DigitalPath, Inc.

TEST REPORT FOR

Weather Node
Model: W1.0

Tested to The Following Standards:

FCC Part 15 Subpart C Section(s)

15.207 & 15.247
(FHSS 902-928 MHz)

Report No.: 102618-7

Date of issue: September 6, 2019

This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

Test Certificate # 803.01

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Testing the Future
CKC LABORATORIES, INC.

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

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1065 Marauder St
Chico CA 95973

Representative: Jim Higgins
Customer Reference Number: 102618v2

REPORT PREPARED BY:

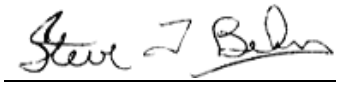
Terri Rayle
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 102618

DATE OF EQUIPMENT RECEIPT: July 25, 2019
DATE(S) OF TESTING: July 25, 2019 – August 8, 2019

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the equipment provided by the client, tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.



Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information

Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

1120 Fulton Place
Fremont, CA 94539

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.12

Site Registration & Accreditation Information

Location	*NIST CB #	FCC	Japan
Canyon Park, Bothell, WA	US0081	US1022	A-0136
Brea, CA	US0060	US1025	A-0136
Fremont, CA	US0082	US1023	A-0136
Mariposa, CA	US0103	US1024	A-0136

*CKC's list of NIST designated countries can be found at: https://standards.gov/cabs/designations.html

SUMMARY OF RESULTS

Standard / Specification: FCC Part 15 Subpart C - 15.247 (FHSS 902-928MHz)

Test Procedure	Description	Modifications	Results
15.247(a)(1)(i)	Occupied Bandwidth	NA	Pass
15.247(a)(1)	Carrier Separation	NA	Pass
15.247(a)(1)(i)	Number of Hopping Channels	NA	Pass
15.247(a)(1)(i)	Average Time of Occupancy	NA	Pass
15.247(b)(2)	Output Power	NA	Pass
15.247(d)	RF Conducted Emissions & Band Edge	NA	Pass
15.247(d)	Radiated Emissions & Band Edge	Mod. #1	Pass
15.207	AC Conducted Emissions	NA	Pass

NA = Not Applicable

ISO/IEC 17025 Decision Rule
The declaration of pass or fail herein is based upon assessment to the specification(s) listed above, including where applicable, assessment of measurement uncertainties. For performance related tests, equipment was monitored for specified criteria identified in that section of testing.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions
Modification #1: Added Wurth Electronics PN 742 715 3 Ferrite was placed on the power wires exiting the chassis of the EUT. The ferrite was clamped around both wires with 2 turns.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions
This unit is a device that has two identical radios (one fitted with a band pass filter and one without). The transmitter measurements were made on both for conducted emissions and verified for radiated measurements. Radio 1 = Radio with Band Pass Filter Radio 2 = Radio without Band Pass Filter Three antennas were tested. 2.5dBi Omni 6dBi Omni 11 dBi Sector The data herein demonstrates compliance with the limits utilizing each antenna listed.

EQUIPMENT UNDER TEST (EUT)

During testing, numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration 1

Equipment Tested:

Device	Manufacturer	Model #	S/N
Weather Node	Digital Path Inc.	W1.0	000001
2.5dBi Omni Antenna	onelinkmore	OL-3043-2	NA
6dBi Omni Antenna	Laird	FG9026	NA
11dBi Sector Antenna	itelite	SECTOR09011V	NA

Support Equipment:

Device	Manufacturer	Model #	S/N
Laptop	HP	3168NGW	CND73893KQ
Laptop Supply	HP	PPP012D-5	3CB5190063

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	FHSS
Operating Frequency Range:	902 – 928MHz
Number of Hopping Channels:	51
Modulation Type(s):	FSK
Maximum Duty Cycle:	100%
Number of TX Chains:	2* (Equipment includes two identical radios, one RF output includes additional passive filter.)
Antenna Type(s) and Gain:	2.5dBi Omni 6dBi Omni 11dBi Sector
Beamforming Type:	NA *
Antenna Connection Type:	External Connector SMA
Nominal Input Voltage:	13 VDC (max 13.5)
Firmware / Software used for Test:	Putty Serial Program Version 0001

*Note: Manufacturer declares the equipment does not support simultaneous coordinated coherent transmissions (MIMO).

FCC Part 15 Subpart C

15.247(a) Transmitter Characteristics

Test Setup/Conditions			
Test Location:	Mariposa Lab A	Test Engineer:	Benny Lovan
Test Method:	ANSI C63.10 (2013)	Test Date(s):	7/25/19 – 7/29/19
Configuration:	1		
Test Setup:	The EUT was placed on a non-conductive table. The antenna port for Radio 2 was connected directly to the spectrum analyzer through 10dB of attenuation. Then, the measurement cable was connected to antenna Port 1 for Radio 1 and the measurements were repeated. Radio 1 = Radio with Band Pass Filter Radio 2 = Radio without Band Pass Filter The EUT has a number of rate settings. The highest rating that the customer will use is Rate 6. The 20dB Bandwidth measurement was taken for each rate and they are defined below.		

Environmental Conditions			
Temperature (ºC)	21	Relative Humidity (%):	42

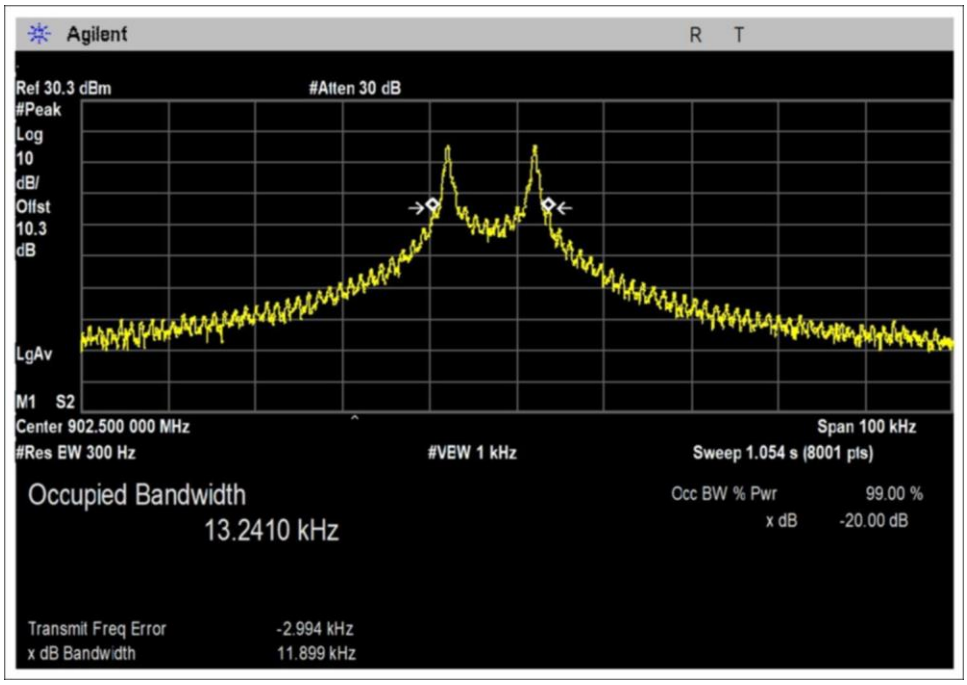
Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03357	Cable	Astrolab	32022-2-29094K-36TC	3/14/2019	3/14/2021
03470	Spectrum Analyzer	Agilent	E4440A	5/2/2019	5/2/2021
P07365	Attenuator	Weinschel	54A-10	3/26/2019	3/26/2021

15.247(a)(1) 20 dB Bandwidth

Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
Rate 0 Setting = 1.2 kbps					
902.5	1	FSK	11.899	≤500	Pass
915	1	FSK	11.900	≤500	Pass
927.5	1	FSK	11.873	≤500	Pass
902.5	2	FSK	12.014	≤500	Pass
915	2	FSK	11.929	≤500	Pass
927.5	2	FSK	11.950	≤500	Pass
Rate 1 Setting = 2.4 kbps					
902.5	1	FSK	21.727	≤500	Pass
915	1	FSK	21.836	≤500	Pass
927.5	1	FSK	21.785	≤500	Pass
902.5	2	FSK	21.752	≤500	Pass
915	2	FSK	21.852	≤500	Pass
927.5	2	FSK	21.764	≤500	Pass
Rate 2 Setting = 4.8 kbps					
902.5	1	FSK	37.043	≤500	Pass
915	1	FSK	36.881	≤500	Pass
927.5	1	FSK	36.964	≤500	Pass
902.5	2	FSK	36.946	≤500	Pass
915	2	FSK	36.842	≤500	Pass
927.5	2	FSK	36.874	≤500	Pass
Rate 3 Setting = 12.5 kbps					
902.5	1	FSK	54.823	≤500	Pass
915	1	FSK	55.173	≤500	Pass
927.5	1	FSK	54.558	≤500	Pass
902.5	2	FSK	55.490	≤500	Pass
915	2	FSK	54.926	≤500	Pass
927.5	2	FSK	53.918	≤500	Pass
Rate 4 Setting = 25 kbps					
902.5	1	FSK	108.940	≤500	Pass
915	1	FSK	110.075	≤500	Pass
927.5	1	FSK	109.809	≤500	Pass
902.5	2	FSK	109.391	≤500	Pass
915	2	FSK	110.017	≤500	Pass
927.5	2	FSK	108.601	≤500	Pass
Rate 5 Setting = 50 kbps					
902.5	1	FSK	170.976	≤500	Pass
915	1	FSK	169.080	≤500	Pass
927.5	1	FSK	170.274	≤500	Pass

Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
902.5	2	FSK	167.929	≤500	Pass
915	2	FSK	168.577	≤500	Pass
927.5	2	FSK	166.811	≤500	Pass
Rate 6 Setting = 55.555 kbps					
902.5	1	FSK	182.932	≤500	Pass
915	1	FSK	182.252	≤500	Pass
927.5	1	FSK	180.772	≤500	Pass
902.5	2	FSK	180.270	≤500	Pass
915	2	FSK	182.363	≤500	Pass
927.5	2	FSK	180.924	≤500	Pass

Plot(s)



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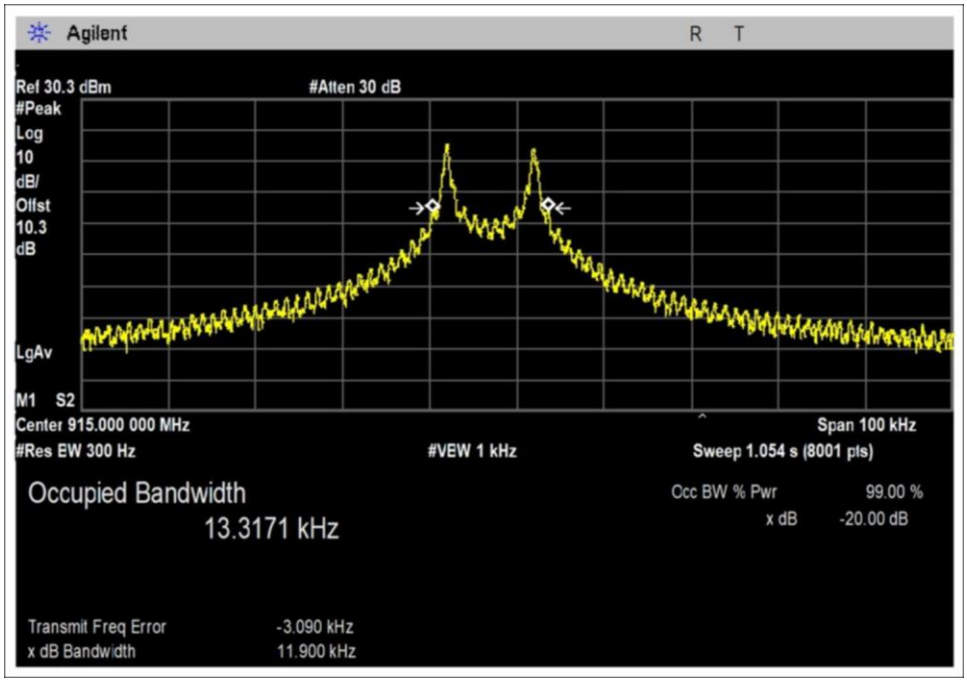

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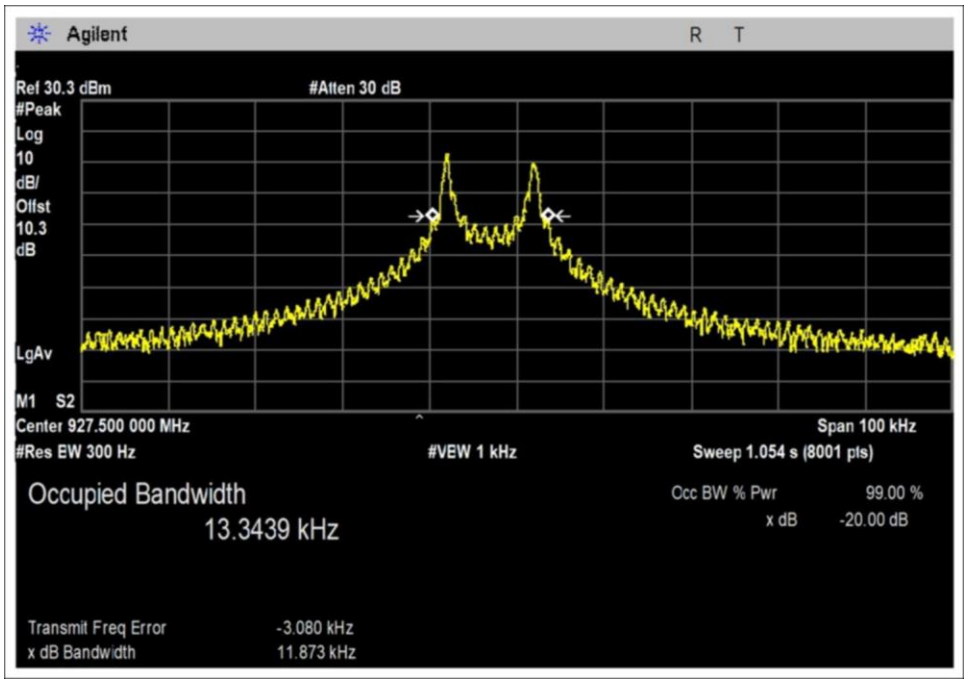

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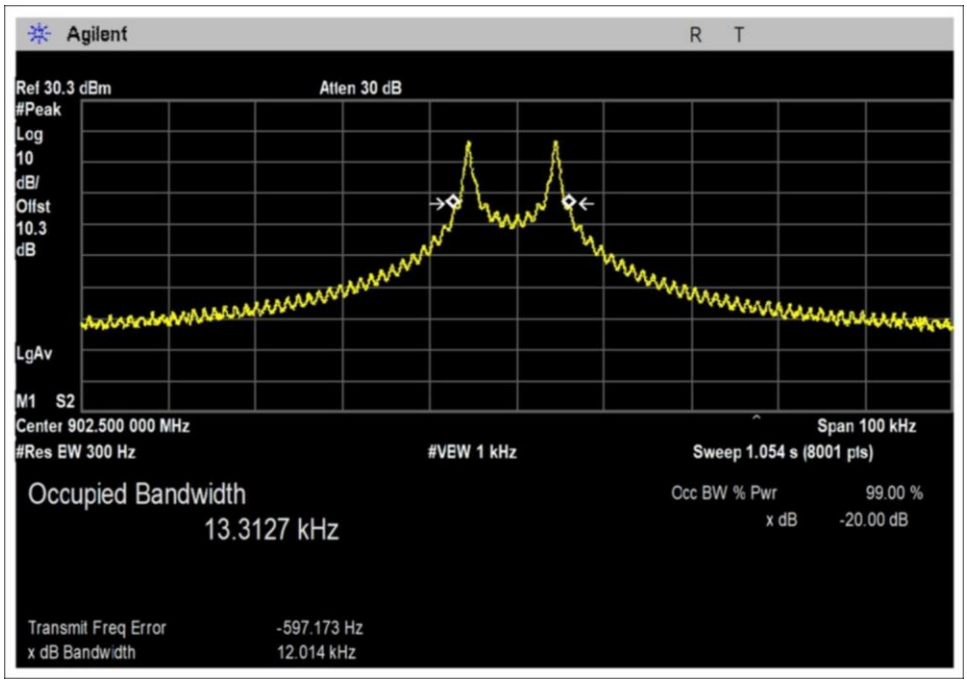

