

# Appendix -

## Test Data and Result for report

**GZCR231000104602**

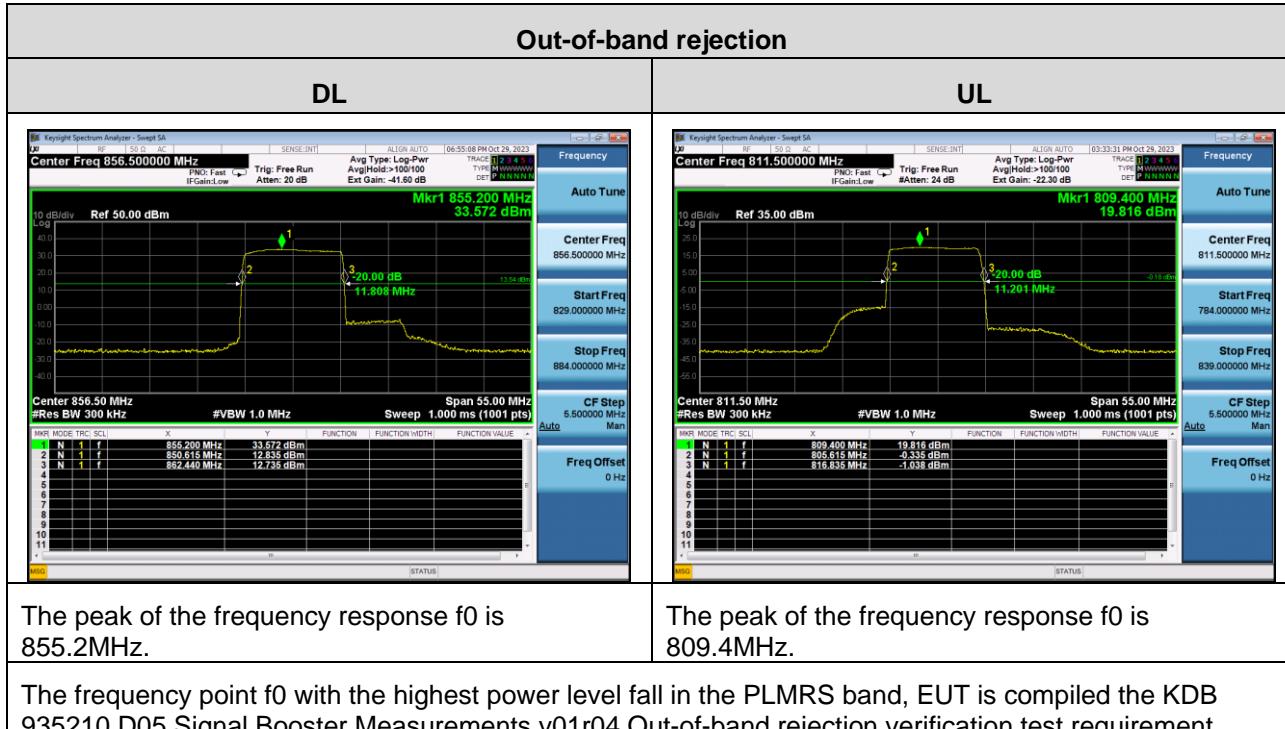
(For 806-817MHz/851-862MHz)



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## 1 Out-of-band rejection



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**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		
	4kHz FM	MCH	Pre-AGC	PASS		
			3dB above AGC	PASS		
	11.3kHz FM	MCH	Pre-AGC	PASS		
			3dB above AGC	PASS		
	16kHz FM	MCH	Pre-AGC	PASS		
			3dB above AGC	PASS		
UL	4.1MHz AWGN	MCH	Pre-AGC	PASS		
			3dB above AGC	PASS		
	4kHz FM	MCH	Pre-AGC	PASS		
			3dB above AGC	PASS		
	11.3kHz FM	MCH	Pre-AGC	PASS		
			3dB above AGC	PASS		
	16kHz FM	MCH	Pre-AGC	PASS		
			3dB above AGC	PASS		
Remark:						
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.						

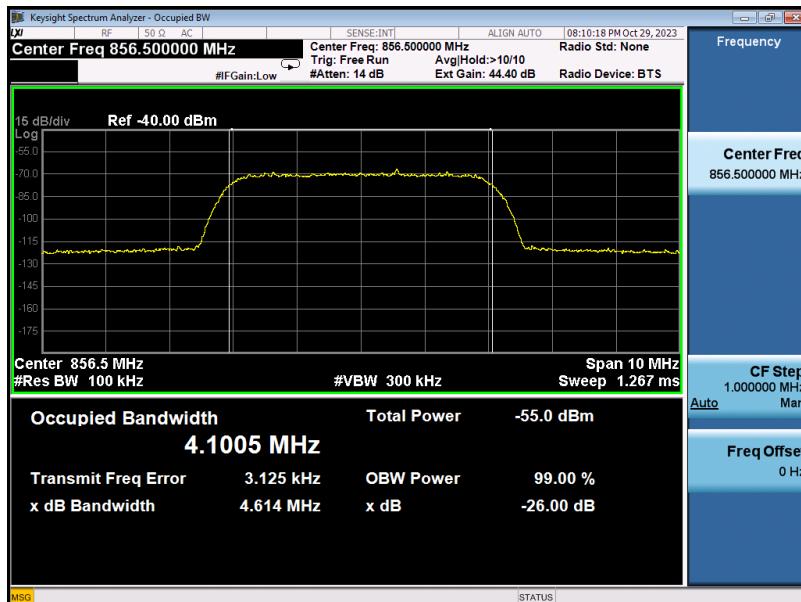
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## DL\_4.1MHz AWGN\_MCH\_Input\_Pre-AGC



## DL\_4.1MHz AWGN\_MCH\_Input\_3dB above AGC



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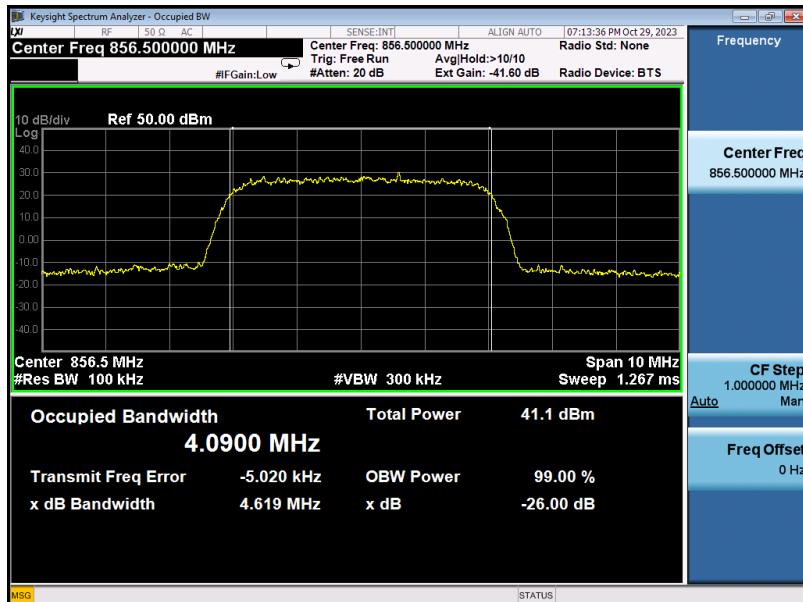
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## DL\_4kHz FM\_MCH\_Input\_Pre-AGC



## DL\_4kHz FM\_MCH\_Input\_3dB above AGC



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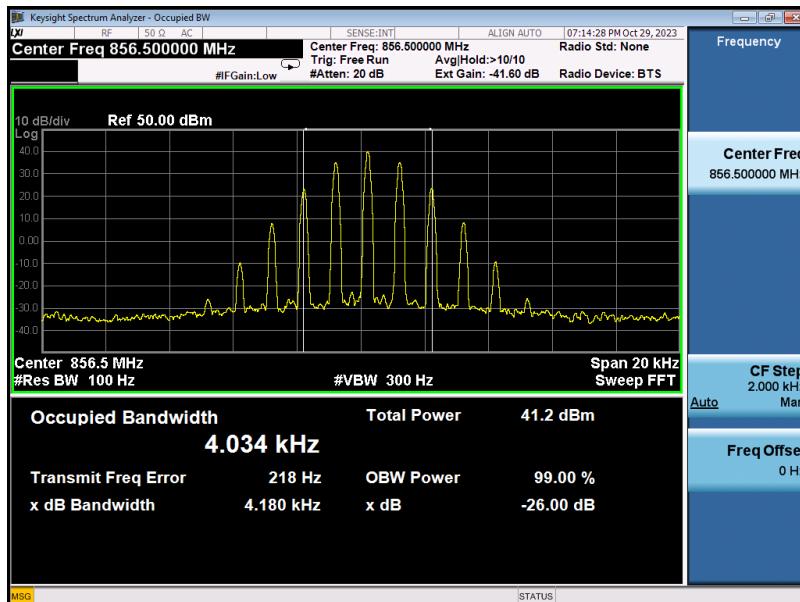
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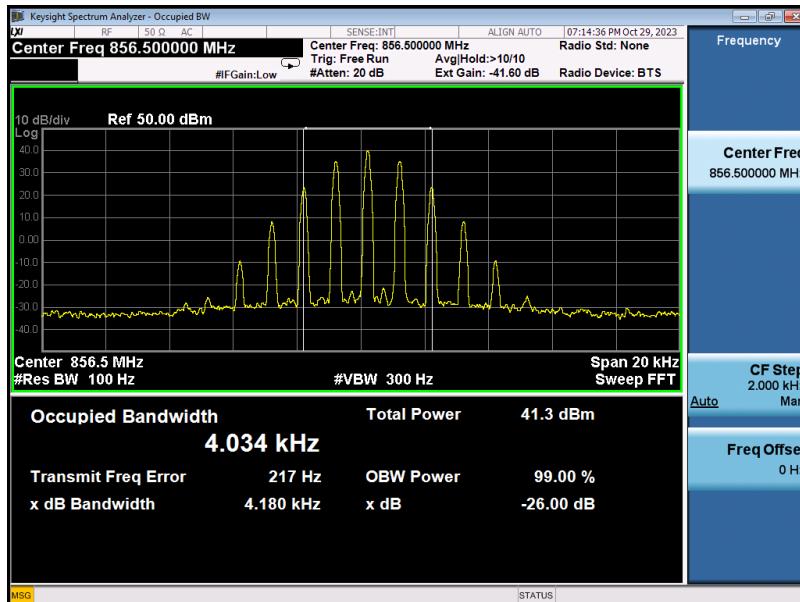
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## DL\_4kHz FM\_MCH\_Output\_Pre-AGC



## DL\_4kHz FM\_MCH\_Output\_3dB above AGC



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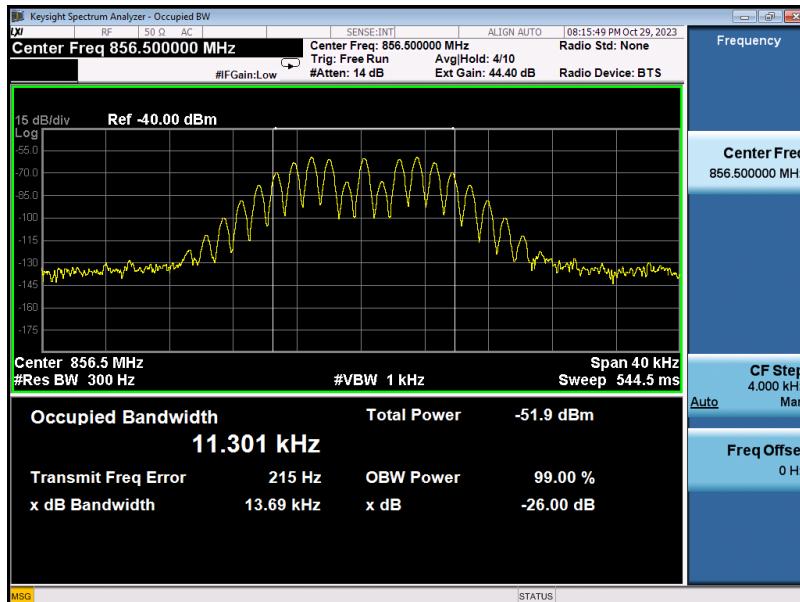
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## DL\_11.3kHz FM\_MCH\_Input\_Pre-AGC



## DL\_11.3kHz FM\_MCH\_Input\_3dB above AGC



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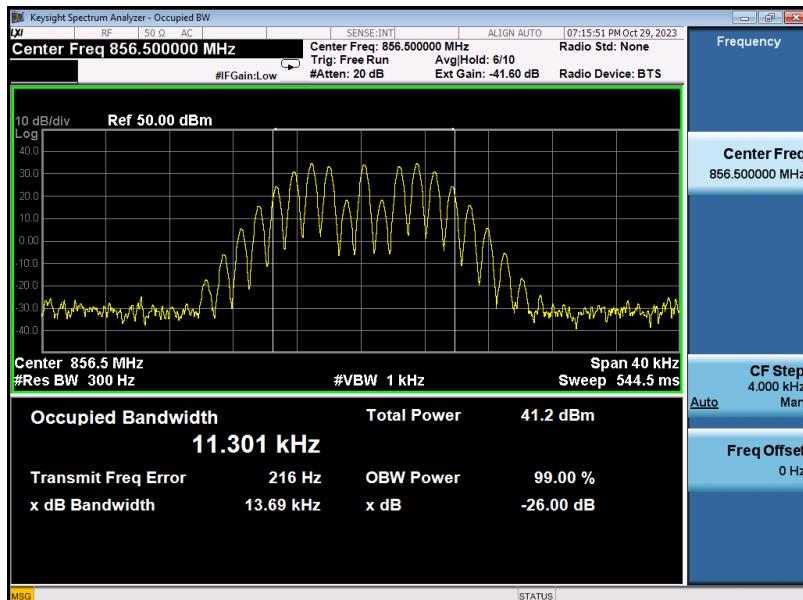
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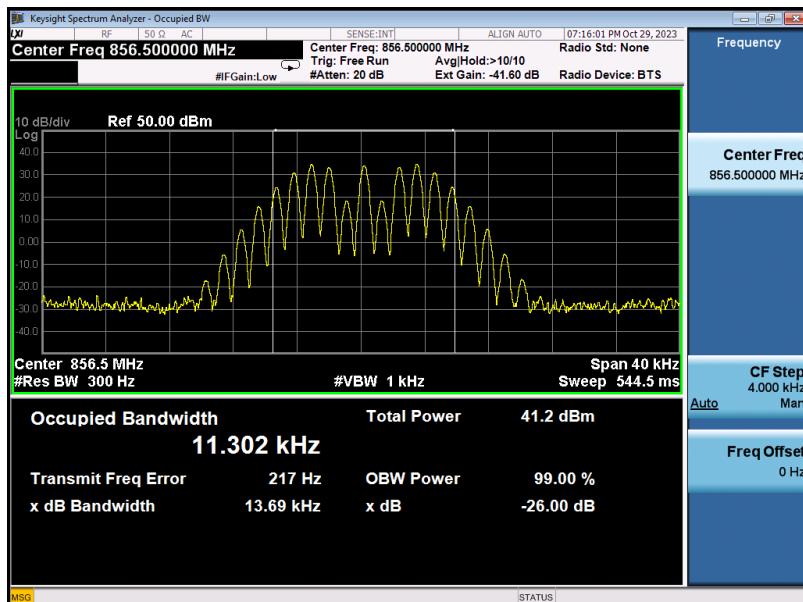
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## DL\_11.3kHz FM\_MCH\_Output\_Pre-AGC



## DL\_11.3kHz FM\_MCH\_Output\_3dB above AGC



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## DL\_16kHz FM\_MCH\_Input\_Pre-AGC



