Cellphone-Mate, Inc.

EMC TEST REPORT FOR

Guardian4-A

Tested to The Following Standards:

FCC Part 90 Section 219
Class A Booster

Report No.: 104177-14

Date of issue: October 13, 2020

This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

Test Certificate # 803.01

Testing the Future
CKC LABORATORIES, INC.

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Cellphone-Mate, Inc.
48346 Milmont Drive
Fremont CA 94538

Representative: Dennis Findley
Customer Reference Number: CKC20200721

REPORT PREPARED BY:

Terri Rayle
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 104177

DATE OF EQUIPMENT RECEIPT: July 20, 2020
DATE(S) OF TESTING: July 20-28, 2020 and September 16-22, 2020

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the equipment provided by the client, tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.
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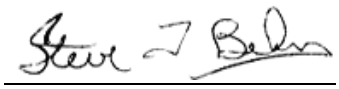


Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information

Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
1120 Fulton Place
Fremont, CA 94539

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.19
EMITest Immunity	5.03.10

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Japan
Canyon Park, Bothell, WA	US0081	US1022	A-0136
Brea, CA	US0060	US1025	A-0136
Fremont, CA	US0082	US1023	A-0136
Mariposa, CA	US0103	US1024	A-0136

*CKC's list of NIST designated countries can be found at: https://standards.gov/cabs/designations.html

SUMMARY OF RESULTS

Standard / Specification: FCC Part(s) 90 Section 219 Class A Booster
Industrial Booster Basic Measurement Guidance KDB 935210 D05 v01r04, April 3, 2020.

Correlation Matrix and Results					
Guidance Sec #	**Guidance Description**	**FCC Sec #**	**FCC Rule Description**	**Mods**	**Results**
3.4	Input-versus-output signal comparison	2.1049/Part 90 Section 219 (a)	Occupied Band Width	NA	Pass
4.3	Out-of-band rejection	Part 90 Section 219 (b)	Frequency Bands	NA	Pass
4.4	Input-versus-output signal comparison and Out of Band Emissions	Part 90 Section 219 (b)	Out of Band Emission	Mod #1	Pass
4.5	Input/output power and amplifier/booster gain	Part 90 Section 219 (e)(1)	Power Limit	Mod #1	Pass
4.6	Noise figure measurements	Part 90 Section 219 (e)(2)	Noise Figure Limit	Mod #1	Pass
4.7.2	Out-of-band/out-of-block emissions conducted measurements	Part 90 Section 219 (e)(3)	Intermodulation Limit	Mod #1	Pass
4.7.3	EUT spurious emissions conducted measurements	Part 90 Section 219 (e)(3)	Spurious emission	NA	Pass
4.8	Frequency stability measurements	Part 90 Section 219 (e)(4)(i)	Power Limit	NA	NA1
4.9	Radiated Spurious Emission	Part 90 Section 219 (e)(3)	Spurious Emission	NA	Pass

NA = Not Applicable
NA1 = Not applicable. This device does not alter the input signal in ways that can influence the output signal.

ISO/IEC 17025 Decision Rule
The declaration of pass or fail herein is based upon assessment to the specification(s) listed above, including where applicable, assessment of measurement uncertainties. For performance related tests, equipment was monitored for specified criteria identified in that section of testing.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions
Modification #1: Change the new firmware to reduce output power. Firmware: 1/DIF board FPGA: FPGA A V1.1_0713 MCU: MCUch32lte_A V1.1_0713 2/RF board MCU: SC_Guardian_DIF_V1_1

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions
None

EQUIPMENT UNDER TEST (EUT)

During testing, numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration 1

Equipment Tested:

Device	Manufacturer	Model #	S/N
Guardian4-A	Cellphone-Mate, Inc.	Guardian4-A	1

Support Equipment:

Device	Manufacturer	Model #	S/N
None			

Configuration 2

Equipment Tested:

Device	Manufacturer	Model #	S/N
Guardian4-A	Cellphone-Mate, Inc.	Guardian4-A	1

Support Equipment:

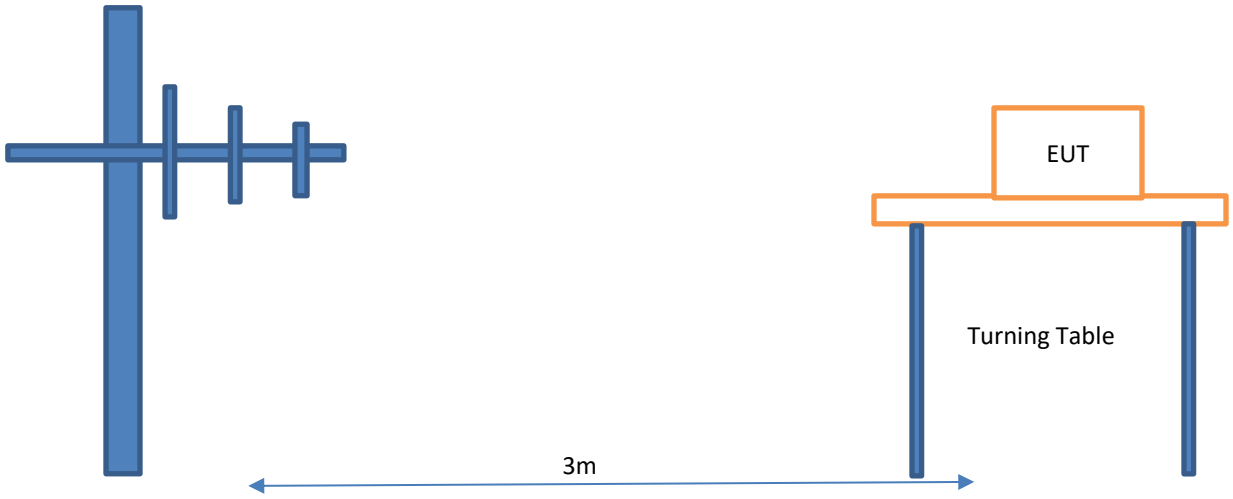
Device	Manufacturer	Model #	S/N
E-Net 8816TPC HUB	eNet	8816TPC	NA

General Product Information:

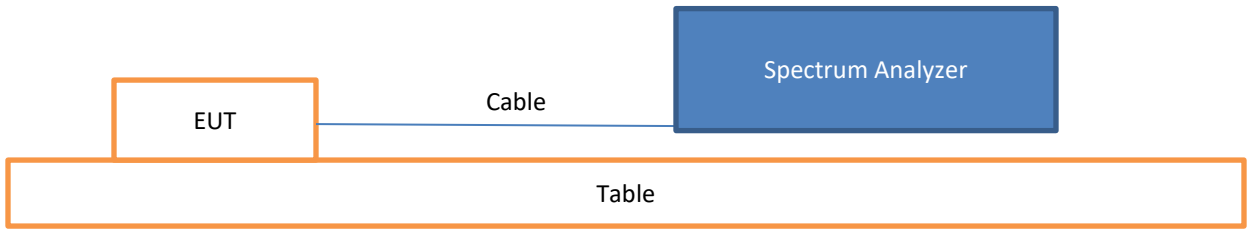
Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Equipment	Zone Enhancer
Operating Frequency Range:	UL: 799-805, 806-816 MHz DL: 769-775, 851-861 MHz
Modulation Type(s):	APCO w/ C4FM Analog FM (25kHz)
Number of TX Chains:	1
Antenna Type(s) and Gain:	Dedicated, See antenna kitting information
Beamforming Type:	NA
Antenna Connection Type:	UL: 50 Ohm/ N Type DL: 50 Ohm/ N Type
Nominal Input Voltage:	120VAC,60Hz
Firmware used for Test:	1. DIF board FPGA: FPGA A V1.0_0528 MCU: MCUch32lte_A V1.0_0528 2. RF board MCU: SC_Guardian_DIF_V1_0

Block Diagram(s) of Test Setup

Radiated Method Setup



Conducted Method Setup



FCC PART(S) 90

General Test Setup

Summary of Conditions
The equipment under test (EUT) is Public Safety Amplifier. It is a channelized authorized unit. It has 29 channels for 700MHz Band and 32 channels for 800MHz Band **Conducted Emission Method**: The EUT is placed on the test bench. Evaluation performed at the Outside (Donor) and Inside (Server) antenna port. The EUT Server port is a type N connector and 50-ohm impedance. The EUT Donor port is type N connector and 50-ohm impedance. All switches are in the on position. Radiated **Emission Method**: The EUT is operated and set up as intended. The output of an antenna port is terminated by 50Ohm loads. The input of antenna port is connected to the signal generation. The EUT is connected to the Ethernet Switch which is outside of the chamber through RJ45 cable to maximize function of the EUT. UL: 799-805, 806-816 MHz DL: 769-775, 851-861 MHz Test Procedure: 935210 D05 Indus Booster Basic Meas v01r04 Dated April 3, 2020.

3.4 Input-versus-Output Signal comparison

Test Setup/Conditions			
Test Location:	Fremont	Test Engineer:	Hieu Song Nguyenpham
Test Date(s):	7/28/2020		
Configuration:	1		
Test Setup:	See General Test Setup According to section 3.4 KDB 935210 D05V01r04, a 26 dB bandwidth measurement shall be performed on the input signal and the output signal		

Environmental Conditions					
Temperature (ºC)	23.5	Relative Humidity (%):	36	Pressure (kPa)	101.5

Test Equipment Radiated					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03471	Spectrum Analyzer	Agilent	E4440A	2/11/2020	2/11/2022
03418	Signal Generator	Agilent	E4438C	5/13/2019	5/13/2021
P05411	Attenuator	Weinschel	54A-10	11/27/2019	11/27/2021
P06467	Attenuator	Pasternack	PE7014-10	4/15/2019	4/15/2021
03360	Cable	Astrolab	32022-2-29094-36TC	4/9/2020	4/9/2022
P07192	Cable	Astro	32022-29094K-29094K-48TC	11/27/2019	11/27/2021

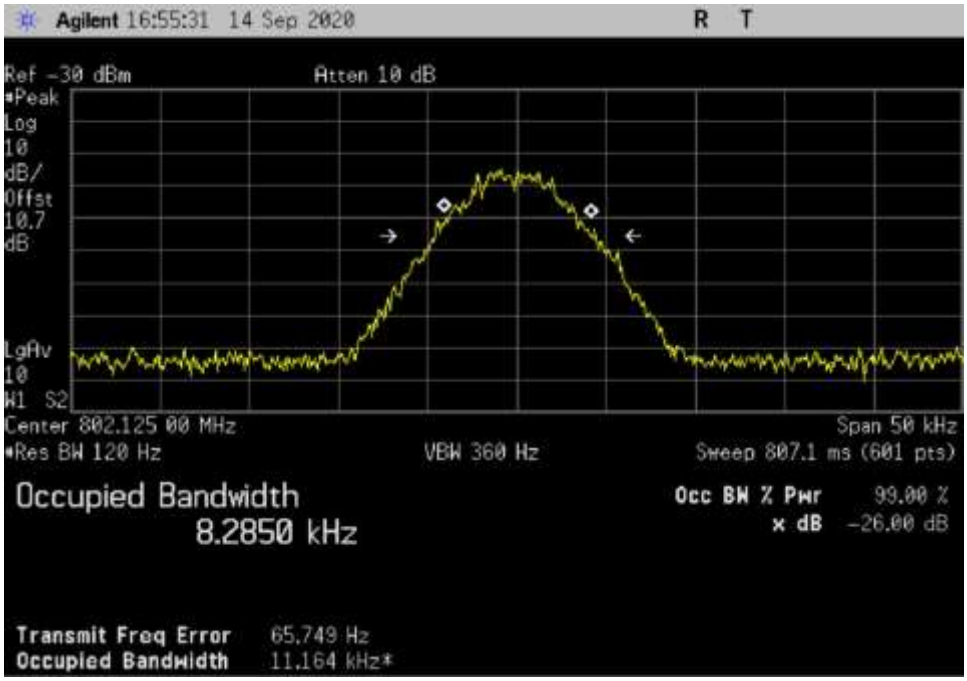
Summary of Results

Pass: Summarized in tables and plots below, the spectral shape of the output is similar to input for all modulations. Worst case results are reported for occupied bandwidth comparison test done with and without AGC circuitry activated.

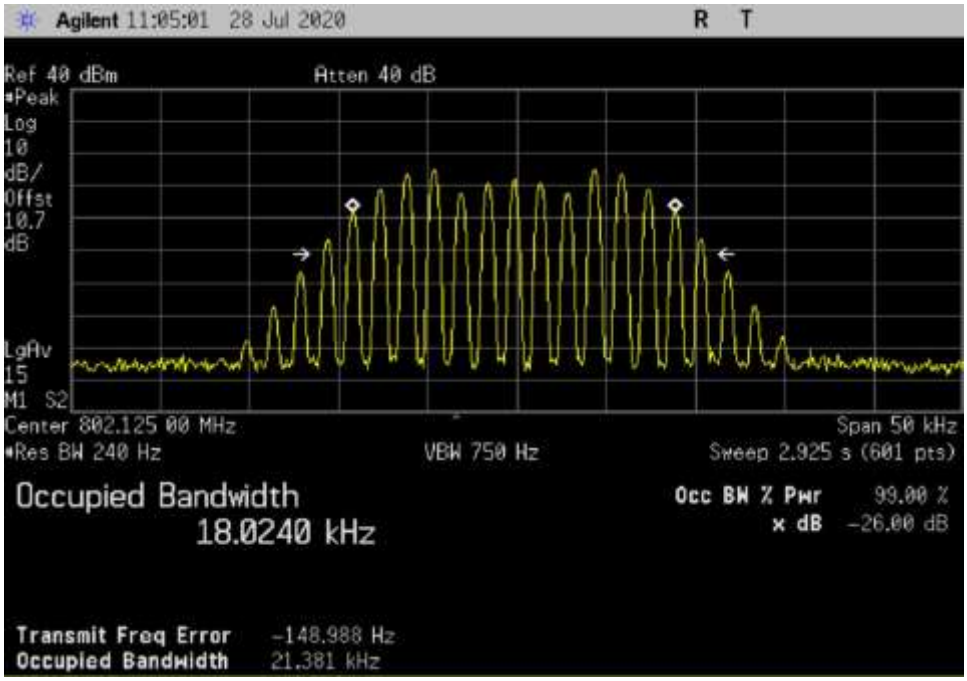
Public Safety 700MHz/800MHz bands

Band	Modulation	Carrier Frequency (MHz)	OBW PreAGC (Hz)	OBW AGC+3 (Hz)	OBW Input (Hz)	Max In&Out Difference (PreAGC)	Max In&Out Difference (AGC+3)
UL_806-809MHz	APCO 25 w/C4FM	807.25	10377	10713	10301	0.74%	4.00%
UL_806-809MHz	Analog FM 25kHz	807.25	21384	21382	21406	0.10%	0.11%
UL_809-816MHz	APCO 25 w/C4FM	812.25	11167	11094	10933	2.14%	1.47%
UL_809-816MHz	Analog FM 25kHz	812.25	21378	21380	21384	0.03%	0.02%
UL_799-805MHz	APCO 25 w/C4FM	802.125	10619	11609	11164	4.88%	3.99%
UL_799-805MHz	Analog FM 25kHz	802.125	21381	21379	21383	0.01%	0.02%
DL_851-854MHz	APCO 25 w/C4FM	852.25	10823	10958	10753	0.65%	1.91%
DL_851-854MHz	Analog FM 25kHz	852.25	21385	21383	21412	0.13%	0.18%
DL_854-861MHz	APCO 25 w/C4FM	857.25	11477	10778	11317	1.41%	4.76%
DL_854-861MHz	Analog FM 25kHz	857.25	21383	21379	21373	0.05%	0.03%
DL_769-775MHz	APCO 25 w/C4FM	772.125	11142	11237	11341	1.75%	0.92%
DL_769-775MHz	Analog FM 25kHz	772.125	21380	21383	21385	0.02%	0.01%

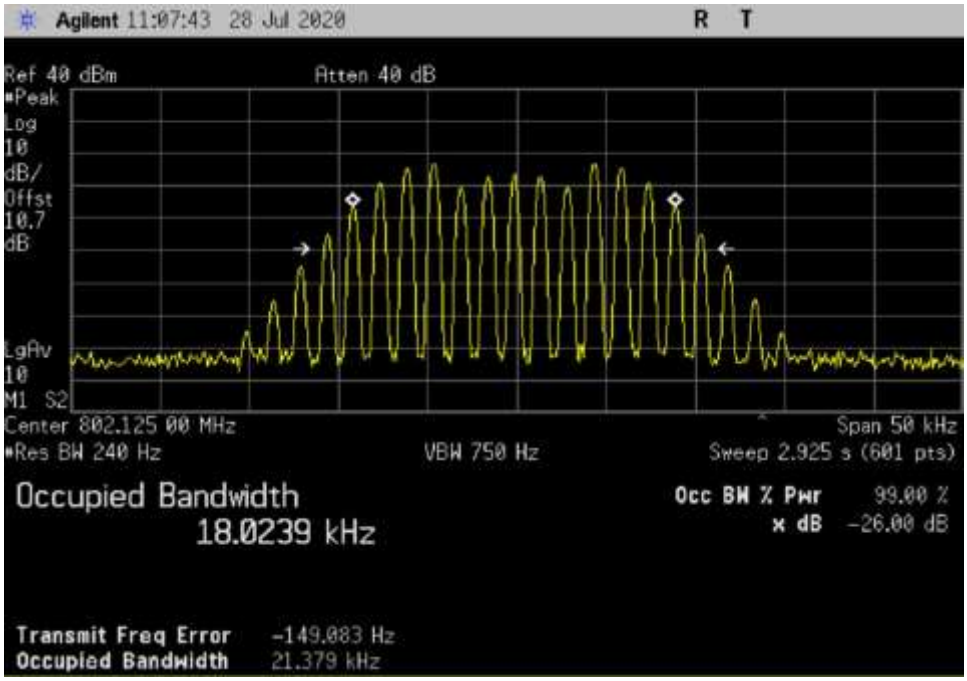
Plots



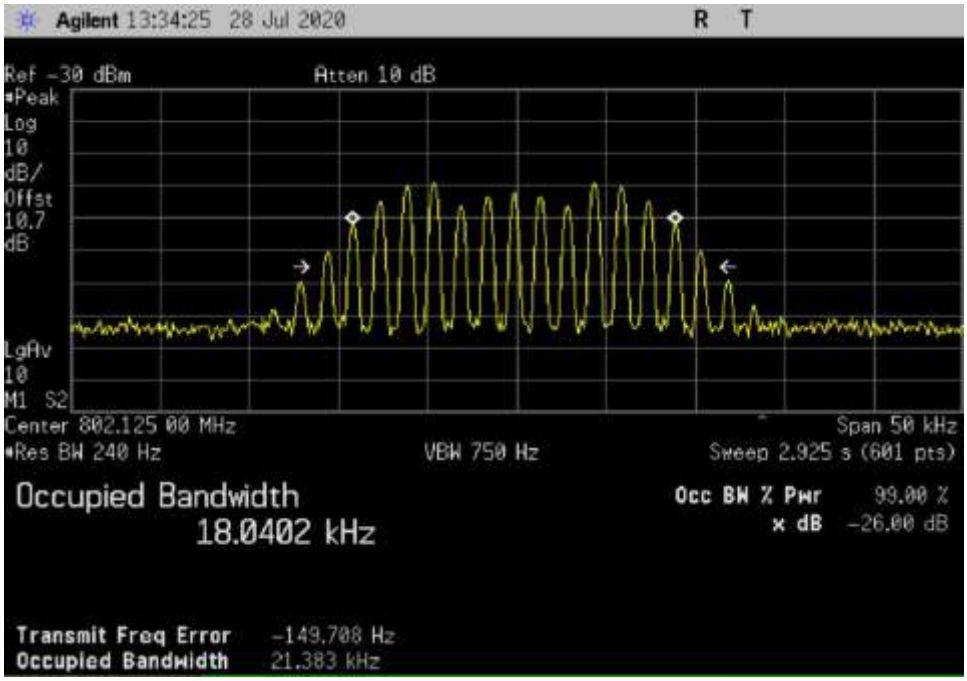
UL_799-805_APCO w/C4FM-Input_ 802.125MHz_MC



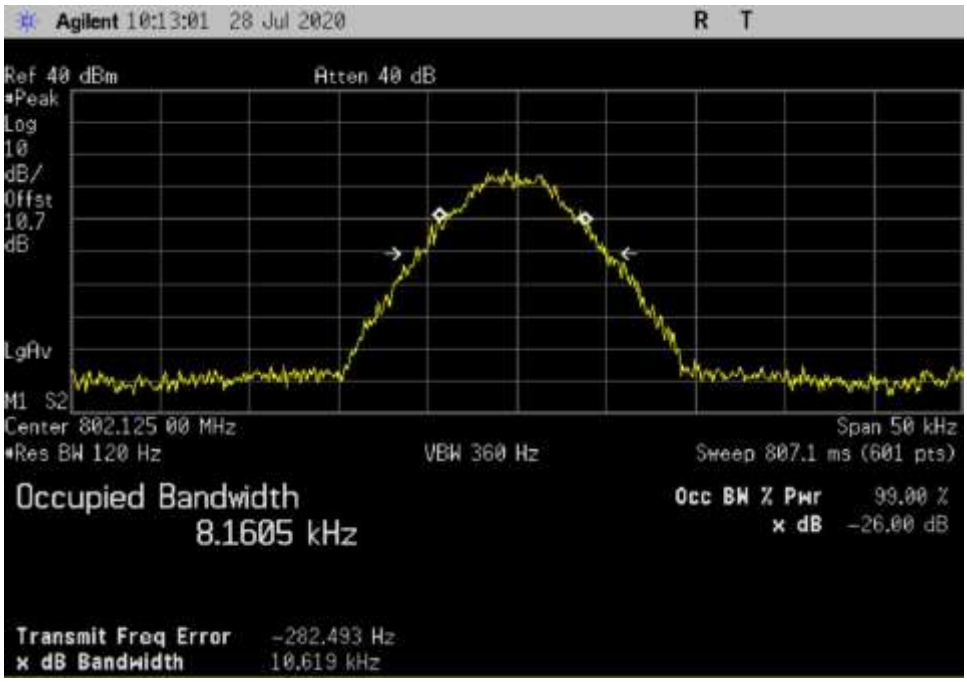
UL_799-805-Analog FM (25 kHz)_ 802.125MHz_MC



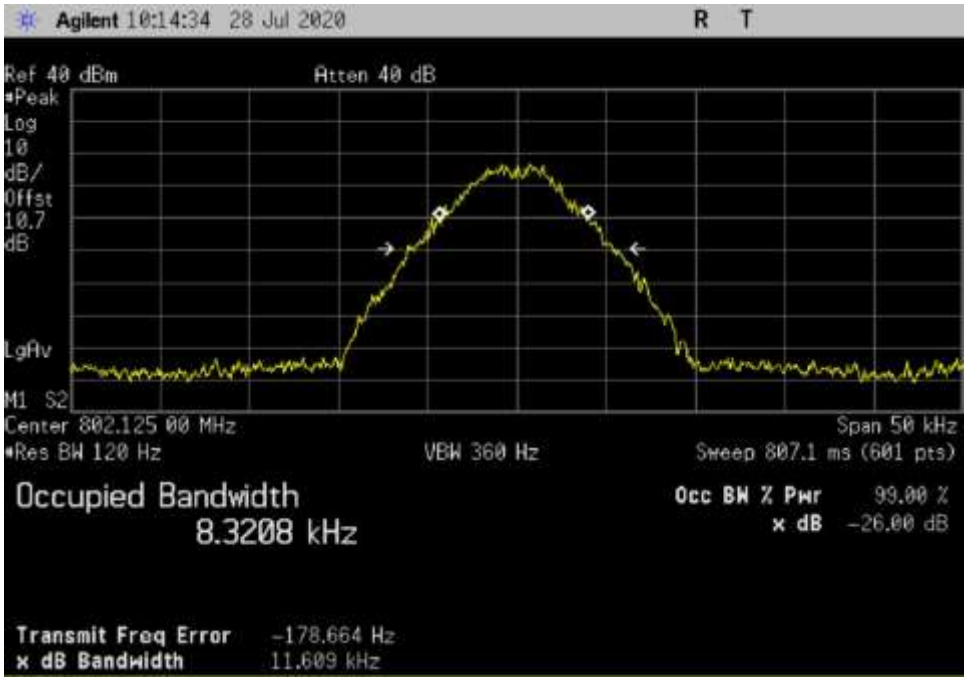
UL_799-805-Analog FM (25 kHz)-AGC+3_ 802.125MHz_MC



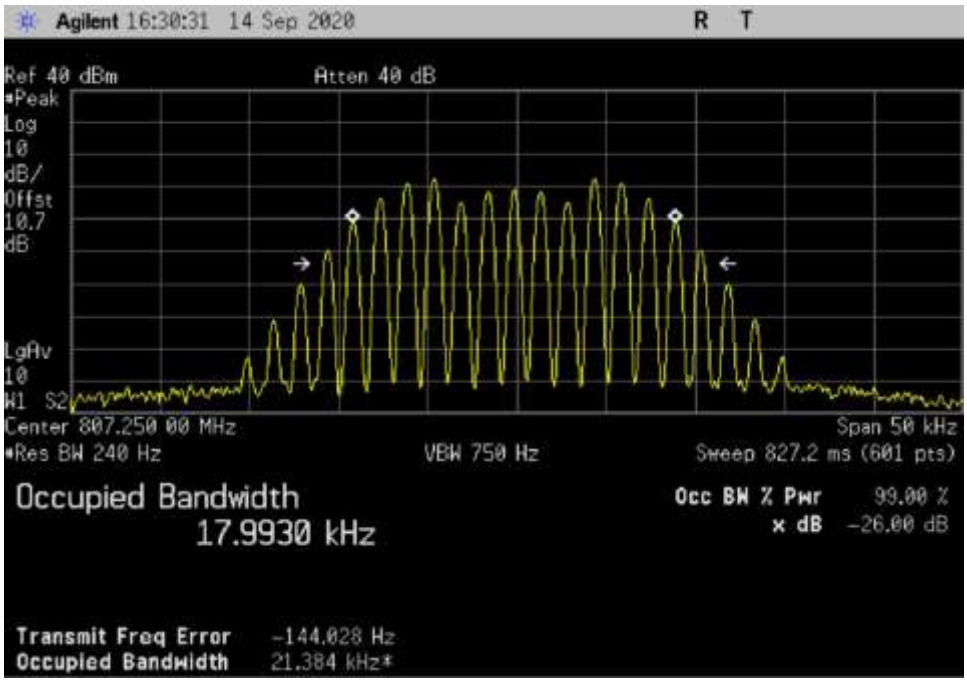
UL_799-805-Analog FM (25 kHz)-Input_ 802.125MHz_MC



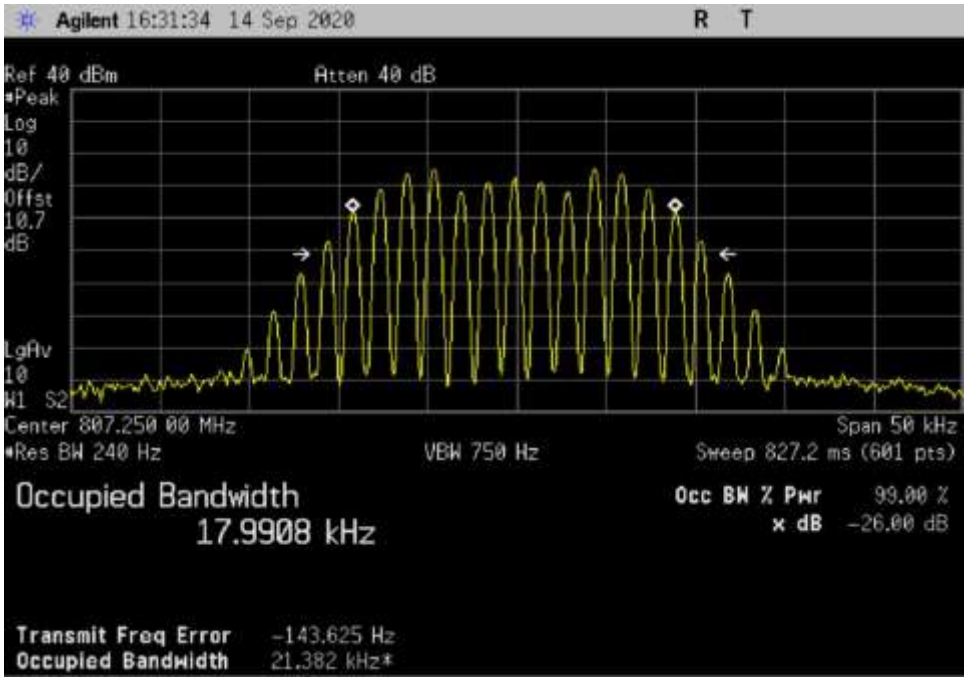
UL_799-805-APCO w/C4FM_ 802.125MHz_MC



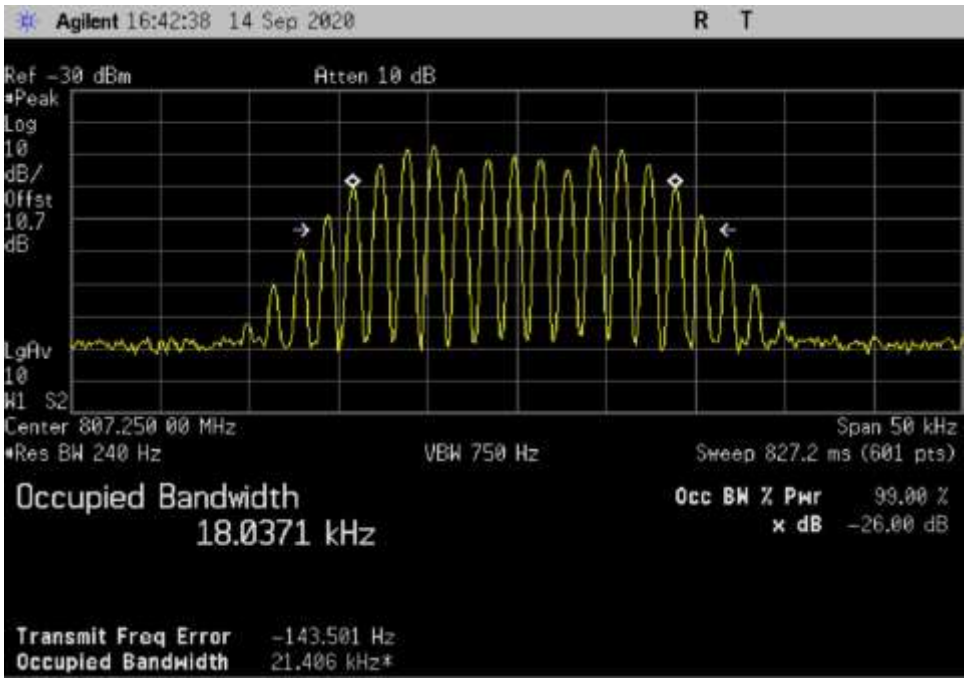
UL_799-805-APCO w/C4FM-AGC+3_ 802.125MHz_MC



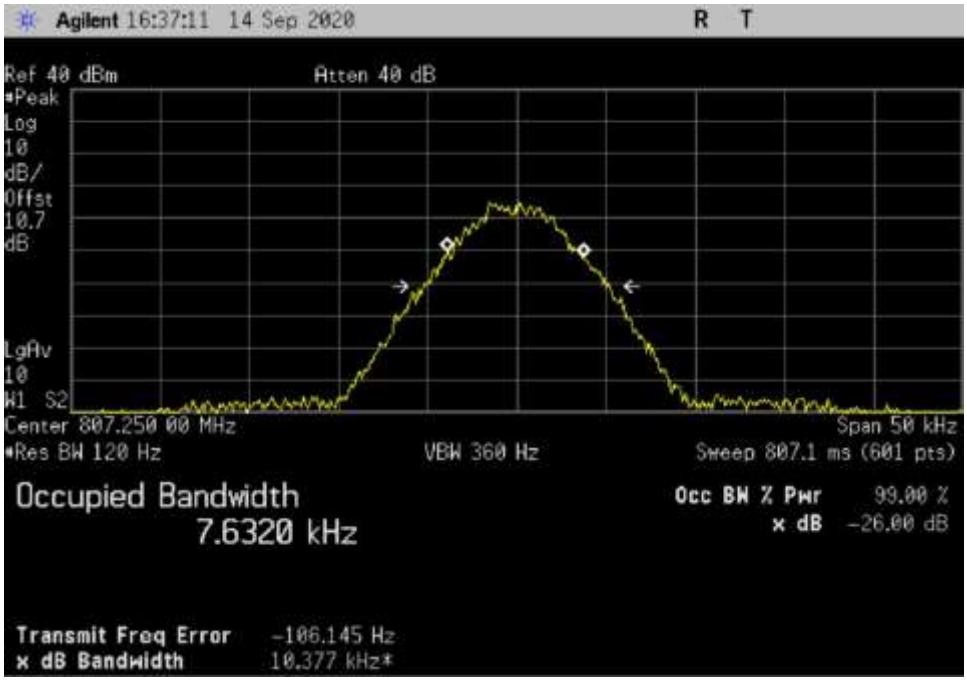
UL_806-809_Analog FM (25 kHz)_ 807.25MHz_MC



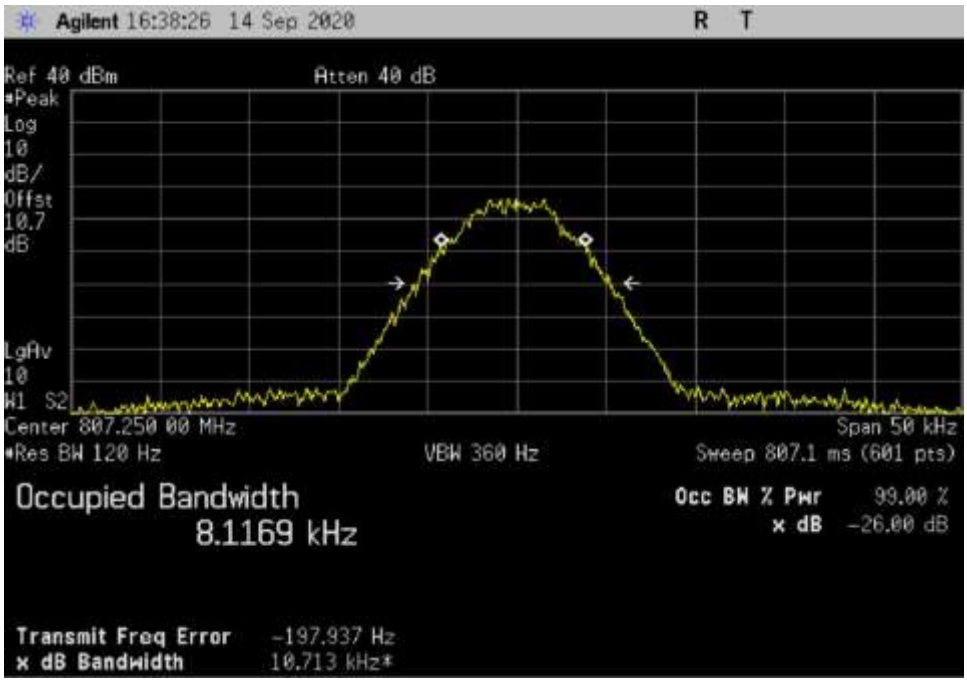
UL_806-809_Analog FM (25 kHz)-AGC+3_ 807.25MHz_MC



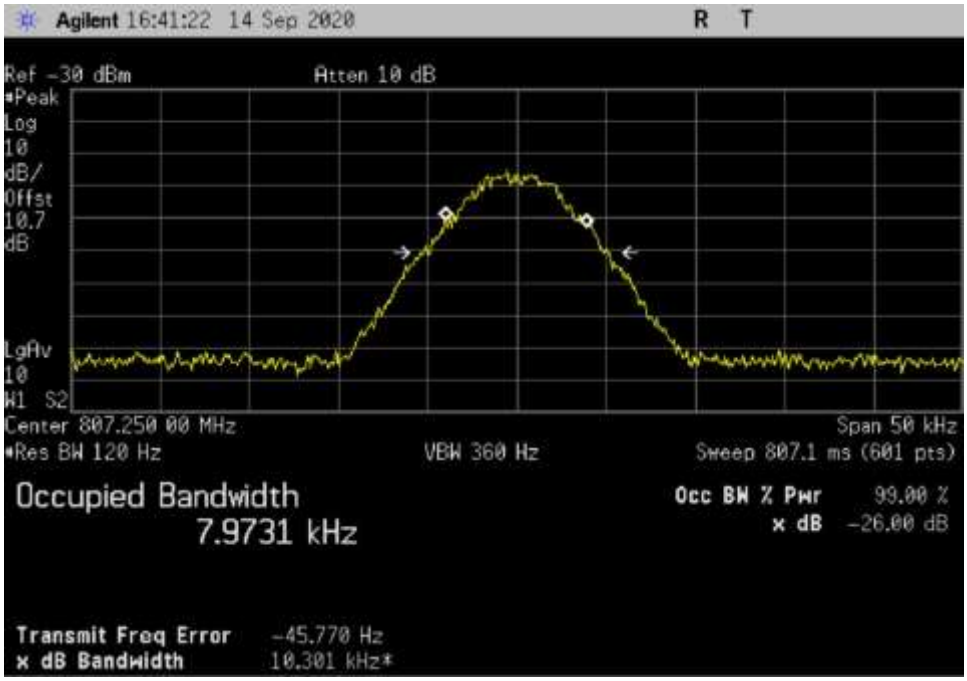
UL_806-809_Analog FM (25 kHz)-Input_ 807.25MHz_MC



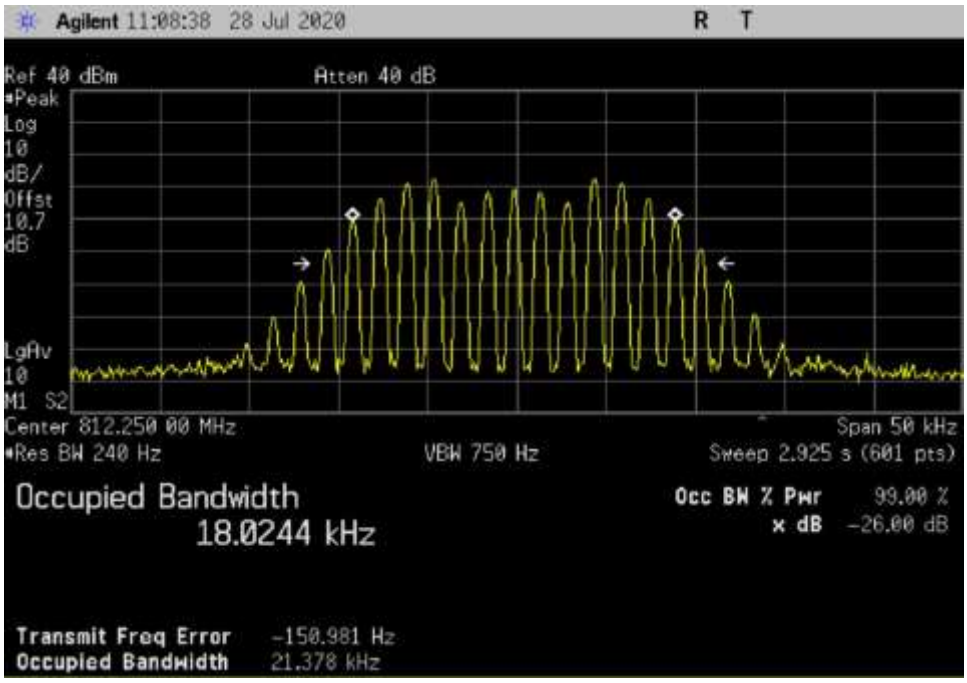
UL_806-809_APCO w/C4FM_ 807.25MHz_MC



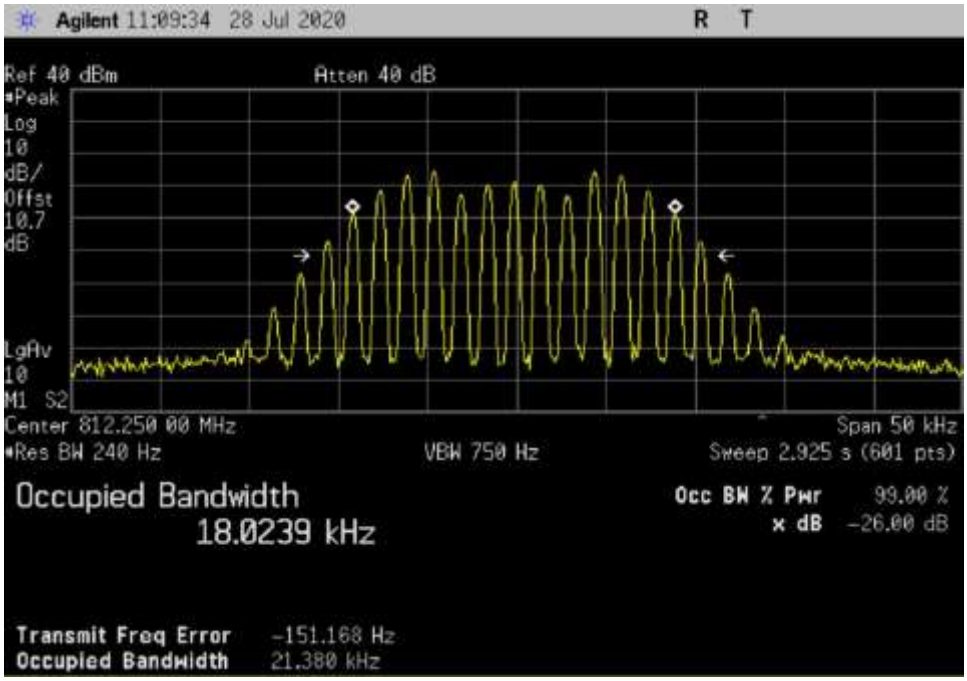
UL_806-809_APCO w/C4FM-AGC+3_ 807.25MHz_MC



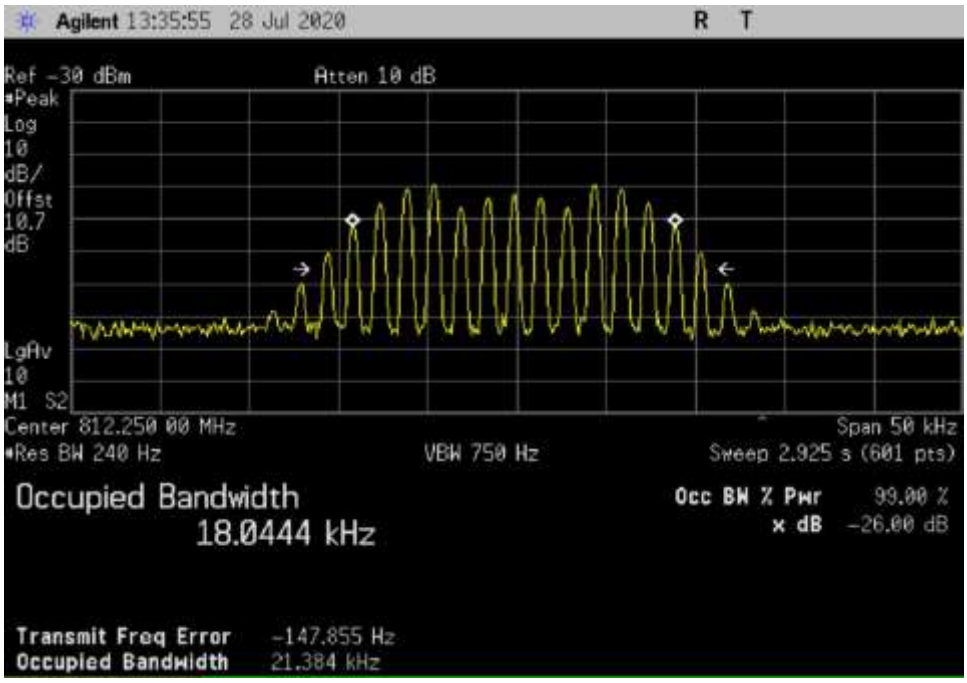
UL_806-809_APCO w/C4FM-Input_ 807.25MHz_MC



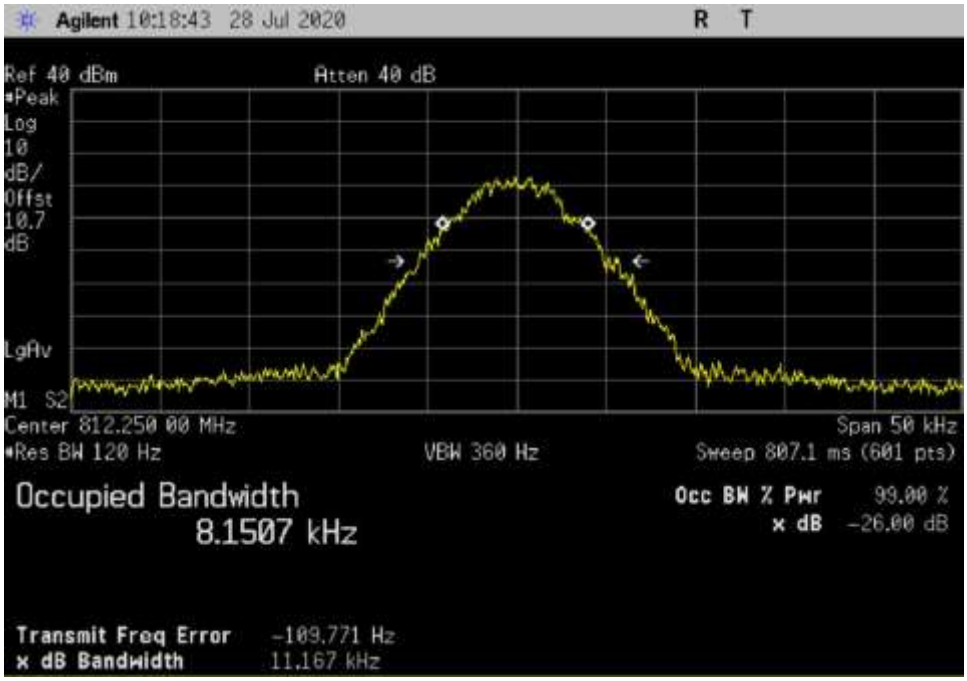
UL_806-816-Analog FM (25 kHz)_ 812.25MHz_MC



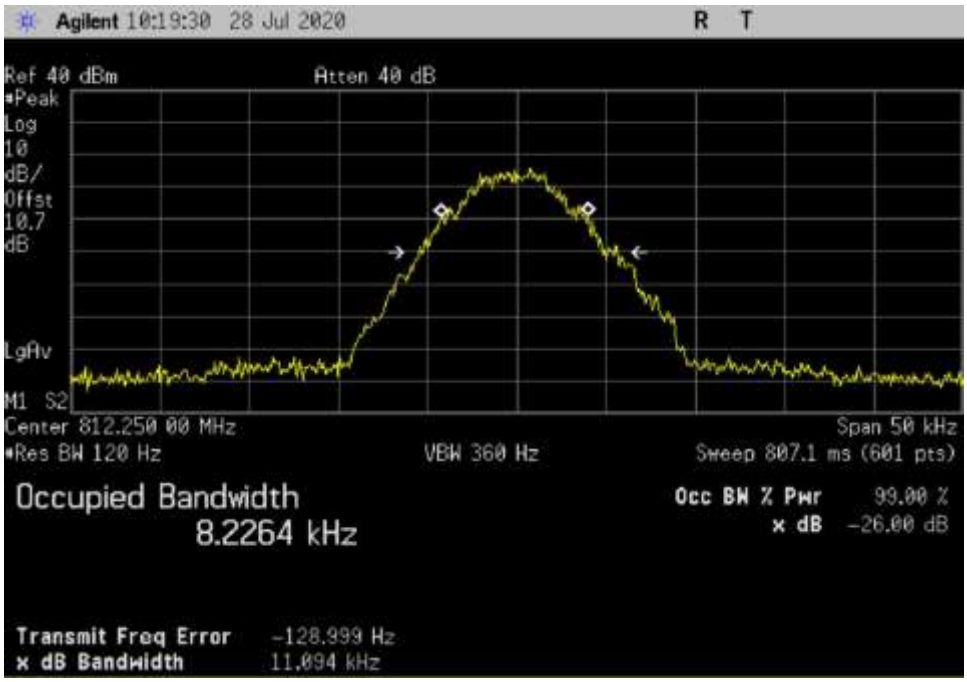
UL_806-816-Analog FM (25 kHz)-AGC+3_ 812.25MHz_MC



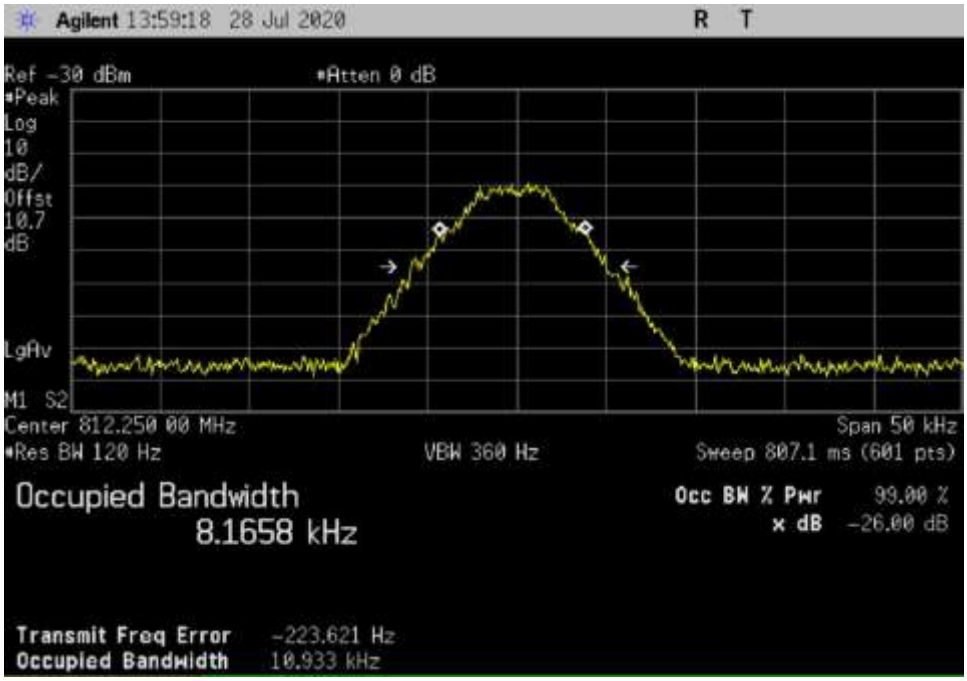
UL_806-816-Analog FM (25 kHz)-Input_ 812.25MHz_MC



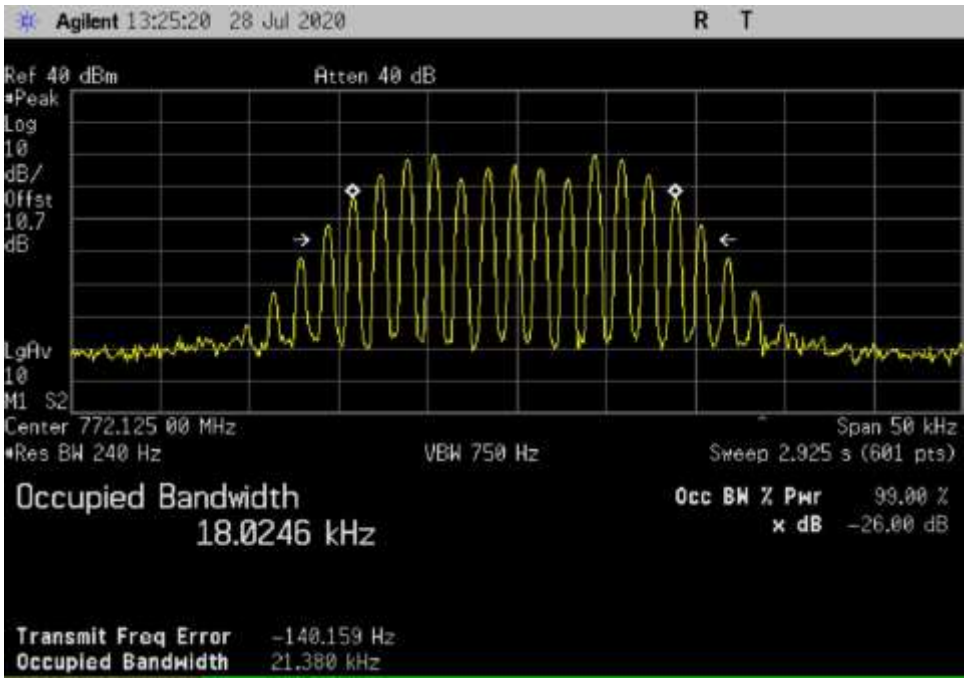
UL_806-816-APCO w/C4FM_ 812.25MHz_MC



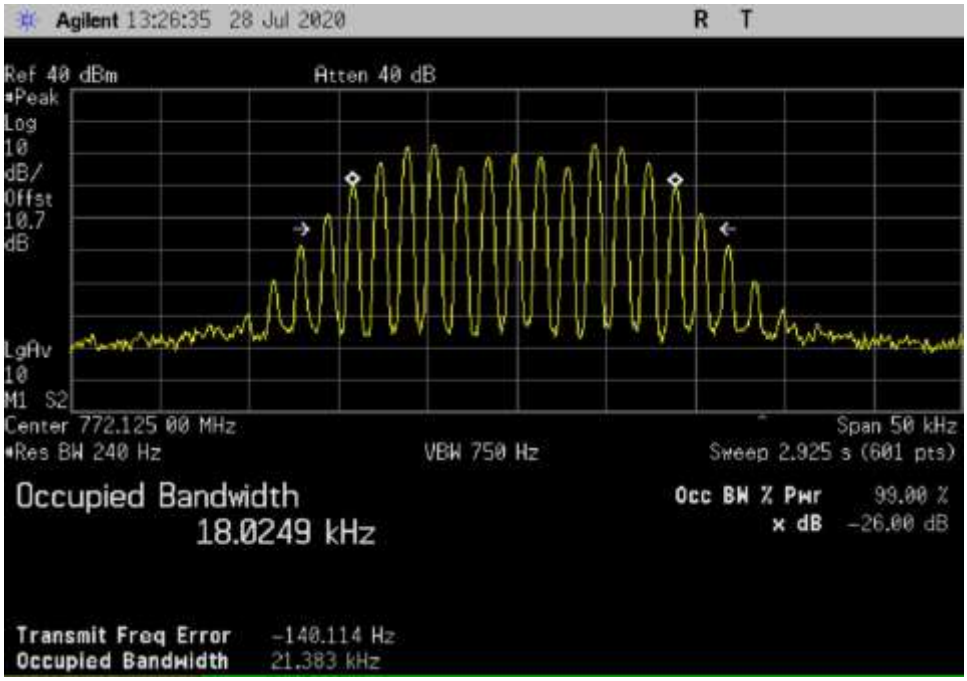
UL_806-816-APCO w/C4FM-AGC+3_ 812.25MHz_MC



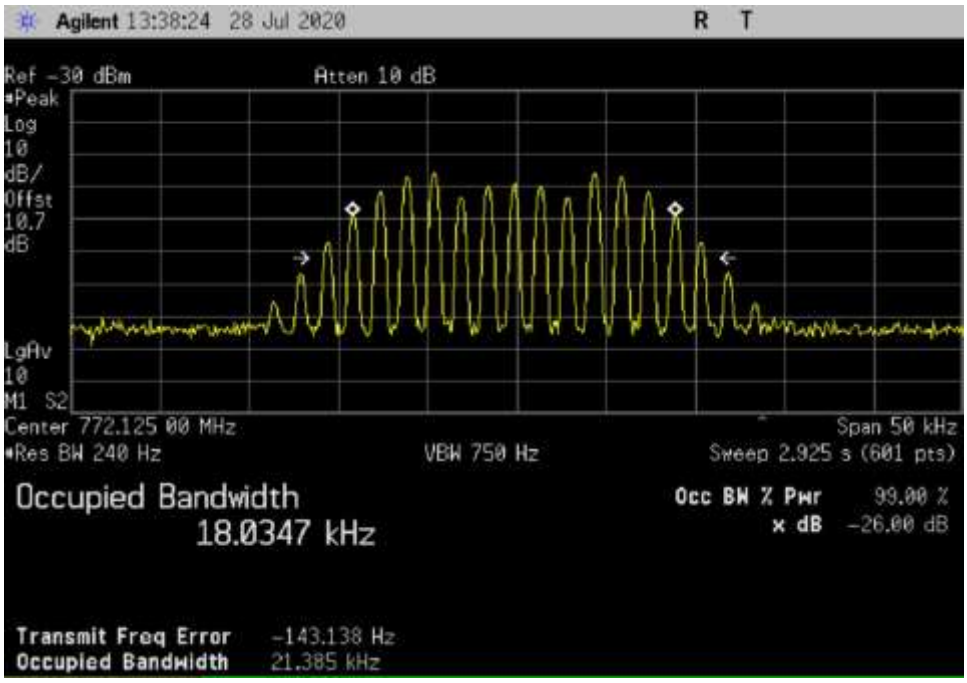
UL_806-816-APCO w/C4FM-Input_ 812.25MHz_MC



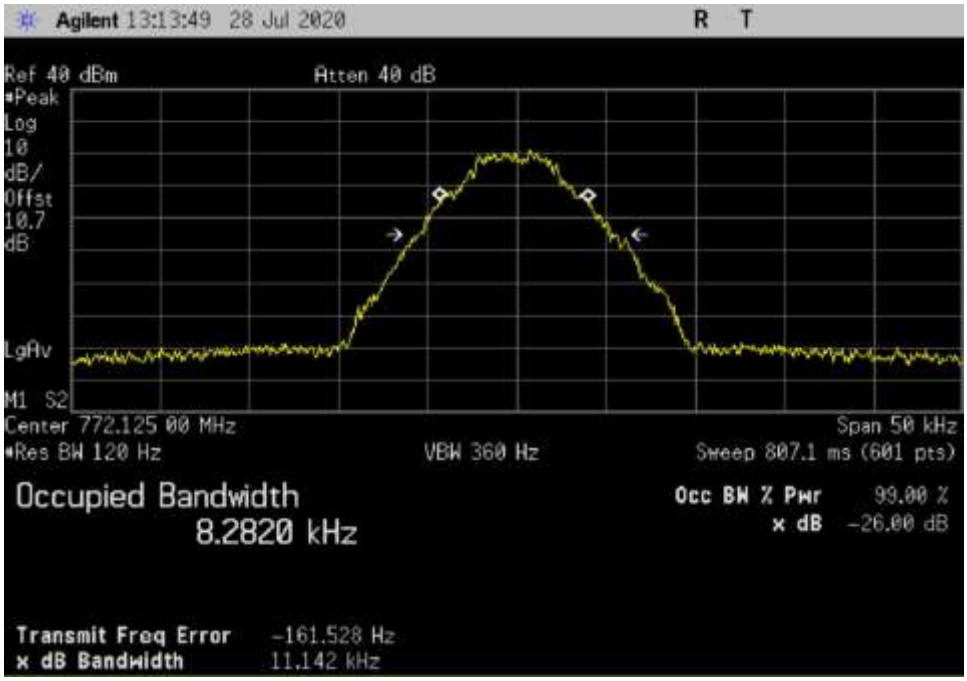
DL_769-775-Analog FM (25 kHz)_ 772.125MHz_MC



