



FCC RF Test Report

APPLICANT : Lenovo (Shanghai) Electronics Technology Co., Ltd.
EQUIPMENT : Portable Tablet Computer
BRAND NAME : Lenovo
MODEL NAME : TB328FU
FCC ID : O57TB328FU
STANDARD : FCC Part 15 Subpart E §15.407
CLASSIFICATION : (NII) Unlicensed National Information Infrastructure
TEST DATE(S) : Jan. 04, 2022 ~ Jan. 14, 2022

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

Reviewed by: Jason Jia / Supervisor

Alex Wang

Approved by: Alex Wang / Manager



Sporton International Inc. (Kunshan)

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



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SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit for U-NII-1 ~ U-NII-2C	Limit for U-NII-3	Result	Remark
3.1	2.1049 & 15.403(i)	6dB, 26dB & 99% Bandwidth	-	> 500kHz	Pass	-
3.2	15.407(a)	Maximum Conducted Output Power	≤ 24 dBm	≤ 30 dBm	Pass	-
3.3	15.407(a)	Power Spectral Density	≤ 11 dBm	≤ 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 3.01 dB at 5149.280 MHz
3.5	15.207	AC Conducted Emission	15.207(a)	15.207(a)	Pass	Under limit 8.01 dB at 2.765 MHz
3.6	15.203 & 15.407(a)	Antenna Requirement	N/A	N/A	Pass	-

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.



1 General Description

1.1 Applicant

Lenovo (Shanghai) Electronics Technology Co., Ltd.

Section 304-305, Building No. 4, # 222, Meiyue Road, China (Shanghai) Pilot Free Trade Zone

1.2 Manufacturer

Lenovo PC HK Limited

23/F, Lincoln House, Taikoo Place 979 King's Road, Quarry Bay, Hong Kong, China

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	Portable Tablet Computer
Brand Name	Lenovo
Model Name	TB328FU
FCC ID	O57TB328FU
HW Version	Lenovo Tablet TB328FU
SW Version	TB328FU_RF01_220118
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	
Tx/Rx Frequency Range	5180 MHz ~ 5240 MHz 5260 MHz ~ 5320 MHz 5500 MHz ~ 5720 MHz 5745 MHz ~ 5825 MHz
Maximum Output Power to Antenna	<p><5180 MHz ~ 5240 MHz> 802.11a : 16.12 dBm / 0.0409 W 802.11n HT20 : 15.54 dBm / 0.0358 W 802.11n HT40 : 13.18 dBm / 0.0208 W 802.11ac VHT20: 14.68 dBm / 0.0294 W 802.11ac VHT40: 13.01 dBm / 0.0200 W 802.11ac VHT80: 12.20 dBm / 0.0166 W</p> <p><5260 MHz ~ 5320 MHz> 802.11a : 16.36 dBm / 0.0433 W 802.11n HT20 : 15.76 dBm / 0.0377 W 802.11n HT40 : 13.23 dBm / 0.0210 W 802.11ac VHT20 : 14.96 dBm / 0.0313 W 802.11ac VHT40 : 12.97 dBm / 0.0198 W 802.11ac VHT80 : 12.56 dBm / 0.0180 W</p> <p><5500 MHz ~ 5720 MHz > 802.11a : 16.65 dBm / 0.0462 W 802.11n HT20 : 16.00 dBm / 0.0398 W 802.11n HT40 : 13.84 dBm / 0.0242 W 802.11ac VHT20 : 15.23 dBm / 0.0333 W 802.11ac VHT40 : 13.28 dBm / 0.0213 W 802.11ac VHT80 : 12.76 dBm / 0.0189 W</p> <p><5745 MHz ~ 5825 MHz> 802.11a : 16.93 dBm / 0.0493 W 802.11n HT20 : 16.08 dBm / 0.0406 W 802.11n HT40 : 13.66 dBm / 0.0232 W 802.11ac VHT20: 15.29 dBm / 0.0338 W 802.11ac VHT40: 13.08 dBm / 0.0203 W 802.11ac VHT80: 11.88 dBm / 0.0154 W</p>
99% Occupied Bandwidth	<p><5180 MHz ~ 5240 MHz> 802.11a : 17.223 MHz 802.11n HT20 : 17.902 MHz 802.11n HT40 : 35.804 MHz 802.11ac VHT80 : 73.367 MHz</p> <p><5260 MHz ~ 5320 MHz> 802.11a : 17.263 MHz 802.11n HT20 : 17.942 MHz 802.11n HT40 : 35.884 MHz 802.11ac VHT80 : 73.686 MHz</p> <p><5500 MHz ~ 5720 MHz> 802.11a : 17.223 MHz 802.11n HT20 : 17.982 MHz 802.11n HT40 : 35.564 MHz 802.11ac VHT80 : 73.686 MHz</p> <p><5745 MHz ~ 5825 MHz> 802.11a : 17.183 MHz 802.11n HT20 : 17.982 MHz 802.11n HT40 : 35.485 MHz 802.11ac VHT80 : 73.526 MHz</p>



Antenna Type / Gain	<5180 MHz ~ 5240 MHz> PIFA Antenna with gain -2.60 dBi <5260 MHz ~ 5320 MHz> PIFA Antenna with gain -3.00 dBi <5500 MHz ~ 5720 MHz> PIFA Antenna with gain -3.30 dBi <5745 MHz ~ 5825 MHz> PIFA Antenna with gain -5.00 dBi
Type of Modulation	802.11a/n : OFDM (BPSK / QPSK / 16QAM / 64QAM) 802.11ac: OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)

Note:

- For 802.11n HT20 / ac VHT20 and 802.11n HT40 / ac VHT40 mode, the whole testing has assessed only 802.11n HT20/ HT40 by referring to their higher conducted power.

1.5 Modification of EUT

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

1.6 Testing Location

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

Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	CO01-KS 03CH06-KS TH01-KS	CN1257	314309



1.7 Test Software

Item	Site	Manufacturer	Name	Version
1.	03CH06-KS	AUDIX	E3	6.2009-8-24al
2.	CO01-KS	AUDIX	E3	6.2009-8-24

1.8 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.
- ♦ 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. The worst cases (Y 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)
5150-5250 MHz U-NII-1	36	5180	44	5220
	38*	5190	46*	5230
	40	5200	48	5240
	42 [#]	5210		

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5250-5350 MHz U-NII-2A	52	5260	60	5300
	54*	5270	62*	5310
	56	5280	64	5320
	58 [#]	5290		

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5470-5725 MHz U-NII-2C	100	5500	116	5580
	102*	5510	132	5660
	104	5520	134*	5670
	106 [#]	5530	136	5680
	108	5540	140	5700
	110*	5550		

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5725-5850 MHz U-NII-3	149	5745	157	5785
	151*	5755	159*	5795
	153	5765	161	5805
	155 [#]	5775	165	5825



Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
TDWR Channel	118*	5590	124	5620
	120	5600	126*	5630
	122 [#]	5610	128	5640

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
Straddle Channel	138 [#]	5690	144	5720
	142*	5710	-	-

Note:

1. The above Frequency and Channel in "*" were 802.11n HT40 and 802.11ac VHT40.
2. The above Frequency and Channel in "[#]" were 802.11ac VHT80.

2.2 Test Mode

Final test modes are considering the modulation and worse data rates as below table.

Modulation	Data Rate
802.11a	6 Mbps
802.11n HT20	MCS0
802.11n HT40	MCS0
802.11ac VHT80	MCS0

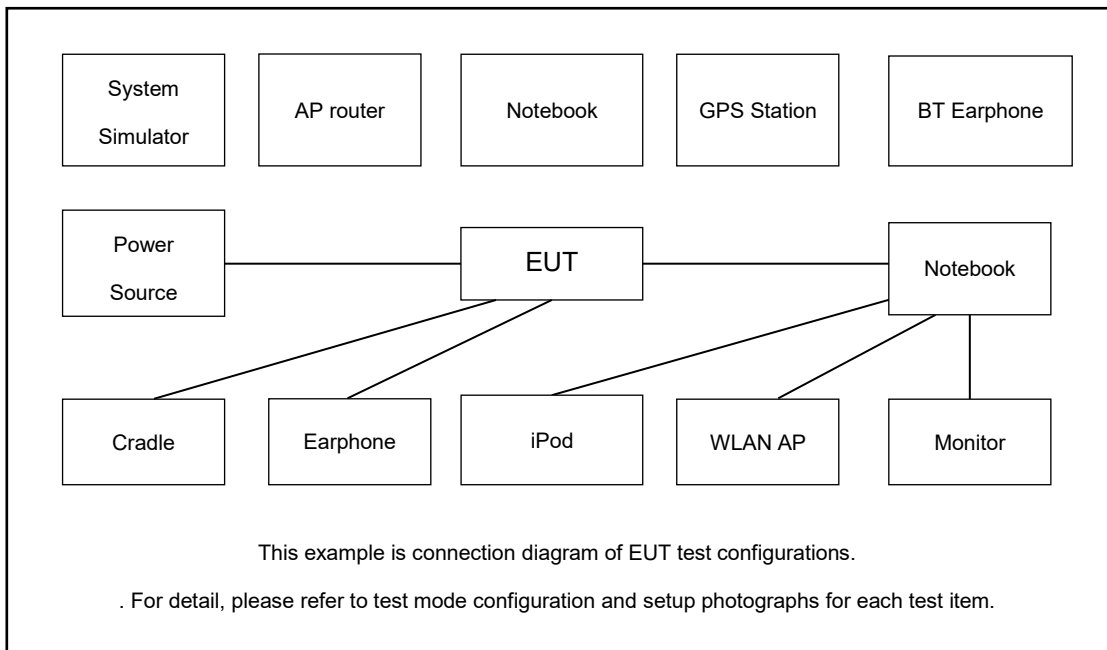
Test Modes: Radiated Spurious Emission	
802.11a	802.11n HT20
CH36 (5180MHz)	CH36 (5180MHz)
CH44 (5220MHz)	CH44 (5220MHz)
CH48 (5240MHz)	CH48 (5240MHz)
CH52 (5260MHz)	CH52 (5260MHz)
CH60 (5300MHz)	CH60 (5300MHz)
CH64 (5320MHz)	CH64 (5320MHz)
CH100 (5500MHz)	CH100 (5500MHz)
CH116 (5580MHz)	CH116 (5580MHz)
CH140 (5700MHz)	CH140 (5700MHz)
CH144 (5720MHz)	CH144 (5720MHz)
CH149 (5745MHz)	CH149 (5745MHz)



CH157 (5785MHz)	CH157 (5785MHz)
CH165 (5825MHz)	CH165 (5825MHz)
802.11n HT40	802.11n HT80
CH38 (5190MHz)	
CH46 (5230MHz)	
CH54 (5270MHz)	CH42 (5210MHz)
CH62 (5310MHz)	CH58 (5290MHz)
CH102 (5510MHz)	CH106 (5530MHz)
CH110 (5550MHz)	CH122 (5610MHz)
CH134 (5670MHz)	CH138 (5690MHz)
CH142 (5710MHz)	CH155 (5775MHz)
CH151 (5755MHz)	
CH159 (5795MHz)	
Remark:	
1. For Radiated Test Cases, The tests were performance with Adapter1, Earphone and USB Cable 1.	
2. All test modes of the Radiated Spurious Emission (RSE) were tested; only the worse data in each UNII band shown in bold for these modes is reported.	

Test Modes: AC Conducted Emission
Mode 1 : Bluetooth Link+WLAN Link(5G)+USB Cable 1(Charging from Adapter1)+ Earphone

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.	Bluetooth Earphone	Lenovo	LBH308	N/A	N/A	N/A
2.	WLAN AP	D-link	DIR-655	KA21R655B1	N/A	Unshielded, 1.8m
3.	Notebook	Lenovo	G480	QDS-BRCM1050I	N/A	AC I/P: Unshielded, 1.8 m DC O/P: Shielded, 1.8 m
4.	SD Card	Kingston	8GB	N/A	N/A	N/A
5.	Earphone	N/A	N/A	N/A	N/A	N/A

2.5 EUT Operation Test Setup

For WLAN RF test items, an engineering test program was provided and enabled to make EUT continuously transmit/receive.

For AC power line conducted emissions, the EUT was set to connect with the WLAN AP under large package sizes transmission.



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.

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 6.75 dB and 10dB attenuator.

$$\begin{aligned} \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)}. \\ &= 6.75 + 10 = 16.75 \text{ (dB)} \end{aligned}$$



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

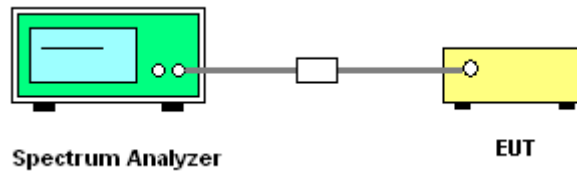
The measuring equipment is listed in the section 4 of this test report.

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)
	<ol style="list-style-type: none"> Set RBW = approximately 1% of the emission bandwidth. Set the VBW > RBW. Detector = Peak. Trace mode = max hold 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%. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1MHz and set the Video bandwidth (VBW) $\geq 3 * RBW$. Measure and record the results in the test report.
<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"> Set RBW = 100kHz. Set the VBW $\geq 3 * RBW$. Detector = Peak. Trace mode = max hold Measure the maximum width of the emission that is 6 dB down from the peak of the emission. Measure and record the results in the test report.

3.1.4 Test Setup



3.1.5 Test Result of 6dB 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 mobile and portable client devices in the 5.15–5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW.

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 $11 \text{ dBm} + 10 \log B$, 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.

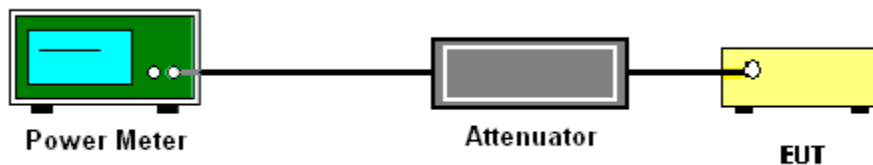
Method PM (Measurement using an RF average power meter):

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.

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

Please refer to Appendix A.



3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

<FCC 14-30 CFR 15.407>

For mobile and portable client devices in the 5.15–5.25 GHz band, the maximum power spectral density shall not exceed 11dBm 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.

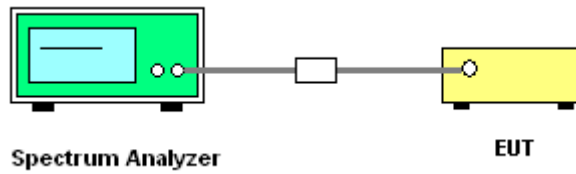
3.3.3 Test Procedures

The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v01r04.

Section F) Maximum power spectral density.

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.

