

TEST REPORT

Report Number: 15312218-E1V2

Applicant : Sonos, Inc.
301 Coromar Dr
Goleta, CA 93117 USA

Model : S19

Brand : SONOS

FCC ID : SBVRM019

IC : 5373A-RM019

EUT Description : 802.11 a/b/g/n(HT20) Master Device with BLE and NFC

Test Standard(s) : FCC 47 CFR PART 15 SUBPART E (EXCEPT DFS)
ISED RSS-247 ISSUE 3
ISED RSS-GEN ISSUE 5 + A1 + A2

Date Of Issue:
2024-08-29

Prepared by:
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REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	2024-08-16	Initial Issue	---
V2	2024-08-29	Updated Section 6.2 and 6.3	Kiya Kedida

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Sonos, Inc.
301 Coromar Dr
Goleta, CA 93117 USA

EUT DESCRIPTION: 802.11 a/b/g/n(HT20) Master device with BLE and NFC

MODEL: S19

BRAND: SONOS

SERIAL NUMBER: Radiated: 000E58710D8F0
Conducted: 000E58B7F67CC

SAMPLE RECEIPT DATE: 2024-07-10

DATE TESTED: 2024-07-11 to 2024-07-17

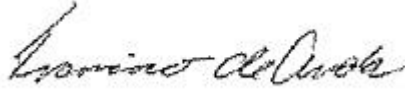
APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC 47 CFR Part 15 Subpart E	Complies
ISED RSS-247 Issue 3	Complies
ISED RSS-GEN Issue 5 + A1 + A2	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document.

Approved & Released For
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2. TEST RESULT SUMMARY

This report contains data provided by the customer which can impact the validity of results. UL Verification Services Inc. is only responsible for the validity of results after the integration of the data provided by the customer.

FCC Clause	ISED Clause	Requirement	Result	Comment
See Comment		Duty Cycle	Reporting purposes only	Per ANSI C63.10, Section 12.2.
See Comment	RSS-GEN 6.7	26dB BW/99% OBW	Reporting purposes only	Per ANSI C63.10 Sections 6.9.2 and 6.9.3
15.407 (e)	RSS-247 6.2.4.1	6 dB BW	Complies	None.
15.407 (a) (1-3), (h) (1)	RSS-247 6.2	Output Power	Complies	None.
15.407 (a) (1-3)	RSS-247 6.2	PSD	Complies	None.
15.209, 15.205, 15.407 (b) (1-4)	RSS-GEN 8.9, 8.10, RSS-247 6.2	Radiated Emissions	Complies	None.
15.207	RSS-Gen 8.8	AC Mains Conducted Emissions	Complies	None.

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with;

- FCC CFR 47 Part 2
- FCC CFR 47 Part 15,
- FCC KDB 662911 D01,
- FCC KDB 905462 D02 /D03 /D06
- FCC KDB 789033 D02,
- FCC KDB 414788 D01 Radiated Test Site
- ANSI C63.10-2013,
- RSS-GEN Issue 5 + A1+A2
- RSS-247 Issue 3

4. FACILITIES AND ACCREDITATION

UL Verification Services Inc. is accredited by A2LA, Certificate Number 0751.05, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
<input checked="" type="checkbox"/>	Building 1: 47173 Benicia Street, Fremont, CA 94538, USA	US0104	2324A	550739
<input type="checkbox"/>	Building 2: 47266 Benicia Street, Fremont, CA 94538, USA			
<input type="checkbox"/>	Building 3: 843 Auburn Court, Fremont, CA 94538, USA			
<input checked="" type="checkbox"/>	Building 4: 47658 Kato Rd, Fremont, CA 94538, USA			
<input type="checkbox"/>	Building 5: 47670 Kato Rd, Fremont, CA 94538, USA			

5. DECISION RULES AND MEASUREMENT UNCERTAINTY

5.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

5.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

5.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	U _{Lab}
Radio Frequency (Spectrum Analyzer)	141.16 Hz
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	1.22%
Power Spectral Density	2.47 dB
RF Power Measurement Direct Method Using Power Meter	1.3 dB (PK) / 0.45 dB (AV)
Unwanted Emissions, Conducted	1.94dB
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.78 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.40 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.87 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	6.01 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.73 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.51 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.29 dB
Time Domain Measurements	3.39%
Temperature	0.57
Humidity	3.39%
DC Supply Voltages	0.57%

Uncertainty figures are valid to a confidence level of 95%.

5.4. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

$$36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$$

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.

$$36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} = 46.6 \text{ dBuV}$$

6. EQUIPMENT UNDER TEST

6.1. EUT DESCRIPTION

The EUT is a 802.11 a/b/g/n(HT20) Master device with BLE and NFC (Client device testing).

6.2. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

This is a request for the class II permissive change for FCC ID: SBVRM019 and IC Certification No: 5373A-RM019 to address the following proposed changes to the firmware for this device:

Client functionality for WiFi 5GHz (UNII-1:5180-5240MHZ, UNII-2A:5260-5320MHZ, UNII-2C:5500-5700MHZ, UNII-3:5745-5825MHZ) 802.11a and 802.11n20 modulations are enabled to Model S19 backhaul radio through only software change. Additional details are provided in the modified theory of operations and radio block diagram exhibits for this application.

The purpose of this change is to add the client functionality of the WiFi 5Ghz to S19 which already has the master functionality at 5GHz. It is relatively minor in scope and only adds backhaul connection capability at 5GHz and does not impact 2.4GHz. No impact on BLE certification.

6.3. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

5.2-5.8 GHz BAND (FCC)

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.2 GHz band, 4TX			
5180-5240	802.11a	17.01	50.23
5180-5240	802.11n HT20 CDD	16.69	46.67

5.3 GHz band, 4TX			
5260-5320	802.11a	17.62	57.81
5260-5320	802.11n HT20 CDD	18.07	64.12

5.6 GHz band, 4TX			
5500-5700	802.11a	18.33	68.08
5500-5700	802.11n HT20 CDD	19.10	81.28

5.8 GHz band, 4TX			
5745-5825	802.11a	24.12	258.23
5745-5825	802.11n HT20 CDD	24.21	263.63

5.2 GHz BAND (IC)

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5.2 GHz band, 4TX			
5180-5240	802.11a	15.07	32.14
5180-5240	802.11n HT20 CDD	15.27	33.65

6.4. DESCRIPTION OF AVAILABLE ANTENNAS

The antenna(s) gain and type, as provided by the manufacturer' are as follows:

Frequency Range (MHz)	Type	Declared Uncorrelated Gain (dBi)	Declared correlated Gain (dBi)
5150 – 5250	PCB	1.6	5.0
5250 – 5350		1.2	4.9
5500 – 5700		1.1	5.6
5725 - 5850		-0.1	4.8

6.5. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was 73.0-39020-diag-ci-1867-hwdiags_apollo_rel-065a2cc

6.6. WORST-CASE CONFIGURATION AND MODE

Radiated emissions below 1GHz, above 18GHz, and power line conducted emissions were performed with the EUT set to transmit at the channel with the highest output power as the worst-case scenario.

Band edge and radiated emissions between 1GHz and 18GHz were performed with the EUT set to transmit at the highest power on low, middle, and high channels.

The EUT can only be set up in desktop orientation; therefore, all radiated testing was performed with the EUT in desktop orientation.

Worst-case data rates as provided by the client were:

802.11a mode: 6 Mbps
802.11n HT20mode: MCS0

6.7. DESCRIPTION OF TEST SETUP

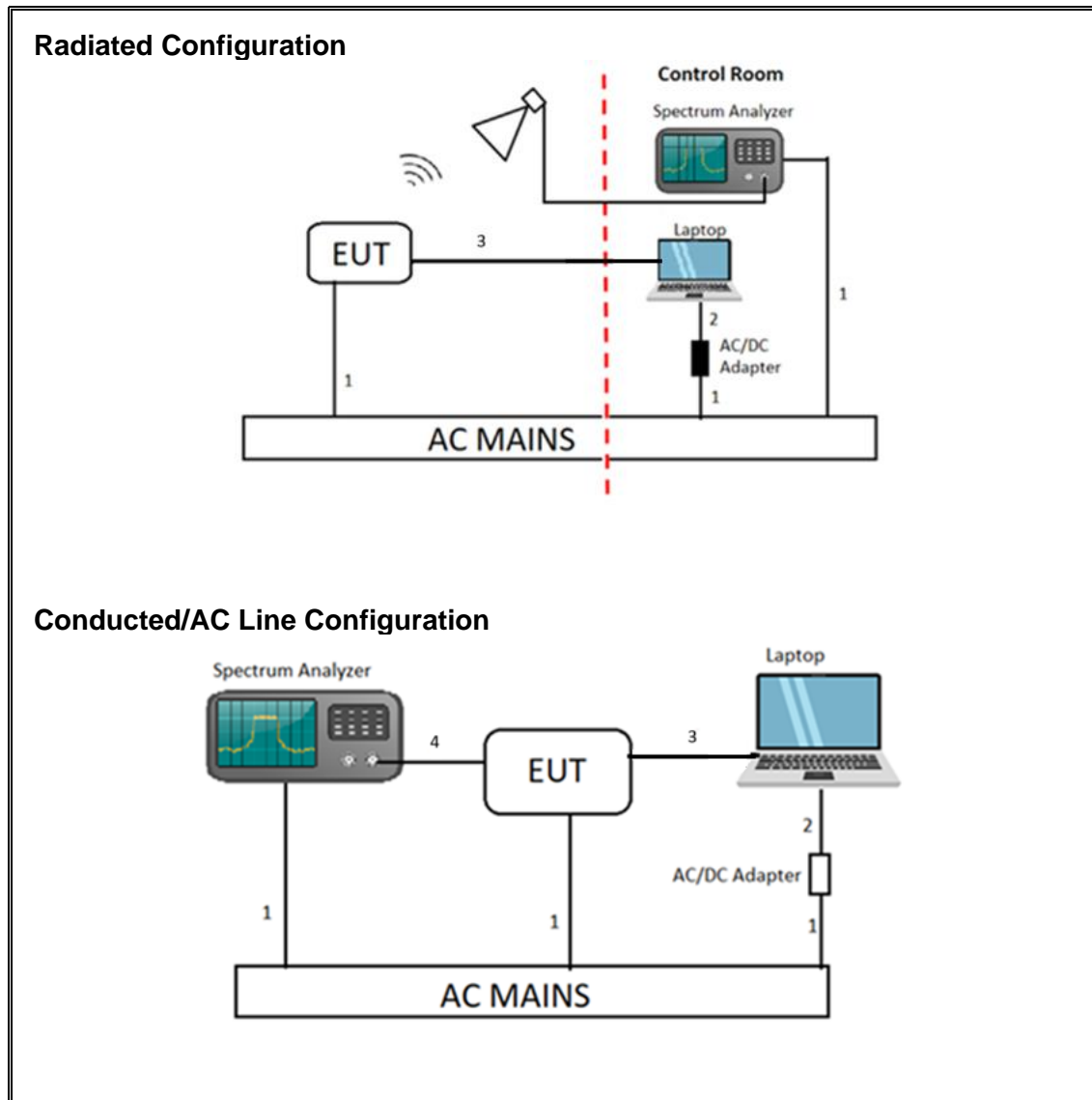
SUPPORT EQUIPMENT

SUPPORT TEST EQUIPMENT						
Description	Manufacturer	Model	Serial Number	FCC ID/ DoC		
Laptop	Lenovo	T60S	PC0JCHLL	Doc		
Laptop AC/DC AC/DC Adapter	Lenovo	ADLX90NLC2A	11S45N0247Z1ZS9B54B8EJ	Doc		
I/O CABLES (CONDUCTED TEST)						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	3	AC	Un-shielded	1.25	AC Mains to Spectrum Analyzer/AC/DC Adapter
2	DC	1	DC	Shielded	1	AC/DC Adapter to Laptop
3	Ethernet	1	RJ45	Un-shielded	1	Laptop to USB Ethernet Adapter
4	SMA Cable	1	SMA	Shielded	1.0	EUT to Spectrum Analyzer
I/O CABLES (RADIATED TEST)						
Cable No.	Port	# Of Identical Ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	3	AC	Un-shielded	1.25	AC Mains to Spectrum Analyzer/AC/DC Adapter
2	DC	1	DC	Shielded	1	AC/DC Adapter to Laptop
3	Ethernet	1	RJ45	Un-shielded	1	Laptop to USB Ethernet Adapter

TEST SETUP

The EUT is a stand-alone unit, and the radio is exercised remotely by Sonos Compliance GUI test utility software via ethernet.

