Electromagnetic Compatibility Test Report

Tests Performed on a Westell Technologies, Incorporated

Booster Amplifier, Model PS71090E

Radiometrics Document RP-9209B3

ACCREDITED
TESTING CERT #1495.01

Product Detail:
FCC ID: NVRPS71090E-PS78 Equipment type: 817-824 & 862-869 MHz Industrial Booster Amplifier

Test Standards:
FCC KDB 935210: 2019 FCC Parts 2, 20.21 CFR Title 47: 2020

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

Test Date(s):
December 19, 2019 thru April 18, 2020

Document RP-9209B2 Revisions:

Rev.	Issue Date	Affected Sections	Revised By
0	April 21, 2020		

Table of Contents

1.0 ADMINISTRATIVE DATA

Equipment Under Test: A Westell, Incorporated Booster Amplifier Model: PS71090E; Serial Number: CNH60713 This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: December 9, 2019	*Test Date(s):* December 19, 2019 thru April 18, 2020
Test Report Written and Approved By: 04/21/2020 Date Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	*Radiometrics' Personnel Responsible for Test:* Joseph Strzelecki Senior EMC Engineer Richard L. Tichgelaar EMC Technician Dave Jarvis EMC Technician
Test Witnessed By: The tests were not witnessed by personnel from Westell Technologies, Incorporated	

2.0 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a Booster Amplifier, Model PS71090E, manufactured by Westell Technologies, Incorporated. 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	817-869 MHz	3.2	Pass
Amplifier Bandwidth	817-869 MHz	3.3	Pass
Input-versus-output signal comparison	817-869 MHz	3.4	Pass
Mean output power and amplifier gain	817-869 MHz	3.5	Pass
Out-of-band/out-of-block emissions conducted measurements	817-869 MHz	3.7.2	Pass
Spurious emissions conducted measurements	30-9,000 MHz	3.7.3	Pass
Frequency Stability	N/A	3.7	Note 1
Field Strength of Spurious Radiated emissions	30-9,000 MHz	3.8	Pass

Note 1: Test not required, since the amplifier repeater does not alter the input signal in any way.

The purpose of this report is to show compliance to the FCC section 20.21.

3.0 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a Booster Amplifier, Model PS71090E, manufactured by Westell Technologies, Incorporated. 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 is a Bi-Directional Amplifier and Public Safety Signal Booster, Model PS71090E, 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.
The EUT has a gain of 90 dB, Power of 33 dBm, and a frequency range of 817-824 MHz for uplink
The EUT has a gain of 90 dB, Power of 33 dBm, and a frequency range of 862-869 MHz for downlink
The output signal coupling attenuation is 0 dB
Note: The 0.5W version has an attenuation of 10dB and a gain of 80 dB.
There is no frequency stability since it does not translate frequency.

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

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	Bi-Directional Amplifier; 2W	E	Westell Inc,	PS71090E	19RF11060004
2	Bi-Directional Amplifier 0.5 W	E	Westell Inc.	PS51080E	19RF11060004

* Type: E = EUT, S = Support Equipment

4.2 EUT Operating Modes

The following Modulations were used during the tests:

Modulation	Description
AWGN	Broadband modulation with an occupied bandwidth (OBW) of 4.1 MHz. This is representative of a 5 MHz LTE channel
MSK	Narrowband MSK modulation. It has a Gaussian Filter of 0.3 and a data rate of 270 kbps. This is representative of a GSM-TDMA signal.
CW	Continuous Wave; No 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	2019	Measurements Guidance for Industrial and Non-Consumer Signal Bi-Directional Wireless, Repeater, and Amplifier Devices; v01r03
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 C: Is a shielded enclosure that measures 17' L X 10' W X 8' H. Lindgren RF Enclosures Inc. of Addison, 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-06	EMCO	Log-Periodic Ant.	3146	1248	200-1000MHz	24 Mo.	12/13/19
ANT-07	RMC	Log-Periodic Ant.	LP1000	1001	200-1000MHz	24 Mo.	11/19/18
ANT-08	RMC	Log-Periodic Ant.	LP1000	1002	200-1000MHz	24 Mo.	11/19/18
ANT-13	EMCO	Horn Antenna	3115	2502	1.0-18GHz	24 Mo.	01/16/19
ANT-36	Ailtech-Eaton	Horn Antenna	96001	2013	1.0-18GHz	24 Mo.	11/19/18
ANT-66	ETS-Lindgren	Horn Antenna	3115	62580	1.0-18GHz	24 Mo.	03/05/19
ATT-53	Weinschel	Attenuator (20 dB)	23-20-34	CG7857	DC-18 GHz	12 Mo	11/06/19
ATT-54	Weinschel	Attenuator (20 dB)	34-20-34	BP7085	DC-4 GHz	12 Mo	07/16/19
ATT-67	JFW Indust.	Variable Atten	50DR-046 SMA	594102	DC-2.5 GHz	12 Mo.	07/24/19
CAB-044A	Teledyne	Coaxial Cable	N/A	044A	DC-18 GHz	24 Mo.	05/15/18
CAB-090C	Teledyne	Coaxial Cable	N/A	090C	DC-18 GHz	24 Mo.	05/15/18
CAB-1090	Teledyne	Coaxial Cable	N/A	1090	DC-18 GHz	24 Mo.	05/16/18
CAB-114F	Teledyne	Coaxial Cable	N/A	114F	DC-18 GHz	24 Mo.	05/15/18
CAB-114G	Teledyne	Coaxial Cable	N/A	114G	DC-18 GHz	24 Mo.	05/15/18
CAB-142G	Teledyne	Coaxial Cable	N/A	142G	DC-18 GHz	24 Mo.	05/09/18
CAB-144F	Teledyne	Coaxial Cable	N/A	142G	DC-18 GHz	24 Mo.	05/15/18
CAB-160B	Teledyne	Coaxial Cable	N/A	160B	DC-18 GHz	24 Mo.	05/09/18
CAB-210A	Teledyne	Coaxial Cable	N/A	210A	DC-18 GHz	24 Mo.	05/09/18
CAB-210B	Teledyne	Coaxial Cable	N/A	210B	DC-18 GHz	24 Mo.	05/09/18
CAB-272A	Teledyne	Coaxial Cable	N/A	272A	DC-18 GHz	24 Mo.	05/09/18
COM-01	Anaren	Coupler	10023-3	COM-01	250-1000MHz	12 Mo.	12/06/19
COM-W1	CSI	Combiner/Splitter	CSI-S2BSC	None	500-3000MHz	12 Mo.	12/06/19
REC-11	Agilent	Spectrum Analyzer	E7405A	US39110103	9kHz-3GHz	24 Mo.	04/02/18
REC-21	Agilent	Spectrum Analyzer	E7405A	MY45118341	9kHz-26.5GHz	24 Mo.	01/06/18 01/14/20
REC-22	Rohde Schwarz	Spectrum Analyzer	ESIB 26	100145	26.5 GHz	24 Mo	09/16/19
REC-31	Agilent	Spectrum Analyzer	E7402A	US41160415	9kHz-3GHz	24 Mo.	05/20/19
SIG-21	HP / Agilent	Signal Generator	8341B	2910A02352	0.01-20 GHz	12 Mo.	07/26/19
SIG-30	Rohde & Schwarz	Signal Generator	SMC100A	102914	9k-3.2GHz	36 Mo.	11/29/17
SIG-31	Rohde Schwarz	Vector Signal Generator	SMJ 100A	101395	100kHz-6GHz	36 Mo.	08/25/17
SIG-32	Agilent	Vector Signal Generator	E4322	19RF1106000 5	100kHz-3GHz	24 Mo.	05/20/19
THM-03	Fluke	Temp/Humid Meter	971	95850465	N/A	12 Mo.	05/03/19

Note: All calibrated equipment is subject to periodic checks.
NCR – No Calibration Required. Device monitored by calibrated equipment. N/A: Not Applicable.
For each individual test, the equipment used was within its calibration interval during the test.

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 3.2.

11.2 Test procedures

a) A signal generator was connected to the input of the EUT.
b) A spectrum analyzer or power meter was connected to the output of the EUT using appropriate attenuation as necessary.
c) The signal generator was initially configured to produce either of the required test signals (i.e., broadband AWGN or narrowband MSK)
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 signals.

11.2.1 AGC Threshold Test Results

Model	PS71090E	Specifications	FCC KDB 935210 D05 Sec. 3.2
Serial Number	19RF11060005	Test Date	April 17, 2020
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	Spectrum Analyzer (REC-21)		

The spectrum analyzer was set to Band power measurements using 100 trace average in the RMS peak mode.

	Generator Settings		Analyzer	Attenuator	Cable	Output	
Modulation	MHz	dBm	dBm	dB	dB	Power dBm	Mode
AWGN	820.5	-40.1	8.6	20.0	0.25	28.9	Uplink
AWGN	820.5	-39.1	9.6	20.0	0.25	29.9	Uplink
AWGN	820.5	-38.1	10.6	20.0	0.25	**30.9**	Uplink
AWGN	820.5	-37.1	11.6	20.0	0.25	31.9	Uplink
AWGN	820.5	-36.1	12.6	20.0	0.25	32.9	Uplink
AWGN	820.5	-36.0	12.7	20.0	0.25	33.0	Uplink
AWGN	820.5	-35.8	12.5	20.0	0.25	32.8	Uplink
AWGN	820.5	-35.5	12.40	20.0	0.25	32.7	Uplink
MSK	820.5	-38.2	9.8	20.0	0.25	30.1	Uplink
MSK	820.5	-37.2	10.8	20.0	0.25	31.1	Uplink
MSK	820.5	-36.2	11.8	20.0	0.25	32.1	Uplink
MSK	820.5	-35.2	12.8	20.0	0.25	33.0	Uplink
MSK	820.5	-35.0	12.5	20.0	0.25	32.8	Uplink

	Generator Settings		Analyzer	Attenuator	Cable	Output	
Modulation	MHz	dBm	dBm	dB	dB	Power dBm	Mode
MSK	820.5	-34.8	12.1	20.0	0.25	32.4	Uplink
AWGN	865.5	-38.7	9.7	20.0	0.25	30.0	Downlink
AWGN	865.5	-37.7	10.7	20.0	0.25	31.0	Downlink
AWGN	865.5	-36.7	11.7	20.0	0.25	32.0	Downlink
AWGN	865.5	-35.7	12.7	20.0	0.25	33.0	Downlink
AWGN	865.5	-35.5	12.5	20.0	0.25	32.8	Downlink
AWGN	865.5	-35.3	12.4	20.0	0.25	32.7	Downlink
MSK	865.5	-38.5	9.7	20.0	0.25	30.0	Downlink
MSK	865.5	-37.5	10.7	20.0	0.25	31.0	Downlink
MSK	865.5	-36.5	11.7	20.0	0.25	32.0	Downlink
MSK	865.5	-35.5	12.7	20.0	0.25	33.0	Downlink
MSK	865.5	-35.3	12.5	20.0	0.25	32.8	Downlink
MSK	865.5	-35.1	12.5	20.0	0.25	32.8	Downlink

The Highlighted cells are the AGC Threshold. This is the Level where a 1 dB change in increase in the input signal power no longer causes a 1 dB increase in the output signal power.

Note that there was a 20-dB attenuator between the Generator output and the Analyzer.

12.0 OUT OF BAND REJECTION

12.1 Applicable Standard

The EUT shall comply with sections 3.3 of FCC KDB 935210 for passband gain.

12.2 Test Procedures

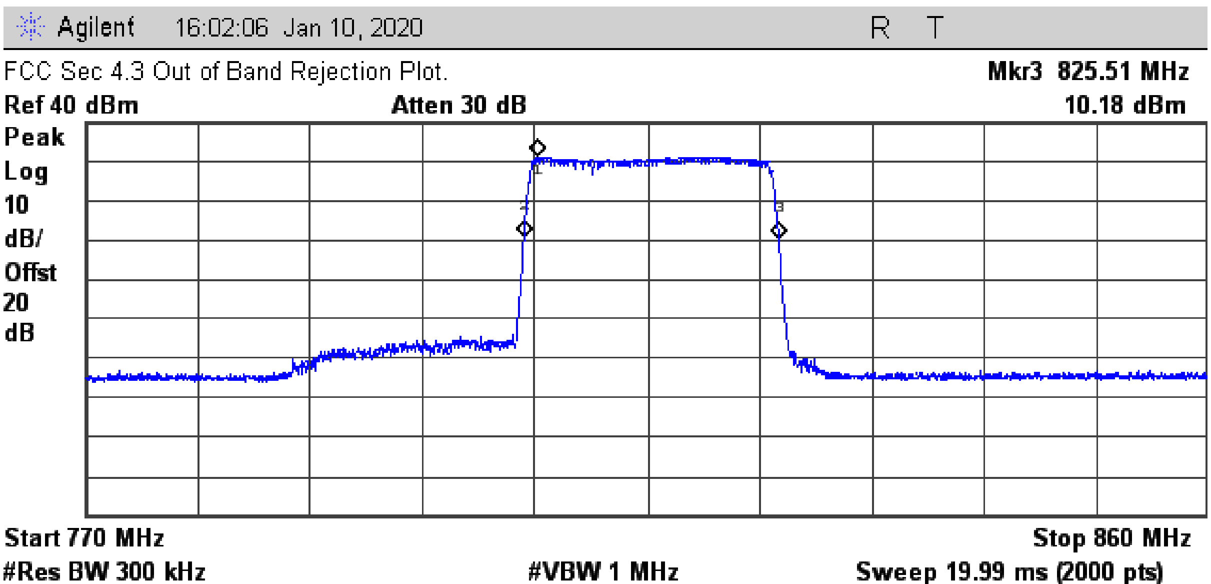
a) A signal generator was connected to the input of the EUT. A spectrum analyzer was connected to the output of the EUT using an external attenuator.
b) The swept CW signal was configured with the following parameters:
1) For each band, the analyzer and signal generator were set to a Frequency range ± 250 % of the passband, for each applicable band.
2) The generator level was set to a level so that the out-of-band rejection is > 20 dB above the noise floor and will not engage the AGC during the entire sweep
3) The Dwell time of each frequency step was at least 10 mS.
4) Number of points was set to at least SPAN/(RBW/2).
c) The resolution bandwidth (RBW) was set to 1 MHz and the video bandwidth (VBW) was set to 3 MHz.
d) The detector was set to Peak, Max-Hold and waited for the spectrum analyzer’s spectral display to fill.
e) A marker was placed to the peak of the frequency response and record this frequency as f0.
f) Two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, were placed such that each marker was at or slightly below the −20 dB down amplitude, to determine the 20 dB bandwidth.
g) The frequency response of the EUT was captured.
h) The procedure was repeated for all frequency bands applicable for use by the EUT.

12.3 Passband Bandwidth Test Results

Model	PS71090E	Specification	KDB 935210 D05 Sec 4.3
Serial Number	19RF11060004	Test Date	1/10/2020
Test Personnel	Richard L. Tichgelaar	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-11)		

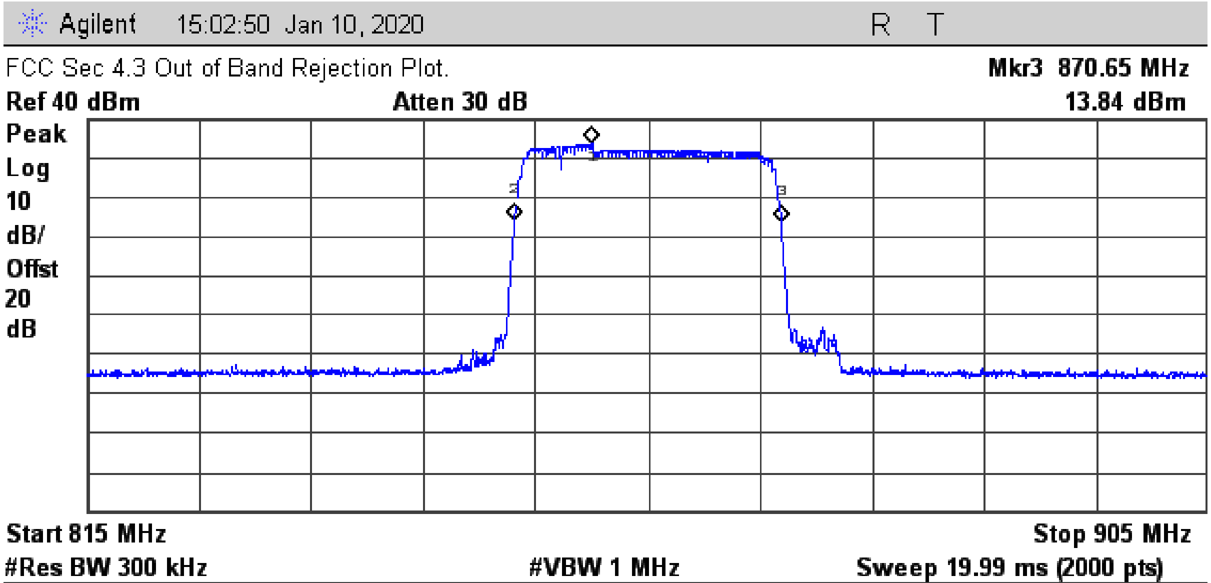
RBW MHz	VBW MHz	Band in MHz	20 dB Down 1st Freq. MHz	20 dB Down 2nd Freq. MHz	20 dB BW MHz	Max Reading F0 MHz	Max Reading dBm
0.3	1.0	806-824	805.2	825.51	20.31	806.24	31.17
0.3	1.0	851-869	849.35	870.65	21.3	855.61	33.62

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



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	806.24 MHz	31.17 dBm
2	(1)	Freq	805.21 MHz	10.64 dBm
3	(1)	Freq	825.51 MHz	10.18 dBm

Uplink



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	855.61 MHz	33.62 dBm
2	(1)	Freq	849.35 MHz	14.07 dBm
3	(1)	Freq	870.65 MHz	13.84 dBm

Downlink

13.0 INPUT VS OUTPUT COMPARISON; WITH OCCUPIED BANDWIDTH

13.1 Applicable Standard

The EUT shall comply with FCC KDB 935210 section 3.4.

13.2 Test procedures

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

a) A signal generator was connected to the input of the EUT.
b) The signal generator was configured to transmit the AWGN signal.
c) The signal generator amplitude was configured to be zero to 0.5 dB below the AGC threshold level.
d) A spectrum analyzer was connected to the output of the EUT using an external attenuator.
e) The spectrum analyzer center frequency was set to the center frequency of the operational band under test. The span range of the spectrum analyzer was between 2 times to 5 times the occupied bandwidth (OBW).
f) The nominal RBW was in the range of 1 % to 5 % of the anticipated OBW, and the VBW was ≥ 3 × RBW.
g) The reference level of the instrument was set as required to preclude the signal from exceeding the maximum spectrum analyzer input mixer level for linear operation.
h) The noise floor of the spectrum analyzer at the selected RBW was at least 36 dB below the reference level.
i) The spectrum analyzer detection function was set to positive peak.
j) The trace mode was set to max hold.
k) The reference value was determined by: Allowing the trace to stabilize, setting the spectrum analyzer marker to the highest amplitude level of the displayed trace (this is the reference value), and recording the associated frequency as f_0.

l) Two markers, one at the lowest and the other at the highest frequency of the envelope of the spectral display, were placed such that each marker is at or slightly below the −26 dB down amplitude. The 26 dB OBW is the positive frequency difference between the two markers. If the spectral envelope crosses the −26 dB down amplitude at multiple points, the lowest or highest frequency was selected as the frequencies that are the furthest removed from the center frequency at which the spectral envelope crosses the −26 dB down amplitude point.
m) Steps e) to l) were repeated with the input signal connected directly to the spectrum analyzer (i.e., input signal measurement).
n) The spectral plot of the input signal (determined from step m) was compared to the output signal (determined from step l) to affirm that they are similar (in passband and roll off characteristic features and relative spectral locations).
o) The procedure [steps e) to n)] was repeated with the input signal amplitude set to 3 dB above the AGC threshold.
p) Steps e) to o) were repeated with the signal generator set to the narrowband signal.
q) Steps e) to p) were repeated for all frequency bands authorized for use by the EUT.

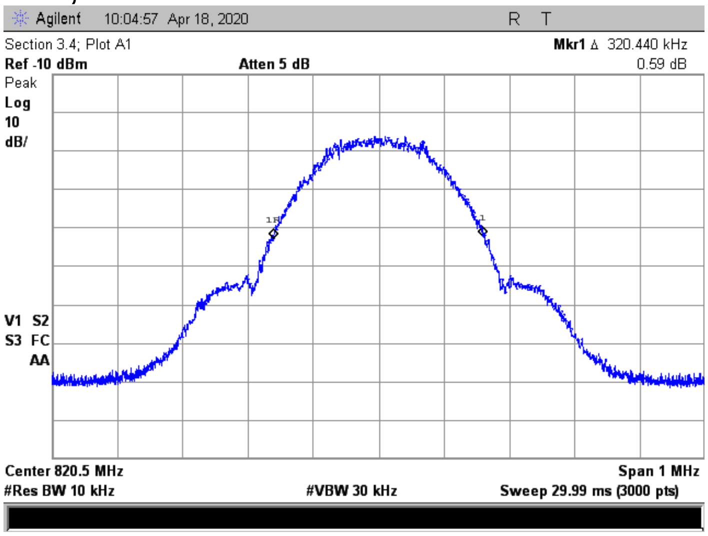
13.2.1 Input Vs Output Test Results

Model	PS71090E	Specifications	FCC KDB 935210 D05 Sec. 3.4
Serial Number	19RF11060005	Test Date	April 18, 2020
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	Spectrum Analyzer (REC-21)		

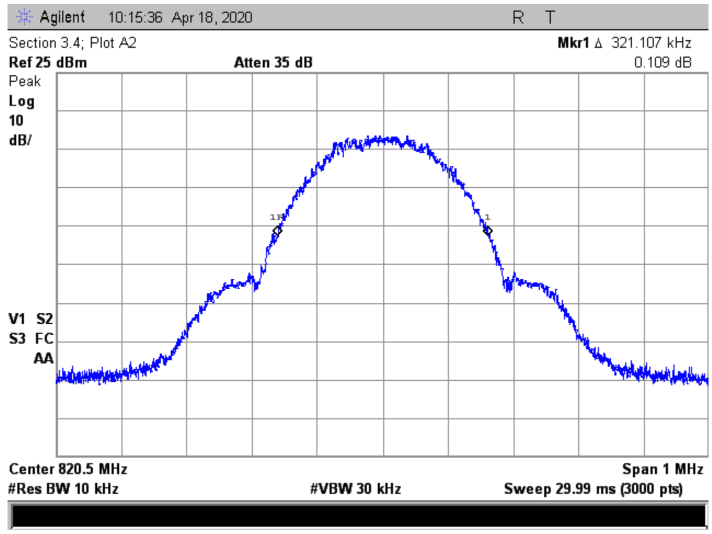
	MOD				Analyzer			26dbOBW	EUT
Output	Type	Plot	Generator Settings		RBW	VBW	Test	Reading	AGC
Mode		#	MHz	dBm	kHz	kHz	Port	MHz	Mode
UP	MSK	**A1**	820.5	-23	10	30	Generator	0.3204	N/A
UP	MSK	**A2**	820.5	-32	10	30	Amp Out	0.3211	Below
UP	MSK	**A3**	820.5	-29	10	30	Amp Out	0.3214	ON+3
DOWN	MSK	**A4**	865.5	-23	10	30	Generator	0.32377	N/A
DOWN	MSK	**A5**	865.5	-32	10	30	Amp Out	0.324	Below
DOWN	MSK	**A6**	865.5	-29	10	30	Amp Out	0.324	ON+3
UP	AWGN	**A7**	820.5	-23	100	300	Generator	4.408	N/A
UP	AWGN	**A8**	820.5	-32	100	300	Amp Out	4.405	Below
UP	AWGN	**A9**	820.5	-29	100	300	Amp Out	4.401	ON+3
DOWN	AWGN	**A10**	865.5	-23	100	300	Generator	4.401	N/A
DOWN	AWGN	**A11**	865.5	-32	100	300	Amp Out	4.408	Below
DOWN	AWGN	**A12**	865.5	-29	100	300	Amp Out	4.401	ON+3

