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NRC7394 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 NRC7394 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 NRC7394 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 NRC7394 via host serial peripheral interface (HSPI).

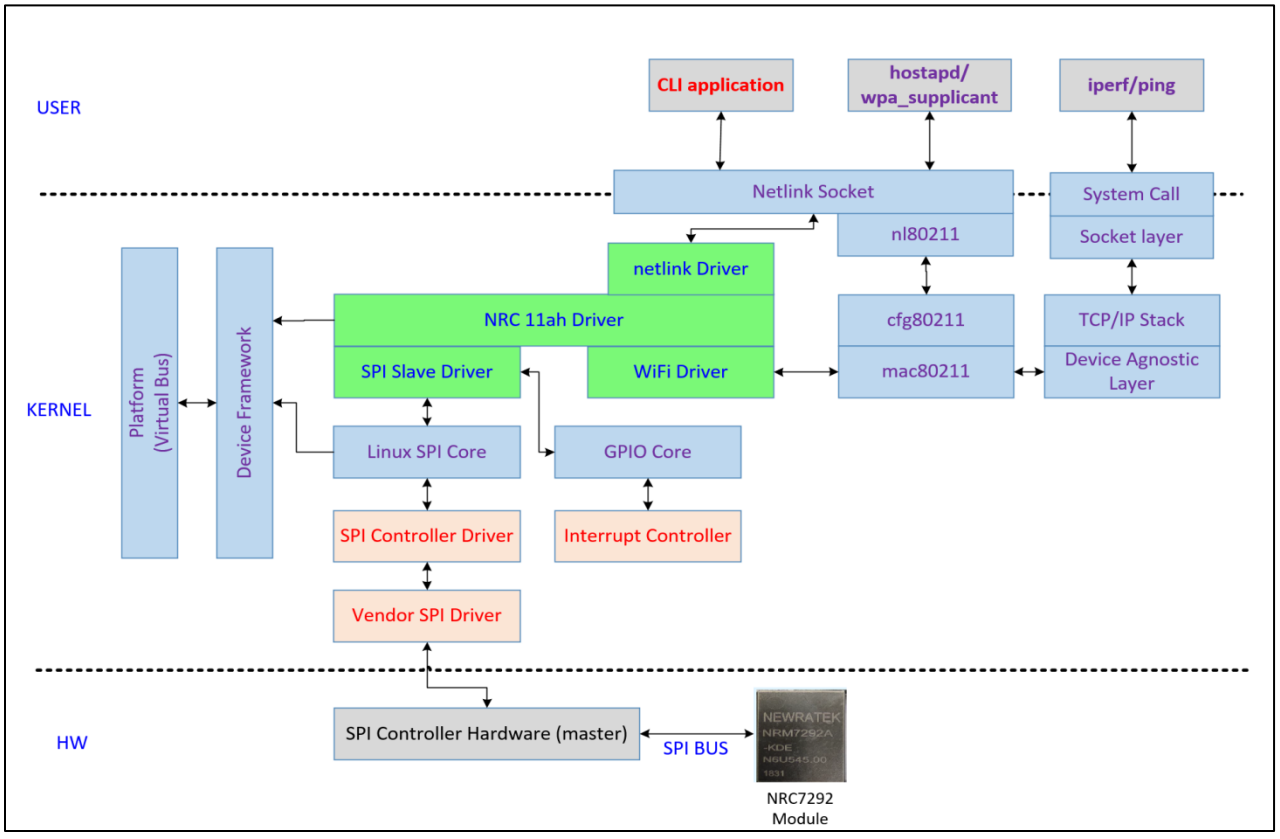

Figure 1.1 Software structure of CLI application

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
libcli_app.a
cli_app
pi@raspberrypi:~/cli_app $
```

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:~/nrc_pkg/script $ ./cli_app
=================================================
    Newracom Command Line Application (2.10.1)
=================================================
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
 write <address> <data>                                                  :write a 32-bit value to memory
 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 | show ampdu clear                                           :show/clear AMPDU count
 show signal {start|stop} [interval] [number]                            :show rssi/snr, {options} are only valid in cli_app prompt
 show maxagg                                                             :show max aggregation
 show duty                                                               :show duty cycle
 show autotxgain                                                         :show autotxgain
 show cal_use                                                            :show cal_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 sta [vif_id] {all|aid [aid_index]}                                 :show station information
 show tx_time                                                            :show tx_time about <CS time> <Blank time>
 show cca_thresh                                                         :show cca_thresh(unit: dBm)
 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(0-8(1Mhz),0-16(2,4Mhz),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} {duty margin}             :set duty cycle
 set cal_use {on|off}                                                    :set cal_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
 set tx_time <CS time> <Blank time>                                      :set tx_time about <CS time> <Blank time>
 set drop [vif id] [mac address] {on|off}                                :set drop frames from configured mac address
 set tsensor [GPIO for SCL] [GPIO for SDA]                               :set temperature sensor scl, sda
 set self_config {Country(KR,US...)}{BW}{dwell time}                     :set self_config
 set cca_thresh {CCA threshold(unit:dBm, -100~-70)}                      :set cca threshold
 test mcs [mcs index]                                                    :set mcs
 gpio read [pin number]                                                  :gpio read
 gpio write [pin number] [0|1]                                           :gpio write
 gpio direction [pin index] {[0(input)|1(output)]}                       :read/write gpio direction
 gpio pullup [pin index] {[0(off)|1(on)]}                                :read/write gpio pullup enable|disable
=================================================================================================================================
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:~/nrc_pkg/script $
```

