TESCOM

# MTP200B WLAN / BT LE Tester

## Operating Manual

R20160511

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# Warranty

TESCOM warrants that this product is free from defects in terms of materials and workmanship for a period of one (1) year from the date of shipment. During the warranty period, TESCOM will -- at its discretion -- either repair or replace products that prove to be defective.

For the warranty service or repair, the Customer must notify TESCOM of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. The Customer shall be responsible for packaging and shipping the defective product to the service center designated by TESCOM. The Customer shall prepay the shipping charge to a TESCOM designated service center, and TESCOM shall pay the shipping charge to return the product to the Customer. In case the Customer is located outside of Korea, the Customer is responsible for all shipping charges including freight, taxes, and any other charge if the product is returned for service to TESCOM.

LIMITATION OF WARRANTY

- The foregoing warranty shall not apply to defects resulting from improper or inadequate malignance by the Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, accident, or abnormal conditions of operation.
- TESCOM`s responsibility to repair or replace defective products is the sole and exclusive remedy provided to the Customer in case of breach of this warranty. TESCOM will not be liable for any indirect, special, incidental, or consequential damages regardless of whether TESCOM served advance notice of the possibility of such damages.

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Product Service

# Attestation of Conformity

**No. E8A 16 03 43088 018**

**Holder of Certificate:** **Tescom Co., Ltd.**
#927 UNITECHVIL, 142, Ilsan-ro
Ilsandong-gu, Goyang-si, Gyeonggi-do 10442
REPUBLIC OF KOREA

**Name of Object:** **Electrical equ. for measurement, control and laboratory use (WLAN / BT LE Tester)**

**Model(s):** **MTP200B, MTP200A**

**Description of Object:**

| | |
|---|---|
| Rated input voltage: | 100-240 Va.c. |
| Rated frequency: | 50/60 Hz |
| Power consumption: | < 45 W |

**Tested according to:**
EN 55011:2009/A1:2010
EN 61326-1:2013

This Attestation of Conformity is issued on a voluntary basis according to the Directive 2014/30/EU relating to electromagnetic compatibility. It confirms that the listed apparatus complies with all essential requirements of the directive and is based on the technical specifications applicable at the time of issuance. It refers only to the particular sample submitted for testing and certification. See also notes overleaf.

**Test report no.:** DRECEE1602-0080

**Date,** 2016-03-04 ( Byung-Soo Kang )

523399

CE After preparation of the necessary technical documentation as well as the EU declaration of conformity the required CE marking can be affixed on the product. That declaration of conformity is issued under the sole responsibility of the manufacturer. Other relevant EU-directives have to be observed.

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Product Service

# Attestation of Conformity

**No. N8 16 02 43088 016**

**Holder of Certificate:** **Tescom Co., Ltd.**
#927 UNITECHVIL, 142, Ilsan-ro
Ilsandong-gu, Goyang-si, Gyeonggi-do 10442
REPUBLIC OF KOREA

**Product:** **Electrical equ. for measurement, control and laboratory use (WLAN/BT LE Tester)**

**Model(s):** **MTP200B, MTP200A**

**Parameters:**

| | |
|---|---|
| Rated input voltage: | 100-240 V a.c. |
| Rated frequency: | 50-60 Hz |
| Rated input power: | 45 W |
| Protection class: | I |
| Installation Category: | II |
| Pollution degree: | 2 |
| Degree of protection against ingress of liquids: | IPX0 |

**Tested according to:** EN 61010-1:2010

This Attestation of Conformity is issued on a voluntary basis according to the Low Voltage Directive 2006/95/EC relating to electrical equipment designed for use within certain voltage limits. It confirms that the listed equipment complies with the principal protection requirements of the directive. It refers only to the particular sample submitted for testing and certification. See also notes overleaf.

**Test report no.:** CPSA01042216

655813

**Date,** 2016-02-23 ( Hyuk-Jun Kwon )

CE After preparation of the necessary technical documentation as well as the EC conformity declaration the required CE marking can be affixed on the product. Other relevant directives have to be observed.

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# Safety Terms and Symbols

Caution on Safety is to prevent accidents/danger and for users to use the product safely and properly. Th erefore, please do follow the instructions.

Caution is divided into 'warning' and 'caution' and the meanings are following. The meanings displayed o n the product are as follows.

| Display | Meaning |
|---|---|
| Warning | The case that serious injury or even death can be caused by disobeying the instructions. |
| Caution | The case that serious injury or defect on the product can be caused by disobeying the instru ctions. |

The meaning of symbols displayed in the user manual are as follows.

| Display | Meaning |
|---|---|
|  | Warning signs provide a description of the conditions and behaviors that may cause physica l injuries or even death.<br>The operator should fully understand the contents of the warning sign before operating the product. |
|  | Caution signs provide a description of the conditions and behaviors that may cause damage to the product or other assets.<br>The operator should fully understand the content s of the caution sign before operating the product. |
|  | An explanation about references when using the product. |

# Safety Consideration

This section describes the rules that the user should follow to use the product safely and to prevent accid ents in advance. Please comply with the following to prevent damage to the product and to eliminate pot ential risk factors:

### Power Cord

To prevent fire, use only the specified power cord.

### Connection and Disconnection

While the power is turned on, do not connect/disconnect the probe or lead to/from the product.

### Grounding

The product is grounded through the grounding cable in the power cord. Before connecting to th e input or output terminal of the product, make sure that the product is properly grounded.

### Installation Environment

Avoid installing the product in humid places or places with risks of explosion or fire. Avoid direct s unlight, sudden temperature changes, dusk, and magnetic devices.

### Rated Power Display

To avoid fire or electric shock, comply with the power rating specifications.

### Others

Do not run the product with the cover or panel opened. In case trouble is suspected, do not opera te the product.

# PART 1. Getting Started

This chapter contains general information such as product specifications, characteristics, warranty and M TP200B's set-up, update, and maintenance.

# 1. Product set-up and storage

## 1.1 Exterior and Accessory Inspection

When MTP200B is delivered, inspect the package and check whether the following accessories are included in the package:

**Table 1-1** MTP200B Accessory List

| NO. | Model No. | Item | Specification | Quantity |
|---|---|---|---|---|
| 1 | 3802-0008 | USB Memory stic 16 G | Document, PC Application program | 1 |
| 2 | 4007-0002 | BNC Cable | RG58, BNC(m) - BNC(m), 35 cm | 1 |
| 3 | 4008-0021 | USB Cable | USB A(p) - USB B(p) 4C 1.8 m | 1 |
| 4 | 4010-0002 | Power Cord | Power cable 220 V | 1 |
| 5 | 4011-0019 | RF Cable | SS402, N(m) - N(m), 2 m | 1 |
| 6 | G99923A | Attenuator | 30 dB, 0.5 W, N Type (DC to 6000 MHz) | 1 |

**⚠WARNING**

In case exterior damage is found, stop using the product for safety reasons.

## 1.2 Power Requirement

**Table 1-2** Power Requirement

| Item | Specification |
|---|---|
| Input Voltage | 100 - 240 V~ |
| Frequency | 50 - 60 Hz |
| Power Consumption | < 45 W (Typ. 26 W) |

**⚠WARNING**

Using power beyond the rated power may cause critical damage to the product. Always inspect the safety of the power source.

## 1.3 Operating Environment and Storage

Avoid locations with severe vibration, explosive danger, and direct sunlight. Store the product in a plac e at 5 °C ~ 40 °C with humidity of less than 85%.

When the product is not used for a long time, safely pack the product and store the packed product in a dry place at room temperature.

## 1.4 Installation and Transportation

Raise the foot on the lower part of MTP200B as shown blow. For transportation, use the handle on the side.

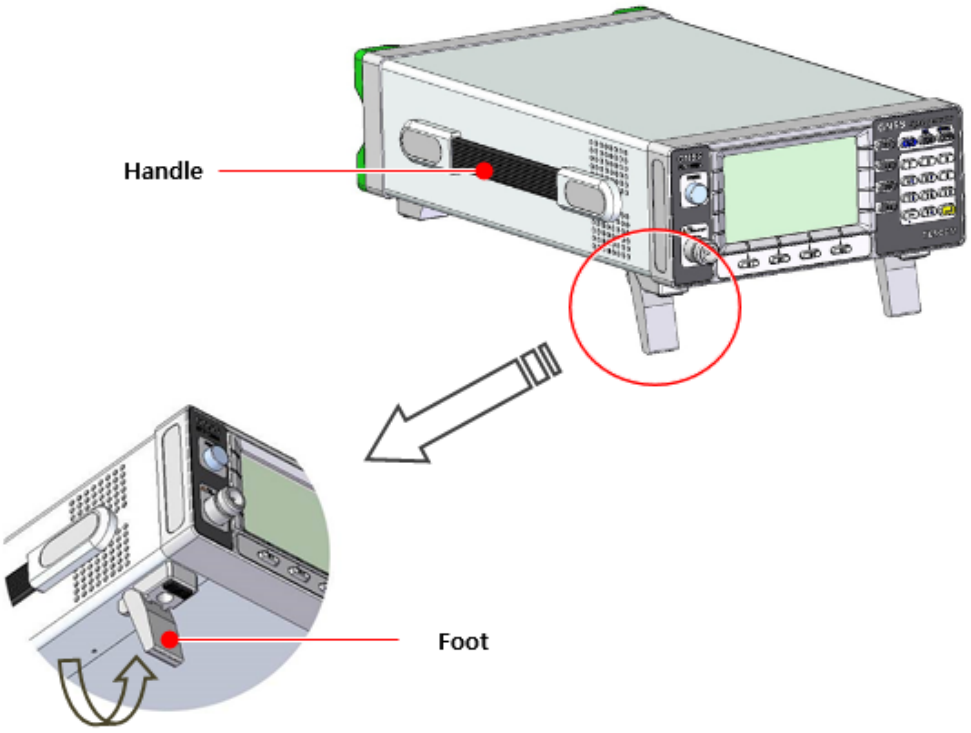



**Figure 1-1** Installation and Transportation

# 2. Product Description and Features

## 2.1 Product Description

Tescom's MTP200B is a non-signaling test-based WLAN or BT LE (Low Energy) tester. As one-body equipment incorporating both Signal Generator and Signal Analyzer, MTP200B is designed to provide effective and stable performance for generating and analyzing WLAN and BT LE waveforms. It can be effectively used in a mass production for testing the RF performance of products with WLAN and BT LE functions such as smart phones. In addition, the best efficiency can be expected at a lower cost thanks to the simple installation and operation of the product.

## 2.2 Features

- One-body equipment incorporating both Signal Generator and Signal Analyzer
- WLAN waveform generation and analysis
- BT LE waveform generation and analysis
- BT LE Direct Test with a remote control program
- Creation of various WLAN test files using Waveform Creator
- CW Mode supported
- Measurement result display through Color LCD.
- Easy control through frontal keypad without PC
- Remote control through USB Port (USB to Serial) and GPIB
- Easy firmware upgrade through USB Port (USB to Serial)
- Compact, lightweight (Half Rack/2U size)

# 2.3 Product Specifications

## 2.3.1 General Specification

| Generator | |
|---|---|
| Frequency Range | (1) 2400 MHz ~ 2500 MHz (2) 4900 MHz ~ 5875 MHz |
| Frequency Accuracy | < ±1.0 ppm/year @ operating temperature |
| Frequency Resolution | 1.0 kHz |
| Output Power Range | -5.0 dBm ~ -70.0 dBm |
| Output Power Accuracy | < ±1.0 dB |
| Output Power Resolution | 0.1 dB |
| VSWR | < 1.4 |
| Harmonics | Out-of-band: < -40.0 dB<br>In-band: < -50.0 dB (100 kHz resolution BW) |
| Phase Noise | < 1.0 degrees (2.4 GHz < f < 2.5 GHz)<br>< 1.5 degrees (4.9 GHz < f < 6.0 GHz) |

| Analyzer | |
|---|---|
| Frequency Range | (1) 2400 MHz ~ 2500 MHz (2) 4900 MHz ~ 5875 MHz |
| Frequency Accuracy | < ±1.0 ppm/year @ operating temperature |
| Input Power Range | +20.0 dBm ~ -50.0 dBm |
| Input Power Accuracy | < ±1.0 dB |
| Input Power Resolution | 0.1 dB |
| VSWR | < 1.6 |

## 2.3.2 WLAN Specification

| Standard | |
|---|---|
| Generator | IEEE 802.11a, IEEE 802.11g, IEEE 802.11n |
| Analyzer | IEEE 802.11a, IEEE 802.11g, IEEE 802.11n |

| WLAN Generator | |
|---|---|
| Frequency Range | (1) 2400 MHz ~ 2500 MHz (2) 4900 MHz ~ 5850 MHz |
| Frequency Accuracy | < ±1.0 ppm/year @ operating temperature |
| Output Power Range | -5.0 dBm ~ -70.0 dBm |
| Output Power Accuracy | < ±1.0 dB |
| Output Power Resolution | 0.1 dB |
| RMS EVM | • IEEE 802.11a/g<br>(1) < -34.0 dB (2.0 %) (2) < -32.0 dB (2.5 %)<br>• IEEE 802.11n<br>(1) < -32.0 dB (2.5 %) (2) < -30.0 dB (3.2 %) |
| Center Frequency Error | < ±1.0 ppm |
| Symbol Clock Error | < ±5.0 ppm |
| Spectrum Flatness | < +1.0 dB, -2.5 dB |

| Waveform Creator | |
|---|---|
| Arbitrary waveform Files | IEEE 802.11a/g/n Signal |

| WLAN Analyzer | |
|---|---|
| Frequency Range | (1) 2400 MHz ~ 2500 MHz (2) 4900 MHz ~ 5850 MHz |
| Frequency Accuracy | < ±1.0 ppm/year @ operating temperature |
| Input Power Range | (1) 2400 ~ 2500 MHz : +15.0 dBm ~ -40.0 dBm<br>(2) 4900 ~ 5850 MHz : +12.0 dBm ~ -40.0 dBm |
| Input Power Accuracy | < ± 1.0 dB |
| Input Power Resolution | 0.1 dB |

| | |
|---|---|
| Residual EVM | (1) +15.0 dBm ~ -40.0 dBm: < -32 dB (2.5 %)<br>(2) +12.0 dBm ~ -35.0 dBm: < -32 dB (2.5 %),<br>-35.0 dBm ~ -40.0 dBm: < -30 dB (3.2 %) |
| Center Frequency Error | < ±1.0 ppm |
| Symbol Clock Error | < ±5.0 ppm |

| Modulation Analysis | |
|---|---|
| Bandwidth | 20 MHz |
| Analysis Modes<br>(802.11 a/g ) | 6M_BPSK_1/2 |
| | 9M_BPSK_3/4 |
| | 12M_QPSK_1/2 |
| | 18M_QPSK_3/4 |
| | 24M_16QAM_1/2 |
| | 36M_16QAM_3/4 |
| | 48M_64QAM_2/3 |
| | 54M_64QAM_3/4 |

| Modulation Analysis | |
|---|---|
| Analysis Modes (802.11 n ) | MCS0 (6.5M_BPSK_1/2) |
| | MCS1 (13M_QPSK_1/2) |
| | MCS2 (19.5M_QPSK_3/4) |
| | MCS3 (26M_16QAM_1/2) |
| | MCS4 (39M_16QAM_3/4) |
| | MCS5 (52M_64QAM_2/3) |
| | MCS6 (58.5M_64QAM_3/4) |
| | MCS7 (65M_64QAM_5/6) |
| Measured Parameters | RMS EVM (%) |
| | Power (dBm) |
| | Center frequency error (kHz) |
| | Symbol clock error (ppm) |
| | I/Q Constellation |

| Standard | Channel / Frequency |
|---|---|
| 802.11g(OFDM) | *Channel 1 to 14<br>(1/2412, 2/2417, 3/2422, 4/2427, 5/2432, 6/2437, 7/2442, 8/2447, 9/2452, 10/2457, 11/2462, 12/2467, 13/2472, 14/2484) |
| 802.11a | *Channels 34, 36, 38, 40, 42, 44, 46, 48, 52, 56, 60 ,64<br>(34/5170, 36/5180, 38/5190, 40/5200, 42/5210, 44/5220, 46/5230, 48/5240, 52/5260, 56/5280, 60/5300, 64/5320)<br>*Channels 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 149, 153, 157, 161,165<br>(100/5500, 104/5520, 108/5540, 112/5560, 116/5580, 120/5600, 124/5620, 128/5640, 132/5660, 136/5680, 140/5700, 149/5745, 153/5765, 157/5785, 161/5805, 165/5825) |

## 2.3.3 BT_LE Specification

| Standard | |
|---|---|
| Standard | Bluetooth Core Specification, Version 4.2(Low Energy) |
| **BT_LE Generator** | |
| Frequency Range | 2400 MHz ~ 2500 MHz |
| Frequency Accuracy | < ±1.0 ppm/year @ operating temperature |
| Output Power Range | -5.0 dBm ~ -70.0 dBm |
| Output Power Accuracy | < ±1.0 dB |
| Output Power Resolution | 0.1 dB |

| BT_LE Signal Type | |
|---|---|
| Signal Type<br>( BT4.0 2MHz,<br>GFSK Modulation) | ALL_ZEROS |
| | ALL_ONES |
| | 10101010 |
| | 11110000 |
| | PRBS9 |

| BT_LE Analyzer | |
|---|---|
| Frequency Range | 2400 MHz ~ 2500 MHz |
| Frequency Accuracy | < ±1.0 ppm/year @ operating temperature |
| Input Power Range | +20.0 dBm ~ -50.0 dBm |
| Input Power Accuracy | < ± 1.0 dB |
| Input Power Resolution | 0.1 dB |

| Modulation Analysis | |
|---|---|
| Analysis Modes | TEST_MODE |
| | ADVERTISING MODE |
| Measured Parameters | Power (dBm) |
| | Frequency deviation df1 |
| | Frequency deviation df2 |
| | Frequency accuracy |
| | Frequency offset |
| | Initial frequency drift |
| | Frequency drift |
| | Max drift rate |
| | df2 max rate 99.9% |

| Channel / Frequency | |
|---|---|
| Channel / Frequency | 0 / 2402 MHz ~ 39 / 2480 MHz |

## 2.3.4 Remote Control

| Port | |
|---|---|
| USB | USB to Serial (Virtual COM Port ) |
| | USB Driver (Silicon Laboratories CP210x USB to UART Bridge)<br>(http://www.silabs.com/products/mcu/Pages/USBtoUARTBridgeVCPDrivers.aspx) |
| GPIB | |

## 2.3.5 Port

| RF Port | |
|---|---|
| IN/OUT | N Type , 50 Ohm, DC isolated |
| **Reference Port** | |
| IN | BNC Type, 10 MHz, +10 dBm ~ 0 dBm @ 50 Ohm |

## 2.3.6 Miscellaneous

| Physical | |
|---|---|
| Dimension | 210(w) x 342(d) x 88(h) mm |
| Weight | 4.1 kg |
| Packing Size | 350(w) x 460(d) x 170(h) mm |
| Packing Weight | Approx. 5.0 kg |
| *The packing size and weight depend on the packing method. | |
| **Line Voltage** | |
| Input | 100 - 240 V~, 50 - 60 Hz |
| Power(Typ.) | < 45 W (Typ. 26 W) |
| **Operation Temperature** | |
| Operating Temperature Range | +15 ℃ ~ +35 ℃ |
| Storage Temperature Range | -20 ℃ ~ +70 ℃ |
| Specification Validity Temperature Range | +15 ℃ ~ +35 ℃ |

# 3. Exterior

## 3.1 Front Panel View

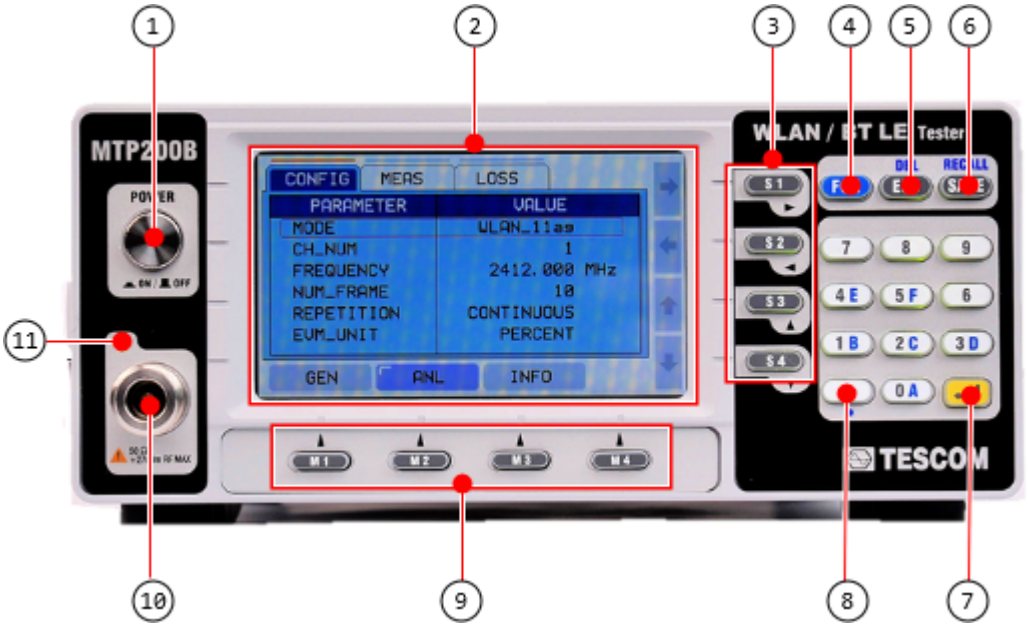



**Figure 3-1** Front Panel of MTP200B

**Table 3-1** MTP200B Front Panel

| No. | Panel Display | Function | No. | Panel Display | Function |
|---|---|---|---|---|---|
| ❶ | POWER | Power switch | ❼ |  | Data input |
| ❷ | LCD | LCD display | ❽ |  | Minus(-) |
| ❸ | S1 ~ S4 | Up/Down and Right/Left keys | ❾ | M1 ~ M4 | Menu keys |
| ❹ | FCN | Second function selection of each key | ❿ | RF Port | RF connector |
| ❺ | ESC | Cancels the selection and closes the popup windows. | ⓫ | Status Display LED | GEN or ANL mode display |
| ❻ | SAVE | Saves the test configuration | | | |

## 3.2 Rear Panel View

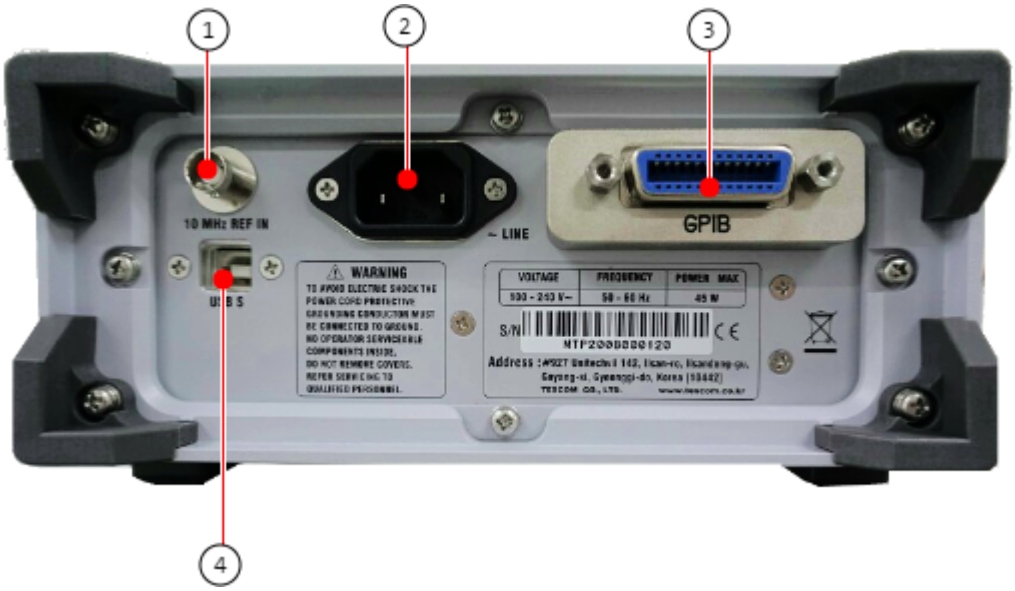



**Figure 3-2** Rear Panel of MTP200B

**Table 3-2** Rear Panel of MTP200B

| No. | Panel Display | Function |
|---|---|---|
| ❶ | 10 MHz REF IN | 10MHz reference signal input |
| ❷ | ~ LINE | Power input |
| ❸ | GPIB | GPIB Port |
| ❹ | USB S | USB port for remote control and firmware upgrade |

# 4. Menu Tree

The menu tree of MTP200B is shown below. Depending on the selection of WLAN option and BT_LE opti on, different parameters may be displayed.

## 4.1 INFO Menu Tree

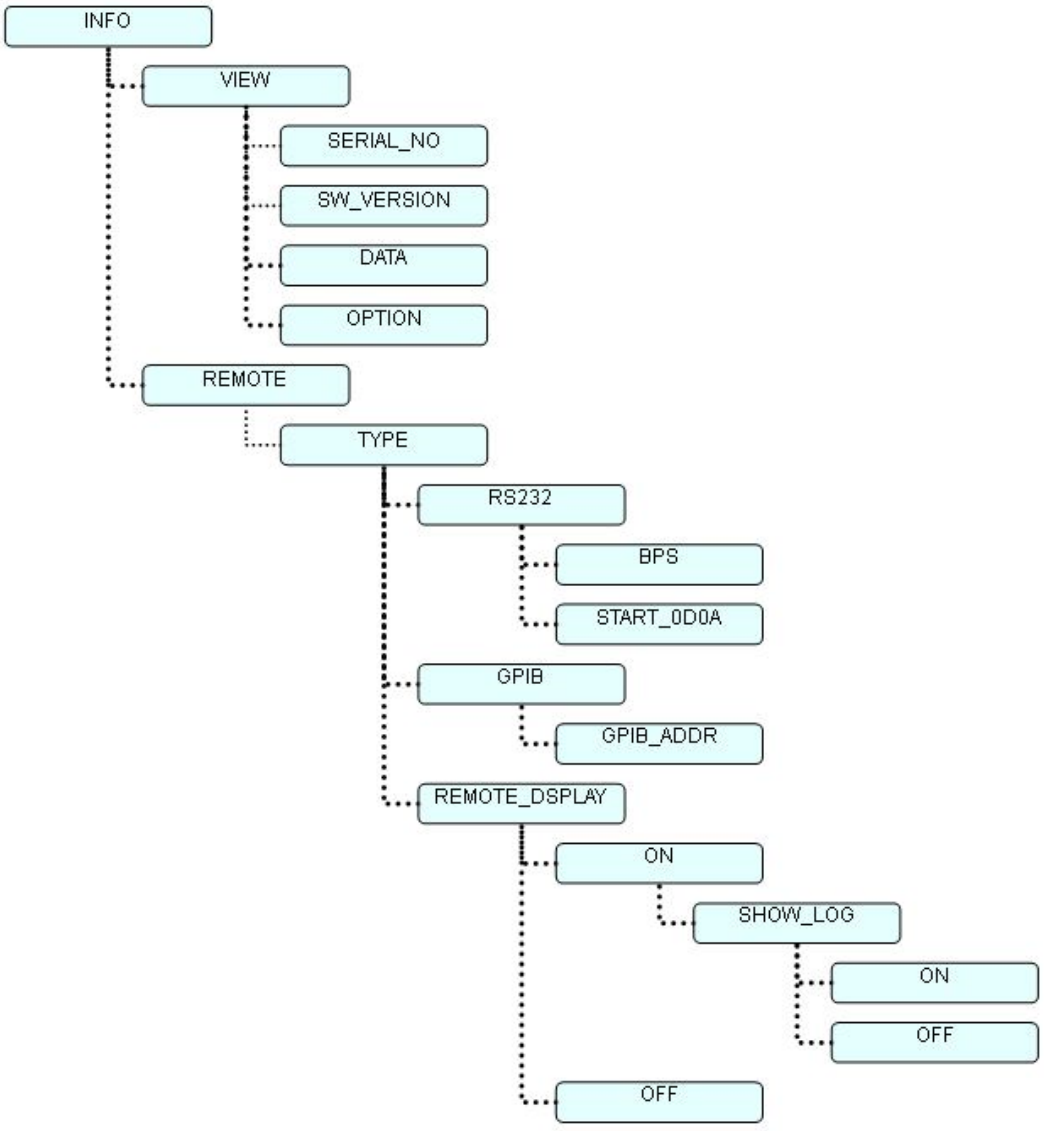



**Figure 4-1** INFO Menu Tree

## 4.2 GEN (Generator) Menu Tree

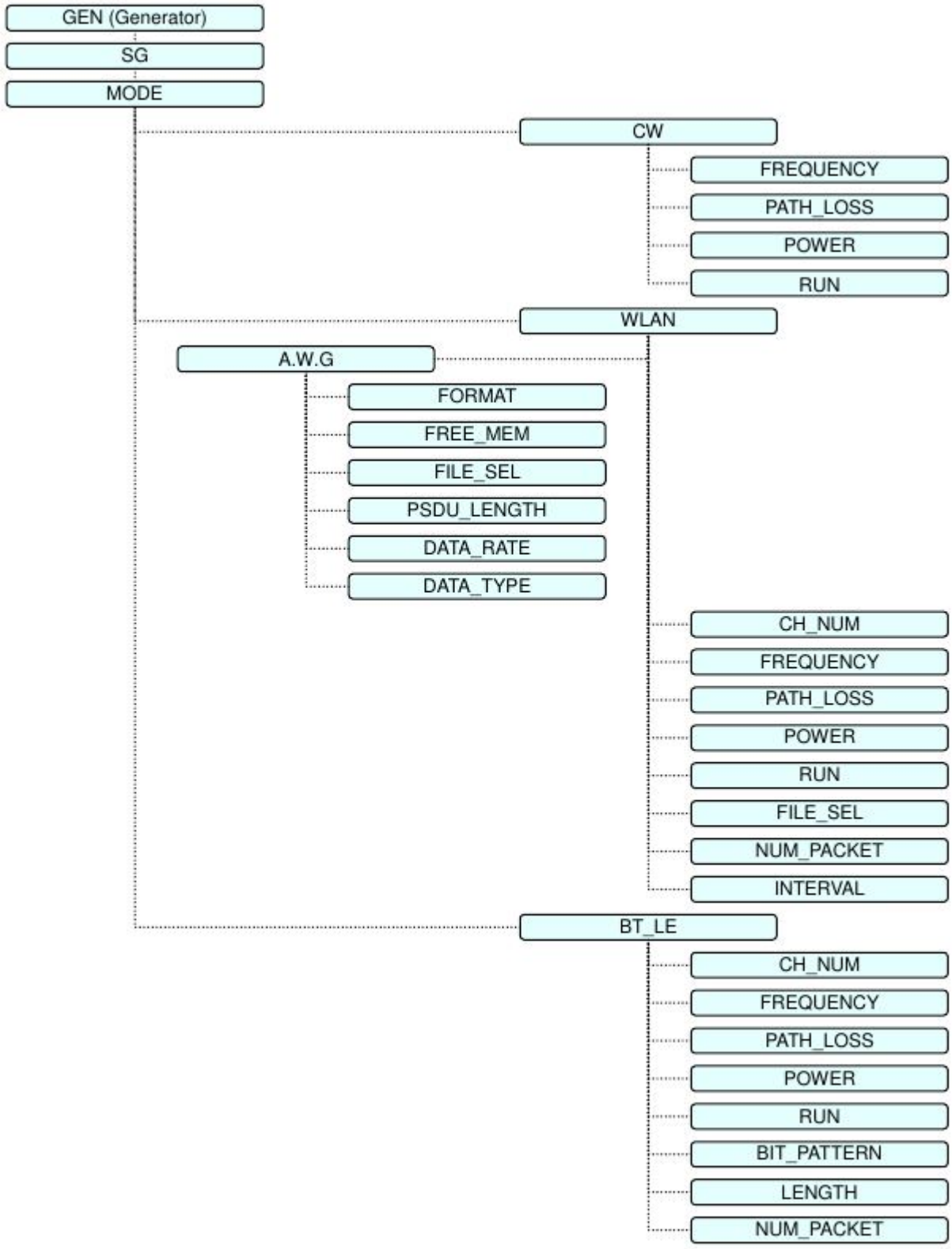



**Figure 4-2** GEN (Generator) Menu Tree

## 4.3 ANL (Analyzer) Menu Tree

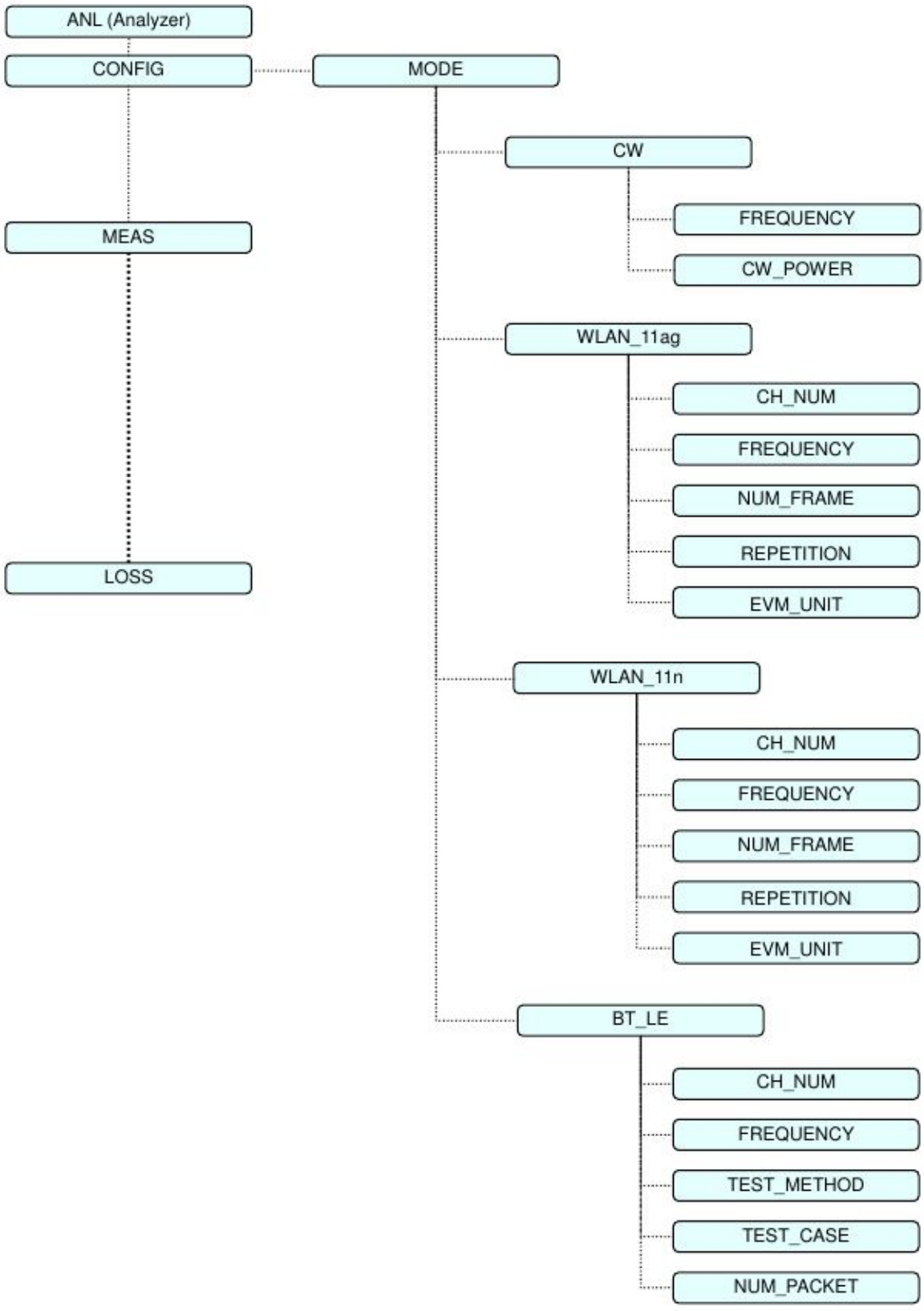



**Figure 4-3** ANL (Analyzer) Menu Tree

# 4.4 Saving and Recalling Device Setting Values

This function is used to save simutanesouly the current field setting in a single buffer and recall the save d setting. Up to 10 field setting values can be saved. Using the function, the user does not need to ma ke field setting each time. The following describes how to save and recall the field setting

## 4.4.1 Save

1. Fill out the required fields and complete the setting
2. Press SAVE (SAVE)
3. Select the number to save on the popup window and press the ENT (ENT) key

## 4.4.2 Recall

1. Press FCN (FCN) and SAVE (SAVE)
2. Select the data number to be recalled on the popup window.

## 4.4.3 Preset

The user can initialize (or preset) the parameter values to the factory setting by selecting [Preset]. The following describes how to preset the parameter values:

> **NOTICE**
> The saved setting using '4.4.1 Save' function and GPIB_ADDR of REMOTE are not initialized ev en though Preset runs.

