Test Plan for RF Performance Evaluation of Wi-Fi® Mobile Converged Devices

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Use Instructions

All testing to this test plan must be conducted in a CTIA Certification and Wi-Fi Alliance Authorized Test Lab.

This may be accomplished in one of three ways:

1. As part of a PTCRB certification request submitted at https://www.ptcrb.com/
2. By submitting an OTA Test Plan use request at https://certify.ctiacertification.org/
3. By completing a Wi-Fi Alliance CWG test application at https://www.cert.wi-fi.org/

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Section 1 Introduction

1.1 Background

Increasingly, the wireless market is seeing converged devices that incorporate both cellular and wireless local area network (WLAN or Wi-Fi®) functionality. Due to the many potential applications and deployment scenarios that converged devices may ultimately function in, operators and device vendors are interested in a uniform and standard way for profiling the RF performance of the devices and associated test methodology. With this standard approach, equipment designers, system operators, and RF engineers have the flexibility to determine their own appropriate RF performance criteria based on their engineering assessments and can easily identify equipment that is suitable for each deployment and application.

1.2 Scope

This test document specifies test methodologies and performance criteria for the RF performance evaluation of Wi-Fi mobile converged devices. The scope of testing includes Handheld, self-contained Wi-Fi/Mobile Module, Access Point, Notebook and Tablet devices that support IEEE 802.11a, 802.11b, 802.11g, 802.11n, 802.11ac [9] and/or 802.11ax [16] as well as cellular technologies. Support for IEEE 802.11 standards shall be confirmed through Wi-Fi Alliance® baseline certification [17]—that is, devices tested using this test plan shall first be Wi-Fi CERTIFIED™ for IEEE 802.11a, 802.11b, 802.11g, 802.11n, 802.11ac and/or 802.11ax [16]. Cellular technologies include GSM, UMTS (WCDMA), LTE and NR.

This document relies on the measurement techniques and methodologies within the *CTIA Certification Test Plan for Wireless Device Over-the-Air Performance* [1] (referred to in this document hereafter as "CTIA Certification OTA Test Plan").

1.3 Purpose

The purpose of this document is to define the test methodology for the RF testing of Wi-Fi mobile converged devices and to specify the test conditions for each test case. The testing covers client devices and access points and specifies conducted as well as radiated tests.

1.4 References

[1] "CTIA Certification Test Plan for Wireless Device Over-the-Air Performance Suite", CTIA Certification, https://ctiacertification.org/test-plans/

[2] "CTIA 01.01, Test Scope, Requirements, and Applicability", CTIA Certification, https://ctiacertification.org/test-plans/

[3] "CTIA 01.20, Test Methodology, SISO, Anechoic Chamber", CTIA Certification, https://ctiacertification.org/test-plans/

[4] "CTIA 01.50, Wireless Technology, 3GPP Radio Access Technologies", CTIA Certification, https://ctiacertification.org/test-plans/

[5] "CTIA 01.70, Measurement Uncertainty", CTIA Certification, https://ctiacertification.org/test-plans/

[6] "CTIA 01.71, Device Setup and Positioning Guidelines", CTIA Certification, https://ctiacertification.org/test-plans/

[7] "CTIA 01.72, Near-Field Phantoms", CTIA Certification, https://ctiacertification.org/test-plans/

[8] "CTIA 01.73, Supporting Procedures", CTIA Certification, https://ctiacertification.org/test-plans/

[9] "IEEE Std. 802.11™-2020 IEEE Standard for Information technology--Telecommunications and information exchange between systems Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications", December 2020 IEEE https://standards.ieee.org/standard/802_11-2020.html

http://standards.ieee.org/about/get

[10] "User Equipment (UE) / Mobile Station (MS) Over The Air (OTA) antenna performance; Conformance testing (3GPP TS 34.114)", Latest Revision,

3GPP http://www.3gpp.org/DynaReport/34114.htm

[11] Check the product's Wi-Fi CERTIFIED Interoperability Certificate at:

https://www.wi-fi.org/product-finder

[12] RFC 792 "Internet Control Message Protocol", IETF, September 1981

https://tools.ietf.org/html/rfc792

[13] RFC 1122 "Requirements for Internet Hosts – Communication Layers", IETF, October 1989.

https://tools.ietf.org/html/rfc1122

[14] OPERATION IN U-NII BANDS –802.11 CHANNEL PLAN (§15.407)

FCC 905462 D06 802 11 Channel Plans New Rules v02

[15] 5 GHz RLAN; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

ETSI ETSI EN 301 893 V2.1.1 (2017-05)

[16] "IEEE Std 802.11ax™-2021, IEEE Standard for Information Technology—Telecommunications and Information Exchange between Systems Local and Metropolitan Area Networks— Specific Requirements, Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications, Amendment 1: Enhancements for High-Efficiency WLAN", February 2021.

[17] Wi-Fi Alliance certification Test plans: https://www.wi-fi.org/members/certification-programs/wi-fi-alliance-test-plans

1.5 Test Nomenclature Overview

1.5.1 Conducted RF Tests

Conducted tests are those RF Tests where the test equipment is connected to the antenna connector of the device under test by co-axial cables. These tests are formulated to measure basic RF performance such as sensitivity and transmit power.

1.5.2 Radiated RF Tests

Radiated tests are those RF Tests that are carried out in a test environment which meets the requirements of the *CTIA Certification Test Plan for Wireless Device Over-the-Air Performance* [1]. These include Wi-Fi radiated TX Power (TRP), Wi-Fi radiated Receive Sensitivity (TIS), Radiated Receive Sensitivity of Wi-Fi with cellular active, and Radiated Receive Sensitivity of the cellular radio(s) with Wi-Fi active.

1.5.3 Desensitization Tests

Desensitization tests measure the impact that the cellular radio, when transmitting, has upon Wi-Fi reception and vice-versa. These tests are performed as radiated tests according to Device Testing Configurations.

1.6 Baseline Methodology

1.6.1 Measurement Techniques and Test Methodologies

TRP and TIS in cellular mode are defined in both the *CTIA Certification Test Plan for Wireless Device Over-the-Air Performance* [1] and *User Equipment (UE) / Mobile Station (MS) Over The Air (OTA) antenna performance; Conformance testing* (3GPP TS 34.114) [10].

This document relies on the measurement techniques and methodologies within the *CTIA Certification Test Plan for Wireless Device Over-the-Air Performance* [1] developed specifically for the purposes of measurement of radiated transmit power and sensitivity. The techniques specified in the *CTIA Certification Test Plan for Wireless Device Over-the-Air Performance* [1] shall be used as the baseline test methodologies for all tests in here, unless otherwise stated. This document contains information to expand the *CTIA Certification Test Plan for Wireless Device Over-the-Air Performance* [1] for use with 802.11 a, b, g, n, ac and ax devices. Since the physical layer characteristics of 802.11n at 5GHz band and 802.11ac are the same for the specified test conditions, for the purposes of this test plan, an 802.11ac device shall be tested as an 802.11n device in 5GHz band. In the test procedures described below, 802.11ac devices shall be tested following the same test procedures and conditions as an 802.11n device. These sections are meant to clarify for the user how the *CTIA Certification OTA Test Plan* [1] can be utilized for Wi-Fi enabled converged devices.

1.6.2 Measurement Uncertainty

Refer to *CTIA 01.20* [3] Section 5 for the uncertainty budget tables for TRP and TIS. The lab shall report their estimated measurement uncertainty for both the 2.4, 5 GHz and 6GHz bands. For the 6GHz band, the measurement uncertainty of 5GHz is applicable until the measurement uncertainty analysis for 6GHz is available.

1.6.3 Minimum Measurement Distance

This section describes the minimum measurement distance, R, which the Far-Field test site shall provide. The measurement distance is defined as the distance from the center of rotation of the DUT to the phase center (alternatively, if not accurately known, the nearest point) of the Measurement Antenna.

For Cellular minimum measurement distance, refer to *CTIA 01.73* [8] Section 2. For Wi-Fi 2.4 GHz and 5 GHz bands, use the guidance for the minimum measurement distance for Band 41 and 46, respectively. For Wi-F 6 GHz bands, use the guidance for the minimum measurement distance for Band 46. Allowances for shorter measurements distances are described in *CTIA 01.70* [5] Section 2.9.4.

1.6.4 Quiet Zone Test Frequencies

Quiet zone test frequencies shall be measured for the following Wi-Fi bands.

1. ISM-band (2400-2483.5MHz): 2450 MHz ± 1MHz (sleeve dipole and loop probe antenna)
2. U-NII-band 5GHz (5150-5895MHz): 5500 MHz ± 1MHz (sleeve dipole and loop probe antenna)
3. U-NII-band 6GHz (5925-7125MHz): 6500 MHz ± 1MHz (sleeve dipole and loop probe antenna)

Note: For testing at 6GHz band, the existing quiet zone evaluation (*CTIA 01.73* [8]) is applicable without the need for additional uncertainty. This requirement waived until 6GHz analysis and loop probe antenna is available.

1.7 Form Factor Submission for Self-contained Wi-Fi/Mobile Modules

The following two cases are considered regarding the antenna subsystem options and required form factor submission for self-contained Wi-Fi/Mobile modules. Also, please refer to Appendix D for Notebook and Tablet.

The test results shall include a description and diagram or photograph of the test conditions used for the device under test.

CASE 1 with Internal Antenna: If the DUT is a self-contained Wi-Fi/Mobile Module with internal antennas, such as a PC Card, then the vendor may choose one of the following options:

1. Supply the DUT together with one of its intended host platforms, e.g., a laptop computer. In this case, the combination shall then be placed on the turntable and the results sheet shall clearly state the combination that was used in the measurements.
2. Test the Module, on its own, mounted in a holder that orientates the module in the position that represents its normal use. In this case the results sheet shall clearly state that the test did not include a host device.
3. Carry out both tests as above. This is the preferred method, but not mandatory.

CASE 2 without Internal Antenna: If the DUT is a self-contained Wi-Fi/Mobile Module without internal antennas, such as an mPCI Card, then the vendor shall supply the complete device, which includes the antennas, for testing. No individual module testing is acceptable.

1.8 List of Acronyms and Definitions

Acronym	Definition
ACK	Acknowledge
AP	Access Point
APSD	Automatic Power Save Delivery
BCC	Binary Convolutional Codes
CC	Convolutional Codes
EIS	Effective Isotropic Sensitivity
DUT	Device Under Test
GSM	Global System for Mobile communication
LAN	Local Area Network
LDPC	Low-Density Parity Check
LTE	Long Term Evolution
MIMO	Multiple Input Multiple Output
NR	New Radio
OFDMA	Orthogonal Frequency Division Multiple Access
PER	Packet Error Rate
PPDU	Physical Layer Protocol Data Unit
RAT	Radio Access Technology
RX	Receive
SA	StandAlone
TB	Trigger Base
TIS	Total Isotropic Sensitivity
TRP	Total Radiated Power
TX	Transmit
UMTS	Universal Mobile Telecommunications System
UTRA-FDD	UMTS Terrestrial Radio Access - Frequency Division Duplexing
UTRA-TDD	UMTS Terrestrial Radio Access - Time Division Duplexing

Acronym	Definition
WCDMA	Wideband Code Division Multiple Access
WLAN	Wireless Local Area Network
WMM	Wi-Fi Multimedia
WWAN	Wireless Wide Area Network

Item	Definition
Child Device	A Notebook platform utilizing an embedded WWAN Module, which is derived from a Parent Notebook platform. A Child Device is unique in that the only allowable changes relative to its Parent product are those applicable to the Notebook platform itself.
Module	Modules are finished WWAN radio devices that do not directly connect to a host via a standardized external interface such as PCMCIA, RS-232, USB, PCIExpress, etc. A module may or may not include an integral antenna system or SIM/USIM interface.
Notebook	See definition in *CTIA 01.01*.[2]
Parent	A device (of any type) from which a Child device can be derived.
Simultaneous operation	A Notebook/Tablet that is capable of simultaneous Wi-Fi/Cellular operation and the user experience is that both radios are on at the same time. An example would be Hot Spot operation.
Tablet	See definition in *CTIA 01.01*.[2]
WLAN	Wireless Local Area Network (WLAN) links two or more devices using some wireless distribution method and usually providing a connection through an access point to the wider internet. Most modern WLANs are based on IEEE 802.11 standards, marketed under the Wi-Fi brand name.
WWAN	Wireless Wide Area Network refers to cellular airlink technologies as noted in Section 1.2.

Section 2 Test Conditions and Device Configuration

2.1 Cellular and Wi-Fi Modes

The test methodology requires the device be placed in a standard operational mode. This includes all sensors in the device as well as proximity sensors. If it becomes evident that DUT thermal protection and/or adaptive power control mechanisms are preventing Wi-Fi and cellular transmitters from maintaining full output power during the course of testing, the test lab shall work with the OEM to identify a suitable mitigation method. Although recognizing that the use of special test modes would enable more simplified testing and the use of formal test equipment, the test methodology proposed in this document allows the testing of any Wi-Fi mobile device in a mode that is as close as possible to its native operation. However, the methodology does require certain specific behavior of the device so that the test can be executed. DUT vendors are required to supply instructions for the lab to configure the devices as specified in this test plan.

All Radiated tests shall be made according to configurations specified in Device Testing Configurations with the device oriented as specified in *CTIA 01.71* [6] Section 2 as applied to the Wi-Fi mode being tested.

Depending on the communication tester and device capabilities, it may be necessary to set or disable the regulatory domain (WLAN Country Code and/or Cellular MCC) setting on the WLAN tester and/or cellular base station simulator in order to test specific channel combinations. Care should be taken to present the specific regulatory domain information to the DUT in an isolated environment so that the regulatory domain information is not obtained from any external Wi-Fi access point and/or cellular network in the country where the test is being executed. The lab should seek guidance from the DUT vendor to ensure that all test channels supported by the DUT are tested.

2.2 Wi-Fi Mode

The DUT is expected to be able to associate with the WLAN tester and stay on the same RF channel for the duration of the test even when the WLAN tester signal appears to be below the sensitivity level of DUT.

Other than for 802.11ax client devices, the PING based method is the primary method for packet generation for UL Power measurement while the ACK based method is the fall-back option if the DUT does not support the PING method. The PING method is the only method to test the conducted (or radiated) power for the 802.11n mode of an 802.11 device.

For 802.11ax client devices, the HE trigger-based (HE TB) format is used for transmission in the uplink. Using HE TB helps with a more stable testing setup for 802.11ax. For 802.11ax Access Point, the PING method is used.

In the PING based method, the WLAN tester generates ICMP echo request packets with configurable transmit interval, payload size and payload type. The ICMP echo request packets are targeted at the DUT's IP stack. The DUT is expected to answer with a well-defined echo reply packet whose payload is identical to the payload of the corresponding request. For this method to be usable, the device must conform to *RFC 792* [12] and *RFC 1122* [13] Section 3.2.2.6.

In the ACK based method, the WLAN tester will be transmitting data frames addressed to the DUT, and the DUT is expected to be able to respond to all of these data frames with an ACK message.

Because 802.11n ACKs are sent in the basic service set (which is in the legacy mode), the 802.11n ACK is sent at 6 Mbps. However, the lowest data rate for 802.11n is 6.5 Mbps. Therefore, the PING method is the only method to test the conducted (or radiated) power for the 802.11n mode of an 802.11 device. In this method, IP traffic message will force the DUT to answer and generate defined uplink traffic using an 802.11n data rate.

The 802.11ax, HE TB is supported for OFDMA or MU-MIMO transmission in the uplink to enable simultaneous transmissions by multiple STAs. HE TB transmission is controlled entirely by the AP. A trigger frame, transmitted by the AP in advance, provides all required parameters for the participating STAs. Each participating STA transmits an HE TB PPDU simultaneously in the frame. For the purpose of 802.11ax client device testing in this test plan, an HE TB transmission is controlled entirely by the WLAN Tester. All the parameters required for the uplink transmission of the HE TB PPDUs are provided in a trigger frame to the DUT.

The following DUT settings are required to perform the test:

- Disable scan mode during testing; scanning for AP/client on other channels shall be disabled
- If applicable, disable Power Save Mode (Note that the WLAN tester will not support WMM APSD)
- If applicable, disable the Bluetooth radio during tests
- Except for the desensitization testing, the cellular transmitter in the DUT shall be inactive
- If Time Averaging is utilized in the device, the Time Averaging shall be disabled in accordance with *CTIA 01.01* [2] Section 1.4.

Radiated testing shall be performed on an unmodified device using all active antennas. Conducted tests shall be performed on each antenna port with the other antenna port(s) properly terminated. If necessary, an equivalent device may be modified to provide conducted access to each antenna port.

With the exception of 802.11b that is using 22 MHz channel bandwidth, all other Wi-Fi RATs, including 802.11n and 802.11ax, 20 MHz channels are used. 802.11n and 802.11ax should be configured for a longest guard interval option.

Section 3 Conducted Measurements

3.1 Wi-Fi Conducted RF Power Output and Receiver Sensitivity Tests

3.1.1 Test Purpose

The purpose of this test is to measure the output power level and receiver sensitivity of the Wi-Fi transceiver in the device in the conducted mode.

