

# User Guide

## (簡易使用手冊)

產品名稱 (Product)	<u>Demo Board for MDBT42Q-AT2 / PAT2</u> <u>in <b>Peripheral / Slave</b> role</u>
產品型號 (Model No.)	<u><b>MDBT42Q – AT2 – UART – S</b></u>
韌體版本 (FW Rev.)	<u>1.5</u>

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# 1. Introduction

This document shows how to use the demo board (MDBT42Q-AT2-UART-S) to test function of MDBT42Q-AT2 & MDBT42Q-PAT2.

MDBT42Q-AT2-UART-S is designed for testing and debugging without building your own board. The board is only available with MDBT42Q-AT2 (chip antenna) module. MDBT42Q-AT2 will be pre-programmed with Raytac's AT command firmware. If you don't need such pre-programming and is looking for nRF52810 module, please check MDBT42Q-192KV2 & MDBT42Q-P192KV2.

Please visit our [website](#) for spec sheet of every module mentioned above.

## 1.1. Contents of the Set

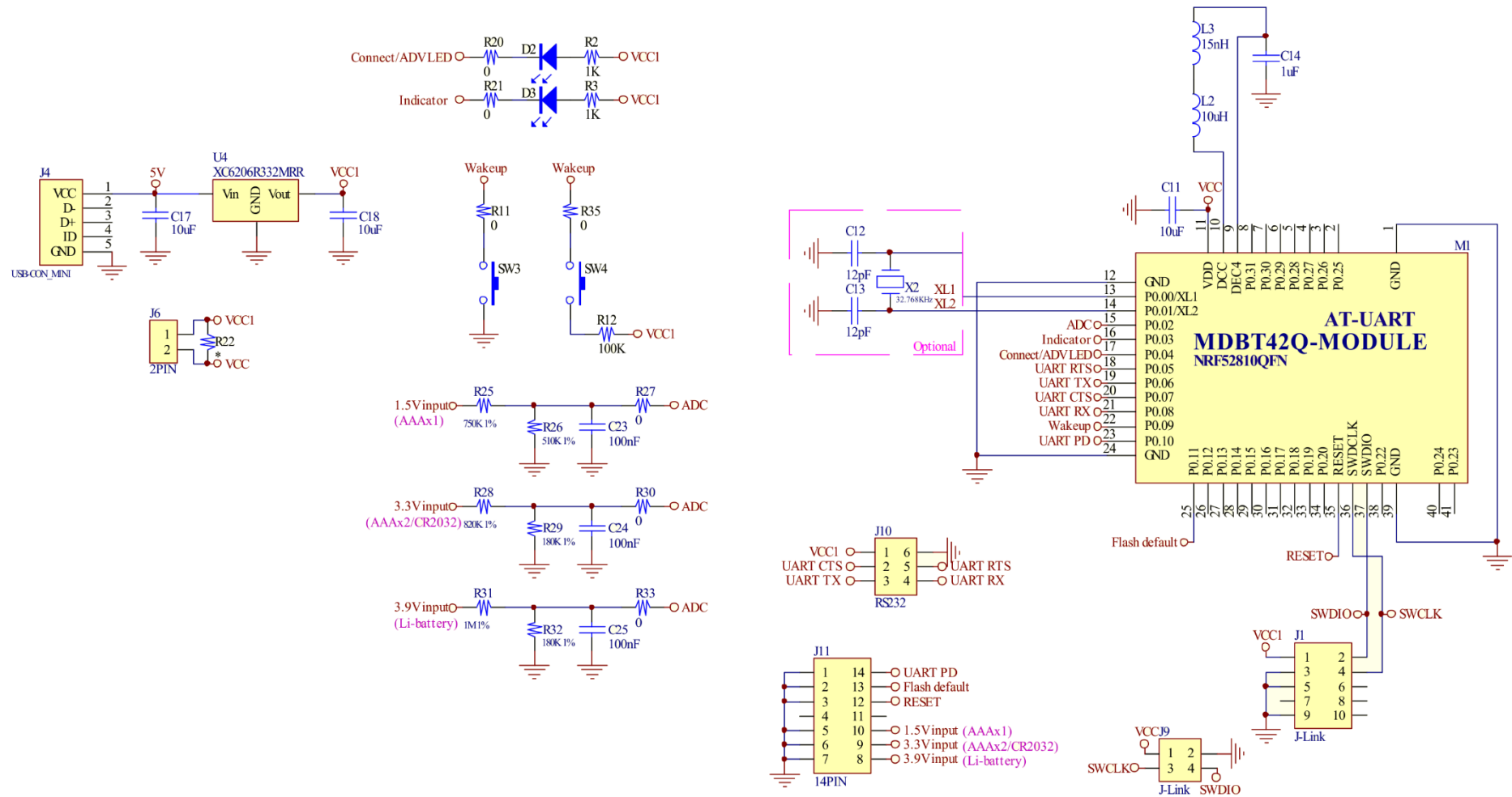
Each set includes MDBT42Q-AT2-UART-S x 1 and mini-USB cable x 1. Please contact us if the set you receive is not complete.





