Electromagnetic Compatibility Test Report

Tests Performed on a Westell, Inc.

ProtectLink VHF Bi-Directional Amplifier, Model 080-300925

Radiometrics Document RP-9563A2

ACCREDITED
TESTING CERT #1495.01

Product Detail:
FCC ID: NVR230021014V
Equipment type: 150-174 MHz Bi-Directional Amplifier

Test Standards:
FCC KDB 935210 D05: 2019
FCC Part 90.219, and CFR Title 47: 2021

Tests Performed For:	*Test Facility:*
Westell, Inc. 750 Commons Dr. Aurora, IL 60504	**Radiometrics Midwest Corporation** 12 Devonwood Avenue Romeoville, IL 60446 Phone: (815) 293-0772

Test Date(s):
December 3, 2021 Thru January 22, 2022

Document RP-9563A2 Revisions:

Rev.	Issue Date	Affected Sections	Revised By
0	January 25, 2022		

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1.0 ADMINISTRATIVE DATA

Equipment Under Test: A Westell, Inc., ProtectLink VHF Bi-Directional Amplifier Model: 080-300925; Serial Number: 080-300925-DVT0002 This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: November 19, 2021	*Test Date(s):* December 3, 2021, to January 22, 2022
Test Report Written and Approved By: 01/25/2022 Date Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	*Radiometrics' Personnel Responsible for Test:* Joseph Strzelecki Senior EMC Engineer Chris D'Alessio Senior EMC Technician
Test Witnessed By: The tests were not witnessed by personnel from Westell, Incorporated	
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2.0 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a VHF Bi-Directional Amplifier, Model 080-300925, manufactured by Westell, Inc. The detailed test results are presented in a separate section. The following is a summary of the test results.

Transmitter Requirements

Environmental Phenomena	Frequency Range	FCC KDB 935210 section	Test Result
AGC Threshold	150-174 MHz	4.2	Pass
Out of Band Rejection	102-222 MHz	4.3	Pass
Input vs Output Signal Comparison	150-174 MHz	4.4	Pass
Input/output power and amplifier gain	150-174 MHz	4.5	Pass
Noise figure Measurements	150-174 MHz	4.6	Pass
Out-of-band/out-of-block emissions conducted measurements	150-174 MHz	4.7.2	Pass
EUT spurious emissions conducted measurements	30-2,000 MHz	4.7.3	Pass
Frequency Stability	N/A	4.7	Note 1
Field Strength of Spurious Radiated emissions	30-2,000 MHz	4.9	Pass

Note 1: Test not required since the amplifier/repeater does not translate input signal.

3.0 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a VHF Bi-Directional Amplifier, Model 080-300925, manufactured by Westell, Inc. The RF communications link is encrypted in both directions. The EUT was in good working condition during the tests, with no known defects.

The EUT was tested at 120 VAC 60 Hz input power.
For both the uplink and downlink, the EUT has a frequency range of 150-174 MHz
The EUT has a gain of 85 dB, Power of 30 dBm for the Uplink amplifier
The EUT has a gain of 85 dB, Power of 30 dBm for the Downlink amplifier

4.0 TESTED SYSTEM DETAILS

4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations. The identification for all equipment used in the tested system is:

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	ProtectLink VHF Bi-Directional Amplifier	E	Westell, Inc.	080-300925	080-300925-DVT0002
2	Emergency Services Radio System	S	Westell, Inc.	N/A	N/A

* Type: E = EUT, S = Support Equipment used during radiated emissions testing only

4.2 EUT Operating Modes

The following Modulations were used during the tests:

Designator	Modulation Description
NON	CW; Continuous Wave; No Modulation
4K00F1E	Frequency Modulation; 4 kHz OBW, 6.25 kHz Channel Bandwidth, 1 kHz Freq.
11K3F3E	Frequency Modulation; 11.3 kHz OBW, 12.5 kHz Channel Bandwidth, 1 kHz Freq.
16K0F3E	Frequency Modulation; 16 kHz OBW, 25 kHz Channel Bandwidth, 1 kHz Freq.
6K25F1D	Digital Modulation

4.3 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

5.0 TEST SPECIFICATIONS AND RELATED DOCUMENTS

Document	Date	Title
FCC KDB 935210 D05	2020	Measurements Guidance for Industrial and Non-Consumer Signal VHF Wireless, Repeater, and Amplifier Devices; v01r04
FCC KDB 971168 D01	2018	Measurement Guidance for Certification of Licensed Digital Transmitters v03r01
TIA-603-E	2016	Land Mobile FM or PM Communications Equipment – Measurement and Performance Standards
ANSI C63.26	2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services

6.0 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 2017 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la2.org).

The following is a list of shielded enclosures located in Romeoville, Illinois used during the tests:

Chamber A: Is an anechoic chamber that measures 24' L X 12' W X 12' H. The walls and ceiling are fully lined with ferrite absorber tiles. The floor has a 10' x 10' section of ferrite absorber tiles located in the center. Panashield of Rowayton, Connecticut manufactured the chamber. The enclosure is NAMAS certified.

Chamber B: Is a shielded enclosure that measures 20' L X 12' W X 8' H. Erik A. Lindgren & Associates of Chicago, Illinois manufactured the enclosure.

Chamber E: Is a custom-made anechoic chamber that measures 52' L X 30' W X 18' H. The walls and ceiling are fully lined with RF absorber. Pro-shield of Collinsville, Oklahoma manufactured the chamber.

A separate ten-foot long, brass plated, steel ground rod, attached via a 6-inch copper braid, grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

The FCC has accepted these sites as test site number US1065. The FCC test site Registration Number is 732175. Details of the site characteristics are on file with the Industry Canada as site number IC3124A-1.

7.0 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

8.0 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification. The results relate only to the EUT listed herein. Any modifications made to the EUT subsequent to the indicated test date will invalidate the data and void this certification.

9.0 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
ANT-07	RMC	Log-Periodic Ant.	LP1000	1001	200-1000MHz	24 Mo.	08/11/21
ANT-08	RMC	Log-Periodic Ant.	LP1000	1002	200-1000MHz	24 Mo.	11/15/21
ANT-13	EMCO	Horn Antenna	3115	2502	1.0-18GHz	24 Mo.	01/29/21
ANT-66	ETS-Lindgren	Horn Antenna	3115	62580	1.0-18GHz	24 Mo.	03/11/21
ANT-79	AH Systems	Bicon Antenna	SAS-540	793	20-330MHz	24 Mo.	01/05/21
ANT-80	AH Systems	Bicon Antenna	SAS-540	794	20-330MHz	24 Mo.	01/05/21
ATT-53	Weinschel	Attenuator (20 dB)	23-20-34	CG7857	DC-18 GHz	24 Mo.	10/19/20
ATT-55	Narda	Attenuator (30 dB)	776-30	8901	DC-4 GHz	24 Mo.	01/11/21
ATT-54	Weinschel	Attenuator (20 dB)	34-20-34	BP7085	DC-4 GHz	24 Mo.	04/27/21
CAB-090C	Teledyne	Coaxial Cable	N/A	090C	DC-18 GHz	24 Mo.	01/07/21
CAB-114F	Teledyne	Coaxial Cable	N/A	114F	DC-18 GHz	24 Mo.	02/07/20
CAB-114G	Teledyne	Coaxial Cable	N/A	114G	DC-18 GHz	24 Mo.	02/05/20
CAB-142G	Teledyne	Coaxial Cable	N/A	142G	DC-18 GHz	24 Mo.	02/05/20
CAB-160B	Teledyne	Coaxial Cable	N/A	160B	DC-18 GHz	24 Mo.	02/05/20
CAB-210B	Teledyne	Coaxial Cable	N/A	210B	DC-18 GHz	24 Mo.	02/05/20
CAB-272A	Teledyne	Coaxial Cable	N/A	272A	DC-18 GHz	24 Mo.	01/30/20
CAB-1090	Teledyne	Coaxial Cable	N/A	1090	DC-18 GHz	24 Mo.	02/06/20
COM-02	Mini-Circuits	Combiner/Splitter	ZAPD-30-S	S F627100938	30-3000MHz	24 Mo.	10/29/21
REC-11	Agilent	Spectrum Analyzer	E7405A	US39110103	9kHz-3GHz	24 Mo.	04/16/20
REC-44	Agilent	Spectrum Analyzer	E4440A		9kHz-26.5GHz	24 Mo.	02/25/20
SIG-30	Rohde Schwarz	Signal Generator	SMC100A	102914	9k-3.2GHz	24 Mo.	12/18/20
SIG-32	Agilent	Vector Signal Generator	E4432B	US400053716	250kHz-3GHz	24 Mo.	10/14/21
SIG-33	Agilent	Vector Signal Generator	E4438C	MY45094643	250kHz-3GHz	24 Mo.	09/01/20
THM-02	Fluke	Temp/Humid Meter	971	93490471	N/A	24 Mo.	11/13/20

Note: All calibrated equipment is subject to periodic checks.
NCR – No Calibration Required. Device monitored by calibrated equipment. N/A: Not Applicable.

9.1 Test Software

Software Company	Test Software Name	Version	Applicable Tests
Radiometrics	REREC11D	07.16.19	RF Radiated Emissions (ISED; FCC Part 15)
Agilent	PSA/ESA-E/L/EMC	2.4.0.42	Bandwidth and screen shots

10.0 TEST SECTIONS

The following sections are the detailed results in accordance with FCC KDB 935210 D05.

11.0 AGC THRESHOLD

11.1 Applicable Standard

The EUT shall comply with FCC KDB 935210 section 4.2.

11.2 Test procedures

a) A signal generator was connected to the input of the EUT.
b) A power meter was connected to the output of the EUT using an external 20 dB attenuator.
c) A signal generator was initially configured to produce a CW signal
d) The signal generator frequency was set to the center frequency of the EUT operating band.
e) While monitoring the output power of the EUT, measured using the methods of 3.5.3 of KDB 935210, the input level was increased until a 1 dB increase in the input signal power no longer causes a 1 dB increase in the output signal power.
f) This level was recorded as the AGC threshold level.
g) The procedure was repeated with the remaining test signal bands.

11.2.1 AGC Threshold Test Results

Model	080-300925	Specifications	FCC KDB 935210 D05 Sec. 4.2
Serial Number	080-300925-DVT0002	Test Date	01/20/2022
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-21)		

Modulation	Path	Generator Output MHz	Generator Output dBm	Uncorrected Reading dBm	Output Change dB	Output Power dBm
CW	Uplink	162.5	-50.0	5.20	N/A	25.20
CW	Uplink	162.5	-49.0	6.20	1.0	26.20
CW	Uplink	162.5	-48.0	7.20	1.0	27.20
CW	Uplink	162.5	-47.0	7.50	0.3	27.50
CW	Uplink	162.5	-46.0	7.10	-0.4	27.10
CW	Downlink	162.5	-48.0	8.0	N/A	28.0
CW	Downlink	162.5	-47.0	9.0	1.0	29.0
CW	Downlink	162.5	-46.0	10.0	1.0	30.0
CW	Downlink	162.5	-45.0	10.5	0.5	30.5
CW	Downlink	162.5	-44.0	9.9	-0.6	29.9
CW	Downlink	162.5	-43.0	9.8	-0.1	29.8

The Highlighted cells are the AGC Threshold.

12.0 OUT OF BAND REJECTION

12.1 Applicable Standard

The EUT shall comply with sections 4.3 of FCC KDB 935210 for passband gain.

12.2 Test Procedures

The internal gain control of the EUT was adjusted to the maximum gain for which equipment certification is sought.
a) A signal generator was connected to the input of the EUT.
b) The swept CW signal was configured with the following parameters:
1) The frequency range was set to ± 250 % of the manufacturer's specified pass band.
2) The CW amplitude was 3 dB below the AGC threshold and did not activate the AGC threshold throughout the test.
3) Dwell time = approximately 10 mS.
4) Frequency step = 50 kHz.

c) A spectrum analyzer was connected to the output of the EUT using appropriate attenuation.
d) The RBW of the spectrum analyzer was set to between 1 % and 5 % of the manufacturer's rated passband, and VBW = 3 × RBW.
e) The detector was set to Peak and the trace to Max-Hold.
f) After the trace was completely filled, a marker was placed at the peak amplitude, which is designated as f0, and with two additional delta markers at the 20 dB bandwidth (where the level has fallen by 20 dB).
g) The frequency response plot was captured for inclusion herein.

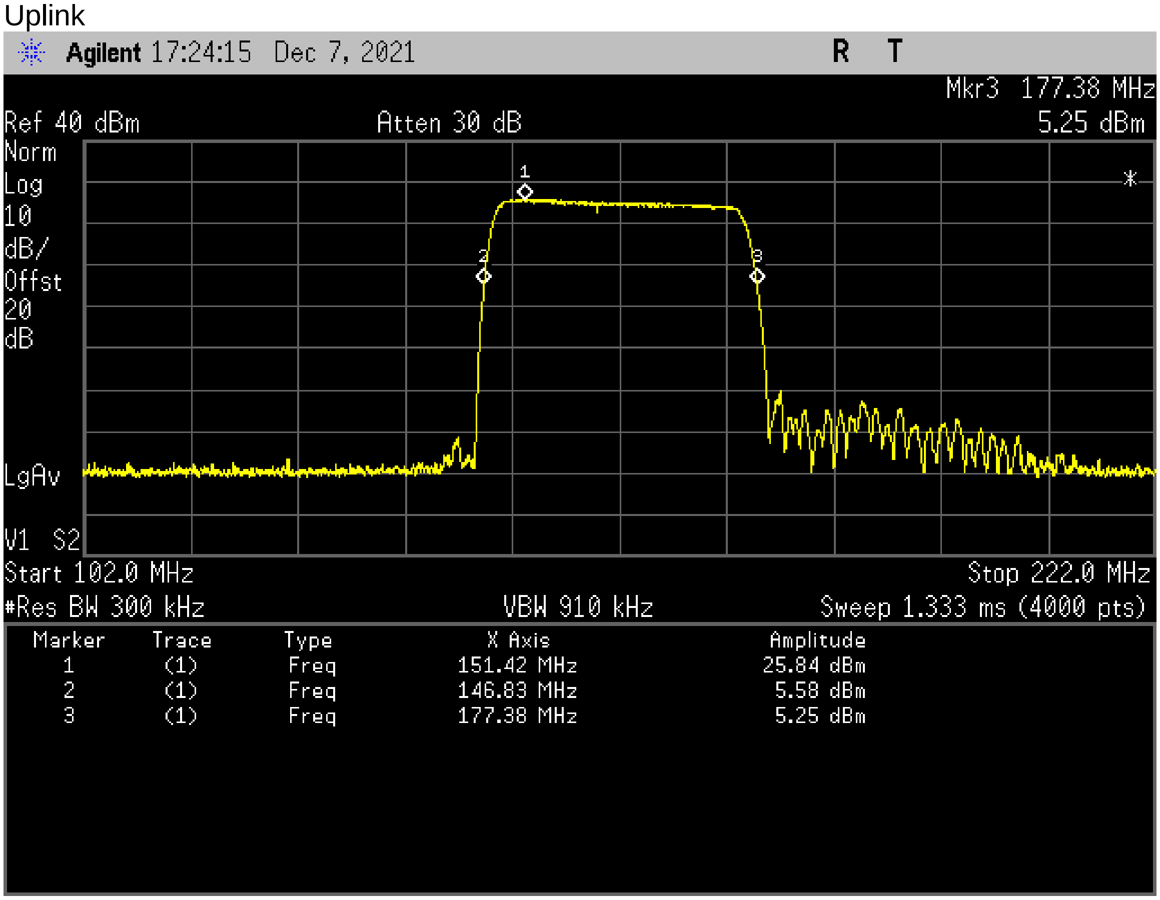
12.3 Passband Bandwidth Test Results

Model	080-300925	Specification	KDB 935210 D05 Sec 4.3
Serial Number	080-300925-DVT0002	Test Date	12/07/2021
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-21)		

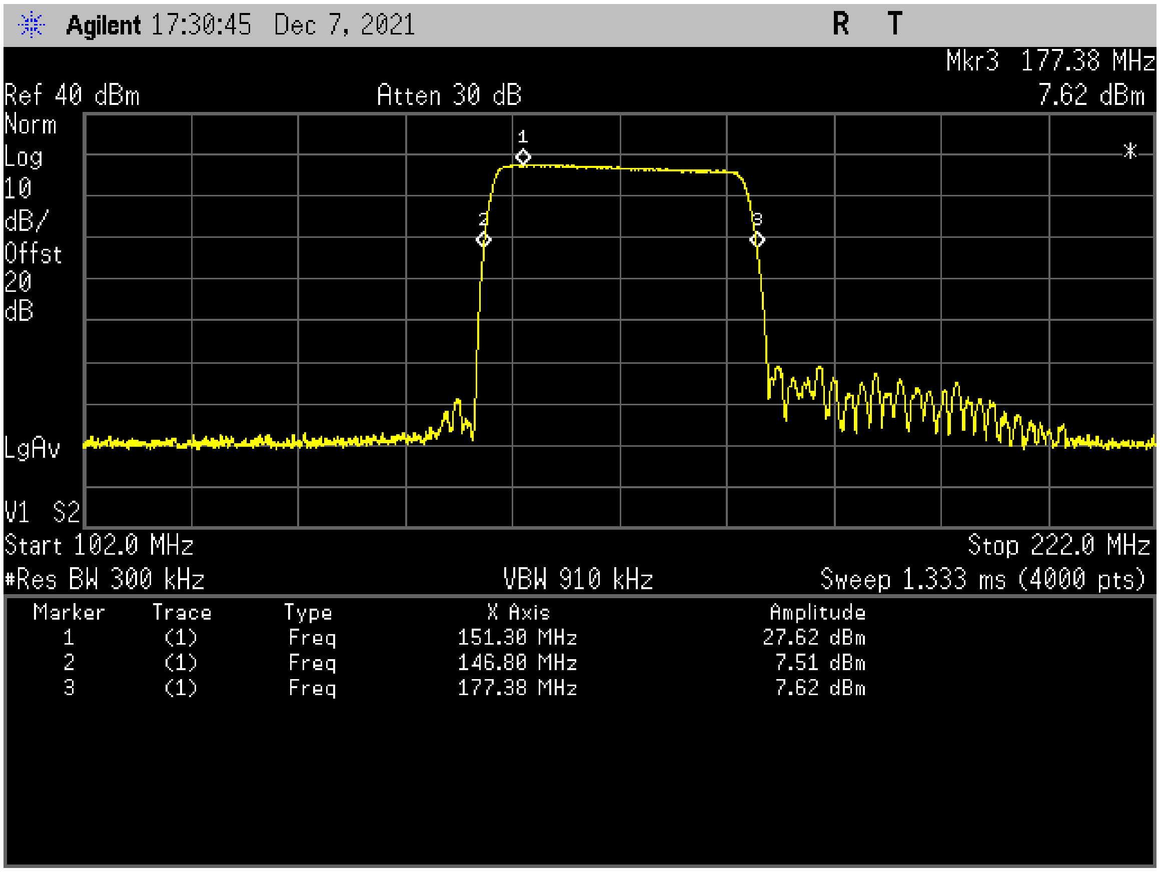
Band	RBW MHz	VBW MHz	Band in MHz	20 dB Down 1st Freq. MHz	20 dB Down 2nd Freq. MHz	20 dB BW MHz	Max Reading F0 MHz	Max Reading dBm
Uplink	0.3	1.0	150 to 174	146.83	177.38	30.55	151.42	25.8
Downlink	0.3	1.0	150 to 174	146.8	177.38	30.58	151.30	27.6

The above data shows the additional marker data from the plots below.

Uplink



Downlink



13.0 INPUT VS OUTPUT SIGNAL COMPARISON

13.1 Applicable Standard

The EUT shall comply with FCC KDB 935210 section 4.4.

13.2 Test procedures

A 26 dB bandwidth measurement was performed on the input signal and the output signal.

Refer to the applicable regulatory requirements (e.g., § 90.210) for emission mask specifications.
a) A signal generator was connected to the input of the EUT.
b) The signal generator was configured to transmit the appropriate test signal associated with the public safety emission designation (see Table 1).
c) The signal level was configured to be just below the AGC threshold (see results from 4.2).
d) A spectrum analyzer was connected to the output of the EUT using appropriate attenuation, as necessary.
e) The spectrum analyzer center frequency was set to the nominal EUT channel center frequency. The span range for the spectrum analyzer was between 2 times to 5 times the EBW (or OBW).
f) The nominal RBW was 300 Hz for 16K0F3E, and 100 Hz for all other emission types.
g) The reference level of the spectrum analyzer was set to accommodate the maximum input amplitude level, i.e., the level at f0 per 4.2.
h) The spectrum analyzer detection mode was set to peak, and trace mode to max hold.
i) The trace was allowed to fully stabilize.
j) The signal was confirmed to be contained within the appropriate emissions mask.
k) The marker function was used to determine the maximum emission level and record the associated frequency as f0.

l) The emissions mask plot was captured for inclusion in the test report (output signal spectra).
m) The EUT input signal power (signal generator output signal) was measured directly from the signal generator using power measurement guidance provided in KDB Publication 971168 [R8] (input signal spectra).
n) The spectral plot of the output signal (determined in step k) was compared to the input signal (determined in step l) to affirm they are similar (in passband and roll off characteristic features and relative spectral locations).
o) Steps d) to n) were repeated with the input signal amplitude set 3 dB above the AGC threshold.
p) Steps b) to o) were repeated for all authorized operational bands and emission types (see applicable regulatory specifications, e.g., § 90.210).
q) All accumulated spectral plots depicting EUT input signal and EUT output signal were included in the test report and noted any observed dissimilarities.

13.2.1 Input Vs Output Test Results

Model	080-300925	Specifications	FCC KDB 935210 D05 Sec. 4.4
Serial Number	080-300925-DVT0002	Test Date	01/22/2022
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-21 & REC-11)		

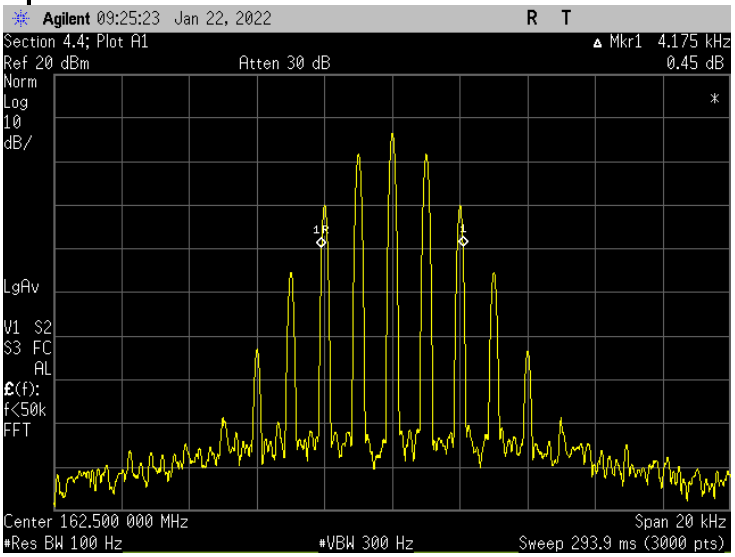
Output Mode	Modul. Type	Plot #	Generator Settings with 20 dB Att. MHz	dBm	Channel BW kHz	Analyzer RBW Hz	VBW Hz	Test Port	26 dB BW Reading MHz	EUT AGC Mode
Generator	4K00F1E	A1	162.5	8.5	4	100	300	Generator	4.175	N/A
Uplink	4K00F1E	A2	162.5	-46.5	4	100	300	Amp Out	4.175	Below
Uplink	4K00F1E	A3	162.5	-43.5	11	100	300	Amp Out	4.175	ON+3
Generator	11K3F3E	A4	162.5	7.5	11	100	300	Generator	14.121	N/A
Uplink	11K3F3E	A5	162.5	-46.5	16	100	300	Amp Out	14.121	Below
Uplink	11K3F3E	A6	162.5	-43.5	16	100	300	Amp Out	14.121	ON+3
Generator	16K0F3E	A7	162.5	8.5	16	300	1000	Generator	20.323	N/A
Uplink	16K0F3E	A8	162.5	-46.5	16	300	1000	Amp Out	20.323	Below
Uplink	16K0F3E	A9	162.5	-43.5	11	300	1000	Amp Out	20.323	ON+3
Generator	6K25F1D	A10	162.5	8.5	4	100	300	Generator	10.237	N/A
Uplink	6K25F1D	A11	162.5	-46.5	4	100	300	Amp Out	10.303	Below
Uplink	6K25F1D	A12	162.5	-43.5	4	100	300	Amp Out	10.237	ON+3
Downlink	4K00F1E	A13	162.5	-44.5	4	100	300	Amp Out	4.175	Below
Downlink	4K00F1E	A14	162.5	-41.5	11	100	300	Amp Out	4.175	ON+3
Downlink	11K3F3E	A15	162.5	-44.5	16	100	300	Amp Out	14.121	Below
Downlink	11K3F3E	A16	162.5	-41.5	16	100	300	Amp Out	14.121	ON+3
Downlink	16K0F3E	A17	162.5	-44.5	16	300	1000	Amp Out	20.323	Below
Downlink	16K0F3E	A18	162.5	-41.5	11	300	1000	Amp Out	20.323	ON+3
Downlink	6K25F1D	A19	162.5	-44.5	4	100	300	Amp Out	10.287	Below
Downlink	6K25F1D	A20	162.5	-41.5	4	100	300	Amp Out	10.437	ON+3

The generator output signal is the amplifier input.