Judgement: Pass

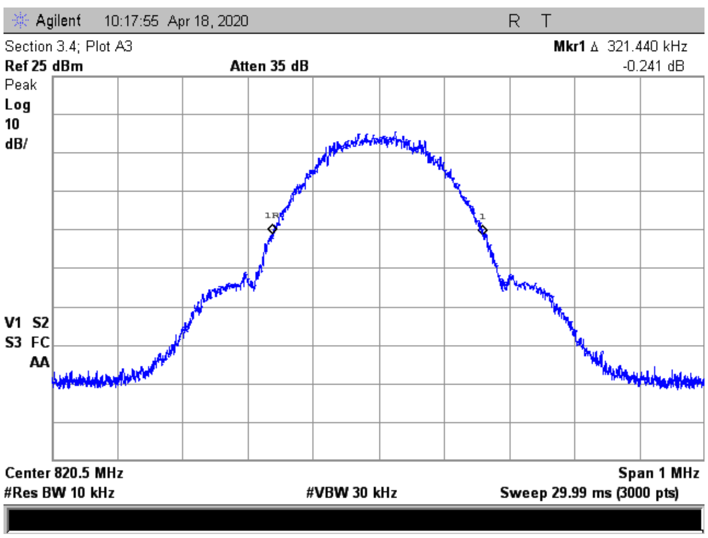
MSK; 820.5 MHz Results



Generator output; 820.5 MHz, MSK

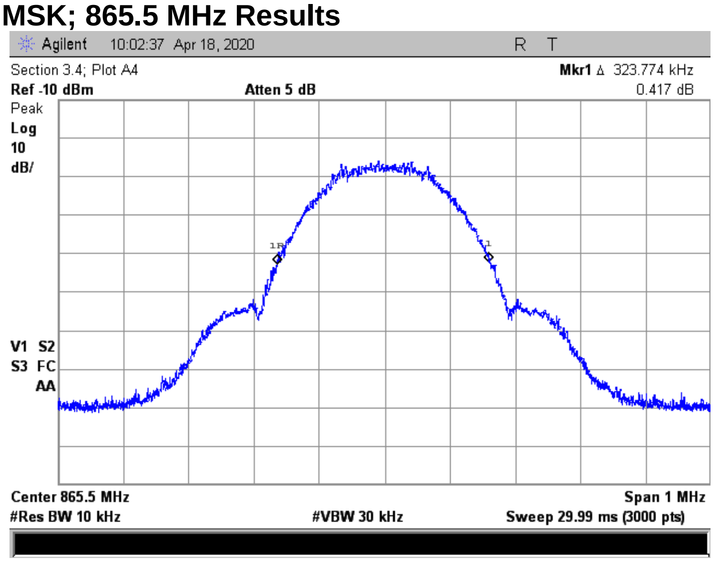


Amp output No AGC; 820.5 MHz, MSK

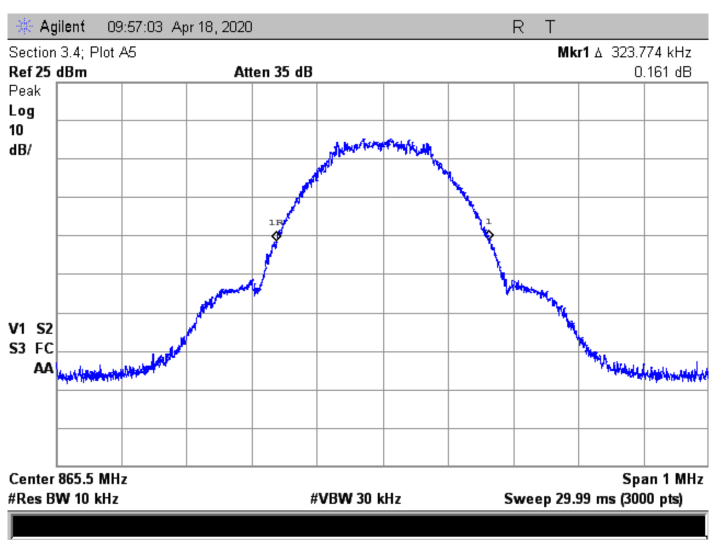


Amp output, with AGC; 820.5 MHz; MSK

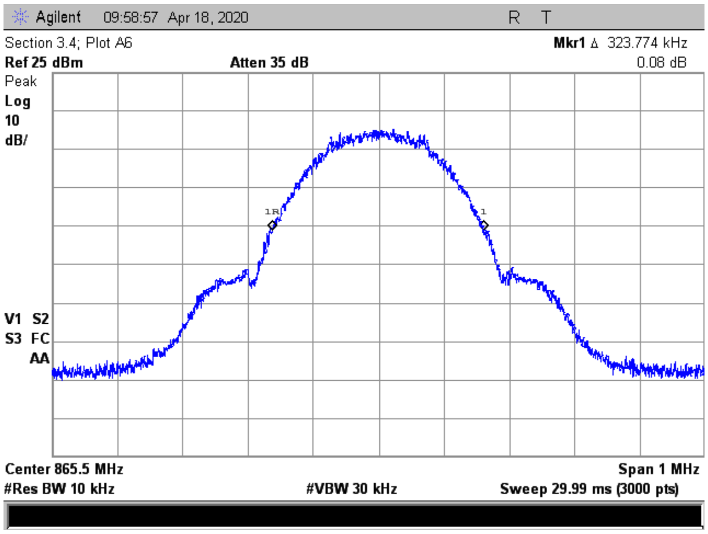
MSK; 865.5 MHz Results



Generator output; 865.5 MHz, MSK

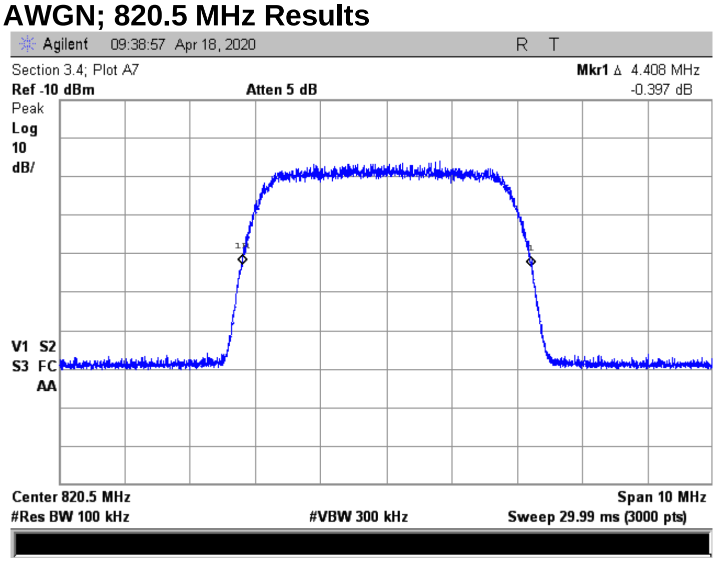


Amp output, no AGC; 865.5 MHz, MSK

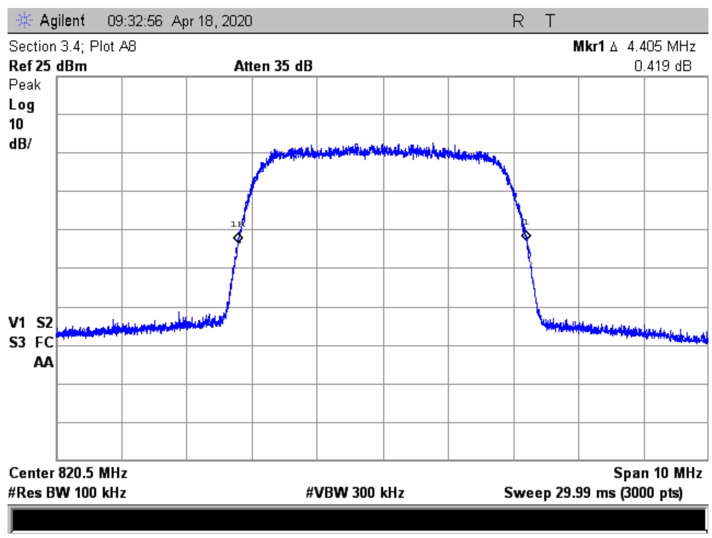


Amp output with AGC; 865.5 MHz, MSK

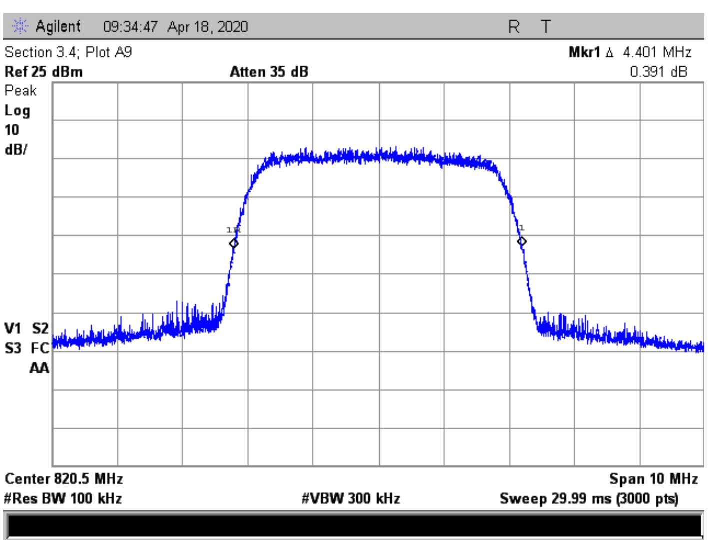
AWGN; 820.5 MHz Results



Generator output; 820.5 MHz, AWGN

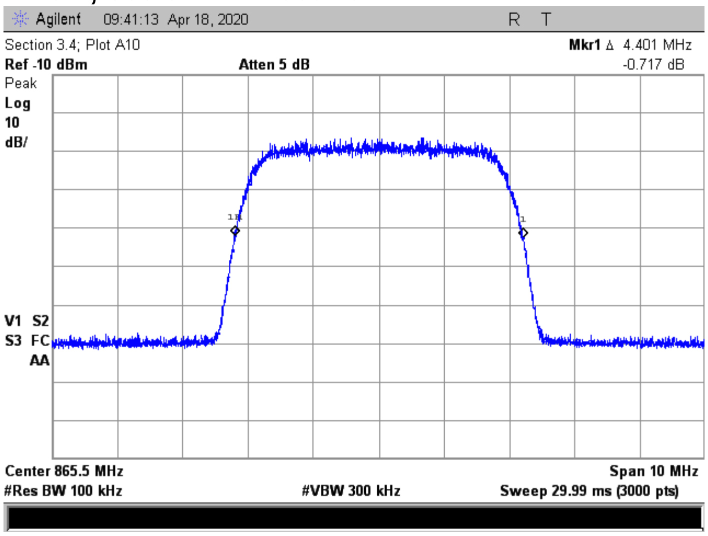


Amp output No AGC; 820.5 MHz, AWGN

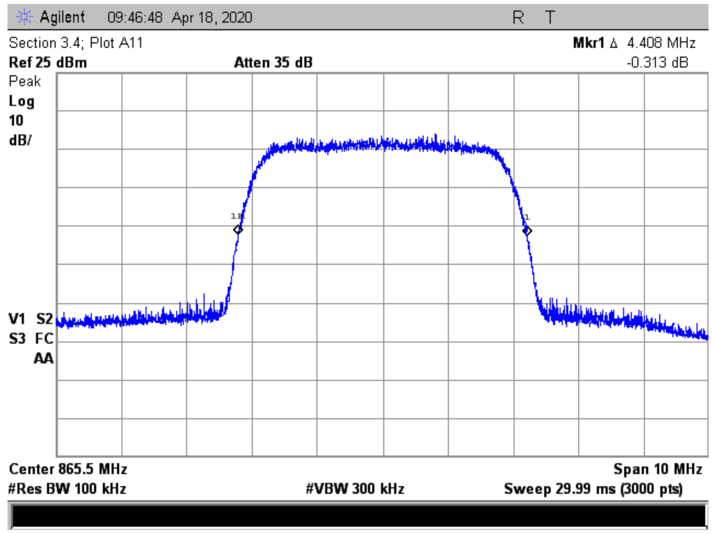


Amp output with AGC; 820.5 MHz, AWGN

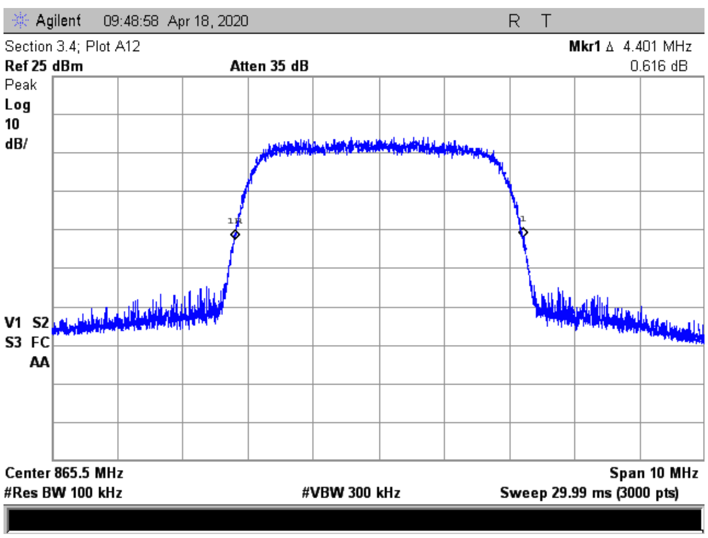
AWGN; 865.5 MHz Results



Generator output; 865.5 MHz, AWGN



Amp output No AGC; 865.5 MHz, AWGN



Amp output with AGC; 865.5 MHz, AWGN

14.0 MEAN POWER OUTPUT AND AMPLIFIER GAIN

14.1 Applicable Standard

The EUT shall comply with FCC KDB 935210 section 3.5.

In accordance with section 3.5 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 signal generator was configured to generate the AWGN (broadband) test signal.
c) The frequency of the signal generator was set to the frequency f0 as determined from 3.3 of KDB 935210.
d) A spectrum analyzer was connected to the output of the EUT using an external attenuator.
e) The signal generator amplitude was configured to be zero to 0.5 dB below the AGC threshold level.
f) The output power of the EUT measured and recorded, using 3.5.3 KDB 935210 for power measurement.
g) 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. EUT gain may be calculated as described in 3.5.5 KDB 935210.
h) Steps f) and g) were repeated with input signal amplitude set to 3 dB above the AGC threshold level.
i) Steps e) to h) were repeated with the narrowband test signal.
j) Steps e) to i) 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	PS71090E	Specification	FCC KDB 935210 Sec. 3.5
Serial Number	19RF11060005	Test Date	April 18, 2020
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-21)		

The spectrum analyzer was set to band power measurements using 100 trace average in the RMS peak mode. RBW = 1 MHz VBW = 3 MHz

		Generator		Amp out	Input	Output	Cable			
		Freq.	Reading	Reading	Atten.	Atten.	Loss	pwr		Gain
Mode	Modul.	MHz	dBm	dBm	dB	dB	dB	dBm	Watts	dB
UP (1)	MSK	820.5	-36.0	12.70	20.0	20.0	0.25	33.0	1.9724	89.0
UP (2)	MSK	820.5	-32.5	12.80	20.0	20.0	0.25	33.1	2.0184	85.6
UP (1)	AWGN	820.5	-36.2	12.75	20.0	20.0	0.25	33.0	1.9953	89.2
UP (2)	AWGN	820.5	-32.7	12.45	20.0	20.0	0.25	32.7	1.8621	85.4
Down (1)	MSK	865.5	-36.7	12.80	20.0	20.0	0.25	33.1	2.0184	89.8
Down (2)	MSK	865.5	-33.3	12.55	20.0	20.0	0.25	32.8	1.9055	86.1
Down (1)	AWGN	865.5	-36.6	12.70	20.0	20.0	0.25	33.0	1.9724	89.6
Down (2)	AWGN	865.5	-33.2	12.40	20.0	20.0	0.25	32.7	1.8408	85.9

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

EUT output Power (dBm) = Amp out dBm + Output Atten (dB) + Cable Loss (dB)
EUT Gain (dB) = Amp out (dBm) – Input to Amp (dBm) + Output Atten (dB) + Input Atten (dB) + Cable Loss (dB)

Judgement: Pass; The passband gain did not exceed the nominal gain by more than 1.0 dB.

15.0 SPURIOUS EMISSIONS

15.1 Applicable Standard

The EUT shall comply with sections 3.6.2 and 3.6.3 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: $43+10\text{x}\text{Log}_{10}\text{P}$, 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.

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.

15.2 Test procedures for section 3.6.2

a) Two signal generators were connected to the input of the Device Under Test (EUT), via a combiner.
b) The signal generator was set to produce two AWGN signals as previously described (e.g., 4.1 MHz OBW).
c) The center frequencies were set such that the AWGN signals occupy adjacent channels at the upper edge of the frequency band or block under test.
d) The composite power levels were set to be zero to 0.5 dB below the AGC threshold level.
e) A spectrum analyzer was connected to the output of the EUT using an external attenuator.
f) The RBW = reference bandwidth was set in accordance with the applicable rule section for the supported frequency band (typically 1 % of the OBW or 100 kHz or 1 MHz).
g) The RBW was set so that the VBW = 3 × RBW.
h) The detector was set to power averaging (rms) detector.
i) The sweep time was set so that sweep time = auto-couple.
j) The spectrum analyzer start frequency was set to the upper block edge frequency, and the stop frequency to the upper block edge frequency plus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively.
k) Trace averaged at least 100 traces in power averaging (rms) mode.
l) The marker function was used to find the maximum power level.
m) The spectrum analyzer trace of the power level was captured for inclusion in the test report.
n) Steps k) thru m) were repeated with the composite input power level set to 3 dB above the AGC threshold.
o) The frequencies of the input signals were reset to the lower edge of the frequency block or band under test.
p) The spectrum analyzer start frequency was reset to the lower block edge frequency minus 300 kHz or 3 MHz, for frequencies below and above 1 GHz, respectively, and the stop frequency to the lower band or block edge frequency.
q) Steps k) to n) were repeated.
r) Steps a) to q) were repeated with the signal generator configured for a single test signal tuned as close as possible to the block edges.
s) Steps a) to r) were repeated with the narrowband test signal.
t) Steps a) to s) were repeated for all authorized frequency bands or blocks used by the EUT.

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

15.3 Results for Section 3.6.2

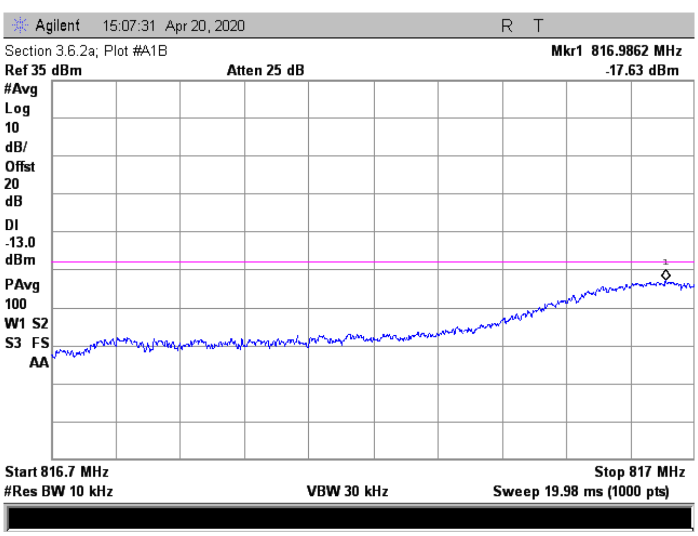
Model	PS71090E	Specification	FCC KDB 935210 Sec. 3.6.2
Serial Number	19RF11060005	Test Date	April 1 & 20, 2020
Test Personnel	Joseph Strzelecki	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-11)		

The spectrum analyzer was set to 100 trace average in the RMS mode. Up = Uplink Side; Down = Down link

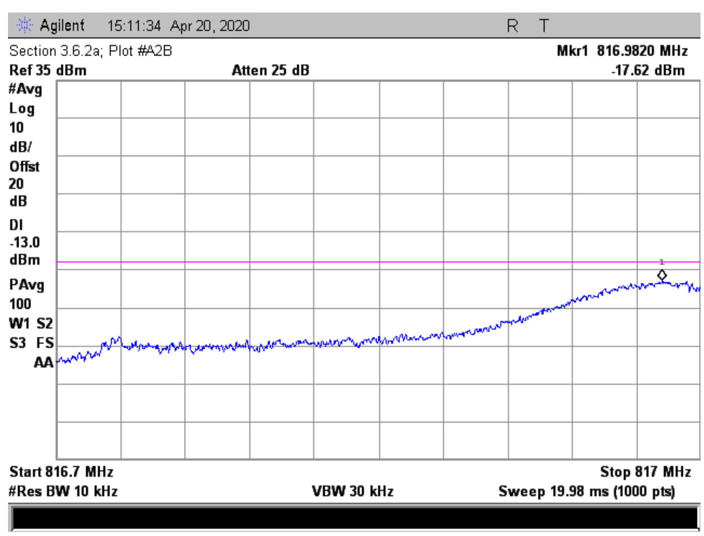
15.3.1 Combined Output Results

Two input signals to amplifier

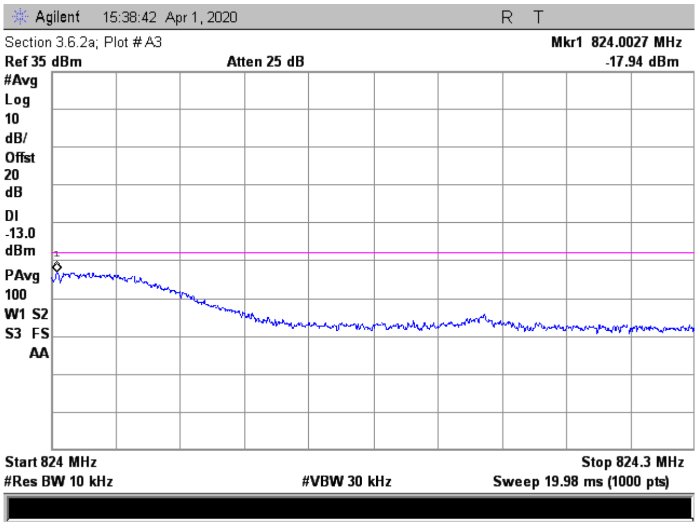
Plot	RBW	VBW		Signal Generator			AGC	Analyzer MHz		Max Reading	
#	kHz	kHz	Mode	Modul.	#1 MHz	#2 MHz	Mode	Start	Stop	MHz	dBm
A1B	10	30	Up	MSK	817.2	817.4	-.5dB Below	816.7	817.0	816.986	-17.6
A2B	10	30	Up	MSK	817.2	817.4	+3dB above	816.7	817.0	816.980	-17.6
A3	10	30	Up	MSK	823.8	823.6	-.5dB Below	824.0	824.3	824.003	-17.9
A4	10	30	Up	MSK	823.8	823.6	+3dB above	824.0	824.3	824.015	-18.5
A5B	10	30	Down	MSK	862.2	862.4	-.5dB Below	861.7	862.0	861.980	-17.4
A6B	10	30	Down	MSK	862.2	862.4	+3dB above	861.7	862.0	861.988	-17.1
A7	10	30	Down	MSK	868.8	868.6	-.5dB Below	869.0	869.3	869.017	-18.6
A8	10	30	Down	MSK	868.8	868.6	+3dB above	869.0	869.3	869.013	-18.8
A9B	100	300	Up	AWGN	819.4	824.4	-.5dB Below	816.7	817.0	817.000	-22.8
A10B	100	300	Up	AWGN	819.4	824.4	+3dB above	816.7	817.0	817.000	-22.1
A11	100	300	Up	AWGN	821.6	816.6	-.5dB Below	824.0	824.3	824.010	-25.9
A12	100	300	Up	AWGN	821.6	816.6	+3dB above	824.0	824.3	824.002	-27.0
A13B	100	300	Down	AWGN	864.4	869.4	-.5dB Below	861.7	862.0	861.990	-22.5
A14B	100	300	Down	AWGN	864.4	869.4	+3dB above	861.7	862.0	861.999	-21.5
A15	100	300	Down	AWGN	866.6	861.6	-.5dB Below	869.0	869.3	869.001	-23.7
A16	100	300	Down	AWGN	866.6	861.6	+3dB above	869.0	869.3	869.000	-26.5

