



REPORT

For

Dali Wireless, Inc.

535 Middlefield Road, Suite 280
Menlo Park, CA 94025

Date: March 2018
Report No.: 16898-3E
Revision No.: **2**
Project No.: 16898
Equipment: Dual Band Medium Power DAS
Model No.: hd33-2-PS-BC-10-1N-D0
FCC ID: HCOHD332PSBC10A

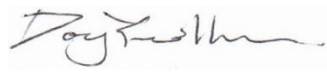
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Unit 3128 – 20800 Westminster HWY, Richmond, BC
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TEST REPORT_FCC Part 2, 90	
Private Land Mobile Services	
Report Reference No.:	16898-3E
Report Revision History.:	✓ Rev. 0: 14 March 2018 ✓ Rev. 1: 26 March 2018 ✓ Rev. 2: 27 March 2018
Compiled by (+ signature)	Sophie Piao,  Daniel Lee 
Approved by (+ signature)	Jeremy Lee 
Date of issue	March 2018
Total number of pages	
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
Test procedure	➤ ANSI/TIA-603- E-2016 ➤ FCC KDB 935210 D05 Indus Booster Basic Meas v01r02: October 27, 2017
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	hd33-2-PS-BC-10-1N-D0
Serial Number	10911105RA1B82001
FCC ID	HCOHD332PSBC10A
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	February 02, 2018
Date (s) of performance of tests.....	February 02, 06 & 13, 2018

Revision History

Revision	Date	Reason For Change	Author(s)
0	14 March 2018	Initial Data	Sophie Piao & Daniel Lee
1	26 March 2018	Revised based on TCB response	Jeremy Lee
2	27 March 2018	Revised based on TCB response	Jeremy Lee

Device Under Test Description

Application for	PS 800/900 Remote Unit, Dual Band Medium Power DAS
Passing Transmit Frequency	851 MHz – 862 MHz 935 MHz – 941 MHz
Operating Transmit Frequency FCC	851 MHz – 861 MHz 935 MHz – 940 MHz
Passing Receive Frequency	806 MHz – 817 MHz 896 MHz – 902 MHz
Operating Receive Frequency FCC	806 MHz – 816 MHz 896 MHz – 901 MHz
Number of Channels	As many as which can fit
Rated RF Output(e.i.r.p.)	33 dBm
Modulation Type	P25 Phase I C4FM, CQPSK; P25 Phase II HDQPSK 4FSK on Band 900 only FM on Band 800 between 851 MHz – 854 MHz only
Equipment mobility	Fixed

Operating condition..... :	-40 to +50 °C
Mass of equipment (g) :	< 22,700g
Dimension(W X D X H)	430 mm X 194 mm X 466 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>3.125</u> 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 800PS 900PS is a dual-band remote unit that provides 2 W of output power on each band. The dual-band unit supports one or two bands in a sealed type 1 pluggable module chassis.

On the downlink path the hd33 PS remote receives an aggregated stream of digitized RF signals from an UBiT-hdHost 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 VHF/UHF 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 UBiT-*hd*Host was connected as the Auxiliary device. The UbiT-*hd*Host does not have antenna port, where the signal was injected and ejected via coaxial cables.

- Top View



- Connector side 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.

hd33-1-PS-B-10-1N-D0 – single band 800PS model

hd33-1-PS-C-10-1N-D0 – single band 900PS model

hd33-2-PS-BC-10-1N-D0 – dual band 800PS & 900PS model as tested

Client Equipment Used During Test

Use*	Product Type	Manufacturer	Model	Comments
EUT	<i>hd33, 800PS, 900PS</i>	Dali Wireless Inc.	hd33-2-PS-BC-10-1N-D0	EUT where the RF (I/O) antenna attached via duplexers/multiplexer when necessary.
AE1	<i>UBiT-hdHost, 800PS, 900PS</i>	Dali Wireless Inc.	UBiT-hdHost-2-PS-BC-4Q	Auxiliary equipment, which is connected to the Base Station via RF coaxial cables, has no air interface.
AE2	UBiT-CP	Dali Wireless Inc.	UBiT-CP	Auxiliary equipment provides the interface between Dali Matrix Console and UBiT-hdHost and <i>hd33</i> .
AE3	Dali Matrix Console	Dali Wireless Inc.	hdCNSL-1-8-4-120G-AC	Auxiliary equipment provides the configuration and control interface to UBiT-CP, UBiT-hdHost 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	2.1.1-rc1.242
AE1	Software installed	2.1.1-rc1.242
AE2	Software installed	2.1.1-rc1.242
AE3	Software installed	2.1.2_rc1-19
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/Output Ports	I/O	No	No	N-Type Coaxial
3	2 * Optical Fibre I/O Ports	I/O	No	No	LC/UPC Duplex
4	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	UbiT-hdHost maximum input threshold set to -10 dBm, uplink attenuation set to 0dB; hd33 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
Input-versus-output Signal Comparison	FCC Part 2 2.1049	ANSI TIA-603- E-2016 & FCC KDB 935210 D05, v01r02 Sec 3.4	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

Output Power (Conducted)

Governing Doc	FCC Part 2 2.1046(a) FCC Part 90.219(d)	Room Temperature (°C)	24
Test Procedure	ANSI/TIA-603- E-2016; FCC KDB 935210 D05, v01r02;	Relative Humidity (%)	33.9
Test Location	Burnaby	Barometric Pressure (kPa)	102.6
Test Engineer	Sophie Piao/Jeremy Lee	Date	Feb 06, 2018
EUT Voltage	☒ DC ☐ 120VAC @ 60Hz		
Test Equipment Used	Manufacturer	Model	Serial Number
Signal Generator	Keysight	N5172B	MY53050270
Spectrum Analyzer	Keysight	N9010A	MY50520285
40dB Attenuator	Aeroflex Winschel	58-40-43	n/p
Calibration 08/04/17 08/04/18 08/07/17 08/07/18 CVP CVP			
Note) CVP = Calibration Verification Performed internally, n/p = not provided.			
Frequency Range:	☒ 851 MHz – 861 MHz ☒ 935 MHz – 940 MHz		
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 33.6 dBm in band 800 and is less than 33.2 dBm in band 900. 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 ☐			

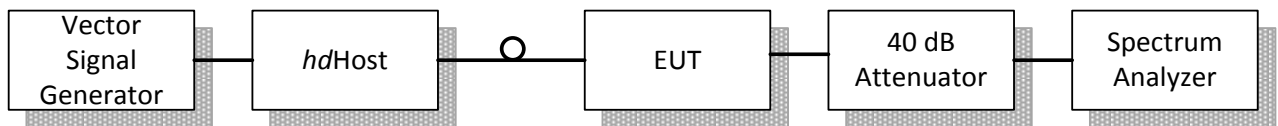
Test setup

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

Frequency (MHz)	Input Power Trip ALC (dBm)	Output Power (dBm)	Limit (37dBm)
851.0125	-9	33.4	PASS
856	-9.5	33.6	PASS
860.9875	-9	33.3	PASS
935.0125	-10.5	33	PASS
937.5	-10	33.2	PASS
939.9875	-10	33.1	PASS

Input-versus-output Signal Comparison (Conducted)

Governing Doc	FCC Part 2 2.1049	Room Temperature (°C)	24
Test Procedure	ANSI/TIA-603- E-2016; FCC KDB 935210 D05, v01r02 Sec 3.4	Relative Humidity (%)	33.9
Test Location	Burnaby	Barometric Pressure (kPa)	102.6
Test Engineer	Sophie Piao/Jeremy Lee	Date	Feb 06/07, 2018
EUT Voltage	☒ DC ☐ 120VAC @ 60Hz		
Test Equipment Used	Manufacturer	Model	Serial Number
Signal Generator	Keysight	N5172B	MY53050270
Spectrum Analyzer	Keysight	N9010A	MY50520285
40dB Attenuator	Aeroflex Winschel	58-40-43	n/p
Calibration 08/04/17 08/04/18 08/07/17 08/07/18 CVP CVP			
Note) CVP = Calibration Verification Performed internally, n/p = not provided.			
Frequency Range:	☒ 851 MHz – 861 MHz ☒ 935 MHz – 940 MHz		
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 - 4 kHz FM with 1kHz deviation < 12.5 kHz			
AGC activation does not distort the signal shape.			
Compliant ☒ Non-Compliant ☐ Not Applicable ☐			

Test setup

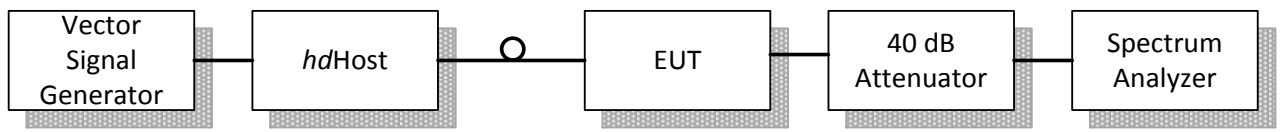
Description of test set-up:

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.**

The occupied bandwidth of DL output is measured under two input conditions:

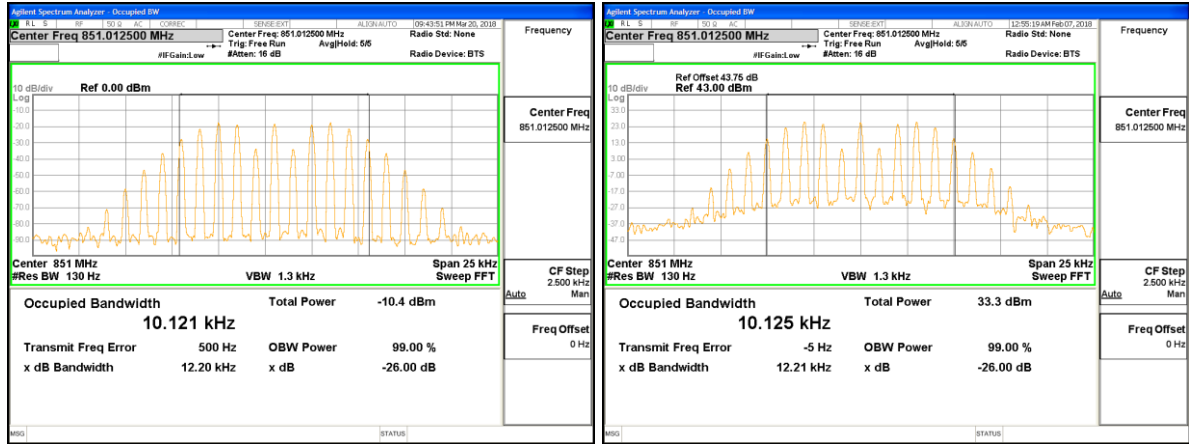
- Nominal: with input 0.5dB below AGC threshold
- AGC: with input 3dB above AGC threshold



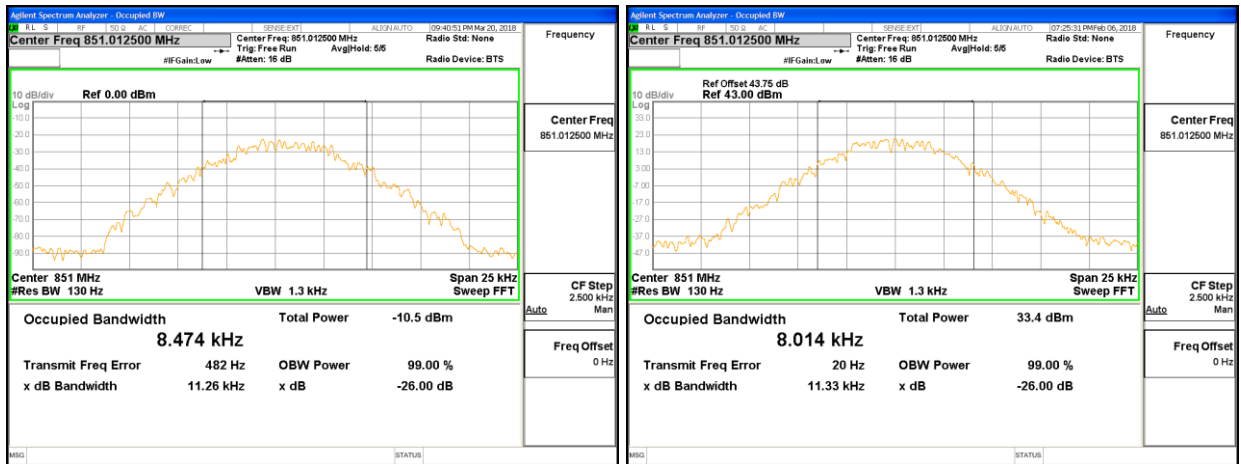
Results – Occupied Bandwidth (OBW)

At Input Power 0.5 dB below AGC threshold: Input OBW vs. Output OBW

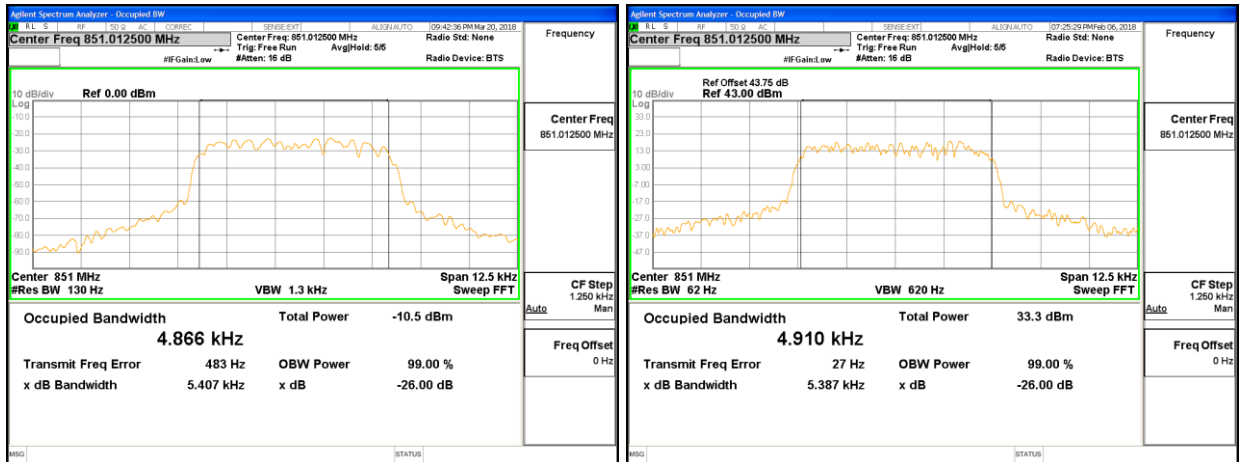
FM Signal at 851.0125MHz



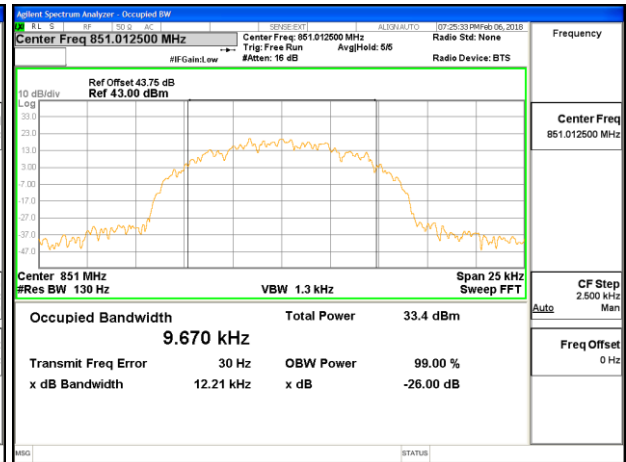
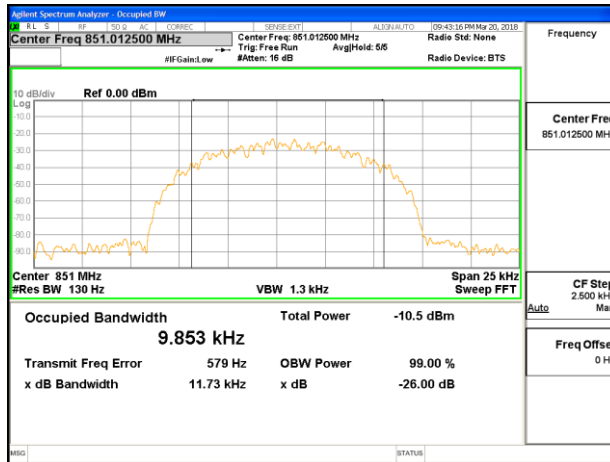
C4FM Signal at 851.0125 MHz



