



## ***Test Report No.7112310971***

***Applicant:   Capacicom LTD.***

***Equipment Under Test:***  
***IoT Repeater - WiFi Transceiver***

***Model:   NBX-R1000-RF***  
***FCC ID: 2AYPY- NBX-R1000-RF***

***Issued by:***  
***The Standards Institution of Israel***  
***Industry Division***  
***Electrical & Electronics Laboratory***  
***EMC Branch***



ANSI National Accreditation Board

A C C R E D I T E D

ISO/IEC 17025

TESTING LABORATORY

*Certificate Number: AT-1359*

**Test Report No.: 7112310971****Page 2 of 50 Pages****Title:** Test on IoT Repeater - WiFi Transceiver**Model:** NBX-R1000-RF**FCC ID:** 2AYPY- NBX-R1000-RF

<b>Applicant:</b>	Capacicom LTD.
<b>Address:</b>	4 Haalon st., 4059300 Kfar Neter Israel
<b>Sample for test selected by:</b>	The customer
<b>The date of test:</b>	7-8/04 & 19/04/2021

**Description of Equipment****under Test (EUT):** IoT Repeater - WiFi Transceiver**Model:** NBX-R1000-RF**Software version :** 1.0.0**Hardware version:** 5**Manufactured by:** Capacicom LTD.**Reference Documents:**

- ❖ CFR 47 FCC (2020). Rules and Regulations: Part 15. Radio frequency devices, Subpart C: Intentional radiators. Section 15.247 Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, 5725 - 5875 MHz

**Test Results**

The EUT was found to be in compliance with the following standard:

CFR47 Part 15 Subpart C

sections: 15.203, 15.205, 15.207, 15.209 and 15.247

This Test Report contains 50 pages and may be used only in its entirety.	This Test Report applies only to the specimen tested and may not be applied to other specimens of the same product.
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Table of Contents

1. Summary of Test Results	4
2. EUT Description	5
2.1. General description:	5
2.2. Transmitter description:	6
2.3. Test setup:	7
2.4. System test configuration:	8
3. Test specification, methods and procedures	9
4. Testing Facility:	9
5. Measurement uncertainty	9
6. Transmitter characteristics - test results	10
6.1. 6dB and Occupied Bandwidth	10
6.2. Maximum Peak Conducted Output Power	14
6.3. Power Spectral Density	18
6.4. Radiated Emissions in Restricted and non-Restricted bands	22
6.5. Band-edge compliance of RF conducted emissions	41
7. AC power line conducted emission measurement	43
8. Antenna requirements	45
9. Appendix 1: Test equipment used	46
10. Appendix 2: Antenna Factor and Cable Loss	47
11. Appendix 3: Test illustrations	49

**Test Report No.: 7112310971****Page 4 of 50 Pages****Title:** Test on IoT Repeater - WiFi Transceiver**Model:** NBX-R1000-RF **FCC ID:** 2AYPY- NBX-R1000-RF

## 1. Summary of Test Results

Transmitter characteristic	Ref. Section
6dB and occupied bandwidth	15.247 (a) (2)
Maximum peak conducted output power	15.247 (b) (3)
Power spectral density	15.247 (e)
Radiated emission in restricted and non-restricted bands	15.247 (d), 15.209, 15.205
Band-edge compliance of RF conducted emission	15.247 (d)
AC power line conducted emission measurements	15.207
Antenna requirement	15. 203

Name: Eng. Yuri Rozenberg  
Position: Head of Branch

Electrical & Electronics  
Laboratory

November 7, 2021

Tested by: Alexander Konkov  
Position: Testing Technician

Written by: Galit Gorodetsky  
Position: Technical Writer

## 2. EUT Description

**Note:** All information in this section was provided by the customer.

### 2.1. General description:

The Equipment under Test (hereinafter: EUT) is a smart IoT LPWAN repeater system with a transceiver Module which operates in the sub-1GHz ISM frequency spectrum and IP M&C over ETH/WiFi/BT.

The EUT uses WiFi/BT transceiver chip is ESP32 from Espressif Systems. ESP32 is a single 2.4GHz Wi-Fi and Bluetooth combo chip. It uses the same 40MHz TCXO clock source.

The 2.4GHz transceiver uses built-in non detachable antenna printed on the PCB.

The EUT has no internal power source. It uses PoE for DC power supply (10-48V).

The test data contained in this report pertains only to the emissions due to the EUT's WiFi transmitter.

