Electromagnetic Compatibility Test Report

Tests Performed on a Primex Wireless, Inc.

OneVue Sync, Model: TX400

Radiometrics Document RP-9038A1

ACCREDITED
TESTING CERT #1495.01

Product Detail:	
FCC ID: PZ3-TX400 IC: 4256A-TX400 Equipment type: 72-73 MHz Transceiver	
Test Standards:	
US CFR Title 47, Chapter I, FCC Part 2 and 90 FCC Parts 2, 15, and 90 CFR Title 47: 2019 IC RSS-119 Issue 12: 2015 IC RSS-GEN Issue 4: 2014	
Tests Performed For:	*Test Facility:*
Primex Wireless, Inc. 965 S. Wells St. Lake Geneva, WI 53147	**Radiometrics Midwest Corporation** 12 East Devonwood Romeoville, IL 60446 Phone: (815) 293-0772
Test Dates:	
February 13 thru 22, 2019	

Document RP-9038A1 Revisions:

Rev.	Issue Date	Affected Sections	Revised By
0	March 25, 2019		
1	April 3, 2019	2.0	Joseph Strzelecki

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1.0 ADMINISTRATIVE DATA

Equipment Under Test:	
A Primex Wireless, Inc., OneVue Sync Model: TX400; Serial Numbers: SMP1, SMP2 These will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics:	*Test Dates:*
February 13, 2019	February 13 thru 22, 2019
Test Report Written and Authorized By:	*Test Witnessed By:*
Joseph Strzelecki Senior EMC Engineer	The tests were not witnessed by personnel from Primex Wireless, Inc.
Radiometrics' Personnel Responsible for Test:	
Joseph Strzelecki 03/25/2019 Date Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE Richard L. Tichgelaar EMC Technician Chris E. Dalessio EMC Technician	

2.0 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a OneVue Sync, Model TX400, manufactured by Primex Wireless, 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 Sections	RSS 119 Section	Test Result
RF Power Output	72-73 MHz	2.1046 & 90.205	5.4	Pass
Occupied Bandwidth Test; Emissions Masks	72-73 MHz	2.1049 & 90.209	5.5	Pass
Spurious RF Conducted Emissions	7-1000 MHz	2.1051 & 90.210	5.8	Pass
Field Strength of Spurious Radiation	30-1000 MHz	2.1053	5.3	Pass
Frequency Vs. Temperature	72-73 MHz	2.1055 & 90.213	5.3	Pass
Frequency Vs. Voltage	72-73 MHz	2.1055 & 90.213	5.3	Pass

3.0 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a OneVue Sync. The EUT is a 72-73 MHz transceiver, manufactured by Primex Wireless, Inc. The EUT was in good working condition during the tests, with no known defects.

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	OneVue Sync	E	Primex Wireless, Inc.	TX400	SMP1
2	OneVue Sync	E	Primex Wireless, Inc.	TX400	SMP2
3	Power supply	E	MEAN WELL	GST25U09	None

* Type: E = EUT

4.2 Special Accessories

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

4.3 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

5.0 TEST SPECIFICATIONS AND RELATED DOCUMENTS

Document	Date	Title
FCC CFR Title 47	2019	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 & 90 - Radio Frequency Devices
ANSI C63.4-2014	2014	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
TIA-603-D	2010	Land Mobile FM or PM Communications Equipment – Measurement and Performance Standards
IC RSS-Gen Issue 4	2014	General Requirements and Information for the Certification of Radiocommunication Equipment (RSS-Gen)
IC RSS-119 Issue 12	2015	Radio Transmitters and Receivers Operating in the Land Mobile and Fixed Services in the Frequency Range 27.41-960 MHz

RSS-Gen & RSS-119 are not currently in Radiometrics' Scope of Accreditation, however it uses the procedures from TIA-603-D and ANSI C63.4 that are in Radiometrics Scope of Accreditation

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: 2005 "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-01.

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.	12/05/17
ANT-68	EMCO	Log Periodic Ant.	93146	9604-4456	200-1000MHz	24 Mo.	12/05/17
ANT-79	AH Systems	Bicon Antenna	SAS-540	293	20-330MHz	24 Mo.	12/14/18
ANT-80	AH Systems	Bicon Antenna	SAS-540	294	20-330MHz	24 Mo.	12/14/18
ATT-28	Narda	Attenuator(20dB)	757B-20	3131	DC - 6 GHz	24 Mo.	11/27/17
ATT-53	Weinschel	Attenuator (20 dB)	23-20-34	CG7857	DC-18 GHz	12 Mo	11/06/18
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-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-788A	Teledyne	Coaxial Cable	N/A	788A	DC-18 GHz	24 Mo.	05/09/18
CAB-106A	Teledyne	Coaxial Cable	N/A	106A	DC-2 GHz	24 Mo.	05/07/18
CAB-1090	Teledyne	Coaxial Cable	N/A	1090	DC-18 GHz	24 Mo.	05/16/18
CAB-160B	Teledyne	Coaxial Cable	N/A	160B	DC-18 GHz	24 Mo.	05/09/18
CNT-01	Racal-Dana	Freq. Counter	1991	910357	DC-160MHz	24 Mo.	07/26/18

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
DMM-11	Fluke	DMM	17B	23490125	DC-100kHz	24 Mo.	04/05/18
HPF-10	Mini-Circuits	High Pass Filter	NHP-150+	VUU28401851	133-3000MHz	12 Mo.	02/15/19
PWM-01	Boonton	Power Meter	4230	22503	50kHz-18GHz	24 Mo.	12/26/17
REC-20	HP / Agilent	Spectrum Analyzer	85460A/84562A	33330A00135 3410A00178	30Hz-6GHz	24 Mo.	08/03/17
REC-21	Agilent	Spectrum Analyzer	E7405A	MY45118341	9kHz-26.5 GHz	24 Mo.	01/06/18
REC-43	Adventest	Spectrum Analyzer	U3772	150800305	9kHz-43GHz	24 Mo.	04/19/17
SIG-30	Rohde & Schwarz	Signal Generator	SMC100A	102914	9k-3.2GHz	24 Mo.	11/29/17
TC-01	GS Blue M Electric	Temperature Chamber	ETC-04S-E	0003-ETC-201	-40 to 100 Deg C	24 Mo.	01/03/18
THM-02	Fluke	Temp/Humid Meter	971	93490471	N/A	24 Mo.	10/17/17

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

10.0 TEST SECTIONS

10.1 Peak Output Power

The peak power was measured by connecting the EUT antenna port to the spectrum analyzer via a low loss coaxial cable and an appropiate power attenuator.

Model	TX400	Specification	FCC part 90.205 RSS-119 Section 5.4
Serial Number	SMP1; SMP2	Test Date	February 19, 2019
Test Personnel	Richard Tichgelaar	Test Location	Chamber B
Test Equipment	Power meter (PWM-01)		

SMP1; With LPF

TX Freq MHz	Reading dBm	Atten & Cable	Total dBm	Peak Power Watts	Antenna Gain dBi	ERP Watts
72.10	9.50	20.00	29.50	0.891	2.15	0.891
72.98	9.60	20.00	29.60	0.912	2.15	0.912

SMP2; No LPF

TX Freq MHz	Reading dBm	Atten & Cable	Total dBm	Peak Power Watts	Antenna Gain dBi	ERP Watts
72.10	9.90	20.00	29.90	0.977	2.15	0.977
72.98	9.95	20.00	29.95	0.989	2.15	0.989

Judgement: Pass
The fundamental emission ERP limit is 300 watts (54.77 dBm), since it will not be operating on mobile only frequencies.

Note that in decibel units:
ERP = EIRP - 2.15 = P+G-2.15
where:
P = transmitter output power in dB(W)
G = Gain of the transmitting antenna in dBi

10.2 Occupied Bandwidth; Emissions Masks

Model	TX400	Specification	FCC Part 90.209 & 90.210 RSS-119 Section 5.5
Serial Number	SMP2	Test Date	02/13 & 19/2019
Test Personnel	Richard Tichgelaar	Test Location	Chamber C
Test Equipment	Spectrum Analyzer (REC-21), (REC-43)		

The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The EUT was transmitting at its maximum data rate. The trace was allowed to stabilize. All Channels are 20 kHz. The emissions Mask C is from FCC part 90.210.

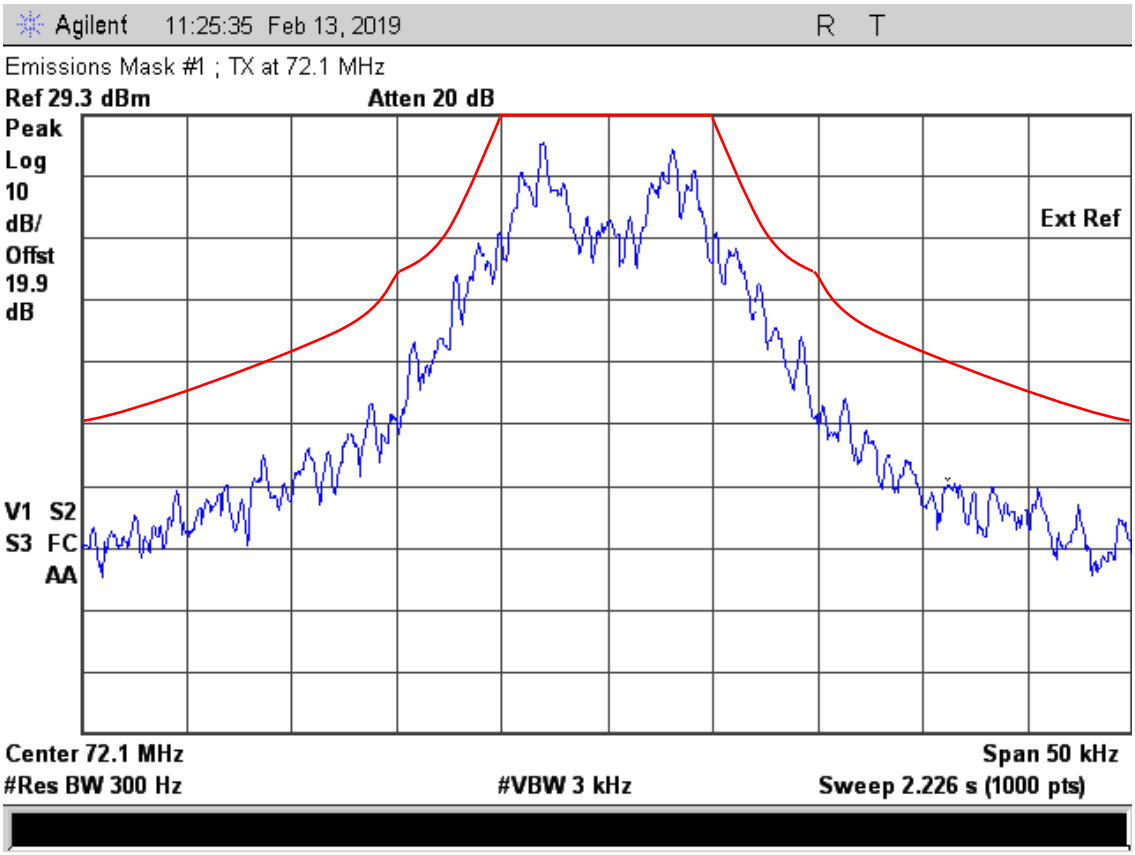
For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:

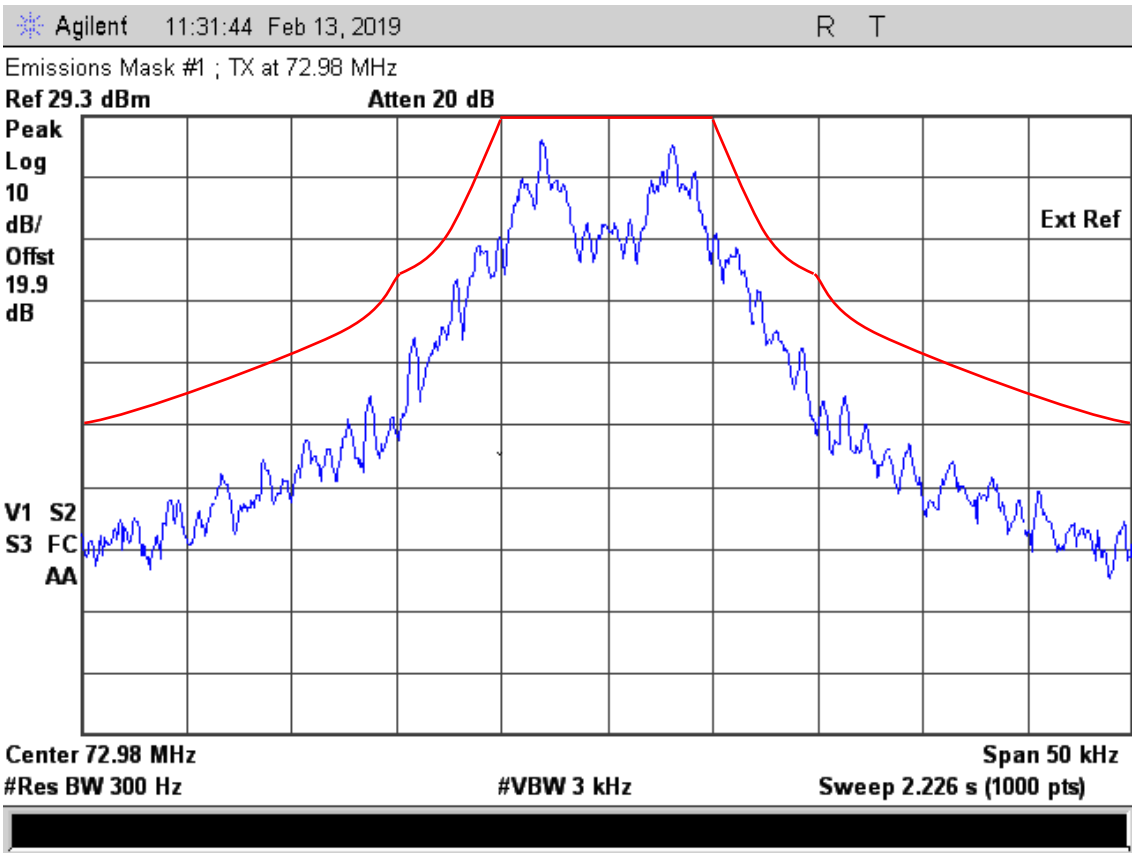
(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 5 kHz, but not more than 10 kHz: At least 83 log (fd/5) dB;

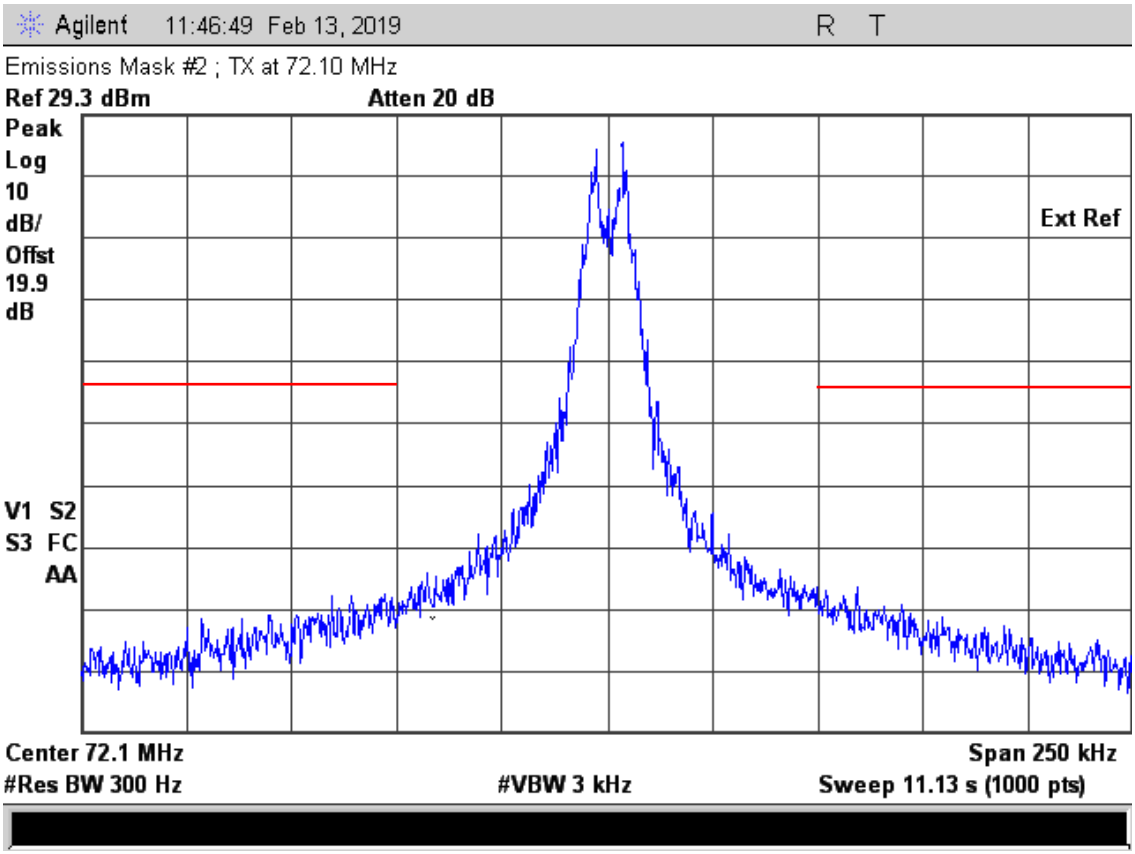
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: At least 29 log (fd2/11) dB or 50 dB, whichever is the lesser attenuation;

