Radio Intentional Test Report: EDCS - 12437517

For

IR510-OFDM-FCC/K9

FCC ID: LDK-IR510OFDM

IC : 2461N-IR510OFDM

Against the following Specifications :

47 CFR 15.247

RSS-247

RSS-Gen

Cisco Systems

EMC Laboratory

170 West Tasman Drive

San Jose, CA 95134

Author: Jose Aguirre
Approved By: Gerard Thorpe
Title: Regulatory Compliance Manager

This report replaces any previously entered test report under EDCS- 12437517

This test report has been electronically authorized and archived using the CISCO Engineering Document Control system.

Section 1: Overview

Test Summary

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

Emissions:
CFR47 Part 15.247
RSS-247
RSSGEN

Notes:

1) Measurements were made in accordance with ANSI C63.10,

Section 2: Assessment Information

2.1 General

This report must not be used to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the federal Government.

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 tolerances and measurement uncertainties.

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	15°C to 35°C (54°F to 95°F)
Atmospheric Pressure	860mbar to 1060mbar (25.4" to 31.3")
Humidity	10% to 75*%

e) All AC testing was performed at one or more of the following supply voltages:
110V (+/-10%) 60Hz

f) Cisco Systems, Inc. is accredited by the American Association for Laboratory Accreditation (A2LA). The scope of accreditation, certificate number 1178-01 is referenced in appendix C, along with further details.

2.2 Start Date of Testing

02-Oct-2017

2.3 Report Issue Date

30-January-2018

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2.4 Testing facilities

This assessment was performed by:

Testing Laboratory

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

Registration Numbers for Industry Canada

Cisco System Site	Site Identifier
Building P, 10m Chamber	Company #: 4624-2
Building P, 5m Chamber	Company #: 4624-1
Building N, 5m Chamber	Company #: 6111
Building I, 5m Chamber	Company #: 6112

Test Engineers

Jose Aguirre

2.5 Equipment Assessed (EUT)

IR510-OFDM-FCC/K9

2.6 EUT Description

The IR510-OFDM-FCC/K9

The following Antenna(s) are supported by this product

Frequency	Part number	Antenna Type	Antenna Gain (dBi)
902-928MHz	External	Omni-directional	5.6

2.7 Scope of Assessment

Tests have been performed in accordance with the relevant Test and Assessment Plan (TAP), a copy of which is contained in Appendix F of this report, and the relevant Cisco Systems, Inc. radio test procedures (EDCS-420238). This test report may not cover all of the tests highlighted in the test plan.

2.8 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

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%.**

2.9 Report Template Control No.

EDCS#703456

Section 3: Result Summary

3.1 Results Summary Table

Conducted emissions

Basic Standard	Technical Requirements / Details	Result
FCC 15.247 RSS-247	**Peak Output Power**: For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels	Pass
FCC 15.247 RSS-247	**Carrier Separation**: 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
FCC 15.247 RSS-247	**20 dB Bandwidth**: The bandwidth of a frequency hopping channel is the – 20 dB emission bandwidth, measured with the hopping stopped, between upper and lower frequency from top carrier (dBc) down.	Reference
FCC 15.247 RSS-247	**No. of Hopping Frequencies / Time Occupancy**: 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; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz. (f) For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. 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 (d) RSS-247	**Conducted Spurious Emissions / 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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required	Pass
FCC 15.209 FCC 15.205 RSS-Gen	**Restricted band**: Unwanted emissions falling within the restricted bands, as defined in FCC 15.205 (a) and RSS-Gen 7.2.2 must also comply with the radiated emission limits specified in FCC 15.209 (a) and RSS-Gen 7.2.5.	Pass

Radiated Emissions (General requirements)

Basic Standard	Technical Requirements / Details	Result
FCC 15.209 RSS-Gen	**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

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. During preliminary testing all three planes (X,Y & Z) were evaluated to determine "Worst Case". The data collected determine that the orientation used for this report was demined "Worst Case".

4.1 Sample Details

Sample Number	Equipment Details	Serial Number	Part Number
S01	IR510-OFDM-FCC/K9	FCW21260071	68-101092-03

The following antennas were evaluated as part of this testing process. The antennas listed reflect the maximum gain allowed for each family type of antenna:

Antenna, Gain = 5.6dBi (no external antenna can be used.)

4.2 System Details

System #	Description	Samples
1	Radio Test Sample	S01

4.3 Mode of Operation Details

Mode#	Description	Comments
1	Test Mode	System is connected to the spectrum analyzer and placed in either continuous TX Mode or Duty Cycle Mode with Hopping Function Turned ON or OFF per test requirements via test utility software.

4.4 Test Mode, Modulation and Data Packet Type Description

Test Mode	Modulation Type	Rate	Spacing	Mode
A	2FSK	50kbps	200kHz	64
B	2FSK	150kbps	400kHz	66
C	2FSK	150kbps	400kHz	98
D	OFDM	50kbps	800kHz	144
E	OFDM	200kbps	800kHz	146
F	OFDM	400kbps	800kHz	147
G	OFDM	800kbps	800kHz	149
H	OFDM	1200kbps	800kHz	150

I	OQPSK	6.25kbps	200kHz	192
Note1: Table above represents the worst case scenarios for all modulation and data packet type combinations.				

Section 5: Modifications

5.1 Sample Modifications Performed During Assessment

No modifications were performed during assessment.

Appendix A: Formal Test Results

6dB Bandwidth

6dB bandwidth of a frequency hopping channel is the 902-928MHz with hopping function disabled.

Measurement Method:
ANSI C63.10 : 2013 section 11.8

Test procedure:

Center Frequecy = nominal EUT channel
Span = 3MHz
RBW = 100kHz
VBW = 3xRBW
Ref Level = Auto
Detector = Peak (trace mode to Max hold)

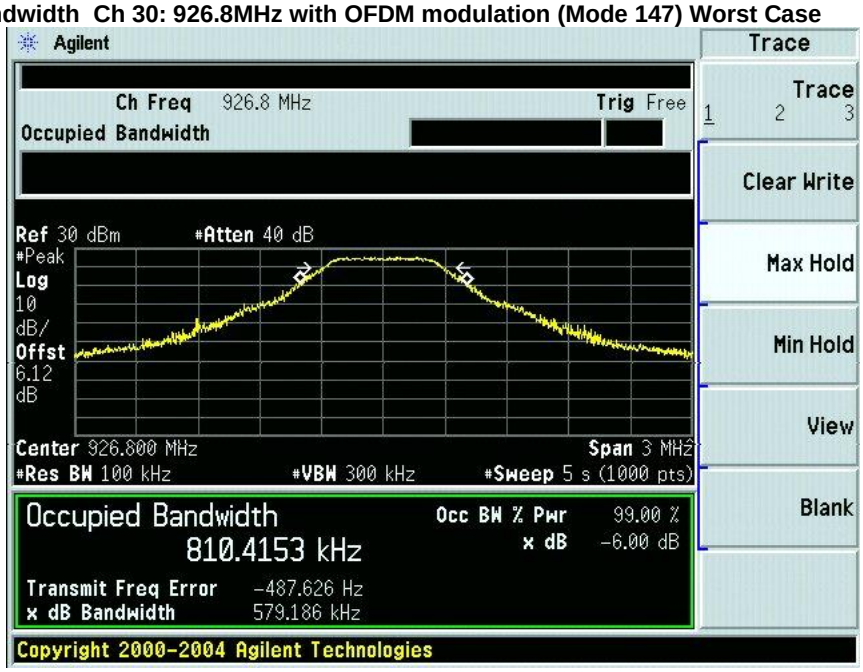
Determine the reference value: Set the EUT to transmit a modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).

Determine the "−xx dB down amplitude" using [(reference value) − xx]. Alternatively, this calculation may be made by using the marker-delta function of the instrument.

Test Data Table

Frequency (channel)	6dB (kHz)	Modulation Type	Rate	Spacing	Mode
902.8 (ch00)	603.0	OFDM	50kbps	800kHz	144
914.8 (ch15)	602.0	OFDM	50kbps	800kHz	144
926.8 (ch30)	601.2	OFDM	50kbps	800kHz	144
902.8 (ch00)	603.5	OFDM	200kbps	800kHz	146
914.8 (ch15)	605.0	OFDM	200kbps	800kHz	146
926.8 (ch30)	604.1	OFDM	200kbps	800kHz	146
902.8 (ch00)	601.1	OFDM	400kbps	800kHz	147
914.8 (ch15)	582.6	OFDM	400kbps	800kHz	147
926.8 (ch30)	**579.2**	**OFDM**	**400kbps**	**800kHz**	**147**
902.8 (ch00)	602.5	OFDM	800kbps	800kHz	149
914.8 (ch15)	602.2	OFDM	800kbps	800kHz	149
926.8 (ch30)	601.4	OFDM	800kbps	800kHz	149
902.8 (ch00)	601.2	OFDM	1200kbps	800kHz	150
914.8 (ch15)	602.0	OFDM	1200kbps	800kHz	150
926.8 (ch30)	598.4	OFDM	1200kbps	800kHz	150

6dB Bandwidth Ch 30: 926.8MHz with OFDM modulation (Mode 147) Worst Case



20dB / 26dB / 99% Bandwidth

20dB bandwidth of a frequency hopping channel is the 902-928MHz with hopping function disabled.

Measurement Method:
ANSI C63.10 : 2013 section 6.9.2 & 6.9.3

Test procedure:

Center Frequecy = nominal EUT channel
Span = Between 2x & 5x the OBW
RBW = 1% to 5% of the OBW
VBW = 3xRBW
Ref Level = Auto
Detector = Peak (trace mode to Max hold)

might require iteration to adjust within the specified tolerances.

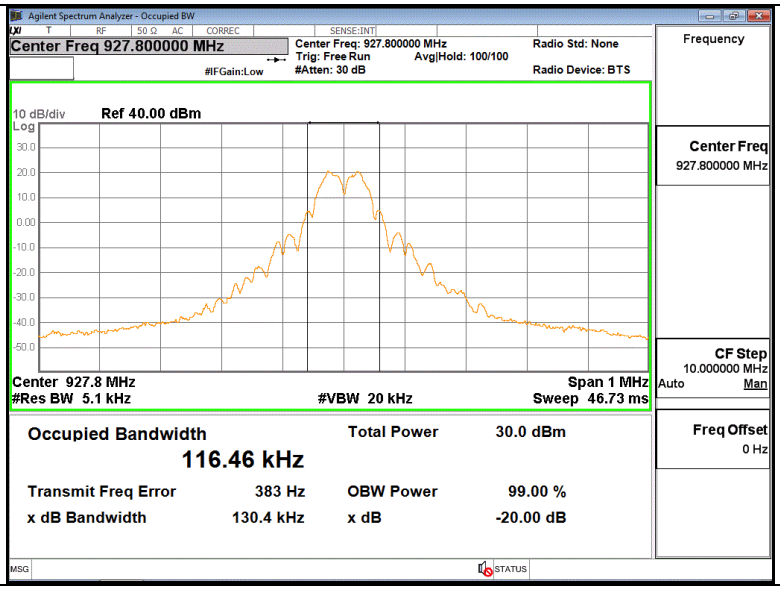
Determine the reference value: Set the EUT to transmit a modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).

Determine the "–xx dB down amplitude" using [(reference value) – xx]. Alternatively, this calculation may be made by using the marker-delta function of the instrument.
Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

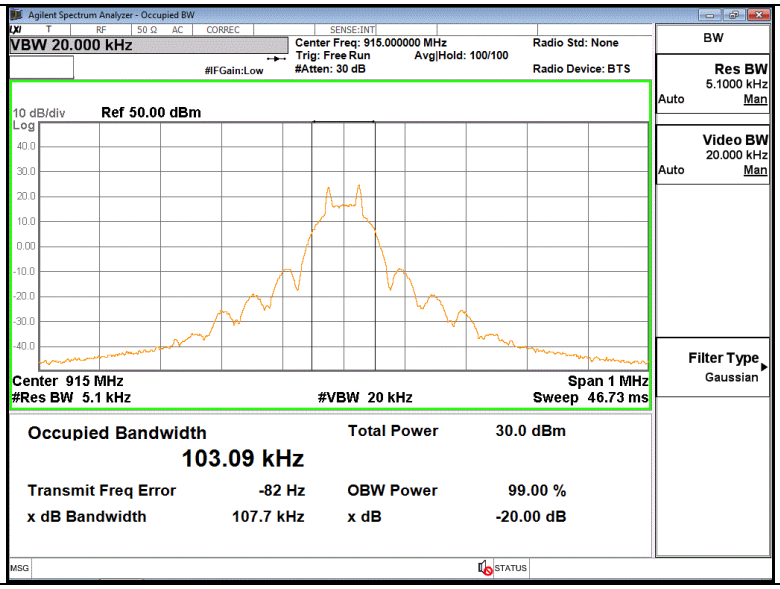
Test Data Table

Frequency (MHz)	Occupied BW			Modulation Type	Rate	Spacing	Mode
	20dB (kHz)	26dB (kHz)	99% (kHz)				
902.2(ch 00)	130.7		117.1	OQPSK	6.25kbps	200kHz	192
915.0 (ch 64)	131.1		117.3	OQPSK	6.25kbps	200kHz	192
927.8 (ch128)	**130.4**		**116.5**	**OQPSK**	**6.25kbps**	**200kHz**	**192**
902.2 (ch 00)	108.9		103.2	2FSK	50kbps	200kHz	64
915.0 (ch 64)	**107.7**		**103.1**	**2FSK**	**50kbps**	**200kHz**	**64**
927.8 (ch128)	109.5		103.5	2FSK	50kbps	200kHz	64
902.4 (ch00)	189.5		175.6	2FSK	150kbps	400kHz	66
915.2 (ch32)	194.3		175.7	2FSK	150kbps	400kHz	66
927.6 (ch63)	192.8		174.1	2FSK	150kbps	400kHz	66
902.4 (ch00)	195.2		175.1	2FSK	150kbps	400kHz	98
915.2 (ch32)	194.8		175.8	2FSK	150kbps	400kHz	98
927.6 (ch63)	193.9		175.2	2FSK	150kbps	400kHz	98
902.8 (ch00)		1020	617.8	OFDM	50kbps	800kHz	144
914.8 (ch15)		1008	602.8	OFDM	50kbps	800kHz	144
926.8 (ch30)		941.6	584.0	OFDM	50kbps	800kHz	144
902.8 (ch00)		1087	619.4	OFDM	200kbps	800kHz	146
914.8 (ch15)		997.5	601.3	OFDM	200kbps	800kHz	146
926.8 (ch30)		894.8	586.2	OFDM	200kbps	800kHz	146
902.8 (ch00)		1077	658.12	OFDM	400kbps	800kHz	147
914.8 (ch15)		1058	639.72	OFDM	400kbps	800kHz	147
926.8 (ch30)		984.1	612.93	OFDM	400kbps	800kHz	147
902.8 (ch00)		984.7	597.6	OFDM	800kbps	800kHz	149
914.8 (ch15)		926.5	580.4	OFDM	800kbps	800kHz	149
926.8 (ch30)		934.6	574.1	OFDM	800kbps	800kHz	149
902.8 (ch00)		**883.4**	**567.3**	**OFDM**	**1200kbps**	**800kHz**	**150**
914.8 (ch15)		842.6	569.0	OFDM	1200kbps	800kHz	150
926.8 (ch30)		823.4	568.2	OFDM	1200kbps	800kHz	150

