902-928 MHz Radio Test Report
FHSS/HYBRID

For
CGM-WPAN-OFDM-FCC in CGR1240/K9
FSK/OQPSK/OFDM
802.15.4g/e

FCC ID: LDK-CGMOFDM
IC ID: 2461N-CGMOFDM

Against the following Specifications:
47 CFR 15.247
47 CFR 15.209
47 CFR 15.205
47 CFR 15.207
RSS 247 Issue 2

Cisco Systems
EMC Laboratory
170 West Tasman Drive
San Jose, CA 95134

ACCREDITED

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Title: See EDCS
Revision: See EDCS

This report replaces any previously entered test report under EDCS – 12438497. This test report has been electronically authorized and archived using the CISCO Engineering Document Control system. Test Report Template EDCS# 11377496

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Section 1: Overview

1.1 Test Summary

The samples were assessed against the tests detailed in section 3 under the requirements of the following specifications:

Specifications
FCC 15.247 RSS 247 Issue 2 RSS Gen Issue 4

Notes: Measurements were made in accordance with FCC Public Notice #: DA 00-0705 & ANSI C63.10:2013.

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Section 2: Assessment Information

2.1 General

This report contains an assessment of an apparatus against Radio Standards based upon tests carried out on the samples submitted. The testing was performed by and for the use of Cisco systems Inc:

With regard to this assessment, the following points should be noted:

a) The results contained in this report relate only to the items tested and were obtained in the period between the date of the initial assessment and the date of issue of the report. Manufactured products will not necessarily give identical results due to production and measurement tolerances.

b) The apparatus was set up and exercised using the configuration and modes of operation defined in this report only.

c) Where relevant, the apparatus was only assessed using the susceptibility criteria defined in this report and the Test Assessment Plan (TAP).

d) All testing was performed under the following environmental conditions:

Temperature	10°C to 40°C (50°F to 104°F)
Atmospheric Pressure	860mbar to 1060mbar (25.4" to 31.3")
Humidity	10% to 90%

e) All AC testing was performed at one or more of the following supply voltages:
110V 60 Hz (+/-20%)

2.2 Units of Measurement

The units of measurements defined in the appendices are reported in specific terms, which are test dependent. Where radiated measurements are concerned these are defined at a particular distance. Basic voltage measurements are defined in units of [dBuV]

As an example, the basic calculation for all measurements is as follows:

Emission level [dBuV] = Indicated voltage level [dBuV] + Cable Loss [dB] + Other correction factors [dB]

The combinations of correction factors are dependent upon the exact test configurations [see test equipment lists for further details] and may include:-

Antenna Factors, Pre Amplifier Gain, LISN Loss, Pulse Limiter Loss and Filter Insertion Loss..

Note: to convert the results from dBuV/m to uV/m use the following formula:-

Level in uV/m = Common Antilogarithm [(X dBuV/m)/20] = Y uV/m

Measurement Uncertainty Values

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voltage and power measurements	± 2 dB
conducted EIRP measurements	± 1.4 dB
radiated measurements	± 3.2 dB
frequency measurements	± 2.4 10-7
temperature measurements	± 0.54º.
humidity measurements	± 2.3%
DC and low frequency measurements	± 2.5%.

Where relevant measurement uncertainty levels have been estimated for tests performed on the apparatus. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Radiated emissions (expanded uncertainty, confidence interval 95%)

30 MHz - 300 MHz	+/- 3.8 dB
300 MHz - 1000 MHz	+/- 4.3 dB
1 GHz - 10 GHz	+/- 4.0 dB
10 GHz - 18GHz	+/- 8.2 dB
18GHz - 26.5GHz	+/- 4.1 dB
26.5GHz - 40GHz	+/- 3.9 dB

Conducted emissions (expanded uncertainty, confidence interval 95%)

30 MHz – 40GHz	+/- 0.38 dB

A product is considered to comply with a requirement if the nominal measured value is below the limit line. The product is considered to not be in compliance in case the nominal measured value is above the limit line.

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2.3 Date of testing (initial sample receipt date to last date of testing)

9th Jan 2018 to 15th Feb 2018

2.4 Report Issue Date

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2.5 Testing facilities

This assessment was performed by:

Testing Laboratories

Cisco Systems, Inc.
125 West Tasman Drive (Building P)
San Jose, CA 95134
USA

Headquarters

Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134
USA

Registration Numbers for Industry Canada

Cisco System Site	Address	Site Identifier
Building P, 5m Chamber	125 West Tasman Dr San Jose, CA 95134	Company #: 2461N-1

Test Engineer

Ronak Patel

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2.6 Equipment Assessed (EUT)

CGM-WPAN-OFDM-FCC in CGR1240/K9

2.7 EUT Description

The WPAN module provides IEEE 802.15.4 g/e-compliant, and highly secure wireless connectivity for the Cisco 1000 Series Connected Grid Routers to enable Field Area Network (FAN) applications. The module is ideal for multi-hop mesh networks and long-reach solutions and helps enable a high ratio of endpoints to the Field Area Router (FAR)

CGM is the next generation Field Area Network solution to meet the demands of Smart Grid applications such as distribution automation, distributed generation, renewable energy, PEV charging stations, generic SCADA telemetry applications and water, oil & gas applications.

CGM includes solution requirements such as higher bandwidth, lower latency, higher availability, improved security, fog computing, and Wi-SUN compliance for CG-Mesh.

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Section 3: Result Summary

3.1 Results Summary Table

Basic Standard	Technical Requirements / Details	Result
FCC 15.247 **RSS-247**	**20 dB Bandwidth (2FSK and OQPSK)**: For frequency hopping systems operating in the 902-928 MHz band: The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz **6 dB and 99 % Bandwidth (OFDM)**: 99% OCB is required only for Average Power measurement The minimum 6 dB bandwidth of a DTS transmission shall be at least 500 kHz.	Pass
FCC 15.247 **RSS-247**	**Maximum Peak Conducted Output Power (2FSK and OQPSK)**: For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power **Maximum Peak Conducted Output Power (OFDM)**: For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one-Watt limit can be based on a measurement of the maximum conducted output power	Pass
FCC 15.247 **RSS-247**	**Power Spectral Density (OFDM Modes) :** The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.	Pass
FCC 15.247 **RSS-247**	**Carrier Frequency Separation (2FSK and OQPSK Modes)**: Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater	Pass

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FCC 15.247 **RSS-247**	**Average Time of Occupancy (2FSK and OQPSK Modes)**: For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20-second period. **Average Time of Occupancy (OFDM Modes)**: The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4	Pass
FCC 15.247 **RSS-247**	**Conducted Band-Edge**: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter Demonstrates compliance with the peak conducted power limits	Pass
FCC15.247/15.205 **RSS-Gen 8.10**	**Restricted band**: Unwanted emissions falling within the restricted bands, as defined in FCC 15.205 (a) and RSS-Gen 6.13 must also comply with the radiated emission limits specified in FCC 15.209 (a) and RSS-Gen 8.10	Pass

Radiated Emissions

Basic Standard	Technical Requirements / Details	Result
FCC 15.209 (a) **RSS-Gen 6.13**	**TX Spurious Emissions:** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the filed strength limits table in this section.	Pass

***** MPE calculation is recorded in a separate report

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Section 4: Sample Details

Note: Each sample was evaluated to ensure that its condition was suitable to be used as a test sample prior to the commencement of testing. Please also refer to the "Justification for worst Case test Configuration" section of this report for further details on the selection of EUT samples.

4.1 Sample Details

Sample No.	Equipment Details	Manufacturer	Hardware Rev.	Firmware Rev.	Software Rev.	Serial Number
S01	CGM-WPAN-OFDM-FCC	Cisco Systems, Inc.	01	6.0.1	6.0.1	49-00-4B-00-05-51-36-32

4.2 System Details

Sample No.	Description	Samples
1	S01	Conducted and Radiated Testing

4.3 Antenna Information

The following antennas are supported by this product series.

Antenna	Frequency (MHz)	Peak gain (dBi)	Radiation pattern	Connector	Mounting	Mechanical specifications
ANT-MP2-I-OUT-M	863 – 928	2.6	Omnidirectional dipole, 84° vertical HPBW	N(m)	Direct connection to N(f) bulkhead adapter or lightning arrestor	7.7" long, 1.02" diameter IP67 -40 to +85°C operating
ANT-LPWA-DB-O-N-5	863 - 928	5.6	Omnidirectional collinear dipole, 24 - 28° vertical HPBW	N(m)	Direct connection to N(f) bulkhead adapter or lightning arrestor	28" long, 1" diameter IP67 -40 to +70° C operating

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4.3 Mode of Operation Details

Mode#	Description	Comments
1	Mgmtserialtest	Mgmtserialtest version allows to do conducted and Radiated testing at antenna port of EUT. Image version : 6.0.1

4.4 Test Mode, Modulation and Data Packet Type Description

Test Mode	Modulation Type	Data Rate (kbps)	Chanel Spacing (kHz)	No of Channels	Mode
A	2FSK	50	200	129	64
B	2FSK	50	200	129	96
C	2FSK	150	400	64	66
D	2FSK	150	400	64	98
E	O-QPSK	6.25	200	129	192
F	OFDM	50	800	31	144
G	OFDM	200	800	31	146
H	OFDM	400	800	31	147
I	OFDM	800	800	31	149
J	OFDM	1200	800	31	150

Note 1: 2FSK and O-QPSK Operates as Frequency Hopping Spread Spectrum Modulations
Note 2: OFDM Operates as Hybrid Modulation (DSSS and FHSS together)
Note 3: The channel spacing is 200 kHz and 400 kHz for 2-FSK at 50 kbps and 150kbps respectively and 800 kHz for OFDM Option 2.

There will be 129 Channels with 200 kHz Channel Spacing for 2FSK and 64 Channels with 400kHz Channel spacing and 31 OFDM RF channels with 800kHz Channel Spacing.

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4.5 Transmit Power versus Channel

Channel 0 through 128			
Mode	**Rate kbps**	**Raw DEC/Hex**	**Pout dBm**
64	50	24/0x18	29
96	50	24/0x18	29
66	150	24/0x18	29
98	150	24/0x18	29
192	6.2	24/0x18	29

OFDM Modes							
Channel 0				**Channel 1 thru 31**			
Mode	**Rate kbps**	**Raw DEC/Hex**	**Pout dBm**	**Mode**	**Rate kbps**	**Raw Dec/Hex**	**Pout dBm**
144	50	18/0x12	23	144	50	27/0x1b	28
146	200	18/0x12	23	146	200	27/0x1b	28
147	400	18/0x12	23	147	400	25/0x19	27
149	800	18/0x12	23	149	800	21/0x15	25
150	1200	18/0x12	23	150	1200	18/0x12	23

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Appendix A: Conducted Test Results

Duty Cycle

Duty Cycle Test Requirement
From KDB 558074 D01 DTS Meas Guidance v04

1. All measurements are to be performed with the EUT transmitting at 100 percent duty cycle at its maximum power control level; however, if 100 percent duty cycle cannot be achieved, measurements of duty cycle, x, and maximum-power transmission duration, *T*, are required for each tested mode of operation.

