



REPORT

For

Dali Wireless, Inc.

535 Middlefield Road, Suite 280
Menlo Park, CA 94025

Date: 14 February 2018
Report No.: 16898-1E
Revision No.: 1
Project No.: 16898
Equipment: Single-band Medium Power airHost Unit
Model No.: AH33-1-PS-D-20-2N-D0
FCC ID: HCOAH331PSD20A




ONE STOP GLOBAL CERTIFICATION SOLUTIONS



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TEST REPORT_FCC Part 2, 90	
Private Land Mobile Services	
Report Reference No.:	16898-1E
Report Revision History	✓ Rev. 0: 07 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	68
FCC Site Registration No.: CA5970	
IC Site Registration No.: 5970A	
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	airHost33™
Model/Type reference	AH33-1-PS-D-20-2N-D0
Serial Number	10911201RA1B79002
FCC ID	HCOAH331PSD20A
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	Feb. 07, 2018	Initial Data	Sophie Piao & Daniel Lee
1	Feb. 14, 2018	Correction some info. Requested by TCB	Jeremy Lee

Device Under Test Description

Application for	PS 150 AirHost 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 HCPM
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:	<u>48 V</u> stand-alone equipment <u>48 V</u> combined (or host) equipment
Supply Voltage:	_____ AC _____ Amps <u>48V</u> DC <u>2.5</u> Amps
If DC Power:	___ Internal Power Supply <input checked="" type="checkbox"/> External Power Supply ___ Battery <input type="checkbox"/> Nickel Cadmium <input type="checkbox"/> Alkaline <input type="checkbox"/> Nickel-Metal Hydride <input type="checkbox"/> Lithium-Ion <input type="checkbox"/> 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
<p>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.</p> <p>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.</p>	

Description of Equipment Under Test and Variant Models

<p>Description: The airHost 150PS is a single-band off-air fed host unit. The airhost PS accepts DL analog RF signals from –ff-air donor antenna and transmits UL RF signal back to macro tower at 5 W maximum. The single-band unit supports one band in a type 2 sealed chassis door.</p> <p>On the downlink path the airHost PS translates analog RF content into a digital data stream, and then</p>
--

transports the data stream to remote units on one to eight optical links, each operating at 10 Gbps. Because radio signal is processed and combined in the digital domain, no passive intermodulation (PIM) is introduced.

On the UL path the airhost PS does the reverse. It receives data stream from the remotes, which are then converted back to analog RF. The signal is filtered and amplified to a composite power of 5 W maximum, and then delivered back to the macro tower through outdoor directional antenna.

The airHost PS also supports 1 Gbps Ethernet backhaul for transporting the data from IP devices such as security cameras and Wi-Fi access points located close to remote units.

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

In order to build up a complete signal booster system, the hd33 remote unit was connected as the Auxiliary device. The signal was injected and ejected via coaxial cables.



Top View



Connector 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	<i>airHost33, 150PS</i>	Dali Wireless Inc.	AH33-1-PS-D-20-2N-D0	EUT where the RF (I/O) antenna attached via a duplexer when necessary.
AE1	<i>hd33, 150PS</i>	Dali Wireless Inc.	hd33-1-PS-D-20-2N-D0	Auxiliary equipment, which is the radio remote end of signal booster system air interfaced to end users.
AE2	<i>Dali Matrix Console</i>	Dali Wireless Inc.	UBiT-CP	Auxiliary equipment provides the configuration and control interface to airHost and <i>hd33</i> .

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	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 (V)	Current (A)	Power (W)	Frequency (DC/AC-Hz)	Phases (#)	Comments
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; <i>hd33</i> 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	± 4.95 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 TIA-603-D	Compliant

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 (%)	35		
Test Location	Burnaby	Barometric Pressure (kPa)	100.5		
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 24-26, 2018		
EUT Voltage	<input checked="" type="checkbox"/> DC <input type="checkbox"/> 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:	<input checked="" type="checkbox"/> see page 5				
Detector:	<input checked="" type="checkbox"/> Peak				
Type of Facility:	<input checked="" type="checkbox"/> Test bench				
Distance:	<input checked="" type="checkbox"/> Direct				
Arrangement of EUT:	<input type="checkbox"/> Table-top only <input type="checkbox"/> Floor-standing only <input checked="" type="checkbox"/> 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 <input checked="" type="checkbox"/> Non-Compliant <input type="checkbox"/> Not Applicable <input type="checkbox"/>					

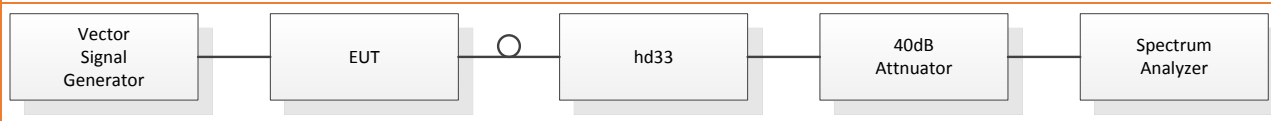
Test setup

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.



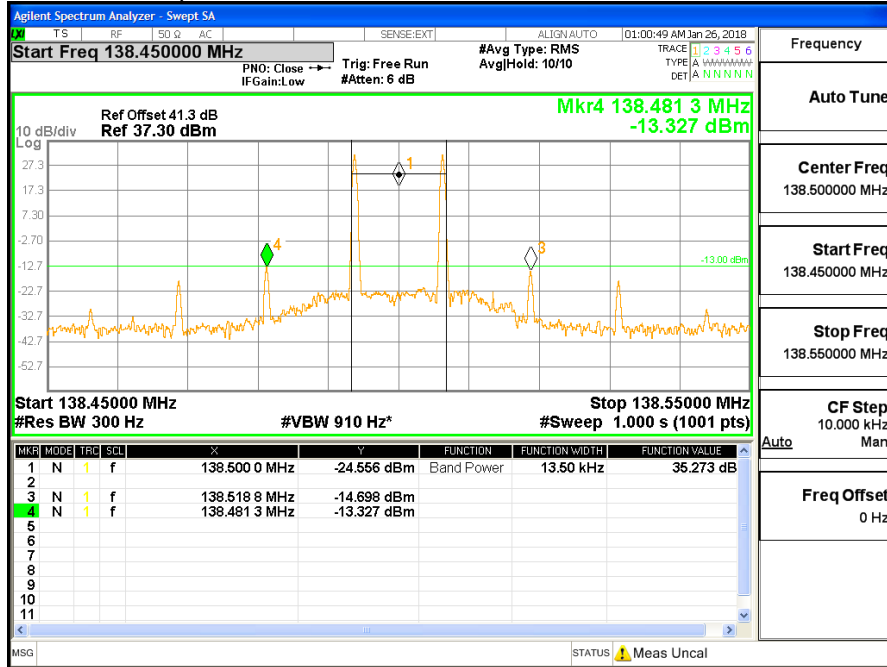
Results – Output Power FCC Requirement and IC Single Channel Requirement

Frequency (MHz)	Input Power Trip ALC (dBm)	Output Power (dBm)	Limit (37dBm)
150.815	-54.5	36.9	PASS
157.47	-55	36.9	PASS
161.79	-55	36.6	PASS
173.39625	-54	36	PASS

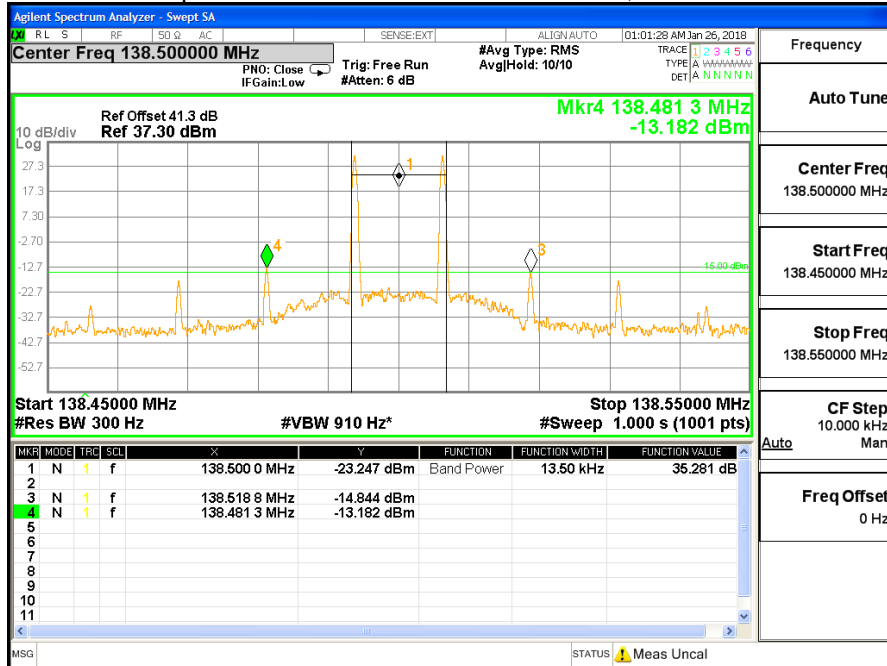
Results – Output Power IC Multi-Channel Requirement

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.

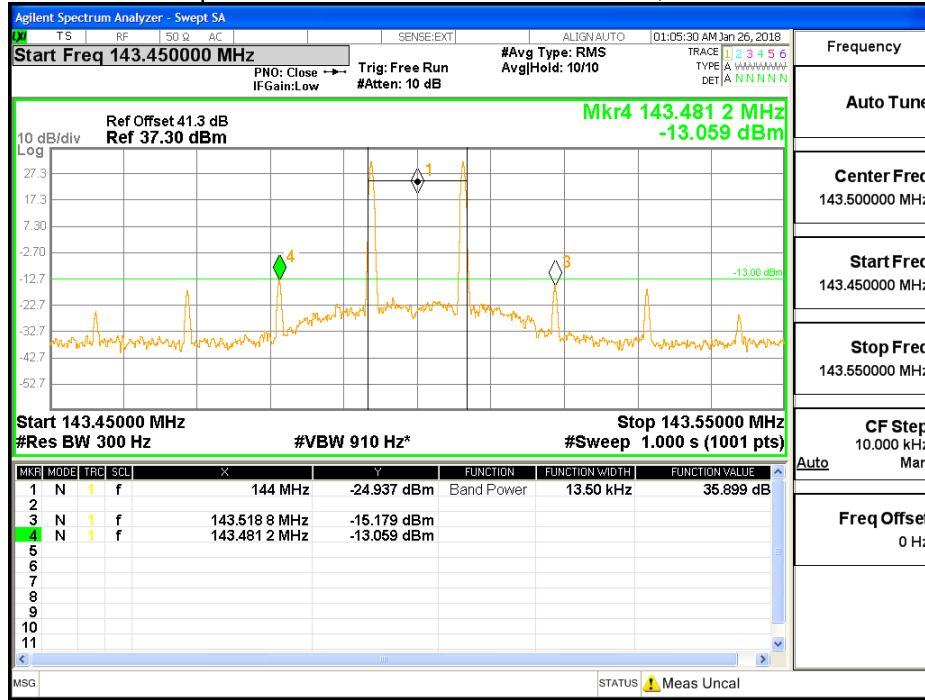
At Input Power 0.5dB below AGC threshold, 138.5 MHz



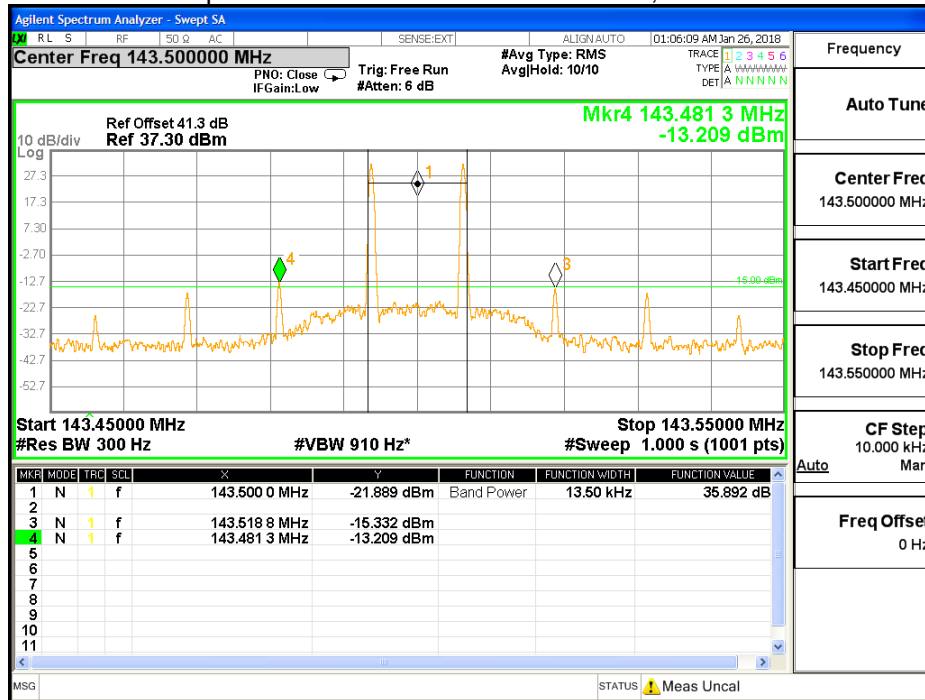
At Input Power 3 dB above AGC threshold; 138.5 MHz



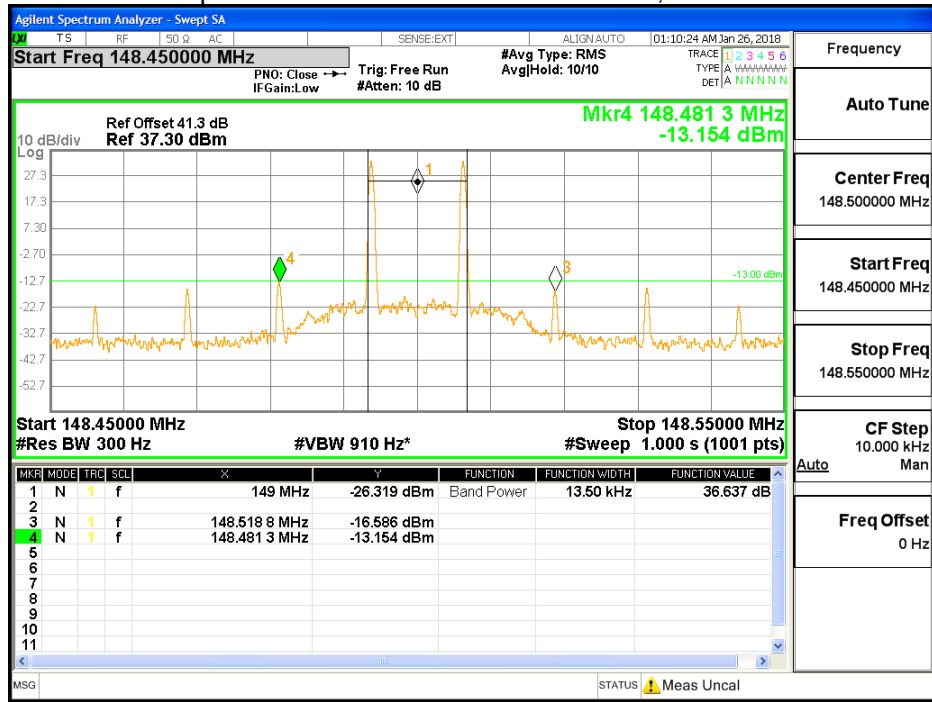
At Input Power 0.5dB below AGC threshold, 143.5 MHz



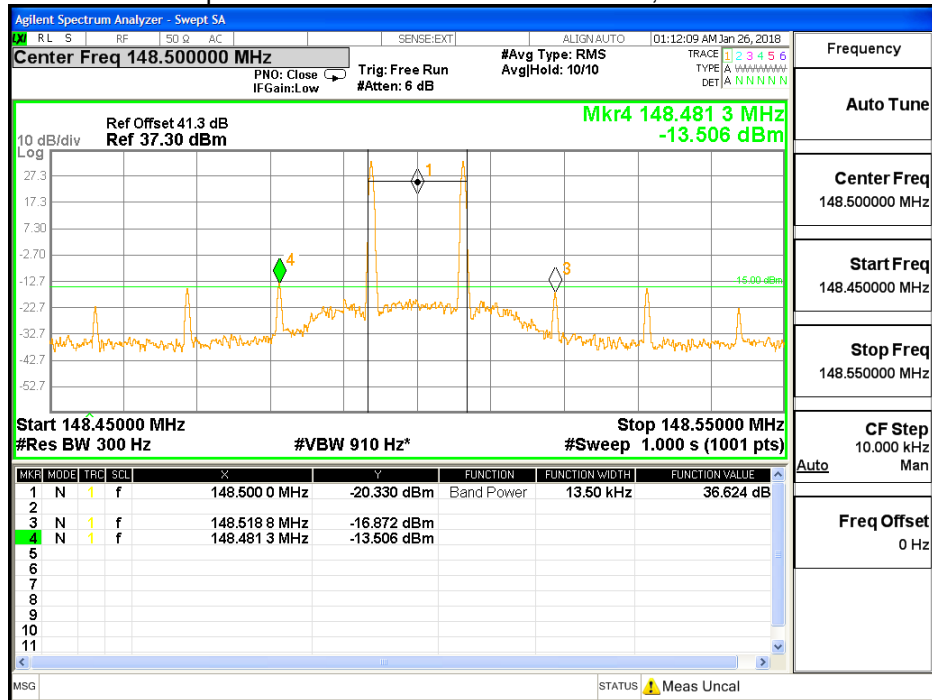
At Input Power 3 dB above AGC threshold; 143.5 MHz



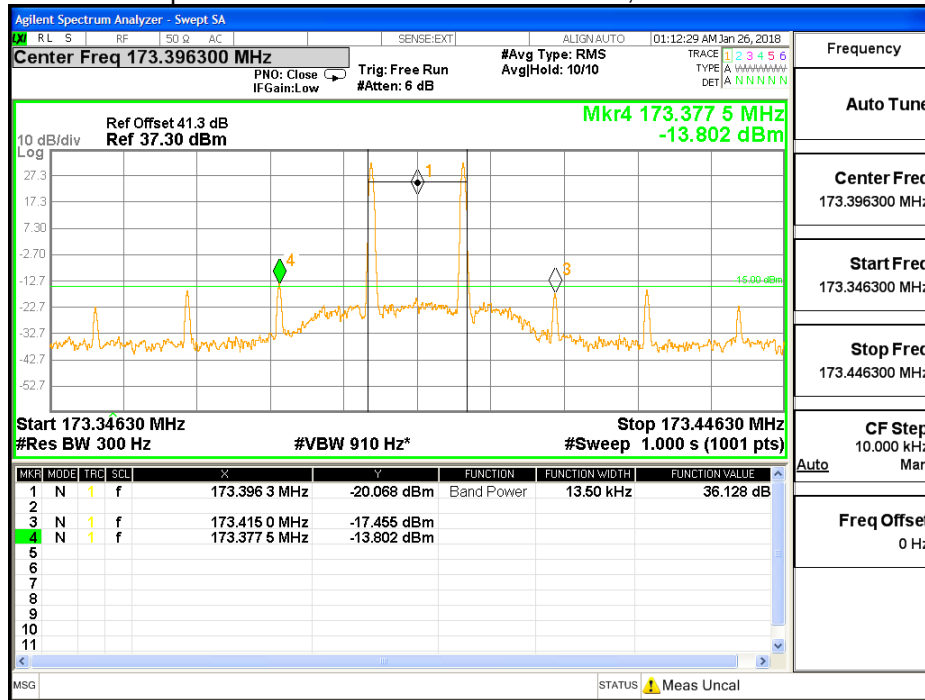
At Input Power 0.5dB below AGC threshold, 148.5 MHz



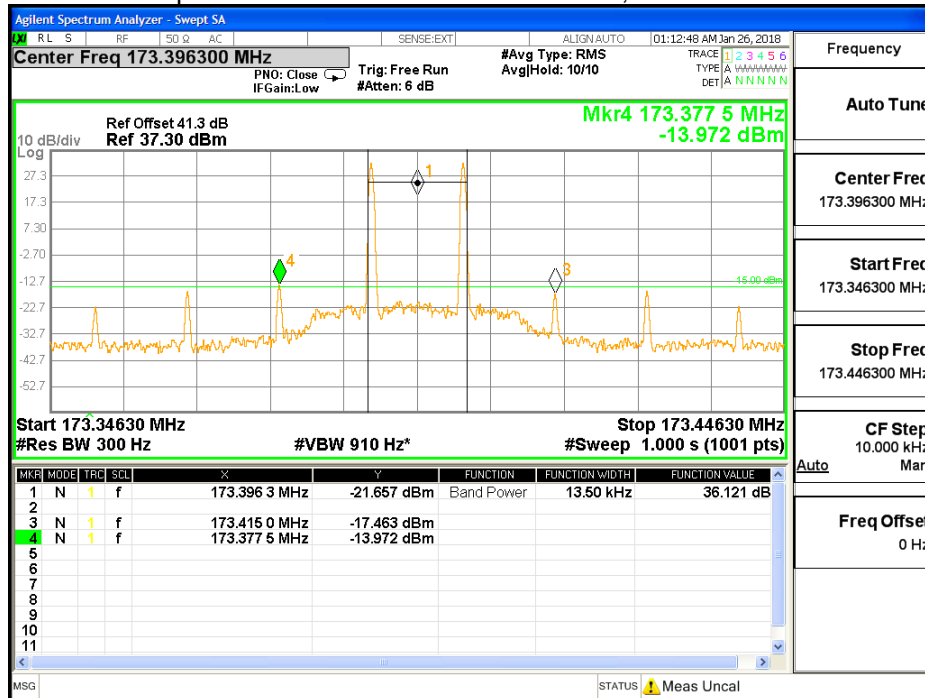
At Input Power 3 dB above AGC threshold; 148.5 MHz