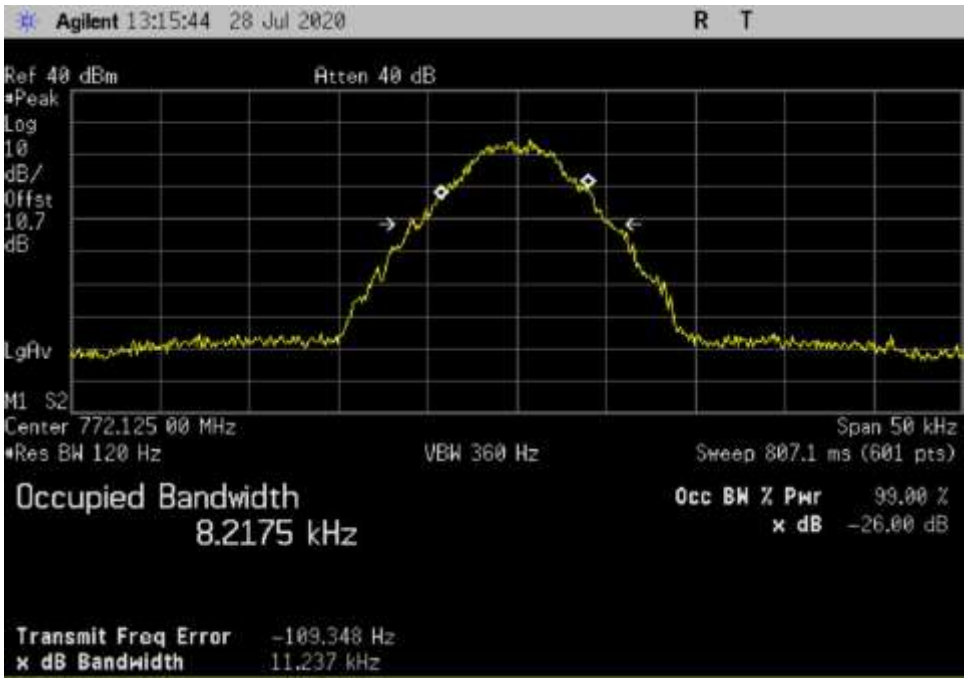
DL_769-775-Analog FM (25 kHz)-AGC+3_ 772.125MHz_MC



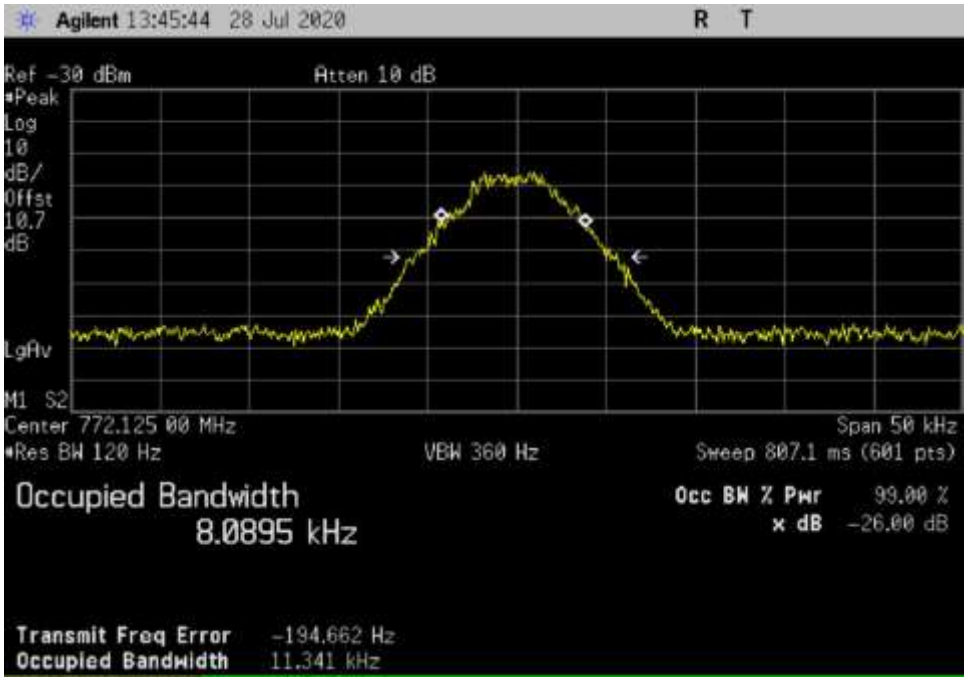
DL_769-775-Analog FM (25 kHz)-Input_ 772.125MHz_MC



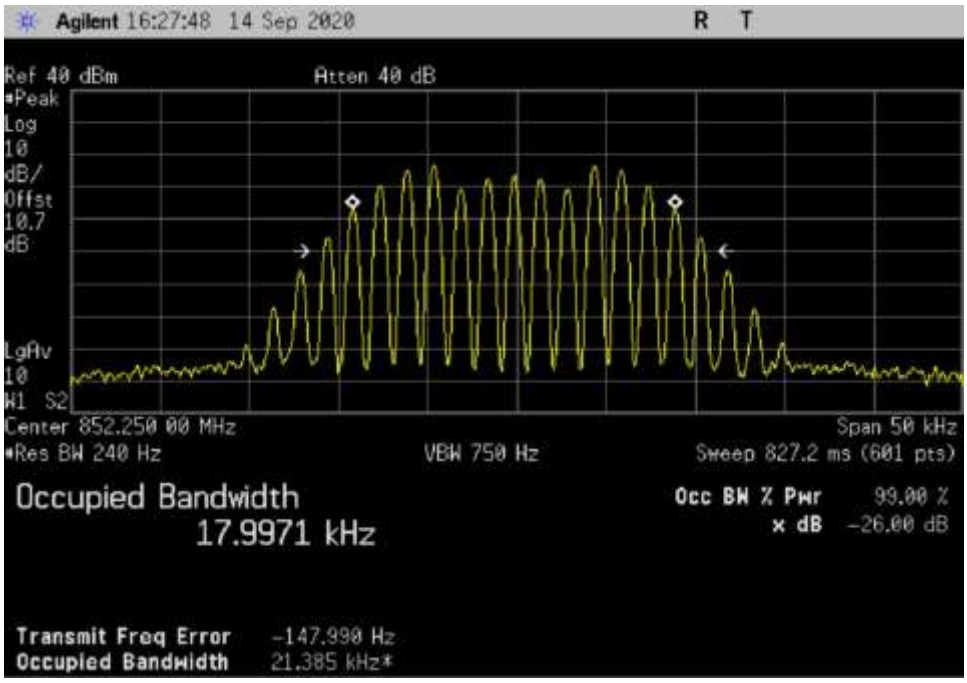
DL_769-775-APCO w/C4FM_ 772.125MHz_MC



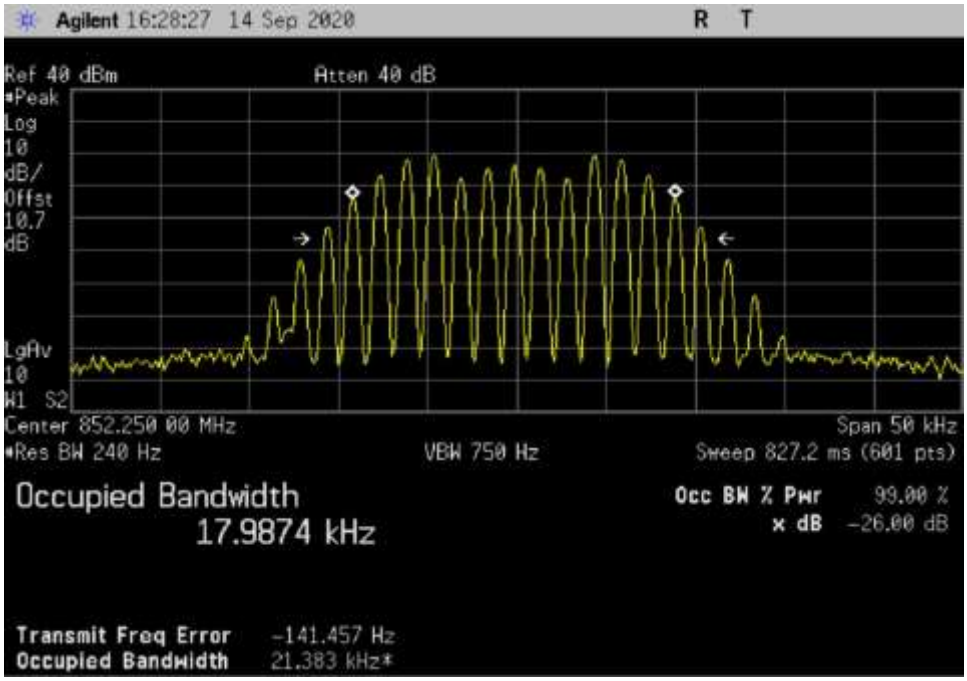
DL_769-775-APCO w/C4FM-AGC+3_ 772.125MHz_MC



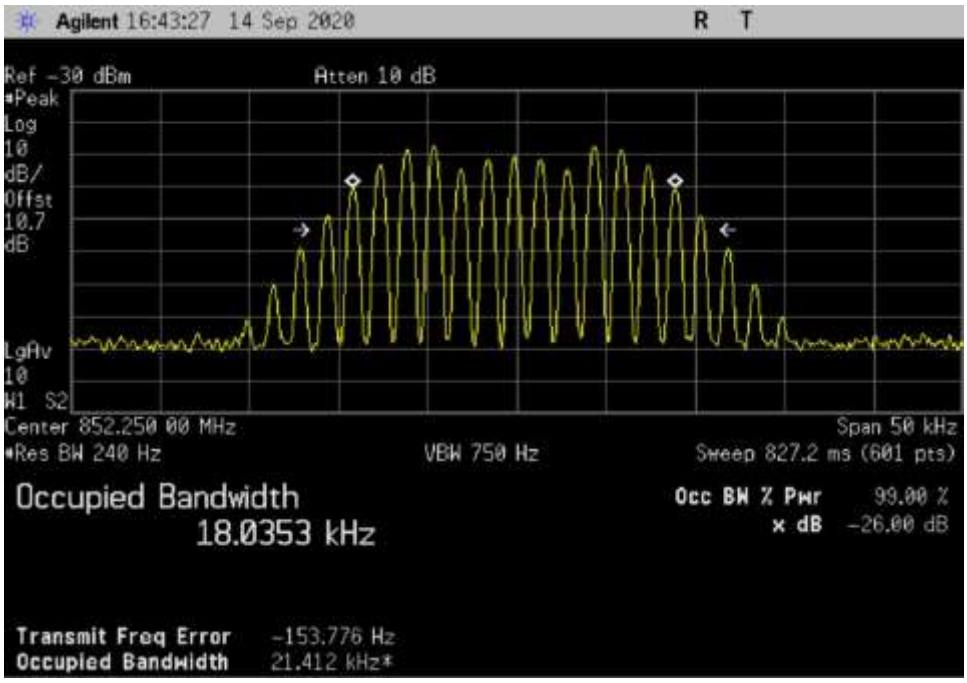
DL_769-775-APCO w/C4FM-Input_ 772.125MHz_MC



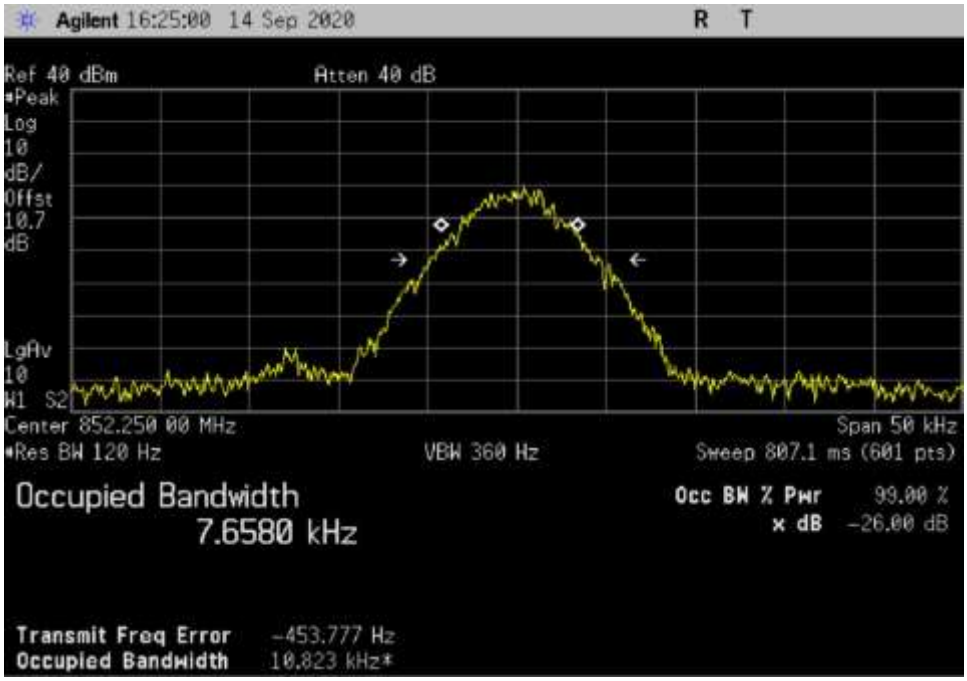
DL_851-854_Analog FM (25 kHz)_ 852.25MHz_MC



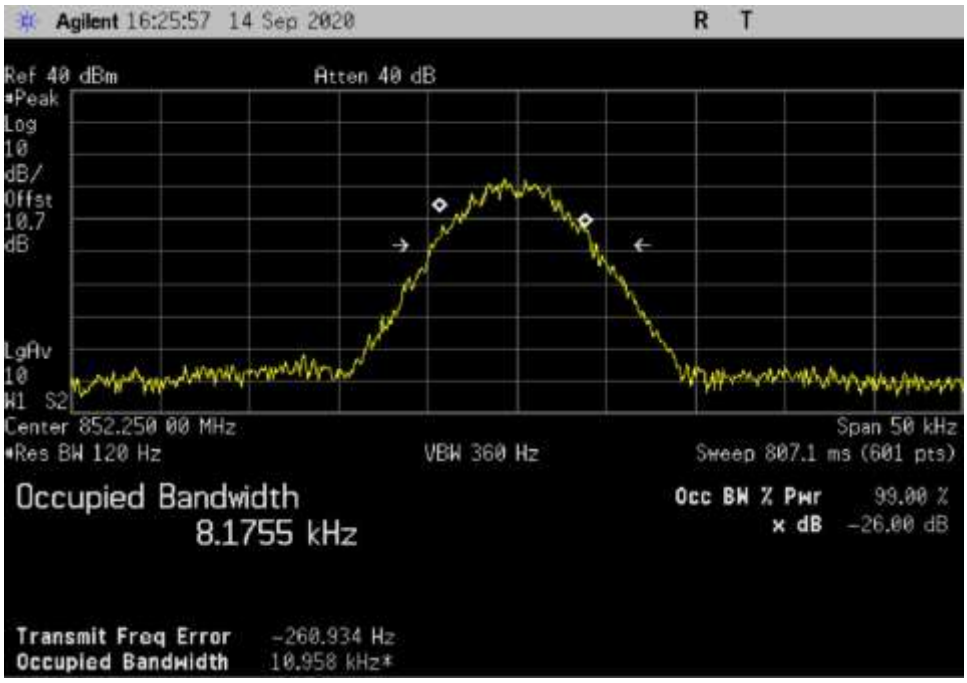
DL_851-854_Analog FM (25 kHz)+AGC+3_ 852.25MHz_MC



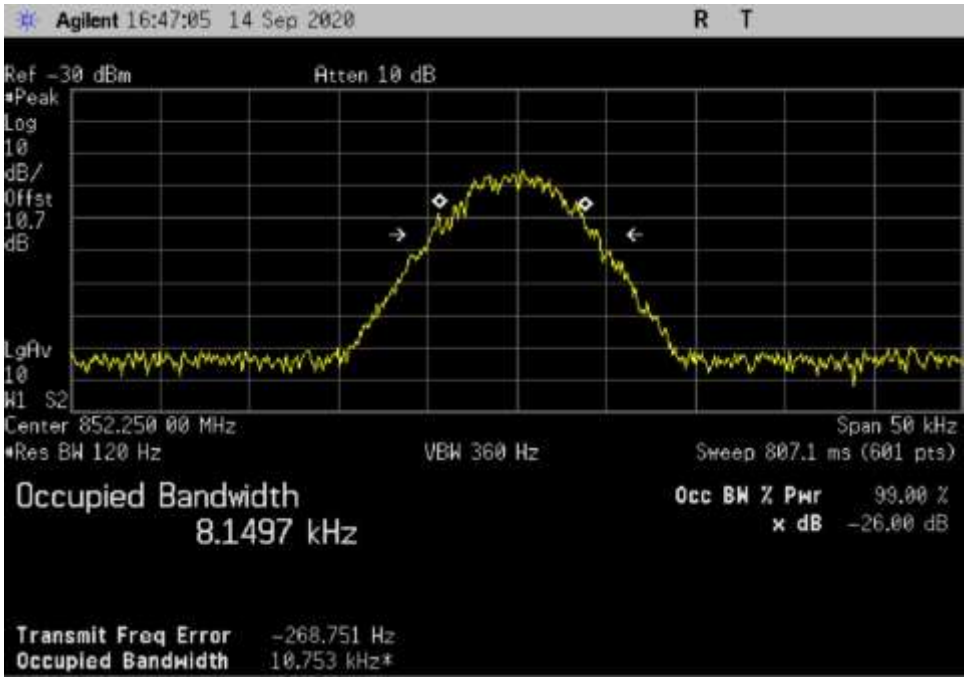
DL_851-854_Analog FM (25 kHz)-Input_ 852.25MHz_MC



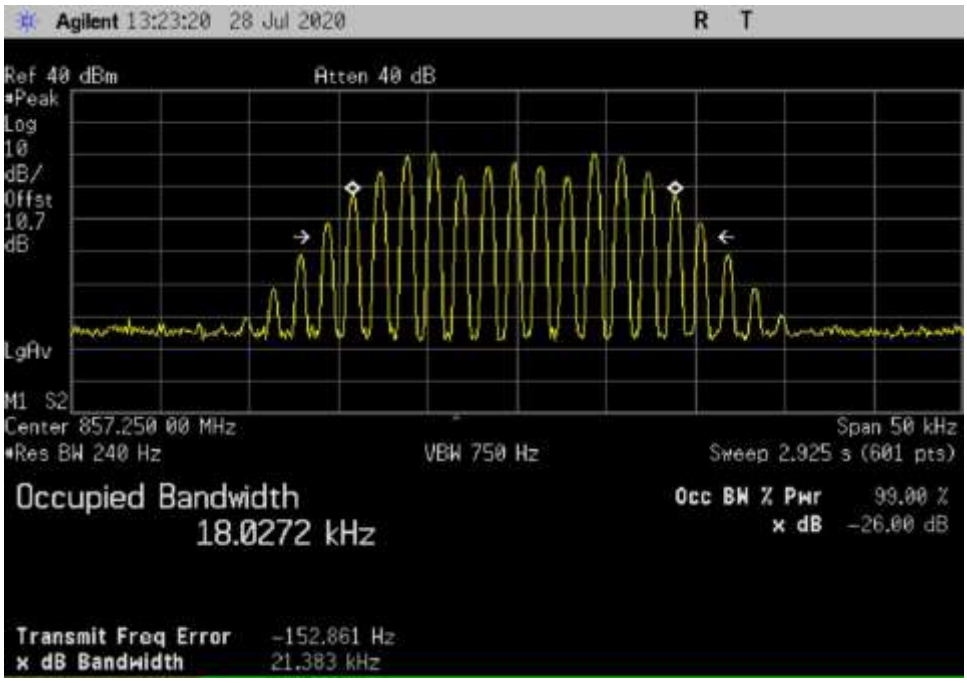
DL_851-854_APCO w/C4FM_ 852.25MHz_MC



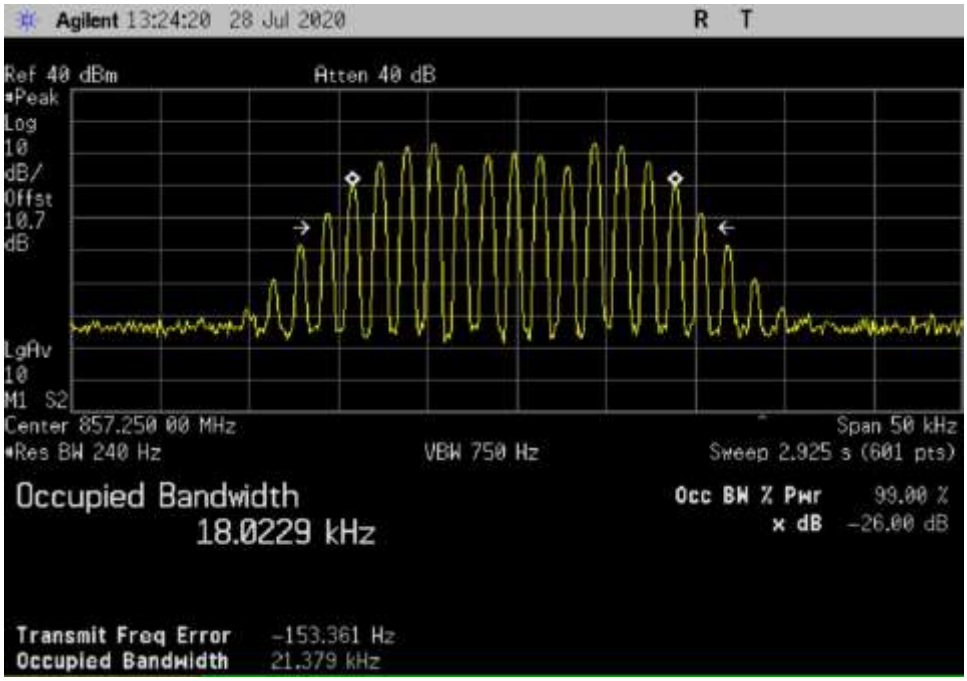
DL_851-854_APCO w/C4FM-AGC+3_ 852.25MHz_MC



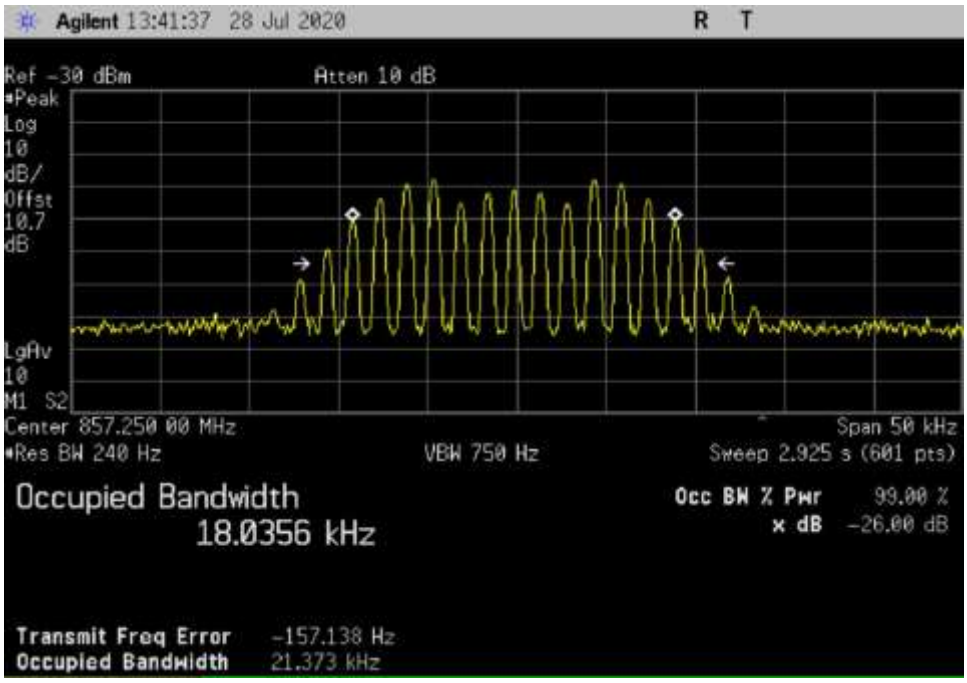
DL_851-854_APCO w/C4FM-Input_ 852.25MHz_MC



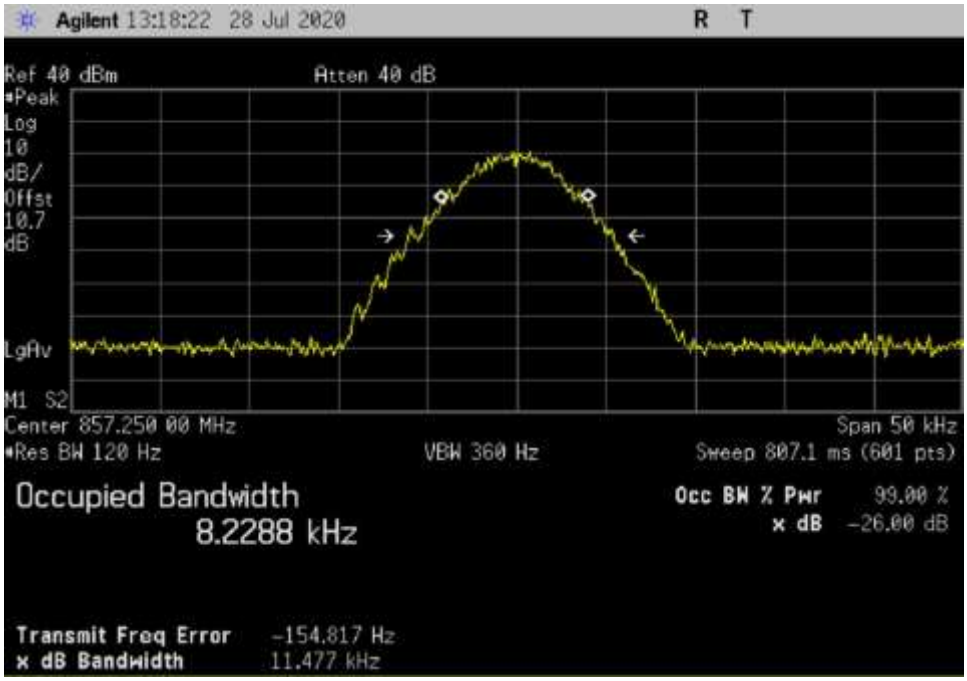
DL_851-861-Analog FM (25 kHz)_ 857.25MHz_MC



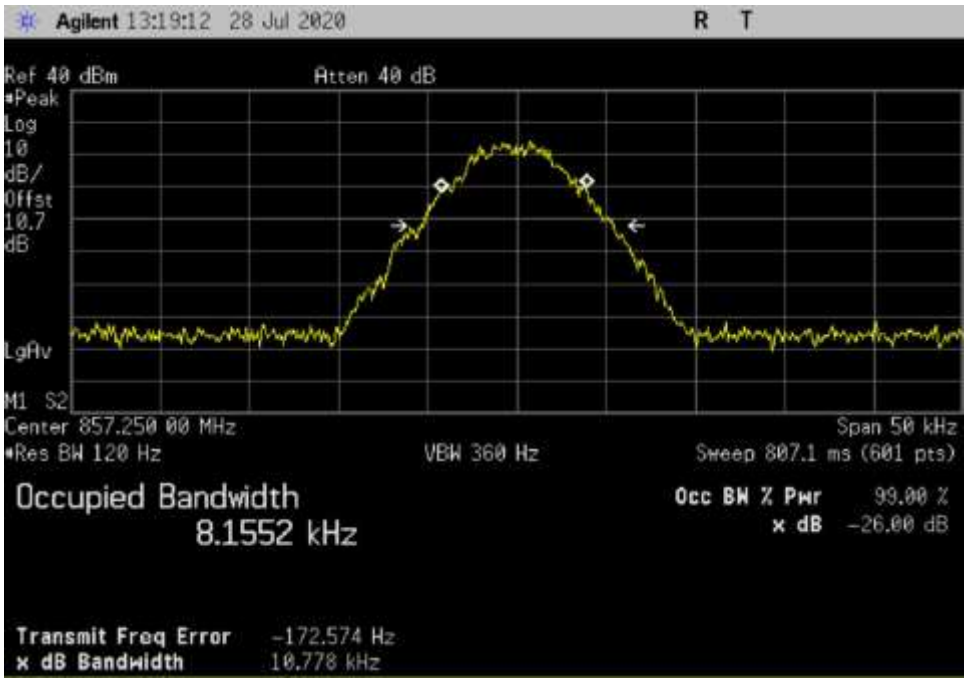
DL_851-861-Analog FM (25 kHz)-AGC+3_ 857.25MHz_MC



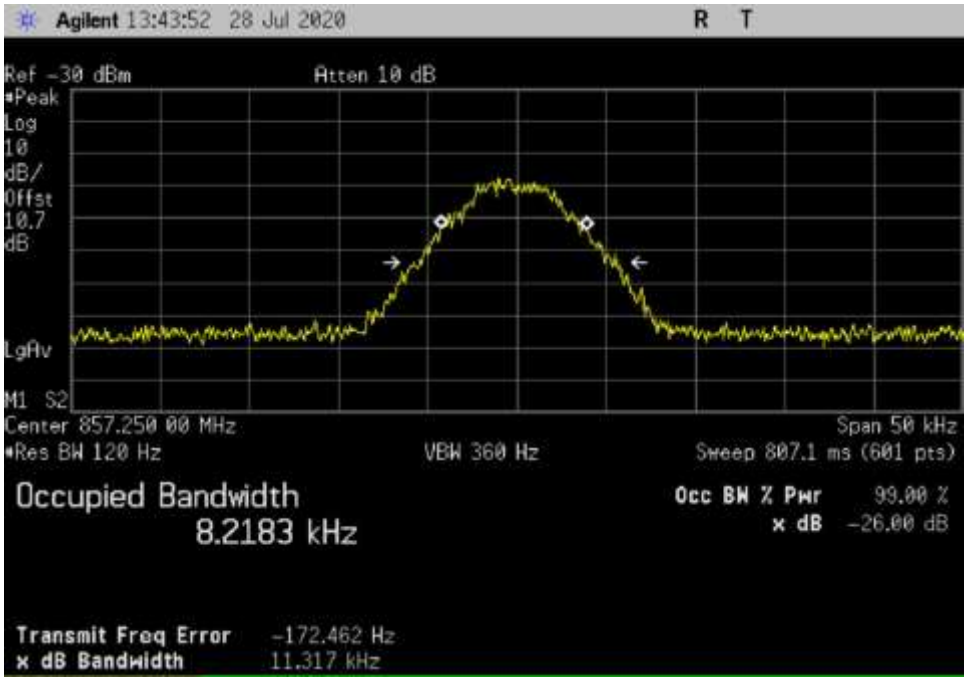
DL_851-861-Analog FM (25 kHz)-Input_ 857.25MHz_MC



_DL_851-861-APCO w/C4FM_ 857.25MHz_MC

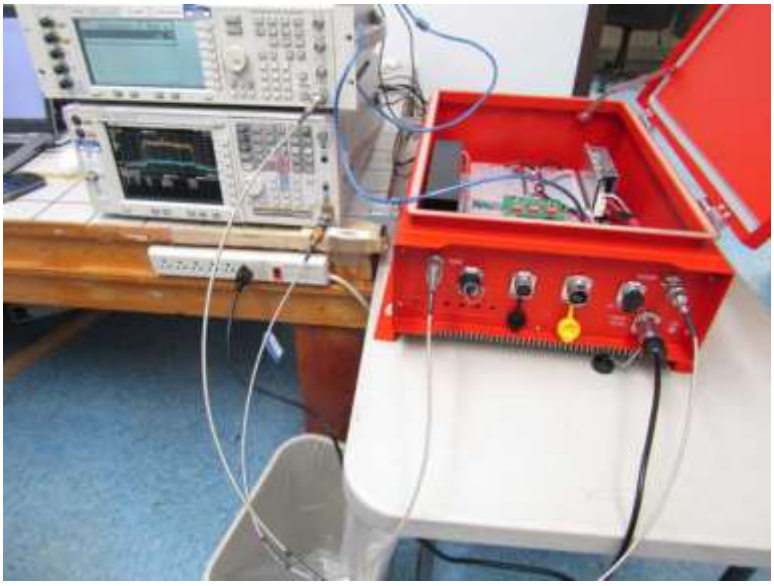


_DL_851-861-APCO w/C4FM-AGC+3_ 857.25MHz_MC



_DL_851-861-APCO w/C4FM-Input_ 857.25MHz_MC

Test Setup Photo(s)



4.3 Out of Band Rejection

Test Setup/Conditions			
Test Location:	Fremont	Test Engineer:	Hieu Song Nguyenpham
Test Date(s):	7/10/2020		
Configuration:	1		
Test Setup:	See General Test Setup		

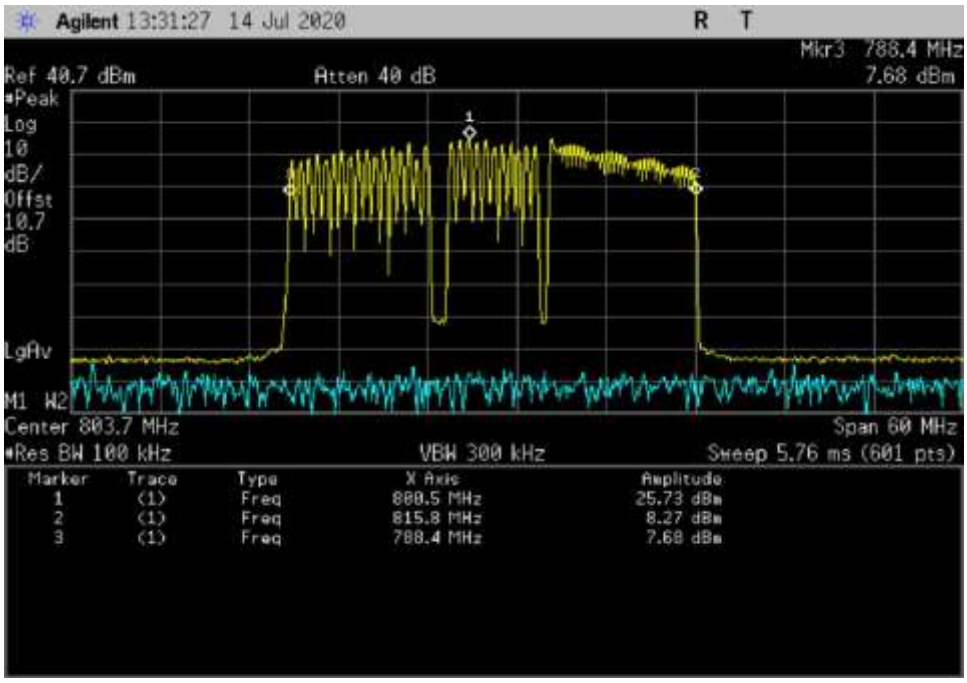
Environmental Conditions					
Temperature (ºC)	23.5	Relative Humidity (%):	42	Pressure (kPa)	101.9

Test Equipment Radiated					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03471	Spectrum Analyzer	Agilent	E4440A	2/11/2020	2/11/2022
03418	Signal Generator	Agilent	E4438C	5/13/2019	5/13/2021
P05411	Attenuator	Weinschel	54A-10	11/27/2019	11/27/2021
P06467	Attenuator	Pasternack	PE7014-10	4/15/2019	4/15/2021
03360	Cable	Astrolab	32022-2-29094-36TC	4/9/2020	4/9/2022
P07192	Cable	Astro	32022-29094K-29094K-48TC	11/27/2019	11/27/2021

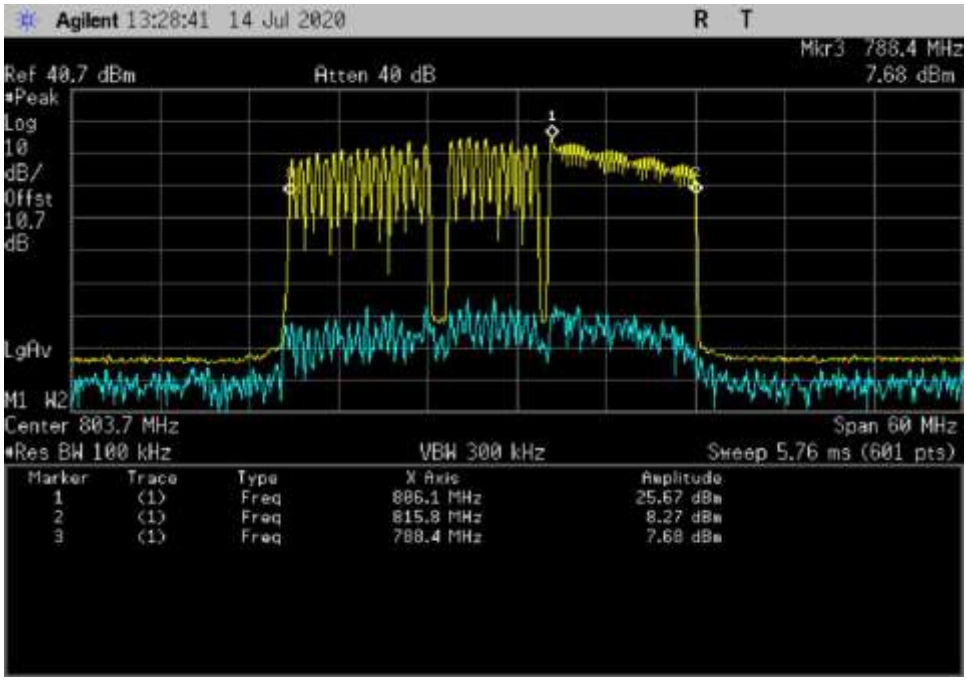
Summary of Results

Pass: Plots show that gain out of band does not increase beyond that value which is present at the edge of each band.

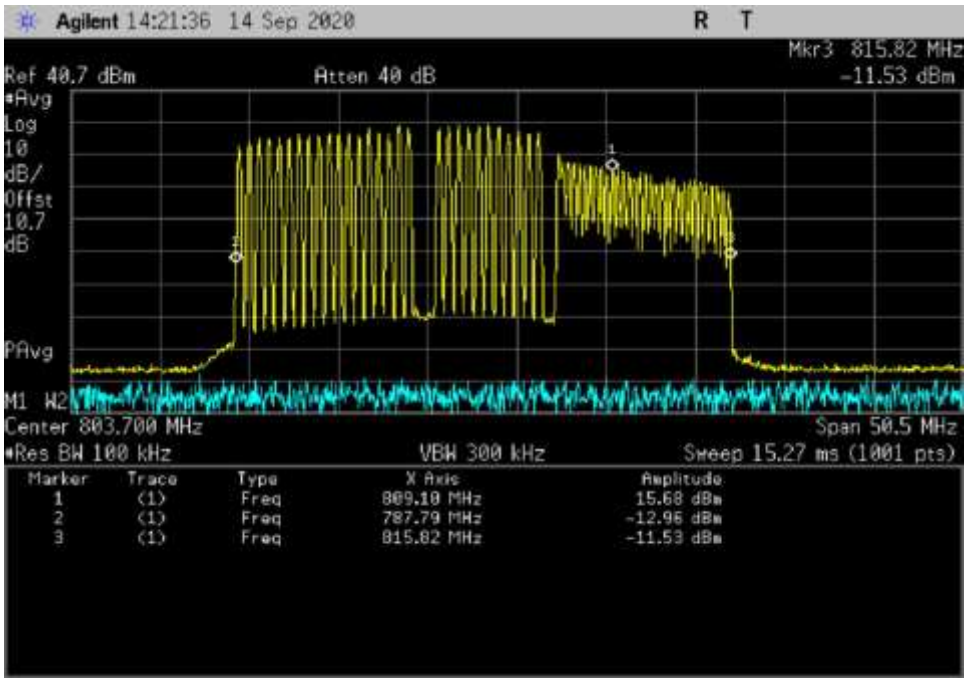
Plots



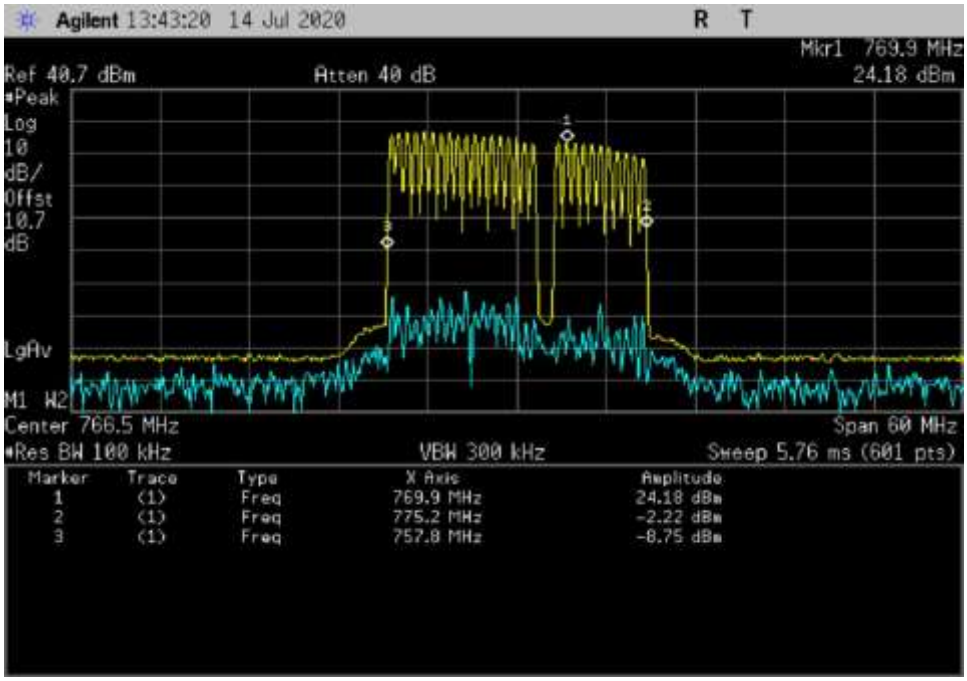
UL_799-805MHz



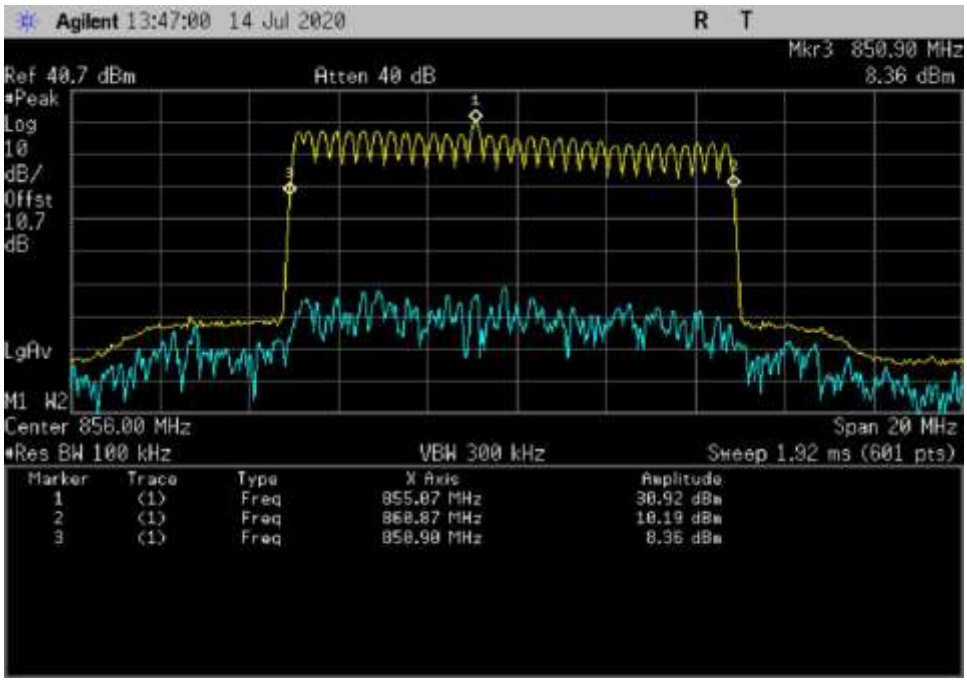
UL_806-809MHz



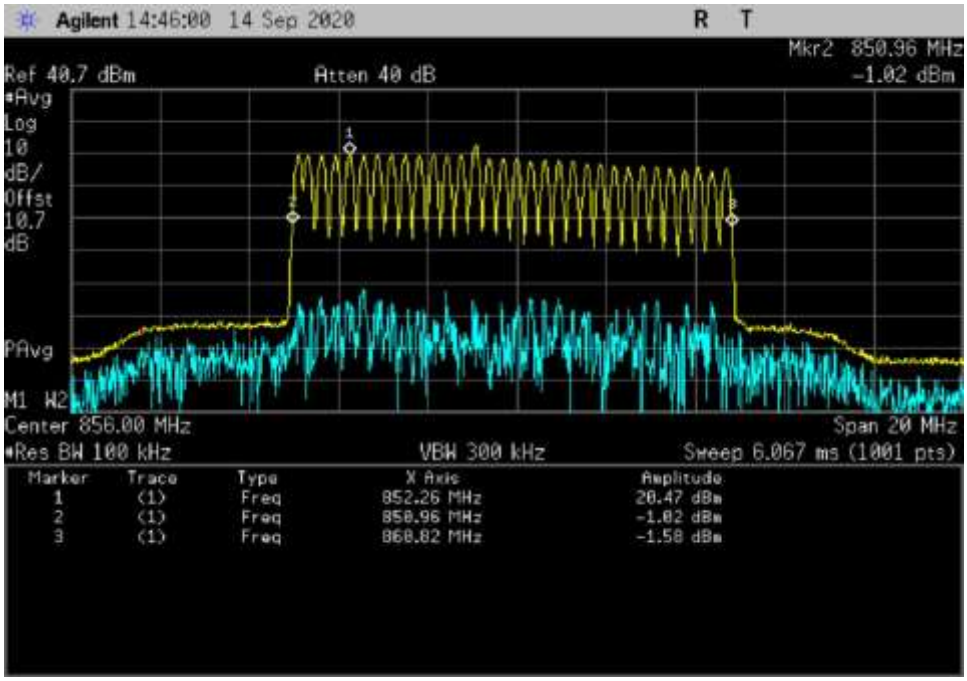
UL_809-816MHz



DL_769-775MHz

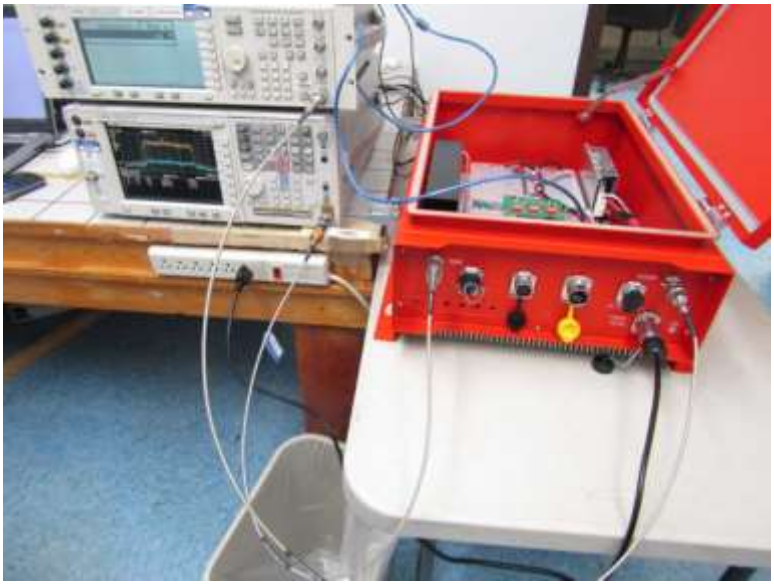


DL_854-861MHz



DL_851-854MHz

Test Setup Photo(s)



4.4 Input-versus-Output Signal comparison and Out Of Band Emissions

Test Setup/Conditions			
Test Location:	Fremont	Test Engineer:	Hieu Song Nguyenpham
Test Date(s):	9/21 and 22/2020		
Configuration:	1		
Test Setup:	See General Test Setup UL_806-809MHz Band and DL-851-854MHz are treated as separated bands. They are only authorized transmitted 12.5kHz Channel Bandwidth Signal Modification #1 was in place during testing.		

Environmental Conditions			
Test Date	Temperature (ºC)	Relative Humidity (%):	Pressure (kPa)
9/21/2020	20.8	50	101.5
9/22/2020	21.2	45	101.8

Test Equipment Radiated					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03471	Spectrum Analyzer	Agilent	E4440A	2/11/2020	2/11/2022
03418	Signal Generator	Agilent	E4438C	5/13/2019	5/13/2021
P05411	Attenuator	Weinschel	54A-10	11/27/2019	11/27/2021
P06467	Attenuator	Pasternack	PE7014-10	4/15/2019	4/15/2021
03360	Cable	Astrolab	32022-2-29094-36TC	4/9/2020	4/9/2022
P07192	Cable	Astro	32022-29094K-29094K-48TC	11/27/2019	11/27/2021

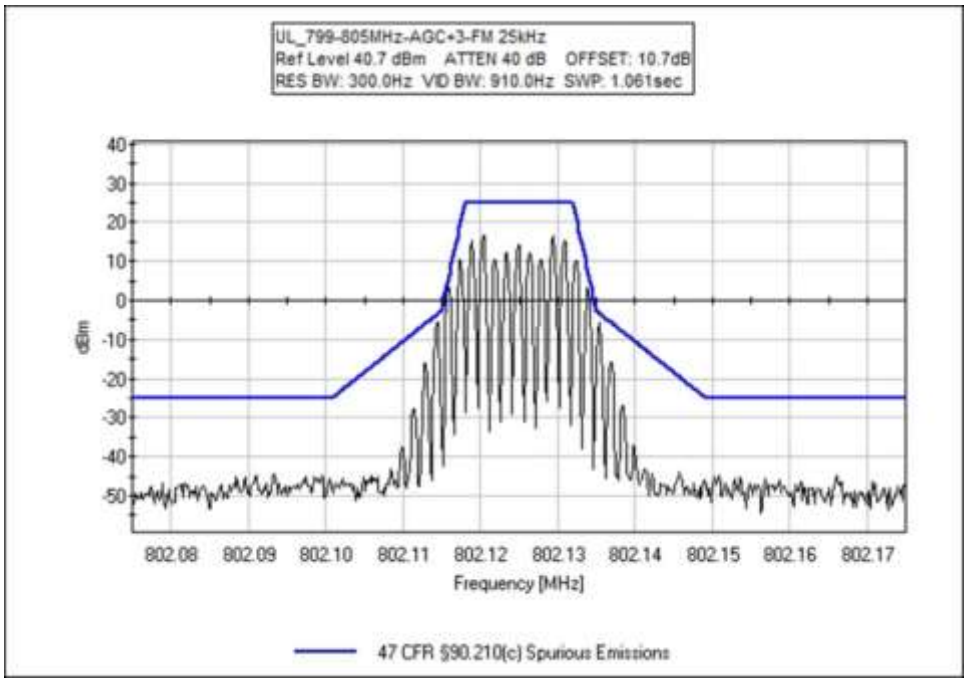
Summary of Results

Pass: As indicated in plots below, all emissions are under the applicable masks.

