

Appendix -

Test Data and Result for report

GZCR230600056704

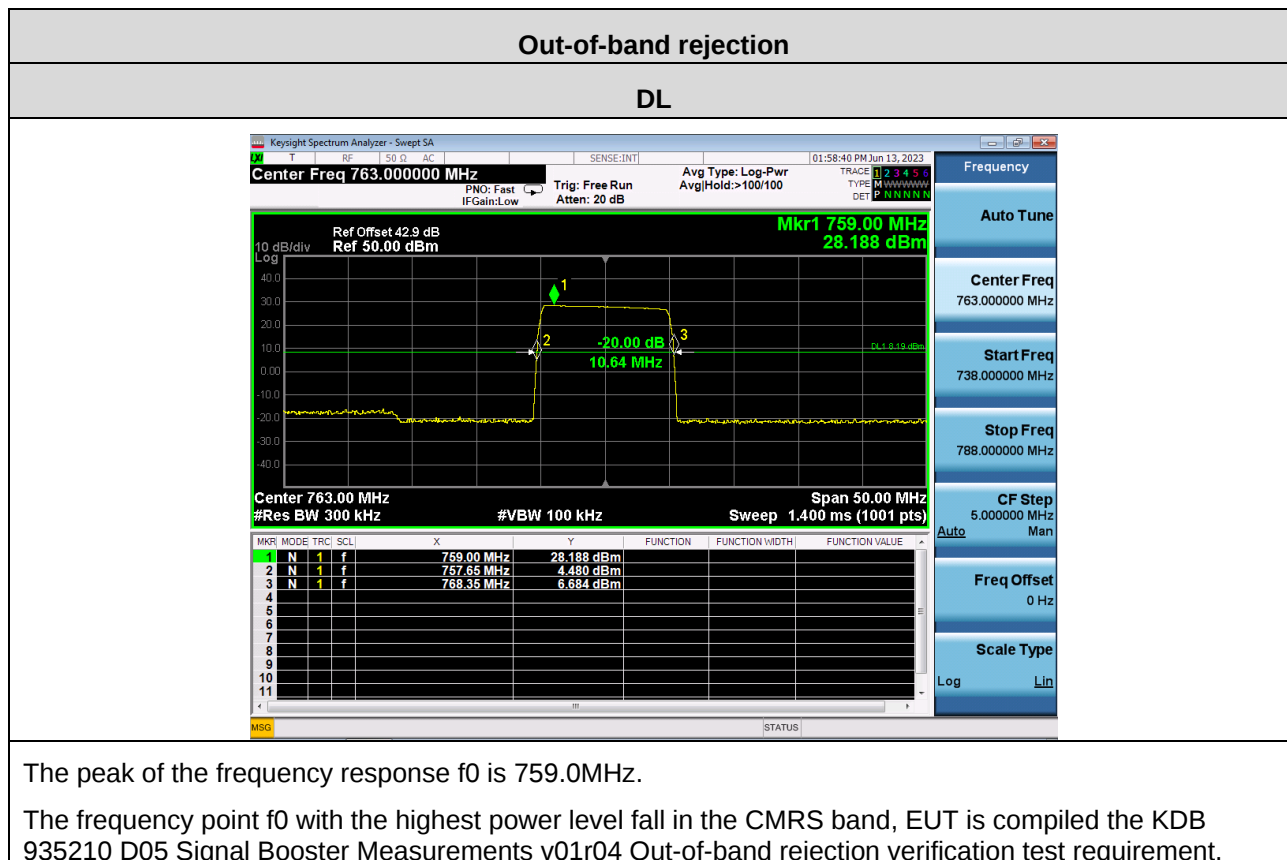
(For FirstNet Band DL)



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1 Out-of-band rejection



2 Input versus Output comparison

Occupied Bandwidth				
Test Path	Test Signal	Test Channel	Signal Level	Verdict
DL	4.1MHz AWGN	MCH	Pre-AGC	PASS
			3dB above AGC	PASS
	100MHz AWGN	MCH	Pre-AGC	PASS*
			3dB above AGC	PASS*
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 was as stimulus 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.				

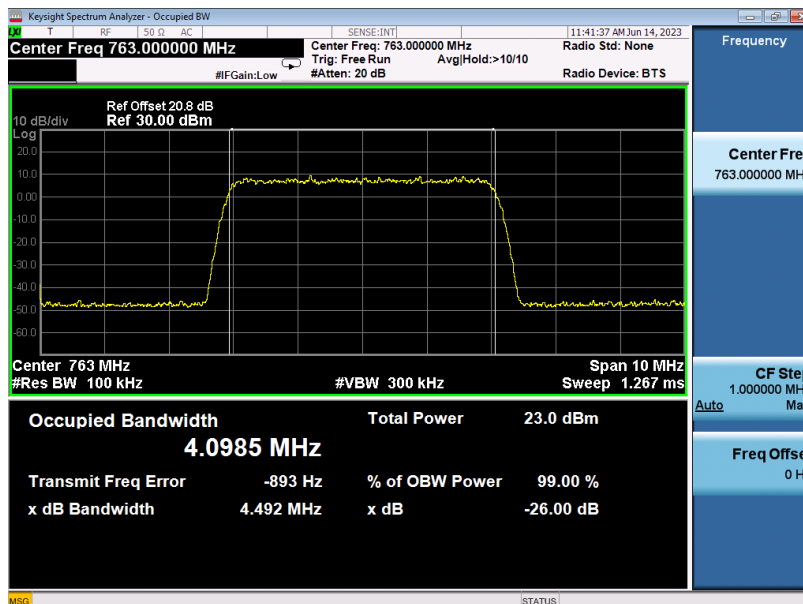


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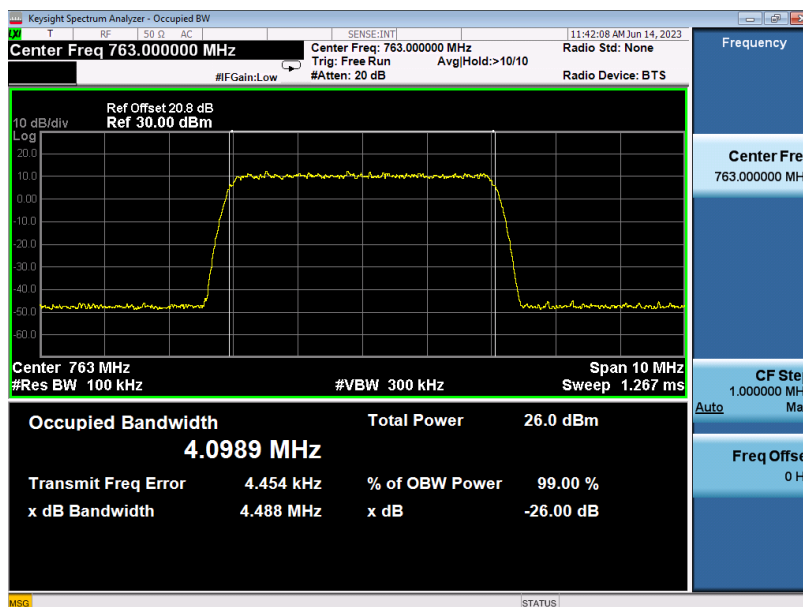
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99% OBW

