UM11434

IW416 Labtool User Guide

Rev. 2 — 2 February 2021 User manual

Document information

Information	Content
Keywords	Labtool test setup, Device under test (DUT) setup, driver, firmware, Labtool application installation and usage, calibration data, Wi-Fi and Bluetooth Labtool commands, Bluetooth RF test sequences, Wi-Fi RF test sequences
Abstract	Explains how to set up the Labtool test environment, how to install the driver and firmware, and how to use the Labtool software application.

Revision history

Rev	Date	Description
v.1	20190917	Initial version
v.2	20210202	**Modifications** • Applied NXP branding and version numbering • Section 1.1 "Purpose and scope": updated • Section 2 "Labtool test setup": updated • Section 3.1 "Linux Ubuntu installation": updated • Section 3.3 "Software download": updated • Section 3.4 "Building IW416 drivers": renamed (no change in the content) • Section 3.5 "Building MFG bridge application and copying MFG firmware": renamed and updated • Section 3.6 "Loading IW416 driver and executing the firmware and bridge": renamed and updated • Section 4.1 "Labtool setup on Windows PC": renamed and updated • Section 4.2 "Calibration data": updated • Section 6.1 "Command 9: Get Tx/Rx antenna configuration (valid when Antenna diversity is supported)": added • Section 6.2 "Command 10: Set Tx/Rx antenna configuration (valid when Antenna diversity is supported)": added • Section 6.3 "Command 11: Get RF channel configuration": updated • Section 6.5 "Command 13: Get RF data rate": added • Section 6.14 "Command 34: Enable/disable BSSID filter": added • Section 6.29 "Command 146: Get the number of calibrations done on OTP": added • Section 6.33 "Command 198: Start RSSI data collection": added • Section 6.34 "Command 199: Stop RSSI data collection and report result": added • Section 6.35 "Wi-Fi RF test examples": added test examples for RSSI measurement • Section 7.26 "Bluetooth RF test examples": updated

1 Introduction

This document provides guidance for the installation and usage of IW416 Labtool application. The Labtool is a software test tool used to control and run various RF and regulatory compliance tests.

1.1 Purpose and scope

This document explains how to set up the IW416 Labtool test environment including the installation of IW416 driver, loading manufacturing firmware, and using Labtool software application. The Wi-Fi and Bluetooth radio Labtool commands are detailed along with some RF test examples.

1.2 References

Table 1 lists the references.

Table 1. References

Reference type	Reference title
Datasheet	DS - IW416 - Dual-band 1x1 Wi-Fi 4 and Bluetooth 5.1 Combo SoC
Design package	RD-IW416-QFN-WIB3-1A-V2: design package for IW416 reference design with QFN package and one antenna
Design package	RD-IW416-QFN-WIB3-2A-V2: design package for IW416 reference design with QFN package and two antennas
Design package	RD-IW416-CSP-WIB3-1A-V1: design package for IW416 reference design with CSP package and one antenna
Design package	RD-W8978-CSP-WIB3-2A-V1: design package for IW416 reference design with CSP package and two antennas
User manual	UM11350 - IW416 Reference Design Kit User Guide
Application note	AN12794 - IW416 Calibration Structure

2 Labtool test setup

The Labtool is a test tool that enables RF testing for IW416 device. The Labtool is used for the following:

- Measurement of RF parameters such as transmit power, EVM, and receiver sensitivity
- Regulatory compliance testing (EMC/EMI)

The Labtool is part of the Manufacturing Software (MFG SW) package which includes the following components:

- Labtool application: this tool runs on a Windows PC
- IW416 device driver for Ubuntu Linux
- IW416 manufacturing (MFG) firmware: specialized firmware build that enables the manufacturing test mode on IW416 device.
- Manufacturing bridge application: this application runs on the device under test (DUT). The bridge application enables Labtool application running on the Windows PC to communicate with the DUT over an ethernet interface.

Figure 1 shows a block diagram of a test setup running the Labtool. The test setup includes:

1. Device Under Test (DUT): The DUT is a system that includes IW416 device. The DUT needs the following software components:
   - IW416 device driver and manufacturing firmware
   - Manufacturing bridge application

   If you are testing IW416 evaluation board using SDIO/UART interface or an IW416-based wireless module, then connect the board or module to a PC/platform running Linux.
2. Windows PC: The Labtool application runs on a Windows PC
3. The RF tester, that is the test instrument
4. Ethernet switch

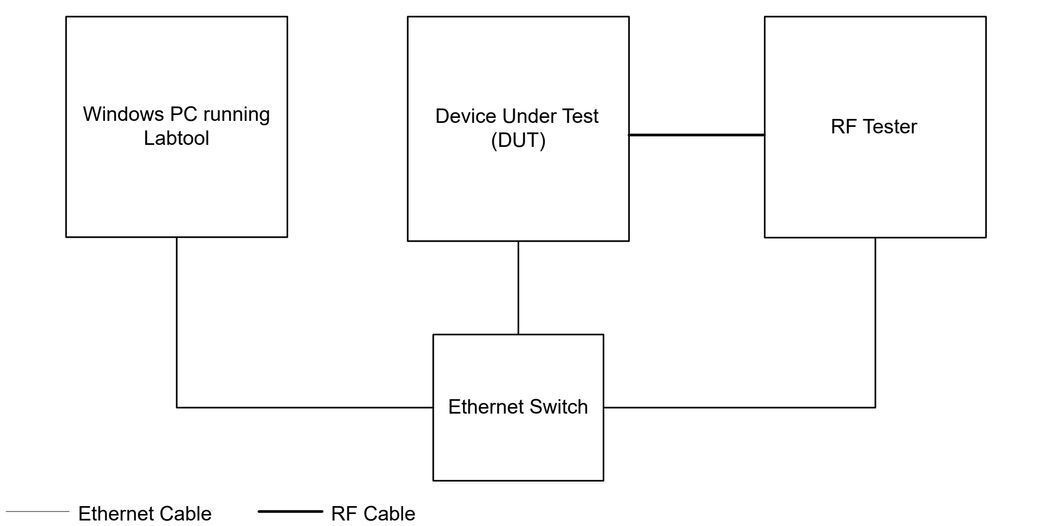


Figure 1. Labtool Test Setup

3 Device under test setup

The host system provides the means for the Labtool to communicate with the DUT that runs on Linux Ubuntu.

This section details the installation of Linux Ubuntu on the (Linux) Bridge computer and the configuration setup prior to the download and build of the driver and firmware.

3.1 Linux Ubuntu installation

Install the Linux Ubuntu 16.04 along with the required tools and applications packages on the (Linux) Bridge computer. Perform this initial setup once. Subsequent releases will only require to copy IW416 firmware and driver files to their respective locations on the Bridge computer.

The procedure to set up a Bridge computer is as follows:

Step 1: Install Linux Ubuntu 16.04 system. The following command installs the 64-bit Linux Ubuntu system and is given as an example. You can also install the 32-bit Linux Ubuntu.:

```
$ Ubuntu-16.04.-desktop-amd64.iso
```

Step 2: Set up the environment.

Create a super-user or root administrator with the following command:

```
$ sudo bash # <user password>
```

Update the kernel and install the related patch with the following commands:

Ask your local NXP FAE for the kernel update package (*Ubuntu_16.tgz*) or download the 4.8.0 kernel from the internet.

Note: *In case of a new requirement for the kernel or patch with the new release driver package, check the driver release notes included in the driver release package available on IW416 Tools and Software tab on NXP website.*

```
$ tar -zxvf Ubuntu_16.tar
$ cd Ubuntu_16
$ bash install.sh
$ reboot
```

Step 3 - Check the kernel version and install the Ubuntu packages:

```
$ uname -r
$ apt-get install vim
$ apt-get install gawk
$ apt-get install openssh-server
$ apt-get install libnl-3-dev
$ apt-get install libnl-genl-3-dev
$ apt-get install libreadline6-dev
$ apt-get install libssl-dev
$ apt-get install libbluetooth-dev
$ apt-get install libncurses5-dev
$ apt-get install libpcsclite-dev
$ apt-get install libc6-dev-i386
```

3.2 Linux bridge computer configuration

Step 1 - Disable the Linux firewall temporarily with the following command:

```
$ service iptables stop
```

Step 2 – Disable the open-source driver (*mwifiex*) to avoid a mutual conflict with NXP driver.

Execute the following commands to disable the open-source driver:

```
$ cd /lib/modules/`uname -r`/kernel/drivers/net/wireless/marvell/
mwifiex
$ for f in `find -name '*mwifi*'`;do mv "$f" `echo "$f" | sed s/.ko/
_none/`;done
$ cd /lib/modules/`uname -r`/kernel/drivers/BT
$ for f in `find -name '*mrvl*'`;do mv "$f" `echo "$f" | sed s/.ko/
_none/`;done
```

3.3 Software download

The software packages are available for download on IW416 Tools and Software tab on NXP website.

Make sure to download the two software packages:

- IW416 production software release package
- IW416 MFG software release package

Note: *Ask your local NXP FAE for specific software packages.*

3.3.1 Production software release package

The production software release package includes the Wi-Fi and Bluetooth driver source code. Both the Wi-Fi and Bluetooth drivers are needed for Labtool testing.

IW416 production software is available for download on IW416 Tools and Software tab on NXP website.

Note: *Ask your local NXP FAE for specific software packages.*

3.3.2 MFG software release package

The MFG software release package includes the MFG firmware, the Labtool executable (*.exe* file), and the MFG bridge application. All three software items are needed for Labtool testing.

The MFG software release is published on IW416 Tools and Software Tab on NXP website.

3.4 Building IW416 drivers

This section explains how to build both the Wi-Fi and Bluetooth drivers once you have downloaded the production software package published on IW416 Tools and Software tab).

Note: *IW416 device was formerly named 88W8978. The firmware and driver still refer to 8978 or 88W8978.*

Step 1 – Open a terminal window on the (Linux) Host PC and use the `cd` command to the folder where the software is downloaded.

Step 2: Unzip the driver release package and all other files in it with the following commands:

```
$ tar -xvf SD-WLAN-SD-BT-8978-U16-MMC...pxx-GPL.tar
$ tar -xzvf SD-BT-8978-U16-MMC-...-GPL-src.tgz
$ tar -xzvf SD-BT-CHAR-8978-U16-MMC-...-GPL-src.tgz
$ tar -xzvf SD-UAPSTA-8978-U16-MMC-...-mlan-src.tgz
$ tar -xzvf SD-UAPSTA-8978-U16-MMC-...-app-src.tgz
$ tar -xzvf SD-UAPSTA-8978-U16-MMC-...-GPL-src.tgz
```

The folder named *SD-UAPSTA-UART-BT-8978-U16-MMC-...-GPL* includes the WiFi and Bluetooth driver source code.

