



**FCC 47 CFR PART 15 SUBPART C
ISED RSS-247 Issue 2**

CERTIFICATION TEST REPORT

For

WLAN+Bluetooth Module

MODEL NUMBER: LBEE5PK2AE

PROJECT NUMBER: 4790016144.1

REPORT NUMBER: 4790016144.1-AE-3

FCC ID: VPYLB2AE

IC: 772C-LB2AE

ISSUE DATE: Jun. 28, 2022

Prepared for

Murata Manufacturing Co., Ltd.

Prepared by

UL-CCIC COMPANY LIMITED

No. 2, Chengwan Road, Suzhou Industrial Park, People's Republic of China

Tel: +86 512-6808 6400

Fax: +86 512-6808 4099

Website: www.ul.com

Form-ULID-008536-9 V1.0

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Revision History

Rev.	Issue Date	Revisions	Revised By
V0	06/28/2022	Initial Issue	



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1. ATTESTATION OF TEST RESULTS

Applicant Information

Company Name: Murata Manufacturing Co., Ltd.
Address: 10-1, Higashikotari 1-chome, Nagaokakyo-shi, Kyoto 617-8555, Japan

Manufacturer Information

Company Name: Murata Manufacturing Co., Ltd.
Address: 10-1, Higashikotari 1-chome, Nagaokakyo-shi, Kyoto 617-8555, Japan

EUT Description

Product Name: WLAN+Bluetooth Module
Model Name: LBEE5PK2AE
Sample Number: 4059724
Data of Receipt Sample: Jul. 12, 2021
Date Tested: Jul. 23, 2021 ~ Jun. 27, 2022

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	PASS
ISED RSS-247 Issue 2	PASS
ISED RSS-GEN Issue 5	PASS



Summary of Test Results			
Clause	Test Items	FCC Rules	Test Results
1	6db DTS Bandwidth and 99% Bandwidth	FCC 15.247 (a) (2) RSS-247 Clause 5.2 (a) RSS-Gen Clause 6.7	Complied
2	Conducted Power	FCC 15.247 (b) (3) RSS-247 Clause 5.4 (d) RSS-Gen Clause 6.12	Complied
3	Power Spectral Density	FCC 15.247 (e) RSS-247 Clause 5.2 (b)	Complied
4	Conducted Band edge And Spurious emission	FCC 15.247 (d) RSS-247 Clause 5.5 RSS-GEN Clause 6.13	Complied
5	Radiated Band edges and Spurious emission	FCC 15.247 (d) FCC 15.209 FCC 15.205 RSS-247 Clause 5.5 RSS-GEN Clause 8.9 RSS-GEN Clause 6.13	Complied
6	Conducted Emission Test for AC Power Port	FCC 15.207 RSS-GEN Clause 8.8	Complied
7	Antenna Requirement	FCC 15.203 RSS-GEN Clause 6.8	Complied
Note: The measurement result for the sample received is <Pass> according to < ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15C, ISSED RSS-GEN, ISSED RSS-247> when <Accuracy Method> decision rule is applied.			

Prepared By:

Tom Tang

Tom Tang

Reviewed By:

Leon Wu

Leon Wu

Authorized By:

Chris Zhong

Chris Zhong
Laboratory Leader



2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC KDB 558074 D01 15.247 Meas Guidance v05r02, KDB 414788 D01 Radiated Test Site v01r01, ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15, ISSED RSS-GEN ISSUE5, ISSED RSS-247 ISSUE2.

3. FACILITIES AND ACCREDITATION

Accreditation Certificate	A2LA (Certificate No.: 4829.01) UL-CCIC COMPANY LIMITED has been assessed and proved to be in compliance with A2LA. FCC (FCC Designation No.: CN1247) UL-CCIC COMPANY LIMITED has been recognized to perform compliance testing on equipment subject to the Commission's Declaration of Conformity (DoC) and Certification rules. IC (IC Designation No.: 25056; CAB No.: CN0073) UL-CCIC COMPANY LIMITED has been recognized to perform compliance testing on equipment subject to the Commission's Declaration of Conformity (DoC) and Certification rules.
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Note 1: All tests measurement facilities use to collect the measurement data are located at No. 2, Chengwan Road, Suzhou Industrial Park, Suzhou 215122, People's Republic of China

Note 2: For below 30MHz, lab had performed measurements at test anechoic chamber and comparing to measurements obtained on an open field site. These measurements below 30MHz had been correlated to measurements performed on an OFS.

Note 3: The test anechoic chamber in UL-CCIC COMPANY LIMITED had been calibrated and compared to the open field sites and the test anechoic chamber is shown to be equivalent to or worst case from the open field site.



4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations and is traceable to recognized national standards.

4.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Test Item	Uncertainty
Conduction emission	3.1dB
Radiation Emission test (include Fundamental emission) (9kHz-30MHz)	3.4dB
Radiation Emission test (include Fundamental emission) (30MHz-1GHz)	3.4dB
Radiation Emission test (1GHz to 26GHz) (include Fundamental emission)	3.9dB (1GHz-18GHz)
	4.2dB (18GHz-26.5GHz)
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.	



5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

Product Name:	WLAN+Bluetooth Module
Model No.:	LBEE5PK2AE
Operating Frequency:	IEEE 802.11b/g/n(HT20): 2412MHz to 2462MHz This report just including 2.4G WIFI part.
Type of Modulation:	IEEE for 802.11b: DBPSK, DQPSK IEEE for 802.11g: BPSK, QPSK, 16QAM, 64QAM IEEE for 802.11 n HT20/HT40: BPSK, QPSK, 16QAM, 64QAM
Channels Step:	Channels with 5MHz step
Rated Input	DC 3.3V
Test software of EUT:	SecureCRT (manufacturer declare)
Antenna Type:	Type 1: PCB Antenna Type 2: External Dipole Antenna
Antenna Gain:	Type 1: 3.0 dBi for 2.4G band; 3.3 dBi for 5G band Type 2: 3.4 dBi for 2.4G band; 4.75 dBi for 5G band Note: 1. The product has only one transmission chain and two antenna types are provided. 2. This data is provided by customer and our lab isn't responsible for this data.



5.2. MAXIMUM OUTPUT POWER

Number of Transmit Chains (NTX)	IEE Std. 802.11	Channel Number	Max AVG Conducted Power (dBm)
1	IEEE 802.11B	1-11[11]	18.53
1	IEEE 802.11G	1-11[11]	17.05
1	IEEE 802.11N HT20	1-11[11]	17.04

5.3. CHANNEL LIST

Channel List for 802.11B/G/N(20 MHz)							
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	4	2427	7	2442	10	2457
2	2417	5	2432	8	2447	11	2462
3	2422	6	2437	9	2452		

5.4. POWER GRADE

Power Grade											
Mode	2412	2417	2422	2427	2432	2437	2442	2447	2452	2457	2462
11B	16	17	17	17	17	17	17	17	17	17	16
11G	9	9	9	16	16	16	16	16	9	9	9
11N HT20	8	8	8	16	16	16	16	16	8	8	8



5.5. TEST CHANNEL CONFIGURATION

Test Mode	Test Channel (MHz)
IEEE 802.11B	LCH: CH01 2412; CH02 2417
	MCH: CH06 2437
	HCH: CH10 2457; CH11 2462
IEEE 802.11G	LCH: CH01 2412; CH04 2427
	MCH: CH06 2437
	HCH: CH08 2447; CH11 2462
IEEE 802.11N HT20	LCH: CH01 2412; CH04 2427
	MCH: CH06 2437
	HCH: CH08 2447; CH11 2462

5.6. THE WORSE CASE POWER SETTING PARAMETER

The Worse Case Power Setting Parameter under 2400 ~ 2483.5MHz Band						
Test Software		SecureCRT				
Modulation Mode	Transmit Antenna Number	Test Channel				
802.11B	1	CH01: 16	CH02: 17	CH06:17	CH10:17	CH11:16
802.11G	1	CH01: 9	CH04: 16	CH06: 16	CH08: 16	CH11: 9
802.11N HT20	1	CH01: 8	CH04: 16	CH06: 16	CH08: 16	CH11: 8



5.7. DESCRIPTION OF AVAILABLE ANTENNAS

Ant.	Frequency (MHz)	Antenna Type	Antenna Gain (dBi)
1	2400-2483.5	PCB Antenna	3.0
		External Dipole Antenna	3.4

Note: This data is provided by customer and our lab isn't responsible for this data.

Test Mode	Transmit and Receive Mode	Description
IEEE 802.11B	☒ 1TX, 1RX	Antenna1 can be used as transmitting/receiving antenna independently.
IEEE 802.11G	☒ 1TX, 1RX	Antenna1 can be used as transmitting/receiving antenna independently.
IEEE 802.11N HT20	☒ 1TX, 1RX	Antenna1 can be used as transmitting/receiving antenna independently.

5.8. THE WORSE CASE CONFIGURATIONS

For WIFI module, the worst-case data rates as provided by the client were:

802.11B mode: 11 Mbps

802.11G mode: 6 Mbps

802.11N HT20 mode: MCS0



5.9. TEST ENVIRONMENT

Environment Parameter	Selected Values During Tests	
Relative Humidity	55 ~ 65%	
Atmospheric Pressure:	101kPa	
Temperature	TN	23 ~ 28°C
Voltage:	VL	N/A
	VN	DC 3.3V
	VH	N/A

Note: VL= Lower Extreme Test Voltage
VN= Nominal Voltage
VH= Upper Extreme Test Voltage
TN= Normal Temperature



5.10. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Item	Equipment	Brand Name	Model Name	Description
1	Laptop	ThinkPad	E590	/
2	Brix	GIGABYTE	/	/
3	DC Power Supply	Tektronix	PWS2326	INPUT: AC 230V OUTPUT: 0-32V, 6A

I/O PORT

Cable No	Port	Connector Type	Cable Type	Cable Length(m)	Remarks
1	RJ45	RJ45	LAN	100cm Length	/

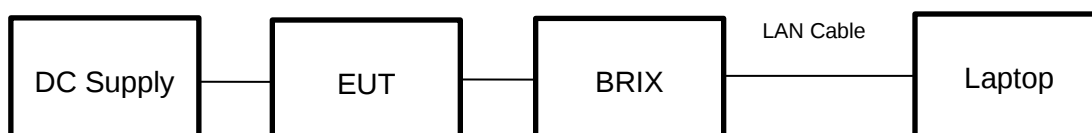
ACCESSORY

Item	Accessory	Brand Name	Model Name	Description
1	/	/	/	/

TEST SETUP

The EUT can work in an engineer mode with a software through a table PC.

SETUP DIAGRAM FOR TESTS





5.11. MEASURING INSTRUMENT AND SOFTWARE USED

Radiated Emissions (Instrument)							
Used	Equipment	Manufacturer	Model No.	Serial No.	Upper Last Cal.	Last Cal.	Next Cal.
☒	Spectrum Analyzer	Keysight	N9010B	155727	2021-05-09	2022-04-09	2023-04-08
☒	EMI test receiver	R&S	ESR26	126703	2020-12-05	2021-12-04	2022-12-03
☒	Receiver Antenna (9kHz-30MHz)	Schwarzbeck	FMZB 1513	155456	2018-06-15	2021-06-03	2024-06-02
☒	Receiver Antenna (30MHz-1GHz)	SunAR RF Motion	JB1	177821	2019-01-19	2022-01-18	2025-01-17
☒	Receiver Antenna (1GHz-18GHz)	R&S	HF907	126705	2019-01-27	2022-02-28	2025-02-27
☒	Receiver Antenna (18GHz-26.5GHz)	Schwarzbeck	BBHA9170	126706	2019-02-29	2022-02-28	2025-02-27
☒	Pre-amplification (To 18GHz)	Compliance Direction System Inc.	PAP-1G18-50	178825	2021-03-26	2022-03-01	2023-02-28
☒	Pre-amplification (To 26.5GHz)	R&S	SCU-26D	135391	2020-12-05	2021-12-04	2022-12-03
☒	Band Reject Filter	Wainwright	WRCJV8-2350-2400-2483.5-2533.5-40SS	1	2021-05-09	2022-05-08	2023-05-07
☒	Highpass Filter	Wainwright	WHKX10-2700-3000-18000-40SS	2	2021-05-09	2022-05-08	2023-05-07
Software							
Used	Description		Manufacturer	Name		Version	
☒	Test Software for Radiated disturbance		Tonscend	TS+		Ver. 2.5	
Other instruments							
Used	Equipment	Manufacturer	Model No.	Serial No.	Upper Last Cal.	Last Cal.	Next Cal.
☒	Spectrum Analyzer	Keysight	N9010B	155368	2021-05-09	2022-05-08	2023-05-07
☒	Power Meter	Keysight	U2021XA	155370	2021-05-09	2022-05-08	2023-05-07
	Wideband Radio Communication Tester	R&S	CMW270	155367	2021-05-09	2022-05-08	2023-05-07
	Vector Signal Generator	Keysight	N5182B	155369	2021-05-09	2022-05-08	2023-05-07
	Analog Signer Generator	Keysight	N5173B	155522	2021-05-09	2022-05-08	2023-05-07



6. MEASUREMENT METHODS

No.	Test Item	KDB Name	Section
1	6dB Bandwidth	KDB 558074 D01 15.247 Meas Guidance v05r02	8.2
2	Output Power	KDB 558074 D01 15.247 Meas Guidance v05r02	8.3.1.3/8.3.2.3
3	Power Spectral Density	KDB 558074 D01 15.247 Meas Guidance v05r02	8.4
4	Out-of-band emissions in non-restricted bands	KDB 558074 D01 15.247 Meas Guidance v05r02	8.5
5	Out-of-band emissions in restricted bands	KDB 558074 D01 15.247 Meas Guidance v05r02	8.6
6	Band-edge	KDB 558074 D01 15.247 Meas Guidance v05r02	8.7
7	Conducted Emission Test for AC Power Port	ANSI C63.10-2013	6.2



