REPORT

For

Dali Wireless, Inc.

535 Middlefield Road, Suite 280
Menlo Park, CA 94025

Date:	14 February 2018
Report No.:	16898-2E
Revision No.:	1
Project No.:	16898
Equipment:	Single-band Medium Power Remote Unit
Model No.:	hd33-1-PS-D-20-2N-D0
FCC ID:	HCOHD331PSD20A

ONE STOP GLOBAL CERTIFICATION SOLUTIONS

Unit 3128 – 20800 Westminster HWY, Richmond, BC
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TEST REPORT_FCC Part 2, 90		
Private Land Mobile Services		
Report Reference No.....:	16898-2E	
Report Revision History. .....:	✓ Rev. 0: 09 February 2018 ✓ Rev. 1: 14 February 2018	
Compiled by (+ signature).....	Sophie Piao,	
	David Johanson	
Approved by (+ signature).....	Jeremy Lee	
Date of issue .....:	14 February 2018	
Total number of pages	67	
FCC Site Registration No.:	CA5970	
IC Site Registration No.:	5970A-2	
Testing Laboratory.....:	LabTest Certification Inc.	
Address .....:	3128-20800 Westminster HWY, Richmond, B.C. V6V 2W3, Canada	
Applicant's name.....:	Dali Wireless, Inc.	
Address .....:	535 Middlefield Road, Suite 280, Menlo Park, CA 94025	
Manufacture's Name .....:	Dali Wireless (Canada) Inc.	
Address .....:	8618 Commerce Court, Burnaby, B.C. V5A 4N6, Canada	
Test specification:		
Standards.....:	➢ FCC Part 2; 2018 ➢ FCC Part 90; 2018 ➢ RSS-131 ➢ RSS-GEN	
Test procedure .....:	➢ ANSI/TIA-603- E-2016 ➢ FCC KDB 935210 D05 Indus Booster Basic Meas v01r02: October 27, 2017 ➢ RSS-131 ➢ RSS-GEN	
Non-standard test method……..:	N/A	

Test Report Form(s) Originator ..... :	Jeremy Lee
Master TRF ..... :	1036_Rev2 – RF Report Template
Test item description :	
Trade Mark ..... :	hd33™
Model/Type reference ..... :	hd33-1-PS-D-20-2N-D0
Serial Number ..... :	10911104RA1B79002
FCC ID ..... :	HCOHD331PSD20A
IC ID ..... :	n/p
Possible test case verdicts:	
- test case does not apply to the test object ..... :	N/A
- test object does meet the requirement ..... :	P (Pass)
- test object does not meet the requirement ..... :	F (Fail)
Testing:	
Date of receipt of test item ..... :	19 October, 2017
Date (s) of performance of tests..... :	October 20, 2017 & January 18 - 29, 2018

Revision History

Revision	Date	Reason For Change	Author(s)
0	09 Feb., 2018	Initial Data	Sophie Piao, David Johanson
1	Feb. 14, 2018	Correction some info. Requested by TCB	Jeremy Lee

Device Under Test Description

Application for	PS 150 Remote Unit, Single Band Medium Power DAS
Passing Transmit/Receive Frequency	130 MHz – 174 MHz
Operating Transmit/Receive Frequency FCC	150.8 MHz – 156.2475 MHz 157.1875 MHz – 161.575 MHz 161.775 MHz – 161.9625 MHz 162. 0375 MHz – 173.4 MHz
Operating Transmit/Receive Frequency Industrial Canada	138 MHz – 144 MHz 148 MHz – 174 MHz
Number of Channels	As many as which can fit
Rated RF Output(e.i.r.p.)	37 dBm

Modulation Type	P25 Phase I C4FM, CQPSK; P25 Phase II HDQPSK
Equipment mobility	Fixed
Operating condition.....	-40 to +50 °C
Mass of equipment (g)	< 27,000g
Dimension(W X D X H)	434 mm X 220 mm X 696 mm
Nominal Voltages for:	48 V stand-alone equipment 48 V combined (or host) equipment
Supply Voltage:	_____ AC _____ Amps 48V DC 2.5 Amps
If DC Power:	___ Internal Power Supply √ External Power Supply ___ Battery ☐ Nickel Cadmium ☐ Alkaline ☐ Nickel-Metal Hydride ☐ Lithium-Ion ☐ Other

Program details

Summary of testing:	
Tests performed (name of test and test clause): **Conducted Measurement** **Radiated Emissions on Enclosure**	**Testing location:** **Client Site as Witness Testing** **In SAC, Richmond**
The tests indicated in Test Summary were performed on the product constructed as described below. The test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted. Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. LabTest does not make any claims of compliance for samples or variants which were not tested.	

Description of Equipment Under Test and Variant Models

Description:
The hd33 150PS is a single-band remote unit that provides 5 W of output power on VHF band. The single-band unit supports one band in a type 2 sealed chassis door.

On the downlink path the hd33 PS remote receives an aggregated stream of digitized RF signals from an UBiT-*hd*Host PS or airHost PS, which it then converts into analog RF signals. Depending on the frequency band, the signal is amplified in the RF module and then sent out through simplex RF ports to an external filter.

On the UL path the hd33 PS remote receives analog RF signals for the RF band, from an external filter. The RF signals are converted into a digital data stream and then delivered over optical fiber to an UBiT-*hd*Host PS or airHost PS. The hd33 PS remote also accommodates a 1 Gbps Ethernet backhaul for transporting the data from nearby IP devices such as security cameras and Wi-Fi access points.

The intentional transmitter only exists in the downlink path and hence the EMC tests in this report dedicated to the downlink emission.

In order to build up a complete signal booster system, the airHost was connected as the Auxiliary device. The signal was injected and ejected via coaxial cables.

Top View 

Connector Panel View 

Variant Models:
The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

NONE

Client Equipment Used During Test

Use*	Product Type	Manufacturer	Model	Comments
EUT	*hd33, 150PS*	Dali Wireless Inc.	hd33-1-PS-D-20-2N-D0	EUT where the RF (I/O) antenna attached via a duplexer when necessary.

AE1	*airHost33, 150PS*	Dali Wireless Inc.	AH33-1-PS-D-20-2N-D0	Auxiliary equipment, which is the front end of signal booster system air interfaced to donor Base Station.
AE2	*Dali Matrix Console*	Dali Wireless Inc.	UBiT-CP	Auxiliary equipment provides the configuration and control interface to airHost and *hd*33.

Abbreviations:
EUT - Equipment Under Test,
AE - Auxiliary/Associated Equipment, or
SIM - Simulator (Not Subjected to Test)

Software and Firmware

Use*	Description	Version
EUT	Software installed	2.1.2-rc1.252
AE1	Software installed	2.1.2-rc1.252
AE2	Software installed	2.1.2-rc1.252

Abbreviations:
EUT - Equipment Under Test,
AE - Auxiliary/Associated Equipment, or
SIM - Simulator (Not Subjected to Test)

Input/Output Ports

Port #	Name	Type*	Cable Max. >3m	Cable Shielded	Comments
1	DC Power Port	DC	No	No	Dual feed 48 VDC Assembly
2	RF Input Ports	I/O	No	No	N-Type Coaxial
3	RF Output Ports	I/O	No	No	N-Type Coaxial
4	Optical Fibre I/O Ports	I/O	No	No	LC/UPC Duplex
5	2 * TP	TP	No	No	RJ-45

*Note: AC = AC Power Port DC = DC Power Port N/E = Non-Electrical
I/O = Signal Input or Output Port (Not Involved in Process Control)
TP = Telecommunication Ports

Power Interface

Mode	Voltage	Current	Power	Frequency	Phases	Comments

#	(V)	(A)	(W)	(DC/AC-Hz)	(#)	
1	48	-	-	DC	-	

EUT Operation Modes

Mode #	Description
1	UL and DL transmission and receiving ON

EUT Configuration Modes

Mode #	Description
1	airHost maximum input threshold set to -55 dBm, uplink attenuation set to 0dB; *hd*33 uplink and downlink attenuation set to 0dB.

Test Equipment Verified for function

Model #	Description	Checked Function	Results
N9038A	Spectrum Analyzer	Frequency and Amplitude	Connected 50MHz and -20 dBm Ref_siganl and checked OK.
JB1	Antenna, 30 to 2000MHz	Checked structure	Normal – no damage.
SAS-571	Antenna, 1 to 18GHz	Checked structure	Normal – no damage.
AL-130	Antenna, 9kHz to 30MHz	Checked structure	Normal – no damage.
KT-N5172B	Signal Generator, up to 6GHz	Frequency, Amplitude and Modulation	Within MFR Specs
KT-N9010A	Spectrum Analyzer	Frquency and Amplitude	Within MFR Specs

Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests:

Parameter	Uncertainty
Radio Frequency	±1 ppm
Total RF Power: Conducted	±1 dB
RF Power Density: Conducted	±2.75 dB
Spurious Emissions: Conducted	±3 dB
Temperature	±1 °C
Humidity	±5 %
DC and Low Frequency Voltages	±3 %
Radiated Emission, 30 to 6,000MHz	± 4.93 dB

Uncertainty figures are valid to a confidence level of 95%.

Result Summary

The Compliance Status is a judgment based on the direct measurements and calculated highest emissions to appropriate standard limits. Measurement uncertainty values, provided on calibration certificates, were not be used in the judgment of the final status of compliance.

FCC Part			
Test Type	**Regulation**	**Measurement Method**	**Result**
Output Power (Conducted)	FCC Part 2 2.1046 FCC Part 90.219	ANSI TIA-603-E-2016	Compliant
Unwanted Emissions (Transmitter Conducted)	FCC Part 2 2.1046(a) FCC Part 90.210	ANSI TIA-603- E-2016 & FCC KDB 935210 D05, v01r02	Compliant
Spectrum Emission Mask	FCC Part 90 90.210	ANSI TIA-603- E-2016 & FCC KDB 935210 D05, v01r02	Compliant
Out of Band Rejection	FCC KDB 935210 D05, v01r02	FCC KDB 935210 D05, v01r02	Compliant
Intermodulation	FCC Part 90 90.219	ANSI TIA-603- E-2016 & FCC KDB 935210 D05, v01r02	Compliant
Input/output Power and Amplifier/Booster Gain	FCC Part 90 90.219	ANSI TIA-603- E-2016 & FCC KDB 935210 D05, v01r02	Compliant
Noise Figure	FCC Part 90 90.219	ANSI TIA-603- E-2016 & FCC KDB 935210 D05, v01r02	Compliant
Radiated Emissions - Enclosure	FCC Part 2.1053, FCC Part 90.210 & FCC Part 90.219	ANSI C63.4:2014 & ANSI TIA-603-D	

Industrial Canada			
Test Type	**Regulation**	**Measurement Method**	**Result**
Output Power (Conducted)	RSS-131, Sec 6.2	RSS-131, Sec 4.3	Compliant
Occupied Bandwidth	RSS-GEN, Sec 4.6.1	RSS-GEN, Sec 4.6.1	Compliant
Unwanted Emissions (Transmitter Conducted)	RSS-131 Sec 6.4	RSS-131 Sec4.4	Compliant

Passband Gain and Bandwidth	RSS-131 Sec 6.1	RSS-131 Sec 4.2	Compliant

Output Power (Conducted)

Governing Doc	FCC Part 2 2.1046(a) FCC Part 90.219(d) RSS-131 Sec 6.2	Room Temperature (°C)	23.6
Test Procedure	ANSI/TIA-603- E-2016; FCC KDB 935210 D05, v01r02; RSS-131 Sec 4.3	Relative Humidity (%)	29.7
Test Location	Burnaby	Barometric Pressure (kPa)	100.5
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 24, 2018
EUT Voltage	☒ DC	☐ 120VAC @ 60Hz	

Test Equipment Used	Manufacturer	Model	Serial Number	Calibration	Calibration due
Signal Generator	Keysight	N5172B	MY53050270	08/04/17	08/04/18
Spectrum Analyzer	Keysight	N9010A	MY50520285	08/07/17	08/07/18
40dB Attenuator	Aeroflex Winschel	58-40-43	n/p	CVP	CVP

Note) CVP = Calibration Verification Performed internally, n/p = not provided.

Frequency Range:	☒
Detector:	☒ Peak
Type of Facility:	☒ Test bench
Distance:	☒ Direct
Arrangement of EUT:	☐ Table-top only ☐ Floor-standing only ☒ Rack Mounted

Output Power is less than 37 dBm in band 150.
The output total power of active dual channels is compressed to the same level due to the ALC control.
Each channel power is accordingly 3 dB down from the total power.

Compliant ☒ Non-Compliant ☐ Not Applicable ☐

Test setup

Description of test set-up:
Output power is measured by connecting a spectrum analyzer to RF output connector of EUT via 40dB Attenuator. With a nominal input power and the amplifier properly adjusted the RF output is measured. The EUT was set to **Operation Mode #1 with configuration Mode #1.** The maximum output power is measured when the Automatic Level Control (ALC) starting to compress the power and hold to a constant level.

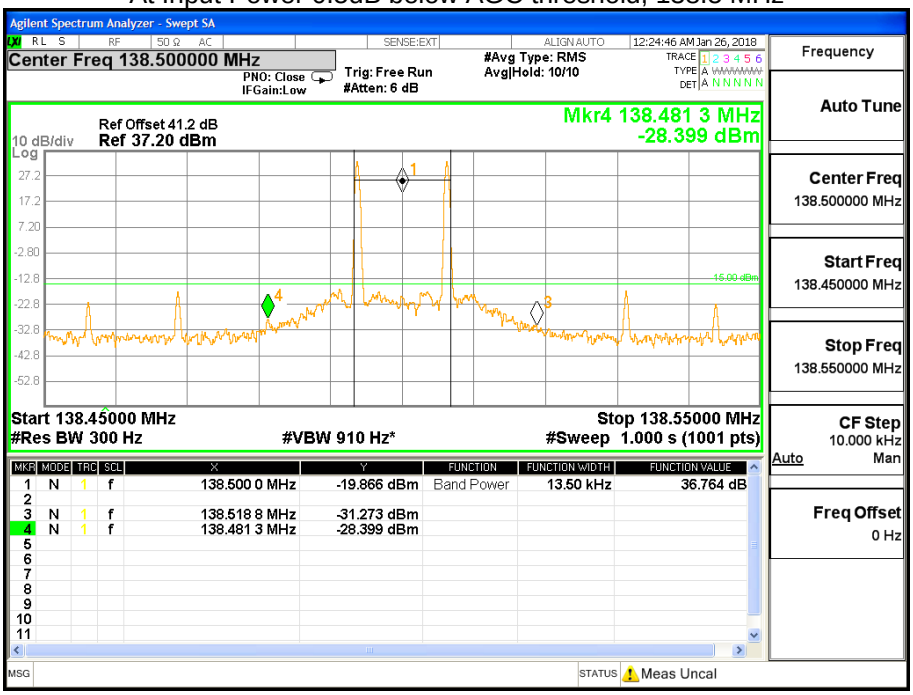

Results – Output Power FCC Requirement and IC Single Channel Requirement

Frequency (MHz)	Input Power Trip ALC (dBm)	Output Power (dBm)	Limit (37dBm)
150.815	-54	37	PASS
157.47	-54.5	37	PASS
161.79	-54.5	36.7	PASS
173.39625	-54.5	36.3	PASS

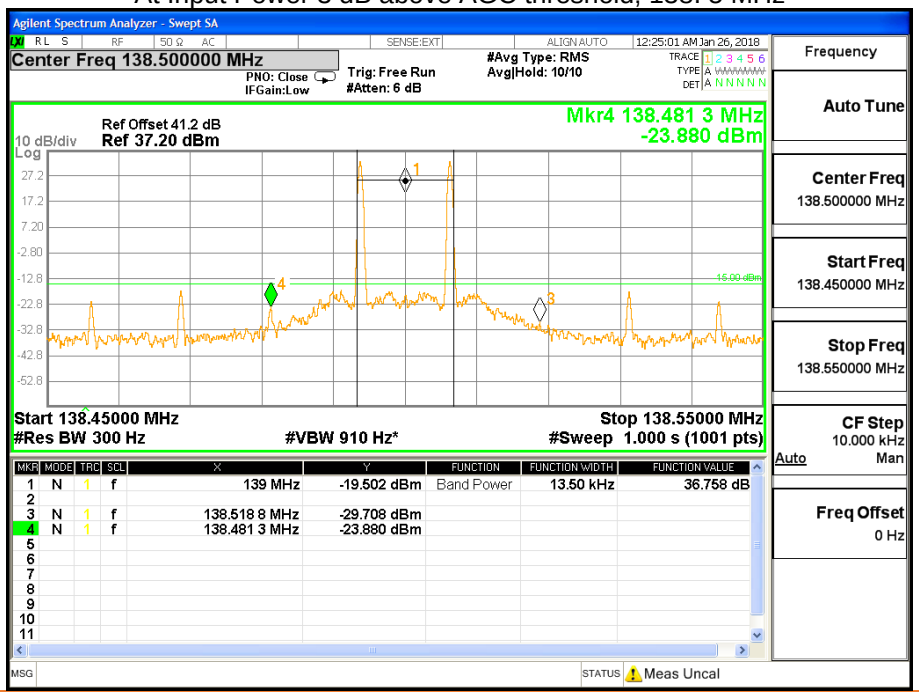
Results – Output Power IC Multi-Channel Requirement

The output total power of active dual channels is compressed to the same level due to the ALC control. Each channel power is accordingly 3 dB down from the total power.

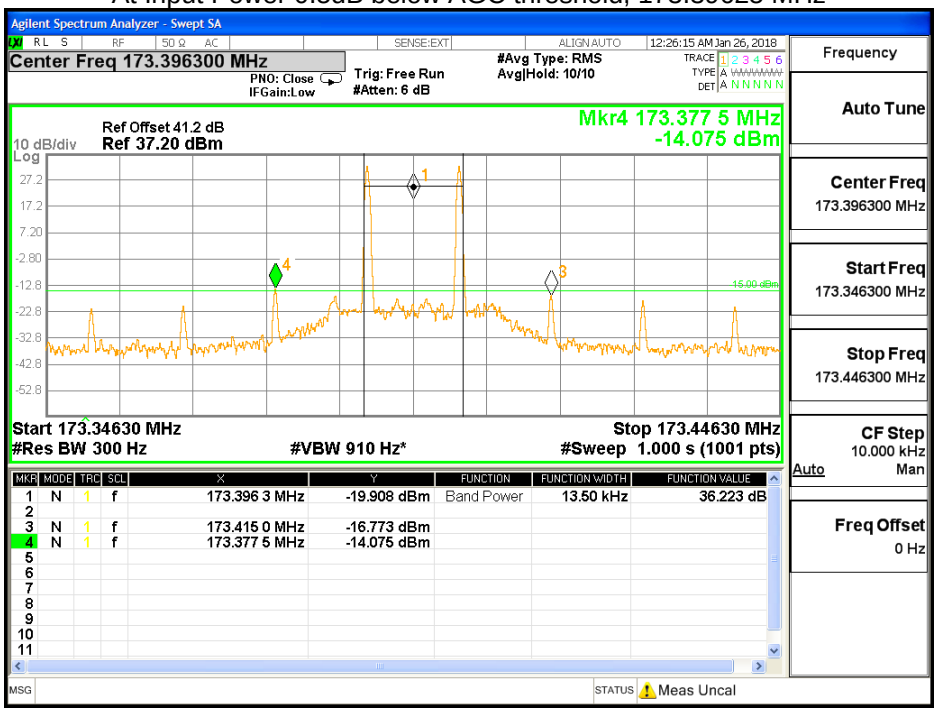
At Input Power 0.5dB below AGC threshold, 138.5 MHz



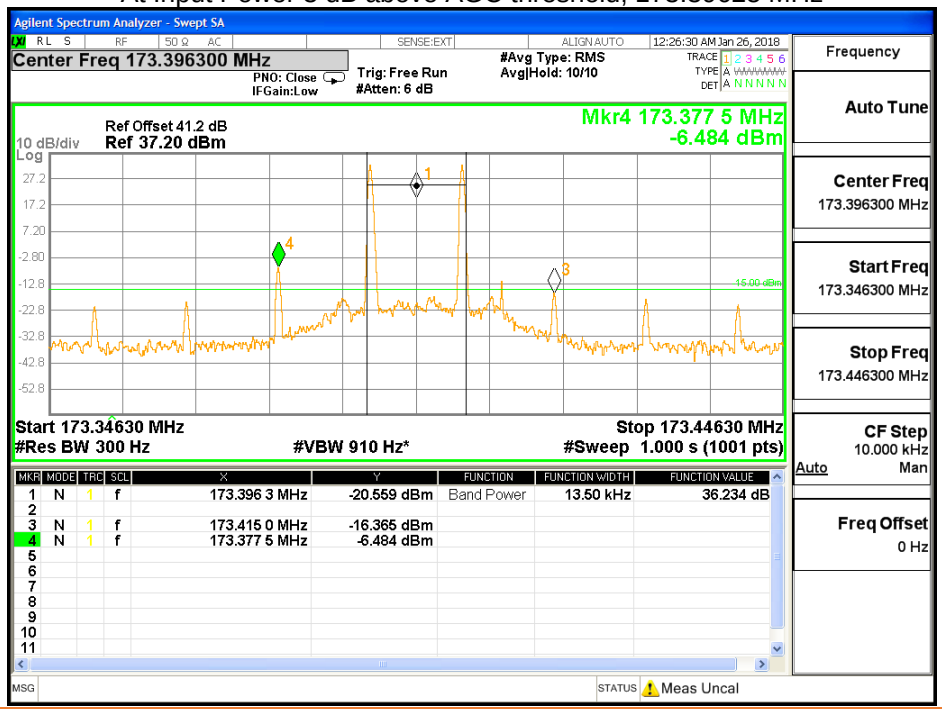
At Input Power 3 dB above AGC threshold; 138. 5 MHz



At Input Power 0.5dB below AGC threshold, 173.39625 MHz



At Input Power 3 dB above AGC threshold; 173.39625 MHz



Occupied Bandwidth

Governing Doc	IC RSS-GEN 4.6.1	Room Temperature (°C)	24
Test Procedure	IC RSS-GEN 4.6.1	Relative Humidity (%)	41
Test Location	Burnaby	Barometric Pressure (kPa)	100.5
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 29, 2018
EUT Voltage	☒ DC	☐ 120VAC @ 60Hz	

Test Equipment Used	Manufacturer	Model	Serial Number	Calibration	Calibration due
Signal Generator	Keysight	N5172B	MY53050270	08/04/17	08/04/18
Spectrum Analyzer	Keysight	N9010A	MY50520285	08/07/17	08/07/18
40dB Attenuator	Aeroflex Winschel	58-40-43	n/p	CVP	CVP

Note) CVP = Calibration Verification Performed internally, n/p = not provided.

Frequency Range:	☒
Detector:	☒ Peak
Type of Facility:	☒ Test bench
Distance:	☒ Direct
Arrangement of EUT:	☐ Table-top only ☐ Floor-standing only ☒ Rack Mounted

Output signal has an occupied channel bandwidth less than the designated channel bandwidth on any location on the operating band.

