

Appendix -

Test Data and Result for report

GZCR231100125502

(B)

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

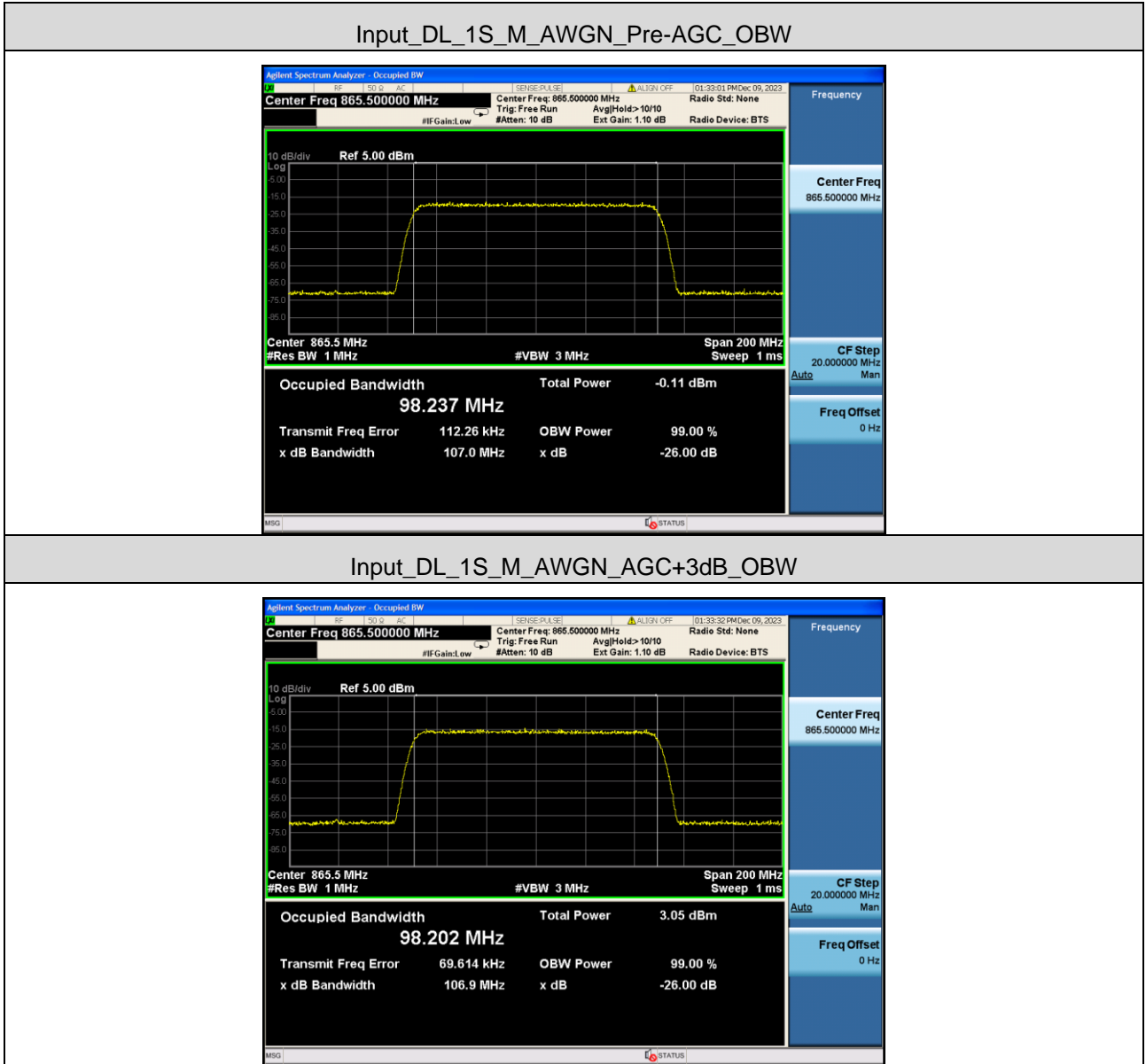


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1 ESMR (only for downlink: 862-869MHz)

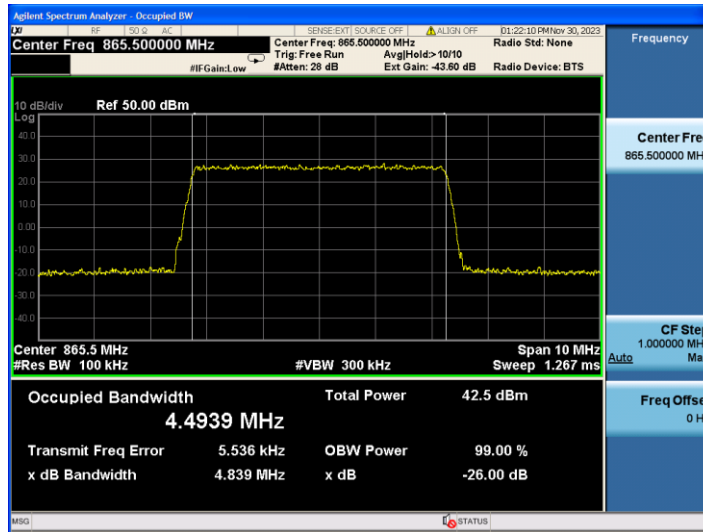
1.1 Input-versus-output signal comparison



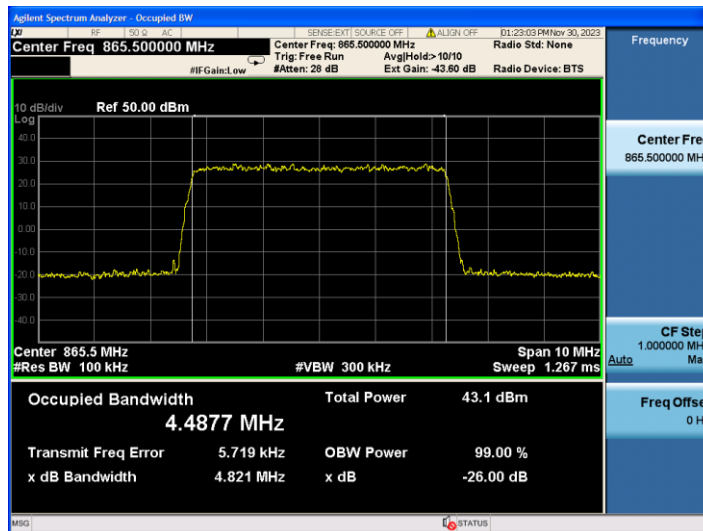
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Output_DL_1S_M_AWGN_Pre-AGC_OBW



Output_DL_1S_M_AWGN_AGC+3dB_OBW



Remark:

1. The band supports maximum channel BW is 5MHz 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.



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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	866.83	Pre-AGC	-6.0	37.13	43.13	PASS
		AGC+3dB	-3.0	37.42	/	PASS

Remark:

According to the declaration from the applicant, the single antenna gain should not exceed 10dBi, the Directional gain = G_{ANT} + 10 log (N_{ANT}) dBi = 10dBi+10log (2) dBi= 13dBi.

ERP= EIRP-2.15dB,

The total maximum ERP for the EUT is (37.42dBm+37.42dBm) +13dBi-2.15dB=51.28dBm (134.28W) 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: 1. 90.691 a (1) Limit:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $116 \text{ Log}_{10}(f/6.1)$ decibels or $50 + 10 \text{ Log}_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

The tested max conducted power for single antenna port is 42.89dBm, the power of any emission must be reduced below the mean output power (P) by at least $50 + 10 \log (P)$ dB
Here, $P=37.42\text{dBm}= 5.53\text{W}$.

So the limit = $P(\text{dBm}) - [50 + 10 \log (5.53)] = -20\text{dBm}$

The EUT supports 2x2 MIMO and the emissions were measured at one of output port, so the limit line was set to -23.01dBm in following test plots in order to determine the test result conveniently.

2. 90.691 a (2) Limit:

(1) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \text{ Log}_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

The tested max conducted power for single antenna port is 37.42dBm, the power of any emission must be reduced below the mean output power (P) by at least $43 + 10 \log (P)$ dB
Here, $P=37.42\text{dBm}= 5.53\text{W}$.

So the limit = $P(\text{dBm}) - [43 + 10 \log (5.53\text{W})] = -13\text{dBm}$

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.

