



SGS-CSTC Standards Technical Services Co., Ltd. Guangzhou Branch

EMC-ARF-05 Rev 1.1

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FCC ID: OJFDHRU-G2-7

Appendix -

Test Data and Result for report

GZCR231100125402

(B)

(Supplement test data for 5G NR with 100MHz AWGN signal)



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Guangzhou Branch EMC Testing Laboratory

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Member of the SGS Group (SGS SA)

1 Lower & Upper 700MHz (only for downlink: 728-757MHz)

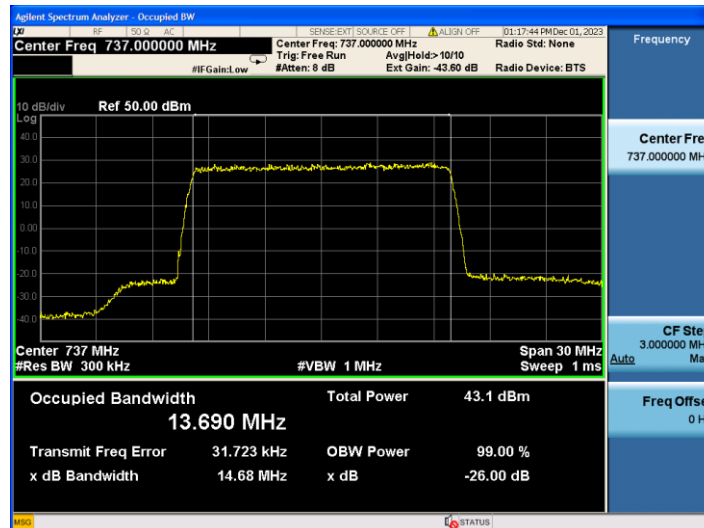
1.1 Input-versus-output signal comparison



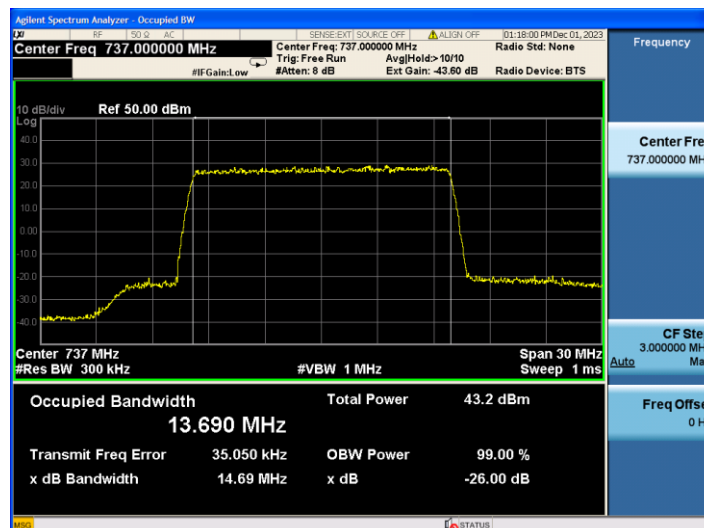
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Output_DL_1S_M_AWGN_Pre-AGC_OBW



Output_DL_1S_M_AWGN_AGC+3dB_OBW

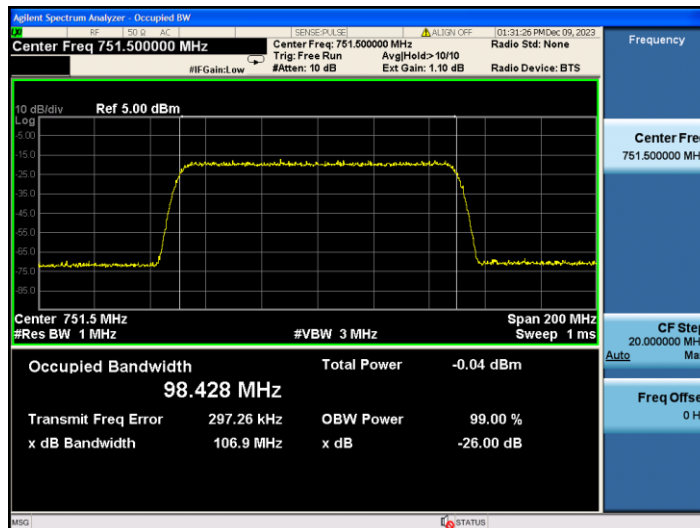


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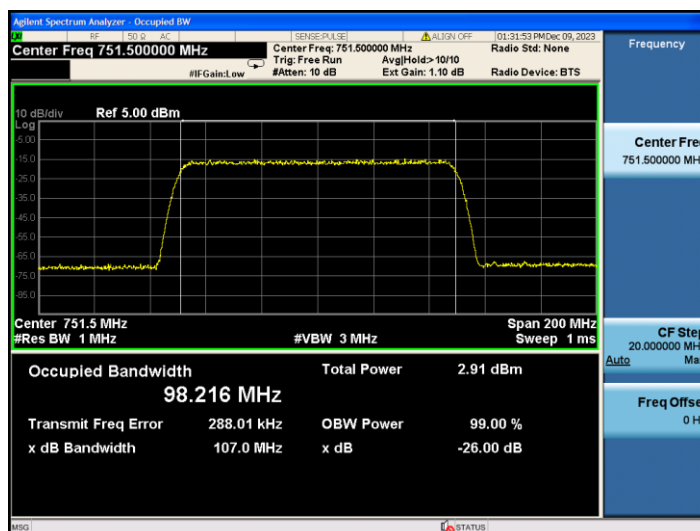
1. The band supports maximum channel BW is 15MHz for NR, so the output signal OBW was less than the input when 100MHz AWGN as input signal.
2. Compare the spectral plot of the input signal to the output signal affirm that they are similar (in passband and roll off characteristic features and relative spectral locations). The test result complies with the requirement.

For Upper 700MHz (746-757)

Input_DL_1S_M_AWGN_Pre-AGC_OBW



Input_DL_1S_M_AWGN_AGC+3dB_OBW



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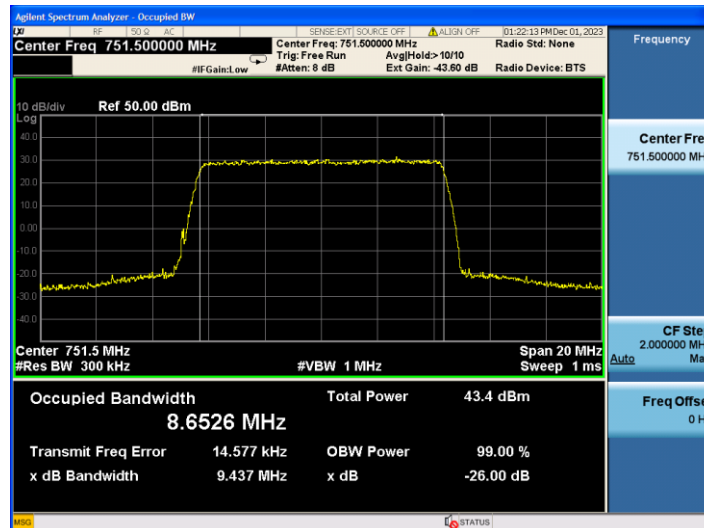
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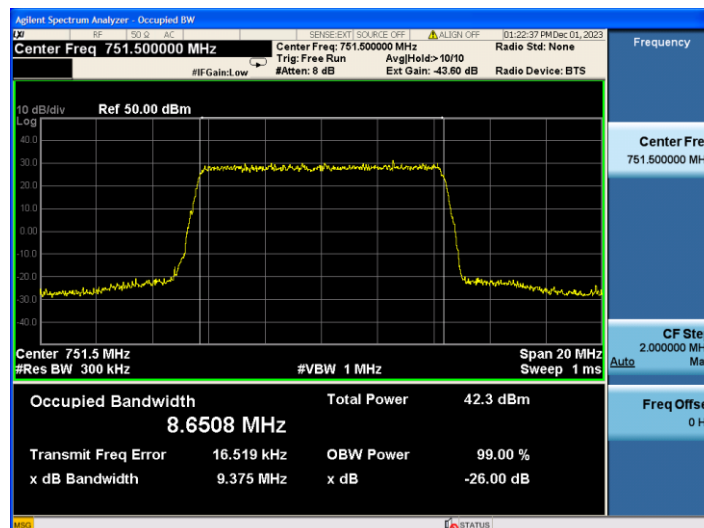
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Output_DL_1S_M_AWGN_Pre-AGC_OBW



Output_DL_1S_M_AWGN_AGC+3dB_OBW



Remark:

1. The band supports maximum channel BW is 10MHz for NR, so the output signal OBW was less than the input when 100MHz AWGN as input signal.
2. Compare the spectral plot of the input signal to the output signal affirm that they are similar (in passband and roll off characteristic features and relative spectral locations). The test result complies with the requirement.

1.2 Mean output power and amplifier/booster gain

Test Conf.	Test Freq. f ₀ (MHz)	Signal Level	Input Power (dBm)	Output Power (dBm)	Gain (dB)	Verdict
DL_1S_AWGN	747.43	Pre-AGC	-7.0	35.89	42.89	PASS
		AGC+3dB	-4.0	36.11	/	PASS
Remark: According to the declaration from the applicant, the single antenna gain should not exceed 12.5dBi, the Directional gain = G _{ANT} + 10 log (N _{ANT}) dBi = 12.5dBi+10log (2) dBi= 15.5dBi. ERP= EIRP-2.15dB, The total maximum ERP for the EUT is (36.11dBm+36.11dBm) +15.5dBi-2.15dB=52.47dBm (176.61W) which don't exceed the required ERP limit (1000W/MHz).						



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1.3 Out-of-band/out-of-block (including intermodulation) emissions and spurious emissions

Note: The tested max conducted power for single antenna port is 36.11dBm, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log (P)$ dB, the limit corresponds to an absolute limit of -13 dBm.

Here,

$P=36.11\text{dBm}=4.09\text{W}$.

So the limit =

$P(\text{dBm}) - [43 + 10 \log (4.09\text{W})] = -13\text{dBm}$

The EUT supports 2x2 MIMO and the emissions were measured at one of output port, so the limit line was set to -16.01dBm in following test plots in order to determine the test result conveniently.