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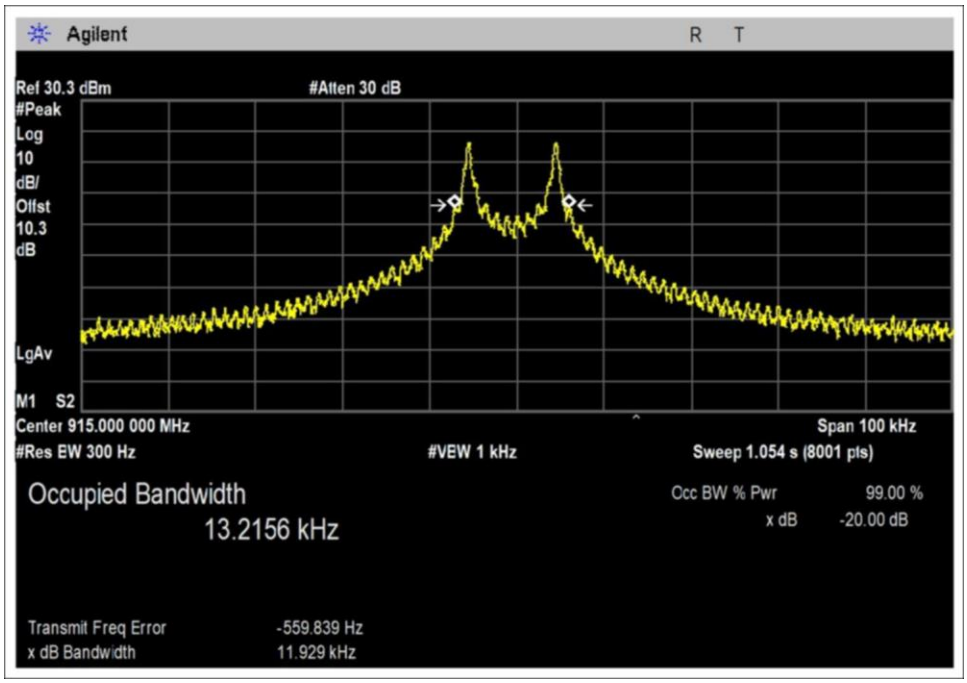

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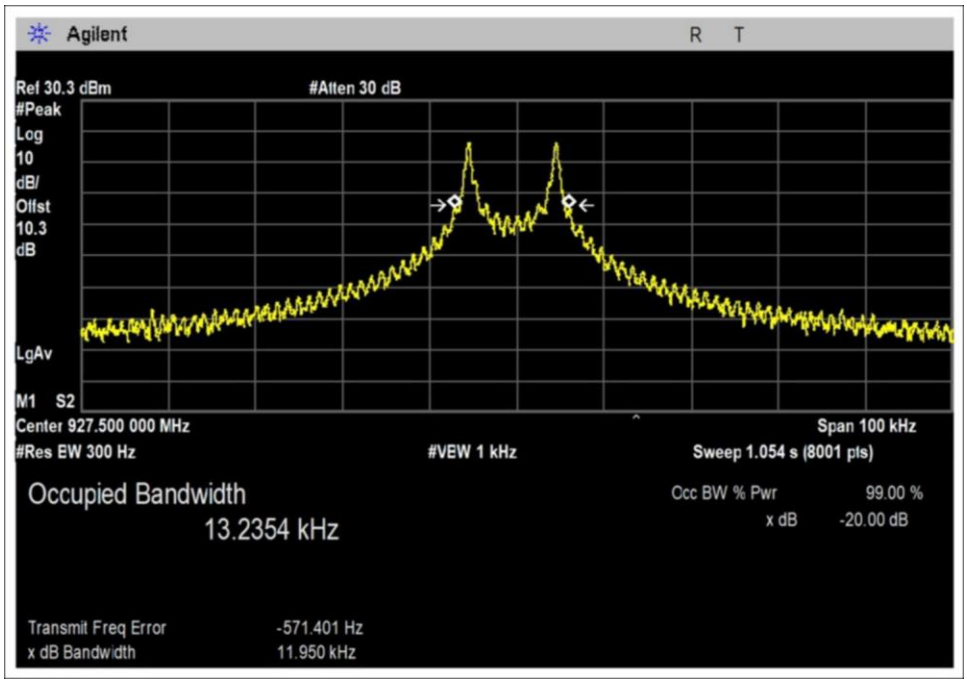

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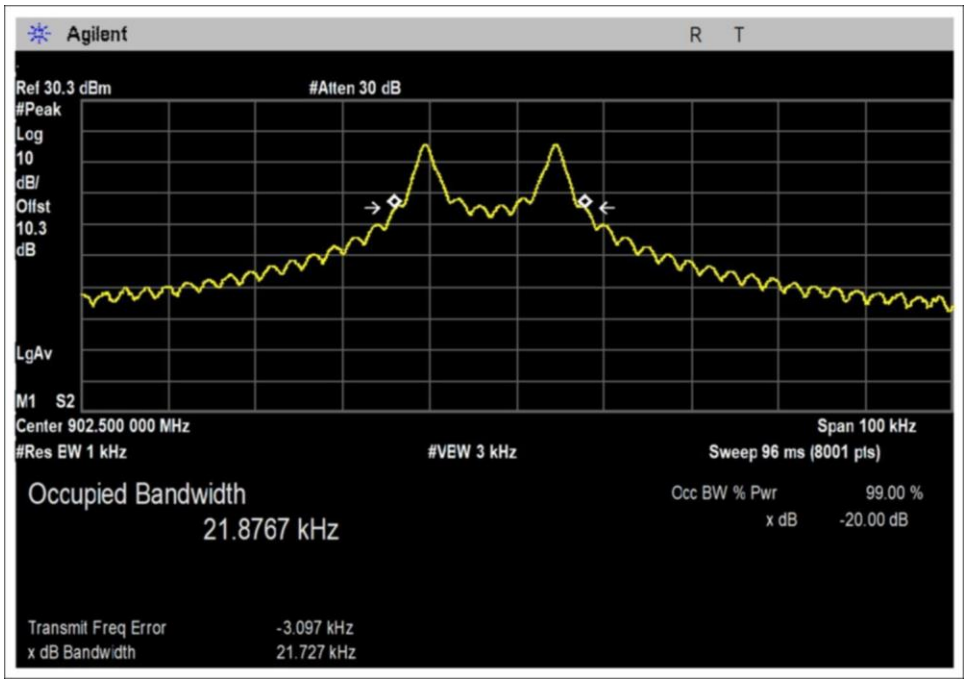

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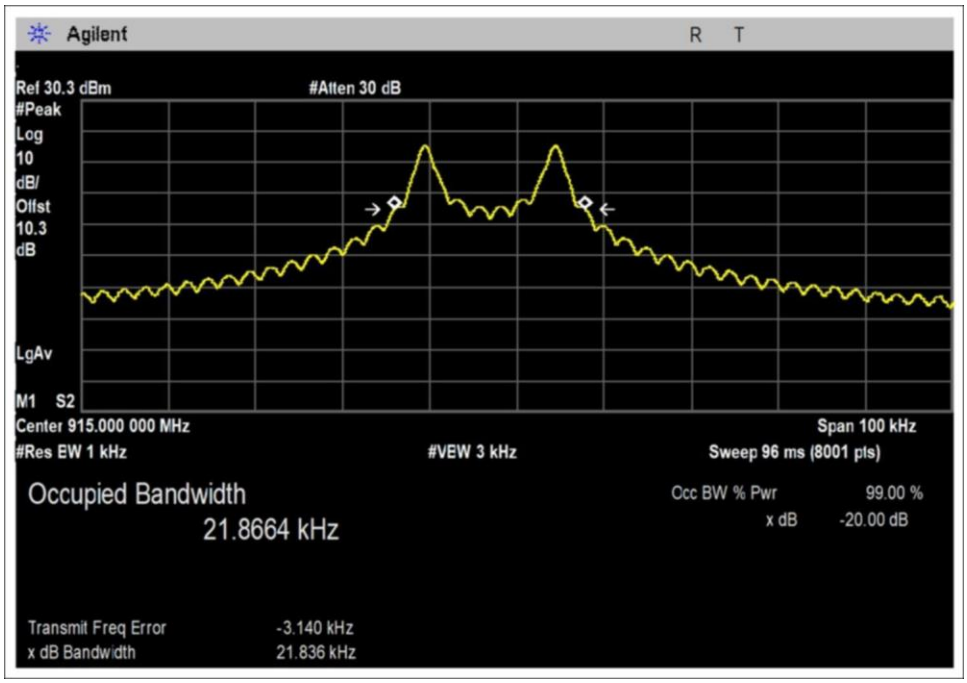

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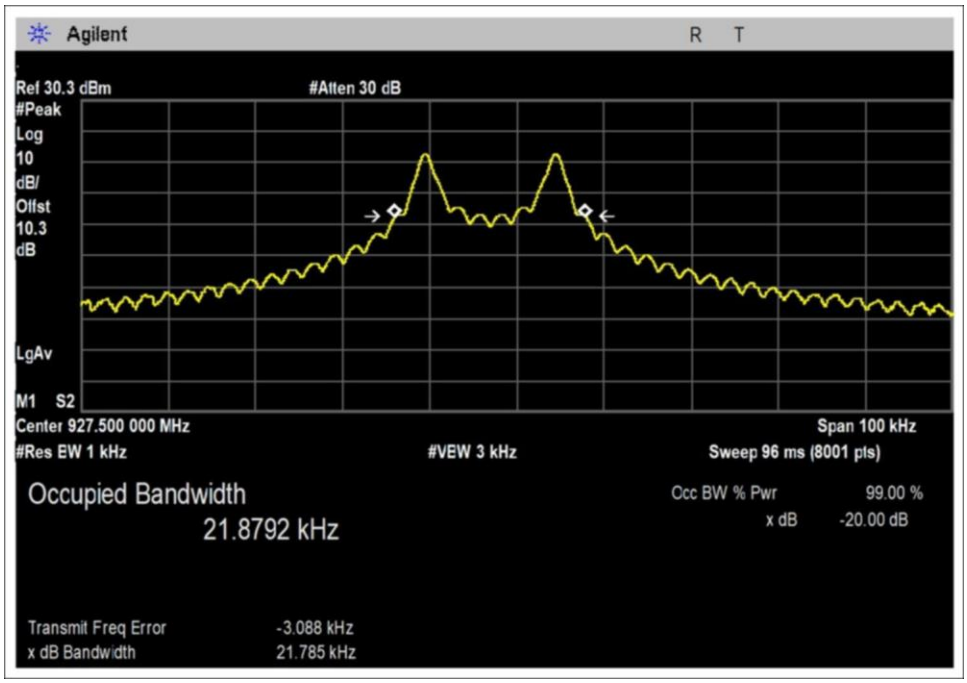

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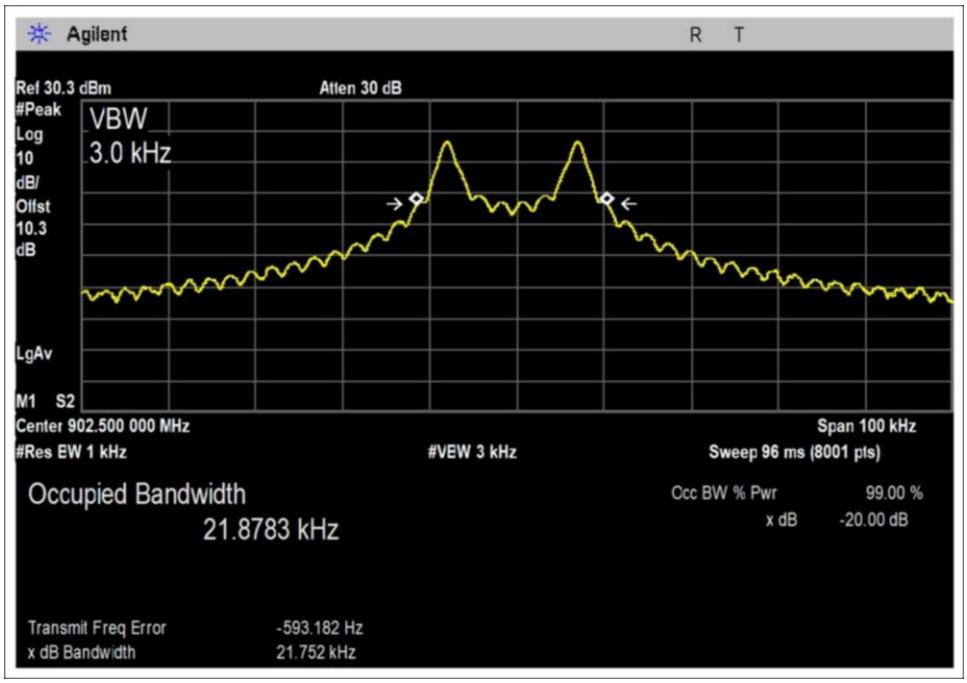

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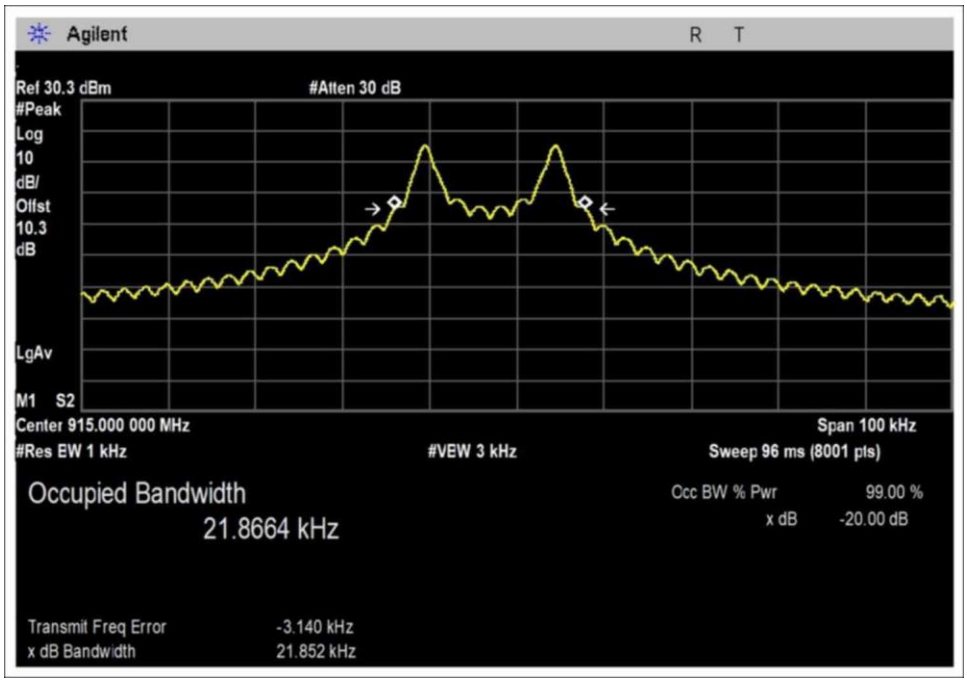

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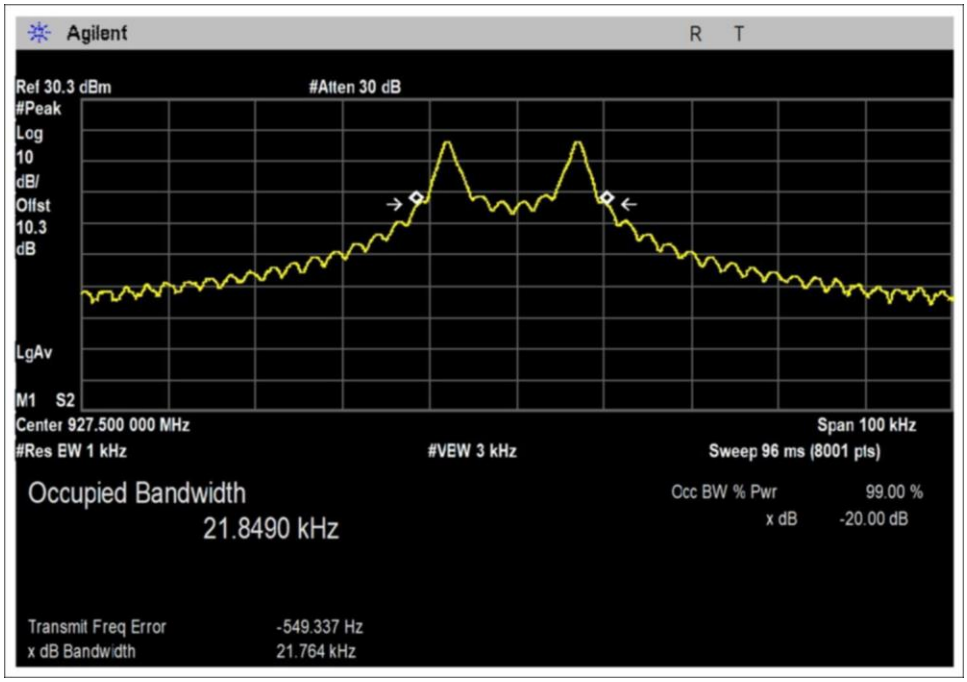