7. ANTENNA PORT TEST RESULTS

7.1. ON TIME AND DUTY CYCLE

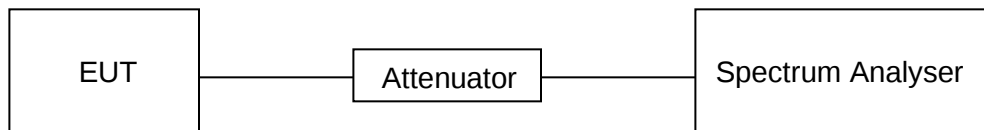
LIMITS

None; for reporting purposes only

PROCEDURE

FCC KDB 558074 Zero-Span Spectrum Analyzer Method

TEST SETUP



TEST ENVIRONMENT

Temperature	22°C	Relative Humidity	56%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

TEST RESULTS TABLE

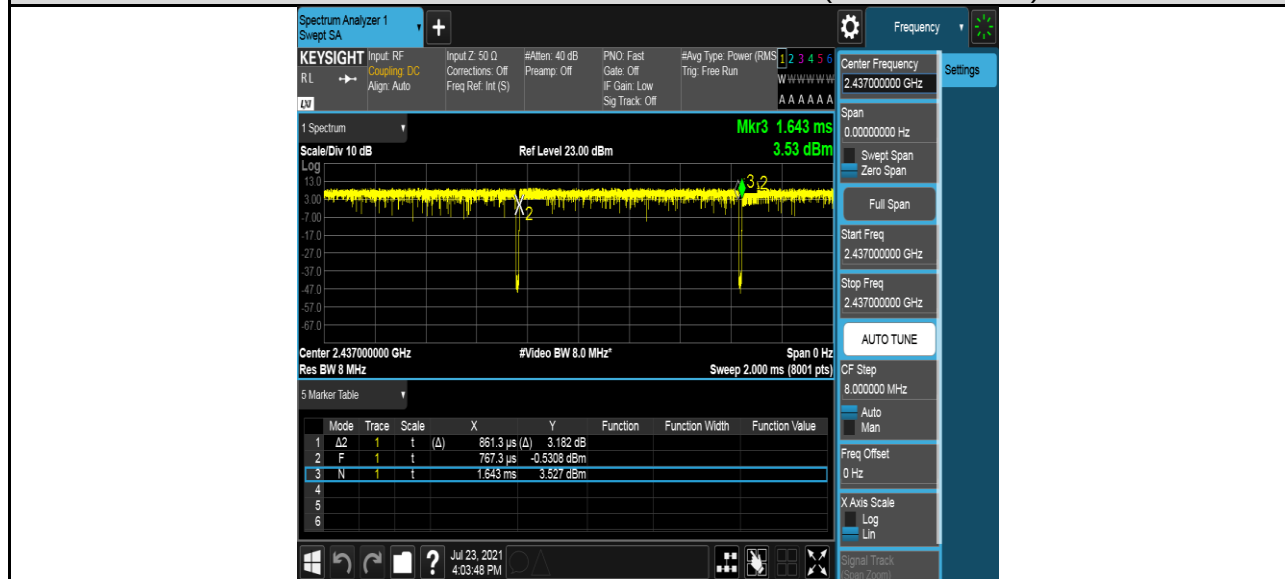
Mode	On Time (msec)	Period (msec)	Duty Cycle x (Linear)	Duty Cycle (%)	Duty Cycle Correction Factor (db)	1/T Minimum VBW (kHz)	Final VBW (kHz)
11B	0.8613	0.8757	0.9836	98.36	0.07	1.16	0.01
11G	1.428	1.4496	0.9851	98.51	0.07	0.70	0.01
802.11N HT20	1.335	1.3576	0.9834	98.34	0.07	0.75	0.01

Note: 1) Duty Cycle Correction Factor= $10\log(1/x)$.
2) Where: x is Duty Cycle (Linear)
3) Where: T is On Time (transmit duration)
4) The duty cycle is above 98%, so the Final VBW is 10Hz.

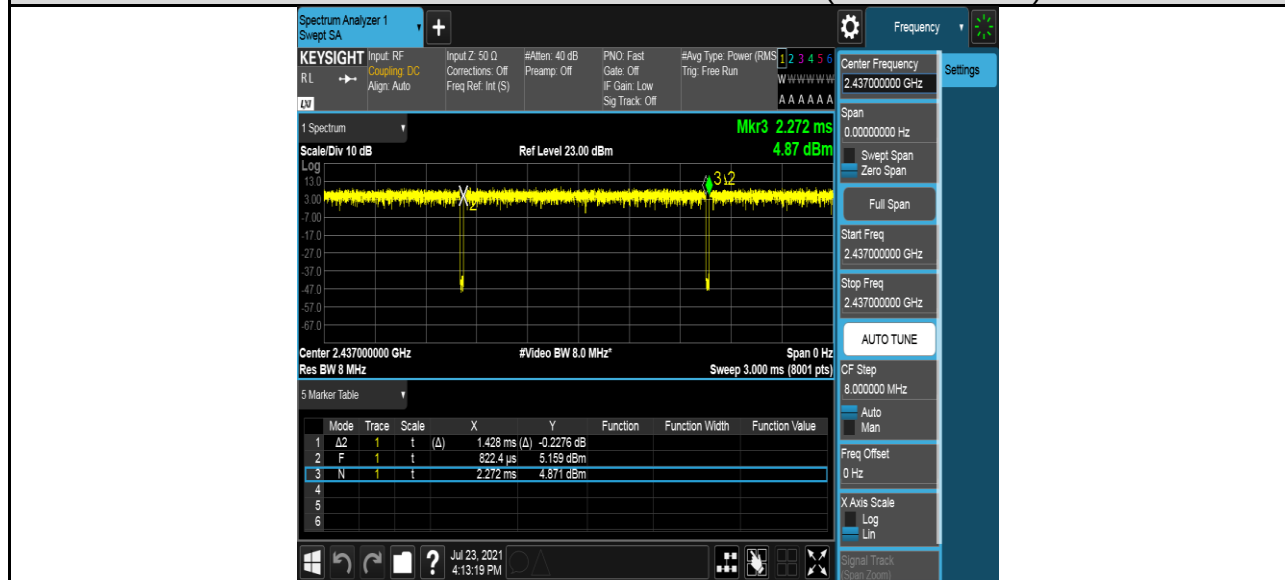


TEST GRAPHS

11B ON TIME AND DUTY CYCLE MID CH (WORSE CASE)

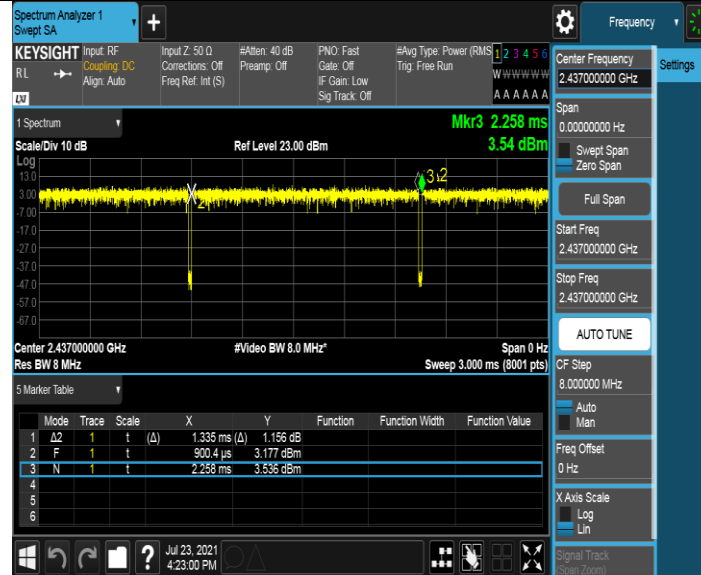


11G ON TIME AND DUTY CYCLE MID CH (WORSE CASE)





11N HT20 ON TIME AND DUTY CYCLE MID CH (WORSE CASE)





7.2. 6 dB BANDWIDTH

LIMITS

FCC Part15 (15.247), Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
CFR 47 FCC 15.247(a)(2) ISED RSS-247 5.2 (a)	6dB Bandwidth	$\geq 500\text{kHz}$	2400-2483.5
ISED RSS-Gen Clause 6.7	99 % Occupied Bandwidth	For reporting purposes only	2400-2483.5

TEST PROCEDURE

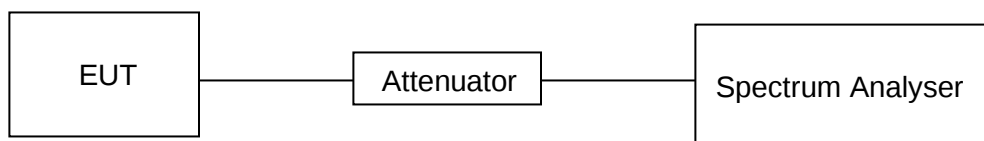
Refer to ANSI C63.10-2013 clause 11.8 for DTS bandwidth.

Connect the EUT to the spectrum analyser and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	For 6dB Bandwidth :100 kHz For 99% Occupied Bandwidth :1% to 5% of the occupied bandwidth
VBW	For 6dB Bandwidth: $\geq 3 \times \text{RBW}$ For 99% Occupied Bandwidth: approximately $3 \times \text{RBW}$
Trace	Max hold
Sweep	Auto couple

Allow the trace to stabilize and measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

TEST SETUP





TEST ENVIRONMENT

Temperature	22°C	Relative Humidity	56%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

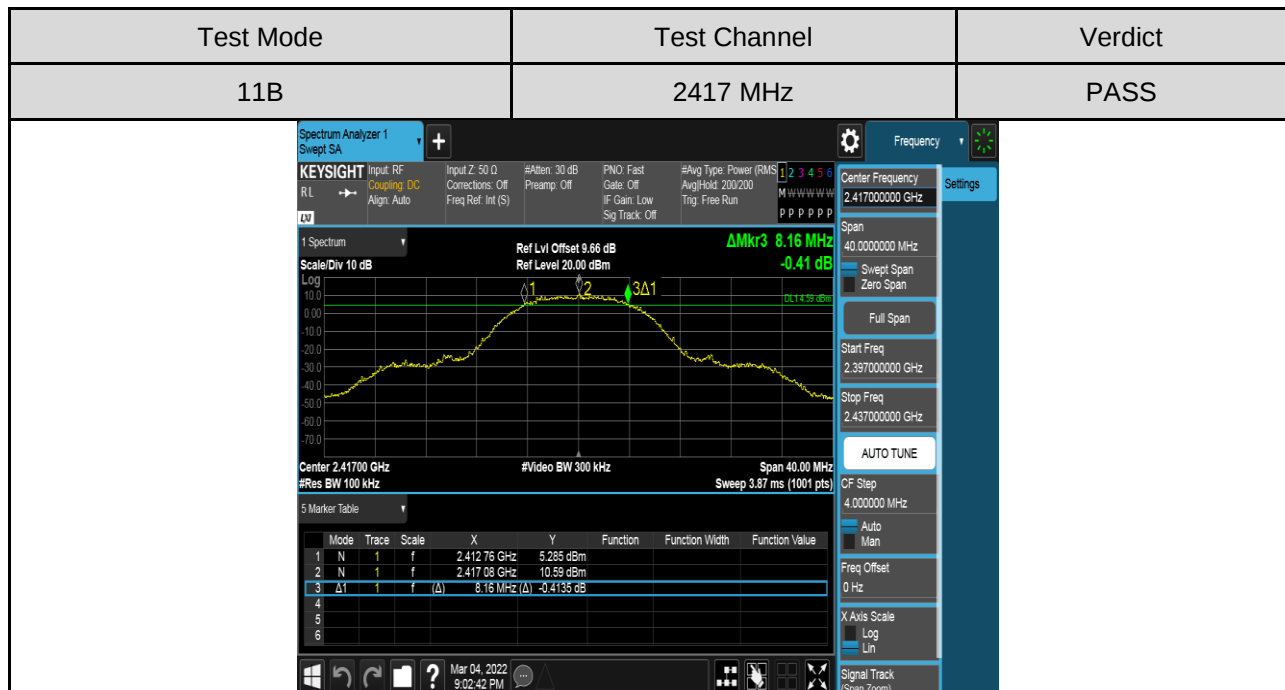
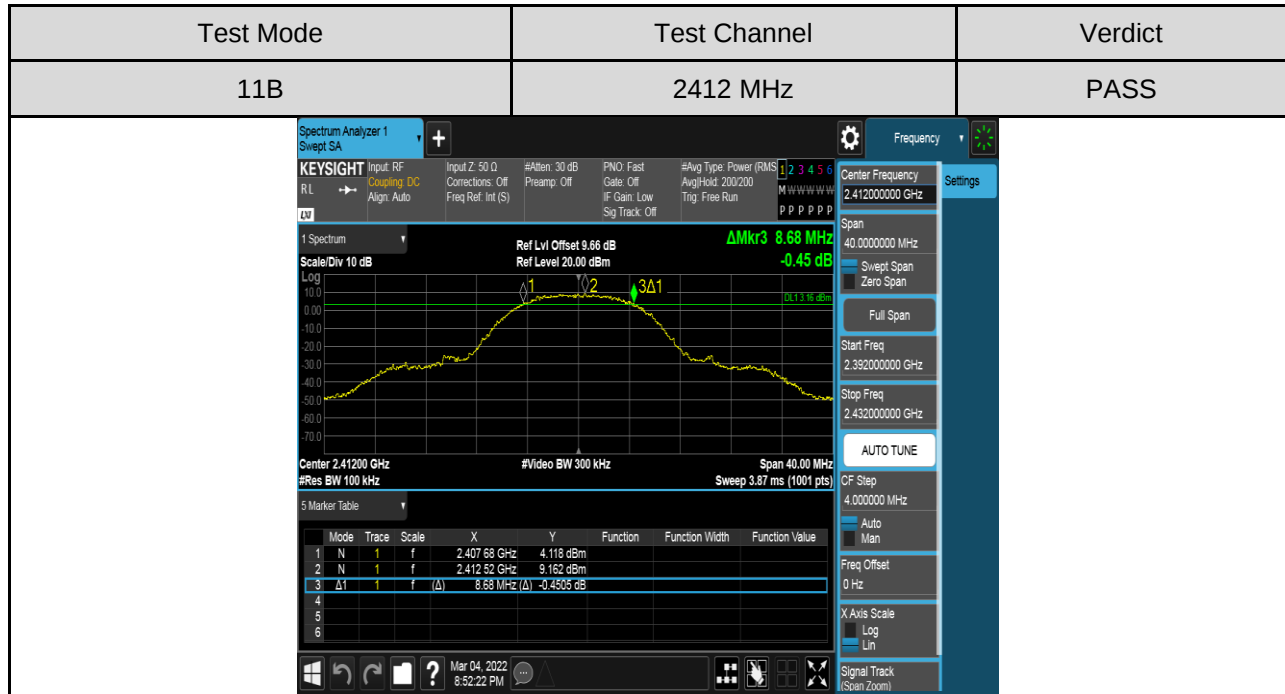
TEST RESULTS TABLE