- C4FM < 12.5 kHz
- CQPSK < 6.25 kHz
- HDQPSK < 12.5 kHz

Compliant ☒ Non-Compliant ☐ Not Applicable ☐

Test setup

Description of test set-up:

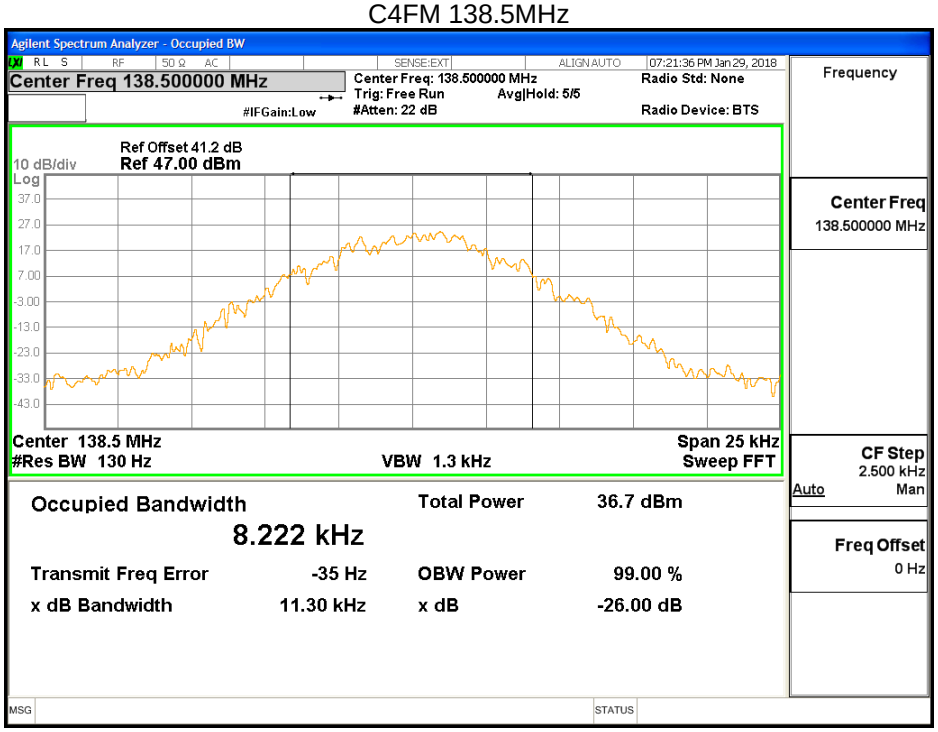
Occupied Bandwidth is measured by connecting a Spectrum Analyzer to the RF output connector via 40dB attenuator. The required measurement resolution bandwidth (RBW) is 1% of the emission bandwidth. 99% energy rule was applied to measure the occupied channel bandwidth. The emission bandwidth is measured as the width of the signal between two frequency points on the channel edge, outside of which the transmission power is attenuated at least 26dB below the transmitter output power