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)	23.6		
Test Procedure	IC RSS-GEN 4.6.1	Relative Humidity (%)	35		
Test Location	Burnaby	Barometric Pressure (kPa)	100.5		
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 24-25, 2018		
EUT Voltage	<input checked="" type="checkbox"/> DC <input type="checkbox"/> 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:	<input checked="" type="checkbox"/> see page 5				
Detector:	<input checked="" type="checkbox"/> Peak				
Type of Facility:	<input checked="" type="checkbox"/> Test bench				
Distance:	<input checked="" type="checkbox"/> Direct				
Arrangement of EUT:	<input type="checkbox"/> Table-top only <input type="checkbox"/> Floor-standing only <input checked="" type="checkbox"/> Rack Mounted				
Output signal has an occupied channel bandwidth less than the designated channel bandwidth on any location on the operating band. <ul style="list-style-type: none"> - C4FM < 12.5 kHz - CQPSK < 6.25 kHz - HCPM < 12.5 kHz 					
Compliant <input checked="" type="checkbox"/>		Non-Compliant <input type="checkbox"/>		Not Applicable <input type="checkbox"/>	

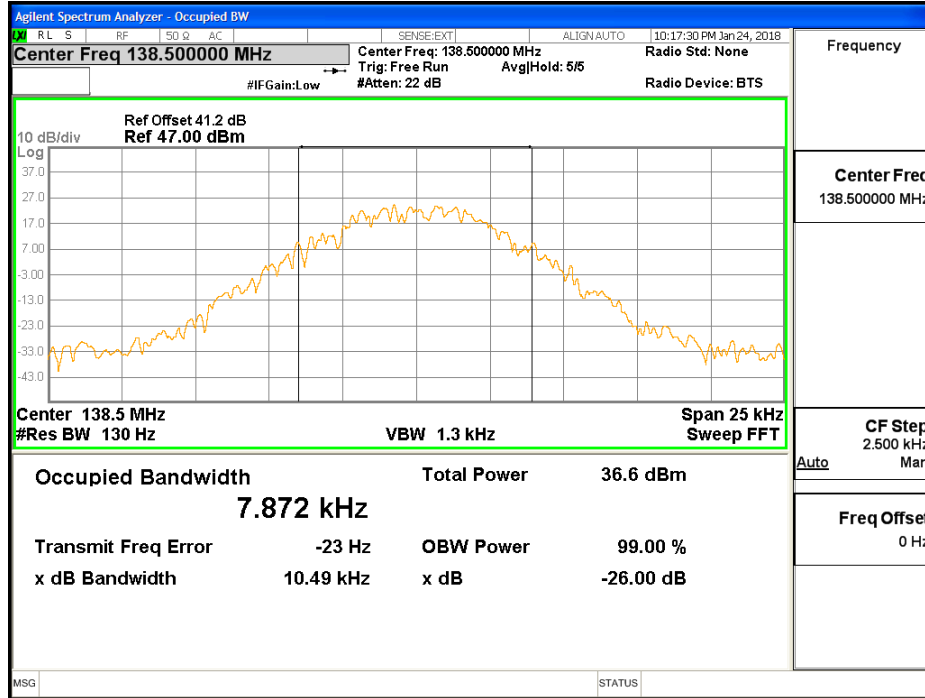
Test setup

Description of test set-up:					
<p>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</p> <p>The EUT was set to Operation Mode #1 with configuration Mode #1.</p>					
Vector Signal Generator	EUT	hd33	40dB Attenuator	Spectrum Analyzer	