- (8) Debug Interface, connecting to Nordic's nRF5X DK.  
***Important: Please be careful not to "erase" the module during testing. Raytac's AT command firmware will not be shared. You may need to send the unit to us for re-programming when module's FW is erased.***
- (9) 3.3V LDO to power up MDBT42Q-AT2.
- (10) LED for status indicator
- (11) USB Power only

# 3. Reference Circuit



# 4. AT Command

## 4.1. List of supported commands

- Setting of device name
- Choose data rate of 1Mbps or 2Mbps on-air
- Set TX output power in 5 levels.
- Set advertising time
- Set connection interval under Mode 2
- Enable/disable advertising
- Set LED pattern indicating advertising or connecting status
- 7 sets of UART baud rates
- Enable/disable UART flow control
- Enable/disable interface of UART hardware
- Support 8 programmable output GPIO
- Power-down mode for power saving and GPIO wake-up
- Support DC-to-DC and LDO power mode
- Use internal or external 32.768KHz oscillator
- Recover-to-default setting with hardware and software method
- System reset of hardware and software
- Set serial number and retrieve
- Set or retrieve MAC Address
- Retrieve ADC value for battery detection, delivering the information through battery service.
- Support maximum MTU 247bytes / data payload up to maximum 244 bytes.

## 4.2. AT Command Sets

### 4.2.1. “Write” Commands

No.	Command	Description
(1)	<b>AT+NAME</b>	Set device name,Max. length of 20 characters e.g. AT+NAME123 (device name 123, 3 characters)
(2)	<b>AT+BAUDRATE9600</b>	Set UART baud rate at 9600 bps,n,8,1
(3)	<b>AT+BAUDRATE19200</b>	Set UART baud rate at 19200 bps,n,8,1
(4)	<b>AT+BAUDRATE38400</b>	Set UART baud rate at 38400 bps,n,8,1
(5)	<b>AT+BAUDRATE57600</b>	Set UART baud rate at 57600 bps,n,8,1
(6)	<b>AT+BAUDRATE115200</b>	Set UART baud rate at 115200 bps,n,8,1
(7)	<b>AT+BAUDRATE230400</b>	Set UART baud rate at 230400 bps,n,8,1 <b>(recommended enabling flow control)</b>
(8)	<b>AT+BAUDRATE460800</b>	Set UART baud rate at 460800 bps,n,8,1 <b>(recommended enabling flow control)</b> <i>(Actual rate:458200 +0.5% / -0.5% MCU must keep total error within 4%)</i>
(9)	<b>AT+FLOWCONTROLDIS</b>	Disable UART flow control
(10)	<b>AT+FLOWCONTROLEN</b>	Enable UART flow control
(11)	<b>AT+TXPOWER4DBM</b>	Set RF TX power at + 4dBm
(12)	<b>AT+TXPOWER0DBM</b>	Set RF TX power at 0dBm
(13)	<b>AT+TXPOWER-4DBM</b>	Set RF TX power at - 4dBm
(14)	<b>AT+TXPOWER-8DBM</b>	Set RF TX power at - 8dBm
(15)	<b>AT+TXPOWER-20DBM</b>	Set RF TX power to - 20dBm
(16)	<b>AT+XTALINTERNAL</b>	Use internal RC 32.768KHZ low frequency oscillator
(17)	<b>AT+XTALEXTERNAL</b>	Use external crystal 32.768KHZ low frequency oscillator
(18)	<b>AT+CONNECTINDICATORLOW</b>	Set logic low output when connecting BT
(19)	<b>AT+CONNECTINDICATORHIGH</b>	Set logic high output when connecting BT
(20)	<b>AT+PHYMODE1MBPS</b>	Set PHY mode at 1Mbps
(21)	<b>AT+PHYMODE2MBPS</b>	Set PHY mode at 2Mbps
(22)	<b>AT+WAKEUPLOW</b>	Set logic low at wake-up when in deep sleep
(23)	<b>AT+WAKEUPHIGH</b>	Set logic high at wake-up when in deep sleep