DL_4.1MHz AWGN_MCH_Input_Pre-AGC



DL_4.1MHz AWGN_MCH_Input_3dB above AGC

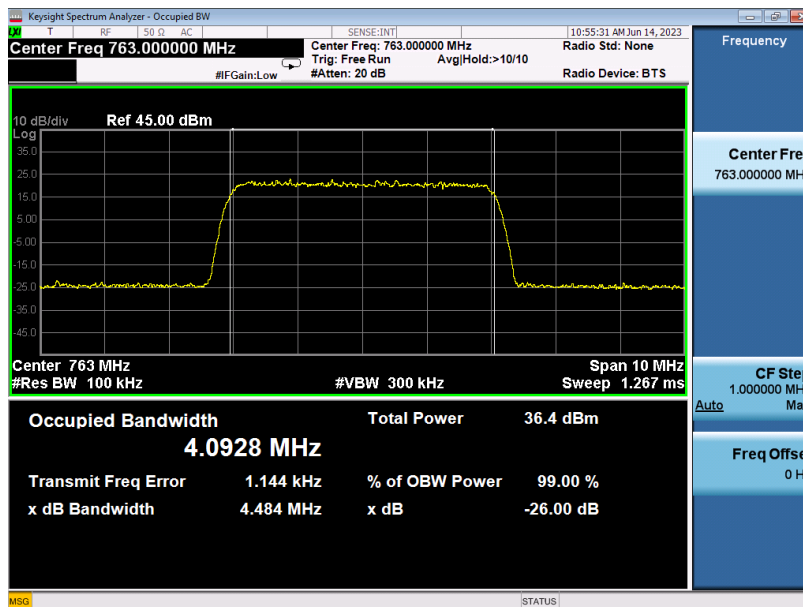


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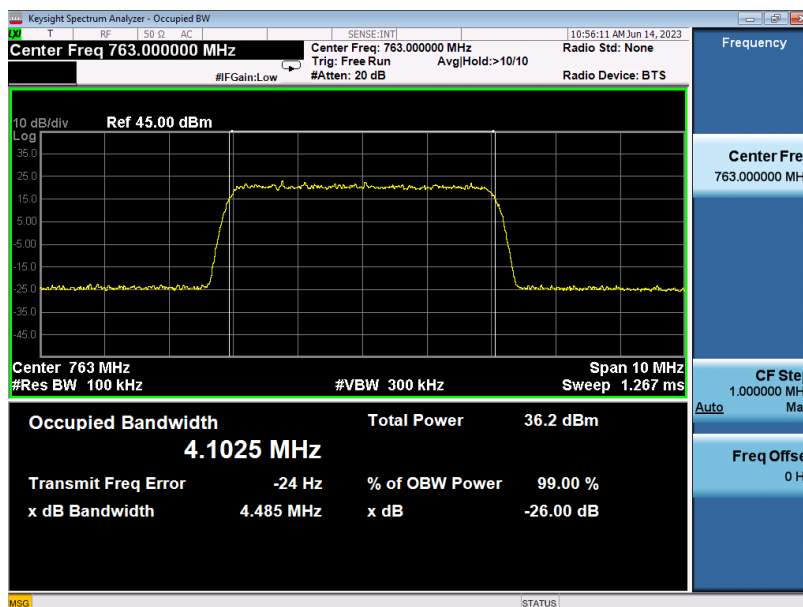
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99% OBW

DL_4.1MHz AWGN_MCH_Output_Pre-AGC



DL_4.1MHz AWGN_MCH_Output_3dB above AGC

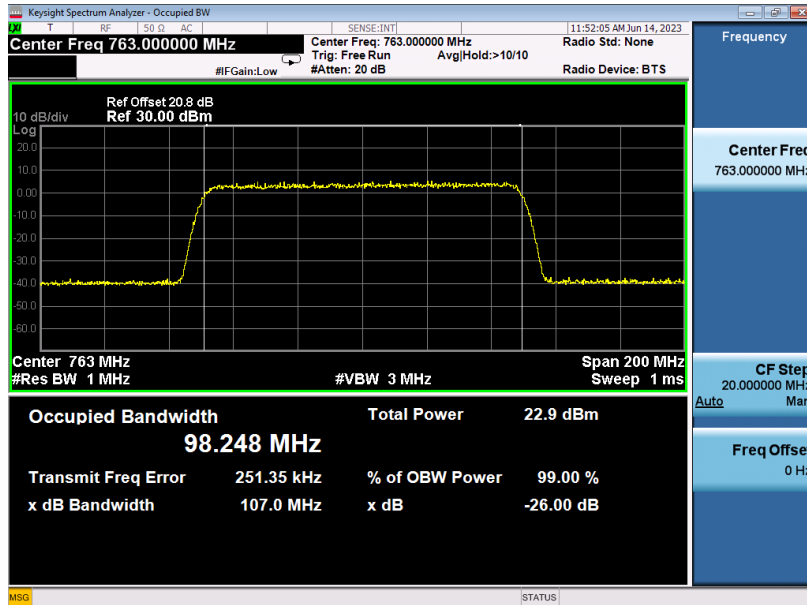


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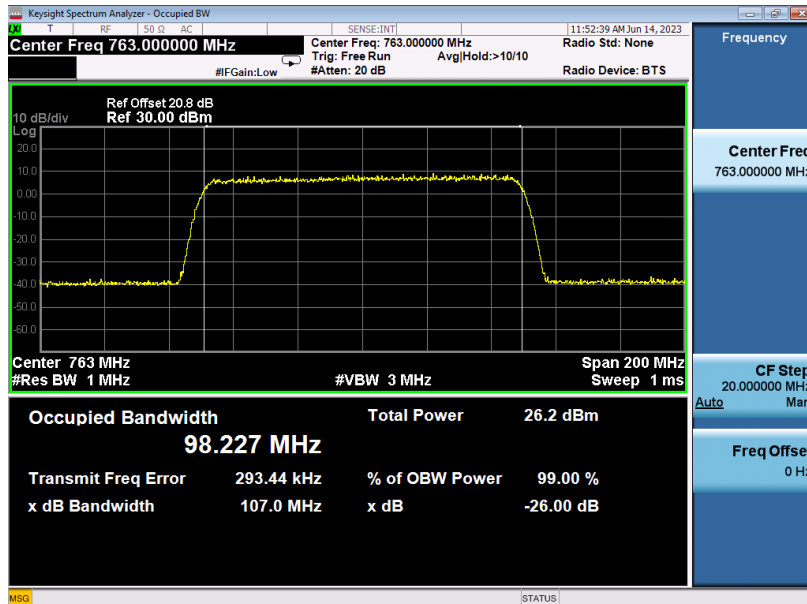
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99% OBW

