Electromagnetic Compatibility Test Report

Tests Performed on a Westell, Inc.

UHF Bi-Directional Amplifier, Model 080-300926

Radiometrics Document RP-9563B2

ACCREDITED
TESTING CERT #1495.01

Product Detail:
FCC ID: NVR230021014U Equipment type: 450 - 512 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 North Commons Dr. Aurora, IL 60504	**Radiometrics Midwest Corporation** 12 Devonwood Avenue Romeoville, IL 60446 Phone: (815) 293-0772

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

Document RP-9563B2 Revisions:

Rev.	Issue Date	Affected Sections	Revised By
0	January 25, 2022		
1	January 26, 2022	Cover, 2.0, 3.1, 13.2.1.2, 14.3, 15.3	Joseph Strzelecki

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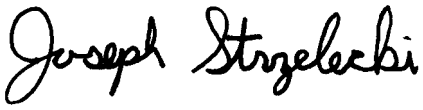
1.0 ADMINISTRATIVE DATA

Equipment Under Test: A Westell, Inc., UHF Bi-Directional Amplifier Model: 080-300926; Serial Number: CS40-U37-U0D-A0-DVT0003 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, thru January 22, 2022
Test Report Written and Approved By:  01/26/2022 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 Technologies, Incorporated	
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2.0 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a UHF Bi-Directional Amplifier, Model 080-300926, 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	450-512 MHz	4.2	Pass
Out of Band Rejection	326-636 MHz	4.3	Pass
Input vs Output Signal Comparison	450-512 MHz	4.4	Pass
Input/output power and amplifier gain	450-512 MHz	4.5	Pass
Noise figure Measurements	450-512 MHz	4.6	Pass
Out-of-band/out-of-block emissions conducted measurements	450-512 MHz	4.7.2	Pass
EUT spurious emissions conducted measurements	30-5,200 MHz	4.7.3	Pass
Frequency Stability	N/A	4.7	Note 1
Field Strength of Spurious Radiated emissions	30-5,200 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 080-300926, 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 450-512 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	UHF Bi-Directional Amplifier	E	Westell, Inc.	080-300926	CS40-U37-U0D-A0-DVT0003
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-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-31	Rohde Schwarz	Vector Signal Generator	SMJ 100A	101395	100kHz-6GHz	24 Mo.	09/08/20
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	080-300926	Specifications	FCC KDB 935210 D05 Sec. 4.2
Serial Number	CS40-U37-U0D-A0-DVT0003	Test Dates	12/03/2021 & 01/07/2022
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	457.0	-50.0	-4.8	N/A	25.40
CW	Uplink	457.0	-49.0	-3.8	1.0	26.40
CW	Uplink	457.0	-48.0	-2.8	1.0	27.40
CW	Uplink	457.0	-47.0	-2.6	0.2	27.60
CW	Uplink	486.025	-50.0	-5.00	N/A	25.20
CW	Uplink	486.025	-49.0	-4.00	1.0	26.20
CW	Uplink	486.025	-48.0	-3.00	1.0	27.20
CW	Uplink	486.025	-47.0	-3.80	-0.8	26.40
CW	Uplink	511.975	-50.0	-4.9	N/A	25.30
CW	Uplink	511.975	-49.0	-3.90	1.0	26.30
CW	Uplink	511.975	-48.0	-2.9	1.0	27.30
CW	Uplink	511.975	-47.0	-3.8	-0.9	26.40
CW	Downlink	450.025	-40.4	4.30	N/A	34.50
CW	Downlink	450.025	-39.4	5.30	1.0	35.50
CW	Downlink	450.025	-38.4	6.30	1.0	36.50
CW	Downlink	450.025	-37.4	5.90	-0.4	36.10
CW	Downlink	482.025	-40.5	4.2	N/A	34.40
CW	Downlink	482.025	-39.5	5.2	1.0	35.40
CW	Downlink	482.025	-38.5	6.2	1.0	36.40
CW	Downlink	482.025	-37.5	5.7	-0.5	35.90
CW	Downlink	508.975	-40.7	3.9	N/A	34.10
CW	Downlink	508.975	-39.7	4.90	1.0	35.10
CW	Downlink	508.975	-38.7	5.9	1.0	36.10
CW	Downlink	508.975	-37.7	4.5	-1.4	34.70

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.

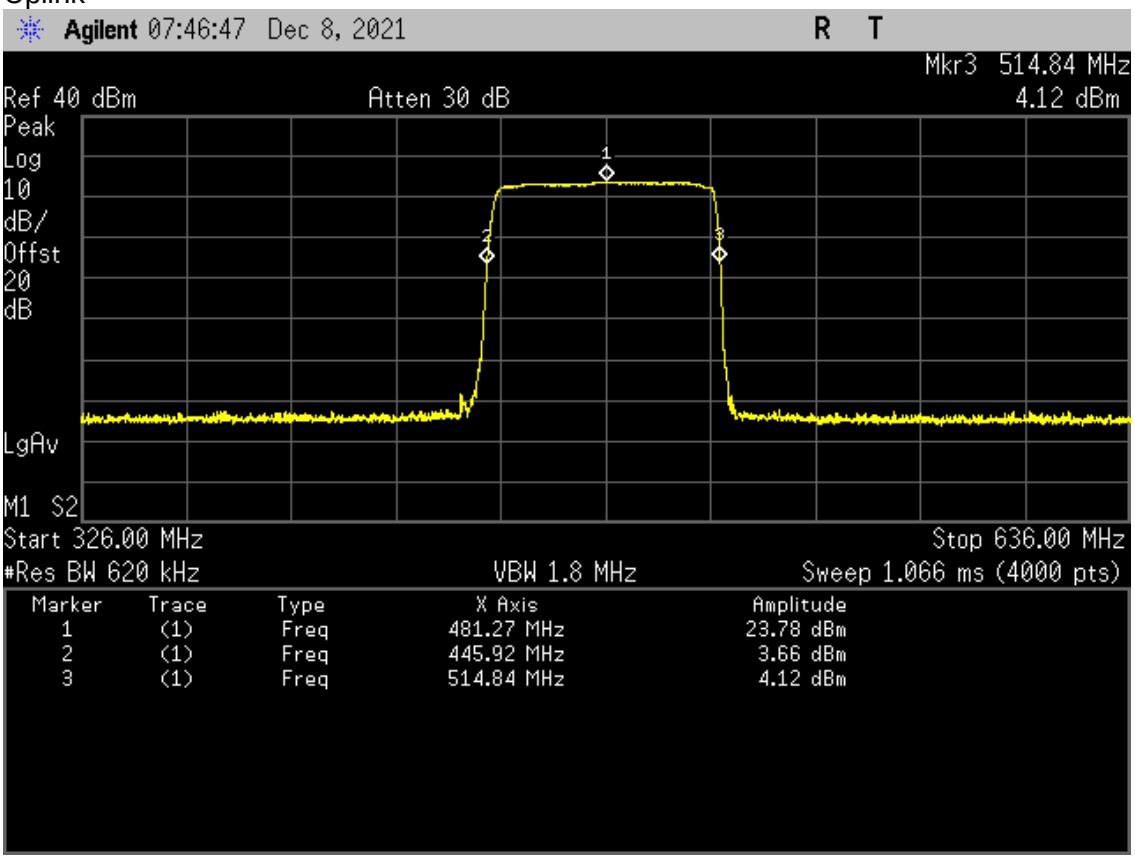
12.3 Passband Bandwidth Test Results

Model	080-300926	Specification	KDB 935210 D05 Sec 4.3
Serial Number	CS40-U37-U0D-A0-DVT0003	Test Date	12/08/2021 & 01/08/2022
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-44); SIG-32		

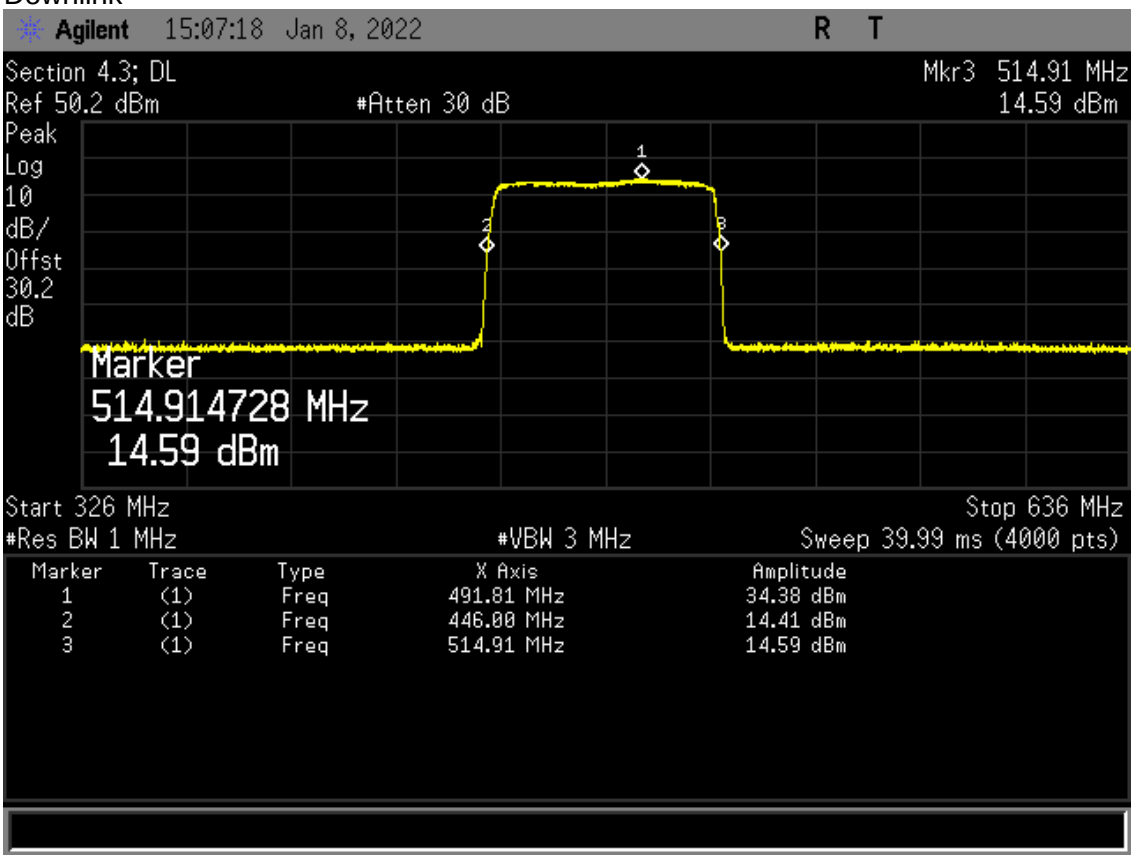
				20 dB Down		20 dB	Max Reading	
Band	RBW MHz	VBW MHz	Band in MHz	1st Freq. MHz	2nd Freq. MHz	BW MHz	F0 MHz	dBm
Uplink	0.3	1.0	450 to 512	445.92	514.84	**68.92**	481.27	23.78
Downlink	0.3	1.0	450 to 512	446	514.9	**68.91**	498.81	34.38

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

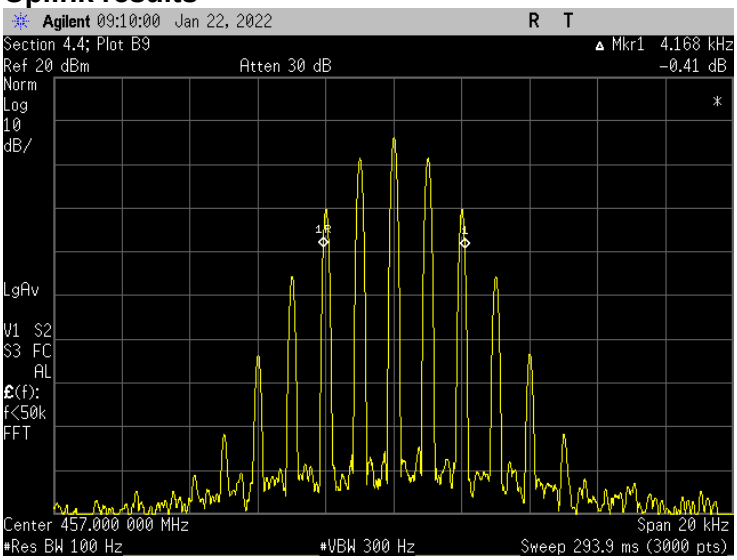
Model	080-300926	Specifications	FCC KDB 935210 D05 Sec. 4.4
Serial Number	CS40-U37-U0D-A0-DVT0003	Test Dates	12/08/2021 & 01/22/2022
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-44); Attenuator (ATT-54);Signal Generator (SIG-33)		

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
Gen	4K00F1E	B9	457.0	8.5	4	100	300	Generator	4.168	N/A
Uplink	4K00F1E	B1	457.0	-46.5	4	100	300	Amp Out	4.141	Below
Uplink	4K00F1E	B2	457.0	-43.5	4	100	300	Amp Out	4.141	ON+3
Gen	11K3F3E	B10	457.0	8.5	11	100	300	Generator	14.121	N/A
Uplink	11K3F3E	B3	457.0	-46.5	11	100	300	Amp Out	14.121	Below
Uplink	11K3F3E	B4	457.0	-43.5	11	100	300	Amp Out	14.121	ON+3
Gen	16K0F3E	B11	457.0	8.5	16	300	1000	Generator	20.323	N/A
Uplink	16K0F3E	B5	457.0	-46.5	16	300	1000	Amp Out	20.309	Below
Uplink	16K0F3E	B6	457.0	-43.5	16	300	1000	Amp Out	20.323	ON+3
Gen	6K25F1D	B12	457.0	8.5	4	100	300	Generator	10.203	N/A
Uplink	6K25F1D	B7	457.0	-46.5	4	100	300	Amp Out	10.320	Below
Uplink	6K25F1D	B8	457.0	-43.5	4	100	300	Amp Out	10.203	ON+3
Gen	4K00F1E	B21	508.975	8.5	4	100	300	Generator	4.168	N/A
Downlink	4K00F1E	B13	508.975	-38.5	4	100	300	Amp Out	4.168	Below
Downlink	4K00F1E	B14	508.975	-35.5	4	100	300	Amp Out	4.168	ON+3
Gen	11K3F3E	B22	508.975	8.5	11	100	300	Generator	14.121	N/A
Downlink	11K3F3E	B15	508.975	-38.5	11	100	300	Amp Out	14.130	Below
Downlink	11K3F3E	B16	508.975	-35.5	11	100	300	Amp Out	14.130	ON+3
Gen	16K0F3E	B23	508.975	8.5	16	300	1000	Generator	20.324	N/A
Downlink	16K0F3E	B17	508.975	-38.5	16	300	1000	Amp Out	20.324	Below
Downlink	16K0F3E	B18	508.975	-35.5	16	300	1000	Amp Out	20.324	ON+3
Gen	6K25F1D	B24	508.975	8.5	4	100	300	Generator	10.586	N/A
Downlink	6K25F1D	B19	508.975	-38.5	4	100	300	Amp Out	10.837	Below
Downlink	6K25F1D	B20	508.975	-35.5	4	100	300	Amp Out	10.320	ON+3

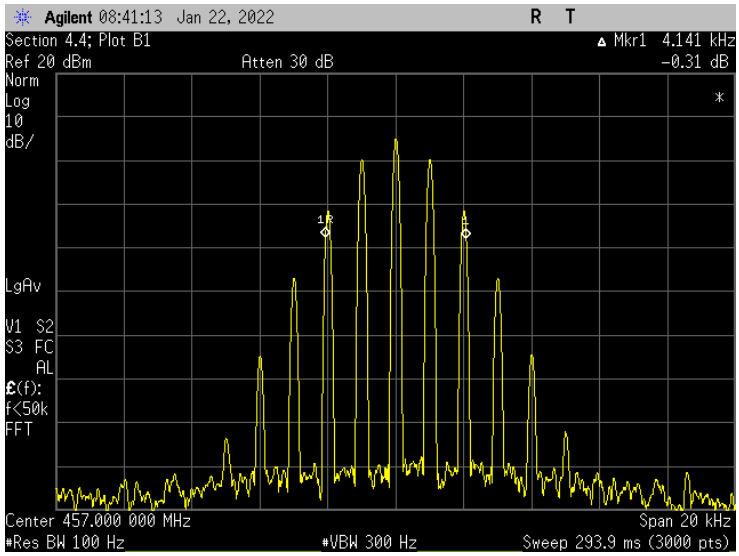
The generator output signal is the amplifier input.
The Generator plots were not repeated for the down link, since they are the same as the up link