SETUP DIAGRAMS



7. MEASUREMENT METHOD

On-Time and Duty Cycle: KDB 789033 D02 v02r01, Section B.

6 dB Emission BW: KDB 789033 D02 v02r01, Section C.2

26 dB Emission BW: KDB 789033 D02 v02r01, Section C.1

99% Occupied BW: KDB 789033 D02 v02r01, Section D.

Conducted Output Power: KDB 789033 D02 v02r01, Section E.3.b (Method PM-G) and Section E.2.b (Method SA-1)

Power Spectral Density: KDB 789033 D02 v02r01, Section F

Unwanted emissions in restricted bands: KDB 789033 D02 v02r01, Sections G.3, G.4, G.5, and G.6.

Unwanted emissions in non-restricted bands: KDB 789033 D02 v02r01, Sections G.3, G.4, and G.5.

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4

8. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST					
Description	Manufacturer	Model	ID Num	Cal Due	Last Cal
Antenna, Broadband Hybrid, 30MHz to 2GHz	Sunol Sciences Corp.	JB1	80293	2025-04-30	2023-04-11
Amplifier, 9KHz to 1GHz, 32dB	SONOMA INSTRUMENT	310	213877	2025-03-31	2024-03-25
Antenna, Horn 1-18GHz	ETS-Lindgren (Cedar Park, Texas)	3117	222741	2024-08-31	2022-08-31
RF Filter Box, 1-18GHz	FREMONT	n/a	171875	2025-03-31	2024-03-23
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	230547	2025-02-28	2024-02-11
Antenna, Horn 18 to 26.5GHz	ARA	MWH-1826/B	199659	2024-12-31	2022-12-06
Amplifier 18-26.5GHz, +5Vdc, 60dB min	AMPLICAL	AMP18G26.5-60	234683	2025-03-31	2024-03-31
Antenna, Horn 26 to 40GHz	AMPLICAL	AMP-26-40-60	224141	2025-01-31	2024-01-25
Amplifier 26-40 GHz,	A.R.A	MWH-2640/B	172366	2025-01-31	2023-01-27
Antenna, Passive Loop 30Hz - 1MHz	ELECTRO METRICS	EM-6871	219908	2024-09-30	2023-09-13
Antenna, Passive Loop 100KHz - 30MHz	ELECTRO METRICS	EM-6872	219910	2025-05-31	2023-05-31
Spectrum Analyzer, PXA, 3Hz to 44GHz	Keysight Technologies Inc	N9030A	85201	2025-01-31	2024-01-30
Power Meter, P-series single channel	Keysight Technologies Inc	N1911A	90718	2025-01-31	2024-01-25
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Keysight Technologies Inc	N1921A	90391	2025-06-30	2024-06-17
AC Line Conducted					
LISN	Fischer Custom Communications, Inc`	FCC-LISN-50/250-25-2-01-480V	175765	2025-01-31	2024-01-26
EMI TEST RECEIVER	Rohde & Schwarz	ESR	171646	2025-02-28	2024-02-27
Transient Limiter	TE	TBFL1	127455	2025-02-28	2024-02-27
UL TEST SOFTWARE LIST					
Radiated Software	UL	UL EMC	Ver 2023-05-01		
Antenna Port Software	UL	UL RF	Ver 2022-08-16		
AC Line Conducted Software	UL	UL EMC	Rev 9.5, 2023-03-03		

9. ANTENNA PORT TEST RESULTS

9.1. ON-TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

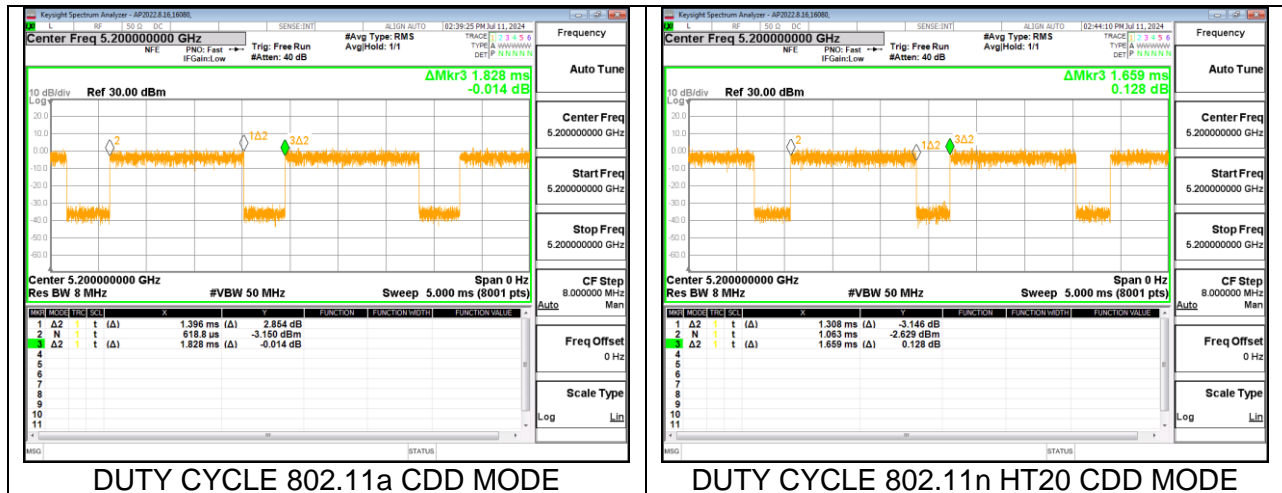
PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

ON-TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
802.11a CDD	1.396	1.828	0.764	76.37	1.17	0.716
802.11n HT20 CDD	1.308	1.659	0.788	78.84	1.03	0.765

DUTY CYCLE PLOTS



9.2. 26 dB BANDWIDTH

LIMITS

None; for reporting purposes only.

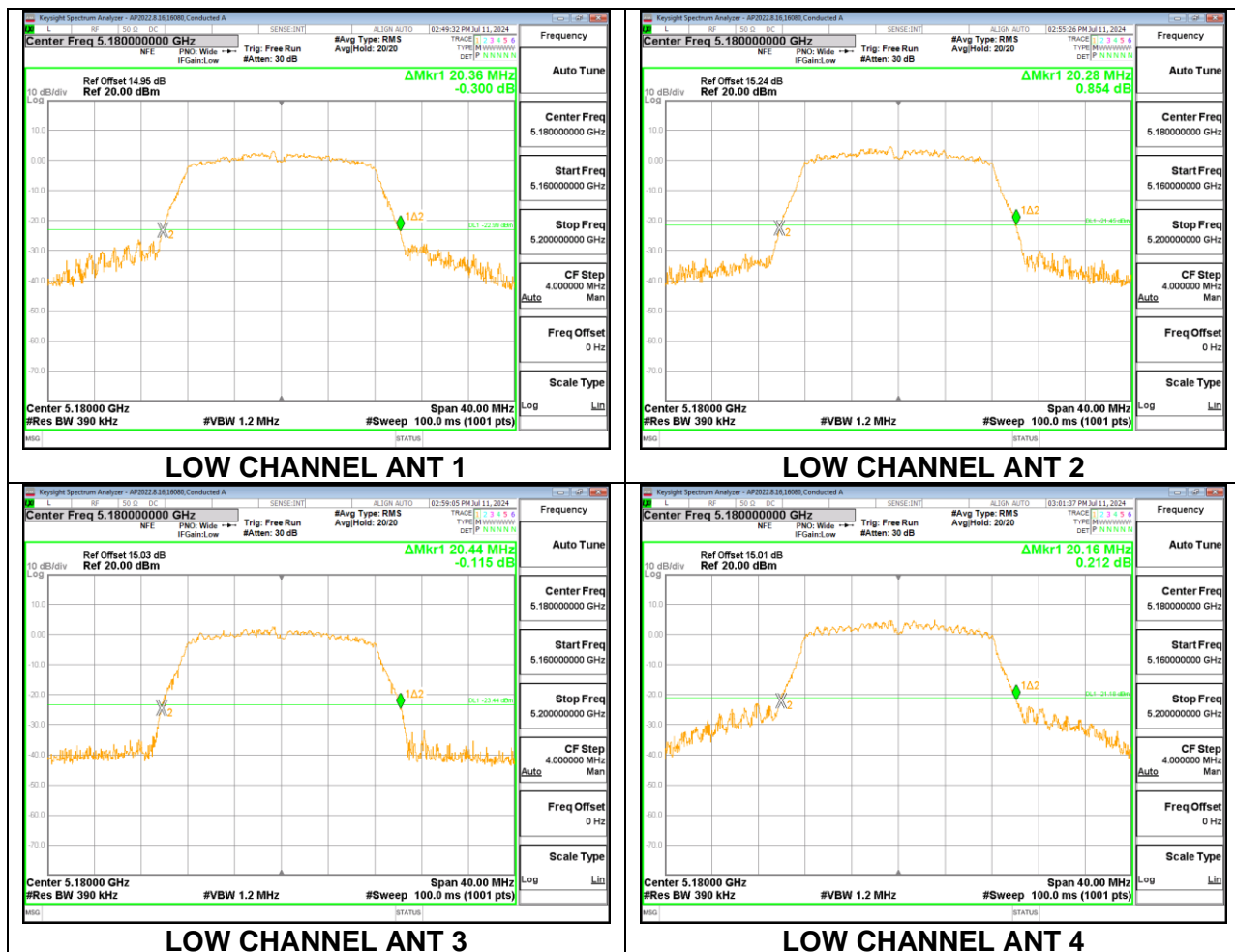
RESULTS

9.2.1. 802.11a MODE IN THE 5.2 GHz BAND

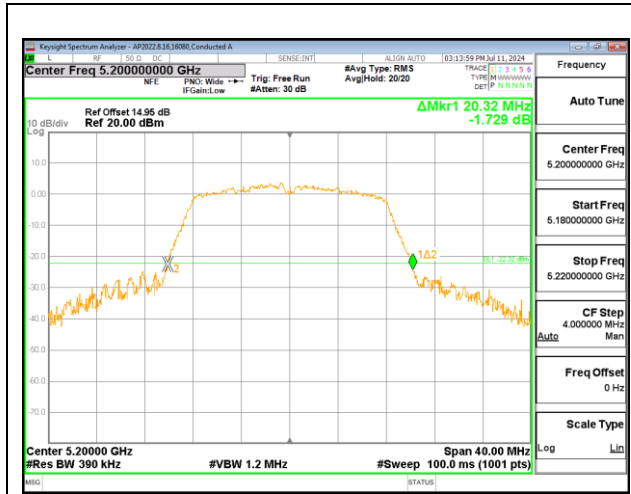
4TX Antenna 1 + Antenna 2 + Antenna 3 + Antenna 4 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 1 (MHz)	26 dB Bandwidth Antenna 2 (MHz)	26 dB Bandwidth Antenna 3 (MHz)	26 dB Bandwidth Antenna 4 (MHz)
Low	5180	20.36	20.28	20.44	20.16
Mid	5200	20.32	20.32	20.32	20.20
High	5240	20.48	20.20	20.48	20.16