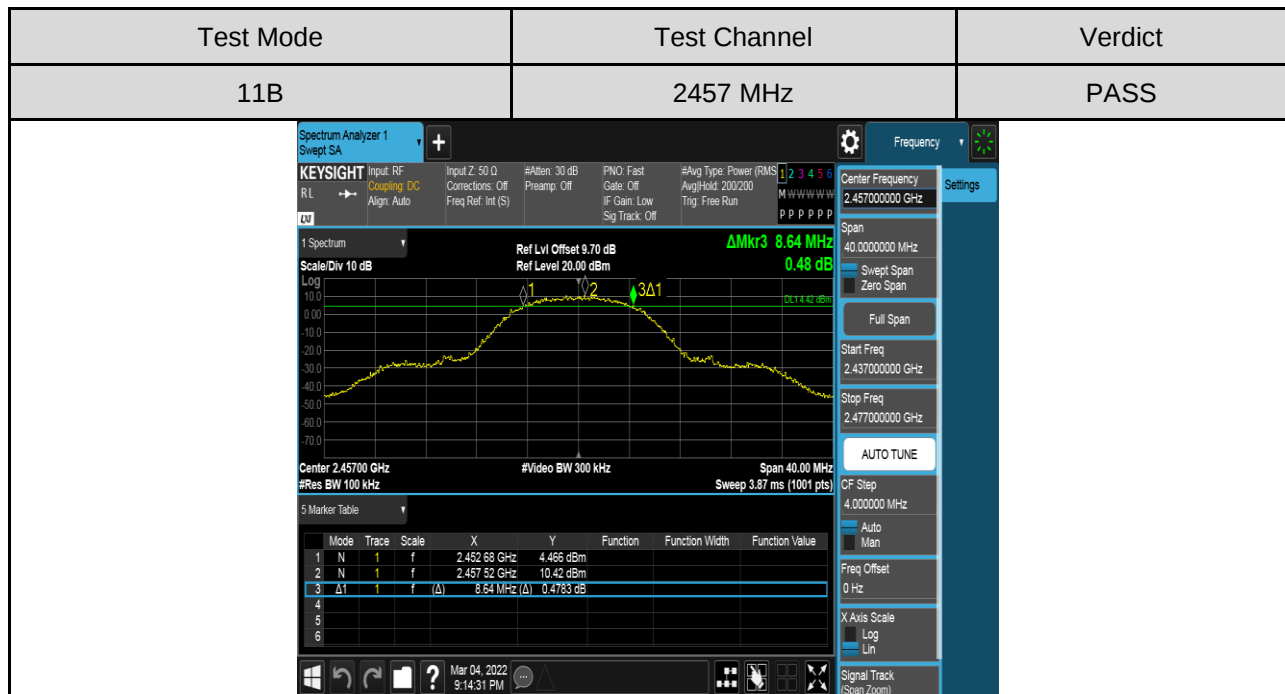
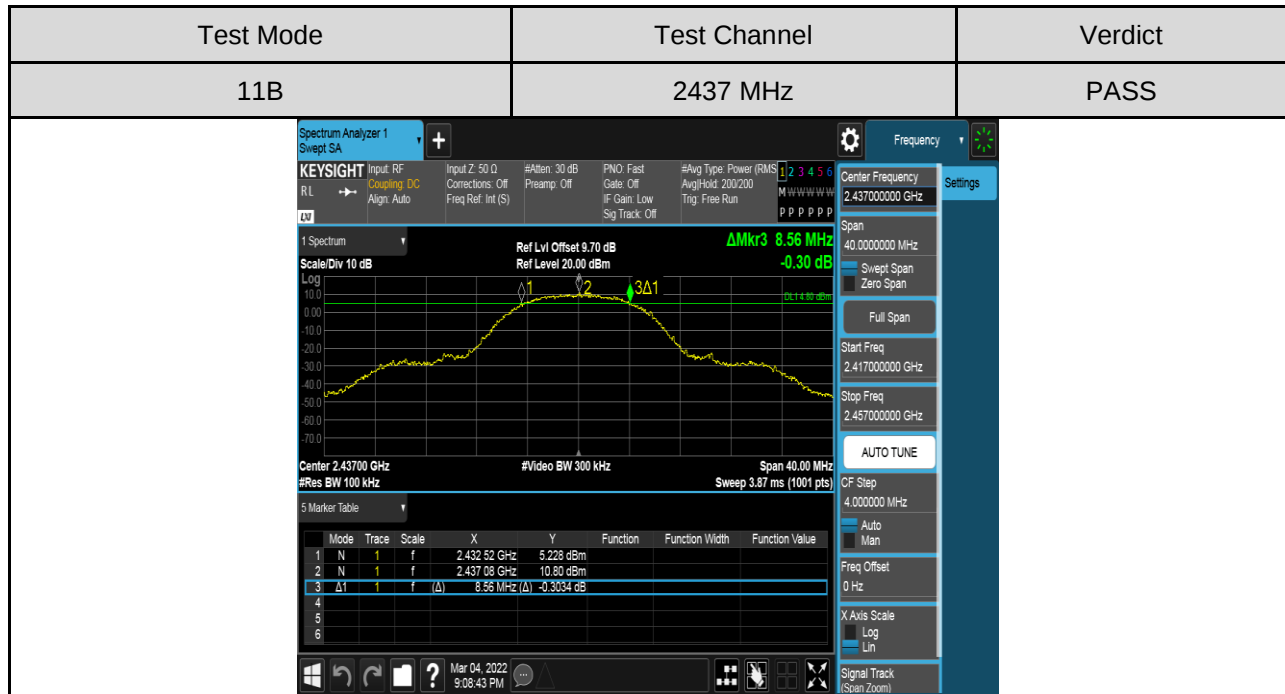
Test Mode	Test Channel (MHz)	6dB bandwidth (MHz)	99% bandwidth (MHz)	Result
11B	2412	8.68	11.722	Pass
	2417	8.16	11.834	Pass
	2437	8.56	11.827	Pass
	2457	8.64	11.853	Pass
	2462	8.60	11.771	Pass
11G	2412	16.28	17.361	Pass
	2427	16.28	18.287	Pass
	2437	16.28	18.088	Pass
	2447	16.04	18.215	Pass
	2462	16.28	17.427	Pass
11N HT20	2412	17.56	18.292	Pass
	2427	17.28	19.005	Pass
	2437	17.16	18.745	Pass
	2447	17.16	18.785	Pass
	2462	17.56	18.330	Pass

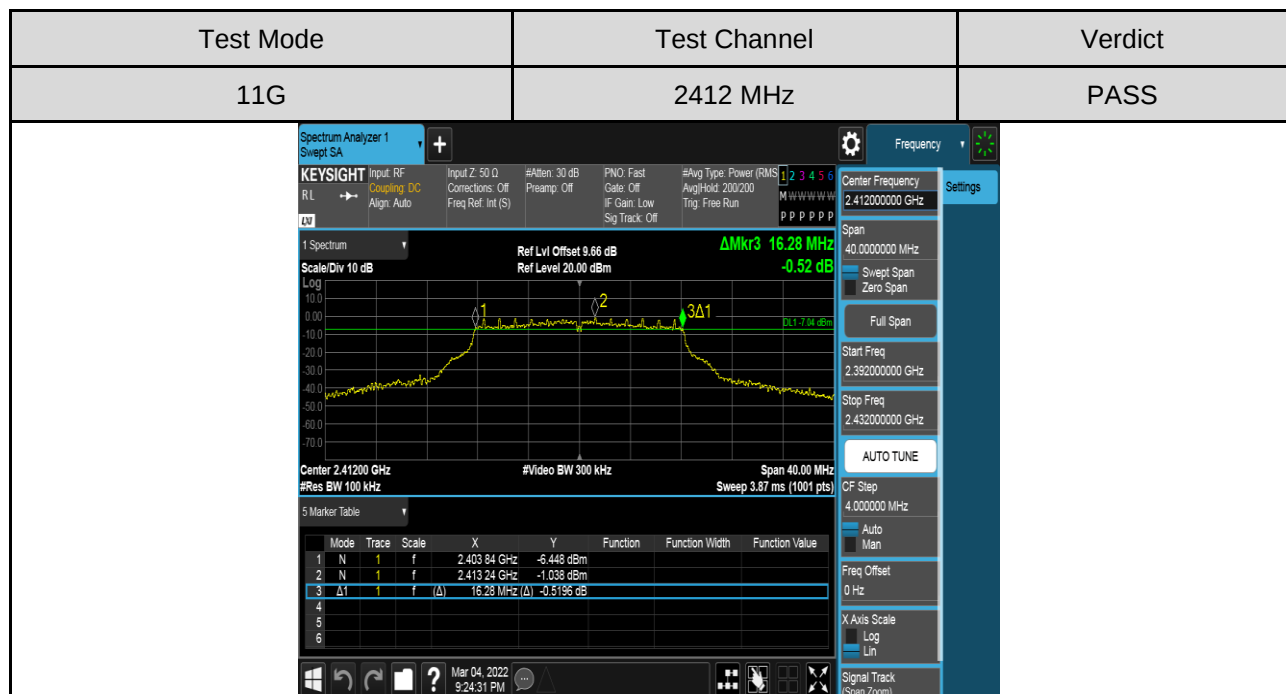
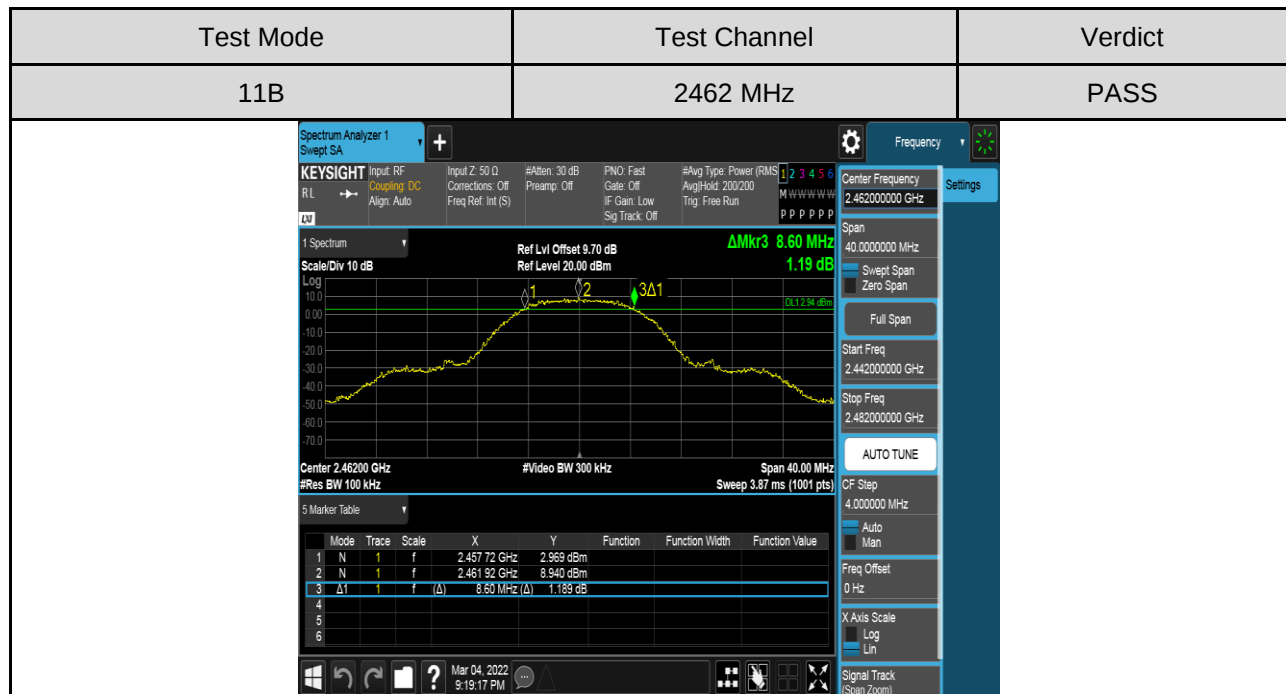


