

User Guide

(簡易使用手冊)

產品名稱 (Product)	<u>Demo Board for MDBT42Q-AT / PAT</u> in Peripheral / Slave role
產品型號 (Model No.)	<u>MDBT42Q – AT – UART – S</u>
韌體版本 (FW Rev.)	<u>1.4</u>

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1. Introduction

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

MDBT42Q-AT-UART-S is designed for testing and debugging without building your own board. The board is only available with MDBT42Q-AT (chip antenna) module. MDBT42Q-AT 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.

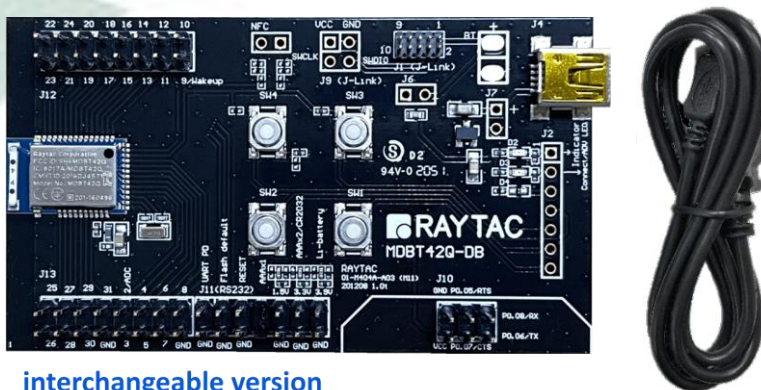
Please visit our [website](#) for spec sheet of every module mentioned above.

1.1. Contents of the Set

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

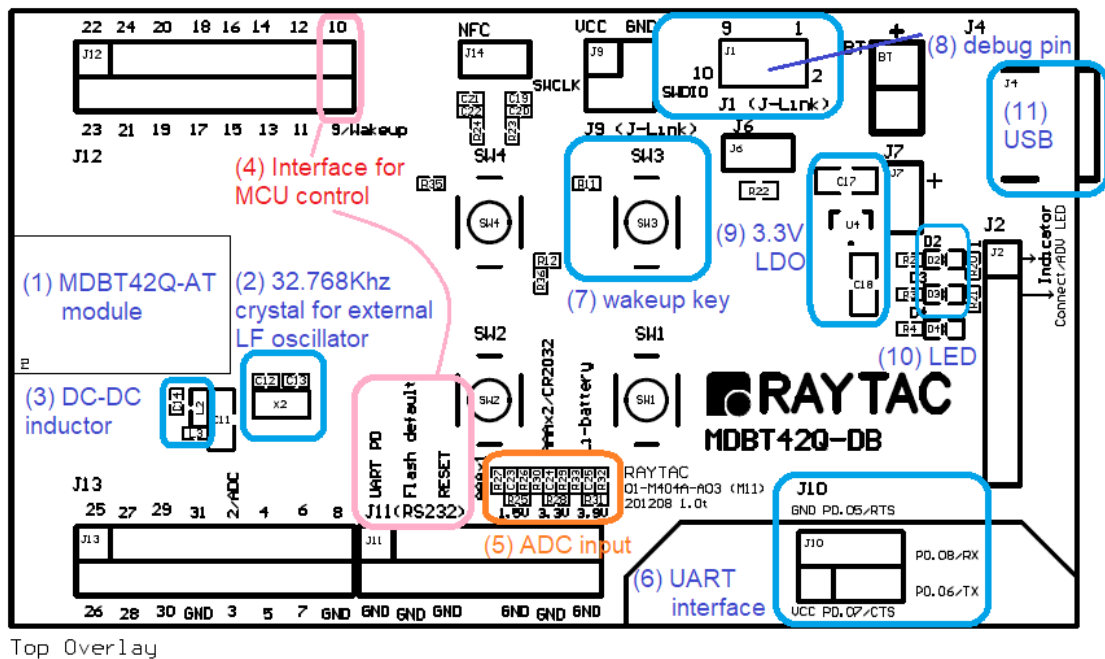


or



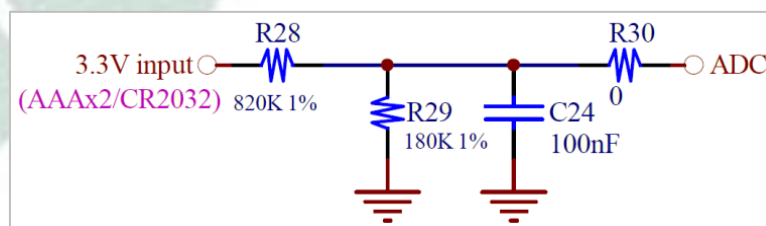
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2. Hardware Description



- (1) MDBT42Q-AT BLE module based on nRF52810.
- (2) 32.768KHz crystal for external LF.
- (3) 10uH & 15nH inductor for DC-to-DC mode.
- (4) Interface to connect to external MCU.
- (5) ADC input for battery detection only. Reference voltage is 0.6V.