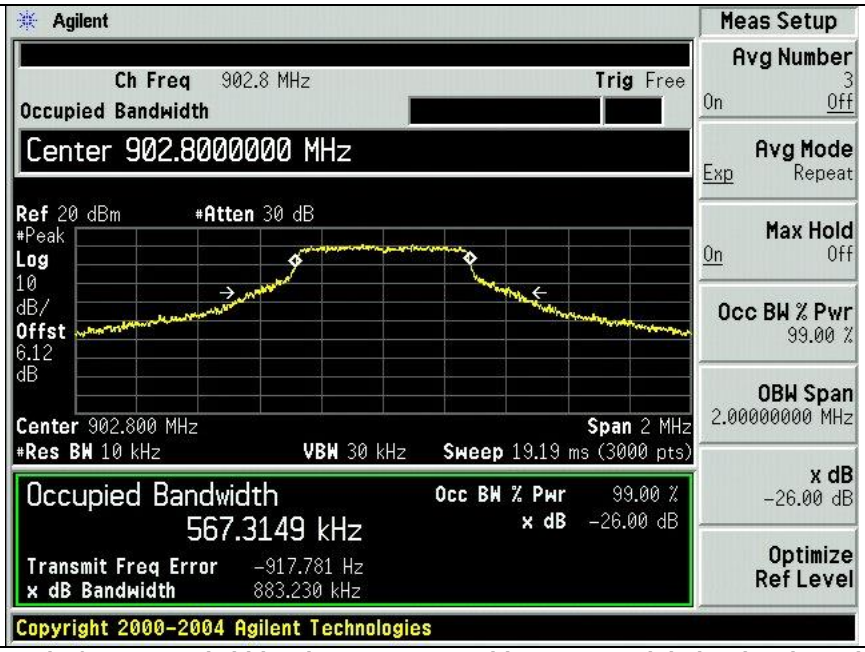
Graphical Test Results



Title: **20dB Bandwidth Ch 0: 927.8MHz with OQPSK modulation (Mode 192)**



Title: **26dB / 99% Bandwidth Ch 15: 915MHz with 2FSK modulation (Mode 64)**



Title: **26dB / 99% Bandwidth Ch 0: 902.8MHz with OFDM modulation (Mode 150)**

Peak Output Power

15.247 & RSS-247:

The maximum conducted output power of the intentional radiator for systems using frequency hopping systems in the 902-928MHz band shall not exceed 1 Watt (30dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Measurement Method:
ANSI C63.10 : 2013 section 7.8.5

Test procedure:

Center Frequecy = nominal EUT channel
Span Approximately five times the 20 dB bandwidth, centered on a hopping channel.
RBW RBW > 20 dB bandwidth of the emission being measured.
VBW ≥ RBW
Ref Level Auto
Detector Peak (trace mode to Max hold)
Sweep Auto

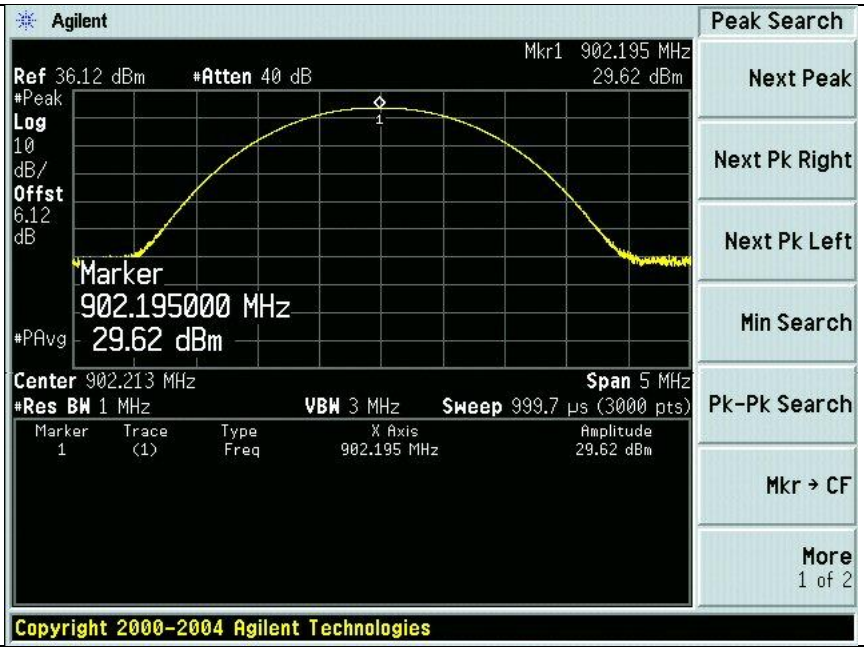
Allow trace to stabilize.
Use the marker-to-peak function to set the marker to the peak of the emission.
The indicated level is the peak output power, after any corrections for external attenuators and cables.
A plot of the test results and setup description shall be included in the test report.

Test Data Table

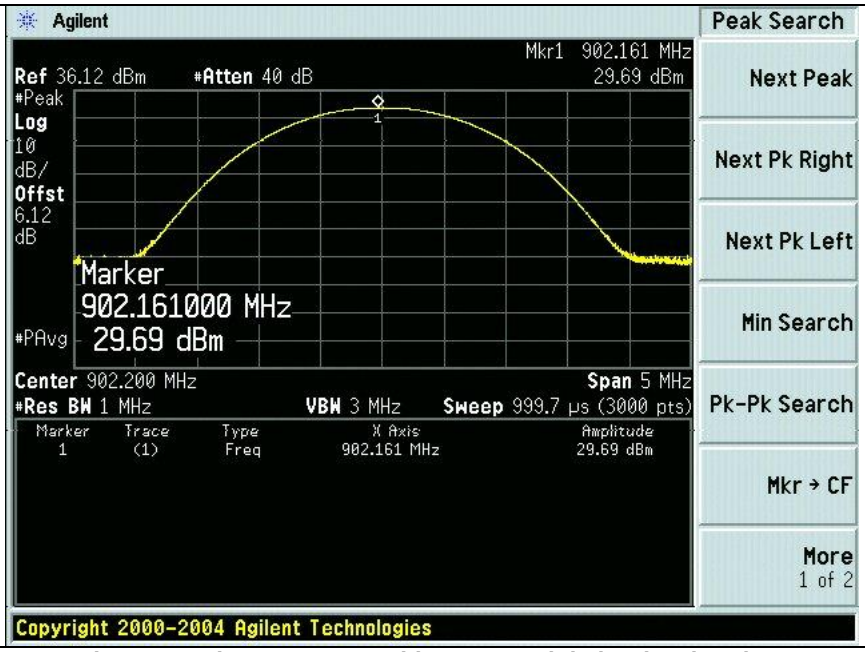
Frequency (MHz)	Tx raw power	RF Power (dBm)	Modulation Type	Rate	Spacing	Mode
902.2(ch 00)	**22**	**29.6 pk**	**OQPSK**	**6.25kbps**	**200kHz**	**192**
915.0 (ch 64)	22	29.4 pk	OQPSK	6.25kbps	200kHz	192
927.8 (ch128)	22	29.2 pk	OQPSK	6.25kbps	200kHz	192
902.2 (ch 00)	**22**	**29.7 pk**	**2FSK**	**50kbps**	**200kHz**	**64**
915.0 (ch 64)	22	29.4 pk	2FSK	50kbps	200kHz	64
927.8 (ch128)	22	29.2 pk	2FSK	50kbps	200kHz	64
902.4 (ch00)	22	29.7 pk	2FSK	150kbps	400kHz	66
915.2 (ch32)	22	29.4 pk	2FSK	150kbps	400kHz	66
927.6 (ch63)	22	29.2 pk	2FSK	150kbps	400kHz	66
902.4 (ch00)	22	29.7 pk	2FSK	150kbps	400kHz	98
915.2 (ch32)	22	29.4 pk	2FSK	150kbps	400kHz	98
927.6 (ch63)	22	29.2 pk	2FSK	150kbps	400kHz	98
902.8 (ch00)	18	24.14 avg	OFDM	50kbps	800kHz	144
914.8 (ch15)	**27**	**28.1 avg**	**OFDM**	**50kbps**	**800kHz**	**144**
926.8 (ch30)	27	27.8 avg	OFDM	50kbps	800kHz	144
902.8 (ch00)	18	24.13 avg	OFDM	200kbps	800kHz	146
914.8 (ch15)	27	28.05 avg	OFDM	200kbps	800kHz	146
926.8 (ch30)	27	27.74 avg	OFDM	200kbps	800kHz	146
902.8 (ch00)	18	24.13 avg	OFDM	400kbps	800kHz	147
914.8 (ch15)	25	27.4 avg	OFDM	400kbps	800kHz	147
926.8 (ch30)	25	26.98 avg	OFDM	400kbps	800kHz	147
902.8 (ch00)	18	24.16 avg	OFDM	800kbps	800kHz	149
914.8 (ch15)	21	25.56 avg	OFDM	800kbps	800kHz	149
926.8 (ch30)	21	25.04 avg	OFDM	800kbps	800kHz	149
902.8 (ch00)	18	24.16 avg	OFDM	1200kbps	800kHz	150
914.8 (ch15)	18	23.54 avg	OFDM	1200kbps	800kHz	150
926.8 (ch30)	18	23.03 avg	OFDM	1200kbps	800kHz	150

Note: Worst case is determined as the modulation with Highest Output Power.
Worst cases emissions to be determined as 2FSK, OFDM & OQPSK

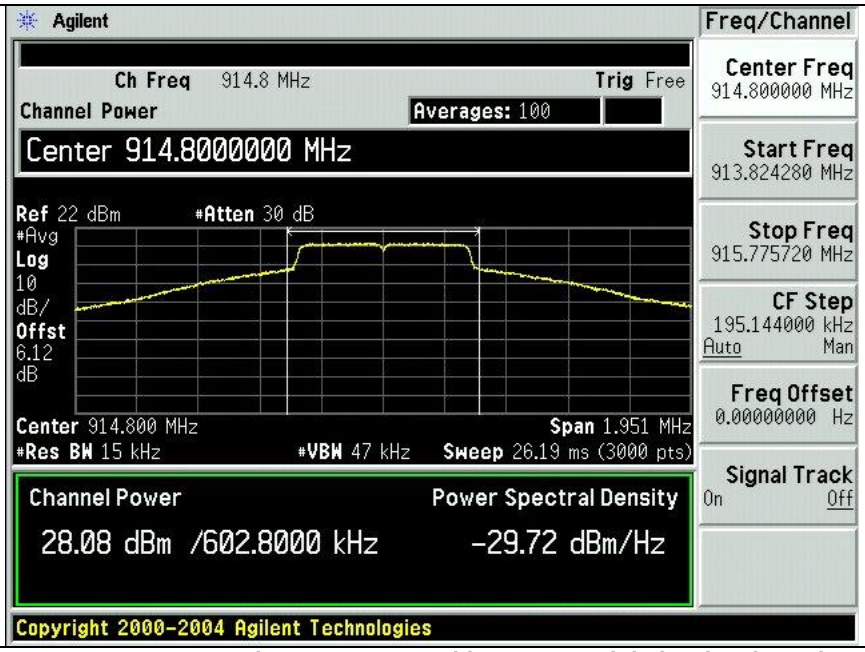
Graphical Test Results



Title: **RF Peak Power Ch 0: 902.2MHz with OQPSK modulation (Mode 192)**



Title: **RF Peak Power Ch 0: 902.2MHz with 2FSK modulation (Mode 64)**



Title: **RF Average Power Ch 15: 914.8MHz with OFDM modulation (Mode 144)**

Overall Result: PASS

Measurement procedure as per ANSI C63.10 : 2013

Carrier Frequency Separation

15.247 & RSS-247
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.

Measurement Method
ANSI C63.10 : 2013 section 7.8.2

Test Procedure:
The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

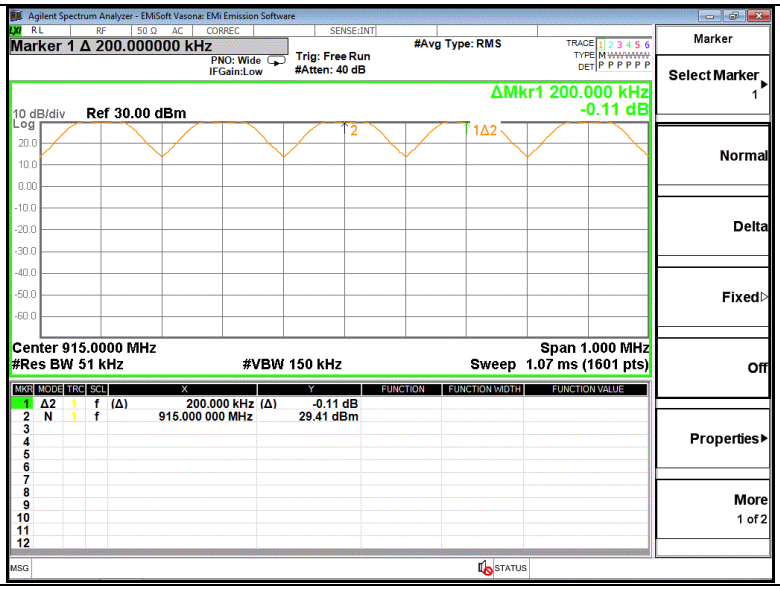
a) Span: Wide enough to capture the peaks of two adjacent channels.
b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
c) Video (or average) bandwidth (VBW) ≥ RBW.
d) Sweep: Auto.
e) Detector function: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

Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Compliance of an EUT with the appropriate regulatory limit shall be determined. A plot of the data shall be included in the test report.