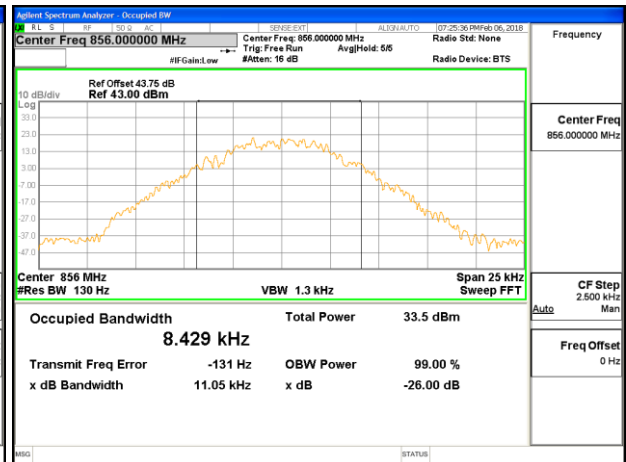
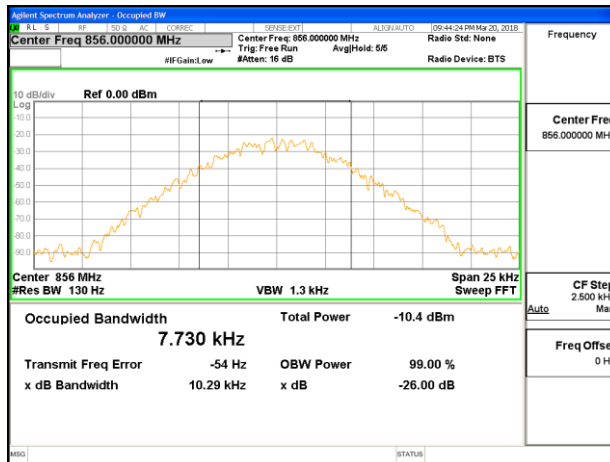
CQPSK Signal at 851.0125 MHz



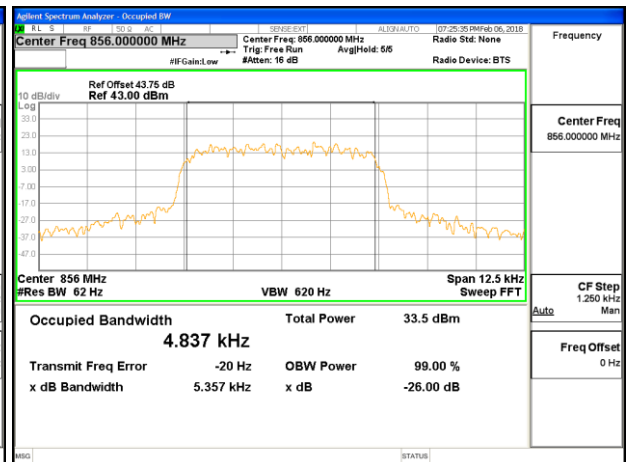
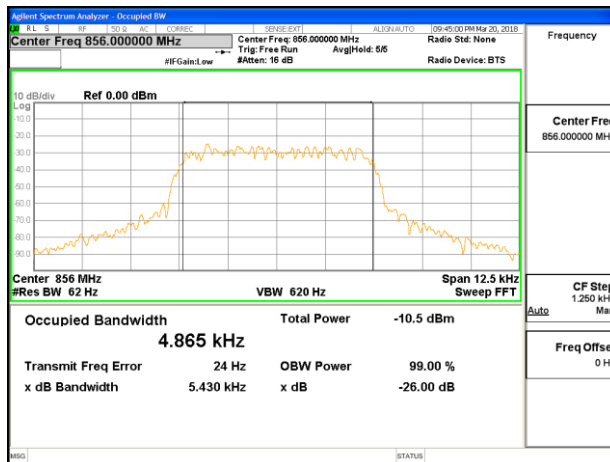
HDQPSK Signal at 851.0125 MHz