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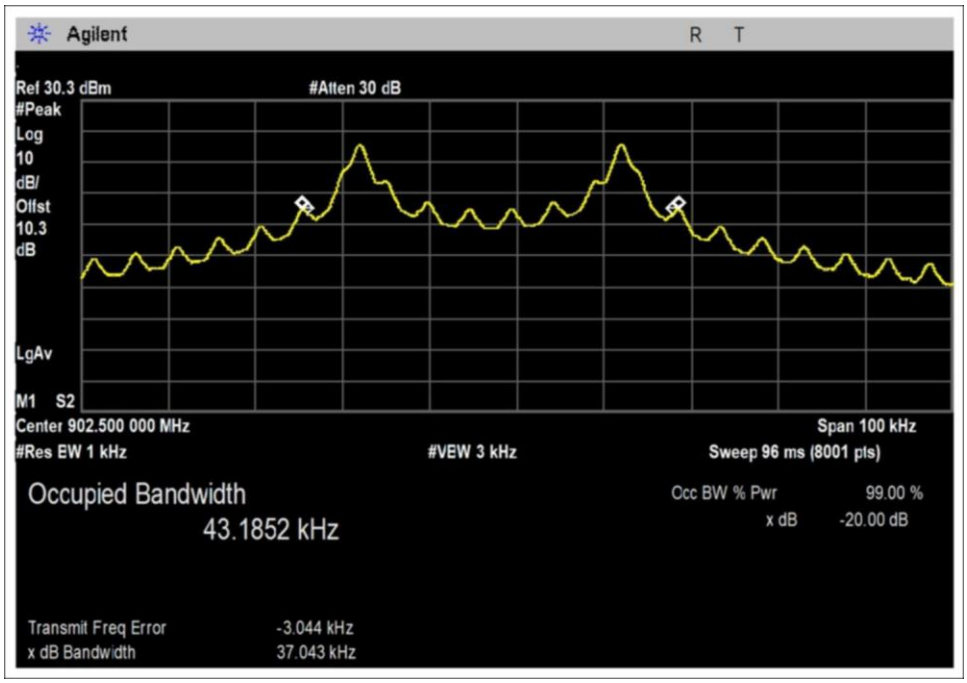

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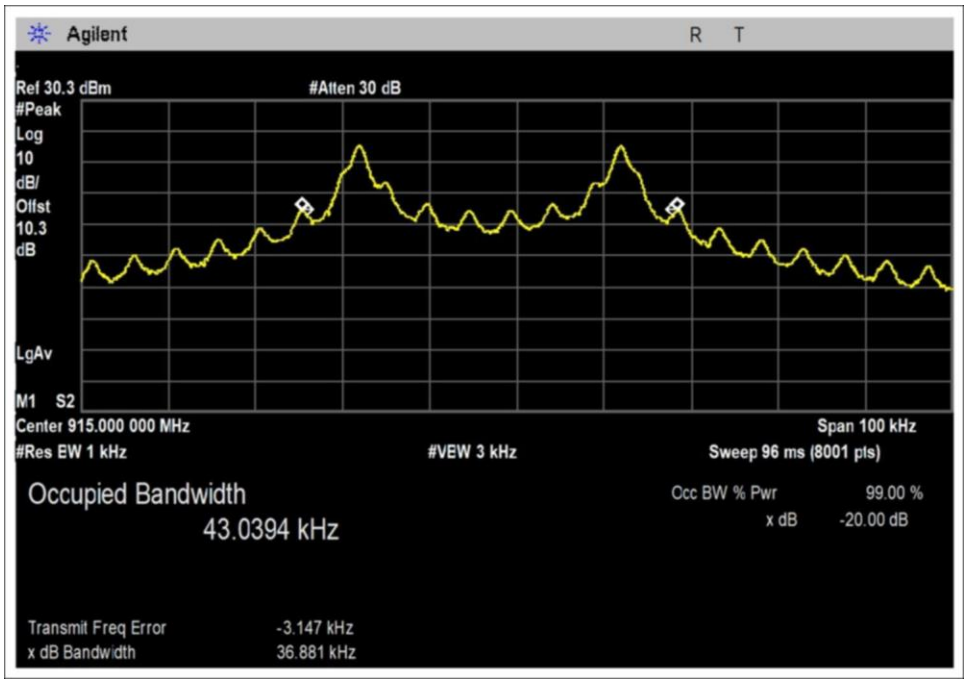

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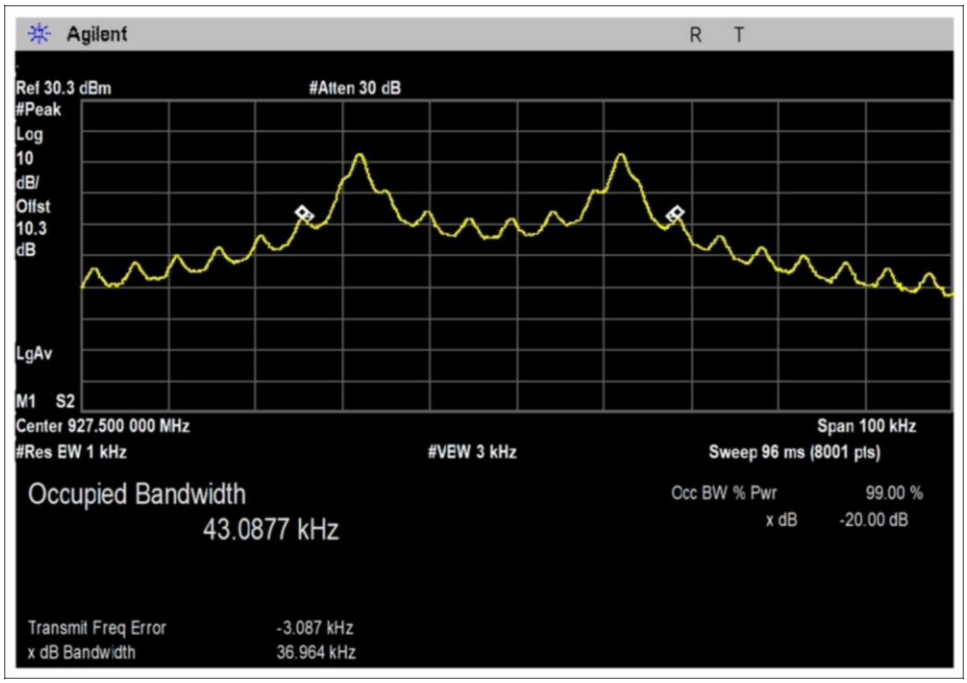

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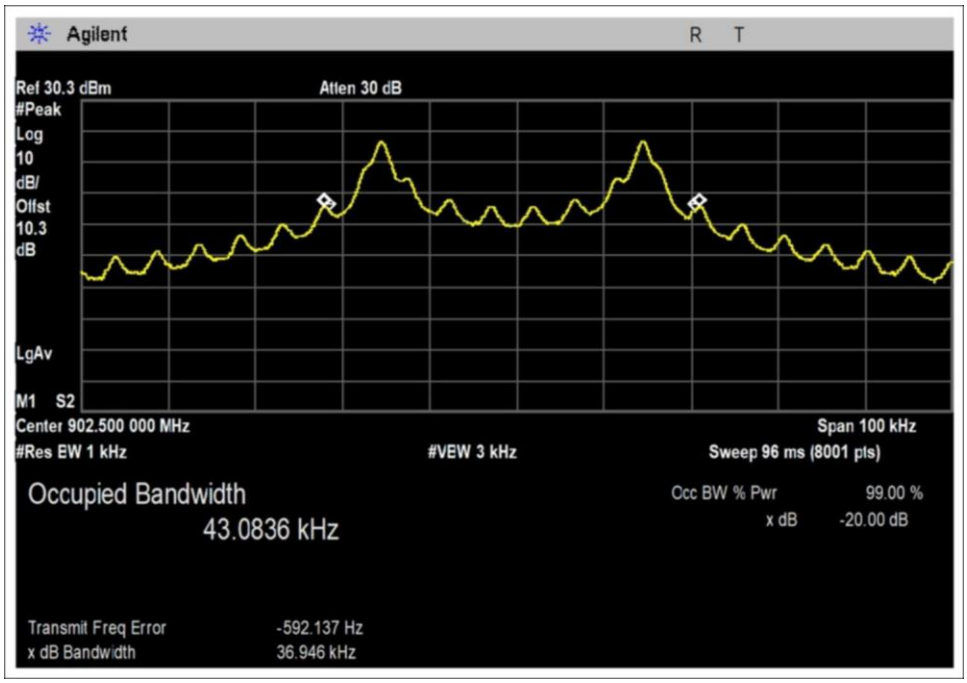

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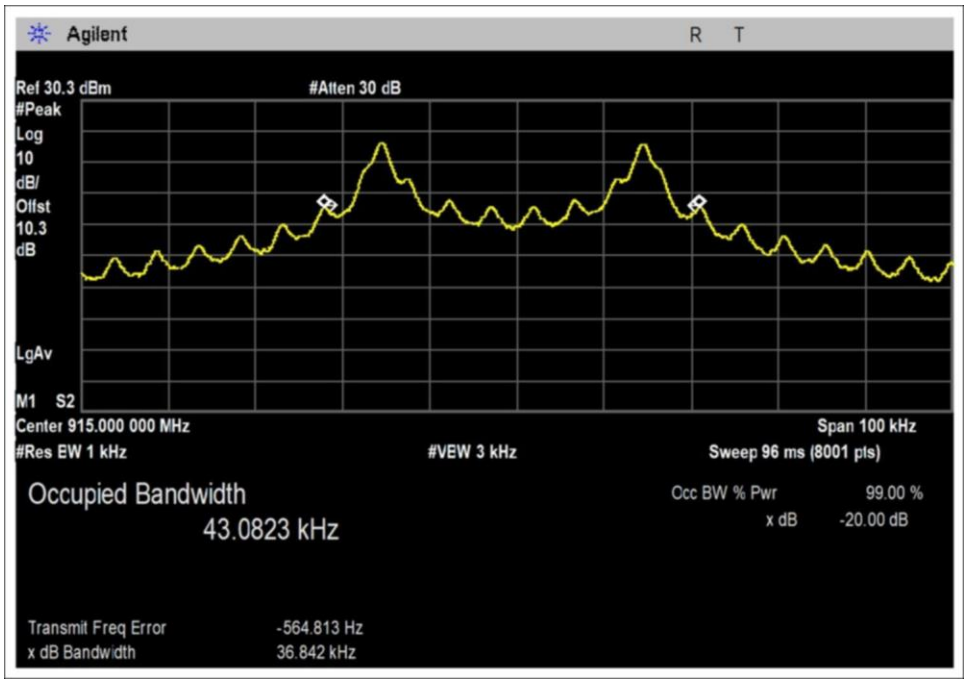

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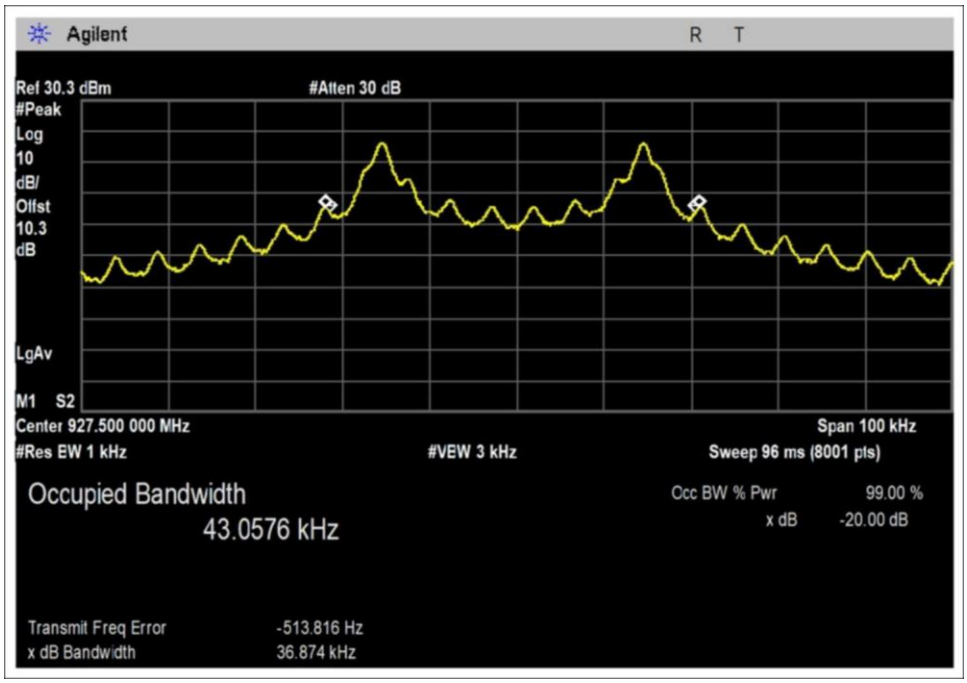

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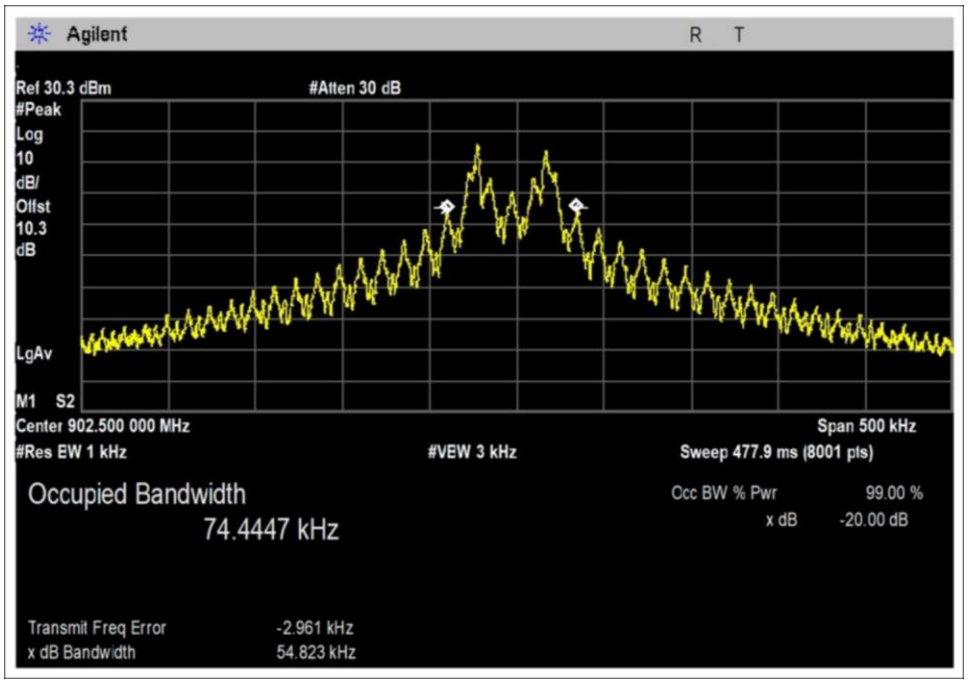