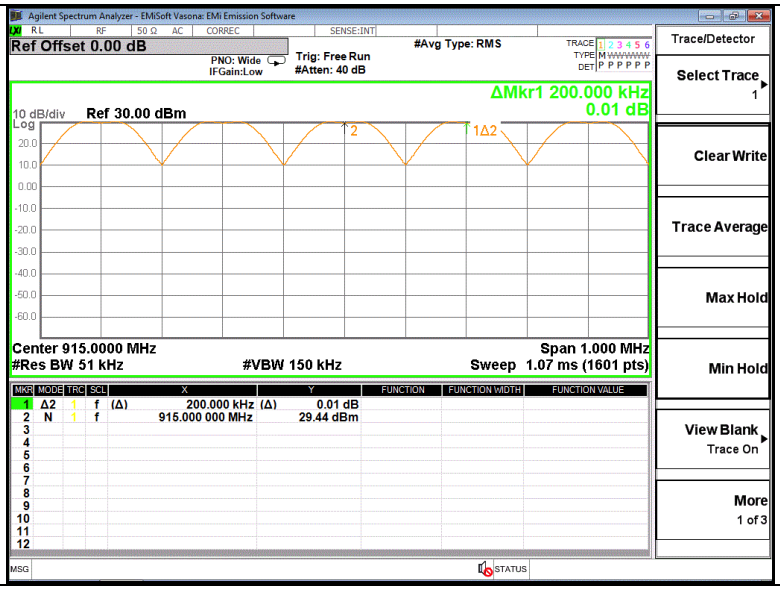
Test Data Table

Channel	Frequency (MHz)	Separation (kHz)	Limit (kHz)	Modulation Type	Rate	Spacing	Mode
64, 65	915 & 915.2	200	>25kHz	OQPSK	6.25kbps	200kHz	192
64, 65	915 & 915.2	200	>25kHz	2FSK	50kbps	200kHz	64
34, 35	916& 916.4	400	>25kHz	2FSK	150kbps	400kHz	66
34, 35	916& 916.4	400	>25kHz	2FSK	150kbps	400kHz	98

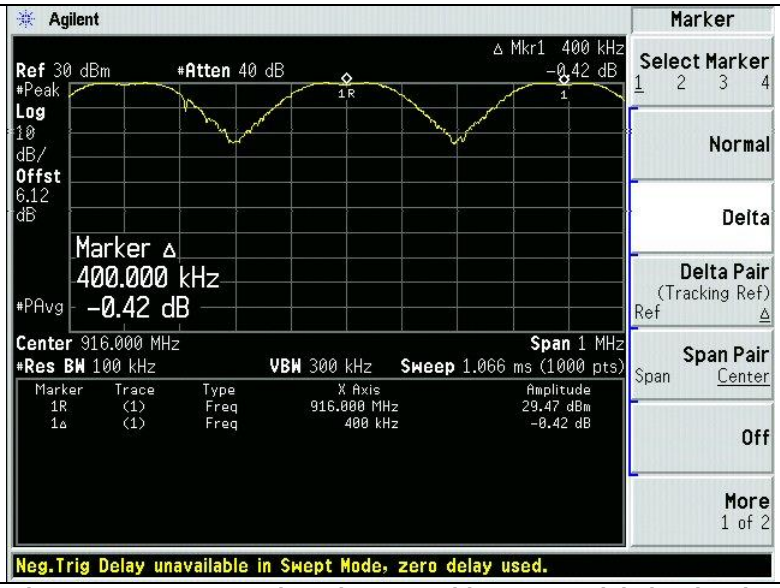
Graphical Test Results



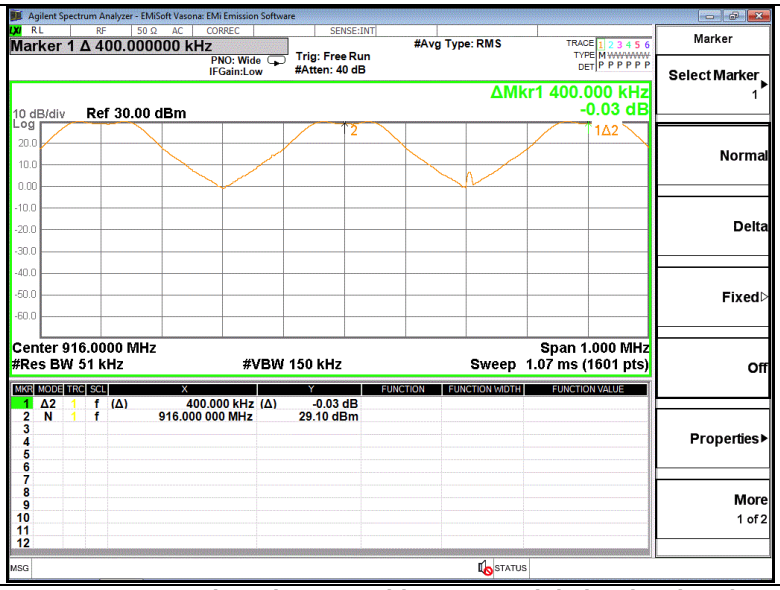
Carrier Frequency Separation Ch 64, 65 with OQPSK modulation (Mode 192)



Carrier Frequency Separation Ch 64, 65 with 2FSK modulation (Mode 64)



Carrier Frequency Separation Ch 34, 35 with 2FSK modulation (Mode 66)



Carrier Frequency Separation Ch 34, 35 with 2FSK modulation (Mode 98)

Overall Result: PASS

Measurement procedure as per KDB Publication ANSI C63.10

Number of Hopping Frequencies

15.247 & RSS-247:

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; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Measurement Method

ANSI C63.10 : 2013 section 7.8.3

Test Procedure:

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

1) 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.
2) 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.
3) VBW ≥ RBW.
4) Sweep: Auto.
5) Detector function: Peak.
6) Trace: Max hold.
7) Allow the trace to stabilize.

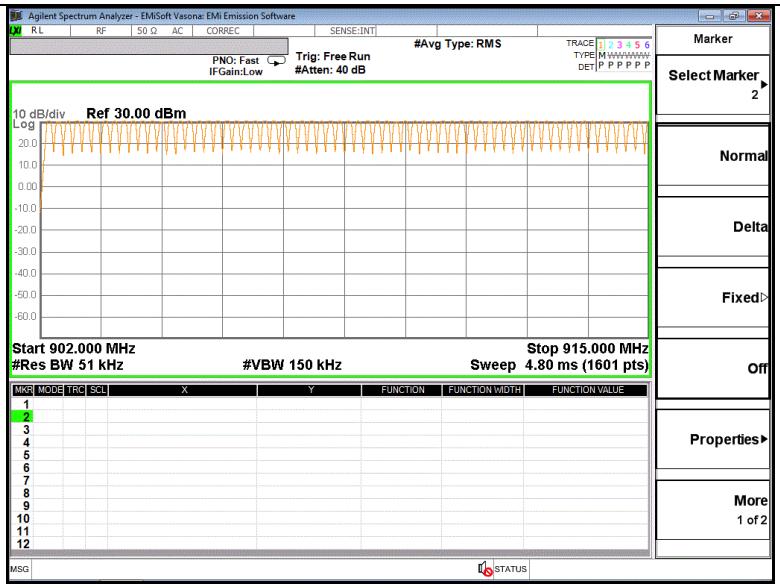
It might prove necessary to break the span up into subranges to show clearly all of the hopping frequencies. Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels. A plot of the data shall be included in the test report.

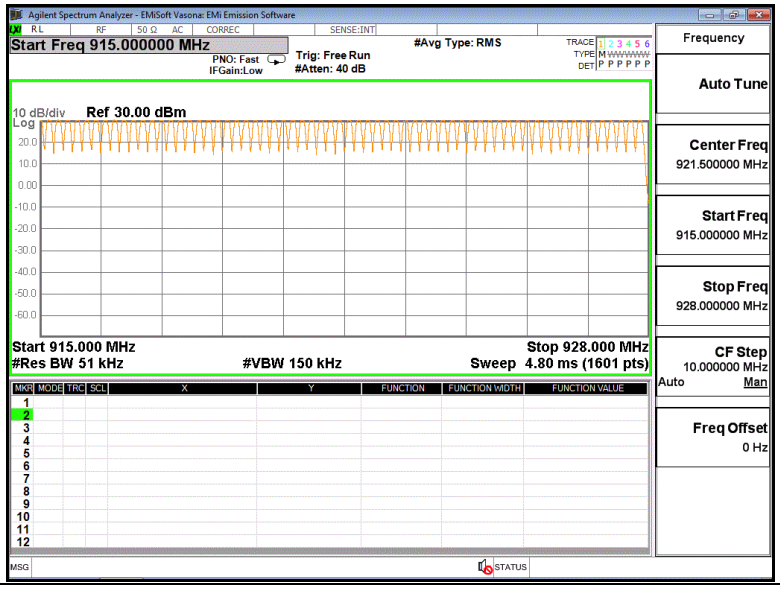
Test Data Table

Frequency (MHz)	Hopping Channels	Hopping Channels	Modulation Type	Rate	Spacing	Mode
902 - 928	129	≥50	OQPSK	6.25kbps	200kHz	192
902 - 928	129	≥50	2FSK	50kbps	200kHz	64
902 - 928	64	≥50	2FSK	150kbps	400kHz	66
902 - 928	64	≥50	2FSK	150kbps	400kHz	98

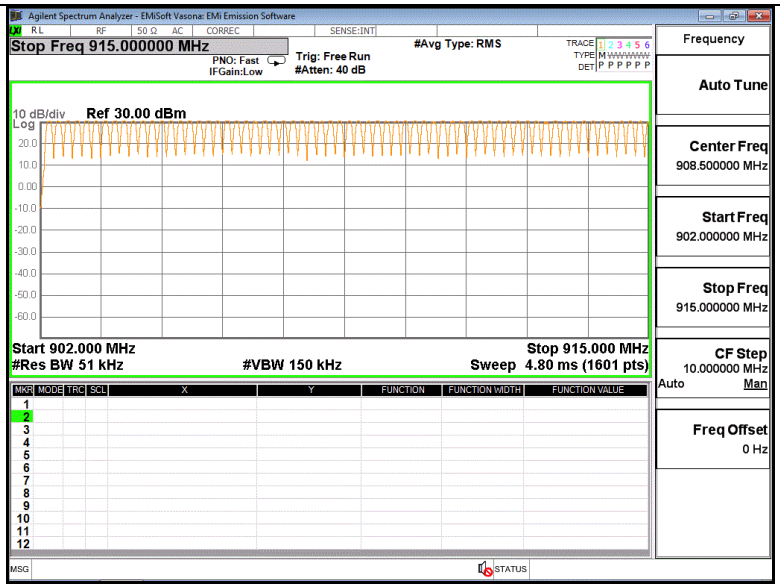
Overall Result: PASS
Measurement procedure as per ANSI C63.10 : 2013

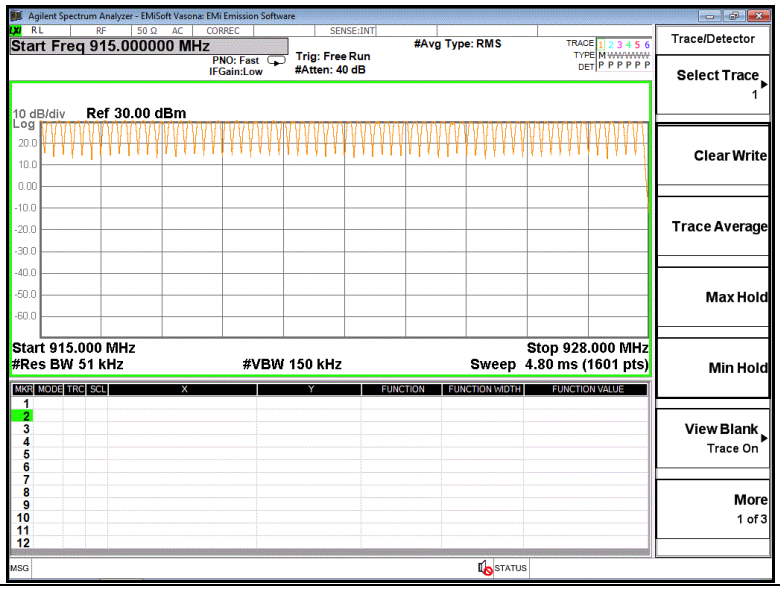
Graphical Test Results



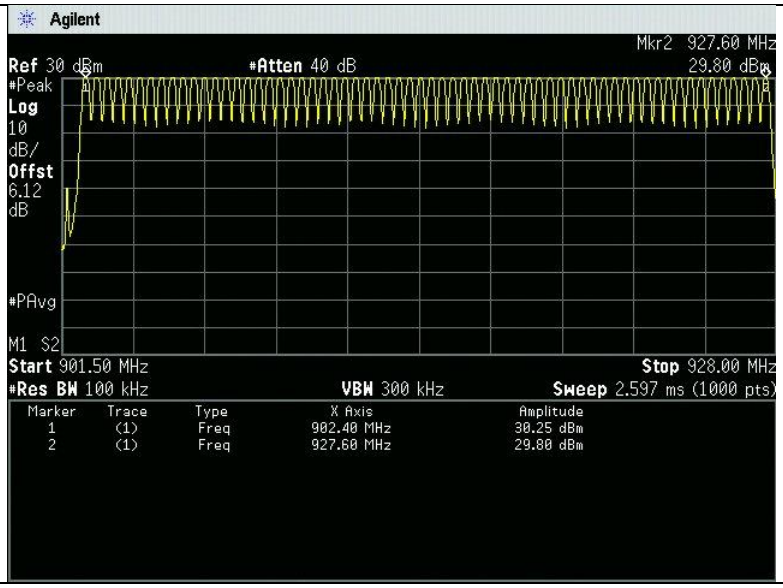


OQPSK modulation (Mode 192).
Total No. of Hops Channels = 129 in the frequency range 902-928MHz.