Step 3: Navigate to *wlan_src* directory and run the following commands to compile the driver for Wi-Fi:

```
$ cd wlan_src
$ make clean
$ make build
```

After the compilation, the folder *bin_sd8978* is created. It includes the Wi-Fi driver files *mlan.ko* and *sd8xxx.ko*.

Step 4: Navigate to *mbt_src* directory and run the following commands to compile the Bluetooth driver:

```
$ mbt_src
$ make clean
$ make build
```

After the compilation, the folder *bin_sd8978_bt* is created and includes the Bluetooth driver file *bt8xxx.ko*.

3.5 Building MFG bridge application and copying MFG firmware

This section provides the steps for the installation of the MFG firmware and the build of the Bridge application.

Step 1: Navigate to the directory where the MFG software release package was downloaded and use the following command to extract the file:

```
$ cd <path-to-folder-with-mfg-software-release-package>
$ unzip MFG-W8978-MF-WiFi-BT-BRG-FC-...-bin.zip
```

The extracted release package includes the following:

- The *FwImage* directory which includes the MFG Firmware
- The *Bridge* directory with the source code for the bridge application
- The *release* directory containing the Labtool executable for the Windows computer

Figure 2 shows the content of *FwImage* directory.

sdio8978_sdio_combo.bin	12/1/2020 5:22 AM	BIN File	415 KB
sdio8978_uart_combo.bin	12/1/2020 5:34 AM	BIN File	415 KB
usb8978_usb_combo.bin	12/1/2020 6:01 AM	BIN File	442 KB
w8978d_SDIO_SDIO_SDIO.bin	12/1/2020 5:22 AM	BIN File	86 KB
w8978d_SDIO_UART_UART.bin	12/1/2020 5:34 AM	BIN File	86 KB
w8978o_SDIO_SDIO_SDIO.bin	12/1/2020 5:18 AM	BIN File	330 KB
w8978o_SDIO_UART_UART.bin	12/1/2020 5:30 AM	BIN File	330 KB

Figure 2. FwImage directory content

Step 2: Navigate to the *FwImage* directory and select the MFG firmware bin file that matches the host interface type and copy it to the Linux firmware path */lib/firmware/nxp/*.

For example, the firmware binary file *sdio8978_sdio_combo.bin* supports both Wi-Fi and Bluetooth over an SDIO interface. Run the commands to copy the bin file:

```
$ cd MFG_W8978...pxx/bin/FwImage
$ cp sdio8978_sdio_combo.bin /lib/firmware/nxp/
```

If there is no folder with the name *nxp* under */lib/firmware/* path, run the commands to create the folder:

```
$ cd /lib/firmware/
$ mkdir nxp
```

Step 3: Go to the *Bridge* folder and compile the bridge application:

```
$ cd MFG_W8xxx...pxx/Bridge
$ tar -xzvf bridge_linux_xx.xx.xx.xx-src.tgz
$ cd bridge_linux_xx.xx.xx.xx/bridge
$ make build
```

The mfgbridge application executable is created in the *bin_mfgbridge* directory.

3.6 Loading IW416 driver and executing the firmware and bridge

The procedure to load the Wi-Fi and Bluetooth drivers and to run the Bridge application is as follows:

Step 1: Install Wi-Fi and Bluetooth drivers.

Go to the folder which includes the Wi-Fi driver files (*mlan.ko* and *sd8xxx.ko*), and run the following commands:

```
$ insmod mlan.ko
$ insmod sd8978.ko mfg_mode=1 drv_mode=1  fw_name=nxp/
sdio8978_sdio_combo.bin cal_data_cfg=none
$ dmesg
$ iwconfig
```

Use the `dmesg` command to check the driver and firmware load status. If the status is correct the command output is as shown below. No message returns if either the firmware or driver did not load correctly.

```
WLAN FW is active
wlan: Driver loaded successfully
```

Use the `iwconfig` command to confirm that the Wi-Fi device is defined as the `mlan0` interface with the following messages:

```
mlan0   IEEE 802.11-DS ESSID:””
Mode:Auto channel=0  Access Point:Not-Associated
Bit Rate:0 kb/s Tx_Power=off
Retry limit:0 RTS thr=0 Fragment thr:off
Power Management:off
Link Quality=0/5 Signal level=0 dBm Noise level=0 dBm
Rx invalid nwid:0 Rx invalid crypt:0 Rx invalid frag:0
Tx excessive retries:0 Invalid misc:0 Missed beacon:0
```

Similarly, navigate to the folder which includes the Bluetooth driver file (*bt8xxx.ko*) and execute the following commands:

```
$ insmod bt8xxx.ko
$ dmesg
$ hciconfig
```

If the status is correct the command output is as shown below. No message returns if either the firmware or driver did not load correctly.

```
BT FW is active (0)
BT: Driver loaded successfully
```

Use the `hciconfig` command to confirm that the Bluetooth device is defined as the `hci0` interface with the following messages:

```
hci0  Type: BR/EDR Bus:SDIO
BD Address: C0:95:DA:00:43:61 ACL MTU: 1021:7 SCO MTU: 120:6
UP RUNNING PSCAN
RX bytes:824 acl:0 sco:0 events:41 errors:0
TX bytes:1168 acl:0 sco:0 events:41 errors:0
```

If the Bluetooth is down, try to reset the Bluetooth interface to `hci0` or disconnect IW416 board. Unload the drivers with the following commands:

```
$ rmmod sd8xxx.ko
$ rmmod mlan.ko
$ rmmod bt8xxx.ko
```

Step 2: Configure the DUT IP address.

We use the following IP addresses as examples in the commands shown for this step:

- (Linux) Bridge computer IP address: 192.168.0.10
- (Windows) Host computer IP address: 192.168.0.58

In the Linux system, configure the Ethernet IP address with the following command:

```
>ifconfig -a
```

Check the Ethernet name. The following command assumes the Ethernet name is `ethx` :

```
>ifconfig ethx 192.168.0.10
```

Check the Ethernet connection state between the (Windows) Host computer and the (Linux) Bridge computer using the `ping` command.

In the Windows Terminal window, execute the following command:

```
>ping 192.168.0.10
```

In the Linux platform terminal execute the following command:

```
>ping 192.168.0.58
```

Ensure that both the (Windows) Host computer and (Linux) Bridge computer IP addresses are under the same subnet.

Step 3: Run the bridge application.

Go to the bridge folder under the MFG release package where the bridge application was compiled previously, and run the bridge application with the following command:

```
$./mfgbridge
```

To terminate the bridge application, type CTRL+C in the bridge window.

To restart the bridge application, execute the `./mfgbridge` command again.

4 Windows PC setup

4.1 Labtool setup on Windows PC

The Host computer runs on Windows operating system (64 bit and 32 bit). The procedure to set up the environment is as follows:

Step 1: Download the MFG software release package *MFG-W8xxx...pax.bin* published on IW416 Tools and Software tab on NXP website. The MFG software release package includes the MFG firmware, the Labtool executable (*.exe* file), and the MFG bridge application. All three software items are needed for Labtool testing.

Step 2: Unzip the MFG firmware software release.

Step 3 - Copy the *...bin/release/labtool* folder to the Host computer and make sure the path length has less than 255 characters. Figure 3 shows the *labtool* repository content:

AddCal.dll	12/1/2020 6:13 AM	Application extens...	1,131 KB
AddCalDLL.dll	12/1/2020 6:13 AM	Application extens...	1,131 KB
AddCalDLL.lib	12/1/2020 6:13 AM	LIB File	2 KB
DutApi89XXDll.h	12/1/2020 6:13 AM	H File	19 KB
DutApiMimoBtDll.dll	12/1/2020 6:13 AM	Application extens...	442 KB
DutApiMimoBtDll.lib	12/1/2020 6:13 AM	LIB File	108 KB
DutApiMimoBtDllDualIf.dll	12/1/2020 6:14 AM	Application extens...	463 KB
DutApiMimoBtDllDualIf.lib	12/1/2020 6:14 AM	LIB File	110 KB
DutApiMimoBtDllUart.dll	12/1/2020 6:14 AM	Application extens...	605 KB
DutApiMimoBtDllUart.lib	12/1/2020 6:14 AM	LIB File	110 KB
DutApiSisoBt	12/1/2020 6:14 AM	Application	376 KB
DutBtApi.hc	12/1/2020 6:13 AM	HC File	7 KB
DutBtApi89XXDll.h	12/1/2020 6:13 AM	H File	21 KB
DutWlanApi.hc	12/1/2020 6:13 AM	HC File	19 KB
DutWlanApi89XXDll.h	12/1/2020 6:13 AM	H File	33 KB
Flash_SPI_header.bin	12/1/2020 6:13 AM	BIN File	4 KB
Flash_SPI_header.sbin	12/1/2020 6:13 AM	SBIN File	4 KB
GenHeader.bin	12/1/2020 6:13 AM	BIN File	1 KB
SetUp	12/1/2020 6:13 AM	Configuration setti...	3 KB
UsbHeader.bin	12/1/2020 6:13 AM	BIN File	1 KB

Figure 3. *Labtool* Repository Content

Step 4: Disable the Windows firewall.

Step 5: Open the Network and Sharing Center on the Windows PC. Change the network address of the Ethernet port to the same subnet as the (Linux) Bridge computer. The following IP addresses are used in this document:

- (Windows) Host computer: 192.168.0.58
- (Linux) Bridge computer: 192.168.0.10

Step 6: Open the *SetUp.ini* file using a text editor. The value of the parameter `DutIpAddress` is the IP address of the DUT. The parameter `HostIpAddress` is the IP address of the Windows PC. Edit the file as follows:

```
[DutIp]
DutIpAddress = 192.168.0.10
HostIpAddress = 192.168.0.58
Protocol = TCP
```

Step 7: In the *SetUp.ini* file, the parameter `NO_EEPROM` is used to specify the calibration data storage option. The default value is `1` (Use calibration data from the external configuration file).

For general RF evaluation and test, set the file option to `1` to use the calibration data from an external file. If the calibration data is already stored in the OTP memory of IW416 device, set the value to `2`.

```
[DutInitSet]
0 = EEPROM support
1 = No_EEPROM support
2 = OTP support
NO_EEPROM = 1
NoEepromBtFlexFileName = WlanCalData_ext.conf
NoEepromWlanFlexFileName = WlanCalData_ext.conf
```

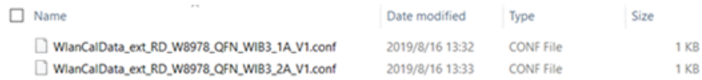
Note: *No_EEPROM support refers to the calibration data from the external configuration file.*

Step 8: Save the “*SetUp.ini*” file after making the changes.