Example:



$$\text{formula: Input Voltage} \times \frac{R1}{R1 + R2} = \text{Reference Voltage}$$

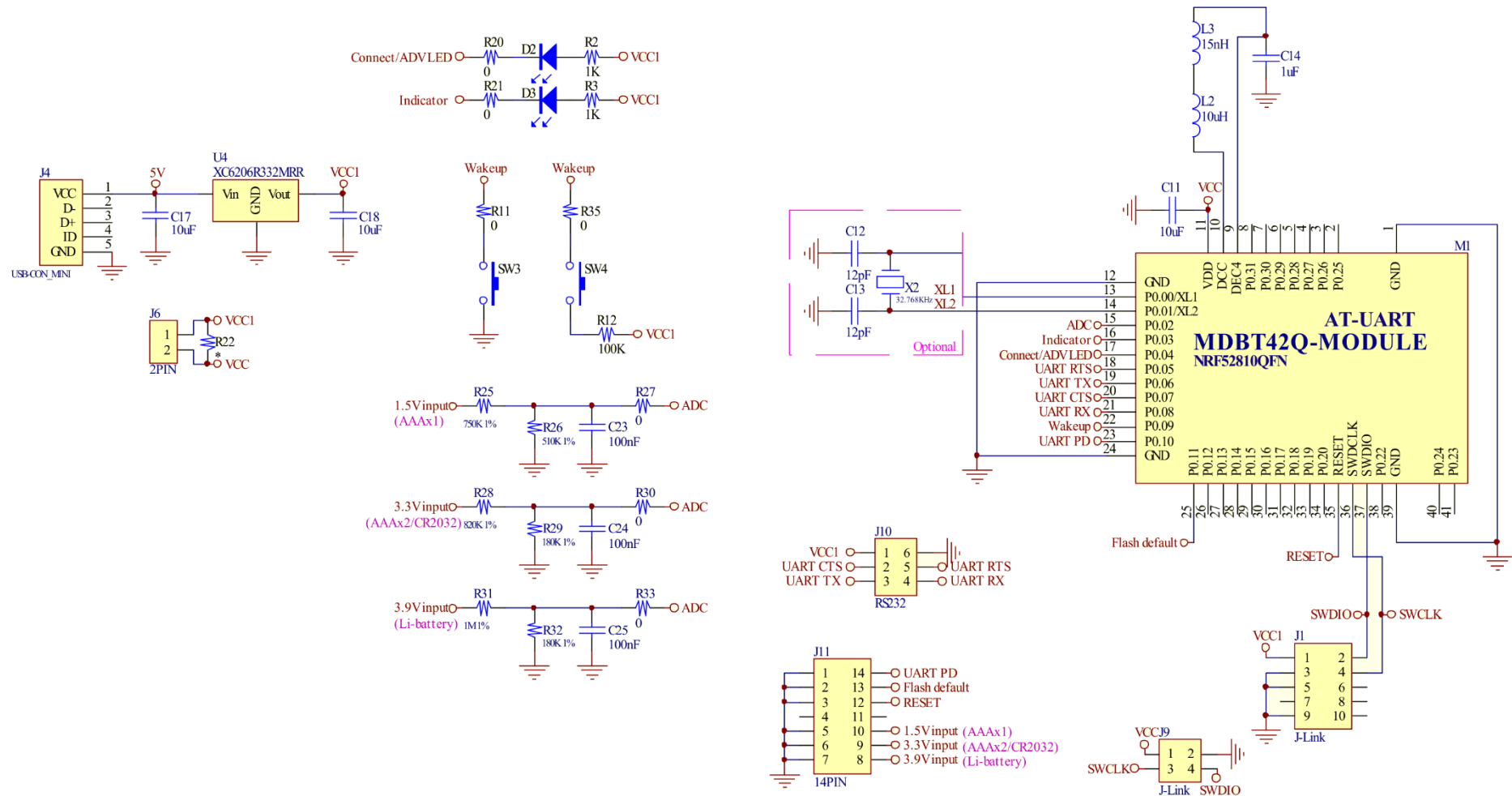
$$\rightarrow 3.3V \times \frac{180}{820 + 180} = 0.594 \approx 0.6V$$

- (6) UART interface for data bridge or AT commands.
- (7) Wake-up key.