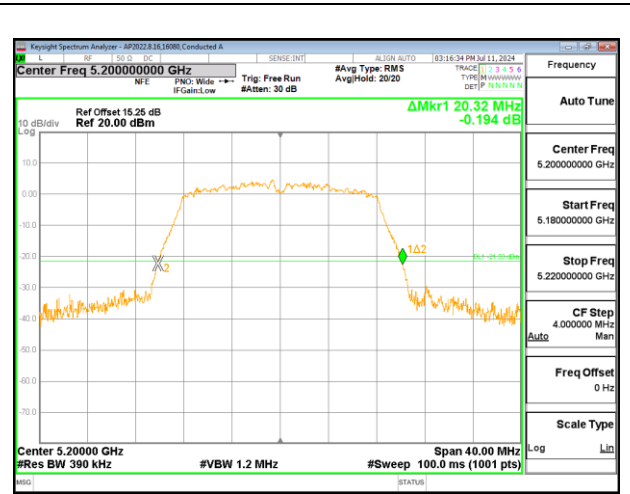
LOW CHANNEL



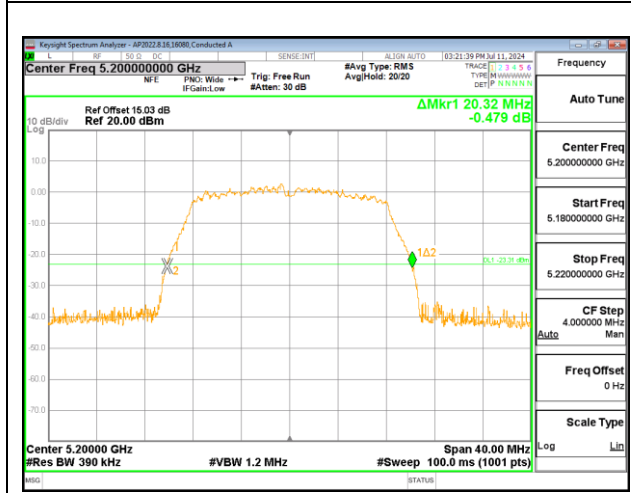
MID CHANNEL



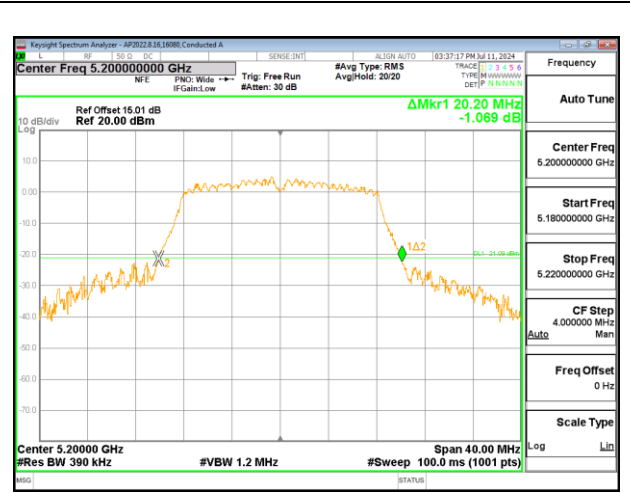
MID CHANNEL ANT 1



MID CHANNEL ANT 2

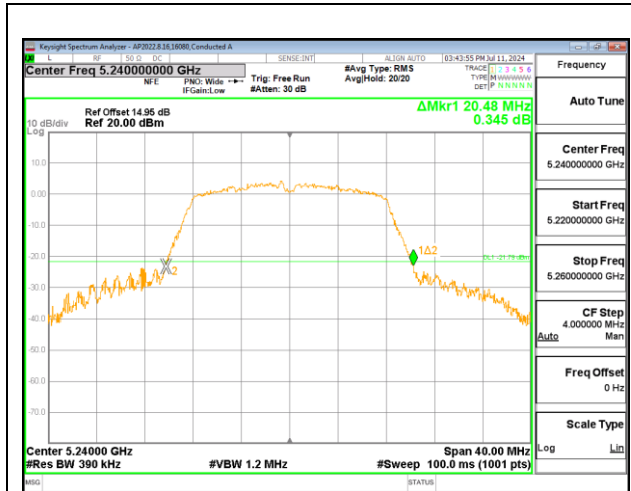


MID CHANNEL ANT 3

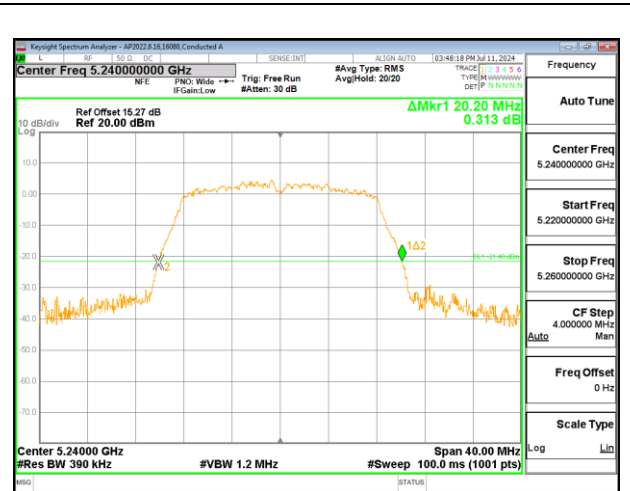


MID CHANNEL ANT 4

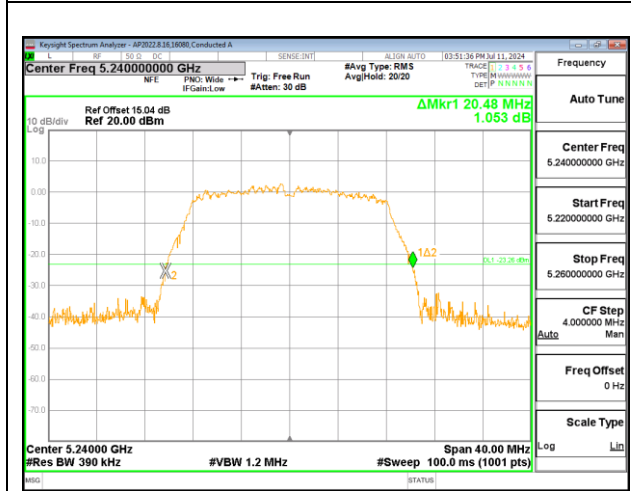
HIGH CHANNEL



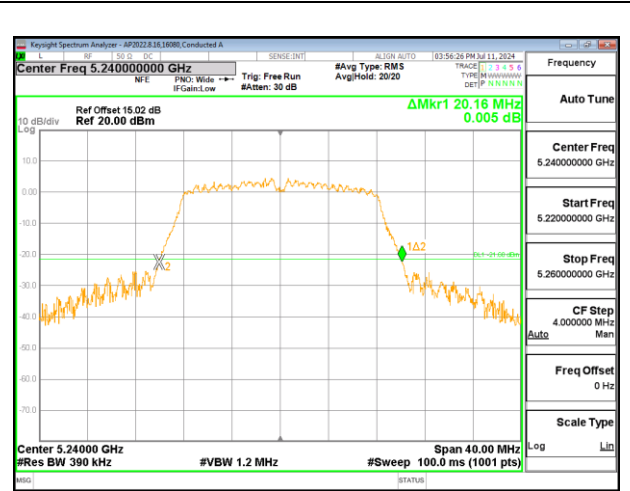
HIGH CHANNEL ANT 1



HIGH CHANNEL ANT 2



HIGH CHANNEL ANT 3



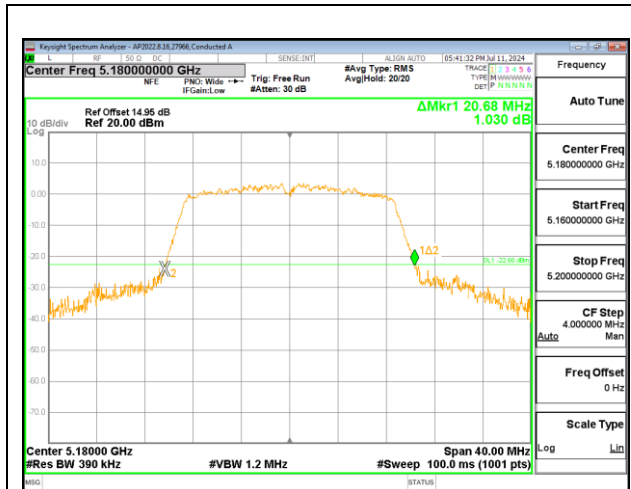
HIGH CHANNEL ANT 4

9.2.2. 802.11n HT20 MODE IN THE 5.2 GHz BAND

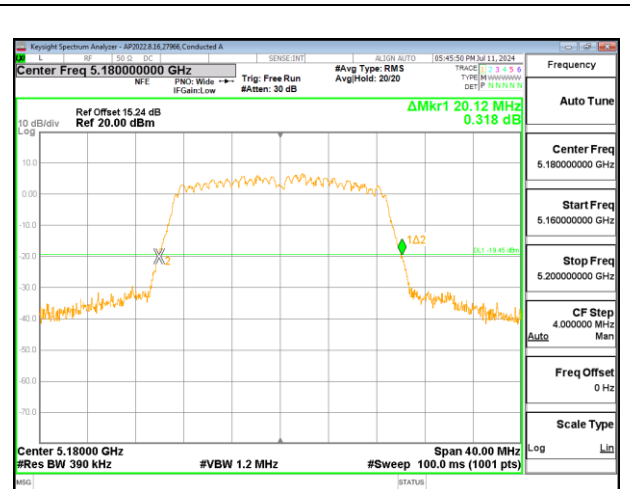
4TX Antenna 1 + Antenna 2 + Antenna 3 + Antenna 4 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 1 (MHz)	26 dB Bandwidth Antenna 2 (MHz)	26 dB Bandwidth Antenna 3 (MHz)	26 dB Bandwidth Antenna 4 (MHz)
Low	5180	20.68	20.12	20.32	20.60
Mid	5200	20.76	20.20	20.32	20.52
High	5240	20.76	20.24	20.28	20.44