3.1.2 Test Setup

The basic test setup is shown in Figure 3.1-1.

Figure 3.1-1 Block Diagram for Wi-Fi Conducted Measurement

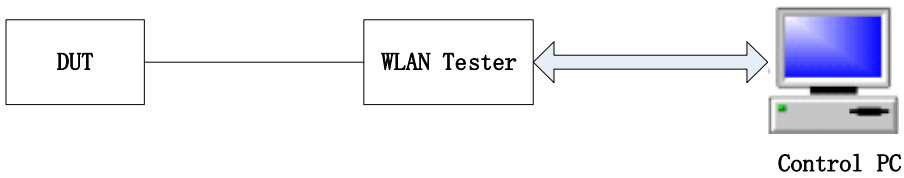


Figure 3.1-1 is intentionally generalized to maximize test equipment design flexibility. A WLAN tester may include receiver and access point capability sub modules as well as internally implemented attenuators to control transmit and receive power to and from DUT.

The DUT shall be provided to the Test Laboratory with the facility to connect directly to the RF test equipment. This may be via an existing antenna connector, or it may be a carefully modified unit to allow such connection. In the latter case, it is the responsibility of the supplier of the DUT to ensure that the connection is present and suitable.

It is recommended that the conducted measurements be performed inside a shielded environment.

A reference measurement shall be made in order to account for the attenuation of the cable used for connecting the DUT and WLAN tester.

For more information about possible test setup configurations see the *CTIA 01.20* [3] Section 6 and for positioning guideline, see *CTIA 01.71* [6] Section 2.

3.1.3 Test Point Parameters

The measurements shall be performed on the lowest, middle and highest channels [9] supported by the device, in each of the 2.4 GHz, 5 GHz and 6GHz bands as specified in Table 3.1-1, all data rates specified in Table 3.1-2 and Table 3.1-3.

US U-NII-4 band includes two new additional 20 MHz channels 173 and 177. It also includes a part of Channel 169 that straddles between U-NII-4 and U-NII-3 that is added to U-NII-4.

Applicable to all transmit and receive conducted tests of Section 3.1, for legacy RATs (i.e., 802.11a/b/g/n/ac) testing, coding shall be CC or BCC, for 802.11ax testing, coding shall be LDPC; use BCC if LDPC is not supported (e.g., in 2.4 GHz products or 20MHz-only products).

Table 3.1-1 Measurement Frequencies for Conducted Tests

Sub Band [14][15]	Frequency Range	Channel Range	Lowest, Middle, Highest Channel Numbers
ISM-band	2.400-2.483.5 GHz	1 to 13	1, 6, 11
US U-NII-1, ETSI Sub-band 1	5.150-5.250 GHz	36 to 48	36, 44, 48
US U-NII-2A, ETSI Sub-band 1	5.250-5.350 GHz	52 to 64	52, 60, 64
US U-NII-2C, ETSI Sub-band 2	5.470-5.725 GHz	100 to 140	100, 120, 140
US U-NII-3, Ofcom	5.725-5.850 GHz	149 to 165	149, 157, 165
US U-NII-4	5.850-5.895 GHz	169- to 177	169, 173, 177
US U-NII-5 ETSI Ofcom	5.945-6.425 GHz	1 to 93	1, 49, 93
US U-NII-6	6.425-6.525 GHz	97 to 113	97, 105, 113
US U-NII-7	6.525-6.875 GHz	117 to 181	117, 149, 181
US U-NII-8	6.875-7.125 GHz	189 to 233	189, 213, 233

Table 3.1-2 TX Test Data Rates for Conducted Testing

Band	Mode	TX Data Rate (Mbps)
2.4GHz	IEEE 802.11b	11
	IEEE 802.11g	6
	IEEE 802.11n	6.5
	IEEE 802.11ax	7.3
5GHz	IEEE 802.11a	6
	IEEE 802.11n	6.5

Band	Mode	TX Data Rate (Mbps)
	IEEE 802.11ax	7.3
6GHz	IEEE 802.11ax	7.3

Table 3.1-3 RX Test Data Rates for Conducted Testing

Band	Mode	RX Data Rate (Mbps)
2.4GHz	IEEE 802.11b	11
	IEEE 802.11g	6, 54
	IEEE 802.11n	6.5, 65
	IEEE 802.11ax	7.3, 73.1
5GHz	IEEE 802.11a	6, 54
	IEEE 802.11n	6.5, 65
	IEEE 802.11ax	7.3, 73.1
6GHz	IEEE 802.11ax	7.3, 73.1

3.1.4 Test Procedure for Output Power Level

This test procedure defines the basic method for measuring the transmit power of the DUT. A WLAN tester is used to establish the connection and generate traffic to and from the DUT. A calibrated WLAN tester or other applicable power measurement device (e.g., signal analyzer) is used to provide traceable power measurements.

With the PING based packet generation method, the WLAN tester will generate ICMP echo request packets with configurable transmit interval, payload size and payload type. The ICMP echo request packets are targeted at the DUT's IP stack. The DUT is expected to answer with a well-defined echo reply packet whose payload is identical to the payload of the corresponding request.

If the ACK based packet generation method is used, the power is measured across multiple ACK control frames from the DUT rather than full data packets. The ACK control frames are sent in response to unicast data packets generated by the WLAN tester. The measurement is taken across multiple packets and a mean value calculated. In the HE TB method for 802.11ax testing, the WLAN Tester is configured in 2.4, 5 or 6GHz band depending on the test. The DUT is configured to join WLAN Tester BSS and associate to it.

For client devices, the tester is typically configured as an AP, although the tester may alternatively be configured as a non-AP STA (networking station) operating in ad-hoc mode to perform the measurement. The tester shall be configured to the channel (frequency) and data rate to be tested as specified in Section 3.1.3. Additional tester settings may also be needed to ensure that the DUT responds at the target data rate.

For access points and devices acting as mobile access points, the tester is configured as a client. In this case, the DUT shall typically be configured for the channel to be tested as specified in Section 3.1.3. The tester shall be configured for the data rate to be tested as specified in Table 3.1-4.

Additional tester settings may also be needed to ensure that the DUT responds at the target data rate.

The DUT shall be configured to transmit at maximum power. Note that in the case of 6GHz band, Wi-Fi devices may operate in three modes 1) Low Power Indoor, 2) Very Low Power and 3) Standard Power. Maximum transmit power for different modes of operation may be different. The maximum transmit power is configured based on vendor declaration for device capability and mode of operation.

To generate the traffic for power measurement using the PING based method, the WLAN tester will generate ICMP echo request packets with configurable transmit interval and payload size and payload type as specified in Table 3.1-5. The reported result is determined from the power measured over the entire payload part of the packet, ignoring the preamble and avoiding the leading and falling edge transitions in the burst. A minimum of 85% of the payload shall be covered by the measurement.

To generate the traffic for power measurement using the ACK based method, the tester is configured to send UDP packets as specified in Table 3.1-5. Table 3.1-5 specifies the size and payload of the packets to be transmitted and the target interval between packets. The transmitted power of the DUT is measured using the WLAN tester or other calibrated receiver capable of measuring the average power of the DATA portion of each ACK message. The reported result is determined from the power measured per ACK averaged over the number of ACKs specified in Table 3.1-5.

To generate the traffic for 802.11ax measurement using the HE TB, the WLAN tester is configured to transmit Trigger frames to solicit TB PPDU from DUT using the following specified fields:

1. Trigger Common Info field:
   a. UL BW = 0 (20 MHz)
   b. GI And LTF Type = 2 (4x HE-LTF + 3.2 µs GI)
   c. UL Target RSSI = MAX
2. User Info fields
   a. RU Allocation = 242-tone RU
   b. Coding = LDPC (use BCC if LDPC is not supported, e.g. in 2.4 GHz products or 20MHz-only products)
   c. MCS = MCS0 or MCS7 according to the test case
   d. NSS = 0 (1SS)

and parameters as specified in Table 3.1-5.Create a table of channel, data rate, and average power for each measurement. See Appendix A for recommended data reporting formats.

Table 3.1-5 Parameter Settings for Output Power Level Test

Parameter	Value
Number of measurements to be averaged	PING Based: 10 ACK Based: 100 HE TB: 100
Interval between packets (ms)*	PING and ACK Based: 10 HE TB: 20
Tester payload size	PING Based: 1000** (bytes) ACK Based: 60 (bytes) HE Trigger Frame: N/A

Parameter	Value
Tester packet payload	PING Based: Pseudo random ACK Based: Pseudo random HE Trigger Frame: N/A
*Note: For PING and ACK based methods, the Interval between packets is defined as the interval between the end of a transmitted unicast packet and the beginning of the next transmitted unicast packet. For triggered method, the interval is between triggers. If the device is capable of responding reliably to packets faster than the specified interval, this time interval may be decreased. If the device is not capable of responding reliably to packets at the specified interval, this time interval may be increased as required. Indicate the used interval size in the test report. **Note: If a device does not support the required packet size, use the maximum supported and indicate the used packet size in the test report.	

3.1.5 Test Procedure for Receiver Sensitivity

This test procedure measures the Wi-Fi receiver sensitivity of the DUT using the WLAN tester to determine the packet error rate (PER) by counting the number of ACK control frames received from the DUT in response to repeated unicast data packets transmitted by the WLAN tester. No other traffic generation shall be enabled during this test. The PER is generally defined as the ratio of packets lost divided by the number of packets transmitted to the DUT. For the purposes of this test plan, the PER is defined at the WLAN tester as the ratio of (Packets Sent – ACKs Received) / Packets Sent, or (1 – ACKs Received / Packets Sent). Receiver Sensitivity measurements shall be performed using the calibrated WLAN tester to determine the DUT's receiver sensitivity by reporting the minimum forward-link power resulting in a PER of 10% or less with 95% confidence. The sensitivity is reported as the last passing power level measured within 1 dB of the target sensitivity level. The system shall be configured as specified in Section 3.1.4 with the exception of the changes specified in Table 3.1-6.

Table 3.1-6 Parameter Settings for Receiver Sensitivity Test

Parameter		Value
Interval between packets (ms)*		1
Packet size (bytes)	IEEE 802.11a/b/g/n/ax	1000**
Min number of packets		1000
*Note: If the device is not capable of responding reliably to packets at the 1 ms interval, this time interval may be increased as required; indicate the used interval size in the test report. **Note: If a device does not support the required packet size, use the maximum supported and indicate the used packet size in the test report.		

3.1.6 Results

Results shall be reported in dBm.

There are no Pass/Fail criteria. Refer to Appendix A for sample report templates.

Section 4 Radiated Measurements

4.1 Wi-Fi Total Radiated Measurements (TRP/TIS)

4.1.1 Test Purpose

The purpose of this test is to measure the Total Radiated Power and Total Isotropic Sensitivity of the Wi-Fi transceiver in the device.

4.1.2 Test Setup

Typical system schematics for both TRP and TIS measurements are shown in the following figures. The configurations shown are only representative examples of test systems configuration.

Figure 4.1-1 shows a configuration where both uplink and downlink communications are transmitted through the measurement antenna. This configuration does not illustrate independent amplification of both signal paths.

Figure 4.1-1 Simplified Block Diagram Showing a Common Configuration for TRP/TIS Measurement

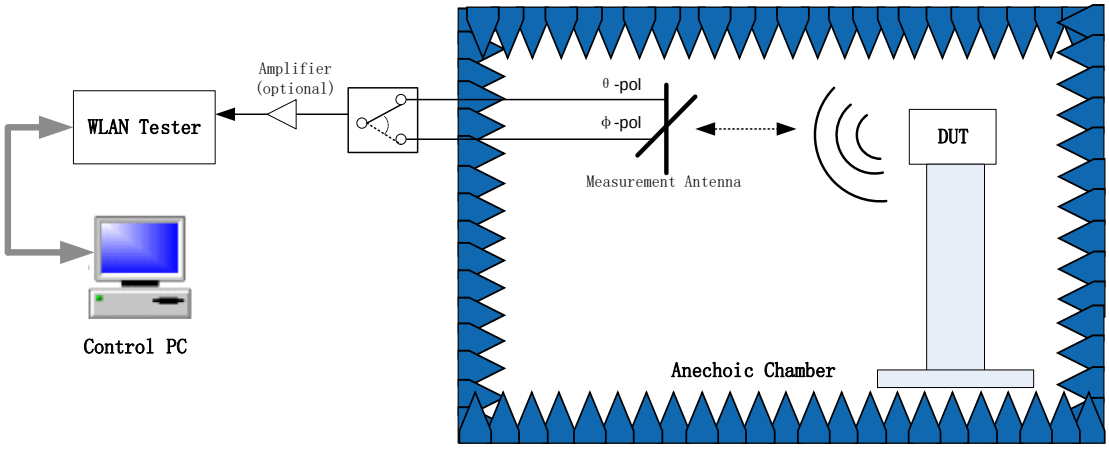


Figure 4.1-2 shows a simplified block diagram showing a configuration for TRP measurement. The uplink communication is transmitted through the measurement antenna and the downlink is transmitted through the link antenna. This configuration supports amplification of both signal paths if necessary.

Figure 4.1-2 Simplified Block Diagram Showing a Configuration for TRP Measurement

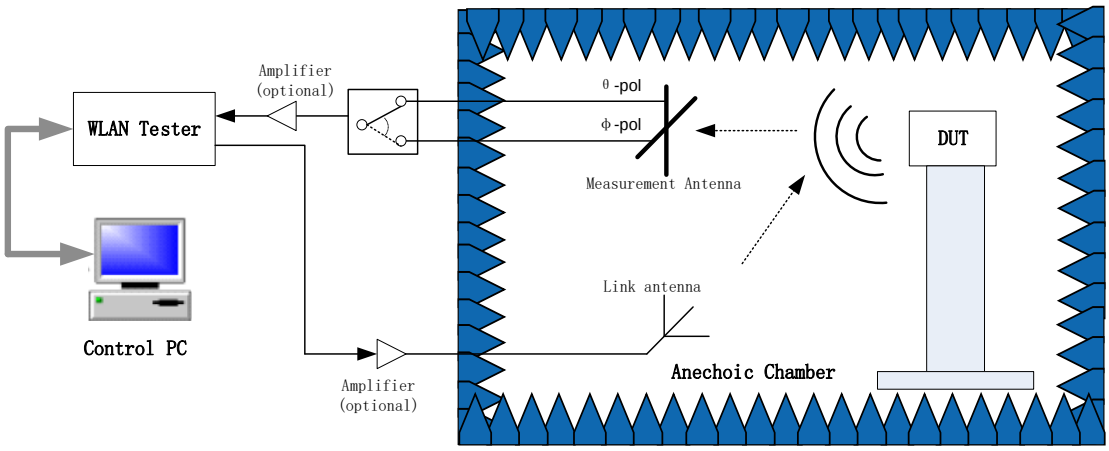
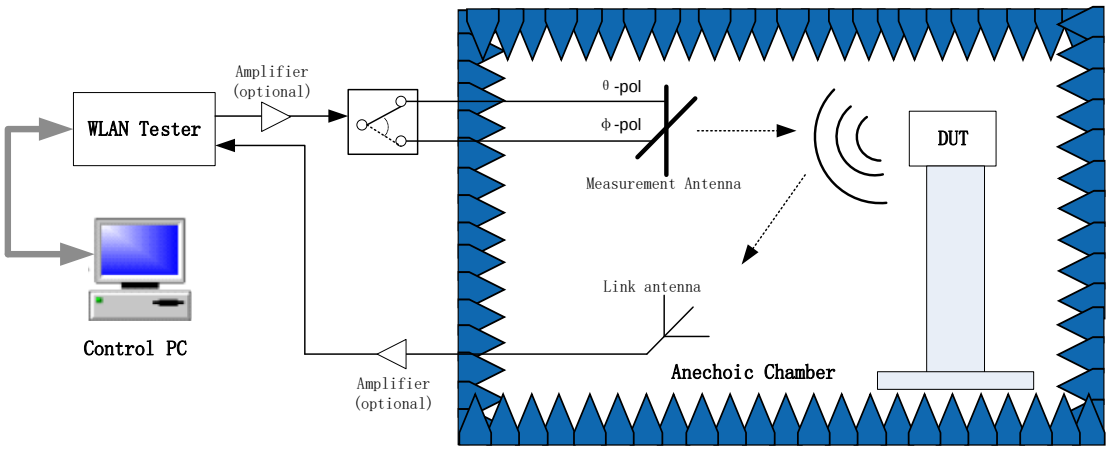


Figure 4.1-3 shows a simplified block diagram showing a configuration for TIS measurement. The downlink communication is transmitted through the measurement antenna and the uplink is transmitted through the link antenna. This configuration supports amplification of both signal paths if necessary.

Figure 4.1-3 Simplified Block Diagram Showing a Configuration for TIS Measurement



For more information about possible test setup configurations and details, refer to *CTIA 01.20* [3] Section 6 for setup illustrations.

4.1.3 Test Point Parameters

For 2.4 GHz IEEE 802.11b/g/n/ax devices, the TRP/TIS measurement is made on Channel 6.