The EUT was set to **Operation Mode #1 with configuration Mode #1.**

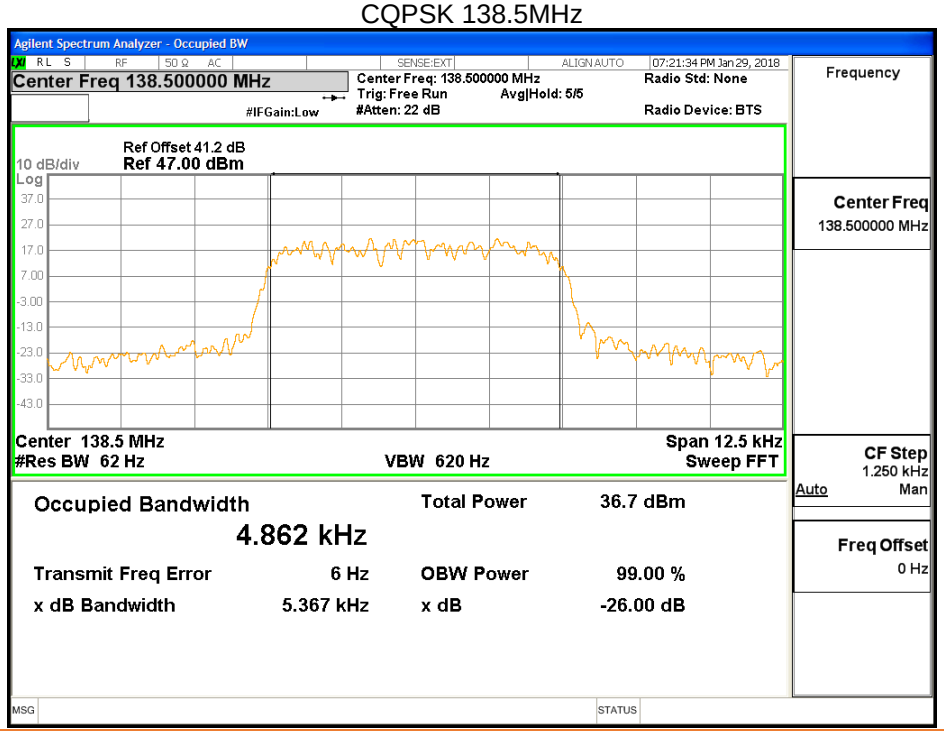
Results

At Input Power 0.5dB below AGC threshold

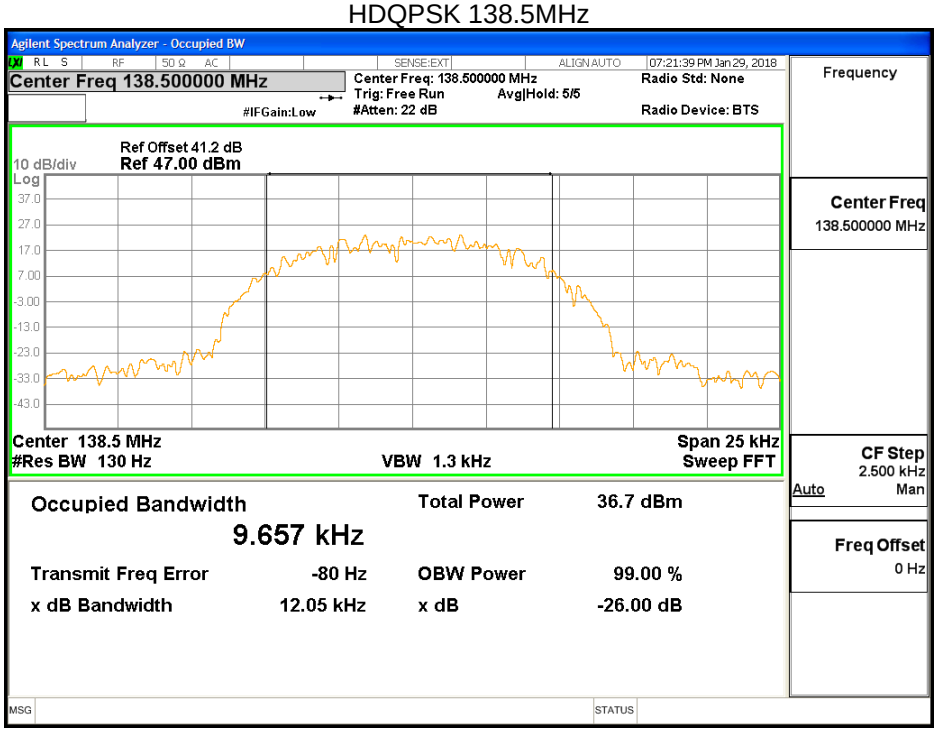
C4FM 138.5MHz



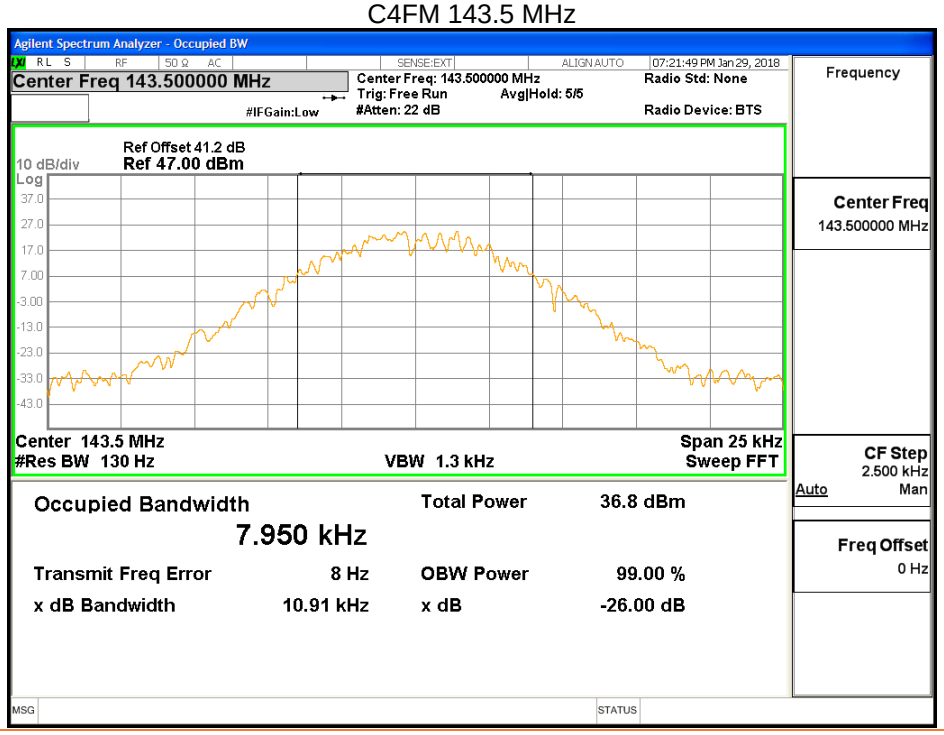
CQPSK 138.5MHz



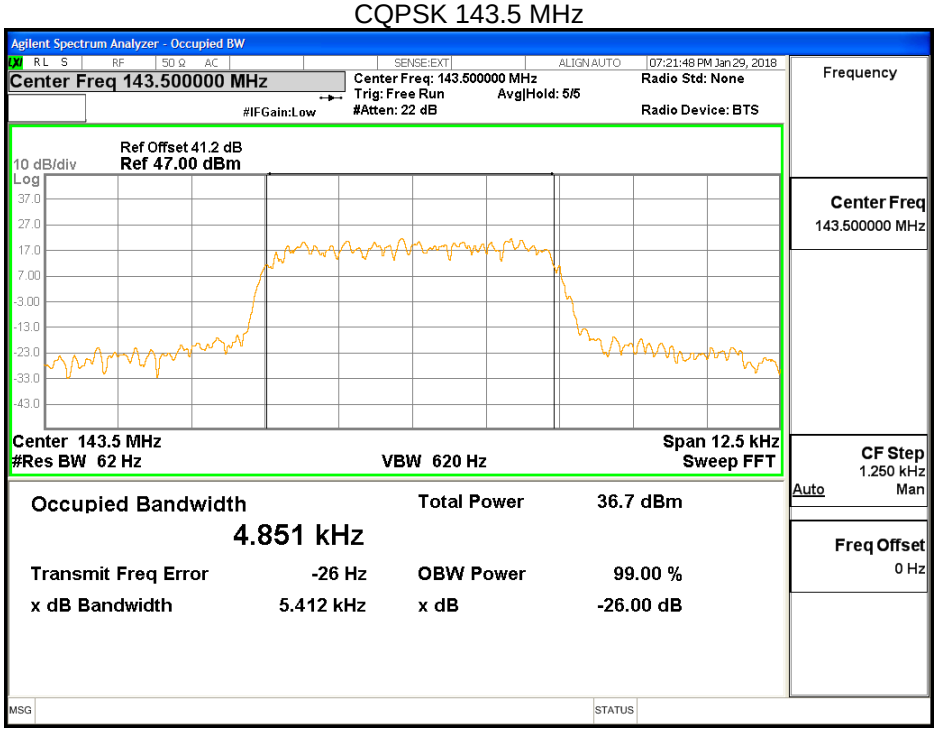
HDQPSK 138.5MHz



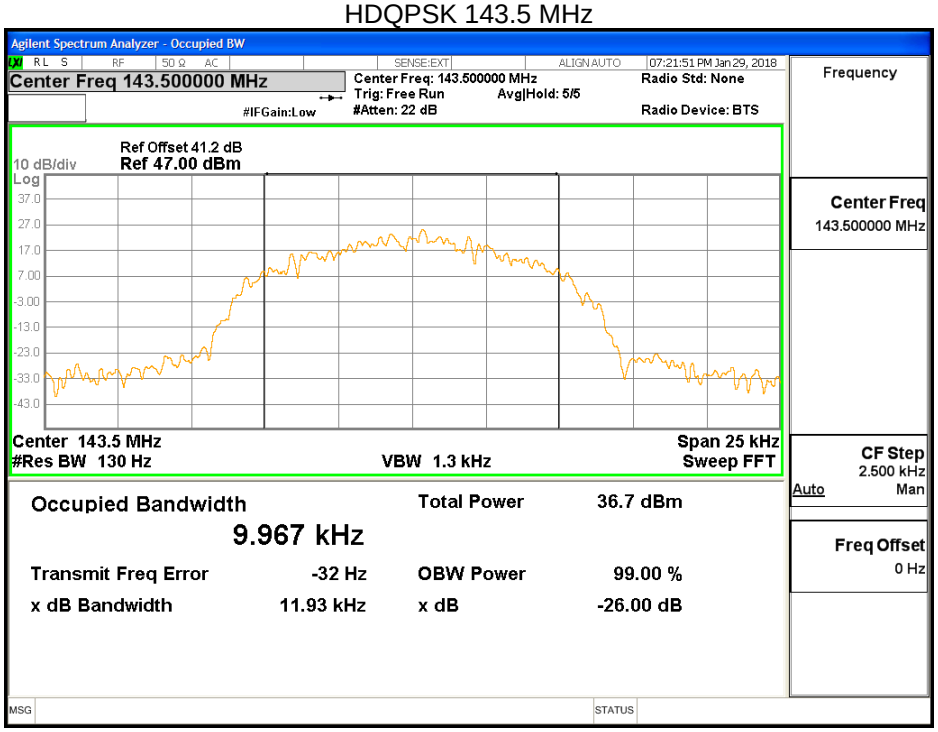
C4FM 143.5 MHz



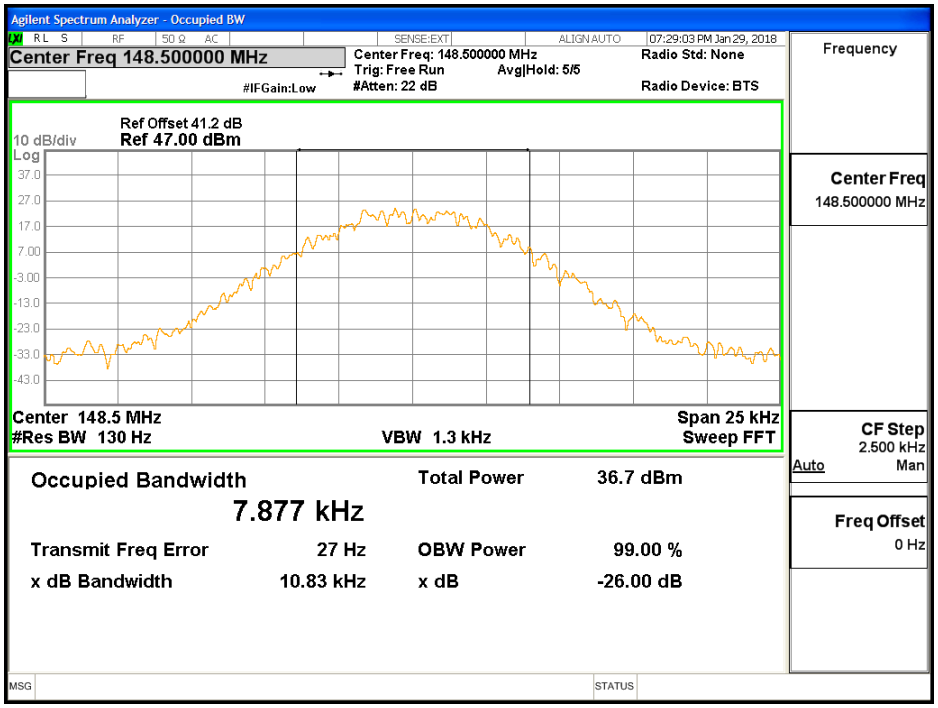
CQPSK 143.5 MHz



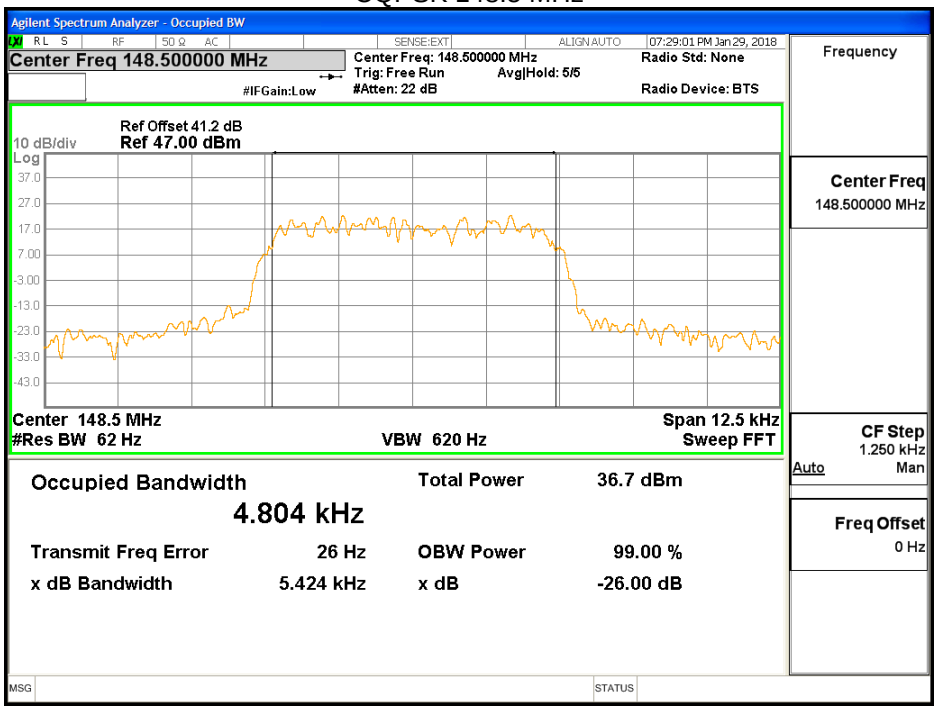
HDQPSK 143.5 MHz



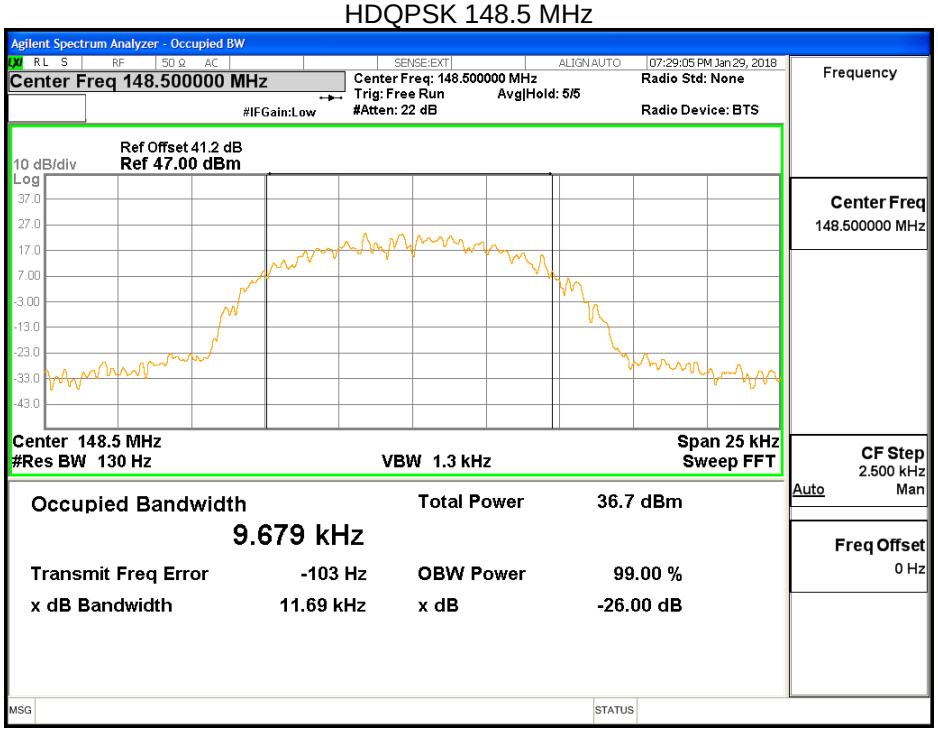
C4FM 148.5 MHz



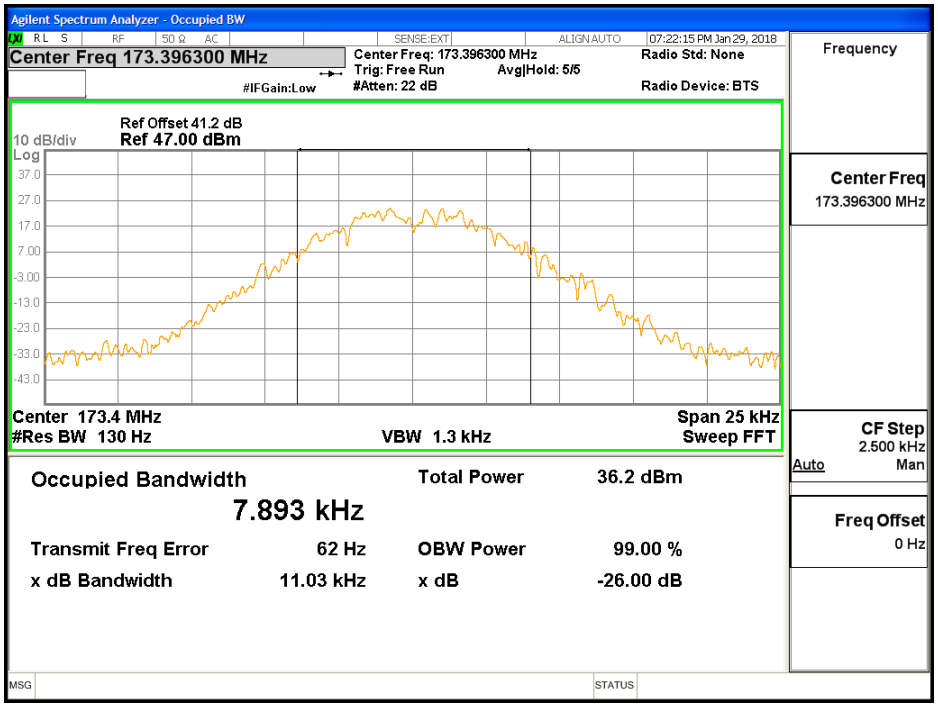
CQPSK 148.5 MHz



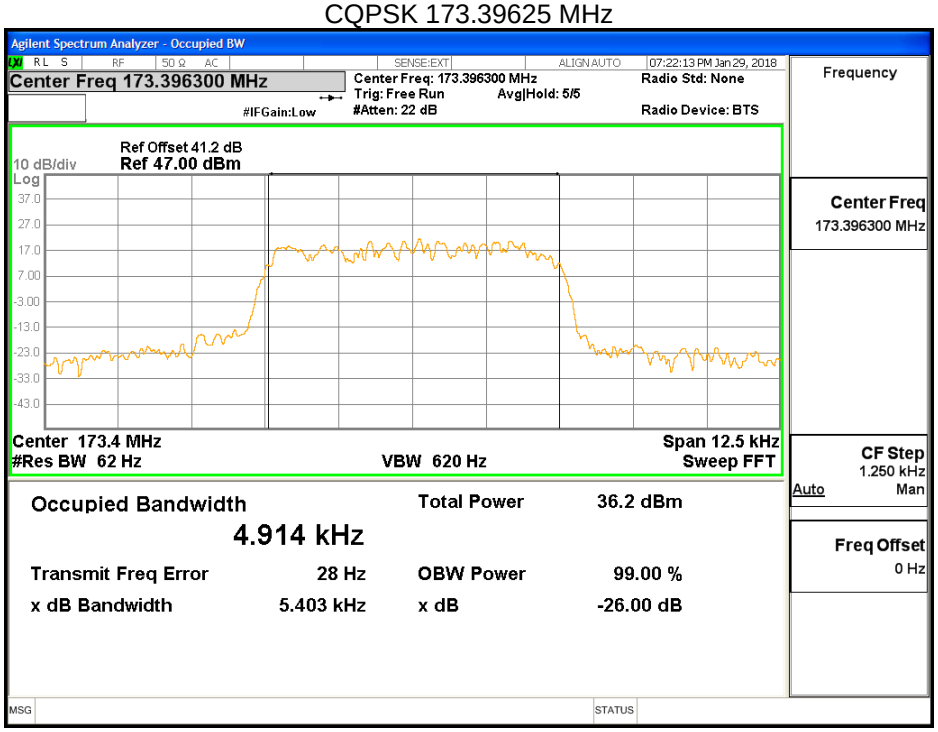
HDQPSK 148.5 MHz



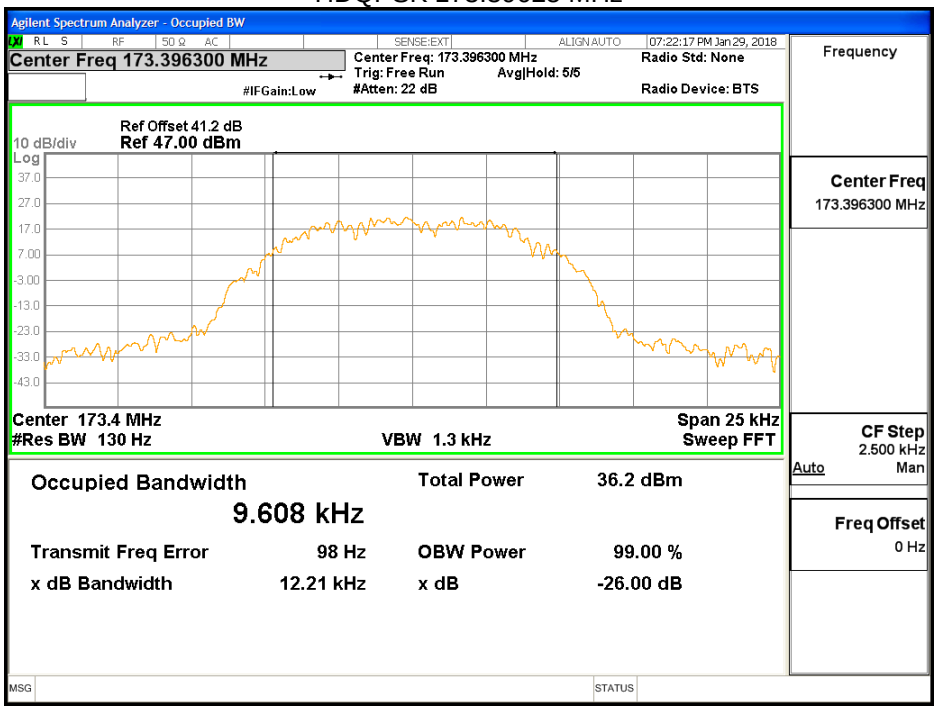
C4FM 173.39625 MHz



CQPSK 173.39625 MHz

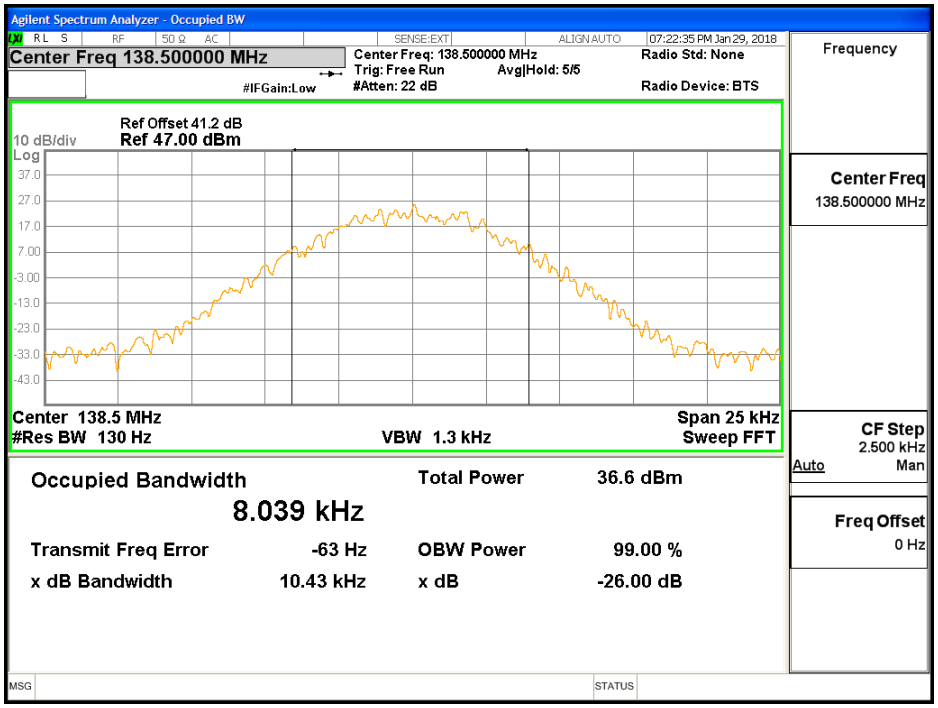


HDQPSK 173.39625 MHz

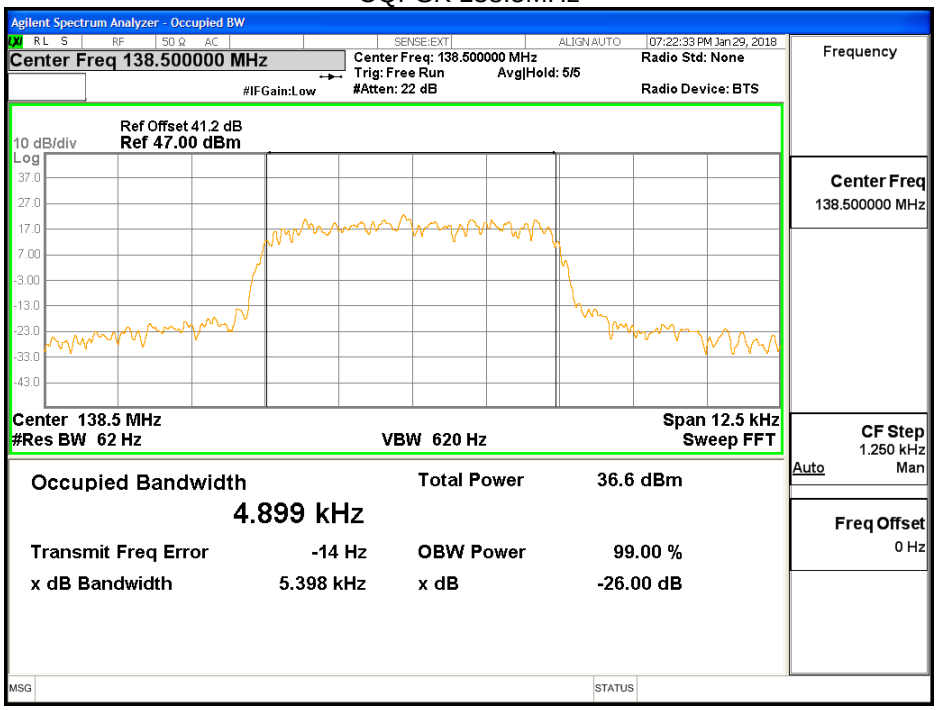


At Input Power 3 dB above AGC threshold

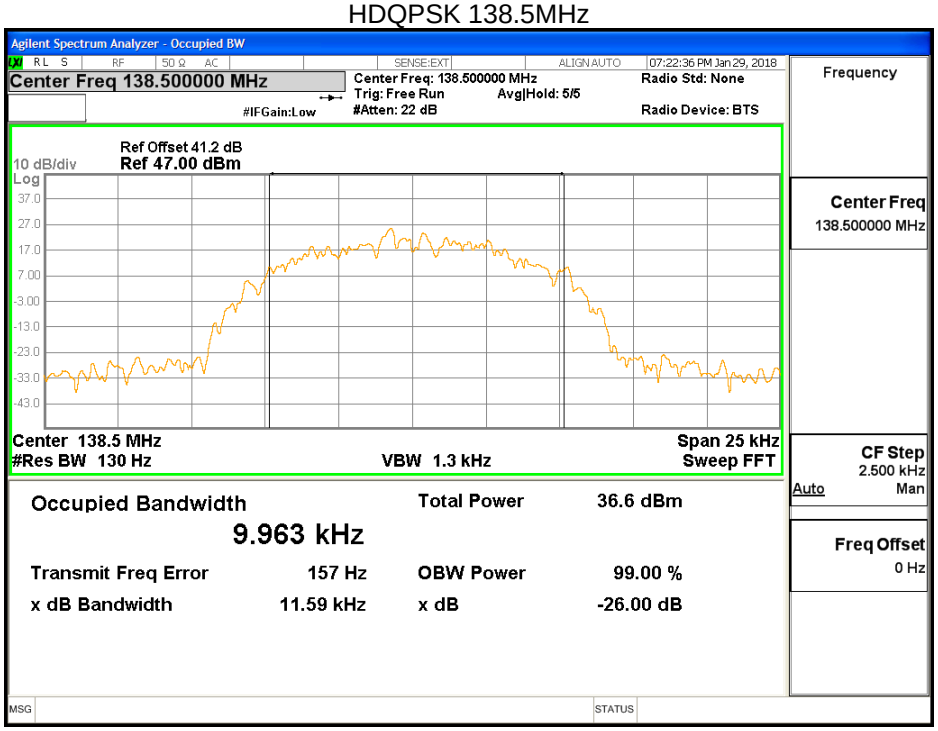
C4FM 138.5MHz



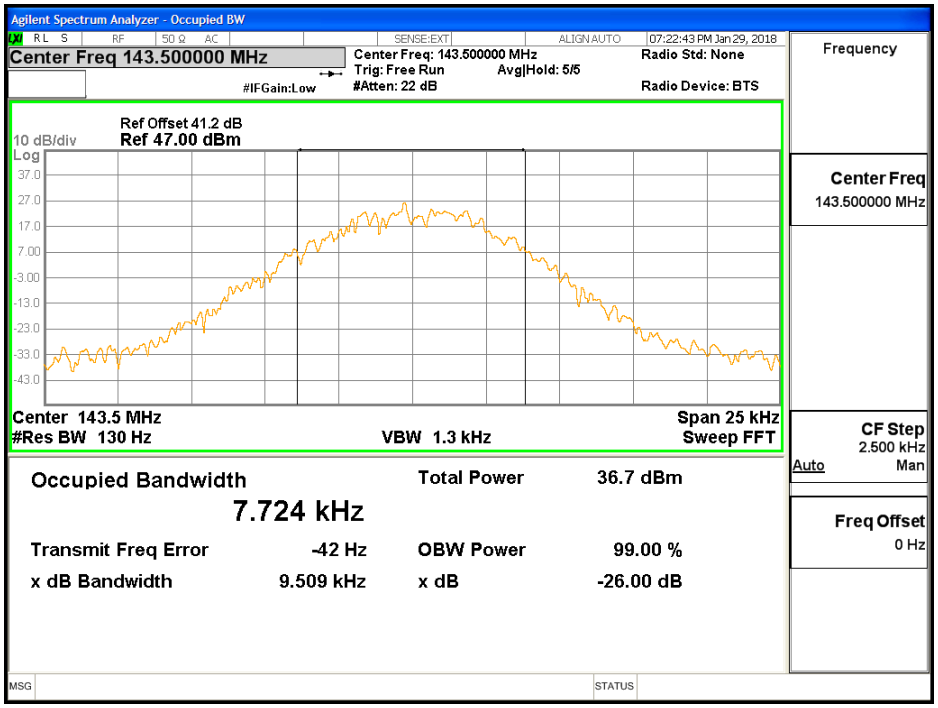
CQPSK 138.5MHz



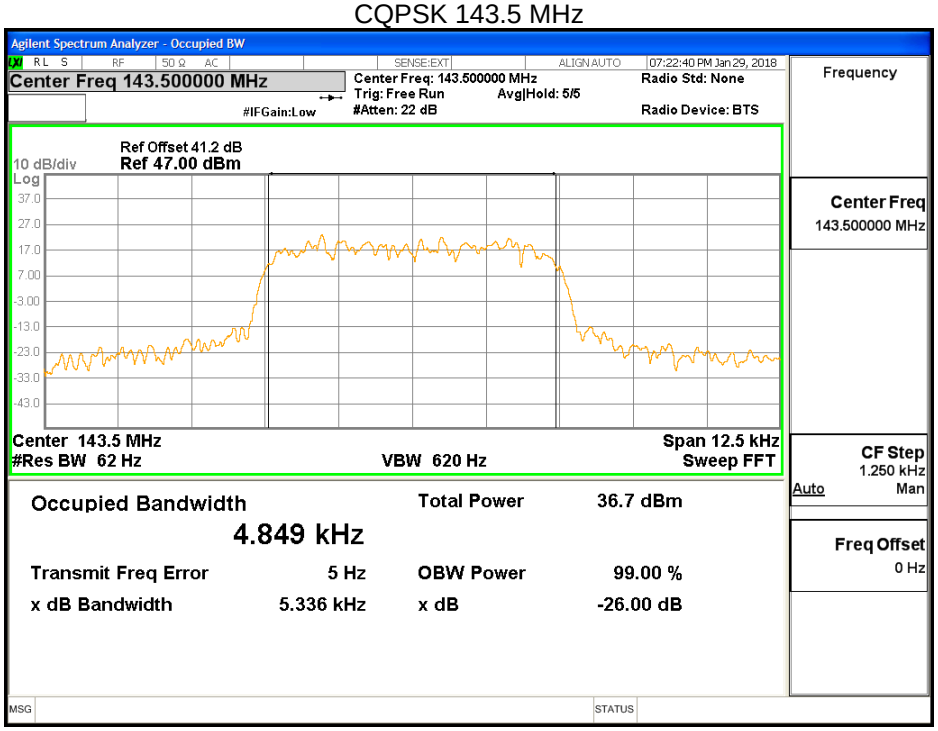
HDQPSK 138.5MHz



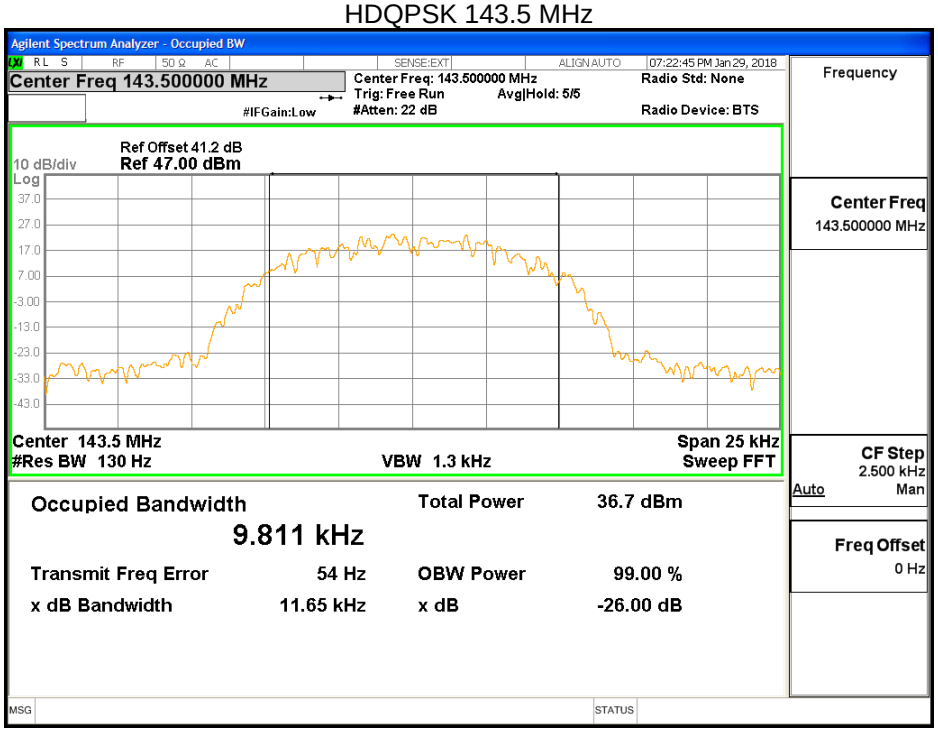
C4FM 143.5 MHz



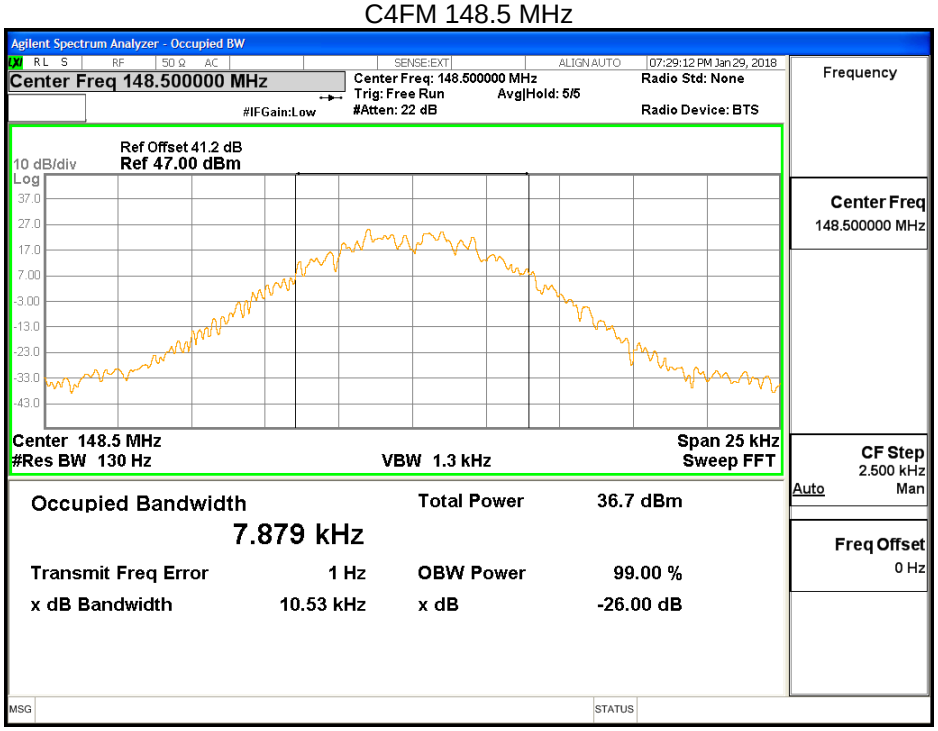
CQPSK 143.5 MHz



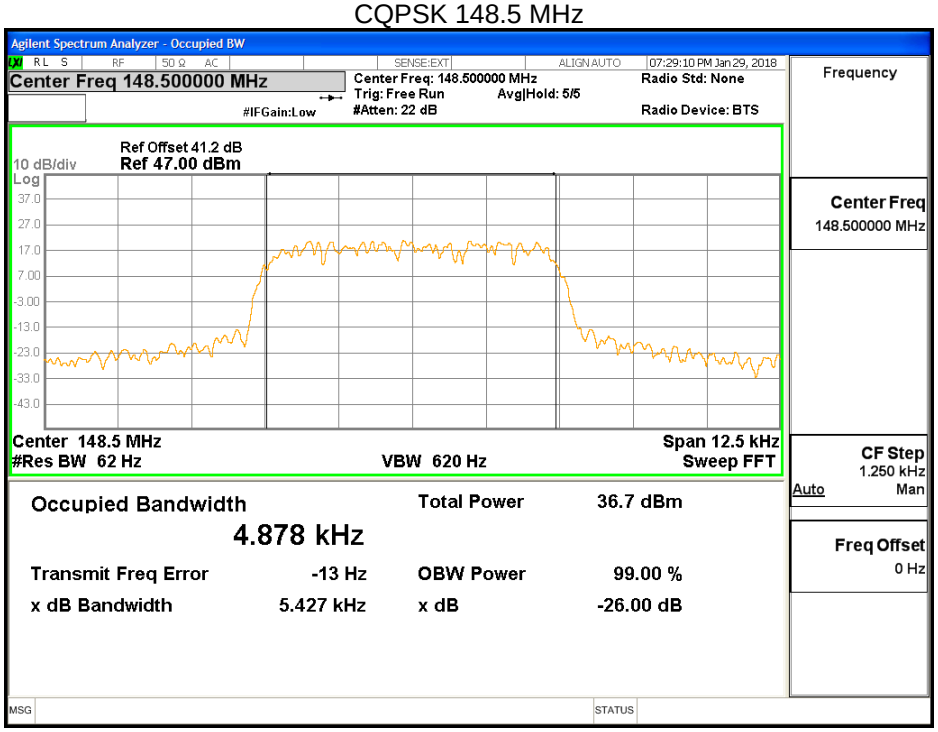
HDQPSK 143.5 MHz



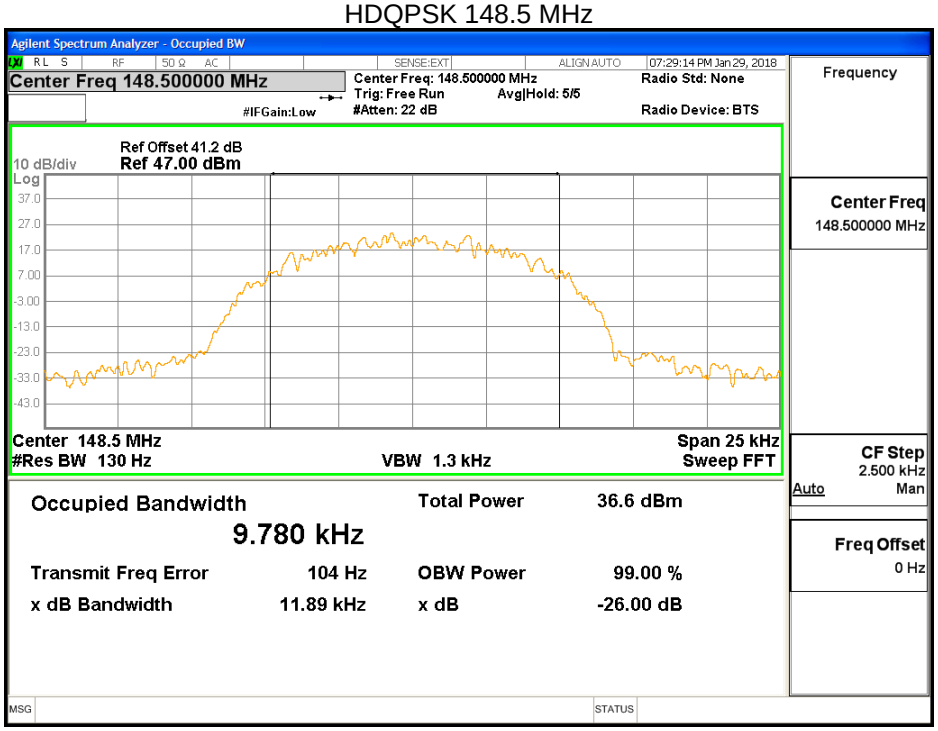
C4FM 148.5 MHz



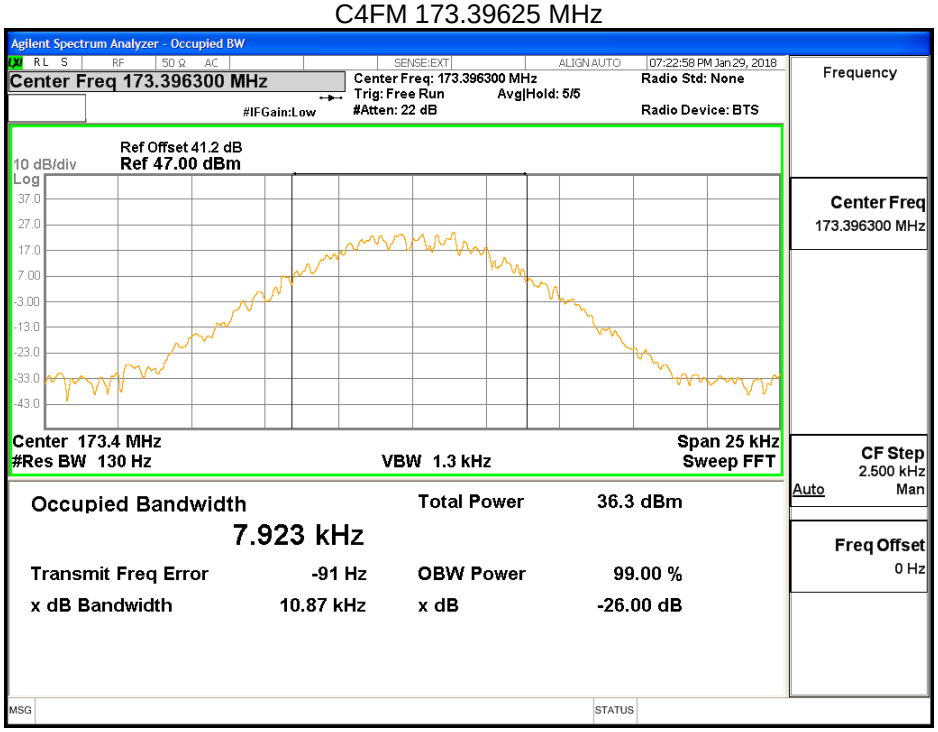
CQPSK 148.5 MHz



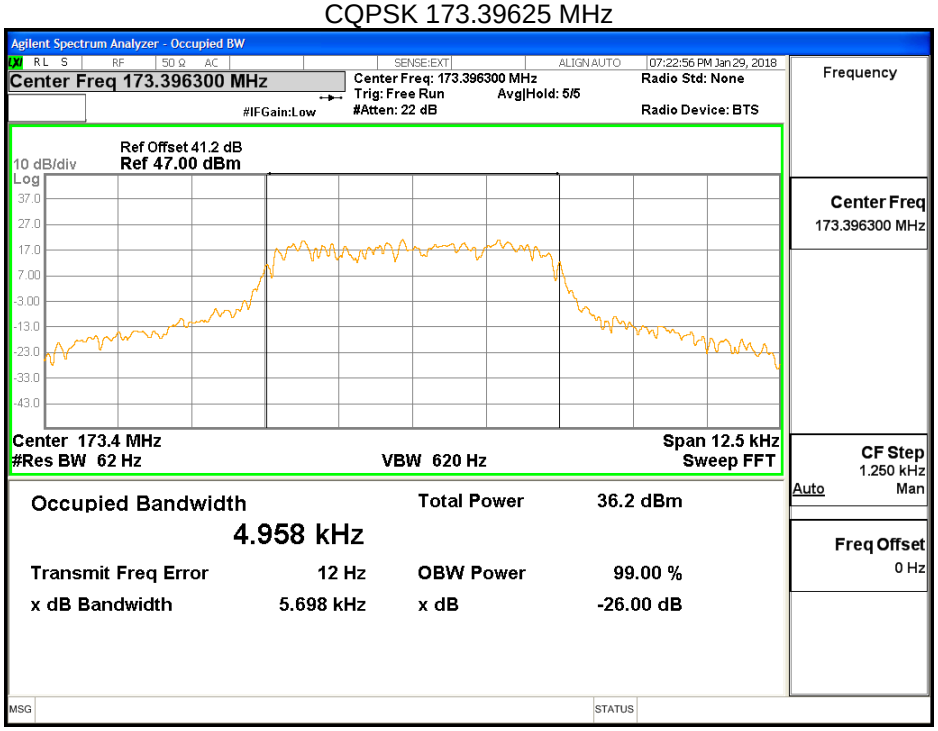
HDQPSK 148.5 MHz



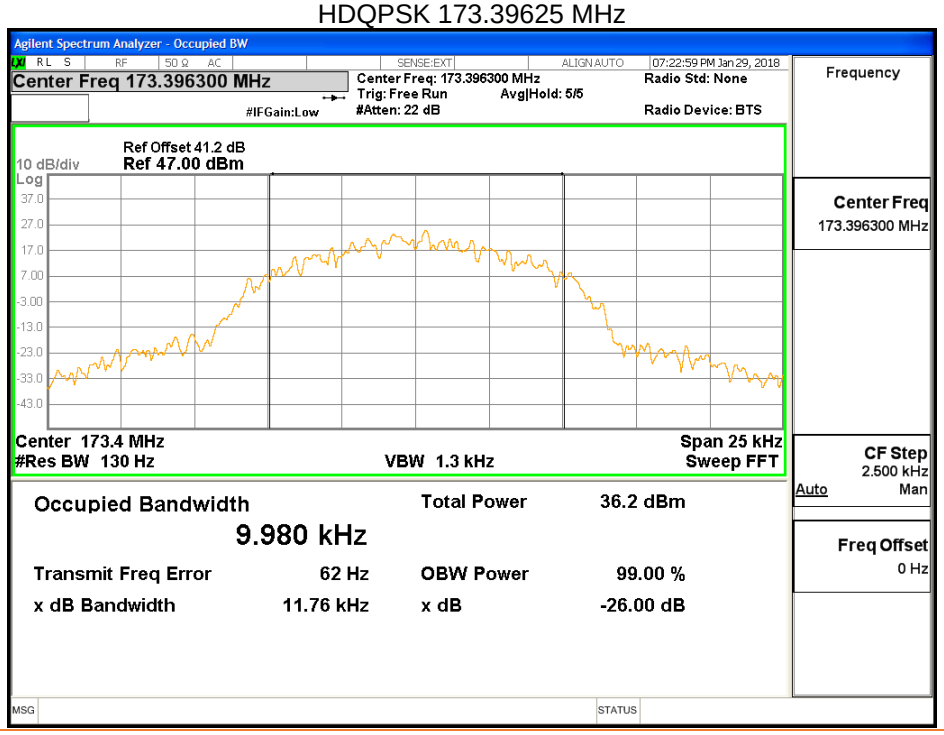
C4FM 173.39625 MHz



CQPSK 173.39625 MHz



HDQPSK 173.39625 MHz



Unwanted Emissions (Conducted)

Governing Doc	FCC Part 2 2.1046(a) FCC Part 90.210 RSS-131 Sec 6.4	Room Temperature (°C)	23.6