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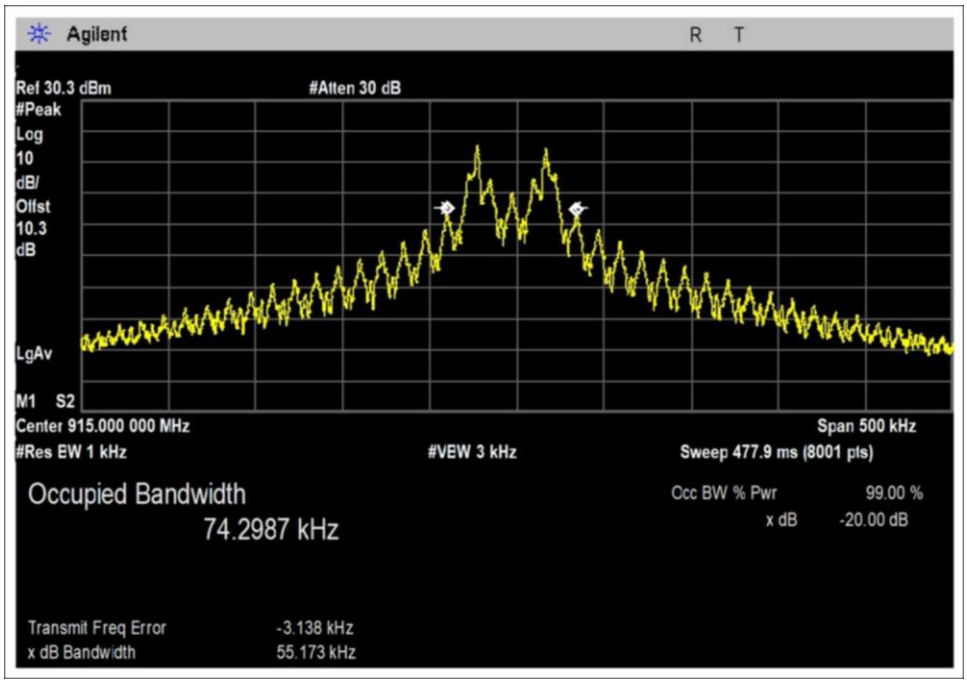

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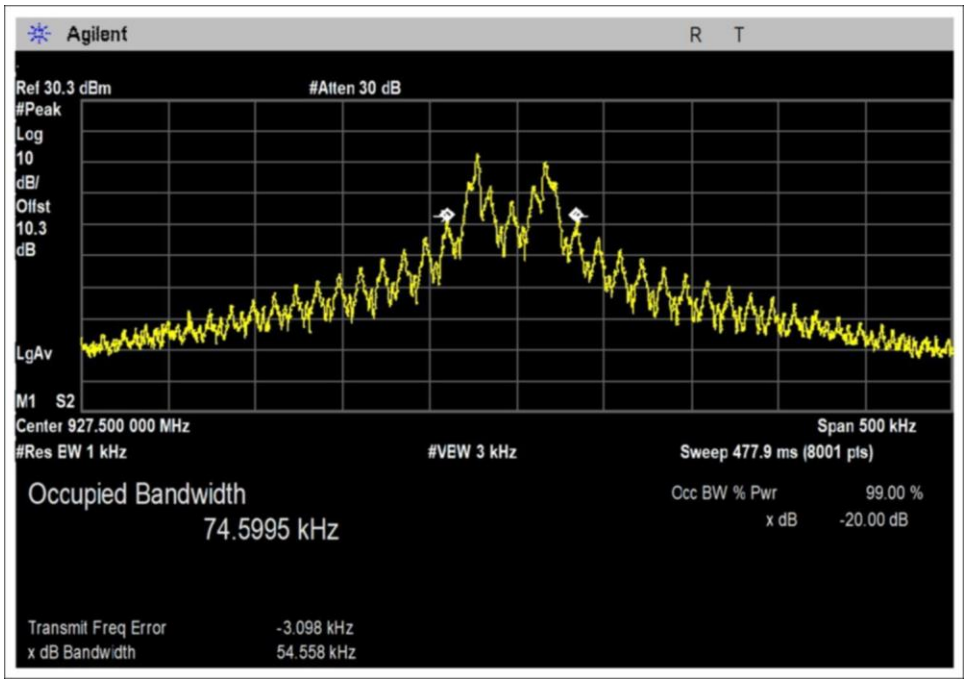

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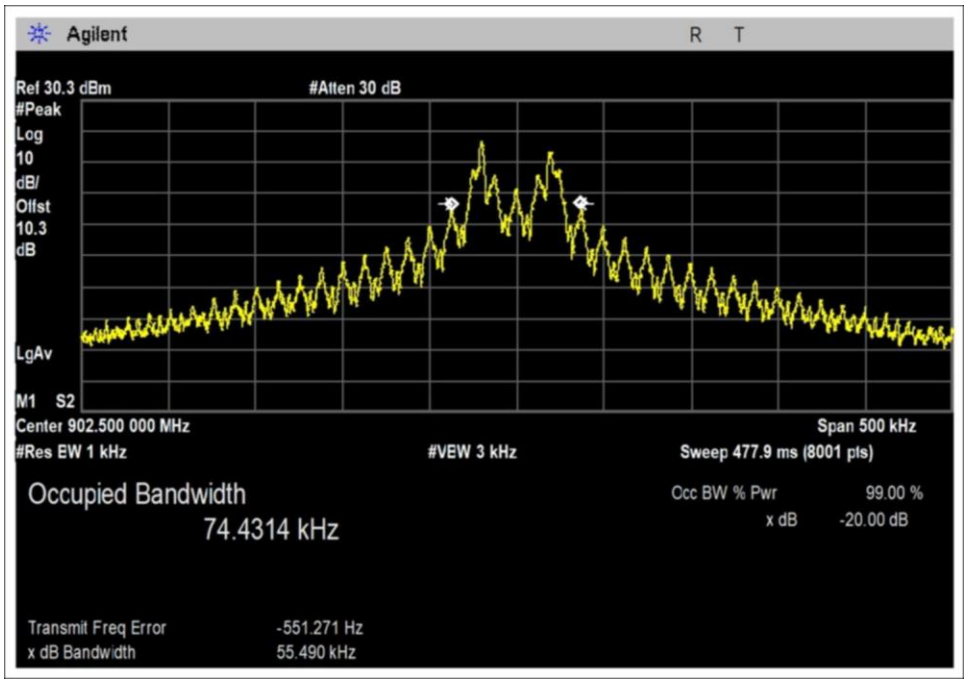

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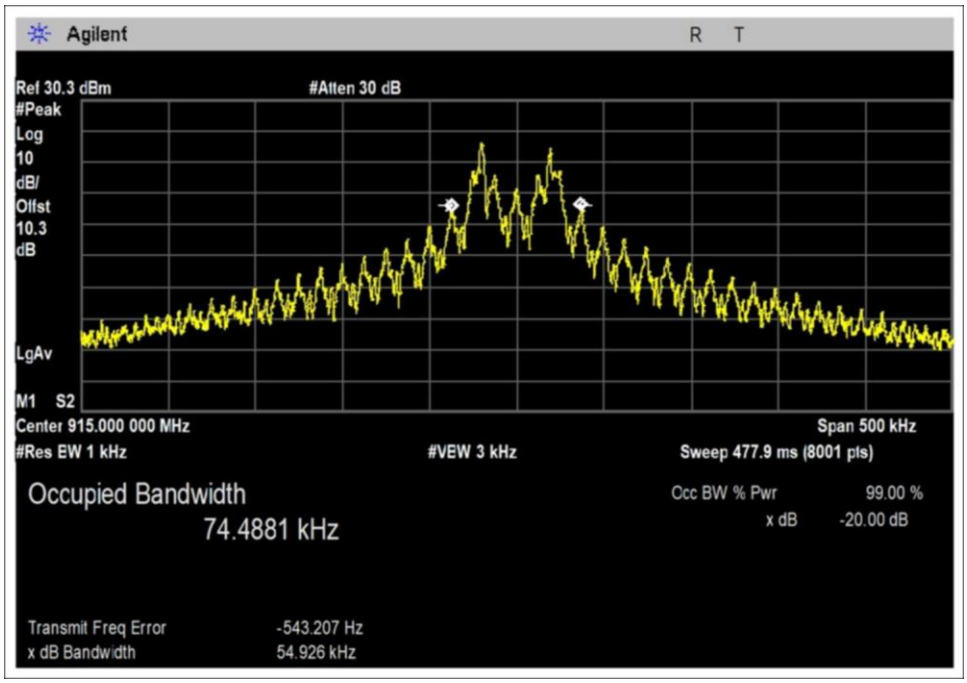

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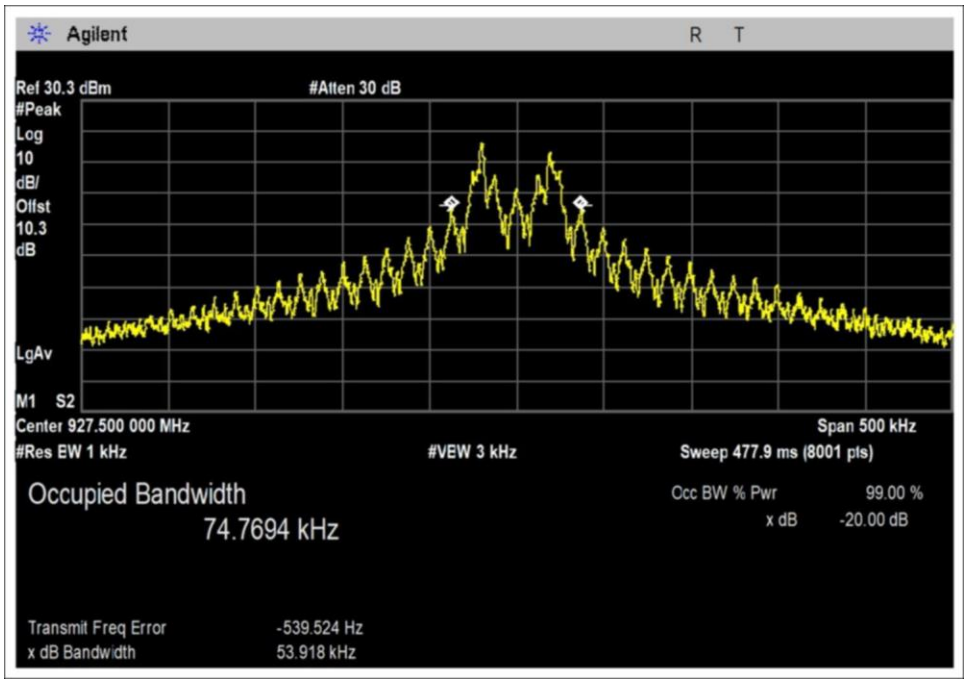

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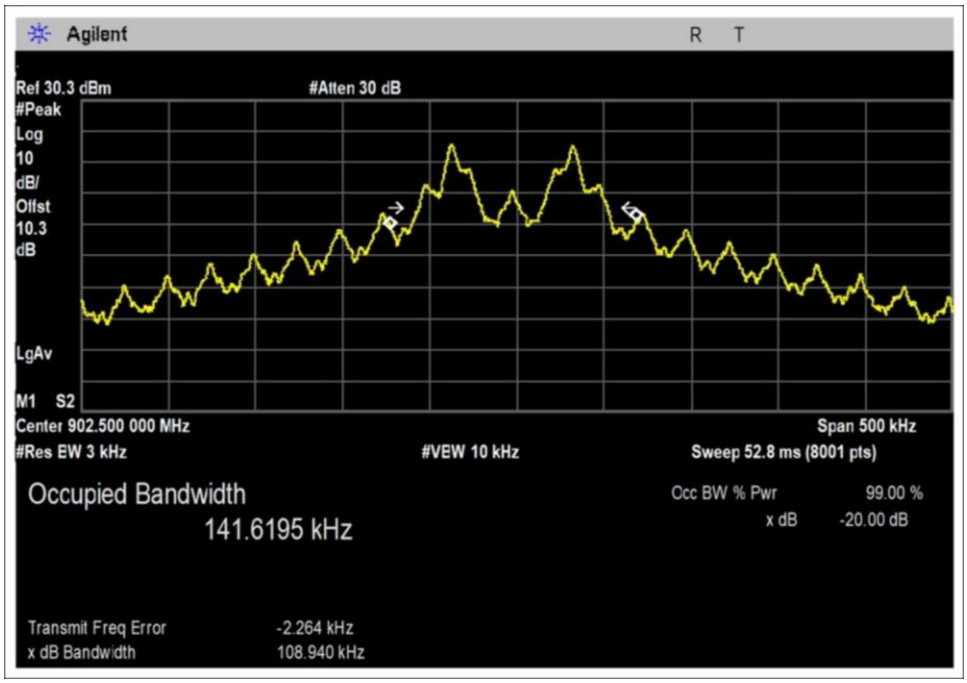

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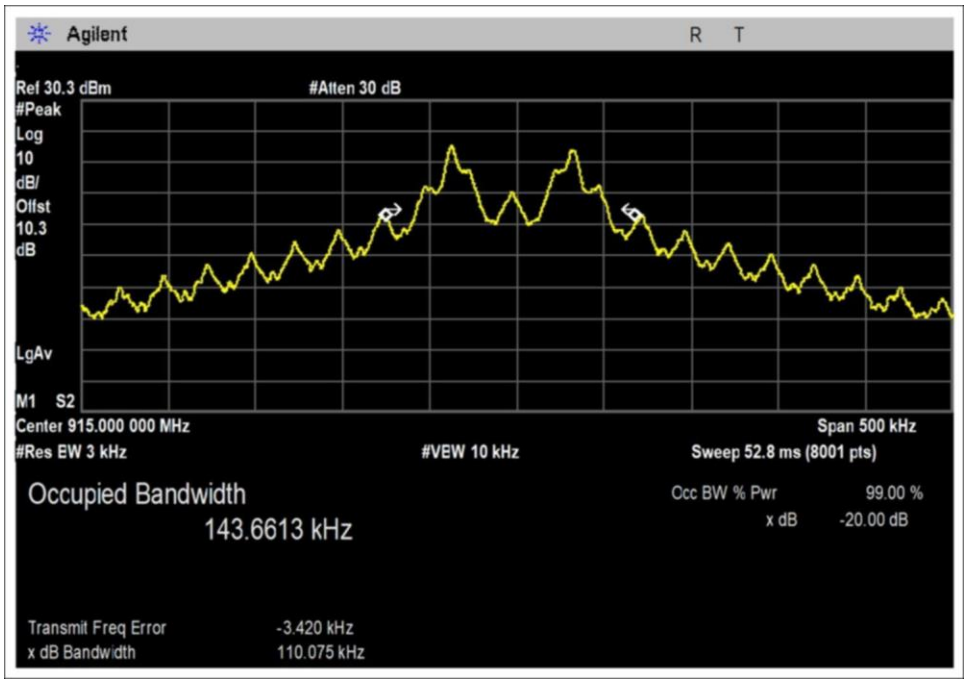
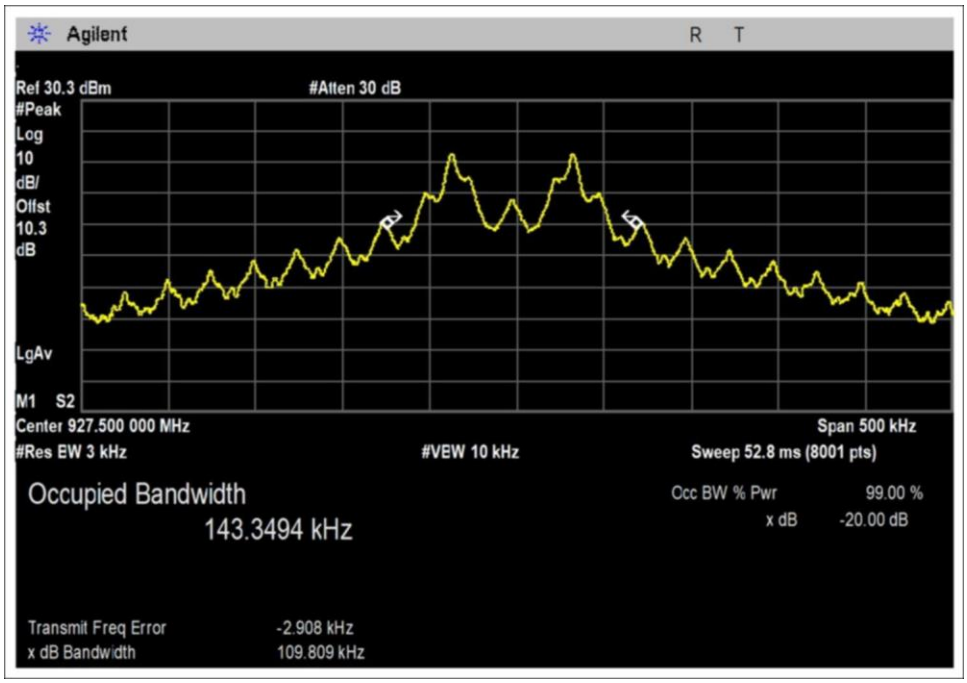