1. Press FCN (FCN) and SAVE (SAVE)
2. Select "Preset" on the popup window and press the ENT (ENT) key.

**Table 4-1** Factory Setting of ANL Parameters

| Parameter | Range | Initial Value |
|---|---|---|
| MODE | CW, WLAN_11ag, BT_LE | WLAN_11ag |
| CH_NUM | | 1 |
| FREQUENCY | | 2412.000 MHz |
| NUM_FRAME | | 10 |
| REPETITION | CONTINUOUS, SINGLE | CONTINUOUS |
| EVM_UNIT | RERCENT, dB | PERCENT |

**Table 4-2** Factory Setting of GEN Parameters

| Parameter | Range | Initial Value |
|---|---|---|
| MODE | CW, WLAN, BT_LE, | WLAN |
| CH_NUM | | 1 |
| PATH_LOSS | 0.0 ~ 50.0 dB | 0.0 dB |
| POWER | -5.0 ~ -70.0 dBm | -5.0 dBm |
| RUN | ON, OFF | OFF |
| FILE_SEL | | WIFITEST_6M.twf |
| NUM_PACKET | 0 ~ 10000 | 0 |
| INTERVAL | 1 ~ 3000 us | 10us |

**Table 4-3** Factory Setting of INFO Parameters

| Parameter | Range | Initial Value |
|---|---|---|
| START_0D0A | NONE, USE | NONE |
| REMOTE_DSPLAY | ON, OFF | OFF |
| SHOW_LOG | ON, OFF | OFF |

# 5. Firmware Upgrade

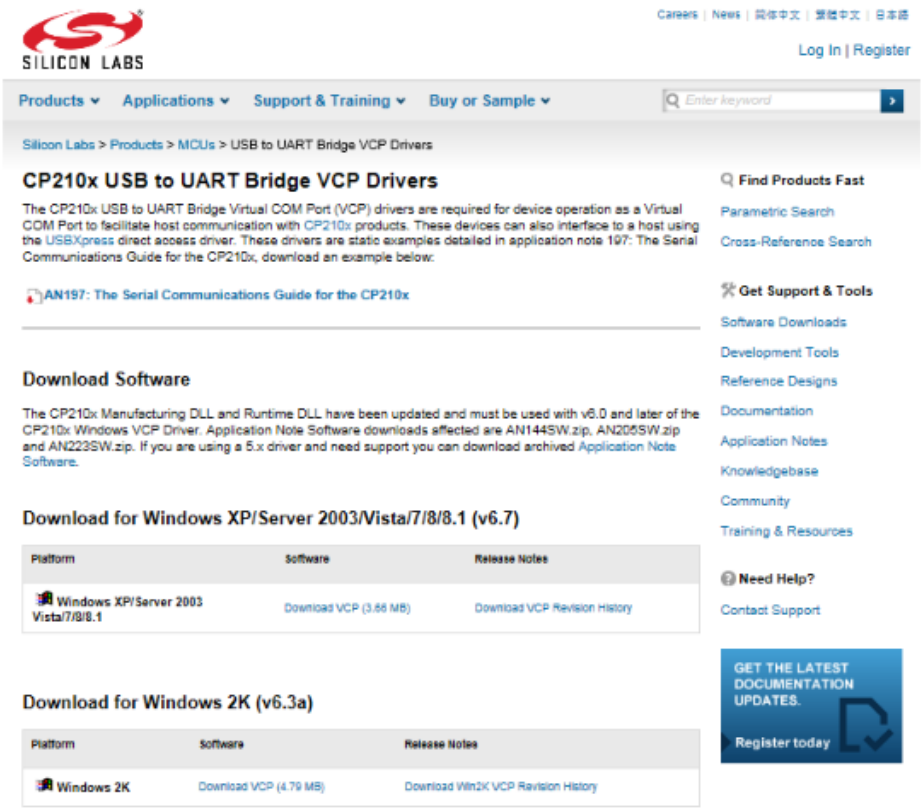
Users can easily upgrade MTP200B through the PC. In particular, the user can easily upgrade the program by running the execution file provided for each version.

Download the upgrade program from the TESCOM website; the program is also provided for free throug h e-mail.

## 5.1 USB Driver Installation

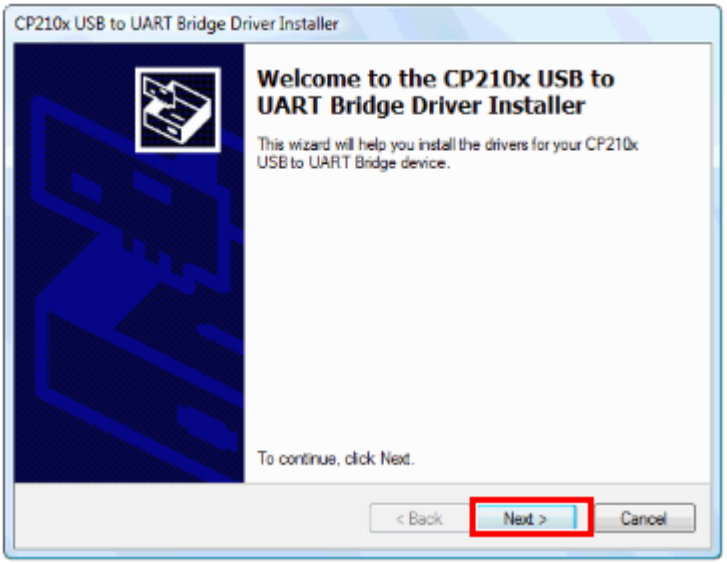
MTP200B communicates with the PC through the USB cable. Actually, USB-to-serial converter with is al ready built in the tester is used for communication. Therefore, upon the installation of the driver, a CO M port will be configured on the PC. A USB driver needs to be downloaded by accessing the MTP200B product CD or Silicon Labs website.(http://www.silabs.com)

You can find the most up-to-date drivers for your system here, from Silicon Labs.

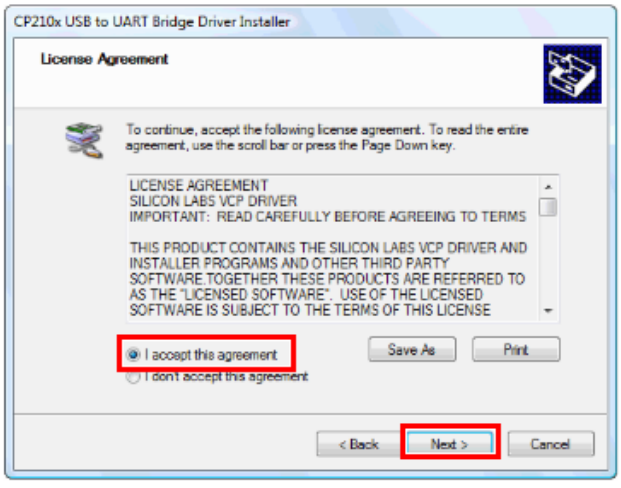


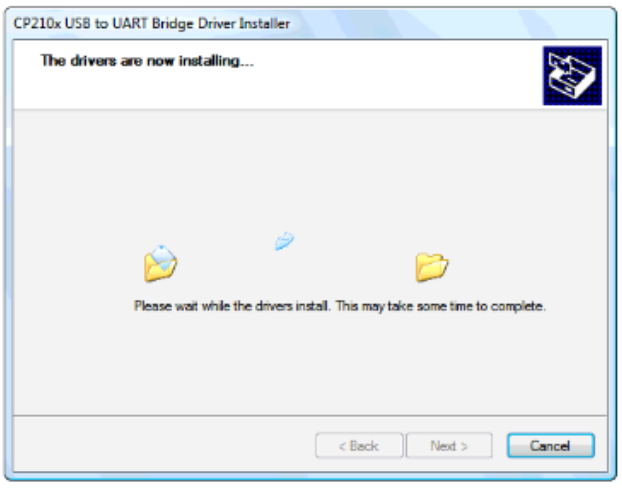
For detailed installation instructions of the USB driver, please refer to the following.

1. Extract the downloaded file "CP210x_VCP_Windows.zip" into a designated folder. In the designated folder, a folder labeled "CP210x_VCP_Windows" will be created. In the folder labeled "CP210x_VCP_Windows", double click the "Cp210xVCPInstaller_x86.exe" with 32-bit OS, or the "Cp210xVCPInstaller_x64.exe" with 64-bit OS. After a few moments, the following window is displayed.

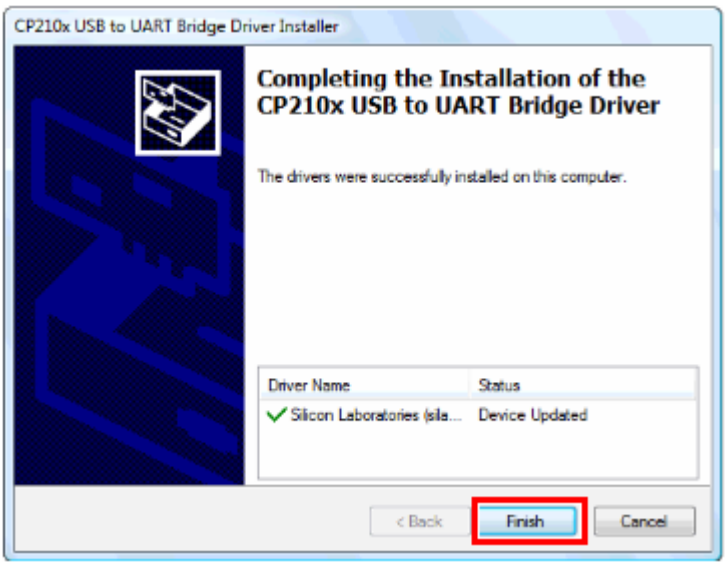



2. The following "License Agreement" window is displayed; please confirm its contents.

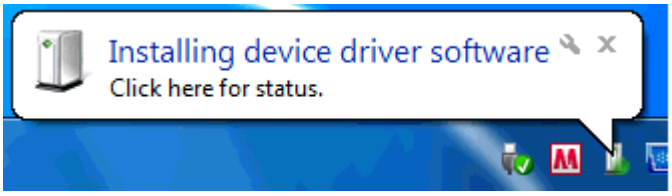


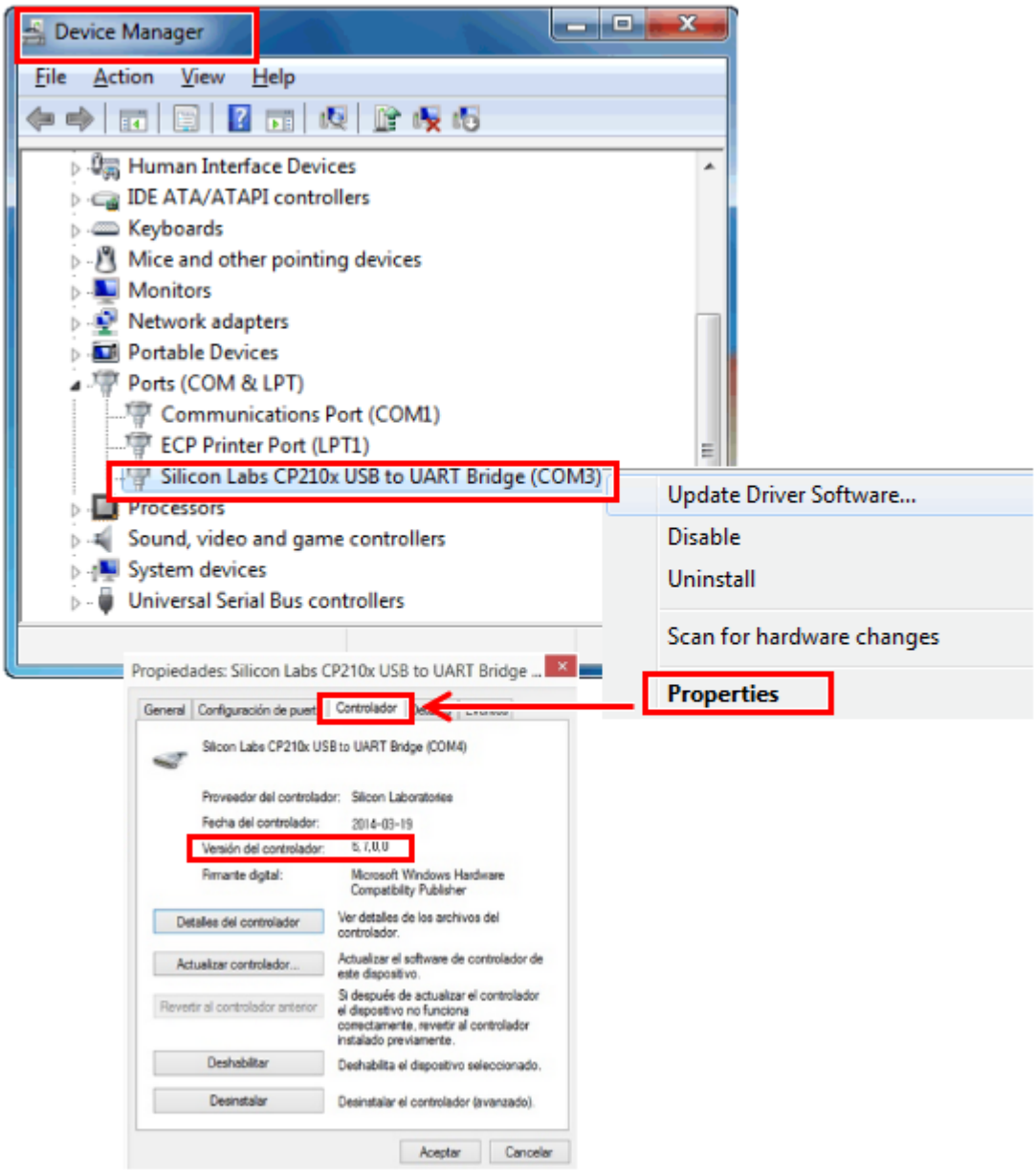

3. Wait until the installation is completed. After a few moments, the following window is displayed. Click [Finish] to complete installation and exit.




4. Connecting the MTP200B to a PC
   A. USB cable between the USB port on the rear side of MTP200B using the provided USB cable t o the USB port of the PC. Then, turn on MTP200B.
   B. Turn the MTP200B power ON, then connect it to a PC via a connection cable for the transceiv er. The PC will detect new hardware, and the following message is displayed.(The message m ay vary depending upon the operating system.)The installation of the device driver software w ill start automatically.




5. Confirming the COM port number
   A. Open the "Device Manager" to confirm which COM port number is assigned for connection with the device.
   B. Click the Windows [Start] button
   C. Right-click [Computer], then click [Properties].
   D. Click [Device Manager] in the displayed window.
   E. Click “Ports (COM & LPT)” to extend it, then you can find “Silicon Labs CP210x USB to UART B ridge (COMxx)”.The “COMxx” number is different depending on your PC.
   F. Right-click [Silicon Labs CP210x USB to UART Bridge], then [Properties].
   G. Click "Controlador" then check the version.




**NOTICE**

The latest version of driver is 6.7.0.0, if the lower version of the driver has been installed, please update to the latest version.

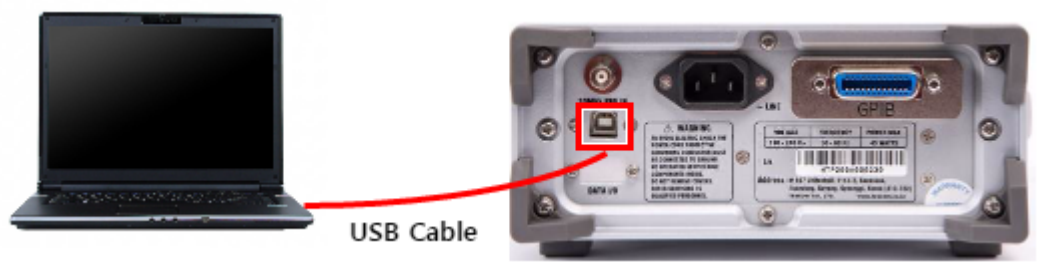
# 5.2 MTP200B Firmware Upgrade Sequence

**⚠CAUTION**

To start downloading the program, .NET Framework 2.0 must be installed on the PC. (usually exists on Windows XP or upper-version OS PC as a default).
Otherwise, download from the Microsoft homepage.

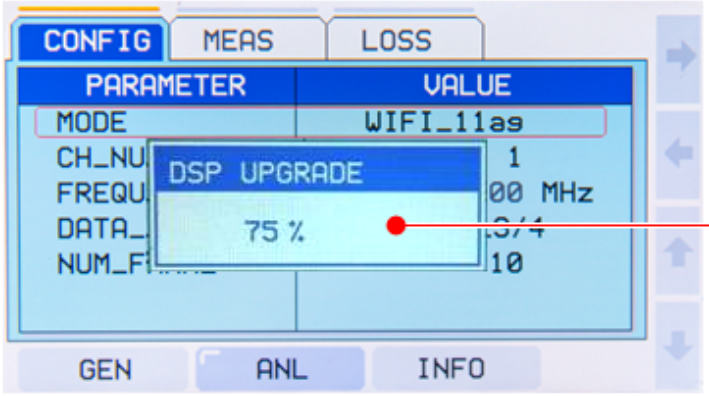
Users can easily upgrade MTP200B through the PC. In particular, the user can easily upgrade the program by running the execution file provided for each version.

1. USB cable between the USB port on the rear side of MTP200B using the provided USB cable to the USB port of the PC. Then, turn on MTP200B




2. Run "MTP200AB Downloader_v.XX.exe" as the upgrade program of MTP200B. (XXX means program version.) The following screen will appear upon automatic upgrade:


3. During the upgrade, the progress shall be displayed on the MTP200B GUI screen.




**Upgrade progress status display**

Displays the part that is currently being upgraded and the progress rate.

4. Once downloading is completed, turn off MTP200B and disconnect the cable. Afterward, turn on MTP200B. The new firmware version and date will be displayed on the start screen.

**NOTICE**

Confirmation of MTP200B's firmware is available at INFO menu.

INFO → VIEW

* SERIAL_NO: Product serial number
* SW_VERSION: Firmware version
* DATE: The date of firmware updated
* OPTION: Information of options

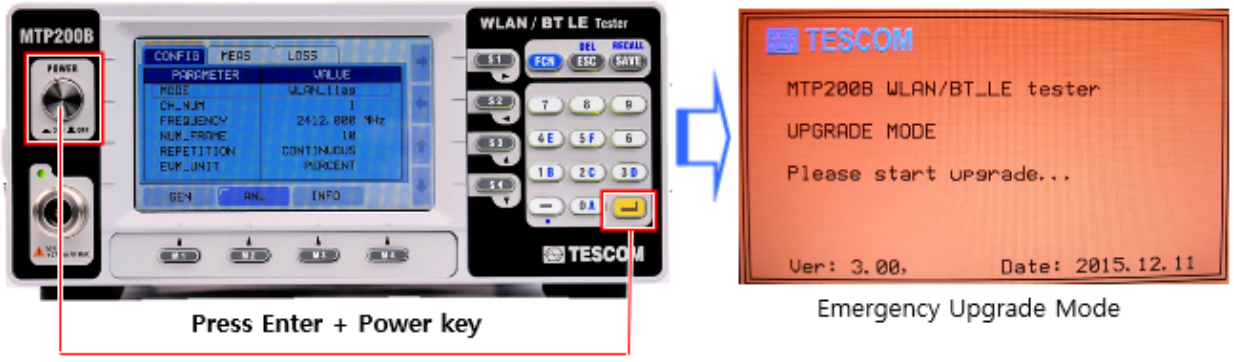
**⚠CAUTION**

In case downloading fails, try again by referring to "5.3 Emergency Upgrade

## 5.3 Emergency Upgrade

In case an error occurs during firmware upgrade, try again as shown below.

1. MTP200B will be booted under Emergency upgrade mode when power button is pushed while th e Enter key is pushed.




Emergency Upgrade Mode

2. Perform upgrade in sequence same as 5.2 MTP200B Firmware Upgrade Sequence.

3. After upgrade is completed, reboot MTP200B.

# PART 2. WLAN Test

# 6. References during WLAN test

MTP200B is capable of generating or analyzing WLAN signals compliant with IEEE 802.11a/g/n.

**NOTICE**

For the WLAN test, MTP200B needs the “S200-10” option.
Information of MTP200B’s option can be confirmed at INFO → VIEW → OPTION.

For the WLAN test, MTP200B supports the Analyzer (ANL) and Generator (GEN) modes.
The LED on the front panel of MTP200B indicates the mode, i.e., Analyzer mode or Generator mode. In Analyzer mode, the green light will be turned on; in Generator mode, however, the red light will be turned on.

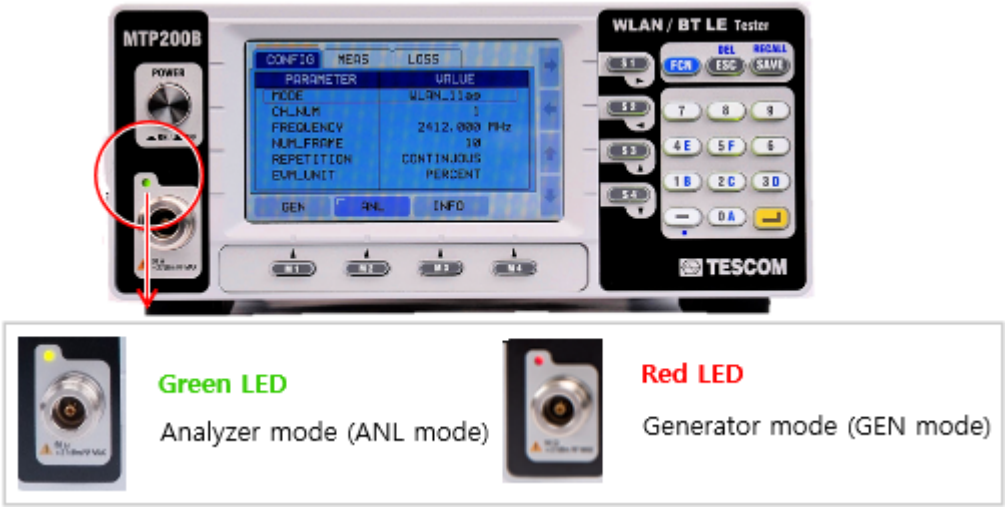



**Figure 6-1** LED Lights in WLAN Mode

# 6.1 WLAN Signal Analyzer(ANL) Mode

It is analyzing mode that measures RF characteristics of WLAN TX signal from DUT. In order to analyze c haracteristics of WLAN signal after connecting WLAN DUT to MTP200B, the followings are needed to b e confirmed and adjusted.

- MTP200B complies with standard of WLAN signal as follows.
  - IEEE802.11a,g,n

**NOTICE**

MTP200B does not support IEEE802.11b.

- Regarding 802.11n signal
  - Frequency range : 2.4 or 5 GHz
  - Signal bandwidth: 20 MHz
  - Transmitted burst type: mixed type
  - OFDM Symbol Duration: 4 μs(0.8 μs (800 ns) guard interval)

**NOTICE**

* MTP200B does not support 40 MHz signal bandwidth.
* MTP200B does not support Greenfield type.
* MTP200B does not support OFDM Symbol Duration: 3.6 μs (400 ns short guard interval).

# 6.2 WLAN Signal Generator(GEN) Mode

Sends the user-defined Wi-Fi test packets to DUT while DUT analyzes the number of received packets; t his mode is used to measure the reception performance of DUT

# 7. WLAN Signal Analyzer

In WLAN Signal analyzer mode, RMS EVM, Power, Frequency Error, and Clock Error are checked for the WLAN signal s transmitted by DUT.

## 7.1 General Configuration for WLAN TX Measurement

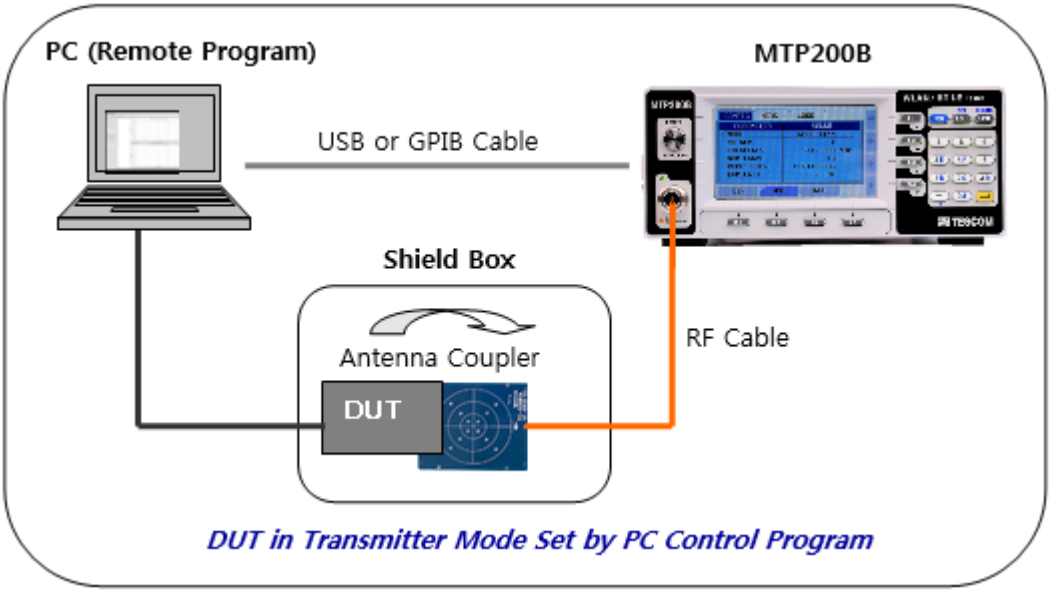



**Figure 7-1** Configuration for WLAN TX Measurement Using a Shield Box

1. **DUT Preparation:** Most WLAN terminals have an internal test mode for performance checking. To set the test mode, users use the PC control program or conduct the required terminal operations d epending on DUT. In test mode, TX signals of the corresponding condition - WLAN mode, channel, and data rate - are transmitted.

2. **Shield Box:** For the reliable measurement and prevention of electromagnetic interferences, use a s hield box. Connect the RF cable to the shield box or create a radiation environment using the ante nna coupler depending on the DUT type.

3. **MTP200B:** MTP200B checks the measurement result on the front LCD or carries out measurement using a separate user remote program. Production lines that require fast measurement tend to use the remote program to control DUT and MTP200B.

4. **Control PC:** A PC may be used to control the remote program of MTP200B and DUT.

## 7.2 MTP200B WLAN Signal Analyzer Set-up

Set WLAN mode, channel, number of packet, and measurement mode to be tested.

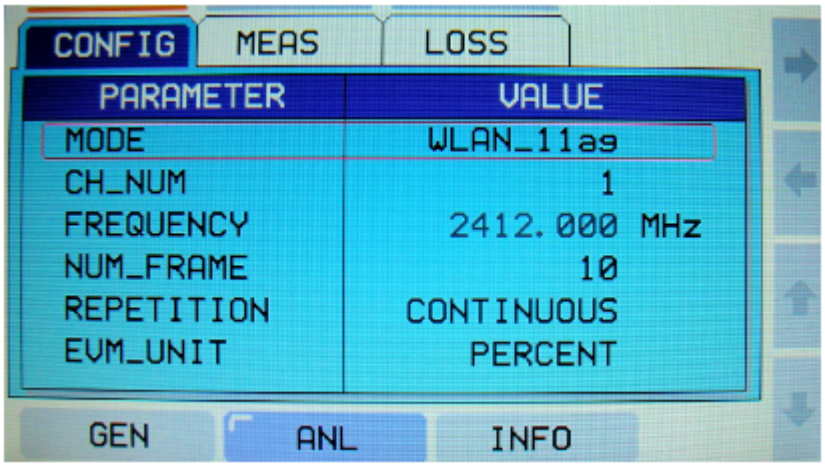



**Figure 7-2** WLAN Analyzer Setting Screen

### 7.2.1 WLAN Mode Setting

Select WLAN standard to be tested. Select WLAN_11ag mode or WLAN_11n mode.

#### 802.11a/g Mode Setting

Select `ANL` (M2) → `CONFIG` → `WLAN_11ag` tab.

#### 802.11n Mode Setting

Select `ANL` (M2) → `CONFIG` → `WLAN_11n` tab.

### 7.2.2 Channel Setting

Select a Channel in the MTP200B. The channel has to be same with DUT TX channel.

- Select `ANL (M2)` → `CONFIG` → `CH_NUM` tab.

**Table 7-1** WLAN 802.11a/g/n Channel Band

| Standard | | Channel Number | Frequency |
|---|---|---|---|
| 802.11g(OFDM) | | 1 to 14 | 2412 MHz to 2484 MHz |
| 802.11a | | 34, 36, 38, 40, 42, 44, 46, 48, 52, 56, 60 ,64 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 149, 153, 157, 161,165 | 4900 MHz to 5850 MHz |
| 802.11n (20 MHz channel bandwidth) | 2.4 GHz | 1 to 14 | 2412 MHz to 2484 MHz |
| | 5 GHz | 34, 36, 38, 40, 42, 44, 46, 48, 52, 56, 60 ,64 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 149, 153, 157, 161,165 | 4900 MHz to 5850 MHz |

## 7.2.3 NUM_FRAME Setting

Set the number of frames to be measured for each measurement. The higher the number is, the longer the measurement time. Enter the minimum value required for reliable measurement.

- Select `ANL (M2)` → `CONFIG` → `NUM_FRAME` tab -> Enter the value between 1 ~ 100 (Default value: 10)

## 7.2.4 Repetition Mode Setting

MTP200B provides two REPETITION mode, SINGLE and CONTINOUS.

- Select `ANL (M2)` → `CONFIG` → `REPETITION` → `SINGLE` or `CONTINOUS` tab.

**Table 7-2** REPETITION mode set-up

| REPETITION | Description |
|---|---|
| SINGLE | One time measurement mode (It stops after measures once by number of WLAN packet that is set) |
| CONTINOUS(Default) | Continuous (It measures repetitively by number of WLAN packet that is set) |

**⚠CAUTION**

The default value of Repetition mode is CONTINUOUS. However, as the main purpose of production program is to decide whether it satisfies the specs, so it is recommended to use under SINGLE mode.

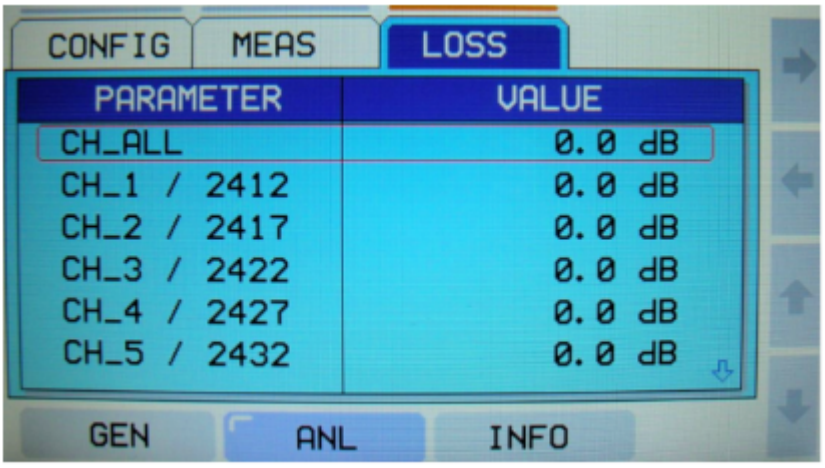
## 7.2.5 Path Loss Setting

Enter the path loss of each channel. Path loss refers to the signal loss occurring between the output end of MTP200B and input port of DUT. MTP200B compensates the path loss and reflects the loss on the measurement result.

There are two ways to set Path Loss as follows.