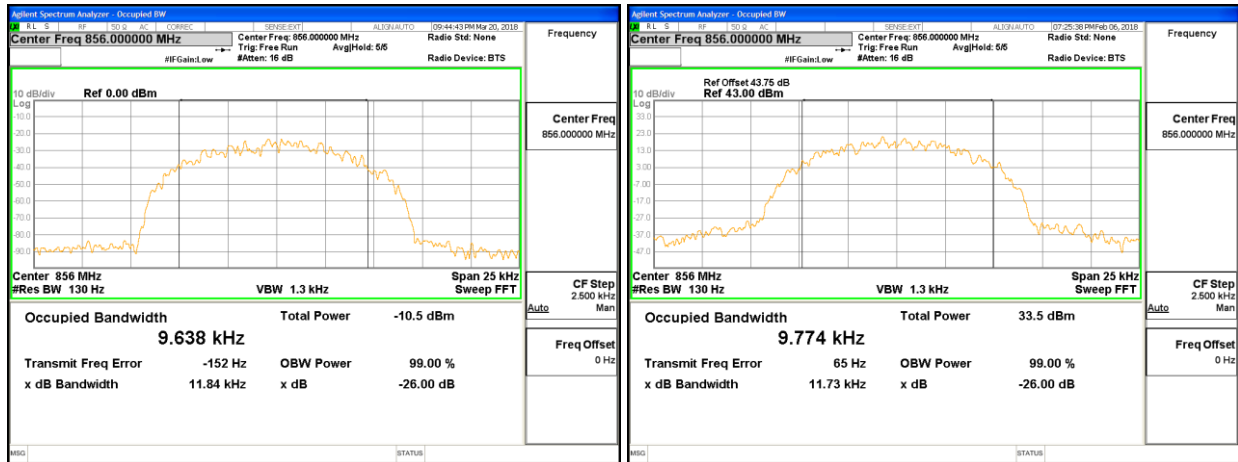
C4FM Signal at 856 MHz



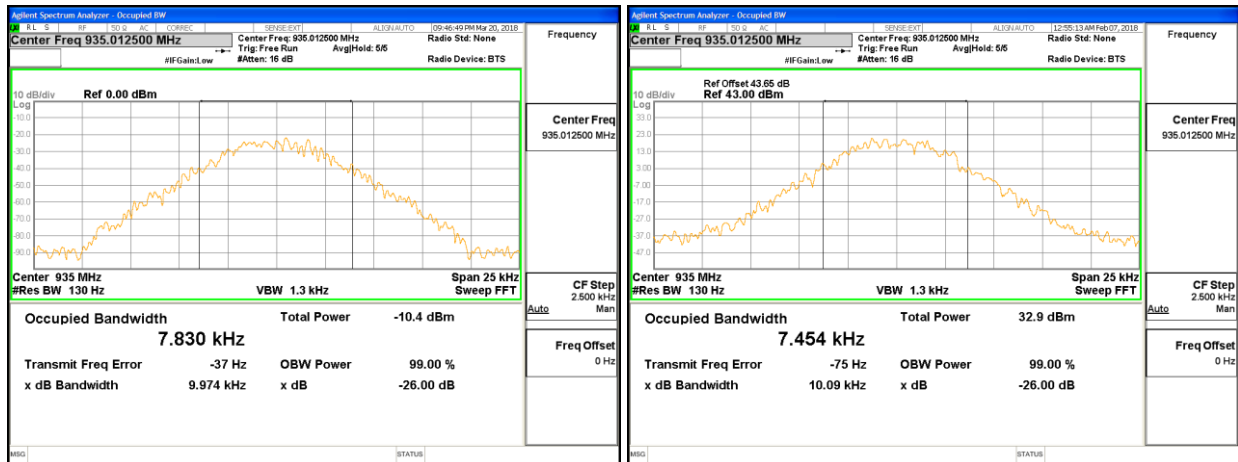
CQPSK Signal at 856 MHz



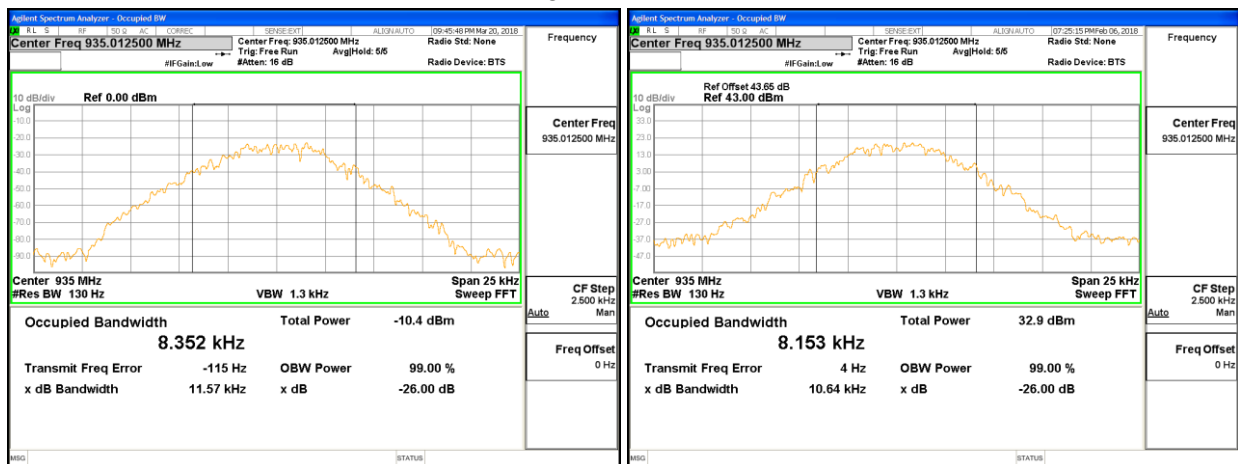
HDQPSK Signal at 856 MHz



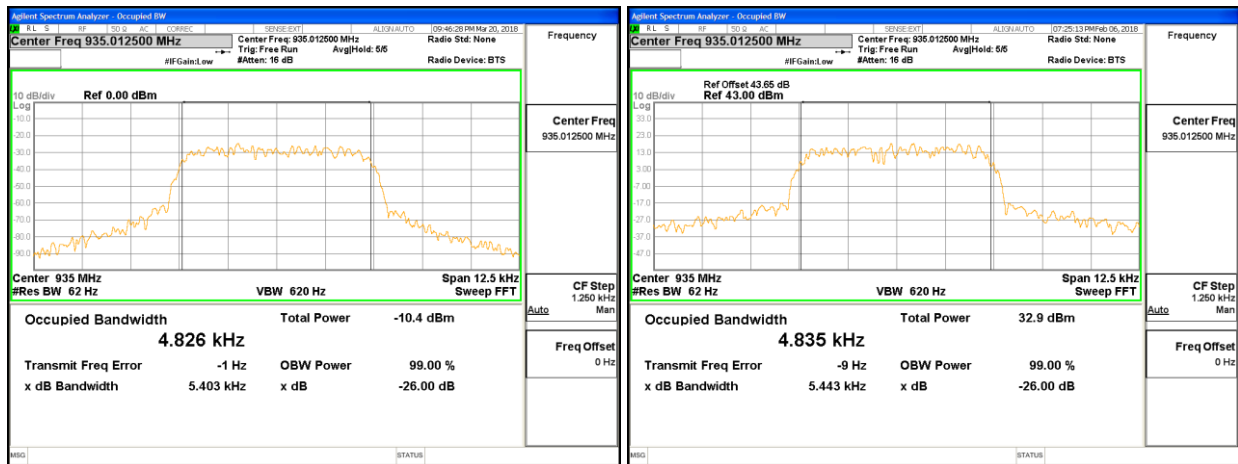
4FSK Signal at 935.0125 MHz



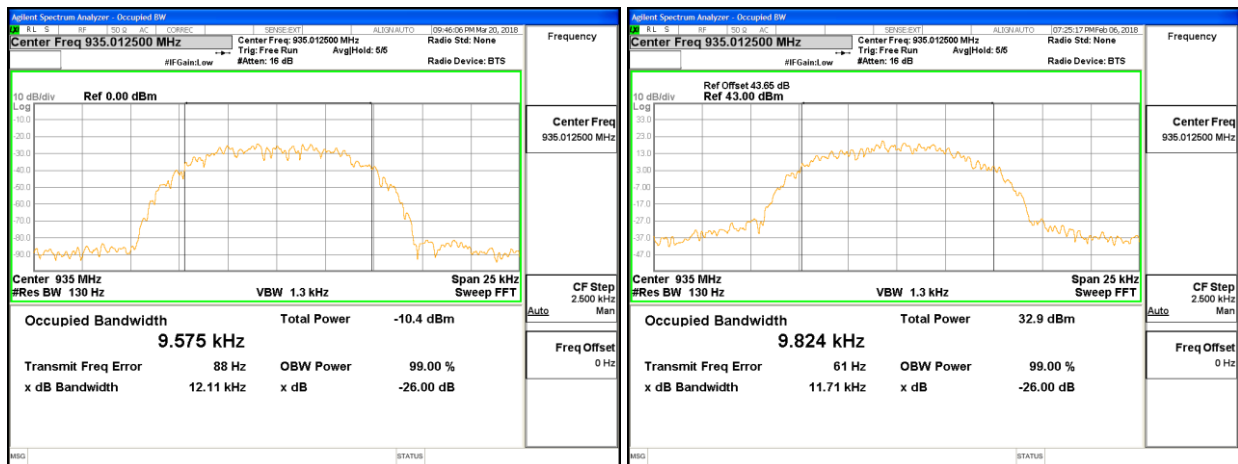
C4FM Signal at 935.0125 MHz



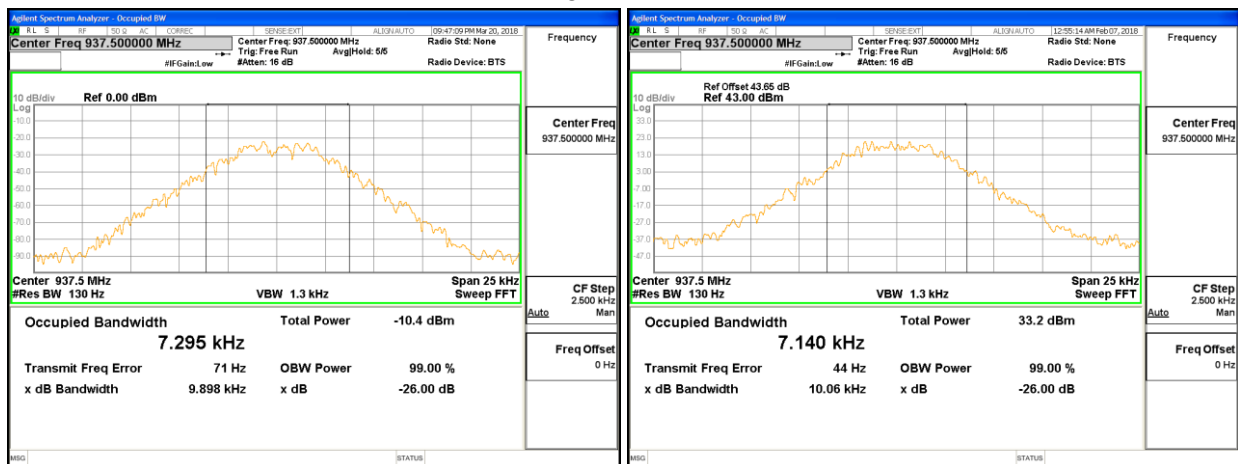
CQPSK Signal at 935.0125 MHz



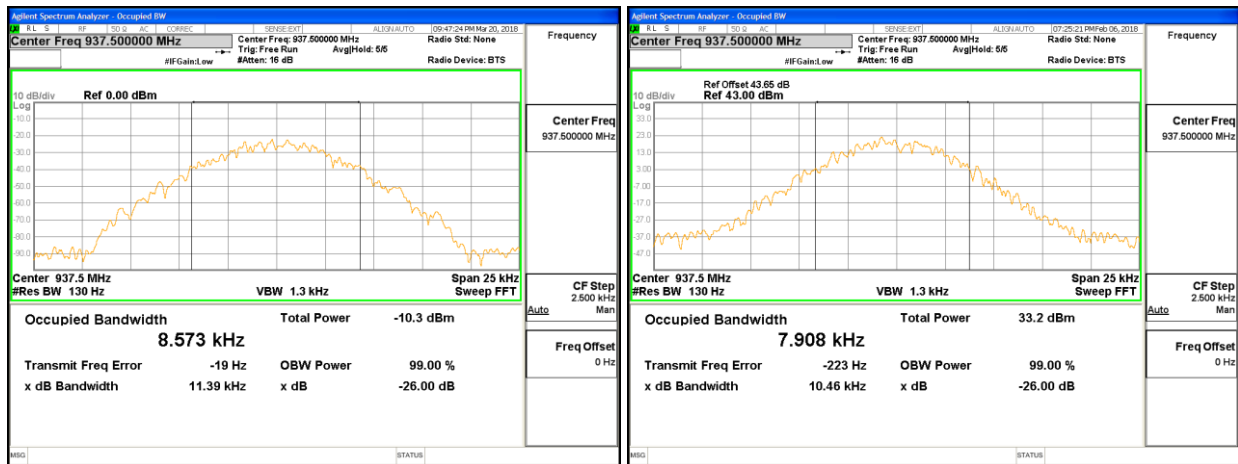
HDQPSK Signal at 935.0125 MHz



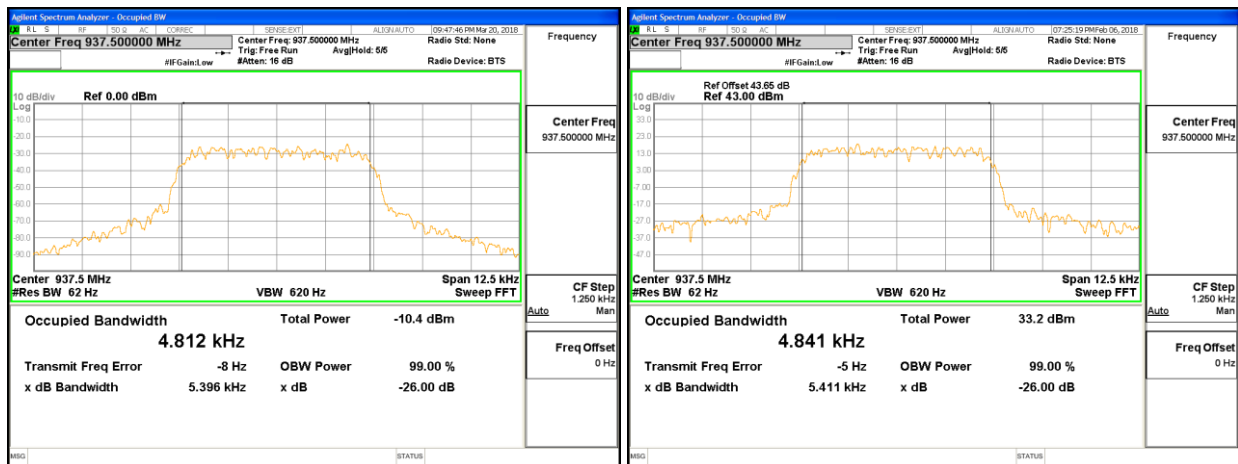
4FSK Signal at 937.5 MHz



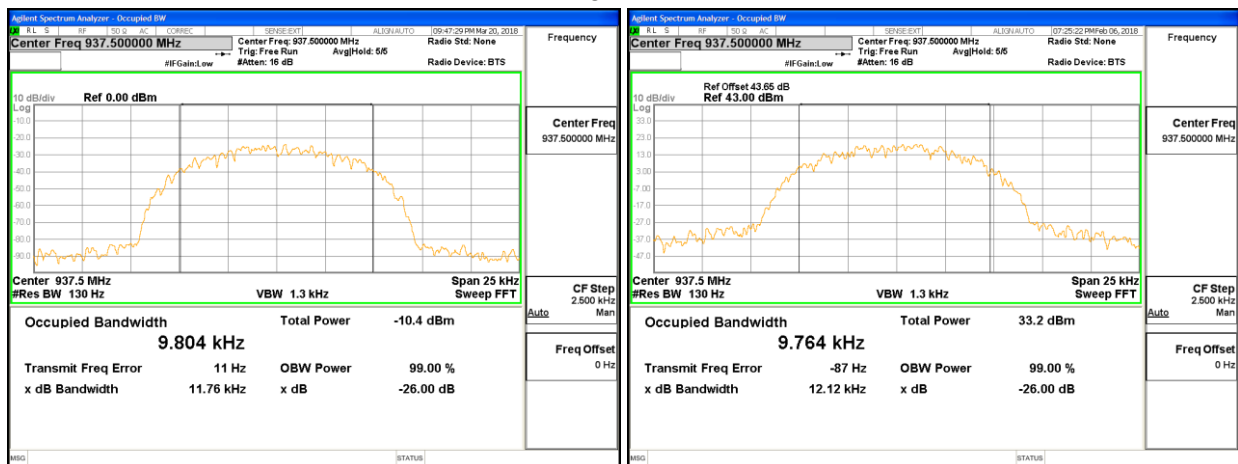
C4FM Signal at 937.5 MHz



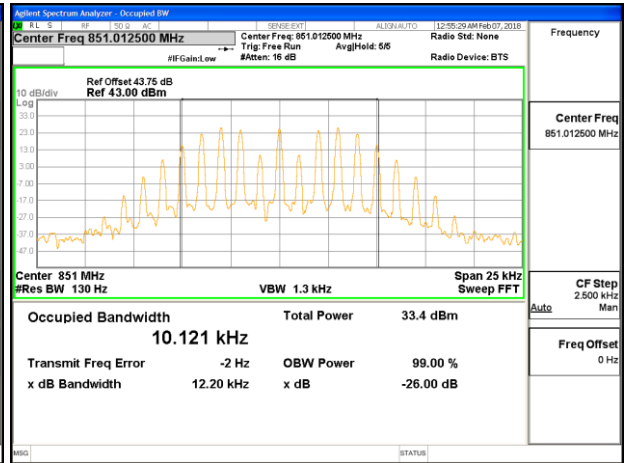
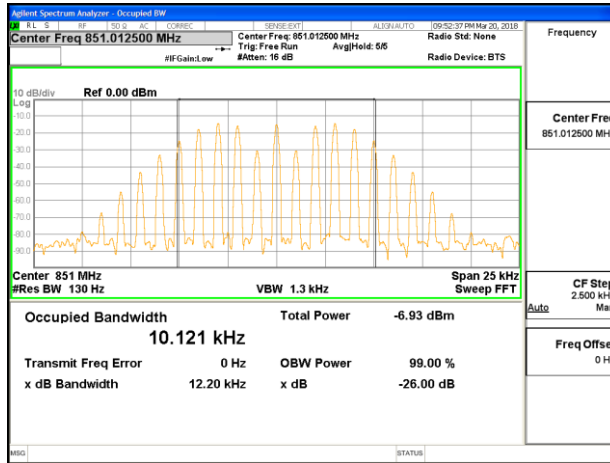
CQPSK Signal at 937.5 MHz



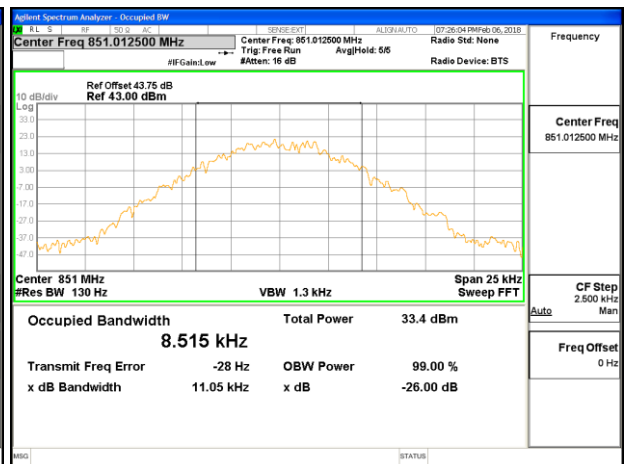
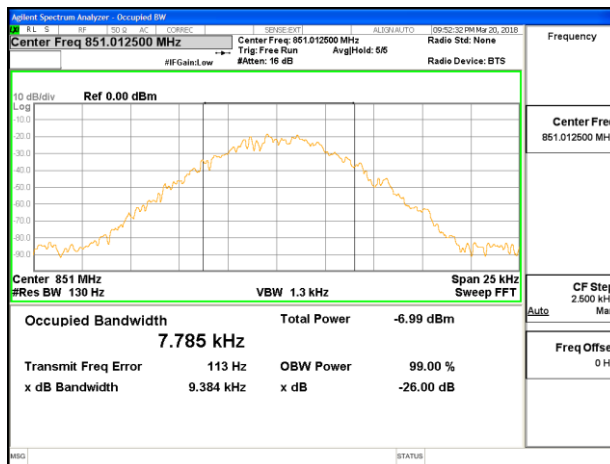
HDQPSK Signal at 937.5 MHz



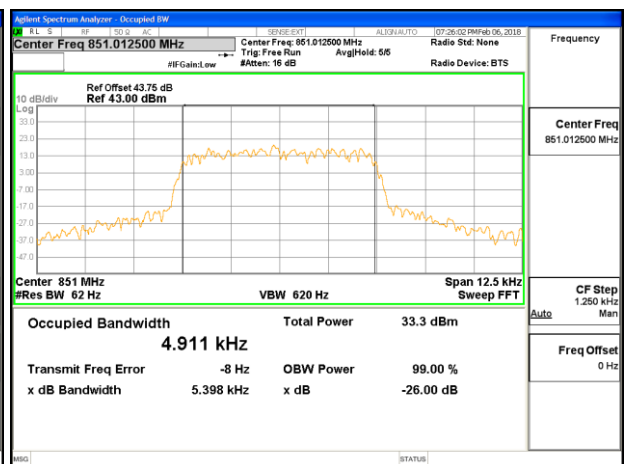
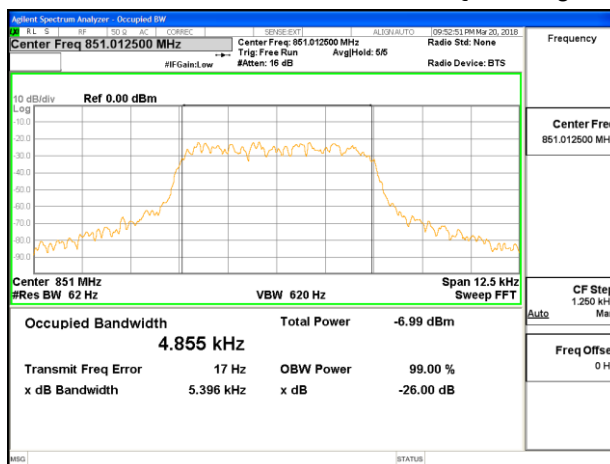
At Input Power 3 dB above AGC threshold: Input OBW vs. Output OBW
FM Signal at 851.0125MHz