## DL\_16kHz FM\_MCH\_Input\_3dB above AGC



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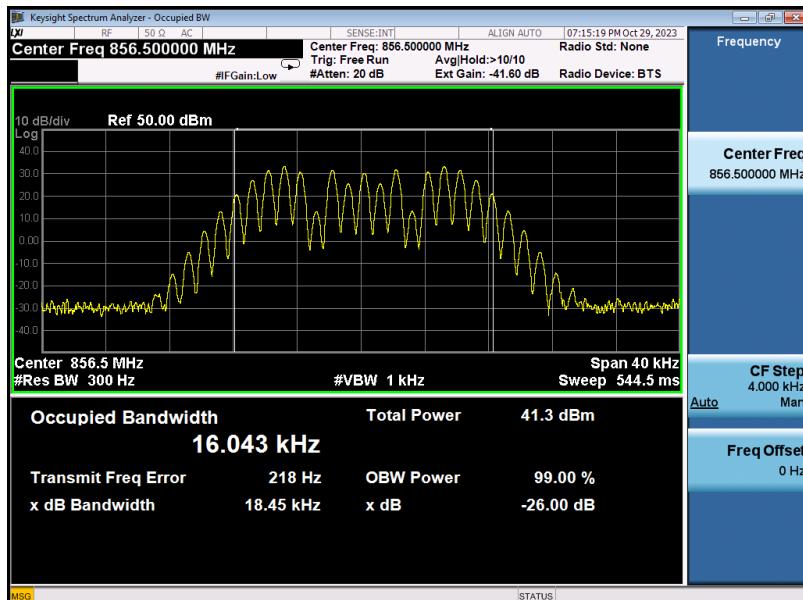
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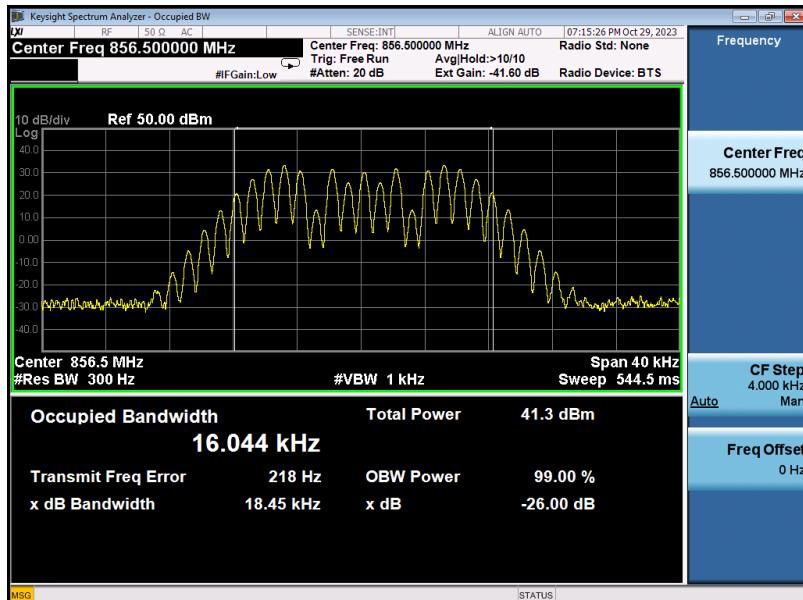
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## DL\_16kHz FM\_MCH\_Output\_Pre-AGC



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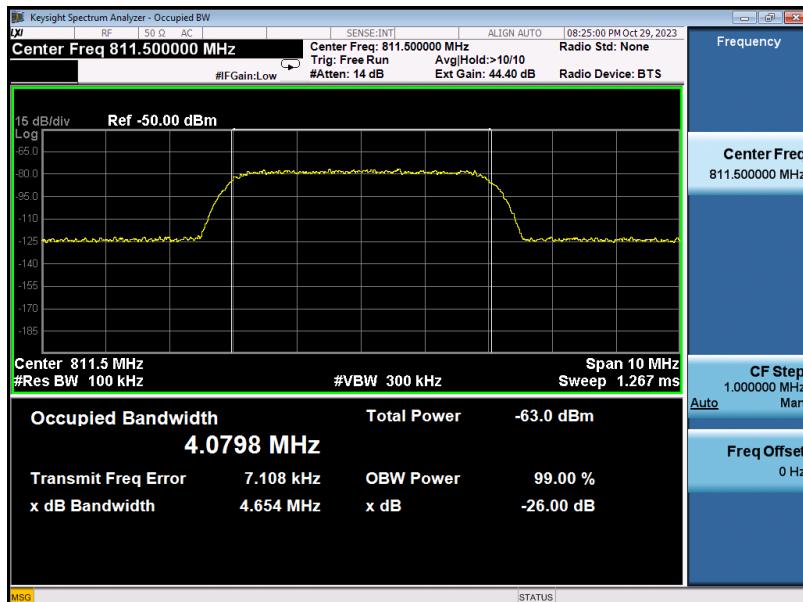
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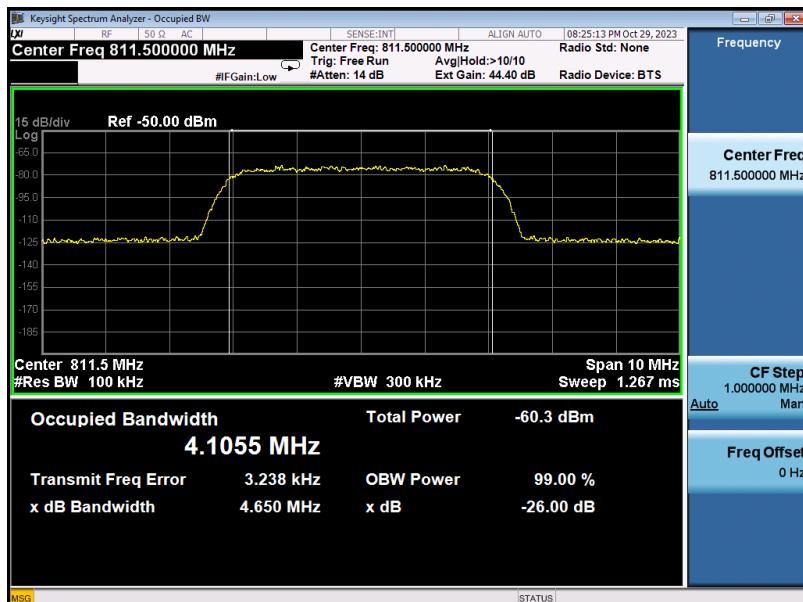
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## UL\_4.1MHz AWGN\_MCH\_Input\_Pre-AGC



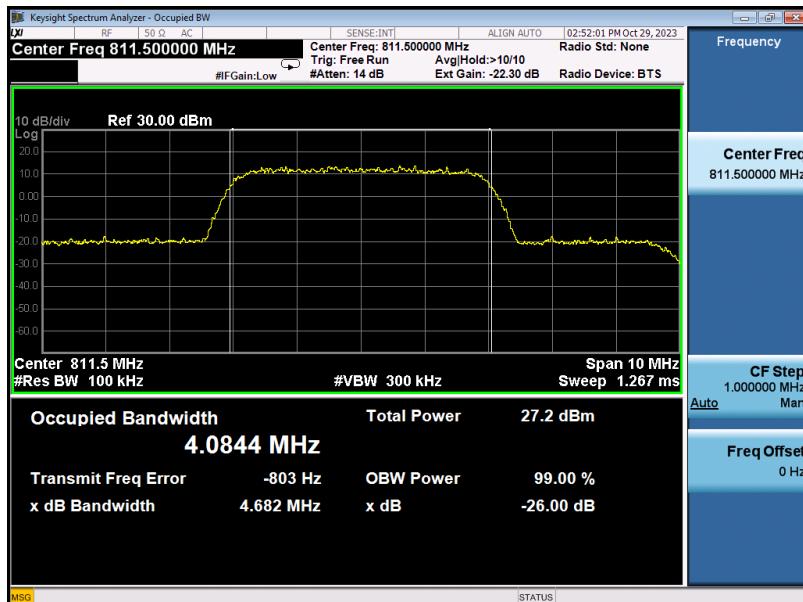
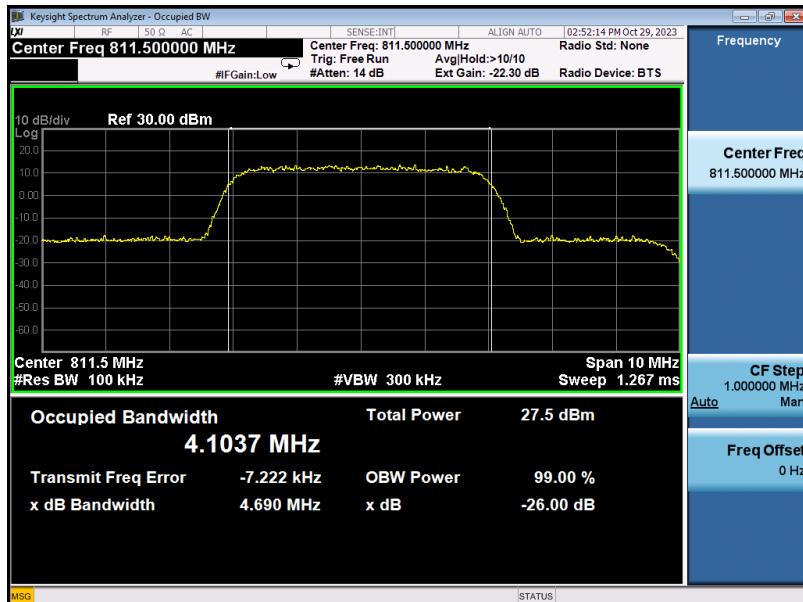
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## UL\_4kHz FM\_MCH\_Input\_Pre-AGC



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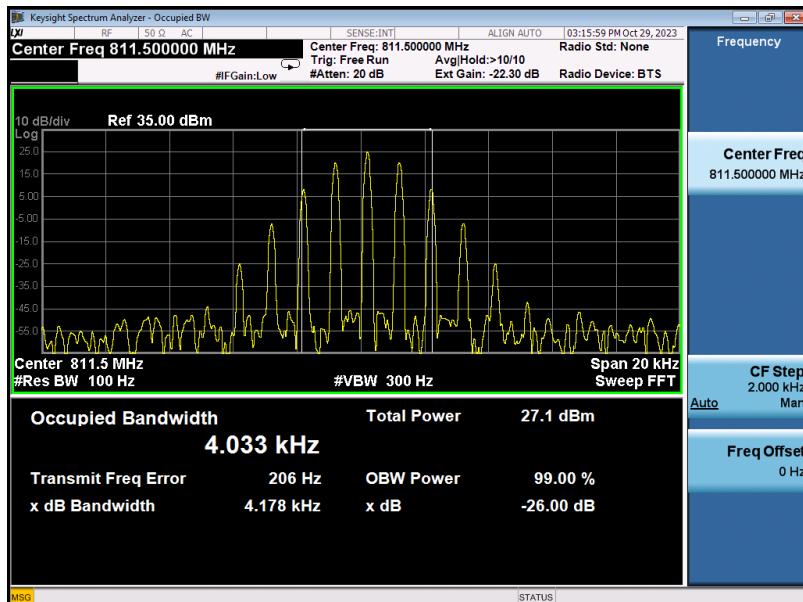
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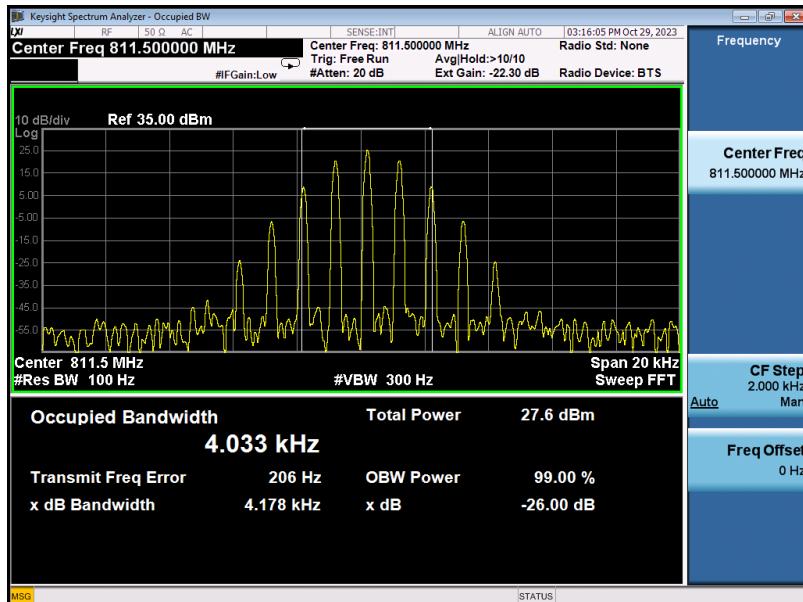
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## UL\_4kHz FM\_MCH\_Output\_Pre-AGC