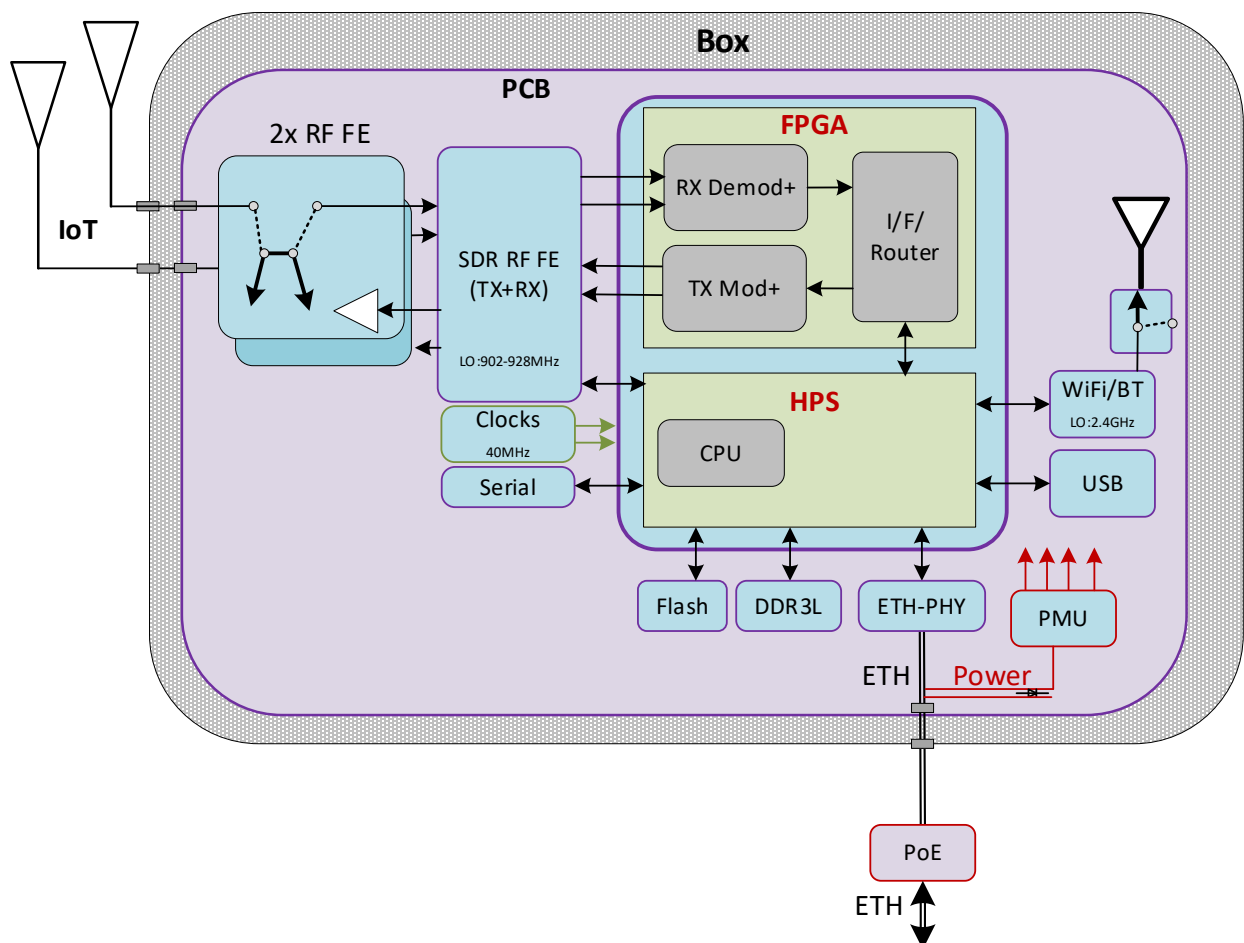


Figure 1. IoT Repeater block diagram



Test Report No.: 7112310971

Page 6 of 50 Pages

Title: Test on IoT Repeater - WiFi Transceiver

Model: NBX-R1000-RF

FCC ID: 2AYPY- NBX-R1000-RF

## 2.2. Transmitter description:

<b>Type of equipment</b>		
Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)		
WLAN standards	IEEE 802.11 b/g/n b – 11Mbit/s g – 54 Mbit/s n – (MCS7) 150 Mbit/s	
<b>Intended use</b>	fixed	
<b>Assigned frequency range</b>	from 2400MHz to 2483.5MHz	
<b>Operating frequency range</b>	from 2412MHz to 2462MHz (WLAN transmitter)	
<b>RF channel spacing</b>	20MHz (b,g), 40MHz (n) (WLAN transmitter)	
<b>Maximum rated output power</b>	Effective radiated power (for equipment with no RF connector)	13dBm
<b>transmitter output power is variable</b>	No	-
<b>Antenna information</b>		
Integral with temporary RF connector on board PCB antenna		
Antenna gain = 2dBi		
<b>Transmitter 99% power bandwidth</b>		
<b>Type of modulation</b>	DSSS, OFDM, QPSK	
<b>Type of multiplexing</b>	DSSS, OFDM	
<b>Modulating test signal (baseband)</b>	PRBS	
<b>Transmitter power source</b>		
Nominal rated voltage	24VDC Min. 10V / Max. 48V	

### 2.3. Test setup:

The EUT was tested per the guidance ANSI C63.10: 2013.

The test setup is shown in Figure 2 and 3.

The EUT was connected with auxiliary Laptop via LAN-Power splitter.

Also EUT gets 19VDC power from the AC power adapter via LAN-Power splitter in order to use PoE technology. The EUT configured to transmit continuously, duty cycle  $\geq 98\%$ .

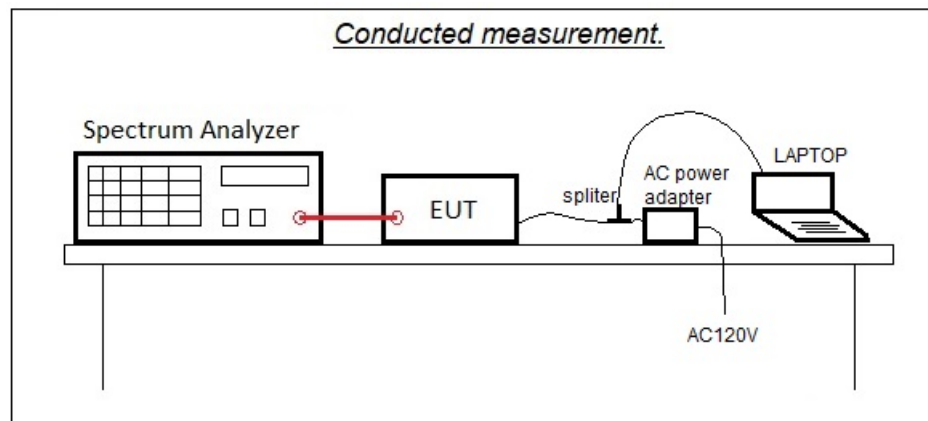


Figure 2. EUT conducted test setup

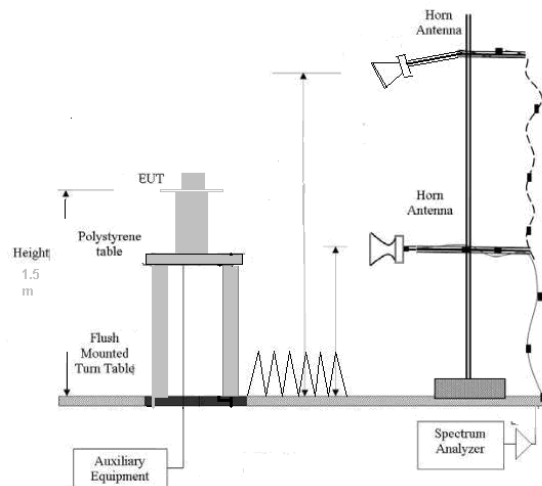


Figure 3. Radiated emission test setup above 1 GHz.



## 2.4. System test configuration:

### 802.11b 11M – 20 MHz and 802.11g 54M – 20 MHz

Channel	Frequency MHz	Channel	Frequency MHz
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437		

### 802.11n MCS7 – 40 MHz

Channel	Frequency MHz	Channel	Frequency MHz
3	2422	7	2442
4	2427	8	2447
5	2432	9	2452
6	2437		





### 3. Test specification, methods and procedures

- ❖ CFR 47 FCC Rules and Regulations: Part 15. Radio frequency devices, Subpart C: Intentional radiators (2020)
- ❖ ANSI C63.4:2014 American National Standard for Method of Measurement of Radio Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range 9 kHz to 40 GHz.
- ❖ ANSI C63.10: 2013 American National Standard for Testing of Unlicensed Wireless Devices

### 4. Testing Facility:

Laboratory Name: Standards Institution of Israel (SII)

Test site location: 42 Haim Levanon st., Tel-Aviv Israel

Laboratory Accreditations:

ANAB: AT-1359

### 5. Measurement uncertainty

The test equipment has been calibrated according to its recommended procedures and is within the manufacturer's published limit of error.