DL_100MHz AWGN_MCH_Input_Pre-AGC



DL_100MHz AWGN_MCH_Input_3dB above AGC

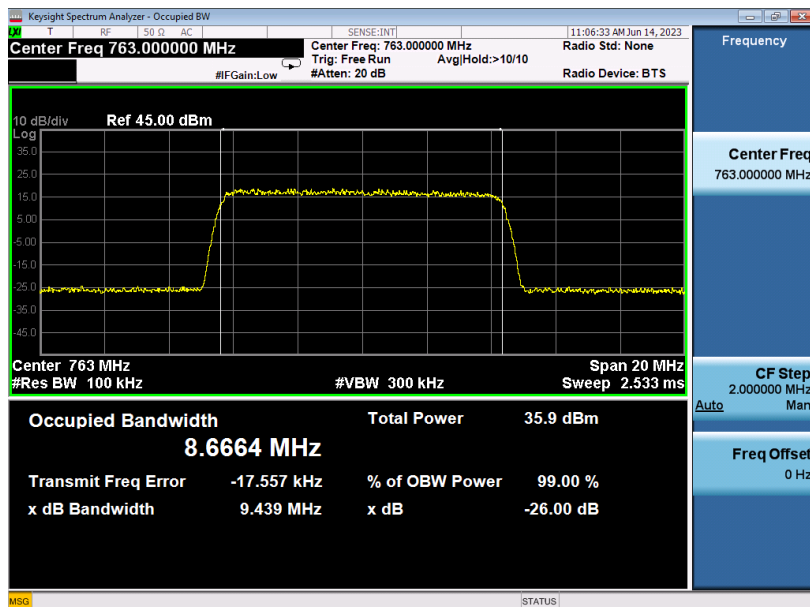


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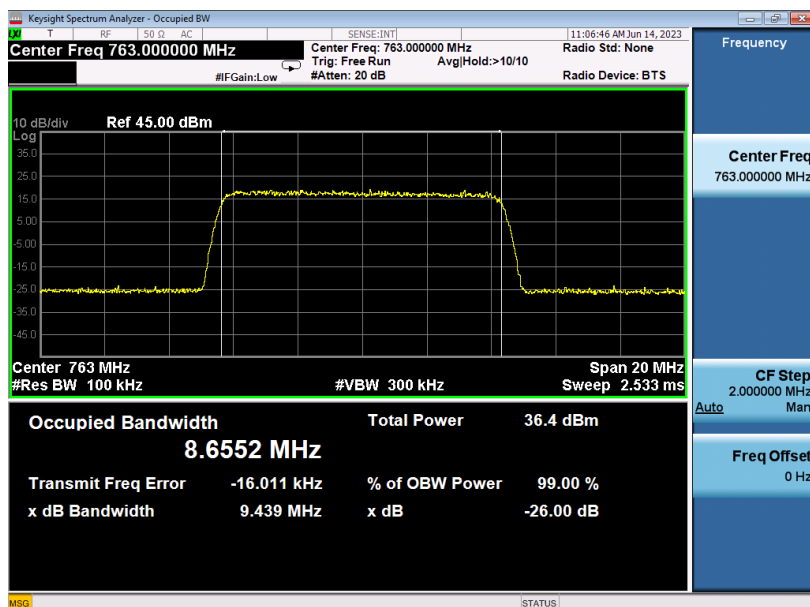
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99% OBW

DL_100MHz AWGN_MCH_Output_Pre-AGC



DL_100MHz AWGN_MCH_Output_3dB above AGC



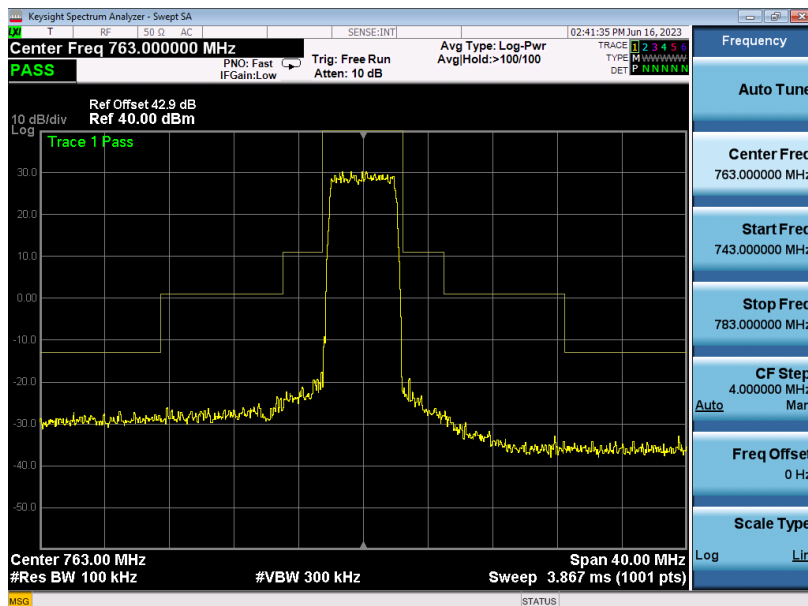
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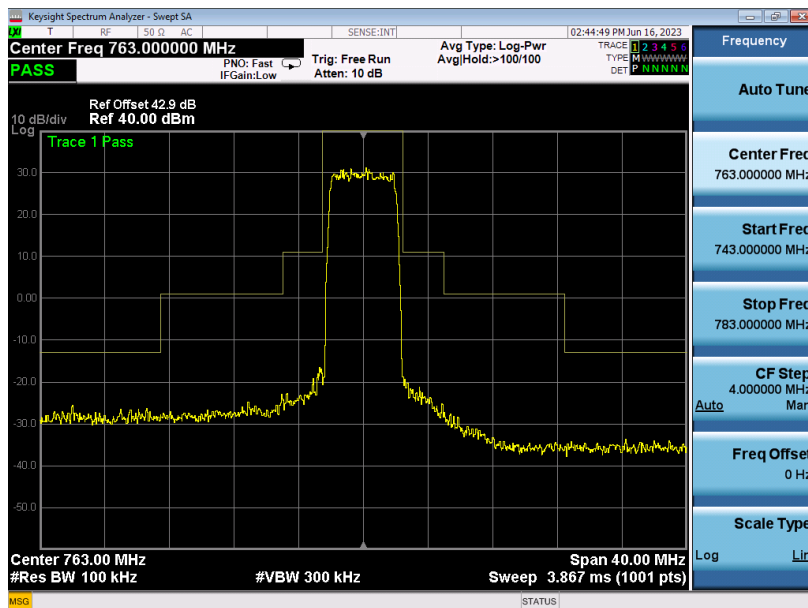
3 Emission Mask

Emission Mask B

DL_4.1MHz AWGN_MCH_Output_Pre-AGC



DL_4.1MHz AWGN_MCH_Output_3dB above AGC

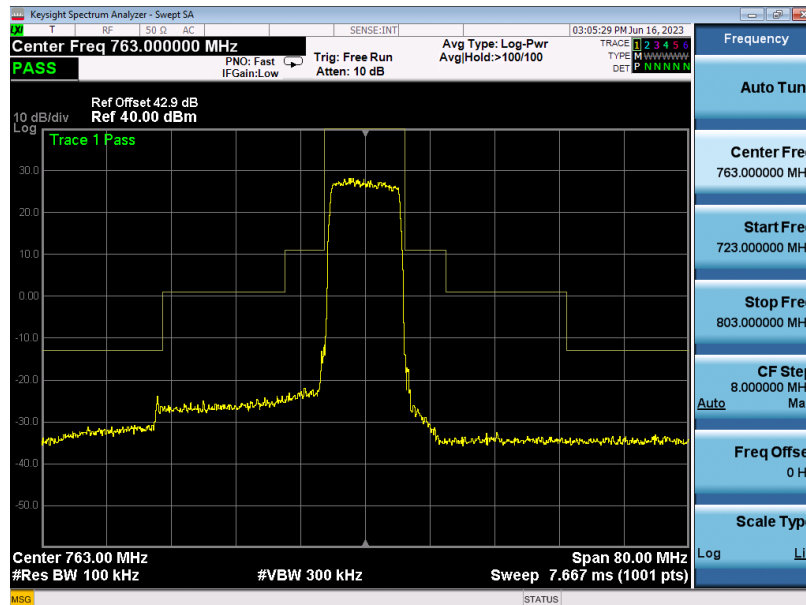


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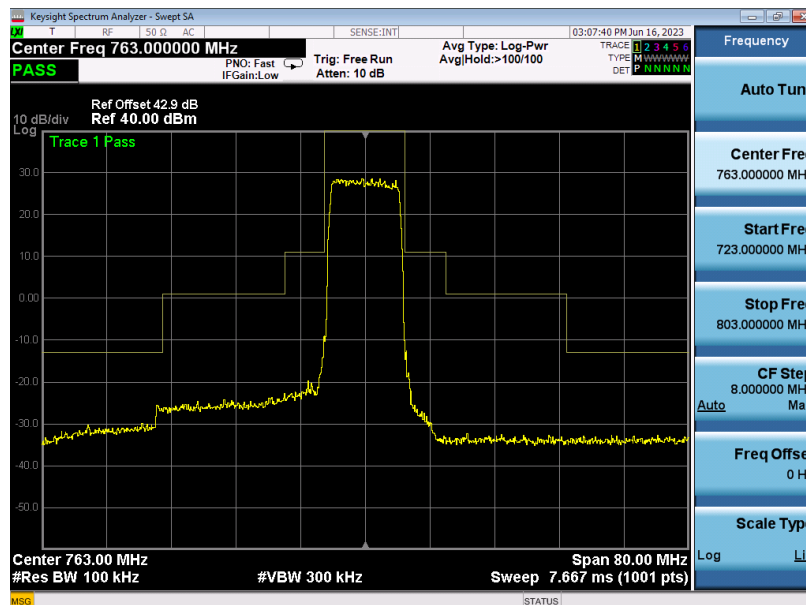
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Emission Mask B

DL_100MHz AWGN_MCH_Output_Pre-AGC



DL_100MHz AWGN_MCH_Output_3dB above AGC



Remark:

The band supports maximum channel BW is 10MHz for NR, so the output signal OBW was less than the input when 100MHz AWGN was as stimulus signal.



