



# FCC RF Test Report

**APPLICANT** : Vantiva USA LLC  
**EQUIPMENT** : DOCSIS 3.1  
**BRAND NAME** : Vantiva  
**MODEL NAME** : CGM4981COM2  
**FCC ID** : G954981X2  
**STANDARD** : FCC Part 15 Subpart E §15.407  
**CLASSIFICATION** : (NII) Unlicensed National Information Infrastructure  
**TEST DATE(S)** : Nov. 13, 2023 ~ Dec. 01, 2023

We, Sporton International Inc. (Kunshan), would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Jason Jia



Approved by: Jason Jia

**Sporton International Inc. (Kunshan)**

**No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300  
People's Republic of China**



# TABLE OF CONTENTS

**REVISION HISTORY..... 3**

**SUMMARY OF TEST RESULT ..... 4**

**1 GENERAL DESCRIPTION ..... 5**

1.1 Applicant ..... 5

1.2 Manufacturer..... 5

1.3 Product Feature of Equipment Under Test..... 5

1.4 Product Specification of Equipment Under Test..... 6

1.5 Specification of Accessory..... 7

1.6 Modification of EUT ..... 7

1.7 Testing Location ..... 8

1.8 Test Software..... 8

1.9 Applicable Standards..... 8

**2 TEST CONFIGURATION OF EQUIPMENT UNDER TEST..... 9**

2.1 Carrier Frequency and Channel ..... 9

2.2 Test Mode..... 10

2.3 Connection Diagram of Test System..... 11

2.4 Support Unit used in test configuration and system..... 12

2.5 EUT Operation Test Setup ..... 12

2.6 Measurement Results Explanation Example..... 12

**3 TEST RESULT..... 13**

3.1 6dB and 26dB and 99% Occupied Bandwidth Measurement ..... 13

3.2 Maximum Conducted Output Power Measurement ..... 15

3.3 Power Spectral Density Measurement ..... 21

3.4 Unwanted Emissions Measurement..... 25

3.5 AC Conducted Emission Measurement..... 31

3.6 Antenna Requirements..... 33

**4 LIST OF MEASURING EQUIPMENT ..... 35**

**5 MEASUREMENT UNCERTAINTY ..... 36**

**APPENDIX A. CONDUCTED TEST RESULTS**

**APPENDIX B. AC CONDUCTED EMISSION TEST RESULT**

**APPENDIX C. RADIATED SPURIOUS EMISSION**

**APPENDIX D. DUTY CYCLE PLOTS**

**APPENDIX E. SETUP PHOTOGRAPHS**



### REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR391301D	Rev. 01	Initial issue of report	Dec. 18, 2023



### SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit for U-NII-1/2A/2C	Limit for U-NII-3	Result	Remark
3.1	2.1049 & 15.403(i)	6dB, 26dB & 99% Bandwidth	-	6dB Bandwidth > 500kHz	Pass	-
3.2	15.407(a)	Maximum Conducted Output Power	≤ 30 dBm for UNII-1, and 24 dBm for UNII-2A/2C	≤ 30 dBm	Pass	-
3.3	15.407(a)	Power Spectral Density	≤ 17 dBm/MHz for UNII-1, and 11 dBm/MHz for UNII-2A/2C	≤ 30 dBm/500kHz	Pass	-
3.4	15.407(b)	Unwanted Emissions	15.407(b) & 15.209(a)	15.407(b)(4)(i) & 15.209(a)	Pass	Under limit 0.11 dB at 8249.60 MHz
3.5	15.207	AC Conducted Emission	15.207(a)	15.207(a)	Pass	Under limit 18.00 dB at 0.199 MHz
3.6	15.203 & 15.407(a)	Antenna Requirement	15.203 & 15.407(a)	15.203 & 15.407(a)	Pass	-

**Conformity Assessment Condition:**

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the section "Measurement Uncertainty"

**Disclaimer:**

The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.



# 1 General Description

## 1.1 Applicant

Vantiva USA LLC  
4855 Peachtree Industrial Blvd. Suite 200 Norcross, Georgia 30092

## 1.2 Manufacturer

Vantiva USA LLC  
4855 Peachtree Industrial Blvd. Suite 200 Norcross, Georgia 30092

## 1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	DOCSIS 3.1
Brand Name	Vantiva
Model Name	CGM4981COM2
FCC ID	G954981X2
HW Version	FGR1
SW Version	6.2p30s1
EUT Stage	Identical Prototype

**Remark:** The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.



### 1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
<b>Tx/Rx Frequency Range</b>	5180 MHz ~ 5250 MHz 5260 MHz ~ 5320 MHz 5500 MHz ~ 5720 MHz 5745 MHz ~ 5825 MHz
<b>Maximum Output Power to Antenna</b>	<b>MIMO &lt;Ant. 1+2+3+4&gt;</b> <b>&lt;5180 MHz ~ 5250 MHz&gt;</b> 802.11a : 28.68 dBm / 0.7379 W 802.11ax HE20: 28.86 dBm / 0.7691 W 802.11ax HE40: 27.84 dBm / 0.6081 W 802.11ax HE80: 21.06 dBm / 0.1276 W 802.11ax HE160: 21.21 dBm / 0.1321 W <b>&lt;5260 MHz ~ 5320 MHz&gt;</b> 802.11a : 22.71 dBm / 0.1866 W 802.11ax HE20: 22.96 dBm / 0.1977 W 802.11ax HE40: 23.97 dBm / 0.2495 W 802.11ax HE80: 22.66 dBm / 0.1845 W <b>&lt;5500 MHz ~ 5720 MHz &gt;</b> 802.11a : 22.40 dBm / 0.1738 W 802.11ax HE20: 22.74 dBm / 0.1879 W 802.11ax HE40: 23.74 dBm / 0.2366 W 802.11ax HE80: 23.90 dBm / 0.2455 W 802.11ax HE160: 20.95 dBm / 0.1245 W <b>&lt;5745 MHz ~ 5825 MHz&gt;</b> 802.11a : 26.07 dBm / 0.4046 W 802.11ax HE20: 27.47 dBm / 0.5585 W 802.11ax HE40: 28.01 dBm / 0.6324 W 802.11ax HE80: 25.45 dBm / 0.3508 W
<b>99% Occupied Bandwidth</b>	<b>MIMO &lt;Ant. 1+2+3+4&gt;</b> <b>&lt;5180 MHz ~ 5250 MHz&gt;</b> 802.11a: 23.377 MHz 802.11ax HE20: 21.499 MHz 802.11ax HE40: 45.315 MHz 802.11ax HE80: 77.842 MHz 802.11ax HE160: 158.242 MHz <b>&lt;5260 MHz ~ 5320 MHz&gt;</b> 802.11a: 17.822 MHz 802.11ax HE20: 19.301 MHz 802.11ax HE40: 38.122 MHz 802.11ax HE80: 77.842 MHz <b>&lt;5500 MHz ~ 5720 MHz&gt;</b> 802.11a: 17.862 MHz 802.11ax HE20: 19.341 MHz 802.11ax HE40: 38.122 MHz 802.11ax HE80: 78.002 MHz 802.11ax HE160: 158.242 MHz <b>&lt;5745 MHz ~ 5825 MHz&gt;</b> 802.11a: 18.382 MHz 802.11ax HE20: 19.900 MHz 802.11ax HE40: 38.841 MHz 802.11ax HE80: 77.842 MHz



<b>Antenna Type</b>	PCB Antenna				
<b>Type of Modulation</b>	802.11a/n : OFDM (BPSK / QPSK / 16QAM / 64QAM) 802.11ac : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM) 802.11ax : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM / 1024QAM)				
<b>Antenna Function Description</b>		Ant. 1	Ant. 2	Ant. 3	Ant. 4
	802.11 a/n/ac/ax SISO	V	V	V	V
	802.11 a/n/ac/ax CDD 1S4T	V	V	V	V
	802.11 n/ac/ax Tx Beamforming 1S4T	V	V	V	V

**Note:**

1. For SISO&MIMO mode, the whole testing has assessed only MIMO mode by referring to their higher conducted power.
2. For 802.11n HT20 / ac VHT20 / ax HE20 and 802.11n HT40 / ac VHT40 / ax HE40 mode and 802.11 ac VHT80 / ax HE80 mode and 802.11 ac VHT160 / ax HE160, the whole testing have assessed only 802.11ax HE20/HE40/HE80/HE160 by referring to their maximum conducted power.
3. The device does not support partial RU tone and channel puncturing function for 802.11ax mode.
4. The device supports multiple spatial streams, the worst case directional gain will occur when NSS = 1, therefore, the 1S4T(CDD&TXBF) mode is the worst; 1S4T: NSS=1, MIMO 4Tx.
5. Please refer to the antenna report for the maximum Single antenna gain and CDD (Cyclic Delay Diversity) directional gain and TXBF (Tx Beamforming) directional gain.

Frequency Band	Max Single Antenna gain (dBi)				CDD DG (dBi)		TXBF DG (dBi)	
	ANT1	ANT2	ANT3	ANT4	For Power	For PSD	For Power	For PSD
5GHz UNII-1	4.10	3.93	2.18	2.48	4.10	5.82	5.82	5.82
5GHz UNII-2A	4.65	3.28	2.00	2.34	4.65	5.77	5.77	5.77
5GHz UNII-2C	5.36	4.38	3.02	2.65	5.36	5.98	5.98	5.98
5GHz UNII-3	5.31	0.95	3.26	3.46	5.31	5.86	5.86	5.86

### 1.5 Specification of Accessory

Specification of Accessory				
AC Adapter 1	Brand Name	Netbit	Model Name	NBC56A120460VU
AC Adapter 2	Brand Name	Netbit	Model Name	NBC56B120460VU
AC Adapter 3	Brand Name	Acbel	Model Name	ADK002

### 1.6 Modification of EUT

No modifications are made to the EUT during all test items.



### 1.7 Testing Location

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

<b>Test Firm</b>	Sporton International Inc. (Kunshan)		
<b>Test Site Location</b>	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158		
<b>Test Site No.</b>	<b>Sporton Site No.</b>	<b>FCC Designation No.</b>	<b>FCC Test Firm Registration No.</b>
	CO01-KS 03CH06-KS TH01-KS	CN1257	314309

### 1.8 Test Software

Item	Site	Manufacturer	Name	Version
1.	TH01-KS	Tonscend	JS1120-3 test system China_210602	3.3.10
2.	03CH06-KS	AUDIX	E3	210616
3.	CO01-KS	AUDIX	E3	6.2009-8-24

### 1.9 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR Part 15 Subpart E
- FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ANSI C63.10-2013

**Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.





## 2 Test Configuration of Equipment Under Test

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z, and Wall installation plane. The worst cases (X plane) were recorded in this report.
- b. AC power line Conducted Emission was tested under maximum output power.

### 2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq.(MHz)	Channel	Freq. (MHz)
5180-5240 MHz U-NII-1	36	5180	44	5220
	38*	5190	46*	5230
	40	5200	48	5240
	42 <sup>#</sup>	5210	50 <sup>##</sup>	5250

Frequency Band	Channel	Freq.(MHz)	Channel	Freq. (MHz)
5260-5320 MHz U-NII-2A	52	5260	60	5300
	54*	5270	62*	5310
	56	5280	64	5320
	58 <sup>#</sup>	5290	-	-

Frequency Band	Channel	Freq.(MHz)	Channel	Freq. (MHz)
5500-5720MHz U-NII-2C	100	5500	112	5560
	102*	5510	116	5580
	104	5520	132	5660
	106 <sup>#</sup>	5530	134*	5670
	108	5540	136	5680
	110*	5550	140	5700

Frequency Band	Channel	Freq.(MHz)	Channel	Freq. (MHz)
5745-5825 MHz U-NII-3	149	5745	157	5785
	151*	5755	159*	5795
	153	5765	161	5805
	155 <sup>#</sup>	5775	165	5825



Frequency Band	Channel	Freq.(MHz)	Channel	Freq. (MHz)
TDWR Channel	118*	5590	124	5620
	120	5600	126*	5630
	122 <sup>#</sup>	5610	128	5640
	-	-	114 <sup>##</sup>	5570

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
Straddle Channel	138 <sup>#</sup>	5690	144	5720
	142*	5710	-	-

**Note:**

1. The above Frequency and Channel in "\*" are 40MHz bandwidth.
2. The above Frequency and Channel in "#n" are 80MHz bandwidth.
3. The above Frequency and Channel in "##n" are 160MHz bandwidth.

## 2.2 Test Mode

Final test modes are considering the modulation and worse data rates refer to Appendix C.

For Radiated Test Cases, the tests were performance with Adapter and RJ45/RJ11/Coaxial Cable

<b>AC Conducted Emission</b>	Mode 1 : WLAN Tx (5G) + Lan Load + Wan Load + CMTS Load + Power from Adapter
--------------------------------------	------------------------------------------------------------------------------

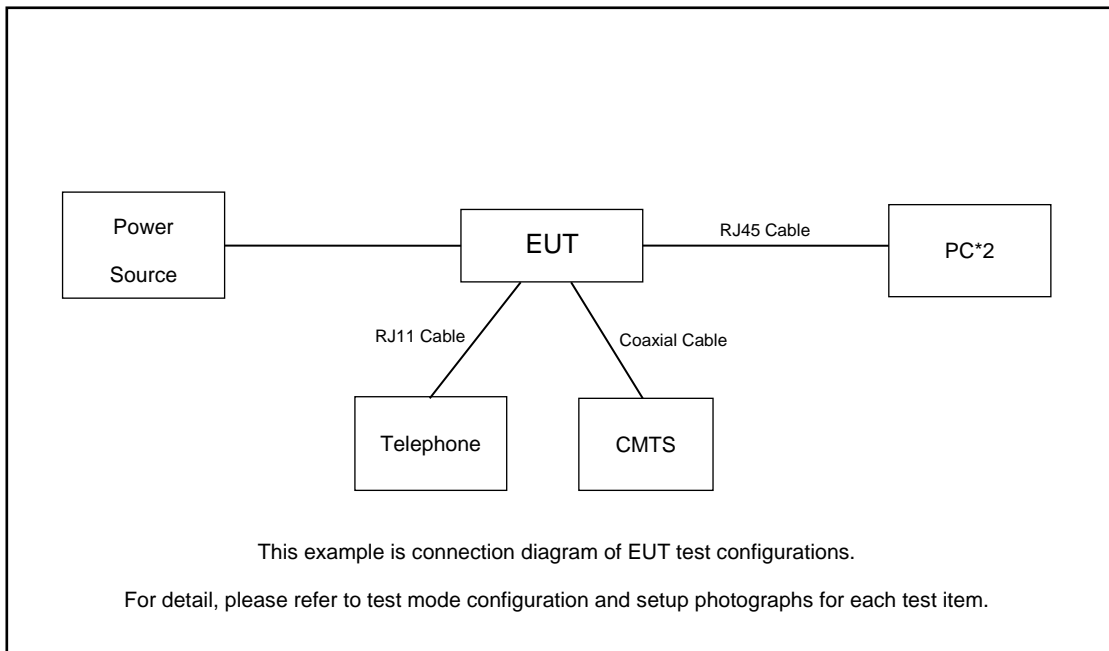
Ch. #		U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
		20M BW	20M BW	20M BW	20M BW
L	Low	36	52	100	149
M	Middle	44	60	116	157
H	High	48	64	140	165
Straddle		-	-	144	-

Ch. #		U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
		40M BW	40M BW	40M BW	40M BW
L	Low	38	54	102	151
M	Middle	-	-	110	-
H	High	46	62	134	159
Straddle		-	-	142	-

Ch. #		U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
		80M BW	80M BW	80M BW	80M BW
L	Low	-	-	106	-
M	Middle	42	58	-	155
H	High	-	-	-	-
Straddle		-	-	138	-

Ch. #		U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
		160M BW		160M BW	160M BW
M	Middle	50		114	-

### 2.3 Connection Diagram of Test System





## 2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	PC	Lenovo	Yangtian M4900c	Fcc DoC	N/A	Unshielded,1.8m
2.	(USB)Mouse	Lenovo	OEUUOA	Fcc DoC	Shielded, 1.8m	N/A
3.	(USB)Keyboard	Lenovo	SK-8821	Fcc DoC	Shielded, 1.8m	N/A
4.	Monitor	Lenovo	LS2033wA	Fcc DoC	N/A	Unshielded,1.8m
5.	PC	Dell	D12M	Fcc DoC	N/A	Unshielded,1.8m
6.	(USB)Mouse	Dell	MS111-P	Fcc DoC	Shielded, 1.8m	N/A
7.	(USB)Keyboard	Dell	SK-8120	Fcc DoC	Shielded, 1.8m	N/A
8.	Telephone	bubugao	HCD007(6082)TSD	N/A	N/A	N/A
9.	RJ45 Cable	N/A	N/A	N/A	N/A	N/A
10.	RJ11 Cable	N/A	N/A	N/A	N/A	N/A
11.	CMTS	TOPISION	N/A	N/A	N/A	N/A

## 2.5 EUT Operation Test Setup

For WLAN RF test items, an engineering test program “QRCT TX Tool” was provided and enabled to make EUT continuously transmit.

## 2.6 Measurement Results Explanation Example

### For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator factor between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

Example :

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

$$\text{Offset} = \text{RF cable loss} + \text{attenuator factor}.$$

Following shows an offset computation example with cable loss 6.25 dB and 10dB attenuator.

$$\begin{aligned} \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)}. \\ &= 6.25 + 10 = 16.25 \text{ (dB)} \end{aligned}$$



### 3 Test Result

#### 3.1 6dB and 26dB and 99% Occupied Bandwidth Measurement

##### 3.1.1 Description of 6dB and 26dB and 99% Occupied Bandwidth

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

26dB and 99% Occupied bandwidth are reporting only.

##### 3.1.2 Measuring Instruments

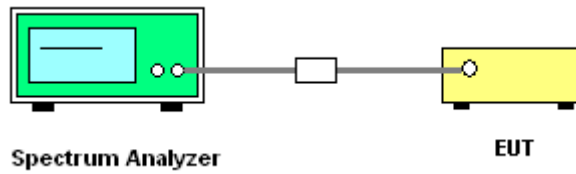
The measuring equipment is listed in the section 4 of this test report.