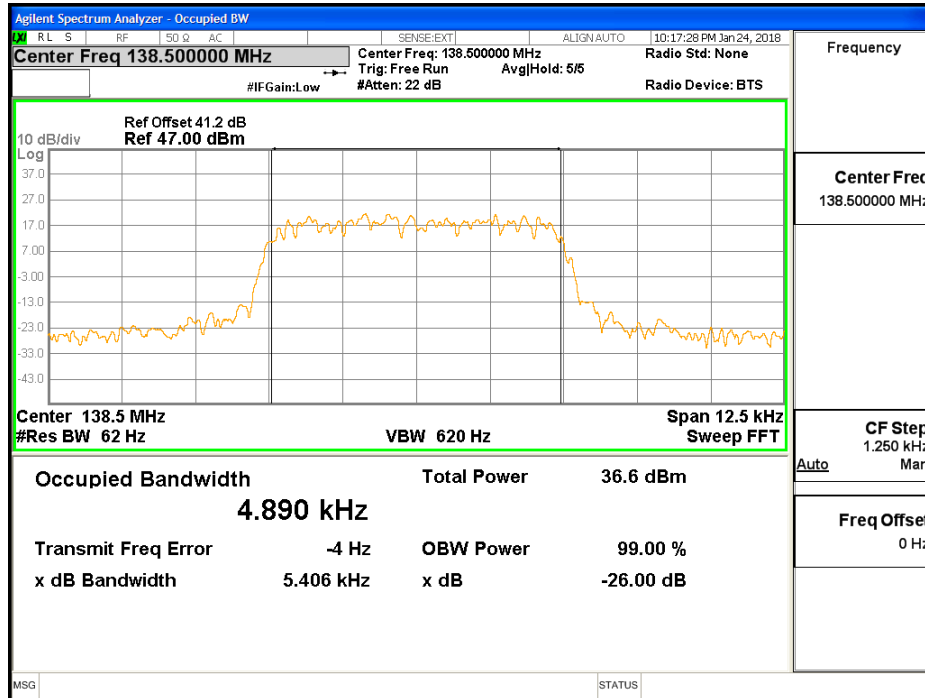
Results

At Input Power 0.5dB below AGC threshold

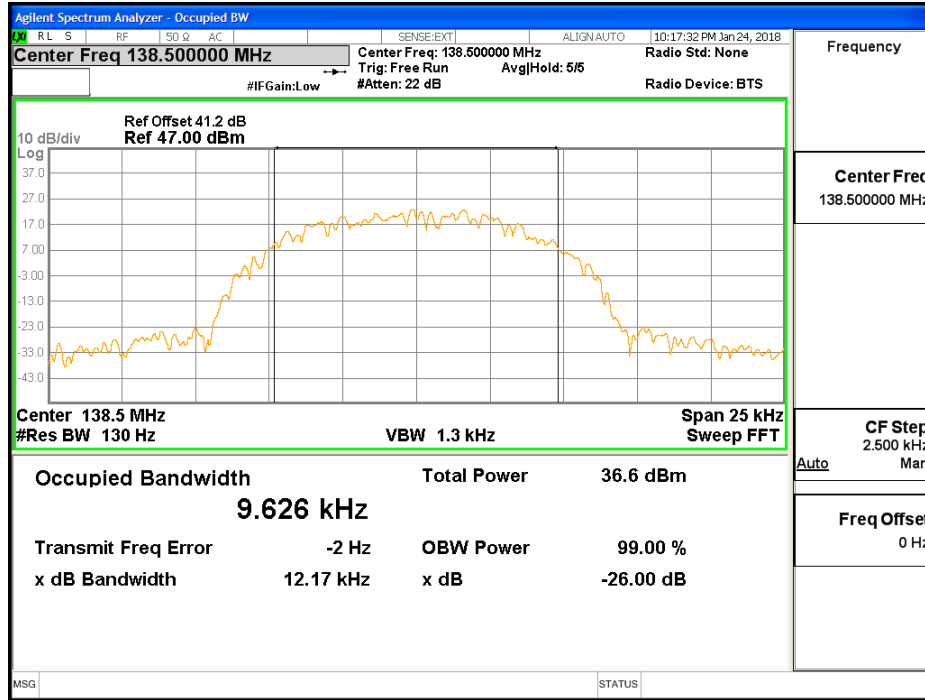
C4FM 138.5MHz



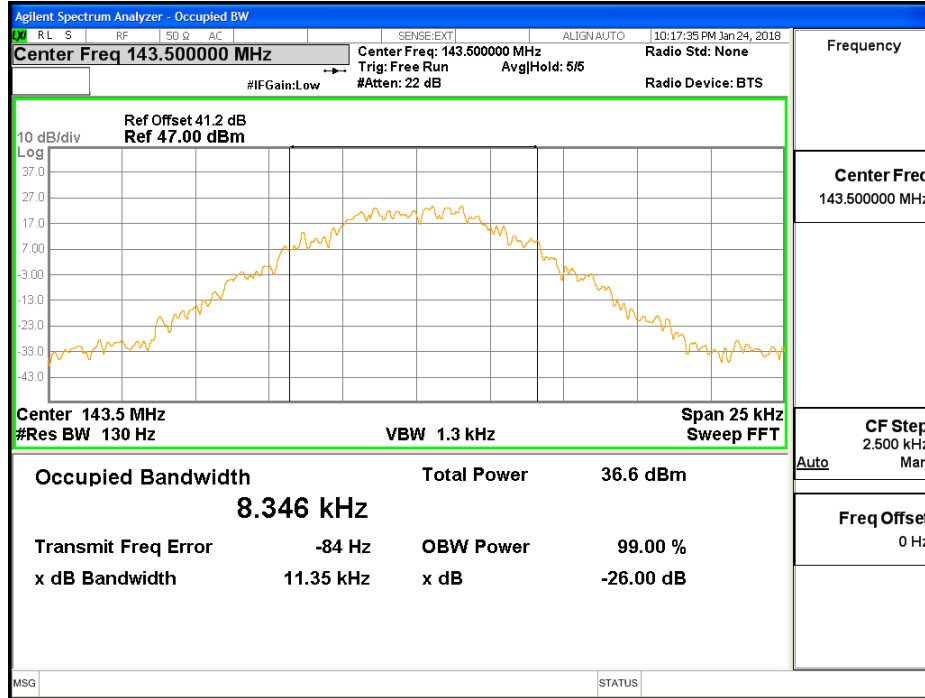
CQPSK 138.5MHz

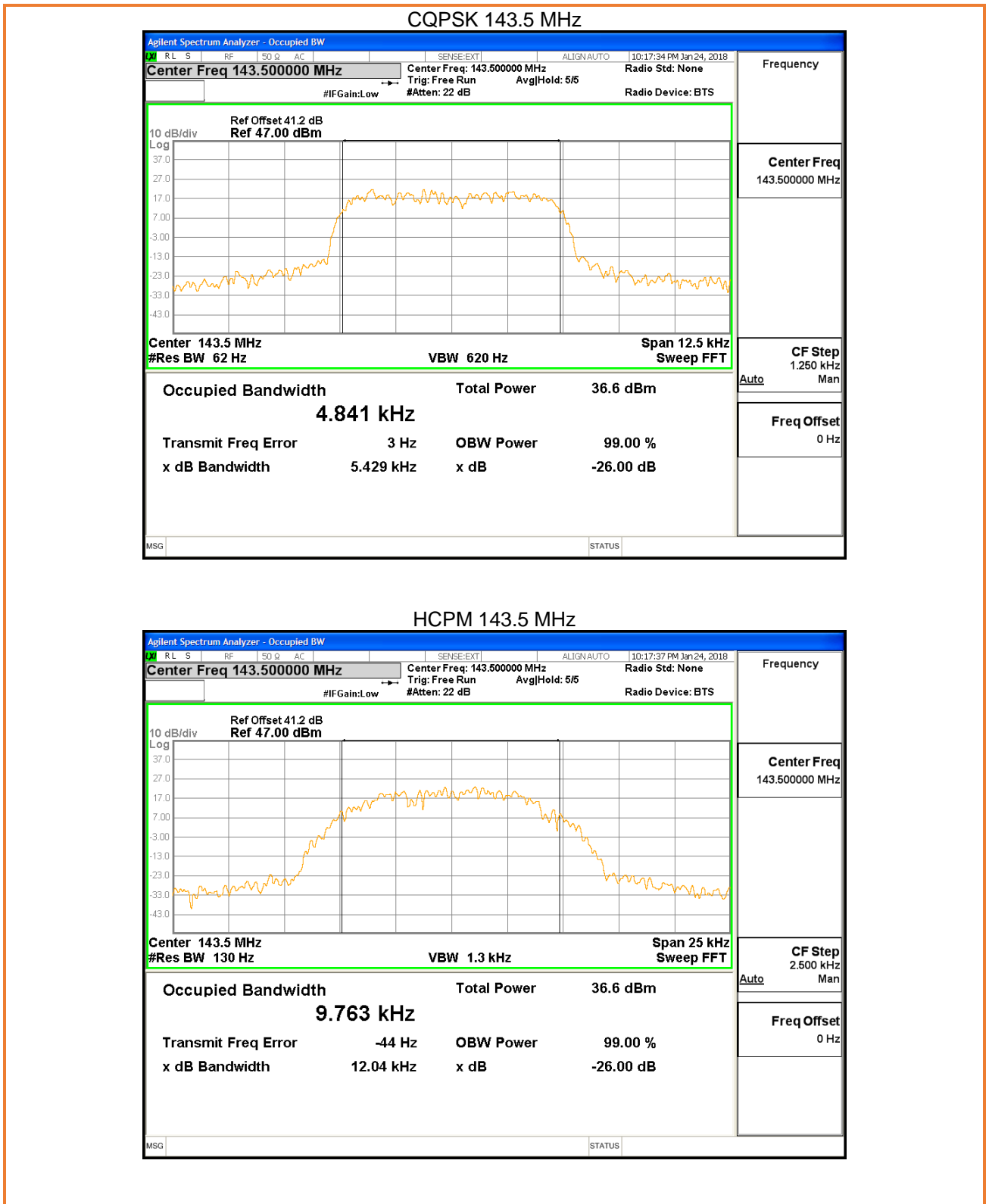


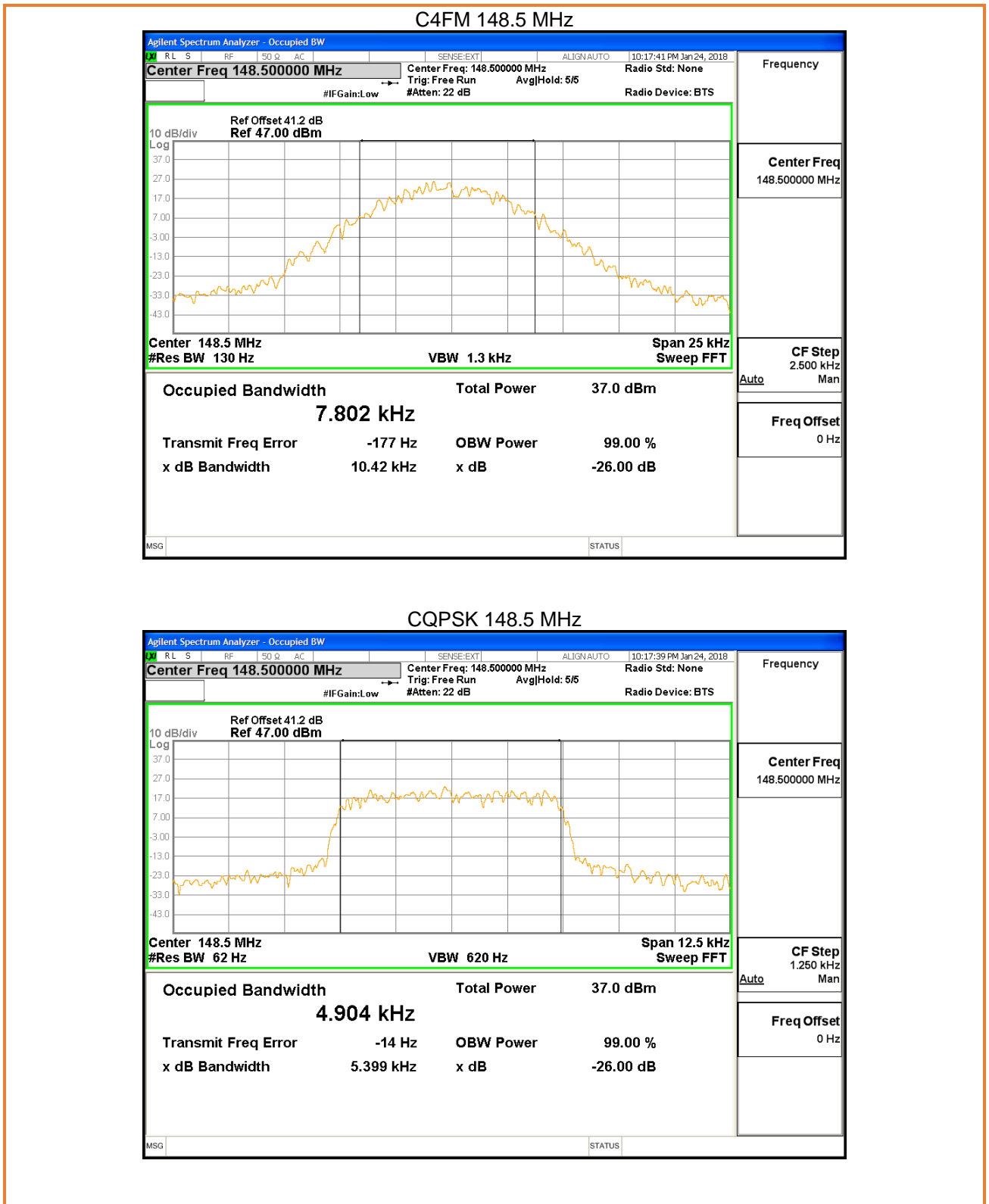
HCPM 138.5MHz

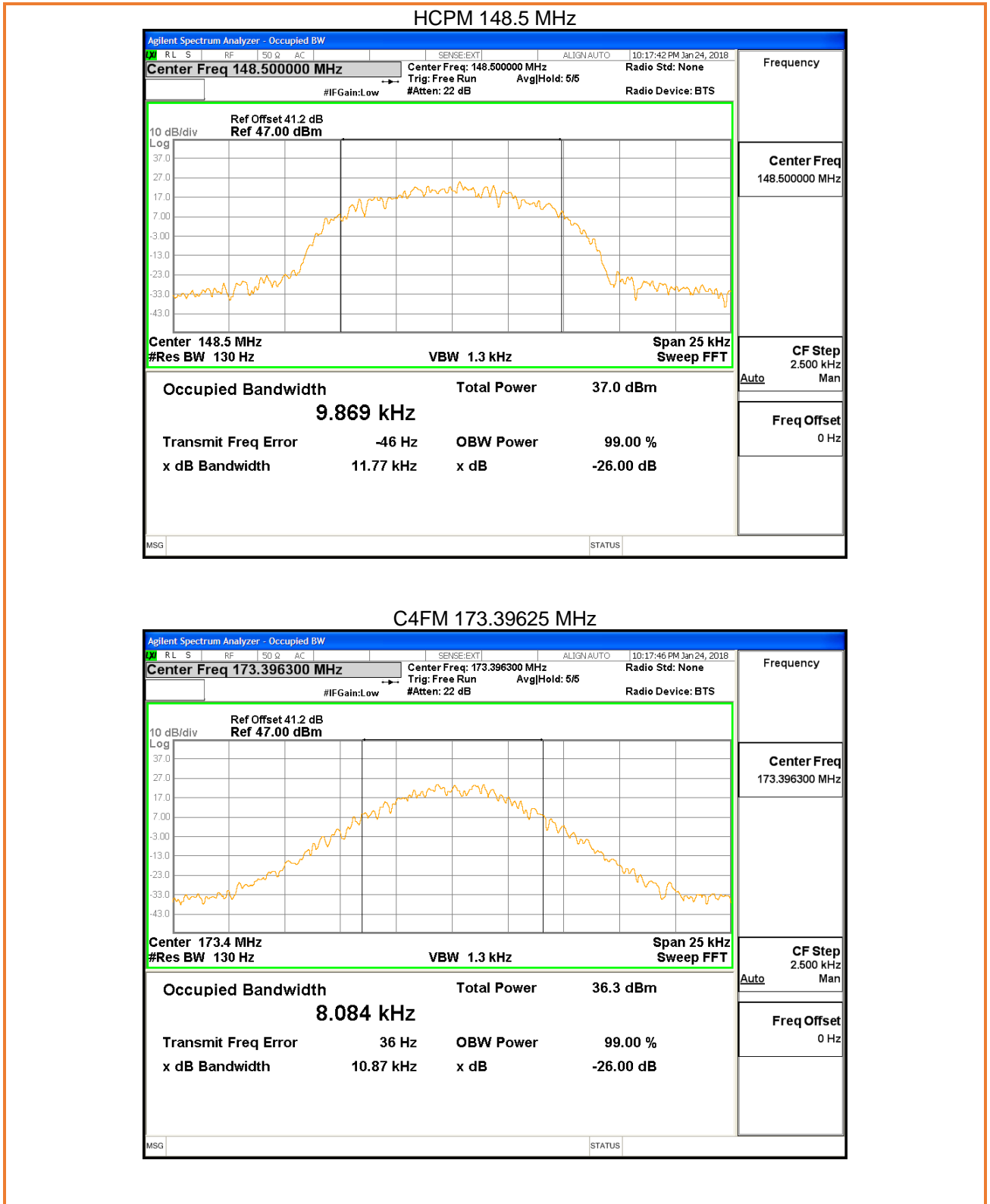


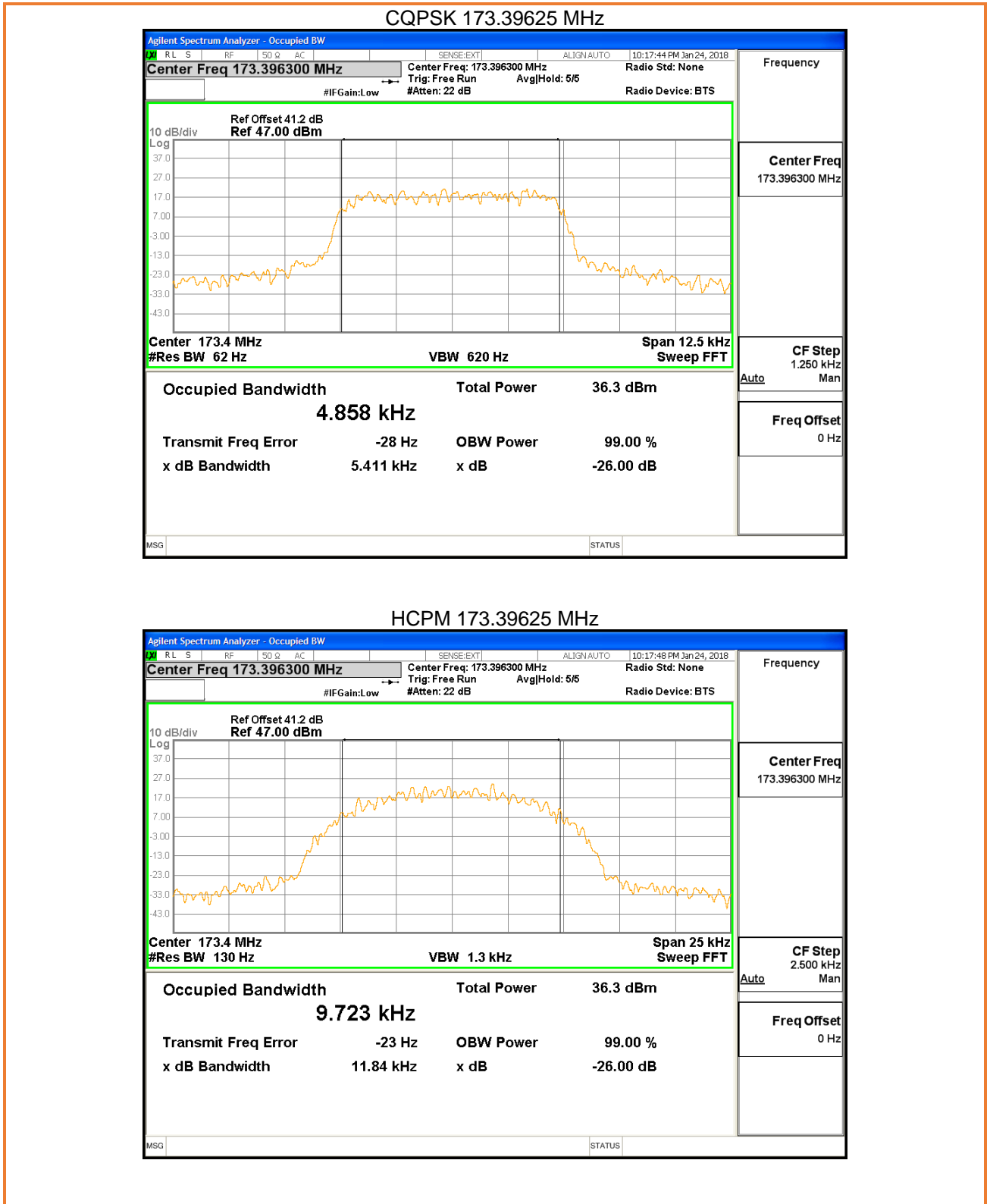
C4FM 143.5 MHz





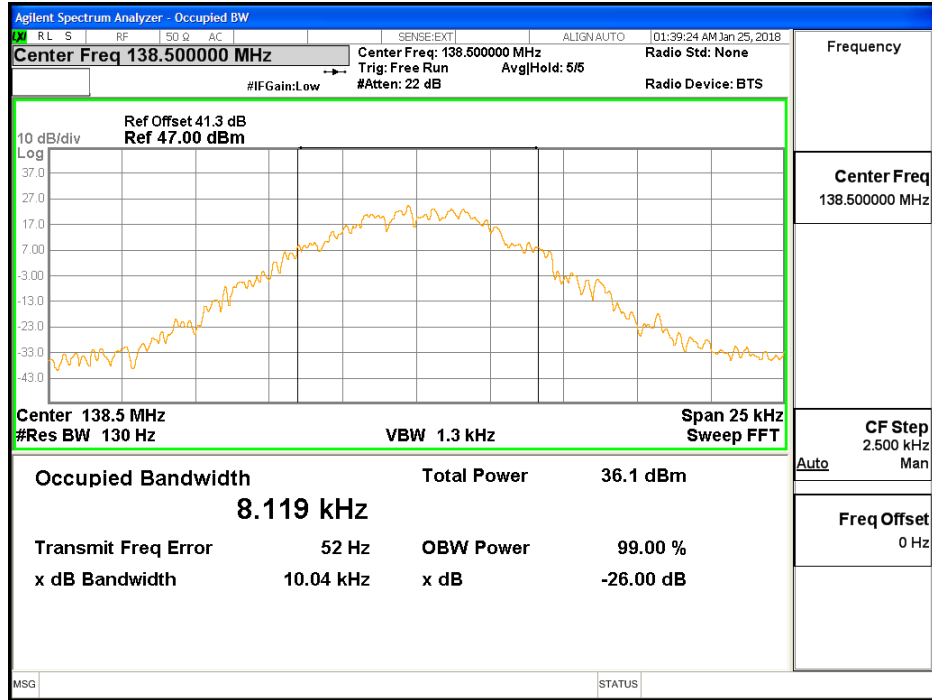




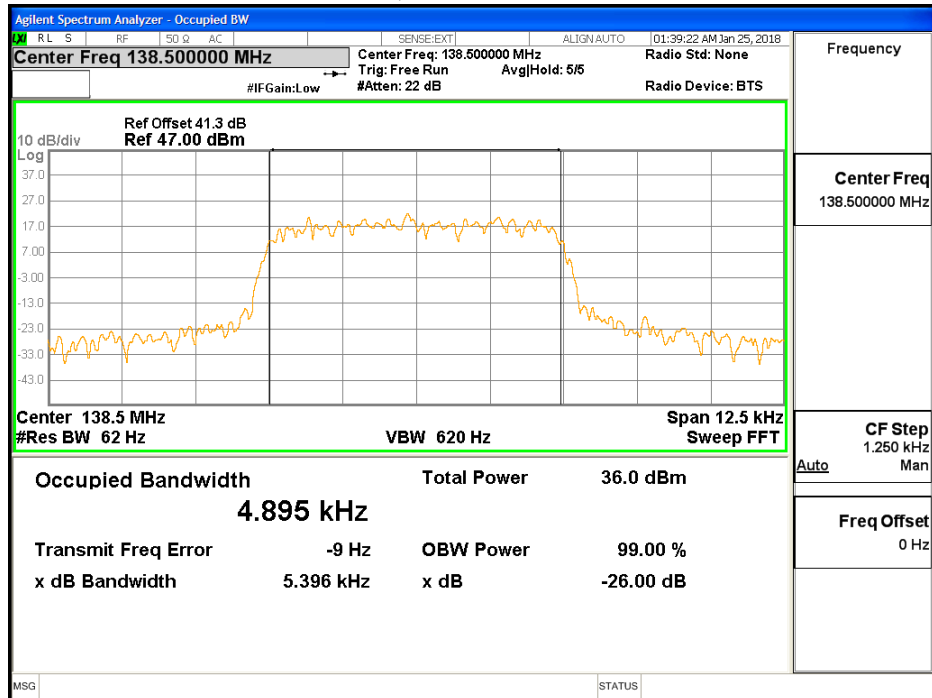


At Input Power 3 dB above AGC threshold

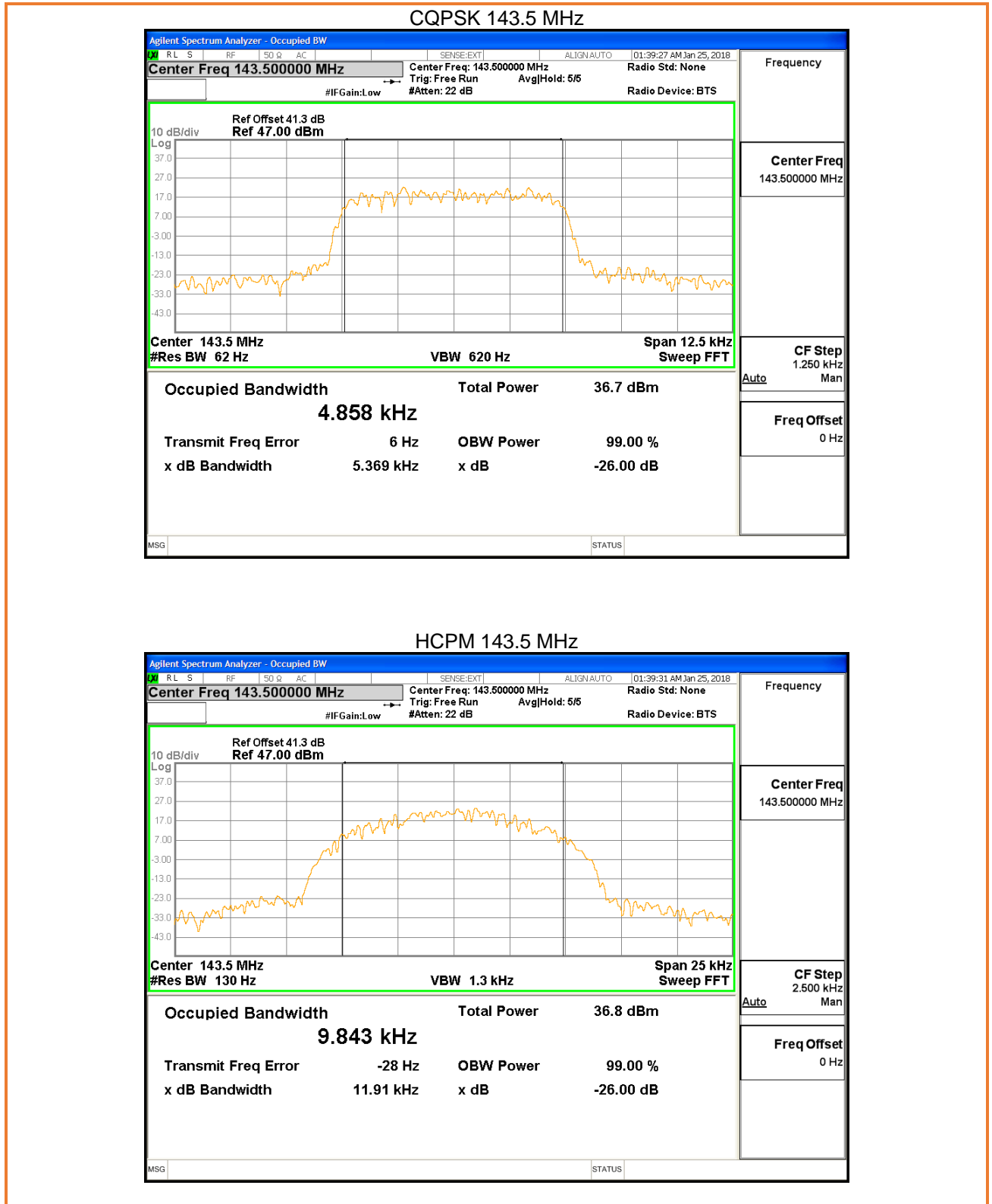
C4FM 138.5MHz

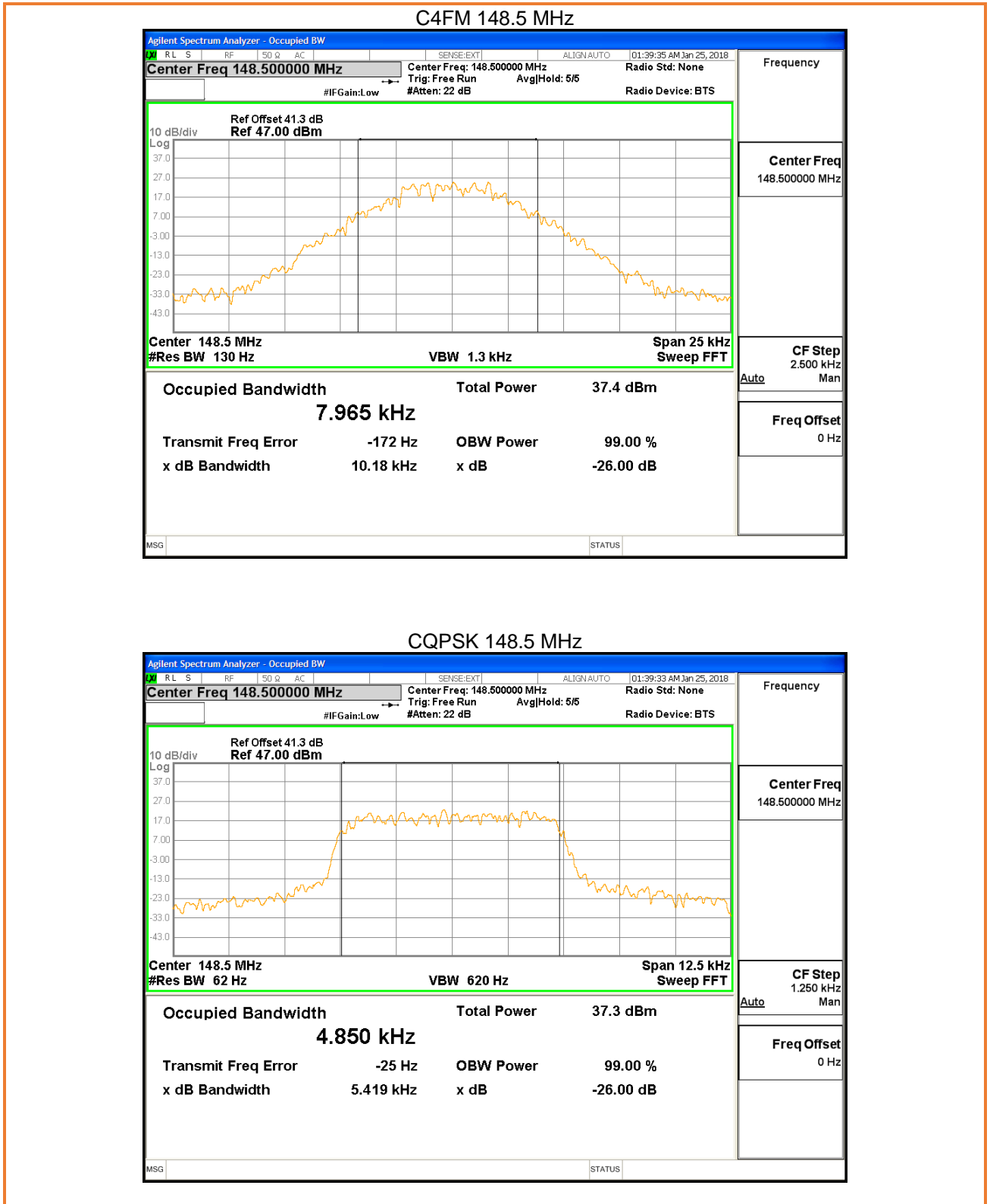


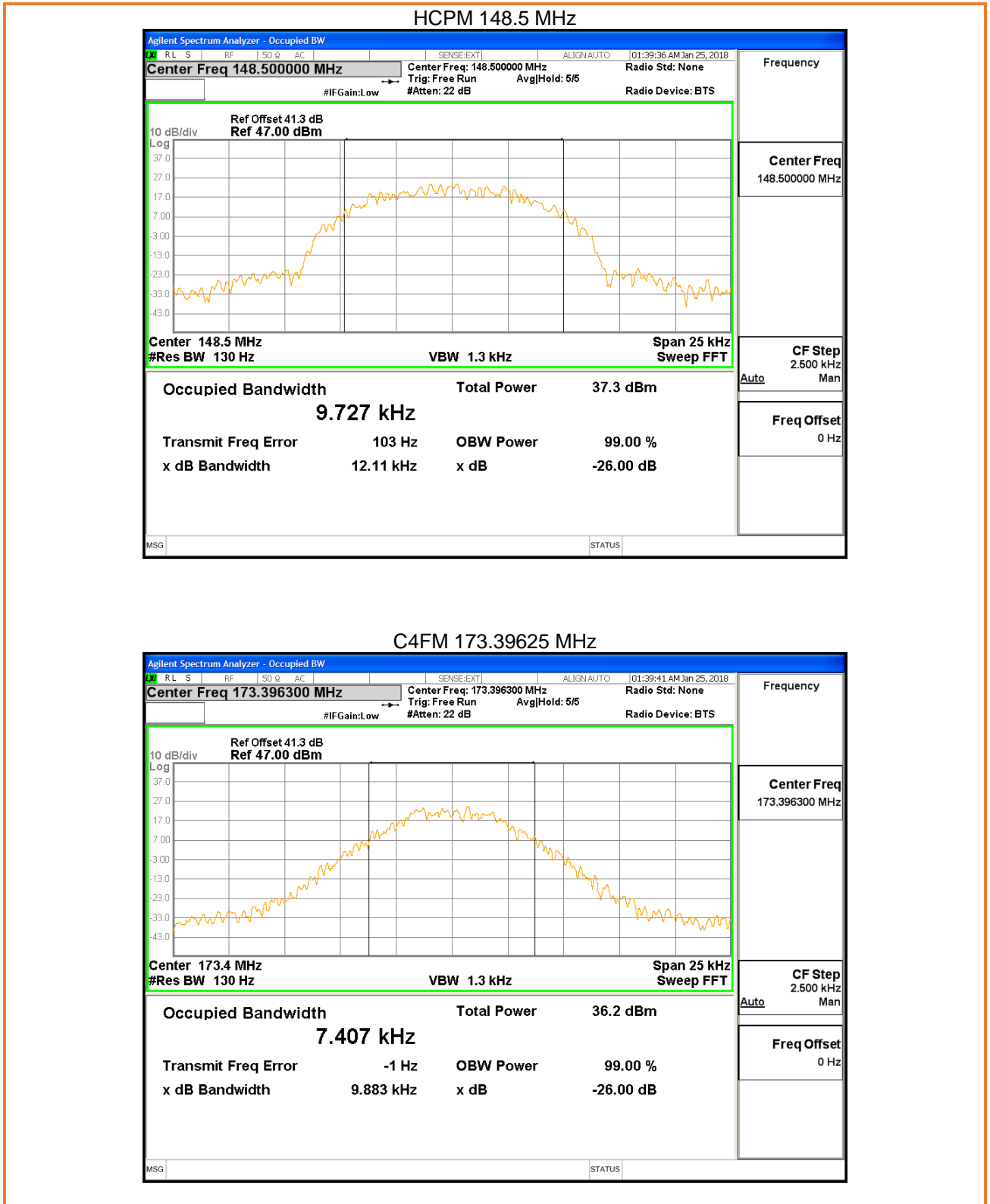
CQPSK 138.5MHz

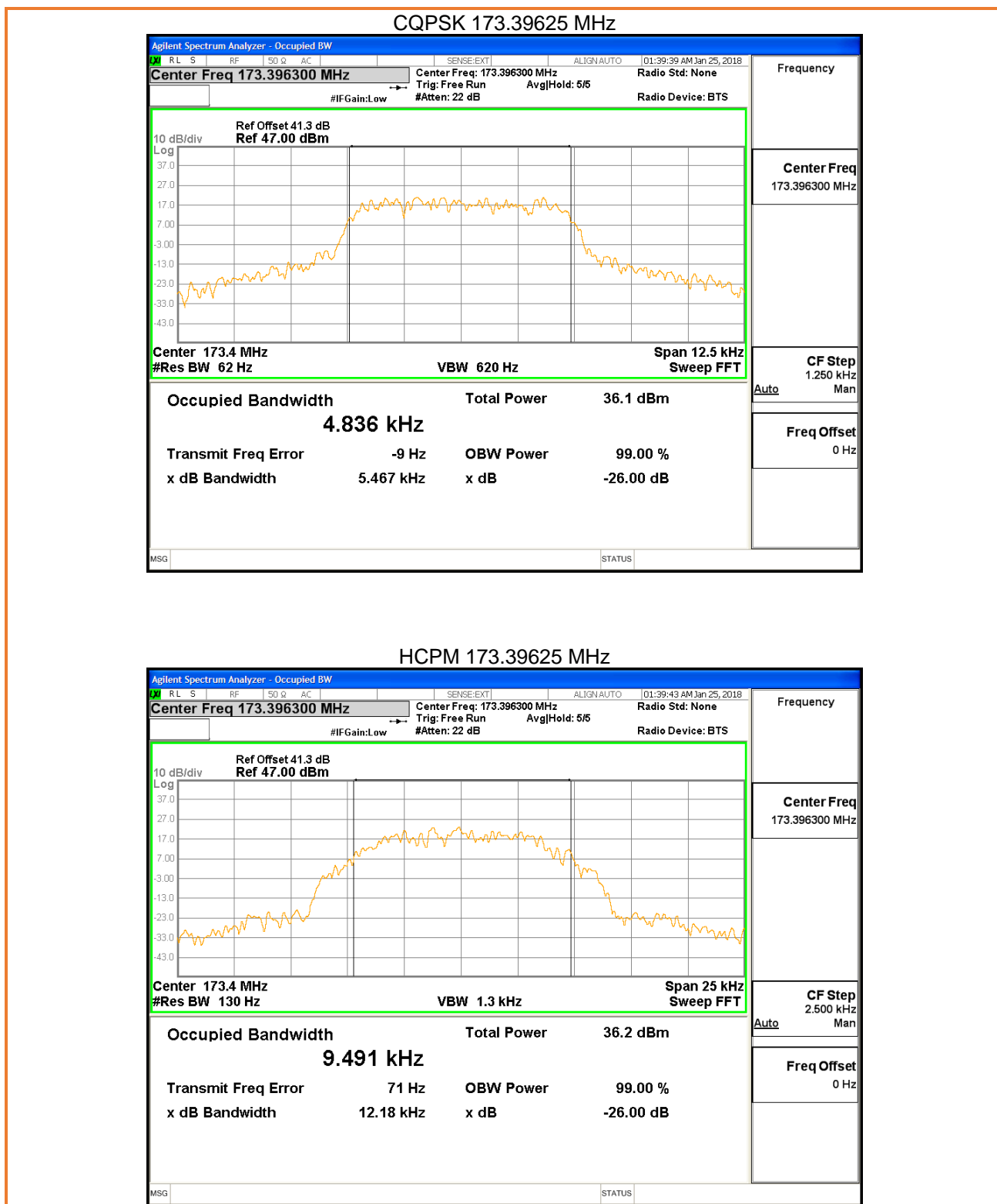












Unwanted Emissions (Conducted)

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 (%)	35		
Test Location	Burnaby	Barometric Pressure (kPa)	100.5		
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 25, 2018		
EUT Voltage	<input checked="" type="checkbox"/> DC <input type="checkbox"/> 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:	<input checked="" type="checkbox"/> 9 kHz – 1.74 GHz				
Detector:	<input checked="" type="checkbox"/> Peak(for Formal)				