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4 Input/output power and amplifier/booster gain

Mean output power and gain								
Test Path	Test Freq. f0 (MHz)	Test Signal	Signal Level	Input power (dBm)	Output Power (dBm)	SISO ERP (W)	Total ERP (W)	Gain (dB)
DL	759.0	4.1MHz AWGN	Pre-AGC	23.00	36.88	29.72	118.86	13.88
			3dB above AGC	26.00	36.34	26.25	104.96	/
		100MHz AWGN	Pre-AGC	20.00	32.56	11.00	43.96	12.56
			3dB above AGC	23.00	32.22	10.17	40.65	/
Remark: 1. f0 is from Out-of-band Rejection test in the report. 2. ERP= output power (dBm)+ antenna gain (dBi)-2.15, the antenna gain is 10dBi declared by the manufacturer, the directional gain = G _{ANT} + 10 log (N _{ANT}) dBi = 13dBi. 3. The conducted test performed at ANT 1 port only due to the two MIMO ports with identical design(Hardware & software) and radio output.								

Mean output power							
Test Path	Test Freq. f0 (MHz)	Test Signal	Signal Level	Output Power (dBm/MHz)	SISO ERP (W/MHz)	Total ERP (W/MHz)	Verdict
DL	759.0	4.1MHz AWGN	Pre-AGC	32.42	10.65	42.57	PASS
			3dB above AGC	32.18	10.07	40.28	PASS
		100MHz AWGN	Pre-AGC	18.45	0.43	1.71	PASS
			3dB above AGC	18.23	0.41	1.63	PASS
Remark: 1. f0 is from Out-of-band Rejection test in the report. 2. ERP= output power (dBm)+ antenna gain (dBi)- 2.15, the antenna gain is 10dBi declared by the manufacturer, the directional gain = G _{ANT} + 10 log (N _{ANT}) dBi = 13dBi. 3. The output power is limited to an EIRP of 1000W/MHz. 4. The conducted test performed at ANT 1 port only due to the two MIMO ports with identical design(Hardware & software) and radio output.							
According to 935210 D02 Signal Boosters Certification v04r02 clause V.J for device support output power higher than the 5 W ERP limit of Section 90.219, the specific station authorizations are required the conditions.							





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EMC-ARF-05 Rev 1.1

Page: 11 of 25

5 Noise Figure

Noise Figure				
Test Path	Test Channel	Maximum Noise Figure (dB)	Limit (dB)	Verdict
DL	LCH	8.17	≤9	PASS
	MCH	8.43	≤9	PASS
	HCH	7.89	≤9	PASS



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6 Intermodulation emissions

Intermodulation emissions					
Test Path	Test Freq. f ₀ (MHz)	CW signals spacing (kHz)	Signal Level	Worst conducted test level (dBm)	
				/300Hz	/10kHz
DL	759.0	6.25	Pre-AGC	-20.99	-5.76
			3dB above AGC	-18.81	-3.58
		12.5	Pre-AGC	-17.70	-2.47
			3dB above AGC	-16.83	-1.60
		25	Pre-AGC	-18.84	-3.61
			3dB above AGC	-17.61	-2.38

Remark:

1. f₀ is from Out-of-band Rejection test in the report.
2. The level in 10kHz measurement bandwidth= the level in 300Hz measurement bandwidth+ 10lg(10000/300).
3. ERP= output power (dBm)+ antenna gain (dBi)- 2.15, the antenna gain is 10dBi declared by the manufacturer, the directional gain = G_{ANT} + 10 log (N_{ANT}) dBi = 13dBi.
4. The maximum ERP of intermodulation product for 2×2 MIMO is -1.60dBm/10kHz+ 10lg(2)+ 13- 2.15= 12.25dBm/10kHz, which exceeded the limit -30dBm/10kHz, the applicant must use good engineering practice to eliminate the intermodulation products interference.

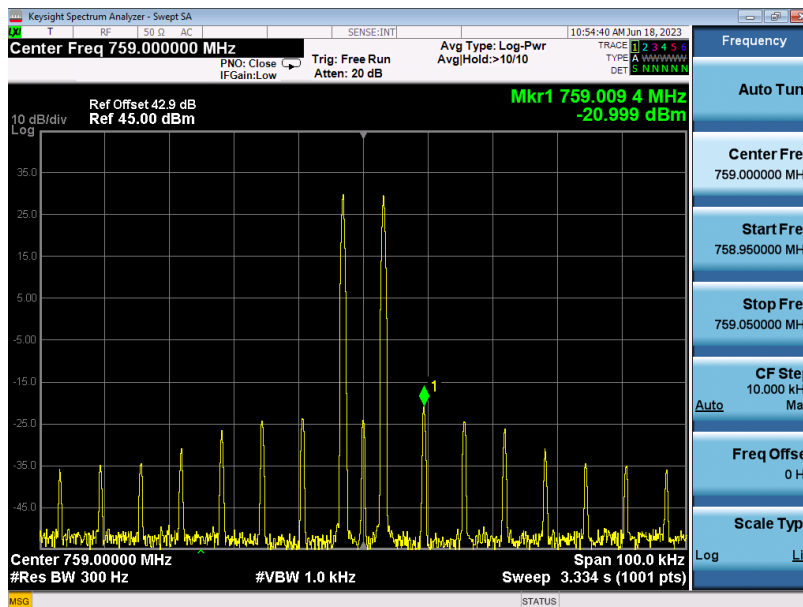


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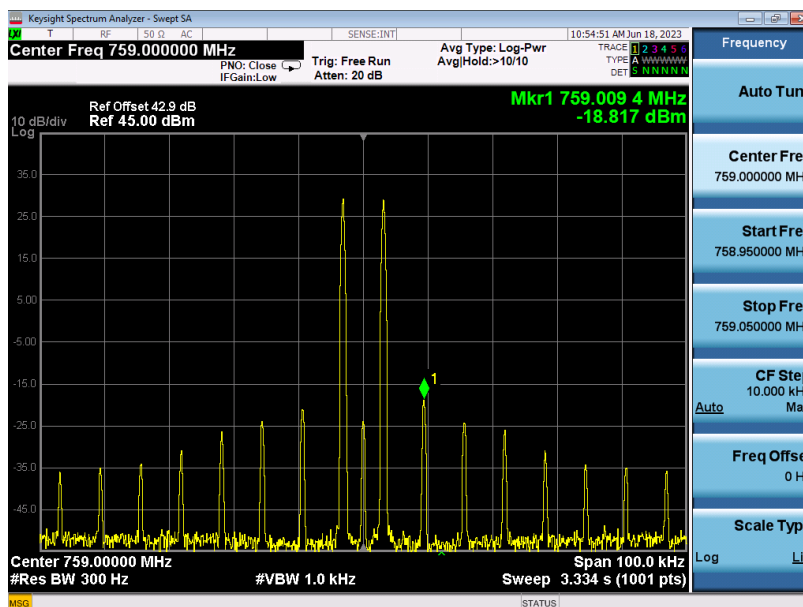
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Intermodulation emissions