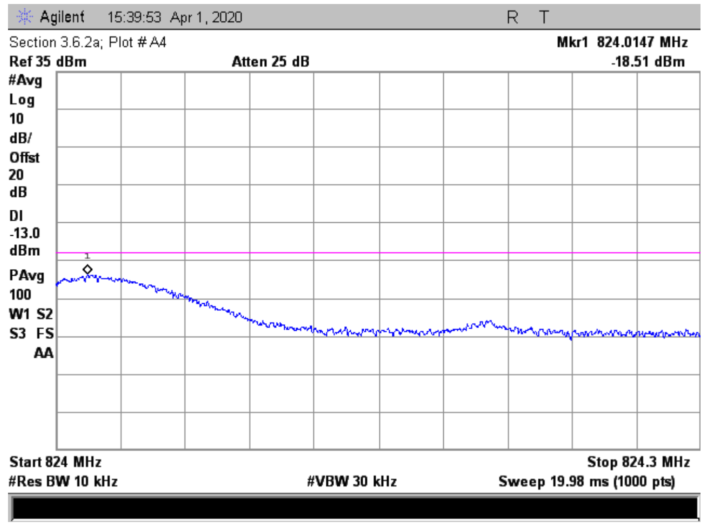


MSK; Plot #A1B

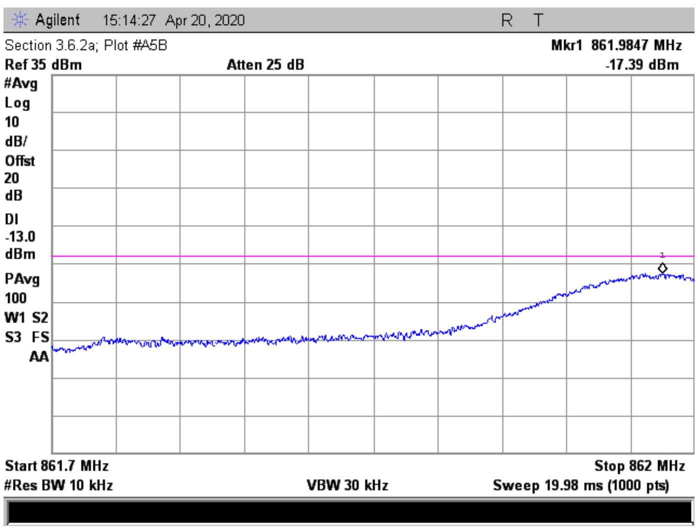


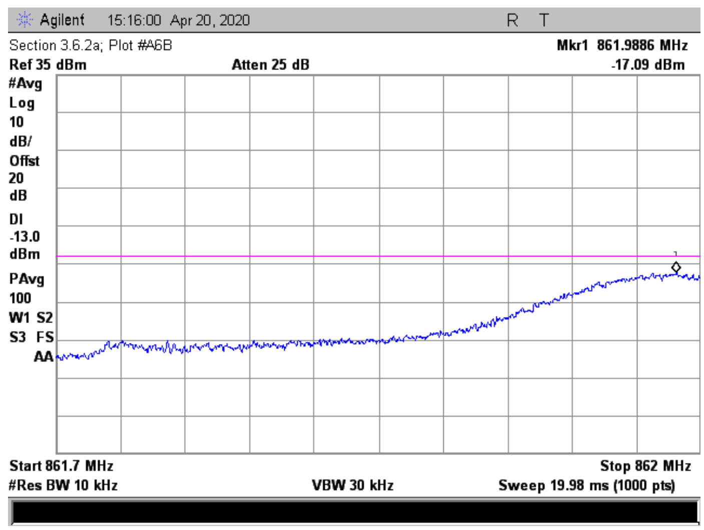
Dual MSK; Plot #A2B



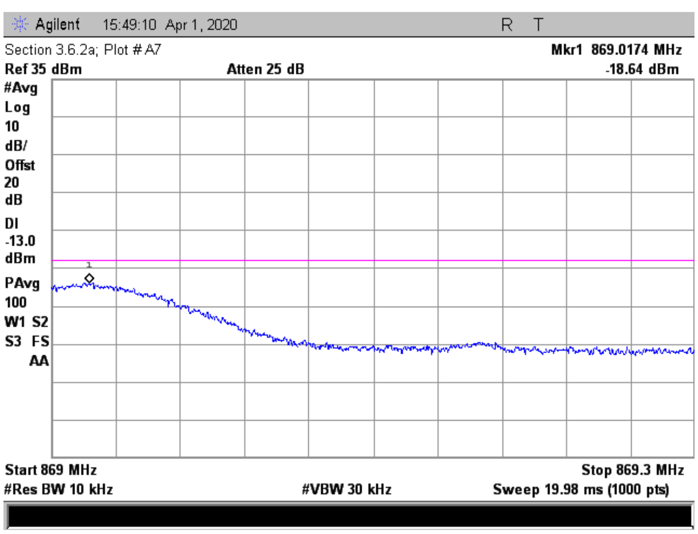


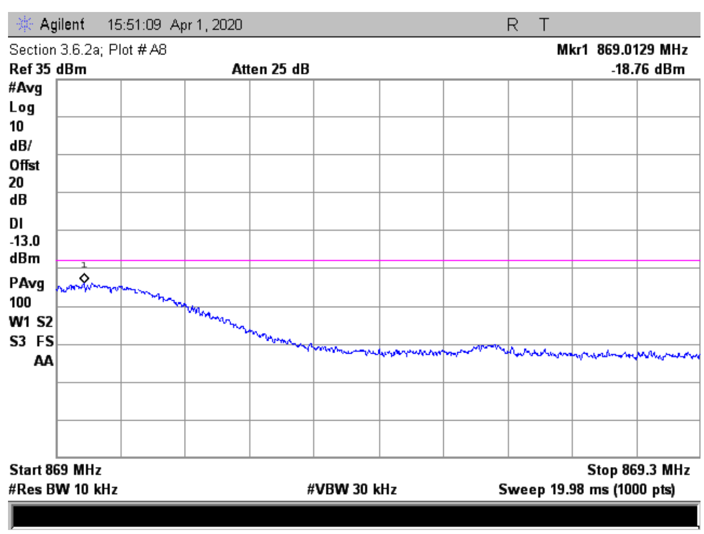
MSK; Plot #A3 Dual MSK; Plot #A4



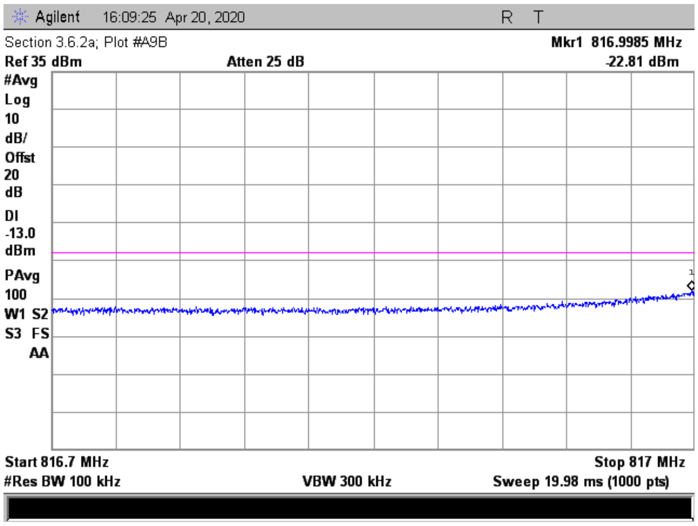


MSK; Plot #A5B Dual MSK; Plot #A6B

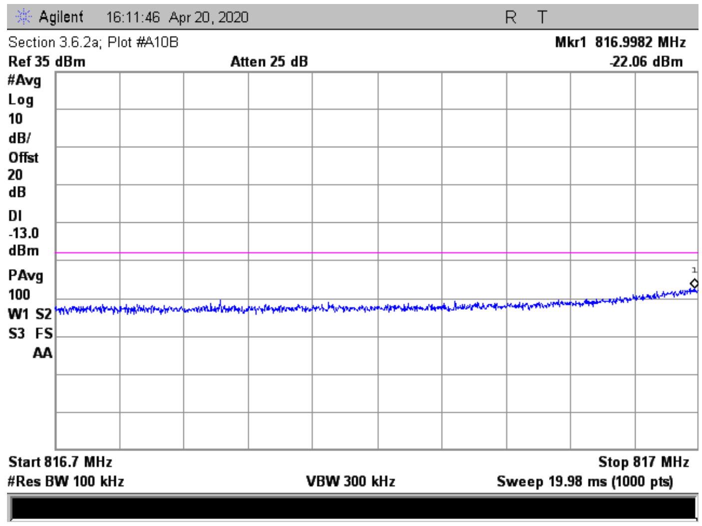




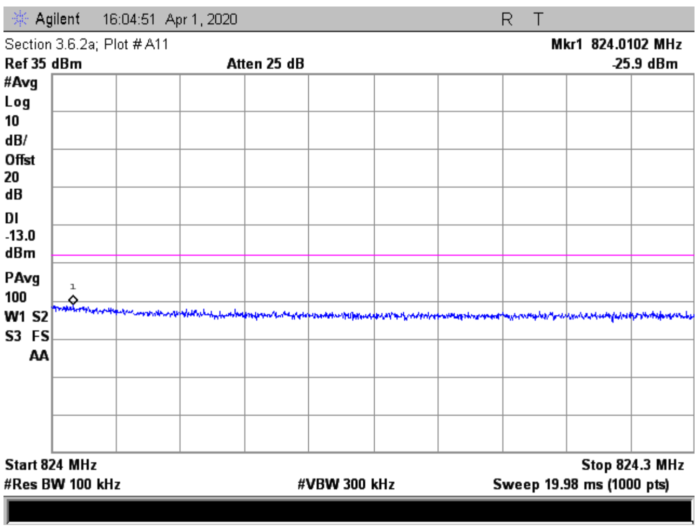
MSK; Plot #A7 Dual MSK; Plot #A8



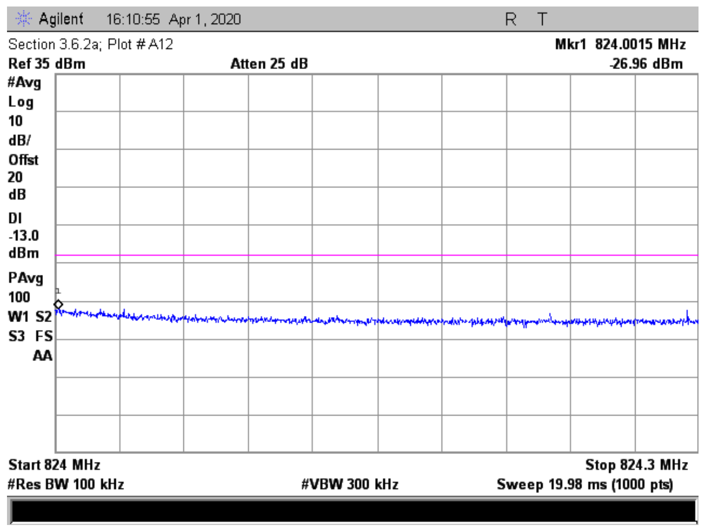
AWGN; Plot #A9B



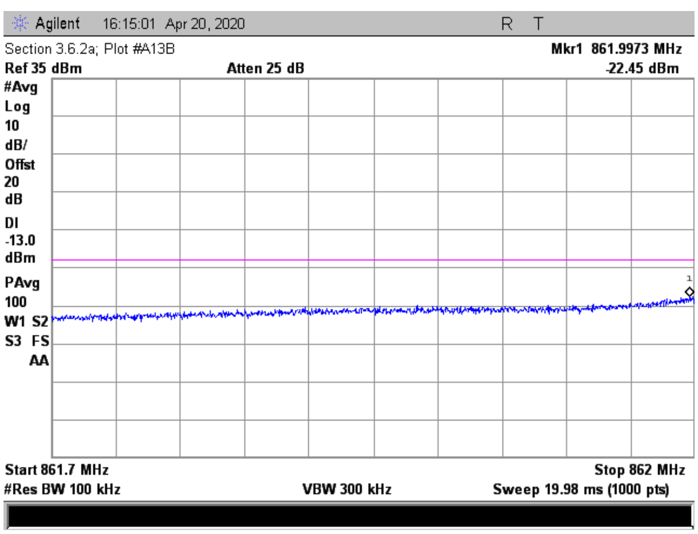
Dual AWGN; Plot #A10B



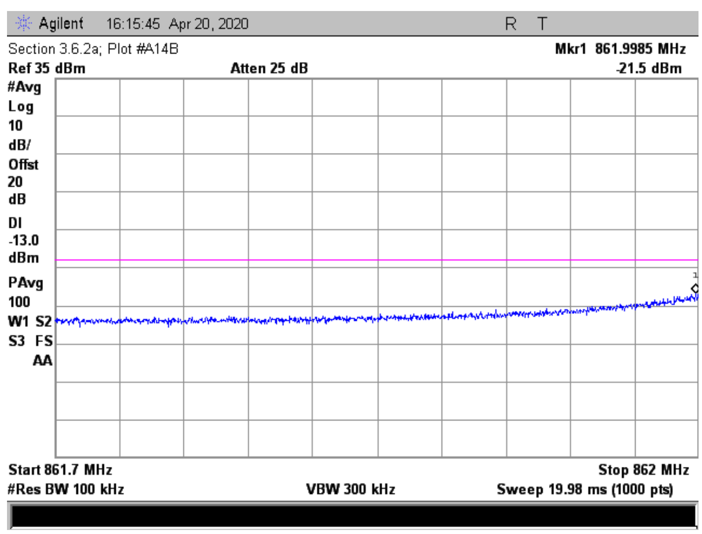
AWGN; Plot #A11



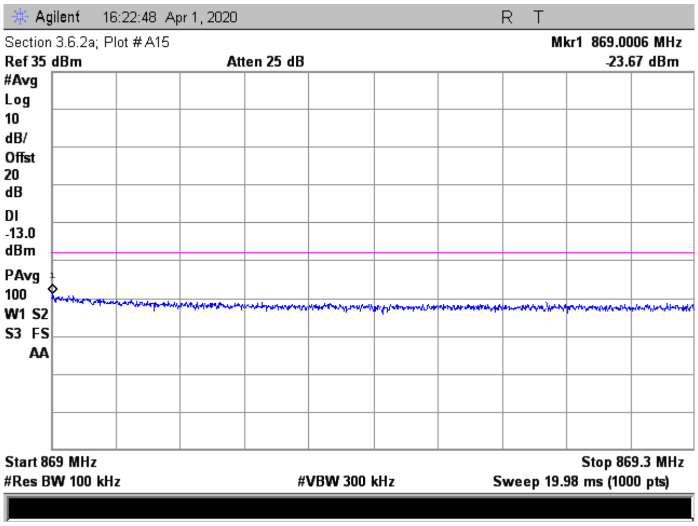
Dual AWGN; Plot #A12



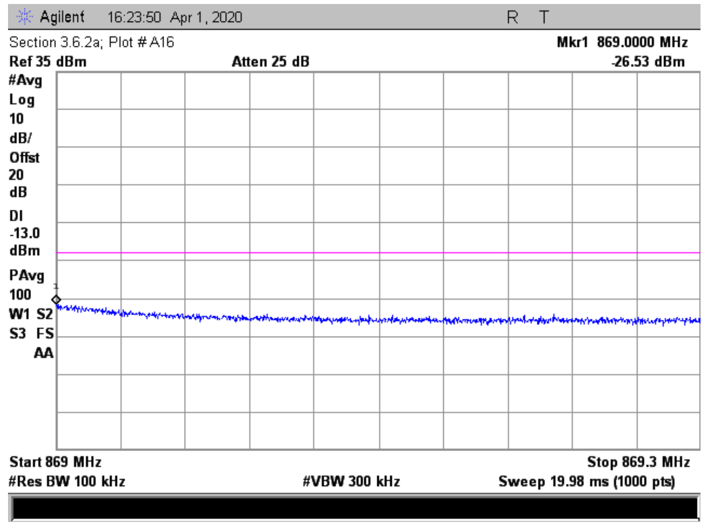
AWGN; Plot #A13B



Dual AWGN; Plot #A14B



AWGN; Plot #A15

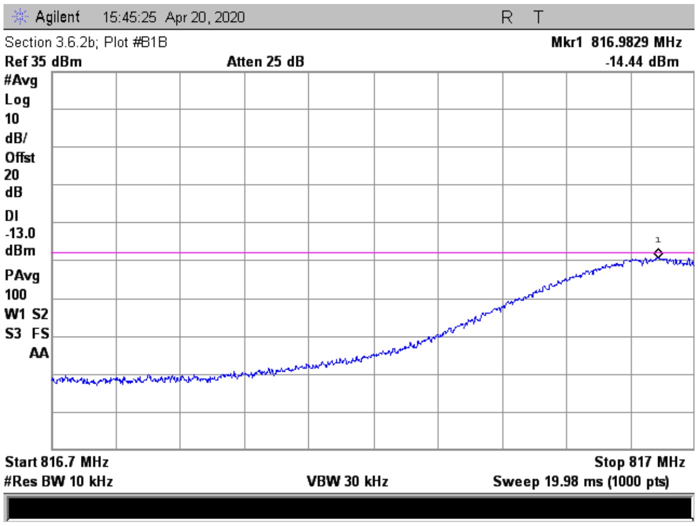


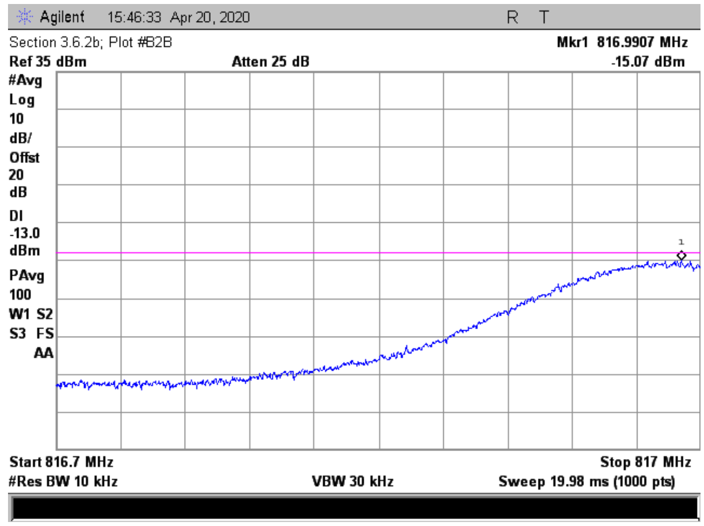
Dual AWGN; Plot #A16

15.3.2 Single Output Results

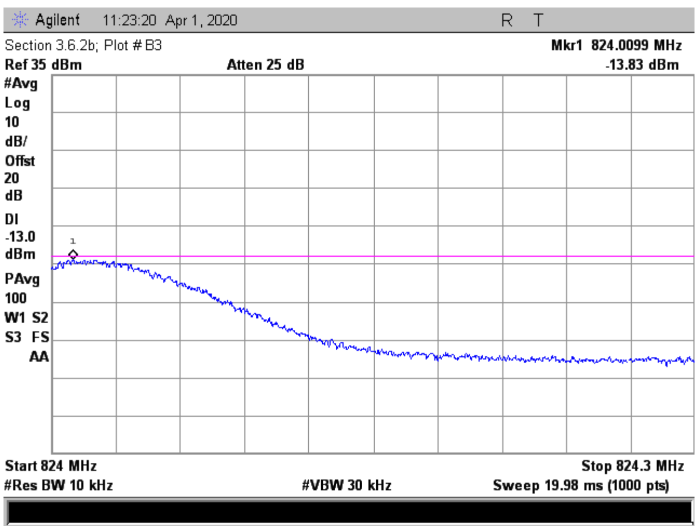
Single input to amplifier.