The spurious emissions from 9kHz to 30MHz was very low and 20dB below the limit, therefore, the data was not recorded in the report.



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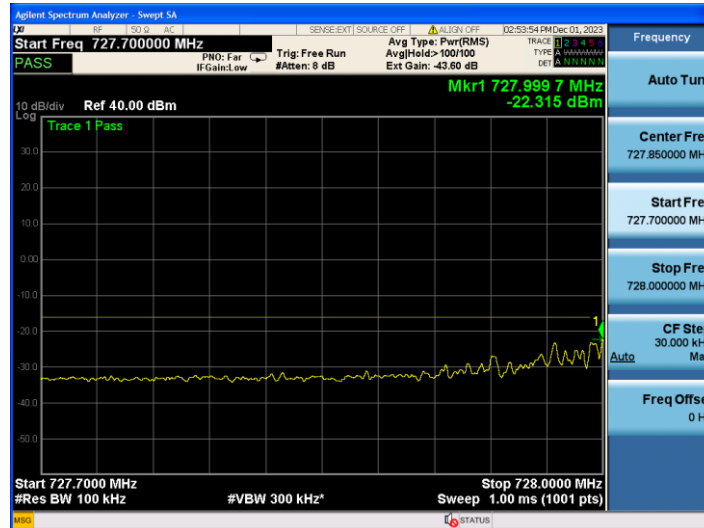
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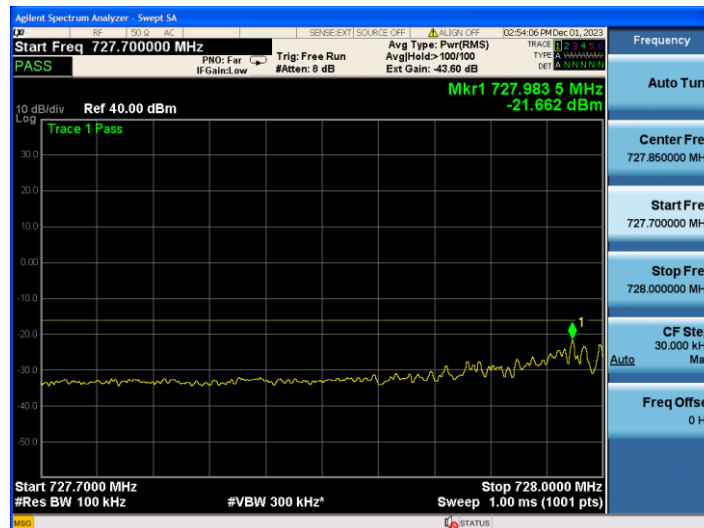
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DL_1S_B_AWGN_Pre-AGC_Out-of-band emission



DL_1S_B_AWGN_AGC+3_Out-of-band emission



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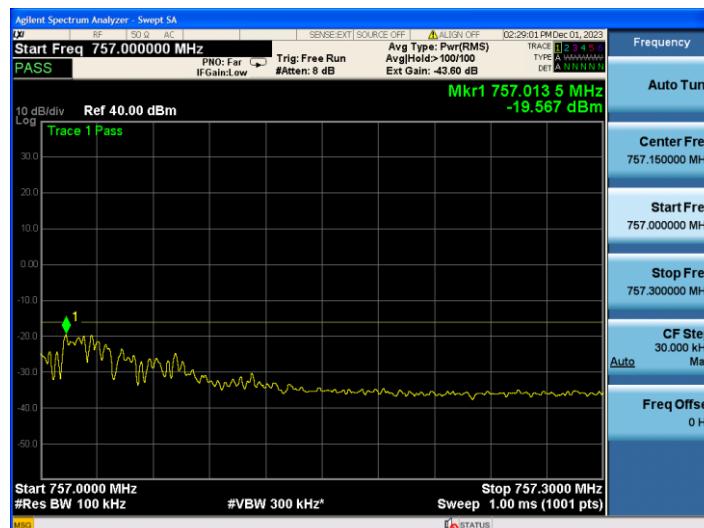
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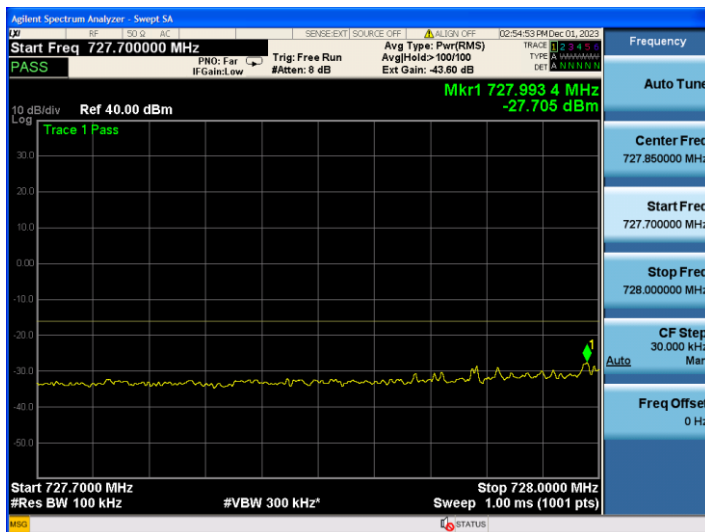
DL_1S_T_AWGN_Pre-AGC_Out-of-band emission



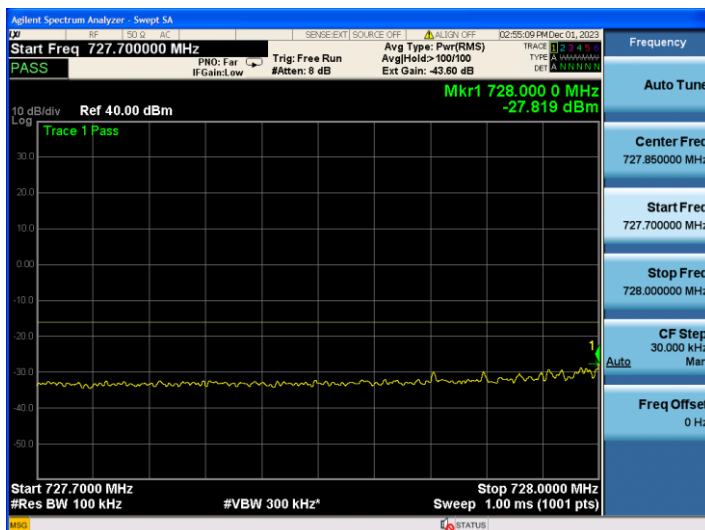
DL_1S_T_AWGN_AGC+3_Out-of-band emission



DL_2S_B_AWGN_Pre-AGC_Out-of-band emission



DL_2S_B_AWGN_AGC+3_Out-of-band emission



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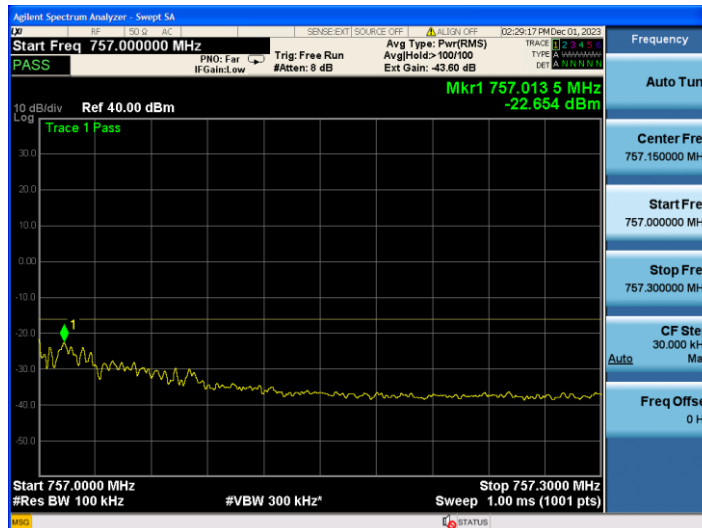
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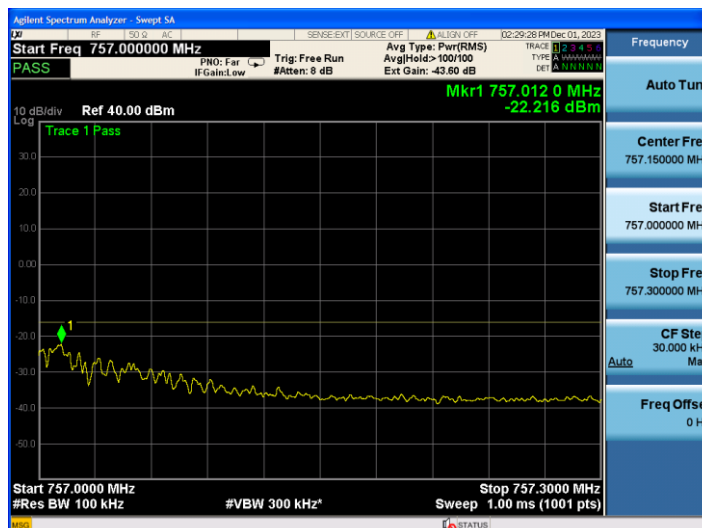
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DL_2S_T_AWGN_Pre-AGC_Out-of-band emission