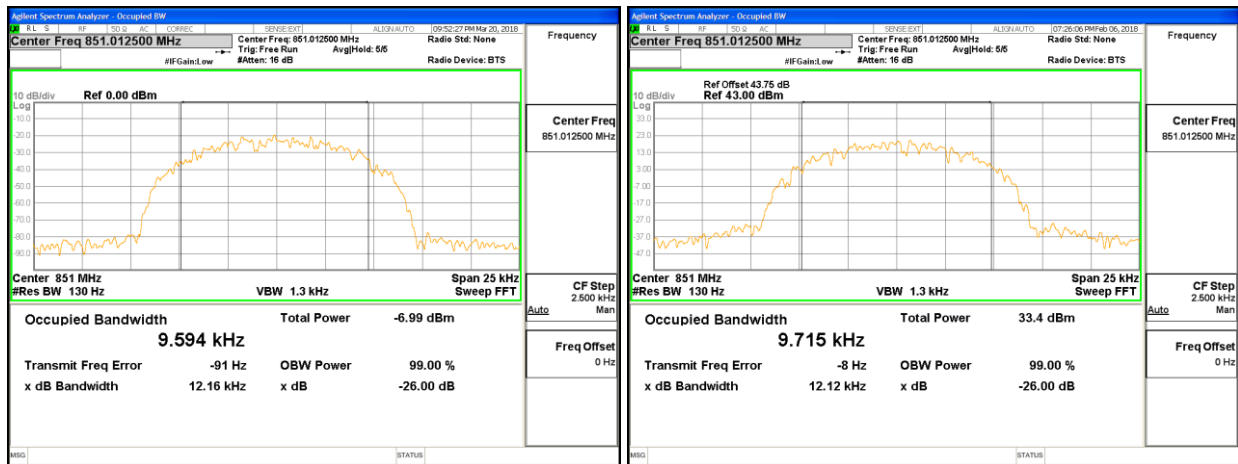
C4FM Signal at 851.0125MHz



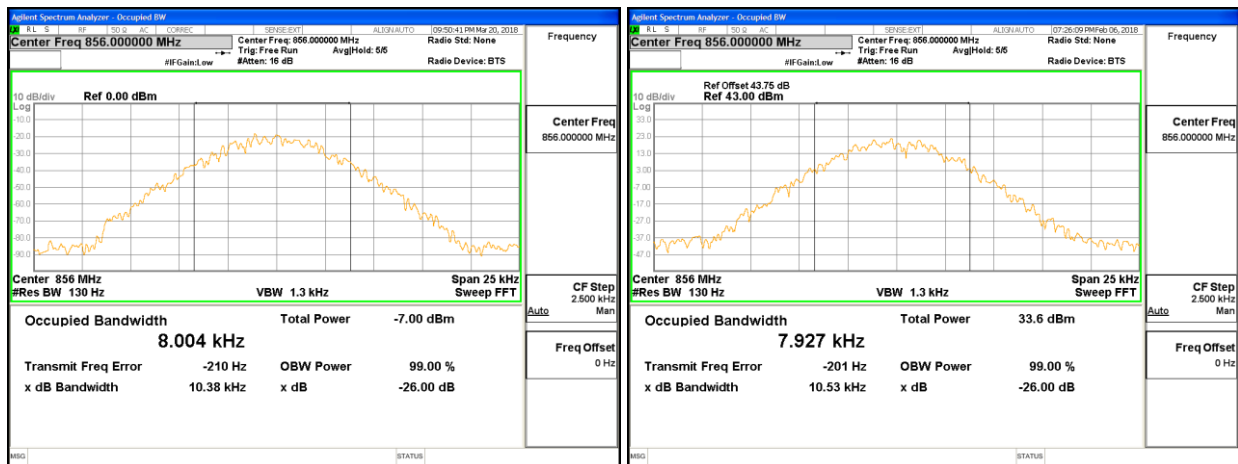
CQPSK Signal at 851.0125 MHz



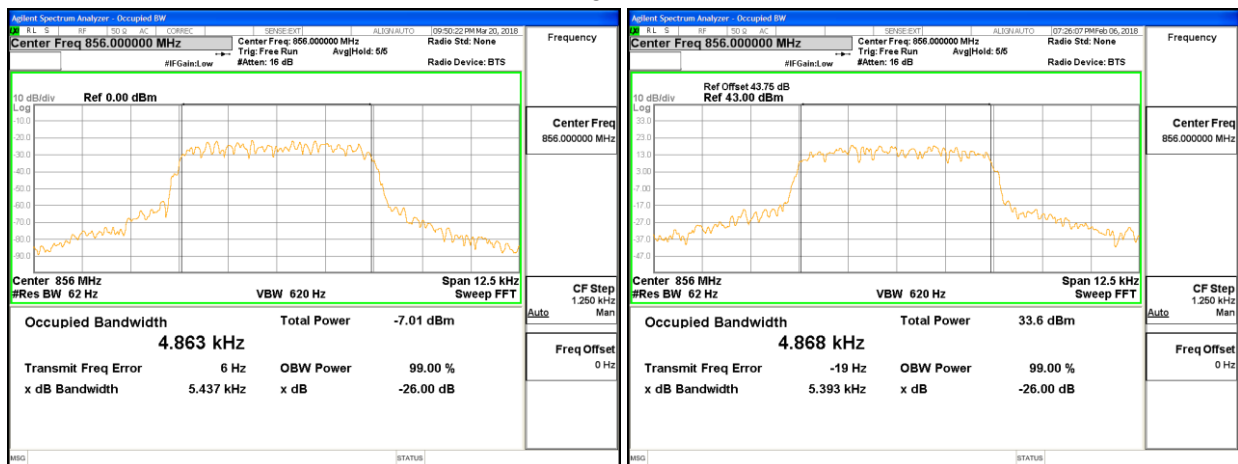
HDQPSK Signal at 851.0125MHz



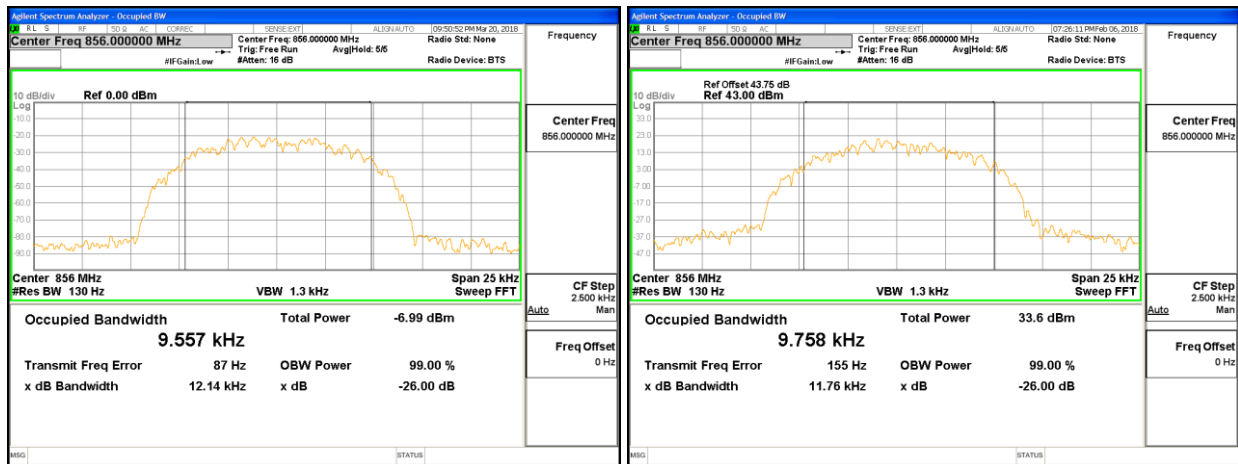
C4FM Signal at 856 MHz



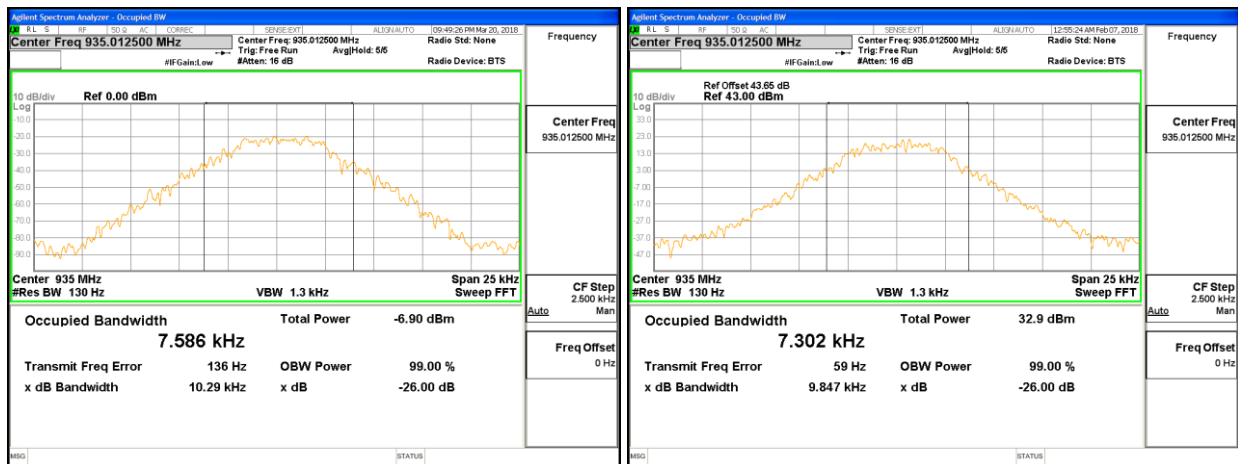
CQPSK Signal at 856 MHz



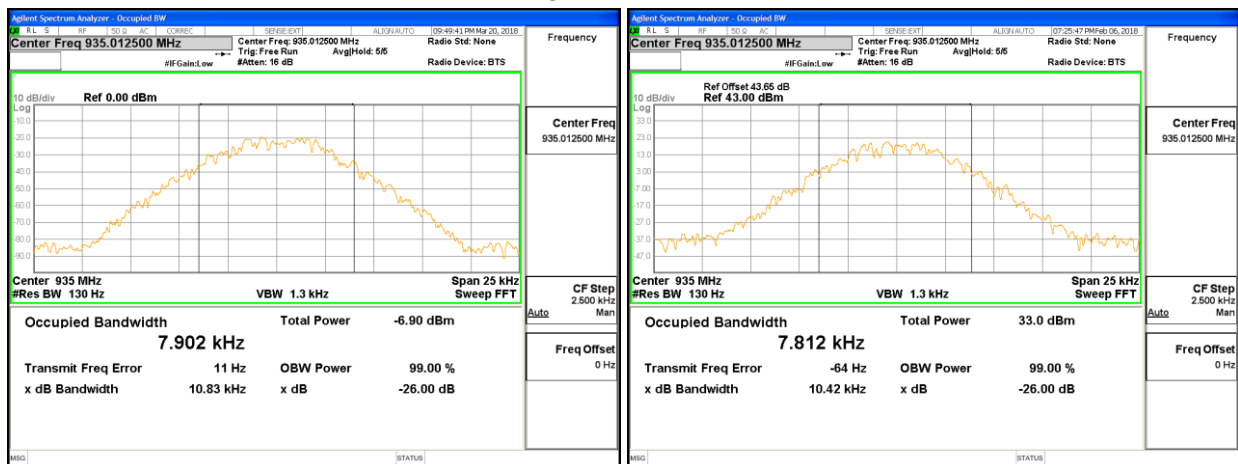
HDQPSK Signal at 856 MHz



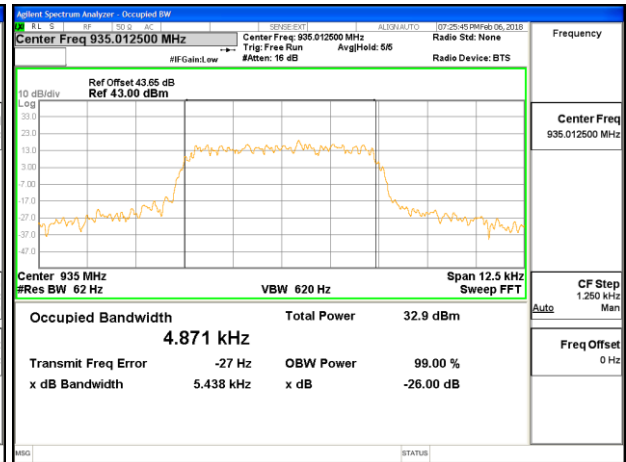
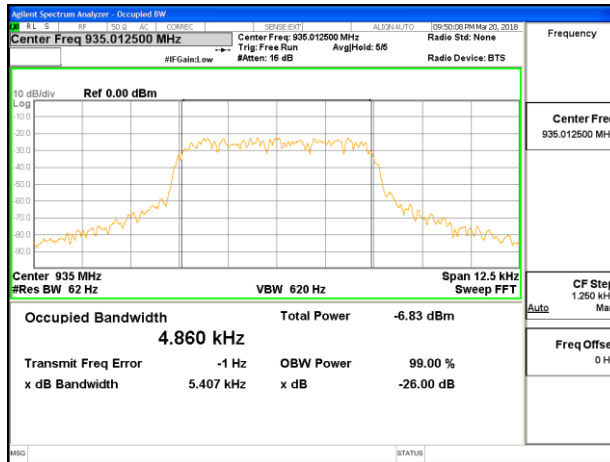
4FSK Signal at 935.0125 MHz



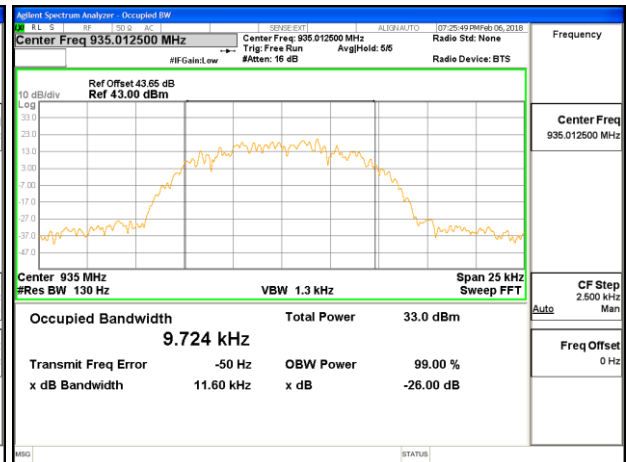
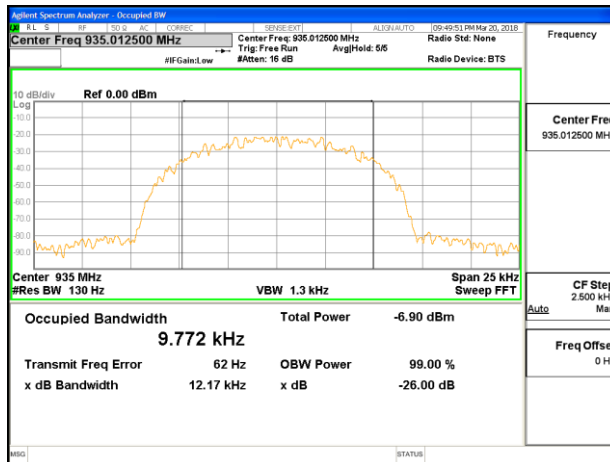
C4FM Signal at 935.0125 MHz



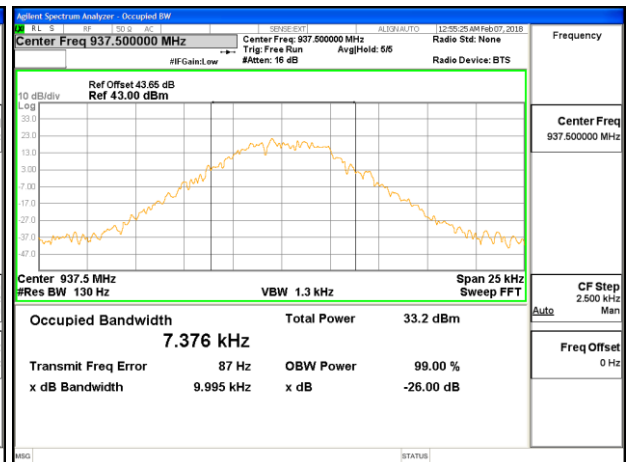
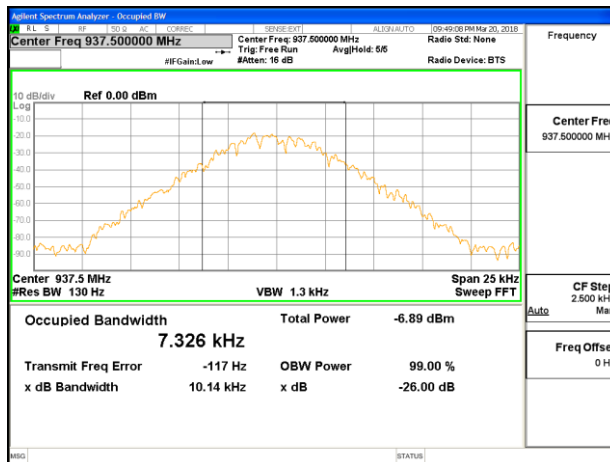
CQPSK Signal at 935.0125 MHz



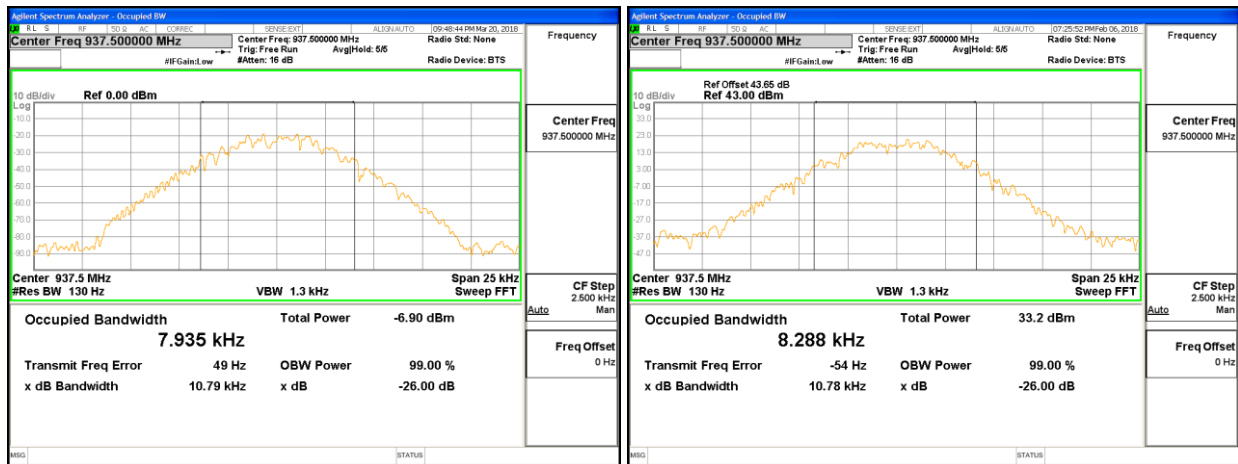
HDQPSK Signal at 935.0125 MHz



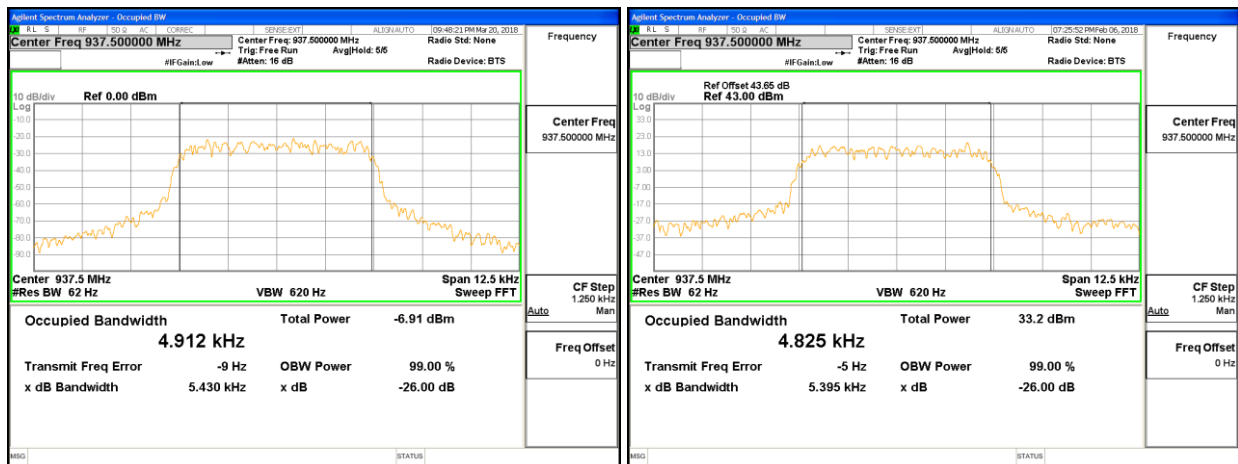
4FSK Signal at 937.5 MHz



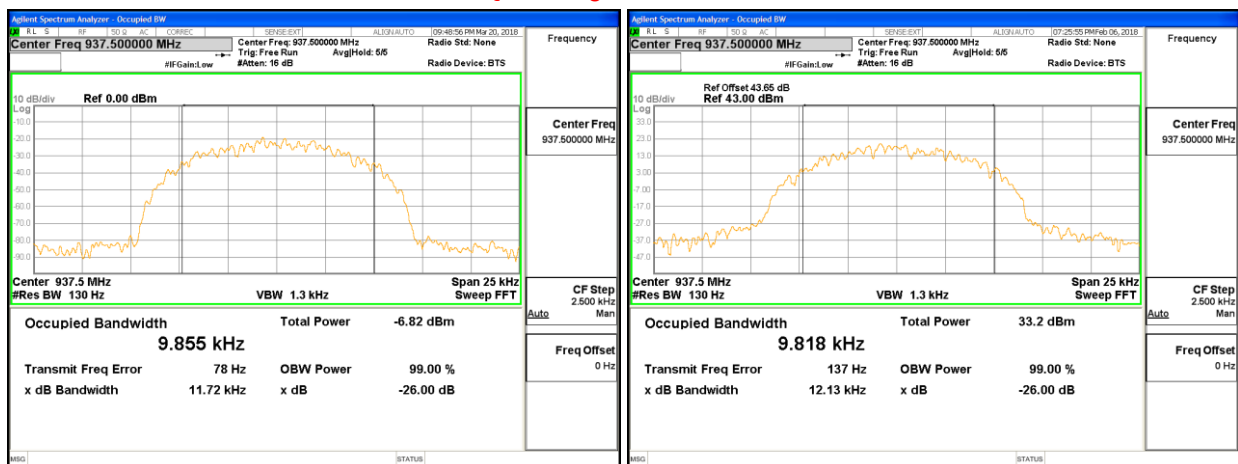
C4FM Signal at 937.5 MHz



CQPSK Signal at 937.5 MHz



HDQPSK Signal at 937.5 MHz



Unwanted Emissions (Conducted)