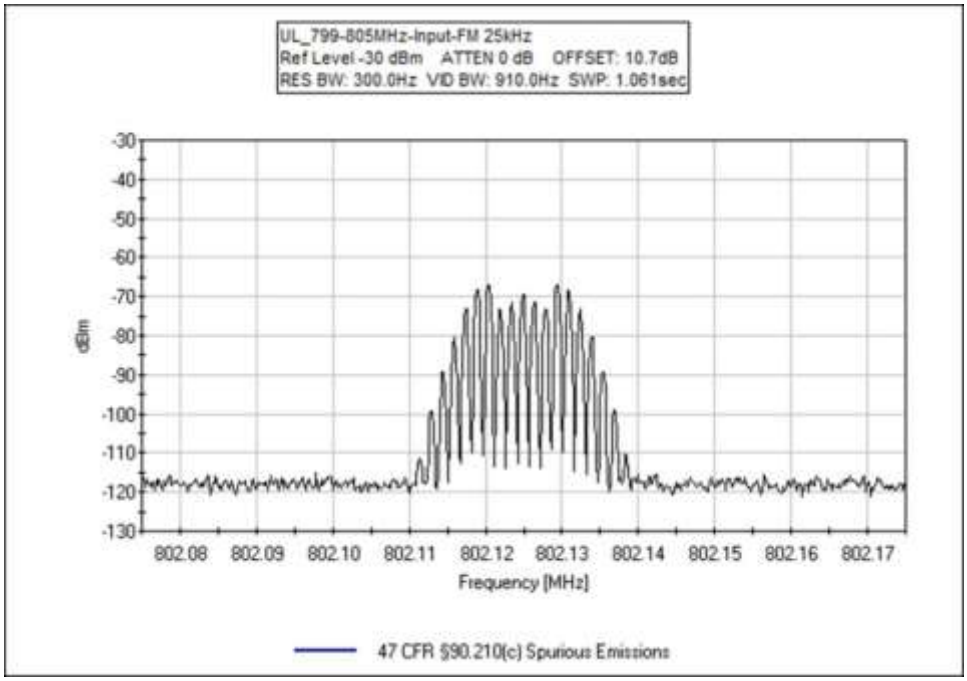
Applicable Masks Public safety						
	UL	**DL**	**UL**	**UL**	**DL**	**DL**
	799-805	769-775	806-809	809-816	851-854	854-861
Mask C	M	M	-	-	-	-
Mask D	-	-	-	M	-	M
Mask H	-	-	LMH	-	LMH	-
Mask G	-	-	-	M	-	M

LMH: Low, Middle and High channels
M: Middle channel

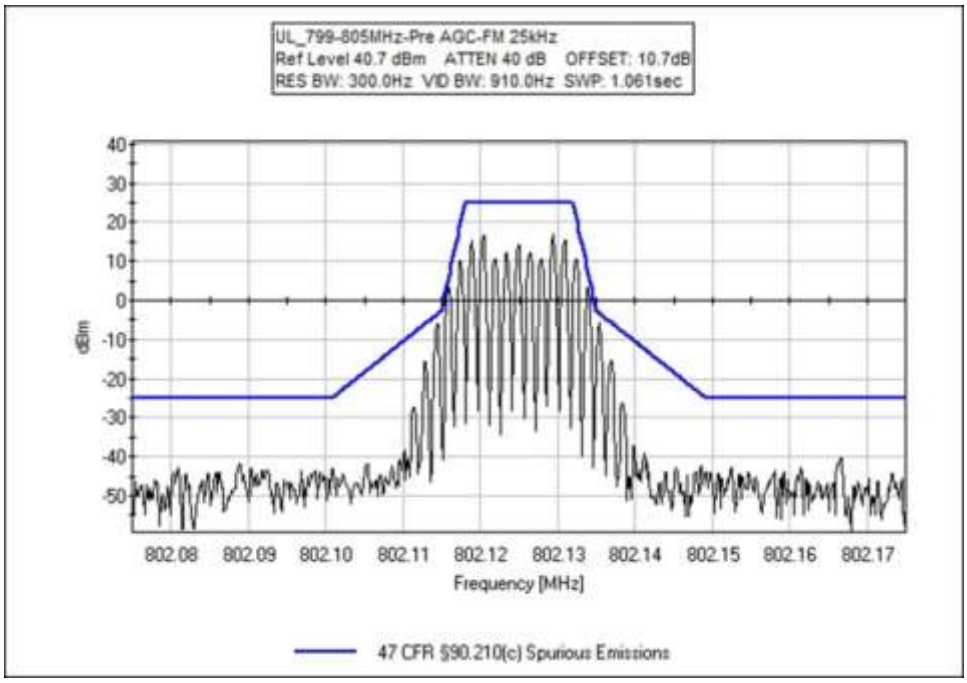
Plots



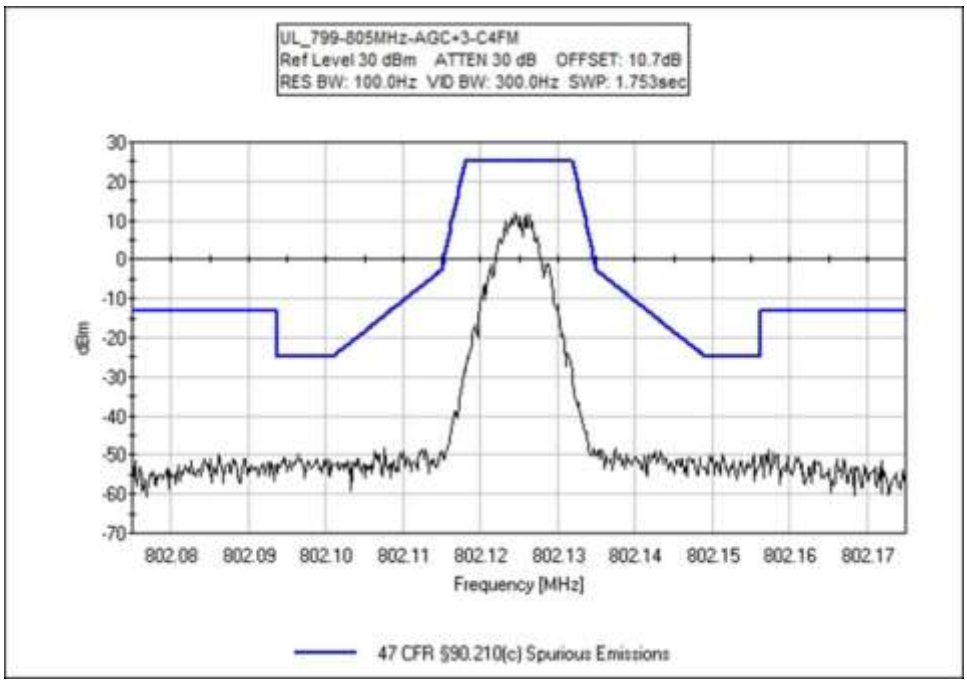
UL_799-805MHz-Analog FM (25 kHz)-AGC+3-Mask C-MC



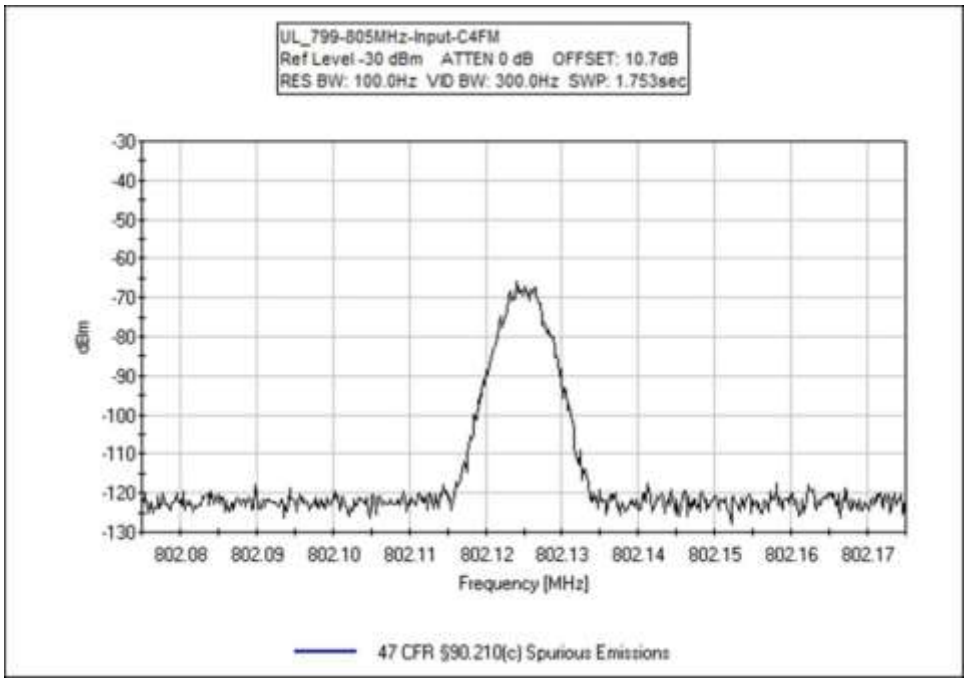
UL_799-805MHz-Analog FM (25 kHz)-Input-Mask C-MC



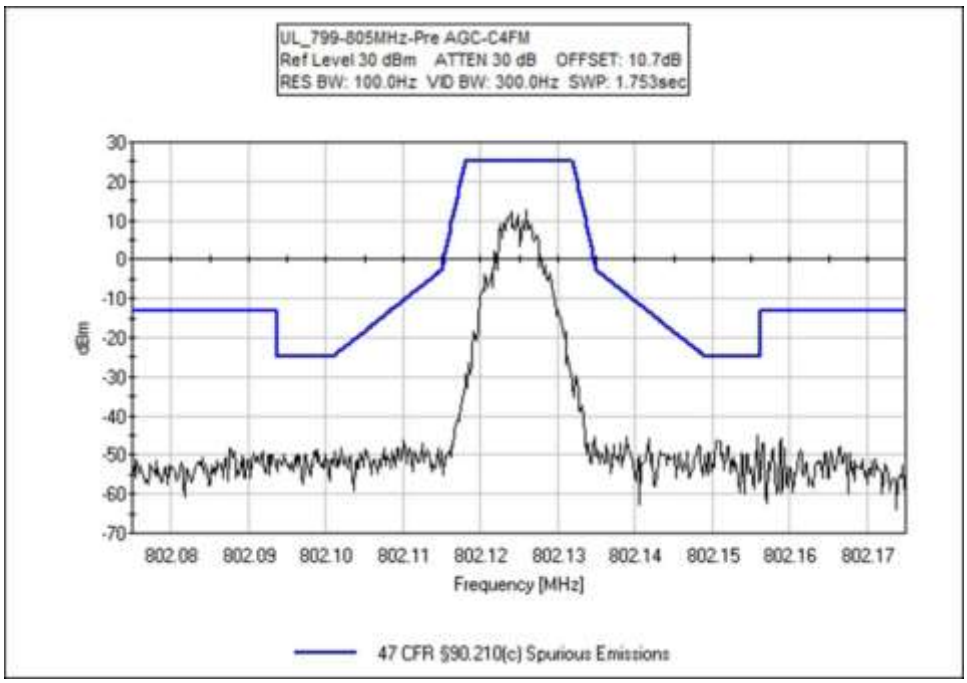
UL_799-805MHz-Analog FM (25 kHz)-Pre AGC-Mask C-MC



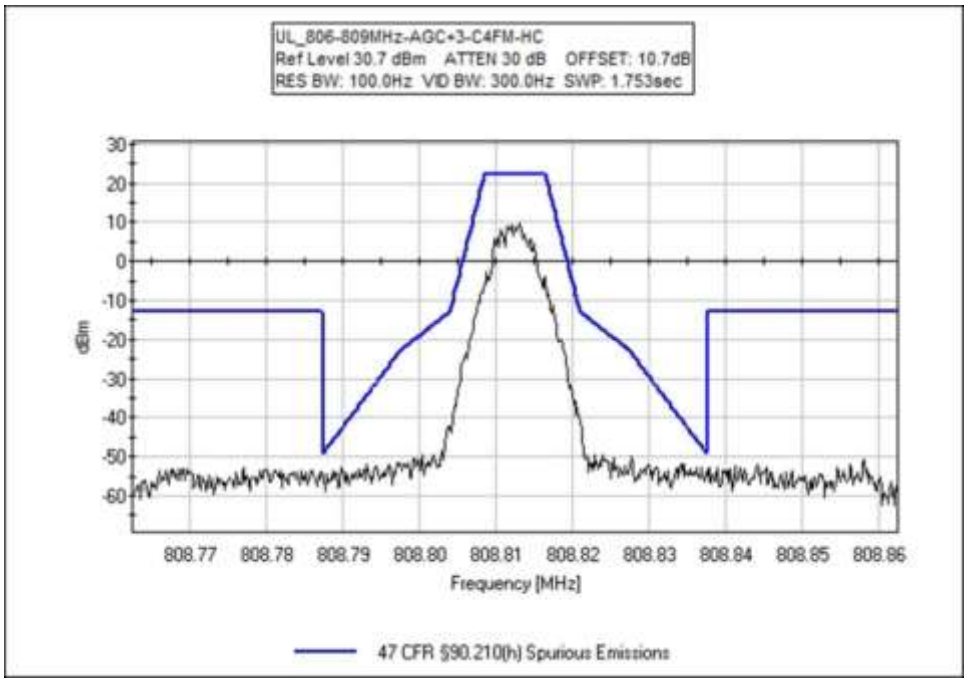
UL_799-805MHz-APCO w/C4FM-AGC+3-Mask C-MC



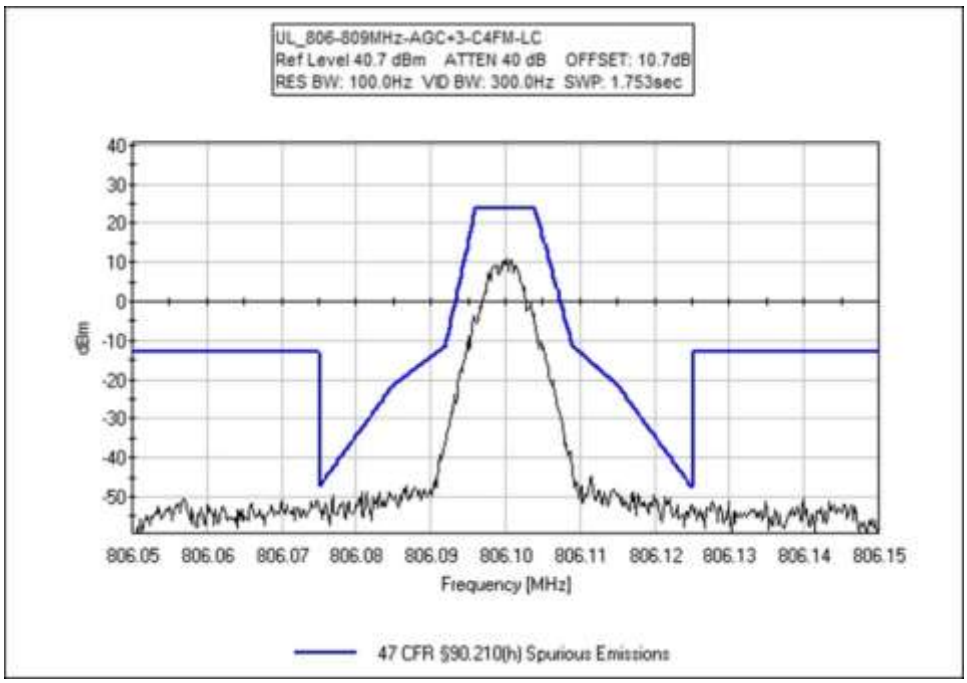
UL_799-805MHz-APCO w/C4FM-Input-Mask C-MC



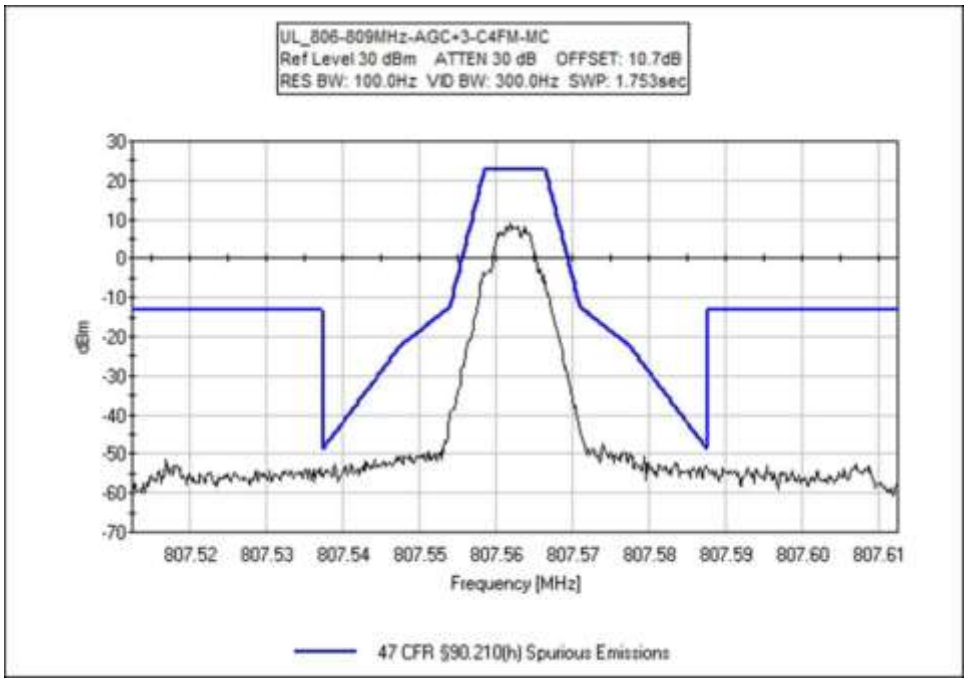
UL_799-805MHz-APCO w/C4FM-Pre AGC-Mask C-MC



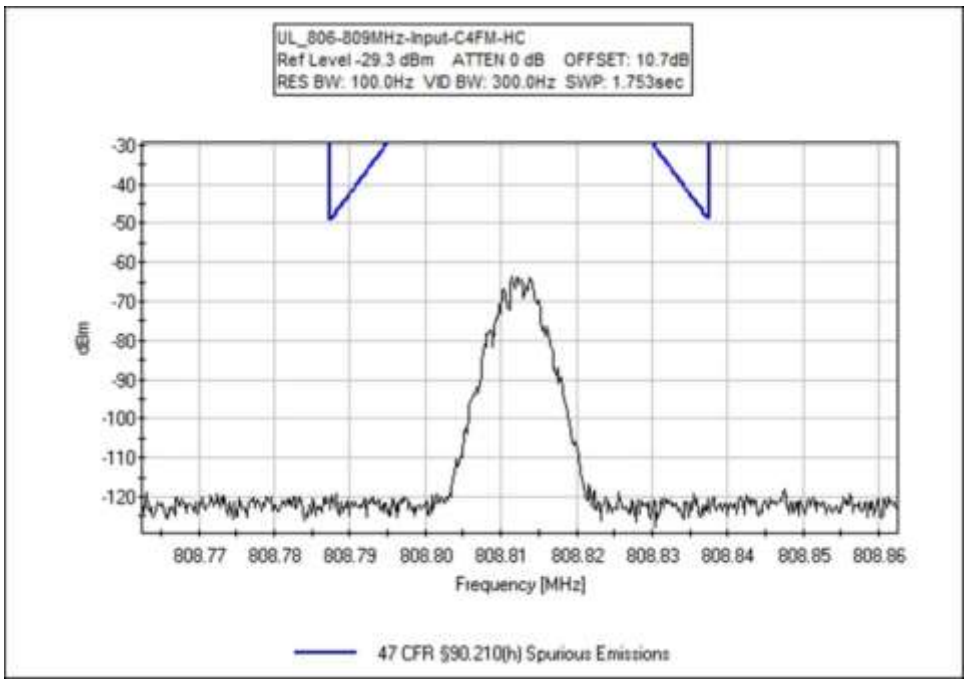
UL_806-809MHz-APCO w/C4FM-AGC+3-Mask H-HC



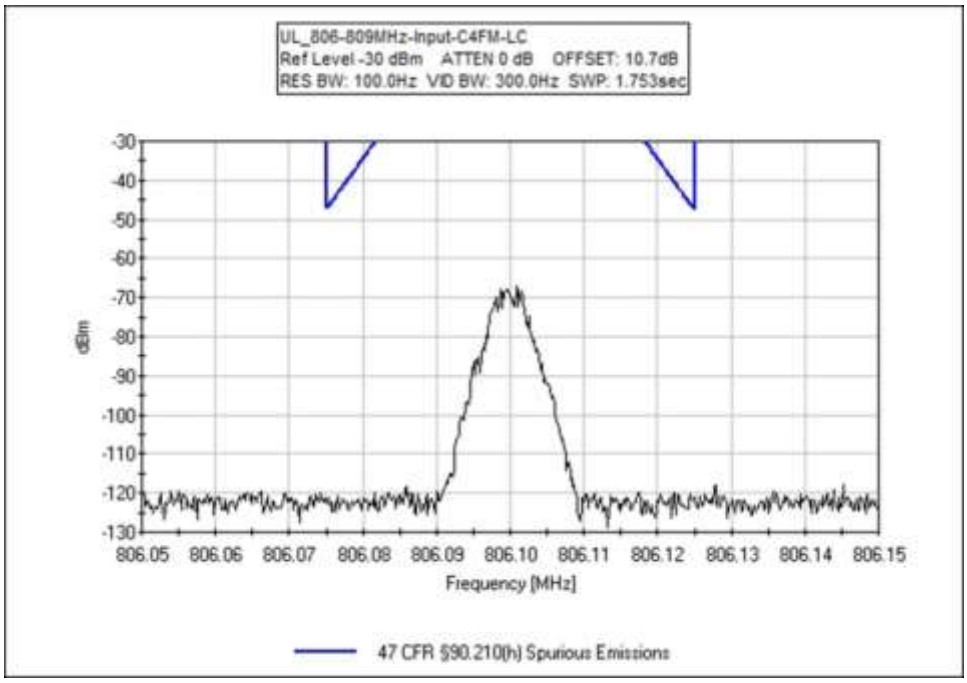
UL_806-809MHz-APCO w/C4FM-AGC+3-Mask H-LC



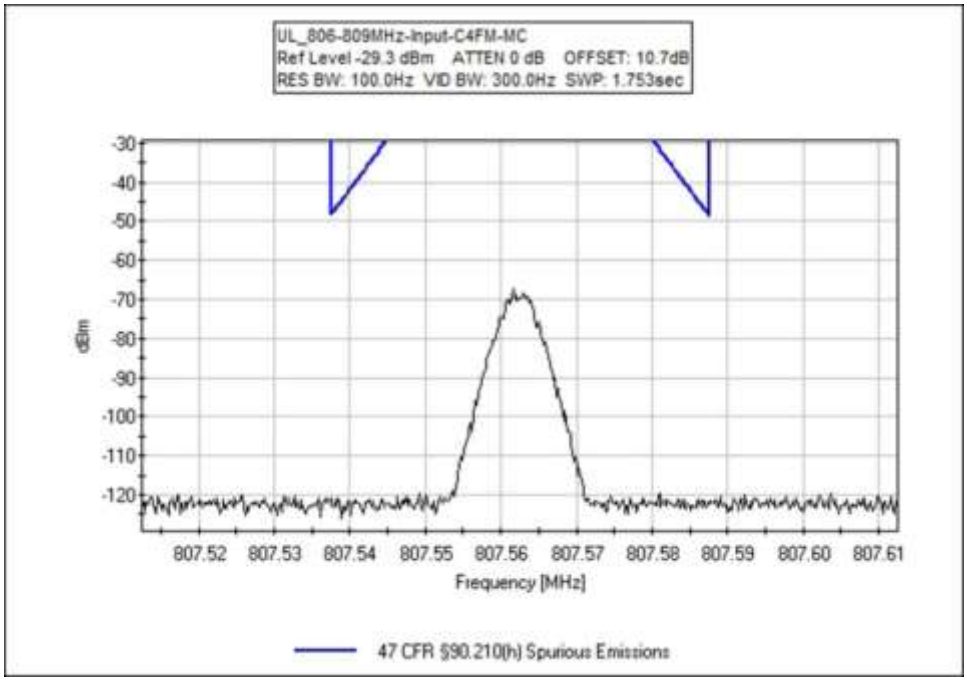
UL_806-809MHz-APCO w/C4FM-AGC+3-Mask H-MC



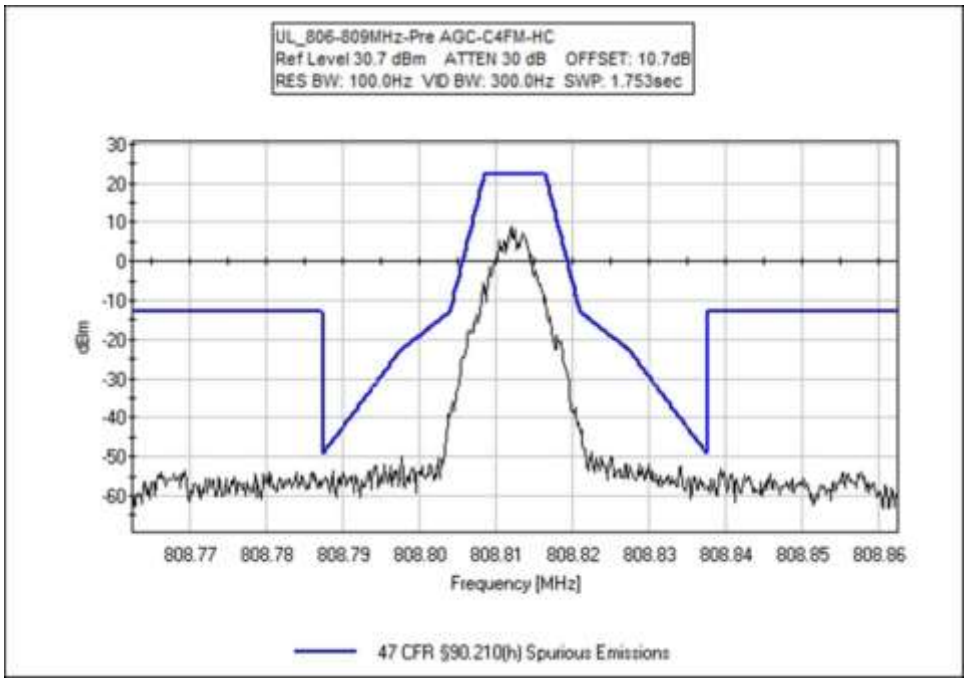
UL_806-809MHz-APCO w/C4FM-Input-Mask H-HC



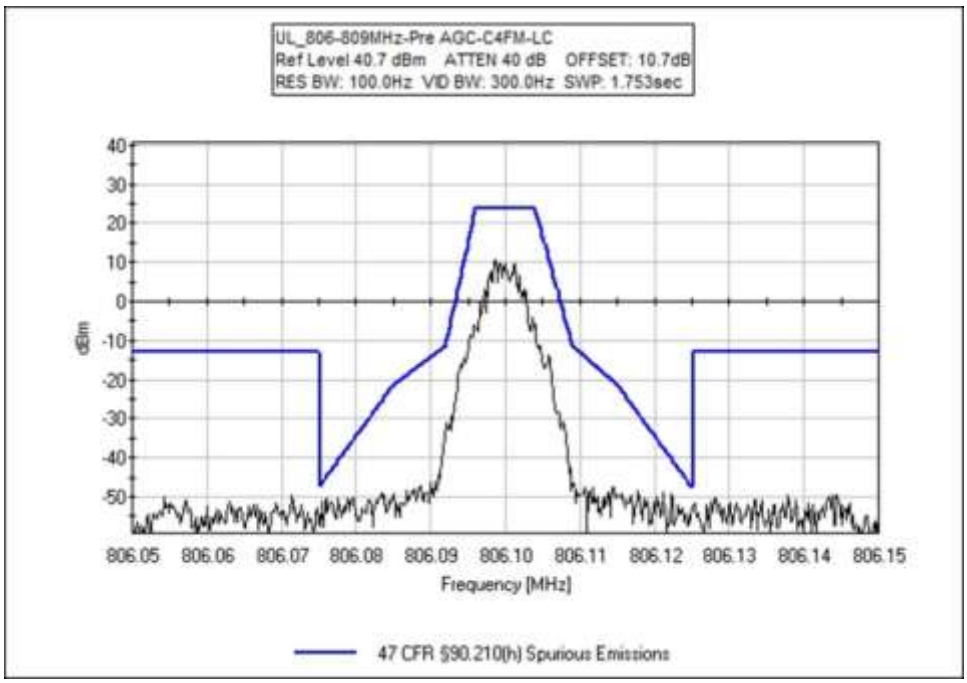
UL_806-809MHz-APCO w/C4FM-Input-Mask H-LC



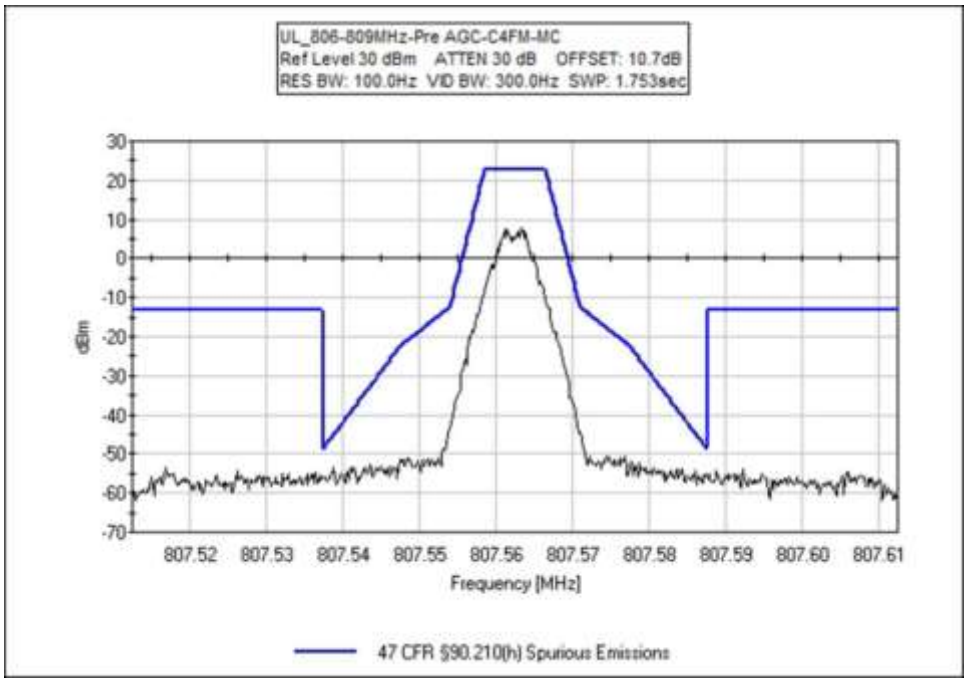
UL_806-809MHz-APCO w/C4FM-Input-Mask H-MC



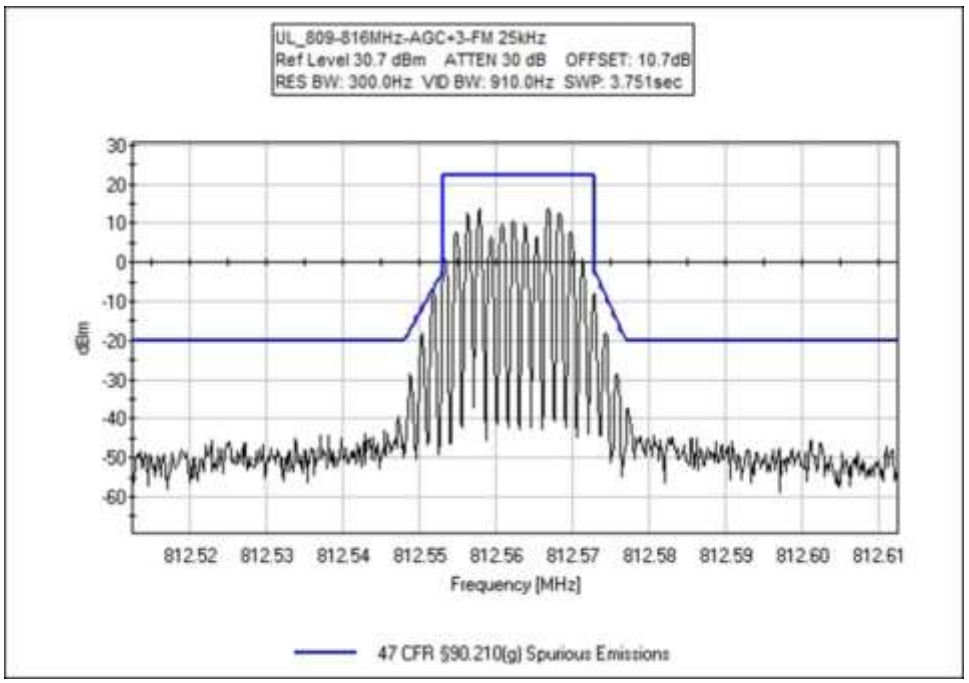
UL_806-809MHz-APCO w/C4FM-Pre AGC-Mask H-HC



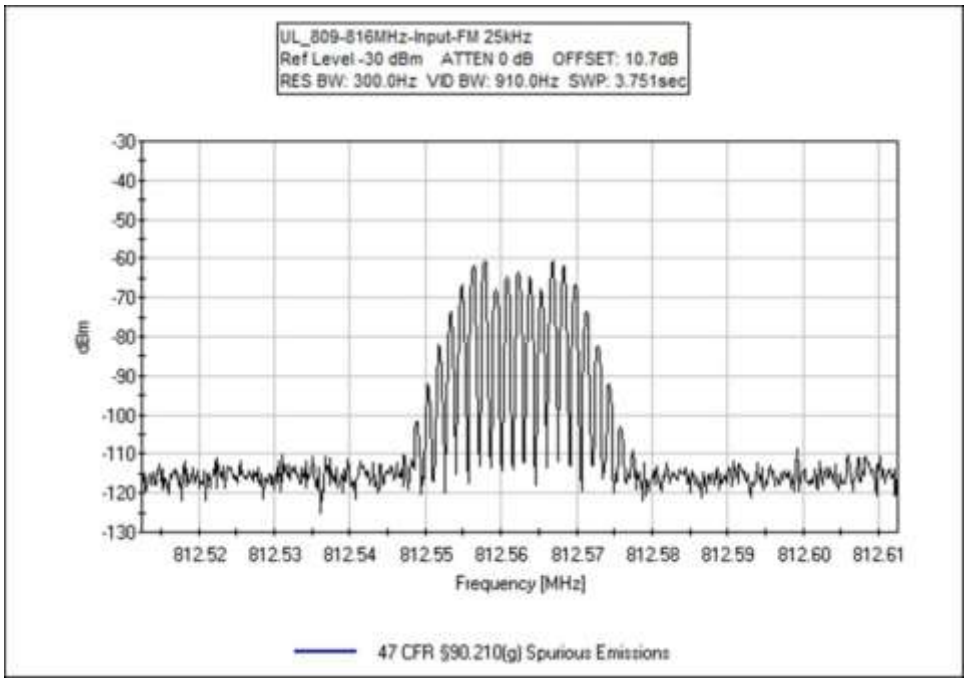
UL_806-809MHz-APCO w/C4FM-Pre AGC-Mask H-LC



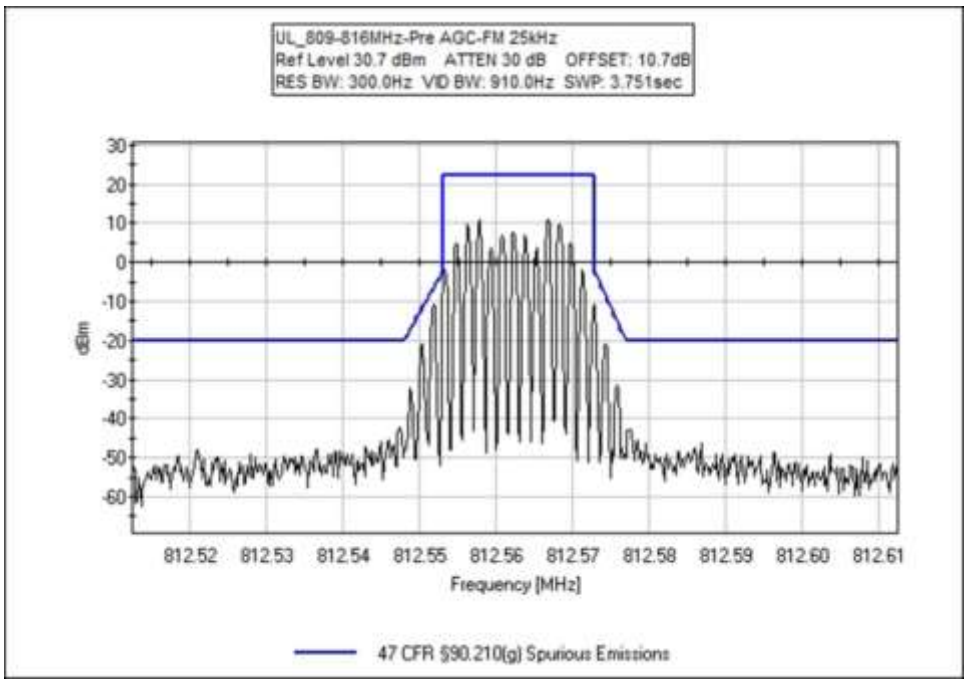
UL_806-809MHz-APCO w/C4FM-Pre AGC-Mask H-MC



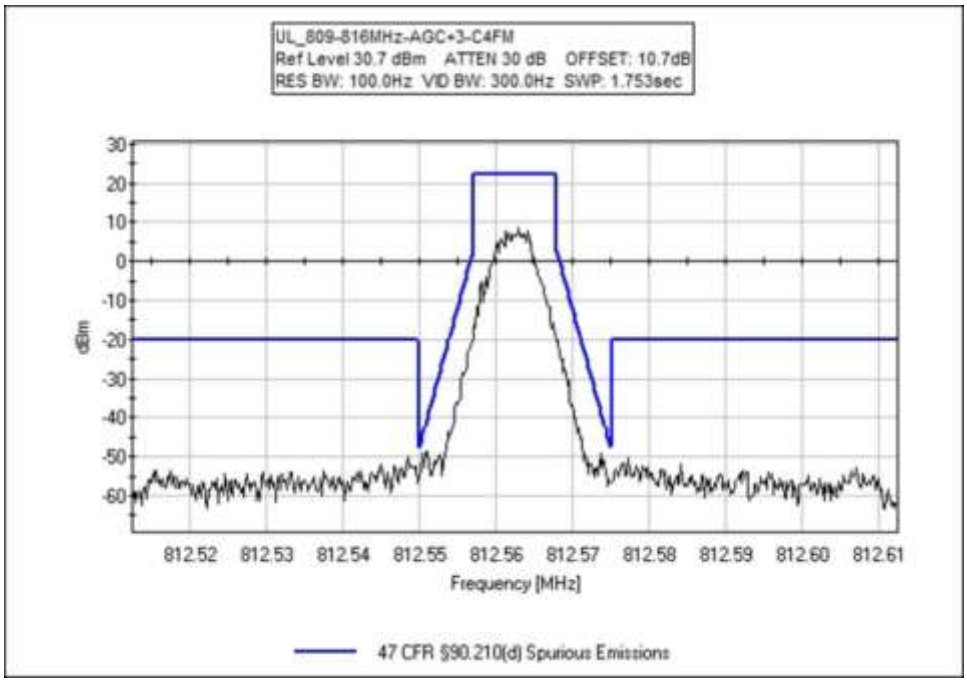
UL_809-816-Analog FM (25 kHz)-AGC+3-Mask G-MC



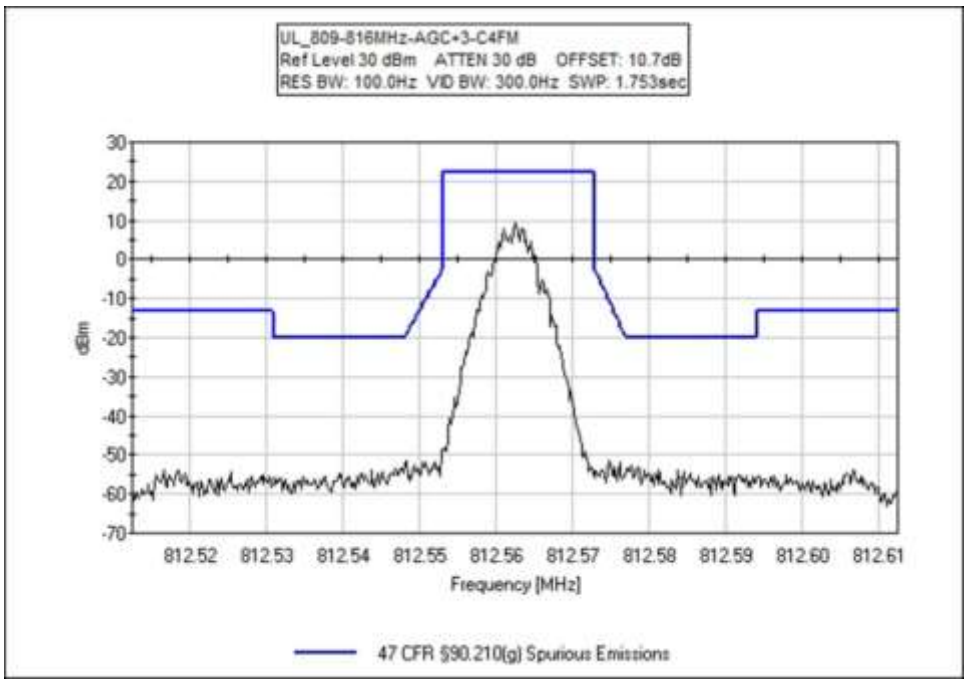
UL_809-816-Analog FM (25 kHz)-Input-Mask G-MC



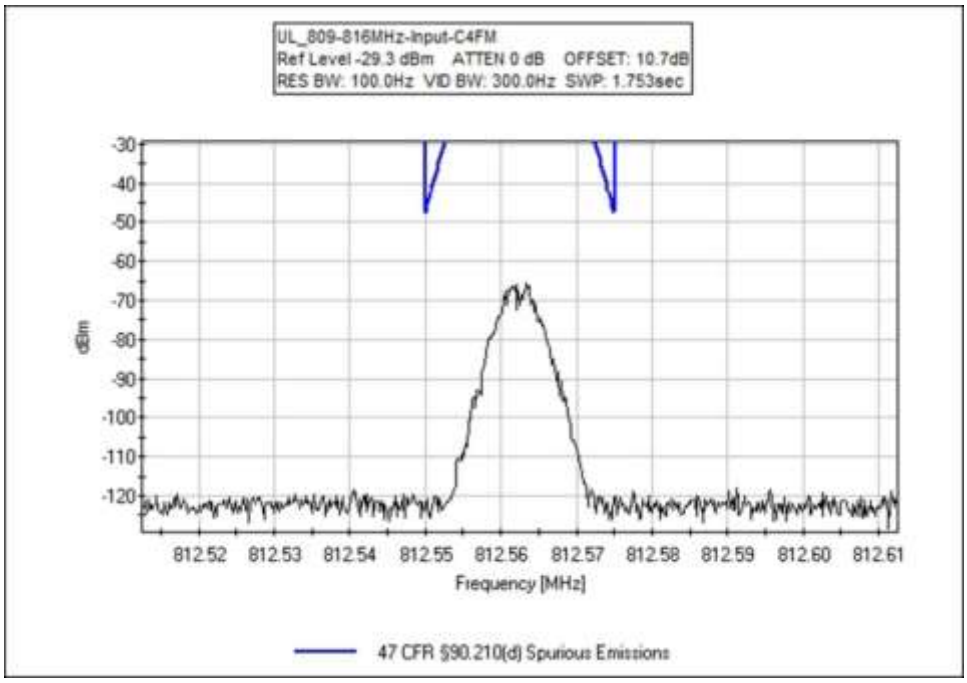
UL_809-816-Analog FM (25 kHz)-Pre AGC-Mask G-MC



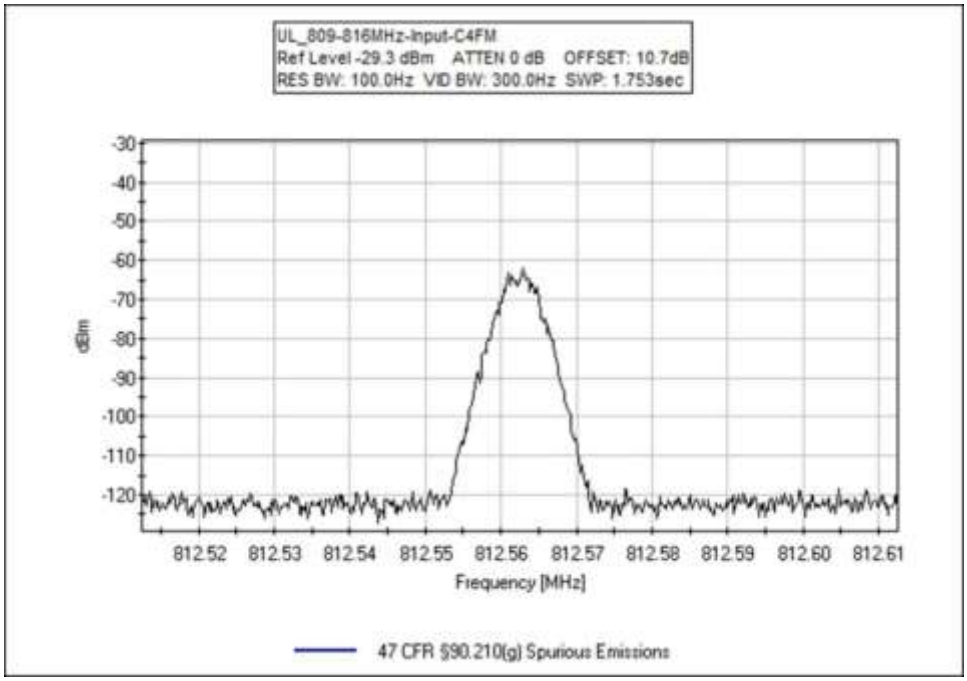
UL_809-816-APCO w/C4FM-AGC+3-Mask D-MC



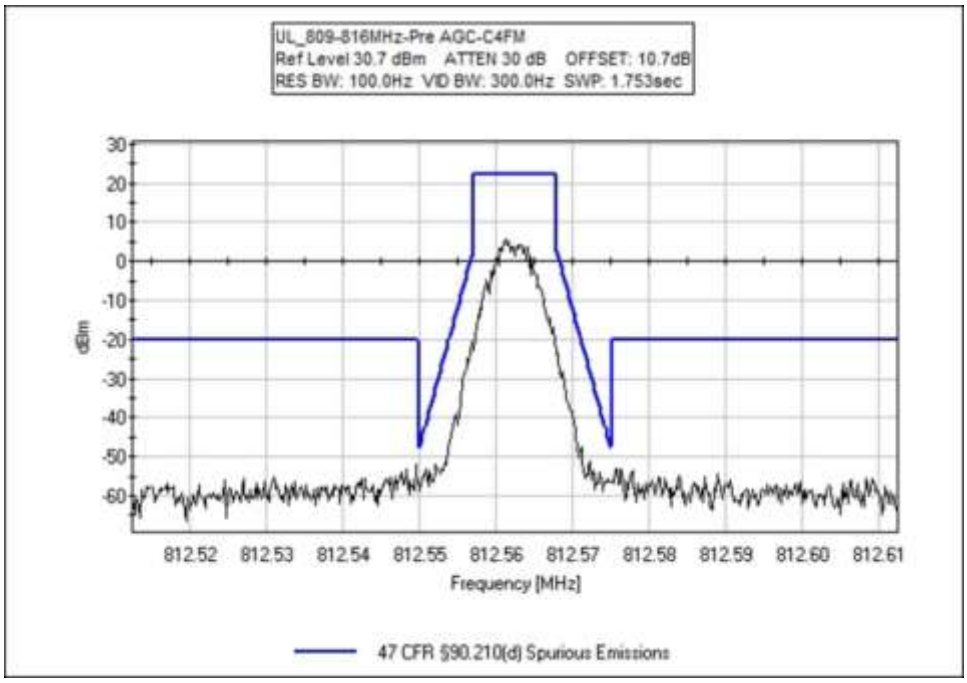
UL_809-816-APCO w/C4FM-AGC+3-Mask G-MC



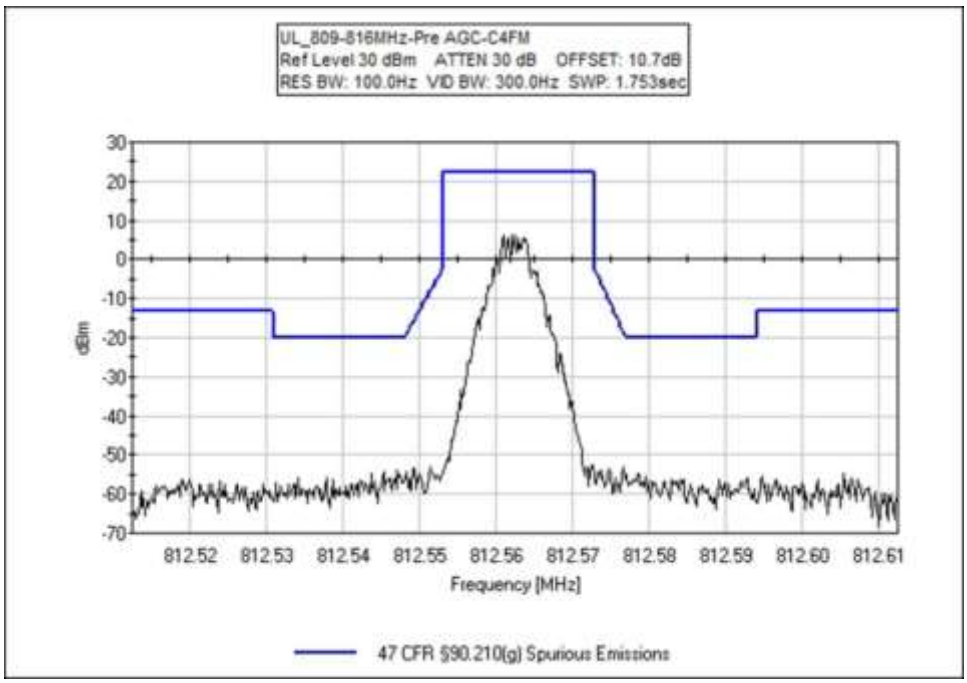
UL_809-816-APCO w/C4FM-Input-Mask D-MC



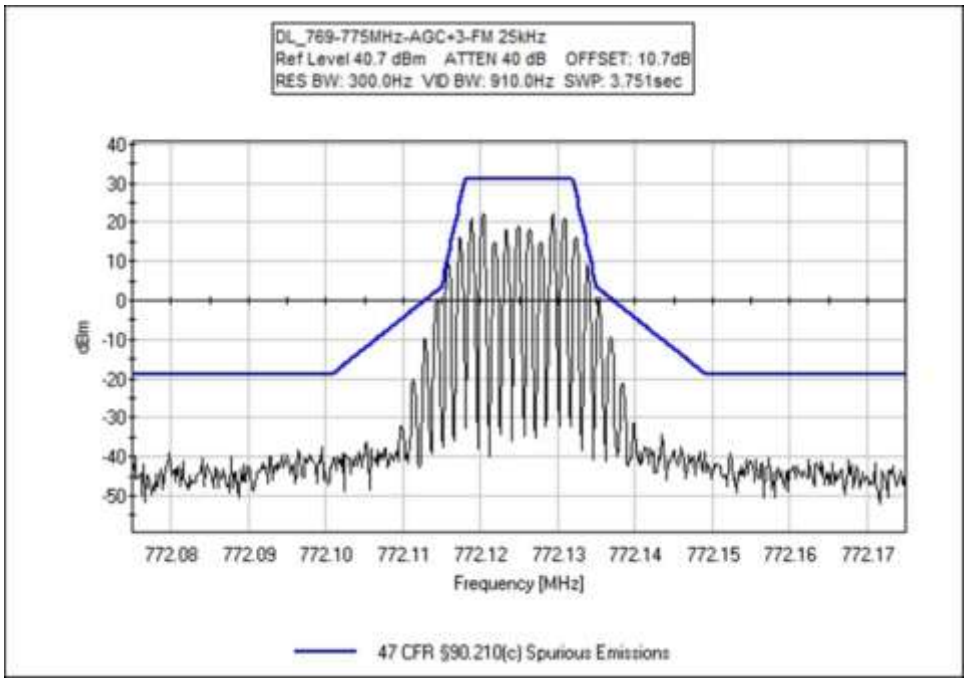
UL_809-816-APCO w/C4FM-Input-Mask G-MC



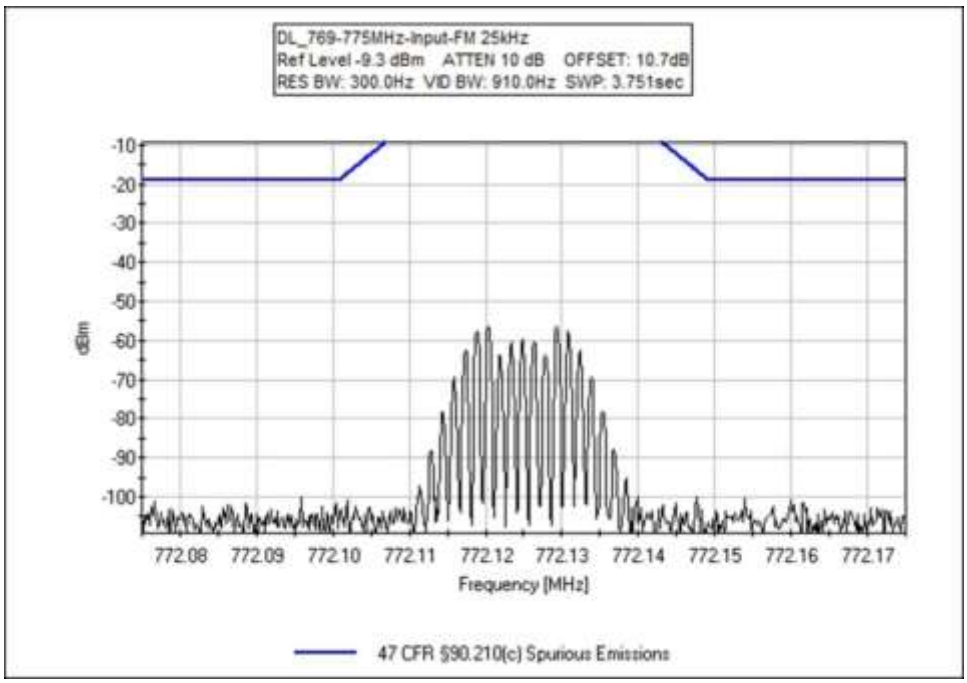
UL_809-816-APCO w/C4FM-Pre AGC-Mask D-MC



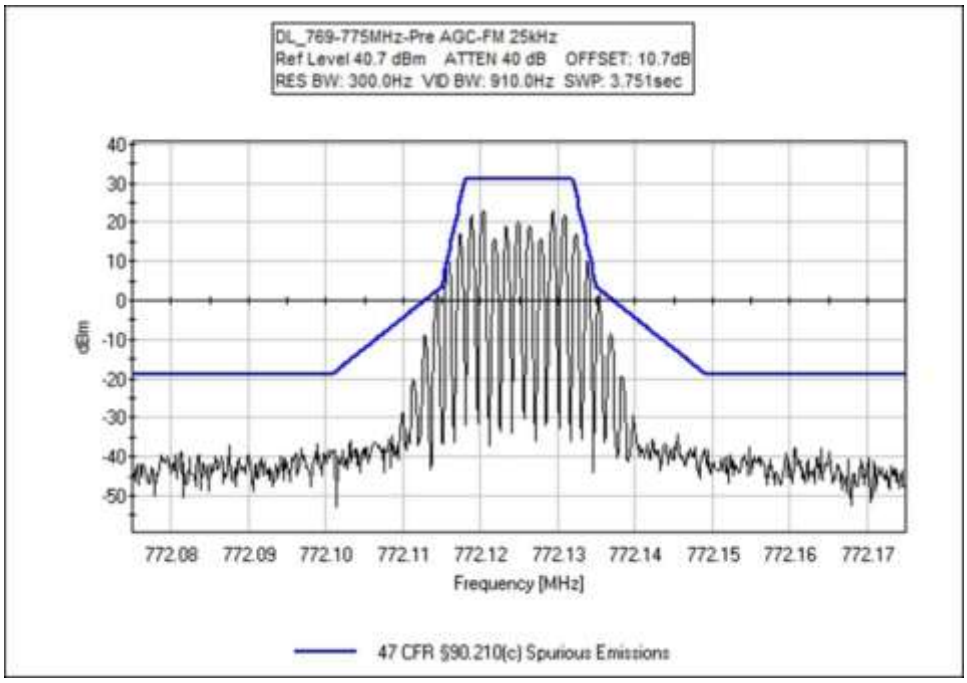
UL_809-816-APCO w/C4FM-Pre AGC-Mask G-MC



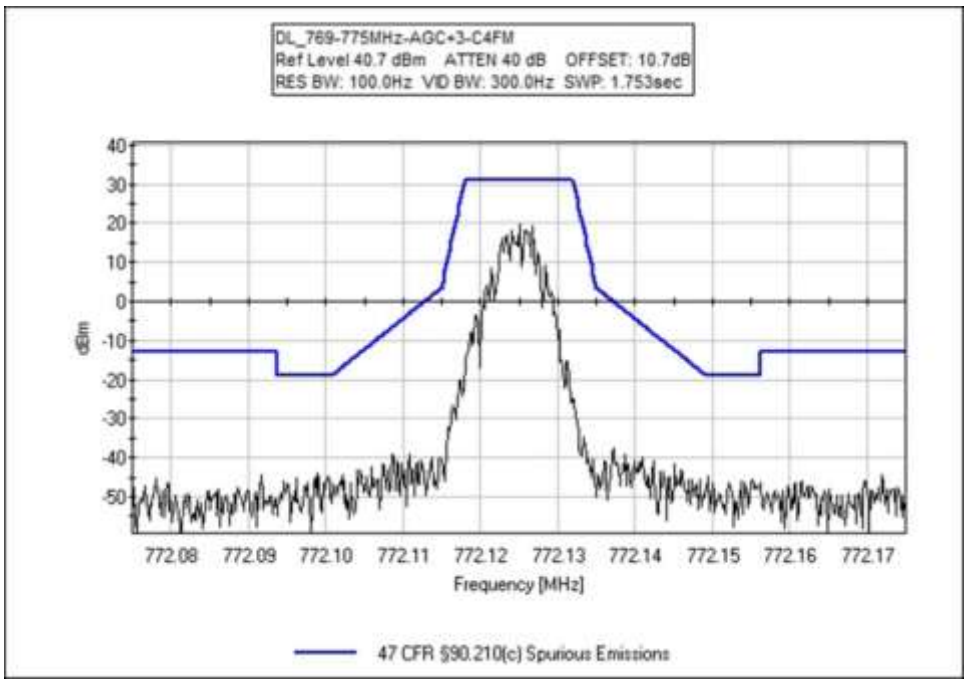
DL_769-775-Analog FM (25 kHz)-AGC+3-Mask C-MC



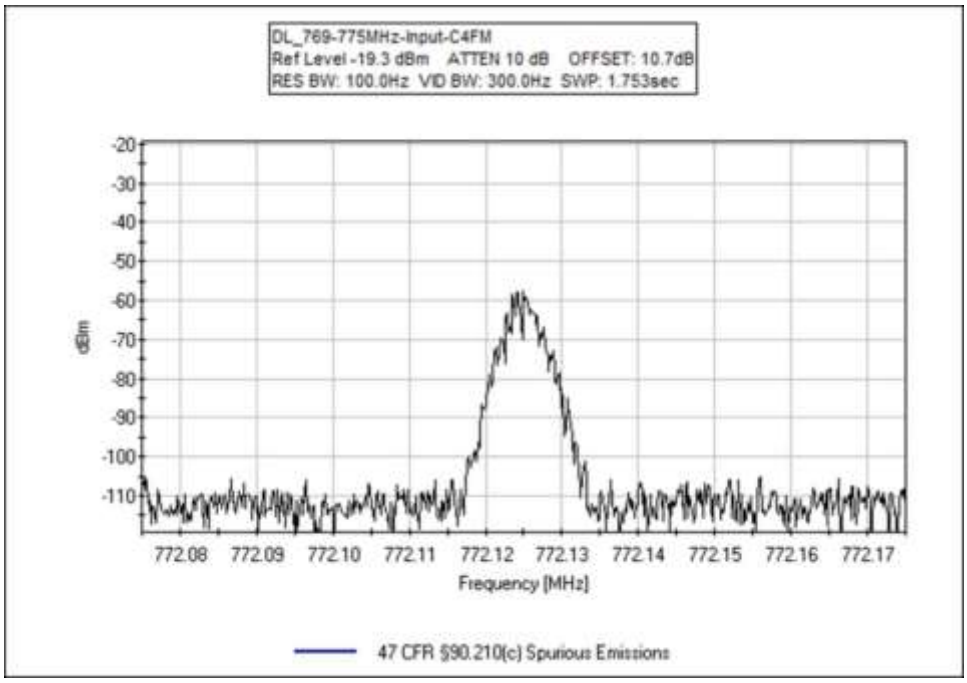
DL_769-775-Analog FM (25 kHz)-Input-Mask C-MC



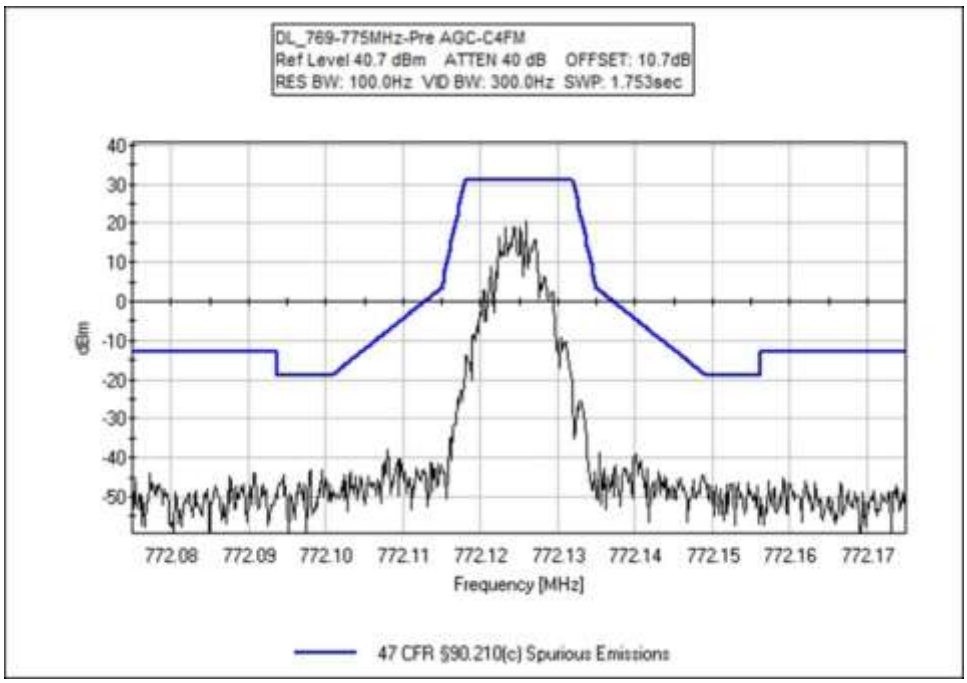
DL_769-775-Analog FM (25 kHz)-Pre AGC-Mask C-MC