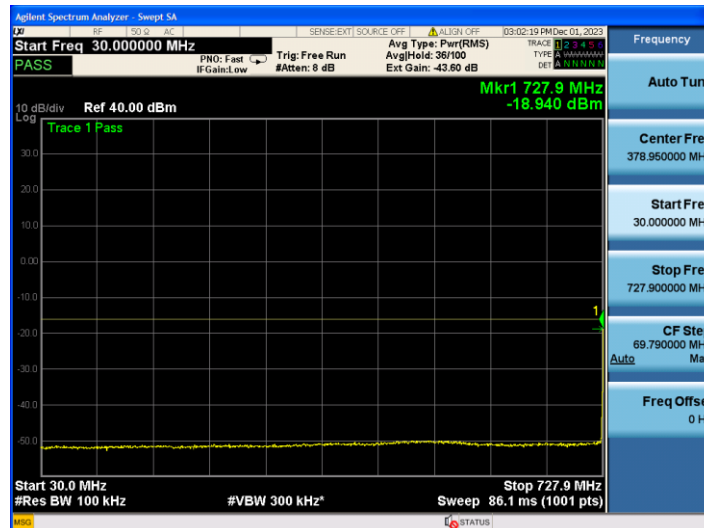
DL_2S_T_AWGN_AGC+3_Out-of-band emission



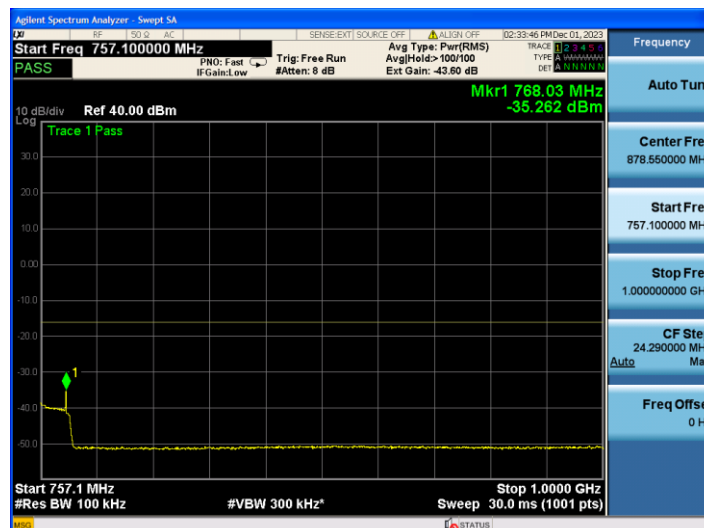
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DL_1S_B_AWGN_Pre-AGC_Spurious emission 1



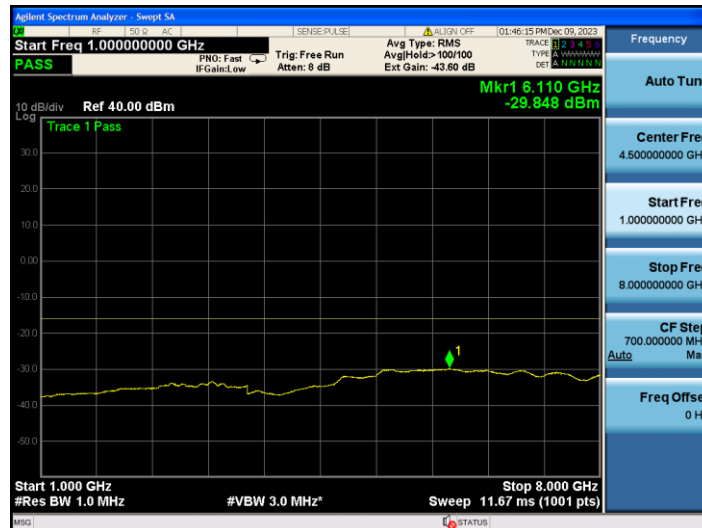
DL_1S_B_AWGN_Pre-AGC_Spurious emission 2



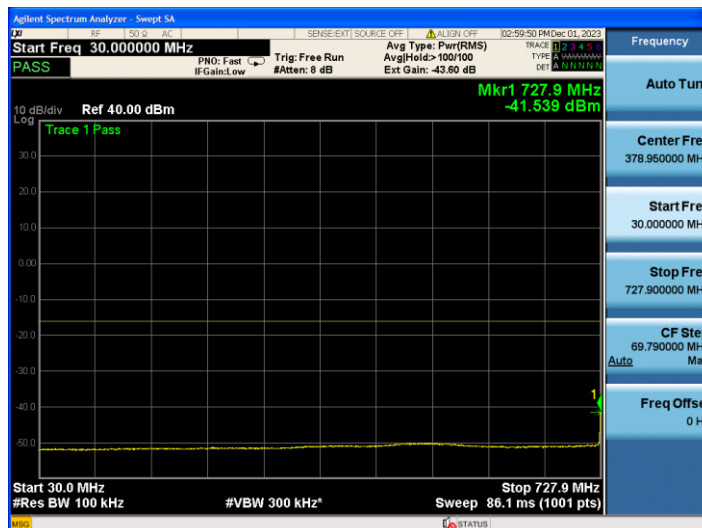
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DL_1S_B_AWGN_Pre-AGC_Spurious emission 3



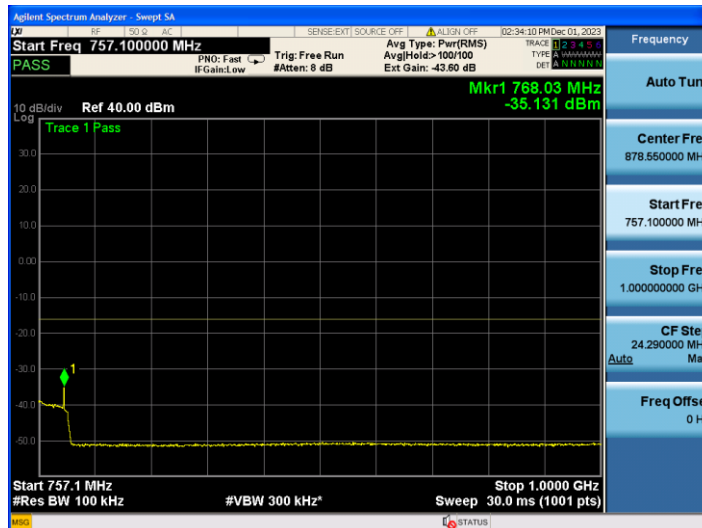
DL_1S_M_AWGN_Pre-AGC_Spurious emission 1



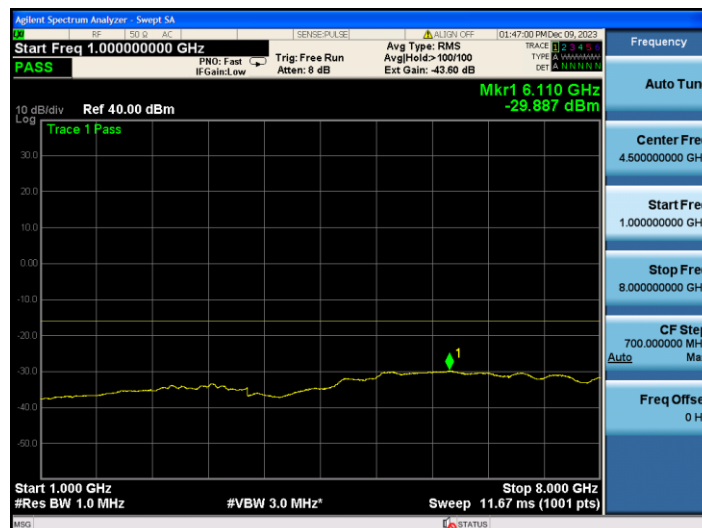
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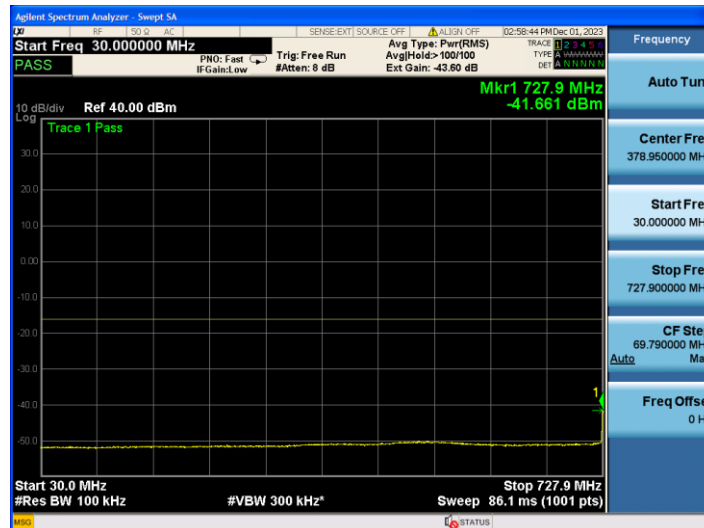
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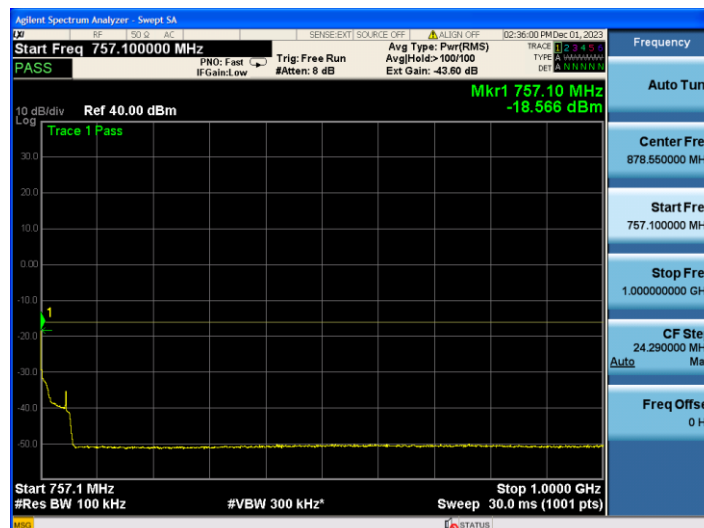
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DL_1S_T_AWGN_Pre-AGC_Spurious emission 1



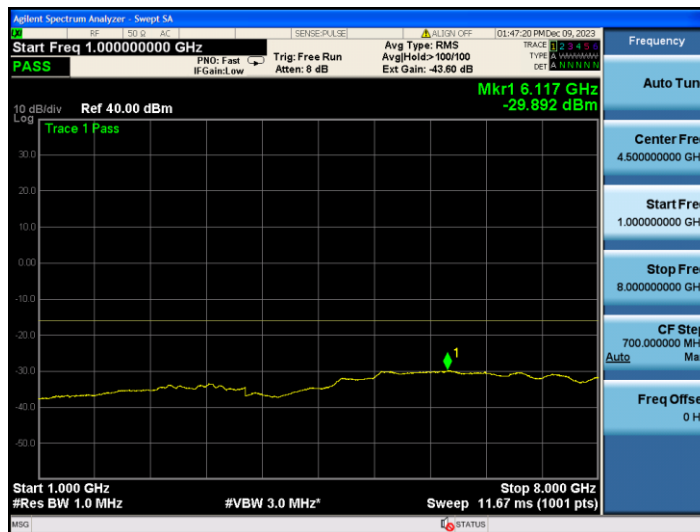
DL_1S_T_AWGN_Pre-AGC_Spurious emission 2



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DL_1S_T_AWGN_Pre-AGC_Spurious emission 3



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1.4 Frequency Stability

- Note:
1. At 10 °C intervals of temperatures between -30 °C and +50 °C at the manufacturer's rated supply voltage, here the rated supply voltage is AC 110V.
 2. At +20 °C temperature and ±15% supply voltage variations. If a product is specified to operate over a range of input voltage, then the -15% variation is applied to the lowermost voltage and the +15% is applied to the uppermost voltage.
 3. The frequency stabilities can be maintained within the authorized bands of operation. Meet the requirement.