RBW/VBW:	<input checked="" type="checkbox"/> 1/10kHz for 9kHz – 150kHz; <input checked="" type="checkbox"/> 10/100kHz for 150kHz – 30 MHz; <input checked="" type="checkbox"/> 100/1000kHz for 30MHz – 1GHz; <input checked="" type="checkbox"/> 1/50MHz for 1GHz – 1.74GHz				
Type of Facility:	<input checked="" type="checkbox"/> Testbench				
Distance:	<input checked="" type="checkbox"/> Direct Connection				
Arrangement of EUT:	<input type="checkbox"/> Table-top only <input type="checkbox"/> Floor-standing only <input checked="" type="checkbox"/> Rack Mounted				
No emission is higher than the -13 dBm emission limit.					
Compliant <input checked="" type="checkbox"/>		Non-Compliant <input type="checkbox"/>		Not Applicable <input type="checkbox"/>	

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.

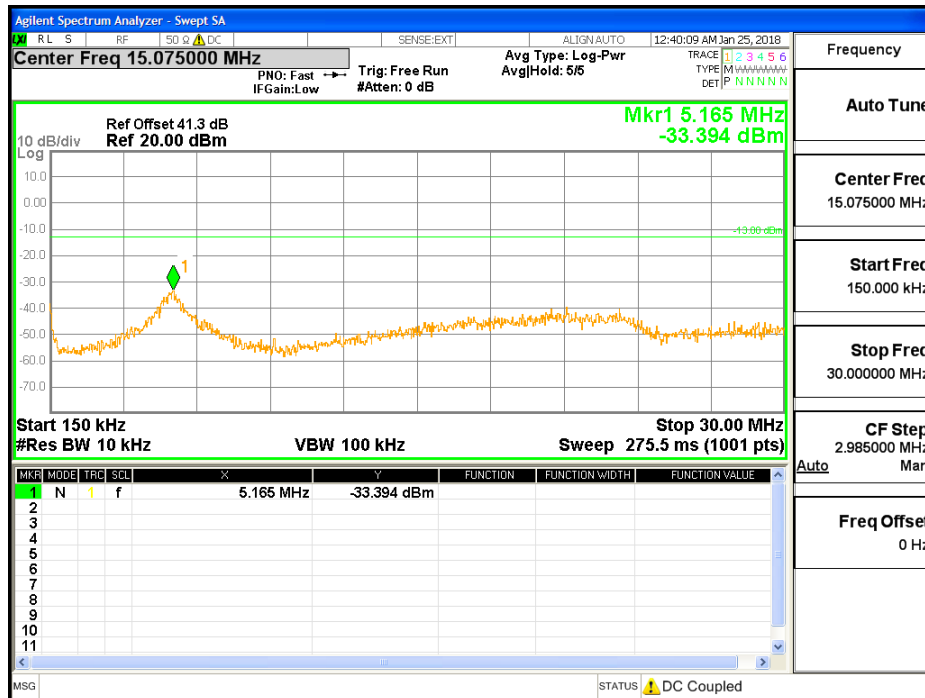
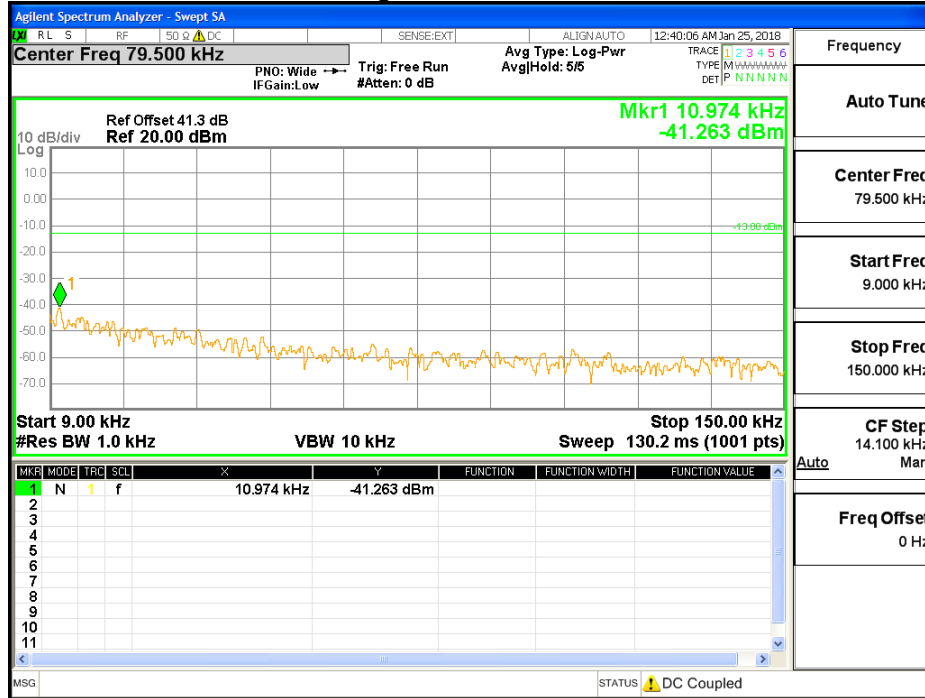
The EUT was set to **Operation Mode #1 with configuration Mode #1.**

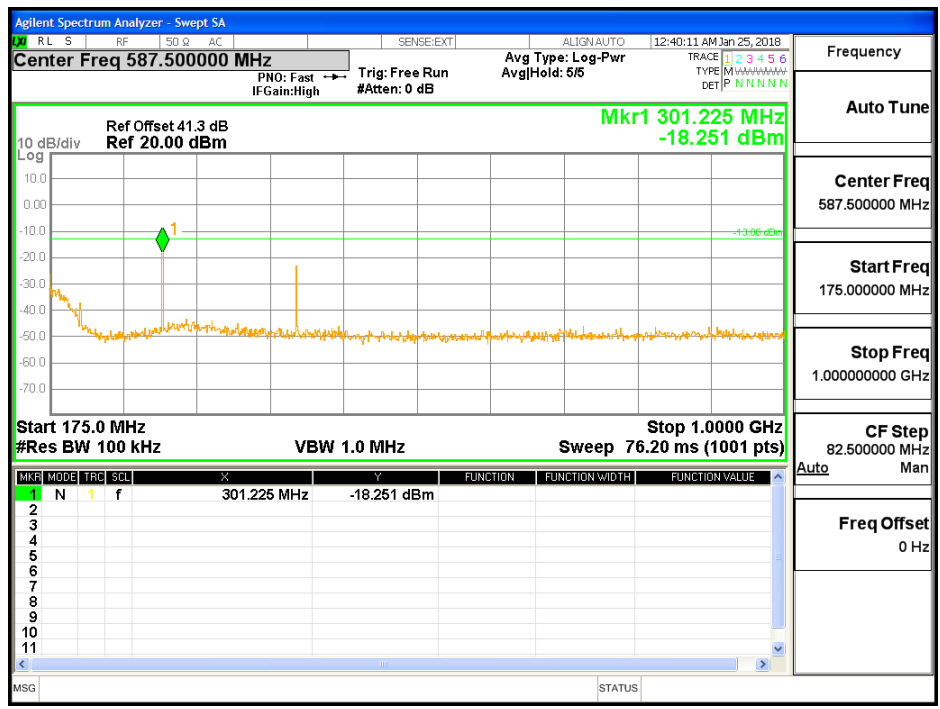
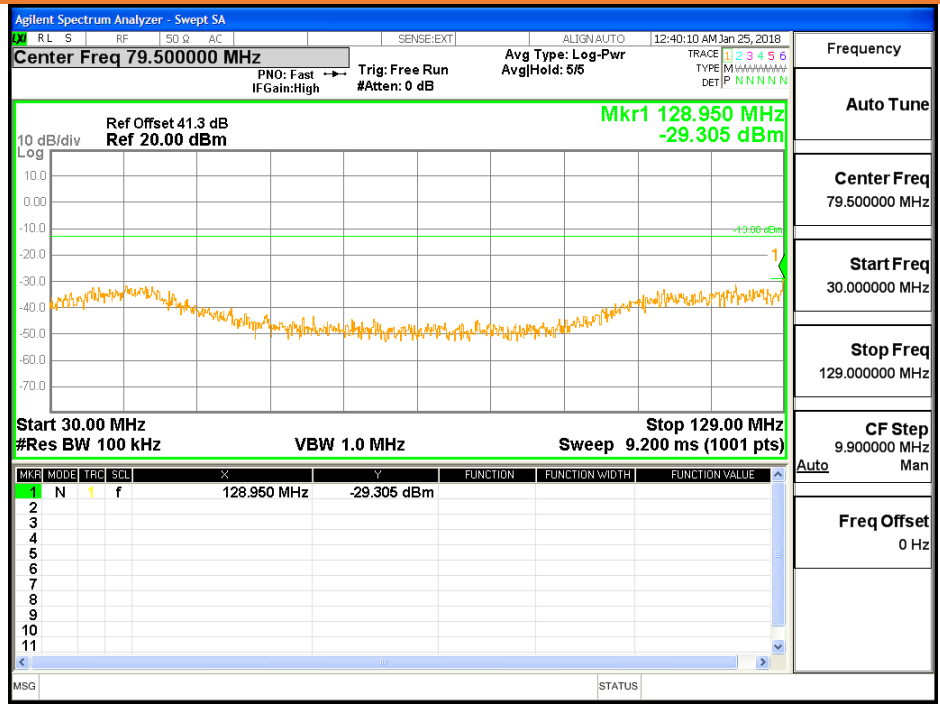


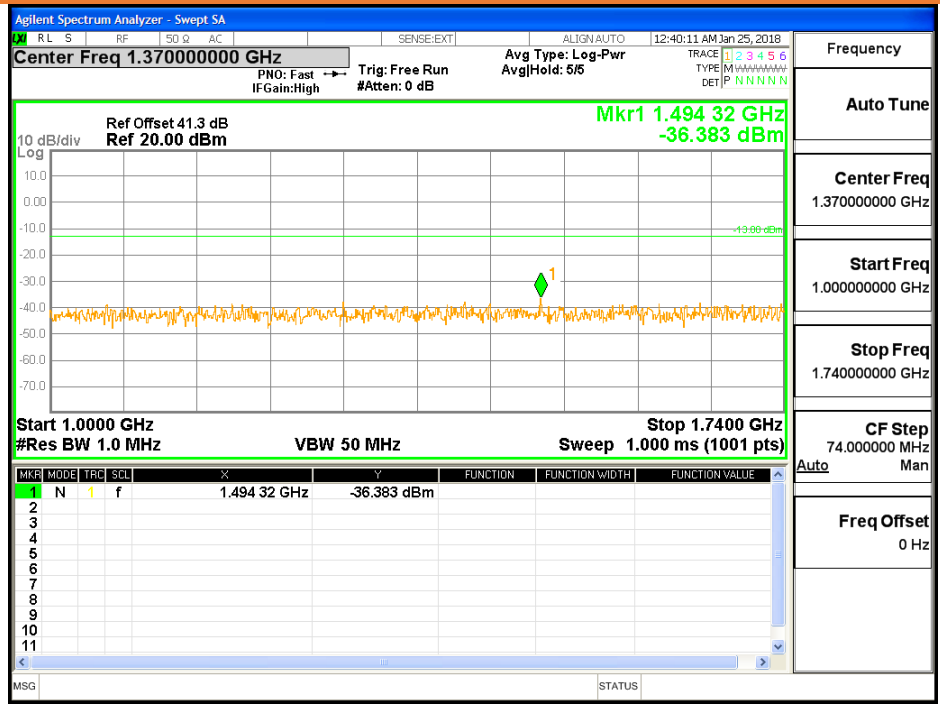
Results

At Input Power 0.5 dB below AGC threshold

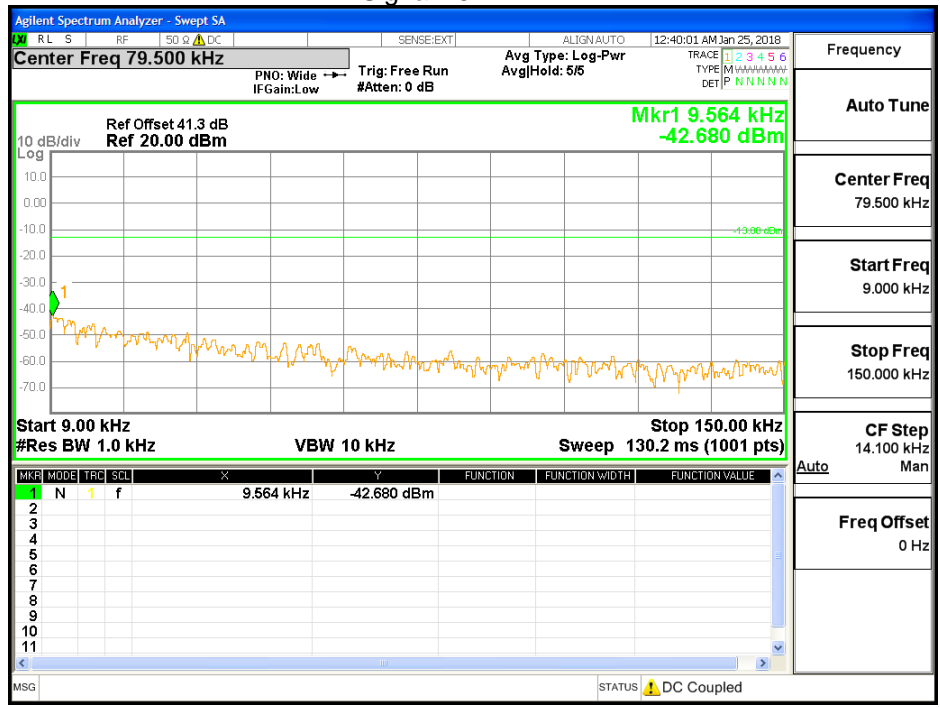
Signal 150.815 MHz

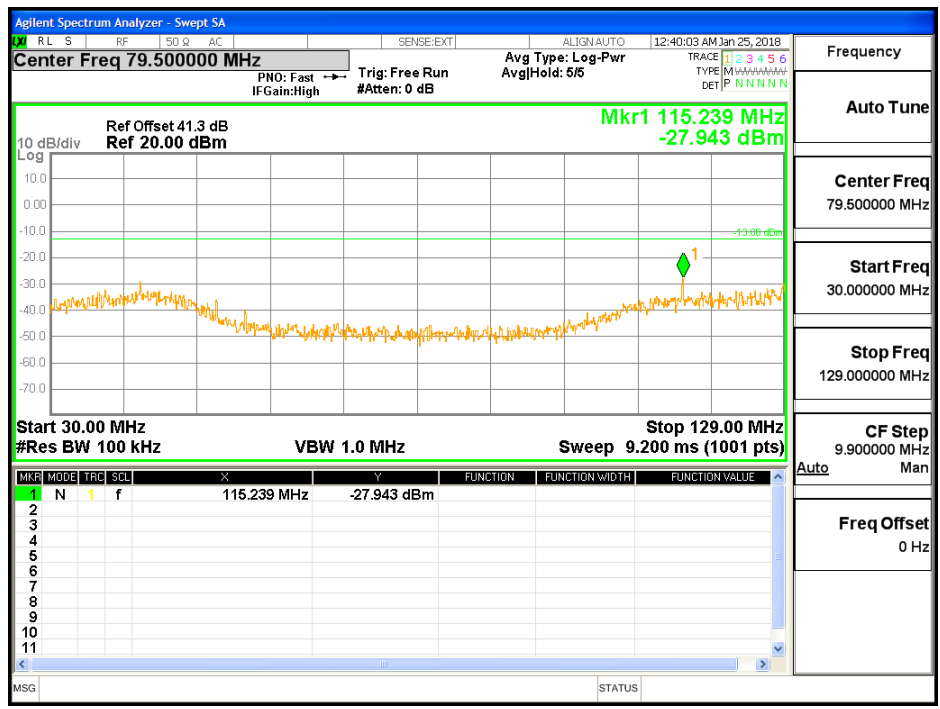
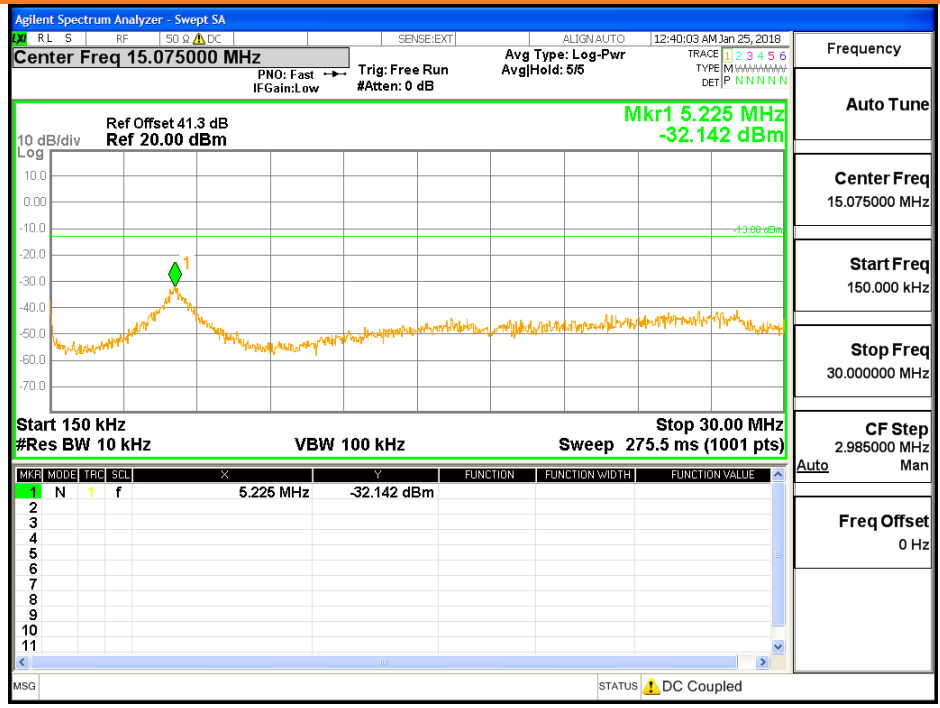


