

Realtek

Bluetooth

MP Flow

(Android by ADB)

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1. Overview

This document is used to introduce MP (Mass Production) test tool for Realtek Bluetooth chip series. Customers should comply with the steps and requirements under this document. Contact Realtek Bluetooth FAE if any problem arises in the use of MP flow.

Realtek

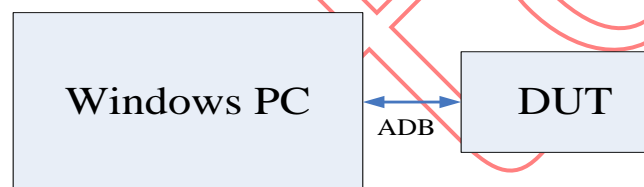
2. Prerequisites

Before MP tool startup, below items should be checked:

- a) The Bluetooth Chip embedded is provided by Realtek;

| Realtek Bluetooth Chip Number |
|-------------------------------|
| RTL8723B series |
| RTL8761A series |
| RTL8821A series |
| RTL8703B series |
| RTL8723D series |
| RTL8822B series |
| RTL8821C series |

- b) The Bluetooth on target production is available and works normally;
c) The ADB utility is available on target production.



2.1 Binary Files

MP tool package is provided to customers in binary format:

| | |
|---------------------|------------------------|
| rtlbtmp | MP ADB tool |
| btmp.default.so | MP library |
| BluetoothMpTest.apk | MP Apk tool (optional) |

Customers should copy these binary files to respective directories on target production:

```
rtlbtmp --> /system/bin/ chmod 755 /system/bin/rtlbtmp
btmp.default.so --> /system/lib/hw/
mp_rtlxxx_fw, mp_rtlxxx_config --> /system/etc/firmware/
```

Notice: If the system is android o or above

```
rtlbtmp --> /vendor/bin/ chmod 755 /system/bin/rtlbtmp
btmp.default.so --> /vendor/lib/hw/
mp_rtlxxx_fw, mp_rtlxxx_config --> /vendor/firmware/
```

3. MP Tool Usage

3.1 MP Initial Commands

These commands used to initialize Bluetooth DUT in MP mode are listed as below:

| MP Command | Parameters | Return | Description |
|------------|--|-----------|---|
| rtlbtmp | None | [success] | Start the MP CMD tool. |
| enable | USB: enable usb:/dev/rtk_btusb Android P enable usb:/dev/rtkbt_dev | [success] | Enable USB I/F Bluetooth MP stack and download FW code. Device node is fixed as /dev/rtk_btusb . If the system is android p or above, Device node is fixed as /dev/rtkbt_dev |
| | UART5: enable uart:/dev/ttyS0 enable uart5:/dev/ttyS0 UART4: enable uart4:/dev/ttyS0 | [success] | Enable Uart I/F Bluetooth MP stack and download FW code. Device node is chosen by vendor specifically . H5 (UART5) or H4 (UART4) is determined by the chip configurations. Customers can consult FAE for detailed information. |
| disable | None | [success] | Disable Bluetooth MP stack and close the device. |
| quit | None | None | Exit from the MP CMD tool. |
| help | None | None | List all MP CMDs supported. |

NOTE: Before running the MP CMD tool, BT on UI settings should be **disabled**; otherwise, MP tool will be at abnormal status.

3.1.1 Start MP CMD Tool

```
# ./chmod 755 /system/bin/rtlbtmp
```

```
# ./rtlbtmp
```

```
127!root@android:/system/bin # chmod 755 /system/bin/rtlbtmp  
chmod 755 /system/bin/rtlbtmp  
root@android:/system/bin # rtlbtmp  
rtlbtmp
```

```
.....  
..... Bluetooth MP Test Tool Starting .....  
>
```

3.1.2 Enable MP Stack

Check Bluetooth stack HCI interface first, then run the enable MP stack CMD.

```
# ./enable usb:/dev/rtk_btusb // usb I/F
```

```
# ./enable uart:/dev/ttyS0 // uart I/F, device node specified by vendor (platform)
```


3.2 MP Mode Control Parameters Commands

3.2.1 Control Parameters Commands Format

These commands used to set/get Bluetooth DUT parameters.

| MP Command | Parameters | Return | | |
|----------------|---|--------------|---------------|--------------|
| bt_mp_SetParam | Index0,value0;Index1,value1;...;IndexN,valueN | Return Index | Return Status | |
| bt_mp_GetParam | Index | Return Index | Return Status | Return Value |

TABLE CONTROL_PARAM_CMD

3.2.2 Control Commands: Set/Get parameter command

You can use “*bt_mp_SetParam*” to set parameters and can use “*bt_mp_GetParam*” to check it.
The Format is “*bt_mp_SetParam Index0,value0; Index1,...;IndexN,valueN*”.

Example : If you want to set the channel 10 and packet type “*BT_PKT_3DH5*”, you can use”
bt_mp_SetParam 0x01,0x0a;0x02,0x08”

```
bt_mp_SetParam 0x01,0x0a;0x02,0x08
bt_mp_SetParam 0x01,0x0a;0x02,0x08
bt_mp_SetParam[Success:0]
> bt_mp_SetParam,2,0x00
```

Return Index and Status

Or set channel and packet type separately.

```
bt_mp_SetParam 0x01,0x0a
bt_mp_SetParam 0x01,0x0a
bt_mp_SetParam[Success:0]
> bt_mp_SetParam,1,0x00
bt_mp_SetParam 0x02,0x08
bt_mp_SetParam 0x02,0x08
bt_mp_SetParam[Success:0]
> bt_mp_SetParam,2,0x00
```

Return Index and Status

Return Index and Status

Using *bt_mp_GetParam* to check parameter settings.

```
bt_mp_GetParam 0x1
bt_mp_GetParam 0x1
bt_mp_GetParam[Success:0]
> bt_mp_GetParam,1,0x00,0x0a
bt_mp_GetParam 0x2
bt_mp_GetParam 0x2
bt_mp_GetParam[Success:0]
> bt_mp_GetParam,2,0x00,0x08
```

Return Index , Status, Value

The parameter Indexes define in “PARAM_INDEX” Table.

| INDEX | VALUE | Length (Byte) | Value Range | Table Index |
|-------|--|------------------|---------------------------------------|--|
| 0 | PGRawData | 256 | Row data | None |
| 1 | ChannelNumber | 1 | 0~78 | None |
| 2 | PacketType | 1 | 0~9 | See PKT_TYPE |
| 3 | PayloadType | 1 | 0~7 | See PAYLOAD_TYPE |
| 4 | TxPacketCount (only for packet tx) | 2 | 0~0xFFF | See Section3.2.3 |
| 6 | WhiteningCoeffValue | 1 | 0x00~0x7F | 0x00~0x7F: Enable Whitening 0x80: Disable Whitening |
| 7 | TxGainIndex | 1 | Realtek define | See Section3.2.5 |
| 9 | PacketHeader | 4 | 0x0~0x3FFFF | See PACKET_HEADER |
| 10 | HoppingFixChannel (for Hopping mode) | 1 | 0 : Disable 1 : Enable Fix Channel | None |
| 11 | HitTarget | 6 | 6 bytes | None |
| 14 | Xtal | 4 | 0~0x7F | Depend Chip |
| 15 | LEDDataLen | 1 | 0~0x255 | 0~0x255 (BT4.0 : 0x00~0x0x25) |
| 16 | PHY | 1 | 1~4 | See BLE_PKT_TYPE |
| 17 | ModulationIndex | 1 | 0,1 | See BLE_MODULATION_TYPE |
| 18 | <ul style="list-style-type: none"> a. set/get enable/disable tx power tracking b. bt_diff_s0s1 c. set gain K d. set flatness e. set tx default power f. SET_K_TX_CH_PWR g. TX_PATH_LOSS_MODULE h. CONFIG_EXTEND i. set Antenna s0/s1 j. set hopping start channel and stop channel | | | |

Table PARAM_INDEX

The packet types are defined in Table PKT_TYPE:

| NAME | INDEX | Payload Length in bits |
|-------------|-------|------------------------|
| BT_PKT_DH1 | 0 | 0~27*8 |
| BT_PKT_DH3 | 1 | 0~183*8 |
| BT_PKT_DH5 | 2 | 0~339*8 |
| BT_PKT_2DH1 | 3 | 0~54*8 |
| BT_PKT_2DH3 | 4 | 0~367*8 |
| BT_PKT_2DH5 | 5 | 0~679*8 |
| BT_PKT_3DH1 | 6 | 0~83*8 |
| BT_PKT_3DH3 | 7 | 0~552*8 |
| BT_PKT_3DH5 | 8 | 0~1021*8 |
| BT_PKT_LE | 9 | 0~39*8 |