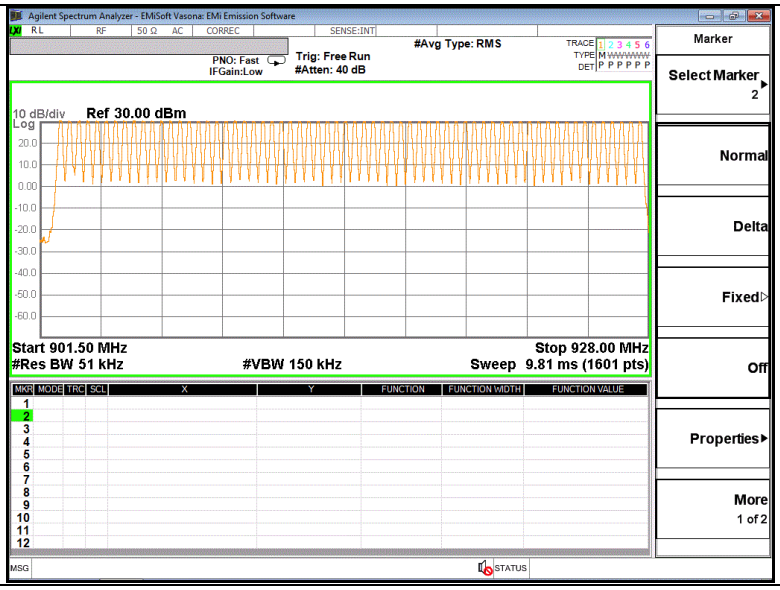




2FSK modulation (Mode 64).
Total No. of Hops Channels = 129 in the frequency range 902-928MHz.



2FSK modulation (Mode 66).
Total No. of Hops Channels = 64 in the frequency range 902-928MHz.



2FSK modulation (Mode 98).
Total No. of Hops Channels = 64 in the frequency range 902-928MHz.

Average Time of Occupancy
15.247 & RSS-247

(i) 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 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

OFDM - (f) For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. 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.

Measurement Method
ANSI C63.10 : 2013 section 7.8.4

Test Procedure:
The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:
a) Span: Zero span, centered on a hopping channel.
b) RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
c) 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.
d) Detector function: Peak.
e) 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.
Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

(Number of hops in the period specified in the requirements) = (number of hops on spectrum analyzer) × (period specified in the requirements / analyzer sweep time)
The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.
The measured transmit time and time between hops shall be consistent with the values described in the operational description for the EUT.

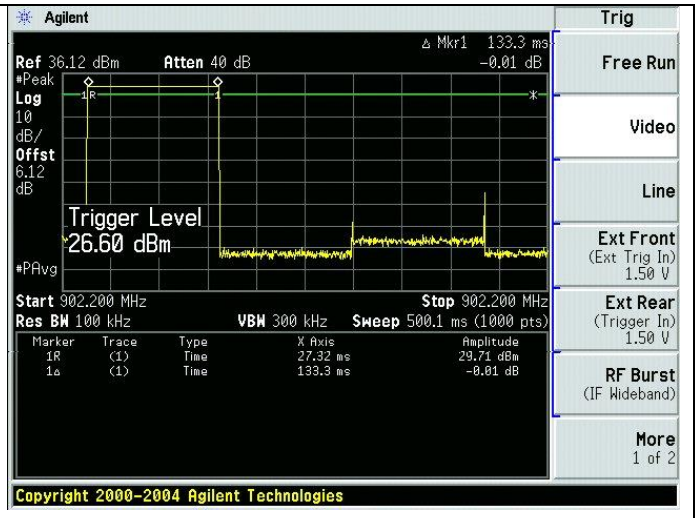
Overall Result: PASS
Measurement procedure as per ANSI C63.10: 2013

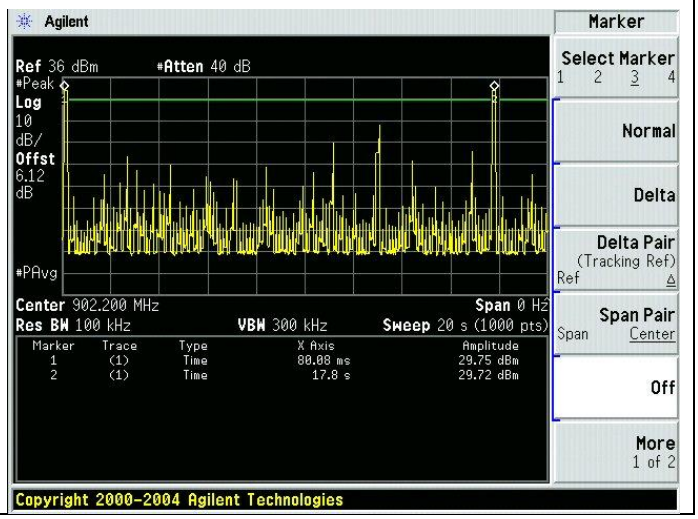
Test Data

Frequency (MHz)	Mode	Mode	Time Occupancy (ms)	Limits (ms)	Results
902.2	OQPSK	192	266.6	400	Pass
902.2	2FSK	64	266.6	400	Pass
902.4	2FSK	66	399.9	400	Pass
902.4	2FSK	98	399.9	400	Pass
902.8	OFDM	144	399.9	400	Pass
902.8	OFDM	146	399.9	400	Pass
902.8	OFDM	147	399.9	400	Pass
902.8	OFDM	149	399.9	400	Pass
902.8	OFDM	150	399.9	400	Pass

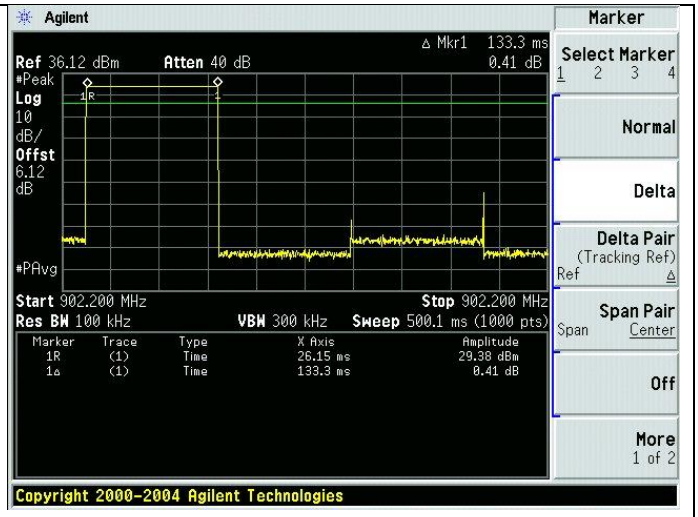
Calculation:

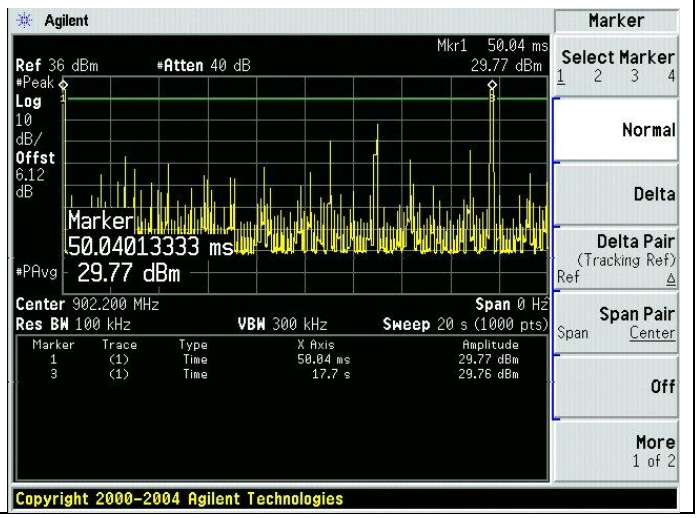
OQPSK modulation (Mode 192)
Dwell Time = 137.5ms
Total bins in 20 s = 2
Total time occupancy (in 20s) = 2 x 133.3ms = **266.6ms**



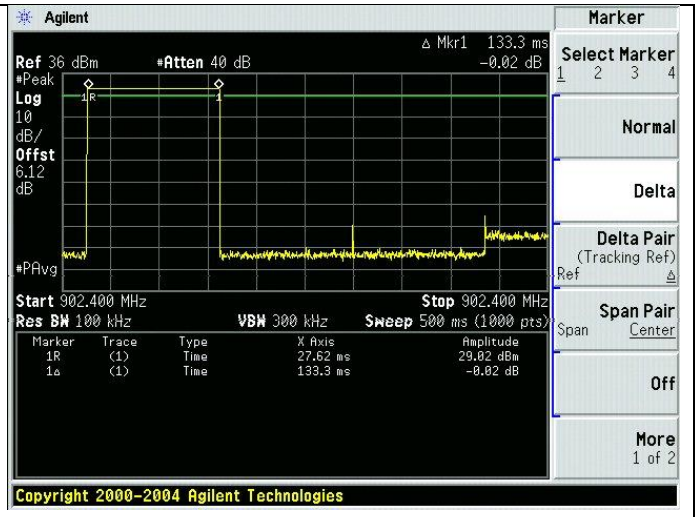


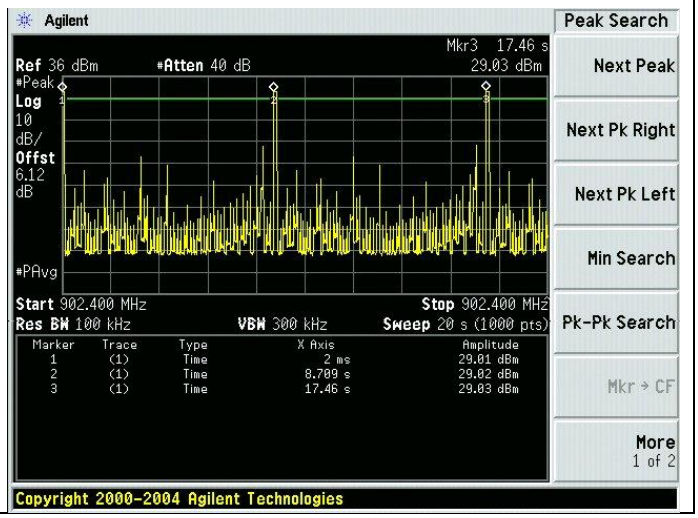
2FSK modulation (Mode 64)
Dwell Time = 137.8ms
Total bins in 20 s = 2
Total time occupancy (in 20s) = 2 x 133.3ms
=**266.6ms**



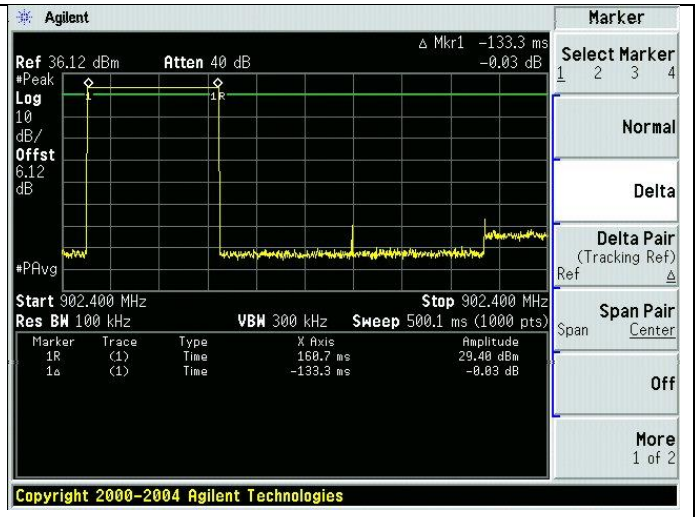


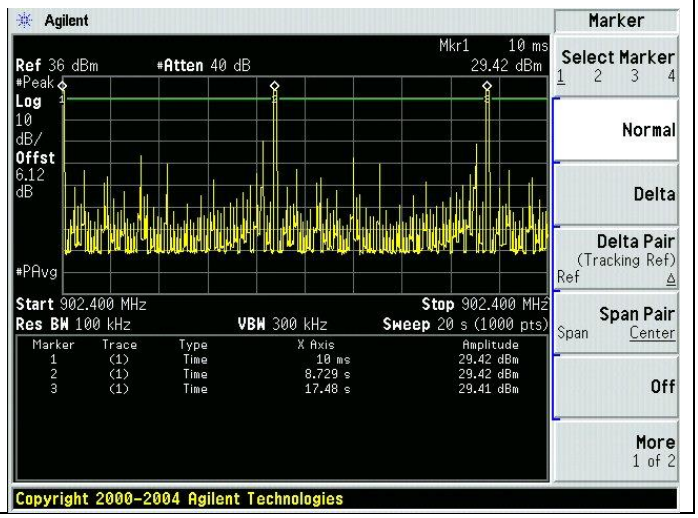
2FSK modulation (Mode 66)
Dwell Time = 133.3ms
Total bins in 20 s = 3
Total time occupancy (in 20s) = 3 x 133.3ms
=**399.9ms**