DL_6.25kHz spacing_Pre-AGC



DL_6.25kHz spacing_3dB above AGC

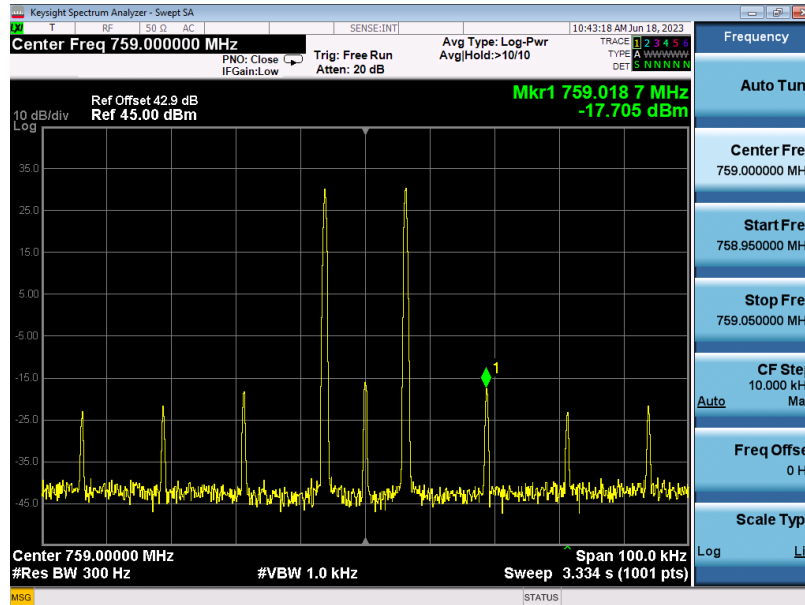


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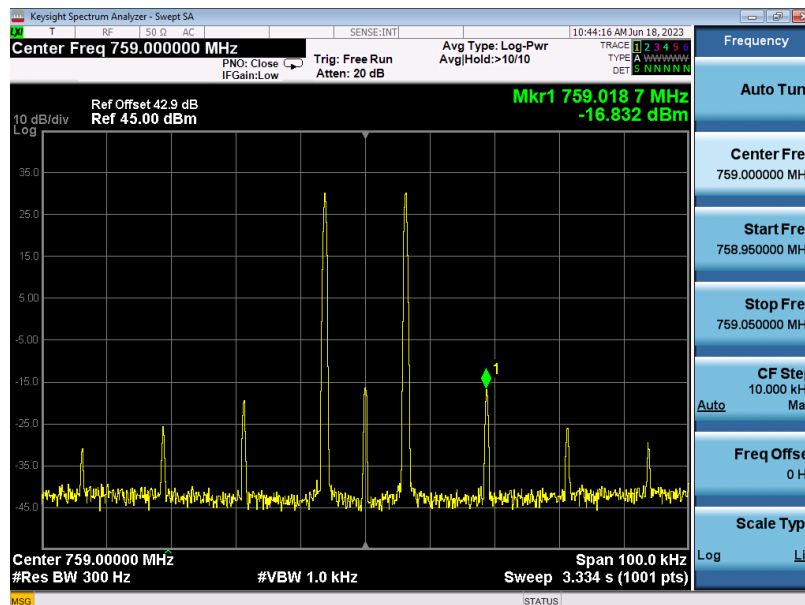
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Intermodulation emissions

DL_12.5kHz spacing_Pre-AGC



DL_12.5kHz spacing_3dB above AGC

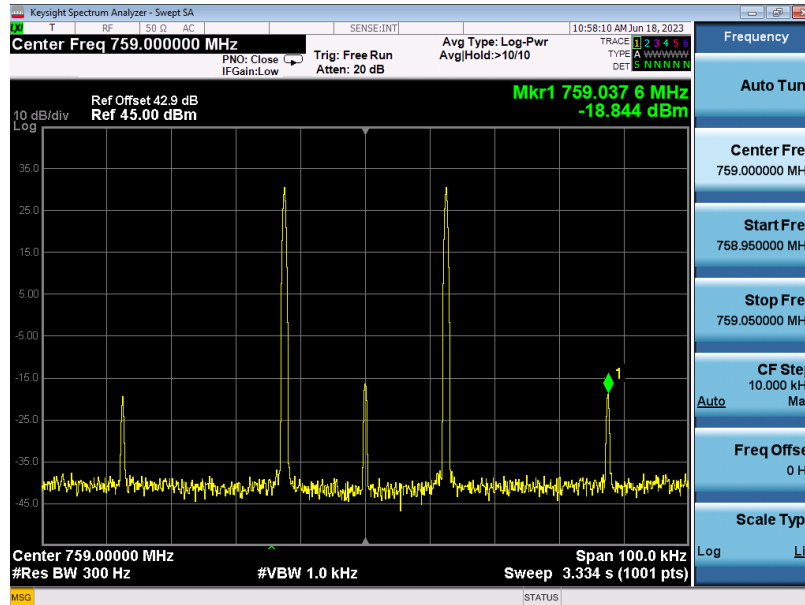


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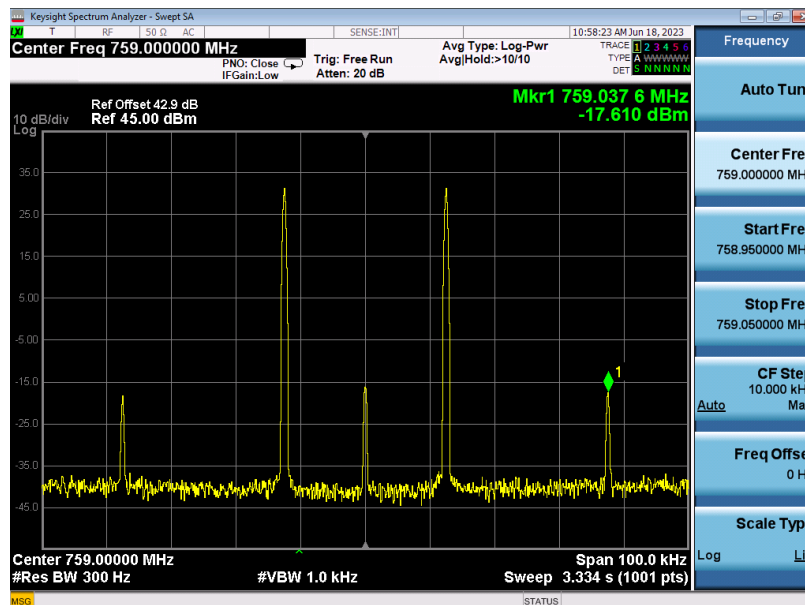
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Intermodulation emissions