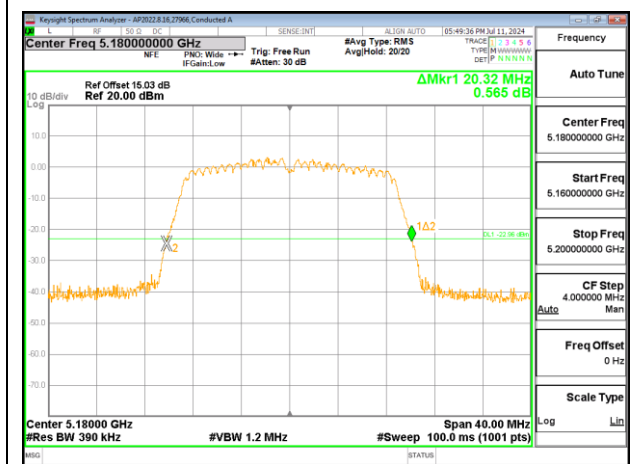
LOW CHANNEL



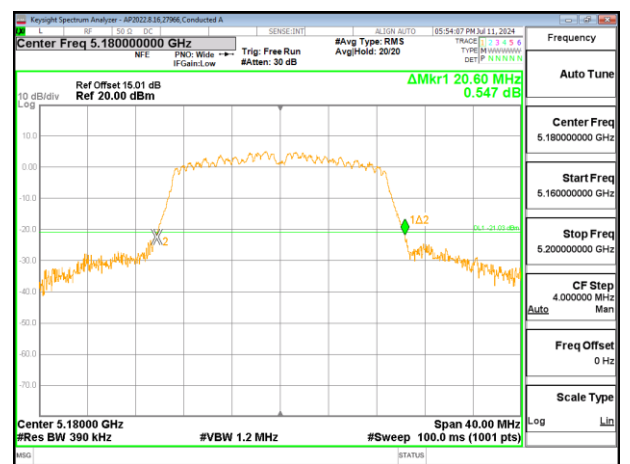
LOW CHANNEL ANT 1



LOW CHANNEL ANT 2

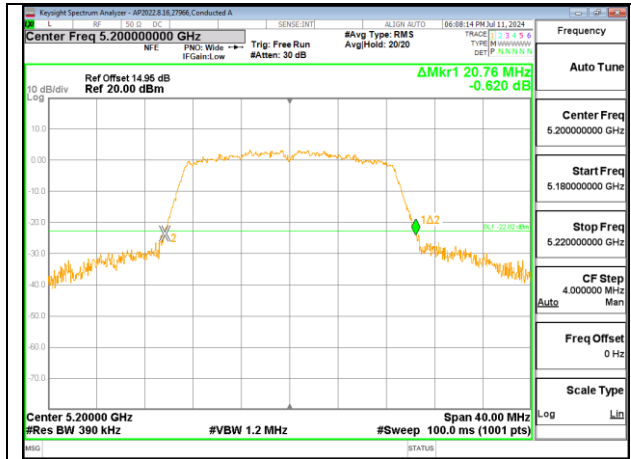


LOW CHANNEL ANT 3

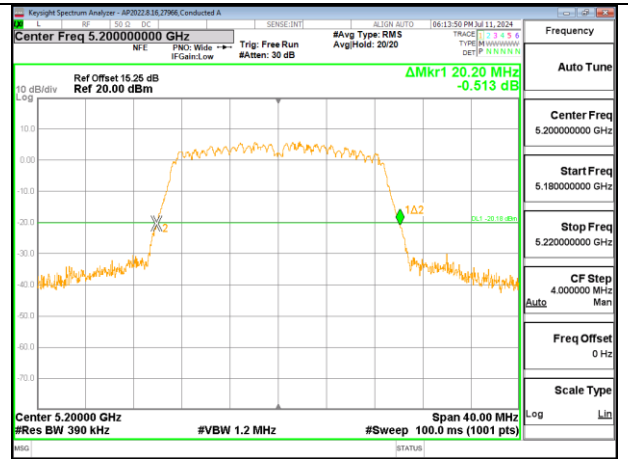


LOW CHANNEL ANT 4

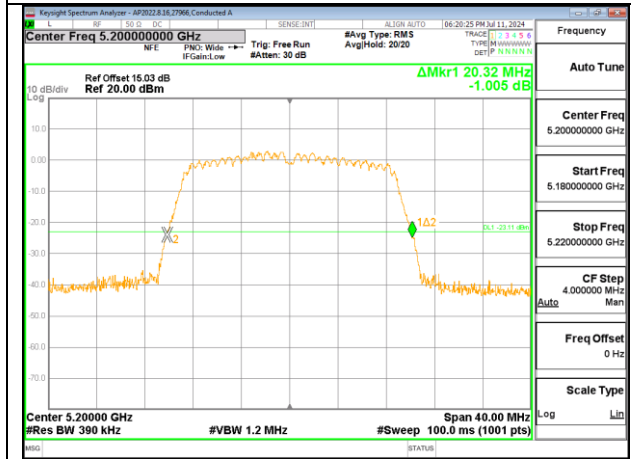
MID CHANNEL



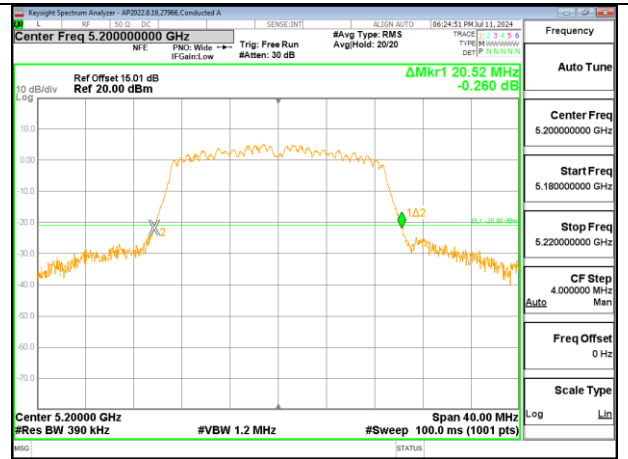
MID CHANNEL ANT 1



MID CHANNEL ANT 2

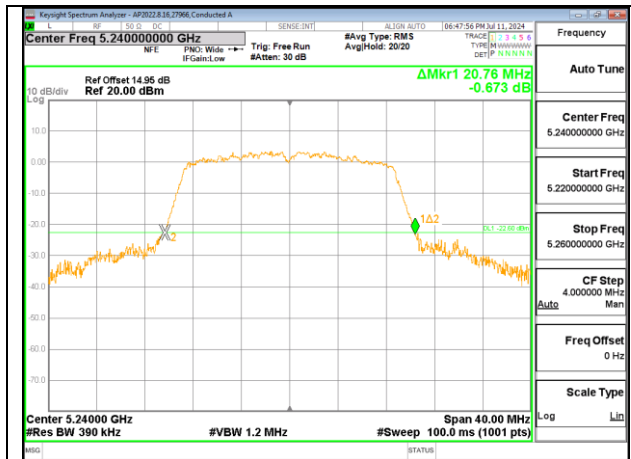


MID CHANNEL ANT 3

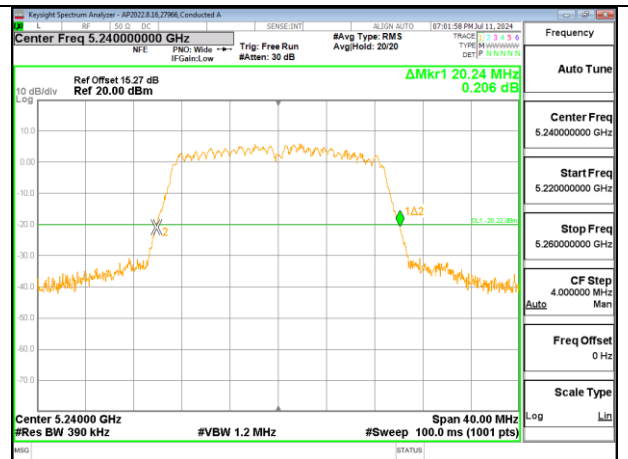


MID CHANNEL ANT 4

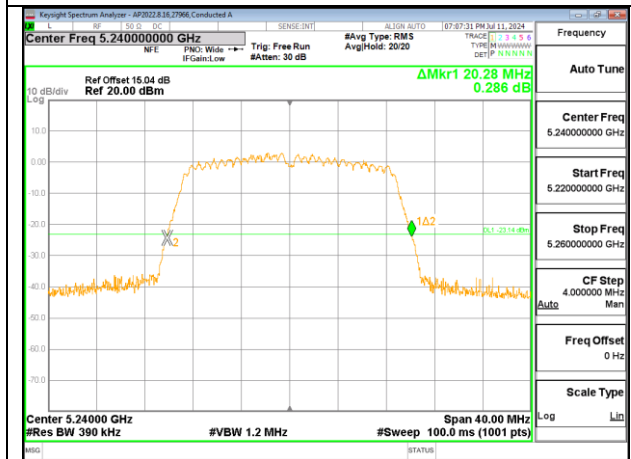
HIGH CHANNEL



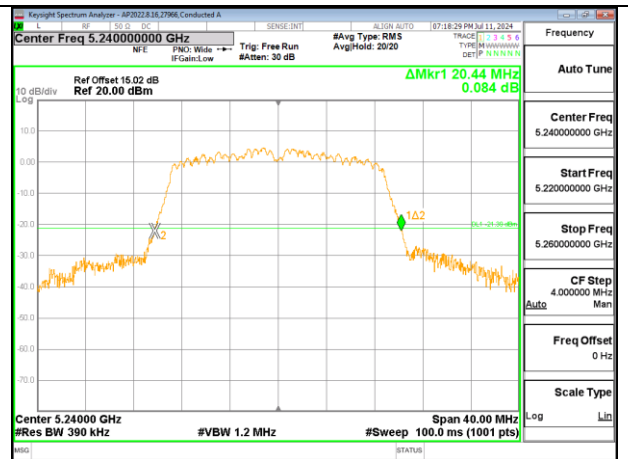
HIGH CHANNEL ANT 1



HIGH CHANNEL ANT 2



HIGH CHANNEL ANT 3



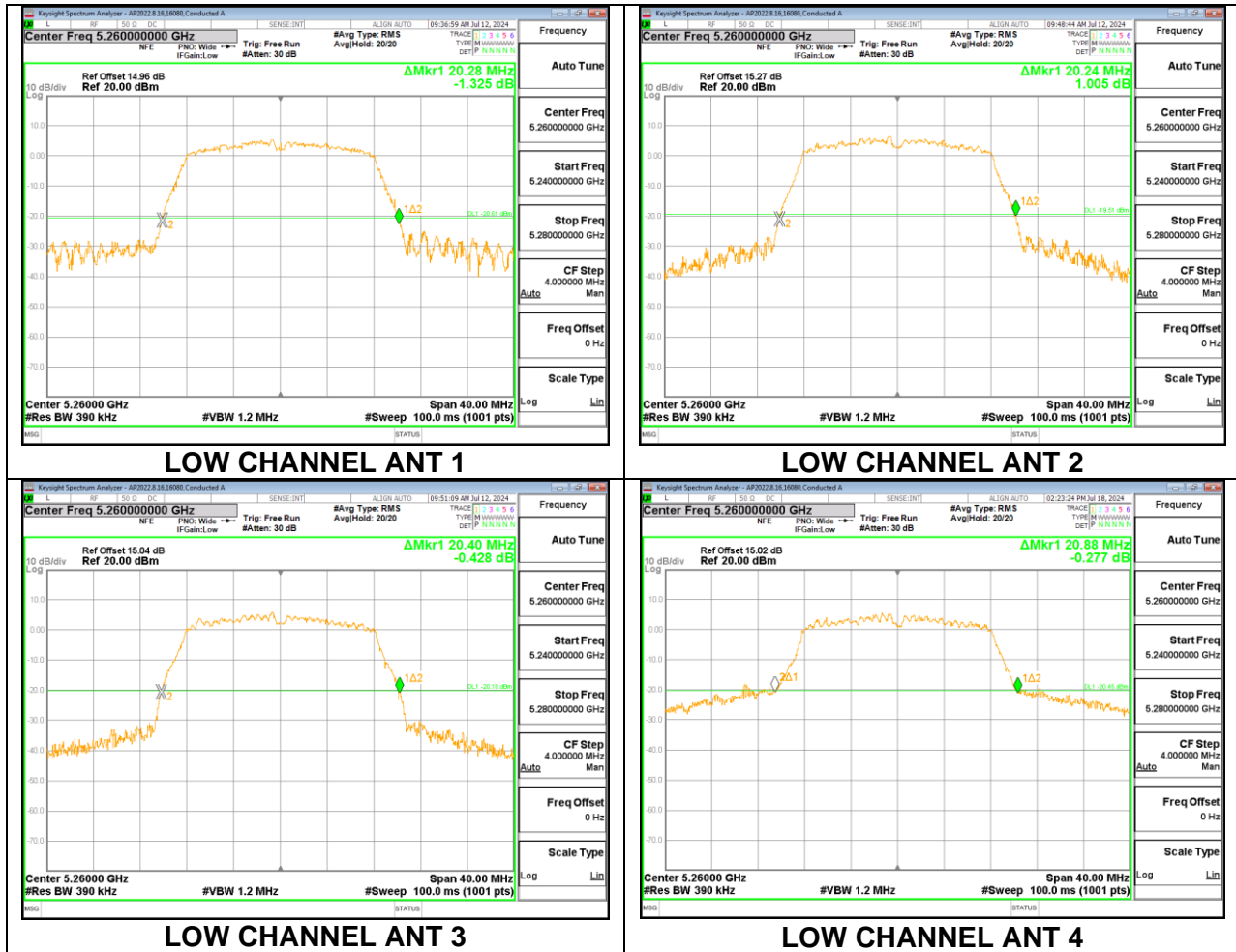
HIGH CHANNEL ANT 4

9.2.3. 802.11a MODE IN THE 5.3 GHz BAND

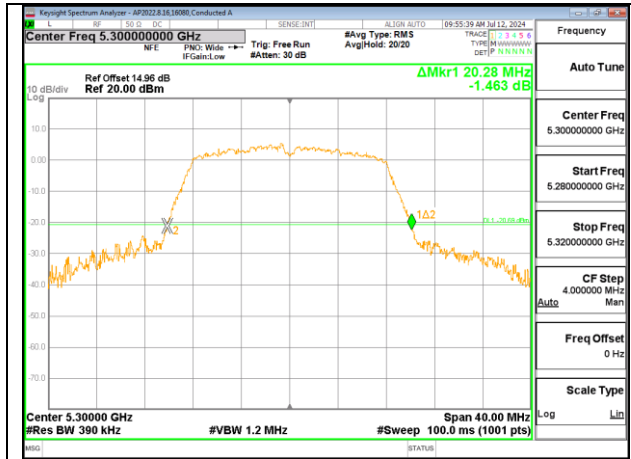
4TX Antenna 1 + Antenna 2 + Antenna 3 + Antenna 4 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 1 (MHz)	26 dB Bandwidth Antenna 2 (MHz)	26 dB Bandwidth Antenna 3 (MHz)	26 dB Bandwidth Antenna 4 (MHz)
Low	5260	20.28	20.24	20.40	20.88
Mid	5300	20.28	20.24	20.88	20.12
High	5320	20.44	20.20	20.48	20.20

