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Version: A
Issued Date: 2020/12/10

User Guide

(簡易使用手冊)

產品名稱 (Product): Demo Board for MDBT42TV-AT / PAT

產品型號 (Model No.): **MDBT42TV – AT – UART** – **S**

韌體版本 (FW Revision): 1.0

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1. Introduction

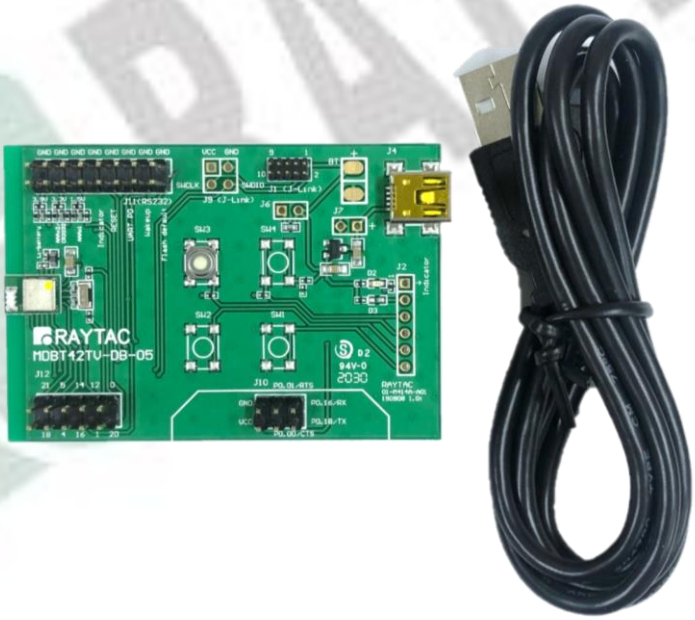
This document shows how to use the demo board (MDBT42TV-AT-UART-S) to test function of MDBT42TV-AT & MDBT42TV-PAT.

MDBT42TV-AT-UART-S is designed for testing and debugging without building your own board. The board is only available with MDBT42TV-AT (chip antenna) module. MDBT42TV-AT will be pre-programmed with Raytac's AT command firmware. If you don't need such pre-programming and is looking for nRF52805 module, please check MDBT42TV-192K & MDBT42TV-P192K.

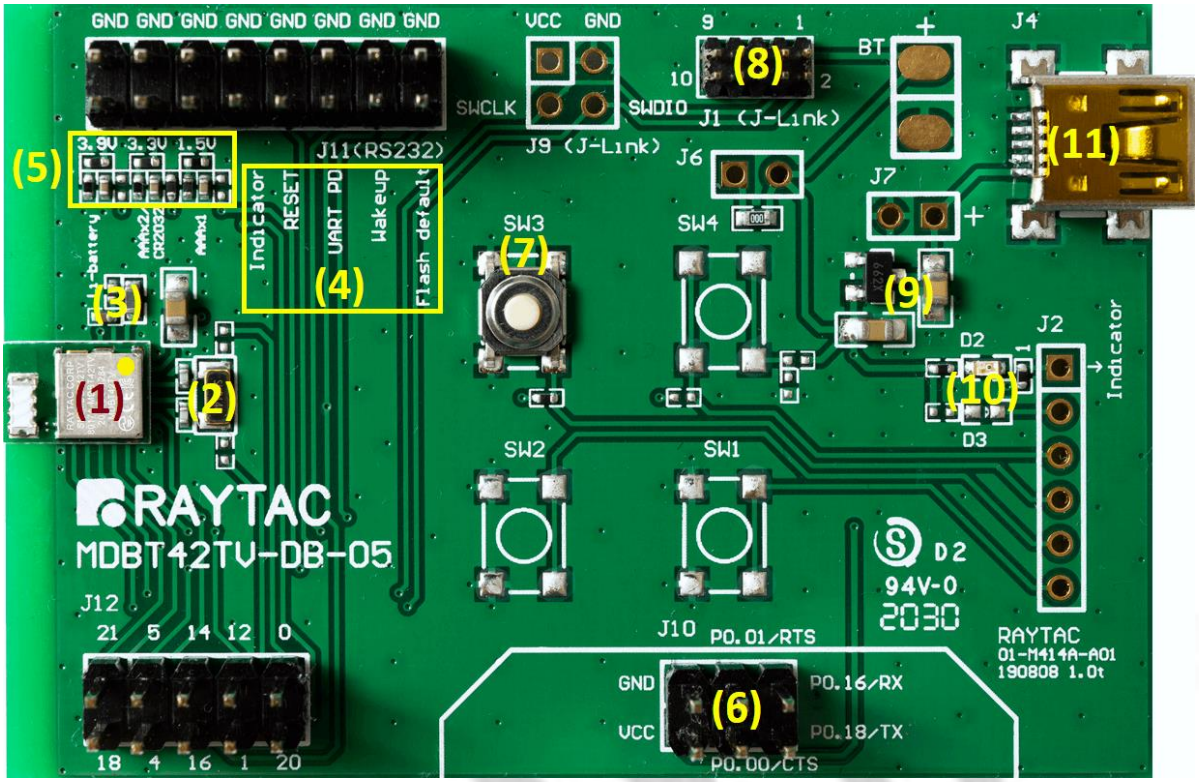
Please visit our website for spec sheet of every module mentioned above.