13.2.1.1 Occupied Bandwidth Results

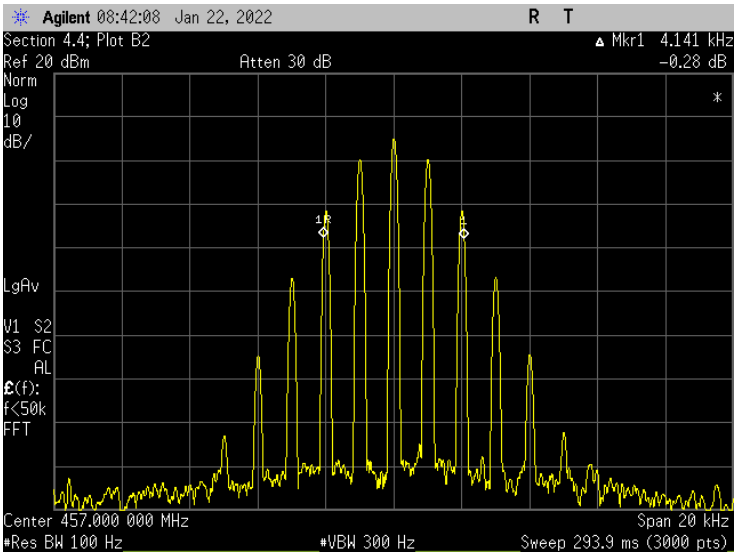
Uplink results



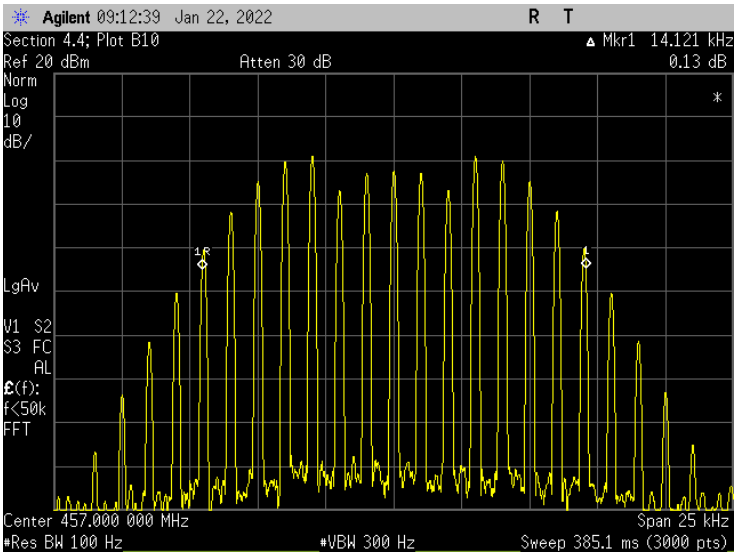
Input Signal to Amp; 4K00F1E



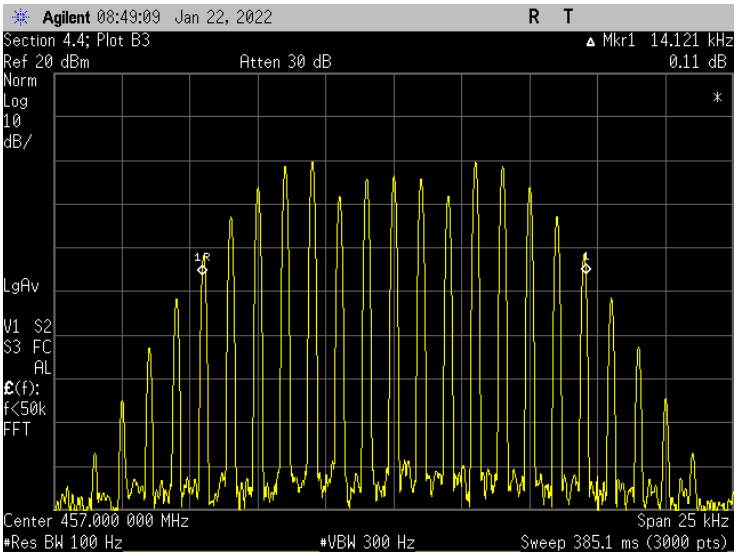
AMP Output: Below AGC, 4K00F1E



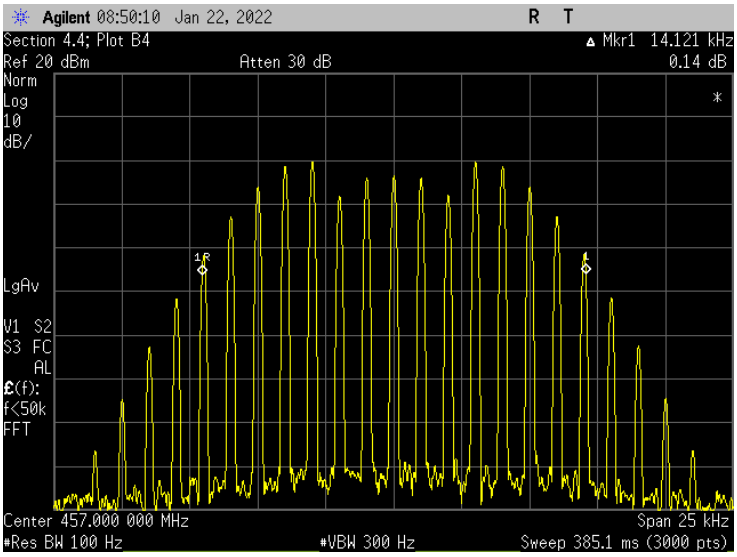
AMP Output: Level Above AGC, 4K00F1E



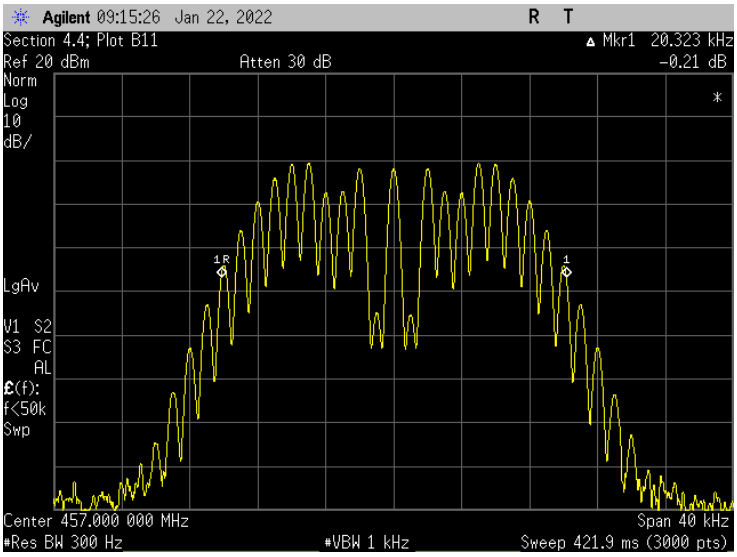
Input Signal to Amp; 11K3F3E



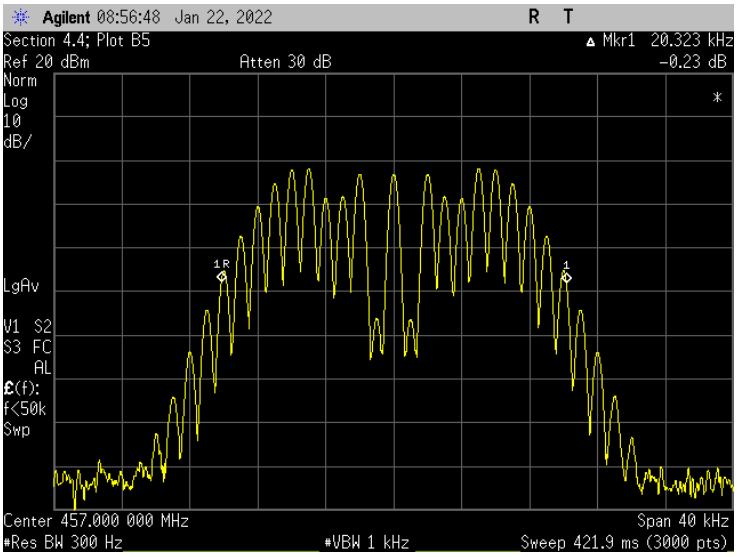
AMP Output: Below AGC; 11K3F3E



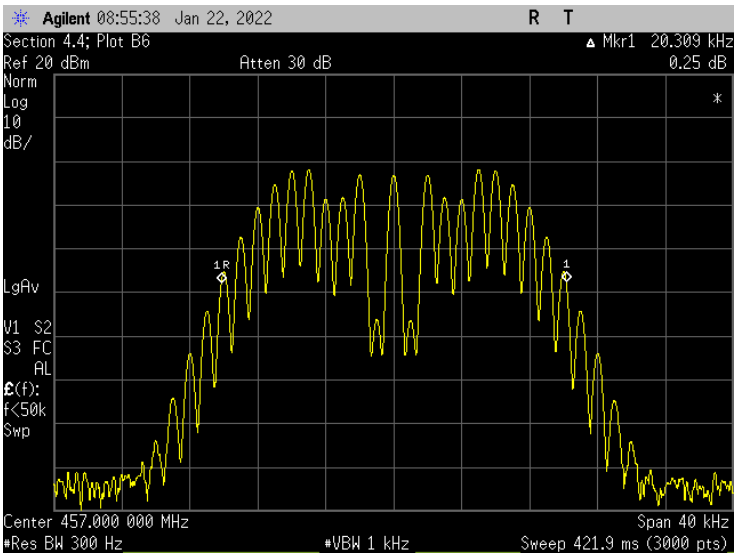
AMP Output: Level Above AGC; 11K3F3E



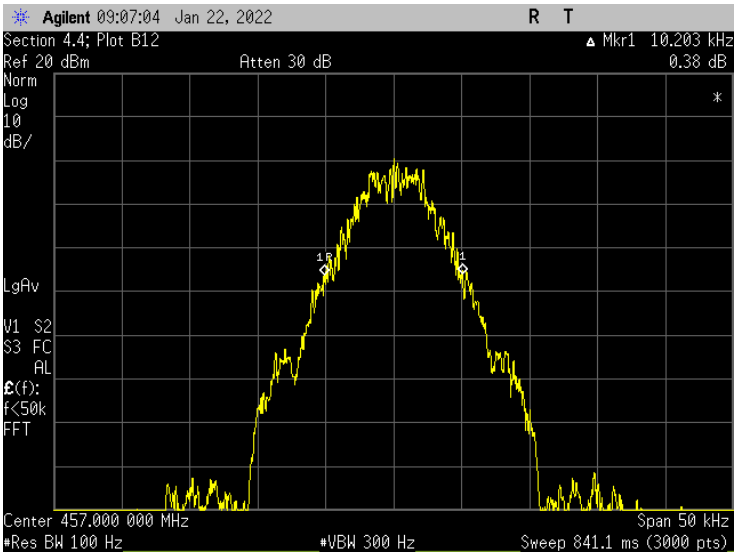
Input Signal to Amp; 16K0F3E



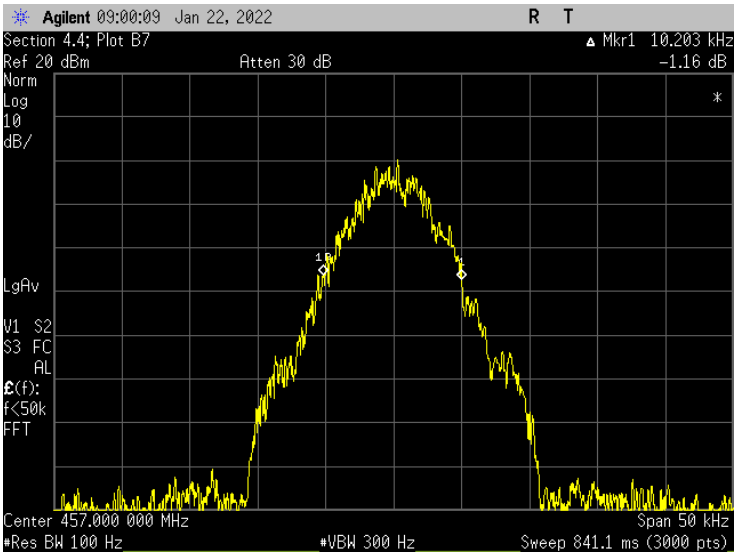
Amp output, Below AGC; 16K0F3E



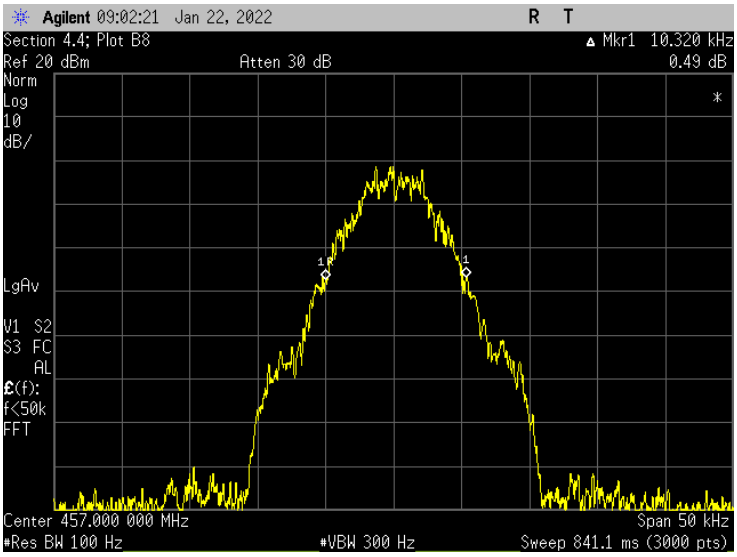
AMP Output: Level Above AGC; 16K0F3E



Input Signal to Amp; 6K25F1D

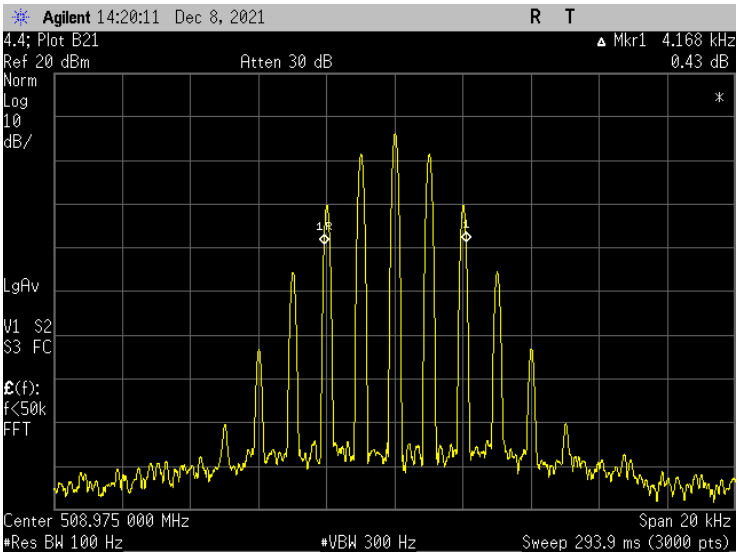


Amp output, Below AGC, 6K25F1D

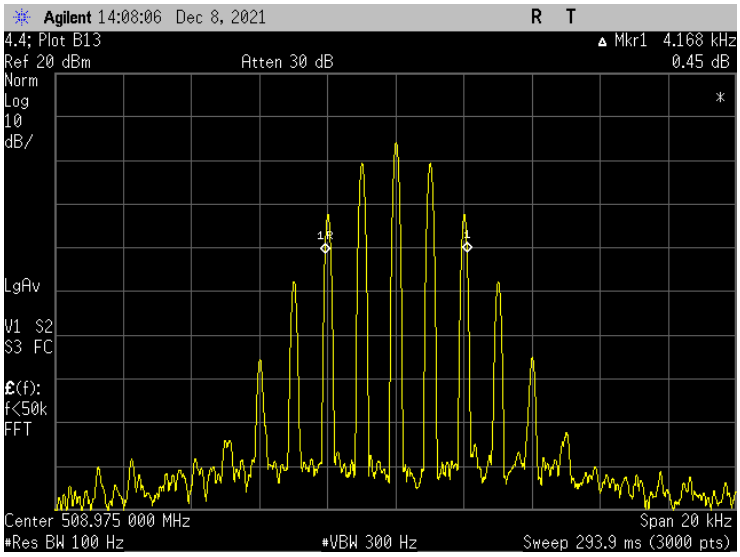


AMP Output: Level above AGC; 6K25F1D

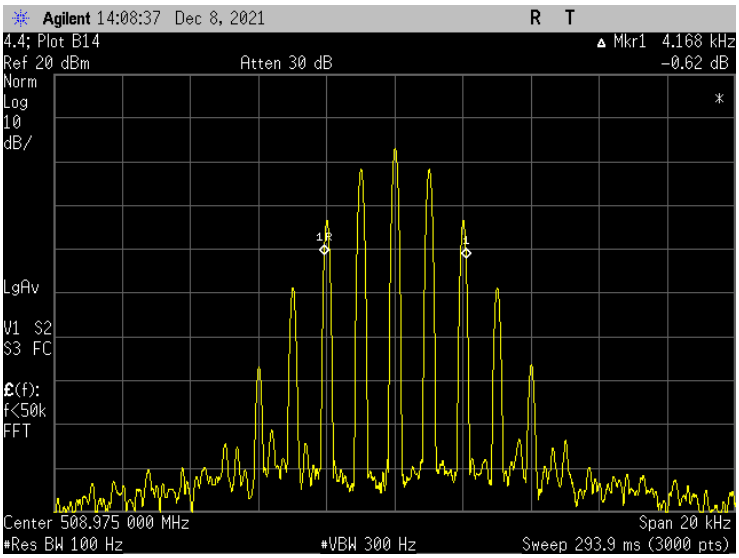
Downlink results



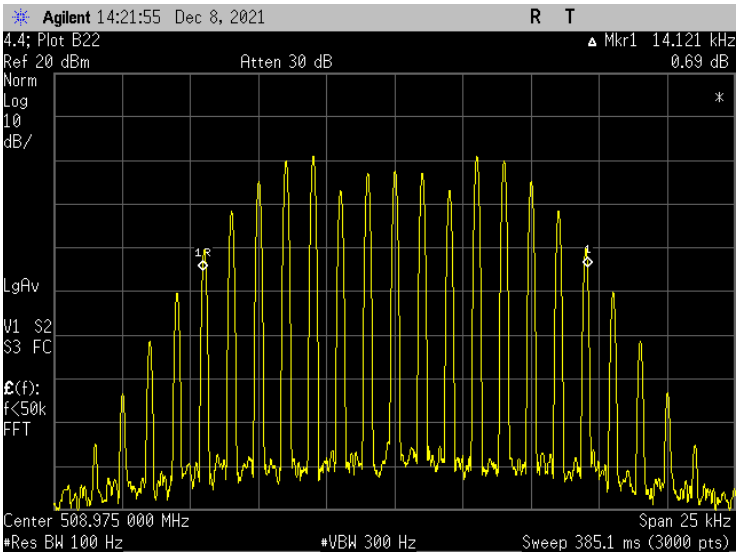
Input Signal to Amp; 4K00F1E



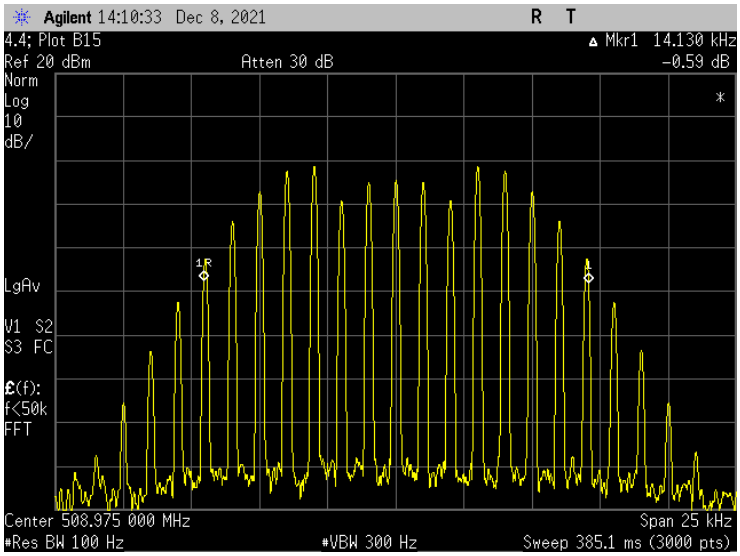
AMP Output: Below AGC, 4K00F1E



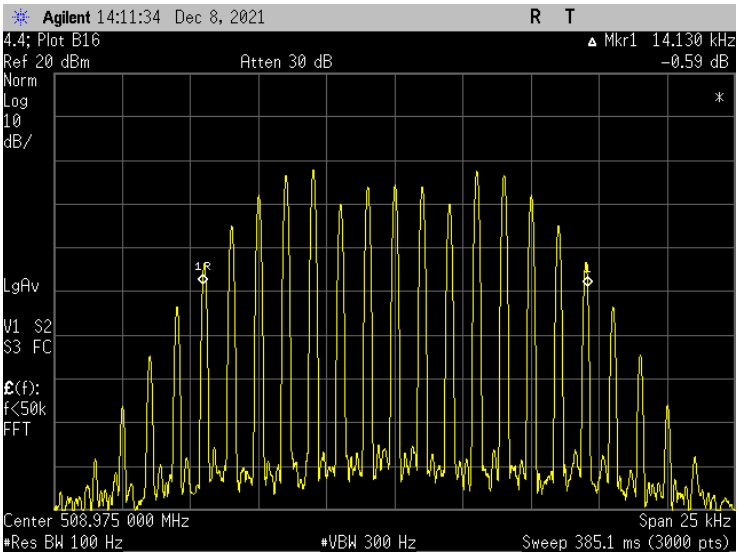
AMP Output: Level above AGC; 4K00F1E



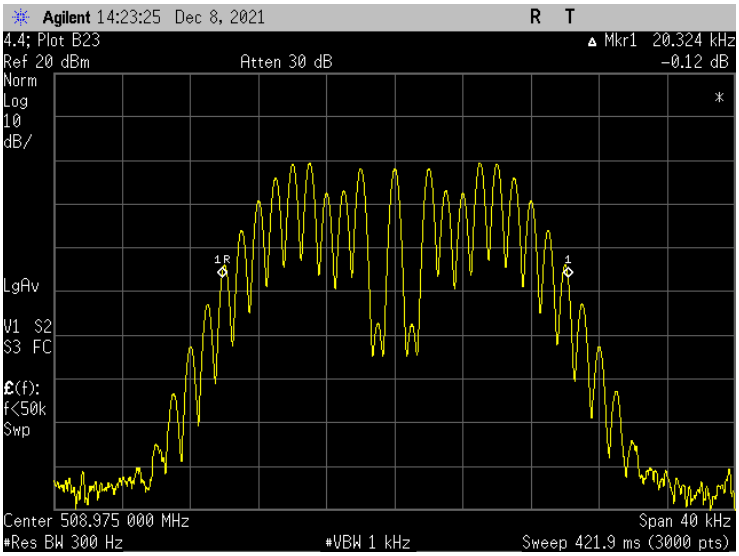
Input Signal to Amp; 11K3F3E



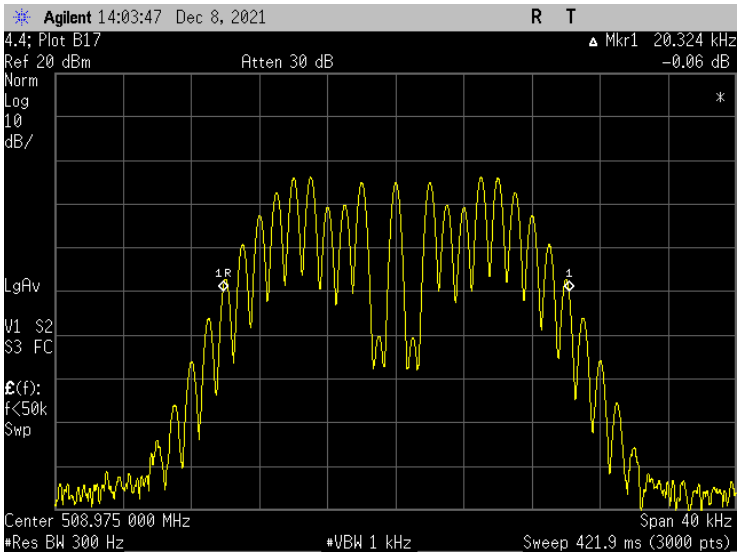
AMP Output: Below AGC, 11K3F3E



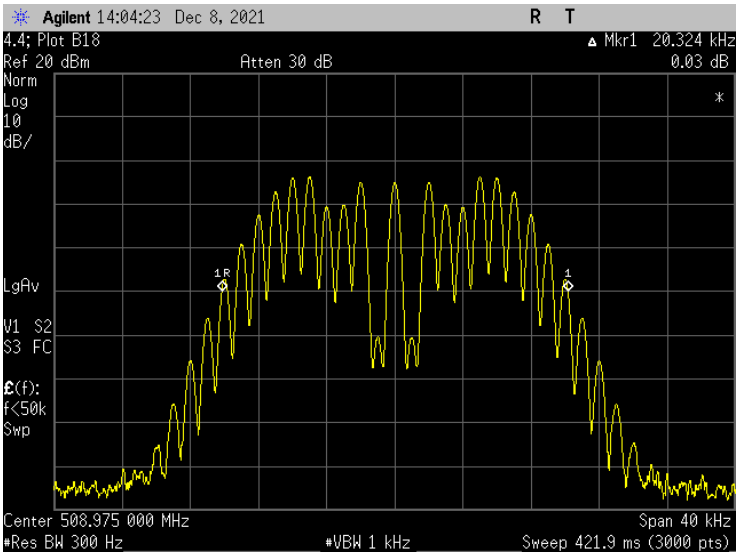
AMP Output: Level above AGC; 11K3F3E



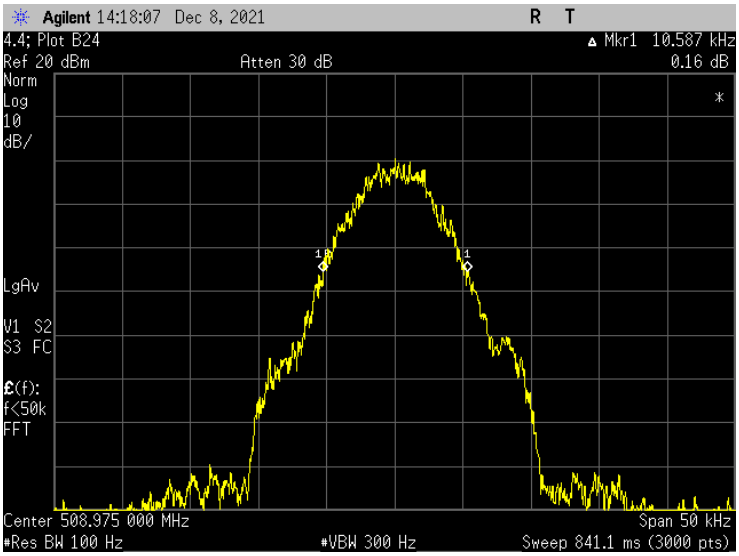
Input Signal to Amp; 16K0F3E



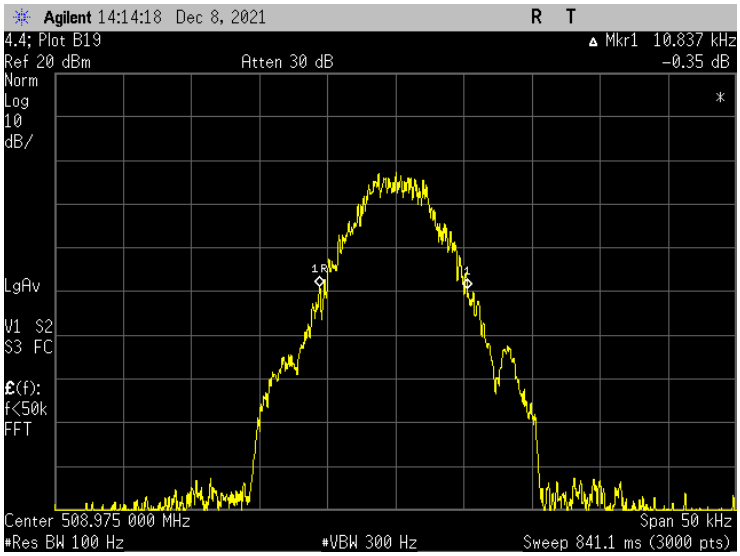
AMP Output: Below AGC, 16K0F3E



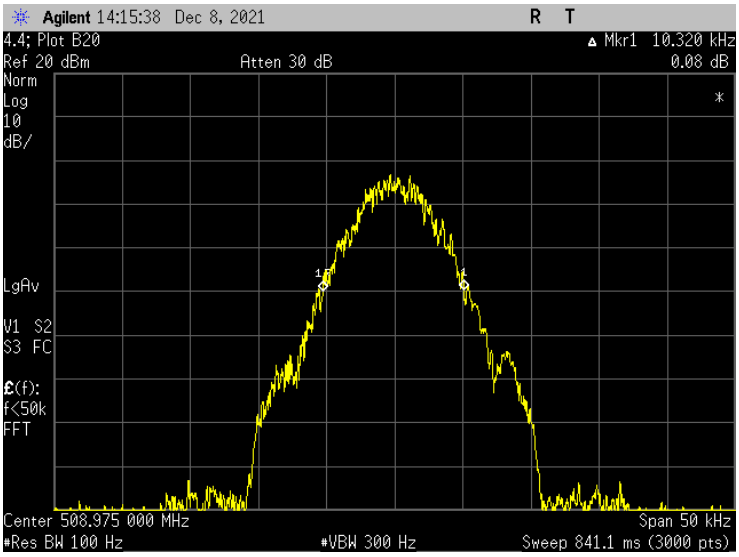
AMP Output: Level above AGC; 16K0F3E



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

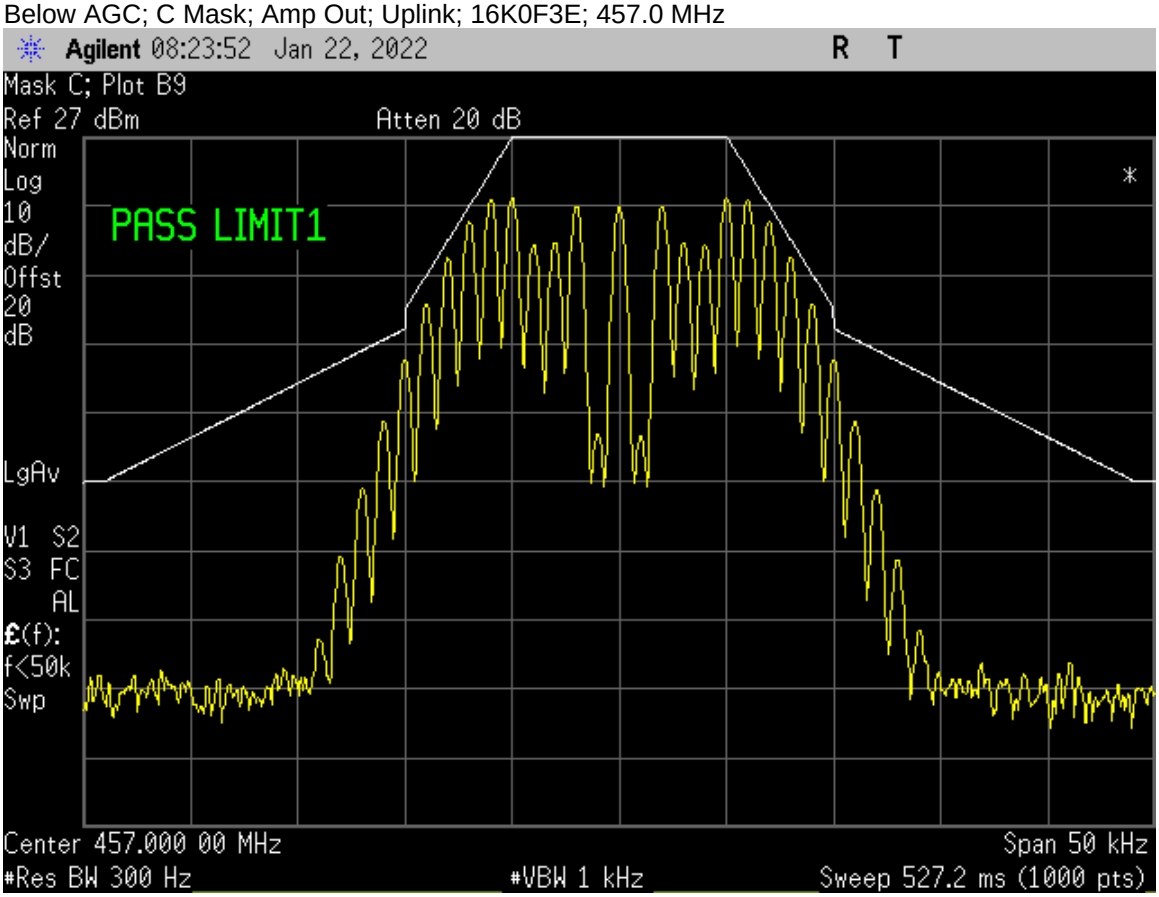
Model	080-300926	Specifications	FCC KDB 935210 D05 Sec. 4.4
Serial Number	CS40-U37-U0D-A0-DVT0003	Test Dates	01/11, 01/12/2022 & 01/22/2022
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-44); Attenuator (ATT-54);Signal Generator (SIG-33)		

Output	Mod. Type	EUT AGC Mode	Plot #	Generator Output MHz	Generator Setting dBm	Mask	Settings RBW Hz	Span kHz	Test Date
Uplink	16KE	Below	B9	457.0	-46.5	C	300	50	1/22/2022
Uplink	16KE	ON+3	B10	457.0	-43.5	C	300	50	1/22/2022
Uplink	4KE	Below	B11	457.0	-46.5	E	100	20	1/22/2022
Uplink	4KE	ON+3	B12	457.0	-43.5	E	100	20	1/22/2022
Uplink	6KD	Below	B13	457.0	-46.5	D	100	50	1/22/2022
Uplink	6KD	ON+3	B14	457.0	-43.5	D	100	50	1/22/2022
Uplink	11KE	Below	B15	457.0	-46.5	D	100	50	1/22/2022
Uplink	11KE	ON+3	B16	457.0	-43.5	D	100	50	1/22/2022
Downlink	16KE	Below	B17	508.975	-39.5	C	300	50	1/11/2022
Downlink	16KE	ON+3	B18	508.975	-36.5	C	300	50	1/11/2022
Downlink	4KE	Below	B19	508.975	-39.5	E	100	20	1/11/2022
Downlink	4KE	ON+3	B20	508.975	-36.5	E	100	20	1/11/2022
Downlink	6KD	Below	B21	508.975	-39.5	D	100	50	1/11/2022
Downlink	6KD	ON+3	B22	508.975	-36.5	D	100	50	1/11/2022
Downlink	11KE	Below	B23	508.975	-39.5	D	100	50	1/11/2022
Downlink	11KE	ON+3	B24	508.975	-36.5	D	100	50	1/11/2022
GEN	16KE	N/A	B25	457.0	7.0	C	300	50	1/22/2022
GEN	4KE	N/A	B26	457.0	7.0	E	100	20	1/22/2022
GEN	6KD	N/A	B27	457.0	7.0	D	100	50	1/22/2022
GEN	11KE	N/A	B28	457.0	7.0	D	100	50	1/22/2022
GEN	16KE	N/A	B29	508.975	7.0	C	300	50	1/12/2022
GEN	4KE	N/A	B30	508.975	7.0	E	100	20	1/12/2022
GEN	6KD	N/A	B31	508.975	7.0	D	100	50	1/12/2022
GEN	11KE	N/A	B32	508.975	7.0	D	100	50	1/12/2022

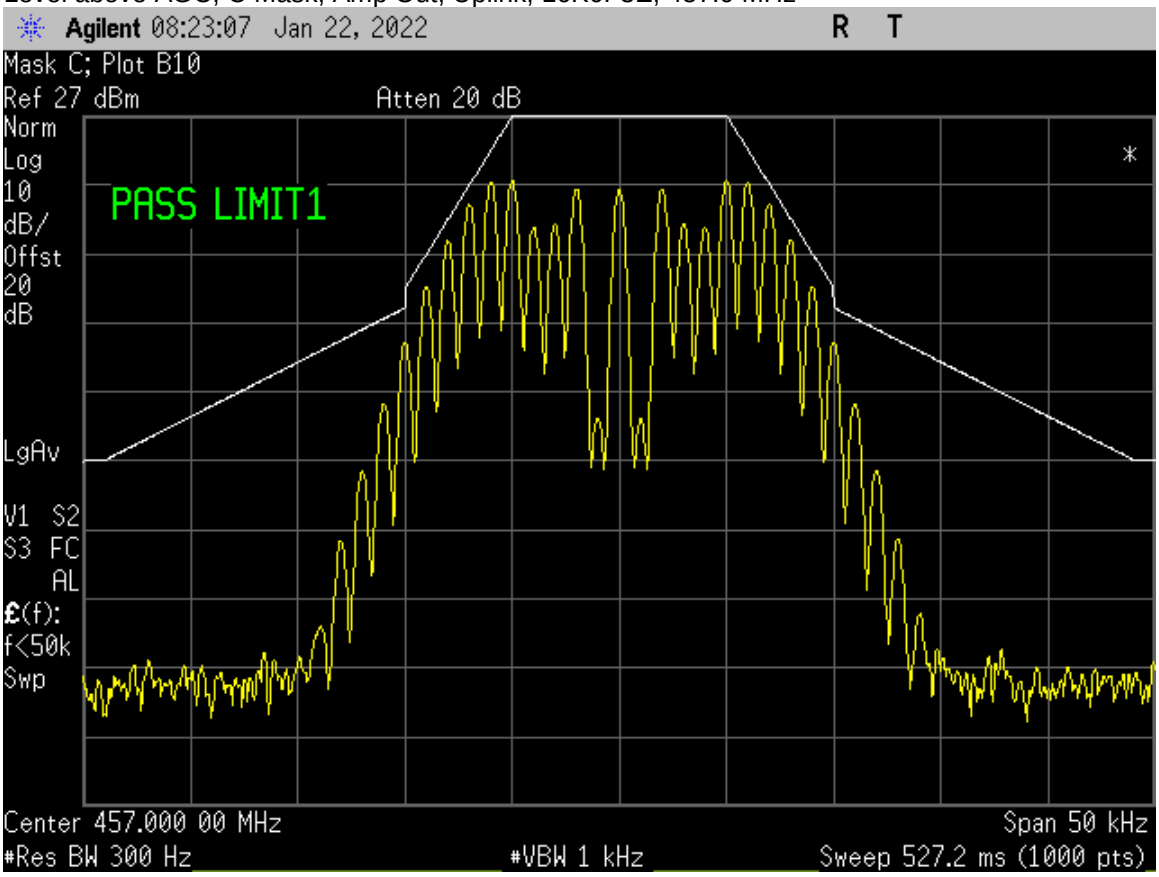
GEN = Generator output or Amp input

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

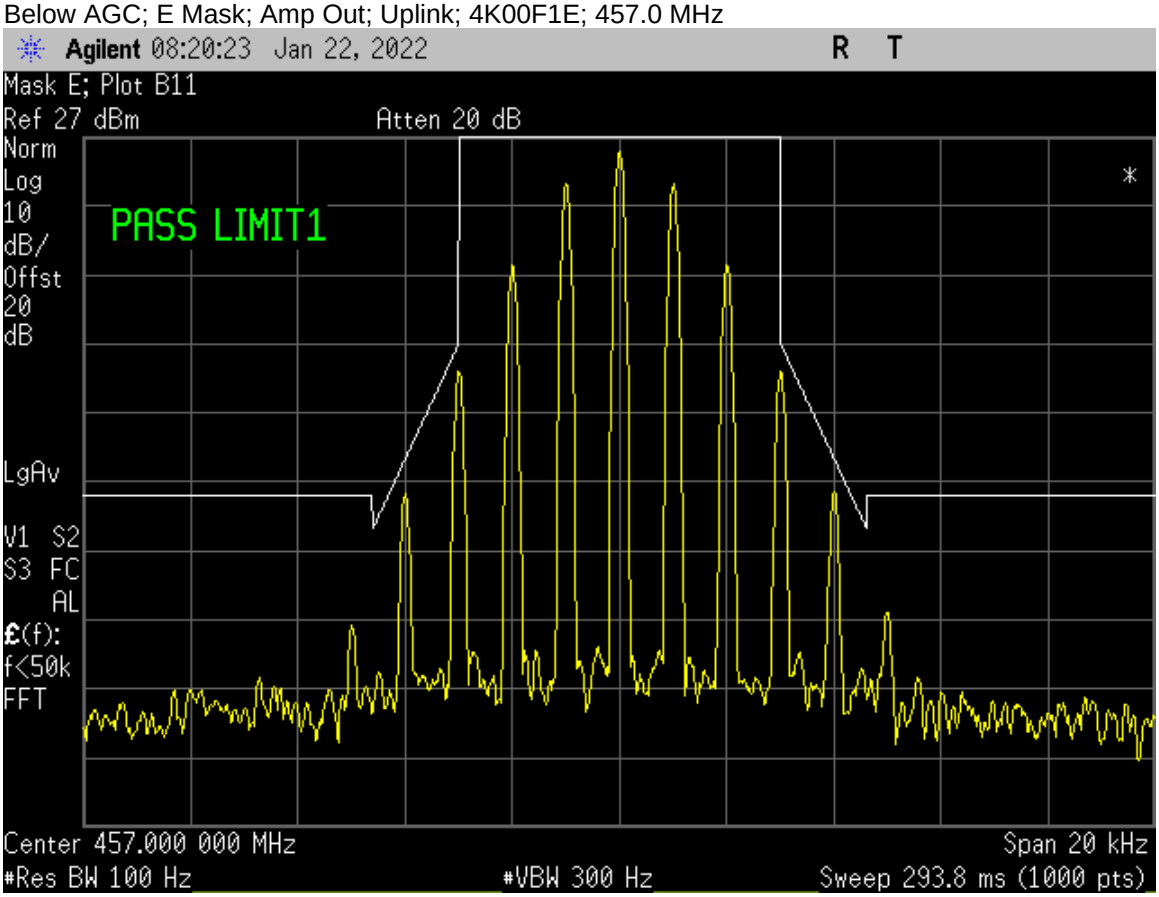
Below AGC; C Mask; Amp Out; Uplink; 16K0F3E; 457.0 MHz