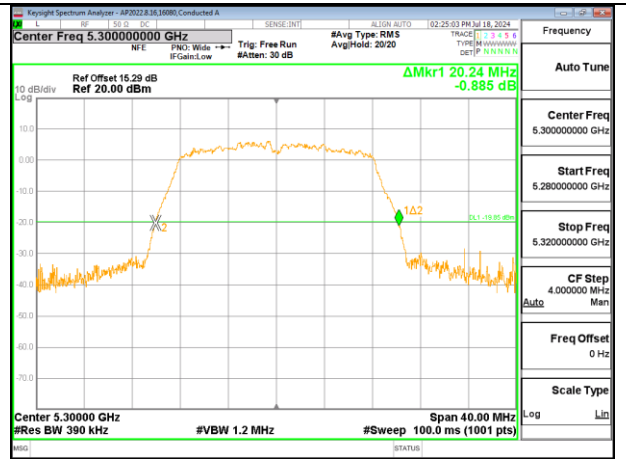
LOW CHANNEL



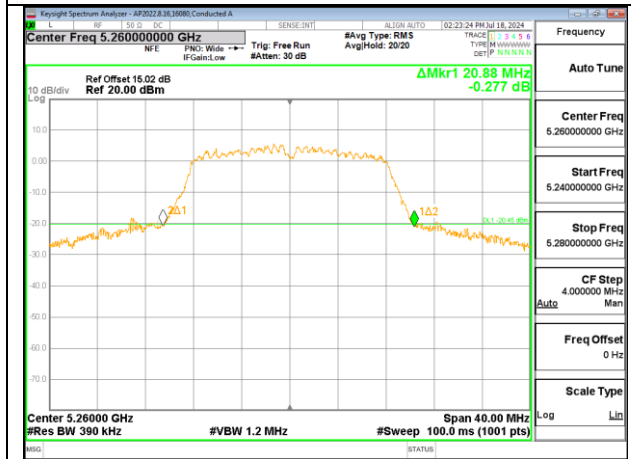
MID CHANNEL



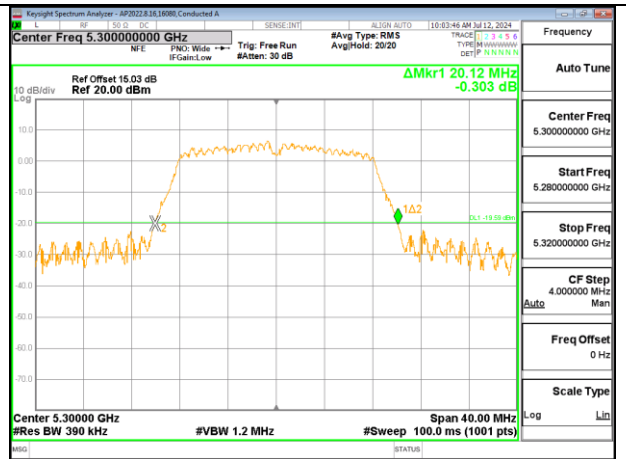
MID CHANNEL ANT 1



MID CHANNEL ANT 2

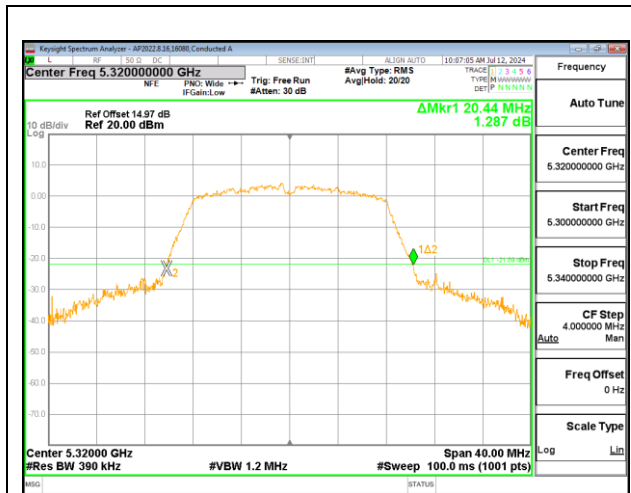


MID CHANNEL ANT 3

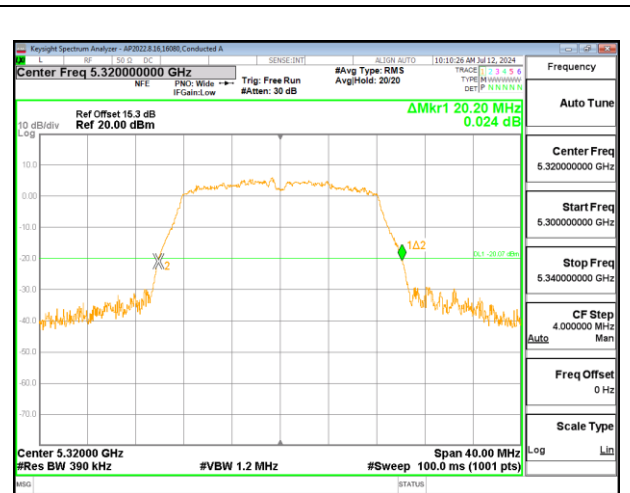


MID CHANNEL ANT 4

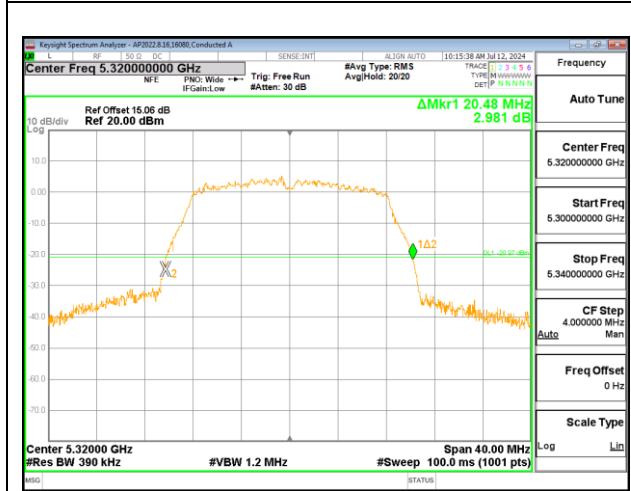
HIGH CHANNEL



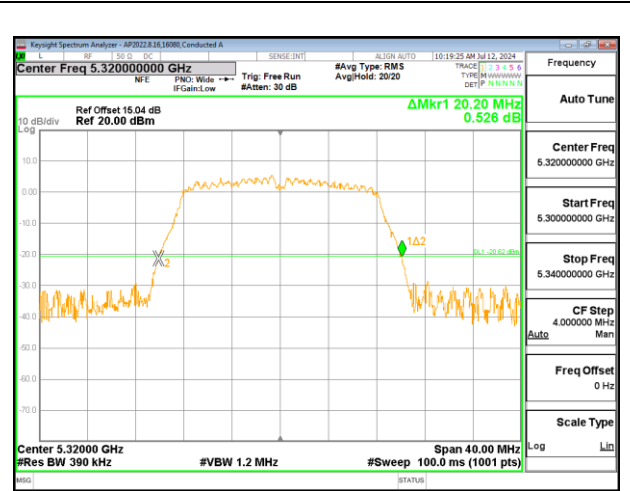
HIGH CHANNEL ANT 1



HIGH CHANNEL ANT 2



HIGH CHANNEL ANT 3



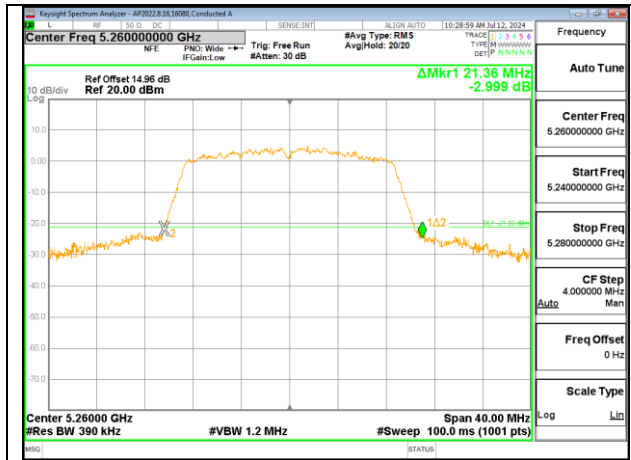
HIGH CHANNEL ANT 4

9.2.4. 802.11n HT20 MODE IN THE 5.3 GHz BAND

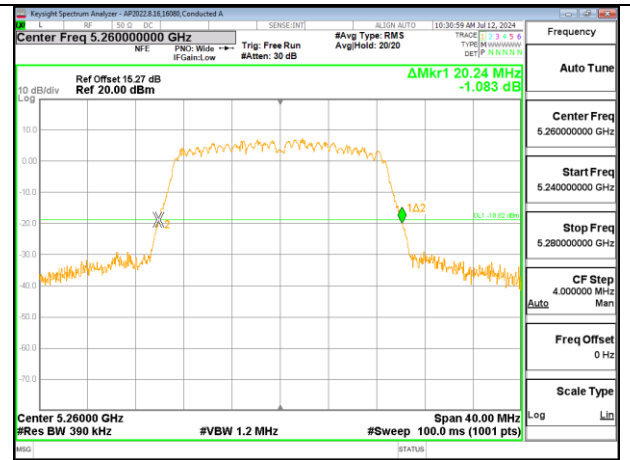
4TX Antenna 1 + Antenna 2 + Antenna 3 + Antenna 4 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 1 (MHz)	26 dB Bandwidth Antenna 2 (MHz)	26 dB Bandwidth Antenna 3 (MHz)	26 dB Bandwidth Antenna 4 (MHz)
Low	5260	21.36	20.24	20.32	20.52
Mid	5300	20.64	20.24	21.00	20.48
High	5320	20.72	20.16	20.24	20.48