## UL\_4kHz FM\_MCH\_Output\_3dB above AGC



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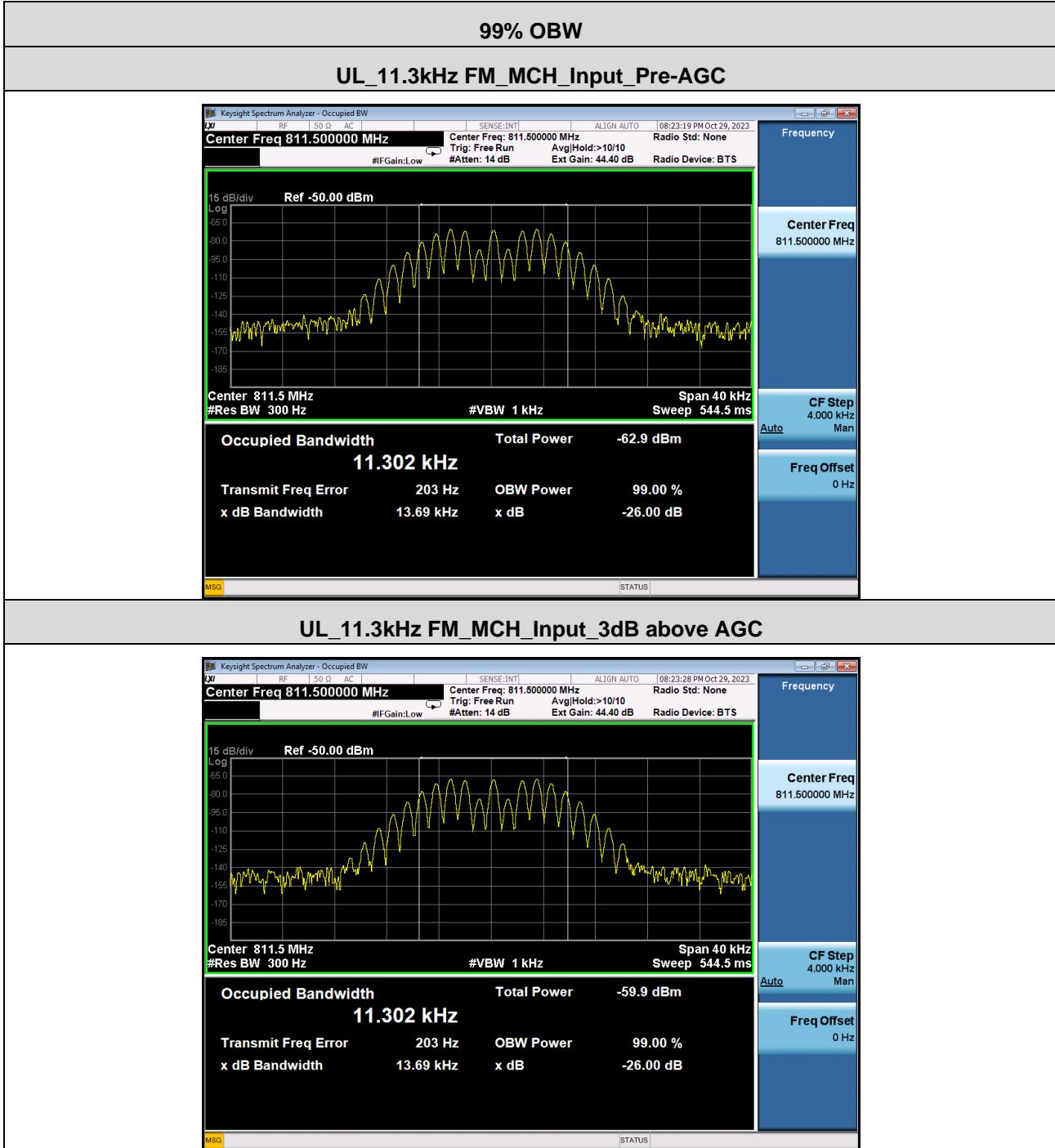
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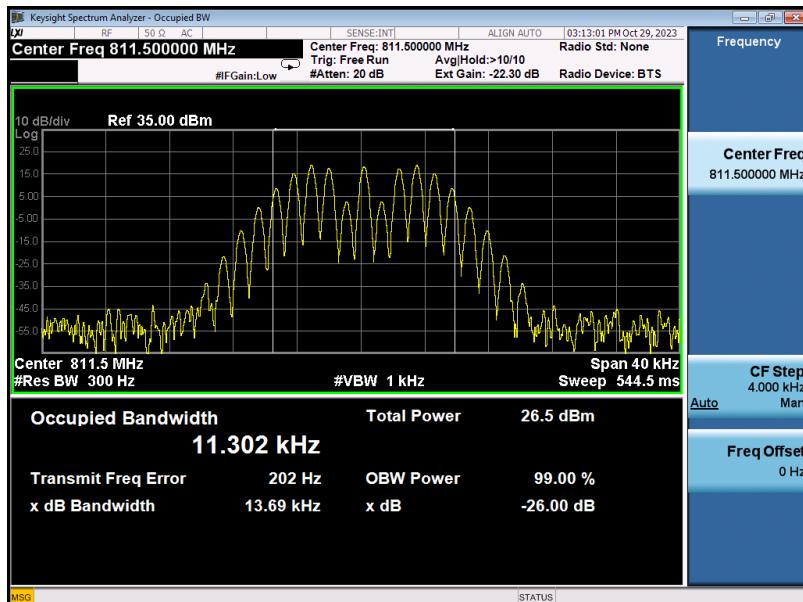
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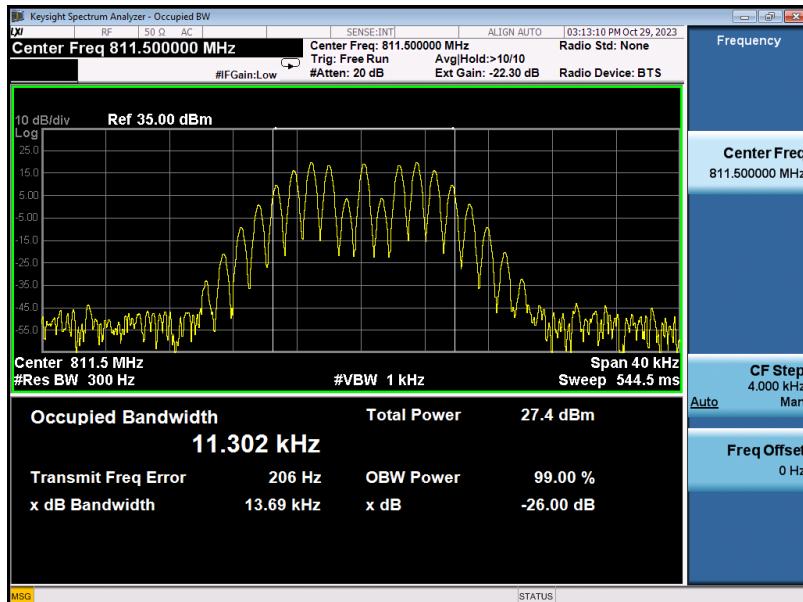
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## UL\_11.3kHz FM\_MCH\_Output\_Pre-AGC



## UL\_11.3kHz FM\_MCH\_Output\_3dB above AGC



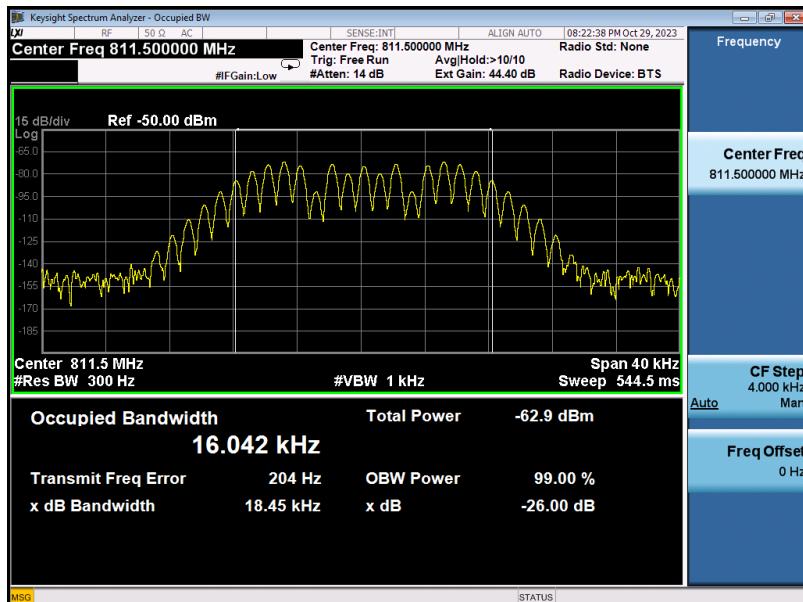
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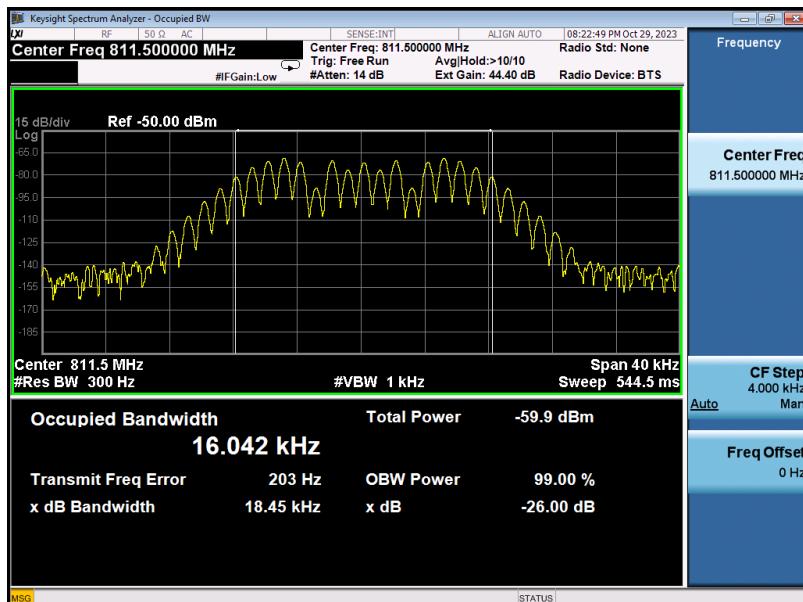


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## UL\_16kHz FM\_MCH\_Input\_Pre-AGC



## UL\_16kHz FM\_MCH\_Input\_3dB above AGC



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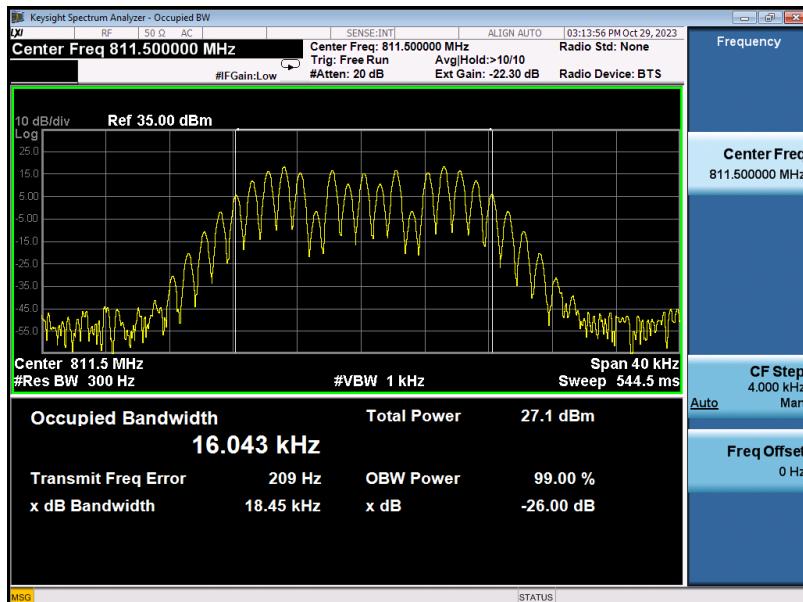
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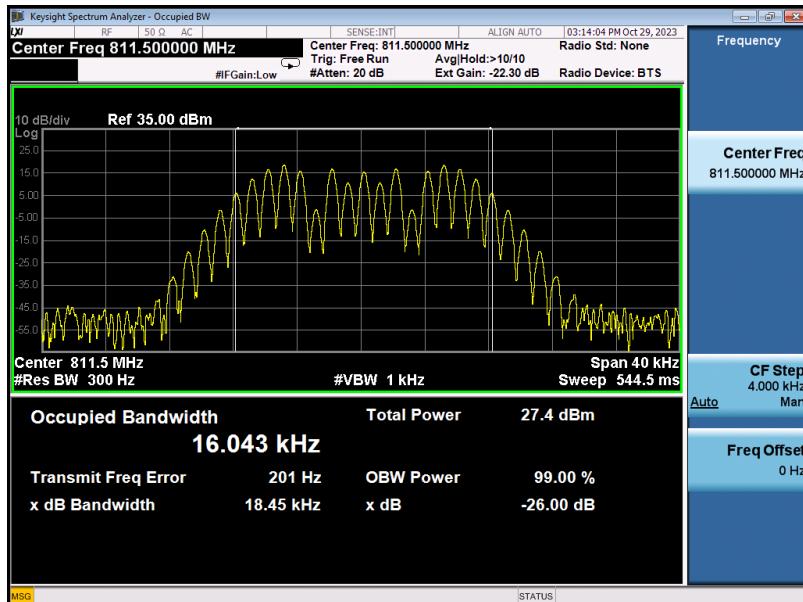
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## UL\_16kHz FM\_MCH\_Output\_Pre-AGC



## UL\_16kHz FM\_MCH\_Output\_3dB above AGC



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**3 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)	ERP (W)	Gain (dB)
DL	855.2	CW	Pre-AGC	-55	41.6	88.2	96.6
			3dB above AGC	-52	41.9	94.5	/
UL	809.4	CW	Pre-AGC	-63	27.6	3.6	90.6
			3dB above AGC	-60	28.1	4.0	/

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.

Mean output power						
Test Path	Test Freq. f0 (MHz)	Test Signal	Signal Level	Output Power (dBm/MHz)	ERP (W/MHz)	Verdict
DL	855.2	CW	Pre-AGC	41.6	88.2	PASS
			3dB above AGC	41.9	94.5	PASS
UL	809.4	CW	Pre-AGC	27.6	3.6	PASS
			3dB above AGC	28.1	4.0	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.
3. The output power is limited to an ERP of 1000W/MHz with antennas below 305 m (1,000 ft).
4. 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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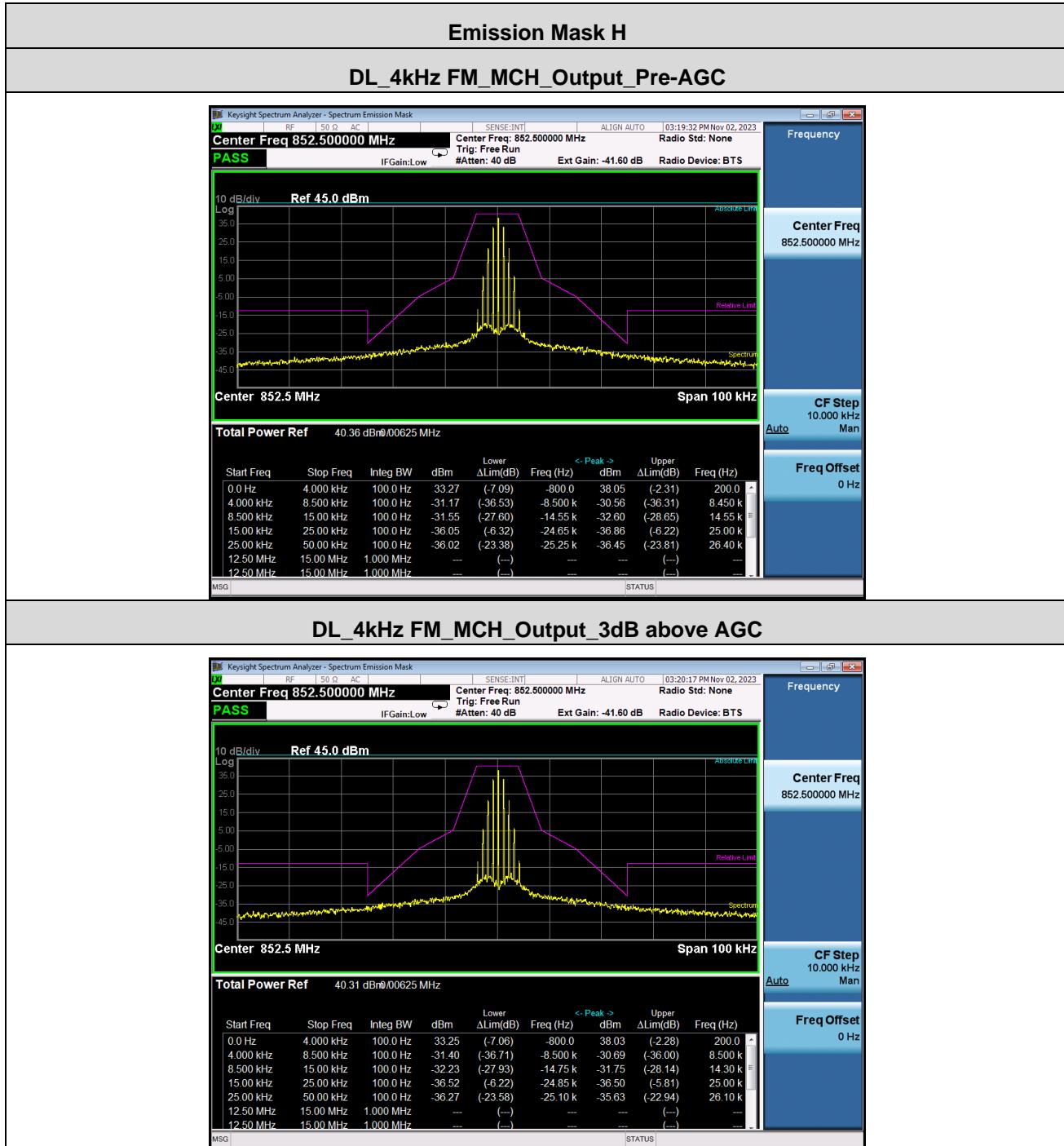
**4 Emission Mask**

Emission MASK					
Test Path	Test Signal	Test Channel	MASK	Signal Level	Verdict
DL	4kHz FM	MCH	H	Pre-AGC	PASS
				3dB above AGC	PASS
	11.3kHz FM	MCH	D	Pre-AGC	PASS
				3dB above AGC	PASS
UL	16kHz FM	MCH	G	Pre-AGC	PASS
				3dB above AGC	PASS
	4kHz FM	MCH	H	Pre-AGC	PASS
				3dB above AGC	PASS
	11.3kHz FM	MCH	D	Pre-AGC	PASS
				3dB above AGC	PASS
	16kHz FM	MCH	G	Pre-AGC	PASS
				3dB above AGC	PASS