##### 3.1.3 Test Procedures

- The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

<input checked="" type="checkbox"/>	Section C) Bandwidth Measurement 1. Emission Bandwidth (EBW) and 99% OBW
	<ol style="list-style-type: none"> <li>Set RBW = approximately 1% of the emission bandwidth.</li> <li>Set the VBW &gt; RBW.</li> <li>Detector = Peak.</li> <li>Trace mode = max hold</li> <li>Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.</li> <li>For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set to 1%~5% of the OBW and set the Video bandwidth (VBW) ≥ 3 * RBW.</li> <li>Measure and record the results in the test report.</li> </ol>
<input checked="" type="checkbox"/>	Section C) Bandwidth Measurement 2. Minimum Emission Bandwidth for the band 5.725 - 5.85 GHz
	<ol style="list-style-type: none"> <li>Set RBW = 100kHz.</li> <li>Set the VBW ≥ 3 x RBW.</li> <li>Detector = Peak.</li> <li>Trace mode = max hold</li> <li>Measure the maximum width of the emission that is 6 dB down from the peak of the emission.</li> <li>Measure and record the results in the test report.</li> </ol>

### 3.1.4 Test Setup



### 3.1.5 Test Result of 6dB and 26dB and 99% Occupied Bandwidth

Please refer to Appendix A.



## 3.2 Maximum Conducted Output Power Measurement

### 3.2.1 Limit of Maximum Conducted Output Power

<FCC 14-30 CFR 15.407>

For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

For the 5.25–5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm  $10 \log B$ , where B is the 26 dB emission bandwidth in megahertz.

For the band 5.725–5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

For Straddle Channel, According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, If the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Note that U-NII-2 band, devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

### 3.2.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

### 3.2.3 Test Procedures

The testing follows Method PM of FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

Method PM (Measurement using an RF average power meter):

1. Measurement is performed using a wideband RF power meter.
2. The EUT is configured to transmit continuously with a consistent duty cycle at its maximum power control level.
3. Measure the average power of the transmitter, and the average power is corrected with duty factor,  $10 \log(1/x)$ , where  $x$  is the duty cycle.
4. For MIMO mode, the measure-and-sum technique should be used for measuring the in-band transmit power of a device.

#### <TXBF Modes>

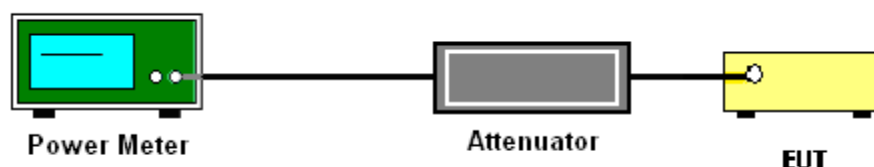
The testing follows Method PM-G of FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01 for TXBF modes.

Method PM-G (Measurement using a gated RF average power meter):

1. Measurement is performed using a wideband RF power meter.
2. The EUT is configured to transmit at its maximum power control level.
3. Measure the average power of the transmitter
4. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

For Straddle Channel, According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, If the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

### 3.2.4 Test Setup







3.2.5 Test Result of Maximum Conducted Output Power

<CDD 1S4T>:

UNII-1															
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Ant	Average Conducted Power with duty factor (dBm)					FCC Power Limit (dBm)	DG (dBi)	FCC EIRP Power (dBm)	Pass/Fail	Power Setting
						Ant 1	Ant 2	Ant 3	Ant 4	SUM					
11a	6Mbps	4	36	5180	1+2+3+4	19.90	19.76	19.70	20.03	25.87	30.00	4.65	30.52	Pass	19.50
11a	6Mbps	4	44	5220	1+2+3+4	22.66	22.55	22.69	22.75	28.68	30.00	4.65	33.33	Pass	22.00
11a	6Mbps	4	48	5240	1+2+3+4	22.51	22.08	22.49	22.34	28.38	30.00	4.65	33.03	Pass	21.50
HE20	MCS0	4	36	5180	1+2+3+4	18.21	18.07	18.00	18.47	24.22	30.00	4.65	28.87	Pass	18.50
HE20	MCS0	4	44	5220	1+2+3+4	22.75	22.83	22.88	22.89	28.86	30.00	4.65	33.51	Pass	22.50
HE20	MCS0	4	48	5240	1+2+3+4	22.60	22.41	22.52	22.63	28.57	30.00	4.65	33.22	Pass	22.00
HE40	MCS0	4	38	5190	1+2+3+4	15.64	15.58	15.62	15.43	21.59	30.00	4.65	26.24	Pass	15.00
HE40	MCS0	4	46	5230	1+2+3+4	21.68	21.84	21.85	21.92	27.84	30.00	4.65	32.49	Pass	21.00
HE80	MCS0	4	42	5210	1+2+3+4	15.00	14.91	15.12	15.12	21.06	30.00	4.65	25.71	Pass	14.50
HE160	MCS0	4	50	5250	1+2+3+4	14.97	15.30	15.25	15.20	21.21	30.00	4.65	25.86	Pass	14.50

UNII-2A																
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Ant	Average Conducted Power with Duty Factor (dB)					FCC Power Limit (dBm)	DG (dBi)	FCC EIRP Power (dBm)	FCC EIRP Power Limit (dBm)	Pass/Fail	Power Setting
						Ant 1	Ant 2	Ant 3	Ant 4	SUM						
11a	6Mbps	4	52	5260	1+2+3+4	16.64	16.50	16.40	16.28	22.48	23.98	4.65	27.13	30.00	Pass	16
11a	6Mbps	4	60	5300	1+2+3+4	15.88	16.28	16.19	15.97	22.10	23.98	4.65	26.75	30.00	Pass	15.5
11a	6Mbps	4	64	5320	1+2+3+4	16.51	16.99	16.60	16.67	22.71	23.98	4.65	27.36	30.00	Pass	16
HE20	MCS0	4	52	5260	1+2+3+4	16.43	16.85	16.48	16.73	22.65	23.98	4.65	27.30	30.00	Pass	16.5
HE20	MCS0	4	60	5300	1+2+3+4	16.02	16.49	16.32	16.36	22.33	23.98	4.65	26.98	30.00	Pass	16
HE20	MCS0	4	64	5320	1+2+3+4	16.11	16.62	16.44	16.41	22.42	23.98	4.65	27.07	30.00	Pass	16
HE40	MCS0	4	54	5270	1+2+3+4	17.65	17.69	17.61	17.87	23.72	23.98	4.65	28.37	30.00	Pass	17
HE40	MCS0	4	62	5310	1+2+3+4	16.28	16.43	16.58	16.57	22.48	23.98	4.65	27.13	30.00	Pass	15.5
HE80	MCS0	4	58	5290	1+2+3+4	16.49	16.49	16.88	16.68	22.66	23.98	4.65	27.31	30.00	Pass	16



UNII-2C																
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Ant	Average Conducted Power with Duty Factor (dB)					FCC Power Limit (dBm)	DG (dBi)	FCC EIRP Power (dBm)	FCC EIRP Power Limit (dBm)	Pass/Fail	Power Setting
						Ant 1	Ant 2	Ant 3	Ant 4	SUM						
11a	6Mbps	4	100	5500	1+2+3+4	15.93	16.02	16.01	15.84	21.97	23.98	5.36	27.33	30.00	Pass	16
11a	6Mbps	4	116	5580	1+2+3+4	15.75	15.86	15.75	15.65	21.77	23.98	5.36	27.13	30.00	Pass	16
11a	6Mbps	4	140	5700	1+2+3+4	16.44	16.21	16.57	16.31	22.40	23.98	5.36	27.76	30.00	Pass	16
11a	6Mbps	4	144	5720	1+2+3+4	16.02	15.83	15.98	15.77	21.92	23.98	5.36	27.28	30.00	Pass	15.5
HE20	MCS0	4	100	5500	1+2+3+4	16.07	16.14	16.22	16.15	22.17	23.98	5.36	27.53	30.00	Pass	16
HE20	MCS0	4	116	5580	1+2+3+4	16.28	16.64	16.23	16.41	22.42	23.98	5.36	27.78	30.00	Pass	16.5
HE20	MCS0	4	140	5700	1+2+3+4	15.55	15.35	15.53	15.44	21.49	23.98	5.36	26.85	30.00	Pass	15
HE20	MCS0	4	144	5720	1+2+3+4	16.76	16.53	16.62	16.53	22.64	23.98	5.36	28.00	30.00	Pass	16
HE40	MCS0	4	102	5510	1+2+3+4	17.28	17.42	17.51	17.39	23.42	23.98	5.36	28.78	30.00	Pass	17
HE40	MCS0	4	110	5550	1+2+3+4	17.47	17.80	17.68	17.63	23.66	23.98	5.36	29.02	30.00	Pass	17.5
HE40	MCS0	4	134	5670	1+2+3+4	17.28	17.04	17.25	17.48	23.28	23.98	5.36	28.64	30.00	Pass	16.5
HE40	MCS0	4	142	5710	1+2+3+4	17.54	17.63	17.68	18.02	23.74	23.98	5.36	29.10	30.00	Pass	17
HE80	MCS0	4	106	5530	1+2+3+4	15.53	15.48	15.13	15.44	21.42	23.98	5.36	26.78	30.00	Pass	15
HE80	MCS0	4	122	5610	1+2+3+4	17.93	17.78	17.77	18.02	23.90	23.98	5.36	29.26	30.00	Pass	17
HE80	MCS0	4	138	5690	1+2+3+4	17.88	17.61	17.63	17.75	23.74	23.98	5.36	29.10	30.00	Pass	17
HE160	MCS0	4	114	5570	1+2+3+4	14.83	15.22	14.84	14.81	20.95	23.98	5.36	26.31	30.00	Pass	14.5

UNII-3																
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power with duty factor (dBm)					FCC Conducted Power Limit (dBm)	DG (dBi)	Pass/Fail	Power Setting			
					Ant 1	Ant 2	Ant 3	Ant 4	SUM							
11a	6Mbps	4	149	5745	19.86	20.36	20.17	19.80	26.07	30.00	5.31	Pass	19.5			
11a	6Mbps	4	157	5785	19.79	20.06	20.12	19.63	25.92	30.00	5.31	Pass	19.5			
11a	6Mbps	4	165	5825	19.89	19.78	19.96	19.66	25.84	30.00	5.31	Pass	20			
HE20	MCS0	4	149	5745	21.04	21.42	21.23	20.95	27.19	30.00	5.31	Pass	20.5			
HE20	MCS0	4	157	5785	21.23	21.67	21.53	21.35	27.47	30.00	5.31	Pass	21			
HE20	MCS0	4	165	5825	21.22	21.35	21.50	21.17	27.34	30.00	5.31	Pass	21.5			
HE40	MCS0	4	151	5755	22.04	22.20	21.77	21.95	28.01	30.00	5.31	Pass	21.5			
HE40	MCS0	4	159	5795	21.79	22.03	21.68	21.72	27.82	30.00	5.31	Pass	21.5			
HE80	MCS0	4	155	5775	19.41	19.53	19.13	19.61	25.45	30.00	5.31	Pass	19			



<TXBF 1S4T>:

UNII-1															
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Ant	Average Conducted Power with duty factor (dBm)					FCC Power Limit (dBm)	DG (dBi)	FCC EIRP Power (dBm)	Pass/Fail	Power Setting
						Ant 1	Ant 2	Ant 3	Ant 4	SUM					
HE20	MCS0	4	36	5180	1+2+3+4	18.09	17.73	17.96	17.63	23.88	30.00	5.82	29.70	Pass	17.50
HE20	MCS0	4	44	5220	1+2+3+4	21.30	21.06	21.21	21.39	27.27	30.00	5.82	33.09	Pass	20.50
HE20	MCS0	4	48	5240	1+2+3+4	21.37	21.12	21.29	21.61	27.38	30.00	5.82	33.20	Pass	20.50
HE40	MCS0	4	38	5190	1+2+3+4	14.83	15.07	15.10	14.95	21.01	30.00	5.82	26.83	Pass	14.50
HE40	MCS0	4	46	5230	1+2+3+4	21.58	21.51	21.45	21.46	27.52	30.00	5.82	33.34	Pass	20.50
HE80	MCS0	4	42	5210	1+2+3+4	12.52	12.58	12.58	12.56	18.58	30.00	5.82	24.40	Pass	12.00
HE160	MCS0	4	50	5250	1+2+3+4	11.01	11.33	11.22	10.95	17.15	30.00	5.82	22.97	Pass	10.50

UNII-2A																
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Ant	Average Conducted Power with Duty Factor (dB)					FCC Power Limit (dBm)	DG (dBi)	FCC EIRP Power (dBm)	FCC EIRP Power Limit (dBm)	Pass/Fail	Power Setting
						Ant 1	Ant 2	Ant 3	Ant 4	SUM						
HE20	MCS0	4	52	5260	1+2+3+4	16.79	17.19	16.67	17.07	22.96	23.98	5.77	28.73	30.00	Pass	16.5
HE20	MCS0	4	60	5300	1+2+3+4	16.22	16.85	16.44	16.74	22.59	23.98	5.77	28.36	30.00	Pass	16
HE20	MCS0	4	64	5320	1+2+3+4	14.47	14.81	14.54	14.76	20.67	23.98	5.77	26.44	30.00	Pass	14
HE40	MCS0	4	54	5270	1+2+3+4	17.97	18.01	17.78	18.04	23.97	23.98	5.77	29.74	30.00	Pass	17.5
HE40	MCS0	4	62	5310	1+2+3+4	11.43	11.48	11.70	11.55	17.56	23.98	5.77	23.33	30.00	Pass	10.5
HE80	MCS0	4	58	5290	1+2+3+4	15.23	14.95	15.18	15.38	21.21	23.98	5.77	26.98	30.00	Pass	14.5



UNII-2C																
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Ant	Average Conducted Power with Duty Factor (dB)					FCC Power Limit (dBm)	DG (dBi)	FCC EIRP Power (dBm)	FCC EIRP Power Limit (dBm)	Pass/Fail	Power Setting
						Ant 1	Ant 2	Ant 3	Ant 4	SUM						
HE20	MCS0	4	100	5500	1+2+3+4	16.26	16.24	16.30	16.14	22.26	23.98	5.98	28.24	30.00	Pass	16
HE20	MCS0	4	116	5580	1+2+3+4	16.67	16.84	16.59	16.76	22.74	23.98	5.98	28.72	30.00	Pass	16.5
HE20	MCS0	4	140	5700	1+2+3+4	13.59	13.71	13.67	13.43	19.63	23.98	5.98	25.61	30.00	Pass	13
HE20	MCS0	4	144	5720	1+2+3+4	16.73	16.42	16.61	16.44	22.58	23.98	5.98	28.56	30.00	Pass	16
HE40	MCS0	4	102	5510	1+2+3+4	12.99	13.07	13.00	12.93	19.02	23.98	5.98	25.00	30.00	Pass	12.5
HE40	MCS0	4	110	5550	1+2+3+4	17.44	17.77	17.64	17.57	23.62	23.98	5.98	29.60	30.00	Pass	17.5
HE40	MCS0	4	134	5670	1+2+3+4	15.37	15.25	15.24	15.60	21.39	23.98	5.98	27.37	30.00	Pass	14.5
HE40	MCS0	4	142	5710	1+2+3+4	17.51	17.58	17.63	17.99	23.70	23.98	5.98	29.68	30.00	Pass	17
HE80	MCS0	4	106	5530	1+2+3+4	13.94	14.05	13.66	13.99	19.93	23.98	5.98	25.91	30.00	Pass	13.5
HE80	MCS0	4	122	5610	1+2+3+4	17.90	17.71	17.72	17.98	23.85	23.98	5.98	29.83	30.00	Pass	17
HE80	MCS0	4	138	5690	1+2+3+4	17.85	17.56	17.59	17.70	23.70	23.98	5.98	29.68	30.00	Pass	17
HE160	MCS0	4	114	5570	1+2+3+4	14.30	14.82	14.52	14.40	20.54	23.98	5.98	26.52	30.00	Pass	14

UNII-3													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power with duty factor (dBm)					FCC Conducted Power Limit (dBm)	DG (dBi)	Pass/Fail	Power Setting
					Ant 1	Ant 2	Ant 3	Ant 4					
HE20	MCS0	4	149	5745	18.97	19.13	19.15	18.70	25.02	30.00	5.86	Pass	18
HE20	MCS0	4	157	5785	18.16	18.40	18.34	17.89	24.23	30.00	5.86	Pass	17.5
HE20	MCS0	4	165	5825	18.22	18.15	18.30	17.86	24.16	30.00	5.86	Pass	18
HE40	MCS0	4	151	5755	18.59	19.01	18.28	18.52	24.63	30.00	5.86	Pass	18
HE40	MCS0	4	159	5795	19.38	19.69	19.02	19.15	25.34	30.00	5.86	Pass	19
HE80	MCS0	4	155	5775	18.12	17.97	17.84	18.09	24.03	30.00	5.86	Pass	17.5



### 3.3 Power Spectral Density Measurement

#### 3.3.1 Limit of Power Spectral Density

<FCC 14-30 CFR 15.407>

For an indoor access point operating in the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band.

For the 5.25–5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

For the band 5.725–5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

For Straddle Channel, According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, If the power and PSD of the devices are uniform and comply with the lower limits specified for the U-NII-2 bands, a single measurement over the entire emission bandwidth can be performed to show compliance.

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

#### 3.3.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.



### 3.3.3 Test Procedures

The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r04.  
Section F) Maximum power spectral density.

#### For devices operating in the bands UNII-1/2A/2C

##### # Method SA-2 #

(trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction).

- Measure the duty cycle.
- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 1 MHz.
- Set VBW  $\geq$  3 MHz.
- Number of points in sweep  $\geq$  2 Span / RBW.
- Sweep time = auto.
- Detector = RMS
- Trace average at least 100 traces in power averaging mode.
- Add  $10 \log(1/x)$ , where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times. For example, add  $10 \log(1/0.25) = 6$  dB if the duty cycle is 25 percent.

#### <TXBF Modes>

##### # Method SA-3 #

(power averaging (rms) detection with max hold):

- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 1 MHz.
- Set VBW  $\geq$  3 MHz
- Number of points in sweep  $\geq$  2 Span / RBW.
- Sweep time  $\leq$  (number of points in sweep)  $\times$  T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
- Detector = power averaging (rms).
- Trace mode = max hold.
- Allow max hold to run for at least 60 seconds, or longer as needed to allow the trace to stabilize.



**For devices operating in the band UNII-3**

**# Method SA-2 #**

(trace averaging across on and off times of the EUT transmissions, followed by duty cycle correction).

- Measure the duty cycle.
- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 500KHz (or 300 kHz if the SA can't set RBW=500KHz).
- Set VBW  $\geq$  1 MHz.
- Number of points in sweep  $\geq$  2 Span / RBW.
- Sweep time = auto.
- Detector = RMS
- Trace average at least 100 traces in power averaging mode.
- If the SA can't set RBW=500KHz, then add  $10 \log(500\text{kHz}/\text{RBW})$  to the test result.
- Add  $10 \log(1/x)$ , where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times. For example, add  $10 \log(1/0.25) = 6$  dB if the duty cycle is 25 percent.