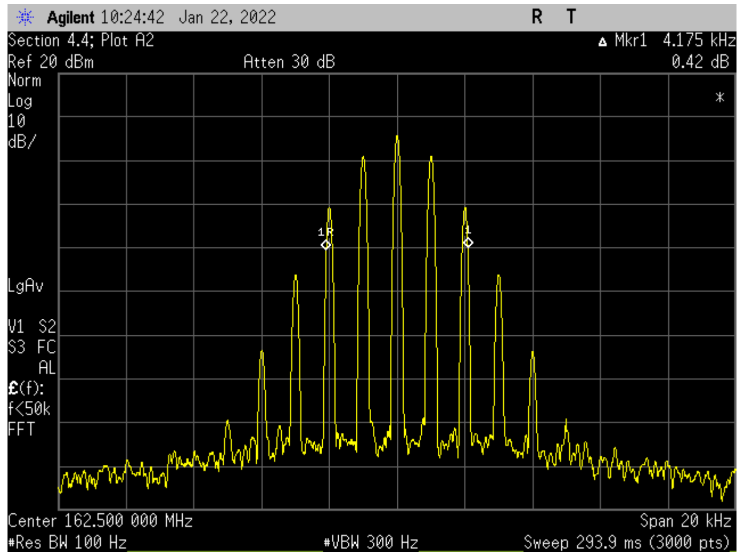
The Generator plots were not repeated for the down link, since they are the same as the up link