1. Input same Path loss value to all channels
   - ANL (M2) → select LOSS tab → Input Path Loss value after selecting CH_ALL

2. Input different Path Loss value to each channel
   - ANL (M2) → select LOSS tab → Input Path Loss value after selecting a channel



# 7.3 WLAN Signal Measurement

## 7.3.1 Measurement Procedure

1. Set DUT to WLAN signal transmit mode. (WLAN signal set-up such as WLAN mode, Channel, and Data Rate to be measured)
2. Set MTP200B. (Refer to the 7.2.1 WLAN Mode Settingand 7.2.2 Channel Setting)
3. Select ANL (M2) → MEAS tab on MTP200B → Press ▶ (S3) to start measurement and confirm.

**NOTICE**

During the measurement ▶ button changes to ■ .

* Under SINGLE measurement mode, measurement stops after it measures once.
* Under CONTINOUS measurement mode, after measurement starts, it repeats measurement until a user press the stop button, ■ .

## 7.3.2 Measurement Result Check

**⚠CAUTION**

The maximum possible testable number of symbol of MTP200B is 30 symbols. For example, if DUT transmit 20 symbols, MTP200B displays results for 20 symbols. If DUT transmit 100 symbols, MTP200B displays results only for 30 symbols.

WLAN measurement result display of MTP200B is as follows.

- ANL (M2) → MEAS tab → ▶ (S3)


**Figure 7-3** Measurement Screen

**Table 7-3** WLAN Measurement Screen

| No. | Items | Description |
|---|---|---|
| ❶ | I/Q Constellation | I/Q Constellation |
| ❷ | Test Result | Measurement value, MAX/AVG/MIN of the following items are displayed<br>• RMS EVM[%] or RMS EVM[dB]<br>• POWER[dBm]<br>• FREQ ERR[kHz]<br>• CLOCK ERR[ppm] |
| ❸ | Data Rate Display | • WLAN 802.11a/g: Displayed as 6M, 9M, 12M, 18M, 24M, 26M, 48M, 54 M<br>• WLAN 802.11n: Displayed as MCS0 ~ MCS7 |

**NOTICE**

The test result of RMS EVM is displayed normally with [%].
If a user wants to see the value with [dB] unit, a user needs to change set-up value of EVM_UNIT as “dB” at Configuration.
* `ANL`(M2) -> `CONFIG` -> `EVM_UNIT` -> Set as `PERCENT` or `dB`

# 7.4 WLAN Transmitter Test Items and Spec

## 7.4.1 WLAN Transmitter Test Items

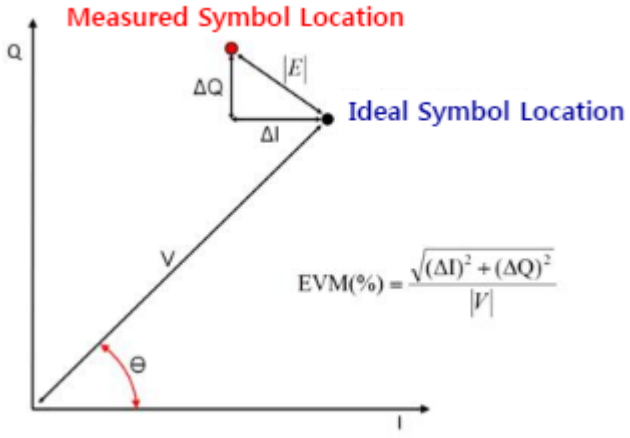
### 7.4.1.1 I/Q Constellation

When IQ Constellation measurement function is used, EVM will be displayed visually. Transmitter's m odulation accuracy can be figured out through below trace represents phase and size of each symbol. The example below is Constellation plot of 64-QAM 54 Mbps.


**Figure 7-4** WLAN Measurement Screen

### 7.4.1.2 RMS EVM

Measure RMS EVM in order to analyze TX modulation characteristics of DUT. EVM measurement, in f act, measures magnitude of difference (Error Vector) comparing actual measured phase and amplitu de of signal to phase and amplitude of ideal signal.



**NOTICE**

The test result of RMS EVM is displayed normally with [%].
If a user wants to see the value with [dB] unit, a user needs to change set-up value of EVM_UNIT as “dB” at Configuration.
* `ANL`(M2) -> `CONFIG` -> `EVM_UNIT` -> Set as `PERCENT` or `dB`

#### 7.4.1.3 POWER

Measure DUT’s transmit power. One of the most important test item in order to verify suitability of WLAN transmitter is the transmit power measurement item.

#### 7.4.1.4 FREQ ERR

Measure DUT’s Center Frequency Tolerance.

#### 7.4.1.5 CLOCK ERR

Measure DUT’s Symbol Frequency Tolerance.

## 7.4.2 IEEE 802.11 a/g/n Specification

### 7.4.2.1 IEEE 802.11a/g Specification

**Table 7-4** IEEE 802.11 a/g Specification

| Item | IEEE 802.11 Test Item Number | Specified Limit |
|---|---|---|
| EVM | 802.11a/g : 17.3.9.6.3<br>Transmitter Constellation Error | < -5 dB, 56.2 % (6 Mbps)<br>< -8 dB, 39.8 % (9 Mbps)<br>< -10 dB, 31.6 % (12 Mbps)<br>< -13 dB, 22.3 % (18 Mbps)<br>< -16 dB, 15.8 % (24 Mbps)<br>< -19 dB, 11.2 % (36 Mbps)<br>< -22 dB, 7.9 % (48 Mbps)<br>< -25 dB, 5.6 % (54 Mbps) |
| POWER | 802.11a/g : 19.4.7.1(18.4.7.1)<br>Transmit Power Level | • Maximum output Power<br>- 1000 mW (30 dBm)<br>- 100 mW(EIRP)(20 dBm)<br>- 10 mW/MHz (10 dBm/MHz)<br>(The global standard specifies only the maximum output power) |
| FREQ ERR | 802.11a : 17.3.9.4<br>Transmit Center Frequency Tolerance | < ±20 ppm |
| | 802.11g : 19.4.7.2<br>Transmit Center Frequency Tolerance | < ±25 ppm |
| CLOCK ERR | 802.11a : 17.3.9.5<br>Symbol Clock Frequency Tolerance | < ±20 ppm |
| | 802.11g : 19.4.7.3<br>Symbol Clock Frequency Tolerance | < ±25 ppm |

### 7.4.2.2 IEEE 802.11n Specification

**Table 7-5** IEEE 802.11n Specification

| Item | IEEE 802.11 Test Item Number | Specified Limit |
|---|---|---|
| EVM | 802.11n : 20.3.21.7.3<br>Transmitter Constellation Error | < -5 dB, 56.2 % (MCS0,6.5 Mbps)<br>< -10 dB, 39.8 % (MCS1,13 Mbps)<br>< -13 dB, 22.3 % (MCS2,19.5 Mbps)<br>< -16 dB, 15.8 % (MCS3, 26 Mbps)<br>< -19 dB, 11.2 % (MCS4, 39 Mbps)<br>< -22 dB, 7.9 % (MCS5, 58 Mbps)<br>< -25 dB, 5.6 % (MCS6, 58.5 Mbps)<br>< -28 dB, 3.98 % (MCS7, 65 Mbps) |
| POWER | 802.11an/gn : 20.3.21.3<br>Transmit Power Level | • Maximum output Power<br>- 1000 mW (30 dBm)<br>- 100 mW(EIRP)(20 dBm)<br>- 10 mW/MHz (10 dBm/MHz)<br>(The global standard specifies only the maximum output power) |
| FREQ ERR | 802.11an/gn : 20.3.21.4<br>Transmit Center Frequency Tolerance | 802.11an, < ±20 ppm |
| | | 802.11gn, < ±25 ppm |
| CLOCK ERR | 802.11an/gn : 20.3.21.6<br>Symbol Clock Frequency Tolerance | 802.11an, < ±20 ppm |
| | | 802.11gn, < ±25 ppm |

# 8. WLAN Signal Generator

MTP200B sends user-defined WLAN test packets to DUT while DUT checks the number of received packets to measure the sensitivity and the Packet Error Rate (PER).

## 8.1 General Configuration for WLAN RX Measurement

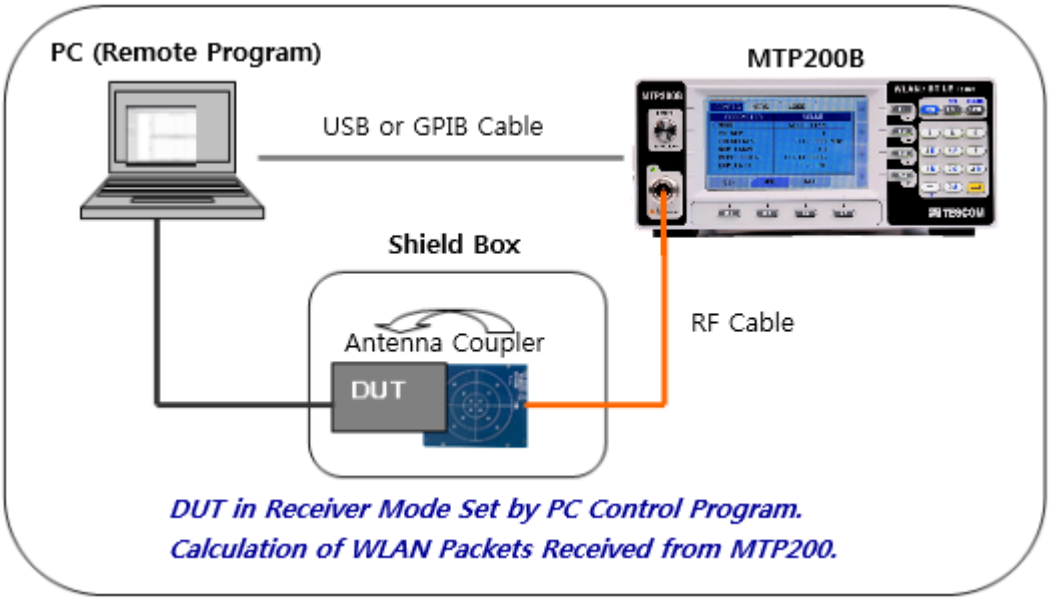



**Figure 8-1** Configuration for WLAN RX Measurement Using a Shield Box

1. **DUT Preparation:** Most WLAN terminals have an internal test mode for performance checking. To set the test mode, users use the PC control program or perform the required terminal operations depending on DUT. In test mode, DUT receives the signals transmitted by the measurement device and analyzes the number of received packets and errors.

2. **Shield Box:** For the reliable measurement and prevention of electromagnetic interferences, use a shield box. Connect the RF cable to the shield box or create a radiation environment using the antenna coupler depending on the DUT type.

3. **MTP200B:** MTP200B generates user-defined WLAN packets and transmits them through the RF port. Production lines requiring fast measurement tend to use the remote program to control DUT and MTP200B.

4. **Control PC:** A PC may be used to control the remote program of MTP200B and DUT.

## 8.2 MTP200B WLAN Signal Generator Set-up

Set the test-related parameters such as channel band (frequency), output power, file, NUM_PACKET, INTERVAL, etc.

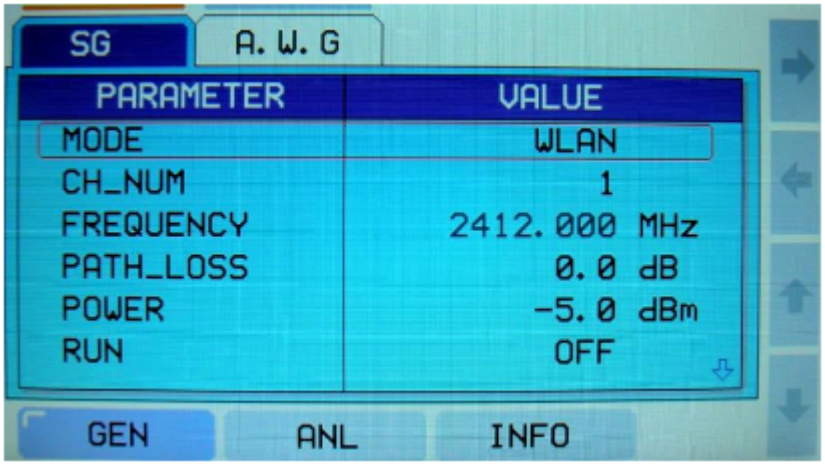



**Figure 8-2** WLAN Generator Setting Screen

### 8.2.1 Mode Setting

- Select `GEN (M1)` → `SG` → `MODE` → `WLAN`

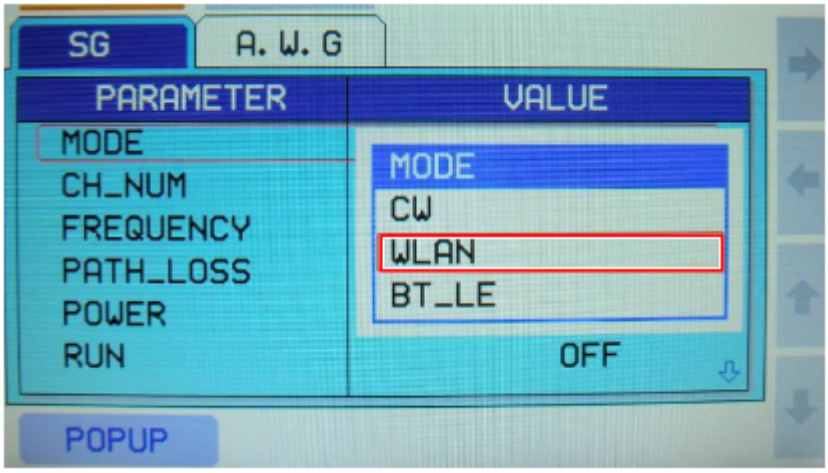



**Figure 8-3** WLAN Generator mode Setting Screen

## 8.2.2 Channel Setting

Input CH_NUM for the reception channel of DUT. See Table 7-1 WLAN 802.11a/g/n Channel Band.

- Select GEN (M1) → SG → CH_NUM

## 8.2.3 Power Level Setting

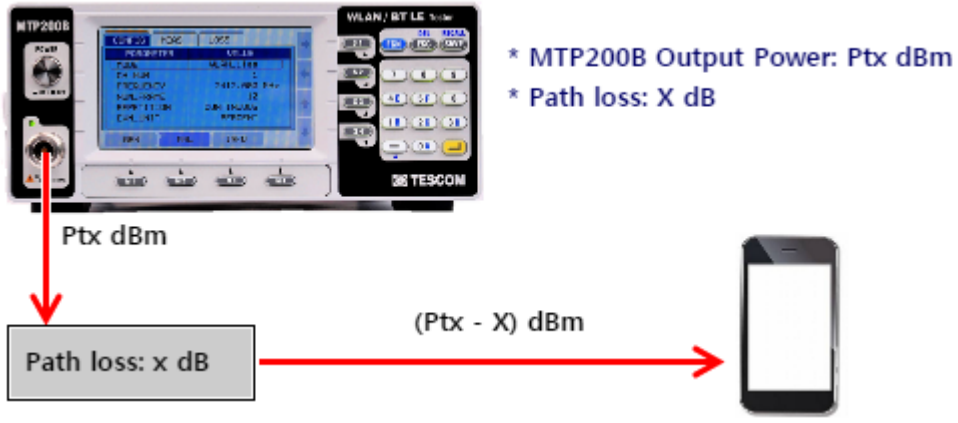
Enter the level of power to be received by DUT. (Tester's transmit power)

- Select GEN (M1) → SG → POWER (Enter a value from -5 to -70 dBm)

## 8.2.4 Path Loss Setting

Input PATH LOSS value. PATH_LOSS is the value of loss from MTP200B's output port to DUT's input port. If a user input PATH_LOSS value, MTP200B displays output power value compensating PATH_LOSS value.

- Select GEN (M1) → SG → PATH_LOSS




**NOTICE**

If a user input PATH_LOSS value, MTP200B displays POWER value as [Ptx - PATH_LOSS value].

## 8.2.5 WLAN Waveform file Setting

MTP200B includes the WLAN waveform files required for the WLAN test.
Among the test files downloaded to MTP200B, set the test file to be received by DUT.

- Select `GEN (M1)` → `SG` → `FILE_SEL`

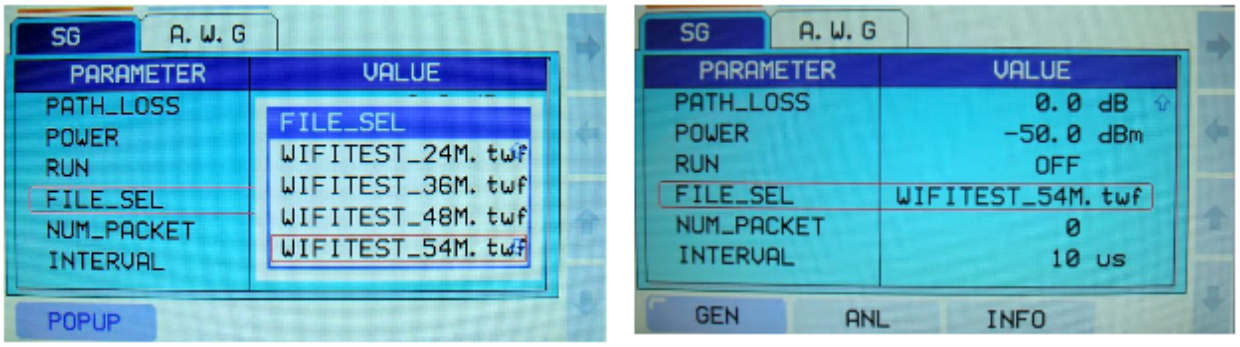



**Figure 8-4** WLAN FILE Setting Screen

**NOTICE**

Basic Waveform file list and information provided form Signal Generator.

[Common items of Waveform file]
- Data Type : PRBS9
- Payload Length : 1024Bytes
- Scrambler Seed : 93

[802.11a/g Waveform file]
- WIFITEST_6M.twf, WIFITEST_9M.twf, WIFITEST_12M.twf, WIFITEST_18M.twf, WIFITEST_24M.twf, WIFITEST_36M.twf, WIFITEST_48M.twf, WIFITEST_54M.twf

[802.11n 20MHz Bandwidth Waveform file]
- Guard Interval : Long
- Mode : HT-Mixed Mode
- N_MCS0.twf, N_MCS1.twf, N_MCS2.twf, N_MCS3.twf, N_MCS4.twf, N_MCS5.twf, N_MCS6.twf, N_MCS7.twf

To conduct a test using the user-defined test file other than the test file provided with MTP200B, the user needs to create a waveform using the Waveform Creator described in 8.4 MTP200B Waveform Creator and download it to MTP200B. For more information on file downloading, see the “Waveform Creator Manual.”

### 8.2.5.1 WLAN Waveform file Checking and Formatting

1. Checking the Files Downloaded to MTP200B
   A. Select GEN (M1) → A.W.G (S1) → FILE_SEL tab.
   B. The list of files currently downloaded to the system will be displayed.
   C. Select the file by pressing S3~S4 (Up/Down key) and view information of the selected file s uch as FREE_MEM, SIZE, MCS, and DATA_TYPE.

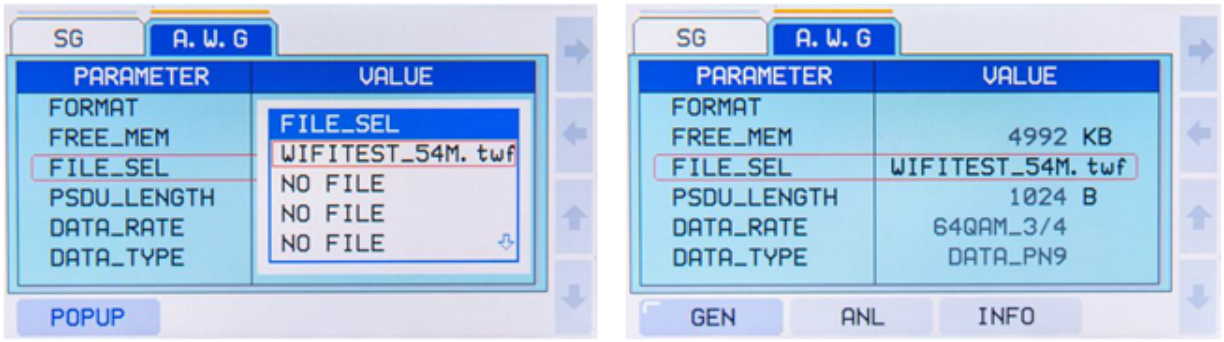



**Figure 8-5** Checking the Downloaded Files

**NOTICE**

If the WLAN test file is not downloaded to MTP200B, NO FILE will be displayed. Up to 40 WL AN test files can be downloaded to MTP200B.

2. File Formatting in MTP200B
   A. Select `GEN (M1)` → `A.W.G (S2)` → `FORMAT` tab.
   B. To format the file downloaded to MTP200B, select `FORMAT` To cancel formatting, select `CANCEL`

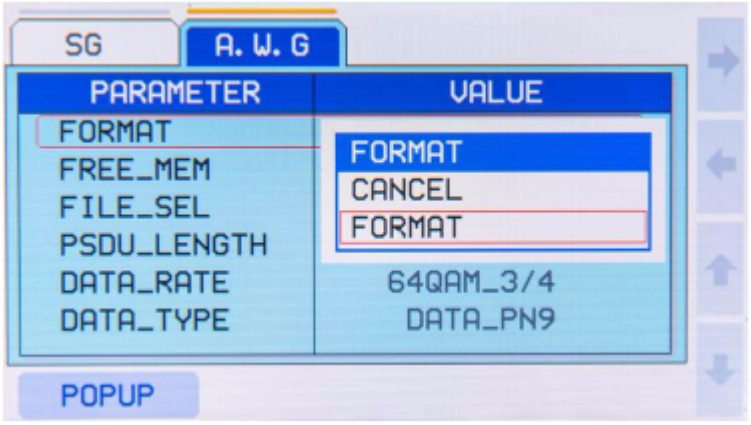



**Figure 8-6** File Formatting Screen

**NOTICE**

MTP200B does not support selective file formatting. Using the Waveform Creator, however, t he user can selectively format the files.

### 8.2.6 NUM_PACKET Setting

Enter the total number of WLAN packets to be transmitted by MTP200B between 0 and 10.000. In ca se of "0," MTP200B continuously transmits the packets.
(In case of a number between 1 and 10,000, only as many packets as specified will be transmitted.)

- Select `GEN (M1)` → `SG` → `NUM_PACKET` → Set value between 0 ~ 10 (Default Value: 0)

### 8.2.7 INTERVAL Setting

Set the WLAN packet transmission interval between 1 and 3,000 ㎲

- Select `GEN (M1)` → `SG` → `INTERVAL` → Set value between 1 ~ 3,000 ㎲ (Default Value: 10 ㎲)

## 8.3 WLAN Signal Transmit

1. Set DUT to WLAN signal receiving mode. (Set WLAN signal to be received such as Channel, Data R ate, etc.)

2. Set MTP200B as follows.
   A. Set MTP200B WLAN signal transmit mode and Channel (Refer to the 8.2.1 Mode Setting and 8.2.2 Channel Setting)
   B. Set output power to be transmitted (Refer to the 8.2.3 Power Level Setting)
   C. Select WLAN waveform file to be transmitted (Refer to the 8.2.5 WLAN Waveform file Setting )
   D. Set WLAN waveform file's total number of packet and Interval to be transmitted (Refer to the 8.2.6 NUM_PACKET Setting and 8.2.7 INTERVAL Setting)

3. MTP200B transmits WLAN waveform file. (`GEN`(M1) → `SG` → Select `RUN` → Select `ON` )
   A. Select `OFF` if a user wants to stop transmitting WLAN waveform file

4. DUT confirms WLAN waveform's number of packet received. Then, calculate PER comparing it to n umber of packet transmitted from MTP200B.

# 8.4 MTP200B Waveform Creator

The Wave Creator of TESCOM generates user-defined test files and downloads the generated test files to MTP200B for the WLAN reception performance test.

The Waveform Creator can edit the parameters related to the WLAN protocol such as MAC Header, Da ta Type, Length, and Data Rate; the files created by the Waveform Creator of TESCOM have an extensi on called .twf.

For more information on the Waveform Creator, see the Waveform Creator Manual.

**NOTICE**

The WLAN Option (S200-10) of MTP200B includes the Waveform Creator program.

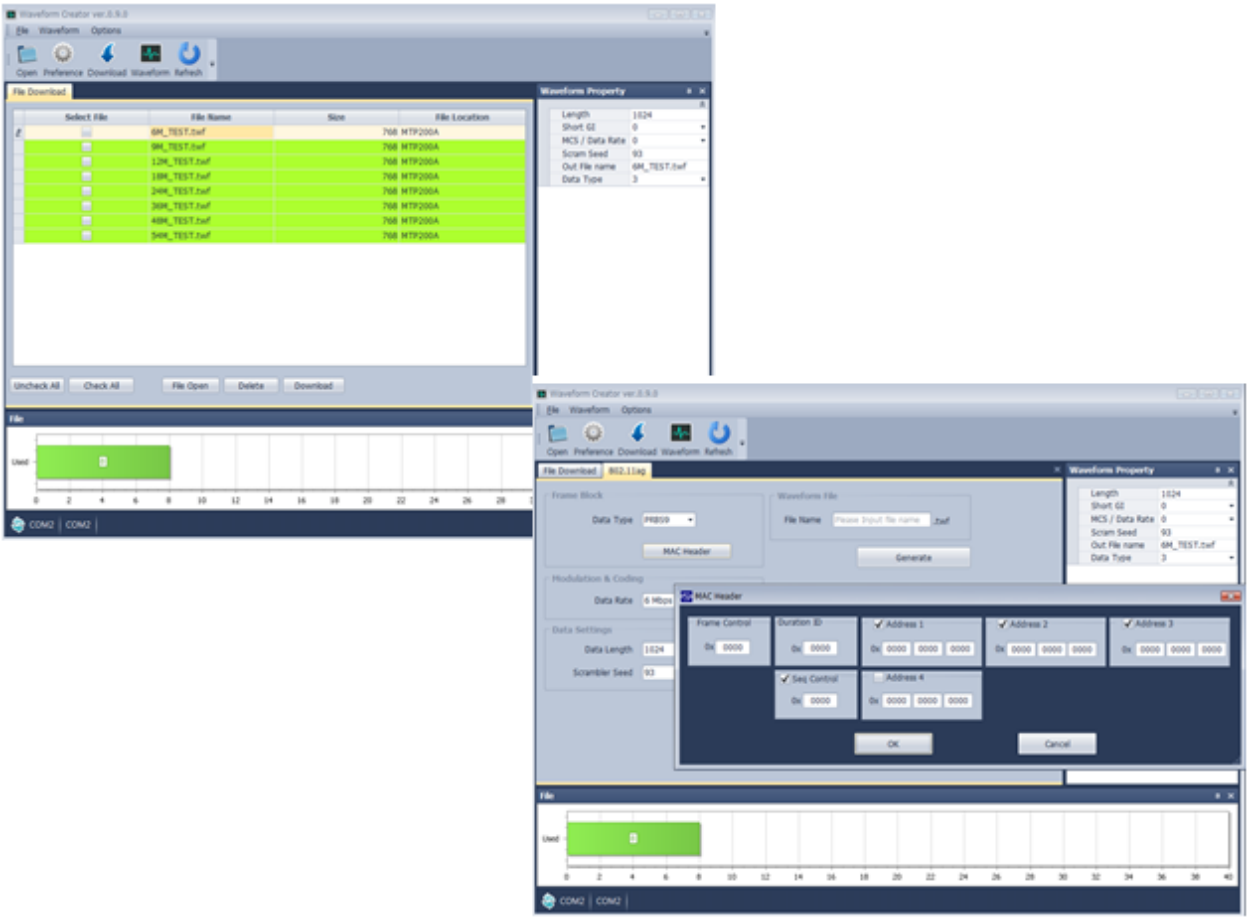


**Figure 8-7** Waveform Creator UI

# PART 3. BT LE Test

# 9. Reference during BT LE Test

MTP200B supports RF TEST introduced in BLE (Bluetooth Low Energy) standard among Bluetooth Core 4.2 spec.

**NOTICE**

For details of Bluetooth Low Energy outline and Bluetooth Core spec 4.2, please refer to the 20. Summary of Bluetooth Low Energy

**NOTICE**

The BT_LE test requires the “BT_LE”(S200-20) option.
MTP200B’s option can be confirmed at INFO → VIEW → OPTION.

**NOTICE**

BT LE Direct Test Mode (DTM) test can be performed by MTP200B remote control program provided separately. For detailed explanation on BT LE test, refer to the BT LE Test Method

To conduct the BT_LE test in addition to the WLAN test, MTP200B supports Analyzer (ANL) and Generator (GEN) modes.

In Analyzer mode, the green light is displayed on the front panel LED; in Generator mode, however, the red light is displayed.

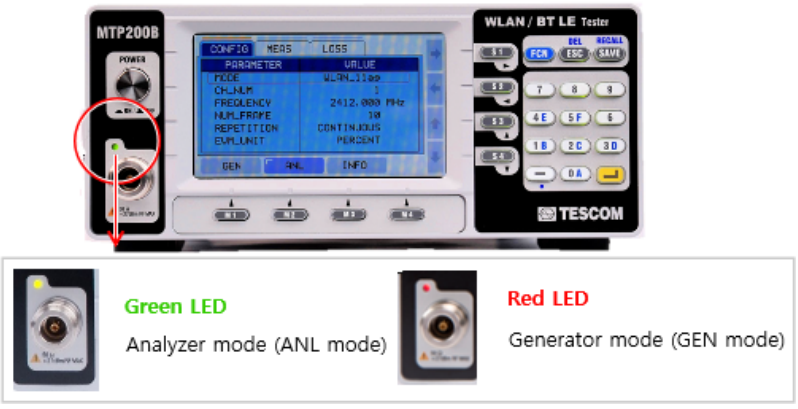



**Figure 9-1** LED Lights in BT LE Mode

# 9.1 BT LE Signal Analyzer(ANL) Mode

The command of BT LE Signal Analyzer can be used for the purpose as follows.

- Measures and analyzes general BT LE signal
  - Measures and analyzes RF characteristics of BT_LE TX transmitted from DUT
- BT LE RF PHY("RF-PHY.TX.4.2.0") Examination items test(3 items)
  - Output Power
  - Modulation Characteristics
  - Carrier Frequency Offset and Drift
- Examination items test thorough Advertising Mode for complete product(2 items)
  - Output Power
  - Modulation and Frequency Offset

# 9.2 BT LE Signal Generator(GEN) Mode

The command of BT LE Signal Generator can be used for the purpose as follows.

- Generates general BT LE signal.
- BT LE RF PHY(RF-PHY.TS.4.2.0) Receiver Sensitivity of examination item test.

# 9.3 BT LE RF Test Cases

MTP200B provides RF Test Cases defined in BTLE test standard.

| BLE Test Cases Supported by MTP200B |
|---|
| Output power(TP/TP/TRM-LE/CA/BV-01-C) |
| Modulation characteristics(TP/TRM-LE/BV-05-C) |
| Carrier frequency offset and drift(TP/TRM-LE/BV-06-C) |
| Receiver sensitivity (TP/RCV-LE/CA/BV-01-C) |
| Maximum input signal level (TP/RCV-LE/CA/BV-06-C) |
| Output Power + Modulation characteristics + Initial carrier frequency tolerance ( at Advertising mode ) |

**⚠CAUTION**

BT LE signal transmitted from MTP200B does not support Dirty Transmitter for Receiver Sensitivity test of BT LE RF PHY(RF-PHY.TS.4.2.0) examination item.

**NOTICE**

Simultaneous testing of power, modulation, and initial carrier frequency offset provided in Advertising Test mode is not defined in the BT_LE standard test specifications. Note, however, that such testing can judge whether the RF performance of the terminal meets the test specifications.

For more details in measurement procedure and Specification on BLE test case, please refer to the 22. BLE RF Test Cases .

# 10. BT LE Signal Analyzer

MTP200B sends user-defined BT LE packets to DUT while DUT checks the number of received packets to measure the sensitivity and the Packet Error Rate (PER).

## 10.1 General Configuration for BLE TX Measurement

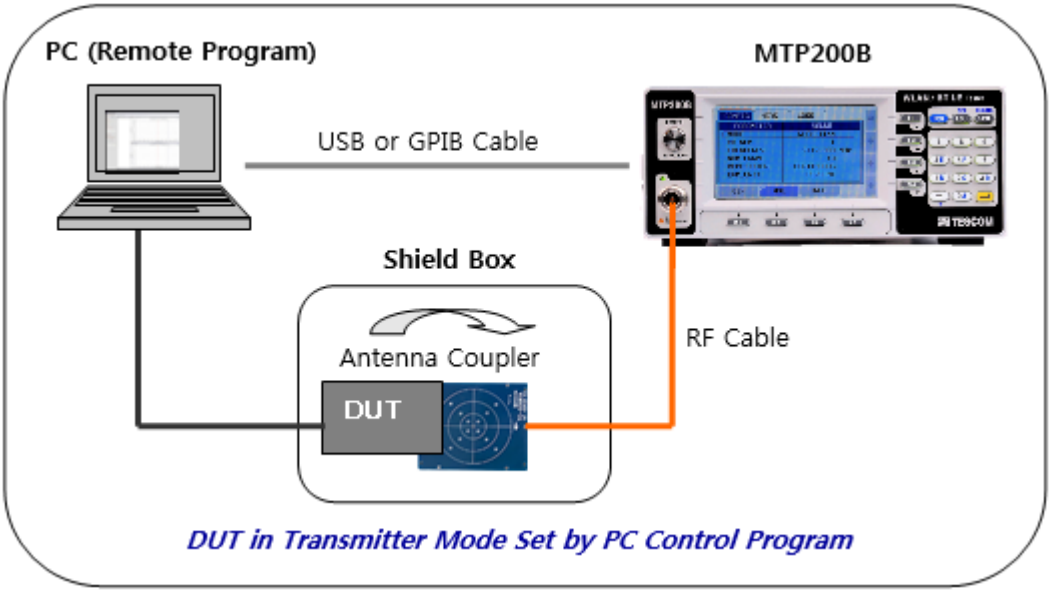



**Figure 10-1** Configuration for BLE TX Measurement Using a Shield Box

1. **DUT Preparation:** Most BLE terminals have a test mode for performance checking. To set the test mode, users use the PC control program or perform the required terminal operations depending o n DUT. In test mode, set the BLE channel, packet length, and data type to be measured and send T X signals.