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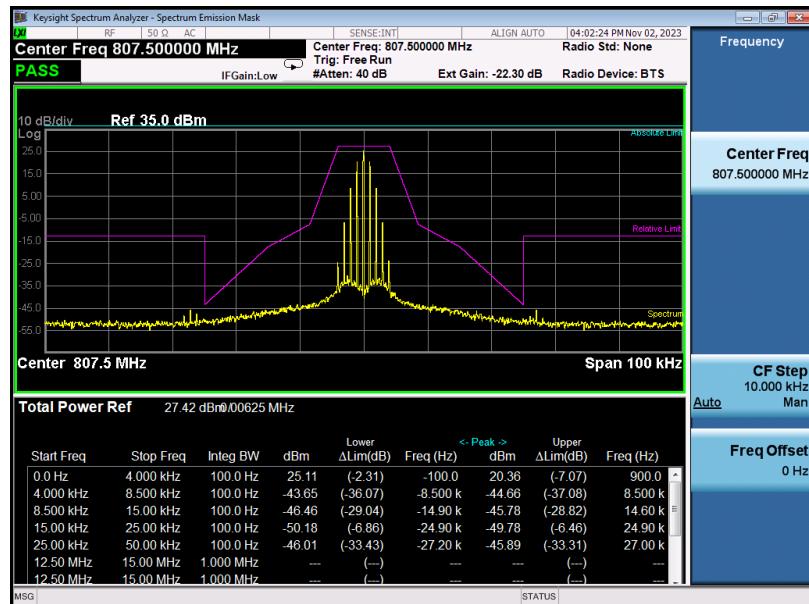


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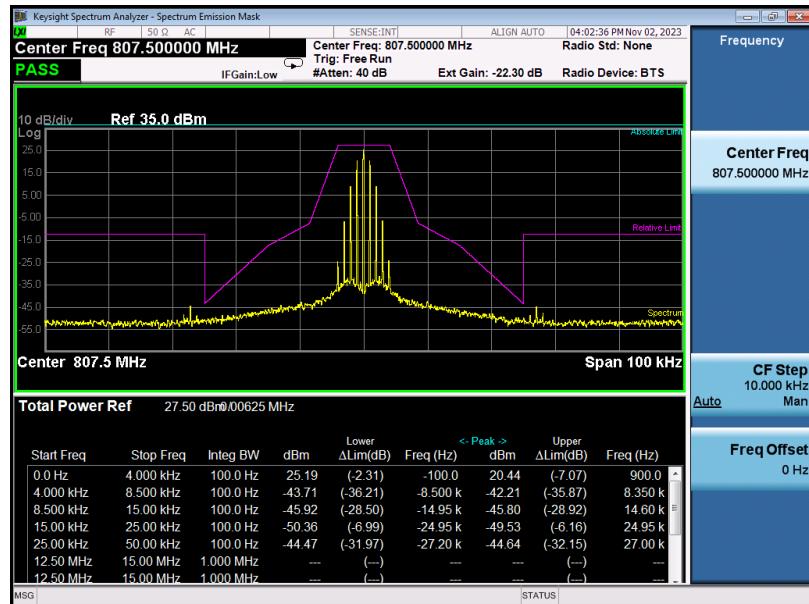
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## Emission Mask H

## UL\_4kHz FM\_MCH\_Output\_Pre-AGC



## UL\_4kHz FM\_MCH\_Output\_3dB above AGC



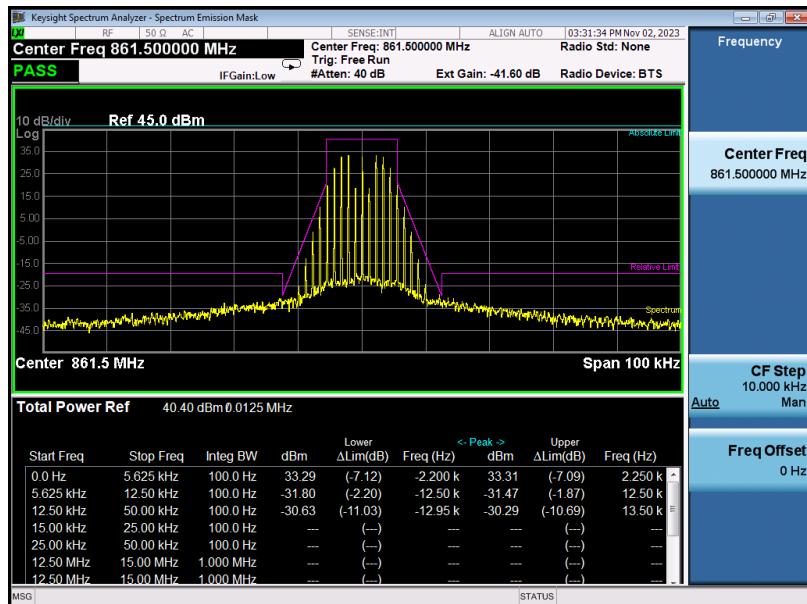
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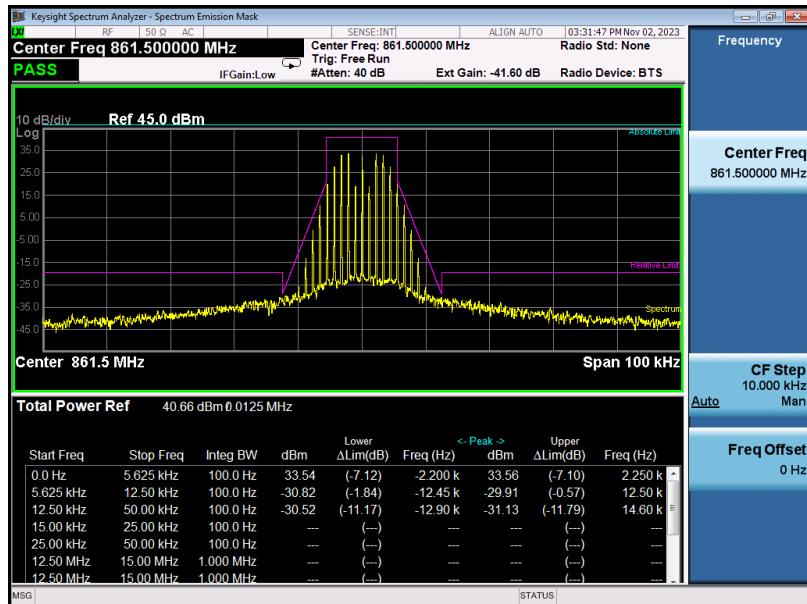


## Emission Mask D

## DL\_11.3kHz FM\_MCH\_Output\_Pre-AGC



## DL\_11.3kHz FM\_MCH\_Output\_3dB above AGC



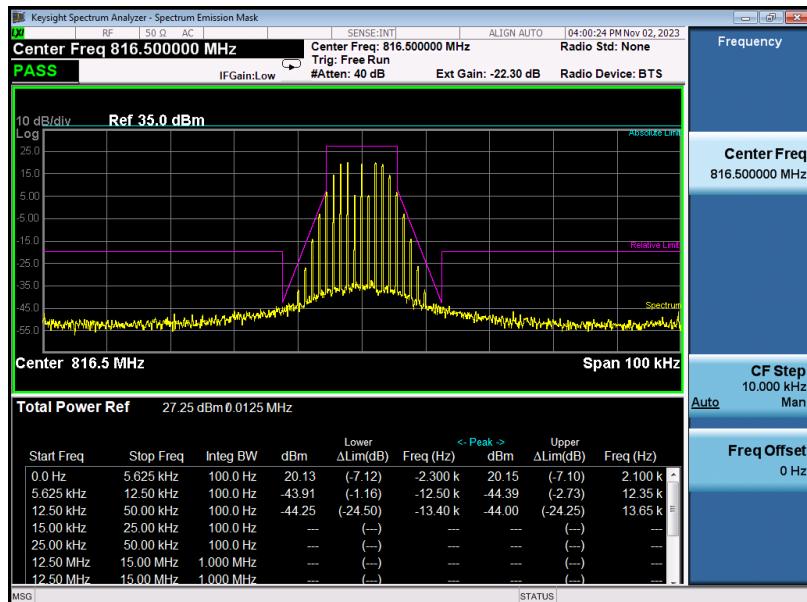
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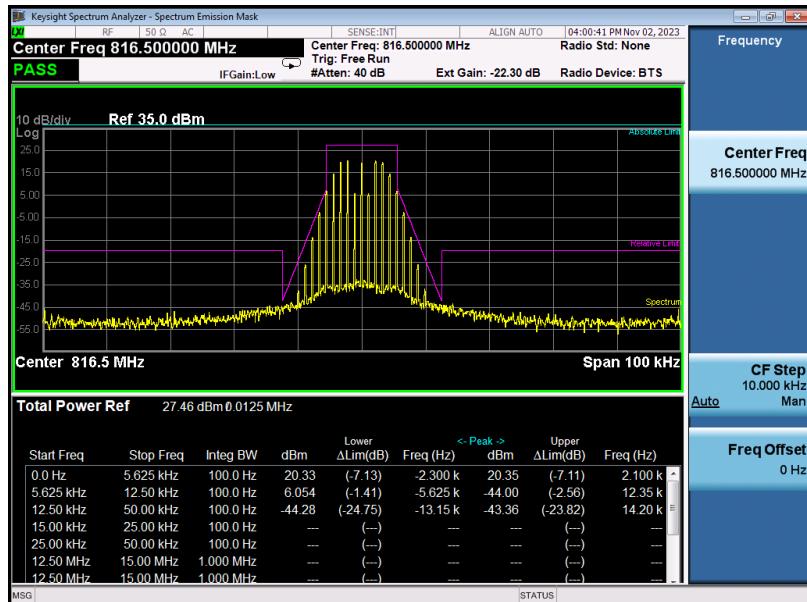


## Emission Mask D

## UL\_11.3kHz FM\_MCH\_Output\_Pre-AGC



## UL\_11.3kHz FM\_MCH\_Output\_3dB above AGC

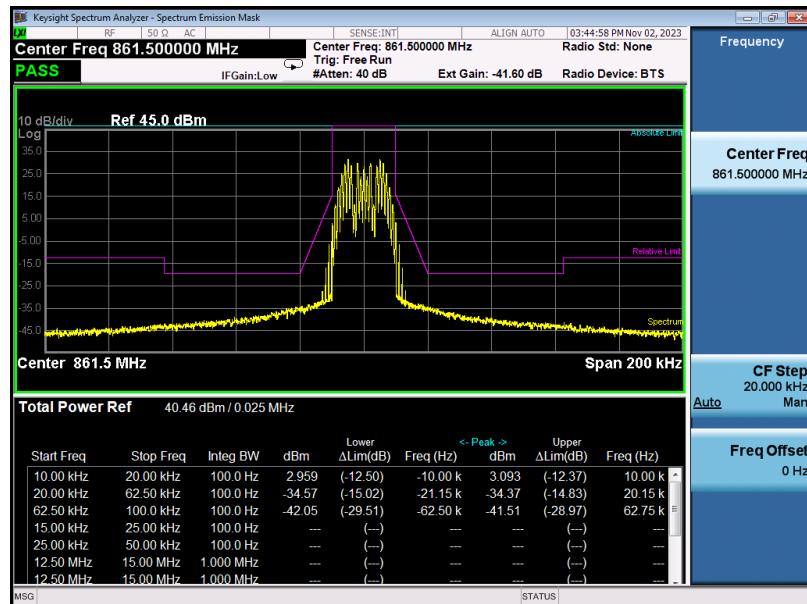


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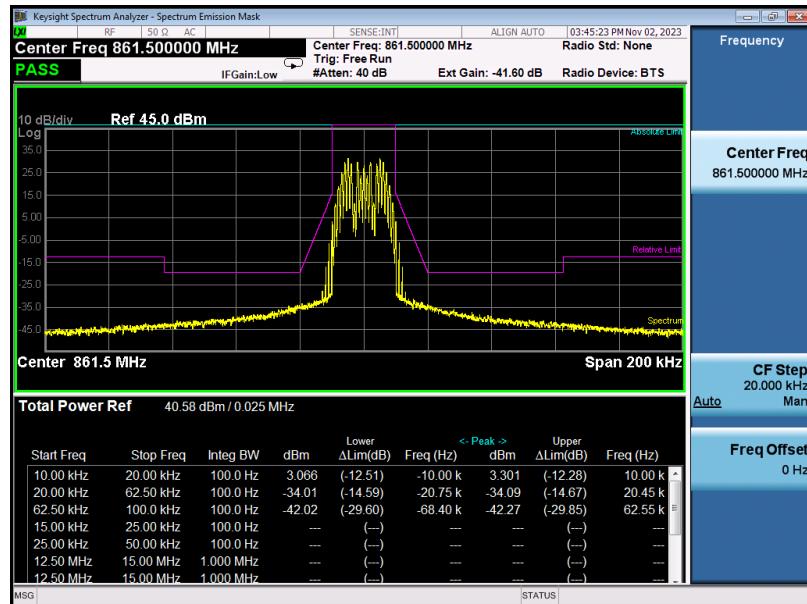
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## Emission Mask G

## DL\_16kHz FM\_MCH\_Output\_Pre-AGC



## DL\_16kHz FM\_MCH\_Output\_3dB above AGC



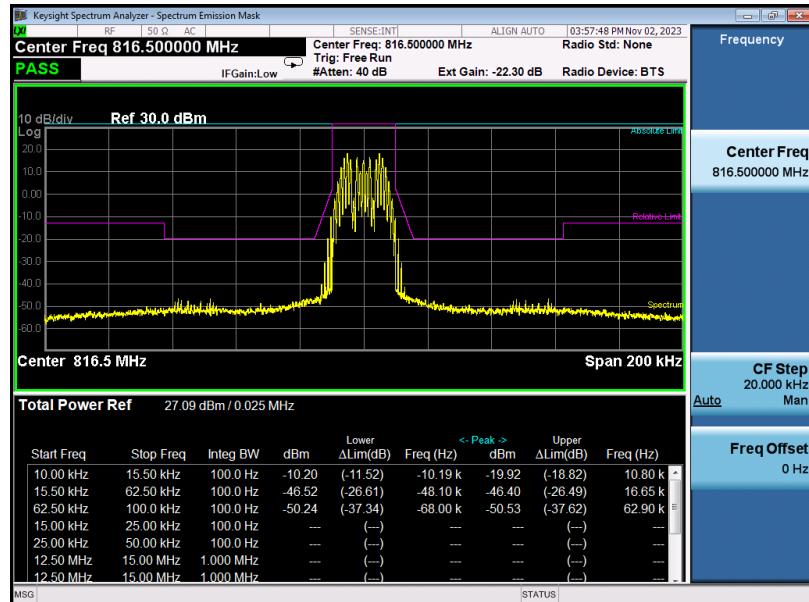
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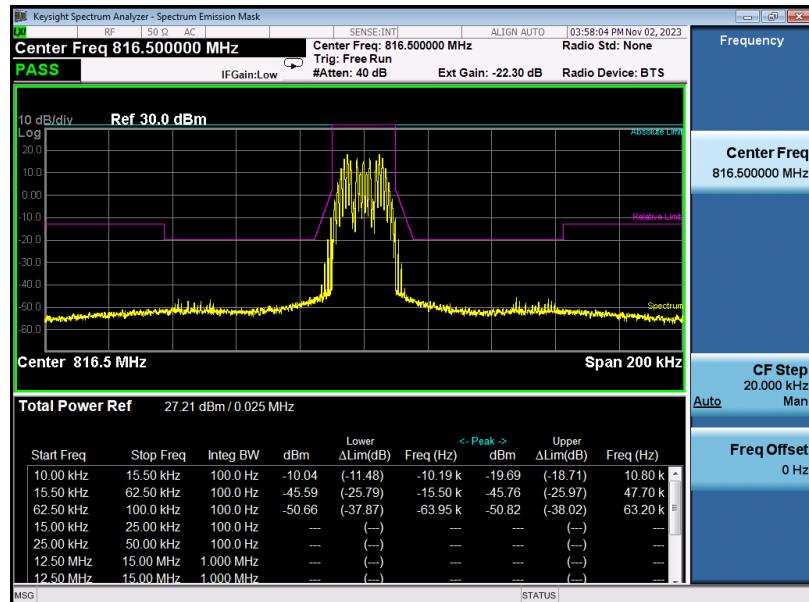


## Emission Mask G

## UL\_16kHz FM\_MCH\_Output\_Pre-AGC



## UL\_16kHz FM\_MCH\_Output\_3dB above AGC



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**5 Noise Figure**

Noise Figure				
Test Path	Test Channel	Maximum Noise Figure (dB)	Limit (dB)	Verdict
DL	LCH	4.68	≤9	PASS
	MCH	4.43	≤9	PASS
	HCH	4.40	≤9	PASS
UL	LCH	4.14	≤9	PASS
	MCH	4.19	≤9	PASS
	HCH	4.32	≤9	PASS

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**6 Intermodulation emissions**

Intermodulation emissions					
Test Path	Test Freq. f0 (MHz)	CW signals spacing (kHz)	Signal Level	Worst conducted test level (dBm)	
				/300Hz	/10kHz
DL	855.2	6.25	Pre-AGC	-3.19	12.04
			3dB above AGC	-3.21	12.02
		12.5	Pre-AGC	-3.20	12.03
			3dB above AGC	-3.20	12.03
		25	Pre-AGC	-3.52	11.71
			3dB above AGC	-3.48	11.75
UL	809.4	6.25	Pre-AGC	-29.02	-13.79
			3dB above AGC	-28.94	-13.71
		12.5	Pre-AGC	-28.73	-13.50
			3dB above AGC	-28.72	-13.49
		25	Pre-AGC	-27.84	-12.61
			3dB above AGC	-26.69	-11.46

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+  $10\lg(10000/300)$ .
3. ERP= output power (dBm)+ antenna gain (dBi)- 2.15, the antenna gain is 10dBi declared by the manufacturer.
4. The maximum ERP of intermodulation product is  $12.04\text{dBm}/10\text{kHz}+ 10- 2.15= 19.89\text{dBm}/10\text{kHz}$ , which exceeded the limit  $-30\text{dBm}/10\text{kHz}$ , the applicant must use good engineering practice to eliminate the intermodulation products interference.