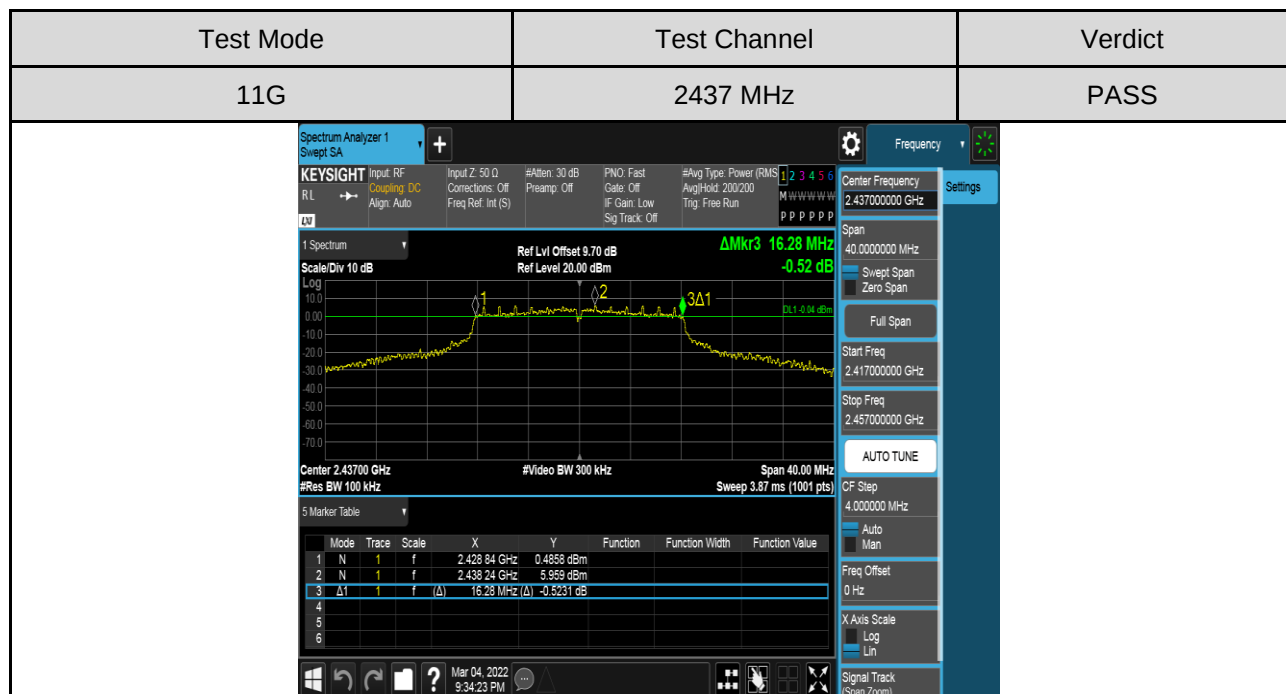
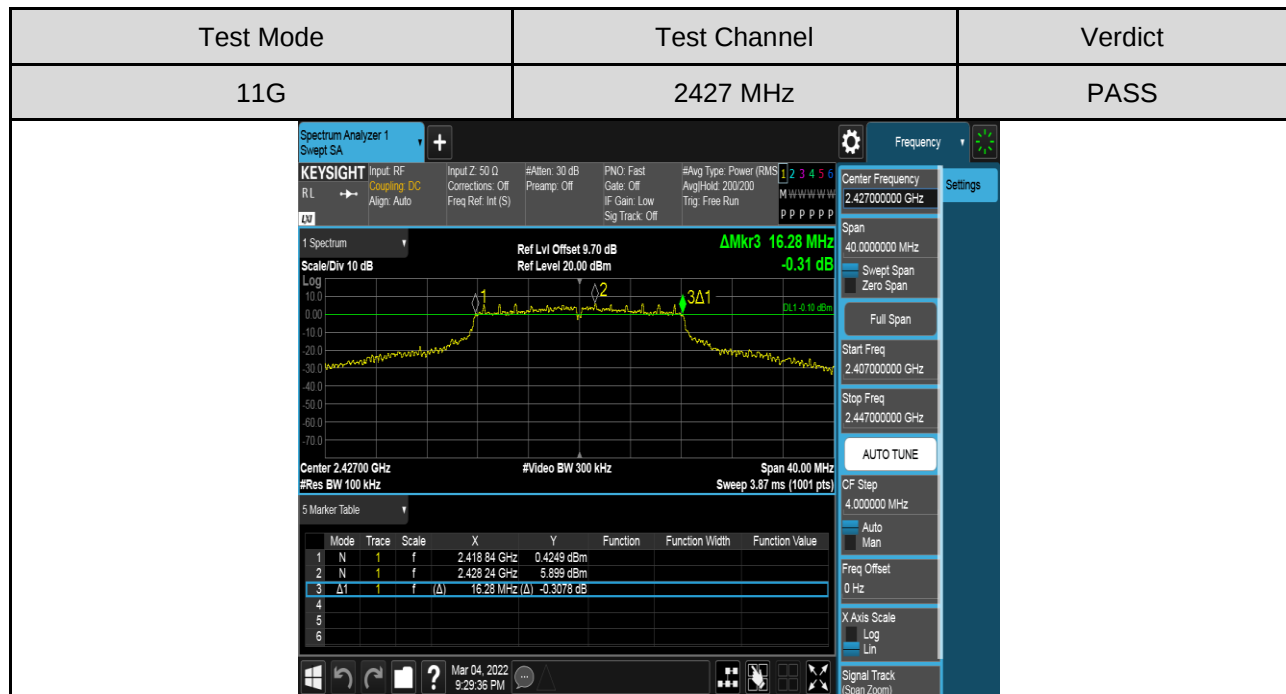
TEST GRAPHS

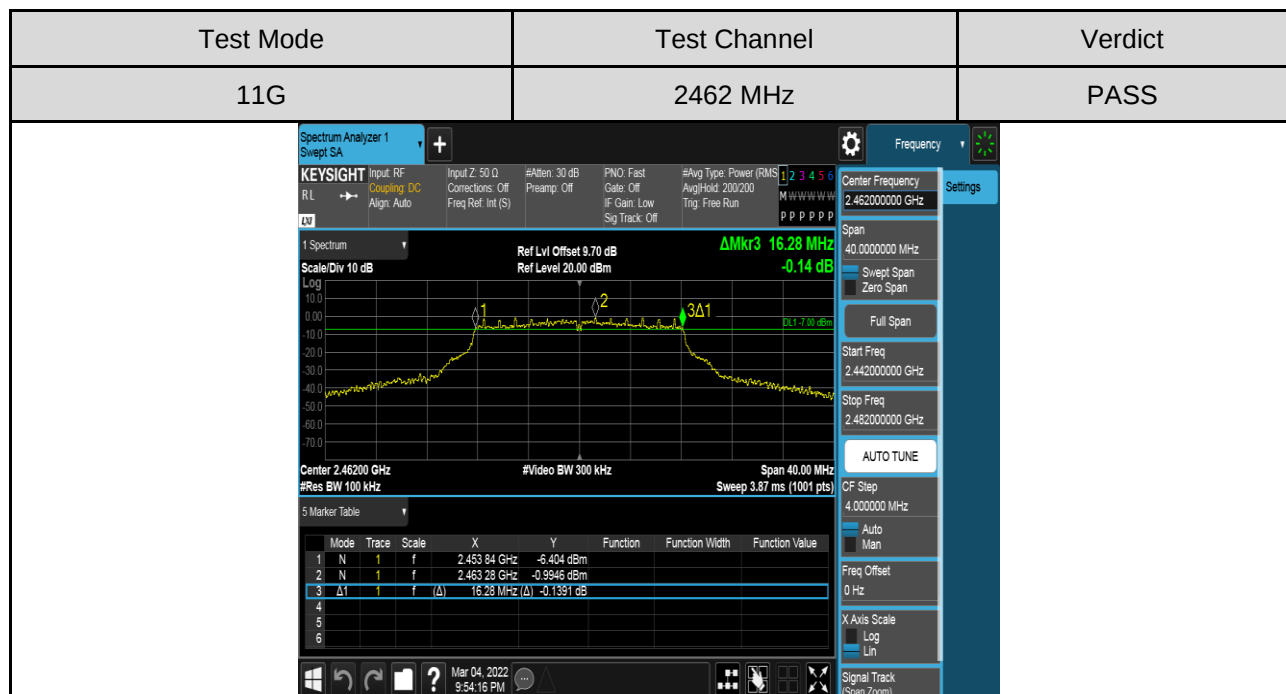
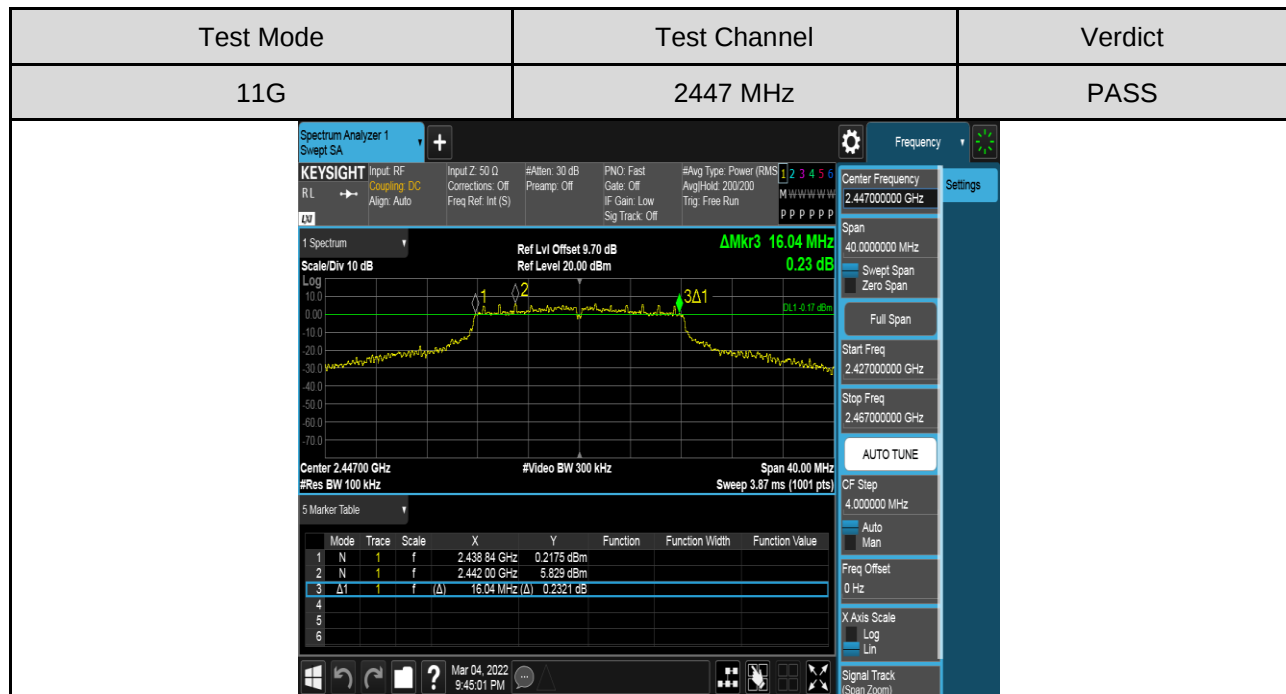
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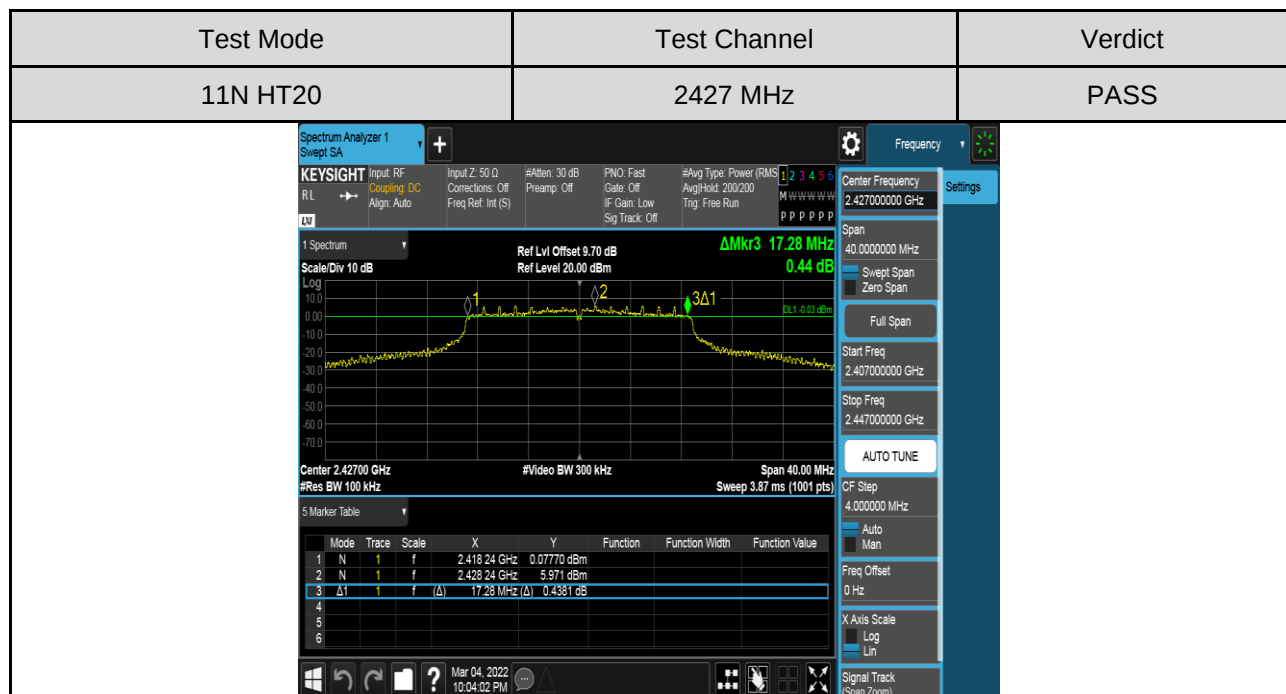
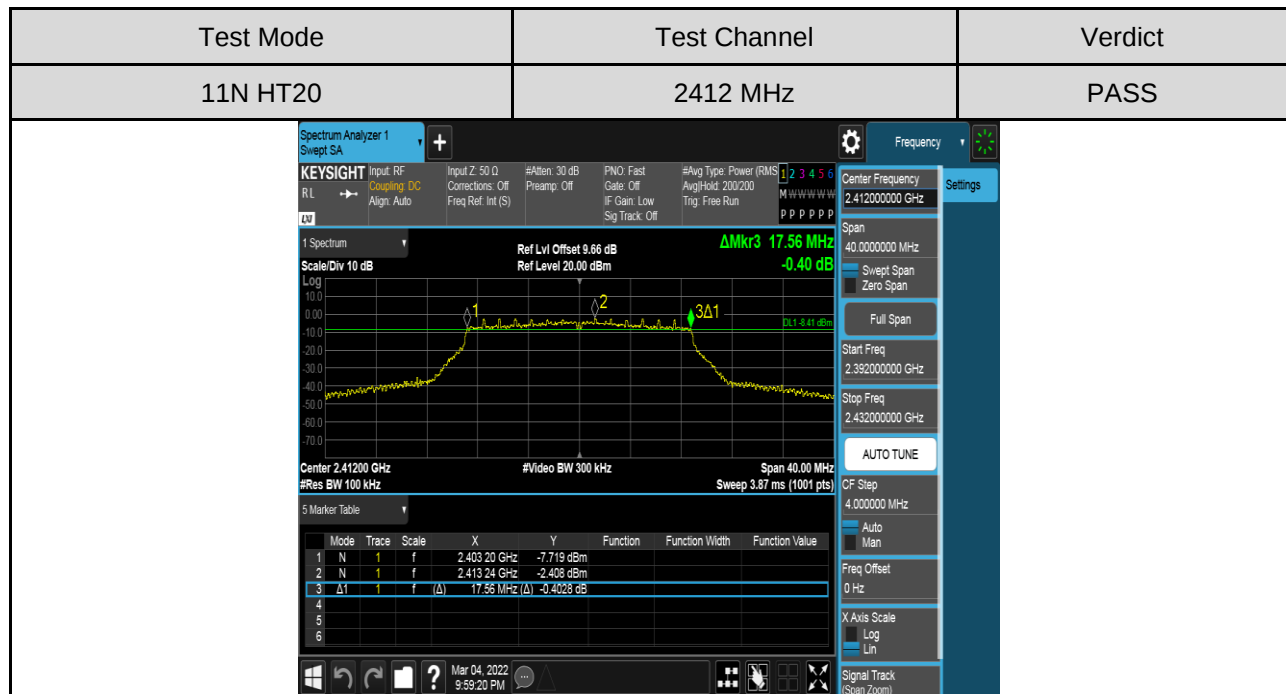