- (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-AT.
- (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)	AT+NAME	Set device name,Max. length of 20 characters e.g. AT+NAME123 (device name 123, 3 characters)
(2)	AT+RESET	Set to reset system
(3)	AT+ADVSTART	Set to start advertising
(4)	AT+ADVSTOP	Set to stop advertising
(5)	AT+SLEEP	Set to get into deep sleep mode
(6)	AT+BAUDRATE9600	Set UART baud rate at 9600 bps,n,8,1
(7)	AT+BAUDRATE19200	Set UART baud rate at 19200 bps,n,8,1
(8)	AT+BAUDRATE38400	Set UART baud rate at 38400 bps,n,8,1
(9)	AT+BAUDRATE57600	Set UART baud rate at 57600 bps,n,8,1
(10)	AT+BAUDRATE115200	Set UART baud rate at 115200 bps,n,8,1
(11)	AT+BAUDRATE230400	Set UART baud rate at 230400 bps,n,8,1 (recommended enabling flow control)
(12)	AT+BAUDRATE460800	Set UART baud rate at 460800 bps,n,8,1 (recommended enabling flow control)
(13)	AT+FLOWCONTROLDIS	Disable UART flow control
(14)	AT+FLOWCONTROLEN	Enable UART flow control
(15)	AT+TXPOWER4DBM	Set RF TX power at + 4dBm
(16)	AT+TXPOWER0DBM	Set RF TX power at 0dBm
(17)	AT+TXPOWER-4DBM	Set RF TX power at - 4dBm
(18)	AT+TXPOWER-8DBM	Set RF TX power at - 8dBm
(19)	AT+TXPOWER-20DBM	Set RF TX power to - 20dBm
(20)	AT+XTALINTERNAL	Use internal RC 32.768KHZ low frequency oscillator
(21)	AT+XTALEXTERNAL	Use external crystal 32.768KHZ low frequency oscillator
(22)	AT+CONNECTINDICATORLOW	Set logic low output when connecting BT
(23)	AT+CONNECTINDICATORHIGH	Set logic high output when connecting BT
(24)	AT+PHYMODE1MBPS	Set PHY mode at 1Mbps

No.	Command	Description
(25)	AT+PHYMODE2MBPS	Set PHY mode at 2Mbps
(26)	AT+WAKEUPLOW	Set logic low at wake-up when in deep sleep
(27)	AT+WAKEUPHIGH	Set logic high at wake-up when in deep sleep
(28)	AT+ADVTIMEtttt	Set advertising time (Hex) e.g. 0x001E (min. 30secs), 0x0E10 (Max. 3,600secs) 0x0000 (forever)
(29)	AT+DCDCDIS	Disable DC to DC converter
(30)	AT+DCDCEN	Enable DC to DC converter
(31)	AT+CONNECTINTERVALMODE0	Set connection interval mode for iOS/Android APP usage (min. 20ms / Max. 40ms),
(32)	AT+CONNECTINTERVALMODE1	Set connection interval mode for nRF52832 Central usage (min. 8ms / Max. 8ms)
(33)	AT+CONNECTINTERVALMODE2	Set connection interval mode for iOS/Android APP usage (programmable: min. / Max. range is 8ms ~ 1,000ms)
(34)	AT+CONNECTINTERVALTIMEtttttttt	Set connection interval time (Hex), available when activating "AT+CONNECTINTERVALMODE2" e.g. 0x0008 (8ms), 0x03E8 (1,000ms), conditions to be met: "min. connection interval ≤ Max. connection interval"
(35)	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)
(36)	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)

No.	Command	Description
(37)	AT+SERIALNOnnnnnnnn	Set serial number e.g. AB000001, fixed 8-character length
(38)	AT+RESPONSEDIS	Disable response when sending "write" command
(39)	AT+RESPONSEEN	Enable response when sending "write" command
(40)	AT+DISCONNECT	Terminate the connection
(41)	AT+DEFAULT	Back to default
(42)	AT+SETGPIOnnHIGH	Set GPIO number p0.nn to high, where "nn" is range from 12 ~ 19 (Ascii)
(43)	AT+SETGPIOnnLOW	Set GPIO number p0.nn to low, where "nn" is range from 12 ~ 19 (Ascii)
(44)	AT+SETGPIOnnOFF	Set GPIO number p0.nn to unused, where "nn" is range from 12 ~ 19 (Ascii)
(45)	AT+MACADDRnnnnnnnnnnnn	Set IC MAC address, where n is Hex . Written order is from MSB byte to LSB byte.