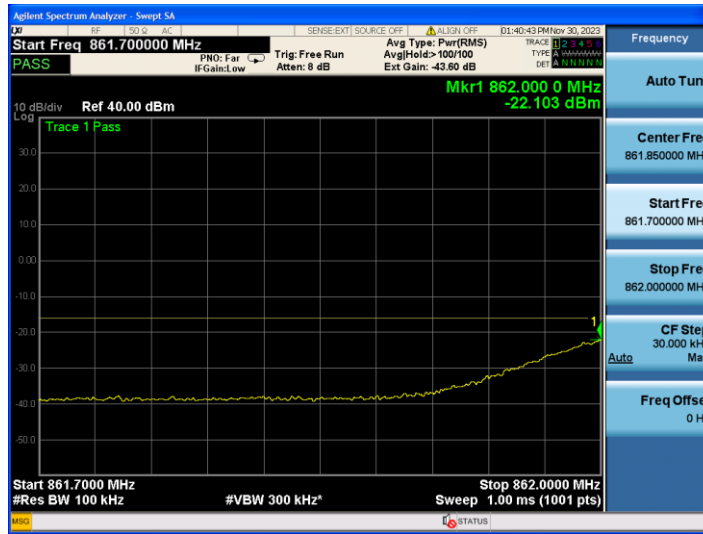
The spurious emissions from 9kHz to 30MHz was very low and 20dB below the limit, therefore, the data was not recorded in the report.



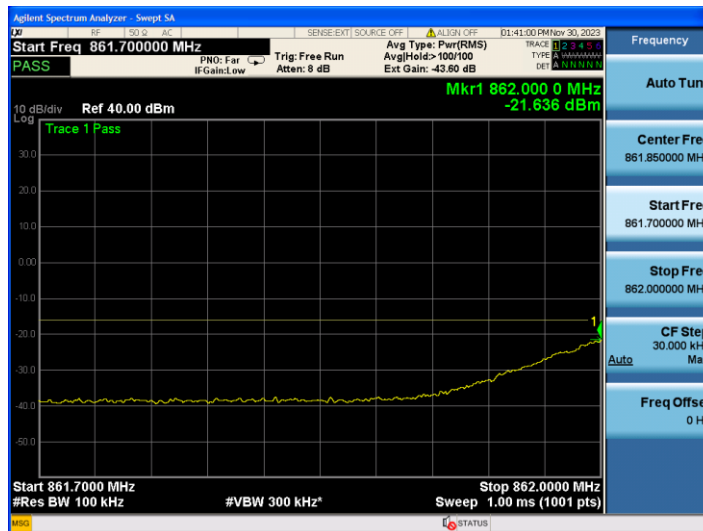
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DL_1S_B_AWGN_Pre-AGC_Out-of-band emission



DL_1S_B_AWGN_AGC+3_Out-of-band emission



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DL_1S_T_AWGN_Pre-AGC_Out-of-band emission



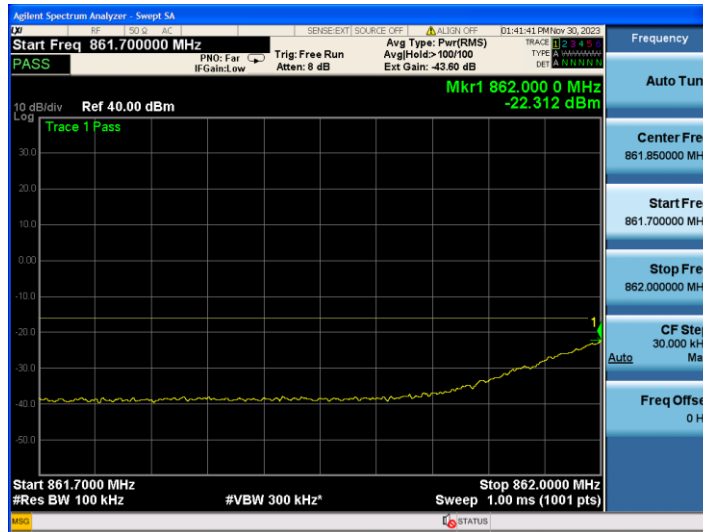
DL_1S_T_AWGN_AGC+3_Out-of-band emission



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DL_2S_B_AWGN_Pre-AGC_Out-of-band emission



DL_2S_B_AWGN_AGC+3_Out-of-band emission



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DL_2S_T_AWGN_Pre-AGC_Out-of-band emission



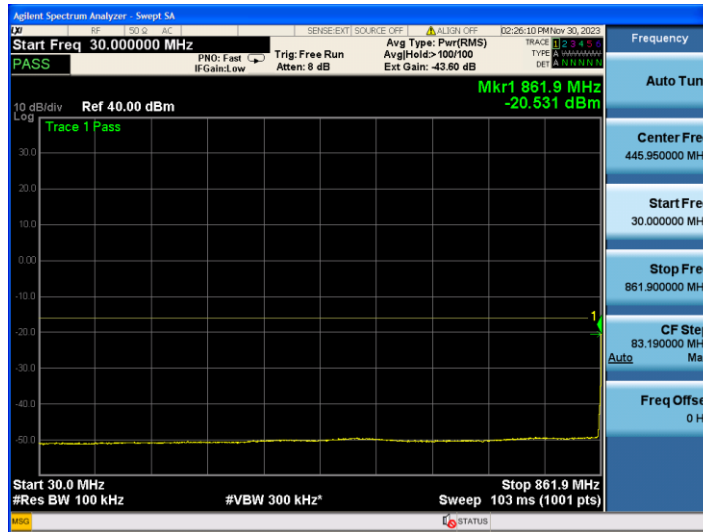
DL_2S_T_AWGN_AGC+3_Out-of-band emission



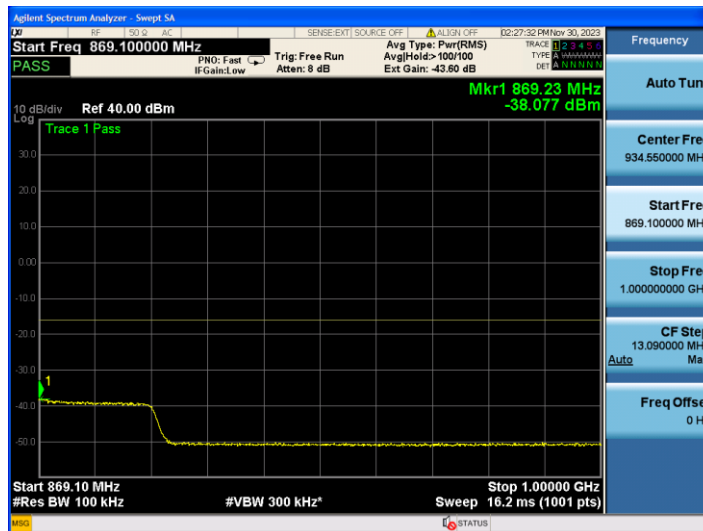
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DL_1S_B_AWGN_Pre-AGC_Spurious emission 1



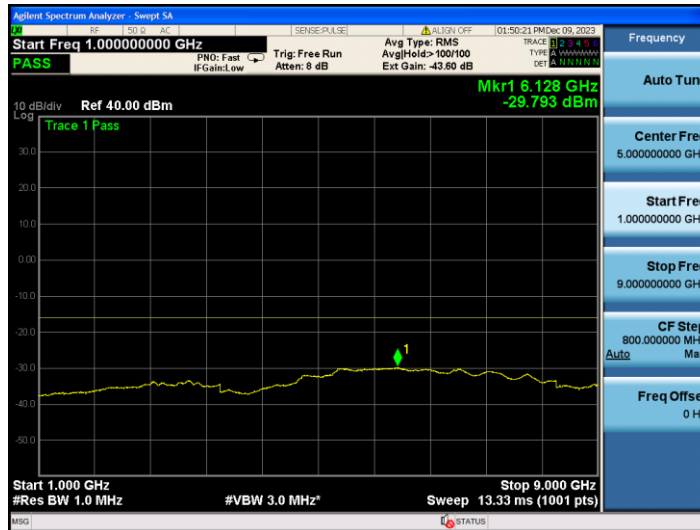
DL_1S_B_AWGN_Pre-AGC_Spurious emission 2



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DL_1S_B_AWGN_Pre-AGC_Spurious emission 3



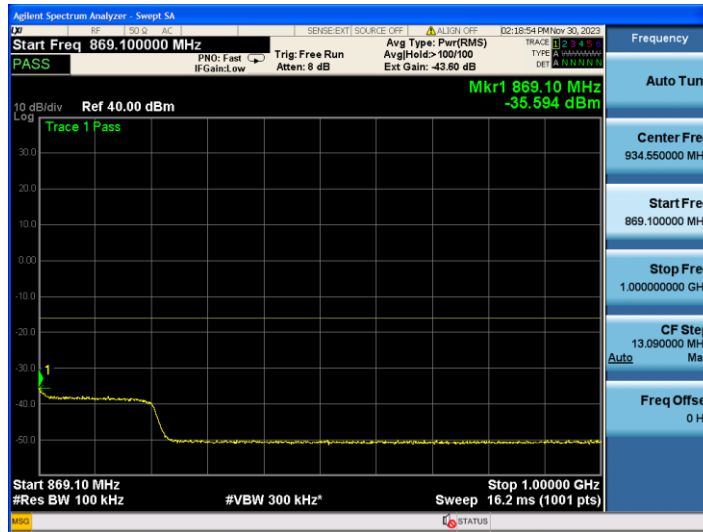
DL_1S_M_AWGN_Pre-AGC_Spurious emission 1