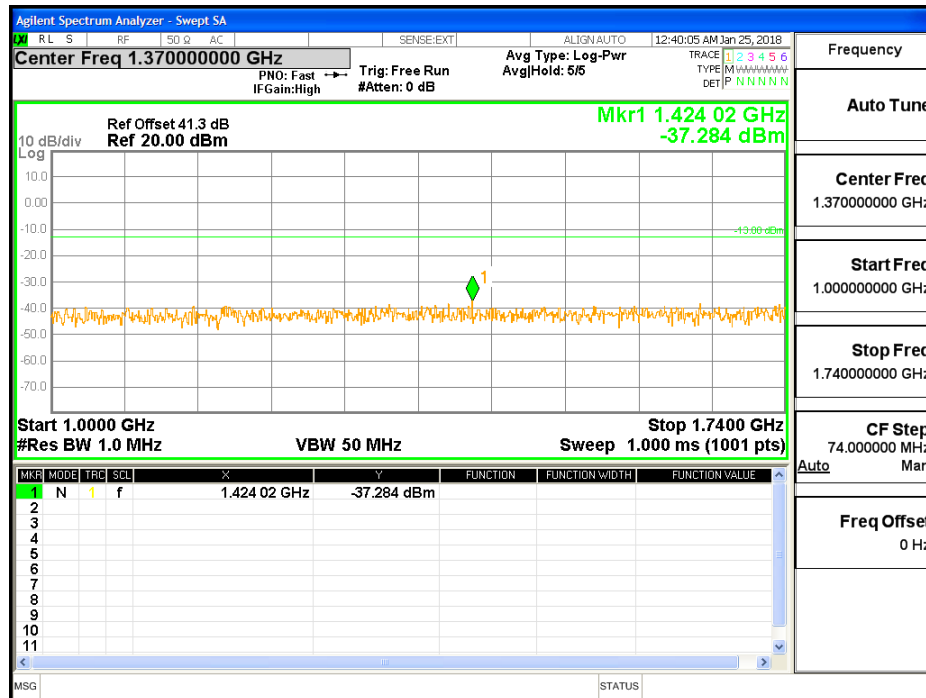
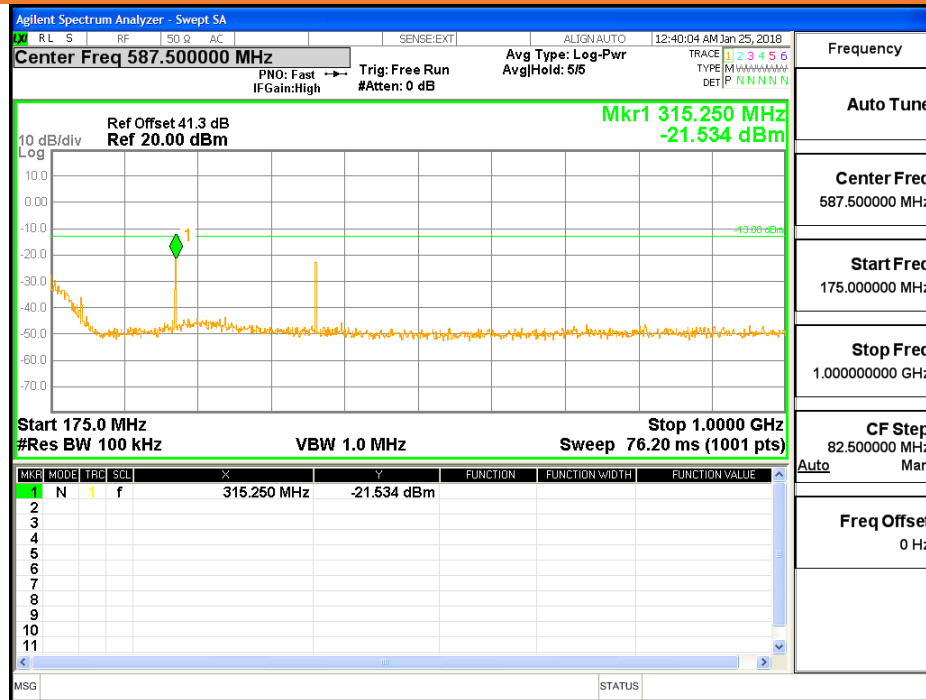




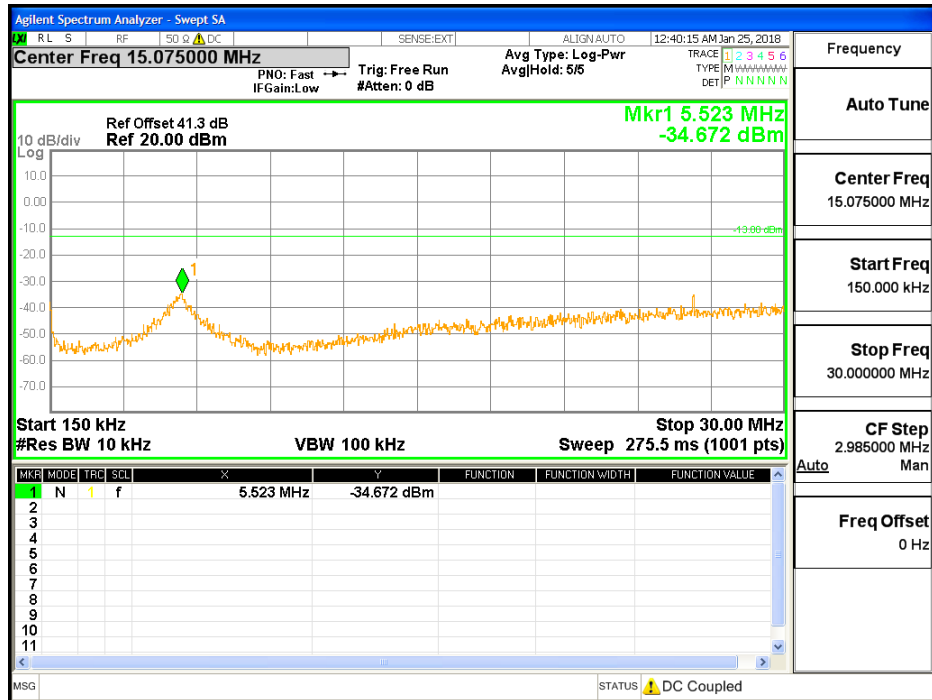
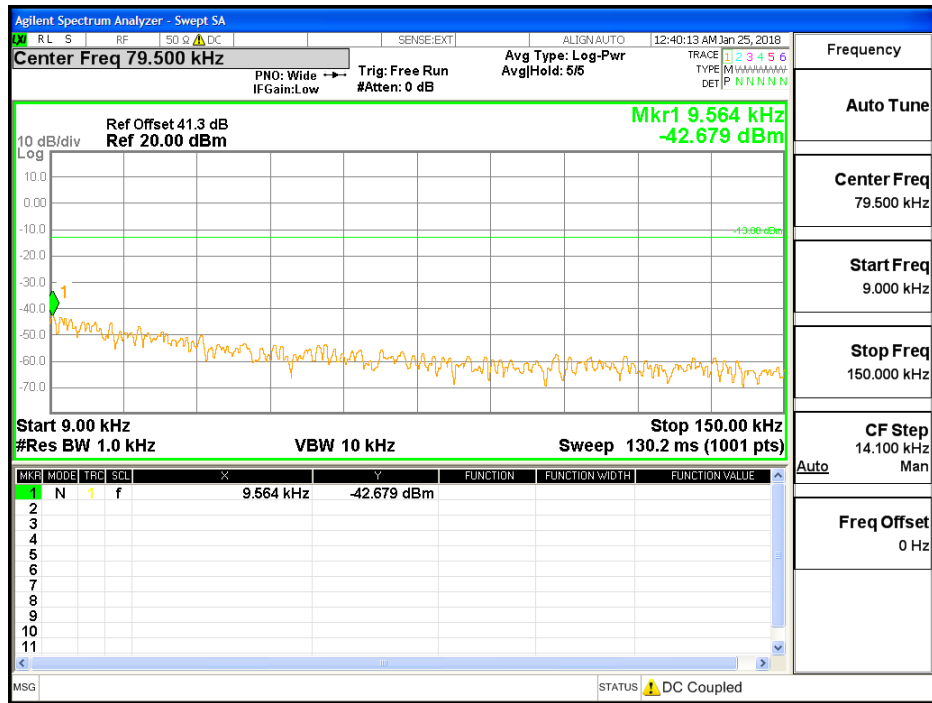
Signal 157.47 MHz

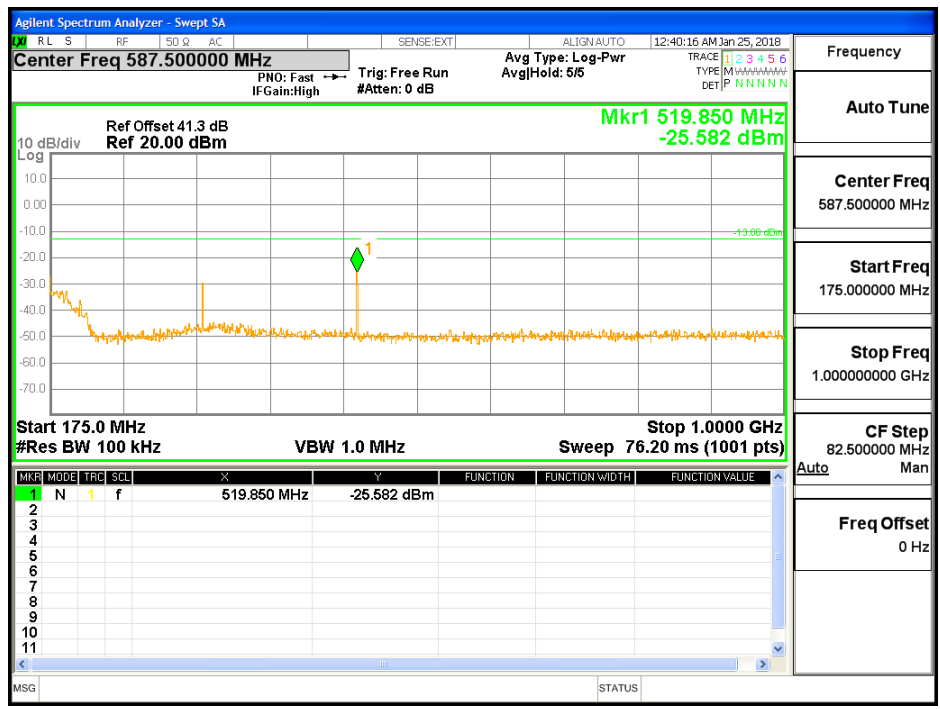
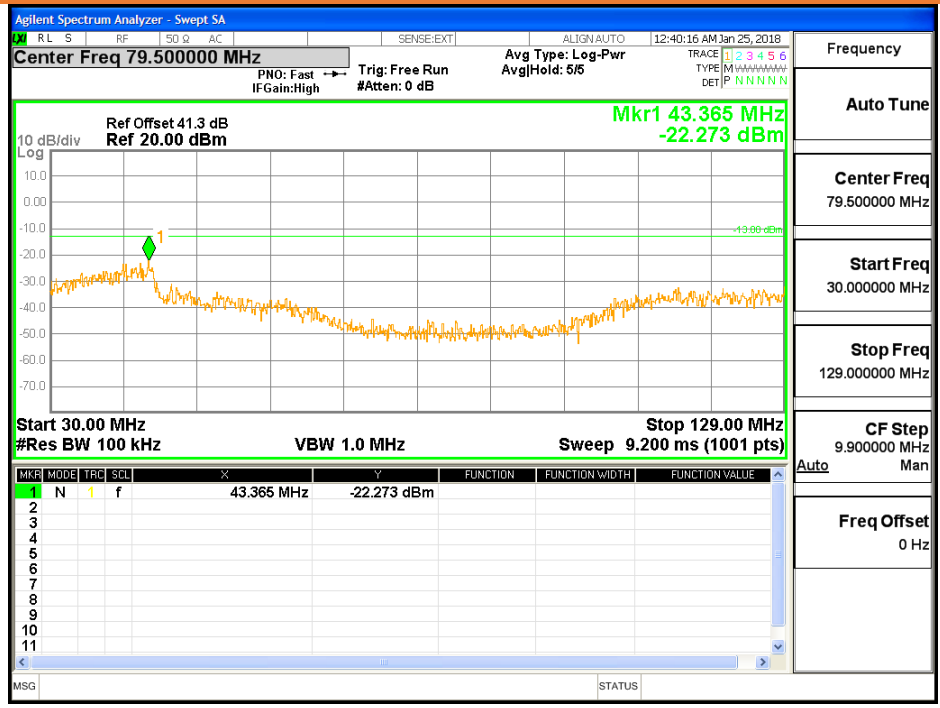


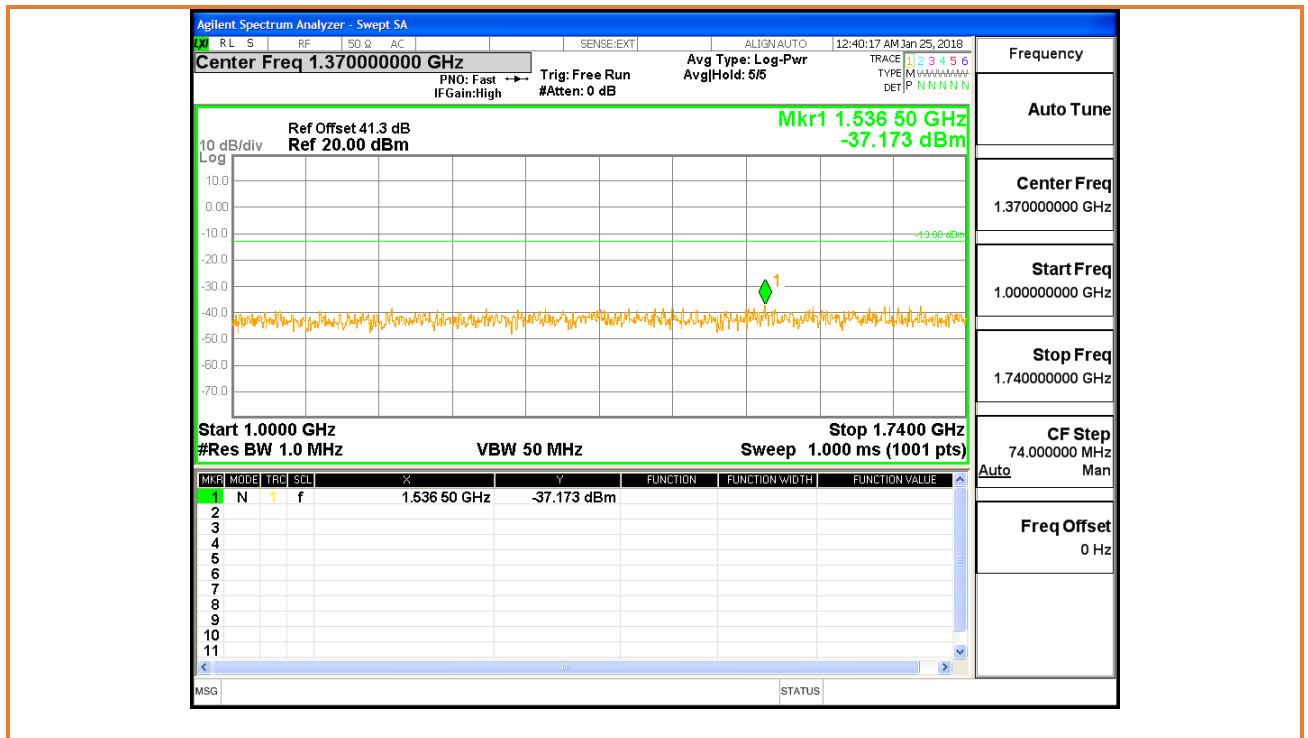




Signal 173.39625 MHz







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 (%)	35		
Test Location	Burnaby	Barometric Pressure (kPa)	100.5		
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 25, 2018		
EUT Voltage	<input checked="" type="checkbox"/> DC <input type="checkbox"/> 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:	<input checked="" type="checkbox"/> Center Channel				
Detector:	<input checked="" type="checkbox"/> Peak				
RBW/VBW:	<input checked="" type="checkbox"/> 100 Hz				
Type of Facility:	<input checked="" type="checkbox"/> Testbench				
Distance:	<input checked="" type="checkbox"/> direct connect				
Arrangement of EUT:	<input type="checkbox"/> Table-top only <input type="checkbox"/> Floor-standing only <input checked="" type="checkbox"/> Rack Mounted				
Signal of all types of modulation is contained within the emission mask.					
Compliant <input checked="" type="checkbox"/> Non-Compliant <input type="checkbox"/> Not Applicable <input type="checkbox"/>					

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.**

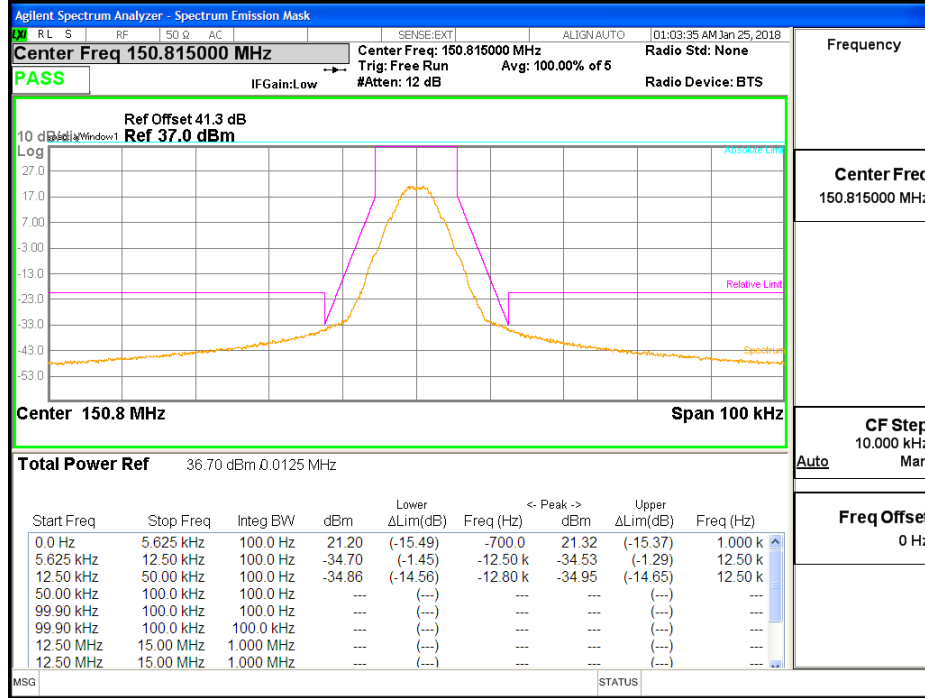
```

    graph LR
      A[Vector Signal Generator] --- B[EUT]
      B --- C(( ))
      C --- D[hd33]
      D --- E[40dB Attenuator]
      E --- F[Spectrum Analyzer]
    
```