Duty Cycle Test Method
From KDB 558074 D01 DTS Meas Guidance v04

a) A diode detector and an oscilloscope that together have sufficiently short response time to permit accurate measurements of the on- and off-times of the transmitted signal.
b) The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on- and off-times of the transmitted signal.

1) Set the center frequency of the instrument to the center frequency of the transmission.
2) Set RBW ≥ OBW if possible; otherwise, set RBW to the largest available value.
3) Set detector = peak or average.
4) The zero-span measurement method shall not be used unless both RBW and VBW are > 50/T and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if T ≤ 16.7 microseconds.)

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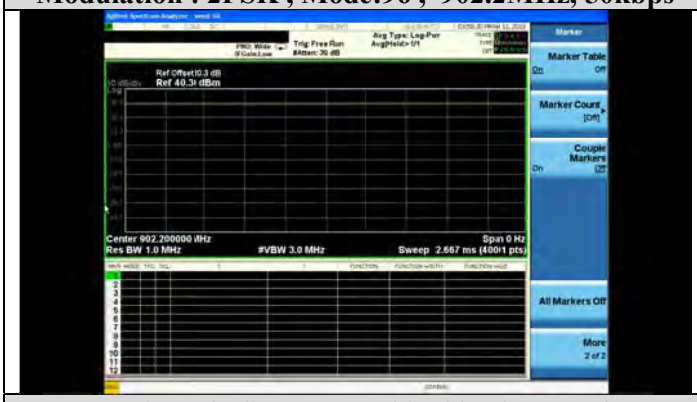
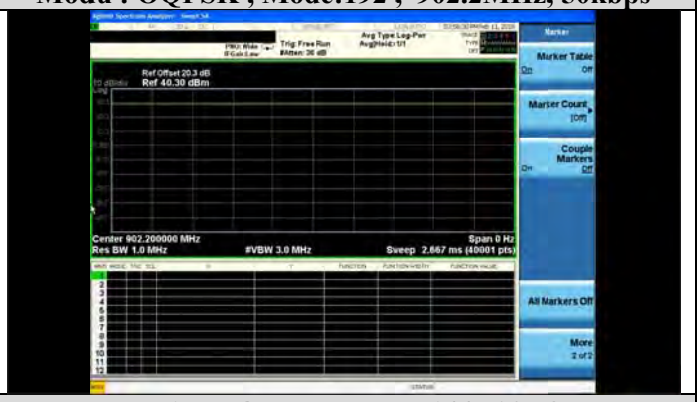
Duty Cycle Plots

Duty Cycle Results	
Modulation : 2FSK , Mode:64 , 902.2MHz, 50kbps	**Modulation : 2FSK , Mode:98 , 927.6MHz, 50kbps**
	
Modulation : 2FSK , Mode:96 , 902.2MHz, 50kbps	**Modu : OQPSK , Mode:192 , 902.2MHz, 50kbps**
	
Modulation : 2FSK , Mode:66 , 927.6MHz, 50kbps	**Modulation : OFDM , Mode:144, 927.8MHz**
	

Duty Cycle Results

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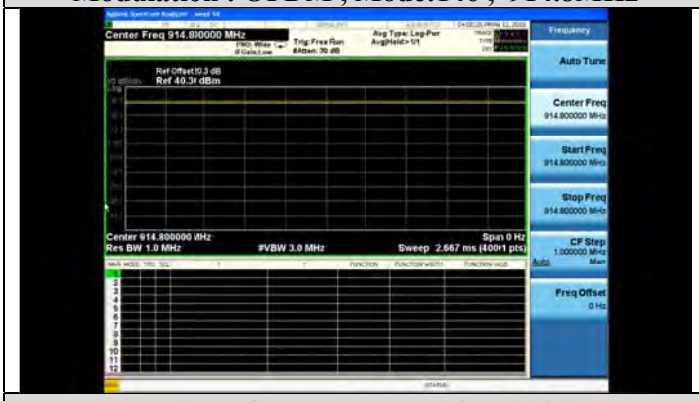
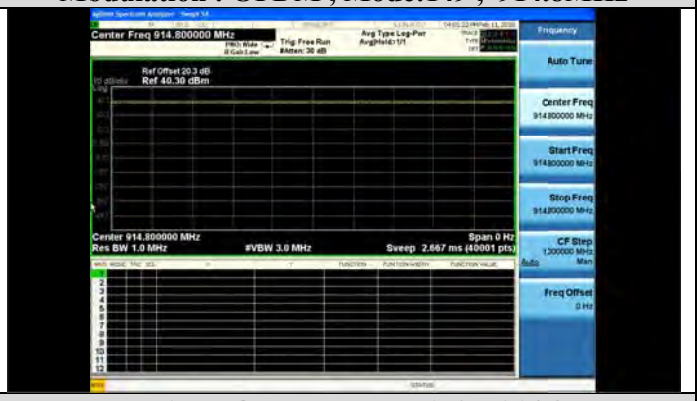
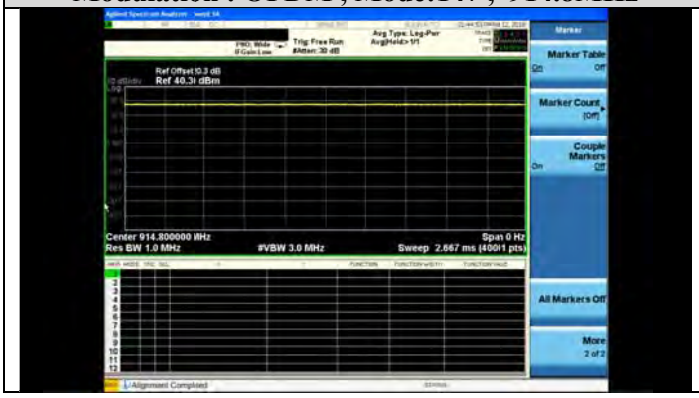
Modulation : OFDM , Mode:146 , 914.8MHz	Modulation : OFDM , Mode:149 , 914.8MHz
	
Modulation : OFDM , Mode:147 , 914.8MHz	**Modulation : OFDM , Mode:150 , 914.8MHz**
	

Duty Cycle is 100% for all modes

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A.1 20dB Bandwidth (2FSK and O-QPSK Modes)

FCC 15.247(a) (1) (i), RSS- 247 5.1(c)
The 20 dB emission bandwidth is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated 20 dB below the maximum in-band spectral density of the modulated signal

A.1.1 Limits

FCC 15.247(a) (1) (i), RSS- 247 5.1(c)
For frequency hopping systems operating in the 902-928 MHz band: The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz

A.1.2 Test Procedure

Refer to Public Notice DA 00-705
Step 1: Edit the spectrum analyzer settings according to the parameters below.

-Center Frequency: frequency under test
-Span: approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
-RBW: ≥ 1% of the 20 dB bandwidth
-VBW: ≥ RBW
- Sweep: Auto Couple
-Ref Level: 10dB (or higher if required)
-Attenuation: 20dB (if required)
-Detector: Peak
- Trace Mode: Max Hold

Step 2: The EUT is set in a transmitter mode at its maximum data rate. Allow the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission. Then use the marker-normal function to place at the 20 dB down on one side of the emission. Reset with the marker-delta function and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. Record data.

Step 3:

- Record the x dB Bandwidth = -20 dB. This value should be in the test report.

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A.1.3 20dB Occupied Bandwidth Data Table

20dB Bandwidth					
Modulation Type	**Phymode**	**Frequency (MHz)**	**Data rate (kbps)**	**Channel Spacing (kHz)**	**20dB BW (kHz)**
2FSK	64	902.2	50	200	110.6
		915.0	50	200	110.2
		927.8	50	200	108.7
2FSK	96	902.2	50	200	109.3
		915.0	50	200	106.6
		927.8	50	200	107.1
2FSK	66	902.4	150	400	191.2
		915.2	150	400	193.6
		927.6	150	400	193.6
2FSK	98	902.4	150	400	190.1
		915.2	150	400	190.1
		927.6	150	400	192.5
O-QPSK	192	902.2	6.25	200	128.7
		915.0	6.25	200	129.1
		927.8	6.25	200	129.5

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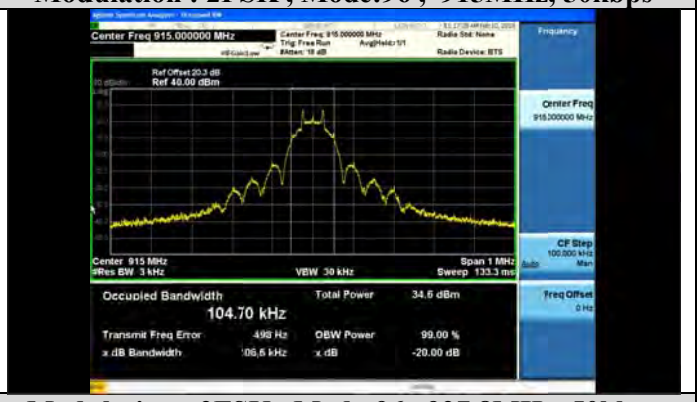
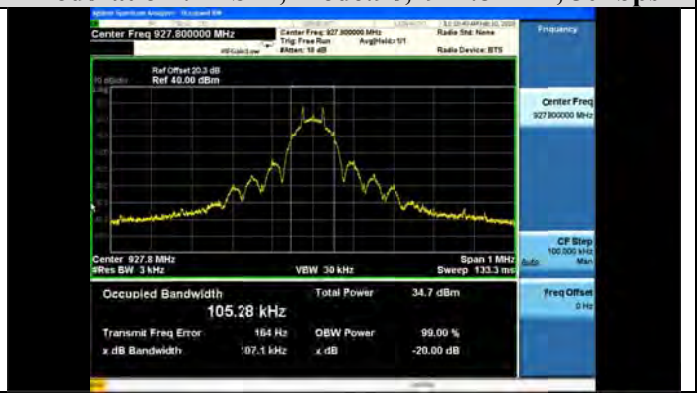
A.1.4 20dB Occupied Bandwidth Graphical Test Results (2FSK and OQPSK Modes)

20dB Ocuupied Bandwidth Results	
Modulation : 2FSK , Mode:64 , 902.2MHz, 50kbps	**Modulation : 2FSK , Mode:96 , 902.2MHz, 50kbps**
	
Modulation : 2FSK , Mode:64 , 915MHz, 50kbps	**Modulation : 2FSK , Mode:96 , 915MHz, 50kbps**
	
Modulation : 2FSK , Mode:64 , 927.8MHz, 50kbps	**Modulation : 2FSK , Mode:96, 927.8MHz, 50kbps**
	

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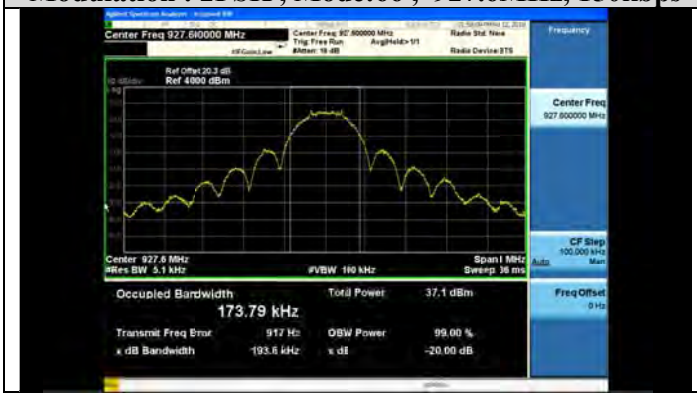
20dB Ocuupied Bandwidth Results	
Modulation : 2FSK , Mode:66 , 902.4MHz, 150kbps	**Modulation : 2FSK , Mode:98 , 902.4MHz, 150kbps**
	