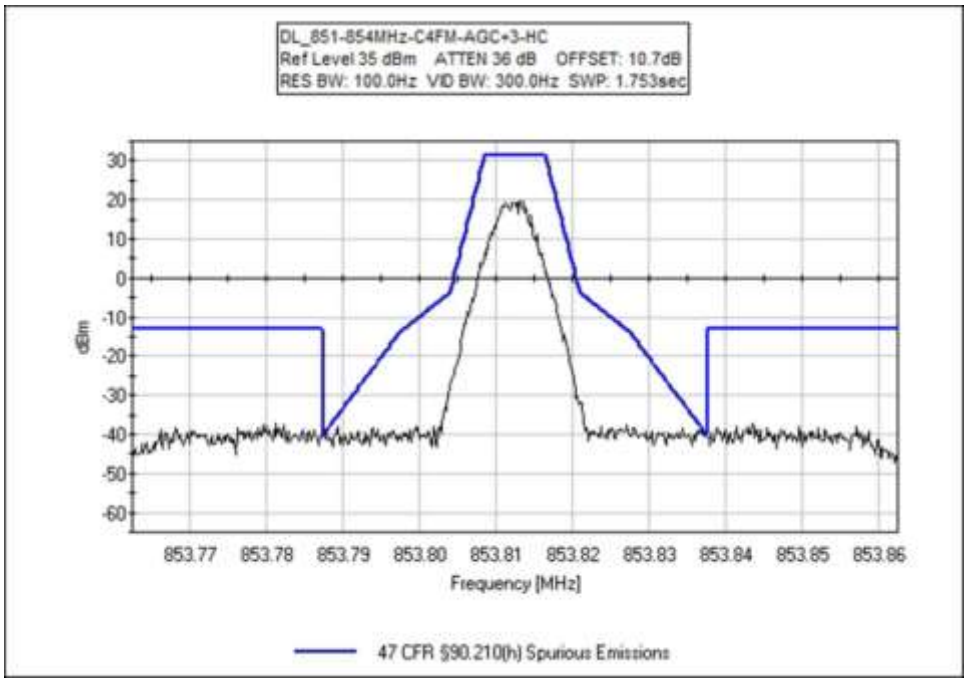
DL_769-775-APCO w/C4FM-AGC+3-Mask C-MC



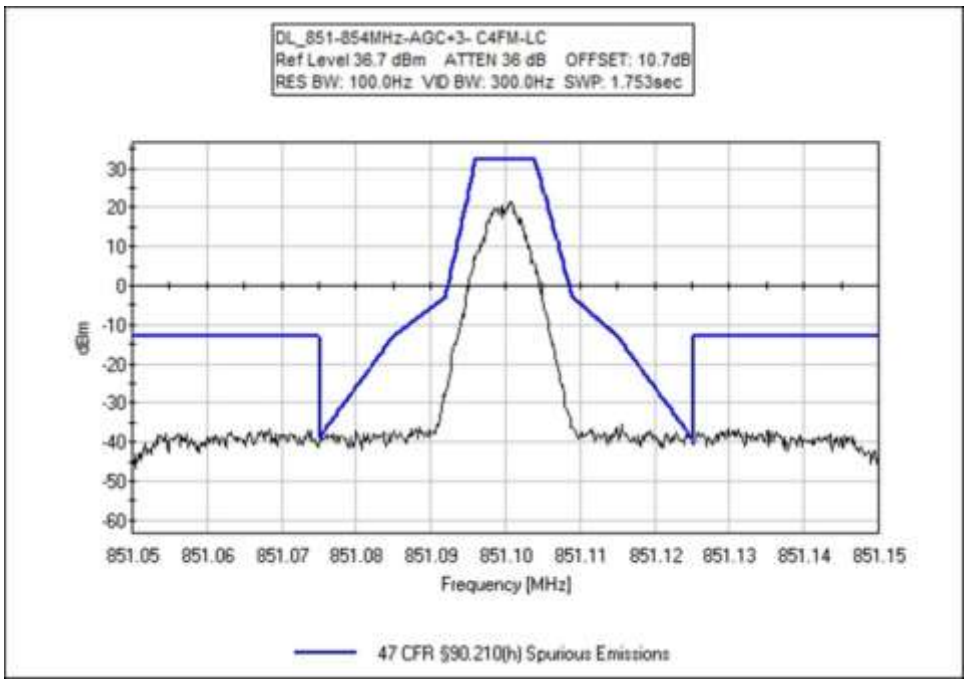
DL_769-775-APCO w/C4FM-Input-Mask C-MC



DL_769-775-APCO w/C4FM-Pre AGC-Mask C-MC



DL_851-854MHz-APCO w/C4FM-AGC+3-Mask H-HC



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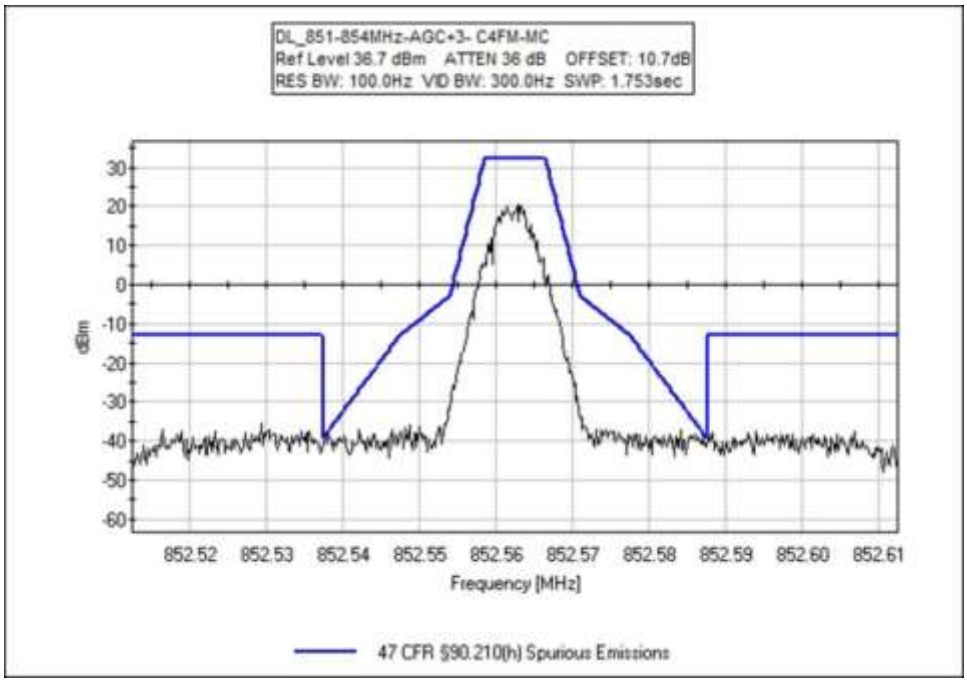

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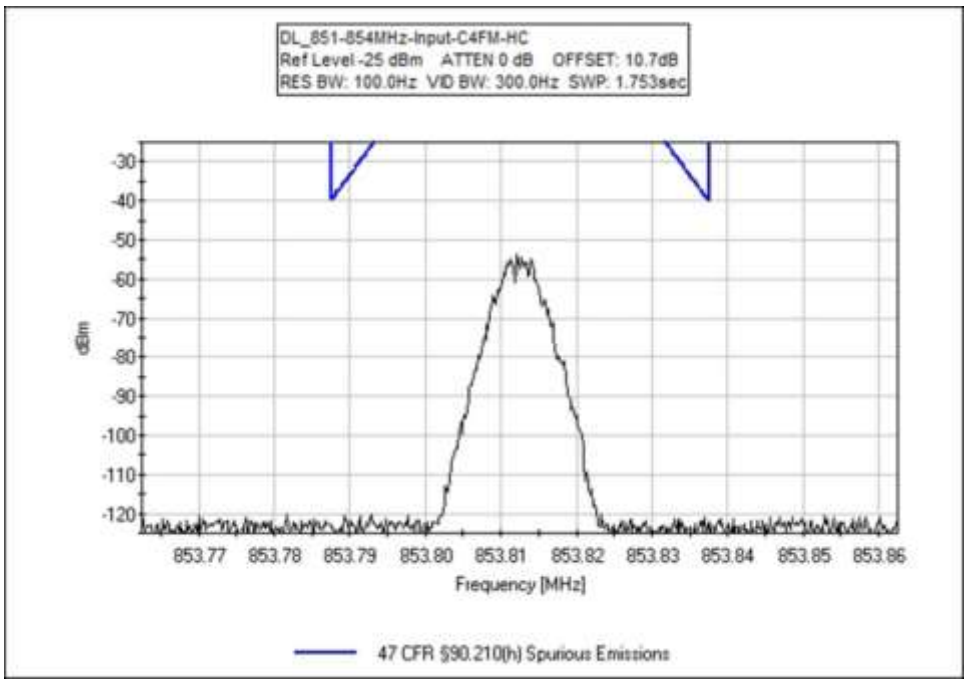

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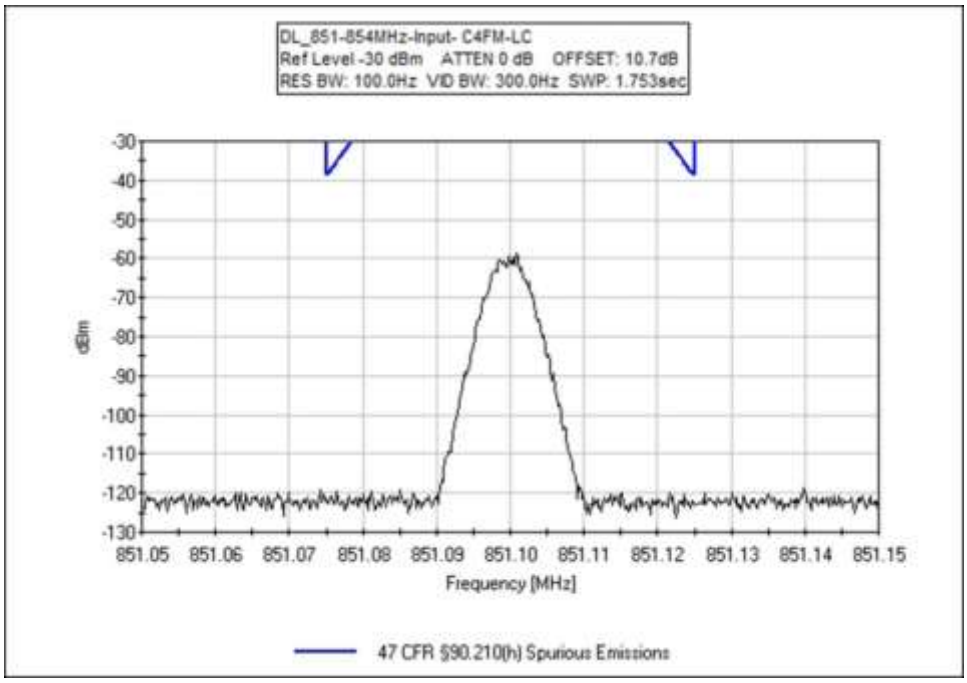

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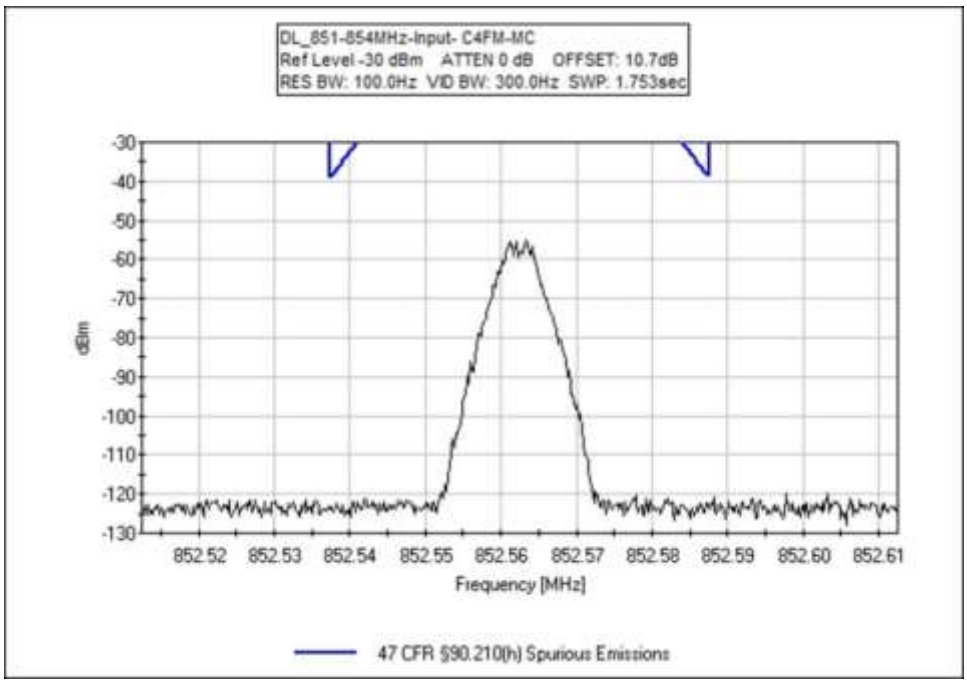
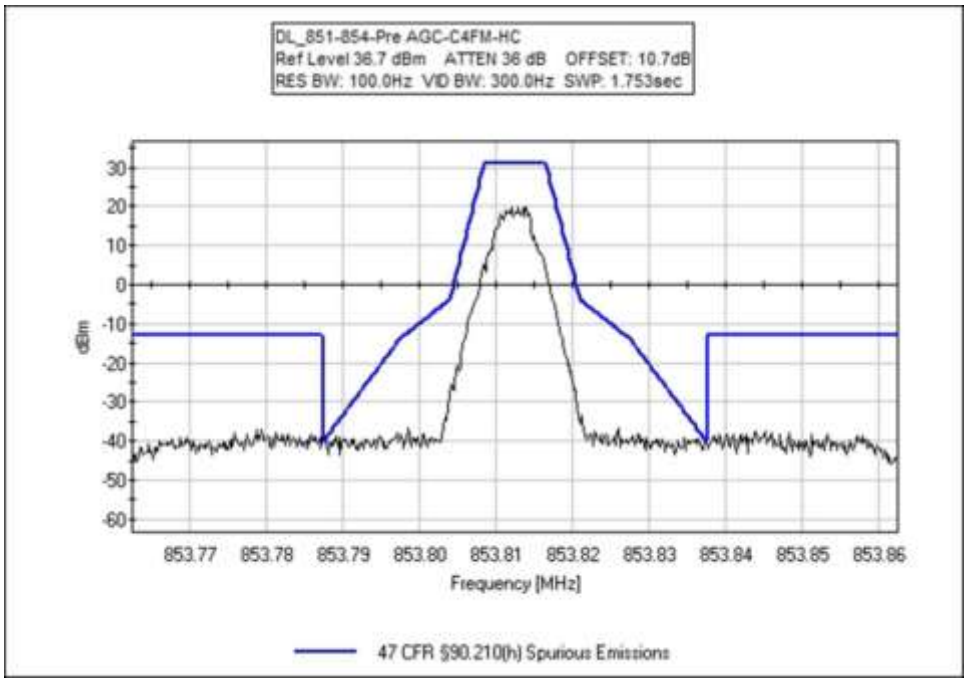
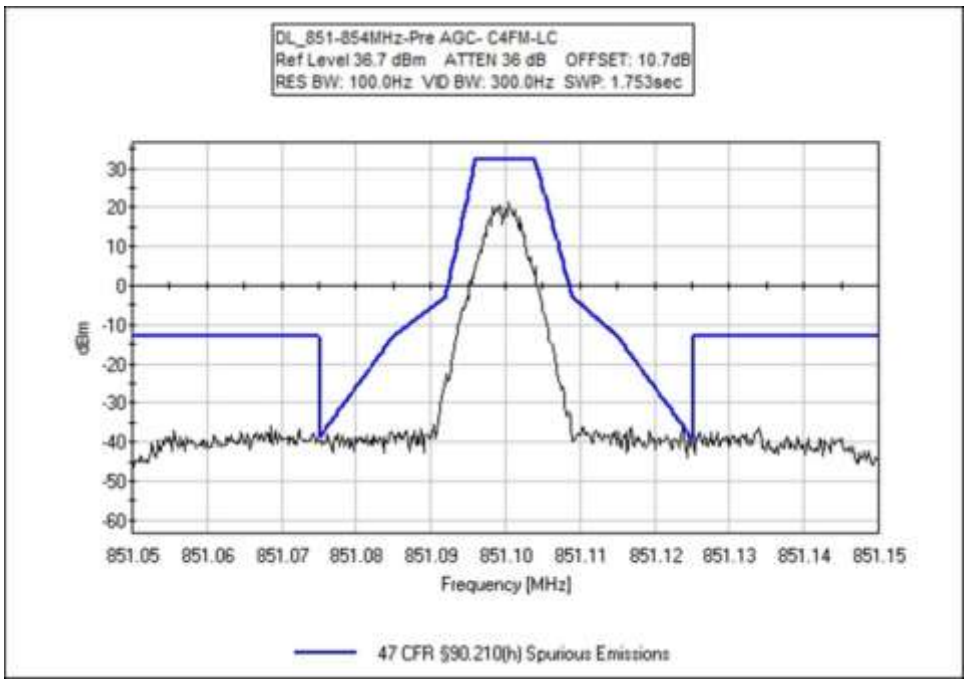


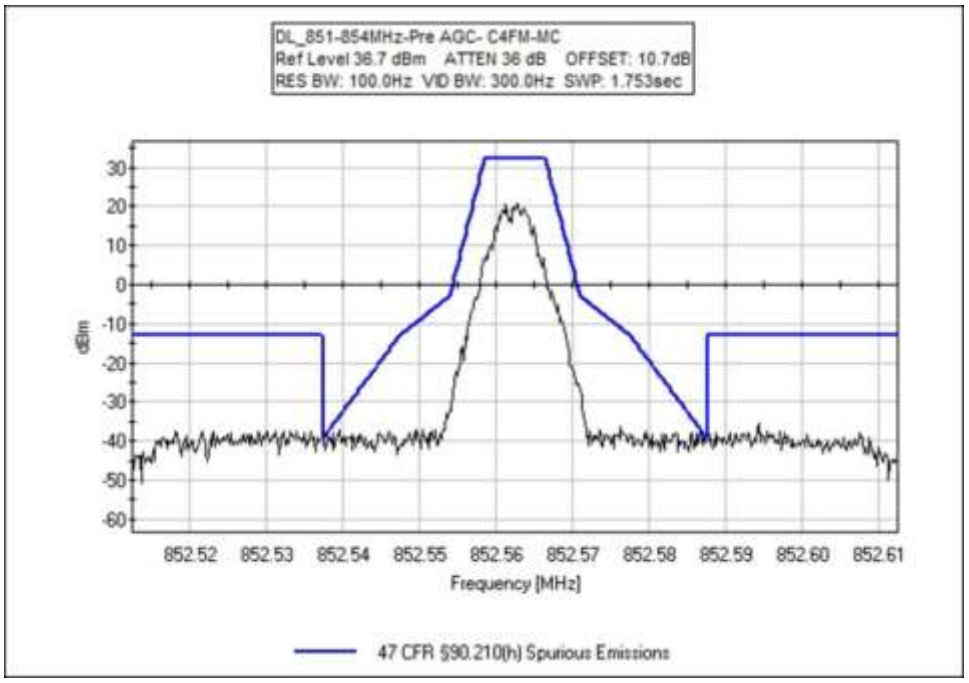
DL_851-854MHz-APCO w/C4FM-Input-Mask H-MC



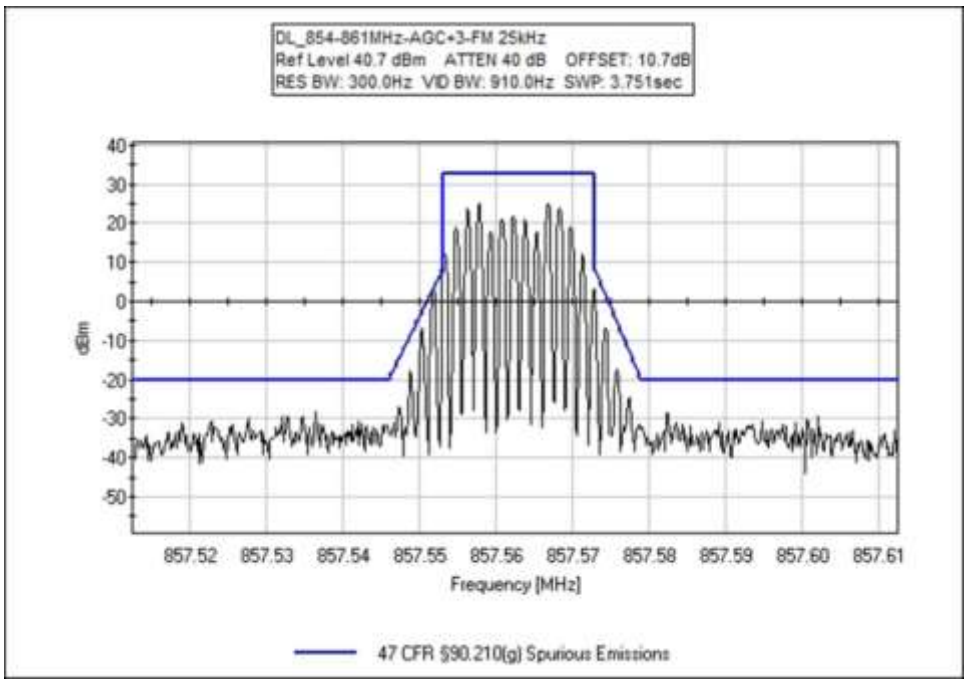
DL_851-854MHz-APCO w/C4FM-Pre AGC-Mask H-HC



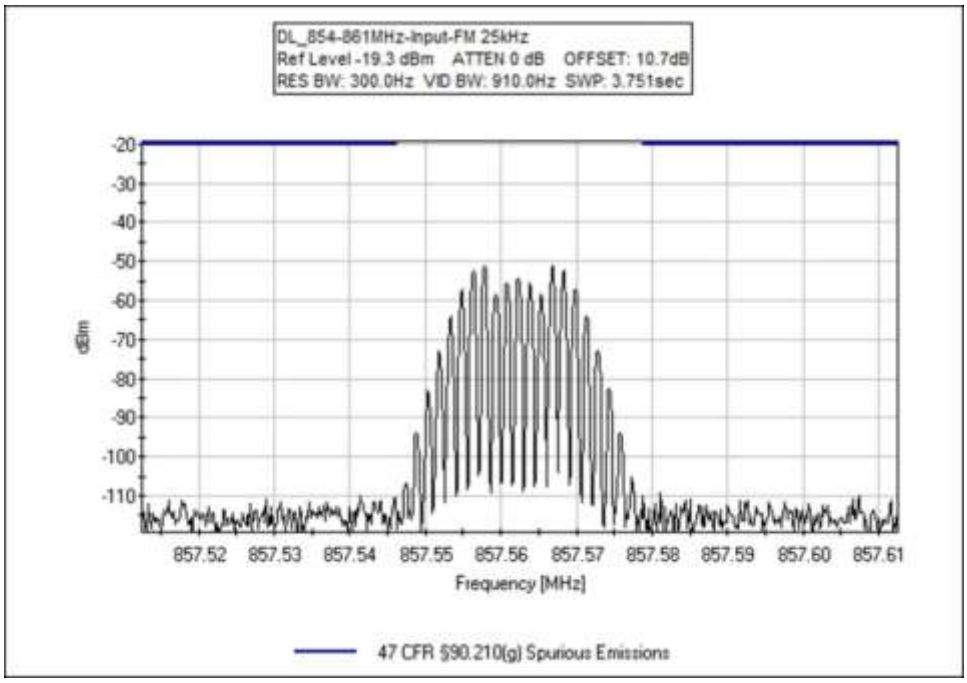
DL_851-854MHz-APCO w/C4FM-Pre AGC-Mask H-LC



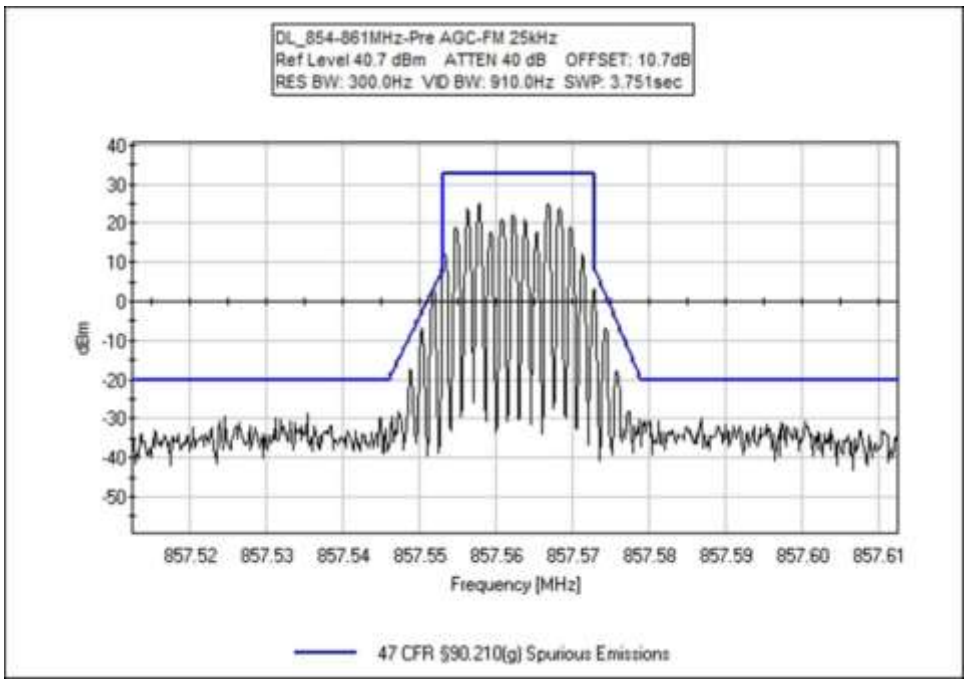
DL_851-854MHz-APCO w/C4FM-Pre AGC-Mask H-MC



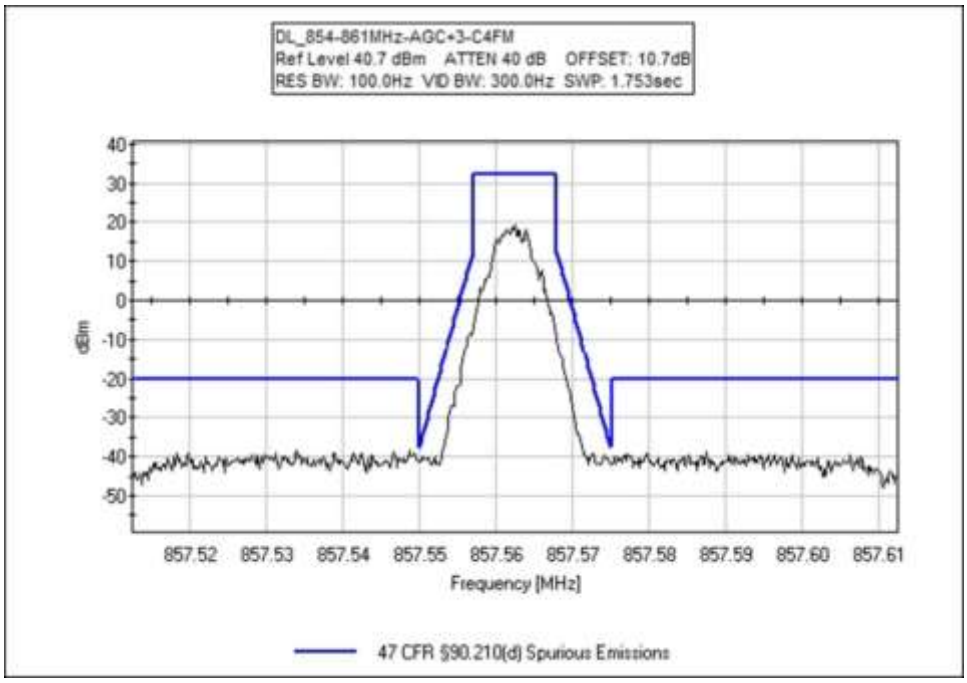
DL_854-861-Analog FM (25 kHz)-AGC+3-Mask G-MC



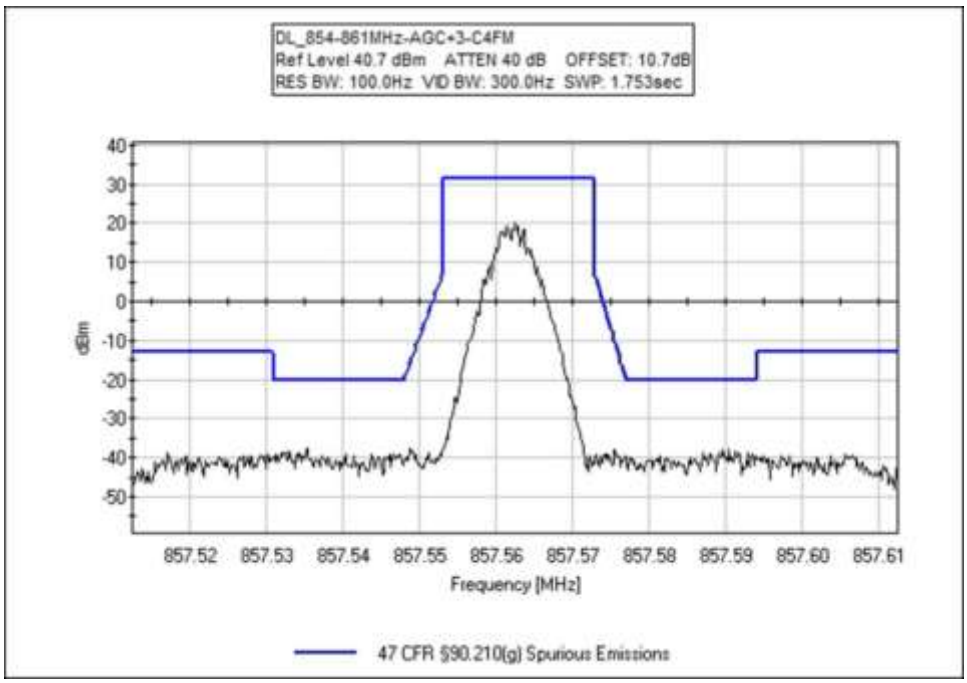
DL_854-861-Analog FM (25 kHz)-Input-Mask G-MC



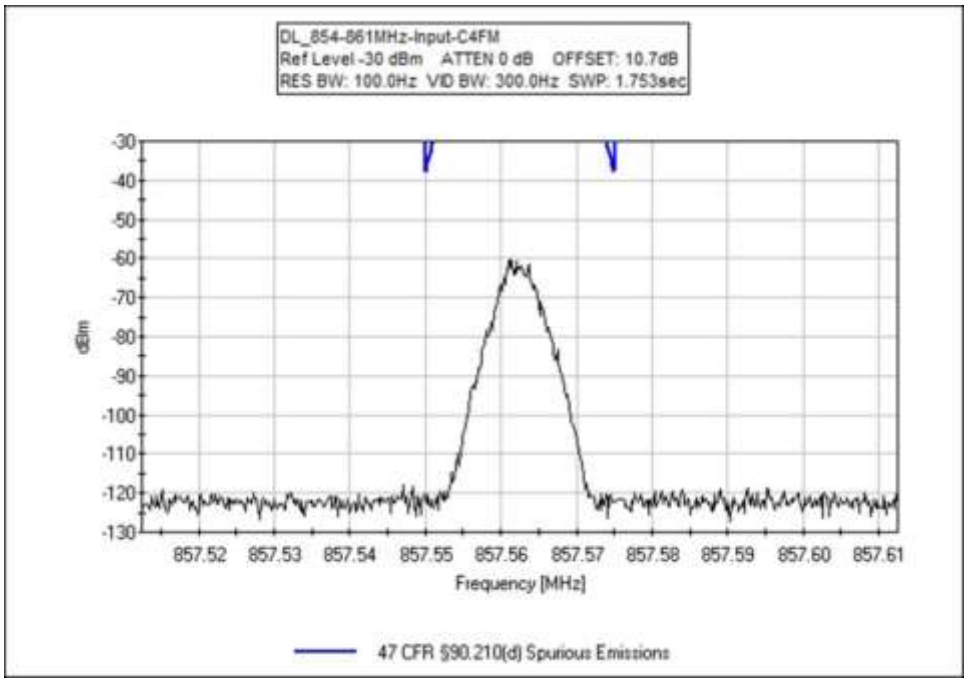
DL_854-861-Analog FM (25 kHz)-Pre AGC-Mask G-MC



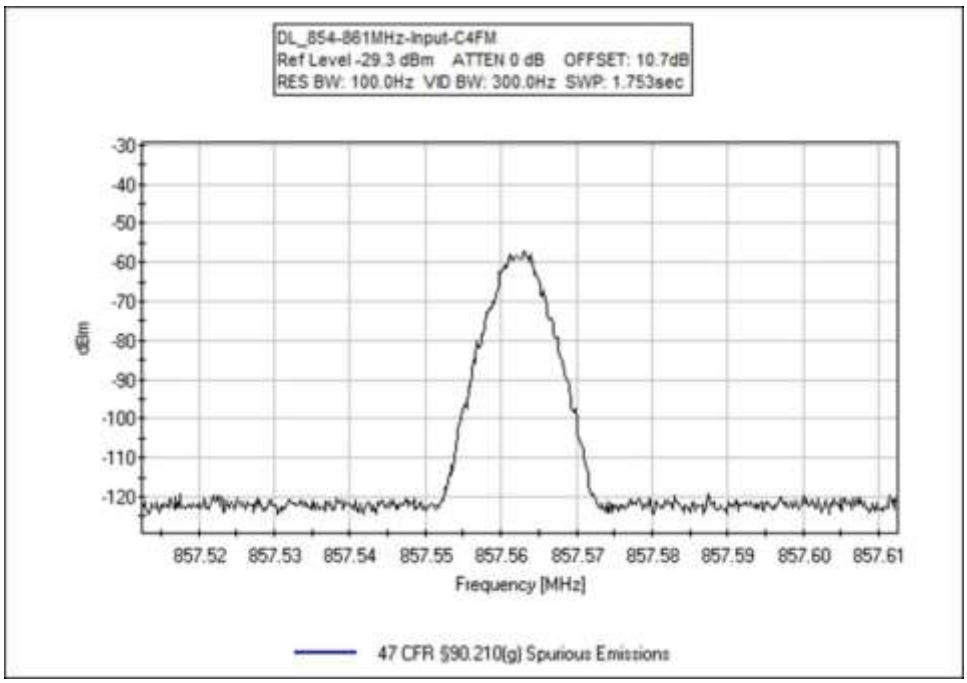
DL_854-861-APCO w/C4FM-AGC+3-Mask D-MC



DL_854-861-APCO w/C4FM-AGC+3-Mask G-MC



DL_854-861-APCO w/C4FM-Input-Mask D-MC



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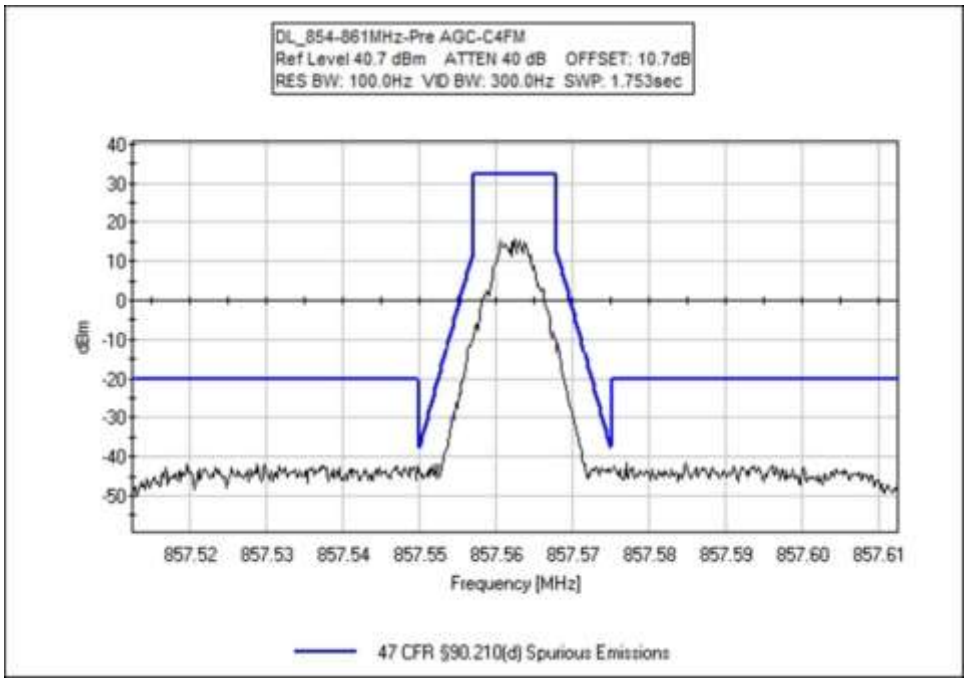
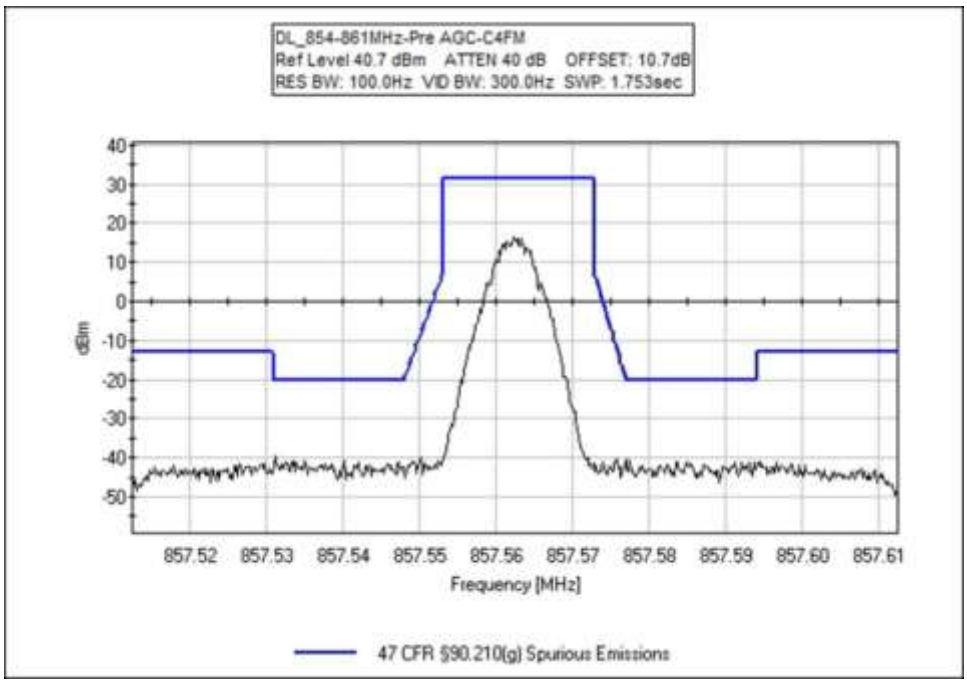
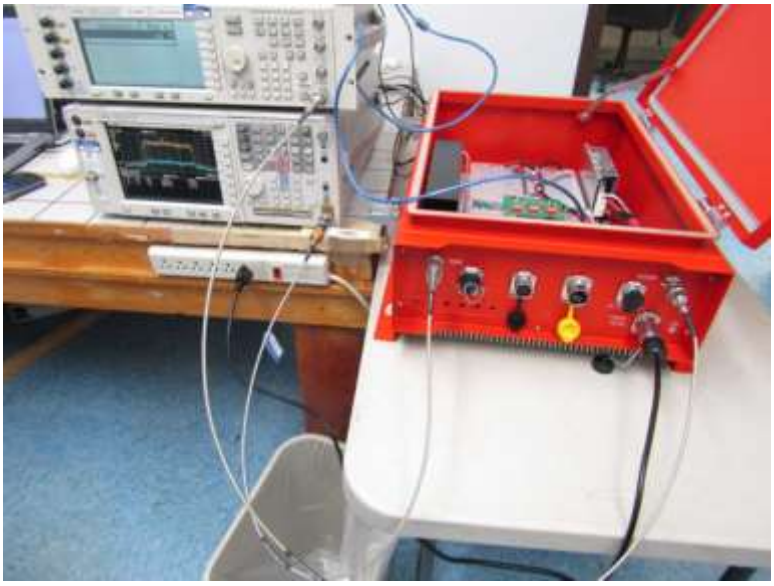


DL_854-861-APCO w/C4FM-Pre AGC-Mask D-MC



DL_854-861-APCO w/C4FM-Pre AGC-Mask G-MC

Test Setup Photo(s)



4.5 Input/Output Power and Amplifier/Booster Gain

Test Setup/Conditions			
Test Location:	Fremont	Test Engineer:	Hieu Song Nguyenpham
Test Date(s):	9/16, 17 and 21/2020		
Configuration:	1		
Test Setup:	See General Test Setup 90.219 (e) (1) The output power capability of a signal booster must be designed for deployments providing a radiated power not exceeding 5 Watts ERP for each retransmitted channel. Modification #1 was in place during testing.		

Environmental Conditions			
Test Date	Temperature (ºC)	Relative Humidity (%):	Pressure (kPa)
9/16/2020	22.8	46	101.3
9/17/2020	21.2	56	101
9/21/2020	21.3	50	101.5

Test Equipment Radiated					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03471	Spectrum Analyzer	Agilent	E4440A	2/11/2020	2/11/2022
03418	Signal Generator	Agilent	E4438C	5/13/2019	5/13/2021
P05411	Attenuator	Weinschel	54A-10	11/27/2019	11/27/2021
P06467	Attenuator	Pasternack	PE7014-10	4/15/2019	4/15/2021
03360	Cable	Astrolab	32022-2-29094-36TC	4/9/2020	4/9/2022
P07192	Cable	Astro	32022-29094K-29094K-48TC	11/27/2019	11/27/2021

Summary of Results

Pass: Summarized in tables below, calculated ERP from measured Conducted Power and Gain, are within limits

Public Safety 700MHz/800MHz bands

Pre AGC-CW						
Frequency (MHz)	**Input(dBm)**	**Output (dBm)**	**Gain (dB)**	**Limit (dBm)**	**Margin**	**Result**
UL 799-805	-74.2	24.5	98.7	37	-12.6	PASS
UL 806-809	-65.2	23.6	88.7	37	-13.5	PASS
UL 809-816	-61.2	22.5	83.7	37	-14.5	PASS
DL 769-775	-62.3	32.3	94.5	37	-4.7	PASS
DL 851-854	-54.8	35.6	90.3	37	-1.4	PASS
DL 854-861	-59.7	34.0	93.8	37	-3.0	PASS

AGC+3-CW						
Frequency (MHz)	**Input(dBm)**	**Output (dBm)**	**Gain (dB)**	**Limit (dBm)**	**Margin**	**Result**
UL 799-805	-71.2	24.3	95.5	37	-12.7	PASS
UL 806-809	-62.2	23.6	85.7	37	-13.4	PASS
UL 809-816	-58.2	22.5	80.6	37	-14.5	PASS
DL 769-775	-59.3	32.1	91.4	37	-4.9	PASS
DL 851-854	-51.8	35.6	87.4	37	-1.4	PASS
DL 854-861	-56.7	34.1	90.8	37	-2.9	PASS

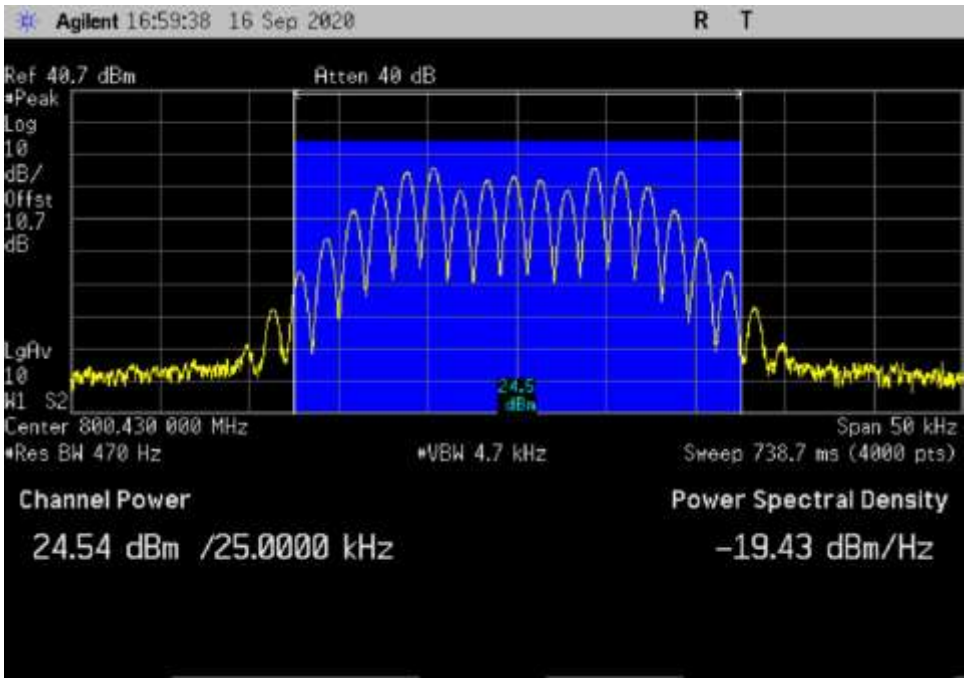
Pre AGC-Analog FM (25kHz)						
Frequency (MHz)	Input(dBm)	Output (dBm)	Gain (dB)	Limit (dBm)	Margin	Result
UL 799-805	-73.8	24.5	98.3	37	-12.5	PASS
UL 806-809	-64.8	23.1	87.9	37	-13.9	PASS
UL 809-816	-61.8	23.3	85.1	37	-13.7	PASS
DL 769-775	-62.3	32.3	94.6	37	-4.7	PASS
DL 851-854	-55.2	35.9	91.1	37	-1.1	PASS
DL 854-861	-60.2	34.3	94.5	37	-2.7	PASS

AGC+3-F Analog FM (25kHz)						
Frequency (MHz)	**Input(dBm)**	**Output (dBm)**	**Gain (dB)**	**Limit (dBm)**	**Margin**	**Result**
UL 799-805	-70.8	24.4	95.2	37	-12.6	PASS
UL 806-809	-61.8	23.2	85.0	37	-13.8	PASS
UL 809-816	-58.8	23.2	82.0	37	-13.8	PASS
DL 769-775	-59.3	31.5	90.8	37	-5.5	PASS
DL 851-854	-52.2	35.7	87.9	37	-1.3	PASS
DL 854-861	-57.2	34.2	91.4	37	-2.8	PASS

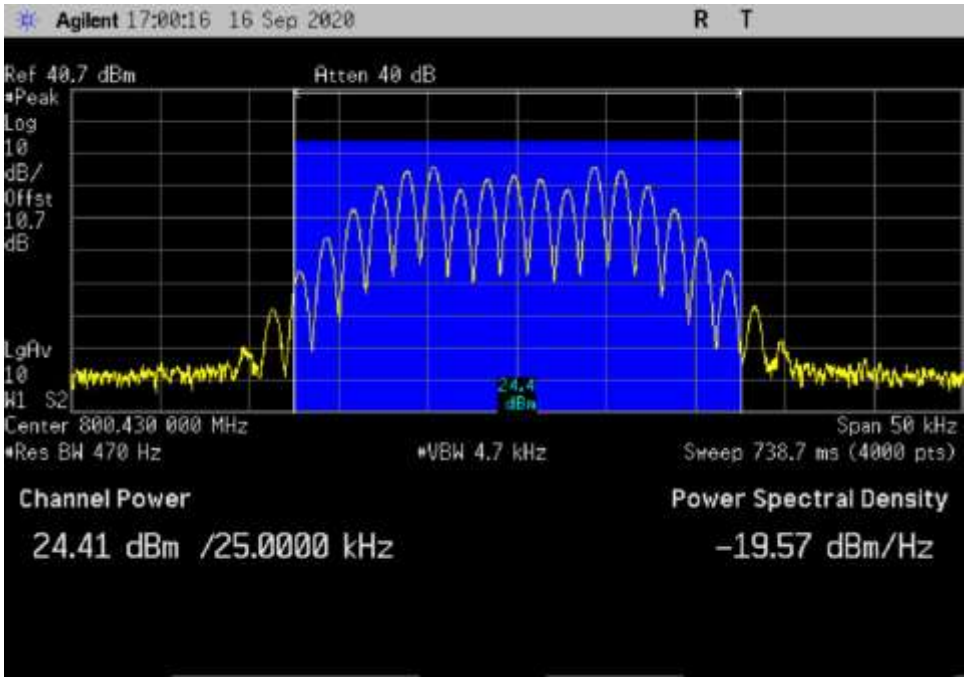
Pre AGC-APCO w/C4FM						
Frequency (MHz)	**Input(dBm)**	**Output (dBm)**	**Gain (dB)**	**Limit (dBm)**	**Margin**	**Result**
UL 799-805	-73.4	24.7	98.1	37	-12.3	PASS
UL 806-809	-64.1	24.0	88.1	37	-13.0	PASS
UL 809-816	-61.4	23.0	84.4	37	-14.0	PASS
DL 769-775	-59.8	32.5	92.3	37	-4.5	PASS
DL 851-854	-55.3	35.6	90.9	37	-1.4	PASS
DL 854-861	-57.3	34.4	91.7	37	-2.6	PASS

AGC+3- APCO w/C4FM						
Frequency (MHz)	**Input(dBm)**	**Output (dBm)**	**Gain (dB)**	**Limit (dBm)**	**Margin**	**Result**
UL 799-805	-70.4	24.5	94.9	37	-12.5	PASS
UL 806-809	-61.1	24.1	85.2	37	-12.9	PASS
UL 809-816	-58.4	22.8	81.2	37	-14.2	PASS
DL 769-775	-56.8	31.5	88.3	37	-5.5	PASS
DL 851-854	-52.3	35.1	87.4	37	-1.9	PASS
DL 854-861	-54.3	34.2	88.5	37	-2.8	PASS

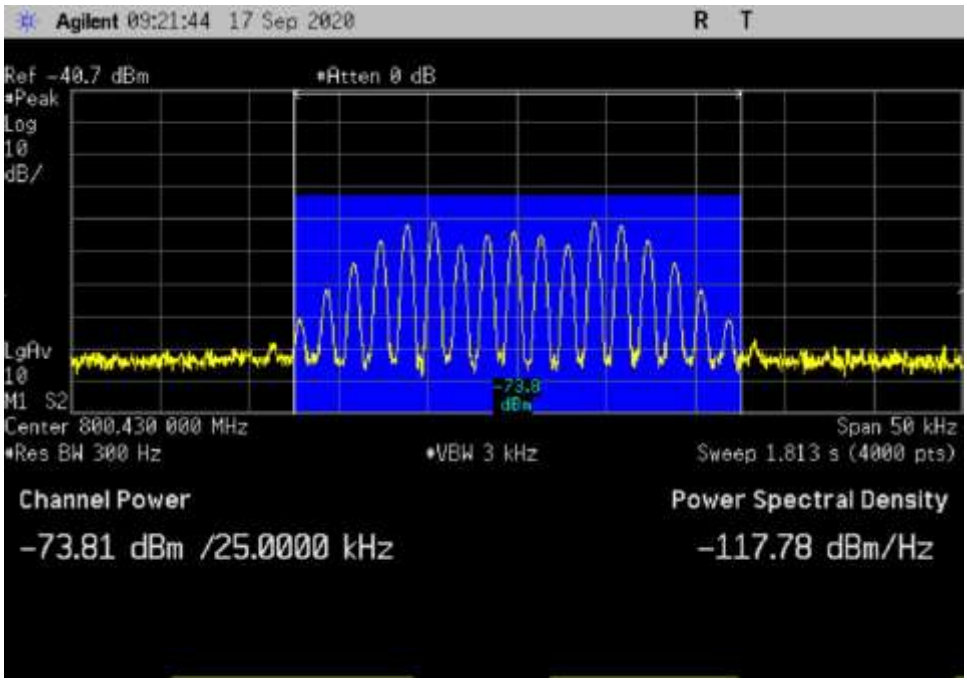
Plots



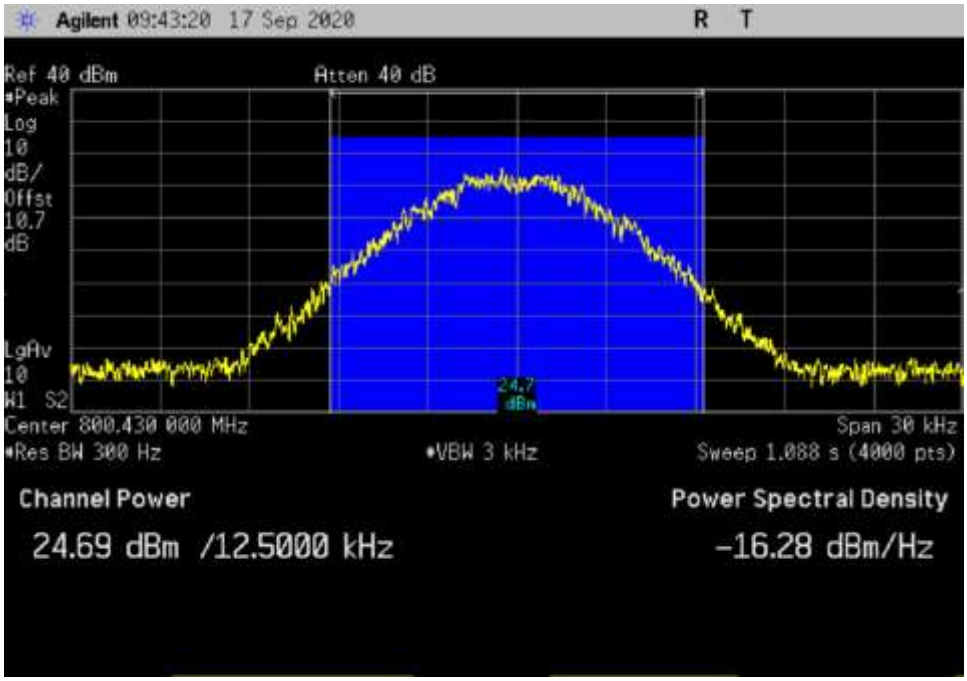
UL_799-805-Analog FM (25kHz)_ 800.43MHz



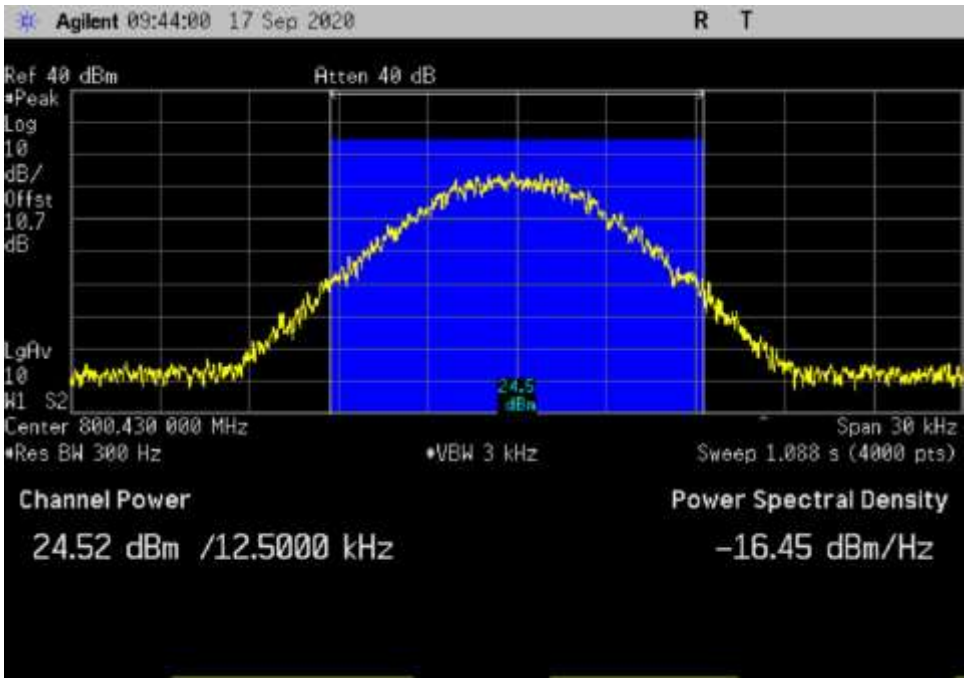
UL_799-805-Analog FM (25kHz)-AGC+3_ 800.43MHz



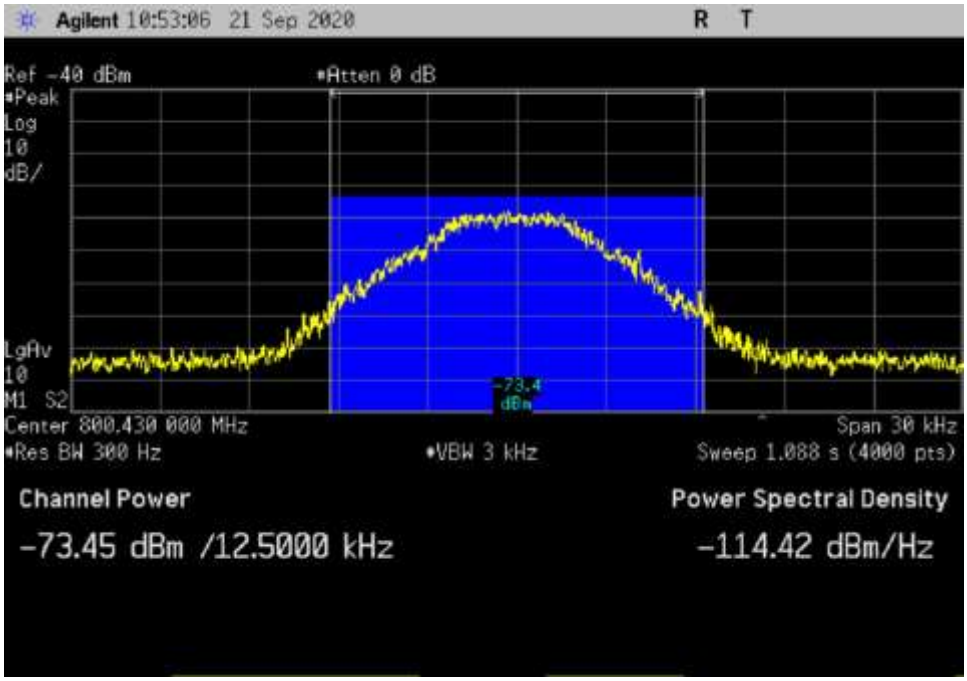
UL_799-805-Analog FM (25kHz)-Input_ 800.43MHz