Test Procedure	ANSI/TIA-603- E-2016; FCC KDB 935210 D05 Indus Booster Basic Meas v01r02: October 27, 2017 RSS-131 Sec 4.4	Relative Humidity (%)	29.7
Test Location	Burnaby	Barometric Pressure (kPa)	100.5
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 24, 2018
EUT Voltage	☒ DC	☐ 120VAC @ 60Hz	

Test Equipment Used	Manufacturer	Model	Serial Number	Calibration	Calibration due
Signal Generator	Keysight	N5172B	MY53050270	08/04/17	08/04/18
Spectrum Analyzer	Keysight	N9010A	MY50520285	08/07/17	08/07/18
40dB Attenuator	Aeroflex Winschel	58-40-43	n/p	CVP	CVP

Note) CVP = Calibration Verification Performed internally, n/p = not provided.

Frequency Range:	☒ 9 kHz – GHz
Detector:	☒ Peak(for Formal)
RBW/VBW:	☒1/10kHz for 9kHz – 150kHz; ☒ 10/100kHz for 150kHz – 30 MHz; ☒ 100/1000kHz for 30MHz – 1GHz; ☒ 1/50MHz for 1GHz – 9.4GHz
Type of Facility:	☒ Testbench
Distance:	☒ Direct Connection
Arrangement of EUT:	☐ Table-top only ☐ Floor-standing only ☒ Rack Mounted

No emission is higher than the -13 dBm emission limit.

Compliant ☒ Non-Compliant ☐ Not Applicable ☐

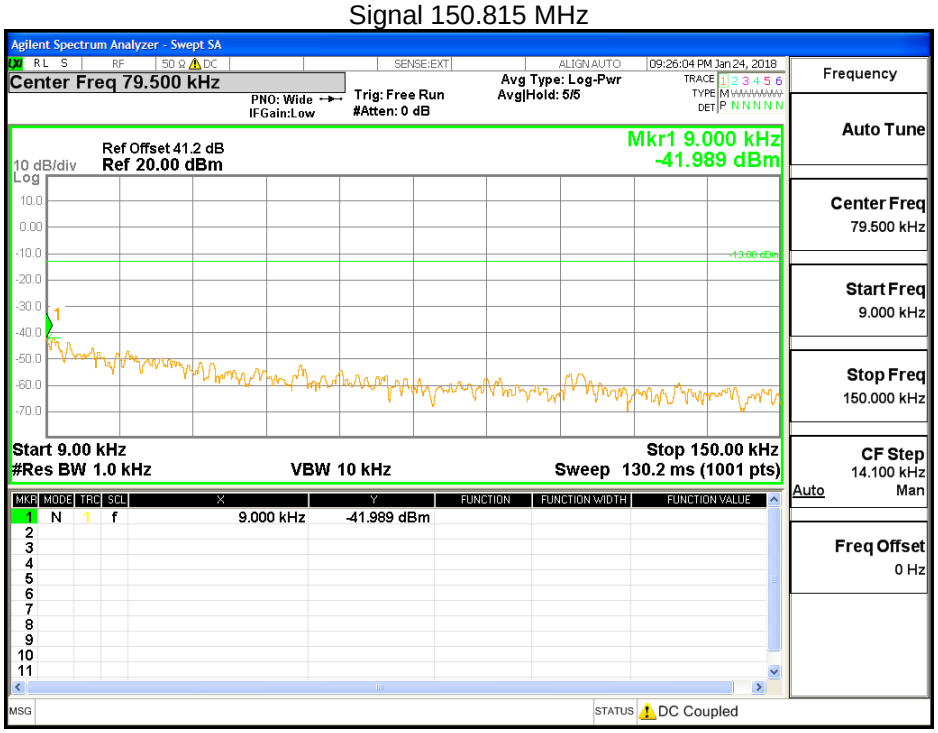
Test setup

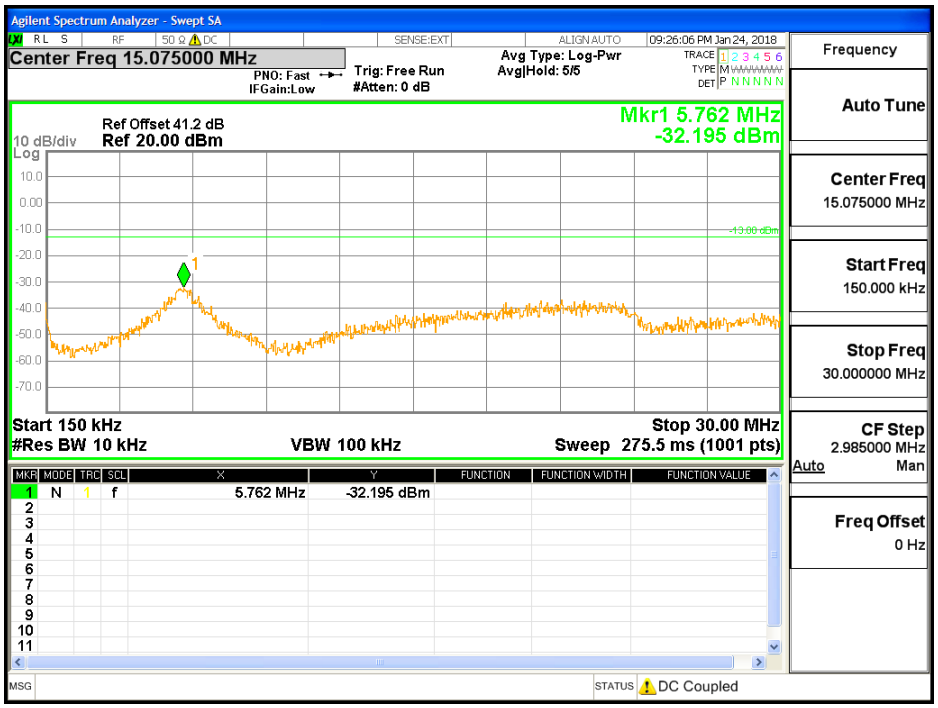
Description of test set-up:
Unwanted emission was measured by connecting a Spectrum Analyzer to the RF output connector via 40dB Attenuator. The input power was adjusted to produce maximum output power on the antenna port and just below the AGC threshold. The CW input signal was set to the lowest channel, center channel and the highest channel of the EUT operating band. The EUT was set to **Operation Mode #1 with configuration Mode #1.**

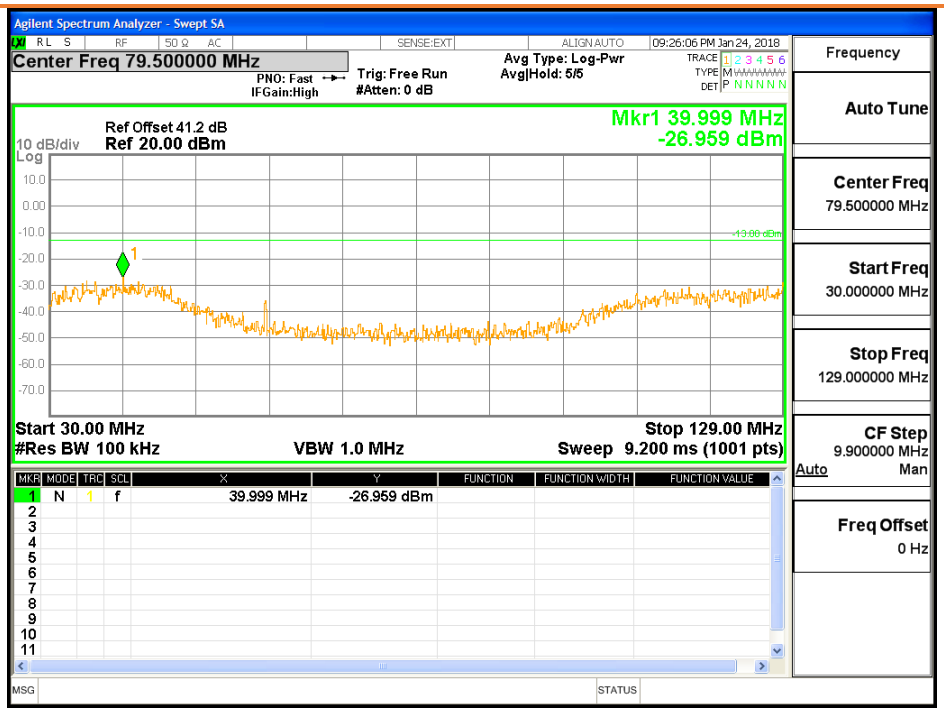

Results

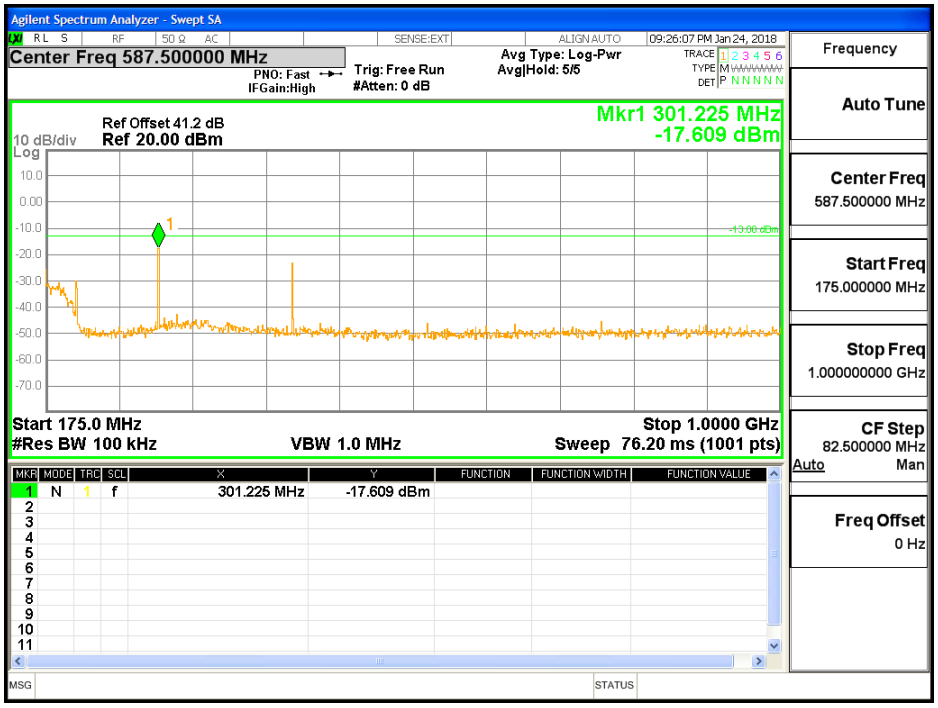
At Input Power 0.5 dB below AGC threshold