Modulation : 2FSK , Mode:66 , 915.2MHz, 150kbps	**Modulation : 2FSK , Mode:98 , 915.2MHz, 150kbps**
	
Modulation : 2FSK , Mode:66 , 927.6MHz, 150kbps	**Modulation : 2FSK , Mode:98, 927.6MHz, 150kbps**
	

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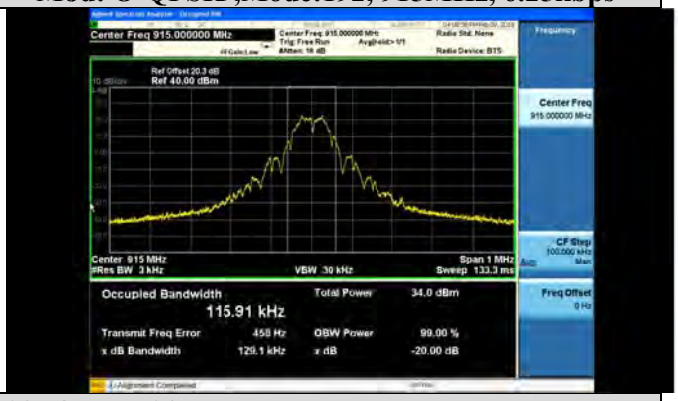
Mod:O-QPSK ,Mode:192,902.2MHz, 6.25kbps	Mod: O-QPSK ,Mode:192, 915MHz, 6.25kbps
	

Mod: O-QPS ,Mode:192,927.8MHz,6.25kbps

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A.1.5 6dB and 99% Occupied Bandwidth (OFDM Modes)

FCC 15.247(a) (2), RSS- 247 5.2(a)

The 99% occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. There is no limit for 99% OBW.

A.1.5.1 Limit

FCC 15.247(a) (2), RSS- 247 5.2(a)

No Limit is Applicable for 99% OCB. 99% OCB is required only for Average Power measurement

The minimum 6 dB bandwidth of a DTS transmission shall be at least 500 kHz.

A.1.5.2 Test Procedure

Refer to ANSI C63.10-2013 Clause 6.9.3

- The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level.
- Peak detection and max hold mode (until the trace stabilizes) shall be used.
- Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

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A.1.5.3 6dB & 99% Occupied Bandwidth Data Table

6dB & 99% Occupied Bandwidth						
Modulation Type	**Phymode**	**Frequency (MHz)**	**Data rate (kbps)**	**Channel Spacing (kHz)**	**99% BW (kHz)**	**6dB BW (kHz)**
OFDM	144	902.8	50	800	612.73	552.6
		914.8			593.39	546.8
		926.8			583.09	553.0
OFDM	146	902.8	200	800	608.94	549.8
		914.8			595.99	553.9
		926.8			579.19	548.4
OFDM	147	902.8	400	800	584.86	552.4
		914.8			576.09	555.0
		926.8			572.17	550.3
OFDM	149	902.8	800	800	607.00	554.4
		914.8			594.16	551.2
		926.8			577.78	550.0
OFDM	150	902.8	1200	800	618.44	552.1
		914.8			587.59	551.0
		926.8			577.01	550.2

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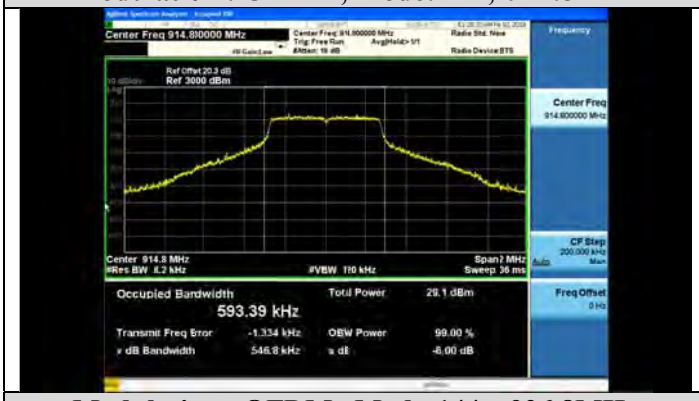
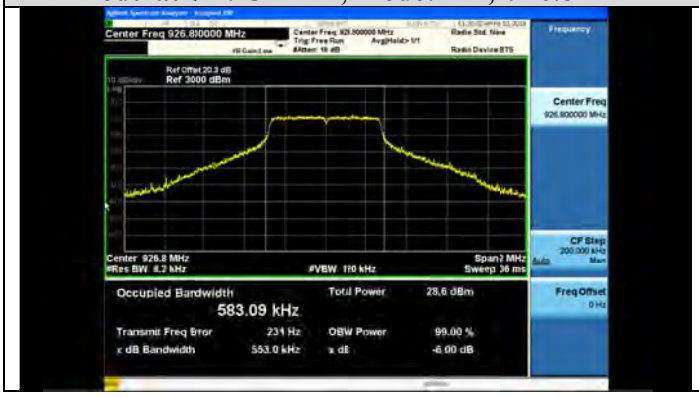
A.1.5.4 6dB & 99% Occupied Bandwidth Graphical Test Results (OFDM Modes)

6dB & 99% Ocuupied Bandwidth Results	
Modulation : OFDM , Mode:144 , 902.8MHz	**Modulation : OFDM , Mode:146 , 902.8MHz**
	
Modulation : OFDM , Mode:144 , 914.8MHz	**Modulation : OFDM , Mode:146 , 914.8MHz**
	
Modulation : OFDM , Mode:144 , 926.8MHz	**Modulation : OFDM, Mode:146, 926.8MHz**
	

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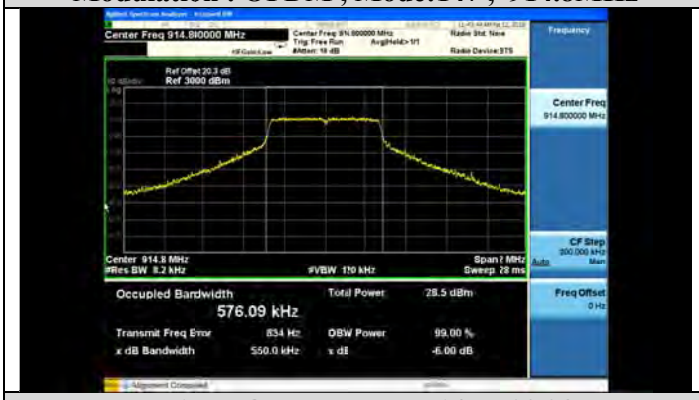
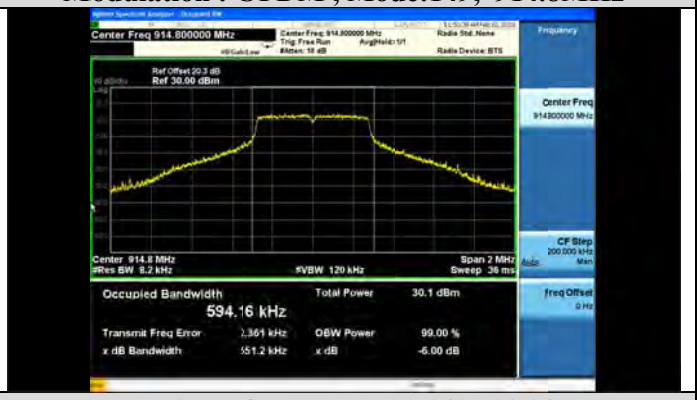
6dB & 99% Ocuupied Bandwidth Results	
Modulation : OFDM , Mode:147 , 902.8MHz	**Modulation : OFDM , Mode:149 , 902.8MHz**
	
Modulation : OFDM , Mode:147 , 914.8MHz	**Modulation : OFDM , Mode:149, 914.8MHz**
	
Modulation : OFDM , Mode:147 , 926.8MHz	**Modulation : OFDM, Mode:149, 926.8MHz**
	

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6dB & 99% Ocuupied Bandwidth Results	
Modulation : OFDM , Mode:150 , 902.8MHz	**Modulation : OFDM , Mode:150 , 914.8MHz**
	
Modulation : OFDM , Mode:150, 926.8MHz	
	

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A.2 Maximum Peak Conducted Output Power (2FSK and OQPSK Modes)

FCC 15.247 (b) (3), RSS 247 5.4 (a)
The maximum peak conducted output power is defined as the maximum power level measured with a peak detector using a filter with width and shape of which is sufficient to accept the signal bandwidth. However, when a filter with adequate width is not available, an integrated method utilizing a peak detector is acceptable.

A.2.1 Limits

FCC 15.247 (b) (3)

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power

RSS 247 5.4 (a)

For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

A.2.3 Test Procedure
Refer to ANSI C63.10 Clause 7.8.5

This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

a) Use the following spectrum analyzer settings:
- Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
- RBW > 20 dB bandwidth of the emission being measured.
- VBW ≥ RBW.
- Sweep: Auto.
- Detector function: Peak.
- Trace: Max hold.

b) Allow trace to stabilize.
c) Use the marker-to-peak function to set the marker to the peak of the emission.
d) The indicated level is the peak output power, after any corrections for external attenuators and cables.
e) A plot of the test results and setup description shall be included in the test report.

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A.2.4 Maximum Peak Conducted Output Power Data Table (2FSK and OQPSK Modes)

Modulation	**2FSK**	**Maximum Peak Conducted Output Power & E.I.R.P**				
Mode	64					
Channel Spacing	200kHz					
Data Rate	50kbps					
Frequency (MHz)	**Peak Conducted Output Power (dBm)**	**Peak Conducted Power Limit (dBm)**	**Antenna Gain (dBi)**	**E.I.R.P (dBm)**	**E.I.R.P Limit (dBm)**	**Result**
902.2	29.067	30	5.6	34.667	36	**Pass**
915.0	28.881	30	5.6	34.481	36	Pass
927.8	28.666	30	5.6	34.266	36	Pass

Modulation	**2FSK**	**Maximum Peak Conducted Output Power & E.I.R.P**				
Mode	96					
Channel Spacing	200kHz					
Data Rate	50kbps					
Frequency (MHz)	**Peak Conducted Output Power (dBm)**	**Peak Conducted Power Limit (dBm)**	**Antenna Gain (dBi)**	**E.I.R.P (dBm)**	**E.I.R.P Limit (dBm)**	**Result**
902.2	**29.074**	**30**	**5.6**	**34.674**	**36**	**Pass**
915.0	28.883	30	5.6	34.483	36	Pass
927.8	28.683	30	5.6	34.283	36	Pass

Note: Worst case mode is determined as the modulation with Highest Output Power.