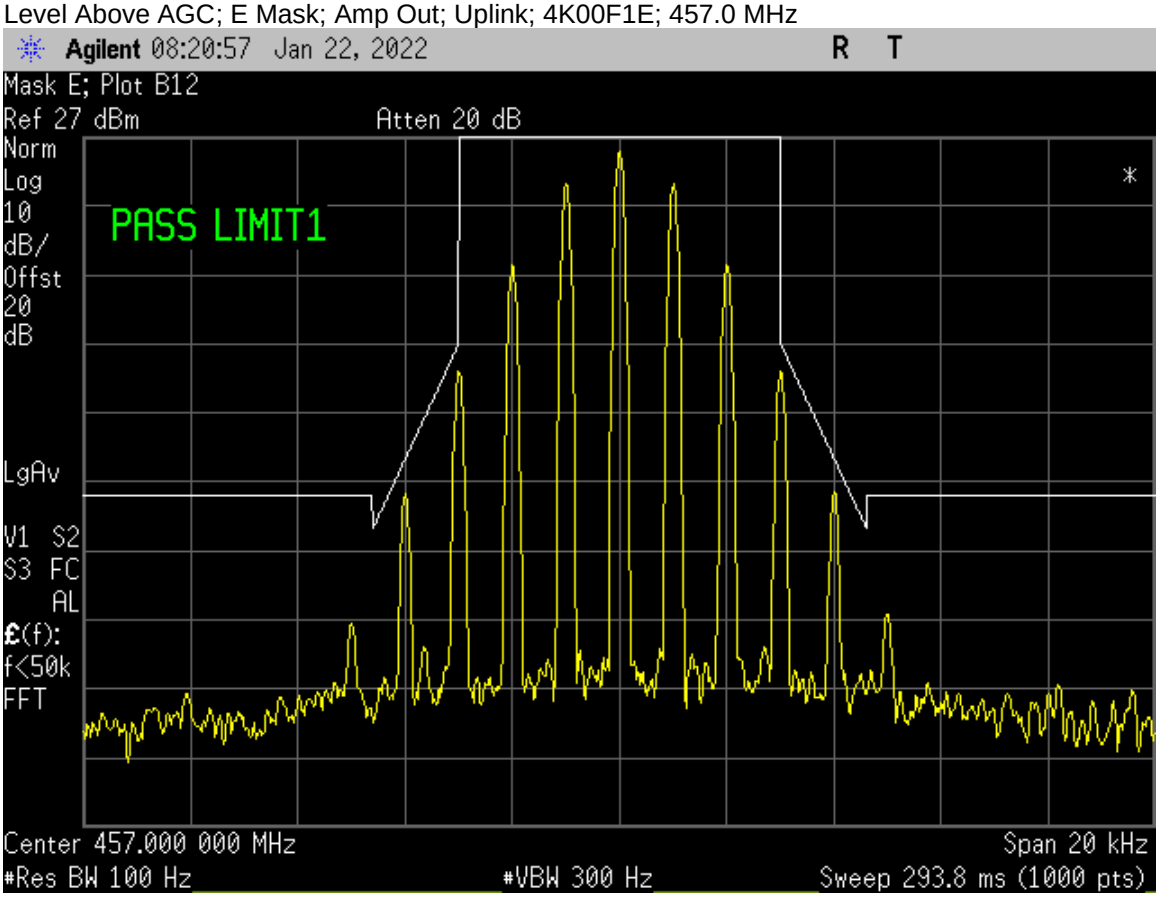
Level above AGC; C Mask; Amp Out; Uplink; 16K0F3E; 457.0 MHz



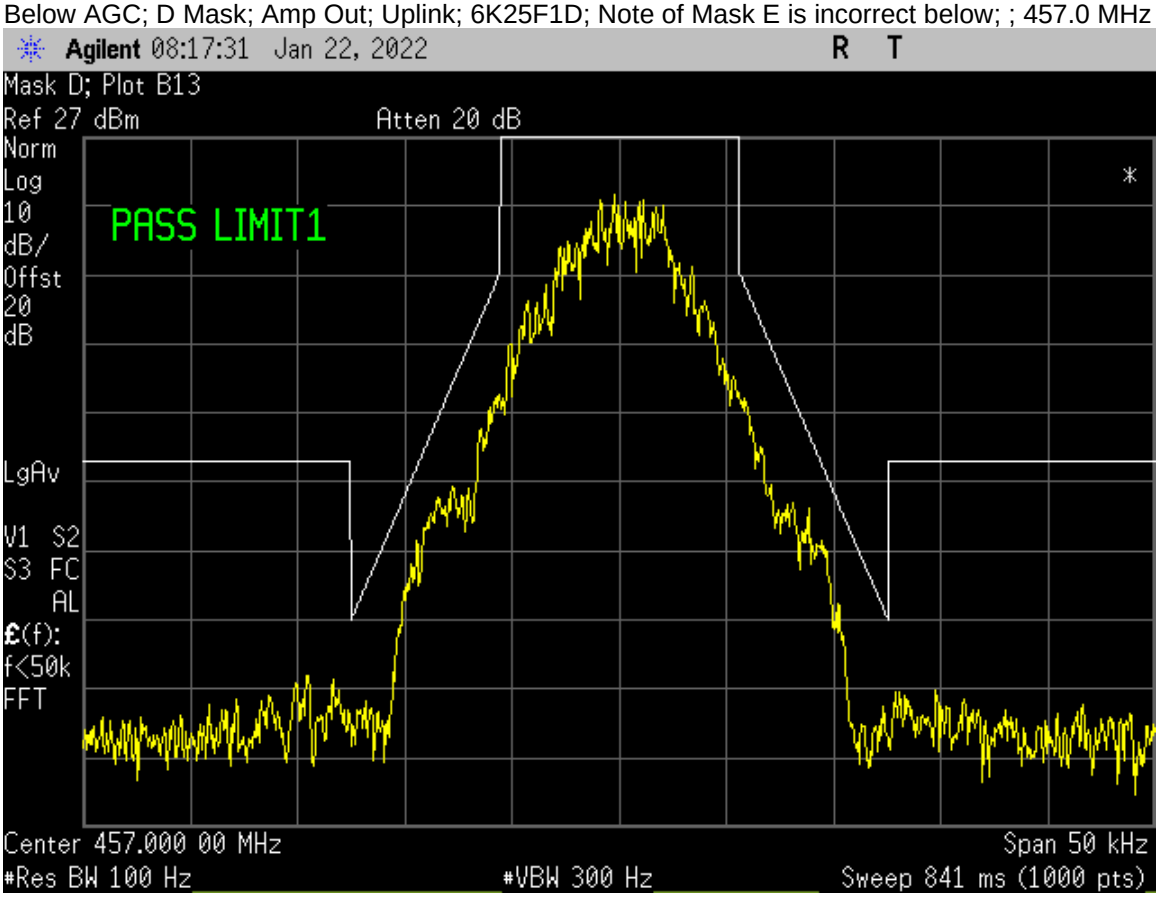
Below AGC; E Mask; Amp Out; Uplink; 4K00F1E; 457.0 MHz



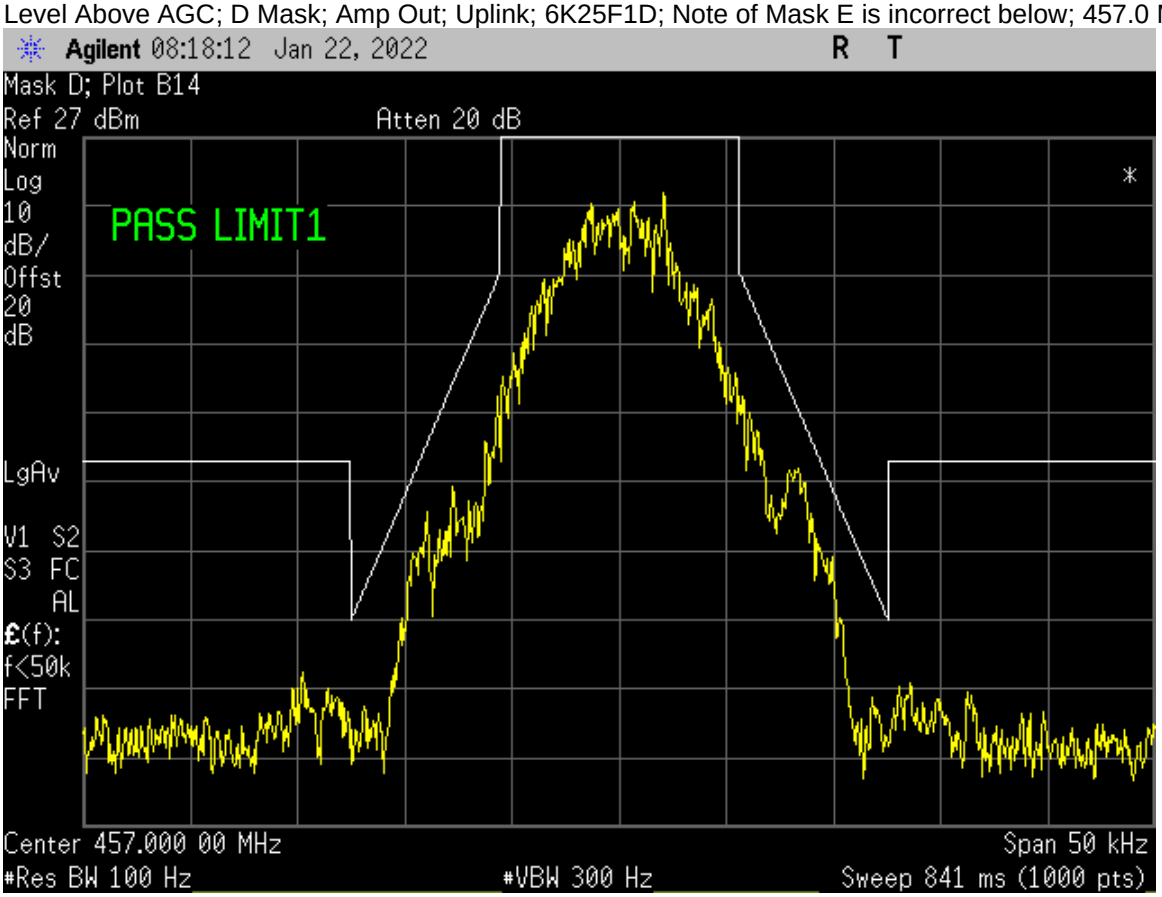
Level Above AGC; E Mask; Amp Out; Uplink; 4K00F1E; 457.0 MHz



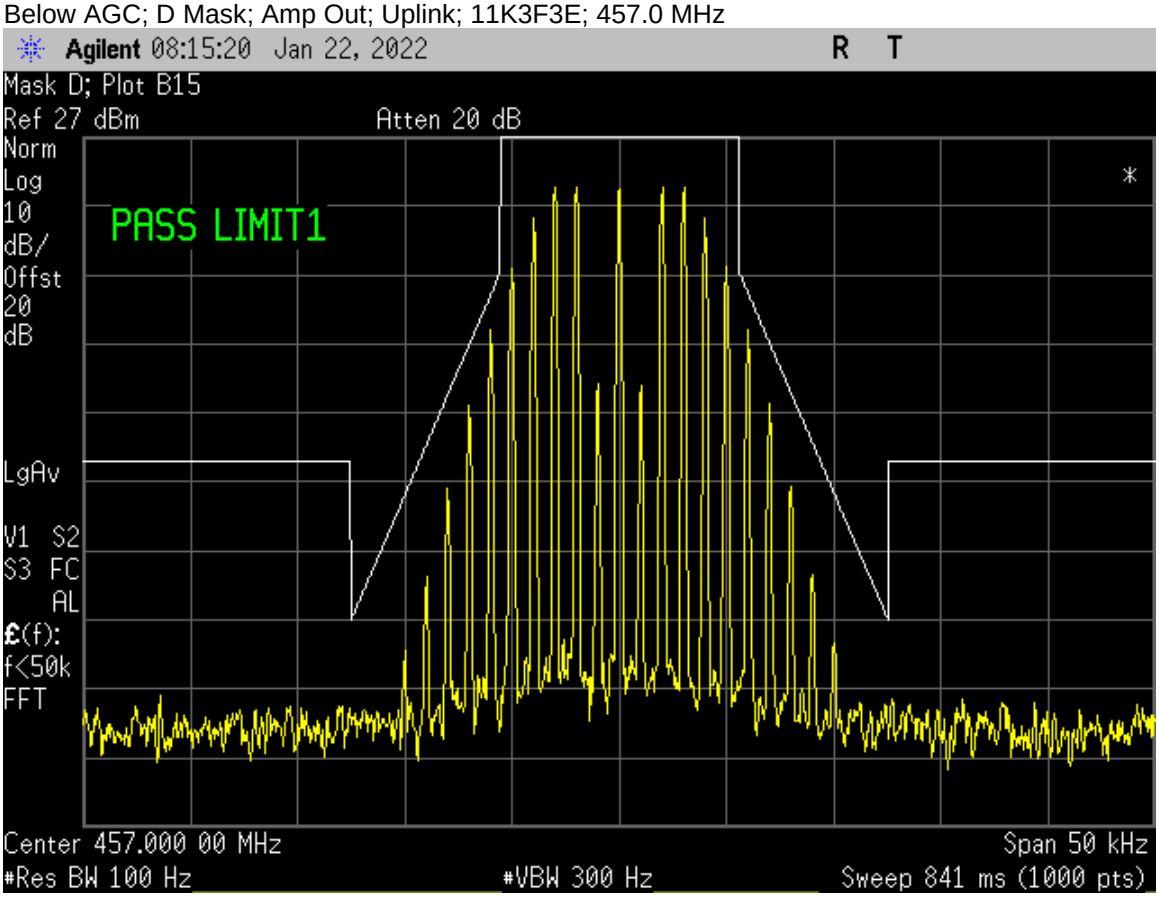
Below AGC; D Mask; Amp Out; Uplink; 6K25F1D; Note of Mask E is incorrect below; ; 457.0 MHz



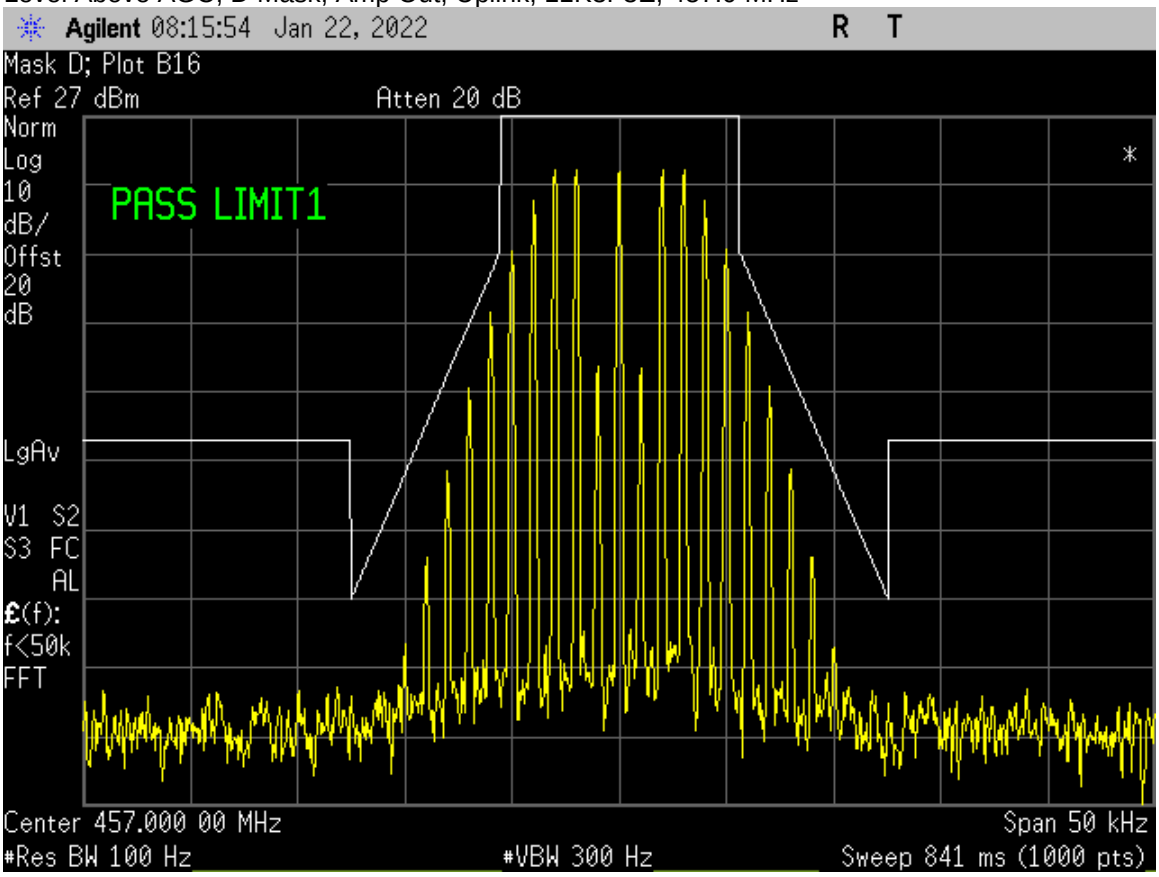
Level Above AGC; D Mask; Amp Out; Uplink; 6K25F1D; Note of Mask E is incorrect below; 457.0 MHz



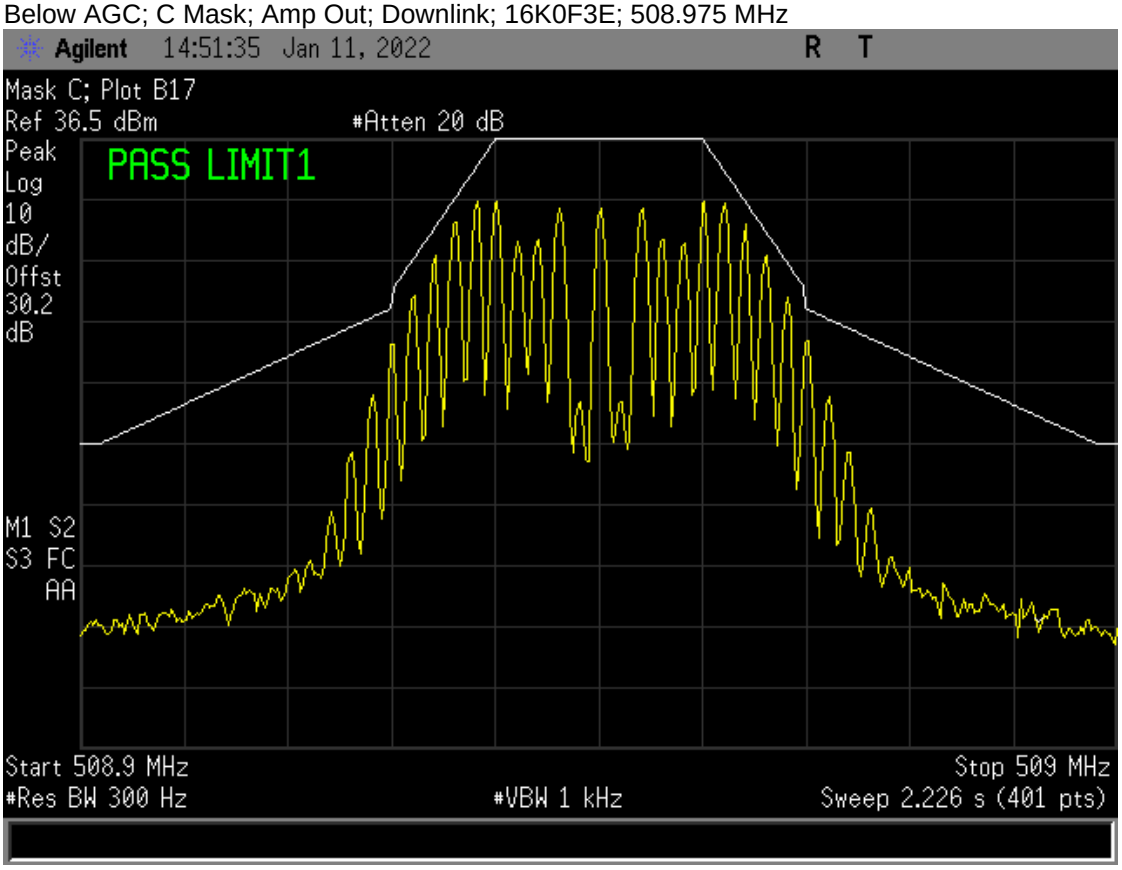
Below AGC; D Mask; Amp Out; Uplink; 11K3F3E; 457.0 MHz



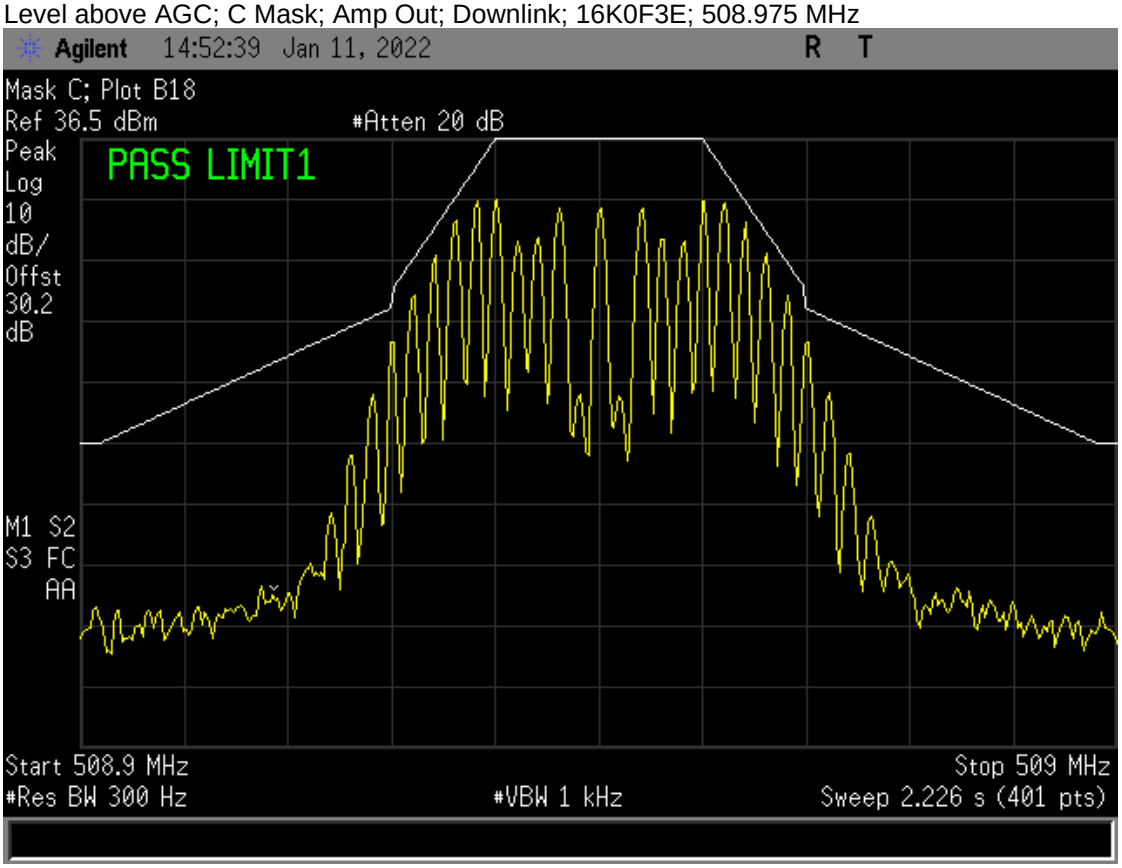
Level Above AGC; D Mask; Amp Out; Uplink; 11K3F3E; 457.0 MHz



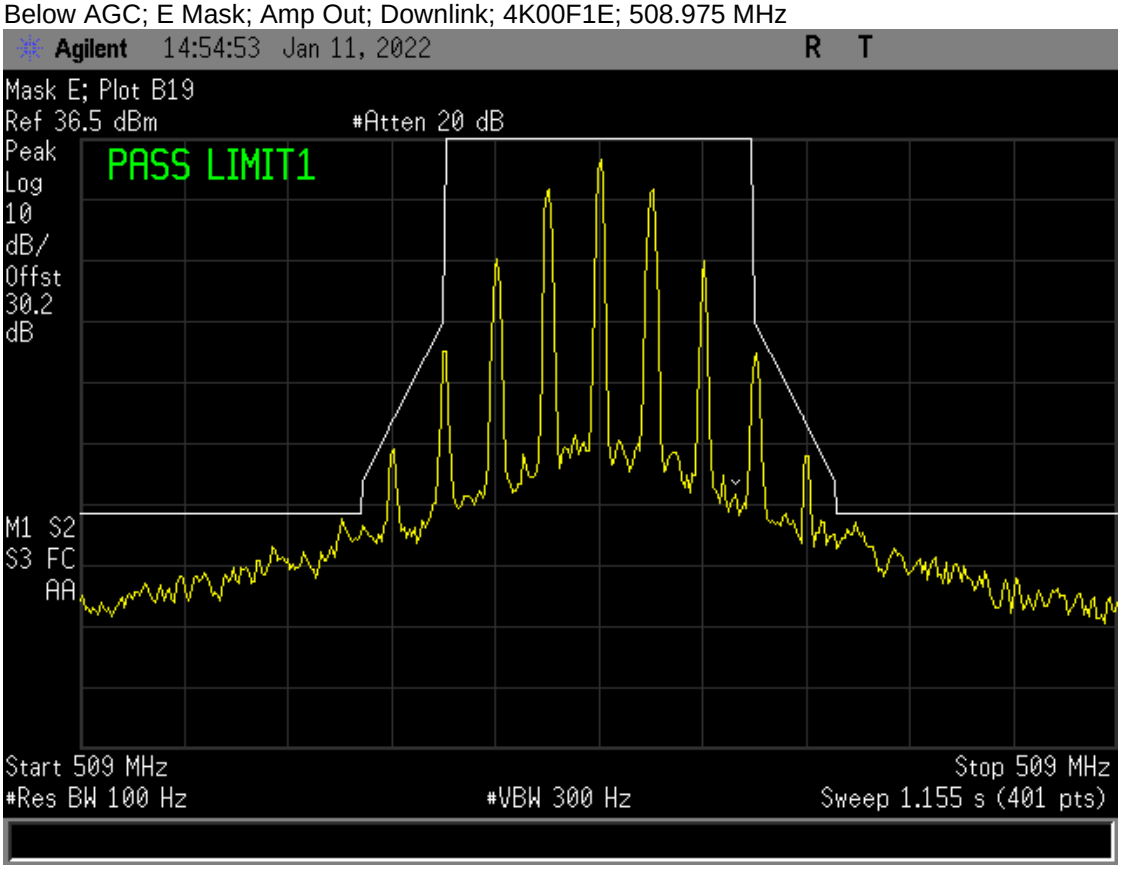
Below AGC; C Mask; Amp Out; Downlink; 16K0F3E; 508.975 MHz



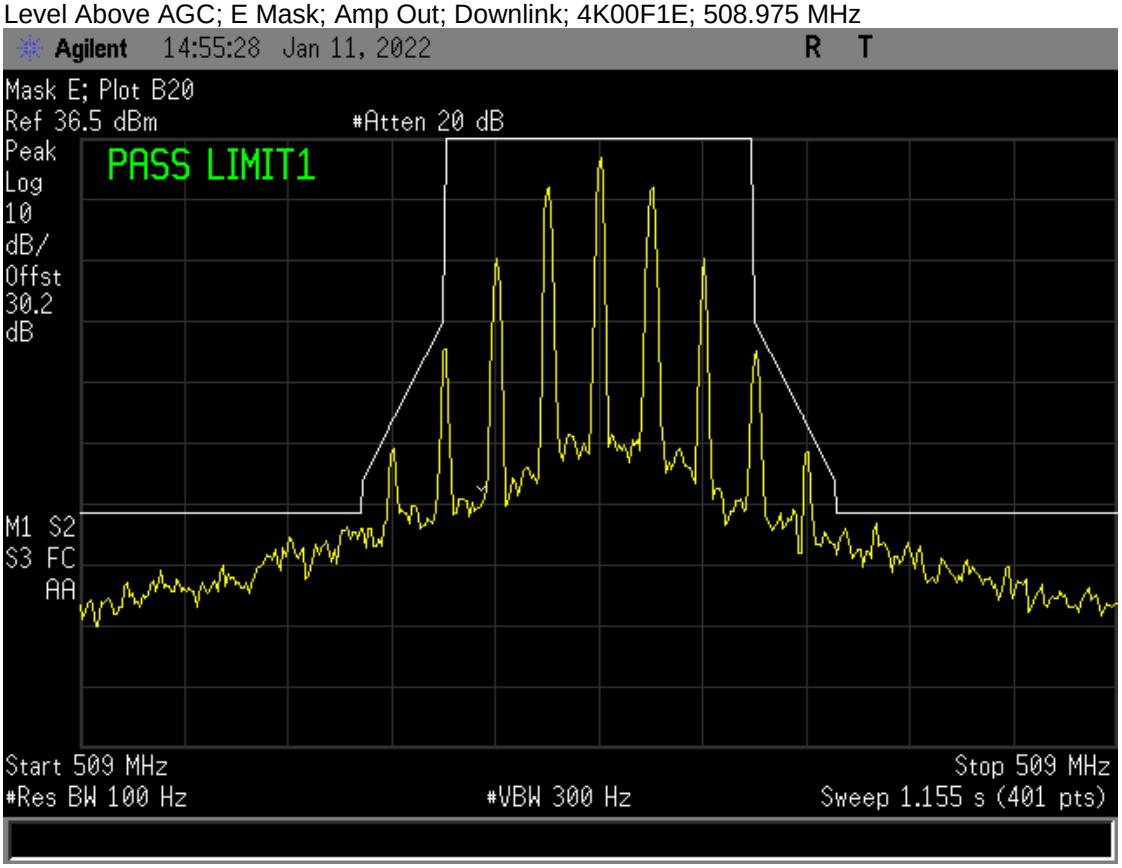
Level above AGC; C Mask; Amp Out; Downlink; 16K0F3E; 508.975 MHz