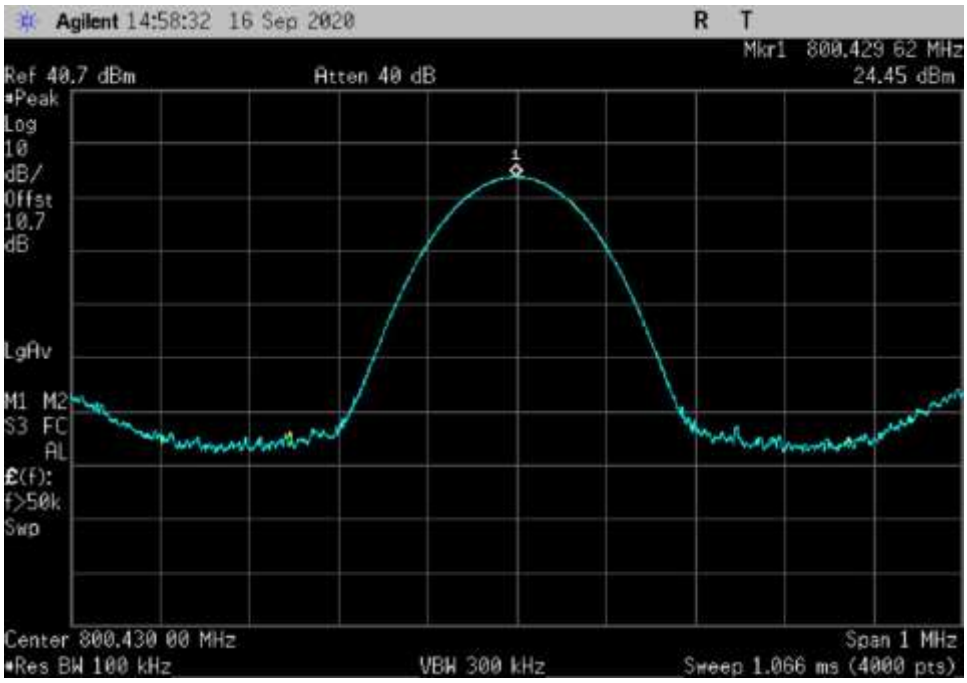
UL_799-805-APCO w/C4FM_ 800.43MHz



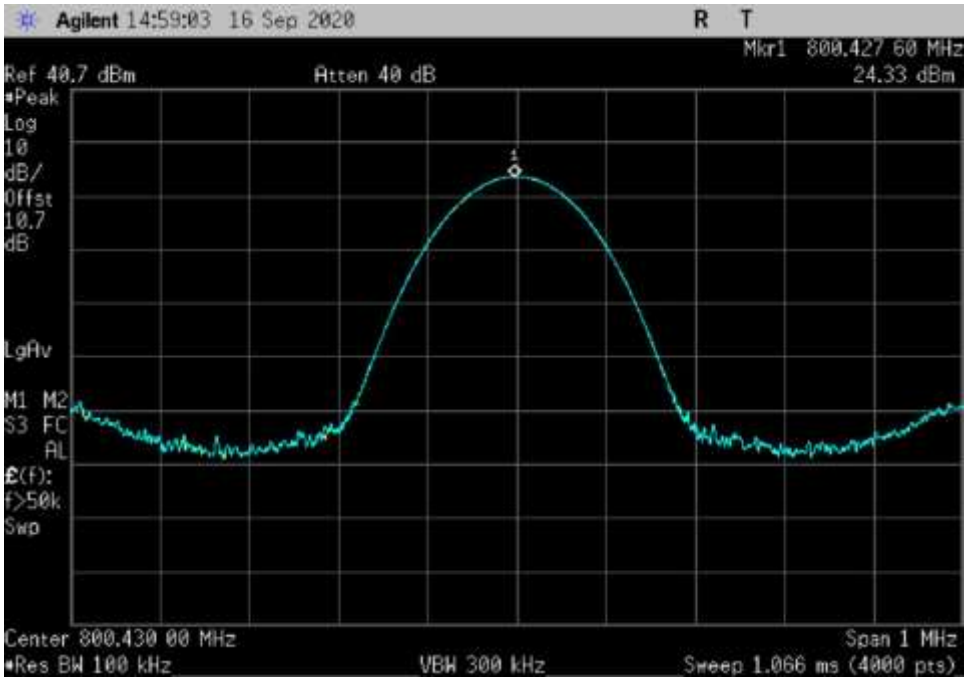
UL_799-805-APCO w/C4FM-AGC+3_ 800.43MHz



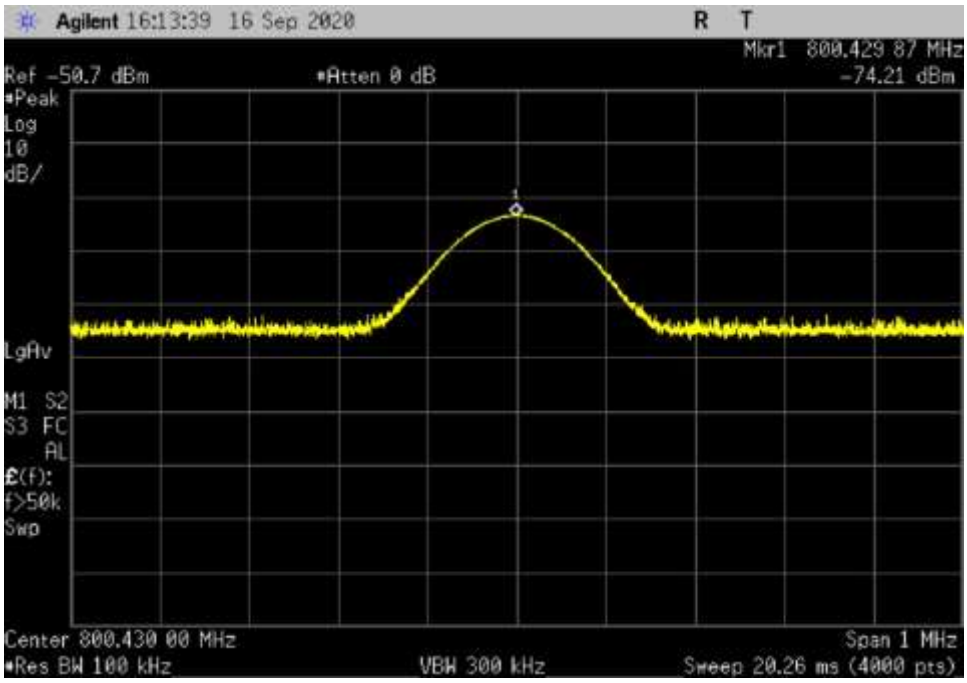
UL_799-805-APCO w/C4FM-Input_ 800.43MHz



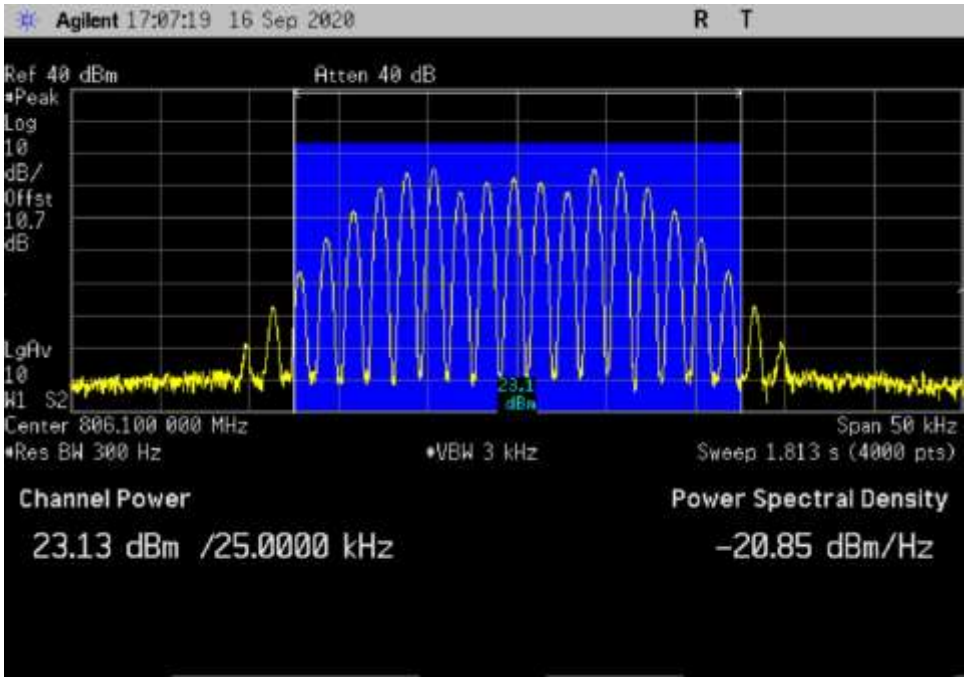
UL_799-805-CW_ 800.43MHz



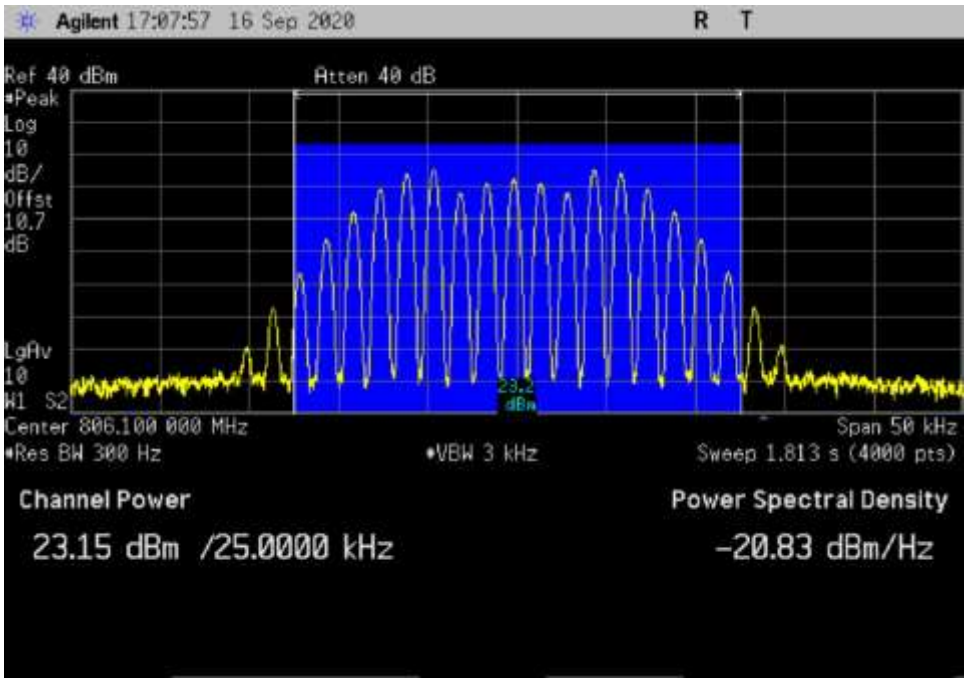
UL_799-805-CW-AGC+3_ 800.43MHz



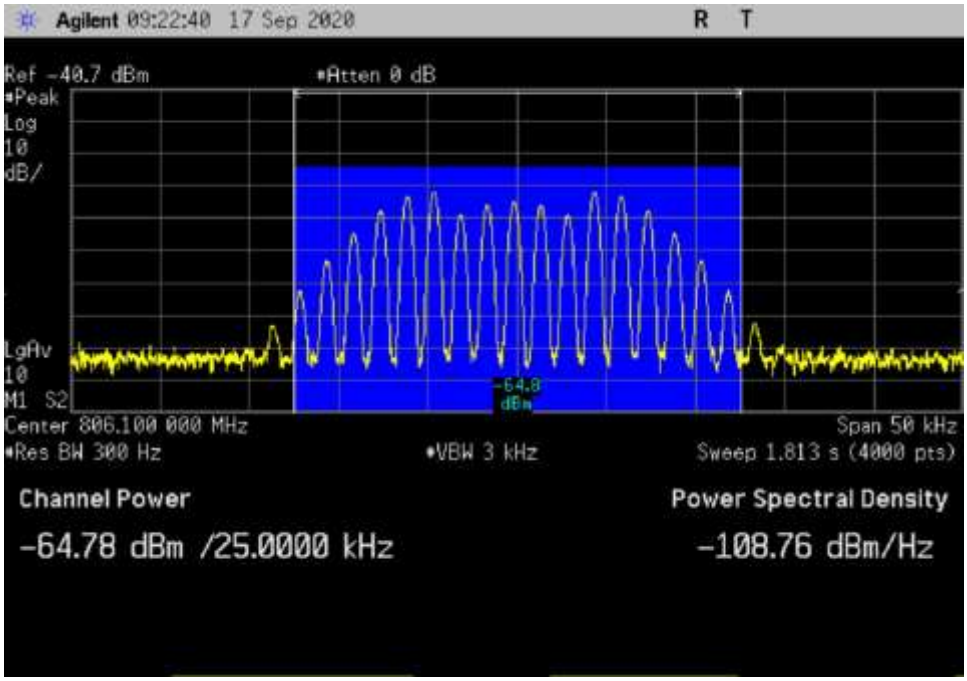
UL_799-805-CW-Input_ 800.43MHz



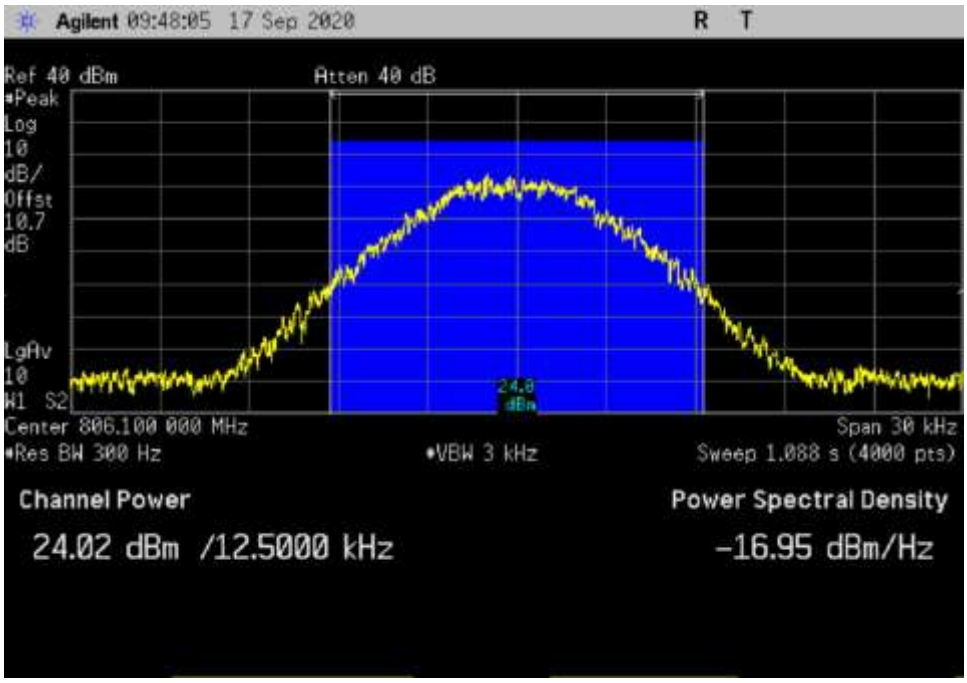
UL_806-809-Analog FM (25kHz)_ 806.1MHz



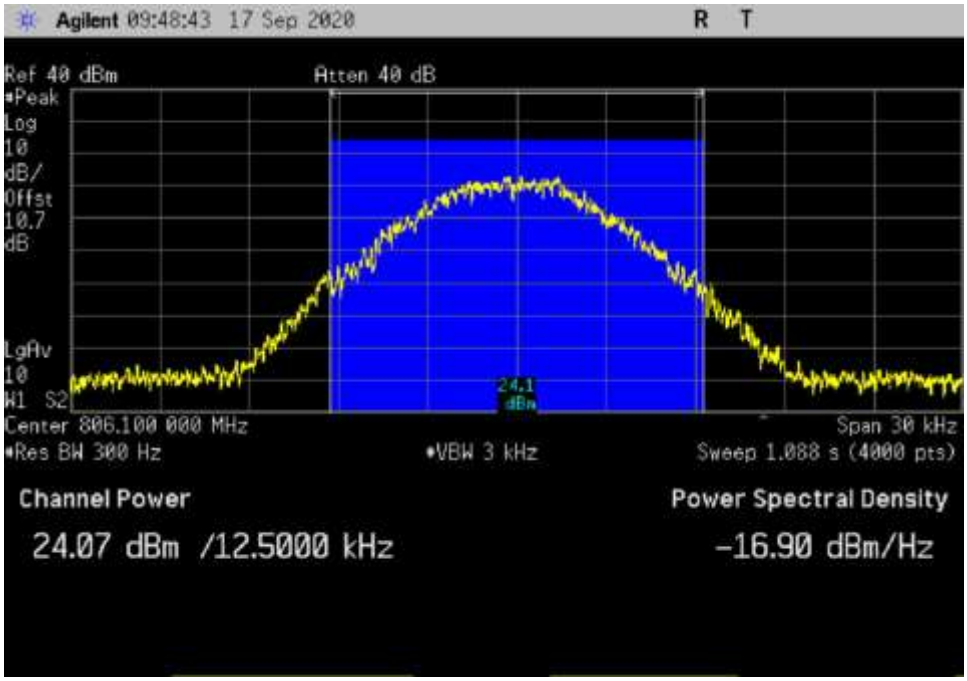
UL_806-809-Analog FM (25kHz)-AGC+3_ 806.1MHz



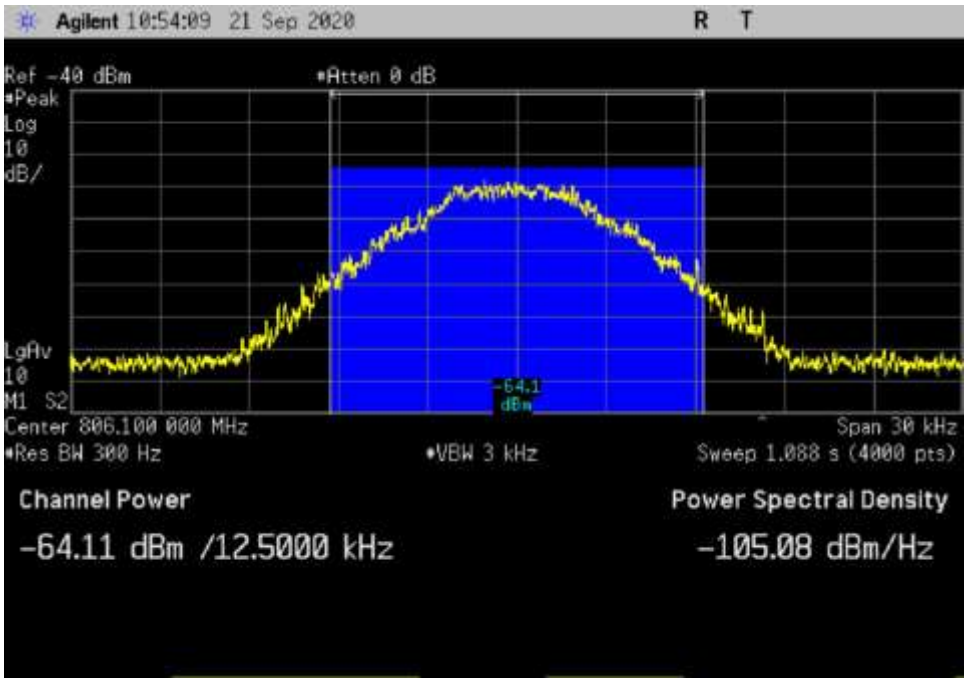
UL_806-809-Analog FM (25kHz)-Input_ 806.1MHz



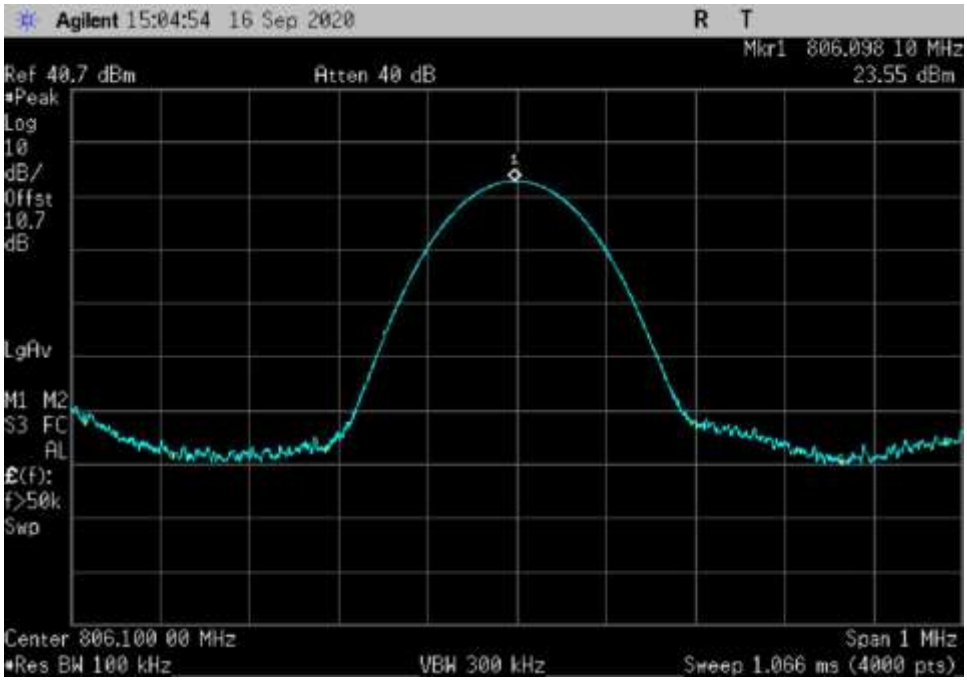
UL_806-809-APCO w/C4FM_ 806.1MHz



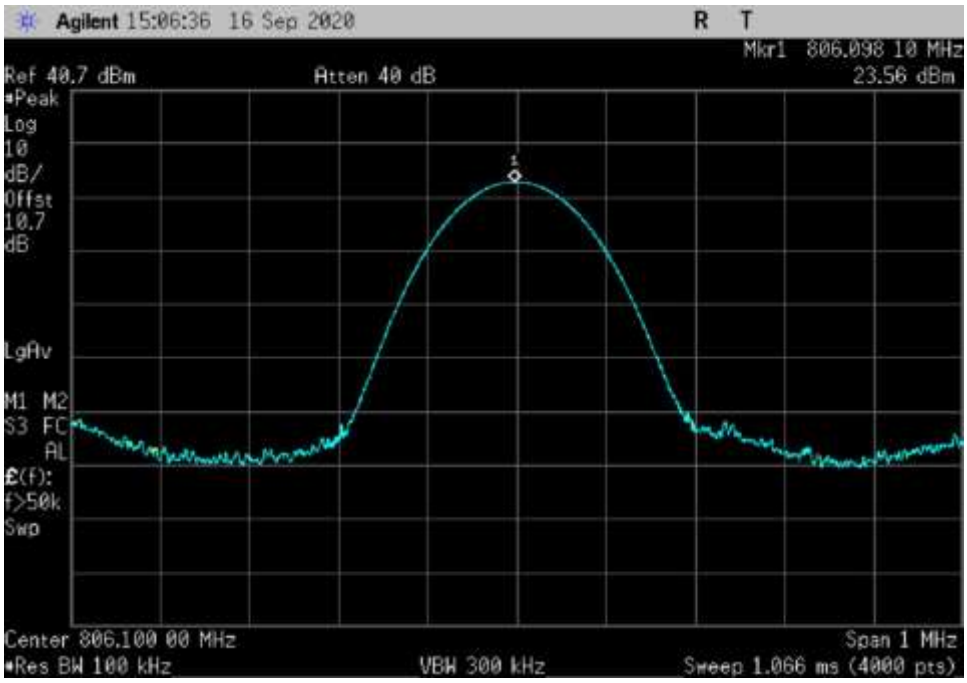
UL_806-809-APCO w/C4FM-AGC+3_ 806.1MHz



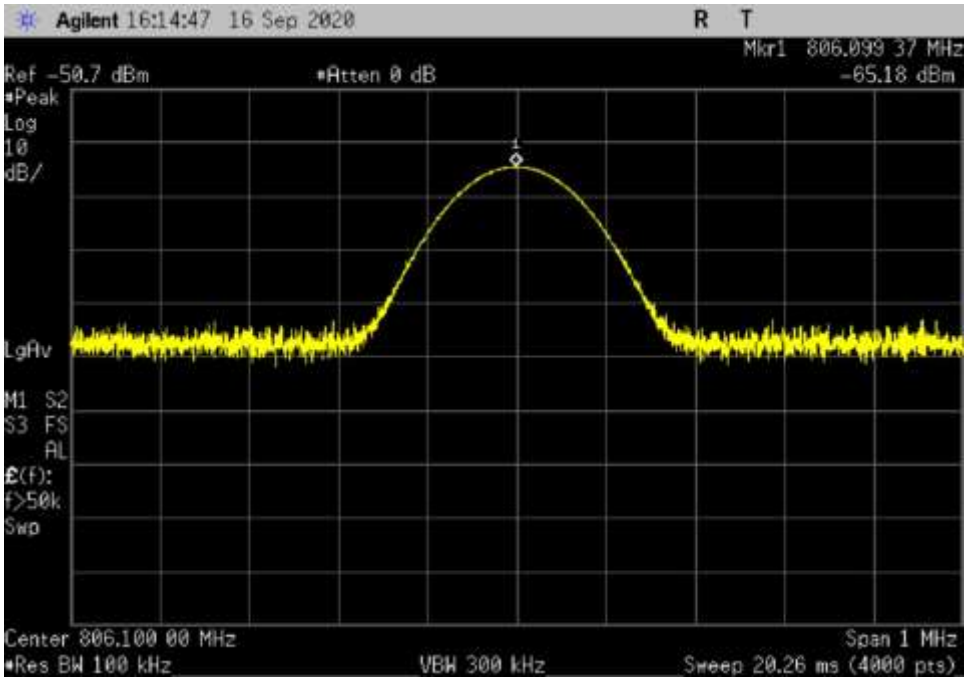
UL_806-809-APCO w/C4FM-Input_ 806.1MHz



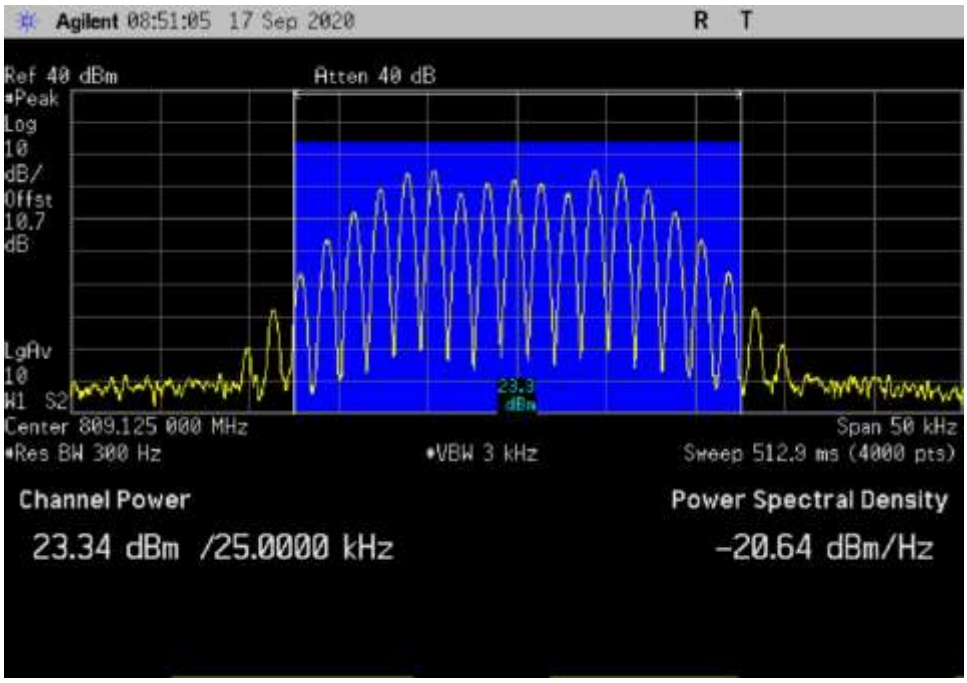
UL_806-809-CW- 806.1MHz



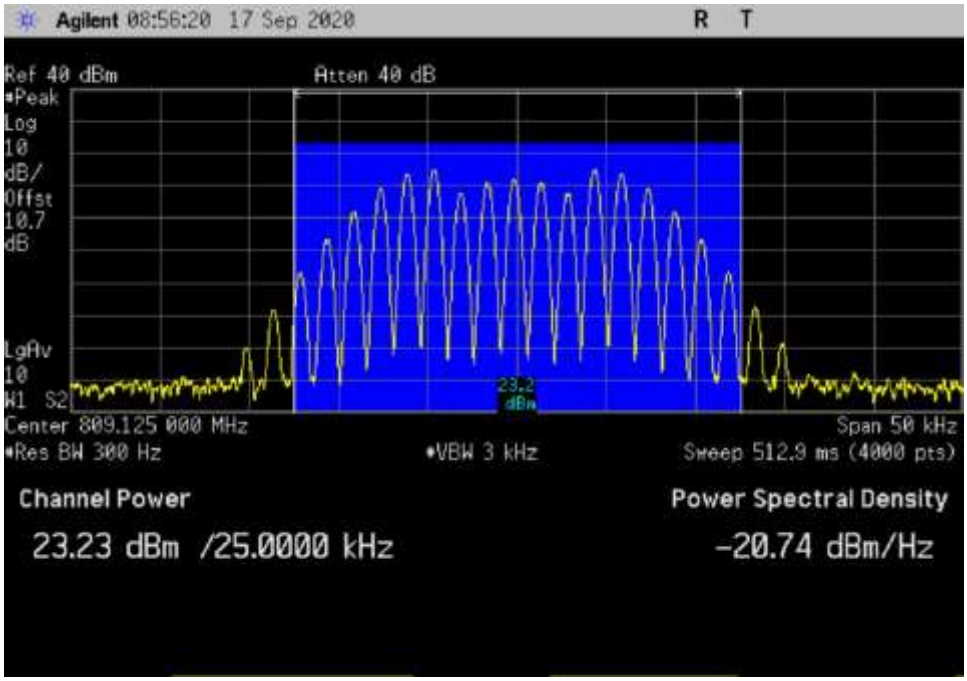
UL_806-809-CW-AGC+3_ 806.1MHz



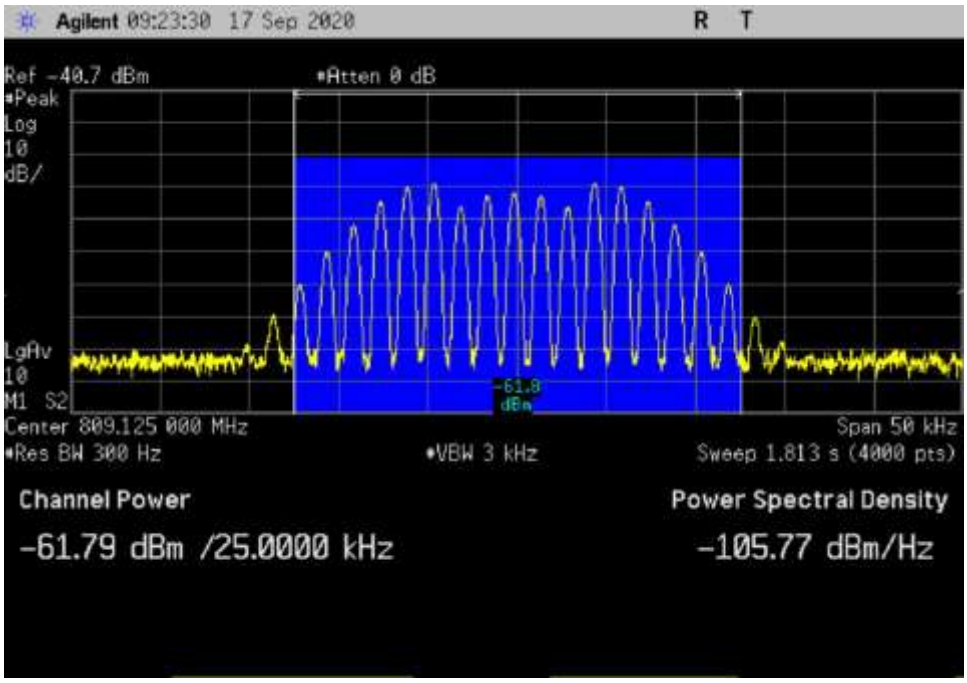
UL_806-809-CW-Input_ 806.1MHz



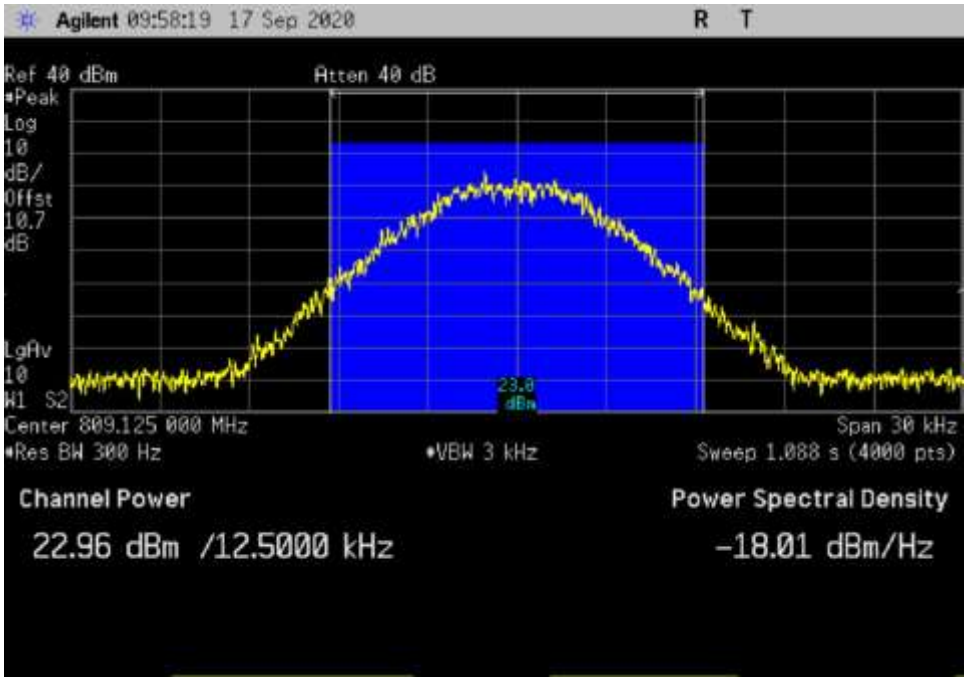
UL_809-816-Analog FM (25kHz)_ 809.125MHz



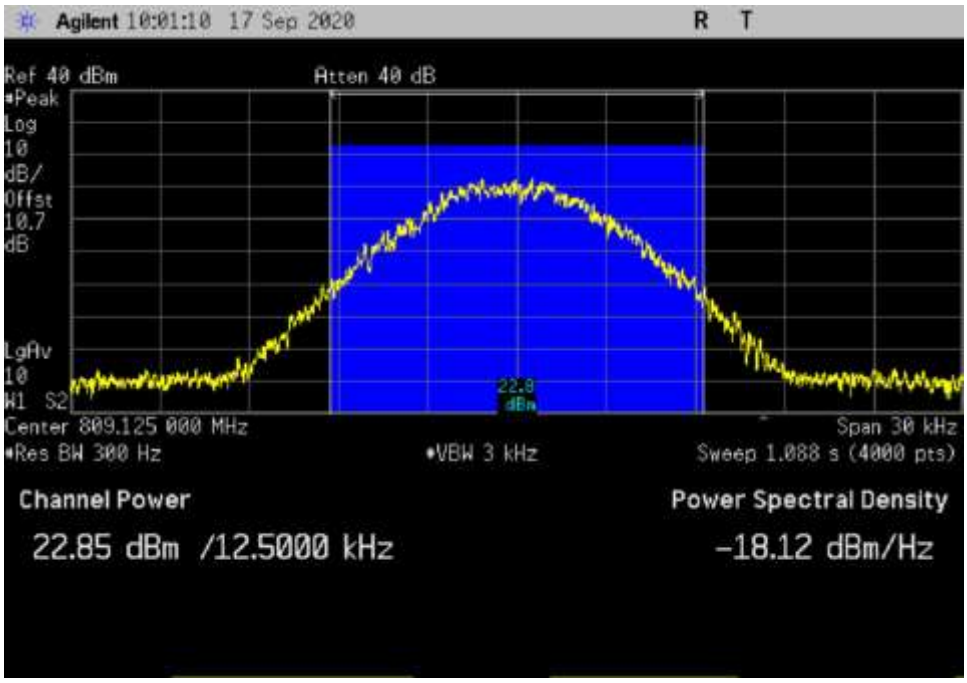
UL_809-816-Analog FM (25kHz)-AGC+3_ 809.125MHz



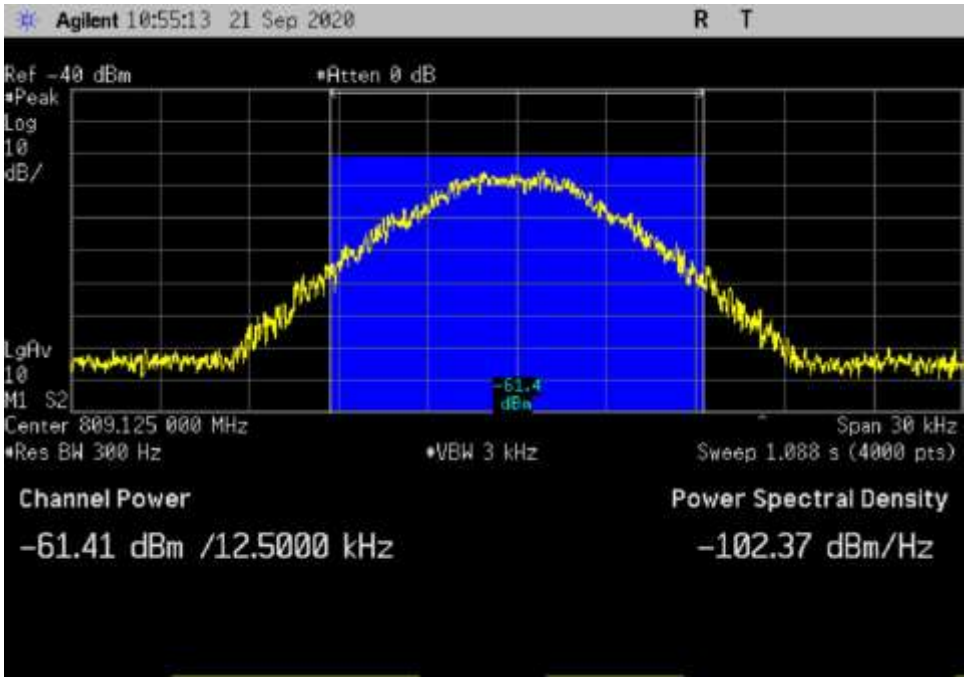
UL_809-816-Analog FM (25kHz)-Input_ 809.125MHz



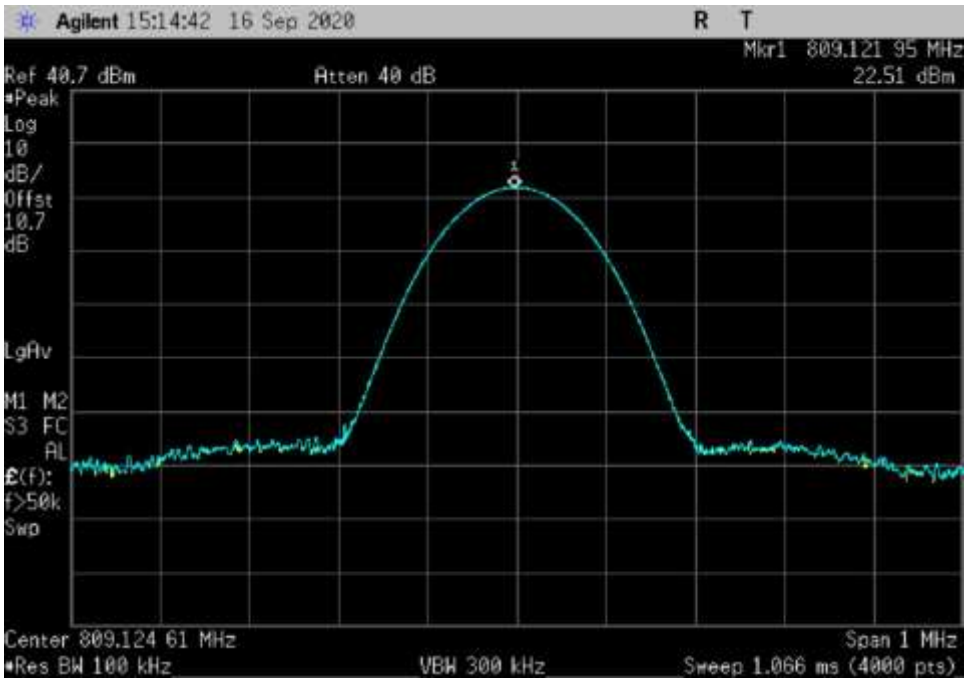
UL_809-816-APCO w/C4FM_ 809.125MHz



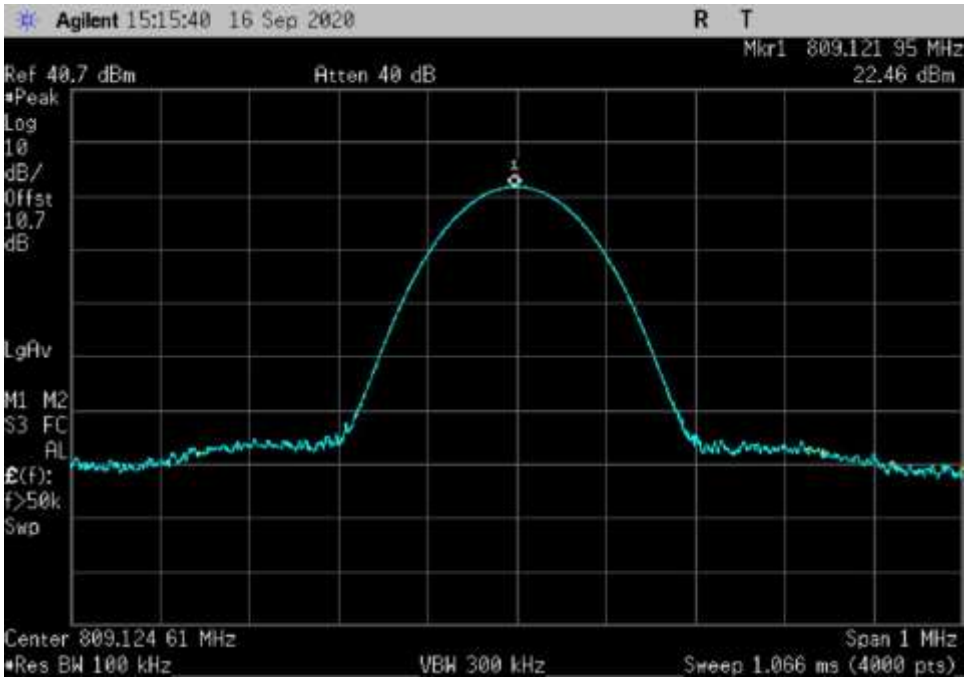
UL_809-816-APCO w/C4FM-AGC+3_ 809.125MHz



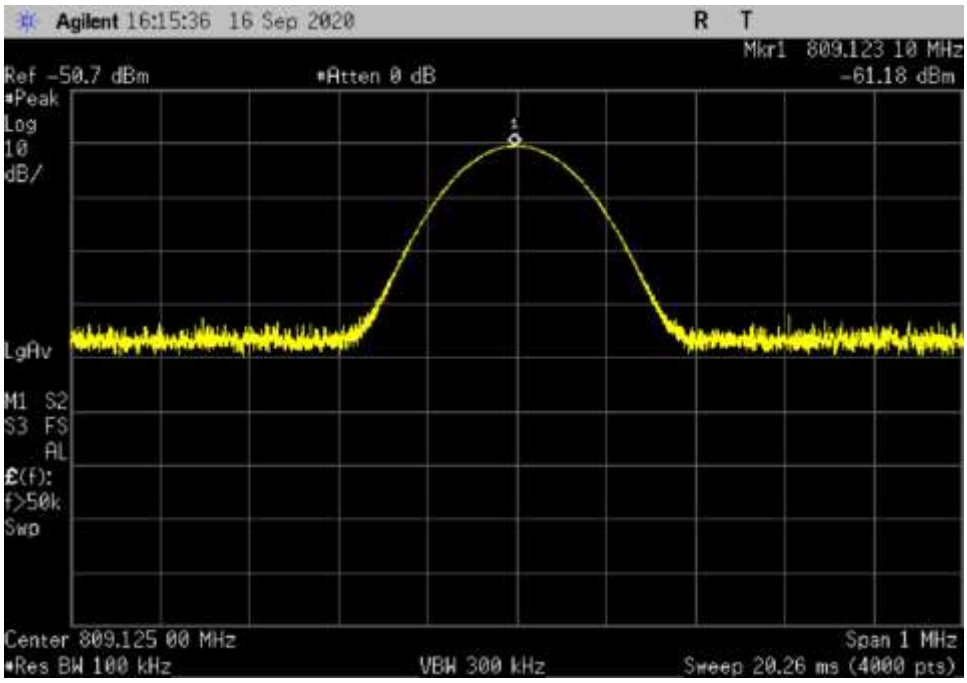
UL_809-816-APCO w/C4FM-Input_ 809.125MHz



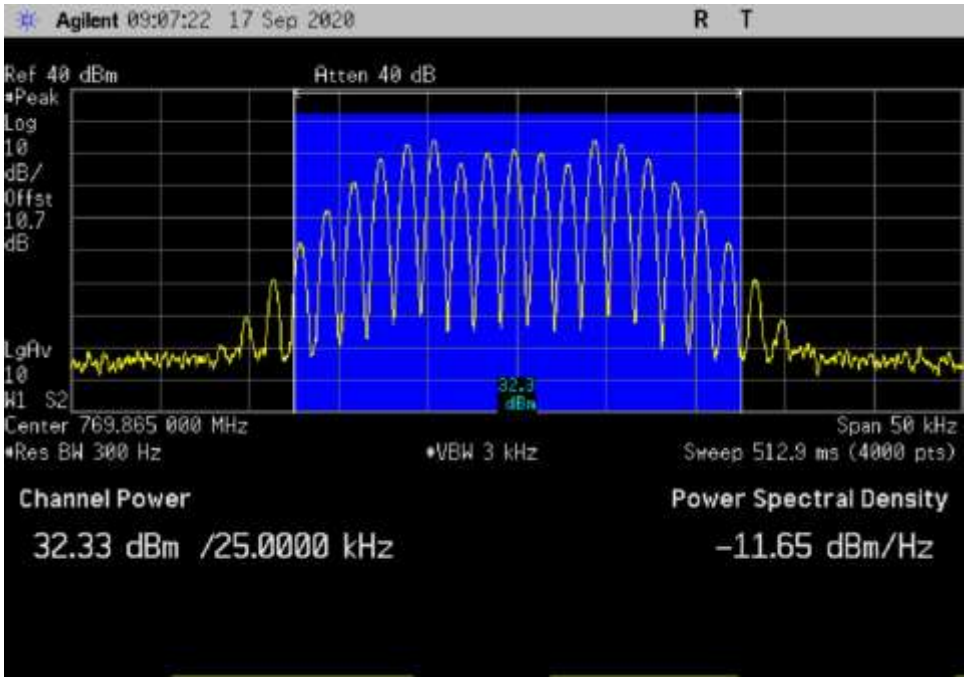
UL_809-816-CW_ 809.124613MHz



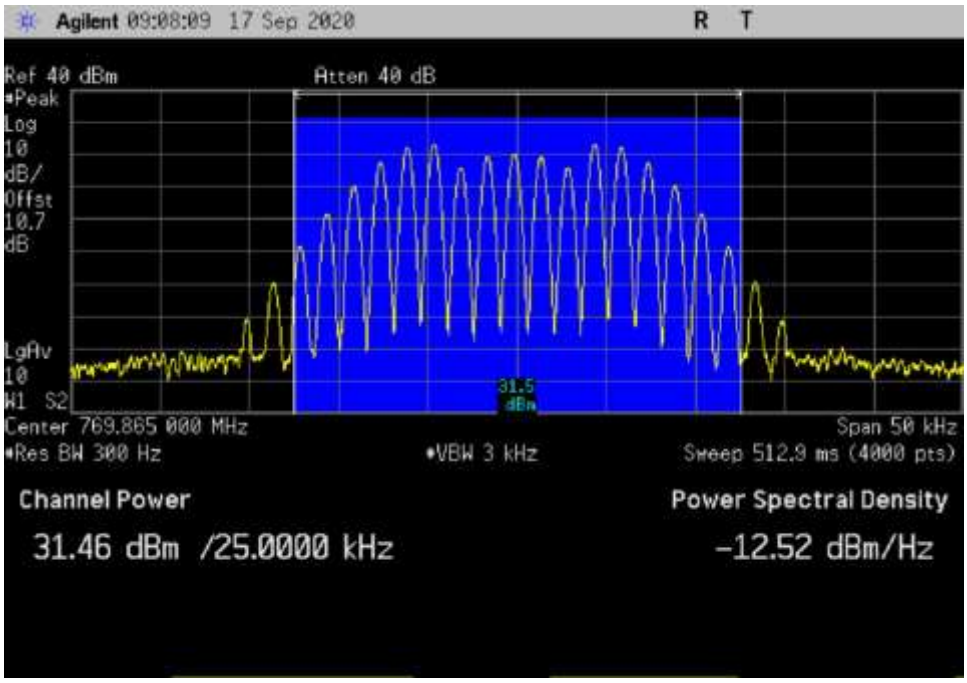
UL_809-816-CW-AGC+3_ 809.124613MHz



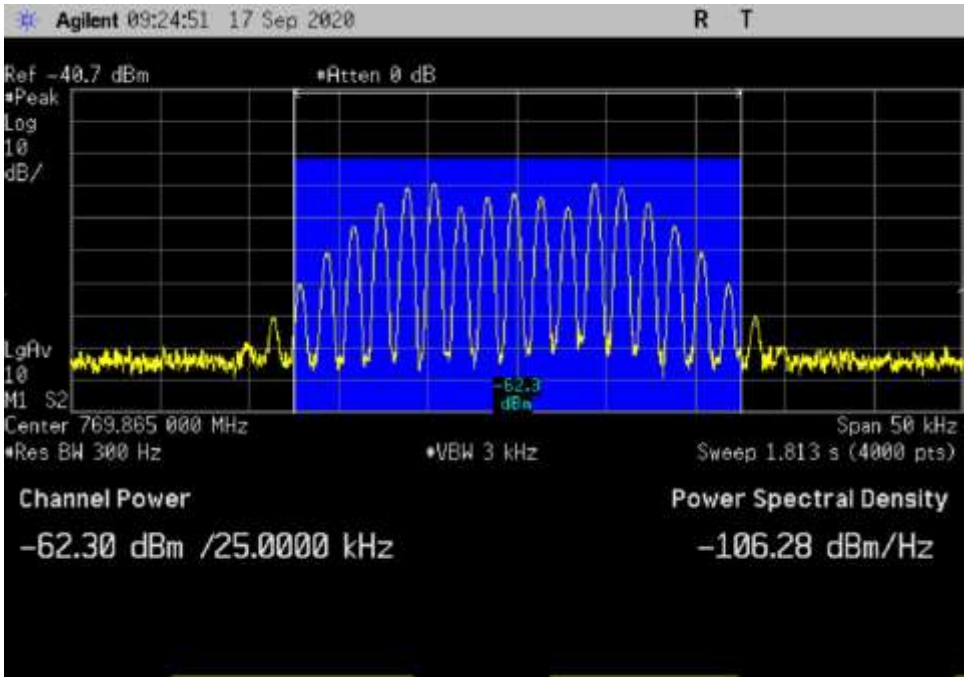
UL_809-816-CW-Input_ 809.125MHz



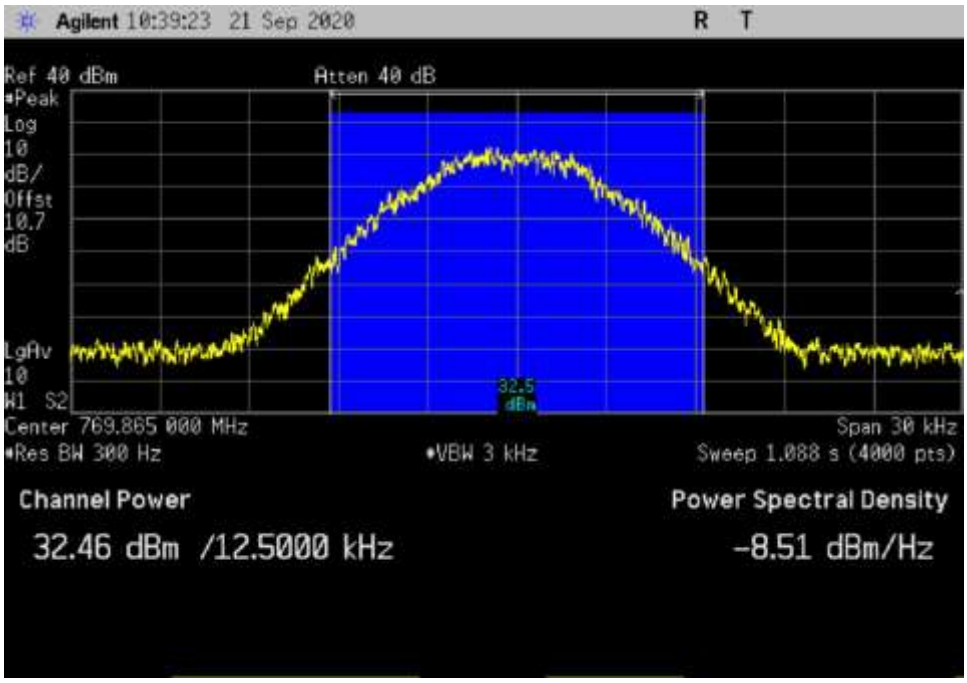
DL_769-775-Analog FM (25kHz)_ 769.865MHz



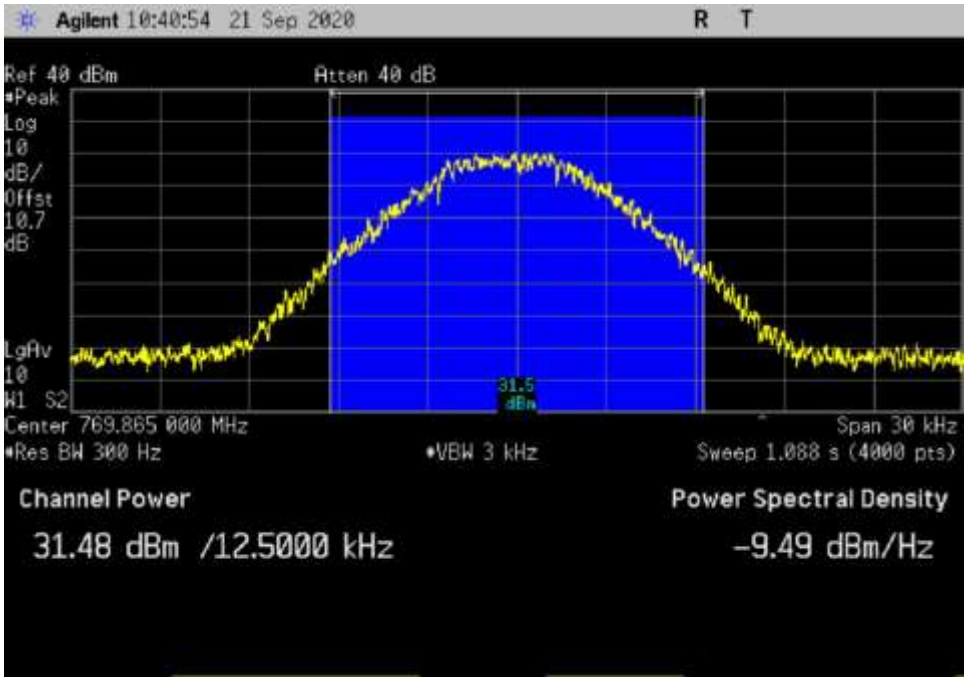
DL_769-775-Analog FM (25kHz)-AGC+3_ 769.865MHz



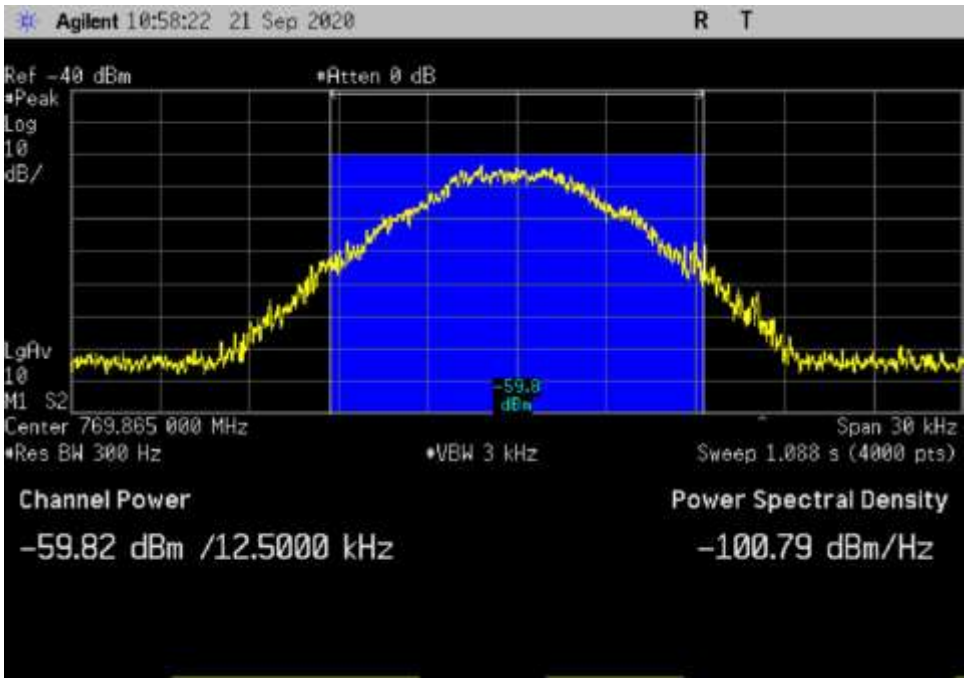
DL_769-775-Analog FM (25kHz)-Input_ 769.865MHz