For 5 GHz IEEE 802.11a/n/ax devices and 6 GHz 11ax devices, the TRP/TIS measurement is made on the channels specified in Table 4.1-1 for commonly supported sub-band by IEEE 802.11a, n and ax.

Table 4.1-1 TIS/TRP Measurement Channels for IEEE 802.11a, n and ax Supported Sub-Bands

Sub Band [14][15]	Frequency Range	Channel Range	TIS/TRP Channel Number
US U-NII-1, ETSI Sub-band 1	5.150-5.250 GHz	36 to 48	44
US U-NII-2A, ETSI Sub-band 1	5.250-5.350 GHz	52 to 64	60
US U-NII-2C, ETSI Sub-band 2	5.470-5.725 GHz	100 to 140	120
US U-NII-3, Ofcom	5.725-5.850 GHz	149 to 165	157
			165
US U-NII-4	5.850-5.895 GHz	169 to 177	173
US U-NII-5 ETSI Ofcom	5.945-6.425 GHz	1 to 93	49
US U-NII-6	6.425-6.525 GHz	97 to 113	105
US U-NII-7	6.525-6.875 GHz	117 to 181	149
US U-NII-8	6.875-7.125 GHz	189 to 233	213

Applicable to all transmit and receive tests of Section 4.1, for legacy RATs (i.e., 802.11a/b/g/n/ac) testing, coding shall be CC or BCC, for 802.11ax testing, coding shall be LDPC; use BCC if LDPC is not supported (e.g., in 2.4 GHz products or 20MHz-only products).

For each of the channels specified in Section 4, the transmit power output shall be measured at the data rates given in Table 3.1-2.

US U-NII-4 band only includes two new additional 20 MHz channels 173 and 177. It also includes a part of Channel 169 that straddles between U-NII-4 and U-NII-3 that is added to U-NII-4.

For devices which have more than one protocol in the same frequency band, such as 802.11b/g/n/ax or 802.11a/n/ax, an alternate test procedure to determine the offset in TRP between different protocols on equivalent channels can be used by referring to the Alternate Test Procedures specified in *CTIA 01.20* [3] Section 3.2 Single Point Offset Test or Section 3.3 Multi-point Offset Test.

For each of the channels specified in Table 4.1-1 , the receive sensitivity shall be measured at the following data rates:

Table 4.1-2 Receiver Sensitivity Test Data Rates

Band	Protocol (Mode)	Test Data Rate (Mbps)
2.4GHz	IEEE 802.11b	11
	IEEE 802.11g	54
	IEEE 802.11n	65
	IEEE 802.11ax	73.1
5GHz	IEEE 802.11a	54
	IEEE 802.11n	65
	IEEE 802.11ax	73.1
6GHz	IEEE 802.11ax	73.1

For devices which have more than one protocol in the same frequency band, such as 802.11b/g/n/ax in 2.4 GHz or 802.11a/n/ax in 5GHz, an alternate test procedure to determine the offset in TIS between different protocols on equivalent channels can be used by referring to the Alternate Test Procedures specified in *CTIA 01.20* [3] Section 4.4 Single Point Offset Test or Section 4.5 Multi-point Offset Test.

4.1.4 Test Procedure for Total Radiated Power Measurement

This test procedure is primarily based on the TRP measurement procedure specified in the CTIA Certification Test Plan for Wireless Device Over-the-Air Performance [1]. For more details, please refer to the CTIA Certification OTA Test Plan 01.20 [3] Section 3 for TRP test procedure.

In order to obtain accurate results of radiated performance of Wi-Fi, it is necessary to perform a range reference measurement to account for the various factors affecting the measurement of these quantities. These factors include components like range length, path loss, gain of the receive antenna, cable losses, and so forth. Please refer to *CTIA 01.73* [8] for more details.

A calibrated WLAN tester capable of maintaining the connection over the air is required. The WLAN tester or other applicable power measurement device (e.g. signal analyzer) is used to provide traceable power measurements. For TRP measurements, use the same parameter settings as specified in Section 3.1.4.

For client devices, the tester is typically configured as an AP, although ad-hoc mode may also be used to communicate with the DUT. The tester shall be configured to the channel (frequency) to be tested as specified in Section 4.1.3. The tester shall be configured for the data rate to be tested as specified in Section 4.1.6. Additional tester settings may also be needed to ensure that the DUT responds at the target data rate.

For access points and devices acting as mobile access points, the tester is configured as a client. In this case, the DUT shall typically be configured for the channel to be tested as specified in Section 4.1.3. The tester shall be configured for the data rate to be tested as specified in Section 4.1.6. Additional tester or DUT settings may also be needed to ensure that the DUT responds at the target data rate.

Capture measurement results. See Appendix A for recommended data reporting format.

Note: The test lab may choose to use Alternative Test Procedures as specified in *CTIA 01.20* [3] Section 5.4.

For devices supporting multiple Wi-Fi TX antennas, guidelines specified in the *CTIA 01.01* [2] Section 2.1.5.1 shall be used.

4.1.5 Test Procedure for Total Isotropic Sensitivity Measurement

The test procedure is primarily based on the TIS measurement procedure specified in the *CTIA Certification OTA Test Plan* [1]. For more details, please refer to the procedure specified in *CTIA 01.20* [3] Section 4 for TIS measurement.

In order to obtain accurate results of radiated performance of Wi-Fi, it is necessary to perform a reference measurement to account for the various factors affecting the measurement of these quantities. These factors include components like range length, path loss, gain of the receive antenna, cable losses, and so forth. Please refer to *CTIA 01.73* [8] for more details.

A calibrated WLAN tester capable of maintaining the connection over the air is required. For TIS measurement, configure the WLAN tester as specified in Section 3.1.5 with the exception of parameters specified in Table 4.1-3.

Table 4.1-3 Parameter Settings for Receiver Sensitivity Test

Parameter	Value
Min number of packets	100

Note: The test lab may choose to use the Alternative Test Procedures as specified in *CTIA 01.20* [3] Section 4, with the exception of Section 4.7, Alternate TIS Test Procedure based on Receive Signal Strength (RSS). The minimum number of packets used during both 'Test Configuration A' and 'Test Configuration B' measurement shall be 1000 packets as outlined in Table 3.1-5 as opposed to the value in Table 4.1-3.

For devices supporting Antenna Switched RX Diversity for Wi-Fi, guidelines specified in the *CTIA 01.01* [2] 2.1.5.2 shall be used.

4.1.6 Results

Results shall be reported in dBm.

There are no Pass/Fail criteria. Refer to Appendix A for sample report templates.

4.2 Wi-Fi Desensitization Measurements with Cellular Transmitter ON

4.2.1 Test Purpose

The following measurements measure the desensitization of the Wi-Fi radio when the Cellular radio is operating.

4.2.2 Test Setup

Typical system diagrams for Wi-Fi desensitization measurements are shown in Figure 4.2-1 and Figure 4.2-2. The configurations shown are only representative examples of common systems and do not represent an exhaustive list of possible configurations.

Figure 4.2-1 is a simplified block diagram showing a common configuration for Wi-Fi desensitization measurements.

Figure 4.2-1 Simplified Block Diagram Showing a Common Configuration for Wi-Fi Desensitization Measurements

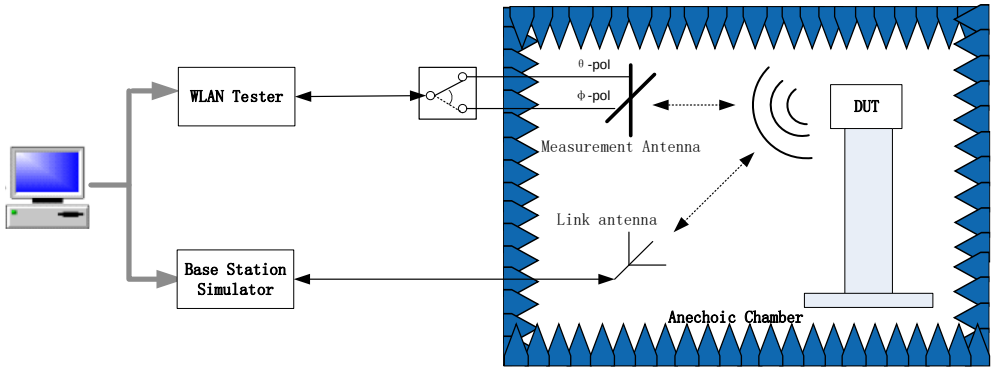
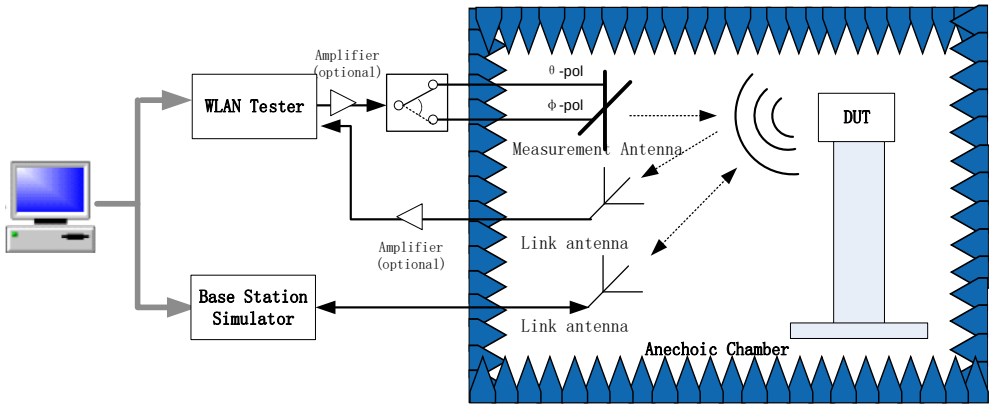


Figure 4.2-2 shows a simplified block diagram showing another common configuration for Wi-Fi desensitization measurements.

Figure 4.2-2 Simplified Block Diagram Showing Another Common Configuration for Wi-Fi Desensitization Measurements



For more information about possible test setup configurations see *CTIA 01.20* [3] Section 6 and for positioning guideline, see *CTIA 01.71* [6] Section 2.

4.2.3 Test Point Parameters

Desensitization measurements shall be made at the same data rates used for the TIS measurements of Section 4.1.3.

Applicable to all tests of Section 4.2, for legacy Wi-Fi RATs (i.e., 802.11a/b/g/n/ac) testing, coding shall be CC or BCC, for 802.11ax testing, coding shall be LDPC; use BCC if LDPC is not supported (e.g., in 2.4 GHz products or 20MHz-only products).

4.2.4 Test Procedures for Wi-Fi Radio Desensitization

The Wi-Fi desensitization tests consist of two groups of test scenarios related to the desensitization by closest cellular uplink frequency and desensitization by cellular uplink harmonics. Section 4.2.5 covers

the test scenario and details for the closest cellular uplink frequency case while Section 4.2.6 covers the details related to the cellular uplink harmonics.

All cellular TX parameter settings shall be set according to *CTIA 01.50* [4].

For the Wi-Fi desensitization tests, configure the test as specified in Section 4.1.5 for the TIS (cellular downlink is disabled on the communication tester and DUT cellular is disabled using airplane mode) testing with the exception of the setup corresponding to the desensitizing cellular signal that is specified here.

The Wi-Fi desensitization test consists of four basic steps as follows:

1. The DUT and chamber positioner(s) are moved to the location & polarization resulting in the best-radiated free-space sensitivity (EIS) measured for the closest, in frequency, channel for which the TIS has been determined, as covered in Section 4.1.5.
2. For the Wi-Fi channels specified in Sections 4.2.5 or 4.2.6, perform a single EIS measurement using the number of packets specified in Table 4.2-1.

Table 4.2-1 Parameter Settings for Wi-Fi Radio Desensitization Test

Parameter	Value
Min number of packets	1000

3. Enable the cellular radio in the DUT and establish a cellular connection to turn on the cellular interferer and repeat measurement for all interfering channels specified in Sections 4.2.5 or 4.2.6.
4. Subtract the EIS measured in Step 2 from the EIS measured in Step 3 and report the results as the resulting desensitization. An example result table is given in Appendix A.

Depending on the details of the equipment used to conduct the tests there will be a limit to which desensitization can be measured. The search for the desensitization level shall be continued until a passing error rate is achieved or the test system limit is reached. If the DUT reaches this limit and the actual value cannot be measured, record the max EIS that the test system can produce and indicate that the limit was reached in the test report. The test equipment should be capable of measuring a desensitization level of 40 dB or more.

Appendix F lists the RATs considered in the construction of the interfering signal for these tests. If a Test Lab is presented with a device containing a RAT that is not listed, the test Lab shall contact support@wi-fi.org for clarification.

For devices supporting multiple cellular TX antennas, Wi-Fi radio desensitization shall be tested with the cellular TX antennas configured per the guidelines specified in *CTIA 01.01* [2] Section 2.1.5.1.

Note: This could require multiple tests if the conditions of *CTIA 01.01* [2] Section 2.1.5.2.1 apply.

4.2.5 Wi-Fi Radio Desensitization by Closest Cellular Uplink Frequency

A cellular radio transmitter in the converged device can overload the front-end of the Wi-Fi radio, or desensitize it by an out of band emission. This can happen at any cellular frequency but is usually most prevalent at cellular frequencies closest to the Wi-Fi bands.

For 2.4GHz band, desensitization of the lowest Wi-Fi channel, Channel 1, shall be measured for all RATs supported by the device whose TX frequencies (the center of the highest channel or the center of the allocated resource blocks at the upper edge of the highest channel for LTE/NR FR1 SA as specified by

the *CTIA 01.50* [4]) fall between 1880 MHz and 2400 MHz. The measurement shall be made with the closest TX channel (and uplink RB allocation for LTE/NR FR1 SA) to Wi-Fi Channel 1.

For 2.4GHz band, desensitization of the highest supported Wi-Fi channel (for example, Channel 11 or Channel 13) shall be measured for all RATs supported by the device whose TX frequencies (the center of the lowest channel or the center of the allocated resource blocks at the lower edge of the lowest channel for LTE/NR FR1 SA as specified by the *CTIA 01.50* [4]) fall between 2483.5 MHz and 3003.5 MHz. The measurement shall be made with the closest TX channel (and uplink RB allocation for LTE/NR FR1 SA) to highest supported Wi-Fi channel.

For 5GHz band, desensitization of the Wi-Fi channel 36, shall be measured for all RATs supported by the device whose TX frequencies (the center of the highest channel or the center of the allocated resource blocks at the upper edge of the highest channel for NR FR1 as specified by *CTIA 01.50* [4]) fall between 4630 MHz and 5150 MHz. The measurement shall be made with the closest TX channel (and uplink RB allocation for LTE/NR FR1) to Wi-Fi Channel 36.

Choose the combinations with minimum frequency offset in Table 4.2-2 depending on what Wi-Fi channels and cellular RATs the DUT supports.

If the device supports more than one band with the same RAT, then only the closest frequency (which is either the center of the channel or center of the resource blocks for LTE/NR FR1 as specified by the *CTIA 01.50* [4]) to the 2400 MHz & 5500MHz Wi-Fi band shall be tested.

All modes 802.11 b, g, n, ax for 2.4GHz, 802.11a, n, ax for 5GHz and 802.11ax for 6GHz (if supported by the Wi-Fi radio) shall be tested.