Frequency stability vs temperature				
Temperature (°C)	Test Conf.	Frequency Error (Hz)	Tolerance (ppm)	Verdict
50	DL_1S_M_AWGN	53	0.0714	PASS
40		78	0.1051	PASS
30		56	0.0754	PASS
20		56	0.0754	PASS
10		59	0.0795	PASS
0		58	0.0781	PASS
-10		82	0.1104	PASS
-20		59	0.0795	PASS
-30		56	0.0754	PASS

Frequency stability vs voltage				
Voltage (V)	Test Conf.	Frequency Error (Hz)	Tolerance (ppm)	Verdict
AC 93.5	DL_1S_M_AWGN	56	0.0754	PASS
AC 110		56	0.0754	PASS
AC 126.5		56	0.0754	PASS



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1.5 Radiated spurious emissions

Note: 1. The tested max conducted power for single antenna port is 36.11dBm, the 2x2 MIMO total power is 36.11dBm+36.11dBm= 8.17W.

The power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log (P)$ dB, the limit corresponds to an absolute limit of -13 dBm.

Here,

$P=8.17W$.

So the limit =

$P(\text{dBm}) - [43 + 10 \log (8.17W)] = -13\text{dBm}$

2. The radiated spurious emissions were performed at bottom / middle / top channel and only the worst-case middle channel test data was recorded in the report.

3. The disturbance from 9kHz to 30MHz was very low and 20dB below the limit, therefore, the data was not recorded in the report.



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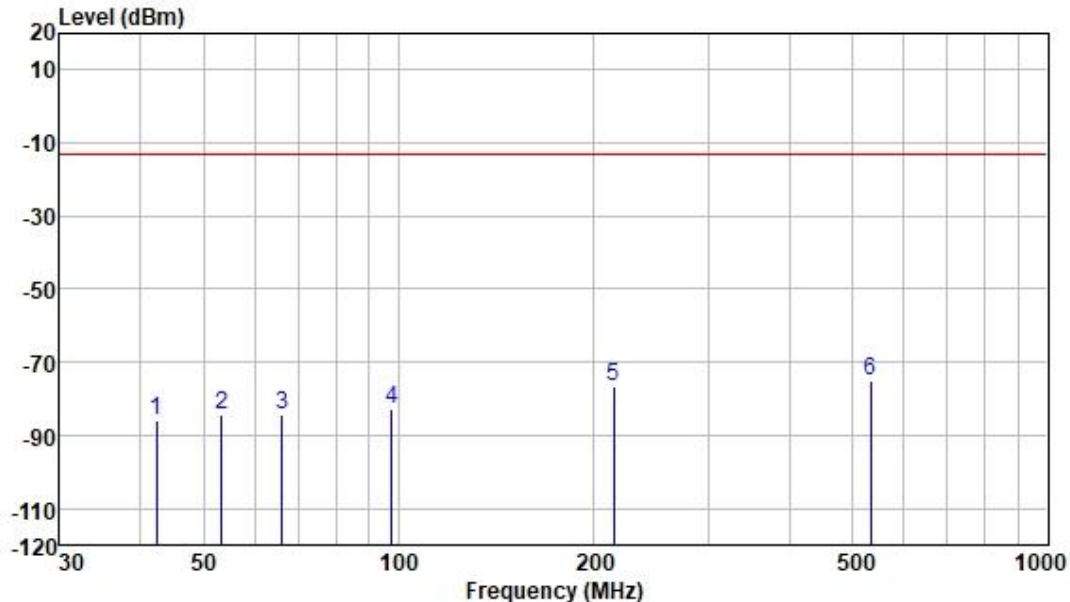
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DL_1S_M_AWGN_Horizontal_30MHz~1GHz



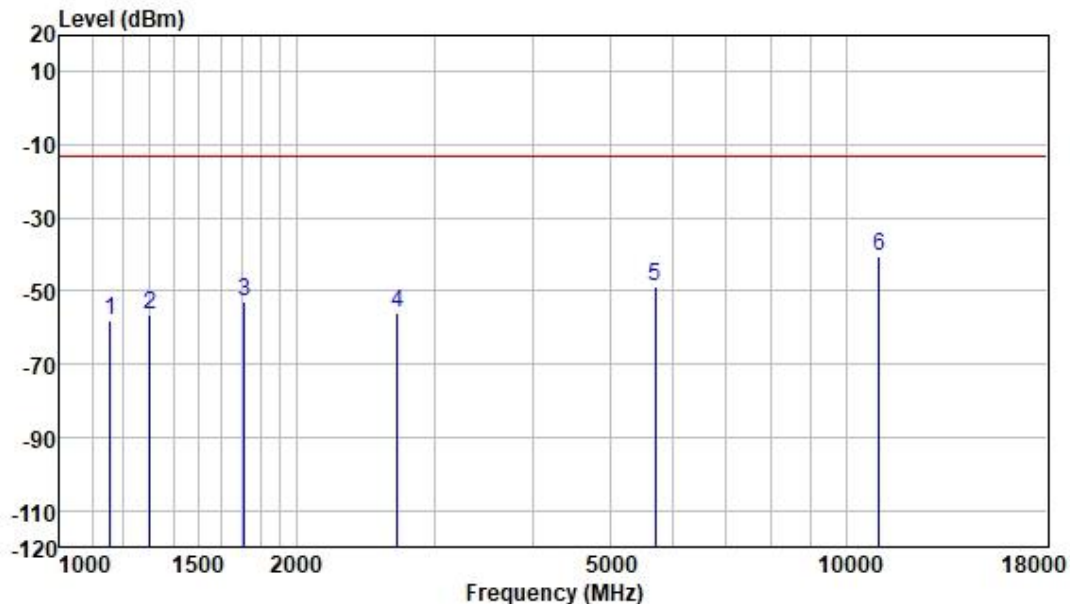
	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	42.30	-84.85	-1.09	-85.94	-13.00	-72.94	HORIZONTAL
2	53.32	-82.65	-1.60	-84.25	-13.00	-71.25	HORIZONTAL
3	66.03	-78.99	-5.18	-84.17	-13.00	-71.17	HORIZONTAL
4	97.46	-73.13	-9.65	-82.78	-13.00	-69.78	HORIZONTAL
5	214.51	-68.99	-7.38	-76.37	-13.00	-63.37	HORIZONTAL
6	533.83	-76.03	0.72	-75.31	-13.00	-62.31	HORIZONTAL



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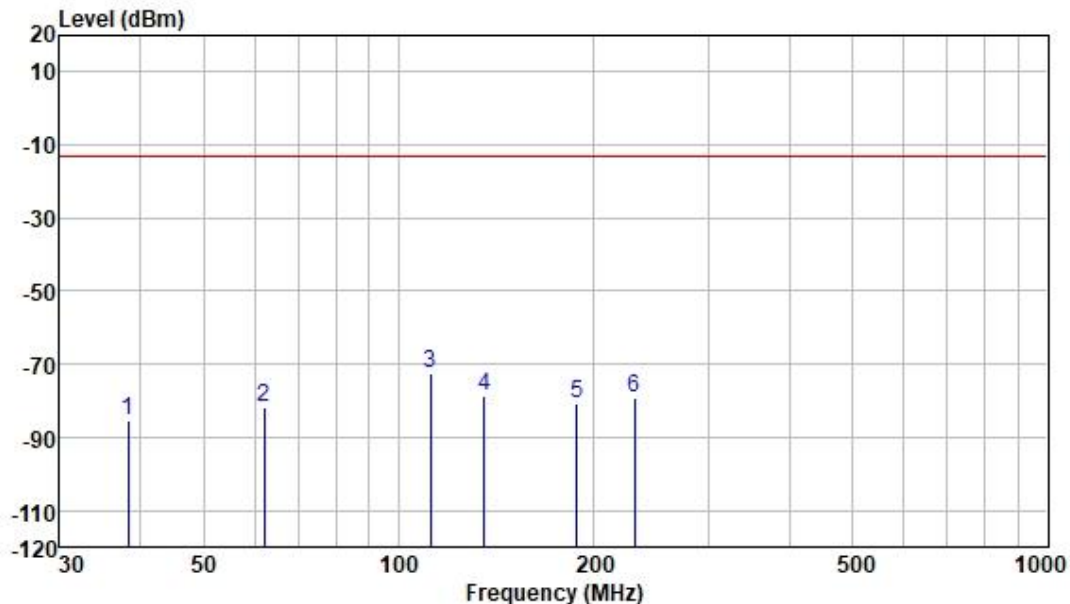
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DL_1S_M_AWGN_Horizontal_above 1GHz



	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	1158.83	-61.30	3.26	-58.04	-13.00	-45.04	HORIZONTAL
2	1300.86	-60.38	3.91	-56.47	-13.00	-43.47	HORIZONTAL
3	1716.86	-59.08	6.31	-52.77	-13.00	-39.77	HORIZONTAL
4	2687.22	-60.69	4.62	-56.07	-13.00	-43.07	HORIZONTAL
5	5713.86	-62.80	13.85	-48.95	-13.00	-35.95	HORIZONTAL
6	10980.47	-64.34	24.07	-40.27	-13.00	-27.27	HORIZONTAL