Rate4-02-PWR31-Radio1-Middle Channel



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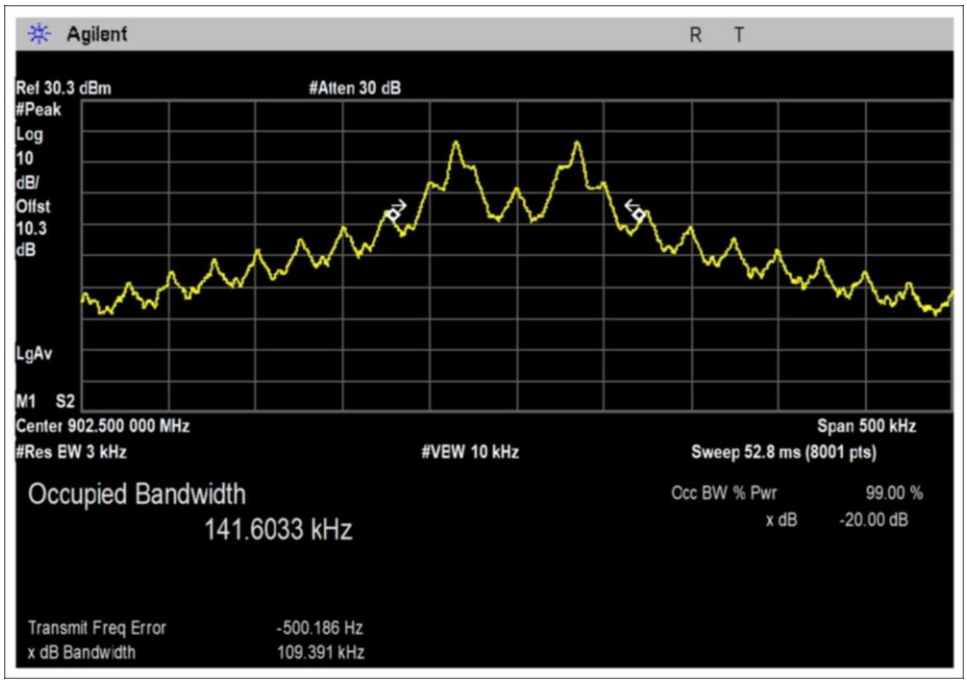

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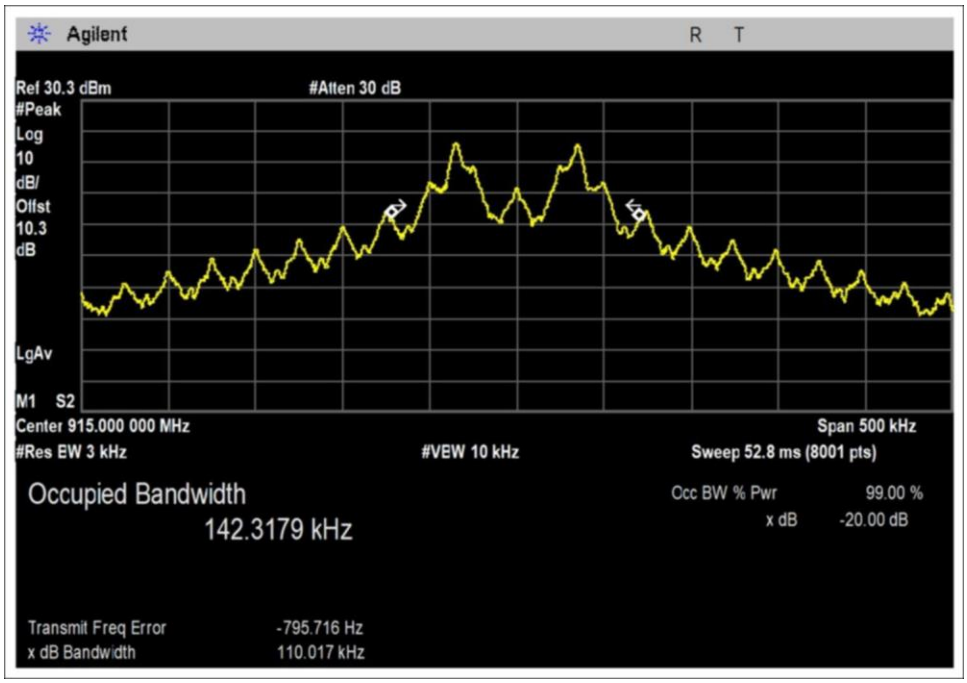

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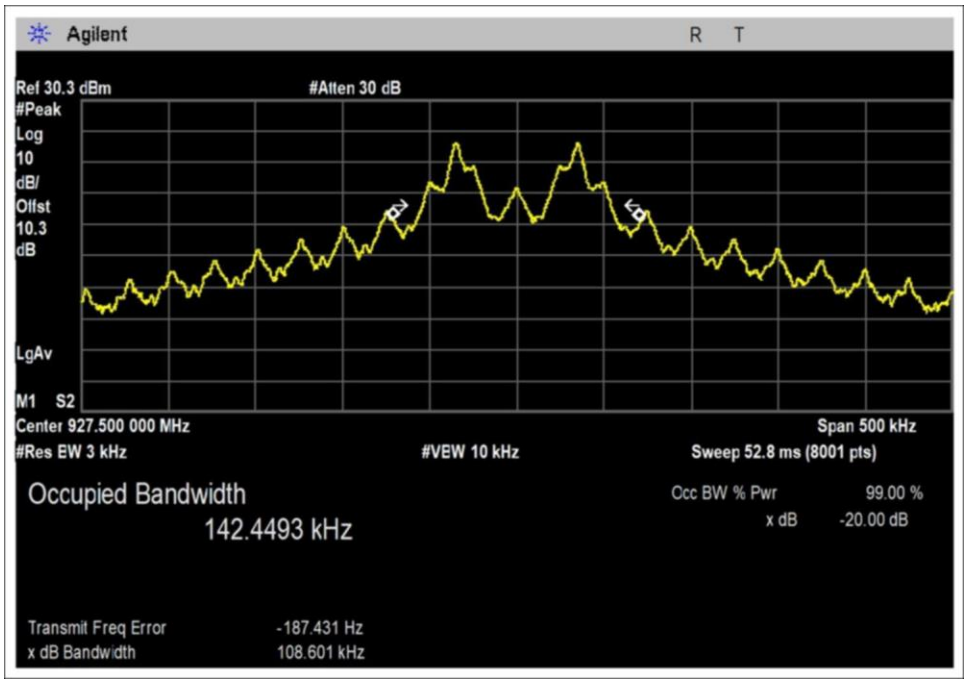
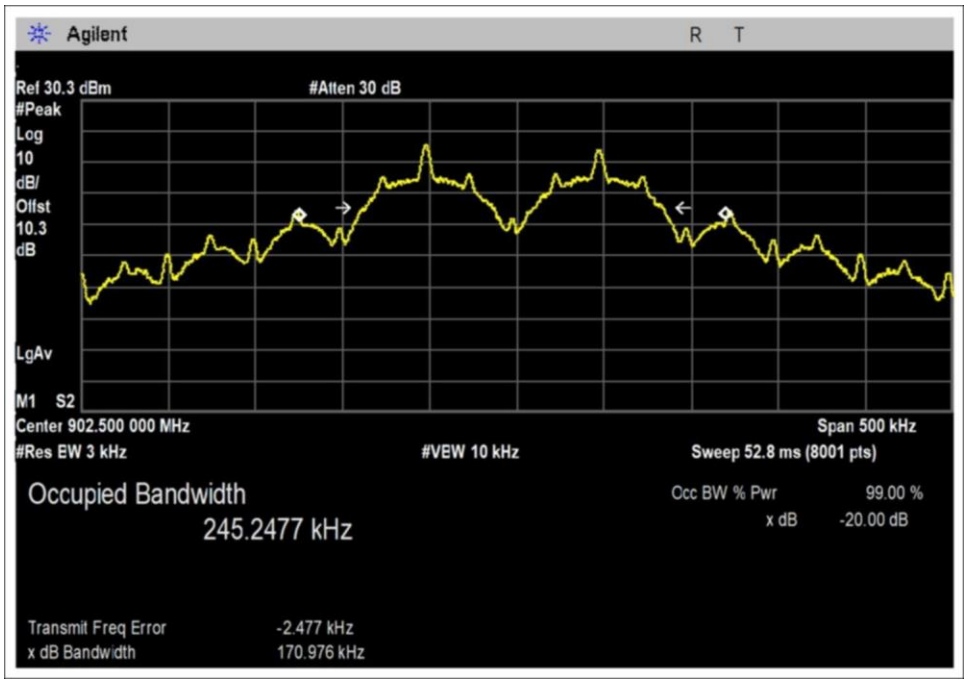
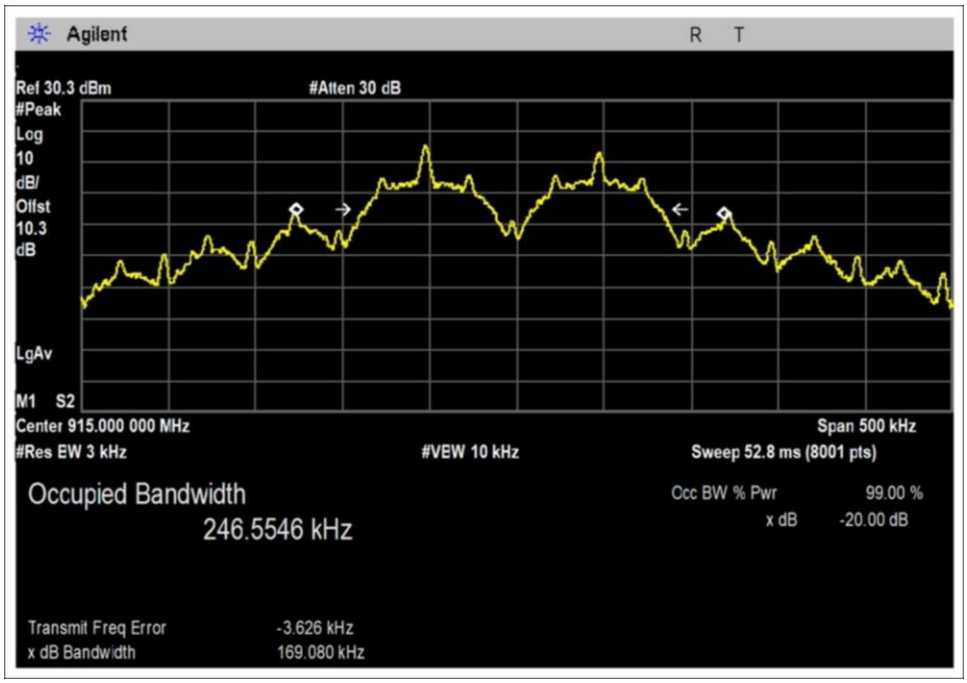


