User Manual

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About this Document

This document describes the usage of the RS9113DB n-Link® Driver for testing transmit & receive Regulatory Performance for Wi-Fi protocols.

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1 Introduction

The software provided for the RS9113DB n-Link® modules is named OneBox-Mobile. The software currently supports performance testing for Wi-Fi.

The subsequent sections explain the use of OneBox-Mobile software on an x86 platform. Installation and operation of the driver on specific representative processor platforms have been explained in the Appendix sections.

1.1 Getting Started

1. Login to user "**test**" with password "**test123**"

2. Open a Terminal

3. Type command "**su**" and press enter key

4. Enter password "**test123**"

5. Connect EUT to Laptop with USB cable as shown below
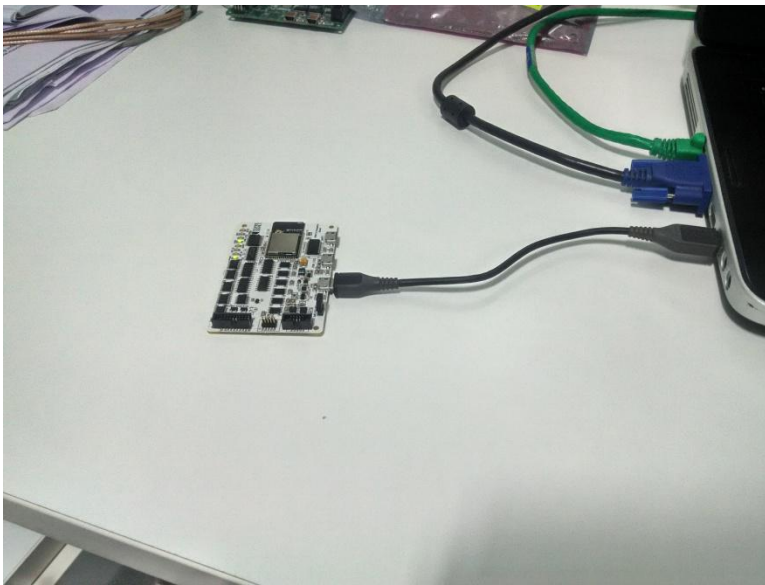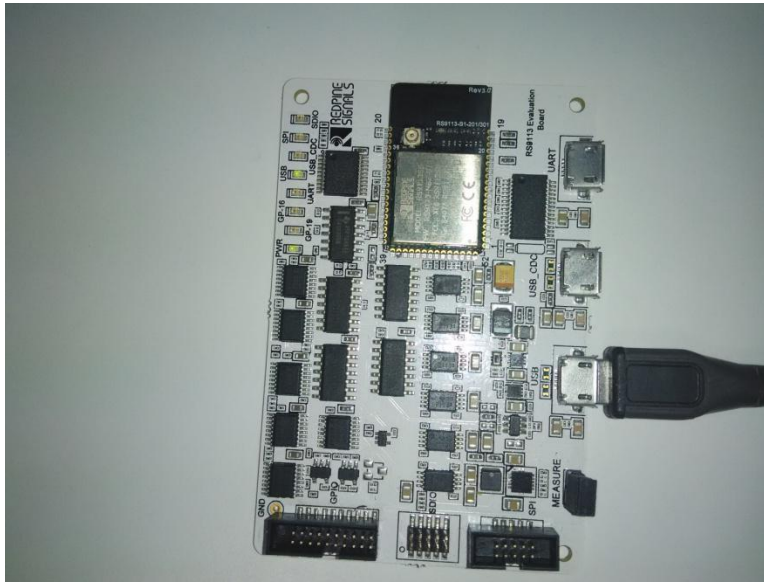
6. Please type "**dmesg**" on the terminal and press enter key and check for the below print

```
[ 3144.505576] usb 2-1.3: USB disconnect, device number 4
[ 3145.705471] usb 2-1.3: new high speed USB device number 5 using ehci_hcd
[ 3145.791837] usb 2-1.3: New USB device found, idVendor=1618, idProduct=9113
[ 3145.791845] usb 2-1.3: New USB device strings: Mfr=1, Product=2, SerialNumber=6
[ 3145.791851] usb 2-1.3: Product: Wireless USB Network Module
[ 3145.791857] usb 2-1.3: Manufacturer: Redpine Signals, Inc.
[ 3145.791862] usb 2-1.3: SerialNumber: 000000000001
```

7. Please go to directory /work/Regulatory_test/host/releases

8. Please read section 2 for performing WLAN Tests

2 WLAN Performance Test Application Usage

The OneBox-Mobile software provides applications to test Transmit and Receive performance of the module. The Band of operation of the module needs to be configured before performing any tests.