**<TXBF Modes>**

**# Method SA-3 #**

(power averaging (rms) detection with max hold):

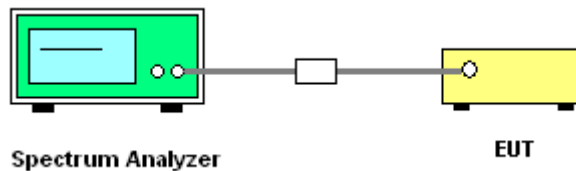
- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 300 kHz.
- Set VBW  $\geq$  1 MHz.
- Number of points in sweep  $\geq$  2 Span / RBW.
- Sweep time  $\leq$  (number of points in sweep)  $\times$  T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
- Detector = power averaging (rms).
- Trace mode = max hold.
- Allow max hold to run for at least 60 seconds, or longer as needed to allow the trace to stabilize.

1. The RF output of EUT was connected to the spectrum analyzer by a low loss cable.
2. Each plot has already offset with cable loss, and attenuator loss. Measure the PPSD and record it.
3. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

Method (b): Measure and sum spectral maxima across the outputs.

The measurement on each individual output were performed with the same span and number on each individual output. The maximum value (peak) of each spectrum is determined. These maximum values are then summed mathematically in linear power units across the outputs.

### 3.3.4 Test Setup



### 3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.





## 3.4 Unwanted Emissions Measurement

This section as specified in FCC Part 15.407(b) is to measure unwanted emissions through radiated measurement for band edge spurious emissions and out of band emissions measurement. The unwanted emissions shall comply with 15.407(b)(1) to (6), and restricted bands per FCC Part 15.205.

### 3.4.1 Limit of Unwanted Emissions

- (1) For transmitters operating in the 5150-5250 MHz band: all emissions outside of the 5150-5350 MHz band shall not exceed an EIRP of  $-27$  dBm/MHz.

For transmitters operating in the 5250-5350 MHz band: all emissions outside of the 5150-5350 MHz band shall not exceed an EIRP of  $-27$  dBm/MHz. Devices operating in the 5250-5350 MHz band that generate emissions in the 5150-5250 MHz band must meet all applicable technical requirements for operation in the 5150-5250 MHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of  $-27$  dBm/MHz in the 5150-5250 MHz band.

For transmitters operating in the 5470-5600 MHz and 5650-5725 MHz band: all emissions outside of the 5470-5600 MHz and 5650-5725 MHz band shall not exceed an EIRP of  $-27$  dBm/MHz.

- (2) For transmitters operating in the 5.725-5.85 GHz band:
- 15.407(b)(4)(i) All emissions shall be limited to a level of  $-27$  dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.



(3) Unwanted spurious emissions fallen in restricted bands shall comply with the general field strength limits as below table,

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

(4) EIRP (dBm)	Field Strength at 3m (dBµV/m)
- 27	68.2

Note: The following formula is used to convert the EIRP to field strength.

$$EIRP = E_{Meas} + 20\log(d_{Meas}) - 104.7$$

where

EIRP is the equivalent isotropically radiated power, in dBm

E<sub>Meas</sub> is the field strength of the emission at the measurement distance, in dBµV/m

d<sub>Meas</sub> is the measurement distance, in m

(4) ANSI C63.10-2013 clause 12.7.3 note 97

As specified by regulatory requirements, emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit. However, an out-of-band emission that complies with both the average and peak general regulatory limits is not required to satisfy the peak emission limit.

### 3.4.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.



### 3.4.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r04. Section G) Unwanted emissions measurement.

(1) Procedure for Unwanted Emissions Measurements Below 1000MHz

- RBW = 120 kHz
- VBW = 300 kHz
- Detector = Peak
- Trace mode = max hold

(2) Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz

- RBW = 1 MHz
- VBW  $\geq$  3 MHz
- Detector = Peak
- Sweep time = auto
- Trace mode = max hold

(3) Procedures for Average Unwanted Emissions Measurements Above 1000MHz

For CDD:

- RBW = 1 MHz
- VBW = 10 Hz, when duty cycle is no less than 98 percent.
- VBW  $\geq$  1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on.
- Detector = peak.

For TXBF:

- RBW = 1 MHz
- VBW = 3 MHz
- Detector = power averaging (rms), set span/(# of points in sweep)  $\geq$  RBW/2.
- Averaging type = power averaging(RMS)
- The correction factor shall be offset is 10 log (1/x), where x is the duty cycle.

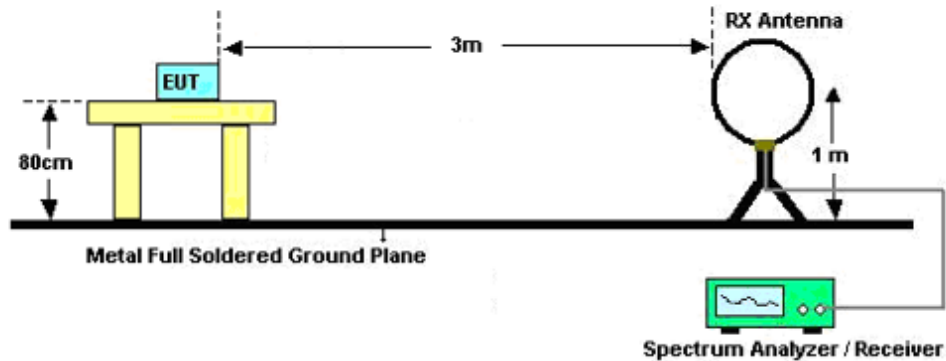
2. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband antenna and its height is adjusted between one meter and four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, the EUT was arranged to its worst case and then adjust the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the

maximum reading.

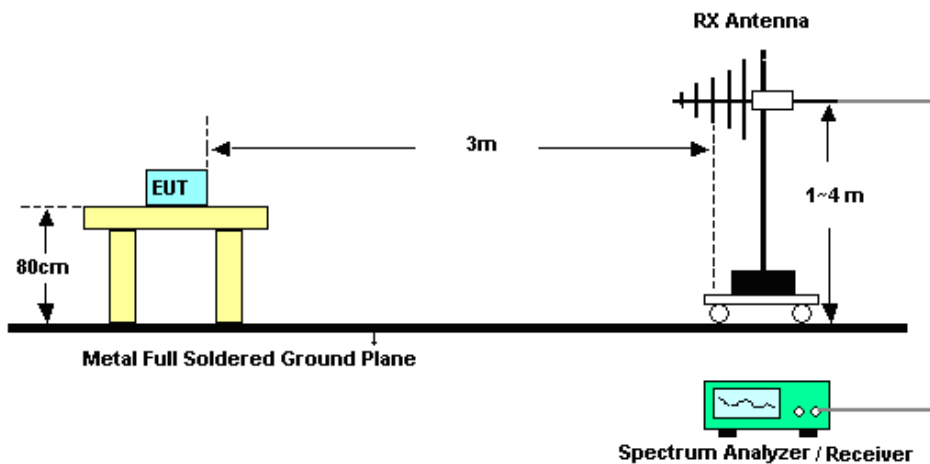
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

### 3.4.4 Test Setup

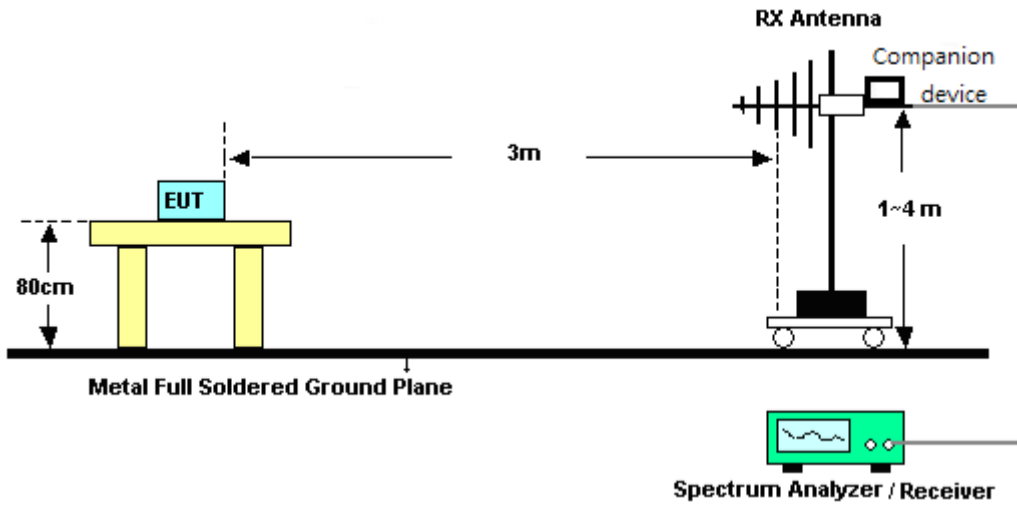
For radiated emissions below 30MHz



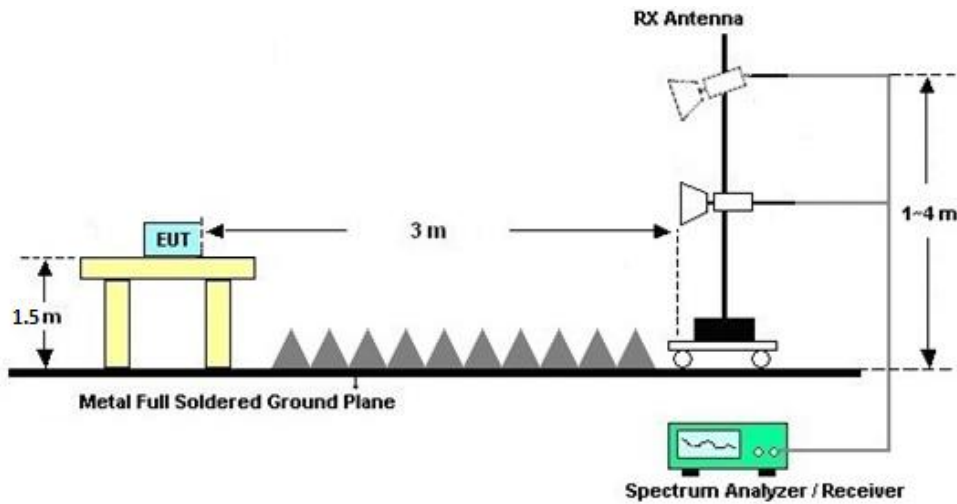
For radiated emissions from 30MHz to 1GHz



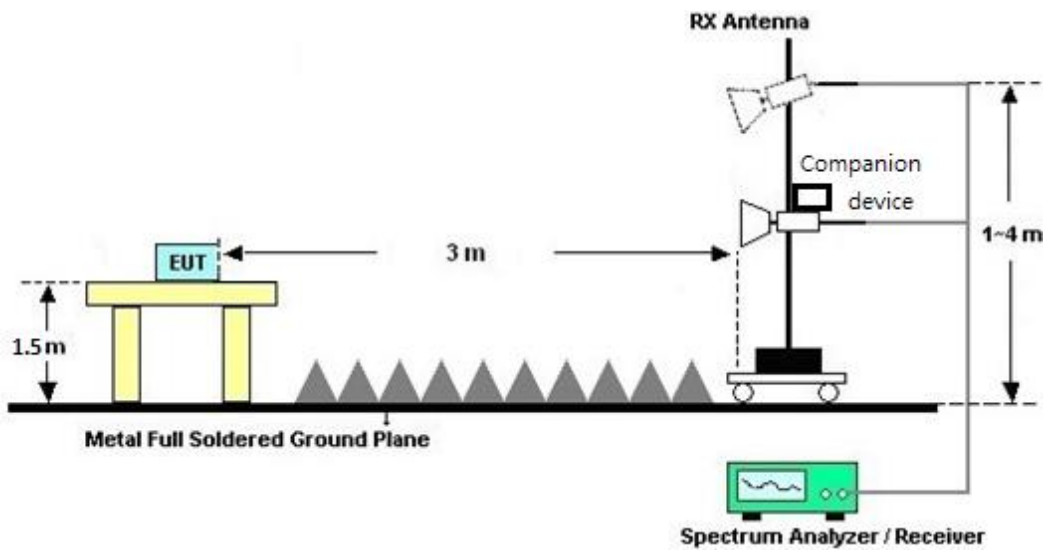
<TXBF Modes>



For radiated emissions above 1GHz



<TXBF Modes>





### **3.4.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)**

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

### **3.4.6 Test Result of Radiated Spurious at Band Edges**

Please refer to Appendix C.

### **3.4.7 Duty Cycle**

Please refer to Appendix D.

### **3.4.8 Test Result of Radiated Spurious Emissions (30MHz ~ 10th Harmonic)**

Please refer to Appendix C.



### 3.5 AC Conducted Emission Measurement

#### 3.5.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\*Decreases with the logarithm of the frequency.

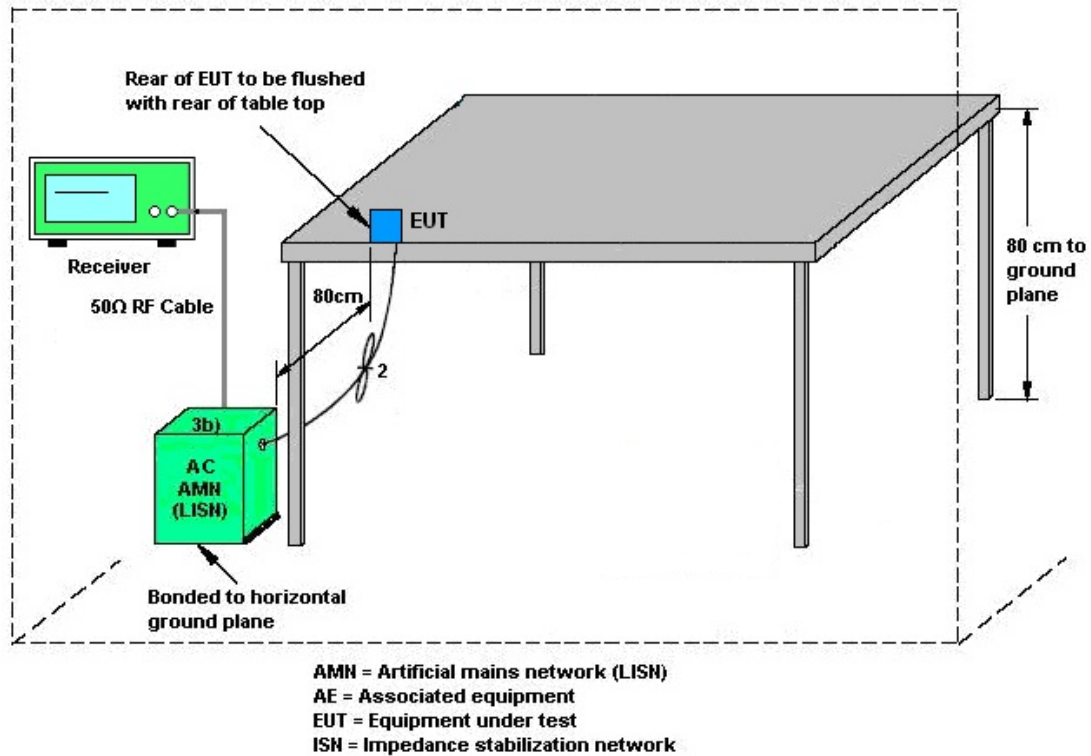
#### 3.5.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

#### 3.5.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.

### 3.5.4 Test Setup



### 3.5.5 Test Result of AC Conducted Emission

Please refer to Appendix B.





### 3.6 Antenna Requirements

#### 3.6.1 Standard Applicable

According to FCC 47 CFR Section 15.407(a)(1)(2) ,if transmitting antenna directional gain is greater than 6 dBi, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

#### 3.6.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

#### 3.6.3 Antenna Gain

<CDD Modes >

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

For CDD transmissions, directional gain is calculated as

Directional gain =  $G_{ANT}$  + Array Gain, where Array Gain is as follows.

For power spectral density (PSD) measurements on all devices,

Array Gain =  $10 \log(N_{ANT}/N_{SS}=1)$  dB.

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for  $N_{ANT} \leq 4$ .

Directional gain may be calculated by using the formulas applicable to equal gain antennas with  $G_{ANT}$  set equal to the gain of the antenna having the highest gain;

The EUT supports CDD mode for 802.11a/n/ac/ax modes.

For power, the directional gain  $G_{ANT}$  is set equal to the antenna having the highest gain, i.e., F)2)f)i).

For PSD, the directional gain calculation is following F)2)f)ii) of KDB 662911 D01 v02r01.

Directional gain =  $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / N_{ANT}]$  dBi

The power and PSD limit should be modified if the directional gain of EUT is over 6 dBi,

**TXBF modes**

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

For TXBF transmissions, directional gain is calculated as

$$DirectionalGain = 10 \cdot \log \left[ \frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

where

Each antenna is driven by no more than one spatial stream;

$N_{SS}$  = the number of independent spatial streams of data;

$N_{ANT}$  = the total number of antennas

$g_{j,k} = 10^{G_k / 20}$  if the  $k$ th antenna is being fed by spatial stream  $j$ , or zero if it is not;  
 $G_k$  is the gain in dBi of the  $k$ th antenna.

The EUT supports beamforming for 802.11n/ac/ax modes.

The directional gain calculation is following F)2)e)ii) of KDB 662911 D01 v02r01.

The power and PSD limit should be modified if the directional gain of EUT is over 6 dBi,

The directional gain “DG” is calculated as following table.