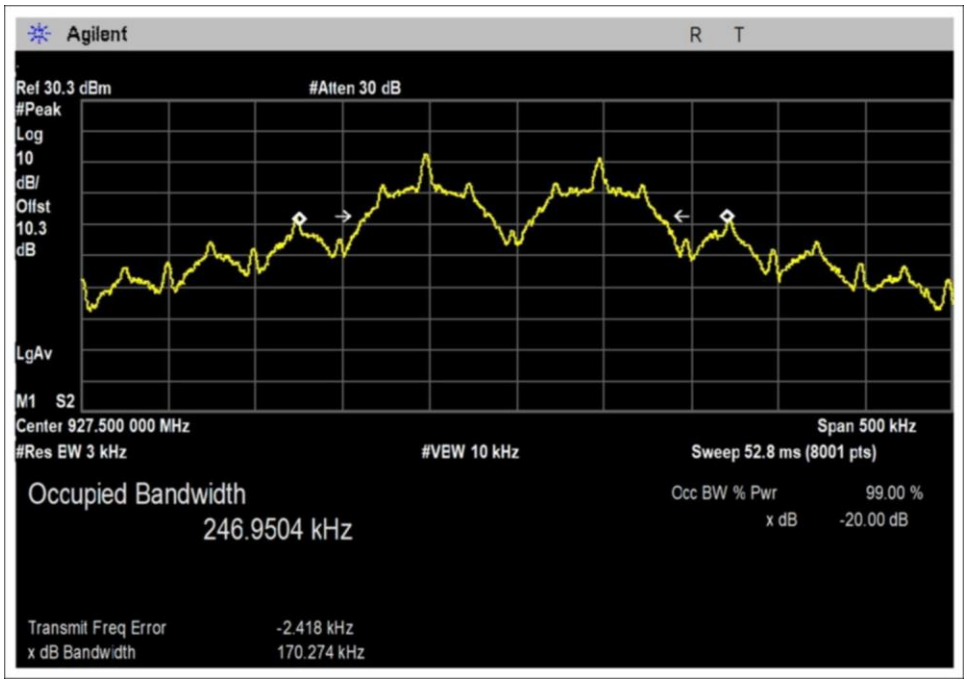
Rate4-06-PWR31-Radio2-High Channel



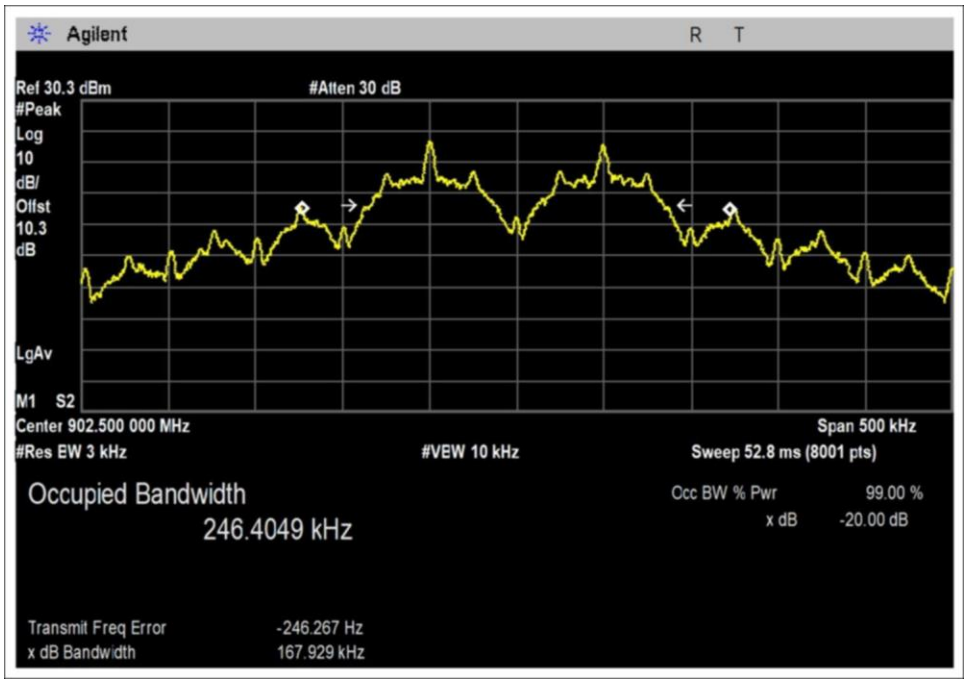
Rate5-01-PWR31-Radio1-Low Channel



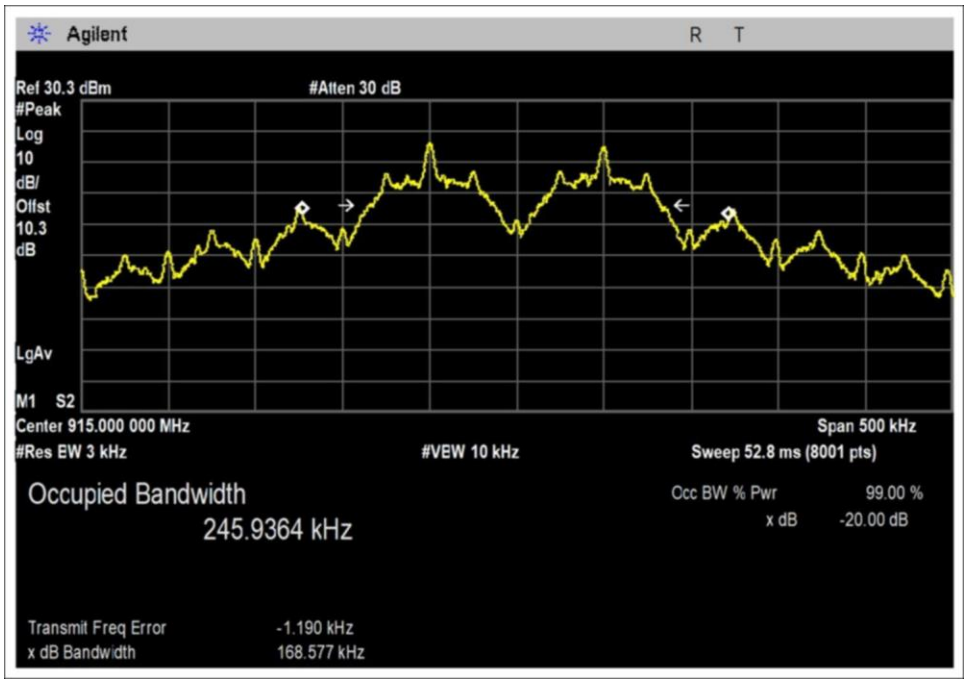
Rate5-02-PWR31-Radio1-Middle Channel



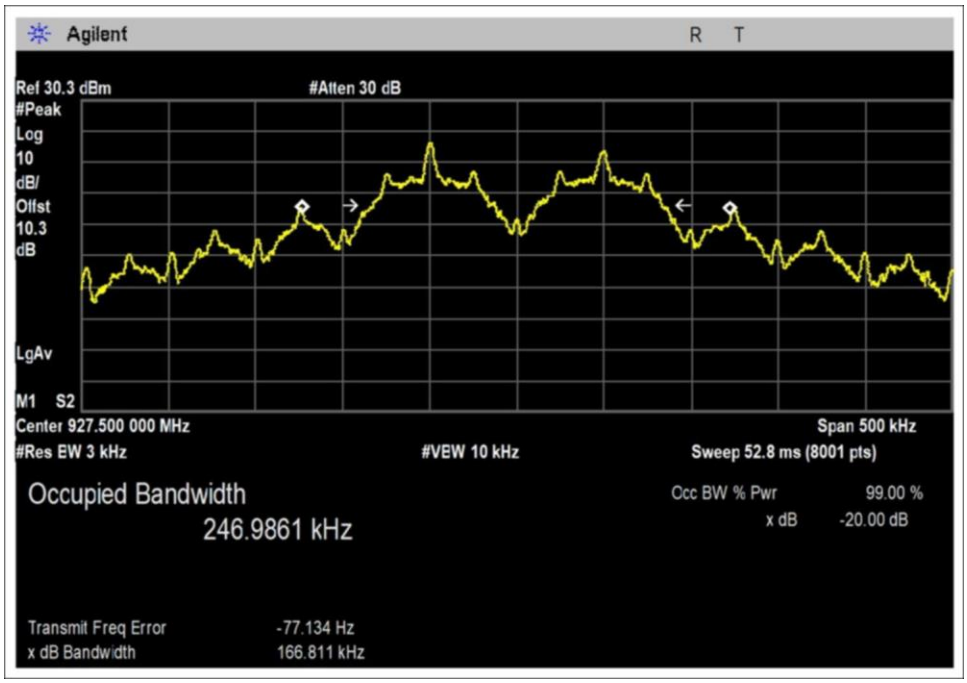
Rate5-03-PWR31-Radio1-High Channel



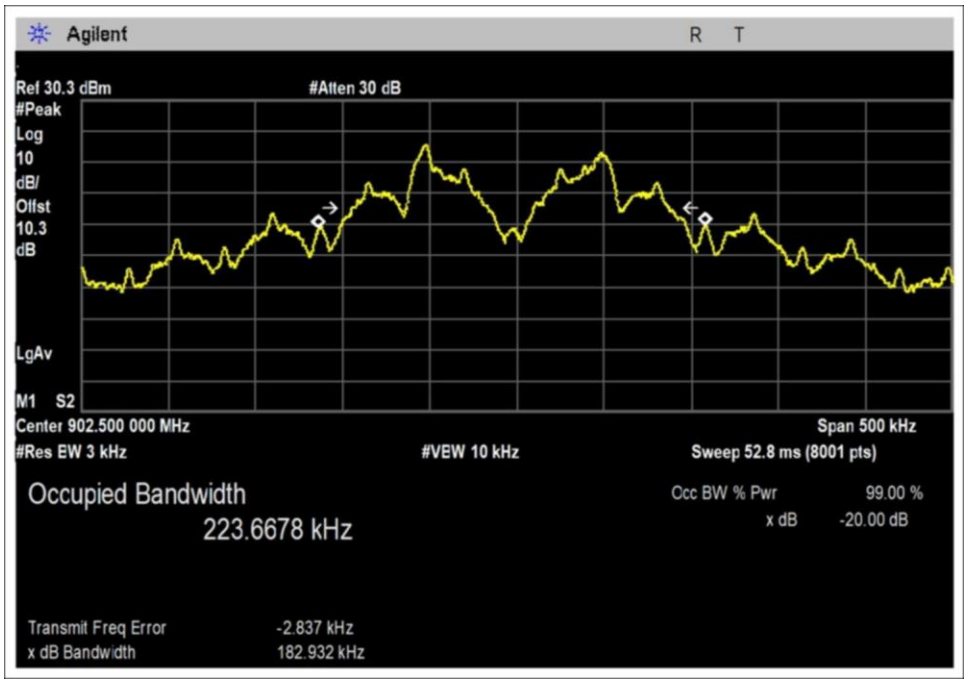
Rate5-04-PWR31-Radio2-Low Channel



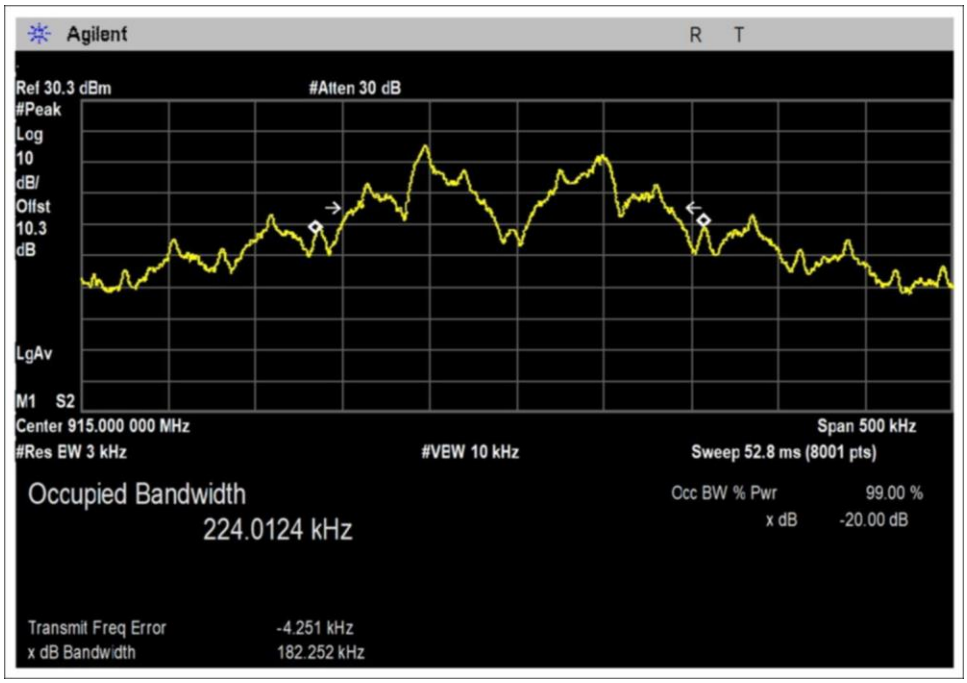
Rate5-05-PWR31-Radio2-Middle Channel



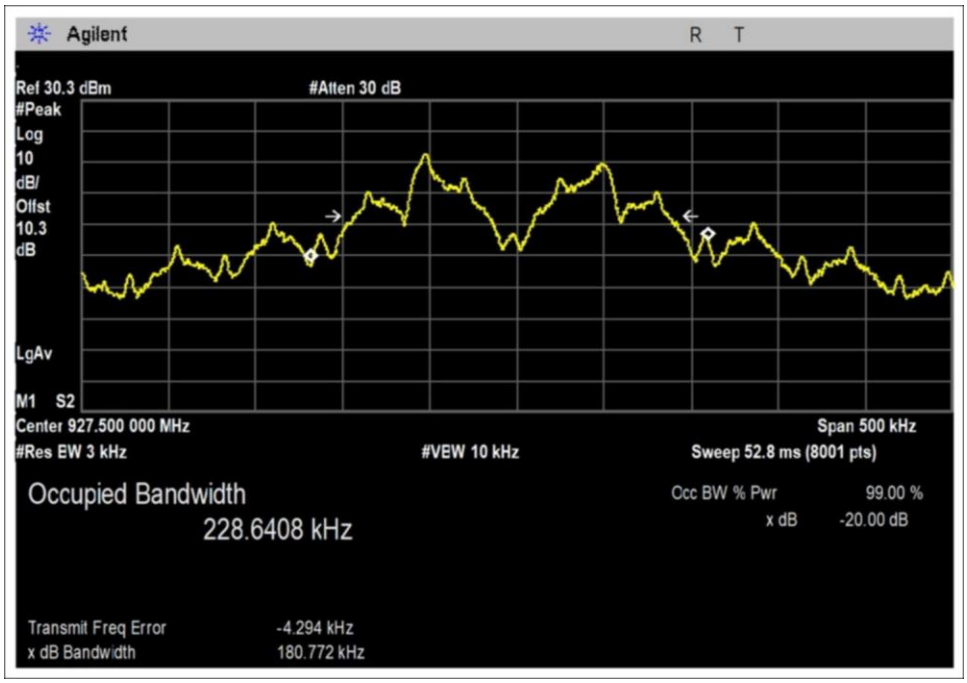
Rate5-06-PWR31-Radio2-High Channel



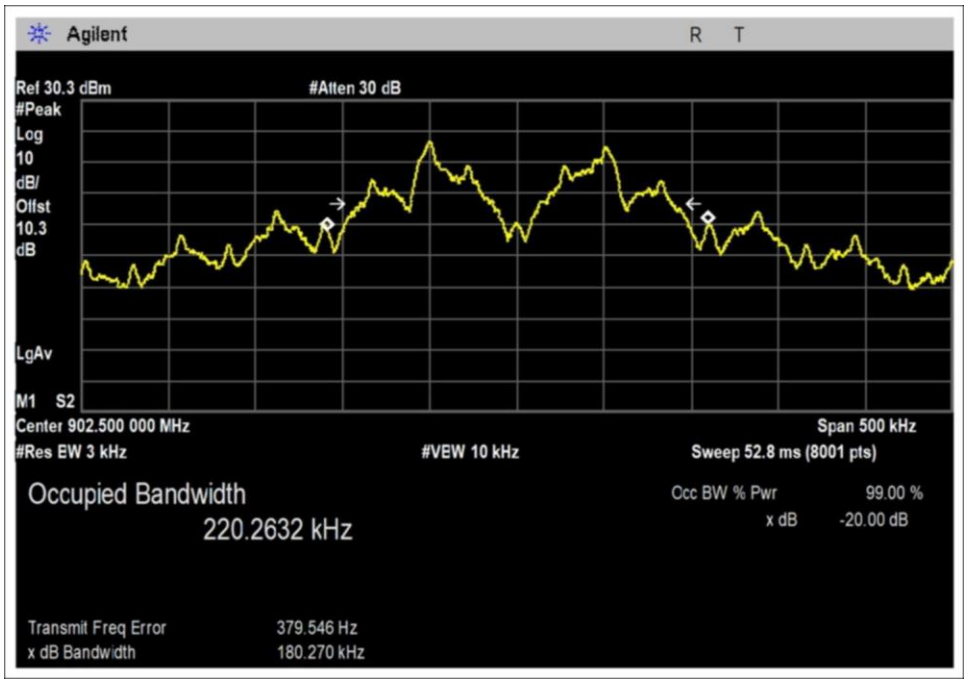
Rate6-01-PWR31-Radio1-Low Channel



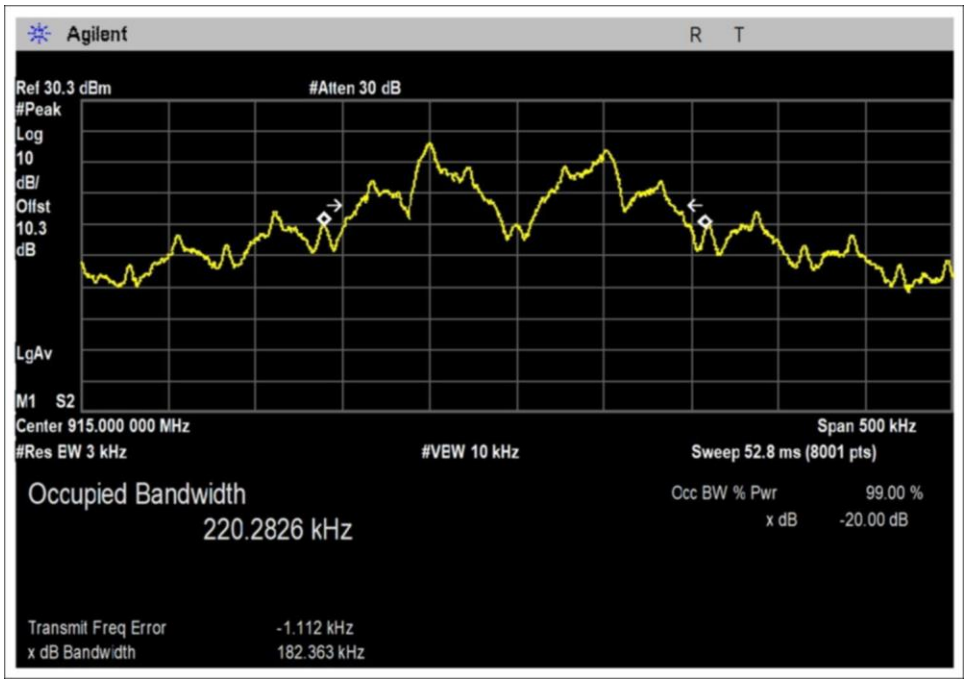
Rate6-02-PWR31-Radio1-Middle Channel



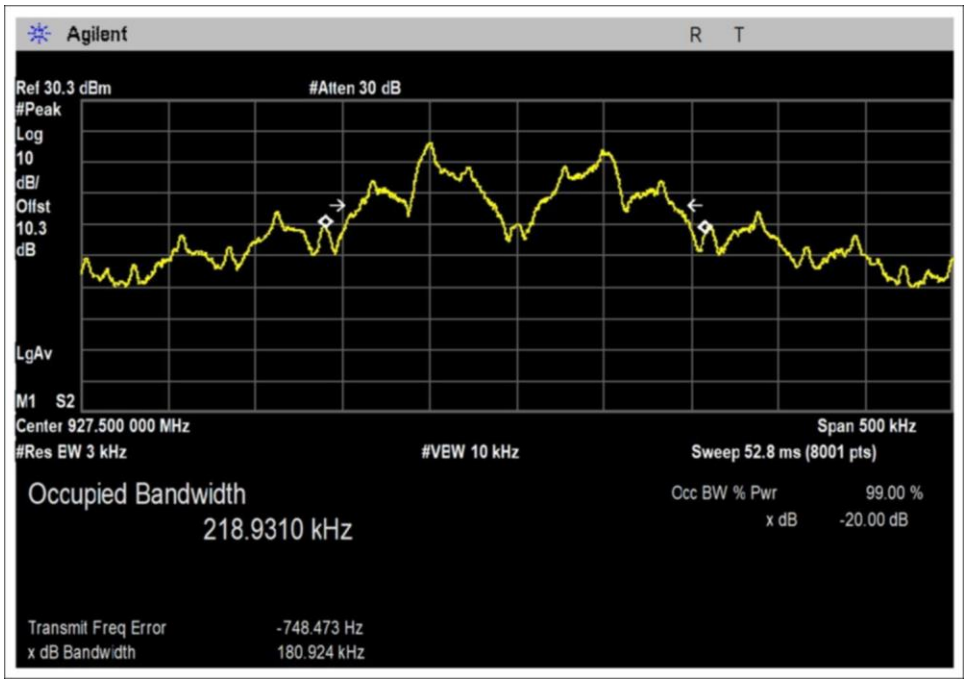
Rate6-03-PWR31-Radio1-High Channel



Rate6-04-PWR31-Radio2-Low Channel



Rate6-05-PWR31-Radio2-Middle Channel

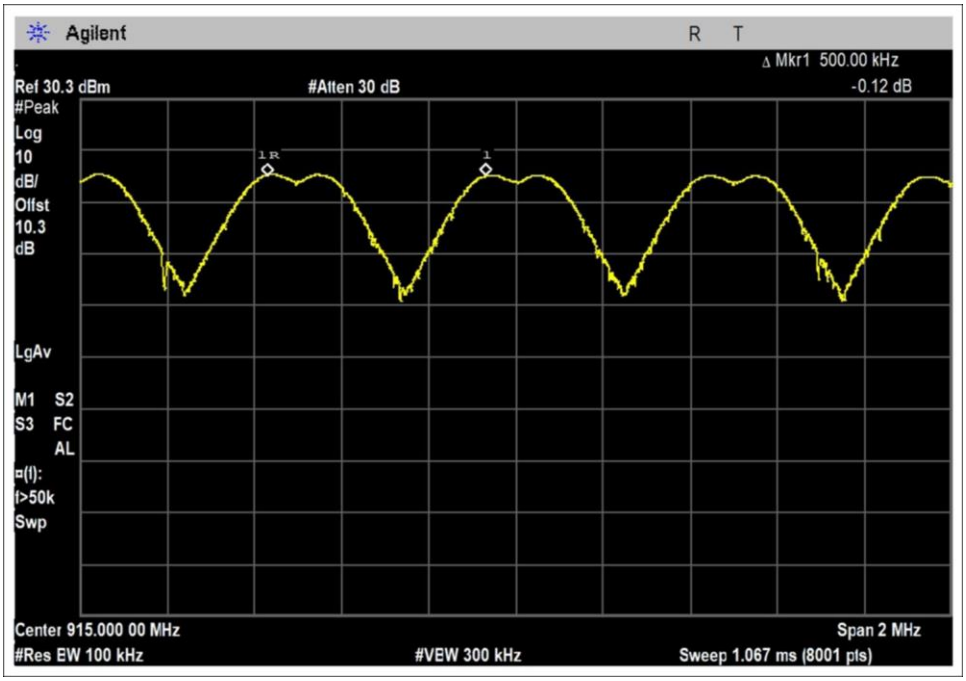


Rate6-06-PWR31-Radio2-High Channel

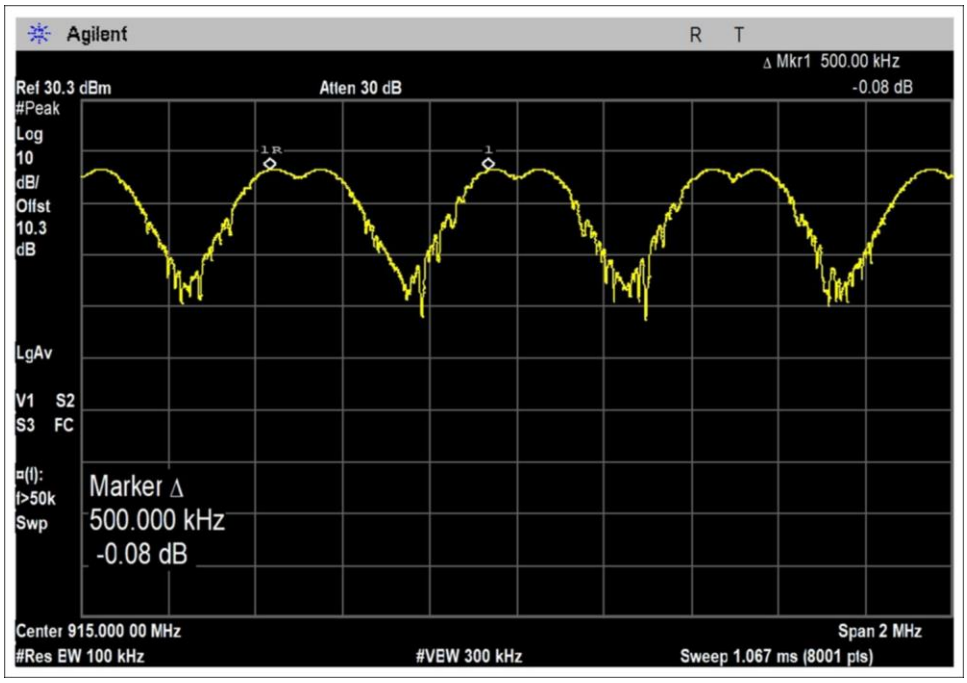
15.247(a)(1) Carrier Separation

Test Data Summary				
Limit applied: 20dB bandwidth of the hopping channel.				
Antenna Port	**Operational Mode**	**Measured (kHz)**	**Limit (kHz)**	**Results**
1	Hopping	500	>182.932	Pass
2	Hopping	500	>182.932	Pass

Plot(s)



Radio1

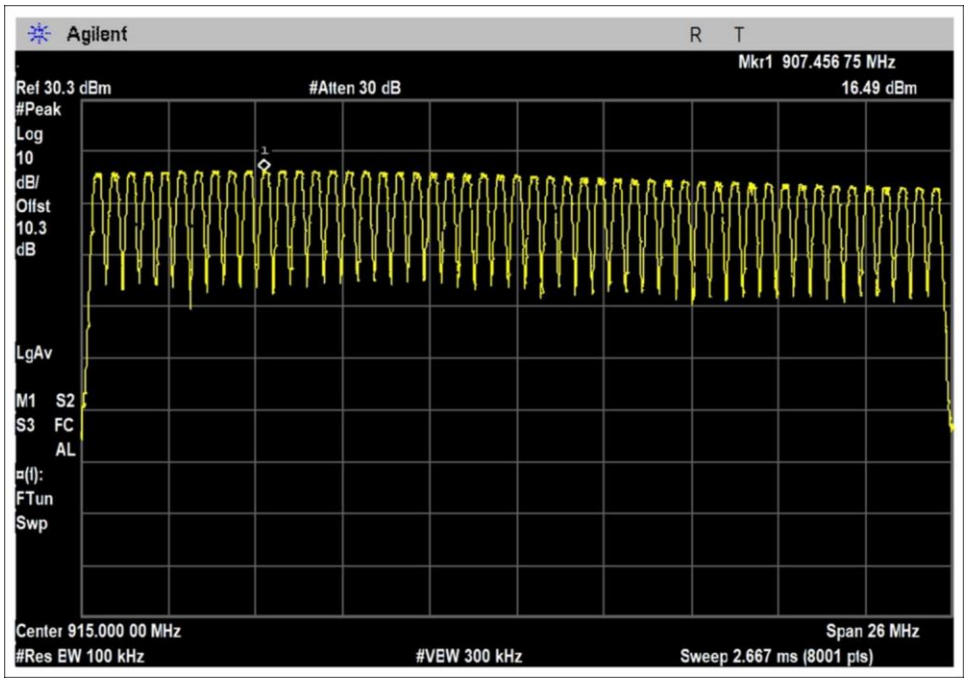

Agilent
R T
Δ Mkr1 500.00 kHz
Ref 30.3 dBm
Atten 30 dB
-0.08 dB
#Peak
Log
10
dB/
Offst
10.3
dB
LgAv
V1 S2
S3 FC
n(f):
f>50k
Swp
Marker Δ
500.000 kHz
-0.08 dB
Center 915.000 00 MHz
Span 2 MHz
#Res EW 100 kHz
#VEW 300 kHz
Sweep 1.067 ms (8001 pts)

Radio2

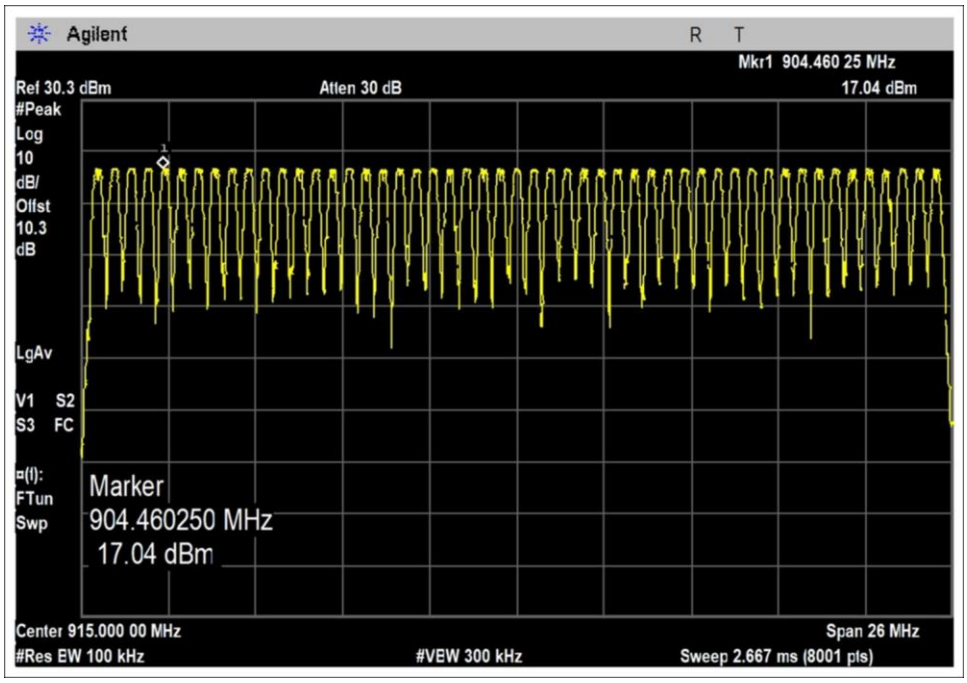
15.247(a)(1)(iii) Number of Hopping Channels

Test Data Summary				
$Limit = \begin{cases} 50\ Channels \mid 20\ dB\ BW < 250kHz \\ 25\ Channels \mid 20\ dB\ BW \geq 250kHz \end{cases}$				