NOTE: Open the **common_insert.sh** file present in the "release" folder using an editor like vim. Ensure that the DRIVER_MODE is set as below:
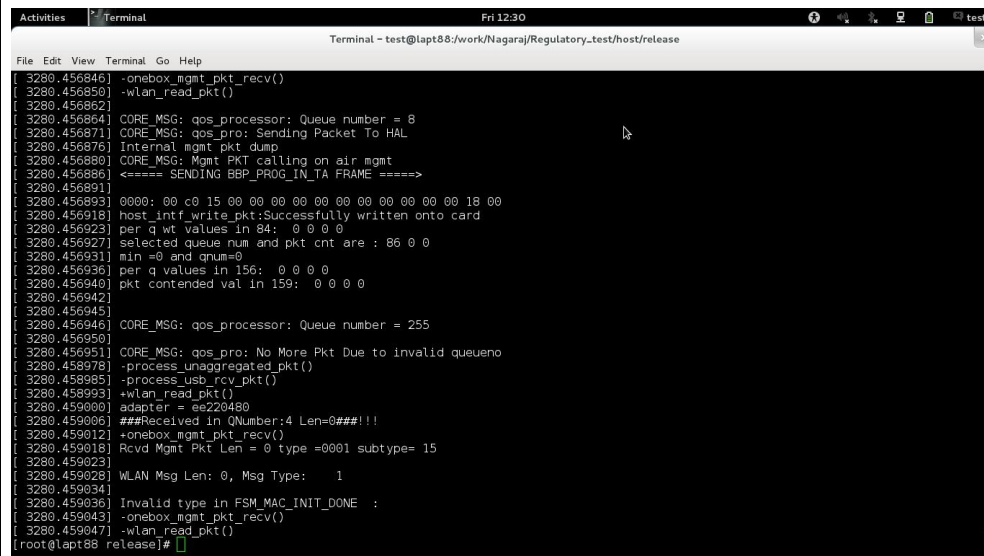
DRIVER_MODE = 2

COEX_MODE = 1

Run the following command to install the Driver in Performance Test mode:

sh wlan_insert.sh

Please type "**dmesg**" in the terminal and press enter key and check for the below print for check if driver has been loaded properly.

Next, follow the instructions below to run the Transmit and Receive tests.

2.1 Transmit Tests

The "transmit" utility, present in the "release" folder allows the configuration of the following parameters and starts the transmission of packets.

1) Transmit Power

2) Transmit Data Rate

3) Packet Length

4) Transmit Mode

5) Channel Number

6) External PA Enable/Disable[1]

7) Rate Flags like Short GI, Greenfield, etc.

8) Enable/Disable Aggregation

9) Number of packets to be transmitted in Burst Mode

10) Delay between packets in Burst Mode

11) Regulatory Domain

2.1.1 Transmit Command

./transmit
<tpow><rate><len><mode><chan><expa><rf><aggr><num><delay><reg>

2.1.2 Transmit Command Description

The command usage is explained below.

<tpow>: Transmit power in dBm for controlling transmit power. To set the transmit power value, enter a value either between -7 and18.If a value of 127 is entered, the packet will be transmitted at the maximum power from the Transmit power table in the module.

<rate>: Transmit Data Rate. To set the transmit data rate, select a value from 1, 2, 5.5, 11, 6, 9, 12, 18, 24, 36, 48, 54, mcs0, mcs1, mcs2, mcs3, mcs4, mcs5, mcs6 and mcs7.

<len>: Transmit packet length in bytes. Enter a value between 24 and 1536 when aggregation is not enabled and between 24 and 30000 when aggregation is enabled.

<mode>: Transmit mode. Enter 0 for Burst mode and 1 for Continuous mode.