Table 4.2-2 Closest Channel Combinations

Wi-Fi Radio Desensitization by Closest Cellular Uplink Frequency									
Wi-Fi Channel Number	**Test ID**	**Wi-Fi Channel Frequency (MHz)**	**Cellular RAT**	**Channel Bandwidth (MHz)**	**RAT Channel Number**	**RAT Uplink Frequency (MHz)**	**Call Setup Reference**	**Special Setup**	**Frequency Gap (MHz)**
1	WDC1.1	2412	GSM1900	-	810	1909.80	CTIA 01.50 [4]		502.20
	WDC1.2		WCDMA Band I	-	9888	1977.60	CTIA 01.50 [4]		434.40
	WDC1.3		WCDMA Band II	-	9538	1907.60	CTIA 01.50 [4]		504.40
	WDC1.4		LTE Band 1	10	18550	1983.42	CTIA 01.50 [4]	12 RB with RBstart = 38	428.58
	WDC1.5		LTE Band 2	10	19150	1908.42	CTIA 01.50 [4]	12 RB with RBstart = 38	503.58
	WDC1.6		LTE Band 25	5	26665	1914.03	CTIA 01.50 [4]	8 RB with RBstart = 17	497.97
	WDC1.7		LTE Band 30	10	27710	2313.42	CTIA 01.50 [4]	12 RB with RBstart = 38	98.58
	WDC1.8		LTE Band 39	20	38550	1917.38	CTIA 01.50 [4]	18 RB with RBstart = 82	494.62

Wi-Fi Radio Desensitization by Closest Cellular Uplink Frequency									
Wi-Fi Channel Number	Test ID	Wi-Fi Channel Frequency (MHz)	Cellular RAT	Channel Bandwidth (MHz)	RAT Channel Number	RAT Uplink Frequency (MHz)	Call Setup Reference	Special Setup	Frequency Gap (MHz)
	WDC1.9		LTE Band 40	20	39550	2397.38	CTIA 01.50 [4]	18 RB with RBstart = 82	14.62
1	WDC1.10	2412	NR FR1 n2	10	381000	1907.25	CTIA 01.50 [4]	25 RB with RBstart = 12, SCS 15kHz.DFT-s-OFDM with QPSK modulation	504.75
	WDC1.11		NR FR1 n25	10	382000	1912.25	CTIA 01.50 [4]	25 RB with RBstart = 12, SCS 15kHz	499.75
11	WDC11.1	2462	LTE Band 7	20	20850	2502.62	CTIA 01.50 [4]	18 RB with RBstart = 0	40.62
	WDC11.2		LTE Band 38	20	37850	2572.62	CTIA 01.50 [4]	18 RB with RBstart = 0	110.62
	WDC11.3		LTE Band 41	20	39750	2498.62	CTIA 01.50 [4]	18 RB with RBstart = 0	36.62
11	WDC11.4	2462	NR FR1 n41	100	509202	2546.01	CTIA 01.50 [4]	135 RB with RBstart = 67, SCS 30kHz	84.01
13	WDC13.5	2472	LTE Band 7	20	20850	2502.62	CTIA 01.50 [4]	18 RB with RBstart = 0	30.62
	WDC13.6		LTE Band 38	20	37850	2572.62	CTIA 01.50 [4]	18 RB with RBstart = 0	100.62
	WDC13.7		LTE Band 41	20	39750	2498.62	CTIA 01.50 [4]	18 RB with RBstart = 0	26.62
13	WDC13.8	2472	NR FR1 n41	100	509202	2546.01	CTIA 01.50 [4]	135 RB with RBstart = 67, SCS 30kHz	74.01

Example – Device 1

- 4 band GSM (1900, 1800, 900, 850),
- 5 band WCDMA (Bands I, II, IV, V, VIII),
- 5 band LTE (2, 4, 5, 13, 17)
- 3 band NR FR1 (n2, n5, n66)
- 802.11 a, b, g, n (Channels 1-11 supported @ 2400 MHz).

Bands and RATs within 520 MHz of Wi-Fi for this device are:

- WCDMA Band I (high channel - 9888, TX uplink = 1977.60 MHz) and
- WCDMA Band II (high channel – 9538, TX uplink = 1907.60 MHz)
- LTE Band 2 (high channel - 19150, 1908.42 MHz @ center of uplink RB allocation)

- GSM 1900 (high channel – 810, 1909.80 MHz)
- NR FR1 n2 (high channel – 381000, 1907.25 MHz @ center of uplink RB allocation)

Set Wi-Fi to lowest supported channel, Channel 1, 2412 MHz, for b/g/n modes.

Test the following

- Wi-Fi Channel 1 against GSM 1900 Channel 810, 1909.80 MHz
- Wi-Fi Channel 1 against WCDMA Band I Channel 9888, 1977.60 MHz
- Wi-Fi Channel 1 against LTE Band 2 Channel 19150, 1908.42 MHz, center of uplink RB allocation
- Wi-Fi Channel 1 against NR FR1 Band n2 Channel 381000, 1907.25 MHz, center of uplink RB allocation

WCDMA Band II is also within the range, but its uplink frequency (1907.6 MHz, Channel 9538) is lower in frequency than WCDMA Band I and the same RAT does not need to be tested again.

Example – Device 2

- Single band LTE TDD Band 41
- Single band NR FR1 Band n41
- 802.11 b, g, n (Channels 1-11)

Bands and RATs within 520 MHz of Wi-Fi for this device are:

- LTE TDD Band 41 (low channel, 39750, 2498.62 MHz @ center of uplink RB allocation).

NR FR1 n41 (low channel – 509202, 2546.01 MHz @ center of uplink RB allocation) Set Wi-Fi to highest supported channel, Channel 11, 2462 MHz, for b/g/n modes.

Test the following

- Wi-Fi Channel 11 against LTE TDD Band 41 Channel 39750, 2498.62 MHz @ center of uplink RB allocation
- Wi-Fi Channel 11 against NR FR1 Band n41 Channel 509202, 2546.01 MHz @ center of uplink RB allocation

4.2.6 Wi-Fi Radio Desensitization by Cellular Radio Uplink Harmonics

The cellular transmitter can produce unwanted harmonics that may interfere with certain Wi-Fi channels depending upon the combination of cellular technologies and Wi-Fi channels implemented in a converged device. Appendix F shows all known RATs and their interaction with Wi-Fi channels and many other details in a large spreadsheet. A subset of Wi-Fi channels has been selected that cover the interaction with as many RATs as possible to simplify the test selection and these are compiled into Table 4.2-3.

The DUT desensitization shall be tested for all relevant interactions in Table 4.2-3. The cellular radio configuration will be set according to the Call Setup Reference, in Table 4.2-3, except for those parameters specifically defined within the table. Relevant interaction is defined by supported RAT implementation or as specified by the manufacturer.

All modes 802.11 b, g, n, ax for 2.4GHz, 802.11a, n, ax for 5GHz and 802.11ax for 6GHz (if supported by the Wi-Fi radio) shall be tested.

Table 4.2-3 Desensitization Cases

Cellular RAT & Wi-Fi Channel Pairs for Testing Harmonic Desensitization of Wi-Fi by Cellular Uplink TX						
Wi-Fi Channel	**Test ID**	**Cellular RAT**	**RAT Channel Number**	**RAT Uplink Frequency (MHz)**	**Call Setup Reference**	**Special Setup**
11	WDH11.1	GSM 850	128	824.2	CTIA 01.50 [4]	N/A
	WDH11.2	WCDMA 850 3GPP Band V	4132	826.4	CTIA 01.50 [4]	N/A
	WDH11.3	LTE Band 5 (not needed if LTE Band 26 is tested)	20450	825.58	CTIA 01.50 [4]	10.0 MHz BW, UL: 12 RB, RBstart = 0
	WDH11.4	LTE Band 26	26815	824.97	CTIA 01.50 [4]	5.0 MHz BW, UL: 8 RB, RBstart=0
	WDH11.5	NR FR1 n5	165800	829	CTIA 01.50 [4]	10MHz, 25 RB with RBstart = 12, SCS 15kHz.DFT-s-OFDM with QPSK modulation

Cellular RAT & Wi-Fi Channel Pairs for Testing Harmonic Desensitization of Wi-Fi by Cellular Uplink TX						
Wi-Fi Channel	**Test ID**	**Cellular RAT**	**RAT Channel Number**	**RAT Uplink Frequency (MHz)**	**Call Setup Reference**	**Special Setup**
13	WDH13.1	GSM 850	128	824.2	CTIA 01.50 [4]	N/A
	WDH13.2	WCDMA 850 3GPP Band V	4132	826.4	CTIA 01.50 [4]	N/A
	WDH13.3	LTE Band 5 (not needed if LTE Band 26 is tested)	20450	825.58	CTIA 01.50 [4]	10.0 MHz BW, UL: 12 RB, RBstart = 0
	WDH13.4	LTE Band 26	26815	824.97	CTIA 01.50 [4]	5.0 MHz BW, UL: 8 RB, RBstart=0
	WDH13.5	NR FR1 n5	165800	829	CTIA 01.50 [4]	10MHz, 25 RB with RBstart = 12, SCS 15kHz.DFT-s-OFDM with QPSK modulation
44	WDH44.1	DCS 1800	661	1740.0	CTIA 01.50 [4]	N/A
	WDH44.2	WCDMA 3GPP Band III	1075	1740.0	CTIA 01.50 [4]	N/A

	WDH44.3	LTE Band 3	19534	1739.98	CTIA 01.50 [4]	10 MHz BW, UL: 12 RB, RBstart=0
	WDH44.4	LTE Band 4 (not needed if LTE Band 66 is tested)	20284	1739.98	CTIA 01.50 [4]	10 MHz BW, UL: 12 RB, RBstart=0
	WDH44.5	LTE Band 38	38150	2610.02	CTIA 01.50 [4]	20 MHz BW, UL: 18 RB, RBstart=0
	WDH44.6	LTE Band 41	40864	2610.02	CTIA 01.50 [4]	20 MHz BW, UL: 18 RB, RBstart=0
	WDH44.7	LTE Band 66	132306	1739.98	CTIA 01.50 [4]	10 MHz BW, UL: 12 RB, RBstart=0
	WDH44.8	NR FR1 n41	518598	2592.99	CTIA 01.50 [4]	100MHz, 135 RB with RBstart = 67, SCS 30kHz.DFT-s-OFDM with QPSK modulation
	WDH44.9	NR FR1 n66	349000	1745	CTIA 01.50 [4]	10MHz, 25 RB with RBstart = 12, SCS 15kHz.DFT-s-OFDM with QPSK modulation

Cellular RAT & Wi-Fi Channel Pairs for Testing Harmonic Desensitization of Wi-Fi by Cellular Uplink TX						
Wi-Fi Channel	**Test ID**	**Cellular RAT**	**RAT Channel Number**	**RAT Uplink Frequency (MHz)**	**Call Setup Reference**	**Special Setup**
60	WDH60.1	DCS 1800	794	1766.6	CTIA 01.50 [4]	N/A
	WDH60.2	WCDMA 3GPP Band III	1208	1766.6	CTIA 01.50 [4]	N/A
	WDH60.3	LTE Band 3	19800	1766.58	CTIA 01.50 [4]	10 MHz BW, UL: 12 RB, RBstart=0
	WDH60.4	LTE Band 41	41264	2650.56	CTIA 01.50 [4]	20 MHz BW, UL: 18 RB, RBstart=0
	WDH60.5	NR FR1 n41	528000	2640	CTIA 01.50 [4]	100MHz, 135 RB with RBstart = 67, SCS 30kHz.DFT-s-OFDM with QPSK modulation
	WDH60.6	NR FR1 n66	353800	1766.16	CTIA 01.50 [4]	10MHz, 25 RB with RBstart = 12, SCS 15kHz.DFT-s-OFDM with QPSK modulation

124	WDH124.1	GSM 1900	628	1873.4	CTIA 01.50 [4]	N/A
	WDH124.2	WCDMA 1900 3GPP Band II	9367	1873.4	CTIA 01.50 [4]	N/A
	WDH124.3	LTE Band 2 (not needed if LTE Band 25 is tested)	18866	1873.18	CTIA 01.50 [4]	10 MHz BW, UL: 12 RB, RBstart=0
	WDH124.4	LTE Band 25	26287	1873.17	CTIA 01.50 [4]	5 MHz BW, UL: 8 RB, RBstart=0
	WDH124.5	NR FR1 n2	376000	1880	CTIA 01.50 [4]	10MHz, 25 RB with RBstart = 12, SCS 15kHz.DFT-s-OFDM with QPSK modulation
	WDH124.6	NR FR1 n25	376500	1882.5	CTIA 01.50 [4]	10MHz, 25 RB with RBstart = 12, SCS 15kHz.DFT-s-OFDM with QPSK modulation
140	WDH140.1	LTE Band 39	38524	1900.0	CTIA 01.50 [4]	20 MHz BW, UL: 18 RB, RBstart=0
157	WDH157.1	WCDMA 3GPP Band I	9642	1928.4	CTIA 01.50 [4]	N/A
	WDH157.2	LTE Band 1	18118	1928.38	CTIA 01.50 [4]	10 MHz BW, UL: 12 RB, RBstart=0
173	WDH173.1	WCDMA 3GPP Band I	9775	1955	CTIA 01.50 [4]	N/A
	WDH173.2	LTE Band 1	18350	1955	CTIA 01.50 [4]	10 MHz BW, UL: 12 RB, RBstart=0
197	WDH197.1	LTE Band 30	27710	2310	CTIA 01.50 [4]	10 MHz BW, UL: 12 RB, RBstart=0
	WDH197.2	LTE Band 40	38750	2310	CTIA 01.50 [4]	20 MHz BW, UL: 18 RB, RBstart=0
211	WDH211.1	LTE Band 40	38950	2330	CTIA 01.50 [4]	20 MHz BW, UL: 18 RB, RBstart=0
221	WDH221.1	LTE Band 40	39150	2350	CTIA 01.50 [4]	20 MHz BW, UL: 18 RB, RBstart=0
233	WDH233.1	LTE Band 48	55290	3555	CTIA 01.50 [4]	10 MHz BW, UL: 18 RB, RBstart=0
141	WDH141.1	NR FR1 SA Band n78 Variant 1	622000	3330	CTIA 01.50 [4]	60 MHz Tx BW, SCS =30kHz, 81@40
165	WDH165.1	NR FR1 SA Band n78 Variant 2	626000	3390	CTIA 01.50 [4]	100 MHz Tx BW, SCS =30kHz, 135@67
189	WDH189.1	NR FR1 SA Band n78 Variant 1	623000	3450	CTIA 01.50 [4]	60 MHz Tx BW, SCS =30kHz, 81@40

214	WDH214.1	NR FR1 SA Band n78 Variant 1	634000	3510	CTIA 01.50 [4]	60 MHz Tx BW, SCS =30kHz, 81@40
229	WDH229.1	NR FR1 SA Band n78 Variant 2	636666	3549.99	CTIA 01.50 [4]	100 MHz Tx BW, SCS =30kHz, 135@67

Example – Device 1

- 4 band GSM (1900, 1800, 900, 850),
- 5 band WCDMA (Bands I, II, V, VIII),
- 5 band LTE (2, 4, 5, 13, 17)
- 3 band NR FR1 (n2, n5, n78 Variant 1)
- 802.11 b, g, n (Channels 1-11 supported @ 2400 MHz).
- 802.11 a Channels 36 – 64
- 802.11 ax Channels 1-233

Test the following:

- Wi-Fi Channel 11 against GSM 850 Channel 128, 824.2 MHz
- Wi-Fi Channel 11 against WCDMA 850 3GPP Band V Channel 4357, 826.4 MHz
- Wi-Fi Channel 11 against LTE Band 5 Channel 20450, 825.6 MHz
- Wi-Fi Channel 11 against NR FR1 n5 Channel 165800, 829 MHz
- Wi-Fi Channel 44 against DCS 1800 GSM 1800 Channel 661, 1740.0 MHz
- Wi-Fi Channel 44 against WCDMA 3GPP Band III Channel 1300, 1740.0 MHz
- Wi-Fi Channel 44 against LTE Band 4 Channel 20250, 1740.0 MHz
- Wi-Fi Channel 60 against DCS 1800 GSM 1800 Channel 794, 1766.6 MHz
- Wi-Fi Channel 124 against NR FR1 n2 Channel 376000, 1880 MHz
- Wi-Fi Channel 141 against NR FR1 n78 Variant 1 Channel 622000, 3330 MHz
- Wi-Fi Channel 165 against NR FR1 n78 Variant 2 Channel 626000, 3390 MHz
- Wi-Fi Channel 189 against NR FR1 n78 Variant 1 Channel 623000, 3450 MHz
- Wi-Fi Channel 214 against NR FR1 n78 Variant 1 Channel 634000, 3510 MHz
- Wi-Fi Channel 229 against NR FR1 n78 Variant 2 Channel 636666, 3549.99 MHz

Example – Device 2

- Single band LTE TDD Band 41 device and 802.11 b, g, n (Channels 1-11).

No test is required.

4.2.7 Results

Results shall be reported in dB.

There are no Pass/Fail criteria. Refer to Appendix A for sample report templates.

4.3 Cellular Desensitization Measurements with Wi-Fi transmitter ON

4.3.1 Test Purpose

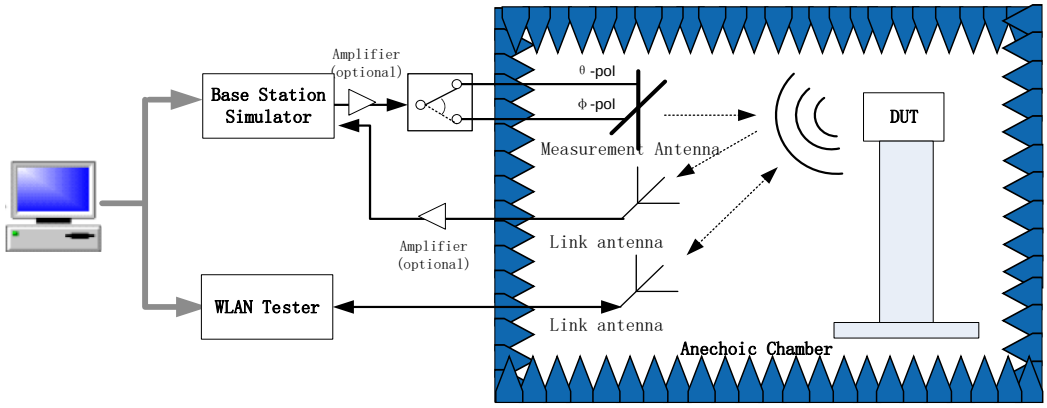
The purpose of this test is to conduct cellular desensitization test when the DUT's Wi-Fi transmitter is ON.

4.3.2 Test Setup

Figure 4.3-1 shows an example test system configuration for the cellular desensitization measurement.