No.	Command	Description
(24)	AT+ADVTIMEtttt	Set advertising time (Hex) e.g. 0x001E (min. 30secs), 0x0E10 (Max. 3,600secs) 0x0000 (forever)
(25)	AT+DCDCDIS	Disable DC to DC converter
(26)	AT+DCDCEN	Enable DC to DC converter
(27)	AT+CONNECTINTERVALMODE0	Set connection interval mode for iOS/Android APP usage (min. 20ms / Max. 40ms),
(28)	AT+CONNECTINTERVALMODE1	Set connection interval mode for nRF52832 Central usage (min. 8ms / Max. 8ms)
(29)	AT+CONNECTINTERVALMODE2	Set connection interval mode for iOS/Android APP usage (programmable: min. / Max. range is 8ms ~ 1,000ms)
(30)	AT+CONNECTINTERVALTIMEtttttttt	Set connection interval time ( <b>Hex</b> ), available when activating “AT+CONNECTINTERVALMODE2” e.g. 0x0008 (8ms), 0x03E8 (1,000ms), conditions to be met: “min. connection interval $\leq$ Max. connection interval”
(31)	AT+ADVPATTERNNnnnnffff	Set LED advertising pattern (Hex), where n = time when LED on, f = time when LED off e.g. 0x0064 (min. 100ms) 0x1388 (Max. 5000ms), 0x00000000 (off) 0xFFFFFFFF (on)
(32)	AT+CONNECTPATTERNNnnnnffff	Set LED connecting pattern (Hex), where n = time when LED on, f = time when LED off e.g. 0x0064 (min. 100ms) 0x1388 (Max. 5000ms) 0x00000000 (off) 0xFFFFFFFF (on)
(33)	AT+SERIALNONnnnnnnnn	Set serial number e.g. AB000001, fixed 8-character length
(34)	AT+RESPONSEDIS	Disable response when sending “write” command
(35)	AT+RESPONSEEN	Enable response when sending “write” command
(36)	AT+MACADDRnnnnnnnnnnnn	Set IC MAC address, where n is <b>Hex</b> . Written order is from MSB byte to LSB byte.

No.	Direct-Action Command	Description
(1)	<b>AT+RESET</b>	Set to reset system
(2)	<b>AT+ADVSTART</b>	Set to start advertising
(3)	<b>AT+ADVSTOP</b>	Set to stop advertising
(4)	<b>AT+SLEEP</b>	Set to get into deep sleep mode
(5)	<b>AT+DISCONNECT</b>	Terminate the connection
(6)	<b>AT+DEFAULT</b>	Back to default
(7)	<b>AT+SETGPIO<sub>nn</sub>HIGH</b>	Set GPIO number p0.nn to high, where “nn” is range from 12 ~ 19 ( <b>Ascii</b> )
(8)	<b>AT+SETGPIO<sub>nn</sub>LOW</b>	Set GPIO number p0.nn to low, where “nn” is range from 12 ~ 19 ( <b>Ascii</b> )
(9)	<b>AT+SETGPIO<sub>nn</sub>OFF</b>	Set GPIO number p0.nn to unused, where “nn” is range from 12 ~ 19 ( <b>Ascii</b> )

*Before sending direct-action command, please ensure to output low to UART PD pin to enable UART interface. Please keep it LOW during the whole time when sending commands. Direct-action command will respond right away without entering AT+RESET.*

*To enter other regular commands, please follow the steps on [5.1 How to Send AT Commands](#).*