DL_1S_M_AWGN_Vertical_30MHz~1GHz



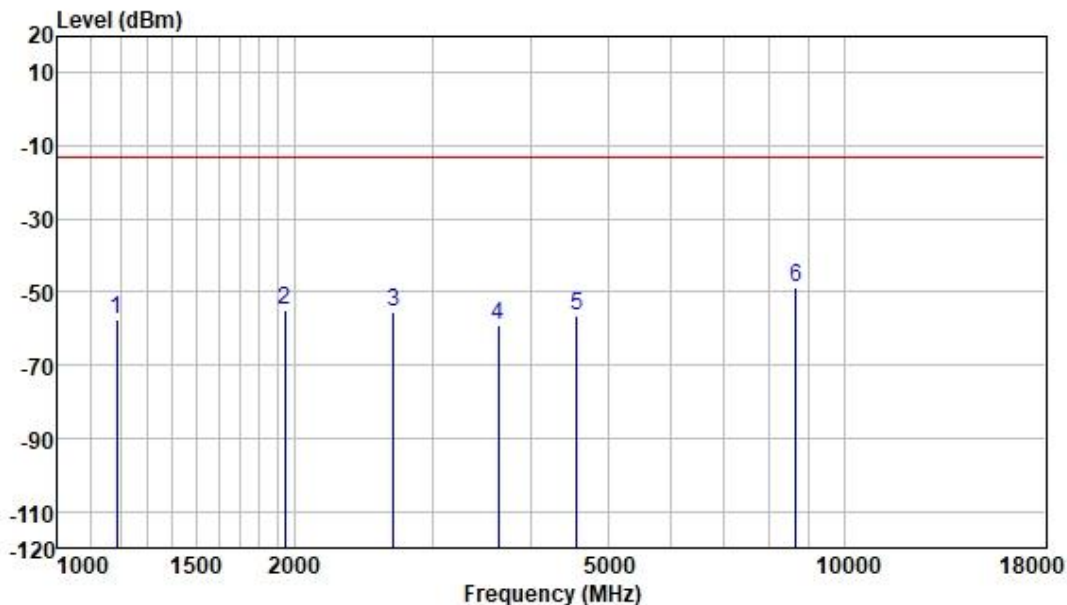
	Freq	Read	Correction	Limit	Over	
	MHz	Level	Factor	Line	Limit	Pol/Phase
	MHz	dBm	dB	dBm	dB	
1	38.21	-77.51	-7.83	-85.34	-13.00	-72.34 VERTICAL
2	62.00	-78.91	-3.01	-81.92	-13.00	-68.92 VERTICAL
3	111.74	-68.12	-4.31	-72.43	-13.00	-59.43 VERTICAL
4	135.51	-74.81	-3.93	-78.74	-13.00	-65.74 VERTICAL
5	187.75	-76.58	-4.21	-80.79	-13.00	-67.79 VERTICAL
6	230.91	-72.90	-6.39	-79.29	-13.00	-66.29 VERTICAL



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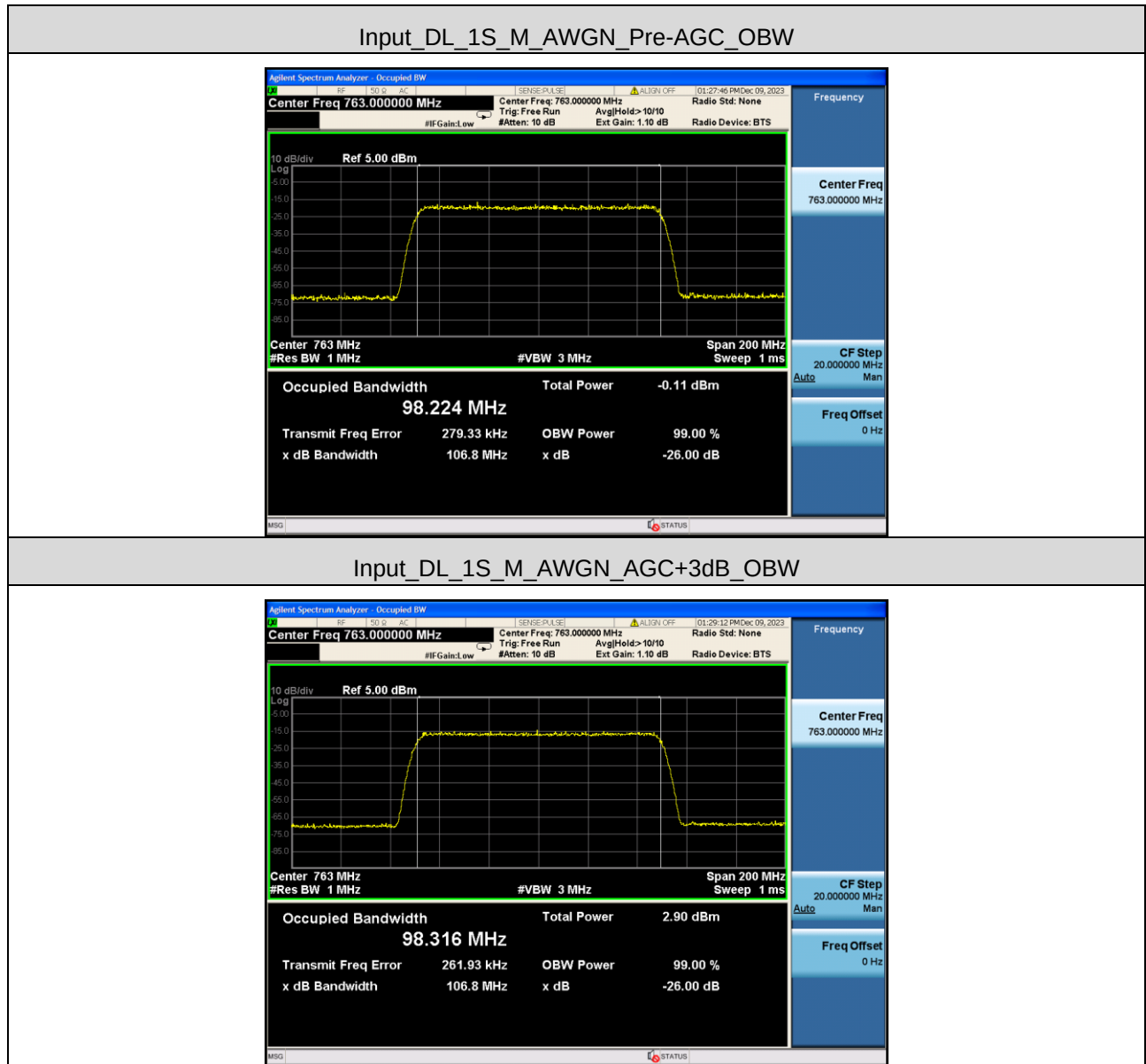
DL_1S_M_AWGN_Vertical_above 1GHz



	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	1189.37	-60.75	3.18	-57.57	-13.00	-44.57	VERTICAL
2	1944.07	-62.30	7.63	-54.67	-13.00	-41.67	VERTICAL
3	2671.73	-60.73	5.23	-55.50	-13.00	-42.50	VERTICAL
4	3629.54	-63.52	4.59	-58.93	-13.00	-45.93	VERTICAL
5	4560.56	-62.96	6.56	-56.40	-13.00	-43.40	VERTICAL
6	8663.40	-62.59	13.99	-48.60	-13.00	-35.60	VERTICAL

2 FirstNet (only for downlink: 758-768MHz)

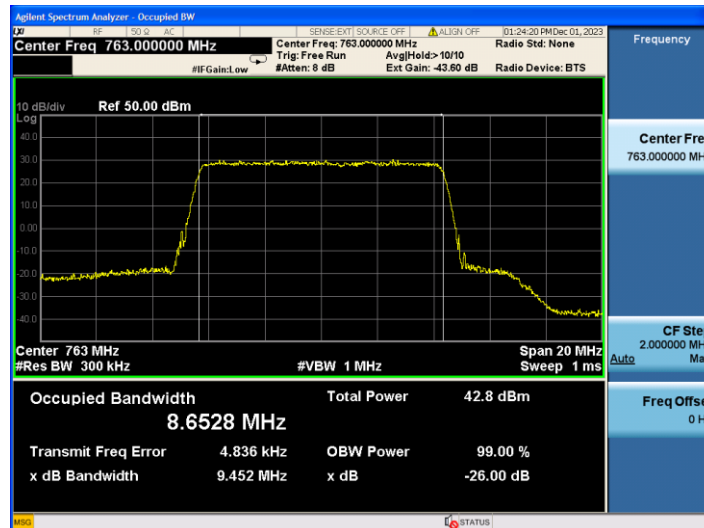
2.1 Input-versus-output signal comparison



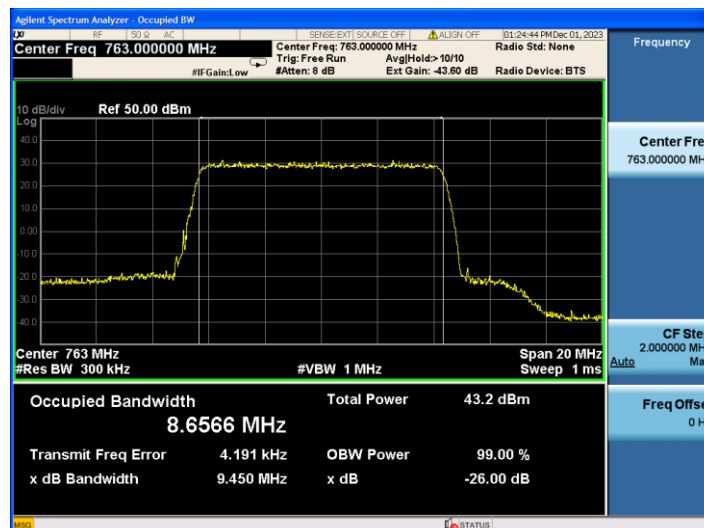
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Output_DL_1S_M_AWGN_Pre-AGC_OBW