All desensitization tests of this section are performed in Free Space condition.

Figure 4.3-1 Example Test System Configuration for Cellular Desensitization Measurements



For more information about possible test setup configurations and details, refer to *CTIA 01.71* [6] Section 2 and *CTIA 01.20* [3] Section 6 for setup illustrations.

For Wi-Fi DUT transmitter stimulus, unicast UDP packets are transmitted by the WLAN tester using the MAC address of the Wi-Fi DUT. The RF port of the WLAN tester is connected to the link antenna inside the chamber.

For this test, ACK based packet generation shall be used to create the Wi-Fi interference signal. The ACK control frames are sent in response to unicast data packets generated by the WLAN tester according to the parameters specified in Table 3.1-6. The DUT will respond with repeated ACKs which will be transmitted at maximum power.

Cellular desensitization tests shall only be performed with 802.11b, 2.4 GHz.(Note: 802.11g/n/ax devices at 2.4 GHz must support 802.11b at 2.4 GHz) and 802.11a, 5 GHz (Note: 802.11n/ac/ax devices at 5 GHz must support 802.11a at 5 GHz) and 802.11ax at 6 GHz Data rates of Table 3.1-2 shall be used for the Wi-Fi interference signal.

US U-NII-4 band only includes two new additional 20 MHz channels 173 and 177. It also includes a part of Channel 169 that straddles between U-NII-4 and U-NII-3 that is added to U-NII-4.

All desensitization tests of this section are performed according to the configurations specified in Appendix B.

For devices supporting multiple Wi-Fi TX antennas, cellular radio desensitization shall be tested with the Wi-Fi TX antennas configured per the guidelines specified in *CTIA 01.01* [2].

Note: This could require multiple tests if the conditions of *CTIA 01.01* [2] Section 2.1.5.2.1 apply.

4.3.3 Test Point Parameters

For the purpose of Testing in Section 4.3, devices that operate in the 2.4 GHz band shall be set to operate on Channel 6 (f_c = 2.437 GHz). Devices that operate in the 5 GHz band shall be set to operate only on the middle channel of the lowest supported sub-band in the 5GHz range. The Middle Channel numbers corresponding to each sub-band are listed in Table 4.3-2. Devices that operate in the 6 GHz band shall be set to operate only on the middle channel of the lowest supported sub-band in the 6GHz range. The Middle Channel numbers corresponding to each sub-band in 6GHz range are listed in Table 4.3-1.

Table 4.3-2 Middle Channels for Wi-Fi U-NII Sub-Bands in 5GHz for TIS Cellular Desensitization

Sub Band [7][8]	Frequency Range	Middle Channel Number	Middle Channel Center Frequency f_c
US U-NII-1, ETSI Sub-band 1	5.150-5.250 GHz	44	5.220 GHz
US U-NII-2A, ETSI Sub-band 1	5.250-5.350 GHz	60	5.300 GHz
US U-NII-2C, ETSI Sub-band 2	5.470-5.725 GHz	120	5.600 GHz
US U-NII-3, Ofcom	5.725-5.850 GHz	157	5.785 GHz
US U-NII-4	5.850-5.895 GHz	173	5.885 GHz

Table 4.3-3 Middle Channels for Wi-Fi U-NII Sub-Bands in 6GHz for TIS Cellular Desensitization

Sub Band [14][15]	Frequency Range	Middle Channel Number	Middle Channel Center Frequency f_c
US U-NII-5	5.945-6.425 GHz	49	6.195 GHz
US U-NII-6	6.425-6.525 GHz	105	6.475 GHz
US U-NII-7	6.525-6.875 GHz	149	6.695 GHz
US U-NII-8	6.875-7.125 GHz	213	7.015 GHz

Applicable to all tests of Section 4.3, for legacy Wi-Fi RATs (i.e., 802.11a/b/g/n/ac) testing, coding shall be CC or BCC, for 802.11ax testing, coding shall be LDPC; use BCC if LDPC is not supported (e.g., in 2.4 GHz products or 20MHz-only products).

4.3.4 Test Procedure for RATs with Free-Space TIS Limits

For GSM and UMTS RATs listed in *CTIA 01.50* [4] Sections 2.1.2 and 3.1.2, perform the following steps. If Section 2.1 and Section 2.2 of *CTIA 01.01* [2] allows for reduced legacy RAT testing for TIS and/or intermediate channel testing in free-space, here the same test reduction is allowed for that legacy RAT.

Initial Conditions

1. Turn on the Wi-Fi radio and let the Wi-Fi DUT associate with the WLAN tester using appropriate settings of the DUT and WLAN tester.
2. Start Wi-Fi DUT Transmitter Stimulus as specified in Section 4.3.2.

Test Procedures

1. With Wi-Fi Radio on, perform the Relative Sensitivity on Intermediate Channels test at all intermediate channels according to the appropriate Receive Performance Test Procedure section of *CTIA 01.50* [4].
2. Compare the resulting digital error rate or throughput rate as specified in the *CTIA 01.50* [4] and determine which channels are desensitized beyond requirements specified in *CTIA 01.01* [2].
3. Repeat Step 3 and Step 4 for all RATs and corresponding supporting bands.
4. Report only the intermediate channels that exceed the limit as specified in *CTIA 01.01* [2].

4.3.5 Test Procedure for RATs without Free-Space TIS Limits

For RATs without reference free-space TIS limits, the test for relative sensitivity on intermediate channels cannot be performed because M1 margin values cannot be determined. In that case, the procedure listed here shall be followed until such time as limits are established. This includes all LTE/NR FR1 RATs in Section 4.1.2 and Section 5.1.1.2 of *CTIA 01.50* [4], and any bands listed in the Section 2.1.3, Section 3.1.3 and Section 4.1.3 of *CTIA 01.50* [4].

If Section 2 and Section 3 of *CTIA 01.01* [2] allows for reduced legacy RAT testing for TIS and/or intermediate channel testing in free-space, here the same test reduction is allowed for that legacy RAT.

Test Procedures

1. Determine the TIS of the DUT at the low channel with the Wi-Fi radio transmitter switched OFF, using the data captured previously per the procedures in the *CTIA 01.50* [4].
2. Use the *CTIA 01.50* [4] procedures to determine the position and polarization that results in the maximum EIS value associated to Step 1.
3. Use the corresponding position and polarization of Step 2 and measure the EIS($_{peak}$) of the DUT at the low channel with the Wi-Fi radio transmitter switched OFF.
4. Capture the measured EIS result as Value A Low.
5. Turn on the Wi-Fi radio and let the Wi-Fi DUT associate with the WLAN tester using appropriate settings of the DUT and WLAN tester.
6. Start Wi-Fi DUT Transmitter Stimulus as specified in Section 4.3.2.
7. Without re-positioning and keeping the same corresponding position and polarization of Step 2, measure the EIS($_{peak}$) of the DUT at the low channel with the Wi-Fi radio transmitter switched ON. Capture the result as Value B Low.
8. Repeat Step 1 to Step 7 for the mid and high channels.
9. Repeat Step 1 to Step 8 for all RATs and corresponding supporting bands.

4.3.6 Test Procedure for all LTE cases

For all LTE single carrier bands in Section 4.1.2.1 of *CTIA 01.50* [4], follow the test procedure of Section 4.3.5.

4.3.7 Error Rate Measure

According to *CTIA 01.50* [4], each cellular protocol (such as GSM and UMTS) specifies a different digital error rate as the DUT cellular receiver performance metric, while LTE/NR FR1 FDD and/or TDD specify the measurement of the DUT cellular receiver's throughput rate as the applicable performance metric. The error rates or throughput values shall be applied to all bands as specified in *CTIA 01.50* [4].

4.3.8 Results

There are no Pass/Fail criteria.

When performing the test according to Section 4.3.3, results shall be reported by giving the channel(s) exceeding the limit. When performing the test according to Section 4.3.4, results shall be reported in dBm for the EIS values.

Refer to Appendix A for sample report templates.

Appendix A Summary Test Report

The following content shall be included in the test report. The tables are provided as examples for information.

Table A.1-1 Sample Summation

Manufacturer	
Model	
Wi-Fi Alliance CID[1]	
CTIA Request #	
Serial Number (e.g., MEID, IMEI).	
Regulatory Approval ID (e.g., FCCID)	
Hardware Version	
Software Version	

A.1 Wi-Fi Conducted Tests

Table A.1-2 Conducted RF Power Output and Receiver Sensitivity Results

Mode	Sub-Band	Channel	Data Rate (Mbps)	Tx Test ID	Output Power (dBm)	Rx Test ID	Receiver Sensitivity (dBm)
802.11b 2.4 GHz	N/A	Low	11	COP1		CRS1	
		6	11	COP2		CRS2	
		High	11	COP3		CRS3	
802.11g 2.4 GHz	N/A	Low	6	COP4		CRS4	
			54	N/A	N/A	CRS5	
		6	6	COP5		CRS6	
			54	N/A	N/A	CRS7	
		High	6	COP6		CRS8	
			54	N/A	N/A	CRS9	

[1] Vendor supplies the Wi-Fi Alliance CID (Certification Identifier) during the CWG application process.

Mode		Sub-Band	Channel	Data Rate (Mbps)	Tx Test ID	Output Power (dBm)	Rx Test ID	Receiver Sensitivity (dBm)
802.11n 2.4 GHz		N/A	Low	6.5	COP7		CRS10	
				65	N/A	N/A	CRS11	
			6	6.5	COP8		CRS12	
				65	N/A	N/A	CRS13	
			High	6.5	COP9		CRS14	
				65	N/A	N/A	CRS15	
802.11ax 2.4 GHz	LDPC/BCC	N/A	Low	7.3	COP10		CRS16	
				73.1	N/A	N/A	CRS17	
			6	7.3	COP11		CRS18	
				73.1	N/A	N/A	CRS19	
			High	7.3	COP12		CRS20	
				73.1	N/A	N/A	CRS21	
802.11a 5 GHz		5.150-5.250 MHz	36	6	COP13		CRS22	
				54	N/A	N/A	CRS23	
			44	6	COP14		CRS24	
				54	N/A	N/A	CRS25	
			48	6	COP15		CRS26	
				54	N/A	N/A	CRS27	
802.11a 5 GHz		5.250-5.350 MHz	52	6	COP16		CRS28	
				54	N/A	N/A	CRS29	
			60	6	COP17		CRS30	
				54	N/A	N/A	CRS31	
			64	6	COP18		CRS32	
				54	N/A	N/A	CRS33	
802.11a 5 GHz		5.470-5.725 MHz	100	6	COP19		CRS34	
				54	N/A	N/A	CRS35	

Mode	Sub-Band	Channel	Data Rate (Mbps)	Tx Test ID	Output Power (dBm)	Rx Test ID	Receiver Sensitivity (dBm)
		120	6	COP20		CRS36	
			54	N/A	N/A	CRS37	
		140	6	COP21		CRS38	
			54	N/A	N/A	CRS39	

Mode	Sub-Band	Channel	Data Rate (Mbps)	Tx Test ID	Output Power (dBm)	Rx Test ID	Receiver Sensitivity (dBm)
802.11a 5 GHz	5.725-5.850 MHz	149	6	COP22		CRS40	
			54	N/A	N/A	CRS41	
		157	6	COP23		CRS42	
			54	N/A	N/A	CRS43	
		165	6	COP24		CRS44	
			54	N/A	N/A	CRS45	
802.11n 5 GHz	5.150-5.250 MHz	36	6.5	COP25		CRS46	
			65	N/A	N/A	CRS47	
		44	6.5	COP26		CRS48	
			65	N/A	N/A	CRS49	
		48	6.5	COP27		CRS50	
			65	N/A	N/A	CRS51	
802.11n 5 GHz	5.250-5.350 MHz	52	6.5	COP28		CRS52	
			65	N/A	N/A	CRS53	
		60	6.5	COP29		CRS54	
			65	N/A	N/A	CRS55	
		64	6.5	COP30		CRS56	
			65	N/A	N/A	CRS57	
802.11n 5 GHz	5.470-5.725 MHz	100	6.5	COP31		CRS58	
			65	N/A	N/A	CRS59	
		120	6.5	COP32		CRS60	
			65	N/A	N/A	CRS61	
		140	6.5	COP33		CRS62	
			65	N/A	N/A	CRS63	

Mode		Sub-Band	Channel	Data Rate (Mbps)	Tx Test ID	Output Power (dBm)	Rx Test ID	Receiver Sensitivity (dBm)
802.11n 5 GHz		5.725-5.850 MHz	149	6.5	COP34		CRS64	
				65	N/A	N/A	CRS65	
			157	6.5	COP35		CRS66	
				65	N/A	N/A	CRS67	
			165	6.5	COP36		CRS68	
				65	N/A	N/A	CRS69	
802.11ax 5 GHz	LDPC/BCC	5.850-5.895 MHz	173	7.3	COP37		CRS70	
				73.1	N/A	N/A	CRS71	
802.11ax 6 GHz	LDPC/BCC	5.945-6.425 GHz	1	7.3	COP38		CRS72	
				73.1	N/A	N/A	CRS73	
			49	7.3	COP39		CRS74	
				73.1	N/A	N/A	CRS75	
			93	7.3	COP40		CRS76	
				73.1	N/A	N/A	CRS77	
802.11ax 6 GHz	LDPC/BCC	6.425-6.525 GHz	97	7.3	COP41		CRS78	
				73.1	N/A	N/A	CRS79	
			105	7.3	COP42		CRS80	
				73.1	N/A	N/A	CRS81	
			113	7.3	COP43		CRS82	
				73.1	N/A	N/A	CRS83	
802.11ax 6 GHz	LDPC/BCC	6.525-6.875 GHz	117	7.3	COP44		CRS84	
				73.1	N/A	N/A	CRS85	
			149	7.3	COP45		CRS86	

Mode		Sub-Band	Channel	Data Rate (Mbps)	Tx Test ID	Output Power (dBm)	Rx Test ID	Receiver Sensitivity (dBm)
				73.1	N/A	N/A	CRS87	
			181	7.3	COP46		CRS88	
				73.1	N/A	N/A	CRS89	
802.11ax 6 GHz	LDPC/BCC	6.875-7.125 GHz	189	7.3	COP47		CRS90	
				73.1	N/A	N/A	CRS91	
			213	7.3	COP48		CRS92	
				73.1	N/A	N/A	CRS93	
			233	7.3	COP49		CRS94	
				73.1	N/A	N/A	CRS95	

A.2 Total Radiated Power (TRP) and Total Isotropic Sensitivity (TIS) for 2.4 GHz 802.11b, 802.11g, 802.11n and 802.11ax

Table A.2-1 TRP for 2.4 GHz 802.11b/g/n/ax

Test ID	Mode		Channel	Data Rate (Mbps)	TRP Results (dBm)
TRP1	IEEE 802.11b		6	11	
TRP2	IEEE 802.11g		6	6	
TRP3	IEEE 802.11n		6	6.5	
TRP4	IEEE 802.11ax	LDPC/BCC	6	7.3	

Table A.2-2 TIS for 2.4 GHz 802.11b/g/n/ax

Test ID	Mode		Channel	Data Rate (Mbps)	TIS Results (dBm)
TIS1	IEEE 802.11b		6	11	
TIS2	IEEE 802.11g		6	54	
TIS3	IEEE 802.11n		6	65	
TIS4	IEEE 802.11ax	LDPC/BCC	6	73.1	

A.3 Total Radiated Power (TRP) and Total Isotropic Sensitivity (TIS) for 5GHz 802.11a, 802.11n and 802.11ax

Table A.3-1 provides the list of sub-band options and corresponding channel frequency and data rates scenarios for TRP and TIS.