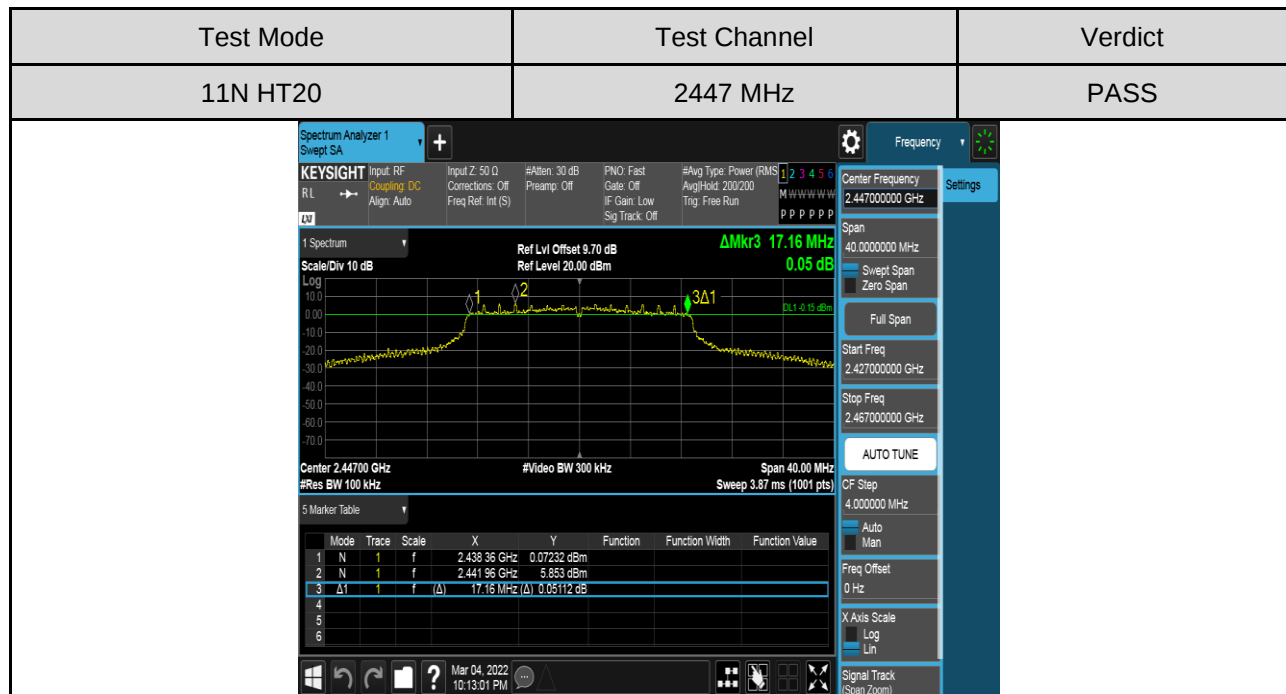
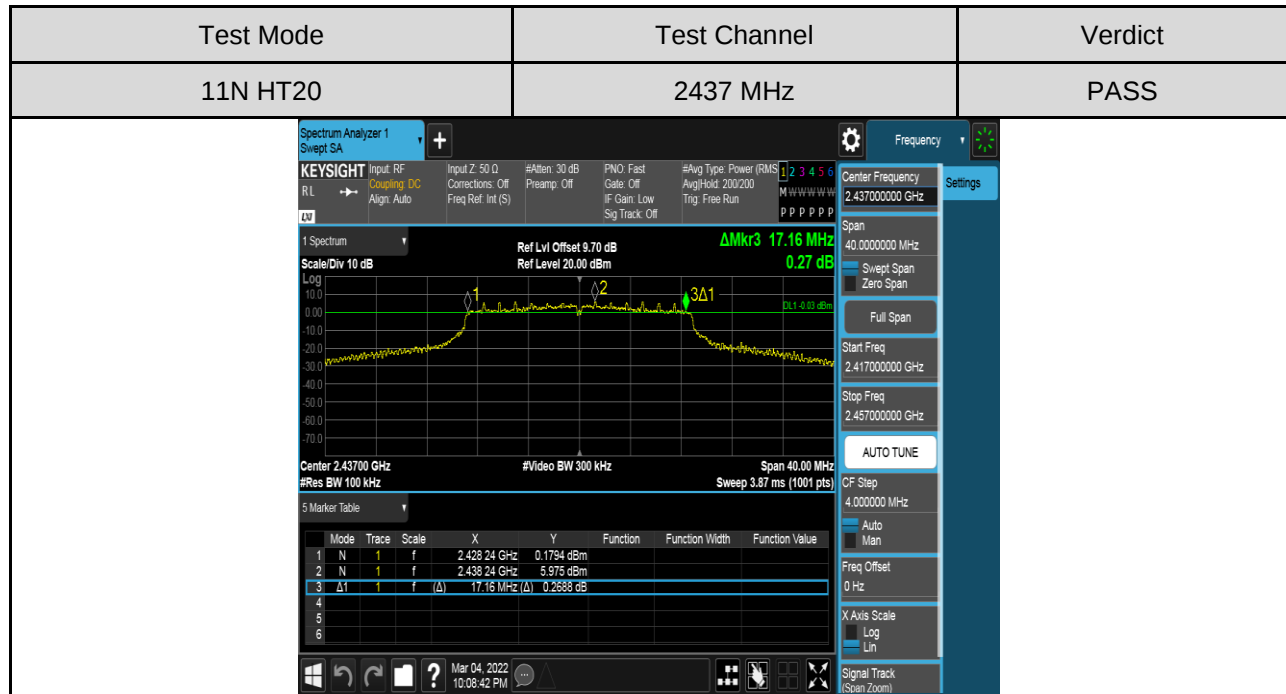