2. **Shield Box:** For the reliable measurement and prevention of electromagnetic interferences, use a s hield box. Connect the RF cable to the shield box or create a radiation environment using the ante nna coupler depending on the DUT type.

3. **MTP200B:** MTP200B checks the measurement result on the front LCD or carries out measurement using a separate user remote program. Production lines that require fast measurement tend to use the remote program to control DUT and MTP200B.

4. **Control PC:** A PC may be used to control the remote program of MTP200B and DUT.

## 10.2 MTP200B BT LE Signal Analyzer Set-up

Set the test-related parameters such as channel, NUM_PACKET, TEST_CASE, and TEST_METHOD.

### 10.2.1 BT LE Mode Setting

- Select `ANL (M2)` → `CONFIG` → `BT_LE` tab.


**Figure 10-2** Setting Screen in BT_LE ANL Mode

### 10.2.2 Channel Setting

Select BLE channel to be measured.

- Select `ANL (M2)` → `CONFIG` → `CH_NUM` → Set CH_NUM for the transmission channel of DUT.

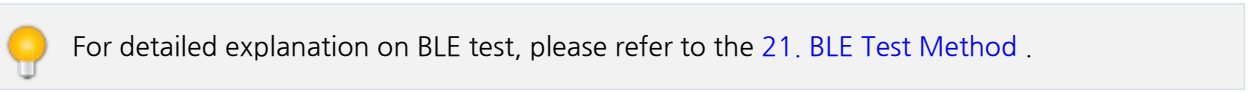
**Table 10-1** Table BLE Channel(CH) & Frequency(FREQ, MHz)

| CH | FREQ | CH | FREQ | CH | FREQ | CH | FREQ | CH | FREQ | CH | FREQ | CH | FREQ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 2402 | 6 | 2414 | 12 | 2426 | 18 | 2438 | 24 | 2450 | 30 | 2462 | 36 | 2474 |
| 1 | 2404 | 7 | 2416 | 13 | 2428 | 19 | 2440 | 25 | 2452 | 31 | 2464 | 37 | 2476 |
| 2 | 2406 | 8 | 2418 | 14 | 2430 | 20 | 2442 | 26 | 2454 | 32 | 2466 | 38 | 2478 |
| 3 | 2408 | 9 | 2420 | 15 | 2432 | 21 | 2444 | 27 | 2456 | 33 | 2468 | 39 | 2480 |
| 4 | 2410 | 10 | 2422 | 16 | 2434 | 22 | 2446 | 28 | 2458 | 34 | 2470 | | |
| 5 | 2412 | 11 | 2424 | 17 | 2436 | 23 | 2448 | 29 | 2460 | 35 | 2472 | | |

## 10.2.3 Test Method Setting

Select either TEST_MODE or ADVERTISING mode according to test method.

- Select `ANL (M2)` → `CONFIG` → `TEST_METHOD` tab → Set TEST_MODE or ADVERTISING
  - Select `TEST_MODE` for Direct Test Mode or Non-signaling test
  - Select `ADVERTISING` for Advertising test



For detailed explanation on BLE test, please refer to the 21. BLE Test Method .

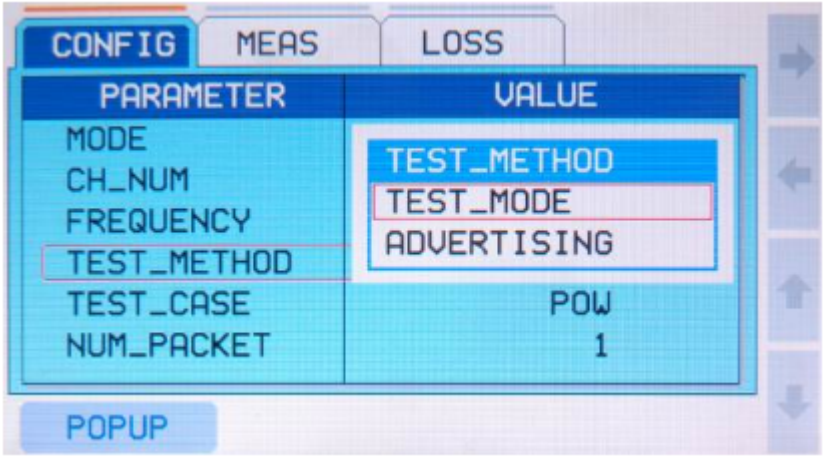
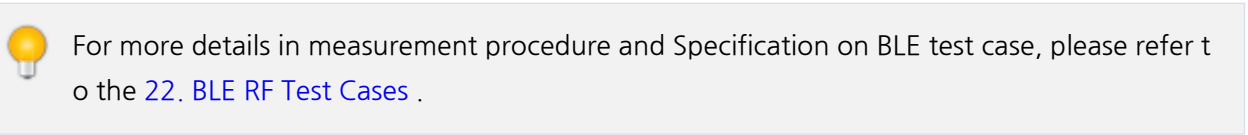



**Figure 10-3** TEST_METHOD Setting Screen

## 10.2.4 Test Case Setting

- Select `ANL (M2)` → `CONFIG` → `TEST_CASE` tab → Select the item to be tested. For supported TEST_CASE item, please refer to the Table 10-2 BT_LE TEST_CASE.



For more details in measurement procedure and Specification on BLE test case, please refer to the 22. BLE RF Test Cases .

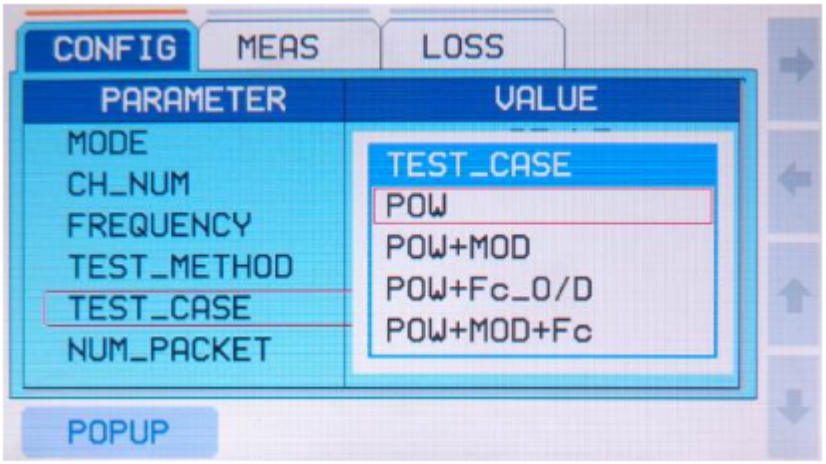



**Figure 10-4** TEST_CASE Setting Screen

**Table 10-2** BT_LE TEST_CASE

| TEST_CASE | Description of TEST_CASE | TEST_METHOD |
|---|---|---|
| POW | Output power | TEST_MODE |
| POW+MOD | Output power + Modulation characteristics | TEST_MODE |
| POW+Fc_O/D | Output power + Carrier frequency offset and drift | TEST_MODE |
| POW+MOD+Fc | Output power + Modulation characteristics+ Carrier frequency offset | TEST_MODE / ADVERTISING |

**NOTICE**

In case the user selects ADVERTISING as TEST_METHOD, the test item selection window will be disabled in TEST_CASE, and POW+MOD+Fc will be automatically selected.

## 10.2.5 Number of Packet Setting

Set the number of packets to be measured for each measurement. The higher the number is, the longer the measurement time. Enter the minimum value required for reliable measurement.

- Select `ANL (M2)` → `CONFIG` → `NUM_PACKET` → Set the number of packets

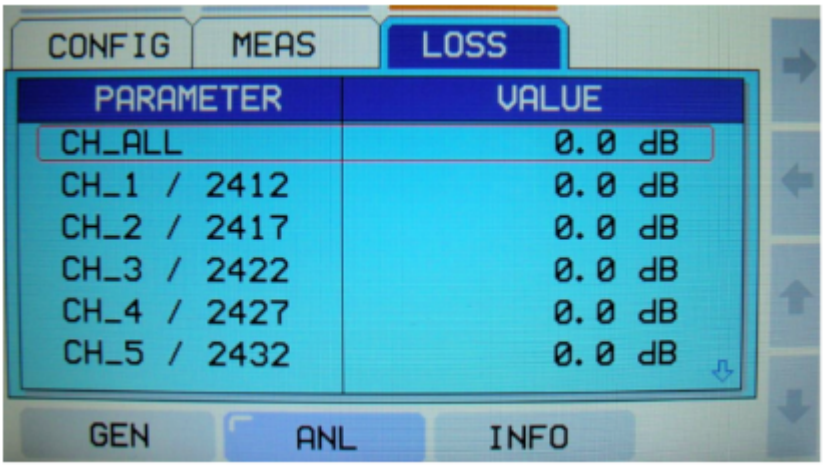
## 10.2.6 Path Loss Setting

Enter the path loss of each channel. To apply the same path loss to all channels, enter the path loss in CH_ALL. Path loss refers to the signal loss occurring between the output end of MTP200B and input port of DUT. MTP200B compensates the path loss and reflects the loss on the measurement result.

There are two ways to set Path Loss as follows.

1. Input same Path loss value to all channels
   - ANL (M2) → select LOSS tab → Input Path Loss value after selecting CH_ALL

2. Input different Path Loss value to each channel
   - ANL (M2) → select LOSS tab → Input Path Loss value after selecting a channel



# 10.3 BLE Signal Measurement

## 10.3.1 Measurement Procedure

1. Set DUT to BLE signal transmit mode. (Test mode, channel, Payload type, etc.)

2. Set MTP200B as follows.
   A. Set MTP200B to BLE measurement mode and select channel (Refer to the 10.2.1 BT LE Mode Settingand 10.2.2 Channel Setting)
   B. Set test method (Refer to the 10.2.3 Test Method Setting )
   C. Select test case (Refer to the 10.2.4 Test Case Setting)
   D. Set number of packet(Refer to the 10.2.5 Number of Packet Setting)

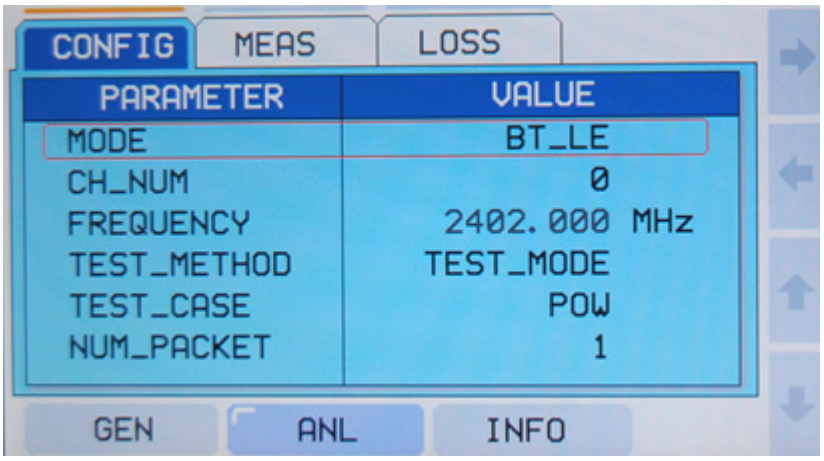



**Figure 10-5** BT LE Analyzer Setting Screen

3. Select ANL (M2) → MEAS tab on MTP200B → Press ▶ (S3) to start measurement and confirm.

**NOTICE**

During the measurement ▶ button changes to ■ .

* Under SINGLE measurement mode, measurement stops after it measures once.

* Under CONTINOUS measurement mode, after measurement starts, it repeats measurement until a user press the stop button, ■ .

## 10.3.2 Measurement Result Check

A sample display of MTP200B's BLE measurement result is as follows.

- Select ANL (M2) → MEAS 탭 → Press ▶ (S3) → Check the measurement result.

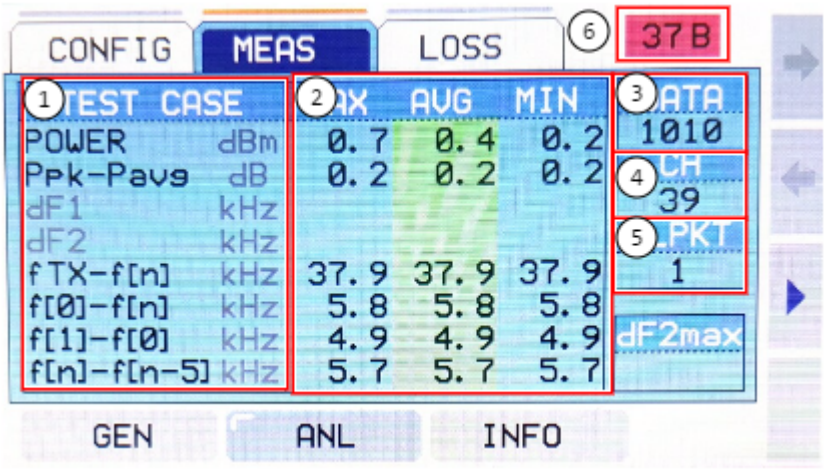



**Figure 10-6** BT LE Measurement Screen

**Table 10-3** BLE Measurement Items

| No | Items | Description |
|---|---|---|
| ❶ | Test Items | Selected test case is activated. |
| ❷ | Test Result | Displays MAX, AVG, and MIN of measurement result. |
| ❸ | Data Packet Type | Displays BLE packet type transmitted from DUT. |
| ❹ | Test Channel | Displays measured channel. |
| ❺ | Packet Number | Displays measured number of packet. |
| ❻ | Data Length | Displays Data Length of measured BT_LE packet. |

# 11. BT LE Signal Generator

In this mode, receiver sensitivity and maximum input signal level of the BT LE signals sent by MTP200B to DUT are checked.

## 11.1 General Configuration for BLE RX Measurement

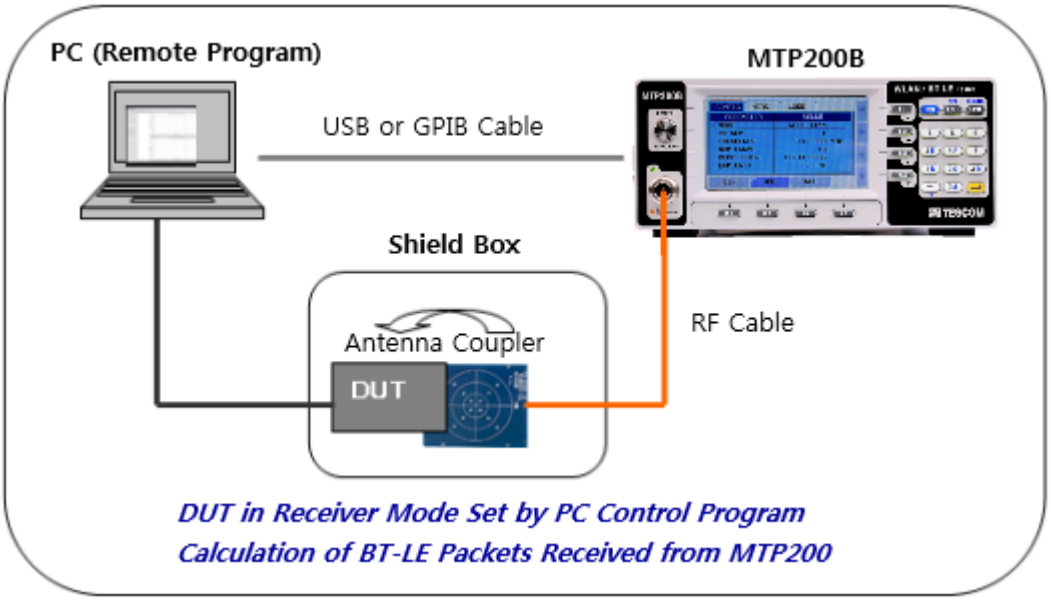



**Figure 11-1** Configuration for BLE RX Measurement Using a Shield Box

1. **DUT Preparation:** Most BT LE terminals have their own test mode for performance checking. To set the test mode, users use the PC control program or perform the required terminal operations depending on DUT. In test mode, DUT receives BT_LE signals from the measurement device and analyzes the received signals (RX Sensitivity, Received Packet Number, etc.).

2. **Shield Box:** For the reliable measurement and prevention of electromagnetic interferences, use a shield box. Connect the RF cable to the shield box or create a radiation environment using the antenna coupler depending on the DUT type.

3. **MTP200B:** MTP200B generates BT LE packets suitable for DUT through the front LCD window and sends them through the RF port. Production lines requiring fast measurement tend to use the remote program to control DUT and MTP200B.

4. **Control PC:** The PC may be used to control the remote program of MTP200B and DUT.

## 11.2 MTP200B BT LE Signal Generator Set-up

Set RF-related parameters such as BT_LE channel, output power, and BIT_PATTERN.

> **⚠CAUTION**
> Before measurement, check the channel (frequency), BIT_PATTERN, LENGTH, and NUM_PACKET of the BT_LE RX signal of DUT.

### 11.2.1 Mode Setting

- Select `GEN (M1)` → `SG` → `MODE` → `BT_LE`

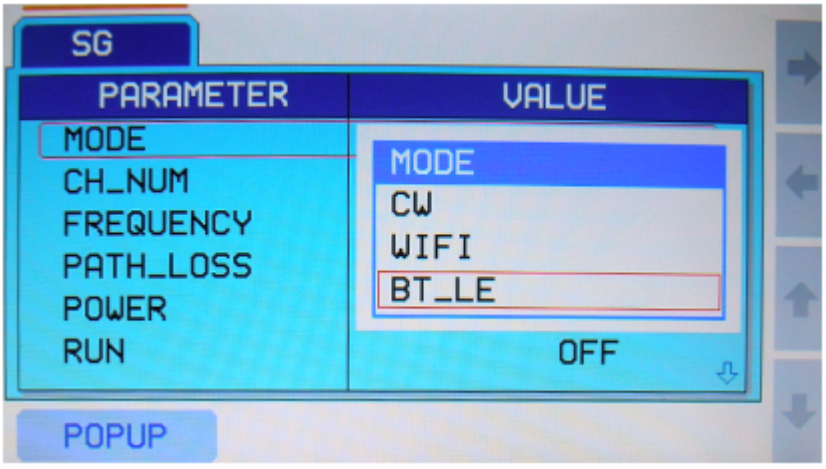



**Figure 11-2** BT_LE Mode Setting Screen

### 11.2.2 Channel Setting

Input CH_NUM for the reception channel of DUT (between 0 and 39).

- Select `GEN (M1)` → `SG` → `CH_NUM` → Input value between CH_NUM → 0 ~ 39

## 11.2.3 Power Level Setting

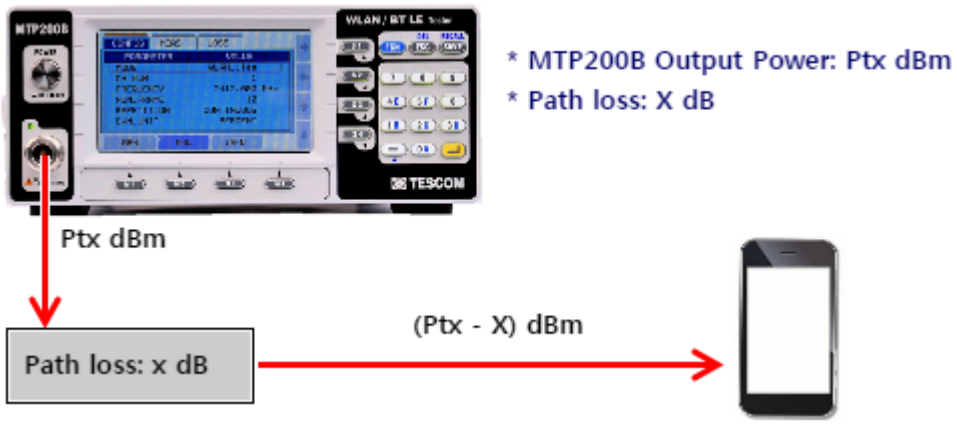
Enter the level of power to be received by DUT (Output power of tester).

- Select `GEN (M1)` → `SG` → Select `POWER` (Input value between -5 ~ -70 dBm)

## 11.2.4 Path Loss Setting

Input PATH LOSS value. PATH_LOSS is the value of loss from MTP200B's output port to DUT's input p ort. If a user input PATH_LOSS value, MTP200B displays output power value compensating PATH_LOS S value.

- Select `GEN (M1)` → `SG` → `PATH_LOSS`




**NOTICE**

If a user input PATH_LOSS value, MTP200B displays POWER value as [Ptx - PATH_LOSS value].

## 11.2.5 Bit Pattern Setting

Set BIT PATTERN of BT_LE to be transmitted from MTP200B. PRBS9 is normally used, but ALL_ZEROS, ALL_ONES, 10101010, 11110000 can be used depending on the test item.

- Select `GEN (M1)` → `SG` → `BIT_PATTERN`

## 11.2.6 Data Length Setting

Input Data Length of BT_LE packet to be transmitted from MTP200B. Set value between 0 ~ 255 Byte.

- Select GEN (M1) → SG → LENGTH (Default: 37 byte)

> **NOTICE**
> Data Length expansion function is available on DUT that supports BLE V4.2
> IF a user want to test BLE V4.0 ~ V4.1, a user must set Data Length value between 0 ~ 37.

## 11.2.7 Number of packet Setting

Set total number of packet of BT_LE to be transmitted from MTP200B.
It is possible for user to set the number of packet 0 ~ 10.000 and MTP200B keep transmitting packet when the number of packet is set to 0,.
(If packet is set between 1 ~ 10,000, MTP200B stops transmitting packet after selected number of pa cket is transmitted.)

- GEN (M1) → SG → NUM_PACKET → Set value between 0 ~ 10,000 (Default: 0)

# 11.3 BT LE Signal Transmit

1. Set DUT to BT LE packet receiving mode (Test mode, channel, etc.)

2. Set MTP200B as follows.
   A. Set MTP200B to BT_LE signal transmit mode and select channel (Refer to the 11.2.1 Mode Setting and 11.2.2 Channel Setting )
   B. Set output power to be transmitted (Refer to the 11.2.3 Power Level Setting)
   C. Set BIT_PATTERN and DATA_LENGTH of BT_LE waveform to be transmitted (Refer to the 11.2.5 Bit Pattern Setting and 11.2.6 Data Length Setting )
   D. Set number of packets to be transmitted (Refer to the 11.2.7 Number of packet Setting)

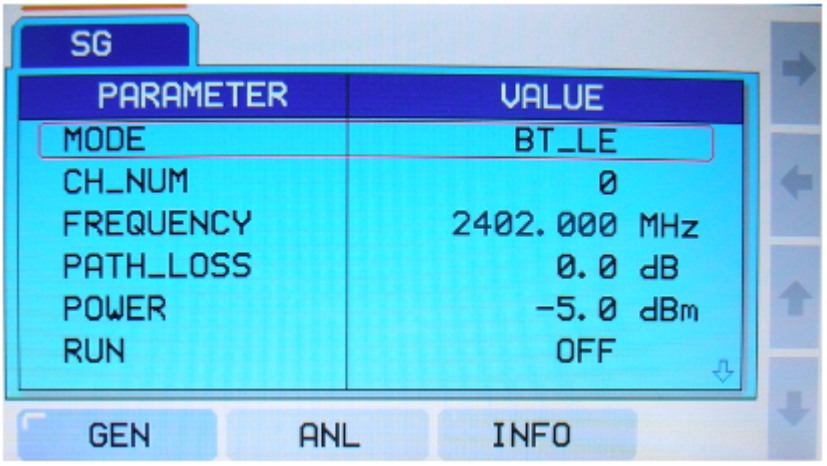



**Figure 11-3** BT_LE GEN Setting Screen

3. BT_LE packet transmit (GEN(M1) → SG → Select RUN → Select ON)
   A. Select RUN → OFF in order to stop BT_LE packet transmit

4. DUT confirms received number of packet of BT_LE. Then, calculate PER comparing it to number of packet transmitted from MTP200B.

For more details in receive test among 22. BLE RF Test Cases, refer to the 22.2 BLE Receiver Test Items.

# PART 4. Programming Guide

# 12. General Set-up

MTP200B can be remotely controlled by RS-232C communication through USB cable or SCPI Command t hrough GPIB cable. This chapter provides information about MTP200B's remote control.

## 12.1 Cable Connection and Driver Installation

1. Install USB driver. For procedure of USB driver installation, refer to the 5.1 USB Driver Installation.
2. Connect between USB port on the rear side of MTP200B and USB port of PC using the provided U SB cable.

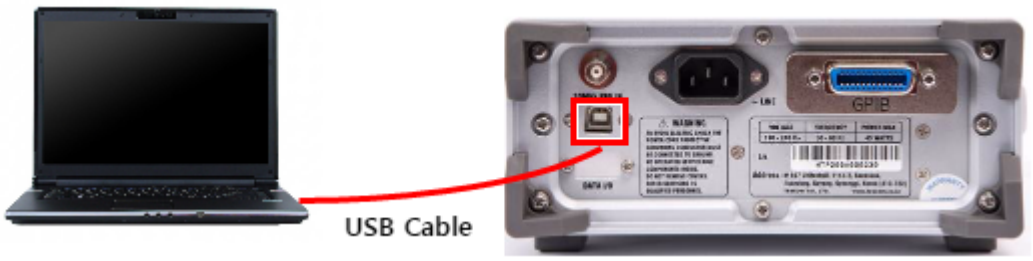



**Figure 12-1** Cable Connection for Remote Control

**NOTICE**

MTP200B communicates with the PC through the USB cable. Actually, USB-to-serial converter is built in MTP200B. Therefore, upon the installation of the driver, a COM port will be configured on the PC.

# 12.2 MTP200B Setting

## 12.2.1 Remote Interface Set-up

MTP200B has RS-232C and GPIB ports on the rear panel for remote control.

- `INFO (M3)` → Select `REMOTE` tab → Select RS232C or GPIB


**Figure 12-2** Remote Interface Setting Screen

**Table 12-1** RS232C Remote Setting Parameters

| Parameter | Input Range | Description |
|---|---|---|
| TYPE | USB2RS232C | Select the device connection type. Set as RS232C. |
| BPS | 115200 | Set the data transmission rate. Set the same value on the PC. BPS is fixed to 115000. |
| REMOTE_DSPLAY | ON/OFF(Default: OFF) | Set display mode of remote commands when remote contro l in use. |

**Table 12-2** GPIB Remote Setting Parameters

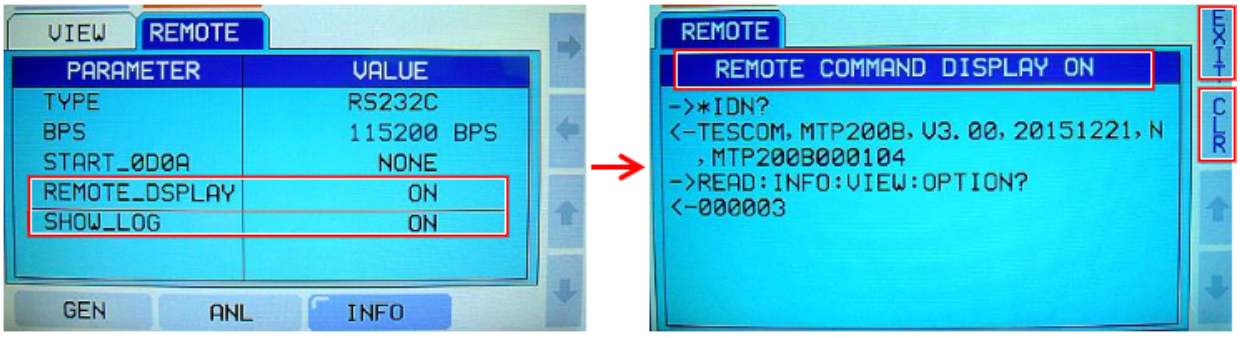
| Parameter | Input Range | Description |
|---|---|---|
| TYPE | GPIB | Select the device connection type. Set as GPIB. |
| GPIB_ADDR | 1 ~ 30(Default: 9) | Set the GPIB address to be used. (After user setting has bee n complete, if PRESET is performed, it is not initialized, but t he set value remains the same.) |
| REMOTE_DSPLAY | ON/OFF(Default: OFF) | Set display mode of remote command when remote control in use. |

## 12.2.2 Remote Display Mode Set-up

When remote control in use, remote display mode can be set for MTP200B to display remote comman d.

Remote display mode is to make users to analyze the cause of unexpected error by displaying log of tr ansmitted command and responded message in the production line.


Default remote display mode is set to 'OFF' and if a user wants to activate remote display mode, a use r needs to set to 'ON'.
When remote display mode is 'ON', screen switches to remote display screen automatically if remoted command is entered to MTP200B.
If SHOW_LOG is 'ON' at remote display mode, the log of remote command and Responses will be shown i n the display.




<SHOW_LOG ON setting> <Remote Display 'ON' Mode>

**Figure 12-3** Remote Display 'ON' Mode

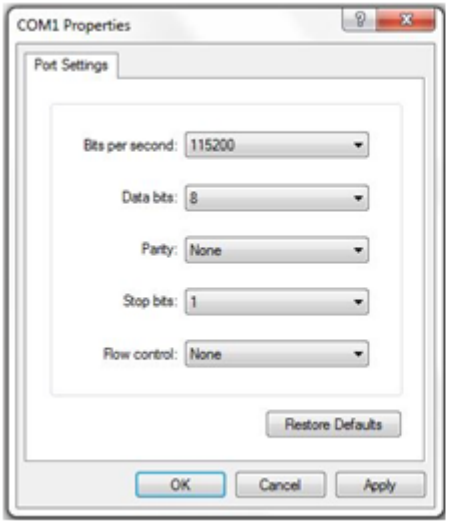
Table 12-3 Parameter of Remote Display Mode

| Parameter | Input Range | Description |
|---|---|---|
| REMOTE_DISPLAY | ON/OFF | ON: Remote display in use<br>OFF: Local mode in use(Remote display mode not in use) |
| SHOW_LOG | ON/OFF | Activated when remoted display mode is ON<br>ON: Display log of remote command<br>OFF: Hide log of remote command |
| EXIT | | Deactivate remote display mode, Local mode activated |
| CLR | | Delete log of remote command |

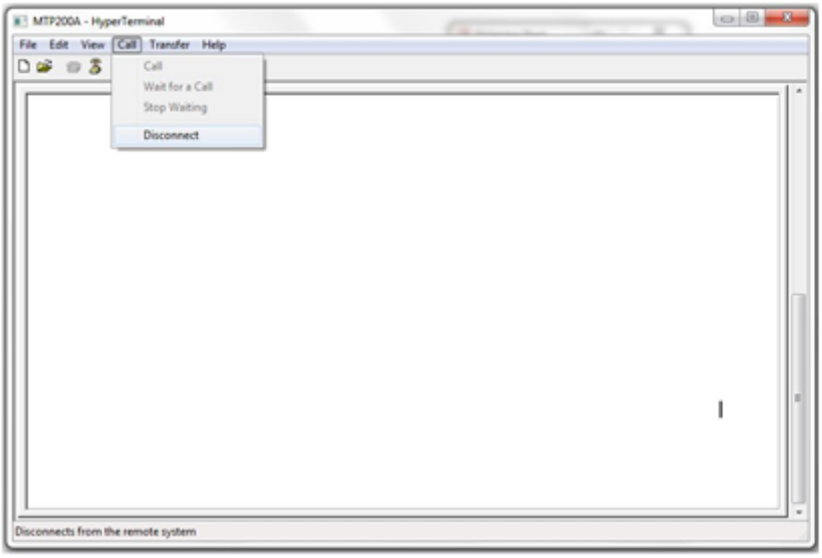
## 12.2.3 RS-232C Connection Status Checking

The user can check the USB-to-Serial connection status between PC RS-232C and MTP200B and the s etting status using the Hyper Terminal provided by Microsoft.

1. Check the COM port number for the USB-to-RS232C driver using the Device Manager of the PC.
2. Select Start -> Program -> Auxiliary Programs -> Communication -> Hyper Terminal.
3. Enter “MTP200B” in the Name field and click the OK button.
4. Enter the COM port number in the PC for modem connection.
5. Configure the port as shown below and click the OK button.

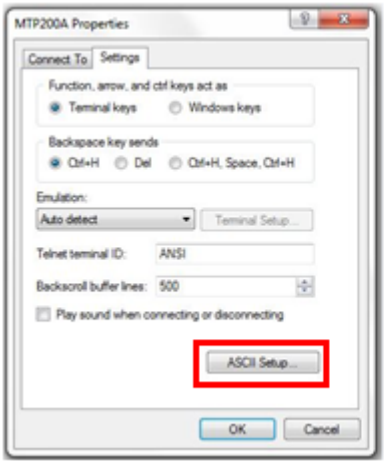


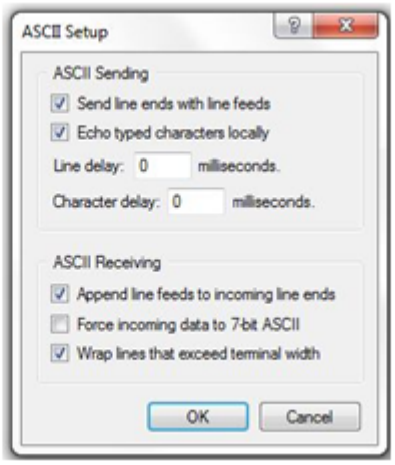
6. Select the Call menu and “Disconnect.”




7. Select File -> Properties and click the Setting tab. Afterward, select the ASCII Setting button.

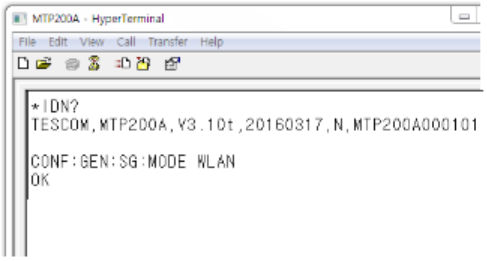
8. Select Add Line Feed (LF) at the End of the Line and Display Inputted Text.