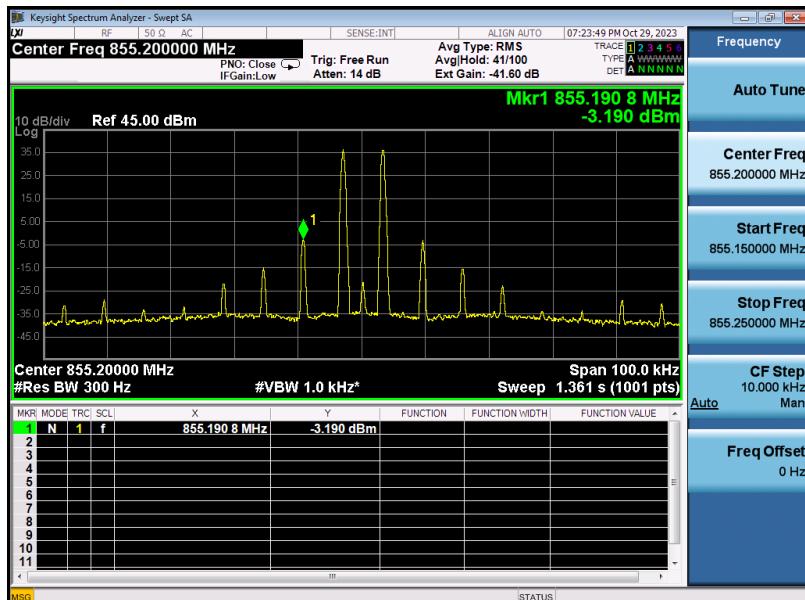
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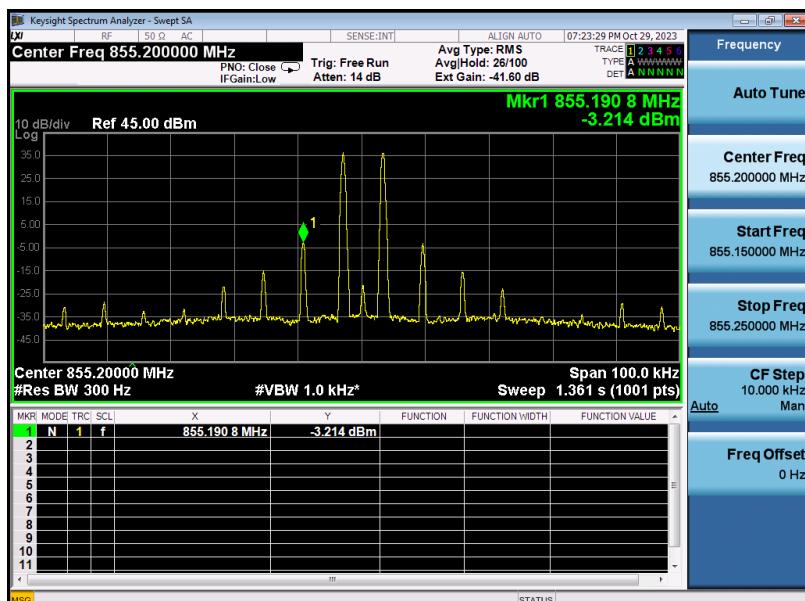


## Intermodulation emissions

## DL\_6.25kHz spacing\_Pre-AGC



## DL\_6.25kHz spacing\_3dB above AGC



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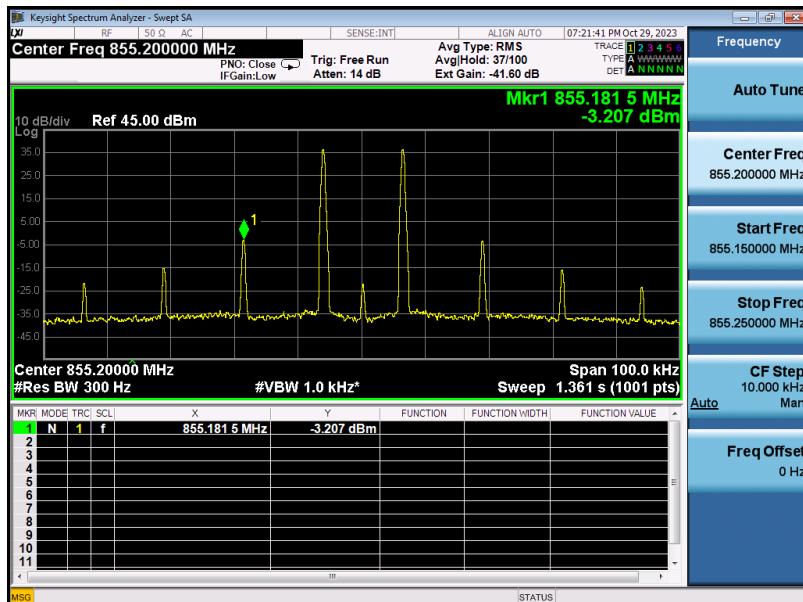
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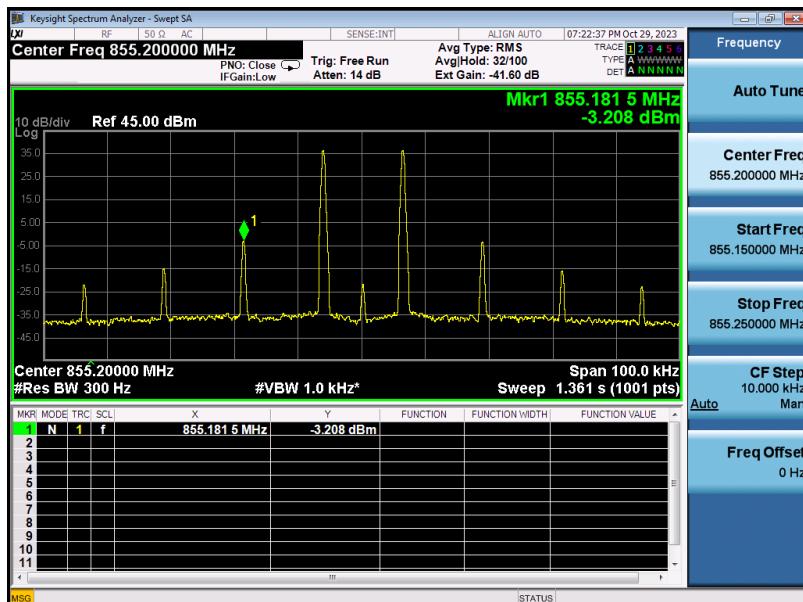
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## Intermodulation emissions

## DL\_12.5kHz spacing\_Pre-AGC



## DL\_12.5kHz spacing\_3dB above AGC



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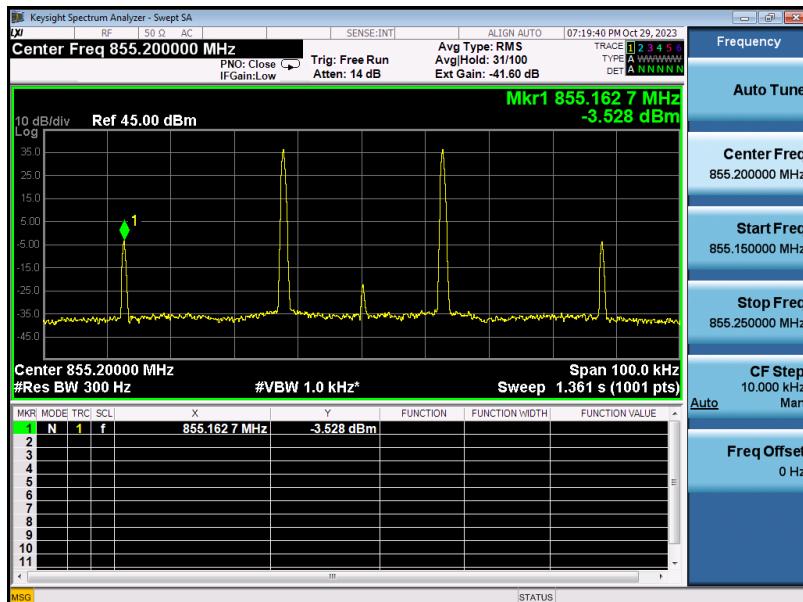
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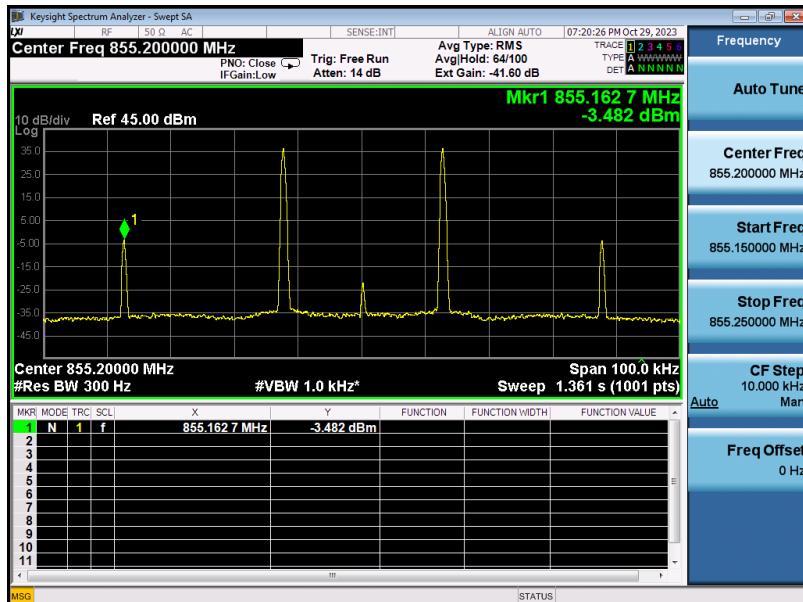
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## Intermodulation emissions

## DL\_25kHz spacing\_Pre-AGC



## DL\_25kHz spacing\_3dB above AGC



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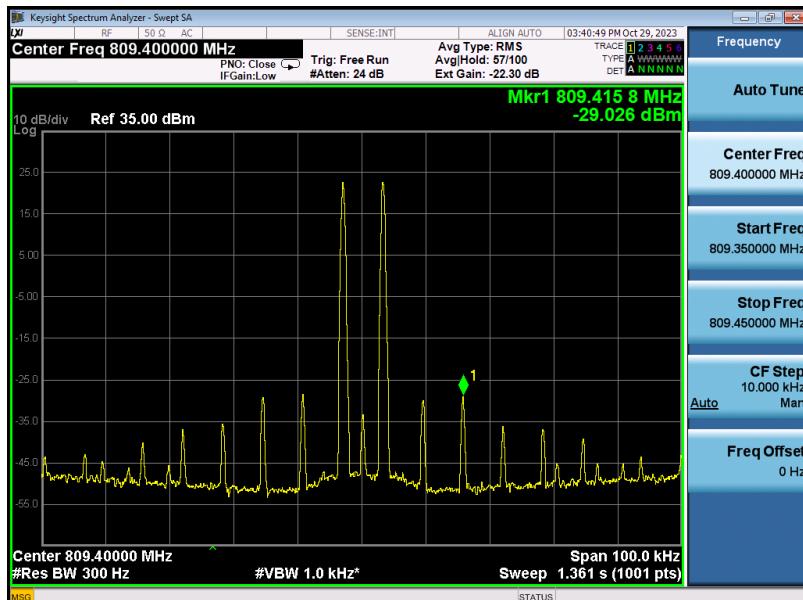
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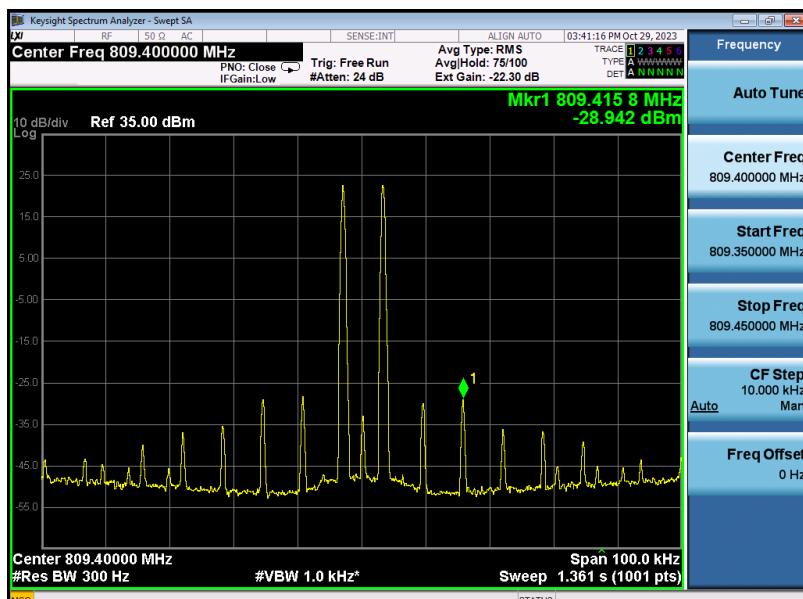
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## Intermodulation emissions