Table A.3-1 TRP for 5 GHz 802.11a/n/ax

Test ID	Sub Band [14][15]	Frequency Range	Channel Number	Mode		Data Rate (Mbps)	TRP Results (dBm)
TRP5	US U-NII-1, ETSI Sub-band 1	5.150-5.250 GHz	44	802.11a		6	
TRP6				802.11n		6.5	
TRP7				802.11ax	LDPC/BCC	7.3	
TRP8	US U-NII-2A, ETSI Sub-band 1	5.250-5.350 GHz	60	802.11a		6	
TRP9				802.11n		6.5	
TRP10				802.11ax	LDPC/BCC	7.3	
TRP11	US U-NII-2C, ETSI Sub-band 2	5.470-5.725 GHz	120	802.11a		6	
TRP12				802.11n		6.5	
TRP13				802.11ax	LDPC/BCC	7.3	
TRP14	US U-NII-3, Ofcom	5.725-5.850 GHz	157	802.11a		6	
TRP15				802.11n		6.5	
TRP16				802.11ax	LDPC/BCC	7.3	
TRP17			165	802.11a		6	
TRP18				802.11n		6.5	
TRP19				802.11ax	LDPC/BCC	7.3	
TRP20	US U-NII-4	5.850-5.895 MHz	173	802.11a		6	
TRP21				802.11n		6.5	
TRP22				802.11ax	LDPC/BCC	7.3	

Table A.3-2 TIS for 5 GHz 802.11a/n/ax

Test ID	Sub Band [14][15]	Frequency Range	Channel Number	Mode		Data Rate (Mbps)	TIS Results (dBm)
TIS5	US U-NII-1, ETSI Sub-band 1	5.150-5.250 GHz	44	802.11a		54	
TIS6				802.11n		65	
TIS7				802.11ax	LDPC/BCC	73.1	
TIS8	US U-NII-2A, ETSI Sub-band 1	5.250-5.350 GHz	60	802.11a		54	
TIS9				802.11n		65	
TIS10				802.11ax	LDPC/BCC	73.1	
TIS11	US U-NII-2C, ETSI Sub-band 2	5.470-5.725 GHz	120	802.11a		54	
TIS12				802.11n		65	
TIS13				802.11ax	LDPC/BCC	73.1	
TIS14	US U-NII-3, Ofcom	5.725-5.850 GHz	157	802.11a		54	
TIS15				802.11n		65	
TIS16				802.11ax	LDPC/BCC	73.1	
TIS17			165	802.11a		54	
TIS18				802.11n		65	
TIS19				802.11ax	LDPC/BCC	73.1	
TIS20	US U-NII-4	5.850-5.895 MHz	173	802.11a		54	
TIS21				802.11n		65	
TIS22				802.11ax	LDPC/BCC	73.1	

A.4 Total Radiated Power (TRP) and Total Isotropic Sensitivity (TIS) for 6GHz 802.11ax

Table A.4-1 provides the list of sub-band options and corresponding channel frequency and data rates scenarios for TRP and TIS.

Table A.4-1 TRP for 6 GHz 802.11ax

Test ID	Mode		Sub Band [14][15]	Frequency Range	Channel Number	Data Rate (Mbps)	TRP Results (dBm)
TRP23	802.11ax	LDPC/BCC	US U-NII-5	5.945-6.425 GHz	49	7.3	
TRP24			US U-NII-6	6.425-6.525 GHz	105	7.3	
TRP25			US U-NII-7	6.525-6.875 GHz	149	7.3	
TRP26			US U-NII-8	6.875-7.125 GHz	213	7.3	

Table A.4-2 TIS for 6 GHz 802.11ax

Test ID	Mode		Mode	Frequency Range	Channel Number	Data Rate (Mbps)	TIS Results (dBm)
TIS23	802.11ax	LDPC/BCC	US U-NII-5	5.945-6.425 GHz	49	73.1	
TIS24			US U-NII-6	6.425-6.525 GHz	105	73.1	
TIS25			US U-NII-7	6.525-6.875 GHz	149	73.1	
TIS26			US U-NII-8	6.875-7.125 GHz	213	73.1	

A.5 Wi-Fi Desensitization Measurements (with Cellular Transmitter On)

Table A.5-1 Wi-Fi Radio Desensitization by Closest Cellular Uplink Frequency

802.11		Closest Cellular Uplink Frequency		802.11	Reference Polarization	Reference Position		Desensitization (dB)	Max Provided EIS in Case of Complete Failure (dBm)
Mode	Channel	Mode	Channel	Data Rate (Mbps)		Theta	Phi		
802.11b									
802.11g									

802.11n 2.4 GHz									
802.11ax									

Note: In case of complete failure, include the maximum EIS that the test system can provide in the last column; leave unused otherwise.

Table A.5-2 Wi-Fi Radio Desensitization by Cellular Radio Uplink Harmonics 802.11b/g/n/a/ax

802.11		Cellular Uplink Frequency		802.11	Reference Polarization	Reference Position		Desensitization (dB)	Max Provided EIS in Case of Complete Failure (dBm)
Mode	Channel	Mode	Channel	Data Rate (Mbps)		Theta	Phi		
802.11b 2.4 GHz									
802.11g 2.4 GHz									
802.11n 2.4 GHz									
802.11ax 2.4 GHz									
802.11a 5 GHz									
802.11n 5 GHz									
802.11ax 5 GHz									
802.11ax 6 GHz									

Note: In case of complete failure, include the maximum EIS that the test system can provide in the last column; leave blank otherwise.

A.6 Cellular Desensitization Measurements (with Wi-Fi Transmitter On)

Reporting Format for Intermediate Channel Sensitivity Tests according to Section 4.3.3.

Table A.6-1 Cellular Desensitization Test Results for 802.11b Operation (Wi-Fi 2.4 GHz Band) with Cellular Free-Space Limits

Cellular Technology/Band	Wi-Fi Channel	Reference Polarization	Reference Position Theta (°)	Reference Position Phi (°)	Intermediate Channels Exceeding Limit
	802.11b Ch. 6 (2.437GHz)				

Table A.6-2 Cellular Desensitization Test Results for 802.11a Operation with Cellular Free-Space Limits

Cellular Technology/Band	Wi-Fi Channel	Reference Polarization	Reference Position Theta (°)	Reference Position Phi (°)	Intermediate Channels Exceeding Limit
	802.11a middle channel of the lowest supported sub-band				

Reporting Format for EIS Tests according to Section 4.3.5.

Table A.6-3 Cellular Desensitization Test Results for 802.11b Operation (Wi-Fi 2.4 GHz Band) without Cellular Free-Space Limits

Cellular Technology Channel	Wi-Fi Channel	Reference Polarization	Reference Position Theta (°)	Reference Position Phi (°)	EIS Value A [with Wi-Fi Off] (dBm)	EIS Value B [with Wi-Fi On] (dBm)
(Low)	802.11b Ch. 6 (2.437GHz)					
(Mid)	802.11b Ch. 6 (2.437GHz)					
(High)	802.11b Ch. 6 (2.437GHz)					

Table A.6-4 Cellular Desensitization Test Results for 802.11a Operation without Cellular Free-Space Limits

Cellular Technology Channel	Wi-Fi Channel	Reference Polarization	Reference Position Theta (°)	Reference Position Phi (°)	EIS Value A [with Wi-Fi Off] (dBm)	EIS Value B [with Wi-Fi On] (dBm)
(Low)	802.11a middle channel of the lowest supported sub-band					
(Mid)	802.11a middle channel of the lowest supported sub-band					
(High)	802.11a middle channel of the lowest supported sub-band					

Appendix B Handheld Device Testing Configurations

All handheld devices shall be tested in their primary mechanical mode, as defined by the manufacturer and noted in the test report. All hand phantom guidelines with each type of wireless device shall be followed as written in the *CTIA Certification Test Plan for Wireless Device Over-the-Air Performance* [1]. The appropriate hand phantom shall be selected according to *CTIA 01.72* [7]. For Wi-Fi testing at 6GHz band (5925-7125MHz), the sub 6GHz phantom specified in *CTIA 01.72* [7] is used with parameters selected at 6GHz.

For a given device class, the test shall be performed as indicated in Table B.1-1. Please note that some cases require testing with multiple configurations.

Table B.1-1 Device Testing Applicability Matrix

Device Capabilities		TIS/TRP	Wi-Fi Desensitization	Cellular Desensitization
Wi-Fi	with Simultaneous WWAN Operation	Free Space	Free Space	Free Space
	without Simultaneous WWAN Operation	Free Space	Test not Required	Test not Required
Wi-Fi Browser [2]	with Simultaneous WWAN Operation	HR = Hand Right Phantom and HL = Hand Left Phantom	Free Space	Free Space
	without Simultaneous WWAN Operation	HR = Hand Right Phantom and HL = Hand Left Phantom	Test not Required	Test not Required

[2] As specified in Appendix O.4 of CTIA Certification OTA Test Plan [1]

Appendix C Test Channels that Require Testing, but are not Defined in the CTIA Certification OTA Test Plan

Editor Notes: Full configuration for band n78 to be included here.

Appendix D Notebook and Tablet Requirements

The purpose of this addendum is to define the requirements for Notebooks and Tablets with embedded WWAN and Wi-Fi radio modules.

Notebooks, Tablets, Convertible PCs and Hybrid PCs shall be tested in their primary mechanical mode based on the guidelines of *CTIA 01.01* [2] and noted in the test report.

To reduce the testing of the cellular de-sense measurements with Wi-Fi Transmitter ON, data only devices shall be tested according to *CTIA 01.01* [2] Section 2.1.3.

D.1 Parent/Child Relationships

During product development, the Manufacturer is expected to determine what represents the most popular configuration of components and to use that configuration for the receiver performance assessment. Once the most popular version of a Parent has been identified, all Child Devices will be assessed against only that specific version of the Parent. This will hold true even if that particular version of the Parent does not remain the most popular over time.

D.2 Parent/Child Antenna Subsystem Considerations

The antenna subsystem in a Child Device must be similar in design and performance to that of its Parent (e.g. the antenna itself may be provided by a manufacturer which differs from that used in the Parent or the transmission line type/length may differ, but the antenna subsystem must be based on the same design specification).

D.3 Test Configurations and Setup Procedures

For testing configuration and setup procedures refer to *CTIA 01.71* [6] Section 2.5.1. The setup configuration in Section L.4 will be used with the exception of the Transmitting Wi-Fi radio which will be "ON".

Table D.3-1 Test Applicability Matrix

Device Capabilities	Wi-Fi TRP/TIS	Wi-Fi Desensitization	Cellular Desensitization
Case 1: Simultaneous WWAN and Wi-Fi operation	Free Space	Free Space	Free Space
Case 2: WWAN and Wi-Fi not operating simultaneously	Free Space	Test not Required	Test not Required

Case 1: Notebooks and Tablets that are capable of simultaneous WWAN and Wi-Fi operation

Case 2: Notebooks and Tablets that are not capable of simultaneous WWAN/Wi-Fi operation

Appendix E Wi-Fi-LTE Emulator Test Equipment Notes when Testing DUTs that Support LTE Band 40 or 41 (Informative)

This is an informative appendix. The information in this appendix is to inform test labs that care should be used with test equipment when performing tests with DUTs that support LTE Band 40 or 41. With an incorrect test setup, results may be incorrect because of test equipment desensitization. Proper RF isolation is required between the cellular and Wi-Fi emulators. The test diagrams shown in this appendix are examples and variations of the test setup may differ or may not be required for each test lab.

Proper Wi-Fi and LTE emulator test equipment setup is required for Wi-Fi or cellular desensitization measurements for DUTs that support LTE Bands 40 or 41. LTE Bands 40 and 41 are next to the 2.4 GHz Wi-Fi band with little or no guard bands (see Figure E.1-1 and Figure E.1-2.)There is the possibility that the Wi-Fi or LTE emulator would be unable to attach to the DUT when performing these measurements due to test equipment immunity issues. The test lab shall insure they are measuring the over the air DUT Wi-Fi or cellular desensitization and not Wi-Fi or LTE emulator test equipment immunity.

Figure E.1-1 LTE Band 40 and Wi-Fi 2.4 GHz Frequency Diagram

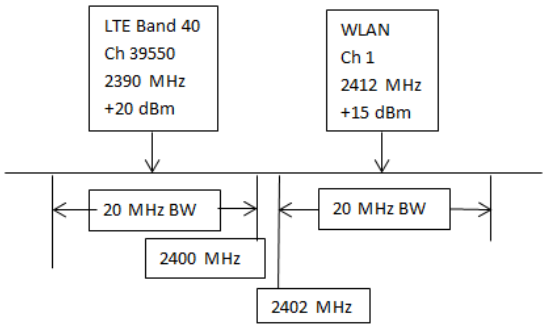
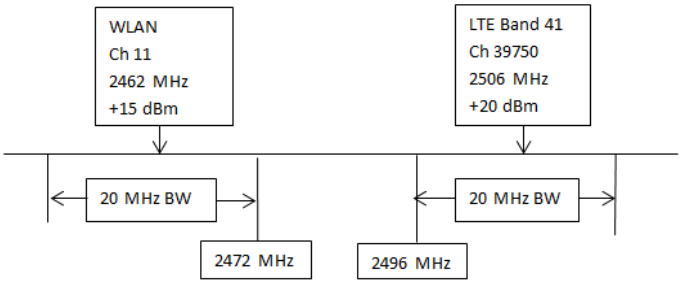


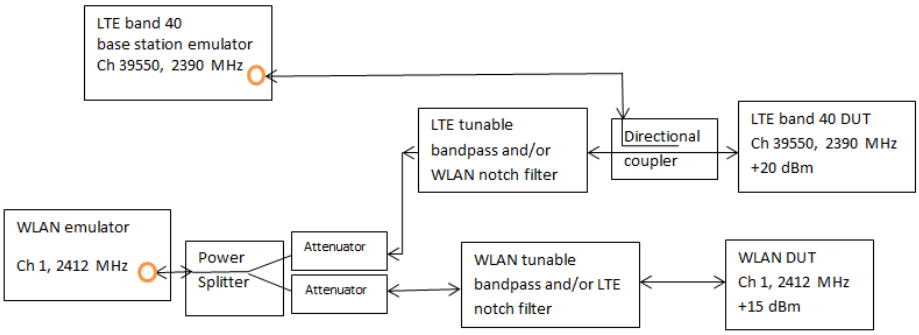
Figure E.1-2 LTE Band 41 and Wi-Fi 2.4 GHz Frequency Diagram



The test lab can verify Wi-Fi emulator test equipment immunity with the example test equipment diagram in Figure E.1-3. RF cavity tuned notch and/or bandpass filters are used to ensure the DUT is not desensitized by the LTE device and for the LTE device to stay attached to the LTE emulator due to interference from the Wi-Fi. Attenuators can be used to simulate expected RF levels present at the Wi-Fi emulator while performing Wi-Fi DUT over the air desensitization measurements. Perform sensitivity measurements with the DUT only (without LTE Band 40) and note results. Then attach LTE Band 40 DUT to the LTE emulator (at maximum output power). With the LTE Band 40 DUT attached, re-measure the Wi-Fi DUT. If the Wi-Fi sensitivity measurements are the same and Wi-Fi/LTE DUTs remain

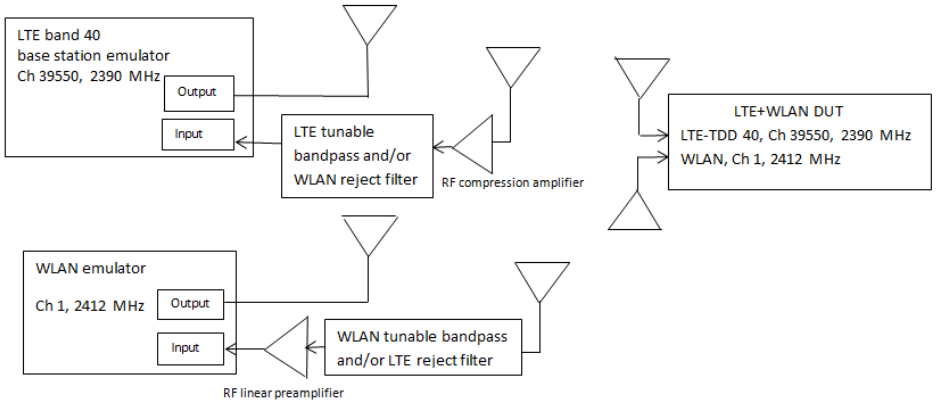
attached, the Wi-Fi emulator is immune to the adjacent channel interference. LTE base station emulator test equipment immunity can be verified by exchanging the positions of the emulators, RF filters and DUTs in the diagram.

Figure E.1-3 Wi-Fi Emulator Test Equipment Verification Test Setup (to Test the LTE Base Station



If the Wi-Fi or LTE emulator does show immunity problems, diagram Figure E.1-4 shows an example on how to eliminate these problems (use RF filters as needed). If the lab is using an RF compression amplifier for the LTE input emulator, the RF filter must be installed after the output of the amplifier. If the device can stay attached to the LTE emulator, no RF filter is required. If the lab is using an RF preamplifier for the Wi-Fi emulator input, the RF filter should be connected to the input of the preamplifier. Care should be used when tuning the RF filters. If a Wi-Fi bandpass RF filter is used, be sure to add its loss into the system path loss and remove the filters when performing Wi-Fi TRP or TIS measurements.

Figure E.1-4 Example Test System Diagram (Only for Wi-Fi Desensitization or LTE Cellular Desensitization Tests, if the DUT Supports LTE Band 40)



Appendix F Table of Wi-Fi Radio Channels Interfered by Cellular Radio Harmonics

The cellular radio configuration will be set according to the Call Setup Reference, in the table below, except for those parameters specifically defined within the table.