3.3.4 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	68.3

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

$$EIRP = E_{Meas} + 20\log (d_{Meas}) - 104.77$$

where

EIRP is the equivalent isotropically radiated power, in dBm

E_{Meas} is the field strength of the emission at the measurement distance, in dBµV/m

d_{Meas} is the measurement distance, in m

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

- 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 and is transmitting at its maximum power control level for the tested mode of operation.

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

- 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.

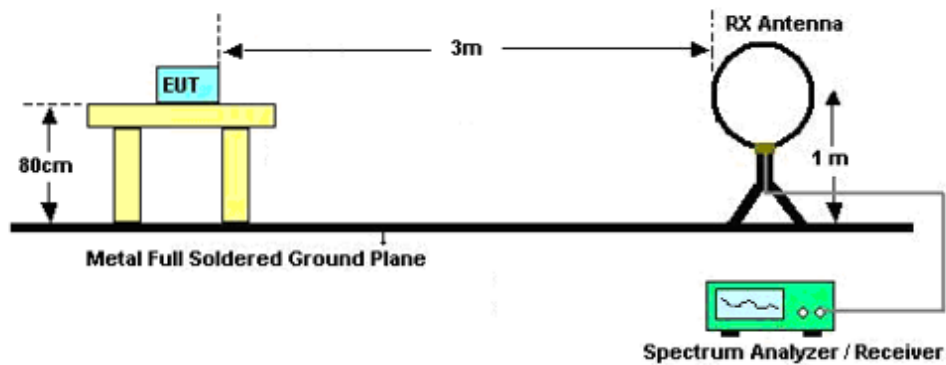
2. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
3. The EUT was set 3 meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
4. The antenna is a broadband 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.

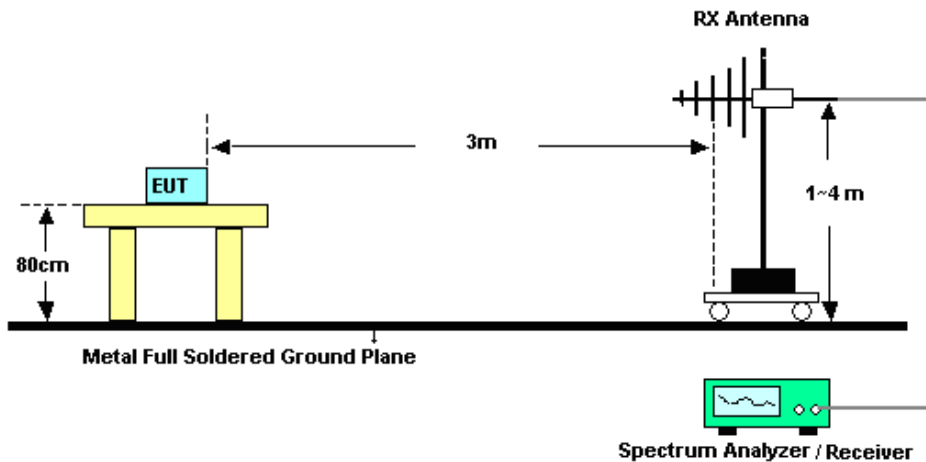
5. For each suspected emission, the EUT was arranged to its worst case and then adjust the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, 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

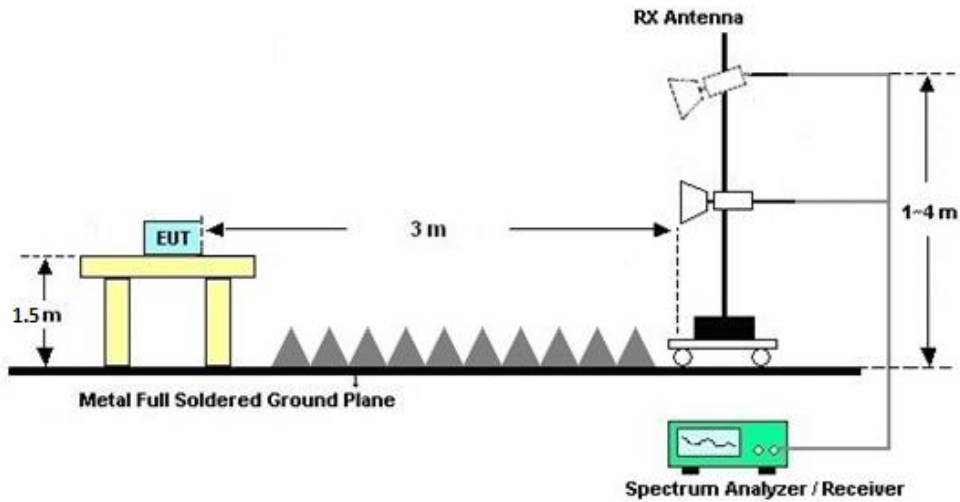
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



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.

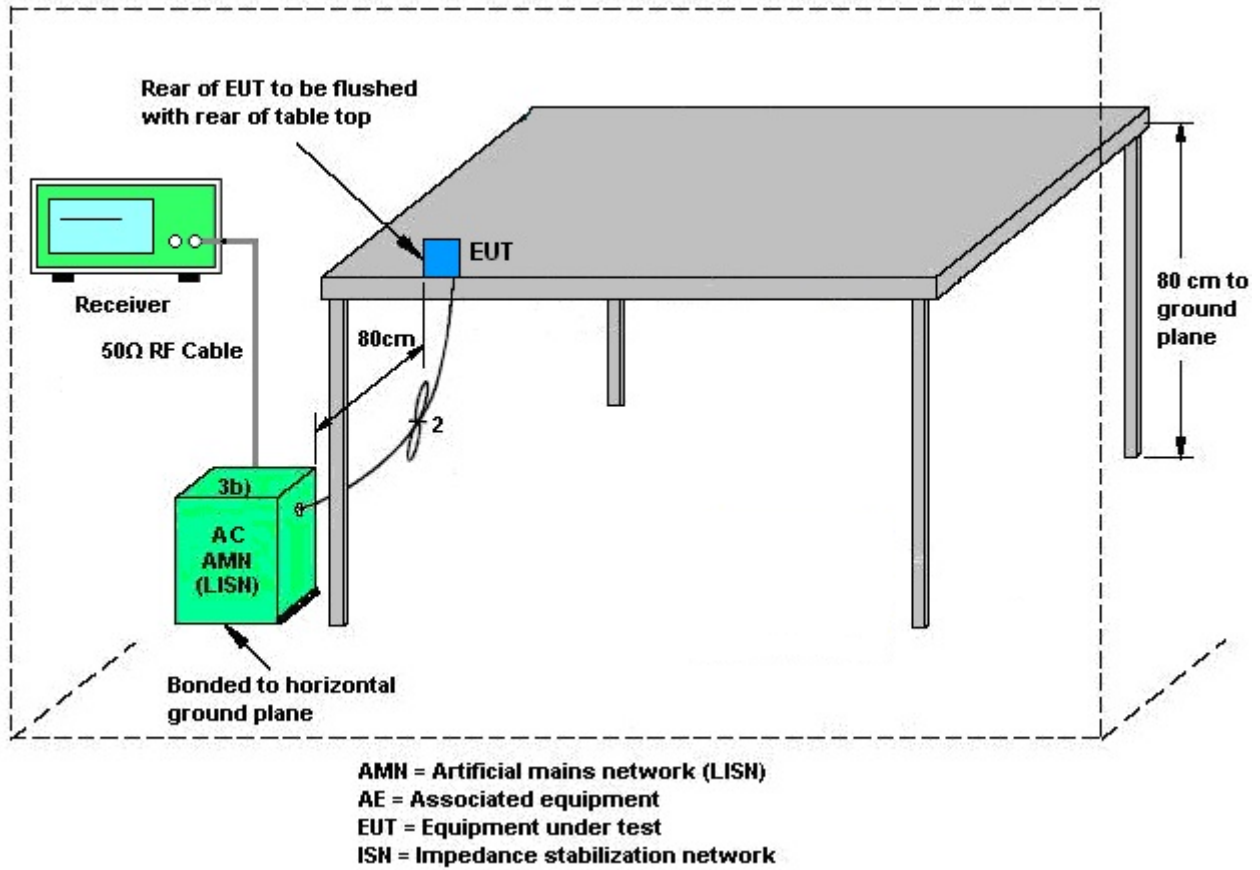
3.5.2 Measuring Instruments

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

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



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. 14, 2021	Jan. 14, 2022	Oct. 13, 2022	Conducted (TH01-KS)
Pulse Power Sensor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 07, 2022	Jan. 14, 2022	Jan. 06, 2023	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 07, 2022	Jan. 14, 2022	Jan. 06, 2023	Conducted (TH01-KS)
Temperature & humidity chamber	Hongzhan	LP-150U	H2014011440	-40~+150°C 20%~95%RH	Jul. 12, 2021	Jan. 14, 2022	Jul. 11, 2022	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz; Max 30dBm	Oct. 16, 2021	Jan. 06, 2022	Oct. 15, 2022	Radiation (03CH06-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150208	10Hz-44GHz	Apr. 12, 2021	Jan. 06, 2022	Apr. 11, 2022	Radiation (03CH06-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 30, 2021	Jan. 06, 2022	Oct. 29, 2022	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6111D	49921	30MHz-1GHz	May 27, 2021	Jan. 06, 2022	May 26, 2022	Radiation (03CH06-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00218652	1GHz~18GHz	Apr. 25, 2021	Jan. 06, 2022	Apr. 24, 2022	Radiation (03CH06-KS)
SHF-EHF Horn	Com-power	AH-840	101093	18GHz~40GHz	Jan. 06, 2022	Jan. 06, 2022	Jan. 05, 2023	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	187289	9KHz ~1GHZ	Apr. 12, 2021	Jan. 06, 2022	Apr. 11, 2022	Radiation (03CH06-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 06, 2022	Jan. 06, 2022	Jan. 05, 2023	Radiation (03CH06-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2025788	1Ghz-18Ghz	Jan. 06, 2022	Jan. 06, 2022	Jan. 05, 2023	Radiation (03CH06-KS)
Amplifier	Keysight	83017A	MY53270203	500MHz~26.5GHz	Apr. 13, 2021	Jan. 06, 2022	Apr. 12, 2022	Radiation (03CH06-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Jan. 06, 2022	NCR	Radiation (03CH06-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Jan. 06, 2022	NCR	Radiation (03CH06-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Jan. 06, 2022	NCR	Radiation (03CH06-KS)
EMI Receiver	R&S	ESC17	100768	9kHz~7GHz;	Apr. 21, 2021	Jan. 04, 2022	Apr. 20, 2022	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 14, 2021	Jan. 04, 2022	Oct. 13, 2022	Conduction (CO01-KS)
AC LISN	R&S	ENV216	100334	9kHz~30MHz	Oct. 14, 2021	Jan. 04, 2022	Oct. 13, 2022	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 14, 2021	Jan. 04, 2022	Oct. 13, 2022	Conduction (CO01-KS)

NCR: No Calibration Required



5 Uncertainty of Evaluation

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 Emission Measurement (150kHz ~ 30MHz)

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

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

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.0dB
---	-------

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.0dB
---	-------

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.0dB
---	-------



Appendix A. Conducted Test Results

Report Number : FR1D0313-01D

Test Engineer:	Jacob Zhang	Temperature:	21~25	°C
Test Date:	2022/1/14	Relative Humidity:	51~54	%

TEST RESULTS DATA
Average Power Table

U-NII-1										
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)	FCC Conducted Power Limit (dBm)	DG (dBi)		Pass/Fail
11a	6Mbps	1	36	5180	0.20	12.12	24.00	-2.60		Pass
11a	6Mbps	1	44	5220	0.20	16.12	24.00	-2.60		Pass
11a	6Mbps	1	48	5240	0.20	16.08	24.00	-2.60		Pass
HT20	MCS0	1	36	5180	0.22	12.45	24.00	-2.60		Pass
HT20	MCS0	1	44	5220	0.22	15.33	24.00	-2.60		Pass
HT20	MCS0	1	48	5240	0.22	15.54	24.00	-2.60		Pass
HT40	MCS0	1	38	5190	0.42	9.17	24.00	-2.60		Pass
HT40	MCS0	1	46	5230	0.42	13.18	24.00	-2.60		Pass
VHT20	MCS0	1	36	5180	0.22	12.23	24.00	-2.60		Pass
VHT20	MCS0	1	44	5220	0.22	14.55	24.00	-2.60		Pass
VHT20	MCS0	1	48	5240	0.22	14.68	24.00	-2.60		Pass
VHT40	MCS0	1	38	5190	0.42	8.98	24.00	-2.60		Pass
VHT40	MCS0	1	46	5230	0.42	13.01	24.00	-2.60		Pass
VHT80	MCS0	1	42	5210	0.10	12.20	24.00	-2.60		Pass

TEST RESULTS DATA
Average Power Table

FCC U-NII-2A										
Mod.	Data Rate	N _{TX}	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)	FCC Conducted Power Limit (dBm)	DG (dBi)	EIRP Power Limit (dBm)	Pass/Fail
11a	6M bps	1	52	5260	0.20	16.14	23.98	-3.00	26.99	Pass
11a	6M bps	1	60	5300	0.20	16.36	23.98	-3.00	26.99	Pass
11a	6M bps	1	64	5320	0.20	14.62	23.98	-3.00	26.99	Pass
HT20	MCS 0	1	52	5260	0.22	15.59	23.98	-3.00	26.99	Pass
HT20	MCS 0	1	60	5300	0.22	15.76	23.98	-3.00	26.99	Pass
HT20	MCS 0	1	64	5320	0.22	13.80	23.98	-3.00	26.99	Pass
HT40	MCS 0	1	54	5270	0.42	13.23	23.98	-3.00	26.99	Pass
HT40	MCS 0	1	62	5310	0.42	11.67	23.98	-3.00	26.99	Pass
VHT20	MCS 0	1	52	5260	0.22	14.80	23.98	-3.00	26.99	Pass
VHT20	MCS 0	1	60	5300	0.22	14.96	23.98	-3.00	26.99	Pass
VHT20	MCS 0	1	64	5320	0.22	13.68	23.98	-3.00	26.99	Pass
VHT40	MCS 0	1	54	5270	0.42	12.97	23.98	-3.00	26.99	Pass
VHT40	MCS 0	1	62	5310	0.42	11.61	23.98	-3.00	26.99	Pass
VHT80	MCS 0	1	58	5290	0.10	12.56	23.98	-3.00	26.99	Pass