Table PKT_TYPE

BLE 5.0 Tx:

| NAME | INDEX | |
|---------------------|-------|--|
| BLE5_TX_1M_PHY | 1 | |
| BLE5_TX_2M_PHY | 2 | |
| LE5_TX_CODED_PHY_S8 | 3 | |
| LE5_TX_CODED_PHY_S2 | 4 | |

BLE 5.0 RX:

| NAME | INDEX | |
|---------------------|-------|--|
| BLE5_TX_1M_PHY | 1 | |
| BLE5_TX_2M_PHY | 2 | |
| LE5_TX_CODED_PHY_LR | 3 | |
| | | |

Table BLE PKT_TYPE

| NAME | INDEX | |
|---------------------------|-------|--|
| STANDARD_MODULATION_INDEX | 0 | |
| STABLE_MODULATION_INDEX | 1 | |

Table BLE_MODULATION_TYPE

The payload types are defined in Table PAYLOAD_TYPE.

| NAME | INDEX |
|---------------------------|-------|
| BT_PAYLOAD_TYPE_ALL0 | 0 |
| BT_PAYLOAD_TYPE_ALL1 | 1 |
| BT_PAYLOAD_TYPE_0101 | 2 |
| BT_PAYLOAD_TYPE_1010 | 3 |
| BT_PAYLOAD_TYPE_0x0_0xF | 4 |
| BT_PAYLOAD_TYPE_0000_1111 | 5 |
| BT_PAYLOAD_TYPE_1111_0000 | 6 |
| BT_PAYLOAD_TYPE_PRBS9 | 7 |

Table PAYLOAD_TYPE

| Packet type | Payload(Bits) | Packet Header Hex |
|-------------|---------------|-------------------|
| DH1 | 216 | 33820 |
| DH3 | 1464 | 39858 |
| DH5 | 2712 | A078 |
| 2DH1 | 432 | 33820 |
| 2DH3 | 2936 | C050 |
| 2DH5 | 5432 | 3F870 |
| 3DH1 | 664 | 15C40 |
| 3DH3 | 4416 | 39858 |
| 3DH5 | 8168 | A078 |

Table PACKET_HEADER

3.2.3 TxPacketCount parameter

TxPacketCount is used to set how many TX packets will be transmitted. The range of *TxPacketCount* is from 0 to 0xFFFF. In UI mode, the value of *TxPacketCount* is “0” that means to send the most tx packet counts “0xFFFF”. In FW mode, the value of *TxPacketCount* is “0” that means to send tx packet counts continuously.

3.2.4 WhiteningCoeffValue parameter

The range of *WhiteningCoeffValue* is from 0 to 0x7F. However, if *WhiteningCoeffValue* is “0x80”, it means to disable whitening.

3.2.5 TxGainIndex parameter

| IC TYPE | UI/FW Mode | GET DEFAULT POWER | Default Tx Index | USED by “bt_mp_Exec” COMMAND |
|----------|------------|--|---------------------------------|--|
| RTL8723B | UI Mode | Load Tx Table # ./bt_mp_Exec 5 #./ bt_mp_Exec 6 | (usb) 1M/2M/3M/LE : 5/5/5/4 | “bt_mp_Exec” 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(1e cont tx) |
| RTL8821A | | | (uart) 1M/2M/3M/LE : 4/4/4/4 | |
| RTL8703B | | | 1M/2M/3M/LE : 7/7/7/6 | |
| | UI Mode | Load Tx Table # ./bt_mp_Exec 5 #./ bt_mp_Exec 6 | 1M/2M/3M/LE : 6/6/6/6 | “bt_mp_Exec” 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(1e cont tx) |

| | | | |
|--|------------|--|--|
| RTL8761A | FW Mode | Get Tx Power Info #./ bt_mp_Exec 38 #./bt_mp_Report 17 [Return format] 17, Status, max tx power index, 1M, 2M, 3M, LE default tx power index The range of "TxGainIndex" value is from 0 to max tx index. | "bt_mp_Exec" 30~31(pkt tx) 32~33(pkt rx) 34~35(cont tx) 36~37(le cont tx) |
| RTL8723D RTL8822B RTL8821C RTL8822C RTL8761B | FW Mode | Get Tx Power Info #./ bt_mp_Exec 38 #./bt_mp_Report 17 [Return format] 17, Status, max tx power index, 1M, 2M, 3M, LE default tx power index The range of "TxGainIndex" value is from 0 to max tx index. | "bt_mp_Exec" 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(le cont tx) |

Only in packet tx, the UI mode and FW mode are different. In other operations they are the same. In UI mode, *TxPacketCount* is "0" that means to send packet "0xFF" counts. In FW mode, *TxPacketCount* is "0" that means to send packets continuously.

3.3 MP Mode Execute Commands

Using this command to control bt mp action, and get current report.

| MP Command | Parameters | Return | |
|------------|------------|---------------|---------------|
| bt_mp_Exec | Action | Return Action | Return Status |

You can use “*bt_mp_Exec ACTION_INDEX*”. The definition of *ACTION_INDEX* can refer to “*BT_ACTIONCONTROL_TAG*” Table.

Example: If you want to run “*PACKET_TX_START*” this action, please use the “*bt_mp_Exec 12*” command. On the contrary “*bt_mp_Exec 14*” is “*PACKET_TX_STOP*”.

```
bt_mp_Exec 12
bt_mp_Exec 12
bt_mp_Exec [Success:0]
bt_mp_Exec,12,0x00
> bt_mp_Exec 14
bt_mp_Exec 14
bt_mp_Exec [Success:0]
> bt_mp_Exec,14,0x00
```

| Command | Index | Support Chip | | | |
|---------------------------|-------|----------------------------------|----------|----------|----------|
| | | RTL8723B RTL8761A RTL8821A | RTL8723D | RTL8822B | RTL8821C |
| HCI_RESET | 0 | ■ | ■ | ■ | ■ |
| TEST_MODE_ENABLE | 1 | ■ | ■ | ■ | ■ |
| WRITE_EFUSE_DATA | 2 | ■ | ■ | ■ | ■ |
| SET_TX_GAIN_TABLE | 3 | ■ | ■ | ■ | ■ |
| SET_TX_DAC_TABLE | 4 | ■ | ■ | ■ | ■ |
| SET_DEFAULT_TX_GAIN_TABLE | 5 | ■ | ■ | ■ | ■ |
| SET_DEFAULT_TX_DAC_TABLE | 6 | ■ | ■ | ■ | ■ |
| SET_POWER_GAIN_INDEX | 7 | ■ | ■ | ■ | ■ |
| SET_POWER_GAIN | 8 | ■ | ■ | ■ | ■ |
| SET_POWER_DAC | 9 | ■ | ■ | ■ | ■ |
| SET_XTAL | 10 | ■ | ■ | ■ | ■ |
| REPORT_CLEAR | 11 | ■ | ■ | ■ | ■ |
| PACKET_TX_START | 12 | ■ | | | |
| PACKET_TX_UPDATE | 13 | ■ | | | |
| PACKET_TX_STOP | 14 | ■ | | | |
| CONTINUE_TX_START | 15 | ■ | | | |
| CONTINUE_TX_UPDATE | 16 | ■ | | | |
| CONTINUE_TX_STOP | 17 | ■ | | | |