RAT			GSM 850		E-GSM 900		DCS 1800		GSM 1900	
Region			North America, South America, Asia		South America, EU, Asia, Australia. Africa		South America, EU, Asia, Australia. Africa		North America, South America	
Suggested alternate name										
Call setup defined in reference document			CTIA 01.50 [1] , Section 2.1.1		CTIA 01.50 [1], Section 2.1.3		CTIA 01.50 [1], Section 2.1.3		CTIA 01.50 [1], Section 2.1.1	
Special setup										
	Band Edges									
	Uplink Freq		824.2	848.8	880.2	914.8	1710.2	1784.8	1850.2	1909.8
	Downlink Freq		869.2	893.8	925.2	959.8	1805.2	1879.8	1930.2	1989.8
			Desensitization of Wi-Fi Rx by Cellular Tx Uplink							
	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq
802.11b/g/n/ax	1	2412								
	2	2417								
	3	2422		Bold box boarders indicate Wi-Fi Rx vulnerability due to Cellular uplink Tx						
	4	2427								
	5	2432								
	6	2437								
	7	2442								
	8	2447								
	9	2452								
	10	2457								
	11	2462	128	824.2						
	12	2467								
	13	2472	128	824.2						

802.11a/n/ac/ax U-NII-1 ETSI 5GHz Sub-band 1	36	5180								
	40	5200								
	44	5220					661	1740		
	48	5240								
802.11a/n/ac/ax U-NII-2A ETSI 5GHz Sub-band 1	52	5260								
	56	5280								
	60	5300					794	1766.6		
	64	5320								
802.11a/n/ac/ax U-NII-2C ETSI 5GHz Sub-band 2	100	5500								
	112	5560								
	116	5580								
	120	5600								
	124	5620							628	1873.4
	128	5640								
	132	5660								
	136	5680								
	140	5700								
802.11a/n/ac/ax U-NII-3 Ofcom	149	5745								
	153	5765								
	157	5785								
	161	5805								
	165	5825								
802.11a/n/ac /ax U-NII-4	169	5845								
	173	5865								
	177	5885								

802.11ax U-NII-5 ETSI 6GHz	1	5955								
	5	5975								
	9	5995								
	13	6015								
	17	6035								
	21	6055								
	25	6075								
	29	6095								
	33	6115								
	37	6135								
	41	6155								
	45	6175								
	49	6195								
	53	6215								
	57	6235								
	61	6255								
	65	6275								
	69	6295								
	73	6315								
	77	6335								
	81	6355								
	85	6375								
	89	6395								
	93	6415								
802.11ax U-NII-6 ETSI 6GHz	97	6435								
	101	6455								
	105	6475								
	109	6495								
	113	6515								

802.11ax U-NII-7	117	6535								
	121	6555								
	125	6575								
	129	6595								
	133	6615								
	137	6635								
	141	6655								
	145	6675								
	149	6695								
	153	6715								
	157	6735								
	161	6755								
	165	6775								
	169	6795								
	173	6815								
	177	6835								
	181	6855								
802.11ax U-NII-8	185	6875								
	189	6895								
	193	6915								
	197	6935								
	203	6955								
	207	6975								
	211	6995								
	214	7015								
	217	7035								
	221	7055								
	225	7075								
	229	7095								
	233	7115								

RAT			WCDMA 3GPP Band I		WCDMA 1900 3GPP Band II		WCDMA 3GPP Band III		WCDMA 2100/1700 3GPP Band IV		WCDMA 850 3GPP Band V		WCDMA 3GPP Band VIII	
Region			EU, Asia, Middle East, Africa, Australia		North America, South America, Asia		EU, Asia		North America, South America		North America, South America, Asia, Australia		EU, Asia, South America, Middle East, Australia, Africa	
Suggested alternate name														
Call setup defined in reference document			CTIA 01.50 [1], Section 3.1.3		CTIA 01.50 [1], Section 3.1.1		CTIA 01.50 [1], Section 3.1.3		CTIA 01.50 [1], Section 3.1.1		CTIA 01.50 [1], Section 3.1.1		CTIA 01.50 [1], Section 3.1.3	
Special setup														
	Band Edges													
	Uplink Freq		1920	1980	1850	1910	1710	1785	1710	1755	824	849	880	915
	Downlink Freq		2110	2170	1930	1990	1805	1880	2110	2155	869	894	925	960
	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq
802.11b/g/n/ax	1	2412												
	2	2417												
	3	2422		Bold box boarders indicate Wi-Fi Rx vulnerability due to Cellular uplink Tx										
	4	2427												
	5	2432												
	6	2437												
	7	2442												
	8	2447												
	9	2452												
	10	2457												
	11	2462									4357	826.4		
	12	2467												
	13	2472									4357	826.4		

802.11a/n/ac /ax U-NII-1	36	5180												
	40	5200												
	44	5220					1300	1740	~~1675~~	~~1740~~				
	48	5240												
802.11a/n/ac /ax U-NII-2A	52	5260												
	56	5280												
	60	5300					1433	1766.6						
	64	5320												
802.11a/n/ac/ax U-NII-2C ETSI 5GHz Sub-band 2	100	5500												
	112	5560												
	116	5580												
	120	5600												
	124	5620			9767	1873.4								
	128	5640												
	132	5660												
	136	5680												
	140	5700												
802.11a/n/ac/ax U-NII-3 Ofcom	149	5745												
	153	5765												
	157	5785	10592	1928.4										
	161	5805												
	165	5825												
802.11a/n /ac/ax U-NII-4	169	5845												
	173	5865	9775	1955										
	177	5885												

802.11ax U-NII-5 ETSI 6GHz	1	5955												
	5	5975												
	9	5995												
	13	6015												
	17	6035												
	21	6055												
	25	6075												
	29	6095												
	33	6115												
	37	6135												
	41	6155												
	45	6175												
	49	6195												
	53	6215												
	57	6235												
	61	6255												
	65	6275												
	69	6295												
	73	6315												
	77	6335												
	81	6355												
	85	6375												
	89	6395												
	93	6415												
802.11ax U-NII-6 ETSI 6GHz	97	6435												
	101	6455												
	105	6475												
	109	6495												
	113	6515												

802.11ax U-NII-7	117	6535												
	121	6555												
	125	6575												
	129	6595												
	133	6615												
	137	6635												
	141	6655												
	145	6675												
	149	6695												
	153	6715												
	157	6735												
	161	6755												
	165	6775												
	169	6795												
	173	6815												
	177	6835												
	181	6855												
802.11ax U-NII-8	185	6875												
	189	6895												
	193	6915												
	197	6935												
	203	6955												
	207	6975												
	211	6995												
	214	7015												
	217	7035												
	221	7055												
	225	7075												
	229	7095												
	233	7115												

RAT			LTE Band 1		LTE Band 2		LTE Band 3		LTE Band 4		LTE Band 5		LTE Band 7		LTE Band 8		LTE Band 12		LTE Band 13	
Region			Japan , EU, Middle East, Africa, Australia		North America, South America		Asia, EU, Middle East, Africa, Australia		North America, South America		North America, South America, Asia, Australia		North America, EU, Asia, Middle East, Africa, Australia		EU, Asia		North America		North America	
Suggested alternate name											E-UTRA Band 5									
Call setup defined in reference document			CTIA 01.50 [1], Section 4.1.4		CTIA 01.50 [1], Section 4.1.1		CTIA 01.50 [1], Section 4.1.4		CTIA 01.50 [1], Section 4.1.1		CTIA 01.50 [1], Section 4.1.1		CTIA 01.50 [1], Section 4.1.1		CTIA 01.50 [1], Section 4.1.4		CTIA 01.50 [1], Section 4.1.1		CTIA 01.50 [1], Section 4.1.1	
Special setup			10 MHz Tx BW, 12 RBs RBstart=0		10 MHz Tx BW, 12 RBs RBstart=0		10 MHz Tx BW, 12 RBs RBstart=0		10 MHz Tx BW, 12 RBs RBstart=0		10 MHz Tx BW, 12 RBs RBstart=0		20 MHz Tx BW, 18 RBs, RBstart=0		10 MHz Tx BW, 12 RBs RBstart=0		5 MHz Tx BW, 8 RBs, RBstart=0		10 MHz Tx BW, 12 RBs RBstart=0	
	Band Edges																			
	Uplink Freq		1920	1980	1850	1900	1710	1785	1710	1755	824	849	2500	2570	880	915	699	716	777	787
	Downlink Freq		2110	2170	1930	1980	1815	1880	2110	2155	870	894	2620	2690	925	960	729	746	746	756
	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq
802.11b/g/n/ax	1	2412																		
	2	2417																		
	3	2422																		
	4	2427																		
	5	2432																		
	6	2437																		
	7	2442																		
	8	2447																		
	9	2452																		
	10	2457																		
	11	2462									20450	825.58								
	12	2467																		
	13	2472									20450	825.58								

Bold box borders indicate Wi-Fi Rx vulnerability due to Cellular uplink Tx

802.11a/n/ac/ax U-NII-1 ETSI 5GHz Sub-band 1	36	5180																		
	40	5200																		
	44	5220					19534	1739.98	20284	1739.98										
	48	5240																		
802.11a/n/ac/ax U-NII-2A ETSI 5GHz Sub-band 1	52	5260																		
	56	5280																		
	60	5300					19800	1766.58												
	64	5320																		
802.11a/n/ac/ax U-NII-2C ETSI 5GHz Sub-band 2	100	5500																		
	112	5560																		
	116	5580																		
	120	5600																		
	124	5620			18866	1873.18														
	128	5640																		
	132	5660																		
	136	5680																		
	140	5700																		
802.11a/n/ac/ax U-NII-3 Ofcom	149	5745																		
	153	5765																		
	157	5785	18118	1928.38																
	161	5805																		
	165	5825																		
802.11a/n/ac/ax U-NII-4	169	5845																		
	173	5865	18350	1955																
	177	5885																		

802.11ax U-NII-5 ETSI 6GHz	1	5955																			
	5	5975																			
	9	5995																			
	13	6015																			
	17	6035																			
	21	6055																			
	25	6075																			
	29	6095																			
	33	6115																			
	37	6135																			
	41	6155																			
	45	6175																			
	49	6195																			
	53	6215																			
	57	6235																			
	61	6255																			
	65	6275																			
	69	6295																			
	73	6315																			
	77	6335																			
	81	6355																			
	85	6375																			
	89	6395																			
	93	6415																			
802.11ax U-NII-6 ETSI 6GHz	97	6435																			
	101	6455																			
	105	6475																			
	109	6495																			
	113	6515																			

802.11ax U-NII-7	117	6535																	
	121	6555																	
	125	6575																	
	129	6595																	
	133	6615																	
	137	6635																	
	141	6655																	
	145	6675																	
	149	6695																	
	153	6715																	
	157	6735																	
	161	6755																	
	165	6775																	
	169	6795																	
	173	6815																	
	177	6835																	
	181	6855																	
802.11ax U-NII-8	185	6875																	
	189	6895																	
	193	6915																	
	197	6935																	
	203	6955																	
	207	6975																	
	211	6995																	
	214	7015																	
	217	7035																	
	221	7055																	
	225	7075																	
	229	7095																	
	233	7115																	

RAT			LTE Band 14		LTE Band 20		LTE Band 25		LTE Band 26		LTE Band 30		LTE Band 66		LTE Band 70		LTE Band 71	
Region			North America		EU, Middle East, Africa		North America		North America		North America		North America		North America		North America	
Suggested alternate name					E-UTRA Band 20													
Call setup defined in reference document			CTIA 01.50 [1], Section 4.1.1		CTIA 01.50 [1], Section 4.1.4		CTIA 01.50 [1], Section 4.1.1		CTIA 01.50 [1], Section 4.1.1		CTIA 01.50 [1], Section 4.1.1		CTIA 01.50 [1], Section 4.1.1		CTIA 01.50 [1], Section 4.1.1		CTIA 01.50 [1], Section 4.1.1	
Special setup			10 MHz Tx BW, 12 RBs RBstart=0		10 MHz Tx BW, 12 RBs RBstart=0		5 MHz Tx BW, 8 RBs, RBstart=0		5 MHz Tx BW, 8 RBs, RBstart=0		10 MHz Tx BW, 12 RBs RBstart=0		10 MHz Tx BW, 12 RBs RBstart=0		15 MHz Tx BW, 16 RBs RBstart=0		10 MHz Tx BW, 12 RBs RBstart=0	
	Band Edges																	
	Uplink Freq		788	798	832	862	1850	1915	814	849	2305	2315	1710	1780	1695	1710	663	698
	Downlink Freq		758	768	791	821	1930	1995	859	994	2350	2360	2110	2100	1995	2020	617	652
	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq
802.11b/g/n/ax	1	2412																
	2	2417																
	3	2422																
	4	2427																
	5	2432																
	6	2437																
	7	2442																
	8	2447																
	9	2452																
	10	2457																
	11	2462							26815	824.97								
	12	2467																
	13	2472							26815	824.97								

802.11a/n/ac/ax U-NII-1 ETSI 5GHz Sub-band 1	36	5180																
	40	5200																
	44	5220											132306	1739.98				
	48	5240																
802.11a/n/ac/ax U-NII-2A ETSI 5GHz Sub-band 1	52	5260																
	56	5280																
	60	5300																
	64	5320																
802.11a/n/ac/ax U-NII-2C ETSI 5GHz Sub-band 2	100	5500																
	112	5560																
	116	5580																
	120	5600																
	124	5620					26287	1873.17										
	128	5640																
	132	5660																
	136	5680																
	140	5700																
802.11a/n/ac/ax U-NII-3 Ofcom	149	5745																
	153	5765																
	157	5785																
	161	5805																
	165	5825																
802.11a/n/ac /ax U-NII-4	169	5845																
	173	5865																
	177	5885																

802.11ax U-NII-5 ETSI 6GHz	1	5955																
	5	5975																
	9	5995																
	13	6015																
	17	6035																
	21	6055																
	25	6075																
	29	6095																
	33	6115																
	37	6135																
	41	6155																
	45	6175																
	49	6195																
	53	6215																
	57	6235																
	61	6255																
	65	6275																
	69	6295																
	73	6315																
	77	6335																
	81	6355																
	85	6375																
	89	6395																
	93	6415																
802.11ax U-NII-6 ETSI 6GHz	97	6435																
	101	6455																
	105	6475																
	109	6495																
	113	6515																

802.11ax U-NII-7	117	6535																
	121	6555																
	125	6575																
	129	6595																
	133	6615																
	137	6635																
	141	6655																
	145	6675																
	149	6695																
	153	6715																
	157	6735																
	161	6755																
	165	6775																
	169	6795																
	173	6815																
	177	6835																
	181	6855																
802.11ax U-NII-8	185	6875																
	189	6895																
	193	6915																
	197	6935									27710	2310						
	203	6955																
	207	6975																
	211	6995																
	214	7015																
	217	7035																
	221	7055																
	225	7075																
	229	7095																
	233	7115																

RAT			LTE Band 38		LTE Band 39		LTE Band 40		LTE Band 41		LTE Band 48	
Region			EU, Asia, Middle East		Asia		Asia, Australia, Middle East, Africa		North America, Asia		North America	
Suggested alternate name												
Call setup defined in reference document			CWG Appendix C		CWG Appendix C		CWG Appendix C		CTIA 01.50 [1], Section 4.1.1		CTIA 01.50 [1], Section 4.1.1	
Special setup			20 MHz Tx BW, 18 RBs, RBstart=0		20 MHz Tx BW, 18 RBs, RBstart=0		20 MHz Tx BW, 18 RBs, RBstart=0		20 MHz Tx BW, 18 RBs, RBstart=0		10 MHz Tx BW, 18 RBs, RBstart=0	
	Band Edges											
	Uplink Freq		2570	2620	1880	1920	2300	2400	2496	2690	3550	3700
	Downlink Freq		2570	2620	1880	1920	2300	2400	2496	2690	3550	3700
			Desensitization of Wi-Fi Rx by Cellular Tx Uplink									
	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq
802.11b/g/n/ax	1	2412										
	2	2417										
	3	2422			Bold box boarders indicate Wi-Fi Rx vulnerability due to Cellular uplink Tx							
	4	2427										
	5	2432										
	6	2437										
	7	2442										
	8	2447										
	9	2452										
	10	2457										
	11	2462										
	12	2467										
	13	2472										

802.11a/n/ac/ax U-NII-1 ETSI 5GHz Sub-band 1	36	5180										
	40	5200										
	44	5220	38150	2610.02					40864	2610.02		
	48	5240										
802.11a/n/ac/ax U-NII-2A ETSI 5GHz Sub-band 1	52	5260										
	56	5280										
	60	5300							41264	2650.56		
	64	5320										
802.11a/n/ac/ax U-NII-2C ETSI 5GHz Sub-band 2	100	5500										
	112	5560										
	116	5580										
	120	5600										
	124	5620										
	128	5640										
	132	5660										
	136	5680										
	140	5700			38524	1900						
802.11a/n/ac/ax U-NII-3 Ofcom	149	5745										
	153	5765										
	157	5785										
	161	5805										
	165	5825										
802.11a/n/ac /ax U-NII-4	169	5845										
	173	5865										
	177	5885										

802.11ax U-NII-5 ETSI 6GHz	1	5955										
	5	5975										
	9	5995										
	13	6015										
	17	6035										
	21	6055										
	25	6075										
	29	6095										
	33	6115										
	37	6135										
	41	6155										
	45	6175										
	49	6195										
	53	6215										
	57	6235										
	61	6255										
	65	6275										
	69	6295										
	73	6315										
	77	6335										
	81	6355										
	85	6375										
	89	6395										
	93	6415										
802.11ax U-NII-6 ETSI 6GHz	97	6435										
	101	6455										
	105	6475										
	109	6495										
	113	6515										