Governing Doc	FCC Part 2 2.1046(a) FCC Part 90.210	Room Temperature (°C)	24
Test Procedure	ANSI/TIA-603- E-2016; FCC KDB 935210 D05 Indus Booster Basic Meas v01r02: October 27, 2017	Relative Humidity (%)	33.9
Test Location	Burnaby	Barometric Pressure (kPa)	102.6
Test Engineer	Sophie Piao/Jeremy Lee	Date	Feb 06, 2018
EUT Voltage	☒ DC ☐ 120VAC @ 60Hz		
Test Equipment Used	Manufacturer	Model	Serial Number
Signal Generator	Keysight	N5172B	MY53050270
Spectrum Analyzer	Keysight	N9010A	MY50520285
40dB Attenuator	Aeroflex Winschel	58-40-43	n/p
Calibration			
Calibration due			
Note) CVP = Calibration Verification Performed internally, n/p = not provided.			
Frequency Range:	☒ 9 kHz – 9.4 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		
800band: No emission is higher than the -13 dBm emission limit. 900band: No emission is higher than the -20 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.

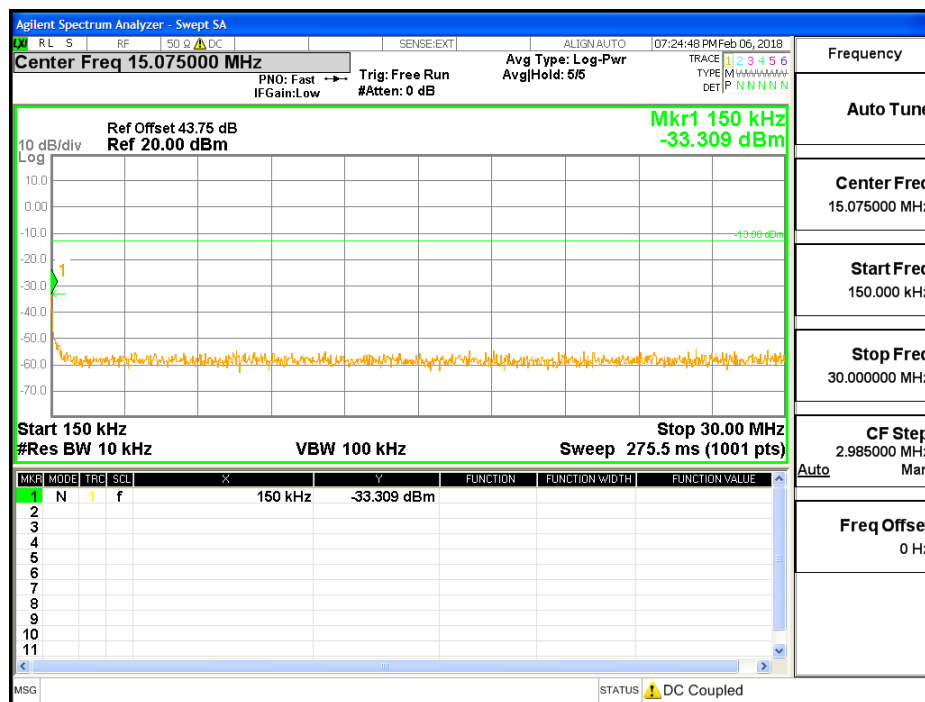
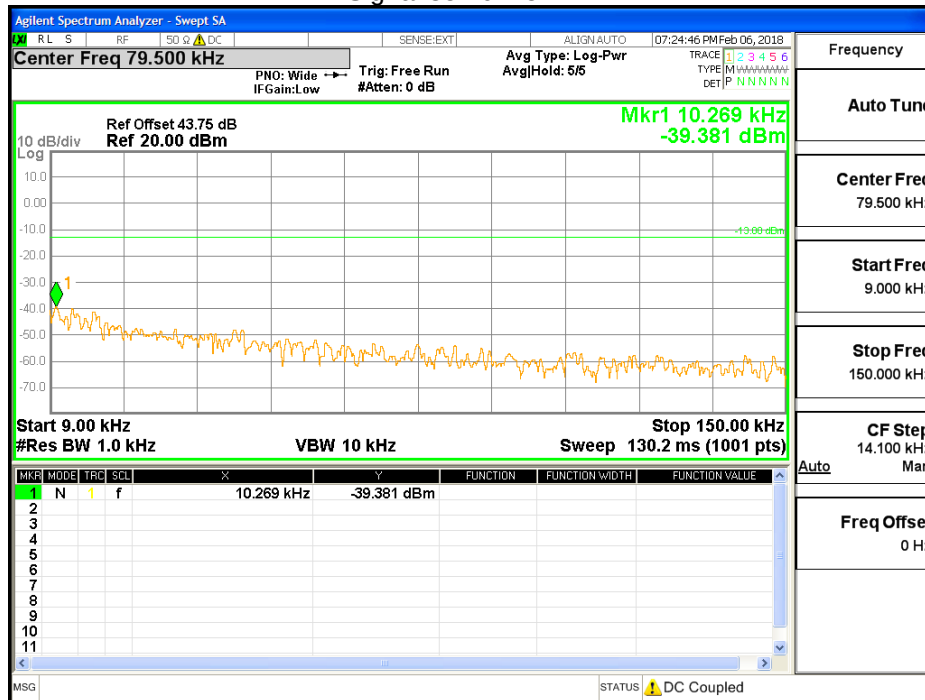
The EUT was set to **Operation Mode #1 with configuration Mode #1**.

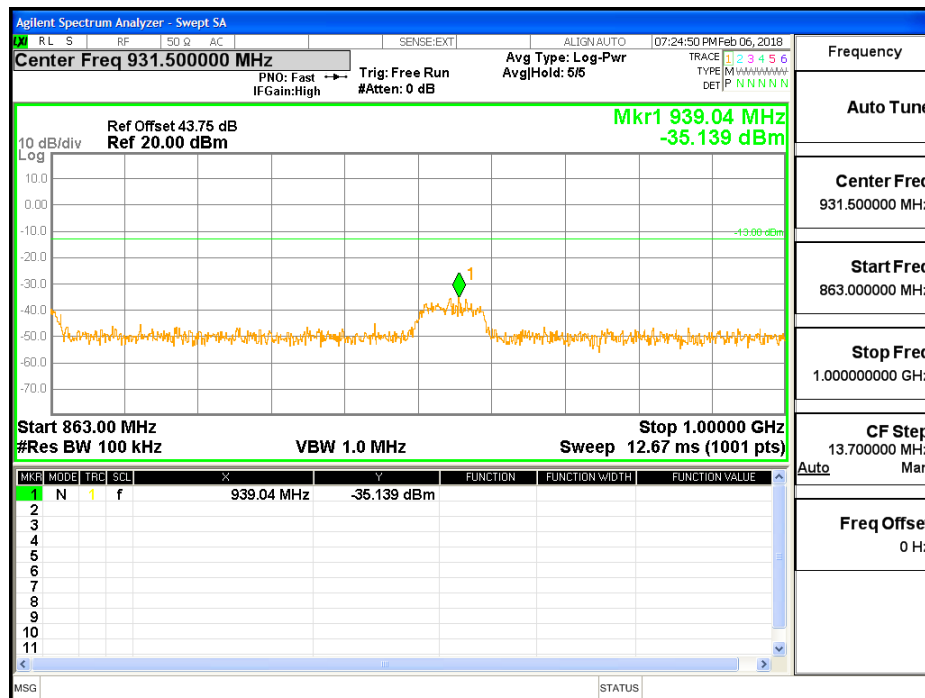
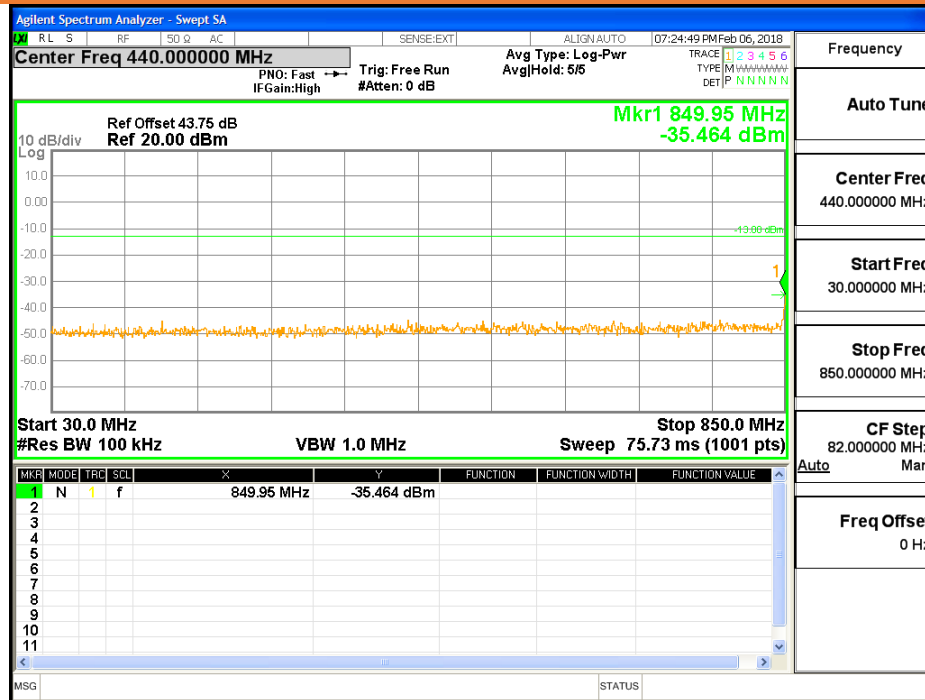