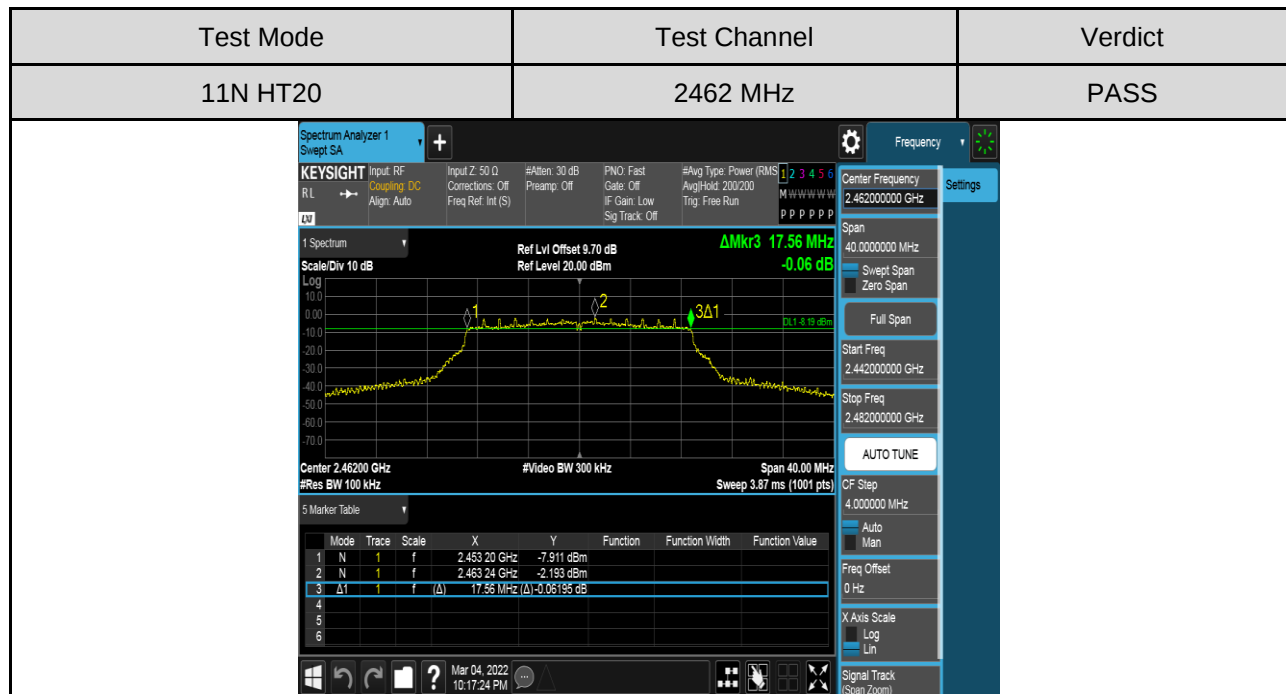




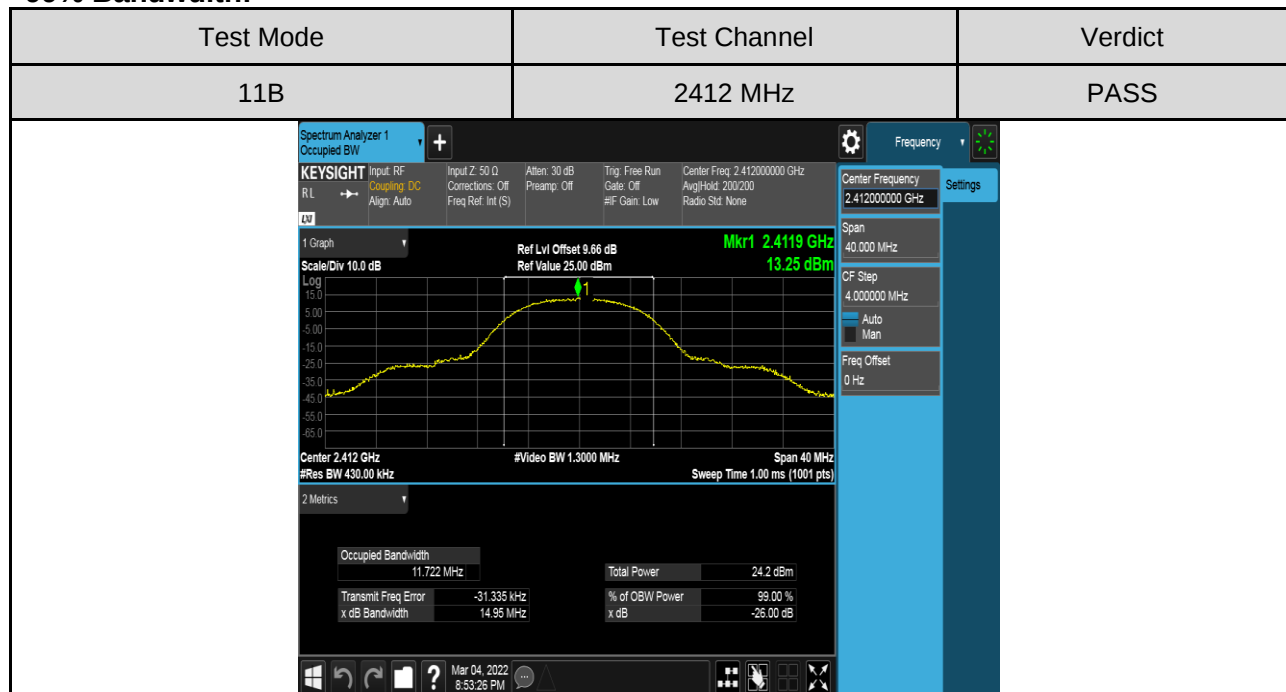


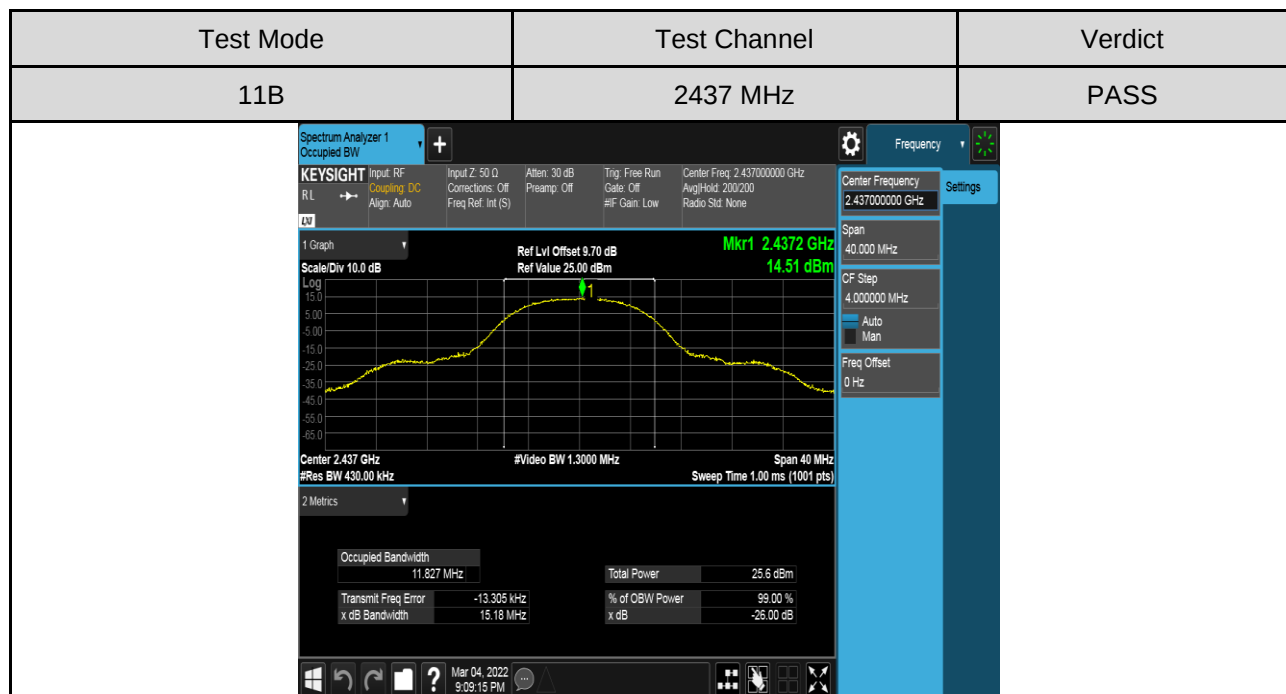
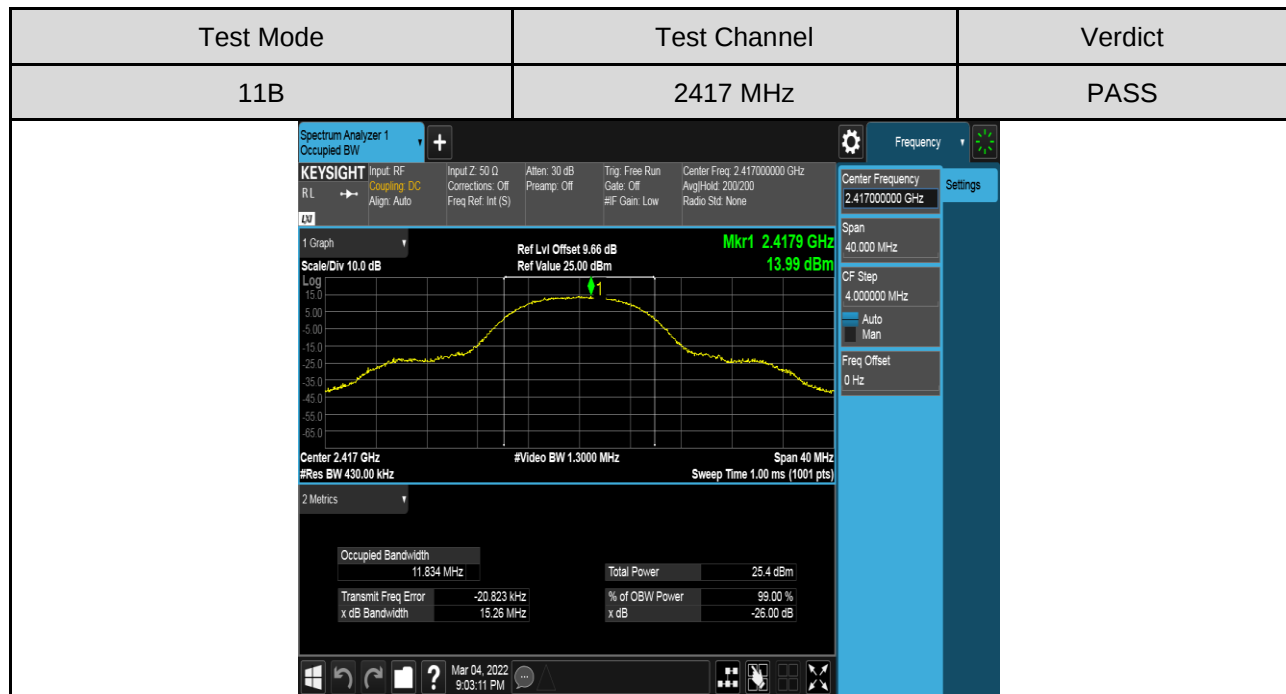


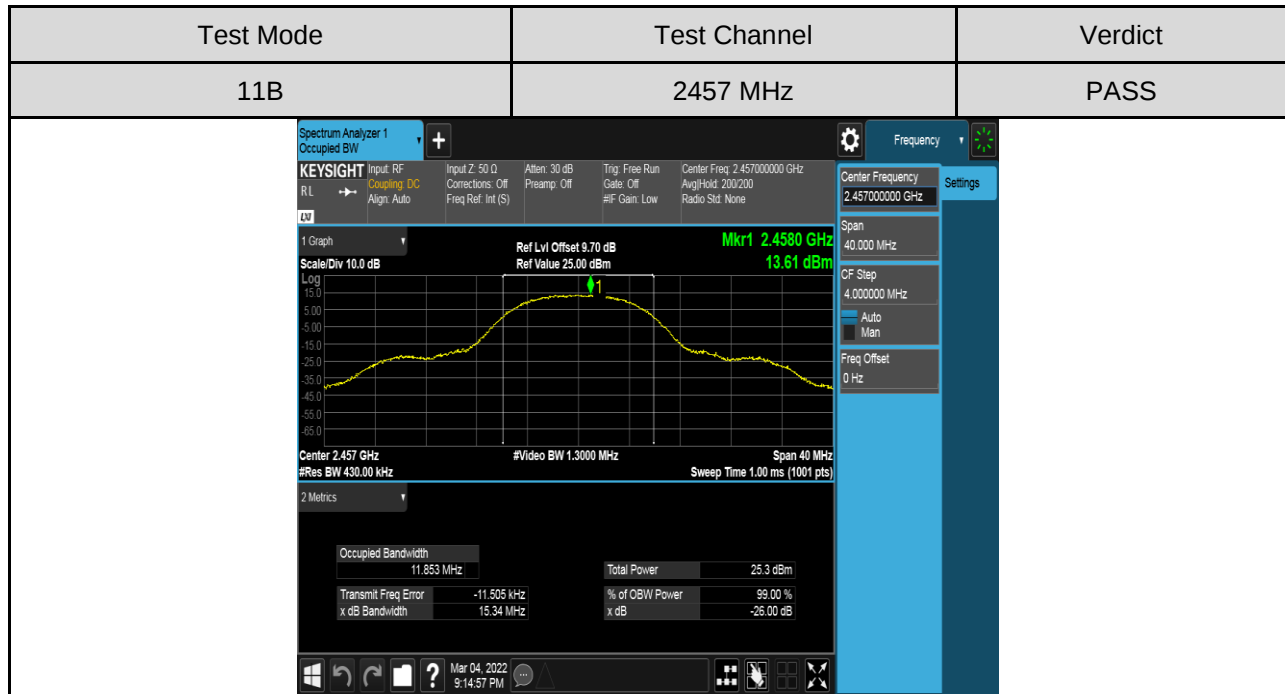


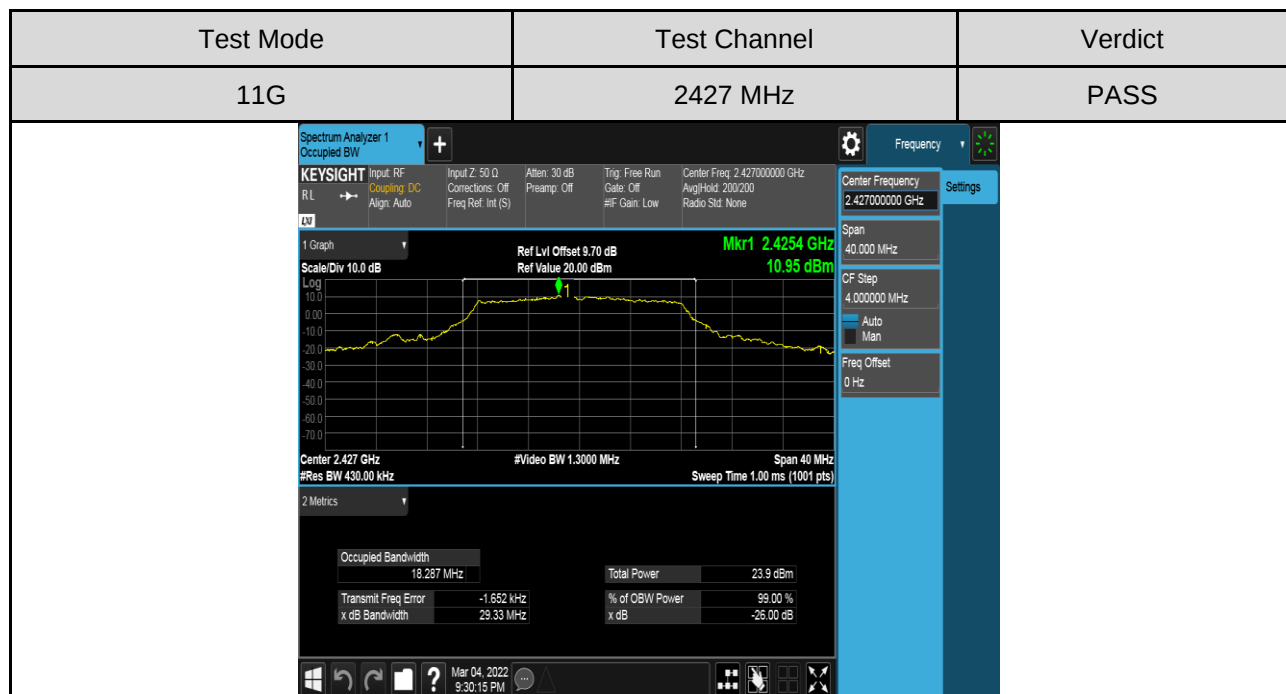
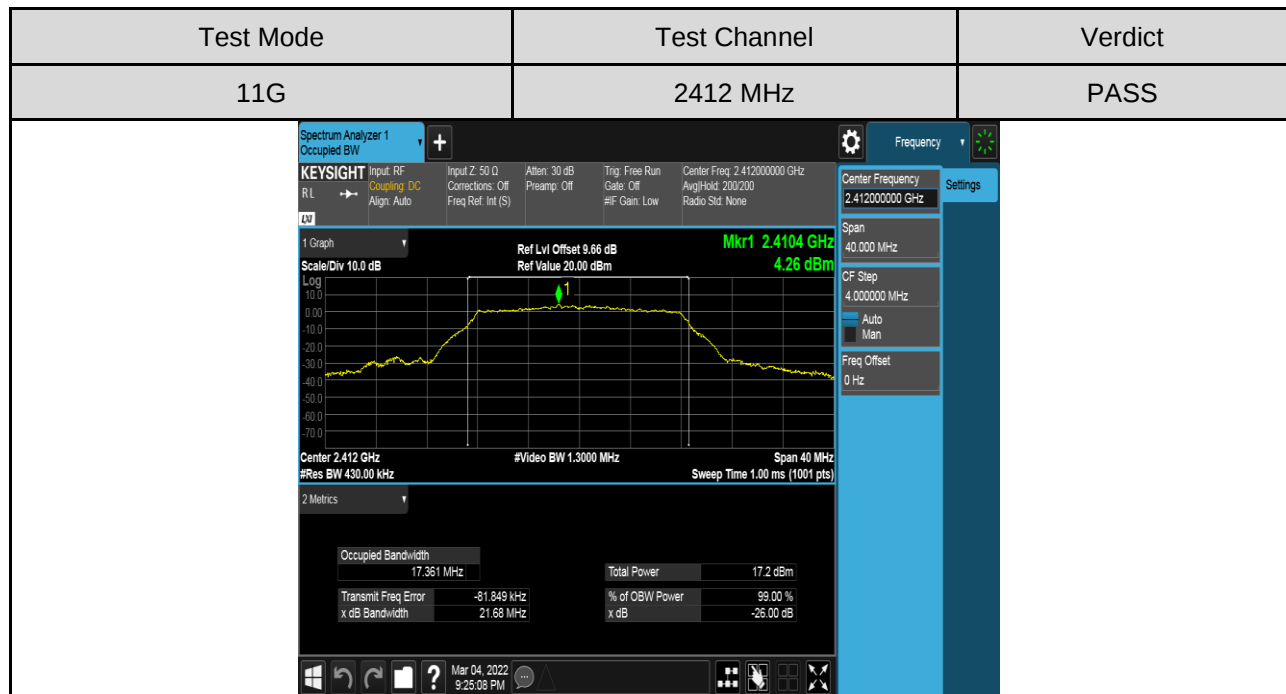