Frequency Band	Max Single Antenna gain (dBi)				CDD DG (dBi)		TXBF DG (dBi)	
	ANT1	ANT2	ANT3	ANT4	For Power	For PSD	For Power	For PSD
5GHz UNII-1	4.10	3.93	2.18	2.48	4.10	5.82	5.82	5.82
5GHz UNII-2A	4.65	3.28	2.00	2.34	4.65	5.77	5.77	5.77
5GHz UNII-2C	5.36	4.38	3.02	2.65	5.36	5.98	5.98	5.98
5GHz UNII-3	5.31	0.95	3.26	3.46	5.31	5.86	5.86	5.86

**Note:**

1. Please refer to the antenna report for the maximum Single antenna gain and CDD (Cyclic Delay Diversity) directional gain and TXBF (Tx Beamforming) directional gain.
2. The device supports 1S4T(CDD&TXBF) mode;  
 1S2T: NSS=1, MIMO 4Tx



## 4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Oct. 11, 2023	Nov. 13, 2023~Nov. 15, 2023	Oct. 10, 2024	Conducted (TH01-KS)
Pulse Power Sensor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 05, 2023	Nov. 13, 2023~Nov. 15, 2023	Jan. 04, 2024	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 05, 2023	Nov. 13, 2023~Nov. 15, 2023	Jan. 04, 2024	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz;Max 30dBm	Oct. 10, 2023	Nov. 23, 2023~Nov. 28, 2023	Oct. 09, 2024	Radiation (03CH06-KS)
EXA Spectrum Analyzer	Keysight	N9010B	MY60242126	10Hz~44GHz	Oct. 10, 2023	Nov. 23, 2023~Nov. 28, 2023	Oct. 09, 2024	Radiation (03CH06-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 10, 2023	Nov. 23, 2023~Nov. 28, 2023	Oct. 09, 2024	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6111D	49921	30MHz~1GHz	Apr. 09, 2023	Nov. 23, 2023~Nov. 28, 2023	Apr. 08, 2024	Radiation (03CH06-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00218652	1GHz~18GHz	Apr. 06, 2023	Nov. 23, 2023~Nov. 28, 2023	Apr. 05, 2024	Radiation (03CH06-KS)
SHF-EHF Horn	Com-power	AH-840	101093	18GHz~40GHz	Jan. 08, 2023	Nov. 23, 2023~Nov. 28, 2023	Jan. 07, 2024	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	380827	9KHz ~1GHZ	Jul. 06, 2023	Nov. 23, 2023~Nov. 28, 2023	Jul. 05, 2024	Radiation (03CH06-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 05, 2023	Nov. 23, 2023~Nov. 28, 2023	Jan. 04, 2024	Radiation (03CH06-KS)
high gain Amplifier	MITEQ	AMF-7D-0010 1800-30-10P	2082395	1Ghz-18Ghz	Jan. 05, 2023	Nov. 23, 2023~Nov. 28, 2023	Jan. 04, 2024	Radiation (03CH06-KS)
Amplifier	Keysight	83017A	MY53270319	500MHz~26.5GHz	Oct. 10, 2023	Nov. 23, 2023~Nov. 28, 2023	Oct. 09, 2024	Radiation (03CH06-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Nov. 23, 2023~Nov. 28, 2023	NCR	Radiation (03CH06-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Nov. 23, 2023~Nov. 28, 2023	NCR	Radiation (03CH06-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Nov. 23, 2023~Nov. 28, 2023	NCR	Radiation (03CH06-KS)
EMI Receiver	R&S	ESC17	100768	9kHz~7GHz;	May 16, 2023	Dec. 01, 2023	May 15, 2024	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 11, 2023	Dec. 01, 2023	Oct. 10, 2024	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	May 16, 2023	Dec. 01, 2023	May 15, 2024	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP0000008 11	AC 0V~300V, 45Hz~1000Hz	Oct. 11, 2023	Dec. 01, 2023	Oct. 10, 2024	Conduction (CO01-KS)

NCR: No Calibration Required



## 5 Measurement Uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage K=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

### Uncertainty of Conducted Measurement

Conducted Spurious Emission & Bandedge	±2.26 dB
Occupied Channel Bandwidth	±0.1%
Conducted Power	±0.46 dB
Conducted Power Spectral Density	±0.88 dB
Frequency	±0.4 Hz

### Uncertainty of AC Conducted Emission Measurement (0.15 MHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	2.94 dB
---------------------------------------------------------------------	---------

### Uncertainty of Radiated Emission Measurement (9 KHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	3.32 dB
---------------------------------------------------------------------	---------

### Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	6.26 dB
---------------------------------------------------------------------	---------

### Uncertainty of Radiated Emission Measurement (1 GHz ~ 18 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.02 dB
---------------------------------------------------------------------	---------

### Uncertainty of Radiated Emission Measurement (18 GHz ~ 40 GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.26 dB
---------------------------------------------------------------------	---------

----- THE END -----



## Appendix A. Conducted Test Results



Ambient Condition: 25 °C, 45 %RH

Test Date: 2023.11.13~11.15

Test Engineer: Long Wu

<CDD 1S4T>:

26dB Emission Bandwidth

Test Result

TestMode	Antenna	Freq(MHz)	26dB EBW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11A-CDD	Ant1	5180	21.08	5169.48	5190.56	---	---
	Ant2	5180	21.36	5169.24	5190.60	---	---
	Ant3	5180	21.32	5169.20	5190.52	---	---
	Ant4	5180	21.44	5169.12	5190.56	---	---
	Ant1	5220	27.60	5206.12	5233.72	---	---
	Ant2	5220	24.76	5206.84	5231.60	---	---
	Ant3	5220	32.20	5203.08	5235.28	---	---
	Ant4	5220	30.16	5205.20	5235.36	---	---
	Ant1	5240	25.72	5227.16	5252.88	---	---
	Ant2	5240	23.12	5228.68	5251.80	---	---
	Ant3	5240	25.48	5227.12	5252.60	---	---
	Ant4	5240	28.40	5227.00	5255.40	---	---
	Ant1	5260	21.16	5249.32	5270.48	---	---
	Ant2	5260	21.24	5249.44	5270.68	---	---
	Ant3	5260	21.12	5249.40	5270.52	---	---
	Ant4	5260	21.16	5249.44	5270.60	---	---
	Ant1	5300	21.16	5289.44	5310.60	---	---
	Ant2	5300	21.12	5289.40	5310.52	---	---
	Ant3	5300	21.04	5289.44	5310.48	---	---
	Ant4	5300	21.28	5289.32	5310.60	---	---
	Ant1	5320	21.08	5309.48	5330.56	---	---
	Ant2	5320	21.16	5309.36	5330.52	---	---
	Ant3	5320	21.28	5309.40	5330.68	---	---
	Ant4	5320	21.32	5309.20	5330.52	---	---
	Ant1	5500	21.16	5489.44	5510.60	---	---
	Ant2	5500	21.08	5489.56	5510.64	---	---
	Ant3	5500	21.16	5489.44	5510.60	---	---
	Ant4	5500	21.00	5489.52	5510.52	---	---
	Ant1	5580	21.32	5569.32	5590.64	---	---
	Ant2	5580	21.20	5569.36	5590.56	---	---
	Ant3	5580	21.08	5569.56	5590.64	---	---
	Ant4	5580	21.28	5569.20	5590.48	---	---
	Ant1	5700	21.12	5689.44	5710.56	---	---
	Ant2	5700	21.28	5689.44	5710.72	---	---
	Ant3	5700	20.88	5689.56	5710.44	---	---
	Ant4	5700	21.12	5689.52	5710.64	---	---
	Ant1	5720	21.28	5709.36	5730.64	---	---
	Ant2	5720	21.32	5709.60	5730.92	---	---
	Ant3	5720	21.24	5709.24	5730.48	---	---
	Ant4	5720	21.08	5709.44	5730.52	---	---



	Ant1	5745	22.44	5733.36	5755.80	---	---
	Ant2	5745	23.36	5733.12	5756.48	---	---
	Ant3	5745	23.52	5732.84	5756.36	---	---
	Ant4	5745	21.20	5734.44	5755.64	---	---
	Ant1	5785	23.44	5773.56	5797.00	---	---
	Ant2	5785	21.76	5774.28	5796.04	---	---
	Ant3	5785	22.64	5773.96	5796.60	---	---
	Ant4	5785	21.12	5774.48	5795.60	---	---
	Ant1	5825	24.96	5811.96	5836.92	---	---
	Ant2	5825	22.44	5813.28	5835.72	---	---
	Ant3	5825	26.04	5812.12	5838.16	---	---
	Ant4	5825	22.52	5813.08	5835.60	---	---
11AX20MIMO	Ant1	5180	26.20	5166.92	5193.12	---	---
	Ant2	5180	33.04	5164.84	5197.88	---	---
	Ant3	5180	26.92	5166.40	5193.32	---	---
	Ant4	5180	27.56	5166.80	5194.36	---	---
	Ant1	5220	28.80	5206.08	5234.88	---	---
	Ant2	5220	30.00	5205.16	5235.16	---	---
	Ant3	5220	36.00	5202.08	5238.08	---	---
	Ant4	5220	35.64	5202.52	5238.16	---	---
	Ant1	5240	30.68	5224.76	5255.44	---	---
	Ant2	5240	29.76	5226.40	5256.16	---	---
	Ant3	5240	32.32	5225.12	5257.44	---	---
	Ant4	5240	29.60	5223.80	5253.40	---	---
	Ant1	5260	21.24	5249.40	5270.64	---	---
	Ant2	5260	21.44	5249.32	5270.76	---	---
	Ant3	5260	21.36	5249.24	5270.60	---	---
	Ant4	5260	21.44	5249.32	5270.76	---	---
	Ant1	5300	21.48	5289.28	5310.76	---	---
	Ant2	5300	21.40	5289.28	5310.68	---	---
	Ant3	5300	21.56	5289.20	5310.76	---	---
	Ant4	5300	21.28	5289.40	5310.68	---	---
	Ant1	5320	21.60	5309.20	5330.80	---	---
	Ant2	5320	21.60	5309.16	5330.76	---	---
	Ant3	5320	21.28	5309.36	5330.64	---	---
	Ant4	5320	21.40	5309.40	5330.80	---	---
	Ant1	5500	21.20	5489.44	5510.64	---	---
	Ant2	5500	21.52	5489.32	5510.84	---	---
	Ant3	5500	21.24	5489.36	5510.60	---	---
	Ant4	5500	21.36	5489.32	5510.68	---	---
	Ant1	5580	21.56	5569.12	5590.68	---	---
	Ant2	5580	21.28	5569.40	5590.68	---	---
	Ant3	5580	21.20	5569.40	5590.60	---	---
	Ant4	5580	21.36	5569.28	5590.64	---	---
	Ant1	5700	21.56	5689.24	5710.80	---	---
	Ant2	5700	21.60	5689.20	5710.80	---	---
	Ant3	5700	21.44	5689.36	5710.80	---	---
	Ant4	5700	21.48	5689.32	5710.80	---	---
	Ant1	5720	21.72	5709.04	5730.76	---	---
	Ant2	5720	21.44	5709.32	5730.76	---	---
	Ant3	5720	21.28	5709.32	5730.60	---	---



	Ant4	5720	21.48	5709.20	5730.68	---	---
	Ant1	5745	28.72	5729.20	5757.92	---	---
	Ant2	5745	31.40	5730.48	5761.88	---	---
	Ant3	5745	33.52	5728.96	5762.48	---	---
	Ant4	5745	29.60	5730.44	5760.04	---	---
	Ant1	5785	36.92	5767.72	5804.64	---	---
	Ant2	5785	32.84	5770.68	5803.52	---	---
	Ant3	5785	36.44	5766.96	5803.40	---	---
	Ant4	5785	25.80	5771.44	5797.24	---	---
	Ant1	5825	33.92	5806.96	5840.88	---	---
	Ant2	5825	28.92	5809.32	5838.24	---	---
	Ant3	5825	39.92	5805.04	5844.96	---	---
	Ant4	5825	27.04	5810.84	5837.88	---	---
11AX40MIMO	Ant1	5190	40.80	5169.68	5210.48	---	---
	Ant2	5190	40.56	5169.76	5210.32	---	---
	Ant3	5190	40.48	5169.76	5210.24	---	---
	Ant4	5190	40.56	5169.68	5210.24	---	---
	Ant1	5230	79.84	5190.08	5269.92	---	---
	Ant2	5230	78.32	5190.48	5268.80	---	---
	Ant3	5230	79.84	5190.08	5269.92	---	---
	Ant4	5230	79.84	5190.08	5269.92	---	---
	Ant1	5270	40.96	5249.52	5290.48	---	---
	Ant2	5270	40.48	5249.76	5290.24	---	---
	Ant3	5270	40.80	5249.76	5290.56	---	---
	Ant4	5270	40.56	5249.68	5290.24	---	---
	Ant1	5310	40.96	5289.60	5330.56	---	---
	Ant2	5310	40.40	5289.84	5330.24	---	---
	Ant3	5310	40.64	5289.68	5330.32	---	---
	Ant4	5310	40.56	5289.76	5330.32	---	---
	Ant1	5510	40.80	5489.68	5530.48	---	---
	Ant2	5510	40.48	5489.84	5530.32	---	---
	Ant3	5510	40.56	5489.76	5530.32	---	---
	Ant4	5510	40.48	5489.76	5530.24	---	---
	Ant1	5550	40.64	5529.76	5570.40	---	---
	Ant2	5550	40.56	5529.76	5570.32	---	---
	Ant3	5550	40.24	5529.84	5570.08	---	---
	Ant4	5550	40.56	5529.76	5570.32	---	---
	Ant1	5670	40.72	5649.68	5690.40	---	---
	Ant2	5670	40.80	5649.68	5690.48	---	---
	Ant3	5670	40.48	5649.76	5690.24	---	---
	Ant4	5670	40.40	5649.84	5690.24	---	---
	Ant1	5710	40.80	5689.52	5730.32	---	---
	Ant2	5710	40.56	5689.84	5730.40	---	---
	Ant3	5710	40.72	5689.68	5730.40	---	---
	Ant4	5710	40.48	5689.84	5730.32	---	---
	Ant1	5755	72.16	5717.08	5789.24	---	---
	Ant2	5755	61.84	5723.88	5785.72	---	---
	Ant3	5755	74.48	5717.24	5791.72	---	---
	Ant4	5755	70.08	5716.92	5787.00	---	---
	Ant1	5795	75.68	5756.76	5832.44	---	---
	Ant2	5795	69.76	5757.00	5826.76	---	---

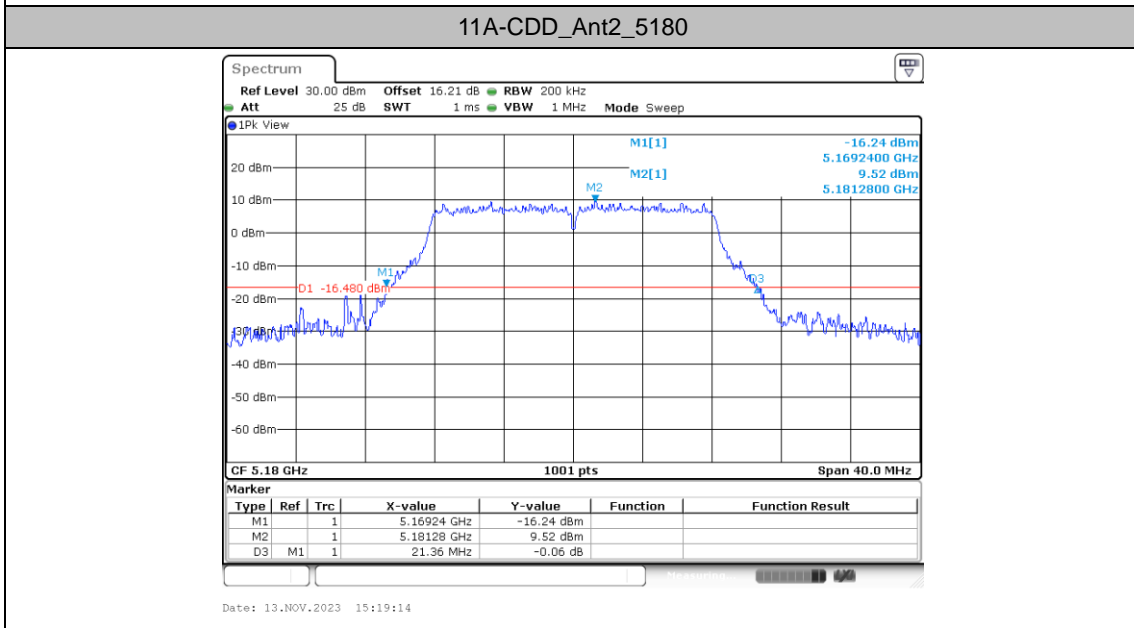
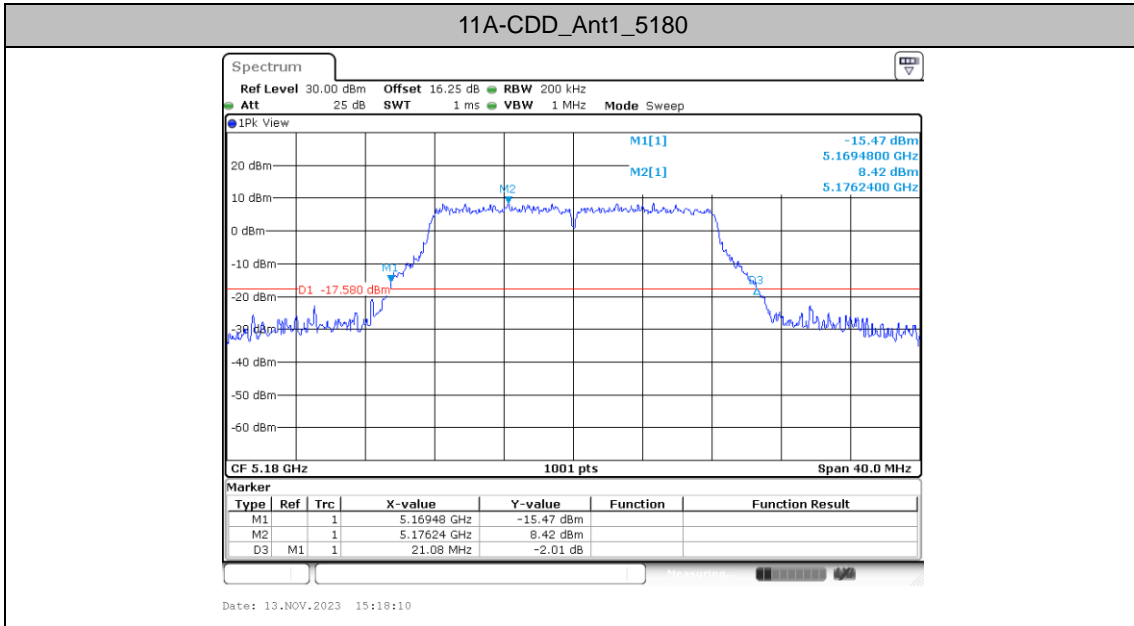