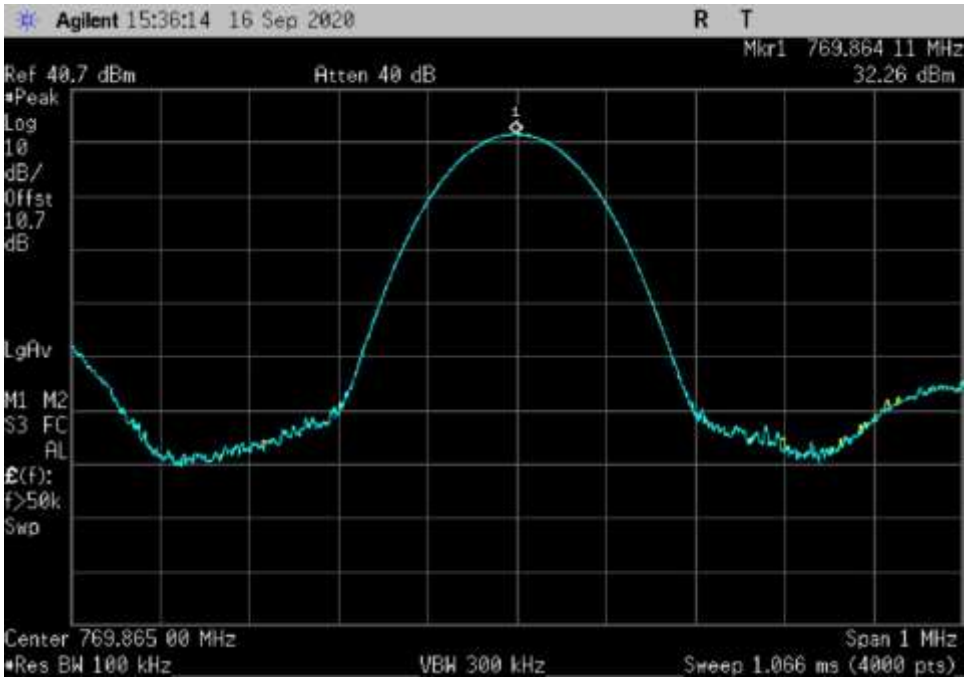
DL_769-775-APCO w/C4FM_ 769.865MHz



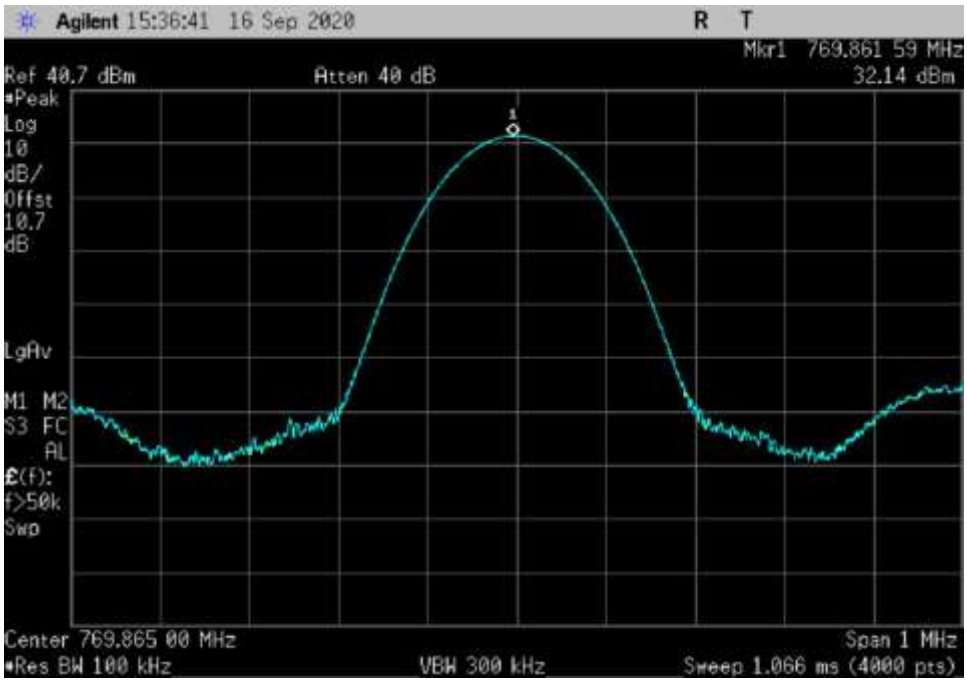
DL_769-775-APCO w/C4FM-AGC+3_ 769.865MHz



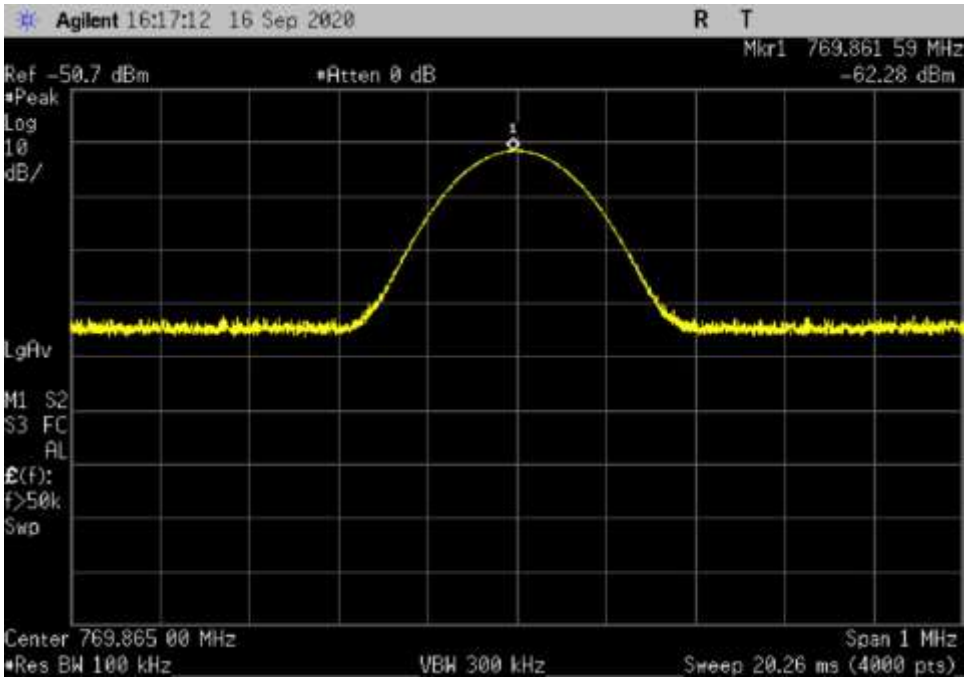
DL_769-775-APCO w/C4FM-Input_ 769.865MHz



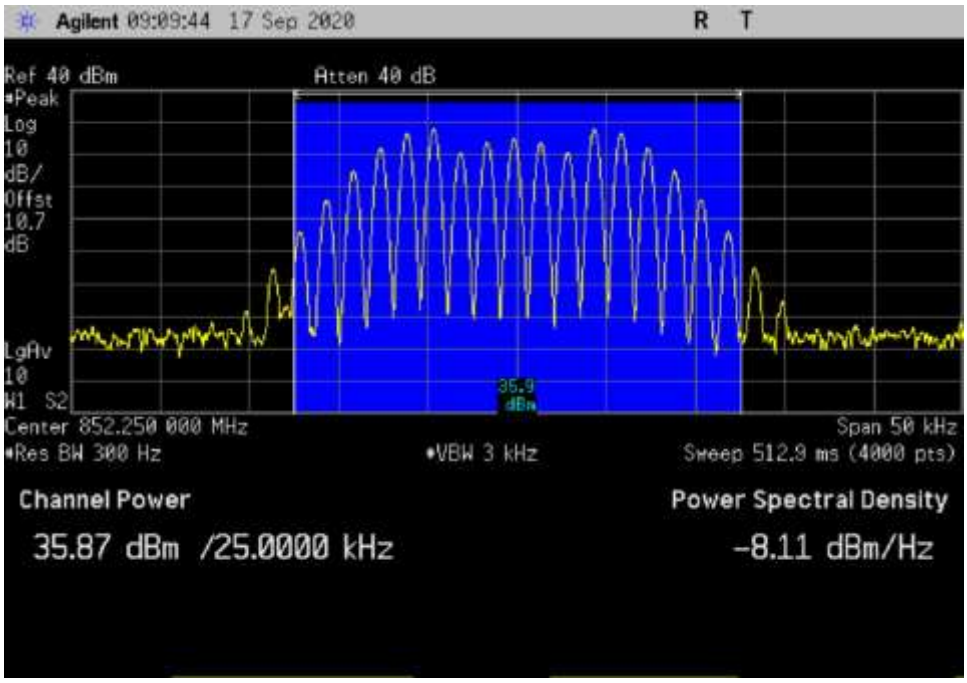
DL_769-775-CW_ 769.865MHz



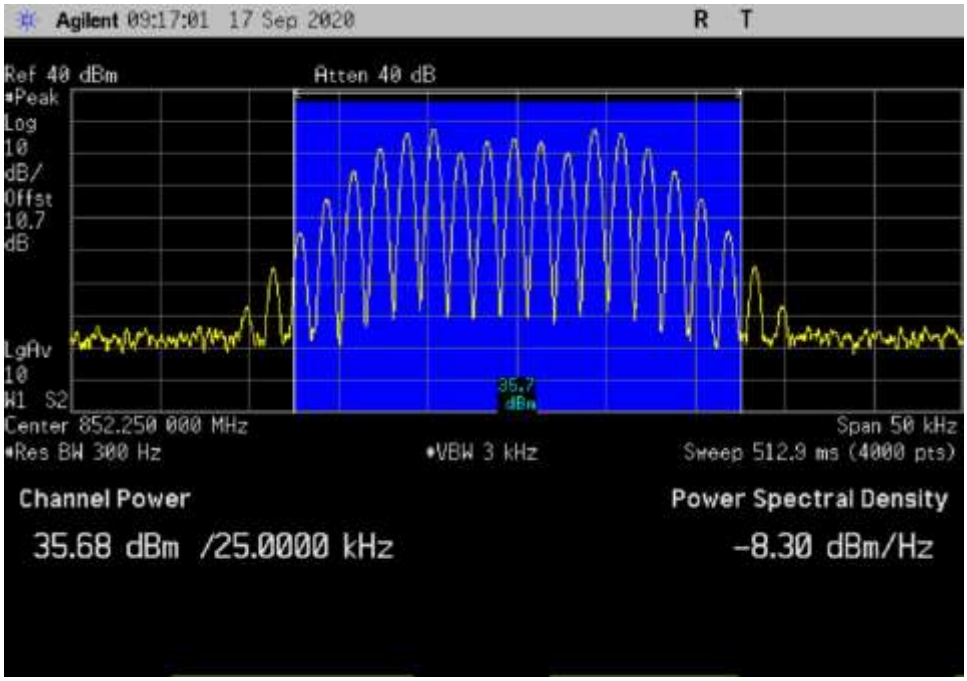
DL_769-775-CW-AGC+3_ 769.865MHz



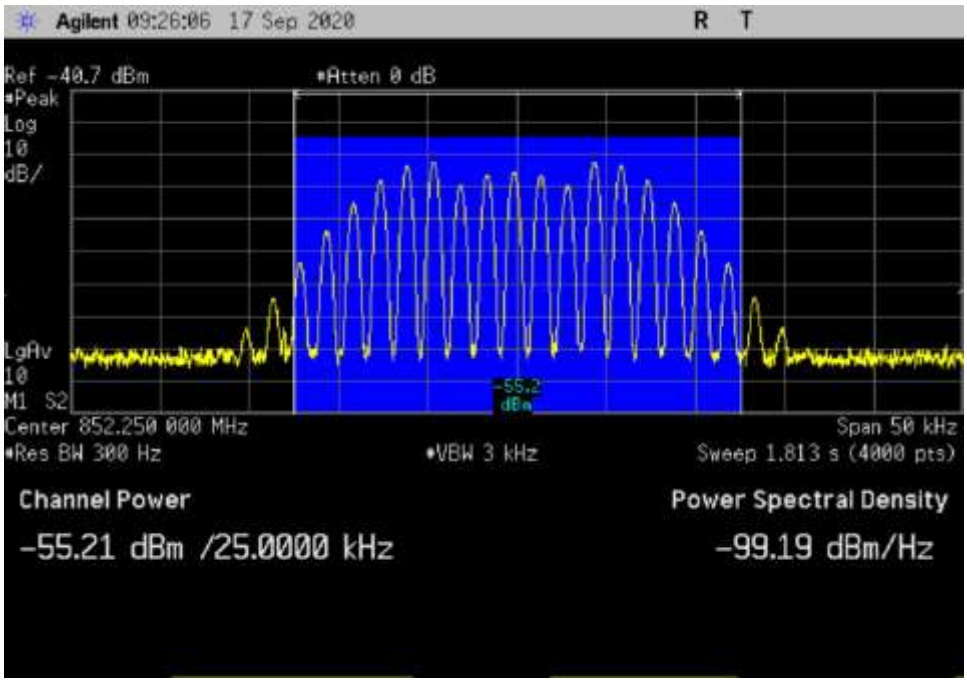
DL_769-775-CW-Input_ 769.865MHz



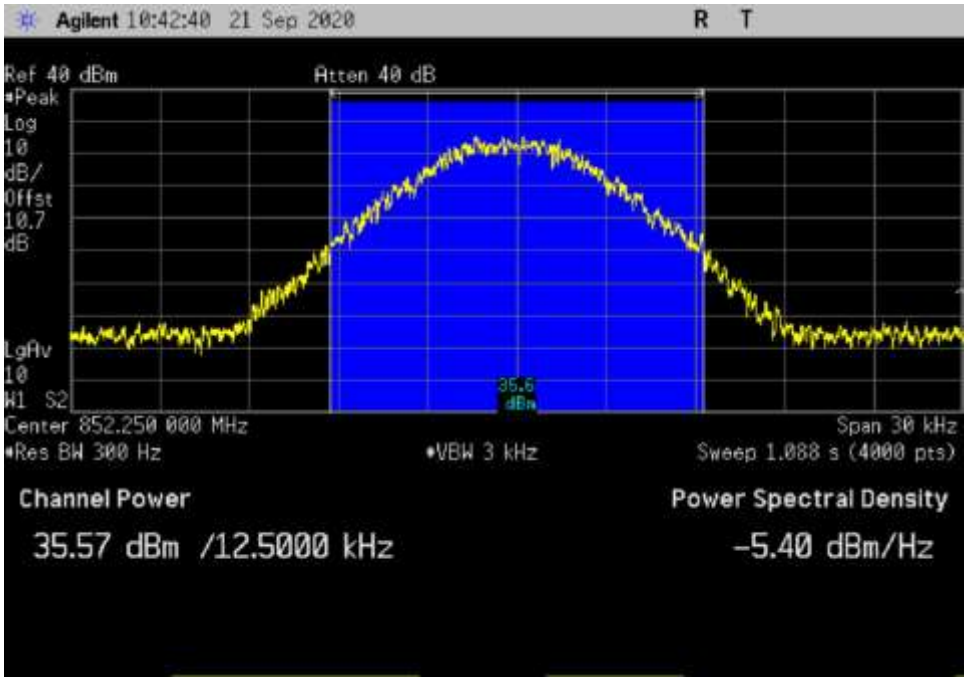
DL_851-854-Analog FM (25kHz)_ 852.25MHz



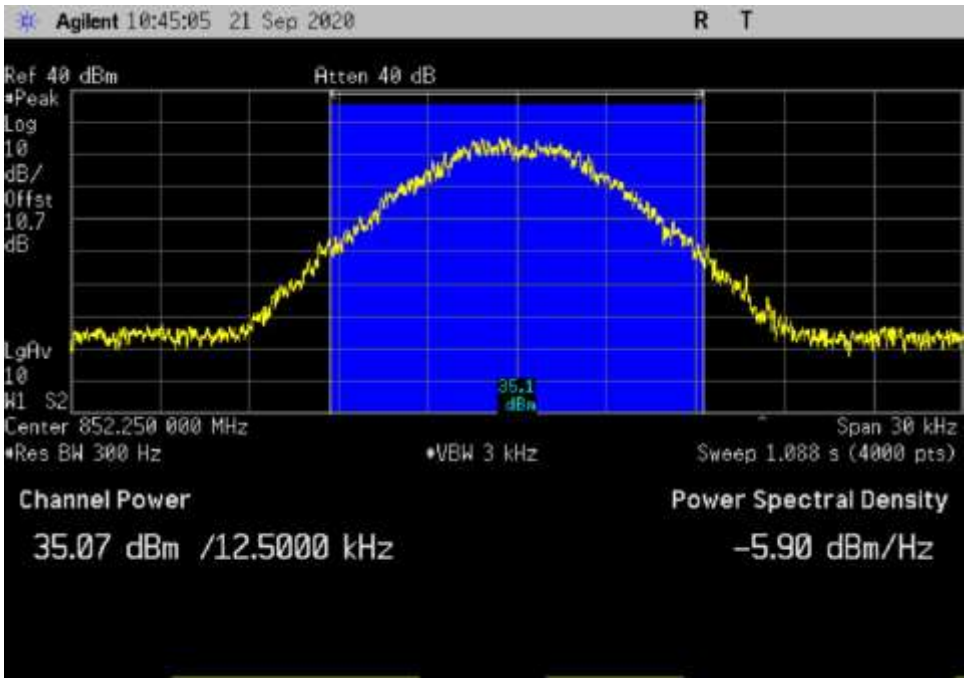
DL_851-854-Analog FM (25kHz)-AGC+3_ 852.25MHz



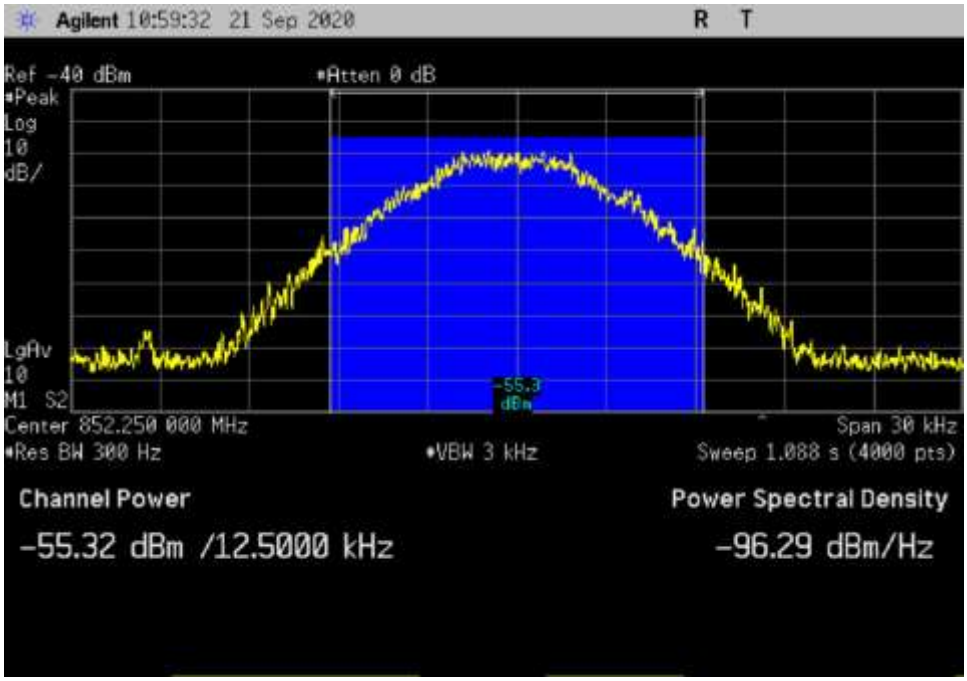
DL_851-854-Analog FM (25kHz)-Input_ 852.25MHz



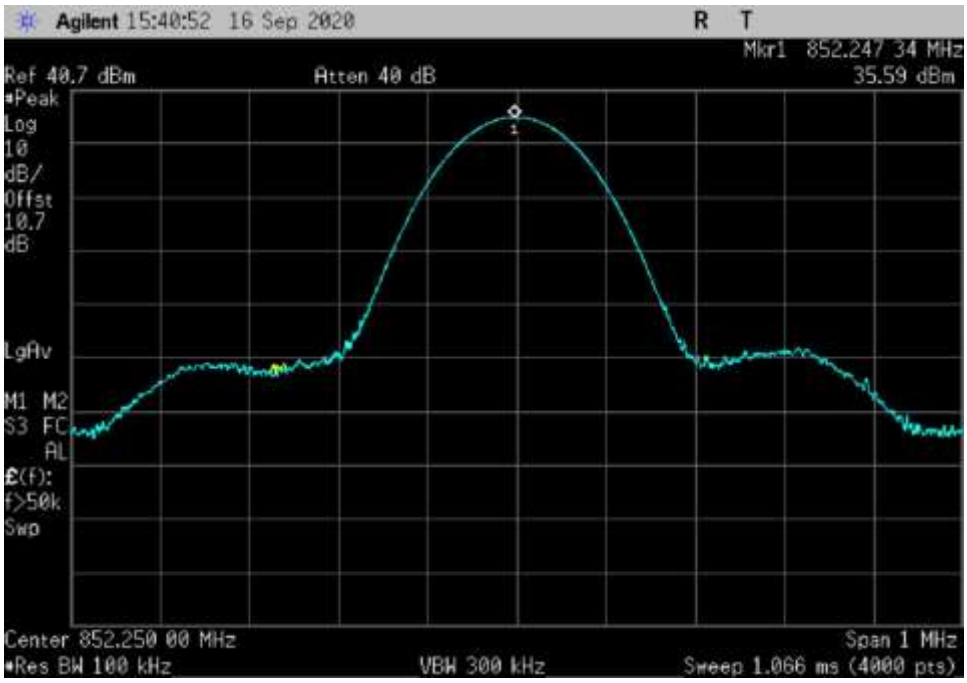
DL_851-854-APCO w/C4FM_ 852.25MHz



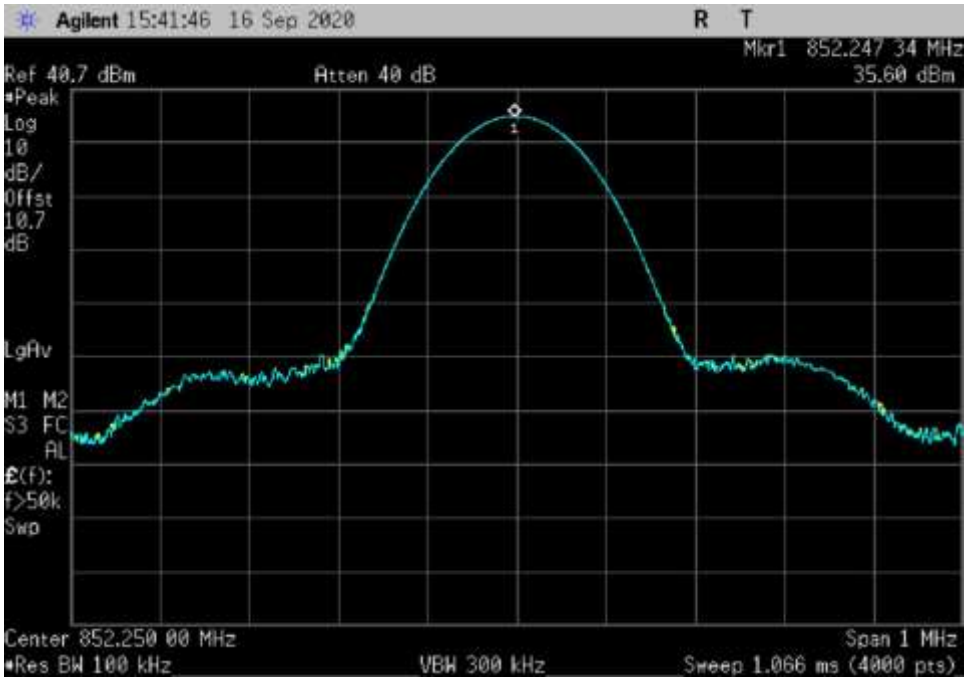
DL_851-854-APCO w/C4FM-AGC+3_ 852.25MHz



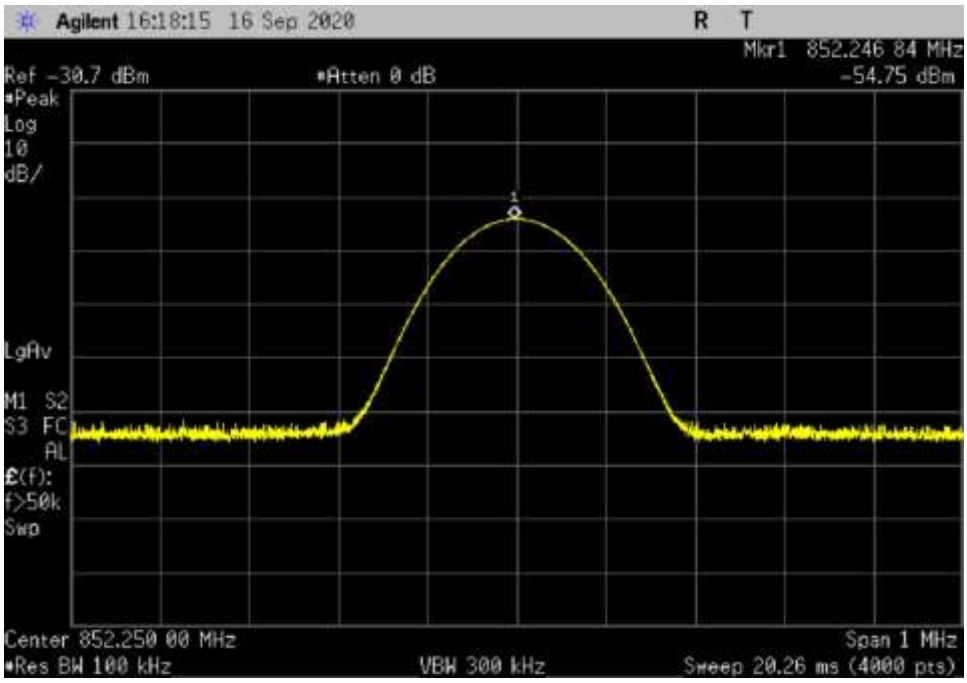
DL_851-854-APCO w/C4FM-Input_ 852.25MHz



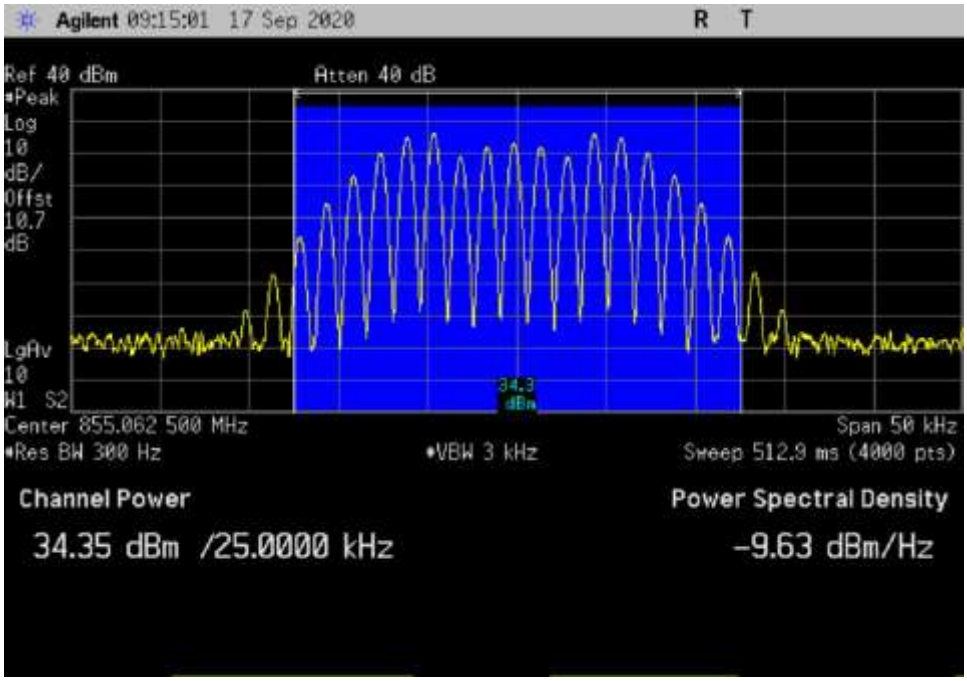
DL_851-854-CW_ 852.25MHz



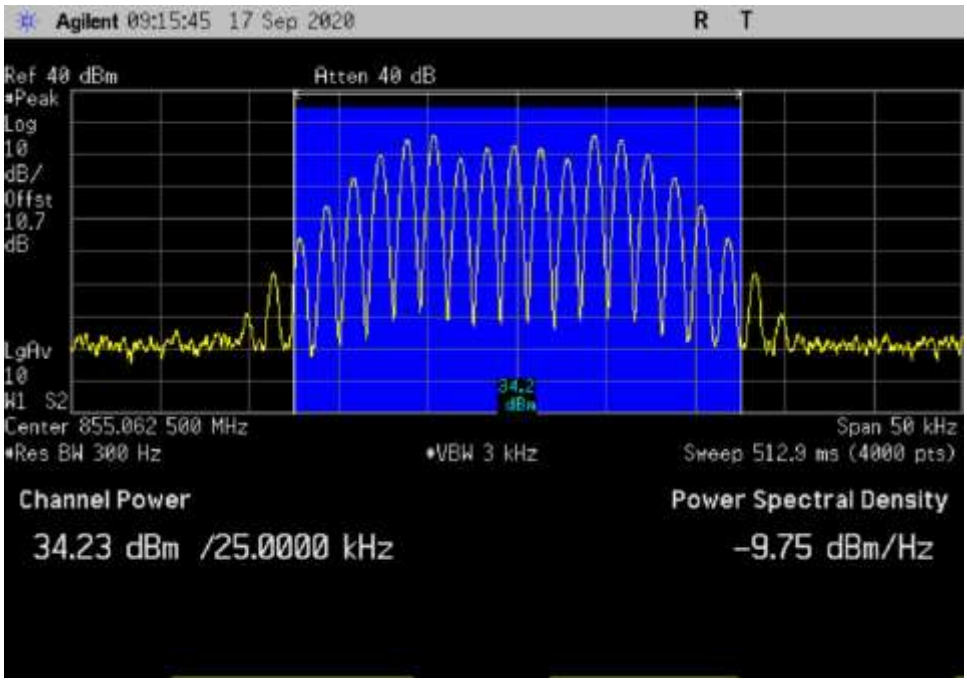
DL_851-854-CW-AGC+3_ 852.25MHz



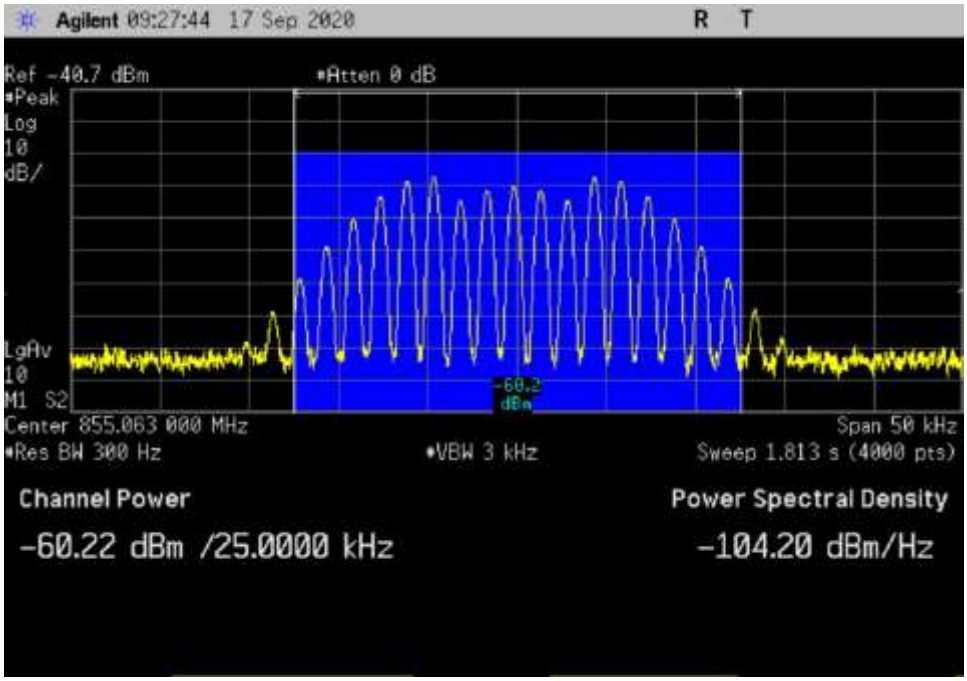
DL_851-854-CW-Input_ 852.25MHz



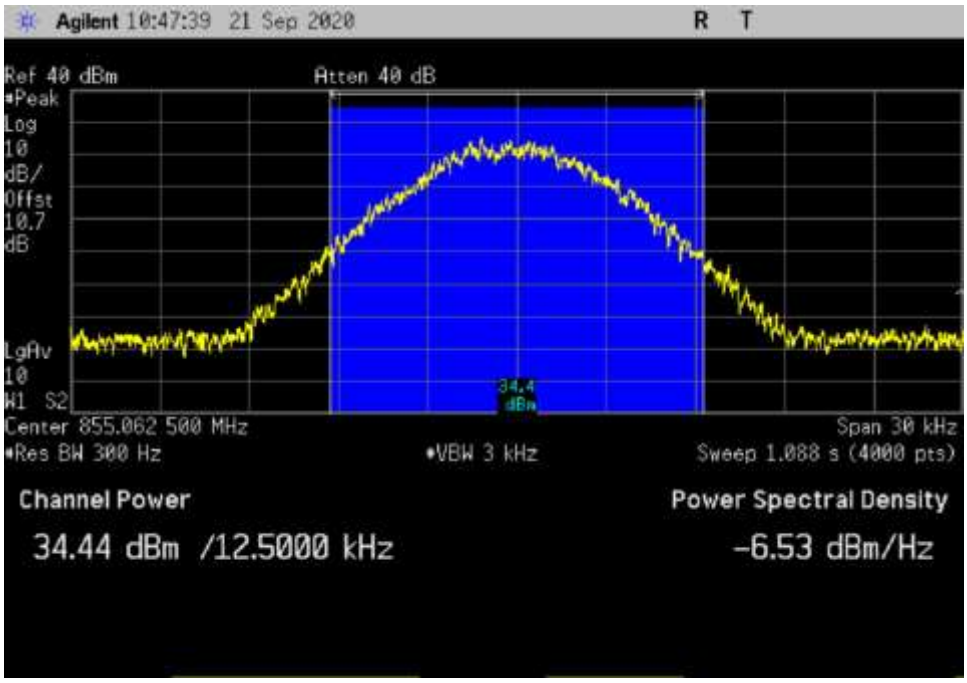
DL_854-861-Analog FM (25kHz)_ 855.0625MHz



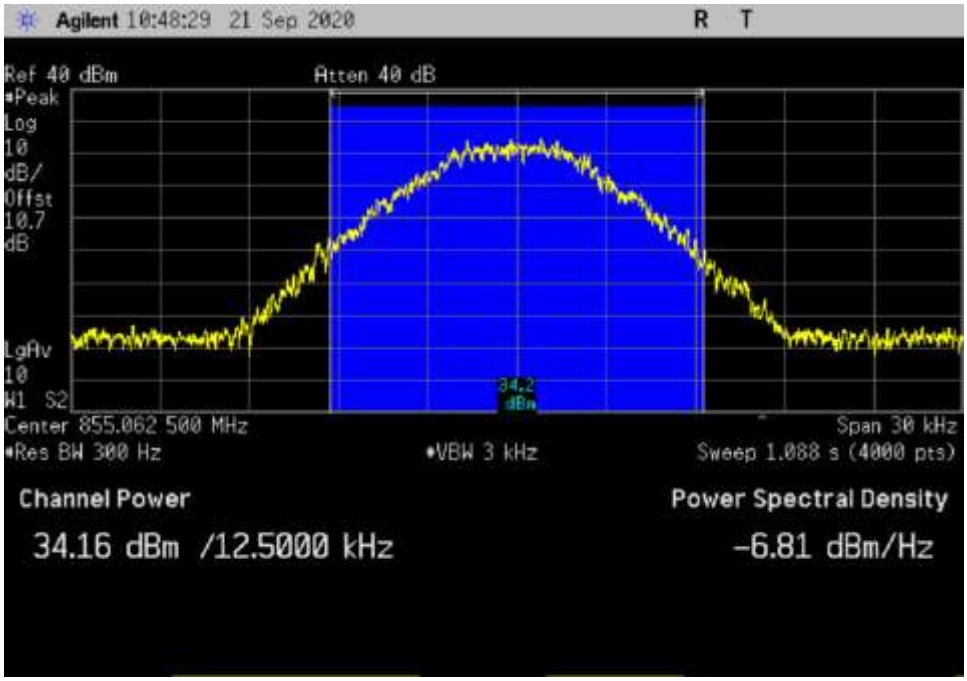
DL_854-861-Analog FM (25kHz)-AGC+3_ 855.0625MHz



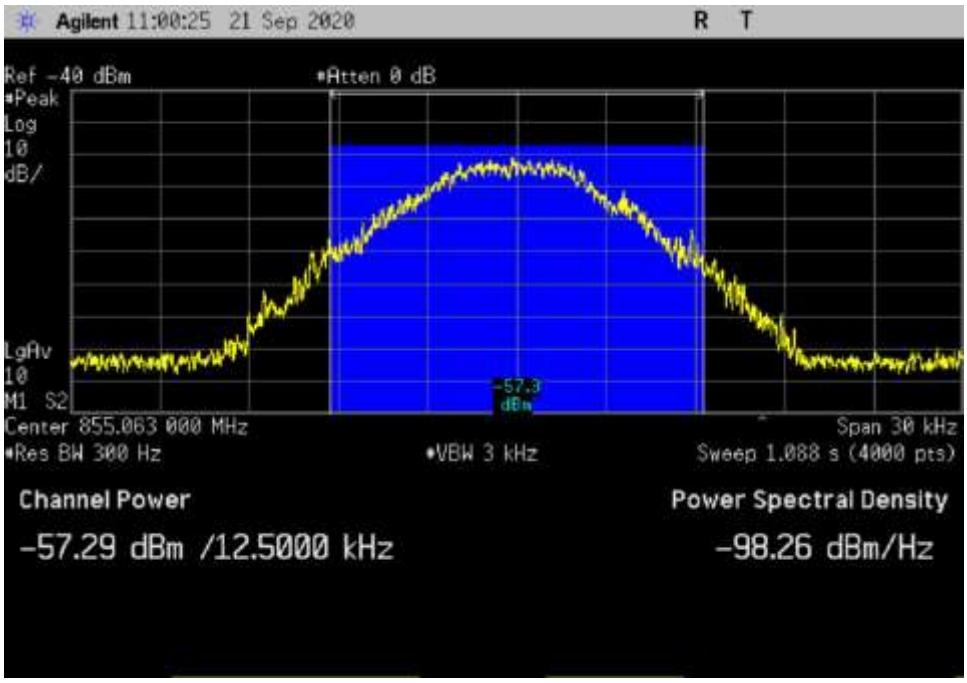
DL_854-861-Analog FM (25kHz)-Input_ 855.063MHz



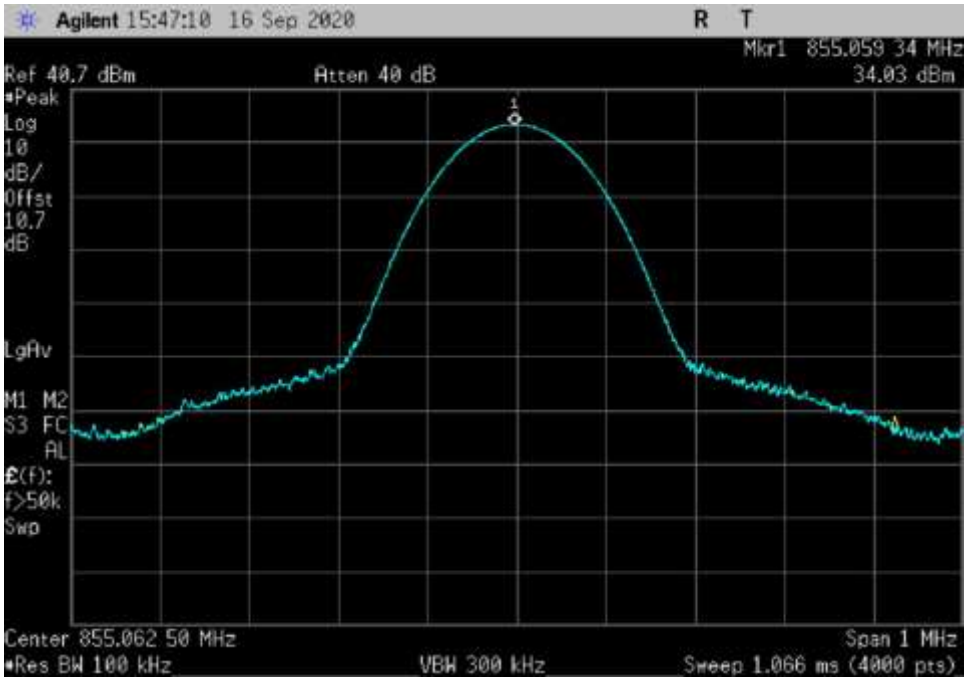
DL_854-861-APCO w/C4FM_ 855.0625MHz



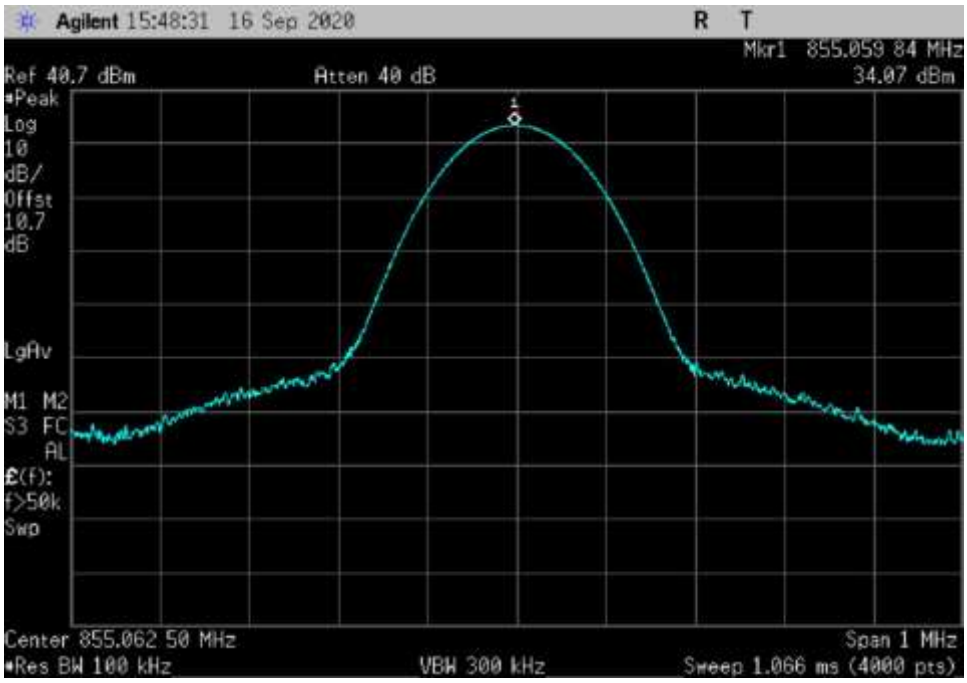
DL_854-861-APCO w/C4FM-AGC+3_ 855.0625MHz



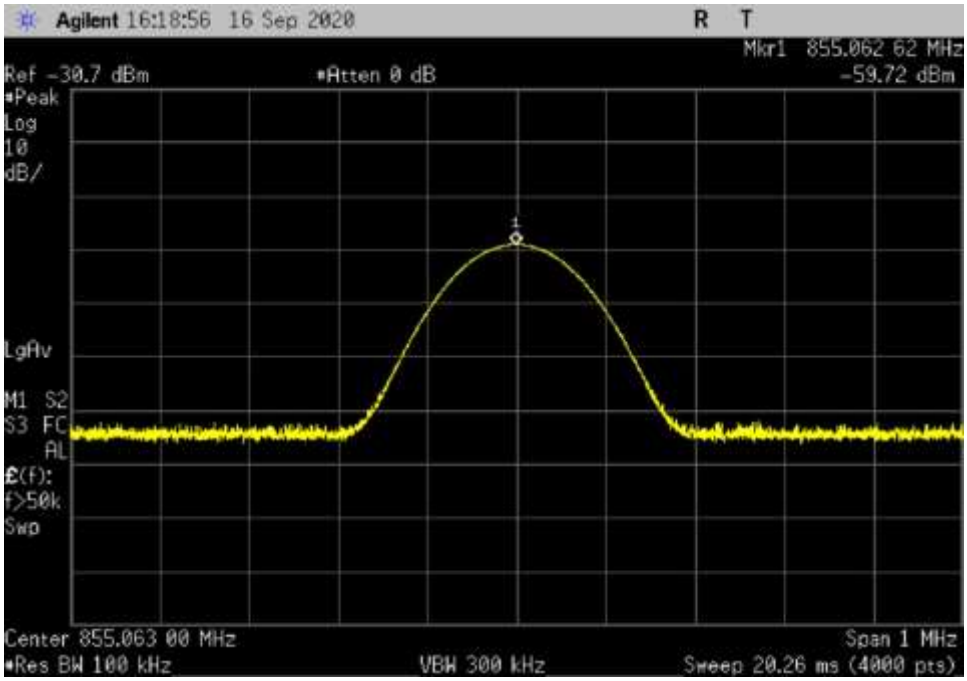
DL_854-861-APCO w/C4FM-Input_ 855.063MHz



DL_854-861-CW_ 855.0625MHz

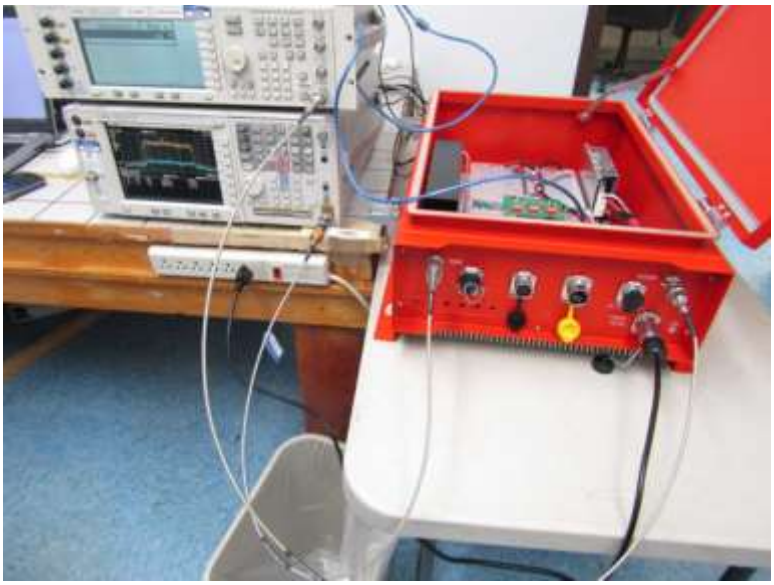


DL_854-861-CW-AGC+3_ 855.0625MHz



DL_854-861-CW-Input_ 855.063MHz

Test Setup Photo(s)



4.6 Noise Figure Measurements

Test Setup/Conditions			
Test Location:	Fremont	Test Engineer:	Hieu Song Nguyenpham
Test Date(s):	9/18/2020		
Configuration:	1		
Test Setup:	See General Test Setup 90.219 (e) (2) The noise figure of a signal booster must not exceed 9 dB in either direction Noise figure measurements was made with AGC circuitry be disabled over the duration of the measurement. Modification #1 was in place during testing.		

Environmental Conditions					
Temperature (ºC)	21.5	Relative Humidity (%):	51	Pressure (kPa)	101.2

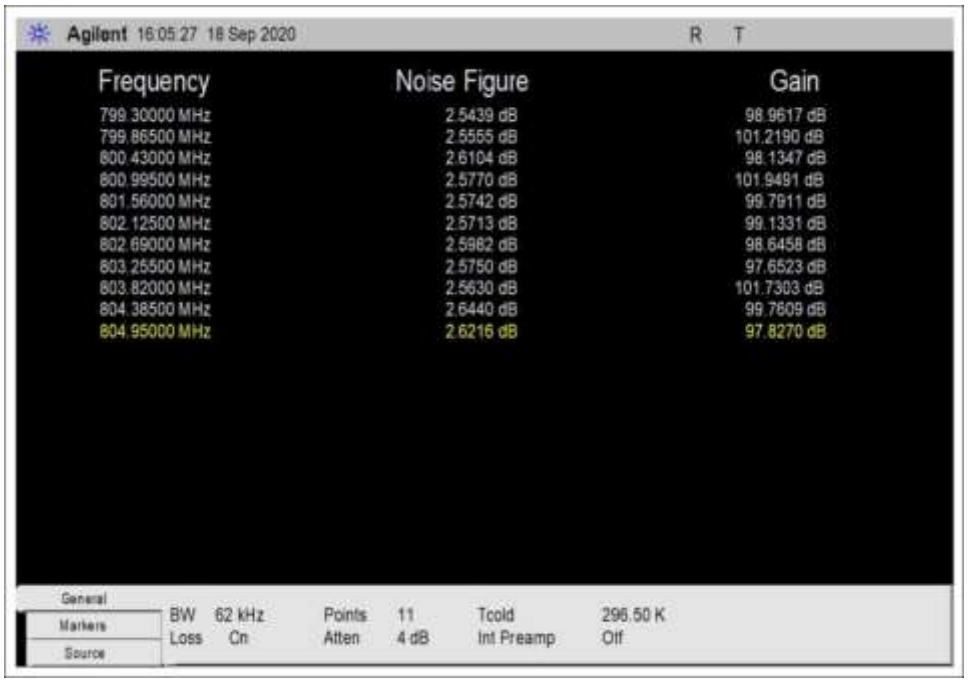
Test Equipment Radiated					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03537	Site Equipment	HP	346A	7/23/2019	7/23/2021
03471	Spectrum Analyzer	Agilent	E4440A	2/11/2020	2/11/2022
P06467	Attenuator	Pasternack	PE7014-10	4/15/2019	4/15/2021
03360	Cable	Astrolab	32022-2-29094-36TC	4/9/2020	4/9/2022

Summary of Results

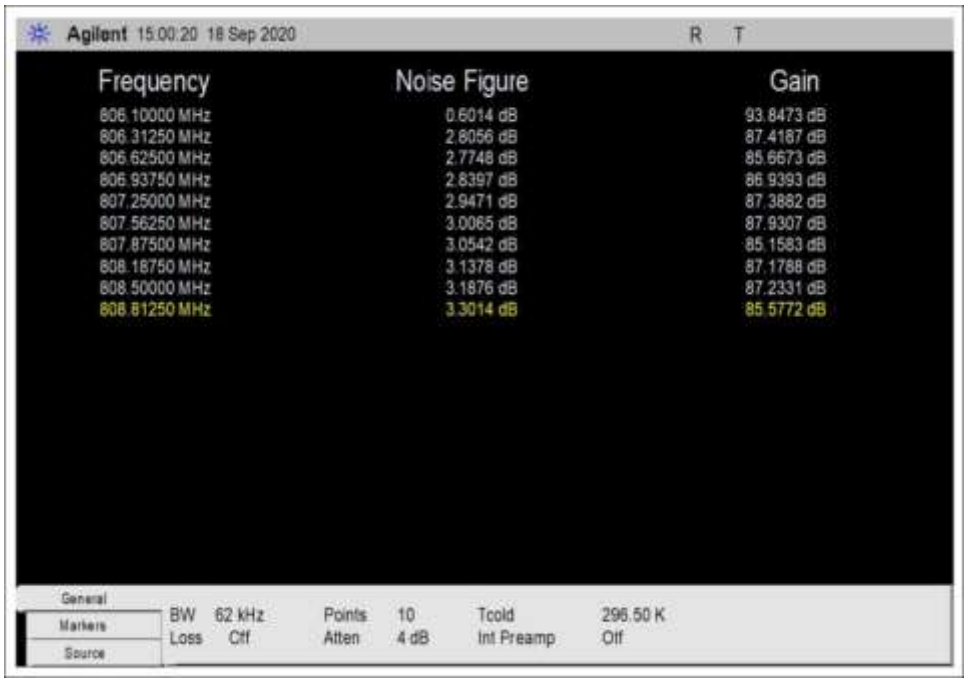
Pass: Summarized in tables and plots below, the noise figure are within limits.