| | | | | | |
|-------------------------|----|---|---|---|---|
| PACKET_RX_START | 18 | ■ | | | |
| PACKET_RX_UPDATE | 19 | ■ | | | |
| PACKET_RX_STOP | 20 | ■ | | | |
| HOPPING_DWELL_TIME | 21 | ■ | ■ | ■ | ■ |
| LE_TX_DUT_TEST_CMD | 22 | ■ | ■ | ■ | ■ |
| LE_RX_DUT_TEST_CMD | 23 | ■ | ■ | ■ | ■ |
| LE_DUT_TEST_END_CMD | 24 | ■ | ■ | ■ | ■ |
| READ_EFUSE_DATA | 25 | ■ | ■ | ■ | ■ |
| LE_CONTINUE_TX_START | 28 | ■ | | | |
| LE_CONTINUE_TX_STOP | 29 | ■ | | | |
| FW_PACKET_TX_START | 30 | | ■ | ■ | ■ |
| FW_PACKET_TX_STOP | 31 | | ■ | ■ | ■ |
| FW_PACKET_RX_START | 32 | | ■ | ■ | ■ |
| FW_PACKET_RX_STOP | 33 | | ■ | ■ | ■ |
| FW_CONTINUE_TX_START | 34 | | ■ | ■ | ■ |
| FW_CONTINUE_TX_STOP | 35 | | ■ | ■ | ■ |
| FW_LE_CONTINUE_TX_START | 36 | | ■ | ■ | ■ |
| FW_LE_CONTINUE_TX_STOP | 37 | | ■ | ■ | ■ |
| FW_READ_TX_POWER_INFO | 38 | | ■ | ■ | ■ |
| SET_GPIO3_0 | 39 | | ■ | | |
| SET_ANT_INFO | 40 | | ■ | | |
| SET_ANT_DIFF_S0S1 | 41 | | ■ | | |
| TX_POWER_TRACKING | 42 | | ■ | ■ | ■ |
| SET_K_TX_CH_PWR | 43 | | ■ | ■ | |
| WRITE_FLASH_CONFIG | 44 | | | | |
| TX_POWER_GAIN_K | 45 | | | | |
| TX_POWER_FLATNESS | 46 | | | | |
| TX_PATH_LOSS_MODULE | 47 | | | | |
| CONFIG_EXTEND | 48 | | | | |
| READ_FLASH_CONFIG | 49 | | | | |
| UNLOCK_8822C | 50 | | | | |
| SetTxPower_8822C | 51 | | | | |

Table BT_ACTIONCONTROL_TAG

3.4 MP Mode Report Commands

These commands used to report Bluetooth DUT TX/RX status are listed as below:

#./bt_mp_Report "Item Index"

| Item Index | Item Index | Return | | | | | | |
|-------------------------|------------|--------|--------------------|------------------------|----------|-------------|-------|----|
| PKT TX = 1 | 1 | Status | TXBits | TxCounts | | | | |
| CONT TX = 2 | 2 | | TXBits | TxCounts | | | | |
| PKT RX = 3 | 3 | | RxRssi | RXBits | RxCounts | RxErrorBits | | |
| Tx Gain Table = 4 | 4 | | Tx Gain Table | | | | | |
| Tx DAC Table = 5 | 5 | | Tx DAC Table | | | | | |
| Xtal = 6 | 6 | | Xtal | | | | | |
| Thermal = 7 | 7 | | Thermal | | | | | |
| Stage = 8 | 8 | | Stage | | | | | |
| Efuse = 10 | 10 | | Efuse | | | | | |
| LE RX = 11 | 11 | | RxCounts | | | | | |
| LE CONT TX=12 | 12 | | TXBits | TxCounts | | | | |
| FW_PKT_TX=13 | 13 | | TXBits | TxCounts | | | | |
| FW_CONT_TX=14 | 14 | | TXBits | TxCounts | | | | |
| FW_PKT_RX=15 | 15 | | RxRssi | RXBits | RxCounts | RxErrorBits | | |
| FW_LE_CONT_TX=16 | 16 | | TXBits | TxCounts | | | | |
| TX_POWER_INFO=17 | 17 | | Max tx power index | default tx power index | | | | |
| | | | 1M | 2M | 3M | BLE1M | BLE2M | LR |
| REPORT_GPIO3_0 | 18 | | | | | | | |
| REPORT_MP_DEBUG_MESSAGE | 19 | | | | | | | |
| REPORT_MP_FT_VALUE | 20 | | | | | | | |
| REPORT_POWER_TRACKING | 21 | | | | | | | |
| REPORT_MP_TXCAL_INFO | 22 | | | | | | | |
| REPORT_FLASH_CONFIG | 23 | | | | | | | |

4. RF Test Mode (Certification)

This chapter describes the entering BQB test and RF safety testing

4.1 Direct Test Mode - BR/EDR (BQB Certification)

Enter the Bluetooth device to Bluetooth DUT Test and stop DUT Test Mode command below:

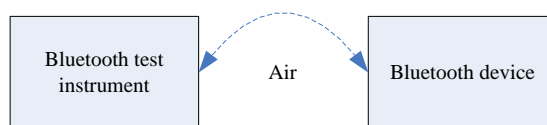
--Enter DUT Test Mode:

Use *bt_mp_Exec(TEST_MODE_ENABLE)* to enter Bluetooth test mode.

--Stop Test Mode

Use *bt_mp_Exec(HCI_RESET)* to stop Bluetooth test mode.

The Test connection diagram :



For example by ADB for android : ex usb interface and use Anritsu 8852B to test

(a) Enter MP Mode and download patch code

```
root@android:/system/bin # rtlbtmp
rtlbtmp
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
:::::::::::: Bluetooth MP Test Tool Starting :::::::::::
> enable uart:/dev/ttyS0
enable uart:/dev/ttyS0
> > enable[Success:0]
```

(b) Enter DUT MP Mode

```
> bt_mp_Exec 1
bt_mp_Exec 1
bt_mp_Exec[Success:0]
> bt_mp_Exec,1,0x00
```

(c) Begin MP test by Bluetooth test instrument (e.g. Anritsu 8852B)

(d) *bt_mp_Exec(HCI_RESET)* to stop test.

```
> bt_mp_Exec 0
bt_mp_Exec 0
bt_mp_Exec[Success:0]
> bt_mp_Exec,0,0x00
```

(e) exit MP Mode

```
disable
disable
disable[Success:0]
> quit
quit
:::::::::::: Bluetooth MP Test Tool Terminating :::::::::::
root@android:/system/bin # _
```

4.2 TX Test- BR/EDR (Certification)

In order to transmit a continuous signal, follow the process below:

Step0: Get default tx power index

| IC TYPE | UI/FW Mode | GET DEFAULT POWER | Default Tx Index | USED by "bt_mp_Exec" COMMAND |
|----------------------------------|------------|---|---|---|
| RTL8723B | UI Mode | Load Tx Table # ./bt_mp_Exec 5 #./ bt_mp_Exec 6 | (usb) 1M/2M/3M/LE : 5/5/5/4 (uart) 1M/2M/3M/LE : 4/4/4/4 | "bt_mp_Exec" 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(le cont tx) |
| RTL8821A | | | 1M/2M/3M/LE : 7/7/7/6 | |
| RTL8703B | | | 1M/2M/3M/LE : 6/6/6/6 | |
| RTL8761A | UI Mode | Load Tx Table # ./bt_mp_Exec 5 #./ bt_mp_Exec 6 | 1M/2M/3M/LE : 6/6/6/5 | "bt_mp_Exec" 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(le cont tx) |
| | FW Mode | Get Tx Power Info #./ bt_mp_Exec 38 #./bt_mp_Report 17 [Retuen format] 17,Status, max tx power index, 1M, 2M, 3M, LE default tx power index The range of "TxGainIndex" value is from 0 to max tx index. | | "bt_mp_Exec" 30~31(pkt tx) 32~33(pkt rx) 34~35(cont tx) 36~37(le cont tx) |
| RTL8723D RTL8822B RTL8821C | FW Mode | Get Tx Power Info #./ bt_mp_Exec 38 #./bt_mp_Report 17 [Retuen format] 17,Status, max tx power index, 1M, 2M, 3M, LE default tx power index The range of "TxGainIndex" value is from 0 to max tx index. | | "bt_mp_Exec" 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(le cont tx) |

Step1: *bt_mp_SetParam*

| INDEX | VALUE |
|-------|---------------------|
| 1 | ChannelNumber |
| 2 | PacketType |
| 3 | PayloadType |
| 6 | WhiteningCoeffValue |
| 7 | TxGainIndex |

| | |
|----|--------------|
| 9 | PacketHeader |
| 11 | HitTarget |

Step2: *bt_mp_Exec*(*CONTINUE_TX_START* = 15) or (*FW_CONTINUE_TX_START*=34)

Step3: *bt_mp_Report* 2

Step4: *bt_mp_Exec*(*CONTINUE_TX_STOP* = 17) or (*FW_CONTINUE_TX_STOP*=35)

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4.3 LE Direct Test Mode (BQB Test)

After testing BT4.0 only enable device and download patch code, you should jump interface to the instrument.