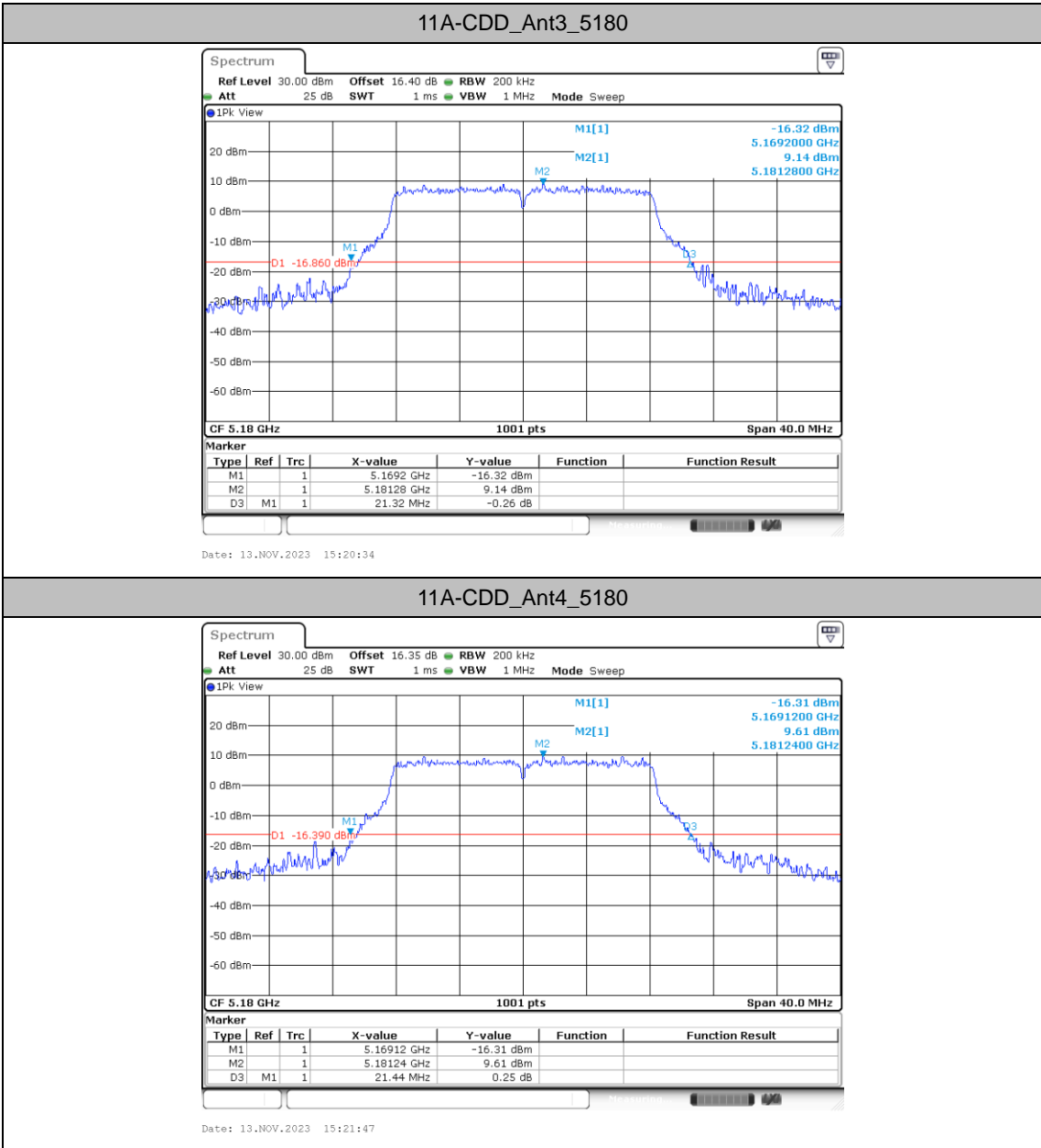


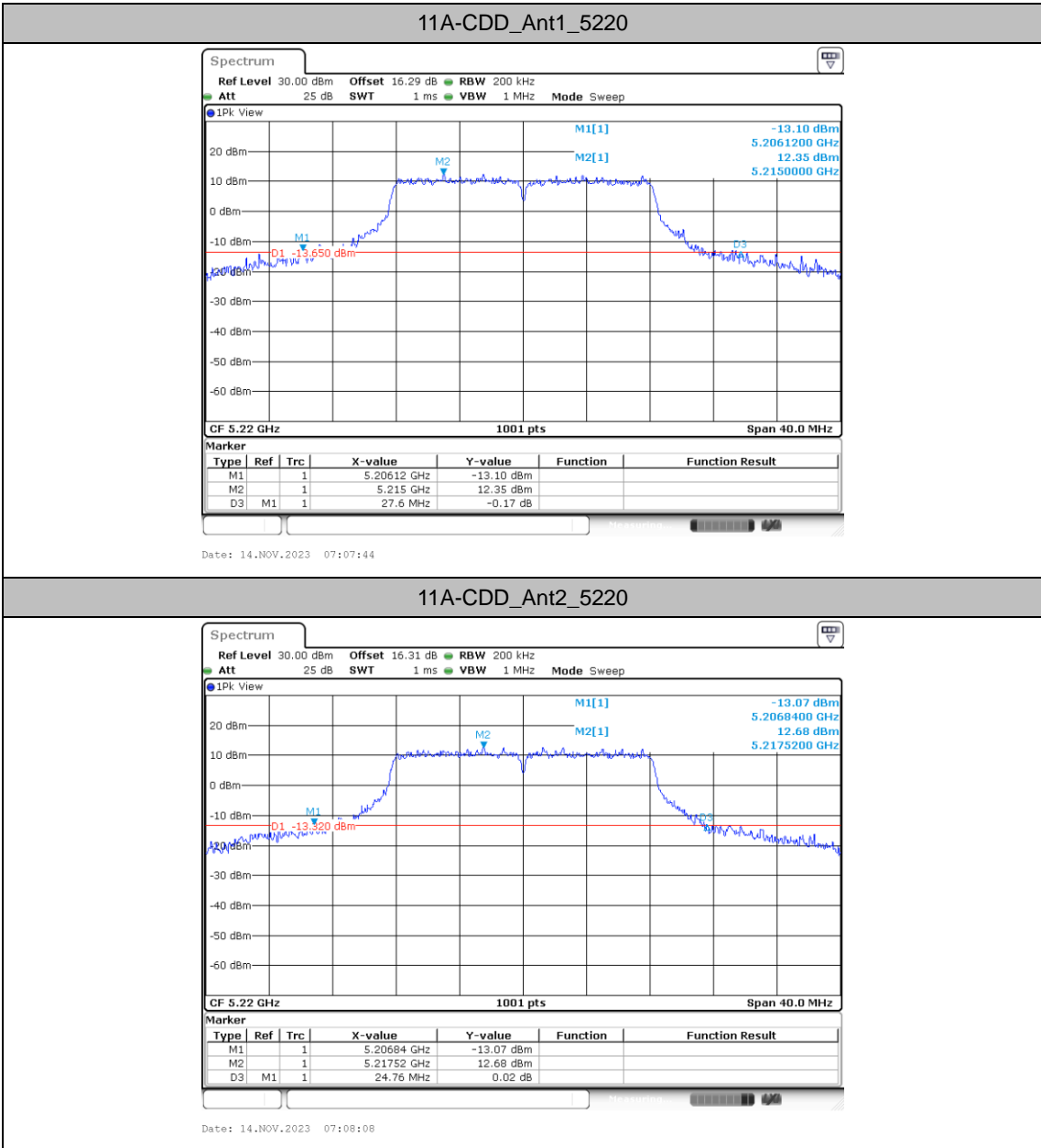
	Ant3	5795	57.04	5766.52	5823.56	---	---
	Ant4	5795	66.32	5757.24	5823.56	---	---
11AX80MIMO	Ant1	5210	81.92	5169.36	5251.28	---	---
	Ant2	5210	81.92	5169.36	5251.28	---	---
	Ant3	5210	81.76	5169.36	5251.12	---	---
	Ant4	5210	82.08	5169.04	5251.12	---	---
	Ant1	5290	82.08	5249.04	5331.12	---	---
	Ant2	5290	82.08	5249.20	5331.28	---	---
	Ant3	5290	81.76	5249.20	5330.96	---	---
	Ant4	5290	82.24	5248.88	5331.12	---	---
	Ant1	5530	82.08	5489.20	5571.28	---	---
	Ant2	5530	81.92	5489.20	5571.12	---	---
	Ant3	5530	82.24	5489.04	5571.28	---	---
	Ant4	5530	81.76	5489.20	5570.96	---	---
	Ant1	5610	82.08	5569.20	5651.28	---	---
	Ant2	5610	81.92	5569.36	5651.28	---	---
	Ant3	5610	81.44	5569.36	5650.80	---	---
	Ant4	5610	82.08	5569.20	5651.28	---	---
	Ant1	5690	82.40	5649.04	5731.44	---	---
	Ant2	5690	82.56	5648.88	5731.44	---	---
	Ant3	5690	82.24	5649.20	5731.44	---	---
	Ant4	5690	82.24	5648.88	5731.12	---	---
	Ant1	5775	82.56	5734.04	5816.60	---	---
	Ant2	5775	82.24	5734.04	5816.28	---	---
	Ant3	5775	82.08	5734.04	5816.12	---	---
	Ant4	5775	81.76	5734.04	5815.80	---	---
11AX160MIMO	Ant1	5250	165.76	5167.44	5333.20	---	---
	Ant2	5250	164.80	5168.08	5332.88	---	---
	Ant3	5250	164.80	5167.76	5332.56	---	---
	Ant4	5250	164.48	5168.08	5332.56	---	---
	Ant1	5570	165.12	5487.76	5652.88	---	---
	Ant2	5570	164.16	5488.40	5652.56	---	---
	Ant3	5570	165.76	5487.12	5652.88	---	---
	Ant4	5570	165.12	5487.44	5652.56	---	---