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Modulation	**2FSK**	**Maximum Peak Conducted Output Power & E.I.R.P**				
Mode	66					
Channel Spacing	400kHz					
Data Rate	150kbps					
Frequency (MHz)	**Peak Conducted Output Power (dBm)**	**Peak Conducted Power Limit (dBm)**	**Antenna Gain (dBi)**	**E.I.R.P (dBm)**	**E.I.R.P Limit (dBm)**	**Result**
902.4	29.172	30	5.6	34.772	36	Pass
915.2	28.903	30	5.6	34.503	36	Pass
927.6	28.617	30	5.6	34.217	36	Pass

Modulation	**2FSK**	**Maximum Peak Conducted Output Power & E.I.R.P**				
Mode	98					
Channel Spacing	400kHz					
Data Rate	150kbps					
Frequency (MHz)	**Peak Conducted Output Power (dBm)**	**Peak Conducted Power Limit (dBm)**	**Antenna Gain (dBi)**	**E.I.R.P (dBm)**	**E.I.R.P Limit (dBm)**	**Result**
902.4	29.107	30	5.6	34.707	36	Pass
915.2	29.027	30	5.6	34.627	36	Pass
927.6	28.588	30	5.6	34.188	36	Pass

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Modulation	**O-QPSK**	**Maximum Peak Conducted Output Power & E.I.R.P**				
Mode	192					
Channel Spacing	200kHz					
Data Rate	6.2kbps					
Frequency (MHz)	**Peak Conducted Output Power (dBm)**	**Peak Conducted Power Limit (dBm)**	**Antenna Gain (dBi)**	**E.I.R.P (dBm)**	**E.I.R.P Limit (dBm)**	**Result**
902.2	29.094	30	5.6	34.694	36	Pass
915.0	28.948	30	5.6	34.548	36	Pass
927.8	28.700	30	5.6	34.300	36	Pass

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A.2.5 Maximum Peak Conducted Output Power Graphical Test Results

Maximum Peak Conducted Power Results	
Modulation : 2FSK , Mode:64 , 902.2MHz	**Modulation : 2FSK , Mode:96 , 902.2MHz**
	
Modulation : 2FSK , Mode:64 , 915MHz	**Modulation : 2FSK , Mode:96 , 915MHz**
	
Modulation : 2FSK , Mode:64 , 927.8MHz	**Modulation : 2FSK , Mode:96, 927.8MHz**
	

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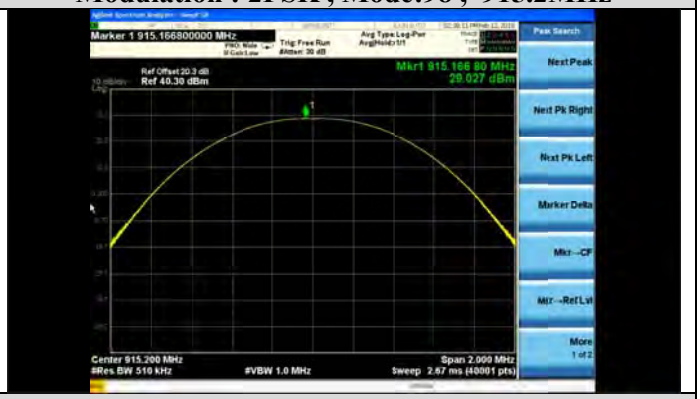
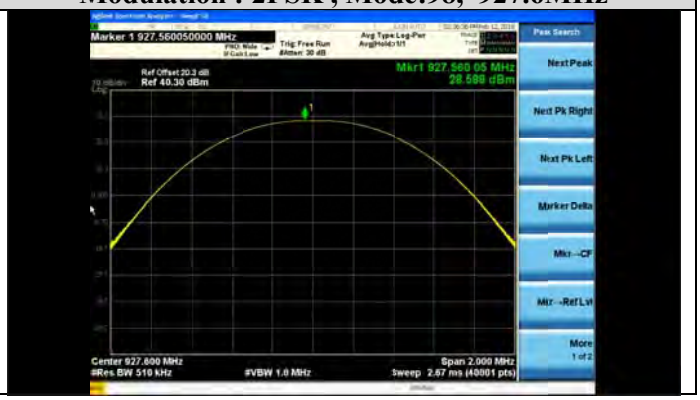
Maximum Peak Conducted Power Results	
Modulation : 2FSK , Mode:66 , 902.4MHz	**Modulation : 2FSK , Mode:98 , 902.4MHz**
	
Modulation : 2FSK , Mode:66 , 915.2MHz	**Modulation : 2FSK , Mode:98 , 915.2MHz**
	
Modulation : 2FSK , Mode:66 , 927.6MHz	**Modulation : 2FSK , Mode:98, 927.6MHz**
	

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Maximum Peak Conducted Power Results	
Modulation : O-QPSK , Mode:192 , 902.2MHz	**Modulation : O-QPSK , Mode:192 , 915MHz**
	
Modulation : O-QPSK, Mode:192, 927.8MHz	
	

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A.2.6 Maximum Conducted Output Power (OFDM Modes)

FCC 15.247 (b) (3), RSS 247 5.4 (d)

The maximum conducted output power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level.

A.2.6.1 Limits

FCC 15.247 (b) (3)

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one-Watt limit can be based on a measurement of the maximum conducted output power

RSS 247 5.4 (d)

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed four Watts

A.2.6.2 Test Procedure

Refer to KDB 558074 D01 DTS Meas Guidance v04 9.2.2.2

(Trace averaging with the EUT transmitting at full power throughout each sweep)

- Set span to at least 1.5 × OBW.
- Set RBW = 1 % to 5 % of the OBW, not to exceed 1 MHz
- Set VBW ≥ 3 × RBW.
- Number of points in sweep ≥ 2 × span / RBW. (This gives bin-to-bin spacing ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
- Sweep time = auto.
- Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
- If transmit duty cycle < 98 %, use a sweep trigger with the level set to enable triggering only on full power pulses. The transmitter shall operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98 %, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to “free run”.
- Trace average at least 100 traces in power averaging **(**i.e., RMS) mode.
- Compute power by integrating the spectrum across the OBW of the signal using the instrument’s band power measurement function, with band limits set equal to the OBW band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW of the spectrum.

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A.2.6.3 Maximum Conducted Output Power Data Table (OFDM Modes)

Modulation	**OFDM**	**Maximum Conducted Output Power & E.I.R.P**				
Mode	144					
Channel Spacing	800kHz					
Data Rate	50kbps					
Frequency (MHz)	**Maximum Conducted Output Power (dBm)**	**Maximum Conducted Power Limit (dBm)**	**Antenna Gain (dBi)**	**E.I.R.P (dBm)**	**E.I.R.P Limit (dBm)**	**Result**
902.8	23.03	30	5.6	28.63	36	Pass
914.8	27.18	30	5.6	32.78	36	Pass
926.8	26.87	30	5.6	32.47	36	Pass

Modulation	**OFDM**	**Maximum Conducted Output Power & E.I.R.P**				
Mode	146					
Channel Spacing	800kHz					
Data Rate	200kbps					
Frequency (MHz)	**Maximum Conducted Output Power (dBm)**	**Maximum Conducted Power Limit (dBm)**	**Antenna Gain (dBi)**	**E.I.R.P (dBm)**	**E.I.R.P Limit (dBm)**	**Result**
902.8	23.03	30	5.6	28.63	36	Pass
914.8	27.12	30	5.6	32.72	36	Pass
926.8	26.85	30	5.6	32.45	36	Pass

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Modulation	**OFDM**	**Maximum Conducted Output Power & E.I.R.P**				
Mode	147					
Channel Spacing	800kHz					
Data Rate	400kbps					
Frequency (MHz)	**Maximum Conducted Output Power (dBm)**	**Maximum Conducted Power Limit (dBm)**	**Antenna Gain (dBi)**	**E.I.R.P (dBm)**	**E.I.R.P Limit (dBm)**	**Result**
902.8	23.25	30	5.6	28.85	36	Pass
914.8	26.46	30	5.6	32.06	36	Pass
926.8	26.08	30	5.6	31.68	36	Pass

Modulation	**OFDM**	**Maximum Conducted Output Power & E.I.R.P**				
Mode	149					
Channel Spacing	800kHz					
Data Rate	800kbps					
Frequency (MHz)	**Maximum Conducted Output Power (dBm)**	**Maximum Conducted Power Limit (dBm)**	**Antenna Gain (dBi)**	**E.I.R.P (dBm)**	**E.I.R.P Limit (dBm)**	**Result**
902.8	23.08	30	5.6	28.68	36	Pass
914.8	24.52	30	5.6	30.12	36	Pass
926.8	24.01	30	5.6	29.61	36	Pass

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Modulation	**OFDM**	**Maximum Conducted Output Power & E.I.R.P**				
Mode	150					
Channel Spacing	800kHz					
Data Rate	1200kbps					
Frequency (MHz)	**Maximum Conducted Output Power (dBm)**	**Maximum Conducted Power Limit (dBm)**	**Antenna Gain (dBi)**	**E.I.R.P (dBm)**	**E.I.R.P Limit (dBm)**	**Result**
902.8	23.10	30	5.6	28.70	36	Pass
914.8	22.58	30	5.6	28.18	36	Pass
926.8	21.97	30	5.6	27.57	36	Pass

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A.2.6.4 Maximum Conducted Output Power Graphical Test Results (OFDM Modes)

Maximum Conducted Power Results	
Modulation : OFDM , Mode:144 , 902.8MHz	**Modulation : OFDM , Mode:146 , 902.8MHz**
	
Modulation : OFDM , Mode:144 , 914.8MHz	**Modulation : OFDM , Mode:146 , 914.8MHz**
	
Modulation : OFDM , Mode:144 , 926.8MHz	**Modulation : OFDM, Mode:146, 926.8MHz**
	

Maximum Conducted Power Results Results	
Modulation : OFDM , Mode:147 , 902.8MHz	**Modulation : OFDM , Mode:149 , 902.8MHz**

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Modulation : OFDM , Mode:147 , 914.8MHz

Modulation : OFDM , Mode:149, 914.8MHz

Modulation : OFDM , Mode:147 , 926.8MHz

Modulation : OFDM, Mode:149, 926.8MHz

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Maximum Conducted Power Results	
Modulation : OFDM , Mode:150 , 902.8MHz	**Modulation : OFDM , Mode:150 , 914.8MHz**
	
Modulation : OFDM , Mode:150, 926.8MHz	
	

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A.3 Power Spectral Density (OFDM Modes)

FCC 15.247(f); RSS-247 5.3(b)
The Power Spectral Density is the total energy output per unit bandwidth from a pulse or sequence of pulses for which the transmit power is at its maximum level, divided by the total duration of the pulses, This total time does not include the time between pulses during which the transmit power is off or below its maximum level.