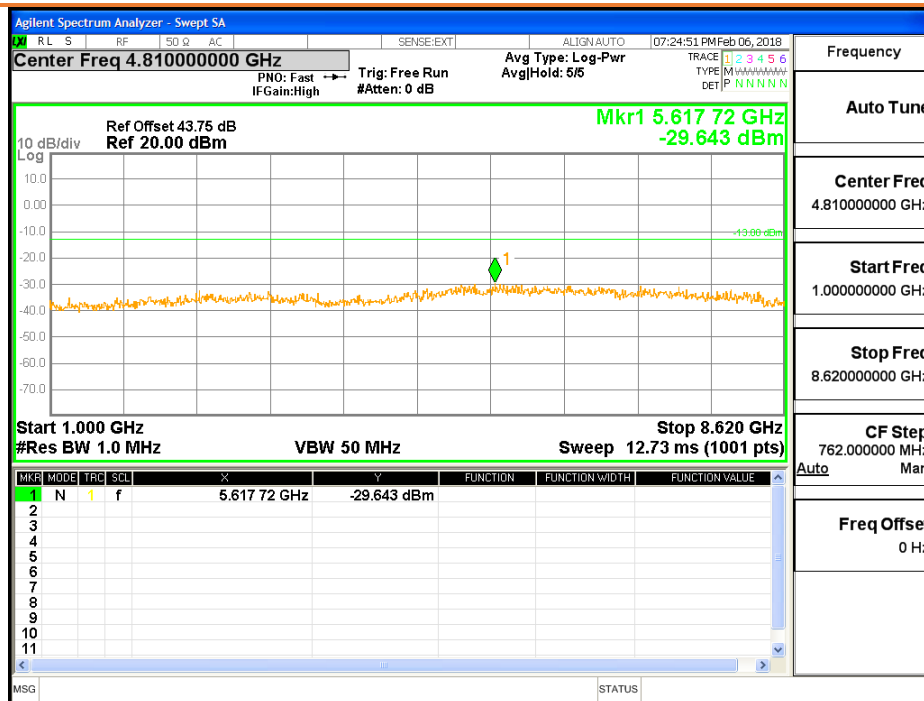
Results

At Input Power 0.5 dB below AGC threshold

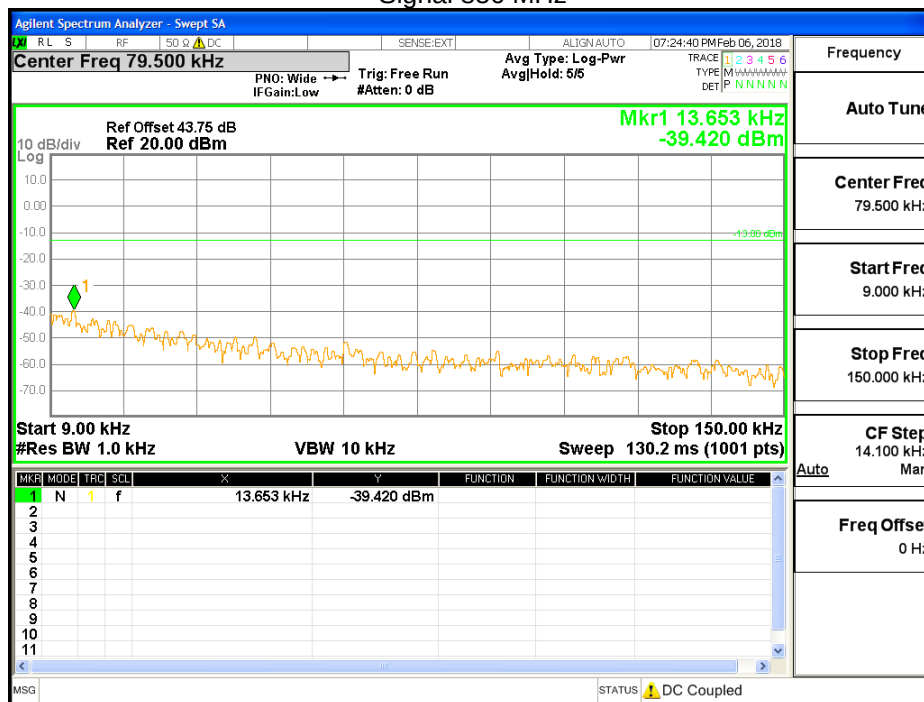
Signal 851.0125 MHz

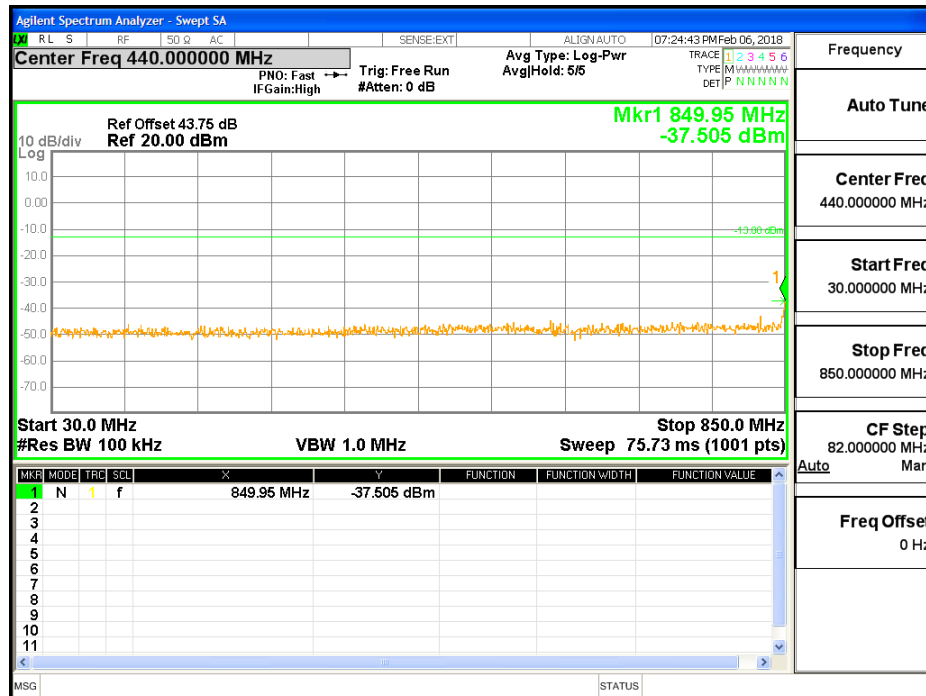
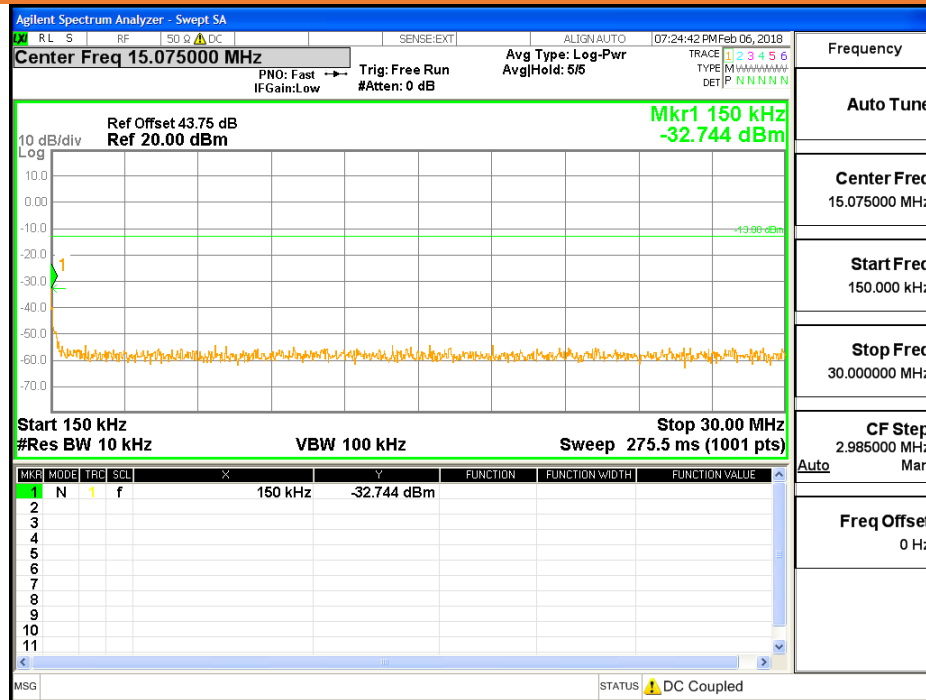


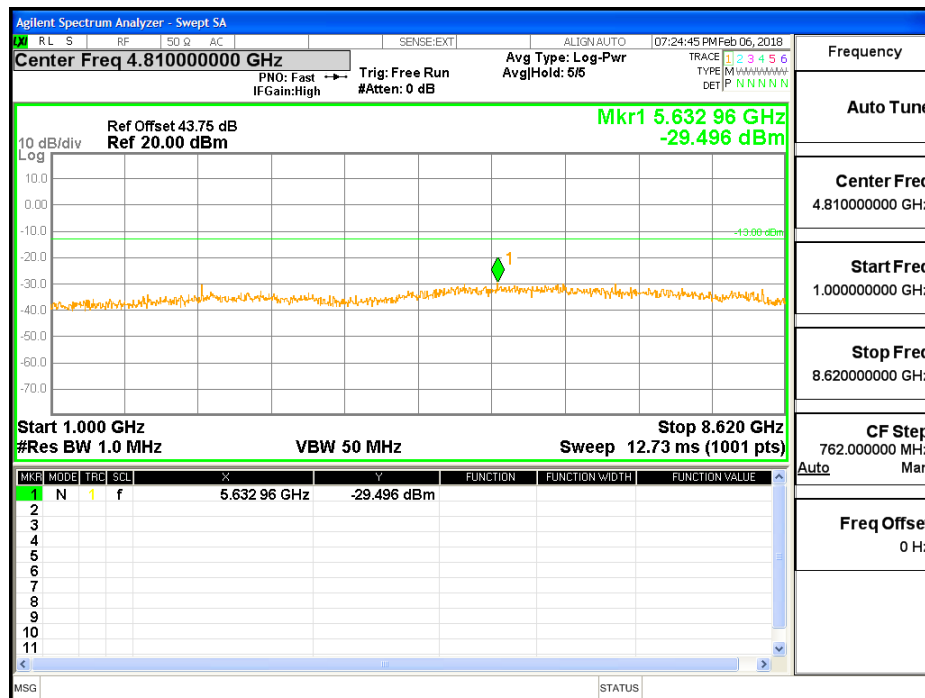
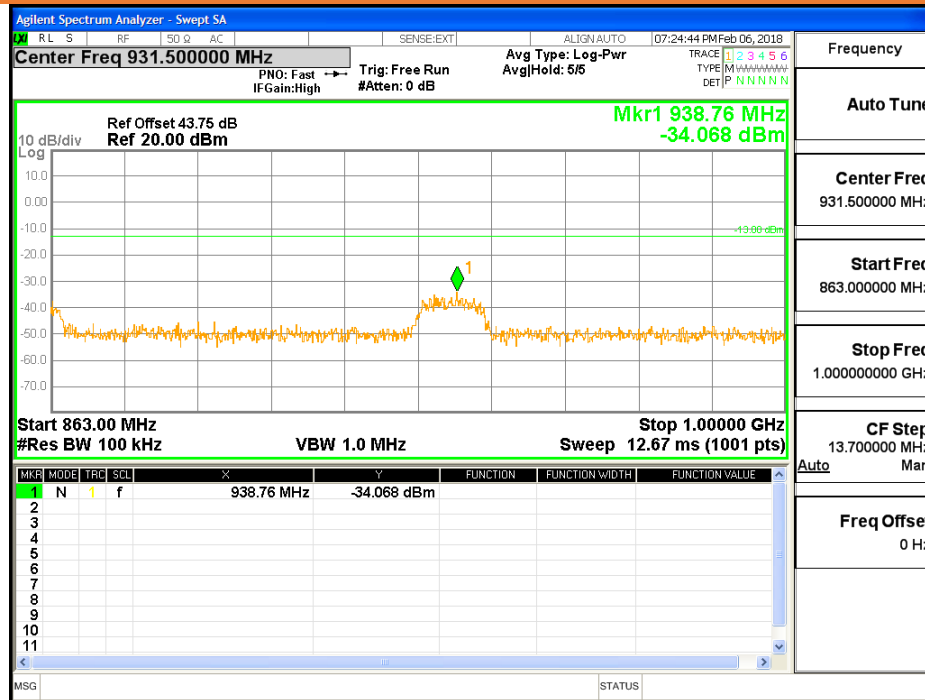




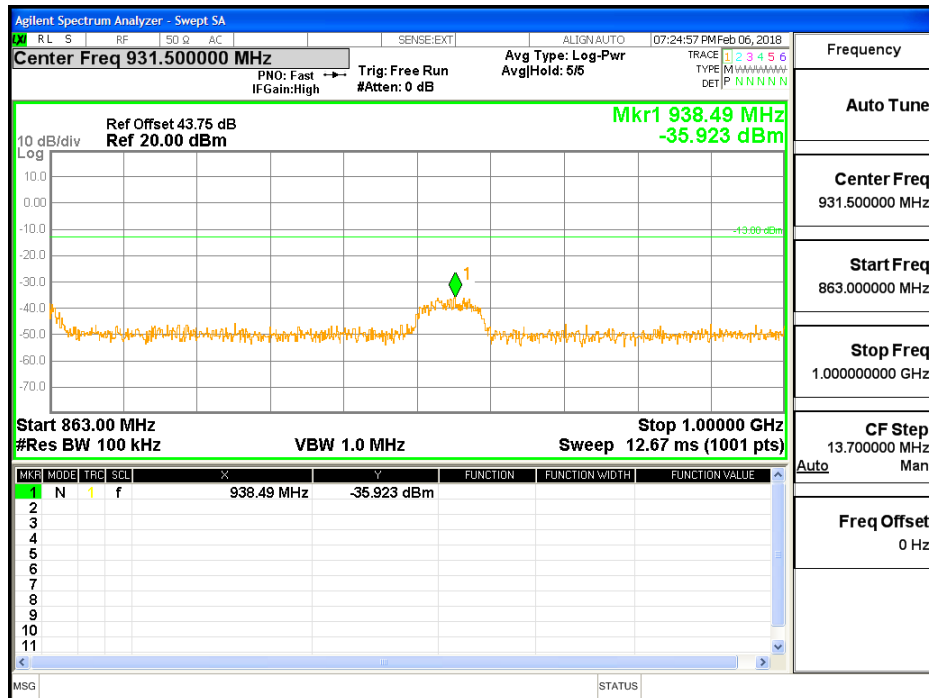
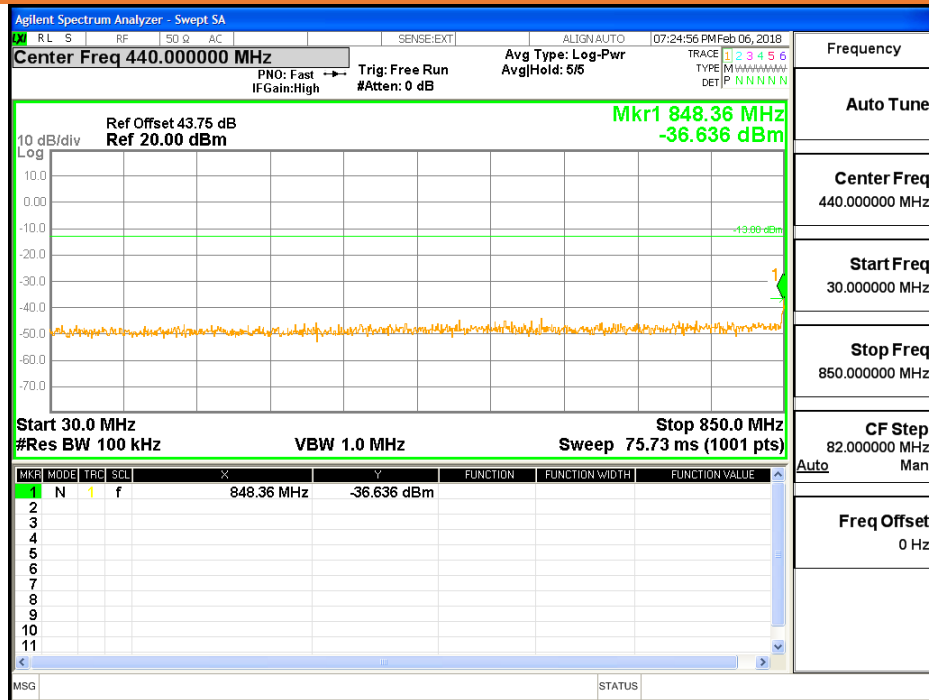
Signal 856 MHz