Link	Band	Noise Figure (dB)	Limit (dB)	Margin (dB)
UL	799-805	2.644	9	-6.356
UL	806-809	3.3014	9	-5.6986
UL	809-816	3.4388	9	-5.5612
DL	769-775	3.5812	9	-5.4188
DL	851-854	6.203	9	-2.797
DL	854-861	5.5247	9	-3.4753

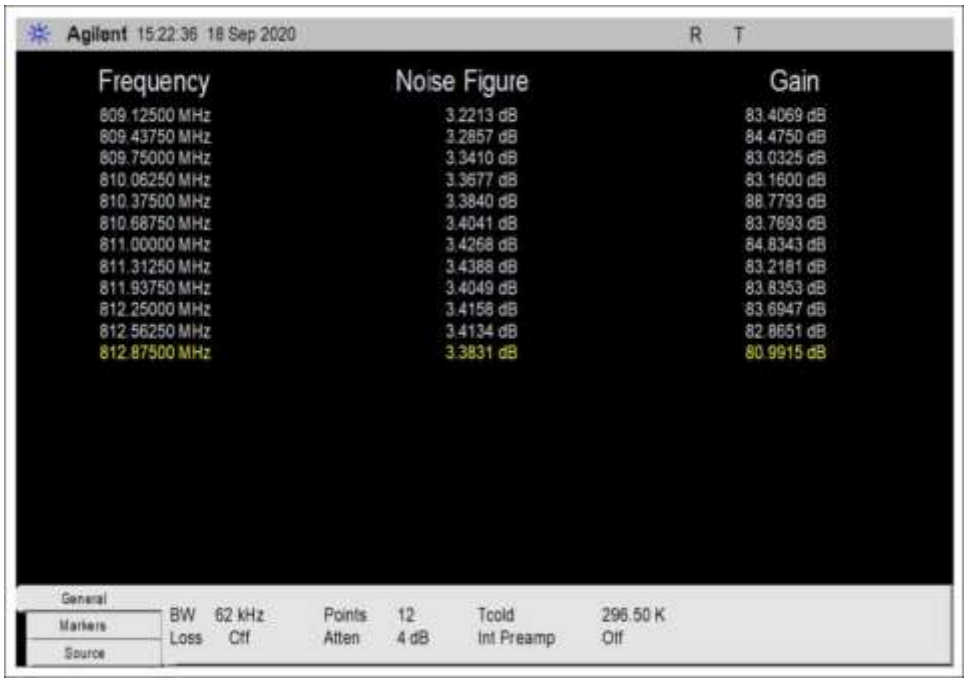
Plots



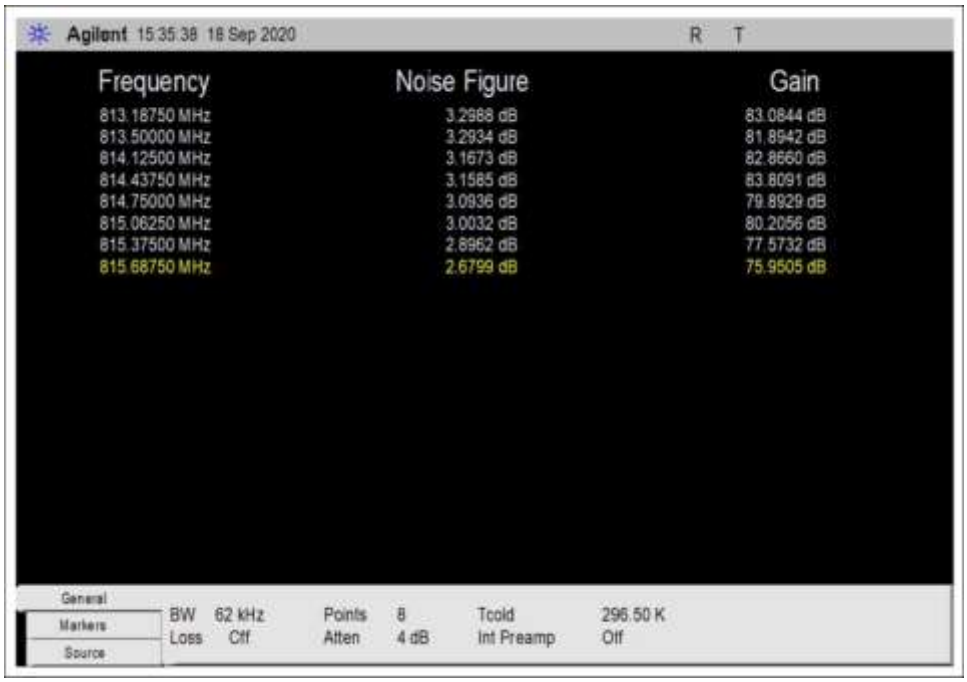
UL-799-805MHz



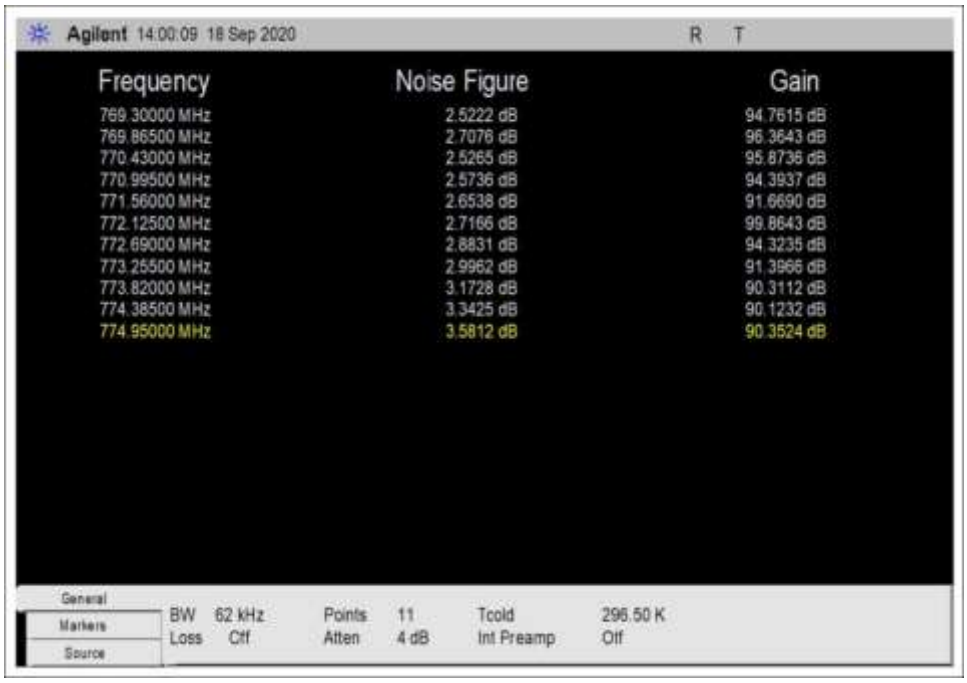
UL-806-809MHz



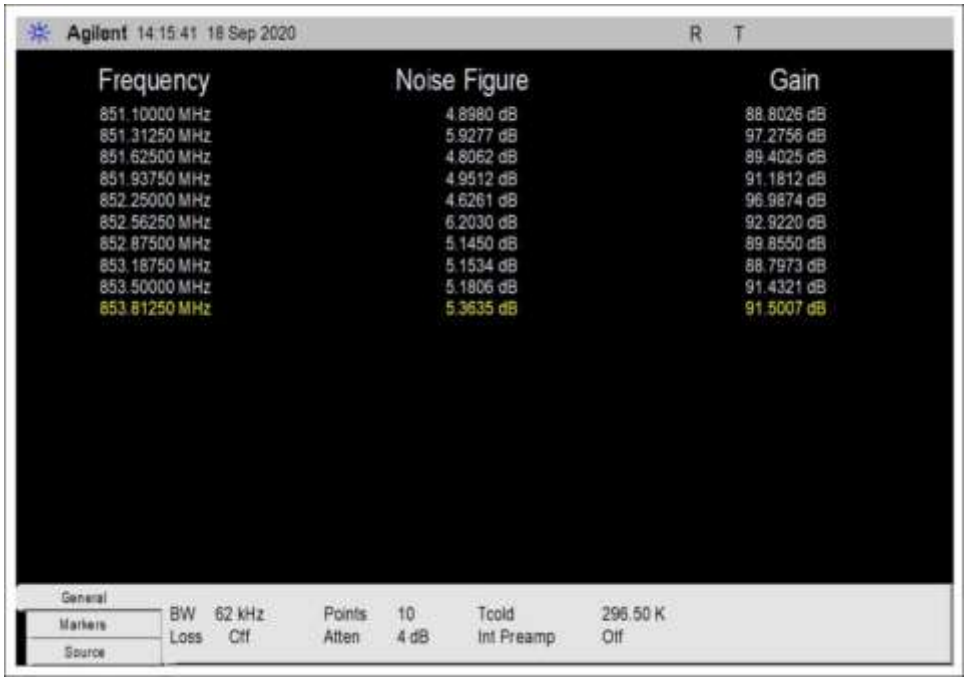
UL-809-816 Chanel 1-13MHz



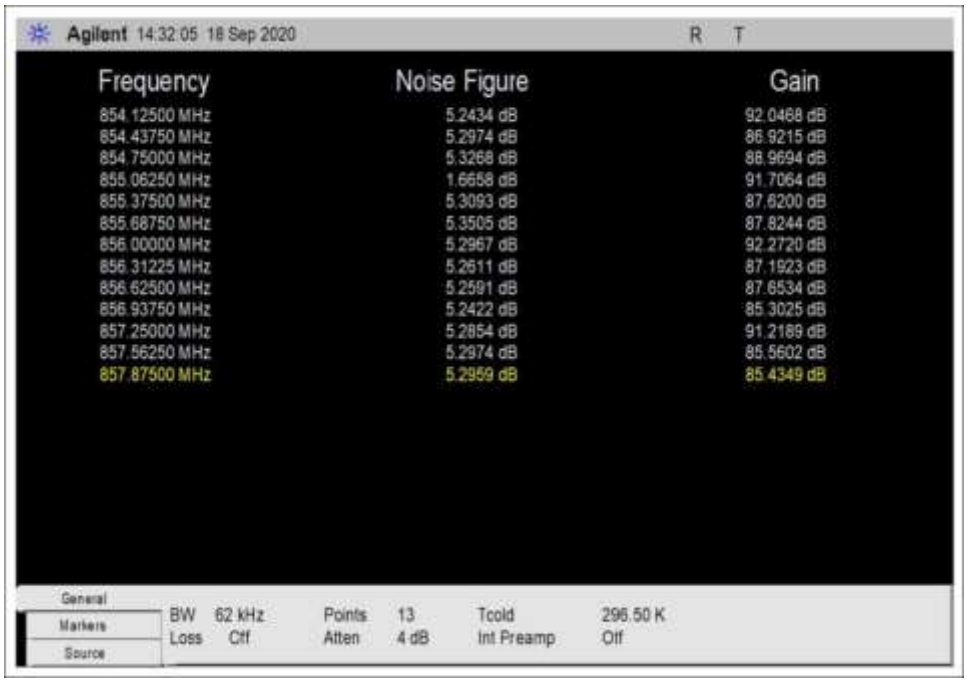
UL-809-816 Chanel 14-18MHz



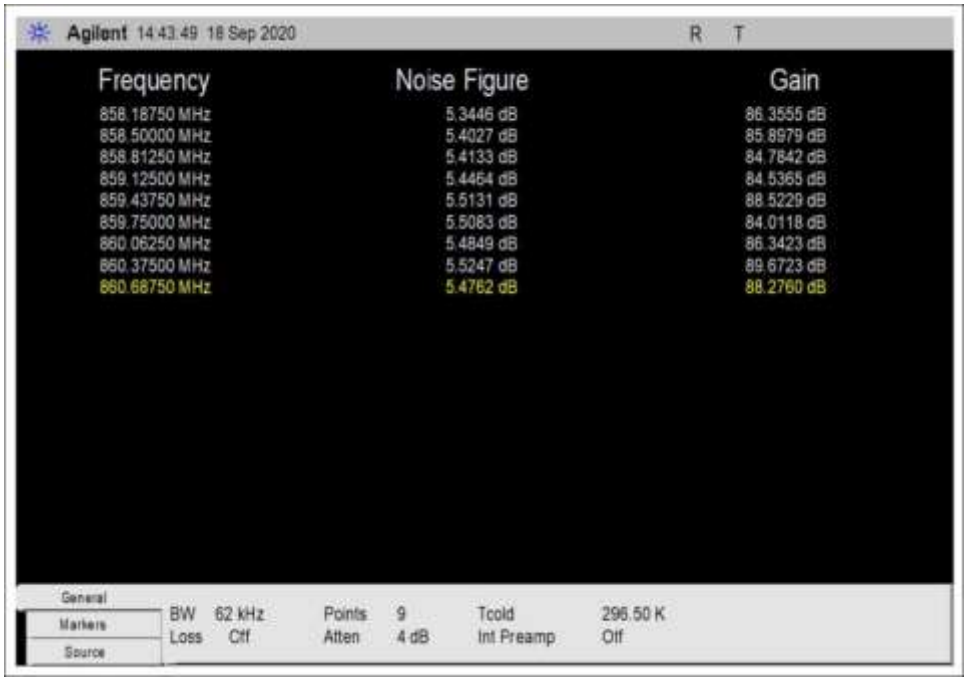
DL-769-775MHz



DL-851-854MHz



DL-854-861MHz-Channel 1-13



DL-854-861MHz-Channel 14-22

Test Setup Photo(s)

4.7.2 Out-of-Band/Out-of-Block Emissions Conducted Measurements

Test Setup/Conditions			
Test Location:	Fremont	Test Engineer:	Hieu Song Nguyenpham
Test Date(s):	9/15 and 16/2020		
Configuration:	1		
Test Setup:	See General Test Setup This a channelize booster, there are 11 channels for 700MHz Band and 32 channels for 800MHz. Using two signal generators to perform this section at the fo and the frequency next to it. The spacing of the signal are set to the channel spacing of the booster. Modification #1 was in place during testing.		

Test Date	Temperature (ºC)	Relative Humidity (%):	Pressure (kPa)
9/15/2020	21.6	48	101.2
9/16/2020	22.8	46	101.3

Test Equipment Radiated					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
03471	Spectrum Analyzer	Agilent	E4440A	2/11/2020	2/11/2022
03418	Signal Generator	Agilent	E4438C	5/13/2019	5/13/2021
P05411	Attenuator	Weinschel	54A-10	11/27/2019	11/27/2021
02138	Attenuator	Weinschel	54-10	11/12/2019	11/12/2021
03360	Cable	Astrolab	32022-2-29094-36TC	4/9/2020	4/9/2022
P07192	Cable	Astro	32022-29094K-29094K-48TC	11/27/2019	11/27/2021
P06903	Cable	Astrolab	32022-29094K-29094K-36TC	1/7/2020	1/7/2022
C00087	Site Equipment	Anaren	44000	11/27/2019	11/27/2021
C00032	Arbitrary Waveform Generator	Agilent	E4433B	3/30/2020	3/30/2022

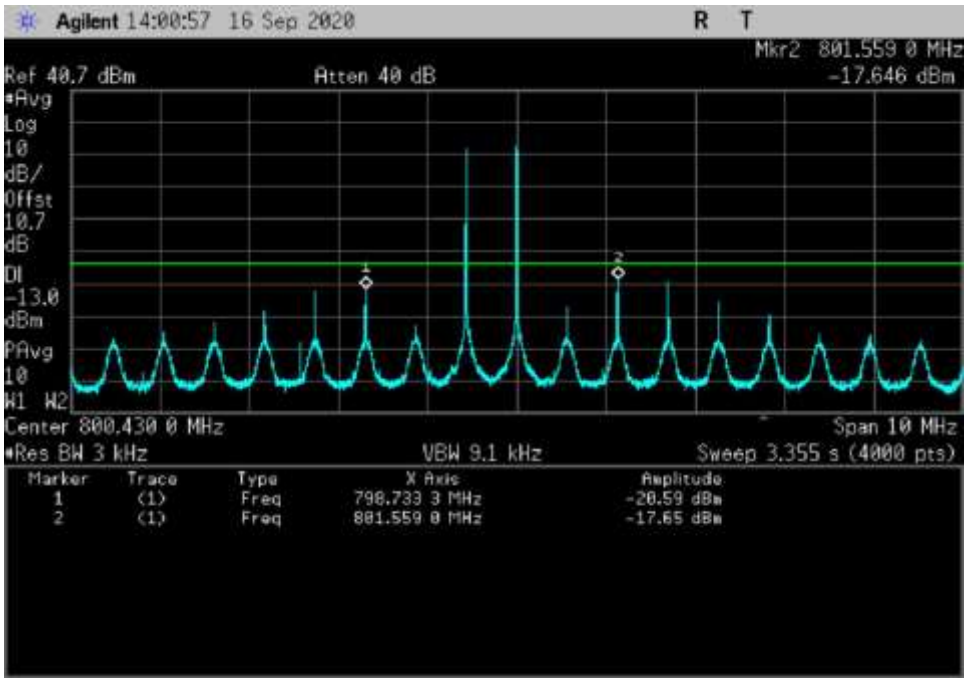
Summary of Results

Pass: Summarized in tables and plots below, all intermodulation products are measured below -13dBm
Worst case results are reported for intermodulation test, done with and without AGC circuitry activated.

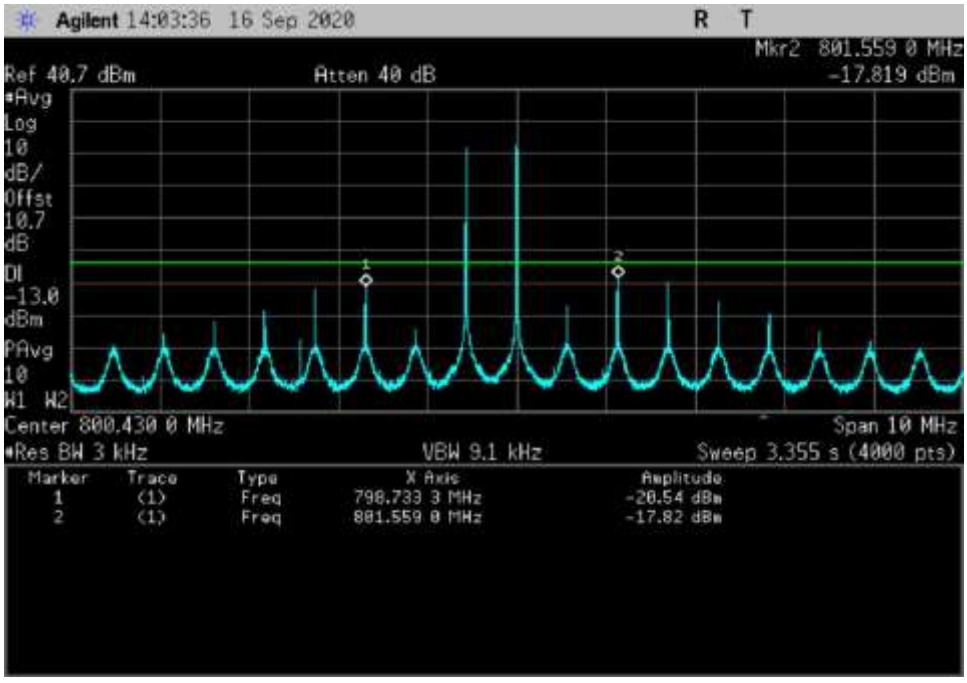
Inter Modulation Product (Pre AGC)			
Frequency (MHz)	**Pre AGC (dBm)**	**Limit (dBm)**	**Results**
UL 799-805	-17.7	-13	Pass
UL 806-809	-16.8	-13	Pass
UL 809-816	-16.8	-13	Pass
DL 769-775	-20.6	-13	Pass
DL 851-854	-13.5	-13	Pass
DL 854-861	-15.0	-13	Pass

Inter Modulation Product (AGC+3)			
Frequency (MHz)	**Pre AGC (dBm)**	**Limit (dBm)**	**Results**
UL 799-805	-17.8	-13	Pass
UL 806-809	-16.7	-13	Pass
UL 809-816	-16.7	-13	Pass
DL 769-775	-21.0	-13	Pass
DL 851-854	-13.2	-13	Pass
DL 854-861	-14.2	-13	Pass

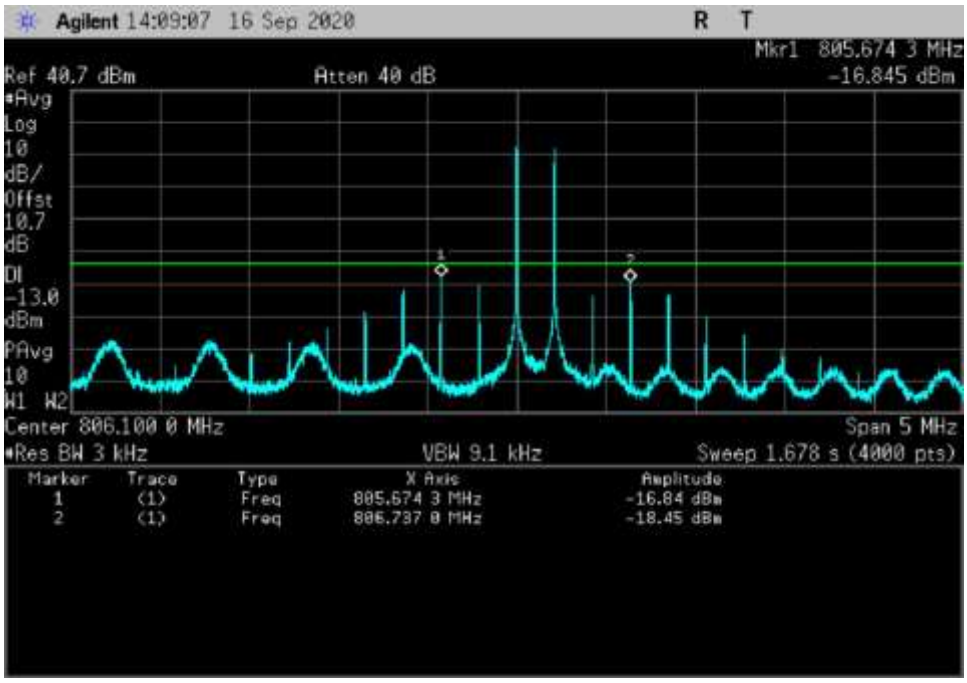
Plots



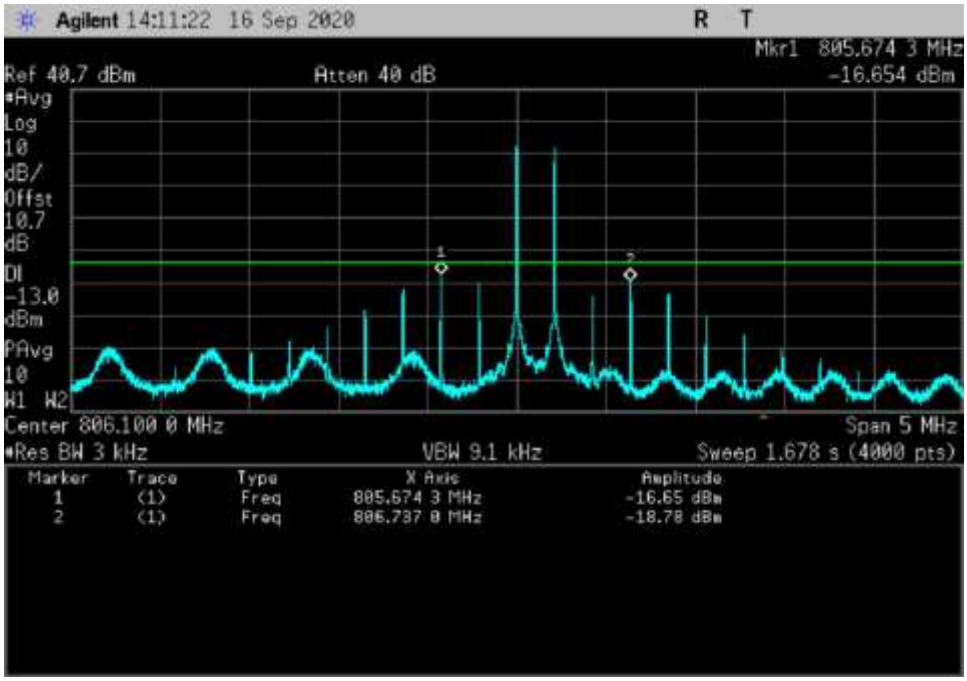
UL_799-805_ 800.43MHz



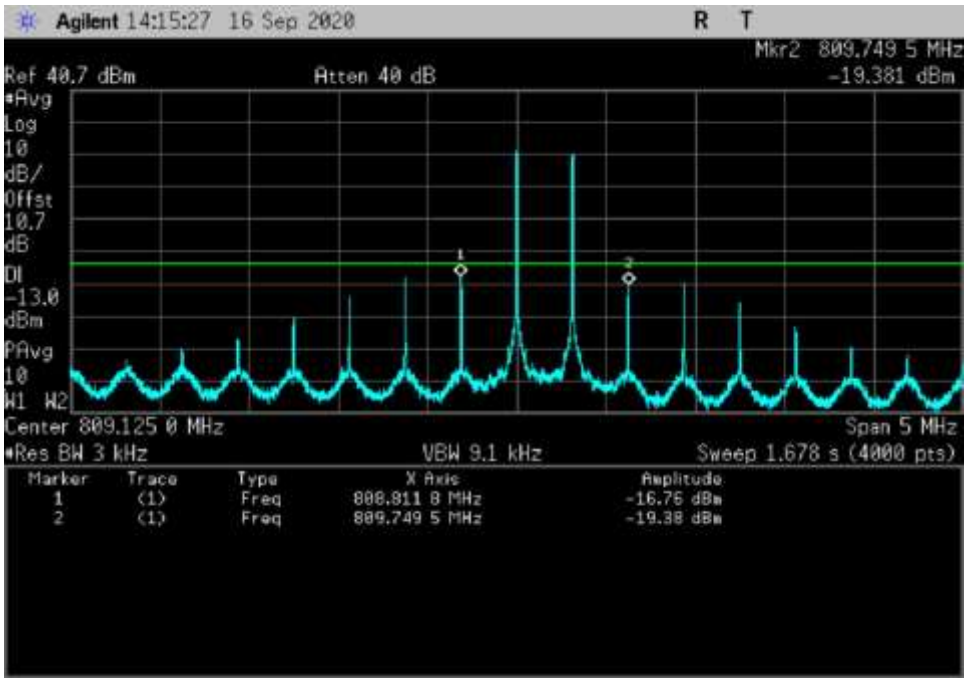
UL_799-805-AGC+3_ 800.43MHz



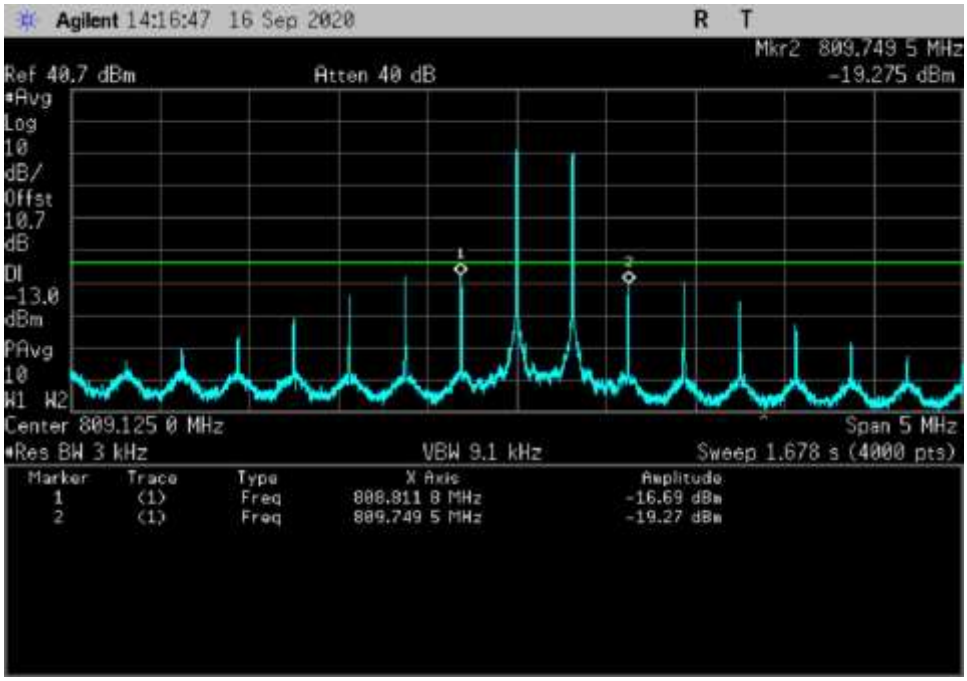
UL_806-809_ 806.1MHz



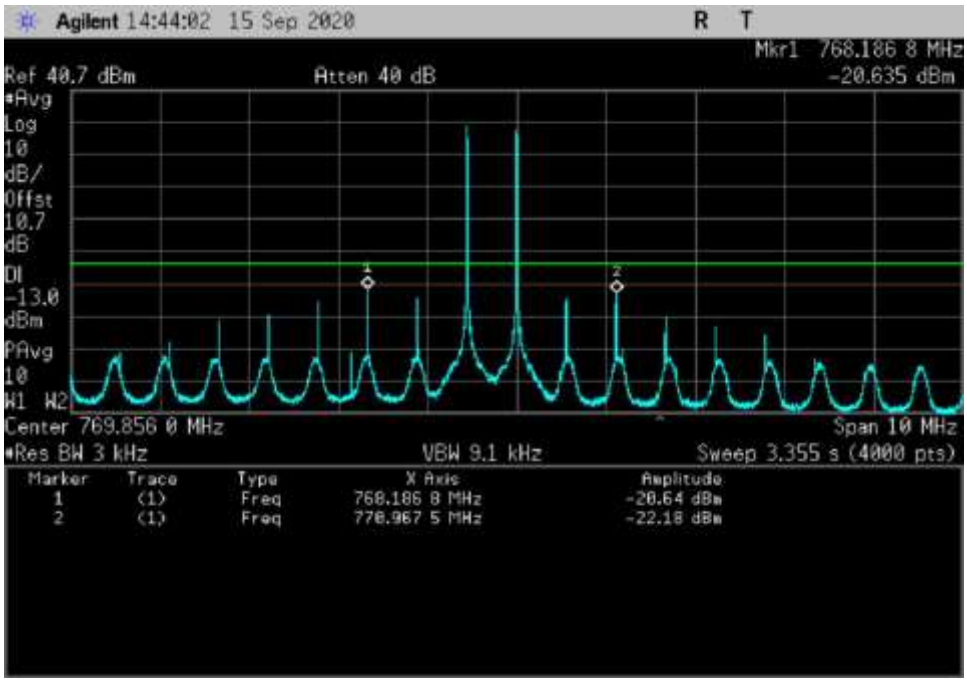
UL_806-809-AGC+3_ 806.1MHz



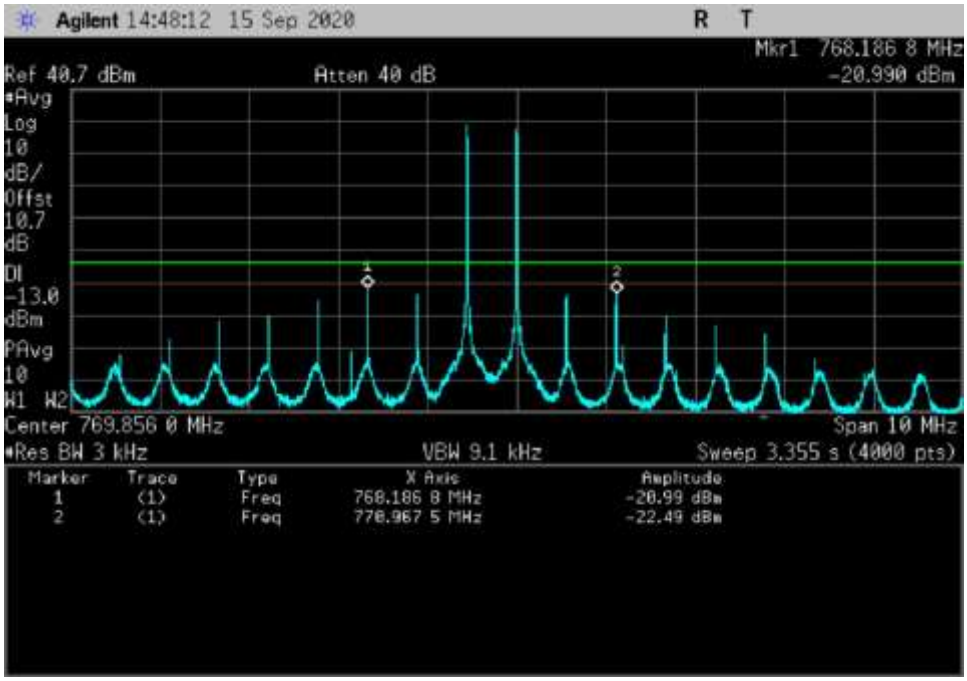
UL_809-816_ 809.125MHz



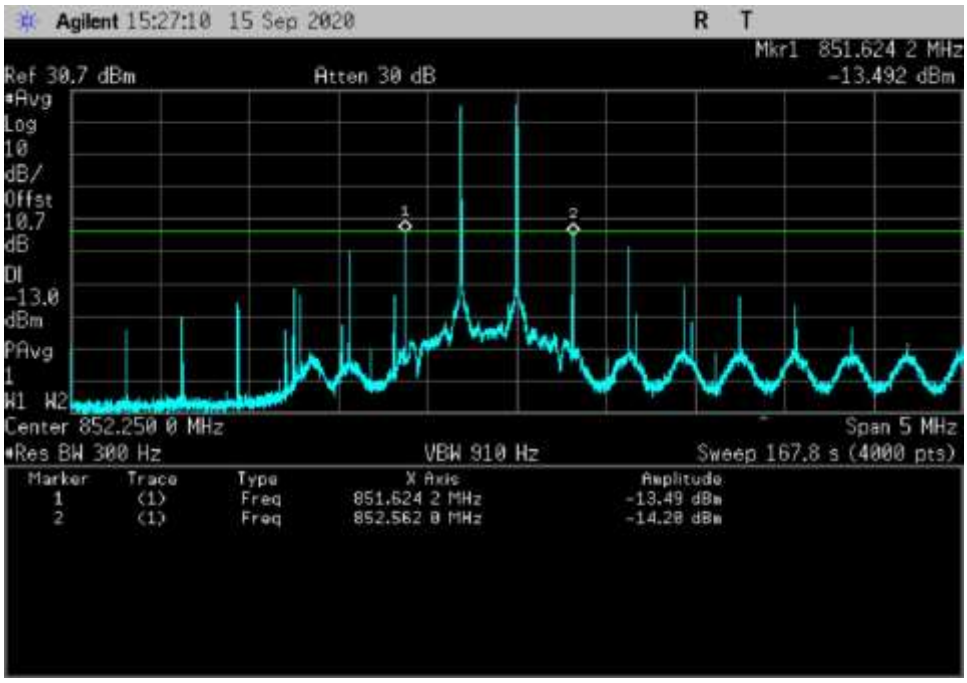
UL_809-816-AGC+3_ 809.125MHz



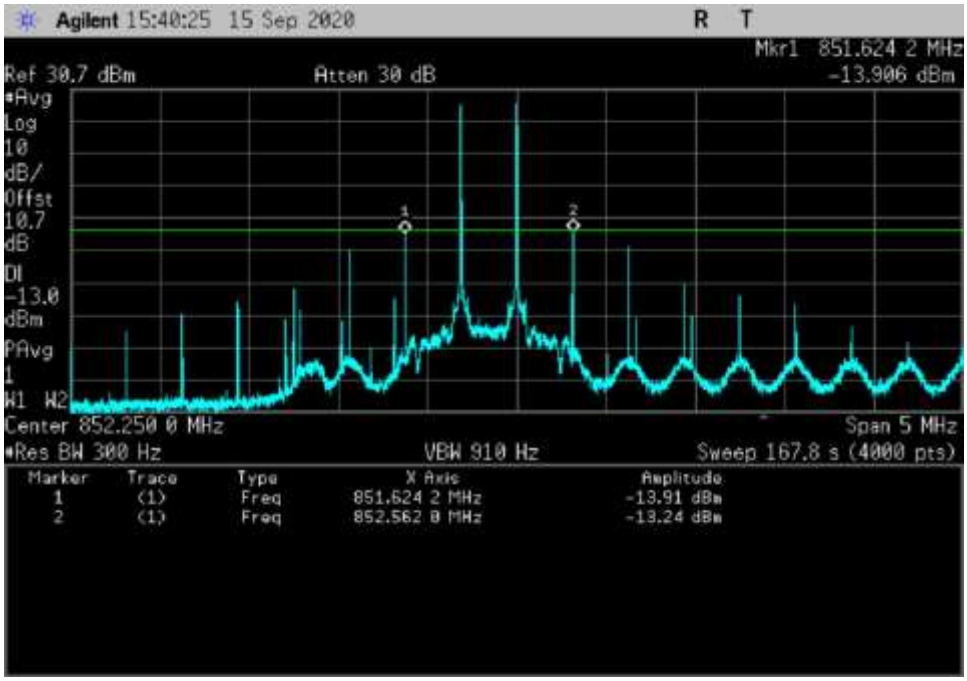
DL_769-775_ 769.856MHz



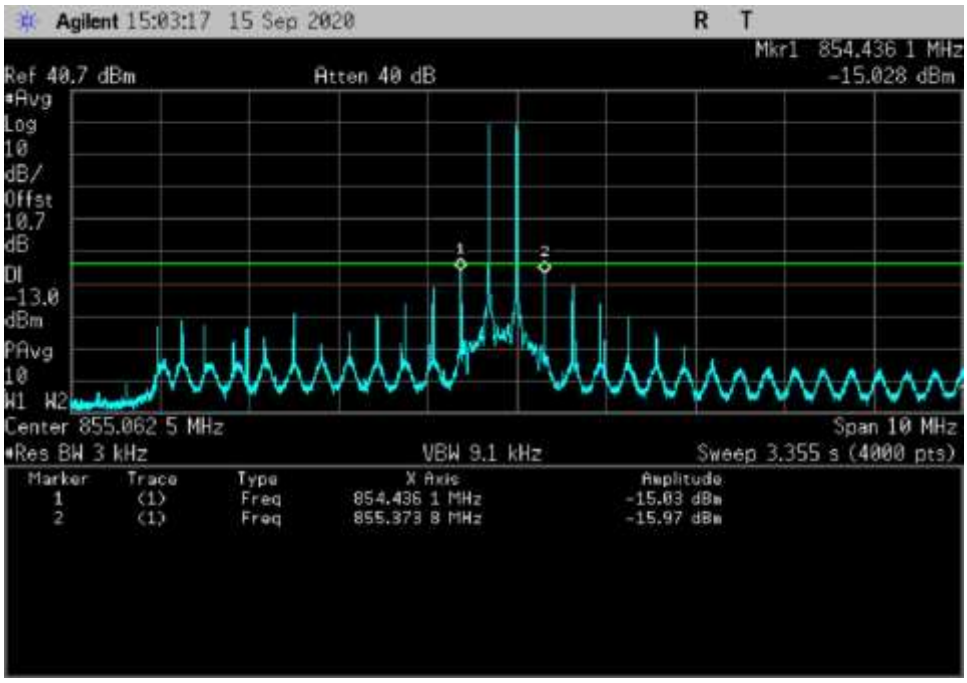
DL_769-775-AGC+3_ 769.856MHz



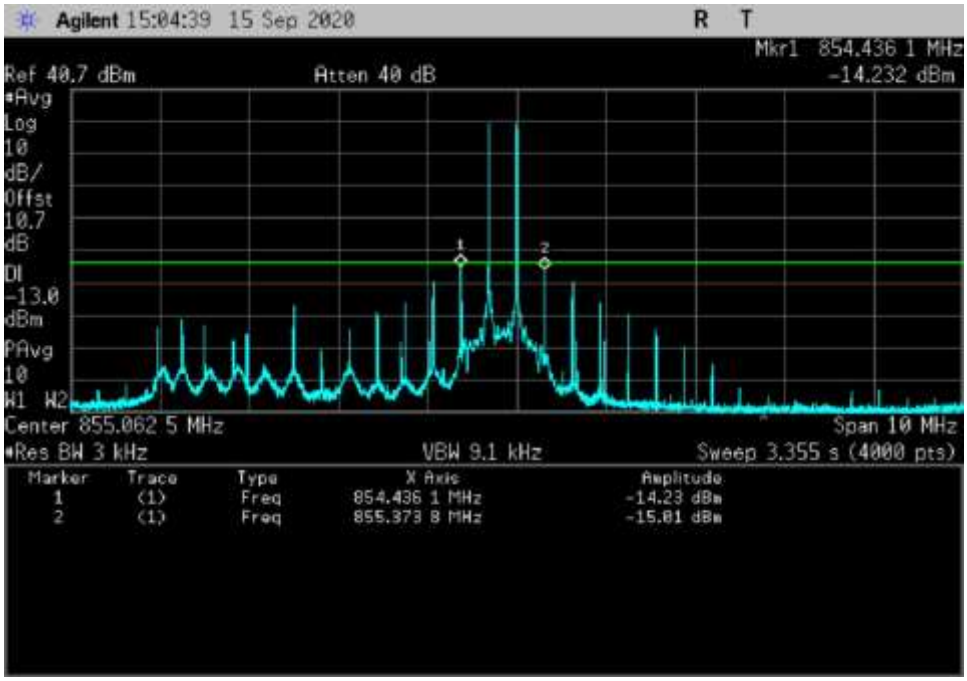
DL_851-854_ 852.25MHz



DL_851-854-AGC+3_ 852.25MHz

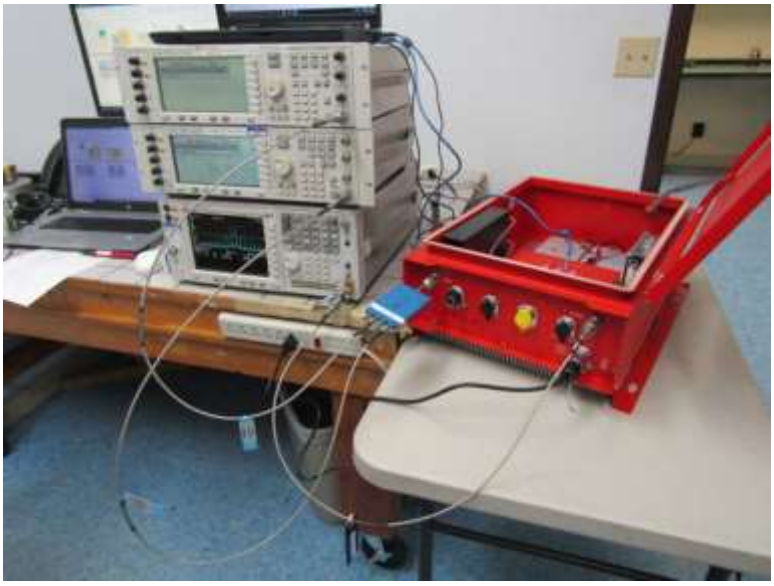


DL_854-861_ 855.0625MHz



DL_854-861-AGC+3_ 855.0625MHz

Test Setup Photo(s)



4.7.3 Spurious Emissions Conducted Measurements

Test Setup/Conditions			
Test Location:	Fremont	Test Engineer:	Hieu Song Nguyenpham
Test Date(s):	7/21/2020		
Configuration:	1		
Test Setup:	See General Test Setup Frequency range of measurement = 9kHz- 9GHz. 9 kHz - 150 kHz -> RBW= 200Hz VBW= 800Hz 150 kHz - 30 MHz -> RBW= 9kHz VBW= 30kHz 30 MHz - 1000MHz -> RBW*= 1MHz VBW= 3MHz 1000 MHz - 9000MHz ->RBW= 1MHz VBW= 3MHz Note: *= measurement performed with larger RBW as worst case. If non-compliant emissions are detected, a final measurement shall be made with a 100 kHz. §90.219 (e) (3) Spurious emissions from a signal booster must not exceed −13 dBm within any 100 kHz measurement bandwidth. §90.543 Emission limitations. (c) Out-of-band emission limit. On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the mean output power (P) by at least 43 + 10log (P) dB measured in a 100 kHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz. (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 equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW 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		

Environmental Conditions					
Temperature (ºC)	21.5	Relative Humidity (%):	42	Pressure (kPa)	101.5

Test Equipment Radiated					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03471	Spectrum Analyzer	Agilent	E4440A	2/11/2020	2/11/2022
03418	Signal Generator	Agilent	E4438C	5/13/2019	5/13/2021
P05411	Attenuator	Weinschel	54A-10	11/27/2019	11/27/2021
P06467	Attenuator	Pasternack	PE7014-10	4/15/2019	4/15/2021
03360	Cable	Astrolab	32022-2-29094-36TC	4/9/2020	4/9/2022
P07192	Cable	Astro	32022-29094K-29094K-48TC	11/27/2019	11/27/2021

Summary of Results

Pass: Summarized in plots below, the conducted spurious emissions are within limits.

9kHz-30 MHz

No Conducted Spurious Emissions were found within 20dB of the limit.

Limit Line For Spurious Conducted Emission

REQUIRED ATTENUATION = 43+10 LOG P DB

Limit line (dBuV) = V_{dBuv} - Attenuation

$$V_{dBuV} = 20 \text{Log} \frac{V}{1 \text{x} 10^{-6}}$$

$$= 20\left(\text{Log } V - \text{Log } 1 \text{x} 10^{-6}\right)$$

$$= 20 \text{Log } V - 20 \text{Log} 1 \text{x} 10^{-6}$$

$$= 20 \text{Log } V - 20(-6)$$

$$= 20 \text{Log } V + 120$$

$$\text{Attenuation} = 43 + 10 \text{Log } P$$

$$= 43 + 10 \text{Log} \frac{V^2}{R}$$

$$= 43 + 10\left(\text{Log } V^2 - \text{Log } R\right)$$

$$= 43 + 10(2 \text{Log } V - \text{Log } R)$$

$$= 43 + 20 \text{Log } V - 10 \text{Log } R$$

Limit line = V_{dBuv} - Attenuation

= 20 Log V + 120 – (43 + 20 Log V – 10Log R)

= 20 Log V + 120 – 43 – 20 Log V + 10Log R

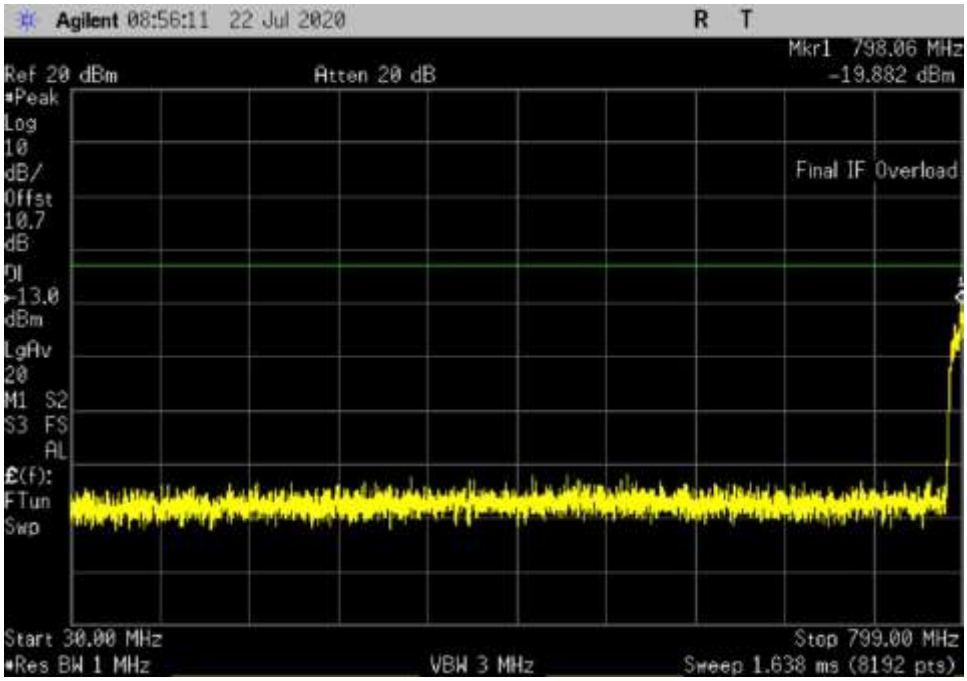
= 20 Log V + 120 – 43 – 20 Log V + 10Log R