TEST RESULTS DATA
Average Power Table

FCC U-NII-2C										
Mod.	Data Rate	N _{TX}	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)	FCC Conducted Power Limit (dBm)	DG (dBi)	EIRP Power Limit (dBm)	Pass/Fail
11a	6M bps	1	100	5500	0.20	16.61	23.98	-3.30	26.99	Pass
11a	6M bps	1	116	5580	0.20	16.65	23.98	-3.30	26.99	Pass
11a	6M bps	1	140	5700	0.20	15.93	23.98	-3.30	26.99	Pass
11a	6Mbps	1	144	5720	0.20	15.95	23.98	-3.30	26.99	Pass
HT20	MCS 0	1	100	5500	0.22	15.89	23.98	-3.30	26.99	Pass
HT20	MCS 0	1	116	5580	0.22	16.00	23.98	-3.30	26.99	Pass
HT20	MCS 0	1	140	5700	0.22	15.36	23.98	-3.30	26.99	Pass
HT20	MCS0	1	144	5720	0.22	15.41	23.98	-3.30	26.99	Pass
HT40	MCS 0	1	102	5510	0.42	13.74	23.98	-3.30	26.99	Pass
HT40	MCS 0	1	110	5550	0.42	13.84	23.98	-3.30	26.99	Pass
HT40	MCS 0	1	134	5670	0.42	13.20	23.98	-3.30	26.99	Pass
HT40	MCS0	1	142	5710	0.42	13.11	23.98	-3.30	26.99	Pass
VHT20	MCS 0	1	100	5500	0.22	15.23	23.98	-3.30	26.99	Pass
VHT20	MCS 0	1	116	5580	0.22	15.21	23.98	-3.30	26.99	Pass
VHT20	MCS 0	1	140	5700	0.22	14.43	23.98	-3.30	26.99	Pass
VHT20	MCS0	1	144	5720	0.22	14.48	23.98	-3.30	26.99	Pass
VHT40	MCS 0	1	102	5510	0.42	13.23	23.98	-3.30	26.99	Pass
VHT40	MCS 0	1	110	5550	0.42	13.28	23.98	-3.30	26.99	Pass
VHT40	MCS 0	1	134	5670	0.42	12.79	23.98	-3.30	26.99	Pass
VHT40	MCS0	1	142	5710	0.42	12.62	23.98	-3.30	26.99	Pass
VHT80	MCS 0	1	106	5530	0.10	12.76	23.98	-3.30	26.99	Pass
VHT80	MCS 0	1	122	5610	0.10	12.66	23.98	-3.30	26.99	Pass
VHT80	MCS0	1	138	5690	0.10	11.92	23.98	-3.30	26.99	Pass

TEST RESULTS DATA
Average Power Table

U-NII-3										
Mod.	Data Rate	N _{TX}	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power (dBm)	FCC Conducted Power Limit (dBm)	DG (dBi)		Pass/Fail
11a	6M bps	1	149	5745	0.20	16.93	30.00	-5.00		Pass
11a	6Mbps	1	157	5785	0.20	15.97	30.00	-5.00		Pass
11a	6Mbps	1	165	5825	0.20	15.94	30.00	-5.00		Pass
HT20	MCS 0	1	149	5745	0.22	16.08	30.00	-5.00		Pass
HT20	MCS 0	1	157	5785	0.22	15.34	30.00	-5.00		Pass
HT20	MCS 0	1	165	5825	0.22	15.23	30.00	-5.00		Pass
HT40	MCS 0	1	151	5755	0.42	13.66	30.00	-5.00		Pass
HT40	MCS 0	1	159	5795	0.42	12.93	30.00	-5.00		Pass
VHT20	MCS 0	1	149	5745	0.22	15.29	30.00	-5.00		Pass
VHT20	MCS 0	1	157	5785	0.22	14.41	30.00	-5.00		Pass
VHT20	MCS 0	1	165	5825	0.22	14.47	30.00	-5.00		Pass
VHT40	MCS 0	1	151	5755	0.42	13.08	30.00	-5.00		Pass
VHT40	MCS 0	1	159	5795	0.42	12.62	30.00	-5.00		Pass
VHT80	MCS 0	1	155	5775	0.10	11.88	30.00	-5.00		Pass



Ambient Condition: 25 °C, 45 %RH,	
Test Date: 2022.1.14	Test Engineer: Smile Wang

Emission Bandwidth

Test Result

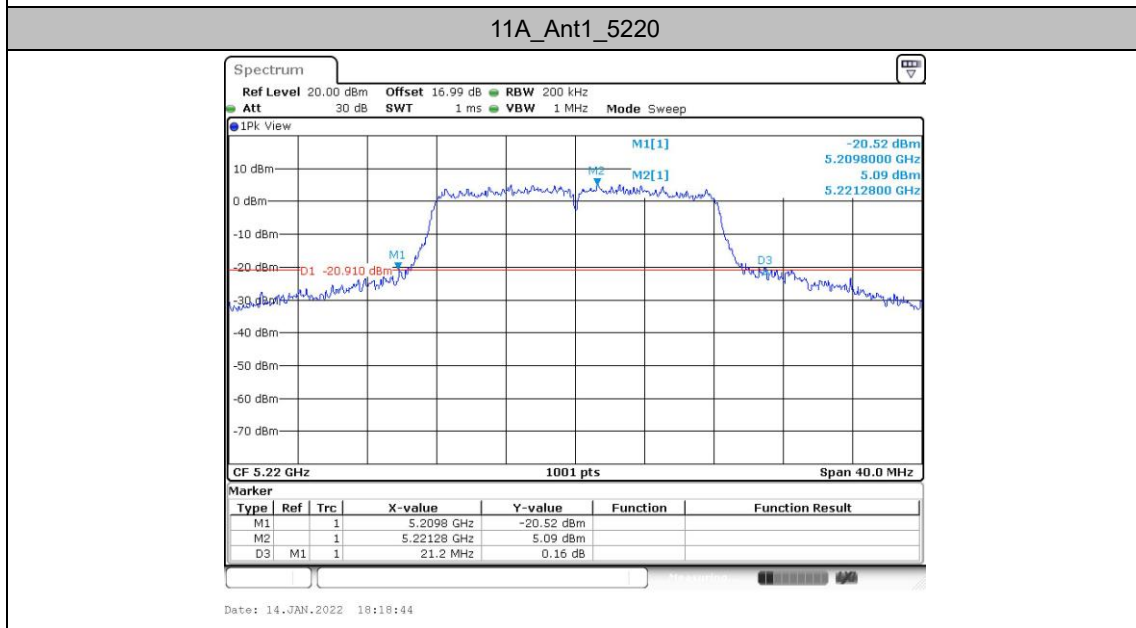
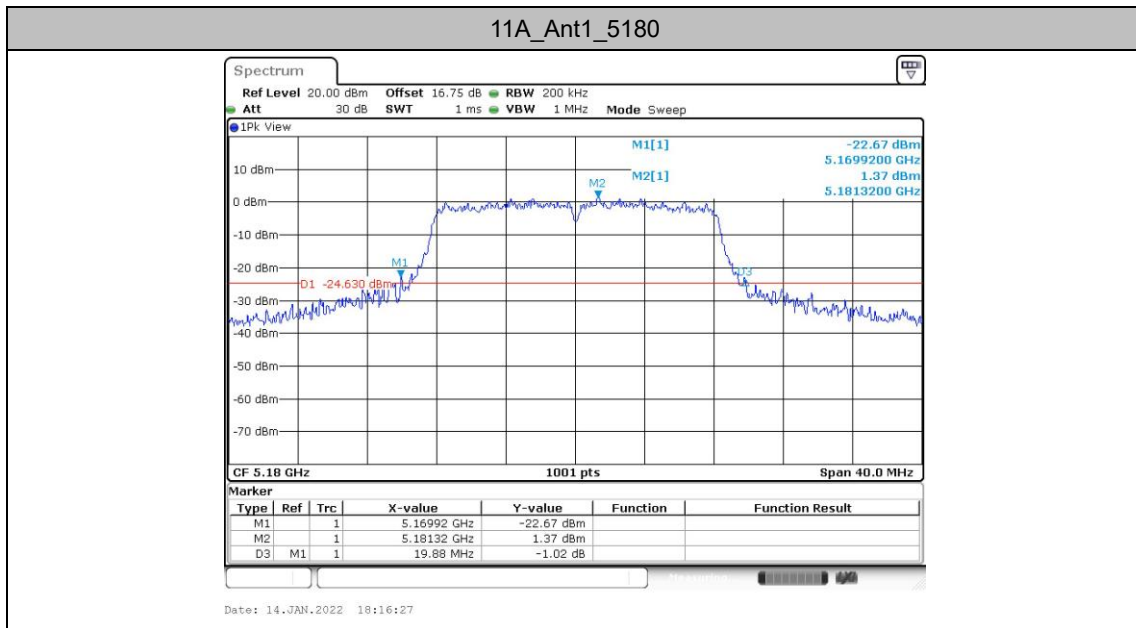
TestMode	Antenna	Frequency[MHz]	26db EBW [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11A	Ant1	5180	19.88	5169.92	5189.80	---	---
		5220	21.20	5209.80	5231.00	---	---
		5240	22.72	5229.88	5252.60	---	---
		5260	21.92	5250.00	5271.92	---	---
		5300	24.04	5289.28	5313.32	---	---
		5320	20.04	5309.84	5329.88	---	---
		5500	20.60	5490.40	5511.00	---	---
		5580	22.68	5569.28	5591.96	---	---
		5700	21.60	5689.40	5711.00	---	---
		5720	21.04	5709.32	5730.36	---	---
		5720_UNII-2C	15.68	5709.32	5725	---	---
		5720_UNII-3	5.36	5725	5730.36	---	---
		5745	21.24	5733.68	5754.92	---	---
		5785	21.60	5774.56	5796.16	---	---
5825	20.20	5814.60	5834.80	---	---		
11N20SISO	Ant1	5180	20.84	5169.28	5190.12	---	---
		5220	23.16	5208.40	5231.56	---	---
		5240	21.84	5230.04	5251.88	---	---
		5260	22.40	5249.72	5272.12	---	---
		5300	22.04	5289.88	5311.92	---	---
		5320	23.44	5308.52	5331.96	---	---
		5500	21.88	5489.40	5511.28	---	---
		5580	22.20	5569.40	5591.60	---	---
		5700	21.48	5689.84	5711.32	---	---
		5720	21.36	5710.24	5731.60	---	---
		5720_UNII-2C	14.76	5710.24	5725	---	---
		5720_UNII-3	6.6	5725	5731.60	---	---
		5745	21.28	5734.76	5756.04	---	---
		5785	24.44	5774.40	5798.84	---	---
5825	22.48	5814.12	5836.60	---	---		