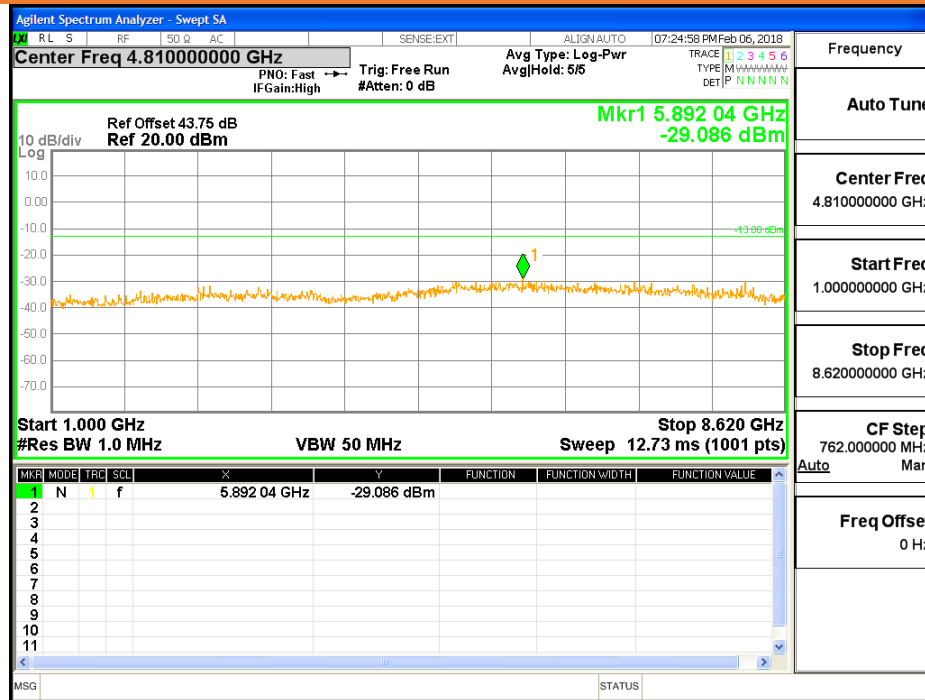




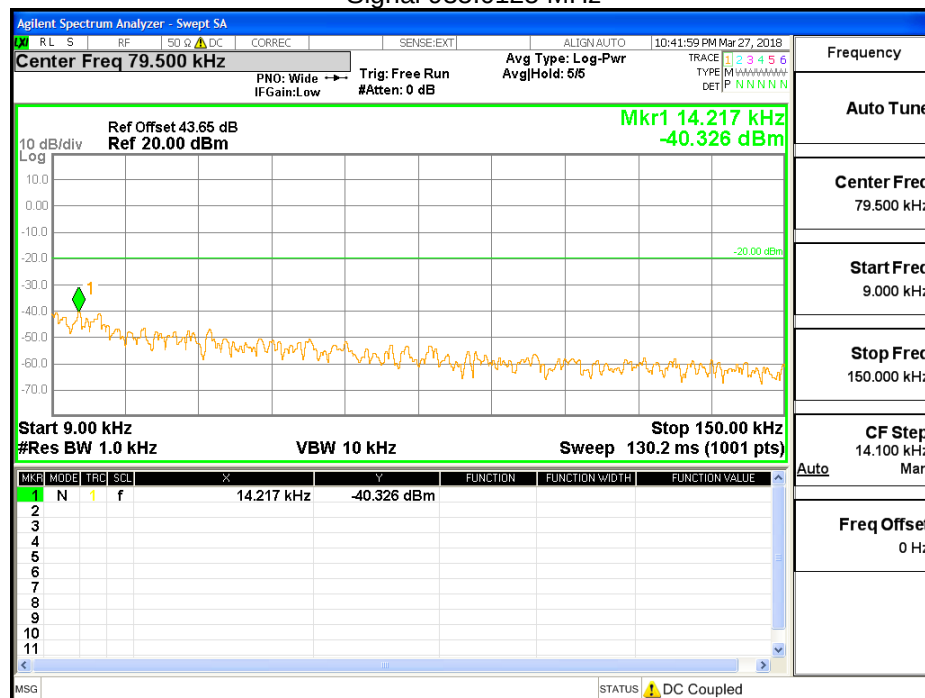


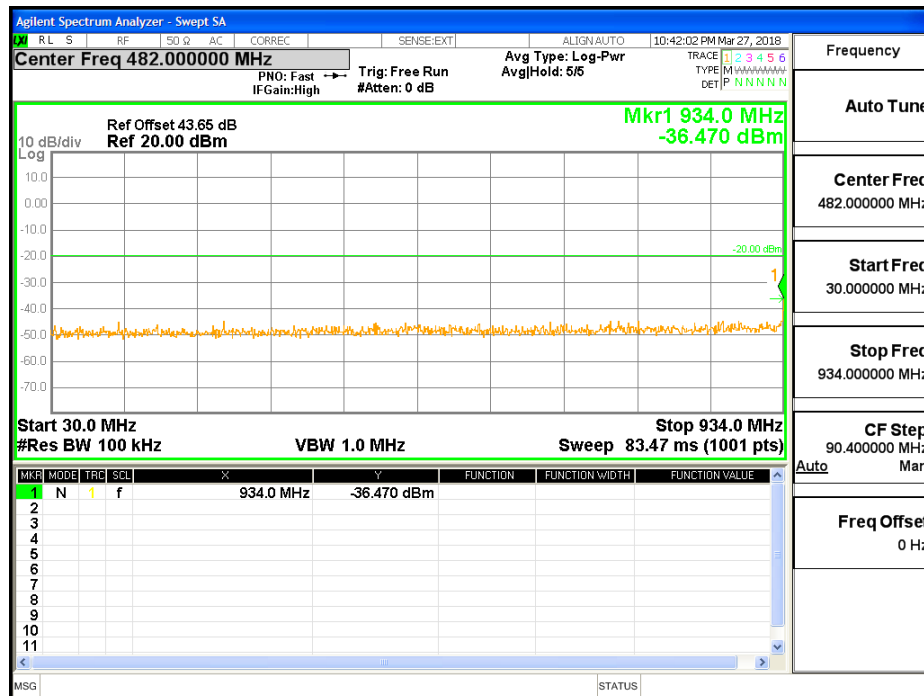
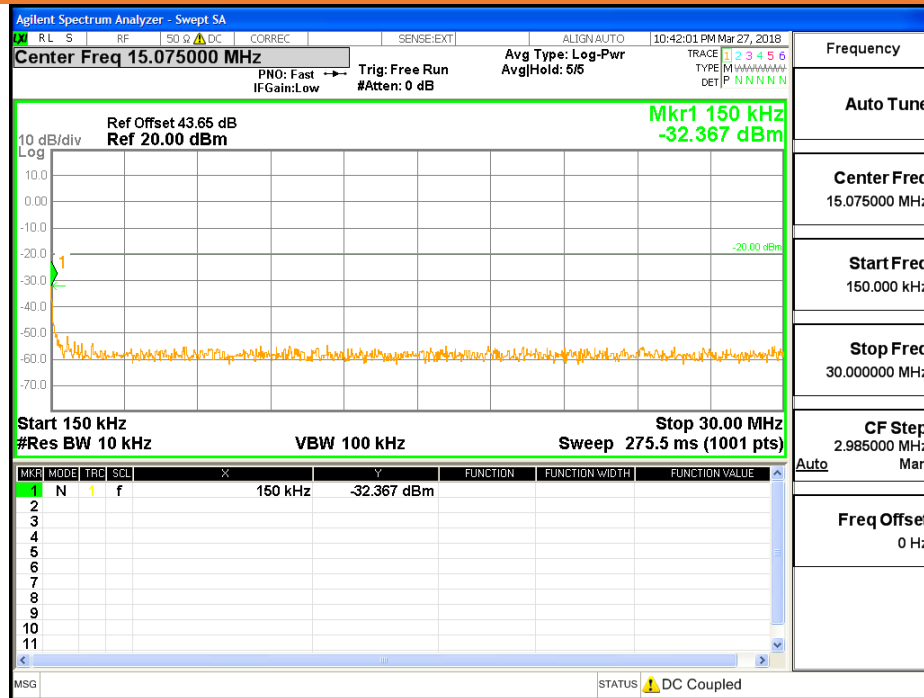


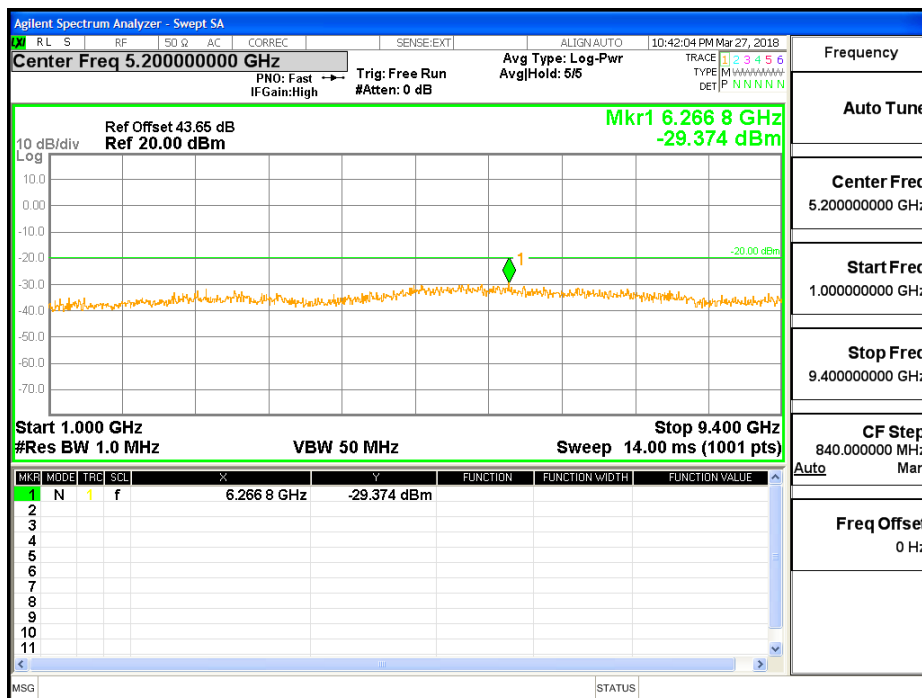
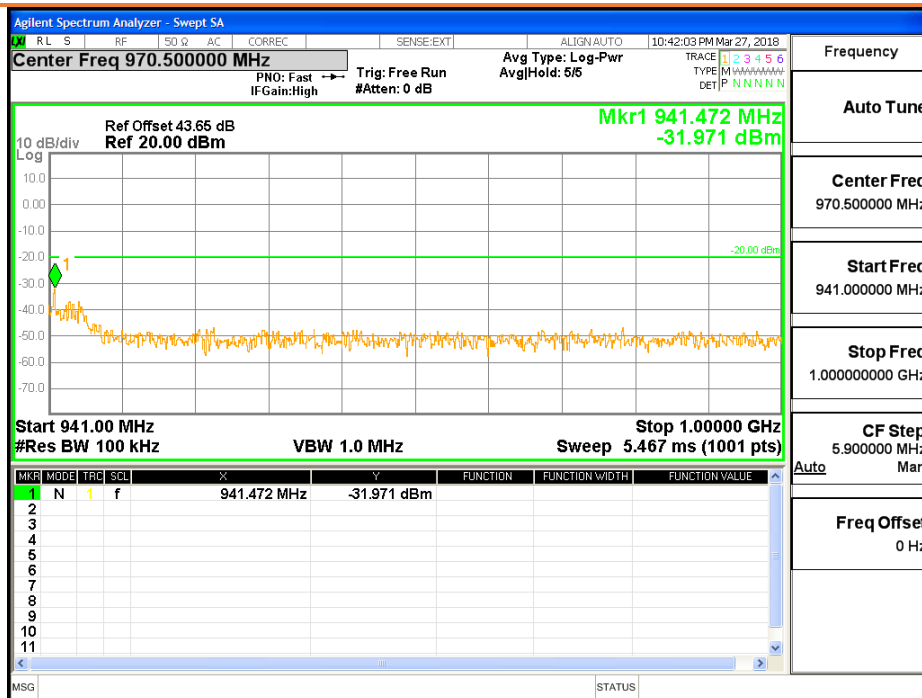


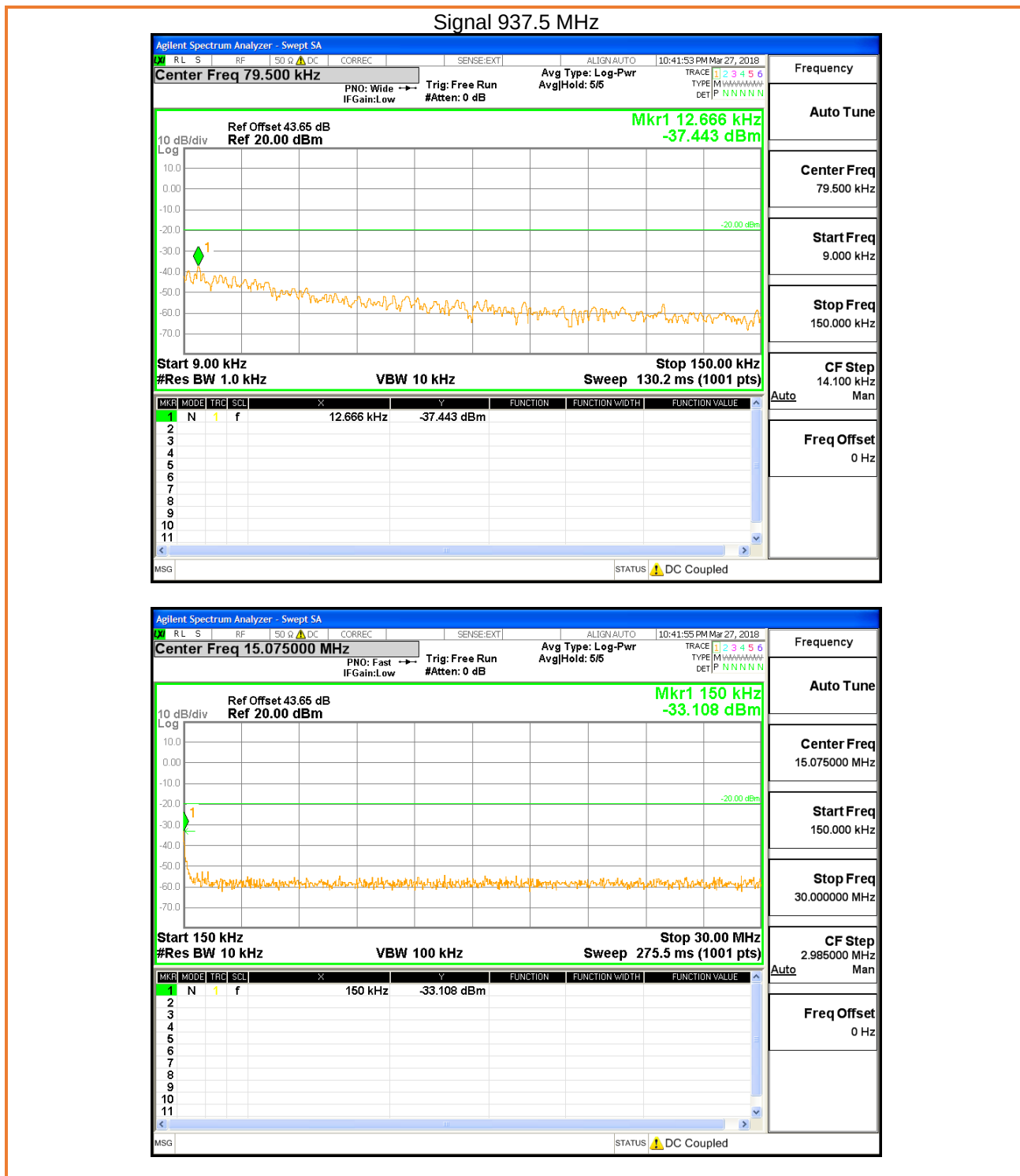


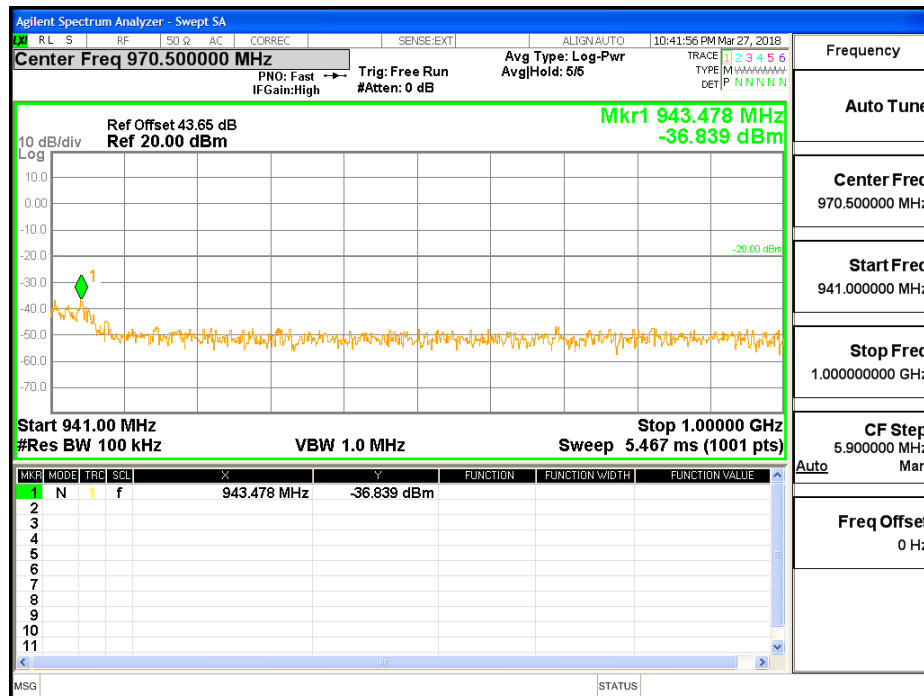
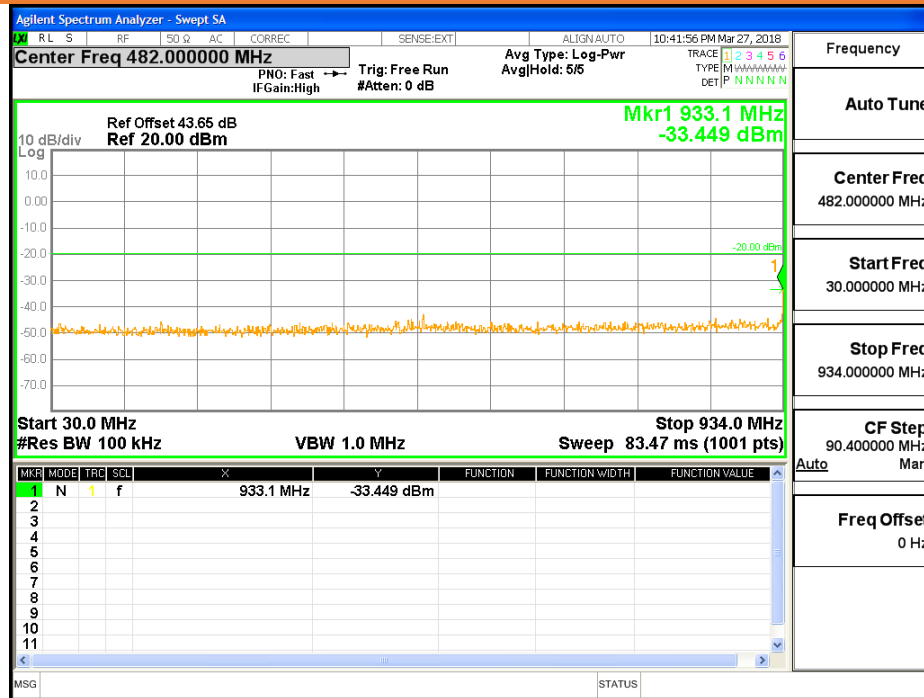
Signal 935.0125 MHz