9. Select the Call menu and “call”

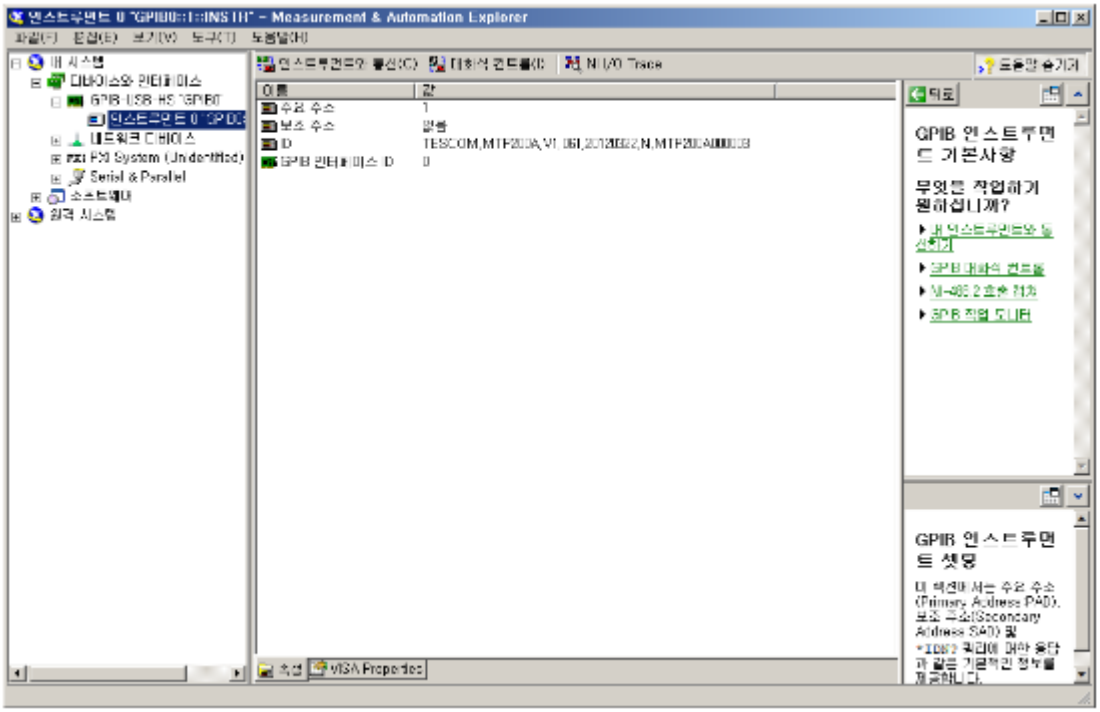
10. Input random characters and press Enter. Upon normal connection, an unknown command error shall be displayed as a response message. Input the CONF:GEN:SG:MODE WLAN command and press Enter. “OK” will then be displayed as a response message.



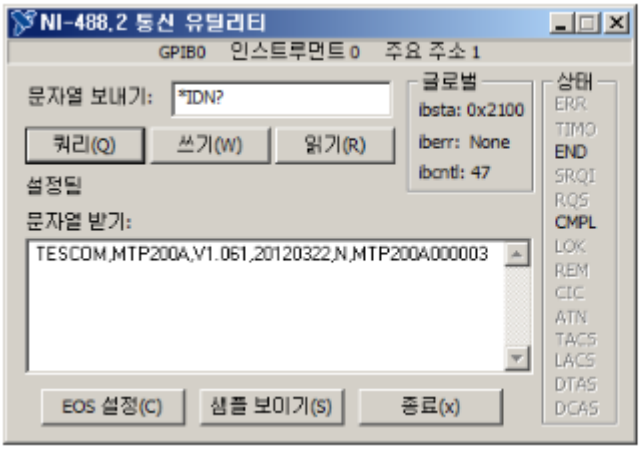
## 12.2.4 GPIB Connection Status Checking

The user can check the connection status between GPIB of the PC and MTP200B GPIB port and the setting status using NI GPIB “Measurement & Automation Explorer” provided by NI.

1. Install the GPIB driver provide by NI or GPIB Card.
2. Start the installed GPIB program. (The following description includes the NI GPIB program.)
3. Select INFO -> Type in MTP2000A followed by GPIB.
4. Set GPIB_ADDR as a number between 1 and 30.
5. When using the NI-GPIB program, select [Instrument Scan] to search MTP200B.

6. Click [Communicate with Instrument] and select “*IDN?”. When the version and the serial numbe r of MTP200B are read, it means GPIB SCPI connection has been normally established.



# 12.3 Writing the RS-232C Control Program on Windows

## 12.3.1 Programming Sequence

1. Configure the serial port.
2. Set the Baud Rate, Parity Bit (None), Data Bit (8-bit), and Stop Bit (1-bit).
3. Open the port.
4. Send the RS-232C command to the serial port.
5. Check the command execution status on the MTP200B screen.
6. Upon command execution, a response will be received from MTP200B, and the next command w ill be sent.

## 12.3.2 Programming Notes

1. Use colons between commands.
2. Do not use space except when inputting the parameter value.
3. Upon transmission of the command, LF (Line Feed, Chr (10)) will also be sent together with the c ommand.
4. For the Write command, “ACK” response will be returned; for the query command, the correspon ding value will be returned. The next command shall be sent after the response is received.

# 13. Commands use example

## 13.1 WLAN related commands use example

### 13.1.1 WLAN Signal Analyzer commands use example

```
CONF:ANL:CONFIG:MODE WLAN_11a // Must set the mode first.
CONF:ANL:CONFIG:REPETITION SINGLE // Recommend to use SINGLE mode when it is production
program.
CONF:ANL:CONFIG:CH_NUM 1
CONF:ANL:CONFIG:NUM_FRAME 10
READ:ANL:MEAS:DATA_RATE?
READ:ANL:MEAS? // Decide whether it satisfies specs of measurements according to DATA_RATE
```

### 13.1.2 WLAN Signal Generator commands use example

```
CONF:GEN:SG:MODE WLAN // Must set the mode first.
CONF:GEN:SG:CH_NUM 1
CONF:GEN:SG:POWER -5
CONF:GEN:SG:FILE_SEL WIFITEST_6M.twf // Select Waveform of signal to be transmitted.
CONF:GEN:SG:NUM_PACKET 0 // Set as signal to be transmitted continuously.
CONF:GEN:SG:INTERVAL 10
CONF:GEN:SG:RUN ON // Signal is transmitted.
```

# 13.2 BT LE related commands use example

## 13.2.1 BT LE Signal Analyzer commands use example

### 13.2.1.1 RF Test Cases measurement example through BT LE Signal Analyzer

```
[Output Power]
// Set common parameters.
CONF:ANL:CONFIG:MODE BTLE_TEST
CONF:ANL:CONFIG:NUM_PACKET 1
CONF:ANL:CONFIG:TEST_CASE POW

// Make DUT transmit PRBS9 signal to CH0 then measure.
CONF:ANL:CONFIG:CH_NUM 0
CONF:ANL:MEAS:START
READ:ANL:MEAS:POWER:AVG?
READ:ANL:MEAS:POWER_PK_AVG:AVG?
CONF:ANL:MEAS:STOP

// Make DUT transmit PRBS9 signal to CH19 then measure.
CONF:ANL:CONFIG:CH_NUM 19
CONF:ANL:MEAS:START
READ:ANL:MEAS:POWER:AVG?
READ:ANL:MEAS:POWER_PK_AVG:AVG?
CONF:ANL:MEAS:STOP

// Make DUT transmit PRBS9 signal to CH39 then measure.
CONF:ANL:CONFIG:CH_NUM 39
CONF:ANL:MEAS:START
READ:ANL:MEAS:POWER:AVG?
READ:ANL:MEAS:POWER_PK_AVG:AVG?
CONF:ANL:MEAS:STOP

[Modulation Characteristics]
// Set common parameters
CONF:ANL:CONFIG:MODE BTLE_TEST
CONF:ANL:CONFIG:NUM_PACKET 10
CONF:ANL:CONFIG:TEST_CASE POW+MOD+Fc
```

```
// Make DUT transmit 11110000 signal to CH0 then measure DF1 related.
CONF:ANL:CONFIG:CH_NUM 0
CONF:ANL:MEAS:START
READ:ANL:MEAS:DF1:AVG?
CONF:ANL:MEAS:STOP

// Make DUT transmit 10101010 signal to CH0 then measure DF2 related.
CONF:ANL:MEAS:START
READ:ANL:MEAS:DF2:AVG?
READ:ANL:MEAS:DF2MAX_RATE?
CONF:ANL:MEAS:STOP

// Make DUT transmit 11110000 signal to CH19 then measure DF1 related.
CONF:ANL:CONFIG:CH_NUM 19
CONF:ANL:MEAS:START
READ:ANL:MEAS:DF1:AVG?
CONF:ANL:MEAS:STOP

// Make DUT transmit 10101010 signal to CH19 then measure DF2 related.
CONF:ANL:MEAS:START
READ:ANL:MEAS:DF2:AVG?
READ:ANL:MEAS:DF2MAX_RATE?
CONF:ANL:MEAS:STOP

// Make DUT transmit 11110000 signal to CH39 then measure DF1 related.
CONF:ANL:CONFIG:CH_NUM 39
CONF:ANL:MEAS:START
READ:ANL:MEAS:DF1:AVG?
CONF:ANL:MEAS:STOP

// Make DUT transmit 10101010 signal to CH39 then measure DF2 related.
CONF:ANL:MEAS:START
READ:ANL:MEAS:DF2:AVG?
READ:ANL:MEAS:DF2MAX_RATE?
CONF:ANL:MEAS:STOP

[Carrier Frequency Offset and Drift]
// Set common parameters.
CONF:ANL:CONFIG:MODE BTLE_TEST
CONF:ANL:CONFIG:NUM_PACKET 10
CONF:ANL:CONFIG:TEST_CASE POW+MOD+Fc
```

```
// Make DUT transmit 10101010 signal to CH0 then measure.
CONF:ANL:CONFIG:CH_NUM 0
CONF:ANL:MEAS:START
READ:ANL:MEAS:FTX_FN:AVG?
READ:ANL:MEAS:F0_FN:AVG?
READ:ANL:MEAS:F1_F0:AVG?
READ:ANL:MEAS:FN_FN_5:AVG?
CONF:ANL:MEAS:STOP

// Make DUT transmit 10101010 signal to CH19 then measure.
CONF:ANL:CONFIG:CH_NUM 19
CONF:ANL:MEAS:START
READ:ANL:MEAS:FTX_FN:AVG?
READ:ANL:MEAS:F0_FN:AVG?
READ:ANL:MEAS:F1_F0:AVG?
READ:ANL:MEAS:FN_FN_5:AVG?
CONF:ANL:MEAS:STOP

// Make DUT transmit 10101010 signal to CH39 then measure.
CONF:ANL:CONFIG:CH_NUM 39
CONF:ANL:MEAS:START
READ:ANL:MEAS:FTX_FN:AVG?
READ:ANL:MEAS:F0_FN:AVG?
READ:ANL:MEAS:F1_F0:AVG?
READ:ANL:MEAS:FN_FN_5:AVG?
CONF:ANL:MEAS:STOP
```

#### 13.2.1.2 Advertising test commands use example through BT LE Signal Analyzer

```
CONF:ANL:CONFIG:MODE BTLE_ADV
CONF:ANL:CONFIG:NUM_PACKET 1
// Confirm Packet Interval that DUT transmits then set.
CONF:ANL:CONFIG:PKT_INTERVAL 400

// Measure for CH0.
CONF:ANL:CONFIG:CH_NUM 0
CONF:ANL:MEAS:START
READ:ANL:MEAS:POWER:AVG?
READ:ANL:MEAS:POWER_PK_AVG:AVG?
READ:ANL:MEAS:DF0:AVG?
READ:ANL:MEAS:DF2:AVG?
READ:ANL:MEAS:DF2MAX_RATE?
CONF:ANL:MEAS:STOP

// Measure for CH12.
CONF:ANL:CONFIG:CH_NUM 12
CONF:ANL:MEAS:START
READ:ANL:MEAS:POWER:AVG?
READ:ANL:MEAS:POWER_PK_AVG:AVG?
READ:ANL:MEAS:DF0:AVG?
READ:ANL:MEAS:DF2:AVG?
READ:ANL:MEAS:DF2MAX_RATE?
CONF:ANL:MEAS:STOP

// Measure for CH39.
CONF:ANL:CONFIG:CH_NUM 39
CONF:ANL:MEAS:START
READ:ANL:MEAS:POWER:AVG?
READ:ANL:MEAS:POWER_PK_AVG:AVG?
READ:ANL:MEAS:DF0:AVG?
READ:ANL:MEAS:DF2:AVG?
READ:ANL:MEAS:DF2MAX_RATE?
CONF:ANL:MEAS:STOP

// Instead of reading each measurements of above commands, a user can select and use the
measurements followed by READ:ANL:MEAS? Command.
```

### 13.2.2 Receiver Sensitivity test commands use example through BT LE Signal Generator

```
CONF:GEN:SG:MODE BT_LE

// Set Sensitivity Level as -70 dBm and set according to production specs of DUT.
CONF:GEN:SG:POWER -70
CONF:GEN:SG:BIT_PATTERN PRBS9
CONF:GEN:SG:LENGTH 37  // Set as 255 for BT v4.2 and more.
CONF:GEN:SG:NUM_PACKET 1500

// DUT counts number of packets received on CH0.
CONF:GEN:SG:CH_NUM 0
CONF:GEN:SG:RUN ON // Signal is transmitted.

// Read until responded value to be 0 in order to confirm whether set number of packet are
all transmitted.
READ:GEN:SG:RUN?

// DUT counts number of packets received on CH19.
CONF:GEN:SG:CH_NUM 19
CONF:GEN:SG:RUN ON // Signal is transmitted.

// Read until responded value to be 0 in order to confirm whether set number of packet are
all transmitted.
READ:GEN:SG:RUN?

// DUT counts number of packets received on CH39.
CONF:GEN:SG:CH_NUM 39

CONF:GEN:SG:RUN ON // Signal is transmitted.

// Read until responded value to be 0 in order to confirm whether set number of packet are
all transmitted.
READ:GEN:SG:RUN?
```

# 14. Sample Program

## 14.1 Sample Program

The following shows an example of the MTP200B remote program and its source written in Microsoft Visual Basic.NET:

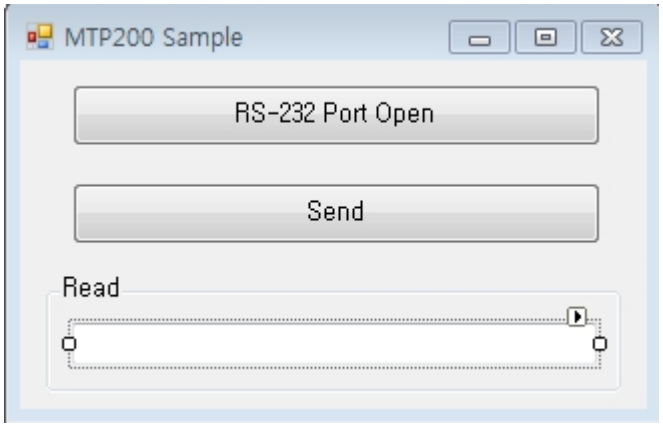



**Figure 14-1** Sample Program GUI

## 14.2 Program Description

1. Select RS-232 Port Open and set the serial port.
2. Select SEND to send the commands sequentially.
3. Upon completion, terminate the program.

## 14.3 Sample Source Code

```
Imports System.IO.Ports
Public Class Main
  Private index As Integer
  Private buff As String

  Private commands() As String = { _
            "CONF:ANL:SG:MODE WLAN_11ag", _
            "CONF:ANL:SG:CH_NUM 36", _
            "CONF:ANL:SG:NUM_FRAME 10", _
            "CONF:ANL:SG:RUN ON" _
            }
  ' Open serial port
  Private Sub bt_portOpen_Click(ByVal sender As System.Object, ByVal e As
  System.EventArgs) Handles bt_portOpen.Click
      serial.BaudRate = 115200
      serial.PortName = "COM3"

      serial.Open()
  End Sub

  Private Sub Main_Disposed(ByVal sender As Object, ByVal e As
System.EventArgs) Handles Me.Disposed
      serial.Close()
      serial.Dispose()
  End Sub

Private Sub serial_DataReceived(ByVal sender As Object, ByVal e As
System.IO.Ports.SerialDataReceivedEventArgs) Handles serial.DataReceived
     If Me.InvokeRequired Then
        Dim d As New SerialDataReceivedEventHandler(AddressOf serial_DataReceived)
        Me.Invoke(d, New System.Object() {sender, e})
        Exit Sub
  End If

  Dim rd As String = ""
  If serial.IsOpen = True Then
     If serial.BytesToRead > 0 Then
        rd = serial.ReadLine()
```

```
        txt_read.Text = rd
      End If
      serial.DiscardInBuffer()
    End If

    index = index + 1
    SendCommand(index)
  End Sub

  Private Sub bt_Send_Click(ByVal sender As System.Object, ByVal e As
System.EventArgs) Handles bt_Send.Click
      SendCommand(index)
  End Sub

  Private Sub SendCommand(ByVal idx As Integer)
  Dim cmd As String
  If idx >= commands.Length Then
      MsgBox("End of commands")
      Application.Exit()
      Exit Sub
  End If

  cmd = commands(idx)
  If String.IsNullOrEmpty(cmd) = False Then
      serial.Write(cmd + Chr(&HA))
  End If
 End Sub
End Class
```

# PART 5. Command List

# 15. General Command List

**NOTICE**

* Command and Response of RS-232C and GPIB for MTP200B are same.
* Command of RS-232C and GPIB for MTP200B are operated according to GUI menu structure.
If improper command or query that is not following GUI menu structure are entered, it will not operate properly.
(Ex: WLAN → GEN mode, WLAN → ANL → If command related to CH set-up is entered, error occurs.)

## 15.1 INFO(Information) Command List

1. *IDN?
   - Description: Checks the product serial number, F/W Version
   - Response: TESCOM,MTP200B,V2.10,20121211,N,MTP200Bxxxxxx

2. READ:INFO:VIEW:SERIAL?
   - Description: Checks the product serial number
   - Response: MTP200Bxxxxxx

3. READ:INFO:VIEW:SW_VER?
   - Description: Checks the product S/W version
   - Response: x.xx

4. READ:INFO:VIEW:OPTION?
   - Description: Checks the product S/W option
   - Response: 000001|000002|000003 (000001:WLAN option, 000002: BT_LE option, 000003: WLAN/BT_LE option)

5. *RST
   - Description: Resets the setting values of the device
   - Response: OK

## 15.2 Remote Display Mode Command List

1. CONF:CONFIG:REMOTE:REMOTE_DISPLAY <Range>
   - Description: Decide whether use of remote display mode (ON|OFF). If commands are activated wh en the mode is ON screen switches to remote display mode.
   - Range: ON|OFF
     - ON: Remote display mode activated
     - OFF: Local mode activated
   - Response: OK|ERR

2. READ:CONFIG:REMOTE:REMOTE_DISPLAY?
   - Description: Confirm remote display mode
   - Response: ON|OFF

3. CONF:CONFIG:REMOTE:SHOW_LOG <Range>
   - Description: This command is activated only when under remote display mode and decide display (ON|OFF) of log (transmit command and responded message).
   - Range: ON|OFF
     - ON: Display log
     - OFF: Hide log
   - Response: OK|ERR

**NOTICE**

SHOW_LOG command can be input when the remote display mode is ‘ON’.
Under remote display ‘OFF’ mode, if 'CONF:CONFIG:REMOTE:SHOW_LOG ON' commend is sent, it responses as ERR.

4. READ:CONFIG:REMOTE:SHOW_LOG?
   - Description: Command to confirm log SHOW mode
   - Response: ON|OFF
     - ON: Status of LOG SHOW mode
     - OFF: Status of LOG SHOW mode OFF

5. CONF:REMOTE:EXIT
   - Description: Deactivate remote display mode, Set to local mode
   - Response: OK|ERR

6. CONF:CONFIG:REMOTE:CLEAR
   - Description: Command to delete remote command and response log of remote display
   - Response: OK|ERR

# 16. WLAN Command List

## 16.1 WLAN Signal Generator Command List

### 16.1.1 Configuration Command

1. CONF:GEN:SG:MODE WLAN
   - Description: Sets the WLAN operation mode
   - Response: OK|ERR

2. READ:GEN:MODE?
   - Description: Checks the operation mode
   - Response: CW|WLAN|BT_LE
   - Default value: CW

3. CONF:GEN:SG:CH_NUM <Range>
   - Description: Sets the WLAN output channel.
   - Range: 1 ~ 14, 34, 36, 38, 40, 42, 44, 46, 48, 52, 56, 60 ,64, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 149, 153, 157, 161,165
   - Response: OK|ERR
   - Default value: 1

4. READ:GEN:SG:CH_NUM?
   - Description: Checks the setting of the WLAN output channel
   - Response:1 ~ 14, 34, 36, 38, 40, 42, 44, 46, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 149, 153, 157, 161, 165
   - Default value: 1

5. READ:GEN:SG:FREQ?
   - Description: Checks the setting of the WLAN output frequency[MHz]
   - Response: 2412.000 ~ 2484.000, 4900.000 ~ 5825.000
   - Default value: 2412.000

6. CONF:GEN:SG:POWER <Range>
   - Description: Sets the WLAN output power[dBm]
   - Range: -5.0 ~ -70.0
   - Response : OK|ERR

7. READ:GEN:SG:POWER?
   - Description: Checks the setting of the WLAN output power[dBm]
   - Respons : -5.0 ~ -70.0

8. CONF:GEN:SG:FILE_SEL <Range>
   - Description: Sets the test file among the WLAN files downloaded to the device
   - Range:

     Sets the default filename set upon shipment from the factory (WIFITEST_6M.twf(Default), WIFITEST_9M.twf. WIFITEST_12M.twf, WIFITEST_18M.twf, WIFITEST_24M.twf, WIFITEST_36M.twf, WIFITEST_48M.twf, WIFITEST_54M.twf. N_MCS0.twf, N_MCS1.twf, N_MCS2.twf, N_MCS3.twf, N_MCS4.twf, N_MCS5.twf, N_MCS6.twf, N_MCS7.twf
   - Response: OK|ERR

9. READ:GEN:SG:FILE_SEL?
   - Description: Checks the setting of the WLAN test file
   - Response:
     - User-defined test file name
     - Default files provided upon shipment from the factory (WIFITEST_6M.twf(Default), WIFITEST_9M.twf. WIFITEST_12M.twf, WIFITEST_18M.twf, WIFITEST_24M.twf, WIFITEST_36M.twf, WIFITEST_48M.twf, WIFITEST_54M.twf. N_MCS0.twf, N_MCS1.twf, N_MCS2.twf, N_MCS3.twf, N_MCS4.twf, N_MCS5.twf, N_MCS6.twf, N_MCS7.twf )

10. CONF:GEN:SG:NUM_PACKET <Range>
    - Description: Sets the number of WLAN packets to be transmitted; “0” is for continuous transmission
    - Range: 0 ~ 10000
    - Response: OK|ERR
    - Default value: 0

11. READ:GEN:SG:NUM_PACKET?
    - Description: Checks the setting of the number of WLAN packets
    - Response: 0 ~ 10000 (0: Continuous transmission of WLAN packets)

12. CONF:GEN:SG:INTERVAL <Range>
    - Description: Sets the transmission interval(us) upon WLAN packet transmission
    - Range: 1 ~ 3,000
    - Response: OK|ERR
    - Default value: 10

13. READ:GEN:SG:INTERVAL?
    - Description: Checks the transmission interval(us) upon WLAN packet transmission
    - Response: 1 ~ 3000
    - Default value: 10

## 16.1.2 Path loss Command

1. CONF:GEN:SG:PATH_LOSS <Range>
    - Description: Set Path Loss value[dB] of WLAN signal generator. It applies to all in CW, WLAN, BT _LE mode
    - Range: 0.0 ~ 50.0
    - Response: OK|ERR

2. READ:GEN:SG:PATH_LOSS?
    - Description: Confirm Path Loss value[dB] of signal generator
    - Response: 0.0 ~ 50.0
    - Default value: 0.0

## 16.1.3 RF ON/OFF Command

1. CONF:GEN:SG:RUN ON
    - Description: Turns on the WLAN RF output (Transmission On)
    - Response: OK|ERR

**NOTICE**

If number of WLAN Packet is set, RF transmit automatically stops after number of WLAN Packe t that is set is transmitted. However, under continuous transmit mode (C**ONF:GEN:SG:NUM_P ACKET 0**), transmit RF signal by '**CONF:GEN:SG:RUN ON**' command and must use '**CONF:GEN: SG:RUN OFF**' command to stop RF transmit.

2. CONF:GEN:SG:RUN OFF
    - Description: Turns off the WLAN RF output (Transmission Off)
    - Response: OK|ERR

3. READ:GEN:SG:RUN?
    - Description: Checks the WLAN RF output status
    - Response: ON|OFF

## 16.1.4 Waveform Command

1. CONF:GEN:AWG:FORMAT FORMAT
   - Description: Formats the WLAN test file stored on the device. It is usable before a user saves WLAN test file created through Waveform Creator.
   - Response: OK|ERR

2. CONF:GEN:AWG:DELETE_FILE <Range>
   - Description: : It is used to delete selected file individually among WLAN test files saved in a device. (Ex. CONF:GEN:AWG:DELETE_FILE WIFITEST_12M.twf)
   - Range: Name of the file to be deleted from among the files stored on the device
   - Response: OK|ERR

3. READ:GEN:AWG:PSDU_LENGTH?
   - Description: Confirm selected PSDU Data Length's[bytes] information of WLAN

4. READ:GEN:AWG:DATA_RATE?
   - Description: Checks the data rate of the selected WLAN file
   - Response: BPSK_1/2|BPSK_3/4|QPSK_1/2|QPSK_3/4|16QAM_1/2|16QAM_3/4|64QAM_2/3|64QAM_3/4|64QAM_5/6

5. READ:GEN:AWG:DATA_TYPE?
   - Description: Checks the data type of the selected WLAN file
   - Response: DATA_PN9

6. READ:GEN:AWG:READ_FILE_INFO? <Range>
   - Description: Checks information of the selected WLAN file
   - Range: 0 ~ 40
   - Response: File information, NAK

7. READ:GEN:AWG:FREE_FILE_NUM?
   - Description: Checks the number of WLAN files downloadable to the device. Based on the time when a device was released maximum 40 files can be saved, but as 16 files are saved, additional 24 files can be saved and a use can confirm.
   - Response: 0 ~ 40
   - Default value: 24

8. READ:GEN:AWG:MAX_FILE_NUM?
   - Description: Checks the maximum number of WLAN files downloadable to the device
   - Response: 40

9. READ:GEN:AWG:SAVED_FILE_NUM?
   - Description: Number of WLAN files downloaded to the device. Total 16 WLAN test files were saved when a device was released and maximum 40 files can be saved.
   - Response: 0 ~ 40
   - Default value: 16

10. READ:GEN:AWG:SAVED_FILE_NAME?
    - Description: Confirm the name of WLAN test file saved in the device
    - Response: List of the name of WLAN test file saved in the device
      - Default: WIFITEST_6M.twf|WIFITEST_9M.twf|WIFITEST_12M.twf|WIFITEST_18M.twf|WIFITEST_24M.twf|WIFITEST_36M.twf|WIFITEST_48M.twf|WIFITEST_54M.twf|N_MCS0.twf|N_MCS1.twf|N_MCS2.twf|N_MCS3.twf|N_MCS4.twf|N_MCS5.twf|N_MCS6.twf|N_MCS7.twf

# 16.2 WLAN Signal Analyzer Command List

## 16.2.1 Configuration Command

1. CONF:ANL:CONFIG:MODE <Range>
   - Description: Sets the WLAN analysis mode as operation mode
   - Range: WLAN_11a|WLAN_11g|WLAN_11ag|WLAN_11n
   - Response: OK|ERR

2. READ:ANL:MODE?
   - Description: Checks the operation mode
   - Response: CW|WLAN_11ag|WLAN_11n|BT_LE
   - Default value: WLAN_11ag

3. CONF:ANL:CONFIG:CH_NUM <Range>
   - Description: Sets the WLAN input channel
   - Range: 1 ~ 14, 34, 36, 38, 40, 42, 44, 46, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 149, 153, 157, 161, 165
   - Response: OK|ERR
   - Default value: 1

4. READ:ANL:CONFIG:CH_NUM?
   - Description: Checks the setting of the WLAN input channel
   - Response: 1 ~ 14, 34, 36, 38, 40, 42, 44, 46, 48, 52, 56, 60, 64, 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 149, 153, 157, 161, 165
   - Default value: 1

5. READ:ANL:CONFIG:FREQ?
   - Description: Checks the setting of the WLAN input frequency[MHz]
   - Response: 2412.000 ~ 2484.000, 4900.000 ~ 5825.000, 2412.000
   - Default value: 2412.000

6. CONF:ANL:CONFIG:NUM_FRAME <Range>
   - Description: Sets the number of frames to be measured for each measurement
   - Range: 1 ~ 100
   - Response: OK|ERR
   - Default value: 10

7. READ:ANL:CONFIG:NUM_FRAME?
   - Description: Checks the setting of the number of frames to be measured for each measurement
   - Response: 1 ~ 100
   - Default value: 10

8. CONF:ANL:CONFIG:EVM_UNIT <Range>
   - Description: Set measurement unit for EVM test
   - Range: PERCENT|dB
   - Response: OK|ERR

9. READ:ANL:CONFIG:EVM_UNIT?
   - Description: Confirm EVM measurement unit
   - Response: PERCENT|dB
   - Default value: PERCENT

10. CONF:ANL:CONFIG:REPETITION <Range>
    - Description: Set repetitive measurement mode
    - Range: CONTINUOUS|SINGLE
      - CONTINUOUS: Continuous measurement mode
      - SINGLE: One time measurement mode
    - Response: OK|ERR
    - Default value: CONTINUOUS

> **⚠CAUTION**
>
> The default value of Repetition mode is CONTINUOUS. However, as the main purpose of prod uction program is to decide whether it satisfies the specs, so it is recommended to use under SI NGLE mode.

11. **READ:ANL:CONFIG:REPETITION?**
    - Description: Confirm repetitive measurement mode
    - Response: CONTINUOUS|SINGLE
    - Default value: CONTINUOUS

## 16.2.2 Path loss Command

1. **CONF:ANL:LOSS:CH_<Range> <Loss Value>**
    - Description: Sets the path loss of each channel
    - <Range>: WLAN or BT_LE channel
    - <Loss Value>: 0.0 ~ 50.0
    - Response : OK|ERR

2. **READ:ANL:LOSS:CH_<Range>?**
    - Description: Checks the path loss setting of each channel
    - Range: WLAN or BT_LE channel
    - Response: 0.0 ~ 50.0

3. **CONF:ANL:LOSS:CH_ALL <Range>**
    - Description: Set same Path Loss value for all channel under WLAN or BT_LE ANL mode
    - <Range>: 0.0 ~ 50.0
    - Response: OK|ERR

4. **READ:ANL:LOSS:CH_ALL?**
    - Description: Checks the path loss setting of all channels; each value is divided by space
    - Response: 0.0 ~ 50.0

## 16.2.3 Measurement Command

1. **CONF:ANL:MEAS:START**
    - Description: Starts measurement
    - Response: OK|ERR

**CAUTION**

Transmit '**CONF:ANL:CONFIG:MEAS START**' command and read the needed measurements aft er receipt of OK message then transmit '**CONF:ANL:CONFIG:MEAS STOP**' command when me asurements are no more needed to be read. After transmit 'CONF:ANL:CONFIG:MEAS STOP' c ommand, a user cannot read the measurements.

2. CONF:ANL:MEAS:STOP
   - Description: Stops measurement
   - Response: OK|ERR

## 16.2.4 List of Command for Measurements

1. READ:ANL:MEAS:ALL:AVG?
   - Description: Confirm AVG value among all measurements(Outputted in order of EVM_AVG, POWER_AVG, FREQERR_AVG, and CLKERR_AVG; each value is divided by comma)
   - Response: “ERR” response will be responded in case there is no measurement

2. READ:ANL:MEAS:EVM:AVG?
   - Description: Checks the average EVM measurements
   - Response: 0.0 ~ 100.0

3. READ:ANL:MEAS:POWER:AVG?
   - Description: Checks the average Power measurements
   - Response: -50.0 ~ +20.0

4. READ:ANL:MEAS:FREQ_ERR:AVG?
   - Description: Checks the average frequency error measurements
   - Response: -100.0 ~ +100.0

5. READ:ANL:MEAS:CLOCK_ERR:AVG?
   - Description: Checks the average clock errors
   - Response: -25.0 ~ +25.0

6. READ:ANL:MEAS:DATA_RATE?
   - Description: Reads the data rate for the packets currently being measured

# 17. BT LE Command List

## 17.1 BT LE Signal Generator Command List

- The commands of BT LE signal generator can be used for the purpose as follows.
  - Transmits general BT LE signal
  - Receiver Sensitivity test of BT LE RF PHY(RF-PHY.TS.4.2.0) test items

> **⚠CAUTION**
>
> BT LE signal transmitted from MTP200B does not support Dirty Transmitter for Receiver Sensitivity test of BT LE RF PHY(RF-PHY.TS.4.2.0) examination item.

### 17.1.1 Configuration Command

1. **CONF:GEN:SG:MODE BT_LE**
   - Description: Sets the BT_LE operation mode
   - Response: OK|ERR

2. **READ:GEN:MODE?**
   - Description: Checks the operation mode
   - Response: CW|WLAN|BT_LE
   - Default value: CW

3. **CONF:GEN:SG:CH_NUM <Range>**
   - Description: Sets the BT_LE output channel, Test as changing channel to 0, 19, 39 for RF PHY Receiver Sensitivity test.
   - Range: 0 ~ 39
   - Response: OK|ERR
   - Default value: 0

4. READ:GEN:SG:CH_NUM?
   - Description: Checks the setting of the BT_LE output channel
   - Response: 0 ~ 39
   - Default value: 0

5. READ:GEN:SG:FREQ?
   - Description: Checks the setting of the BT_LE output frequency[MHz]
   - Response: 2402.000 ~ 2480.000
   - Default value: 2402.000

6. CONF:GEN:SG:POWER <Range>
   - Description: Sets the BT_LE output power[dBm], Use to set power to be added to input signal of DUT receiver under RF PHY Receiver Sensitivity test item and set as -70.0 [dBm] or according to a user's production specs.
   - Range: -5.0 ~ -70.0
   - Response : OK|ERR
   - Default value: -5.0

**NOTICE**

When test BT_LE Receiver Sensitivity, if DUT's receiver sensitivity level is -93 dBm, MTP200B's minimum output power is -70 dBm. Therefore, a user must connect 30dB Attenuator which provided when MTP200B was released to RF Port to test.