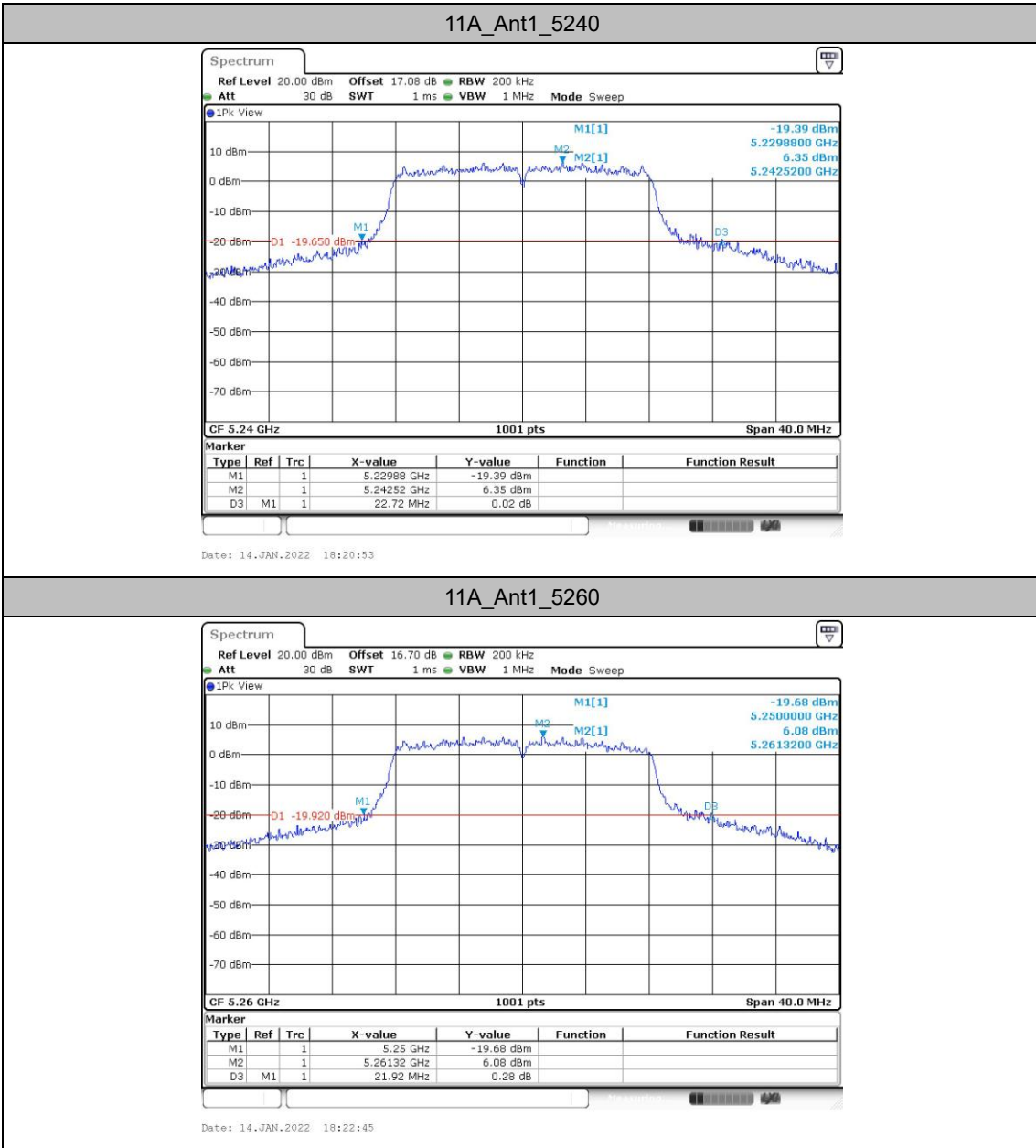


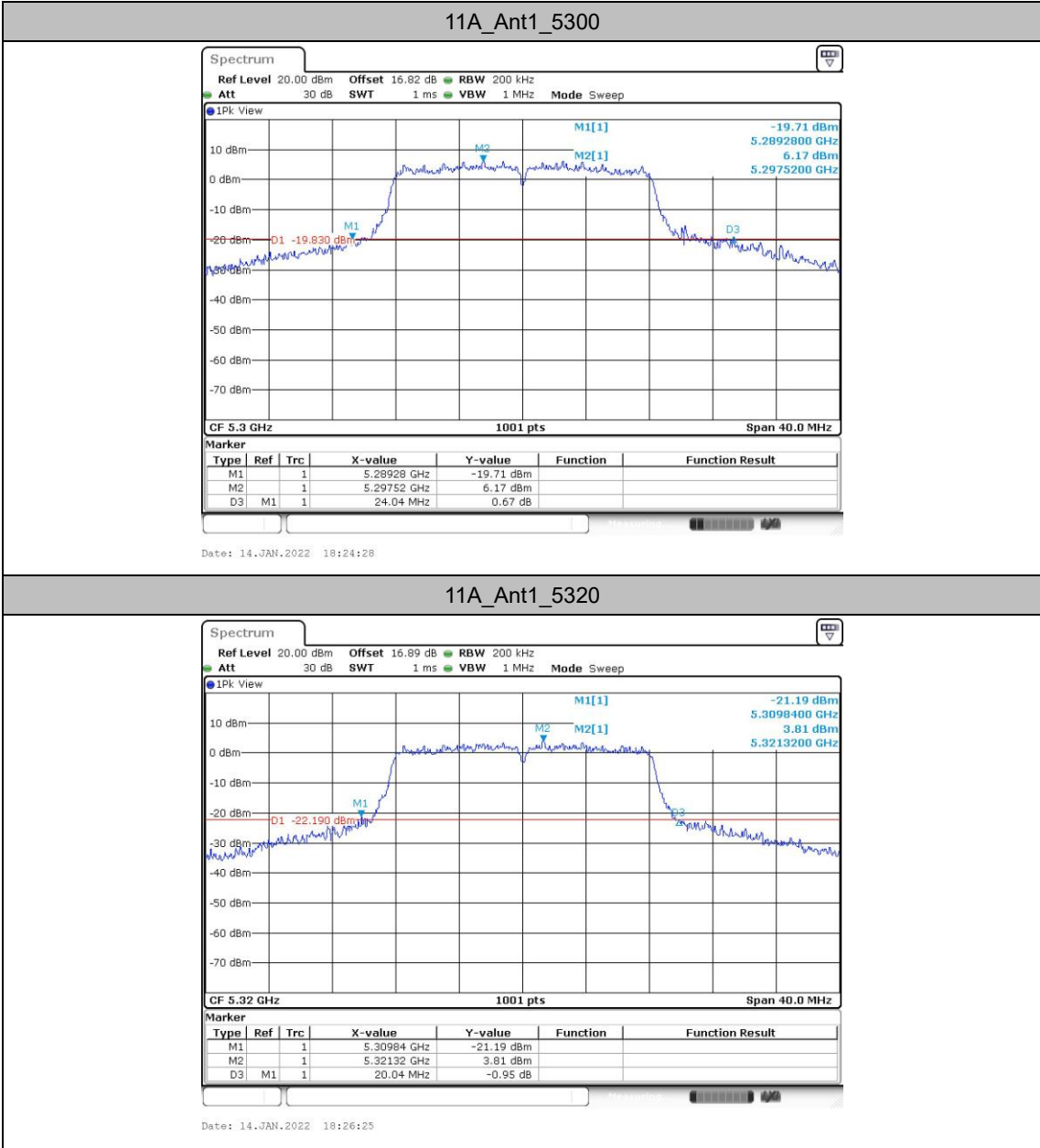
11N40SISO	Ant1	5190	39.28	5170.40	5209.68	---	---
		5230	39.04	5210.56	5249.60	---	---
		5270	39.52	5250.48	5290.00	---	---
		5310	40.24	5289.76	5330.00	---	---
		5510	38.88	5490.64	5529.52	---	---
		5550	39.20	5530.48	5569.68	---	---
		5670	38.96	5650.48	5689.44	---	---
		5710	39.28	5690.40	5729.68	---	---
		5710_UNII-2C	34.6	5690.40	5725	---	---
		5710_UNII-3	4.68	5725	5729.68	---	---
		5755	38.88	5735.64	5774.52	---	---
		5795	39.20	5775.48	5814.68	---	---
11AC80SISO	Ant1	5210	78.72	5170.80	5249.52	---	---
		5290	78.88	5250.64	5329.52	---	---
		5530	78.72	5490.64	5569.36	---	---
		5610	78.40	5570.96	5649.36	---	---
		5690	78.72	5650.80	5729.52	---	---
		5690_UNII-2C	74.2	5650.80	5725	---	---
		5690_UNII-3	4.52	5725	5729.52	---	---
		5775	78.56	5735.80	5814.36	---	---