The laboratory calibrates its standards by a third party (traceable to NIST, USA) on a regular basis according to equipment manufacturer requirements.

Test description	Calculated uncertainty $U_{LAB}$
<b>Conducted measurements</b>	
Frequency error	37.6 Hz
Spurious emission	$\pm 2.98$ dB
<b>Radiated measurements</b>	
Electric field strength in a SAR at 3 m distance 30 MHz – 1.0 GHz	$\pm 4.32$ dB
Electric field strength in a FAR at 3 m distance 1.0 GHz – 18 GHz	$\pm 4.47$
<b>Substitution measurements</b>	
In a FAR at 3 m distance 1.0 GHz – 18 GHz	$\pm 3.41$ dB



## 6. Transmitter characteristics - test results

### 6.1. 6dB and Occupied Bandwidth

#### Limits & methods:

FCC requirements	15.247(a)(2)		
Test procedure	ANSI 63.10 Section 11.8.2 option 2. Conducted measurement		
Operating Frequencies	802.11b 11M – 20 MHz 802.11g 54M – 20 MHz 802.11n MCS7 – 40 MHz		
Ambient Temperature	22°C	Relative Humidity	46%      Air Pressure      1006hPa

#### Limit :

The minimum 6dB bandwidth shall be at least 500 kHz.

#### Results:

WLAN standard	Frequency, MHz	Limit, kHz	6dB bandwidth, MHz	Verdict	Plot #
802.11b11M – 20 MHz	2412	500	9.67	Pass	1
	2437		9.68	Pass	2
	2462		9.68	Pass	3
802.11g 54M – 20 MHz	2412		16.54	Pass	4
	2437		16.54	Pass	5
	2462		16.53	Pass	6
802.11n MCS7 – 40 MHz	2422		36.48	Pass	7
	2437		36.47	Pass	8
	2452		36.47	Pass	9

#### Test procedure

The measurements were performed in hopping transmission mode of operation for carrier (channel) frequency at bottom, middle and at the top of 2412MHz to 2462MHz frequency band and maximum transmitting data rate.



Test Report No.: 7112310971

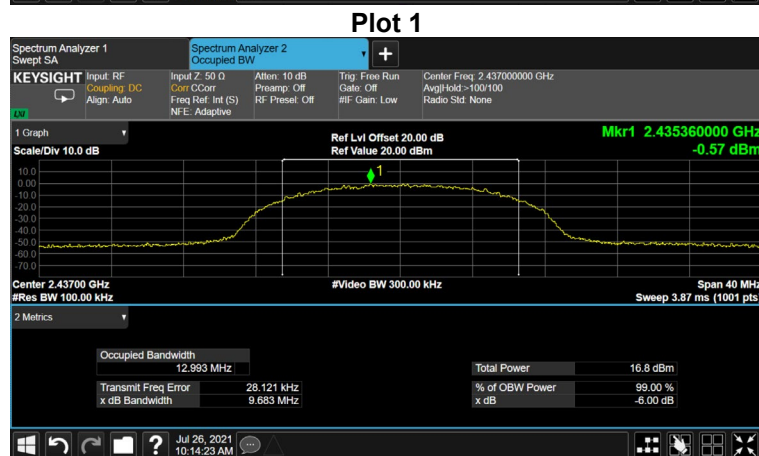
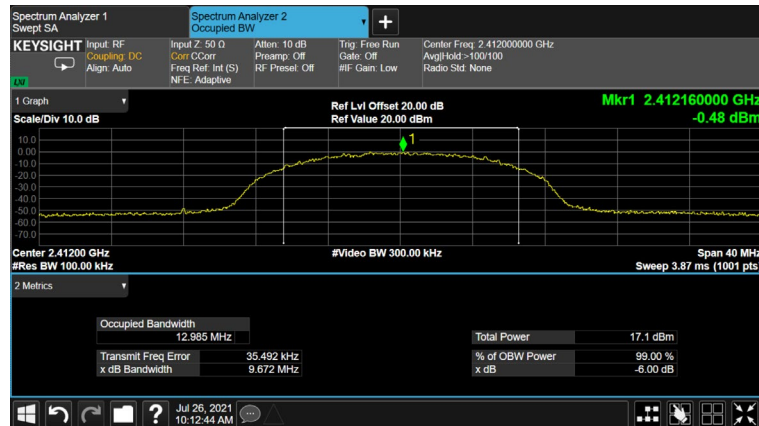
Page 11 of 50 Pages