**Commands use example:**

CONF:GEN:SG:PATH_LOSS 30

CONF:GEN:SG:POWER -93 // When the above commands are transmitted, -63dBm is outputted from RF port of MTP200B and -93dBm is inputted to input port of DUT passing through 30dB Attenuator.

7. READ:GEN:SG:POWER?
   - Description: Checks the setting of the BT_LE output power[dBm]
   - Response: -5.0 ~ -70.0
   - Default value: -5.0

8. CONF:GEN:SG:BIT_PATTERN <Range>
   - Description: Sets the BT LE BIT pattern, Set as PRBS9 for F PHY Receiver Sensitivity test.
   - Range: ALL_ZEROS|ALL_ONES|10101010|11110000|PRBS9
   - Response: OK|ERR
   - Default value: ALL_ZEROS

9. READ:GEN:SG:BIT_PATTERN?
   - Description: Checks the setting of the BT_LE BIT pattern
   - Response: ALL_ZEROS|ALL_ONES|10101010|11110000|PRBS9

10. CONF:GEN:SG:LENGTH <Range>
   - Description: Sets the BT_LE packet length
   - Range: 0 ~ 255
   - Response: OK|ERR
   - Default value: 37

**NOTICE**

A user can set Payload Length of Packet to maximum 37 bytes for DUT with Bluetooth Core Specification, Version 4.1(Low Energy) and lower, but maximum 255 bytes depending on DUT with Version 4.2 and more.

11. READ:GEN:SG:LENGTH?
   - Description: Checks the setting of the BT_LE packet length
   - Response: 0 ~ 255
   - Default value: 37

12. CONF:GEN:SG:NUM_PACKET <Range>
   - Description: Sets the number of BT_LE packets to be transmitted; “0” is for continuous transmission. Set as 1500 for RF PHY Receiver Sensitivity test.
   - Range: 0 ~ 10000
   - Response: OK|ERR
   - Default value: 0

13. READ:GEN:SG:NUM_PACKET?
   - Description: Checks the setting of the number of BT_LE packets
   - Response: 0 ~ 10000 (0: Continuous transmission of BT_LE packets)

## 17.1.2 Path loss Command

1. **CONF:GEN:SG:PATH_LOSS <Range>**
   - Description: Set Path Loss value[dB] of BT LE signal generator. It applies to all in CW, WLAN, BT_LE mode
   - Range: 0.0 ~ 50.0
   - Response: OK|ERR

2. **READ:GEN:SG:PATH_LOSS?**
   - Description: Confirm Path Loss value[dB] of signal generator
   - Response: 0.0 ~ 50.0
   - Default value: 0.0

## 17.1.3 RF ON/OFF Command

1. **CONF:GEN:SG:RUN ON**
   - Description: Turns on the BT_LE RF output (Transmission On)
   - Response : OK|ERR

**NOTICE**

If number of BT LE Packet is set, RF transmit automatically stops after number of BT LE Packet that is set is transmitted. However, under continuous transmit mode (**CONF:GEN:SG:NUM_PACKET 0**), transmit RF signal by '**CONF:GEN:SG:RUN ON**' command and must use '**CONF:GEN:SG:RUN OFF**' command to stop RF transmit.

2. **CONF:GEN:SG:RUN OFF**
   - Description: BT_LE RF output (Transmission Off)
   - Response : OK|ERR

3. **READ:GEN:SG:RUN?**
   - Description: Checks the BT_LE RF output status
   - Response: ON|OFF
   - Default value: OFF

# 17.2 BT_LE Signal Analyzer Command List

- The commands of BT LE signal analyzer can be used for the purpose as follows.
  - Measure and analyze general BT LE signal
- BT LE RF PHY("RF-PHY.TX.4.2.0") test items (3 items)
  - Output Power
  - Modulation Characteristics
  - Carrier Frequency Offset and Drift
- Test items for complete product through Advertising Mode (2 items)
  - Output Power
  - Modulation and Frequency Offset

## 17.2.1 Configuration Command

1. CONF:ANL:CONFIG:MODE BTLE_TEST
   - Description: Set operating MODE to BT_LE TEST mode. For RF PHY Output Power, Modulation Characteristics, Carrier Frequency Offset and Drift test items, it must be set as BTLE_TEST mode.
   - Response: OK|ERR

2. CONF:ANL:CONFIG:MODE BTLE_ADV
   - Description: Set operating MODE to BT_LE ADVERTISING mode. For Output Power, Modulation and Frequency Offset test through Advertising mode of complete products, it must be set as BTLE_ADV mode.
   - Response: OK|ERR

> **⚠CAUTION**
>
> For above commands, if it is set as BTLE_TEST, it is measured according to Payload Bit Pattern demanded by test items of Direct Test Mode. However, if it is set as BTLE_ADV, it is measured (dF0 and dF2) using Bit pattern of Preamble.

3. READ:ANL:CONFIG:TEST_METHOD?
   - Description: Checks the setting of the BT_LE test method
   - Response: TEST_MODE|ADVERTISING
   - Default value: TEST_MODE

4. READ:ANL:MODE?
   - Description: Checks the operation mode
   - Response: CW|WLAN_11ag|WLAN_11n|BT_LE
   - Default value: CW

5. CONF:ANL:CONFIG:CH_NUM <Range>
   - Description: Sets the BT_LE input channel
   - Range: 0 ~ 39
   - Response: OK|ERR
   - Default value: 0

6. READ:ANL:CONFIG:CH_NUM?
   - Description: Checks the setting of the BT_LE input channel. According to Test Spec., set 0, 19, 39 in sequence and test. If it is Advertising, set 0, 12, 39 and test.
   - Response: 0 ~ 39
   - Default value: 0

7. READ:ANL:CONFIG:FREQ?
   - Description: Checks the setting of the BT_LE input frequency[MHz]
   - Response: 2402.000 ~ 2480.000
   - Default value: 2402.000

8. CONF:ANL:CONFIG:TEST_CASE <Range>
   - Description: Sets the BT_LE test case
   - Range: POW|POW+MOD|POW+Fc_O/D|POW+MOD+Fc
   - Response : OK|ERR
   - Default value: POW

9. READ:ANL:CONFIG:TEST_CASE?
   - Description: Checks the setting of the BT_LE test case
   - Response: POW|POW+MOD|POW+Fc_O/D|POW+MOD+Fc
   - Default value: POW

In order to measure BT LE RF PHY("RF-PHY.TX.4.2.0") 3 test items under single mode, it is recommended to set as POW+MOD+Fc.

10. CONF:ANL:CONFIG:NUM_PACKET <Range>
    - Description: Set number of BT LE Packet to be measured
    - Range: 1 ~ 10
    - Response: OK|ERR
    - Default value: 10

11. READ:ANL:CONFIG:NUM_PACKET?
    - Description: Confirm number of BT LE Packet to be measured
    - Response: 1 ~ 10
    - Default value: 10

12. CONF:ANL:CONFIG:PKT_INTERVAL
    - Description: When operating MODE is BT_LE ADVERTISING, set after confirm Interval [ms] of BT LE Advertising packet transmitted from DUT.
    - Range: 20 ~ 10250
    - Response: OK|ERR
    - Default value: 1000

> **NOTICE**
> The longer the Packet Interval range the longer the measurement time. Therefore, set as the va lue that guarantee reliability at least.

13. READ:ANL:CONFIG:PKT_INTERVAL?
    - Description: When operating MODE is BT_LE ADVERTISING, set after confirm Interval [ms] of BT LE Advertising packet transmitted from DUT.
    - Response: 20 ~ 10250

## 17.2.2 Path loss Command

1. CONF:ANL:LOSS:CH_<Range> <Loss Value>
    - Description: Sets the path loss of each channel
    - <Range>: WLAN or BT_LE channel
    - <Loss Value>: 0.0 ~ 50.0
    - Response : OK|ERR

2. READ:ANL:LOSS:CH_<Range>?
    - Description: Checks the path loss setting of each channel
    - Range: WLAN or BT_LE channel
    - Response: 0.0 ~ 50.0

3. CONF:ANL:LOSS:CH_ALL <Range>
    - Description: Set same Path Loss value for all channel under WLAN or BT_LE ANL mode
    - <Range>: 0.0 ~ 50.0
    - Response: OK|ERR

4. READ:ANL:LOSS:CH_ALL?
   - Description: Checks the path loss setting of all channels; each value is divided by space
   - Response: 0.0 ~ 50.0

## 17.2.3 Measurement Command

1. CONF:ANL:MEAS:START
   - Description: Starts measurement
   - Response : OK|ERR

> **CAUTION**
>
> Transmit '**CONF:ANL:CONFIG:MEAS START**' command and read the needed measurements after receipt of OK message then transmit '**CONF:ANL:CONFIG:MEAS STOP**' command when measurements are no more needed to be read. After transmit 'CONF:ANL:CONFIG:MEAS STOP' command, a user cannot read the measurements.

2. CONF:ANL:MEAS:STOP
   - Description: Stops measurement
   - Response : OK|ERR

## 17.2.4 List of Command of Measurements

**NOTICE**

There are two ways to read the measurements.

1. To read the measurements all at once.

- READ:ANL:MEAS:ALL:AVG?

* Measurements used to decide the specs of each test item (when BTLE_TEST)

- Outpout Power : Power_avg, Ppk_Pavg_avg
- Modulation and Carrier Frequency Offset and Drift : FTx-Fn_avg, F[0]-F[n]_avg, F[1]-F[0]_avg, F[n]-F[n-5]_avg

* Measurements used to decide the specs of each test (when BTLE_ADV)

- Outpout Power : Power_avg, Ppk_Pavg_avg
- Modulation and Frequency Offset : dF0_avg, dF2_avg

2. To read the measurements what user wants by individual command.

- READ:ANL:MEAS:POWER:AVG?~READ:ANL:MEAS:DF2MAX_RATE? (9 commands)

**1. READ:ANL:MEAS:ALL:AVG?**

- Description: Confirm AVG value among all measurements (Available under both TEST_MODE and ADVERTISING)
- Response
  - TEST_MODE: Outputted in order of Power_avg, Ppk-Pavg_avg, dF1_avg, dF2_avg, FTx-Fn_avg, F[0]-F[n]_avg, F[1]-F[0]_avg, F[n]-F[n-5]_avg, data_pattern, current_channel, meas_count, and dF2_rate: each value is divided by comma, 'N' is displayed if there is no measurments
  - ADVERTISING: Outputted in order of Power_avg, Ppk-Pavg_avg, dF0_avg, dF2_avg, current_channel, and meas_count; each value is divided by comma, 'N' is displayed if there is no measurments
  - "ERR" response will be returned in case there is no measurement

**2. READ:ANL:MEAS:POWER:AVG?**

- Description: Checks the average Power measurements (Available under both TEST_MODE and ADVERTISING)
- Response: -50.0 ~ +20.0, ERR

**3. READ:ANL:MEAS:POWER_PK_AVG:AVG?**

- DescriptionChecks the average Power measurements (Available under both TEST_MODE and ADVERTISING)
- Response: Measurements or ERR

4. READ:ANL:MEAS:DF1:AVG?
   - Description: Checks the average dF1 among the modulation measurements
   - Response: Measurements or ERR

5. READ:ANL:MEAS:DF2:AVG?
   - Description: Checks the average Df2 among the modulation measurements (Available under both TEST_MODE and ADVERTISING)
   - Response: Measurements or ERR

6. READ:ANL:MEAS:FTX_FN:AVG?
   - Description: Checks the average FTX_FN among the measurements
   - Response: Measurements or ERR

7. READ:ANL:MEAS:F0_FN:AVG?
   - Description: Checks the average F0_FN among the measurements
   - Response: Measurements or ERR

8. READ:ANL:MEAS:F1_F0:AVG?
   - Description: Checks the average F1_F0 among the measurements
   - Response: Measurements or ERR

9. READ:ANL:MEAS:FN_FN_5:AVG?
   - Description: Checks the average FN_FN_5 among the measurements
   - Response: Measurements or ERR

10. READ:ANL:MEAS:DF2MAX_RATE?
    - Description: Checks the dF2 rate among the modulation measurements
    - Response: 0.0 ~ 100.0 or ERR

11. READ:ANL:MEAS:DATA?
    - Description: Checks BT_LE BIT_PATTERN upon measurement
    - Response: ALL_ZEROS|ALL_ONES|10101010|11110000|PRBS9|ERR

12. READ:ANL:MEAS:PLD_LEN?
    - Description: Confirm Payload length as Byte unit of currently measuring packet under TEST-MODE of BT_LE
    - Response : 0 ~ measurements, ERR

# 18. CW Command List

## 18.1 CW Signal Generator Command List

### 18.1.1 Configuration Command

1. CONF:GEN:SG:MODE CW
   - Description: Sets the CW operation mode
   - Response: OK|ERR

2. READ:GEN:MODE?
   - Description: Checks the operation mode
   - Response: CW|WLAN|BT_LE
   - Default value: CW

3. CONF:GEN:SG:FREQ <Range>
   - Description: Sets the CW output frequency[MHz]
   - Range: 2400.000 ~ 2500.000, 4900.000 ~ 5350.000, 5470.000 ~ 5875.000
   - Response: OK|ERR
   - Default value: 2412.000

4. READ:GEN:SG:FREQ?
   - Description: Checks the setting of the CW output frequency[MHz]
   - Response: 2400.000 ~ 2500.000, 4900.000 ~ 5350.000, 5470.000 ~ 5875.000
   - Default value: 2412.000

5. CONF:GEN:SG:POWER <Range>
   - Description: Sets the CW output power[dBm]
   - Range: -5.0 ~ -70.0
   - Response : OK|ERR

6. READ:GEN:SG:POWER?
   - Description: Checks the setting of the CW output power[dBm]
   - Response : -5.0 ~ -70.0

## 18.1.2 Path loss Command

1. **CONF:GEN:SG:PATH_LOSS <Range>**
   - Description: Set Path Loss value[dB] of CW signal generator. It applies to all in CW, WLAN, BT_LE mode
   - Range: 0.0 ~ 50.0
   - Response: OK|ERR

2. **READ:GEN:SG:PATH_LOSS?**
   - Description: Confirm Path Loss value[dB] of signal generator
   - Response: 0.0 ~ 50.0
   - Default value: 0.0

## 18.1.3 RF ON/OFF Command

3. **CONF:GEN:SG:RUN ON**
   - Description: Turns on the CW RF output (Transmission On)
   - Response : OK

**NOTICE**

If number of BT LE Packet is set, RF transmit automatically stops after number of BT LE Packet that is set is transmitted. However, under continuous transmit mode (**CONF:GEN:SG:NUM_PACKET 0**), transmit RF signal by '**CONF:GEN:SG:RUN ON**' command and must use '**CONF:GEN:SG:RUN OFF**' command to stop RF transmit.

4. **CONF:GEN:SG:RUN OFF**
   - Description: Turns off the CW RF output (Transmission Off)
   - Response : OK|ERR

5. **READ:GEN:SG:RUN?**
   - Description: Checks the CW RF output status
   - Response : ON|OFF

# 18.2 CW Signal Analyzer Command List

## 18.2.1 Configuration Command

1. CONF:ANL:CONFIG:MODE CW
   - Description: Sets the CW operation mode
   - Response: OK|ERR

2. READ:ANL:MODE?
   - Description: Checks the operation mode
   - Response: CW|WLAN_11ag|WLAN_11n|BT_LE
   - Default value: WLAN_11ag

3. CONF:ANL:CONFIG:FREQ <Range>
   - Description: Sets the CW input frequency[MHz]
   - Range: 2400.000 ~ 2500.000 MHz, 4900.000 ~ 5875.000
   - Response: OK|ERR

4. READ:ANL:CONFIG:FREQ?
   - Description: Checks the setting of the CW input frequency[MHz]
   - Response: 2400.000 ~ 2500.000, 4900.000 ~ 5875.000
   - Default value: 2412.000

5. READ:ANL:MEAS:CW_POWER?
   - Description: Checks the power[dBm] of the CW input signal (When CONFIG -> MODE is CW, a response will be returned. In other modes, ERR will be returned.)
   - Response : +20 ~ -85

## 18.2.2 Path loss Command

1. CONF:ANL:LOSS:CW_<Range> <Loss Value>
   - Description: Set Path Loss according to frequency range under CW mode
   - <Range>: 2G|5G|ALL
     - 2G: Apply Path Loss to 2 GHz range (2400 MHz ~ 2500 MHz)
     - 5G: Apply Path Loss to 5 GHz (4900 MHz ~ 5875 MHz)
     - ALL: Apply same Path Loss to all frequency range (2400 MHz ~ 2500 MHz , 4900 MHz ~ 5875 MHz)
   - <Loss Value>: Loss value: 0.0 ~ 50.0
   - Response : OK|ERR

2. READ:ANL:LOSS:CW_<Range>?

- Description: Confirm Path Loss value according to frequency range under CW mode.
- <Range>: 2G|5G|ALL
  - 2G: Confirm Path Loss value applied to 2 GHz (2400 MHz ~ 2500 MHz)
  - 5G: Confirm Path Loss value applied to 5 GHz (4900 MHz ~ 5875 MHz)
  - ALL: Confirm Path Loss value applied to all frequency range (2400 MHz ~ 2500 MHz , 4900 MHz ~ 5875 MHz)
- Response: 0.0 ~ 50.0

# PART 6. User's Device Diagnosis

# 19. User's Device Diagnosis

This chapter describes how a user can diagnose the performance of MTP200B. Regularly diagnosing the device will allow the user to run MTP200B in optimal conditions.

## 19.1 General Information

This chapter describes how a user can inspect the general conditions of MTP200B for optimal operation. The user can judge whether the device functions normally by performing the following:

To perform each measurement, the user needs to have basic understanding of MTP200B: functions, front panel, and GUI screens

### 19.1.1 Measurement Device

Measurement devices may be replaced with other devices that meet the legal requirements; the measurement steps can be changed depending on the measurement device.

**Table 19-1** Measurement Device List for the User's Device Diagnosis

| Measurement Device | Minimum Specification | Model |
|---|---|---|
| Signal Generator | 250 kHz to 6.0 GHz, | E4438C |
| Frequency Counter | +/- 0.1 ppm, 10 Hz ~ 2 GHz, 9 digit | HP-53181A |
| Power Sensor | -20 to -70 dBm, 100 kHz to 26.5 GHz | HP-8485A |
| Power Sensor | 27 to -30 dBm, 100 kHz to 4 GHz | HP-8482A |

**⚠CAUTION**

Before starting measurement, fully pre-heat the device.

### 19.1.2 Default Setting of MTP200B

> **NOTICE**
> Before starting measurement, configure MTP200B as described below. In GEN mode, a damaged cable will be considered missing cable (Path Loss = 0).

1. Turn on the power.
2. Fully pre-heat the device.
3. Press the FCN (**FCN**) -> SAVE (**SAVE**) keys and select “RESET” to result the device.
4. Press M1 (**M1**) to shift to GEN mode.

## 19.2 Signal Analyzer

### 19.2.1 Frequency Accuracy

> **Specification:** 2400.00 MHz ± 1 ppm
> **Objective:** To measure the frequency deviation of the reference signal

1. Test Setup: Connect the device as shown below.


2. MTP200B Setting
   A. FCN -> Recall -> RESET <Resets the device>
   B. MODE: GEN -> CW <Set the measurement mode CW>
   C. FREQUENCY: Set the measurement frequency to 2400.00 MHz.
   D. POWER: -5 dBm
   E. RUN: ON

3. Configure the frequency Counter as follows:
   A. Press Freq Ch 2 key

4. Record the measurement of the Frequency Counter and compare with the specification.

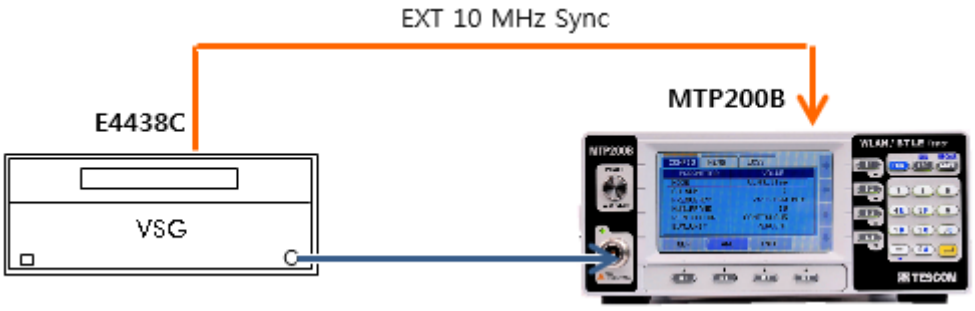
| Item | Measurement Result [MHz] |
|---|---|
| Frequency Counter Measurement Value | |

## 19.2.2 Input Power Level Accuracy

### 19.2.2.1 CW Mode Power Level Accuracy

> **Specification:** ±1 dB
> **Objective:** To measure the level accuracy of the input CW signal.

1. Test Setup: Connect the device as shown below.




2. Configure MTP200B as shown below.
   A. FCN -> Recall -> RESET <Resets the device>
   B. MODE: ANL -> MODE -> CW <Set the measurement mode CW>
   C. FREQUENCY: Set the measurement frequency to 2412.000 MHz.

3. VSG(Vector Signal Generator) Setting:
   A. RESET <Resets the device>
   B. Amplitude: +10 dBm <Sets the output power>
   C. RF: ON <Turns on the output power>

4. Connect the RF output of VSG to MPT200A RF input.

5. Synchronize the time base of the two devices by connecting 10 MHz REF Out of VSG to MTP20 0B 10 MHz REF In.

6. Set the frequency/channel of VSG and MTP200B as shown below and record the “INPUT_POWE R” displayed on MTP200B.

7. Measurement results

**Table 19-2** 2.4 GHz WLAN Frequency Band

| Level | Frequency (Ch) | | |
|---|---|---|---|
| | 2412 MHz (1 CH) | 2442 MHz (7 CH) | 2484 MHz (14 CH) |
| 10 dBm | | | |
| 0 dBm | | | |
| -10 dBm | | | |
| -20 dBm | | | |
| -30 dBm | | | |
| -40 dBm | | | |
| -50 dBm | | | |

**Table 19-3** 5 GHz WLAN Frequency Low Band

| Level | Frequency (Ch) | | |
|---|---|---|---|
| | 5180 MHz (36 CH) | 5240 MHz (48 CH) | 5320 MHz (64 CH) |
| 10 dBm | | | |
| 0 dBm | | | |
| -10 dBm | | | |
| -20 dBm | | | |
| -30 dBm | | | |
| -40 dBm | | | |
| -50 dBm | | | |

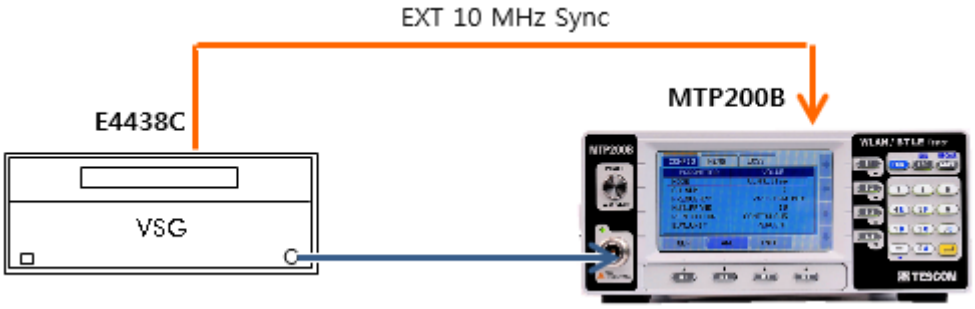
**Table 19-4** 5 GHz WLAN Frequency High Band

| Level | Frequency (Ch) | | |
|---|---|---|---|
| | 5500 MHz (100 CH) | 5660 MHz (132 CH) | 5825 MHz (165 CH) |
| 10 dBm | | | |
| 0 dBm | | | |
| -10 dBm | | | |
| -20 dBm | | | |
| -30 dBm | | | |
| -40 dBm | | | |
| -50 dBm | | | |

### 19.2.2.2 WLAN Mode Bust Power Level Accuracy

> **Specification:** ±1 dB
> **Objective:** To measure the bust power level of the WLAN mode signal

1. Test Setup: Connect the device as shown below.




2. MTP200B Setting
   A. FCN -> Recall -> RESET <Resets the device>
   B. MODE: ANL -> MODE -> WLAN_11ag <Set the WLAN measurement mode>
   C. CH_NUM: 1 <Select channel number 1>
   D. NUM_FRAME: 10 <Set 10 as the number of frames to be measured>

3. VSG(Vector Signal Generator) Setting:
   A. RESET <Resets the device>
   B. Amplitude: +10 dBm <Sets the output power>
   C. RF: ON <Turns on the output power>
   D. Modulation: WLAN 54Mbps 64-QAM OFDM Signal

4. Connect the RF output of the Vector Signal Generator (VSG) to the RF input of MTP200B.

5. Synchronize the time base of the two devices by connecting 10 MHz REF Out of VSG to MTP20 0B 10 MHz REF In.

6. Set the frequency/channel of VSG and MTP200B as shown below and record the displayed “PO WER” value by pressing the S1 key.

7. Measurement results

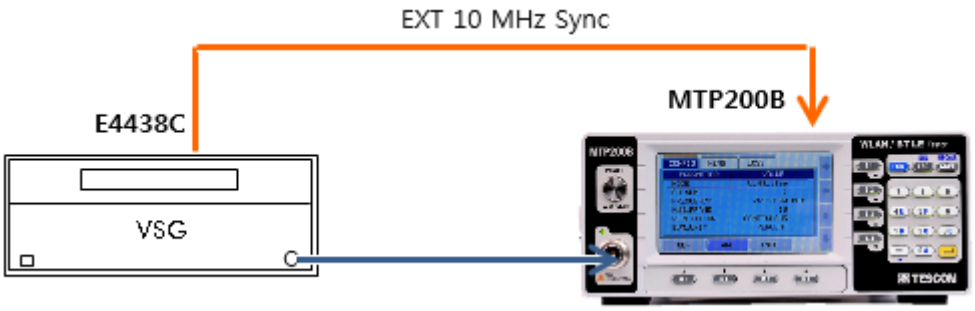
**Table 19-5** Burst Power

| Level | Frequency (Ch) | | |
|---|---|---|---|
| | 2442 MHz (7 CH) | 5240 MHz (48 CH) | 5660 MHz (132 CH) |
| 10 dBm | | | |
| -20 dBm | | | |
| -40 dBm | | | |

### 19.2.2.3 WLAN Mode Residual EVM Accuracy

> **Specification:** ≤ 4 %: 2400 ~ 2500 MHz, ≤ 5 %: 4900 ~ 5850 MHz,
> **Objective:** To verify the minimum EVM measurement of the device

1. Test Setup: Connect the device as shown below.




2. MTP200B Setting:
   A. FCN -> Recall -> RESET <Resets the device>
   B. MODE: ANL -> MODE -> WLAN_11ag <Set the WLAN measurement mode>
   C. CH_NUM: 1 <Select channel number 1>
   D. NUM_FRAME: 10 <Set 10 as the number of frames to be measured>

3. VSG(Vector Signal Generator) Setting:
   A. RESET <Resets the device>
   B. Amplitude: +10 dBm <Sets the output power>
   C. RF: ON <Turns on the output power>
   D. Modulation: WLAN 54Mbps 64-QAM OFDM Signal

4. Connect the RF output of the Vector Signal Generator (VSG) to the RF input of MTP200B.

5. Synchronize the time base of the two devices by connecting 10 MHz REF Out of VSG to MTP20 0B 10 MHz REF In.

6. Set the frequency/channel of VSG and MTP200B as shown below and record the displayed “EV M” value by pressing the S1 key.

7. Measurement results

**Table 19-6** Residual EVM

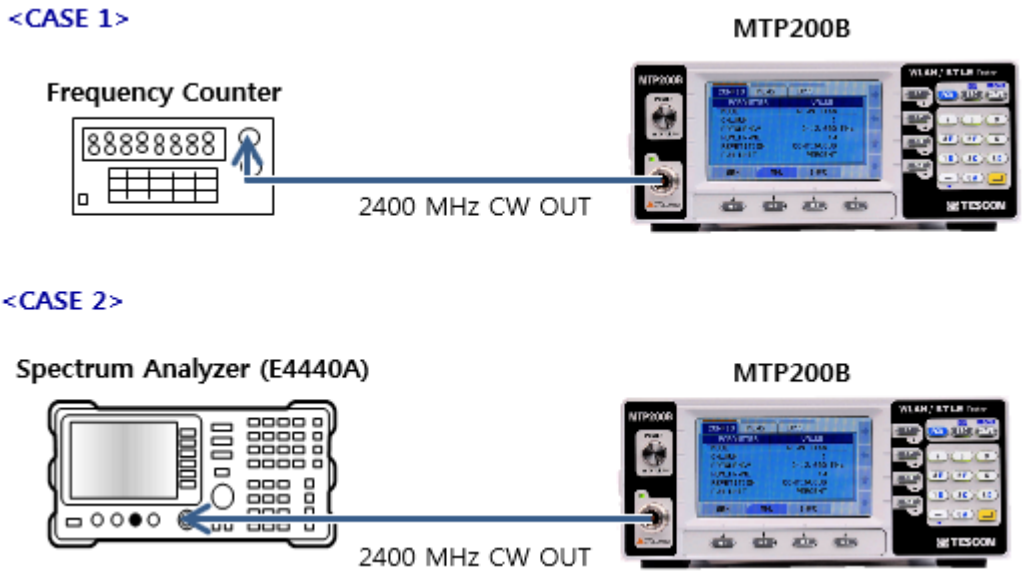
| Level | Frequency (Ch) | | |
|---|---|---|---|
| | 2442 MHz (7 CH) | 5240 MHz (48 CH) | 5660 MHz (132 CH) |
| 10 dBm | | | |
| -20 dBm | | | |
| -40 dBm | | | |

# 19.3 Signal Generator

## 19.3.1 Frequency Accuracy

> **Specification**: 2400.00 MHz ± 1 ppm (2399.9976 ~ 2400.0024 MHz)
> **Objective**: To measurem the frequency deviance of the Reference signal.

1. Test Setup: Connect the device as shown below.



2. MTP200B Setting
   A. FCN -> Recall -> RESET <Resets the device>
   B. MODE: GEN -> MODE -> CW <Set the measurement mode CW>
   C. FREQUENCY: 2400 MHz <Input the CW frequency>
   D. POWER: -5 dBm
   E. RUN: ON,

3. Configure the frequency counter as follows:
   A. Frequency Counter: Press Freq Ch 2 key
   B. E4440A: [Mode] -> Measuring Receiver -> Frequency Counter key

4. Record the measurement of the Frequency Counter or E4440A and compare with the specificatio n.

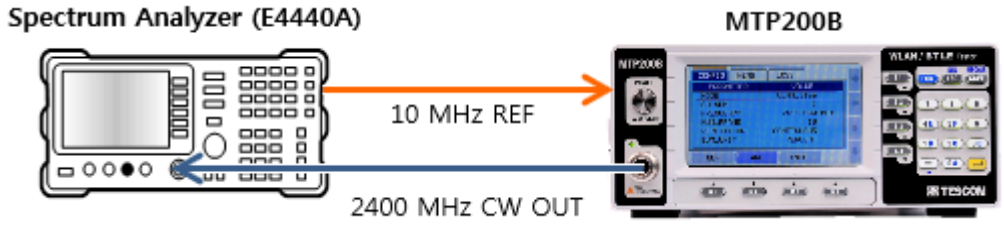
**Table 19-7** Frequency Accuracy

| Item | Measurement Result [MHz] |
|---|---|
| Frequency Counter Measurement Value | |

## 19.3.2 CW Mode Power Generator Level Accuracy

> **Specification:** ±1 dB
> **Objective:** Measure the power level accuracy of the output signal.

1. Test Setup: Connect the device as shown below.




2. MTP200B Setting:
   A. FCN -> Recall -> RESET <Resets the device>
   B. MODE: GEN -> MODE -> CW <Set the measurement mode CW>
   C. FREQUENCY: 2402 MHz <Input the CW frequency>
   D. RUN: ON, POWER : -5 dBm

3. Configure the spectrum analyzer as follows:
   A. MODE: Spectrum Analyzer
   B. FREQUENCY: 2402 MHz
   C. SPAN: 1 kHz
   D. RBW, VBW: AUTO
   E. AVG: 10
   F. MARK: Peak Search

4. Set the frequency and power of MTP200B as shown below and record the measurement by the spectrum analyzer.

5. Measurement results

**Table 19-8** CW Power Generator Level Accuracy

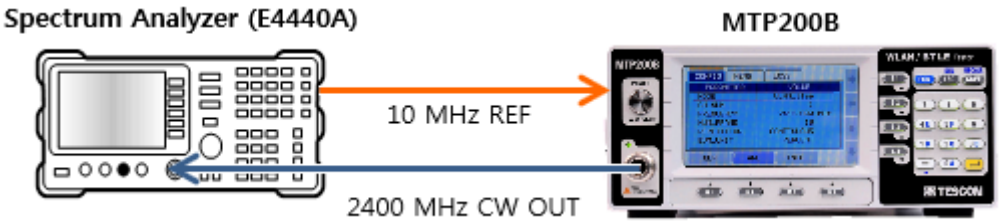
| Level | Frequency | | |
|---|---|---|---|
| | 2402 MHz | 2440 MHz | 2480 MHz |
| -5 dBm | | | |
| -10 dBm | | | |
| -15 dBm | | | |
| -20 dBm | | | |
| -25 dBm | | | |
| -30 dBm | | | |
| -35 dBm | | | |
| -40 dBm | | | |
| -45 dBm | | | |
| -50 dBm | | | |
| -55 dBm | | | |
| -60 dBm | | | |
| -65 dBm | | | |
| -70 dBm | | | |

## 19.3.3 BT LE Mode Power Generator Level Accuracy

> **Specification:** ±1 dB
> **Objective:** To measure the burst power level of the BT LE mode signal.

### 19.3.3.1 Measurement Procedure using Spectrum Analyzer

1. Test Setup: Connect the device as shown below.




2. MTP200B Setting:
   A. FCN -> Recall -> RESET <Resets the device>
   B. MODE: GEN -> MODE -> BT_LE <Select the BT LE measurement mode>
   C. CH_NUM: 0 <Select channel number 0>
   D. BIT_PATTERN: PRBS9, LENGTH : 37 B
   E. NUM_PACKET: 0 (Continuous output)
   F. RUN: ON, POWER : -5 dBm

3. Configure the spectrum analyzer as follows:
   A. MODE: Spectrum Analyzer
   B. FREQUENCY: 2402 MHz
   C. SPAN: 0 Hz (ZZ Time Domain)
   D. RBW, VBW: 3 MHz
   E. Sweep Time: 700 us
   F. Detector: Peak
   G. MARK: Peak Search (Measure the maximum power)

**NOTICE**

BLE Power Generator Level Accuracy can be measured as follows other than above procedure 3.

