



FCC RADIO TEST REPORT

FCC ID : 2AEUPBHAFL011
Equipment : Floodlight Cam
Brand Name : Ring
Model Name : 5L4C4T
Applicant : Ring LLC
 1523 26th St Santa Monica, CA 90404 USA
Manufacturer : Ring LLC
 1523 26th St Santa Monica, CA 90404 USA
Standard : FCC Part 15 Subpart C §15.247

The product was received on Dec. 07, 2021 and testing was performed from Jan. 09, 2022 to Mar. 28, 2022. We, Sporton International Inc. Wensan Laboratory, 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 from Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu

Sporton International Inc. Wensan Laboratory

No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C)



Table of Contents

History of this test report.....	3
Summary of Test Result.....	4
1 General Description	5
1.1 Product Feature of Equipment Under Test.....	5
1.2 Modification of EUT	5
1.3 Testing Location	5
1.4 Applicable Standards.....	6
2 Test Configuration of Equipment Under Test	7
2.1 Carrier Frequency and Channel	7
2.2 Test Mode.....	8
2.3 Connection Diagram of Test System.....	9
2.4 Support Unit used in test configuration and system	9
2.5 EUT Operation Test Setup	9
2.6 Measurement Results Explanation Example.....	10
3 Test Result	11
3.1 6dB and 99% Bandwidth Measurement	11
3.2 Output Power Measurement.....	22
3.3 Power Spectral Density Measurement	23
3.4 Conducted Band Edges and Spurious Emission Measurement	29
3.5 Radiated Band Edges and Spurious Emission Measurement	45
3.6 AC Conducted Emission Measurement.....	49
3.7 Antenna Requirements	51
4 List of Measuring Equipment.....	52
5 Uncertainty of Evaluation	54
Appendix A. Conducted Test Results	
Appendix B. AC Conducted Emission Test Result	
Appendix C. Radiated Spurious Emission	
Appendix D. Radiated Spurious Emission Plots	
Appendix E. Duty Cycle Plots	
Appendix F. Setup Photographs	



History of this test report

Report No.	Version	Description	Issue Date
FR240816B	01	Initial issue of report	Apr. 28, 2022



Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.247(a)(2)	6dB Bandwidth	Pass	-
3.1	2.1049	99% Occupied Bandwidth	Reporting only	-
3.2	15.247(b)(3)	Power Output Measurement	Pass	-
3.3	15.247(e)	Power Spectral Density	Pass	-
3.4	15.247(d)	Conducted Band Edges	Pass	-
		Conducted Spurious Emission	Pass	-
3.5	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	Pass	6.09 dB under the limit at 30.000 MHz
3.6	15.207	AC Conducted Emission	Pass	21.61 dB under the limit at 2.826 MHz
3.7	15.203 & 15.247(b)	Antenna Requirement	Pass	-

Declaration of Conformity:

1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. It's means measurement values may risk exceeding the limit of regulation standards, if measurement uncertainty is include in test results.
2. The measurement uncertainty please refer to this report "Uncertainty of Evaluation".

Comments and Explanations:

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

Reviewed by: Keven Cheng

Report Producer: Lucy Wu



1 General Description

1.1 Product Feature of Equipment Under Test

LoRa

Product Feature		
Antenna Type	PIFA Antenna	
Antenna information		
902 MHz ~ 928 MHz	Peak Gain (dBi)	-1.19

Remark: The above EUT's information was declared by manufacturer. Please refer to Comments and Explanations in report summary.

1.2 Modification of EUT

No modifications made to the EUT during the testing.

1.3 Testing Location

Test Site	Sporton International Inc. EMC & Wireless Communications Laboratory
Test Site Location	No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978
Test Site No.	Sporton Site No. TH02-HY (TAF Code: 1190)
Remark	The Conducted test item subcontracted to Sporton International Inc. EMC & Wireless Communications Laboratory

Test Site	Sporton International Inc. Wensan Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	Sporton Site No. 03CH16-HY, CO07-HY

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW1190 and TW3786



1.4 Applicable Standards

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

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v05r02
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01.
- ♦ ANSI C63.10-2013

Remark:

1. All the test items were validated and recorded in accordance with the standards without any modification during the testing.
2. The TAF code is not including all the FCC KDB listed without accreditation.



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, the measured emission level of the EUT was maximized by rotating the EUT on a turntable, adjusting the orientation of the EUT and EUT antenna in three orthogonal axis (X: flat, Y: portrait, Z: landscape), and adjusting the measurement antenna orientation, following C63.10 exploratory test procedures and find Z plane as worst plane.

- b. AC power line Conducted Emission was tested under maximum output power.

2.1 Carrier Frequency and Channel

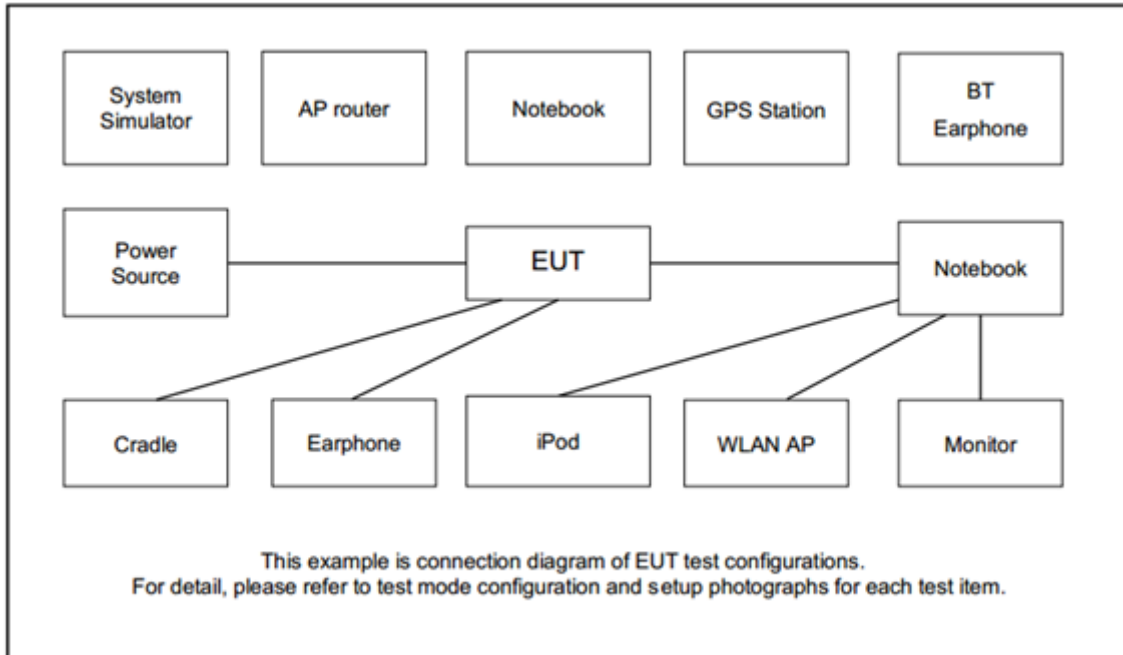
Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
902 – 928 MHz	1	902.5	17	915.3
	2	903.3	18	916.1
	3	904.1	19	916.9
	4	904.9	20	917.7
	5	905.7	21	918.5
	6	906.5	22	919.3
	7	907.3	23	920.1
	8	908.1	24	920.9
	9	908.9	25	921.7
	10	909.7	26	922.5
	11	910.5	27	923.3
	12	911.3	28	924.1
	13	912.1	29	924.9
	14	912.9	30	925.7
	15	913.7	31	926.5
	16	914.5		



2.2 Test Mode

Summary table of Test Cases		
Test Item	Feature	LoRa
Conducted Test Cases	LoRa 500 KHz DTS_SF5	Mode 1: CH01 Tx_902.50 MHz Mode 2: CH16 Tx_914.50 MHz Mode 3: CH31 Tx_926.50 MHz
	LoRa 500 KHz DTS_SF8	Mode 4: CH01 Tx_902.50 MHz Mode 5: CH16 Tx_914.50 MHz Mode 6: CH31 Tx_926.50 MHz
	LoRa 500 KHz DTS_SF9	Mode 7: CH01 Tx_902.50 MHz Mode 8: CH16 Tx_914.50 MHz Mode 9: CH31 Tx_926.50 MHz
	LoRa 500 KHz DTS_SF10	Mode 10: CH01 Tx_902.50 MHz Mode 11: CH16 Tx_914.50 MHz Mode 12: CH31 Tx_926.50 MHz
	LoRa 500 KHz DTS_SF11	Mode 13: CH01 Tx_902.50 MHz Mode 14: CH16 Tx_914.50 MHz Mode 15: CH31 Tx_926.50 MHz
Radiated Test Cases	LoRa 500 KHz DTS_SF11	Mode 1: CH01 Tx_902.50 MHz Mode 2: CH16 Tx_914.50 MHz Mode 3: CH31 Tx_926.50 MHz
AC Conducted Emission	Mode 1: LoRa Tx + USB Cable (Charging from Adapter)	

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Adapter	DVE	DSA-5PFM-05 FUS	FCC DoC	N/A	N/A
2.	USB Cable	NA	NA	N/A	N/A	N/A

2.5 EUT Operation Test Setup

The RF test items, utility “J-Link RTT Viewer V7.54a” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.



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 4.2 dB and 10 dB attenuator.

$$\begin{aligned} \text{Offset(dB)} &= \text{RF cable loss(dB)} + \text{attenuator factor(dB)}. \\ &= 4.2 + 10 = 14.2 \text{ (dB)} \end{aligned}$$

3 Test Result

3.1 6dB and 99% Bandwidth Measurement

3.1.1 Limit of 6dB and 99% Bandwidth

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

3.1.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.1.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 6.9.3 (OBW) and 11.8.1 (6dB BW).
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
5. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the emission bandwidth and set the Video bandwidth (VBW) $\geq 3 * RBW$.
6. Measure and record the results in the test report.

3.1.4 Test Setup



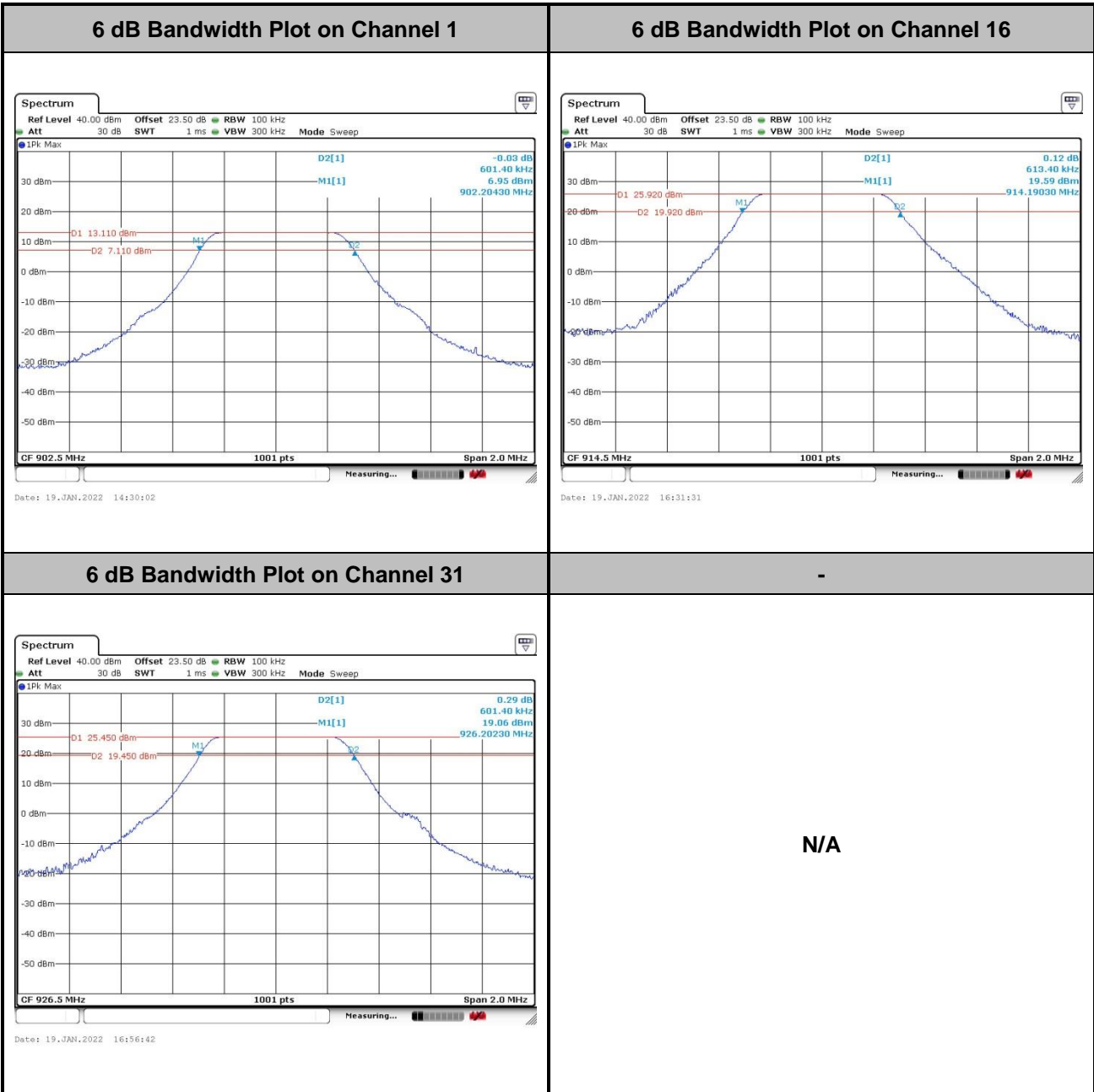


3.1.5 Test Result of 6dB and 99% Occupied Bandwidth

Please refer to Appendix A.