13.2.1.1 Occupied Bandwidth Results

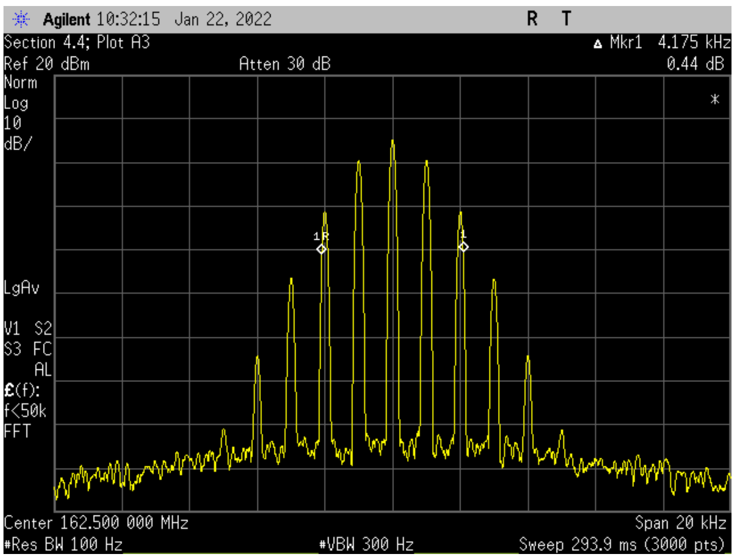
Uplink results



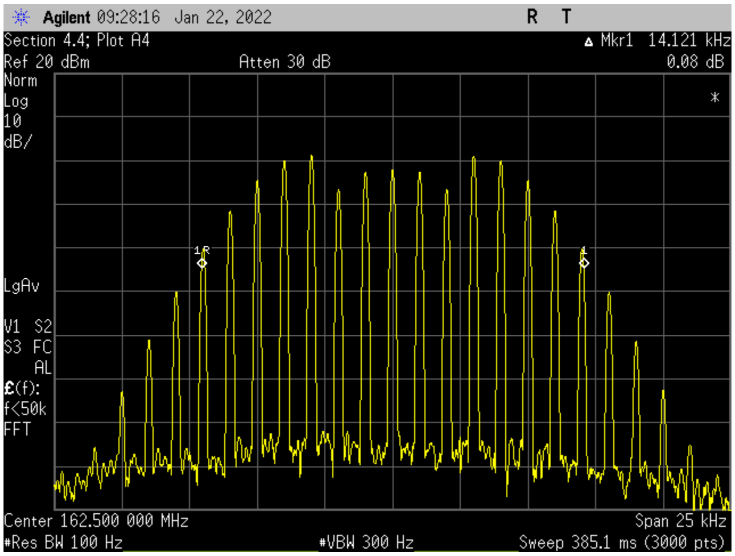
Input Signal to Amp; 4K00F1E



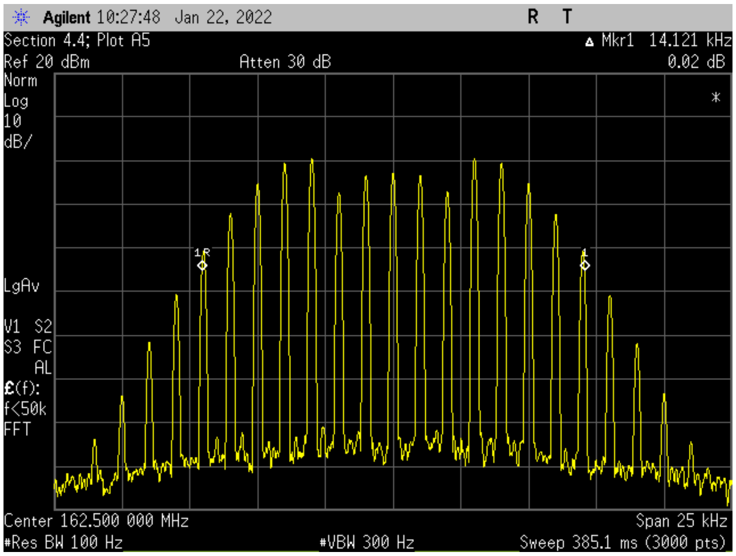
AMP Output: Below AGC, 4K00F1E



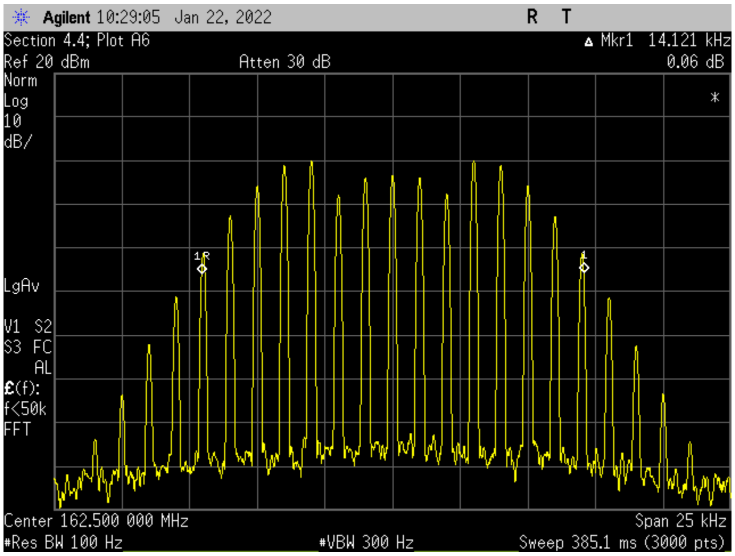
AMP Output: Level Above AGC, 4K00F1E



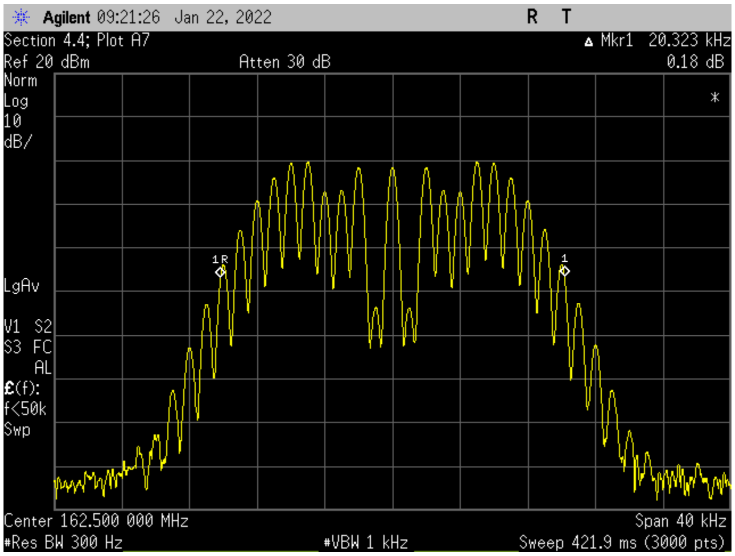
Input Signal to Amp; 11K3F3E



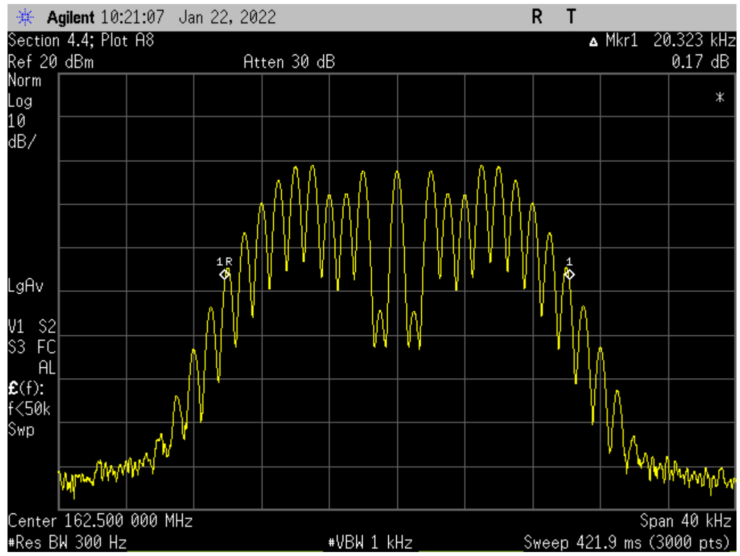
AMP Output: Below AGC; 11K3F3E



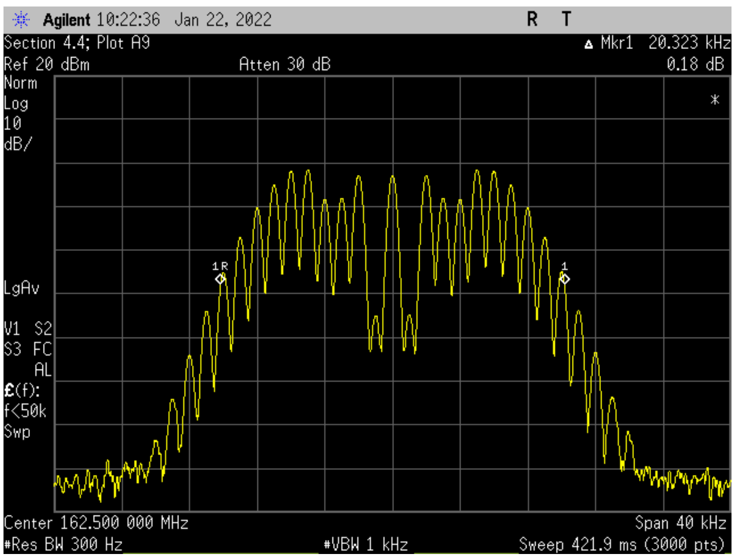
AMP Output: Level Above AGC; 11K3F3E



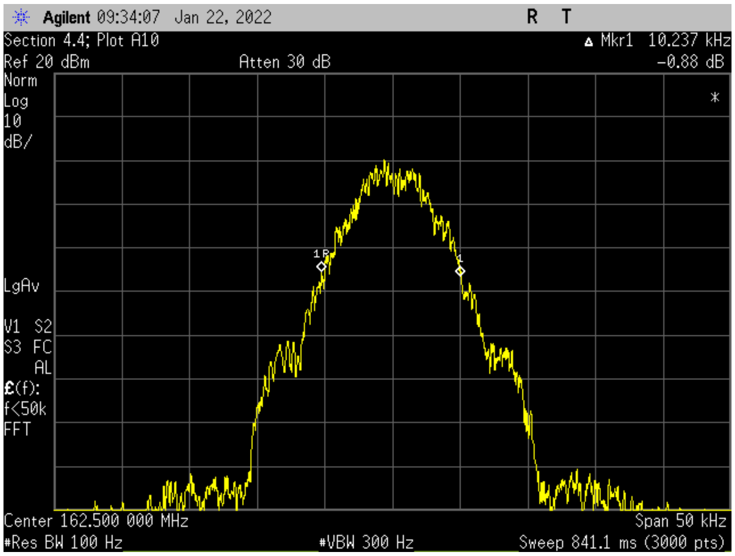
Input Signal to Amp; 16K0F3E



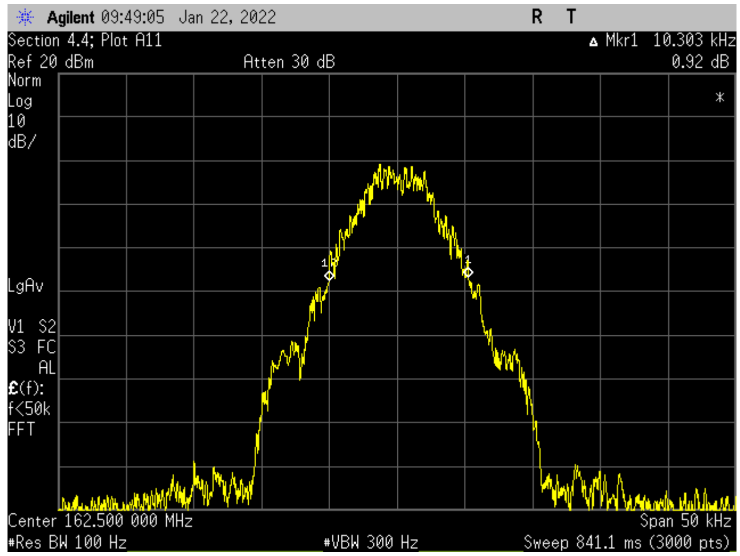
Amp output, Below AGC; 16K0F3E



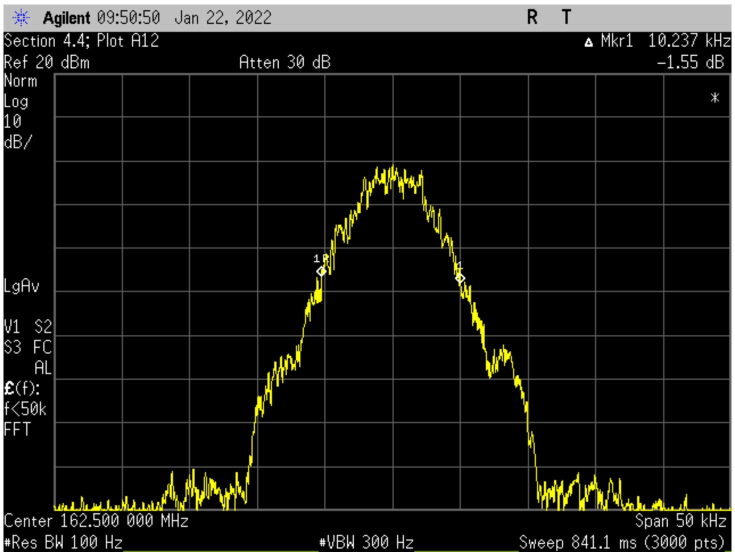
AMP Output: Level Above AGC; 16K0F3E



Input Signal to Amp; 300 Hz, 6K25F1D

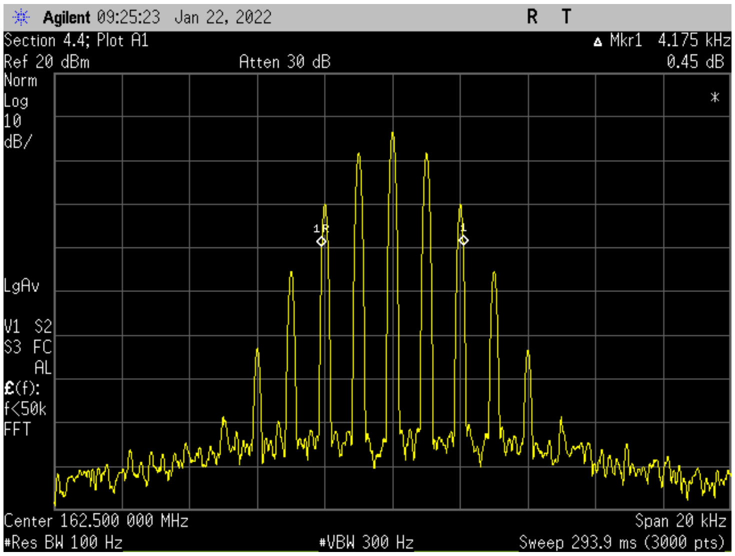


Amp output, Below AGC, 6K25F1D

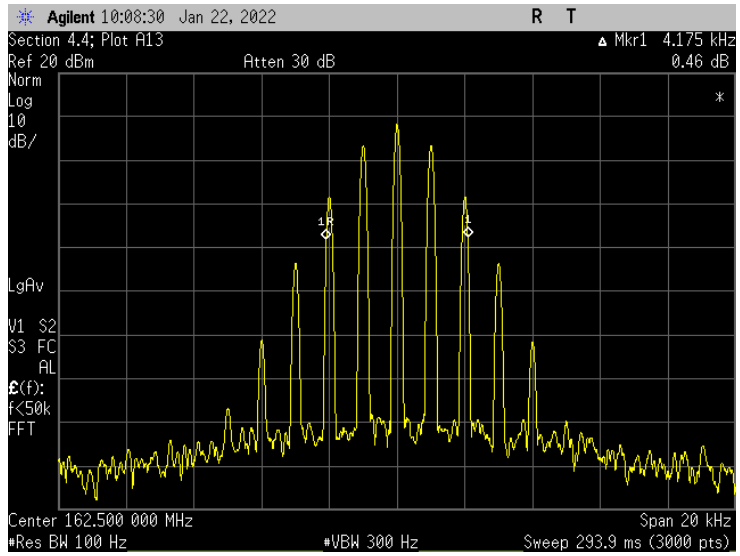


AMP Output: Level above AGC; 6K25F1D

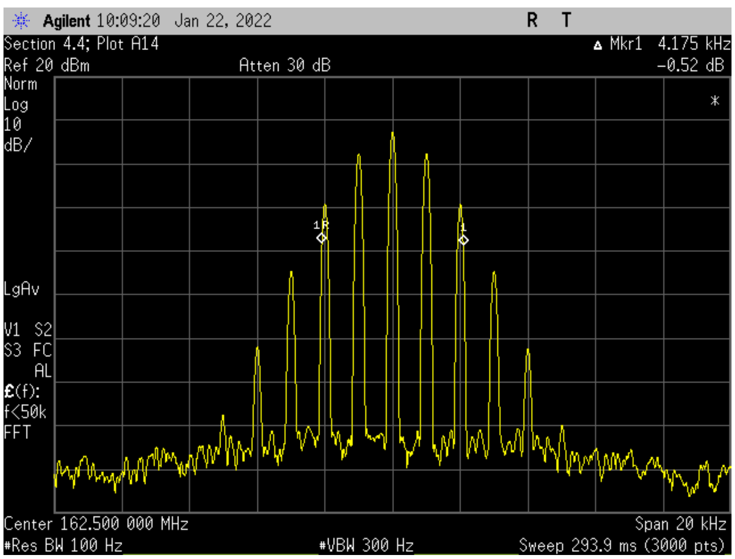
Downlink results



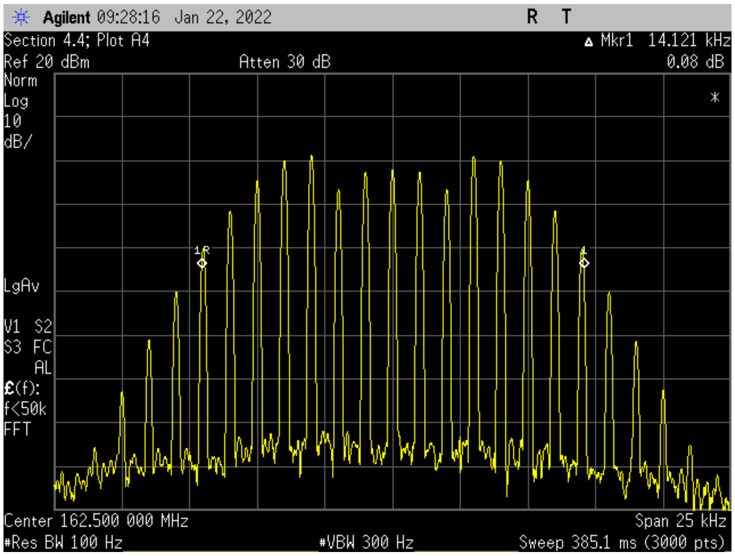
Input Signal to Amp; 4K00F1E



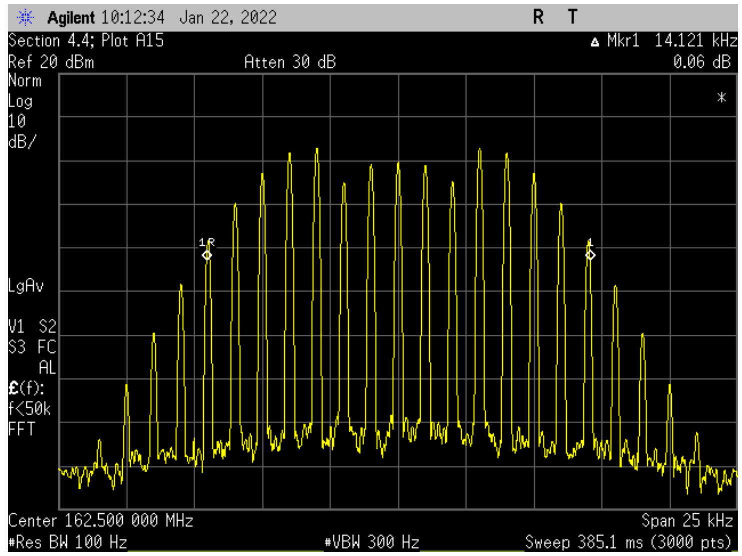
AMP Output: Below AGC, 4K00F1E



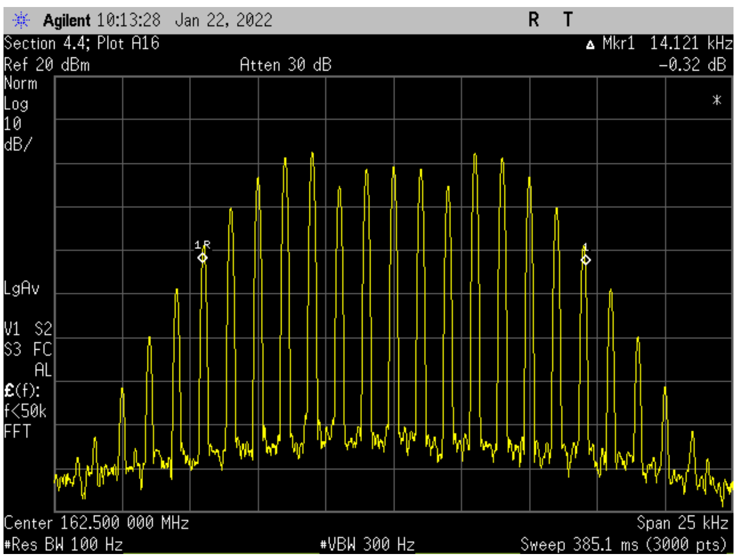
AMP Output: Level above AGC; 4K00F1E



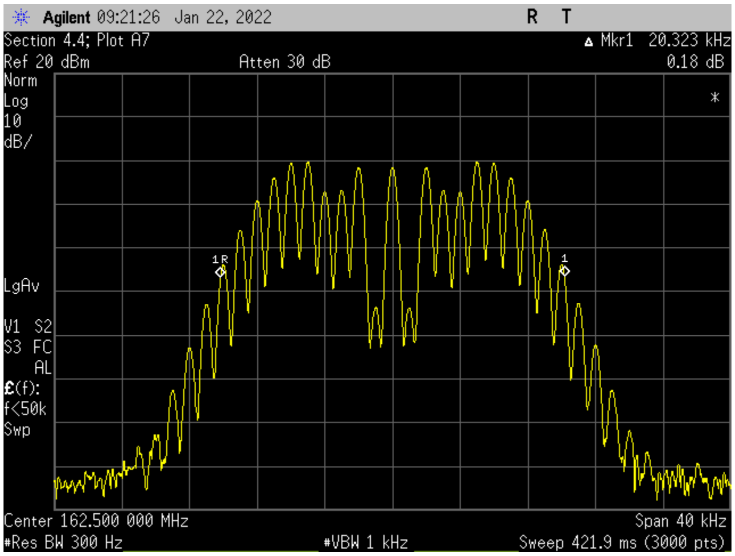
Input Signal to Amp; 11K3F3E



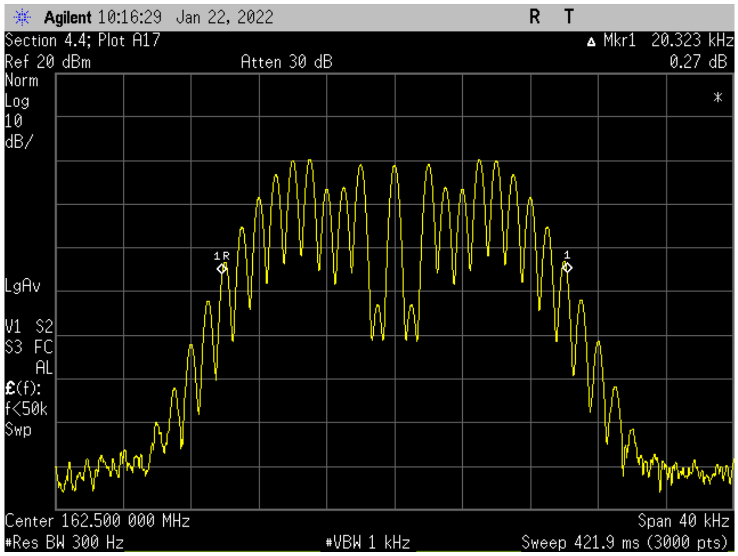
AMP Output: Below AGC, 11K3F3E



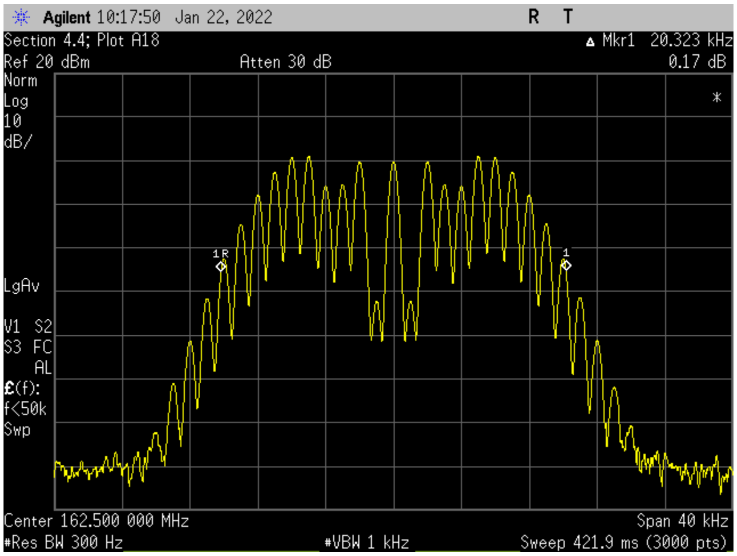
AMP Output: Level above AGC; 11K3F3E



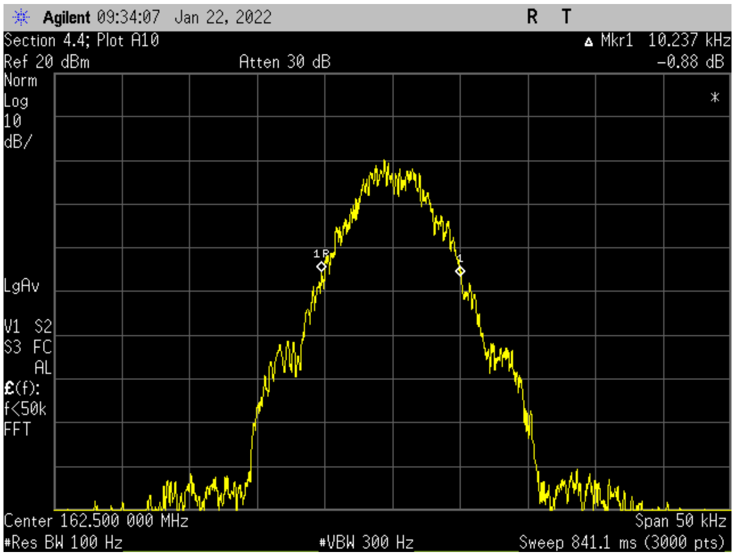
Input Signal to Amp; 16K0F3E



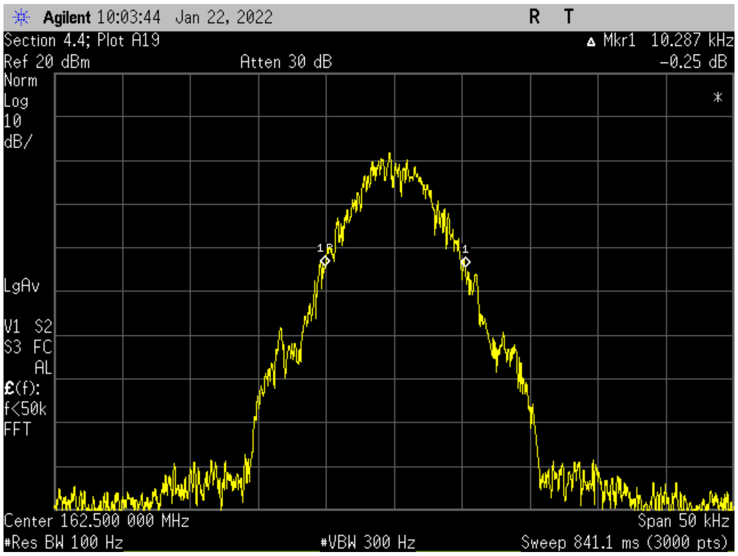
AMP Output: Below AGC, 16K0F3E



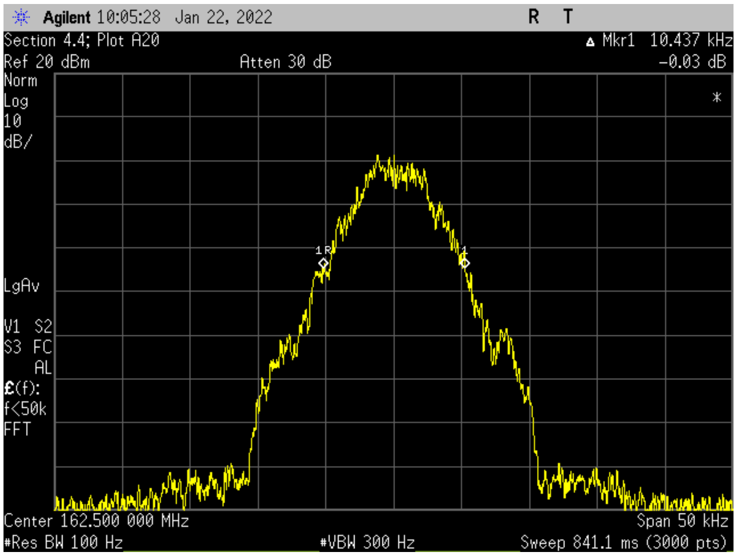
AMP Output: Level above AGC; 16K0F3E



Input Signal to Amp; 6K25F1D



AMP Output: Below AGC, 6K25F1D



AMP Output: Level above AGC; 6K25F1D

Judgement: Pass

13.2.1.2 Emissions Masks per 90.210

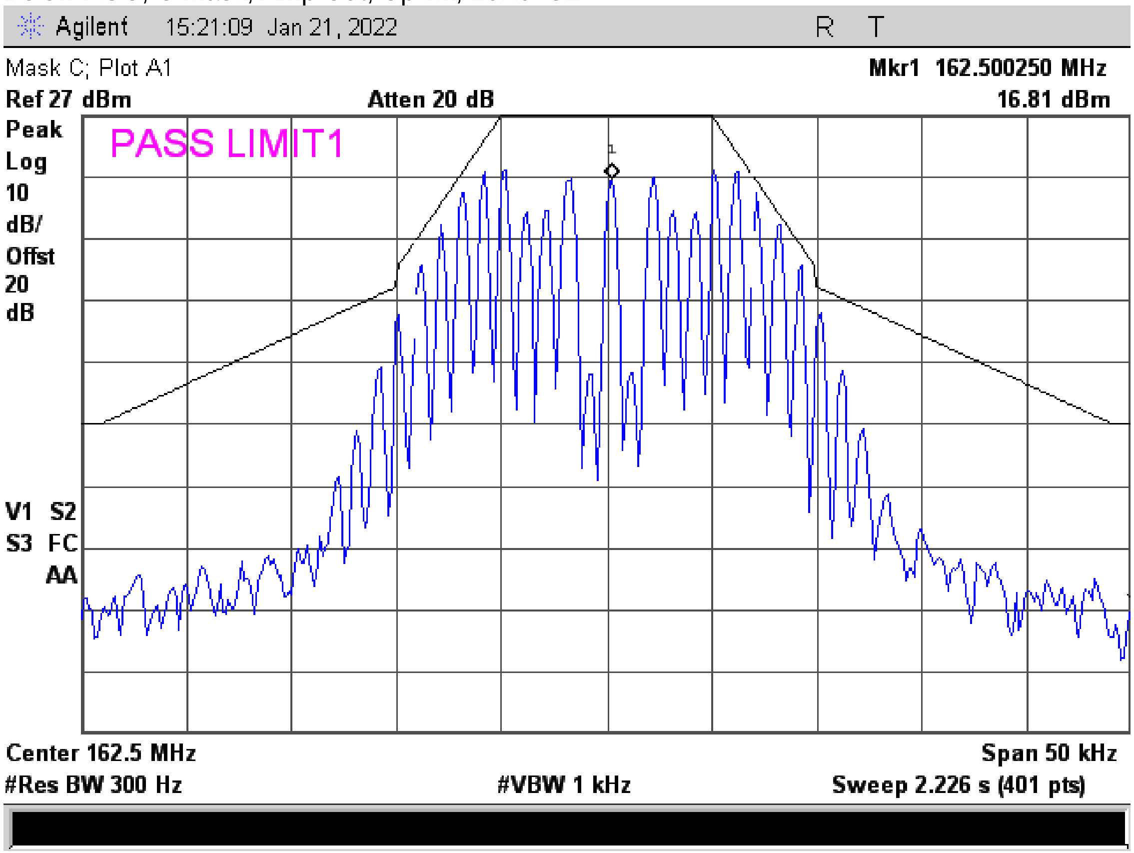
Model	080-300925	Specifications	FCC KDB 935210 D05 Sec. 4.4
Serial Number	080-300925-DVT0002	Test Date	01/21/20222
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-11); ATT-54; SIG-33		

Output	Mod. Type	EUT AGC Mode	Plot #	Generator Output MHz	Generator Setting dBm	Mask	Settings RBW Hz	Span kHz	REC Ref level dBm	Test Date
Uplink	16KE	Below	A1	162.5	-46.5	C	300	50	27	01/21/2022
Uplink	16KE	ON+3	A2	162.5	-43.5	C	300	50	27	01/21/2022
Uplink	4KE	Below	A3	162.5	-46.5	E	100	20	27	01/21/2022
Uplink	4KE	ON+3	A4	162.5	-43.5	E	100	20	27	01/21/2022
Uplink	6KD	Below	A5	162.5	-46.5	D	100	50	27	01/21/2022
Uplink	6KD	ON+3	A6	162.5	-43.5	D	100	50	27	01/21/2022
Uplink	11KE	Below	A7	162.5	-46.5	D	100	50	27	01/21/2022
Uplink	11KE	ON+3	A8	162.5	-43.5	D	100	50	27	01/21/2022
Downlink	16KE	Below	A9	162.5	-44.5	C	300	50	30	01/21/2022
Downlink	16KE	ON+3	A10	162.5	-41.5	C	300	50	30	01/21/2022
Downlink	4KE	Below	A11	162.5	-44.5	E	100	20	30	01/21/2022
Downlink	4KE	ON+3	A12	162.5	-41.5	E	100	20	30	01/21/2022
Downlink	6KD	Below	A13	162.5	-44.5	D	100	50	30	01/21/2022
Downlink	6KD	ON+3	A14	162.5	-41.5	D	100	50	30	01/21/2022
Downlink	11KE	Below	A15	162.5	-44.5	D	100	50	30	01/21/2022
Downlink	11KE	ON+3	A16	162.5	-41.5	D	100	50	30	01/21/2022
GEN	16KE	N/A	A17	162.5	7	C	300	50	27	01/21/2022
GEN	4KE	N/A	A18	162.5	7	E	100	20	27	01/21/2022
GEN	6KD	N/A	A19	162.5	7.5	D	100	50	27	01/21/2022
GEN	11KE	N/A	A20	162.5	7	D	100	50	27	01/21/2022

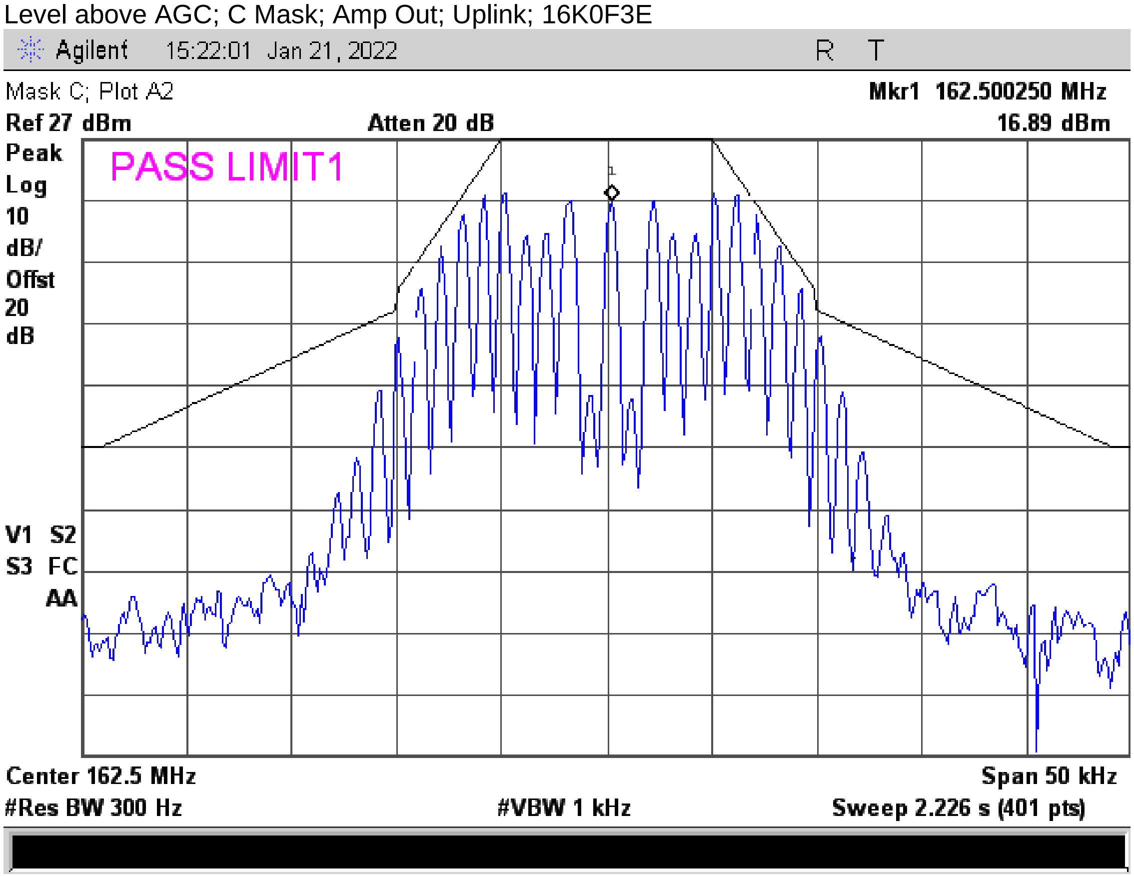
GEN = Generator output or Amp input

Modulation	Abbreviation
4K00F1E	4KE
11K3F3E	11KE
16K0F3E	16KE
6K25F1D	6KD

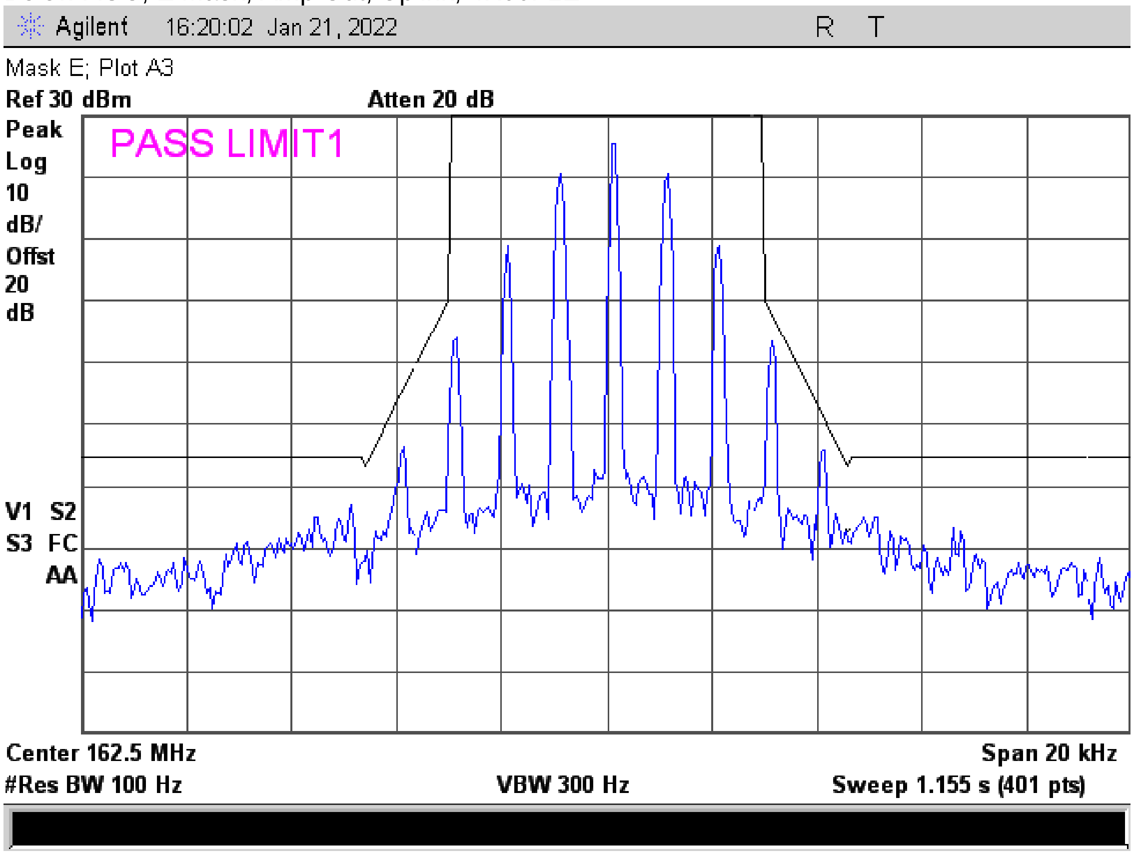
Below AGC; C Mask; Amp Out; Uplink; 16K0F3E



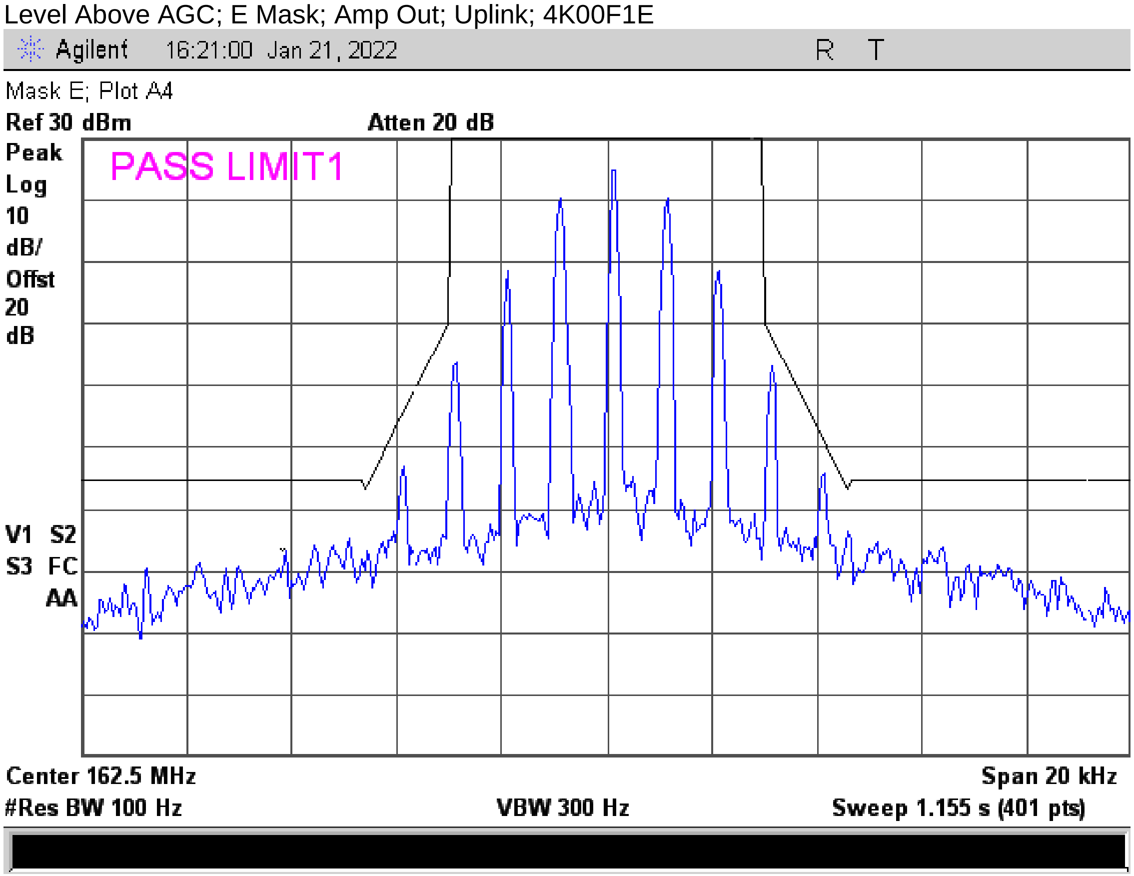
Level above AGC; C Mask; Amp Out; Uplink; 16K0F3E



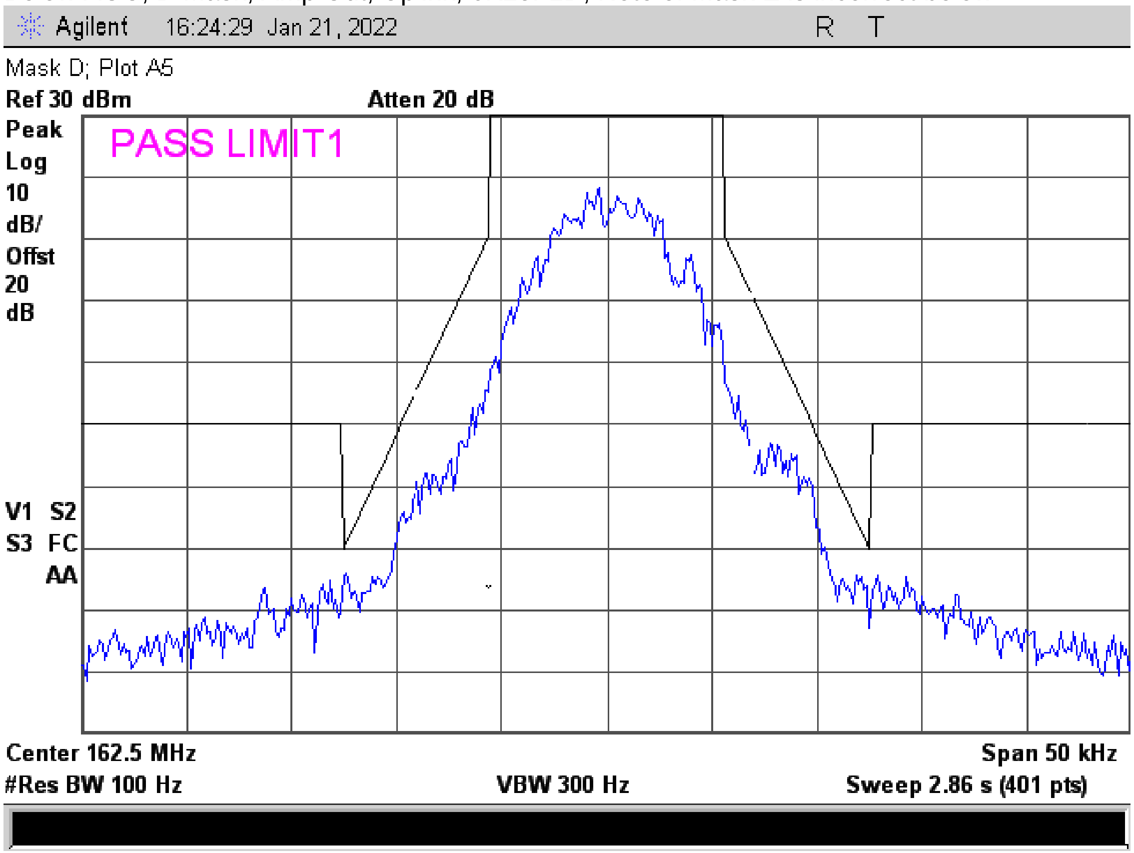
Below AGC; E Mask; Amp Out; Uplink; 4K00F1E



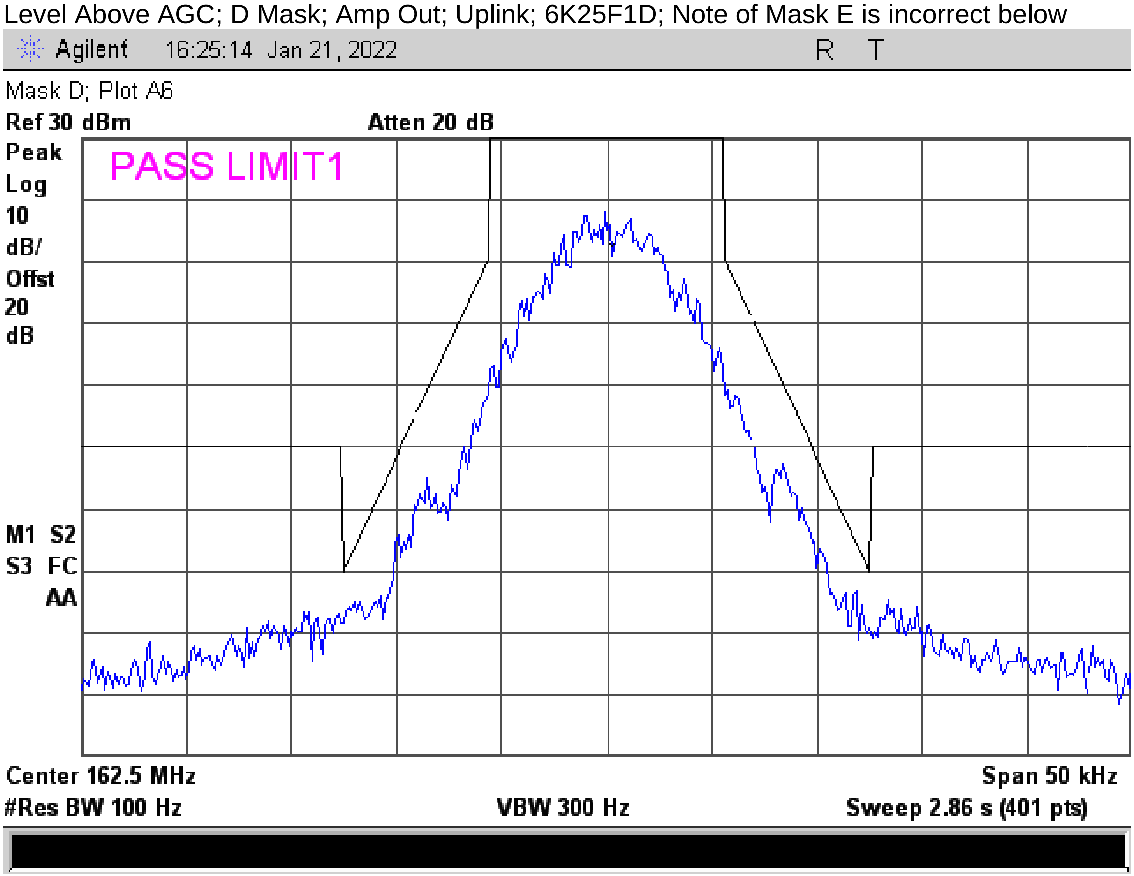
Level Above AGC; E Mask; Amp Out; Uplink; 4K00F1E



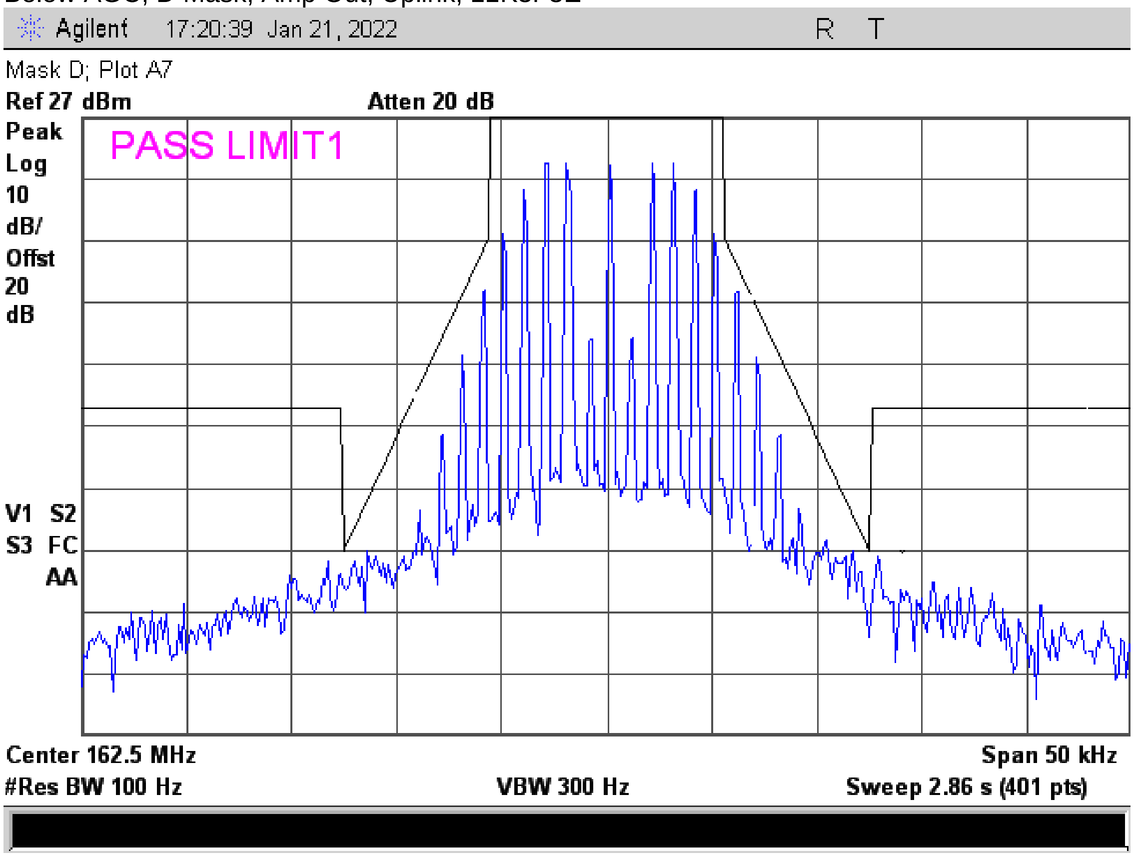
Below AGC; D Mask; Amp Out; Uplink; 6K25F1D; Note of Mask E is incorrect below