## UL\_6.25kHz spacing\_Pre-AGC



## UL\_6.25kHz spacing\_3dB above AGC



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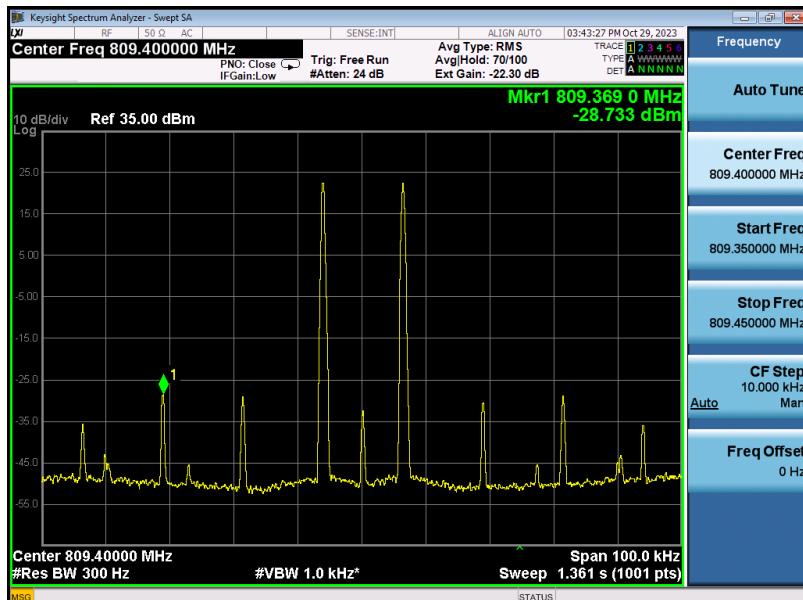
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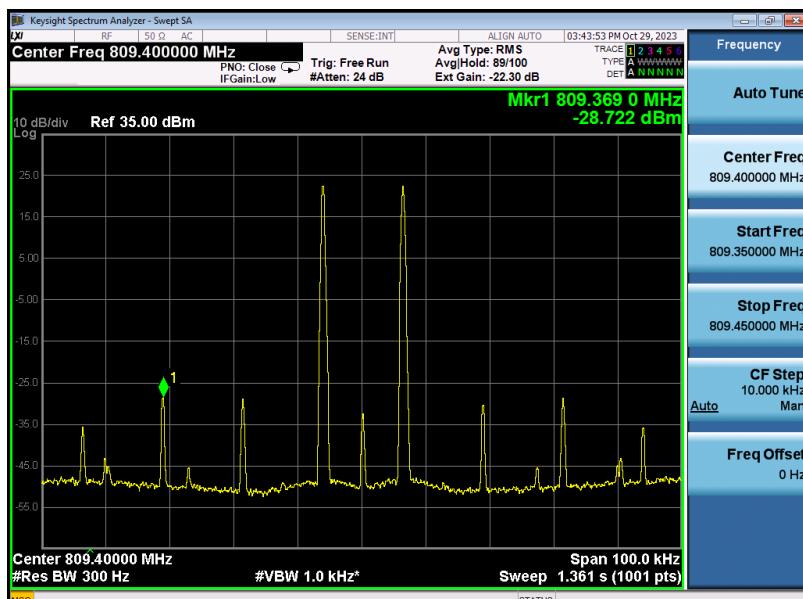
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## Intermodulation emissions

## UL\_12.5kHz spacing\_Pre-AGC



## UL\_12.5kHz spacing\_3dB above AGC



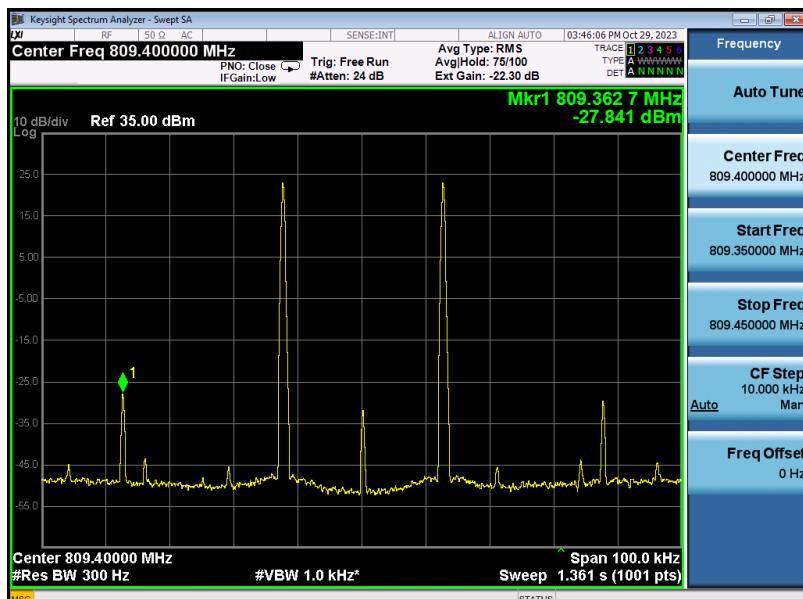
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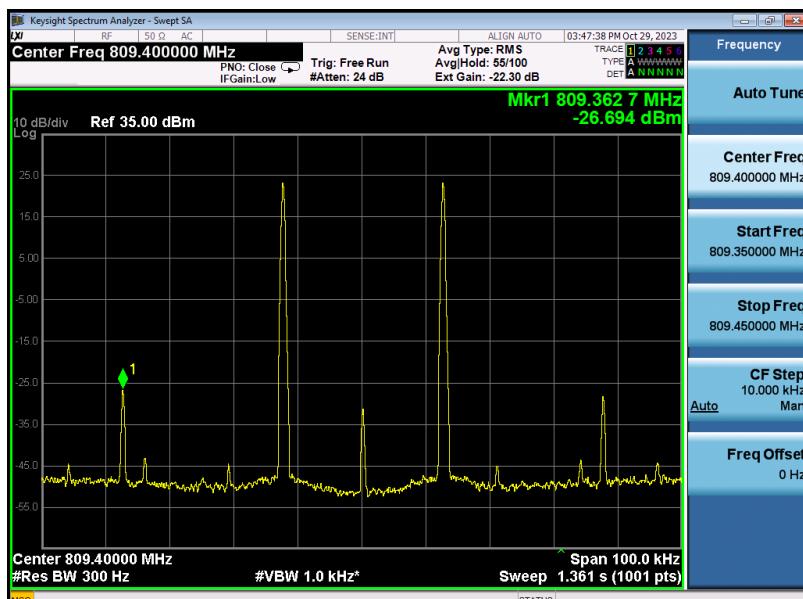


## Intermodulation emissions

## UL\_25kHz spacing\_Pre-AGC



## UL\_25kHz spacing\_3dB above AGC



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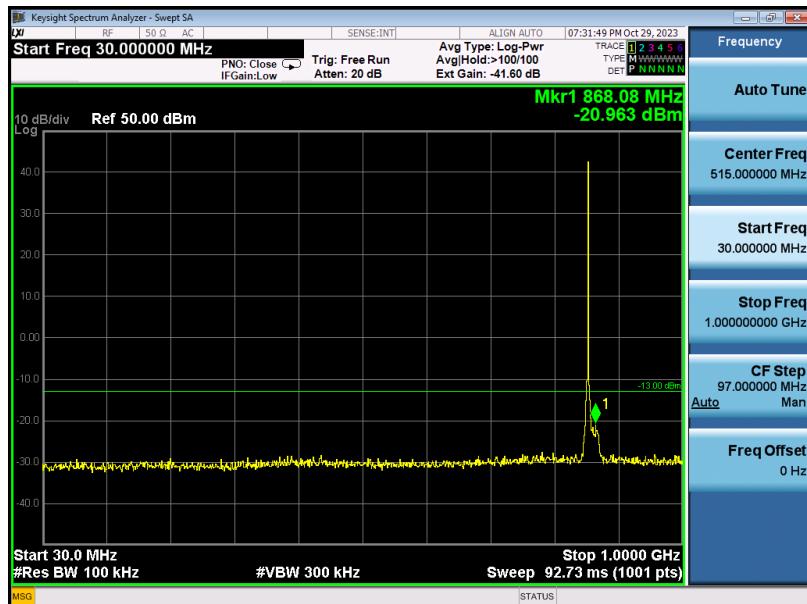
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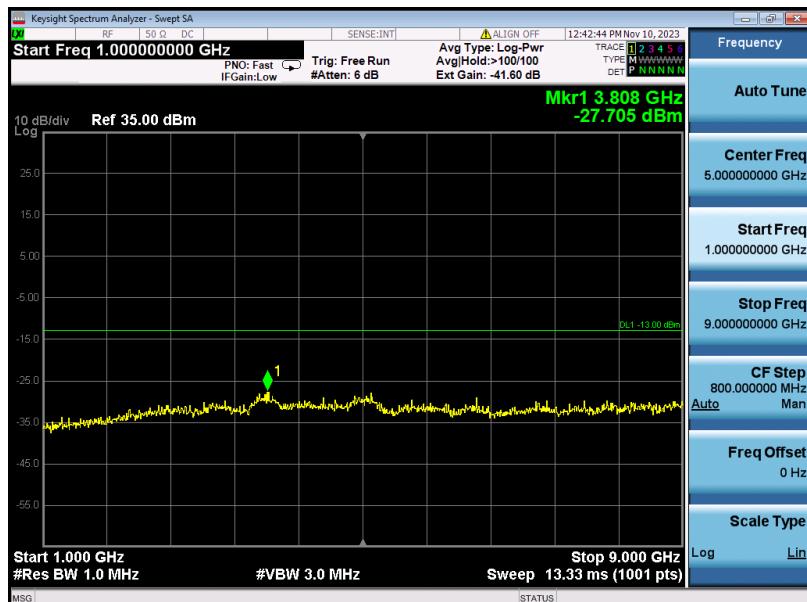
## 7 Conducted Spurious emissions.

### Conducted spurious emissions

#### DL\_CW\_MCH\_Pre-AGC



#### DL\_CW\_MCH\_Pre-AGC



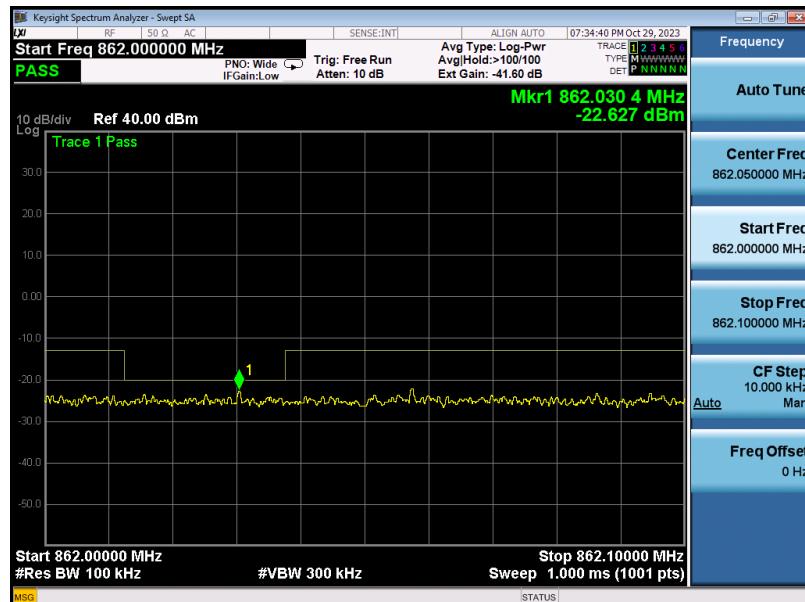
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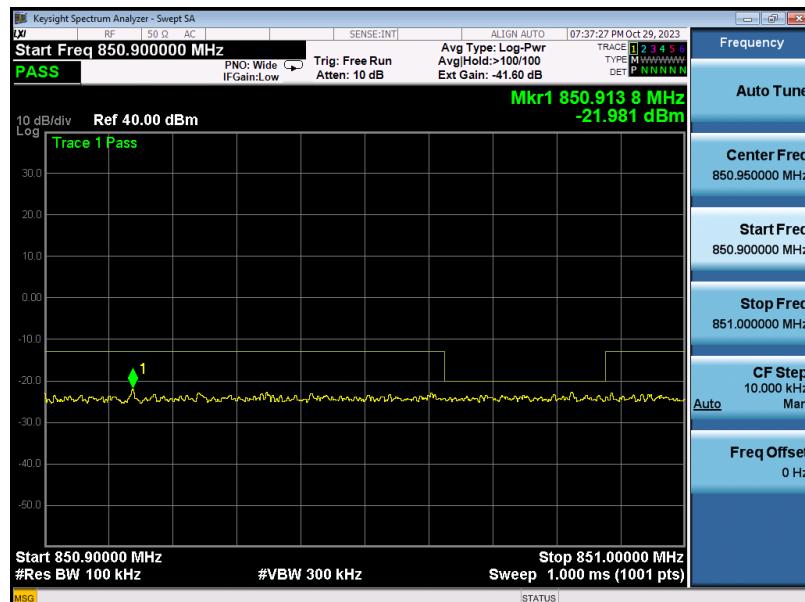


## Conducted spurious emissions

## DL\_CW\_MCH\_Pre-AGC



## DL\_CW\_MCH\_Pre-AGC



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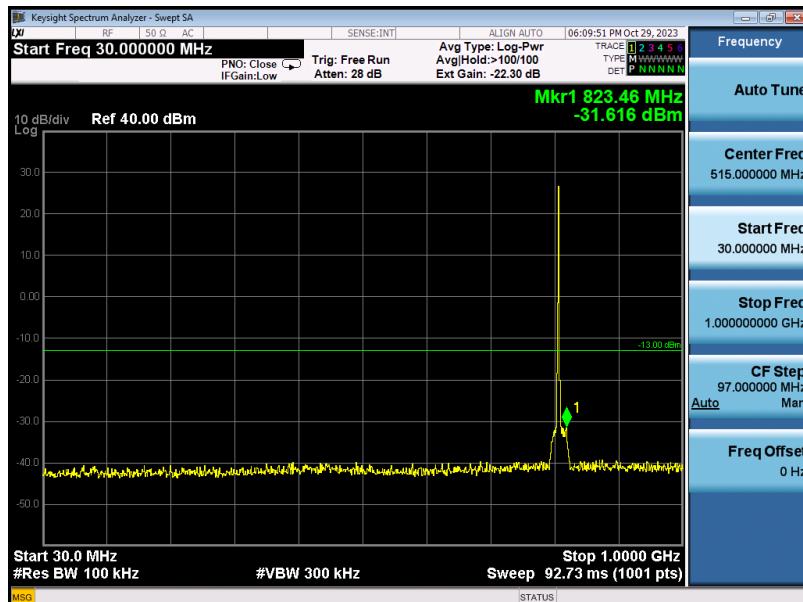
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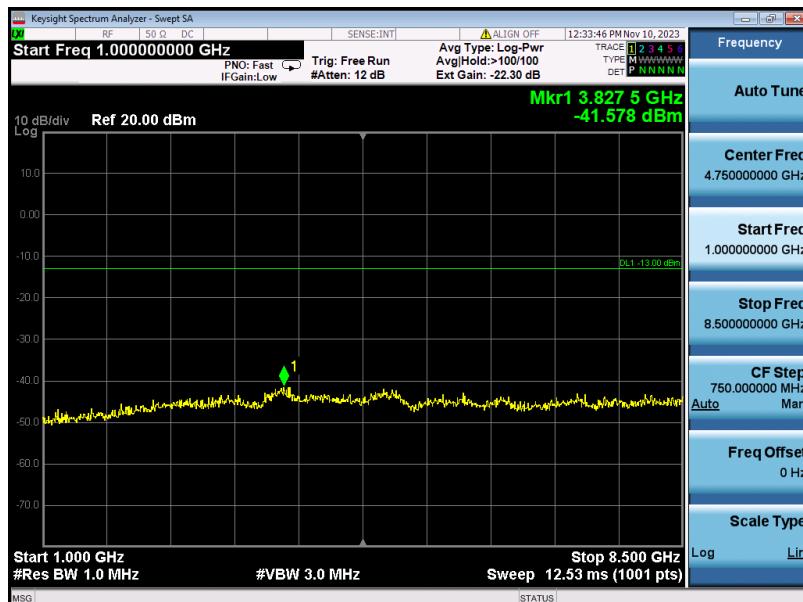
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## Conducted spurious emissions