1. Mode Setup]: Radio Std ->Bluetooth
2. [Measure]: Burst Power
3. FREQUENCY: 2402 MHz
4. [Measure Set-up]: Avg Number -> 10 -> ON
5. [Measure Set-up]: Optimize Ref Level (Max & Avg Power measurement)

4. Set the frequency and power of MTP200B as shown below and record the measurement by the spectrum analyzer.

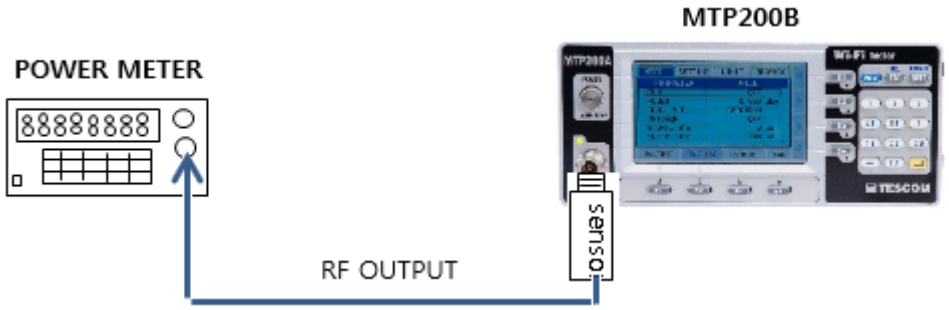
5. Measurement results

**Table 19-9** BLE Power Generator Level Accuracy Test (Spectrum Analyzer)

| Level | Frequency (CH) | | |
|---|---|---|---|
| | 2402 MHz (0 CH) | 2440 MHz (19 CH) | 2480 MHz (39 CH) |
| -5 dBm | | | |
| -20 dBm | | | |
| -40 dBm | | | |
| -60 dBm | | | |
| -70 dBm | | | |

### 19.3.3.2 Measurement Procedure using Power Meter

1. Test Setup: Connect the device as shown below.




2. MTP200B Setting:
   A. FCN -> Recall -> RESET <Resets the device>
   B. MODE: GEN -> MODE -> BT_LE <Select the BT LE measurement mode>
   C. CH_NUM: 0 <Select channel number 0>
   D. BIT_PATTERN : PRBS9
   E. LENGTH: 37 B
   F. POWER : -5dBm
   G. RUN: ON

3. POWER METER Setting:
   A. RESET <Resets the device>

4. Set the frequency and power of MTP200B as shown below and record the measurement by the Power Meter.

5. Measurement results

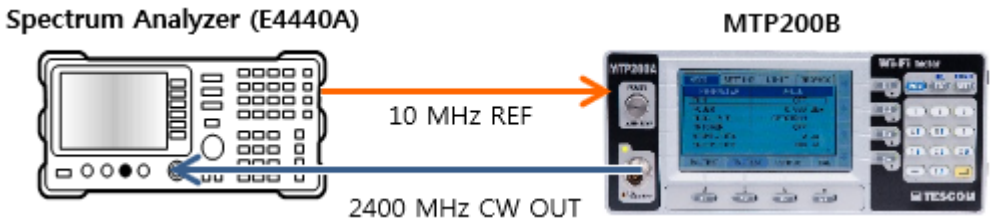
**Table 19-10** BLE Power Generator Level Accuracy Test (8482A Power Sensor)

| Level | Frequency (CH) | | |
|---|---|---|---|
| | 2402 MHz (0 CH) | 2440 MHz (19 CH) | 2480 MHz (39 CH) |
| -5 dBm | | | |
| -20 dBm | | | |
| -40 dBm | | | |
| -60 dBm | | | |
| -70 dBm | | | |

## 19.3.4 BT LE Mode Power Generator Deviation Average

> **Specification:** 225 kHz ≤ Δ favg ≤ 275 kHz
> **Objective:** To measure the deviation(modulation index) average of the burst power of the BT LE mode signal.

1. Test Setup: Connect the device as shown below.




2. MTP200B Setting:
   A. FCN -> Recall -> RESET <Resets the device>
   B. MODE: GEN -> MODE -> BT_LE <Select the BT LE measurement mode>
   C. CH_NUM: 0 <Select channel number 0>
   D. BIT_PATTERN : 11110000
   E. LENGTH : 37B
   F. NUM_PACKET: 0 (Continuous output)
   G. POWER : -5 dBm
   H. RUN : ON

3. Configure the spectrum analyzer as follows:
   A. [MODE]: Digital Modulation-> Modulation Analysis
   B. [Mode Setup]: Radio Std ->Bluetooth
   C. FREQUENCY: 2402 MHz
   D. [Measure Set-up]: Average -> 10
   E. [Measure Set-up]: Burst/Sync Search -> Sync -> RF Amp
   F. [Trace/View]: Eye

4. Set the frequency and power of MTP200B as shown below and record the deviation average measured by the spectrum analyzer.

5. Measurement results

**Table 19-11** BLE Power Generator Deviation Average Test

| Level | Frequency (CH) | | |
|---|---|---|---|
| | 2402 MHz (0 CH) | 2440 MHz (19 CH) | 2480 MHz (39 CH) |
| -5 dBm | | | |
| -20 dBm | | | |
| -40 dBm | | | |

# PART 7. Appendix

# 20. Summary of Bluetooth Low Energy

## 20.1 Introduction to Bluetooth Low Energy

A technology, Bluetooth Low Energy (BLE), of Bluetooth has been added to Bluetooth Specification ver siono 4.0. "Bluetooth Smart" typically reduces Bluetooth Low Energy also known as call by BLE.

As it is recognized from its name, low energy and low cost are the main concern, so it is specially desig ned to be operated even by coin-cell battery. As a result, Bluetooth Low Energy (BLE) makes devices to be developed with low cost.
Also, Bluetooth Low Energy (BLE) is designed to be operated with existing Bluetooth devices.
It is operated on 40 channels, which constitutes with interval of 2 MHz, in ISM band of 2.4 GHz. It prov ides data transmission rate of 1 Mbps within range of 10 meters using GFSK modulation. As well as exi sting Bluetooth (Classic Bluetooth), BLE uses frequency hopping but as it uses adaptive frequency hopp ing, hopping speed is slower than existing Bluetooth's hopping speed. BLE performs 'Advertise' functio n, which discovers devices using 3 channels among 40 channels. If devices are discovered, it sends and receives data using rest of 37 channels.

It is operated on 40 channels, which constitutes with interval of 2 MHz, in ISM band of 2.4 GHz. It prov ides data transmission rate of 1 Mbps within range of 10 meters using GFSK modulation. As well as exi sting Bluetooth (Classic Bluetooth), BLE uses frequency hopping but as it uses adaptive frequency hopp ing, hopping speed is slower than existing Bluetooth's hopping speed. BLE performs 'Advertise' functio n, which discovers devices using 3 channels among 40 channels. If devices are discovered, it sends and receives data using rest of 37 channels.

If version 4.0 is in use, there would be huge decrease in power consumption. Therefore, it can produce single mode products that can be used in sports, healthcare, sensor, device control and etc. Also, it can creates dual mode products that support both existing Bluetooth and Low energy technique.

**Table 20-1** Comparison between existing Bluetooth and Low energy

| Technical Specifications | BR/EDR | LE |
|---|---|---|
| Frequency | 2400 ~ 2500 MHz | 2400 ~ 2500 MHz |
| Number of RF Channels | 79 | 40 |
| Channel Bandwidth | 1 MHz | 2 MHz |
| Modulation | GFSK, DPSK | GFSK |
| Data Transmit Speed | 1 ~ 3 Mbps | 1 Mbps |
| Voice Support | Support | Not Support |
| Power Consumption | < 30 mA | < 15 mA |
| Mainly used Application | Mobile phone, Headset, PC Hand-held device, and etc. | Mobile phone, Watch, Sports, Healthcare, Sensor, Device Control, and etc. |

## 20.1.1 BLE Protocol Structure

BLE's protocol stack is divided into controller, host and application. HCI is used in order to communicate between controller and host.

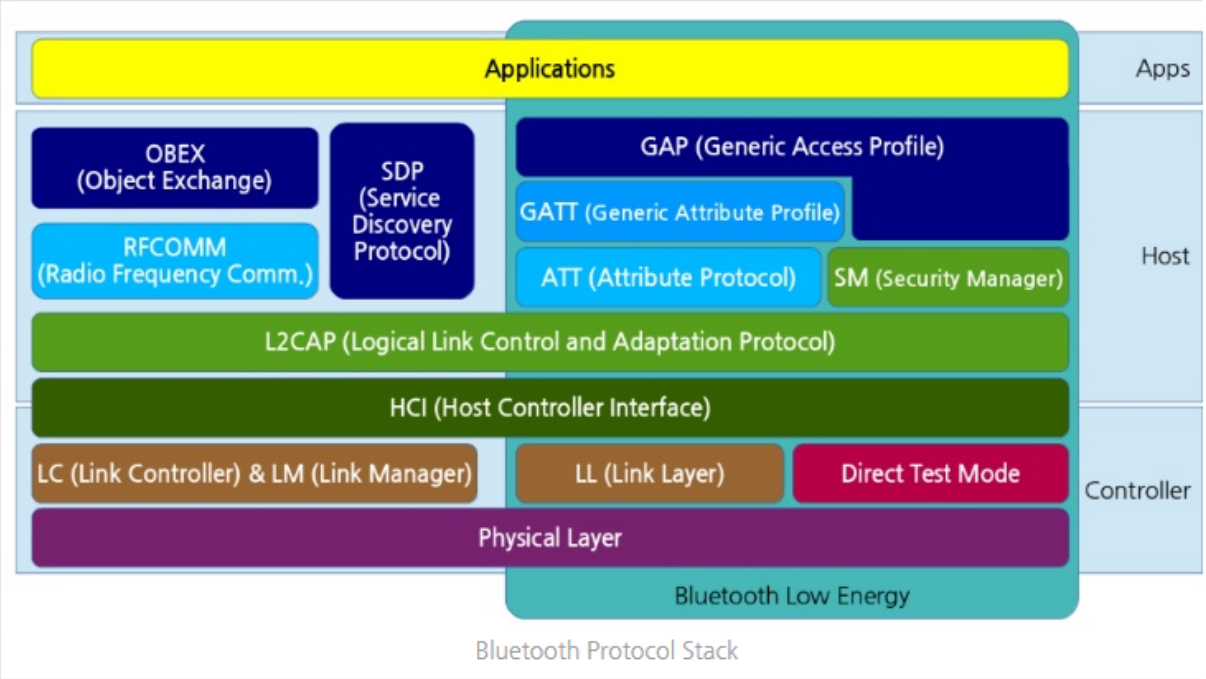



**Figure 20-1** Dual mode and Single mode's Protocol Structure

Like Figure 20-1 Dual mode and Single mode's Protocol Structure, Bluetooth Low Energy can be divided into Dual mode and Single mode.

### Dual mode (BR/EDR/LE, Bluetooth Smart Ready)

It's mode that both existing Bluetooth and Low energy technique exist in a device and mostly us ed in Mobile phone and called as Bluetooth Smart Ready.

### Single mode (BLE, Bluetooth Smart)

It is used in independent product such as sensor and called as Bluetooth Smart. Protocol structu re is same as in Dual mode. RF, HCI(Host Controller Interface), L2CAP(Logical Link Control and Adaptation Protocol) are equivalent to existing one in order to be compatible with existing Blue tooth technique and some functions are added for Low energy technique. LL stage in low energ y technique performs BB(Baseband) and LM(Link Manager) roles of existing Bluetooth.

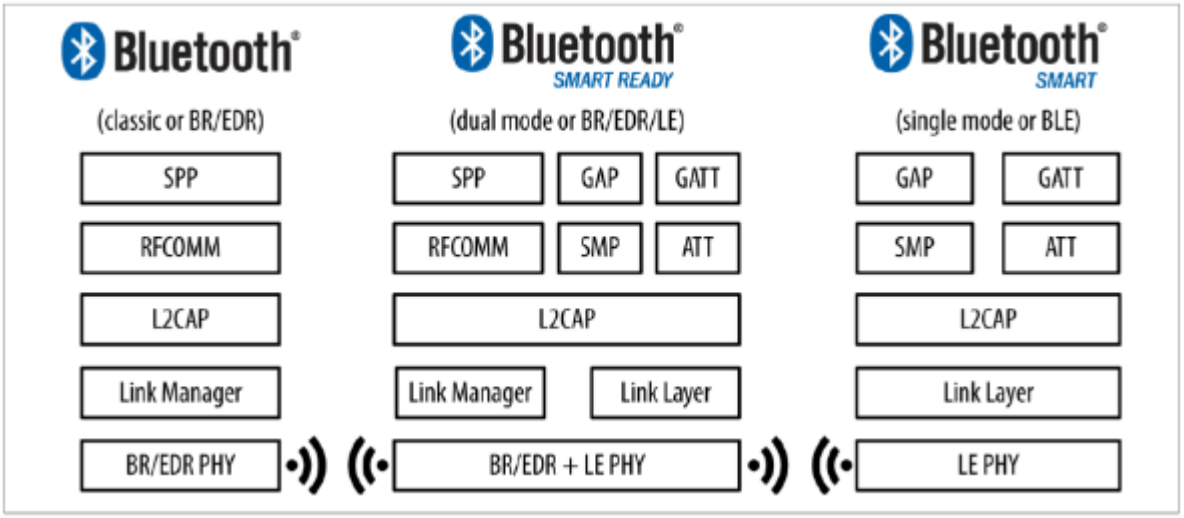



**Figure 20-2** Configurations between Bluetooth version and device types

## 20.1.2 Roles

BLE has two roles as Peripheral device or Central device. Usually, central would be smartphone that sc ans and Peripheral would be sensor device such as Beacon.

### Peripheral

It plays roles as Broadcaster and plays roles as Slave in Link Layer. Peripheral is mostly operated with low power and has small battery capacity and used for device that has limited source.

### Central

It plays role as Master in Link Layer. Central is used in devices that have rich resources such as m emory, battery, and etc. and plays roles as Central in smartphone.

Peripheral generates Advertising packet with constant interval through Protocol as in the image below. Central calls Connection (Pairing/Bonding) by reading Advertising packet information though Observe r (scan) and it is controlled by GAP.

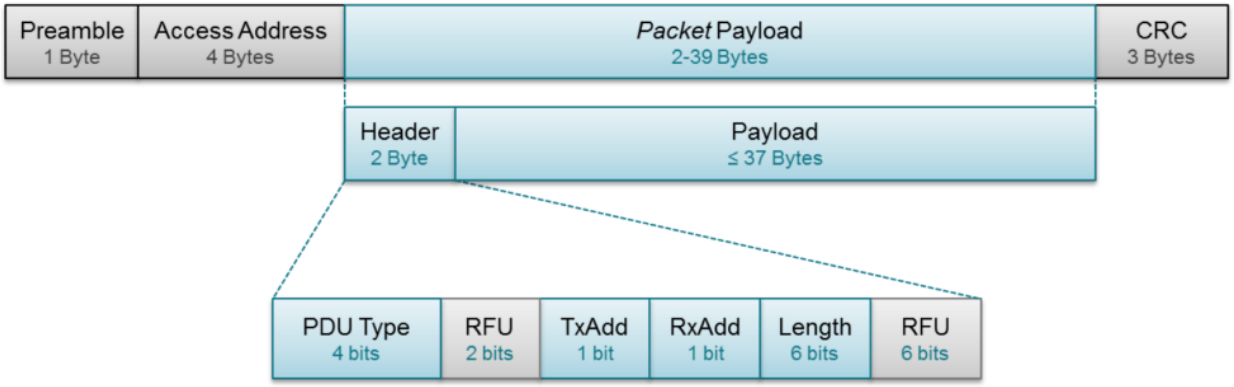



**Figure 20-3** Advertising Protocol

## 20.1.3 Data Length Extension of Bluetooth 4.2

In MTP200B, Data Length Extension test, which is introduced in BLE (Bluetooth Low Energy) standard specification among Bluetooth Core 4.2 spec, is available.

**NOTICE**

BLE Data Length Extension test is available in MTP200B's firmware version V3.1 or newer.

As BLE data packet length has been expended from 37 bytes to 255 bytes, data transmitting speed ha s been increased 2.5 times comparing to previous 4.0 standard. Especially, the volume of packet, whic h can be transmitted at a time has been increased 10 times, so transmit error and battery consumptio n has been decreased. Therefore, efficient data transmit is available.

Please refer to the Bluetooth 4.2 Standard in the Bluetooth SIG website for further explanation and be tter understanding.

# 21. BLE Test Method

There are three ways to test BLE DUT as follows.

## 21.1 Direct Test Mode(DTM)

DTM is a standard mode in the BLE 4.1 specification (Vol 6, Part F) that allows testing of the radio's Phy sical Layer (PHY) by transmitting and receiving sequences of test packets. This is often used in complian ce and production-line testing, without the need of going through the complete BLE Protocol Stack, i.e. it skips the Host Stack and talks directly to the radio in an isolated manner.

Another layer in the BLE specification is the **Host Controller Interface (HCI)** - a standard-defined interfac e to exchange data between the BLE Host Stack and the radio Controller.

In Direct Test mode, the test packets required for DUT are sent to MTP200B and DUT through HCI or 2-Wire UART interfaces, and the received packet counts are reported.

There are two test methods for Direct Test Mode.

1. Test through HCI Interface (UART or USB)
2. Test through 2-wire UART Interface

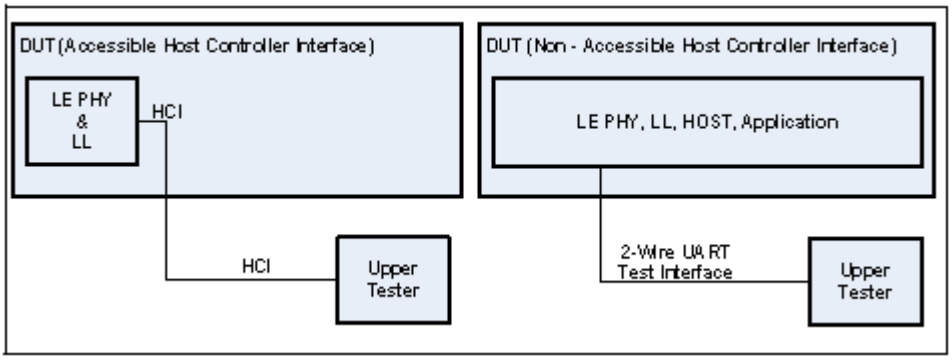



**Figure 21-1** Direct Test Mode Setup : HCI Interface(left), 2-wire UART Interface(right)

MTP200B supports UART HCI and 2-Wire UART required in BT LE Direct Test Mode.

**CAUTION**

MTP200B does not support USB HCI.

**NOTICE**

BT LE Direct Test Mode (DTM) test can be performed by remote control program provided separ ately.

## 21.2 Non-Signaling Test

If DUT can be controlled through DUT control software provided from Chipset company, not using HCI interface and 2-Wire interface, it is to be called Non-Signaling Test.

### DUT's TX Test (Test for DUT's transmitting efficiency)

By using the Test Control Software provided by the Chipset company, set DUT to transmit the LE packet required for test and measure DUT's TX efficiency with MTP200B.

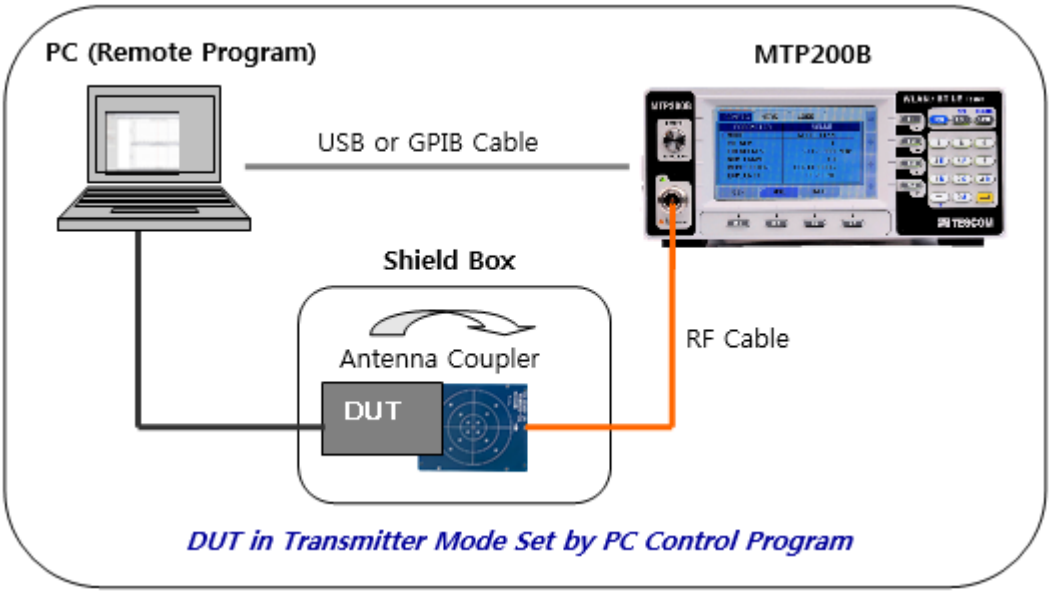



**Figure 21-2** Configuration for BLE TX Measurement Using a Shield Box

### DU's RX Test (Test for DUT's receiving efficiency)

MTP200B sends the LE standard packet to DUT, then DUT reports the number of packets receive d using the Test Control Software provided by the Chipset company.

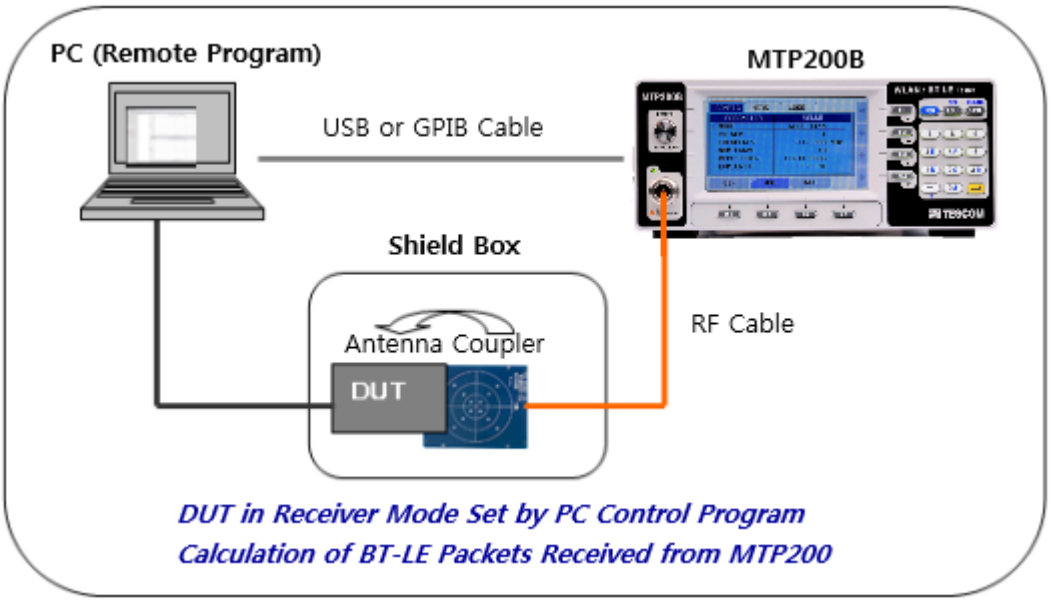
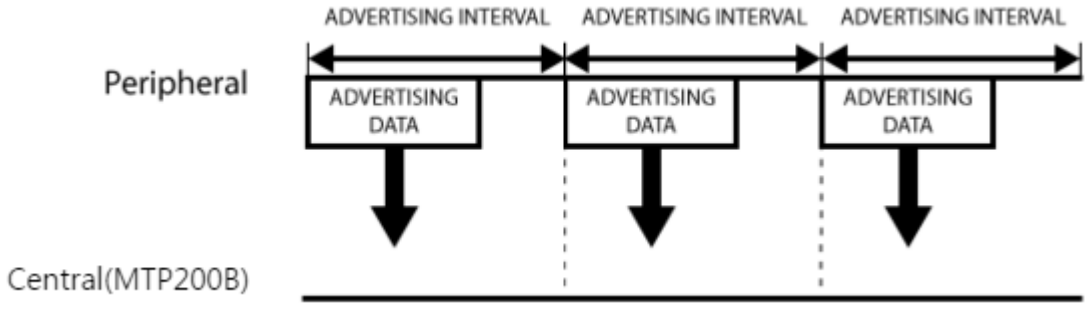



**Figure 21-3** Configuration for BLE RX Measurement Using a Shield Box

# 21.3 Advertising Test

Advertising data packet is transmitted continuously from DUT (peripheral) through Advertising Channel (0,12,39) in order for Central device can recognize. DUT (peripheral) transmits Advertising Data packet within certain period **(Advertising Interval).** In MTP200B, RF characteristics can be simply tested by anal yzing Advertising packet that DUT transmits.




This method involves measuring only the quality of the TX
signal at the radiation status without using the external interfaces of DUT (for production).

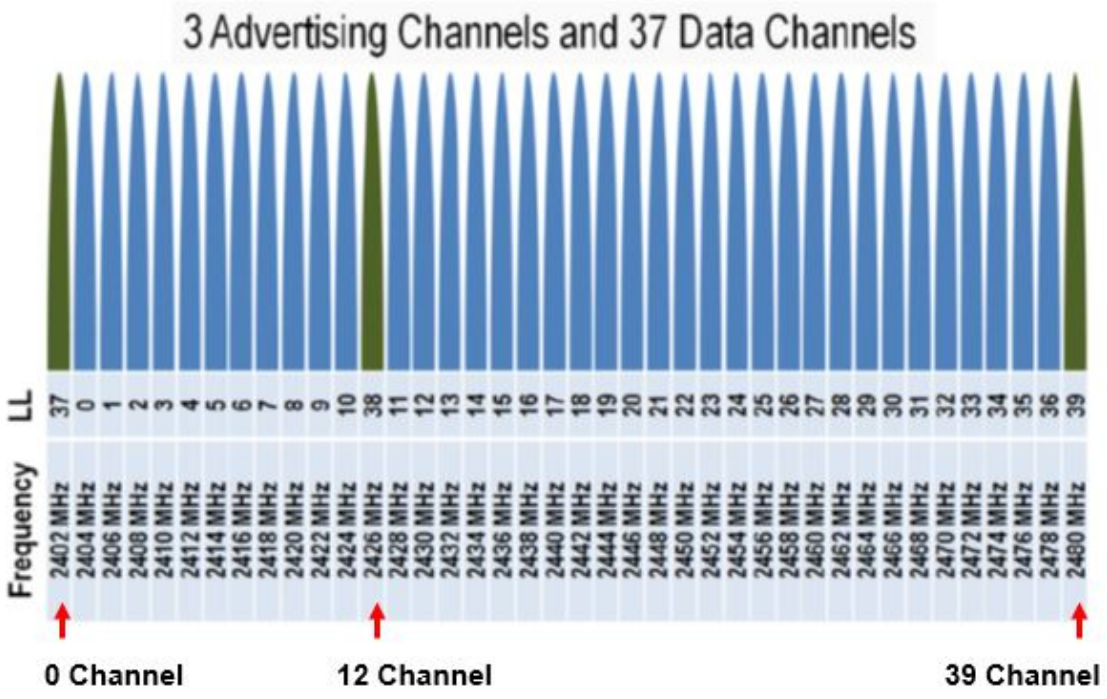
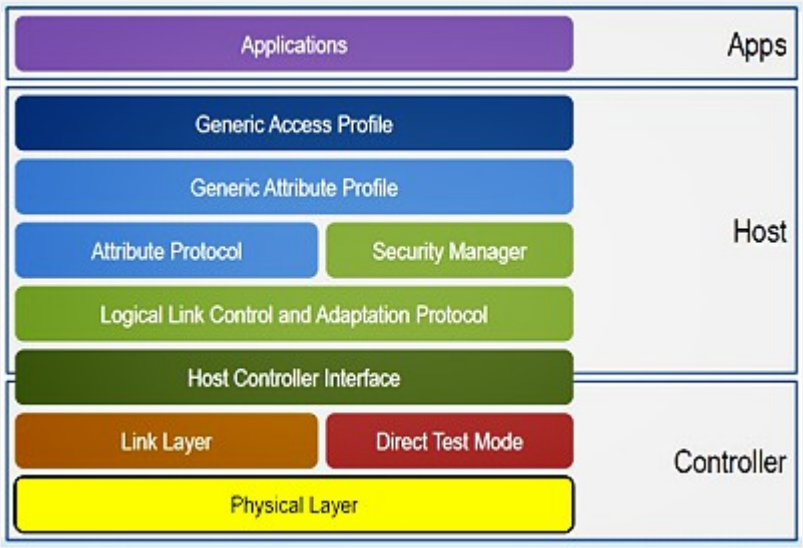



**Figure 21-4** Advertising Channel Description

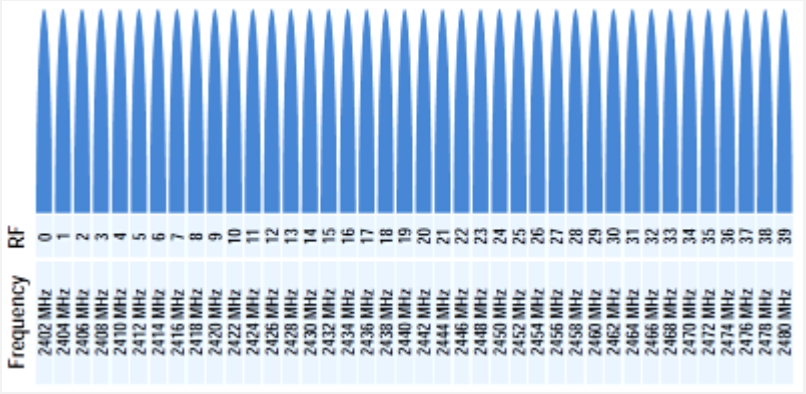
**NOTICE**

Advertising Channel

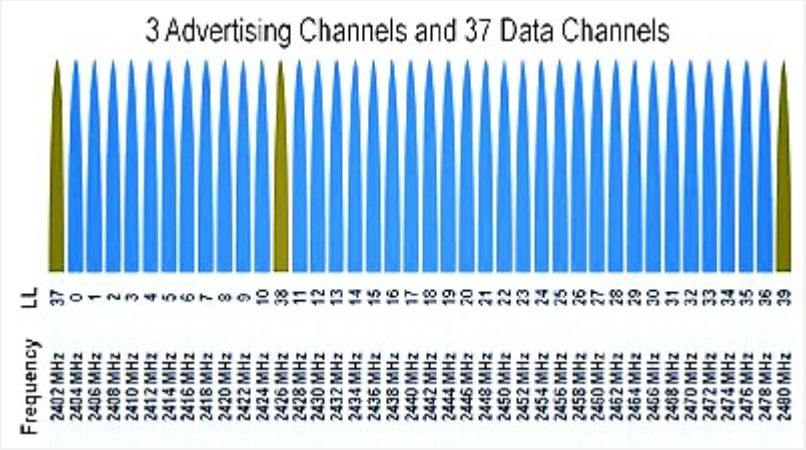
There are Link Layer (LL) and Physical Layer under BLE Protocol Stack as shown in the image bel ow.




Channels in the Physical Layer means RF Channels as shown in the image below.




And Channels in the Link Layer means LL Channels as shown in the image below and operates d ifferently from Physical Channels (RF Channel) above.