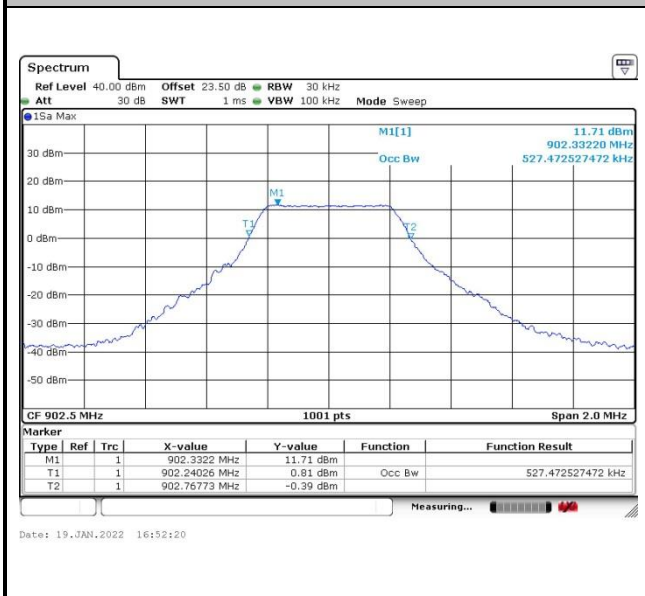
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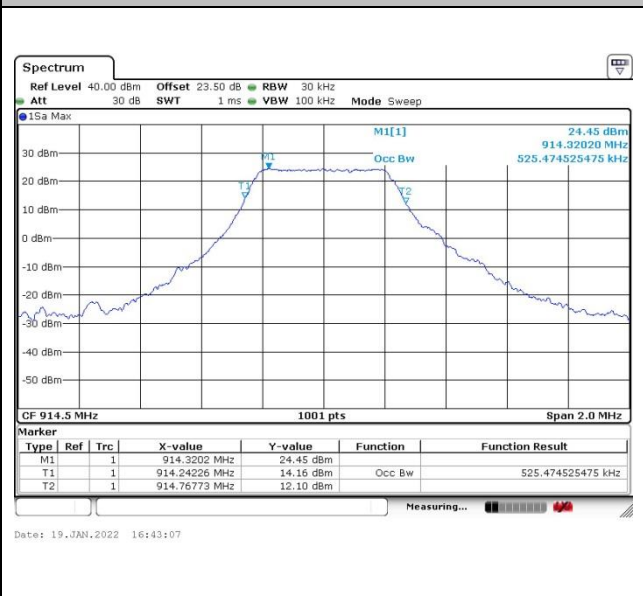




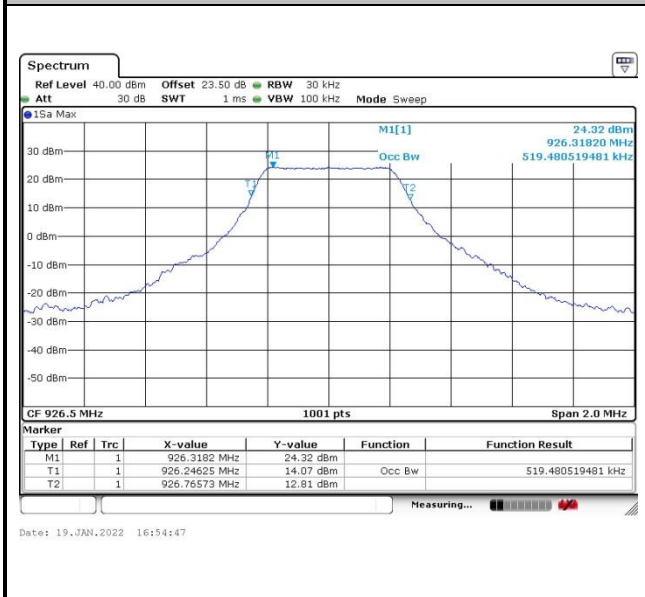
99% Occupied Bandwidth Plot on Channel 1



99% Occupied Plot Bandwidth on Channel 16



6 dB Bandwidth Plot on Channel 31



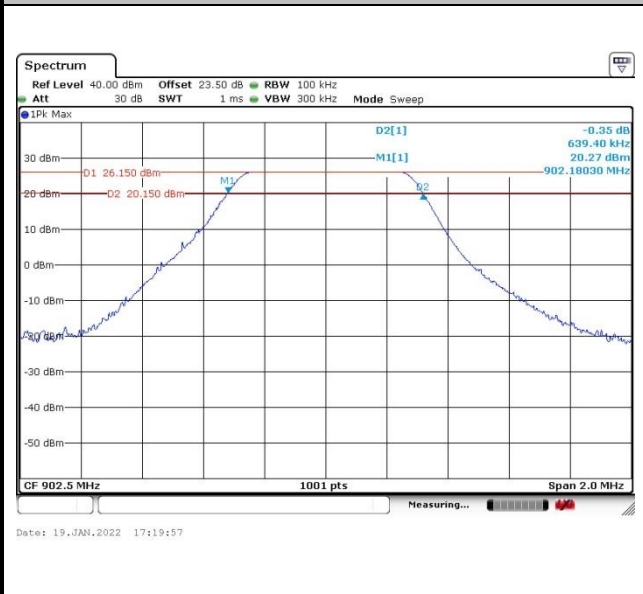
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Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

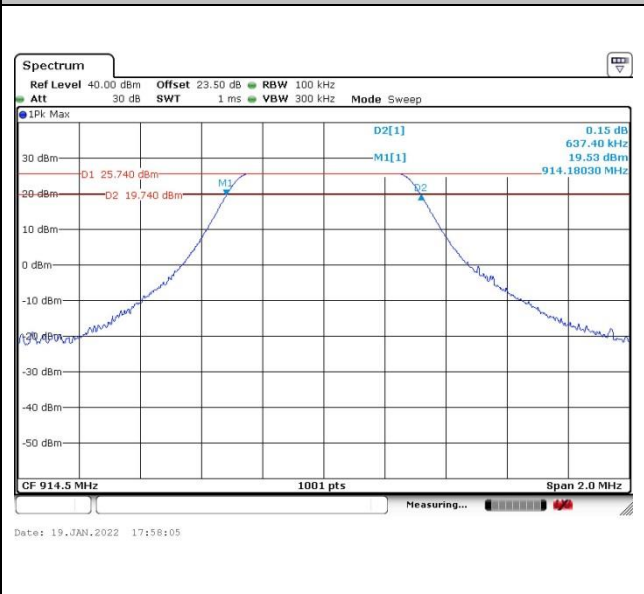


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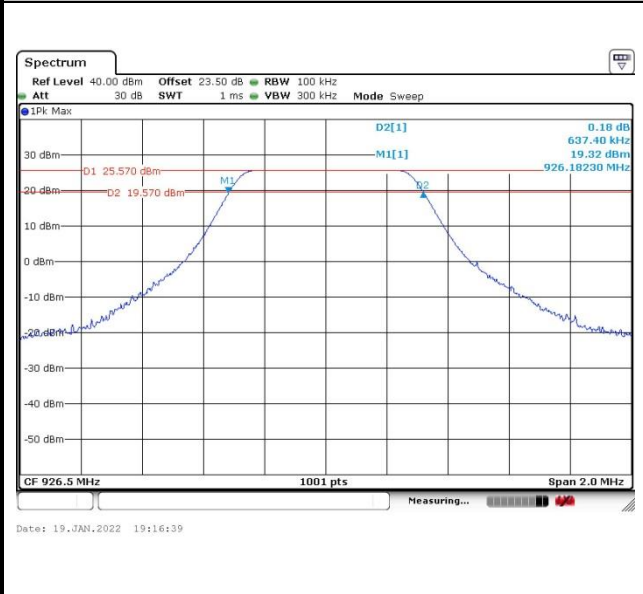
6 dB Bandwidth Plot on Channel 1



6 dB Bandwidth Plot on Channel 16



6 dB Bandwidth Plot on Channel 31



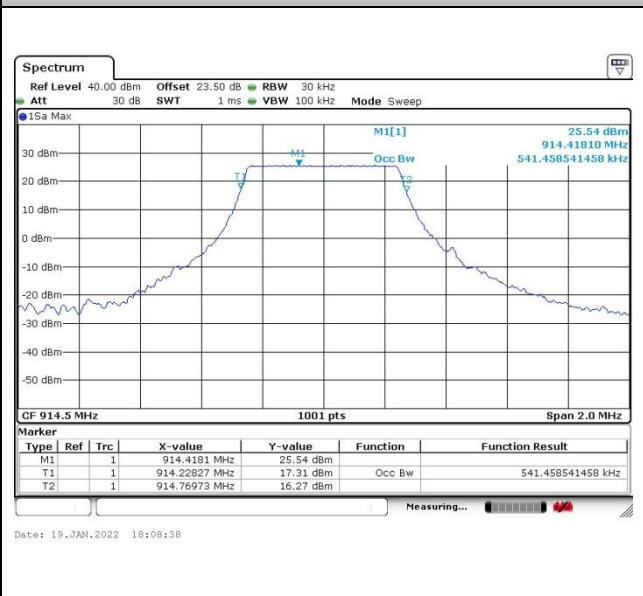
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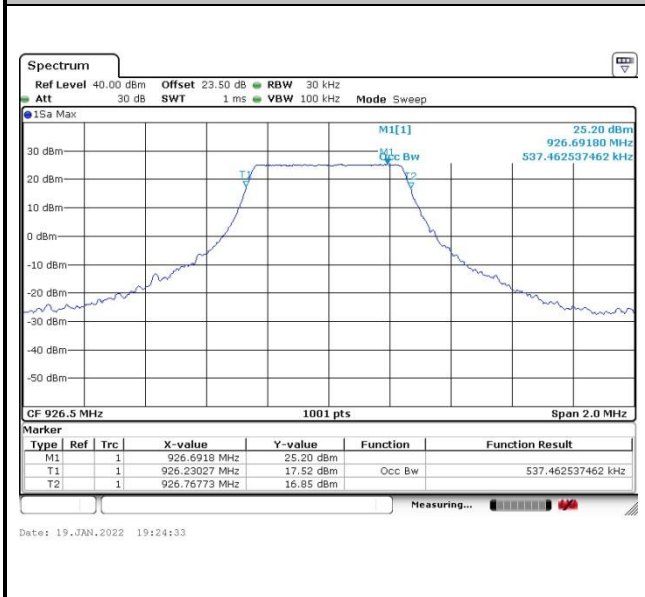
99% Occupied Bandwidth Plot on Channel 1



99% Occupied Plot Bandwidth on Channel 16



6 dB Bandwidth Plot on Channel 31



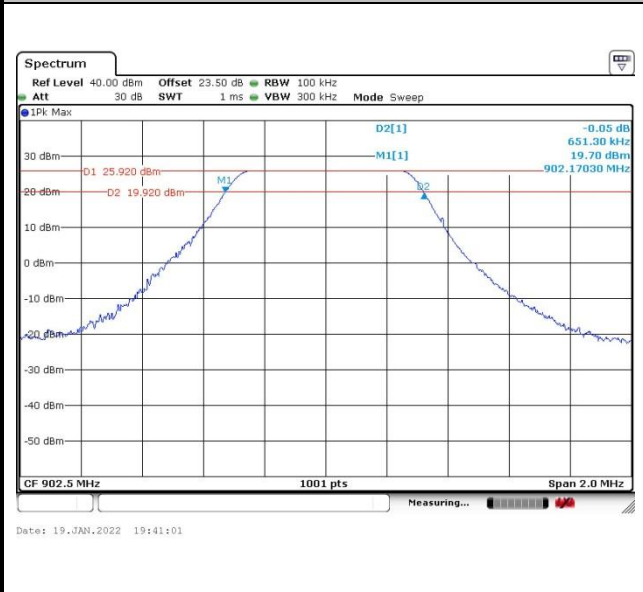
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Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

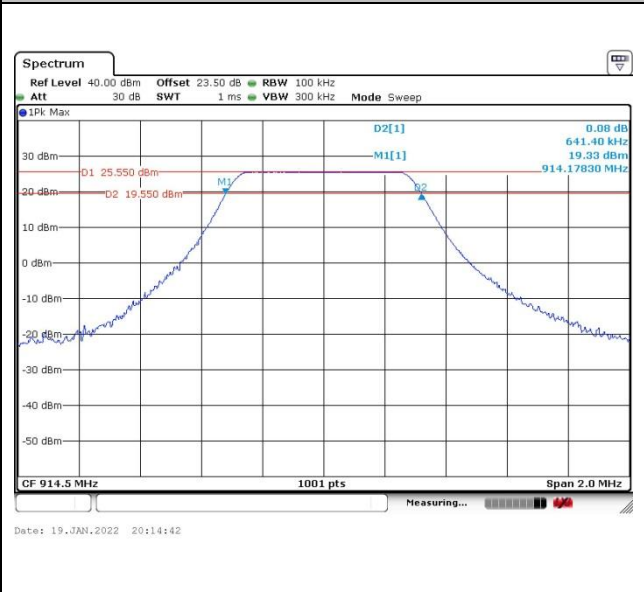


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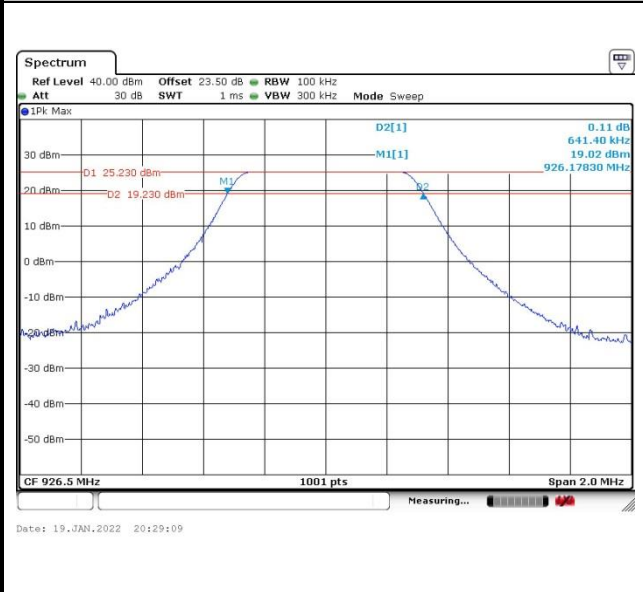
6 dB Bandwidth Plot on Channel 1



6 dB Bandwidth Plot on Channel 16



6 dB Bandwidth Plot on Channel 31



N/A



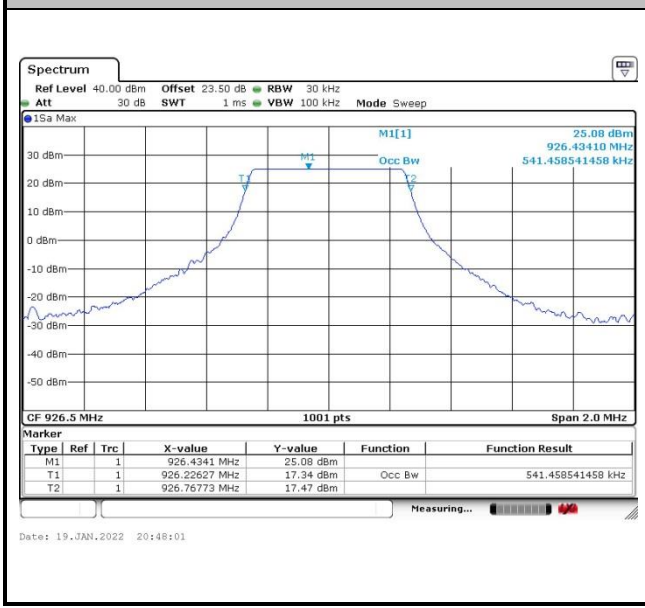
99% Occupied Bandwidth Plot on Channel 1