Antenna Port	**Operational Mode**	**Measured (Channels)**	**Limit (Channels)**	**Results**
1	Hopping	51	≥50	Pass
2	Hopping	51	≥50	Pass

Plot(s)



Radio1


Agilent
R T
Mkr1 904.460 25 MHz
Ref 30.3 dBm
Atten 30 dB
17.04 dBm
#Peak
Log
10
dB/
Offst
10.3
dB
LgAv
V1 S2
S3 FC
n(f):
FTun
Swp
Marker
904.460250 MHz
17.04 dBm
Center 915.000 00 MHz
Span 26 MHz
#Res EW 100 kHz
#VEW 300 kHz
Sweep 2.667 ms (8001 pts)

Radio2

15.247(a)(1)(iii) Time of Occupancy

Test Data Summary				
Observation Period, P_{obs} is derived from the following: $P_{Obs} = \begin{cases} 20\ Seconds & 20\ dB\ BW < 250kHz \\ 10\ Seconds & 20\ dB\ BW \geq 250kHz \end{cases}$				
Antenna Port	**Operational Mode**	**Measured (ms)**	**Limit (ms/P_{obs})**	**Results**
1*	Hopping	386.4	≤400	Pass

*Note: Both antenna ports tested; worst case results reported.

Measured results are calculated as follows:

$$Dwell\ time = \left(\sum_{Bursts} RF\ Burst\ On\ Time + \sum_{Control} Control\ Signal\ On\ time \right)\Bigg|_{P_{obs}}$$

Actual Calculated Values:

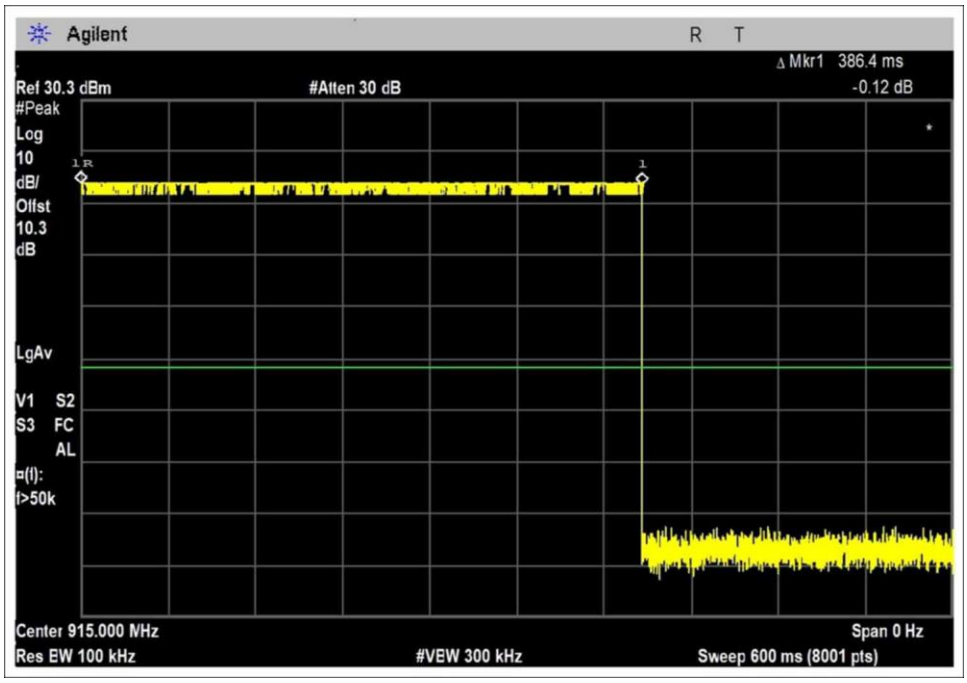
Parameter	Value
Observation Period (P_{obs}):	20 s**
Number of RF Bursts / P_{obs}:	1
On time of RF Burst:	386.4mS
Number of Control or other signals / P_{obs}:	0
On time of Control or other Signals:	0
Total Measured On Time:	386.4 mS

**Note: The plots below utilize a 30 second span to demonstrate the silent period between successive RF bursts is greater than 20 seconds. Therefore, only one RF burst occurs in any 20 second period.

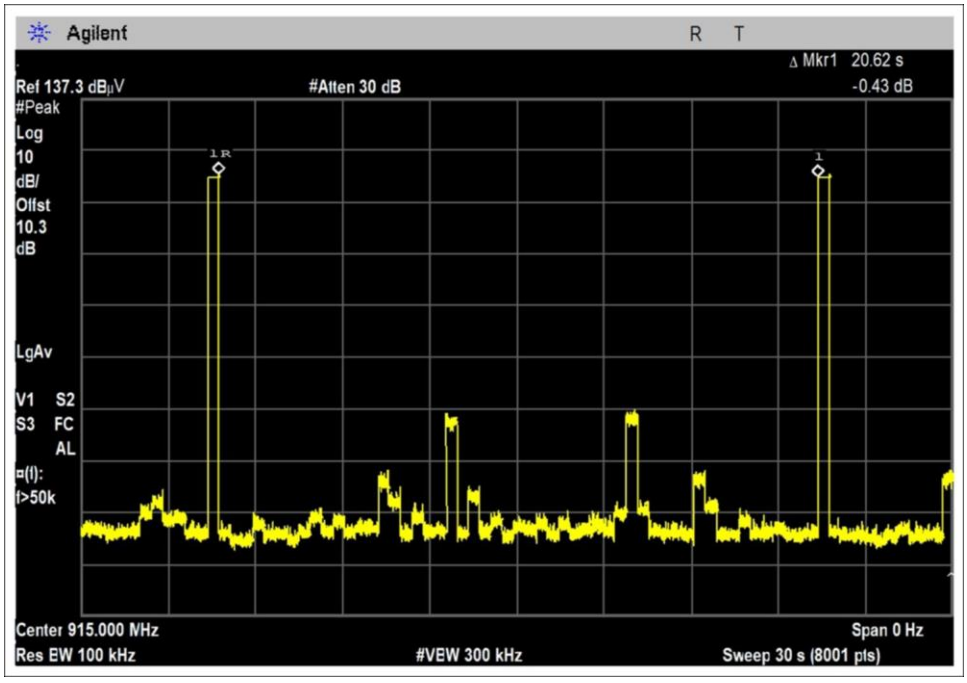
The manufacturer declares the maximum number of RF bursts on a single channel in any 20 second period is 1.

The manufacturer declares the RF bursts are constant power; intermediate RF bursts on the plot <30dBc are from adjacent channels.