1.1. Contents of the Set

Each set includes MDBT42TV-AT-UART-S x 1 and mini-USB cable x 1. Please contact us if the set you receive is not complete.



2. Hardware Description



(1) MDBT42TV-AT BLE module based on nRF52805.

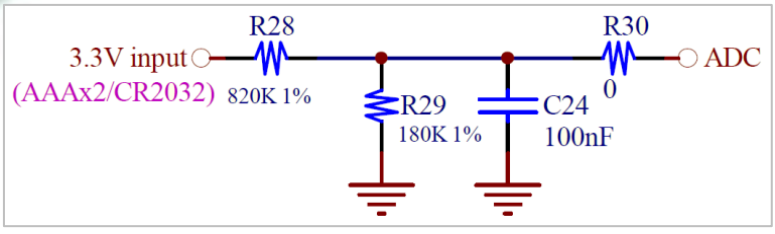
(2) 32.768KHz crystal for external LF.

(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:



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

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

(6) UART interface for data bridge or AT commands.

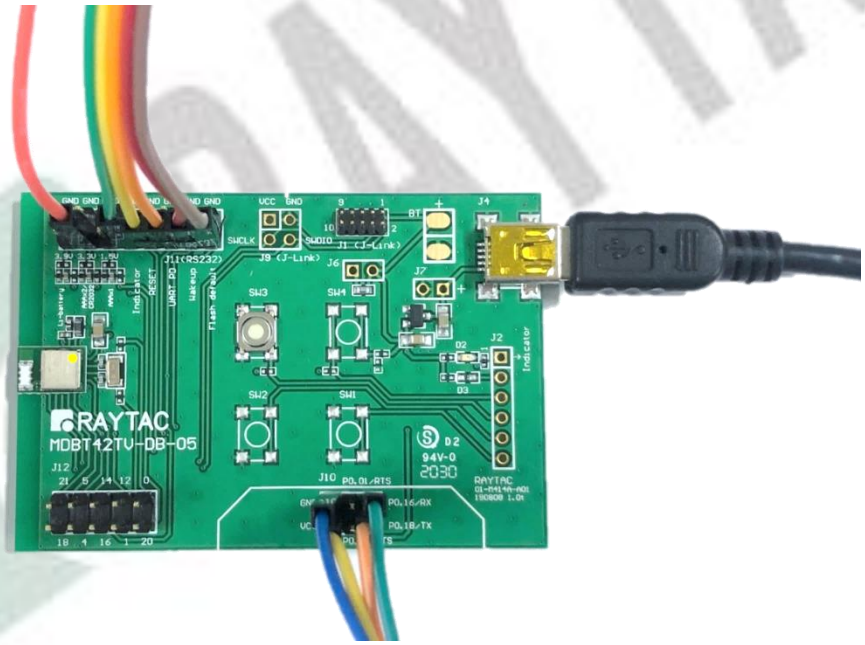
(7) Wake-up key.

(8) Debug interface, connecting to Nordic's nRF5X DK.
<u>Important:</u> 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.