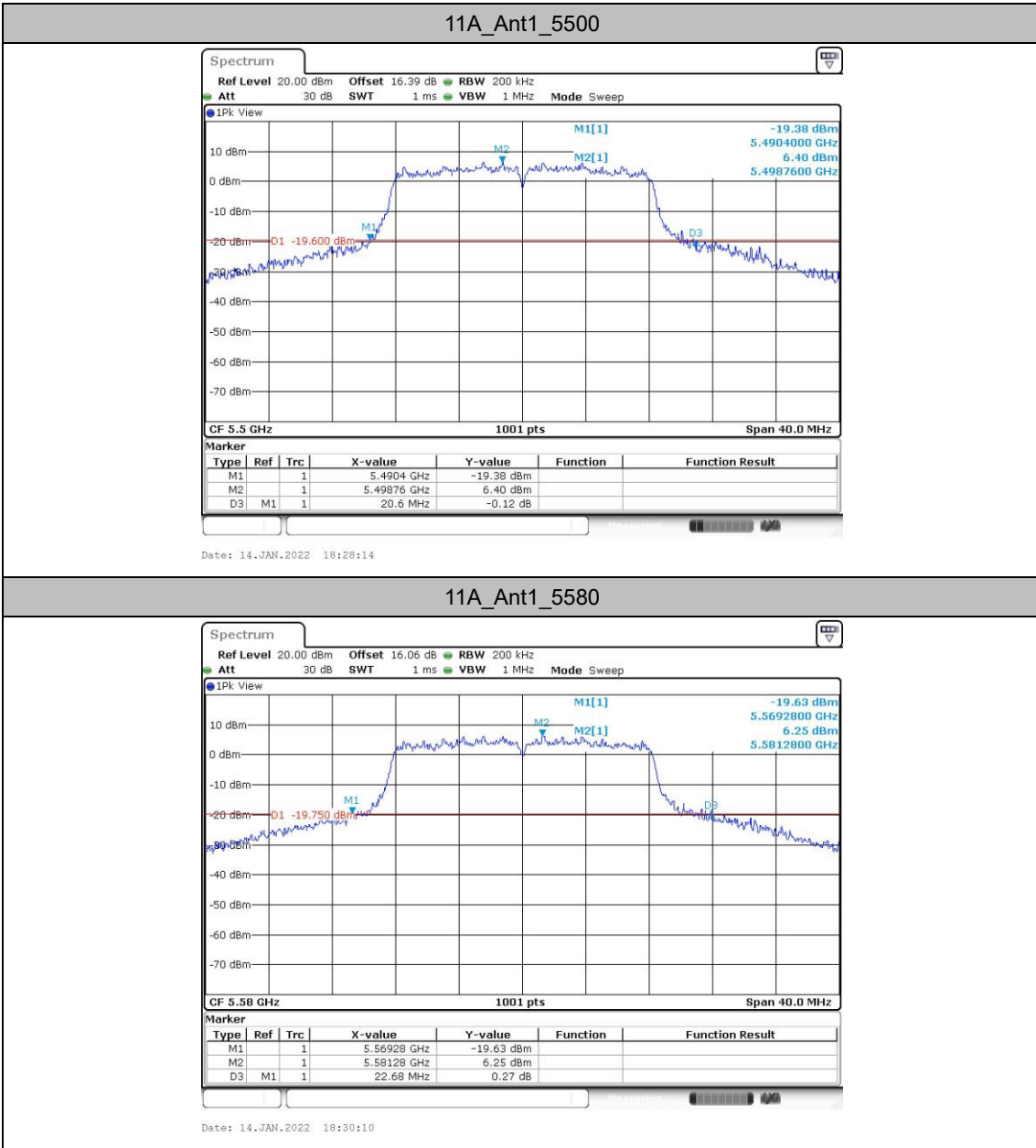


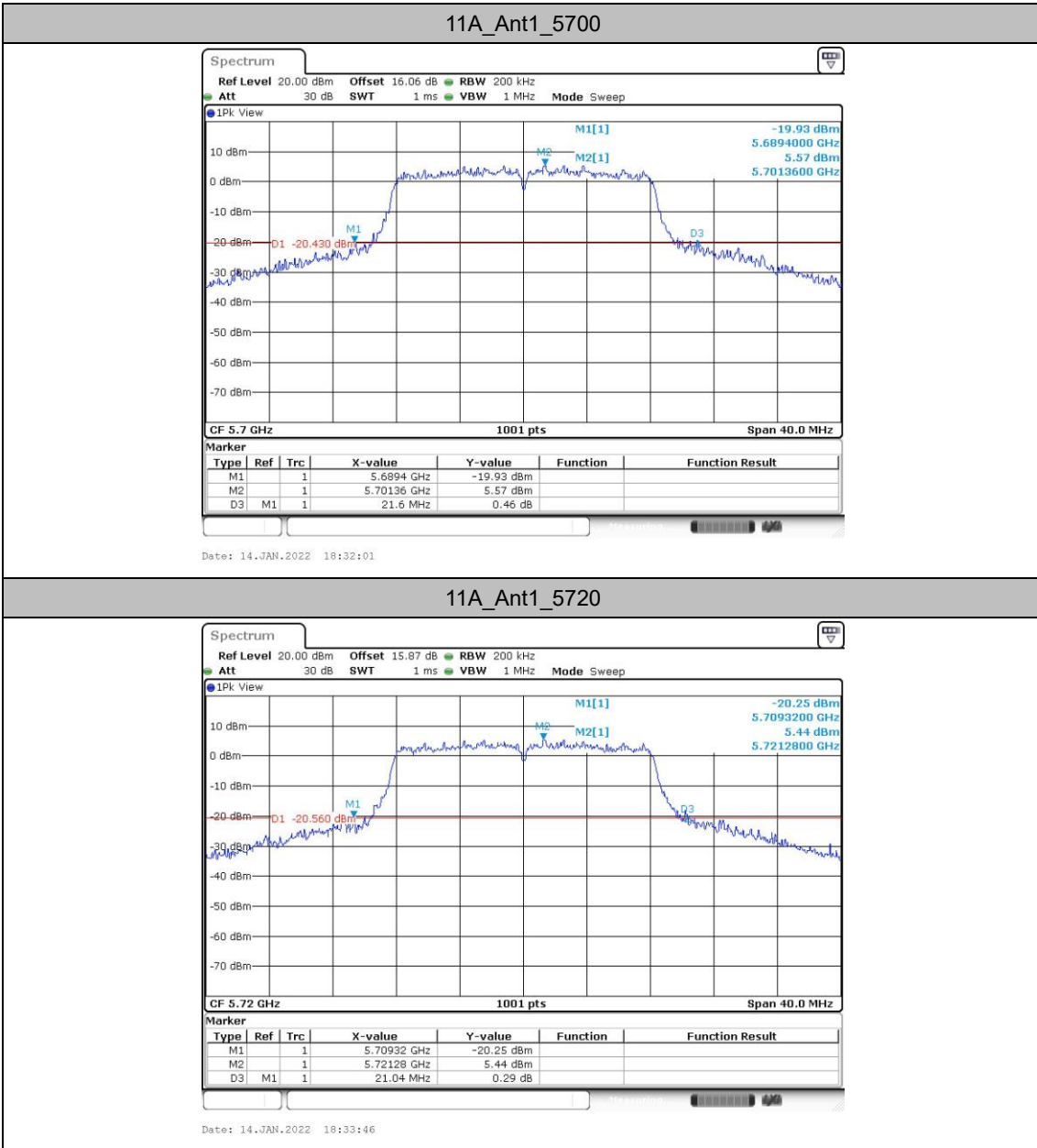
Test Graphs

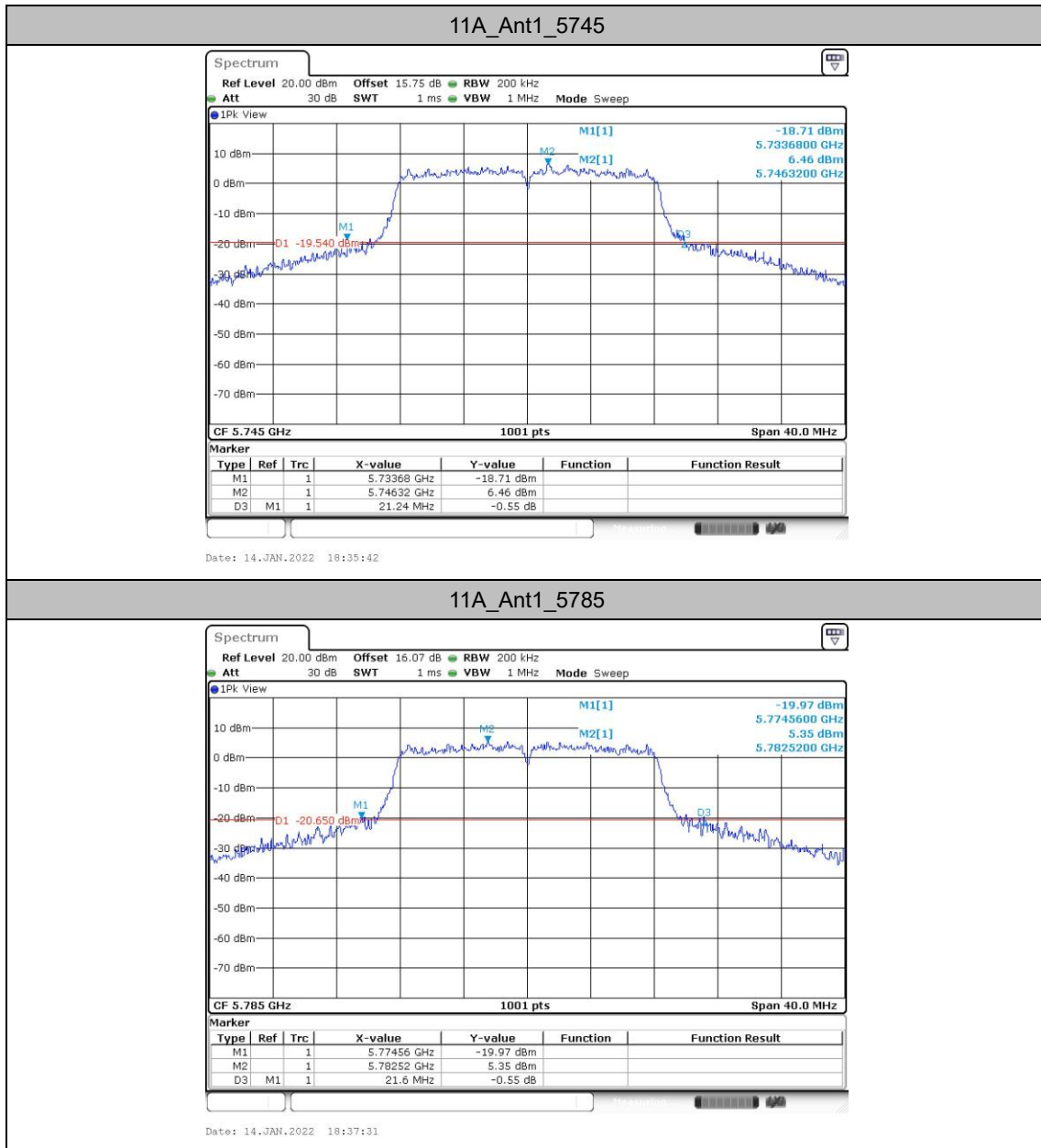


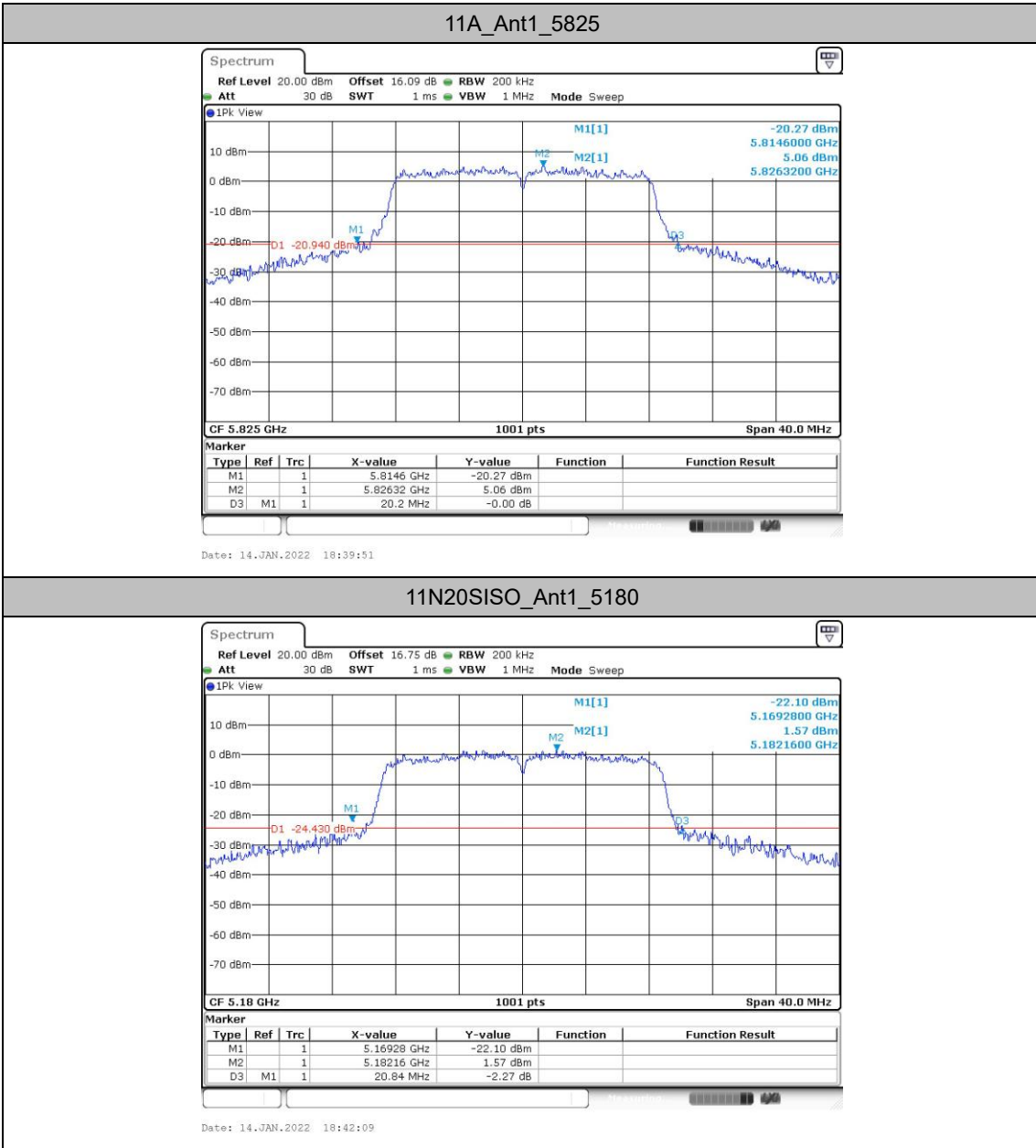


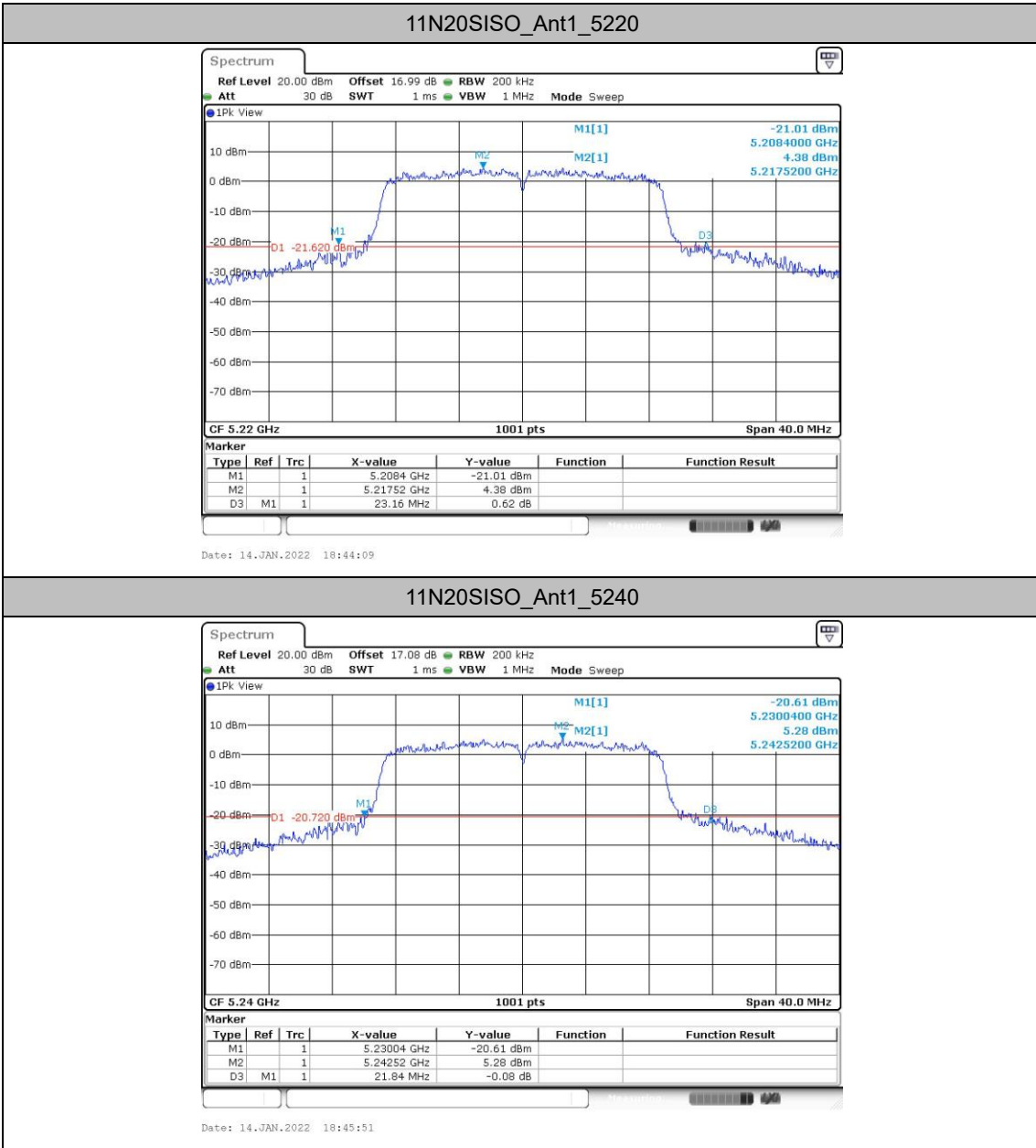


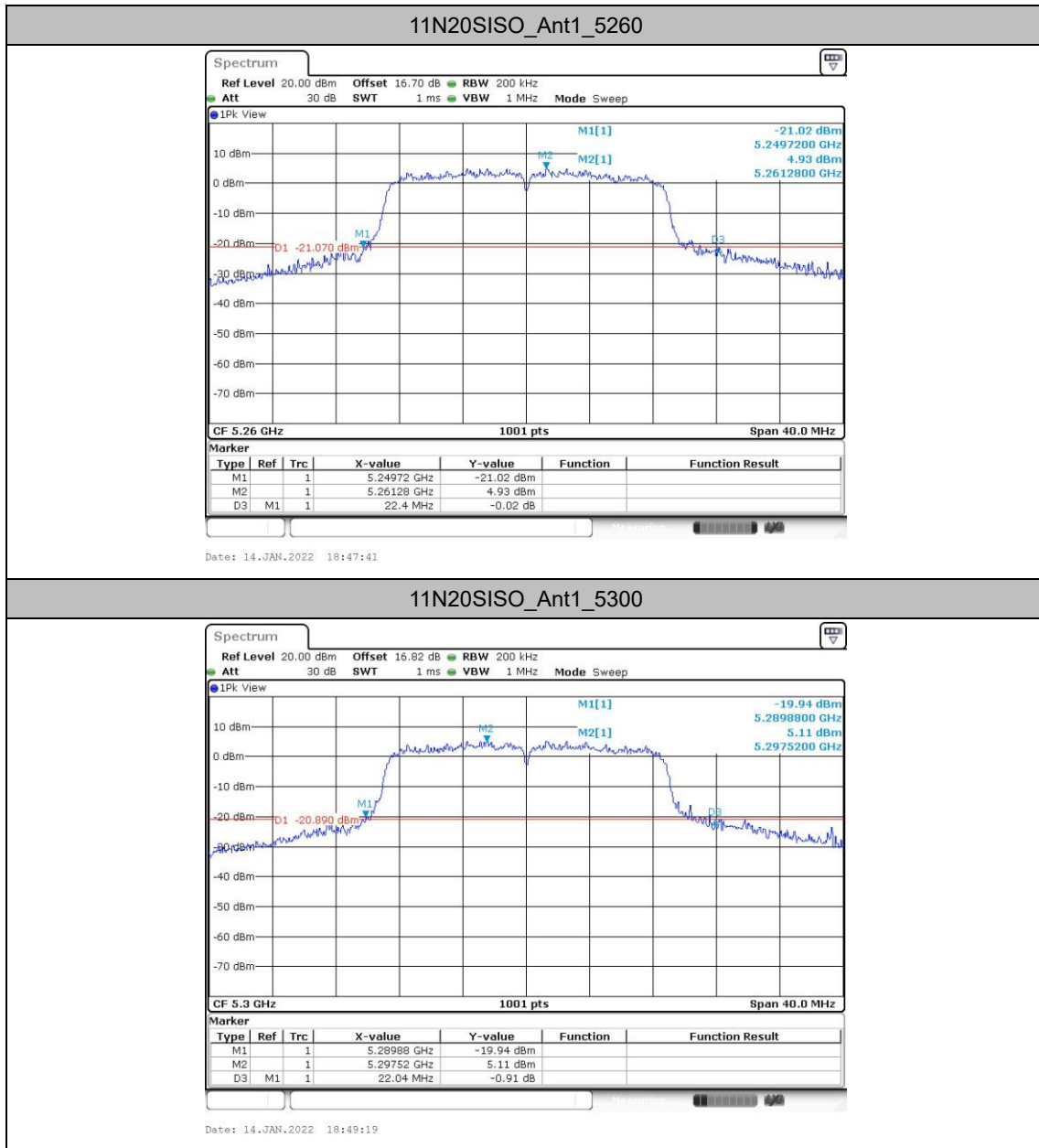


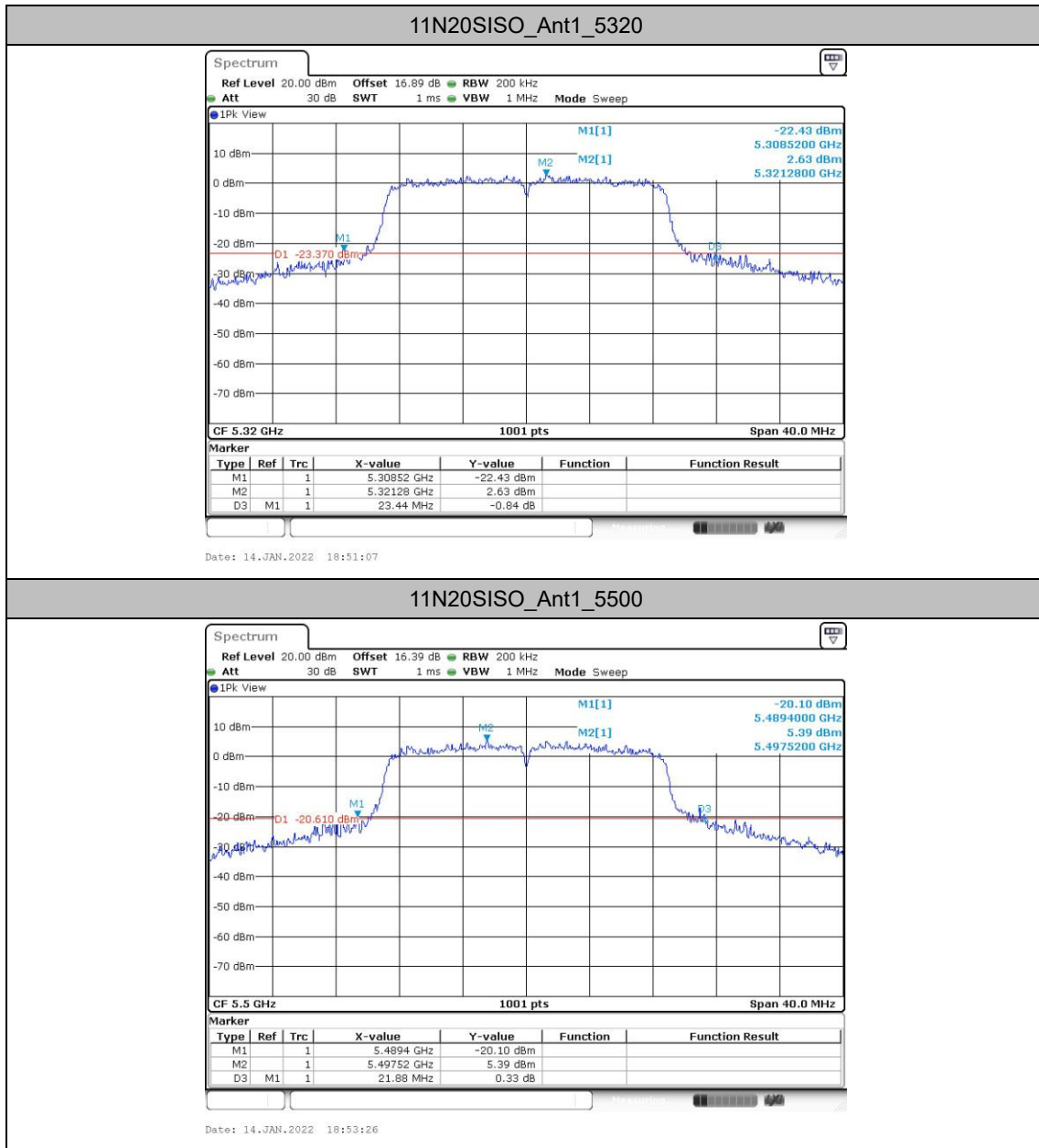


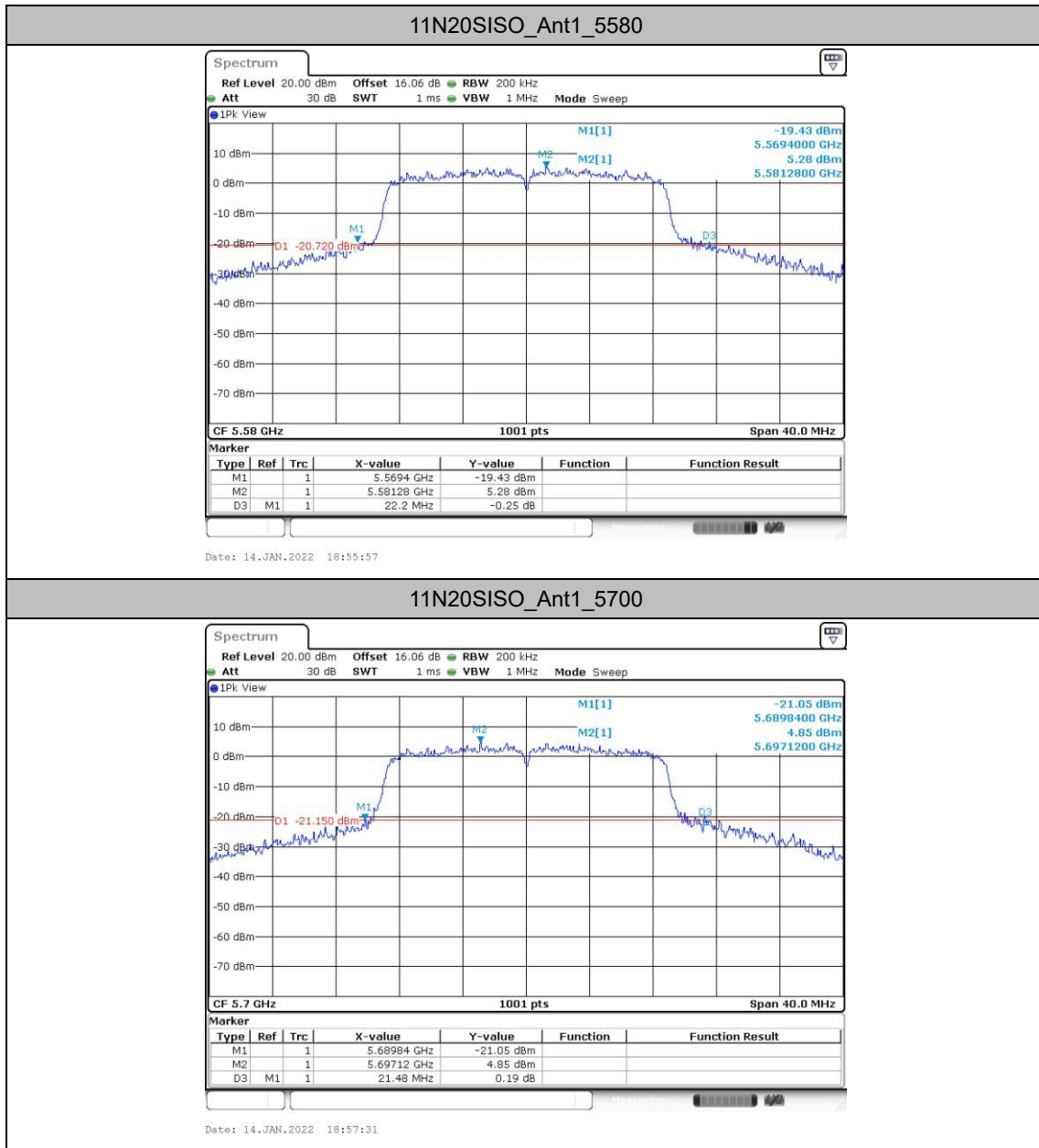


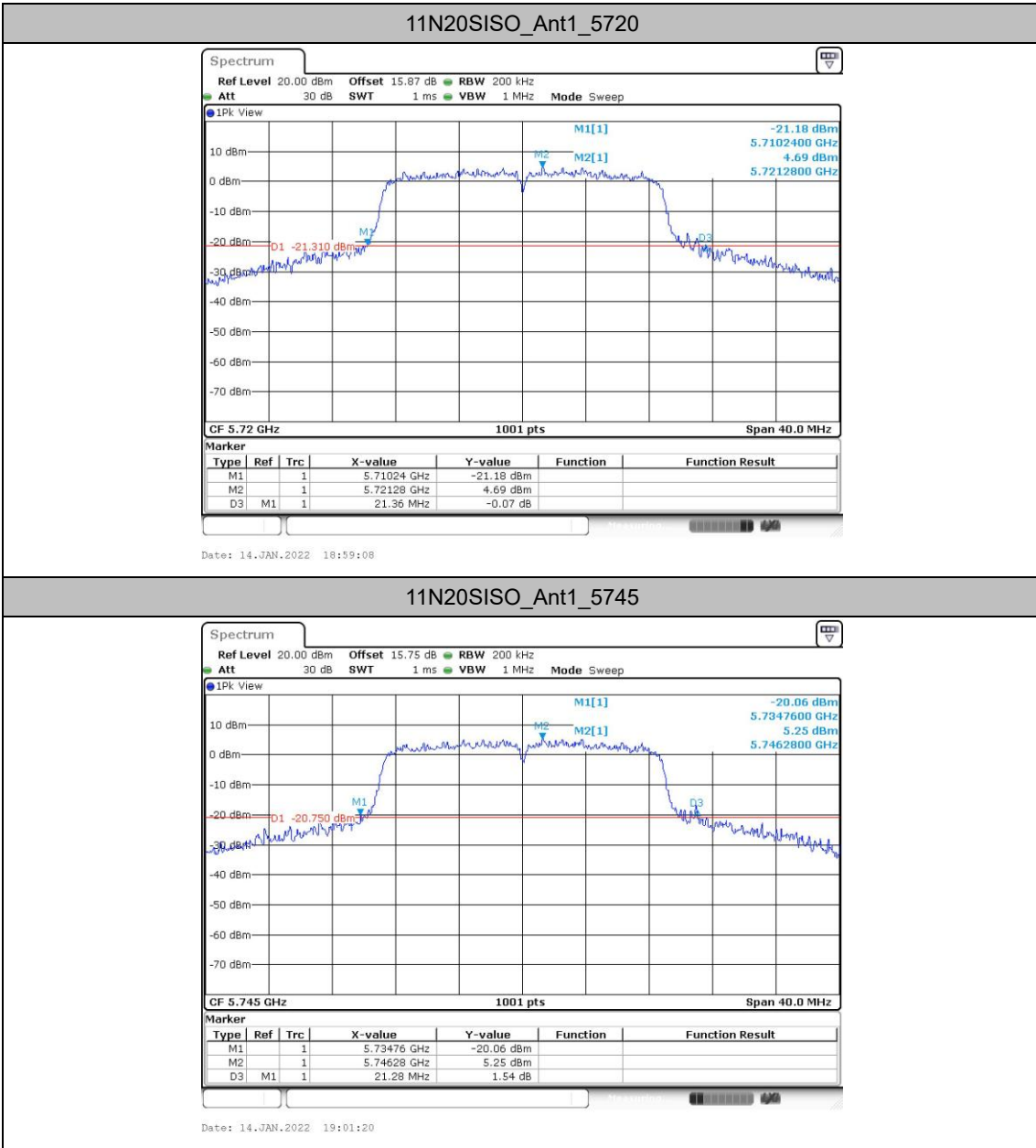


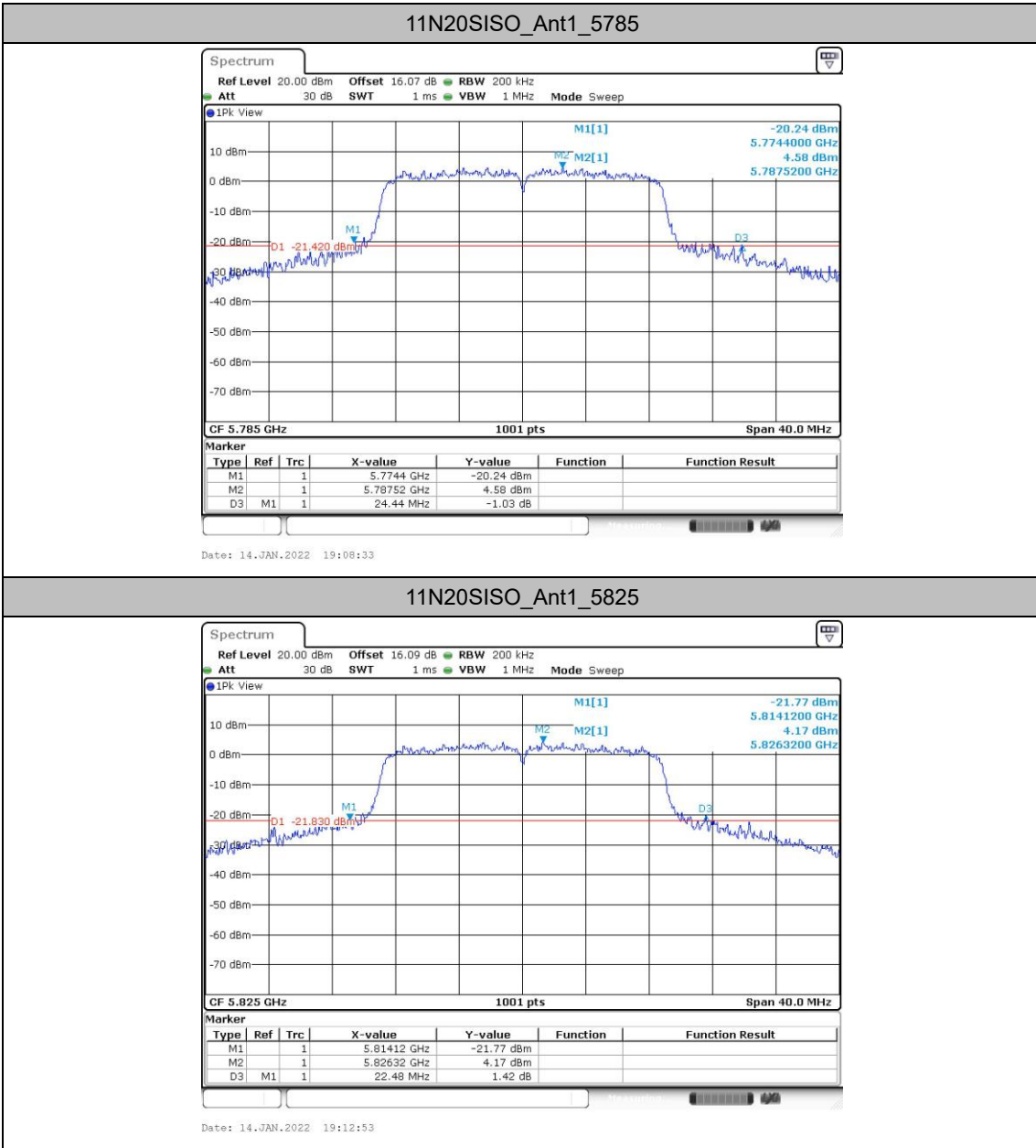


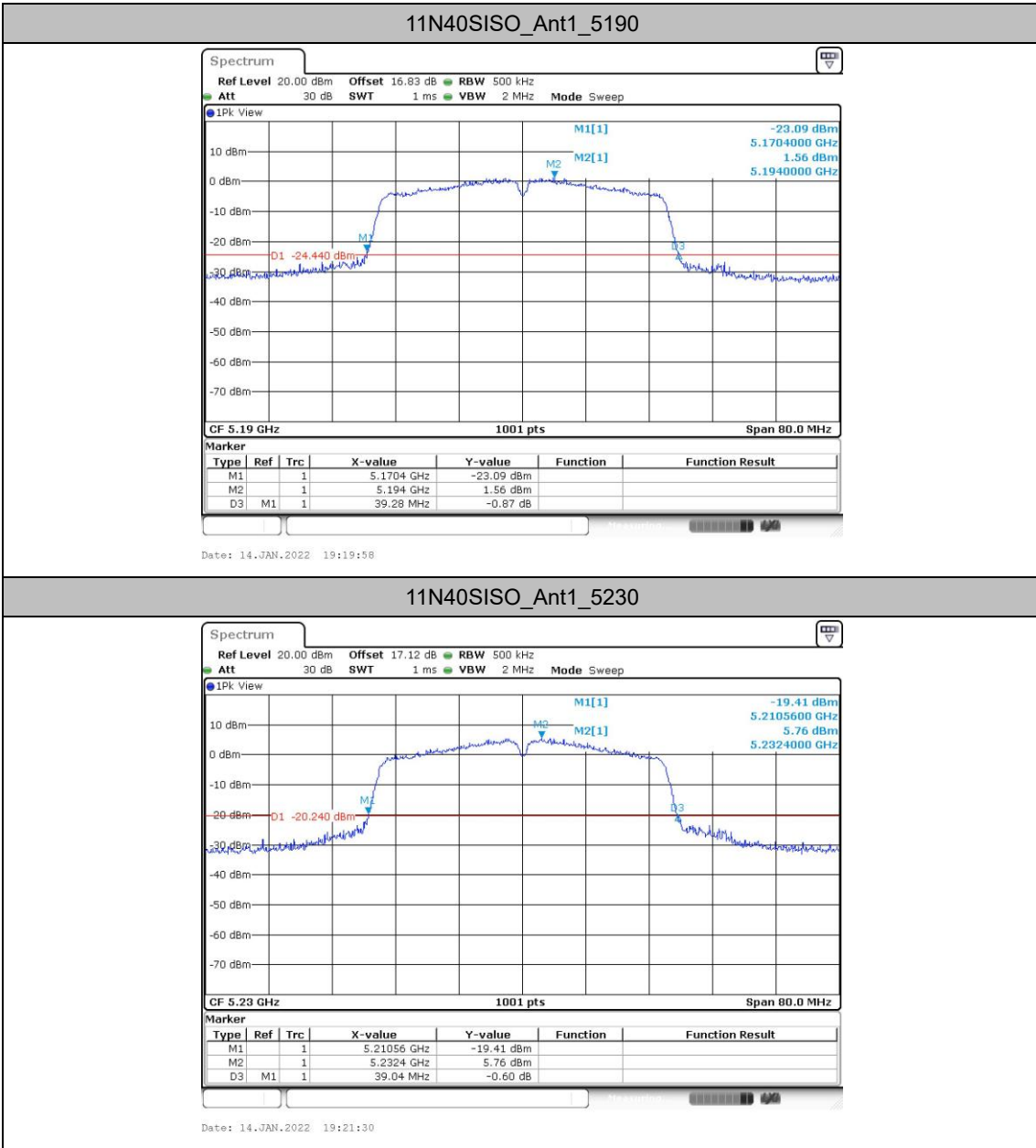


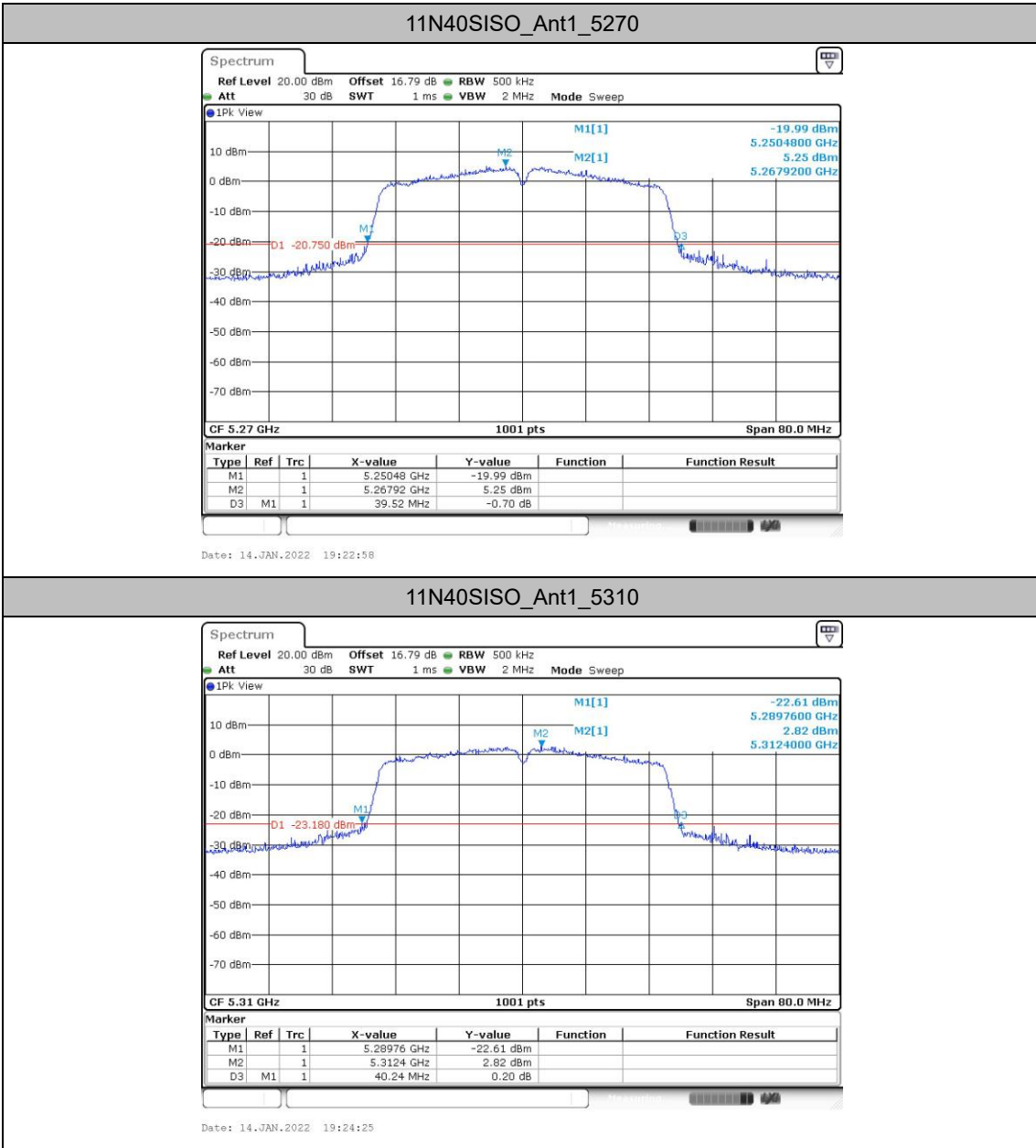


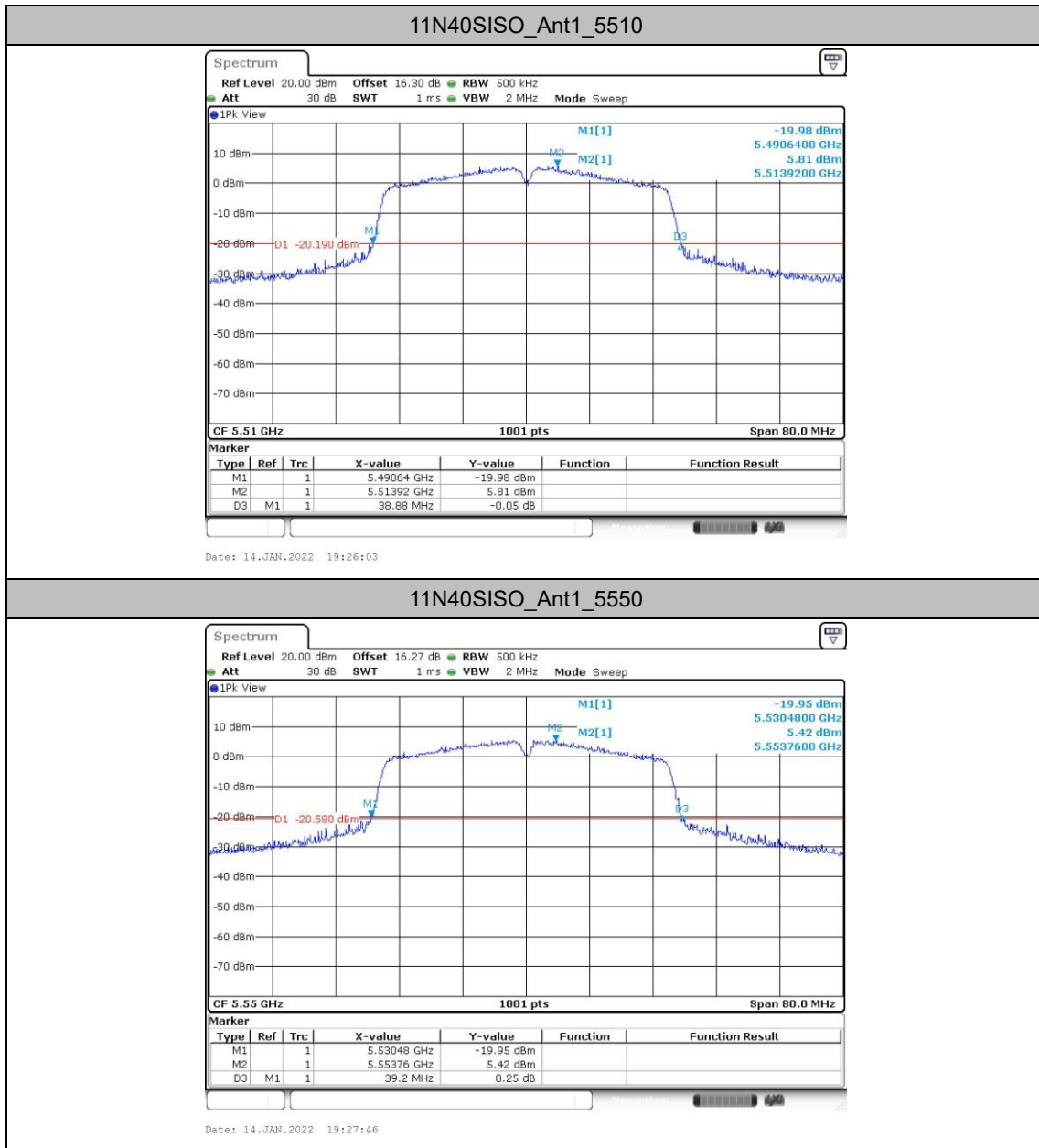


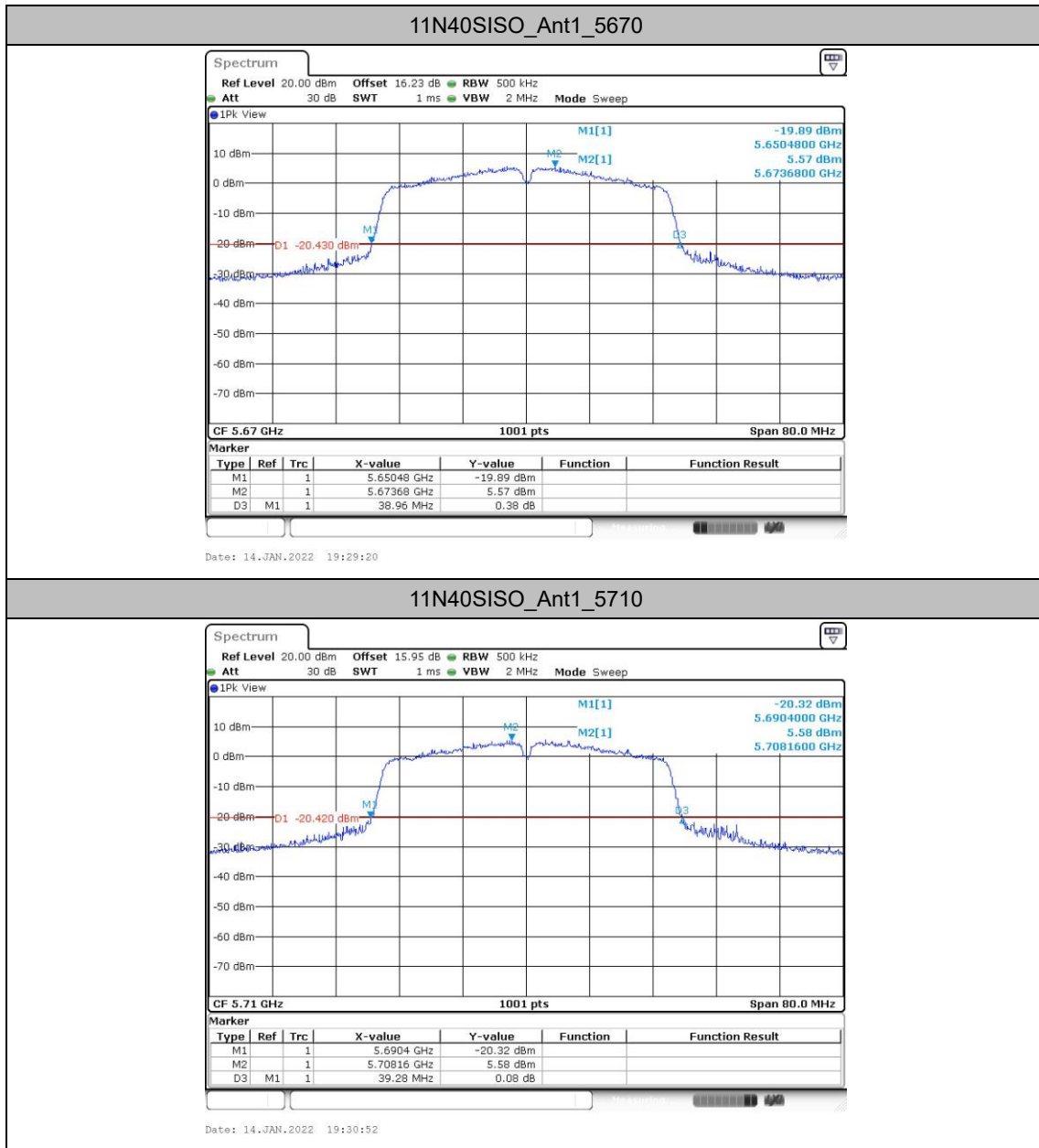


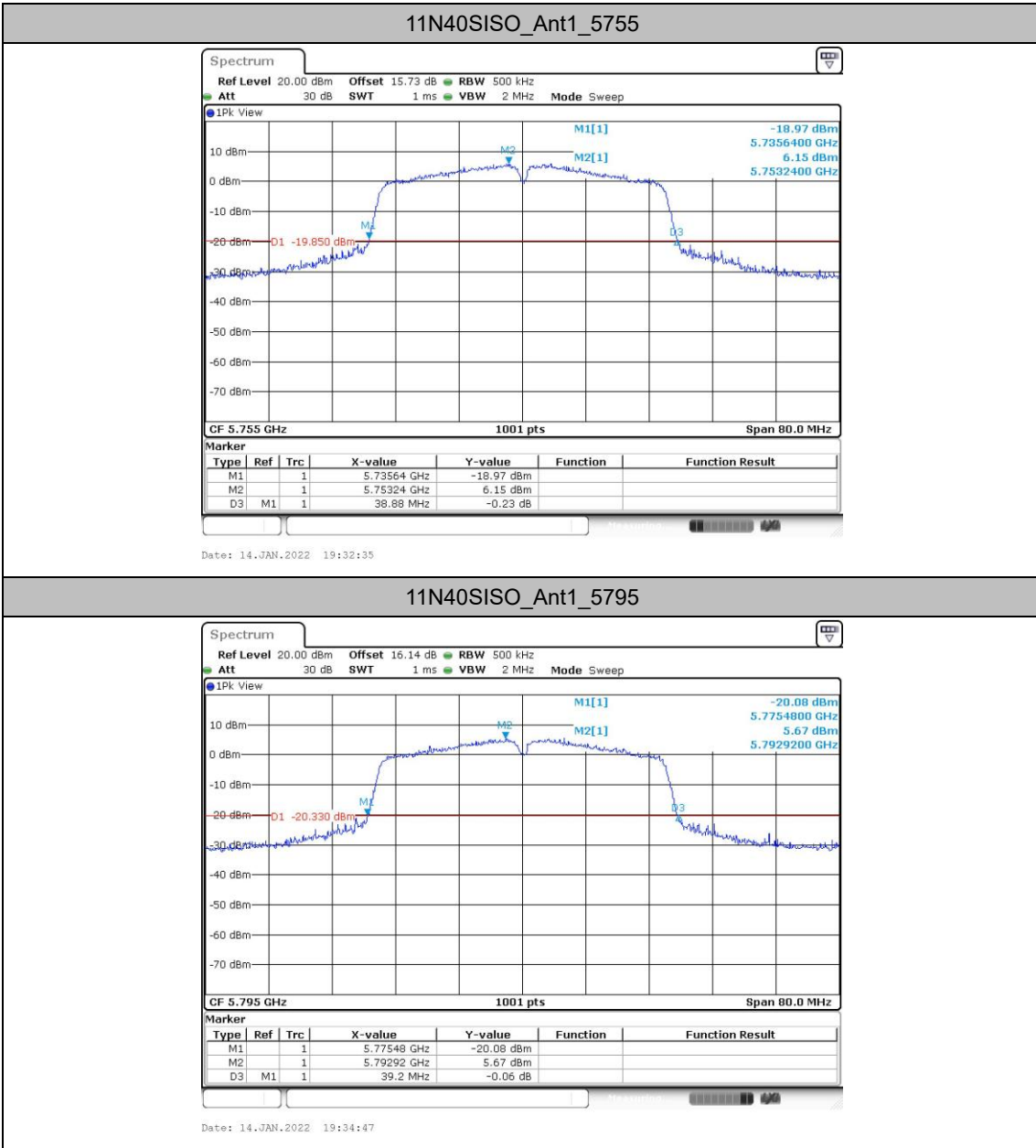


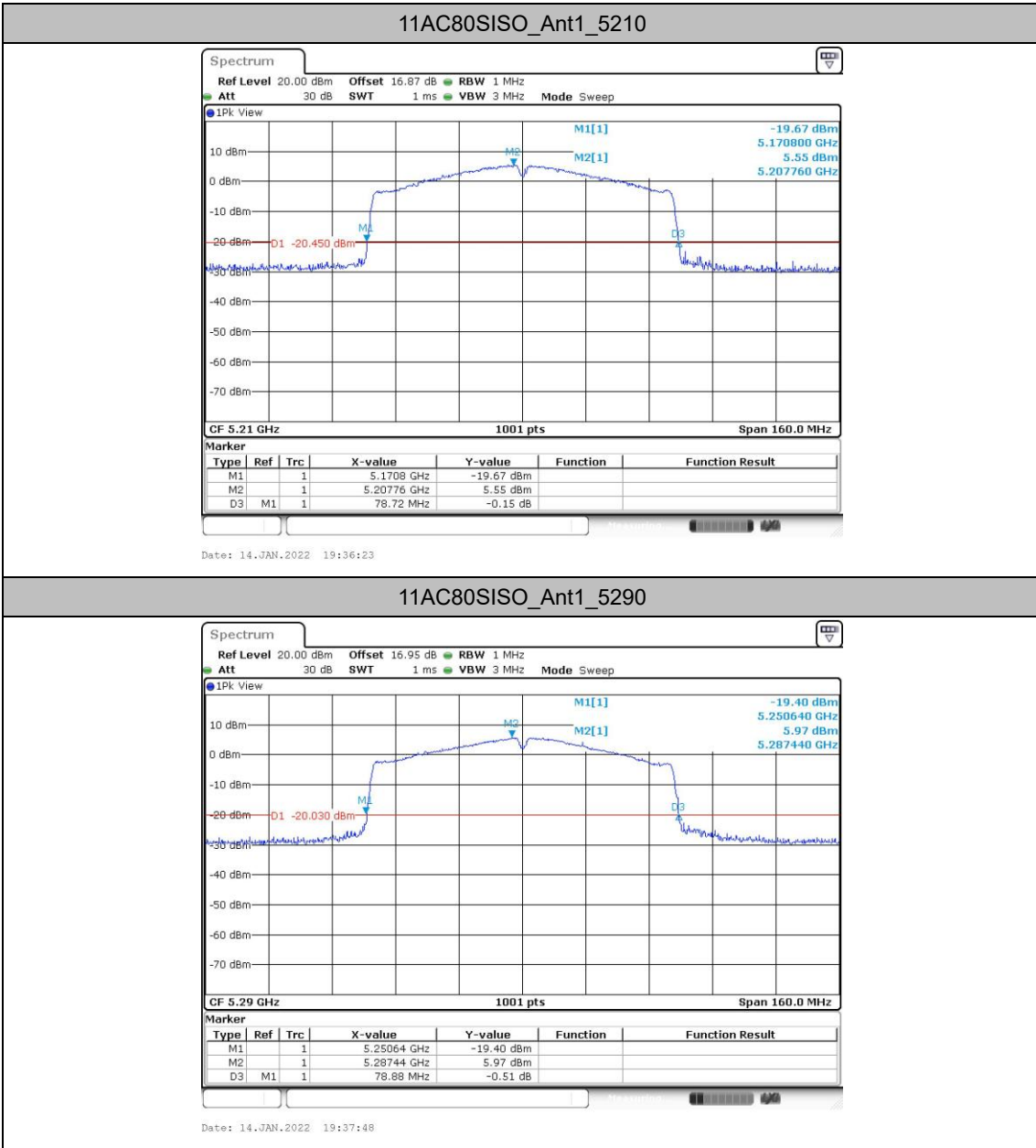


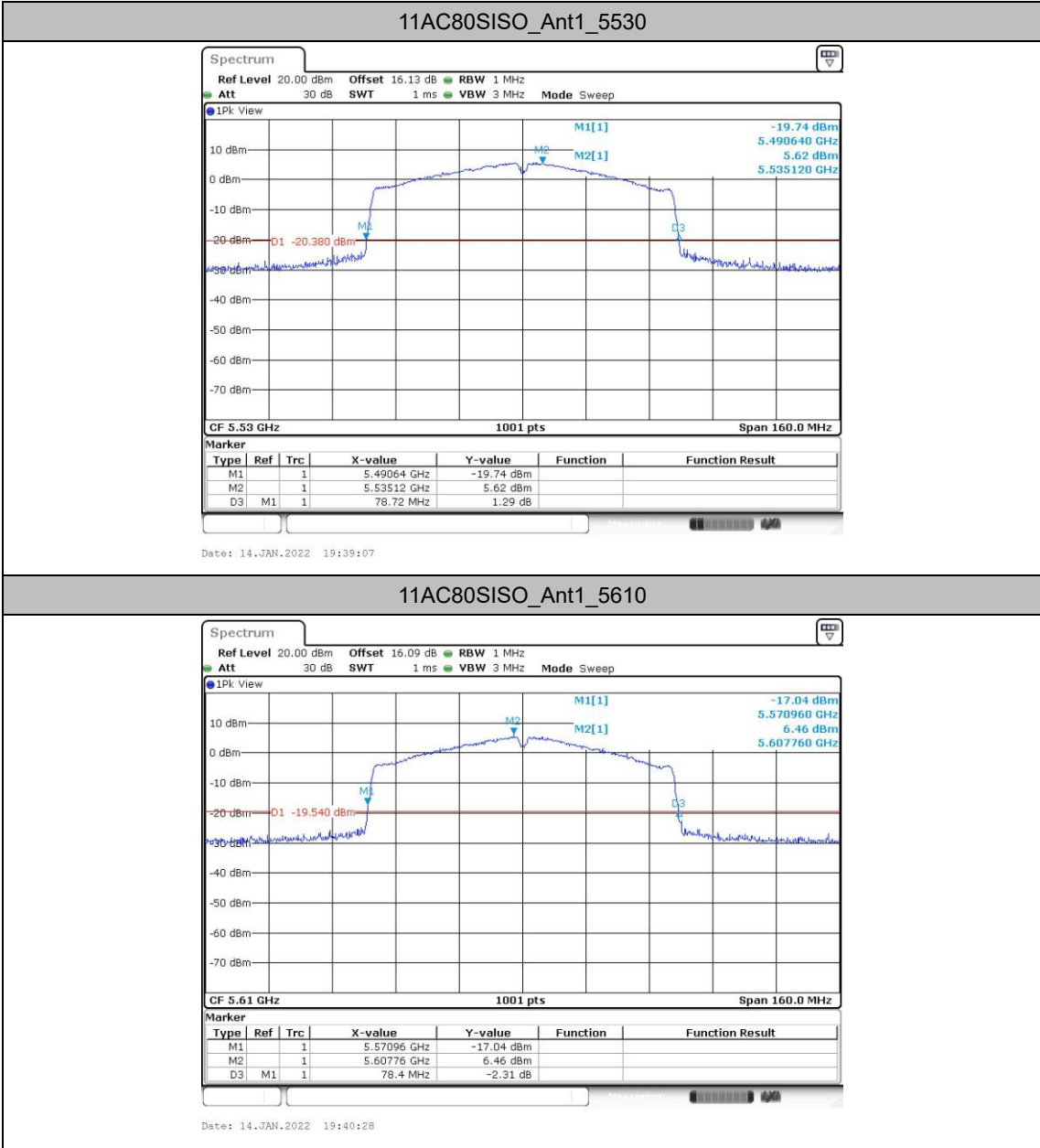






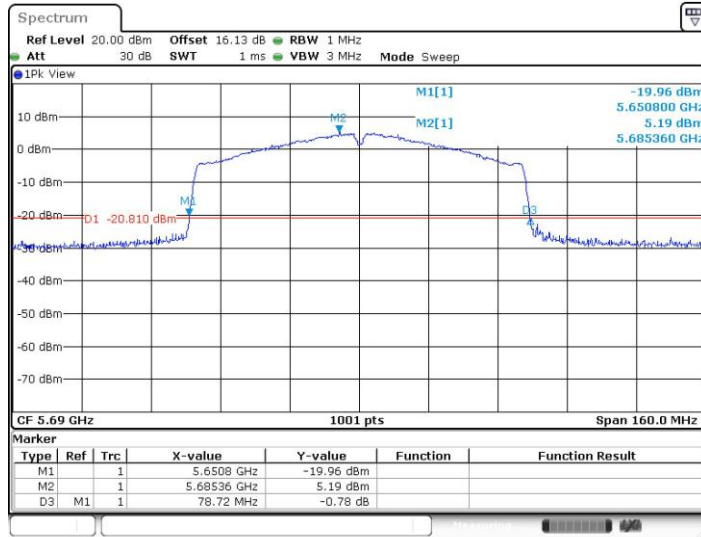