4.2 Calibration data

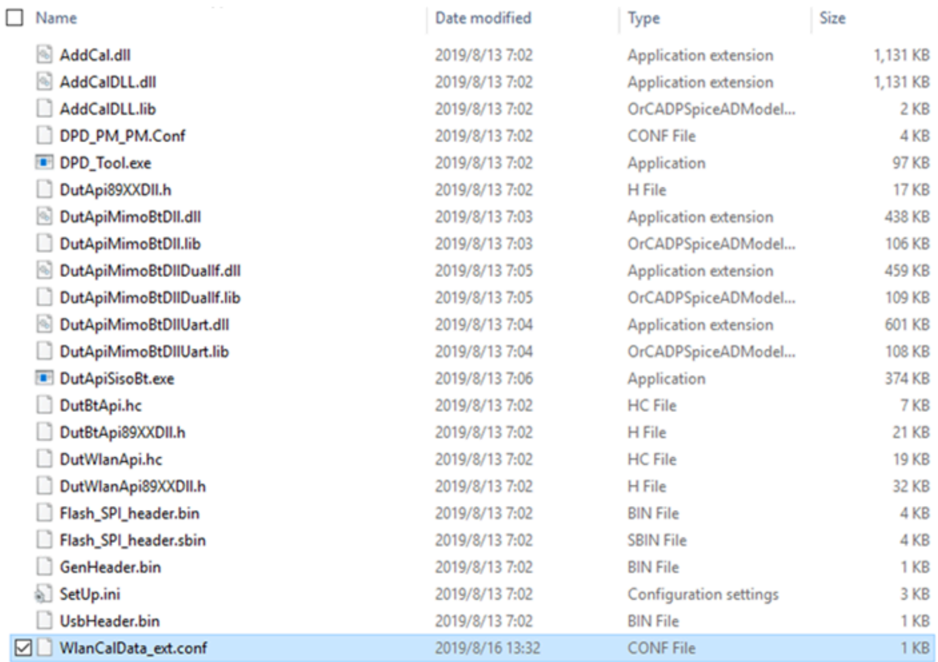
The DUT requires calibration data for optimal performance. The calibration data is included in the *.conf* file or programmed into the on-chip OTP memory of IW416 device. The *.conf* file is included in the reference design package for the WLCSP and QFN packages available on IW416 Tools and Software tab. See Figure 4.

Before launching the Labtool, copy the *.conf* file into the Labtool working directory and rename the file as *WlanCalData_ext.conf* (see Figure 5).



Name	Date modified	Type	Size
WlanCalData_ext_RD_W8978_QFN_WIB3_1A_V1.conf	2019/8/16 13:32	CONF File	1 KB
WlanCalData_ext_RD_W8978_QFN_WIB3_2A_V1.conf	2019/8/16 13:33	CONF File	1 KB

Figure 4. Calibration data file (*.conf*)



Name	Date modified	Type	Size
AddCal.dll	2019/8/13 7:02	Application extension	1,131 KB
AddCalDLL.dll	2019/8/13 7:02	Application extension	1,131 KB
AddCalDLL.lib	2019/8/13 7:02	OrCADPSpiceADModel...	2 KB
DPD_PM_PM.Conf	2019/8/13 7:02	CONF File	4 KB
DPD_Tool.exe	2019/8/13 7:02	Application	97 KB
DutApi89XXDll.h	2019/8/13 7:02	H File	17 KB
DutApiMimoBtDll.dll	2019/8/13 7:03	Application extension	438 KB
DutApiMimoBtDll.lib	2019/8/13 7:03	OrCADPSpiceADModel...	106 KB
DutApiMimoBtDllDualIf.dll	2019/8/13 7:05	Application extension	459 KB
DutApiMimoBtDllDualIf.lib	2019/8/13 7:05	OrCADPSpiceADModel...	109 KB
DutApiMimoBtDllUart.dll	2019/8/13 7:04	Application extension	601 KB
DutApiMimoBtDllUart.lib	2019/8/13 7:04	OrCADPSpiceADModel...	108 KB
DutApiSisoBt.exe	2019/8/13 7:06	Application	374 KB
DutBtApi.hc	2019/8/13 7:02	HC File	7 KB
DutBtApi89XXDll.h	2019/8/13 7:02	H File	21 KB
DutWlanApi.hc	2019/8/13 7:02	HC File	19 KB
DutWlanApi89XXDll.h	2019/8/13 7:02	H File	32 KB
Flash_SPI_header.bin	2019/8/13 7:02	BIN File	4 KB
Flash_SPI_header.sbin	2019/8/13 7:02	SBIN File	4 KB
GenHeader.bin	2019/8/13 7:02	BIN File	1 KB
SetUp.ini	2019/8/13 7:02	Configuration settings	3 KB
UsbHeader.bin	2019/8/13 7:02	BIN File	1 KB
WlanCalData_ext.conf	2019/8/16 13:32	CONF File	1 KB

Figure 5. *WlanCalData_Ext.conf* in Labtool directory

5 Labtool usage

5.1 Starting Labtool

Ensure the bridge application is running prior to starting the Labtool application. The procedure to start the Labtool application is as follows:

Step 1: Double-click on *DutApiSisoBt.exee*. Figure 6 shows the Labtool start window:

```
Name:            Dut labtool
Version:         1.0.0.10
Date:            Dec  1 2020 (06:14:31)

Note:

1. =========WiFi tool=============
2. =========BT   tool=============

Enter CMD 99 to Exit
```

Figure 6. Labtool start window

Step 2: At the command prompt, enter “1” to start the Wi-Fi radio operation or “2” to start the Bluetooth radio operation.

Step 3: To confirm whether the bridge and host setups are working properly, issue the command `88` to check the firmware and Labtool version number.

- If the correct version numbers are returned, start the RF test procedure.
- If the version numbers are incorrect, check the host, DUT, and bridge connections. Confirm the Wi-Fi and Bluetooth drivers are installed correctly.

Figure 7 shows the correct state of command `88` execution.

```
Name:           Dut labtool
Version:        1.0.0.10
Date:           Dec  1 2020 (06:14:31)

Note:

1. =========WiFi tool============
2. =========BT   tool============

Enter CMD 99 to Exit

Enter option: 1

Name:           DutApiClass
Interface:      EtherNet
Version:        1.0.0.10
Date:           Dec  1 2020 (06:13:26)

Note:

D:\MFG-W8978-MF-WIFI-BT-BRG-FC-VS2013-1.0.0.10-16.80.10.p127\bin\release\labtool\setup.ini
Dut's IP 192.168.0.10:9930
Host's IP 192.168.0.58:9931
DutIf_UdpIp::delay 0
DutIf_UdpIp::vg_IfSpy 0
TCP connecting...
 DutIf_InitConnection: 0x00000000
--------------------------------------------------------
                W89xx (802.11a/g/b/n/ac) TEST MENU
--------------------------------------------------------
Enter option: 88

DLL Version : 1.0.0.10
LabTool Version: 1.0.0.10
FW Version:  16.80.10.127       Mfg Version: 3.0.0.4
SOC OR Version: 2.3      Customer ID:   0
RF OR Version:  1.1      Customer ID:   0
Enter option: 22?
```

Figure 7. Command 88 execution

5.2 Running commands

Each time a Labtool command is executed, the console returns a status byte. A successful command execution is indicated by a status byte with all 0s (Figure 8).

```
Enter option: 11
 DutIf_GetRfChannel: 0x00000000
 RF Channel: 6 (2437.0 MHz)
Enter option: 111
DutIf_GetChannelBw: 0x00000000
Channel Bw: 0
Enter option: _
```

Figure 8. Status – Successful command execution

A failed command returns invalid data and is indicated by a non-0 status byte (0x00000001 to 0xFFFFFFFF). This could indicate a problem with the communication to the DUT, incorrect firmware, no firmware download, wrong version of Labtool/firmware, and so on.

```
Enter option: 11
 DutIf_GetRfChannel: 0xFFFFFFF9
 RF Channel: 0 (0.0 MHz)
Enter option: 111
DutIf_GetChannelBw: 0xFFFFFFF9
Channel Bw: 0
```

Figure 9. Status – Failed command execution

When using the transmit commands (25, 33, 35), note that all the Very High Throughput (VHT) rates are not available for all bandwidth and antenna path combinations. An error code in the returned status byte of 0xE indicates that the rate is not supported by the DUT. Enter a “?” at the Labtool prompt to list all the available commands.

5.3 Closing Labtool

To **close** Labtool, issue Command 99 once.

To **quit** Labtool, issue command 99 twice.

5.4 Getting help

The Labtool application realizes its functions (such as enable Tx/Rx tests) through the related Labtool commands. Labtool commands are listed in the Command Line Interface (CLI) menu.

Enter `?` at the command prompt in the main window to get the CLI menu.

Enter `<command number>?` for the detailed usage and help menu for the respective command.

For example, enter `10?`.to get the detailed Command 10 usage (including the command options) and related help file are shown in the main window.

6 Wi-Fi Labtool commands

Table 2. Wi-Fi Labtool command summary

Command
Command 9: Get Tx/Rx antenna configuration (valid when Antenna diversity is supported)
Command 10: Set Tx/Rx antenna configuration (valid when Antenna diversity is supported)
Command 11: Get RF channel configuration
Command 12: Set RF channel configuration
Command 13: Get RF data rate
Command 18: Set transmitter in CW mode
Command 22: Set power at antenna using calibration data
Command 25: Transmit with duty cycle Tx mode
Command 29: Get RF band configuration
Command 30: Set RF band configuration
Command 31: Clear Rx packet count
Command 32: Get and clear Rx packet count
Command 33: Transmit multicast packets
Command 34: Enable/disable BSSID filter
Command 35: Transmit with SIFS gap
Command 38: Transmit unicast packet
Command 44: Storage type get/set function
Command 45: Read MAC address from OTP
Command 46: Write MAC address to OTP
Command 53: Set calibration data to storage from text file
Command 54: Get calibration data from storage into file
Command 88: Get firmware/hardware version
Command 95: Get XTAL calibration offset
Command 96: Set XTAL calibration offset
Command 99: Exit Labtool application
Command 111: Get channel bandwidth
Command 112: Set channel bandwidth
Command 144: Read OTP raw data
Command 146: Get the number of calibrations done on OTP
Command 147: Get free lines in OTP
Command 148: Write patch block to OTP
Command 149: Write user data to OTP
Command 198: Start RSSI data collection
Command 199: Stop RSSI data collection and report result

6.1 Command 9: Get Tx/Rx antenna configuration (valid when Antenna diversity is supported)

This command is used to check which antenna is connected to the Wi-Fi radio when more than one antenna is used for Antenna diversity application.

Syntax: `9`

Return data: `GetTxAntenna: Antenna X (where X = 1 or 2)`

6.2 Command 10: Set Tx/Rx antenna configuration (valid when Antenna diversity is supported)

This command is used to set the desired antenna to the Wi-Fi radio when more than one antenna is used for Antenna diversity application

Syntax: `10 <antenna number>`

Where:

Command parameter	Description
`antenna number`	Number used to qualify the Tx/Rx antenna 1 = Main 2 = Aux

Example

`10 1` // Sets the main antenna

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.3 Command 11: Get RF channel configuration

This command returns the values of the current RF channel, such as channel and offset.