(3) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

SMP1; With LPF



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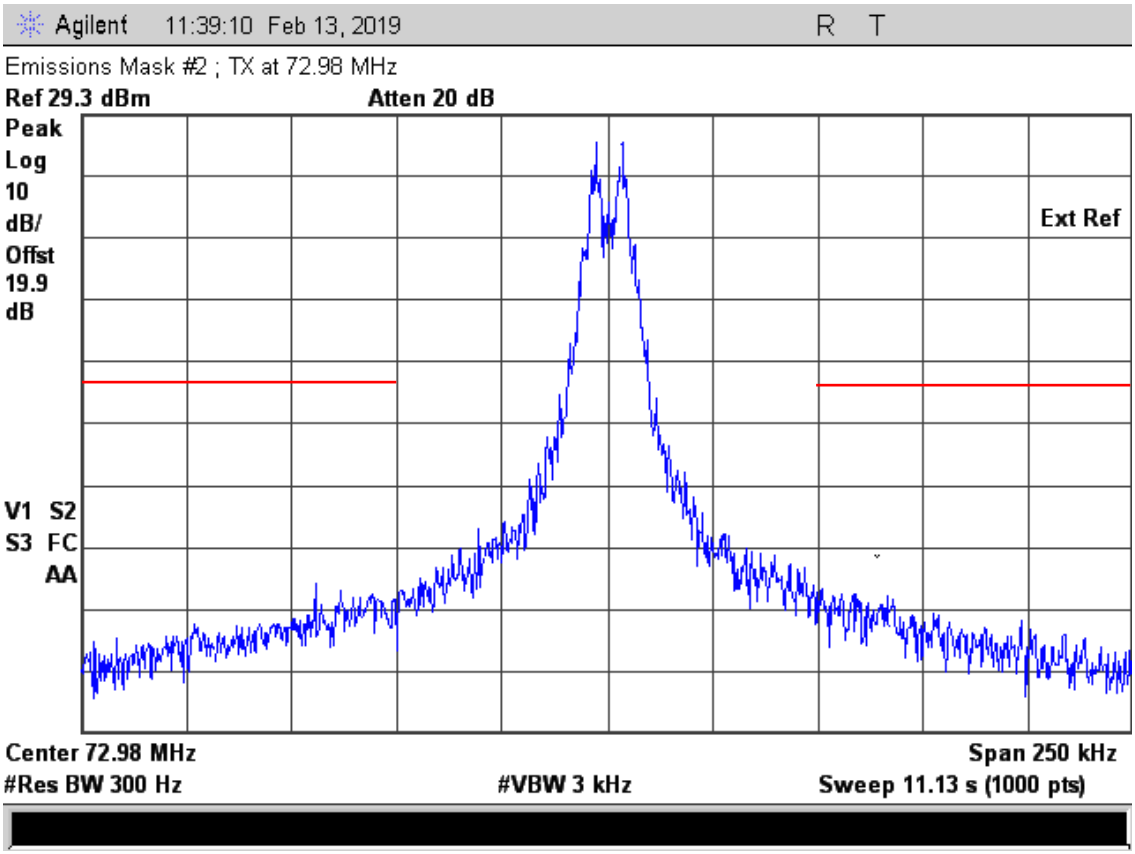
Ref 29.3 dBm
Atten 20 dB
Peak
Log
10
dB/
Offst
19.9
dB
Ext Ref
V1 S2
S3 FC
AA
Center 72.1 MHz
Span 250 kHz
#Res BW 300 Hz
#VBW 3 kHz
Sweep 11.13 s (1000 pts)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Peak
Log
10
dB/
Offst
19.9
dB
Ext Ref
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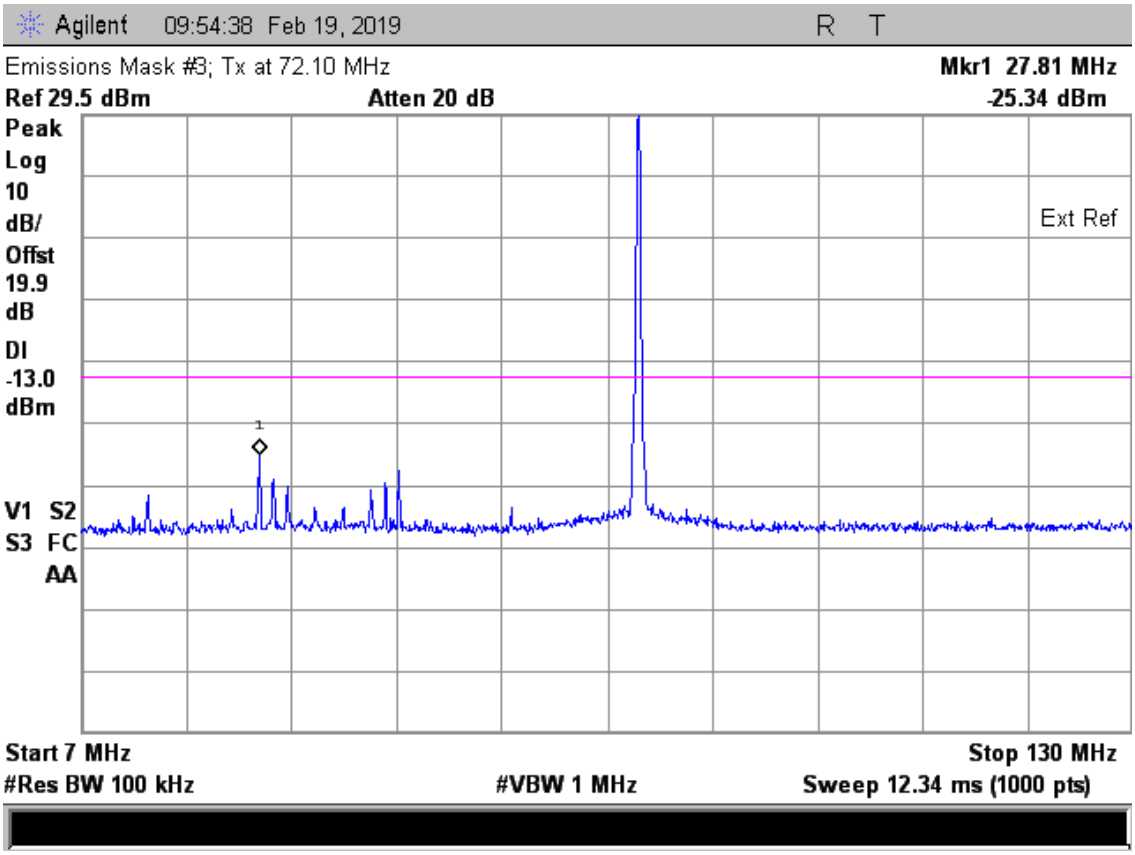
S3 FC
AA
Center 72.98 MHz
Span 250 kHz
#Res BW 300 Hz
#VBW 3 kHz
Sweep 11.13 s (1000 pts)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Atten 20 dB
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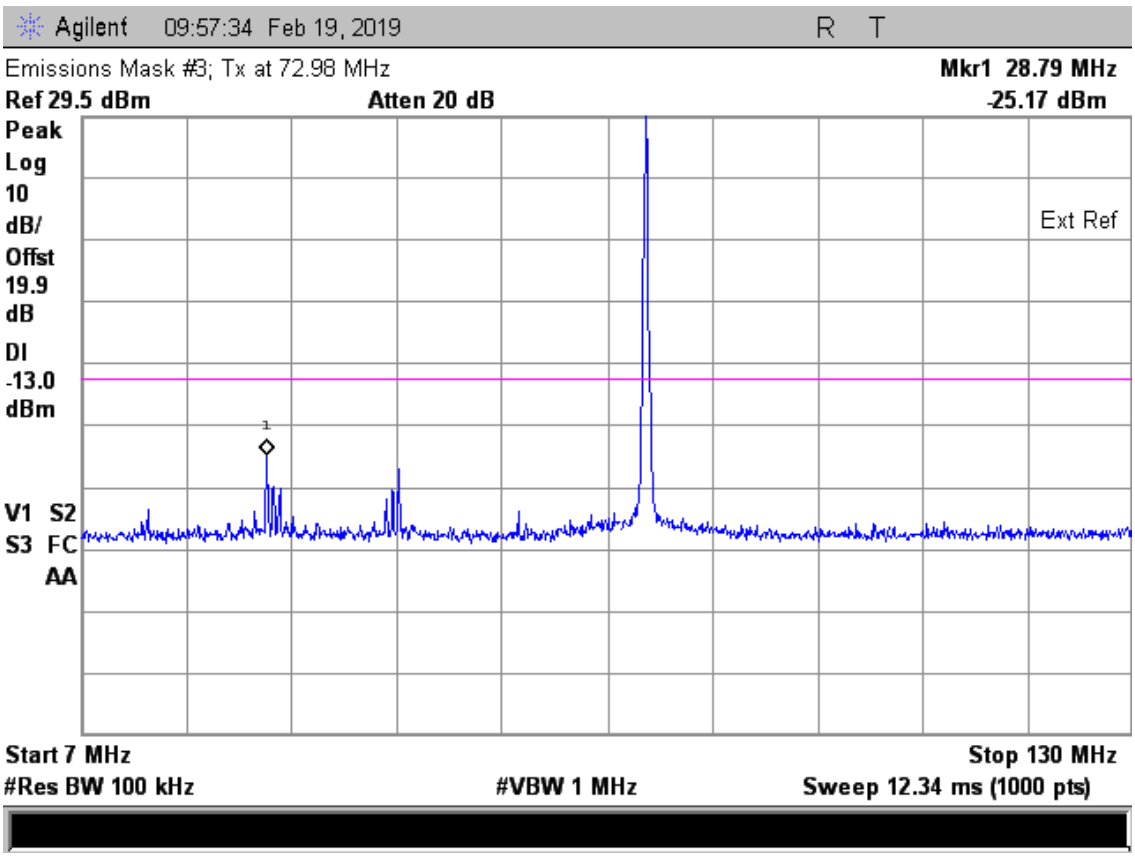
Peak
Log
10
dB/
Offst
19.9
dB
Dl
-13.0
dBm
Ext Ref
V1 S2
S3 FC
AA
Start 7 MHz
Stop 130 MHz
#Res BW 100 kHz
#VBW 1 MHz
Sweep 12.34 ms (1000 pts)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Mkr1 28.79 MHz
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Atten 20 dB
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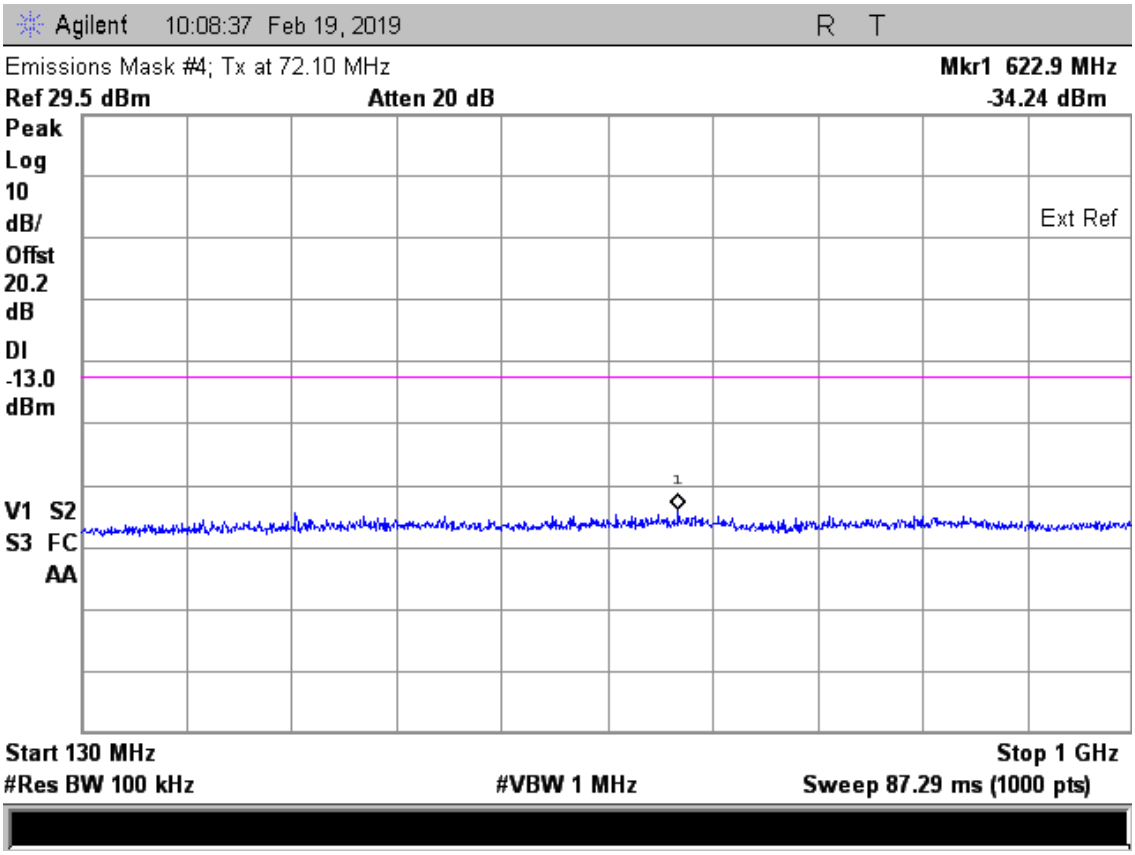
Peak
Log
10
dB/
Offst
19.9
dB
Dl
-13.0
dBm
Ext Ref
V1 S2
S3 FC
AA
Start 7 MHz
Stop 130 MHz
#Res BW 100 kHz
#VBW 1 MHz
Sweep 12.34 ms (1000 pts)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Mkr1 622.9 MHz
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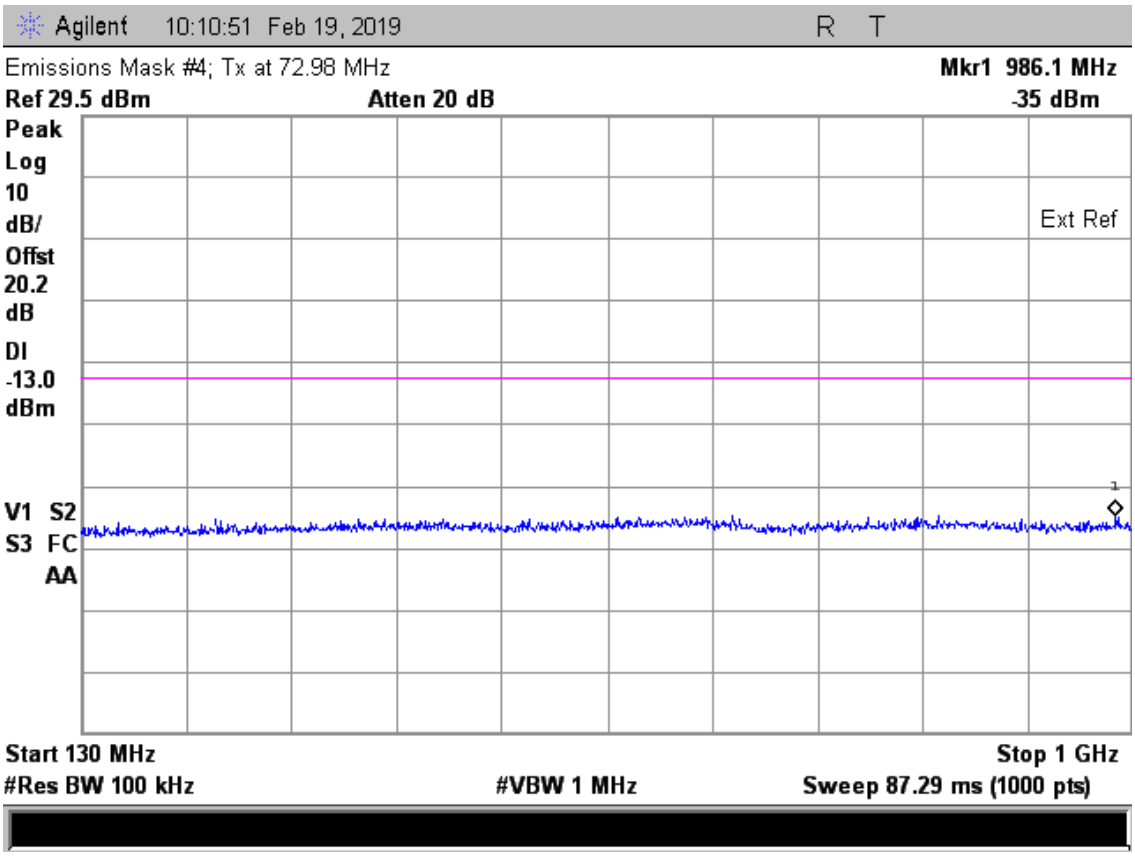
Peak
Log
10
dB/
Offst
20.2
dB
Dl
-13.0
dBm
Ext Ref
V1 S2
S3 FC
AA
Start 130 MHz
Stop 1 GHz
#Res BW 100 kHz
#VBW 1 MHz
Sweep 87.29 ms (1000 pts)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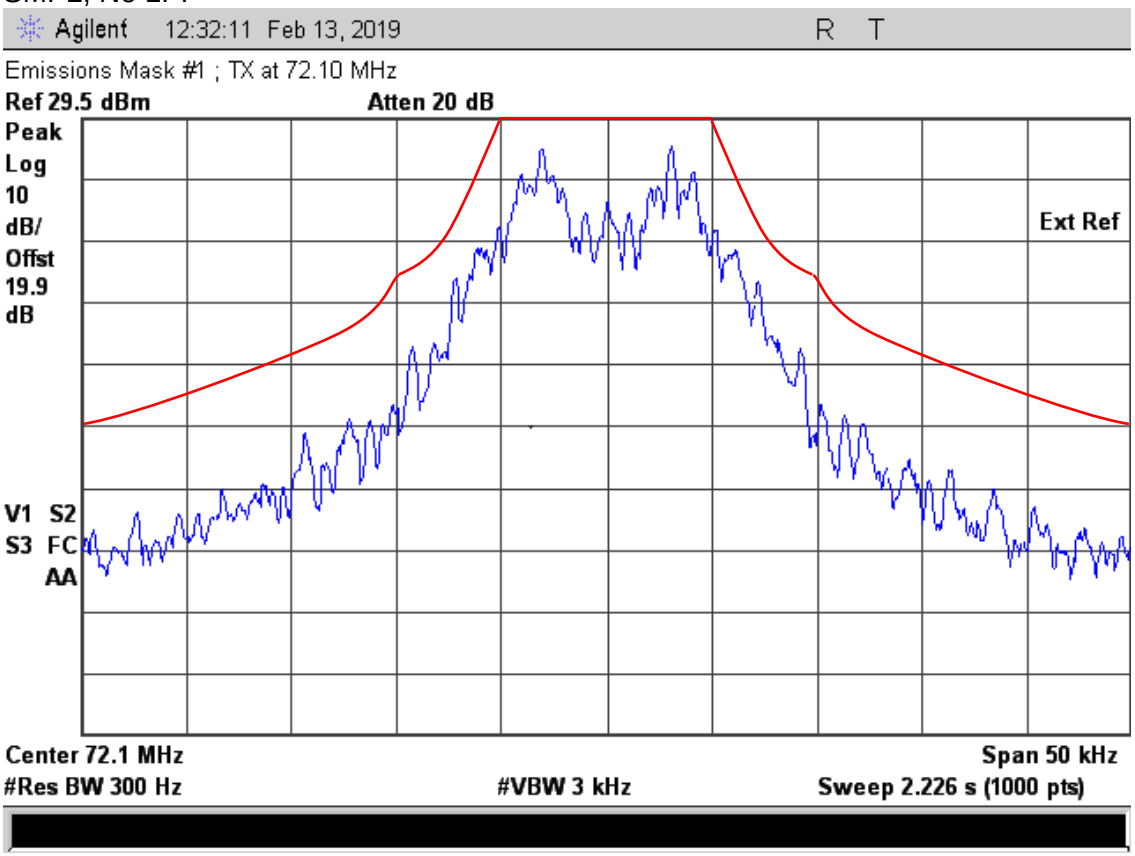
Peak
Log
10
dB/
Offst
20.2
dB
Dl
-13.0
dBm
Ext Ref
V1 S2
S3 FC
AA
Start 130 MHz
Stop 1 GHz
#Res BW 100 kHz
#VBW 1 MHz
Sweep 87.29 ms (1000 pts)