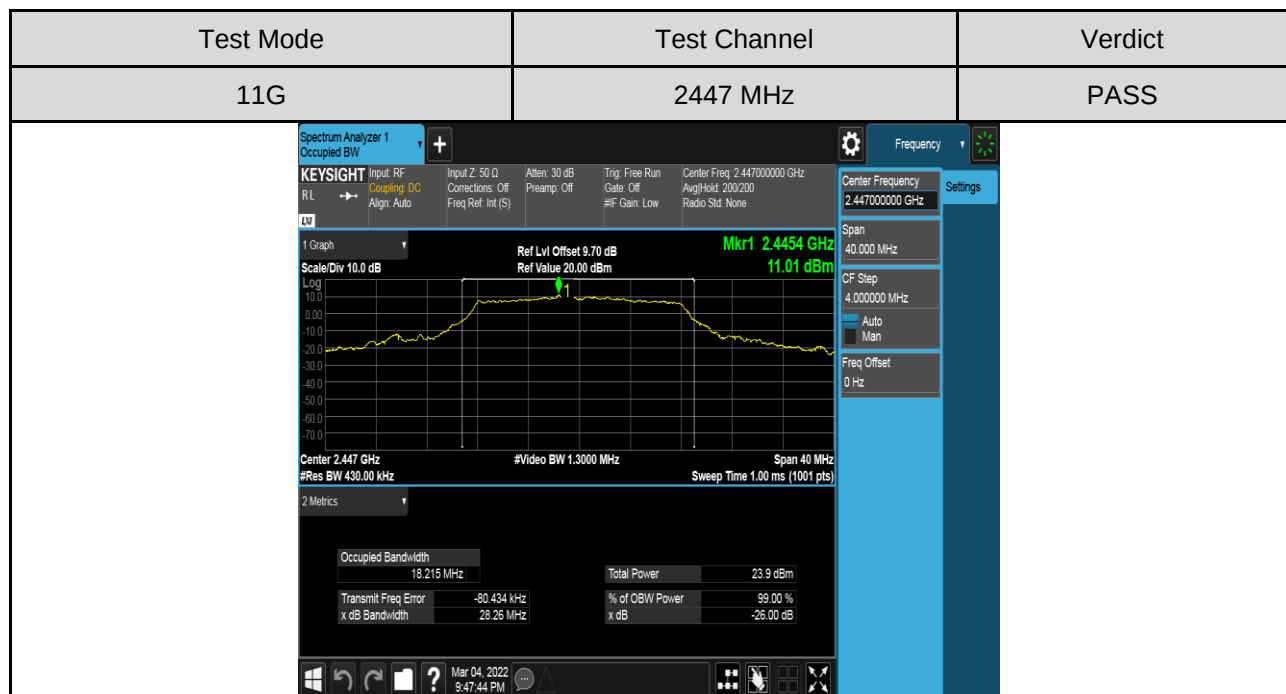
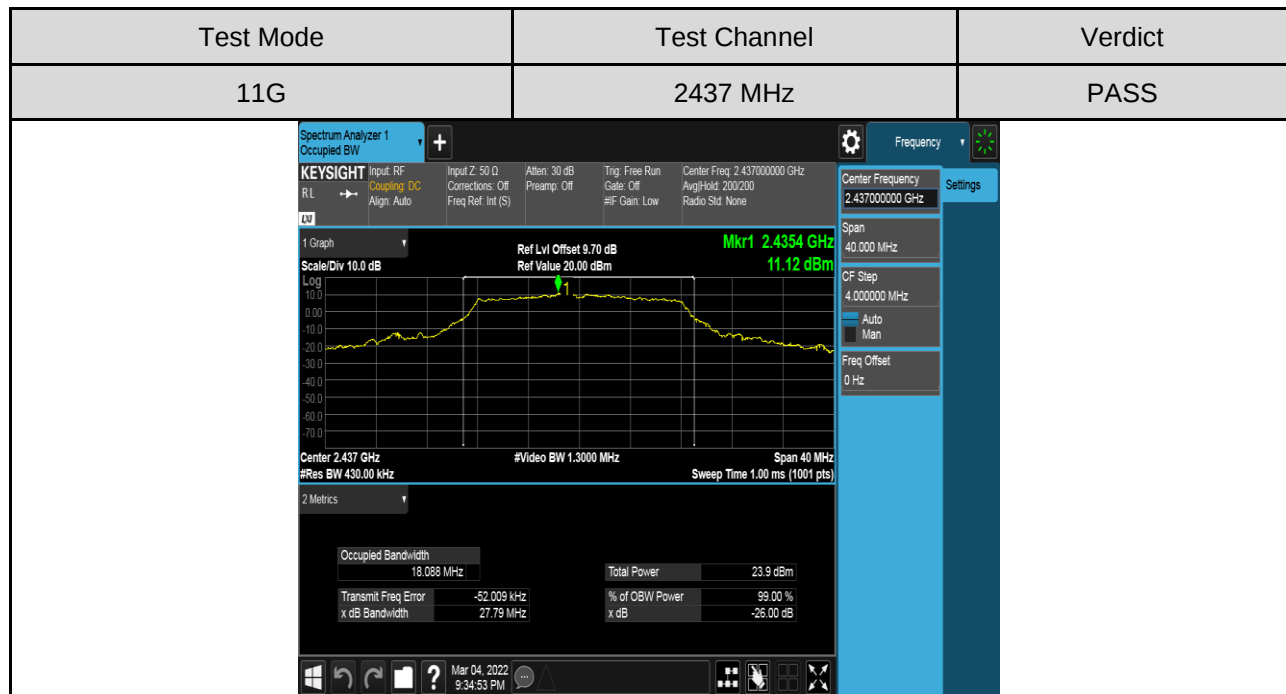
99% Bandwidth:

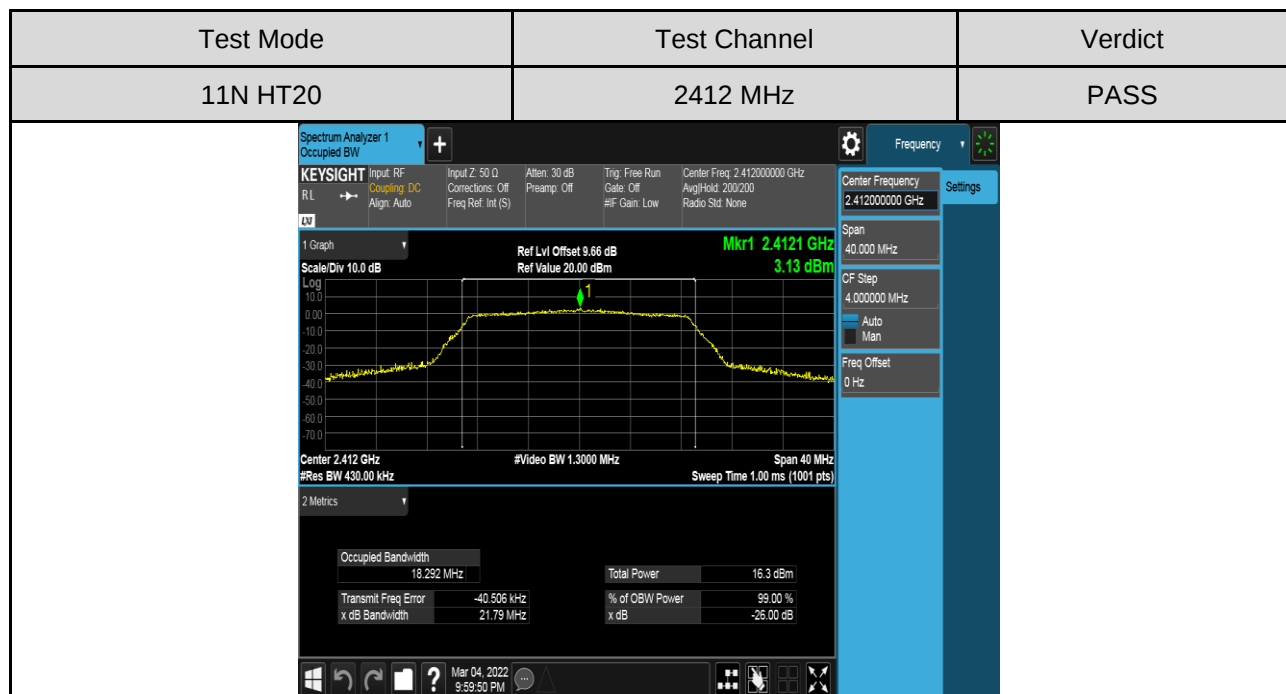
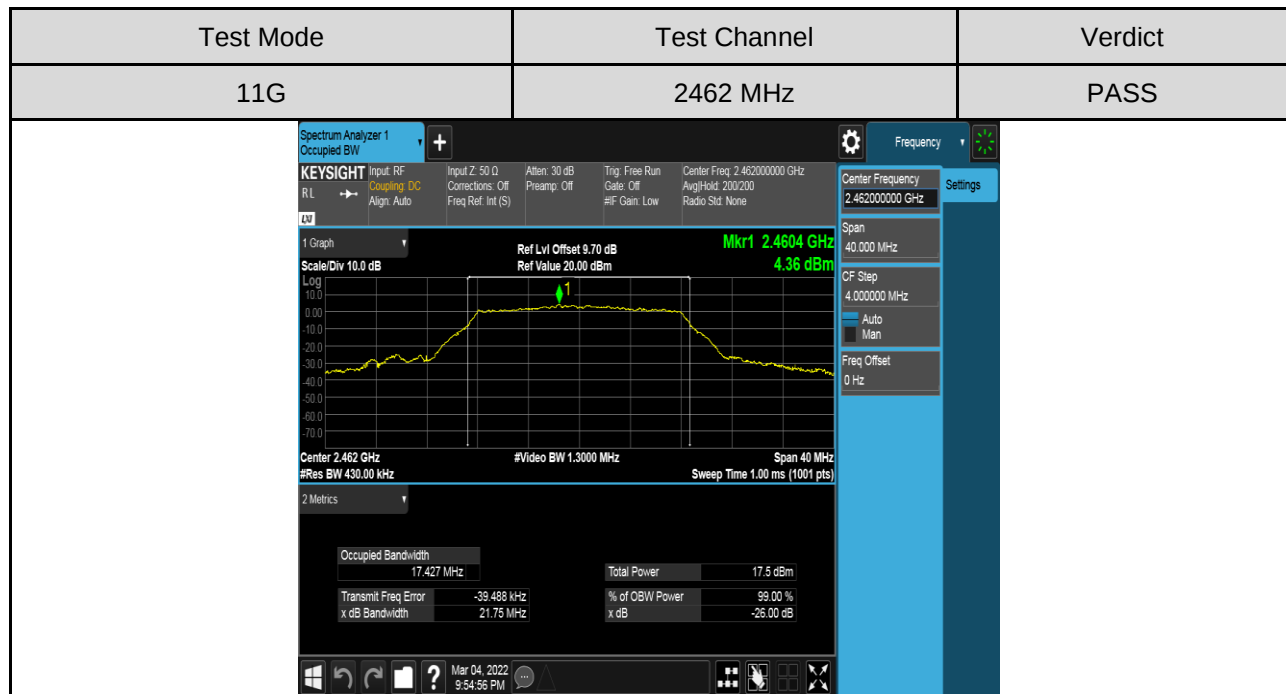