99% Occupied Plot Bandwidth on Channel 16



6 dB Bandwidth Plot on Channel 31



-

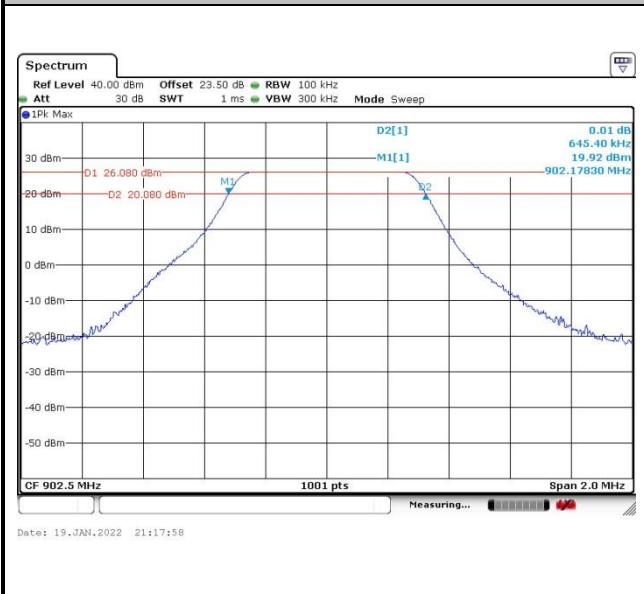
N/A

Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

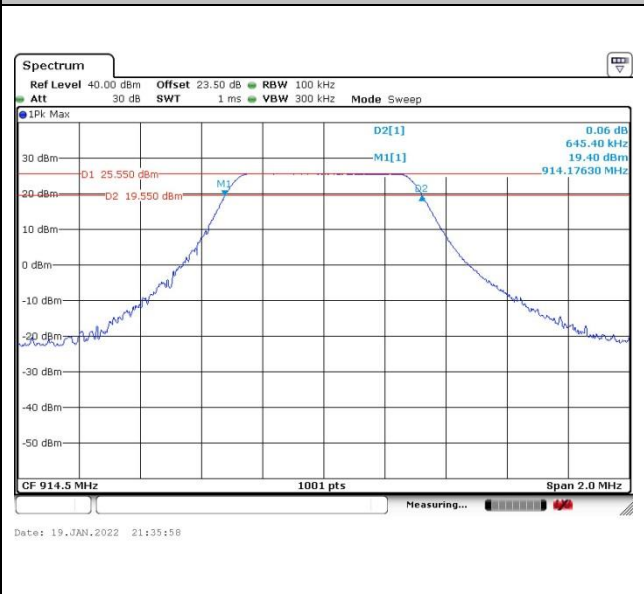


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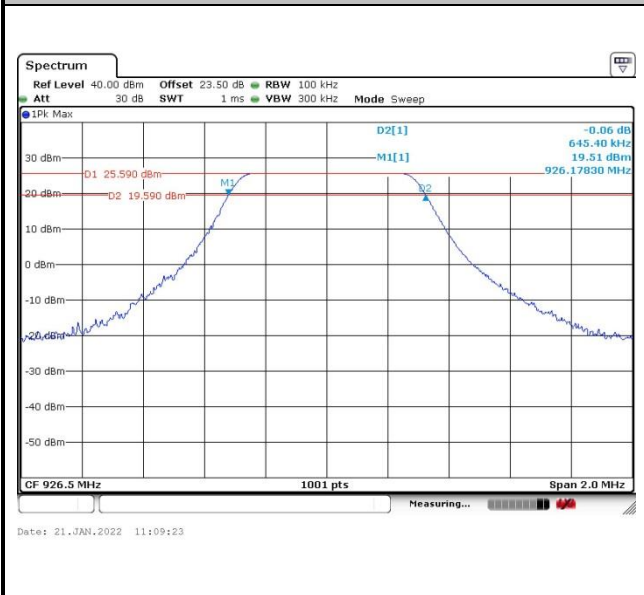
6 dB Bandwidth Plot on Channel 1



6 dB Bandwidth Plot on Channel 16



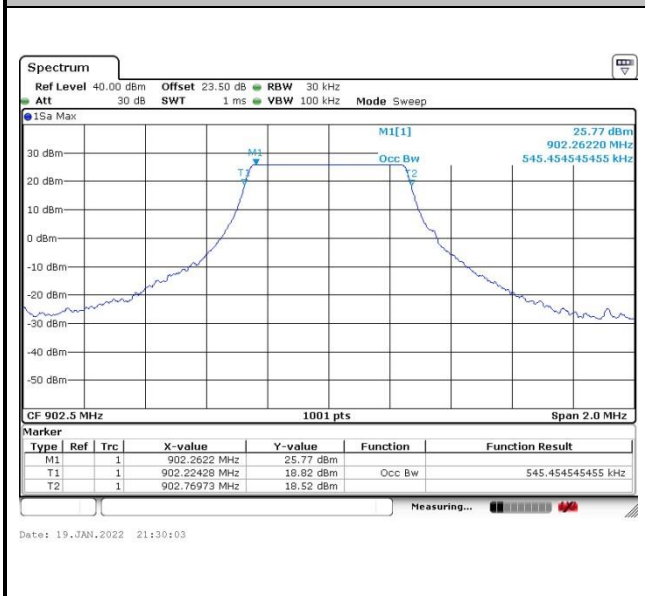
6 dB Bandwidth Plot on Channel 31



N/A



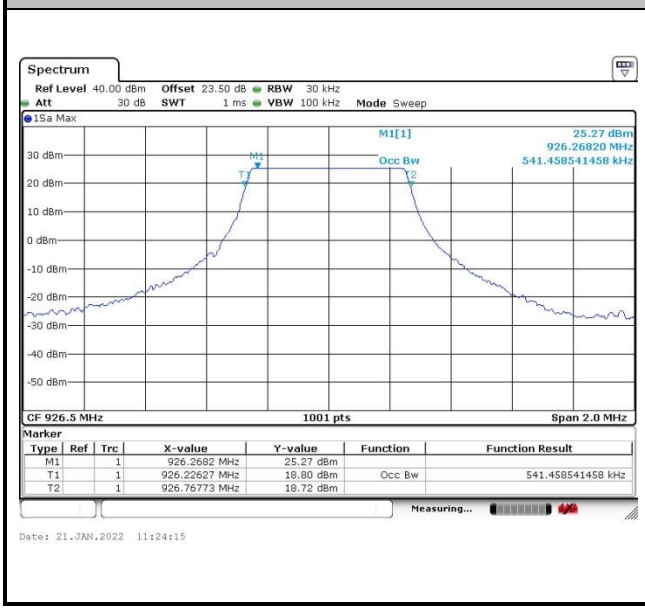
99% Occupied Bandwidth Plot on Channel 1



99% Occupied Plot Bandwidth on Channel 16



6 dB Bandwidth Plot on Channel 31



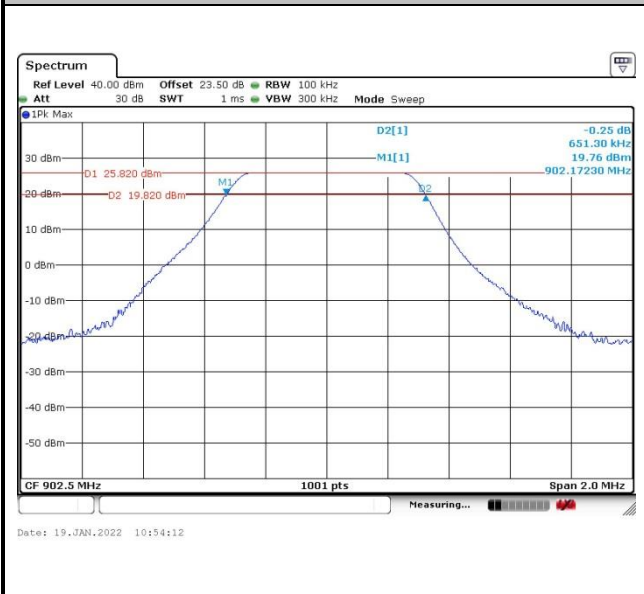
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Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

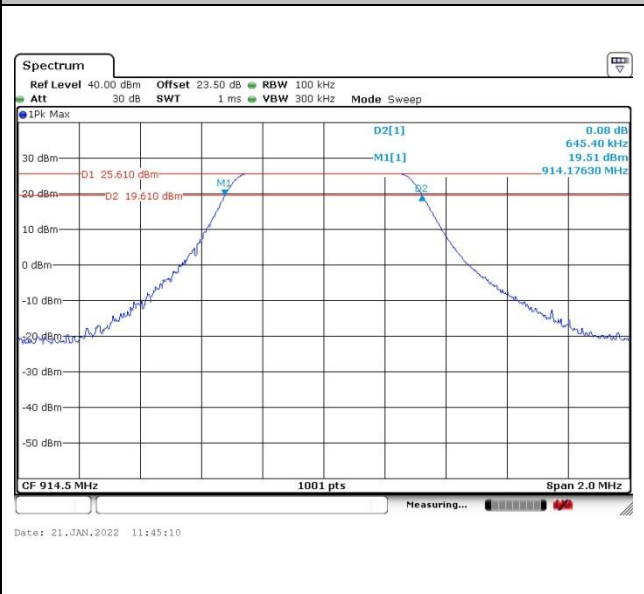


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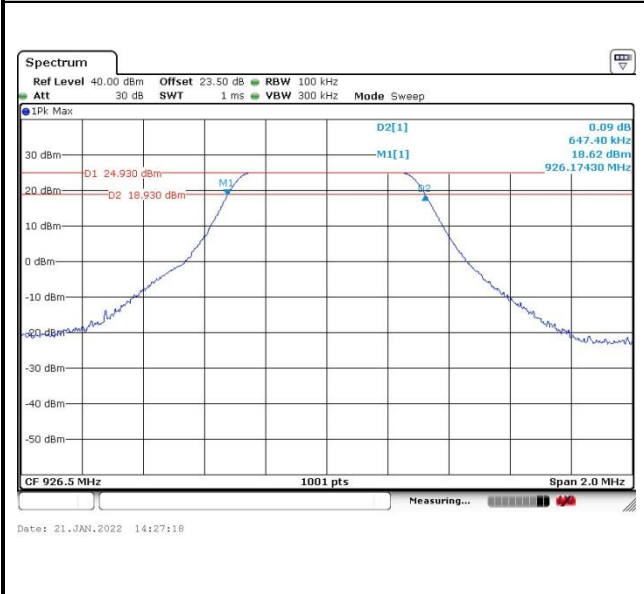
6 dB Bandwidth Plot on Channel 1



6 dB Bandwidth Plot on Channel 16



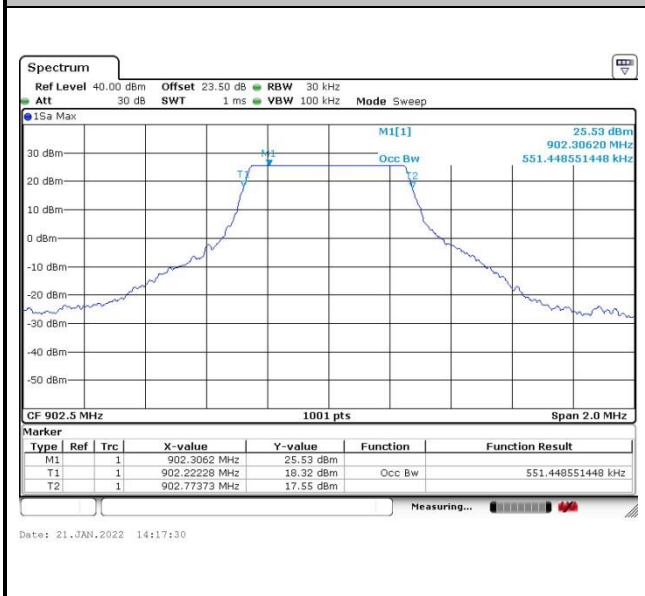
6 dB Bandwidth Plot on Channel 31



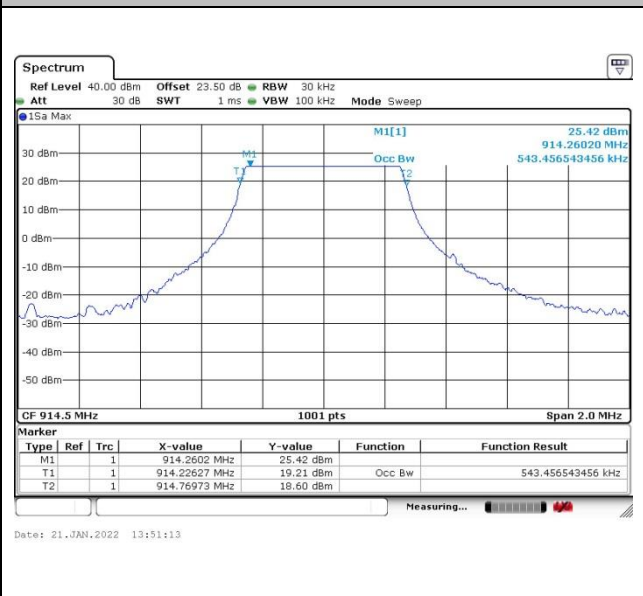
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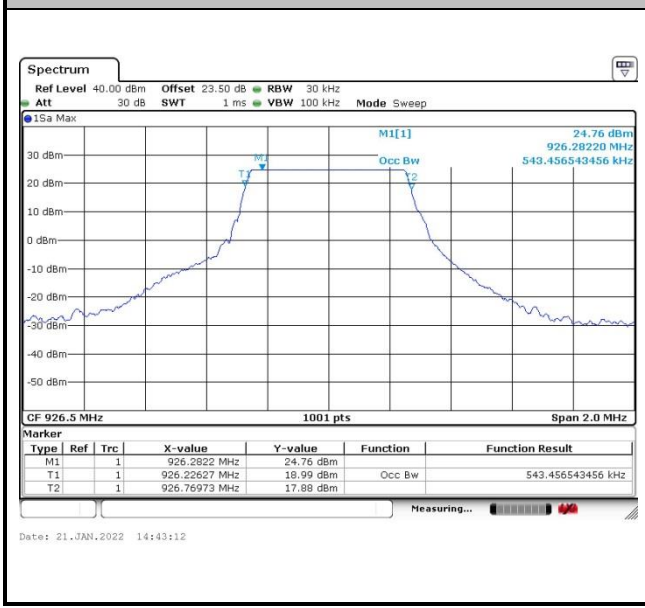
99% Occupied Bandwidth Plot on Channel 1



99% Occupied Plot Bandwidth on Channel 16



6 dB Bandwidth Plot on Channel 31



N/A

Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.2 Output Power Measurement

3.2.1 Limit of Output Power

Section 15.247(b)(3) For systems using digital modulation in the 902-928 MHz, the limit for peak output power is 1 watt.

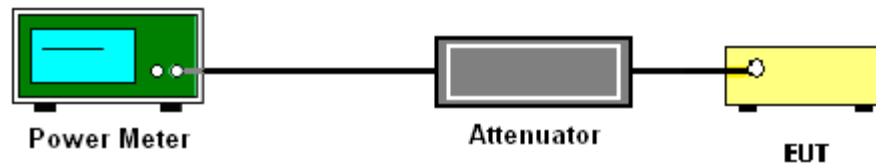
3.2.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.2.3 Test Procedures

1. For Average Power, the testing follows ANSI C63.10 Section 11.9.2.3.2 Method AVGPM-G
2. The RF output of EUT is connected to the power meter by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Measure the conducted output power and record the results in the test report.

3.2.4 Test Setup



3.2.5 Test Result of Average Output Power

Please refer to Appendix A.

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

The peak power spectral density shall not be greater than 8 dBm in any 3 kHz band at any time interval of continuous transmission.

3.3.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.3.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.10.2 Method PKPSD.
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.