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
write	Write a 32-bit value to 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 sta [vif id] <all|aid <aid index>>

Display station information including TX/RX phy rate

Parameters

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

all | aid <aid index> : 'all' shows information of whole connected stations. 'aid <aid index>' shows information of the specified station.

2.1.7 show ap [vif id]

Display ap information including TX/RX phy rate

Parameters

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

2.1.8 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 : 8c:0f:fa:00:2b:0e    rssi     : 9          snr      : 25
OK
```

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

```
NRC> show signal start
OK
NRC> Mac Addr : 8c:0f:fa:00:2b:0e       rssi: 9         snr: 26

Mac Addr : 8c:0f:fa:00:2b:0e    rssi: 9         snr: 26

Mac Addr : 8c:0f:fa:00:2b:0e    rssi: 9         snr: 26

Mac Addr : 8c:0f:fa:00:2b:0e    rssi: 9         snr: 26

show signal stop
-------------------------------------------------
[MAC Addr]: 8c:0f:fa:00:2b:0e
[Total]   : 23
[RSSI]
 average  : 1.565
 std_dev  : 3.411
[SNR]
 average  : 4.522
 std_dev  : 9.855
-------------------------------------------------
OK
```

2.1.9 show maxagg

Display aggregation status per AC

Parameters

N/A

```
NRC> show maxagg
AC_BK: OFF
AC_BE:  ON (16,    0 bytes)
AC_VI: OFF
AC_VO: OFF
OK
```

2.1.10 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

Parameters

N/A

Returns

Duty cycle : off

or

Duty cycle : on
Duty window : 60000000
Tx duration : 5000000
Remain tx duration : 5000000

2.1.11 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

2.1.12 show cca_thresh

Display CCA threshold value

Parameters

N/A

```
NRC> show cca_thresh
-70
OK
```

2.1.13 show recovery stats

The count statistics of recovery function entered

Parameters

N/A

2.1.14 show detection stats

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

Parameters

N/A

2.1.15 show temp

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

Parameters

N/A

```
NRC> show temp
Temperature                    : 0x21(33)
OK
```

2.1.16 show tx_time

Show tx_time parameters.

Parameters

N/A

```
NRC> show tx_time
CS time                        : 988
TX delay                       : 100
OK
```

2.1.17 show wakeup_pin

Get configuration of wakeup gpio pin from deep sleep mode

Parameters

N/A

```
NRC> show wakeup_pin
Debounce : off                 Pin number : 11
OK
```

2.1.18 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
```

2.1.19 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                            : -27
CS_Cnt                          : 595182
PSDU_Succ                       : 2603
MPDU_Rcv                        : 1134
MPDU_Succ                       : 1046
SNR                             : 31
-------------------------------------------------
OK
```

2.1.20 show mac clear

Clear MAC-layer TX and RX statistics

Parameters

N/A

2.1.21 show mac tx stats

Display MAC-layer TX statistics

Parameters

N/A

Returns