Test Graphs

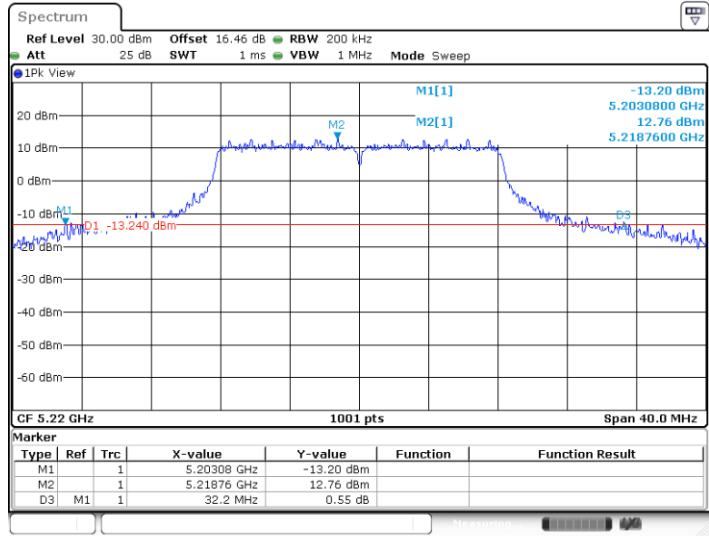






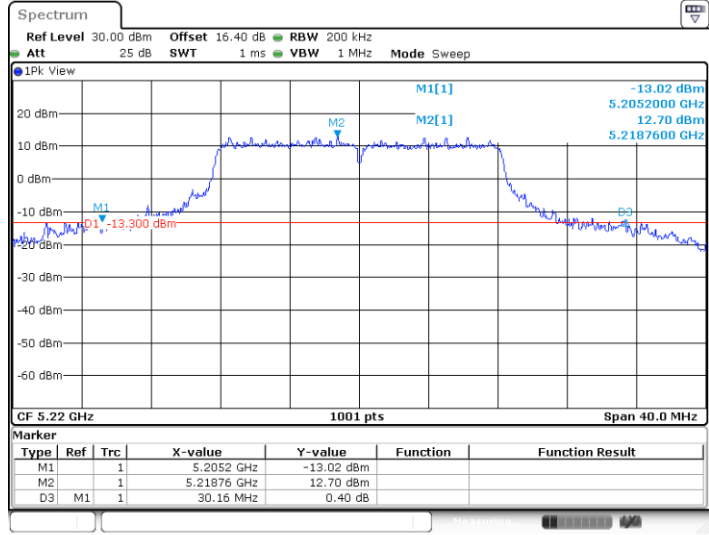


11A-CDD\_Ant3\_5220

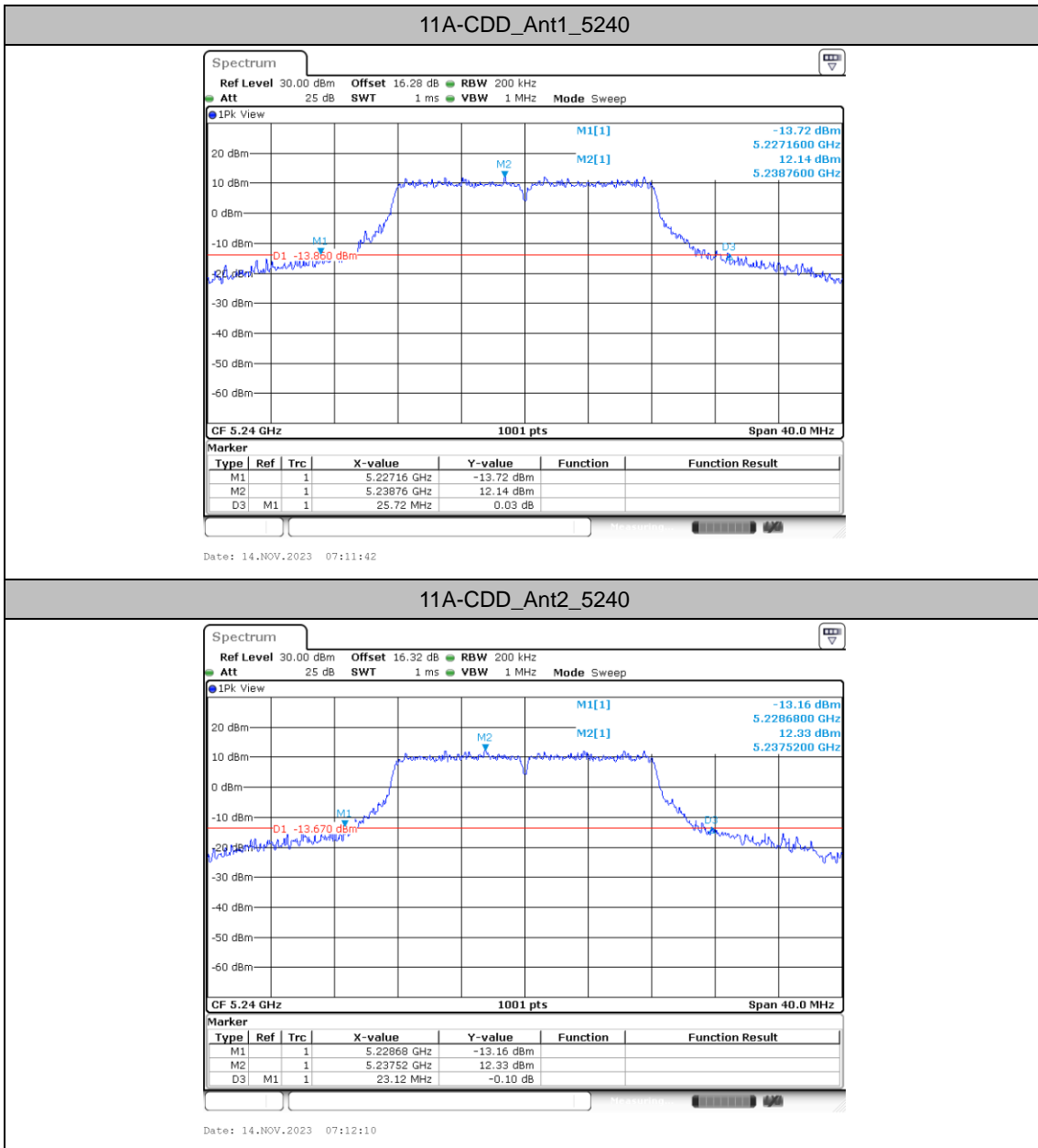


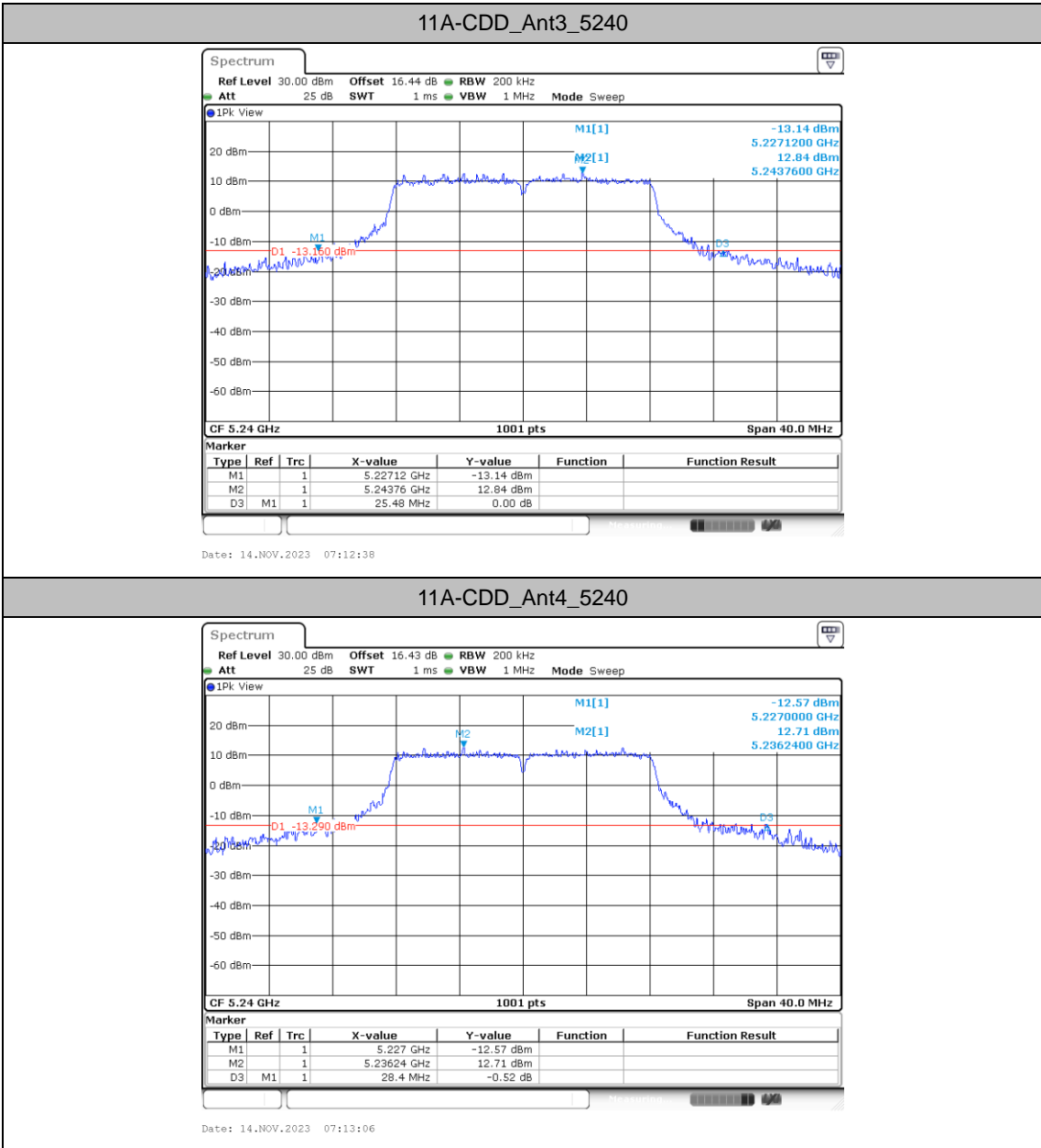
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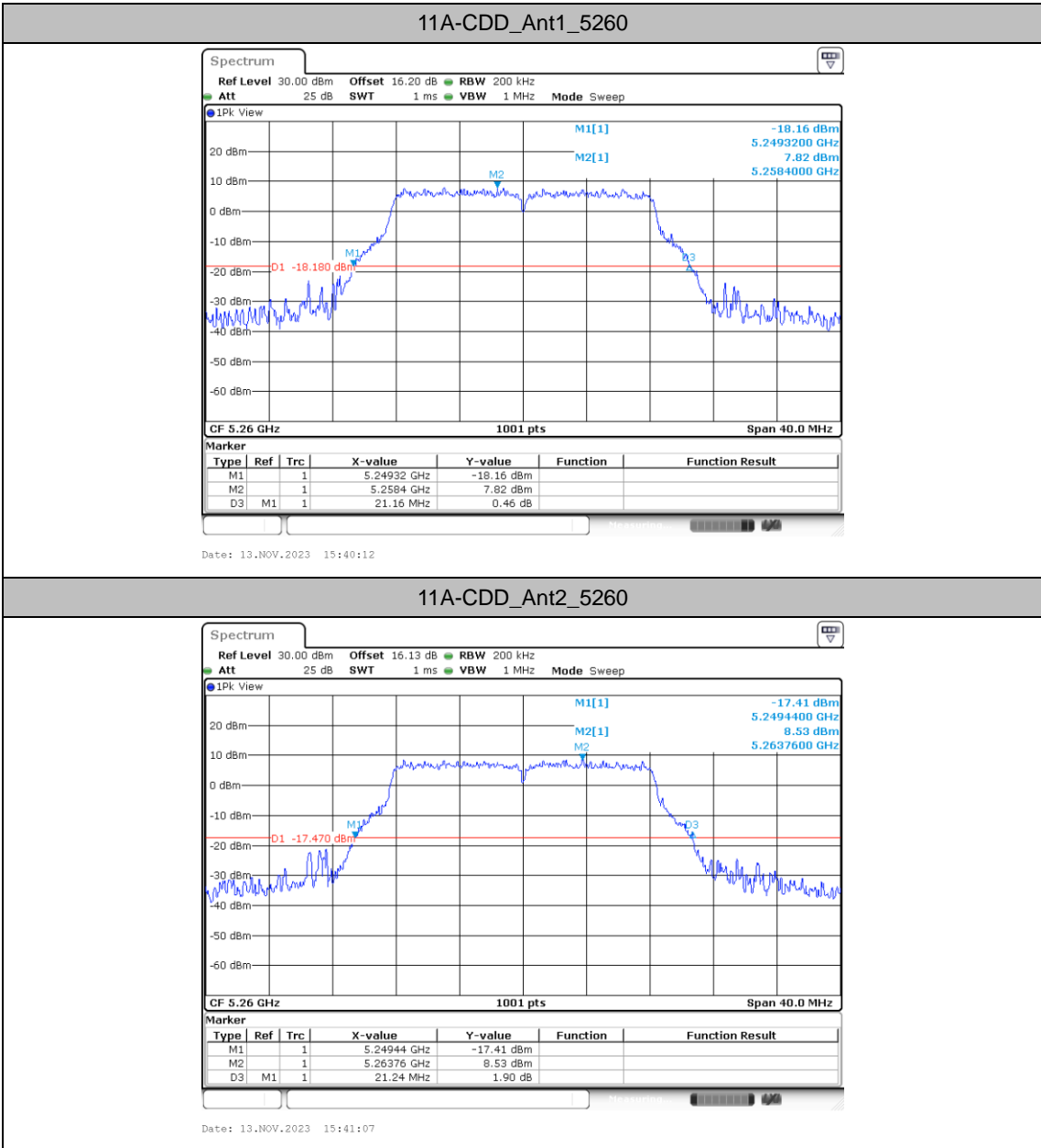
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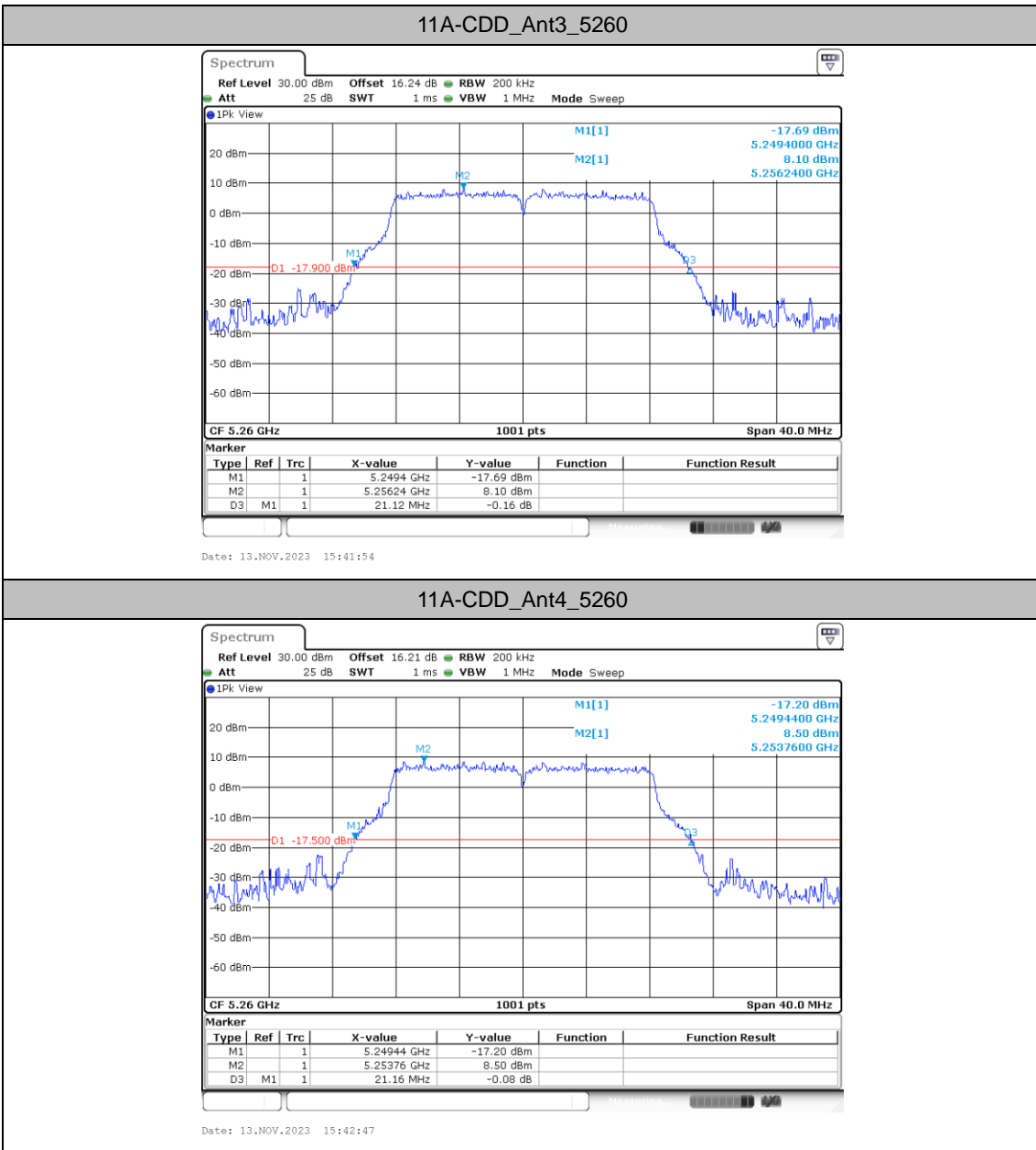
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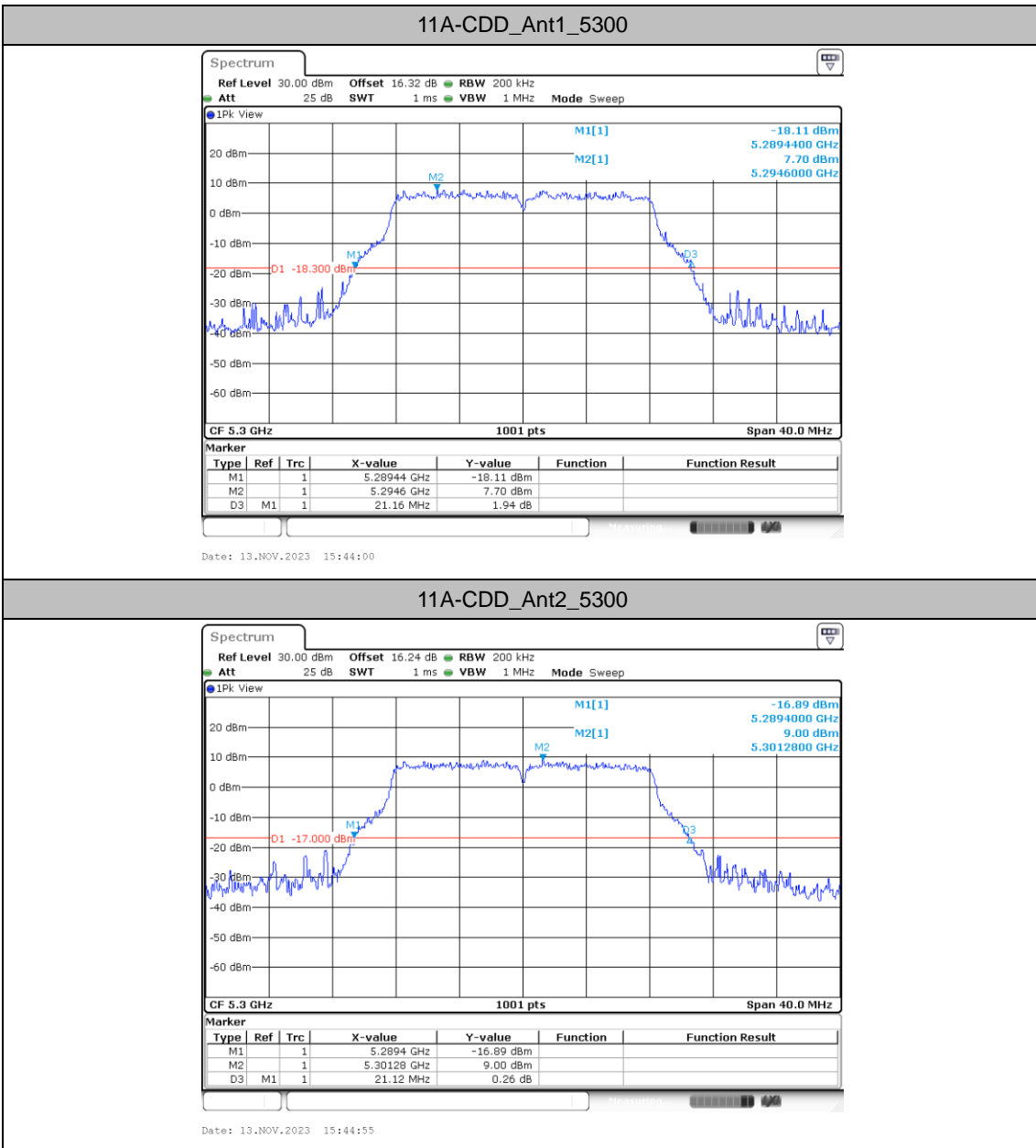