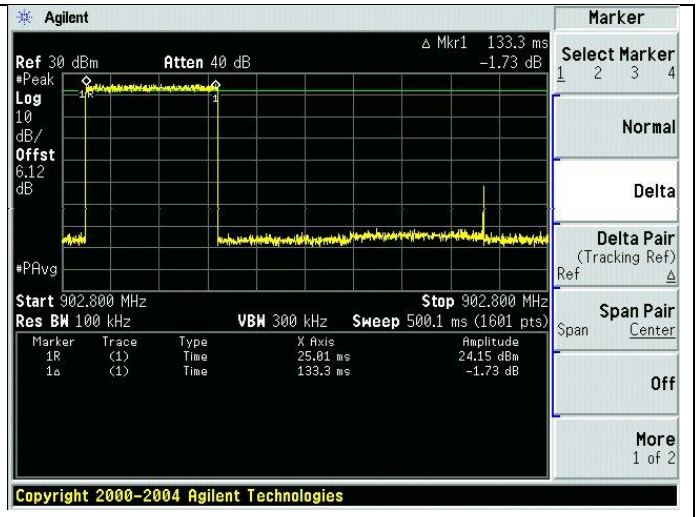


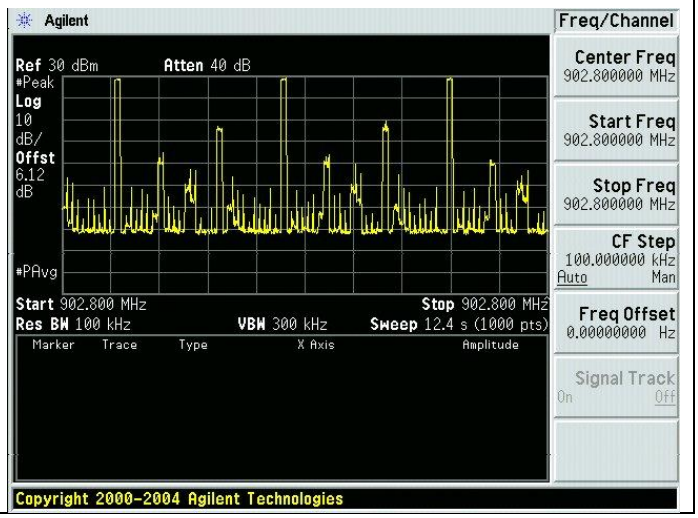
2FSK modulation (Mode 98)
Dwell Time = 133.3ms
Total bins in 20 s = 3
Total time occupancy (in 20s) = 3 x 133.3ms = **399.9ms**



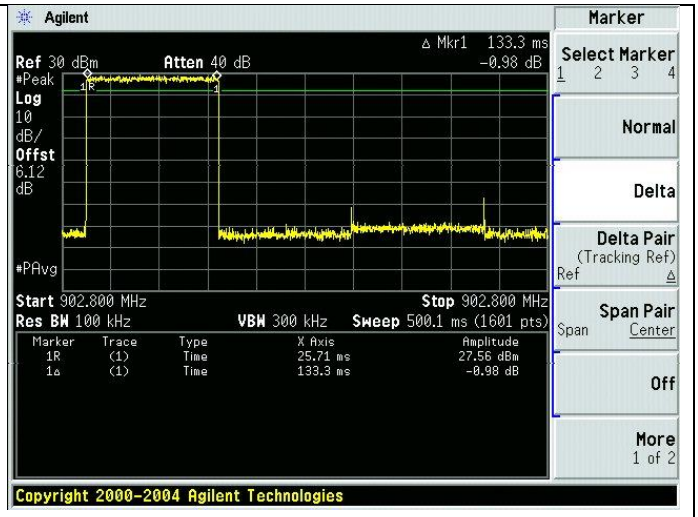


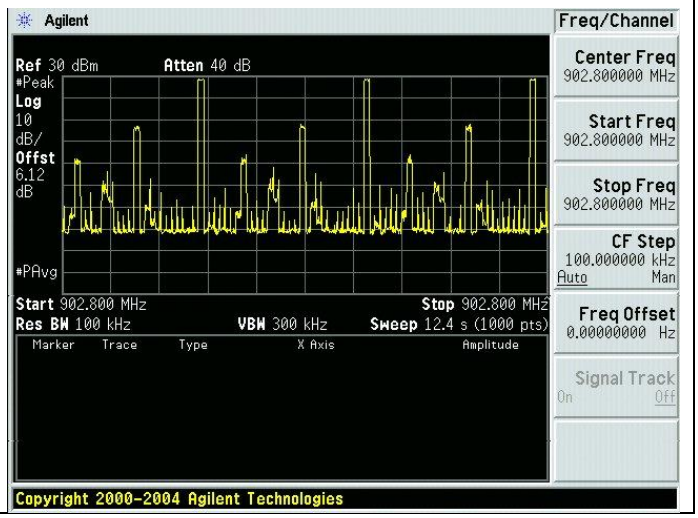
OFDM modulation (Mode 144)
Dwell Time = 133.3ms
Total bins in 12.4s = 3
Total time occupancy (in 12.4s) = 3 x 133.3ms = **399.9ms**



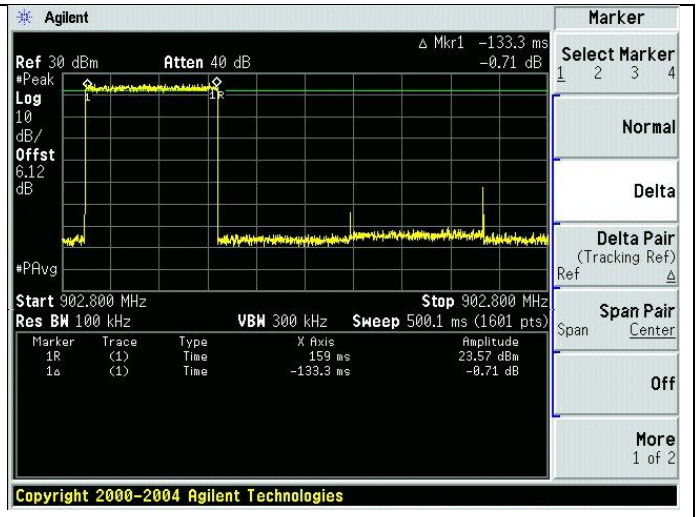


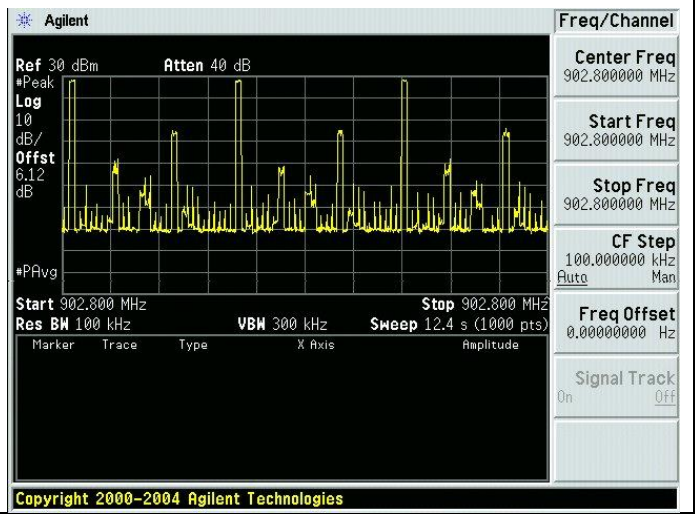
OFDM modulation (Mode 146)
Dwell Time = 133.3ms
Total bins in 12.4 s = 3
Total time occupancy (in 12.4s) = 3 x 133.3ms = **399.9ms**



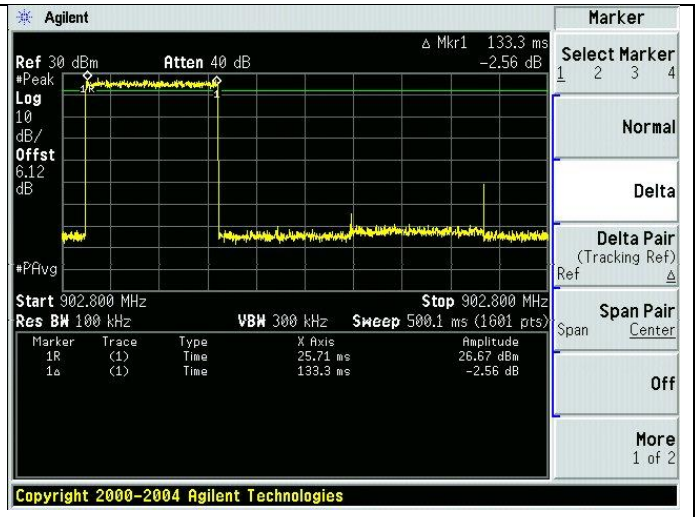


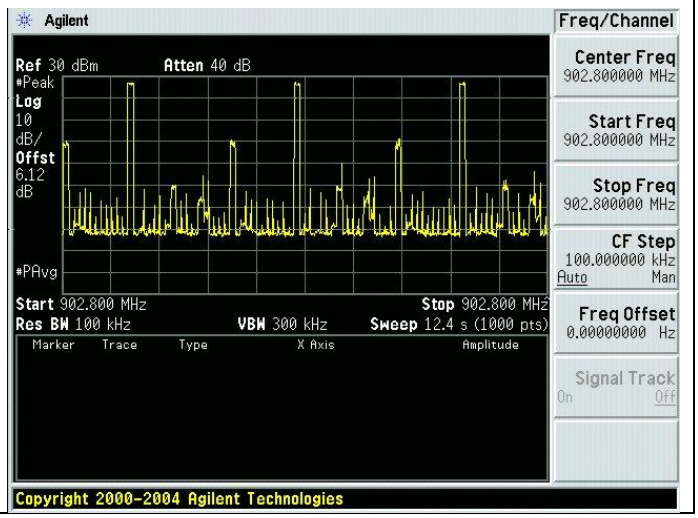
OFDM modulation (Mode 147)
Dwell Time = 133.3ms
Total bins in 12.4s = 3
Total time occupancy (in 12.4s) = 3 x 133.3ms = **399.9ms**



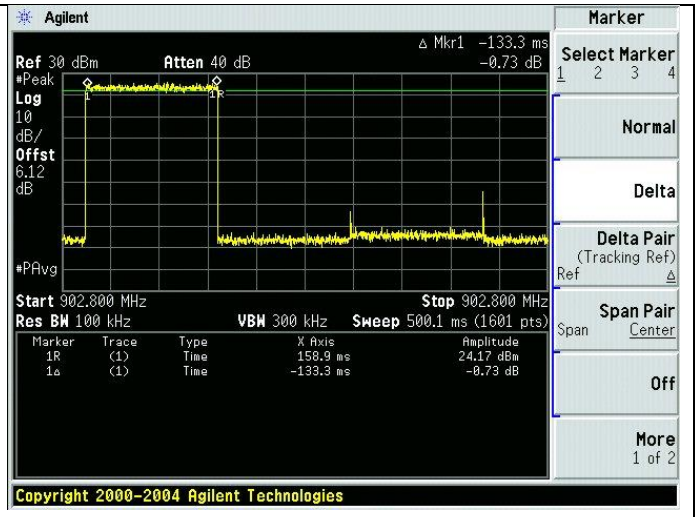


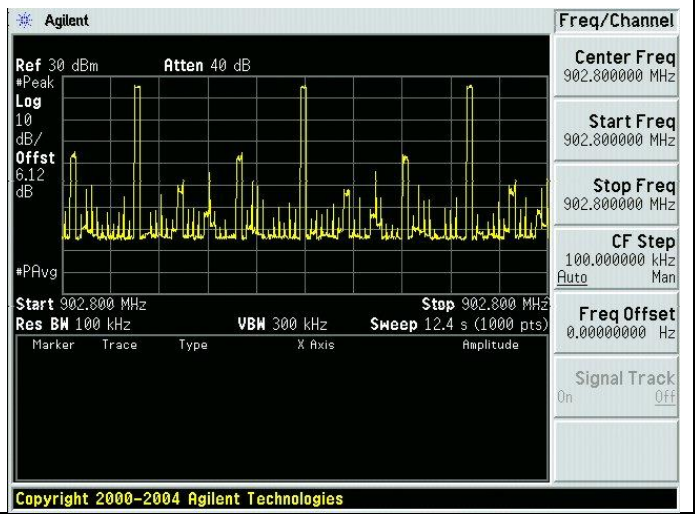
OFDM modulation (Mode 149)
Dwell Time = 133.3ms
Total bins in 12.4s = 3
Total time occupancy (in 12.4s) = 3 x 133.3ms = **399.9ms**





OFDM modulation (Mode 150)
Dwell Time = 133.3ms
Total bins in 12.4s = 3
Total time occupancy (in 12.4s) = 3 x 133.3ms = **399.9ms**





Conducted Band Edge Measurements (non-restricted band)

15.247 (d) & RSS-247

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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in FCC §15.209(a) & RSS-Gen is not required.

Test Procedure

Ref. KDB 558074 D01 DTS Meas Guidance v03r05
ANSI C63.10: 2013

Test Procedure
1. Connect the antenna port(s) to the spectrum analyzer input. 2. Place the radio in continuous transmit mode. Use the procedures in KDB 558074 D01 DTS Meas Guidance v03r05 to substitute conducted measurements in place of radiated measurements. 3. Configure Spectrum analyzer as per test parameters below below (be sure to enter all losses between the transmitter output and the spectrum analyzer). 4. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands.. 5. The “measure-and-sum technique” is used for measuring in-band transmit power of a device. In the measure-and-sum approach, the conducted emission level is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in linear power units. The worst case output is recorded. 6. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands 7. Capture graphs and record pertinent measurement data.

Test parameters non-restricted Band
KDB 558074 D01 v03r05 section 11.1b, 11.2-3, also see
ANSI C63.10: 2013 section 11.10.3

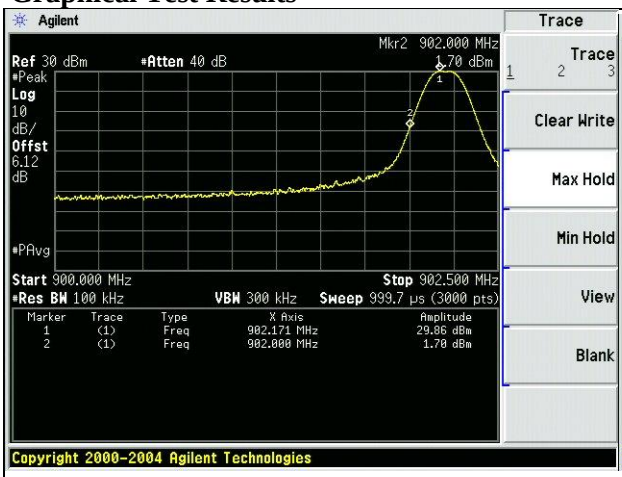
RBW = 100 kHz
VBW ≥ 3 x RBW
Sweep = Auto couple
Detector = Peak
Trace = Max Hold.