3.3.4 Test Setup

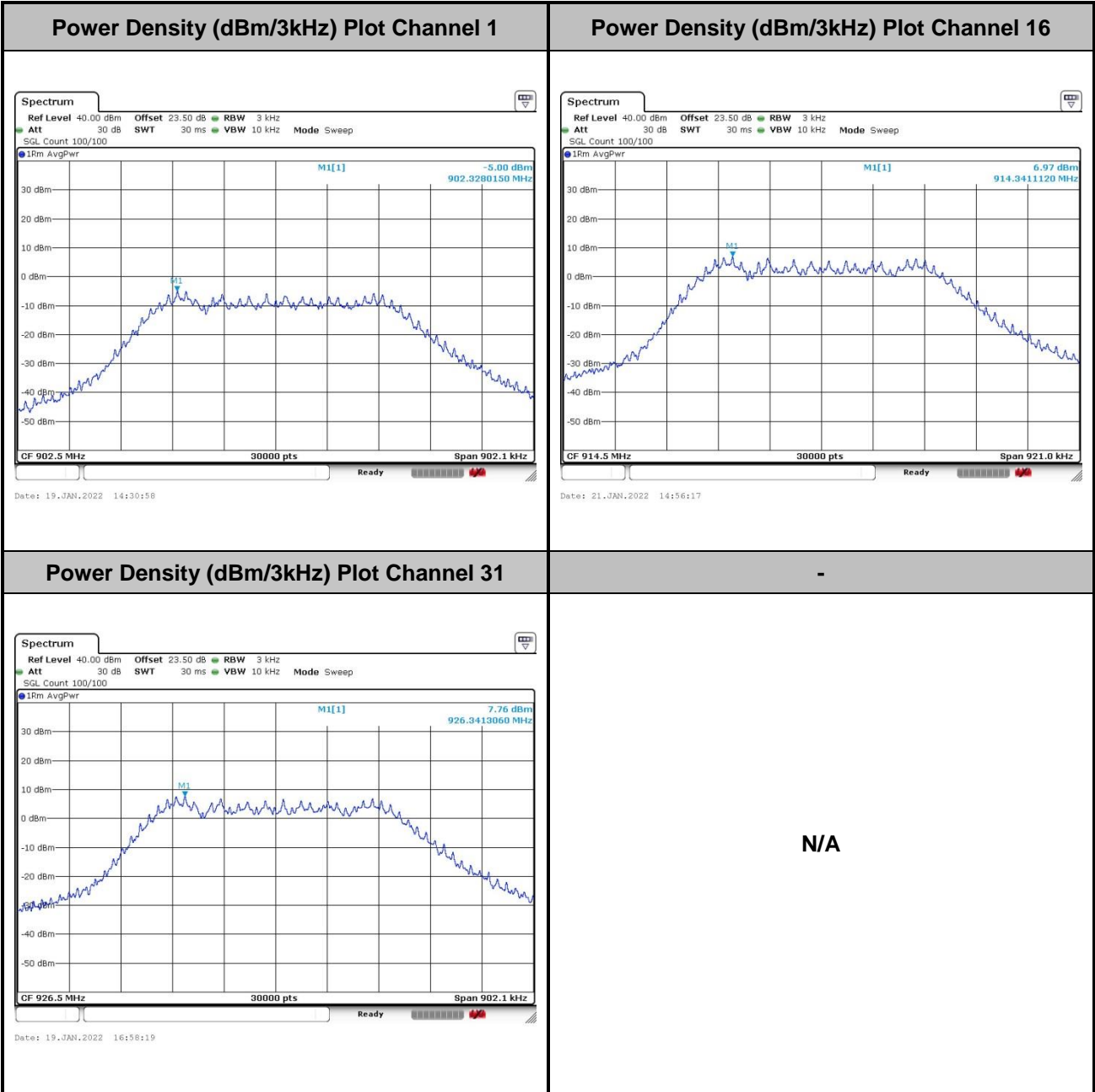




3.3.5 Test Result of Power Spectral Density

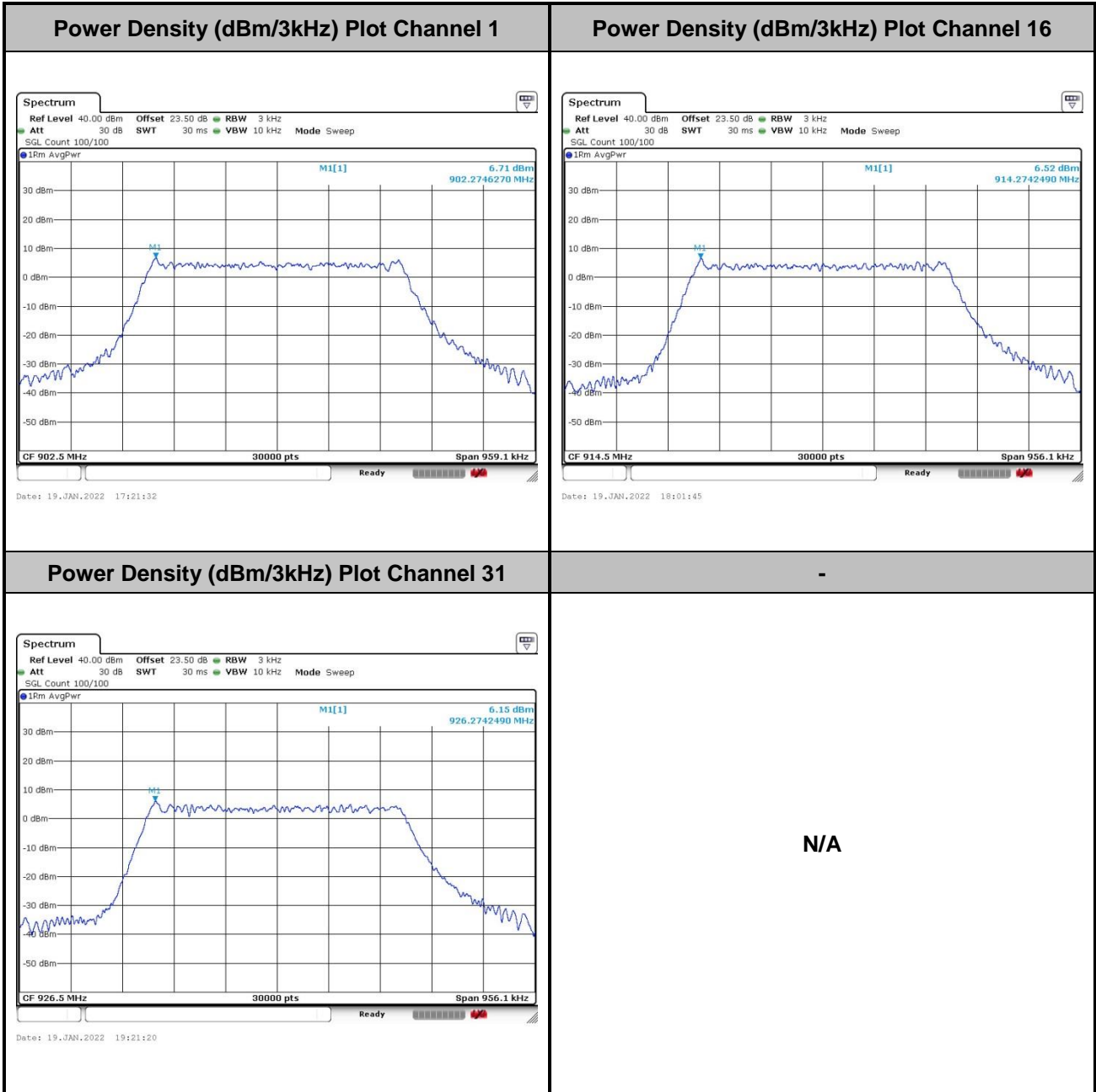
Please refer to Appendix A.

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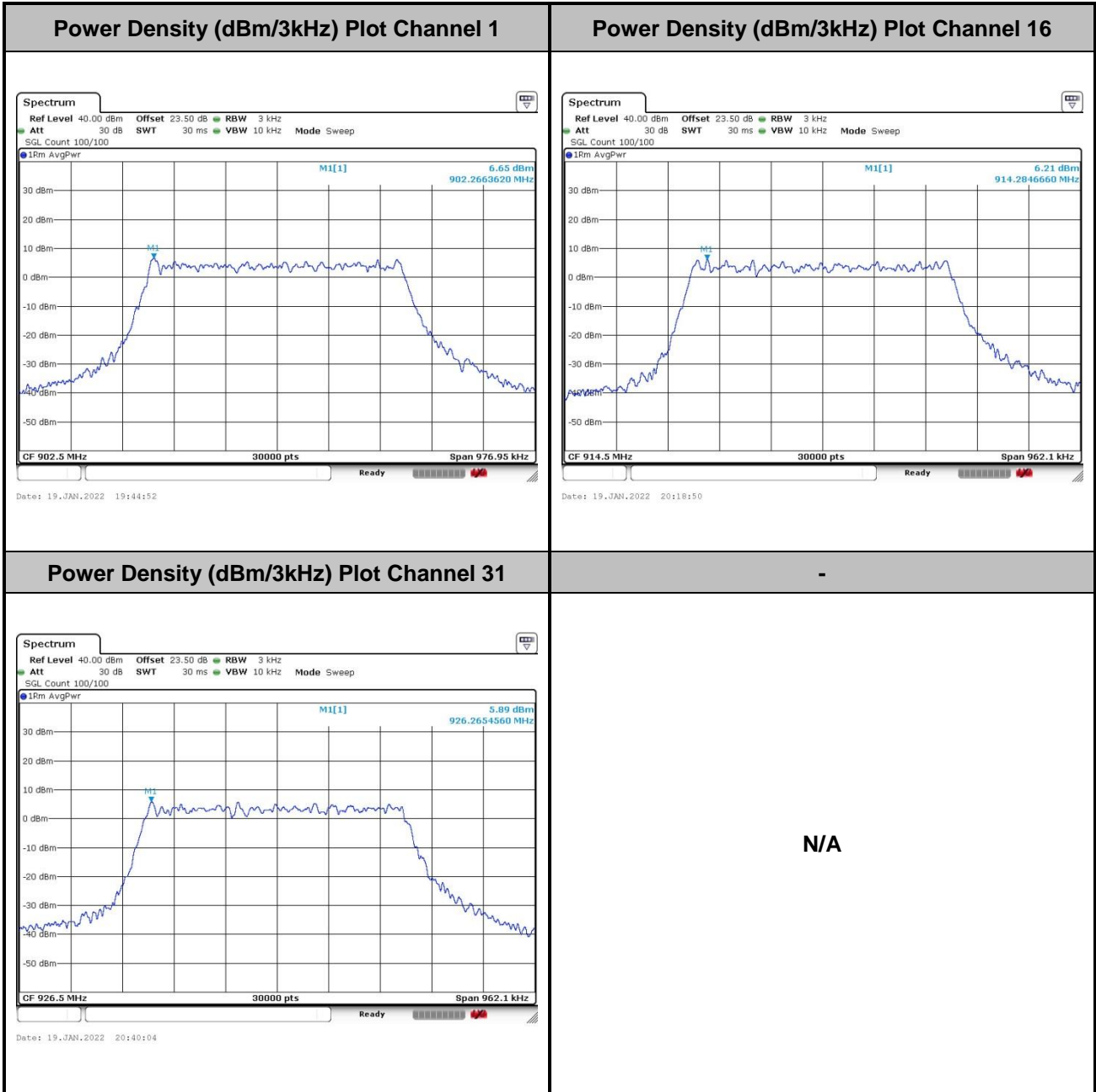


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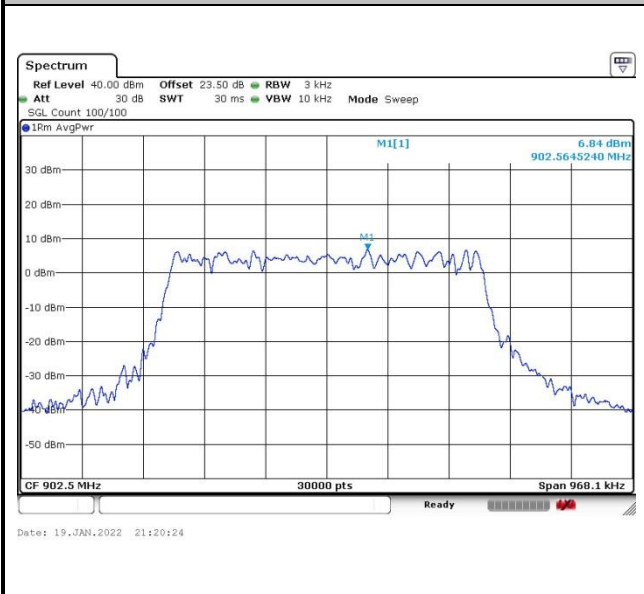
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<Data Rate: SF10>

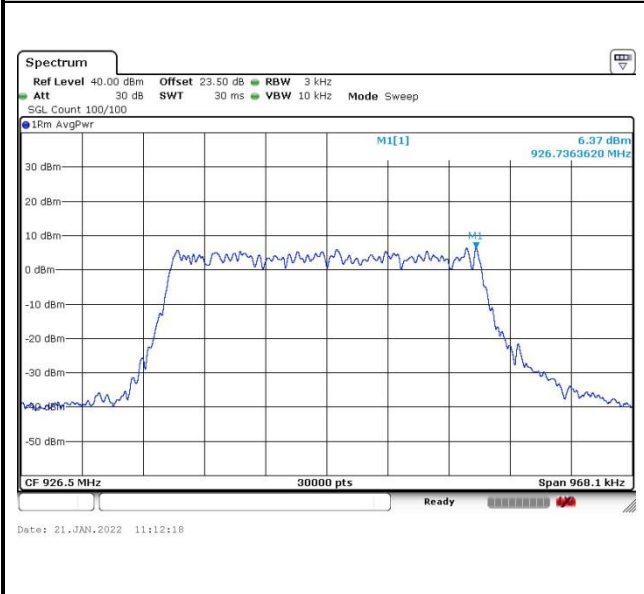
Power Density (dBm/3kHz) Plot Channel 1



Power Density (dBm/3kHz) Plot Channel 16



Power Density (dBm/3kHz) Plot Channel 31

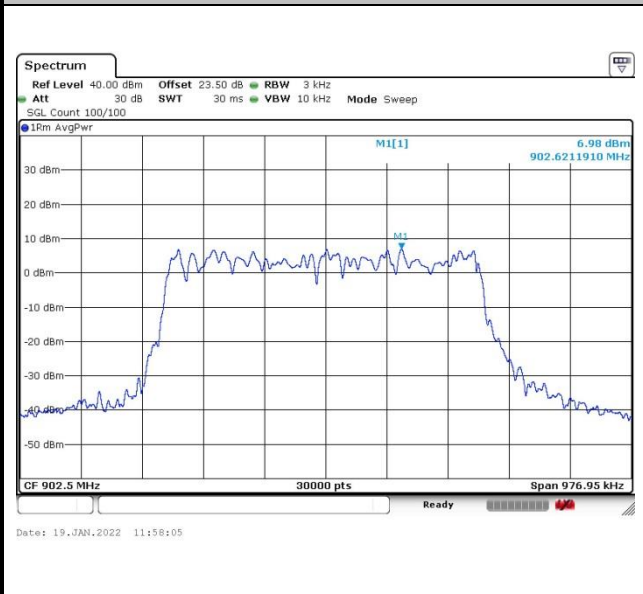


N/A



<Data Rate: SF11>

Power Density (dBm/3kHz) Plot Channel 1



Power Density (dBm/3kHz) Plot Channel 16



Power Density (dBm/3kHz) Plot Channel 31



N/A

3.4 Conducted Band Edges and Spurious Emission Measurement

3.4.1 Limit of Conducted Band Edges and Spurious Emission Measurement

In any 100 kHz bandwidth outside of the authorized frequency band, the emissions which fall in the non-restricted bands shall be attenuated at least 20 dB / 30dB relative to the maximum PSD level in 100 kHz by RF conducted measurement.