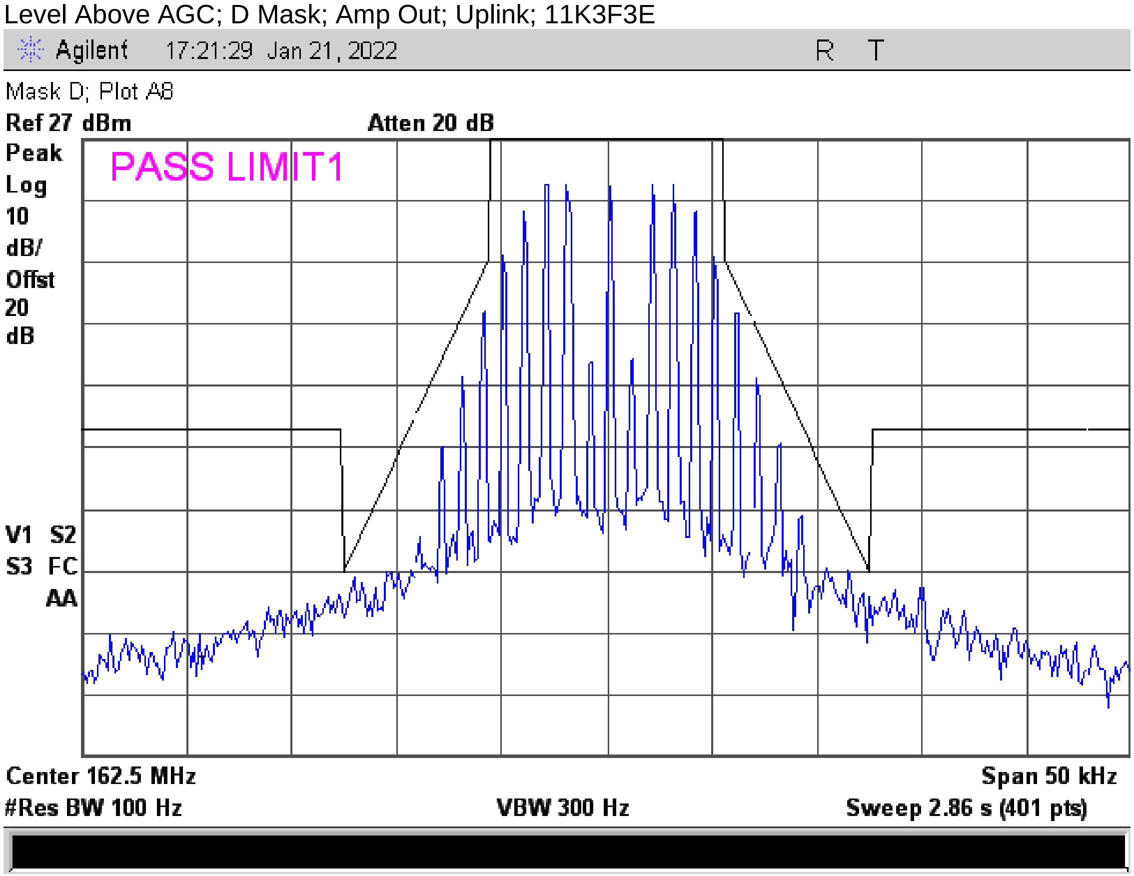
Level Above AGC; D Mask; Amp Out; Uplink; 6K25F1D; Note of Mask E is incorrect below



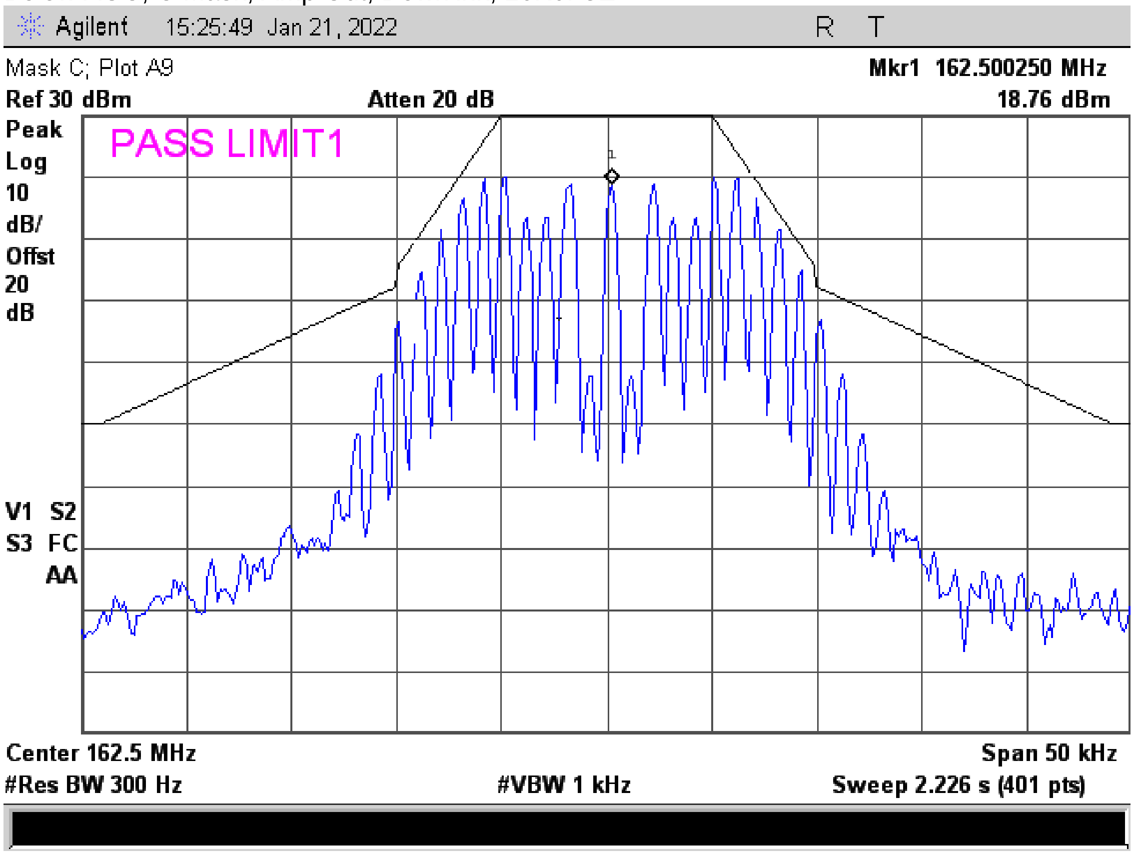
Below AGC; D Mask; Amp Out; Uplink; 11K3F3E



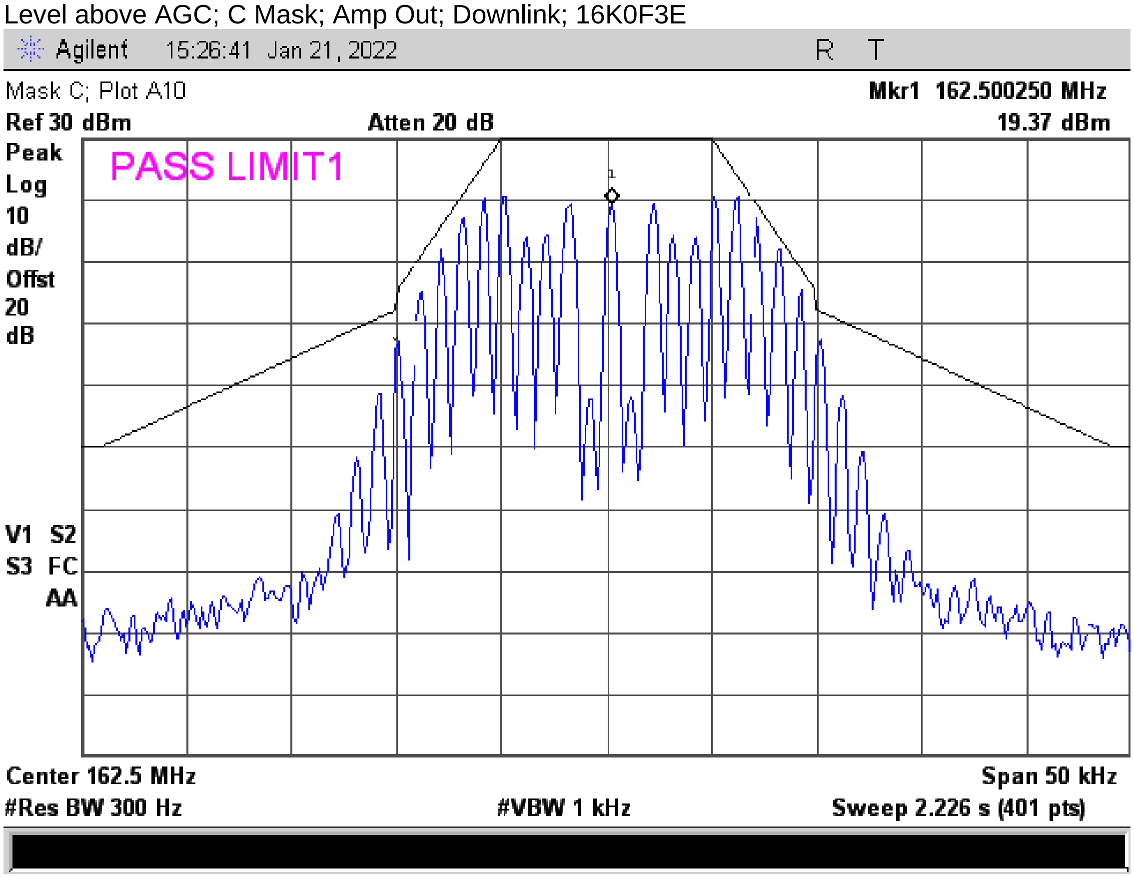
Level Above AGC; D Mask; Amp Out; Uplink; 11K3F3E



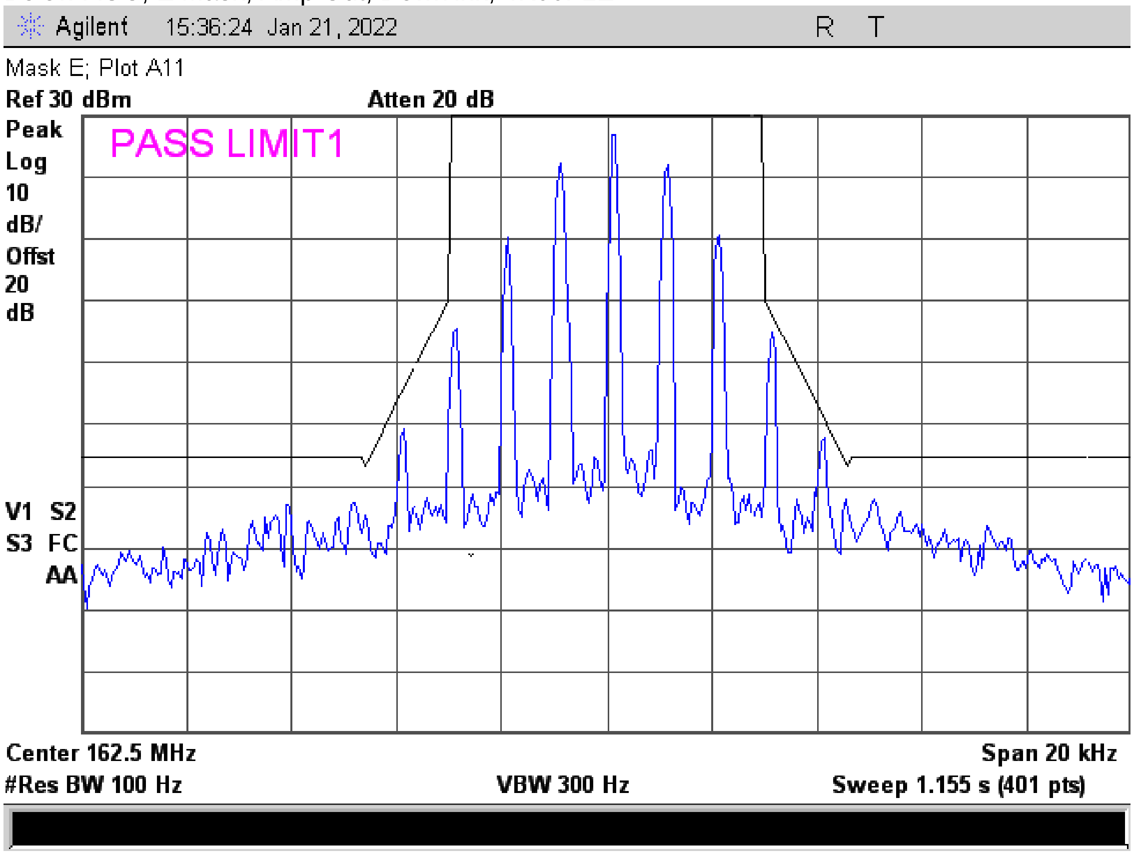
Below AGC; C Mask; Amp Out; Downlink; 16K0F3E



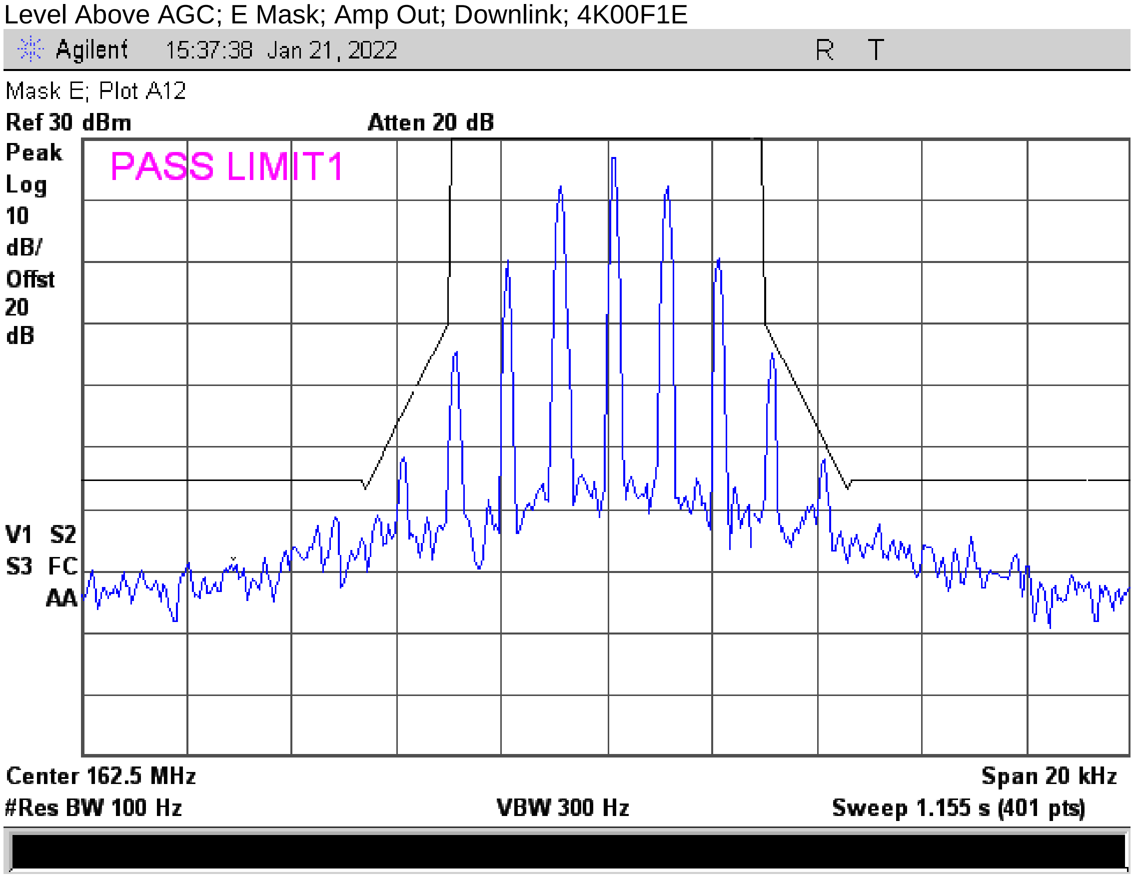
Level above AGC; C Mask; Amp Out; Downlink; 16K0F3E



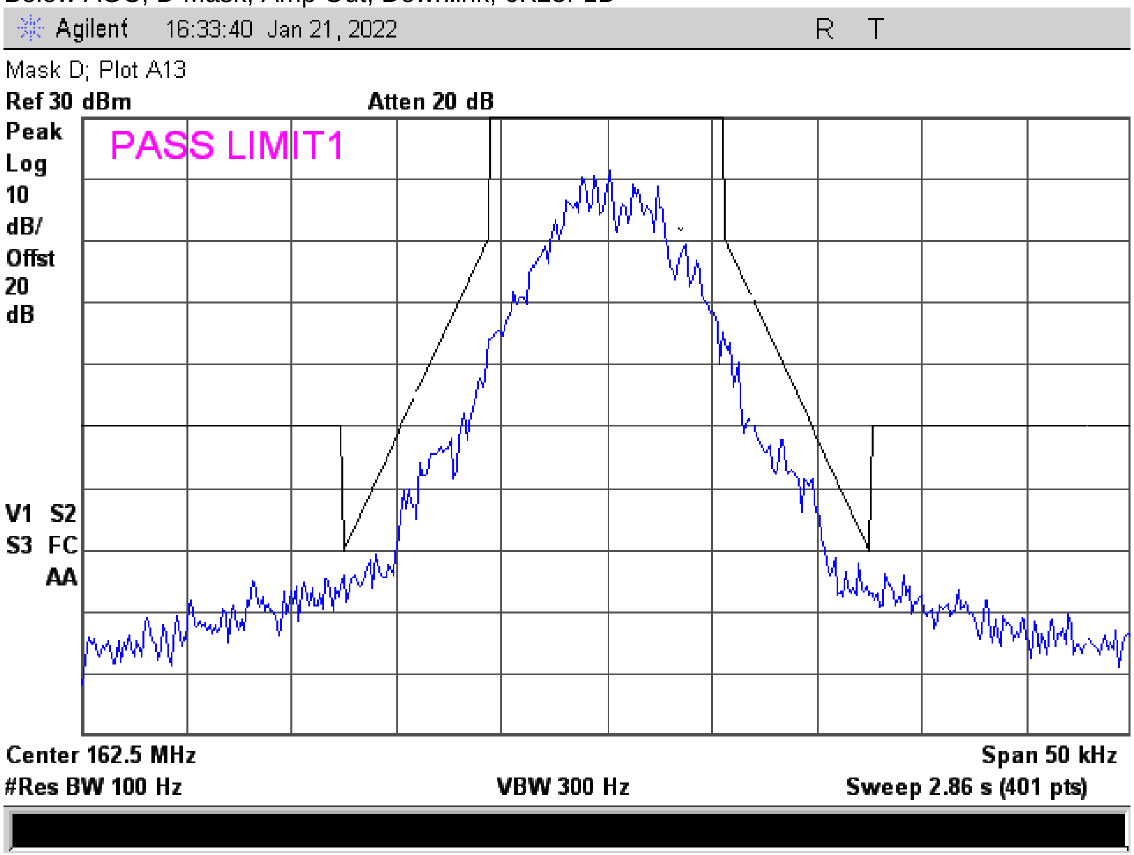
Below AGC; E Mask; Amp Out; Downlink; 4K00F1E



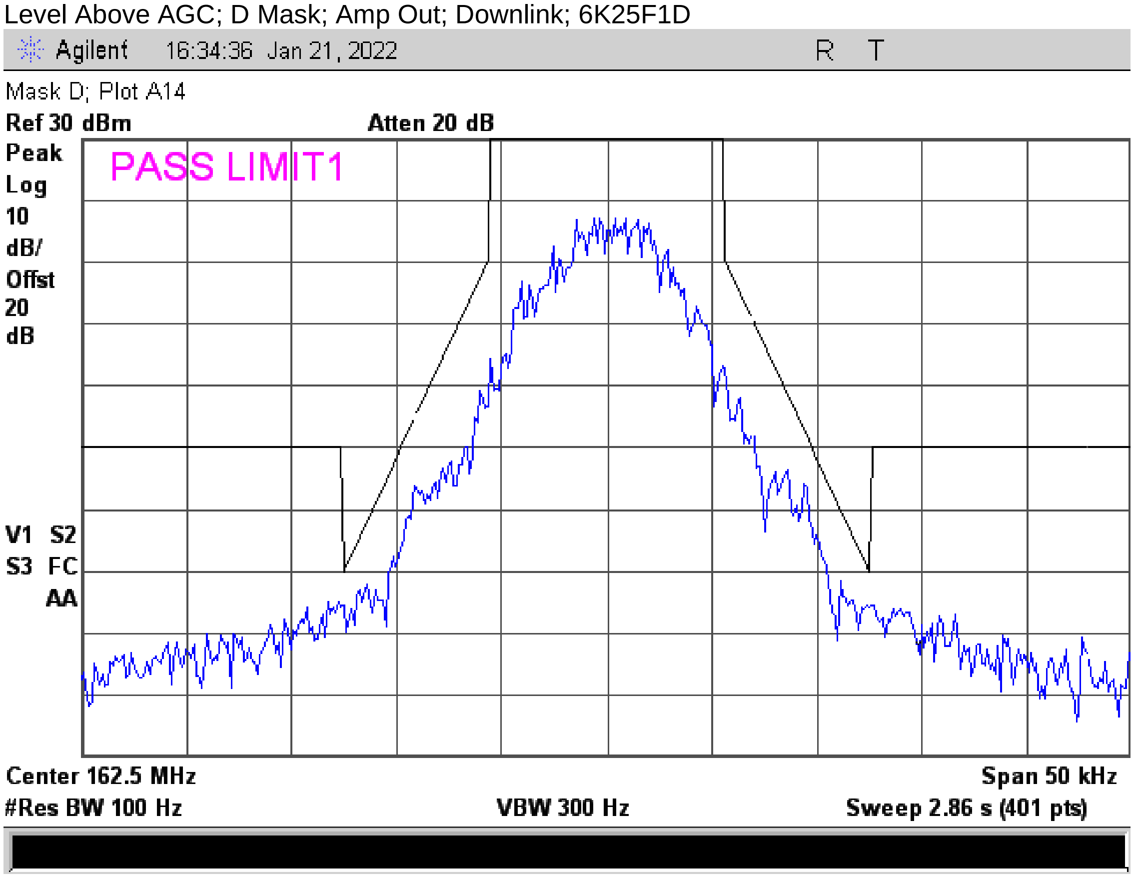
Level Above AGC; E Mask; Amp Out; Downlink; 4K00F1E



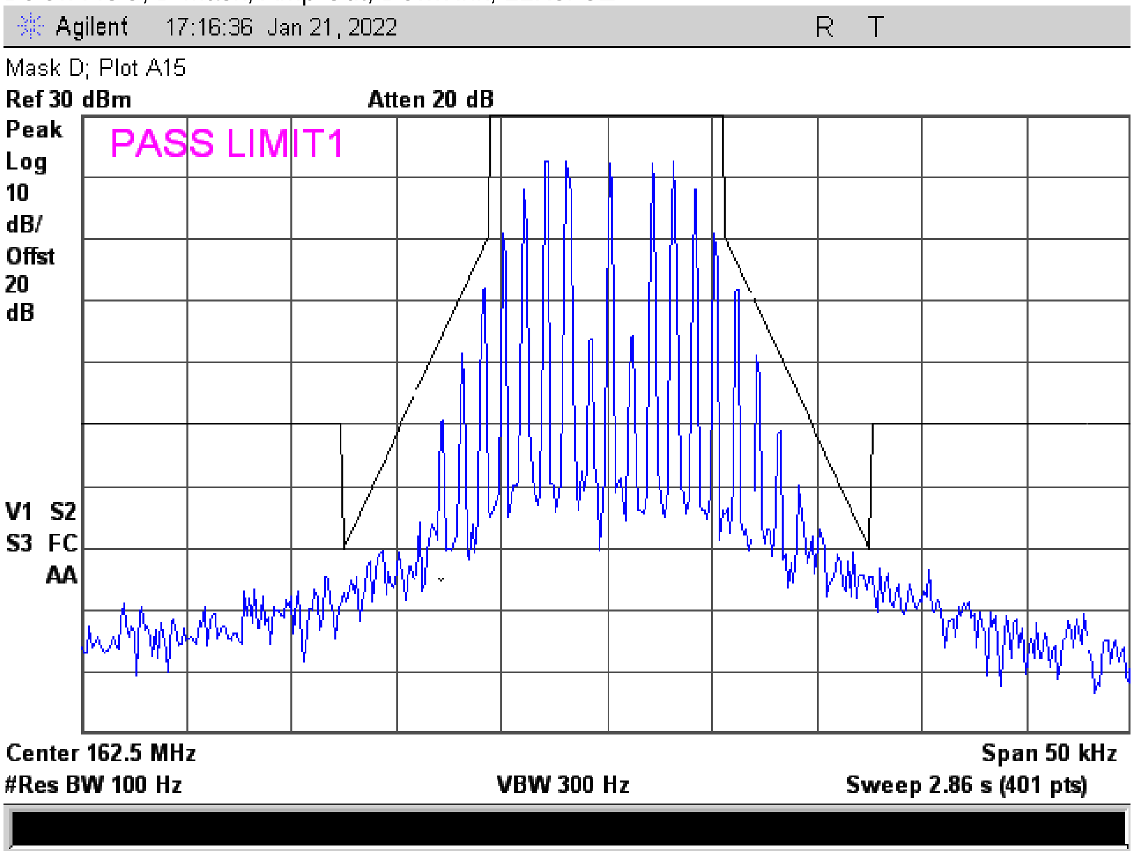
Below AGC; D Mask; Amp Out; Downlink; 6K25F1D



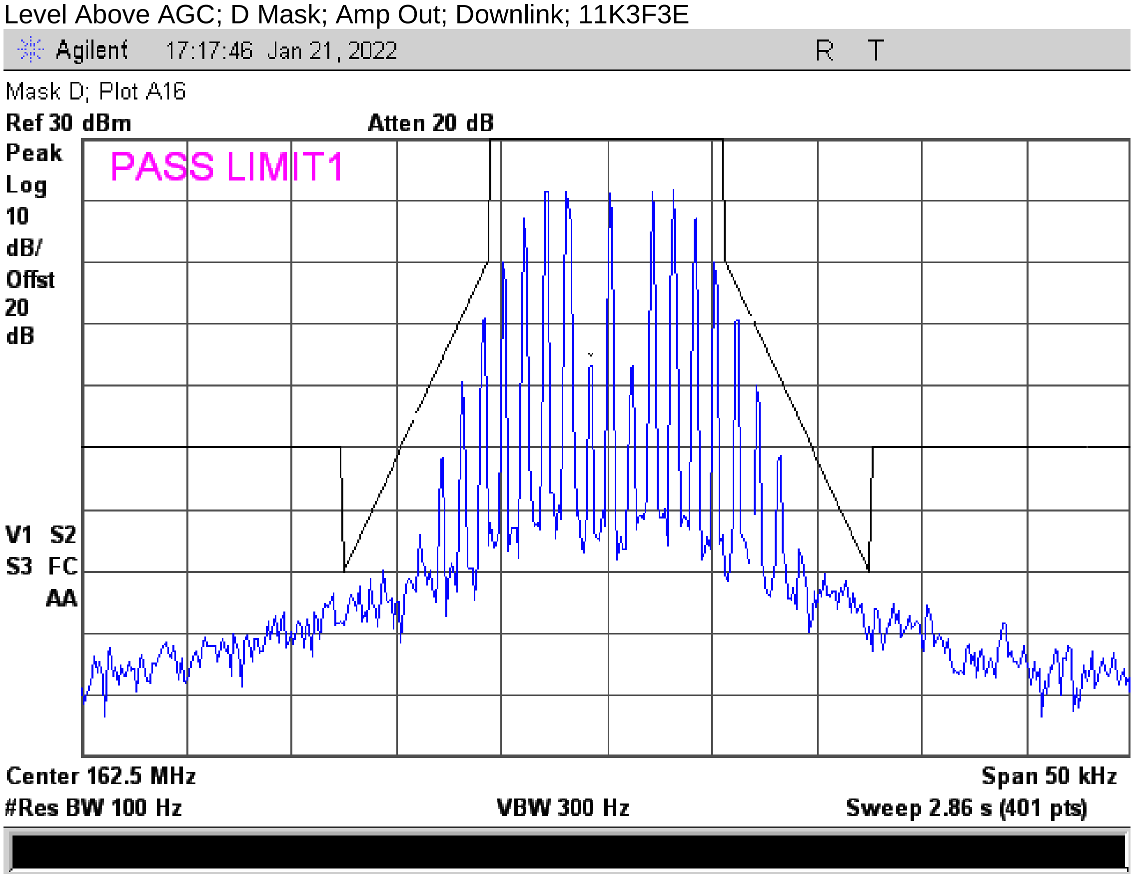
Level Above AGC; D Mask; Amp Out; Downlink; 6K25F1D