A.3.1 Limits

FCC 15.247(f); RSS-247 5.3(b)

The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

A.3.2 Test Procedure

Ref. KDB 558074 DTS Meas Guidance v04 section 10.3

- Set instrument center frequency to DTS channel center frequency.
- Set span to at least 1.5 × OBW.
- Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
- Set VBW ≥ 3 × RBW.
- Detector = power averaging (RMS) or sample detector (when RMS not available).
- Ensure that the number of measurement points in the sweep ≥ 2 × span/RBW. g) Sweep time = auto couple.
- Employ trace averaging (RMS) mode over a minimum of 100 traces.
- Use the peak marker function to determine the maximum amplitude level

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A.3.3 Power Spectral Density Data Table

Power Spectral Density Table						
Modulation Type	**Phymode**	**Frequency (MHz)**	**Data rate (kbps)**	**Channel Spacing (kHz)**	**PSD (dBm/kHz)**	**PSD Limit (8dBm/3kHz)**
OFDM	144	902.8	50	800	2.689	8dBm/3kHz
		914.8			6.770	8dBm/3kHz
		926.8			6.316	8dBm/3kHz
OFDM	146	902.8	200	800	2.206	8dBm/3kHz
		914.8			6.673	8dBm/3kHz
		926.8			6.268	8dBm/3kHz
OFDM	147	902.8	400	800	2.723	8dBm/3kHz
		914.8			5.902	8dBm/3kHz
		926.8			5.562	8dBm/3kHz
OFDM	149	902.8	800	800	2.432	8dBm/3kHz
		914.8			4.165	8dBm/3kHz
		926.8			3.510	8dBm/3kHz
OFDM	150	902.8	1200	800	2.385	8dBm/3kHz
		914.8			2.079	8dBm/3kHz
		926.8			1.595	8dBm/3kHz

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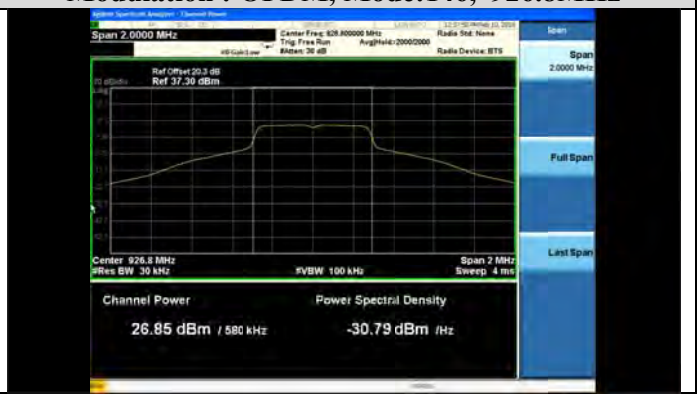
A.3.4 Power Spectral Density Graphical test results (OFDM Modes)

Power Spectral Density Results	
Modulation : OFDM , Mode:144 , 902.8MHz	**Modulation : OFDM , Mode:146 , 902.8MHz**
	
Modulation : OFDM , Mode:144 , 914.8MHz	**Modulation : OFDM , Mode:146 , 914.8MHz**
	
Modulation : OFDM , Mode:144 , 926.8MHz	**Modulation : OFDM, Mode:146, 926.8MHz**
	

Power Spectral Density Results	
Modulation : OFDM , Mode:147 , 902.8MHz	**Modulation : OFDM , Mode:149 , 902.8MHz**

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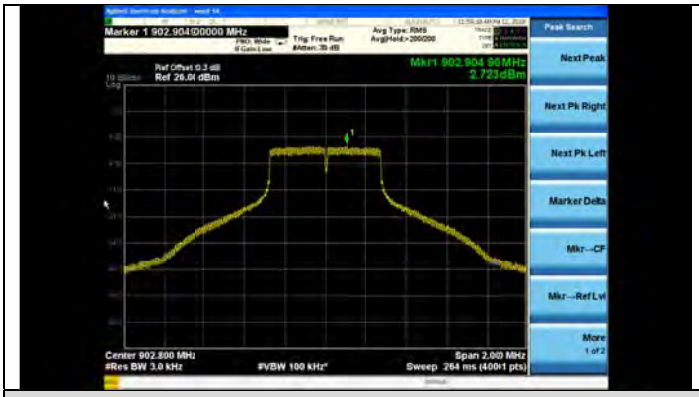
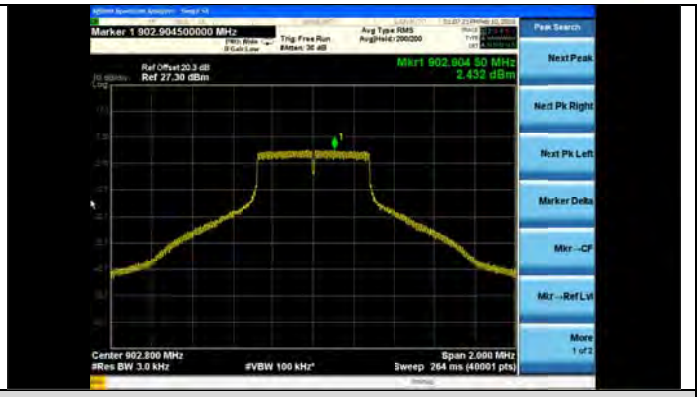


Modulation : OFDM , Mode:147 , 914.8MHz



Modulation : OFDM , Mode:149, 914.8MHz

Modulation : OFDM , Mode:147 , 926.8MHz

Modulation : OFDM, Mode:149, 926.8MHz

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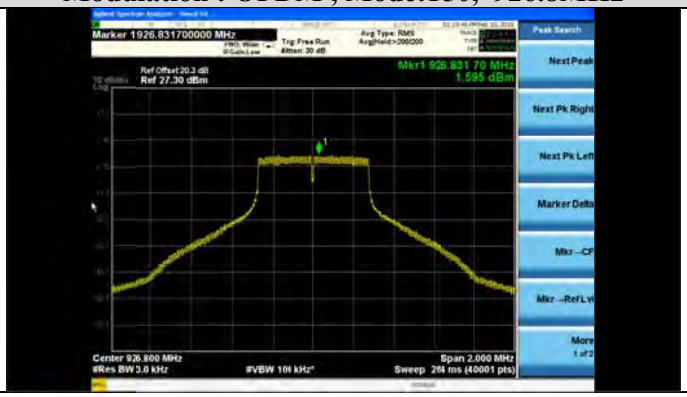
Power Spectral Density Results	
Modulation : OFDM , Mode:150 , 902.8MHz	**Modulation : OFDM , Mode:150 , 914.8MHz**
	
Modulation : OFDM , Mode:150, 926.8MHz	
	

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A.4 Carrier Frequency Separation

A.4.1 Limits

FCC 15.247(a) (1) & & RSS-247 5.1(b)
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater

A.4.2 Test Procedure

Refer ANSI C63.10 Section 7.8.2
The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

- Span: Wide enough to capture the peaks of two adjacent channels.
- RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
- Video (or average) bandwidth (VBW) ≥ RBW.
- Sweep: Auto.
- Detector function: Peak.
- Trace: Max hold.
- Allow the trace to stabilize.

Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

A.4.3 Carrier Frequency Separation Data Table

Frequency (MHz)	Modulation Systems	Phymode	Carrier Frequency Separation (kHz)	Limits (kHz) 20db BW	Results
914.0 & 913.8	2FSK	64	200.055	110	Pass
914.0 & 914.2	2FSK	96	199.905	106	Pass
915.4 & 914.8	2FSK	66	399.525	193	Pass
915.4 & 914.8	2FSK	98	400.425	194	Pass
914.0 & 914.2	OQPSK	192	199.995	129	Pass
914.8 & 915.6	OFDM	144	726.225	553	Pass
914.8 & 915.6	OFDM	146	786.450	553	Pass
914.0 & 914.8	OFDM	147	768.525	550	Pass
914.8 & 915.6	OFDM	149	891.600	551	Pass
902.8 & 903.6	OFDM	150	939.375	550	Pass

A.4.4 Carrier Frequency Separation Graphical Results

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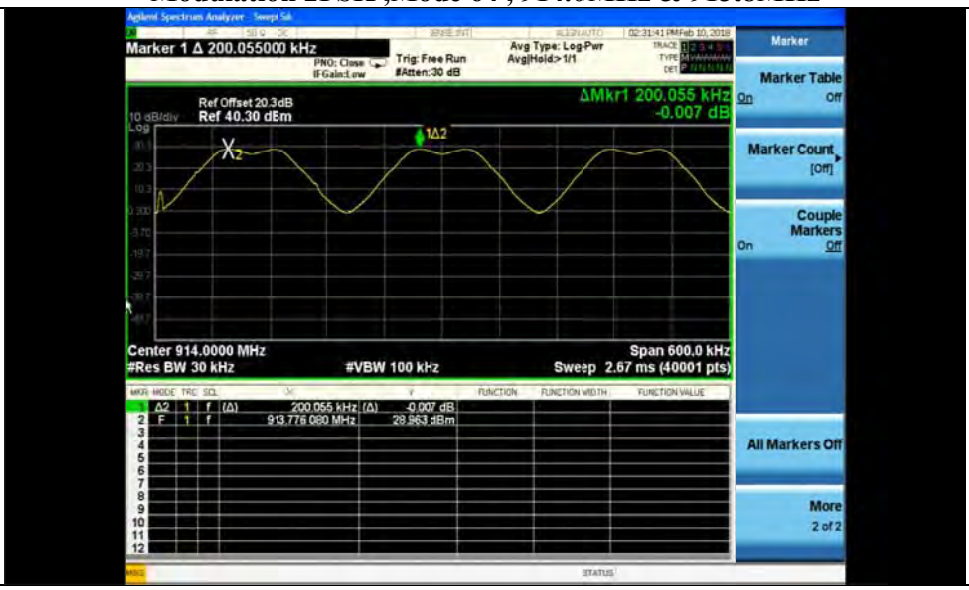
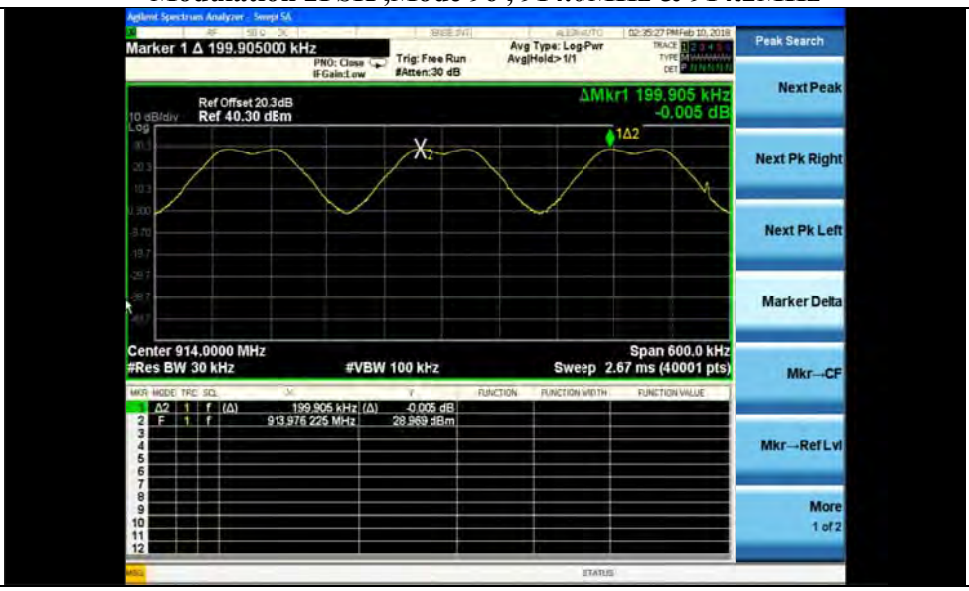
Modulation 2FSK ,Mode 64 , 914.0MHz & 913.8MHz