<chan>: Transmit channel number[2]. The following table maps the channel numbers to the center frequencies for 20MHz and 40MHz bandwidth modes in 2.4GHz and 5GHz band.

Band (GHz)	Bandwidth (MHz)	Channel Number	Center Frequency (MHz)
2.4	20	1	2412
2.4	20	2	2417
2.4	20	3	2422
2.4	20	4	2427
2.4	20	5	2432

---

[1] This is not supported in the current release.
[2] On-air testing in DFS channels should be avoided till the module is certified for DFS. Cabled tests can be run in these channels.

Band (GHz)	Bandwidth (MHz)	Channel Number	Center Frequency (MHz)
2.4	20	6	2437
2.4	20	7	2442
2.4	20	8	2447
2.4	20	9	2452
2.4	20	10	2457
2.4	20	11	2462
2.4	20	12	2467
2.4	20	13	2472
2.4	20	14	2484
5	20	36	5180
5	20	40	5200
5	20	44	5220
5	20	48	5240
5	20	52	5260
5	20	56	5280
5	20	60	5300
5	20	64	5320
5	20	100	5500
5	20	104	5520
5	20	108	5540
5	20	112	5560
5	20	116	5580
5	20	120	5600
5	20	124	5620
5	20	128	5640
5	20	132	5660
5	20	136	5680

Band (GHz)	Bandwidth (MHz)	Channel Number	Center Frequency (MHz)
5	20	140	5700
5	20	149	5745
5	20	153	5765
5	20	157	5785
5	20	161	5805
5	20	165	5825

Table 1: Channel Numbers and Corresponding Center Frequencies

<expa>: Enable/Disable External PA. This parameter is not supported in the current release.

<rf>: Rate Flags. This parameter is used to enable/disable Short GI and Greenfield and also to set the channel width of the transmitted packets. The table below explains the flags that can be enabled and disabled. Multiple flags can be set at a time.

Bit	Description
0	Short GI 0 – Disable Short GI 1 – Enable Short GI
1	Greenfield transmission 0 – Disable Greenfield transmission 1 – Enable Greenfield transmission
[4:2]	Operating bandwidth of the channel (3 bits) 0 – 20MHz 2 (Bit 3 is set) – NA 4 (Bit 4 is set) – NA 6 (Bits 3 and 4 are set) – NA

Table 2: Rate Flags for Transmit Tests

<aggr>: Enable/Disable Aggregation. Enter 0 to disable aggregation and 1 to enable aggregation. The packet length is divided into chunks of size 1792 bytes and aggregated. This parameter applies only to the Burst mode transmission and is ignored in the case of Continuous mode of transmission.

<num>: Number of packets to be transmitted in Burst mode. The transmission stops after the number of packets specified by this parameter are transmitted in the Burst mode. If this value is 0, then the transmission will not stop until the user gives the "./transmit 0" command to stop the transmissions. This parameter is ignored in the case of Continuous mode of transmission.

<delay>: Delay between packets in Burst mode. This parameter is used to introduce a delay between any two packets. The delay has to be specified in microseconds. If this value is 0, then the packets will be transmitted without any delay. This parameter is ignored in the case of Continuous mode of transmission.

<reg>: Regulatory Domain. Refer the table below for the mapping of values to the regulatory domains.

Input Value	Regulatory Domain
0	US (FCC)
1	Europe (ETSI)
255	World Domain(No Regulatory Restriction)

Table 3: Regulatory Domain Input in Transmit Tests

NOTE: While doing Regulatory testing, Please use only World Domain option.

NOTE: After the transmission starts, the following commands need to be given to stop the transmissions.

Burst Mode: ./transmit 0

Continuous Mode: ./transmit 0

2.1.3 Examples

#./transmit 2 54 1000 1 11 0 0 0 0 0 255

The above command starts continuous transmission with the following configuration:

Transmit gain – 2dbm

Data rate – 54Mbps

Packet Length – 1000 bytes

Transmit mode – 1 (continuous mode).