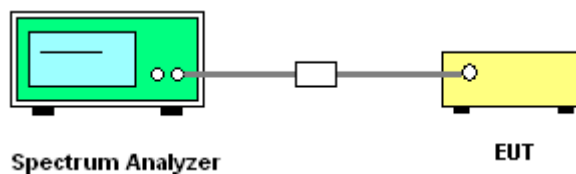
3.4.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.4.3 Test Procedures

1. The testing follows the ANSI C63.10 Section 11.11.3 Emission level measurement.
2. The RF output of EUT is connected to the spectrum analyzer by RF cable and attenuator. The path loss is compensated to the results for each measurement.
3. Set the maximum power setting and enable the EUT to transmit continuously.
4. Set RBW = 100 kHz, VBW=300 kHz, Peak Detector. Unwanted Emissions measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when maximum peak conducted output power procedure is used. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB per 15.247(d).
5. Measure and record the results in the test report.
6. The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

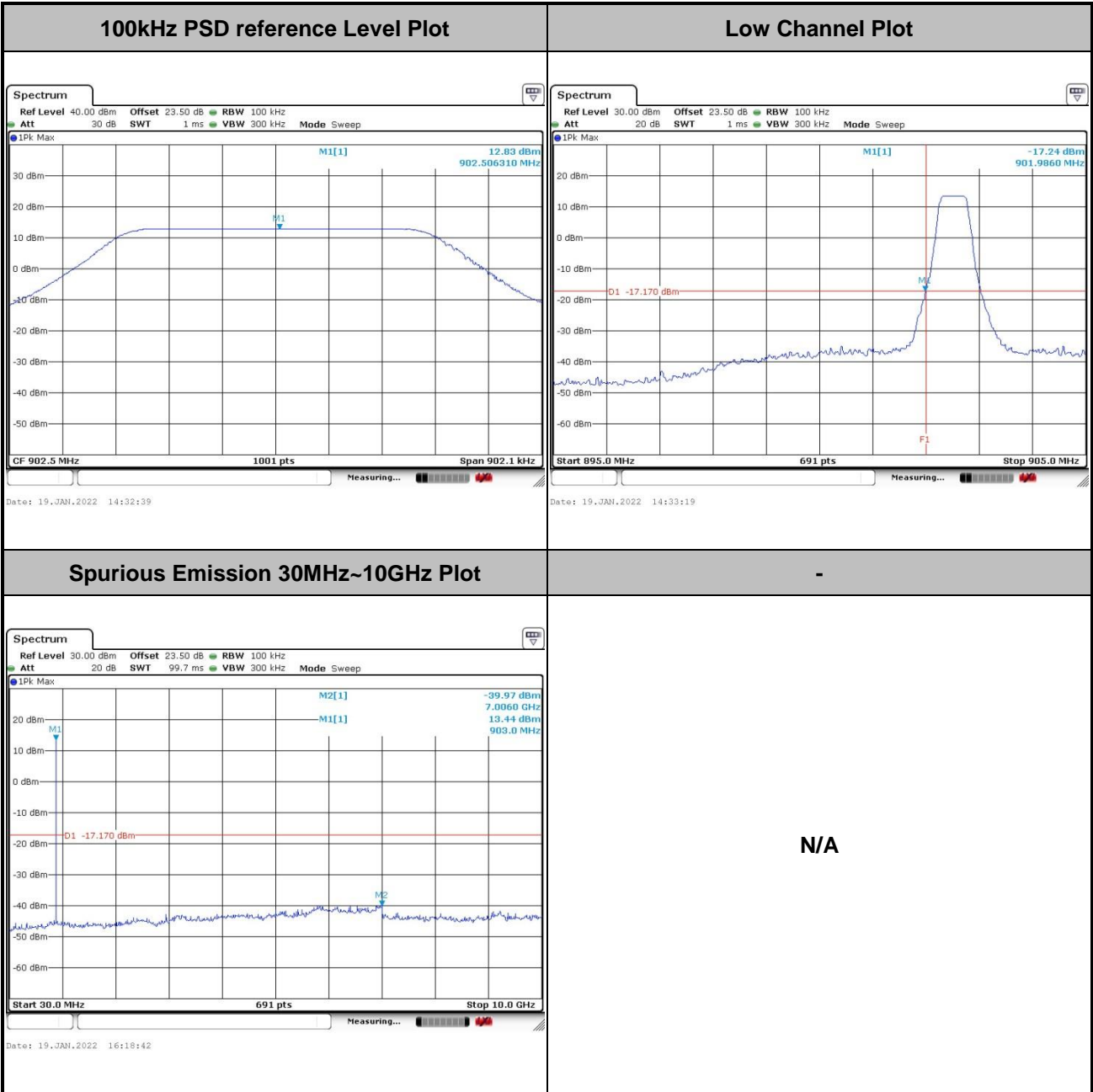
3.4.4 Test Setup





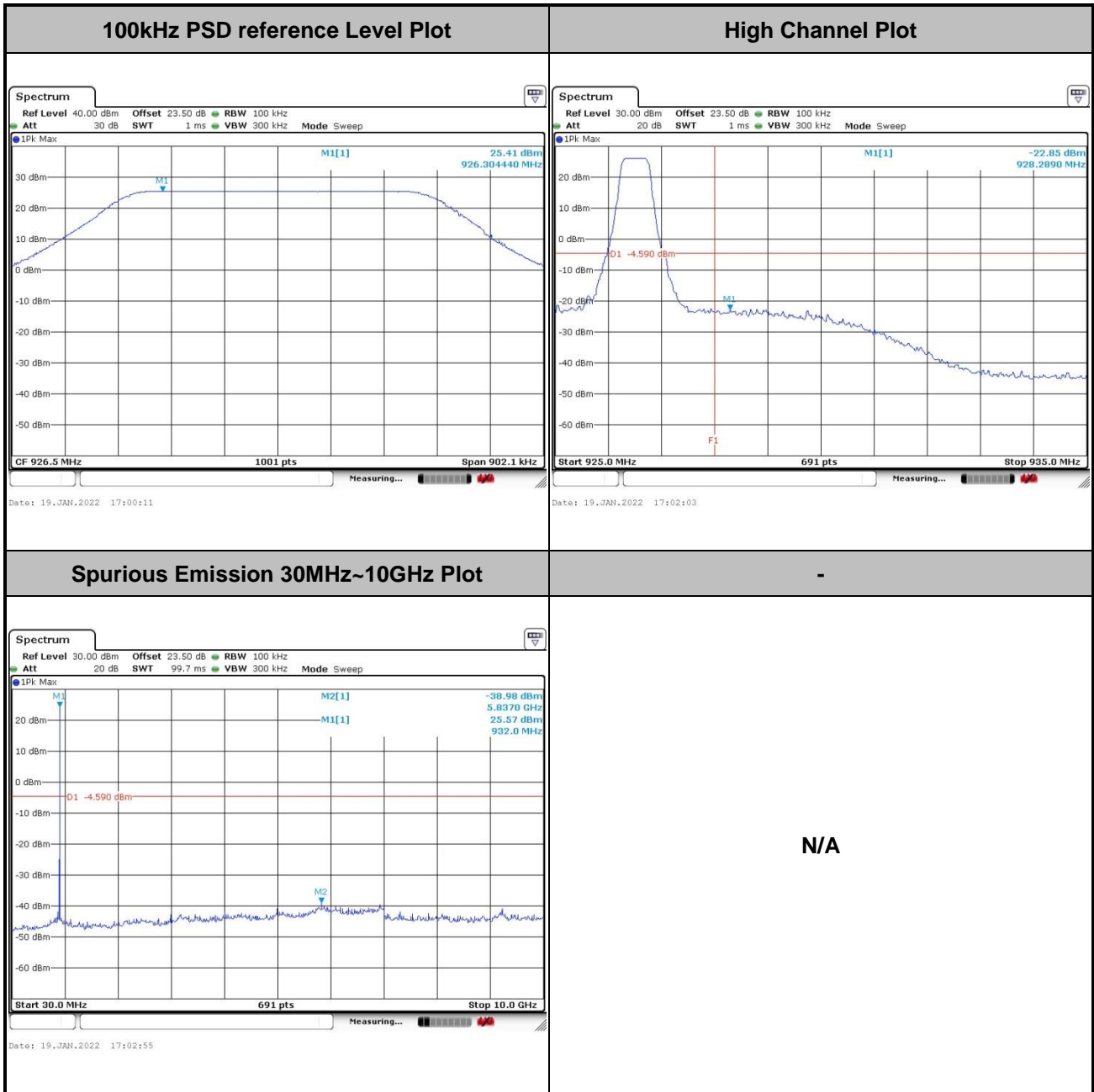
3.4.5 Test Result of Conducted Band Edges and Spurious Emission

<Data Rate: SF5>



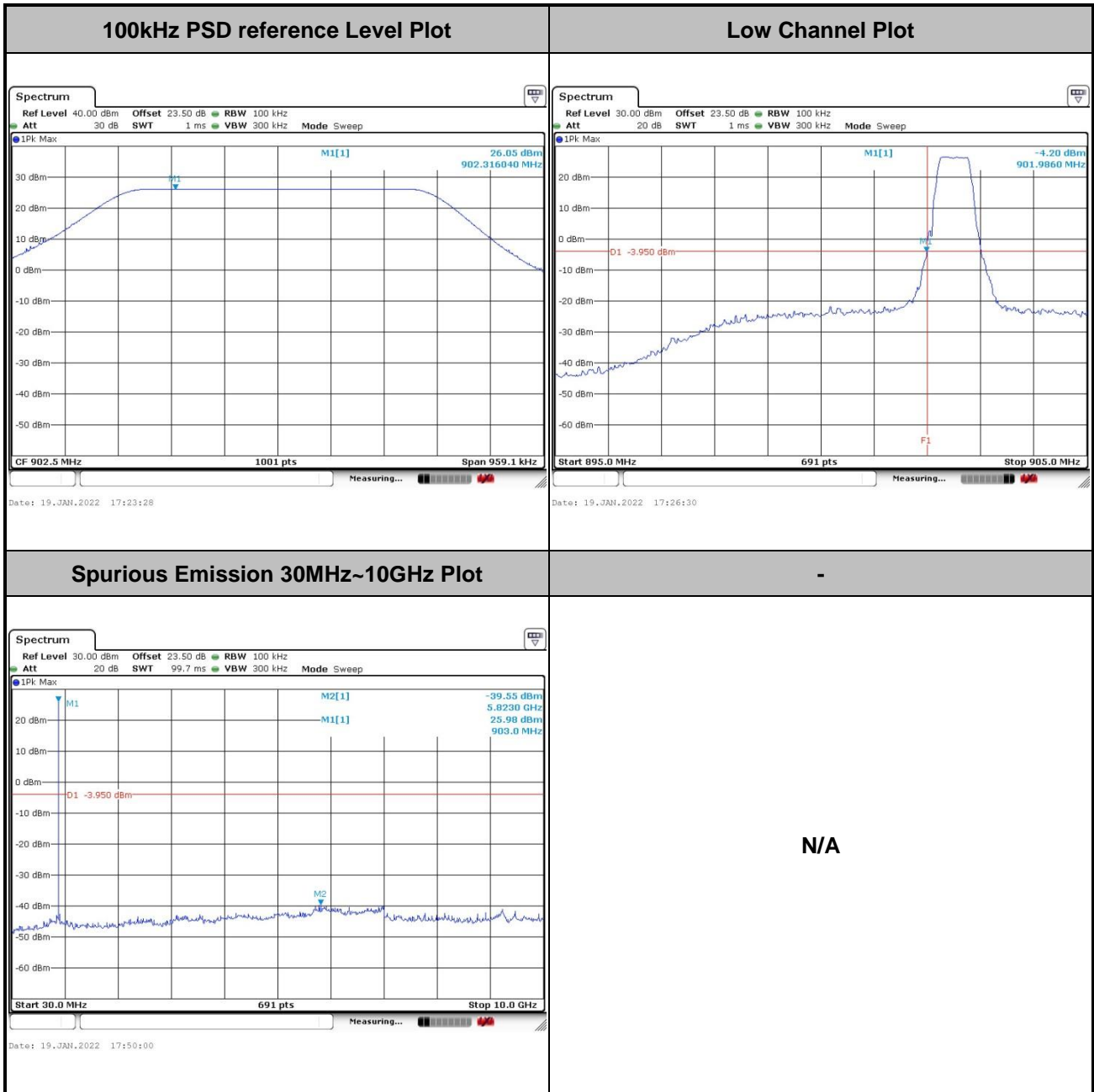


100kHz PSD reference Level Plot	Middle Channel Plot
<p>Spectrum Ref Level 40.00 dBm Offset 23.50 dB RBW 100 kHz Att 30 dB SWT 1 ms VBW 300 kHz Mode Sweep 1Pk Max M1 24.74 dBm M1[1] 24.74 dBm 914.303300 MHz CF 914.5 MHz 1001 pts Span 920.1 kHz Measuring... Date: 21.JAN.2022 14:57:52</p>	
Spurious Emission 30MHz~10GHz Plot	-
<p>Spectrum Ref Level 30.00 dBm Offset 23.50 dB RBW 100 kHz Att 20 dB SWT 99.7 ms VBW 300 kHz Mode Sweep 1Pk Max M1 24.65 dBm M1[1] 24.65 dBm 917.0 MHz M2[1] -40.23 dBm 5.8090 GHz D1 -5.260 dBm M2 Start 30.0 MHz 691 pts Stop 10.0 GHz Measuring... Date: 21.JAN.2022 14:58:38</p>	<p>N/A</p>

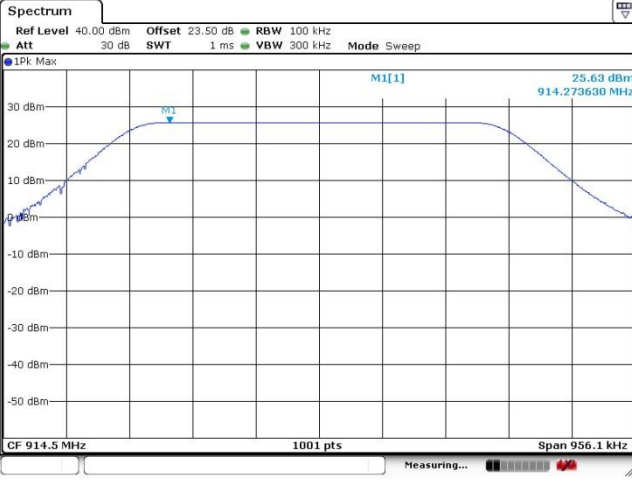
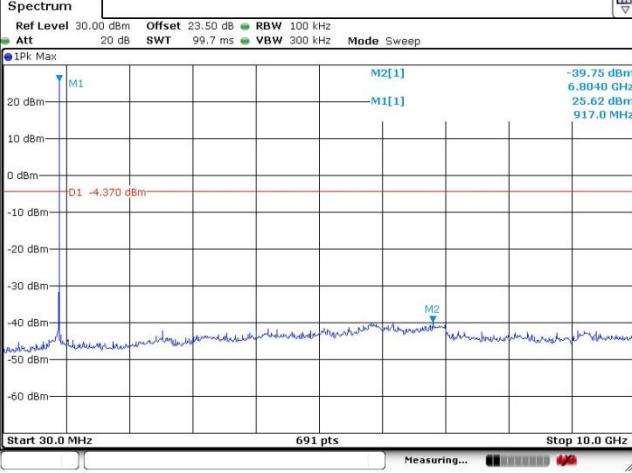