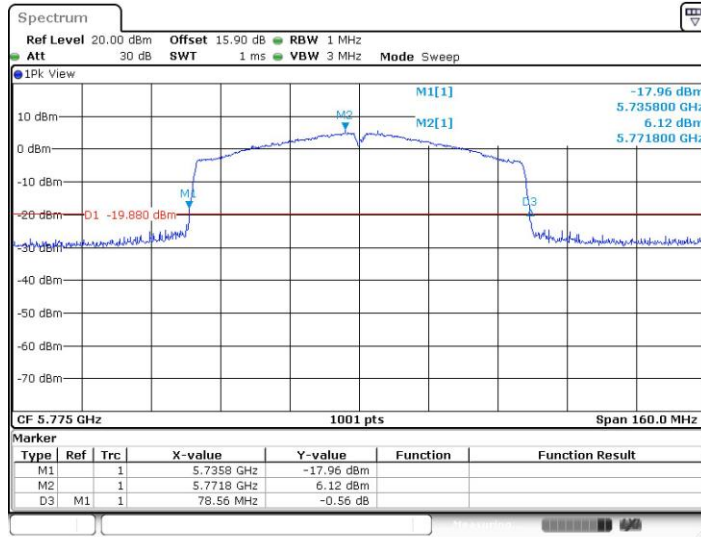


11AC80SISO_Ant1_5690



Date: 14.JAN.2022 19:41:53

11AC80SISO_Ant1_5775



Date: 14.JAN.2022 19:43:28



Occupied channel bandwidth

Test Result

TestMode	Antenna	Frequency[MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
11A	Ant1	5180	17.103	5171.449	5188.551	---	---
		5220	17.143	5211.489	5228.631	---	---
		5240	17.223	5231.489	5248.711	---	---
		5260	17.143	5251.449	5268.591	---	---
		5300	17.263	5291.409	5308.671	---	---
		5320	17.103	5311.489	5328.591	---	---
		5500	17.143	5491.449	5508.591	---	---
		5580	17.223	5571.409	5588.631	---	---
		5700	17.103	5691.489	5708.591	---	---
		5720	17.143	5711.449	5728.591	---	---
		5720_UNII-2C	13.551	5711.449	5725	---	---
		5720_UNII-3	3.591	5725	5728.591	---	---
