <ack[0,1]> <agg[0,1]> <mcs>                  :set ack, aggregation, mcs
 set rc <on|off> [vif_id] [mode]                         :set rate control
 set duty <on|off> {duty window} {tx duration} {exclude mgmt[0|1]}:set duty cycle
 set cal_use <on|off>                                    :set cal_use
 set bdf_use <on|off>                                    :set board data use
 set txpwr <value(1~30)>                                 :set txpwrt
 set wakeup_pin {Debounce:on|off} {PIN Number:0~31}      :set wakeup pin for deepsleep
 set wakeup_soruce rtc gpio hspi                         :set wakeup source for deepsleep
 set addba [tid] {mac address}                           :set addba tid / send addba with mac address
 set delba [tid] {mac address}                           :set delba tid / send delba with mac address
 set rts <on|off|default> <threshold> <vif_id>           :set rts on/off
 test mcs <mcs value>                                    :set mcs
 test country JP <CS time> <Blank time> or <show>        :set/show tx time control for JP(Japan)
=================================================================================================
OK
```

Figure 1.4 "help" CLI command

To stop the CLI application, a user can use "exit" command.

```
NRC> exit
================================================
      Exit Newracom Command Line Application
================================================
pi@raspberrypi:~/cli_app $
```

Figure 1.5 Exit of CLI application

2 CLI Commands

The categories of CLI commands is described in the below. The user can use the phy, set, and test CLI commands only for test purposes.

Table 2.1 Category of CLI commands

Category	Description
show	display statistics, status, signal, etc.
set	set MAC-layer parameters
test	set test parameters
read	read memory
gpio	write/read gpio, set gpio dirction & pullup

2.1 show

2.1.1 show version

Display Firmware version, gerrit/master number and board revision

Parameters

N/A

2.1.2 show config [vif_id]

Display device configurations including device mode, MAC address, frequency, bandwidth, etc.

Parameters

vif_id : interface ID (default 0, vif_id can be 0 or 1 when the concurrent mode is enabled)

2.1.3 show edca

Display EDCA parameters per access category (AC)

Parameters

N/A

2.1.4 show uinfo [vif_id]

Display 11ah capability information

Parameters

vif_id : interface ID (default 0, vif_id can be 0 or 1 when the concurrent mode is enabled)

2.1.5 show ampdu [clear]

Display statistics for aggregated MPDU (AMPDU)

Parameters

clear : clear all statistics

2.1.6 show signal [start|stop] [interval] [number]

Display channel quality information (RSSI and SNR)

Parameters

start : start periodic display with interval (Ex. show signal start 1: display RSSI & SNR every 1 second)
stop : stop displaying
interval : period in second unit (default 1 second)
number : number of samples to display

Returns

```
NRC> show signal
MAC addr: 00:10:40:39:78:62     rssi    :9              snr     :29
MAC addr: 02:00:eb:1a:ce:6b     rssi    :11             snr     :26
OK
```

Total : total number of samples displayed
average : average value of RSSI and SNR
std_dev : standard deviation

```
NRC> show signal start
OK
NRC> 0 [ 00:10:40:39:78:62] rssi:9      snr:29
1 [ 02:00:eb:1a:ce:6b] rssi:11  snr:26

show signal stop
OK
NRC> ----------------------
[Total]    : 1
[RSSI]
 average   : 9.000
 std_dev   : 0.000
[SNR]
 average   : 29.000
 std_dev   : 0.000
----------------------
----------------------
[Total]    : 1
[RSSI]
 average   : 11.000
 std_dev   : 0.000
[SNR]
 average   : 26.000
 std_dev   : 0.000
----------------------
```

2.1.7 show maxagg

Display aggregation status per AC

Parameters

N/A