Plot(s)



Dwell Time



Average Time of Occupancy

Test Setup Photo(s)

15.247(b)(1) Output Power

Test Setup/Conditions			
Test Location:	Mariposa Lab A	Test Engineer:	Benny Lovan
Test Method:	ANSI C63.10 (2013)	Test Date(s):	07/25/19 – 07/31/19
Configuration:	1		
Test Setup:	The EUT was placed on a non-conductive table. The antenna port for Radio 2 was connected directly to the spectrum analyzer through 10dB of attenuation. Then, the measurement cable was connected to antenna Port 1 for Radio 1 and the measurements were repeated. Radio 1 = Radio with Band Pass Filter Radio 2 = Radio without Band Pass Filter The radio was setup in the determined worse case condition with the highest power setting and rate 6. Power Setting 31 = 20dBm Rate Setting 6 = 55.555 kbps		

Environmental Conditions			
Temperature (ºC)	21	Relative Humidity (%):	42

Test Equipment					
Asset#	**Description**	**Manufacturer**	**Model**	**Cal Date**	**Cal Due**
03357	Cable	Astrolab	32022-2-29094K-36TC	3/14/2019	3/14/2021
03470	Spectrum Analyzer	Agilent	E4440A	5/2/2019	5/2/2021
P07365	Attenuator	Weinschel	54A-10	3/26/2019	3/26/2021

Test Data Summary - Voltage Variations					
Frequency (MHz)	**Modulation / Ant Port**	**$V_{Minimum}$ (dBm)**	**$V_{Nominal}$ (dBm)**	**$V_{Maximum}$ (dBm)**	**Max Deviation from $V_{Nominal}$ (dB)**
902.5	FSK/External Port 1	16.18	16.19	16.19	0.01
915	FSK/External Port 1	15.89	15.88	15.89	0.01
927.5	FSK/External Port 1	13.50	13.50	13.50	0.01
902.5	FSK/External Port 2	17.17	17.17	17.16	0.01
915	FSK/External Port 2	17.03	17.04	17.05	0.02
927.5	FSK/External Port 2	17.08	17.06	17.06	0.02

Test performed using operational mode with the highest output power, representing worst case.

Parameter Definitions:

Measurements performed at input voltage Vnominal ± 15%.

Parameter	Value
$V_{Nominal}$:	13 VDC
$V_{Minimum}$:	11.05 VDC
$V_{Maximum}$:	14.95 VDC

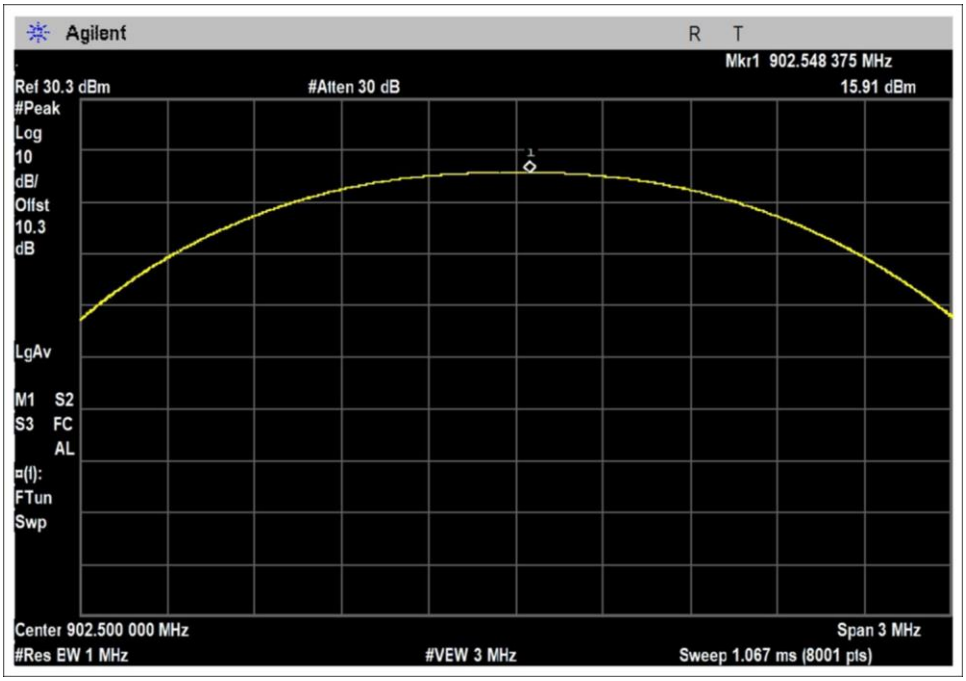
Note: The equipment is battery operated with a solar charger attached. The test is performed with a simulated fully charged battery. The equipment automatically regulated maximum battery input voltage to a maximum of 13.0 VDC while not charging. The transmitter operates at a voltage of 3.3 VDC from a secondary regulator.

Test Data Summary - RF Conducted Measurement

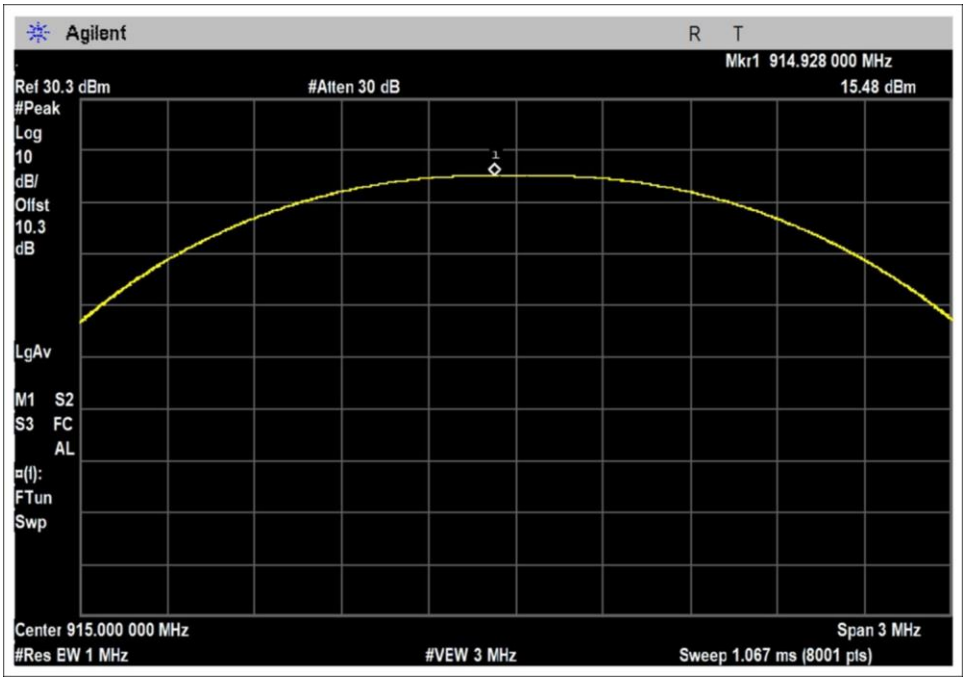
$Limit = \begin{cases} 30dBm\ Conducted/36dBm\ EIRP \mid \geq 50\ Channels \\ 24dBm\ Conducted/30dBm\ EIRP \mid < 50\ Channels\ (\min 25) \end{cases}$

Frequency (MHz)	Modulation	Ant. Type / Gain (dBi)	Measured (dBm)	Limit (dBm)	Results
902.5	FSK/External Port 1	Omni / 2.5dBi Omni / 6dBi Sector / 11dBi	15.91	≤25	Pass
915	FSK/External Port 1	Omni / 2.5dBi Omni / 6dBi Sector / 11dBi	15.48	≤25	Pass
927.5	FSK/External Port 1	Omni / 2.5dBi Omni / 6dBi Sector / 11dBi	13.06	≤25	Pass
902.5	FSK/External Port 2	Omni / 2.5dBi Omni / 6dBi Sector / 11dBi	16.87	≤25	Pass
915	FSK/External Port 2	Omni / 2.5dBi Omni / 6dBi Sector / 11dBi	16.72	≤25	Pass
927.5	FSK/External Port 2	Omni / 2.5dBi Omni / 6dBi Sector / 11dBi	16.74	≤25	Pass

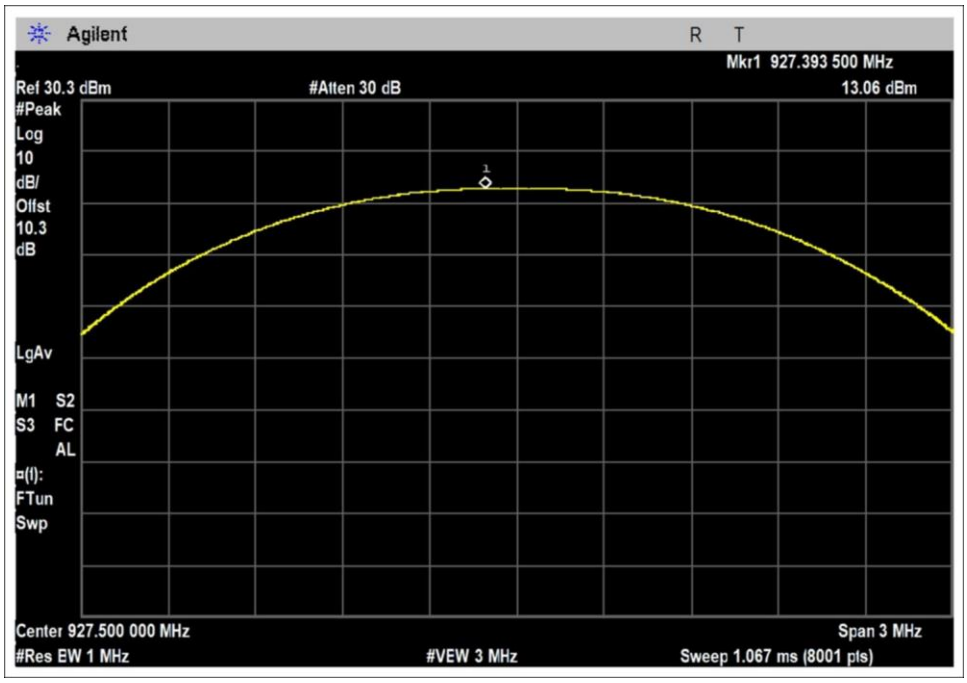
Plots



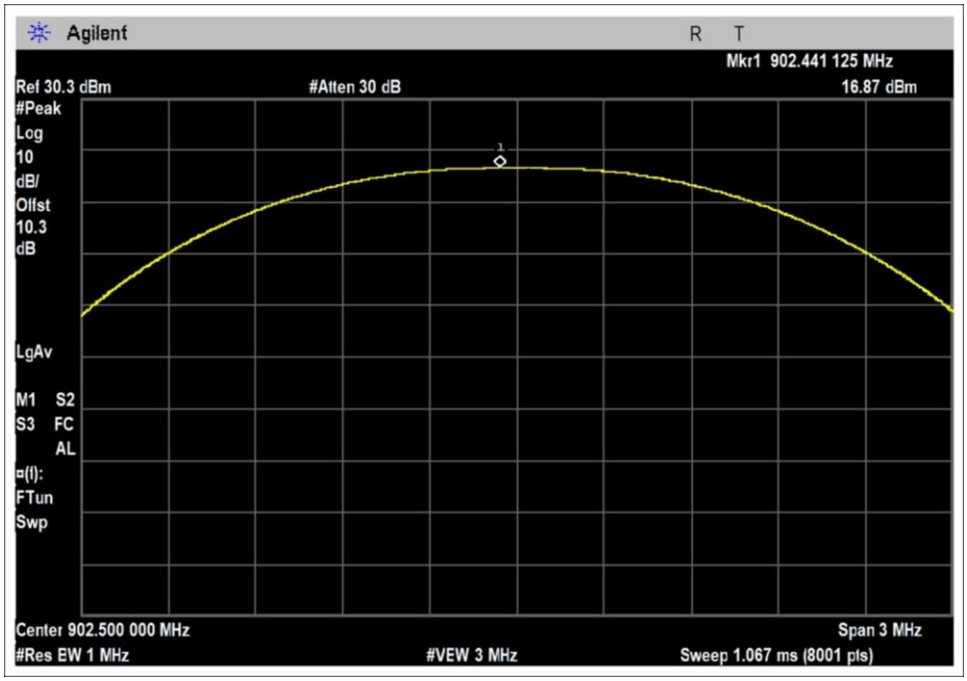
Low Channel Radio1



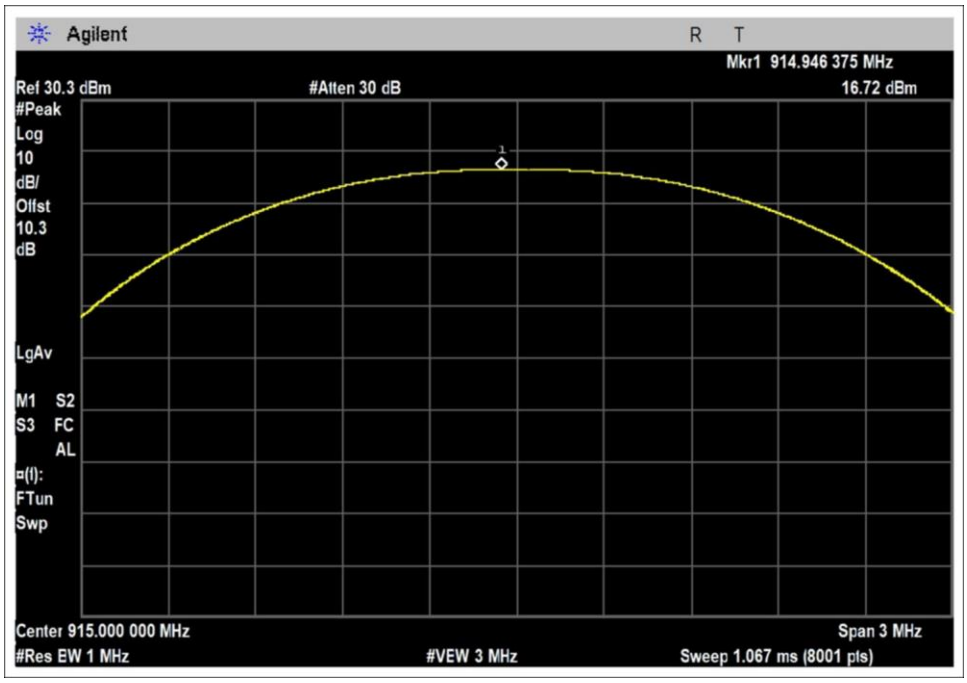
Middle Channel Radio1



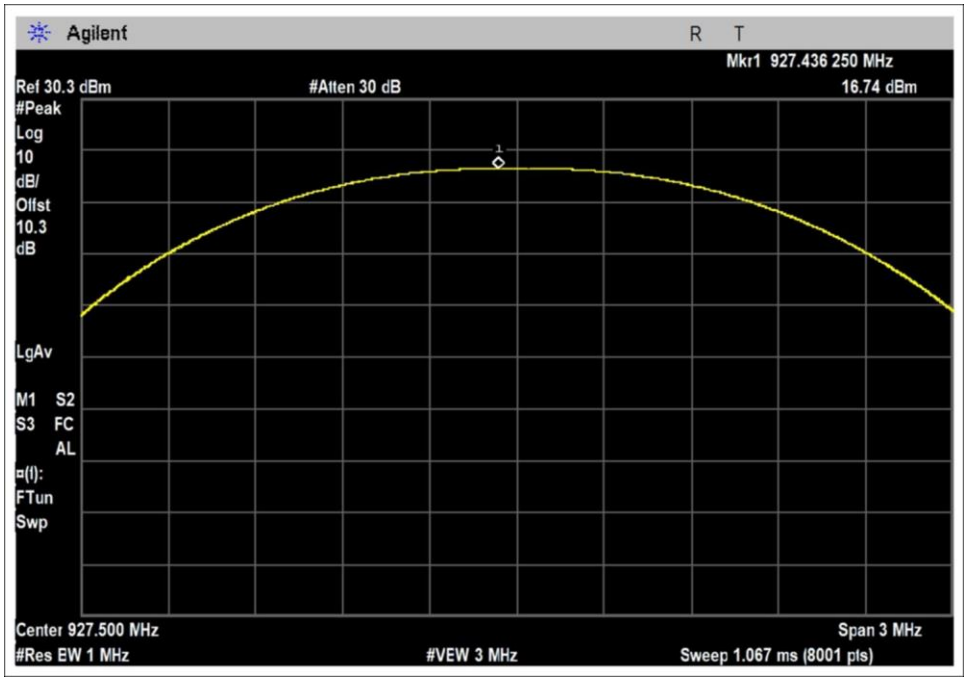
High Channel Radio1



Low Channel Radio2



Middle Channel Radio2



High Channel Radio2

Test Setup Photo(s)