4.2.2. “Read” Commands

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

4.2.3. Response (Default)

No.	Command	Response
(1)	AT?NAME	Raytac AT-UART (default)
(2)	AT?VERSION	e.g. version: 1.0
(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 = fixed connection interval for iOS/Android APP usage 1 = fixed connection interval, for nRF52832 Central usage 2 = programmable connection interval for iOS/Android APP usage)
(14)	AT?ADVPATTERN	01F401F4 (default: Hex , 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: Hex , 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. **Please wait for at least 250 ms between sending each command.**

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.

Please prolong the delay (over 250 ms) when writing or/and reading is not successful.

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

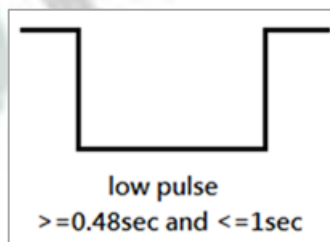
5.3. How to Return to Flashed Default Setting

*** 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	0.85 mA	0.3 mA
	Low	1.56 mA	1 mA
Enable	High	0.45 mA	0.16 mA
	Low	0.95 mA	0.68 mA

	Logic of UART PD pin	Sleep Current
Sleep Mode	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-AT/MDBT42Q-PAT) → 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-AT/MDBT42Q-PAT) → 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

FW Ver.	Compatible HW Build	Release Date	Description of Revision	Note
1.0		2018/04/24	1 st release.	99-52810-02A
1.1		2018/06/01	<ol style="list-style-type: none"> 1. UI changes: <ul style="list-style-type: none"> - Add battery service. - Add "AT?ADCVALUE" to get ADC value in BLE connecting status. - Add "AT+DISCONNECT" to terminate the connection. - If response enabled, "AT+" will response info. - Set forever advertising (no timeout) as default. 2. Add new AT commands: <ul style="list-style-type: none"> - AT+RESPONSEDIS - AT+RESPONSEEN (Default) - AT?RESPONSE - AT?ALLPARAMETERS 	99-52810-02B
1.2		2018/06/27	Fixed bugs of battery service.	99-52810-02C
1.3		2018/10/22	<ol style="list-style-type: none"> 1. Improved power consumption. 2. UI Changes: <ul style="list-style-type: none"> - Add "AT+SLEEP" to sleep in connected state 3. Add new AT commands <ul style="list-style-type: none"> - AT+CONNECTINTERVALMODE2 - AT+CONNECTINTERVALTIMEttttttt 	99-52810-02D

FW Ver.	Compatible HW Build	Release Date	Description of Revision	Note
1.3		2018/10/22	(continued) <ul style="list-style-type: none"> - AT?CONNECTINTERVALTIME - AT+SETGPIOnnHIGH - AT+SETGPIOnnLOW - AT+SETGPIOnnOFF 4. Modify detection for ADC value. 5. Add function of setting MAC address by the user.	99-52810-02D
1.4		2019/04/09	1. Fixed issues of reading MAC address. 2. Added an update process on DLE after connection.	99-52810-02E

Release Note

- 2018/07/24 Version A: 1st release
- 2018/10/30 Version B
 - (1) Change model no. to “MDBT42Q-AT-UART-**S**”.
 - (2) Update Chapter 4: AT Command, Chapter 5: How to Control External MCU and Chapter 6: Test Report to match new FW revision 1.3. See [History of Firmware Revision](#) for more details.
- 2018/11/08 Version C
 - (1) Correct circuit in Chapter 3: Reference Circuit.
- 2020/04/22 Version D:
 - (1) See [History of Firmware Revision](#) for FW revision 1.4.
- 2021/07/07 Version E
 - (1) Updated the photo of demo board in Chapter 1: Introduction.
 - (2) Updated the graph in Chapter 2: Hardware Description.
 - (3) Refined the description in Chapter 5: How to Control via External MCU.
 - (4) Adding information of current consumption in sleep mode in Chapter 6: Current Test.