```
NRC> show maxagg
[STA AID:    1]
AC_BK: OFF (16, 0bytes), BA session: NO
AC_BE: OFF (16, 0bytes), BA session: YES
AC_VI: OFF (16, 0bytes), BA session: NO
AC_VO: OFF (16, 0bytes), BA session: YES
OK
```

2.1.8 show duty

Show status of duty cycle function

If it is on, it shows duty window, tx duration, and remain tx duration time in usec

※ This command only could be applied for Japan promotion council.

Parameters

N/A

Returns

Duty cycle : off

or

Duty cycle : on

Duty window : 60000000

Tx duration : 5000000

Remain tx duration : 5000000

2.1.9 show autotxgain

Show status of autotxgain function

If it is on, it shows Tx power index for each MCS

Parameters

N/A

Auto txgain : off

or

Auto txgain : on

Tx power index for MCS 0 : 22

Tx power index for MCS 1 : 21

Tx power index for MCS 2 : 20

Tx power index for MCS 3 : 19

Tx power index for MCS 4 : 19

Tx power index for MCS 5 : 18

Tx power index for MCS 6 : 17

Tx power index for MCS 7 : 16

Tx power index for MCS 10 : 23

2.1.10 show cal_use

Display RF calibration usage status

Parameters

N/A

2.1.11 show bdf_use

Display Board Data usage status

Parameters

N/A

2.1.12 show recovery stats

The count statistics of recovery function entered

Parameters

N/A

2.1.13 show detection stats

The count statistics of detection function entered, which are tx triggered

Parameters

N/A

2.1.14 show temp

The temperature of temperature sensor. If temperature sensor is not existed, it displays Not Support'.

Parameters

N/A

```
NRC> show temp
Temperature                     : Not Support
OK
```

2.1.15 show wakeup_pin

Get configuration of wakeup gpio pin from deep sleep mode

Parameters

N/A

```
NRC> show wakeup_pin
Debounce : on                   Pin number : 15
OK
```

2.1.16 show wakeup_source

Get configuration of wakeup source from deep sleep mode

Parameters

N/A

```
NRC> show wakeup_source
Wakeup source                    : RTC GPIO HSPI
OK
```

2.1.17 show stats simple_rx

Display received packet information

Parameters

N/A

Returns

RSSI : received signal strength indication

CS_Cnt : number of carrier sense counted

PSDU_Succ : number of PSDU count successfully received (SIG CRC OK)

MPDU_Rcv : number of MPDU count received

MPUD_Succ : number of MPDU count successfully received (FCS OK)

SNR : signal to noise ratio

※ The PSDU_Succ counts NDP packets. However, the MPDU_Rcv does not count NDP packet. In addition, The PSDU_Suss regards A-MPDU packet as 1 packet.

```
NRC> show stats simple_rx
-------------------------------------------------
RSSI                             : -22
CS_Cnt                           : 379875
PSDU_Succ                        : 693188
MPDU_Rcv                         : 395994
MPDU_Succ                        : 390051
SNR                              : 37
-------------------------------------------------
OK
```

2.1.18 show mac clear

Clear MAC-layer TX and RX statistics

Parameters

N/A

2.1.19 show mac tx stats

Display MAC-layer TX statistics

Parameters

N/A

Returns

```
NRC> show mac tx stats
-------------------------------------------------------------------------
 MAC TX Statistics (OK count:137, RTX count:22, last MCS:7)
-------------------------------------------------------------------------
- AC[BK]        : OK(         0/         0)  RTX(         0/         0)
- AC[BE]        : OK(        31/      5819)  RTX(         7/       917)
- AC[VI]        : OK(         0/         0)  RTX(         0/         0)
- AC[VO]        : OK(       106/      4658)  RTX(        15/       492)
- AC[BC]        : OK(         0/         0)  RTX(         0/         0)
- AC[GP]        : OK(         0/         0)  RTX(         0/         0)
-------------------------------------------------------------------------
- TYPE[MGMT]    : OK(        49/      2812)  RTX(         3/       180)
- TYPE[CTRL]    : OK(         0/         0)  RTX(         0/         0)
- TYPE[DATA]    : OK(        88/      7665)  RTX(        19/      1229)
- TYPE[BEAC]    : OK(         0/         0)  RTX(         0/         0)
-------------------------------------------------------------------------
- MCS[ 0]       : OK(         4/       384)  RTX(         2/       232)
- MCS[ 1]       : OK(         0/         0)  RTX(         0/         0)
- MCS[ 2]       : OK(         0/         0)  RTX(         0/         0)
- MCS[ 3]       : OK(         0/         0)  RTX(         0/         0)
- MCS[ 4]       : OK(         0/         0)  RTX(         0/         0)
- MCS[ 5]       : OK(         0/         0)  RTX(         0/         0)
- MCS[ 6]       : OK(         0/         0)  RTX(         0/         0)
- MCS[ 7]       : OK(        76/      5964)  RTX(        17/       997)
- MCS[10]       : OK(        57/      4129)  RTX(         3/       180)
-------------------------------------------------------------------------
OK
```

OK (number of packets successfully transmitted / total aggregated bytes successfully transmitted)

RTX (number of packets retransmitted / total aggregated bytes retransmitted)

※ AC[GP] : GP stands for general purpose. This is used to send a frame which is the highest priority. This is a vendor-specific function.

2.1.20 show mac rx stats

Display MAC-layer RX statistics

Parameters

N/A

Returns