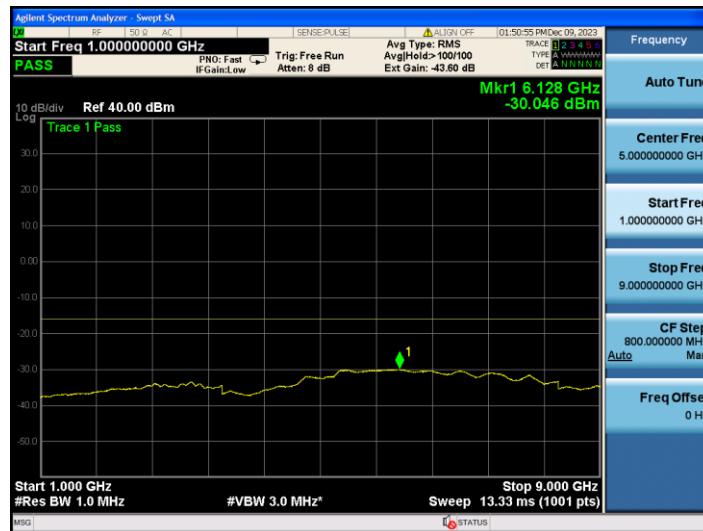
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DL_1S_M_AWGN_Pre-AGC_Spurious emission 2



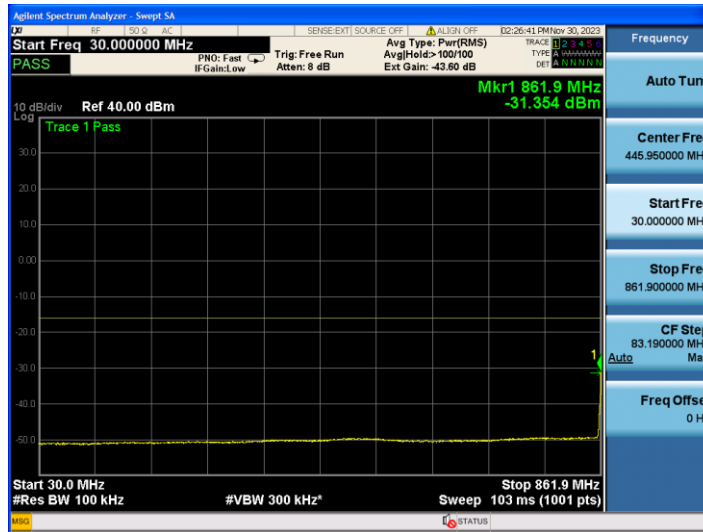
DL_1S_M_AWGN_Pre-AGC_Spurious emission 3



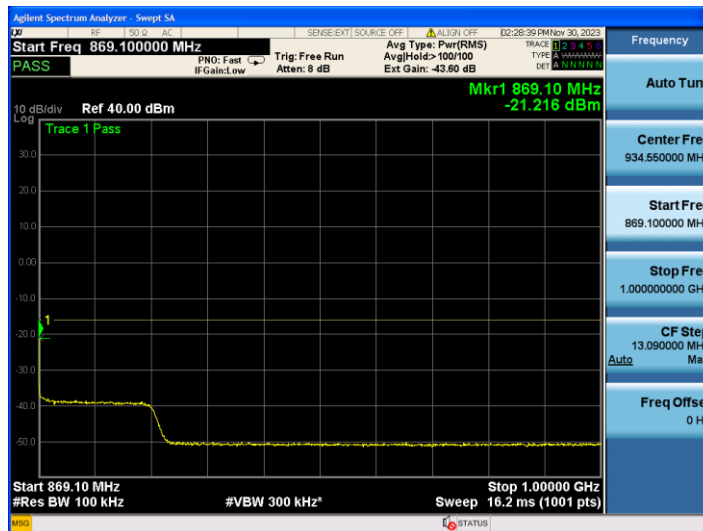
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DL_1S_T_AWGN_Pre-AGC_Spurious emission 1



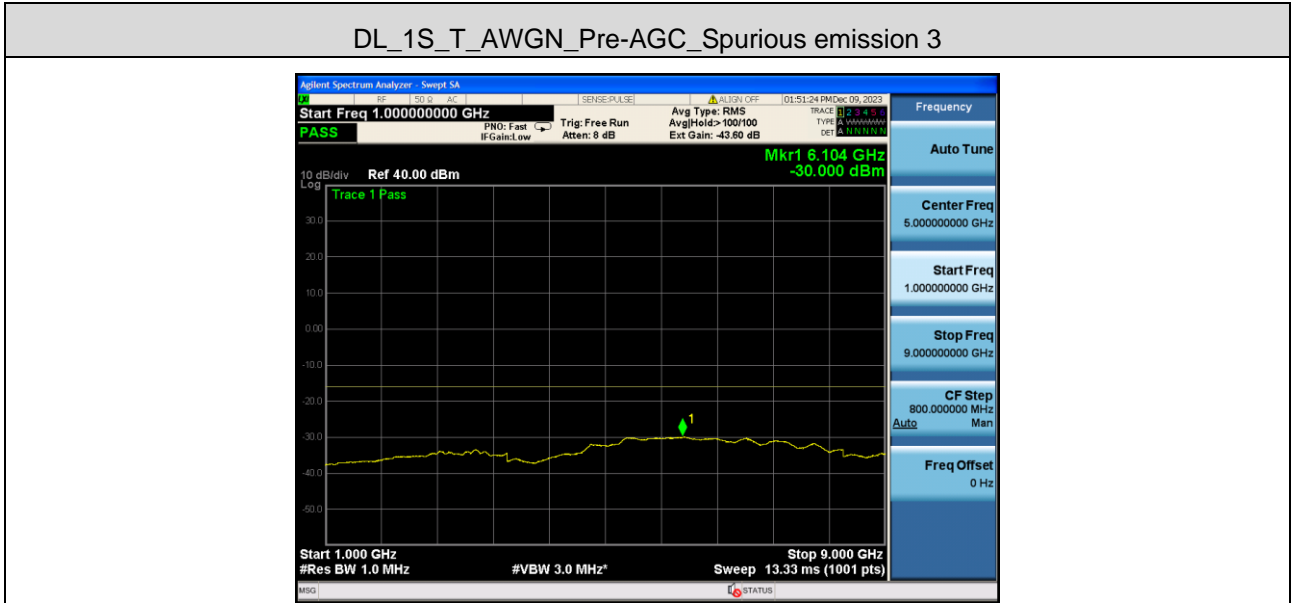
DL_1S_T_AWGN_Pre-AGC_Spurious emission 2



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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 and less than 1.5ppm. Meet the requirement.

Frequency stability vs temperature				
Temperature (°C)	Test Conf.	Frequency Error (Hz)	Tolerance (ppm)	Verdict
50	DL_1S_M_AWGN	48	0.0555	PASS
40		47	0.0543	PASS
30		52	0.0601	PASS
20		70	0.0809	PASS
10		83	0.0959	PASS
0		64	0.0739	PASS
-10		67	0.0774	PASS
-20		76	0.0878	PASS
-30		63	0.0728	PASS

Frequency stability vs voltage				
Voltage (V)	Test Conf.	Frequency Error (Hz)	Tolerance (ppm)	Verdict
AC 93.5	DL_1S_M_AWGN	70	0.0809	PASS
AC 110		70	0.0809	PASS
AC 126.5		70	0.0809	PASS



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1.5 Radiated spurious emissions

Note: 1. The tested max conducted power for single antenna port is 37.42dBm, the 2x2 MIMO total power is 37.42dBm+37.42dBm=11.28W

a) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 116 Log₁₀(f/6.1) decibels or 50 + 10 Log₁₀(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

Here, P=11.28W,

the limit = P(dBm)- [50 + 10 log (11.28W)] =-20dBm

b) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log₁₀(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

Here, P=11.28W,

the limit = P(dBm)- [43 + 10 log (11.28W)] =-13dBm

The limit line was set to -20dBm (the strictest limit) in following test plots in order to determine the test result conveniently.

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.