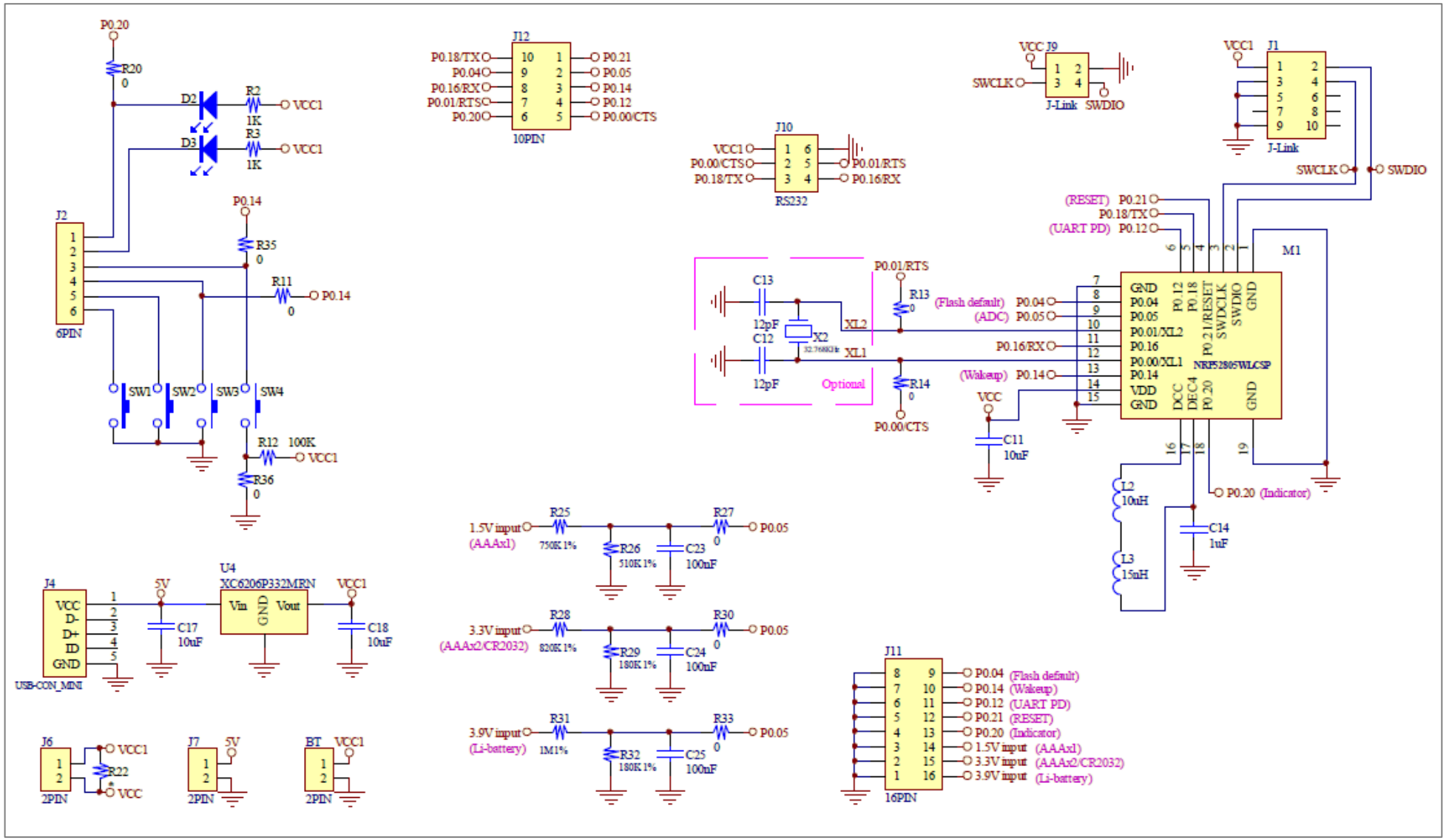
(9) 3.3V LDO to power up MDBT42TV-AT.

(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
- 7 sets of UART baud rates
- Enable/disable UART flow control
- Enable/disable interface of UART hardware
- 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”

No.	Command	Description
(35)	**AT+SERIALNOnnnnnnnn**	Set serial number e.g. AB000001, fixed 8-character length
(36)	**AT+RESPONSEDIS**	Disable response when sending “write” command
(37)	**AT+RESPONSEEN**	Enable response when sending “write” command
(38)	**AT+DISCONNECT**	Terminate the connection
(39)	**AT+DEFAULT**	Back to default
(40)	**AT+MACADDRnnnnnnnnnnnn**	Set IC MAC address, where n is **Hex**. Written order is from MSB byte to LSB byte.

****** Important ******

Flow control function cannot be activated when use external 32.768 Khz crystal oscillator. A “fail” response will return.

	Status of Flow Control	
	Disable	**Enable**
Internal RC oscillator	√	√
External crystal oscillator	√	fail

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?SERIALNO**	To retrieve serial number
(15)	**AT?ADCVALUE**	To retrieve 10bit ADC value
(16)	**AT?RESPONSE**	To retrieve status of response
(17)	**AT?ALLPARAMETERS**	To retrieve value of all parameters
(18)	**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)

No.	Command	Response
(14)	**AT?SERIALNO**	Display “ no data! ” string (default)
(15)	**AT?ADCVALUE**	Value varies from input voltage
(16)	**AT?RESPONSE**	1 response en (default) (0 = disable response; 1 = enable response)
(17)	**AT?ALLPARAMETERS**	Display value of all parameters, separated by "0x0d0x0a"
(18)	**AT?CONNECTINTERVALTIME**	006400C8 (default: **Hex**, 100ms min. connection interval / 200ms Max. connection interval, tttttttt: 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)	**Serial number**	Display “ no data! ” string
(15)	**ADC value**	Value varies from input voltage between 0x0000 ~ 0x03FF (Hex).
(16)	**State of response**	Enabled

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 recommended 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 pinto turn off UART interface.

- **When BT is connected for following commands ONLY**
  Write: AT+DISCONNECT, AT+SLEEP
  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”

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 the Setting of Default Flash

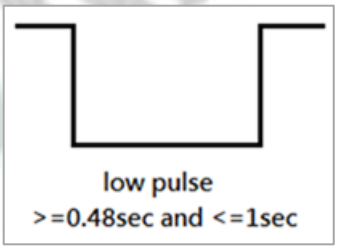
**** Only when BT is NOT connected ****

**** 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 in 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

6.2. Throughput Test

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

- MCU → Peripheral (MDBT42TV-AT/MDBT42TV-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 Tras. 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 (MDBT42TV-AT/MDBT42TV-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 nRF52805 : https://www.nordicsemi.com/Products/Low-power-short-range-wireless/nRF52805
  A brief introduction to nRF52805 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		2020/09/24	1st release.	99-52805-03A

Release Note

- 2020/12/14 Version A: 1st release