```
NRC> show mac rx stats
-------------------------------------------------------------------------
 MAC RX Statistics (OK count:159, NOK count:1, last MCS:8)
-----------------+-------------------------------+-------------------------
- AC[BK]         : OK(          0/          0) | NOK(          0/          0)
- AC[BE]         : OK(         12/       1134) | NOK(          1/        101)
- AC[VI]         : OK(          0/          0) | NOK(          0/          0)
- AC[VO]         : OK(          0/          0) | NOK(          0/          0)
- AC[BC]         : OK(        147/       4232) | NOK(          0/          0)
- AC[GP]         : OK(          0/          0) | NOK(          0/          0)
-----------------+-------------------------------+-------------------------
- TYPE[MGMT]     : OK(          0/          0) | NOK(          0/          0)
- TYPE[CTRL]     : OK(          0/          0) | NOK(          0/          0)
- TYPE[DATA]     : OK(         12/       1134) | NOK(          1/        101)
- TYPE[BEAC]     : OK(        147/       4232) | NOK(          0/          0)
-----------------+-------------------------------+-------------------------
- MCS[ 0]        : OK(          0/          0) | NOK(          1/        101)
- MCS[ 1]        : OK(          0/          0) | NOK(          0/          0)
- MCS[ 2]        : OK(          0/          0) | NOK(          0/          0)
- MCS[ 3]        : OK(          0/          0) | NOK(          0/          0)
- MCS[ 4]        : OK(          0/          0) | NOK(          0/          0)
- MCS[ 5]        : OK(          3/        304) | NOK(          0/          0)
- MCS[ 6]        : OK(          6/        606) | NOK(          0/          0)
- MCS[ 7]        : OK(          1/        101) | NOK(          0/          0)
- MCS[10]        : OK(        148/       4356) | NOK(          0/          0)
-----------------+-------------------------------+-------------------------
OK
```

OK (number of packets successfully received / total aggregated bytes successfully received)

NOK (number of packets received but discarded / total aggregated bytes discarded)

※ NOK : Even though the MPDU is successfully received, it can be discarded due to duplication or address mismatch.

2.1.21 show mac tx clear

Clear MAC-layer TX statistics

Parameters

N/A

2.1.22 show mac rx clear

Clear MAC-layer RX statistics

Parameters

N/A

2.2 set

2.2.1 set gi <short|long|auto>

Set Guard Interval

Parameters

short : Short Guard Interval

long : Long Guard Interval (default)

auto : Change the guard interval from long to short automatically in MCS7

2.2.2 set maxagg <ac> <maxagg> {options}

Set maximum number of MPDU of AC in AMDPU

```
(AP)
set maxagg ac maxagg                // set maxagg for all-sta
set maxagg ac maxagg maxsize    // set maxagg and maxsize for all-sta
set maxagg ac maxagg vif aid      // set maxagg for specifi aid