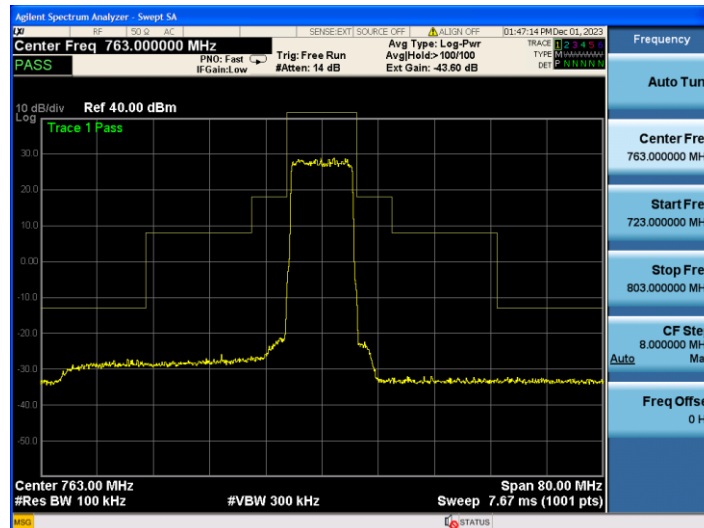
Output_DL_1S_M_AWGN_AGC+3dB_OBW



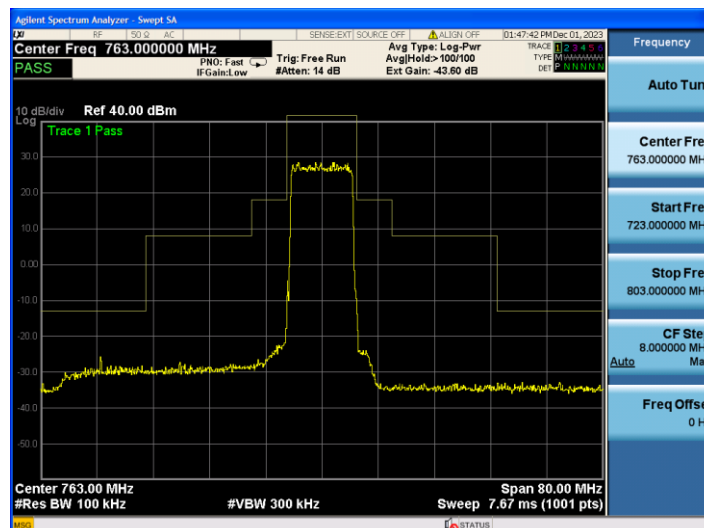
Remark:

1. The band supports maximum channel BW is 10MHz for NR, so the output signal OBW was less than the input when 100MHz AWGN as input signal.
2. Compare the spectral plot of the input signal to the output signal affirm that they are similar (in passband and roll off characteristic features and relative spectral locations). The test result complies with the requirement.

Output_DL_1S_M_AWGN_Pre-AGC_Emission Mask



Output_DL_1S_M_AWGN_AGC+3dB_Emission Mask



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2.2 Input/output power and amplifier/booster gain

Test Conf.	Test Freq. f ₀ (MHz)	Signal Level	Input Power (dBm)	Output Power (dBm)	Gain (dB)	Verdict
DL_1S_AWGN	758.3	Pre-AGC	-6.0	36.94	42.94	PASS
		AGC+3dB	-3.0	36.75	/	PASS
Remark: According to the declaration from the applicant, the single antenna gain should not exceed 12.5dBi, the Directional gain = G _{ANT} + 10 log (N _{ANT}) dBi = 12.5dBi+10log (2) dBi= 15.5dBi. ERP= EIRP-2.15dB The total maximum ERP for the EUT is (36.94dBm+36.94dBm) +15.5dBi-2.15dB=53.30dBm (213.80W) which don't exceed the required ERP limit (1000W).						

2.3 Noise Figure

Test Conf.	Noise Figure (dB)	Limit (dB)	Verdict
DL_1S_M_AWGN	8.11	9	PASS

2.4 Out-of-band/out-of-block (including intermodulation) emissions and spurious emissions

Note: 1. 90.543(c) Out-of-band emission limit.

the power of any emission must be reduced below the mean output power (P) by at least $43 + 10 \log (P)$ dB, Here,

$$P=36.94\text{dBm}= 4.95\text{W}$$

$$\text{So the limit} = P(\text{dBm}) - [43 + 10 \log (4.95\text{W})] = -13\text{dBm}$$

The EUT supports 2x2 MIMO and the emissions were measured at one of output port, so the limit line was set to -16.01dBm in following test plots in order to determine the test result conveniently.

2. 90.543e (1) limit:

On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than $76 + 10 \log (P)$ dB in a 6.25 kHz band segment, for base and fixed stations.

$$\text{Here, } P=36.94\text{dBm}= 4.95\text{W}$$

$$\text{So the limit} = P(\text{dBm}) - [76 + 10 \log (4.95\text{W})] = -46\text{dBm}$$

The EUT supports 2x2 MIMO and the emissions were measured at one of output port, so the limit line was set to -49.01dBm in following test plots in order to determine the test result conveniently.

3. 90.543 (e)(3) limit:

On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least $43 + 10 \log (P)$ dB

$$\text{Here, } P=36.94\text{dBm}= 4.95\text{W}$$

So the limit =

$$P(\text{dBm}) - [43 + 10 \log (4.95\text{W})] = -13\text{dBm}$$

The EUT supports 2x2 MIMO and the emissions were measured at one of output port, so the limit line was set to -16.01dBm in following test plots in order to determine the test result conveniently.

The spurious emissions were performed at bottom / middle / top channel and only the worst-case middle channel test data was recorded in the report.

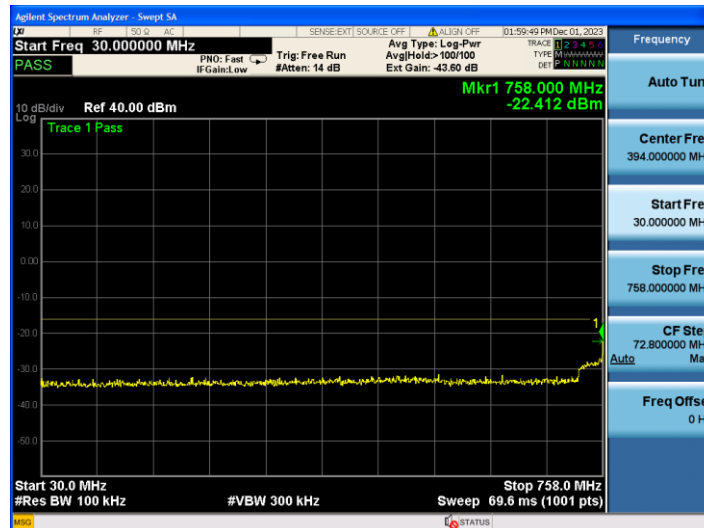
The spurious emissions from 9kHz to 30MHz was very low and 20dB below the limit, therefore, the data was not recorded in the report.



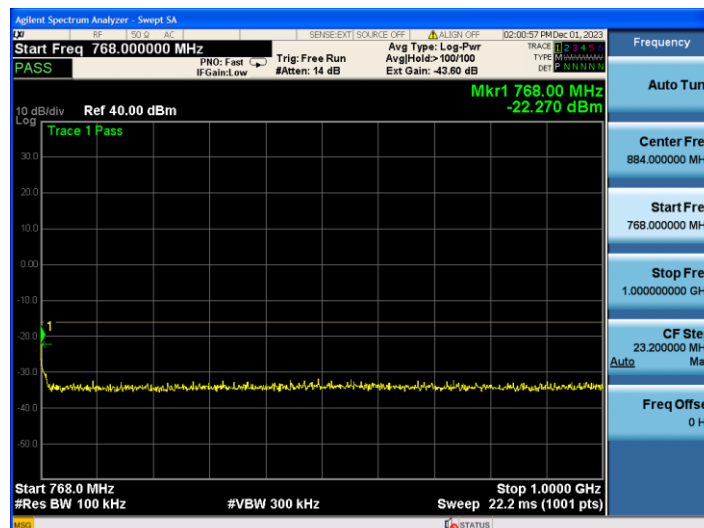
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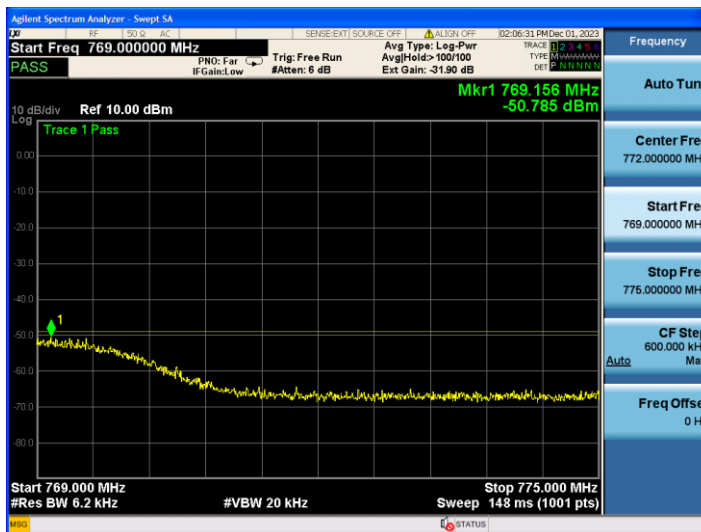
DL_1S_M_AWGN_Pre-AGC_Spurious emission 1



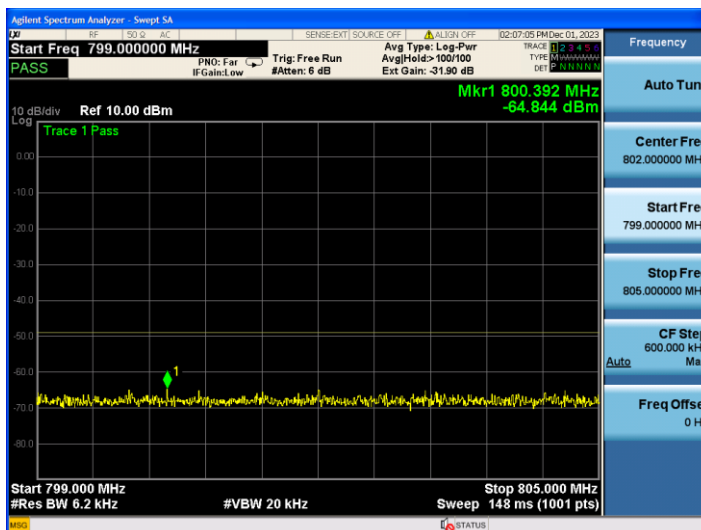
DL_1S_M_AWGN_Pre-AGC_Spurious emission 2