DL_25kHz spacing_Pre-AGC



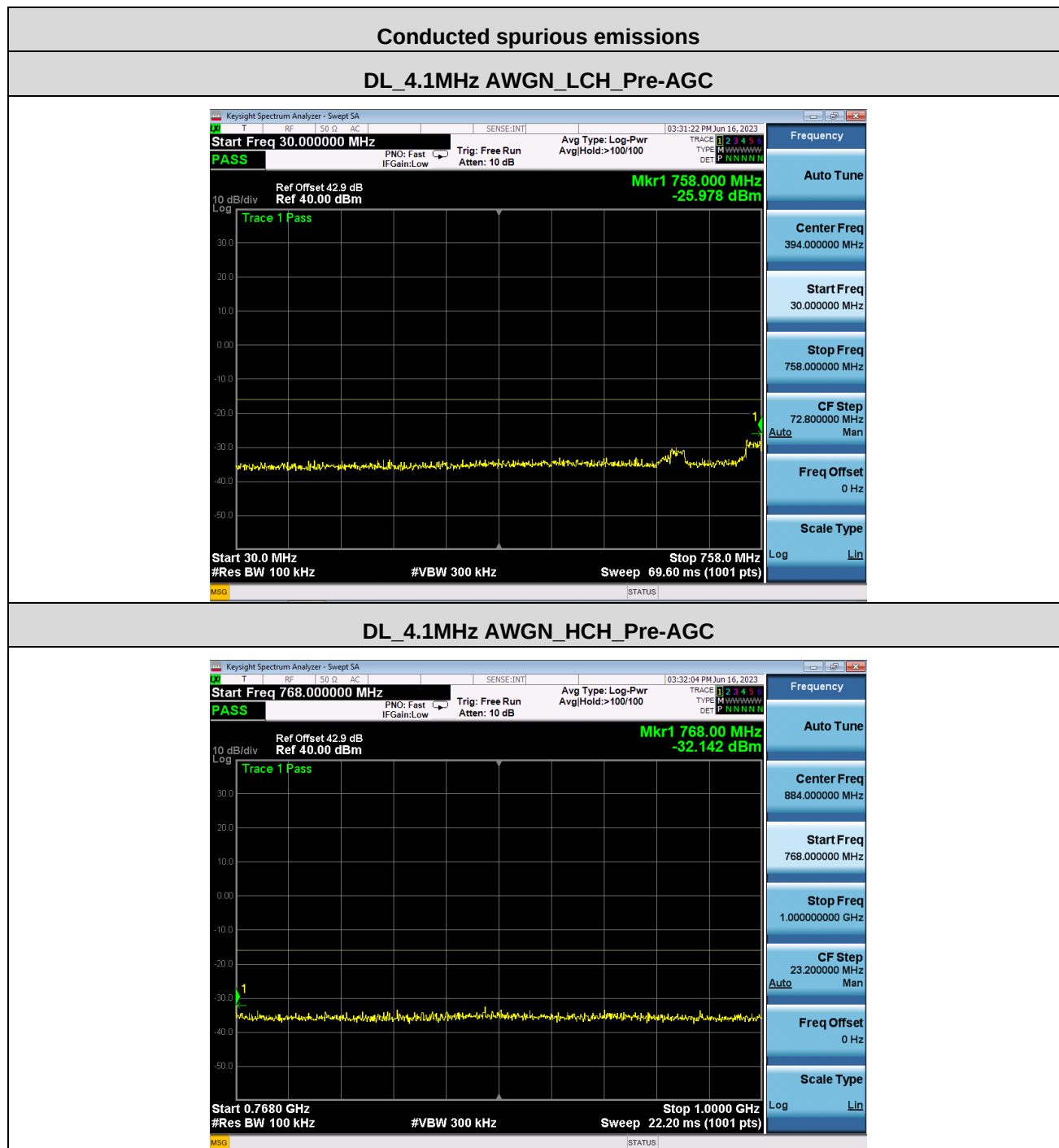
DL_25kHz spacing_3dB above AGC



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7 Conducted Spurious emissions

**DL_4.1MHz AWGN_HCH_Pre-AGC**

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Conducted spurious emissions

DL_4.1MHz AWGN_HCH_Pre-AGC

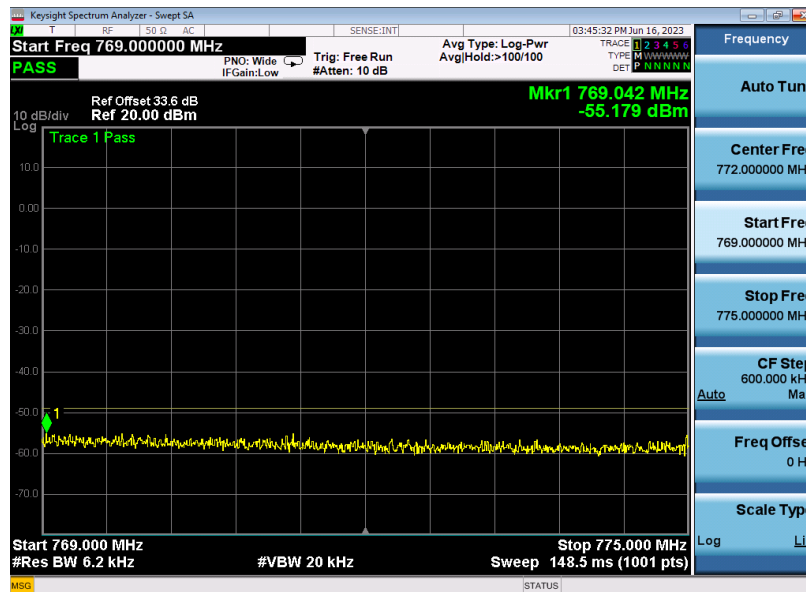


Remark:

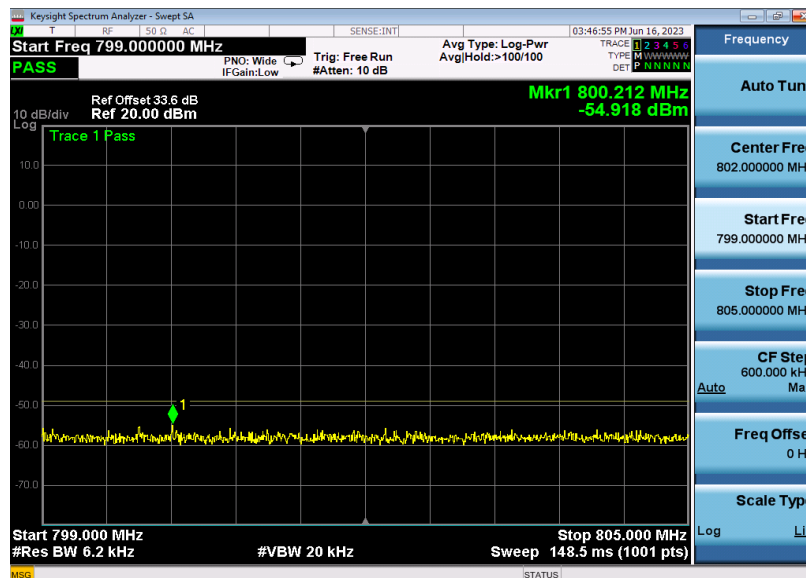
1. Spurious emissions from a signal booster must not exceed -13 dBm within any 100 kHz measurement bandwidth.
2. On any frequency between 775–788 MHz, above 805 MHz, and below 758 MHz, by at least $43 + 10\log(P)$ dB, here,
 $P = 36\text{dBm} = 3.98\text{W}$
the limit = $36\text{dBm} - [43 + 10\log_{10}(3.98\text{W})] \text{ dB} = -13\text{dBm}$
3. For 2x2 MIMO, ANT1 port was measured and the limit was showed $-13\text{dBm} - 10\lg(2) = -16\text{dBm}$ to determine the test result conveniently.
4. The spurious emissions 9kHz to 30MHz were very low and not displayed in this report.
5. All modes (LCH/MCH/HCH, with 4.1MHz AWGN signal/ with 100MHz AWGN signal) had been tested, only show the worst-case in this report.

Conducted spurious emissions

DL_4.1MHz AWGN_HCH_Pre-AGC



DL_4.1MHz AWGN_HCH_Pre-AGC



Remark:

- 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, here,
 $P = 36\text{dBm} = 3.98\text{W}$,
the limit = $36\text{dBm} - [76 + 10 \log_{10}(3.98\text{W})] \text{ dB} = -46\text{dBm}$
- For 2x2 MIMO, ANT1 port was measured and the limit was showed $-46\text{dBm} - 10\lg(2) = -49\text{dBm}$ to determine the test result conveniently.
- All modes (LCH/MCH/HCH, with 4.1MHz AWGN signal/ with 100MHz AWGN signal) had been tested, only show the worst-case in this report.