(STA)
set maxagg ac maxagg                //set maxagg
set maxagg ac maxagg maxsize    //set maxagg and maxsize
```

Parameters

ac : access category

maxagg : number of MPDU in AMPDU (0-8(1Mhz), 0-16(2,4Mhz), 0: off)

maxsize: aggregation threshold size (default : 0)

vif : virtue interface identification

aid: association identification

2.2.3 set config <ack> <agg> <mcs>

Set MAC-layer configuration

Parameters

ack : ack mode (0: no ack, 1: ndp ack, 2: normal ack) (default: ndp ack)

agg : aggregation (AMPDU) (0: off, 1:on)

mcs: 0~7, 10 (10 can be used only in 1MHz bandwidth)

2.2.4 set rc <on|off> [vif_id]

rate control on / off

Parameters

on : enable rate control (automatic selection of MCS based on the link condition) (default)

off : disable rate control (user can select MCS manually by using “test mcs” command)

2.2.5 set duty <on|off> {duty window in usec} {tx duration in usec} {exclude mgmt}

Set duty cycle

Parameters

on|off : enable|disable duty cycle function (default; off)

duty window : specify duty cycle window in usec. (default: 60 sec)

tx duration : specify allowed tx duration within duty cycle window in usec. (default: 5 sec)

exclude mgmt : 0 (MGMT Frmae not sent after duty cycle) or 1 (MGMT Frame sent after duty cycle)

(ex) duty window 10000000 (10sec) and tx duration 1000000 (1sec) will be set to access the channel 1 second during every 10 seconds.

※ This command only could be applied for japan.

2.2.6 set cal_use <on|off>

Set RF calibration usage on|off, if avaliable RF calibration is existed.

Parameters

on|off : enable|disable RF calibration usage

2.2.7 set bdf_use <on|off>

Set board data usage on|off

Parameters

on|off : enable|disable board data usage

2.2.8 set txpwr <value>

Set tx power

Parameters

value : 1~20

※ This command only could be applied when autotxgain is off.

2.2.9 set wakeup_pin <debounce> <pin index>

Configure a wakeup-gpio-pin when system state is uCode or deepsleep

Parameters

debounce : on|off

pin index : 0~31

2.2.10 set wakeup_source <wakeup_sources>

Configure wakeup sources when system state is deepsleep.

Parameters

wakeup_sources : rtc gpio hspi

※ It is possible to assign multiple sources (ex) set wakeup_source rtc gpio

2.2.11 set addba [tid] {mac address}

set addba tid / send addba with mac address

Parameters

tid: Traffic Identifier

mac address : mac address

2.2.12 set delba [tid] {mac address}

set delba tid / send delba with mac address

Parameters

tid: Traffic Identifier

mac address : mac address

2.2.13 set rts <on|off|default> <threshold> <vif_id>

Enable/disable RTS, set RTS threshold

Parameters

threshold : RTS & CTS threshold in Byte

vif_id : virtue interface identification

Ex1) send RTS regardless of packet length (set rts on 0 0)

Ex2) no use of RTS (set rts off 0 0)

Ex3) set RTS threshold (set rts default 1000 0)

2.2.14 set tx_time <CS time> <Blank time>

set tx_time about <CS time> <Blank time>

Parameters

CS time: Carrier sensing time. Listen before talk (in us)

Blank time: Tx pause time (in us)

2.2.15 set drop [vif id] [mac address] {on|off}

set drop frames from configured mac address

Parameters

vif_id : virtue interface identification

mac address: drop frames from mac address

on|off: Enable disable drop mac address

2.2.16 set tsensor [GPIO for SCL] [GPIO for SDA]

set temperature sensor scl, sda

Parameters

SCL: GPIO for SCL (default 31)