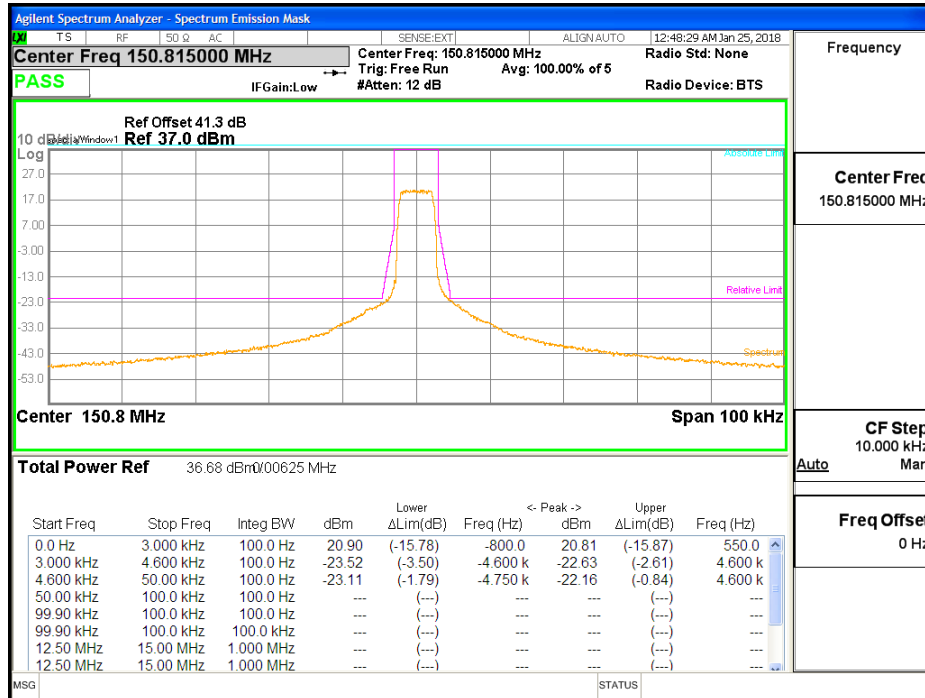

Results

At Input Power 0.5 dB below AGC threshold

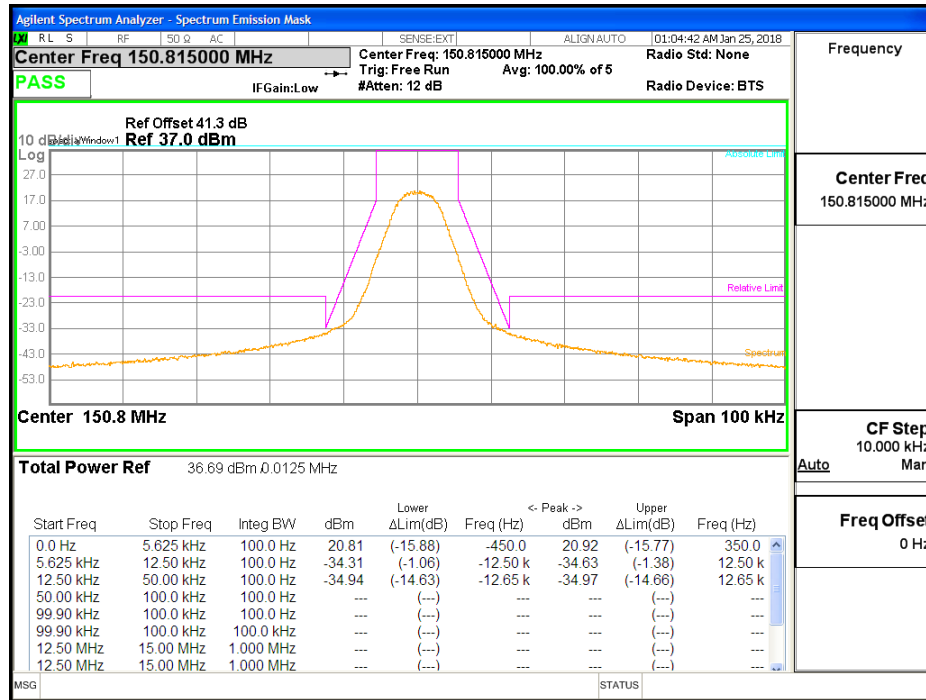
C4FM 150.815 MHz – Mask D



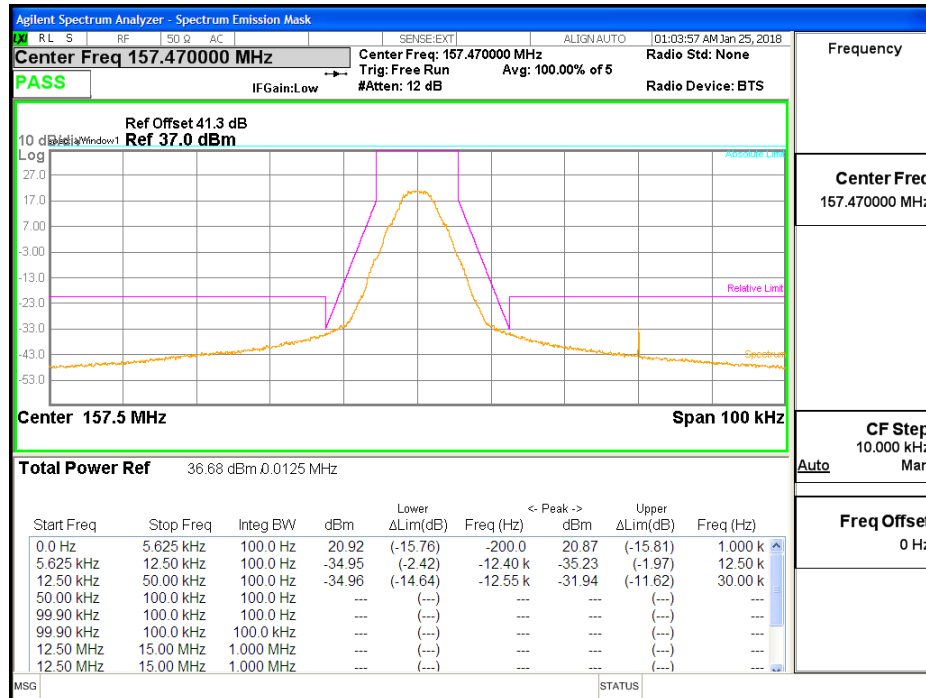
CQPSK 150.815 MHz - Mask E



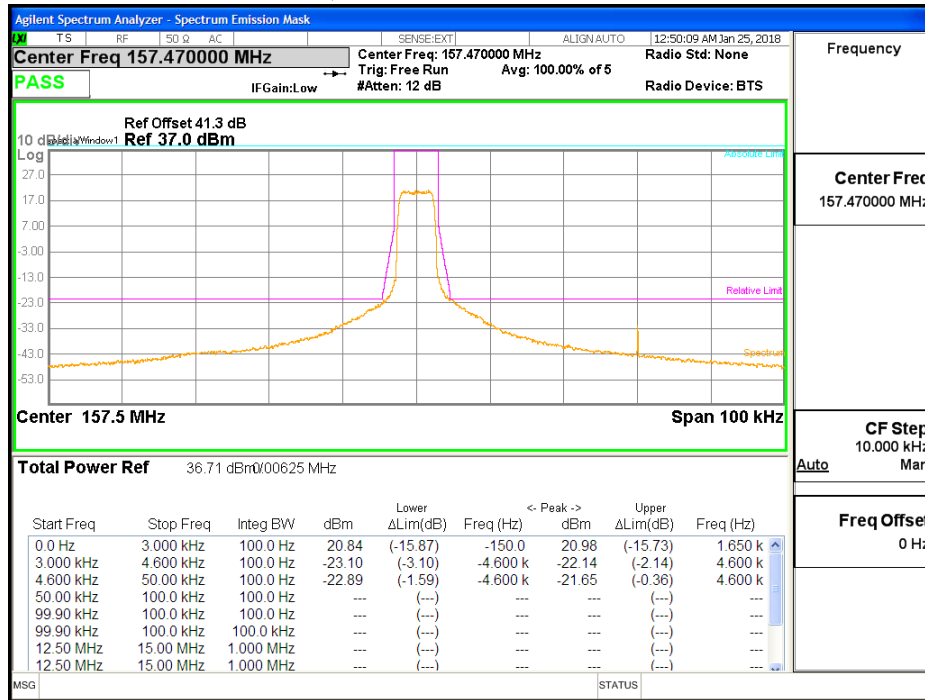
HCPM 150.815 MHz - Mask D



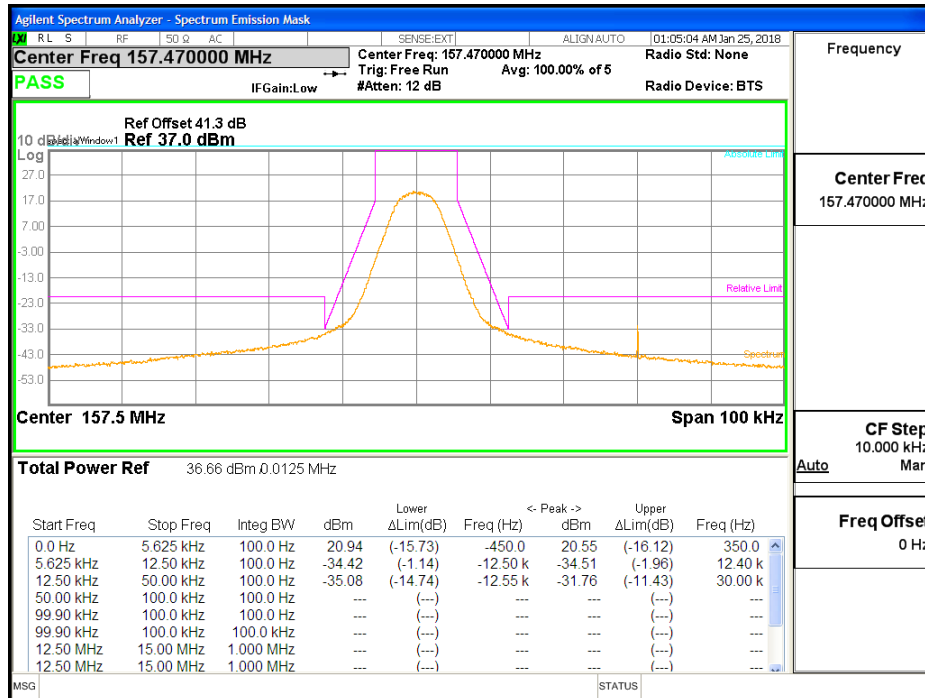
C4FM 157.45MHz - Mask D



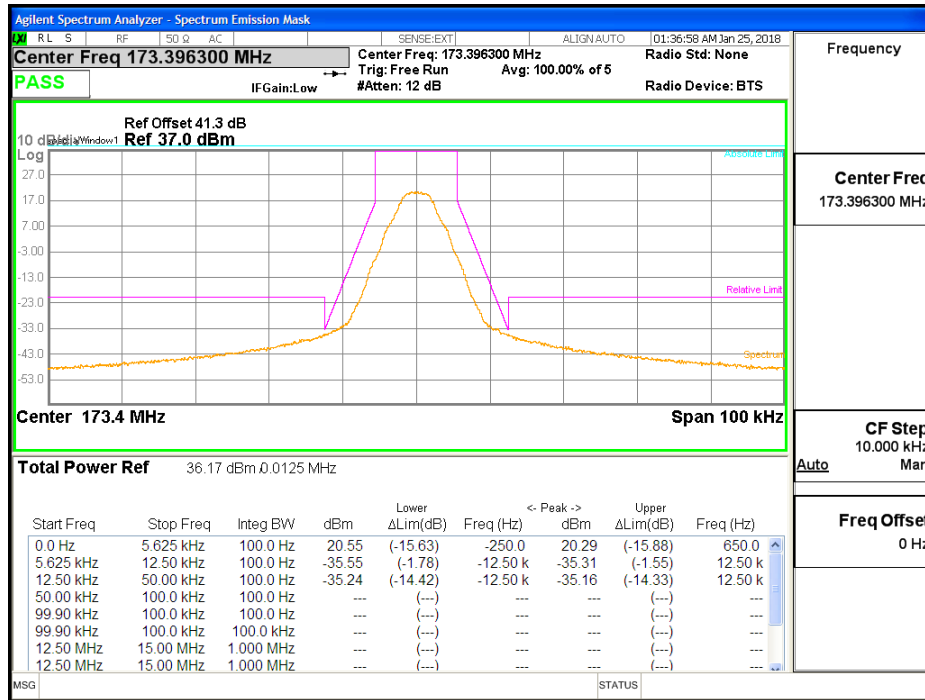
CQPSK 157.45 MHz - Mask E



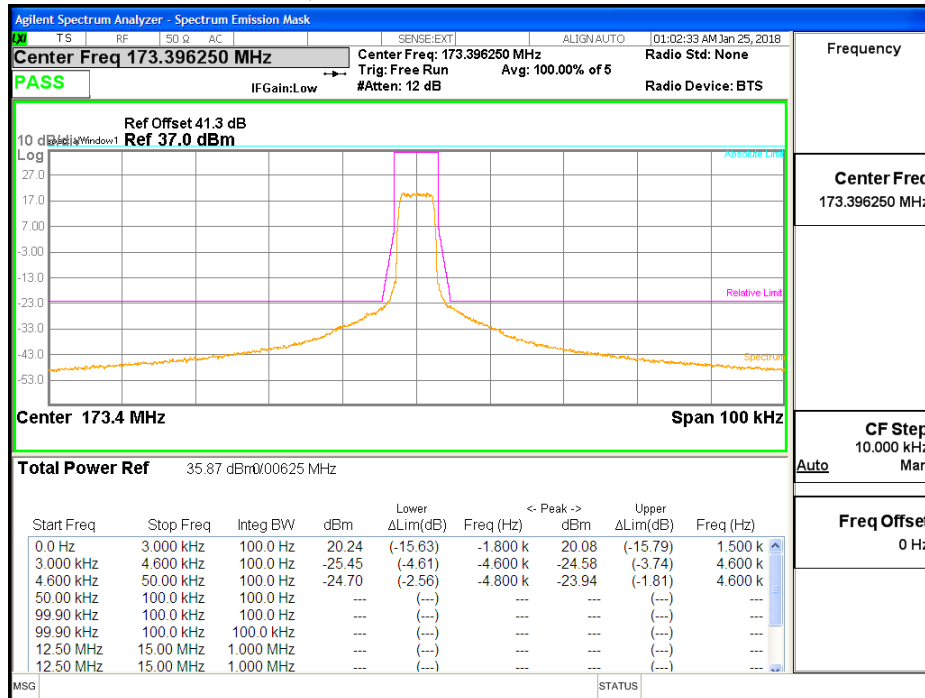
HCPM 157.45 MHz - Mask D



C4FM 173.39625 MHz - Mask D

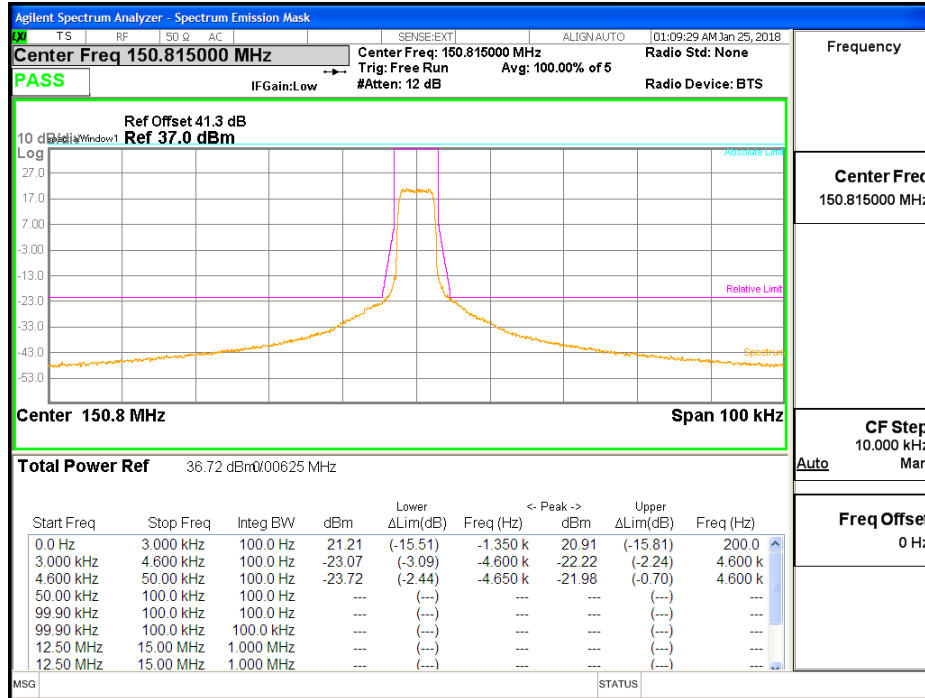


CQPSK 173.39625 MHz - Mask E

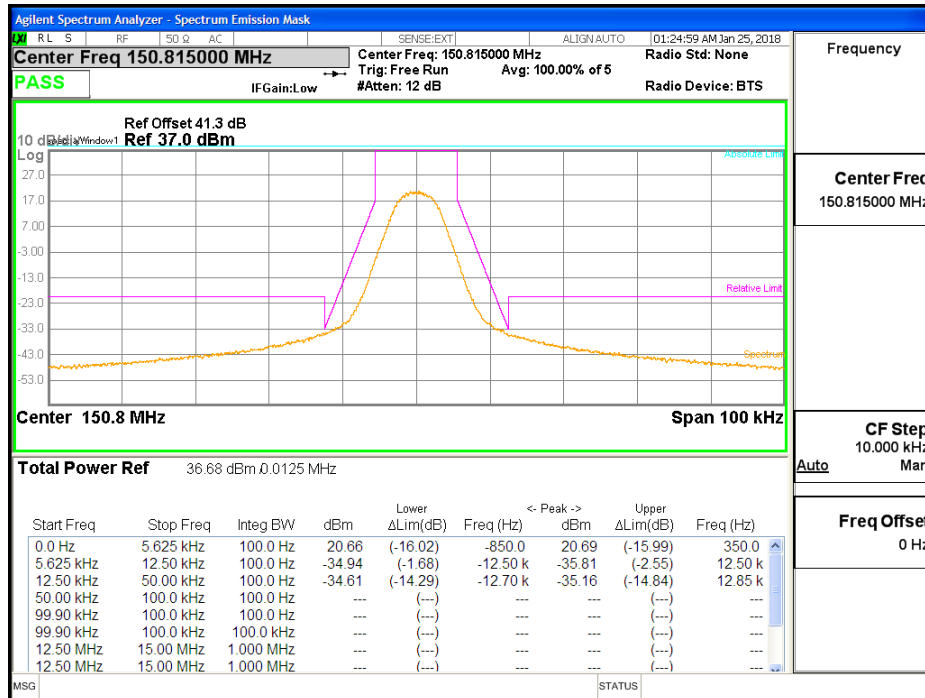




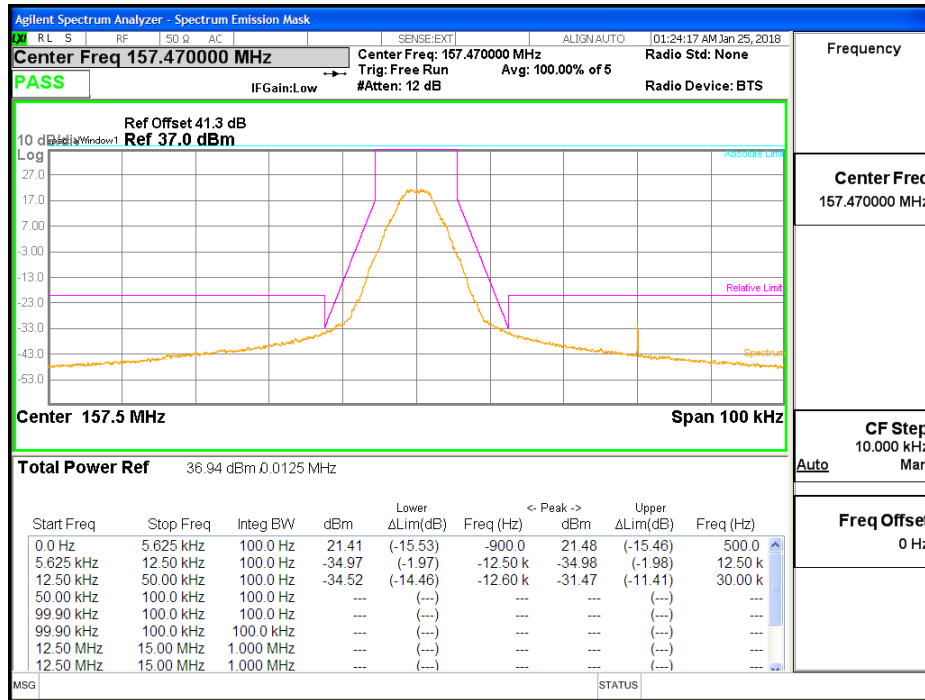
CQPSK 150.815 MHz - Mask E



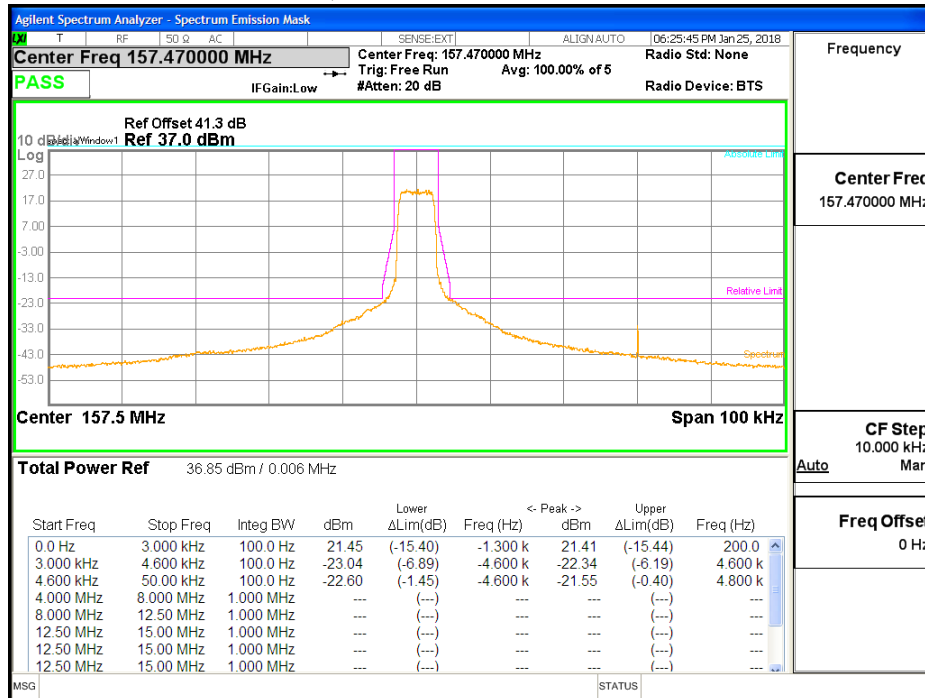
HCPM 150.815 MHz - Mask D



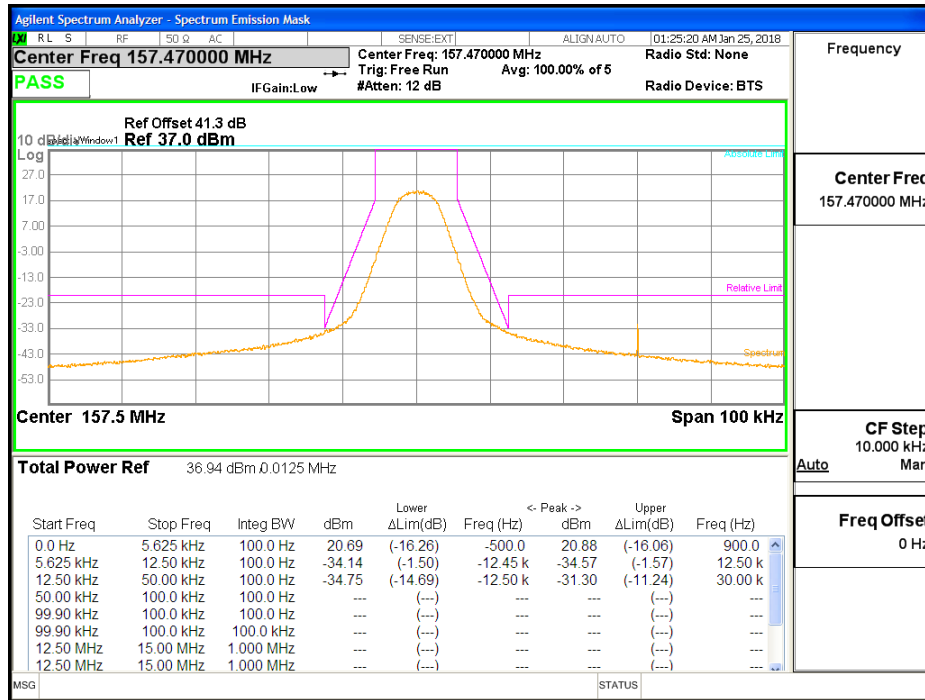
C4FM 157.47 MHz - Mask D



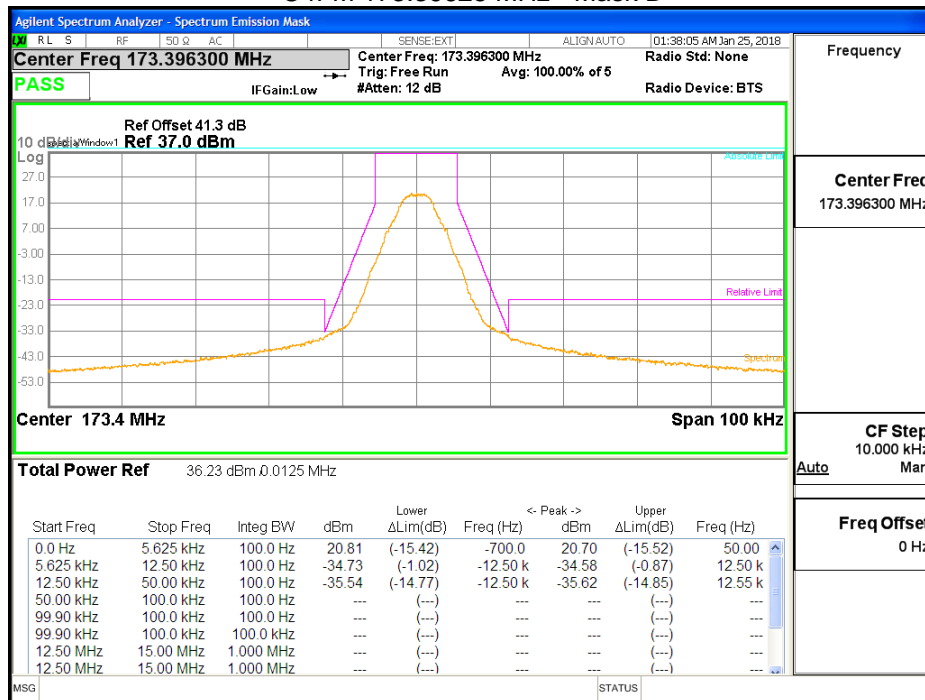
CQPSK 157.47 MHz - Mask E

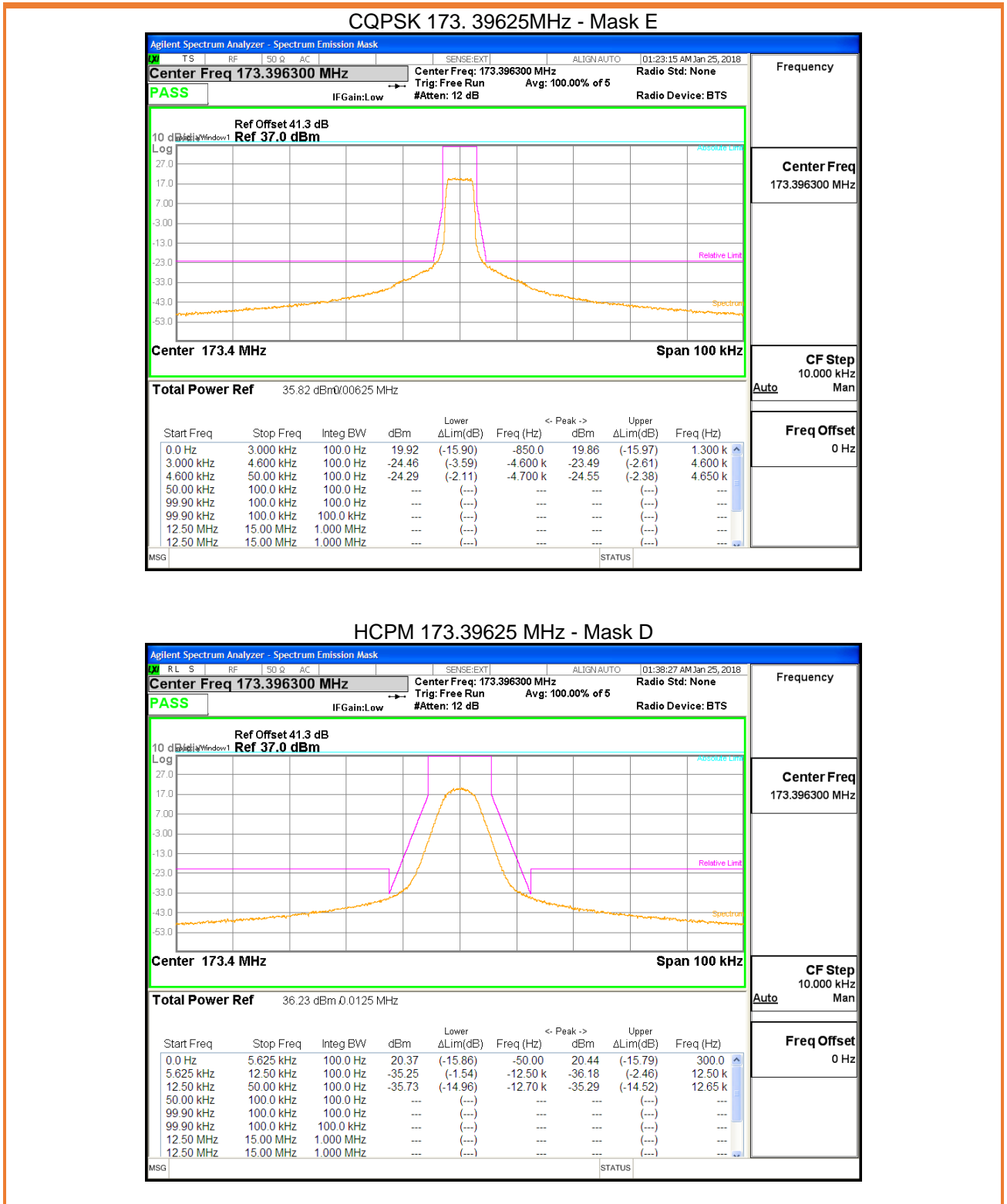


HCPM 157.47 MHz - Mask D



C4FM 173.39625 MHz - Mask D





Frequency Stability

The airHost33 and hd33 are synchronized 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 (%)	35		
Test Location	Burnaby	Barometric Pressure (kPa)	100.5		
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 25, 2018		
EUT Voltage	<input checked="" type="checkbox"/> DC <input type="checkbox"/> 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:	<input checked="" type="checkbox"/> Product Passband ± 250%				
Detector:	<input checked="" type="checkbox"/> Peak				
RBW/VBW:	<input checked="" type="checkbox"/> 0.1% of 5 times of passband bandwidth				
Type of Facility:	<input checked="" type="checkbox"/> Tabletop				
Distance:	<input checked="" type="checkbox"/> Direct				
Compliant <input checked="" type="checkbox"/> Non-Compliant <input type="checkbox"/> Not Applicable <input type="checkbox"/>					

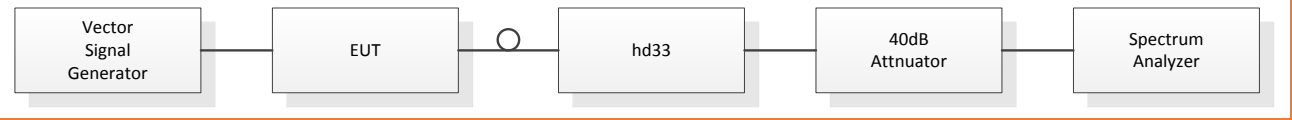
Test setup

Description of test set-up:

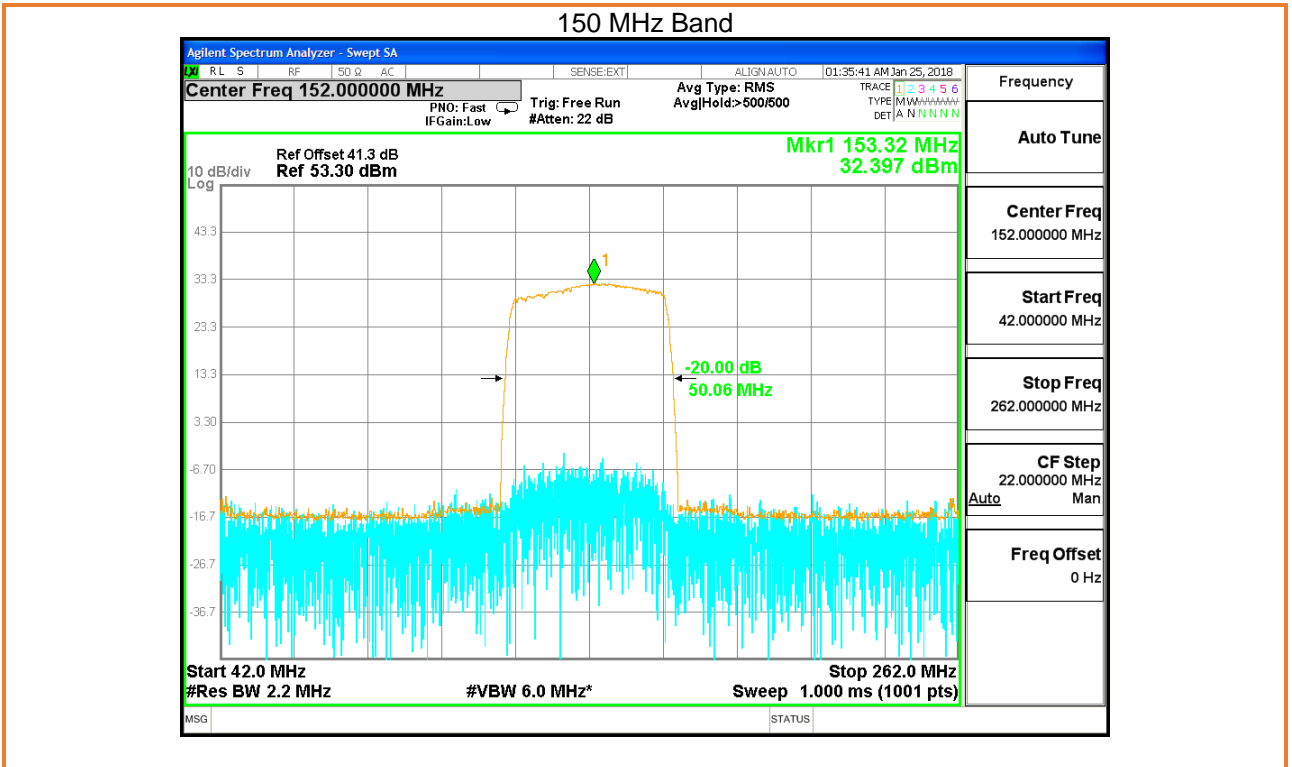
The procedure used was ANSI/TIA-603-E-2016 and FCC KDB 935210 D05 Indus Booster Basic Meas v01r02. The signal booster was set to maximum gain. A swept CW signal was set to the range of $\pm 250\%$ of the product pass band. The CW amplitude was set to 5 dB below the AGC threshold so that the ALC should 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



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 (%)	35		