Overall Result: PASS

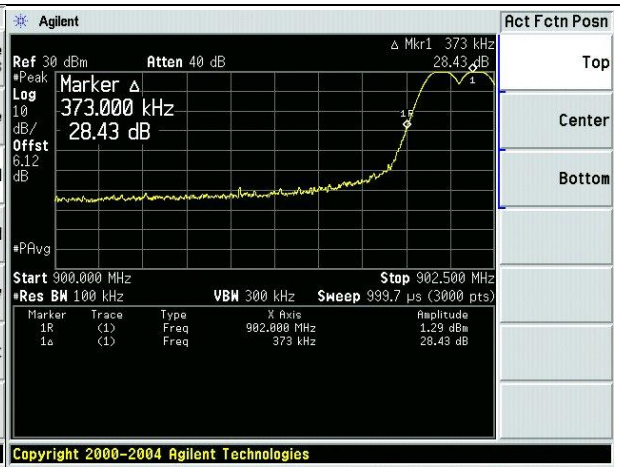
Measurement procedure as per KDB Publication ANSI C63.10: 2013

Frequency (MHz)	Mode	Data Rate (Kbps)	Conducted Bandedge Delta (dBc)	Limit (dBc)	Margin (dB)
902.2 (ch0)	**OQPSK (200kHz spacing) mode 192**	**6.25**	**28.16**	**>20**	**8.16**
	2FSK (200kHz spacing mode 64	50.00	30.16	>20	10.16
902.4 (ch0)	2FSK (400kHz spacing) mode 66	150	46.03	>20	26.03
	2FSK (400kHz spacing) mode 98	150	45.86	>20	25.86
902.8 (ch0)	OFDM (800kHz spacing) mode 144	50	31.91	>30	1.91
	OFDM (800kHz spacing) mode 146	**200**	**30.44**	**>30**	**0.44**
	OFDM (800kHz spacing) mode 147	400	30.72	>30	0.72
	OFDM (800kHz spacing) mode 149	800	32.29	>30	2.29
	OFDM (800kHz spacing) mode 150	1200	30.62	>30	0.62
926.8 (ch30)	**OFDM (800kHz spacing) mode 144**	**50**	**31.22**	**>30**	**1.22**
	OFDM (800kHz spacing) mode 146	200	32.44	>30	2.44
	OFDM (800kHz spacing) mode 147	400	33.01	>30	3.01
	OFDM (800kHz spacing) mode 149	800	43.24	>30	13.24
	OFDM (800kHz spacing) mode 150	1200	46.83	>30	16.83
927.6 (ch63)	2FSK (400kHz spacing) mode 66	150	45.41	>20	25.41
	2FSK (400kHz spacing) mode 98	150	44.93	>20	24.93
927.8 (ch128)	**OQPSK (200kHz spacing) mode 192**	**6.25**	**29.67**	**>20**	**9.67**
	2FSK (200kHz spacing mode 64	50.00	30.67	>20	10.67

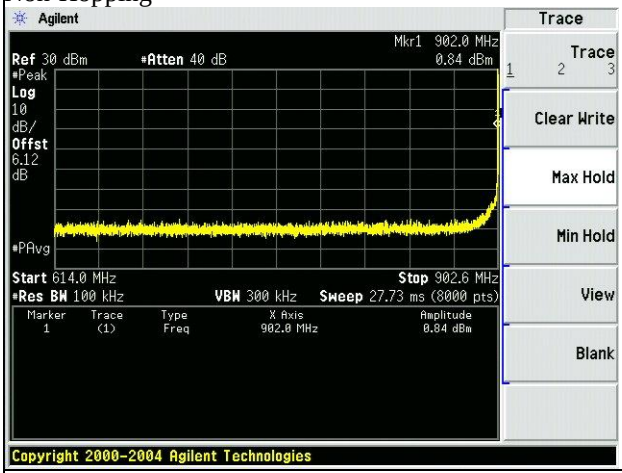
Graphical Test Results



Non-Hopping

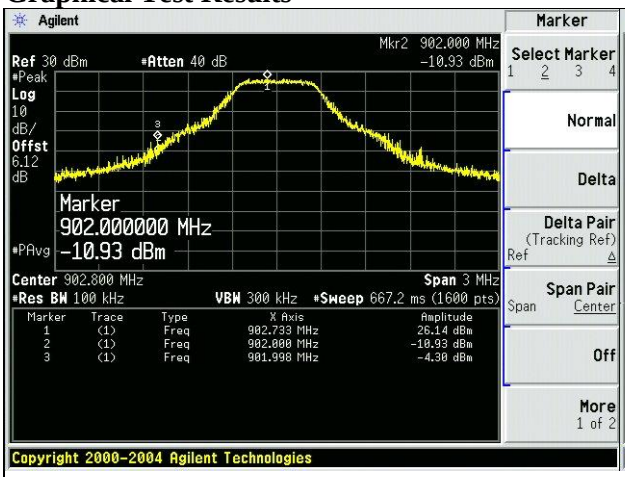


Hopping

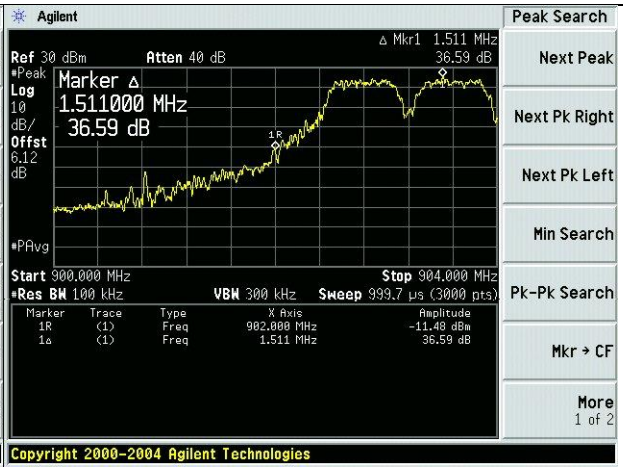


Title: Lower Band Edge Ch0: 902.2MHz with OQPSK modulation Mode 192

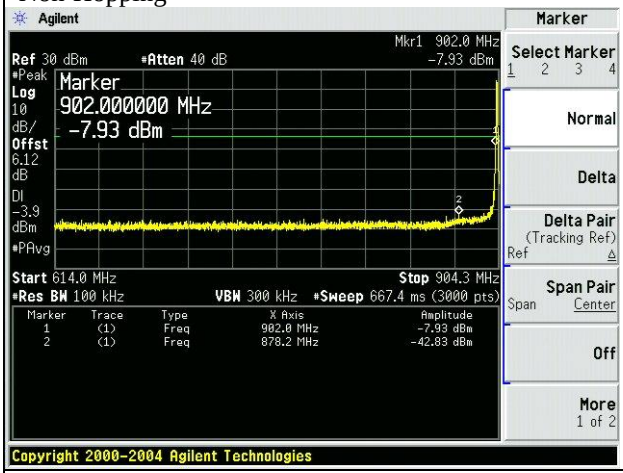
Graphical Test Results



Non-Hopping

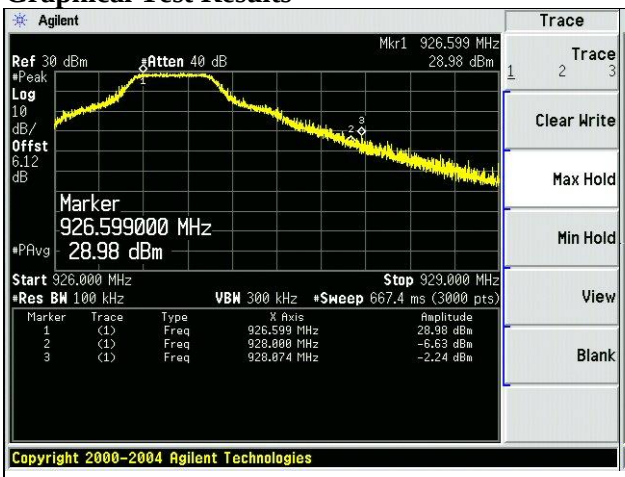


Hopping

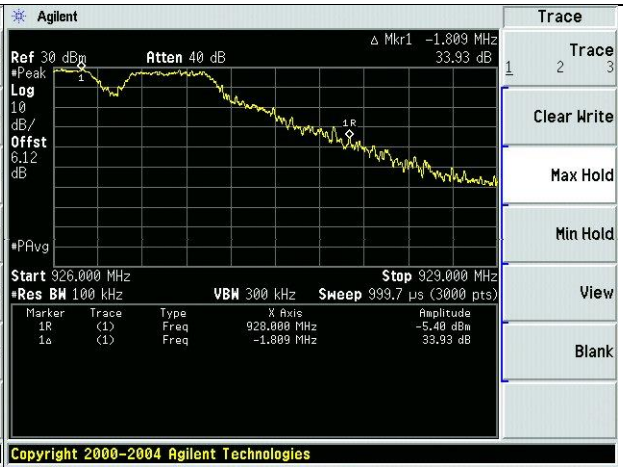


Title: Lower Band Edge Ch0: 902.8MHz with OFDM modulation Mode 146

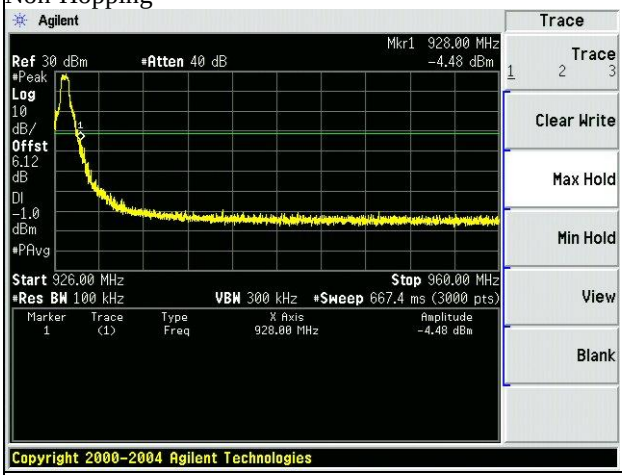
Graphical Test Results



Non-Hopping

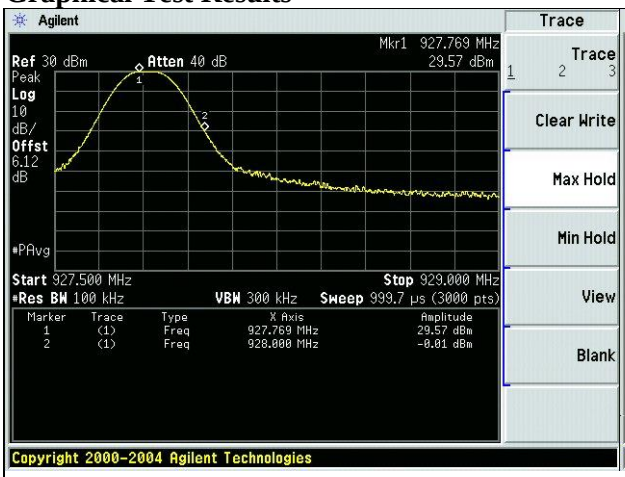


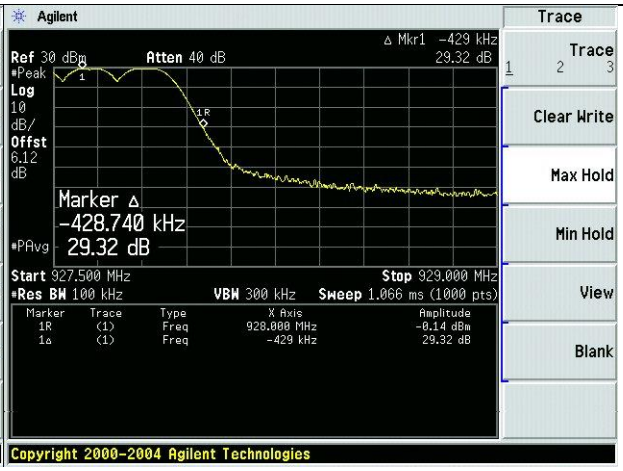
Hopping



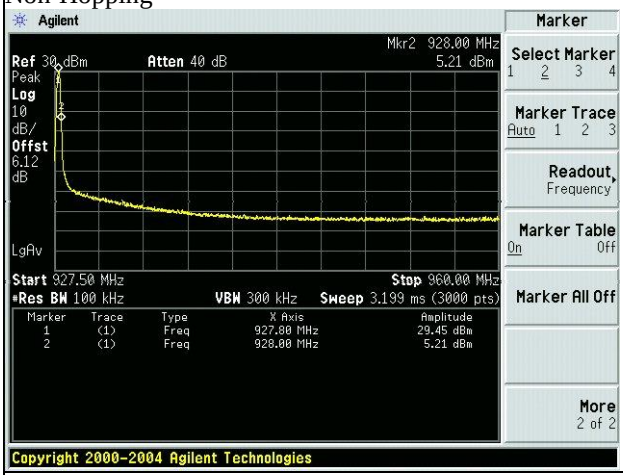
Title: Upper Band Edge Ch30: 926.8MHz with OFDM modulation Mode 144

Graphical Test Results





Non-Hopping Hopping



Title: Lower Band Edge Ch128: 927.8MHz with OQPSK modulation Mode 192

Conducted Spurious Emissions (non-restricted band)

15.247 (d) & RSS-247:
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. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in FCC §15.209(a) & RSS-Gen is not required.

Test Procedure

Ref. KDB 558074 D01 DTS Meas Guidance v03r05
ANSI C63.10: 2013

Test Procedure
1. Connect the antenna port(s) to the spectrum analyzer input. 2. Place the radio in continuous transmit mode. Use the procedures in KDB 558074 D01 DTS Meas Guidance v03r05 to substitute conducted measurements in place of radiated measurements. 3. Configure Spectrum analyzer as per test parameters below below (be sure to enter all losses between the transmitter output and the spectrum analyzer). 4. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands.. 5. The “measure-and-sum technique” is used for measuring in-band transmit power of a device. In the measure-and-sum approach, the conducted emission level is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in linear power units. The worst case output is recorded. 6. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands 7. Capture graphs and record pertinent measurement data.