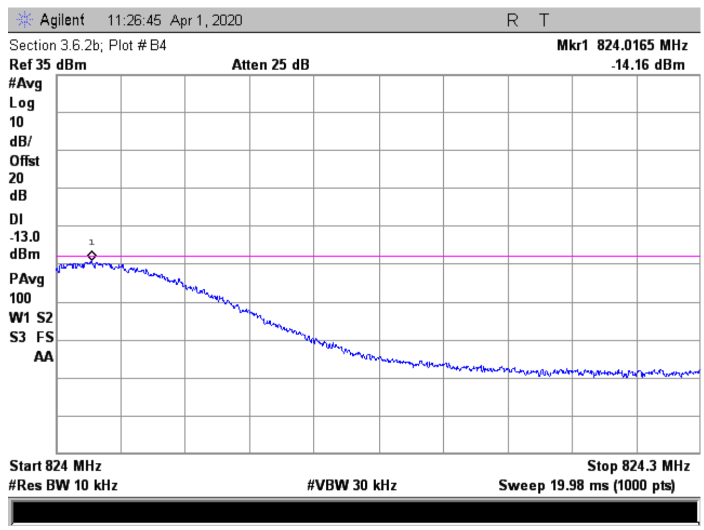
Plot	RBW	VBW		Signal Generator			AGC	Analyzer		Max Reading	
#	kHz	kHz	Mode	Modul.	#1 MHz	#2 MHz	Mode	Start	Stop	MHz	dBm
B1B	10	30	Up	MSK	817.2	None	-.5dB Below	816.7	817.0	816.980	-14.4
B2B	10	30	Up	MSK	817.2	None	+3dB above	816.7	817.0	816.990	-15.1
B3	10	30	Up	MSK	823.8	None	-.5dB Below	824.0	824.3	824.010	-13.8
B4	10	30	Up	MSK	823.8	None	+3dB above	824.0	824.3	824.017	-14.2
B5B	10	30	Down	MSK	862.2	None	-.5dB Below	861.7	862.0	861.979	-14.6
B6B	10	30	Down	MSK	862.2	None	+3dB above	861.7	862.0	861.990	-14.6
B7	10	30	Down	MSK	868.8	None	-.5dB Below	869.0	869.3	869.010	-14.7
B8	10	30	Down	MSK	868.8	None	+3dB above	869.0	869.3	869.024	-14.5
B9B	100	300	Up	AWGN	819.4	None	-.5dB Below	816.7	817.0	816.990	-21.7
B10B	100	300	Up	AWGN	819.4	None	+3dB above	816.7	817.0	816.999	-20.4
B11	100	300	Up	AWGN	821.6	None	-.5dB Below	824.0	824.3	824.001	-24.3
B12	100	300	Up	AWGN	821.6	None	+3dB above	824.0	824.3	824.012	-23.5
B13B	100	300	Down	AWGN	864.4	None	-.5dB Below	861.7	862.0	862.000	-22.1
B14B	100	300	Down	AWGN	864.4	None	+3dB above	861.7	862.0	861.990	-21.9
B15	100	300	Down	AWGN	866.6	None	-.5dB Below	869.0	869.3	869.002	-24.0
B16	100	300	Down	AWGN	866.6	None	+3dB above	869.0	869.3	869.001	-24.5



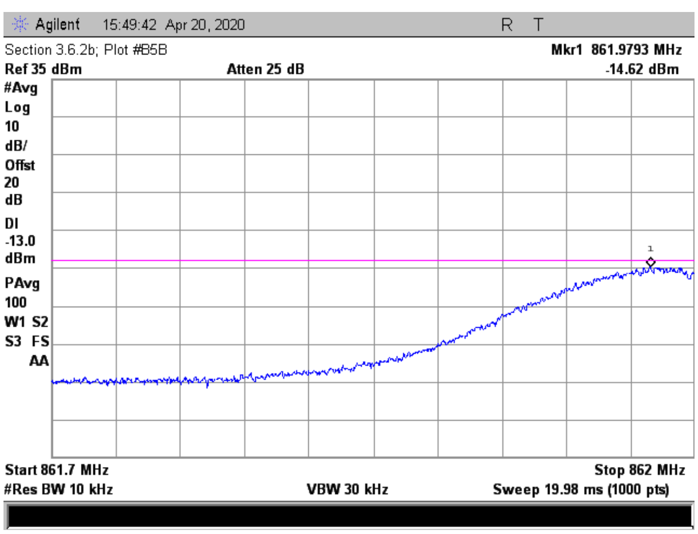


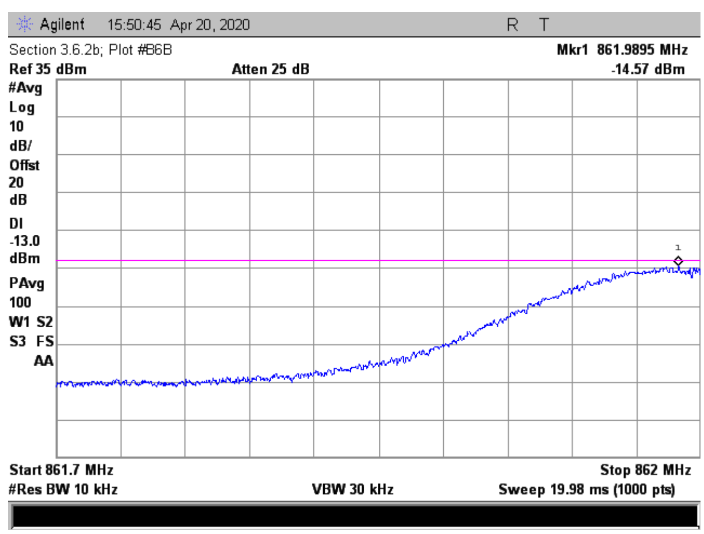
MSK; Plot B1B Single MSK; Plot B2B



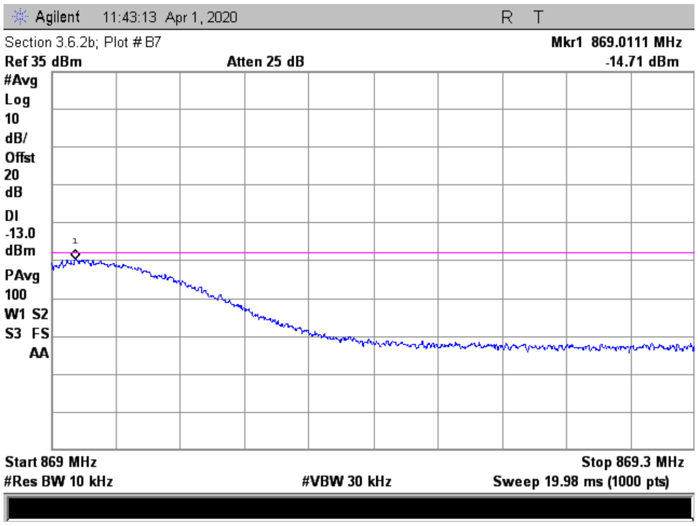


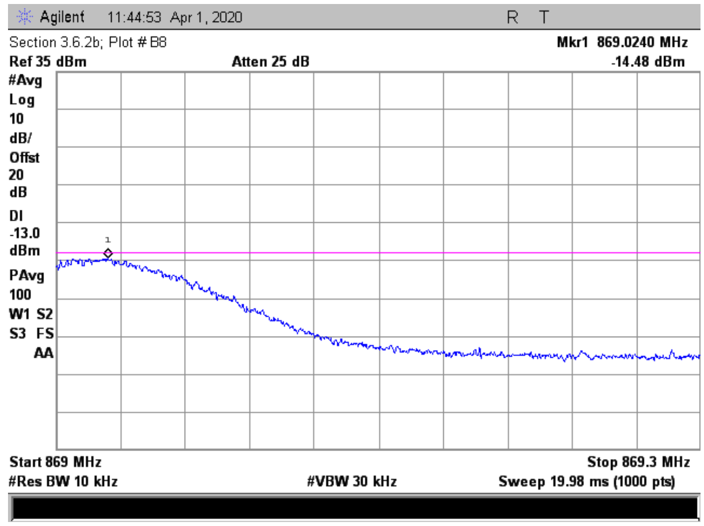
MSK; Plot B3 Single AWGN; Plot B4



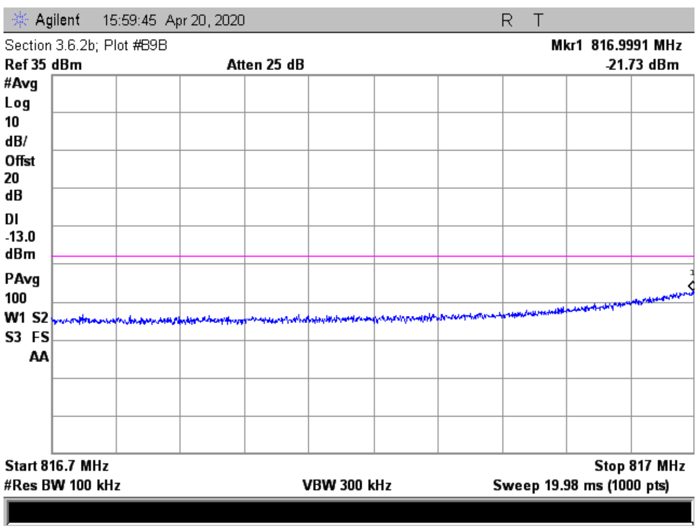


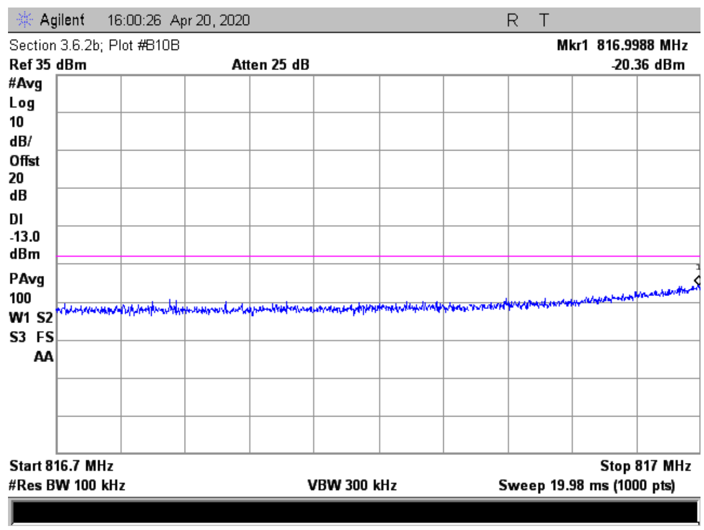
MSK; Plot B5B Single MSK; Plot B6B



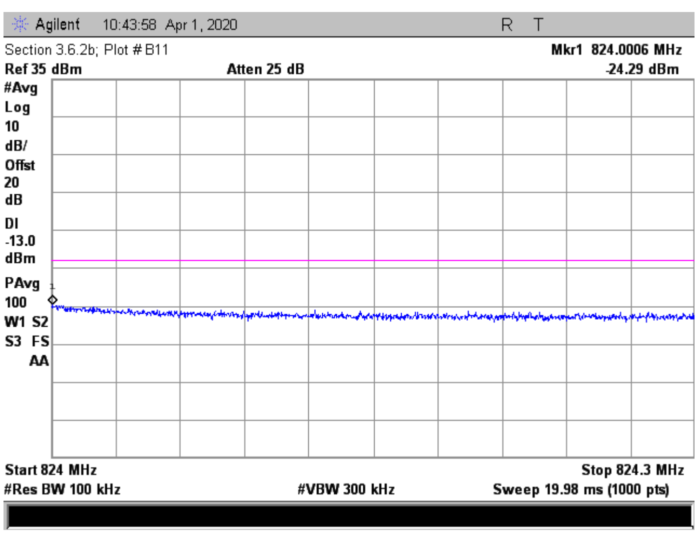


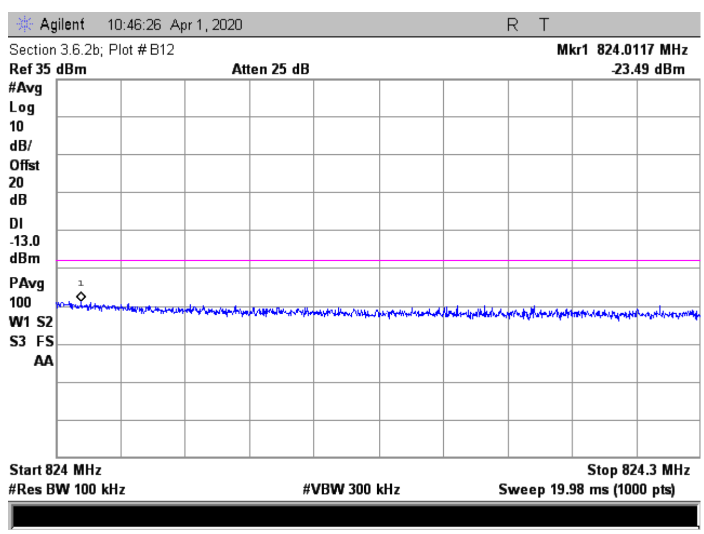
MSK; Plot B7 Single MSK; Plot B8



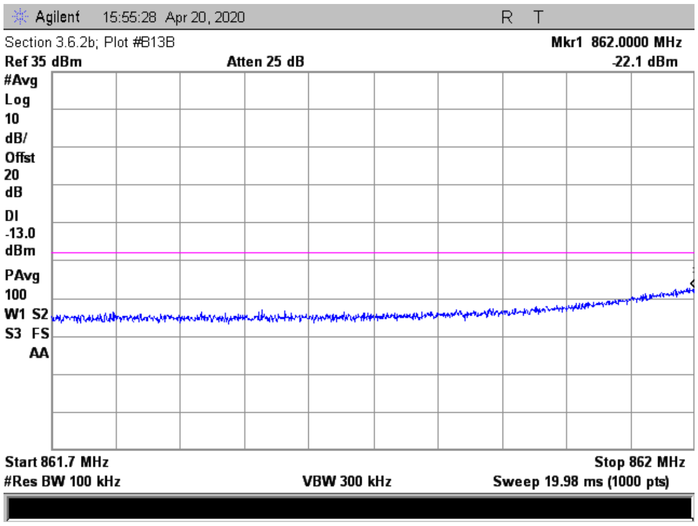


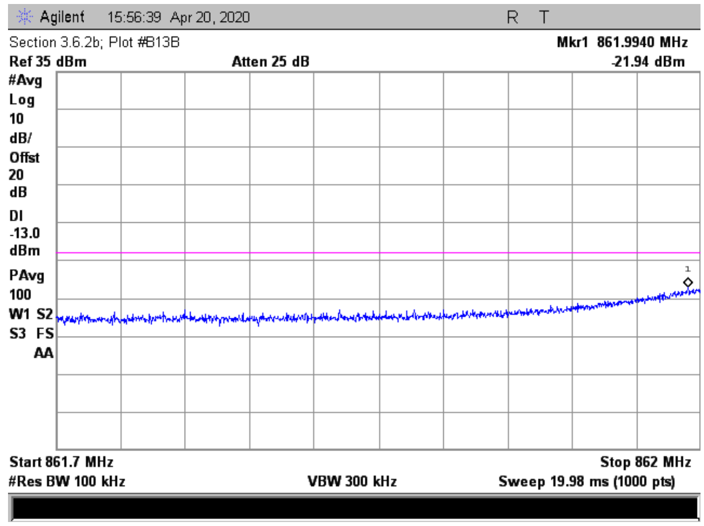
AWGN; Plot B9B Single AWGN; Plot B10B



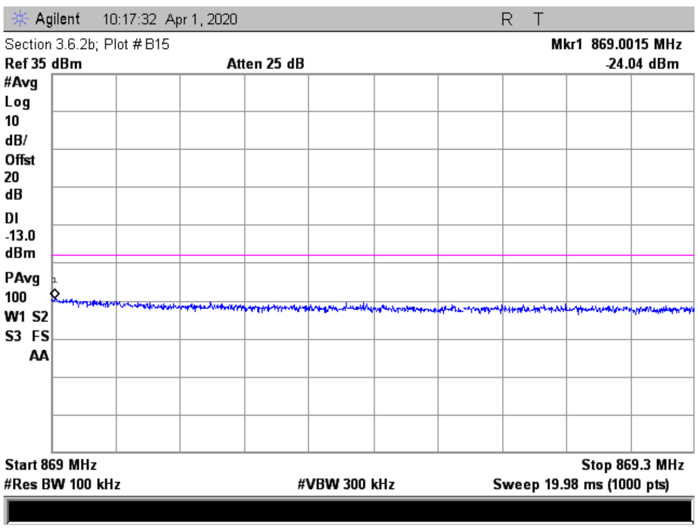


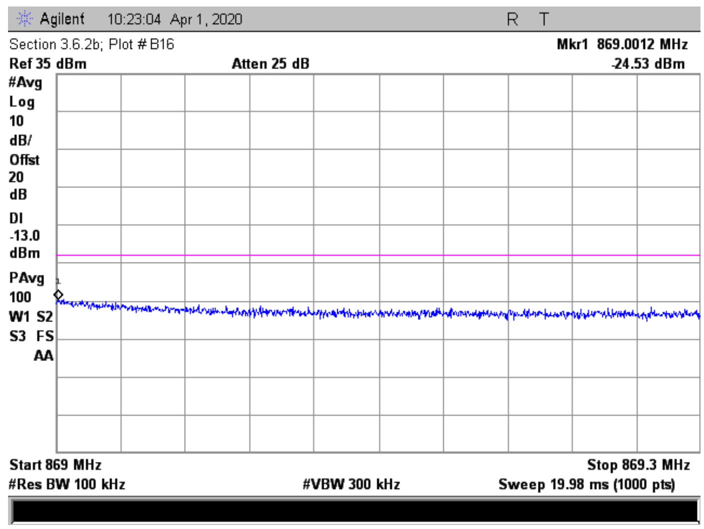
AWGN; Plot B11 Single AWGN; Plot B12





AWGN; Plot B13B Single AWGN; Plot B14B





AWGN; Plot B15 Single AWGN; Plot B16

Judgement: Pass

15.4 Test procedures 3.6.3

a) A signal generator was connected to the input of the EUT.
b) The signal generator was set to produce the broadband test signal as previously described (i.e., 4.1 MHz OBW AWGN).
c) The center frequency of the test signal was set to the lowest available channel within the frequency band or block.
d) The EUT input power was set to zero to 0.5 dB below the AGC threshold level.
e) A spectrum analyzer was connected to the output of the EUT using appropriate attenuation as necessary.
f) Set the RBW = reference bandwidth in the applicable rule section for the supported frequency band of operation (e.g., reference bandwidth is typically 100 kHz or 1 MHz).
g) The VBW was set as ≥ 3 × RBW.
h) The Sweep time was set to equal auto-couple.
i) The spectrum analyzer start frequency was set to the lowest RF signal generated in the equipment, without going below 9 kHz, and the stop frequency to the lower band/block edge frequency minus 100 kHz or 1 MHz, as specified in the applicable rule part. The number of measurement points in each sweep must be ≥ (2 ×

span/RBW), which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.
j) The power averaging (rms) detector function was selected.
k) A trace average measurement with at least 10 traces in power averaging (rms) mode was performed.
l) The peak marker function was used to identify the highest amplitude level over each measured frequency range. The frequency and amplitude were recorded and captured in a plot.
m) The spectrum analyzer start frequency was reset to the upper band/block edge frequency plus 100 kHz or 1 MHz, as specified in the applicable rule part, and the spectrum analyzer stop frequency to 10 times the highest frequency of the fundamental emission. The number of measurement points in each sweep was ≥ (2 × span/RBW), which may require that the measurement range defined by the start and stop frequencies be subdivided, depending on the available number of measurement points provided by the spectrum analyzer.
n) Trace averages were at least 10 traces in power averaging (rms) mode.
o) The peak marker function was used to identify the highest amplitude level over each of the measured frequency ranges. The frequency and amplitude were recorded and captured in a plot for inclusion in the test report; also providing tabular data, if required.
p) Steps i) to o) were repeated with the input test signals firstly tuned to a middle band/block frequency/channel, and then tuned to a high band/block frequency/channel.
q) Steps b) to p) were repeated with the narrowband test signal.
r) Steps b) to q) were repeated for all authorized frequency bands/blocks used by the EUT.

On any frequency outside the authorized bandwidth shall be attenuated by at least 43 + 10 log (P) dB. This corresponds to an absolute level of -13 dBm.
The readings have a +20 dB offset due to an external attenuator.
The spectrum analyzer was set to 20 trace average in the RMS mode.

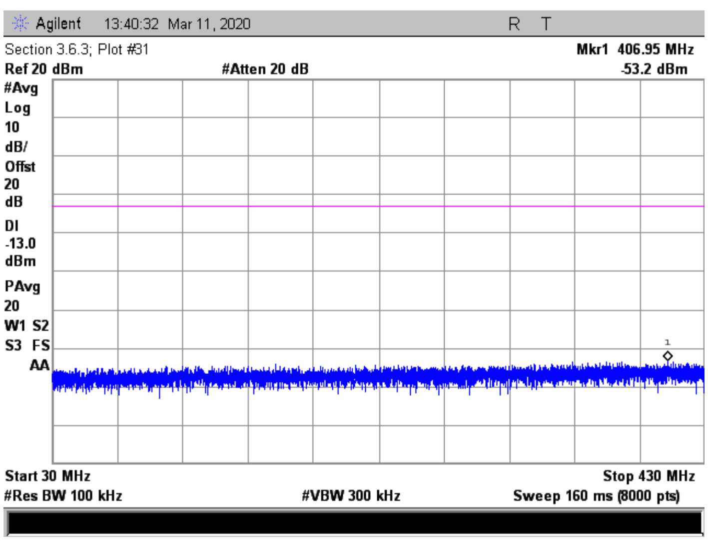
15.5 Test Results for Section 3.6.3 MSK

Model	PS71090E	Specifications	FCC KDB 935210 Secs. 3.6.3
Serial Number	19RF11060005	Test Date	April 2 & 18, 2020
Test Personnel	Joseph Strzelecki	Test Location	Chamber C
Test Equipment	EMI Receiver (REC-21)		

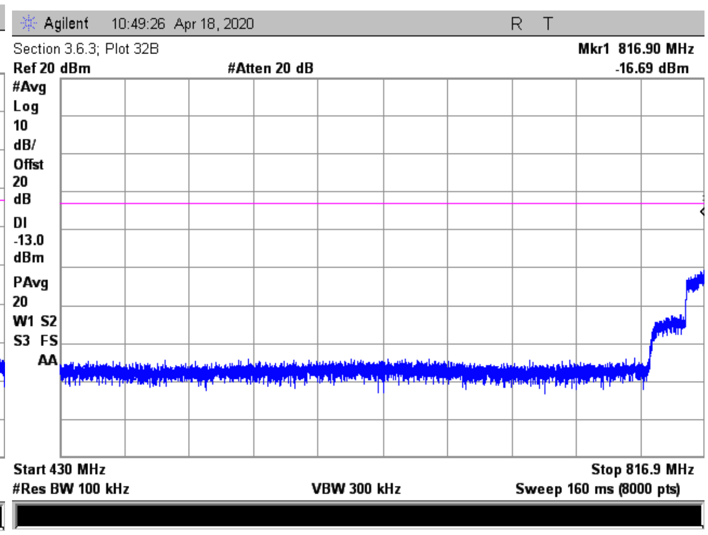
3.6.3	RBW	VBW		Sig Gen			Start	Stop	# of	# of	Freq	Max Reading
Plot #	MHz	MHz	Mode	Modul	MHz	dBm	MHz	MHz	points	Swps	MHz	dBm
31	0.1	0.3	Up	MSK	817.4	-26.2	30	30	430	20	406.95	-53.2
32B	0.1	0.3	Up	MSK	817.4	-26.2	430	430	816.9	20	816.9	-16.7
33	0.1	0.3	Up	MSK	817.4	-26.2	824.1	824.1	1000	20	824.32	-30.3
34	1	3	Up	MSK	817.4	-26.2	1000	1000	5000	20	2418.7	-37.4
35	1	3	Up	MSK	817.4	-26.2	5000	5000	9000	20	7424.8	-41.4
36	0.1	0.3	Up	MSK	820.5	-26.2	30	30	430	20	347.13	-52.5
37B	0.1	0.3	Up	MSK	820.5	-26.2	430	430	816.9	20	816.9	-30.9
38	0.1	0.3	Up	MSK	820.5	-26.2	824.1	824.1	1000	20	824.39	-31.5
39	1	3	Up	MSK	820.5	-26.2	1000	1000	5000	20	2443.7	-36.89
40	1	3	Up	MSK	820.5	-26.2	5000	5000	9000	20	7453.8	-41.95
41	0.1	0.3	Up	MSK	823.6	-25.9	30	30	430	20	347.4	-53.28
42B	0.1	0.3	Up	MSK	823.6	-25.9	430	430	816.9	20	816.5	-30.4
43	0.1	0.3	Up	MSK	823.6	-25.9	824.1	824.1	1000	20	824.1	-16.9
44	1	3	Up	MSK	823.6	-25.9	1000	1000	5000	20	1647.1	-33.9
45	1	3	Up	MSK	823.6	-25.9	5000	5000	9000	20	7323.3	-42.3
76	0.1	0.3	Down	MSK	862.4	-26.1	30	30	300	20	263.58	-54

3.6.3	RBW	VBW		Sig Gen			Start	Stop	# of	# of	Freq	Max Reading
Plot #	MHz	MHz	Mode	Modul	MHz	dBm	MHz	MHz	points	Swps	MHz	dBm
77	0.1	0.3	Down	MSK	862.4	-26.1	300	300	600	20	588.3	-54.1
78	0.1	0.3	Down	MSK	862.4	-26.1	600	600	861.9	20	869.3	-27.2
79B	0.1	0.3	Down	MSK	862.4	-26.1	869.1	869.1	1000	20	869.3	-27.2
80	1	3	Down	MSK	862.4	-26.1	1000	1000	5000	20	1702.6	-37.8
81	1	3	Down	MSK	862.4	-26.1	5000	5000	9000	20	7417.3	-43
82	0.1	0.3	Down	MSK	865.5	-24.6	30	30	300	20	235.8	-53.1
83	0.1	0.3	Down	MSK	865.5	-24.6	300	300	600	20	582.3	-53.4
84B	0.1	0.3	Down	MSK	865.5	-24.6	600	600	861.9	20	775.6	-27.0
85	0.1	0.3	Down	MSK	865.5	-24.6	869.1	869.1	1000	20	869.3	-29.6
86	1	3	Down	MSK	865.5	-24.6	1000	1000	5000	20	1720.1	-37.6
87	1	3	Down	MSK	865.5	-24.6	5000	5000	9000	20	7404.3	-42.1
88	0.1	0.3	Down	MSK	868.6	-27.6	30	30	300	20	281.37	-53.3
89	0.1	0.3	Down	MSK	868.6	-27.6	300	300	600	20	475.15	-53.6
90B	0.1	0.3	Down	MSK	868.6	-27.6	600	600	861.9	20	759.6	-24.8
91B	0.1	0.3	Down	MSK	868.6	-27.6	869.1	1000	2618	20	869.1	-17.5
92	1	3	Down	MSK	868.6	-27.6	1000	5000	8000	20	2605.2	-38
93	1	3	Down	MSK	868.6	-27.6	5000	9000	8000	20	7792.3	-42