= 120 – 43 + 10 Log 50 Note : R = 50 Ω

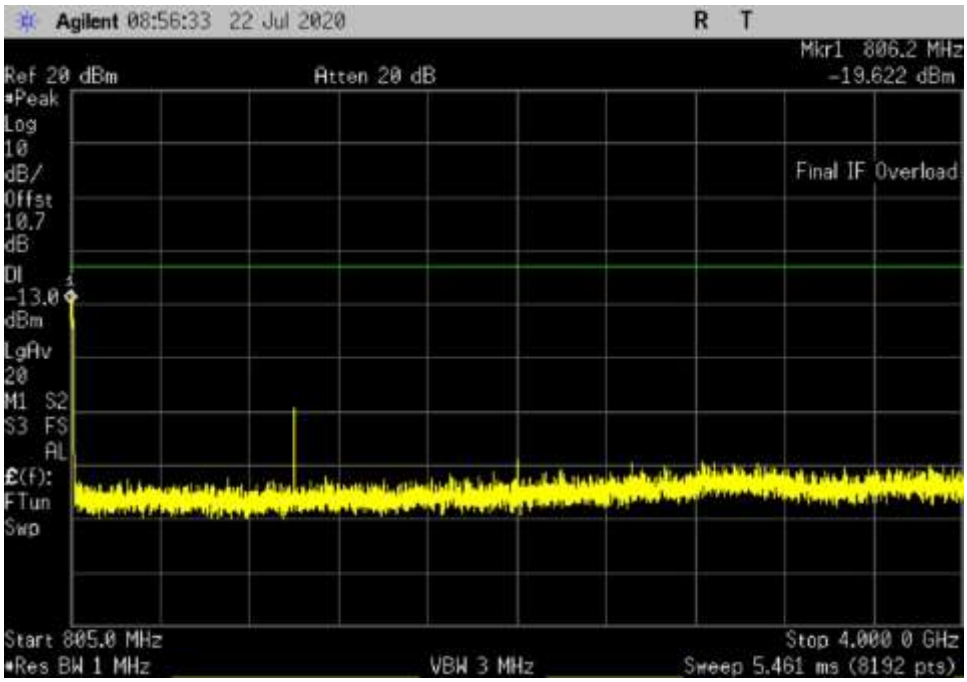
= 120 –43 + 16.897

= 94 dBuV at any power level

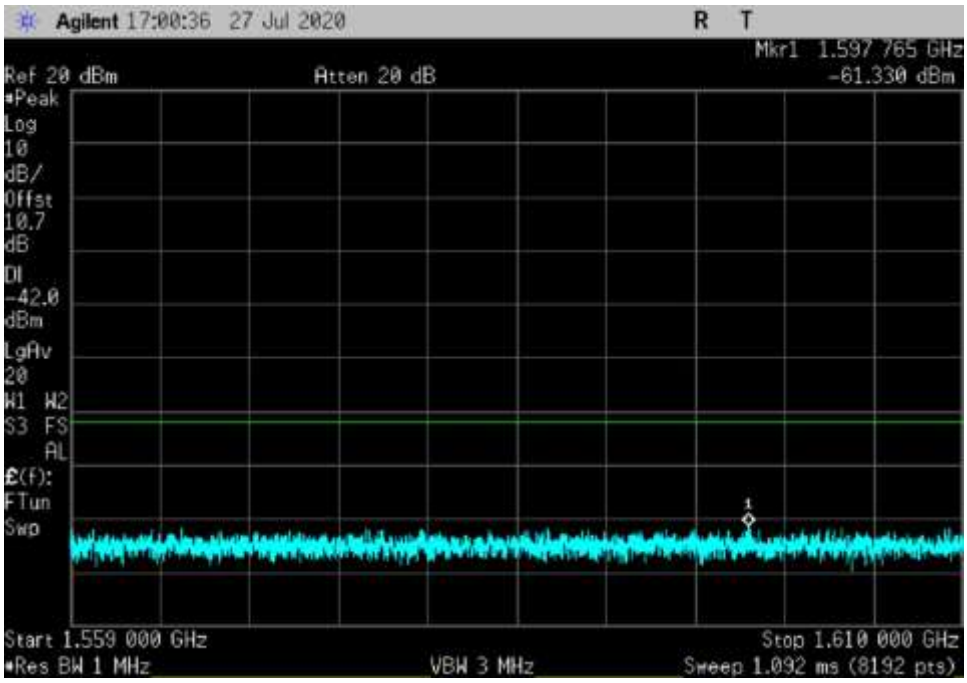
Plots



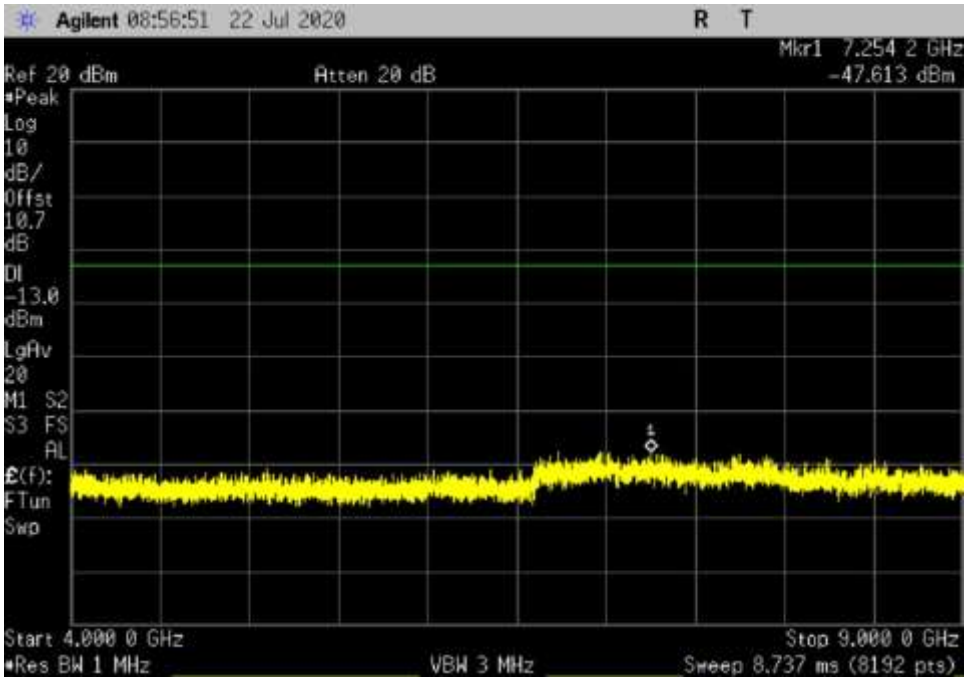
UL_799-805_ 30- 799MHz_MC



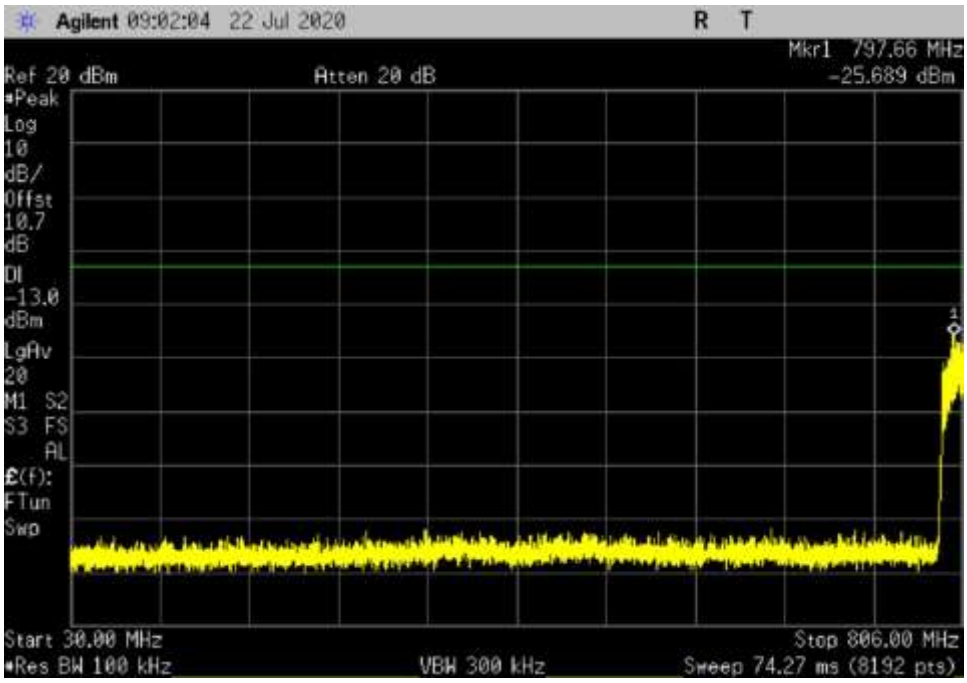
UL_799-805_ 805- 4000MHz_MC



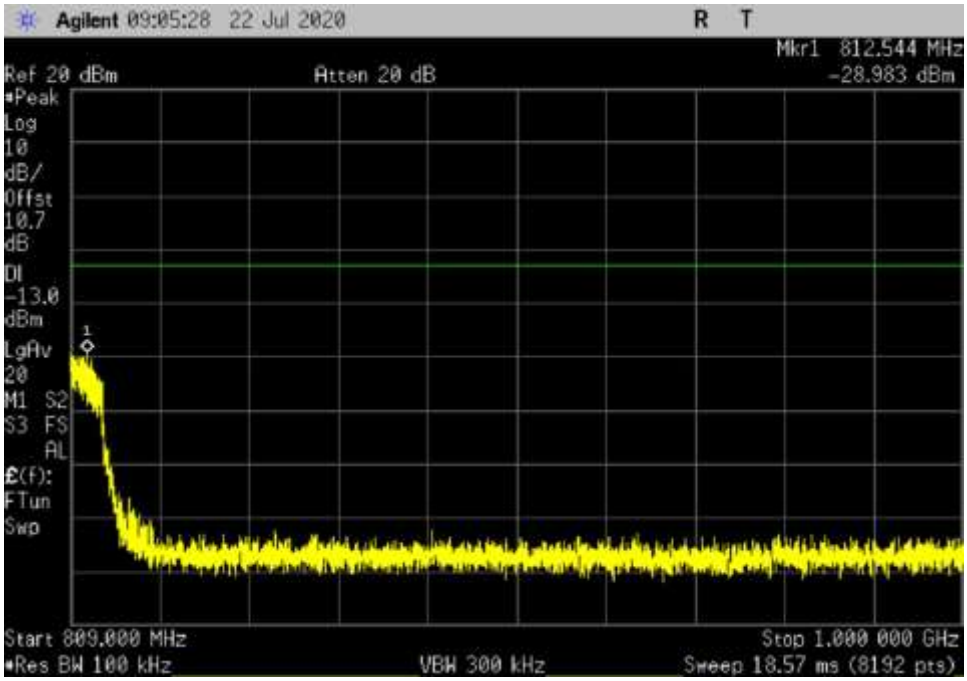
UL_799-805_ 1559- 1610MHz_MC



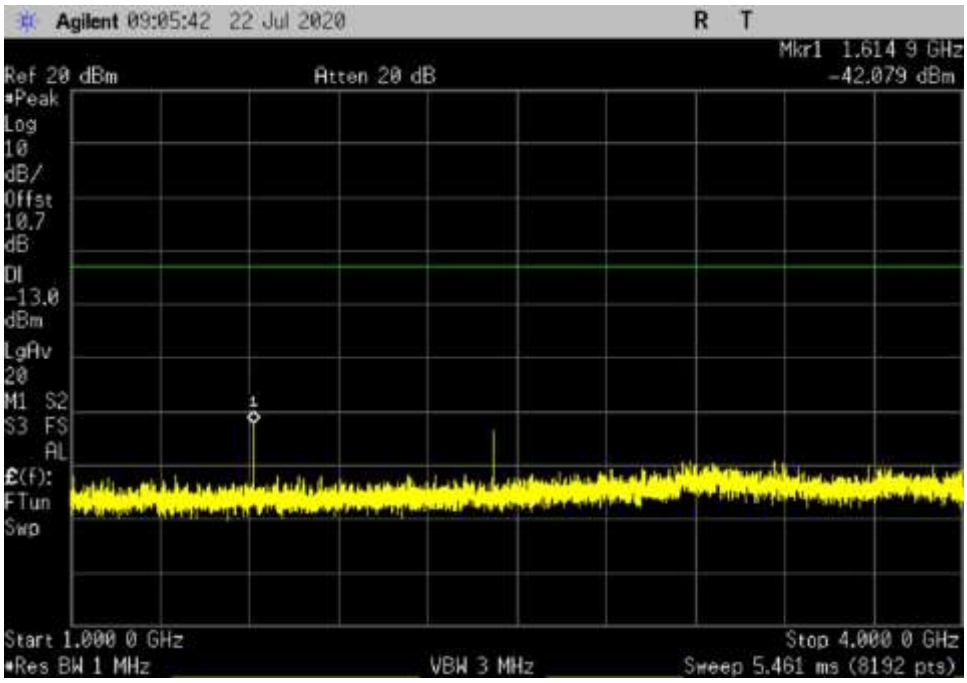
UL_799-805_ 4000- 9000MHz_MC



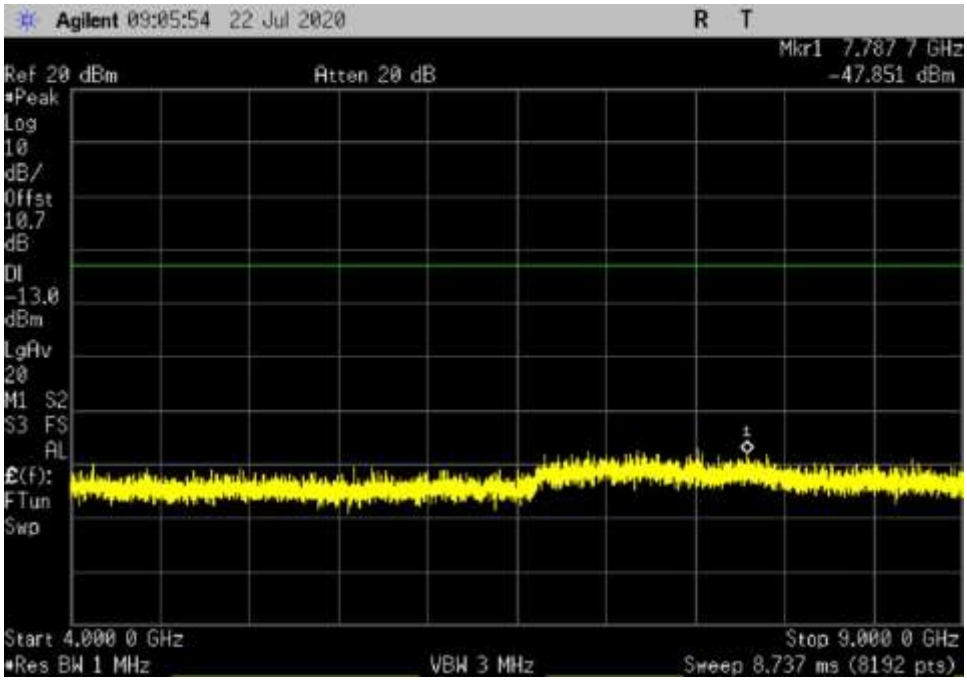
UL_806-809_ 30- 806MHz_MC



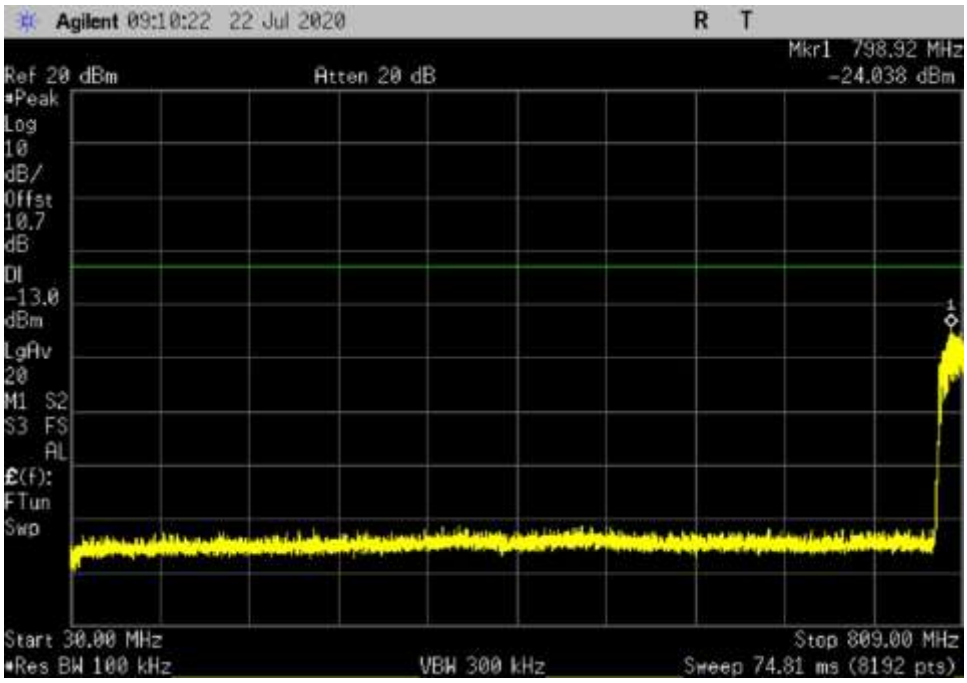
UL_806-809_ 809- 1000MHz_MC



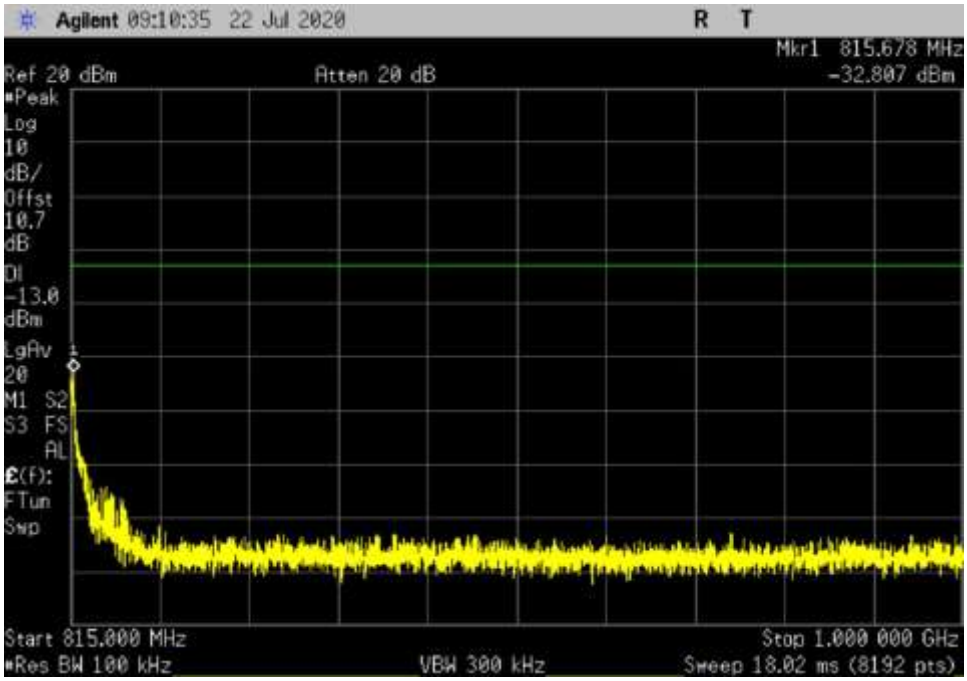
UL_806-809_ 1000- 4000MHz_MC



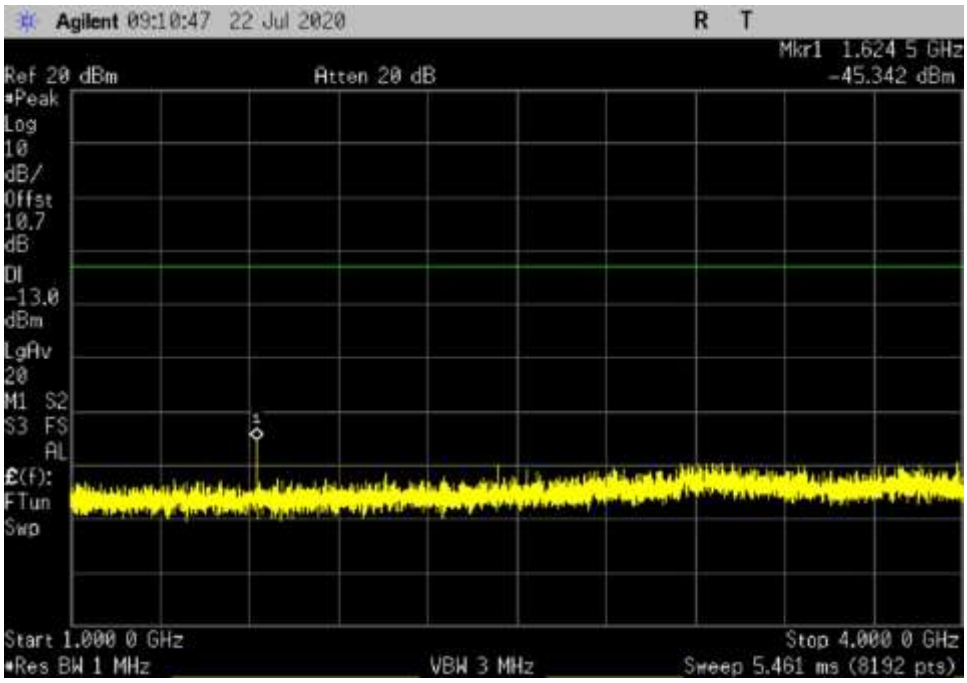
UL_806-809_ 4000- 9000MHz_MC



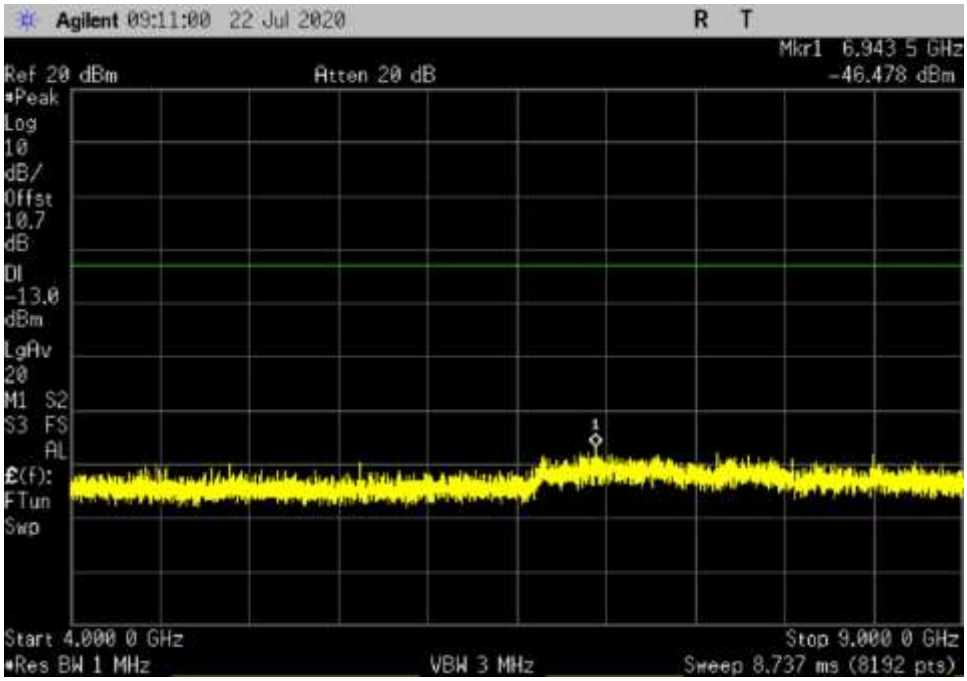
UL_809-816_ 30- 809MHz_MC



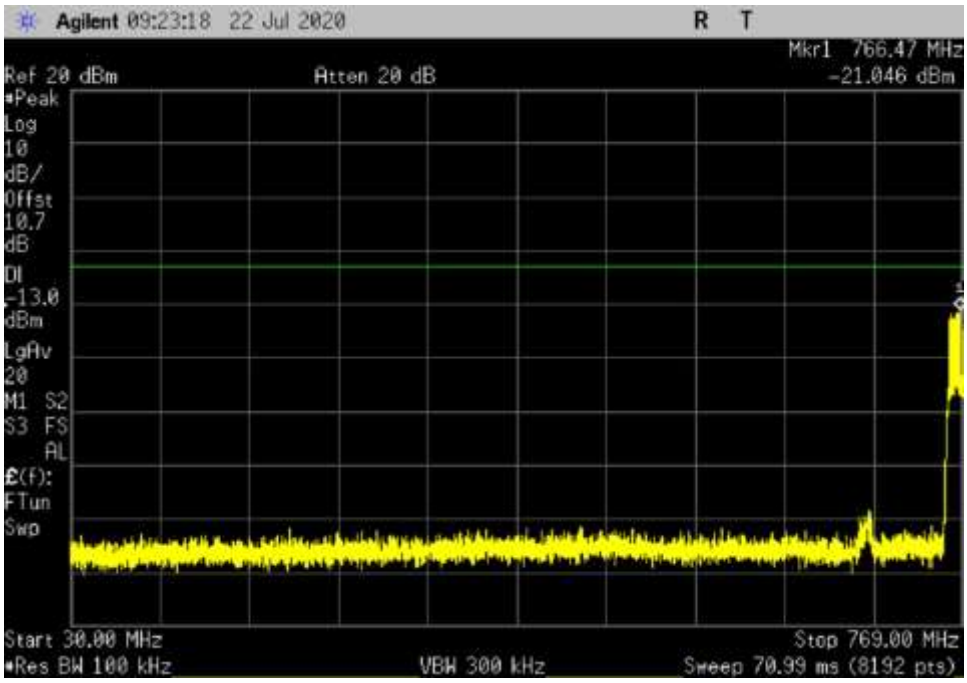
UL_809-816_ 815- 1000MHz_MC



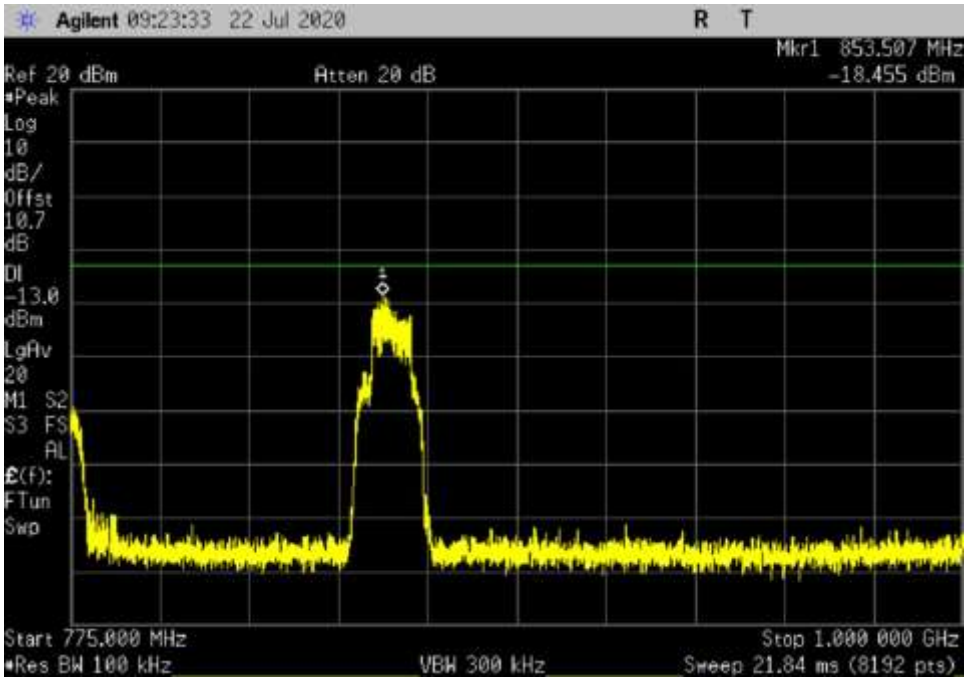
UL_809-816_ 1000- 4000MHz_MC



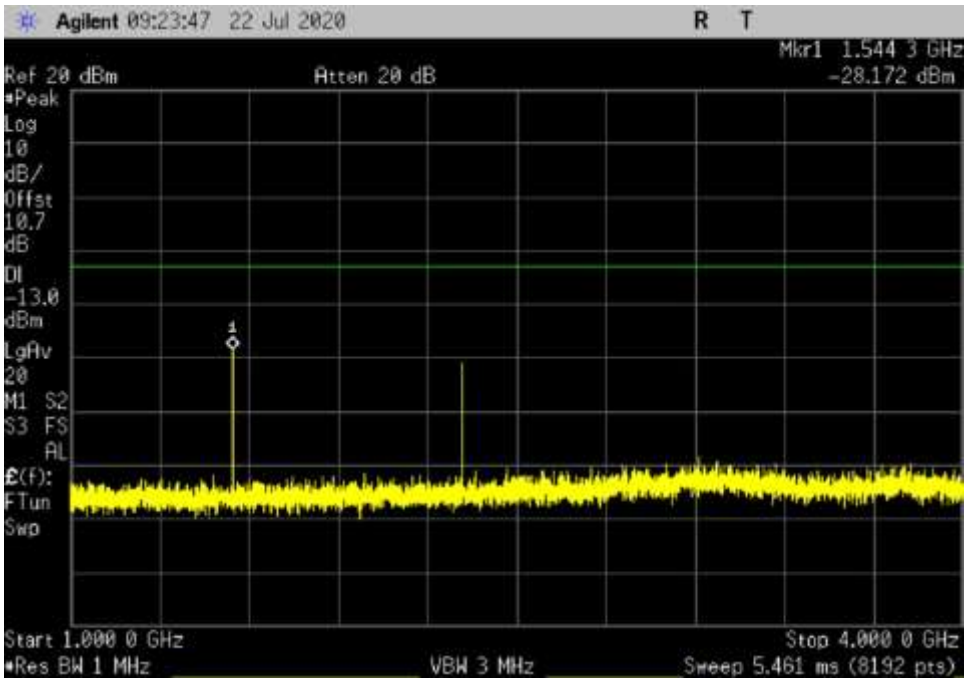
UL_809-816_ 4000- 9000MHz_MC



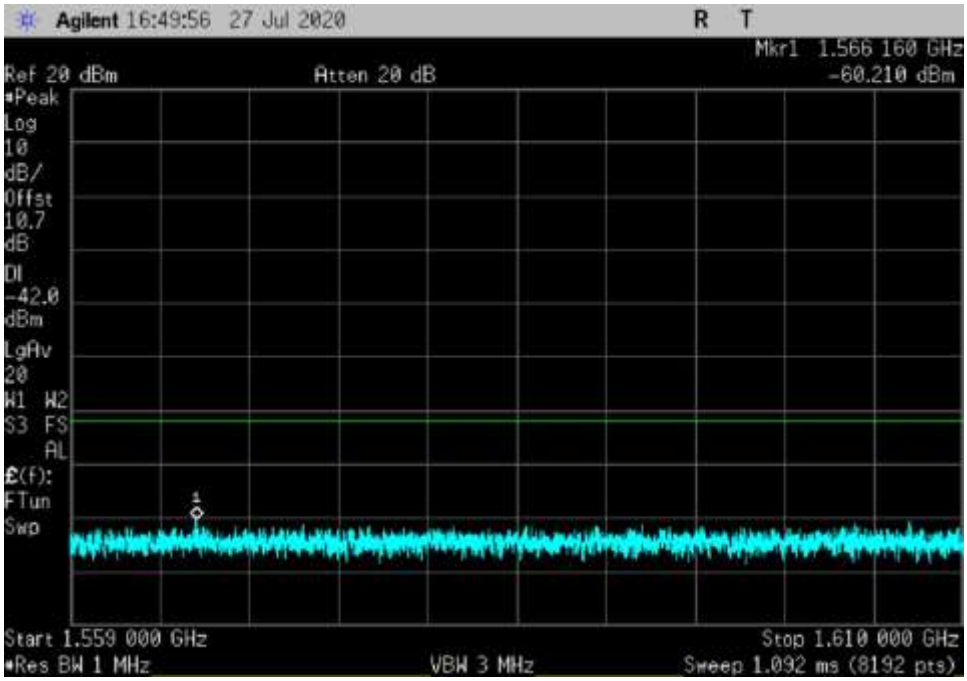
DL_769-775_ 30- 769MHz_MC



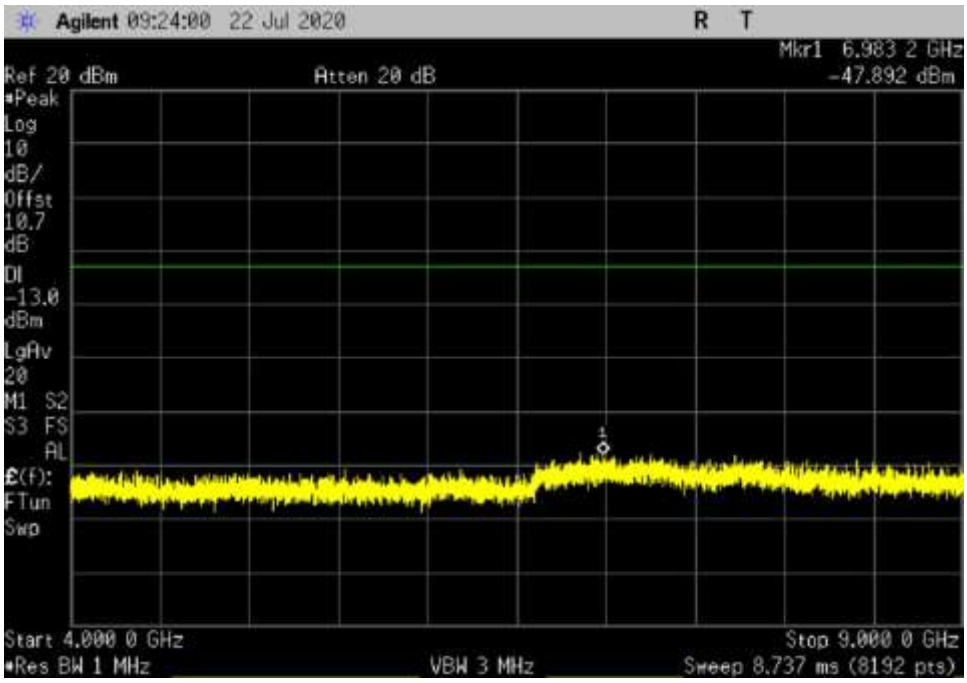
DL_769-775_ 775- 1000MHz_MC



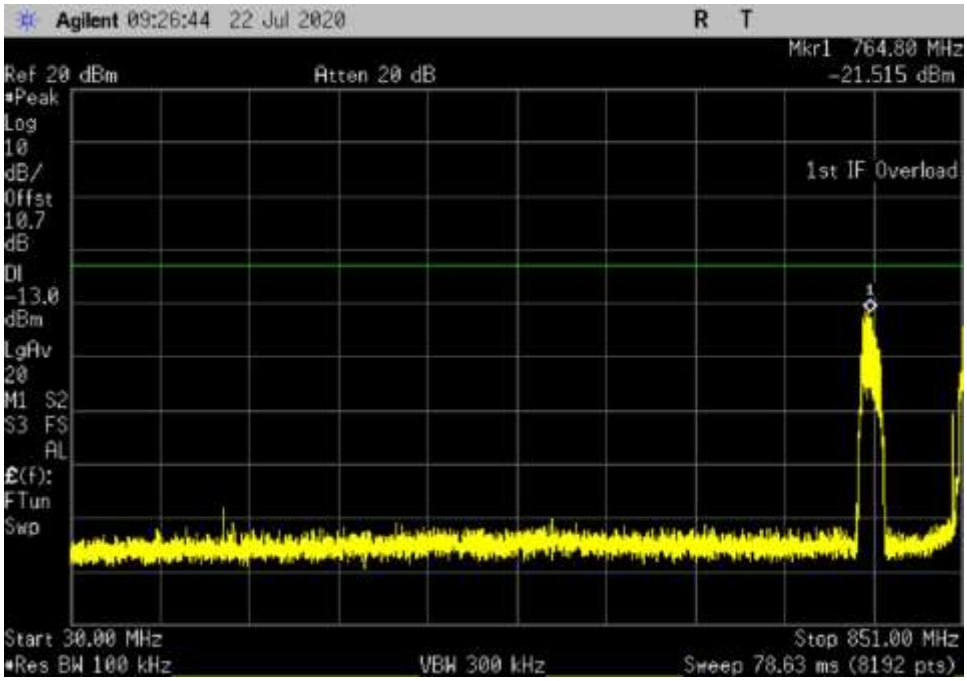
DL_769-775_ 1000- 4000MHz_MC



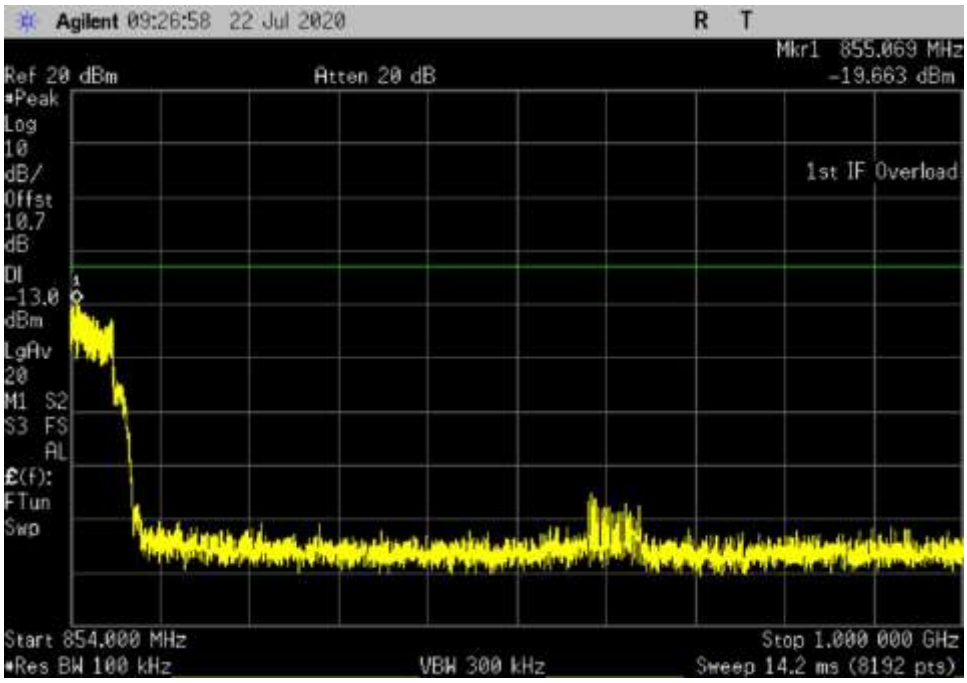
DL_769-775_ 1559- 1610MHz_MC



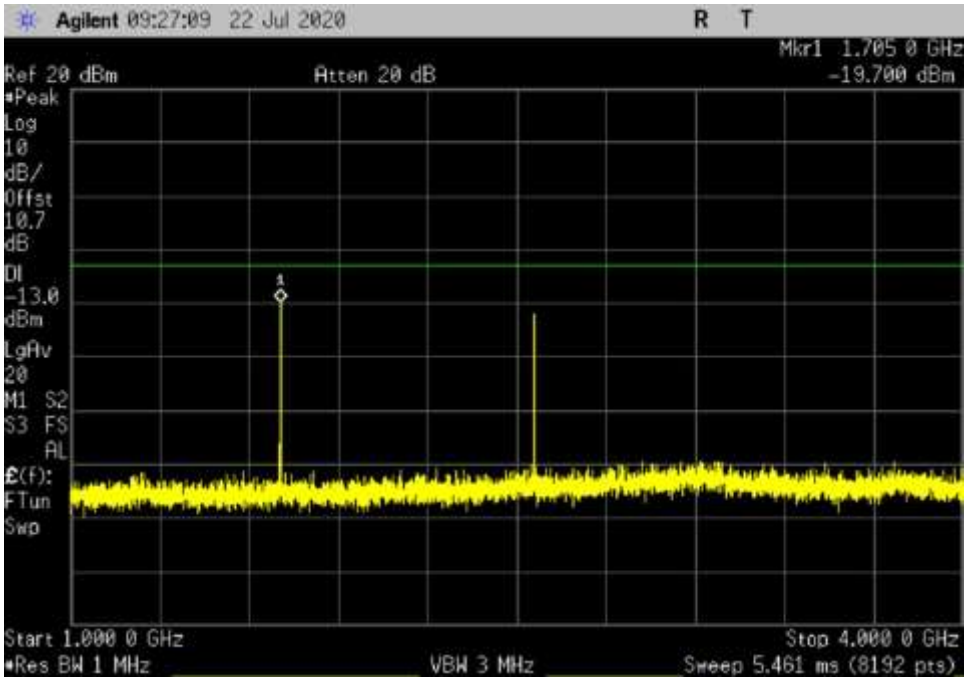
DL_769-775_ 4000- 9000MHz_MC



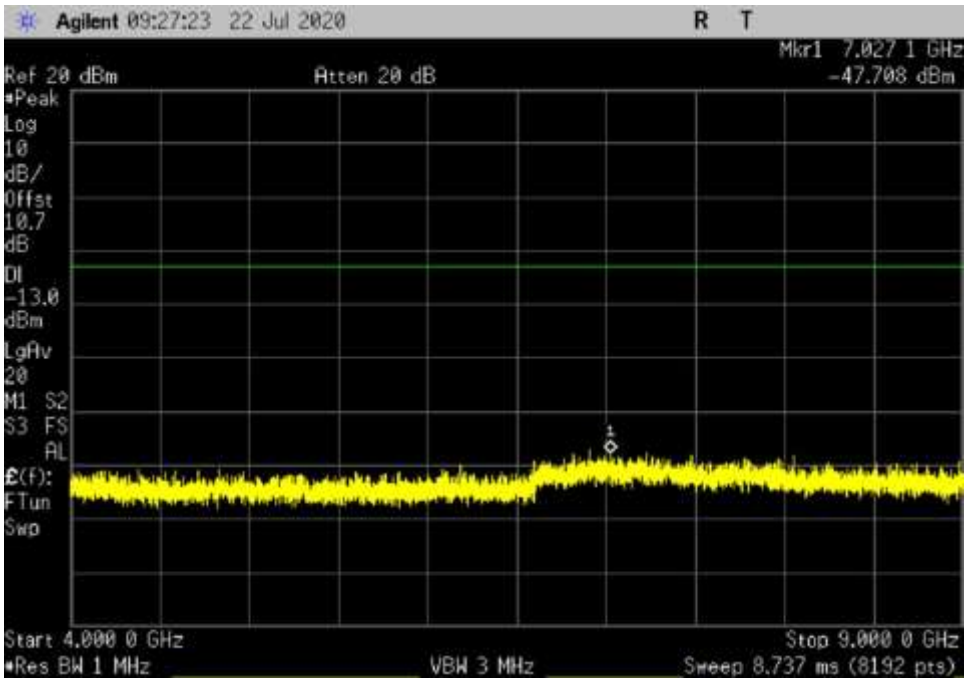
DL_851-854_ 30- 851MHz_MC



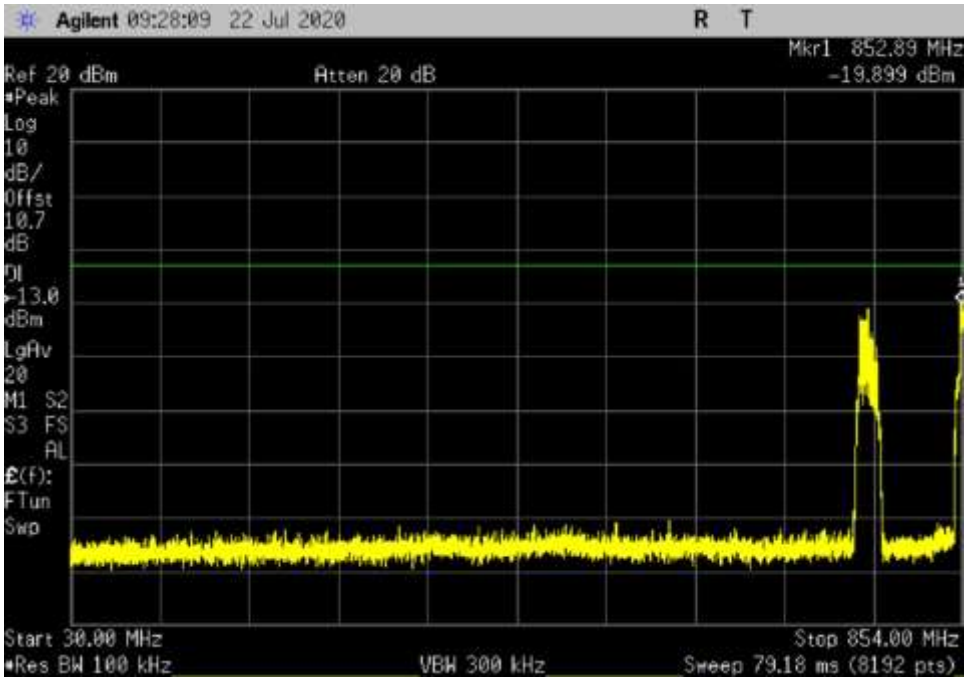
DL_851-854_ 854- 1000MHz_MC



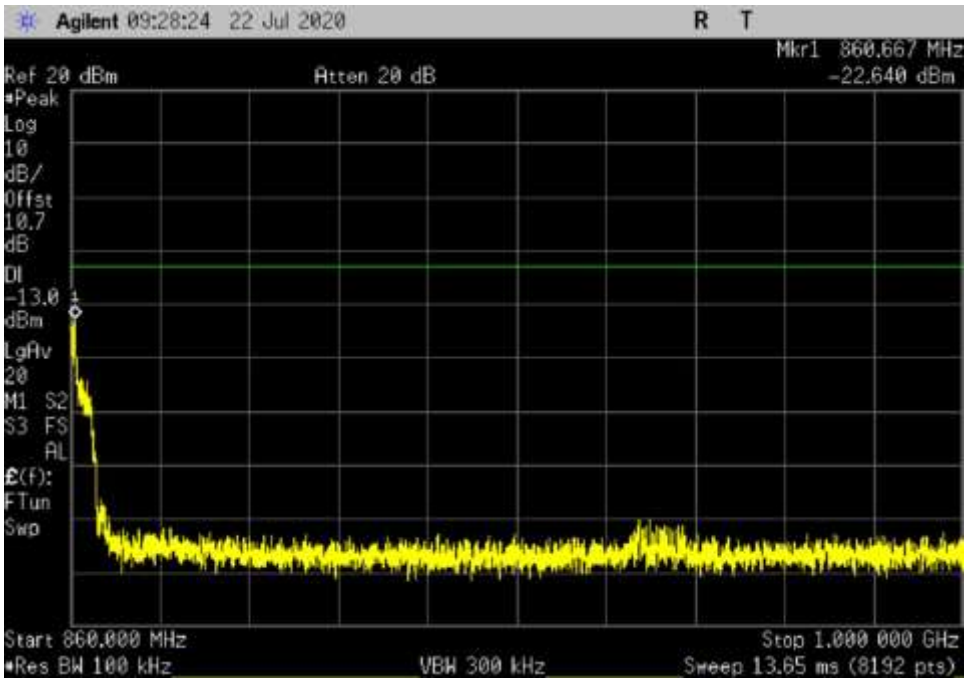
DL_851-854_ 1000- 4000MHz_MC



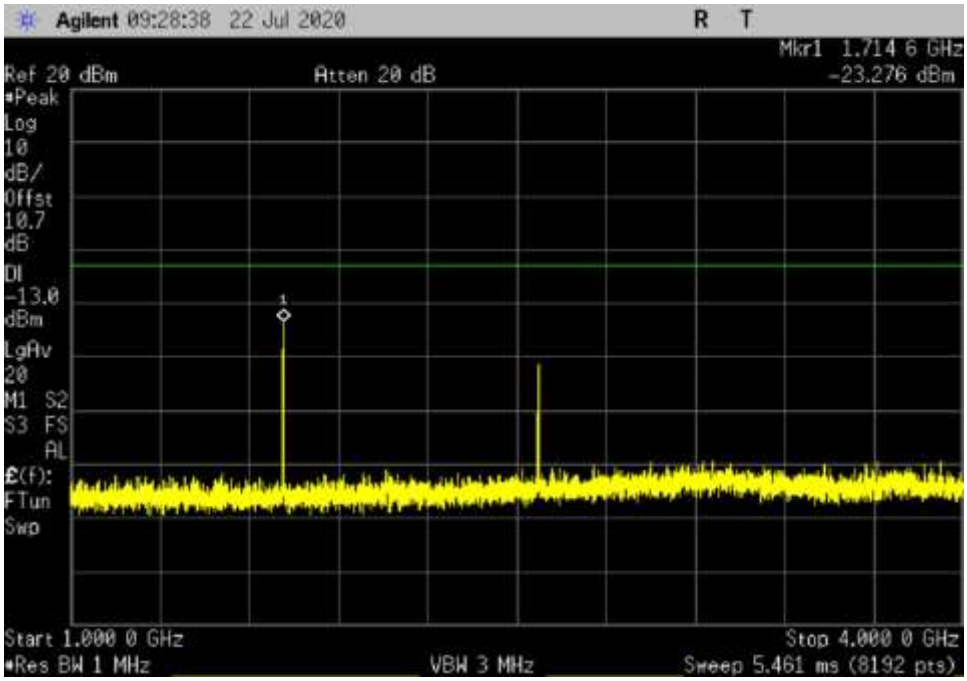
DL_851-854_ 4000- 9000MHz_MC



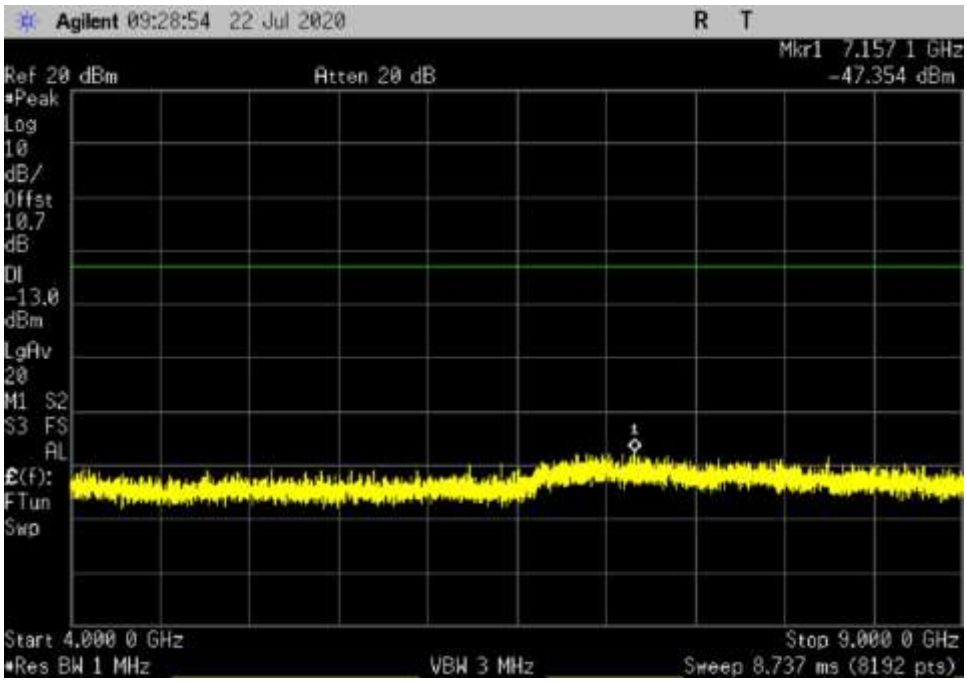
DL_854-861_ 30- 854MHz_MC



DL_854-861_ 860- 1000MHz_MC

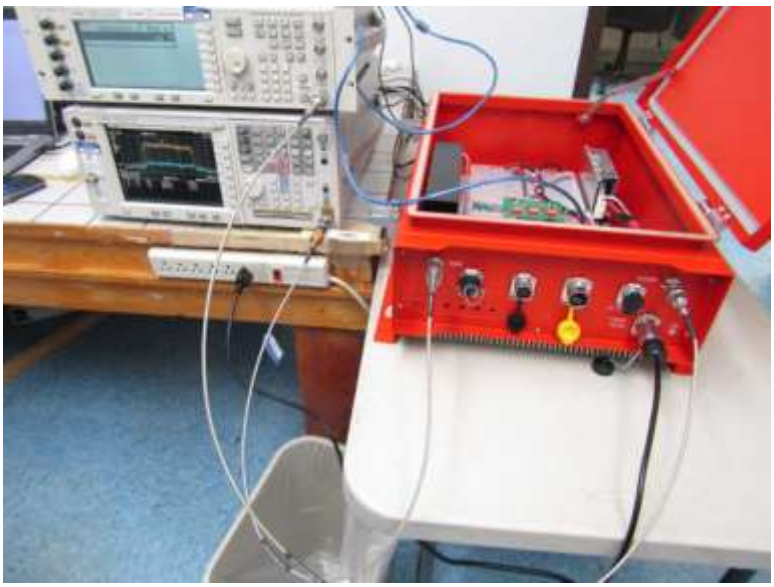


DL_854-861_ 1000- 4000MHz_MC



DL_854-861_ 4000- 9000MHz_MC

Test Setup Photo(s)



4.9 Radiated Spurious Emission

Test Setup/Conditions			
Test Location:	Fremont	Test Engineer:	Hieu Song Nguyenpham
Test Date(s):	7/20/2020		
Configuration:	2		
Test Setup:	The equipment under test (EUT) is placed on the Styrofoam table top. EUT set at maximum gain. A remotely located signal generator is connected to input of EUT. Evaluation of DL path was performed with signal fed into the Outside antenna port while Inside antenna port terminated with 50 Ohm load. Evaluation of UL path was performed with signal fed into the Inside antenna port while Outside antenna port terminated with 50 Ohm load. UL: 799-805, 806-816 MHz DL: 769-775, 851-861 MHz Test procedure: The test was performed IAW 47CFR, Section 2.1053 and Appendix D3 of the FCC document: 935210 D05 Indus Booster Basic Meas v01r04 Dated April 03, 2020 Frequency range of measurement = 9kHz- 10GHz. 9 kHz - 150 kHz -> RBW= 200Hz VBW= 800Hz 150 kHz - 30 MHz -> RBW= 9kHz VBW= 30kHz 30 MHz - 1000MHz -> RBW= 100kHz VBW= 3MHz 1000 MHz - 10000MHz ->RBW= 1MHz VBW= 3MHz Emissions in the band 1559-1610 MHz were investigated and these were not found within 20dB of the limit line		

Limit Line For Spurious Radiated Emission

REQUIRED ATTENUATION = 43+10 LOG P (DB)

For radiated spurious emission measured at 3 meter test distance,

Required attenuation = 43+10 Log $P_{t\ at\ 3\ meter}$ dB
Limit line (dBuV) = E_{dBuv} - Attenuation

E_{dBuv} = Measured field strength at 3 meter in dBuV/m

Power Density (Isotropic)

$$P_D = \frac{P_t}{4\pi r^2}$$

P_D = Power Density in Watts /m^2
Pt = Average Transmit Power
r = Test distance

Field Intensity E (V/m)

$$E = \sqrt{P_D \times 377}$$

$$E = \frac{\sqrt{P_t \times 377}}{4\pi r^2}$$

$$E = \sqrt{\frac{P_t \times 30}{r^2}}$$

$$P_t = \left(\frac{E^2 \times r^2}{30} \right)$$

10 Log P_t = 10 Log E^2 (V/m)+ 10 Log r^2 – 10 Log 30
10 Log P_t = 20 Log E (V/m) + 20 Log r – 10 Log 30

At 3 meter, r = 3 m
10 Log P_t = 20 Log E (V/m) + 20 Log 3 – 10 Log 30
10 Log P_t = 20 Log E (V/m) + 9.54 – 14.77
10 Log P_t = 20 Log E (V/m) - 5.23

Since 20 Log E (V/m) = 20 Log E (uV/m) –120
10 Log P_t = 20 Log E (uV/m) - 120 - 5.23
10 Log P_t = 20 Log E (uV/m) –125.23
Limit line (dBuV) at 3 meter = E_{dBuv} – Attenuation

= E_{dBuv} - (43+10 Log $P_{t\ at\ 3\ meter}$)
= E_{dBuv} - 43 - 10 Log $P_{t\ at\ 3\ meter}$
= E_{dBuv} - 43 – (20 Log E (uV/m) –125.23)
= E_{dBuv} - 43 - 20 Log E (uV/m) + 125.23
= E_{dBuv} - 20 Log E (uV/m) + 82.23

Since 20 Log E (uV/m) = E in dBuV/m = ~~E_{dBuv}~~ - ~~E_{dBuv}~~ + 82.23

Radiated Emission limit 3 meter = 82.23 dBuV at any power level measured in dBuV

Test Setup / Conditions / Data

Test Location:	CKC Laboratories Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510 249-1170		
Customer:	**Cellphone-Mate, Inc.**		
Specification:	**47 CFR §90.543(c) Spurious Radiated Emissions**		
Work Order #:	**104177**	Date:	7/20/2020
Test Type:	**Radiated Scan**	Time:	13:31:38
Tested By:	Hieu Song Nguyenpham	Sequence#:	8
Software:	EMITest 5.03.19		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

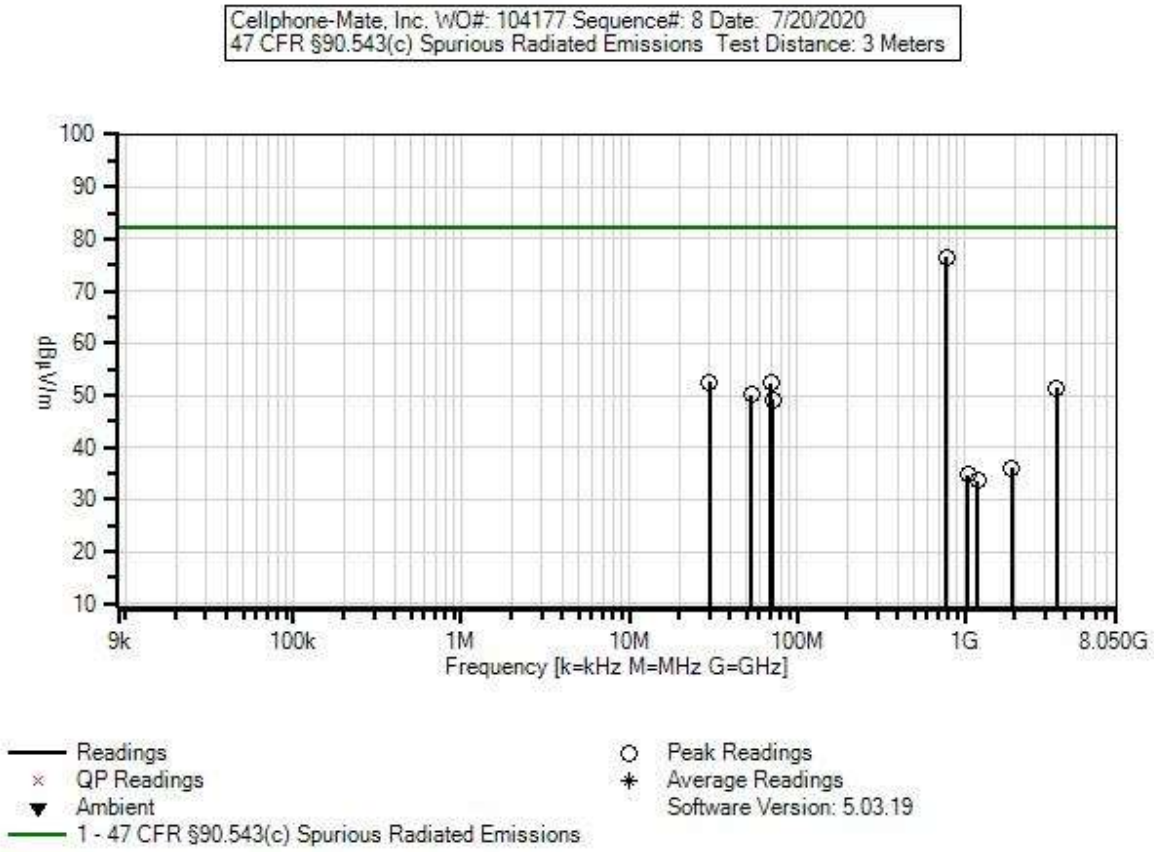
Test Conditions / Notes:

Radiated Emission
Frequency Range: 9kHz to 10GHz

Temperature: 22.6°C
Humidity: 44 %
Atmospheric Pressure:101.3Pa
Highest Generation Frequency: 861MHz
Method: KDB 971168 D01

The EUT is operated and set up as intended. The output antenna port for uplink path is terminated by 50Ohm loads. The input antenna port is connected to the signal generation. The EUT is connected to the Ethernet Switch which is outside of the chamber through RJ45 cable to maximize function of the EUT

UL path



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07508	Preamp	310N	7/9/2020	7/9/2022
T2	AN00852	Biconilog Antenna	CBL 6111C	4/14/2020	4/14/2022
T3	ANP06049	Attenuator	PE7002-6	5/11/2020	5/11/2022
T4	ANP00880	Cable	RG214U	3/25/2020	3/25/2022
T5	ANP01187	Cable	CNT-195	7/6/2020	7/6/2022
T6	ANP06691	Cable	PE3062-180	3/25/2020	3/25/2022
T7	AN03470	Spectrum Analyzer	E4440A	5/2/2019	5/2/2021
T8	AN00432	Loop Antenna	6502	2/19/2019	2/19/2021
	AN02157	Horn Antenna-ANSI C63.5	3115	1/15/2019	1/15/2021
	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2020	1/9/2022
	ANP01210	Cable	FSJ1P-50A-4A	12/18/2018	12/18/2020
	AN03360	Cable	32022-2-29094-36TC	4/9/2020	4/9/2022
	AN03713	Preamp	01001800-221055-202525	5/22/2019	5/22/2021

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5	T6	T7	T8					
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	774.061M	75.7	-32.0	+22.1	+6.0	+3.0	+0.0	76.5	82.2	-5.7	Vert
			+0.6	+1.1	+0.0	+0.0					
2	30.253M	59.4	-32.1	+18.6	+5.9	+0.5	+0.0	52.5	82.2	-29.7	Vert
			+0.0	+0.2	+0.0	+0.0					
3	70.064M	71.3	-32.0	+6.0	+5.9	+0.7	+0.0	52.3	82.2	-29.9	Vert
			+0.1	+0.3	+0.0	+0.0					
4	3544.542M	72.1	+0.0	+0.9	-57.0	+30.7	+0.0	51.4	82.2	-30.8	Vert
			+1.5	+3.2	+3.2	+3.2					
5	53.651M	67.3	-32.1	+8.0	+5.9	+0.7	+0.0	50.1	82.2	-32.1	Vert
			+0.1	+0.2	+0.0	+0.0					
6	72.084M	67.7	-32.0	+6.4	+5.9	+0.7	+0.0	49.1	82.2	-33.1	Vert
			+0.1	+0.3	+0.0	+0.0					
7	1906.000M	63.6	+0.0	+0.7	-58.3	+26.6	+0.0	36.0	82.2	-46.2	Vert
			+1.1	+2.3	+2.3	+2.3					
8	1049.000M	65.4	+0.0	+0.7	-58.3	+24.1	+0.0	34.7	82.2	-47.5	Vert
			+1.1	+1.7	+1.7	+1.7					
9	1194.000M	64.5	+0.0	+0.5	-58.3	+24.2	+0.0	33.6	82.2	-48.6	Vert
			+0.9	+1.8	+1.8	+1.8					

Test Location:	CKC Laboratories Inc. • 1120 Fulton Place • Fremont, CA 94539 • 510 249-1170		
Customer:	**Cellphone-Mate, Inc.**		
Specification:	**47 CFR §90.543(c) Spurious Radiated Emissions**		
Work Order #:	**104177**	Date:	7/20/2020
Test Type:	**Radiated Scan**	Time:	14:46:59
Tested By:	Hieu Song Nguyenpham	Sequence#:	10
Software:	EMITest 5.03.19		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

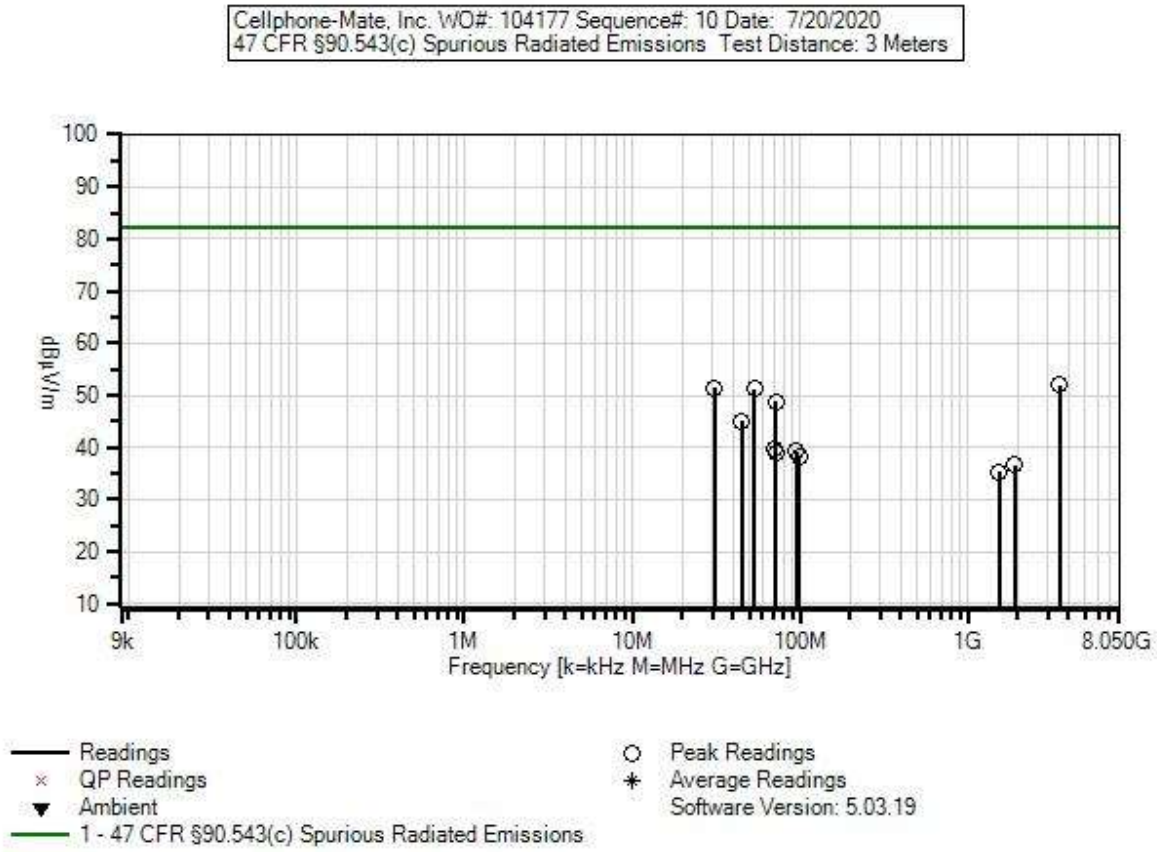
Test Conditions / Notes:

Radiated Emission
Frequency Range: 9kHz to 10GHz

Temperature: 22.6°C
Humidity: 44 %
Atmospheric Pressure:101.3Pa
Highest Generation Frequency: 861MHz
Method: KDB 971168 D01

The EUT is operated and set up as intended. The output antenna port for downlink path is terminated by 50Ohm loads. The input antenna port is connected to the signal generation. The EUT is connected to the Ethernet Switch which is outside of the chamber through RJ45 cable to maximize function of the EUT

DL Path



Test Equipment:

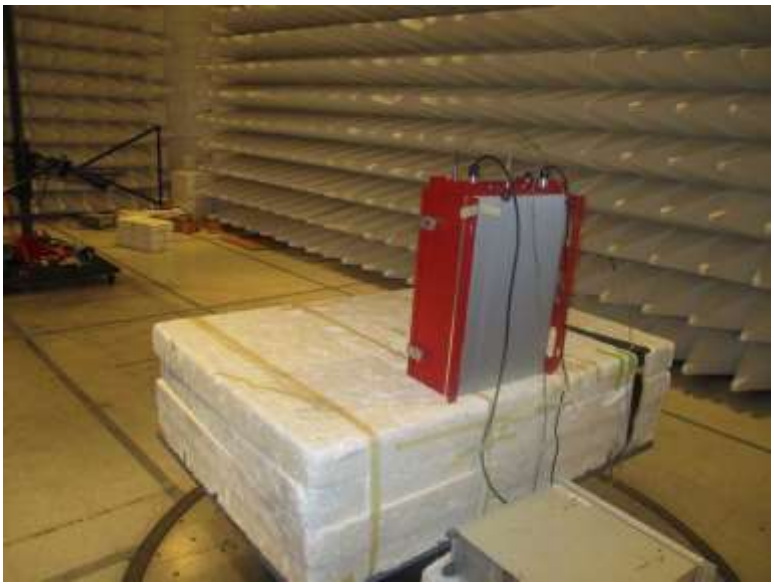
ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP07508	Preamp	310N	7/9/2020	7/9/2022
T2	AN00852	Biconilog Antenna	CBL 6111C	4/14/2020	4/14/2022
T3	ANP06049	Attenuator	PE7002-6	5/11/2020	5/11/2022
T4	ANP00880	Cable	RG214U	3/25/2020	3/25/2022
T5	ANP01187	Cable	CNT-195	7/6/2020	7/6/2022
T6	ANP06691	Cable	PE3062-180	3/25/2020	3/25/2022
	AN03470	Spectrum Analyzer	E4440A	5/2/2019	5/2/2021
	AN00432	Loop Antenna	6502	2/19/2019	2/19/2021
	AN02157	Horn Antenna-ANSI C63.5	3115	1/15/2019	1/15/2021
	AN03302	Cable	32026-29094K-29094K-72TC	1/9/2020	1/9/2022
	ANP01210	Cable	FSJ1P-50A-4A	12/18/2018	12/18/2020
	AN03360	Cable	32022-2-29094-36TC	4/9/2020	4/9/2022
	AN03713	Preamp	01001800-221055-202525	5/22/2019	5/22/2021

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

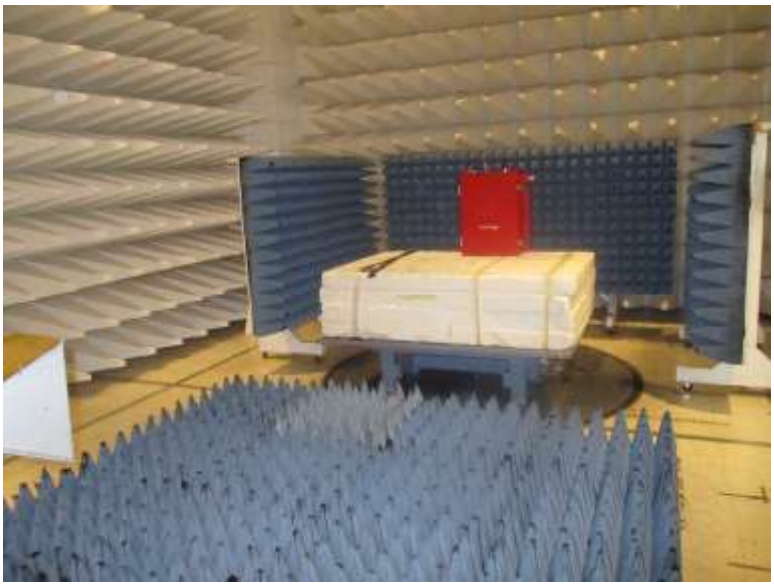
#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	3544.542M	72.7	+0.0 +1.5	+0.9 +3.2	-57.0	+30.7	+0.0	52.0	82.2	-30.2	Vert
2	31.094M	58.7	-32.1 +0.0	+18.2 +0.2	+5.9	+0.5	+0.0	51.4	82.2	-30.8	Vert
3	53.609M	68.4	-32.1 +0.1	+8.0 +0.2	+5.9	+0.7	+0.0	51.2	82.2	-31.0	Vert
4	71.495M	67.4	-32.0 +0.1	+6.3 +0.3	+5.9	+0.7	+0.0	48.7	82.2	-33.5	Vert
5	44.940M	59.3	-32.1 +0.0	+11.1 +0.2	+5.9	+0.6	+0.0	45.0	82.2	-37.2	Vert
6	70.527M	58.5	-32.0 +0.1	+6.1 +0.3	+5.9	+0.7	+0.0	39.6	82.2	-42.6	Horiz
7	94.938M	54.1	-32.0 +0.1	+9.9 +0.3	+5.9	+0.9	+0.0	39.2	82.2	-43.0	Horiz
8	72.084M	57.7	-32.0 +0.1	+6.4 +0.3	+5.9	+0.7	+0.0	39.1	82.2	-43.1	Horiz
9	98.881M	52.8	-32.0 +0.1	+10.3 +0.3	+5.9	+0.9	+0.0	38.3	82.2	-43.9	Horiz
10	1903.000M	64.3	+0.0 +1.1	+0.7 +2.3	-58.3	+26.6	+0.0	36.7	82.2	-45.5	Vert
11	1535.000M	65.4	+0.0 +1.0	+0.6 +2.0	-58.3	+24.6	+0.0	35.3	82.2	-46.9	Vert

Test Setup Photo(s)

Below 1GHz



Below 1GHz



Above 1GHz

Above 1GHz

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2. Compliance is deemed to occur provided measurements are below the specified limits.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dBµV/m, the spectrum analyzer reading in dBµV was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

SAMPLE CALCULATIONS		
	Meter reading	(dBµV)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBµV/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point, the measuring device is set into the linear mode and the scan time is reduced.