Channel number – 11

External PA – disabled

Rate flags – 0

Aggregation – disabled (ignored in continuous mode)

Number of packets to be transmitted – 0(ignored in continuous mode)

Delay between the packets – 0(ignored in continuous mode)

Regulatory Domain is set to – World Domain

./transmit 12 36 1000 0 6 0 25 0 0 1000 0 0

The above command starts burst mode transmission with the following configuration:

Transmit gain – 12dBm

Data rate – 36Mbps

Packet Length – 1000 bytes

Transmit mode – 0 (Burst mode).

Channel number – 6

External PA – disabled

Rate flags – 25 (Short GI with Full 40MHz Channel width)

Aggregation – disabled

Number of packets to be transmitted – 1000

Delay between the packets – 0

Regulatory Domain is set to – World Domain

2.2 Receive Tests

The "receive" utility, present in the "release" folder, can be invoked for displaying the following information

- Total number of CRC PASS packets
- Total number of CRC FAIL packets and
- Total number of FALSE CCAs

2.2.1 Receive Command

./receive <filename><channel_number><start/stop><channel_width>

2.2.2 Receive Command Description

<filename>: Name of the file into which the statistics will be logged, in addition to being displayed on the console.

<channel_number>[3]: Channel number in which the statistics need to be logged. Refer to the Table 1 in Section 2.1.2 for more details.

<start/stop>: Parameter to start or stop logging the statistics. Enter 0 to start logging and 1 to stop logging.

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[3] On-air testing in DFS channels should be avoided till the module is certified for DFS. Cabled tests can be run in these channels.

<channel_width>: Operating bandwidth of the channel. Refer to the table below.

Value	Channel Width
0	20MHz
2	NA
4	NA
6	NA

Table 4: Channel Width Values

2.2.3 Examples

./receive stats 6 0 0

The above command starts the receive utility and logs statistics with the following parameters.

Filename – stats

Channel number – 6

Channel Width – 20MHz

The test utility displays the following information:

- Total number of packets received with correct CRC.
- Total number of packets received with incorrect CRC.
- Total number of False CCA's received.

./receive stats 6 1 0

The above command will stop the receive application

2.3 Transmit Continuous Wave (CW) mode

The OneBox-Mobile software provides applications to test Transmit and Receive performance of the module. The Band of operation of the module needs to be configured before performing any tests.

NOTE: Open the common_insert.sh file present in the "release" folder using an editor like vim. Ensure that the DRIVER_MODE is set as below:

DRIVER_MODE = 2

Run the following command to install the Driver in Performance Test mode:

sh wlan_insert.sh

Next, follow the instructions below to run the Transmit and Receive tests.

The Continuous Wave mode is used to transmit a single tone – either a sine wave or a cosine wave.

2.3.1 Command Usage

./onebox_util <base_interface> cw_mode <channel><start/stop><type>

<base_interface>: Base Interface (string like rpine0)

<channel_number>: Channel number in which the transmission has to be done. Please refer to the Table 1 in Section 2.1.2 for a mapping between the channel numbers and the center frequencies.

<start/stop>: Parameter to start or stop the transmission. Enter 0 to start transmission and 3 to stop transmission.

<type>: Parameter to select from among the different types of waves to be transmitted. Enter 1 for Single Tone. The transmit power for the CW mode transmission is set using the "transmit" utility. The "transmit" command has to be first issued to start transmission at the required transmit power level and then called again to stop the transmission before giving the "onebox_util" command to start the CW transmission.

> '1':-2.5 MHz
>
> '2': +5 MHz
>
> '3': Two tone
>
> '4': OFDM test symbol
>
> '5': DC 200mV

2.3.2 Examples

./transmit 2 5.5 750 1 11 0 1 0 0 0 0

./transmit 0

./onebox_util rpine0 cw_mode 6 0 1

The above command starts continuous wave transmission with the following configuration.

Channel number – 6

Type – Single tone

Transmit Power – 2dBm

./onebox_util rpine0 cw_mode 6 3 1

The above command stops continuous wave transmission.

3 FCC and IC Declaration

This device complies with Part 15 of the FCC Rules.

Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) This device must accept any interference received, including interference that may cause undesired operation.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

This Class B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

This device complies with Industry Canada license-exempt RSSstandard(s).Operation is subject to the Following two conditions:(1) This device may notcause interference, and(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence.

L'exploitation est autorisée aux deux conditions suivantes:(1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptibled'en compromettre le fonctionnement.