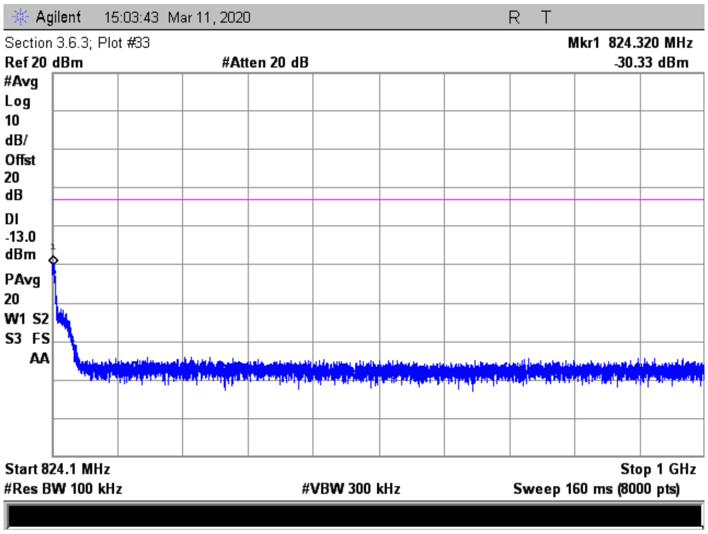
Judgement: Pass



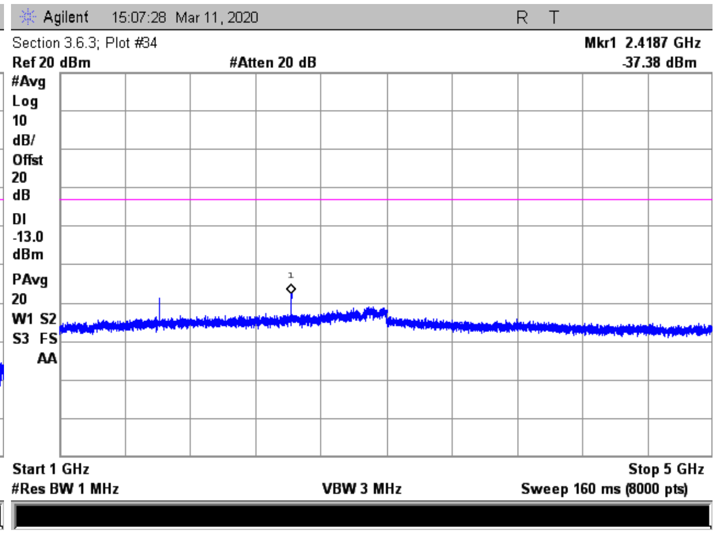
MSK; 817.4 MHz Injected Signal



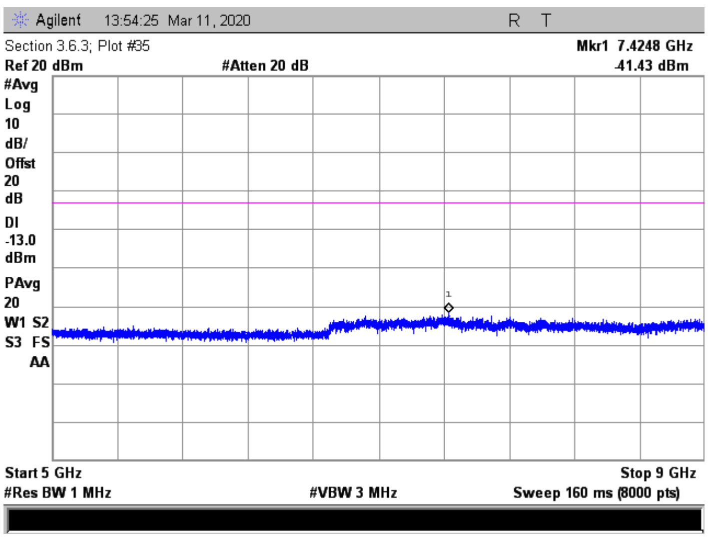
MSK; 817.4 MHz Injected Signal



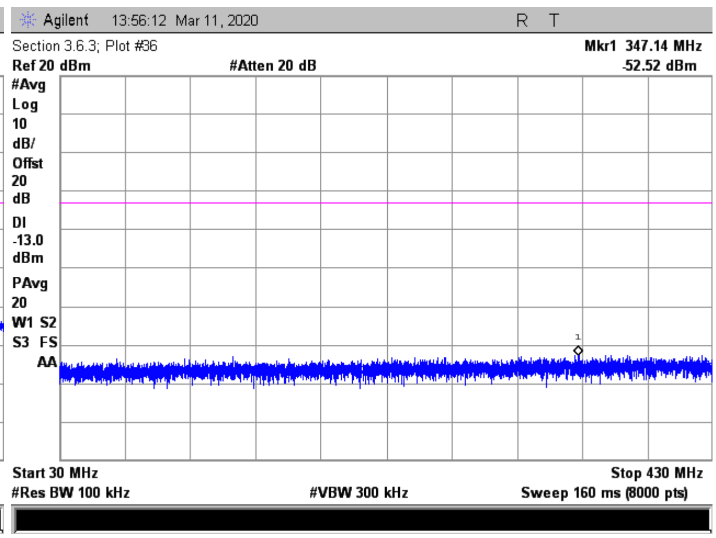
MSK; 817.4 MHz Injected Signal



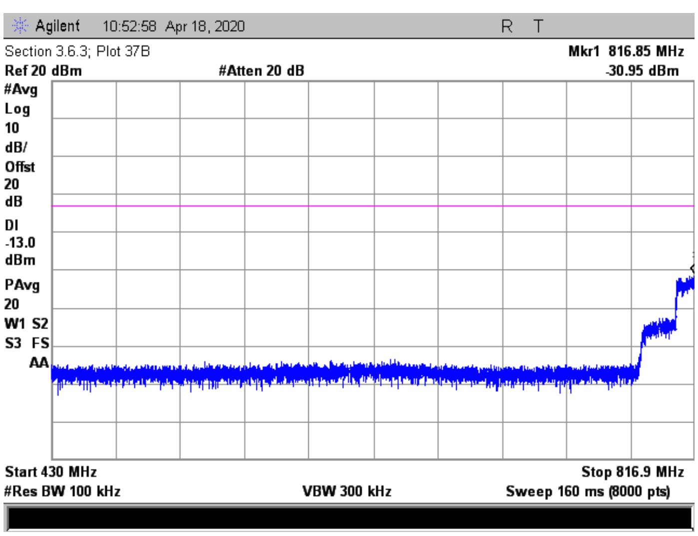
MSK; 817.4 MHz Injected Signal



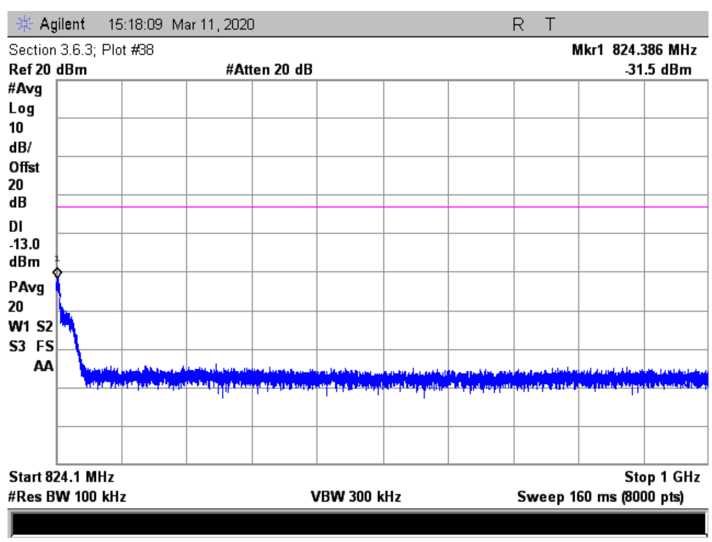
MSK ; 817.6 MHz Injected Signal



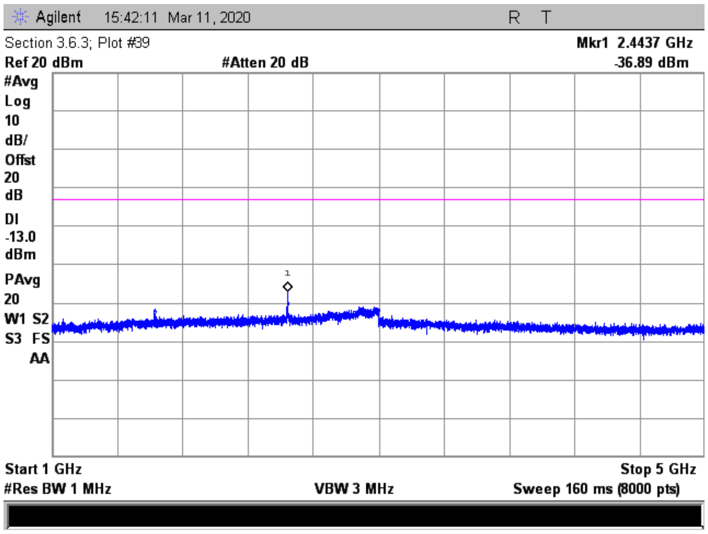
MSK ; 820.5 MHz Injected Signal



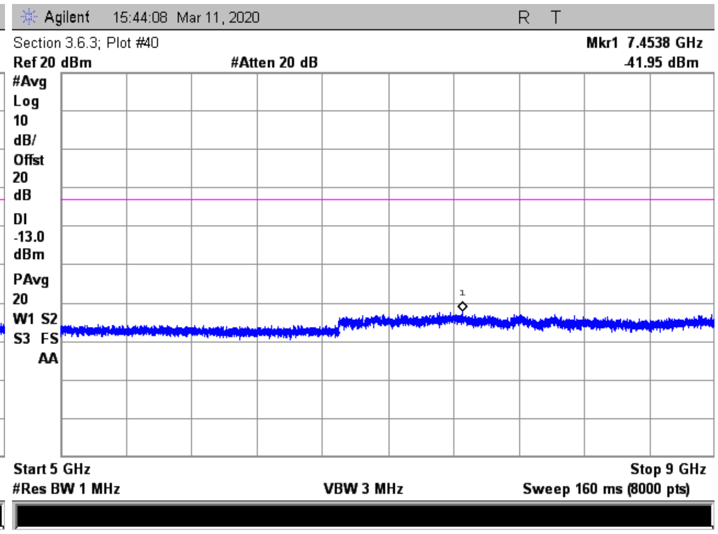
MSK ; 820.5 MHz Injected Signal



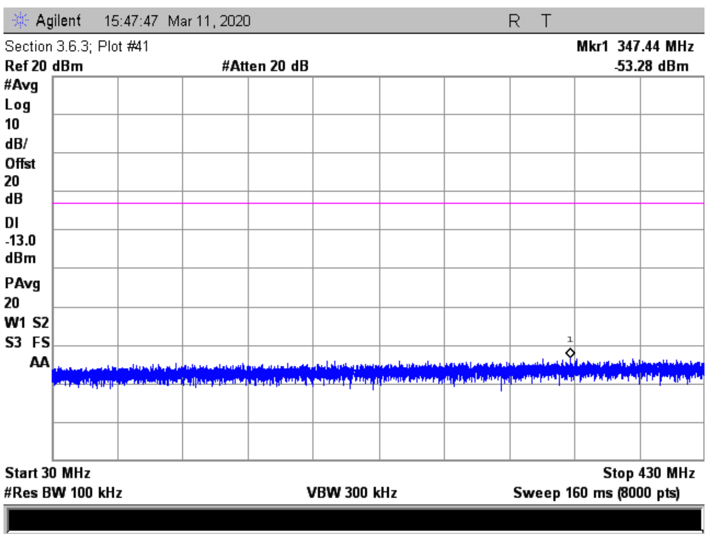
MSK ; 820.5 MHz Injected Signal



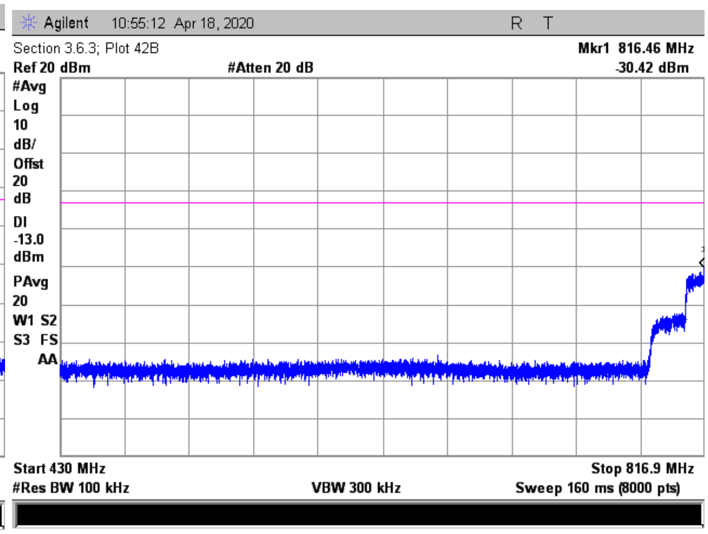
MSK ; 820.5 MHz Injected Signal



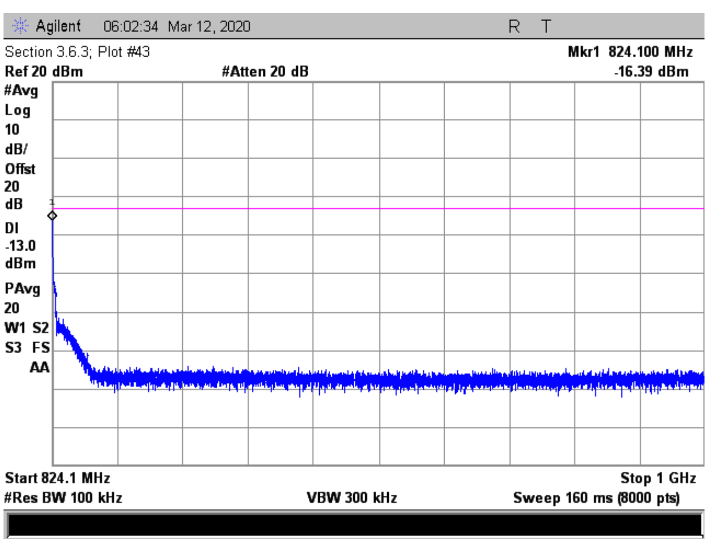
MSK ; 820.5 MHz Injected Signal



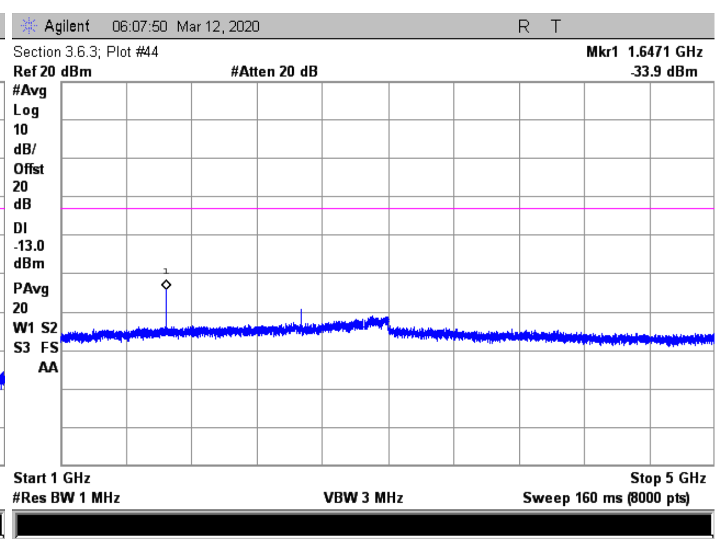
MSK ; 823.6 MHz Injected Signal



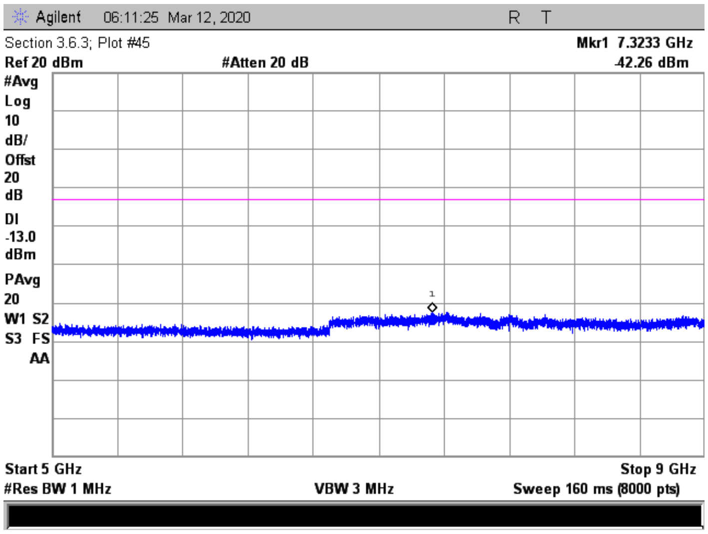
MSK ; 823.6 MHz Injected Signal



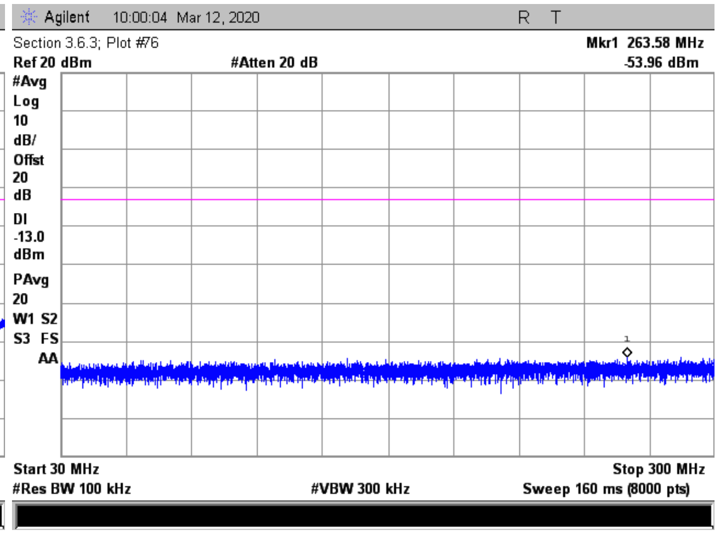
MSK ; 823.6 MHz Injected Signal



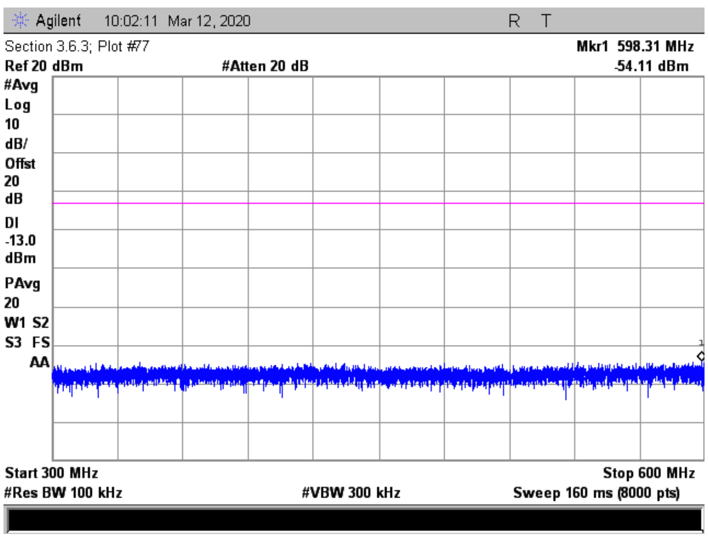
MSK ; 823.6 MHz Injected Signal



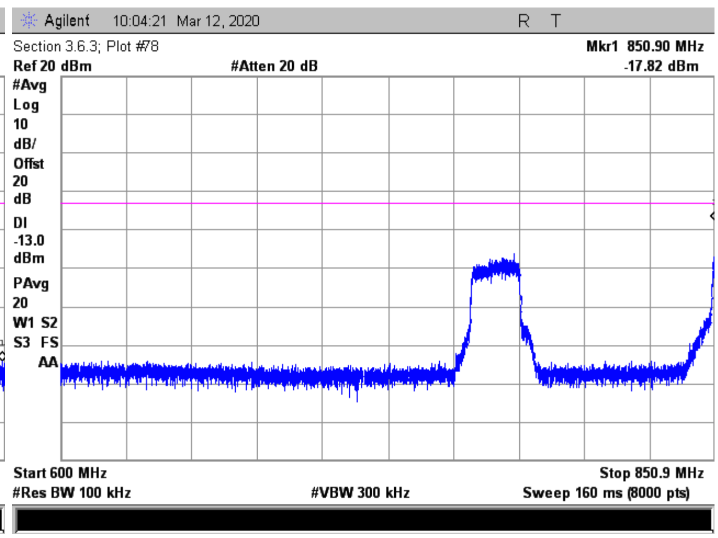
MSK ; 823.6 MHz Injected Signal



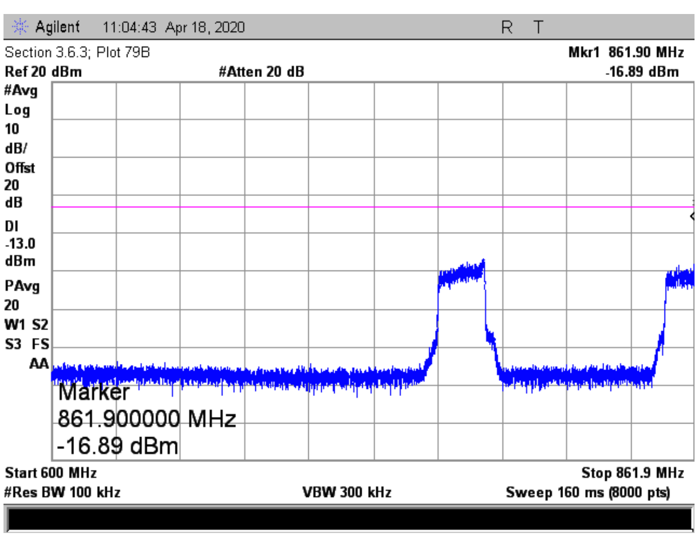
MSK; 862.4 MHz Injected Signal



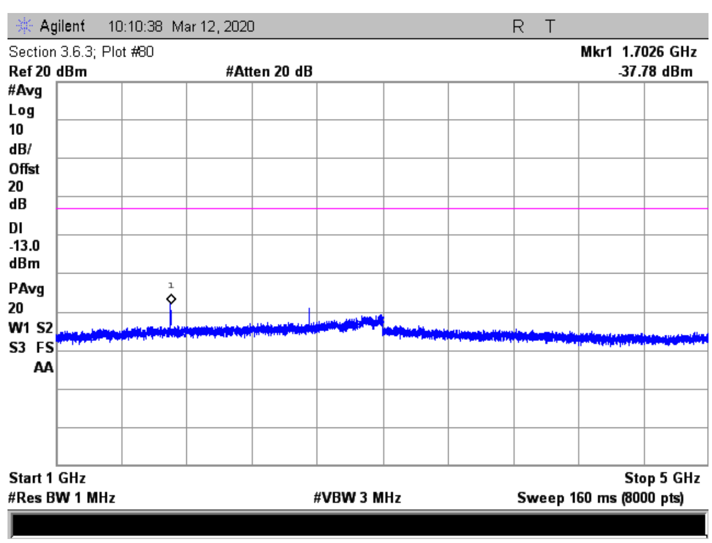
MSK; 862.4 MHz Injected Signal



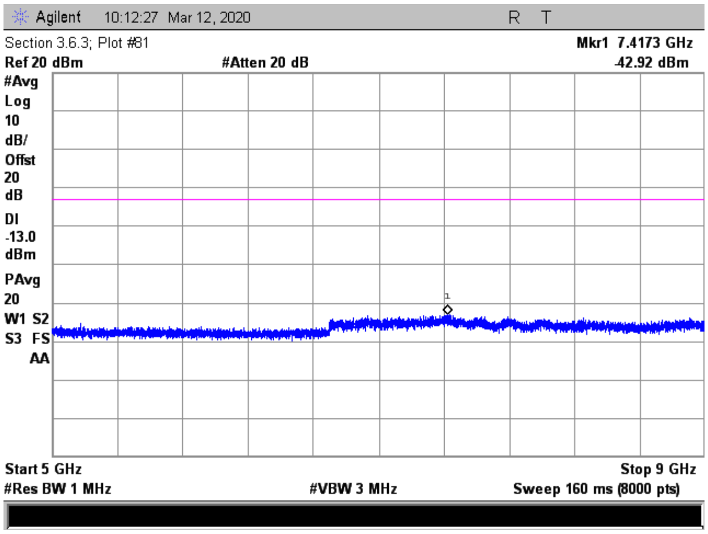
MSK; 862.4 MHz Injected Signal



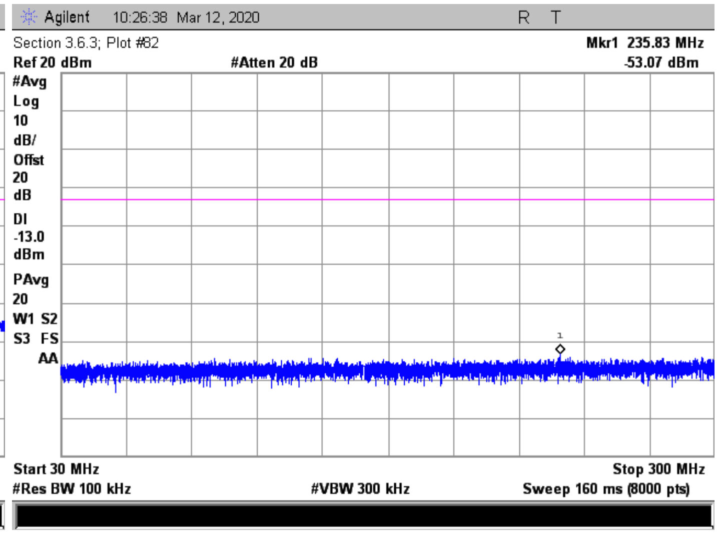
MSK; 862.4 MHz Injected Signal



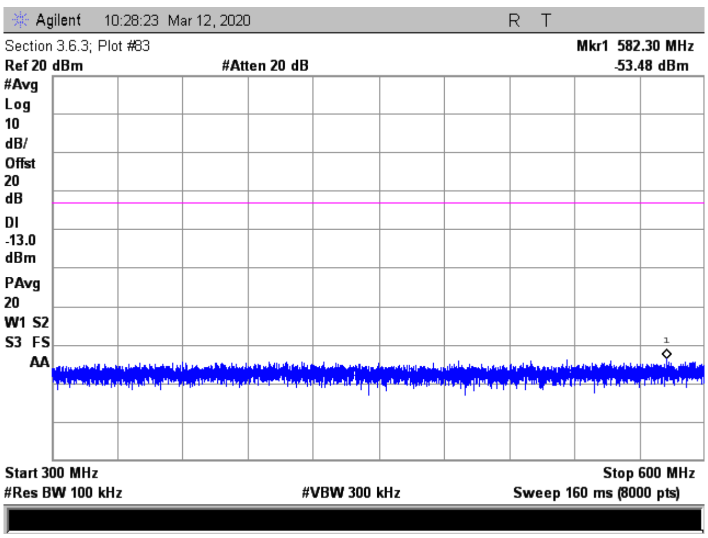
MSK; 862.4 MHz Injected Signal



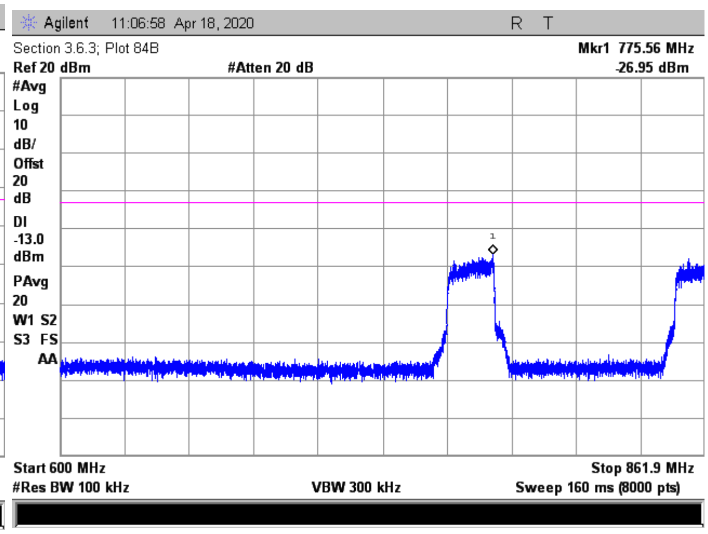
MSK; 862.4 MHz Injected Signal



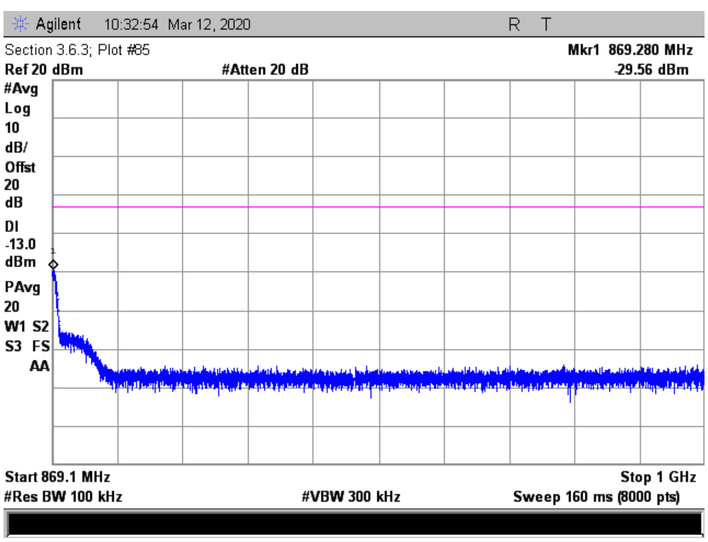
MSK; 865.5 MHz Injected Signal



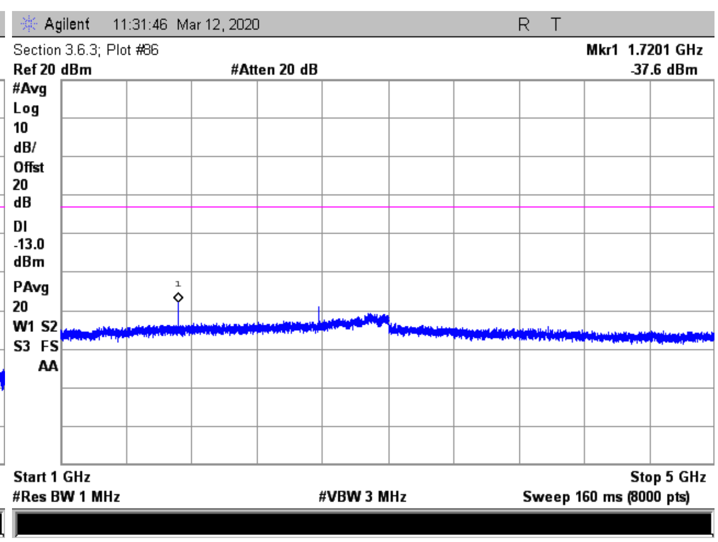
MSK; 865.5 MHz Injected Signal



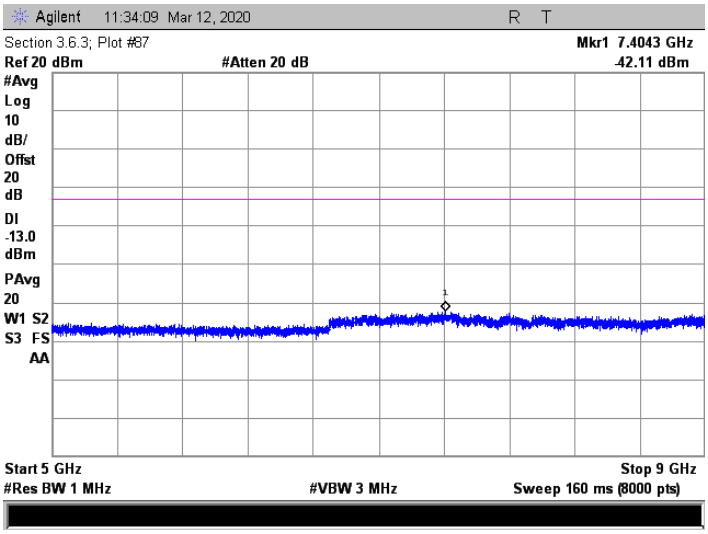
MSK; 865.5 MHz Injected Signal



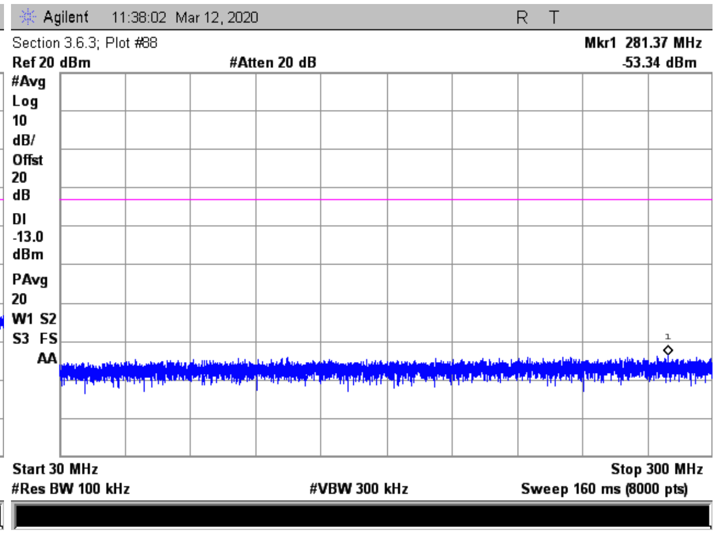
MSK; 865.5 MHz Injected Signal



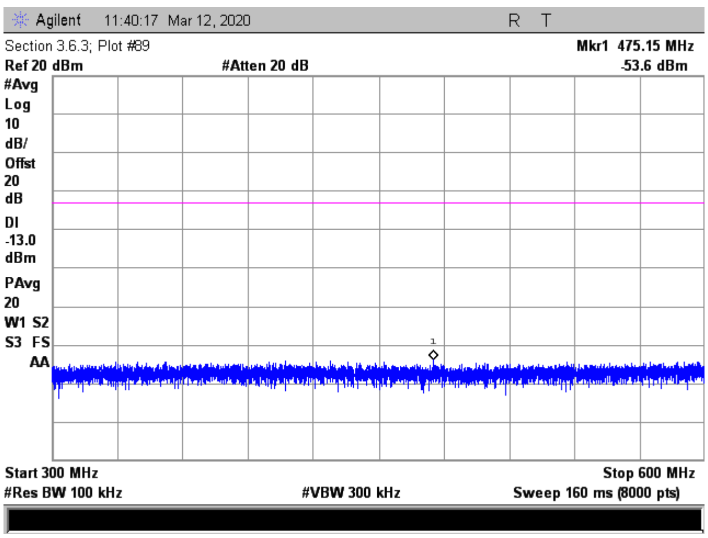
MSK; 865.5 MHz Injected Signal



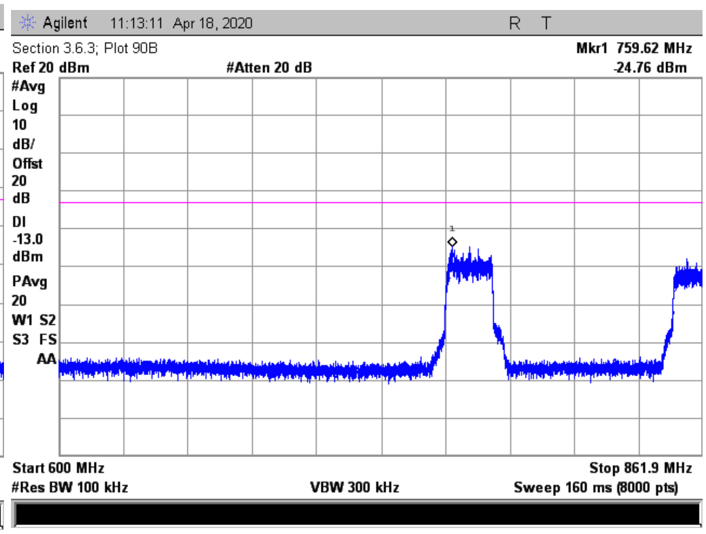
MSK; 865.5 MHz Injected Signal



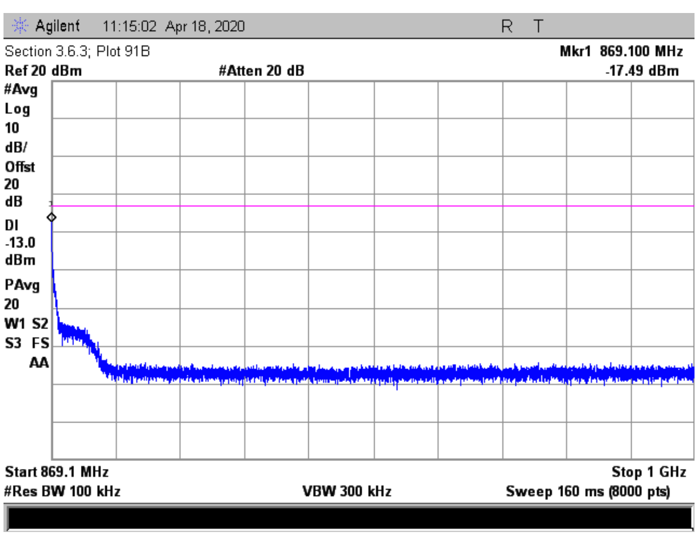
MSK; 868.6 MHz Injected Signal



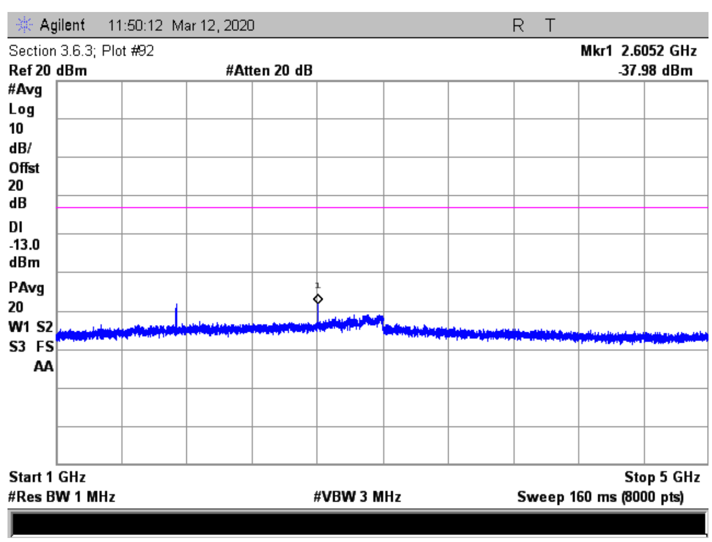
MSK; 868.6 MHz Injected Signal



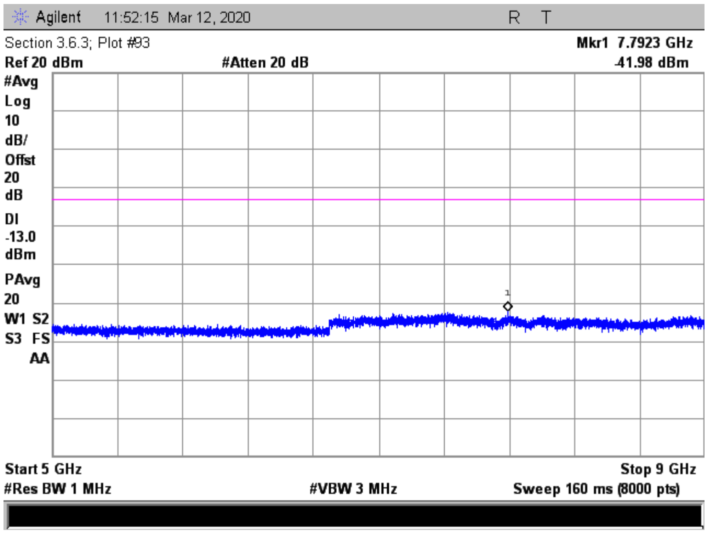
MSK; 868.6 MHz Injected Signal



MSK; 868.6 MHz Injected Signal



MSK; 868.6 MHz Injected Signal



MSK; 868.6 MHz Injected Signal

15.6 Test Results for Section 3.6.3 AWGN

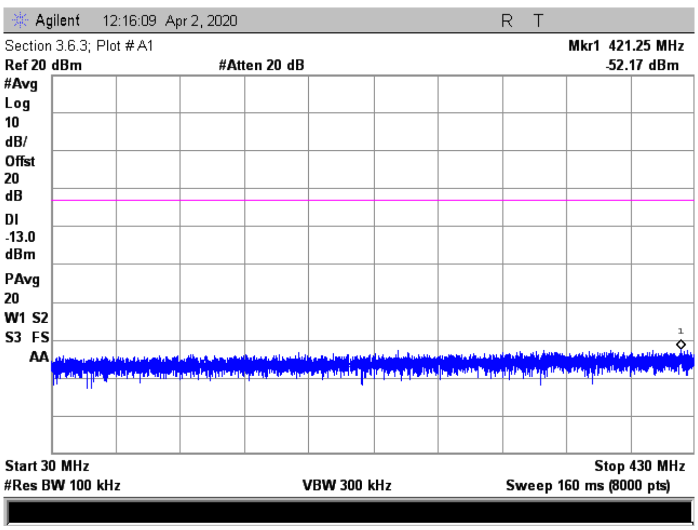