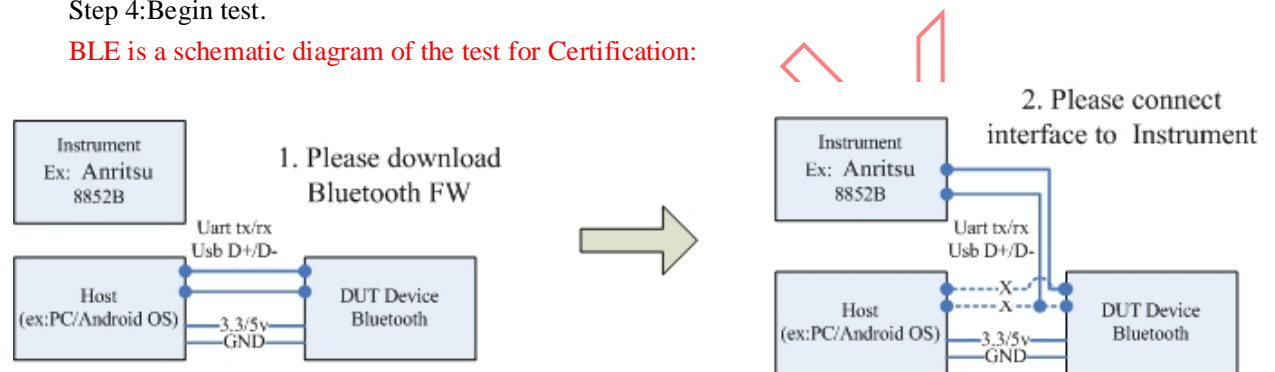
Step 1: *rtlbtmp*

Step 2: *enable* (xxxxxxx)

Step 3: Jump hardware interface to the instrument.

Step 4: Begin test.

BLE is a schematic diagram of the test for Certification:



4.4 LE Certification TX Mode(Certification)

In order to facilitate RF safety testing, such as the band edge. We often use to facilitate continuous tx RF safety testing. eg. Bandedge

Step0: Get default tx power index

| IC TYPE | UI/FW Mode | GET DEFAULT POWER | Default Tx Index | USED by "bt_mp_Exec" COMMAND |
|----------|------------|---|---------------------------------|---|
| RTL8723B | UI Mode | Load Tx Table # ./bt_mp_Exec 5 #./ bt_mp_Exec 6 | (usb) 1M/2M/3M/LE : 5/5/5/4 | "bt_mp_Exec" 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(le cont tx) |
| RTL8821A | | | (uart) 1M/2M/3M/LE : 4/4/4/4 | |
| RTL8703B | | | 1M/2M/3M/LE : 7/7/7/6 | |
| | UI Mode | Load Tx Table # ./bt_mp_Exec 5 #./ bt_mp_Exec 6 | 1M/2M/3M/LE : 6/6/6/6 | "bt_mp_Exec" 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(le cont tx) |
| | | | 1M/2M/3M/LE : 6/6/6/5 | |

| | | | |
|--|------------|--|--|
| RTL8761A | FW Mode | <p>Get Tx Power Info</p> <p>#./ bt_mp_Exec 38</p> <p>#./bt_mp_Report 17</p> <p>[Retuen format] 17,Status, max tx power index, 1M, 2M, 3M, LE default tx power index</p> <p>The range of "TxGainIndex" value is from 0 to max tx index.</p> | <p>"bt_mp_Exec"</p> <p>30~31(pkt tx)</p> <p>32~33(pkt rx)</p> <p>34~35(cont tx)</p> <p>36~37(le cont tx)</p> |
| RTL8723D RTL8822B RTL8821C RTL8822C RTL8763B RTL8761B | FW Mode | <p>Get Tx Power Info</p> <p>#./ bt_mp_Exec 38</p> <p>#./bt_mp_Report 17</p> <p>[Retuen format] 17,Status, max tx power index, 1M, 2M, 3M, LE default tx power index</p> <p>The range of "TxGainIndex" value is from 0 to max tx index.</p> | <p>"bt_mp_Exec"</p> <p>12~14(pkt tx)</p> <p>15~17(cont tx)</p> <p>18~20(pkt rx)</p> <p>28~29(le cont tx)</p> |

Step1: *bt_mp_SetParam* : Channel Number = 0~39

| INDEX | VALUE |
|-------|---------------|
| 1 | ChannelNumber |
| 7 | TxGainIndex |

Step2: *bt_mp_Exec*(LE_CONTINUE_TX_START = 28) or
(FW_LE_CONTINUE_TX_START=36)

Step3: *bt_mp_Exec*(LE_CONTINUE_TX_STOP = 29) or
(FW_LE_CONTINUE_TX_STOP=37)

4.5 Hopping Test (Certification- Dwell time)

In order to start hopping mode test, follow the steps below:

Step 1: *bt_mp_SetParam*....(to setting packet type:DH1,DH2....3DH5)

| NAME | INDEX |
|-------------|-------|
| BT_PKT_DH1 | 0 |
| BT_PKT_DH3 | 1 |
| BT_PKT_DH5 | 2 |
| BT_PKT_2DH1 | 3 |
| BT_PKT_2DH3 | 4 |
| BT_PKT_2DH5 | 5 |
| BT_PKT_3DH1 | 6 |
| BT_PKT_3DH3 | 7 |

| | |
|-------------|----|
| BT_PKT_3DH5 | 8 |
| BT_PKT_LE | 9 |
| BT_PKT_NULL | 10 |

| INDEX | VALUE |
|-------|----------------------------|
| 2 | PacketType |
| 10 | HoppingFixChannel (0 or 1) |
| 1 | ChannelNumber (0~78) |
| 6 | WhiteningCoeffValue |

Step 2: *bt_mp_Exec*(HOPPING_DWELL_TIME = 21)

Step 3: *bt_mp_Exec*(HCI_RESET = 0) to disable hopping mode.

PS. If HoppingFixChannel = 1, it enable fix channel that is controlled by “ChannelNumber”.

If HoppingFixChannel = 0, “ChannelNumber” is useless.

5. MP Mode Test Control Steps (MP)

5.1 DUT Single Tone TX Mode

For test , only use the commands below to implement the single tone signal.

To Set Single-Tone Tx, step by step:

Step0: Get default tx power index

| IC TYPE | UI/FW Mode | GET DEFAULT POWER | Default Tx Index | USED by “bt_mp_Exec” COMMAND |
|----------|------------|---|---------------------------------|---|
| RTL8723B | UI Mode | Load Tx Table # ./bt_mp_Exec 5 #./ bt_mp_Exec 6 | (usb) 1M/2M/3M/LE : 5/5/5/4 | “bt_mp_Exec” 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(le cont tx) |
| RTL8821A | | | (uart) 1M/2M/3M/LE : 4/4/4/4 | |
| RTL8703B | | | 1M/2M/3M/LE : 7/7/7/6 | |
| | UI Mode | Load Tx Table # ./bt_mp_Exec 5 #./ bt_mp_Exec 6 | 1M/2M/3M/LE : 6/6/6/6 | “bt_mp_Exec” 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(le cont tx) |

| | | | |
|----------------------------------|------------|--|--|
| RTL8761A | FW Mode | <p>Get Tx Power Info</p> <p>#./ bt_mp_Exec 38</p> <p>#./bt_mp_Report 17</p> <p>[Retuen format] 17,Status, max tx power index, 1M, 2M, 3M, LE default tx power index</p> <p>The range of "TxGainIndex" value is from 0 to max tx index.</p> | <p>"bt_mp_Exec"</p> <p>30~31(pkt tx)</p> <p>32~33(pkt rx)</p> <p>34~35(cont tx)</p> <p>36~37(le cont tx)</p> |
| RTL8723D RTL8822B RTL8821C | FW Mode | <p>Get Tx Power Info</p> <p>#./ bt_mp_Exec 38</p> <p>#./bt_mp_Report 17</p> <p>[Retuen format] 17,Status, max tx power index, 1M, 2M, 3M, LE default tx power index</p> <p>The range of "TxGainIndex" value is from 0 to max tx index.</p> | <p>"bt_mp_Exec"</p> <p>12~14(pkt tx)</p> <p>15~17(cont tx)</p> <p>18~20(pkt rx)</p> <p>28~29(le cont tx)</p> |

Step1: *bt_mp_SetParam*

| INDEX | VALUE |
|-------|---------------------|
| 1 | ChannelNumber |
| 2 | PacketType |
| 3 | PayloadType |
| 6 | WhiteningCoeffValue |
| 7 | TxGainIndex |
| 9 | PacketHeader |
| 11 | HitTarget |

```
> bt_mp_SetParam 1,39;2,0x08;3,0x00;4,0x00;6,0xFF;7,0x07;9,0x3FFFF;11,0x000000c6967e
bt_mp_SetParam 1,39;2,0x08;3,0x00;4,0x00;6,0xFF;7,0x07;9,0x3FFFF;11,0x000000c6967e
bt_mp_SetParam[Success:0]
> bt_mp_SetParam,11,0x00
```

In this example we use 0X3FFFF that different PACKET_HEADER, please check PACKET_HEADER table.