## UL\_CW\_MCH\_Pre-AGC



## UL\_CW\_MCH\_Pre-AGC



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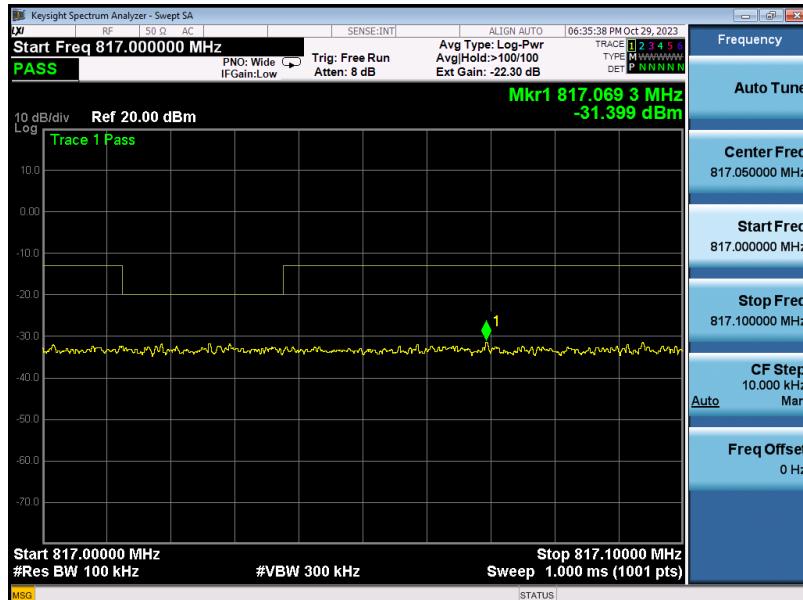
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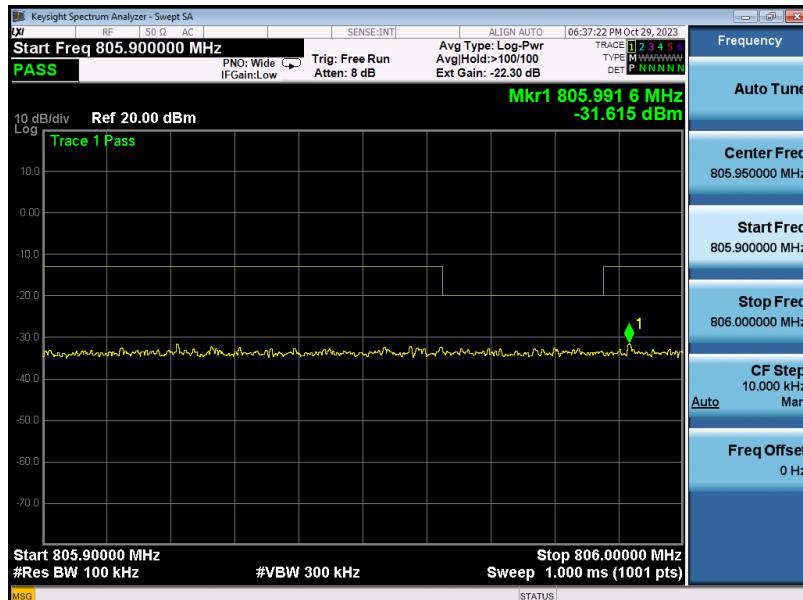
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## Conducted spurious emissions

## UL\_CW\_MCH\_Pre-AGC



## UL\_CW\_MCH\_Pre-AGC



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**Remark:**

1. Spurious emissions from a signal booster must not exceed -13 dBm within any 100 kHz measurement bandwidth.
2. 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  $116 \text{ Log10}(f/6.1)$  decibels or  $50 + 10 \text{ Log10}(P)$  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.

For DL,  $P = 40 \text{ dBm} = 10 \text{ W}$ ,  $50 + 10 \log_{10}(10 \text{ W}) = 60 \text{ dB}$

For UL,  $P = 27 \text{ dBm} = 0.5 \text{ W}$ ,  $50 + 10 \log_{10}(0.5 \text{ W}) = 47 \text{ dB}$

$116 \text{ Log10}(f/6.1) = 36.2 \text{ dB}$  (min.) or  $91.5 \text{ dB}$  (max.)

The attenuation below the transmitter power (P) was taken  $50 + 10 \text{ Log10}(P)$  as most restricted limit to determine the test result conveniently.

Therefore,

For DL, the limit was  $40 - [50 + 10 \log_{10}(10 \text{ W})] = -20 \text{ dBm}$

For UL, the limit was  $27 - [50 + 10 \log_{10}(0.5 \text{ W})] = -20 \text{ dBm}$

3. 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  $43 + 10 \text{ Log10}(P)$  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 37.5 kHz.

For DL,  $P = 40 \text{ dBm} = 10 \text{ W}$

The limit =  $40 \text{ dBm} - [43 + 10 \log_{10}(10 \text{ W})] \text{ dB} = -13 \text{ dBm}$

For UL,  $P = 27 \text{ dBm} = 0.5 \text{ W}$

The limit =  $27 \text{ dBm} - [43 + 10 \log_{10}(0.5 \text{ W})] \text{ dB} = -13 \text{ dBm}$

4. The spurious emissions 9kHz to 30MHz were very low and not displayed in this report.



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## 8 Noise

Noise			
Test Path	Frequency Range (MHz)	Worst conducted test level (dBm)	Note
DL	851-862	-20.29	Within the passband
	30-850	-35.64	Outside of the passband
	863-9000	-31.70	
UL	806-817	-27.42	Within the passband
	30-805	-43.24	Outside of the passband
	818-8500	-42.96	

Remark:

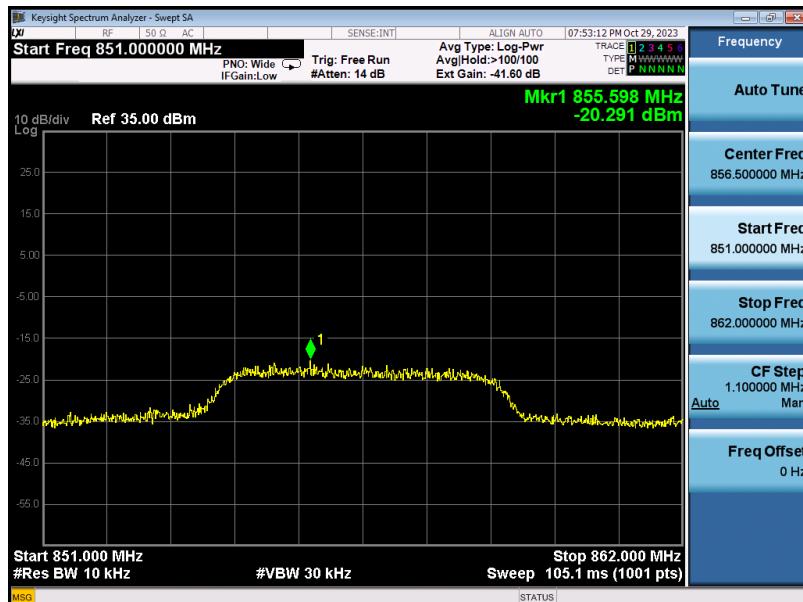
1. ERP= output power (dBm)+ antenna gain (dBi)- 2.15, the antenna gain is 10dBi declared by the manufacturer.
2. For DL, the ERP of worst noise within the passband is  $-20.29/10\text{kHz} + 10\text{dBi} - 2.15\text{dB} = -12.44\text{dBm}$ , the applicant must use good engineering practice to make sure that the ERP of noise within the passband should not exceed the limit -43dBm in 10kHz measurement bandwidth.
- The ERP of worst noise outside of the passband is  $-31.70/10\text{kHz} + 10\text{dBi} - 2.15\text{dB} = -23.85\text{dBm}$ , 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.
3. For UL, the ERP of worst noise within the passband is  $-27.42/10\text{kHz} + 10\text{dBi} - 2.15\text{dB} = -19.57\text{dBm}$ , 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.
- The ERP of worst noise outside of the passband is  $-42.96/10\text{kHz} + 10\text{dBi} - 2.15\text{dB} = -35.11\text{dBm}$ , 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.
4. The noise 9kHz to 30MHz were very low and not displayed in this report.

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## Noise

## DL\_Within the passband



## UL\_Within the passband



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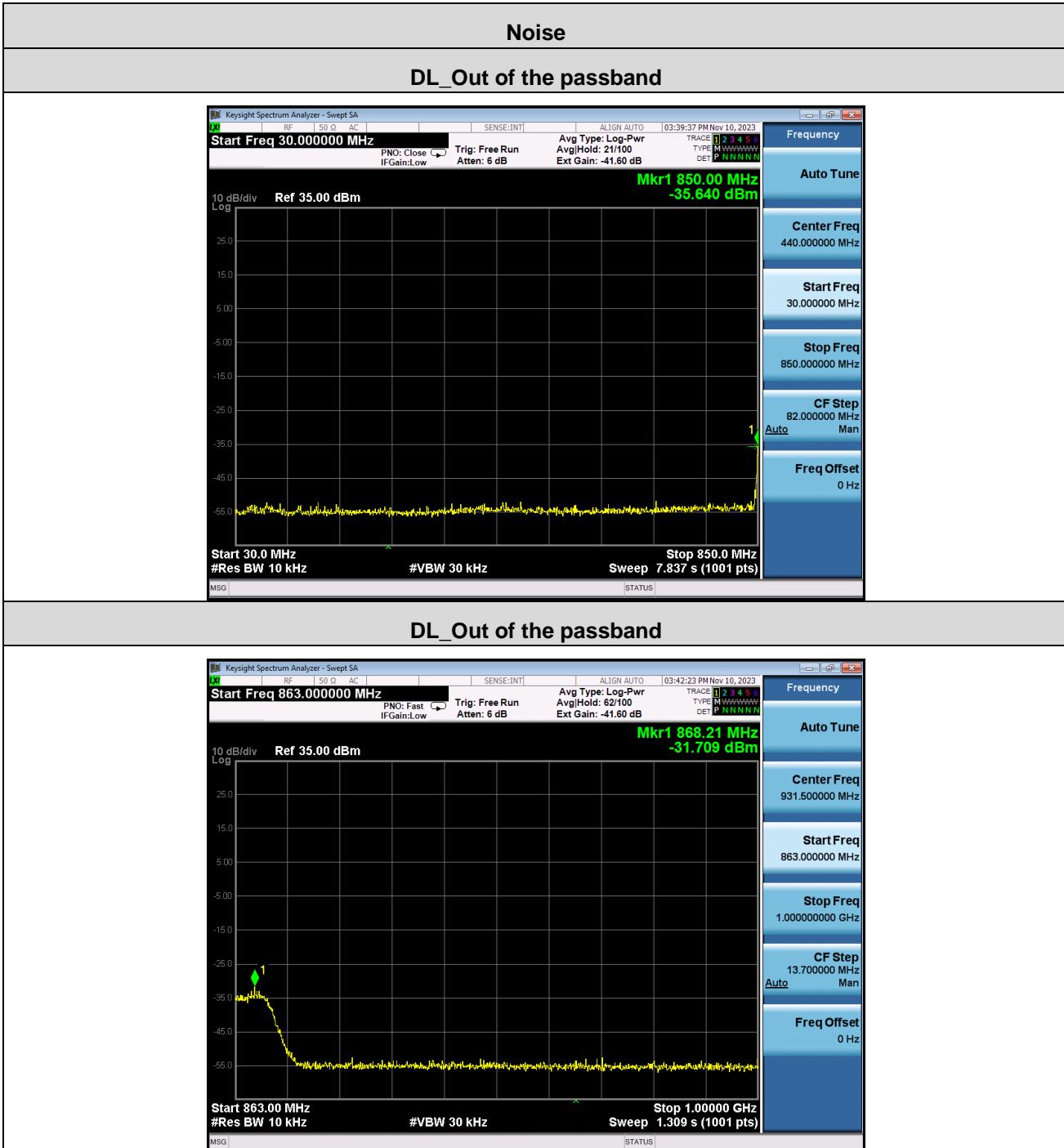
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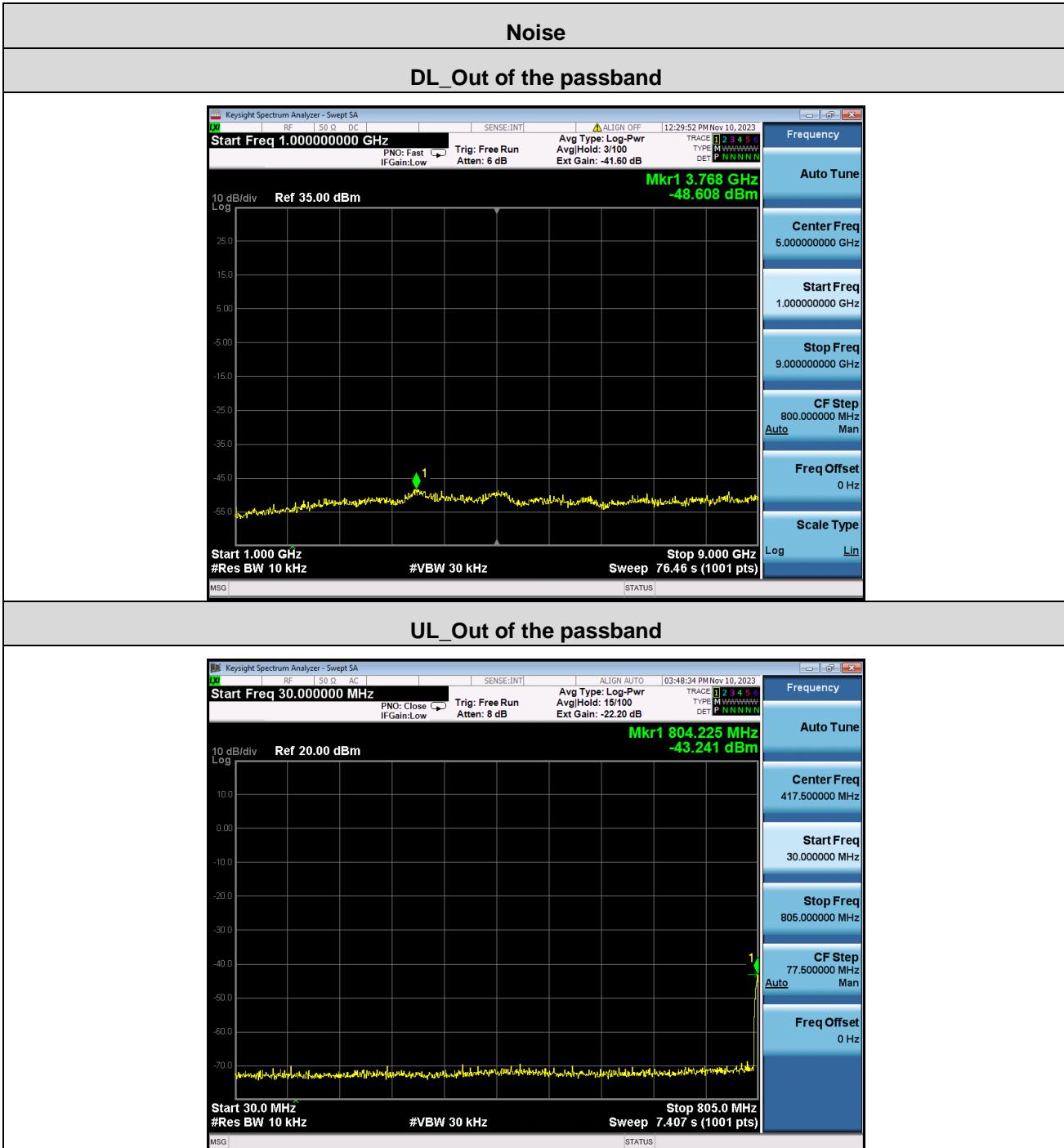
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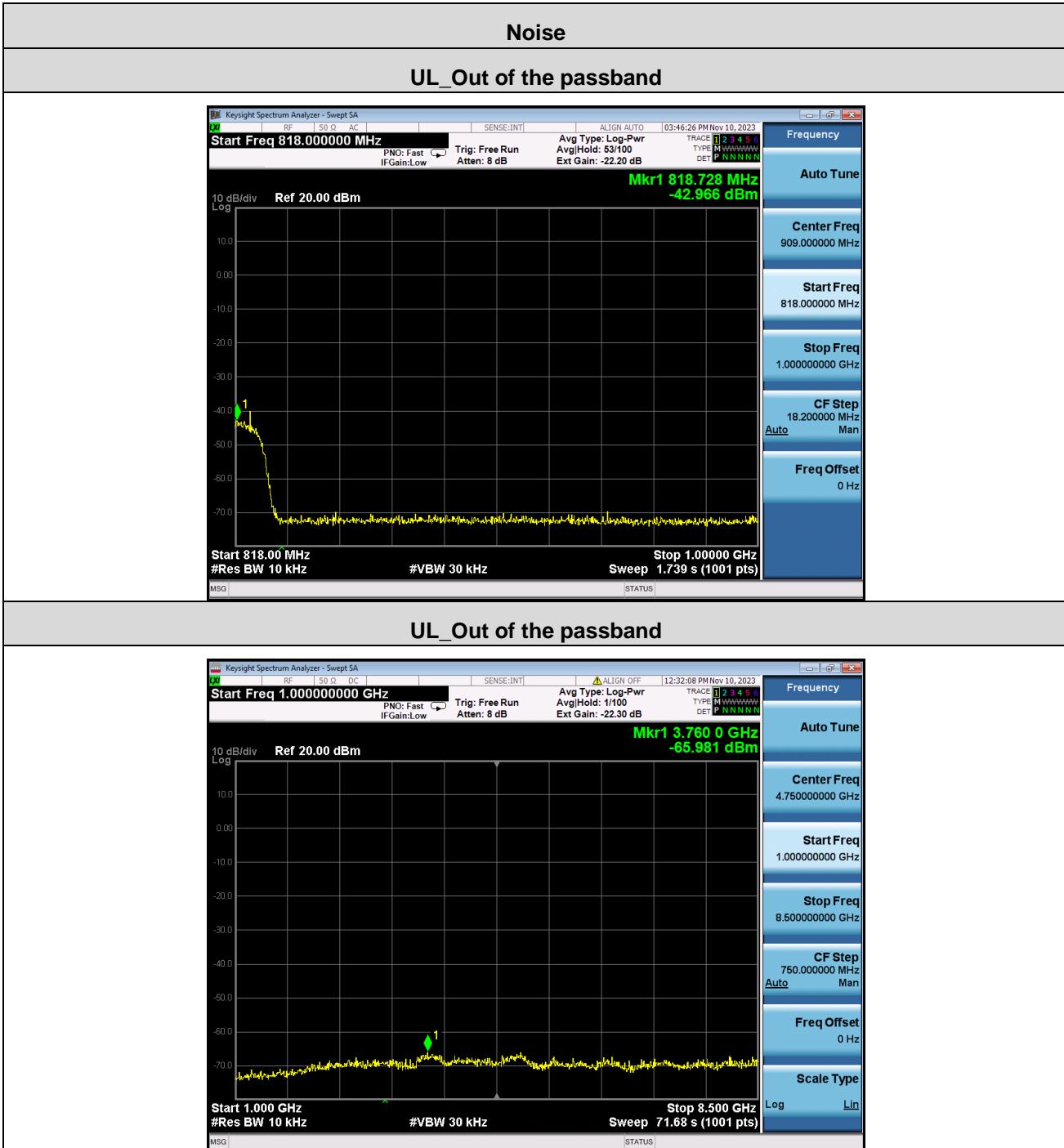
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**9 Frequency Stability**