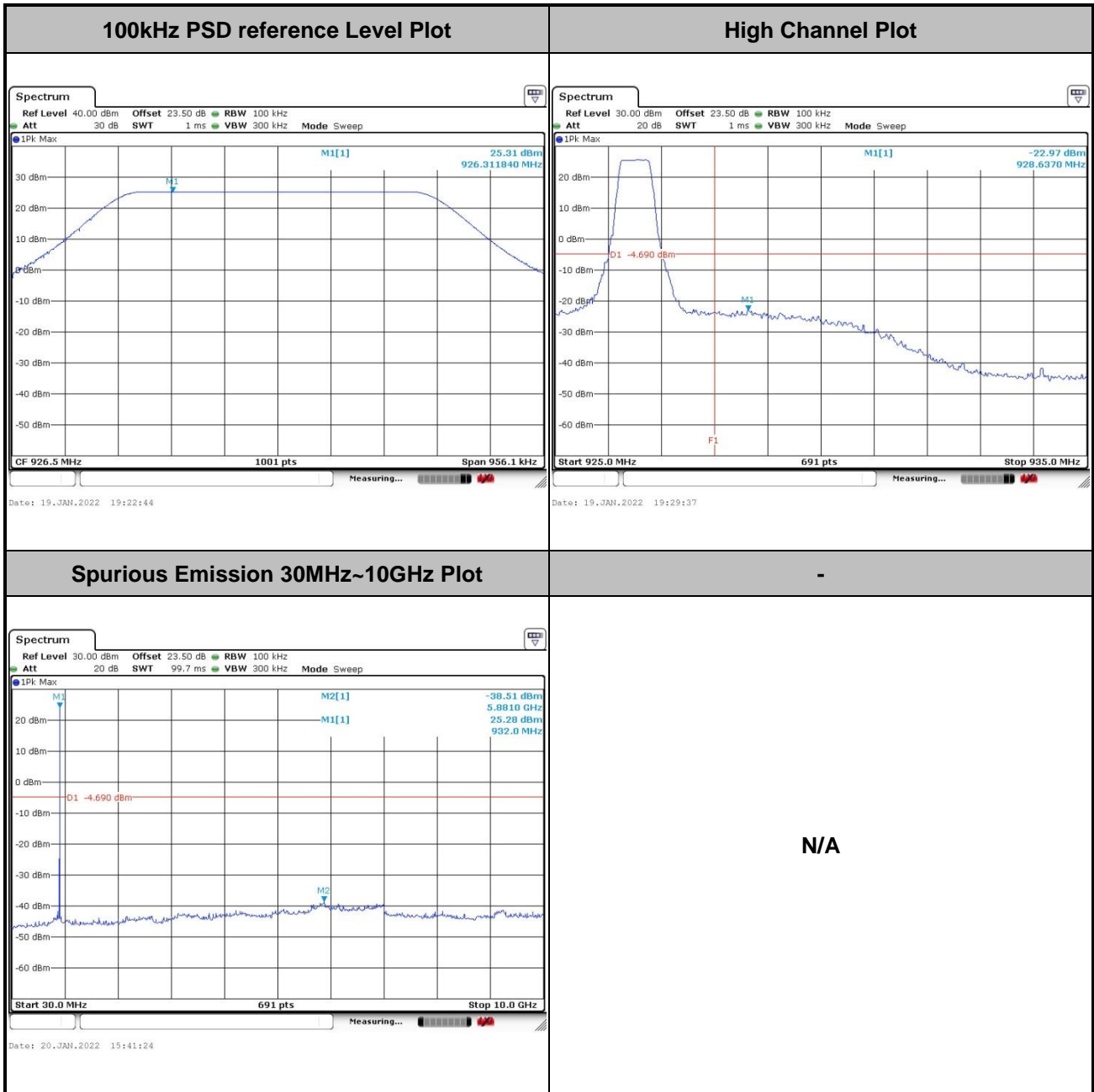


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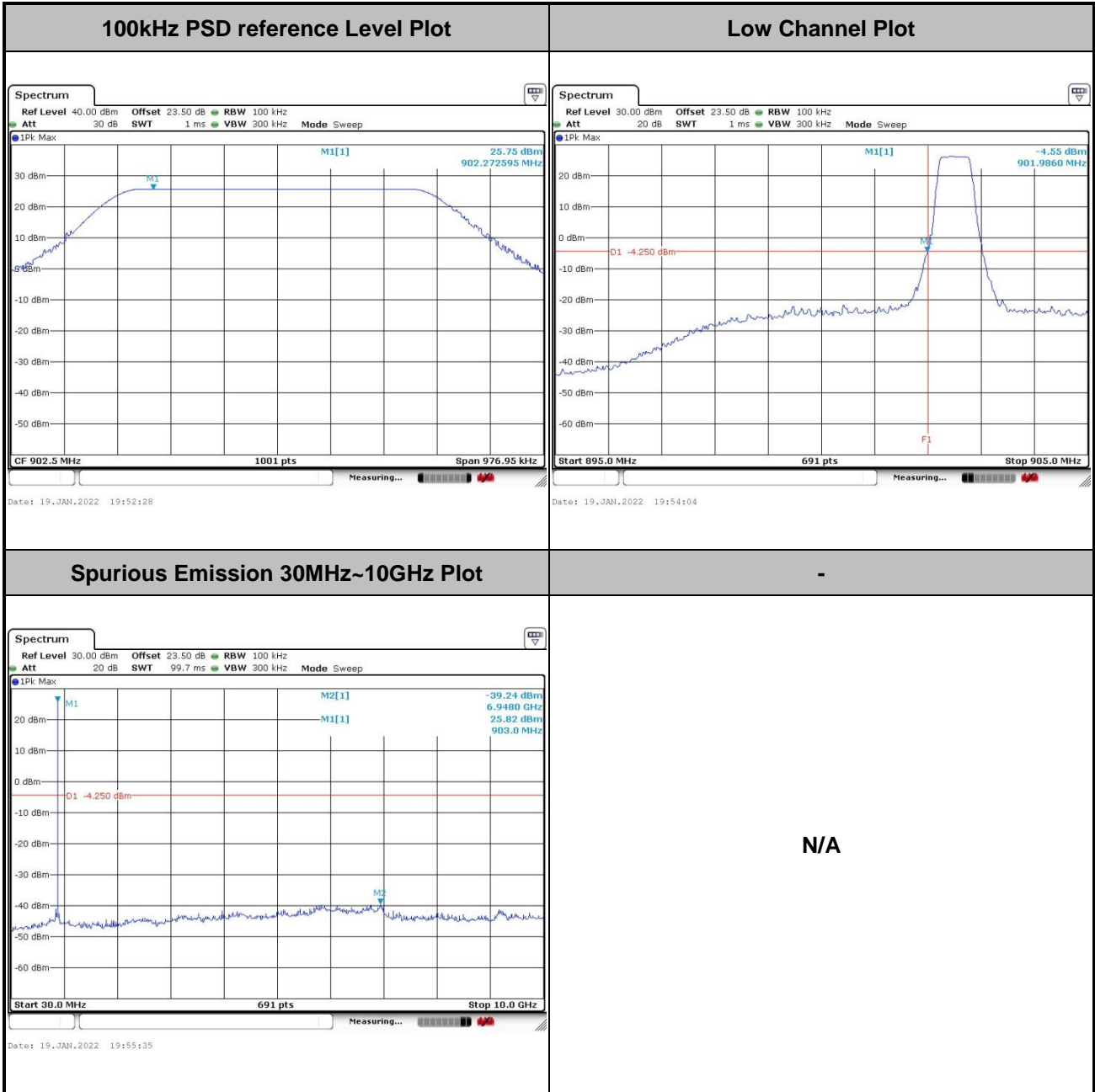


100kHz PSD reference Level Plot	Middle Channel Plot
 <p>Spectrum Ref Level 40.00 dBm Offset 23.50 dB RBW 100 kHz Att 30 dB SWT 1 ms VBW 300 kHz Mode Sweep 1Pk Max M1[1] 25.63 dBm 914.273630 MHz CF 914.5 MHz 1001 pts Span 956.1 kHz Date: 19.JAN.2022 18:03:09</p>	
Spurious Emission 30MHz~10GHz Plot	-
 <p>Spectrum Ref Level 30.00 dBm Offset 23.50 dB RBW 100 kHz Att 20 dB SWT 99.7 ms VBW 300 kHz Mode Sweep 1Pk Max M1 -4.370 dBm M2[1] -39.75 dBm 6.8040 GHz M1[1] 25.62 dBm 917.0 MHz M2 Start 30.0 MHz 691 pts Stop 10.0 GHz Date: 19.JAN.2022 18:04:19</p>	<p>N/A</p>

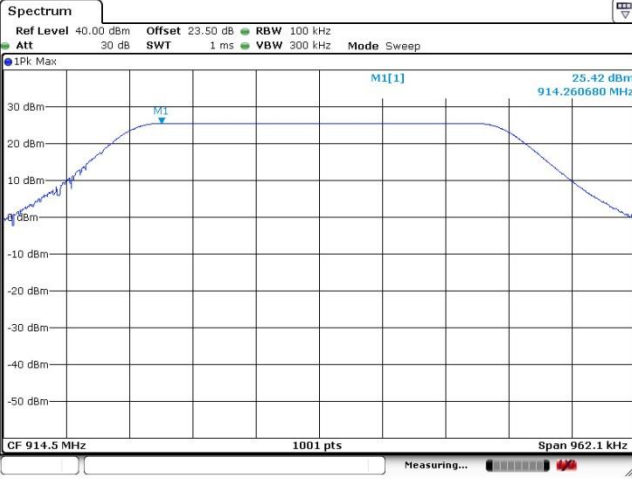
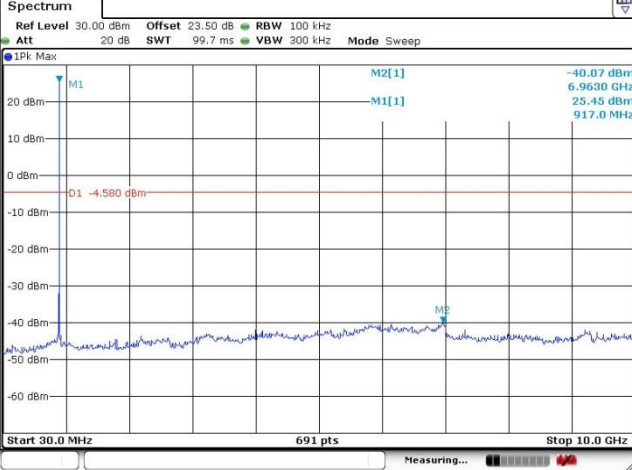


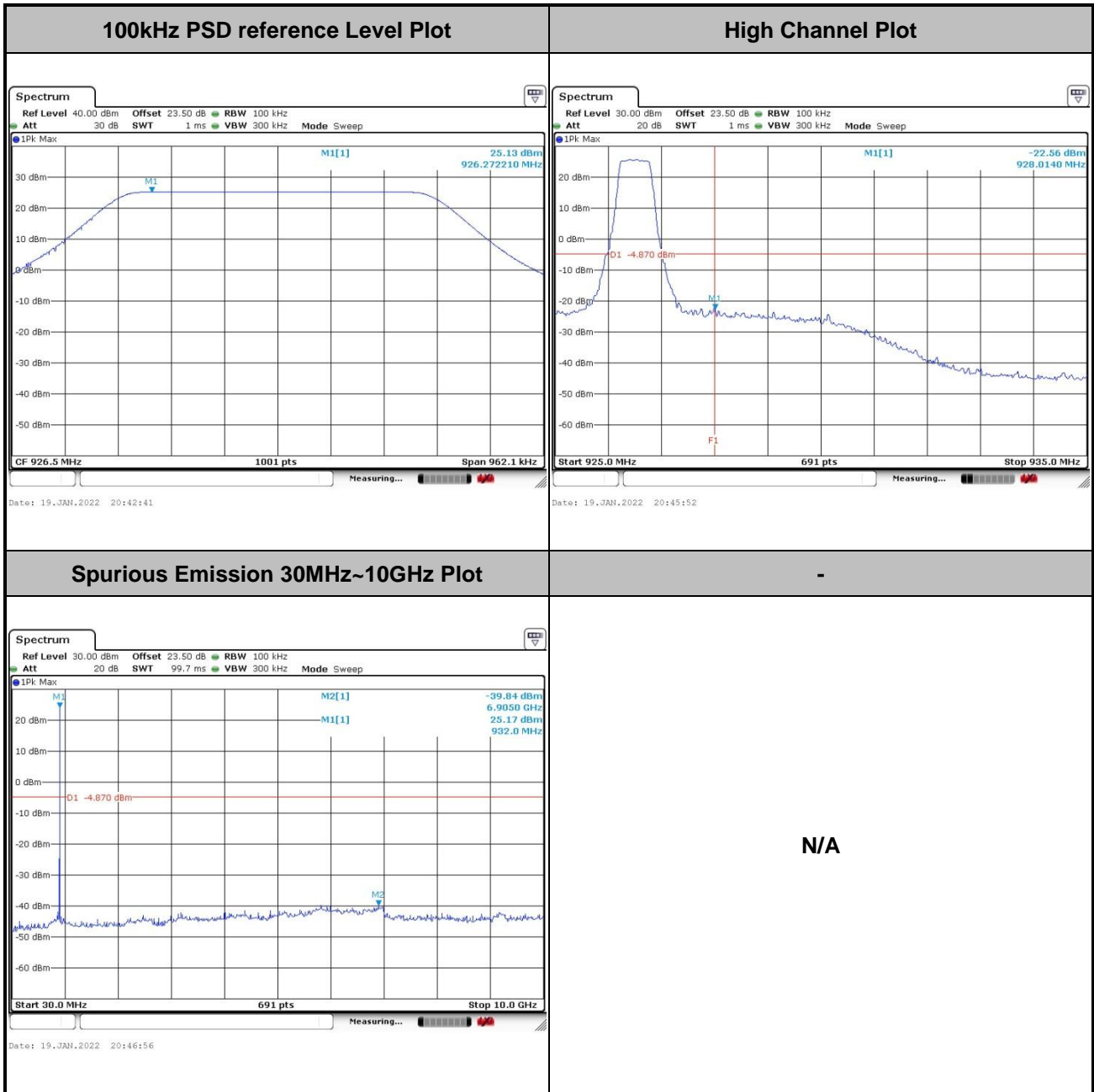


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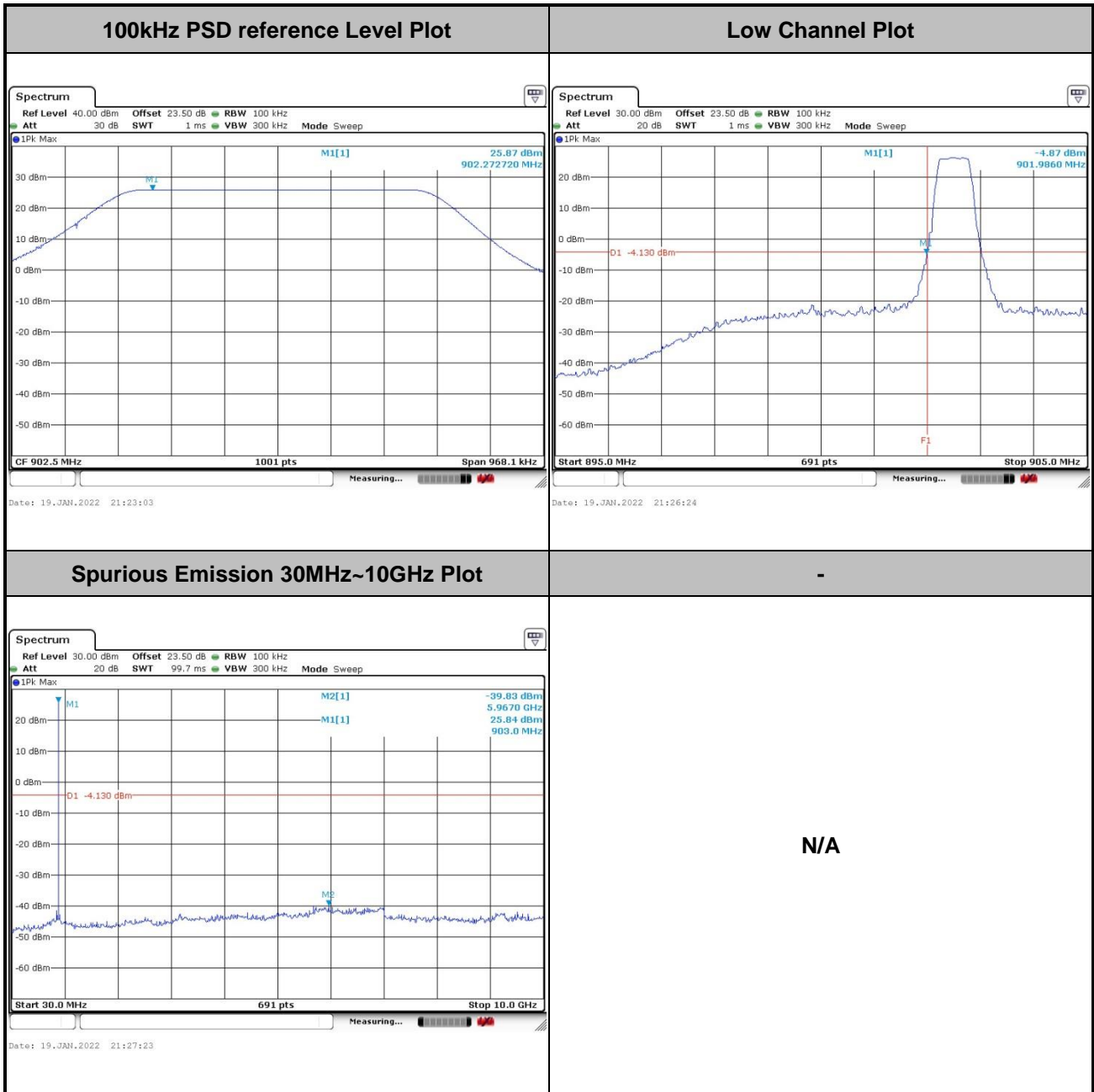