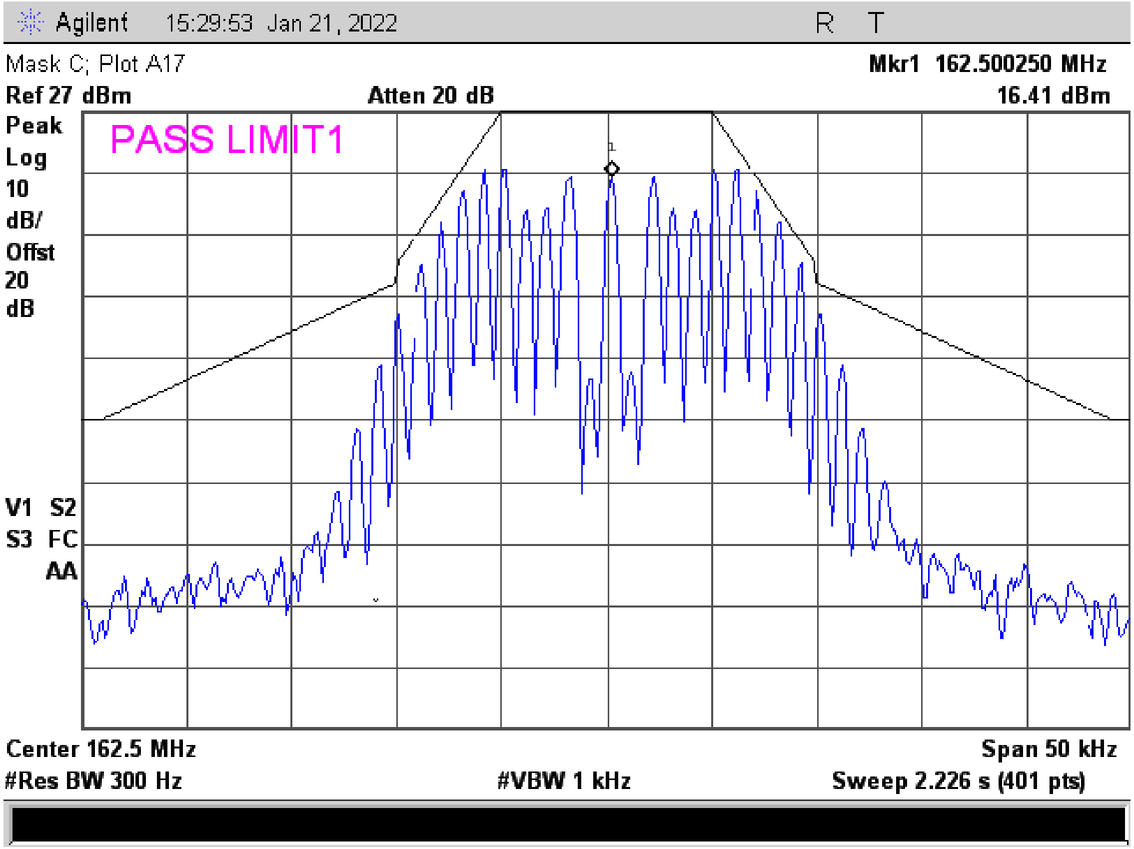
Below AGC; D Mask; Amp Out; Downlink; 11K3F3E



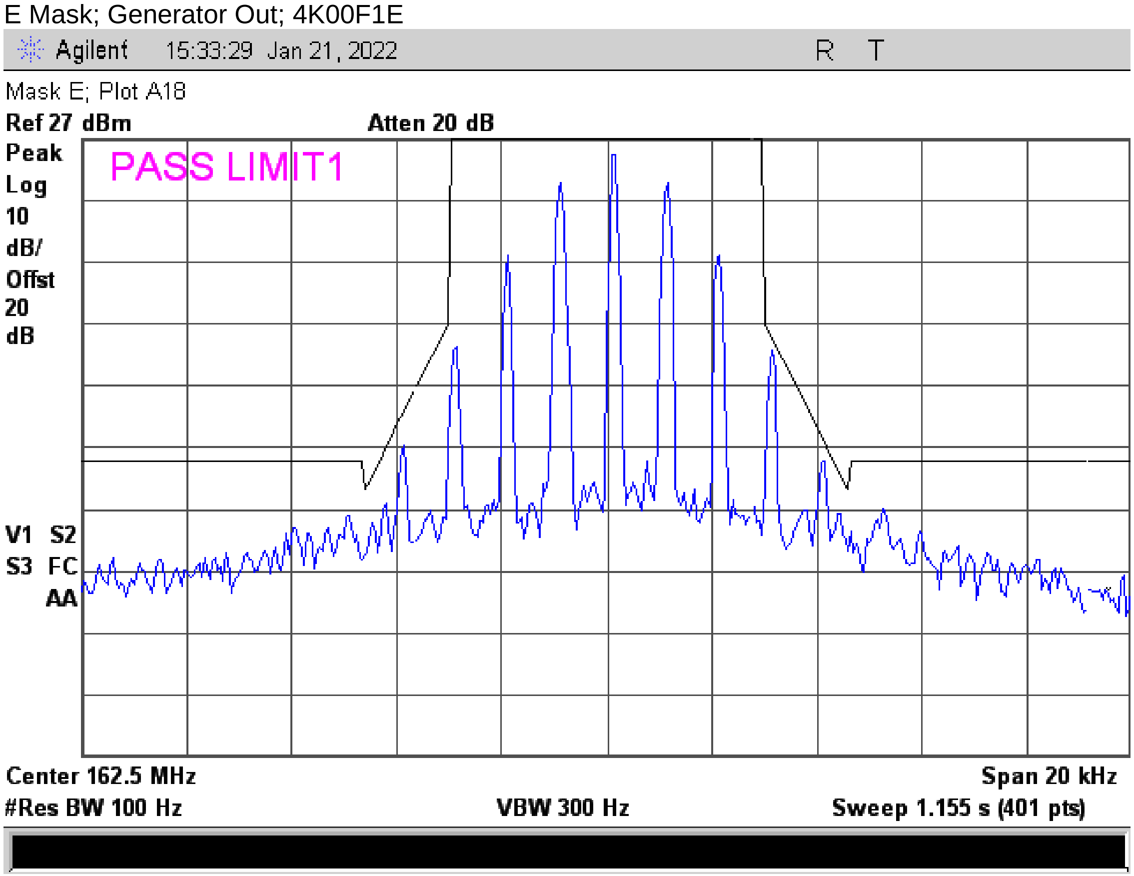
Level Above AGC; D Mask; Amp Out; Downlink; 11K3F3E



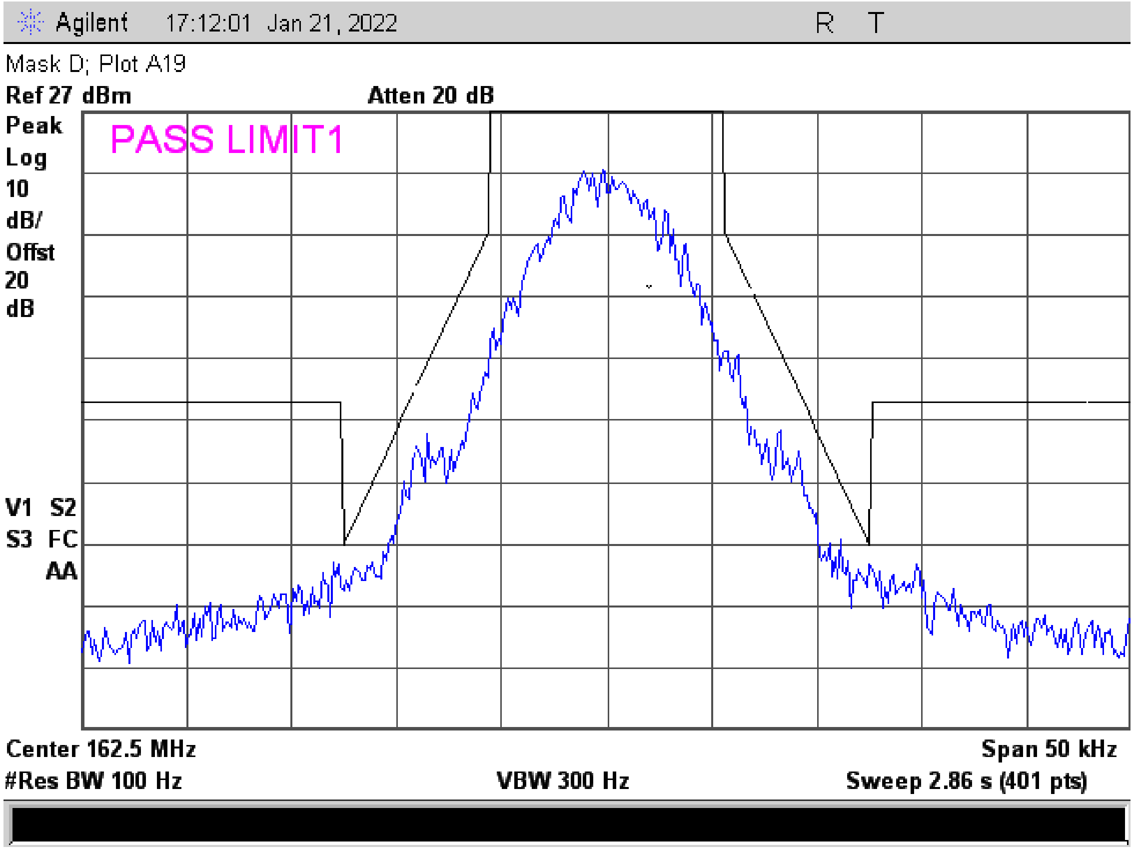
C Mask; Generator Out; 16K0F3E



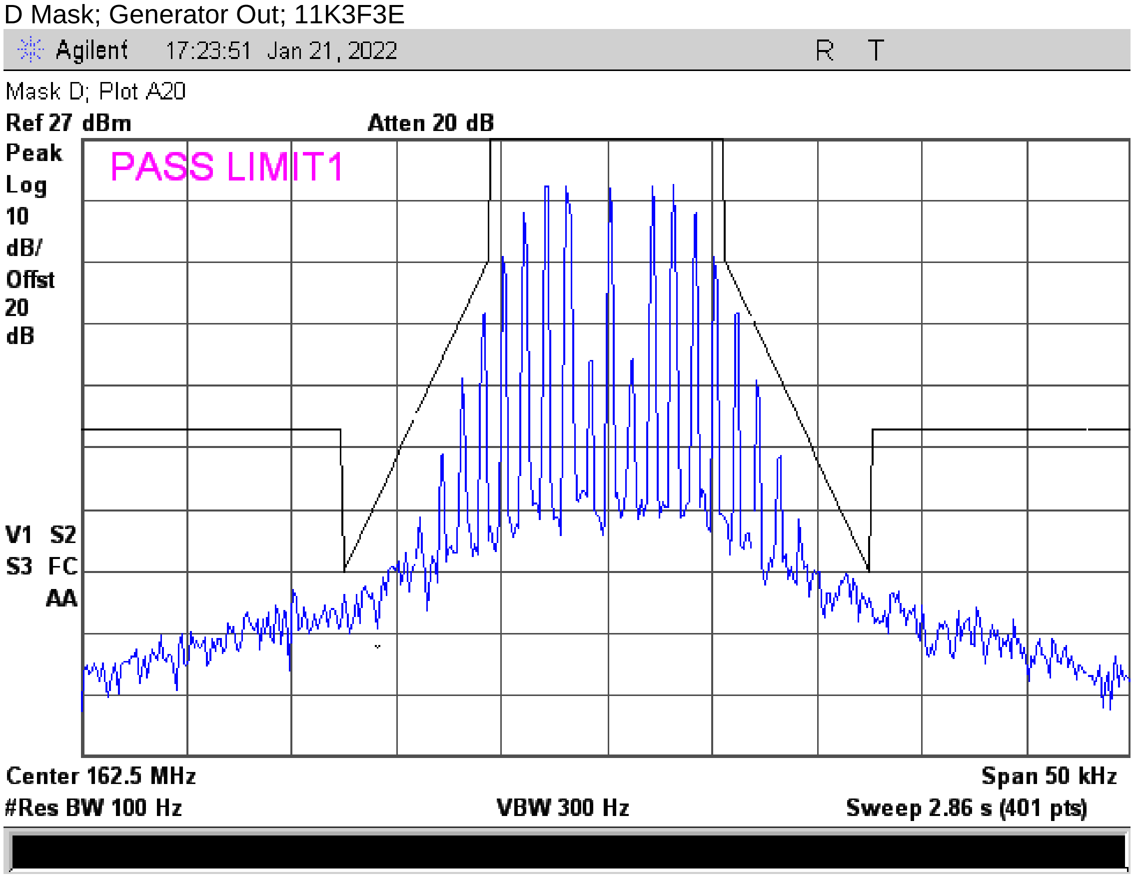
E Mask; Generator Out; 4K00F1E



D Mask; Generator Out; 6K25F1D



D Mask; Generator Out; 11K3F3E



14.0 INPUT/OUTPUT POWER AND AMPLIFIER GAIN

14.1 Applicable Standard

The EUT shall comply with FCC KDB 935210 section 4.5.

In accordance with section 4.5 of KDB 935210 D05, the mean input and output power and the amplifier gain was measured by adjusting the internal gain control of the EUT to the maximum gain for which equipment certification is sought. Any EUT attenuation settings were set to their minimum value.

Input power levels (uplink and downlink) were set to maximum input ratings while confirming that the device is not capable of operating in saturation (non-linear mode) at the rated input levels, including during the performance of the input/output power measurements.

14.2 Test procedures

a) A signal generator was connected to the input of the EUT.
b) The frequency of the signal generator was set to the frequency f0 as determined from 3.3 of KDB 935210.
c) A power meter was connected to the output of the EUT using an external attenuator.
d) The signal generator amplitude was configured to be zero to 0.5 dB below the AGC threshold level.
e) The output power of the EUT measured and recorded.
f) The EUT was removed from the measurement setup. Using the same signal generator settings, the power measurement was repeated at the signal generator port, which was used as the input signal to the EUT and recorded as the input power.
h) Steps e) and f) were repeated with input signal amplitude set to 3 dB above the AGC threshold level.
j) Steps d) to f) were repeated for all frequency bands authorized for use by the EUT.

The mean gain was reported for each authorized operating frequency band and each test signal stimulus.

After the mean input and output power levels have been measured as described in the preceding subclauses, the mean gain of the EUT can be determined from:
Gain (dB) = output power (dBm) − input power (dBm).

14.3 Gain Test Results

Model	080-300925	Specification	FCC KDB 935210 Sec. 4.5
Serial Number	080-300925-DVT0002	Test Date	12/07/2021 & 1/20/2022
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-44)		

Notes: A CW signal was used.

Mode	Freq. MHz	Signal Generator Out dB	Peak power dBm	Output Atten dB	Cable Loss dB	Output Power dBm	Output power Watts	Gain dB
UP (1)	151.0	-58.2	7.7	19.9	0.1	27.7	0.589	85.9
UP (2)	151.0	-55.2	7.9	19.9	0.1	27.9	0.617	83.1
UP (1)	162.5	-58.1	7.5	19.9	0.1	27.5	0.562	85.6
UP (2)	162.5	-55.1	7.6	19.9	0.1	27.7	0.589	82.5
UP (1)	173.0	-57.1	7.7	19.9	0.1	27.7	0.589	84.8
UP (2)	173.0	-54.1	7.5	19.9	0.1	27.5	0.562	81.6
Down (1)	151.0	-55.1	10.5	19.9	0.1	30.5	1.122	85.6

Mode	Freq. MHz	Signal Generator Out dB	Peak power dBm	Output Atten dB	Cable Loss dB	Output Power dBm	Output power Watts	Gain dB
Down (2)	151.0	-52.1	10.1	19.9	0.1	30.1	1.023	82.2
Down (1)	162.5	-55.1	10.1	19.9	0.1	30.1	1.023	85.2
Down (2)	162.5	-52.1	9.7	19.9	0.1	29.8	0.955	81.9
Down (1)	173.0	-54.6	9.9	19.9	0.1	29.9	0.977	84.5
Down (2)	173.0	-51.6	9.8	19.9	0.1	29.8	0.955	81.4

(1) Level is 0 to 0.5 dB below AGC threshold; (2) Level is 3 dB above AGC threshold

Judgement: Pass; The passband gain did not exceed the nominal gain.

15.0 NOISE FIGURE MEASUREMENTS

15.1 Applicable Standard

The EUT shall comply with sections 4.6 of KDB 935210 D05.

§ 90.219(e)(2) limits the noise figure of a signal VHF amplifier to ≤ 9 dB in either direction.

15.2 Test procedures for section 4.6

a) A spectrum analyzer was connected to the downlink output of the amplifier.
b) The uplink was unterminated.
c) The spectrum analyzer was set to 200 trace average in the RMS average mode.
d) A peak reading was recorded
e) The noise figure was calculated using the following formula

$NF = P_{NOUT} - (-174dBm/Hz + 10*LOG_{10}(RBW) + Gain)$

Notes:
P_{NOUT} = Output noise of the amplifier in dBm
174 = Thermal noise for 1 Hz RBW at room temperature
The Thermal noise for 1 MHz RBW = $-174 + 10*LOG_{10}(1E6)$
RBW = Resolution Bandwidth of Spectrum analyzer in Hz
Gain = Gain of amplifier in dB

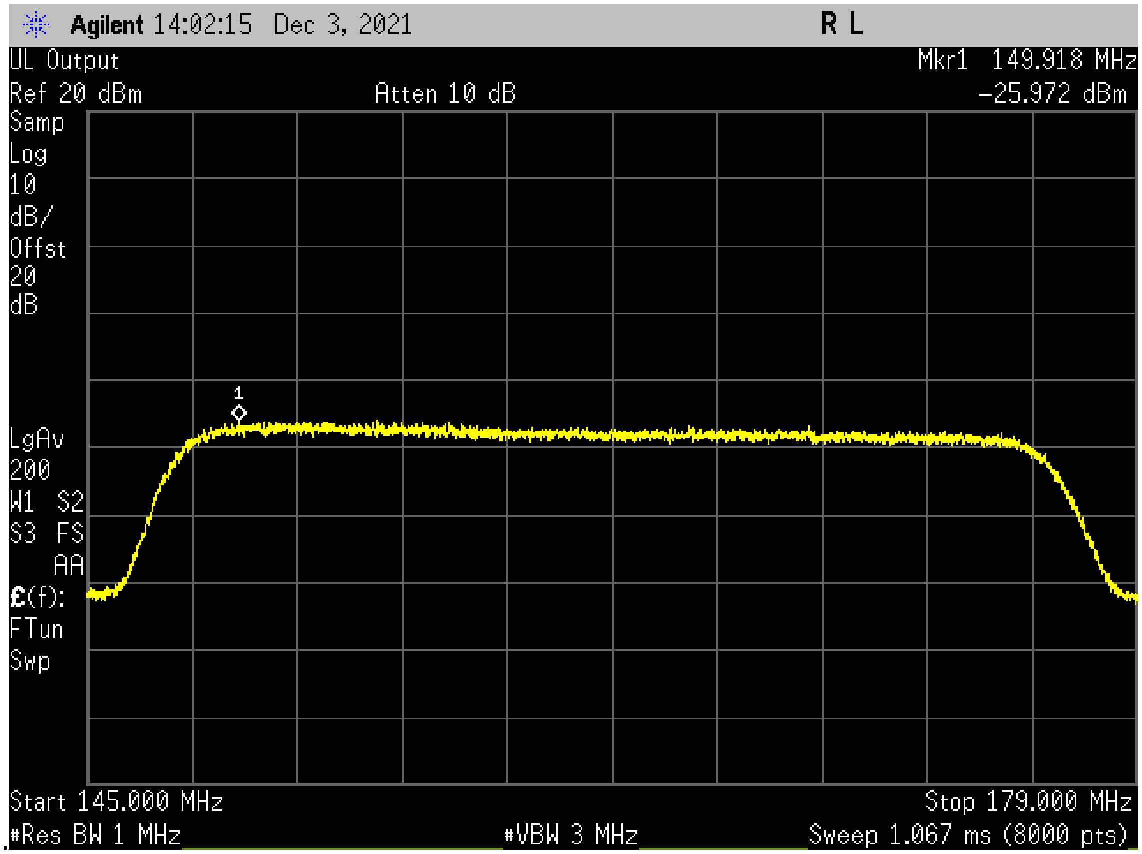
f) Steps a) to e) were repeated with the analyzer connected to the uplink output of the amplifier

15.3 Results for Section 4.6

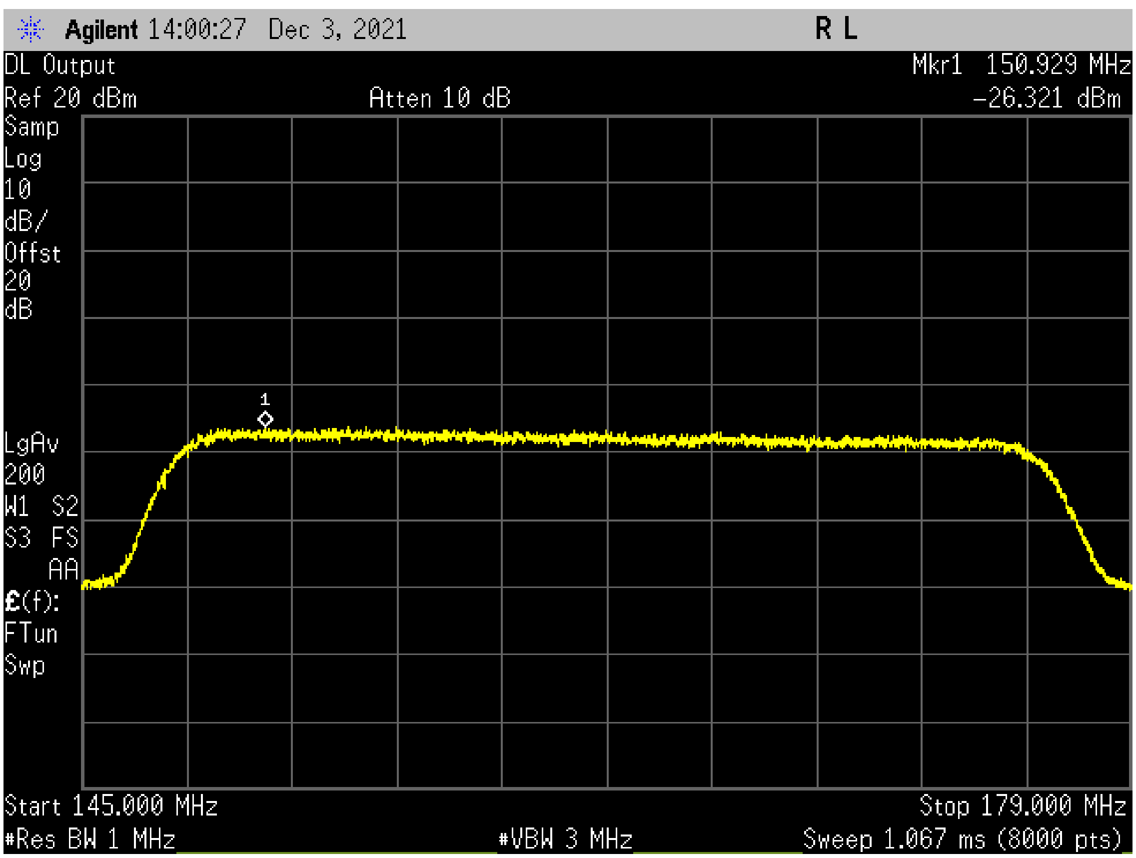
Model	080-300925	Specification	FCC KDB 935210 Sec. 4.6
Serial Number	080-300925-DVT0002	Test Date	12/03/2021
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver REC-44; RBW= 1 MHz; VBW= 3 MHz		

Mode	Start MHz	Stop MHz	Center MHz	Reading dBm	Gain dB	Thermal Noise dB	Cable Loss dB	Noise Figure dB	NF Limit dB
UP	145	179	162	-26.0	85.0	-114.0	0.4	3.4	9.0
Down	145	179	162	-26.3	85.0	-114.0	0.4	3.1	9.0

Judgement: Pass



Uplink



Downlink

16.0 OUT-OF-BAND/OUT-OF-BLOCK EMISSIONS

16.1 Applicable Standard

The EUT shall comply with sections 4.7.2 of KDB 935210 D05.

For a multi-channel enhancer, any intermodulation product level must be attenuated, relative to P, by at least: $43+10\text{xLog}_{10}\text{P}$, or 70 dB, whichever is less stringent, where P is the total RF output power of the test tones in watts. Since $43 +10\text{xLog}_{10}\text{P}$ is less stringent than 70 dB, that limit was used.

Spurious emissions shall be measured using a single test signal sequentially tuned to the low, middle, and high channels or frequencies within each authorized frequency band of operation.

Out-of-band/out-of-block emissions (including intermodulation products) was measured under each of the following two stimulus conditions:
a) two adjacent test signals sequentially tuned to the lower and upper frequency band/block edges,
b) a single test signal sequentially tuned to the lowest and highest frequencies or channels within the frequency band/block under examination.

16.2 Test procedures for section 4.7.2

a) A signal generator was connected to the input of the EUT.
Note; If the signal generator is not capable of producing two independent modulated carriers simultaneously, then two discrete signal generators can be connected, with an appropriate combining network to support the two-signal test.
b) The two signal generators were configured to produce CW on frequencies spaced consistent with 4.7.1, with amplitude levels set to just below the AGC threshold (see 4.2).
c) A spectrum analyzer was connected to the EUT output.
d) The span was set to 100 kHz.
e) RBW was set = 300 Hz with VBW ≥ 3 × RBW.
f) The detector was set to power averaging (rms).
g) A marker was placed on the highest intermodulation product amplitude.
h) The plot was captured for inclusion in the test report.
i) Steps c) to h) were repeated with the composite input power level set to 3 dB above the AGC threshold.
j) Steps b) to i) were repeated for all operational bands.

Any frequency outside the authorized bandwidth was attenuated by at least 43 + 10 log (P) dB. This corresponds to an absolute level of -13 dBm.