Model	PS71090E	Specifications	FCC KDB 935210 Secs. 3.6.3
Serial Number	19RF11060005	Test Date	April 2, 2020
Test Personnel	Joseph Strzelecki	Test Location	Chamber C
Test Equipment	EMI Receiver (REC-21)		

3.6.3	RBW	VBW		Sig Gen			Start	Stop	# of	# of	Freq	Max Reading
Plot #	MHz	MHz	Mode	Modul	MHz	dBm	MHz	MHz	points	Swps	MHz	dBm
Up	A1	0.1	0.3	AWGN	819.4	-26.2	30	430	8000	20	421.25	-52.17
Up	A2B	0.1	0.3	AWGN	819.4	-32	430	816.9	7738	20	816.8	26.5
Up	A3	0.1	0.3	AWGN	819.4	-26.2	824.1	1000	3518	20	824.496	-36.32
Up	A4	1	3	AWGN	819.4	-26.2	1000	5000	8000	20	2426.7	-36.12
Up	A5	1	3	AWGN	819.4	-26.2	5000	9000	8000	20	7136.3	-42.92
Up	A6	0.1	0.3	AWGN	820.5	-26.2	30	430	8000	20	379.09	-52.4
Up	A7B	0.1	0.3	AWGN	820.5	-26.2	430	816.9	7738	20	794.3	-27.5
Up	A8	0.1	0.3	AWGN	820.5	-26.2	824.1	1000	3518	20	824.232	-36.83
Up	A9	1	3	AWGN	820.5	-26.2	1000	5000	8000	20	2443.7	-34.43
Up	A10	1	3	AWGN	820.5	-26.2	5000	9000	8000	20	7438.8	-42.2
Up	A11	0.1	0.3	AWGN	821.6	-25.9	30	430	8000	20	299.73	-52.7
Up	A12B	0.1	0.3	AWGN	821.6	-25.9	430	816.9	7738	20	792.3	-27
Up	A13B	0.1	0.3	AWGN	821.6	-25.9	824.1	1000	3518	20	824.1	-28.4
Up	A14	1	3	AWGN	821.6	-25.9	1000	5000	8000	20	1643.1	-35.14
Up	A15	1	3	AWGN	821.6	-25.9	5000	9000	8000	20	7089.8	-42.65
Down	A16	0.1	0.3	AWGN	864.4	-26.1	30	300	5400	20	268.78	-53.39
Down	A17	0.1	0.3	AWGN	864.4	-26.1	300	600	6000	20	312.41	-53.99
Down	A18B	0.1	0.3	AWGN	864.4	-26.1	600	850.9	5018	20	775.4	-26.5
Down	A19	0.1	0.3	AWGN	864.4	-26.1	869.1	1000	2618	20	869.1	-26.49
Down	A20	1	3	AWGN	864.4	-26.1	1000	5000	8000	20	2561.2	-38.85
Down	A21	1	3	AWGN	864.4	-26.1	5000	9000	8000	20	7412.8	-42.63
Down	A22	0.1	0.3	AWGN	865.5	-24.6	30	300	5400	20	232.19	-53.31
Down	A23	0.1	0.3	AWGN	865.5	-24.6	300	600	6000	20	370.88	-54.33

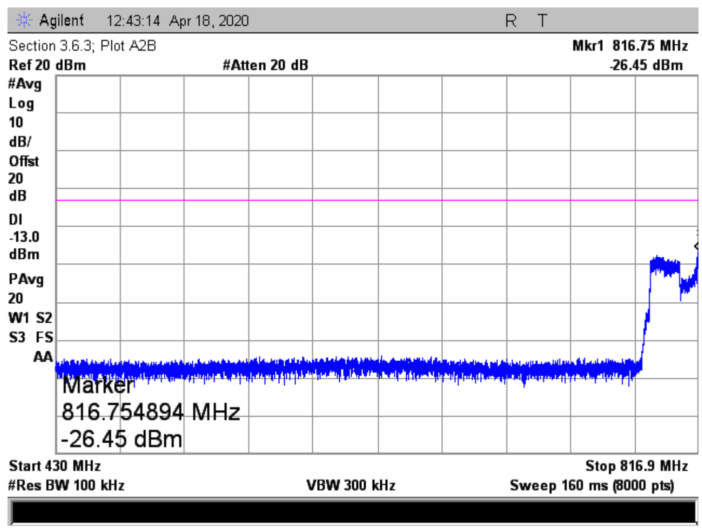
3.6.3	RBW	VBW		Sig Gen			Start	Stop	# of	# of	Freq	Max Reading
Plot #	MHz	MHz	Mode	Modul	MHz	dBm	MHz	MHz	points	Swps	MHz	dBm
Down	A24B	0.1	0.3	AWGN	865.5	-24.6	600	850.9	5018	20	771.4	-27.9
Down	A25	0.1	0.3	AWGN	865.5	-24.6	869.1	1000	2618	20	869.133	-26.05
Down	A26	1	3	AWGN	865.5	-24.6	1000	5000	8000	20	2580.2	-34.3
Down	A27	1	3	AWGN	865.5	-24.6	5000	9000	8000	20	7403.3	-42.69
Down	A28	0.1	0.3	AWGN	866.6	-27.6	30	300	5400	20	259.12	-53.38
Down	A29	0.1	0.3	AWGN	866.6	-27.6	300	600	6000	20	581.51	-53.91
Down	A30B	0.1	0.3	AWGN	866.6	-27.6	600	850.9	5018	20	769.97	-27.9
Down	A31B	0.1	0.3	AWGN	866.6	-27.6	869.1	1000	2618	20	861.1	-26.4
Down	A32	1	3	AWGN	866.6	-27.6	1000	5000	8000	20	2599.7	-37.72
Down	A33	1	3	AWGN	866.6	-27.6	5000	9000	8000	20	7427.3	-42.75