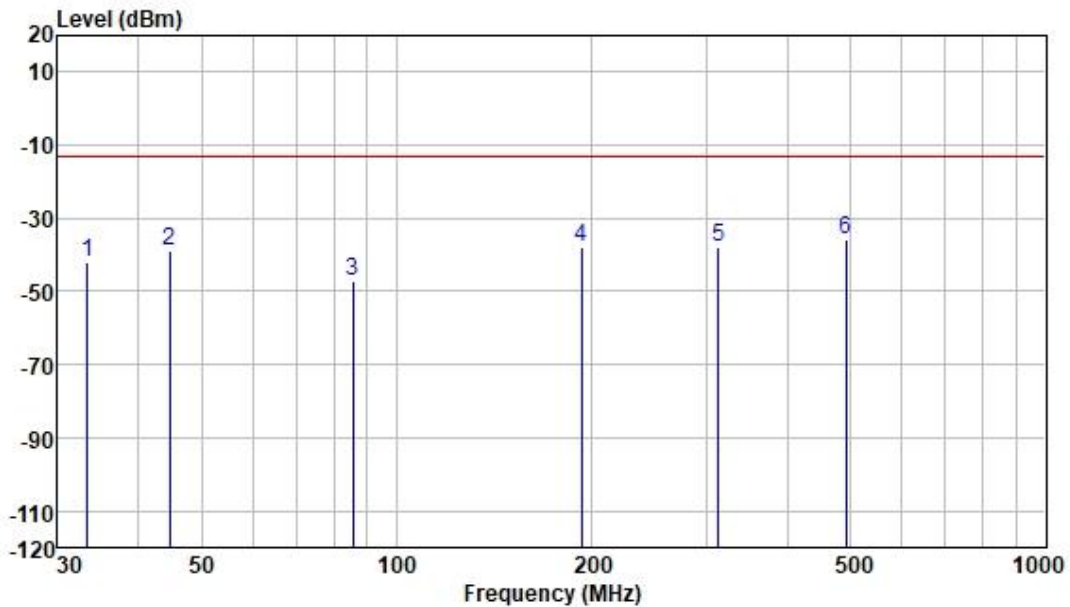
3. The disturbance from 9kHz to 30MHz was very low and 20dB below the limit, therefore, the data was not recorded in the report.



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DL_1S_M_AWGN_Horizontal_30MHz~1GHz



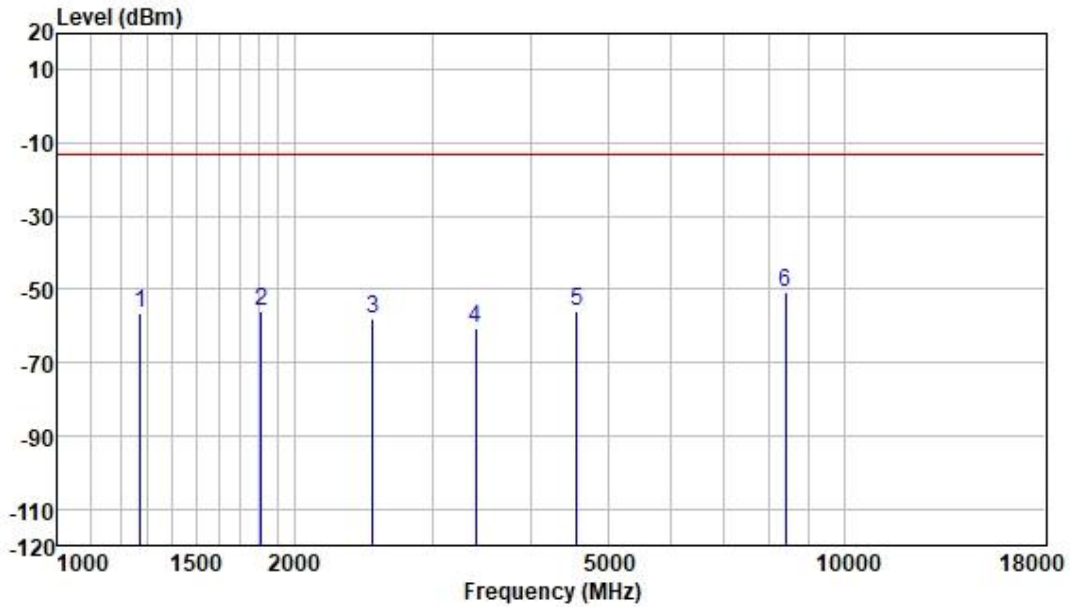
	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	33.33	-45.29	3.04	-42.25	-13.00	-29.25	HORIZONTAL
2	44.59	-34.64	-4.29	-38.93	-13.00	-25.93	HORIZONTAL
3	85.60	-37.28	-9.92	-47.20	-13.00	-34.20	HORIZONTAL
4	192.42	-31.69	-6.37	-38.06	-13.00	-25.06	HORIZONTAL
5	313.28	-34.56	-3.38	-37.94	-13.00	-24.94	HORIZONTAL
6	492.47	-36.41	0.37	-36.04	-13.00	-23.04	HORIZONTAL



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DL_1S_M_AWGN_Horizontal_above 1GHz



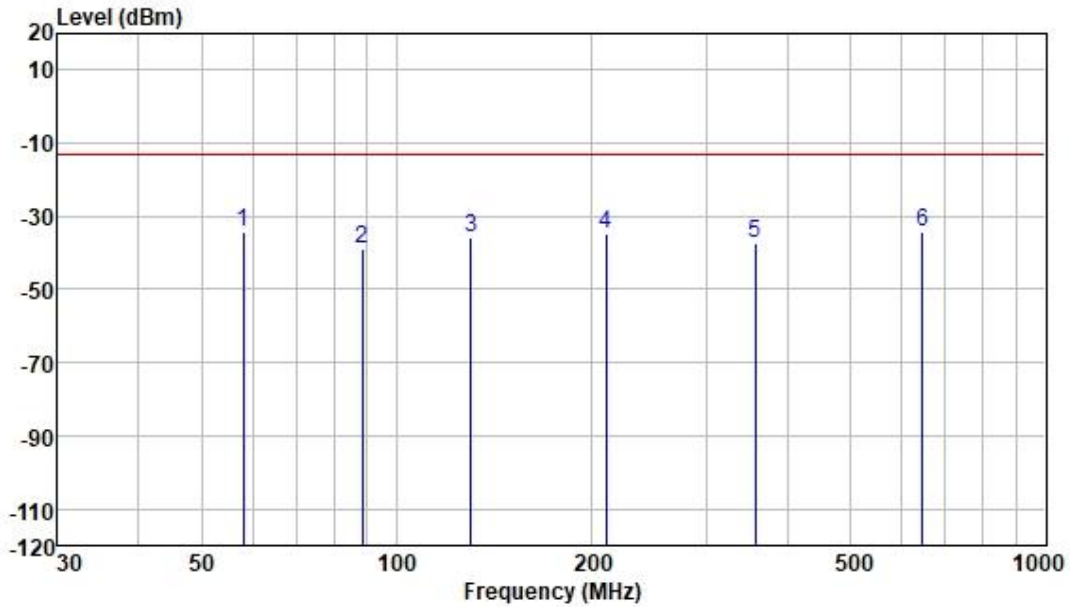
	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	1274.80	-60.71	4.11	-56.60	-13.00	-43.60	HORIZONTAL
2	1813.79	-61.91	5.75	-56.16	-13.00	-43.16	HORIZONTAL
3	2514.39	-65.09	7.01	-58.08	-13.00	-45.08	HORIZONTAL
4	3396.10	-62.57	2.21	-60.36	-13.00	-47.36	HORIZONTAL
5	4560.56	-62.64	6.88	-55.76	-13.00	-42.76	HORIZONTAL
6	8416.58	-64.03	13.42	-50.61	-13.00	-37.61	HORIZONTAL



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DL_1S_M_AWGN_Vertical_30MHz~1GHz



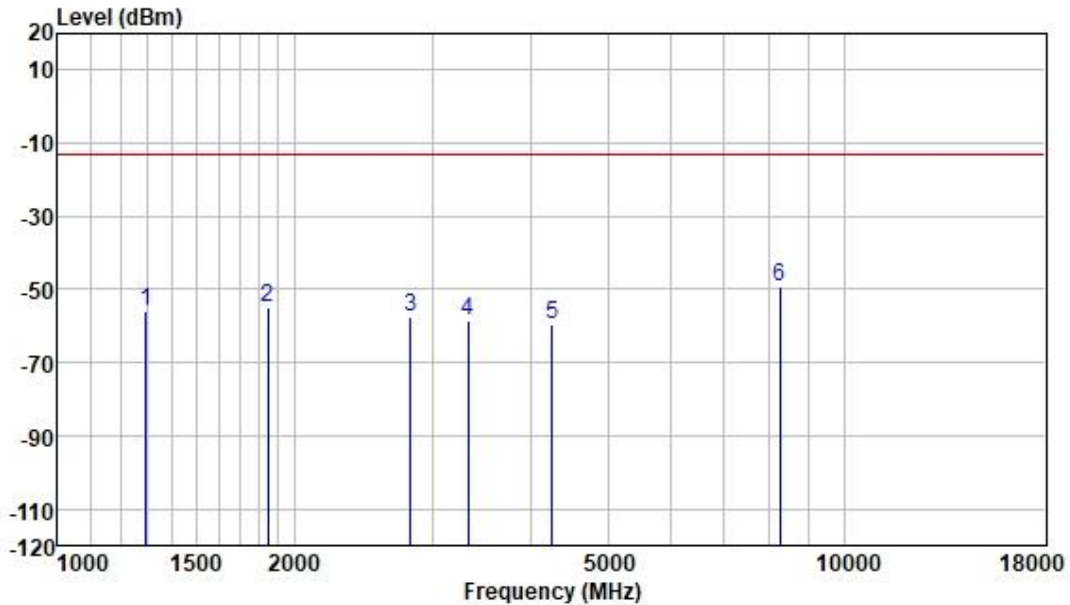
	Freq	Read Level	Correction Factor	Level	Limit	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	58.00	-31.72	-2.70	-34.42	-13.00	-21.42	VERTICAL
2	88.34	-30.33	-8.35	-38.68	-13.00	-25.68	VERTICAL
3	129.92	-31.81	-3.93	-35.74	-13.00	-22.74	VERTICAL
4	210.05	-29.01	-5.62	-34.63	-13.00	-21.63	VERTICAL
5	356.68	-35.60	-1.98	-37.58	-13.00	-24.58	VERTICAL
6	645.12	-38.75	4.68	-34.07	-13.00	-21.07	VERTICAL