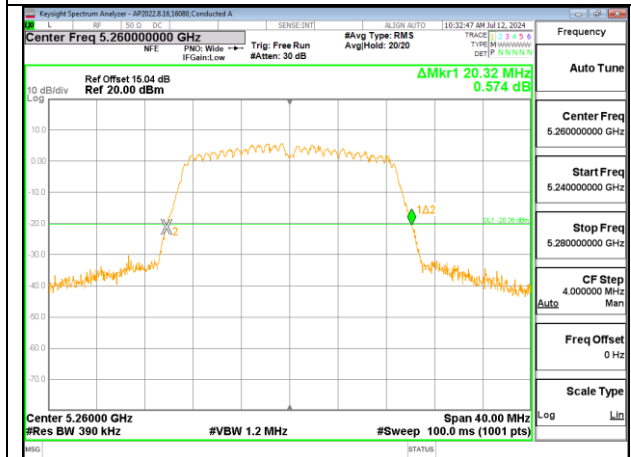
LOW CHANNEL



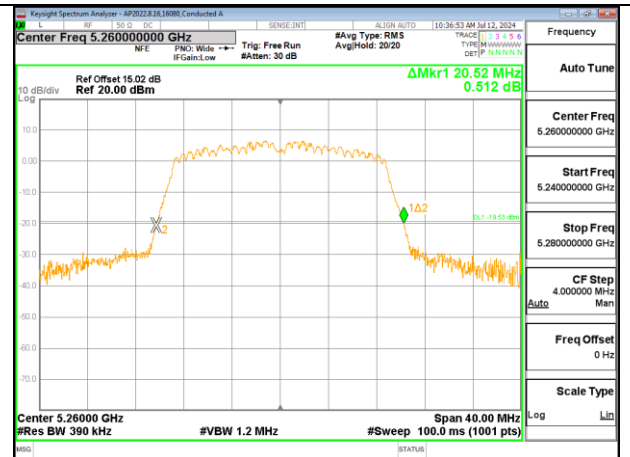
LOW CHANNEL ANT 1



LOW CHANNEL ANT 2

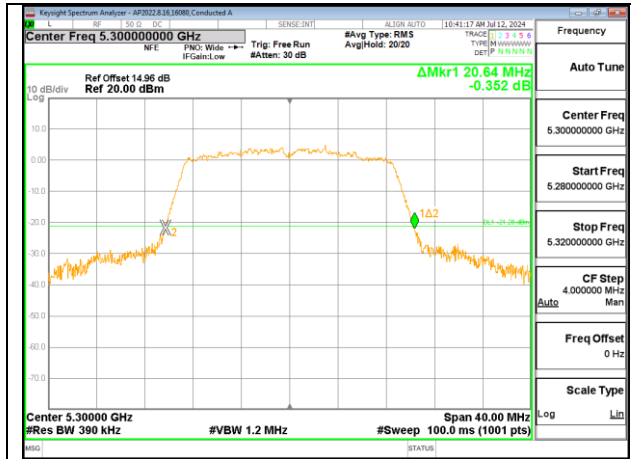


LOW CHANNEL ANT 3

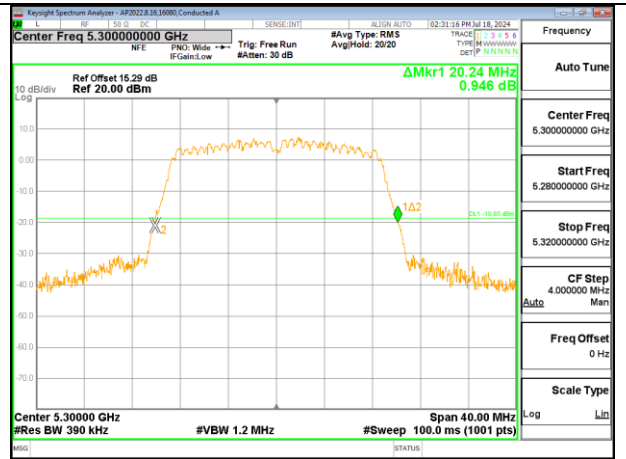


LOW CHANNEL ANT 4

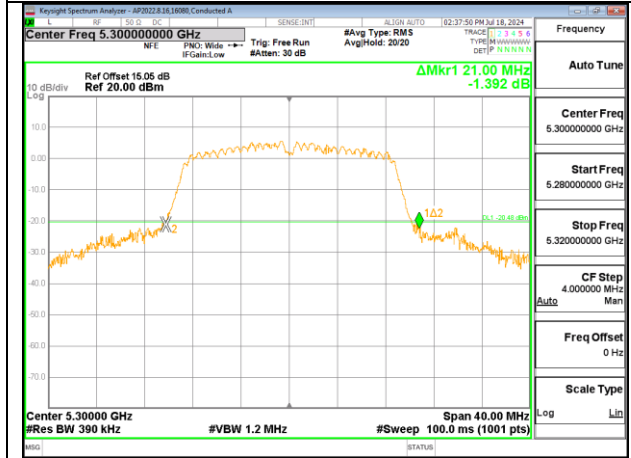
MID CHANNEL



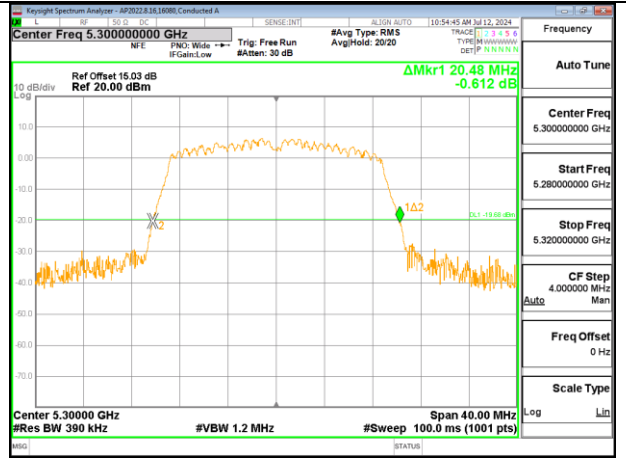
MID CHANNEL ANT 1



MID CHANNEL ANT 2

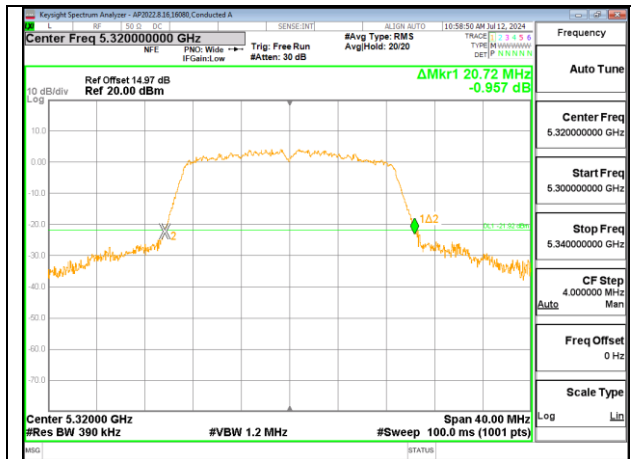


MID CHANNEL ANT 3

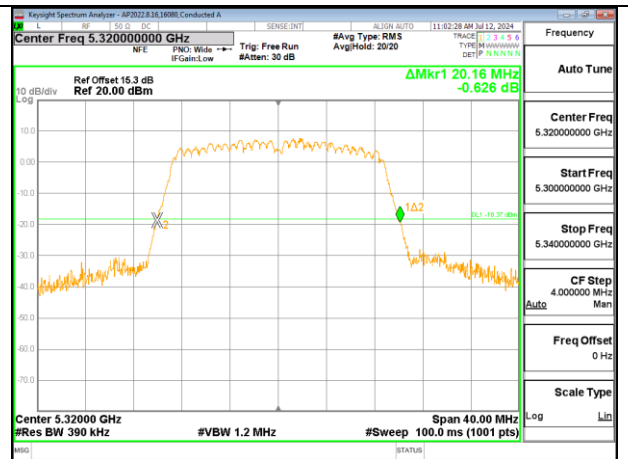


MID CHANNEL ANT 4

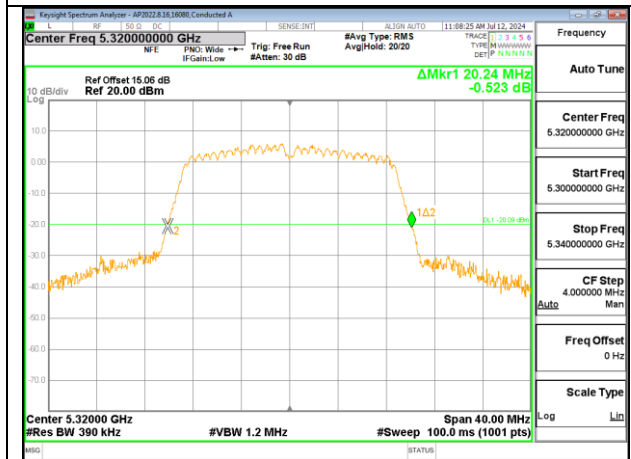
HIGH CHANNEL



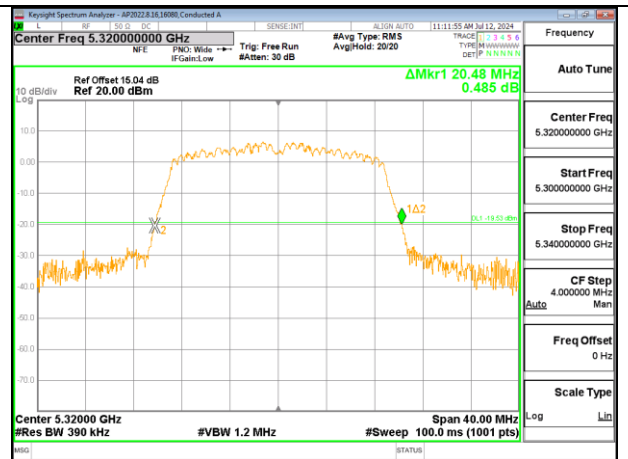
HIGH CHANNEL ANT 1



HIGH CHANNEL ANT 2



HIGH CHANNEL ANT 3



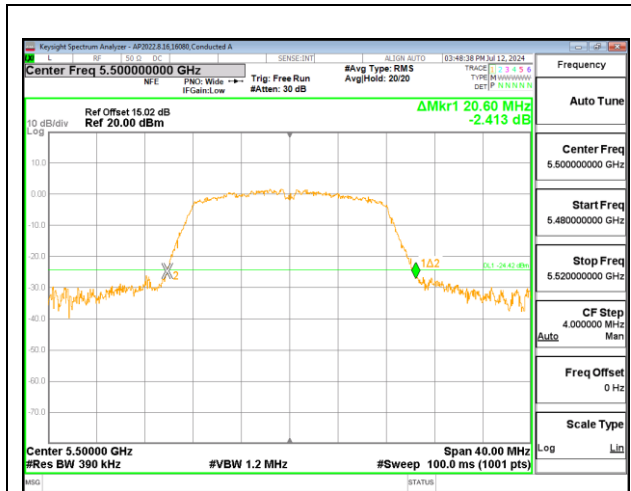
HIGH CHANNEL ANT 4

9.2.5. 802.11a MODE IN THE 5.6 GHz BAND

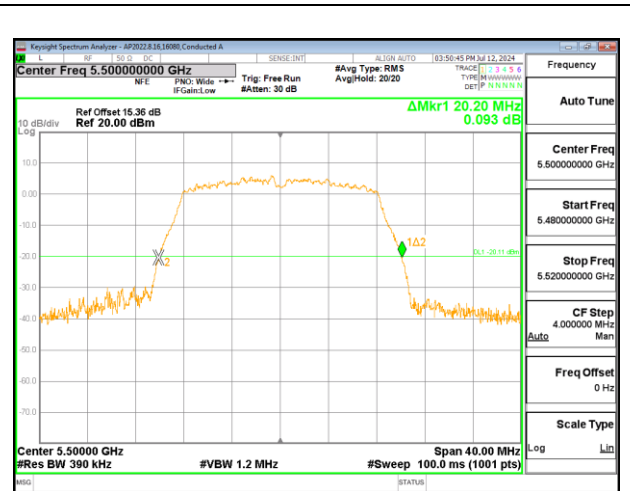
4TX Antenna 1 + Antenna 2 + Antenna 3 + Antenna 4 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 1 (MHz)	26 dB Bandwidth Antenna 2 (MHz)	26 dB Bandwidth Antenna 3 (MHz)	26 dB Bandwidth Antenna 4 (MHz)
Low	5500	20.60	20.20	20.36	20.36
Mid	5580	20.28	20.44	20.40	20.36
High	5700	20.40	20.36	20.36	20.12