SMP2; No LPF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Atten 20 dB
Peak
Log
10
dB/
Offst
19.9
dB
Ext Ref
V1 S2
S3 FC
AA
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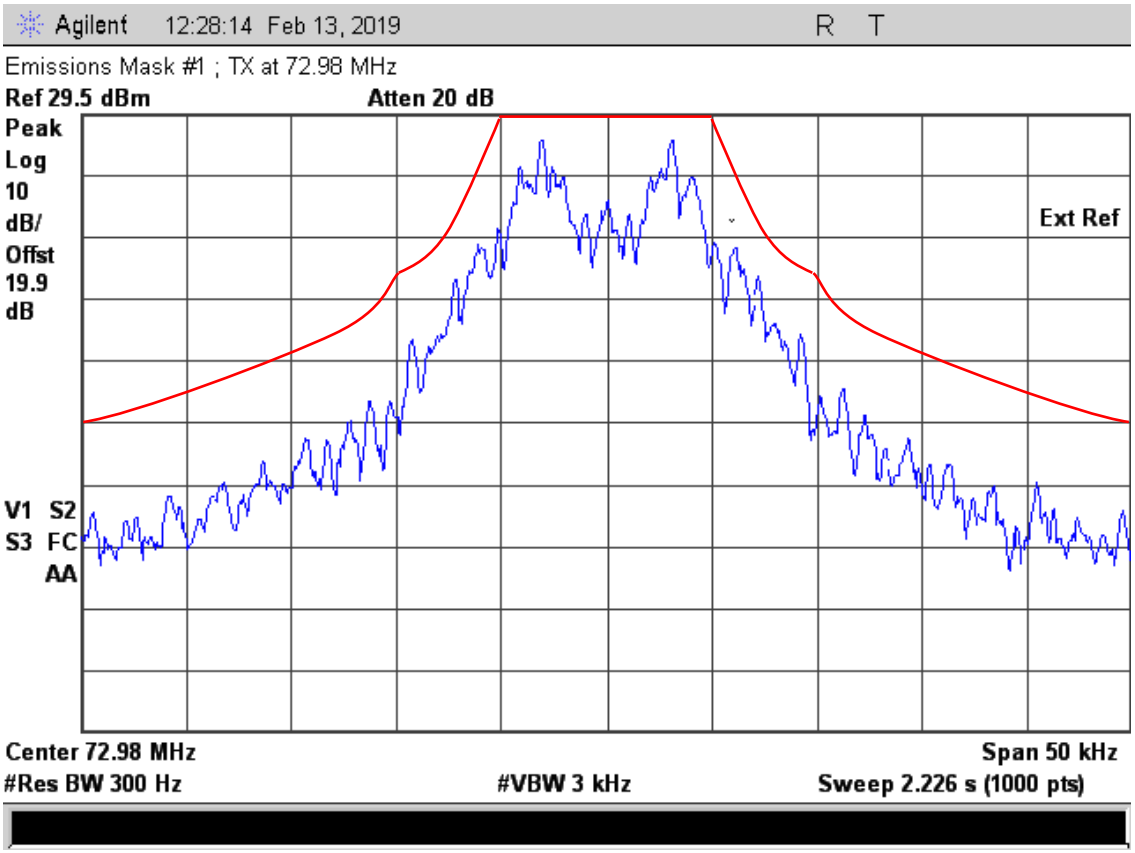
Span 50 kHz
#Res BW 300 Hz
#VBW 3 kHz
Sweep 2.226 s (1000 pts)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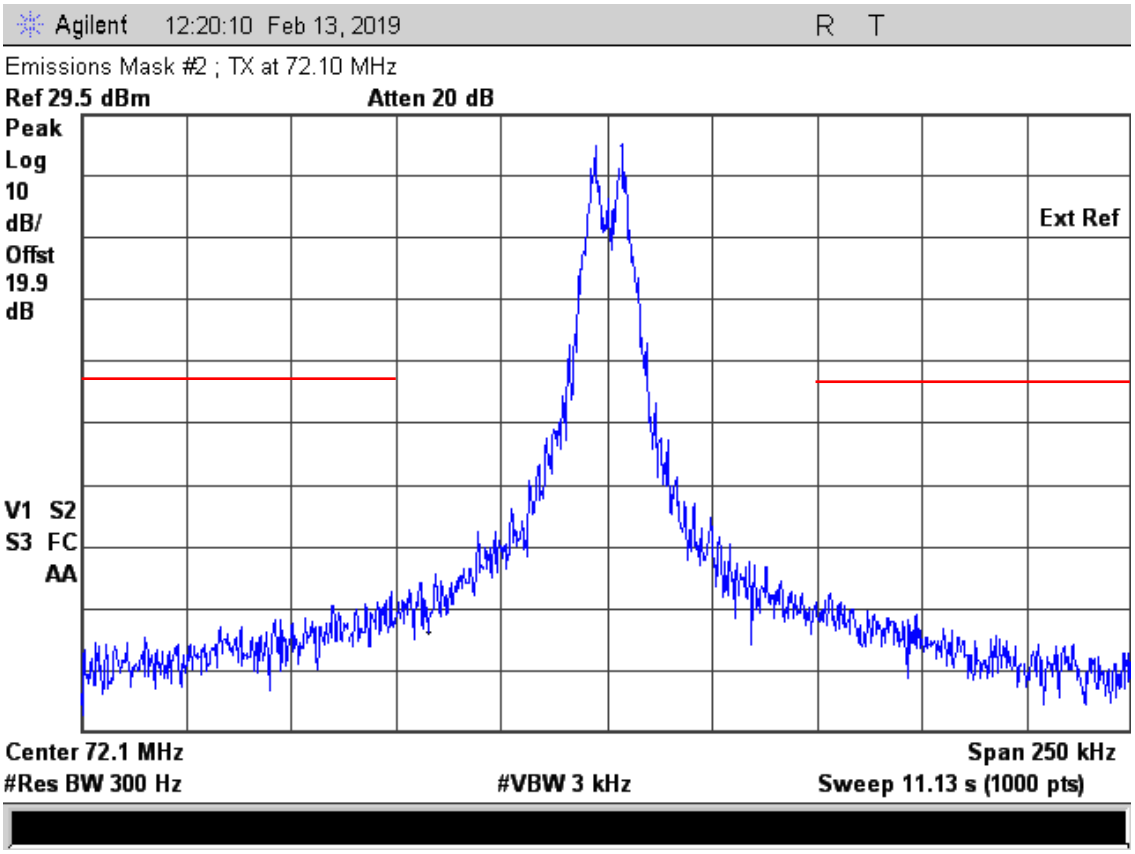
Atten 20 dB
Peak
Log
10
dB/
Offst
19.9
dB
Ext Ref
V1 S2
S3 FC
AA
Center 72.98 MHz
Span 50 kHz
#Res BW 300 Hz
#VBW 3 kHz
Sweep 2.226 s (1000 pts)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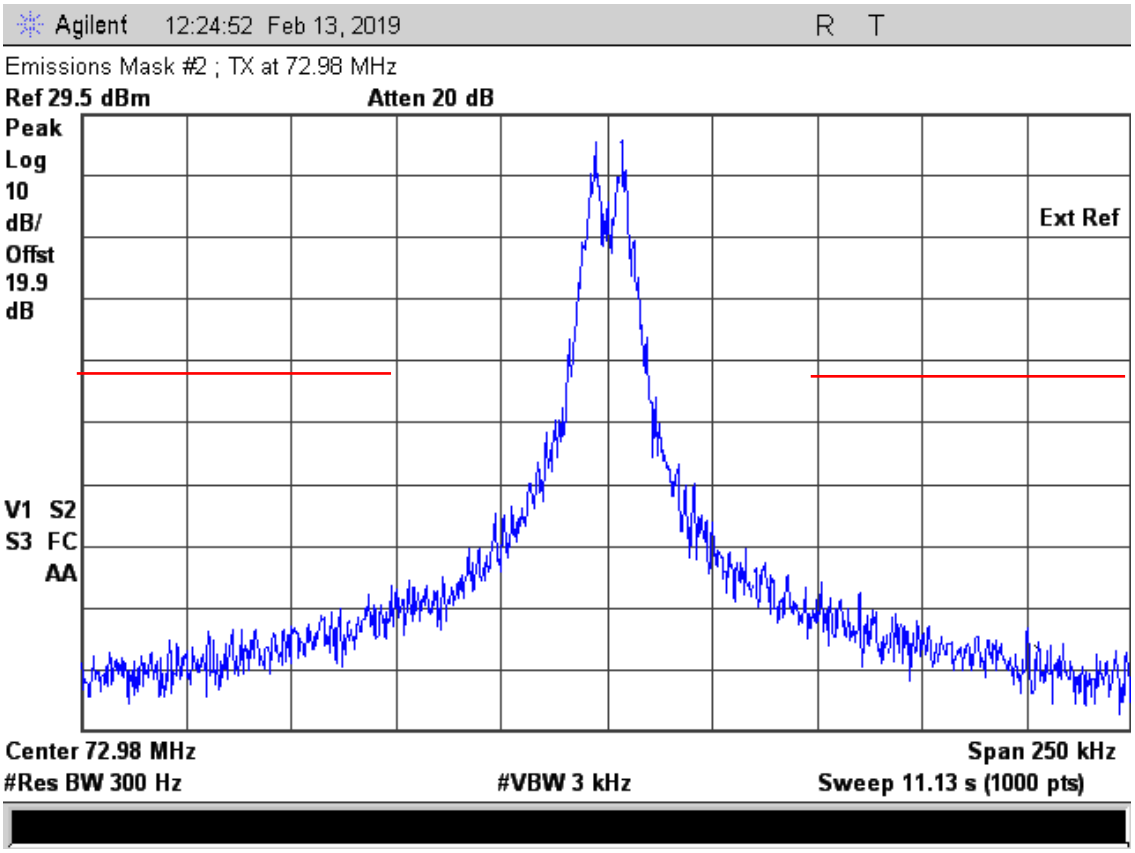
Atten 20 dB
Peak
Log
10
dB/
Offst
19.9
dB
Ext Ref
V1 S2
S3 FC
AA
Center 72.1 MHz
Span 250 kHz
#Res BW 300 Hz
#VBW 3 kHz
Sweep 11.13 s (1000 pts)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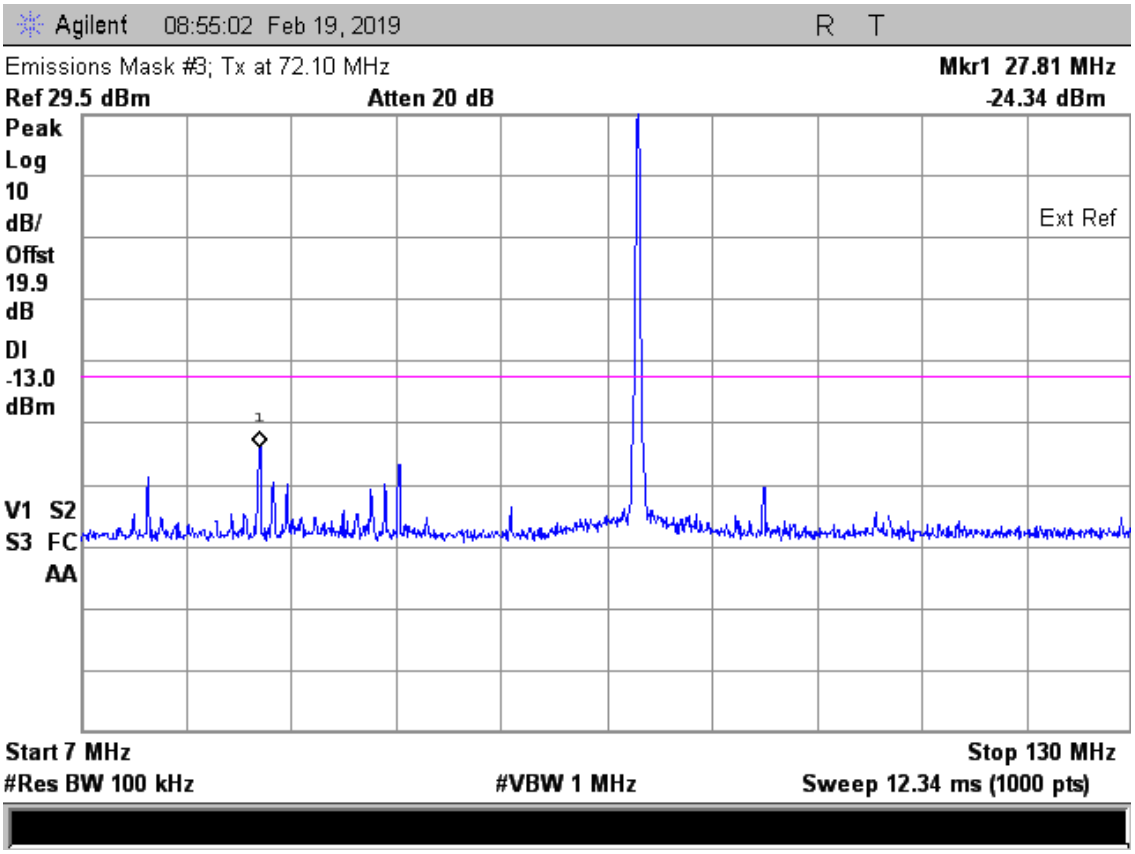
Atten 20 dB
Peak
Log
10
dB/
Offst
19.9
dB
Ext Ref
V1 S2
S3 FC
AA
Center 72.98 MHz
Span 250 kHz
#Res BW 300 Hz
#VBW 3 kHz
Sweep 11.13 s (1000 pts)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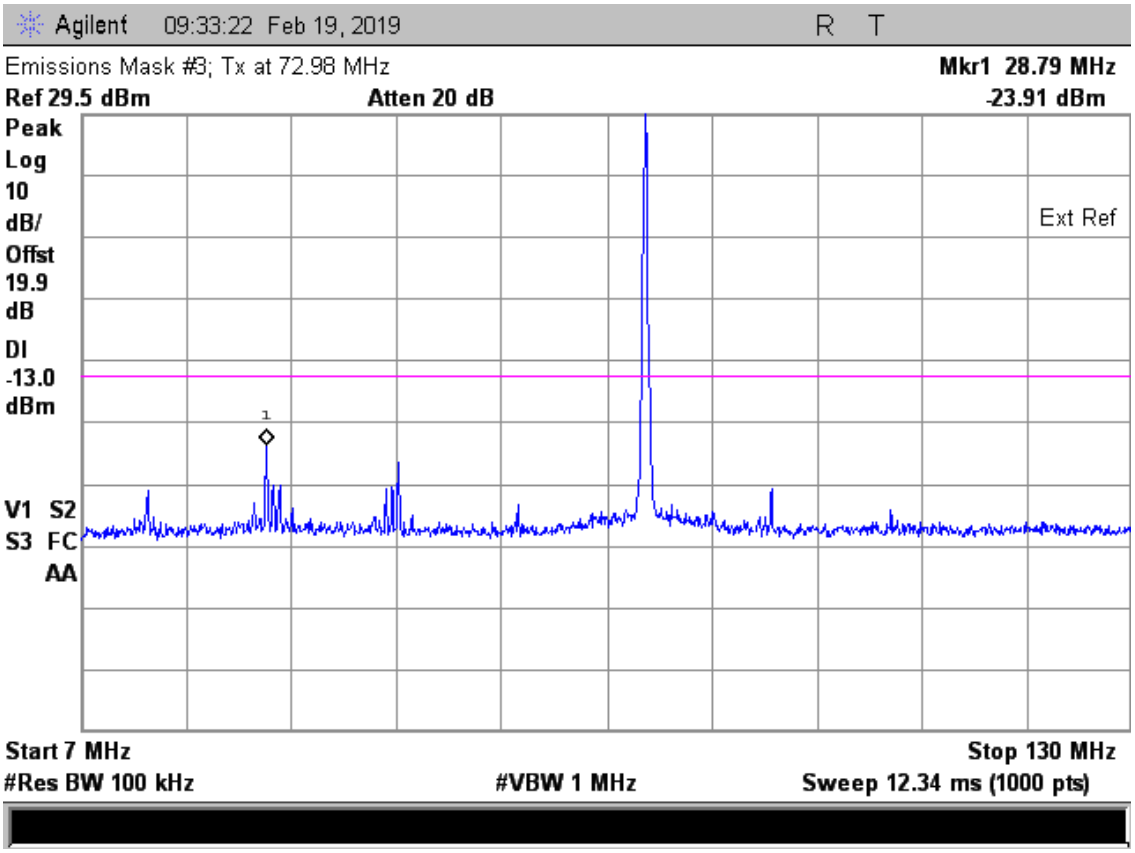
Log
10
dB/
Offst
19.9
dB
Dl
-13.0
dBm
Ext Ref
V1 S2
S3 FC
AA
Start 7 MHz
Stop 130 MHz
#Res BW 100 kHz
#VBW 1 MHz
Sweep 12.34 ms (1000 pts)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Atten 20 dB
-23.91 dBm
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Log
10
dB/
Offst
19.9
dB
Dl
-13.0
dBm
Ext Ref
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S3 FC
AA
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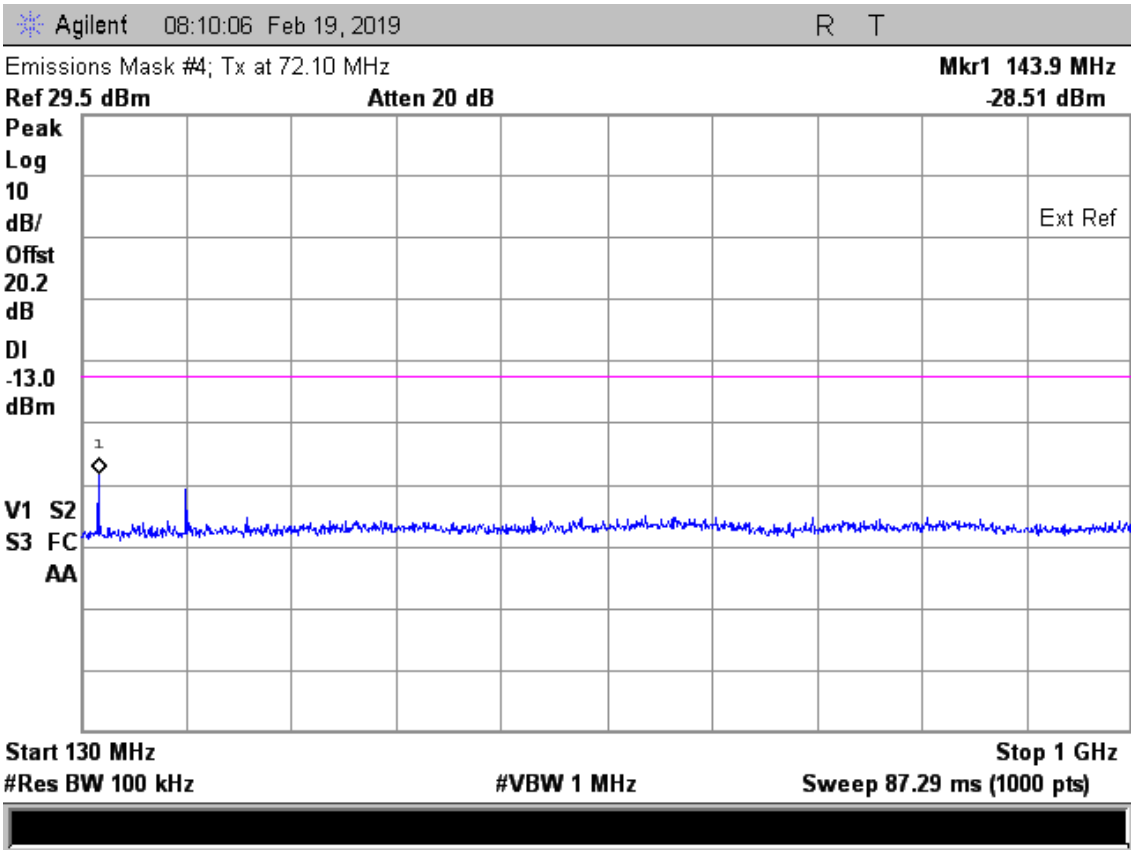
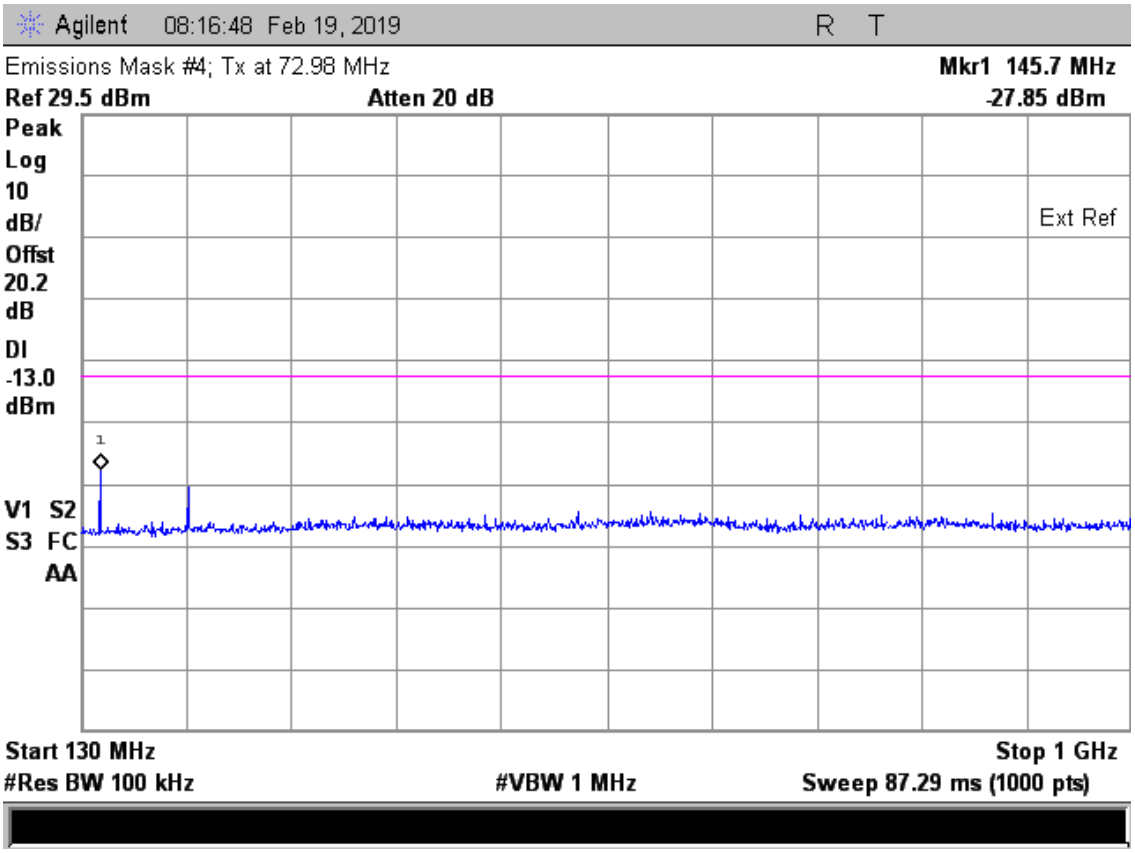
Stop 130 MHz
#Res BW 100 kHz
#VBW 1 MHz
Sweep 12.34 ms (1000 pts)