16.3 Results for Section 4.7.2

Model	080-300925	Specification	FCC KDB 935210 Sec. 4.7.2
Serial Number	080-300925-DVT0002	Test Date	01/22/2022
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver REC-44; SIG, 32, SIG-33 & ATT-54		

The spectrum analyzer was set to max hold mode. Both signal generators were set to CW

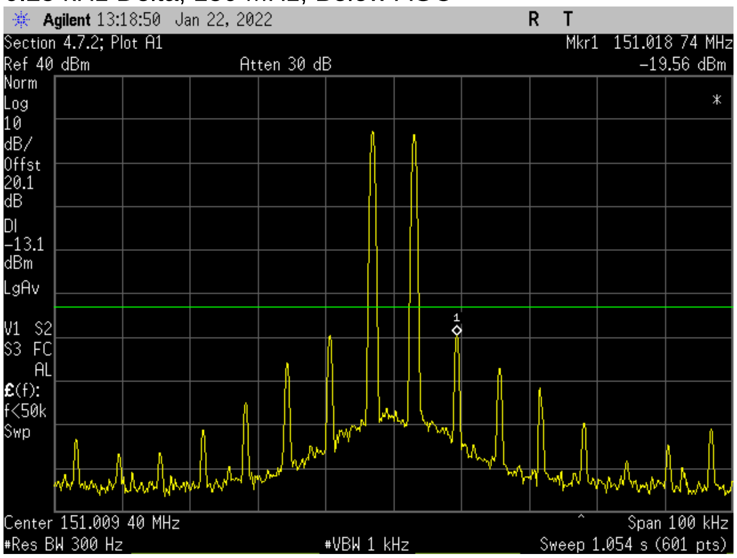
Plot #	RBW Hz	VBW Hz	Signal Generator Channel kHz	Signal Generator #1 MHz	Signal Generator #2 MHz	AGC	Analyzer Center MHz	Max Readings from Amplifier Freq MHz	Max Readings from Amplifier Reading dBm	Output
1	300	1000	6.25	151.00625	151.0125	off	151.009375	151.0187	-19.56	Uplink
2	300	1000	6.25	151.00625	151.0125	on	151.009375	151.0187	-20.12	Uplink
3	300	1000	6.25	162.50625	162.5125	off	162.509375	162.5000	-21.74	Uplink
4	300	1000	6.25	162.50625	162.5125	on	162.509375	162.5000	-20.74	Uplink
5	300	1000	6.25	172.99375	172.9875	off	172.990625	172.9999	-21.53	Uplink
6	300	1000	6.25	172.99375	172.9875	on	172.990625	172.9999	-20.03	Uplink
7	300	1000	12.5	151.0125	151.025	off	151.01875	150.9999	-20.68	Uplink
8	300	1000	12.5	151.0125	151.025	on	151.01875	150.9999	-18.19	Uplink
9	300	1000	12.5	162.5125	162.525	off	162.51875	162.4999	-24.09	Uplink
10	300	1000	12.5	162.5125	162.525	on	162.51875	162.4999	-22.57	Uplink
11	300	1000	12.5	172.9875	172.975	off	172.98125	172.9625	-22.81	Uplink
12	300	1000	12.5	172.9875	172.975	on	172.98125	173.0000	-21.86	Uplink
13	300	1000	25	151.025	151.05	off	151.03750	150.9990	-22.82	Uplink
14	300	1000	25	151.025	151.05	on	151.03750	150.9990	-20.98	Uplink
15	300	1000	25	162.525	162.55	off	162.53750	162.5000	-22.77	Uplink
16	300	1000	25	162.525	162.55	on	162.53750	162.5000	-22.82	Uplink
17	300	1000	25	172.975	172.95	off	172.96250	172.9250	-20.79	Uplink
18	300	1000	25	172.975	172.95	on	172.96250	172.9250	-20.46	Uplink
19	300	1000	6.25	151.00625	151.0125	off	151.009375	151.0000	-22.22	Downlink
20	300	1000	6.25	151.00625	151.0125	on	151.009375	151.0000	-22.22	Downlink
21	300	1000	6.25	162.50625	162.5125	off	162.509375	162.5000	-25.14	Downlink
22	300	1000	6.25	162.50625	162.5125	on	162.509375	162.5000	-23.41	Downlink
23	300	1000	6.25	172.99375	172.9875	off	172.990625	172.9813	-21.59	Downlink
24	300	1000	6.25	172.99375	172.9875	on	172.990625	172.9813	-20.88	Downlink
25	300	1000	12.5	151.0125	151.025	off	151.01875	151.0375	-24.51	Downlink
26	300	1000	12.5	151.0125	151.025	on	151.01875	151.0375	-25.06	Downlink
27	300	1000	12.5	162.5125	162.525	off	162.51875	162.5000	-27.16	Downlink
28	300	1000	12.5	162.5125	162.525	on	162.51875	162.5000	-25.66	Downlink
29	300	1000	12.5	173.9875	173.975	off	173.98125	173.9625	-23.64	Downlink
30	300	1000	12.5	173.9875	173.975	on	173.98125	173.9625	-22.5	Downlink
31	300	1000	25	151.025	151.05	off	151.03750	151.0750	-25.16	Downlink
32	300	1000	25	151.025	151.05	on	151.03750	151.0750	-25.07	Downlink
33	300	1000	25	162.525	162.55	off	162.53750	162.5000	-26.17	Downlink
34	300	1000	25	162.525	162.55	on	162.53750	162.5000	-25.43	Downlink
35	300	1000	25	172.975	172.95	off	172.96250	172.9251	-22.61	Downlink
36	300	1000	25	172.975	172.95	on	172.96250	151.0187	-19.56	Downlink

The table shows the highest spurious noise from the amplifier for each plot. The limit is -13 dBm.