## 4.2.2. “Read” Commands

No.	Direct-Action Command	Description
(1)	<b>AT?NAME</b>	To retrieve device name
(2)	<b>AT?VERSION</b>	To retrieve firmware version
(3)	<b>AT?MACADDR</b>	To retrieve IC MAC address
(4)	<b>AT?BAUDRATE</b>	To retrieve current UART baud rate
(5)	<b>AT?FLOWCONTROL</b>	To retrieve UART status of flow control
(6)	<b>AT?TXPOWER</b>	To retrieve RF TX power
(7)	<b>AT?XTAL</b>	To retrieve status of oscillator
(8)	<b>AT?CONNECTINDICATOR</b>	To retrieve logic of pin for BT-connecting indicator
(9)	<b>AT?PHYMODE</b>	To retrieve status of PHY mode
(10)	<b>AT?WAKEUP</b>	To retrieve logic of wake-up pin
(11)	<b>AT?ADVTIME</b>	To retrieve advertising time (Hex)
(12)	<b>AT?DCDC</b>	To retrieve DC to DC converter status
(13)	<b>AT?CONNECTINTERVALMODE</b>	To retrieve status of connection interval mode
(14)	<b>AT?ADVPATTERN</b>	To retrieve LED advertising pattern (Hex)
(15)	<b>AT?CONNECTPATTERN</b>	To retrieve LED connecting pattern (Hex)
(16)	<b>AT?SERIALNO</b>	To retrieve serial number
(17)	<b>AT?ADCVALUE</b>	To retrieve 10bit ADC value
(18)	<b>AT?RESPONSE</b>	To retrieve status of response
(19)	<b>AT?ALLPARAMETERS</b>	To retrieve value of all parameters
(20)	<b>AT?CONNECTINTERVALTIME</b>	To retrieve value of connection interval time under Mode 2

*Before sending direct-action command, please ensure to output low to UART PD pin to enable UART interface. Please keep it LOW during the whole time when sending commands. Direct-action command will respond right away without entering AT+RESET.*

*To enter other regular commands, please follow the steps on [5.1 How to Send AT Commands](#).*

## 4.2.3. Response (Default)

No.	Command	Response
(1)	AT?NAME	Raytac AT-UART (default)
(2)	AT?VERSION	e.g. version: 1.5
(3)	AT?MACADDR	e.g. D352BDE1E414
(4)	AT?BAUDRATE	0 baudrate9600 (default) (0 = 9600; 1 = 19200; 2 = 38400; 3 = 57600; 4 = 115200; 5 = 230400; 6 = 460800)
(5)	AT?FLOWCONTROL	0 flowcontrol dis (default) (0 = disabled; 1 = enabled)
(6)	AT?TXPOWER	0 txpower 4dbm (default) (0 = 4dBm; 1 = 0dBm; 2 = -4dBm; 3 = -8dBm, 4 = -20dBm)
(7)	AT?XTAL	0 xtal internal (default) (0 = internal; 1 = external, and XTAL = 32.768KHz oscillator)
(8)	AT?CONNECTINDICATOR	0 connect indicator low (default) (0 = output low; 1 = output high)
(9)	AT?PHYMODE	0 PHY mode 1Mbps (default) (0 = 1Mbps; 1 = 2Mbps)
(10)	AT?WAKEUP	0 wakeup low (default) (0 = low active; 1 = high active)
(11)	AT?ADVTIME	0000 (default: Hex, forever advertising with no timeout, tttt: 0x0000)
(12)	AT?DCDC	0 dcdc dis (default) (0 = disabled; 1 = enabled)
(13)	AT?CONNECTINTERVALMODE	0 connect interval mode 0 (default) (0 = <b>fixed</b> connection interval for iOS/Android APP usage 1 = <b>fixed</b> connection interval, for nRF52832 Central usage 2 = programmable connection interval for iOS/Android APP usage)
(14)	AT?ADVPATTERN	01F401F4 (default: <b>Hex</b> , 0.5sec on / 0.5sec off, nnnn: 0x01F4, ffff: 0x01F4)

No.	Command	Response
(15)	AT?CONNECTPATTERN	00c80708 (default: Hex, 0.2sec on / 1.8sec off, nnnn: 0x00c8, ffff: 0x0708)
(16)	AT?SERIALNO	Display " no data! " string (default)
(17)	AT?ADCVALUE	Value varies from input voltage
(18)	AT?RESPONSE	1 response en (default) (0 = disable response; 1 = enable response)
(19)	AT?ALLPARAMETERS	Display value of all parameters, separated by "0x0d0x0a"
(20)	AT?CONNECTINTERVALTIME	006400C8 (default: <b>Hex</b> , 100ms min. connection interval / 200ms Max. connection interval, tttttt: 0x006400C8)