Syntax: `11`

Return data

Channel: Current channel number (see Section 8.1 "RF channels")

Offset: Boundary (applicable to non-20 MHz bandwidth channel)

- 0x1 = lower boundary of channel
- 0x3 = upper boundary of channel

Offset = 1 indicates that the channel number displayed (or set, in the case of Command 12) is the lower boundary of the channel.

If the channel bandwidth is 40 MHz (2.4 GHz band) and the channel center is 8, the Labtool reports Ch 6 with offset 1 or Ch 10 with offset 3.

6.4 Command 12: Set RF channel configuration

This command sets the RF channel. Specify the RF channel in the appropriate band (2.4 GHz or 5 GHz) or an error will occur.

Syntax: `#23 <channel>`

Where:

Command parameter	Description
`Channel`	Channel number When 40 MHz bandwidth is enabled, then the channel specified is the left most/lower channel.

Examples

`12 6` // Sets Ch 6 in 20 MHz bandwidth mode

```
112 1   // Sets to 40 MHz bandwidth
12 36   // Sets Ch 36 with offset 1 (Ch 36 + Ch 40 boned pair)
```

`12 6` // Sets Ch 6 in 20 MHz bandwidth mode

```
112 1   // Sets to 40 MHz bandwidth
12 40   // Sets Ch 40 with offset 3 (Ch 36 + Ch 40 bonded pair)
```

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.5 Command 13: Get RF data rate

This command is used to check the current data rate set for the Wi-Fi radio.

Syntax: `13`

Example(s)

`13` // reads back current data rate for Wi-Fi radio

Return data: `DataRate: X` // Where X is the number associated with the data rate. See Table 3

Table 3. RF data rates

DataRate (X)	RF data rate
1	1M
2	2M
3	5.5M
4	11M
5	22M
6	6M
7	9M
8	12M
9	18M
10	24M
11	36M
12	48M
13	54M
14	72M
15	MCS0
16	MCS1
17	MCS2
18	MCS3
19	MCS4
20	MCS5
21	MCS6
22	MCS7
47	MCS32

6.6 Command 18: Set transmitter in CW mode

This command transmits an un-modulated carrier as a Continuous Wave (CW) tone.

Syntax: `18 <Enable>`

Where:

Command parameter	Description
`Enable`	Mode enable 0 = disable (default) 1 = enable

Examples

`18 1` // Turns on transmission

`18 0` // Turns off transmission

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.7 Command 22: Set power at antenna using calibration data

This command sets the Tx power at the antenna using stored calibration data.

Syntax: `22 <channel> <power level> <modulation> <forceCalData>`

Where:

Command parameter	Description
`channel`	Tx Channel See Section 8.1. Default = Ch 6.
`power level`	Tx Power Level (dBm)
`modulation`	Modulation 00 = 802.11b CCK (default) 01 = 802.11g/a/p OFDM 10 = 802.11n MCS
`forceCalData`	Force calibration data Valid only for NO_EEPROM mode 0 = download calibration data only if not downloaded yet (default) 1 = force configuration file to be downloaded

Example

`22 6 13 1 1` // Sets power for Ch 6, 13 dBm transmit power with OFDM modulation rates, and forces the configuration file download

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.8 Command 25: Transmit with duty cycle Tx mode

This command enables the device in modulated, packet-based, fixed duty cycle transmit mode after the power is manually set.

Syntax: `25 <enable> <data rate> <PayLoadWeight> <ShortGI> <AdvCoding> <TxBfOn> <GFMode> <STBC> <PowerID> <SignalBw>`

Where:

Command parameter	Description
`enable`	Mode enable 0 = disable (default) 1 = enable
`data rate`	Data Rate See Section 8.2 "Data rates" for mapping. Default = 4
`PayLoadWeight`	Represents a payload duty percentage (default = 50) Pattern = 0xB496DEB6 Short Preamble = 0 | 1 (default =0)
`ShortGI`	Short guard interval 0 = long guard interval (default) 1 = short guard interval
`AdvCoding`	Advanced Coding 0 = BCC (default) 1 = LDPC
`TxBfOn`	Tx Beamform On 0 = disable (default) 1 = enable
`GFMode`	Greenfield mode 0 = disable (default) 1 = enable
`PowerID`	Power ID Set to -1 See Section 6.7 "Command 22: Set power at antenna using calibration data" for Power ID mapping.
`SignalBW`	Signal bandwidth 0 = 20 MHz 1 = 40 MHz -1 = follow deviceBW as in Section 6.3 "Command 11: Get RF channel configuration" and Section 6.4 "Command 12: Set RF channel configuration" (default)

Examples

`25 1 4` // Turns on transmitter and specifies data rate (11 Mbit/s)

`25 0` // Turns off transmitter

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.9 Command 29: Get RF band configuration

This command gets the RF band configuration.

Syntax: `29`

Return data: Current RF band

- 0 = 2.4 GHz
- 1 = 5 GHz

6.10 Command 30: Set RF band configuration

This command sets the RF band configuration.

Syntax: `30 <band>`

Where:

Command parameter	Description
`band`	RF band 0 = 2.4 GHz (default) 1 = 5 GHz

Examples

`30 0` // Sets 2.4 GHz band

`30 1` // Sets 5 GHz band

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.11 Command 31: Clear Rx packet count

This command clears the packet count register (start Rx Frame Error Rate (FER) test). The receiver continuously counts the received multi-cast packets.

Syntax: `31`

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.12 Command 32: Get and clear Rx packet count

This command gets the counts for Rx, multi-cast and error packets, and clears the Rx packet counter (stop Rx FER test).

Syntax: `32`

Return data: Displays the received multi-cast packet count

6.13 Command 33: Transmit multicast packets

This command transmits a specific number of multicast packets. It is used for measuring Rx sensitivity if connected to another radio module, such as a receiver

Syntax: `33 <Len> <Count> <Rate> <Pattern> <ShortPreamble> <ActSubCh> <ShortGI> <AdvCoding> <TxBfOn> <GFMode> <STBC> <PowerID> <SignalBw> <BSSID>`

Where:

Command parameter	Description
`Len`	Packet byte length Default is 0x400
`Count`	Packet count Default is 0x64
`Rate`	Data rate See Section 8.2 "Data rates". Default is 4.
`Pattern`	Packet data pattern Default is 0xB496DEB6
`ShortPreamble`	Short preamble 0 = long preamble 1 = short preamble (default)
`ActSubCh`	Active sub channel 00 = low 01 = upper 10 = both 11 = both (default)
`ShortGI`	Guard interval (GI) length 0 = long GI (default) 1 = short GI
`AdvCoding`	Advanced coding 0 = BCC (default) 1 = LDPC
`TxBfOn`	Tx Beamform On 0 = disable (default) 1 = enable
`GFMode`	Greenfield mode 0 = disable (default) 1 = enable
`STBC`	Space-time block code 0 = disable (default) 1 = enable
`PowerID`	Power ID Set to -1. See Section 6.7 "Command 22: Set power at antenna using calibration data" for Power ID mapping

Command parameter	Description
`SignalBW`	Signal Bandwidth -1 = follows deviceBW as in Section 6.26 "Command 111: Get channel bandwidth" and Section 6.27 "Command 112: Set channel bandwidth" (default) 0x0 = 20 MHz 0x1 = 40 MHz
`BSSID`	Basic Service Set ID The format is xx.xx.xx.xx.xx.xx. If is not set, all 0xFs will be used.

Example

`33 400 64 4` // Transmits 100 multicast packets with 1024-byte payload at data rate of 11 Mbit/s

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.14 Command 34: Enable/disable BSSID filter

This command is used to enable/disable BSSID filter for the Wi-Fi receiver test.

Syntax: `34 <mode> <BSSID>`

Where:

Command parameter	Description
`mode`	Number associated with the mode 0 = set the receiver in promiscuous mode 1 = enable BSSID filter 2 = read BSSID register settings (default) 3 = disable promiscuous mode 4 = disable BSSID filter
`BSSID`	Hex number representing the basic service set ID: xx.xx.xx.xx.xx.xx (x must be a Hex Number)

Example(s)

`34 1 66.77.88.99.AA.BB` // enables BSSID filter for BSSID = 66.77.88.99.AA.BB

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.15 Command 35: Transmit with SIFS gap

This command continuously transmits standard 802.11 packets with an adjustable time gap specified by a configurable Short Interframe Space (SIFS) interval of 0 to 250 µs.

Syntax: `35 <Enable> <Rate> <AdjustTxBurstGap> <BurstSifsInUs> <Packet Length> <Pattern> <ShortPreamble> <ActSubCh> <ShortGI> <AdvCoding> <TxBfOn> <GFMode> <STBC> <DPD> <PowerID> <SignalBw> <BSSID>`

Where:

Command parameter	Description
`Enable`	Mode enable 0 = disable (default) 1 = enable
`Rate`	Data Rate See Section 8.2 "Data rates" for mapping. Some data rates are only available in some channel bandwidth modes. Default is 4.
`AdjustTxBurstGap`	Adjust Tx burst gap 0 = disable (default) 1 = enable
`BurstSifsInUs`	Burst SIFS (µs) Minimum is 16 µs. Maximum is 10 ms.
`Packet Length`	Packet byte length (in hexadecimal) Maximum length is 15 KB (Kilobytes), or 0x3A98 in hexadecimal.
`Pattern`	Packet data pattern Default is 0xB496DEB6
`ShortPreamble`	Short preamble 0 = long preamble 1 = short preamble (default)
`ActSubCh`	Active sub channel 00 = low 01 = upper 10 = both 11 = both (default)
`ShortGI`	Short guard interval (GI) 0 = long GI (default) 1 = short GI
`AdvCoding`	Advanced coding 0 = BCC (default) 1 = LDPC
`TxBfOn`	Tx Beamform On 0 = disable (default) 1 = enable

Command parameter	Description
GFMode	Greenfield Mode 0 = disable (default) 1 = enable
STBC	Space-time block code 0 = disable (default) 1 = enable
DPD	Deep power down (DPD) 0 = disable (default) 1 = enable
PowerID	Power ID Set to -1. See Section 6.7 "Command 22: Set power at antenna using calibration data" for Power ID mapping.
SignalBW	Signal bandwidth -1 = follows deviceBW as in in Section 6.26 "Command 111: Get channel bandwidth" and Section 6.27 "Command 112: Set channel bandwidth" (default) 0x0 = 20 MHz 0x1 = 40 MHz
BSSID	Basic Service Set ID The format is xx.xx.xx.xx.xx.xx. If is not set, all 0xFs will be used.

Examples

`35 1 13 1 20 400` // Transmits a 1024-byte packet at 54 Mbps with a SIFS gap of 20 µs.

`35 1 22 1 45 200` // Transmits a 512-byte packet at HT_MCS7 with a SIFS gap of 45 µs.

`35 0` // Turns off transmission with SIFS Interval.