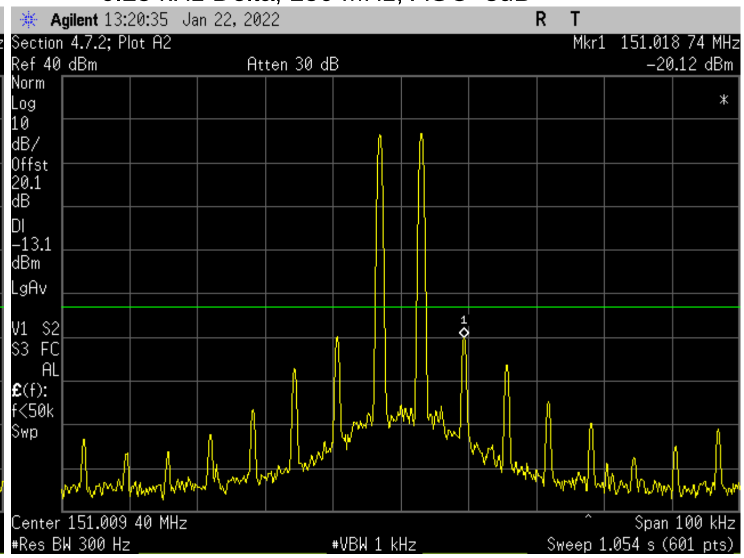
Judgement: Pass

16.3.1 Combined Output Results; Out-of-band/out-of-block emissions

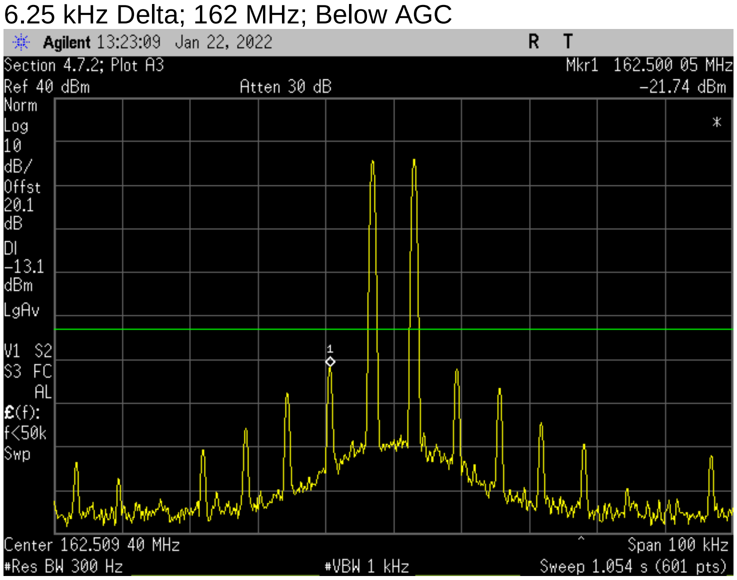
6.25 kHz Delta; 150 MHz; Below AGC



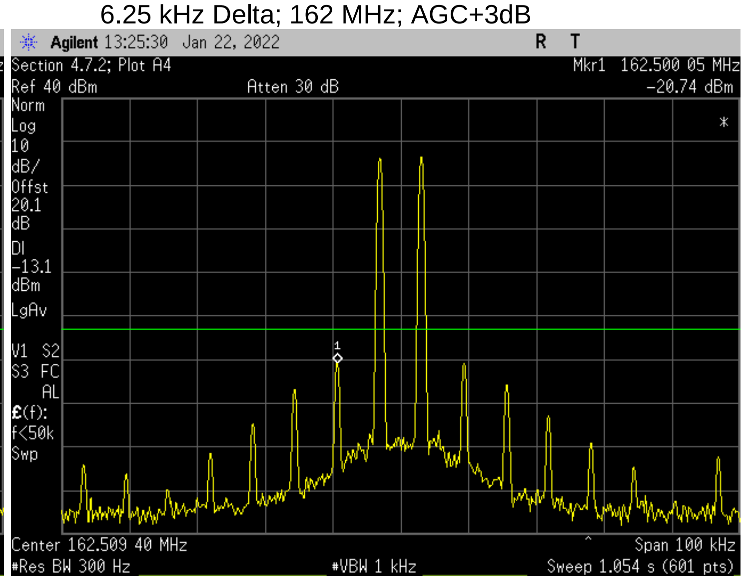
6.25 kHz Delta; 150 MHz; AGC+3dB



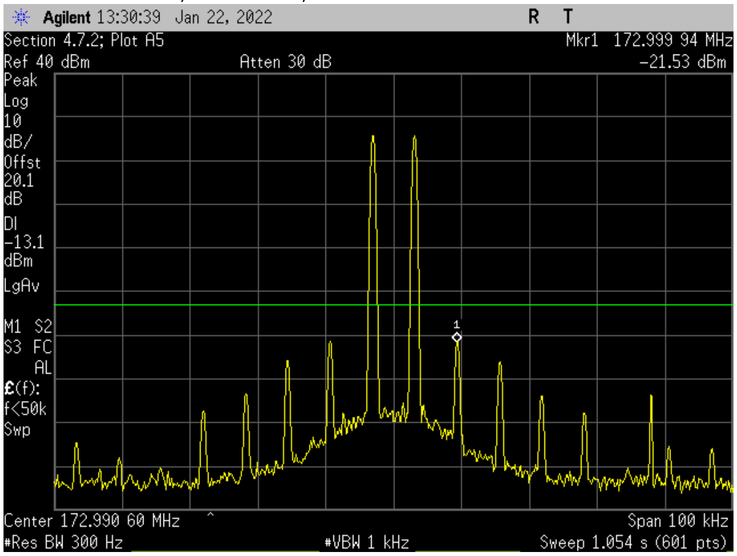
6.25 kHz Delta; 162 MHz; Below AGC



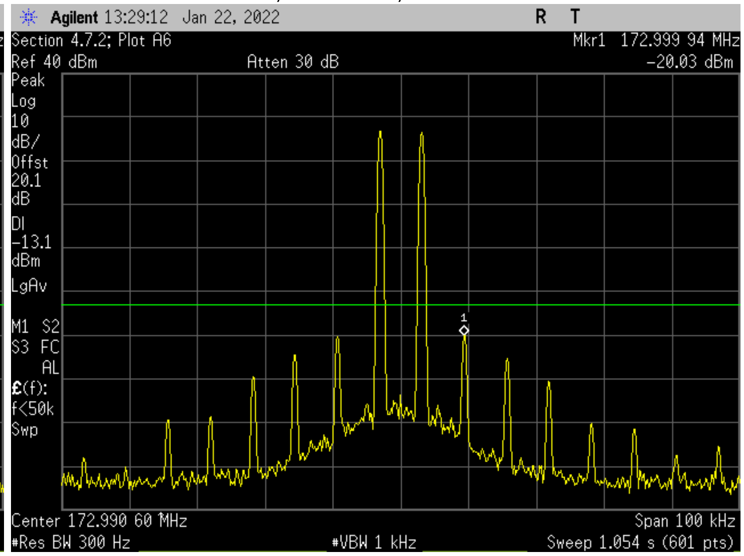
6.25 kHz Delta; 162 MHz; AGC+3dB



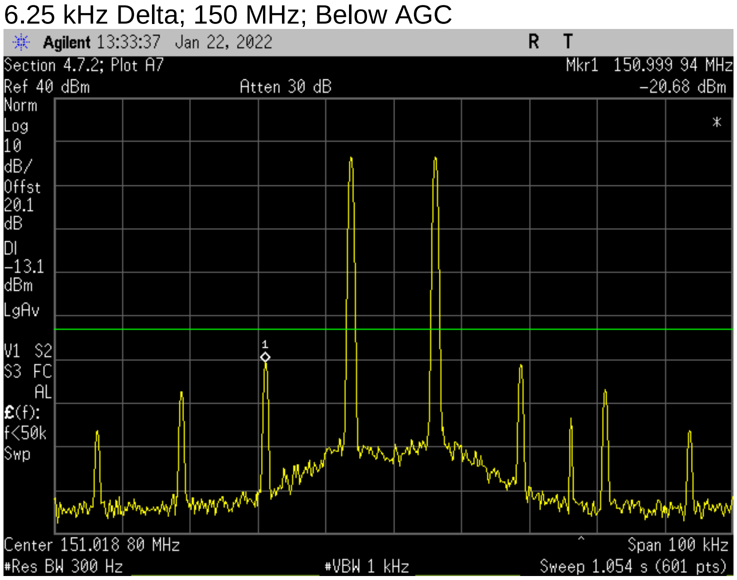
6.25 kHz Delta; 174 MHz; Below AGC



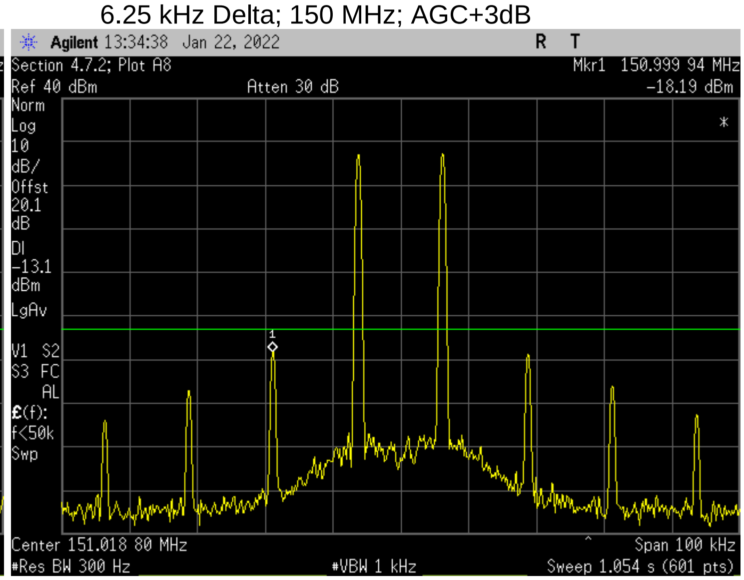
6.25 kHz Delta; 174 MHz; AGC+3dB



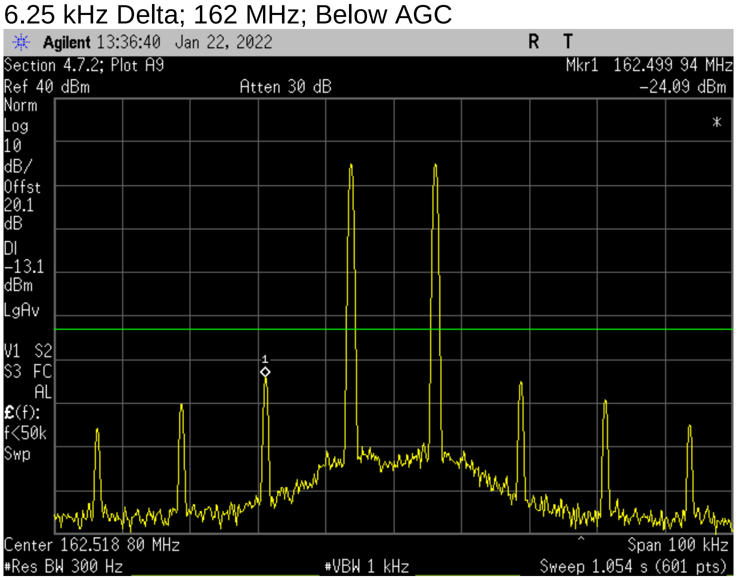
6.25 kHz Delta; 150 MHz; Below AGC



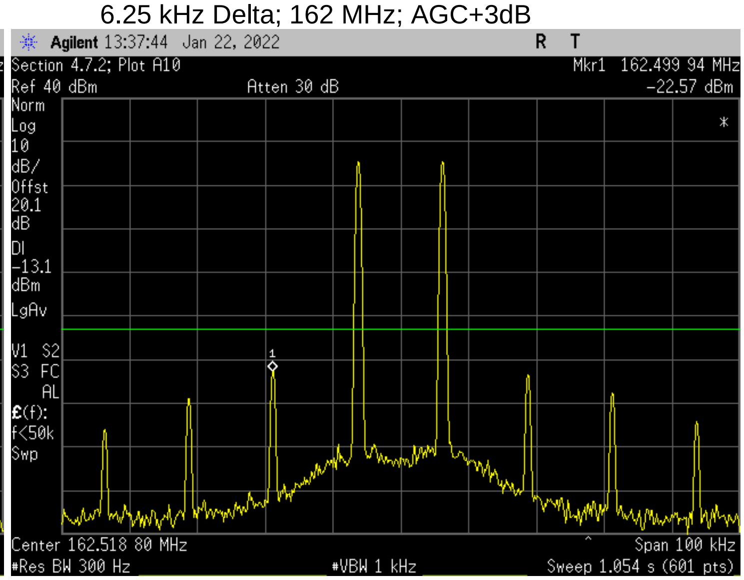
6.25 kHz Delta; 150 MHz; AGC+3dB



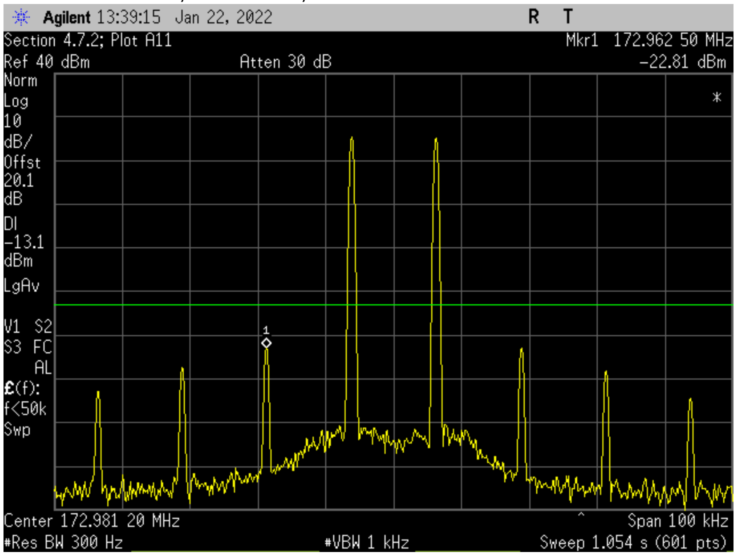
6.25 kHz Delta; 162 MHz; Below AGC



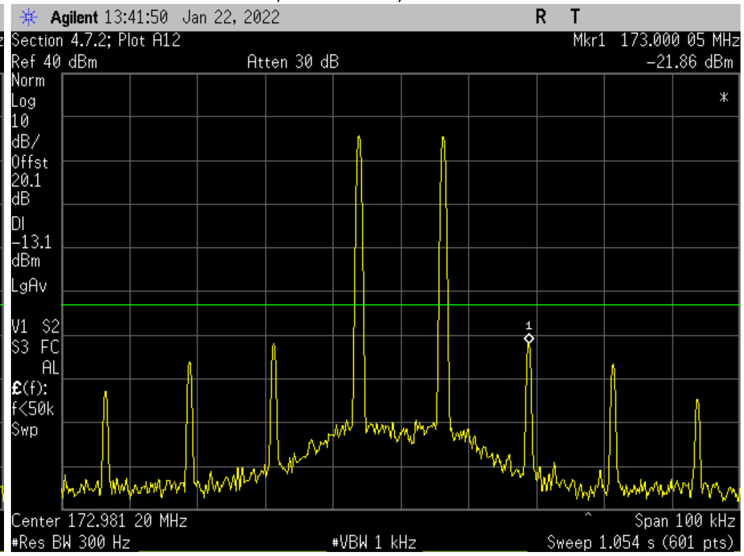
6.25 kHz Delta; 162 MHz; AGC+3dB



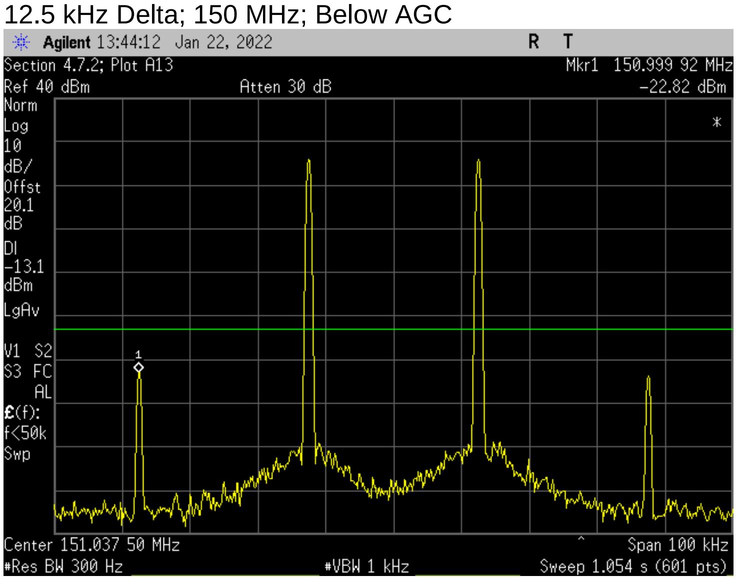
6.25 kHz Delta; 174 MHz; Below AGC



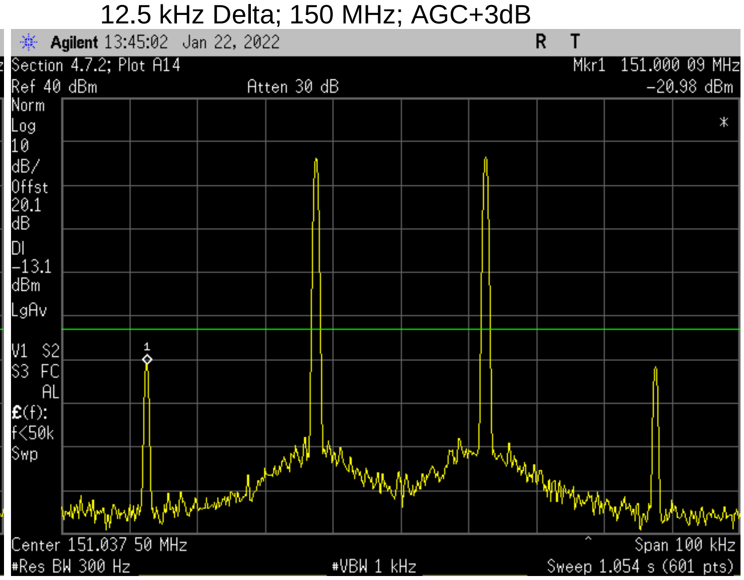
6.25 kHz Delta; 174 MHz; AGC+3dB



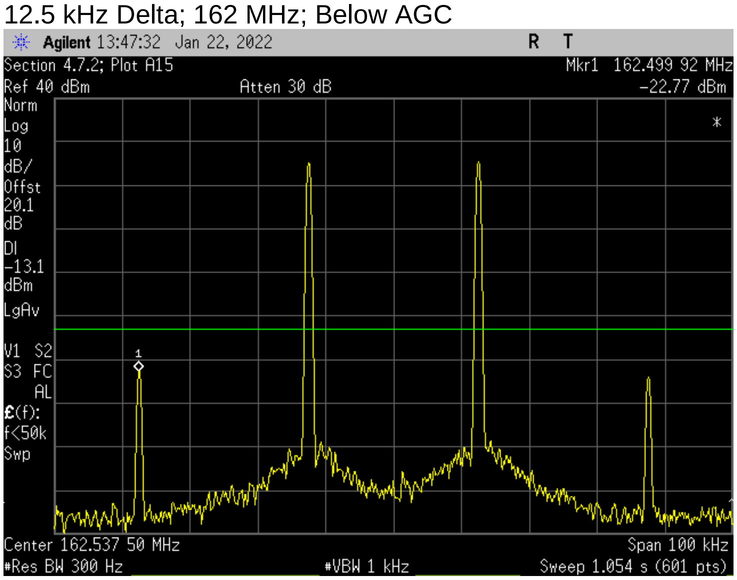
12.5 kHz Delta; 150 MHz; Below AGC



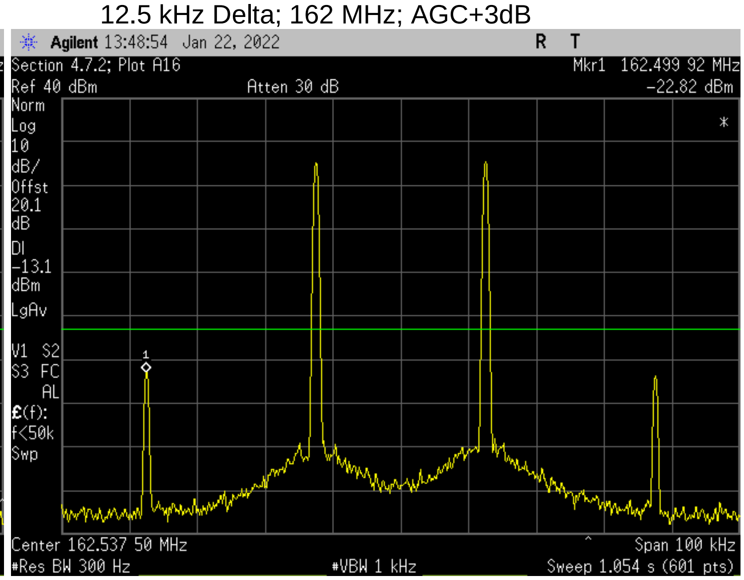
12.5 kHz Delta; 150 MHz; AGC+3dB



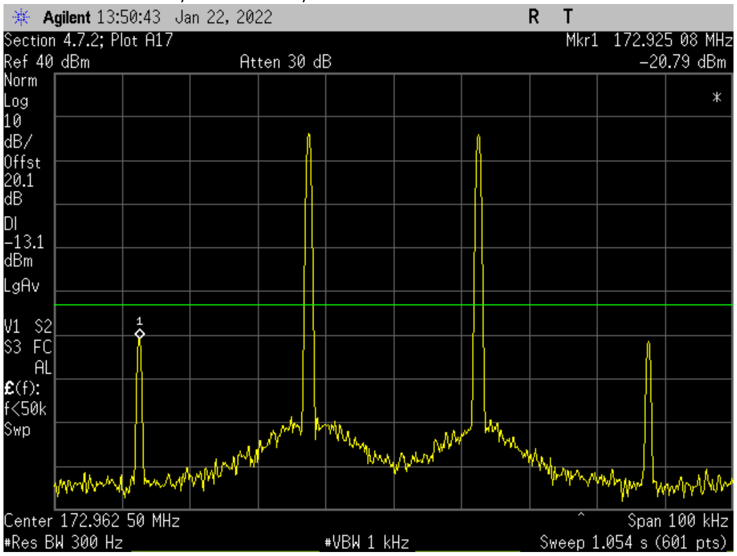
12.5 kHz Delta; 162 MHz; Below AGC



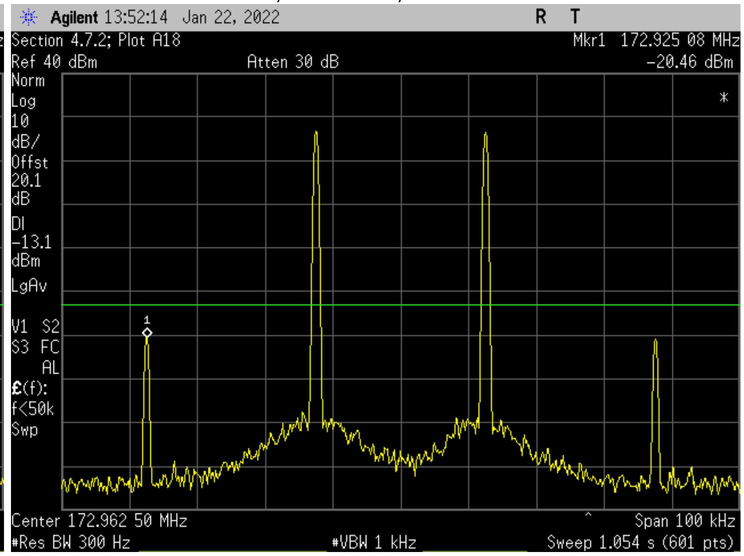
12.5 kHz Delta; 162 MHz; AGC+3dB



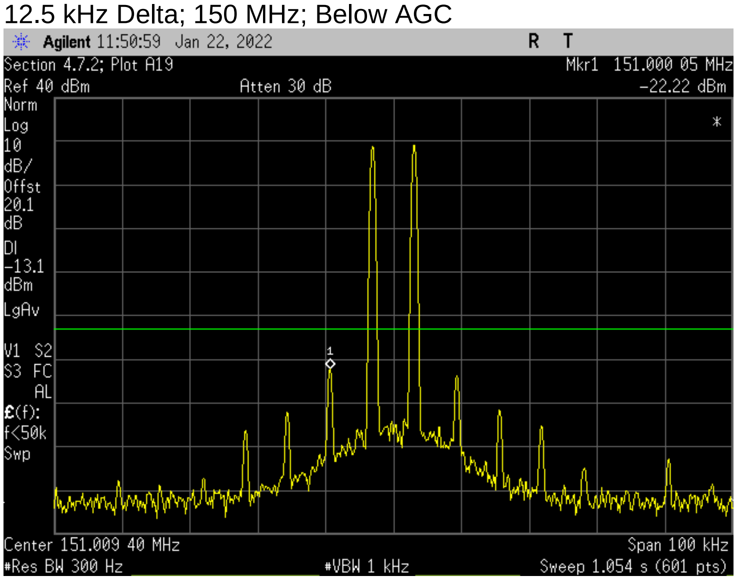
12.5 kHz Delta; 174 MHz; Below AGC



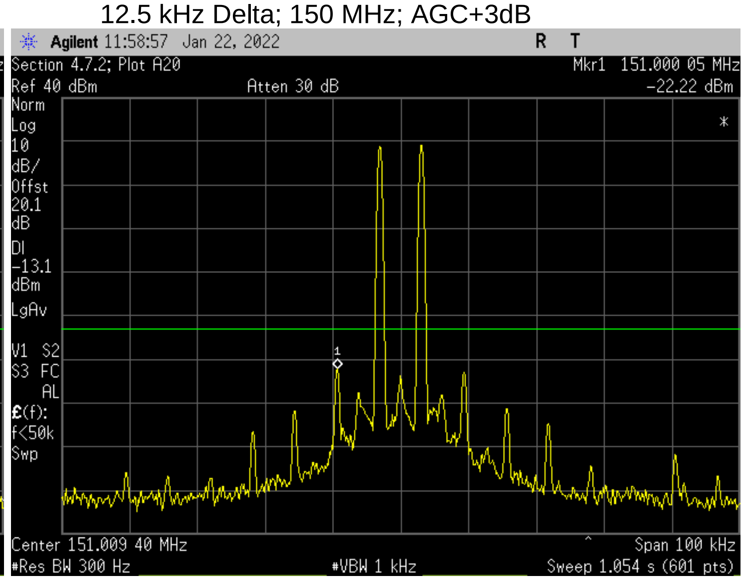
12.5 kHz Delta; 174 MHz; AGC+3dB



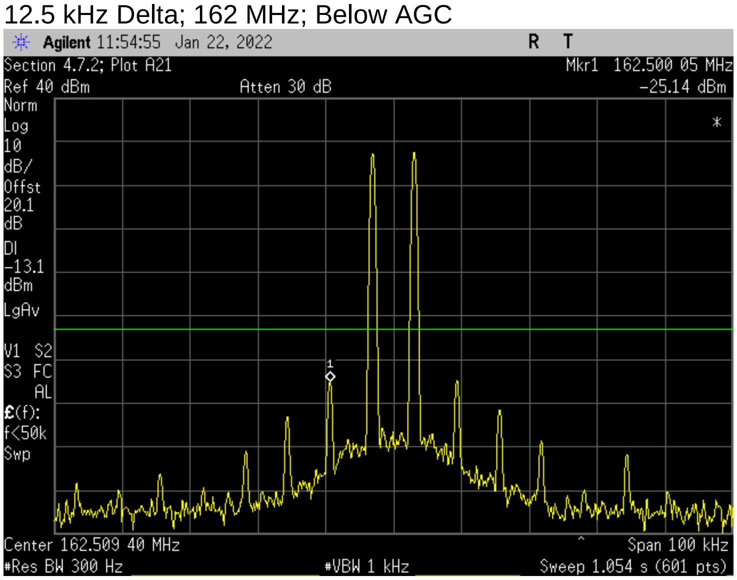
12.5 kHz Delta; 150 MHz; Below AGC



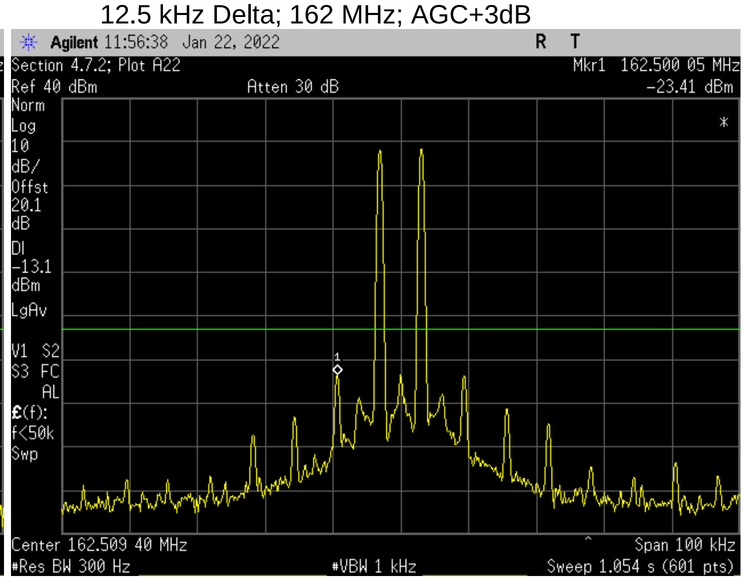
12.5 kHz Delta; 150 MHz; AGC+3dB



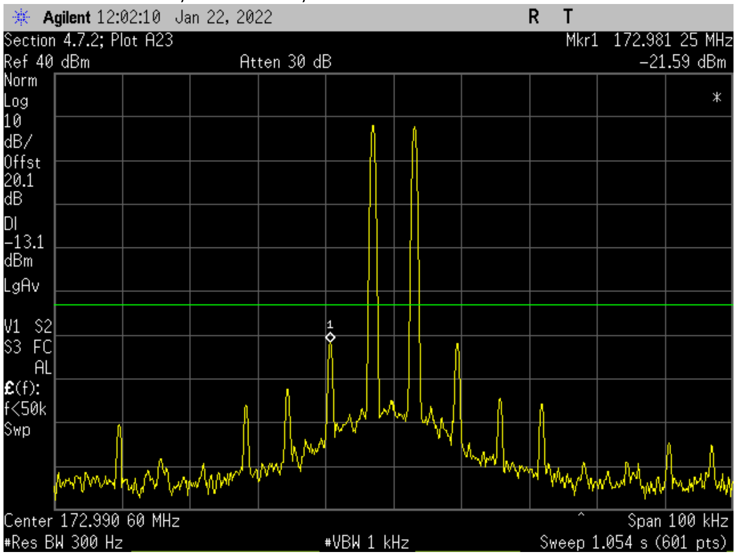
12.5 kHz Delta; 162 MHz; Below AGC



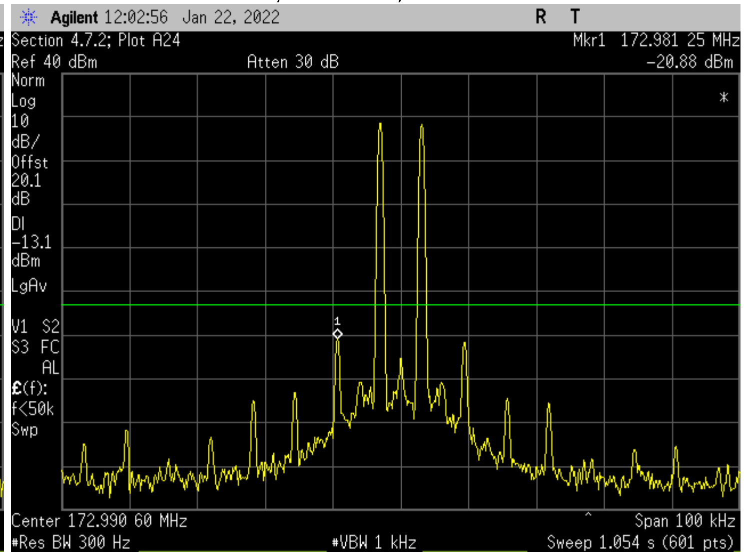
12.5 kHz Delta; 162 MHz; AGC+3dB



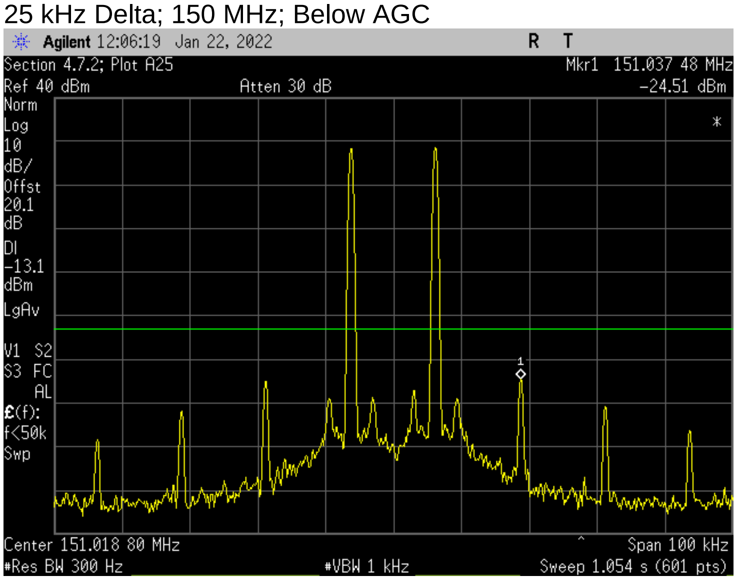
12.5 kHz Delta; 174 MHz; Below AGC



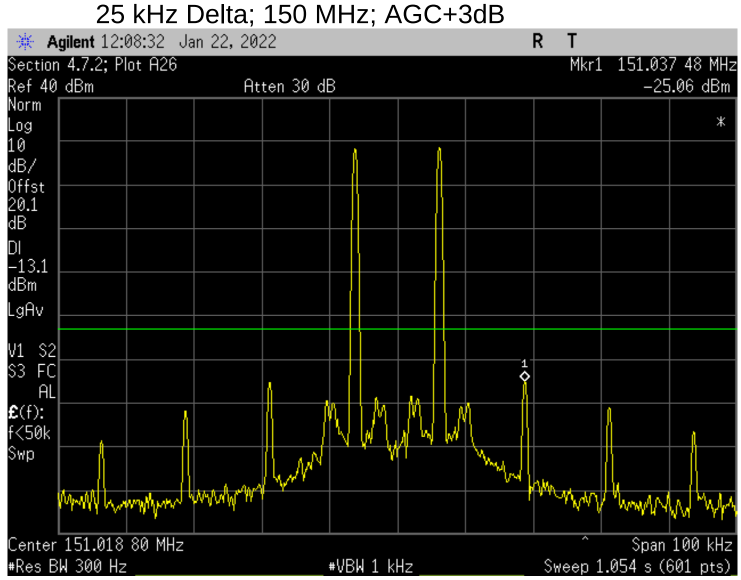
12.5 kHz Delta; 174 MHz; AGC+3dB



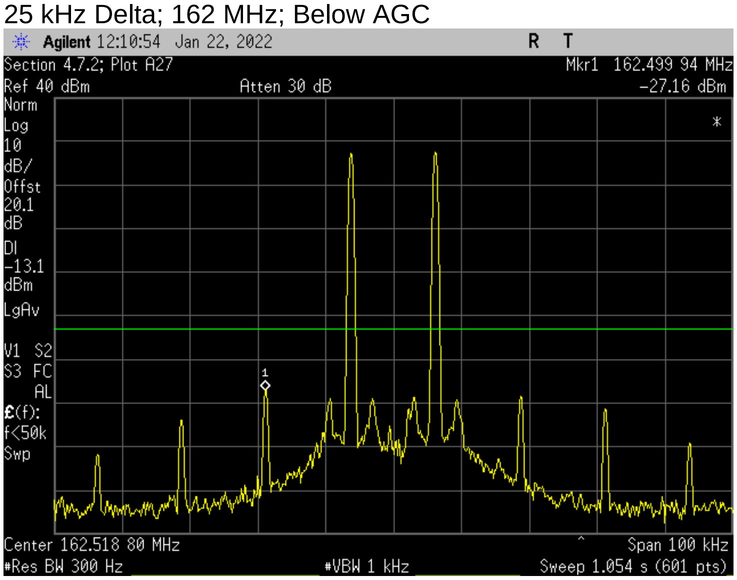
25 kHz Delta; 150 MHz; Below AGC



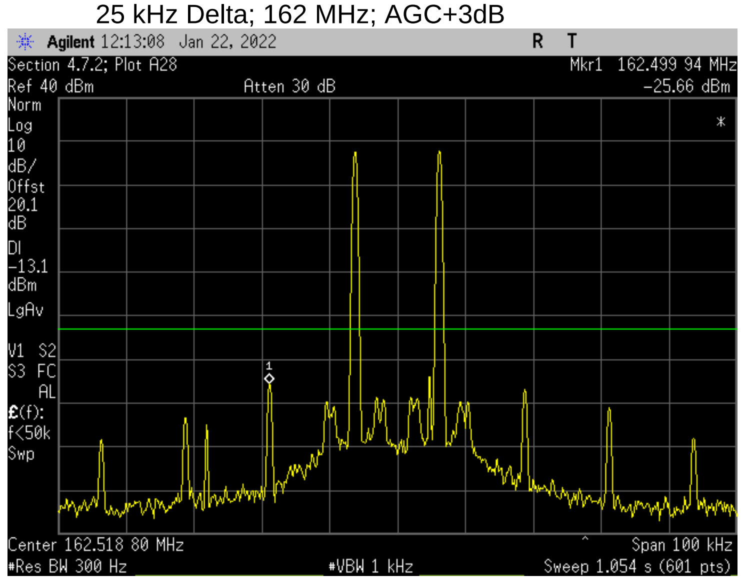
25 kHz Delta; 150 MHz; AGC+3dB



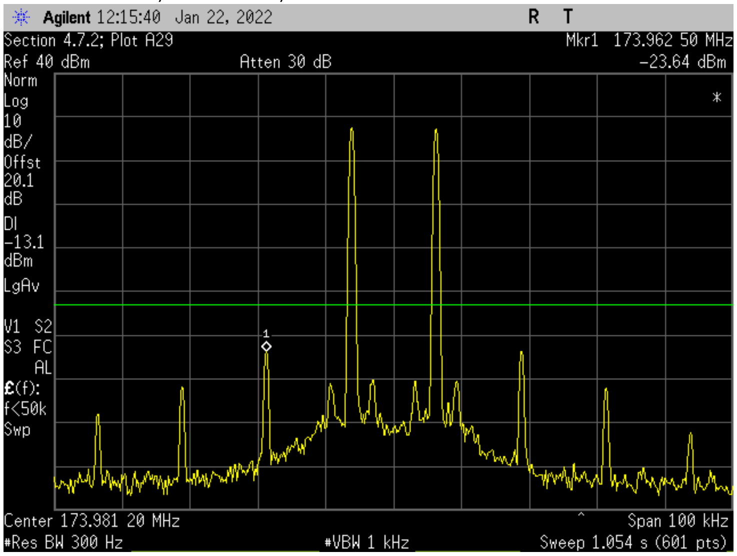
25 kHz Delta; 162 MHz; Below AGC



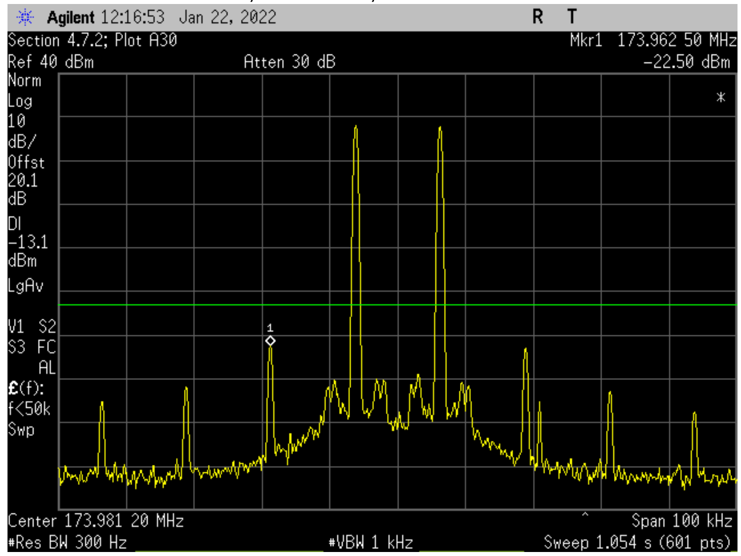
25 kHz Delta; 162 MHz; AGC+3dB



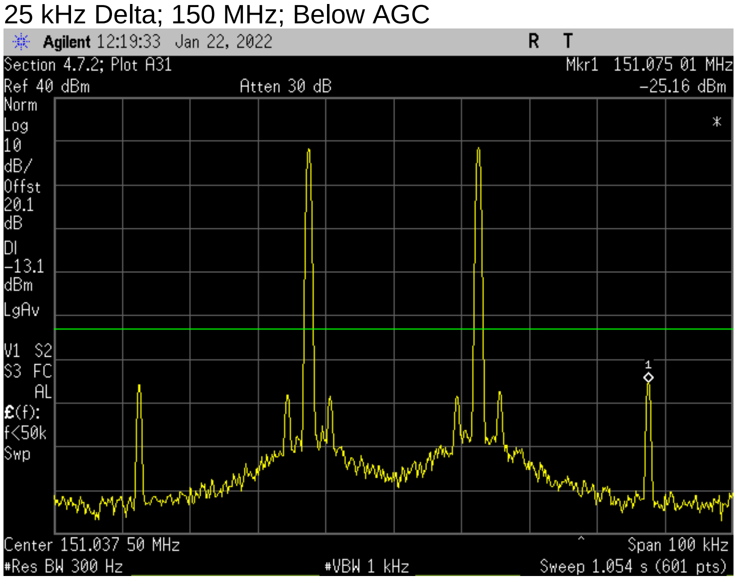
25 kHz Delta; 174 MHz; Below AGC



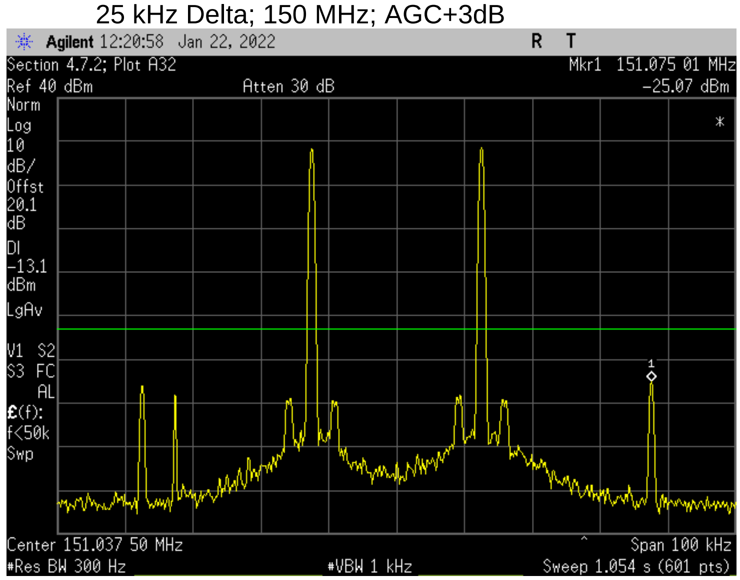
25 kHz Delta; 174 MHz; AGC+3dB



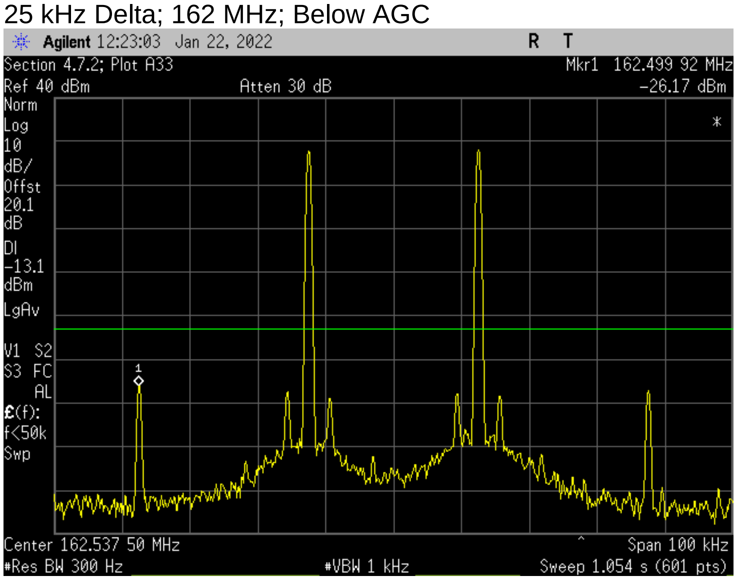
25 kHz Delta; 150 MHz; Below AGC



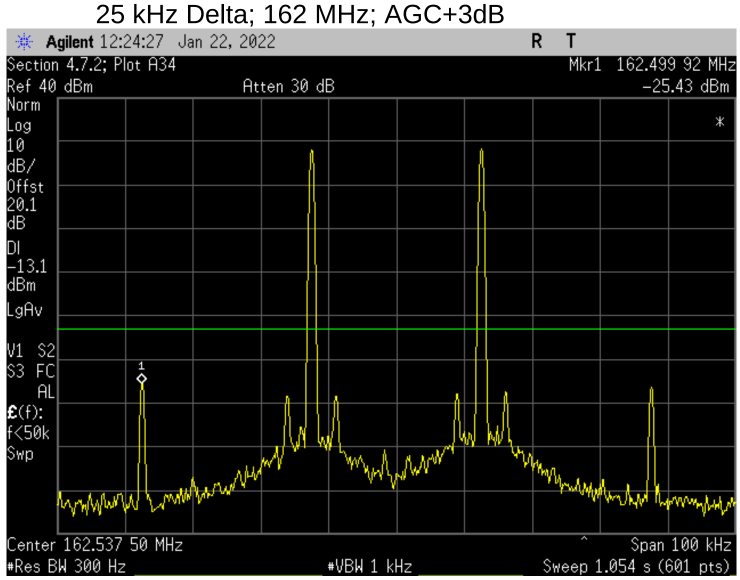
25 kHz Delta; 150 MHz; AGC+3dB



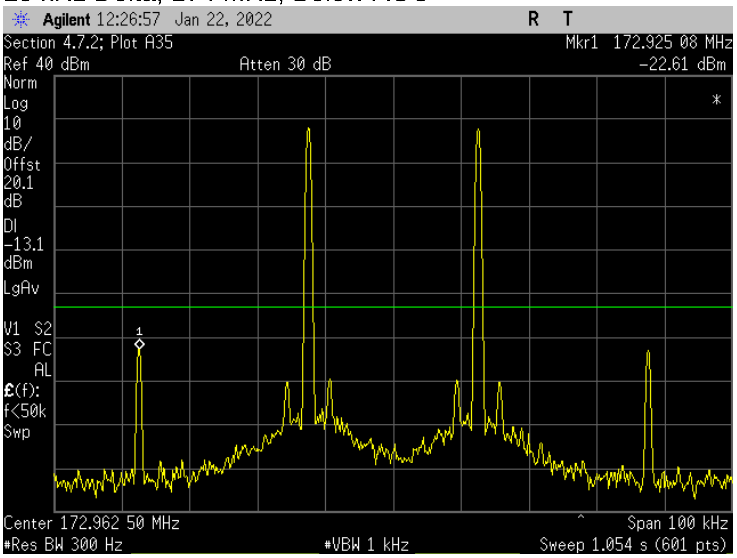
25 kHz Delta; 162 MHz; Below AGC



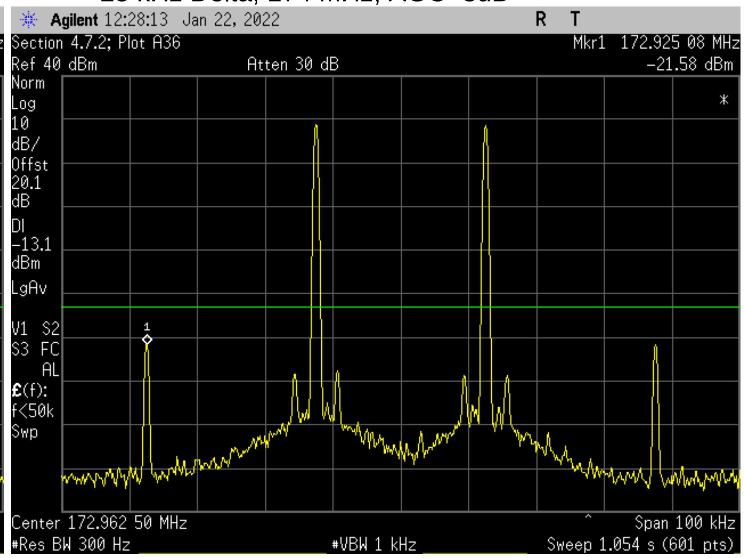
25 kHz Delta; 162 MHz; AGC+3dB



25 kHz Delta; 174 MHz; Below AGC



25 kHz Delta; 174 MHz; AGC+3dB



17.0 SPURIOUS EMISSIONS CONDUCTED MEASUREMENTS

17.1 Applicable Standard

The EUT shall comply with sections 4.7.3 of KDB 935210 D05 since it is a Multi-Channel Enhancer.

For a multi-channel enhancer, any intermodulation product level must be attenuated, relative to P, by at least: $43+10xLog_{10}P$, or 70 dB, whichever is less stringent, where P is the total RF output power of the test tones in watts. Since $43 +10xLog_{10}P$ is less stringent than 70 dB, that limit was used.

Spurious emissions shall be measured using a single test signal sequentially tuned to the low, middle, and high channels or frequencies within each authorized frequency band of operation.

Out-of-band/out-of-block emissions (including intermodulation products) was measured under each of the following two stimulus conditions:
a) two adjacent test signals sequentially tuned to the lower and upper frequency band/block edges.
b) a single test signal sequentially tuned to the lowest and highest frequencies or channels within the frequency band/block under examination.

17.2 Test procedures for section 4.7.3

a) A signal generator was connected to the input of the EUT.
b) The signal generator was configured to produce a CW signal.
c) The frequency of the CW signal was set to the center channel of the EUT passband.
d) The output power level was set so that the resultant signal is just below the AGC threshold (see 4.2).
e) A spectrum analyzer was connected to the output of the EUT, using appropriate attenuation, as necessary.
f) The RBW was set to 100 kHz for tests from 30 MHz to 1 GHz and 1 MHz for tests above 1 GHz
g) The VBW was set to 3 × RBW.
h) The Sweep time was set = auto-couple.
i) The detector was set to PEAK.
j) The spectrum analyzer start frequency was set to 30 MHz (or the lowest radio frequency signal generated in the EUT, without going below 9 kHz if the EUT has additional internal clock. frequencies), and the stop frequency to ten times the highest allowable frequency of the EUT passband.

k) MAX HOLD was selected, and the marker peak function was used to find the highest emission(s) outside the passband. (This could be either at a frequency lesser or greater than the passband frequencies.)
l) A plot was captured for inclusion in the test report.
m) Steps c) to l) were repeated for each authorized frequency band/block of operation.

Any frequency outside the authorized bandwidth was attenuated by at least 43 + 10 log (P) dB. This corresponds to an absolute level of -13 dBm.