```
NRC> show mac tx stats
-------------------------------------------------------------------------
 MAC TX Statistics (OK count:24728, RTX count:259, last MCS:0)
-------------------------------------------------------------------------
- AC[BK]        : OK(          0/          0)  RTX(          0/          0)
- AC[BE]        : OK(        228/      28426)  RTX(        214/      25084)
- AC[VI]        : OK(          0/          0)  RTX(          0/          0)
- AC[VO]        : OK(        823/      84826)  RTX(         45/       4565)
- AC[BC]        : OK(      23677/     805039)  RTX(          0/          0)
- AC[GP]        : OK(          0/          0)  RTX(          0/          0)
-------------------------------------------------------------------------
- TYPE[MGMT]    : OK(        820/      83730)  RTX(         45/       4565)
- TYPE[CTRL]    : OK(          0/          0)  RTX(          0/          0)
- TYPE[DATA]    : OK(        231/      29522)  RTX(        214/      25084)
- TYPE[BEAC]    : OK(      23678/     805066)  RTX(          0/          0)
-------------------------------------------------------------------------
- MCS[ 0]       : OK(        168/      19824)  RTX(         36/       4248)
- MCS[ 1]       : OK(          0/          0)  RTX(          0/          0)
- MCS[ 2]       : OK(         37/       6168)  RTX(          0/          0)
- MCS[ 3]       : OK(          0/          0)  RTX(          0/          0)
- MCS[ 4]       : OK(          0/          0)  RTX(         59/       6962)
- MCS[ 5]       : OK(          0/          0)  RTX(         55/       6490)
- MCS[ 6]       : OK(          0/          0)  RTX(          4/        472)
- MCS[ 7]       : OK(          0/          0)  RTX(         57/       6726)
- MCS[10]       : OK(      24525/     892353)  RTX(         48/       4751)
-------------------------------------------------------------------------
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.

2.1.22 show mac rx stats

Display MAC-layer RX statistics

Parameters

N/A

Returns

```
NRC> show mac rx stats
-------------------------------------------------------------------------
 MAC RX Statistics (OK count:4673, NOK count:12, last MCS:10)
-------------------------------------------------------------------------
- AC[BK]         : OK(          0/          0)  NOK(          0/          0)
- AC[BE]         : OK(       3778/    5319311)  NOK(         12/      16672)
- AC[VI]         : OK(          0/          0)  NOK(          0/          0)
- AC[VO]         : OK(        895/      38776)  NOK(          0/          0)
- AC[BC]         : OK(          0/          0)  NOK(          0/          0)
- AC[GP]         : OK(          0/          0)  NOK(          0/          0)
------------------------------------------------------------------------------
- TYPE[MGMT]     : OK(        889/      38332)  NOK(          0/          0)
- TYPE[CTRL]     : OK(          0/          0)  NOK(          0/          0)
- TYPE[DATA]     : OK(       3784/    5319755)  NOK(         12/      16672)
- TYPE[BEAC]     : OK(          0/          0)  NOK(          0/          0)
------------------------------------------------------------------------------
- MCS[ 0]        : OK(         58/      17980)  NOK(          0/          0)
- MCS[ 1]        : OK(          1/        130)  NOK(          0/          0)
- MCS[ 2]        : OK(         21/      31710)  NOK(          0/          0)
- MCS[ 3]        : OK(          5/       6114)  NOK(          0/          0)
- MCS[ 4]        : OK(         29/      43790)  NOK(          0/          0)
- MCS[ 5]        : OK(         11/      12318)  NOK(          1/       1510)
- MCS[ 6]        : OK(        137/     206870)  NOK(          3/       4530)
- MCS[ 7]        : OK(       3488/    4997538)  NOK(          7/      10570)
- MCS[10]        : OK(        923/      41637)  NOK(          1/         62)
------------------------------------------------------------------------------
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.

2.1.23 show mac tx clear

Clear MAC-layer TX statistics

Parameters

N/A

2.1.24 show mac rx clear

Clear MAC-layer RX statistics

Parameters

N/A

2.1.25 show self_config <Country> <BW> <dwell time>

Show self config

Parameters

Country : Country Code. KR, US, EU……

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

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

2.2 set

2.2.1 set gi <short|long|auto> [vif_id]

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

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

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 ack_mode {mode}

Set ACK mode

Parameters

mode: no|ndp|normal|show

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)

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

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

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)

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

2.2.6 set cca_thresh <value>

set CCA threshold value

Parameters

value: CCA threshold value (-85 dbm ~ -76 dbm)

```
NRC> set cca_thresh -70
-70
OK
```

2.2.7 set txpwr <value>

Set tx power

Parameters

value : 1~20

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

2.2.8 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

2.2.9 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

2.2.10 set addba [tid] {mac address}

set addba tid / send addba with mac address

Parameters

tid: Traffic Identifier

mac address : mac address

2.2.11 set delba [tid] {mac address}

set delba tid / send delba with mac address

Parameters

tid: Traffic Identifier

mac address : mac address

2.2.12 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)

2.2.13 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)

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

set drop frames from configured mac address

Parameters

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

mac address: drop frames from mac address

on|off: Enable disable drop mac address

2.2.15 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)

2.2.16 set self_config <Country> <BW> <dwell time>

set self_config

Parameters

Country : Country Code. KR, US, EU……

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)

2.4 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	4/5/2023	Initial version