Step2: Execute :

CONTINUE_TX_START = 15 or *FW_CONTINUE_TX_START*=34

```
> bt_mp_Exec 15
bt_mp_Exec 15
bt_mp_Exec[Success:0]
> bt_mp_Exec,15,0x00
```

Step 3: Stop Single-Tone Tx.

CONTINUE_TX_STOP = 17 or *FW_CONTINUE_TX_STOP*=35

```

> bt_mp_Exec 17
bt_mp_Exec 17
bt_mp_Exec [Success:0]
> bt_mp_Exec,17,0x00

```

5.2 DUT TX Test Mode(MP)

In order to transmit a packet signal, follow the process below:

Step0: Get default tx power index

| IC TYPE | UI/FW Mode | GET DEFAULT POWER | Default Tx Index | USED by "bt_mp_Exec" COMMAND |
|----------------------------------|------------|---|------------------------------|---|
| RTL8723B | UI Mode | Load Tx Table # ./bt_mp_Exec 5 #./ bt_mp_Exec 6 | (usb) 1M/2M/3M/LE : 5/5/5/4 | "bt_mp_Exec" 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(le cont tx) |
| RTL8821A | | | (uart) 1M/2M/3M/LE : 4/4/4/4 | |
| RTL8703B | | | 1M/2M/3M/LE : 7/7/7/6 | |
| RTL8761A | UI Mode | Load Tx Table # ./bt_mp_Exec 5 #./ bt_mp_Exec 6 | 1M/2M/3M/LE : 6/6/6/5 | "bt_mp_Exec" 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(le cont tx) |
| | FW Mode | Get Tx Power Info #./ bt_mp_Exec 38 #./bt_mp_Report 17 [Retuen format] 17,Status, max tx power index, 1M, 2M, 3M, LE default tx power index The range of "TxGainIndex" value is from 0 to max tx index. | | "bt_mp_Exec" 30~31(pkt tx) 32~33(pkt rx) 34~35(cont tx) 36~37(le cont tx) |
| RTL8723D RTL8822B RTL8821C | FW Mode | Get Tx Power Info #./ bt_mp_Exec 38 #./bt_mp_Report 17 [Retuen format] 17,Status, max tx power index, 1M, 2M, 3M, LE default tx power index The range of "TxGainIndex" value is from 0 to max tx index. | | "bt_mp_Exec" 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(le cont tx) |

Step1: bt_mp_SetParam....

| INDEX | VALUE |
|-------|---------------------|
| 1 | ChannelNumber |
| 2 | PacketType |
| 3 | PayloadType |
| 4 | TxPacketCount |
| 6 | WhiteningCoeffValue |
| 7 | TxGainIndex |
| 9 | PacketHeader |
| 11 | HitTarget |

Step2: *bt_mp_Exec(PACKET_TX_START =12) or (FW_PACKET_TX_START=30)*

Step3: *bt_mp_Report 1* (if need report, to do..)

Step4: *bt_mp_Exec(PACKET_TX_STOP =14) or (FW_PACKET_TX_STOP=31)*

5.3 DUT RX Test Mode(MP)

In order to receive a packet signal, follow the process below:

Step1: *bt_mp_SetParam....*

| INDEX | VALUE |
|-------|---------------------|
| 1 | ChannelNumber |
| 2 | PacketType |
| 3 | PayloadType |
| 6 | WhiteningCoeffValue |
| 9 | PacketHeader |
| 11 | HitTarget |

Step2: *bt_mp_Exec(PACKET_RX_START =18) or (FW_PACKET_RX_START=32)*

Step3: *bt_mp_Report 3*

Step4: *bt_mp_Exec(PACKET_RX_STOP=20) or (FW_PACKET_RX_STOP=33)*

PS. "*bt_mp_Report 3*" should be excuted every 1s.

5.4 LE DUT TX/RX Test Mode (MP)

To start LE TX DUT test mode, follow the steps below:

Step0: Get default tx power index

| IC TYPE | UI/FW Mode | GET DEFAULT POWER | Default Tx Index | USED by "bt_mp_Exec" COMMAND |
|----------------------------------|------------|---|---|---|
| RTL8723B | UI Mode | Load Tx Table # ./bt_mp_Exec 5 #./ bt_mp_Exec 6 | (usb) 1M/2M/3M/LE : 5/5/5/4 (uart) 1M/2M/3M/LE : 4/4/4/4 | "bt_mp_Exec" 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(le cont tx) |
| RTL8821A | | | 1M/2M/3M/LE : 7/7/7/6 | |
| RTL8703B | | | 1M/2M/3M/LE : 6/6/6/6 | |
| RTL8761A | UI Mode | Load Tx Table # ./bt_mp_Exec 5 #./ bt_mp_Exec 6 | 1M/2M/3M/LE : 6/6/6/5 | "bt_mp_Exec" 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(le cont tx) |
| | FW Mode | Get Tx Power Info #./ bt_mp_Exec 38 #./bt_mp_Report 17 [Retuen format] 17,Status, max tx power index, 1M, 2M, 3M, LE default tx power index The range of "TxGainIndex" value is from 0 to max tx index. | | "bt_mp_Exec" 30~31(pkt tx) 32~33(pkt rx) 34~35(cont tx) 36~37(le cont tx) |
| RTL8723D RTL8822B RTL8821C | FW Mode | Get Tx Power Info #./ bt_mp_Exec 38 #./bt_mp_Report 17 [Retuen format] 17,Status, max tx power index, 1M, 2M, 3M, LE default tx power index The range of "TxGainIndex" value is from 0 to max tx index. | | "bt_mp_Exec" 12~14(pkt tx) 15~17(cont tx) 18~20(pkt rx) 28~29(le cont tx) |

Step 1: *bt_mp_SetParam*

| INDEX | VALUE | Value Range |
|-------|---------------|-------------|
| 1 | ChannelNumber | 0~39 |

| | | |
|----|-------------|---|
| 3 | PayloadType | BT_LE_PAYLOAD_TYPE_PRBS9 = 0, BT_LE_PAYLOAD_TYPE_1111_0000 = 1, BT_LE_PAYLOAD_TYPE_1010 = 2, BT_LE_PAYLOAD_TYPE_PRBS15 = 3, BT_LE_PAYLOAD_TYPE_ALL1 = 4, BT_LE_PAYLOAD_TYPE_ALL0 = 5, BT_LE_PAYLOAD_TYPE_0000_1111 = 6, BT_LE_PAYLOAD_TYPE_0101 = 7, |
| 7 | TxGainIndex | Get default tx power index in step 0 |
| 15 | LEDataLen | 0x00~0x25 |

Step 2: *bt_mp_Exec*(LE_TX_DUT_TEST_CMD = 22)

Step 3: *bt_mp_Exec*(LE_DUT_TEST_END_CMD=24) to stop LE TX DUT mode.

```
> bt_mp_SetParam 1,0x03;2,0x09;3,0x03;7,7;15,0x25
bt_mp_SetParam 1,0x03;2,0x09;3,0x03;7,7;15,0x25
bt_mp_SetParam[Success:0]
> bt_mp_SetParam,15,0x00

> bt_mp_Exec 22
bt_mp_Exec 22
bt_mp_Exec[Success:0]
> bt_mp_Exec,22,0x00

> bt_mp_Exec 24
bt_mp_Exec 24
bt_mp_Exec[Success:0]
> bt_mp_Exec,24,0x00
```

To start LE RX DUT test mode, follow the steps below:

Step 1: *bt_mp_SetParam*

| INDEX | VALUE | Value Range |
|-------|---------------|-------------|
| 1 | ChannelNumber | 0~39 |

Step 2: *bt_mp_Exec*(LE_RX_DUT_TEST_CMD=23)

Step 3: *bt_mp_Exec*(LE_DUT_TEST_END_CMD=24) to stop LE RX DUT mode.