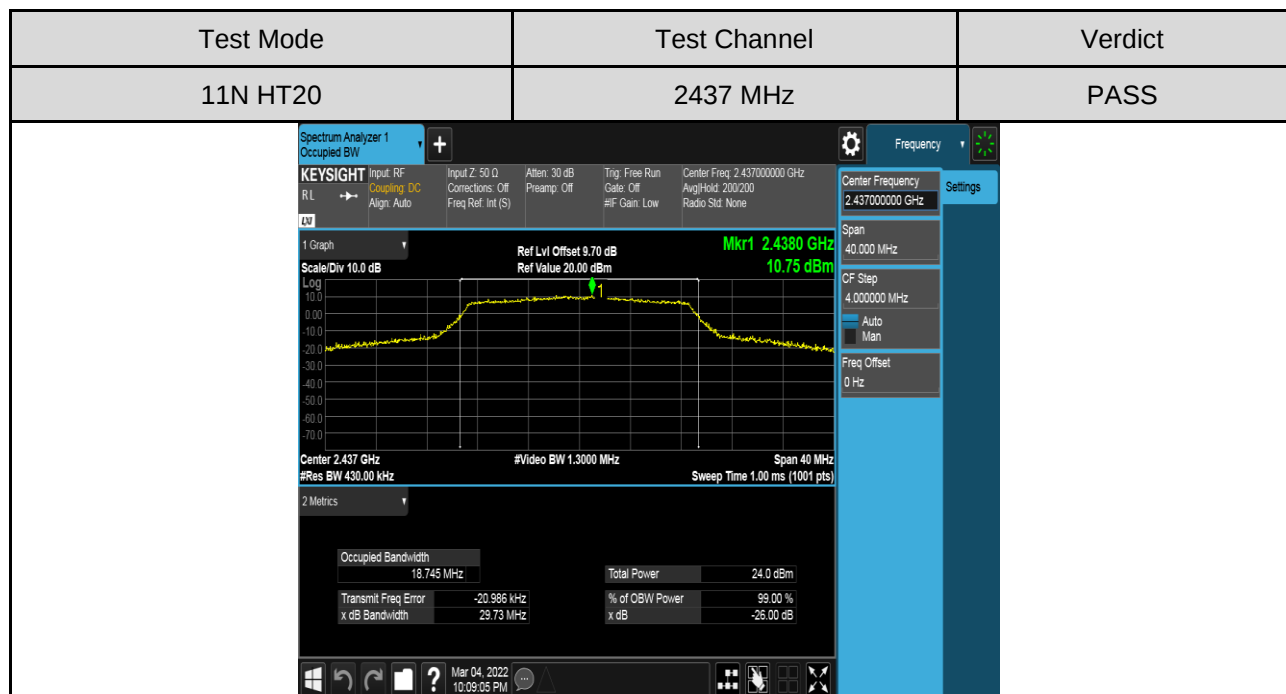
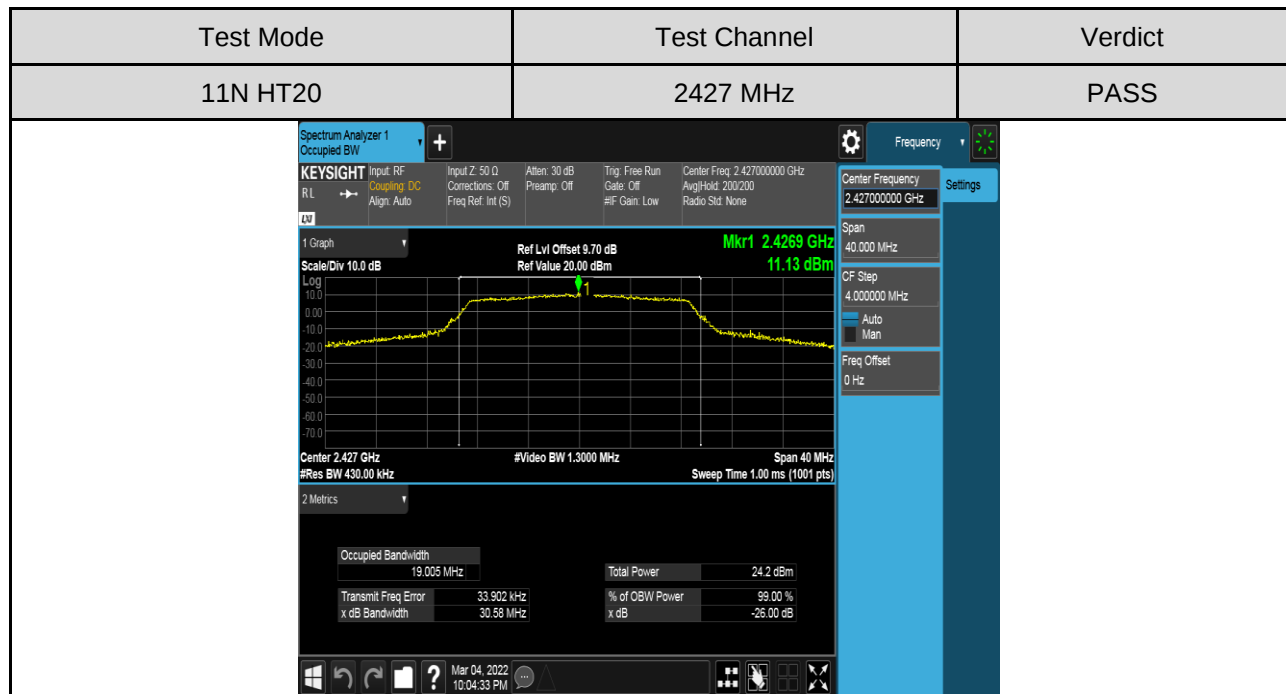


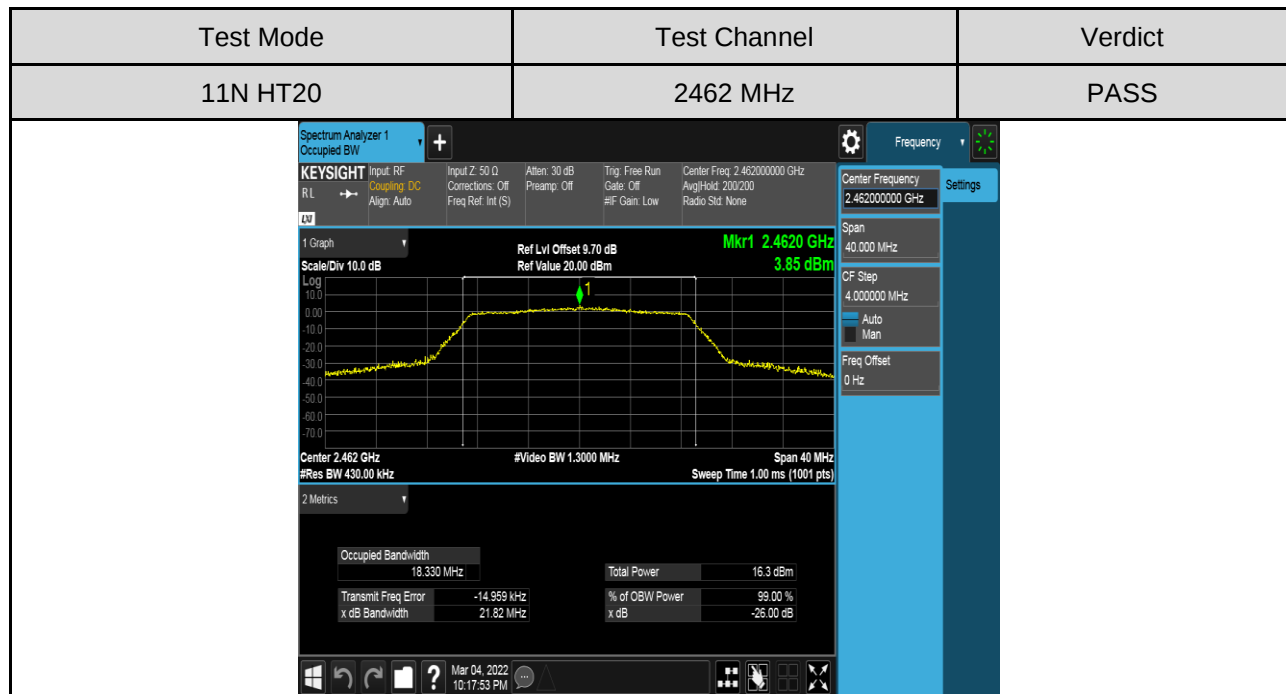
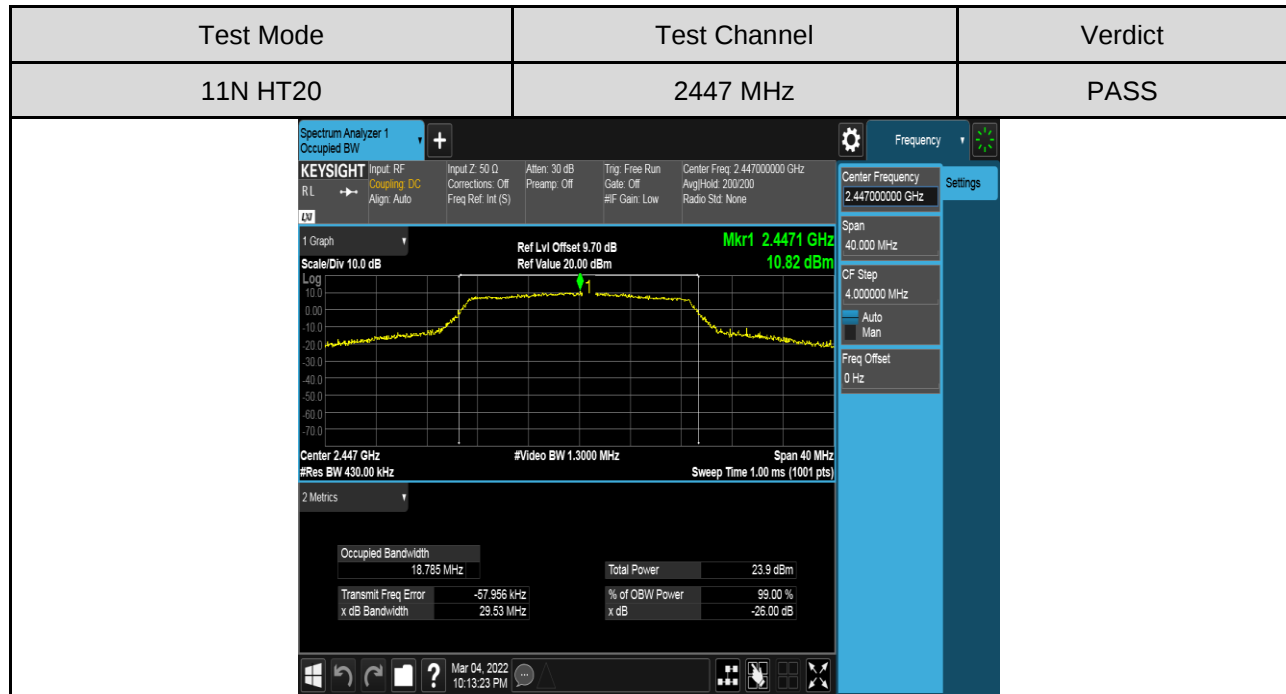














7.3. CONDUCTED OUTPUT POWER

LIMITS

FCC Part15 (15.247), Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
FCC 15.247(b)(3) ISED RSS-247 5.4 (d) RSS-Gen Clause 6.12	Output Power	1 watt or 30dBm	2400-2483.5

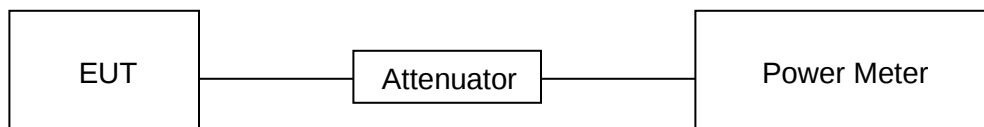
TEST PROCEDURE

Place the EUT on the table and set it in the transmitting mode.
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the Power sensor.
Measure the power of each channel.
AVG Detector used for AVG result.

TEST ENVIRONMENT

Temperature	22°C	Relative Humidity	56%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

TEST SETUP





TEST RESULTS TABLE

Test Mode	Test Channel	Measurement Output Power (AV)	10log(1/x) Factor	Maximum Conducted Output Power (AV)	LIMIT
		dBm	dBm	dBm	dBm
11B	2412	17.23	0.07	17.30	30
	2417	18.28	0.07	18.35	30
	2437	18.46	0.07	18.53	30
	2457	18.08	0.07	18.15	30
	2462	17.08	0.07	17.15	30
11G	2412	10.21	0.07	10.28	30
	2427	16.88	0.07	16.95	30
	2437	16.98	0.07	17.05	30
	2447	16.89	0.07	16.96	30
	2462	10.48	0.07	10.55	30
11N HT20	2412	9.05	0.07	9.12	30
	2427	16.93	0.07	17.00	30
	2437	16.97	0.07	17.04	30
	2447	16.79	0.07	16.86	30
	2462	9.11	0.07	9.18	30



7.4. POWER SPECTRAL DENSITY

LIMITS

FCC Part15 (15.247), Subpart C			
Section	Test Item	Limit	Frequency Range (MHz)
FCC §15.247 (e) ISED RSS-247 5.2 (b)	Power Spectral Density	8 dBm/3 kHz	2400-2483.5

TEST PROCEDURE

Refer to FCC KDB 558074, connect the UUT to the spectrum analyser and use the following settings:

Center Frequency	The centre frequency of the channel under test
Detector	Peak
RBW	$3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
VBW	$\geq 3 \times \text{RBW}$
Span	$1.5 \times \text{DTS bandwidth}$
Trace	Max hold
Sweep time	Auto couple.

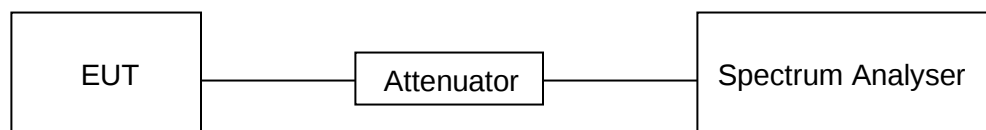
Allow trace to fully stabilize and use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

TEST ENVIRONMENT

Temperature	22°C	Relative Humidity	56%
Atmosphere Pressure	101kPa	Test Voltage	DC 3.3V

TEST SETUP





TEST RESULTS TABLE

Test Mode	Test Channel	Maximum Peak power spectral density (dBm/30kHz)	Result
11B	2412	4.40	Pass
	2417	6.02	Pass
	2437	6.70	Pass
	2457	6.28	Pass
	2462	4.53	Pass
11G	2412	-5.44	Pass
	2427	1.18	Pass
	2437	1.46	Pass
	2447	1.20	Pass
	2462	-5.29	Pass
11N HT20	2412	-5.67	Pass
	2427	2.51	Pass
	2437	1.88	Pass
	2447	2.27	Pass
	2462	-5.64	Pass



TEST GRAPHS