		5745	17.183	5736.449	5753.631	---	---
		5785	17.183	5776.409	5793.591	---	---
		5825	17.143	5816.409	5833.551	---	---
11N20SISO	Ant1	5180	17.862	5171.049	5188.911	---	---
		5220	17.862	5211.089	5228.951	---	---
		5240	17.902	5231.129	5249.031	---	---
		5260	17.822	5251.089	5268.911	---	---
		5300	17.942	5291.089	5309.031	---	---
		5320	17.942	5311.049	5328.991	---	---
		5500	17.862	5491.089	5508.951	---	---
		5580	17.982	5571.049	5589.031	---	---
		5700	17.902	5691.089	5708.991	---	---
		5720	17.982	5711.049	5729.031	---	---
		5720_UNII-2C	13.951	5711.049	5725	---	---
		5720_UNII-3	4.031	5725	5729.031	---	---
		5745	17.942	5736.049	5753.991	---	---
		5785	17.942	5776.049	5793.991	---	---
		5825	17.982	5816.009	5833.991	---	---



11N40SISO	Ant1	5190	35.804	5172.098	5207.902	---	---
		5230	35.405	5212.338	5247.742	---	---
		5270	35.564	5252.178	5287.742	---	---
		5310	35.884	5292.018	5327.902	---	---
		5510	35.405	5492.338	5527.742	---	---
		5550	35.564	5532.178	5567.742	---	---
		5670	35.485	5652.258	5687.742	---	---
		5710	35.564	5692.258	5727.822	---	---
		5710_UNII-2C	32.742	5692.258	5725	---	---
		5710_UNII-3	2.822	5725	5727.822	---	---
		5755	35.485	5737.258	5772.742	---	---
		5795	35.485	5777.258	5812.742	---	---
11AC80SISO	Ant1	5210	73.367	5173.397	5246.763	---	---
		5290	73.686	5253.077	5326.763	---	---
		5530	73.686	5493.077	5566.763	---	---
		5610	73.207	5573.237	5646.444	---	---
		5690	73.526	5653.237	5726.763	---	---
		5690_UNII-2C	71.763	5653.237	5725	---	---
		5690_UNII-3	1.763	5725	5726.763	---	---
		5775	73.526	5738.077	5811.603	---	---



Test Graphs