Step 4: *bt_mp_Report 11*

6. MP Test Flow

Support function by chap is defined as:

| Function | RTL8723B | RTL8703B | RTL8821A | RTL8761A | RTL8822B | RT8821C | RTL8822C | RTL8761B | Ameba | BBPRO | BBPRO2 | BBLite | Bee | Bee2 | Other |
|---------------------------------------|----------|----------|----------|----------|----------|---------|----------|----------|-------|-------|--------|--------|-----|------|-------|
| Thermal power tracking Enable/Disable | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Tx gain K | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Tx flatness K | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Tx Path loss | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Set Tx Power level | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |

6.1 Mass Production Initial and basic commands of Test Flow by Non-signaling Mode

In the initial stage, the Bluetooth device must set to factory default.

6.1.1 Disable TX power tracking

For Linux/Android platform: In bt RF(MP) test mode, use the following command to set it.

| | |
|--|--|
| Disable: | Enable: |
| <code>bt_mp_SetParam 18,0,0</code> <code>bt_mp_Exec 42</code> | <code>bt_mp_SetParam 18,0,1</code> <code>bt_mp_Exec 42</code> |

6.1.2 Set TX gain cal (K) value

If you need to calibrate TX power to target tx power , then must reset the TX gain Cal Value.

For Linux/Android platform: In bt RF(MP) test mode, use the following command to complete.

`bt_mp_SetParam 18,1,value`
`bt_mp_Exec 45`

The **value** is Tx Gain k value.

6.1.3 Set TX flatness Value

If you need to calibrate TX power for each frequency, then must set flatness value to 0 first.

For Linux/Android platform: In bt rf(MP) test mode, use the following command to complete.

`bt_mp_SetParam 18,1,value`
`bt_mp_Exec 46`

The value is flatness k value and is 2byte (Word)

6.1.4 Set TX path loss module Value

For verify TX performance need to setting temporarily set the current TX level. You can use the APIs below to set the device to the ram.

`bt_mp_SetParam 18,1,value`

`bt_mp_Exec 47`

The value is path loss value.

6.1.5 Set TX Power Level To RAM

For verify TX performance need to setting temporarily set the current TX level. You can use the commands below to set the device to the ram.

`bt_mp_SetParam 18,0x31,0x38,0x38,0x31,0x31; //max ,1M,2M,3M,BLE1M,BLE2M`

`bt_mp_Exec 51`

6.1.6 Set Crystal cap vale

If need to set crystal cap then use this commands to set it.

`bt_mp_SetParam 14,vaule`

`bt_mp_Exec 10`

```
> bt_mp_SetParam 14,0x20
bt_mp_SetParam[Success:0]
> bt_mp_SetParam,14,0x00

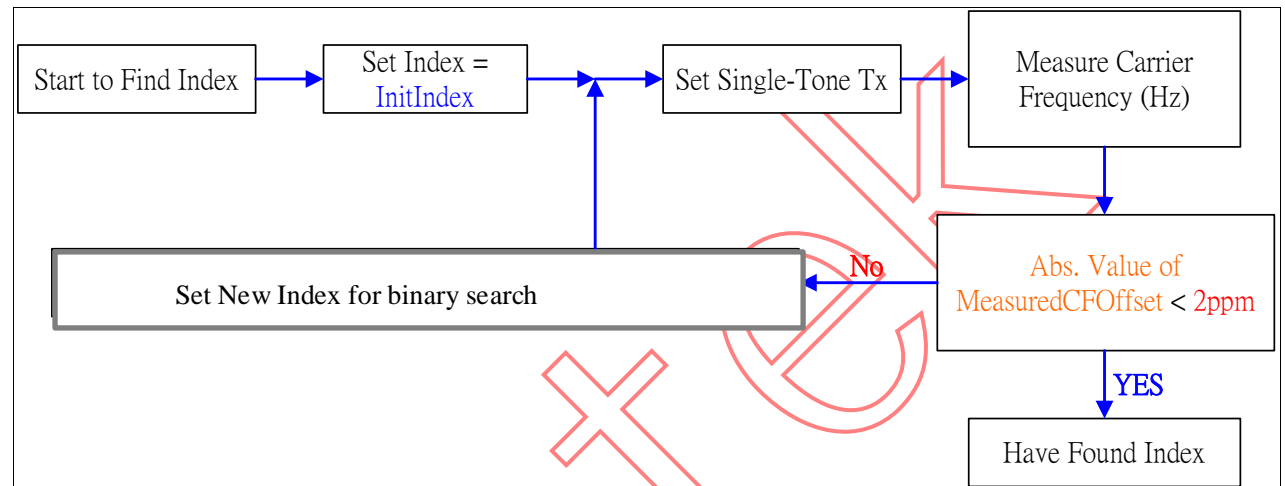
> bt_mp_Exec 10
bt_mp_Exec[Success:0]
> bt_mp_Exec,10,0x00
█
```

The value is crystal cap value.

6.2 Bluetooth Calibrates Crystal (Xtal) Cap by Non-Signaling mode

First, take a look at eFuse content about setting of Crystal Cap. . Normal driver will load this value in initial step. So this value must be well-calibrated and filled on correct eFuse location.

The flow of calibration Bluetooth step is as below:



Finding Crystal Cap. Index Flow

InitIndex: the default value is 0x20. Index range is 0x0 to 0x3F.

MeasuredCFOffset: Carrier frequency measured by instrument - Ideal Carrier Frequency Target range Abs. Value of 2ppm in 2.441GHz band is about 10KHz(±5KHz).

Step1 : Get default tx gain index

| IC TYPE | MODE | GET DEFAULT POWER |
|----------|---------|---|
| RTL8723B | UI mode | Load Tx Table # ./bt_mp_Exec 5 // SET TX GAIN TABLE #./ bt_mp_Exec 6 //SET TX DAC TABLE Default Tx Index(usb) 1M/2M/3M/LE : 5/5/5/4 Default Tx Index(uart) 1M/2M/3M/LE : 4/4/4/4 |
| RTL8821A | UI mode | Load Tx Table # ./bt_mp_Exec 5 // SET TX GAIN TABLE #./ bt_mp_Exec 6 //SET TX DAC TABLE Default Tx Index 1M/2M/3M/LE : 7/7/7/6 |
| RTL8703B | UI mode | Load Tx Table # ./bt_mp_Exec 5 // SET TX GAIN TABLE #./ bt_mp_Exec 6 //SET TX DAC TABLE Default Tx Index 1M/2M/3M/LE : 6/6/6/6 |
| | UI mode | Load Tx Table # ./bt_mp_Exec 5 // SET TX GAIN TABLE #./ bt_mp_Exec 6 //SET TX DAC TABLE |

| | | |
|----------------------------------|---------|---|
| RTL8761A | | Default Tx Index 1M/2M/3M/LE : 6/6/6/5 |
| | FW mode | Get Tx Power Info #./ bt_mp_Exec 38 #./bt_mp_Report 17 [Retuen format] 17,Status, max tx power index, 1M, 2M, 3M, LE default tx power index The range of "TxGainIndex" value is from 0 to max tx index. |
| RTL8723D RTL8822B RTL8821C | FW mode | Get Tx Power Info #./ bt_mp_Exec 38 #./bt_mp_Report 17 [Retuen format] 17,Status, max tx power index, 1M, 2M, 3M, LE default tx power index The range of "TxGainIndex" value is from 0 to max tx index. |
| RTL8723B RTL8822C RTL8761B | | |

Step 2: Set Index = `InitIndex(0x20)`

```
> bt_mp_SetParam 14,0x20
bt_mp_SetParam[Success:0]
> bt_mp_SetParam,14,0x00

> bt_mp_Exec 10
bt_mp_Exec[Success:0]
> bt_mp_Exec,10,0x00
```

Step 3: Set Single-Tone Tx

```
Channel=39;
PacketType=3DH5;
PayloadType=ALL0;
TxPacketCount=Infinite;
WhiteningCoeffValue =0xFF(disable);
TxGainIndex=7;
PacketHeader=0XA078;
HitTarget= 0x000000c6967e
CONTINUE_TX_START = 15 or FW_CONTINUE_TX_START=34
```

```
> bt_mp_SetParam 1,39;2,0x08;3,0x00;4,0x00;6,0xFF;7,0x07;9,0x3FFFF;11,0x000000C6967E
bt_mp_SetParam[Success:0]
> bt_mp_SetParam,11,0x00
```

In this example we use 0X3FFFF that different PACKET_HEADER, please check PACKET_HEADER table.

```
> bt_mp_Exec 15
bt_mp_Exec[Success:0]
> bt_mp_Exec,15,0x00
```

Step 4: Stop Single-Tone Tx.