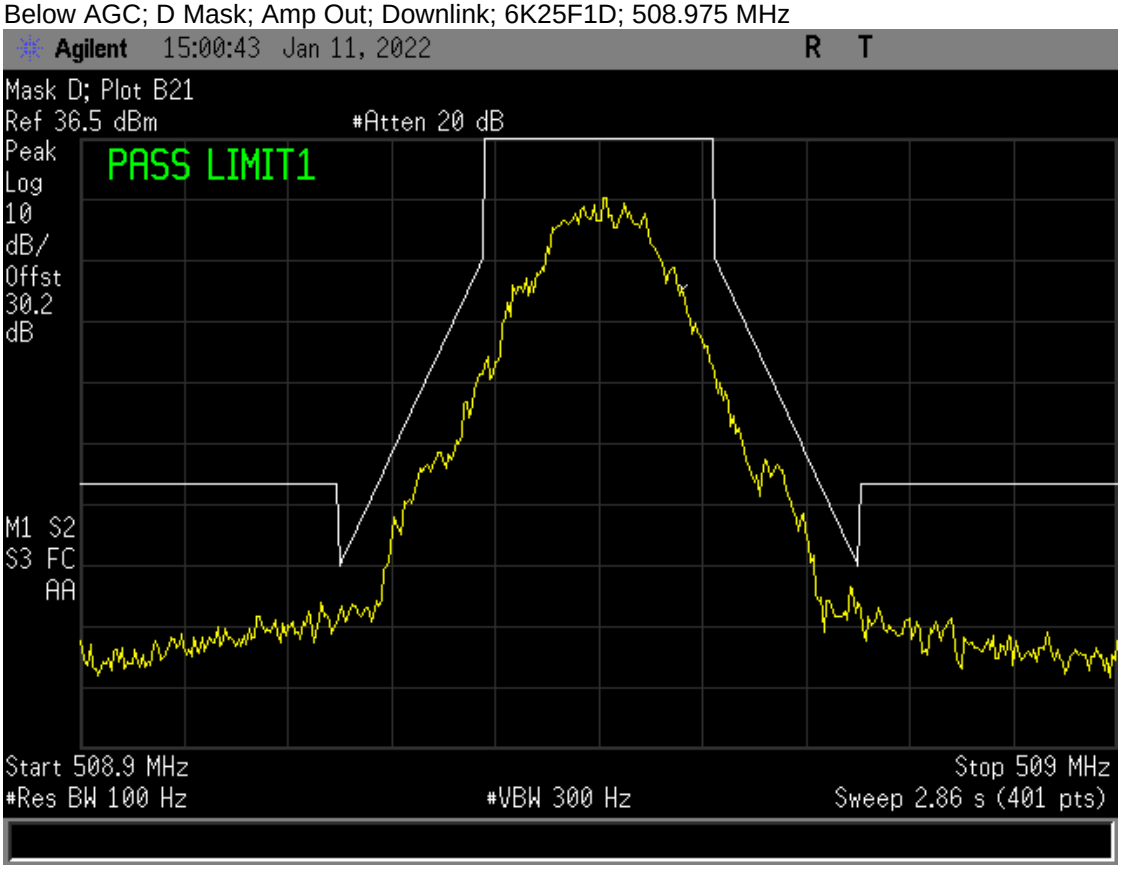
Below AGC; E Mask; Amp Out; Downlink; 4K00F1E; 508.975 MHz



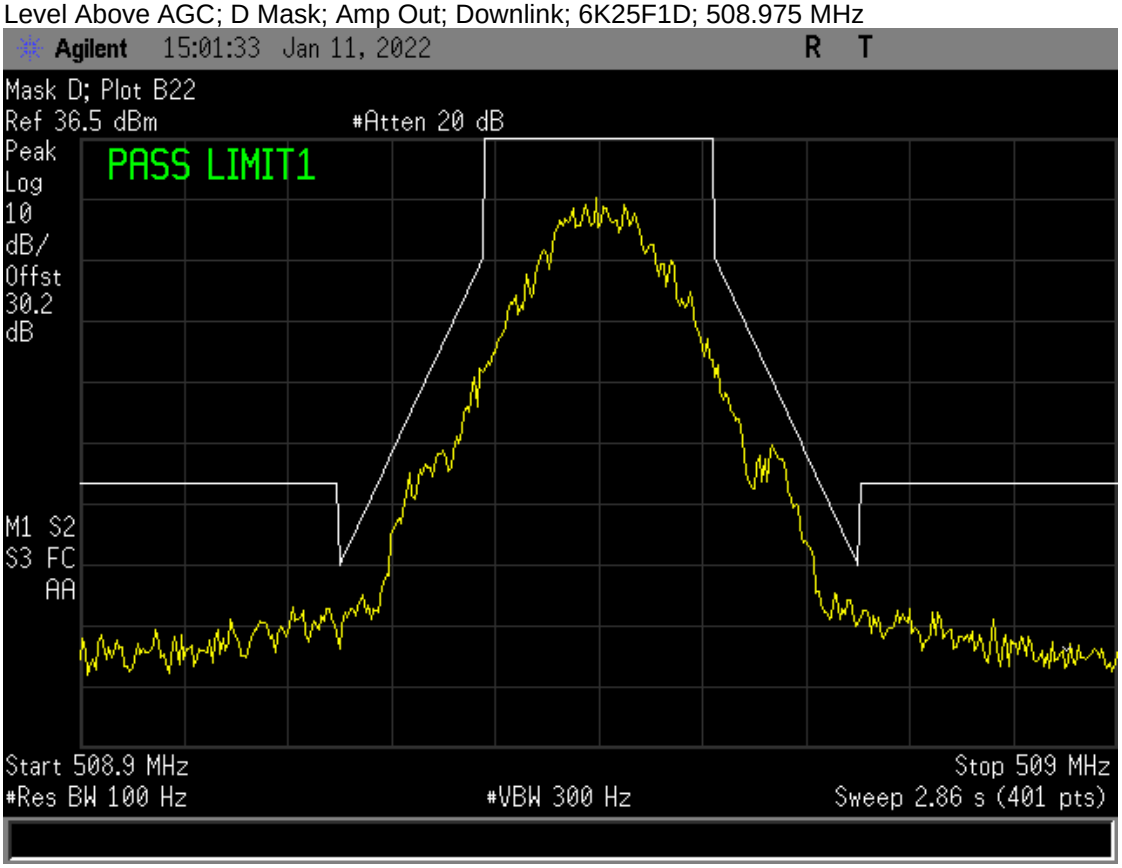
Level Above AGC; E Mask; Amp Out; Downlink; 4K00F1E; 508.975 MHz



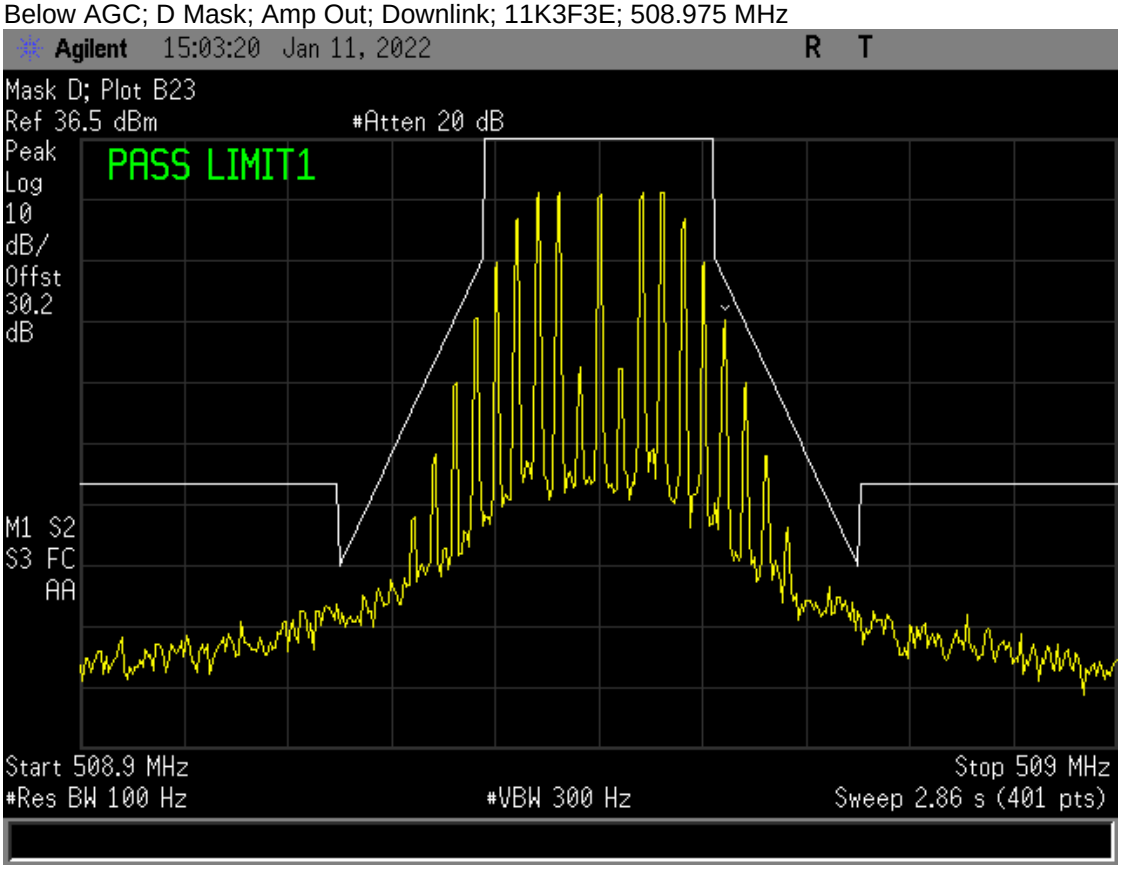
Below AGC; D Mask; Amp Out; Downlink; 6K25F1D; 508.975 MHz



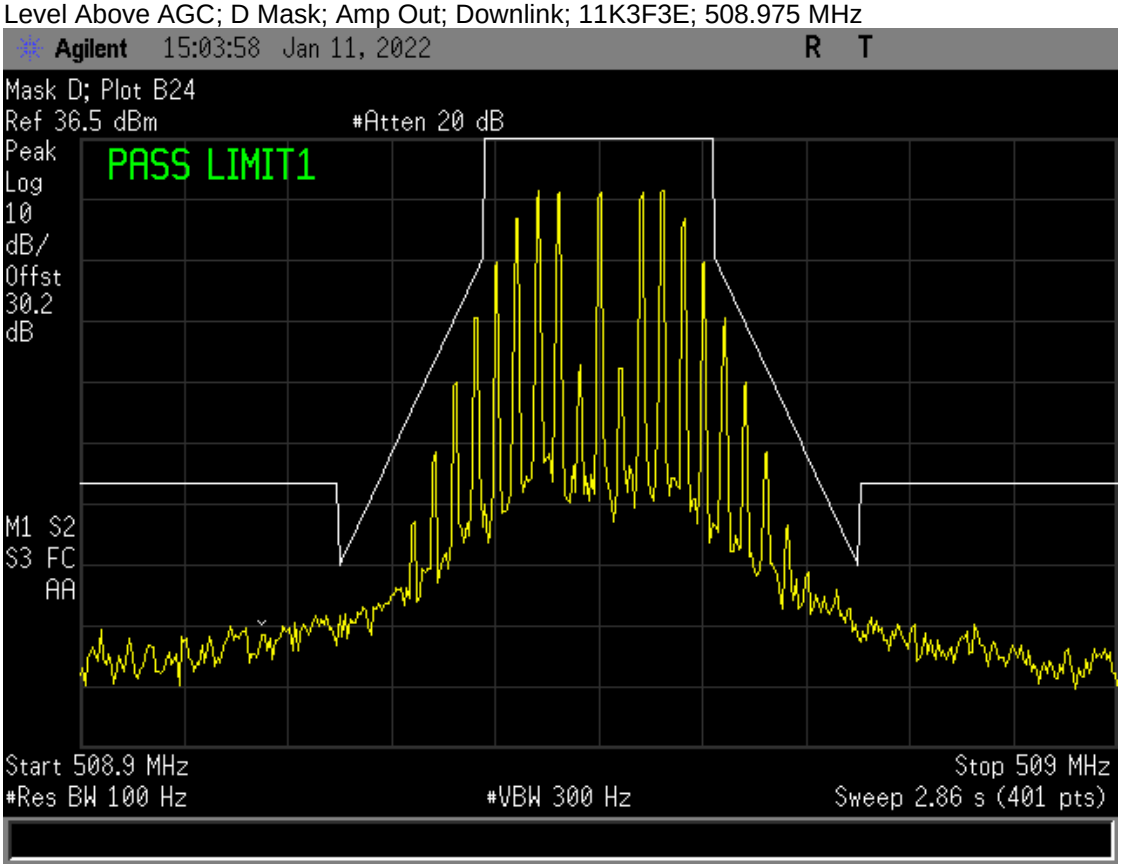
Level Above AGC; D Mask; Amp Out; Downlink; 6K25F1D; 508.975 MHz



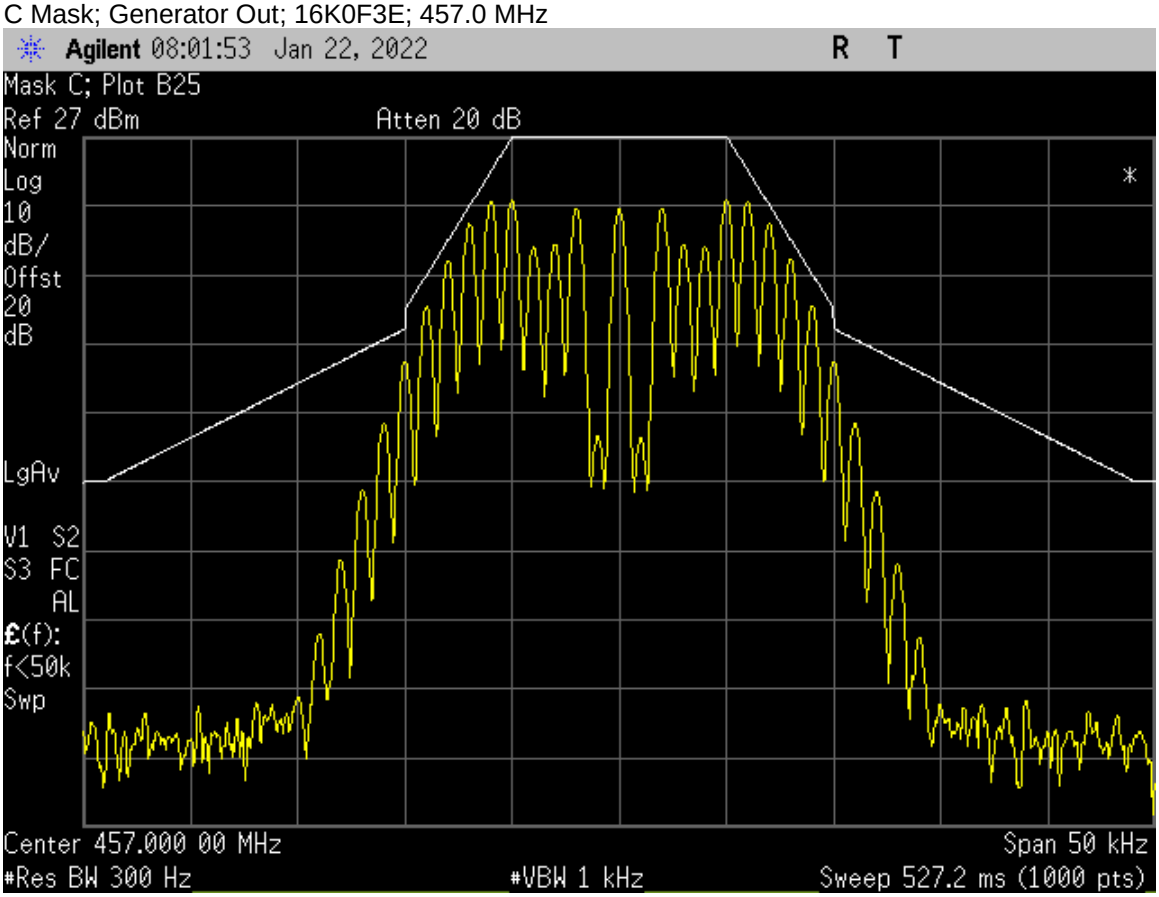
Below AGC; D Mask; Amp Out; Downlink; 11K3F3E; 508.975 MHz



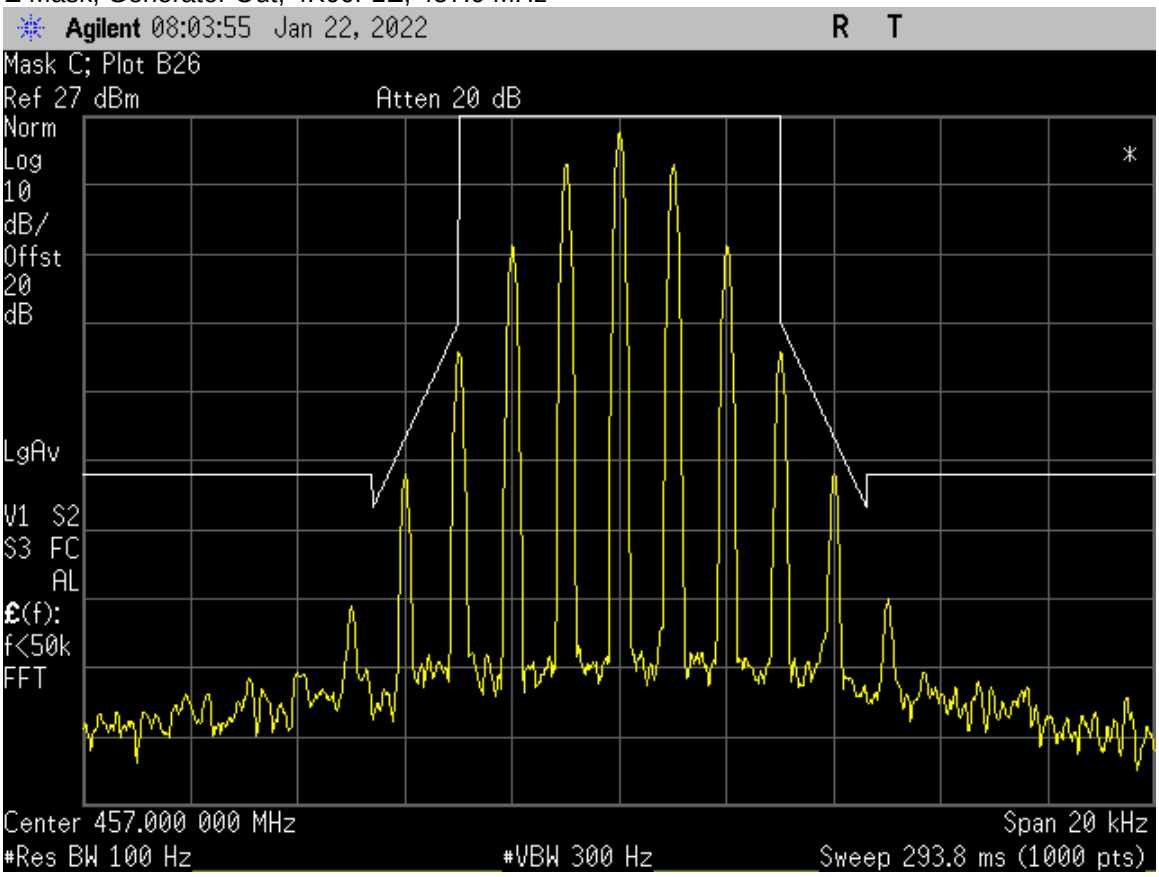
Level Above AGC; D Mask; Amp Out; Downlink; 11K3F3E; 508.975 MHz



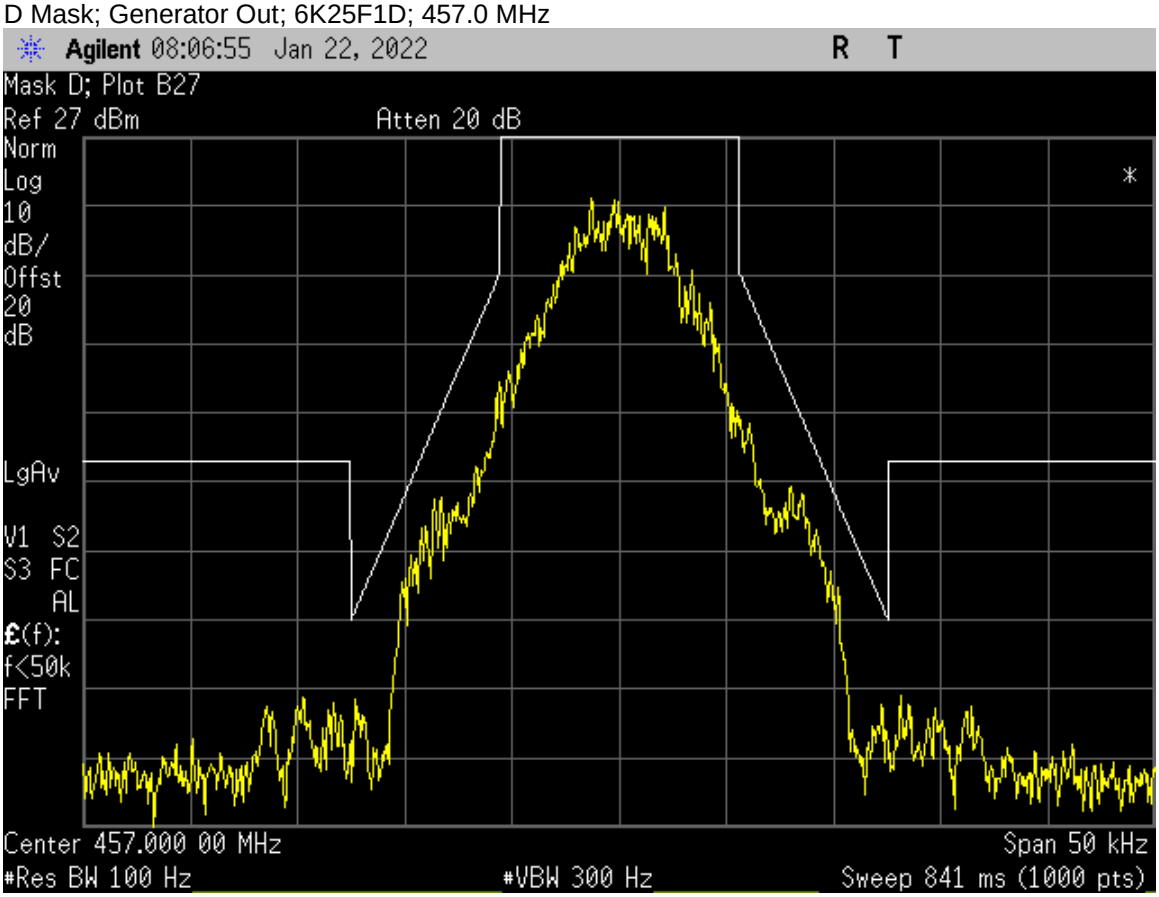
C Mask; Generator Out; 16K0F3E; 457.0 MHz



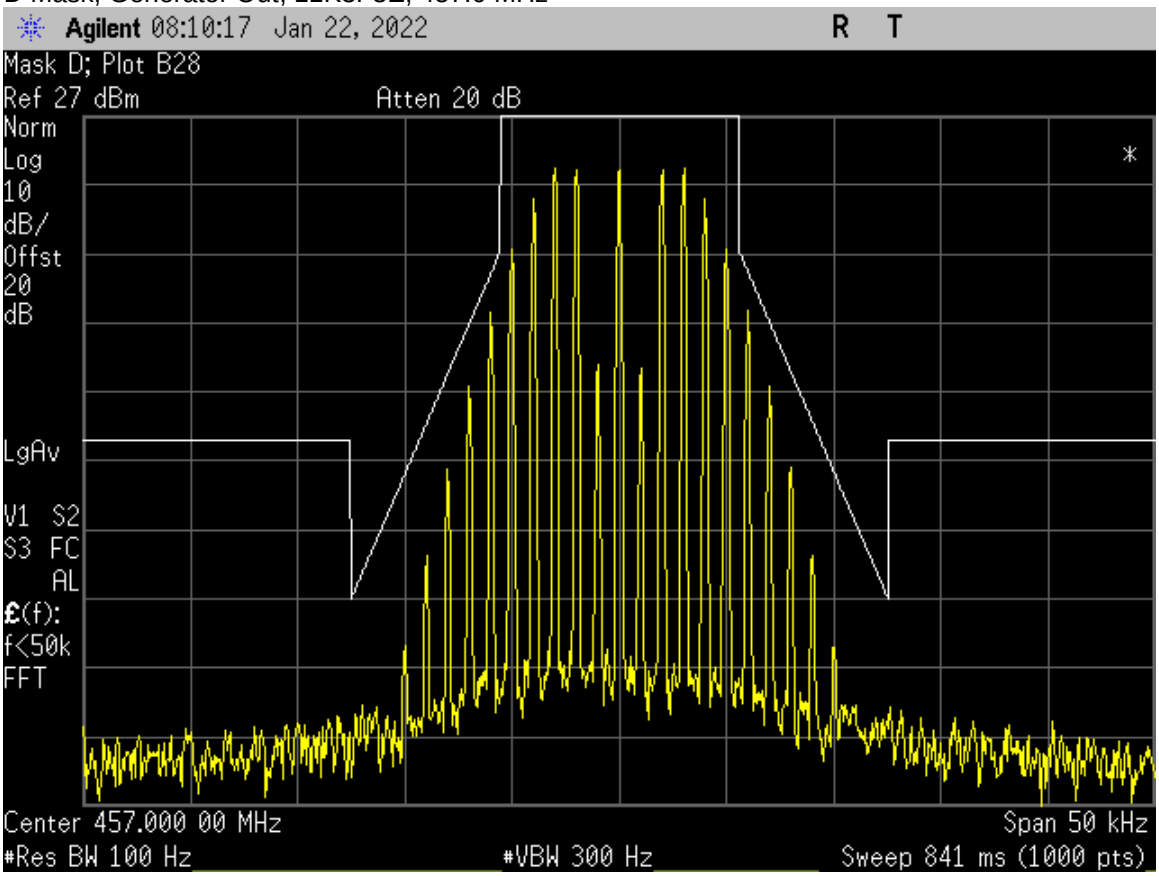
E Mask; Generator Out; 4K00F1E; 457.0 MHz



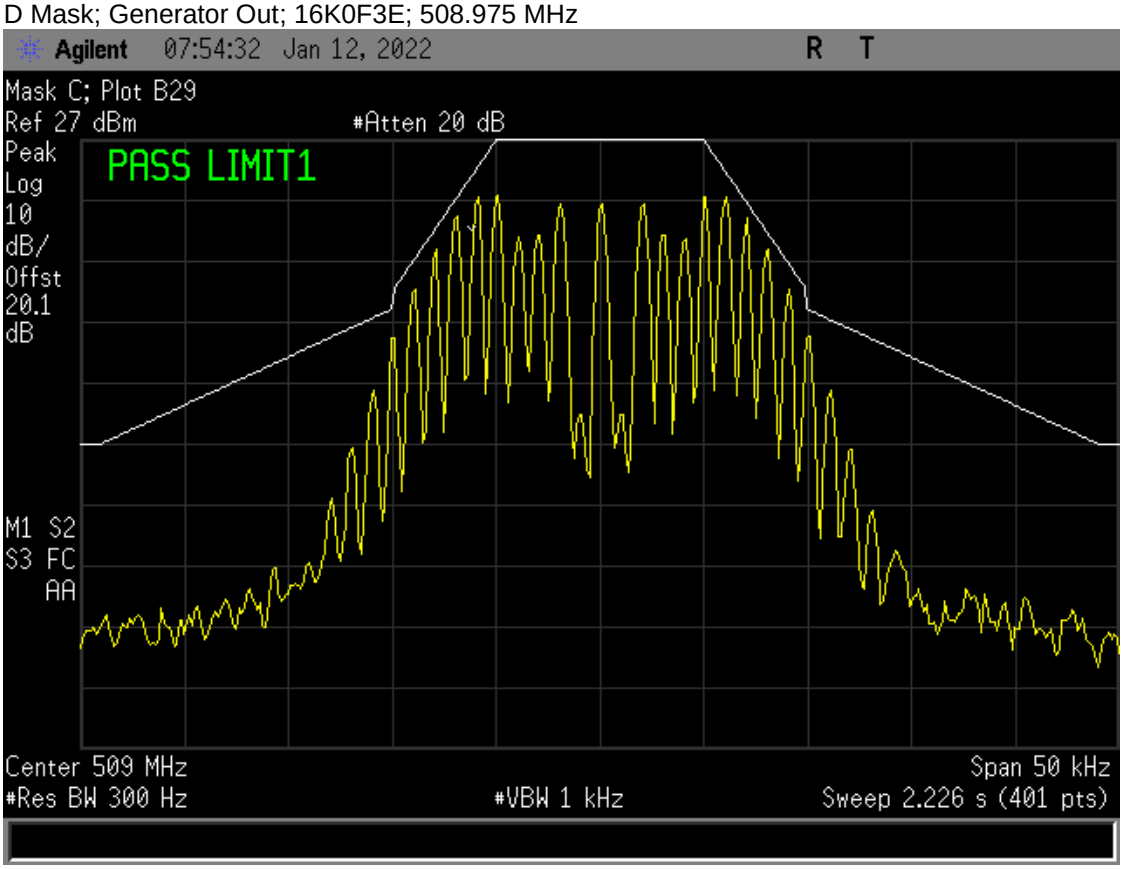
D Mask; Generator Out; 6K25F1D; 457.0 MHz