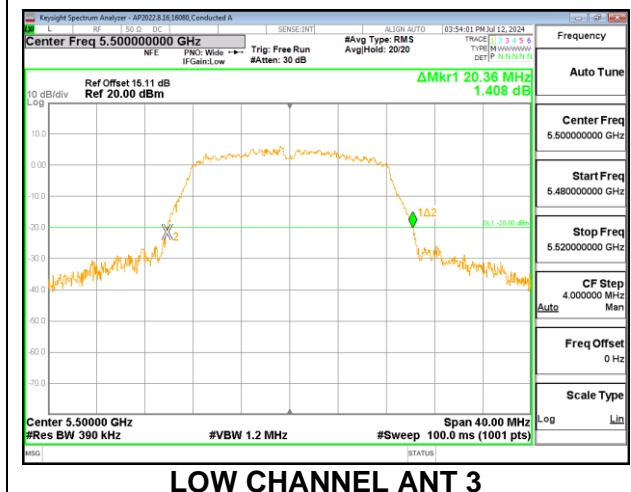
LOW CHANNEL



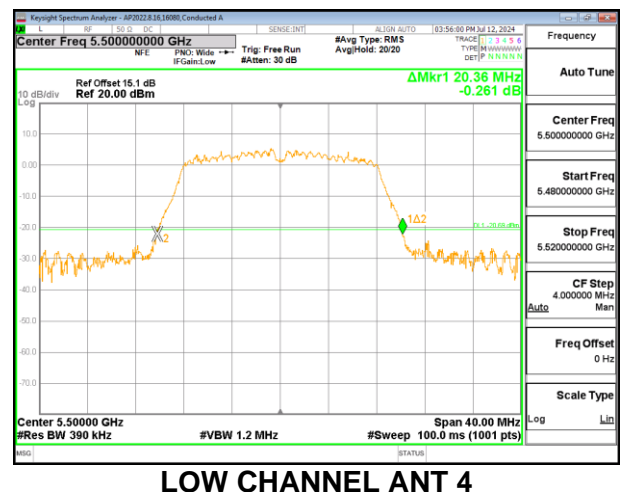
LOW CHANNEL ANT 1



LOW CHANNEL ANT 2

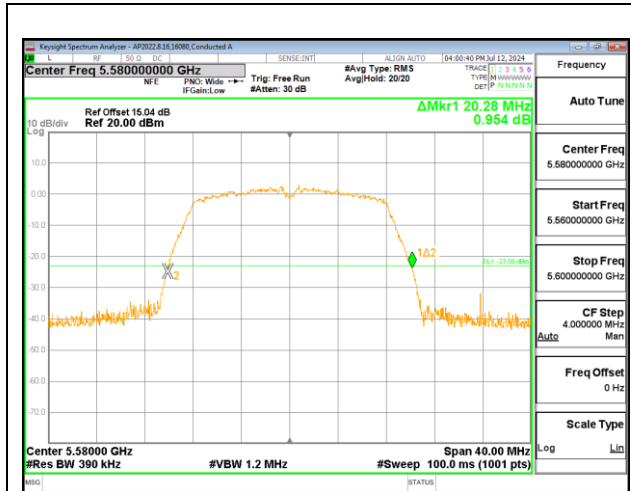


LOW CHANNEL ANT 3

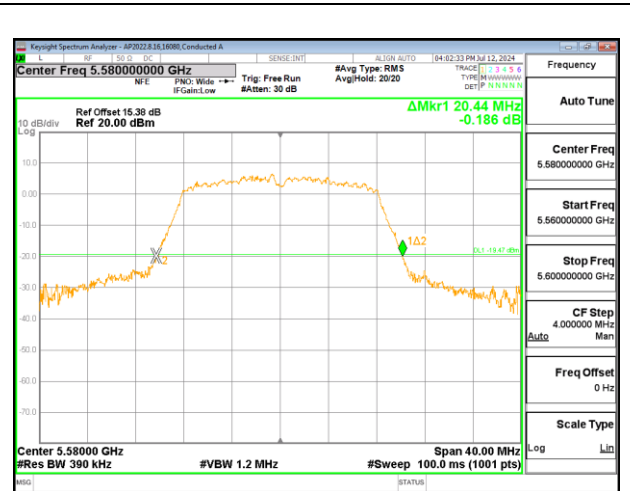


LOW CHANNEL ANT 4

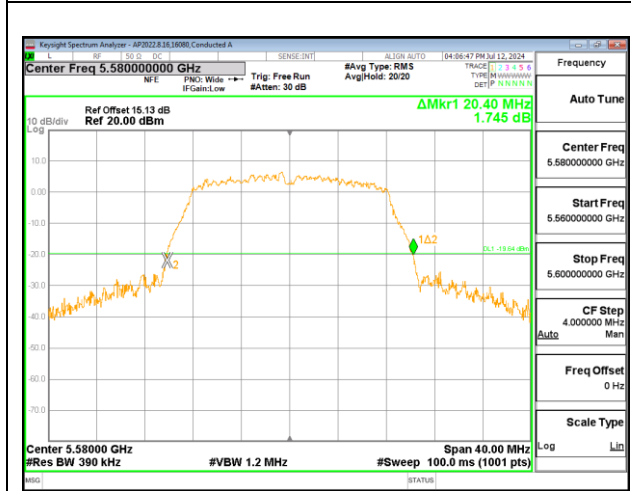
MID CHANNEL



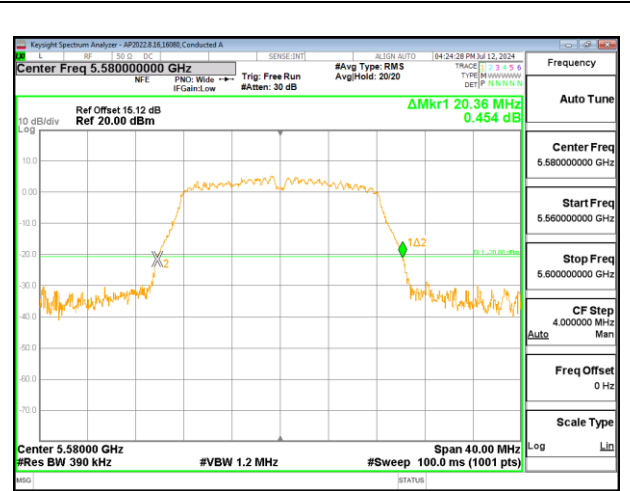
MID CHANNEL ANT 1



MID CHANNEL ANT 2

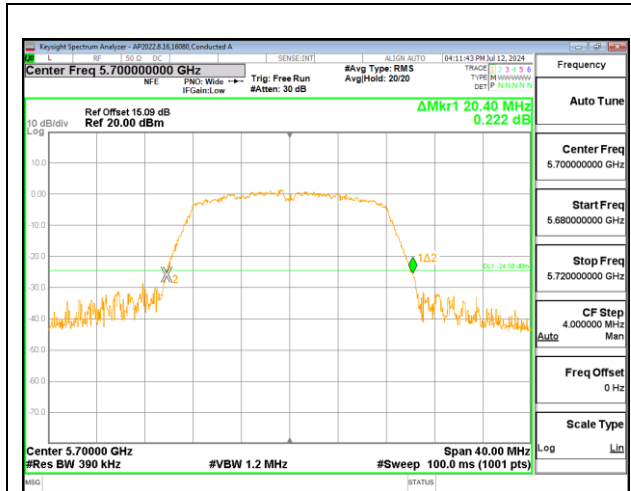


MID CHANNEL ANT 3

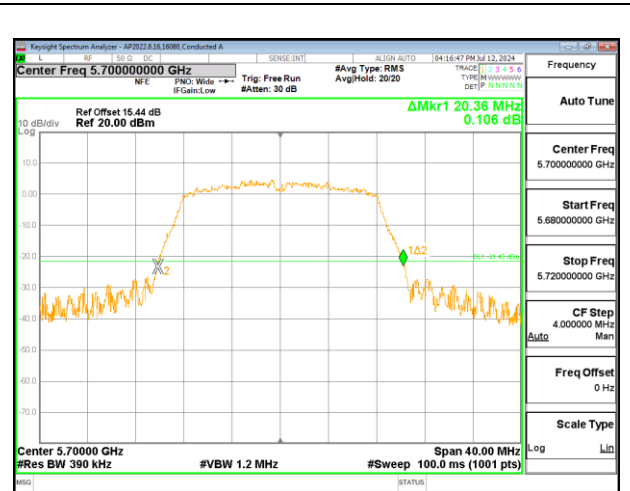


MID CHANNEL ANT 4

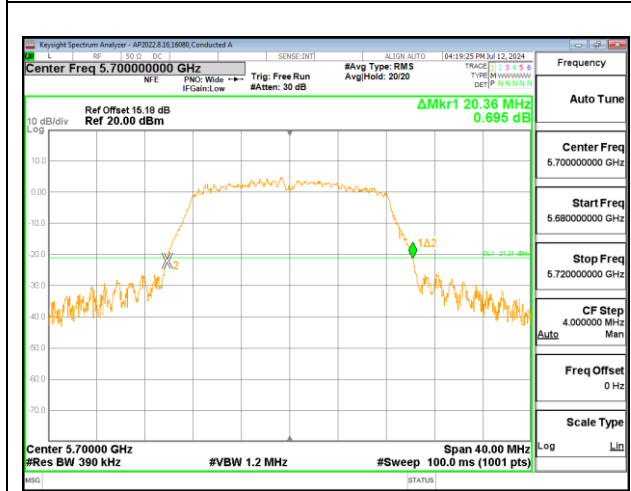
HIGH CHANNEL



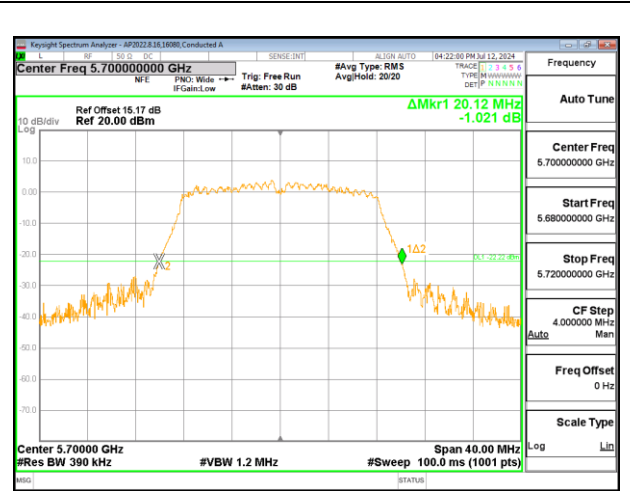
HIGH CHANNEL ANT 1



HIGH CHANNEL ANT 2



HIGH CHANNEL ANT 3



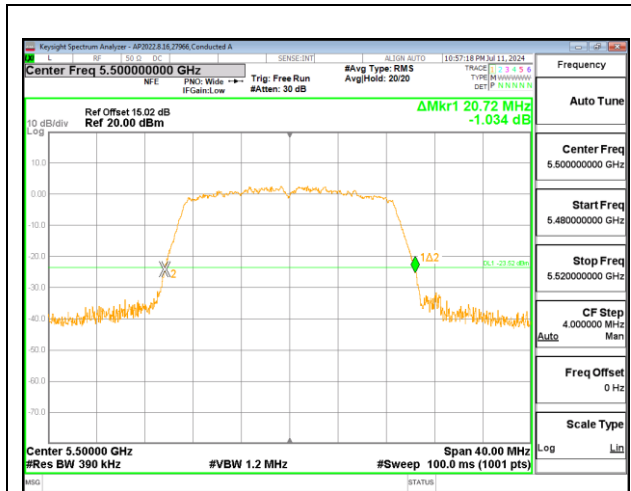
HIGH CHANNEL ANT 4

9.2.6. 802.11n HT20 MODE IN THE 5.6 GHz BAND