Frequency stability vs voltage							
Test path	Test Freq. (MHz)	Test Signal	Temperature	Voltage	Freq. error (Hz)	Tolerance (ppm)	Verdict
DL	856.5	4.1MHz AWGN	TN	VL	23	0.0269	PASS
			TN	VH	19	0.0222	PASS
		4kHz FM	TN	VL	11	0.0128	PASS
			TN	VH	13	0.0152	PASS
		11.3kHz FM	TN	VL	17	0.0198	PASS
			TN	VH	14	0.0163	PASS
		16kHz FM	TN	VL	19	0.0222	PASS
			TN	VH	21	0.0245	PASS
UL	811.5	4.1MHz AWGN	TN	VL	28	0.0345	PASS
			TN	VH	21	0.0259	PASS
		4kHz FM	TN	VL	11	0.0136	PASS
			TN	VH	14	0.0173	PASS
		11.3kHz FM	TN	VL	15	0.0185	PASS
			TN	VH	17	0.0209	PASS
		16kHz FM	TN	VL	12	0.0148	PASS
			TN	VH	21	0.0259	PASS

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Frequency stability vs temperature							
Test Path	Test Freq. (MHz)	Test Signal	Voltage	Temperature (°C)	Freq. error (Hz)	Tolerance (ppm)	Verdict
DL	856.5	4.1MHz AWGN	VN	+50	21	0.0245	PASS
			VN	+40	22	0.0257	PASS
			VN	+30	20	0.0234	PASS
			VN	+20	21	0.0245	PASS
			VN	+10	22	0.0257	PASS
			VN	0	24	0.0280	PASS
			VN	-10	19	0.0222	PASS
			VN	-20	23	0.0269	PASS
			VN	-30	21	0.0245	PASS
	856.5	4kHz FM	VN	+50	10	0.0117	PASS
			VN	+40	14	0.0163	PASS
			VN	+30	10	0.0117	PASS
			VN	+20	15	0.0175	PASS
			VN	+10	12	0.0140	PASS
			VN	0	14	0.0163	PASS
			VN	-10	13	0.0152	PASS
			VN	-20	9	0.0105	PASS
			VN	-30	17	0.0198	PASS

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Frequency stability vs temperature							
Test Path	Test Freq. (MHz)	Test Signal	Voltage	Temperature (°C)	Freq. error (Hz)	Tolerance (ppm)	Verdict
DL	856.5	11.3kHz FM	VN	+50	16	0.0187	PASS
			VN	+40	15	0.0175	PASS
			VN	+30	18	0.0210	PASS
			VN	+20	10	0.0117	PASS
			VN	+10	12	0.0140	PASS
			VN	0	12	0.0140	PASS
			VN	-10	10	0.0117	PASS
			VN	-20	10	0.0117	PASS
			VN	-30	14	0.0163	PASS
	856.5	16kHz FM	VN	+50	17	0.0198	PASS
			VN	+40	14	0.0163	PASS
			VN	+30	12	0.0140	PASS
			VN	+20	12	0.0140	PASS
			VN	+10	17	0.0198	PASS
			VN	0	16	0.0187	PASS
			VN	-10	13	0.0152	PASS
			VN	-20	19	0.0222	PASS
			VN	-30	16	0.0187	PASS

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Frequency stability vs temperature							
Test Path	Test Freq. (MHz)	Test Signal	Voltage	Temperature (°C)	Freq. error (Hz)	Tolerance (ppm)	Verdict
UL	811.5	4.1MHz AWGN	VN	+50	23	0.0283	PASS
			VN	+40	22	0.0271	PASS
			VN	+30	19	0.0234	PASS
			VN	+20	24	0.0296	PASS
			VN	+10	19	0.0234	PASS
			VN	0	26	0.0320	PASS
			VN	-10	22	0.0271	PASS
			VN	-20	25	0.0308	PASS
			VN	-30	19	0.0234	PASS
	811.5	4kHz FM	VN	+50	12	0.0148	PASS
			VN	+40	16	0.0197	PASS
			VN	+30	18	0.0222	PASS
			VN	+20	18	0.0222	PASS
			VN	+10	16	0.0197	PASS
			VN	0	12	0.0148	PASS
			VN	-10	18	0.0222	PASS
			VN	-20	10	0.0123	PASS
			VN	-30	18	0.0222	PASS

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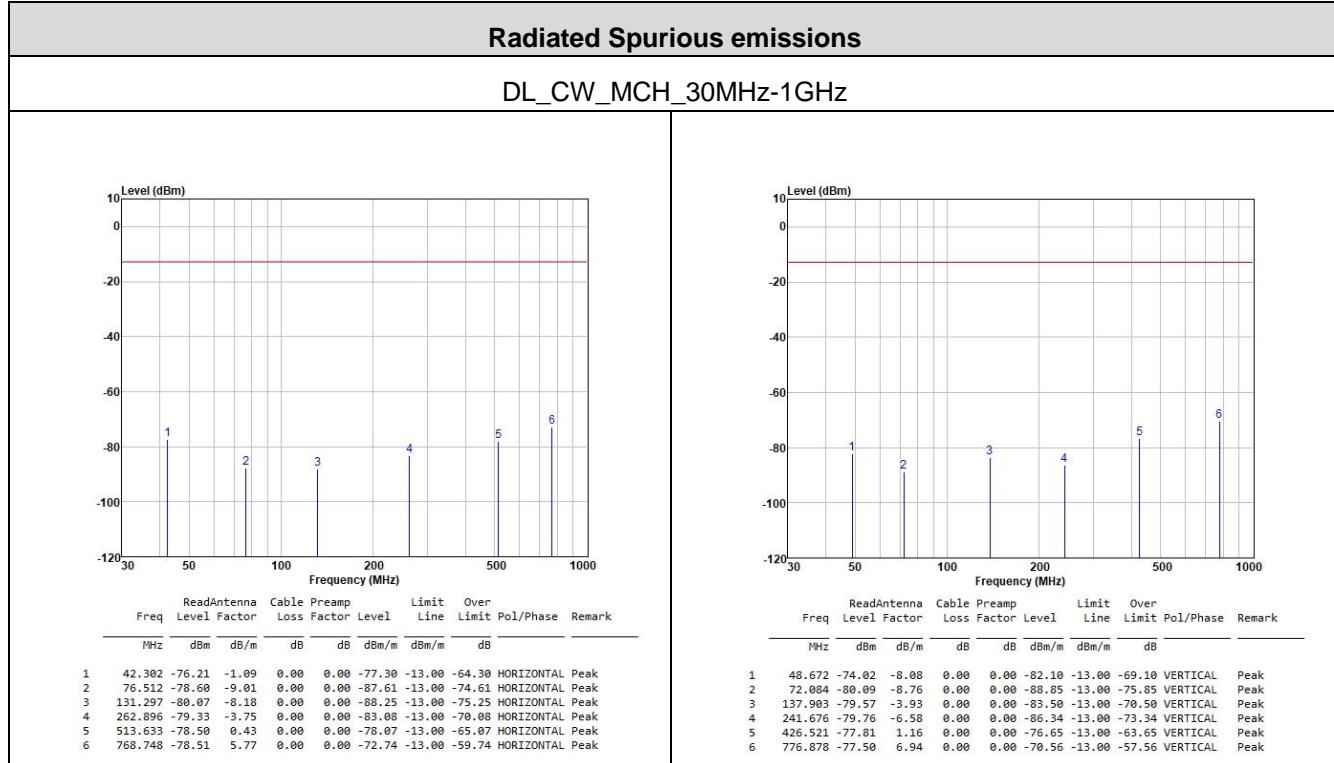
Frequency stability vs temperature							
Test Path	Test Freq. (MHz)	Test Signal	Voltage	Temperature (°C)	Freq. error (Hz)	Tolerance (ppm)	Verdict
UL	811.5	11.3kHz FM	VN	+50	14	0.0173	PASS
			VN	+40	18	0.0222	PASS
			VN	+30	12	0.0148	PASS
			VN	+20	14	0.0173	PASS
			VN	+10	15	0.0185	PASS
			VN	0	16	0.0197	PASS
			VN	-10	15	0.0185	PASS
			VN	-20	13	0.0160	PASS
			VN	-30	18	0.0222	PASS
	811.5	16kHz FM	VN	+50	10	0.0123	PASS
			VN	+40	18	0.0222	PASS
			VN	+30	9	0.0111	PASS
			VN	+20	10	0.0123	PASS
			VN	+10	17	0.0209	PASS
			VN	0	11	0.0136	PASS
			VN	-10	13	0.0160	PASS
			VN	-20	18	0.0222	PASS
			VN	-30	13	0.0160	PASS

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## 10 Radiated Spurious emissions



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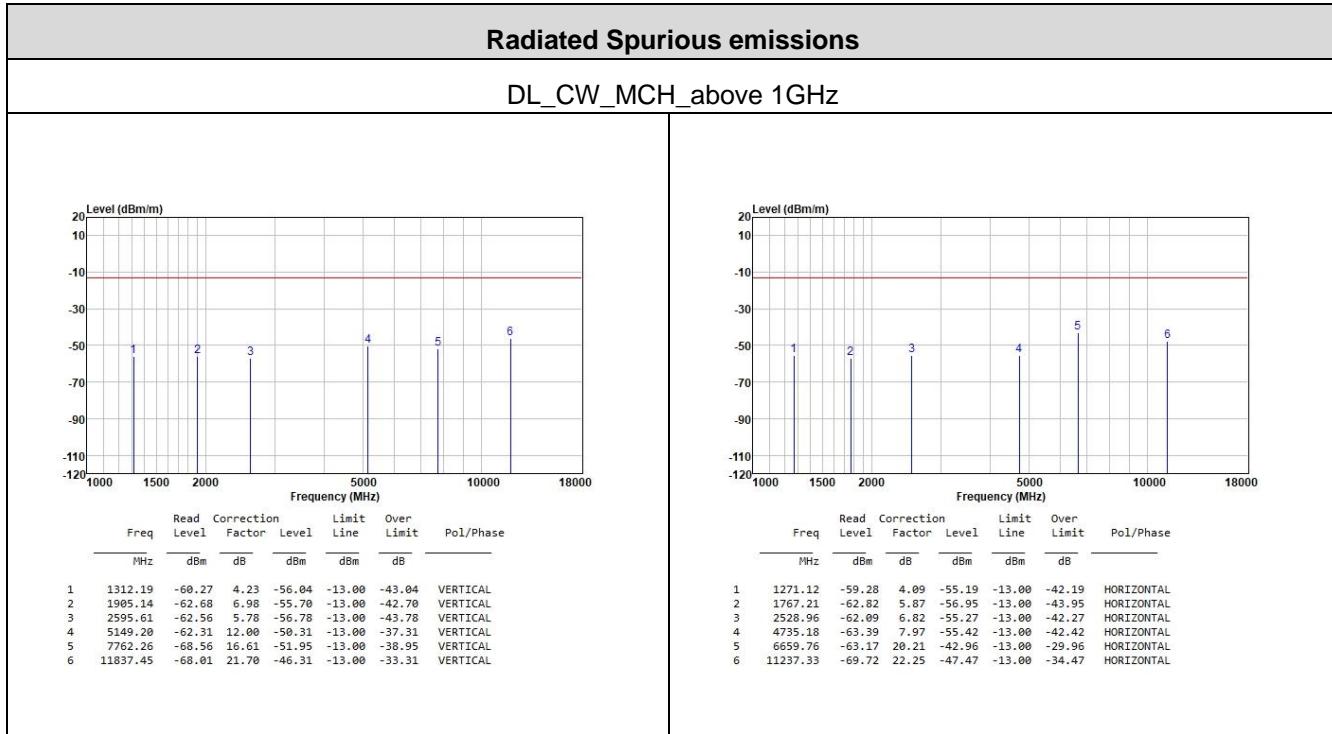
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**Remark:**

1. Pre-test was performed for UL/DL, 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.
2. 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  $43 + 10\log_{10}(P)$  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.

For DL, P = 40dBm = 10W

The limit =  $40\text{dBm} - [43 + 10 \log_{10} (10\text{W})] \text{ dB} = -13\text{dBm}$

For UL, P = 27dBm = 0.5W

The limit =  $27\text{dBm} - [43 + 10 \log_{10} (0.5\text{W})] \text{ dB} = -13\text{dBm}$

**--End of Appendix--**

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