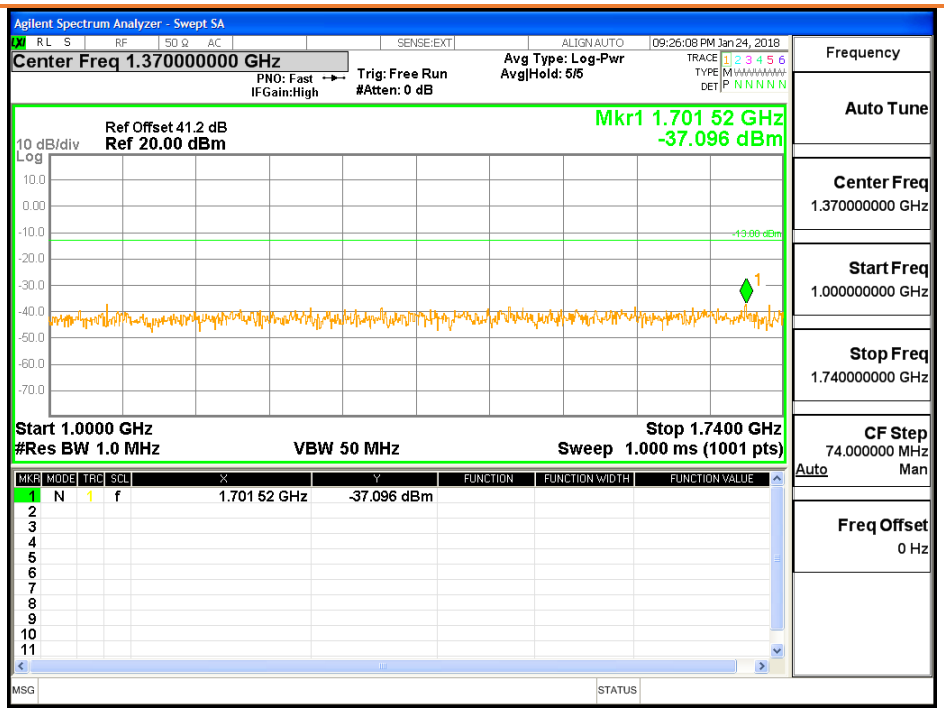
Signal 150.815 MHz



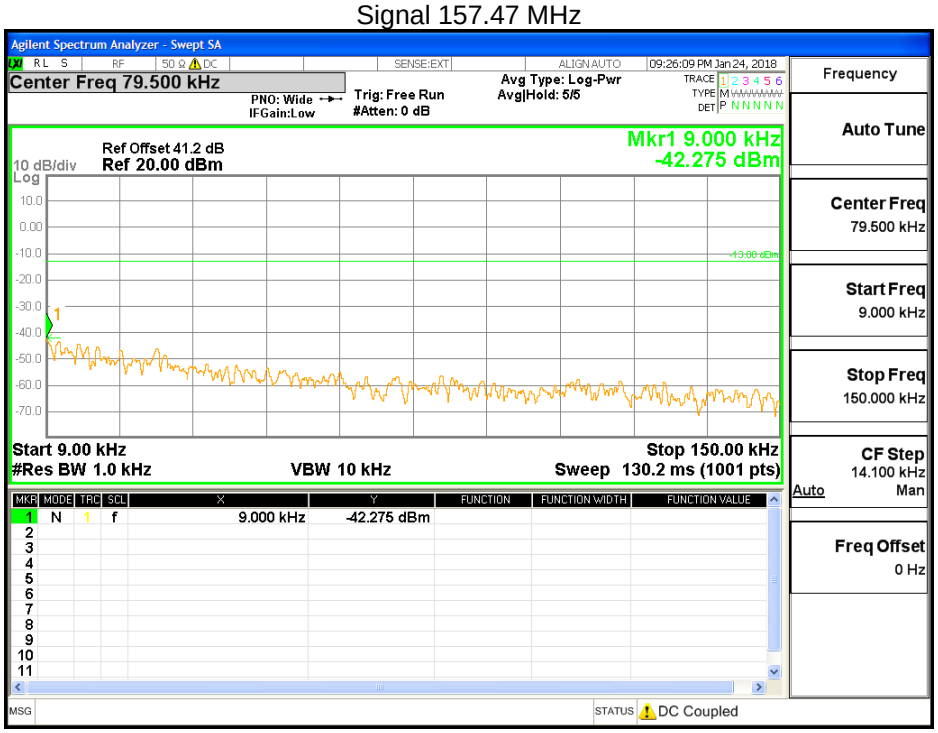


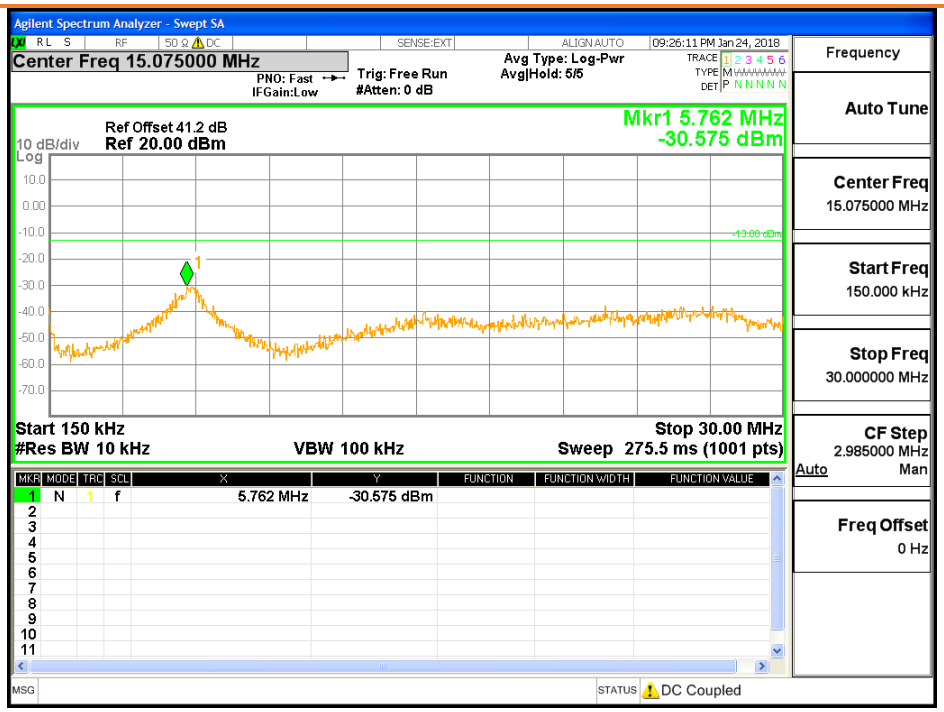


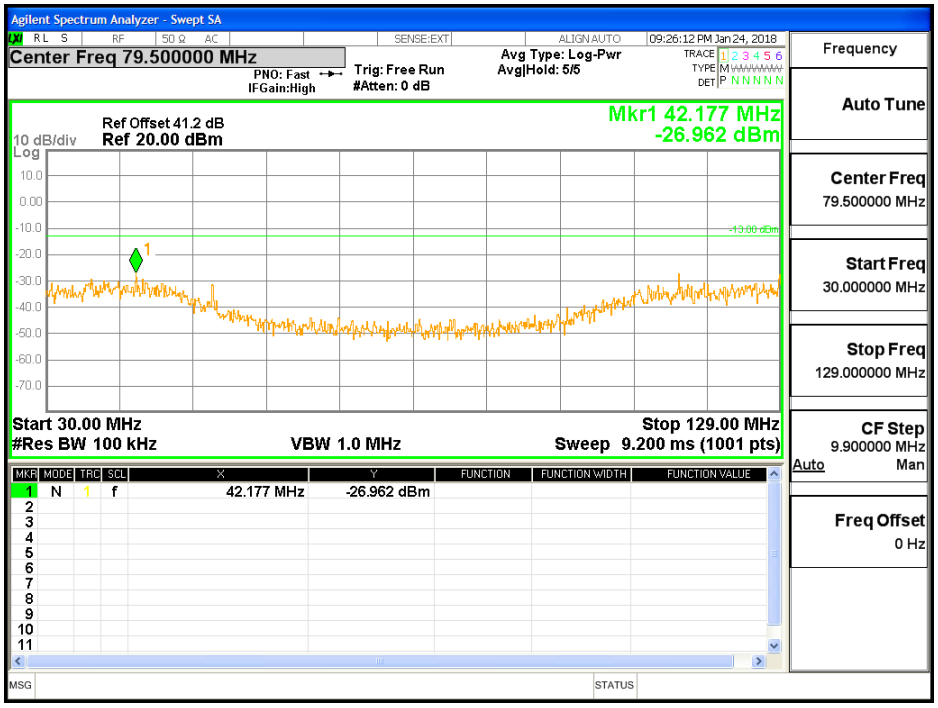


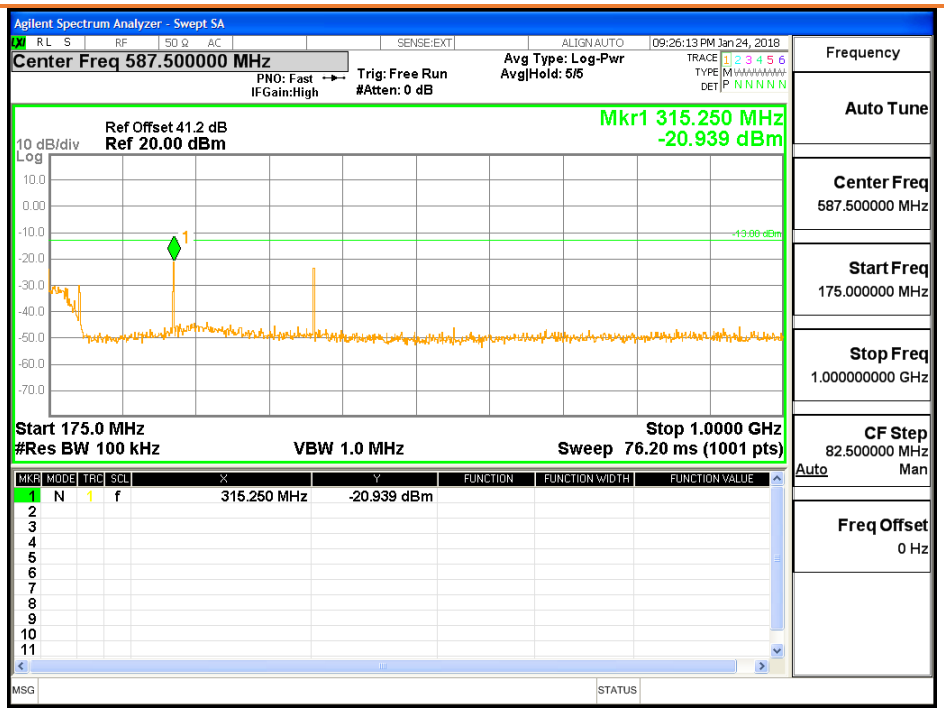


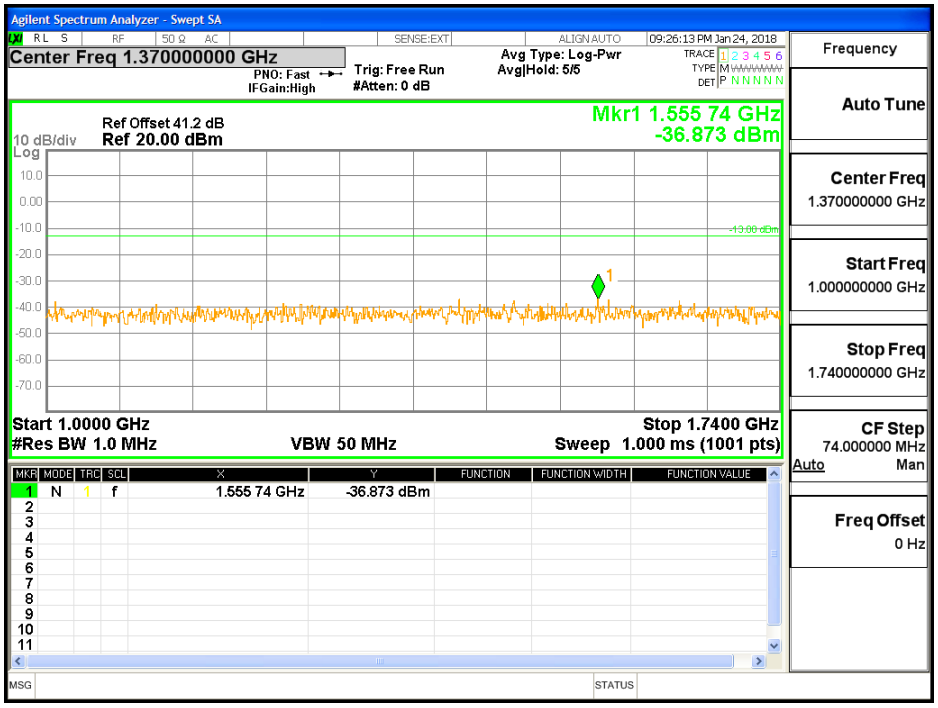
Signal 157.47 MHz



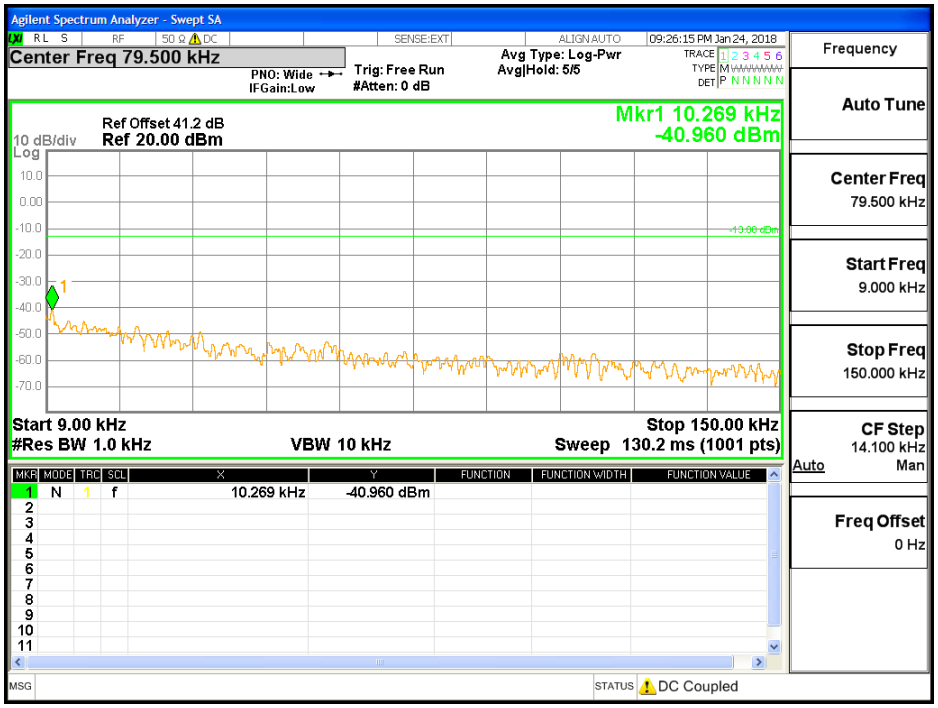


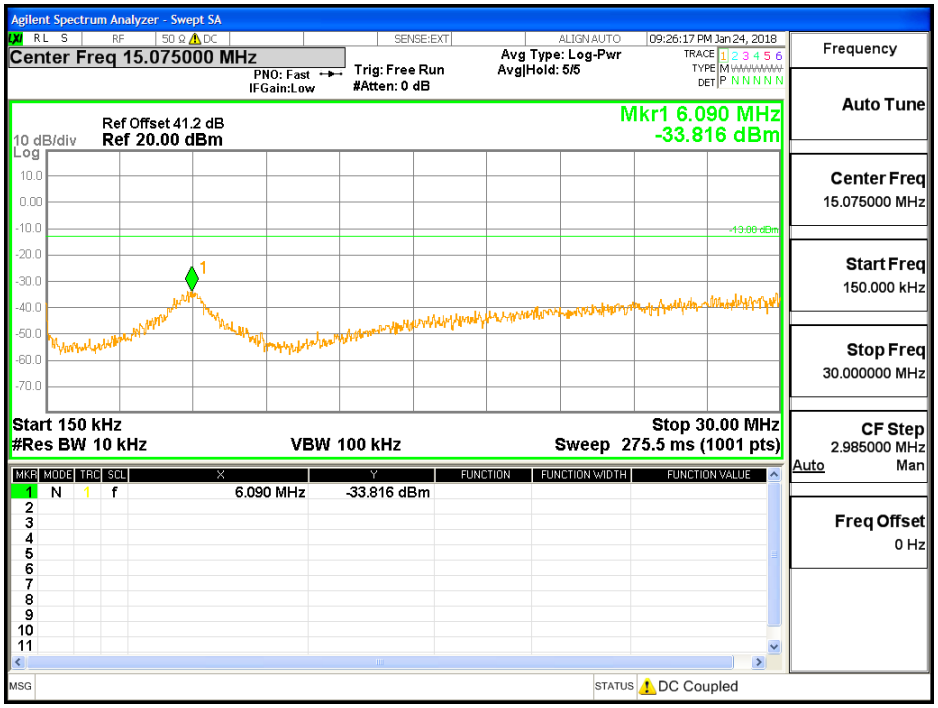


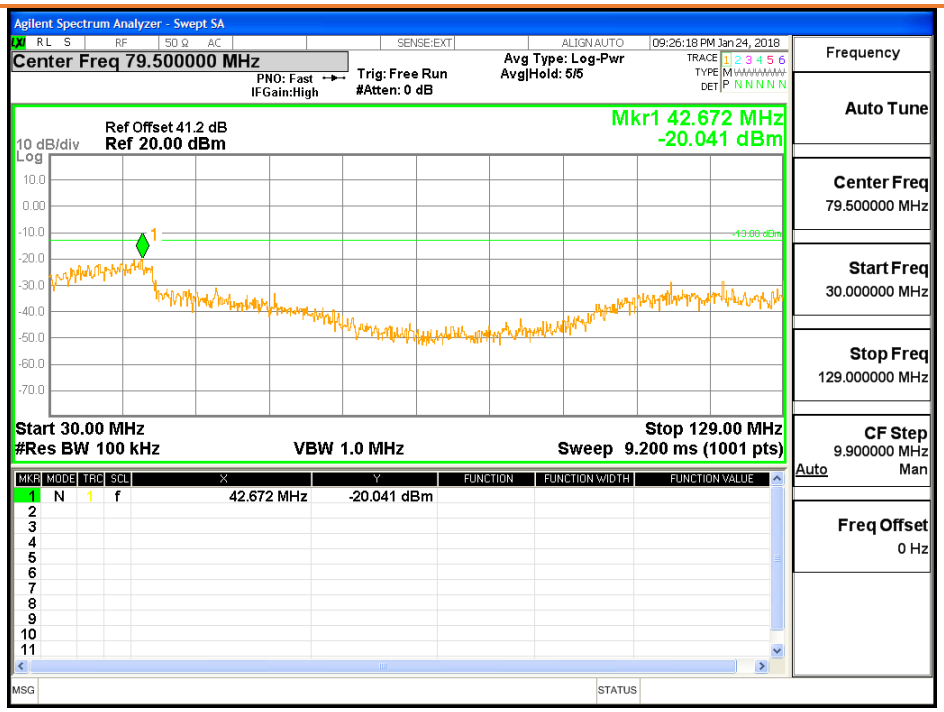


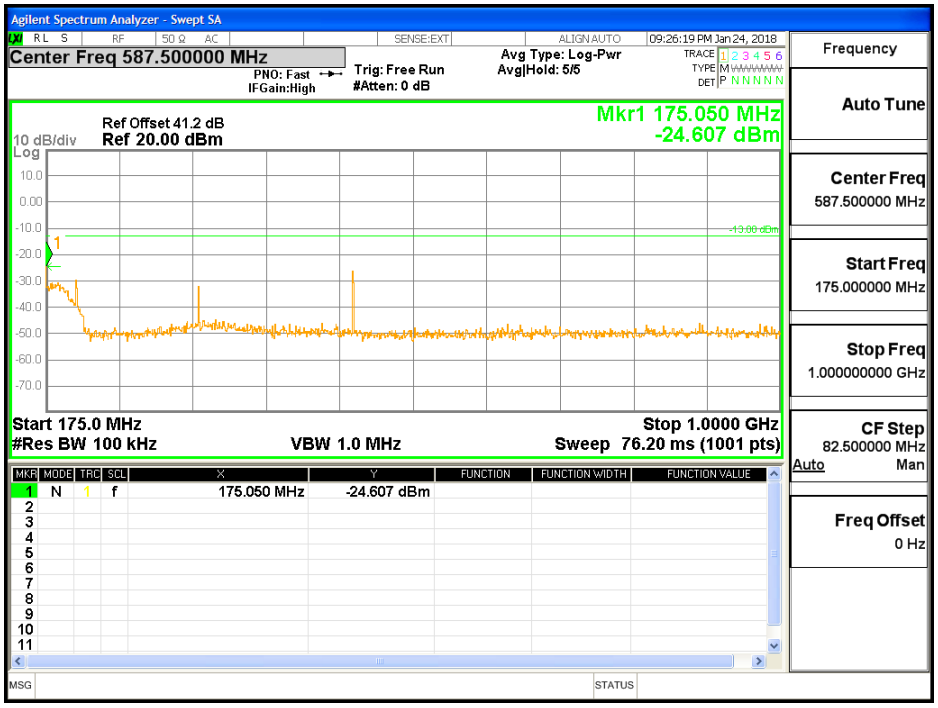


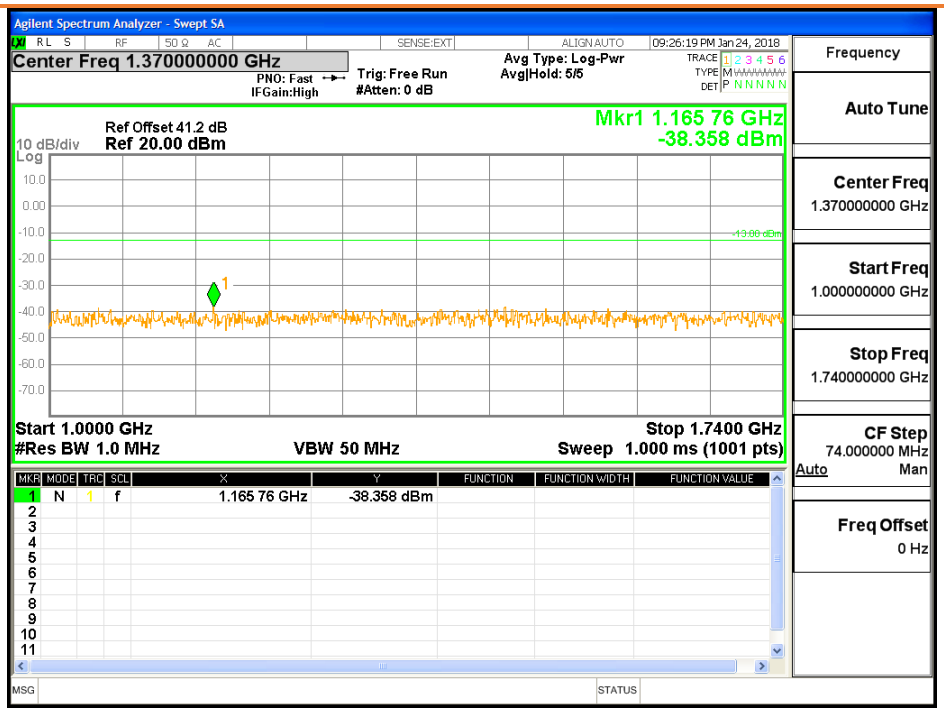
Signal 173.39625 MHz











Spectrum Emission Mask

Governing Doc	FCC Part 90.210 (i)	Room Temperature (°C)	23.6
Test Procedure	ANSI/TIA-603- E-2016; FCC KDB 935210 D05 Indus Booster Basic Meas v01r02: October 27, 2017	Relative Humidity (%)	29.7
Test Location	Burnaby	Barometric Pressure (kPa)	100.5
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 24, 2018
EUT Voltage	☒ DC	☐ 120VAC @ 60Hz	

Test Equipment Used	Manufacturer	Model	Serial Number	Calibration	Calibration due
Signal Generator	Keysight	N5172B	MY53050270	08/04/17	08/04/18
Spectrum Analyzer	Keysight	N9010A	MY50520285	08/07/17	08/07/18
40dB Attenuator	Aeroflex Winschel	58-40-43	n/p	CVP	CVP

Note) CVP = Calibration Verification Performed internally, n/p = not provided.

Frequency Range:	☒ Center Channel
Detector:	☒ Peak
RBW/VBW:	☒100 Hz
Type of Facility:	☒ Testbench
Distance:	☒ direct connect
Arrangement of EUT:	☐ Table-top only ☐ Floor-standing only ☒ Rack Mounted

Signal of all types of modulation is contained within the emission mask.

Compliant ☒ Non-Compliant ☐ Not Applicable ☐

Test setup

Description of test set-up:

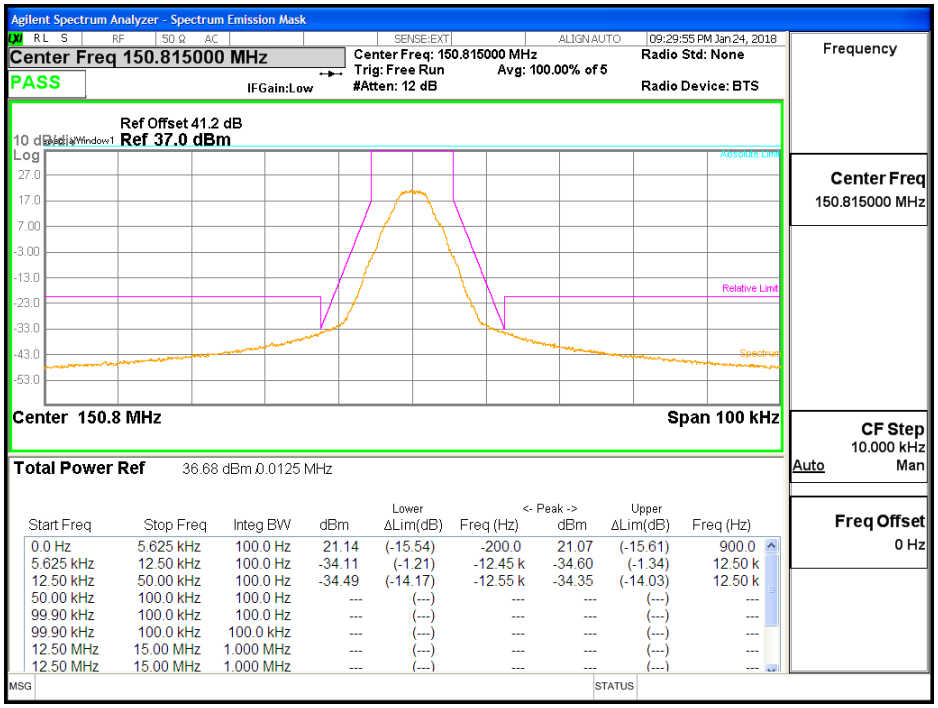
Spectrum Emission Mask is measured by connecting a Spectrum Analyzer to the RF output connector. The input power was adjusted to produce maximum output power on the antenna port. The reference level was measured with integrated BW 2 times of the channel BW. The emission was measured with RBW 100 Hz.