Judgement: Pass

10.2.1 Conducted Spurious Emissions

Model	TX400	Specification	FCC Part 90.210 RSS-119 Section 5.5
Serial Number	SMP1 & SMP2	Test Date	February 21, 2019
Test Personnel	Richard Tichgelaar	Test Location	Chamber B
Test Equipment	EMI Receiver (REC-21)		

This is a direct measurement from the Antenna port to the EMI Receiver

SMP1; With LPF

Freq. Tx	Harm	Tested Freq.	Rec Reading	HPF-10 Attn. Factor	Ext. Atten. Factor	Cable Loss	Total Power	Power Limit	Margin Under Limit
MHz	#	MHz	dBm	dB	dB	dB	dBm	dBm	dB
72.100	1	72.10	9.50	0.0	19.9	0.10	29.5	54.8	25.3
72.100	2	144.20	-73.20	0.4	19.8	0.04	-53.0	-13.0	40.0
72.100	3	216.30	-72.50	0.3	19.8	0.06	-52.3	-13.0	39.3
72.100	4	288.40	-72.80	0.2	19.8	0.08	-52.7	-13.0	39.7
72.100	5	360.50	-72.90	0.2	19.8	0.09	-52.8	-13.0	39.8
72.100	6	432.60	-73.20	0.2	19.9	0.10	-53.0	-13.0	40.0
72.100	7	504.70	-73.50	0.2	19.9	0.13	-53.3	-13.0	40.3
72.100	8	576.80	-72.30	0.2	19.9	0.13	-52.1	-13.0	39.1
72.100	9	648.90	-72.90	0.2	19.9	0.15	-52.7	-13.0	39.7
72.100	10	721.00	-73.00	0.1	19.9	0.16	-52.8	-13.0	39.8
72.980	1	72.98	9.6	0.0	19.9	0.10	29.6	54.8	25.2
72.980	2	145.96	-73.1	0.4	19.8	0.04	-52.9	-13.0	39.9
72.980	3	218.94	-72.3	0.3	19.8	0.06	-52.1	-13.0	39.1
72.980	4	291.92	-72.4	0.2	19.8	0.08	-52.3	-13.0	39.3
72.980	5	364.90	-72.7	0.2	19.8	0.09	-52.6	-13.0	39.6
72.980	6	437.88	-72.8	0.2	19.9	0.10	-52.6	-13.0	39.6
72.980	7	510.86	-72.9	0.2	19.9	0.13	-52.7	-13.0	39.7
72.980	8	583.84	-73.0	0.2	19.9	0.13	-52.8	-13.0	39.8
72.980	9	656.82	-72.3	0.2	19.9	0.15	-52.1	-13.0	39.1
72.980	10	729.80	-73.0	0.1	19.9	0.16	-52.8	-13.0	39.8