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DL_1S_M_AWGN_Vertical_above 1GHz



	Freq	Read Level	Correction Factor	Level	Limit	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	1293.36	-60.44	4.32	-56.12	-13.00	-43.12	VERTICAL
2	1850.86	-61.54	6.41	-55.13	-13.00	-42.13	VERTICAL
3	2806.29	-61.60	4.11	-57.49	-13.00	-44.49	VERTICAL
4	3318.47	-61.39	2.94	-58.45	-13.00	-45.45	VERTICAL
5	4242.64	-63.83	4.29	-59.54	-13.00	-46.54	VERTICAL
6	8271.88	-63.99	14.51	-49.48	-13.00	-36.48	VERTICAL

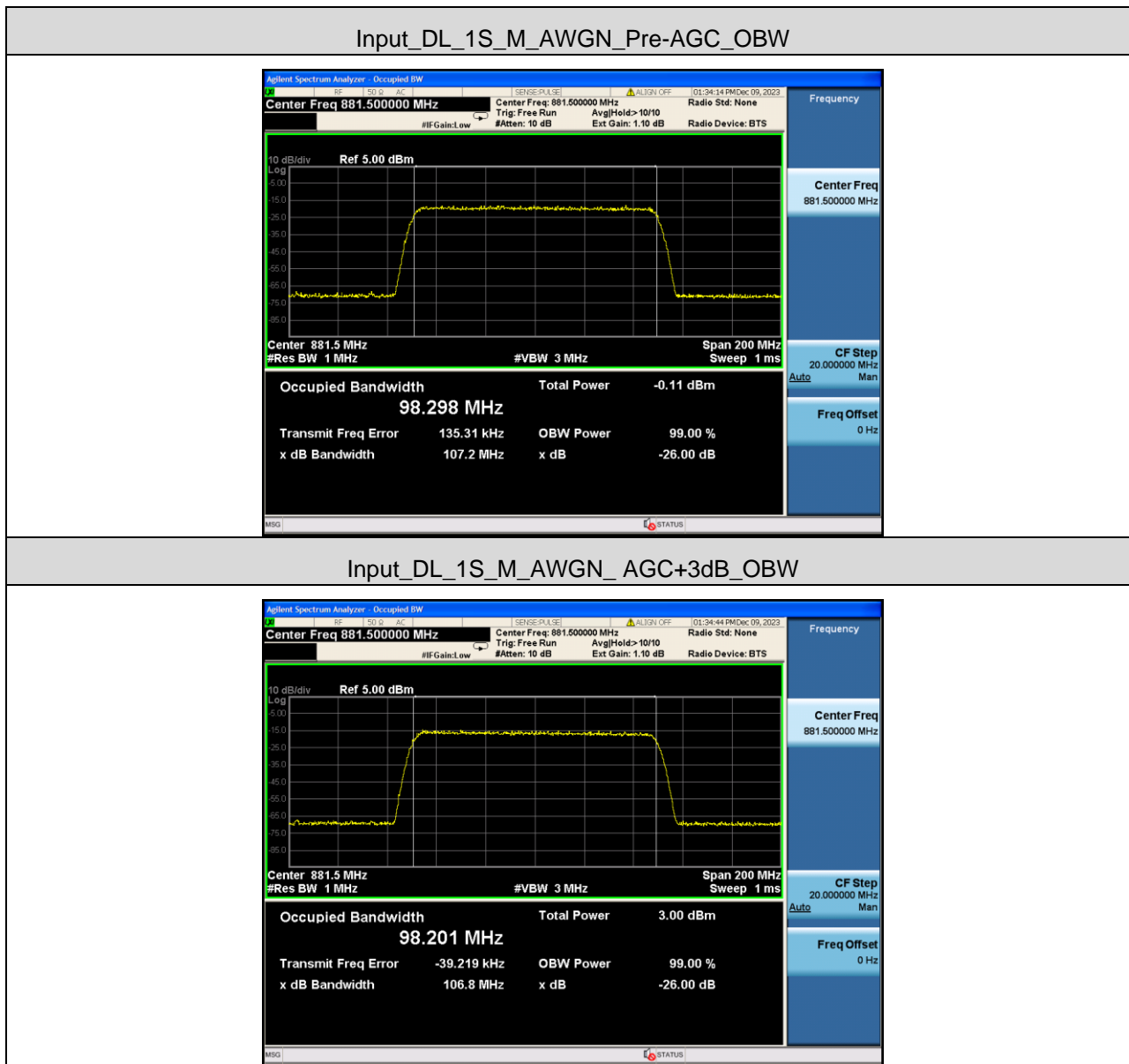


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2 Cellular (only for downlink: 869-894MHz)

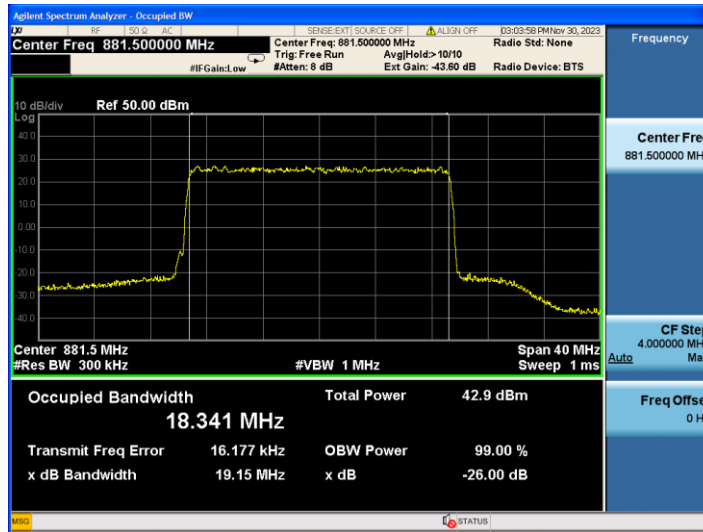
2.1 Input-versus-output signal comparison



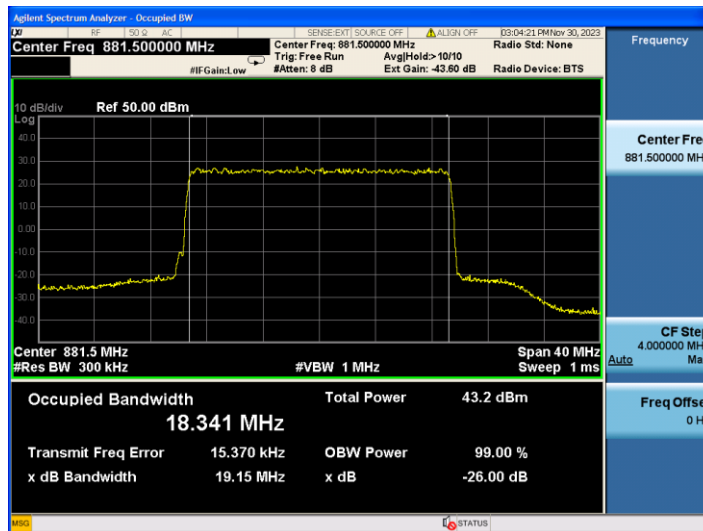
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Output_DL_1S_M_AWGN_Pre-AGC_OBW



Output_DL_1S_M_AWGN_AGC+3dB_OBW



Remark:

1. The band supports maximum channel BW is 20MHz 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.



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2.2 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	877.25	Pre-AGC	-6.0	36.21	42.21	PASS
		AGC+3dB	-3.0	36.32	/	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 = 10dBi+10log (2) dBi= 13dBi.