CAUTION: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

End Product Labeling

This Module is labeled with its own FCC ID. If the FCC ID Certification Number is not visible while installed inside another device, then the device should display the label on it referring the enclosed module. In that case, the final end product must be labeled in a visible area with the following:

"Contains Transmitter Module FCC ID: XF6-RS9113DB"

OR

"Contains FCC ID: XF6-RS9113DB"

The OEM should not provide information to the end user regarding installation or removal of this RF module or change RF related parameters in the user manual of the end product.

The OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

énoncé de la FCC (états-Unis seulement) Cet équipement a été testé et jugé conforme aux limites de Classe B pour un appareil numérique, en vertu de l'article 15 de la réglementation de la FCC. Ces limites ont été instaurées our fournir une rotection raisonnable contre toute interférence nuisible dans une installation résidentielle. Cet équipement génère, utilise et peut émettre de l'énergie radiofréquence. S'il n'est pas installé et utilisé conformément aux instructions, il peut provoquer des interférences sur les communications radio. Cependant, il n'est pas garanti que des interférences ne se produiront pas dans certaines installations. Si cet équipement cause des interférences à la reception radio ou télévisée (ce qui peut être vérifi é en éteignant l'appareil puis en le remettant sous tension),

l'utilisateur peut enter de ésoudre en suivant une ou plusieurs des mesures ci-après :

Réorienter ou déplacer l'antenne réceptrice.

ugmenter l'espace entre l'appareil et le récepteur. Brancher l'appareil à une prise de courant différente de celle sur laquelle le récepteur est branché. Pour obtenir de l'aide, contacter le vendeur ou un technician radio/television expérimenté.

REMARQUE: Toute modifi cation non autorisée expressément par le fabricant responsable de la onformité peut annuler le droit de l'utilisateur à faire fonctionner le produit.

This Module is labeled with its own IC ID. If the IC ID Certification Number is not visible while installed inside another device, then the device should display the label on it referring the enclosed module. In that case, the final end product must be labeled in a visible area with the following:

"Contains Transmitter Module IC ID: 8407A-RS9113DB"

OR

"Contains IC ID: 8407A-RS9113DB"

4 Confirmation on Unlawful Usage of TX power with respect to Certified Antennas

This is to confirm that Redpine Signals, Inc., will ensure that the following information is included in the RS9113DB (FCC ID: XF6-RS9113DB, IC ID: 8407A-RS9113DB) Module's Programming Manual for customers who use this module with different antennas to help them comply with the FCC/IC regulatory requirements for products which use the module's modular approval.

The list of antennas with which the module has been tested with and certified for FCC/IC are given in Table 1 below.

Antenna Make	Model/Part #	Antenna Gain at 2.4GHz (dBi)	Antenna Gain at 5GHz (dBi)	Type of Antenna
Laird	001-0034	1.7 (Typ) 1.9 (Max)	5.2 (Typ) 5.8 (Max)	PIFAr

Table 5: List of Antennas Used for RS9113DB FCC/IC Certification

The RS9113DB Module's Programming Reference Manual will include the information listed below. The Manual is provided to customers as part of the module's collateral which also includes the module's software and firmware. The module's firmware applies the attenuations required to comply with the regulatory requirements based on the type of antenna programmed. The commands required to program the transmit power and the antenna type and the attenuations applied are given in the tables that follow.

1) Commands to program the antenna being used for Wi-Fi – see Table 9.

2) Commands to set transmit power of the module for Wi-Fi– see Table 12.

3) Transmit power and attenuation values used during testing with PIFA Antenna – see Tables 16.

4.1 Commands to Program Antenna Type

4.1.1 Command to Program Antenna Type for Wi-Fi

Command Name	Program Antenna Type for Wi-Fi
Description	This command is used to program antenna being used by the module for Wi-Fi out of the list of certified antennas. This command needs to be given before creating the VAP in the normal mode and before the "./transmit" command in the Wi-Fi

	Performance Test mode.
Default Value	0
Input Parameters	Base Interface (string like rpine0) Integer value mapped as follows: 4- PIFA Antenna
Output Parameter	None
Reset Required	No
Usage	# ./onebox_util<base_interface>ant_type<antenna_type>
Example	The command below sets the Antenna type to Fractus Antenna for Wi-Fi: # ./onebox_util rpine0 ant_type 4