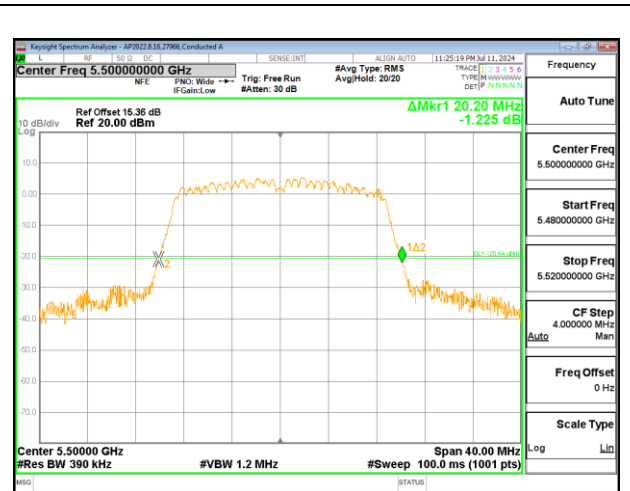
4TX Antenna 1 + Antenna 2 + Antenna 3 + Antenna 4 CDD MODE

Channel	Frequency (MHz)	26 dB Bandwidth Antenna 1 (MHz)	26 dB Bandwidth Antenna 2 (MHz)	26 dB Bandwidth Antenna 3 (MHz)	26 dB Bandwidth Antenna 4 (MHz)
Low	5500	20.72	20.20	20.24	20.52
Mid	5580	20.56	20.28	20.28	20.44
High	5700	20.72	20.20	20.36	20.48

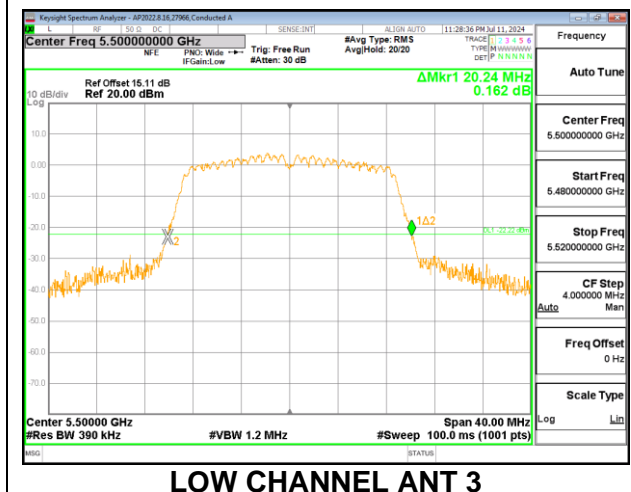
LOW CHANNEL



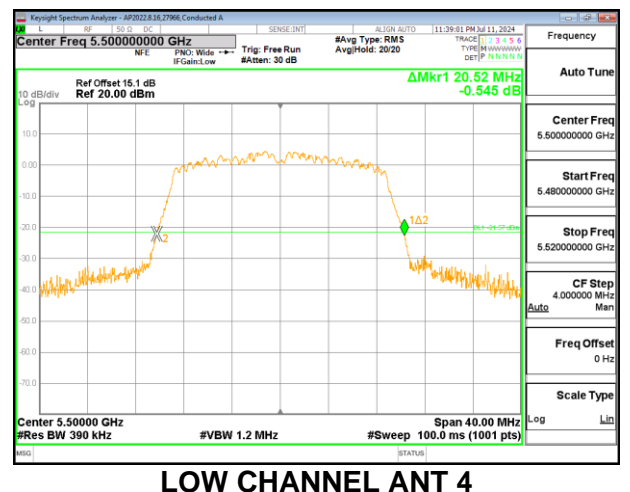
LOW CHANNEL ANT 1



LOW CHANNEL ANT 2

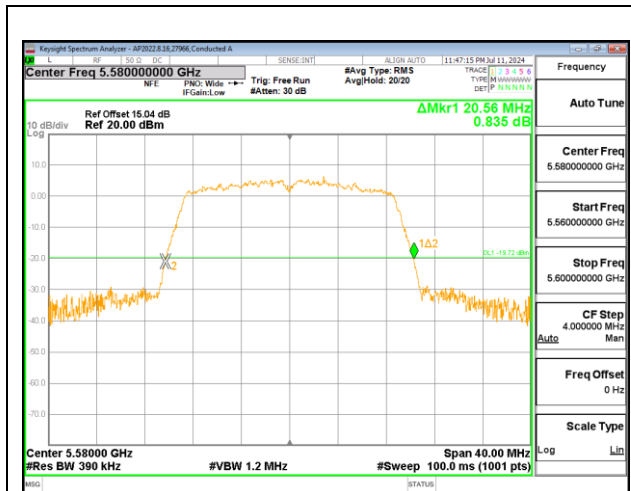


LOW CHANNEL ANT 3

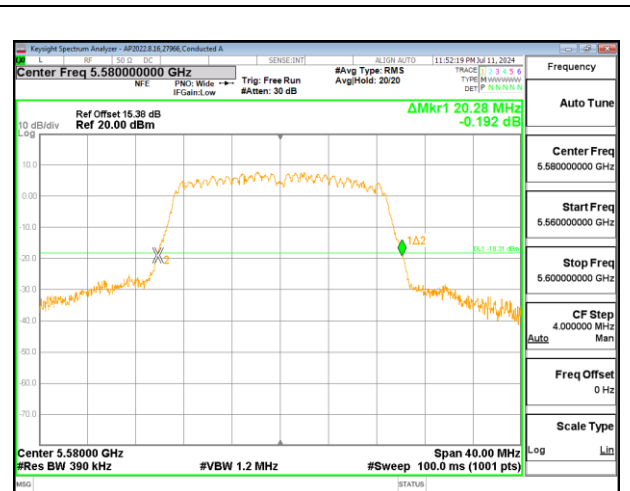


LOW CHANNEL ANT 4

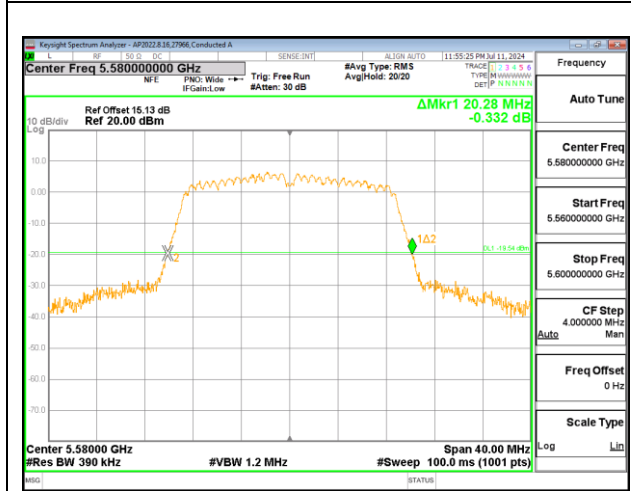
MID CHANNEL



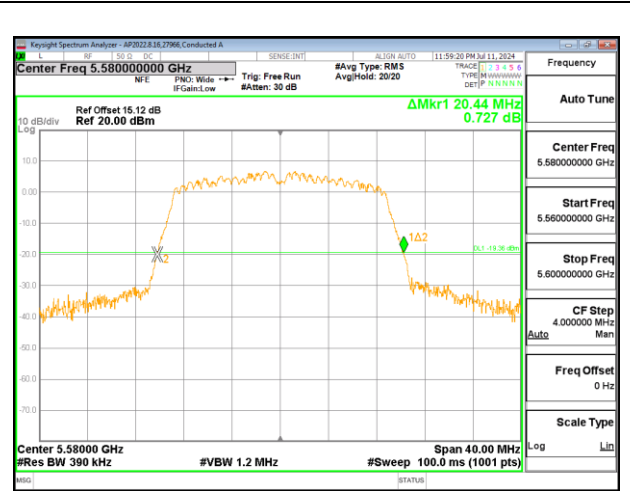
MID CHANNEL ANT 1



MID CHANNEL ANT 2



MID CHANNEL ANT 3



MID CHANNEL ANT 4