### 4.3. Default Info

No.	Description	Default
(1)	Device name	Raytac AT-UART
(2)	Base UUID	0x9E, 0xCA, 0xDC, 0x24, 0x0E, 0xE5, 0xA9, 0xE0 0x93, 0xF3, 0xA3, 0xB5, 0x00, 0x00, 0x40, 0x6E
(3)	Service UUID	0x0001 TX characteristic: 0x0003; RX characteristic: 0x0002
(4)	Baud rate	9600bps,n,8,1
(5)	Status of flow control	Disabled
(6)	RF TX power	+4dBm
(7)	32.768Khz oscillator	Using internal RC with 1000ms calibration time
(8)	Logic of BT connecting indicator	Output set as logic low when BT is connecting
(9)	PHY mode	1Mbps
(10)	Logic of wake-up pin	Set logic low to wake up in deep sleep
(11)	Advertising time	Forever advertising with no timeout
(12)	Status of DC-to-DC converter	Disabled
(13)	Connection interval mode	Set at min. 20ms and Max. 40ms for iOS/Android usage
(14)	Advertising LED pattern	0.5sec on / 0.5sec off
(15)	Connecting LED pattern	0.2sec on / 1.8secs off
(16)	Serial number	Display “ no data! ” string
(17)	ADC value	Value varies from input voltage between 0x0000 ~ 0x03FF (Hex).
(18)	State of response	Enabled
(19)	Programmable output GPIO	P0.12, P0.13, P0.14, P0.15, P0.16, P0.17, P0.18 and P0.19 are unused

# 5. How to Control via External MCU

## 5.1. How to Send AT Commands

- **When BT is NOT connected, for ALL commands**

1. Output low to [UART PD](#) pin to enable UART interface. Please keep it LOW during the whole time when sending AT commands.
2. Send any AT commands you want.

We recommend sending corresponding “Read” command ([section 4.2.2](#)) right after the delay to know whether the writing is successful before moving on to step 3 to save your settings.

3. **Send command “ AT+RESET ” (not HW reset) to save all your settings.**

**After sending “AT+RESET” command, do NOT write any command and wait at least 1 second for flash to update. Keep the power on during the whole period.**

4. Output high or NC to [UART PD](#) pin to turn off UART interface.

- **When BT is connected for following commands ONLY**

**Write: AT+DISCONNECT, AT+SLEEP, AT+SETGPIOnnHIGH,  
AT+SETGPIOnnLOW, AT+SETGPIOnnOFF**

**Read: AT?ADCVALUE**

1. Output low to **UART PD** pin to enable UART interface. Please keep it LOW during the whole time when sending AT commands.
2. Output low to **flash default** pin to enable receiving AT commands when BT is connected. Please keep it LOW during the whole time when sending AT commands.
3. Send “AT?ADCVALUE” or “AT+DISCONNECT” or “AT+SLEEP” or “AT+SETGPIOnnHIGH” or “AT+SETGPIOnnLOW” or “AT+SETGPIOnnOFF”.
4. Output high or NC to **UART PD** pin to turn off UART interface.
5. Output high or NC to **flash default** pin to disable the module to receive AT commands when BT is connected.



## 5.2. How to Transmit Data

**\* Only when BT is connected \***

1. Output low to **UART PD** pin to enable UART interface. Please keep it LOW during the whole time when transmitting data.
2. Output high or NC to **UART PD** pin to turn off UART interface.

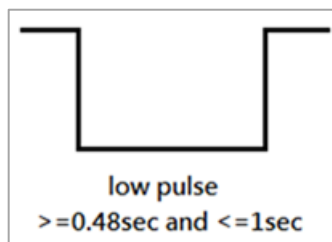
## 5.3. How to Return to Setting of Default Flash

**\* Only when BT is NOT connected \***

**\* Note that default baud rate is “9600bps,n,8,1”. For other default, please check [“4.3 Default Info”](#)**

### ● Use Hardware Method

1. Read **indicator** pin first to check if BT is *NOT* in connection.
2. Output a low pulse to **flash default** pin, then system will return to default setting.