`35 1 4 1 150 100 AA 1 3 0 0 0 0 0 0 -1 1.22.33.44.55.66` // Set duty cycle transmit with SIFS gap of 150 µs at 11 Mbit/s and 256 bytes with data pattern “AA” and MAC is 11.22.33.44.55.66.

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.16 Command 38: Transmit unicast packet

This command transmits a specified number of unicast packets.

Syntax: `38 <Len> <Count> <Rate> <Pattern> <TxBfOn> <SLP> <SignalBW> <PowerID> <BSSID>`

Where:

Command parameter	Description
`Len`	Packet Length (in hexadecimal) Default is 0x400.
`Count`	Packet count (in hexadecimal) Default is 0x64.
`Rate`	Data rate See Section 8.2 "Data rates" for mapping. Some data rates are only available in some channel bandwidth modes. Default is 4.
`Pattern`	Pattern Default is 0xB496DEB6 for MFG testing
`TxBfOn`	Tx Beamform on 0 = disable (default) 1 = enable
`SLP`	Service location protocol (SLP) parameter used to enable/disable steering 0 = disable 1 = enable (default)
`SignalBw`	Signal bandwidth 0 = 20 MHz 1 = 40 MHz -1 = follow deviceBW as in Section 6.26 "Command 111: Get channel bandwidth" and Section 6.27 "Command 112: Set channel bandwidth" (default)
`PowerID`	Power ID Set to -1. See Section 6.7 "Command 22: Set power at antenna using calibration data" for Power ID mapping
`BSSID`	Basic Service Set ID The format is xx.xx.xx.xx.xx.xx. If is not set, all 0xFs will be used.

Example

`38 400 64 4 AA 1 1 -1 -1 00.50.43.11.22.33` // Transmits 100 unicast packets with 1024-byte payload at data rate of 11 Mbps, data pattern “AA”, enables SLP, and MAC is 00.50.43.11.22.

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.17 Command 44: Storage type get/set function

This command gets/sets the storage type for Read/Write during the Labtool session.

Syntax: `44 <Type>`

Where:

Command parameter	Description
`Type`	Storage Type 01 = NO_EPPROM (see configuration calibration file) 10 = OTP

Examples

`44` // Reads back storage type

`44 1` // Sets the storage type to configuration file

Return data: Storage type if there is no option in the command.

6.18 Command 45: Read MAC address from OTP

This command returns the MAC address. Before this operation, the storage type must set to OTP.

Syntax: `45`

Return data: MAC address

6.19 Command 46: Write MAC address to OTP

Command 46 writes the MAC address. Before this operation, the storage type must set to OTP.

Syntax: `46 <MAC Address>`

Where:

Command parameter	Description
`MAC Address`	MAC address in xx.xx.xx.xx.xx.xx format

Example

`46 C0.95.DA.00.43.61` // Writes MAC address `C0.95.DA.00.43.61` to OTP

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.20 Command 53: Set calibration data to storage from text file

This command sets the calibration data to storage from the following calibration data text files:

- *CalWlanDataFile.txt*
- *CalBtDataFile.txt*
- *PwrTble_Path0.txt*

When the storage type is set to OTP, this command loads the calibration data generated from the text files into OTP.

Syntax: `53`

Examples

```
44 1  // Set NO_EEPROM as storage type
53   // Generate calibration configuration file "WlanCalData_ext.conf"
 from the text files
```

```
44 2  // Set OTP as storage type
53   // Generate calibration configuration file "WlanCalData_ext.conf"
 from the text files and load into OTP memory
```

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.21 Command 54: Get calibration data from storage into file

This command gets the calibration data from storage and saves it to the following text files:

- *CalWlanDataFile_Upload.txt*
- *CalBtDataFile_Upload.txt*
- *PwrTble_Path0_Upload.txt*

These text files allow users to edit parameters, such as XTAL and FEM_Loss.

Syntax: `54`

Example

```
44 1   // Set NO_EEPROM as storage type
54    //  Generate text files from calibration configuration file
```

Return data:

- *CalWlanDataFile_Upload.txt*
- *CalBtDataFile_Upload.txt*
- *PwrTble_Path0_Upload.txt*

6.22 Command 88: Get firmware/hardware version

This command returns the firmware, hardware, and Labtool versions.

Syntax: `88`

Return data:

- DLL Version: 1.0.0.10
- Labtool Version: 1.0.0.10
- FW Version: 16.80.10.127
- Mfg Version: 3.3.0.4
- SoC OR Version: 2.3 Customer ID: 0
- RF OR Version: 1.1 Customer ID: 0

6.23 Command 95: Get XTAL calibration offset

This command gets the 8-bit crystal calibration offset.

Syntax: `95`

Return data XTAL: 80

6.24 Command 96: Set XTAL calibration offset

This command sets the 8-bit crystal calibration offset to adjust the frequency offset when viewed on a Vector Signal Analyzer (VSA), a spectrum analyzer, or a frequency counter.

Syntax: `96 <XTAL offset value>`

Where:

Command parameter	Description
`XTAL offset value`	Crystal offset value comprised between 0x00 and 0xFF

Example(s)

`96 AA` // Sets crystal offset value to 0xAA.

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.25 Command 99: Exit Labtool application

This command exits either the Wi-Fi or Bluetooth menu. A second Command 99 will exit the Labtool and close the command prompt window.

Syntax: `99`

Return data: --

6.26 Command 111: Get channel bandwidth

This command returns the channel bandwidth in use.

Syntax: `111`

Return data: Channel bandwidth

- 0x0 = 20 MHz
- 0x1 = 40 MHz

6.27 Command 112: Set channel bandwidth

This command sets the channel bandwidth.

Syntax: `112 <Bandwidth>`

Where:

Command parameter	Description
`Bandwidth`	Bandwidth 0x0 = 20 MHz 0x1 = 40 MHz

Examples

`112 0` // Sets the channel bandwidth to 20 MHz

`112 1` // Sets the channel bandwidth to 40 MHz

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.28 Command 144: Read OTP raw data

This command reads the OTP raw data.

Syntax: `144 <Line>`

Where:

Command parameter	Description
`Line`	Specifies the line to read in OTP

Examples

`144 0` // Reads all raw data in OTP

`144 1` // Reads raw data of 16th line in OTP

Return data: Raw data in OTP

6.29 Command 146: Get the number of calibrations done on OTP

This command is used to check how many times the device was calibrated based on the number of calibration data sets stored in the on-chip OTP memory.

Syntax: `146`

Example

`146` // reads back the number of calibrations stored in the OTP

`## ##` // description of what the example does

Return data: `Number of calibration DONE on OTP: X` // (X is the number of calibrations performed)

6.30 Command 147: Get free lines in OTP

This command checks and returns the free lines in OTP.

Syntax: `147`

Return data: Free lines on OTP

6.31 Command 148: Write patch block to OTP

This command writes the special binary file patch into OTP. For example, the regulatory power table bin file is programmed into OTP using this command.

Syntax: `148 <Bin File>`

Where:

Command parameter	Description
`Bin File`	Name of the binary file to be written into OTP If left blank, default patch block file “PatchBlockFileOTP.bin” is used.

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.32 Command 149: Write user data to OTP

This command writes the user data bin file into OTP.

Syntax: `149 <User Data>`

Where:

Command parameter	Description
`User Data`	User Bin File to be Written into OTP If left blank, default user data file “UserDataFileOTP.bin” is used.

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.33 Command 198: Start RSSI data collection

This command is used to start RSSI measurement

Syntax: `198`

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

6.34 Command 199: Stop RSSI data collection and report result

This command is used to stop RSSI measurement and report the RSSI result. The RSSI measurement report includes the number of packets received, the measured RSSI value, and the measured noise floor (NF) value.

Syntax: `199`

Return data:

- RSSI_packet_count
- RSSI_Val
- RSSI_NF

6.35 Wi-Fi RF test examples

This section shows some manual test examples using the Labtool command sequences for various Wi-Fi RF performance tests.

6.35.1 802.11b test sequences

6.35.1.1 Tx, 2.4 GHz, 20 MHz bandwidth, 11 Mbit/s data rate, Ch 6 at 10 dBm, CCK

Table 4. 802.11b test sequence - Tx, 2.4 GHz, 20 MHz bandwidth, 11 Mbit/s data rate, Ch 6 at 10 dBm, CCK

Command	Description
35	Stop Tx
30 0	Set to 2.4 GHz band
112 0	Set to 20 MHz bandwidth
12 6	Set to Ch 6
22 6 10 1	Set target power level to 10 dBm using calibration data on Ch 6
35 1 4 1 100 400	Tx at 11 Mbps with 100 µs burst gap and 1024 bytes PSDU length
35	Stop Tx

6.35.1.2 Rx, 2.4 GHz, 20 MHz Bandwidth, Ch 6

Table 5. 802.11b test sequence - Rx, 2.4 GHz, 20 MHz Bandwidth, Ch 6

Command	Description
35	Stop Tx
30 0	Set to 2.4 GHz band
112 0	Set to 20 MHz bandwidth
12 6	Set to Ch 6
31	Clear received packet count
Transmit Wi-Fi packets from tester	
32	Get Rx packet count and clear Rx packet counter

6.35.1.3 RSSI, 2.4 GHz, 20 MHz bandwidth, Ch6

Table 6. 802.11b test sequence - RSSI, 2.4 GHz, 20 MHz Bandwidth, Ch 6

Command	Description
35	Stop Tx
30 0	Set to 2.4 GHz band
112 0	Set to 20 MHz bandwidth
12 6	Set to Ch 6
198	Start RSSI data collection
Transmit Wi-Fi packets from tester	
199	Stop RSSI data collection and report the result

6.35.2 802.11g test sequences

6.35.2.1 Tx, 2.4 GHz, 20 MHz bandwidth, 54 Mbit/s data rate, Ch 6 at 10 dBm, OFDM

Table 7. 802.11g test sequence - Tx, 2.4 GHz, 20 MHz bandwidth, 54 Mbit/s data rate, Ch 6 at 10 dBm, OFDM

Command	Description
35	Stop Tx
30 0	Set to 2.4 GHz band
112 0	Set to 20 MHz bandwidth
12 6	Set to Ch 6
22 6 10 1	Set target power level to 10 dBm using calibration data on Ch 6
35 1 13 1 100 908	Tx at 54 Mbit/s with 100 μs burst gap and 2312 bytes PSDU length
35	Stop Tx

6.35.2.2 Rx, 2.4 GHz, 20 MHz bandwidth, Ch 6

Table 8. 802.11g test sequence - Rx, 2.4 GHz, 20 MHz Bandwidth, Ch 6

Command	Description
35	Stop Tx
30 0	Set to 2.4 GHz band
112 0	Set to 20 MHz bandwidth
12 6	Set to Ch 6
31	Clear received packet count
Transmit Wi-Fi packets from tester	
32	Get Rx packet count and clear Rx packet counter