Title: Test on IoT Repeater - WiFi Transceiver

Model: NBX-R1000-RF

FCC ID: 2AYPY- NBX-R1000-RF

802.11b11M – 20 MHz





Test Report No.: 7112310971

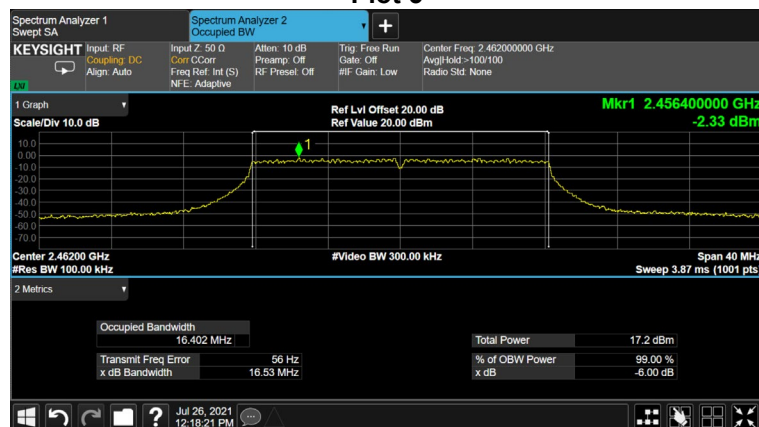
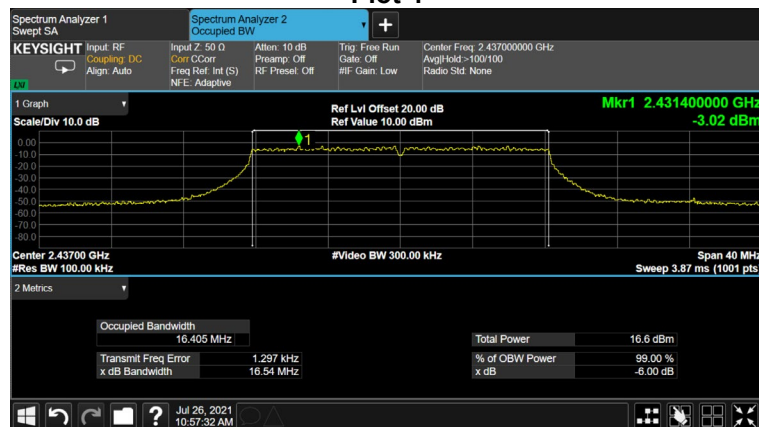
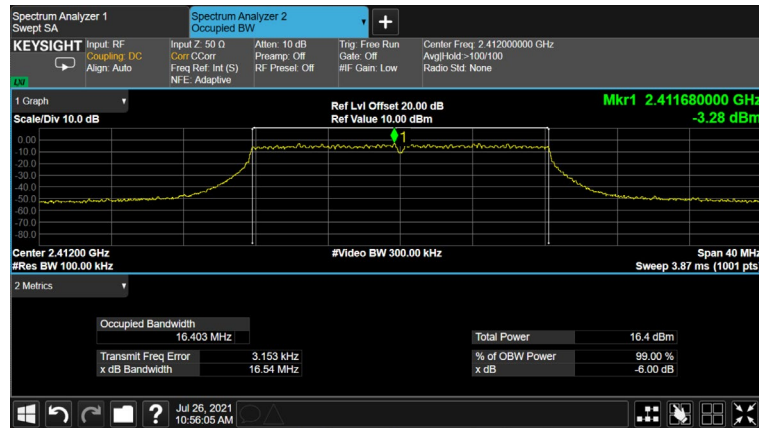
Page 12 of 50 Pages

Title: Test on IoT Repeater - WiFi Transceiver

Model: NBX-R1000-RF

FCC ID: 2AYPY- NBX-R1000-RF

802.11g 54M – 20 MHz





Test Report No.: 7112310971

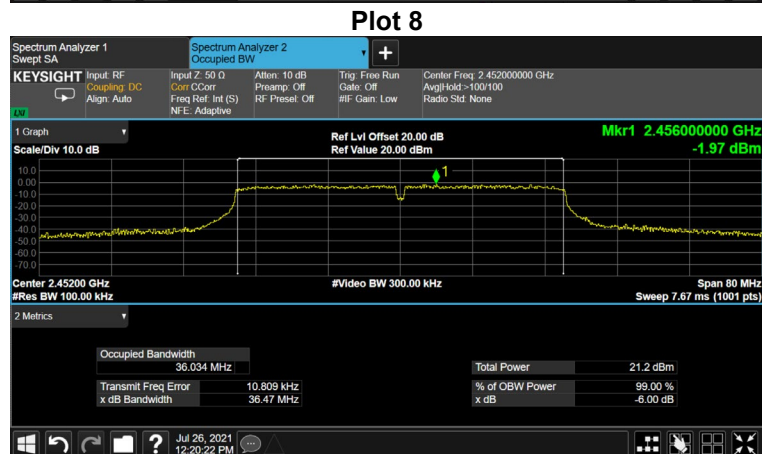
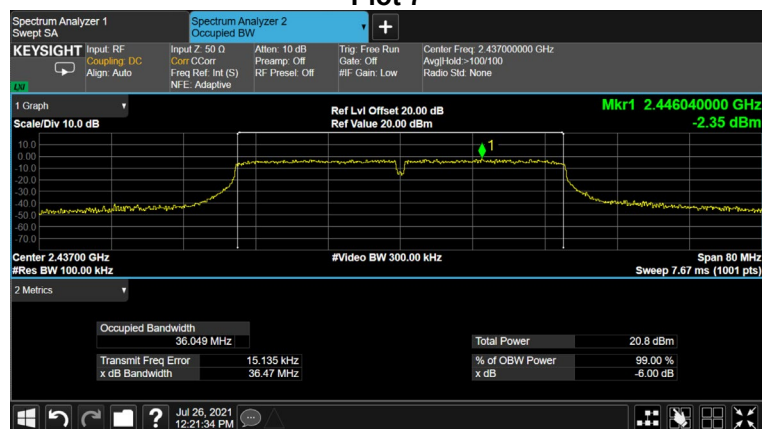
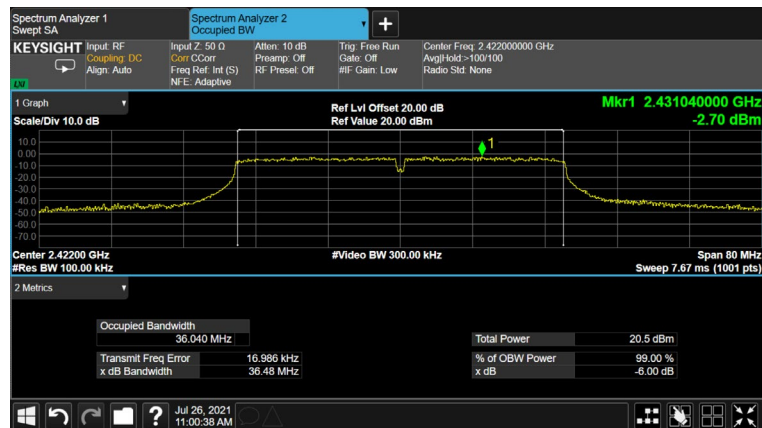
Page 13 of 50 Pages

Title: Test on IoT Repeater - WiFi Transceiver

Model: NBX-R1000-RF

FCC ID: 2AYPY- NBX-R1000-RF

802.11n MCS7 – 40 MHz





**Test Report No.: 7112310971****Page 14 of 50 Pages****Title:** Test on IoT Repeater - WiFi Transceiver**Model:** NBX-R1000-RF**FCC ID:** 2AYPY- NBX-R1000-RF**6.2. Maximum Peak Conducted Output Power****Limits & methods:**

<b>FCC requirements</b>	15.247(b)(3)		
<b>Test procedure</b>	ANSI 63.10 Section 11.9.1.2 Conducted Measurement		
<b>Operating Frequencies</b>	802.11b 11M – 20 MHz 802.11g 54M – 20 MHz 802.11n MCS7 – 40 MHz		
Ambient Temperature	22°C	Relative Humidity	46% Air Pressure 1006hPa

**Limit**

The maximum peak conducted output power shall not exceed 1 watt.