### ● Use Software method

1. Output low to **UART PD** pin to enable UART interface. Please keep it LOW during the whole time when sending AT commands.
2. Send command “AT+DEFAULT”, then system will return to default setting.

# 6. Test Report

All testing is done under **PHY mode at 1M bps.**

## 6.1. Current Test

DC/DC	Logic of UART PD pin	Advertising Current	Connected Current
Disable	High	0.98 mA	0.51 mA
	Low	1.78 mA	1.3 mA
Enable	High	0.76 mA	0.54 mA
	Low	1.1 mA	0.86 mA

Sleep Mode	Logic of UART PD pin	Sleep Current
	High	3 uA
	Low	3 uA

## 6.2. Throughput Test

Here **D.L.** means “**Data Length**” and **D.I.** means “**Data Interval**” in the table.

- MCU → Peripheral (MDBT42Q-AT2/MDBT42Q-PAT2) → Central → Console

Central Connection Interval	Peripheral Connection Interval	Baud Rate	Flow Control	MCU D.L. (bytes)	MCU D.I. (ms)	Total D.L. (bytes)	Total Trans. Time (sec)	Data Rate (k-bytes/sec)
min = 20ms Max = 75ms	min = 20ms Max = 40ms	9600	X	64	60	262152	273	0.96
				244	250	999432	1,042	
			V	244	250	999432	1,042	
min = 20ms Max = 75ms	min = 20ms Max = 40ms	115200	X	64	8	262152	33	7.9
				244	30	999432	124	8
			V	244	30	999432	124	8
min = 20ms Max = 75ms	min = 20ms Max = 40ms	460800	X	244	25	999432	103	9.7
			V					
min = Max = 8ms	min = Max = 8ms	9600	X	64	60	262152	273	0.96
				244	250	999432	1,042	
			V	244	250	999432	1,042	
min = Max = 8ms	min = Max = 8ms	115200	X	64	8	262152	33	7.9
				244	30	999432	124	8
			V	244	30	999432	124	8
min = Max = 8ms	min = Max = 8ms	460800	X	244	15	999432	62	16.1
			V					

● MCU → Central → Peripheral (MDBT42Q-AT2/MDBT42Q-PAT2) → Console

Central Connection Interval	Peripheral Connection Interval	Baud Rate	Flow Control	MCU D.L. (bytes)	MCU D.I. (ms)	Total D.L. (bytes)	Total Trans. Time (sec)	Data Rate (k-bytes/sec)
min = 20ms Max = 75ms	min = 20ms Max = 40ms	9600	X	64	60	262152	273	0.96
				244	250	999432	1,042	
			V	244	250	999432	1,042	
min = 20ms Max = 75ms	min = 20ms Max = 40ms	115200	X	64	8	262152	33	7.9
				244	30	999432	124	8
			V	244	30	999432	124	8
min = 20ms Max = 75ms	min = 20ms Max = 40ms	460800	X	244	18	999432	74	13.5
			V					
min = Max = 8ms	min = Max = 8ms	9600	X	64	60	262152	273	0.96
				244	250	999432	1,042	
			V	244	250	999432	1,042	
min = Max = 8ms	min = Max = 8ms	115200	X	64	8	262152	33	7.9
				244	30	999432	124	8
			V	244	30	999432	124	8
min = Max = 8ms	min = Max = 8ms	460800	X	244	15	999432	61	16.3
			V					

## 7. Useful Links

- **Nordic Infocenter:** <https://infocenter.nordicsemi.com/index.jsp>  
All the necessary technical files and software development kits of Nordic's chip are on this website.
- **Nordic Developer Zone:** <https://devzone.nordicsemi.com/questions/>  
A highly recommended website for firmware developer. Interact with other developers and Nordic's employees will help with your questions. The site also includes tutorials in detail to help you get started.
- **Official Page of nRF52810 :** <https://www.nordicsemi.com/eng/Products/nRF52810>  
A brief introduction to nRF52810 and download links for Nordic's developing software and SoftDevices.

# History of Firmware Revision

<b>FW Ver.</b>	<b>Compatible HW Build</b>	<b>Release Date</b>	<b>Description of Revision</b>	<b>Note</b>
1.5		2022/10/06	1st release.	99-52810-02F

# Release Note

- 2022/10/26 Version A: 1<sup>st</sup> release