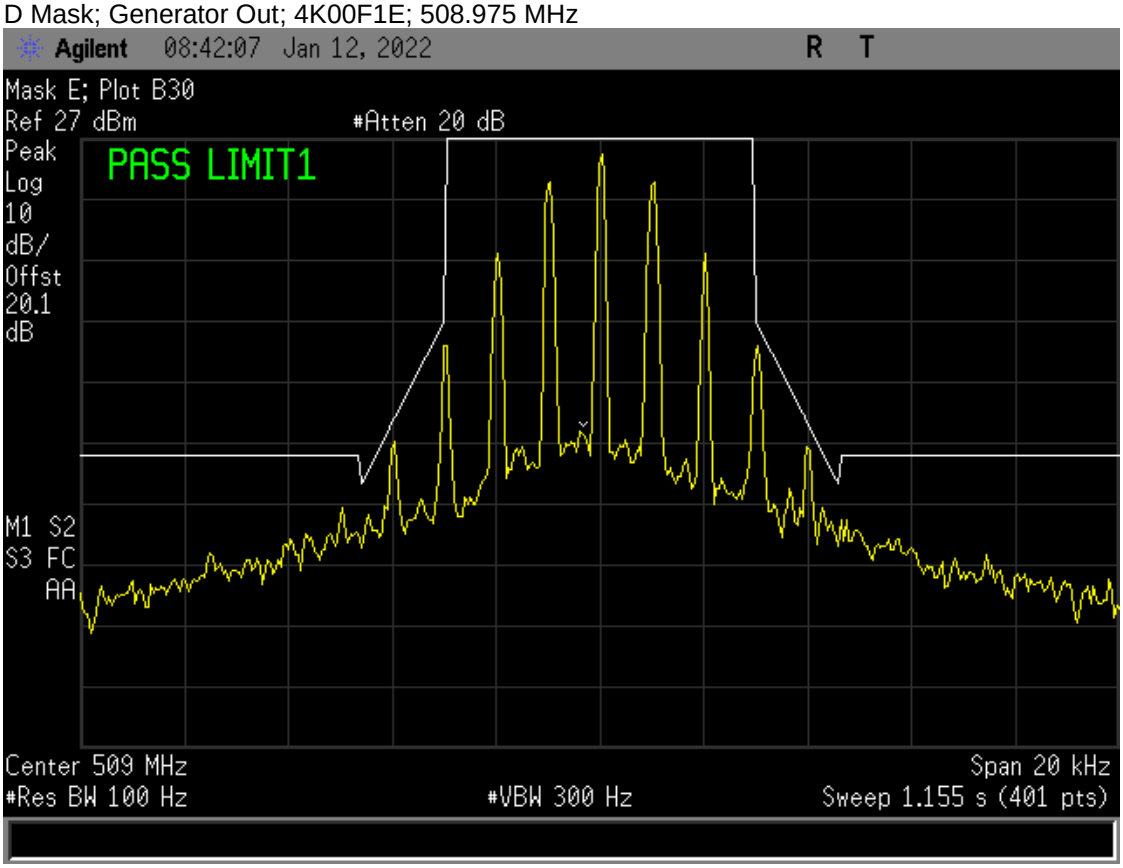
D Mask; Generator Out; 11K3F3E; 457.0 MHz



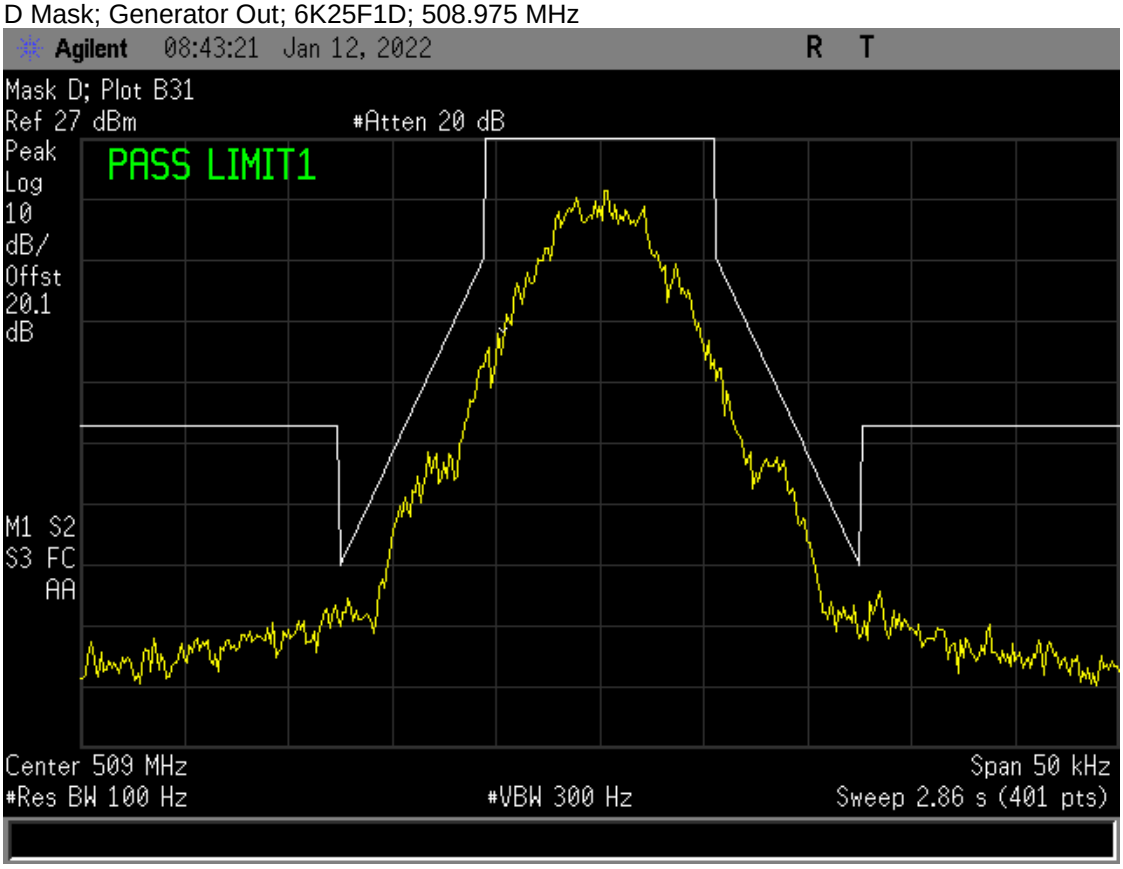
D Mask; Generator Out; 16K0F3E; 508.975 MHz



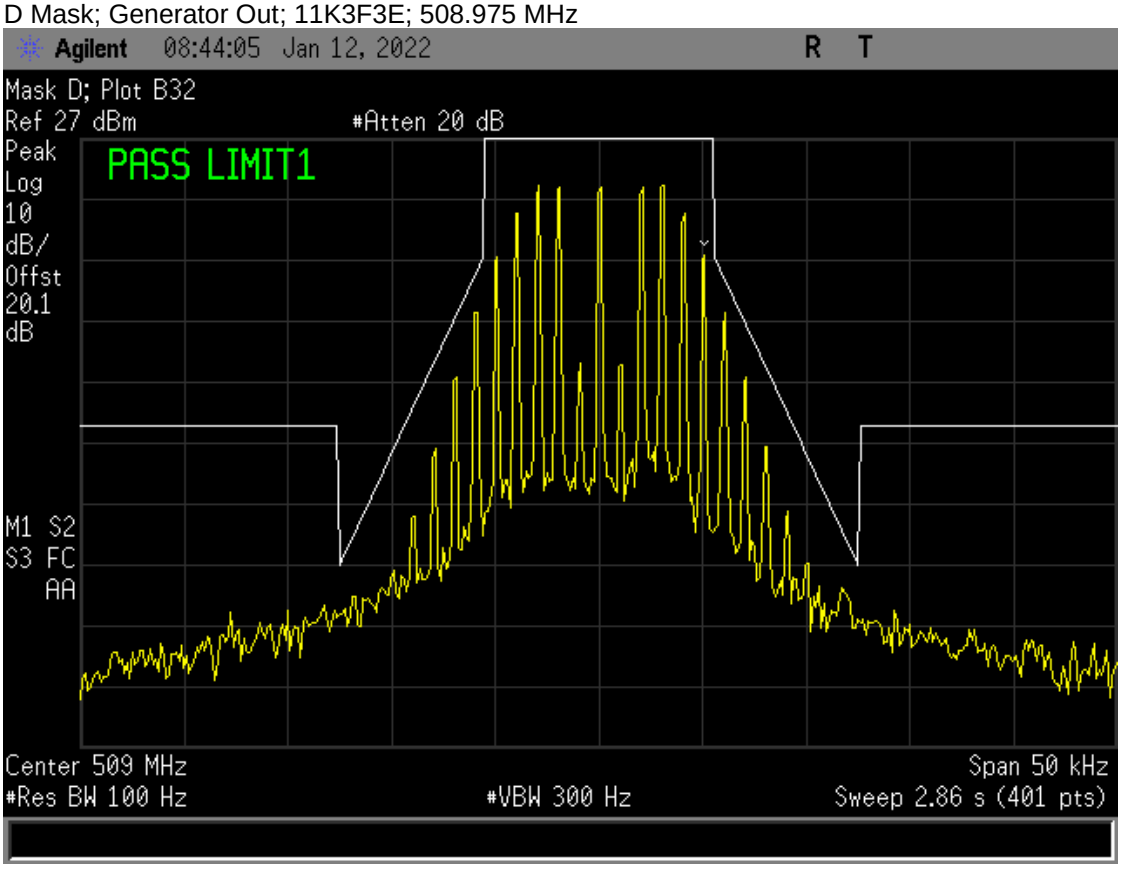
D Mask; Generator Out; 4K00F1E; 508.975 MHz



D Mask; Generator Out; 6K25F1D; 508.975 MHz



D Mask; Generator Out; 11K3F3E; 508.975 MHz



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	080-300926	Specification	FCC KDB 935210 Sec. 4.5
Serial Number	CS40-U37-U0D-A0-DVT0003	Test Date	12/08/2021 & 01/20/2022
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-44); Attenuator (ATT-54);Signal Generator (SIG-33)		

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)	457.000	-47.4	7.3	19.9	0.2	27.4	0.550	84.8
UP (2)	457.000	-44.4	7.5	19.9	0.2	27.6	0.575	82.0
UP (1)	485.000	-47.4	7.2	19.9	0.2	27.3	0.537	84.7
UP (2)	485.000	-44.4	7.4	19.9	0.2	27.5	0.562	81.9
UP (1)	511.975	-47.8	6.5	19.9	0.2	26.6	0.457	84.5
UP (2)	511.975	-44.8	6.0	19.9	0.2	26.1	0.407	81.0
Down (1)	457.000	-38.4	6.3	30	0.2	36.5	4.467	85.0

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)	457.000	-35.4	5.5	30	0.2	35.7	3.715	81.2
Down (1)	482.025	-38.5	6.2	30	0.2	36.4	4.365	85.0
Down (2)	482.025	-35.5	5.4	30	0.2	35.6	3.631	81.2
Down (1)	508.975	-38.4	6.1	30	0.2	36.3	4.266	84.8
Down (2)	508.975	-35.4	5.1	30	0.2	35.3	3.388	80.8

(1) Level is 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

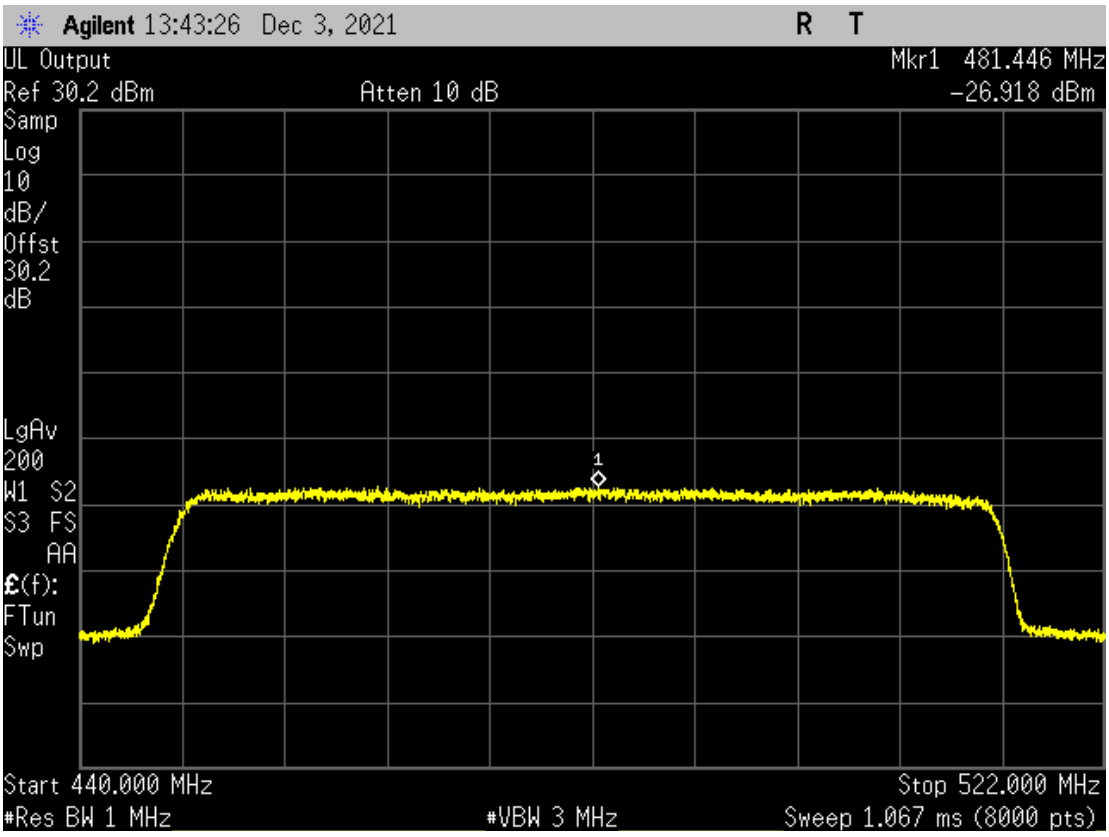
f) Steps a) to e) were repeated with the analyzer connected to the uplink output of the amplifier

15.3 Results for Section 4.6

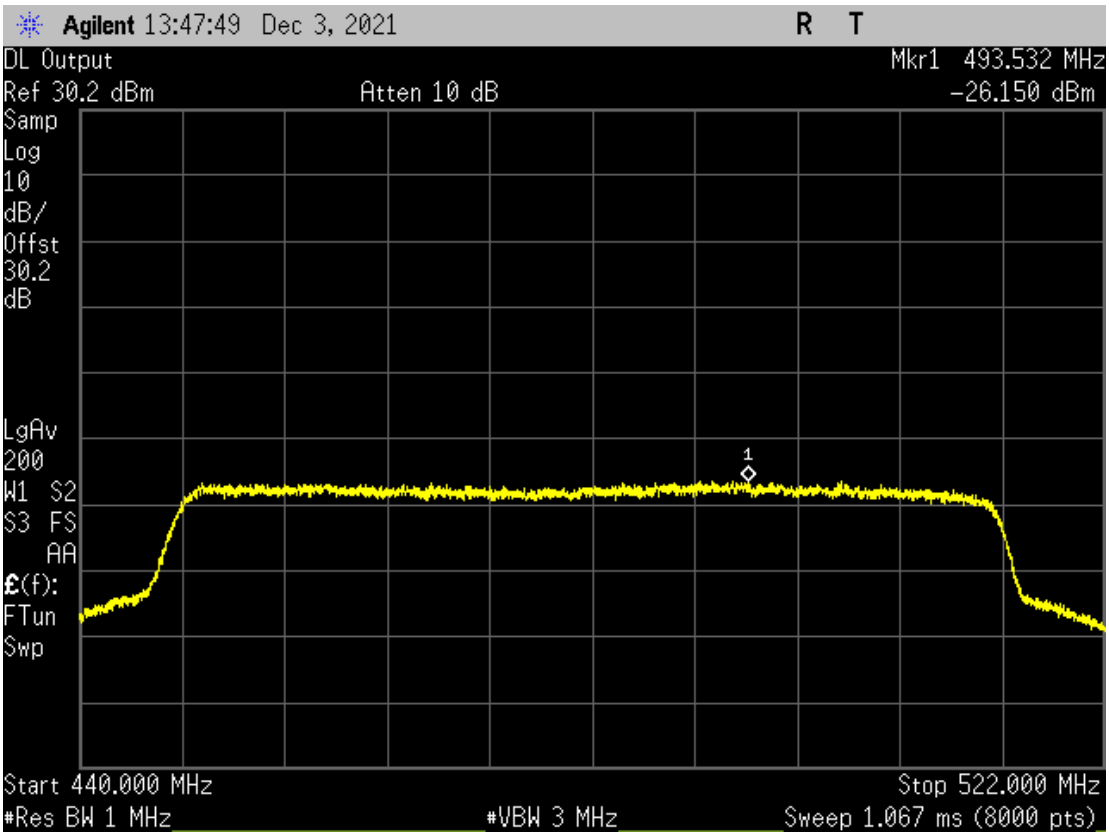
Model	080-300926	Specification	FCC KDB 935210 Sec. 4.6
Serial Number	CS40-U37-U0D-A0-DVT0003	Test Date	12/03/2021
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver REC-44; RBW= 1 MHz; VBW= 3 MHz		

	Start	Stop	Center	Reading	Gain	Thermal Noise	Cable Loss	Noise Figure	NF Limit
Mode	MHz	MHz	MHz	dBm	dB	dB	dB	dB	dB
UP	440	522	481	-26.9	85.0	-114.0	0.4	2.5	9.0
Down	440	522	481	-26.1	85.0	-114.0	0.4	3.3	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: $43+10xLog_{10}P$, 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.

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	080-300926	Specification	FCC KDB 935210 Sec. 4.7.2
Serial Number	CS40-U37-U0D-A0-DVT0003	Test Dates	12/07 & 16/2021 & 01/22/2022
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-44); Attenuator (ATT-54) Signal Generators (SIG-32 & SIG-33)		

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

								Max Readings from Amplifier		
			Signal Generator				Analyzer			
Plot #	RBW Hz	VBW Hz	Channel kHz	#1 MHz	#2 MHz	AGC	Center MHz	Freq MHz	Reading dBm	Output
A1	300	1000	6.25	457.00625	457.0125	off	457.009375	457.0000	-22.02	Uplink
A2	300	1000	6.25	457.00625	457.0125	on	457.009375	457.0000	-20.57	Uplink
3	300	1000	6.25	485.00625	485.0125	off	485.009375	485.0000	-29.58	Uplink
4	300	1000	6.25	485.00625	485.0125	on	485.009375	485.0000	-31.26	Uplink
5	300	1000	6.25	511.99375	511.9875	off	511.990625	511.9810	-31.46	Uplink
6	300	1000	6.25	511.99375	511.9875	on	511.990625	511.9810	-31.96	Uplink
A7	300	1000	12.5	457.0125	457.025	off	457.01875	457.0000	-20.68	Uplink
A8	300	1000	12.5	457.0125	457.025	on	457.01875	457.0000	-20.94	Uplink
9	300	1000	12.5	485.0125	485.025	off	485.01875	485.0000	-29.67	Uplink
10	300	1000	12.5	485.0125	485.025	on	485.01875	485.0000	-31.37	Uplink
11	300	1000	12.5	511.9875	511.975	off	511.98125	511.9620	-32.89	Uplink
12	300	1000	12.5	511.9875	511.975	on	511.98125	511.9620	-32.79	Uplink
A13	300	1000	25	457.025	457.05	off	457.03750	457.0750	-22.28	Uplink
A14	300	1000	25	457.025	457.05	on	457.03750	457.0750	-21.96	Uplink
15	300	1000	25	485.025	485.05	off	485.03750	485.0000	-29.89	Uplink
16	300	1000	25	485.025	485.05	on	485.03750	485.0000	-29.56	Uplink
17	300	1000	25	511.975	511.95	off	511.96250	511.9240	-32.92	Uplink
18	300	1000	25	511.975	511.95	on	511.96250	511.9240	-33.1	Uplink
19	300	1000	6.25	450.00625	450.0125	off	450.009375	450.0000	-17.03	Downlink
20	300	1000	6.25	450.00625	450.0125	on	450.009375	450.0000	-16.01	Downlink
21	300	1000	6.25	478.00625	478.0125	off	478.009375	478.0250	-18.81	Downlink
22	300	1000	6.25	478.00625	478.0125	on	478.009375	478.0250	-20.63	Downlink
23	300	1000	6.25	508.99375	508.9875	off	508.990625	509.0000	-21.58	Downlink
24	300	1000	6.25	508.99375	508.9875	on	508.990625	509.0000	-21.12	Downlink
25	300	1000	12.5	450.0125	450.025	off	450.01875	450.0375	-15.96	Downlink
26	300	1000	12.5	450.0125	450.025	on	450.01875	450.0375	-16.14	Downlink
27	300	1000	12.5	478.0125	478.025	off	478.01875	478.0500	-20.77	Downlink
28	300	1000	12.5	478.0125	478.025	on	478.01875	478.0500	-21.08	Downlink
29	300	1000	12.5	508.9875	508.975	off	508.98125	508.9499	-22.84	Downlink
30	300	1000	12.5	508.9875	508.975	on	508.98125	508.9624	-17.24	Downlink
31	300	1000	25	450.025	450.05	off	450.03750	450.0000	-17.25	Downlink
32	300	1000	25	450.025	450.05	on	450.03750	450.0000	-17.52	Downlink
33	300	1000	25	478.025	478.05	off	478.03750	478.0000	-24.84	Downlink
34	300	1000	25	478.025	478.05	on	478.03750	478.0000	-20.84	Downlink
35	300	1000	25	508.975	508.95	off	508.96250	508.9250	-21.06	Downlink
36	300	1000	25	508.975	508.95	on	508.96250	508.9250	-17.01	Downlink

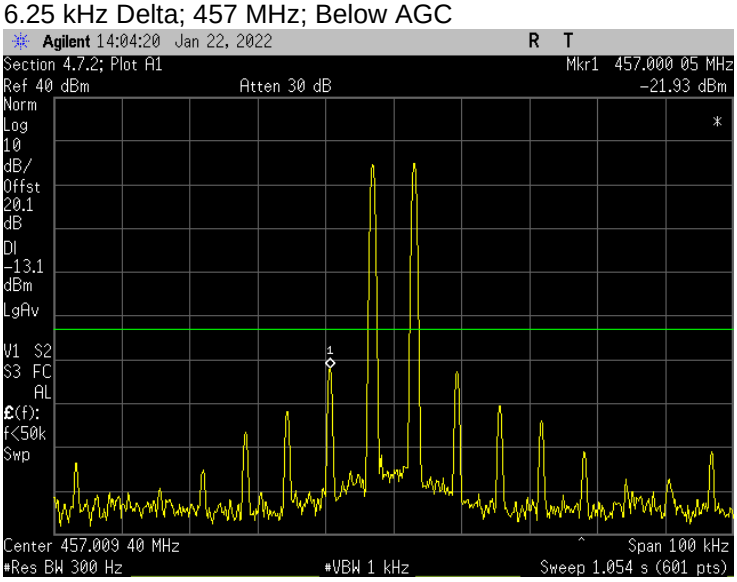
The table shows the highest spurious noise from the amplifier for each plot. The limit is -13 dBm.

Judgement: Pass

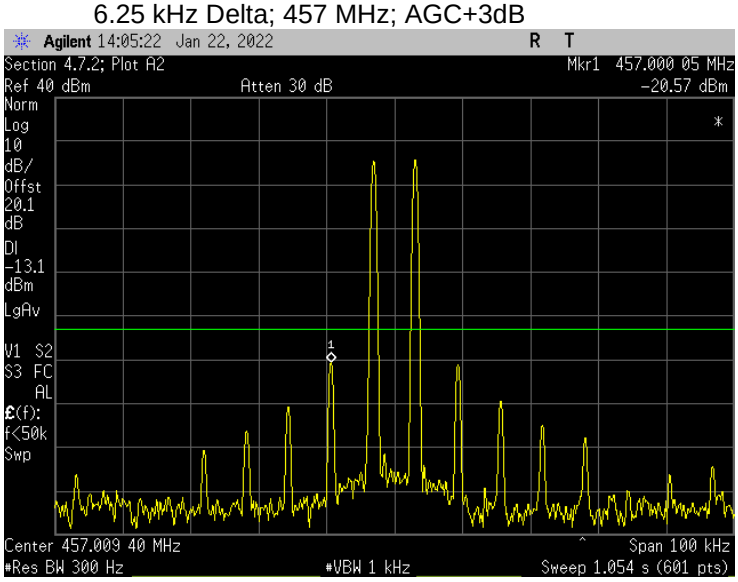
16.3.1 Combined Output Results; Out-of-band/out-of-block emissions