Test Location	Burnaby	Barometric Pressure (kPa)	100.5		
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 25, 2018		
EUT Voltage	<input checked="" type="checkbox"/> DC <input type="checkbox"/> 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:	<input checked="" type="checkbox"/> Max Gain Frequency \pm 50kHz				
Detector:	<input checked="" type="checkbox"/> Average				
RBW/VBW:	<input checked="" type="checkbox"/> 100/910Hz				
Type of Facility:	<input checked="" type="checkbox"/> Tabletop				
Distance:	<input checked="" type="checkbox"/> Direct				
The intermodulation product of 2 tone is below the -13dBm emission limit with input power <ul style="list-style-type: none"> - 0.5dBm below AGC threshold and - 3 dB above AGC threshold 					
Compliant <input checked="" type="checkbox"/> Non-Compliant <input type="checkbox"/> Not Applicable <input type="checkbox"/>					

Test setup

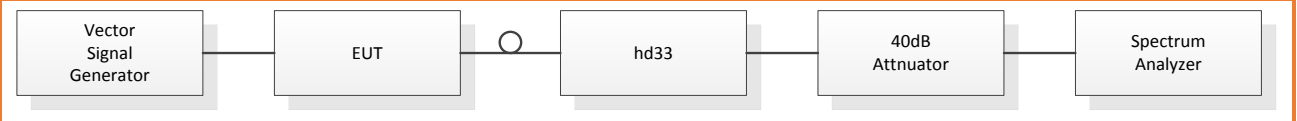
Description of test set-up:

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 frequency in the passing band, and separated with the available spacing, which is 12.5kHz in 150 MHz band.

Measurements were performed with 2-tone at identical input amplitude which produced integrated maximum rated output power.

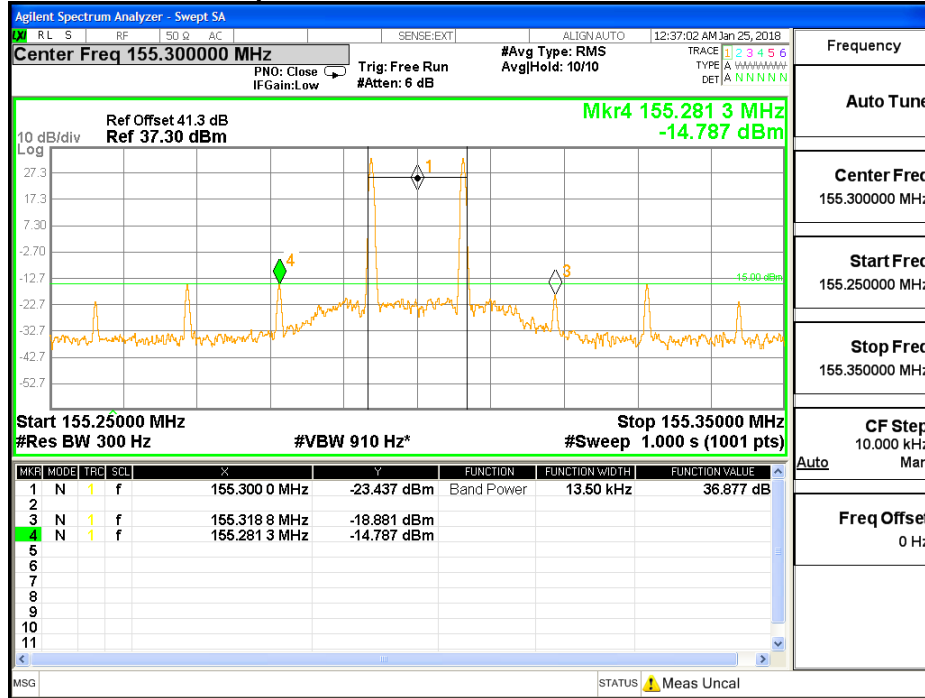
The EUT was set to **Operation Mode #1 with configuration Mode #1.**



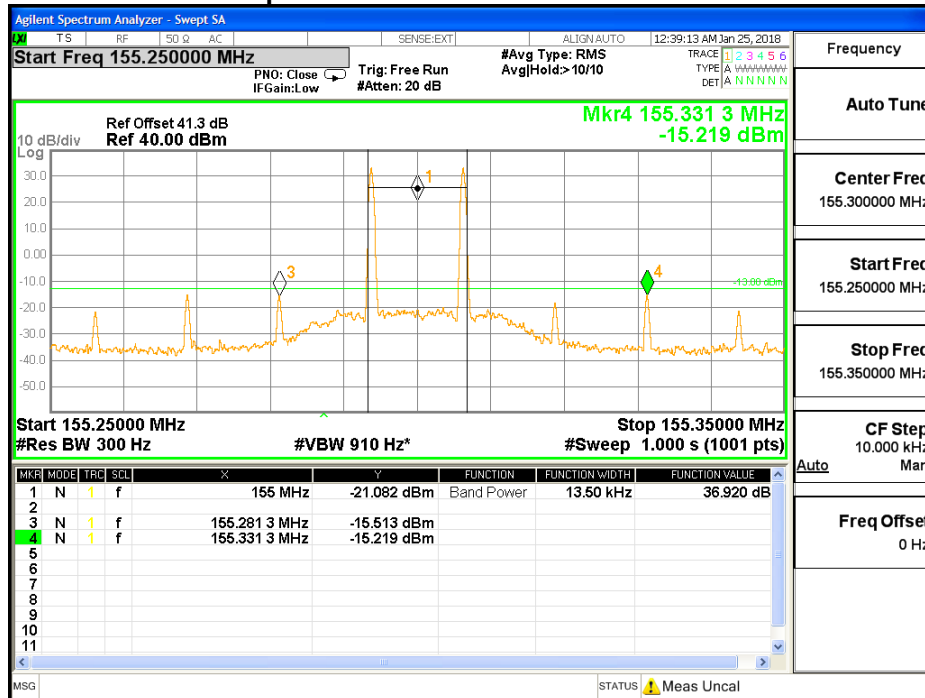
Results

On the maximum gain channel 155.3 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 (%)	35		
Test Location	Burnaby	Barometric Pressure (kPa)	100.5		
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 25, 2018		
EUT Voltage	<input checked="" type="checkbox"/> DC <input type="checkbox"/> 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:	<input checked="" type="checkbox"/> Max Gain Frequency \pm 1500kHz				
Detector:	<input checked="" type="checkbox"/> Peak				
RBW/VBW:	<input checked="" type="checkbox"/> 100k Hz/ 300 kHz				
Type of Facility:	<input checked="" type="checkbox"/> Tabletop				
Distance:	<input checked="" type="checkbox"/> Direct				
Maximum booster gain is 91.987 dB.					
Compliant <input checked="" type="checkbox"/> Non-Compliant <input type="checkbox"/> Not Applicable <input type="checkbox"/>					

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.	
<pre> graph LR A[Vector Signal Generator] --> B[EUT] B --> C(()) C --> D[hd33] D --> E[40dB Attenuator] E --> F[Spectrum Analyzer] </pre>	