Modulation 2FSK ,Mode 96 , 914.0MHz & 914.2MHz


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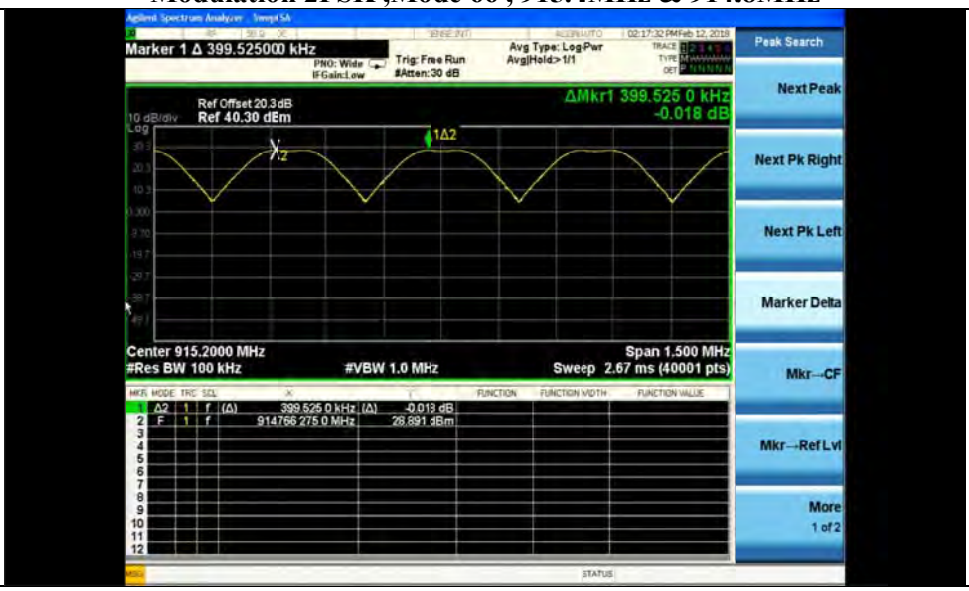
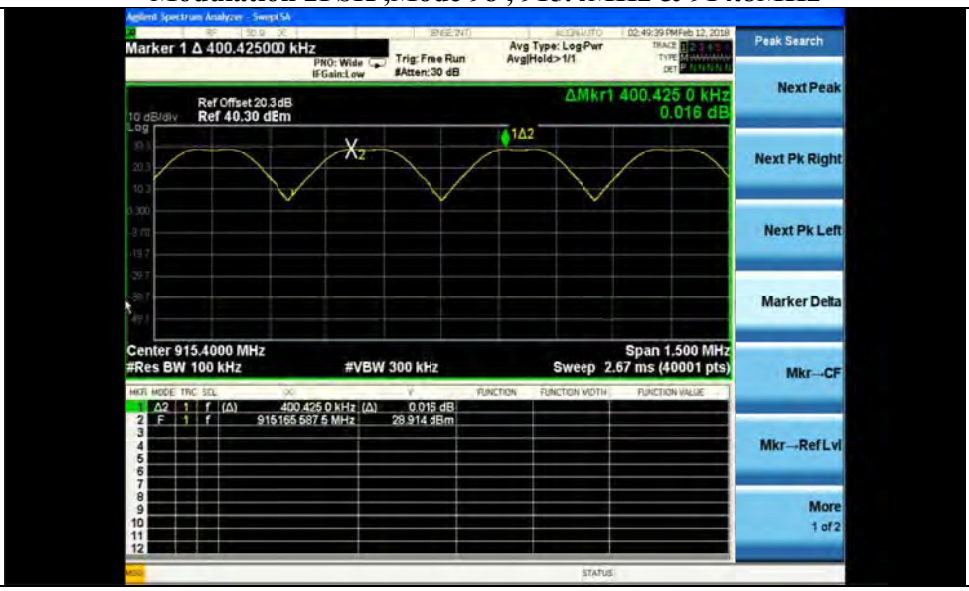
Modulation 2FSK ,Mode 66 , 915.4MHz & 914.8MHz

Modulation 2FSK ,Mode 98 , 915.4MHz & 914.8MHz


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Modulation O-QPSK ,Mode 192 , 914.0MHz & 914.2MHz

Modulation OFDM ,Mode 144 , 914.8MHz & 915.6MHz


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Modulation OFDM ,Mode 146 , 914.8MHz & 915.6MHz

Modulation OFDM ,Mode 147 , 914.8MHz & 915.6MHz

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Modulation OFDM ,Mode 149 , 914.8MHz & 915.6MHz

Modulation OFDM ,Mode 150 , 902.0MHz & 902.8Hz


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A.5 Number of Hopping Frequencies (2FSK and O-QPSK Modes)

A.5.1 Limits

FCC 15.247(a) (1) (i) & RSS-247 (5.1) (c)

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies

A.5.2 Test Procedures

Refer ANSI C63.10 Section 7.8.3
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

- Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
- RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
- VBW ≥ RBW.
- Sweep: Auto.
- Detector function: Peak.
- Trace: Max hold.
- Allow the trace to stabilize.

A.5.3 Number of Hopping Frequencies Data Table

Frequency (MHz)	Total No. of Channels	Limits	Results
902-928	129	≥ 50	Pass
902-928	64	≥ 50	Pass
Total number of hopping frequencies in the 902-928MHz Band = 129 Channels for 2FSK with 200kHz Channel spacing and 64 channels for 2FSK with 400kHz Channel Spacing			

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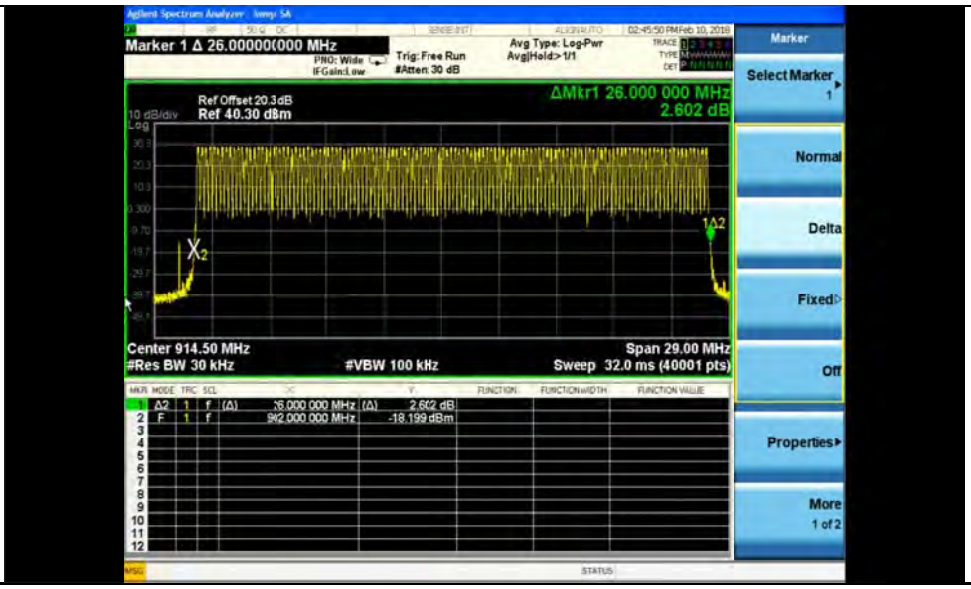
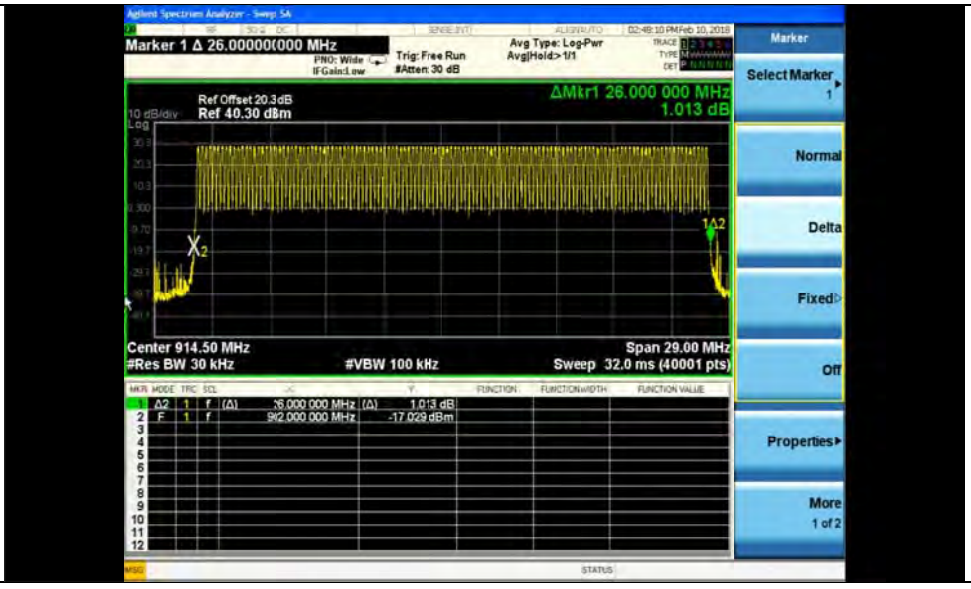
A.4.3 Number of Hopping Frequencies Graphical Test Results