Uplink

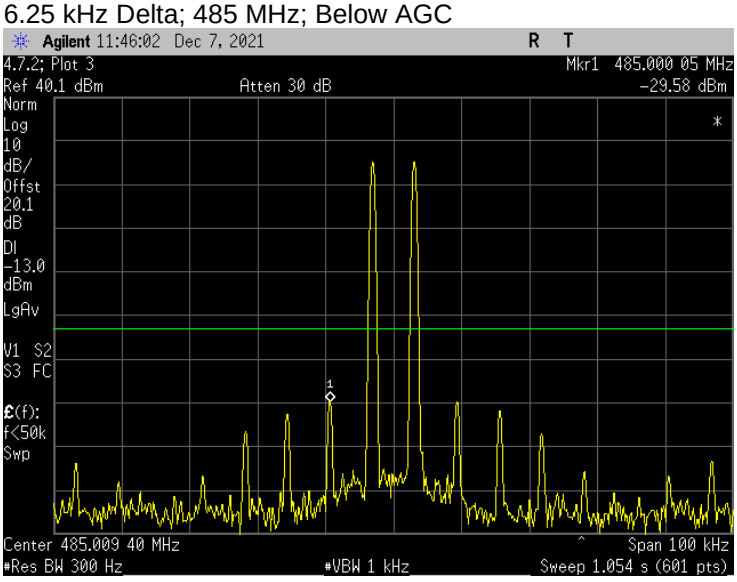
6.25 kHz Delta; 457 MHz; Below AGC



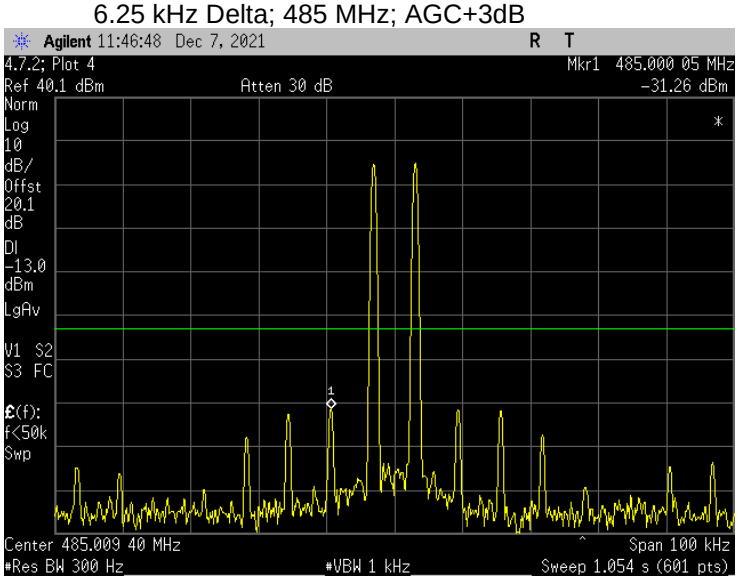
6.25 kHz Delta; 457 MHz; AGC+3dB



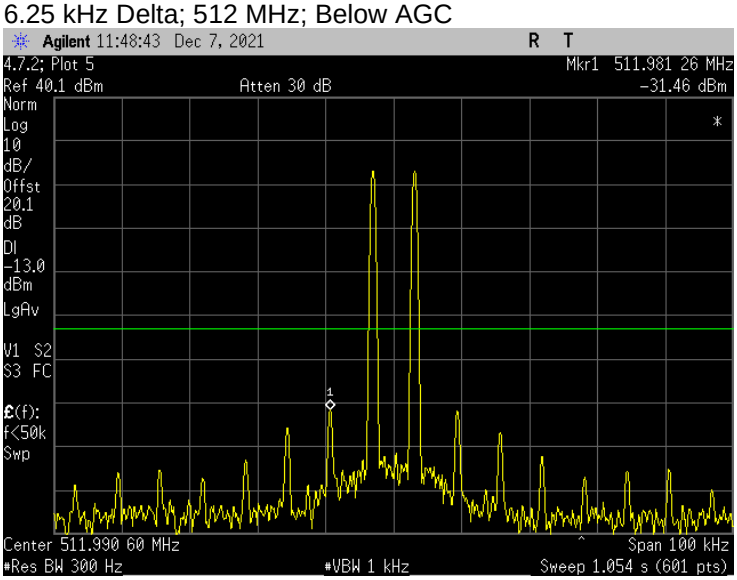
6.25 kHz Delta; 485 MHz; Below AGC



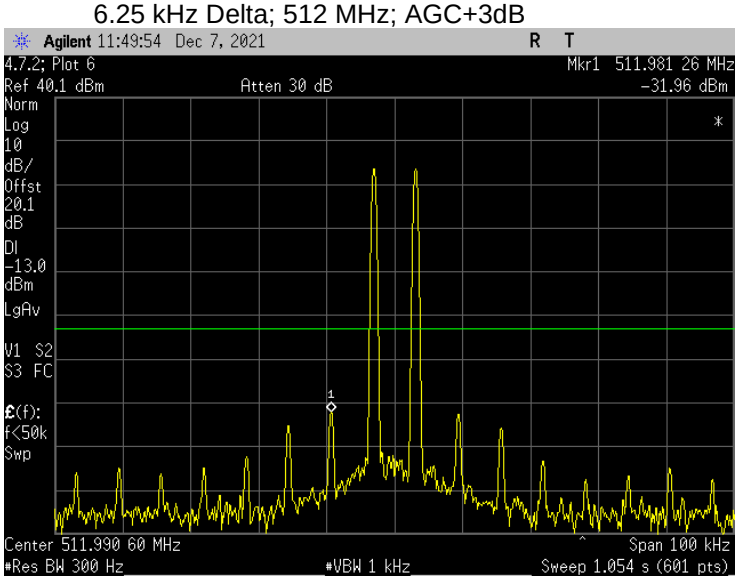
6.25 kHz Delta; 485 MHz; AGC+3dB



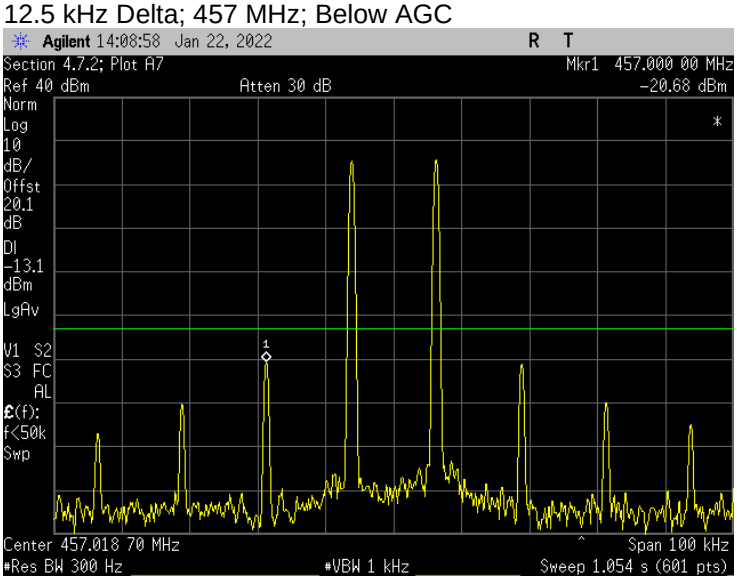
6.25 kHz Delta; 512 MHz; Below AGC



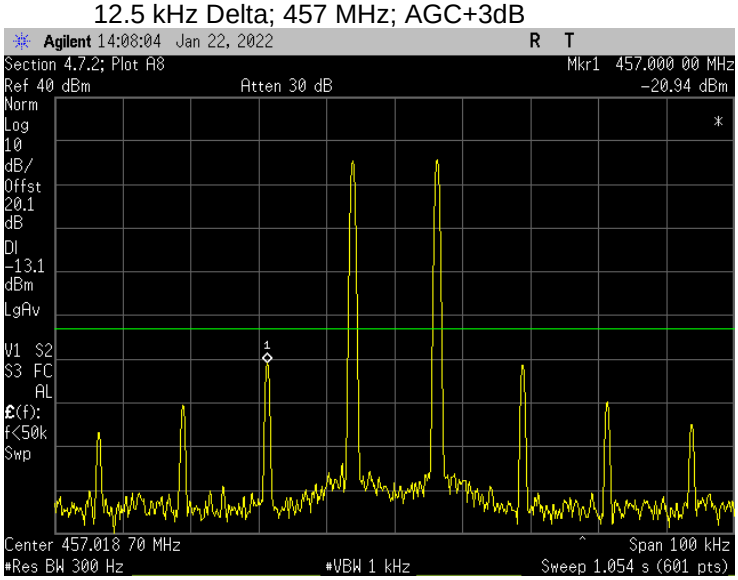
6.25 kHz Delta; 512 MHz; AGC+3dB



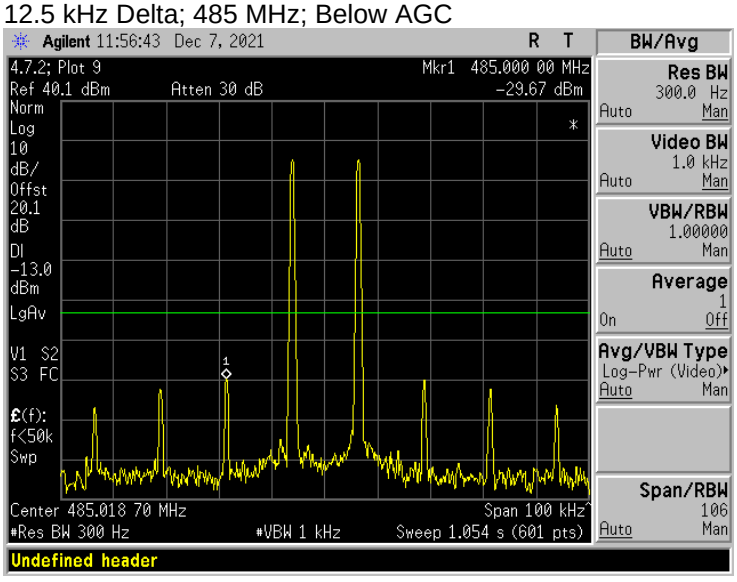
12.5 kHz Delta; 457 MHz; Below AGC



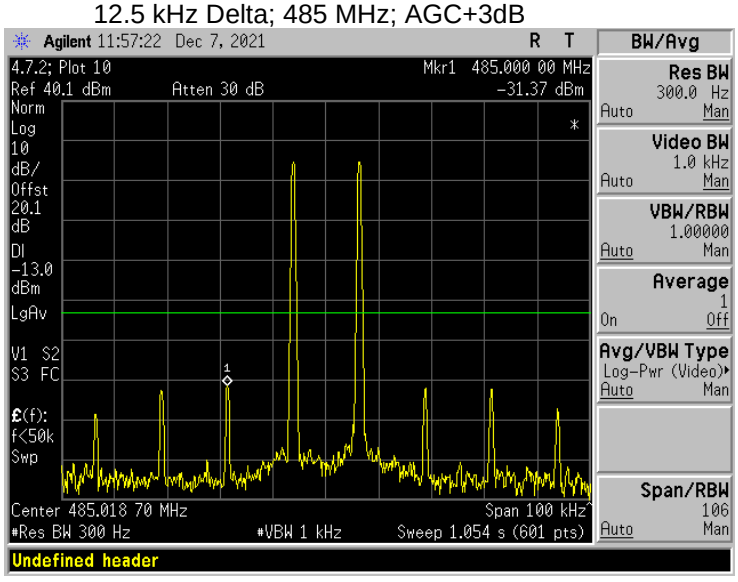
12.5 kHz Delta; 457 MHz; AGC+3dB



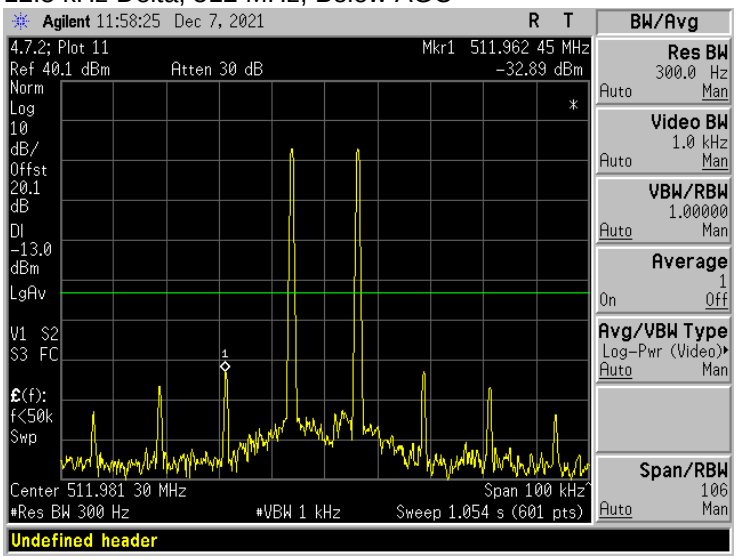
12.5 kHz Delta; 485 MHz; Below AGC



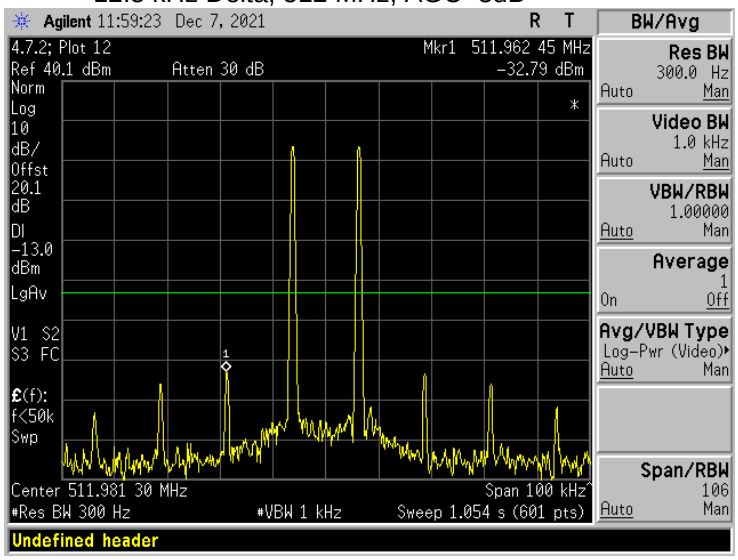
12.5 kHz Delta; 485 MHz; AGC+3dB



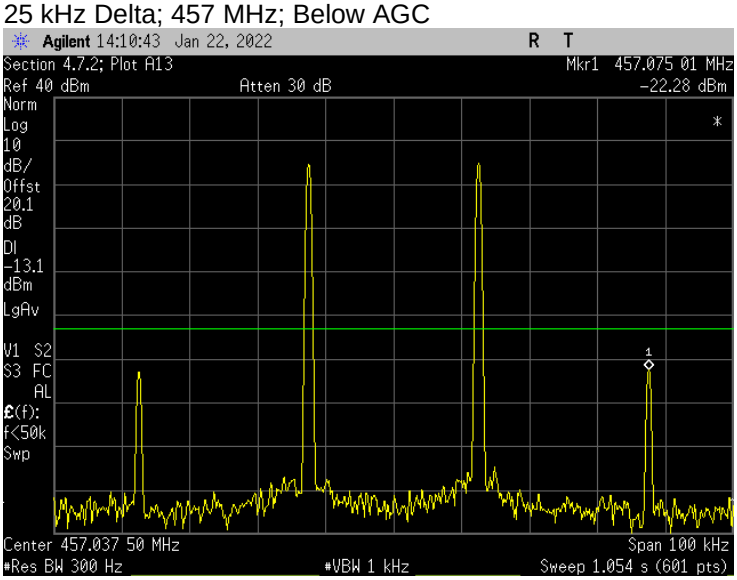
12.5 kHz Delta; 512 MHz; Below AGC



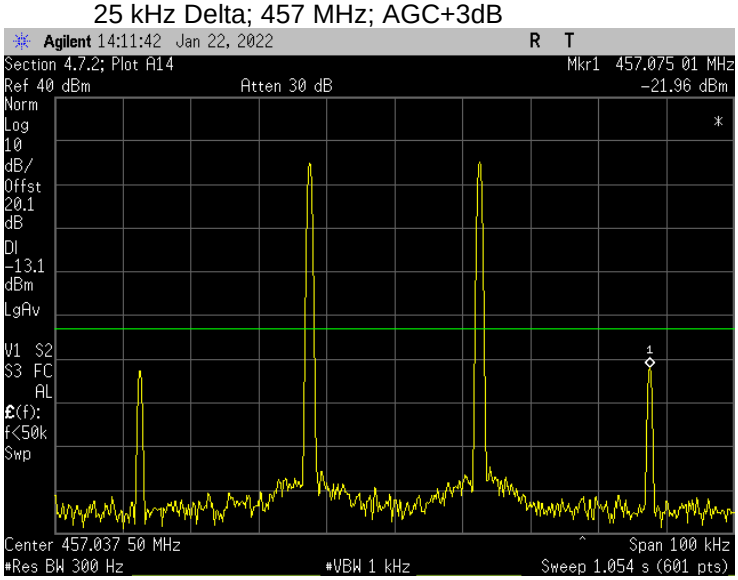
12.5 kHz Delta; 512 MHz; AGC+3dB



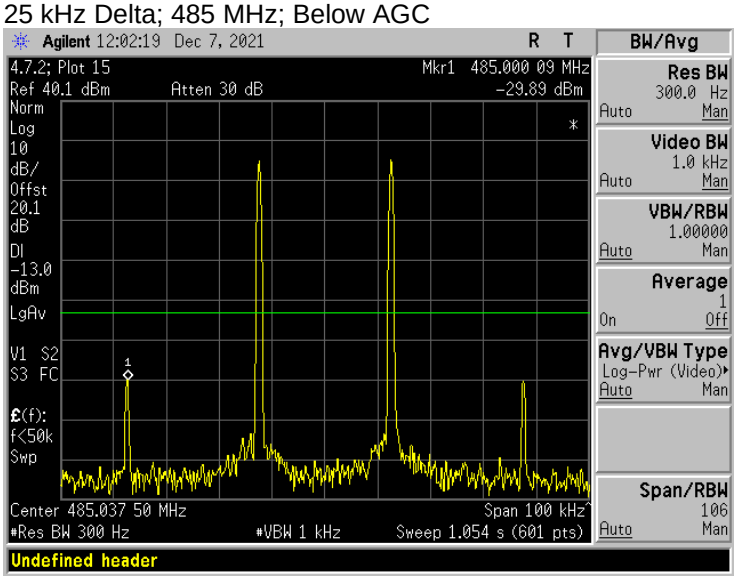
25 kHz Delta; 457 MHz; Below AGC



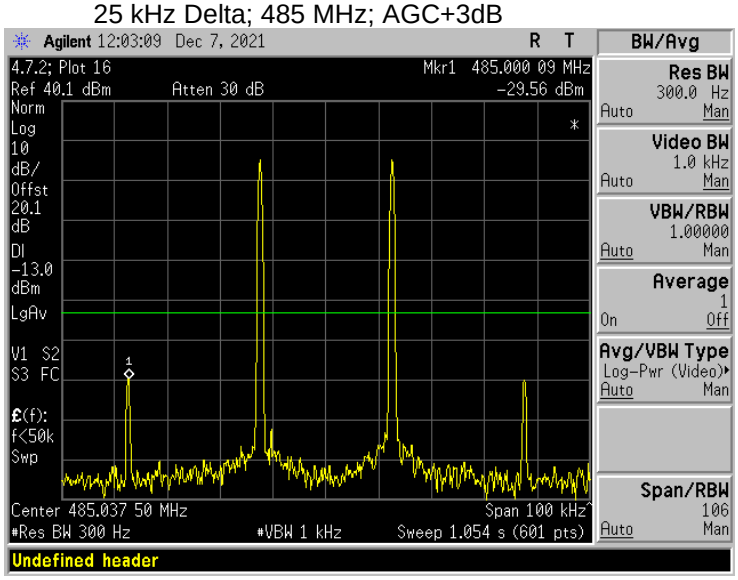
25 kHz Delta; 457 MHz; AGC+3dB



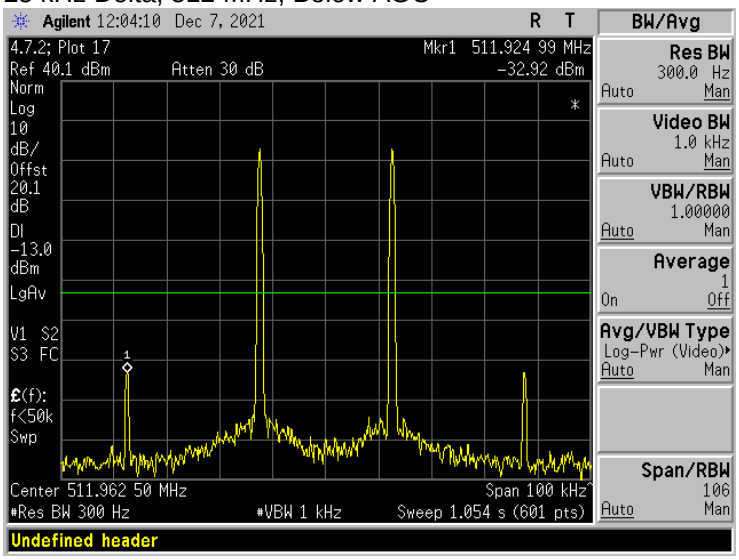
25 kHz Delta; 485 MHz; Below AGC



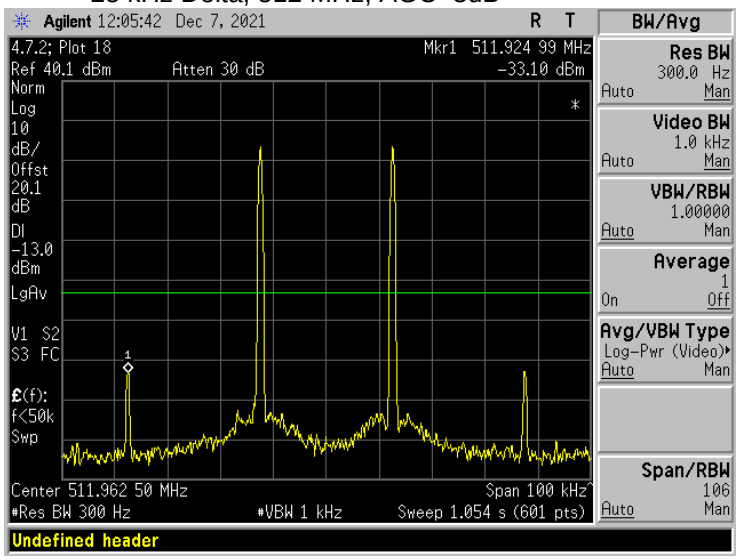
25 kHz Delta; 485 MHz; AGC+3dB



25 kHz Delta; 512 MHz; Below AGC

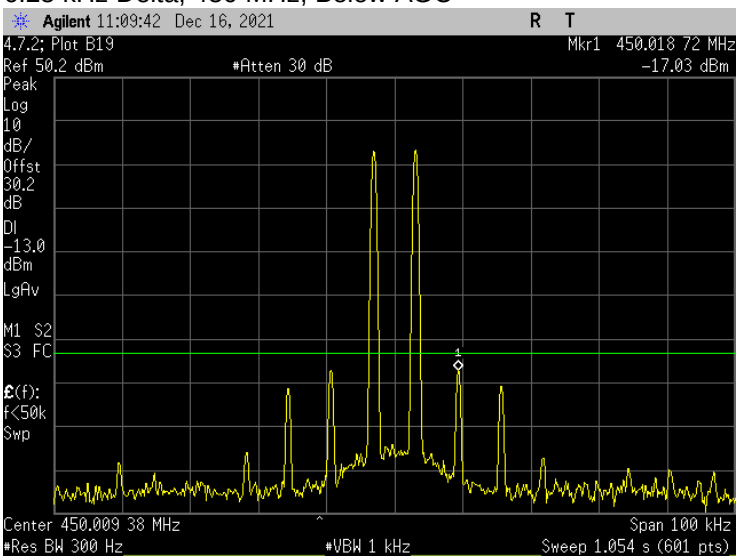


25 kHz Delta; 512 MHz; AGC+3dB

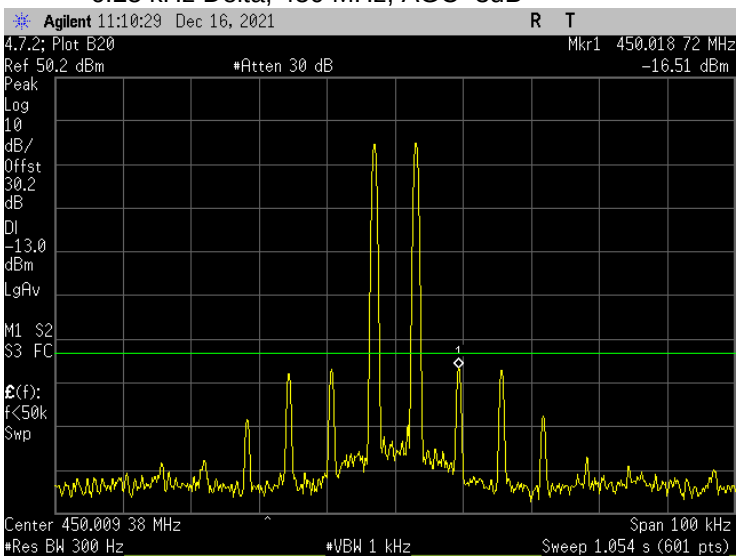


Downlink

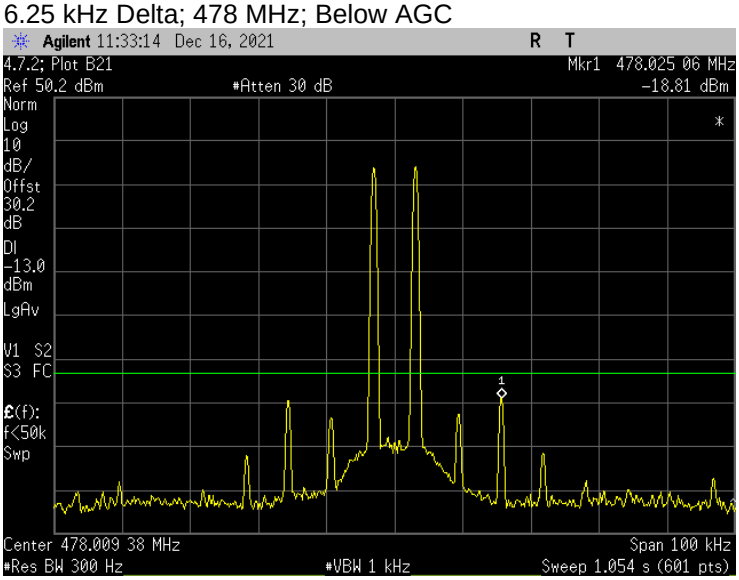
6.25 kHz Delta; 450 MHz; Below AGC



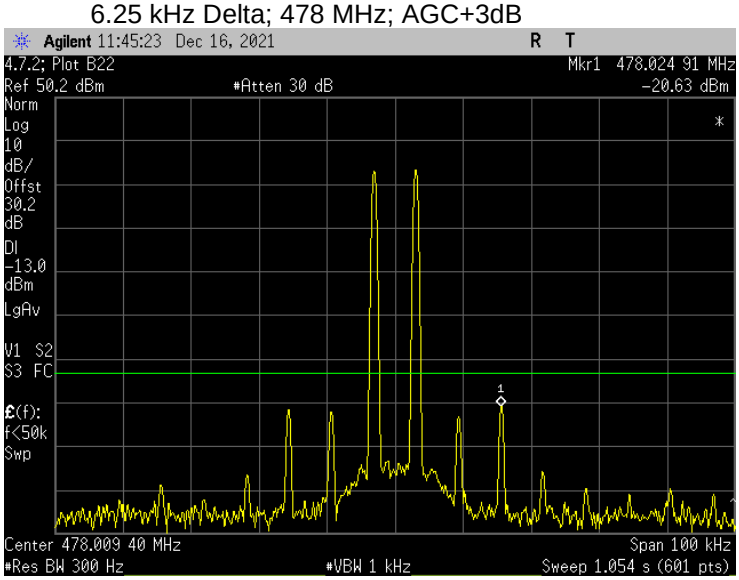
6.25 kHz Delta; 450 MHz; AGC+3dB



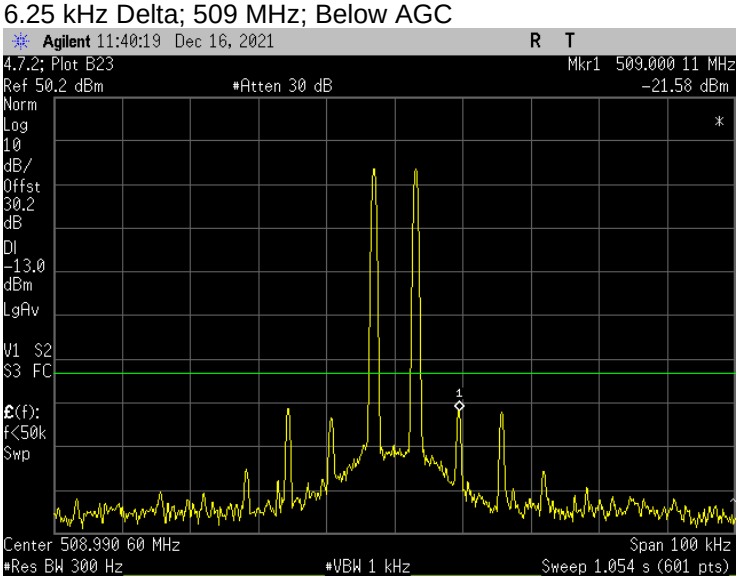
6.25 kHz Delta; 478 MHz; Below AGC



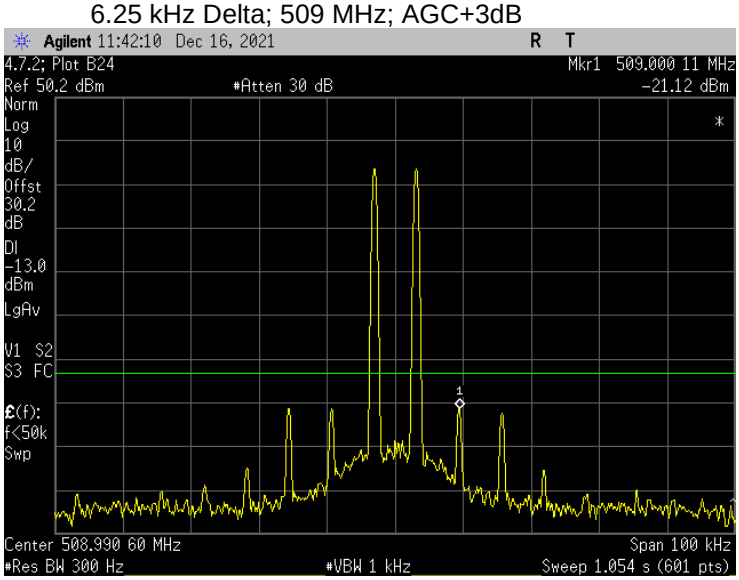
6.25 kHz Delta; 478 MHz; AGC+3dB



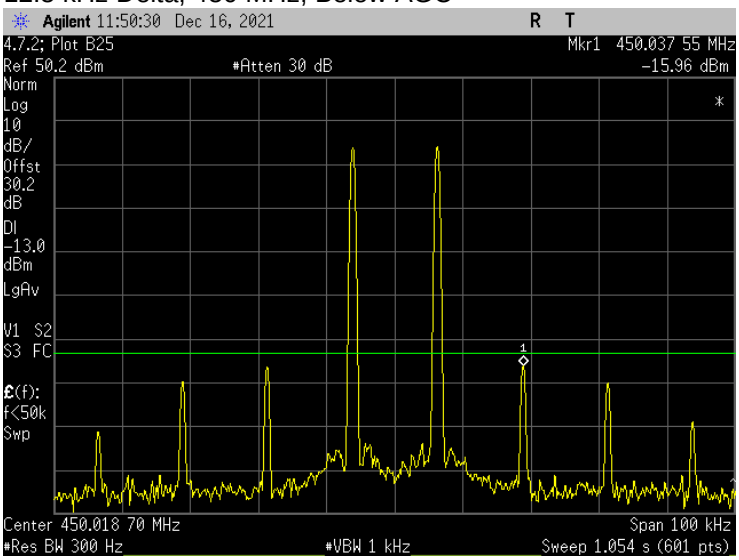
6.25 kHz Delta; 509 MHz; Below AGC



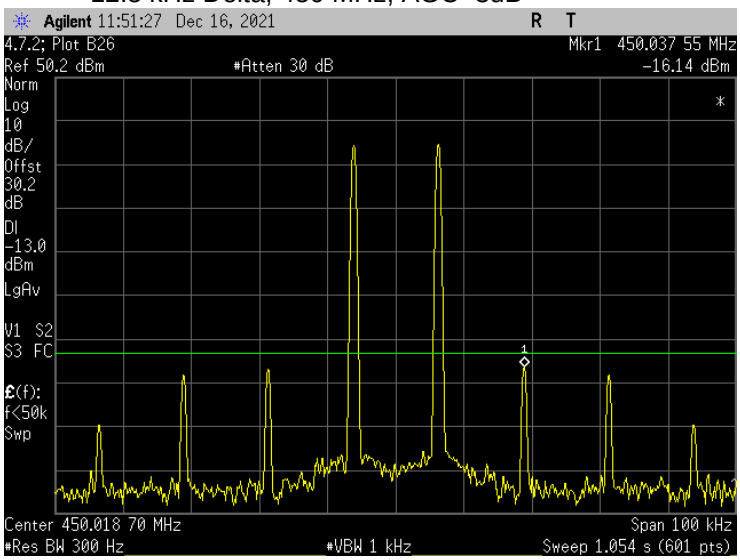
6.25 kHz Delta; 509 MHz; AGC+3dB



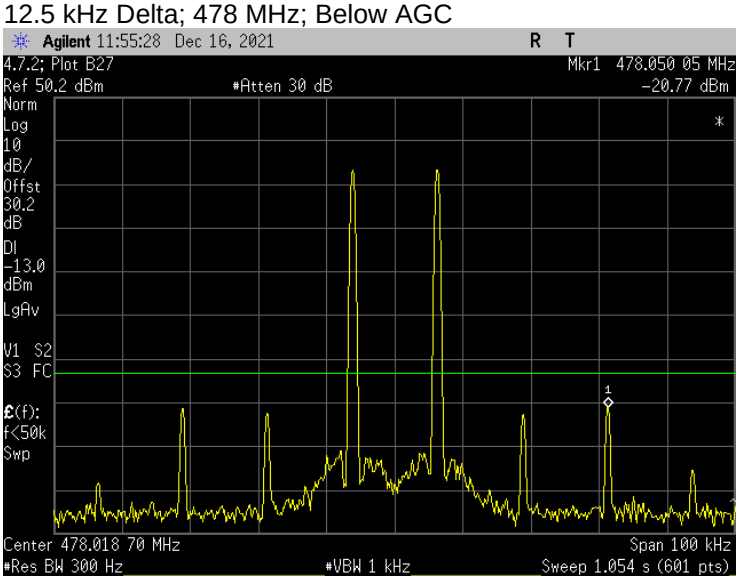
12.5 kHz Delta; 450 MHz; Below AGC



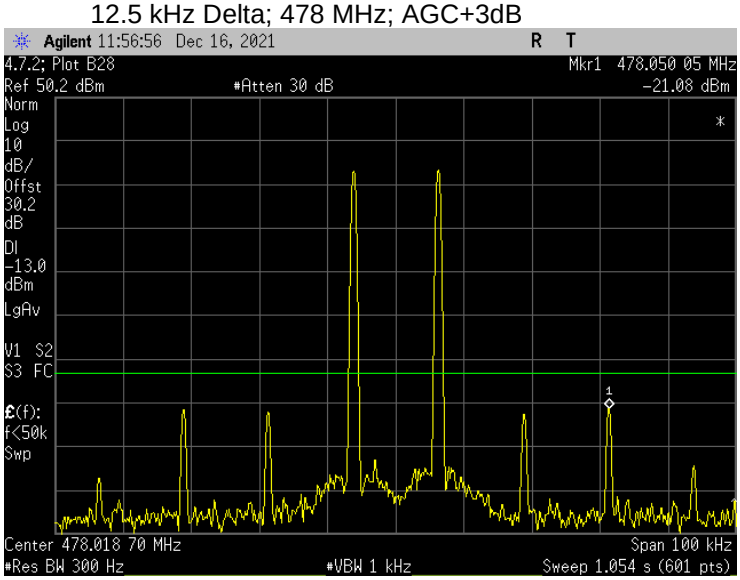
12.5 kHz Delta; 450 MHz; AGC+3dB



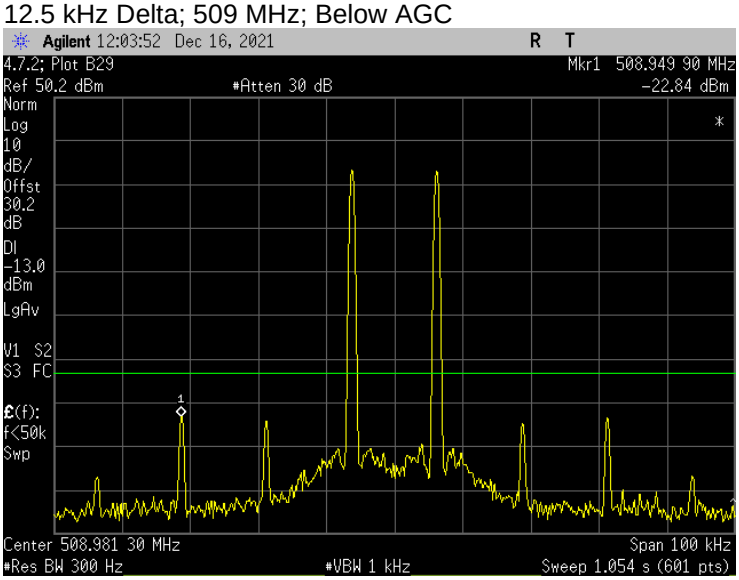
12.5 kHz Delta; 478 MHz; Below AGC



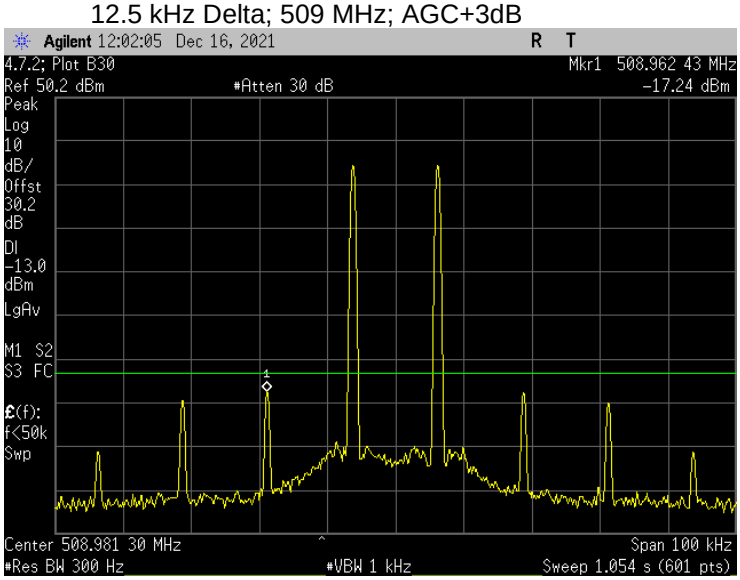
12.5 kHz Delta; 478 MHz; AGC+3dB



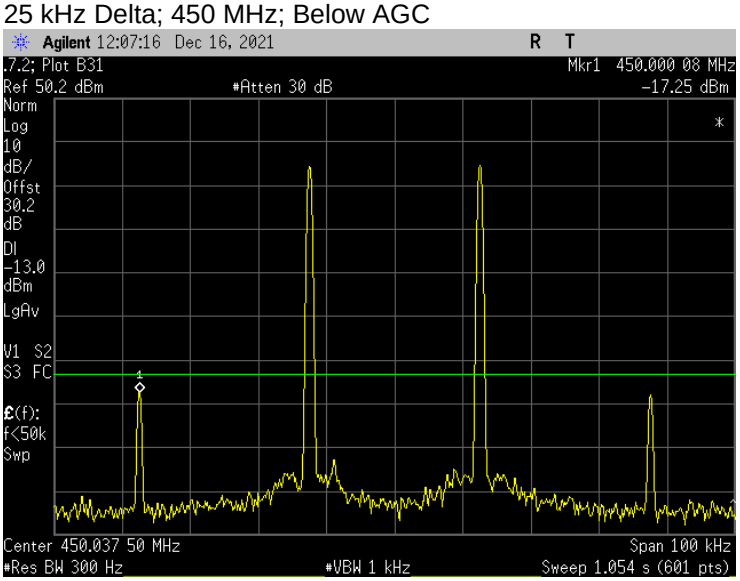
12.5 kHz Delta; 509 MHz; Below AGC



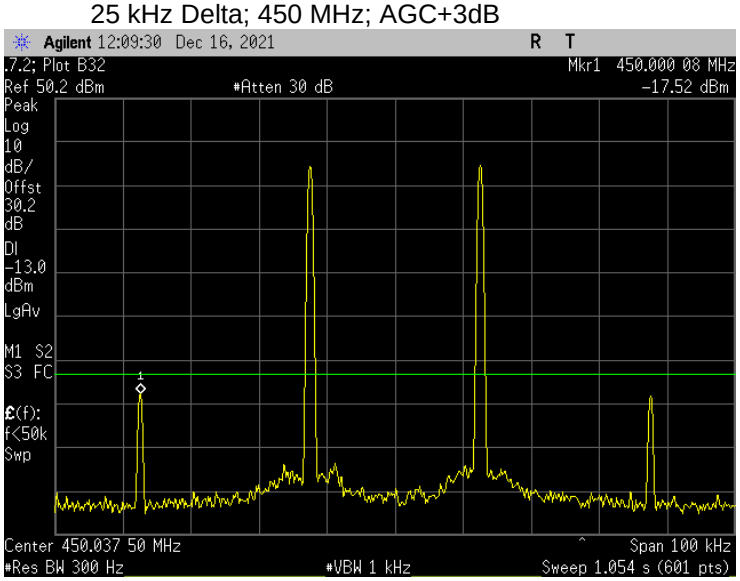