6.35.2.3 RSSI, 2.4 GHz, 20 MHz bandwidth, Ch 6

Table 9. 802.11g test sequence - RSSI, 2.4 GHz, 20 MHz Bandwidth, Ch 6

Command	Description
35	Stop Tx
30 0	Set to 2.4 GHz band
112 0	Set to 20 MHz bandwidth
12 6	Set to Ch 6
198	Start RSSI data collection
Transmit Wi-Fi packets from tester	
199	Stop RSSI data collection and report the result

6.35.3 802.11a test sequences

6.35.3.1 Tx, 5 GHz, 20 MHz bandwidth, 54 Mbit/s data rate, Ch 36 at 10 dBm, OFDM

Table 10. 802.11a test sequence - Tx, 5 GHz, 20 MHz bandwidth, 54 Mbit/s data rate, Ch 36 at 10 dBm, OFDM

Command	Description
35	Stop Tx
30 1	Set to 5 GHz band
112 0	Set to 20 MHz bandwidth
12 36	Set to Ch 36
22 6 10 1	Set target power level to 10 dBm using calibration data on Ch 6
35 1 13 1 100 908	Tx at 54 Mbps with 100 µs burst gap and 2312 bytes PSDU length
35	Stop Tx

6.35.3.2 Rx, 5 GHz, 20 MHz bandwidth, Ch 36

Table 11. 802.11a test sequence - Rx, 5 GHz, 20 MHz bandwidth, Ch 36

Command	Description
35	Stop Tx
30 1	Set to 5 GHz band
112 0	Set to 20 MHz bandwidth
12 36	Set to Ch 36
31	Clear received packet count
Transmit Wi-Fi packets from tester	
32	Get Rx packet count and clear Rx packet counter

6.35.3.3 RSSI, 5 GHz, 20 MHz bandwidth, Ch 36

Table 12. 802.11a test sequence - RSSI, 5 GHz, 40 MHz Bandwidth, Ch 36

Command	Description
35	Stop Tx
30 1	Set to 5 GHz band
112 0	Set to 20 MHz bandwidth
12 36	Set to Ch 36
198	Start RSSI data collection
Transmit Wi-Fi packets from tester	
199	Stop RSSI data collection and report the result

6.35.4 802.11n test sequences

6.35.4.1 Tx, 2.4 GHz, 20 MHz bandwidth, MCS7 data rate, Ch 6 at 10 dBm

Table 13. 802.11n test sequence - Tx, 2.4 GHz, 20 MHz bandwidth, MCS7 data rate, Ch 6 at 10 dBm

Command	Description
35	Stop Tx
30 0	Set to 2.4 GHz band
112 0	Set to 20 MHz bandwidth
12 6	Set to Ch 6
22 6 10 2	Set target power level to 10 dBm using calibration data on Ch 6
35 1 22 1 100 F00	Tx at MCS7with 100 µs burst gap and 3840 bytes PSDU length
35	Stop Tx

6.35.4.2 Tx, 2.4 GHz, 40 MHz bandwidth, MCS7 data rate, Ch 6/10 (bonded pair) at 10 dBm

Table 14. 802.11n test sequence - Tx, 2.4 GHz, 40 MHz bandwidth, MCS7 data rate, Ch 6/10 (bonded pair) at 10 dBm

Command	Description
35	Stop Tx
30 0	Set to 2.4 GHz band
112 1	Set to 40 MHz bandwidth
12 6	Set to Ch 6 Ch 6 is lower bonded pair. Ch 10 is higher bonded pair. Set lower channel in 40 MHz mode.
22 6 10 2	Set target power level to 10 dBm using calibration data on Ch 6
35 1 22 1 100 F00	Tx at MCS7with 100 µs burst gap and 3840 bytes PSDU length
35	Stop Tx

6.35.4.3 Tx, 5 GHz, 20 MHz bandwidth, MCS7 data rate, Ch 36 at 10 dBm

Table 15. 802.11n test sequence - Tx, 5 GHz, 20 MHz bandwidth, MCS7 data rate, Ch 36 at 10 dBm

Command	Description
35	Stop Tx
30 1	Set to 5 GHz band
112 0	Set to 20 MHz bandwidth
12 36	Set to Ch 36
22 6 10 2	Set target power level to 10 dBm using calibration data on Ch 6
35 1 22 1 100 F00	Tx at MCS7with 100 µs burst gap and 3840 bytes PSDU length
35	Stop Tx

6.35.4.4 Tx, 5 GHz, 40 MHz bandwidth, MCS7 data rate, Ch 36/40 (bonded pair) at 10 dBm

Table 16. 802.11n test sequence - Tx, 5 GHz, 40 MHz bandwidth, MCS7 data rate, Ch 36/40 (bonded pair) at 10 dBm

Command	Description
35	Stop Tx
30 1	Set to 5 GHz band
112 1	Set to 40 MHz bandwidth
12 36	Set to Ch 36 Ch 36 is lower bonded pair. Ch 40 is higher bonded pair. Set lower channel in 40 MHz mode.
22 6 10 2	Set target power level to 10 dBm using calibration data on Ch 6
35 1 22 1 100 F00	Tx at MCS7with 100 µs burst gap and 3840 bytes PSDU length
35	Stop Tx

6.35.4.5 Rx, 2.4 GHz, 20 MHz bandwidth, Ch 6

Table 17. 802.11n test sequence - Rx, 2.4 GHz, 20 MHz bandwidth, Ch 6

Command	Description
35	Stop Tx
30 0	Set to 2.4 GHz band
112 0	Set to 20 MHz bandwidth
12 6	Set to Ch 6
31	Clear received packet count
Transmit Wi-Fi packets from tester	
32	Get Rx packet count and clear Rx packet counter

6.35.4.6 RSSI, 2.4 GHz, 20 MHz bandwidth, Ch 6

Table 18. 802.11n test sequence - RSSI, 2.4 GHz, 20 MHz Bandwidth, Ch 6

Command	Description
35	Stop Tx
30 0	Set to 2.4 GHz band
112 0	Set to 20 MHz bandwidth
12 6	Set to Ch 6
198	Start RSSI data collection
Transmit Wi-Fi packets from tester	
199	Stop RSSI data collection and report the result

6.35.4.7 Rx, 2.4 GHz, 40 MHz bandwidth, Ch 6/10 (bonded pair)

Table 19. 802.11n test sequence - Rx, 2.4 GHz, 40 MHz bandwidth, Ch 6/10 (bonded pair)

Command	Description
35	Stop Tx
30 0	Set to 2.4 GHz band
112 1	Set to 40 MHz bandwidth
12 6	Set to Ch 6 Ch 6 is lower bonded pair. Ch 10 is higher bonded pair. Set lower channel in 40 MHz mode.
31	Clear received packet count
Transmit Wi-Fi packets from tester	
32	Get Rx packet count and clear Rx packet counter

6.35.4.8 RSSI, 2.4 GHz, 40 MHz bandwidth, Ch6/10 (bonded pair)

Table 20. 802.11n test sequence - RSSI, 2.4 GHz, 40 MHz Bandwidth, Ch 6/10 (bonded pair)

Command	Description
35	Stop Tx
30 0	Set to 2.4 GHz band
112 1	Set to 40 MHz bandwidth
12 6	Set to Ch 6 Ch 6 is the lower bonded pair and Ch 10 is the higher bonded pair. Set the lower channel in 40 MHz mode
198	Start RSSI data collection
Transmit Wi-Fi packets from tester	
199	Stop RSSI data collection and report the result

6.35.4.9 Rx, 5 GHz, 20 MHz bandwidth, Ch 36

Table 21. 802.11n test sequence - Rx, 5 GHz, 20 MHz bandwidth, Ch 36

Command	Description
35	Stop Tx
30 1	Set to 5 GHz band
112 0	Set to 20 MHz bandwidth
12 36	Set to Ch 36
31	Clear received packet count
Transmit Wi-Fi packets from tester	
32	Get Rx packet count and clear Rx packet counter

6.35.4.10 RSSI, 5 GHz, 20 MHz bandwidth, Ch 36

Table 22. 802.11n test sequence - RSSI, 5 GHz, 40 MHz Bandwidth, Ch 36

Command	Description
35	Stop Tx
30 1	Set to 5 GHz band
112 0	Set to 20 MHz bandwidth
12 36	Set to Ch 36
198	Start RSSI data collection
Transmit Wi-Fi packets from tester	
199	Stop RSSI data collection and report the result

6.35.4.11 Rx, 5 GHz, 40 MHz bandwidth, Ch 36/40 (bonded pair)

Table 23. 802.11n test sequence - Rx, 5 GHz, 40 MHz bandwidth, Ch 36/40 (bonded pair)

Command	Description
35	Stop Tx
30 1	Set to 5 GHz band
112 1	Set to 40 MHz bandwidth
12 36	Set to Ch 36 Ch 36 is lower bonded pair. Ch 40 is higher bonded pair. Set lower channel in 40 MHz mode.
31	Clear received packet count
Transmit Wi-Fi packets from tester	
32	Get Rx packet count and clear Rx packet counter

6.35.4.12 RSSI, 5 GHz, 40 MHz bandwidth, Ch 36/40 (bonded pair)

Table 24. 802.11n test sequence - RSSI, 5 GHz, 40 MHz Bandwidth, Ch 36/40 (bonded pair)

Command	Description
35	Stop Tx
30 1	Set to 5 GHz band
112 1	Set to 40 MHz bandwidth
12 36	Set to Ch 36 Ch 36 is the lower bonded pair and Ch 40 is the higher bonded pair. Set the lower channel in 40 MHz mode
198	Start RSSI data collection
Transmit Wi-Fi packets from tester	
199	Stop RSSI data collection and report the result

7 Bluetooth Labtool commands

Table 25 shows a summary of the commands available.

Table 25. Bluetooth Labtool command summary

Command
Command 11: Get Bluetooth channel
Command 12: Set Bluetooth channel
Command 15: Get power level value
Command 16: Set power level value
Command 17: Set continuous modulated Tx
Command 21: Step power level
Command 31: Get Rx result report
Command 32: Set Rx test
Command 45: Read BD address from storage
Command 46: Write BD address to storage
Command 78: Set test mode
Command 80: Reset Bluetooth hardware
Command 88: Get firmware/hardware version
Command 99: Exit Labtool application
Command 113: Get power control class
Command 114: Set power control class
Command 115: Get disable Bluetooth baseband unit power control
Command 116: Set disable Bluetooth baseband unit power control
Command 125: Set Bluetooth LE Tx test
Command 126: Get Bluetooth LE Tx test packet count
Command 127: Set Bluetooth LE Rx test
Command 129: Stop Bluetooth LE test
Command 133: Set Bluetooth LE Tx power
Command 225: Set Tx duty cycle
Command 234: Reload Bluetooth calibration data

7.1 Command 11: Get Bluetooth channel

This command gets the Bluetooth channel in use.

Syntax: `11`

Return data: Channel in use

7.2 Command 12: Set Bluetooth channel

This command places the device on a specific channel.