ERP= EIRP-2.15dB,

The total maximum ERP for the EUT is (36.32dBm+36.32dBm) +13dBi-2.15dB=50.18dBm (104.24W)

which don't exceed the required ERP limit (500W).



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

Note: The tested max conducted power for single antenna port is 36.32dBm, the power of any emission must be reduced below the mean output power (P) by at least $43 + 10\log(P)$ dB

Here,

$$P=36.32\text{dBm}= 4.29\text{W}.$$

So the limit =

$$P(\text{dBm})- [43 + 10 \log (4.29\text{W})] =-13\text{dBm}$$

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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DL_1S_B_AWGN_Pre-AGC_Out-of-band emission



DL_1S_B_AWGN_AGC+3_Out-of-band emission



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DL_1S_T_AWGN_Pre-AGC_Out-of-band emission



DL_1S_T_AWGN_AGC+3_Out-of-band emission



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DL_2S_B_AWGN_Pre-AGC_Out-of-band emission



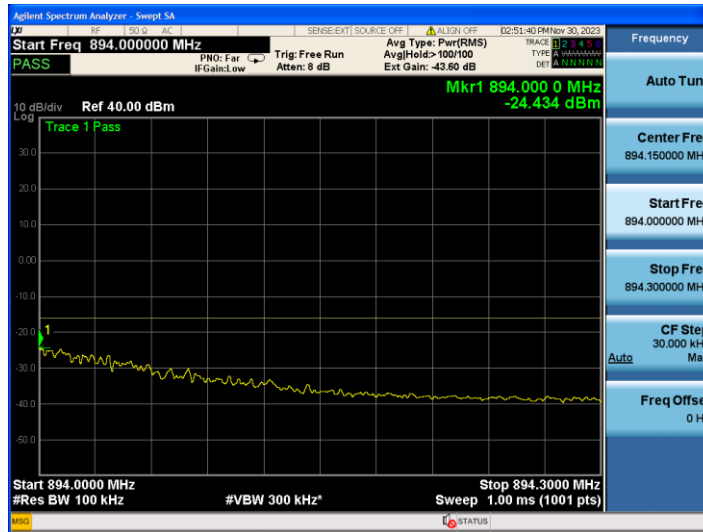
DL_2S_B_AWGN_AGC+3_Out-of-band emission



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DL_2S_T_AWGN_Pre-AGC_Out-of-band emission



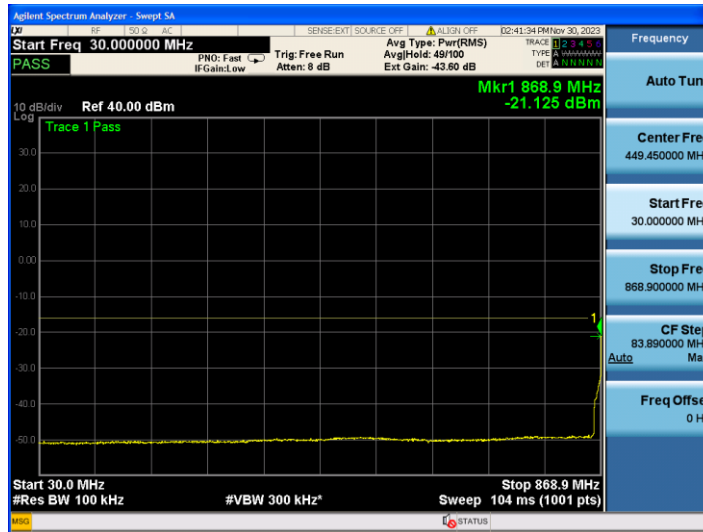
DL_2S_T_AWGN_AGC+3_Out-of-band emission



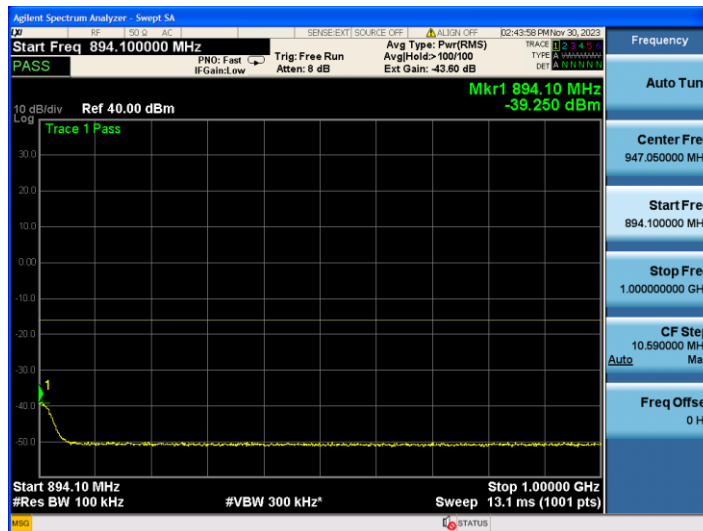
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DL_1S_B_AWGN_Pre-AGC_Spurious emission 1



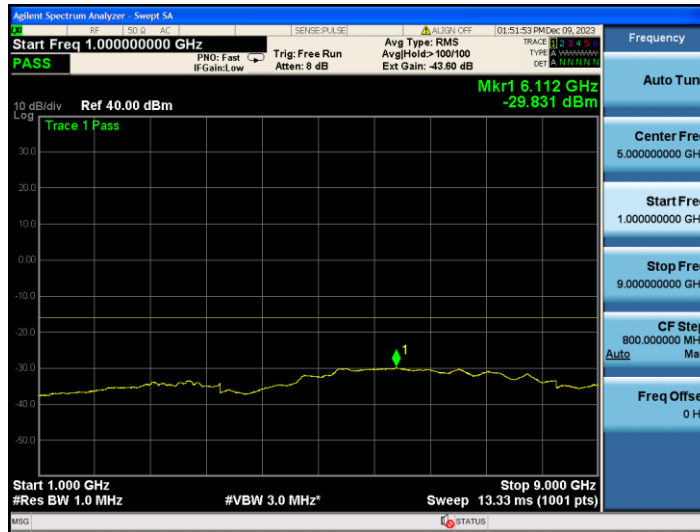
DL_1S_B_AWGN_Pre-AGC_Spurious emission 2



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DL_1S_B_AWGN_Pre-AGC_Spurious emission 3



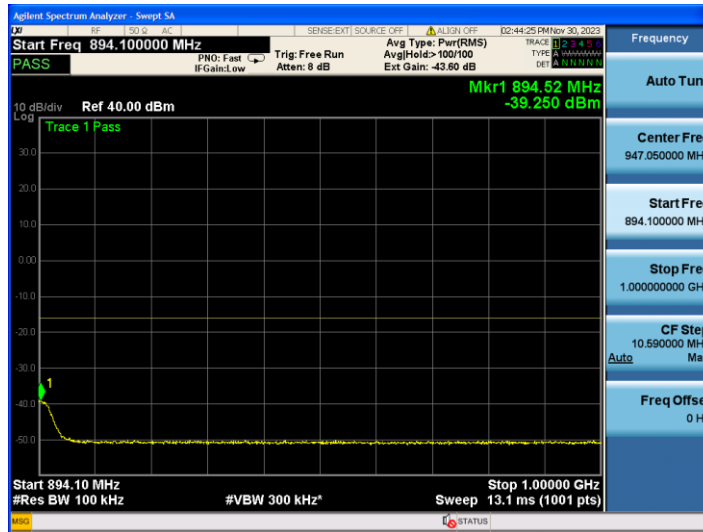
DL_1S_M_AWGN_Pre-AGC_Spurious emission 1



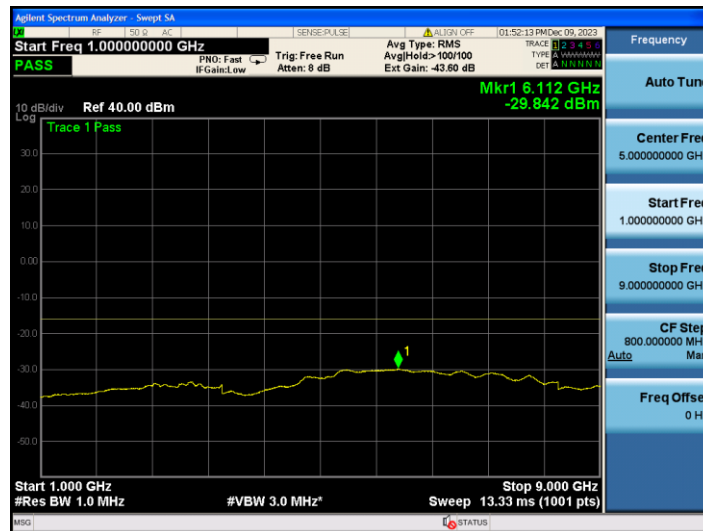
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DL_1S_M_AWGN_Pre-AGC_Spurious emission 2