Judgement: Pass

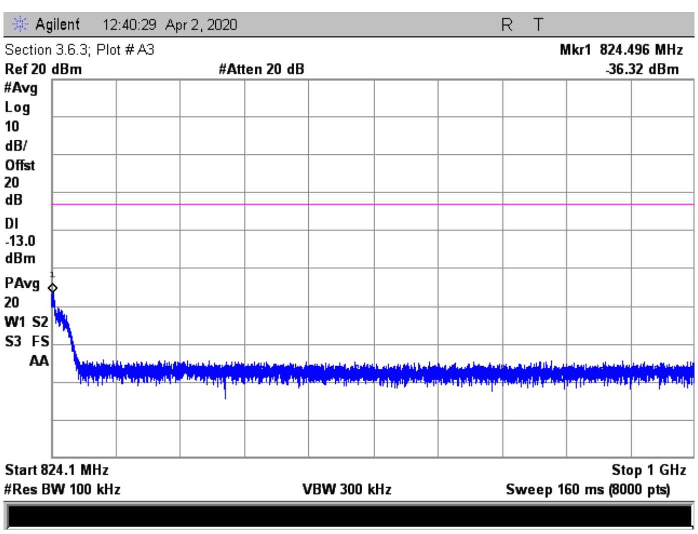
Uplink



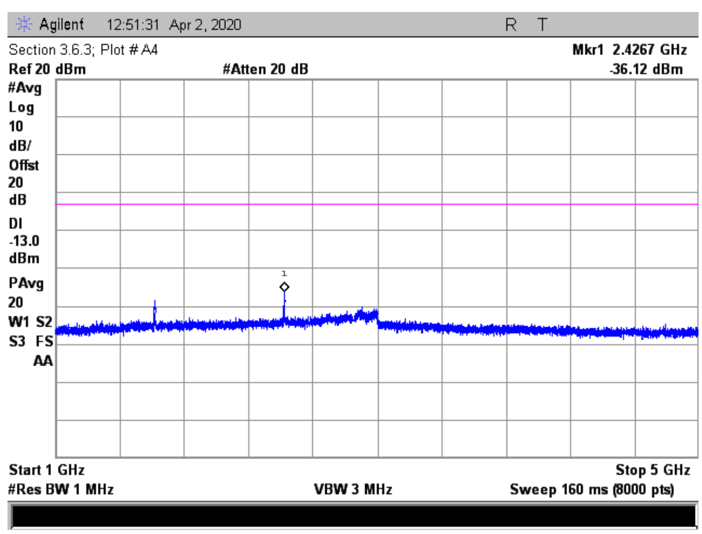
AWGN; 819.4 MHz Injected Signal



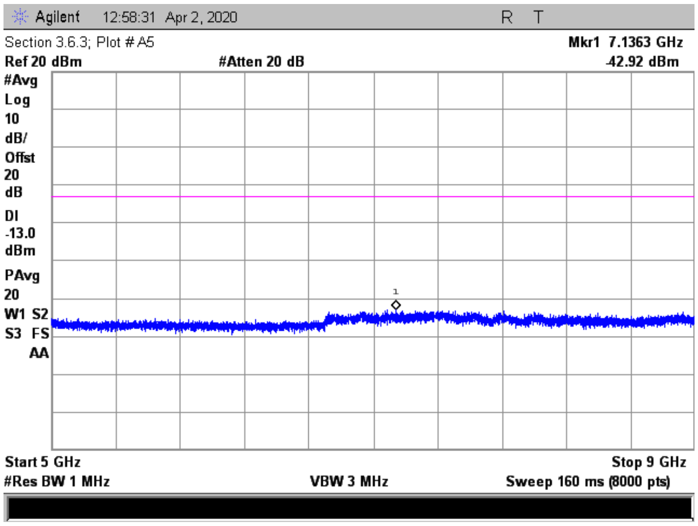
AWGN; 819.4 MHz Injected Signal



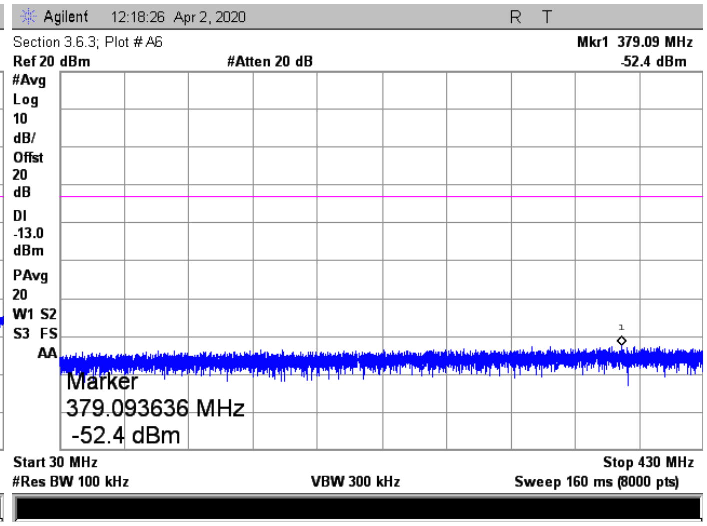
AWGN; 819.4 MHz Injected Signal



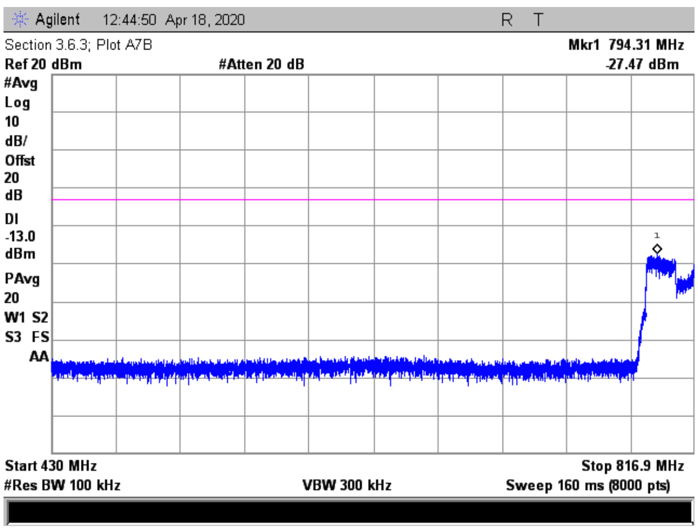
AWGN; 819.4 MHz Injected Signal



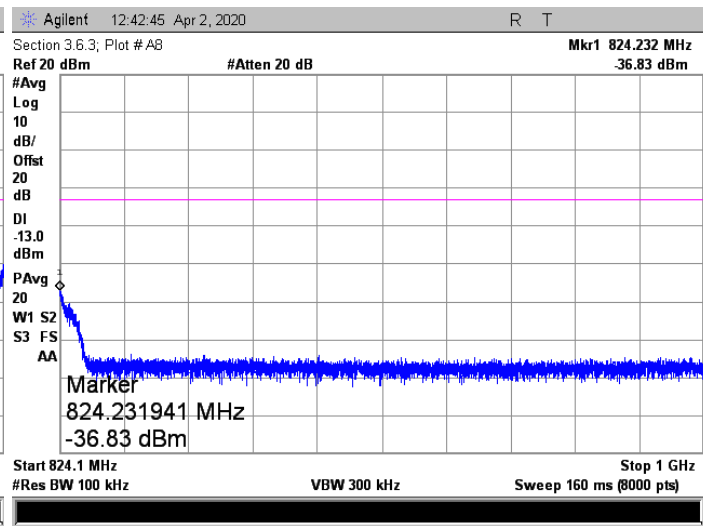
AWGN; 819.4 MHz Injected Signal



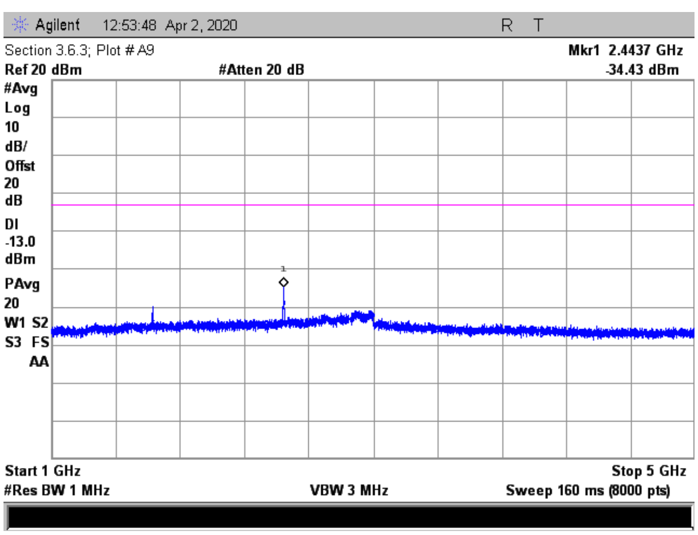
AWGN; 820.5 MHz Injected Signal



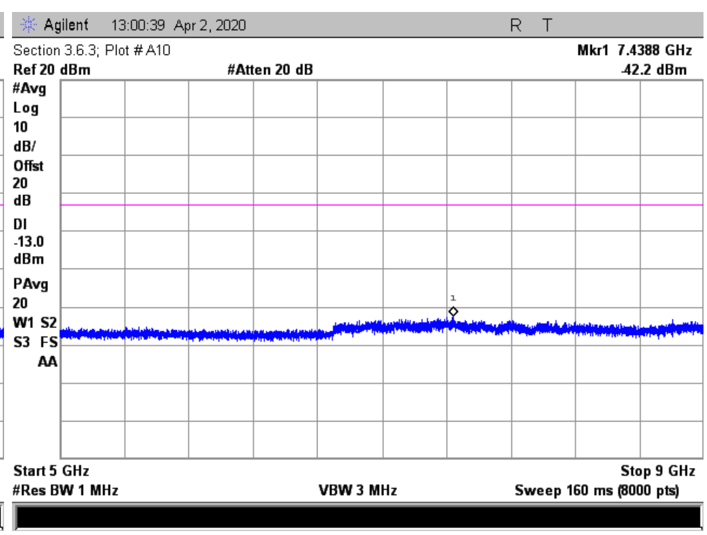
AWGN; 820.5 MHz Injected Signal



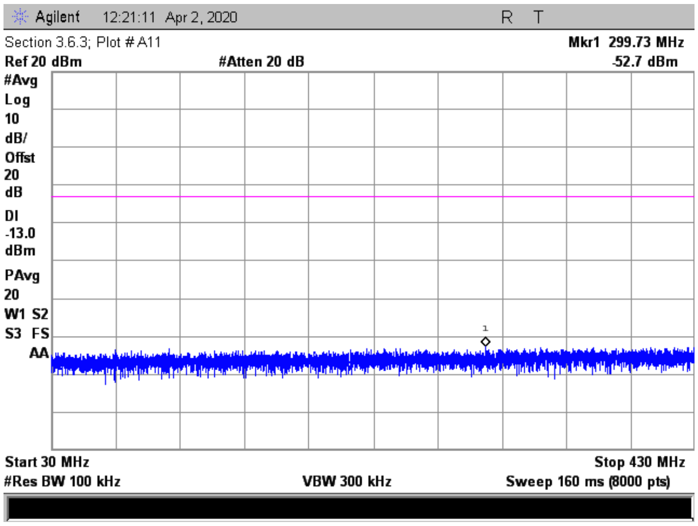
AWGN; 820.5 MHz Injected Signal



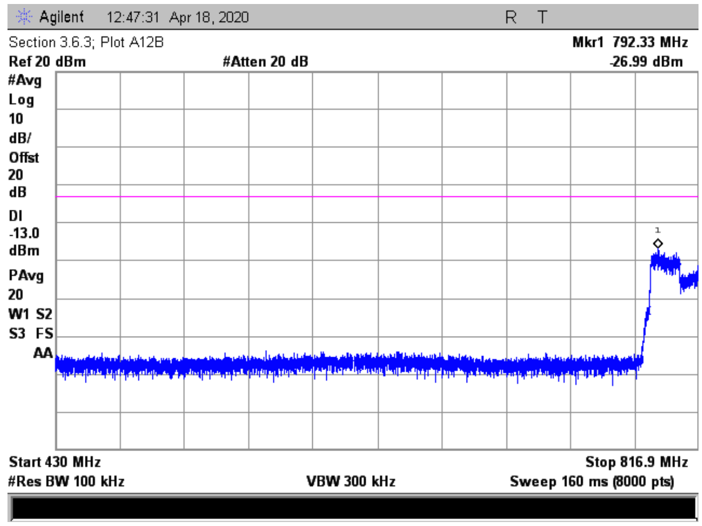
AWGN; 820.5 MHz Injected Signal



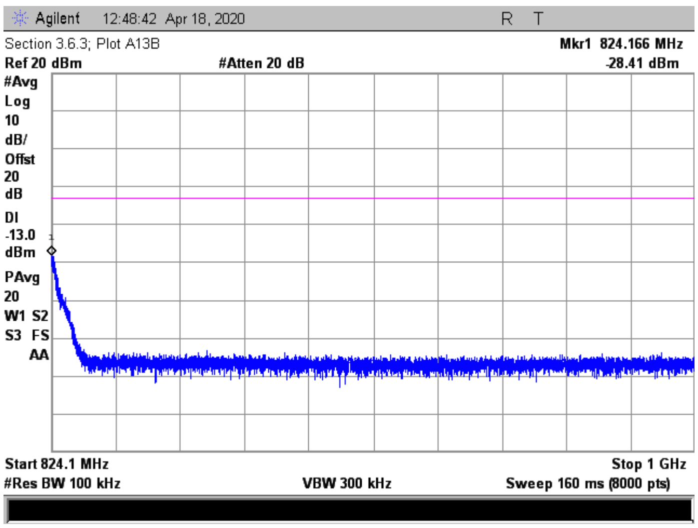
AWGN; 820.5 MHz Injected Signal



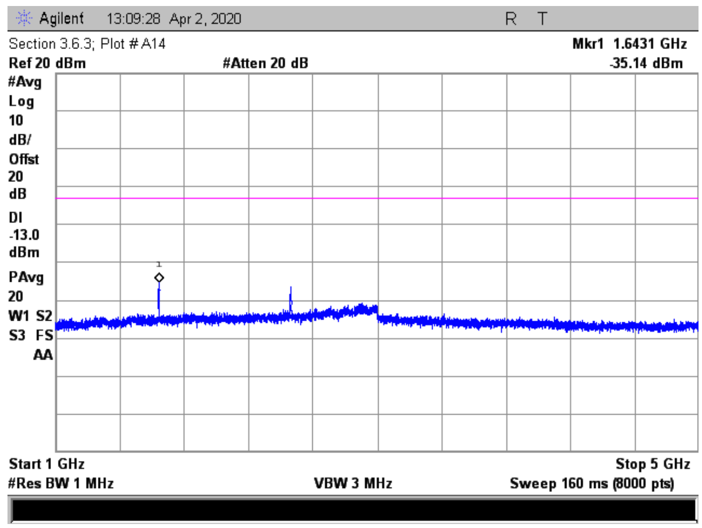
AWGN; 821.6 MHz Injected Signal



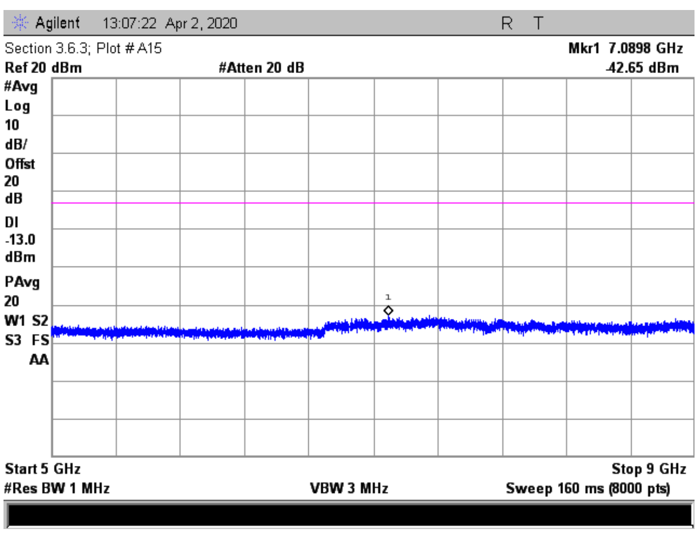
AWGN; 821.6 MHz Injected Signal



AWGN; 821.6 MHz Injected Signal

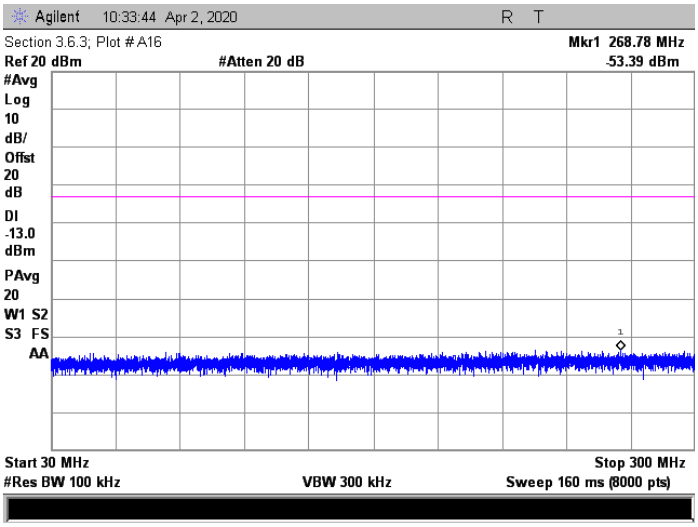


AWGN; 821.6 MHz Injected Signal

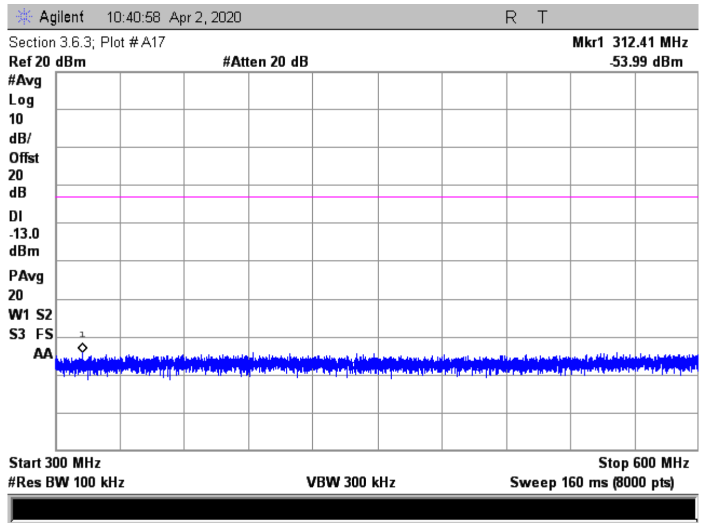


AWGN; 821.6 MHz Injected Signal

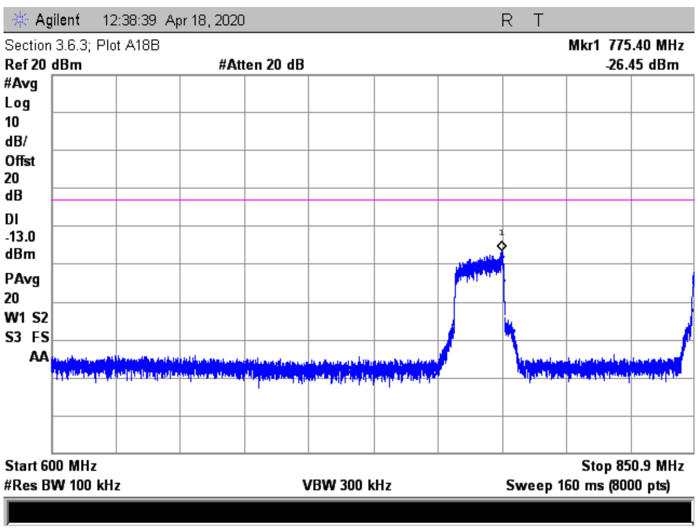
DownLink



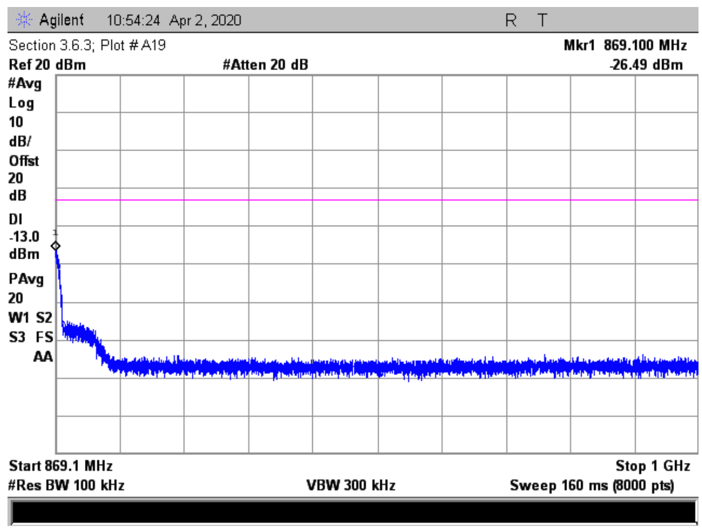
AWGN; 864.4 MHz Injected Signal



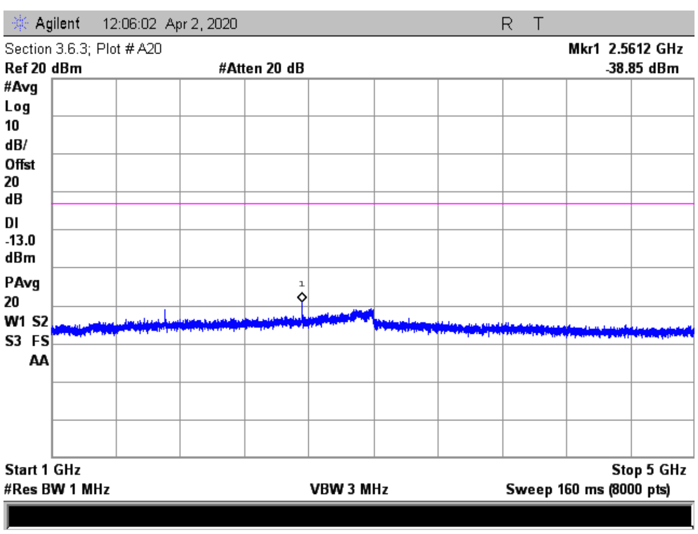
AWGN; 864.4 MHz Injected Signal



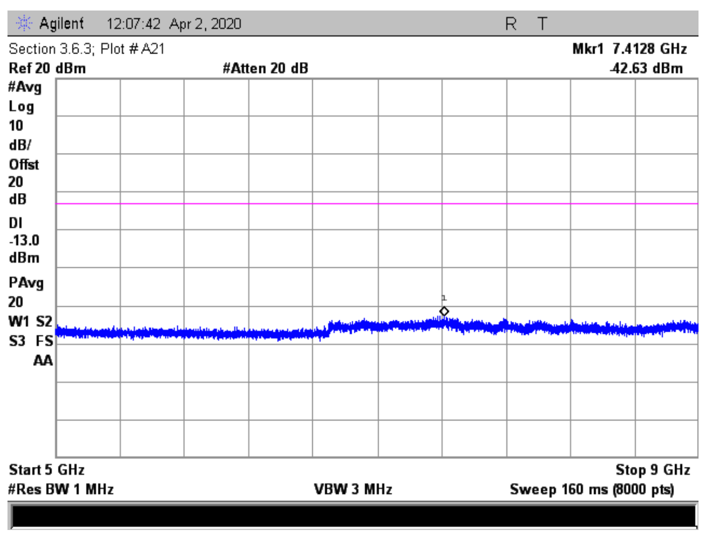
AWGN; 864.4 MHz Injected Signal



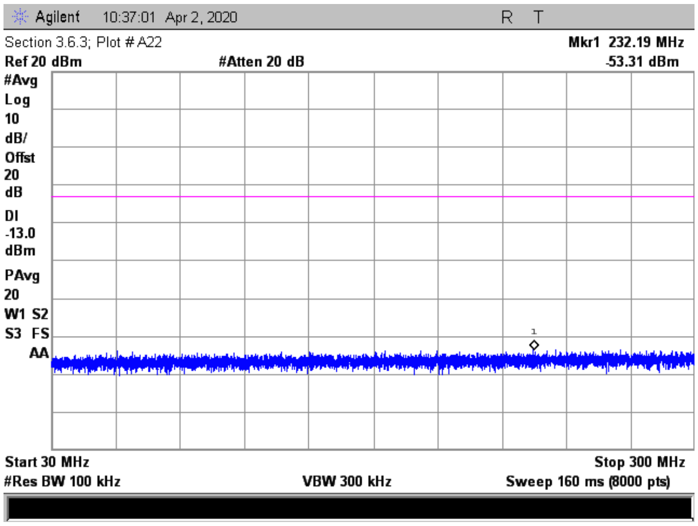
AWGN; 864.4 MHz Injected Signal



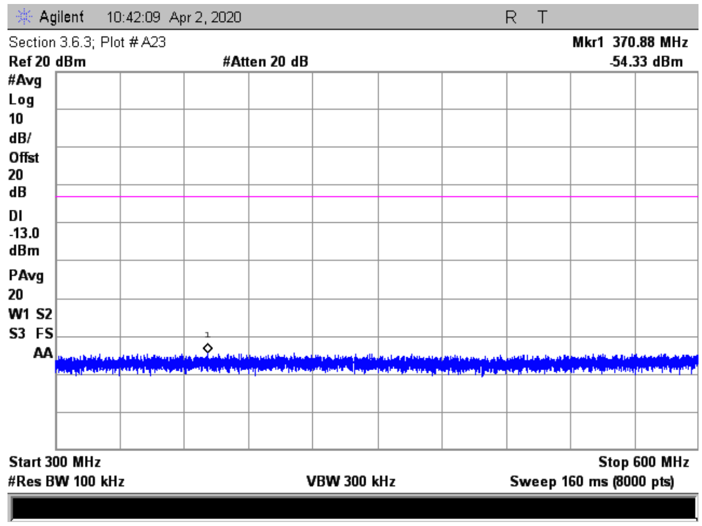
AWGN; 864.4 MHz Injected Signal



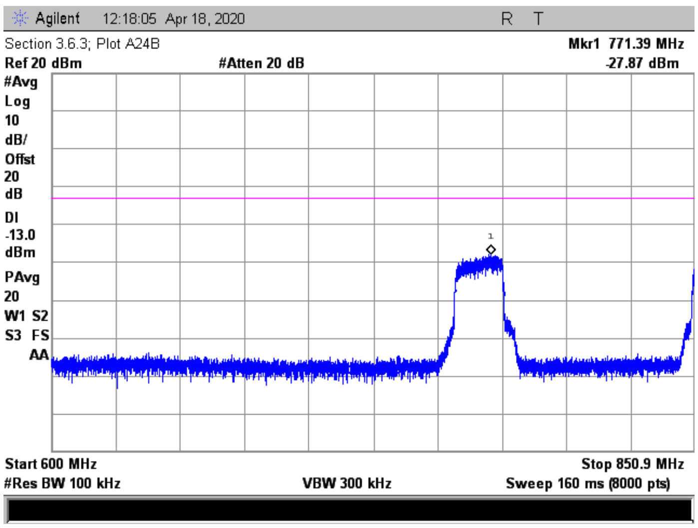
AWGN; 864.4 MHz Injected Signal



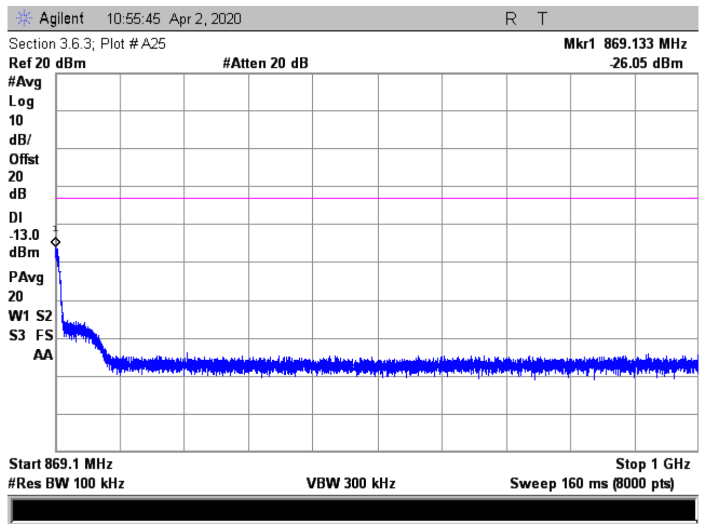
AWGN; 865.5 MHz Injected Signal



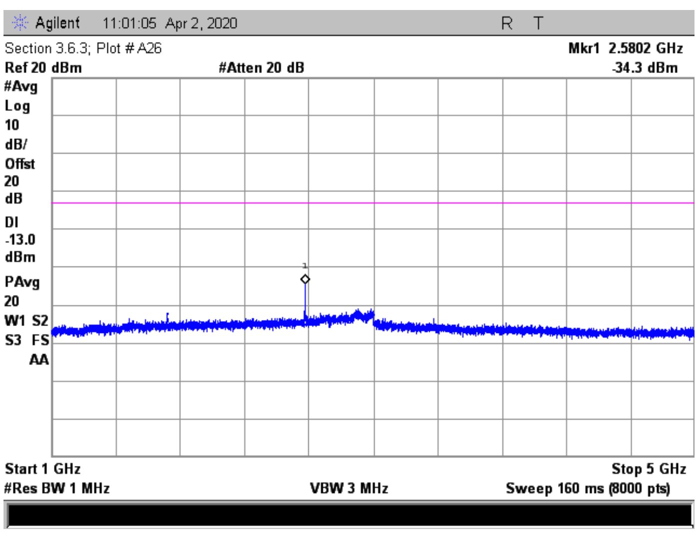
AWGN; 865.5 MHz Injected Signal



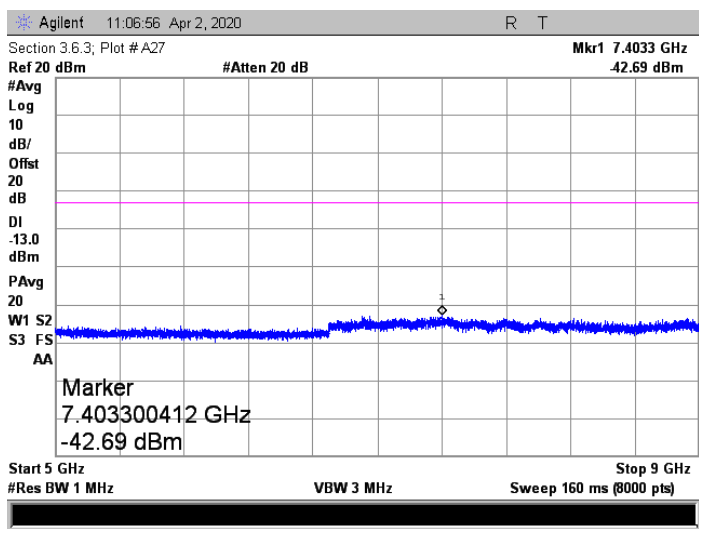
AWGN; 865.5 MHz Injected Signal



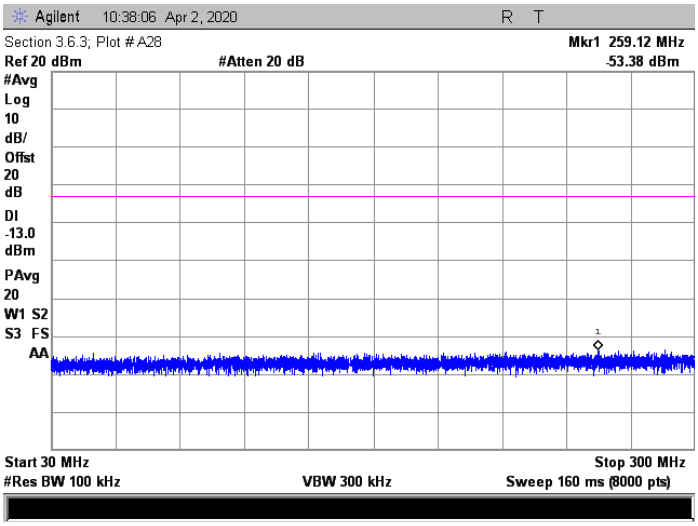
AWGN; 865.5 MHz Injected Signal



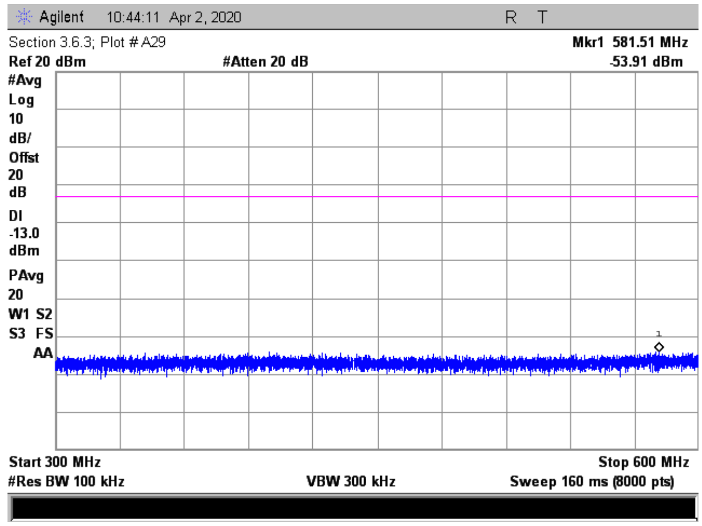
AWGN; 865.5 MHz Injected Signal



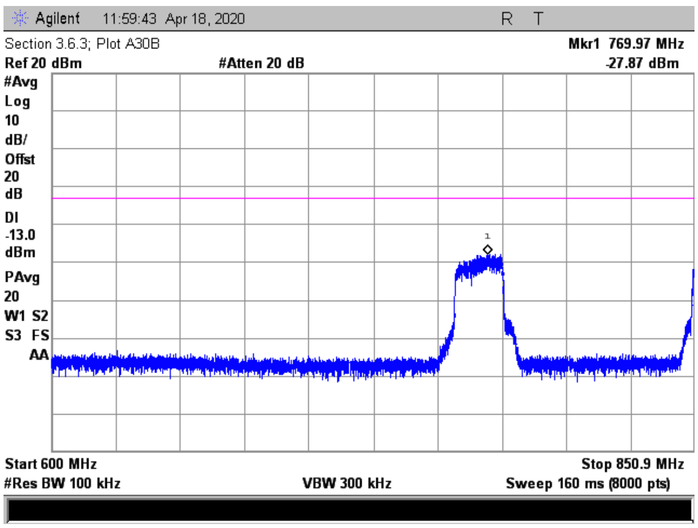
AWGN; 865.5 MHz Injected Signal



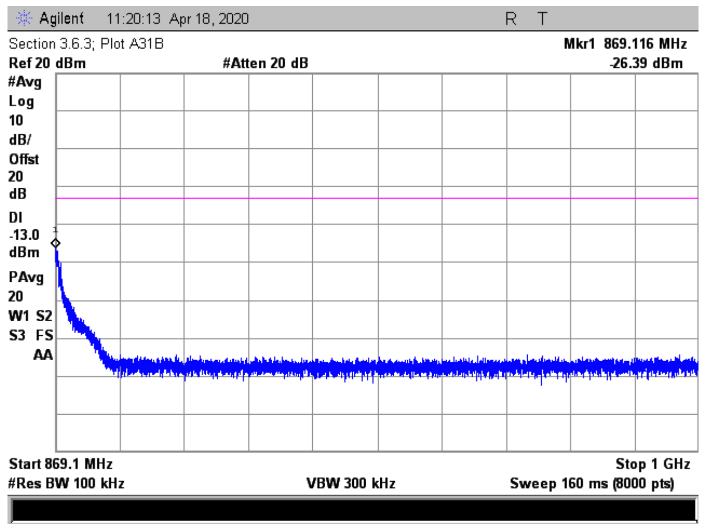
AWGN; 866.6 MHz Injected Signal



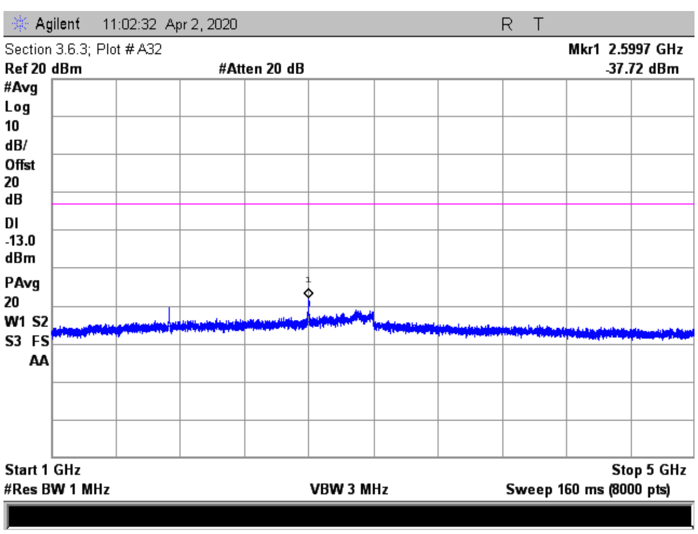
AWGN; 866.6 MHz Injected Signal



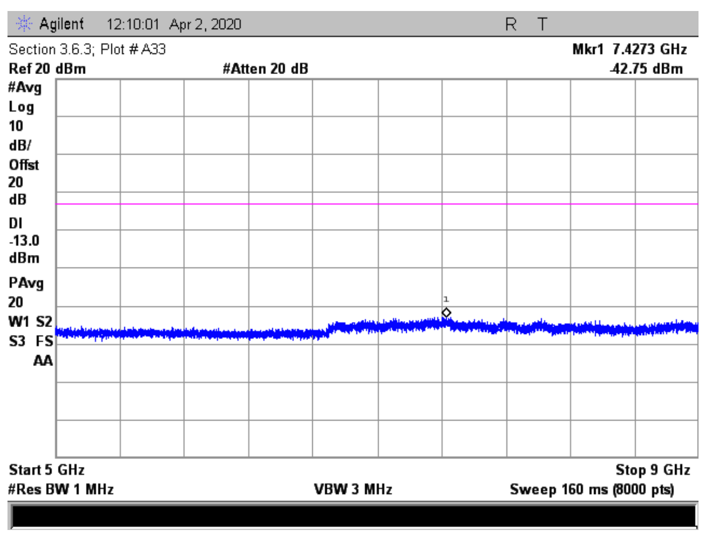
AWGN; 866.6 MHz Injected Signal



AWGN; 866.6 MHz Injected Signal



AWGN; 866.6 MHz Injected Signal



AWGN; 866.6 MHz Injected Signal

Judgment: Pass

16.0 FIELD STRENGTH OF SPURIOUS RADIATED EMISSIONS

16.1 Applicable Standard

The EUT shall comply with section 3.8 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.

16.2 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:

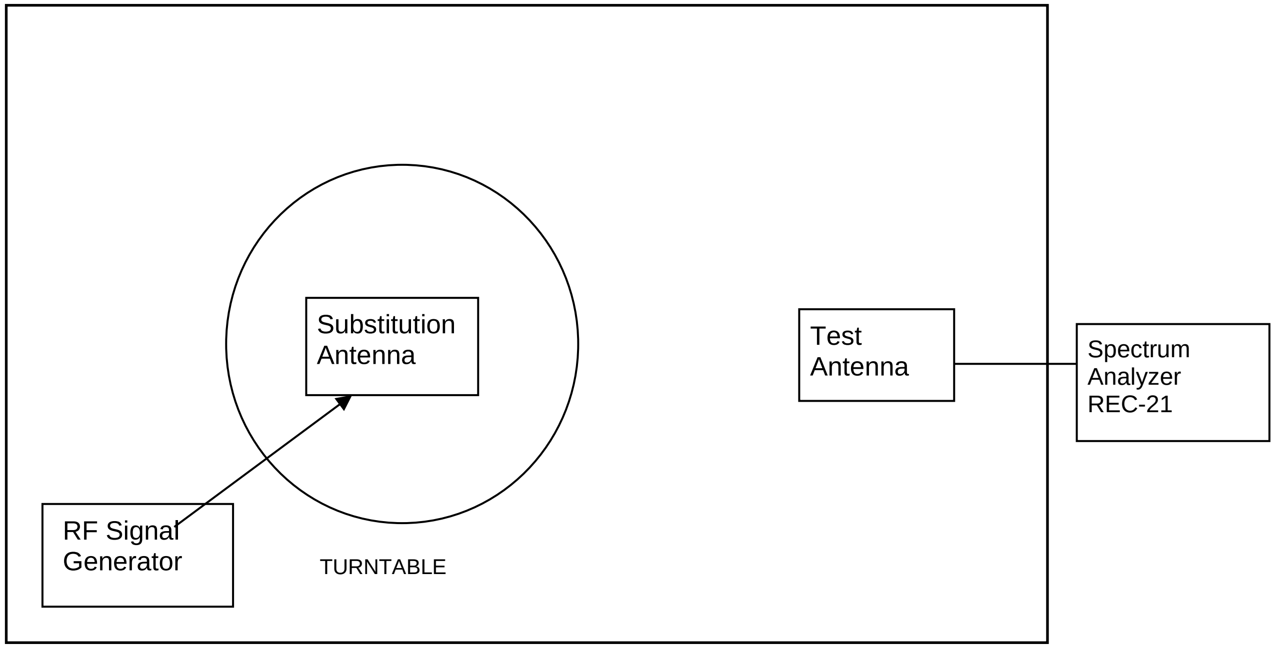
1) Resolution Bandwidth = 100 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1GHz.
2) Video Bandwidth = 300 kHz for spurious emissions below 1 GHz, and 3 MHz for spurious emissions above 1 GHz.
3) Sweep Speed slow enough to maintain measurement calibration.
4) Detector 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-21	SIG-21
200 - 1000	ANT-06	ANT-07	REC-21	SIG-21
1000-9,000	ANT-13	ANT-66	REC-21	SIG-21