**Results:**

WLAN standard	Frequency, MHz	Peak power Limit, Watt	Peak power, dBm	Calculated power, mWatt	Verdict	Plot #
802.11b 11M – 20 MHz	2412	1	12.61	18.239	Pass	10
	2437		12.80	19.055	Pass	11
	2462		12.88	19.409	Pass	12
802.11g 54M – 20 MHz	2412		12.27	16.87	Pass	13
	2437		12.51	17.82	Pass	14
	2462		12.80	19.05	Pass	15
802.11n MCS7 – 40 MHz	2422		12.93	19.63	Pass	16
	2437		12.95	19.72	Pass	17
	2452		12.43	17.50	Pass	18

**Test procedure**

The measurements were performed in hopping transmission mode of operation for carrier (channel) frequency at bottom, middle and at the top of 2412MHz to 2462MHz frequency band and maximum transmitting data rate.



Test Report No.: 7112310971

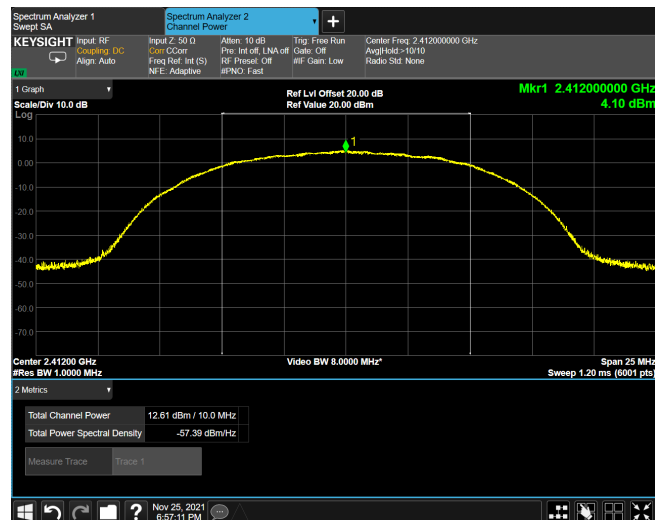
Page 15 of 50 Pages

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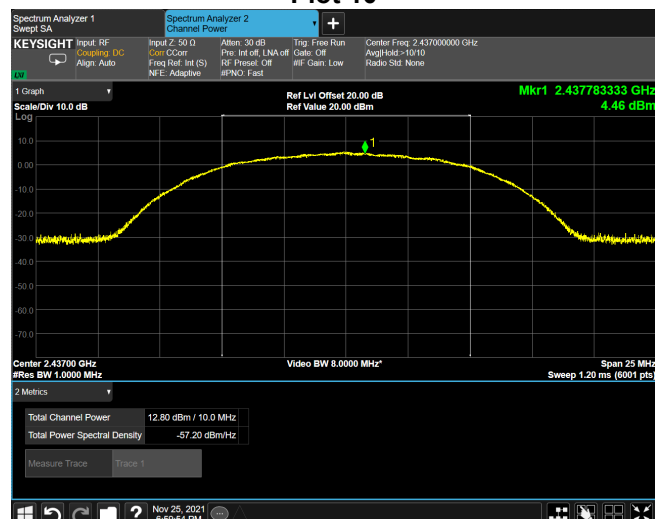
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FCC ID: 2AYPY- NBX-R1000-RF

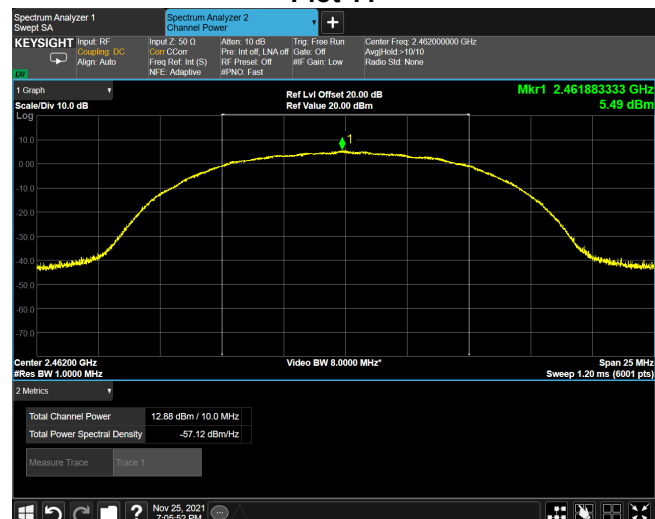
802.11b 11M



Plot 10



Plot 11



Plot 12



Test Report No.: 7112310971

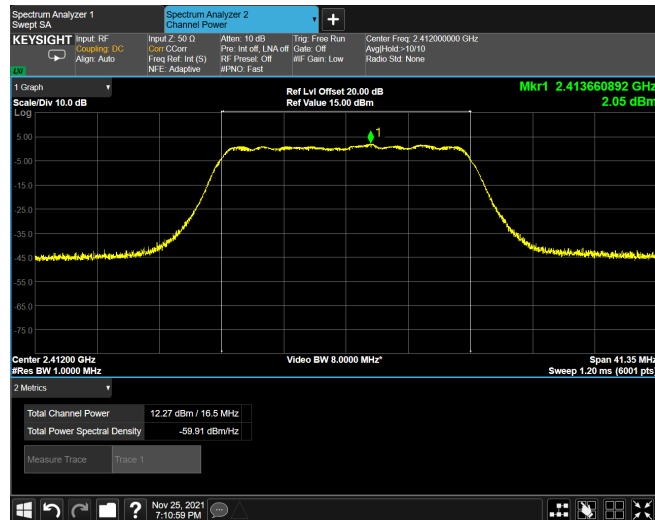
Page 16 of 50 Pages

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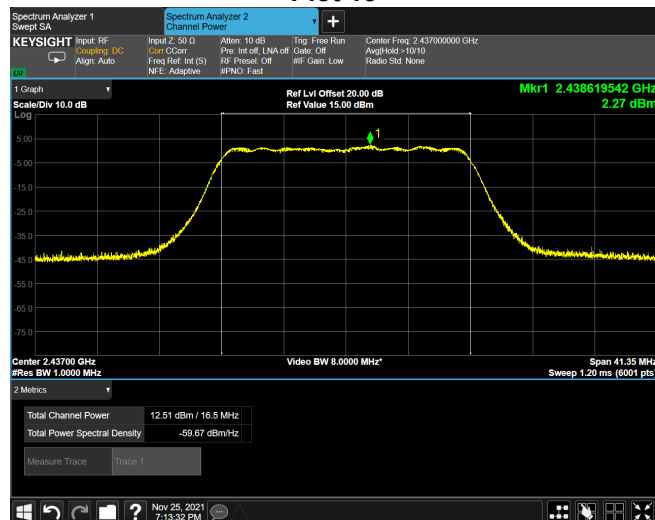
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FCC ID: 2AYPY- NBX-R1000-RF