12.5 kHz Delta; 509 MHz; AGC+3dB



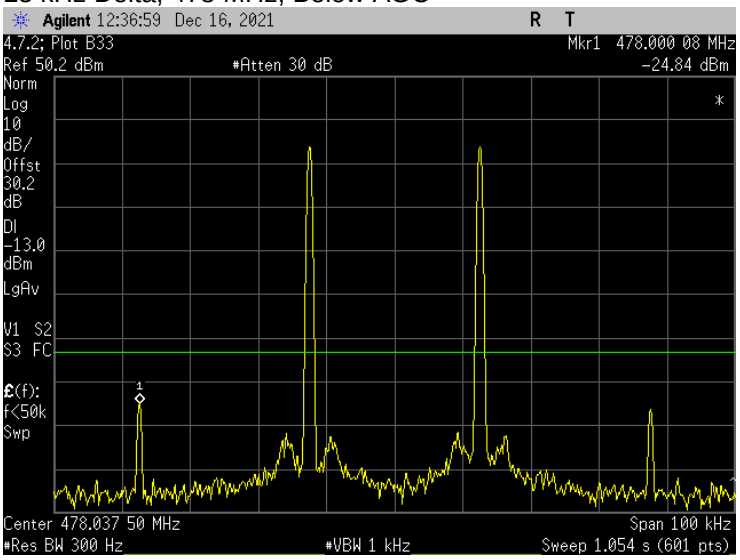
25 kHz Delta; 450 MHz; Below AGC



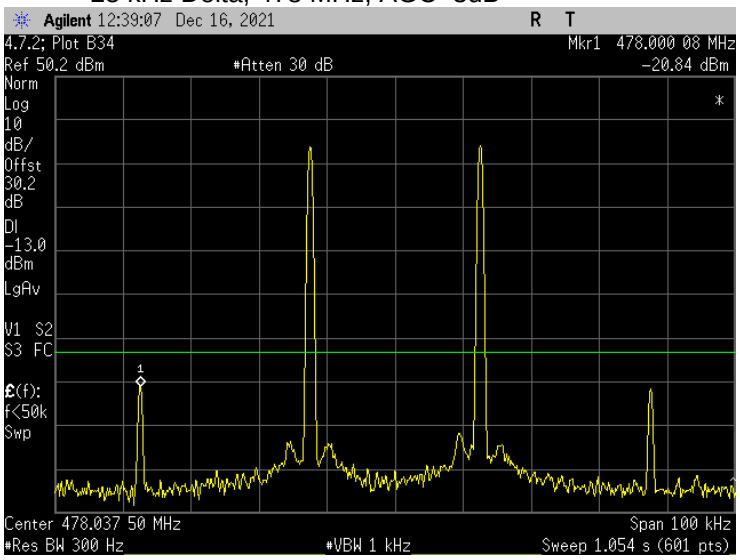
25 kHz Delta; 450 MHz; AGC+3dB



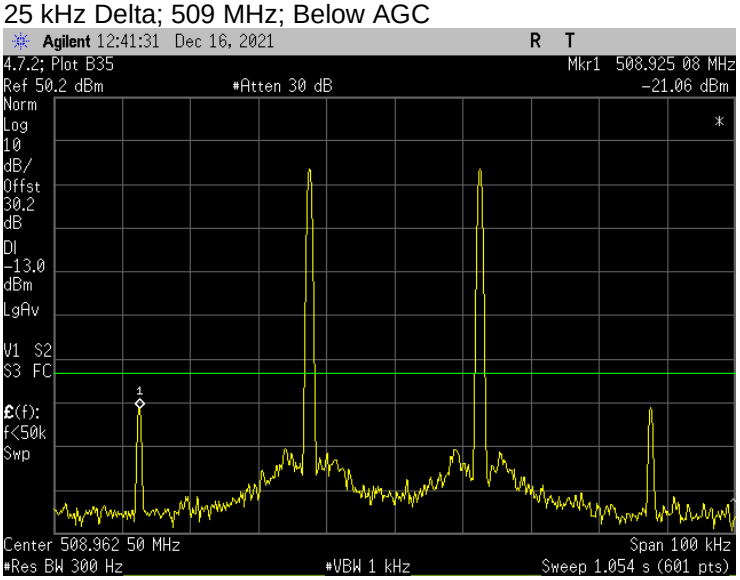
25 kHz Delta; 478 MHz; Below AGC



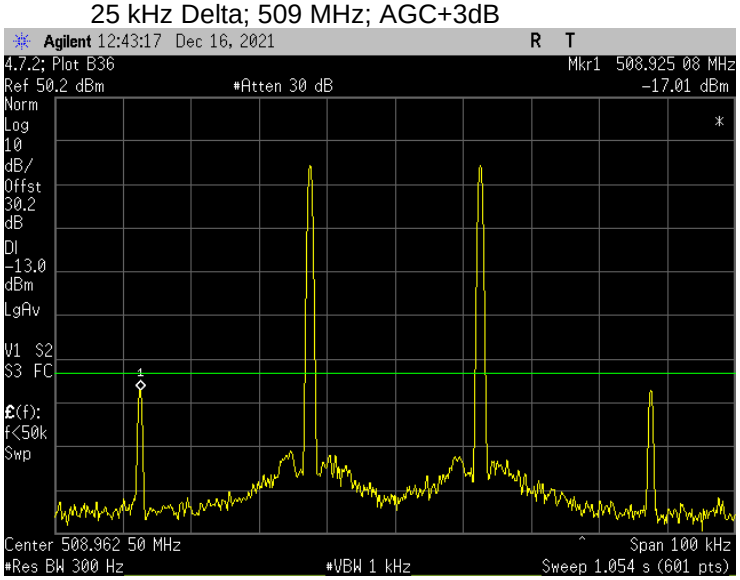
25 kHz Delta; 478 MHz; AGC+3dB



25 kHz Delta; 509 MHz; Below AGC



25 kHz Delta; 509 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.

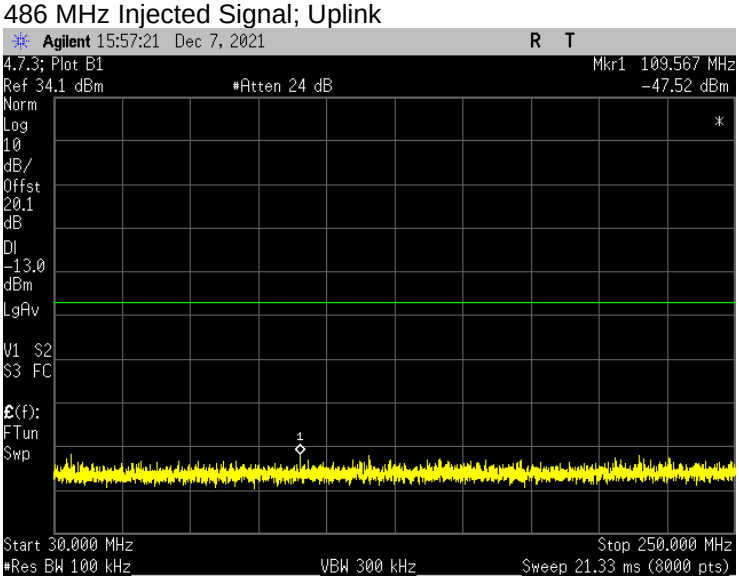
17.3 Results for Section 4.7.3

Model	080-300926	Specification	FCC KDB 935210 Sec. 4.7.3 FCC part 90.543 (e)(3)
Serial Number	CS40-U37-U0D-A0-DVT0003	Test Date	January 8, 2022
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-44); Attenuator (ATT-53);Signal Generator (SIG-33)		

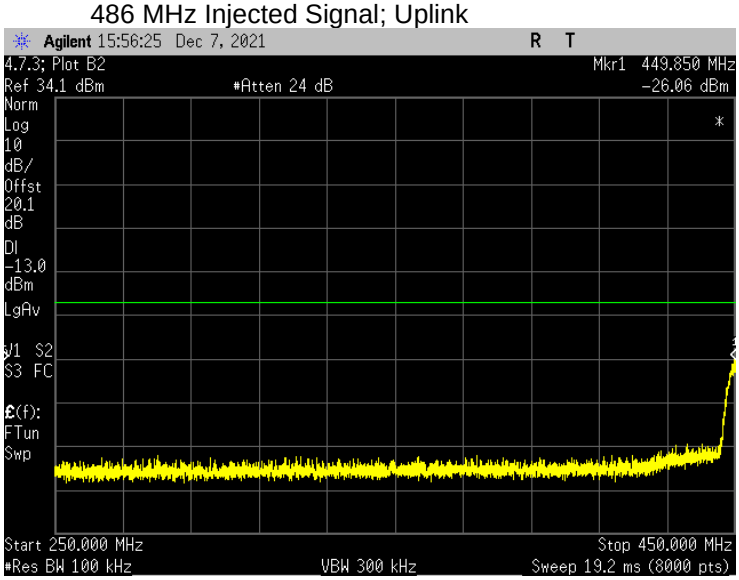
The spectrum analyzer was set to max hold mode.

Plot	RBW	VBW	Output	Sig Gen			Spectrum Analyzer Start	Spectrum Analyzer Stop	Max reading Freq	Max reading
#	MHz	MHz	Mode	Modul	MHz	dBm	MHz	MHz	MHz	dBm
B1	0.1	0.3	Uplink	CW	486.0	-48.5	30	250	109.567	-47.52
B2	0.1	0.3	Uplink	CW	486.0	-48.5	250	450	449.85	-26.06
B3	0.1	0.3	Uplink	CW	486.0	-48.5	512	750	512.03	-27.04
B4	0.1	0.3	Uplink	CW	486.0	-48.5	750	1000	972	-24.05
B5	1	3	Uplink	CW	486.0	-48.5	1000	3000	2893.74	-36.07
B6	1	3	Uplink	CW	486.0	-48.5	3000	5500	3006	-35.38
B13	0.1	0.3	Downlink	CW	451.0	-37	30	250	131.189	-37.47
B14	0.1	0.3	Downlink	CW	451.0	-37	250	450	449.175	-23.28
B15	0.1	0.3	Downlink	CW	451.0	-37	512	750	512.387	-26.29
B16	0.1	0.3	Downlink	CW	451.0	-37	750	1000	901.99	-13.63
B17	1	3	Downlink	CW	451.0	-37	1000	3000	2824.48	-26.07
B18	1	3	Downlink	CW	451.0	-37	3000	5500	3026.3	-24.0
B19	0.1	0.3	Downlink	CW	478.0	-37	30	250	164.134	-37.45
B20	0.1	0.3	Downlink	CW	478.0	-37	250	450	448.6	-25.55
B21	0.1	0.3	Downlink	CW	478.0	-37	512	750	512.149	-26.13
B22	0.1	0.3	Downlink	CW	478.0	-37	750	1000	955.99	-14.47
B23	1	3	Downlink	CW	478.0	-37	1000	3000	2804.48	-25.13
B24	1	3	Downlink	CW	478.0	-37	3000	5500	3062.8	-23.49
B25	0.1	0.3	Downlink	CW	511.0	-37	30	250	157.671	-36.4
B26	0.1	0.3	Downlink	CW	511.0	-37	250	450	450	-25.97
B27	0.1	0.3	Downlink	CW	511.0	-37	512	750	512.298	-25.89
B28	0.1	0.3	Downlink	CW	511.0	-37	750	1000	957.18	-36.6
B29	1	3	Downlink	CW	511.0	-37	1000	3000	1021.75	-14.8
B30	1	3	Downlink	CW	511.0	-37	3000	5500	3007.5	-23.66