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8 Noise

Noise			
Test Path	Frequency Range (MHz)	Worst conducted test level (dBm)	Note
DL	758-768	-53.91	Within the passband
	0.009-757	-51.50	Outside of the passband
	769-1000	-65.17	
	1000-8000	-65.87	

Remark:

1. ERP= output power (dBm)+ antenna gain (dBi)- 2.15, the antenna gain is 10dBi declared by the manufacturer, the directional gain = GANT + 10 log (NANT) dBi = 13dBi.
2. The ERP of worst noise within the passband is -53.91/10kHz+ 10lg(2)+ 13dBi- 2.15dB= -40.06dBm, the applicant must use good engineering practice to make sure that the ERP of noise within the passband should not exceed the limit -43dBm in 10kHz measurement bandwidth.
3. The ERP of worst noise outside of the passband is -51.50/10kHz+ 10lg(2)+ 13dBi- 2.15dB= -37.65dBm, the applicant must use good engineering practice to make sure that the ERP of noise outside the passband should not exceed -70dBm in 10kHz measurement bandwidth.

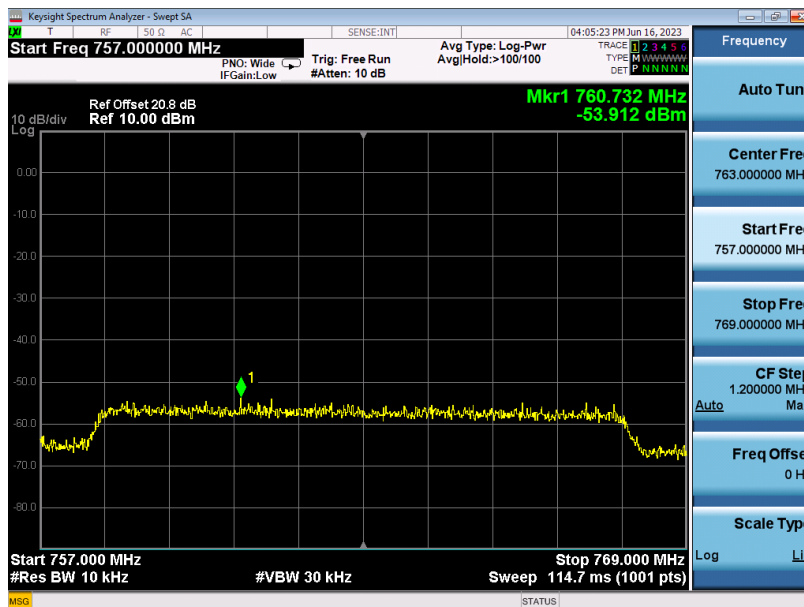


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Noise

DL_Within the passband

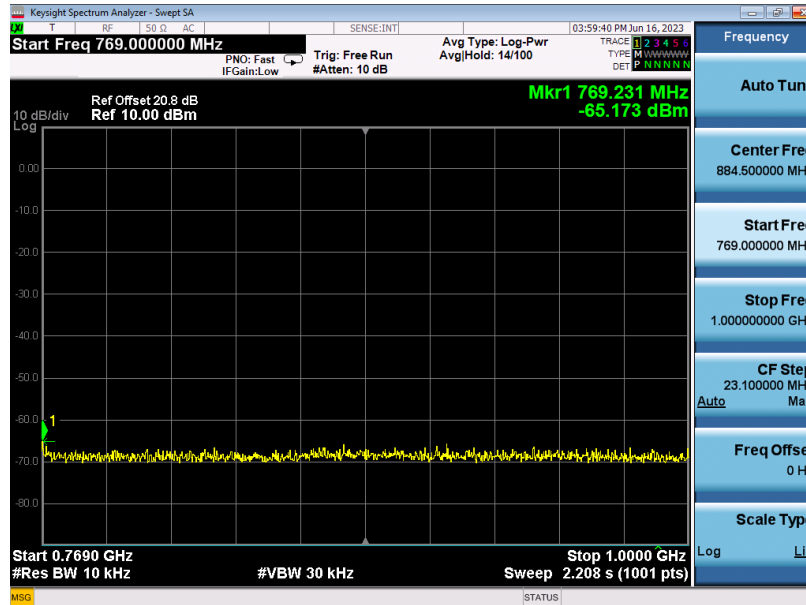


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Noise

DL_Out of the passband



DL_Out of the passband



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9 Frequency Stability

Frequency stability vs voltage							
Test path	Test Freq. (MHz)	Test Signal	Temperature	Voltage	Freq. error (Hz)	Tolerance (ppm)	Verdict
DL	763	4.1MHz AWGN	TN	VL	19	0.0249	PASS
			TN	VH	12	0.0157	PASS
		100MHz AWGN	TN	VL	21	0.0275	PASS
			TN	VH	13	0.0170	PASS

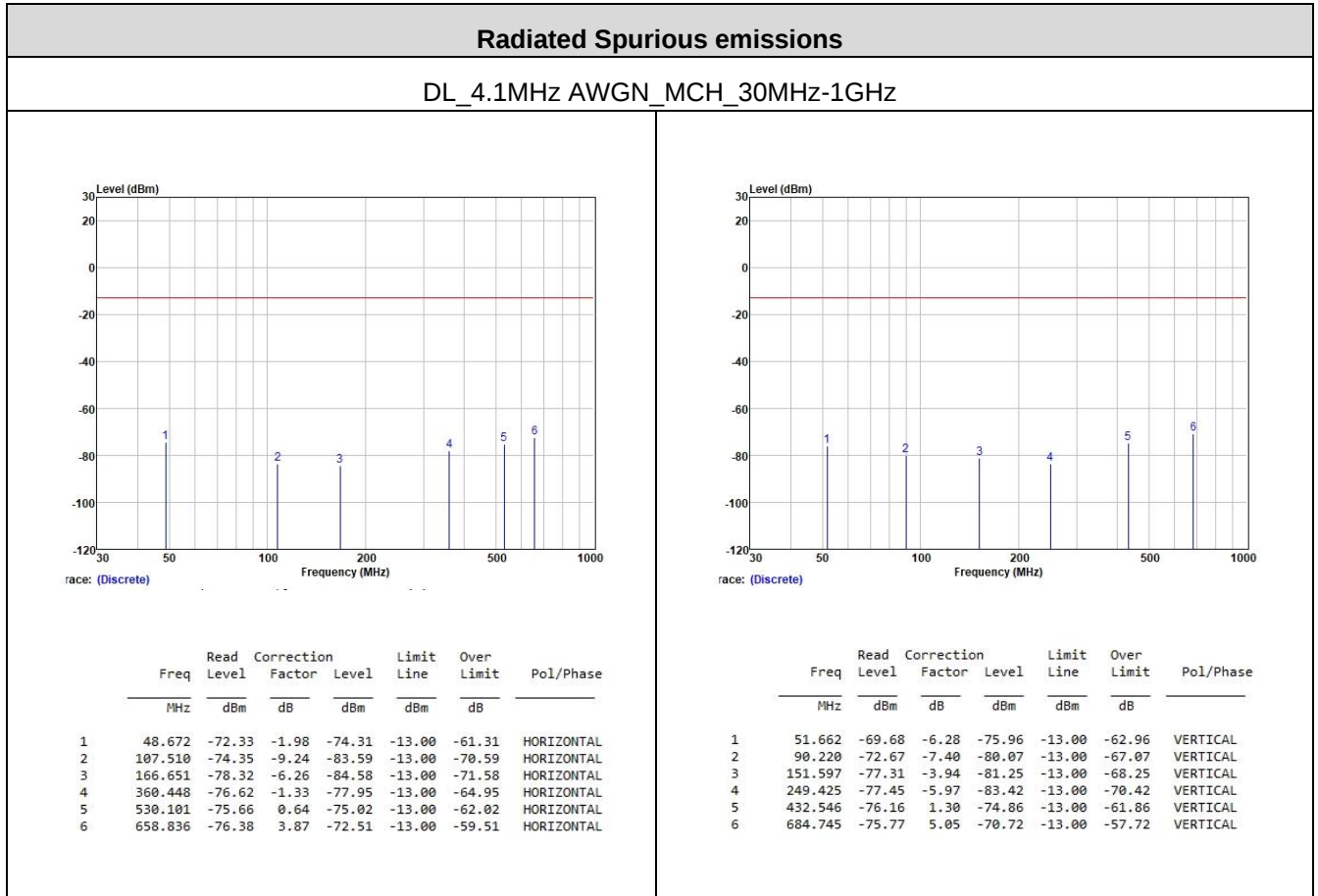
Frequency stability vs temperature							
Test Path	Test Freq. (MHz)	Test Signal	Voltage	Temperature (°C)	Freq. error (Hz)	Tolerance (ppm)	Verdict
DL	763	4.1MHz AWGN	VN	+50	12	0.0157	PASS
			VN	+40	14	0.0183	PASS
			VN	+30	13	0.0170	PASS
			VN	+20	23	0.0301	PASS
			VN	+10	16	0.0210	PASS
			VN	0	15	0.0197	PASS
			VN	-10	22	0.0288	PASS
			VN	-20	11	0.0144	PASS
			VN	-30	24	0.0315	PASS
	763	100MHz AWGN	VN	+50	23	0.0301	PASS
			VN	+40	19	0.0249	PASS
			VN	+30	10	0.0131	PASS
			VN	+20	16	0.0210	PASS
			VN	+10	9	0.0118	PASS
			VN	0	23	0.0301	PASS
			VN	-10	19	0.0249	PASS
			VN	-20	24	0.0315	PASS
			VN	-30	19	0.0249	PASS