Test parameters non-restricted Band
KDB 558074 D01 v03r05 section 11.1b, 11.2-3, also see
ANSI C63.10: 2013 section 11.10.3

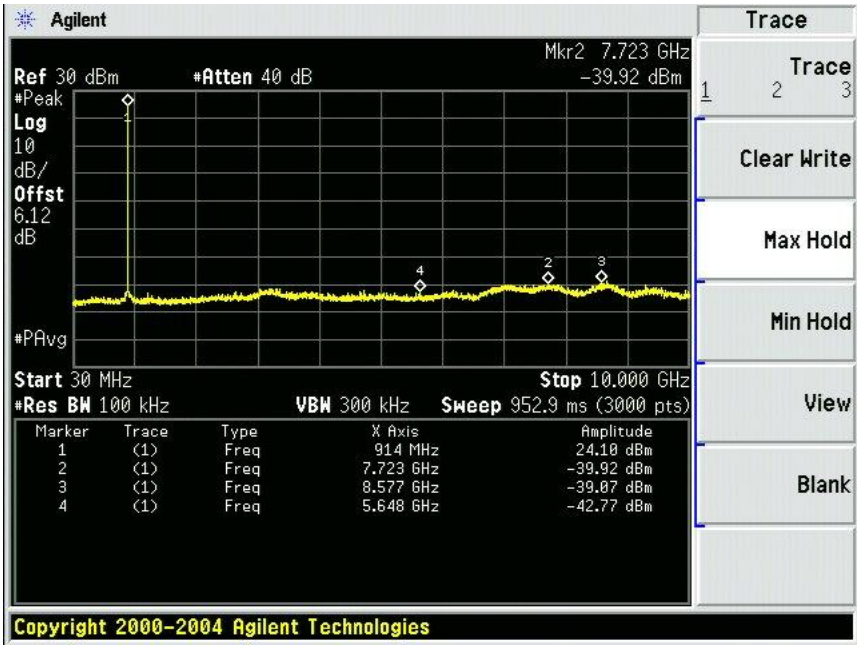
RBW = 100 kHz
VBW ≥ 3 x RBW
Sweep = Auto couple
Detector = Peak
Trace = Max Hold.

Test Results

Frequency (MHz)	Mode	Data Rate (Kbps)	Conducted Bandedge Delta (dBc)	Limit (dBc)	Margin (dB)
902.2 (ch0)	OQPSK (200kHz spacing) mode 192	6.25	68.84	20	48.84
	2FSK (200kHz spacing mode 64	50.00	69.45	20	49.45
902.4 (ch0)	2FSK (400kHz spacing) mode 66	150	68.39	20	48.39
	2FSK (400kHz spacing) mode 98	150	67.41	20	47.41
902.8 (ch0)	OFDM (800kHz spacing) mode 144	50	64.14	30	34.14
	OFDM (800kHz spacing) mode 146	200	65.31	30	35.31
	OFDM (800kHz spacing) mode 147	400	64.3	30	34.3
	OFDM (800kHz spacing) mode 149	800	64.88	30	34.88
	OFDM (800kHz spacing) mode 150	1200	63.43	30	33.43
914.8 (ch15)	OFDM (800kHz spacing) mode 144	50	69.23	30	39.23
	OFDM (800kHz spacing) mode 146	200	65.9	30	35.9
	OFDM (800kHz spacing) mode 147	400	66.69	30	36.69
	OFDM (800kHz spacing) mode 149	800	64.17	30	34.17
	OFDM (800kHz spacing) mode 150	1200	63.17	30	33.17
915 (ch64)	OQPSK (200kHz spacing) mode 192	6.25	71.69	20	51.69
	2FSK (200kHz spacing mode 64	50.00	68.87	20	48.87
915.2 (ch32)	2FSK (400kHz spacing) mode 66	150	64.74	20	44.74
	2FSK (400kHz spacing) mode 98	150	68.84	20	48.84
926.8 (ch30)	OFDM (800kHz spacing) mode 144	50	67.85	30	37.85
	OFDM (800kHz spacing) mode 146	200	67.54	30	37.54
	OFDM (800kHz spacing) mode 147	400	67.31	30	37.31
	OFDM (800kHz spacing) mode 149	800	65.3	30	35.3

	OFDM (800kHz spacing) mode 150	1200	62.5	30	32.5
927.6 (ch63)	2FSK (400kHz spacing) mode 66	150	68.47	20	48.47
	2FSK (400kHz spacing) mode 98	150	68.84	20	48.84
927.8 (ch128)	OQPSK (200kHz spacing) mode 192	6.25	69.37	20	49.37
	2FSK (200kHz spacing mode 64	50.00	68.98	20	48.98

Conducted Emissions in Non-Restricted Band ch30 926.8MHz OFDM (800kHz spacing) mode 150



Conducted Spurious Emissions (restricted band)

15.205 / 15.209 / LP0002 - Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Use formula below to substitute conducted measurements in place of radiated measurements

E[dBµV/m] = EIRP[dBm] - 20 log(d[meters]) + 104.77, where E = field strength and d = 3 meter

1) Average Plot, Limit= -41.25 dBm eirp
2) Peak plot, Limit = -21.25 dBm eirp

Test Procedure

Ref. KDB 558074 D01 DTS Meas Guidance v03r05
ANSI C63.10: 2013

Conducted Spurious Emissions Test Procedure
1. Connect the antenna port(s) to the spectrum analyzer input. 2. Place the radio in continuous transmit mode 3. Configure Spectrum analyzer as per test parameters below (be sure to enter all losses between the transmitter output and the spectrum analyzer). 4. Use the peak marker function to determine the maximum spurs amplitude level. 5. The “measure-and-sum technique” is used for measuring in-band transmit power of a device. In the measure-and-sum approach, the conducted emission level is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in linear power units. The worst case output is recorded. (see ANSI C63.10 2013 section 14.3.2.2) 6. Capture graphs and record pertinent measurement data.

Ref. 558074 D01 DTS Meas Guidance v03r05 section 11.1b, 11.2-3, 12.2.4 & 12.2.5.3
ANSI C63.10: 2013 section 11.10.3 & 11.12.2.4 & 11.12.2.5.3

Conducted Spurious Emissions Test parameters
Span = 30 MHz-10GHz RBW = 100 kHz. VBW ≥ 3 x RBW Sweep = Auto couple Detector = Peak Trace = Max Hold

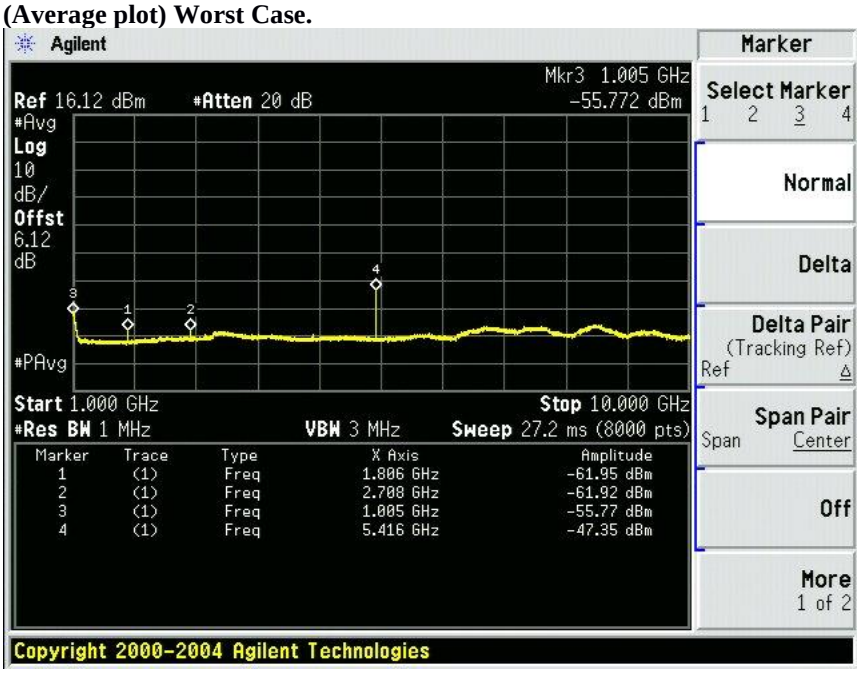
KDB: 558074 D01 DTS Meas Guidance v03r05 section 12.2.2 © add the max antenna gain + ground reflection factor (4.7 dB for frequencies between 30 MHz and 1000 MHz, and 0 dB for frequencies > 1000 MHz).

Average Conducted Emissions

Frequency (MHz)	Mode	Data Rate (Kbps)	Antenna Gain (dBi)	Tx 1 Spur Power (dBm)	Total Conducted Spur (dBm)	Limit (dB)	Margin (dB)
902.2 (ch0)	OQPSK (200kHz spacing) mode 192	6.25	5.6	-53.42	-47.82	-41.25	6.57
	2FSK (200kHz spacing) mode 64	50	5.6	-53.68	-48.08	-41.25	6.83
902.4 (ch0)	2FSK (400kHz spacing) mode 66	150	5.6	-57.08	-51.48	-41.25	10.23
	2FSK (400kHz spacing) mode 98	150	5.6	-54.03	-48.43	-41.25	7.18
902.8 (ch0)	OFDM (800kHz spacing) mode 144	50	5.6	-47.41	-41.81	-41.25	0.56
	OFDM (800kHz spacing) mode 146	**200**	**5.6**	**-47.35**	**-41.75**	**-41.25**	**0.5**
	OFDM (800kHz spacing) mode 147	400	5.6	-56.16	-50.56	-41.25	9.31
	OFDM (800kHz spacing) mode 149	800	5.6	-56.17	-50.57	-41.25	9.32
	OFDM (800kHz spacing) mode 150	1200	5.6	-56.08	-50.48	-41.25	9.23
914.8 (ch15)	OFDM (800kHz spacing) mode 144	50	5.6	-50.29	-44.69	-41.25	3.44
	OFDM (800kHz spacing) mode 146	200	5.6	-50.23	-44.63	-41.25	3.38
	OFDM (800kHz spacing) mode 147	400	5.6	-50.52	-44.92	-41.25	3.67
	OFDM (800kHz spacing) mode 149	800	5.6	-53.09	-47.49	-41.25	6.24
	OFDM (800kHz spacing) mode 150	1200	5.6	-56.29	-50.69	-41.25	9.44
915 (ch64)	OQPSK (200kHz spacing) mode 192	6.25	5.6	-55.99	-50.39	-41.25	9.14
	2FSK (200kHz spacing) mode 64	50	5.6	-55.94	-50.34	-41.25	9.09
915.2 (ch32)	2FSK (400kHz spacing) mode 98	150	5.6	-55.67	-50.07	-41.25	8.82
	2FSK (400kHz spacing) mode 98	150	5.6	-51.47	-45.87	-41.25	4.62
926.8 (ch30)	OFDM (800kHz spacing) mode 144	50	5.6	-52.31	-46.71	-41.25	5.46
	OFDM (800kHz spacing) mode 146	200	5.6	-52.17	-46.57	-41.25	5.32
	OFDM (800kHz spacing) mode 147	400	5.6	-51.47	-45.87	-41.25	4.62
	OFDM (800kHz spacing) mode 149	800	5.6	-53.69	-48.09	-41.25	6.84

	OFDM (800kHz spacing) mode 150	1200	5.6	-56.61	-51.01	-41.25	9.76
927.6 (ch63)	2FSK (400kHz spacing) mode 66	150	5.6	-57.29	-51.69	-41.25	10.44
	2FSK (400kHz spacing) mode 98	150	5.6	-55.6	-50	-41.25	8.75
927.8 (ch128)	OQPSK (200kHz spacing) mode 192	6.25	5.6	-52.36	-46.76	-41.25	5.51
	2FSK (200kHz spacing) mode 64	50	5.6	-55.4	-49.8	-41.25	8.55

Conducted Emissions in Restricted Band ch0 902.8MHz OFDM (800kHz spacing) mode 146 (Average plot) Worst Case.

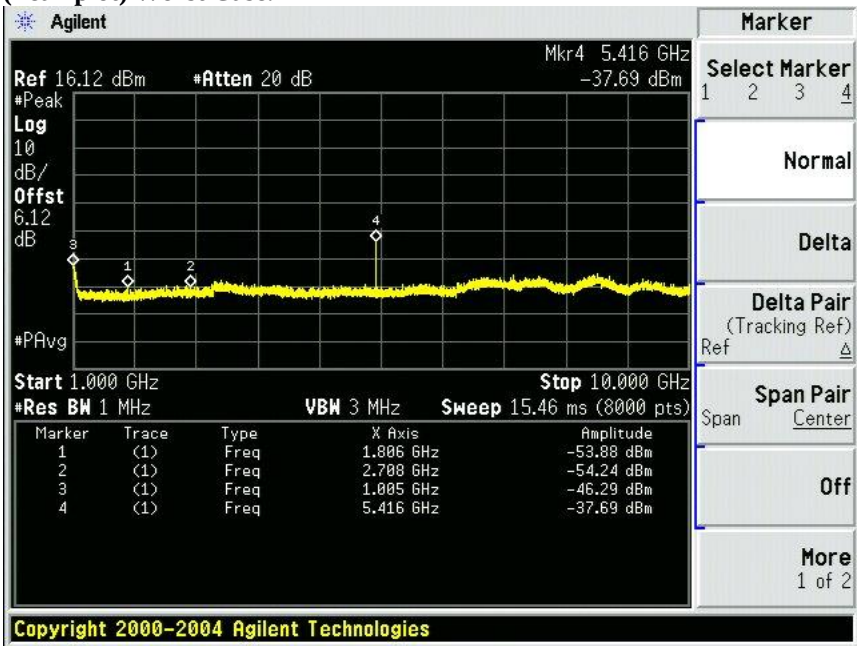


Peak Measurements

Frequency (MHz)	Mode	Data Rate (Kbps)	Antenna Gain (dBi)	Tx 1 Spur Power (dBm)	Total Conducted Spur (dBm)	Limit (dB)	Margin (dB)
902.2 (ch0)	OQPSK (200kHz spacing) mode 192	6.25	5.6	-48.51	-42.91	-21.25	21.66
	2FSK (200kHz spacing) mode 64	50	5.6	-47.05	-41.45	-21.25	20.2
902.4 (ch0)	2FSK (400kHz spacing) mode 66	150	5.6	-47.05	-41.45	-21.25	20.2
	2FSK (400kHz spacing) mode 98	150	5.6	-48.54	-42.94	-21.25	21.69
902.8 (ch0)	OFDM (800kHz spacing) mode 144	50	5.6	-37.81	-32.21	-21.25	10.96
	OFDM (800kHz spacing) mode 146	**200**	**5.6**	**-37.69**	**-32.09**	**-21.25**	**10.84**
	OFDM (800kHz spacing) mode 147	400	5.6	-46.6	-41	-21.25	19.75
	OFDM (800kHz spacing) mode 149	800	5.6	-44.66	-39.06	-21.25	17.81
	OFDM (800kHz spacing) mode 150	1200	5.6	-44.97	-39.37	-21.25	18.12
914.8 (ch15)	OFDM (800kHz spacing) mode 144	50	5.6	-40.69	-35.09	-21.25	13.84
	OFDM (800kHz spacing) mode 146	200	5.6	-41.04	-35.44	-21.25	14.19
	OFDM (800kHz spacing) mode 147	400	5.6	-40.02	-34.42	-21.25	13.17
	OFDM (800kHz spacing) mode 149	800	5.6	-42.87	-37.27	-21.25	16.02
	OFDM (800kHz spacing) mode 150	1200	5.6	-46.53	-40.93	-21.25	19.68
915 (ch64)	OQPSK (200kHz spacing) mode 192	6.25	5.6	-45.6	-40	-21.25	18.75
	2FSK (200kHz spacing) mode 64	50	5.6	-47.82	-42.22	-21.25	20.97
915.2 (ch32)	2FSK (400kHz spacing) mode 66	150	5.6	-47.63	-42.03	-21.25	20.78
	2FSK (400kHz spacing) mode 98	150	5.6	-47.62	-42.02	-21.25	20.77
926.8 (ch30)	OFDM (800kHz spacing) mode 144	50	5.6	-40.38	-34.78	-21.25	13.53
	OFDM (800kHz spacing) mode 146	200	5.6	-40.94	-35.34	-21.25	14.09
	OFDM (800kHz spacing) mode 147	400	5.6	-40.38	-34.78	-21.25	13.53
	OFDM (800kHz spacing) mode 149	800	5.6	-44.03	-38.43	-21.25	17.18