DL_1S_M_AWGN_Pre-AGC_Spurious emission 3



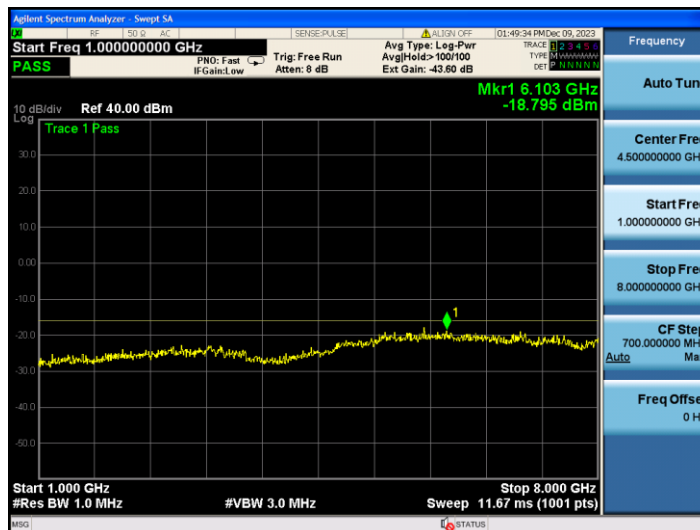
DL_1S_M_AWGN_Pre-AGC_Spurious emission 4



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DL_1S_M_AWGN_Pre-AGC_Spurious emission 5



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2.5 Frequency Stability

- Note:
1. At 10 °C intervals of temperatures between -30 °C and +50 °C at the manufacturer's rated supply voltage, here the rated supply voltage is AC 110V.
 2. At +20 °C temperature and ±15% supply voltage variations. If a product is specified to operate over a range of input voltage, then the -15% variation is applied to the lowermost voltage and the +15% is applied to the uppermost voltage.
 3. The frequency stabilities can be maintained within the authorized bands of operation. Meet the requirement.

Frequency stability vs temperature				
Temperature (°C)	Test Conf.	Test data (MHz)	Tolerance (ppm)	Verdict
50	DL_1S_M_AWGN	54	0.0708	PASS
40		73	0.0957	PASS
30		52	0.0682	PASS
20		63	0.0826	PASS
10		59	0.0773	PASS
0		53	0.0695	PASS
-10		62	0.0813	PASS
-20		82	0.1075	PASS
-30		80	0.1048	PASS

Frequency stability vs voltage				
Voltage (V)	Test Conf.	Test data (MHz)	Tolerance (ppm)	Verdict
AC 93.5V	DL_1S_M_AWGN	63	0.0826	PASS
AC 110V		63	0.0826	PASS
AC 126.5V		63	0.0826	PASS



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2.6 Radiated spurious emissions

Note: 1. 47 CFR Part 90.219(e)(3)

Spurious emissions from a signal booster must not exceed -13 dBm within any 100 kHz measurement bandwidth.

The tested max conducted power for single antenna port is 36.94dBm. the 2x2 MIMO total power is 36.94dBm+36.94dBm= 9.89W.

The any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log (P)$ dB.

Here,

$P=9.89W$

So the limit =

$P(\text{dBm}) - [43 + 10 \log (9.89W)] = -13\text{dBm}$

2. 47 CFR Part 90.543(f)

For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to -70 dBW/MHz (i.e. -40dBm) equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW (i.e. -50dBm) EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

3. The radiated spurious emissions were performed at bottom / middle / top channel, the data with more than 20db margin, therefore, only the worst-case middle channel test data was recorded in the report.

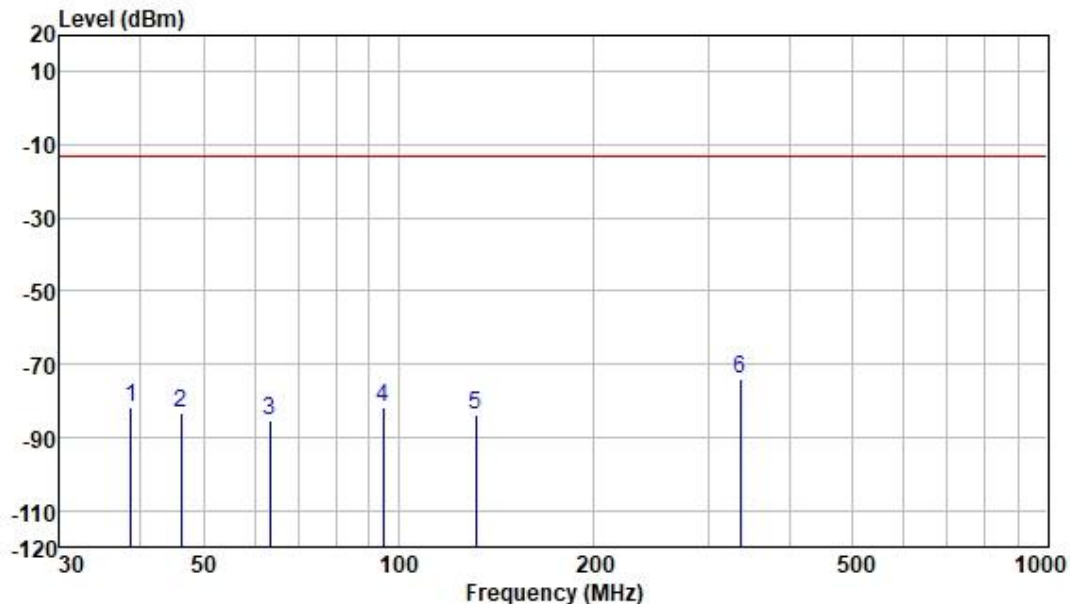
4. The disturbance from 9kHz to 30MHz was very low and 20dB below the limit, therefore, the data was not recorded in the report.



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DL_1S_M_AWGN_Horizontal_30MHz~1GHz



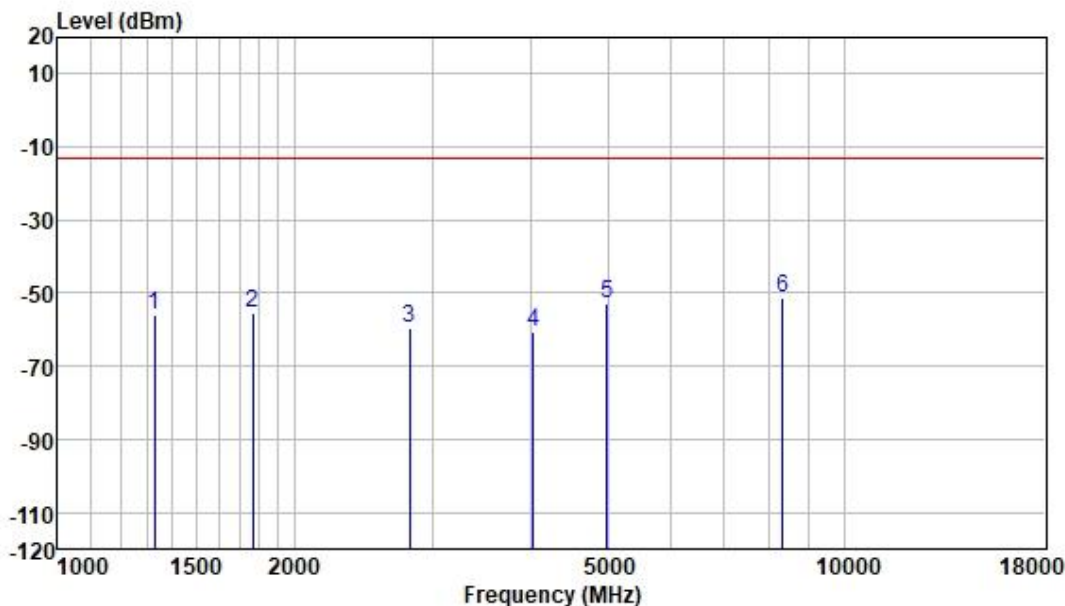
	Freq	Read	Correction	Limit	Over	
	MHz	Level	Factor	Line	Limit	Pol/Phase
	MHz	dBm	dB	dBm	dB	
1	38.62	-83.90	2.07	-81.83	-13.00	-68.83 HORIZONTAL
2	46.18	-79.33	-4.07	-83.40	-13.00	-70.40 HORIZONTAL
3	63.31	-81.65	-3.59	-85.24	-13.00	-72.24 HORIZONTAL
4	94.43	-72.12	-9.69	-81.81	-13.00	-68.81 HORIZONTAL
5	131.30	-75.70	-8.18	-83.88	-13.00	-70.88 HORIZONTAL
6	336.04	-72.11	-2.01	-74.12	-13.00	-61.12 HORIZONTAL



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DL_1S_M_AWGN_Horizontal_above 1GHz



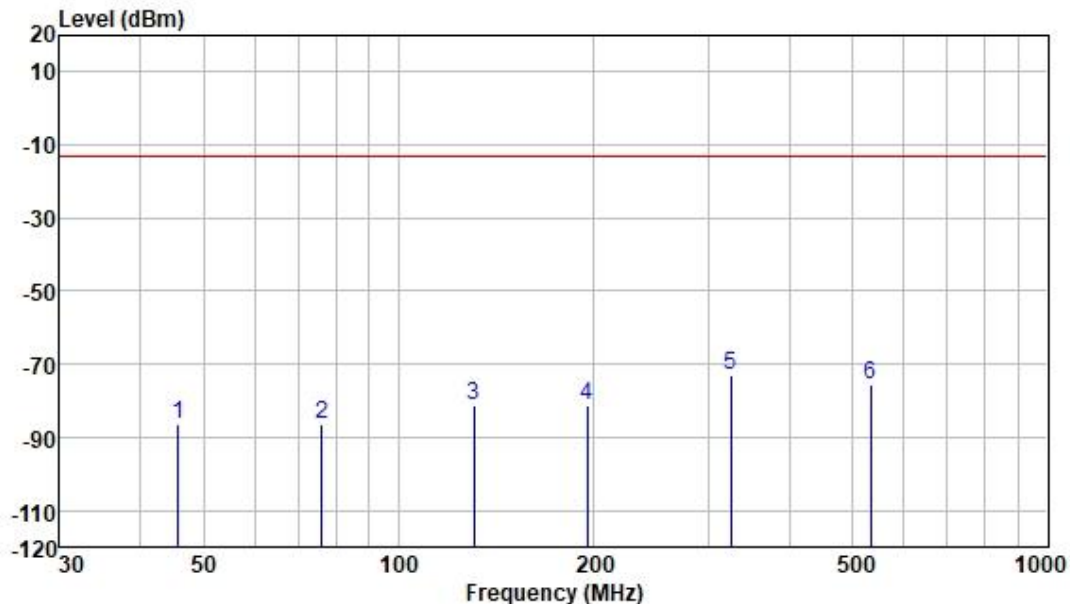
	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	1327.45	-60.24	4.06	-56.18	-13.00	-43.18	HORIZONTAL
2	1767.21	-61.30	5.87	-55.43	-13.00	-42.43	HORIZONTAL
3	2798.19	-63.15	3.70	-59.45	-13.00	-46.45	HORIZONTAL
4	4015.93	-63.33	2.74	-60.59	-13.00	-47.59	HORIZONTAL
5	4988.06	-63.77	11.06	-52.71	-13.00	-39.71	HORIZONTAL
6	8343.92	-64.62	13.39	-51.23	-13.00	-38.23	HORIZONTAL