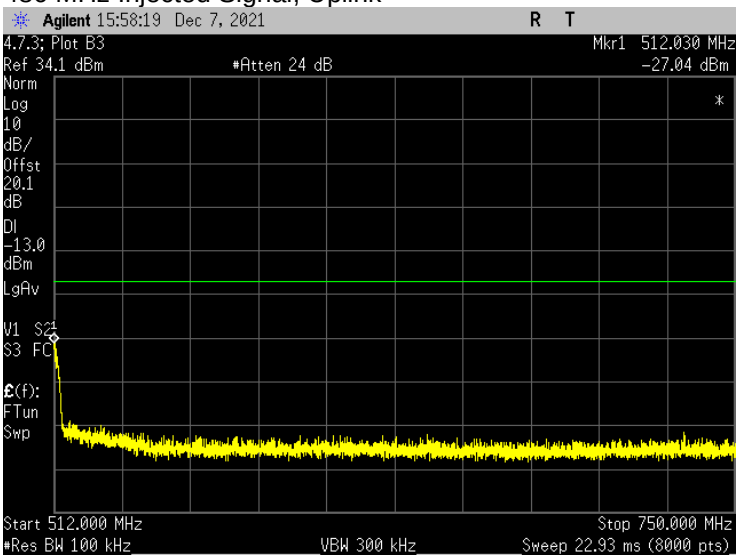
486 MHz Injected Signal; Uplink



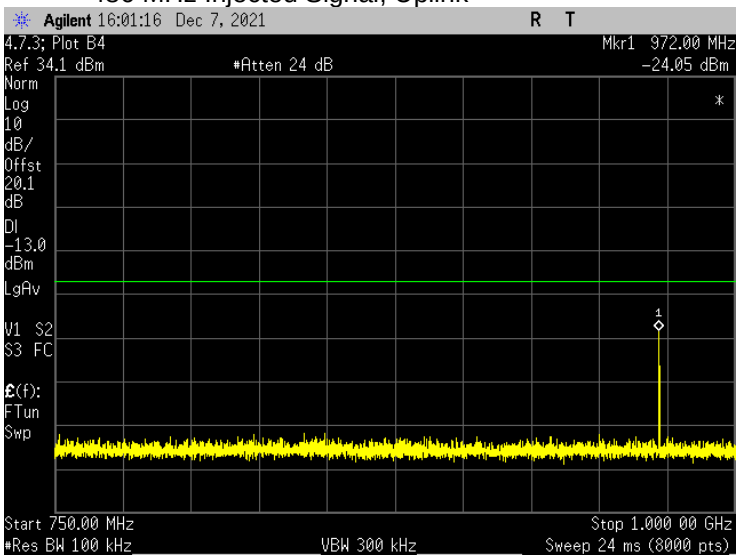
486 MHz Injected Signal; Uplink



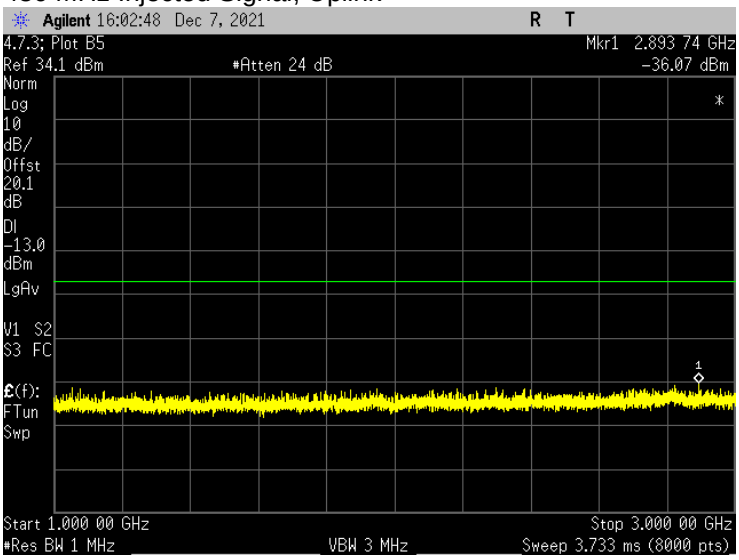
486 MHz Injected Signal; Uplink



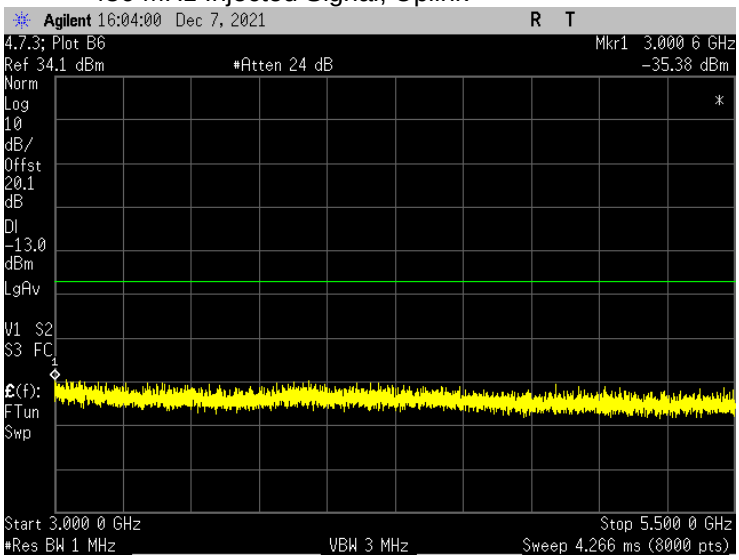
486 MHz Injected Signal; Uplink



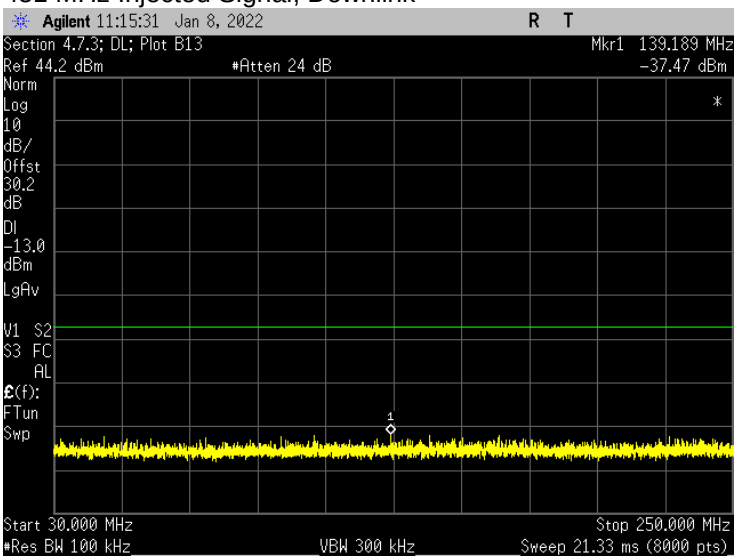
486 MHz Injected Signal; Uplink



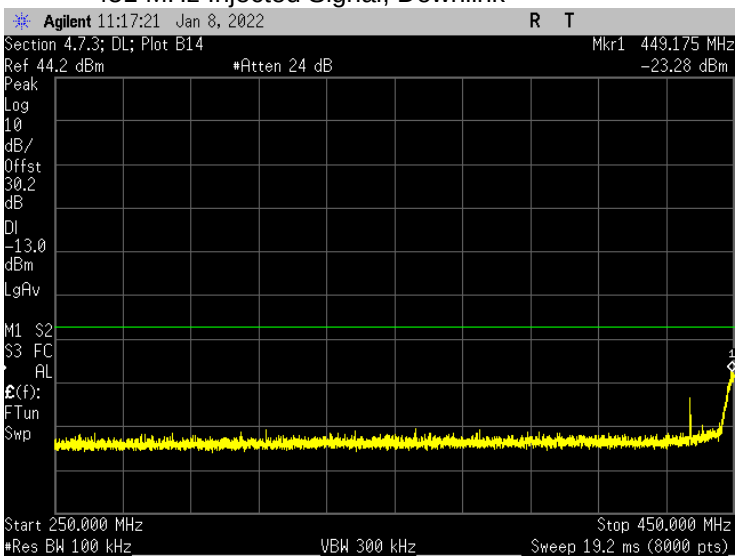
486 MHz Injected Signal; Uplink



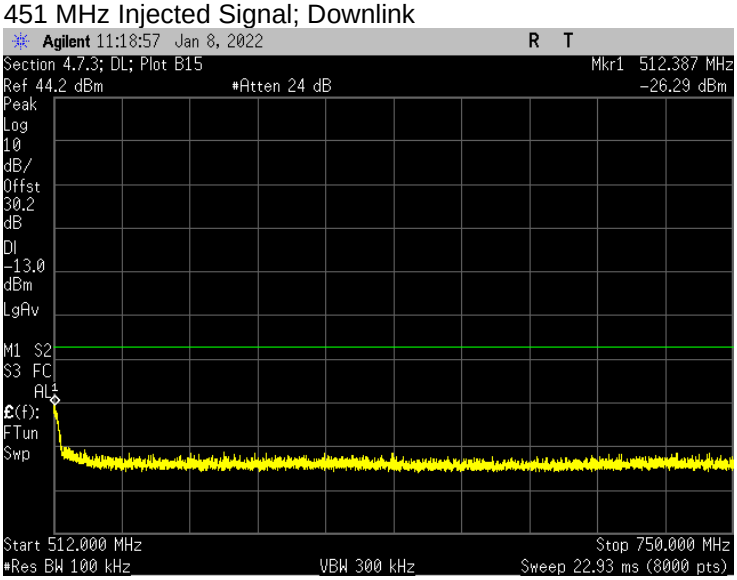
451 MHz Injected Signal; Downlink



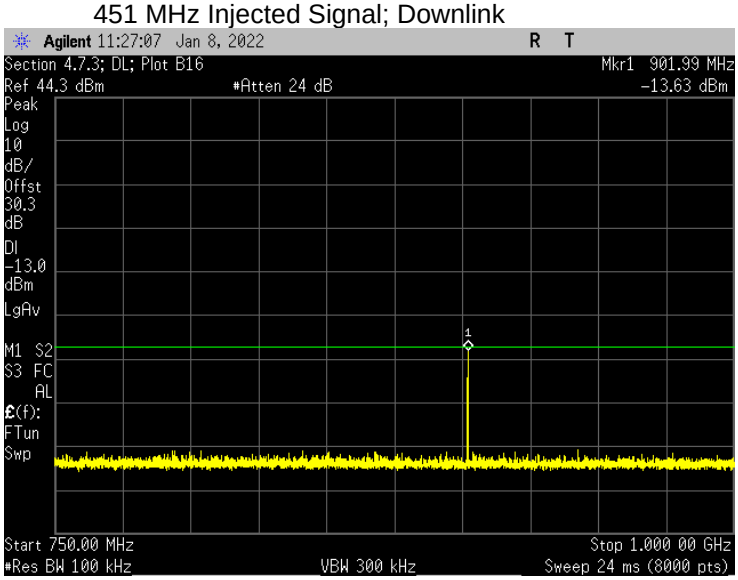
451 MHz Injected Signal; Downlink



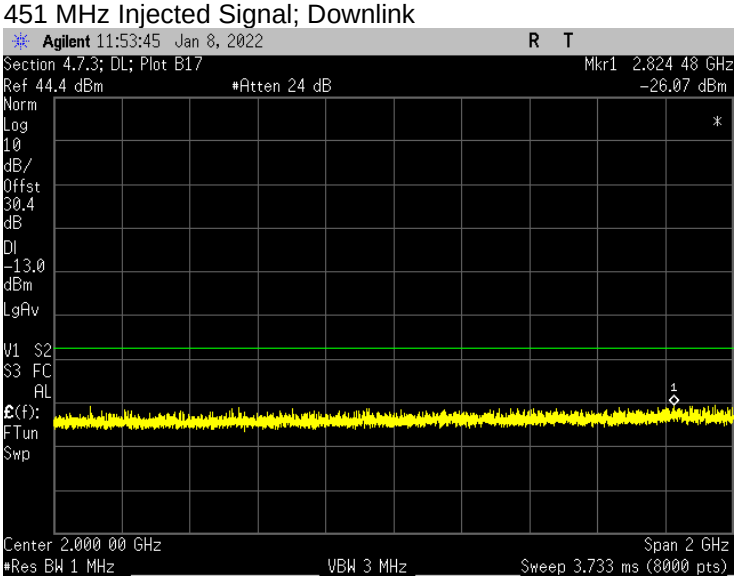
451 MHz Injected Signal; Downlink



451 MHz Injected Signal; Downlink



451 MHz Injected Signal; Downlink



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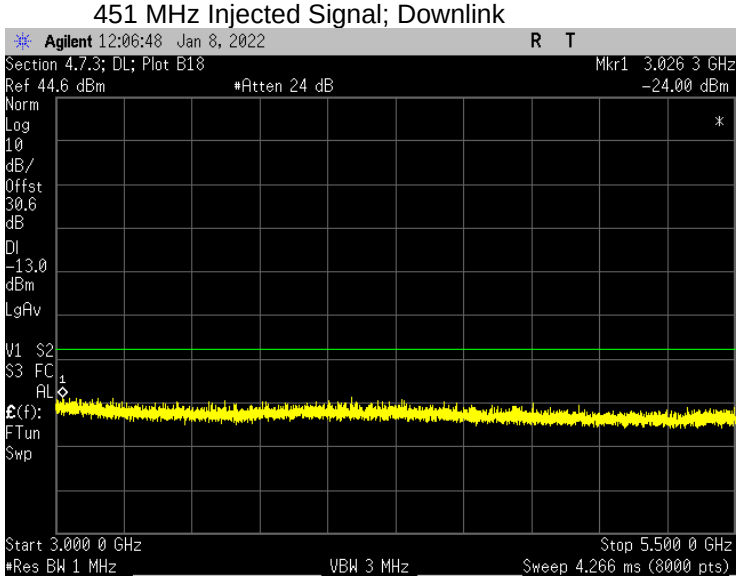
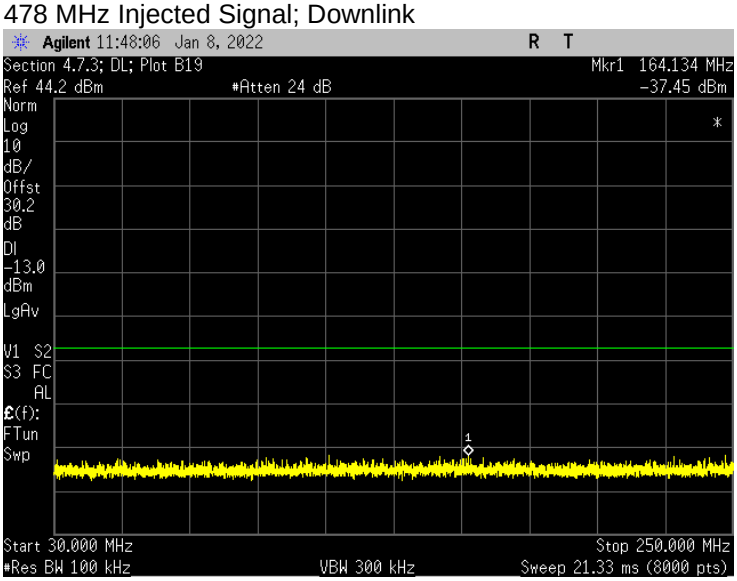
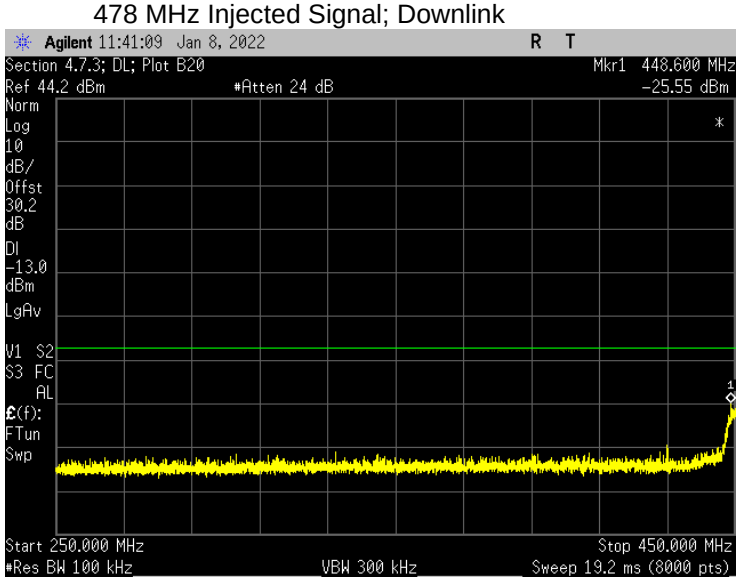


478 MHz Injected Signal; Downlink



478 MHz Injected Signal; Downlink



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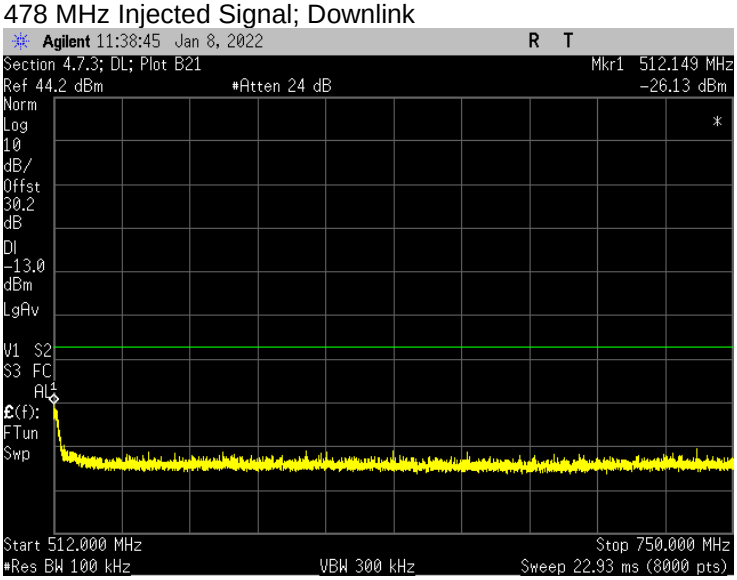
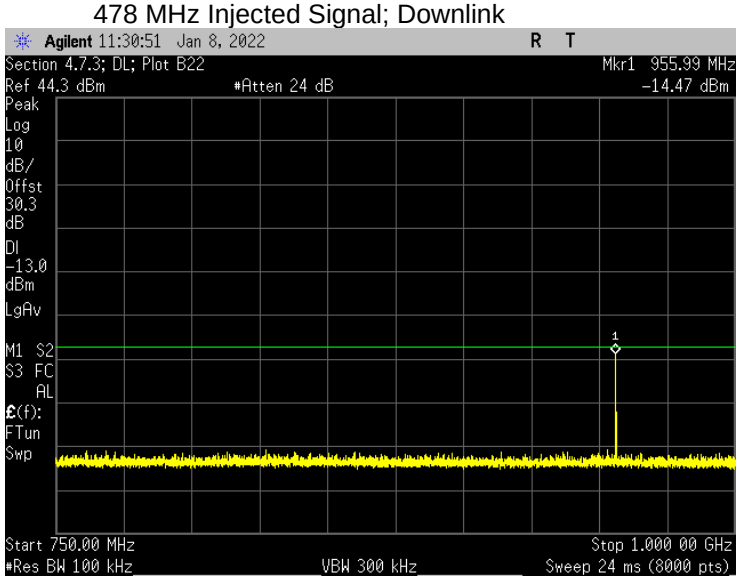
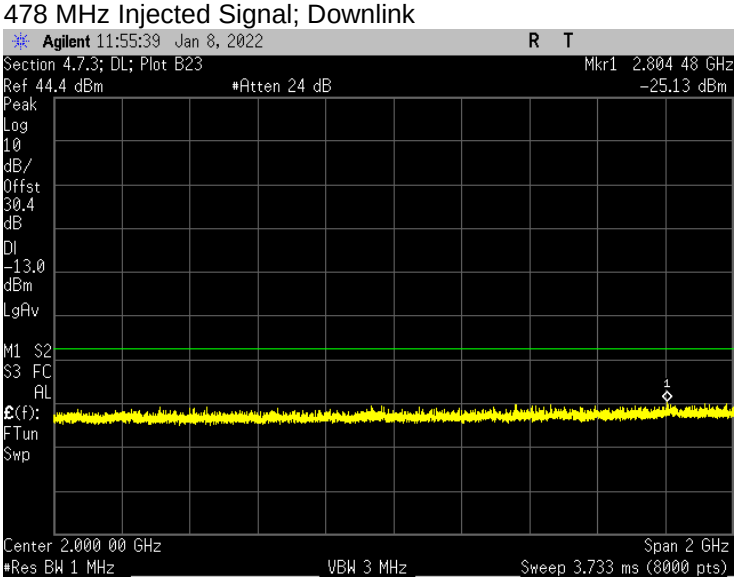


478 MHz Injected Signal; Downlink



478 MHz Injected Signal; Downlink



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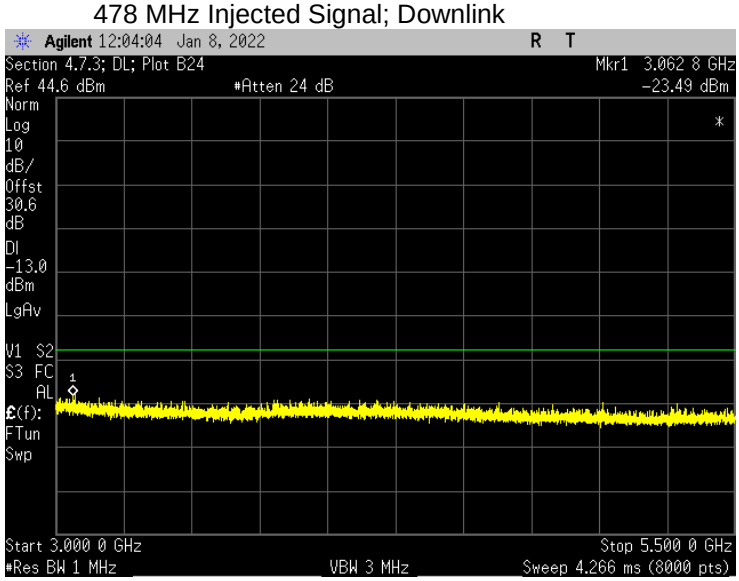
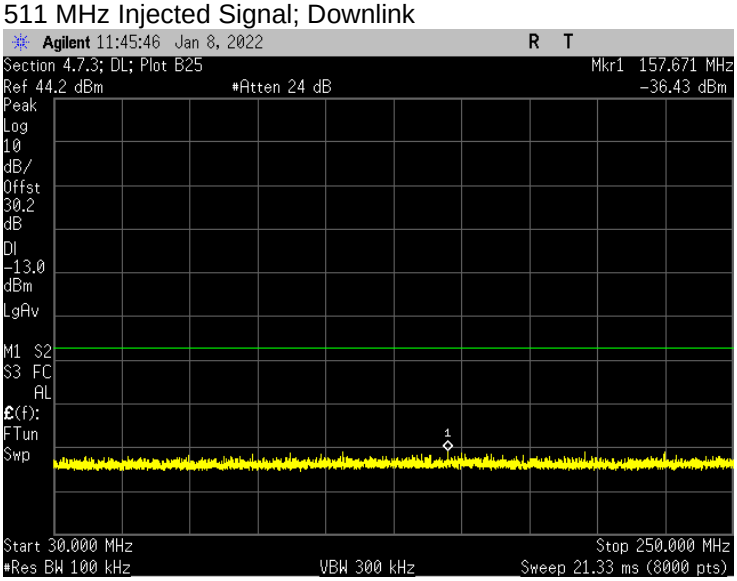
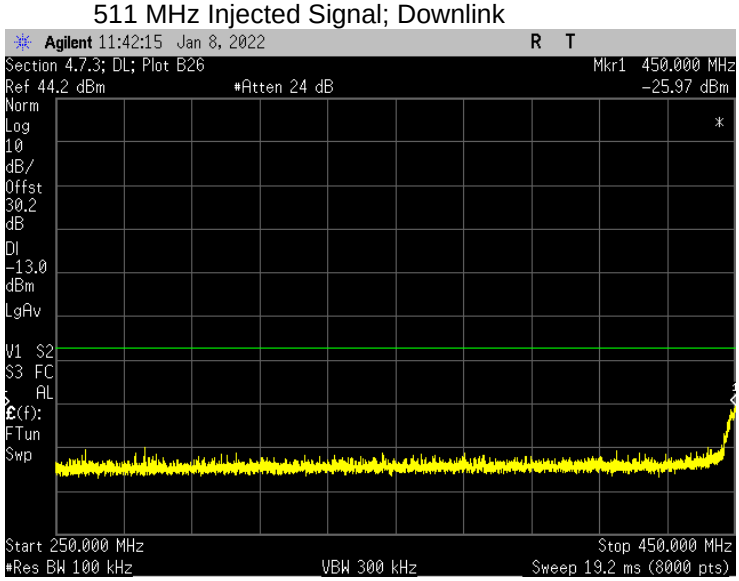


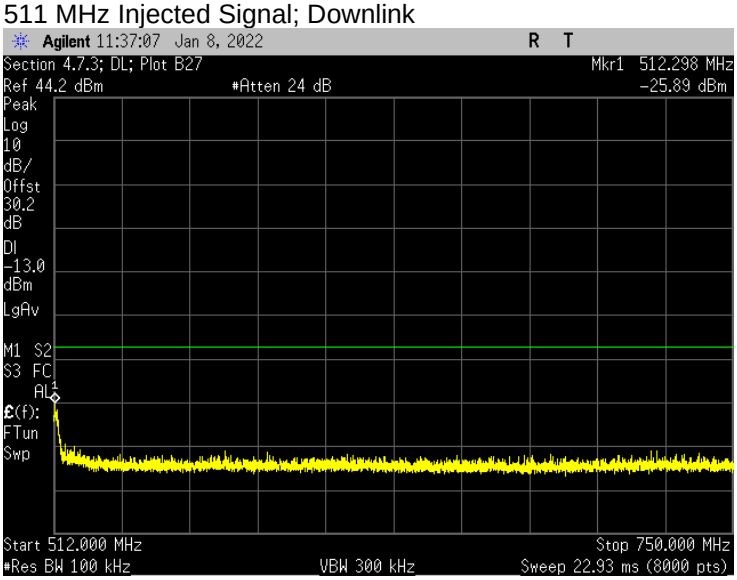
511 MHz Injected Signal; Downlink



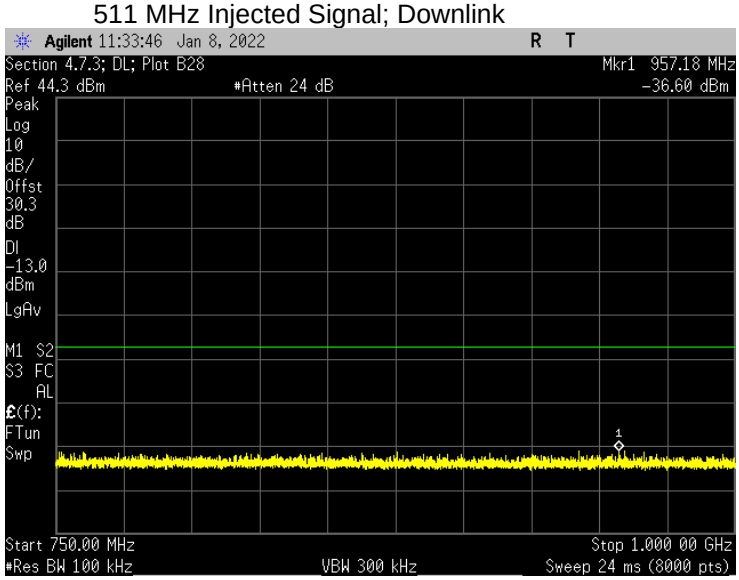
511 MHz Injected Signal; Downlink



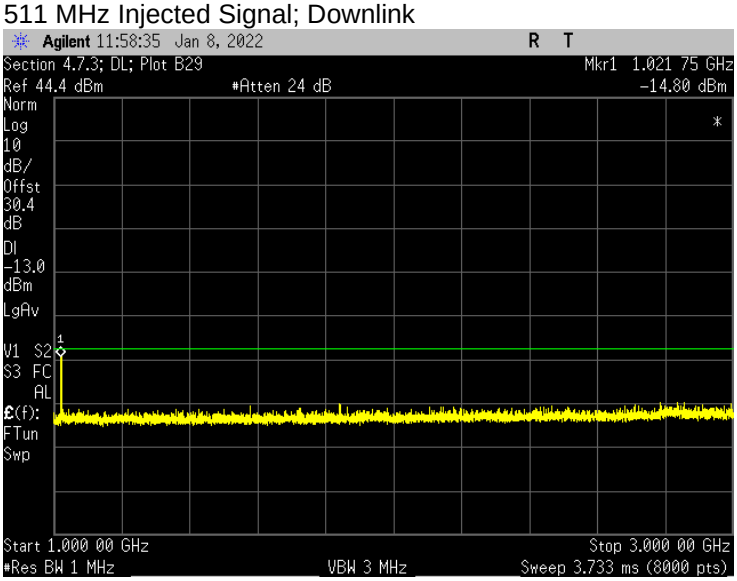
511 MHz Injected Signal; Downlink



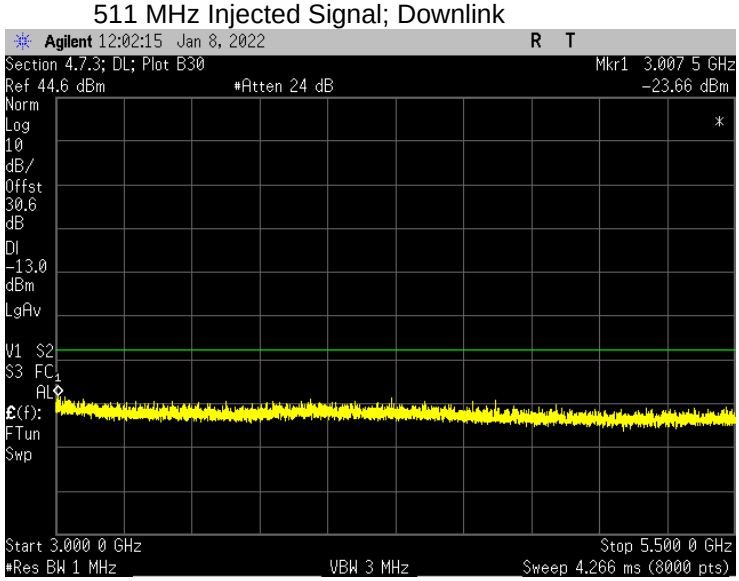
511 MHz Injected Signal; Downlink



511 MHz Injected Signal; Downlink



511 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: $43+10xLog_{10}P$, 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.

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:

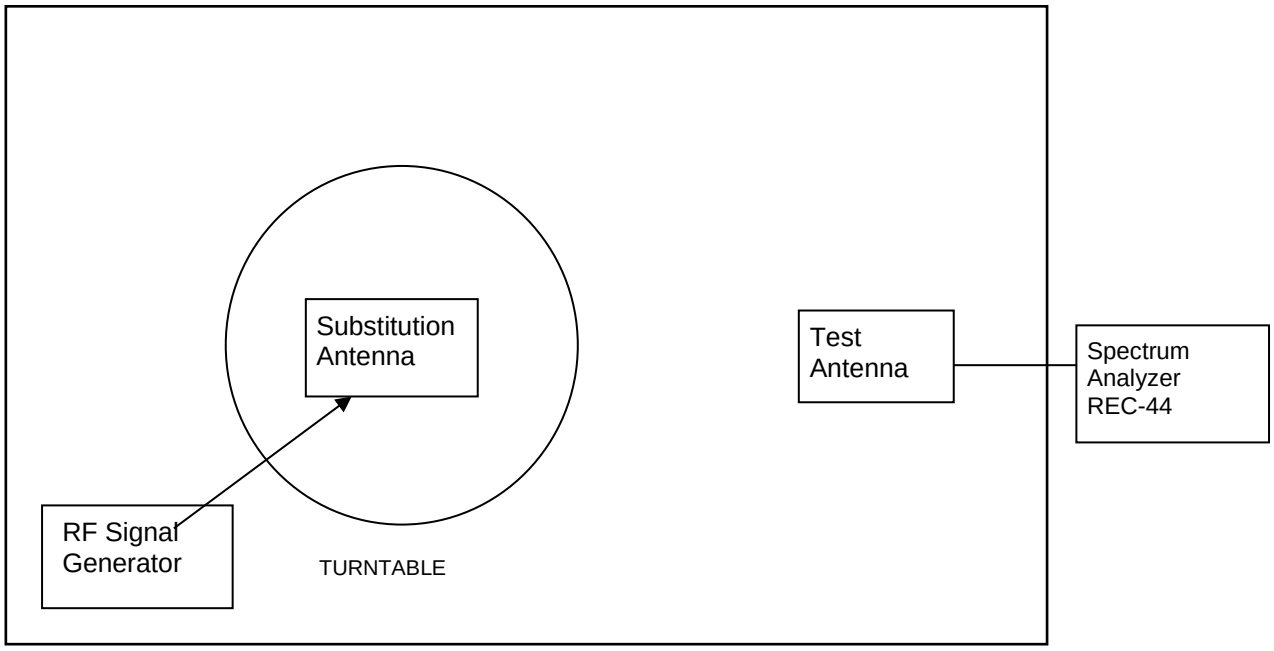
1) Resolution Bandwidth = 100 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1GHz.
2) Video Bandwidth = 300 kHz for spurious emissions below 1 GHz, and 3 MHz for spurious emissions above 1 GHz.
3) Sweep Speed = Slow enough to maintain measurement calibration.
4) Detector 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
1000-6000	ANT-13	ANT-66	REC-44	SIG-31

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	080-300926	Specification	FCC KDB 935210
Serial Number	CS40-U37-U0D-A0-DVT0003	Test Dates	December 6, 2021 & January 21, 2022
Test Distance	3 Meters	Notes	Transmit Mode
Test Personnel	Chris Dalessio	Test Location	Chamber E
Test Equipment	See Figure 1		

The emissions were measured from 30-5200 MHz. The worst case is shown below.

Freq. MHz	Dect.	Ant. Pol.	EUT dBm	Limit dBm	Margin Under Limit dB
41.6	P	H	-49.4	-13.0	36.4
97.4	P	H	-56.6	-13.0	43.6
112.9	P	H	-65.8	-13.0	52.8
152.7	P	H	-57.1	-13.0	44.1
166.5	P	H	-59.7	-13.0	46.7
180.8	P	H	-47.2	-13.0	34.2
194.6	P	H	-40.5	-13.0	27.5
208.5	P	H	-50.3	-13.0	37.3
222.3	P	H	-50.4	-13.0	37.4
236.1	P	H	-47.2	-13.0	34.2
249.9	P	H	-50.3	-13.0	47.3
264.0	P	H	-57.6	-13.0	44.6
486.4	P	H	-54.4	-13.0	41.4
512.5	P	H	-52.0	-13.0	39.0
542.5	P	H	-59.7	-13.0	46.7
751.3	P	H	-59.1	-13.0	46.1
851.3	P	H	-57.8	-13.0	44.8
960.0	P	H	-50.6	-13.0	37.6
1125.0	P	H	-50.8	-13.0	37.8
1250.0	P	H	-55.7	-13.0	42.7
1375.0	P	H	-52.0	-13.0	39.0
1500.0	P	H	-57.5	-13.0	44.5
1625.0	P	H	-51.7	-13.0	38.7
1750.0	P	H	-55.7	-13.0	42.7
1875.0	P	H	-52.1	-13.0	39.1
1921.7	P	H	-51.0	-13.0	38.0
2125.0	P	H	-50.5	-13.0	37.5
2220.0	P	H	-54.5	-13.0	41.5
2375.0	P	H	-53.9	-13.0	40.9
2875.0	P	H	-53.8	-13.0	40.8
3125.0	P	H	-51.2	-13.0	38.2
3350.0	P	H	-51.3	-13.0	38.3

Freq. MHz	Dect.	Ant. Pol.	EUT dBm	Limit dBm	Margin Under Limit dB
3525.0	P	H	-51.2	-13.0	38.2
3673.3	P	H	-50.6	-13.0	37.6
3948.3	P	H	-48.8	-13.0	35.8
4130.0	P	H	-49.9	-13.0	36.9
4351.7	P	H	-49.5	-13.0	36.5
4581.7	P	H	-48.9	-13.0	35.9
4853.3	P	H	-49.5	-13.0	36.5
35.0	P	V	-55.9	-13.0	42.9
38.8	P	V	-57.2	-13.0	44.2
152.7	P	V	-55.8	-13.0	42.8
180.8	P	V	-39.6	-13.0	26.6
194.6	P	V	-40.3	-13.0	27.3
208.5	P	V	-46.9	-13.0	43.9
236.1	P	V	-42.7	-13.0	29.7
291.7	P	V	-59.1	-13.0	46.1
486.4	P	V	-54.6	-13.0	41.6
512.5	P	V	-53.1	-13.0	40.1
750.0	P	V	-55.5	-13.0	42.1
840.0	P	V	-59.5	-13.0	46.5
901.3	P	V	-53.8	-13.0	40.8
960.0	P	V	-51.3	-13.0	38.3
1125.0	P	V	-51.4	-13.0	38.4
1153.3	P	V	-54.7	-13.0	41.7
1250.0	P	V	-54.7	-13.0	41.7
1320.0	P	V	-54.0	-13.0	41.0
1386.7	P	V	-51.2	-13.0	38.2
1583.3	P	V	-54.4	-13.0	41.4
1805.0	P	V	-53.4	-13.0	40.4
1875.0	P	V	-52.9	-13.0	39.9
2075.0	P	V	-54.4	-13.0	41.4
2125.0	P	V	-46.8	-13.0	33.8
2250.0	P	V	-53.7	-13.0	40.7
2376.7	P	V	-51.1	-13.0	38.1
2508.3	P	V	-52.3	-13.0	39.3
2640.0	P	V	-52.1	-13.0	39.1
2850.0	P	V	-53.9	-13.0	40.9
2960.0	P	V	-52.7	-13.0	39.7
3108.3	P	V	-50.0	-13.0	37.0
3386.7	P	V	-50.8	-13.0	37.8
3608.3	P	V	-49.9	-13.0	36.9
3901.7	P	V	-48.2	-13.0	35.2
4056.7	P	V	-48.3	-13.0	35.3
4135.0	P	V	-49.5	-13.0	36.5
4473.3	P	V	-49.3	-13.0	36.3
4963.3	P	V	-49.1	-13.0	36.1

Judgment: Passed by at least 27 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 450-512 MHz	0.8 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-9563B2 Revisions:			
Rev.	Affected Sections	Description	Rationale
1	Cover, 2.0, 3.1, 14.3	Changed frequency range	Transfer Error
1	Cover	Changed address	Incomplete address
1	13.2.1.2	Changed frequency	Header does not match plots; Transfer Error
1	15.3	Changed frequency	Incorrect center frequency