100kHz PSD reference Level Plot	Middle Channel Plot
 <p>Spectrum Ref Level 40.00 dBm Offset 23.50 dB RBW 100 kHz Att 30 dB SWT 1 ms VBW 300 kHz Mode Sweep 1Pk Max M1[1] 25.42 dBm 914.260680 MHz CF 914.5 MHz 1001 pts Span 962.1 kHz Measuring... Date: 19.JAN.2022 20:21:12</p>	
Spurious Emission 30MHz~10GHz Plot	-
 <p>Spectrum Ref Level 30.00 dBm Offset 23.50 dB RBW 100 kHz Att 20 dB SWT 99.7 ms VBW 300 kHz Mode Sweep 1Pk Max M1 M2[1] -40.07 dBm 6.9630 GHz M1[1] 25.45 dBm 917.0 MHz D1 -4.580 dBm Start 30.0 MHz 691 pts Stop 10.0 GHz Measuring... Date: 19.JAN.2022 20:21:59</p>	<p>N/A</p>

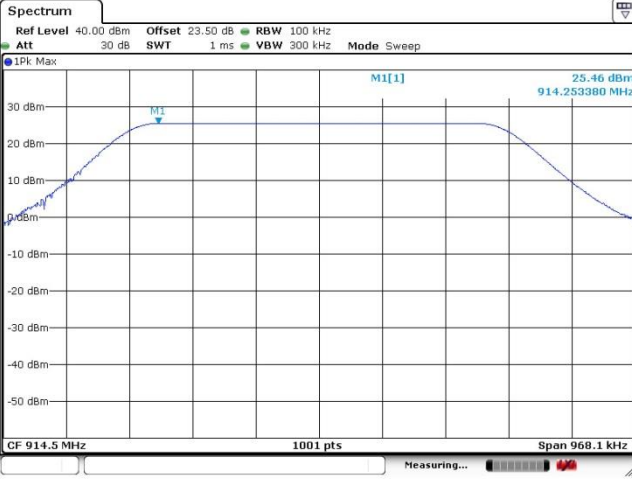
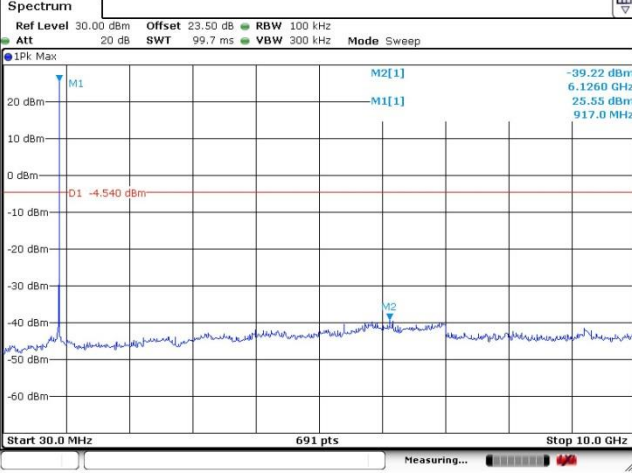


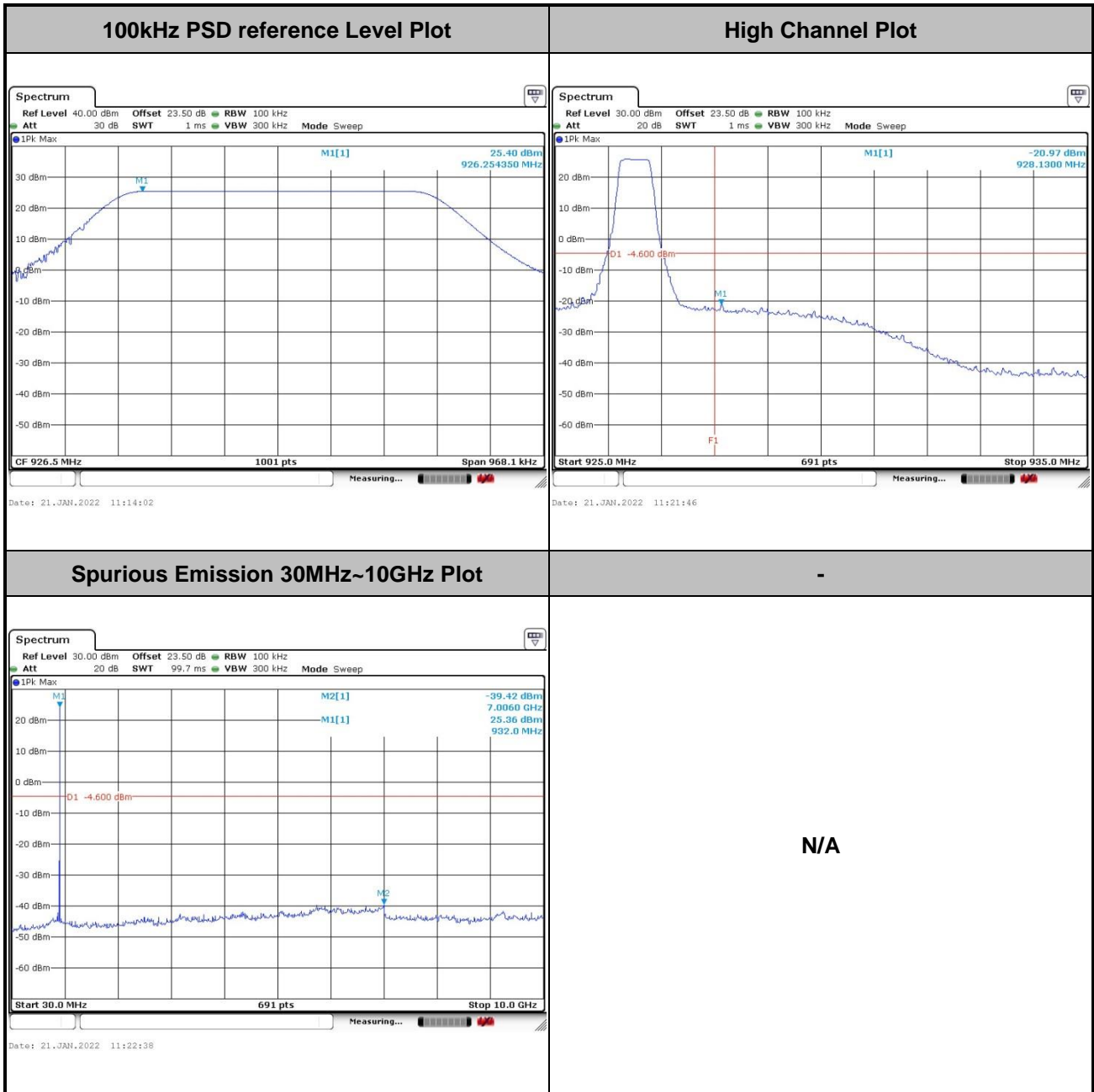


<Data Rate: SF10>



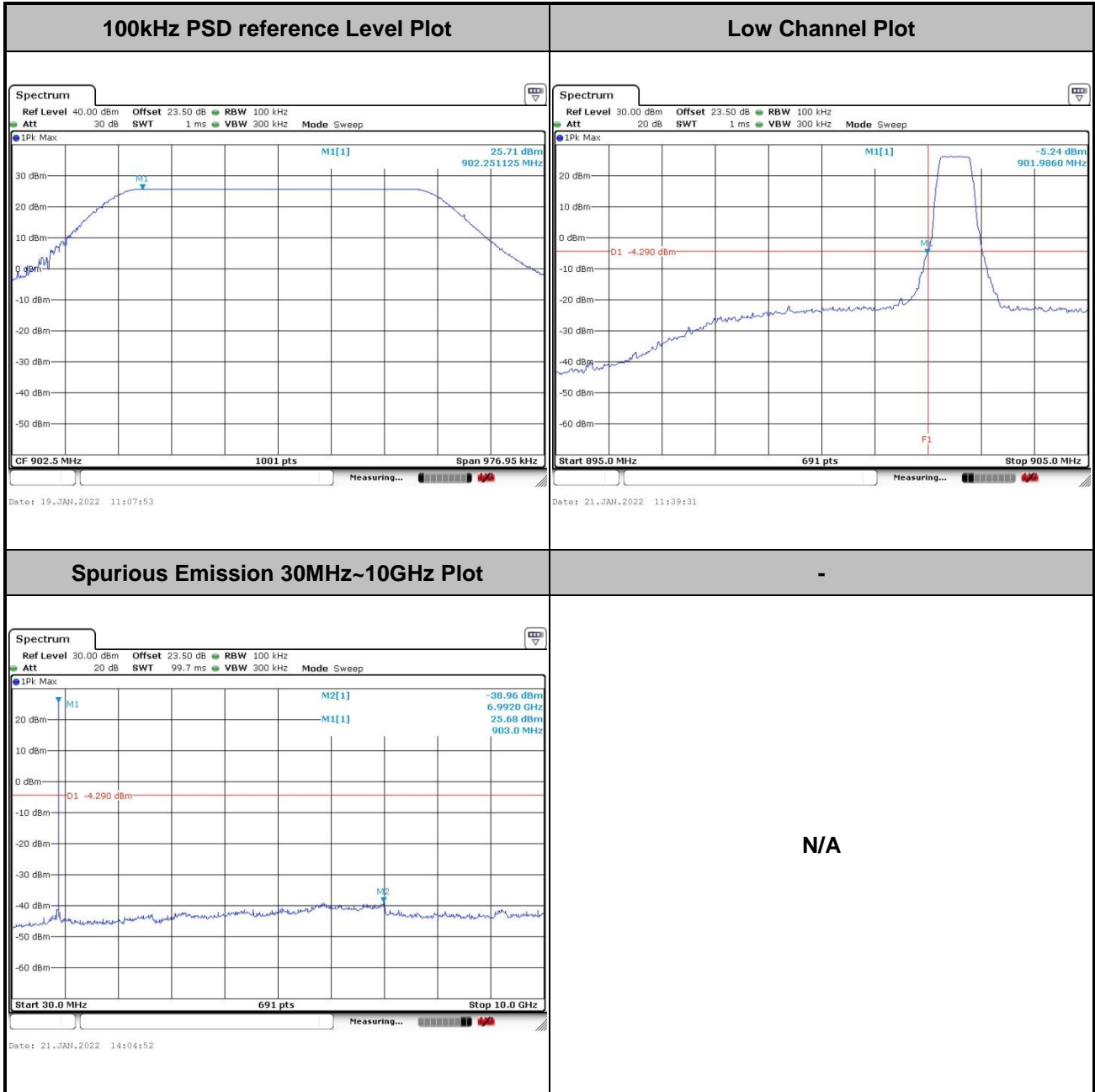


100kHz PSD reference Level Plot	Middle Channel Plot
 <p>Spectrum Ref Level 40.00 dBm Offset 23.50 dB RBW 100 kHz Att 30 dB SWT 1 ms VBW 300 kHz Mode Sweep 1Pk Max M1[1] 25.46 dBm 914.253380 MHz CF 914.5 MHz 1001 pts Span 968.1 kHz Measuring... Date: 19.JAN.2022 21:40:42</p>	
Spurious Emission 30MHz~10GHz Plot	-
 <p>Spectrum Ref Level 30.00 dBm Offset 23.50 dB RBW 100 kHz Att 20 dB SWT 99.7 ms VBW 300 kHz Mode Sweep 1Pk Max M1[1] -39.22 dBm 6.1260 GHz M2[1] 25.55 dBm 917.0 MHz D1 -4.540 dBm Start 30.0 MHz 691 pts Stop 10.0 GHz Measuring... Date: 19.JAN.2022 21:41:40</p>	<p>N/A</p>

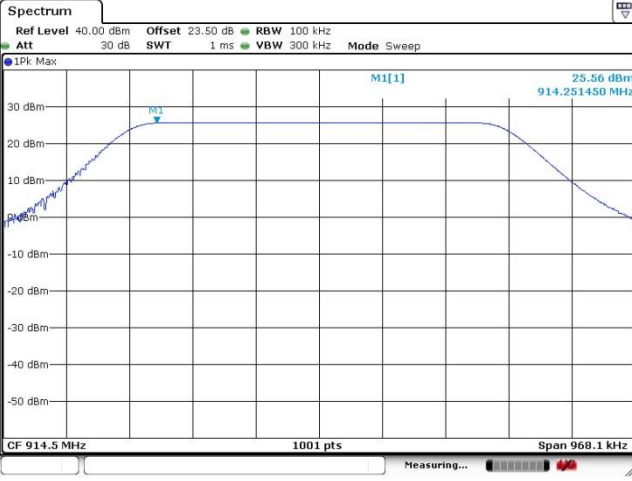
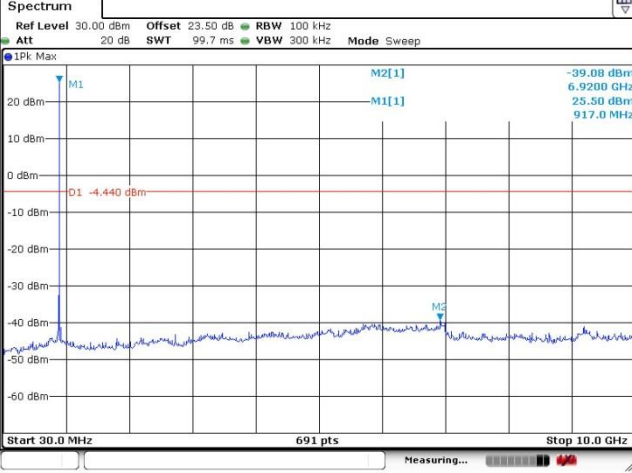