The EUT was set to **Operation Mode #1 with configuration Mode #1.**

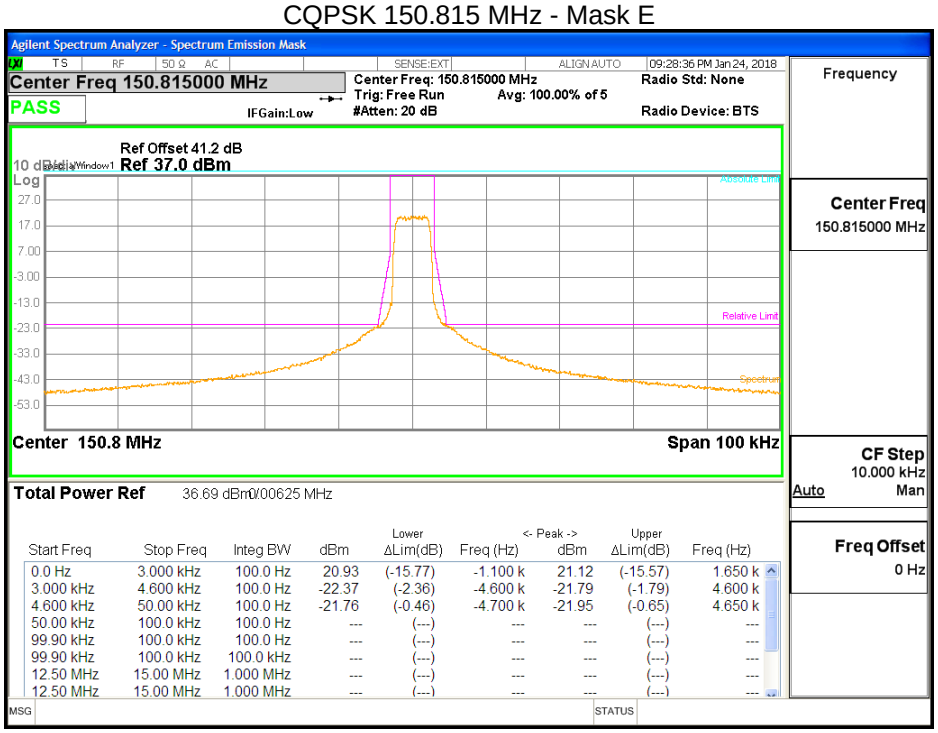
Results

At Input Power 0.5 dB below AGC threshold

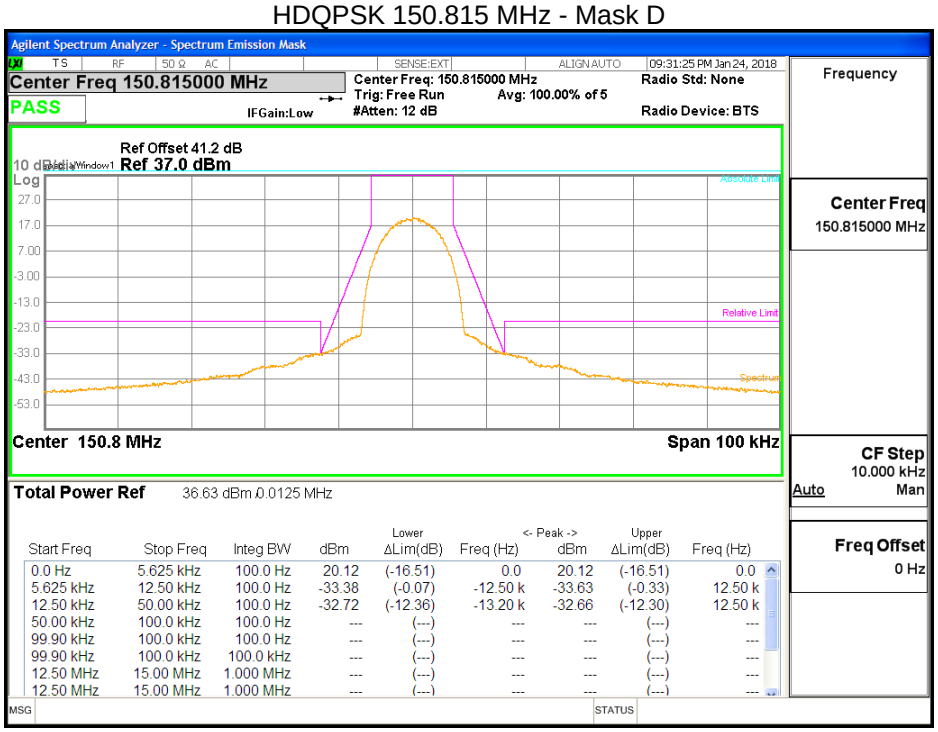
C4FM 150.815 MHz – Mask D



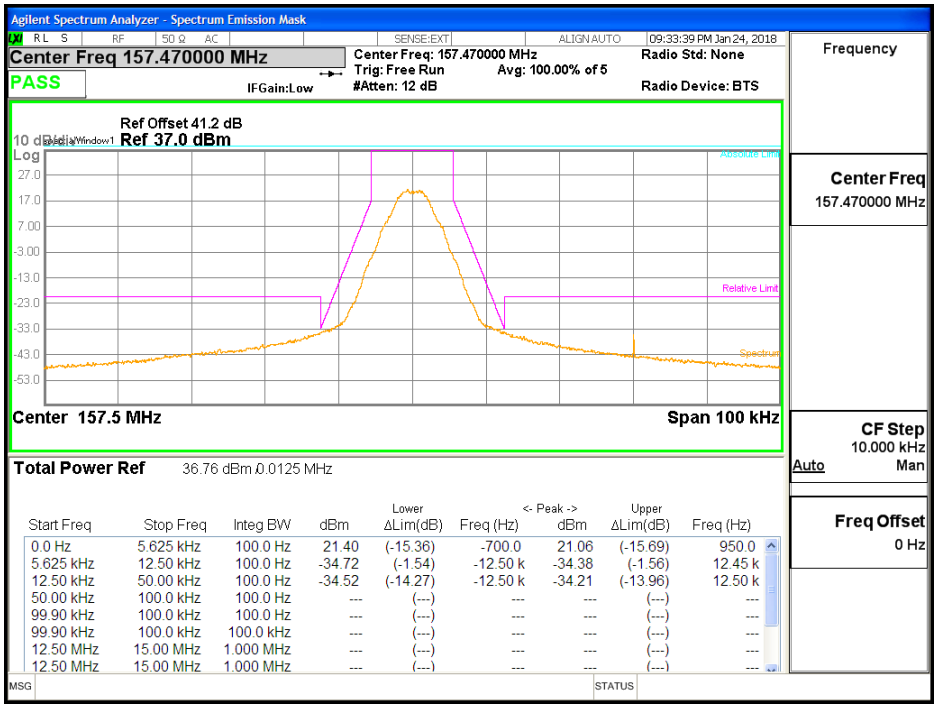
CQPSK 150.815 MHz - Mask E



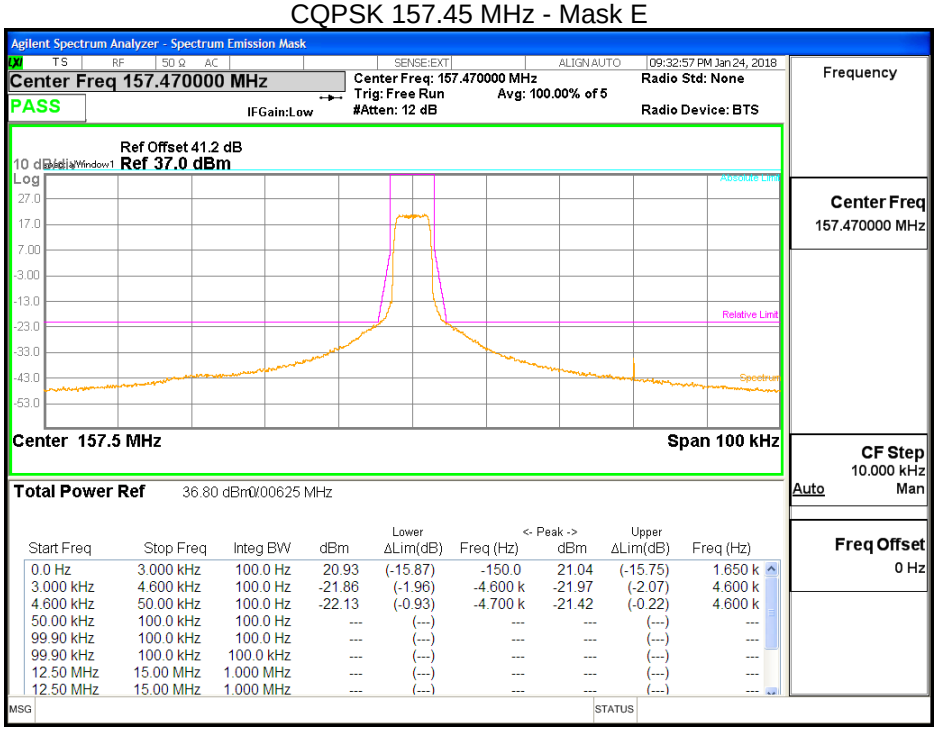
HDQPSK 150.815 MHz - Mask D



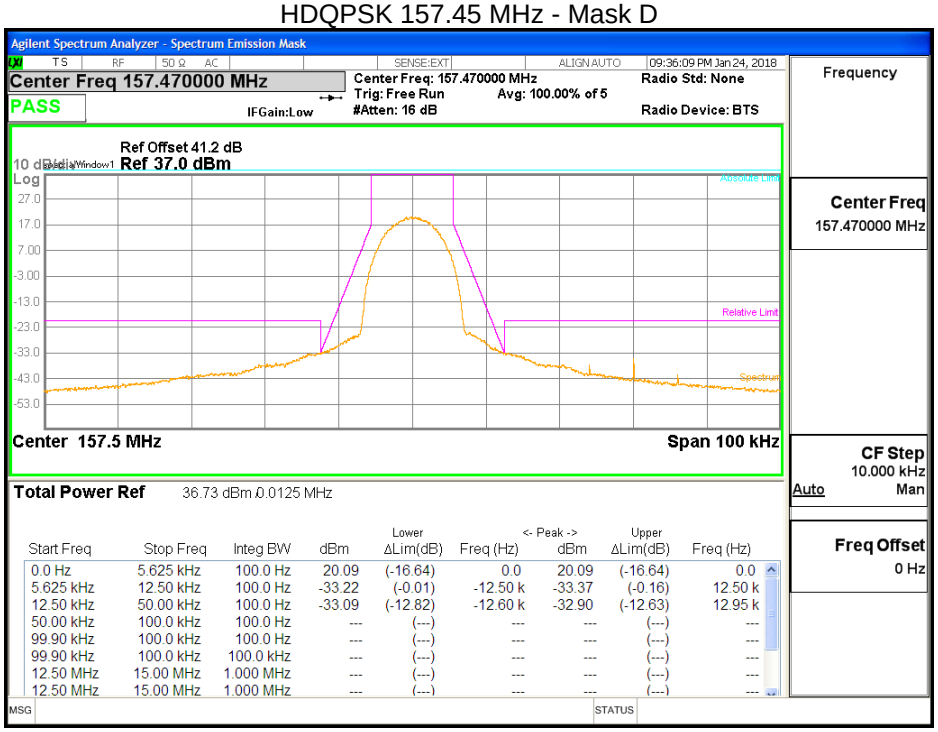
C4FM 157.45MHz - Mask D



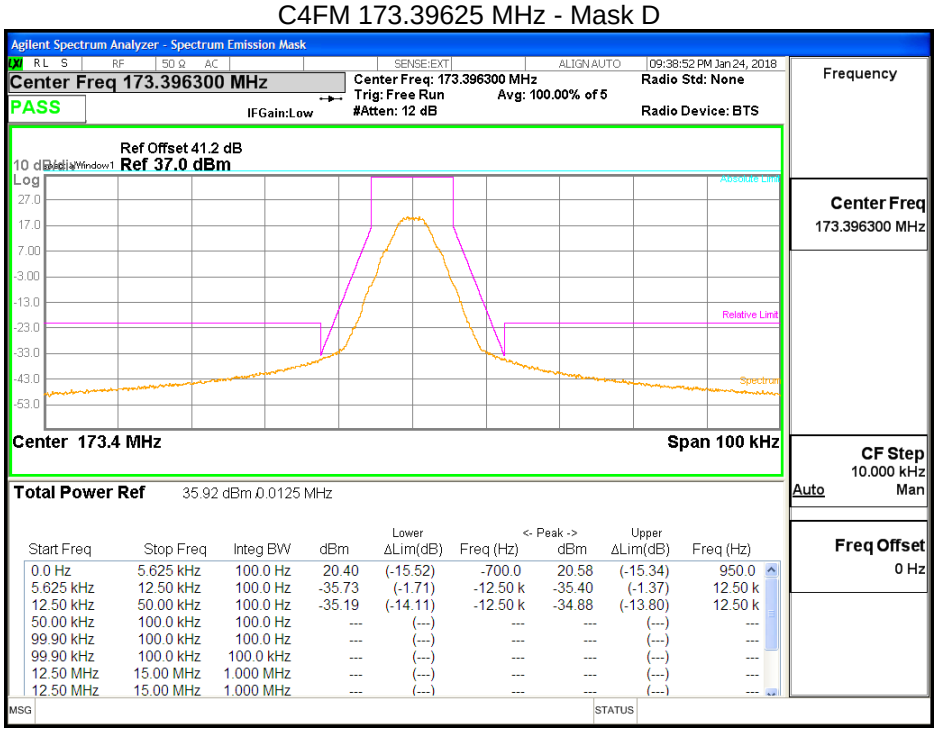
CQPSK 157.45 MHz - Mask E



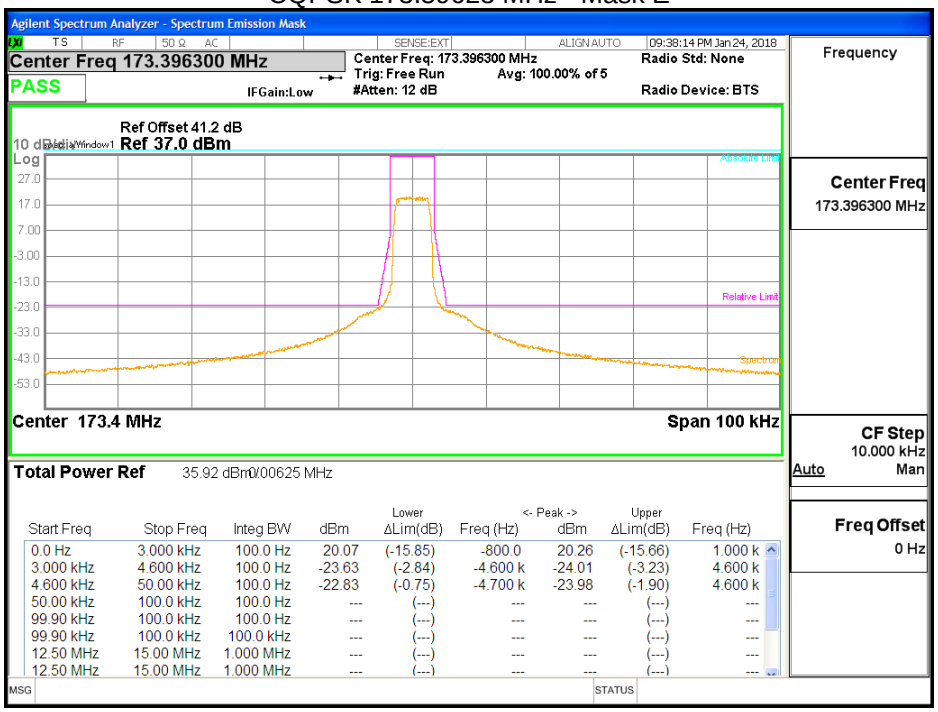
HDQPSK 157.45 MHz - Mask D



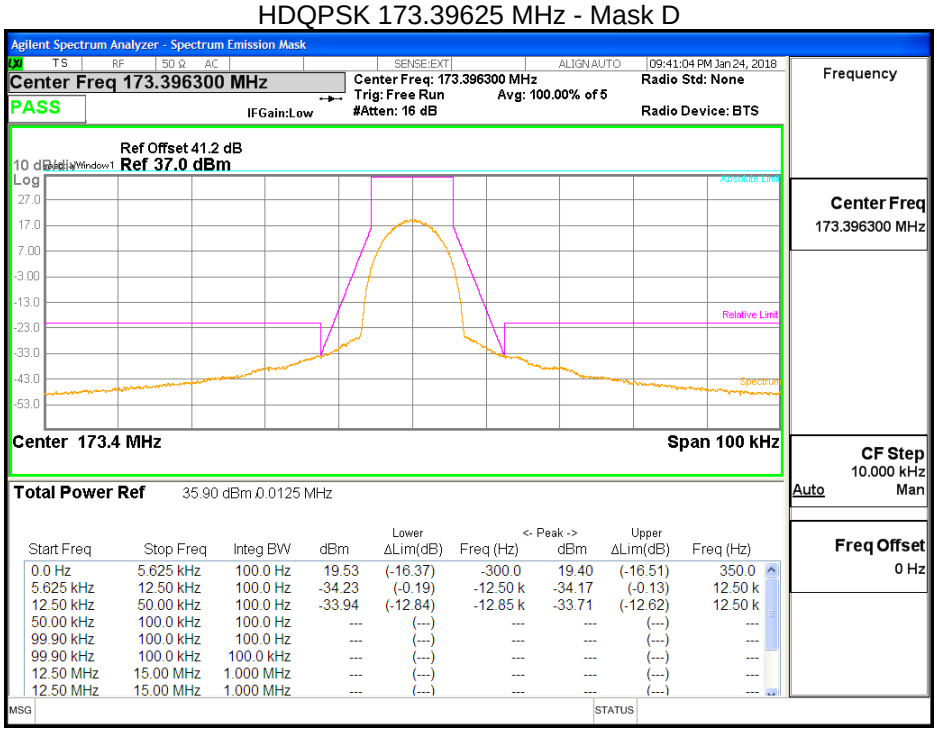
C4FM 173.39625 MHz - Mask D



CQPSK 173.39625 MHz - Mask E

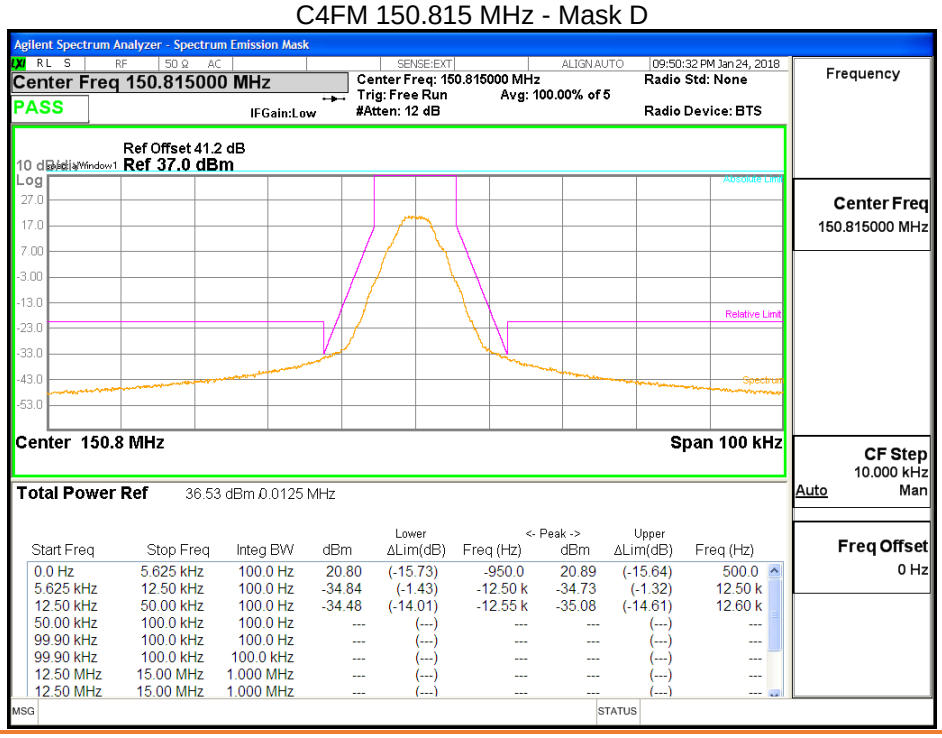


HDQPSK 173.39625 MHz - Mask D

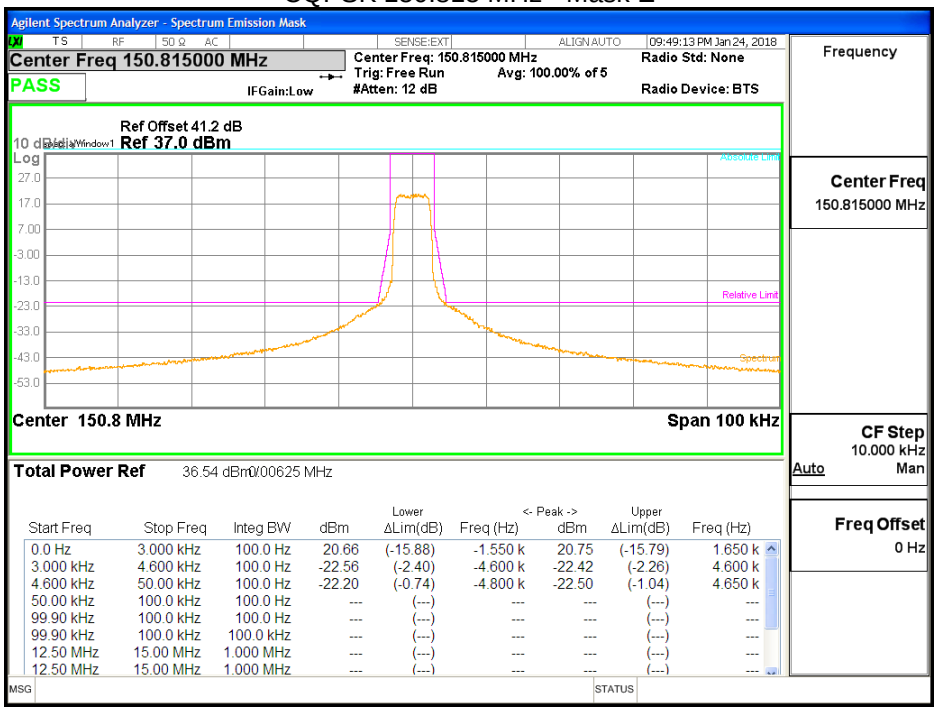


At Input Power 3 dB above AGC threshold

C4FM 150.815 MHz - Mask D

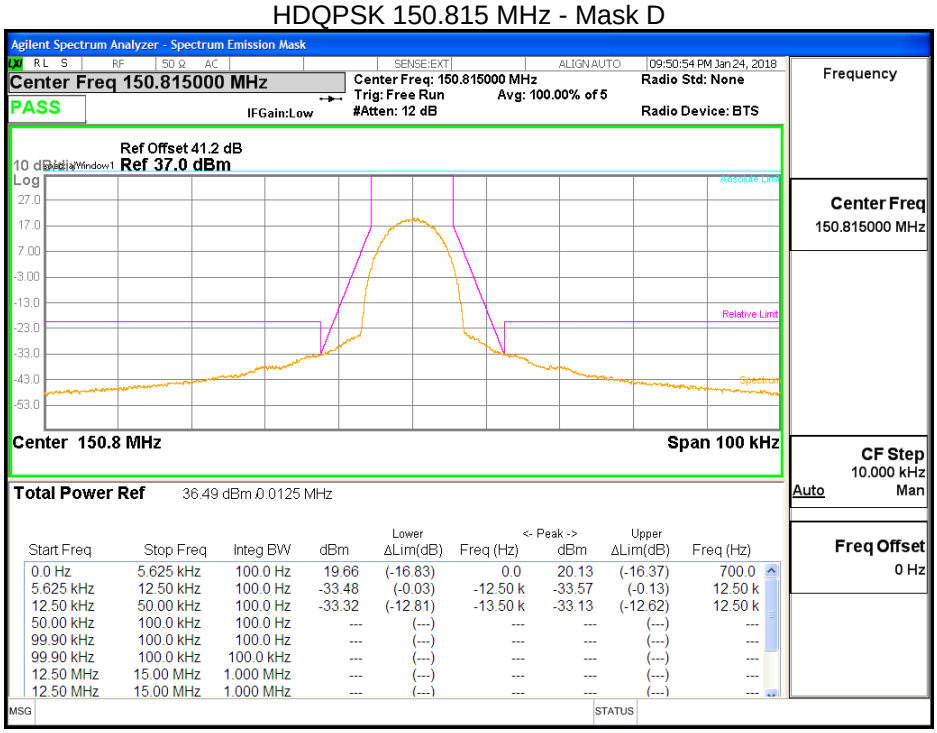


CQPSK 150.815 MHz - Mask E



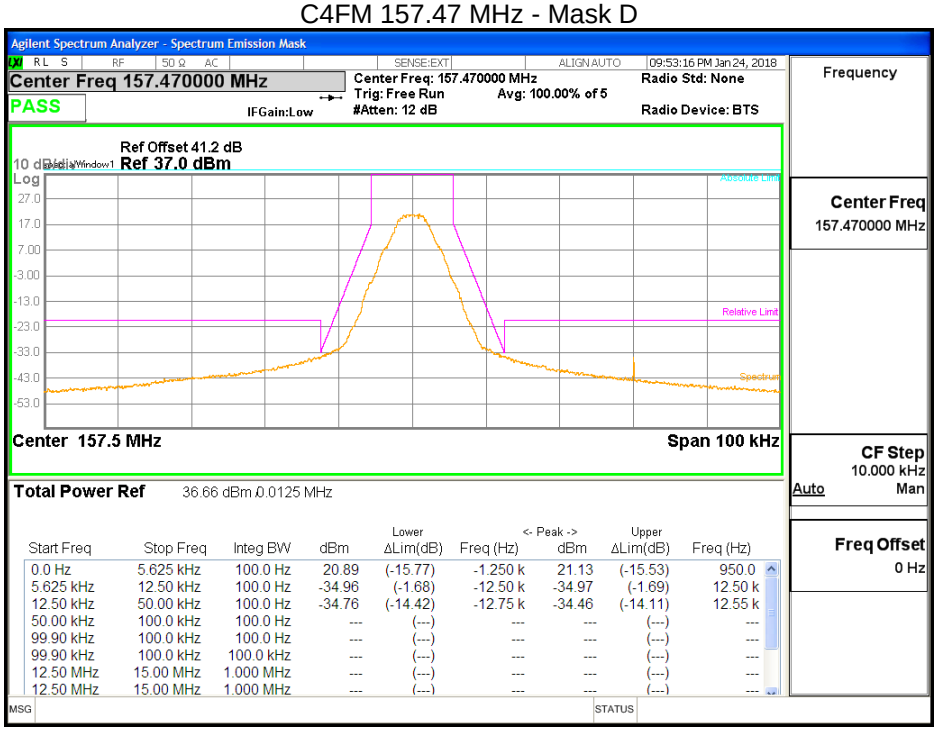
Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	3.000 kHz	100.0 Hz	20.66	(-15.88)	-1.550 k	20.75	(-15.79)	1.650 k
3.000 kHz	4.600 kHz	100.0 Hz	-22.56	(-2.40)	-4.600 k	-22.42	(-2.26)	4.600 k
4.600 kHz	50.00 kHz	100.0 Hz	-22.20	(-0.74)	-4.800 k	-22.50	(-1.04)	4.650 k
50.00 kHz	100.0 kHz	100.0 Hz	---	(---)	---	---	(---)	---
99.90 kHz	100.0 kHz	100.0 Hz	---	(---)	---	---	(---)	---
99.90 kHz	100.0 kHz	100.0 kHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

HDQPSK 150.815 MHz - Mask D

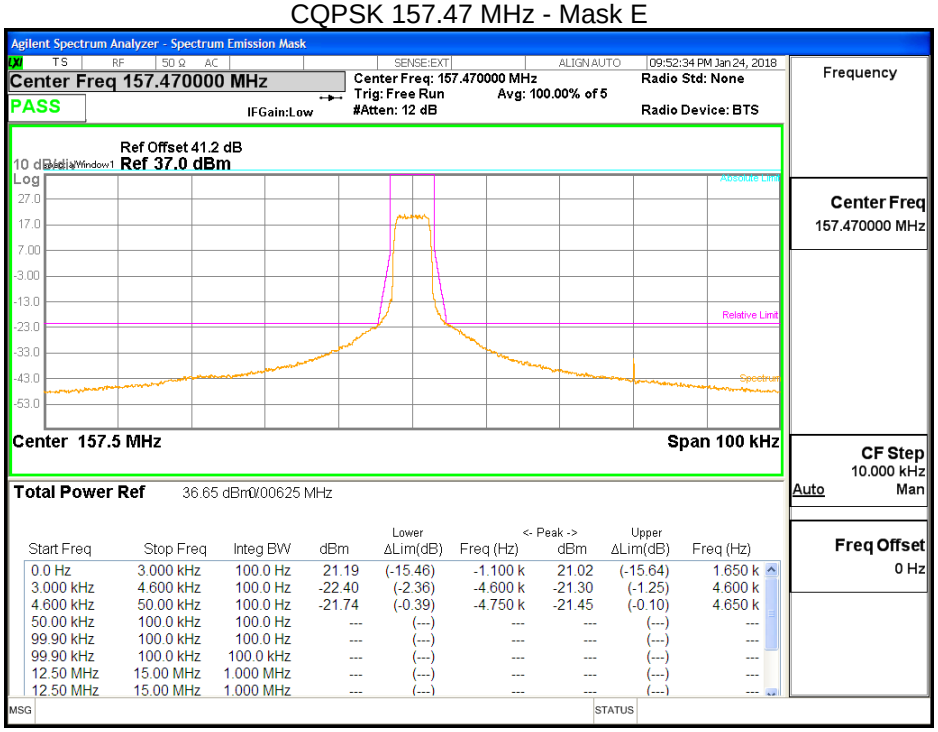


Start Freq	Stop Freq	Integ BW	dBm	Lower ΔLim(dB)	Lower Freq (Hz)	<- Peak -> dBm	Upper ΔLim(dB)	Upper Freq (Hz)
0.0 Hz	5.625 kHz	100.0 Hz	19.66	(-16.83)	0.0	20.13	(-16.37)	700.0
5.625 kHz	12.50 kHz	100.0 Hz	-33.48	(-0.03)	-12.50 k	-33.57	(-0.13)	12.50 k
12.50 kHz	50.00 kHz	100.0 Hz	-33.32	(-12.81)	-13.50 k	-33.13	(-12.62)	12.50 k
50.00 kHz	100.0 kHz	100.0 Hz	---	(---)	---	---	(---)	---
99.90 kHz	100.0 kHz	100.0 Hz	---	(---)	---	---	(---)	---
99.90 kHz	100.0 kHz	100.0 kHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---
12.50 MHz	15.00 MHz	1.000 MHz	---	(---)	---	---	(---)	---