Syntax: `12 <Channel>`

Where:

Command parameter	Description
`Channel`	Channel number (0 to 78)

Example

`12 7` // Sets Ch 7 (desired channel for testing)

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

7.3 Command 15: Get power level value

This command returns the power level value in 0.5 dB steps.

Syntax: `15`

Return data: Power level value (in 0.5 dB steps)

7.4 Command 16: Set power level value

This command sets the power level value in 0.5 dB steps.

Syntax: `16 <pwr> <isEDR>`

Where:

Command parameter	Description
pwr	Power Level (in 0.5 dB step)
isEDR	Data rate flag 0 = BDR/Bluetooth LE 1 = EDR

Examples

`16 2.5 0` // Sets BDR power as 2.5 dBm

`16 4 1` // Sets EDR power as 4 dBm for Bluetooth Class 2 and 1 dBm for Bluetooth Class 1.5

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

Note:

The result of this command depends on the Bluetooth Class, FE_Loss, and initial power level set in the calibration data file.

For Bluetooth Class 1.5, Enhanced Data Rate (EDR) Tx power is 3 dBm less than Basic Data Rate (BDR) Tx power.

For Bluetooth Class 2, EDR Tx power is same as BDR Tx power.

7.5 Command 17: Set continuous modulated Tx

This command transmits the continuous modulated signal.

Syntax: `17 <Enable> <DataRate> <PayloadPattern>`

Where:

Command parameter	Description
`Enable`	Mode enable 0 = disable (default) 1 = enable
`DataRate`	Data Rate 0x1 = 1 Mbit/s (GFSK) (default) 0x2 = 2 Mbit/s (DQPSK) 0x3 = 3 Mbit/s (8PSK)
`PayloadPattern`	Pattern 00 = 11110000 01 = 0101 10 = PN9

Example

`17 1 3 2` // Enables the device to transmit continuous modulated signal with 3 Mbit/s data rate, PN9 payload pattern.

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

7.6 Command 21: Step power level

This command increases/decreases the power level in steps.

Syntax: `21 <Step>`

Where:

Command parameter	Description
`Step`	Step power level (in 0.5 dBm step)

Example

`21 -2.5` // Steps power level as -2.5 dBm. After this command, the power level decreases by 2.5 dBm

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

7.7 Command 31: Get Rx result report

This command returns the Rx result report including Bit Error Rate (BER) and Packet Error Rate (PER).

Syntax: `31`

Return data:

- BER 0%
- PER 0%

7.8 Command 32: Set Rx test

This command sets the Rx test.

Syntax: `32 <RxChannel> <FrameCount> <PayloadLength> <PacketType> <PayloadPattern> <TxBdAddress>`

Where:

Command parameter	Description
`RxChannel`	Rx Channel. Default is 10.
`FrameCount`	Number of frames to Rx. Default is 1000.
`PayloadLength`	Length of Payload (in bytes). Default is -1 (maximum for PacketType)
`PacketType`	Packet Type 0x01 = DM1 (GFSK, 1M FEC) 0x03 = DM3 (GFSK, 1M FEC) 0x05 = DM5 (GFSK, 1M FEC) 0x11 = DH1 (GFSK, 1M) 0x13 = DH3 (GFSK, 1M) 0x15 = DH5 (GFSK, 1M) 0x21 = 2-DH1 (DQPSK, 2M) 0x23 = 2-DH3 (DQPSK, 2M) 0x25 = 2-DH5 (DQPSK, 2M) 0x31 = 3-DH1 (8PSK, 3M) 0x33 = 3-DH3 (8PSK, 3M) 0x35 = 3-DH5 (8PSK, 3M) (default)
`PayloadPattern`	Payload Pattern 0x0 = all 0x01 = all 0x2 = PN9 (default) 0x3 = 0xAA 0x4 = 0xF0
`TxBdAddress`	BD Address of Tx Default is 00.00.88.C0.FF.EE.

Example

```
32 10 10 -1 35 2 00.00.88.C0.FF.EE
```

Sets Rx Test in Ch 10, 10 packets with maximum payload (-1) in packet type 3-DH5, with pattern PN9, to BD address 00.00.88.C0.FF.EE.s

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

7.9 Command 45: Read BD address from storage

This command returns the Bluetooth Device (BD) address from OTP or a configuration file.

Syntax: `45`

Return data: BD address

7.10 Command 46: Write BD address to storage

This command writes the BD address to storage or a configuration file.

Syntax: `46 <BD Address>`

Where:

Command parameter	Description
`BD Address`	Bluetooth device (BD) address in xx.xx.xx.xx.xx.xx format

Example

`46 C0.95.DA.00.43.61` // Writes BD address into storage/configuration file

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

7.11 Command 78: Set test mode

This command enables/disables Bluetooth loopback test mode (link mode).

Syntax: `78 <Enable>`

Where:

Command parameter	Description
`Enable`	Mode enable 0 = disable 1 = enable

Example(s)

`78 1` // Enables Bluetooth device "in loopback" test mode

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

7.12 Command 80: Reset Bluetooth hardware

This command resets the Bluetooth RF block.

Syntax: `80`

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

7.13 Command 88: Get firmware/hardware version

This command returns the firmware, hardware, and Labtool versions.

Syntax: `88`

Return data:

- DLL version: 1.0.0.10
- Labtool version: 1.0.0.10
- Firmware version: 16.80.10.127
- Mfg Version: 1.0.0.10

7.14 Command 99: Exit Labtool application

This command exits either the Wi-Fi or Bluetooth menu. Enter the command 99 a second time to exit the Labtool application and close the command prompt window.

Syntax: `99`

Return data: --

7.15 Command 113: Get power control class

This command gets the power control class in use.

Syntax: `113`

Example(s)

`114 0` // Sets the power control class to Class 2

Return data: Value for the power control class

- 0 = Class 2
- 1 = Class 1

Note: *For Class 1 operation, IW416 max transmit power is 13 dBm at pin.*

7.16 Command 114: Set power control class

This command sets the power control class.

Syntax: `114 <Mode>`

Where:

Command parameter	Description
Mode	Power control class mode 0 = Class2 1 = Class 1.5[1]

[1] Class 1.5 refers to Bluetooth class 1 operation. However in this mode, IW416 max transmit power is 13 dBm at pin.

Example

`114 0` // Sets power control class to Class2

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

7.17 Command 115: Get disable Bluetooth baseband unit power control

This command returns Bluetooth baseband unit power control status (enabled/disabled).

Syntax: `115`

Return data: Bluetooth baseband unit power control status (enabled/disabled)

7.18 Command 116: Set disable Bluetooth baseband unit power control

This command sets disable Bluetooth baseband unit power control.

Syntax: `116 <Mode>`

Where:

Command parameter	Description
Mode	Mode enable 0 = disable (default) 1 = enable

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

7.19 Command 125: Set Bluetooth LE Tx test

This command sets the Bluetooth Low Energy (LE) Tx test.

Syntax: `125 <FreqIndex> <Len> <Pattern> <Phy>`

Where:

Command parameter	Description
`FreqIndex`	Frequency index 0x00 = 2042 MHz 0x01 = 2404 MHz ... 0x39 = 2480 MHz
`Len`	Payload data length Range: 0 to 37. Default is 37.
`Pattern`	Payload data pattern 0x0 = PN9 0x1 = 0xF0 0x2 = 0xAA 0x3 = PN15 0x4 = all 1 0x5 = all 0 0x6 = 0x0F 0x7 = 0x55
`Phy`	Data rate 1 = 1M 2 = 2M 3 = LR8 4 = LR2

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

7.20 Command 126: Get Bluetooth LE Tx test packet count

This command gets the Tx test packet counts after the Bluetooth LE Tx test.

Syntax: `126`

Return data: Tx packet count

7.21 Command 127: Set Bluetooth LE Rx test

This command sets Bluetooth Low Energy (LE) Rx test.

Syntax: `127 <FreqIndex>`

Where:

Command parameter	Description
`FreqIndex`	Frequency Index 0x00 = 2042 MHz 0x01 = 2404 MHz ... 0x39 = 2480 MHz

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

7.22 Command 129: Stop Bluetooth LE test

This command stops the Bluetooth LE Tx/Rx test. It is always used after the Bluetooth LE Tx/Rx test (Section 7.19 "Command 125: Set Bluetooth LE Tx test" and Section 7.21 "Command 127: Set Bluetooth LE Rx test", respectively).

Syntax: `129`

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

7.23 Command 133: Set Bluetooth LE Tx power

This command sets the Bluetooth LE Tx power level value.

Syntax: `133 <pwr>`

Where:

Command parameter	Description
`pwr`	Tx Power (dBm) - Default is 0.

Example(s)

`133 6` // Sets Bluetooth LE power level as 6 dBm

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

7.24 Command 225: Set Tx duty cycle

This command sets the transmit duty cycle.

Syntax: `225 <Enable> <PacketType> <PayloadPattern> <PayloadLenInByte> <HopMode> <Interval> <Whitening> <ChannelAccessMode>`

Where:

Command parameter	Description
`Enable`	Mode enable 0 = disable (default) 1 = enable
`PacketType`	Packet type Test Pattern and ACL: 0x01 = DM1 (GFSK, 1M FEC) 0x03 = DM3 (GFSK, 1M FEC) 0x05 = DM5 (GFSK, 1M FEC) 0x11 = DH1 (GFSK, 1M) 0x13 = DH3 (GFSK, 1M) 0x15 = DH5 (GFSK, 1M) 0x21 = 2-DH1 (DQPSK, 2M) 0x23 = 2-DH3 (DQPSK, 2M) 0x25 = 2-DH5 (DQPSK, 2M) 0x31 = 3-DH1 (8PSK, 3M) 0x33 = 3-DH3 (8PSK, 3M) 0x35 = 3-DH5 (8PSK, 3M) SCO: 0x11 = HV1 (GFSK, 1M) (default) 0x12 = HV2 (GFSK, 1M) 0x13 = HV3 (GFSK, 1M) eSCO: 0x13 = EV3 (DQPSK, 1M) 0x14 = EV4 (DQPSK, 1M) 0x15 = EV5 (DQPSK, 1M) 0x23 = 2-EV3 (DQPSK, 2M) 0x25 = 2-EV5 (DQPSK, 2M) 0x33 = 3-EV3 (8PSK, 2M) 0x35 = 3-EV5 (8PSK, 2M)
`PayloadPattern`	Payload data pattern 0x0 = all 0 0x1 = all 1 0x2 = PN9 (default) 0x3 = 0xAA 0x4 = 0xF0 0x5 = PRBS 0x6 = PRBS SCO 0x7 = PRBS eSCO
`PayloadLenInByte`	Packet type dependent Default is -1 (maximum possible)

Command parameter	Description
`HopMode`	0 = fixed channel (default) 1 = random hopping
`Interval`	User-defined test interval. The default is 1
`Whitening`	Whitening whole packet 0 = disable (default) 1 = enable
`ChannelAccessMode`	Channel access mode Specify if a channel hopped into a hop mode. Default is 0x7FFFFFFFFFFFFFFFFFFF (all on) Bit[78]: Ch 78 ... Bit[0]: Ch 0 0 = off 1 = on

Return data: xx or

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

7.25 Command 234: Reload Bluetooth calibration data

This command reloads the Bluetooth calibration data to make the modified Bluetooth calibration data valid after the Bluetooth calibration data in "*WlanCalData_ext.conf*" is modified.