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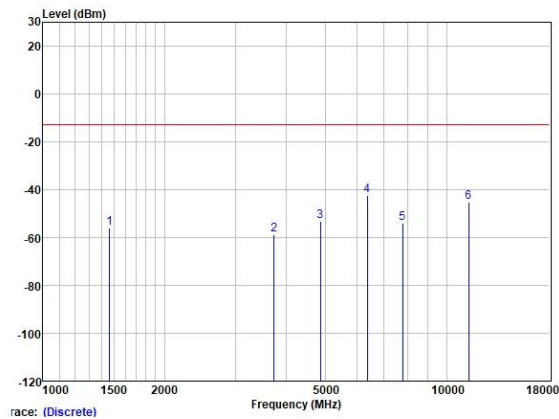
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10 Radiated Spurious emissions

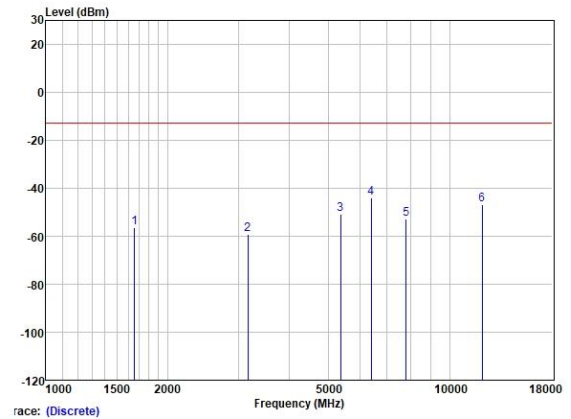


Radiated Spurious emissions

DL_4.1MHz AWGN_MCH_above 1GHz



	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	1464.522	-60.76	4.69	-56.07	-13.00	-43.07	HORIZONTAL
2	3735.978	-62.24	3.54	-58.70	-13.00	-45.70	HORIZONTAL
3	4874.043	-62.52	9.25	-53.27	-13.00	-40.27	HORIZONTAL
4	6358.789	-61.94	19.36	-42.58	-13.00	-29.58	HORIZONTAL
5	7784.729	-68.33	14.33	-54.00	-13.00	-41.00	HORIZONTAL
6	11335.190	-67.17	21.83	-45.34	-13.00	-32.34	HORIZONTAL

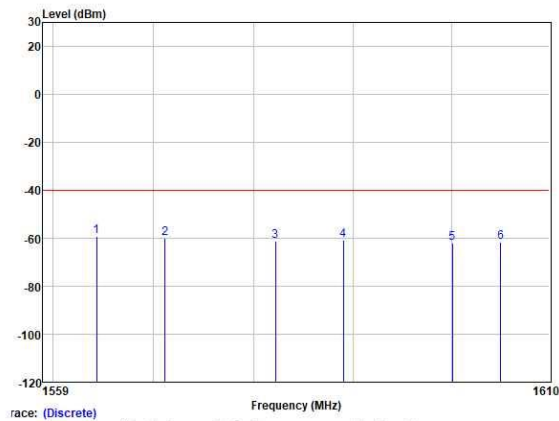


	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	1658.337	-61.83	5.29	-56.54	-13.00	-43.54	VERTICAL
2	3168.500	-61.87	2.64	-59.23	-13.00	-46.23	VERTICAL
3	5377.354	-63.87	13.23	-50.64	-13.00	-37.64	VERTICAL
4	6395.654	-63.43	19.45	-43.98	-13.00	-30.98	VERTICAL
5	7807.262	-69.33	16.66	-52.67	-13.00	-39.67	VERTICAL
6	12044.520	-68.68	21.95	-46.73	-13.00	-33.73	VERTICAL

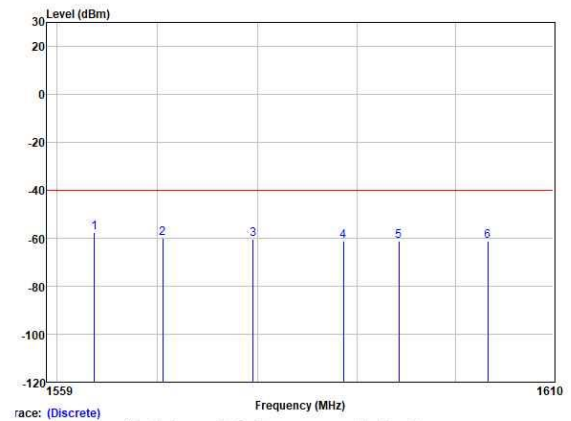


Radiated Spurious emissions

DL_4.1MHz AWGN_MCH_1559-1610MHz



	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	1564.328	-64.32	5.07	-59.25	-40.00	-19.25	HORIZONTAL
2	1571.141	-65.27	5.10	-60.17	-40.00	-20.17	HORIZONTAL
3	1582.205	-66.30	5.17	-61.13	-40.00	-21.13	HORIZONTAL
4	1589.045	-66.06	5.19	-60.87	-40.00	-20.87	HORIZONTAL
5	1600.080	-67.24	5.24	-62.00	-40.00	-22.00	HORIZONTAL
6	1604.981	-66.93	5.28	-61.65	-40.00	-21.65	HORIZONTAL



	Freq	Read Level	Correction Factor	Level	Limit Line	Over Limit	Pol/Phase
	MHz	dBm	dB	dBm	dBm	dB	
1	1563.724	-63.06	5.51	-57.55	-40.00	-17.55	VERTICAL
2	1570.535	-65.29	5.41	-59.88	-40.00	-19.88	VERTICAL
3	1579.559	-65.73	5.21	-60.52	-40.00	-20.52	VERTICAL
4	1588.635	-66.18	5.04	-61.14	-40.00	-21.14	VERTICAL
5	1594.271	-66.18	4.97	-61.21	-40.00	-21.21	VERTICAL
6	1603.277	-65.83	4.82	-61.01	-40.00	-21.01	VERTICAL

Remark:

Pre-test was performed for all modes (LCH/MCH/HCH, with 4.1MHz AWGN signals/ with 100MHz AWGN signals), the test result always keeps more than 20dB margin, the spurious emissions 9kHz to 30MHz were very low and not displayed in this report. Therefore, only show the worst-case in this report.

Emission in band 1559-1610Mhz tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

--End of Appendix--