CONTINUE_TX_STOP = 17 or FW_CONTINUE_TX_STOP=35

```
> bt_mp_Exec 17
bt_mp_Exec[Success:0]
> bt_mp_Exec,17,0x00
```

Step 5: Go to Step2and re-tune Index value until find the best Crystal index value.

6.3 Verify Bluetooth Legacy Tx Performance by Non-Signaling mode

To measure the DUT TX power/initial Carrier offset/modulation characteristics to check Tx performance is ok or not. Bluetooth TX criterion is shown as below:

| | Test Item | Sub Test Item | Packet Type | Channel | Criterion |
|-----------------------|---------------------------------|------------------|-------------|-----------------------|-----------------|
| | | | | | Bluetooth Spec. |
| Verify Tx DH1 | Maximum Output Power | Average Power | DH1 | Low (CH6-2408MHZ) | > 0dBm |
| | | | | Middle (CH42-2444MHZ) | > 0dBm |
| | | | | High (CH70-2472MHZ) | > 0dBm |
| | Modulation Characteristics | Delta F1 Avg. | DH1 | Low (CH6-2408MHZ) | 140KHz ~ 175KHz |
| | | Delta F2 Max. | | Middle (CH42-2444MHZ) | > 115KHz |
| | | Modulation Index | | High (CH70-2472MHZ) | > 0.8 |
| | Initial Carrier Frequency Error | | DH1 | Low (CH6-2408MHZ) | -20KHz ~ 20KHz |
| Middle (CH42-2444MHZ) | | | | | |
| High (CH70-2472MHZ) | | | | | |
| Verify Tx 3DH1 | Maximum Output Power | Average Power | 3DH1 | Low (CH6-2408MHZ) | > 0dBm |
| | | | | Middle (CH42-2444MHZ) | > 0dBm |
| | | | | High (CH70-2472MHZ) | > 0dBm |
| | Modulation Characteristics | RMS DEVM | 3DH1 | Low (CH6-2408MHZ) | 0.13 |
| | | Peak DEVM | | Middle (CH42-2444MHZ) | 0.25 |
| | | 99% DEVM | | High (CH70-2472MHZ) | 0.20 |
| | Initial Carrier Frequency Error | | 3DH1 | All | -20KHz ~ 20KHz |

Table The recommended test items of Bluetooth Tx

For example, use adb commands android platform, device is UART interface.
step by step command:

(1) Enter MP Mode and download patch code

```
root@tristan-PORTEGE-R700:~# rtlbtmp

::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
::::::::: Bluetooth MP Test Tool Starting ::::::::::
> enable uart:/dev/ttyUSB0
> > > enable[Success:0]
```

Get default tx gain index

| IC TYPE | MODE | GET DEFAULT POWER |
|----------|---------|---|
| RTL8723B | UI mode | Load Tx Table # ./bt_mp_Exec 5 // SET TX GAIN TABLE #./ bt_mp_Exec 6 //SET TX DAC TABLE Default Tx Index(usb) 1M/2M/3M/LE : 5/5/5/4 Default Tx Index(uart) 1M/2M/3M/LE : 4/4/4/4 |
| RTL8821A | UI mode | Load Tx Table # ./bt_mp_Exec 5 // SET TX GAIN TABLE #./ bt_mp_Exec 6 //SET TX DAC TABLE Default Tx Index 1M/2M/3M/LE : 7/7/7/6 |
| RTL8703B | UI mode | Load Tx Table # ./bt_mp_Exec 5 // SET TX GAIN TABLE #./ bt_mp_Exec 6 //SET TX DAC TABLE Default Tx Index 1M/2M/3M/LE : 6/6/6/6 |
| RTL8761A | UI mode | Load Tx Table # ./bt_mp_Exec 5 // SET TX GAIN TABLE #./ bt_mp_Exec 6 //SET TX DAC TABLE Default Tx Index 1M/2M/3M/LE : 6/6/6/5 |
| | FW mode | Get Tx Power Info #./ bt_mp_Exec 38 #./bt_mp_Report 17 [Retuen format] 17,Status, max tx power index, 1M, 2M, 3M, LE default tx power index The range of "TxGainIndex" value is from 0 to max tx index. |

| | | |
|----------------------------------|---------|---|
| RTL8723D RTL8822B RTL8821C | FW mode | Get Tx Power Info #./ bt_mp_Exec 38 #./bt_mp_Report 17 [Return format] 17,Status, max tx power index, 1M, 2M, 3M, LE 1M, BLE 2M ,BLE LR default tx power index The range of "TxGainIndex" value is from 0 to max tx index.(The value is default tx power level in 25 deg C) |
|----------------------------------|---------|---|

(2) Set Parameter :

| Test Item | | adb command |
|-----------|---------------|--|
| | Test Item | Channel = 6 |
| DH1 | Maximum Power | bt_mp_SetParam 1,0x06;2,0x00;3,0x07;4,0x00;6,0x7F;7,0x7;9, 0x33820;11,0x0000009e8b33 |
| DH1 | Delta F1 | bt_mp_SetParam 1,0x06;2,0x00;3,0x05;4,0x00;6,0xFF;7,0x7;9, 0x33820;11,0x0000009e8b33 |
| DH1 | Delta F2 | bt_mp_SetParam 1,0x06;2,0x00;3,0x02;4,0x00;6,0xFF;7,0x7;9, 0x33820;11,0x0000009e8b33 |
| 3DH1 | ALL | bt_mp_SetParam 1,0x06;2,0x06;3,0x07;4,0x00;6,0x7F;7,0x7;9, 0x15C40;11,0x0000009e8b33 |

| Test Item | | adb command |
|-----------|---------------|--|
| | Test Item | Channel = 42 |
| DH1 | Maximum Power | bt_mp_SetParam 1,0x2a;2,0x00;3,0x07;4,0x00;6,0x7F;7,0x7;9, 0x33820;11,0x0000009e8b33 |
| DH1 | Delta F1 | bt_mp_SetParam 1,0x2a;2,0x00;3,0x05;4,0x00;6,0xFF;7,0x7;9, 0x33820;11,0x0000009e8b33 |
| DH1 | Delta F2 | bt_mp_SetParam 1,0x2a;2,0x00;3,0x02;4,0x00;6,0xFF;7,0x7;9, 0x33820;11,0x0000009e8b33 |
| 3DH1 | ALL | bt_mp_SetParam 1,0x2a;2,0x06;3,0x07;4,0x00;6,0x7F;7,0x7;9, 0x15C40;11,0x0000009e8b33 |

| Test Item | | adb command |
|-----------|---------------|--|
| | Test Item | Channel = 70 |
| DH1 | Maximum Power | bt_mp_SetParam 1,0x46;2,0x00;3,0x07;4,0x00;6,0x7F;7,0x7;9, 0x33820;11,0x0000009e8b33 |
| DH1 | Delta F1 | bt_mp_SetParam 1,0x46;2,0x00;3,0x05;4,0x00;6,0xFF;7,0x7;9, 0x33820;11,0x0000009e8b33 |
| DH1 | Delta F2 | bt_mp_SetParam 1,0x46;2,0x00;3,0x02;4,0x00;6,0xFF;7,0x7;9, 0x33820;11,0x0000009e8b33 |
| 3DH1 | ALL | bt_mp_SetParam 1,0x46;2,0x06;3,0x07;4,0x00;6,0x7F;7,0x7;9, 0x15C40;11,0x0000009e8b33 |

(3)Run Packe Tx

(PACKET_TX_START =12) or (FW_PACKET_TX_START=30)

```
> bt_mp_Exec 12
bt_mp_Exec[Success:0]
> bt_mp_Exec,12,0x00
```