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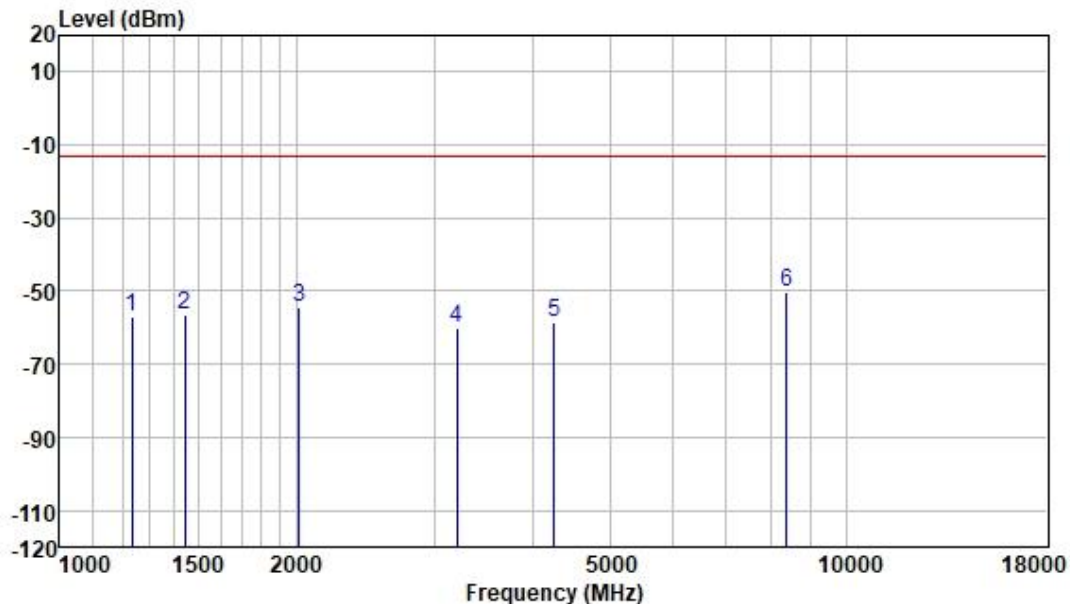
DL_1S_M_AWGN_Vertical_30MHz~1GHz



	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	45.69	-74.36	-12.26	-86.62	-13.00	-73.62	VERTICAL
2	75.98	-76.72	-9.70	-86.42	-13.00	-73.42	VERTICAL
3	130.38	-77.08	-3.93	-81.01	-13.00	-68.01	VERTICAL
4	195.14	-76.51	-4.59	-81.10	-13.00	-68.10	VERTICAL
5	324.46	-70.71	-2.48	-73.19	-13.00	-60.19	VERTICAL
6	533.83	-77.19	1.45	-75.74	-13.00	-62.74	VERTICAL

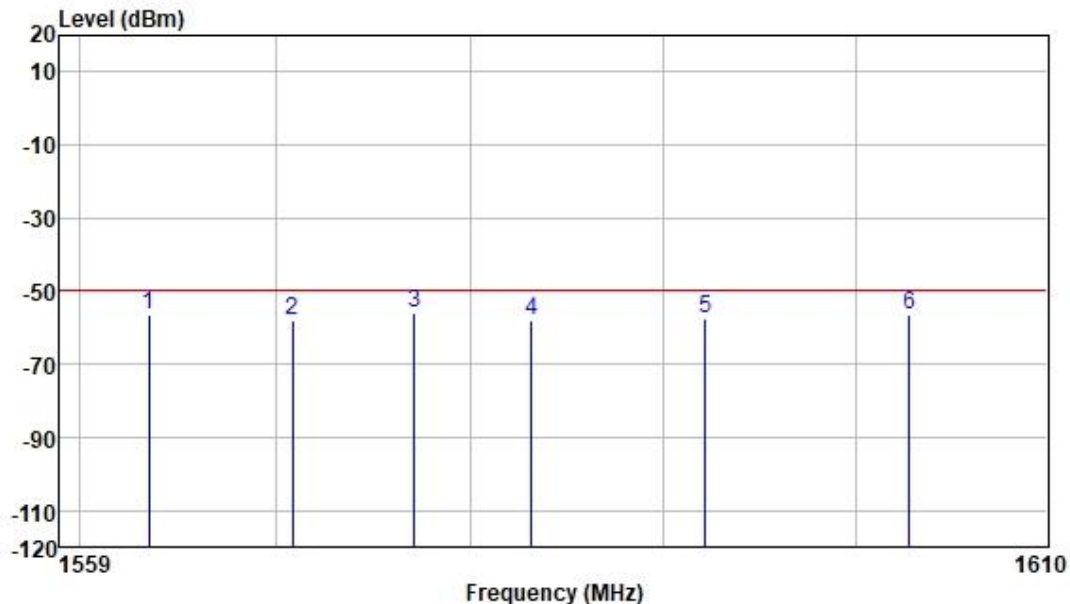


DL_1S_M_AWGN_Vertical_above 1GHz



	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	1234.91	-60.75	3.71	-57.04	-13.00	-44.04	VERTICAL
2	1443.51	-61.57	5.33	-56.24	-13.00	-43.24	VERTICAL
3	2012.69	-62.80	8.64	-54.16	-13.00	-41.16	VERTICAL
4	3196.09	-62.59	2.60	-59.99	-13.00	-46.99	VERTICAL
5	4242.64	-62.71	4.29	-58.42	-13.00	-45.42	VERTICAL
6	8392.29	-64.56	14.31	-50.25	-13.00	-37.25	VERTICAL

DL_1S_M_AWGN_Horizontal_1559MHz~1610MHz



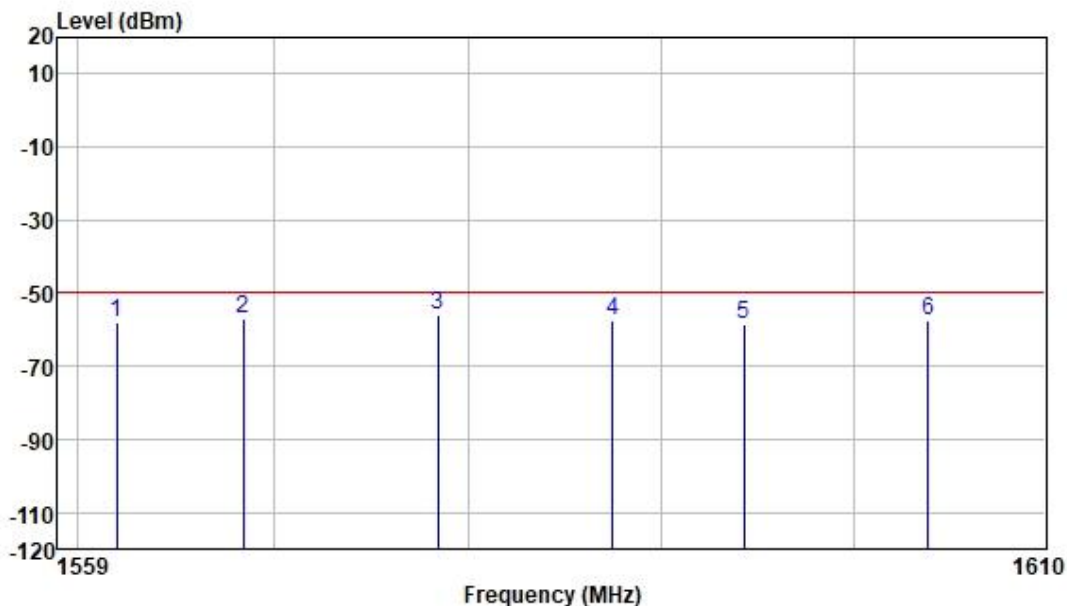
	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	1563.52	-61.61	5.07	-56.54	-49.99	-6.55	HORIZONTAL
2	1570.89	-63.05	5.10	-57.95	-49.99	-7.96	HORIZONTAL
3	1577.12	-61.11	5.14	-55.97	-49.99	-5.98	HORIZONTAL
4	1583.17	-63.40	5.17	-58.23	-49.99	-8.24	HORIZONTAL
5	1592.12	-62.72	5.20	-57.52	-49.99	-7.53	HORIZONTAL
6	1602.76	-61.68	5.24	-56.44	-49.99	-6.45	HORIZONTAL



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DL_1S_M_AWGN_Vertical_1559MHz~1610MHz



	Freq	Read	Correction	Limit	Over	
	MHz	Level	Factor	Line	Limit	Pol/Phase
	MHz	dBm	dB	dBm	dB	
1	1562.01	-63.49	5.63	-57.86	-49.99	-7.87 VERTICAL
2	1568.46	-62.36	5.41	-56.95	-49.99	-6.96 VERTICAL
3	1578.44	-61.01	5.21	-55.80	-49.99	-5.81 VERTICAL
4	1587.46	-62.54	5.04	-57.50	-49.99	-7.51 VERTICAL
5	1594.27	-63.63	4.97	-58.66	-49.99	-8.67 VERTICAL
6	1603.85	-62.43	4.82	-57.61	-49.99	-7.62 VERTICAL

--End of Appendix--