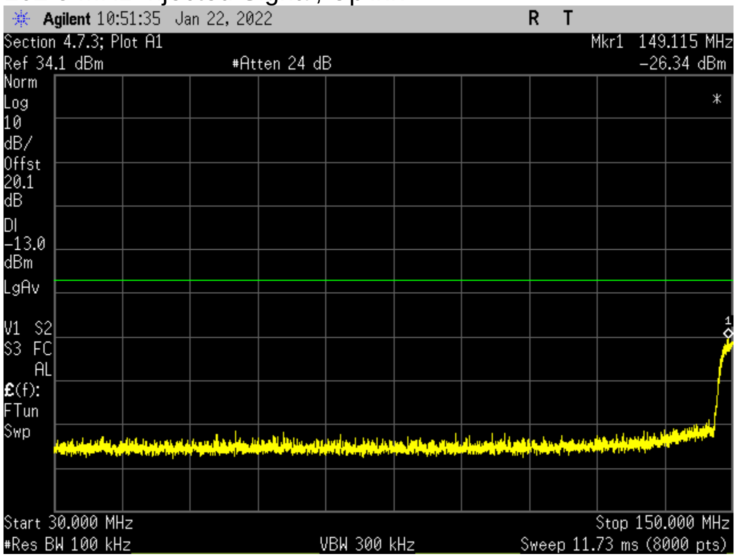
17.3 Results for Section 4.7.3

Model	080-300925	Specification	FCC KDB 935210 Sec. 4.7.3 FCC part 90.543 (e)(3)
Serial Number	080-300925-DVT0002	Test Date	01/22/2022
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-44); SIG-30; ATT-54		

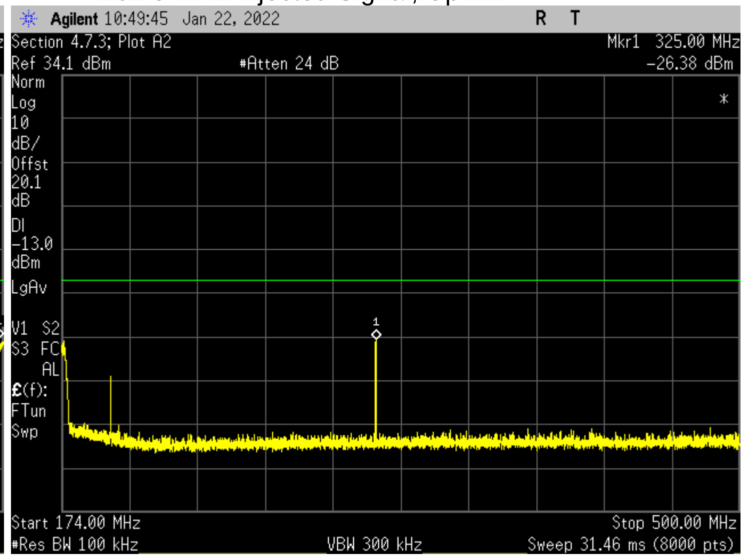
The spectrum analyzer was set to max hold mode.

Plot #	RBW MHz	VBW MHz	Output Mode	Sig Gen Modul	Sig Gen MHz	Sig Gen dBm	Spectrum Analyzer Start MHz	Spectrum Analyzer Stop MHz	Max reading Freq MHz	Max reading dBm
1	0.1	0.3	Uplink	CW	162.5	-47.5	30	150	149.115	-26.34
2	0.1	0.3	Uplink	CW	162.5	-47.5	174	500	325.00	-26.38
3	0.1	0.3	Uplink	CW	162.5	-47.5	500	750	503.59	-46.44
4	0.1	0.3	Uplink	CW	162.5	-47.5	750	1000	858.86	-47.63
5	1.0	3.0	Uplink	CW	162.5	-47.5	1000	2000	1930.99	-36.78
6	0.1	0.3	Downlink	CW	162.5	-45	30	150	149.76	-24.08
7	0.1	0.3	Downlink	CW	162.5	-45	174	500	325.00	-16.28
8	0.1	0.3	Downlink	CW	162.5	-45	500	750	622.08	-45.94
9	0.1	0.3	Downlink	CW	162.5	-45	750	1000	809.32	-47.02
10	1.0	3.0	Downlink	CW	162.5	-45	1000	2000	1757.59	-37.11

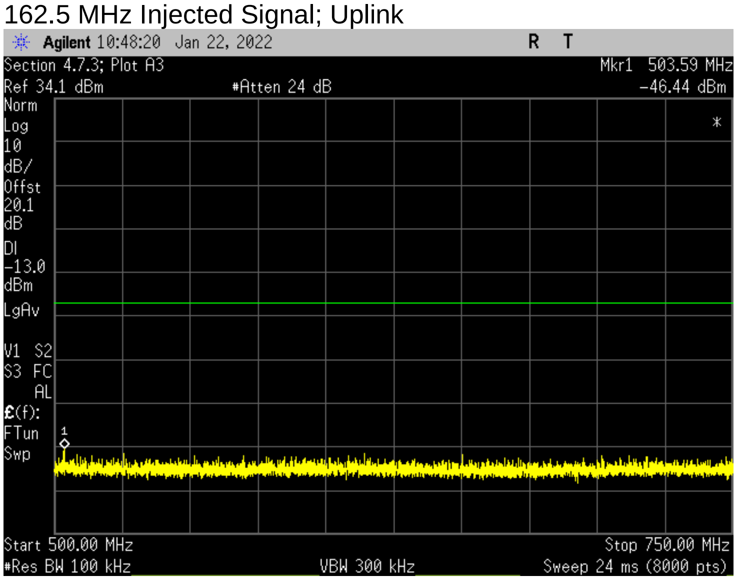
162.5 MHz Injected Signal; Uplink



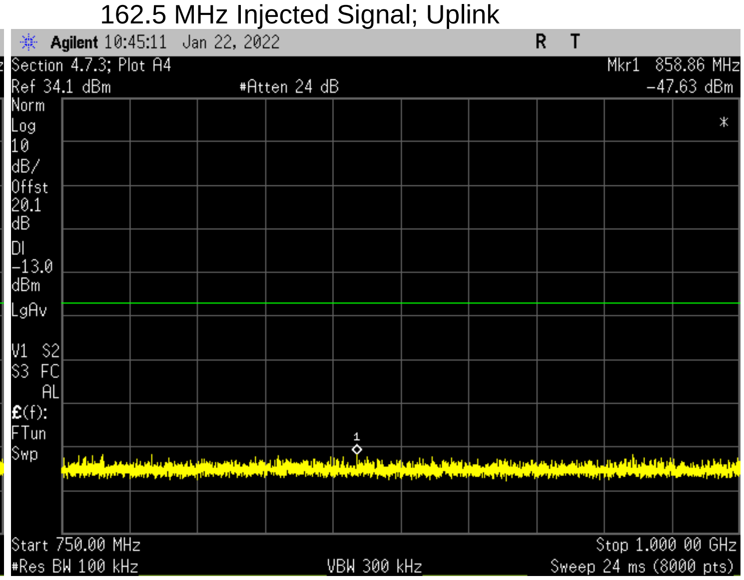
162.5 MHz Injected Signal; Uplink



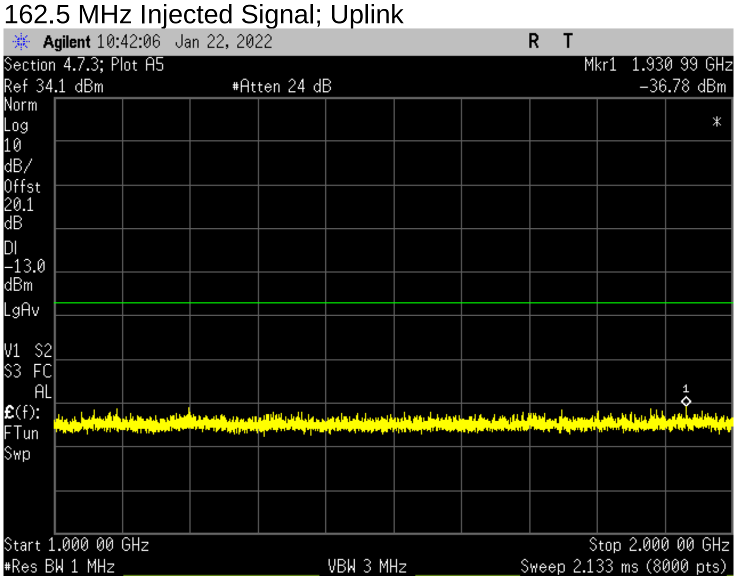
162.5 MHz Injected Signal; Uplink



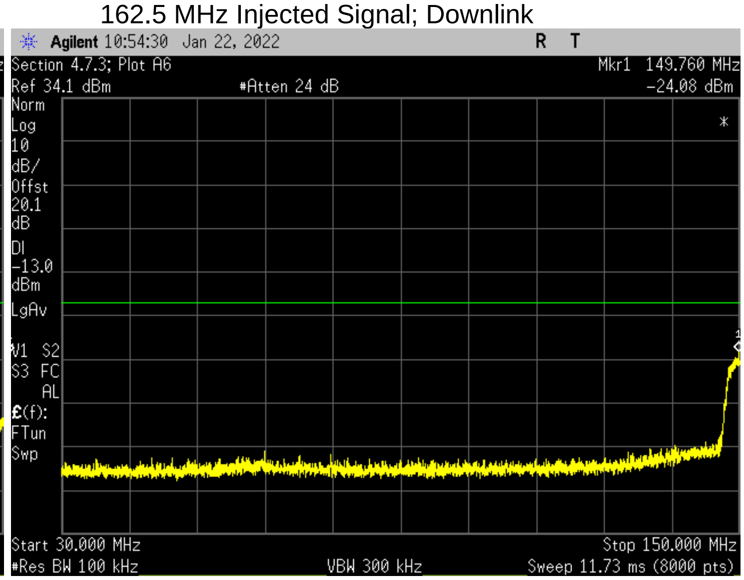
162.5 MHz Injected Signal; Uplink



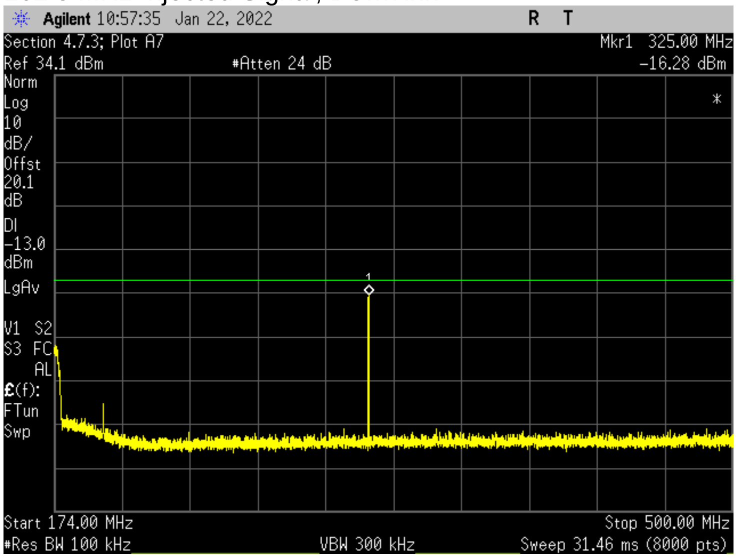
162.5 MHz Injected Signal; Uplink



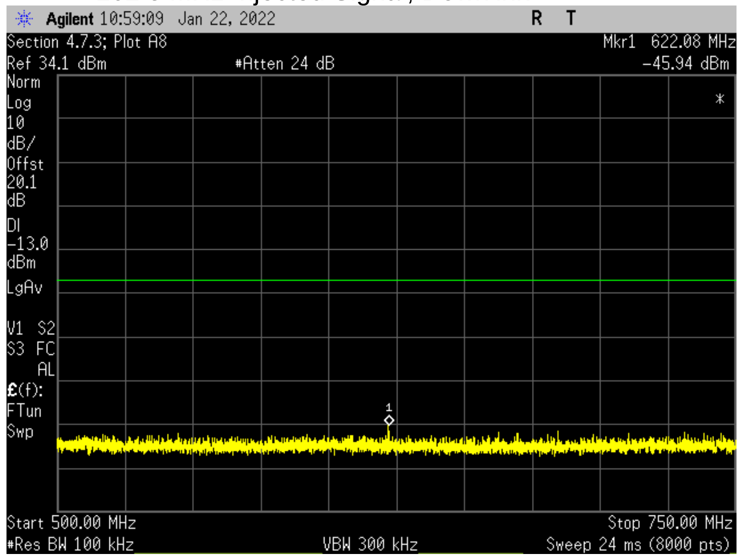
162.5 MHz Injected Signal; Downlink



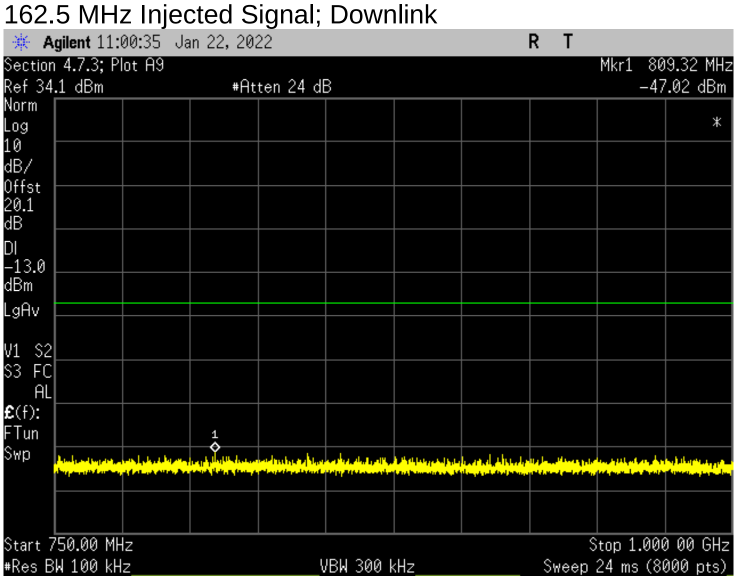
162.5 MHz Injected Signal; Downlink



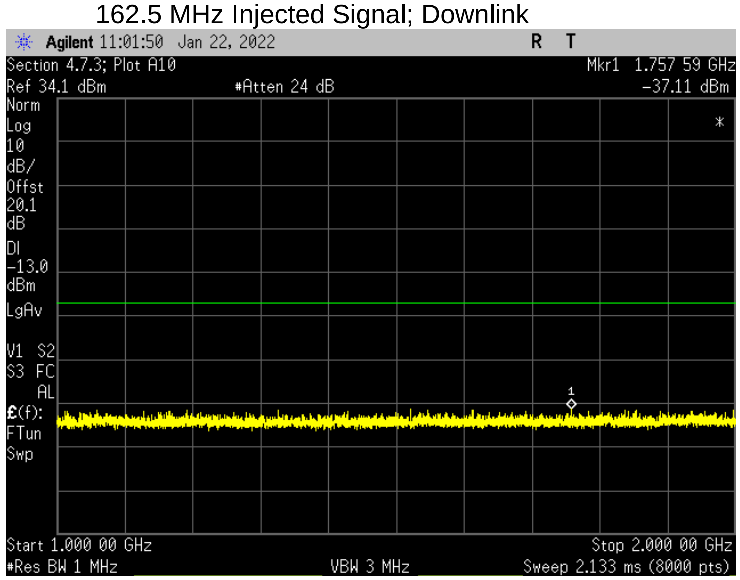
162.5 MHz Injected Signal; Downlink



162.5 MHz Injected Signal; Downlink



162.5 MHz Injected Signal; Downlink



18.0 SPURIOUS RADIATED EMISSIONS

18.1 Applicable Standard

The EUT shall comply with section 4.9 of FCC KDB 935210 D05 and FCC Part 2.1053. This test is intended to capture any emissions that radiate directly from the case, cabinet, control circuits, etc., instead of via the antenna output port, and thus would not be captured in conducted spurious emission measurements.

Spurious emissions of zone enhancers shall be suppressed as much as possible. Any emission must be attenuated below the power (P) of the highest emission contained within the authorized band, by at least: $43+10\text{x}\text{Log}_{10}\text{P}$, or 70 dB, whichever is less stringent, where P is the total RF output power of the test tones in watts. Since $43 +10\text{x}\text{Log}_{10}\text{P}$ is less stringent than 70 dB, that limit was used.

18.2 Test Procedures

Radiated emission measurements in the restricted bands were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists. Radiated emissions measurements were performed in the anechoic chamber at a test distance of 3 meters. The entire frequency range from 30 to 7500 MHz was slowly scanned and the emissions in the restricted frequency bands were recorded. Measurements were performed using the peak detector function.

The spectrum analyzer was adjusted for the following settings:

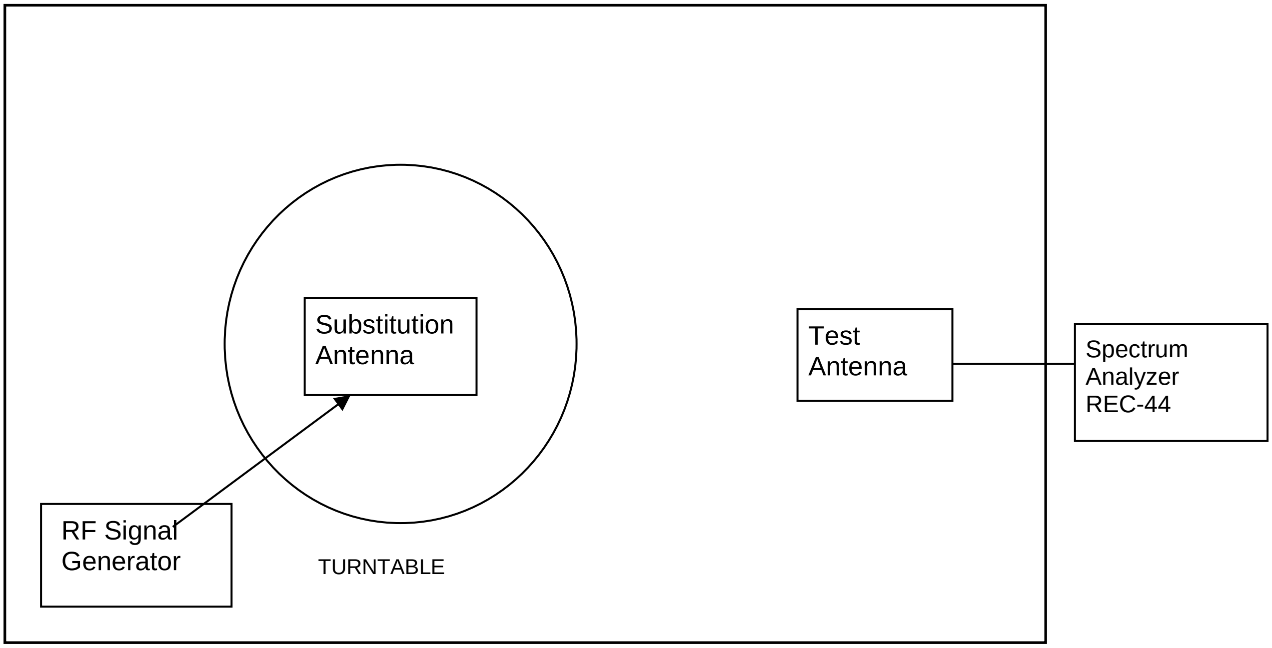
1) Resolution Bandwidth = 100 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1GHz.
2) Video Bandwidth = 300 kHz for spurious emissions below 1 GHz, and 3 MHz for spurious emissions above 1 GHz.
3) Sweep Speed = Slow enough to maintain measurement calibration.
4) Detector Mode = Positive Peak.

The transmitter to be tested was placed on the turntable in the standard test site, or an FCC listed site compliant with ANSI C63.4. The transmitter is transmitting into a non-radiating load that is placed on the turntable (except for the fundamental reading which had an antenna). Since the transmitter has an integral antenna, the tests are to be run with the unit operating into the integral antenna. Measurements were made from the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier. The transmitter was keyed during the tests.

For each spurious frequency, the test antenna was raised and lowered from 1 m to 4m to obtain a maximum reading on the spectrum analyzer with the test antenna at horizontal polarity. Then the turntable was rotated 360°to determine the maximum reading. This procedure was repeated to obtain the highest possible reading. This maximum reading was recorded.

Each measurement was repeated for each spurious frequency with the test antenna polarized vertically.

Figure 1. Drawing of Radiated Emissions Setup



ANSI C63.4 Listed Test Site

Notes:
- Test Antenna height varied from 1 to 4 meters
- Distance from antenna to tested system is 3 meters
- Not to Scale

Frequency MHz	Test Antenna	Substitution Antenna	Receiver	Signal Generator
30 - 200	ANT-80	ANT-79	REC-44	SIG-30
200 - 1000	ANT-08	ANT-07	REC-44	SIG-30
1000-2000	ANT-13	ANT-66	REC-44	SIG-30

The transmitter was removed and replaced with a broadband substitution antenna. The substitution antenna is calibrated so that the gain relative to a dipole is known. The center of the substitution antenna was at the same location as the center of the transmitter.

The substitution antenna was fed at the transmitter end with a signal generator connected to the antenna by means of a non-radiating cable. With the antennas at both ends horizontally polarized, and with the signal generator tuned to a particular spurious frequency, the test antenna was raised and lowered to obtain a maximum reading at the spectrum analyzer. The level of the signal generator output was adjusted until the previously recorded maximum reading for this set of conditions was obtained. The measurements were repeated with both antennas horizontally and vertically polarized for each spurious frequency.

The power in dBm into a reference ideal half-wave dipole antenna was calculated by reducing the readings obtained in steps k) and l) by the power loss in the cable between the generator and the antenna, and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna by the following formula:
Pd(dBm) = *Pg*(dBm) – *cable loss* (dB) + *antenna gain* (dB)

where:
Pd is the dipole equivalent power and
Pg is the generator output power into the substitution antenna.
The *Pd* levels record in step m) are the absolute levels of radiated spurious emissions in dBm.

Since by mathematical definition, P(dBm) – (43+10xLOG P(W)) = -13 dBm, the limit for spurious emissions was set to -13 dBm equivalent radiated power.

18.2.1 Spurious Radiated Emissions Test Results

Model	080-300925	Specification	FCC KDB 935210
Serial Number	080-300925-DVT0002	Test Date	December 6, 2021 & January 21, 2022
Test Distance	3 Meters	Notes	Transmit Mode
Test Personnel	Joseph Strzelecki; Chris Dalessio	Test Location	Chamber E
Test Equipment	See Figure 1		

The emissions were measured from 30-2000 MHz. The worst case is shown below.

Transmit at 162.5 MHz

Freq. MHz	Dect.	Ant. Pol.	EUT dBm	Limit dBm	Margin Under Limit dB
41.6	P	H	-50.6	-13.0	37.6
69.2	P	H	-51.4	-13.0	38.4
97.4	P	H	-40.4	-13.0	27.4
125.0	P	H	-34.2	-13.0	21.2
152.7	P	H	-50.6	-13.0	37.6
162.0	P	H	-36.1	-13.0	23.1
180.8	P	H	-42.2	-13.0	29.2
208.5	P	H	-33.0	-13.0	20.0
222.3	P	H	-48.7	-13.0	35.7
236.1	P	H	-45.4	-13.0	32.4
250.1	P	H	-51.8	-13.0	38.8
291.7	P	H	-48.2	-13.0	35.2
319.4	P	H	-42.6	-13.0	29.6
347.1	P	H	-42.4	-13.0	29.4
374.9	P	H	-43.9	-13.0	30.9
388.7	P	H	-56.2	-13.0	43.2
402.6	P	H	-46.1	-13.0	33.1
430.3	P	H	-46.7	-13.0	33.7
458.7	P	H	-51.6	-13.0	38.6
487.5	P	H	-46.0	-13.0	33.0
525.0	P	H	-62.9	-13.0	49.9
575.0	P	H	-63.0	-13.0	50.0
626.3	P	H	-52.9	-13.0	39.9
653.8	P	H	-51.9	-13.0	38.9
681.3	P	H	-45.2	-13.0	32.2
736.3	P	H	-51.8	-13.0	38.8
792.5	P	H	-53.9	-13.0	40.9
1125.0	P	H	-48.5	-13.0	35.5
1150.0	P	H	-54.5	-13.0	41.5
1320.0	P	H	-54.7	-13.0	41.7

Freq. MHz	Dect.	Ant. Pol.	EUT dBm	Limit dBm	Margin Under Limit dB
1375.0	P	H	-51.5	-13.0	38.5
1500.0	P	H	-56.6	-13.0	43.6
1625.0	P	H	-52.3	-13.0	39.3
1875.0	P	H	-53.4	-13.0	40.4
1921.7	P	H	-52.2	-13.0	39.2
1980.0	P	H	-54.3	-13.0	41.3
35.0	P	V	-51.8	-13.0	38.8
41.6	P	V	-43.4	-13.0	30.4
97.4	P	V	-43.4	-13.0	30.4
109.0	P	V	-56.8	-13.0	43.8
125.0	P	V	-36.3	-13.0	23.3
143.3	P	V	-50.6	-13.0	37.6
152.7	P	V	-43.6	-13.0	30.6
162.0	P	V	-36.7	-13.0	23.7
180.8	P	V	-46.7	-13.0	33.7
208.5	P	V	-39.7	-13.0	26.7
264.0	P	V	-47.5	-13.0	34.5
291.7	P	V	-44.1	-13.0	31.1
347.1	P	V	-45.6	-13.0	32.6
361.0	P	V	-51.3	-13.0	38.3
374.9	P	V	-45.1	-13.0	32.1
402.6	P	V	-48.1	-13.0	35.1
430.3	P	V	-45.7	-13.0	32.7
458.7	P	V	-45.9	-13.0	32.9
487.5	P	V	-45.8	-13.0	32.8
515.0	P	V	-47.8	-13.0	34.8
542.5	P	V	-45.8	-13.0	32.8
626.3	P	V	-49.9	-13.0	36.9
650.1	P	V	-40.5	-13.0	27.5
681.3	P	V	-37.2	-13.0	24.2
708.8	P	V	-50.9	-13.0	37.9
736.3	P	V	-47.4	-13.0	34.4
792.5	P	V	-52.9	-13.0	39.9
820.0	P	V	-50.7	-13.0	37.7
847.5	P	V	-50.6	-13.0	37.6
903.8	P	V	-51.9	-13.0	38.9
1125.0	P	V	-52.3	-13.0	39.3
1250.0	P	V	-55.8	-13.0	42.8
1320.0	P	V	-54.1	-13.0	41.1
1386.7	P	V	-52.4	-13.0	39.4
1451.7	P	V	-55.9	-13.0	42.9
1585.0	P	V	-55.0	-13.0	42.0
1660.0	P	V	-54.2	-13.0	41.2
1875.0	P	V	-53.6	-13.0	40.6
1986.7	P	V	-50.7	-13.0	37.7

Judgment: Passed by at least 20 dB.

19.0 MEASUREMENT INSTRUMENTATION UNCERTAINTY

Measurement	Uncertainty
Radiated Emissions, E-field, 3 meters, 30 to 200 MHz	4.8 dB
Radiated Emissions, E-field, 3 meters, 200 to 1000 MHz	4.6 dB
Radiated Emissions, E-field, 3 meters, 1 to 6 GHz	4.9 dB
Bandwidth using marker delta method	1% of frequency span
Conducted power 150-174 MHz	0.5 dB
Amplitude measurement 1-6000 MHz;	1.8 dB

The uncertainties represent expanded uncertainties expressed at the 95% confidence level using a coverage factor of k=2 in accordance with CISPR 16-4-2.

20.0 REVISION HISTORY

RP-9563A2 Revisions:			
Rev.	Affected Sections	Description	Rationale