SMP2; No LPF

Freq. Tx	Harm	Tested Freq.	Rec Reading	HPF-10 Attn. Factor	Ext. Atten. Factor	Cable Loss	Total Power	Power Limit	Margin Under Limit
MHz	#	MHz	dBm	dB	dB	dB	dBm	dBm	dB
72.100	1	72.10	9.90	0.0	19.9	0.10	29.9	54.8	24.9
72.100	2	144.20	-50.00	0.4	19.8	0.04	-29.8	-13.0	16.8
72.100	3	216.30	-53.90	0.3	19.8	0.06	-33.7	-13.0	20.7
72.100	4	288.40	-73.00	0.2	19.8	0.08	-52.9	-13.0	39.9
72.100	5	360.50	-70.70	0.2	19.8	0.09	-50.6	-13.0	37.6
72.100	6	432.60	-73.20	0.2	19.9	0.10	-53.0	-13.0	40.0
72.100	7	504.70	-71.70	0.2	19.9	0.13	-51.5	-13.0	38.5
72.100	8	576.80	-73.30	0.2	19.9	0.13	-53.1	-13.0	40.1
72.100	9	648.90	-71.20	0.2	19.9	0.15	-51.0	-13.0	38.0
72.100	10	721.00	-74.00	0.1	19.9	0.16	-53.8	-13.0	40.8
72.980	1	72.98	9.9	0.0	19.9	0.10	29.9	54.8	24.9
72.980	2	145.96	-49.0	0.4	19.8	0.04	-28.8	-13.0	15.8
72.980	3	218.94	-53.5	0.3	19.8	0.06	-33.3	-13.0	20.3

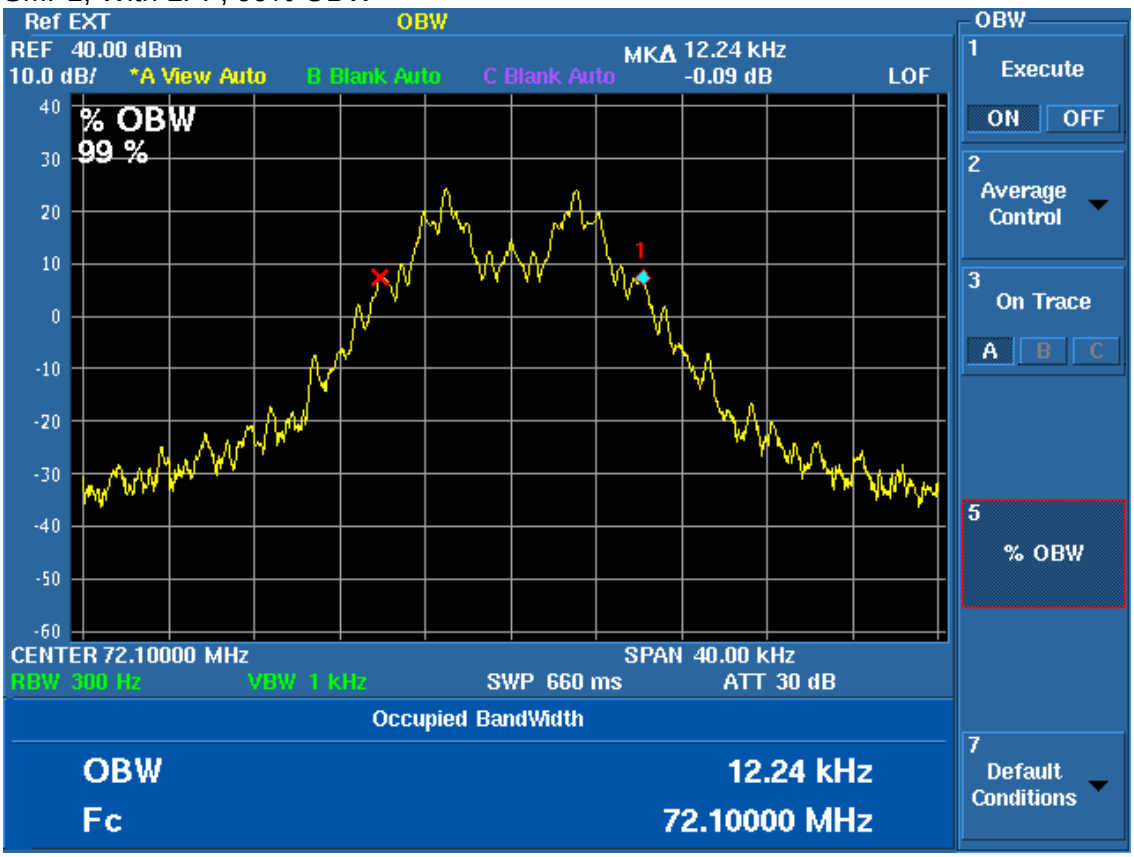
Freq. Tx	Harm	Tested Freq.	Rec Reading	HPF-10 Attn. Factor	Ext. Atten. Factor	Cable Loss	Total Power	Power Limit	Margin Under Limit
MHz	#	MHz	dBm	dB	dB	dB	dBm	dBm	dB
72.980	4	291.92	-73.0	0.2	19.8	0.08	-52.9	-13.0	39.9
72.980	5	364.90	-70.3	0.2	19.8	0.09	-50.2	-13.0	37.2
72.980	6	437.88	-74.0	0.2	19.9	0.10	-53.8	-13.0	40.8
72.980	7	510.86	-70.9	0.2	19.9	0.13	-50.7	-13.0	37.7
72.980	8	583.84	-73.0	0.2	19.9	0.13	-52.8	-13.0	39.8
72.980	9	656.82	-72.2	0.2	19.9	0.15	-52.0	-13.0	39.0
72.980	10	729.80	-74.0	0.1	19.9	0.16	-53.8	-13.0	40.8

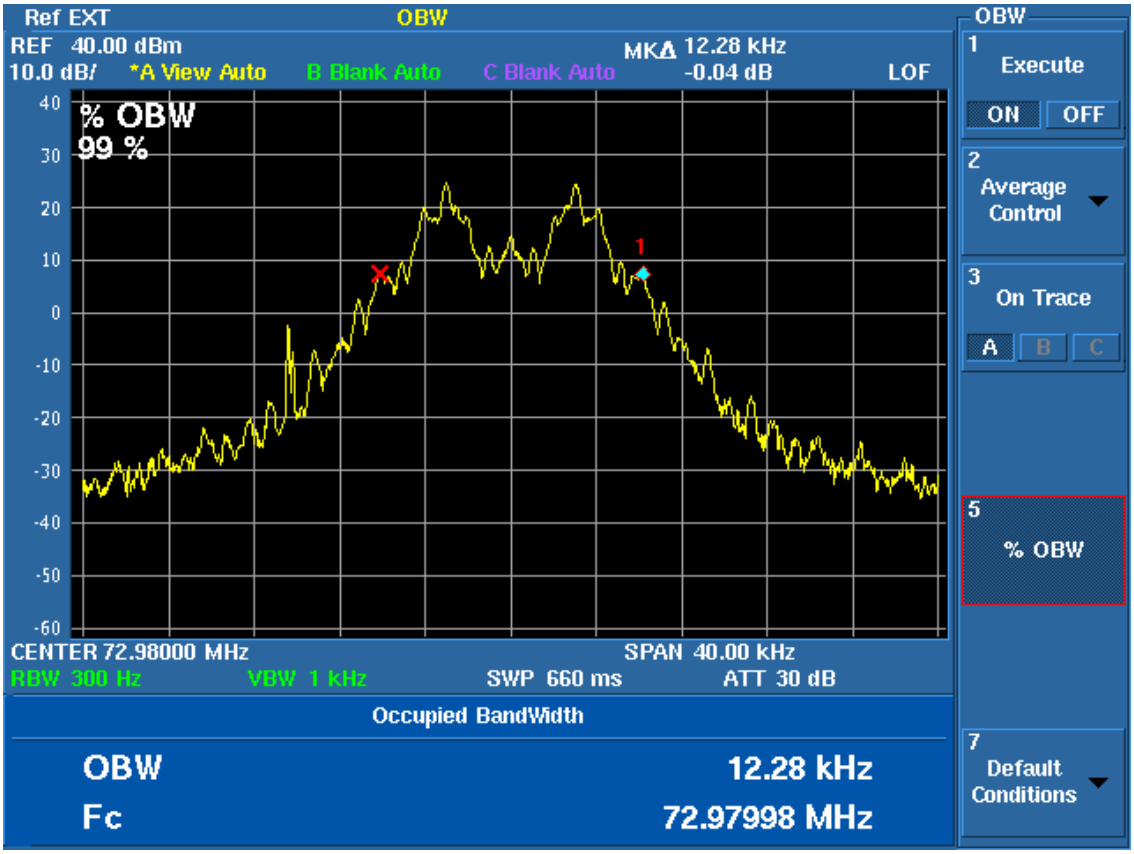
The fundamental emission ERP limit is 300 watts (54.77 dBm)
Judgment: Passed by 15.8 dB.

10.3 Occupied Bandwidth

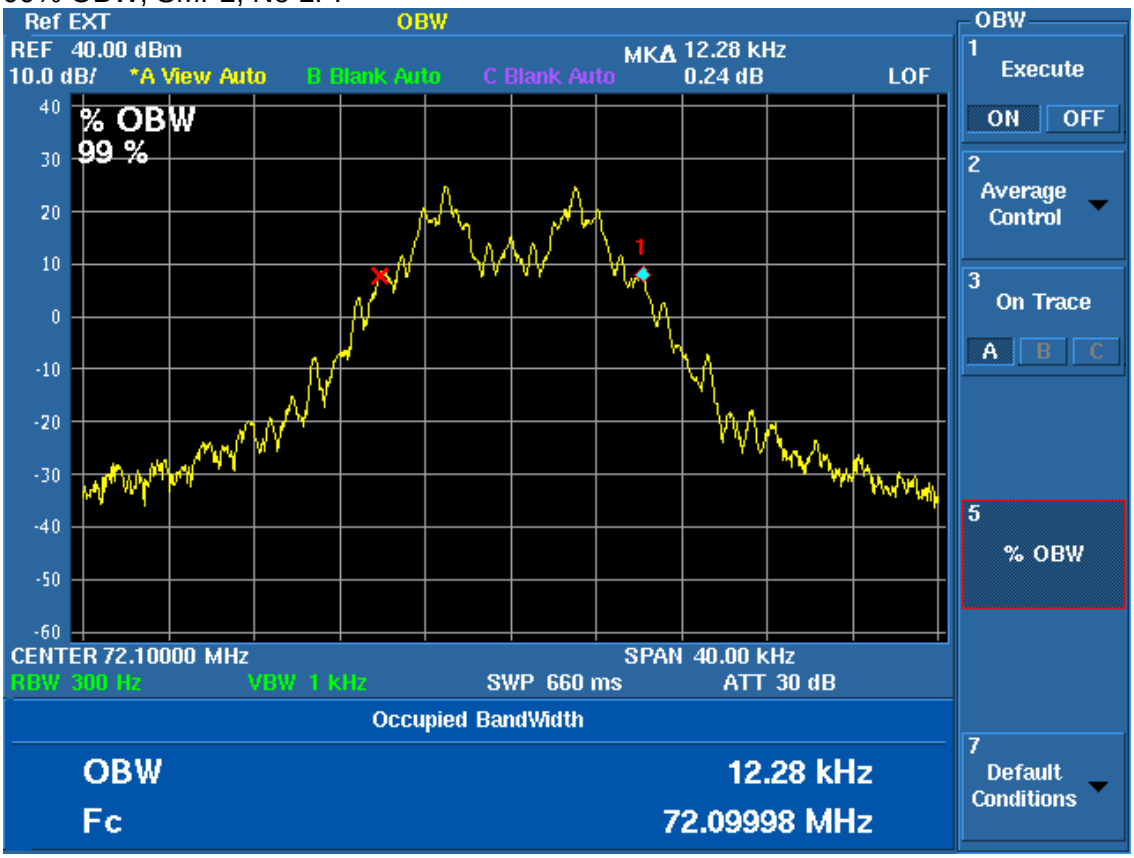
Channel MHz	SMP1 99% OBW (kHz)	SMP2 99% OBW (kHz)
72.10	12.24	12.28
72.98	12.28	12.28