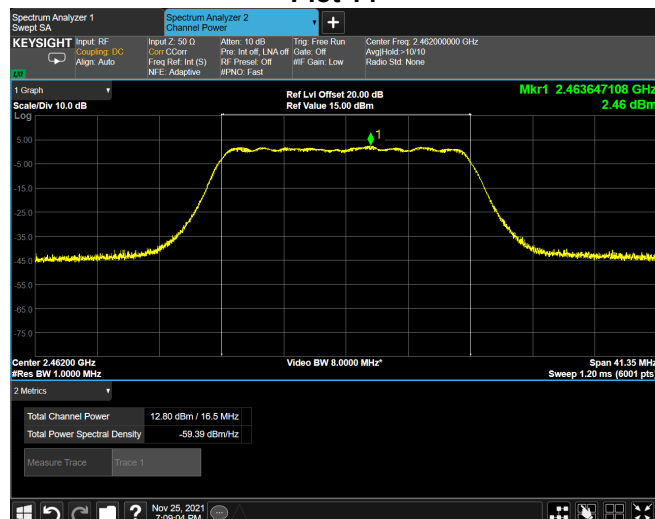
802.11g 54M



Plot 13



Plot 14



Plot 15





Test Report No.: 7112310971

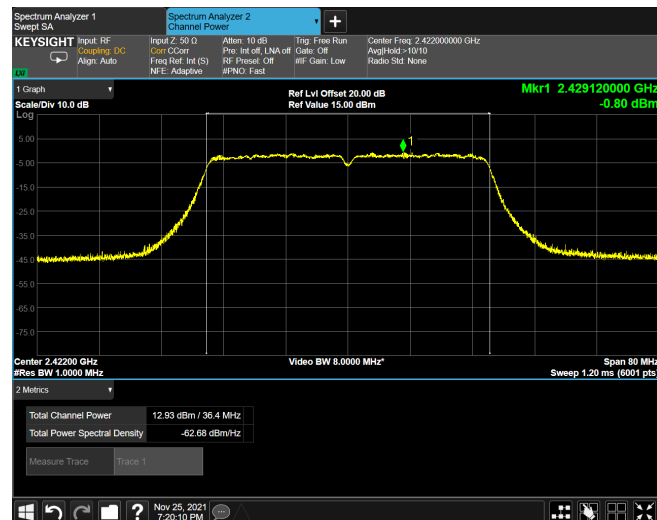
Page 17 of 50 Pages

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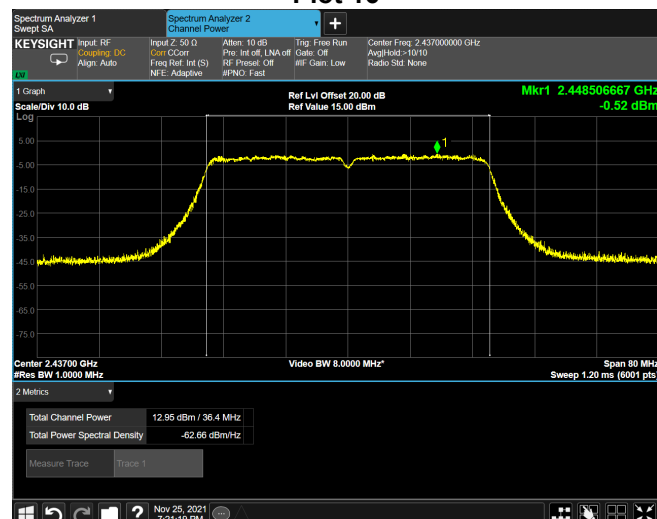
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FCC ID: 2AYPY- NBX-R1000-RF

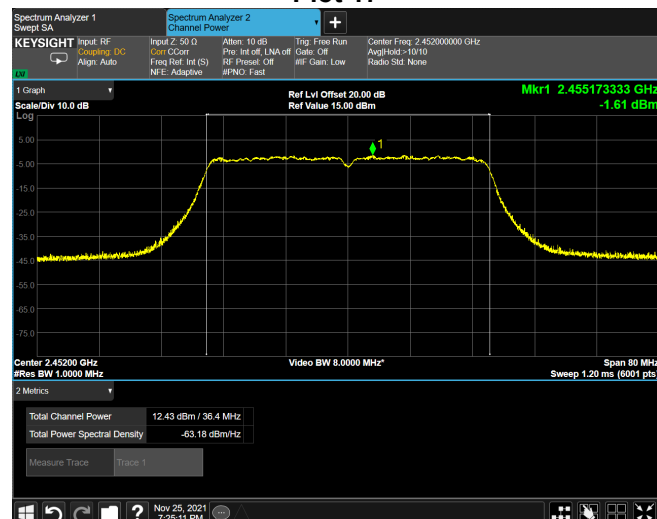
802.11n MCS7



Plot 16



Plot 17



Plot 18

**Test Report No.: 7112310971****Page 18 of 50 Pages****Title:** Test on IoT Repeater - WiFi Transceiver**Model:** NBX-R1000-RF**FCC ID:** 2AYPY- NBX-R1000-RF

### 6.3. Power Spectral Density

#### Limits & methods:

<b>FCC requirements</b>	15.247(e)		
<b>Test procedure</b>	ANSI 63.10 Section 11.10.2 method PKPSD (peak PSD) Conducted measurement		
<b>Operating Frequencies</b>	802.11b 11M – 20 MHz 802.11g 54M – 20 MHz 802.11n MCS7 – 40 MHz		
Ambient Temperature	22°C	Relative Humidity	46%      Air Pressure      1006hPa

#### Limit

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

#### Results:

WLAN standard	Frequency, MHz	Limit, dBm/ 3kHz	Measured result, dBm/ 3kHz	Verdict	Plot #
802.11b11M – 20 MHz	2412	8	-1.05	Pass	19
	2437		-1.15	Pass	20
	2462		0.52	Pass	21
802.11g 54M – 20 MHz	2412		-3.43	Pass	22
	2437		-3.16	Pass	23
	2462		-2.41	Pass	24
802.11n MCS7 – 40 MHz	2422		-2.88	Pass	25
	2437		-2.39	Pass	26
	2452		-2.07	Pass	27

#### Test procedure

The measurements were performed in hopping transmission mode of operation for carrier (channel) frequency at bottom, middle and at the top of 2412MHz to 2462MHz frequency band and maximum transmitting data rate.