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 approximately 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.

16.2.1 Spurious Radiated Emissions Test Results

Model	PS71090E	Specification	FCC KDB 935210
Serial Number	19RF11060004	Test Date	April 17, 2019
Test Distance	3 Meters	Notes	Transmit Mode
Test Personnel	Joseph Strzelecki	Test Location	Chamber E
Test Equipment	REC-21		

The emissions were measured from 30-8700 MHz. The worst case is shown below.

Transmit at 865.5 MHz; Downlink 862-869 MHz Band

Freq. MHz	Dect.	Ant. Pol.	EUT dBm	Limit dBm	Margin Under Limit dB
69.2	P	H	-47.8	-13.0	34.8
119.7	P	H	-40.1	-13.0	27.1
388.9	P	H	-35.5	-13.0	22.5
578.0	P	H	-31.9	-13.0	18.9
798.7	P	H	-28.6	-13.0	15.6
806.0	P	H	-30.4	-13.0	17.4
932.1	P	H	-27.5	-13.0	14.5
975.8	P	H	-26.8	-13.0	13.8
2223.3	P	H	-42.7	-13.0	29.7
3131.7	P	H	-33.5	-13.0	20.5
3858.3	P	H	-30.3	-13.0	17.3
4111.7	P	H	-30.7	-13.0	17.7
4923.3	P	H	-29.2	-13.0	16.2
5930.0	P	H	-28.8	-13.0	15.8
6493.3	P	H	-27.9	-13.0	14.9
7135.0	P	H	-25.2	-13.0	12.2
7503.3	P	H	-24.3	-13.0	11.3
8151.7	P	H	-23.3	-13.0	10.3
8498.3	P	H	-23.4	-13.0	10.4
76.1	P	V	-47.9	-13.0	34.9
86.9	P	V	-48.3	-13.0	35.3
105.2	P	V	-41.4	-13.0	28.4
136.7	P	V	-41.1	-13.0	28.1
153.8	P	V	-45.1	-13.0	32.1
168.1	P	V	-43.1	-13.0	30.1
235.0	P	V	-40.5	-13.0	27.5
287.0	P	V	-40.3	-13.0	27.3
405.9	P	V	-36.1	-13.0	23.1
624.1	P	V	-31.0	-13.0	18.0
633.8	P	V	-33.9	-13.0	20.9

Freq. MHz	Dect.	Ant. Pol.	EUT dBm	Limit dBm	Margin Under Limit dB
922.4	P	V	-27.3	-13.0	14.3
975.8	P	V	-28.0	-13.0	15.0
1955.0	P	V	-42.1	-13.0	29.1
2516.7	P	V	-39.9	-13.0	26.9
2866.7	P	V	-37.2	-13.0	24.2
3178.3	P	V	-25.0	-13.0	12.0
3870.0	P	V	-30.0	-13.0	17.0
4918.3	P	V	-29.7	-13.0	16.7
5075.0	P	V	-30.1	-13.0	17.1
5858.3	P	V	-28.3	-13.0	15.3
6180.0	P	V	-30.1	-13.0	17.1

Judgment: Passed by at least 10 dB.

Transmit at 820.5 MHz; Uplink 817-824 MHz Band

Freq. MHz	Dect.	Ant. Pol.	EUT dBm	Limit dBm	Margin Under Limit dB
134.3	P	H	-42.5	-13.0	29.5
243.4	P	H	-40.6	-13.0	27.6
806.0	P	H	-29.6	-13.0	16.6
961.2	P	H	-27.0	-13.0	14.0
1125.0	P	H	-54.4	-13.0	41.4
1878.3	P	H	-45.0	-13.0	32.0
2861.7	P	H	-50.9	-13.0	37.9
3213.3	P	H	-34.4	-13.0	21.4
3833.3	P	H	-29.5	-13.0	16.5
4878.3	P	H	-29.4	-13.0	16.4
5498.3	P	H	-29.5	-13.0	16.5
5826.7	P	H	-27.9	-13.0	14.9
6493.3	P	H	-28.6	-13.0	15.6
54.3	P	V	-43.0	-13.0	30.0
418.0	P	V	-34.8	-13.0	21.8
738.1	P	V	-31.2	-13.0	18.2
927.3	P	V	-29.9	-13.0	16.9
1848.3	P	V	-43.3	-13.0	30.3
3455.0	P	V	-33.7	-13.0	20.7
3866.7	P	V	-28.6	-13.0	15.6
4200.0	P	V	-32.0	-13.0	19.0
4485.0	P	V	-30.1	-13.0	17.1
4870.0	P	V	-29.7	-13.0	16.7
5500.0	P	V	-30.4	-13.0	17.4
5870.0	P	V	-28.8	-13.0	15.8
6173.3	P	V	-29.5	-13.0	16.5
6506.7	P	V	-30.1	-13.0	17.1
7210.0	P	V	-25.8	-13.0	12.8

Judgment: Passed by at least 10 dB.

17.0 MEASUREMENT INSTRUMENTATION UNCERTAINTY

Measurement	Uncertainty
Radiated Emissions, E-field, 3 meters, 30 to 200 MHz	3.3 dB
Radiated Emissions, E-field, 3 meters, 200 to 1000 MHz	4.9 dB
Radiated Emissions, E-field, 3 meters, 1 to 18 GHz	4.8 dB
Bandwidth using marker delta method	1% of frequency span
Conducted power	0.8 dB
Amplitude measurement 1-8000 MHz;	1.5 dB

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

18.0 REVISION HISTORY

RP-9209B2 Revisions:			
Rev.	Affected Sections	Description	Rationale