(4) measured by Bluetooth test instrument (e.g. Litepoint IQNxnN)


```
> bt_mp_Report 1
bt_mp_Report[Success:0]
> bt_mp_Report,1,0x00,0x042402a8,0x00002139
█
```

(5)Stop Packet Tx

(PACKET_TX_STOP =14) or (FW_PACKET_TX_STOP=31)

```
> bt_mp_Exec 14
bt_mp_Exec[Success:0]
> bt_mp_Exec,14,0x00
█
```

-- If you need to test other parameters, please stop packet tx and go back to step 2

(6)exit MP Mode

```
> disable
disable[Success:0]
> quit
::::::::: Bluetooth MP Test Tool Terminating ::::::::::
root@tristan-PORTEGE-R700:~# █
```

6.4 Verify Bluetooth Rx Performance by Non-Signaling mode

Measure the DUT Rx sensitivity to check Rx performance is ok or not. The Rx performance test can be measured in Signaling mode (ex: Anritsu 8852B, Agilent N4010A) or Non-Signaling mode (ex: LitePoint IQNxn). Bluetooth Rx criterion is shown as below:

| Verify Bluetooth Rx | Test Item | Packet Type | Criterion |
|---------------------|-------------|-------------|-----------------|
| | | | Bluetooth Spec |
| | Sensitivity | DH1 or 3DH5 | < -70dBm |

For final MP, Rx can just test DH1, 3DH5 BER at sensitivity criterion power level at channel 0 and 78 to reduce time. All Bluetooth Rx criterion is shown as:

| Test Item | | Criterion(Bluetooth Spec) |
|-----------|-------------|---------------------------|
| Channel | Packet type | < -70dBm |
| 6 | DH1 | < -70dBm |
| 42 | DH1 | < -70dBm |
| 70 | DH1 | < -70dBm |
| 6 | 3DH1 | < -70dBm |
| 42 | 3DH1 | < -70dBm |
| 70 | 3DH1 | < -70dBm |

Figure The recommended test items of Bluetooth Rx

(1) Enter MP Mode and download patch code

```
root@tristan-PORTEGE-R700:~# rtlbtmp
::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
::::::::: Bluetooth MP Test Tool Starting ::::::::::
> enable uart:/dev/ttyUSB0
> > > enable[Success:0]
█
```

Set default table

```
> bt_mp_Exec 5
bt_mp_Exec[Success:0]
> bt_mp_Exec,5,0x00

> bt_mp_Exec 6
bt_mp_Exec[Success:0]
> bt_mp_Exec,6,0x00
█
```

(2) Set Parameter

| Test Item | | adb command |
|-----------|-------------|--|
| Channel | Packet type | PayloadType=PRBS9; WhiteningCoeffValue= 0xFF(disable); PacketHeader= PACKET_HEADER Table ; HitTarget= 0x000000c6967e |
| 6 | DH1 | bt_mp_SetParam 1,0x06;2,0x00;3,0x07;6,0xFF;9, 0x33820;11,0x000000c6967e |
| 42 | DH1 | bt_mp_SetParam 1,0x2a;2,0x00;3,0x07;6,0xFF;9, 0x33820;11,0x000000c6967e |
| 70 | DH1 | bt_mp_SetParam 1,0x46;2,0x00;3,0x07;6,0xFF;9, 0x33820;11,0x000000c6967e |
| 6 | 3DH1 | bt_mp_SetParam 1,0x06;2,0x06;3,0x07;6,0xFF;9, 0x15C40;11,0x000000c6967e |
| 42 | 3DH1 | bt_mp_SetParam 1,0x2a;2,0x06;3,0x07;6,0xFF;9, 0x15C40;11,0x000000c6967e |
| 70 | 3DH1 | bt_mp_SetParam 1,0x46;2,0x06;3,0x07;6,0xFF;9, 0x15C40;11,0x000000c6967e |

Please refer to Chapter 3.

(3) To setting Parameter with the Bluetooth test instrument. Bluetooth test instrument begin transmit..

(4) Run Packe Rx

(PACKET_RX_START =18) or (FW_PACKET_RX_START=32)

```
> bt_mp_Exec 18
bt_mp_Exec[Success:0]
> bt_mp_Exec,18,0x00
█
```

(5) Report Received Result.

```
> bt_mp_Report 3
bt_mp_Report[Success:0]
> bt_mp_Report,3,0x00,-96,0x00000000,0x00000000,0x00000000
█
```

-- "bt_mp_Report 3" should be executed every 1s.

(6)Stop Packet Rx

(PACKET_RX_STOP=20) or (FW_PACKET_RX_STOP=33)

```
> bt_mp_Exec 20  
bt_mp_Exec[Success:0]  
> bt_mp_Exec,20,0x00  
█
```

-- If you need to test other parameters, please stop packet Rx and go back to step 2.

(7)exit MP Mode

```
> disable  
disable[Success:0]  
> quit  
:::::::::: Bluetooth MP Test Tool Terminating ::::::::::  
root@tristan-PORTEGE-R700:~# █
```

6.5 Verify Bluetooth BLE Tx Performance

To measure the DUT BLE TX power and modulation index to check BLE TX performance is ok or not. Bluetooth BLE TX criterion is shown as below:

| | Test Item | Sub Test Item | Payload Type | Channel | Criterion |
|---------------|----------------------------|------------------|---------------------------|-----------------------|-------------------|
| | | | | | Bluetooth Spec. |
| Verify BLE Tx | BLE Output Power | Average Power | PRBS9 | Low (CH0-2402MHZ) | > 0dBm |
| | | | | Middle (CH19-2440MHZ) | > 0dBm |
| | | | | High (CH34-2470MHZ) | > 0dBm |
| | Modulation Characteristics | Delta F1 Avg. | BT_PAYLOAD_TYPE_1111_0000 | 2440MHZ | 225 kHz ~ 275 kHz |
| | | Delta F2 Max. | BT_PAYLOAD_TYPE_1010 | CH19- | ≥ 185 kHz |
| | | Modulation Index | None | | ≥ 0.8 |

Table The recommended test items of Bluetooth BLE Tx

For example, use adb commands android platform, device is UART interface.

step by step command:

- (1) Enter MP Mode and download patch code
- (2) Set Parameter :

| Test Item | | adb command |
|-----------|-----------|---|
| Channel | Test item | PayloadType=PRBS9; WhiteningCoeffValue = 0x(dis80able); PacketHeader=PACKET_HEADER Table; HitTarget= 0x000000c6967e |
| 0 | Avg_power | bt_mp_SetParam 1,0x00;3,0x00;7,0x06 |
| 19 | Avg_power | bt_mp_SetParam 1,0x13;3,0x00;7,0x06 |
| 34 | Avg_power | bt_mp_SetParam 1,0x22;3,0x00;7,0x06 |
| 0 | Delta F1 | bt_mp_SetParam 1,0x00;3,0x01;7,0x06 |
| 0 | Delta F2 | bt_mp_SetParam 1,0x00;3,0x02;7,0x06 |

6.6 Verify Bluetooth BLE Rx Performance

Measure the DUT BLE Rx sensitivity to check Rx performance is ok or not. The Bluetooth Rx criterion is shown as below:

| Channel | Payload Type | BLE sensitivity limit | Criterion Bluetooth Spec |
|-----------------------|--------------|-----------------------|-----------------------------|
| Low (CH0-2402MHZ) | PRBS9 | PER<= 30.800 % | < -70dBm |
| Middle (CH19-2440MHZ) | | | |
| High (CH34-2470MHZ) | | | |

Figure The recommended test items of Bluetooth BLE Rx

To calculate the Packet Error Rate(PER)

$$\text{PER}\% = 100 * (1 - (\text{Packets Received} / \text{Packets Send}))$$

The step by step list below :

(1) Enter MP Mode and download patch code

(2) Set Parameter :

| Test Item | | adb command |
|-------------|--------------|-----------------------------|
| Item | Payload type | |
| Sensitivity | PRBS9 | bt_mp_SetParam 1,0x00;3,0x0 |
| Sensitivity | PRBS9 | bt_mp_SetParam 1,0x13;3,0x0 |
| Sensitivity | PRBS9 | bt_mp_SetParam 1,0x22;3,0x0 |

(3) To setting Parameter with the Bluetooth test instrument.

(4) Run LE Packet Rx

(5) Stop LE Packet Rx and to obtain the receive packet count

(6) Calculate PER

If (PER < limit) , goto step (3) , else Stop