SDA: GPIO for SDL (default 30)

2.2.17 set self_config {Country(KR,US...)}{BW}{dwell time}

set self_config

Parameters

country : Country Code

BW: scan channel bandwidth (1M, 2M, 4M)

dwell time: scan time for CCA (10 ~ 1000 ms)

2.3 test

2.3.1 test mcs <value>

Set MCS

Parameters

value : 0~7, 10 (10 can be used only in 1MHz bandwidth)

2.3.2 test country jp <CS time> <Blank time>

Set carrier sense time and blank time

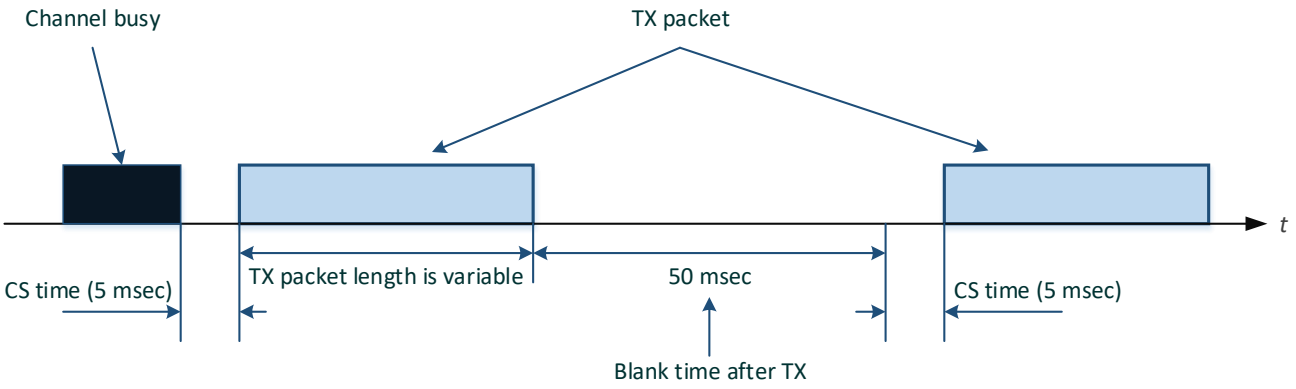
Parameters

CS time : 0~12,480 (unit in us, default is 5,000 meaning 5 ms)

Blank time : 0~4,294,967,295 (unit in us, default is 50,000 meaning 50 ms)

The CS time is the time radio equipment should wait and monitor the channel to confirm that the channel is idle (no equipment uses) before sending a transmit packet. The blank time is the time that radio equipment shall wait for the consecutive transmission after transmitting a packet.

※ This command only could be applied for Japan promotion council.



2.4 gpio

The GPIO CLI commands listed below can be used to configure GPIO options to read from and write to GPIO pins. Note that GPIO command usage is valid for non-dedicated GPIO pins only. Refer to the NRC7292 Technical Reference Manual for the list of dedicated GPIO pins.

2.4.1 gpio read <pin index>

Read the value (0: low / 1: high) from a GPIO pin.

Parameters

pin index: GPIO pin index

2.4.2 gpio write <pin index> <value>

Write a value (0: low / 1: high) to a GPIO pin.

Parameters

pin index: GPIO pin index

value: 0: low / 1: high

2.4.3 gpio direction <pin index> {direction}

Get or set the direction (0: input / 1: output) of a GPIO pin.

Parameters

pin index: GPIO pin index

(For set command only) direction: 0: input / 1: output

2.4.4 gpio pullup <pin index> {pull-up option}

Get or set the pull-up option (0: disable / 1: enable) for a GPIO pin.

Parameters

pin index: GPIO pin index

(For set command only) pull-up option: 0: disable / 1: enable

3 Revision History

Revision No	Date	Comments
Ver 1.0	02/26/2019	Initial version for customer release created
Ver 1.1	03/25/2019	Add CLI commands (2.1.2, 2.1.3, 2.1.4, 2.1.5, 2.1.6, 0, 0, 0, 0, 2.1.22, 2.1.18,2.2.1, 2.2.2) Removed CLI commands (“show rx <start | stop> <duration>”, “phy txpower <value>”)
Ver 1.2	10/03/2019	CLI commands description updated
Ver 1.3	11/01/2019	Add set duty, show duty, set autotxgain, show autotxgain commands
Ver 1.4	11/18/2019	Add response example about show 27ignal start/stop
Ver 1.5	12/05/2019	Add response example about set cal_use & show cal_use
Ver 1.6	12/13/2019	Add ‘auto’ option for “set gi <short|long|auto>” command
Ver 1.7	12/19/2019	Add “test recovery <interval> <count>”, “show recovery stats”, “show detection stats” command Add parameter for “set maxagg {ac} {maxagg} {size(optional, 0: default)}” and “set txpwr [val]”
Ver 1.8	12/27/2019	Add ‘test assert’ option for recovery testing
Ver 1.9	01/17/2020	Add gpio, gprf commands
Ver 1.10	04/13/2020	Remove a ‘set autotxgain’ command
Ver 1.11	04/22/2020	Add ‘show temp’
Ver 1.12	05/30/2020	Add ‘set/show wakeup_pin’, ‘set/show wakeup_source’
Ver 1.13	08/03/2020	Add ‘set/show bdf_use’, ‘test ucode’
Ver 1.14	03/10/2021	2.2.21 set rst and 2.3.5 test country jp commands added
Ver 1.15	04/13/2021	Remove gpio/gprf, test recovery/ucode/assert
Ver 1.16	10/19/2021	Add gpio command Update maxagg command
Ver 1.17	12/10/2021	Update maxagg paramter range
Ver 1.18	12/10/2021	set txpwr value range