Results

	UL Gain	UL Input	UL Output
150 band	92 dB	-55 dBm	37 dBm

Noise Figure

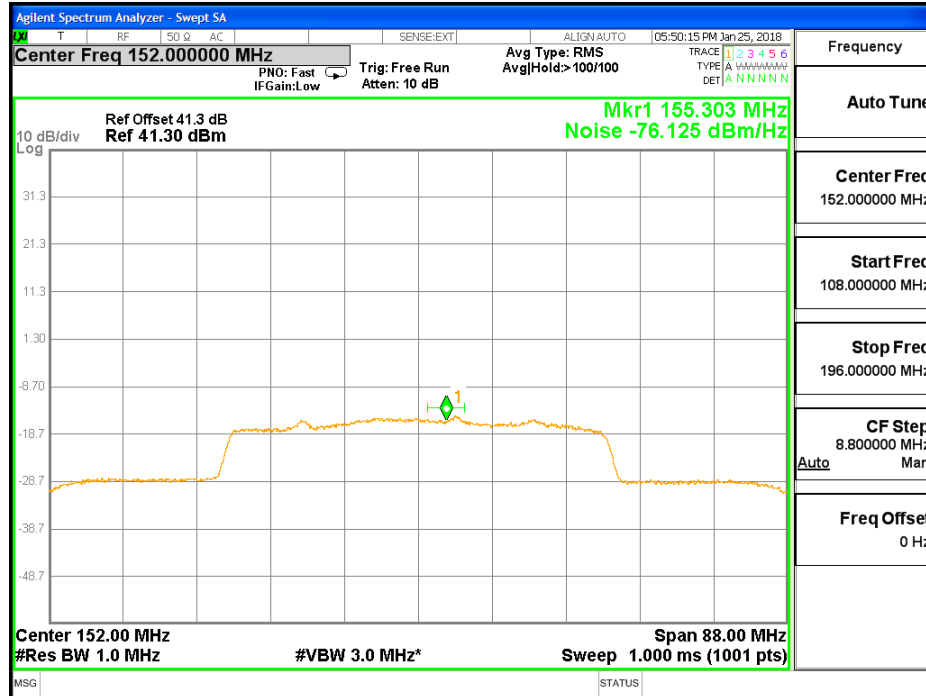
Governing Doc	FCC Part 90.219	Room Temperature (°C)	23.4		
Test Procedure	ANSI/TIA-603-E-2016; FCC KDB 935210 D05 Indus Booster Basic Meas v01r02: October 27, 2017	Relative Humidity (%)	32.7		
Test Location	Burnaby	Barometric Pressure (kPa)	101.5		
Test Engineer	Sophie Piao/Jeremy Lee	Date	Jan 25, 2018		
EUT Voltage	<input checked="" type="checkbox"/> DC <input type="checkbox"/> 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:	<input checked="" type="checkbox"/> 88 MHz centered at the center frequency of the passband on each band				
Detector:	<input checked="" type="checkbox"/> Average				
RBW:	<input checked="" type="checkbox"/> 910 kHz				
Type of Facility:	<input checked="" type="checkbox"/> Tabletop				
Distance:	<input checked="" type="checkbox"/> Direct				
Noise Figure on each band is less than the 9 dB required.					
Compliant <input checked="" type="checkbox"/> Non-Compliant <input type="checkbox"/> Not Applicable <input type="checkbox"/>					

Test setup

<p>Description of test set-up:</p> <p>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.</p> <p>The noise figure is then calculated by $NF = NP - Gain + KTB \text{ Noise}$; where</p> <p>NP is in band noise power per Herz,</p> <p>Gain is in band booster gain, which is 92 dB in UL.</p> <p>KTB Noise is 174dB/Hz at room temperature.</p> <p>The EUT was set to Operation Mode #1 with configuration Mode #1.</p> <p style="text-align: center;">For Noise Power Measurement</p> <pre> graph LR SA[Spectrum Analyzer] --- EUT[EUT] EUT --- hd33[hd33] </pre>

Results

150MHz band
 $NF = -76.125 - 92 + 174 = 5.875 \text{ dB}$



Radiated Emissions - Enclosure

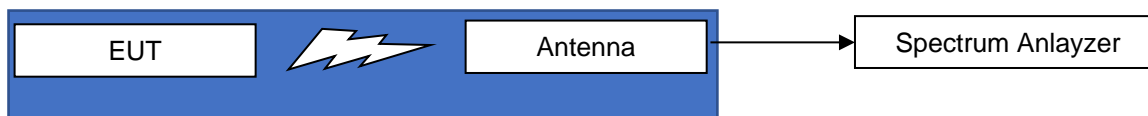
Governing Doc	FCC Part 2.1053, FCC Part 90.210 & FCC Part 90.219	Room Temperature (°C)	20.6		
Test Procedure	ANSI TIA-603-D	Relative Humidity (%)	48		
Test Location	Richmond	Barometric Pressure (kPa)	100.4		
Test Engineer	David Johanson	Date	20 October 2017		
EUT Voltage	<input checked="" type="checkbox"/> DC <input type="checkbox"/> 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	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:	<input checked="" type="checkbox"/> 9kHz-30MHz	<input checked="" type="checkbox"/> 30-1000MHz	<input checked="" type="checkbox"/> 1-3GHz		
Detector:	<input checked="" type="checkbox"/> Peak (for Prescan)	<input checked="" type="checkbox"/> Quasi-Peak(for Formal)	<input checked="" type="checkbox"/> Average(for Formal)		
RBW/BW:	<input checked="" type="checkbox"/> 9/30kHz	<input checked="" type="checkbox"/> 120/300kHz	<input checked="" type="checkbox"/> 1/3MHz		
Type of Facility:	<input checked="" type="checkbox"/> SAC	<input checked="" type="checkbox"/> FSOATS	<input type="checkbox"/> <i>in-situ</i>		
Distance:	<input checked="" type="checkbox"/> 3meter	<input type="checkbox"/> 10meter	<input type="checkbox"/> 1meter		
Arrangement of EUT:	<input checked="" type="checkbox"/> Table-top only	<input type="checkbox"/> Floor-standing only	<input type="checkbox"/> Rack Mounted		
Results: There were no measurable spurious emissions from the transmitter for each Fundamental 130, 153 and 170MHz.					
Compliant <input checked="" type="checkbox"/> Non-Compliant <input type="checkbox"/> Not Applicable <input type="checkbox"/>					

Test setup

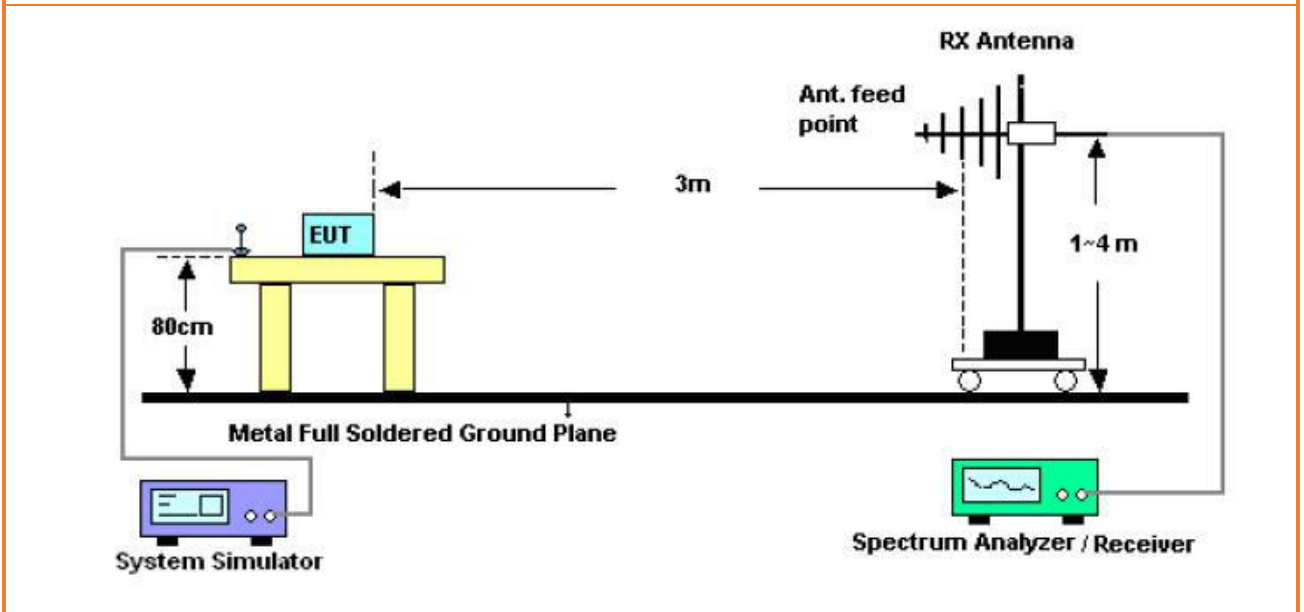
Description of test set-up:

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 [uplinked from hd33](#). 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 emissions .

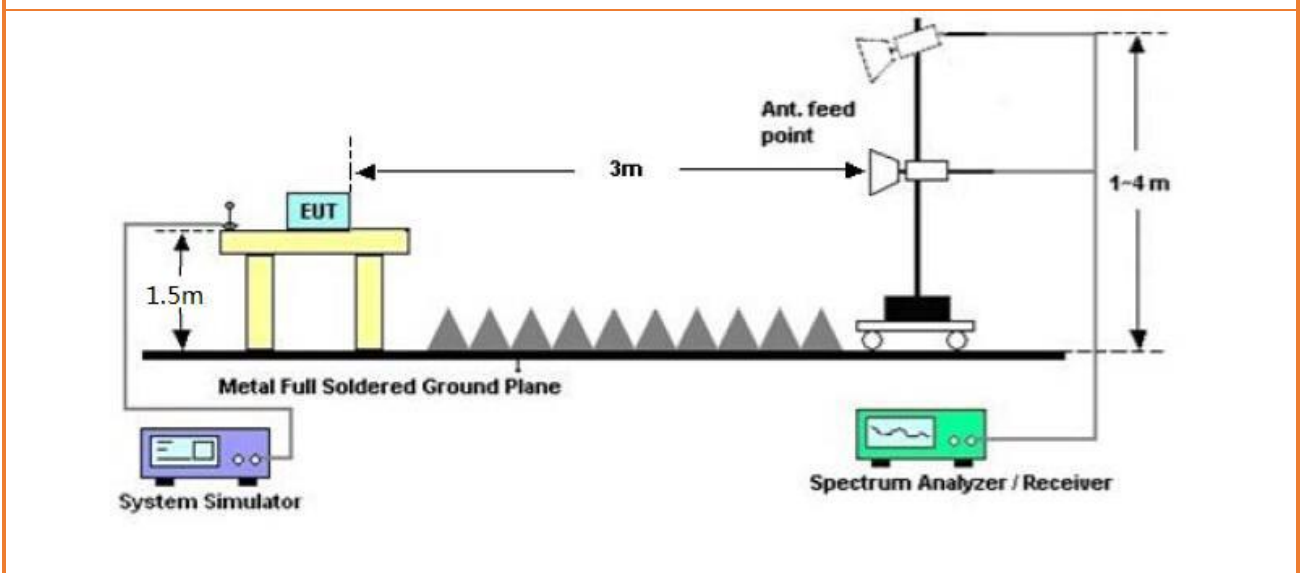
The EUT was set to **Operation Mode #1 with configuration Mode #1**.



- 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 2GHz 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: $43 + 10\log(P) = 43 + 10\log(1) = 49.99\text{dB}$ attenuation = -13dBm

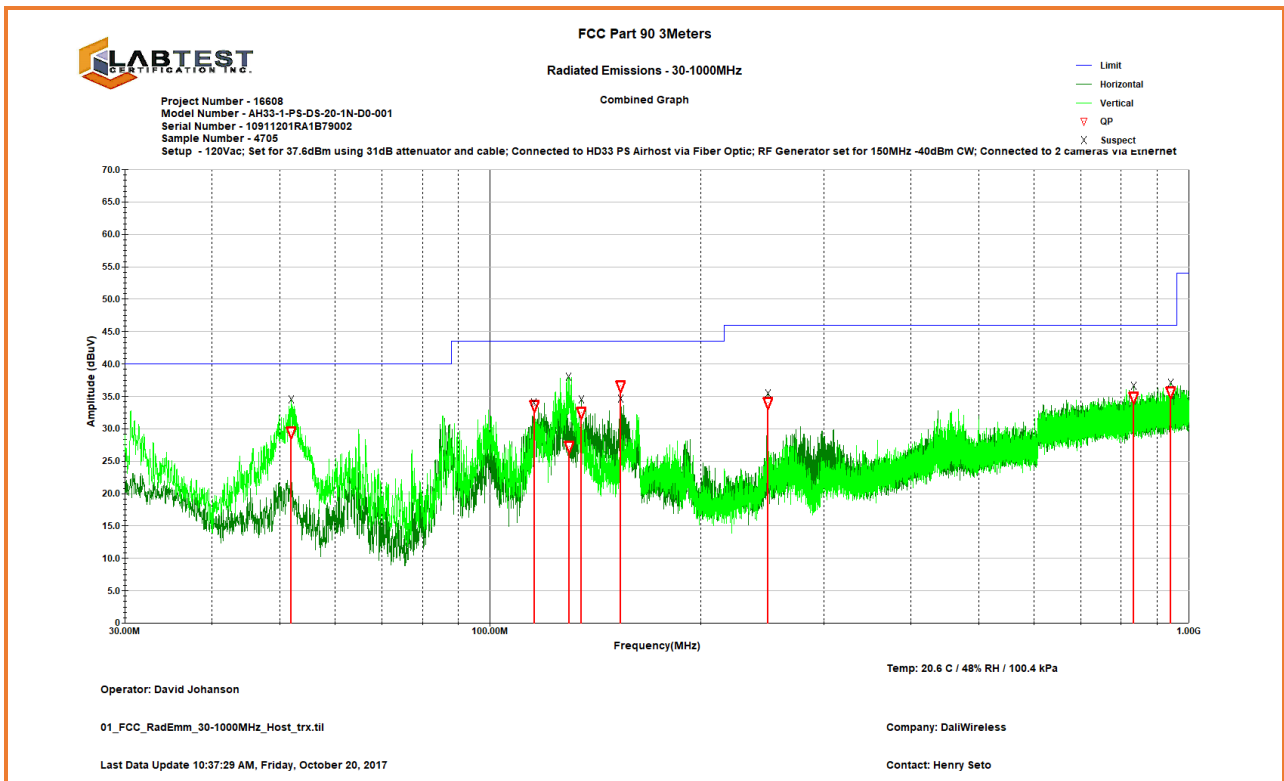
Since of radiated measurement was performed at 3 meters, the limit line was converted to dBuV/m using the formulas as outlined in KDB 971168 (5.8.4): $-13\text{ dBm ERP} = 84.38\text{ dBuV/m}$ at 3 meters.

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

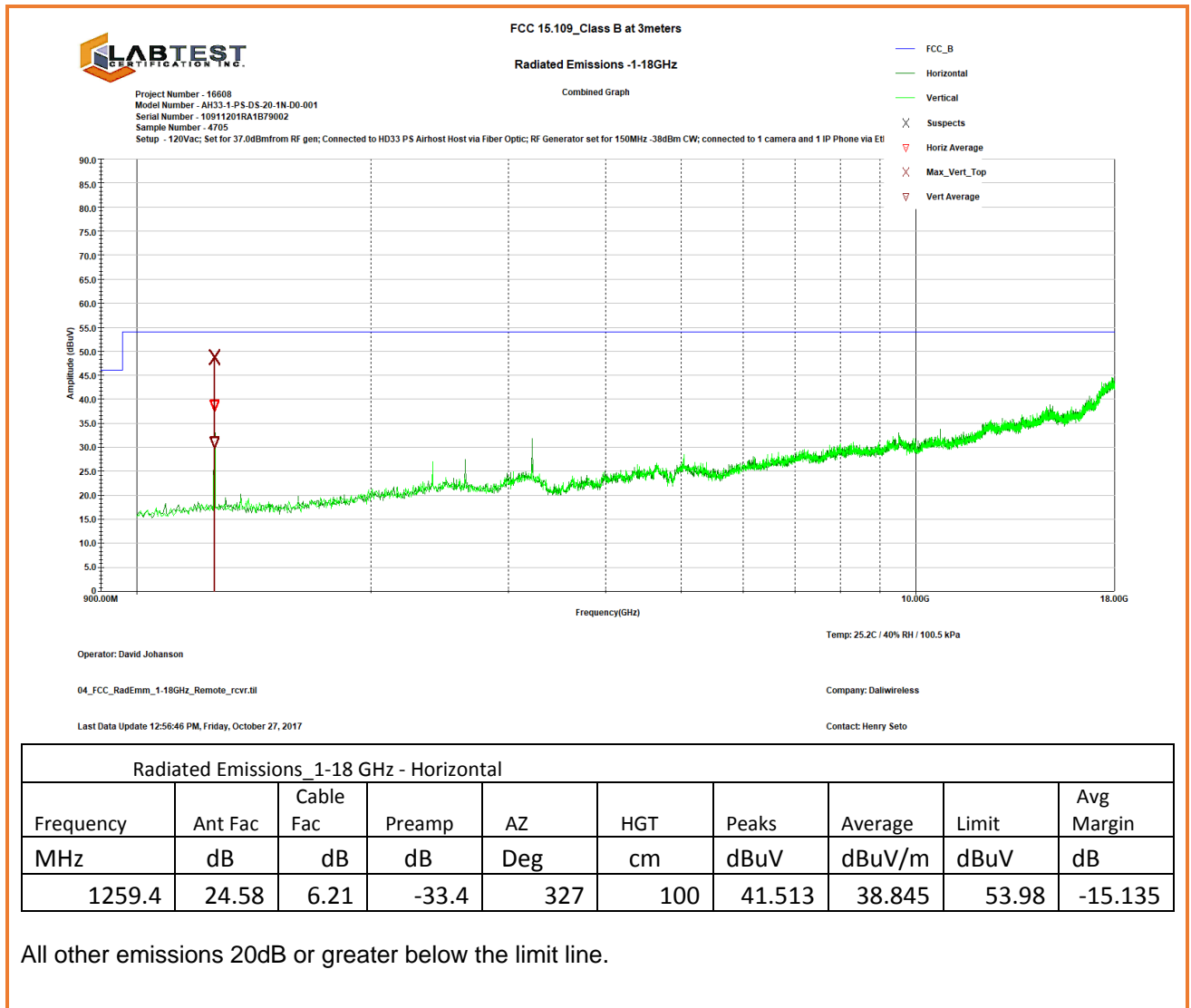


Radiated Emissions_30 MHz -1 GHz – Horizontal - Spurious Emissions into a Load									
Frequency	Ant Fac	Cable Loss	Preamp	AZ	HGT	Peak	QP	Limit	Margin
MHz	dB	dB	dB	Deg	cm	dBuV/m	dBuV/m	dBuV/m	dB
115.5840	15.3	1.3	0	156.3	263.9	36.334	33.636	43.52	-20.344
135.0695	16.7	1.4	0	0	101.8	35.301	32.51	43.52	-21.47
153.6150	16.1	1.5	0	138	185.6	39.543	36.651	43.52	-17.329
832.8948	21.7	4.4	0	192	111.9	38.723	34.907	46.02	-21.993

Radiated Emissions_30 MHz -1 GHz - Vertical – Spurious Emissions in to a Load									
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
51.9462	7.63	0.84	0	234	177	33.292	29.473	40	-20.067
129.6548	16.73	1.37	0	92	131	31.1	27.276	43.52	-26.704
249.9717	13.3	2	0	293	100	36.692	34.027	46.02	-22.873
941.4975	22.77	4.68	0	359	244	39.541	35.699	46.02	-21.201

The measurements taken represent the worst case emissions from the Digital Circuitry during a transmission at 153MHz at 5Watts

Graphical Representation for Emission - Radiated 1 to 18GHz



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).



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 rubenUgarte@labtestcert.com
 www.labtestcert.com

TESTING

Valid to: **March 4, 2018**

Certificate Number: **A-T-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		





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	<ul style="list-style-type: none"> 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)	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> ANSI/TIA-603-D 		
Microwave and Millimeter Bands Radio Services (FCC Licensed Radio Service Equipment) •Part 25 •Part 74 •Part 90 (90Y, 90Z, D SRC) •Part 101	<ul style="list-style-type: none"> ANSI/TIA-603-D TIA-102.CAAA-D 		
Broadcast Radio Services (FCC Licensed Radio Service Equipment) •Part 73 •Part 74 (non-microwave)	<ul style="list-style-type: none"> ANSI/TIA-603-D TIA-102.CAAA-D 		
RF Exposure •Devices subject to SAR requirements	<ul style="list-style-type: none"> IEEE Std 1528™-2013 	KDB Publication 865664 KDB Publication 447498	
Hearing Aid Compatibility (Part 20) •HAC for Commercial mobile services	<ul style="list-style-type: none"> ANSI C63.19-2007; or ANSI C63.19-2011 		





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	<ul style="list-style-type: none"> 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 O STMP-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

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