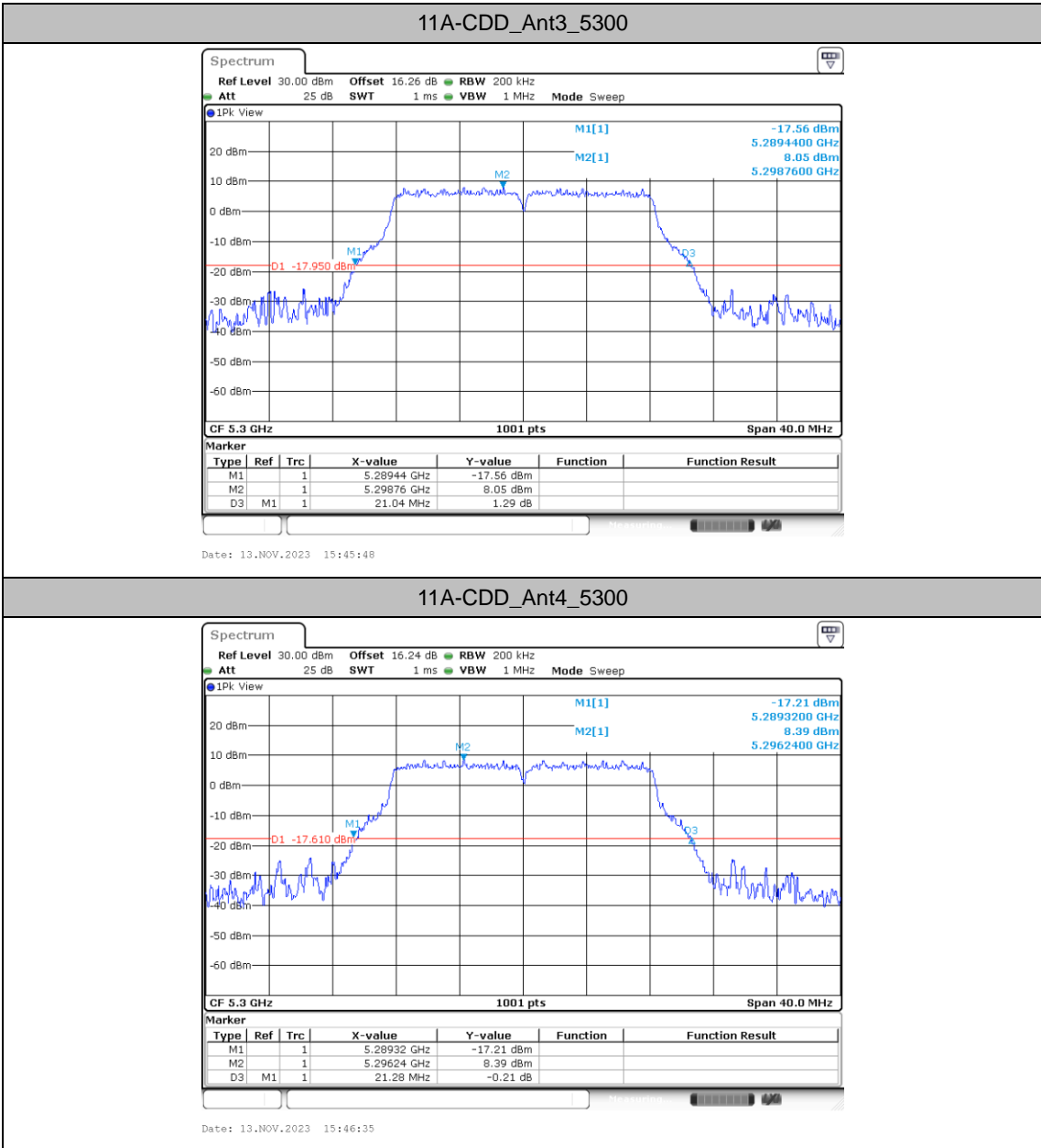


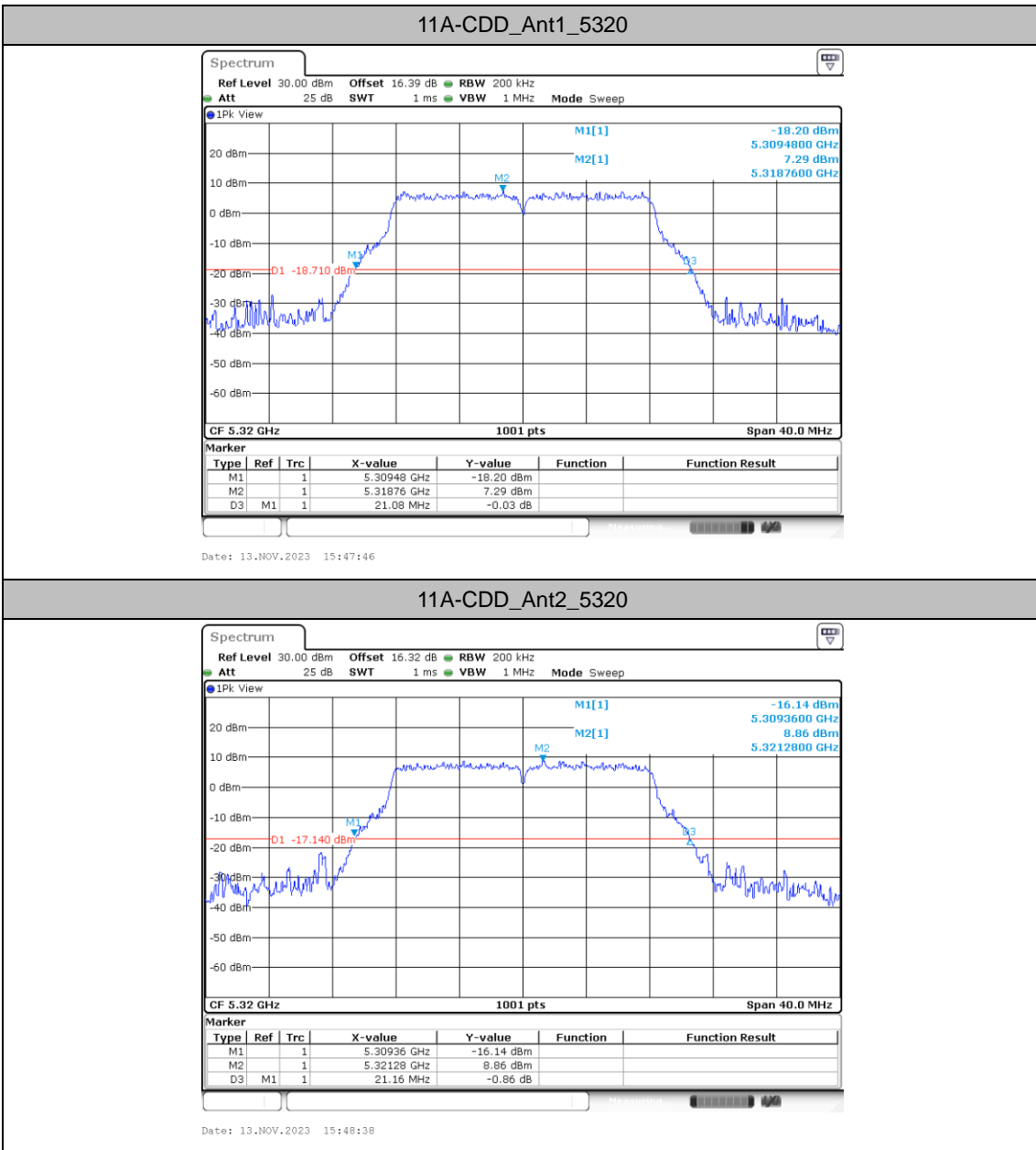


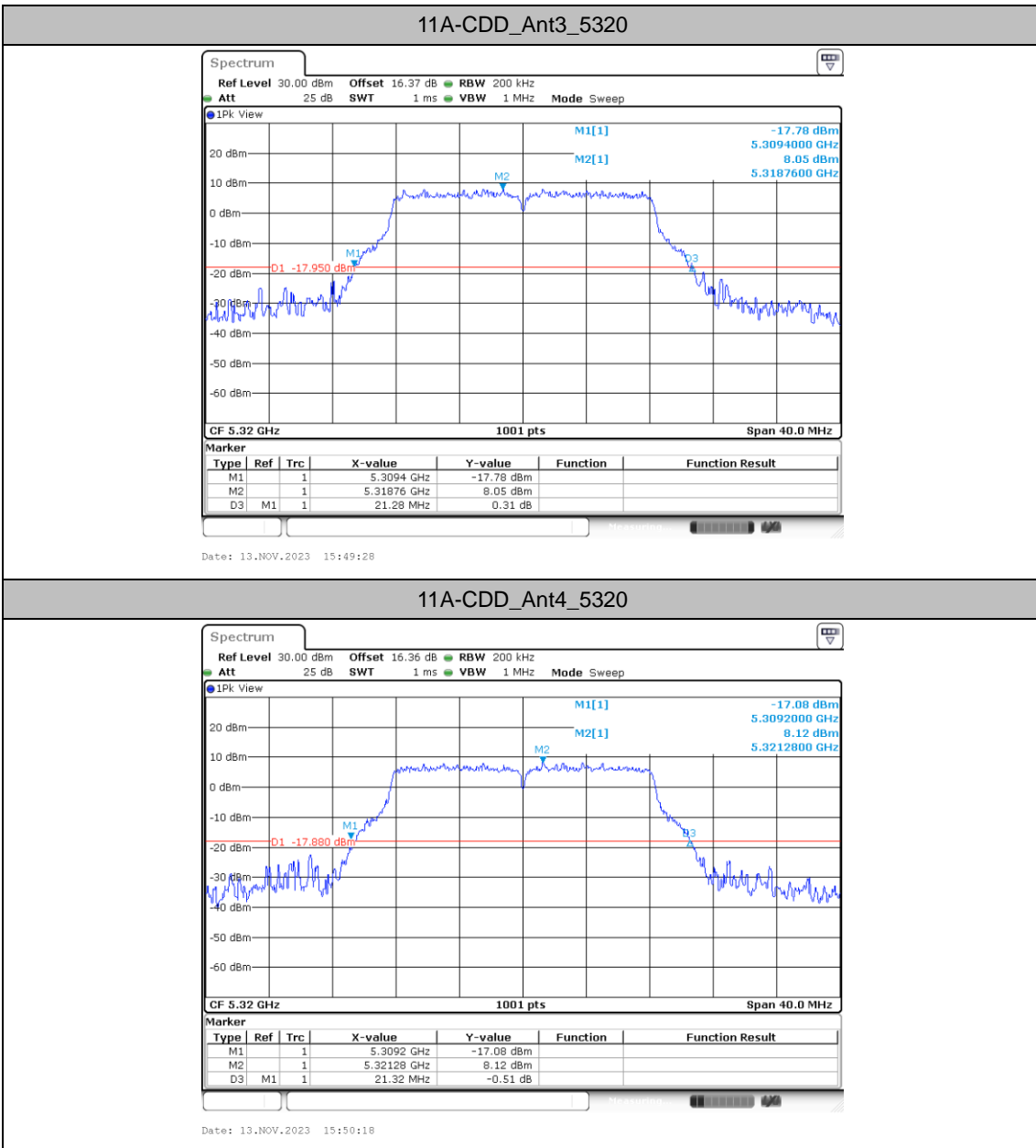


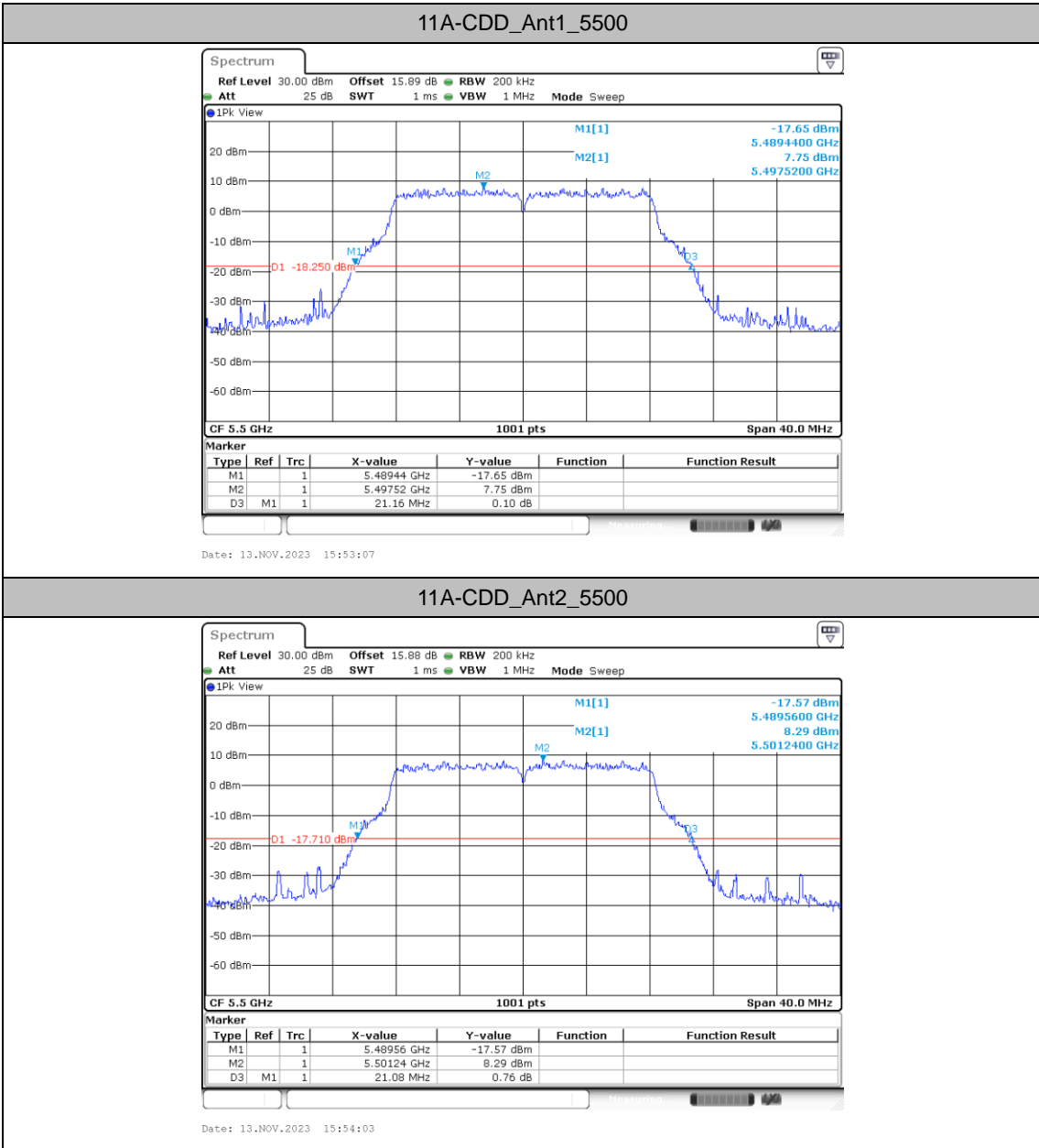


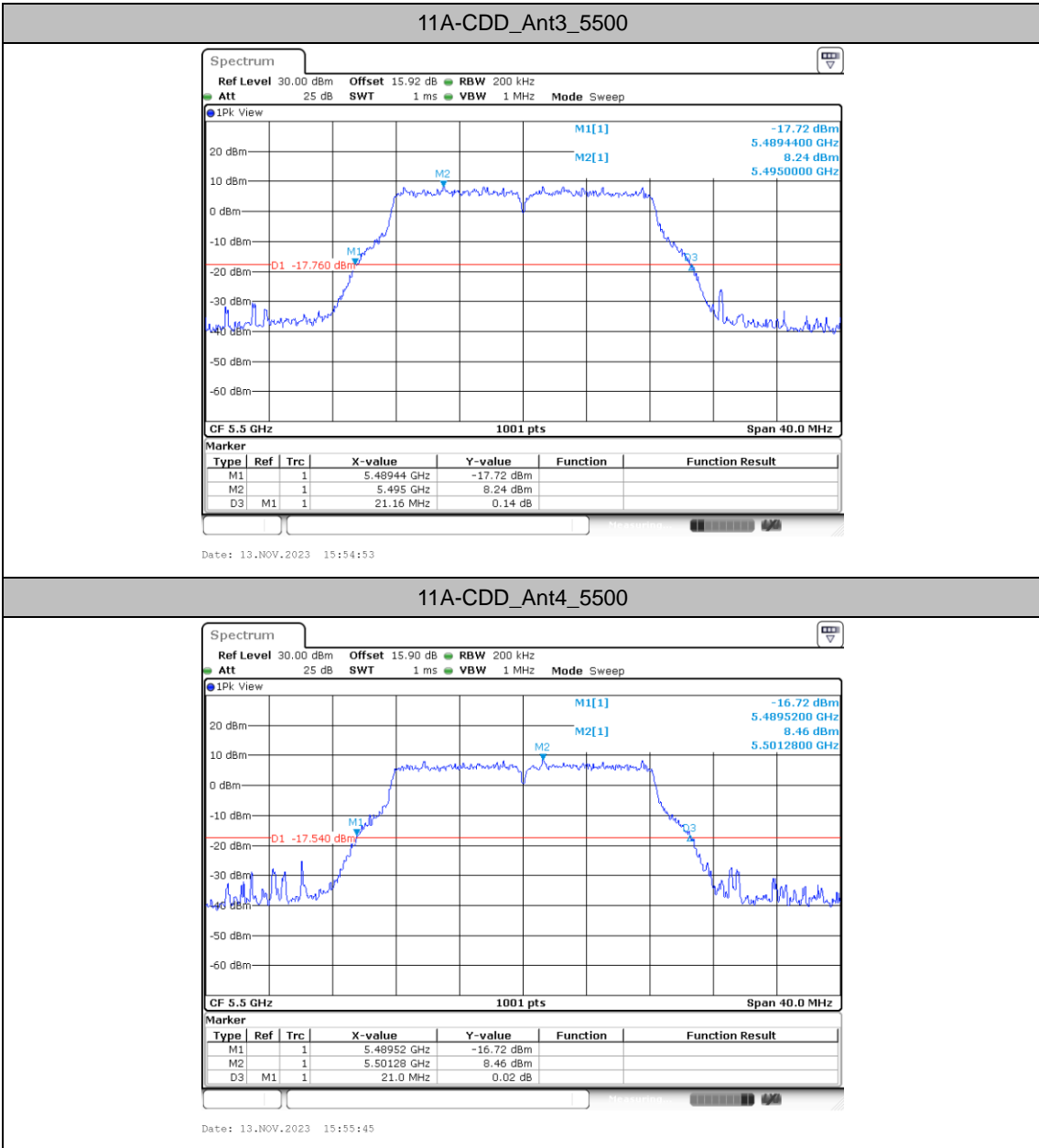


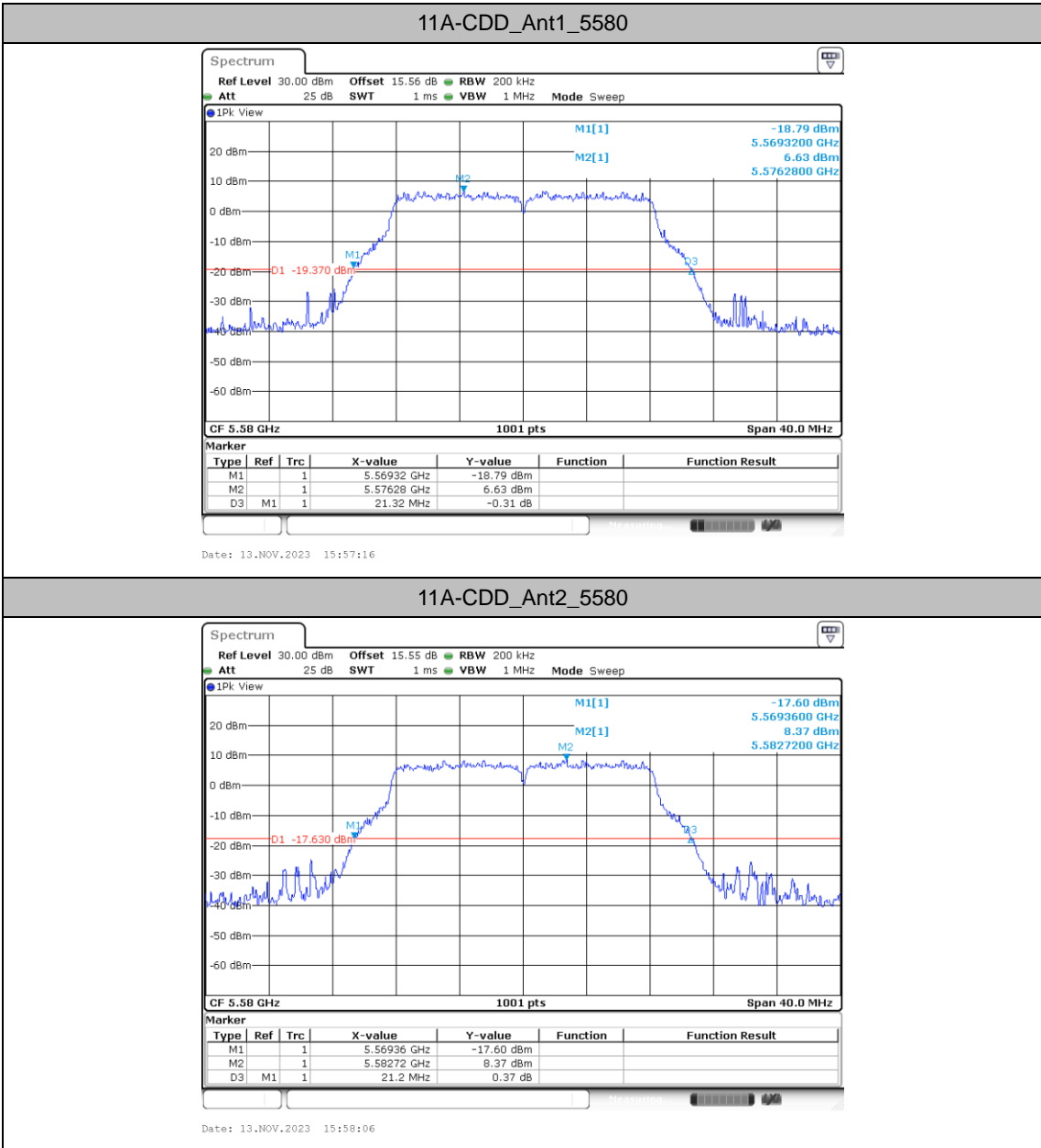




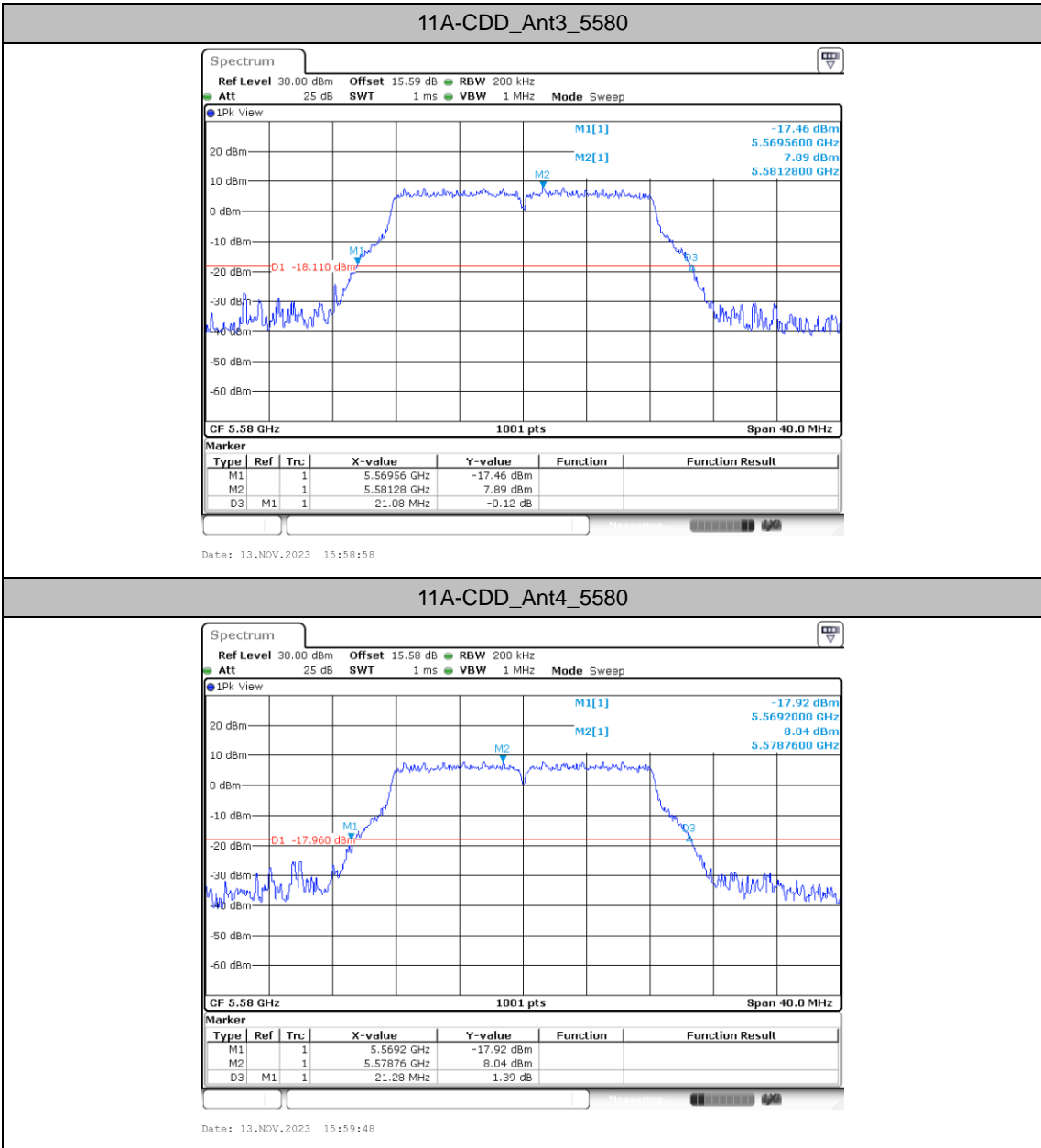


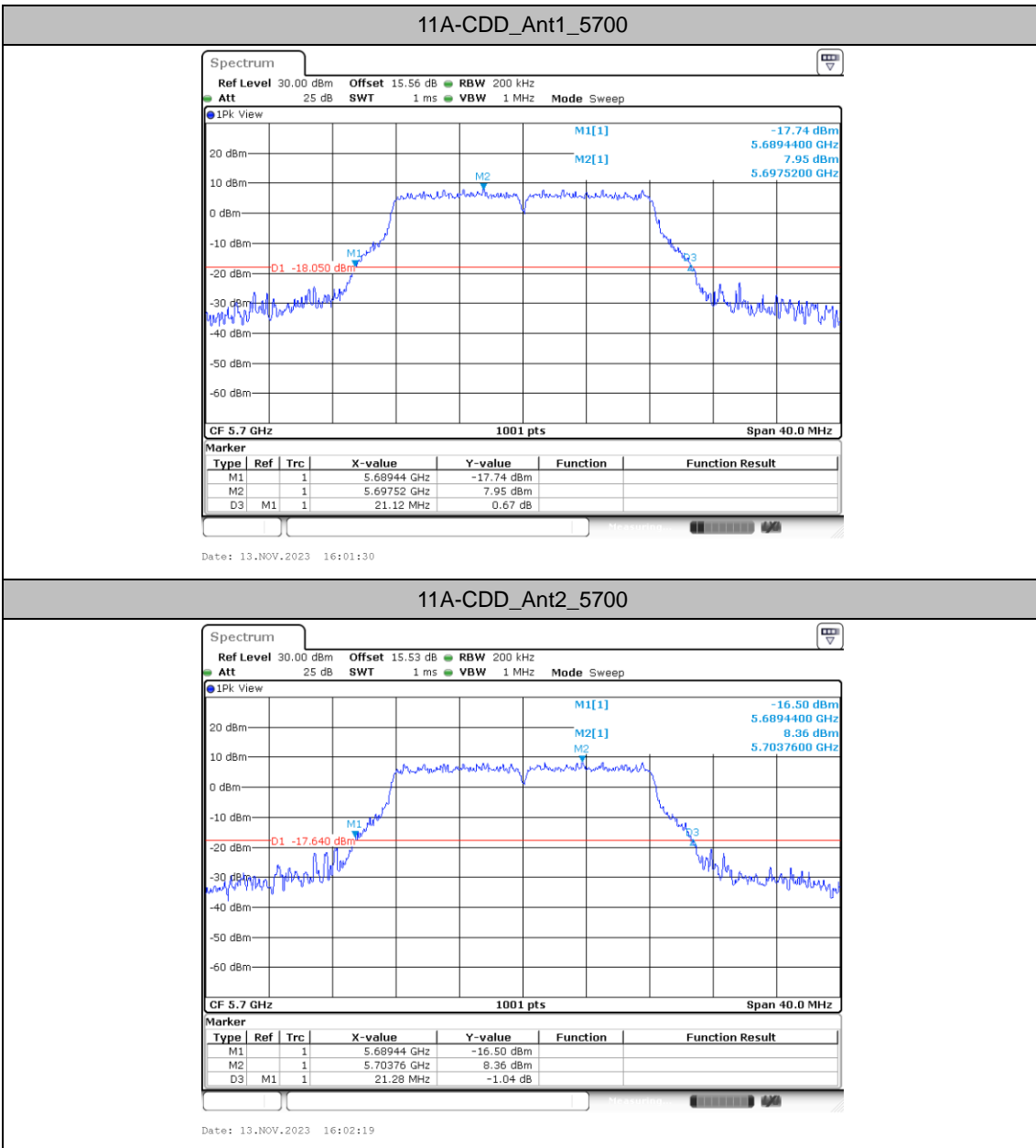