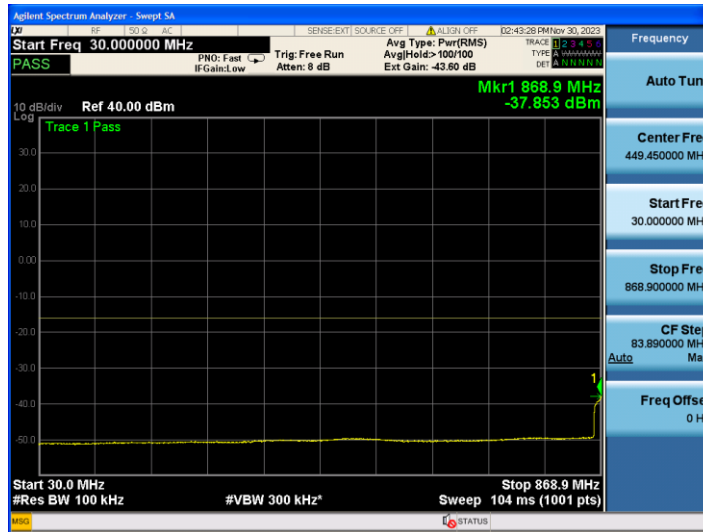
DL_1S_M_AWGN_Pre-AGC_Spurious emission 3



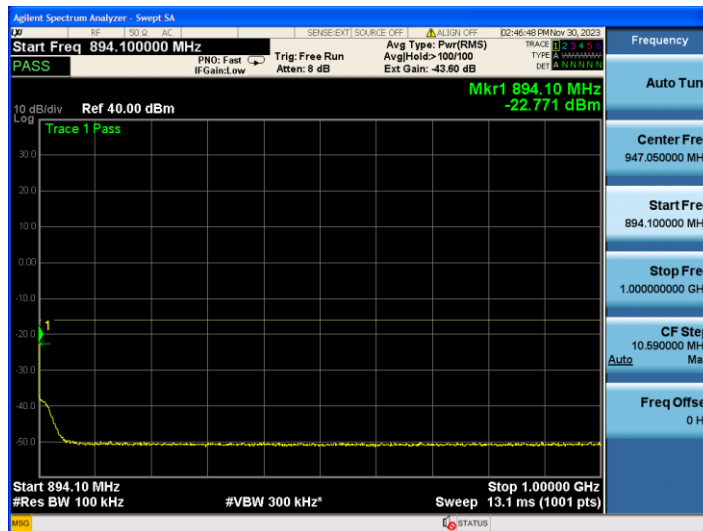
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DL_1S_T_AWGN_Pre-AGC_Spurious emission 1



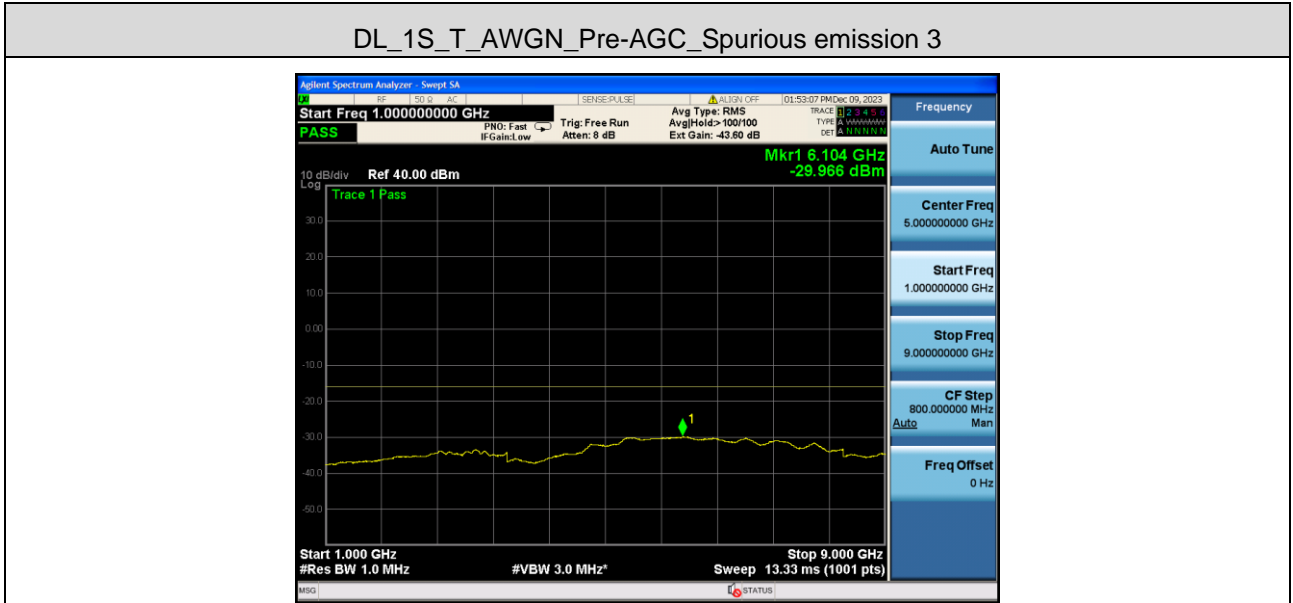
DL_1S_T_AWGN_Pre-AGC_Spurious emission 2



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DL_1S_T_AWGN_Pre-AGC_Spurious emission 3



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2.4 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	71	0.0805	PASS
40		55	0.0624	PASS
30		60	0.0681	PASS
20		54	0.0613	PASS
10		70	0.0794	PASS
0		54	0.0613	PASS
-10		67	0.0760	PASS
-20		48	0.0545	PASS
-30		67	0.0760	PASS

Frequency stability vs voltage				
Voltage (V)	Test Conf.	Frequency Error (Hz)	Tolerance (ppm)	Verdict
AC 93.5	DL_1S_M_AWGN	54	0.0613	PASS
AC 110		54	0.0613	PASS
AC 126.5		54	0.0613	PASS



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2.5 Radiated spurious emissions

Note: 1. The tested max conducted power for single antenna port is 36.32dBm, the 2x2 MIMO total power is 36.32dBm+36.32dBm=8.58W, the power of any emission must be reduced below the mean output power (P) by at least $43 + 10\log(P)$ dB

Here,

$P = 8.58W$.

So the limit =

$P(\text{dBm}) - [43 + 10 \log(8.58W)] = -13\text{dBm}$

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.

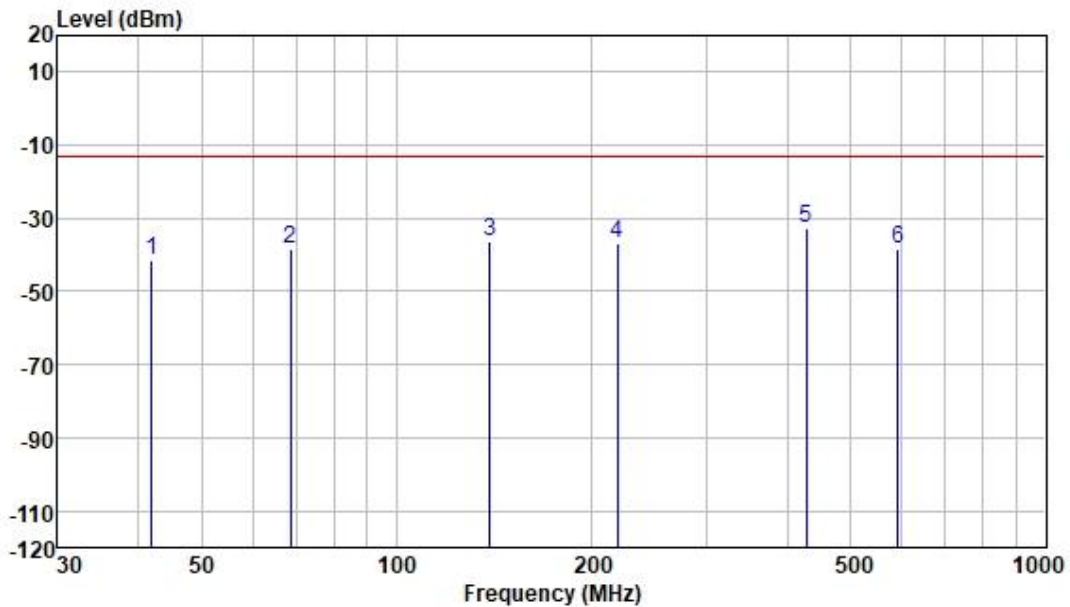
3. The disturbance from 9kHz to 30MHz was very low and 20dB below the limit, therefore, the data was not recorded in the report.