Syntax: `234`

Return data:

- Successful command: all-0 status byte (0x00000000)
- Failed command: non-0 status byte (0x00000001 to 0xFFFFFFFF)

7.26 Bluetooth RF test examples

This section shows some examples of Labtool command sequences for various Bluetooth RF tests.

7.26.1 Bluetooth BDR test sequences

7.26.1.1 BDR Tx, Ch 0 at 4 dBm, DH1 packet type

Table 26. Bluetooth test sequence - BDR Tx, Ch 0 at 4 dBm, DH1 packet type

Command	Description
234	Reload Bluetooth calibration data
80	Reset Bluetooth RF block
116 1	Set disable Bluetooth baseband power control
114 1	Set to Class 1.5
16 4 0	Set to BDR power to 4 dBm
12 0	Set to Ch 0
225 1 11	Tx with DH1 packet type
225	Stop Tx

7.26.1.2 BDR Rx, Ch 10

Table 27. Bluetooth BDR test sequence - BDR Rx, Ch 10

Command	Description
234	Reload Bluetooth calibration data
80	Reset Bluetooth RF block
Connect system to Bluetooth tester: • Set generator file • Set Bluetooth channel to Ch 10 • Set signal level at -70 dBm	
`32 10 10 -1 15 2 00.00.88.C0.FF.EE` Receive 10 packets of DH5 with maximum payload length, PN9 pattern on Ch 10, BD address is `00.00.88.C0.FF.EE`	
Transmit packets from Bluetooth tester	
31	Return Rx result report

7.26.2 Bluetooth EDR test sequences

7.26.2.1 EDR Tx, Ch 78 at 4 dBm, 3-DH5 packet type

Table 28. Bluetooth test sequence - EDR Tx, Ch 78 at 4 dBm, 3-DH5 packet type

Command	Description
234	Reload Bluetooth calibration data
80	Reset Bluetooth RF block
116 1	Set disable Bluetooth baseband power control
114 1	Set to Class 1.5
16 7 1	Set to EDR power to 4 dBm
12 78	Set to Ch 78
225 1 35	Tx with 3-DH5 packet type
225	Stop Tx

7.26.2.2 EDR Rx, Ch 10

Table 29. Bluetooth test sequence - EDR Rx, Ch 10

Command	Description
234	Reload Bluetooth calibration data
80	Reset Bluetooth RF block
Connect system to Bluetooth tester: • Set generator file • Set Bluetooth channel to Ch 10 • Set signal level at -70 dBm	
`32 10 10 -1 35 2 00.00.88.C0.FF.EE` Receive 10 packets of 3-DH5 with maximum payload length, PN9 pattern on Ch 10, BD address is `00.00.88.C0.FF.EE`	
Transmit packets from Bluetooth tester	
31	Return Rx result report

7.26.3 Bluetooth LE test sequences

7.26.3.1 Bluetooth LE Tx, Ch 39 at 6 dBm

Table 30. Bluetooth test sequence - Bluetooth LE Tx, Ch 39 at 6 dBm, 1M

Command	Description
234	Reload Bluetooth calibration data
80	Reset Bluetooth RF block
133 6	Set LE power to 6 dBm
125 39 37 0 1	Tx on Ch 39, packet length 37, packet pattern PN9, data rate 1M
129	Stop Tx
126	Get Tx packet count

Table 31. Bluetooth test sequence - Bluetooth LE Tx, Ch 39 at 6 dBm, 2M

Command	Description
234	Reload Bluetooth calibration data
80	Reset Bluetooth RF block
133 6	Set LE power to 6 dBm
125 39 37 0 2	Tx on Ch 39, packet length 37, packet pattern PN9, data rate 2M
129	Stop Tx
126	Get Tx packet count

Table 32. Bluetooth test sequence - Bluetooth LE Tx, Ch 39 at 6 dBm, LR8

Command	Description
234	Reload Bluetooth calibration data
80	Reset Bluetooth RF block
133 6	Set LE power to 6 dBm
125 39 37 0 3	Tx on Ch 39, packet length 37, packet pattern PN9, data rate LR8
129	Stop Tx
126	Get Tx packet count

Table 33. Bluetooth test sequence - Bluetooth LE Tx, Ch 39 at 6 dBm, LR2

Command	Description
234	Reload Bluetooth calibration data
80	Reset Bluetooth RF block
133 6	Set LE power to 6 dBm
125 39 37 0 4	Tx on Ch 39, packet length 37, packet pattern PN9, data rate LR2
129	Stop Tx
126	Get Tx packet count

7.26.3.2 Bluetooth LE Rx, Ch 39

Table 34. Bluetooth test sequence - Bluetooth LE Rx, Ch 39, 1M

Command	Description
234	Reload Bluetooth calibration data
80	Reset Bluetooth RF block
127 39 1	Rx on Ch 39, 1M
Configure Bluetooth tester to transmit x number of packets	
129	Stop Rx test
126	Get Rx test error

Table 35. Bluetooth test sequence - Bluetooth LE Rx, Ch 39, 2M

Command	Description
234	Reload Bluetooth calibration data
80	Reset Bluetooth RF block
127 39 2	Rx on Ch 39, 2M
Configure Bluetooth tester to transmit x number of packets	
129	Stop Rx test
126	Get Rx test error

Table 36. Bluetooth test sequence - Bluetooth LE Rx, Ch 39, LR8

Command	Description
234	Reload Bluetooth calibration data
80	Reset Bluetooth RF block
127 39 3	Rx on Ch 39, LR8
Configure Bluetooth tester to transmit x number of packets	
129	Stop Rx test
126	Get Rx test error

Table 37. Bluetooth test sequence - Bluetooth LE Rx, Ch 39, LR2

Command	Description
234	Reload Bluetooth calibration data
80	Reset Bluetooth RF block
127 39 4	Rx on Ch 39, LR2
Configure Bluetooth tester to transmit x number of packets	
129	Stop Rx test
126	Get Rx test error

8 Conversion tables

This section provides the conversion tables for RF channels and data rates.

8.1 RF channels

Table 38 shows the RF conversion values for 2.4 GHz and 5 GHz channels.

Table 38. RF channel conversion

Channel	Frequency	Channel	Frequency	Channel	Frequency
2.4 GHz channels					
1	2412 MHz	2	2417 MHz	3	2442 MHz
4	2427 MHz	5	2432 MHz	6	2437 MHz
7	2442 MHz	8	2447 MHz	9	2452 MHz
10	2457 MHz	11	2462 MHz	12	2467 MHz
13	2472 MHz	—	—	—	—
5 GHz channels					
8 (JP)	5040 MHz	12 (JP)	5060 MHz	16 (JP)	5080 MHz
34 (JP)	5170 MHz	38 (JP)	5190 MHz	42 (JP)	5210 MHz
46 (JP)	5230 MHz	184 (JP)	5920 MHz	188 (JP)	4940 MHz
192 (JP)	4960 MHz	196 (JP)	4980 MHz	—	—
36	5180 MHz	40	5200 MHz	44	5220 MHz
48	5240 MHz	52	5260 MHz	56	5280 MHz
60	5300 MHz	64	5320 MHz	100	5500 MHz
104	5520 MHz	108	5540 MHz	112	5560 MHz
116	5580 MHz	120	5600 MHz	124	5620 MHz
128	5640 MHz	132	5660 MHz	136	5680 MHz
140	5700 MHz	149	5645 MHz	153	5765 MHz
157	5785 MHz	161	5805 MHz	165	5825 MHz

8.2 Data rates

Table 39 provides the data rate values.

Table 39. Data rate values

ID	Data rate	ID	Data rate	ID	Data rate	ID	Data rate
1	1 Mbit/s	7	9 Mbit/s	13	54 Mbit/s	19	HT_MCS4
2	2 Mbit/s	8	12 Mbit/s	14	Reserved	20	HT_MCS5
3	5.5 Mbit/s	9	18 Mbit/s	15	HT_MCS0	21	HT_MCS6
4	11 Mbit/s	10	24 Mbit/s	16	HT_MCS1	22	HT_MCS7
5	Reserved	11	36 Mbit/s	17	HT_MCS2	—	—
6	6 Mbit/s	12	48 Mbit/s	18	HT_MCS3	—	—

9 Acronyms and abbreviations

Table 40. Acronyms and abbreviations

Acronym	Definition
ACL	Access Control List
API	Application Programming Interface
BCC	Block Check Character
BD	Bluetooth Device
BDR	Basic Data Rate
BER	Bit Error Rate
BSS	Basic Service Set
BSSID	Basic Service Set ID
CCK	Complementary Code Keying
CLI	Command Line Interface
CW	Continuous Wave
DPD	Deep Power Down
DQPSK	Differential Quadrature Phase Shift Keying
DUT	Device Under Test
EDR	Enhanced Data Rate
EEPROM	Electrically Erasable Programmable Read Only Memory
eSCO	Extended Synchronous Connection
FAE	Field Application Engineer
FER	Frame Error Rate
GCC	GNU Compiler Collection
GFSK	Gaussian Frequency Shift Keying
GI	Guard Interval
GNU	Gnu’s Not Unix
IP	Internet Protocol
LDPC	Low-Density Parity Check
MAC	Media/Medium Access Controller
MCS	Modulation and Coding Scheme
MFG	Manufacturing
NF	Noise floor
OFDM	Orthogonal Frequency Division Multiplexing
OTP	One Time Programmable
PC	Personal Computer
PCIe	Peripheral Component Interconnect Express
PER	Packet Error Rate

Table 40. Acronyms and abbreviations...*continued*

Acronym	Definition
PLCP	Physical Layer Convergence Protocol
PRBS	Pseudo-Random Binary Sequence
PSDU	PLCP Service Data Unit
PSK	Phase Shift Keying
RF	Radio Frequency
RSSI	Received Signal Strength Indicator
Rx	Receive
SCO	Synchronous Connection Oriented
SDIO	Secure Digital Input/Output
SIFS	Short Interframe Space
SLP	Service location protocol
SoC	System-on-Chip
STBC	Space-Time Block Code
TCP	Transmission Control Protocol
Tx	Transmit
UART	Universal Asynchronous Receive/Transmitter
UDP	User Datagram Protocol
USB	Universal Serial Bus
VHT	Very High Throughput
VSA	Vector Signal Analyzer
Wi-Fi	Hardware implementation of IEEE 802.11 for wireless connectivity
WLAN	Wireless Local Area Network
XTAL	Crystal

10 Legal information

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