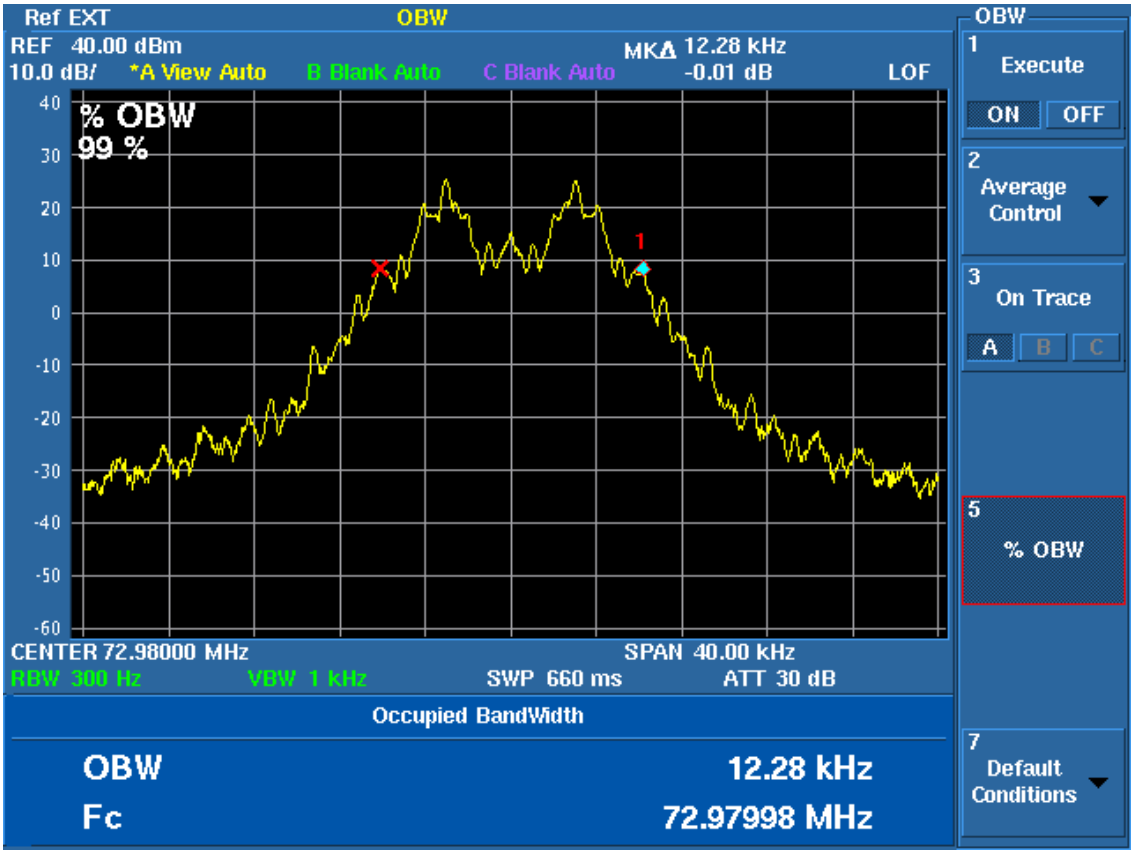
SMP1; With LPF; 99% OBW





99% OBW; SMP2; No LPF





10.4 Field Strength of Unwanted Spurious Radiation

10.4.1 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. From 30 to 4700 MHz, a spectrum analyzer with a preselector was used for measurement. Radiated emissions measurements were performed at the anechoic chamber at a test distance of 3 meters. The entire frequency range from 30 to 4700 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:

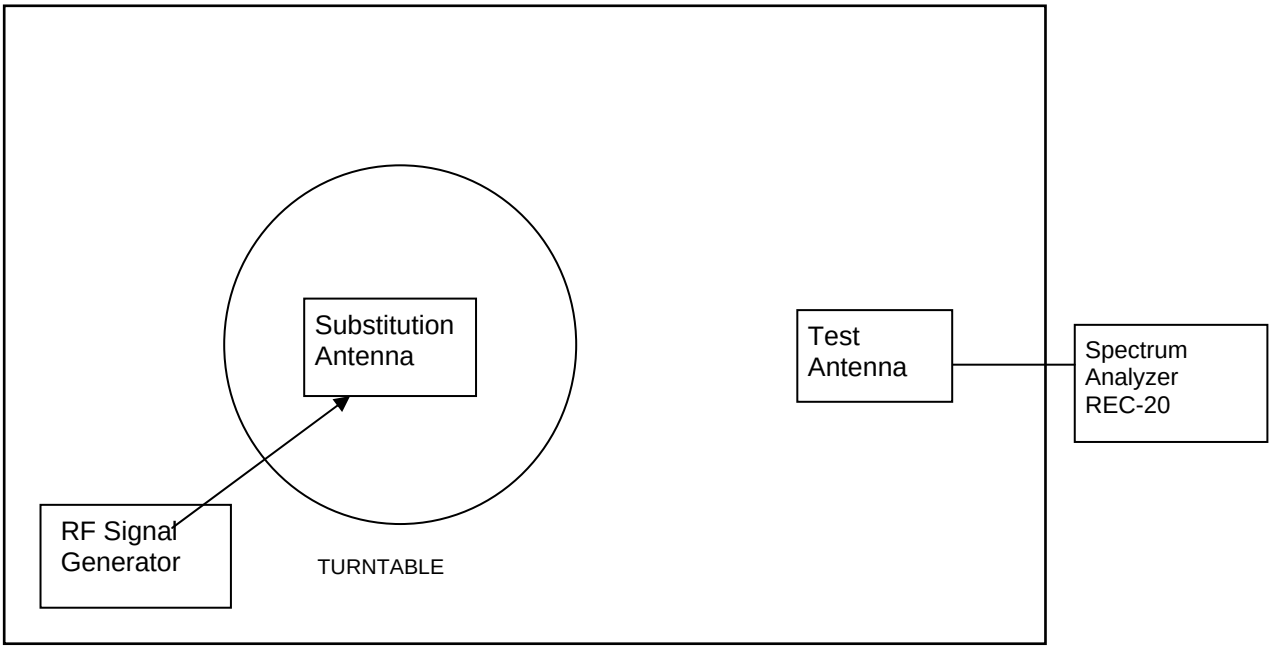
1) Resolution Bandwidth = 100 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1GHz.
2) Video Bandwidth = 300 kHz for spurious emissions below 1 GHz, and 3 MHz for spurious emissions above 1 GHz.
3) Sweep Speed slow enough to maintain measurement calibration.
4) Detector 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. 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 to Coupler	Signal Generator
30 - 200	ANT-80	ANT-79	REC-20	SIG-30
200 - 1000	ANT-68	ANT-06	REC-20	SIG-30

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

Any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

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.

10.4.2 Spurious Radiated Emissions Test Results

Model	TX400	Specification	FCC Part 90.210 RSS-119 Section 5.8
Serial Number	SMP2		
Test Distance	3 Meters	Test Date	02/22/2019
Test Personnel	Chris Dalessio	Notes	Transmit Mode with Load

Channel 1

Freq MHz	Detector	Ant. Pol.	EUT dBm	Limit dBm	Margin dB
58.4	Peak	Horz	-56.3	-13.0	43.3
144.2	Peak	Horz	-38.2	-13.0	25.2
150.0	Peak	Horz	-47.3	-13.0	34.3
216.3	Peak	Horz	-40.9	-13.0	27.9
249.8	Peak	Horz	-38.5	-13.0	25.5
288.4	Peak	Horz	-47.4	-13.0	34.4
350.2	Peak	Horz	-39.8	-13.0	26.8
360.5	Peak	Horz	-44.5	-13.0	31.5
449.9	Peak	Horz	-47.3	-13.0	34.3
474.8	Peak	Horz	-50.5	-13.0	37.5
499.7	Peak	Horz	-49.2	-13.0	36.2
576.3	Peak	Horz	-53.7	-13.0	40.7
651.3	Peak	Horz	-52.3	-13.0	39.3
751.3	Peak	Horz	-48.4	-13.0	35.4
951.3	Peak	Horz	-50.9	-13.0	37.9
976.3	Peak	Horz	-45.7	-13.0	32.7
31.7	Peak	Vert	-42.2	-13.0	29.2
35.2	Peak	Vert	-46.2	-13.0	33.2
42.9	Peak	Vert	-49.1	-13.0	36.1

50.6	Peak	Vert	-48.4	-13.0	35.4
72.1	Peak	Vert	-44.9	-13.0	31.9
144.2	Peak	Vert	-41.6	-13.0	28.6
150.0	Peak	Vert	-50.6	-13.0	37.6
170.2	Peak	Vert	-48.4	-13.0	35.4
216.3	Peak	Vert	-44.6	-13.0	31.6
249.8	Peak	Vert	-43.0	-13.0	30.0
288.4	Peak	Vert	-46.5	-13.0	33.5
350.2	Peak	Vert	-43.2	-13.0	30.2
360.5	Peak	Vert	-43.6	-13.0	30.6
420.5	Peak	Vert	-50.7	-13.0	37.7
449.9	Peak	Vert	-42.3	-13.0	29.3
474.8	Peak	Vert	-45.5	-13.0	32.5
551.3	Peak	Vert	-49.1	-13.0	36.1
576.3	Peak	Vert	-53.9	-13.0	40.9
976.3	Peak	Vert	-46.2	-13.0	33.2

Channel 74

Freq MHz	Detector	Ant. Pol.	EUT dBm	Limit dBm	Margin dB
146.0	Peak	Horz	-42.8	-13.0	29.8
150.0	Peak	Horz	-47.7	-13.0	34.7
218.9	Peak	Horz	-52.6	-13.0	39.6
249.8	Peak	Horz	-44.0	-13.0	31.0
274.7	Peak	Horz	-48.4	-13.0	35.4
291.9	Peak	Horz	-47.8	-13.0	34.8
325.3	Peak	Horz	-52.6	-13.0	39.6
350.2	Peak	Horz	-40.2	-13.0	27.2
364.9	Peak	Horz	-47.4	-13.0	34.4
449.9	Peak	Horz	-48.7	-13.0	35.7
576.3	Peak	Horz	-52.3	-13.0	39.3
751.3	Peak	Horz	-49.8	-13.0	36.8
951.3	Peak	Horz	-51.2	-13.0	38.2
976.3	Peak	Horz	-44.4	-13.0	31.4
36.0	Peak	Vert	-48.6	-13.0	35.6
42.9	Peak	Vert	-50.3	-13.0	37.3
146.0	Peak	Vert	-39.6	-13.0	26.6
150.0	Peak	Vert	-51.1	-13.0	38.1
218.9	Peak	Vert	-50.2	-13.0	37.2
249.8	Peak	Vert	-44.1	-13.0	31.1
291.9	Peak	Vert	-49.9	-13.0	36.9
303.4	Peak	Vert	-46.5	-13.0	33.5
350.2	Peak	Vert	-44.2	-13.0	31.2
364.9	Peak	Vert	-50.0	-13.0	37.0
449.9	Peak	Vert	-42.4	-13.0	29.4
474.8	Peak	Vert	-48.0	-13.0	35.0
499.7	Peak	Vert	-51.5	-13.0	38.5
551.3	Peak	Vert	-50.6	-13.0	37.6
576.3	Peak	Vert	-52.3	-13.0	39.3
751.3	Peak	Vert	-51.2	-13.0	38.2
975.0	Peak	Vert	-47.7	-13.0	34.7

Judgment: Passed by at least 20 dB.

No other radiated emissions were detected within 20 dB of the limits from 30 MHz to 1 GHz.

10.5 Frequency Stability

10.5.1 Frequency Stability Vs Temperature

The chamber was then set to the lowest temperature. The transmitter was in the chamber and allowed to stabilize for 15 minutes. The transmitter was then keyed, and the frequency was recorded. The chamber was then incremented in 10°C steps with a minimum of 15-minute stabilization period for each temperature measurement. The transmitter was off during the temperature transitions.