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DL_1S_M_AWGN_Horizontal_30MHz~1GHz



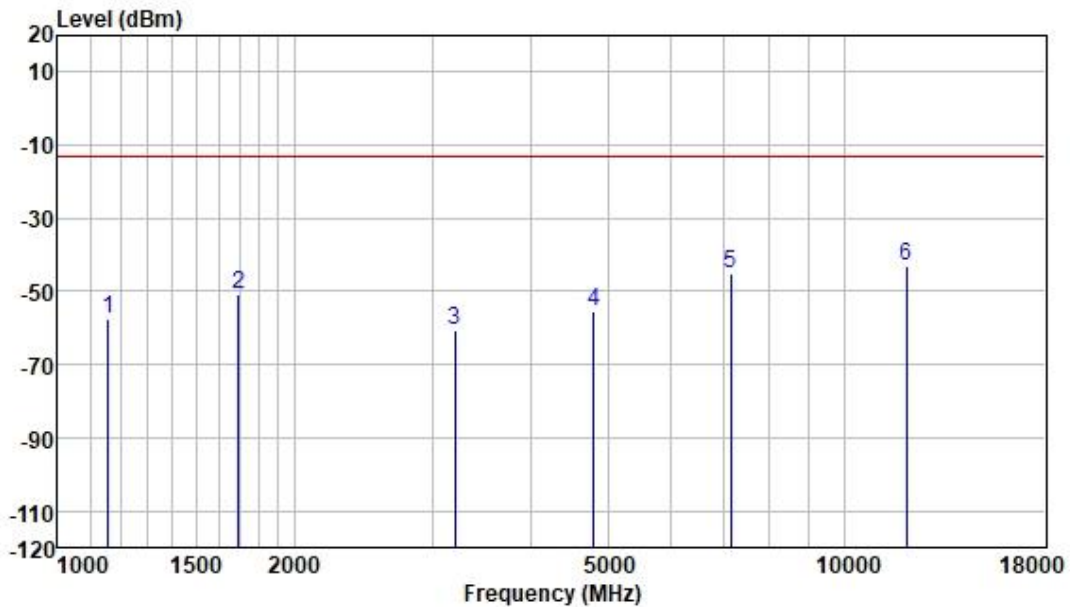
	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	41.86	-41.28	-0.30	-41.58	-13.00	-28.58	HORIZONTAL
2	68.63	-32.32	-6.11	-38.43	-13.00	-25.43	HORIZONTAL
3	138.87	-28.65	-7.87	-36.52	-13.00	-23.52	HORIZONTAL
4	218.31	-29.35	-7.46	-36.81	-13.00	-23.81	HORIZONTAL
5	428.02	-33.06	0.15	-32.91	-13.00	-19.91	HORIZONTAL
6	590.97	-40.88	2.59	-38.29	-13.00	-25.29	HORIZONTAL



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DL_1S_M_AWGN_Horizontal_above 1GHz



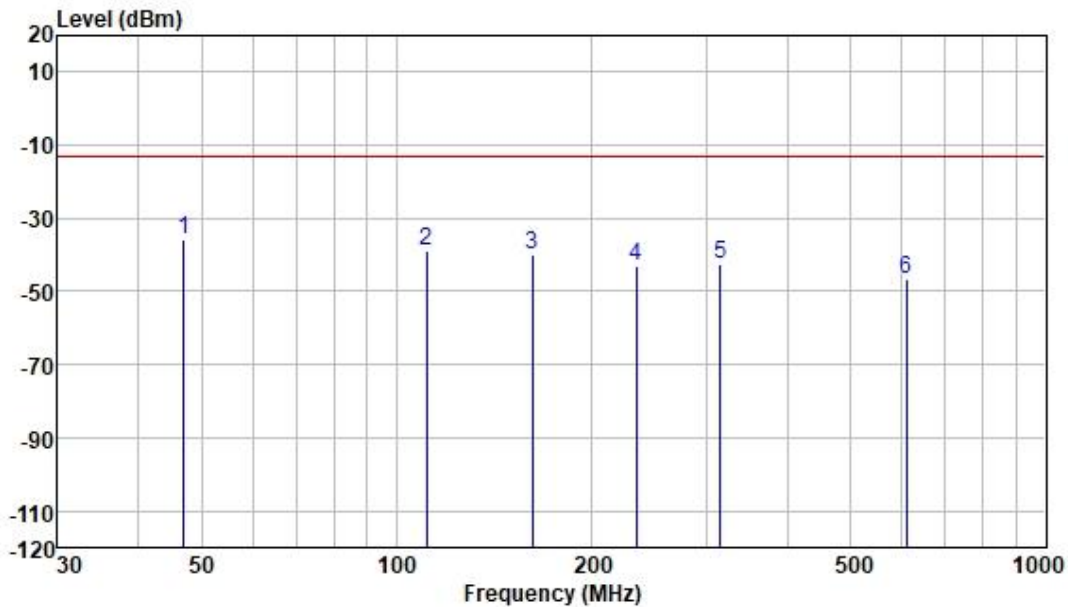
	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	1158.83	-60.79	3.26	-57.53	-13.00	-44.53	HORIZONTAL
2	1697.13	-57.18	6.36	-50.82	-13.00	-37.82	HORIZONTAL
3	3196.09	-62.71	2.23	-60.48	-13.00	-47.48	HORIZONTAL
4	4804.11	-63.91	8.29	-55.62	-13.00	-42.62	HORIZONTAL
5	7158.81	-64.01	18.71	-45.30	-13.00	-32.30	HORIZONTAL
6	11975.10	-64.45	21.34	-43.11	-13.00	-30.11	HORIZONTAL



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DL_1S_M_AWGN_Vertical_30MHz~1GHz



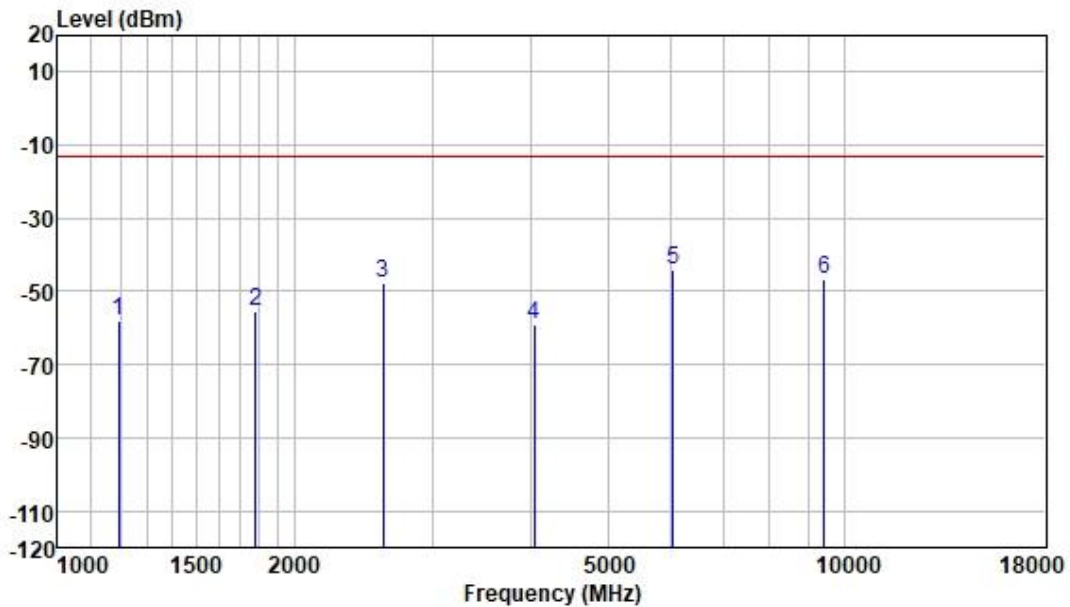
	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	46.99	-25.31	-10.68	-35.99	-13.00	-22.99	VERTICAL
2	110.96	-34.59	-4.38	-38.97	-13.00	-25.97	VERTICAL
3	161.47	-35.99	-3.94	-39.93	-13.00	-26.93	VERTICAL
4	234.17	-36.29	-6.52	-42.81	-13.00	-29.81	VERTICAL
5	315.48	-39.79	-2.58	-42.37	-13.00	-29.37	VERTICAL
6	609.92	-50.96	4.28	-46.68	-13.00	-33.68	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	1196.26	-61.20	3.01	-58.19	-13.00	-45.19	VERTICAL
2	1782.60	-61.17	5.75	-55.42	-13.00	-42.42	VERTICAL
3	2588.12	-53.64	5.87	-47.77	-13.00	-34.77	VERTICAL
4	4027.55	-62.79	3.57	-59.22	-13.00	-46.22	VERTICAL
5	6053.89	-63.74	19.43	-44.31	-13.00	-31.31	VERTICAL
6	9420.88	-64.30	17.46	-46.84	-13.00	-33.84	VERTICAL

--End of Appendix--



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