Modulation 2FSK ,Mode 64



Modulation 2FSK ,Mode 96



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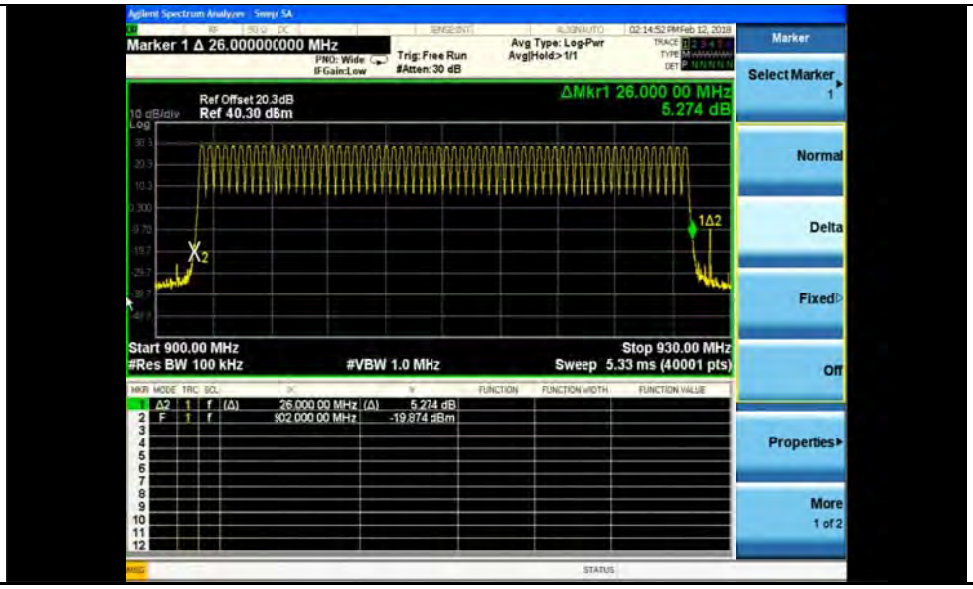
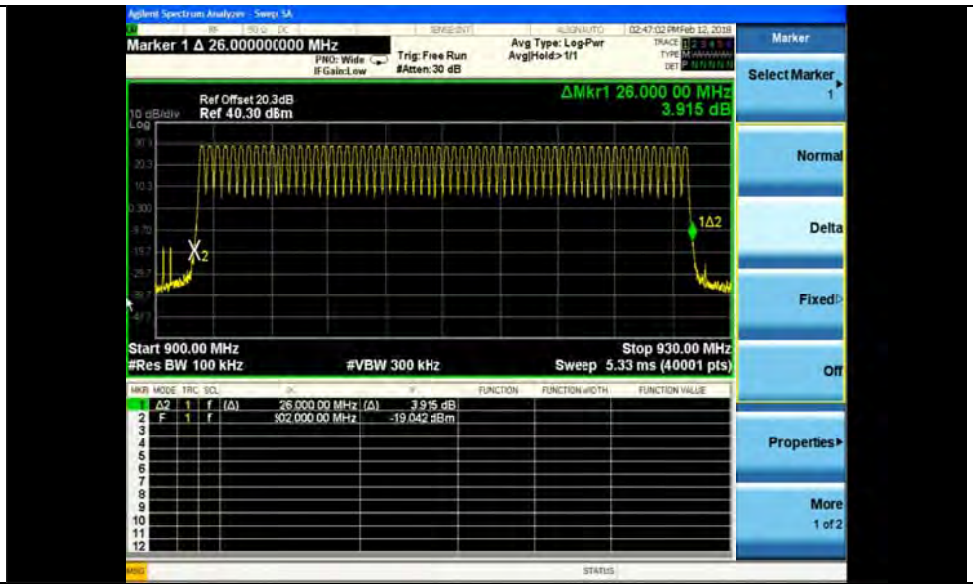
Modulation 2FSK ,Mode 66

Modulation 2FSK ,Mode 98


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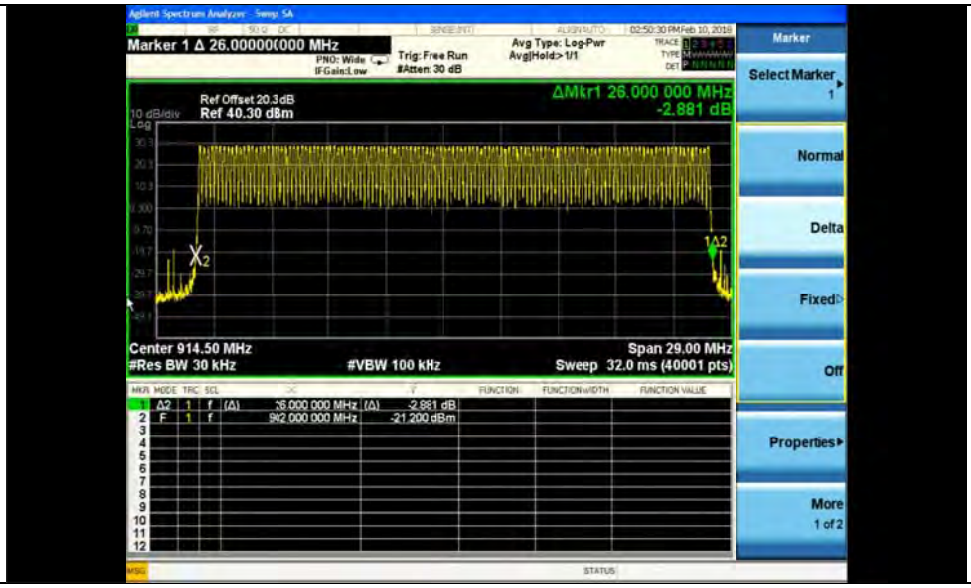
Modulation O-QPSK ,Mode 192


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A.5 Average Time of Occupancy (2FSK and OQPSK Modes)

A.5.1 Limits

FCC 15.247 (a) (1) (i) & RSS-247 (5.1) (c)

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20-second period.

A.5.2 Test Procedure

Refer to ANSI C63.10 7.8.4
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

- Span: Zero span, centered on a hopping channel.
- RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
- Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
- Detector function: Peak.
- Trace: Max hold.

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

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Modulation Type : 2FSK , Mode 64, 50kbps	
Measured time of occupancy (dwell time) for one total transmission =	138.2 ms
Time Frame = 0.4 s * 50 hopping channels =	20000 ms
Measured time to return to one channel =	17820 ms
Total transmit events for one channel in the Time Frame, 20000 ms / 17820 ms =	1.122 events
Total time that one channel transmits within the 20 s Time Frame = 1.122 * 138.2 ms =	**155.0604 ms**

Modulation Type : 2FSK , Mode 96, 50kbps	
Measured time of occupancy (dwell time) for one total transmission =	138.3 ms
Time Frame = 0.4 s * 50 hopping channels =	20000 ms
Measured time to return to one channel =	17820 ms
Total transmit events for one channel in the Time Frame, 20000 ms / 17820 ms =	1.122 events
Total time that one channel transmits within the 20 s Time Frame = 1.122 * 138.3 ms =	**168.726 ms**

Modulation Type : 2FSK , Mode 66, 150kbps	
Measured time of occupancy (dwell time) for one total transmission =	136.4 ms
Time Frame = 0.4 s * 50 hopping channels =	20000 ms
Measured time to return to one channel =	8800 ms
Total transmit events for one channel in the Time Frame, 20000 ms / 8800 ms =	2.28 events
Total time that one channel transmits within the 20 s Time Frame = 2.28 * 136.4 ms =	**310.992 ms**

Modulation Type : 2FSK , Mode 98, 150kbps	
Measured time of occupancy (dwell time) for one total transmission =	137.5 ms
Time Frame = 0.4 s * 50 hopping channels =	20000 ms
Measured time to return to one channel =	8783 ms
Total transmit events for one channel in the Time Frame, 20000 ms / 8783 ms =	2.277 events
Total time that one channel transmits within the 20 s Time Frame = 2.277 * 137.5 ms =	**313.0875 ms**

Modulation Type : O-QPSK , Mode 192, 6.2kbps	
Measured time of occupancy (dwell time) for one total transmission =	138 ms
Time Frame = 0.4 s * 50 hopping channels =	20000 ms
Measured time to return to one channel =	17820 ms
Total transmit events for one channel in the Time Frame, 20000 ms / 17820 ms =	1.122 events
Total time that one channel transmits within the 20 s Time Frame = 1.122 * 138 ms =	**154 ms**

A.5.3 Average Time of Occupancy and Dwell time Data table

Modulation Type	Phymode	Dwell Time	Time Occupancy	Limits (ms)	Results

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		(ms)	(ms)		
2FSK	64	138.2	155	400	Pass
2FSK	96	138.3	168	400	Pass
2FSK	66	136.4	310	400	Pass
2FSK	98	137.5	313	400	Pass
Q-QPSK	192	138.0	154	400	Pass

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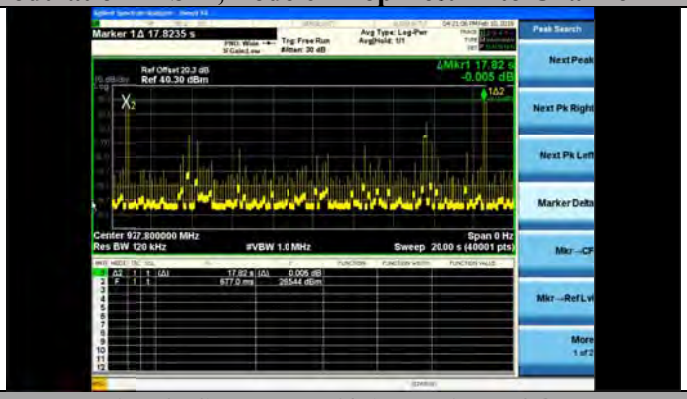
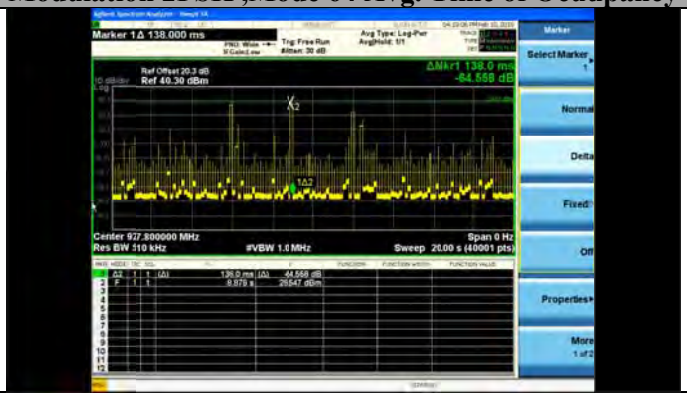
A.5.4 Average Time of Occupancy and Dwell Time Graphical Test Results

Dwell Time & Frequency Occupation Time
Modulation 2FSK ,Mode 64 Dwell time

Modulation 2FSK ,Mode 64 Hop Return to Channel Time

Modulation 2FSK ,Mode 64 Avg. Time of Ocuupancy


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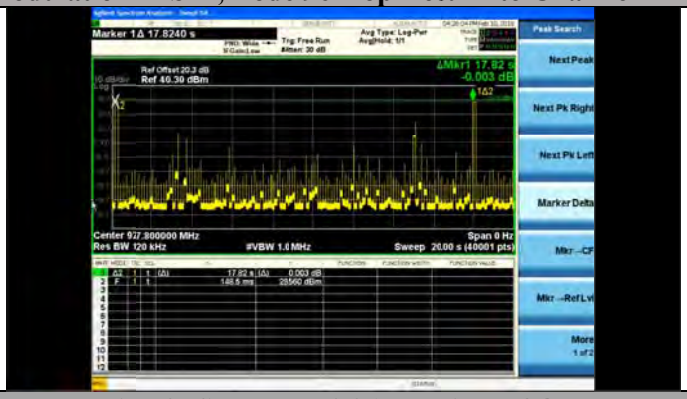
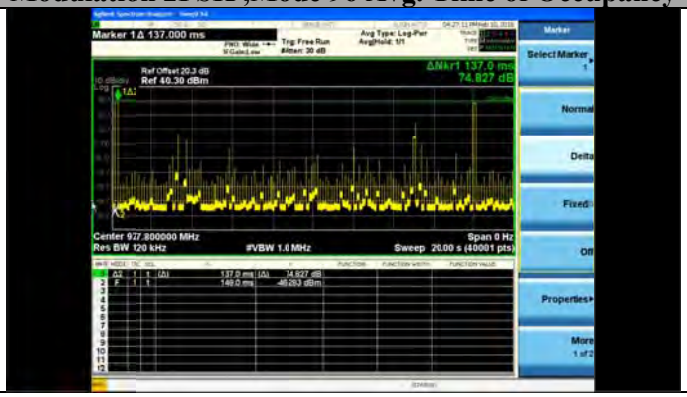
Dwell Time & Frequency Occupation Time
Modulation 2FSK ,Mode 96 Dwell time