10.5.2 Frequency Stability Vs Supply Voltage

The EUT was allowed to stabilize with the nominal primary power supply voltage applied. The primary input voltage was varied from the lowest to the highest rated levels specified by the manufacturer. Frequency readings were taken at increments of 5% of nominal.

10.5.3 Test Results for Frequency Stability

Model	TX400	Specification	FCC Part 90.213 RSS-119 Section 5.3
Serial Number	SMP2; No LPF	Test Date	February 15, 2019
Test Personnel	Richard Tichgelaar	Test Location	Chamber F
Test Equipment	Freq. Counter (CNT-01); Temperature Chamber (TC-01); Multimeter (DMM-11)		
Notes	15 minutes at each Temperature; 1 min at each voltage		
Nominal Frequency	72.500 MHz		

Volts	Freq.	Deviation	
VAC	(MHz)	Hz	PPM
100.0	72.500083	83	1.14
102.0	72.500091	91	1.26
108.0	72.500095	95	1.31
114.0	72.500093	93	1.28
120.0	72.500094	94	1.30
126.0	72.500087	87	1.20
132.0	72.500084	84	1.16
138.0	72.500086	85	1.18

Temp	Initial Freq	after 15 min	Freq.	
Deg C	(MHz)	(MHz)	Dev Hz	PPM
50	72.5001047	72.5001014	101	1.40
40	72.5001018	72.5001007	101	1.39
30	72.5000984	72.5000928	93	1.28
20	72.5000908	72.5000898	90	1.24
10	72.5000859	72.5000803	80	1.11
0	72.5000773	72.5000761	76	1.05
-10	72.5000592	72.5000579	58	0.80
-20	72.5000408	72.5000426	43	0.59
-30	72.5000548	72.5000553	55	0.76

Test Requirements: Limit is 5 ppm
Judgement: Pass

10.6 Radiated Emissions (Receive Mode)

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. The radiated emission measurements were performed with a spectrum analyzer. The bandwidth used from 150 kHz to 30 MHz is 9 or 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. Above 1 GHz, a 1 MHz bandwidth is used. A 10-dB linearity check is performed prior to start of testing in order to determine if an overload condition exists.

From 30 to 2000 MHz, an Anritsu spectrum analyzer was used. Final radiated emissions measurements were performed inside of an anechoic chamber at a test distance of 3 meters. The anechoic chamber is designated as Chamber E. This Chamber meets the Site Attenuation requirements of ANSI C63.4 and CISPR 16-1. Chamber E is located at 12 East Devonwood Ave. Romeoville, Illinois EMI test lab.

The entire frequency range from 30 to 2000 MHz was slowly scanned with attention paid to those frequency ranges which appeared high. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst-case emissions were recorded. All measurements may be performed using either the peak, average or quasi-peak detector functions. If the peak detector data exceeds or is marginally close to the limits, the measurements are repeated using a quasi-peak detector or average function as required by the specification for final determination of compliance.

The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground.

10.6.1 Radiated Emissions Field Strength Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + CF - AG

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain

10.6.2 Spurious Radiated Emissions Test Results (Receive Mode)

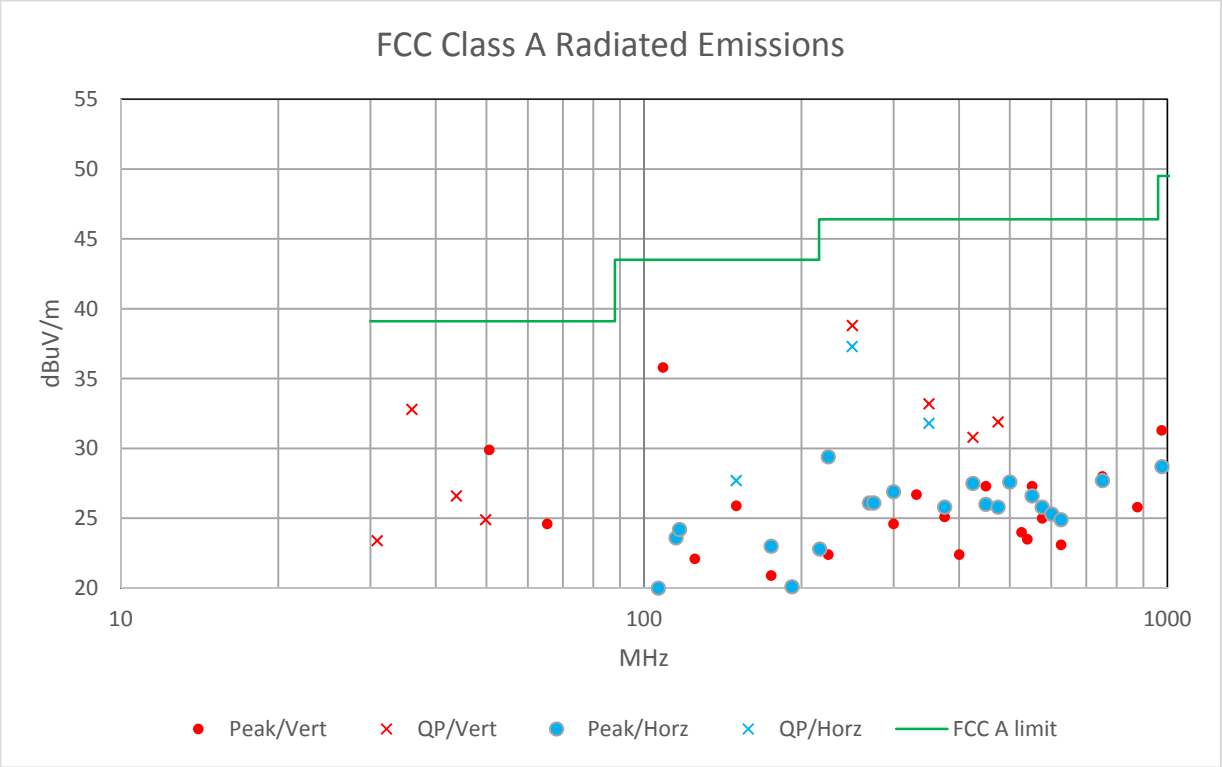
Model	TX400	Specification	FCC Part 15 Subpart B & RSS-Gen Class A
Serial Number	SMP2	Test Date	February 22 & 25, 2019
Tested by	Chris Dalessio	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; P = peak; Q = QP		
Notes	Corr. Factors = Cable Loss – Preamp Gain		
Configuration	Receive Mode; ferrite 0461164281 On GPS Antenna Coax cable		

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor	Cable & Amp Factors	Dist. Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
36.0	18.0	P	H	12.0	0.4	-10.5	19.9	39.1	19.2	
48.9	14.9	P	H	9.7	0.5	-10.5	14.6	39.1	24.5	
65.7	19.7	P	H	9.2	0.6	-10.5	19.0	39.1	20.1	
90.6	15.8	P	H	9.8	0.7	-10.5	15.8	43.5	27.7	
106.5	19.0	P	H	10.7	0.8	-10.5	20.0	43.5	23.5	

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor	Cable & Amp Factors	Dist. Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
115.1	22.0	P	H	11.3	0.8	-10.5	23.6	43.5	19.9	
116.9	22.5	P	H	11.4	0.8	-10.5	24.2	43.5	19.3	
125.0	13.3	P	H	11.9	0.8	-10.5	15.5	43.5	28.0	
150.0	24.5	Q	H	12.8	0.9	-10.5	27.7	43.5	15.8	
174.9	19.3	P	H	13.2	1.0	-10.5	23.0	43.5	20.5	
191.7	15.6	P	H	13.9	1.1	-10.5	20.1	43.5	23.4	
216.6	21.4	P	H	10.8	1.1	-10.5	22.8	46.4	23.6	
224.9	28.2	P	H	10.6	1.1	-10.5	29.4	46.4	17.0	
249.8	34.7	Q	H	11.9	1.2	-10.5	37.3	46.4	9.1	
269.5	22.9	P	H	12.4	1.3	-10.5	26.1	46.4	20.3	
274.7	22.4	P	H	12.9	1.3	-10.5	26.1	46.4	20.3	
299.7	22.0	P	H	14.0	1.4	-10.5	26.9	46.4	19.5	
350.2	26.2	Q	H	14.6	1.5	-10.5	31.8	46.4	14.6	
375.2	20.1	P	H	14.7	1.5	-10.5	25.8	46.4	20.6	
400.1	13.3	P	H	15.2	1.6	-10.5	19.6	46.4	26.8	
425.0	20.1	P	H	16.3	1.6	-10.5	27.5	46.4	18.9	
449.9	18.8	P	H	16.0	1.7	-10.5	26.0	46.4	20.4	
474.8	17.9	P	H	16.7	1.7	-10.5	25.8	46.4	20.6	
499.7	18.8	P	H	17.5	1.8	-10.5	27.6	46.4	18.8	
551.3	17.2	P	H	18.0	1.9	-10.5	26.6	46.4	19.8	
576.3	16.1	P	H	18.3	1.9	-10.5	25.8	46.4	20.6	
601.3	15.2	P	H	18.6	2.0	-10.5	25.3	46.4	21.1	
626.3	13.8	P	H	19.6	2.0	-10.5	24.9	46.4	21.5	
751.3	14.4	P	H	21.6	2.2	-10.5	27.7	46.4	18.7	
976.3	14.1	P	H	22.5	2.6	-10.5	28.7	49.5	20.8	
30.9	20.3	Q	V	13.2	0.4	-10.5	23.4	39.1	15.7	
35.2	17.1	Q	V	12.1	0.4	-10.5	19.1	39.1	20.0	
36.0	30.9	Q	V	12.0	0.4	-10.5	32.8	39.1	6.3	
43.8	26.2	Q	V	10.4	0.5	-10.5	26.6	39.1	12.5	
49.8	25.4	Q	V	9.5	0.5	-10.5	24.9	39.1	14.2	
50.6	30.5	P	V	9.4	0.5	-10.5	29.9	39.1	9.2	
65.3	25.2	P	V	9.3	0.6	-10.5	24.6	39.1	14.5	
108.7	34.7	P	V	10.8	0.8	-10.5	35.8	43.5	7.7	
125.0	19.9	P	V	11.9	0.8	-10.5	22.1	43.5	21.4	
150.0	22.7	P	V	12.8	0.9	-10.5	25.9	43.5	17.6	
174.9	17.2	P	V	13.2	1.0	-10.5	20.9	43.5	22.6	
192.1	15.4	P	V	13.9	1.1	-10.5	19.9	43.5	23.6	
224.9	21.2	P	V	10.6	1.1	-10.5	22.4	46.4	24.0	
250.0	36.2	Q	V	11.9	1.2	-10.5	38.8	46.4	7.6	
299.7	19.7	P	V	14.0	1.4	-10.5	24.6	46.4	21.8	
331.4	21.9	P	V	13.9	1.4	-10.5	26.7	46.4	19.7	
350.2	27.6	Q	V	14.6	1.5	-10.5	33.2	46.4	13.2	
375.2	19.4	P	V	14.7	1.5	-10.5	25.1	46.4	21.3	
400.1	16.1	P	V	15.2	1.6	-10.5	22.4	46.4	24.0	
425.0	23.4	Q	V	16.3	1.6	-10.5	30.8	46.4	15.6	
449.9	20.1	P	V	16.0	1.7	-10.5	27.3	46.4	19.1	
474.8	24.0	Q	V	16.7	1.7	-10.5	31.9	46.4	14.5	
526.3	14.8	P	V	17.8	1.9	-10.5	24.0	46.4	22.4	
540.0	14.8	P	V	17.3	1.9	-10.5	23.5	46.4	22.9	
551.3	17.9	P	V	18.0	1.9	-10.5	27.3	46.4	19.1	
576.3	15.3	P	V	18.3	1.9	-10.5	25.0	46.4	21.4	
626.3	12.0	P	V	19.6	2.0	-10.5	23.1	46.4	23.3	
751.3	14.7	P	V	21.6	2.2	-10.5	28.0	46.4	18.4	

Freq. MHz	Meter Reading dBuV	Dect.	Ant. Pol.	Ant Factor	Cable & Amp Factors	Dist. Fact dB	EUT dBuV/m	Limit dBuV/m	Margin Under Limit dB	Note
876.3	11.7	P	V	22.2	2.4	-10.5	25.8	46.4	20.6	
975.0	16.7	P	V	22.5	2.6	-10.5	31.3	49.5	18.2	

Judgment: Passed by 7.7 dB.



Radiated emissions in a graphical format. The above chart is the same data as the previous table. The peak limit is not shown, since the peak readings meet the lower average limit.

11.0 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
99% Occupied Bandwidth using REC-43	1% of frequency span
Conducted power PWM-01 at 72 MHz	0.14 dB
Amplitude measurement 1-1000 MHz	1.5 dB
Temperature THM-02	0.6 Deg. C

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.