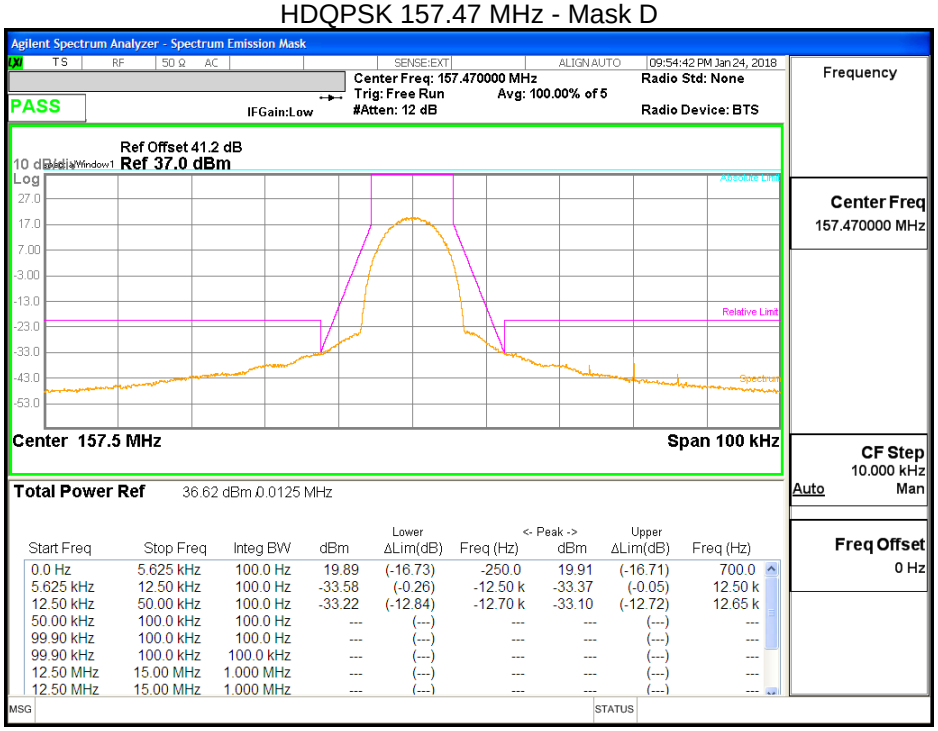
C4FM 157.47 MHz - Mask D



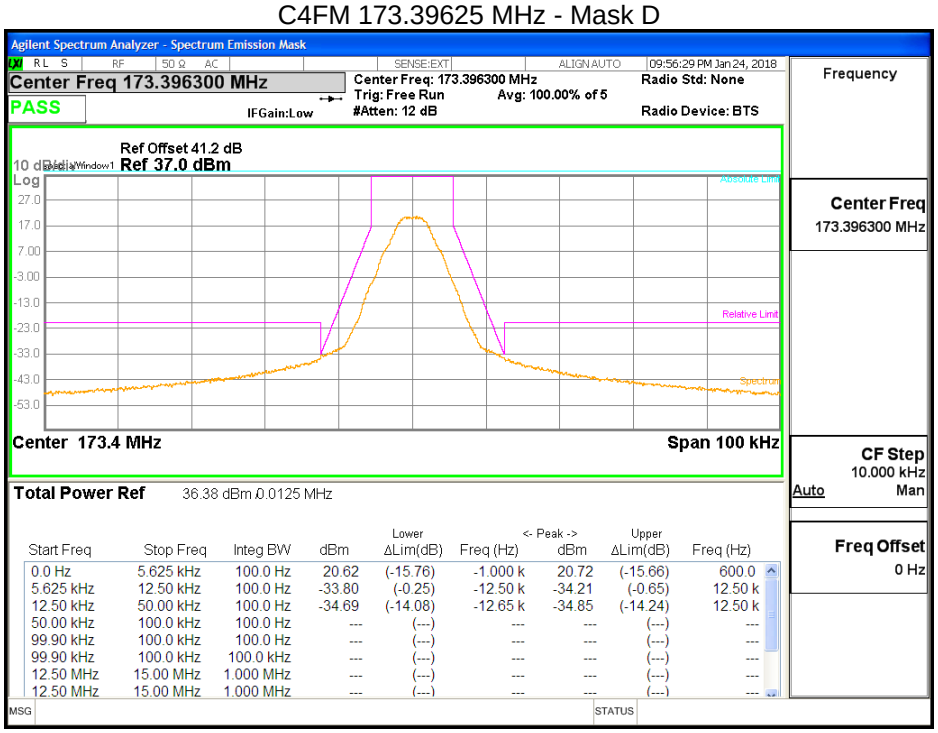
CQPSK 157.47 MHz - Mask E



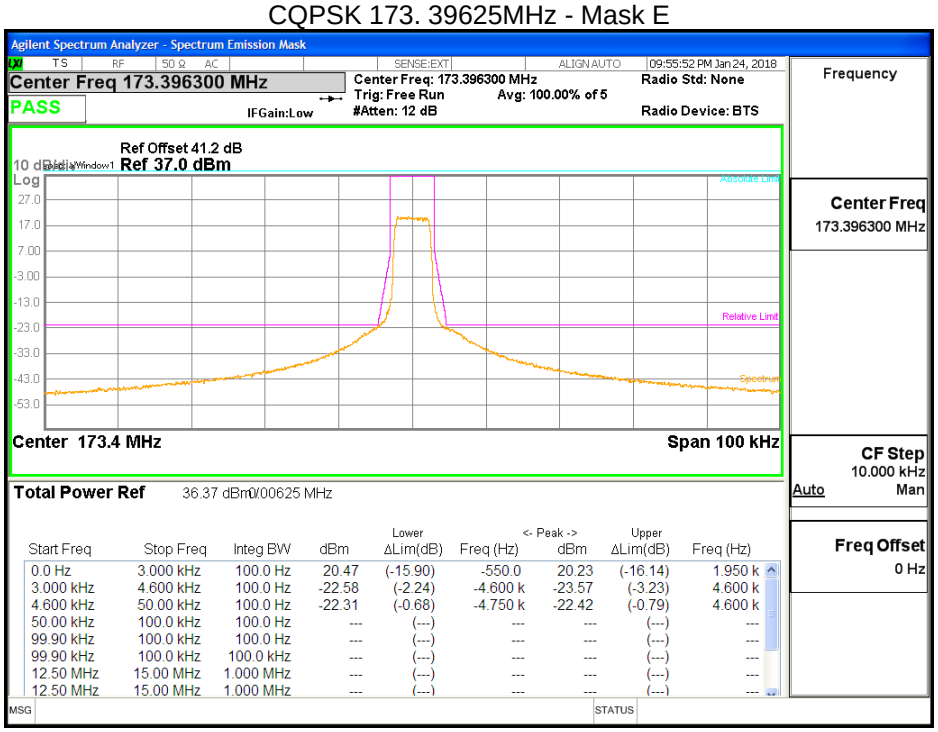
HDQPSK 157.47 MHz - Mask D



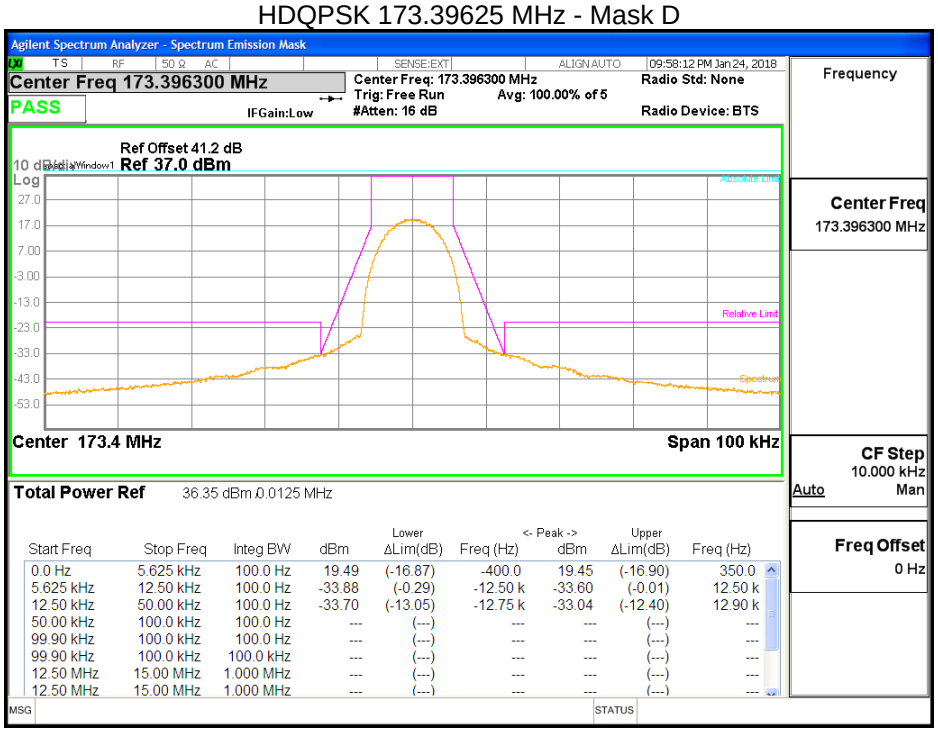
C4FM 173.39625 MHz - Mask D



CQPSK 173. 39625MHz - Mask E



HDQPSK 173.39625 MHz - Mask D



Frequency Stability

The airHost and hd33 are sychronized to the same reference clock. Therefore there is no frequency error after down and up frequency conversion are performed.

The frequency stability check is not applicable to the EUT.

Passband Gain and Bandwidth & Out of Band Rejection

Governing Doc	FCC KDB 935210 D05 Indus Booster Basic Meas v01r02: October, 2017 RSS-131 Sec 6.1	Room Temperature (°C)	23.6
Test Procedure	ANSI/TIA-603- E-2016; FCC KDB 935210 D05 Indus Booster Basic Meas v01r02: October, 2017 RSS-131 Sec 4.2	Relative Humidity (%)	29.7
Test Location	Burnaby	Barometric Pressure (kPa)	100.5
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 24, 2018
EUT Voltage	☒ DC	☐ 120VAC @ 60Hz	

Test Equipment Used	Manufacturer	Model	Serial Number	Calibration	Calibration due
Signal Generator	Keysight	N5172B	MY53050270	08/04/17	08/04/18
Spectrum Analyzer	Keysight	N9010A	MY50520285	08/07/17	08/07/18
40dB Attenuator	Aeroflex Winschel	58-40-43	n/p	CVP	CVP

Note) CVP = Calibration Verification Performed internally, n/p = not provided.

Frequency Range:	☒ Product Passband ± 250%
Detector:	☒ Peak
RBW/VBW:	☒0.1% of 5 times of passband bandwidth
Type of Facility:	☒ Tabletop
Distance:	☒ Direct

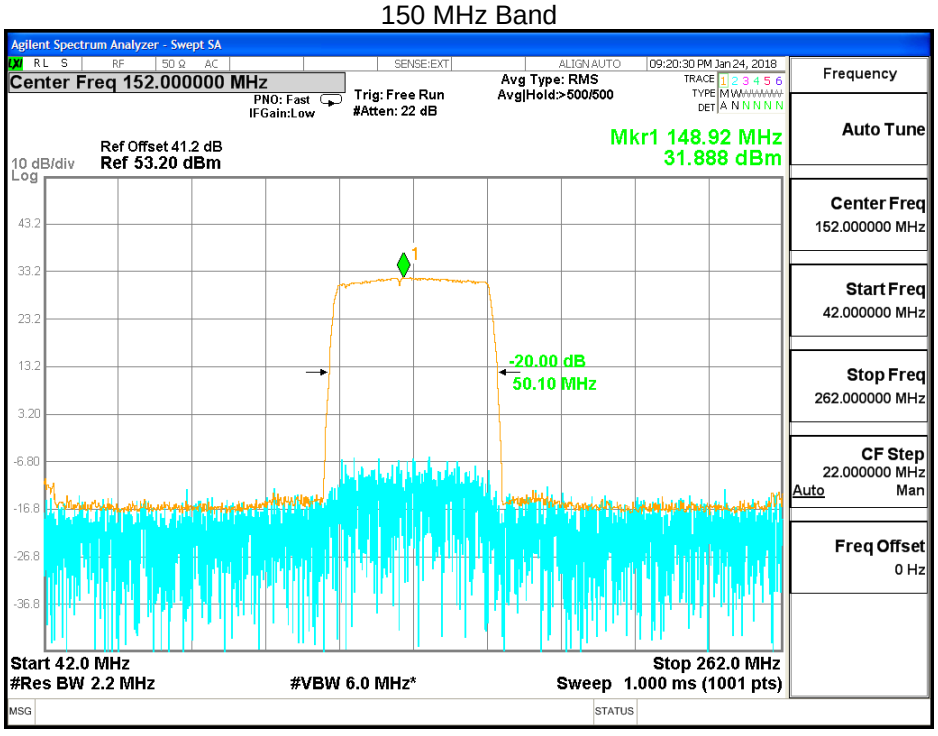
Compliant ☒ Non-Compliant ☐ Not Applicable ☐

Test setup

Description of test set-up:
The procedure used was ANSI/TIA-603-E-2016 and FCC KDB 935210 D05 Indus Booster Basic Meas v01r02. The signal booster was set to maximum gain. A swept CW signal was set to the range of ±250 % of the product pass band. The CW ampltitude was set to 5 dB below the AGC threshold so that the ALC should not activate throughout the test. After the max-hold sweep trace was completed, a marker was set to the peak amplitude, and a 20dB bandwidth was measured between two additional markers fall 20 dB from the peak. The EUT was set to **Operation Mode #1 with configuration Mode #1.**

Results

150 MHz Band



Intermodulation

Governing Doc	FCC Part 90.219	Room Temperature (°C)	23.6
Test Procedure	ANSI/TIA-603- E-2016; FCC KDB 935210 D05 Indus Booster Basic Meas v01r02: October, 2017	Relative Humidity (%)	29.7
Test Location	Burnaby	Barometric Pressure (kPa)	100.5
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 24, 2018
EUT Voltage	☒ DC	☐ 120VAC @ 60Hz	

Test Equipment Used	Manufacturer	Model	Serial Number	Calibration	Calibration due
Signal Generator	Keysight	N5172B	MY53050270	08/04/17	08/04/18
Spectrum Analyzer	Keysight	N9010A	MY50520285	08/07/17	08/07/18
40dB Attenuator	Aeroflex Winschel	58-40-43	n/p	CVP	CVP

Note) CVP = Calibration Verification Performed internally, n/p = not provided.

Frequency Range:	☒ Max Gain Frequency ± 50kHz
Detector:	☒ Average
RBW/VBW:	☒100/910Hz
Type of Facility:	☒ Tabletop
Distance:	☒ Direct

The intermodulation product of 2 tone is below the -13dBm emission limit with input power
- 0.5dBm below AGC threshold and
- 3 dB above AGC threshold

Compliant ☒ Non-Compliant ☐ Not Applicable ☐

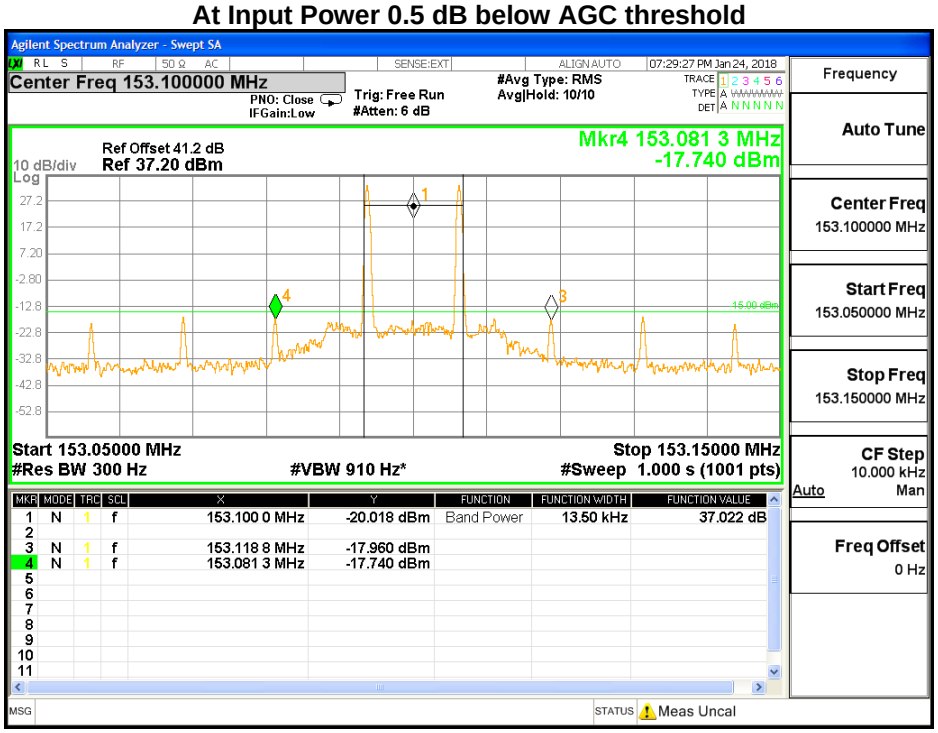
Test setup

Description of test set-up:
The procedure used was ANSI/TIA-603-E-2016. Two tones (CW) method was used. The input power to the amplifier was set at maximum drive level by combining the two tones. The two tones were chosen in such a way (1) the third order intermodulation product frequencies are located within the pass band of the DUT and (2) they produce the worst-case emissions out of band. All signals were modulated. Based on FCC KDB 935210 D05 Indus Booster Basic Meas v01r02: 2017, the two tone was located on either side of the maximum gain frequence in the passing band, and separated with the available spacing, which is 12.5kHz in 150 MHz band. Measurements were performed with modulated -tone at identical input amplitude which produced integrated maximum rated output power. The EUT was set to **Operation Mode #1 with configuration Mode #1.**

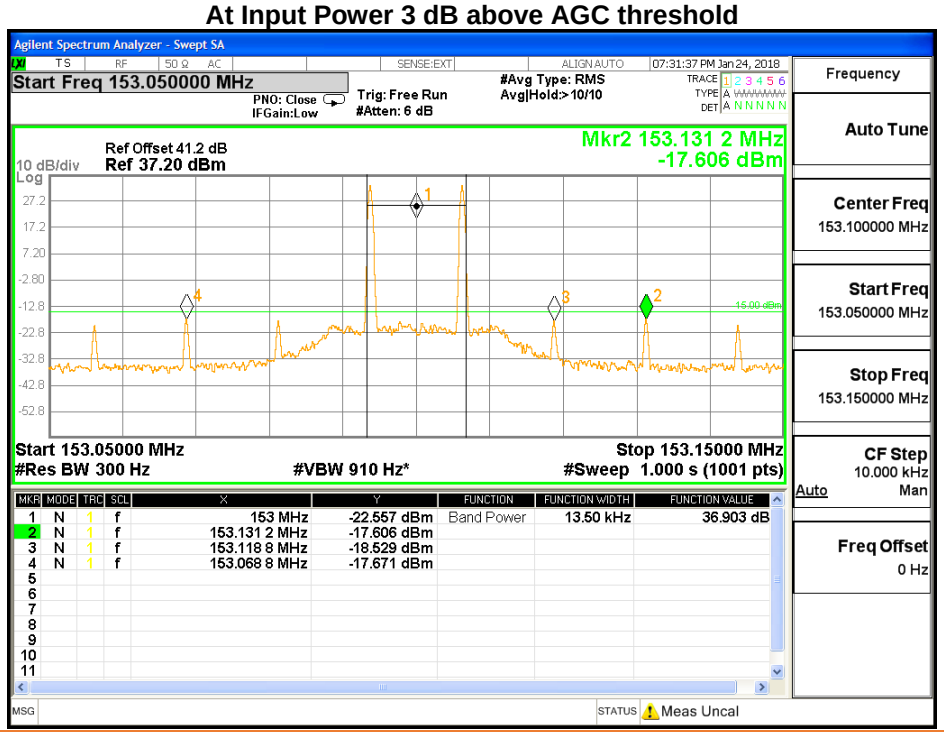

Results

On the maximum gain channel 153.32 MHz:

At Input Power 0.5 dB below AGC threshold



At Input Power 3 dB above AGC threshold



Input/output Power and Amplifier/Booster Gain

Governing Doc	FCC Part 90.219	Room Temperature (°C)	23.6
Test Procedure	ANSI/TIA-603-E-2016; FCC KDB 935210 D05 Indus Booster Basic Meas v01r02: October 27, 2017	Relative Humidity (%)	29.7
Test Location	Burnaby	Barometric Pressure (kPa)	100.5
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 24, 2018
EUT Voltage	☒ DC	☐ 120VAC @ 60Hz	

Test Equipment Used	Manufacturer	Model	Identifier	Calibration	Calibration due
Signal Generator	Keysight	N5172B	MY53050270	08/04/17	08/04/18
Spectrum Analyzer	Keysight	N9010A	MY50520285	08/07/17	08/07/18
40dB Attenuator	Aeroflex Winschel	58-40-43	n/p	CVP	CVP

Note) CVP = Calibration Verification Performed internally, n/p = not provided.

Span:	☒ Max Gain Frequency ± 1500kHz
Detector:	☒ Peak
RBW/VBW:	☒100k Hz/ 300 kHz
Type of Facility:	☒ Tabletop
Distance:	☒ Direct

Maximum booster gain is 91.987 dB.

Compliant ☒ Non-Compliant ☐ Not Applicable ☐

Test setup

Description of test set-up:

The procedure used was ANSI/TIA-603-E-2016 and FCC KDB 935210 D05 Indus Booster Basic Meas v01r02:. A CW tone was input at the frequency where the system gain is the maximum in the pass band, with the nominal input power level -55 dBm. The spectrum analyzer was connected to the output RF port via a 50 Ohm 40 dB attenuator. The maximum hold trace and peak detector was used to capture the output power. The output power minus the input power (-55 dBm) equals to the booster gain in dB.

The EUT was set to **Operation Mode #1 with configuration Mode #1.**

Results

	DL Gain	DL Input	DL Output
150 band	91.987 dB	-55 dBm	36.987 dBm

Noise Figure

Governing Doc	FCC Part 90.219	Room Temperature (°C)	23.4
Test Procedure	ANSI/TIA-603-E-2016; FCC KDB 935210 D05 Indus Booster Basic Meas v01r02: October 27, 2017	Relative Humidity (%)	32.7
Test Location	Burnaby	Barometric Pressure (kPa)	101.5
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 25, 2018
EUT Voltage	☒ DC	☐ 120VAC @ 60Hz	

Test Equipment Used	Manufacturer	Model	Serial Number	Calibration	Calibration due
Spectrum Analyzer	Keysight	N9010A	MY50520285	08/07/17	08/07/18

Note) CNR = Calibration not required when used with other calibrated equipment.

Frequency Range:	☒ 100 MHz centered at the center frequency of the passband on each band
Detector:	☒ Average
RBW:	☒910 kHz
Type of Facility:	☒ Tabletop
Distance:	☒ Direct

Noise Figure on each band is less than the 9 dB required.

Compliant ☒ Non-Compliant ☐ Not Applicable ☐

Test setup

Description of test set-up:

Based on FCC KDB 935210 D05 Indus Booster Basic Meas v01r02: 2017, the system maximum gain and the noise density is measured.Measurements were performed within the EUT's passband.

The noise figure is then calculated by NF = NP – Gain + KTB Noise; where

NP is in band noise power per Herz,

Gain is in band booster gain, which is 91.987 dB in DL.

KTB Noise is 174dB/Hz at room temperature.