Modulation 2FSK ,Mode 96 Hop Return to Channel Time

Modulation 2FSK ,Mode 96 Avg. Time of Occupancy


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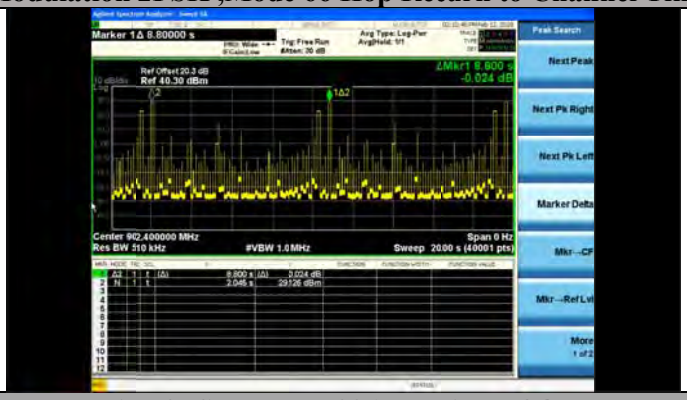
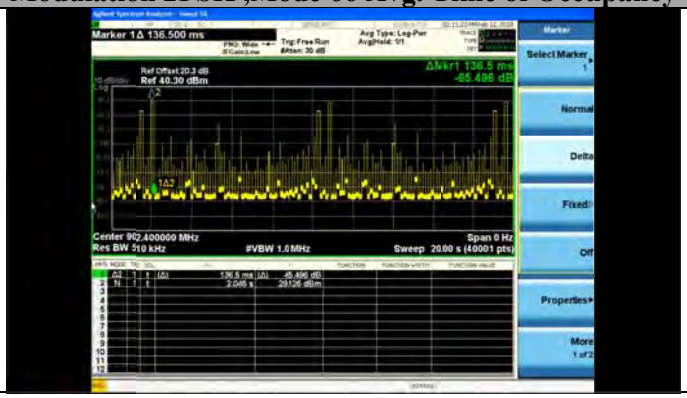
Dwell Time & Frequency Occupation Time
Modulation 2FSK ,Mode 66 Dwell time

Modulation 2FSK ,Mode 66 Hop Return to Channel Time

Modulation 2FSK ,Mode 66 Avg. Time of Occupancy


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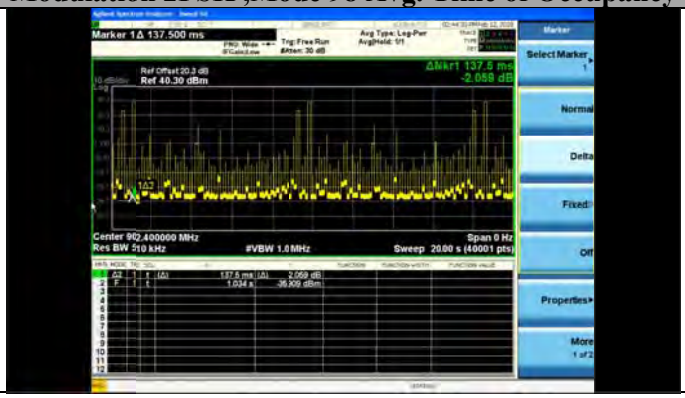
Dwell Time & Frequency Occupation Time
Modulation 2FSK ,Mode 98 Dwell time

Modulation 2FSK ,Mode 98 Hop Return to Channel Time

Modulation 2FSK ,Mode 98 Avg. Time of Occupancy


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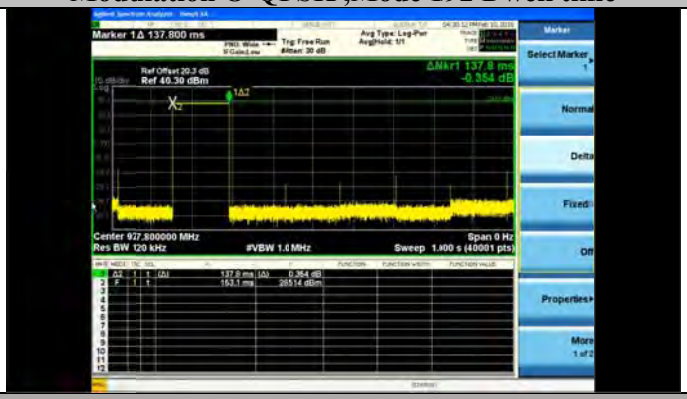
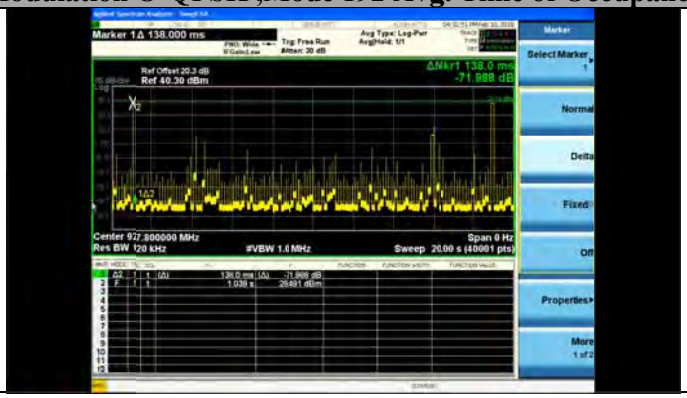
Dwell Time & Frequency Occupation Time
Modulation O-QPSK ,Mode 192 Dwell time

Modulation O-QPSK ,Mode 192 Hop Return to Channel Time

Modulation O-QPSK ,Mode 192 Avg. Time of Occupancy


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A.5.5 Average Time of Occupancy (OFDM Modes)

A.5.5.1 Limits

FCC 15.247 (f) & RSS-247 (5.3) (a)

The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4

A.5.5.2 Test Procedure

Refer to ANSI C63.10 7.8.4
The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

- Span: Zero span, centered on a hopping channel.
- RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
- Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
- Detector function: Peak.
- Trace: Max hold.

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

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Average Time of Occupancy and Dwell Time Calculations

Modulation Type : OFDM , Mode 144	
Measured time of occupancy (dwell time) for one total transmission =	137 ms
Time Frame = 0.4 s * 31 hopping channels =	12400 ms
Measured time to return to one channel =	4267 ms
Total transmit events for one channel in the Time Frame, 12400 ms / 4267 ms =	2.906 events
Total time that one channel transmits within the 20 s Time Frame = 2.906 * 137 ms =	**398.122 ms**

Modulation Type : OFDM , Mode 146	
Measured time of occupancy (dwell time) for one total transmission =	137 ms
Time Frame = 0.4 s * 31 hopping channels =	12400 ms
Measured time to return to one channel =	4267 ms
Total transmit events for one channel in the Time Frame, 12400 ms / 4267 ms =	2.906 events
Total time that one channel transmits within the 20 s Time Frame = 2.906 * 137 ms =	**398.122 ms**

Modulation Type : OFDM , Mode 147	
Measured time of occupancy (dwell time) for one total transmission =	136.6 ms
Time Frame = 0.4 s * 31 hopping channels =	12400 ms
Measured time to return to one channel =	4242 ms
Total transmit events for one channel in the Time Frame, 12400 ms / 4242 ms =	2.923 events
Total time that one channel transmits within the 20 s Time Frame = 2.923 * 136.6 ms =	**399. 281 ms**

Modulation Type : OFDM , Mode 149	
Measured time of occupancy (dwell time) for one total transmission =	137 ms
Time Frame = 0.4 s * 31 hopping channels =	12400 ms
Measured time to return to one channel =	4287 ms
Total transmit events for one channel in the Time Frame, 12400 ms / 4287 ms =	2.892 events
Total time that one channel transmits within the 20 s Time Frame = 2.892 * 137 ms =	**396. 204 ms**

Modulation Type : OFDM , Mode 150	
Measured time of occupancy (dwell time) for one total transmission =	137 ms
Time Frame = 0.4 s * 31 hopping channels =	12400 ms
Measured time to return to one channel =	4287 ms
Total transmit events for one channel in the Time Frame, 12400 ms / 4287 ms =	2.892 events
Total time that one channel transmits within the 20 s Time Frame = 2.892 * 137 ms =	**396. 204 ms**

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A.5.5.3 Average Time of Occupancy and Dwell time Data table

Modulation Type	Phymode	Dwell Time (ms)	Time Occupancy (ms)	Limits (ms)	Results
OFDM	144	137	398	400	Pass
OFDM	146	137	398	400	Pass
OFDM	147	136.6	399	400	Pass
OFDM	149	137	396	400	Pass
OFDM	150	137	396	400	Pass

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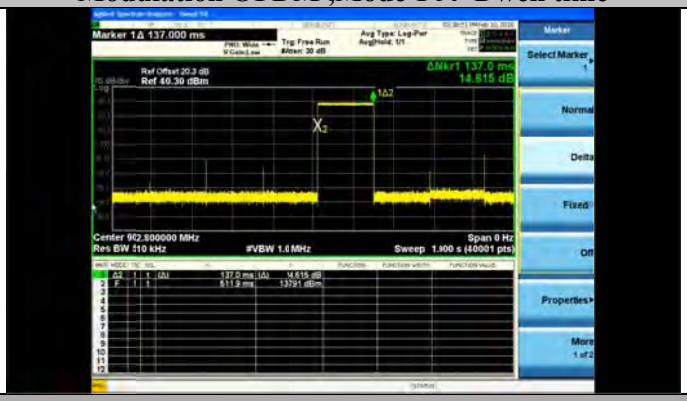
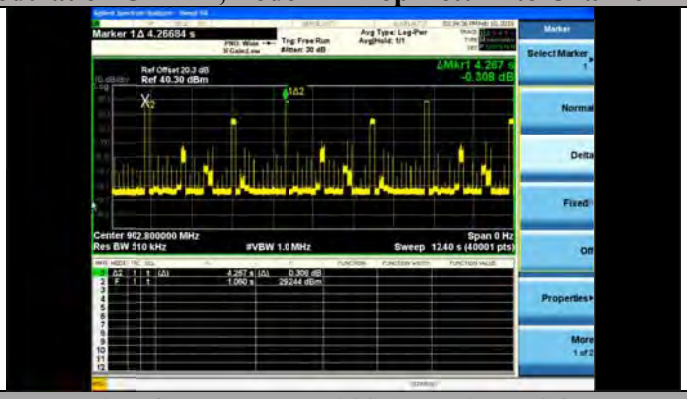
A.5.5.4 Average Time of Occupancy and Dwell Time Graphical Test Results

Dwell Time & Frequency Occupation Time
Modulation OFDM ,Mode 144 Dwell time

Modulation OFDM ,Mode 144 Hop Return to Channel Time

Modulation OFDM ,Mode 144 Avg. Time of Occupancy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