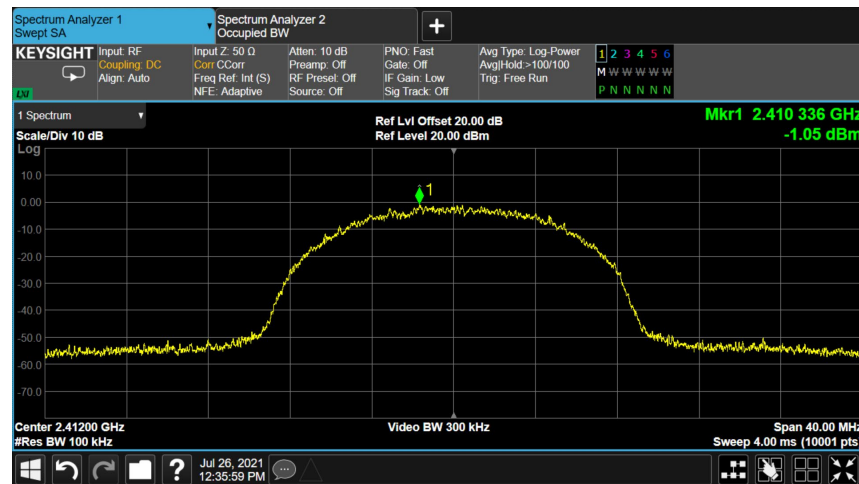
Test Report No.: 7112310971

Page 19 of 50 Pages

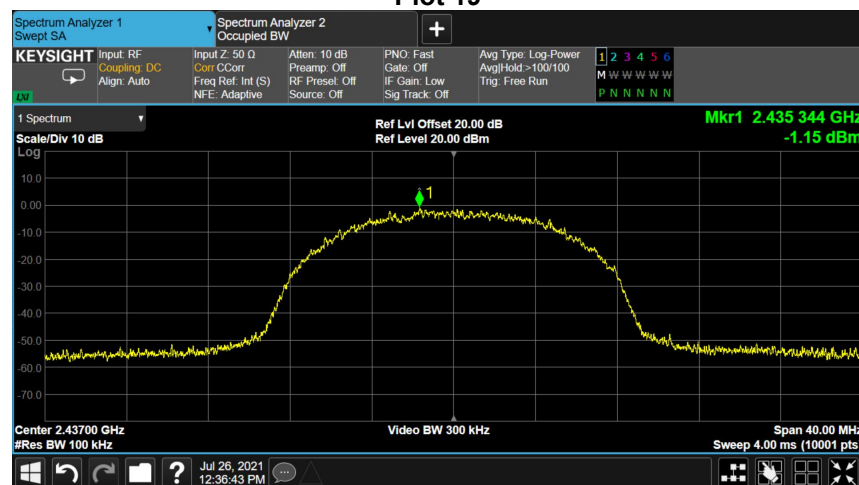
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Model: NBX-R1000-RF FCC ID: 2AYPY- NBX-R1000-RF