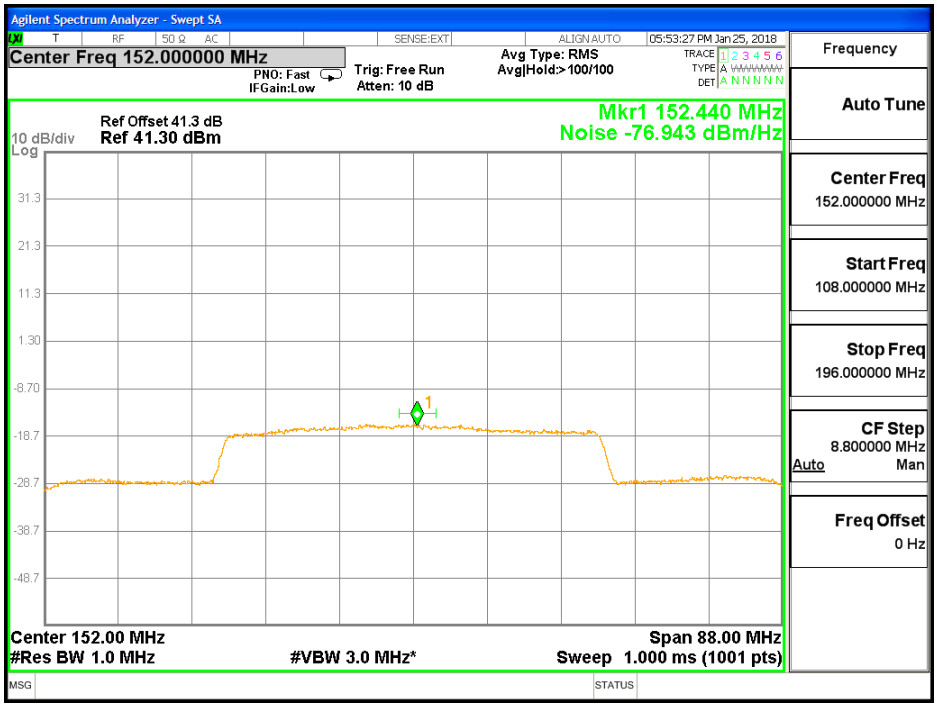
The EUT was set to **Operation Mode #1 with configuration Mode #1.**

For Noise Power Measurement

Results

150MHz band

NF = -76.94 – 91.987 + 174 = 5.07 dB



Radiated Emissions - Enclosure

Governing Doc	FCC 15.209	Room Temperature (°C)	20.6
Test Procedure	ANSI C63.4	Relative Humidity (%)	48
Test Location	Richmond	Barometric Pressure (kPa)	100.4
Test Engineer	David Johanson	Date	20 October 2017
EUT Voltage	☒ DC	☐ 120VAC @ 60Hz	

Test Equipment Used	Manufacturer	Model	Identifier	Calibration date	Calibration
Spectrum Analyzer	KeySight	N9038A	702	18-Apr-2017	18-Apr-2018
Broadband Antenna	Sunol	JB1	371	29-Mar-2016	29-Mar-2018
Loop Antenna	ComPower	AL-130	241	28-Oct-2015	28-Oct-2017
Loop Antenna	ComPower	AL-130	241	11-Nov-2017	11-Nov-2019
Horn Antenna	A.H Systems	SAS-571	227C	22-Sep-2016	22-Sep-2018
RF Preamplifier	Agilent	8449B	273	NCR	NCR
EMC Shielded Enclosure	USC	USC-26	374	NCR[1]	NCR[1]

Note1) NCR = No Calibration Required, but NSA was done at 2016.

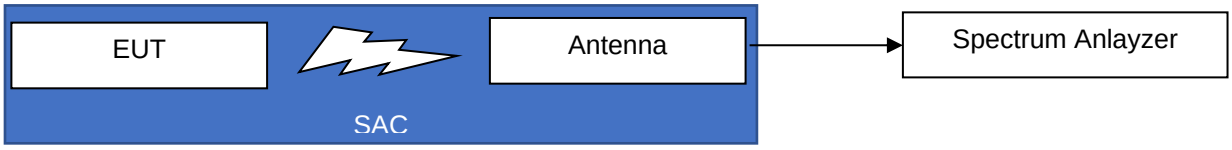
Frequency Range:	☒ 9kHz-30MHz	☒ 30-1000MHz	☒ 1-18GHz
Detector:	☒ Peak (for Prescan)	☒ Quasi-Peak(for Formal))	☒ Average(for Formal)
RBW/VBW:	☒ 9/30kHz	☒ 120/300kHz	☒ 1/3MHz
Type of Facility:	☒ SAC	☐ FSOATS	☐ *in-situ*
Distance:	☒ 3meter	☐ 10meter	☐ 1meter
Arrangement of EUT:	☒ Table-top only	☐ Floor-standing only	☐ Rack Mounted

Compliant ☒ Non-Compliant ☐ Not Applicable ☐

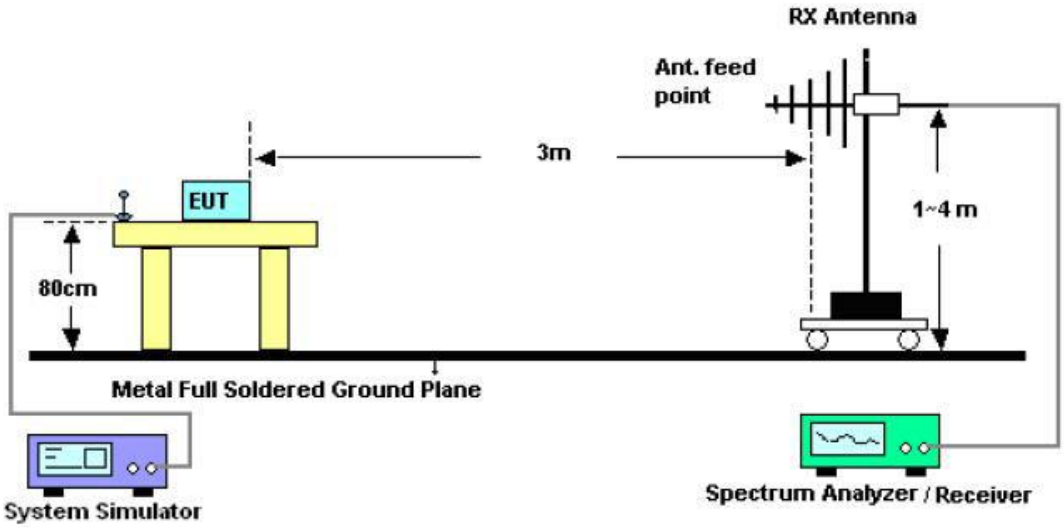
Test setup

Description of test set-up:

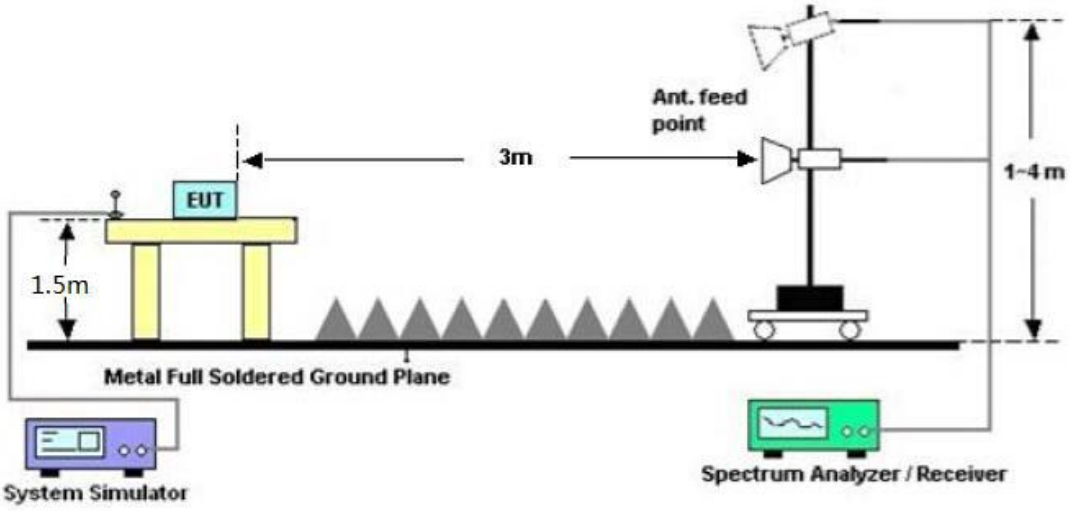
The EUT was placed on a nonconducting platform (i.e., an “EUT support table”), of nominal size 1 m by 1.5 m, whose top surface is nominally 80 cm above the reference ground plane. The EUT was set up on 3 meters away from the EUT. The EUT was set continually on its Radio, 5W Max., which was downlinked from airHost. And the output of RF was terminated via 40dB attenuator, for rejecting the high power of carrier. The lowest, middle and highest channels were used for measuring of all radiated spurious emisions .
The EUT was set to **Operation Mode #1 with configuration Mode #1.**



- Radiated Emission 30 to 1,000MHz, with JB-1



- Radiated Emission 1 to 18GHz, with SAS-571



Measurement Procedure

Testing was performed in accordance with the test standard(s) referenced in the test summary section of this report. The Equipment Under Test (EUT) was configured based upon the requirements of the applicable test standard. Initially, the primary emission frequencies are identified by positioning a broadband receive antenna three meter from the EUT.

Scans were made with an EMC Analyzer, controlled by EMC Test Software, Tile7!, from 30kHz to 18GHz with the receiver in the peak mode. The receiver IF bandwidth was 9kHz,120 kHz or 1MHz as appropriate for the frequency and scan step was about 30kHz. To ensure that the maximum emission at each discrete frequency of interest is observed, the receive antenna is varied in height from one to four meters and rotated to produce horizontal and vertical polarities while the turntable is rotated to determine the worst emitting configuration. Under 30MHz was only tested at 1meter height and Antenna was changed both polarization, Horizontal and Vertical. Measurements were then made using CISPR quasi peak when the peak readings were within 10dB of the limit line. The numerical results are included herein to demonstrate compliance.

Test Result

The output of EUT was set to 5 Watt(+37dBm),
The PASS level of Spurious is: 43 + 10log(P) = 43 + 10log(1) = 49.99dB attenuation = -13dBm

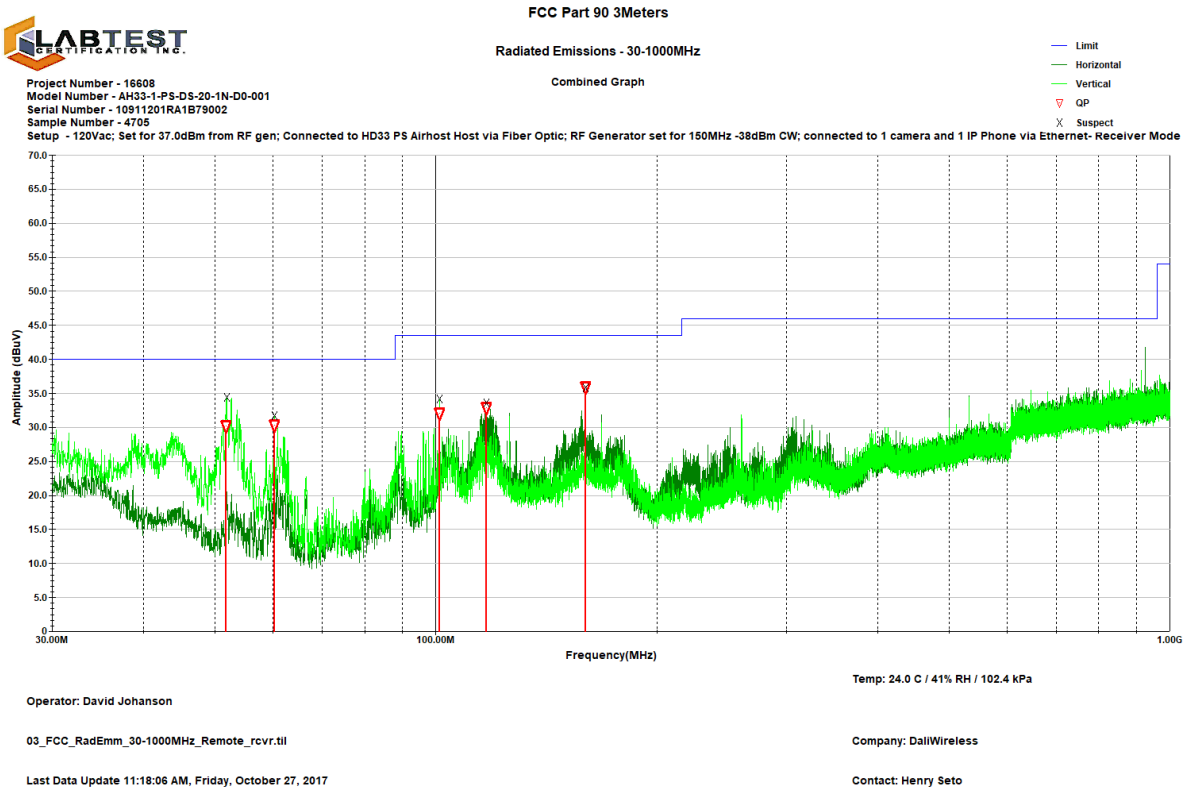
Since of radiated measurement was performed at 3 meters, the limit line was converted to dBuV/m using the formulas as outlined in KDB 971168 (5.8.4): -13 dBm ERP = 84.38 dBuV/m at 3 meters.

Spurious Emission level (dBuV/m) = Detected level (dBuV) + Path Loss(dB) + Antenna Factor (dB/m) - Preamplifier's Gain (dB)

Graphical Representation for Emission - Radiated 30kHz to 30MHz

Spectrum was scanned manually from 30kHz to 30MHz. No automated plot is available for this frequency range. No spurious emissions from the product were detectable

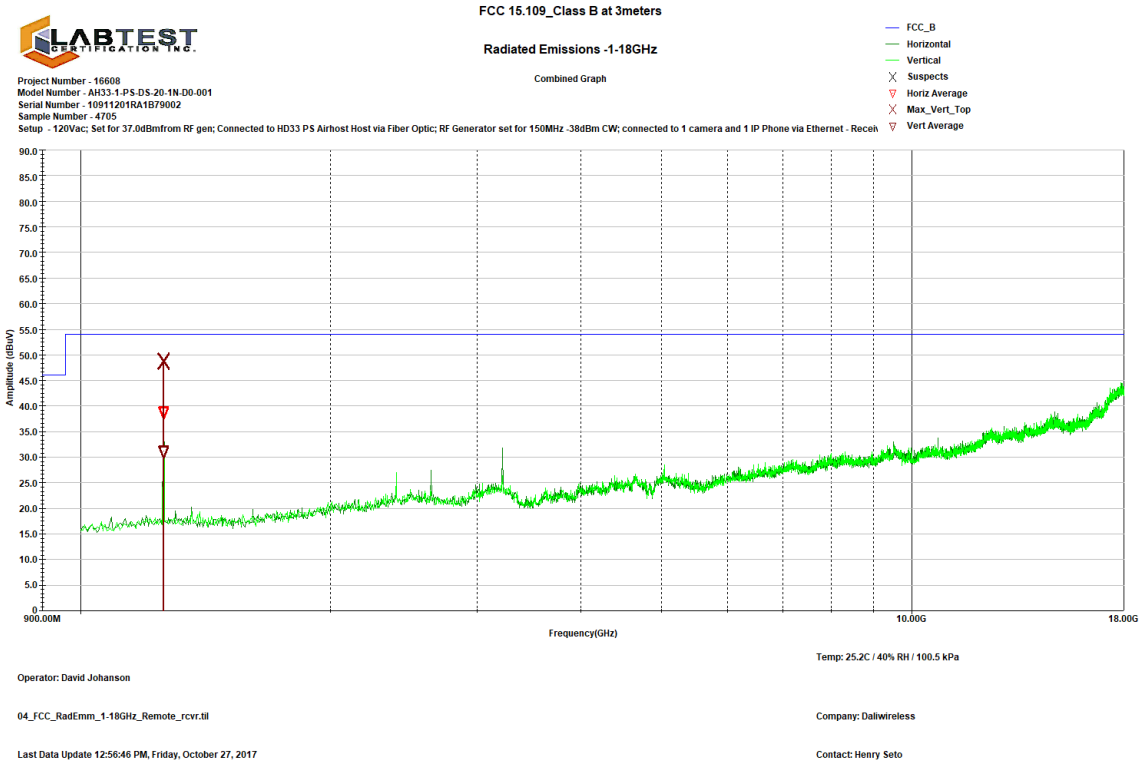
Graphical Representation for Emission - Radiated 30MHz to 1GHz



15.209 Limit Line									
Radiated Emissions_30 MHz -1 GHz - Vertical									
Frequency	Ant Fac	Cable Fac	Preamp	AZ	HGT	Peak	QP	Limit	Margin
MHz	dB	dB	dB	Deg	cm	dBuV/m	dBuV/m	dBuV/m	dB
51.7893	7.66	0.84	0	0	126	33.693	30.231	40	-9.769
60.1797	6.11	0.9	0	48	105	32.716	30.303	40	-9.697
101.1137	12.88	1.19	0	176	124	34.556	32.066	43.52	-11.454

15.209 Limit Line									
Radiated Emissions_30 MHz -1 GHz - Horizontal									
Frequency	Ant Fac	CableLoss	Preamp	AZ	HGT	Peak	QP	Limit	Margin
MHz	dB	dB	dB	Deg	cm	dBuV/m	dBuV/m	dBuV/m	dB
117.1773	15.6	1.3	0	127.3	265.8	36.485	32.947	43.52	-10.573
160.0043	15.9	1.5	0	134	194.8	38.576	35.883	43.52	-7.637

Graphical Representation for Emission - Radiated 1 to 18GHz



15.209 Limit Line									
Radiated Emissions_1-18GHz - Vertical									
Frequency	Peaks	Average	Limit	Peak Margin	Ant Fac	Cable Fac	Preamp	AZ	HGT
	dBuV/m	dBuV/m	dBuV/m	dB	dB	dB	dB	Deg	cm
1.2594 GHz	37.17	31.203	53.98	-16.81	24.59	6.21	-33.4	360	244

15.209 Limit Line									
Radiated Emissions_1-18GHz - Horizontal									
Frequency	Peaks	Average	Limit	Peak Margin	Ant Fac	Cable Fac	Preamp	AZ	HGT
	dBuV/m	dBuV/m	dBuV/m	dB	dB	dB	dB	Deg	cm
1.2594 GHz	41.513	38.845	53.98	-12.467	24.58	6.21	-33.4	327	100

All other emissions 20dB or greater below the limit line.

APPENDIX A: ISO 17025:2005 Accreditation Certificate

CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board
500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

Labtest Certification, Inc.
3128, 20800 Westminster HWY
Richmond B.C. V6V 2W3

has been assessed by ANAB
and meets the requirements of international standard

ISO/IEC 17025:2005

while demonstrating technical competence in the field of

TESTING

Refer to the accompanying Scope of Accreditation for information regarding the types of tests to which this accreditation applies.

AT-2033
Certificate Number

ANAB Approval

Certificate Valid: 08/07/2017-03/04/2018
Version No. 004 Issued: 08/07/2017

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

ANSI-ASQ National Accreditation Board

ANAB

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

Labtest Certification, Inc.
3128, 20800 Westminster HWY
Richmond, B.C. V6V 2W3
Kavinder Dhillon Ruben Ugarte Phone: 604-247-0444
kdhillon@labtestcert.com ruben.Ugarte@labtestcert.com
www.labtestcert.com

TESTING

Valid to: **March 4, 2018** Certificate Number: **AT-2033**

Testing performed in support of FCC DoC and Certification approval procedures

Type of Device Examples	Scope of Accreditation	Supporting FCC Guidance	Comments
Unintentional Radiators (FCC Part 15, Subpart B)	• ANSI C63.4-2014		
Industrial, Scientific, and Medical Equipment (FCC Part 18) • Consumer ISM equipment	• FCC MP-5, (February 1986)		
Intentional Radiators (FCC Part 15 Subpart C)	• ANSI C63.10-2013		
UPCS (FCC Part 15, Subpart D) •Unlicensed Personal Communication Systems devices	• ANSI C63.17-2013		
U-NII without DFS Intentional Radiators (FCC Part 15, Subpart E) •Unlicensed National Information Infrastructure Devices (U-NII without DFS)	• ANSI C63.10-2013	KDB Publication 789033	
U-NII with DFS Intentional Radiators (FCC Part 15 Subpart E) • Unlicensed National Information Infrastructure U-NII) Devices with Dynamic Frequency Selection (DFS)	• FCC KDB Publication 905462 D02 UNII DFS Compliance Procedures New Rules v01 (April 8, 2016)		
UWB Intentional Radiators (FCC Part 15, Subpart F) •Ultra-wideband Operation	• ANSI C63.10-2013		
BPL Intentional Radiators (FCC Part 15, Subpart G) •Access Broadband Over Power Line (Access BPL)	• ANSI C63.10-2013		
White Space Device Intentional Radiators (FCC Part 15, Subpart H) •White Space Devices	• ANSI C63.10-2013		

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Testing performed in support of FCC DoC and Certification approval procedures

Type of Device Examples	Scope of Accreditation	Supporting FCC Guidance	Comments
Commercial Mobile Services (FCC Licensed Radio Service Equipment) •Part 22 (cellular) •Part 24 •Part 25 (non-microwave) •Part 27	• ANSI/TIA-603-D • TIA-102.CAAA-D	KDB Publication 971168	
General Mobile Radio Services (FCC Licensed Radio Service Equipment) •Part 22 (non-cellular) •Part 90 (non-microwave) •Part 95 •Part 97 •Part 101 (non-microwave)	• ANSI/TIA-603-D • TIA-102.CAAA-D		Microwave Frequencies, as used in this part, refers to frequencies of 890 MHz and above.
Citizens Broadband Radio Services (FCC Licensed Radio Service Equipment) •Part 96	• ANSI/TIA-603-D • TIA-102.CAAA-D	KDB Publication 971168	
Maritime and Aviation Radio Services (FCC Licensed Radio Service Equipment) •Part 80 •Part 87	• ANSI/TIA-603-D		
Microwave and Millimeter Bands Radio Services (FCC Licensed Radio Service Equipment) •Part 25 •Part 74 •Part 90 (90Y, 90Z, DSRC) •Part 101	• ANSI/TIA-603-D • TIA-102.CAAA-D		
Broadcast Radio Services (FCC Licensed Radio Service Equipment) •Part 73 •Part 74 (non-microwave)	• ANSI/TIA-603-D • TIA-102.CAAA-D		
RF Exposure •Devices subject to SAR requirements	• IEEE Std 1528™-2013	KDB Publication 865664 KDB Publication 447498	
Hearing Aid Compatibility (Part 20) •HAC for Commercial mobile services	• ANSI C63.19-2007; or • ANSI C63.19-2011		

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Testing performed in support of FCC DoC and Certification approval procedures

Type of Device Examples	Scope of Accreditation	Supporting FCC Guidance	Comments
Signal Boosters (Part 20) •Wideband Consumer signal boosters •Provider-specific signal boosters •Industrial signal boosters	• FCC KDB Publication 935210 D03 Signal Booster Measurements v04(February 12,2016) • FCC KDB Publication 935210 D04 Provider Specific Booster Measurements v02 (February 12,2016) • FCC KDB Publication 935210 D05 Indus Booster Basic Meas v01r01 (February 12,2016)		

Electromagnetic Compatibility (EMC)

Test Method	Test Specification(s)	Range	Comments
Unintentional Radiators	ANSI C63.4-2003 ANSI C63.4-2009		
Radiated and Conducted Emissions	ANSI C63.4:2014; FCC OST/MP-05 (1986); ICES-001(2006); ICES-002(2013); ICES-003(2016); ICES-005(2009); CISPR 16-1-1(2015); CISPR 16-1-2(2014); CISPR 16-1-3(2006); CISPR 16-2-1(2014); CISPR 16-2-2(2010); CISPR 16-2-3(2014); CISPR 16-2-5(2008); CISPR 16-4-2(2014); EN 55016-1-1(2010); EN 55016-1-2(2014); EN 55016-1-3(2006); EN 55016-1-4(2010); EN 55016-2-1(2014); EN 55016-2-2(2011); EN 55016-2-3(2014); EN 55016-4-2(2014); CISPR 11(2012); EN 55011(2013); AS/NZS CISPR 11(2013); KN 11 (RRA Announce 2015-110, Dec, 03, 2015); VCCI V-3 (up to 6 GHz); VCCI V-5; CNS 13438	9 kHz to 40 GHz	

END OF REPORT