Table 6: Command to Program Antenna Type for Wi-Fi

4.2 Commands to Program Transmit Power

4.2.1 Command to Program Transmit Power for Wi-Fi

Description	This command is used to program the transmit power of the module for Wi-Fi. If the value of transmit power exceeds the maximum allowed power supported by the channel specified by the regulatory domain, then the minimum of the two values will be used.
Default Value	-
Input Parameters	VAP Name (string like wifi0, wifi1, etc.) Integer value in dBm
Output Parameter	None
Reset Required	No.
Usage	# iwconfig<vap_name>txpower<val_in_dBm>
Example	The command below sets the Wi-Fi transmit power to 15dBm:

	# iwconfig wifi0 txpower 15
Output Parameter	None

Table 7: Command to Program Transmit Power for Wi-Fi

4.3 Maximum Transmit Power and Attenuation Values

The transmit power and attenuation value settings in the following tables are mentioned for IEEE 802.11a/b/g/n for the Low, Mid and High channel frequencies. The table below lists the actual frequencies for each technology corresponding to the Low, Mid and High columns in subsequent tables.

Technology	Low Channel Frequency (MHz)	Mid Channel Frequency (MHz)	High Channel Frequency (MHz)
802.11b	2412	2437	2462
802.11g	2412	2437	2462
802.11n 20MHz Bandwidth	2412	2437	2462
802.11a (5GHz U-NII- 1)	5180	5200	5240
802.11n 20MHz Bandwidth(5GHz U-NII- 1)	5180	5200	5240
802.11a (5GHz U-NII- 2)	5260	5500	5720
802.11n 20MHz Bandwidth(5GHz U-NII- 2)	5260	5500	5720
802.11a (5GHz U-NII- 3)	5745	5785	5825
802.11n 20MHz Bandwidth (U-NII- 3)	5745	5785	5825

Table 8: Low, Mid and High Channel Frequencies for Wi-Fi

4.3.1 Maximum Transmit Power and Attenuation Values for PIFA Antenna

Mode	Data Rate (Mbps)	Channels					
		Low		Mid		High	
		Max. Tx Power (dBm)	Attenuation Value (dBm)	Max. Tx Power (dBm)	Attenuation Value (dBm)	Max. Tx Power (dBm)	Attenuation Value (dBm)
802.11 b	1	16	3	16	3	16	3
	11	16	3	16	3	16	3
802.11 g	6	11	3	18	3	10	3
	24	11	3	18	3	10	3
	54	11	3	18	3	10	3
802.11 n_20MHz	MCS0	10	3	18	4	9	3
	MCS4	10	3	18	4	9	3
	MCS7	10	3	18	4	9	3
802.11a (5GHz U-NII-1)	6	12	0	14	0	14	0
	24	12	0	14	0	14	0
	54	12	0	14	0	14	0
802.11n 20MHz (5GHz U-NII-1)	MCS0	11	0	14	0	14	0
	MCS4	11	0	14	0	14	0
	MCS7	11	0	14	0	14	0
802.11a (5GHz U-NII-2)	6	9	0	10	0	7	0
	24	9	0	10	0	7	0
	54	9	0	10	0	7	0
802.11n 20MHz (5GHz U-NII-2)	MCS0	8	0	9	0	5	0
	MCS4	8	0	9	0	5	0
	MCS7	8	0	9	0	5	0
802.11a (5GHz U-	6	11	0	10	0	10	0
	24	11	0	10	0	10	0

NII-3)	54	11	0	10	0	10	0
802.11n 20MHz (5GHz U-NII-3)	MCS0	11	0	9	0	9	0
	MCS4	11	0	9	0	9	0
	MCS7	11	0	9	0	9	0

Table 9: Maximum Transmit Power and Attenuation Values for PIFA Antenna

4.4 Grant Note

Only those antenna(s) tested with the device or similar type antenna(s) with equal or lesser gain may be used with this transmitter.

The antenna of this transmitter must be installed to provide a separation distance of at least 20 cm from all persons, and must not be co-located or operating in conjunction with other antennas or transmitters within a host device, except in accordance with FCC multi transmitter product procedures.

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