# 22. BLE RF Test Cases

## 22.1 BLE Transmitter Test Items

### 22.1.1 Output power(TP/TP/TRM-LE/CA/BV-01-C)

1. Objective: To measure the average and maximum output power of DUT

2. Test Procedure:
   A. The DUT transmits LE test packets with PRBS9 payload.
   B. DUT transmits at maximum power.
   C. Set the instrument, as in the following table.
   D. For the given channel frequency the tester records output power of the DUT from the start to the end of a packet. Tester records the highest and the lowest power value in the trace and calculates average power from 20% to 80% of the trace. The path losses value is added to the results.

| Parameter | DUT | MTP200B |
|---|---|---|
| TEST_METHOD | | TEST_MODE |
| TEST_CASE | | POW |
| CH_NUM | 0 ~ 39 | Same channel as of DUT |
| NUM_PACKET | | 1 ~ 10 |
| Packet Length(octets) | 37(255 for BT v4.2 or more) | |
| Test Packet Type(payload Type) | PRBS9 | |

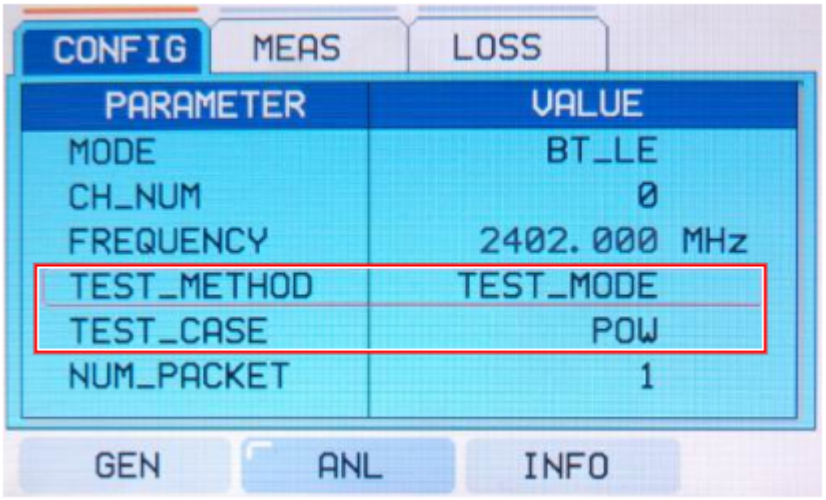



**Figure 22-1** POW Test Setting Screen

3. Test Results:
   A. Pavg: Pavg is the average RF-output power of the DUT for given frequency channel, measured in dBm.
   B. Pmax: Pmax is the maximum RF-output power of the DUT for given frequency channel, measured in dBm
   C. Pmin: Pmin is the minimum RF-output power of the DUT for given frequency channel, measured in dBm. The result has only informative character and is not used to reach a verdict
   D. Ppk: Pmax is the maximum peak RF-output power of the DUT for given frequency channel, measured in dBm

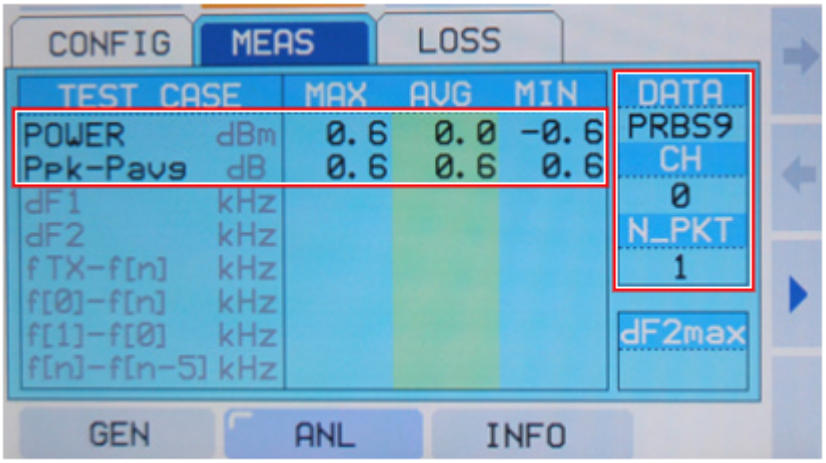



**Figure 22-2** POW Measurement Screen

4. Specification
   A. -20 dBm ≤ Pavg ≤ +10 dBm
   B. Ppk ≤ (Pavg + 3 dB)

## 22.1.2 Modulation characteristics(TP/TRM-LE/BV-05-C)

1. Objective: To measure the modulation index to analyze the transmission modulation characteristics of DUT.

2. Test Procedure:
   A. The DUT transmits LE test packets with MAX_TX_LENGTH octet packet payload consisting of a repetitive sequence of 0F hex octets (11110000 bin in transmission order).
   B. Set number of test packet to 10 at least.
   C. DUT transmits at maximum power.
   D. Set the instrument, as in the following table.
   E. The measurement shall start at the beginning of the fifth bit of the payload (See Figure 22-5 Frequency deviation measurement principle for 11110000-payload sequence for description). The last four bits in the payload shall be disregarded. The sequence center frequency; f1ccf is calculated as the average frequency of all samples over each 00001111 bin sequence. For the second, third, sixth and seventh bits in each 00001111bin sequence, the absolute value of the frequency offset from f1ccf is recorded as Δf1max. Δf1max is defined as the average deviation for each individual bit. The average frequency value of all Δf1max frequencies in a packet is calculated and recorded as Δf1avg.
   F. The DUT transmits LE test packets with MAX_TX_LENGTH octet payload consisting of a repetitive sequence of 55hex octets (10101010bin in transmission order).
   G. The measurement shall start at the beginning of the fifth bit in the payload field. The last four bits in the payload shall be disregarded. The sequence center frequency; f2ccf is calculated as the average frequency of all samples over each 10101010bin sequence. The maximum deviation from the sequence center frequency, f2ccf is recorded as ☒f2max for each individual bit. See Frequency deviation measurement principle for 10101010-payload sequence for reference. The average frequency value of all ☒f2max frequencies in a packet is calculated and recorded as Δf2avg.

| Parameter | DUT | MTP200B |
|---|---|---|
| TEST_METHOD | | TEST_MODE |
| TEST_CASE | | POW+MOD |
| CH_NUM | 0 ~ 39 | Same channel as of DUT |
| NUM_PACKET | | 1 ~ 10 |
| Packet Length(octets) | 37(255 for BT v4.2 or more) | |
| Test Packet Type(payload type) | 11110000(f1) | |
| | 10101010(f2) | |

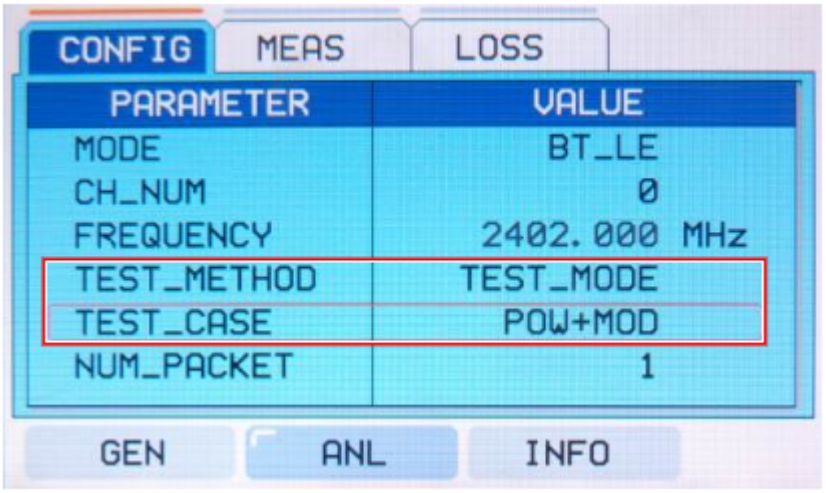



**Figure 22-3** POW+MOD Test Setting Screen

3. Test Results
   A. df1avg: df1 is the average of all frequency deviations for 11110000 bit pattern as payload, measured in KHz.
   B. df2avg: df2avg is the average of all frequency deviations for 10101010 bit pattern as payload, measured in KHz.
   C. df2max: At least 99.9% of all df2 max frequency values recorded over 10 LE test packets must be greater than 185 kHz

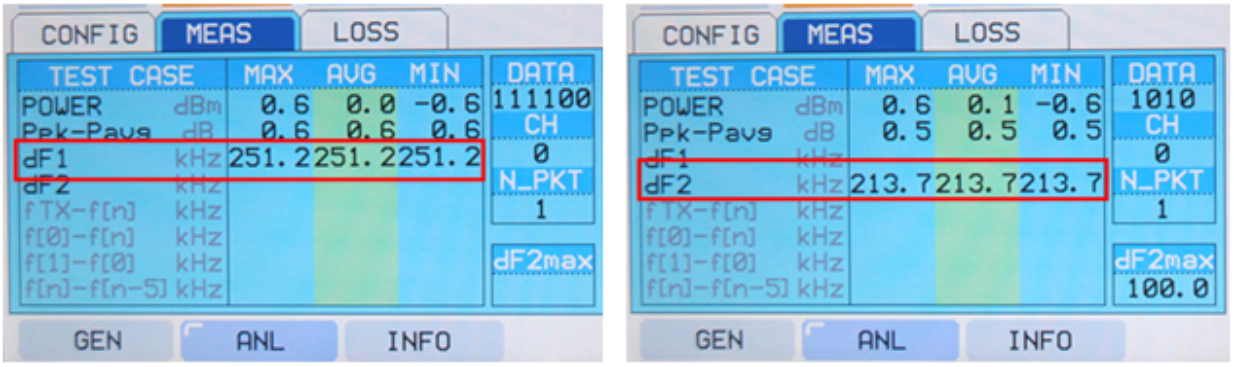



**Figure 22-4** POW+MOD Measurement Screen

**NOTICE**

For the test, conduct the test twice while changing the packet type in DUT. In the first test, set the packet type as “11110000” and measure dF1. In the second test, set the packet type as “10101010” and measure dF2 and dF2max.

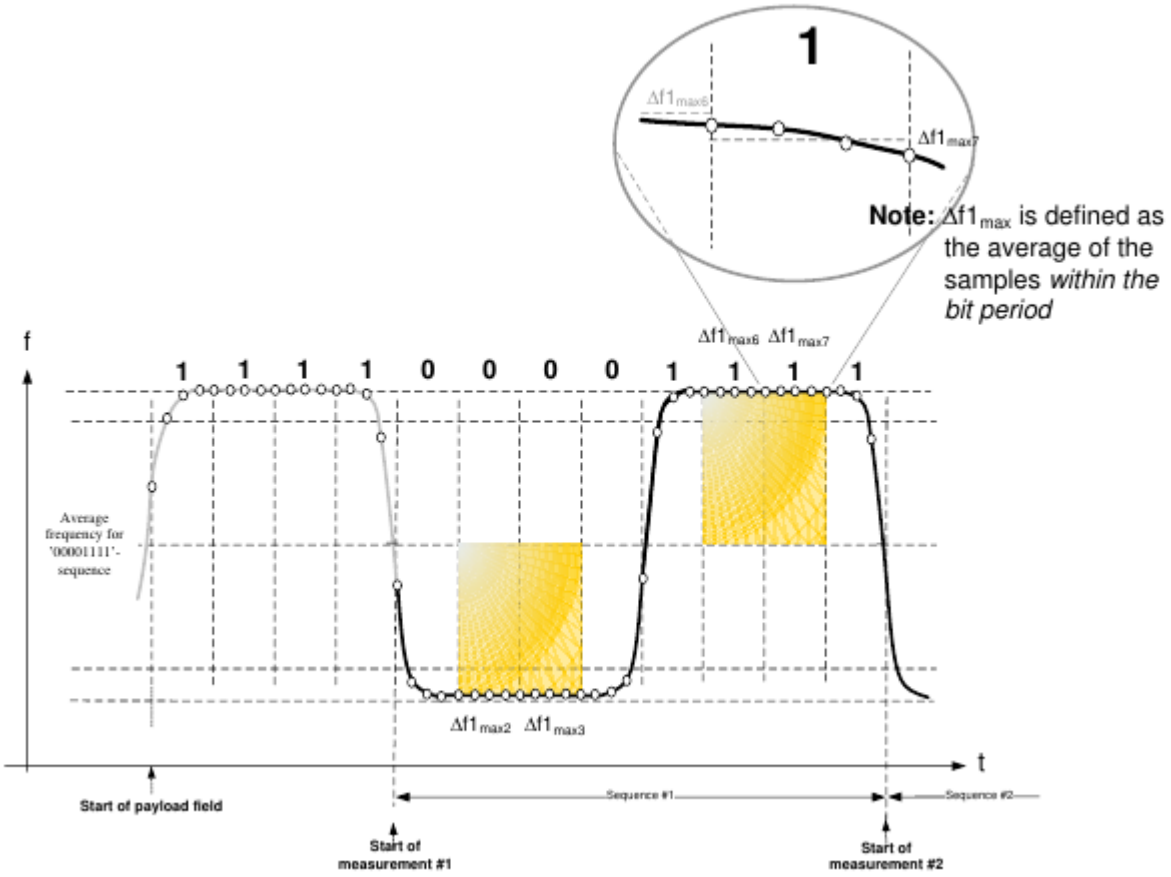



Figure 22-5 Frequency deviation measurement principle for 11110000-payload sequence

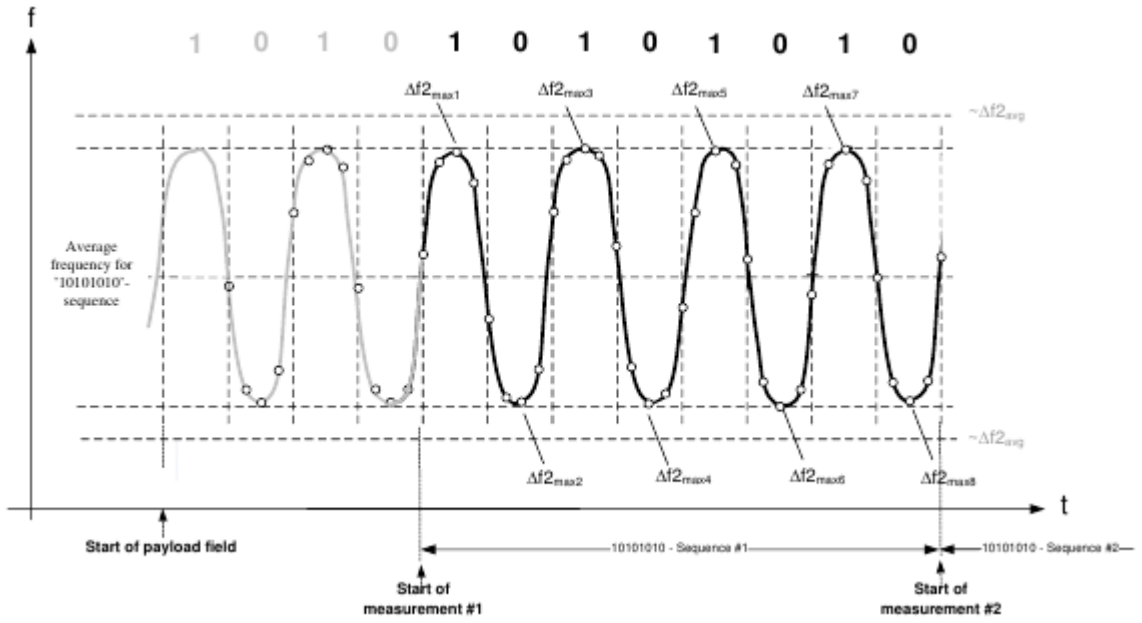
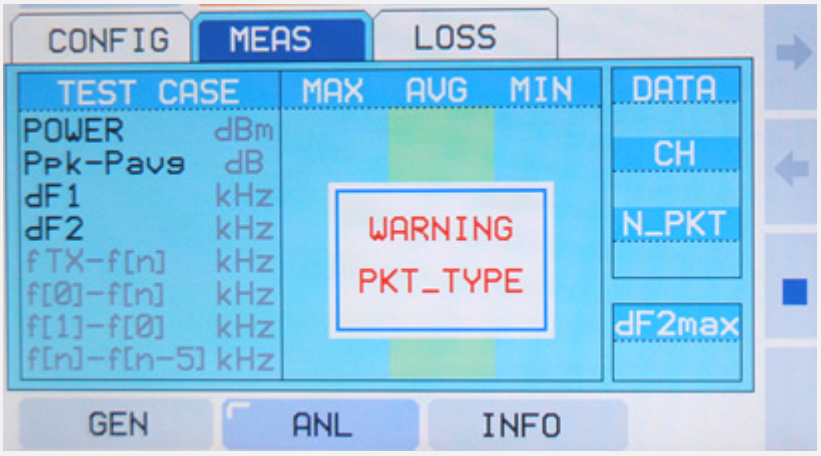



Figure 22-6 Frequency deviation measurement principle for 10101010-payload sequence

4. Specification
   A. 225 kHz ≤ df1_avg ≤ 275 kHz
   B. df2_max_rate ≥ 99.90 %,
   C. df2avg/df1avg ≥ 0.8

**⚠CAUTION**

When measuring the modulation characteristics, set the Test Packet Type as “11110000” or “10101010” in DUT. If other packets such as PRBS9 are set, a warning message (e.g., “WARNING PKT_TYPE”) will be displayed.



## 22.1.3 Carrier frequency offset and drift(TP/TRM-LE/BV-06-C)

1. Objective: To measure the frequency accuracy of the initial transmission signal and the center frequency stability within a packet

2. Test Procedure:
   A. The DUT transmits LE test packets with MAX_TX_LENGTH octet payload consisting of a repetitive sequence of 55 hex octets (10101010 bin in transmission order) in the payload.
   B. Set number of test packet to 10 at least.
   C. DUT transmits at maximum power.
   D. Set the instrument, as in the following table.
   E. The measurement is to be performed at the start of the preamble field in the transmitted packet. The tester integrates the frequency of the FM demodulated signal from the center of the first preamble bit to the center of the first bit following the 8th preamble bit, 8 bits in total. See Initial frequency offset (f0 ) measurement principle for reference.
   F. The integral sum in E is considered to be the initial carrier frequency of the DUT, and is recorded as f0.
   G. Throughout the payload of the packet, the tester integrates the frequency of the FM demodulated signal in 10-bit intervals, starting at the second bit in the payload. The measurement is repeated until the end of the payload duration. The last 10-bit sequence should not overlap the CRC-field at the end of the packet. See Frequency drift measurement principle for reference.
   H. The integral sums are recorded as fn, where n is an integer from 1 to k. fk represents the last integral sum before the start of the CRC field in the packet.

| Parameter | DUT | MTP200B |
|---|---|---|
| TEST_METHOD | | TEST_MODE |
| TEST_CASE | | POW+Fc_O/D |
| CH_NUM | 0 ~ 39 | Same channel as of DUT |
| NUM_PACKET | | 1 ~ 10 |
| Packet Length(octets) | 37(255 for BT v4.2 or more) | |
| Test Packet Type(payload Type) | 10101010 | |

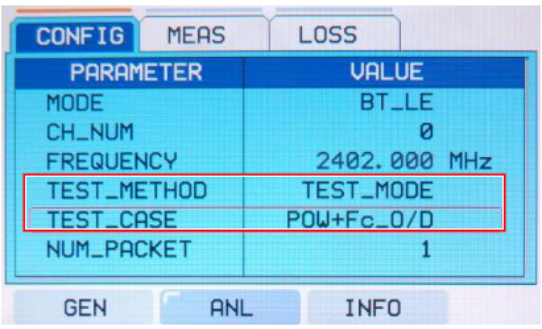



**Figure 22-7** POW+Fc_O/D Test Setting Screen

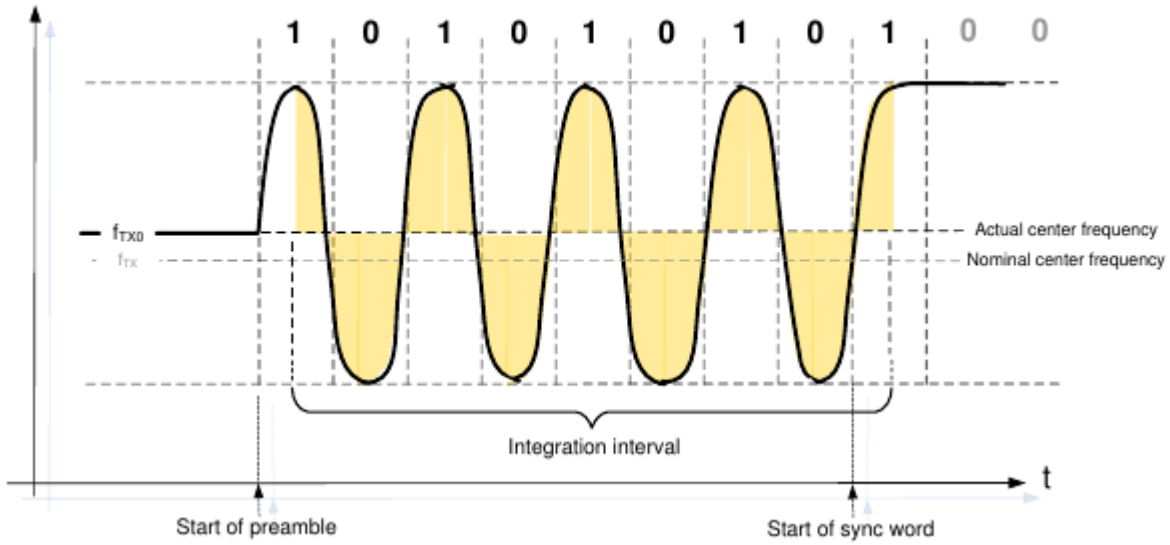



**Figure 22-8** Initial frequency offset (f0 ) measurement principle

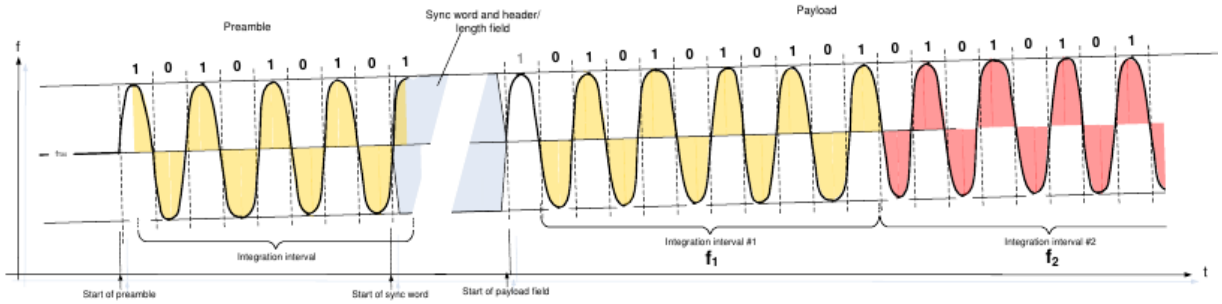



**Figure 22-9** Frequency drift measurement principle

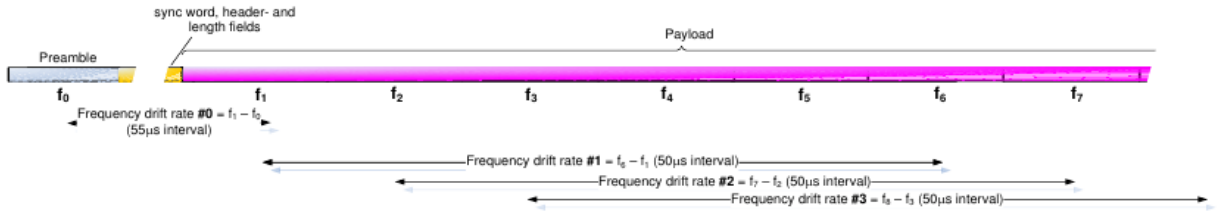



**Figure 22-10** Frequency drift rate measurement principle

3. Test Results:

A. | $f_{TX}$ - fn | : the frequency difference between the nominal transmit frequency and frequency measurement fn(n=0,1...k), anywhere in the packet.

B. | f0 -fn |: the frequency difference between the initial frequency measurement f0 and the pa yload frequency measurement fn(n=2...k) .

C. | f1 -f0 |: the frequency difference between the initial frequency measurement f0 and the firs t payload frequency measurement f1 .

D. | fn -fn-5|n=6,7,8,···k : The difference between any two 10-bit groups separated by 50ms wi thin the payload field of the packet transmitted by the DUT

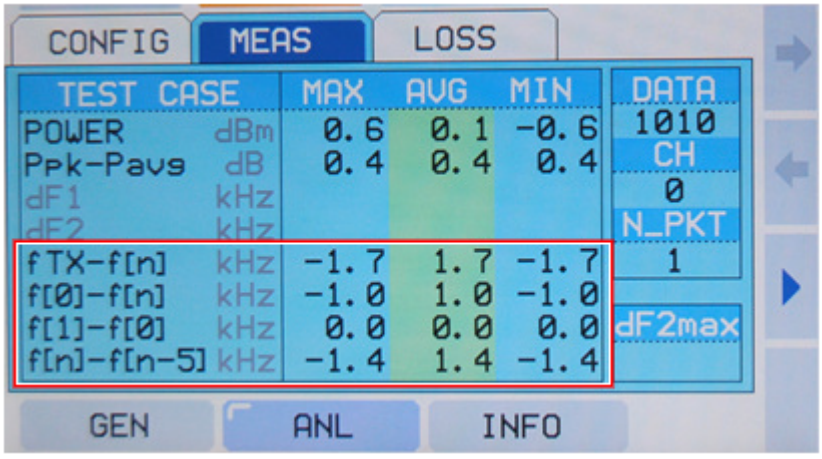



**Figure 22-11** POW+ Fc_O/D Measurement Screen

4. Specification

A. $f_{TX}$ - 150 kHz ≤ fn ≤ $f_{TX}$ + 150 kHz , $f_{TX}$ is the nominal transmit frequency and n=0,1,2,3··· k

B. | f0 -fn | ≤ 50 kHz (n=2,3,4,···k)

C. | f1 -f0 | ≤ 20 kHz (n=2,3,4,···k)

D. | fn -fn-5|n=6,7,8,···k ≤ 20 kHz

## 22.1.4 Quick Test(POW+MOD+Fc)

1. Objective: To measure simultaneously three TX test items -- output power, modulation characteristics, carrier frequency offset, and drift -- within a shorter period of time

2. Test Procedure:
   A. The DUT transmits LE test packets with MAX_TX_LENGTH octet packet payload consisting of a repetitive sequence of 0F hex octets (11110000 bin in transmission order).
   B. Set LE test packet length of DUT to the longest that DUT supports and set number of packet between 1 ~ 10 that is sufficient to production. Duration of test would take for a while if number of packet is set to long. Therefore, set the least measurement value that is confident in order to shorten duration of test.
   C. DUT transmits at maximum power.
   D. Set the instrument, as in the following table.
   E. Measure in the same procedure of 22.1.2 Modulation characteristics(TP/TRM-LE/BV-05-C) .
   F. Measure in the same procedure of 22.1.3 Carrier frequency offset and drift(TP/TRM-LE/BV-06-C) .

| Parameter | DUT | MTP200B |
|---|---|---|
| TEST_METHOD | | TEST_MODE |
| TEST_CASE | | POW+MOD+Fc |
| CH_NUM | 0 ~ 39 | Same channel as of DUT |
| NUM_PACKET | | 1 ~ 10 |
| Packet Length(octets) | 37(255 for BT v4.2 or more) | |
| Payload Type | 11110000(f1) | |
| | 10101010(f2) | |

**NOTICE**

For the test, conduct the test twice while changing the packet type in DUT. In the first test, set the packet type as “11110000” and measure dF1. In the second test, set the packet type as “10101010” and measure dF2 and dF2max.

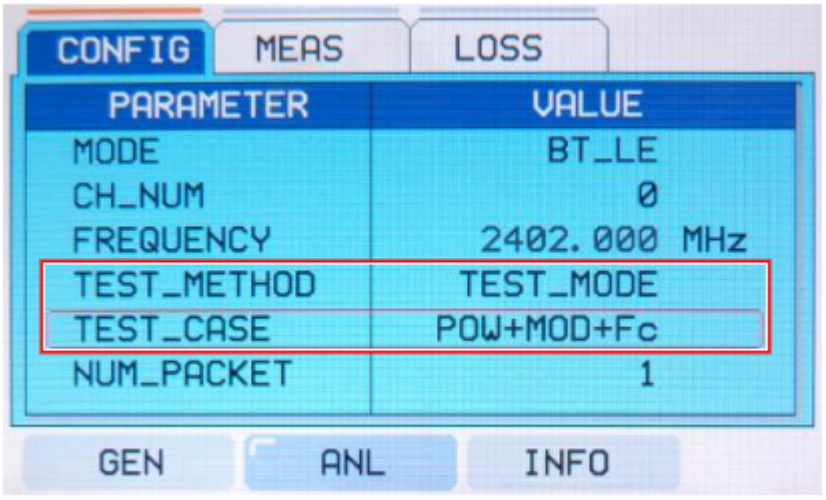



**Figure 22-12** POW+MOD+Fc Setting Screen

3. Test Results

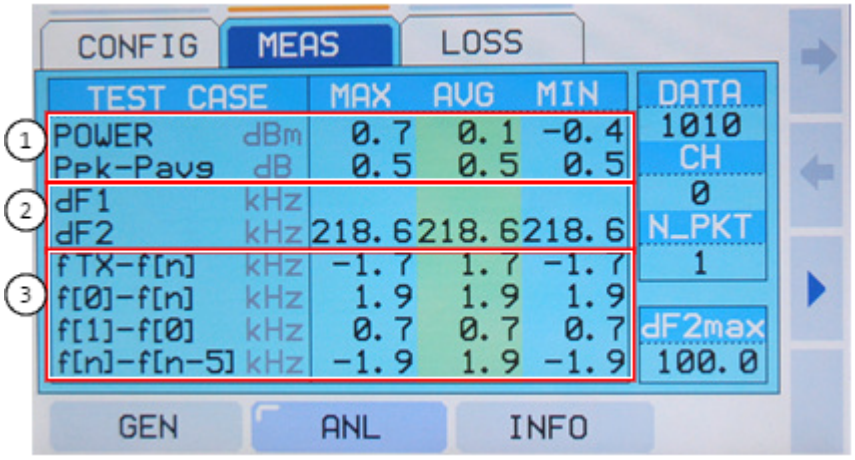



**Figure 22-13** POW+MOD+Fc_O/D Measurement Screen

❶ Power measurement

❷ Modulation characteristics measurement result

❸ Carrier frequency offset and drift measurement result

**4.** Specification

A. -20 dBm ≤ Pavg ≤ +10 dBm

B. Ppk ≤ (Pavg + 3 dB)

C. 225 kHz ≤ df1_avg ≤ 275 kHz

D. df2_max_rate ≥ 99.90 %,

E. df2avg/df1avg ≥ 0.8

F. $f_{TX}$ - 150 kHz ≤ fn ≤ $f_{TX}$ + 150 kHz , $f_{TX}$ is the nominal transmit frequency and n=0,1,2,3,...k

G. | f0 -fn | ≤ 50 kHz (n=2,3,4,⋯k)

H. | f1 -f0 | ≤ 20 kHz (n=2,3,4,⋯k)

I. | fn -fn-5|n=6,7,8,⋯k ≤ 20 kHz

## 22.1.5 POWER + MOD + Fc (Advertising mode)

1. Objective: When DUT is in Normal mode, TX signals are sent to the Advertising channels, i.e., 0, 12, and 39 channels (Figure 21-4 Advertising Channel Description for reference). At this time, MTP200B analyzes the TX signals of DUT to measure output power, carrier frequency offset, and modulation characteristics. MTP200B measurement is based on the sampling data of the preamble node among the TX signals of DUT; thus, the measurement may be different from the RF test case measurement result. This method may be used to measure the TX signal quality of DUT in a simple way.

2. Test Procedure:
   A. DUT transmits Advertising packet.
   B. Set the equipment, as in the following table.

| Parameter | DUT | MTP200B |
|---|---|---|
| TEST_METHOD | ADVERTISING | ADVERTISING |
| TEST_CASE | | POW+MOD+Fc |
| CH_NUM | | 0, 12, 39 |
| PKT_INTERVAL | | Set as same as Packet Interval of signal transmitted from DUT. |
| NUM_PACKET | | 1 ~ 10 |

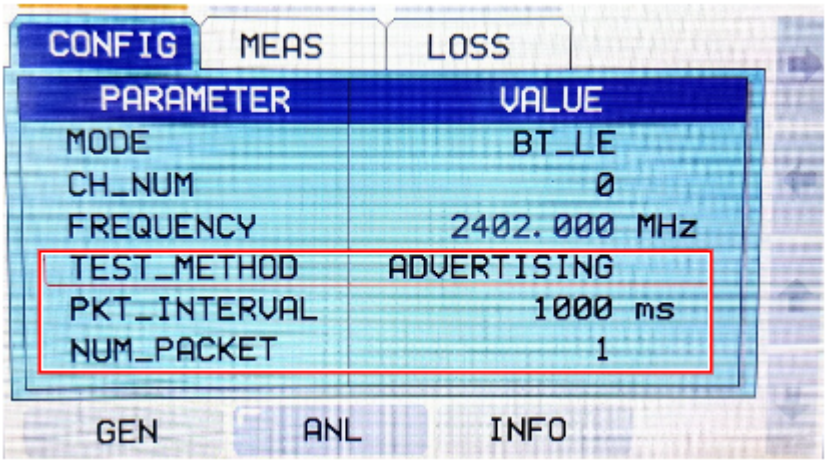



**Figure 22-14** ADVERTISING Setting Screen

3. Test Results

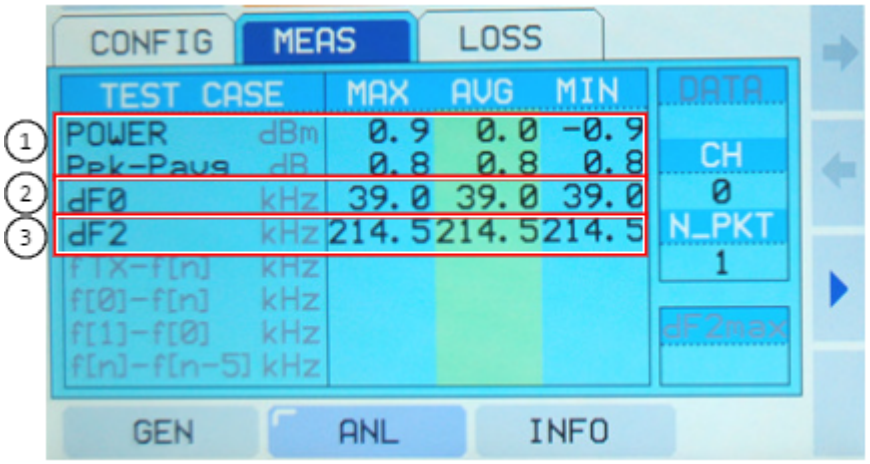



**Figure 22-15** ADVERTISING TEST_CASE Measurement Screen

❶ Power measurement result

❷ Initial carrier frequency offset measurement result (dF0)

❸ Modulation characteristics measurement result (dF2)

# 22.2 BLE Receiver Test Items

## 22.2.1 Receiver Sensitivity (TP/RCV-LE/CA/BV-01-C)

1. Objective: To measure the reception performance of DUT in a weak.

2. Test Procedure:
   A. The DUT is set to RX mode.
   B. The tester's transmit power is chosen such that the input power to the DUT receiver is -70 dBm.
   C. Set the instrument, as in the following table.
   D. Tester transmits 1500 LE Packet and measure PER of responded Packet.

| Parameter | DUT | MTP200B |
|---|---|---|
| CH_NUM | | 0~39 |
| POWER in dBm | | -70 |
| Payload Type(BIT_PATTERN) | | PRBS9 |
| Packet Length | | 37(255 for BT v4.2 or more) |
| NUM_PACKET | | 1500 |

3. Specification
   ◦ - PER ≤ 30.8 %

**NOTICE**

PER is calculated by the formula as follows.

PER [%] = (1-(received value(received number of packet)/transmitted value(transmitted number of packet)) * 100.

## 22.2.2 Maximum input signal level (TP/RCV-LE/BV-06-C)

1. Objective: To measure the performance of the receiver at the maximum input leve.

2. Test Procedure:
   A. The DUT is set to RX mode.
   B. The tester's transmit power is chosen such that the input power to the DUT receiver is -30 d Bm.
   C. Set the instrument, as in the following table.
   D. Tester transmits 1500 LE Packet and measure PER of responded Packet.

| Parameter | DUT | MTP200B |
|---|---|---|
| CH_NUM | | 0~39 |
| POWER in dBm | | -30 |
| Payload Type(BIT_PATTERN) | | PRBS9 |
| Packet Length | | 37(255 for BT v4.2 or more) |
| NUM_PACKET | | 1500 |

3. Specification
   ○ - PER ≤ 30.8 %