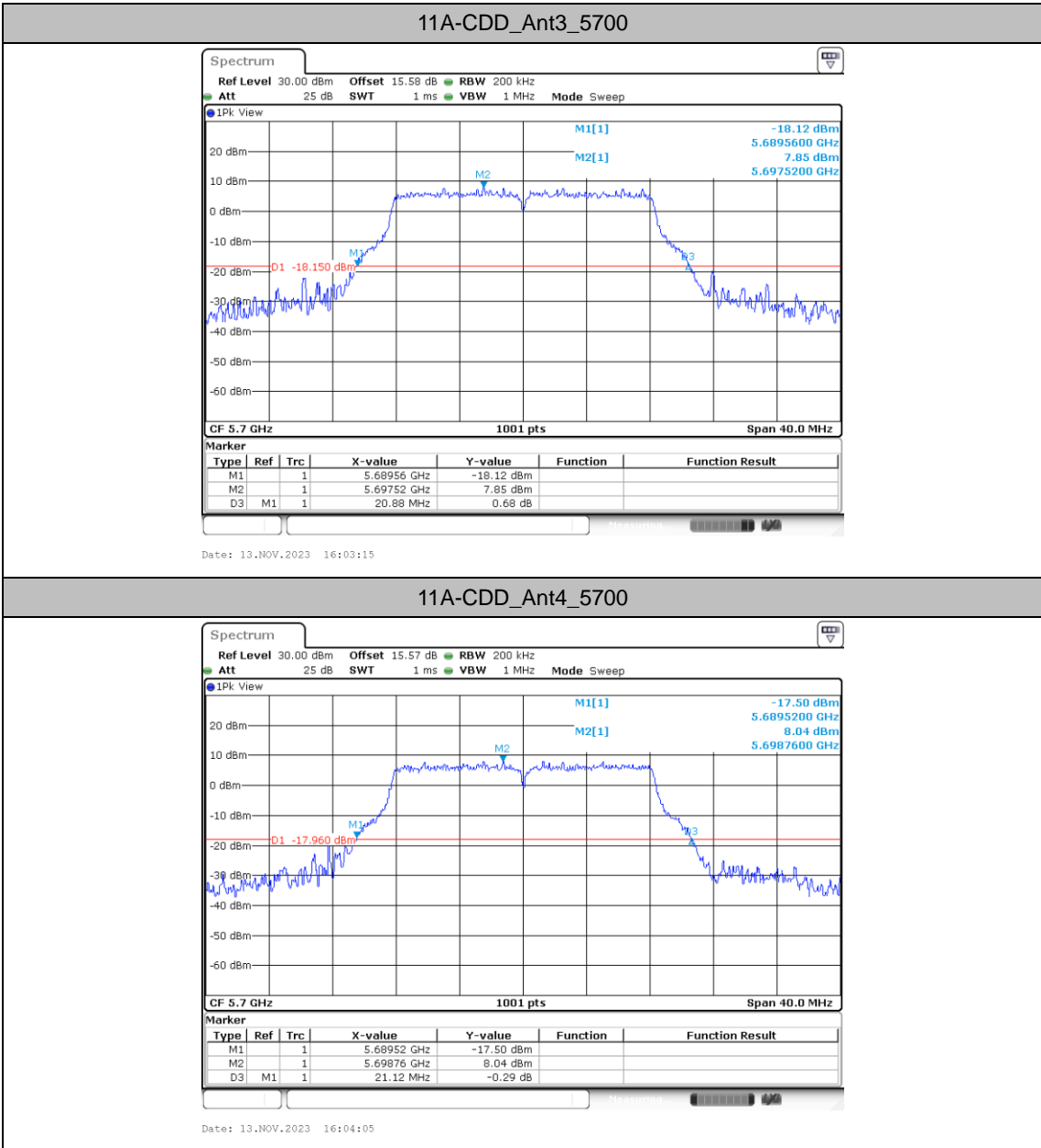


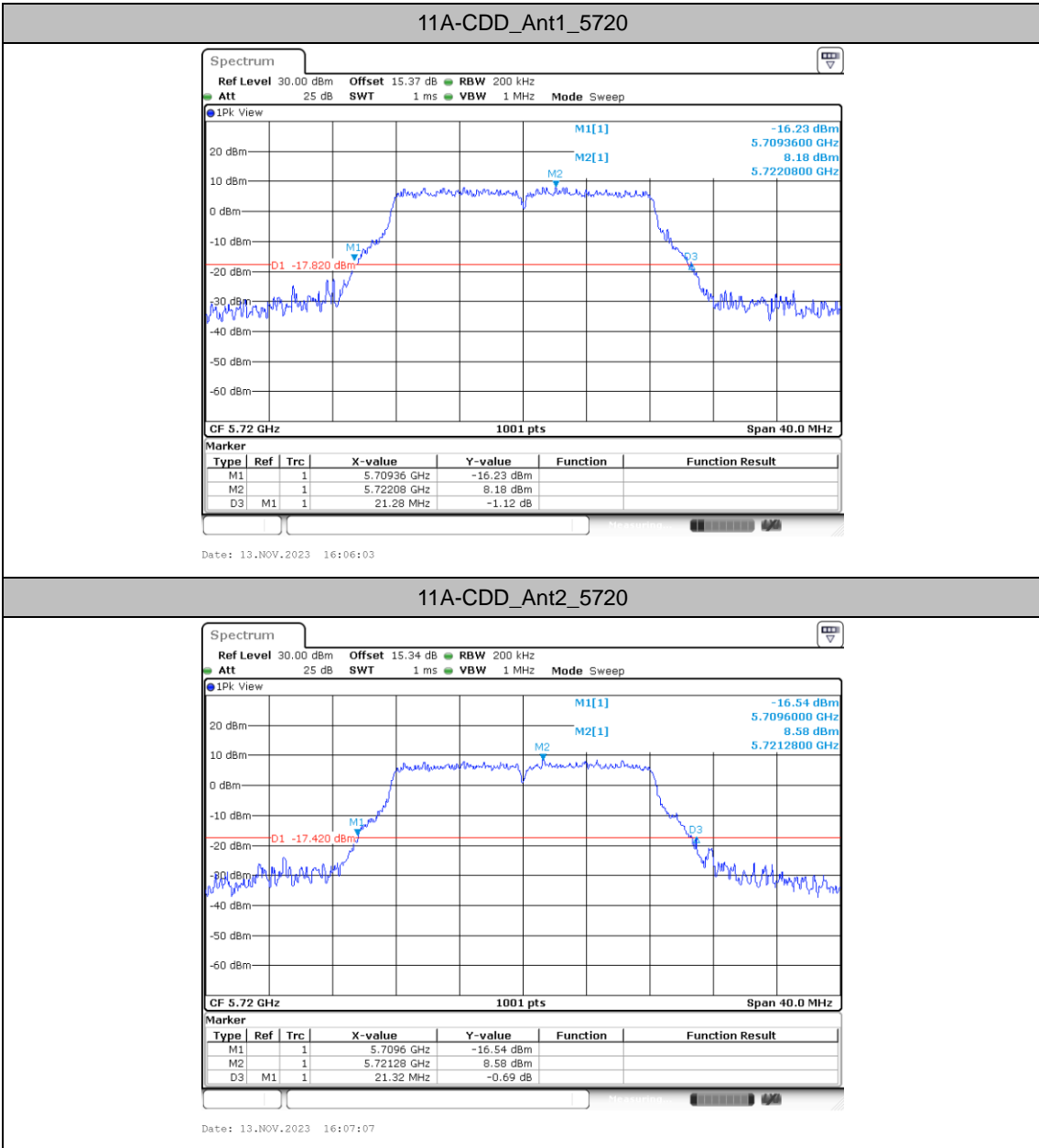


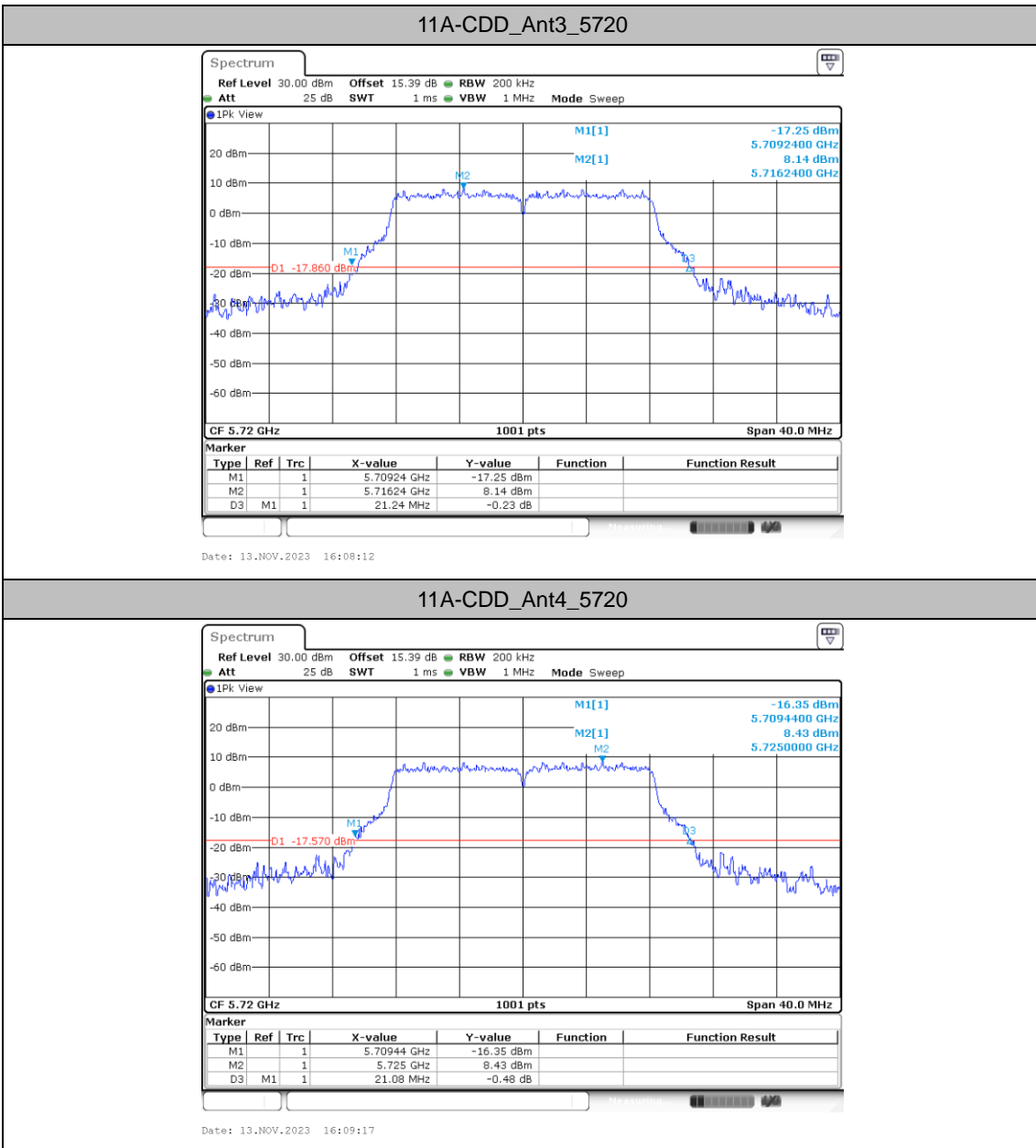






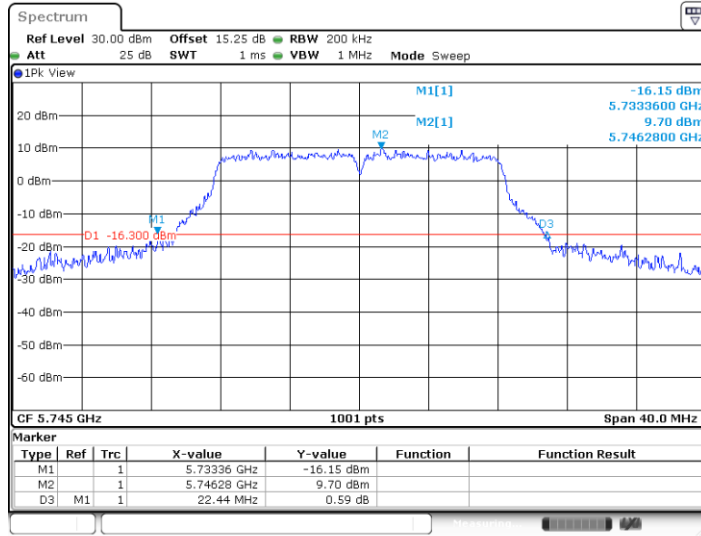






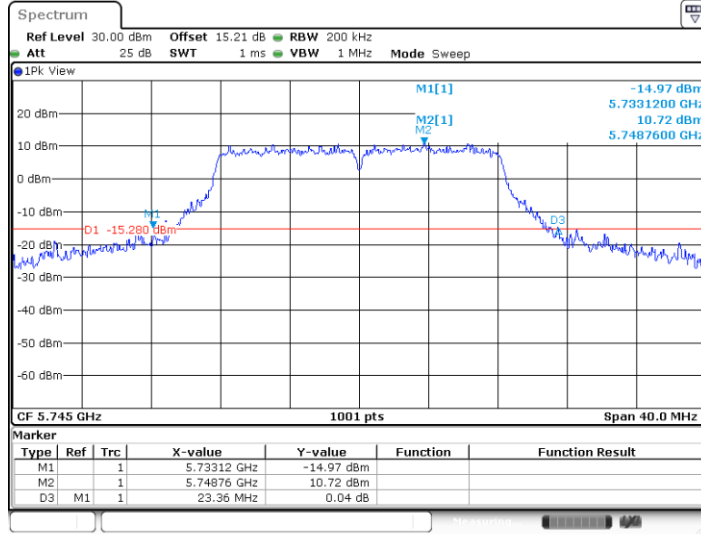


11A-CDD\_Ant1\_5745



Date: 13.NOV.2023 16:11:01

11A-CDD\_Ant2\_5745



Date: 13.NOV.2023 16:12:05