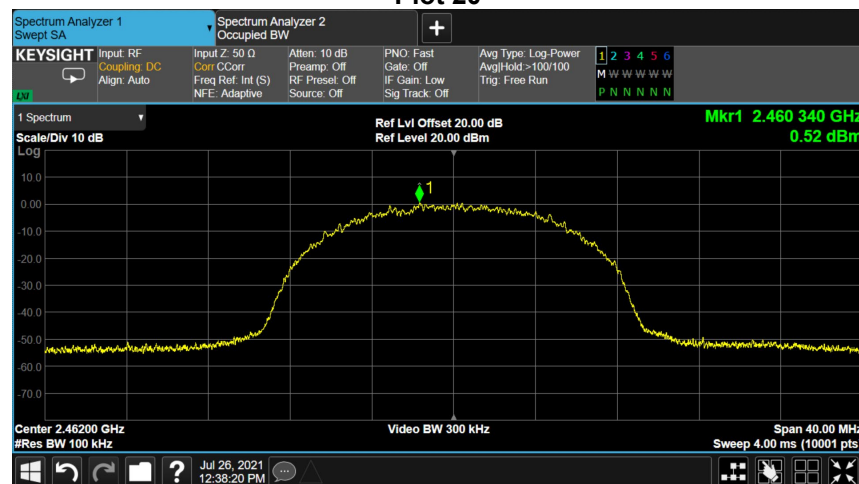
802.11b 11M



Plot 19



Plot 20



Plot 21



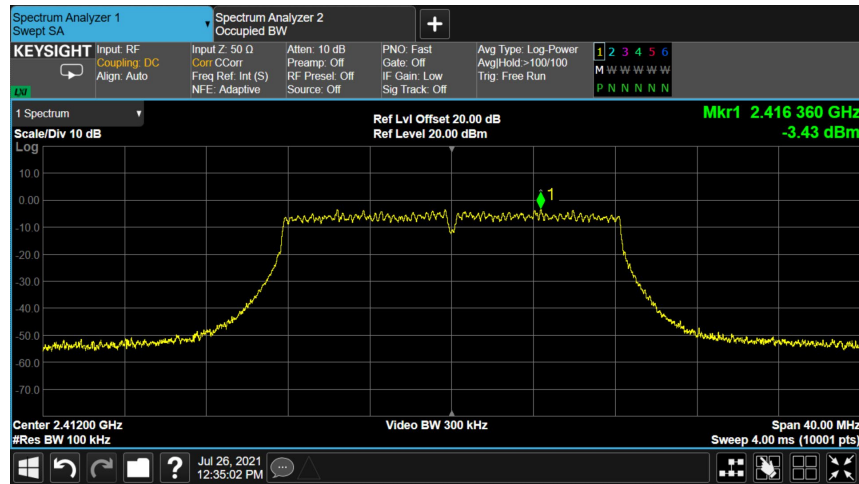
Test Report No.: 7112310971

Page 20 of 50 Pages

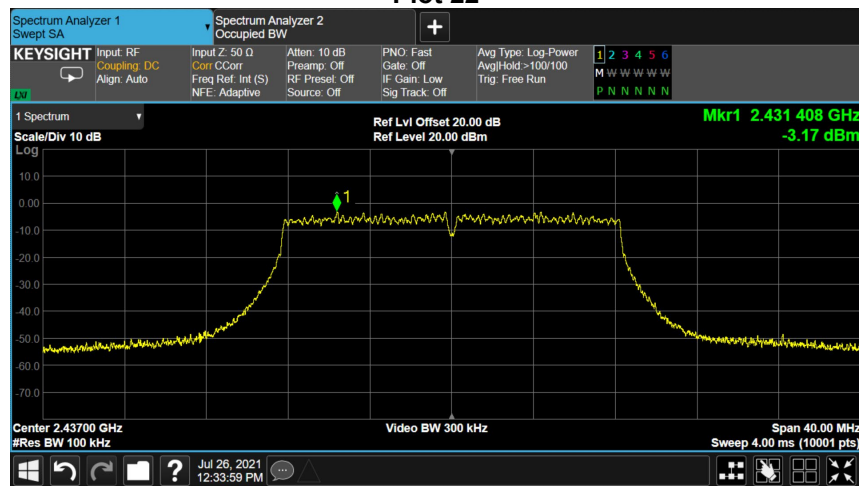
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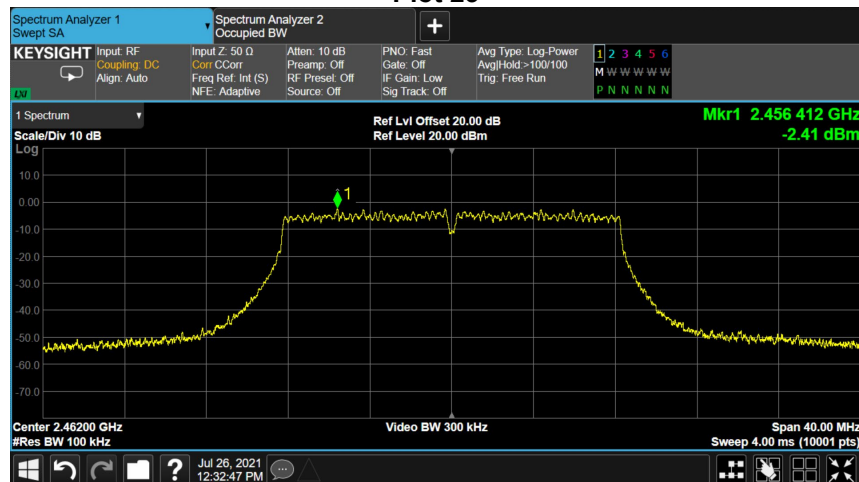
802.11g 54M



Plot 22



Plot 23



Plot 24



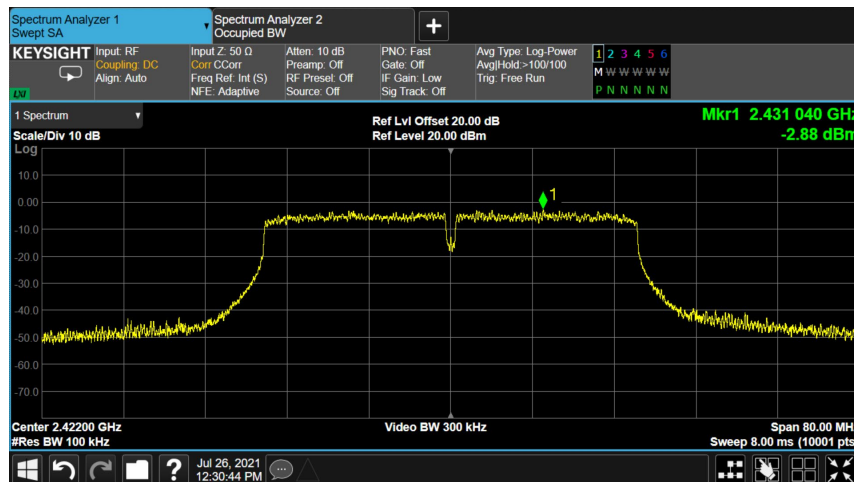
Test Report No.: 7112310971

Page 21 of 50 Pages

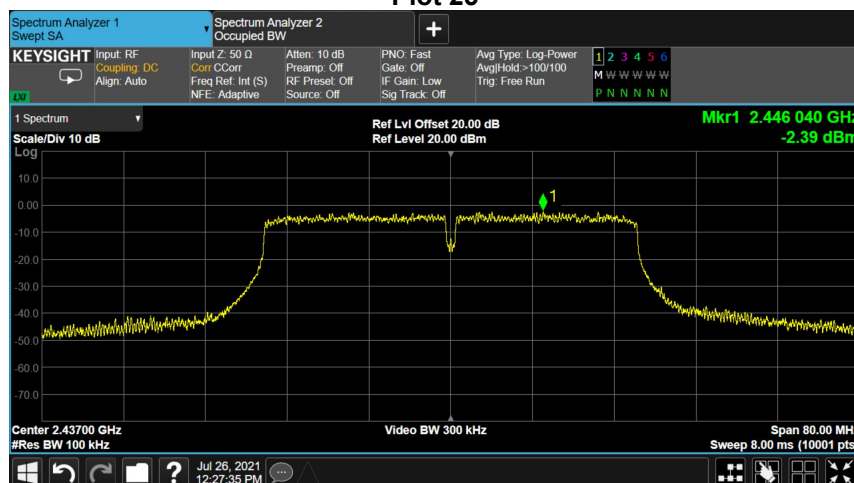
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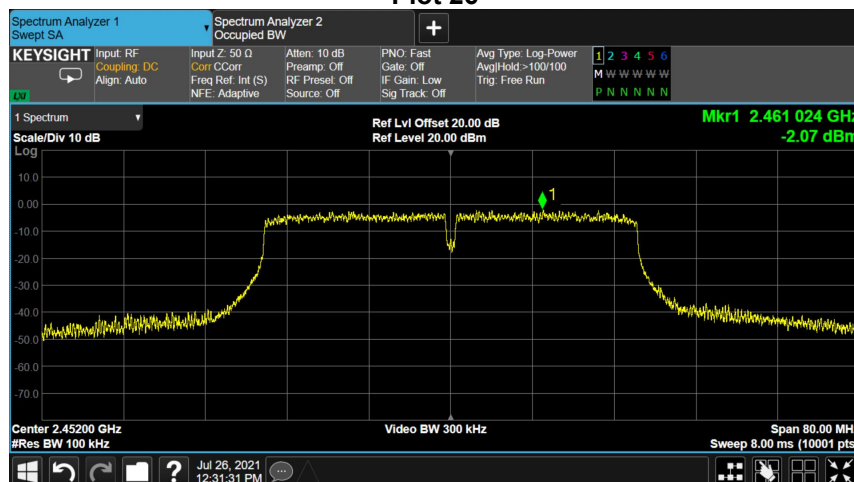
802.11n MCS7



Plot 25



Plot 26



Plot 27