802.11ax U-NII-7	117	6535										
	121	6555										
	125	6575										
	129	6595										
	133	6615										
	137	6635										
	141	6655										
	145	6675										
	149	6695										
	153	6715										
	157	6735										
	161	6755										
	165	6775										
	169	6795										
	173	6815										
	177	6835										
	181	6855										
802.11ax U-NII-8	185	6875										
	189	6895										
	193	6915										
	197	6935					38750	2310				
	203	6955										
	207	6975										
	211	6995					38950	2330				
	214	7015										
	217	7035										
	221	7055					39150	2350				
	225	7075										
	229	7095										
	233	7115									55290	3555

RAT			NR FR1 SA Band n2		NR FR1 SA Band n5		NR FR1 SA Band n25 Variation 1		NR FR1 SA Band n66 Variation 1		NR FR1 SABand n70 Variation 1		NR FR1 SA Band n71	
Region			North America, South America		North America, South America, Asia, Australia		North America		North America		North America		North America	
Suggested alternate name														
Call setup defined in reference document			CTIA 01.50 [1], Section 5.1.1.1		CTIA 01.50 [1], Section 5.1.1.1		CTIA 01.50 [1], Section 5.1.1.1		CTIA 01.50 [1], Section 5.1.1.1		CTIA 01.50 [1], Section 5.1.1.1		CTIA 01.50 [1], Section 5.1.1.1	
Special setup			10 MHz Tx BW, SCS =15kHz, 25@12		10 MHz Tx BW, SCS =15kHz, 25@12		10 MHz Tx BW, SCS =15kHz, 25@12		10 MHz Tx BW, SCS =15kHz, 25@12		5 MHz Tx BW, SCS =15kHz, 12@6		10 MHz Tx BW, SCS =15kHz, 25@12	
	Band Edges													
	Uplink Freq		1850	1900	824	849	1850	1915	1710	1780	1695	1710	663	698
	Downlink Freq		1930	1980	870	894	1930	1995	2110	2100	1995	2020	617	652
	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq
802.11b/g/n/ax	1	2412												
	2	2417												
	3	2422	**Bold box borders indicate Wi-Fi Rx vulnerability due to Cellular uplink Tx**											
	4	2427												
	5	2432												
	6	2437												
	7	2442												
	8	2447												
	9	2452												
	10	2457												
	11	2462			165600	825.16								
	12	2467												
	13	2472			165600	825.16								

RAT			NR FR1 SA Band n2		NR FR1 SA Band n5		NR FR1 SA Band n25 Variant 1		NR FR1 SA Band n66 Variant 1		NR FR1 SA Band n70 Variant 1		NR FR1 SA Band n71	
Region			North America, South America		North America, South America, Asia, Australia		North America		North America		North America		North America	
Suggested alternate name														
Call setup defined in reference document			CTIA 01.50 [1], Section 5.1.1.1		CTIA 01.50 [1], Section 5.1.1.1		CTIA 01.50 [1], Section 5.1.1.1		CTIA 01.50 [1], Section 5.1.1.1		CTIA 01.50 [1], Section 5.1.1.1		CTIA 01.50 [1], Section 5.1.1.1	
Special setup			10 MHz Tx BW, SCS =15kHz, 25@12		10 MHz Tx BW, SCS =15kHz, 25@12		10 MHz Tx BW, SCS =15kHz, 25@12		10 MHz Tx BW, SCS =15kHz, 25@12		5 MHz Tx BW, SCS =15kHz, 12@6		10 MHz Tx BW, SCS =15kHz, 25@12	
	Band Edges													
	Uplink Freq		1850	1900	824	849	1850	1915	1710	1780	1695	1710	663	698
	Downlink Freq		1930	1980	870	894	1930	1995	2110	2100	1995	2020	617	652
	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq	Chan	Freq
802.11b/g/n/ax	1	2412												
	2	2417												
	3	2422					**Bold box boarders indicate Wi-Fi Rx vulnerability due to Cellular uplink Tx**							
	4	2427												
	5	2432												
	6	2437												
	7	2442												
	8	2447												
	9	2452												
	10	2457												
	11	2462			165600	825.16								
	12	2467												
	13	2472			165600	825.16								

802.11ax U-NII-5 ETSI 6GHz	1	5955												
	5	5975												
	9	5995												
	13	6015												
	17	6035												
	21	6055												
	25	6075												
	29	6095												
	33	6115												
	37	6135												
	41	6155												
	45	6175												
	49	6195												
	53	6215												
	57	6235												
	61	6255												
	65	6275												
	69	6295												
	73	6315												
	77	6335												
	81	6355												
	85	6375												
	89	6395												
	93	6415												
802.11ax U-NII-6 ETSI 6GHz	97	6435												
	101	6455												
	105	6475												
	109	6495												
	113	6515												

802.11ax U-NII-7	117	6535												
	121	6555												
	125	6575												
	129	6595												
	133	6615												
	137	6635												
	141	6655												
	145	6675												
	149	6695												
	153	6715												
	157	6735												
	161	6755												
	165	6775												
	169	6795												
	173	6815												
	177	6835												
	181	6855												
802.11ax U-NII-8	185	6875												
	189	6895												
	193	6915												
	197	6935												
	203	6955												
	207	6975												
	211	6995												
	214	7015												
	217	7035												
	221	7055												
	225	7075												
	229	7095												
	233	7115												

RAT			NR FR1 SA Band n41		NR FR1 SA Band n78 Variant 1	
Region			North America, Asia		EU, Asia, North America	
Suggested alternate name						
Call setup defined in reference document			CTIA 01.50 [1], Section 5.1.1.1		CTIA 01.50 [1], Section 5.1.1.1	
Special setup			100 MHz Tx BW, SCS =30kHz, 135@67		60 MHz Tx BW, SCS =30kHz, 81@40	
	Band Edges					
	Uplink Freq		2496	2690	3300	3800
	Downlink Freq		2496	2690	3300	3800
	Chan	Freq	Chan	Freq	Chan	Freq
802.11b/g/n/ax	1	2412				
	2	2417				
	3	2422	**Bold box boarders indicate Wi-Fi Rx vulnerability due to Cellular uplink Tx**			
	4	2427				
	5	2432				
	6	2437				
	7	2442				
	8	2447				
	9	2452				
	10	2457				
	11	2462				
	12	2467				
	13	2472				

802.11a/n/ac/ax U-NII-1 ETSI 5GHz Sub-band 1	36	5180				
	40	5200				
	44	5220	522000	2584.12		
	48	5240				
802.11a/n/ac/ax U-NII-2A ETSI 5GHz Sub-band 1	52	5260				
	56	5280				
	60	5300	528000	2614.12		
	64	5320				
802.11a/n/ac/ax U-NII-2C ETSI 5GHz Sub-band 2	100	5500				
	112	5560				
	116	5580				
	120	5600				
	124	5620				
	128	5640				
	132	5660				
	136	5680				
	140	5700				
802.11a/n/ac/ax U-NII-3 Ofcom	149	5745				
	153	5765				
	157	5785				
	161	5805				
	165	5825				
802.11a/n/ac /ax U-NII-4	169	5845				
	173	5865				
	177	5885				

802.11ax U-NII-5 ETSI 6GHz	1	5955				
	5	5975				
	9	5995				
	13	6015				
	17	6035				
	21	6055				
	25	6075				
	29	6095				
	33	6115				
	37	6135				
	41	6155				
	45	6175				
	49	6195				
	53	6215				
	57	6235				
	61	6255				
	65	6275				
	69	6295				
	73	6315				
	77	6335				
	81	6355				
	85	6375				
	89	6395				
	93	6415				
802.11ax U-NII-6 ETSI 6GHz	97	6435				
	101	6455				
	105	6475				
	109	6495				
	113	6515				

802.11ax U-NII-7	117	6535				
	121	6555				
	125	6575				
	129	6595				
	133	6615				
	137	6635				
	141	6655			622000	3330
	145	6675				
	149	6695				
	153	6715				
	157	6735				
	161	6755				
	165	6775			626000	3390
	169	6795				
	173	6815				
	177	6835				
	181	6855				
802.11ax U-NII-8	185	6875				
	189	6895			623000	3450
	193	6915				
	197	6935				
	203	6955				
	207	6975				
	211	6995				
	214	7015			634000	3510
	217	7035				
	221	7055				
	225	7075				
	229	7095			636666	3549.99
	233	7115				

Appendix G Revision History

Date	Version	Description
August 2006	1.0	Document Approved
August 2007	1.1	Updated Purpose and References sections Clarified text and added footnote in Radiated RF Tests nomenclature section Clarified text in Minimum Measurement Distance section Clarified testing conditions for cellular inactive state Corrected step reference in step 14 of Receive Sensitivity Measurement. Removed repeated text. Removed reference to CTIA website for traffic generator software download Corrected step 1 and clarified language in step 9 regarding antenna connection in WLAN Access Point Testing Methodology section Removed requirement for OFMD transmit mask test on Mobile Stations and Access Points Updated WLAN Test Set Estimated Signal Level tables Added Sample Summation test report table Corrected title on Test 5.2.2. and 6.2.2 test report table Added text to clarify that Wi-Fi desensitization testing is done in free-space only Clarified that cellular desensitization testing is done in free-space only, and to perform reference measurements if not previously done Removed references to specific test equipment from document
June 2008	1.2	5 GHz TRP, TIS, & Reference Measurement frequency changes – Sections 5.1.1.2, 5.1.2.2, 5.2.1.2, 5.2.2.2, Table 5.2 5, 6.1.1.2, 6.1.2.2, 6.2.1.2, 6.2.2.2, Table B2 , Table B3, Table B4, Table B5, Table B6, Table B7, New Appendix D Other sections changed: Table B1 - CID Added, section 1.4 - CTIA Reference updated, Table A1 Channel change UTRA FDD Band I - IV, 4120/824.0 changed to 4132/826.4, Table B3 Reference changed from (2) to (1), Table 5.1.1 and table 6.1.1 - removed "Check TX Mask" from comments column
June 2009	1.3	Added footnote to Section 2.1, 2nd sentence. Added text to Section 4.1, 2nd sentence. Added CTIA Request # to Appendix B table. Added Appendix E Device Capabilities Testing Matrix
February 2015	2.0	Added 802.11n Added LTE and TD-SCDMA protocols Updated cellular and Wi-Fi desensitization sections Updated Appendix B Device Capabilities Test Matrix, removed right head and added right and left hand phantoms Added Appendix C – Radio Access Technologies that require testing, but are not covered in the CTIA Certification OTA Test Plan [1]. Added Appendix D - Notebook and Tablet PC Requirements

Date	Version	Description
		Added Appendix E - WLAN-LTE emulator test equipment notes when testing DUTs that support LTE band 40 or 41 (Informative) Added Appendix F - Table of Wi-Fi Radio channels interfered by cellular radio harmonics Revised Wi-Fi test procedure Sections 3.1, 4.1, 4.2 & 4.3 Updated the Acknowledgements list Updated Section 4.1.3 Measurement Frequencies for Radiated tests Updated Table 2 parameters Split Table 3 to Table 3 and Table 4 for TX and RX and also changed RX parameters Updated Section 2.1 Replaced WLAN with Wi-Fi thought out the document as appropriate Revised Section 2.2 to specify PING as the primary mode for packet generation Revised Tables 17 and 18 to replace DER with Pass/Fail info on Intermediate Channels Updated title and introduction text of Appendix A Updated Table 12 consistent with the test case requirements of Section 4.6 and 4.17 Updated Appendix F to include Wi-Fi desensitization matrix Reference Polarization columns added to all Appendix A tables that include Reference Position information
July 2015	2.0.1	Modified document reference in 5th paragraph of Section 2.2. Updated RAT Channel Number and RAT Uplink Frequency columns in Table 4-5 Updated channel for UNII Low, Middle and Upper Bands in Table A-5 and Table A-6. Deleted first sentence of Appendix A.3. Added text to section 1.6.2. Removed stray text in Table A-2. Fixed cross-references
October 2015	2.0.2	“Draft 1” removed from the footnote Publication and footnote dates updated based on CTIA format Tables A-7 and A-8 modified to include a field for Lab comments on maximum EIS Modified Section 2.2 to provide explicit guidelines for PING method for 802.11n Applied other purely editorial changes to the titles in Appendices sections and tables Removed “(WI-FI U-NII MIDDLE BAND)” from the titles and references to Channel 60 in Tables A-10 and A-12 Requirement for usage of Hand Phantoms is clarified in Appendix B

Date	Version	Description
September 2016	2.0.3	Modified Appendix B text regarding usage of Hand Phantoms. Added reference table for Wi-Fi radio desensitization by closest cellular uplink frequency in Section 4.2.4. Examples corrected. Updated CTIA logo and Wi-Fi Alliance logo. Applied purely editorial correction throughout document. Applied changes to Section 2.1 regarding adaptive power control and regulatory domain (country code) setting. Applied further modifications to Section 4.2.4. Updated Table numbering in Section 4. Table B-1 modified to cover testing applicability for devices with and without WWAN simultaneous operation capability. Applied purely editorial changes to Sections 4.2.4 and 4.2.5. Clarification made in Section 3.1.5 regarding traffic generation. Table B-1 was reformatted without change in the content. Corrected Item 44.6 LTE Band 38 Channel Number and some references in Table 4-6. Editorial changes applied throughout document. References in Section 4.1 was updated/corrected. Applied further corrections to Table 4-6. Updated Appendix F. Updated Acknowledgement table.
January 2019	2.1	Applied changes throughout document to cover 802.11ac Applied changes throughout document to make CTIA Certification OTA Test Plan as the basis Updated reference to latest release of IEEE 802.11 (IEEE Std. 802.11-2016) Updated Section 4.1.4 & 4.3.2 as related to support for multiple Wi-Fi TX antennas Updated Section 4.1.5 as related to support for Antenna Switched RX Diversity for Wi-Fi Updated Section 4.2.3 as related to support for multiple cellular TX antennas Coverage for TD-SCDMA was added to Section 4.2.3, 4.3.4 Corrected Table 4.2-3 for CDMA 1800 BC 15 Reference to OTA Test Plan Appendix O.3, O.4 and O.5 added to Section 4.3.3, 4.3.4 and Appendix D to enable support for reduced legacy RAT testing for TIS and/or intermediate channel testing in free-space Section 4.3.4 title and content updated to properly cover Test Procedure for RATs without Free-Space Limits A new sub-band column added to Table A- 1; rows updated to make the report template complete Appendix guidelines related to Notebooks, Tablets, Convertible PCs and Hybrid PCs testing in their primary mechanical mode was added to Appendix D

Date	Version	Description
September 2020	2.2	Changed EUT to DUT throughout the document. Updated Wi-Fi Sub Band titles and related regulatory domains throughout document. Reformatted Wi-Fi Sub-band tables throughout document. In Section 1.4, Added references for FCC and ETSI for 5GHz sub-bands. In Section 1.6.2: updated measurement uncertainty requirements for 2.4 and 5GHz bands. In Section 1.6.3: updated minimum measurement distance requirements for 2.4 and 5GHz bands. In Section 3.1, added Table 3.1-1 Measurement Frequencies For Conducted Tests. Clarified/corrected Section 4.1.5 Note on Note on Alternative TIS Test Procedures as specified in Section 6.15.4. Clarified/corrected Section 4.1.6 text as related to the Alternate Test Procedures specified in CTIA Certification OTA Test Plan Section 5.11.1 Single Point Offset Test or 5.11.2 Multi-point Offset Test. Clarified/corrected Section 4.1.7 text as related to the Alternate Test Procedures specified in CTIA Certification OTA Test Plan Section 6.15.1 Single Point Offset Test or 6.15.2 Multi-point Offset Test. In Section 4.2, removed all references to Wi-Fi Channel 14. Table 4.2-3 Desensitization Cases: Updated test case 44.5; added LTE band 66 as test case 44.8. Appendix B: updated hand phantom selection guidelines. Updated Appendix F Table of Wi-Fi Radio channels interfered by Cellular Radio Harmonics contents and Wi-Fi Sub-band labels and removed references to Wi-Fi Channel 14.
April 2021	2.2.1	Updated CTIA Certification URL Added Wi-Fi Alliance application option to “Use Instructions”
February 2023	4.0.0	Added Single Carrier 5G NR FR1 (SISO) to scope, throughout relevant sections in particular Sections 4.2 and 4.3 Added 802.11ax (SISO) to scope, throughout relevant sections in particular Sections 3.1, 3.2, 4.2 and 4.3. Added coverage for 6GHz and 5.9GHz Wi-Fi bands to test cases in various Sections 3.1, 3.2, 4.2 and 4.3 Updated Appendix F and Section 4.2.6 Wi-Fi Radio Desensitization by Cellular Radio Uplink Harmonics to include new test cases added to v4.0. Removed WCDMA Band IV and TD-SCDMA from scope and throughout the document. Updated references to the CTIA Test Plan for Wireless Device Over-the-Air Performance Suite v4.0 and IEEE 802.11-2020 and 802.11ax and cross references throughout the document. Removed Appendix C Radio Access Technologies that Require Testing, but are not Normative in the CTIA Certification OTA Test Plan.