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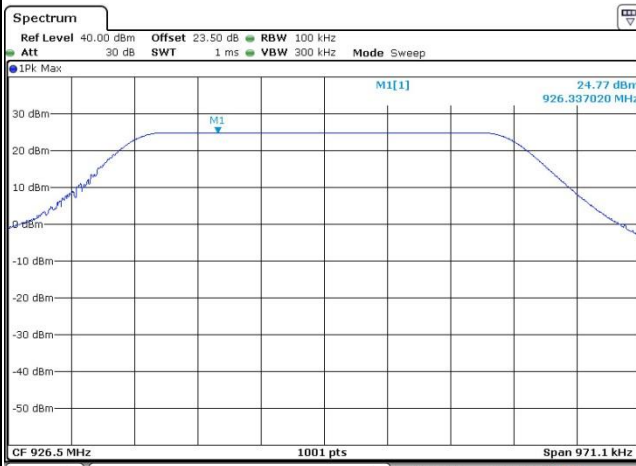




100kHz PSD reference Level Plot	Middle Channel Plot
 <p>Spectrum Ref Level 40.00 dBm Offset 23.50 dB RBW 100 kHz Att 30 dB SWT 1 ms VBW 300 kHz Mode Sweep 1Pk Max M1[1] 25.56 dBm 914.251450 MHz CF 914.5 MHz 1001 pts Span 968.1 kHz Measuring... Date: 21.JAN.2022 12:00:29</p>	
Spurious Emission 30MHz~10GHz Plot	-
 <p>Spectrum Ref Level 30.00 dBm Offset 23.50 dB RBW 100 kHz Att 20 dB SWT 99.7 ms VBW 300 kHz Mode Sweep 1Pk Max M1 -39.00 dBm 6.9200 GHz M2[1] 25.50 dBm 917.0 MHz M1[1] D1 -4.440 dBm Start 30.0 MHz 691 pts Stop 10.0 GHz Measuring... Date: 21.JAN.2022 13:48:17</p>	<p>N/A</p>

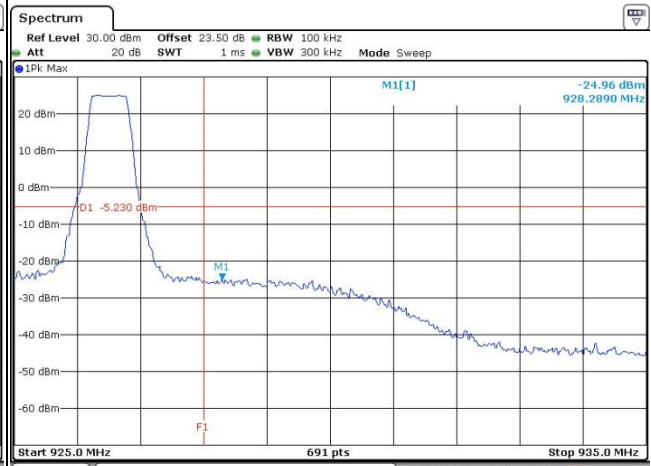


100kHz PSD reference Level Plot



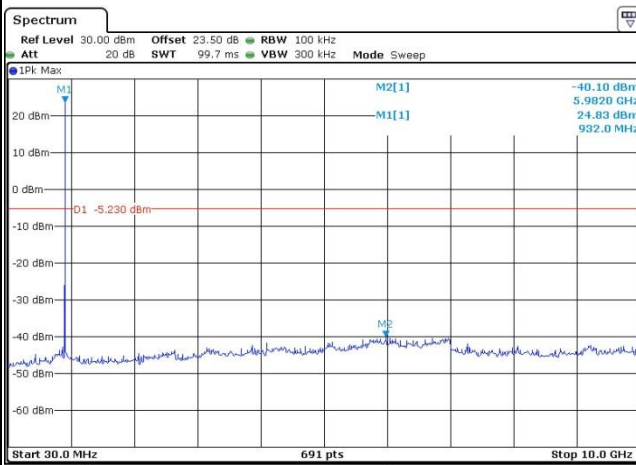
Date: 21.JAN.2022 14:39:34

High Channel Plot



Date: 21.JAN.2022 14:41:43

Spurious Emission 30MHz~10GHz Plot



Date: 21.JAN.2022 14:42:18

N/A



3.5 Radiated Band Edges and Spurious Emission Measurement

3.5.1 Limit of Radiated band edge and Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device is measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the limits as below.

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

3.5.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

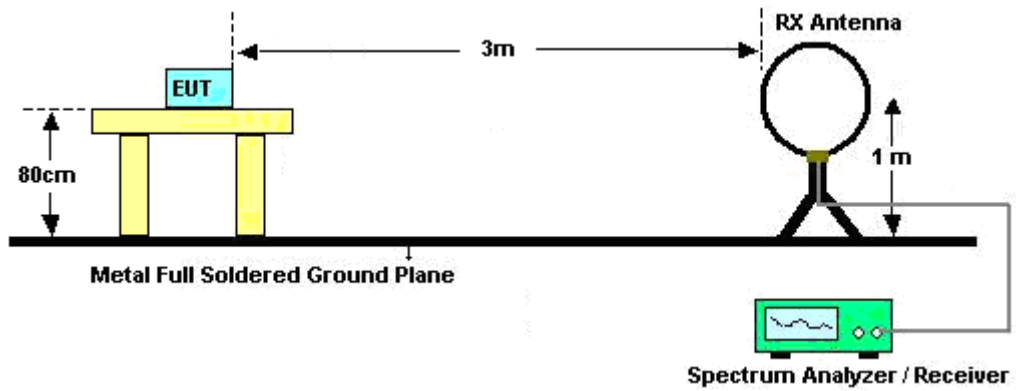


3.5.3 Test Procedures

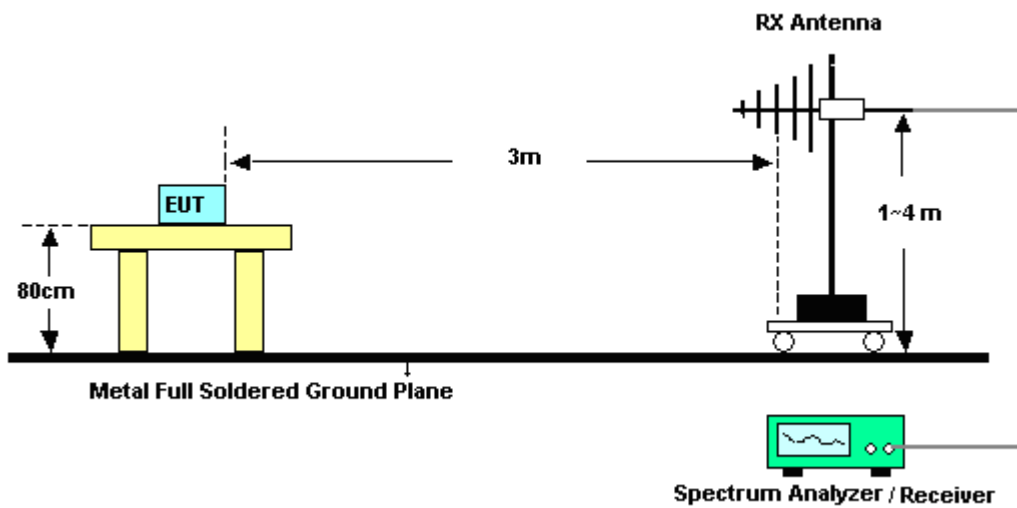
1. The testing follows the ANSI C63.10 Section 11.12.1 Radiated emission measurements.
2. The EUT is arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT is placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
4. The EUT is set 3 meters away from the receiving antenna, which is mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. Radiated testing below 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6 dB margin against QP limit line, the position is marked as “-“.
7. Radiated testing above 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found and the harmonic emission level is with at least 6 dB margin against average limit line, the position is marked as “-“.
8. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW = 100 kHz for $f < 1$ GHz; $VBW \geq RBW$; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, $VBW = 3$ MHz for $f \geq 1$ GHz for peak measurement.
For average measurement:
 - $VBW = 10$ 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.

3.5.4 Test Setup

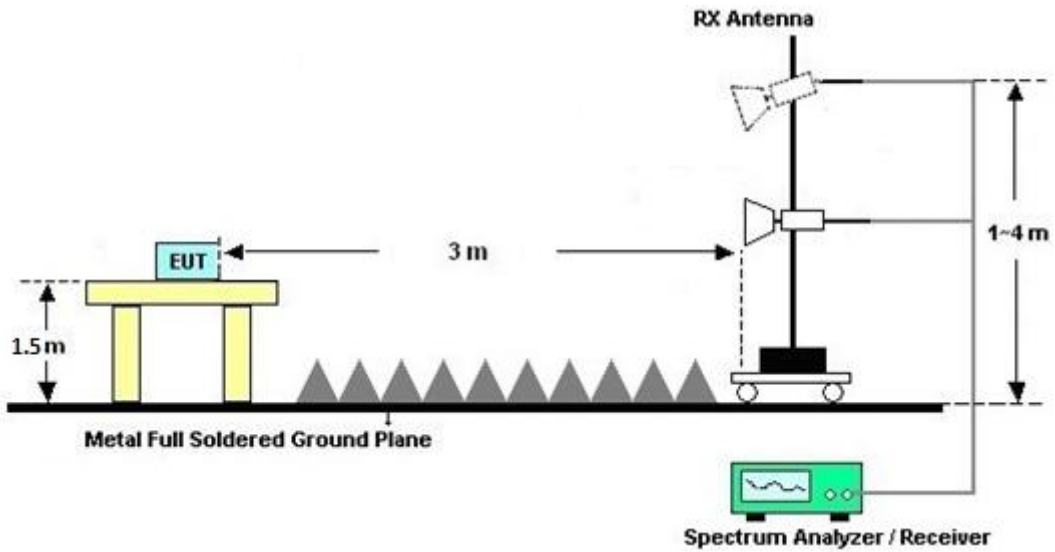
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated test above 1GHz



3.5.5 Test Results of Radiated Spurious Emissions (9kHz ~ 30MHz)

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

There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result comes out very similar.

3.5.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix C and D.

3.5.7 Duty Cycle

Please refer to Appendix E.

3.5.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix C and D.



3.6 AC Conducted Emission Measurement

3.6.1 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 (dB μ V)	
	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.

3.6.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.6.3 Test Procedures

1. The EUT is placed 0.4 meter away from the conducting wall of the shielding room, and is 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 shall be used.
6. Both Line and Neutral shall be tested in order to find out the maximum conducted emission.
7. The frequency range from 150 kHz to 30 MHz is scanned.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF bandwidth = 9kHz) with Maximum Hold Mode.

3.6.4 Test Setup



3.6.5 Test Result of AC Conducted Emission

Please refer to Appendix B.



3.7 Antenna Requirements

3.7.1 Standard Applicable

If directional gain of transmitting Antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.7.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.7.3 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	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Hygrometer	TECPEL	TR-32	HE17XB2468	N/A	Mar. 09, 2021	Jan. 15, 2022~ Mar. 07, 2022	Mar. 08, 2022	Conducted (TH02-HY)
Hygrometer	TECPEL	TECPEL	TP210073	N/A	Nov. 16, 2021	Mar. 08, 2022~ Mar. 28, 2022	Nov. 15, 2022	Conducted (TH02-HY)
Signal Analyzer	Rohde & Schwarz	FSV40	101566	10Hz~40GHz	Aug. 30, 2021	Jan. 15, 2022~ Mar. 28, 2022	Aug. 29, 2022	Conducted (TH02-HY)
Power Meter	Anritsu	ML2495A	1036004	N/A	Aug. 01, 2021	Jan. 15, 2022~ Mar. 28, 2022	Jul. 31, 2022	Conducted (TH02-HY)
Power Meter	Anritsu	MA2411B	1027253	300MHz~40GHz	Aug. 01, 2021	Jan. 15, 2022~ Mar. 28, 2022	Jul. 31, 2022	Conducted (TH02-HY)
Switch Box & RF Cable	Burgeon	ETF-058	EC1208321 (Box2)	N/A	Jun. 08, 2021	Jan. 15, 2022~ Mar. 28, 2022	Jun. 07, 2022	Conducted (TH02-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 07, 2021	Jan. 09, 2022~ Feb. 23, 2022	Sep. 06, 2022	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00802N1D01 N-06	47020 & 06	30MHz to 1GHz	Oct. 09, 2021	Jan. 09, 2022~ Feb. 23, 2022	Oct. 08, 2022	Radiation (03CH16-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-02114	1G~18GHz	Aug. 04, 2021	Jan. 09, 2022~ Feb. 23, 2022	Aug. 03, 2022	Radiation (03CH16-HY)
Amplifier	SONOMA	310N	371607	9kHz~1G	Jul. 05, 2021	Jan. 09, 2022~ Feb. 23, 2022	Jul. 04, 2022	Radiation (03CH16-HY)
Amplifier	EMCI	EMC051845 SE	980729	1-18GHz	Jul. 09, 2021	Jan. 09, 2022~ Feb. 23, 2022	Jul. 08, 2022	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY53270264	1GHz~26.5GHz	Dec. 09, 2021	Jan. 09, 2022~ Feb. 23, 2022	Dec. 08, 2022	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A	MY57290111	3Hz~26.5GHz	Dec. 15, 2021	Jan. 09, 2022~ Feb. 23, 2022	Dec. 14, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11680/4PE	NA	Aug. 28, 2021	Jan. 09, 2022~ Feb. 23, 2022	Aug. 27, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY11688/4PE	NA	Aug. 28, 2021	Jan. 09, 2022~ Feb. 23, 2022	Aug. 27, 2022	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	EC-A5-300-57 57	NA	Aug. 28, 2021	Jan. 09, 2022~ Feb. 23, 2022	Aug. 27, 2022	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	Jan. 09, 2022~ Feb. 23, 2022	N/A	Radiation (03CH16-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Jan. 09, 2022~ Feb. 23, 2022	N/A	Radiation (03CH16-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Jan. 09, 2022~ Feb. 23, 2022	N/A	Radiation (03CH16-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Jan. 09, 2022~ Feb. 23, 2022	N/A	Radiation (03CH16-HY)
Hygrometer	TECPEL	DTM-303B	TP200881	QA-3-031	Sep. 30, 2021	Jan. 09, 2022~ Feb. 23, 2022	Sep. 29, 2022	Radiation (03CH16-HY)



Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
AC Power Source	ACPOWER	AFC-11003G	F317040033	N/A	N/A	Mar. 08, 2022	N/A	Conduction (CO07-HY)
Software	Rohde & Schwarz	EMC32 V10.30	N/A	N/A	N/A	Mar. 08, 2022	N/A	Conduction (CO07-HY)
Pulse Limiter	SCHWARZBECK	VTSD 9561-F N	9561-F N00373	9kHz-200MHz	Oct. 29, 2021	Mar. 08, 2022	Oct. 28, 2022	Conduction (CO07-HY)
RF Cable	HUBER + SUHNER	RG 214/U	1358175	9kHz~30MHz	Mar. 17, 2021	Mar. 08, 2022	Mar. 16, 2022	Conduction (CO07-HY)
Two-Line V-Network	TESEQ	NNB 51	45051	N/A	Feb. 16, 2022	Mar. 08, 2022	Feb. 15, 2023	Conduction (CO07-HY)
EMI Test Receiver	Rohde & Schwarz	ESR3	102317	9kHz~3.6GHz	Oct. 21, 2021	Mar. 08, 2022	Oct. 20, 2022	Conduction (CO07-HY)



5 Uncertainty of Evaluation

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.3 dB
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Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.8 dB
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.2 dB
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Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.8 dB
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