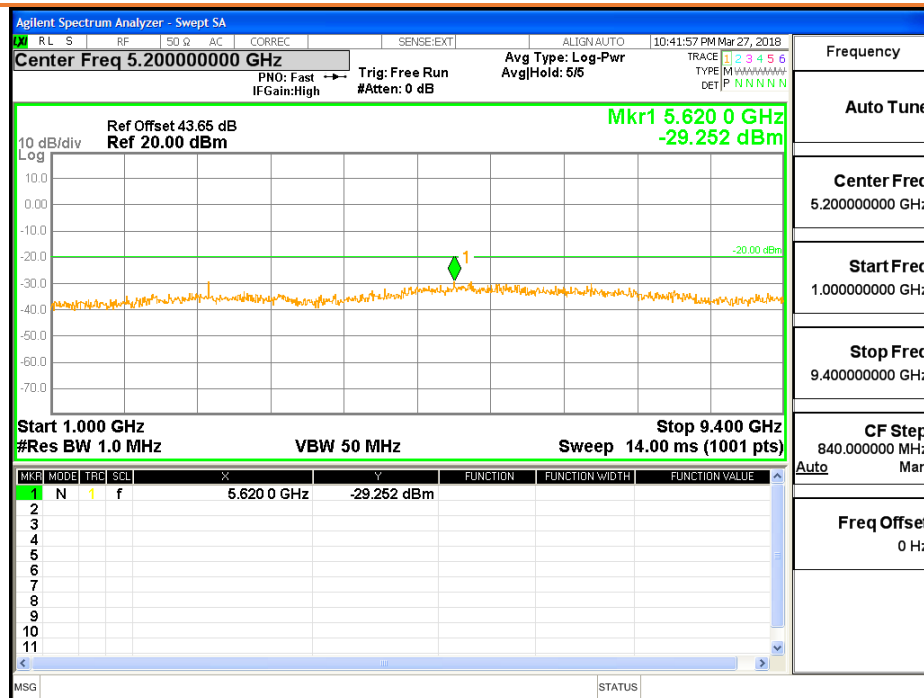




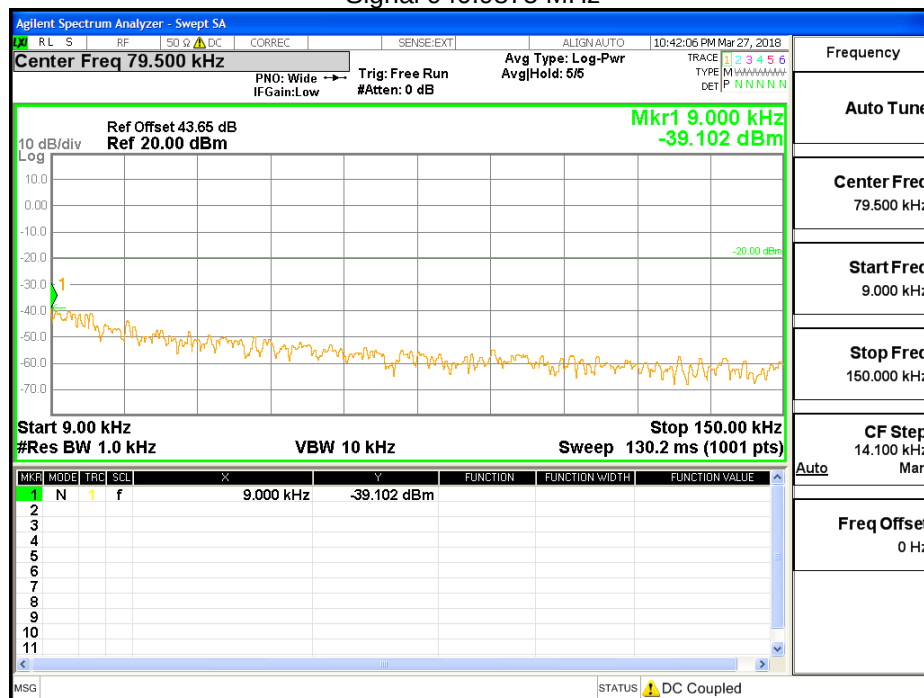


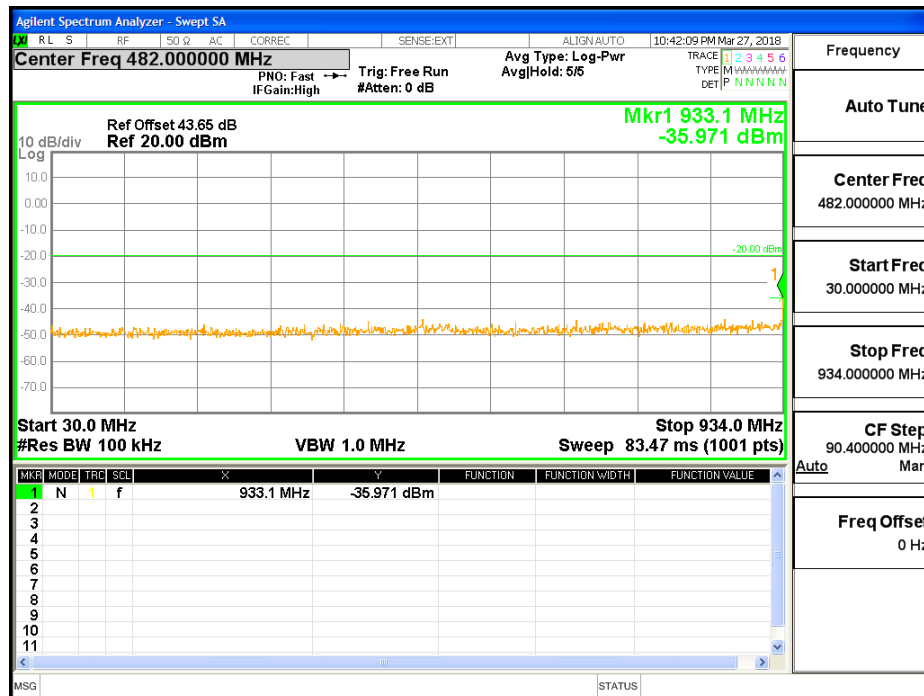
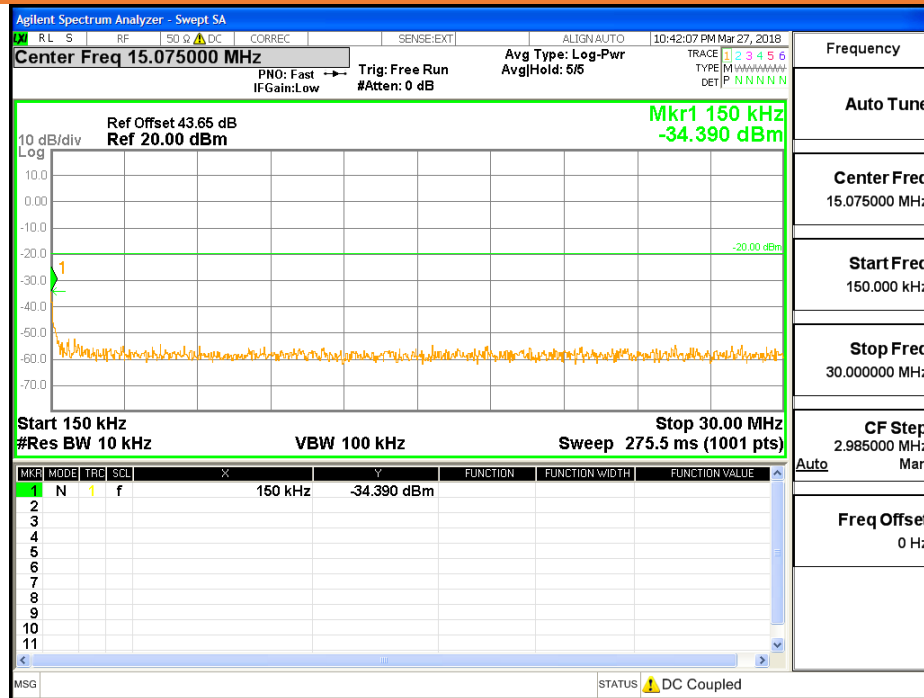


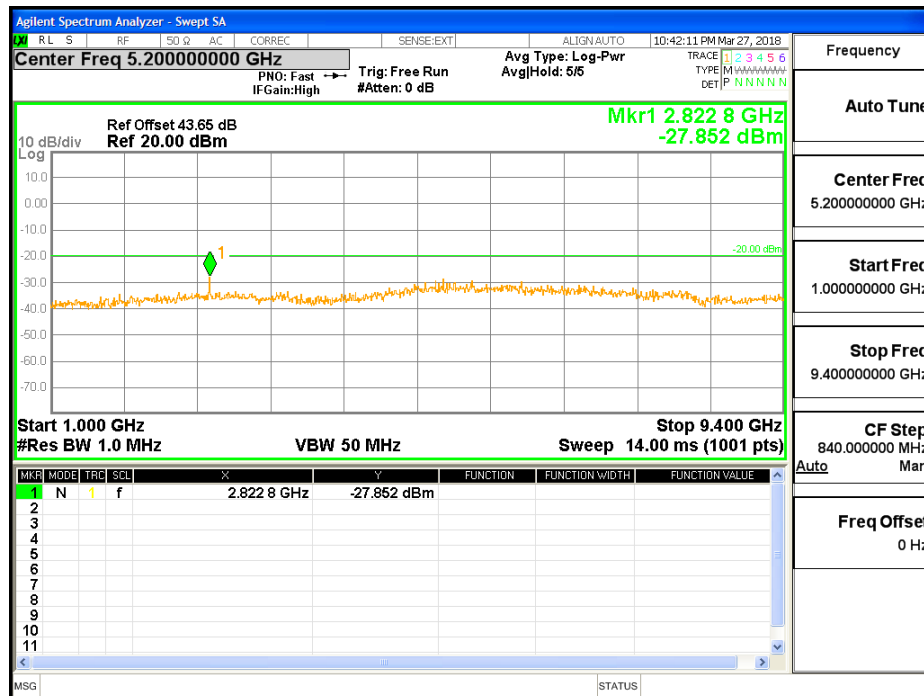
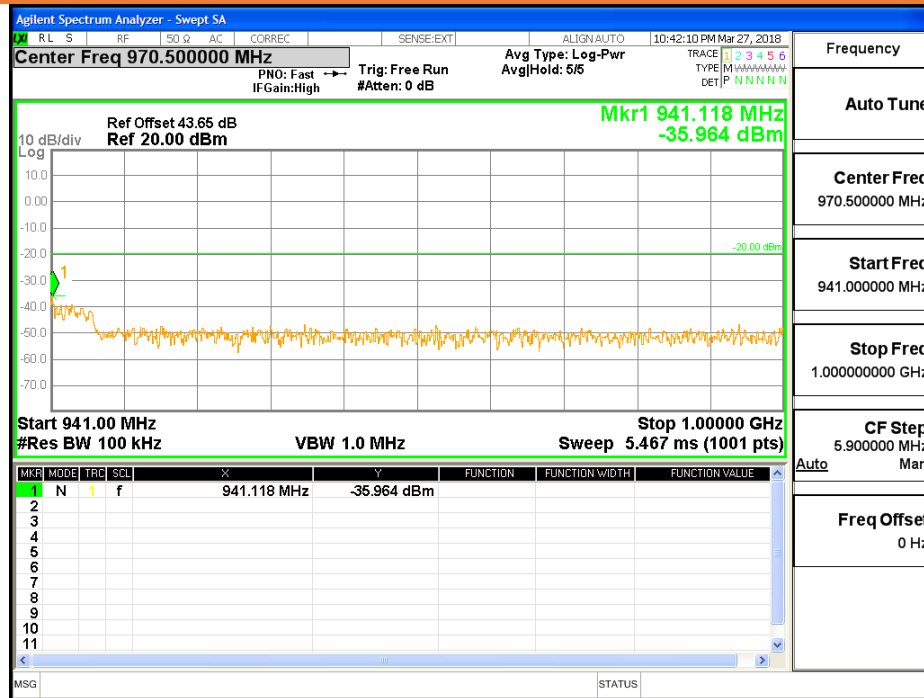




Signal 940.9875 MHz



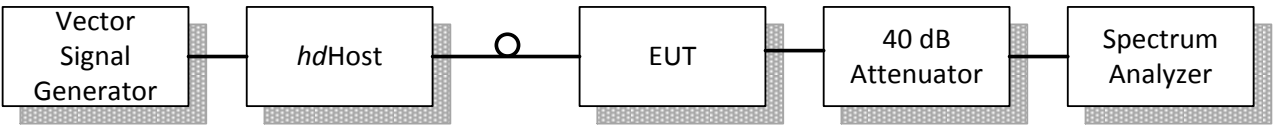




Spectrum Emission Mask

Governing Doc	FCC Part 90.210 (i)	Room Temperature (°C)	24
Test Procedure	ANSI/TIA-603- E-2016; FCC KDB 935210 D05 Indus Booster Basic Meas v01r02: October 27, 2017	Relative Humidity (%)	33.9
Test Location	Burnaby	Barometric Pressure (kPa)	102.6
Test Engineer	Sophie Piao/Jeremy Lee	Date	Feb 06, 2018
EUT Voltage	☒ DC ☐ 120VAC @ 60Hz		
Test Equipment Used	Manufacturer	Model	Serial Number
Signal Generator	Keysight	N5172B	MY53050270
Spectrum Analyzer	Keysight	N9010A	MY50520285
40dB Attenuator	Aeroflex Winschel	58-40-43	n/p
			CVP
Note) CVP = Calibration Verification Performed internally, n/p = not provided.			
Frequency Range:	☒ 851 MHz – 861 MHz ☒ 935 MHz – 940 MHz		
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 ☐			

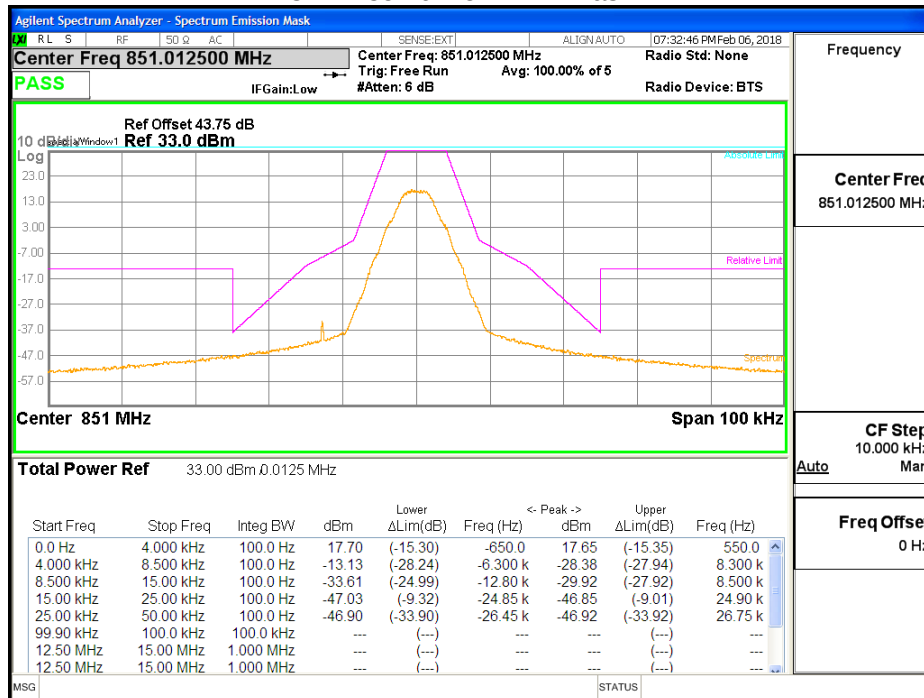
Test setup

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 of the designated channel BW. The emission was measured with RBW 100 Hz. The EUT was set to Operation Mode #1 with configuration Mode #1.  <pre> graph LR A[Vector Signal Generator] --> B[hdHost] B --> C(()) C --> D[EUT] D --> E[40 dB Attenuator] E --> F[Spectrum Analyzer] </pre>
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Results

At Input Power 0.5 dB below AGC threshold

C4FM 851.0125 MHz – Mask H



CQPSK 851.0125 MHz - Mask H