	OFDM (800kHz spacing) mode 150	1200	5.6	-44.7	-39.1	-21.25	17.85
927.6 (ch63)	2FSK (400kHz spacing) mode 66	150	5.6	-48.52	-42.92	-21.25	21.67
	2FSK (400kHz spacing) mode 98	150	5.6	-48.64	-43.04	-21.25	21.79
927.8 (ch128)	OQPSK (200kHz spacing) mode 192	6.25	5.6	-48.16	-42.56	-21.25	21.31
	2FSK (200kHz spacing) mode 64	50	5.6	-49.12	-43.52	-21.25	22.27

Conducted Emissions in Restricted Band ch0 902.8MHz OFDM (800kHz spacing) mode 146 (Peak plot) Worst Case.



AC Conducted Emissions for AC Power Adapter:

15.207 & RSS GEN sec 7.2.4
(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

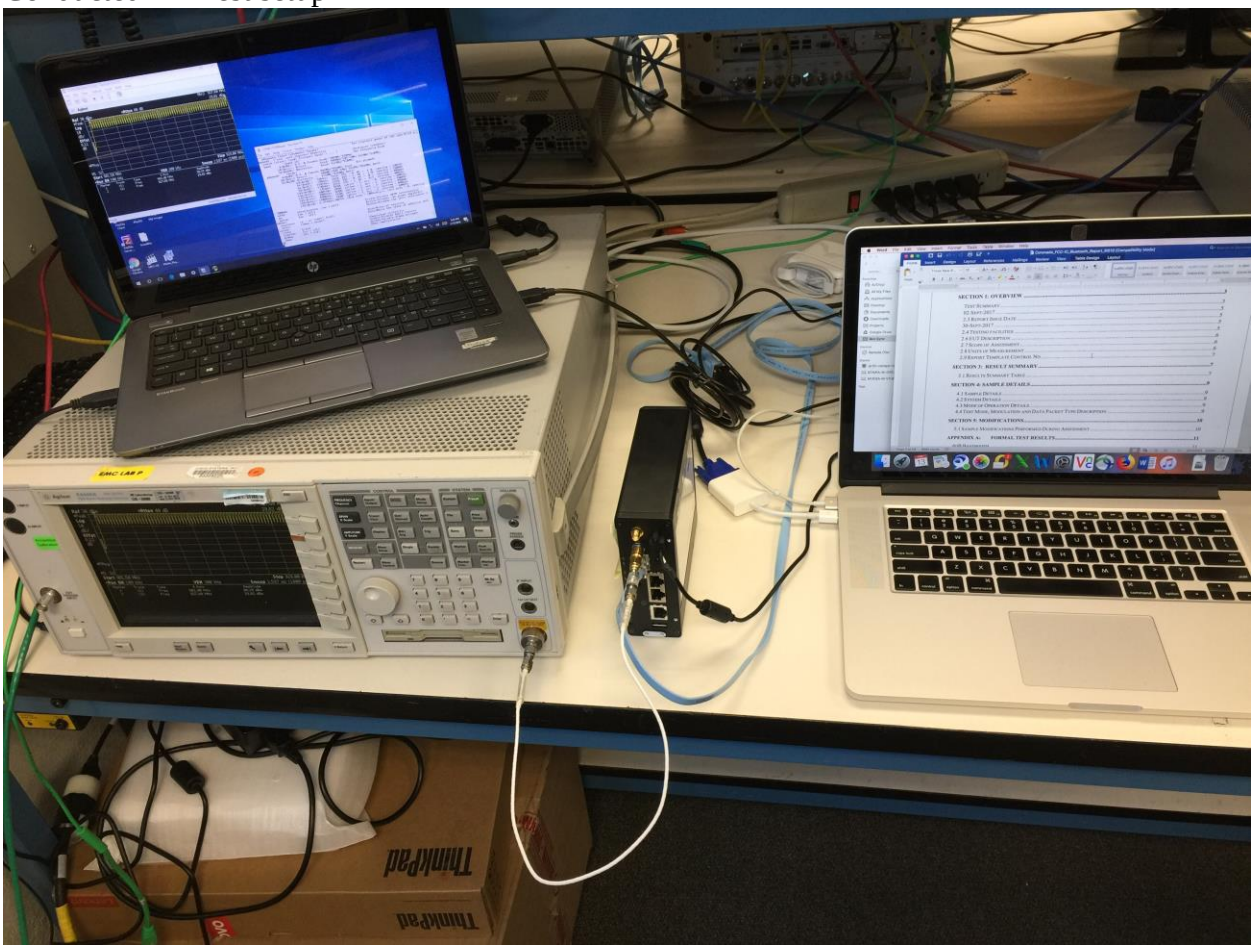
Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). Place the radio in continuous transmit mode.

Span:	150kHz – 30Hz
Reference Level:	70 dBuV
Attenuation:	10 dB
Sweep Time:	Auto
Resolution Bandwidth:	9Hz
Video Bandwidth:	30kHz
Detector: Quasi-Peak	

The IR510 is DC powered, Test not applicable

Physical Test arrangement Photograph:

Conducted RF Test setup



Radiated Spurious and Harmonics Emissions (TX)

15.205 / 15.209: Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

1. Device under test is placed in a Continuous Tx Mode with Hopping Sequence Turned "OFF"
2. For Testing performed above 1GHz a HighPass Filter is used. Correction factors are factored into the test results. Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer).

Span:	1GHz – 10 GHz
Reference Level:	80 dBuV
Attenuation:	10 dB
Sweep Time:	Coupled
Resolution Bandwidth:	1MHz
Video Bandwidth:	3MHz for peak
Detector:	Peak , RMS for Average
Averageing Type:	RMS

Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

Save 2 plots: 1) Average Plot (Vertical and Horizontal), Limit= 54dBuV/m @3m
2) Peak plot (Vertical and Horizontal), Limit = 74dBuV/m @3m

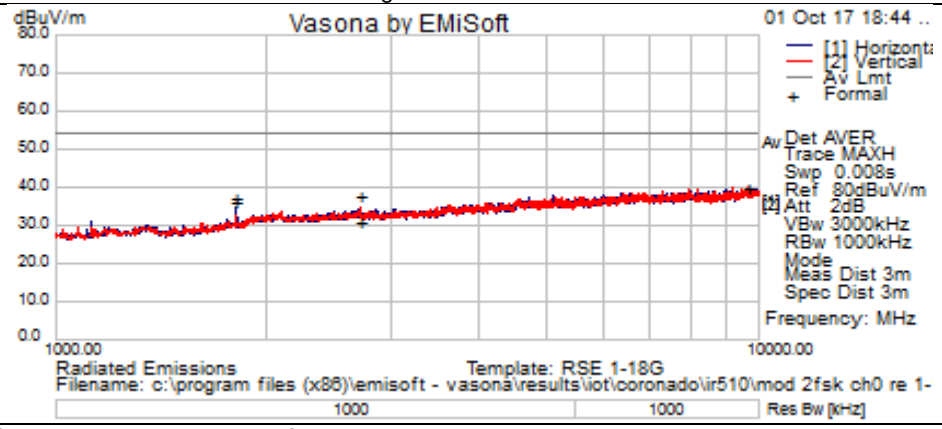
This report represents the worst case data for all supported operating modes and antennas. System was evaluated up to 10GHz.

Note: A RF Filter was used during formal testing from 1 – 10GHz to help prevent the front end of the analyzer from over loading. The High pass filters used are designed to suppress Tx fundamental frequency but do not effect harmonics of the fundamental frequency from being measured

Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Results	
Subtest Title	902.2 MHz RE 1-10GHz Average plot
Subtest Result	Pass
Highest Frequency	10000.0
Lowest Frequency	1000.0
Comments on the above Test Results	**902.2 MHz RE 1-10GHz Average plot**

Graphical Test Results

Note that the data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements



Title: **902.2Mhz RE 1-10GHz Average plot**

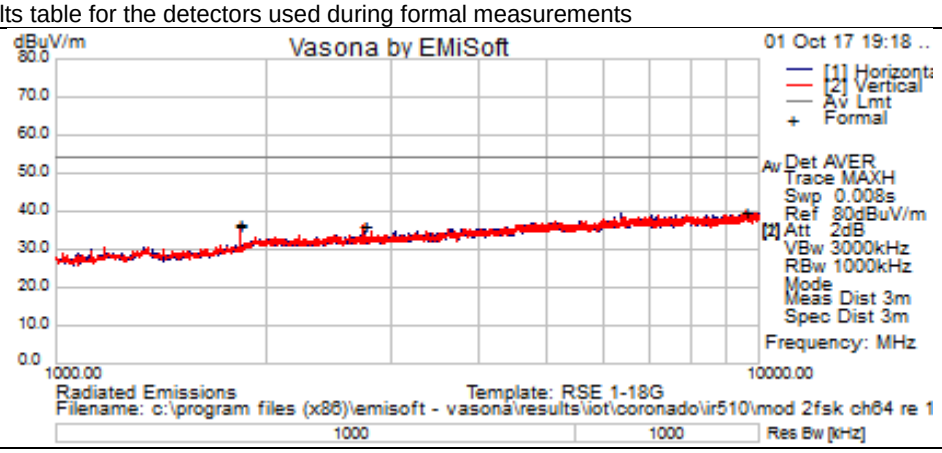
Test Results Table

Frequency MHz	Raw d BuV	Cable Loss	AF d B	Level dBu V/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBu V/m	Margin dB	Pass / Fail
1804.414	47.41	3.46	-13.48	37.38	Average.	V	113	150	54	-16.62	Pass
1804.414	46.37	3.46	-13.48	36.34	Average.	H	147	100	54	-17.66	Pass
2706.477	43.54	4.33	-10.33	37.55	Average.	H	113	274	54	-16.46	Pass
2706.477	37.03	4.33	-10.33	31.04	Average.	V	169	219	54	-22.96	Pass
9640	33.72	9.23	-3.13	39.83	Average.	H	150	0	54	-14.17	Pass

Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Results	
Subtest Title	915 Mhz RE 1-10GHz Average plot
Subtest Result	Pass
Highest Frequency	10000.0
Lowest Frequency	1000.0
Comments on the above Test Results	**915 Mhz RE 1-10GHz Average plot**

Graphical Test Results

Note that the data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements



Title: 915 **Mhz RE 1-10GHz Average plot**

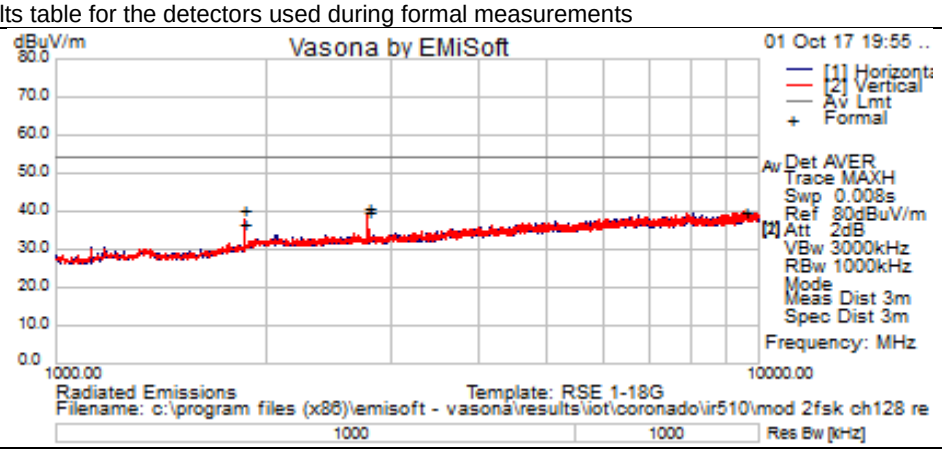
Test Results Table

Frequency MHz	Raw d BuV	Cable Loss	AF dB	Level dBuV /m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
1829.688	46.3	3.5	-13.2	36.6	Average.	V	117	284	54	-17.4	Pass
1829.688	45.9	3.5	-13.2	36.19	Average.	H	163	102	54	-17.81	Pass
2743.79	41.7	4.4	-10.1	35.97	Average.	H	126	312	54	-18.03	Pass
2743.79	41.7	4.4	-10.1	35.97	Average.	V	174	115	54	-18.03	Pass
9586.563	33.66	9.22	-3.17	39.71	Average.	V	150	0	54	-14.29	Pass

Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Results	
Subtest Title	907.8Mhz RE 1-10GHz Average plot
Subtest Result	Pass
Highest Frequency	10000.0
Lowest Frequency	1000.0
Comments on the above Test Results	**927.8Mhz RE 1-10GHz Average plot**

Graphical Test Results

Note that the data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements



Title: **CH128 RE 1-10GHz Average plot**

Test Results Table

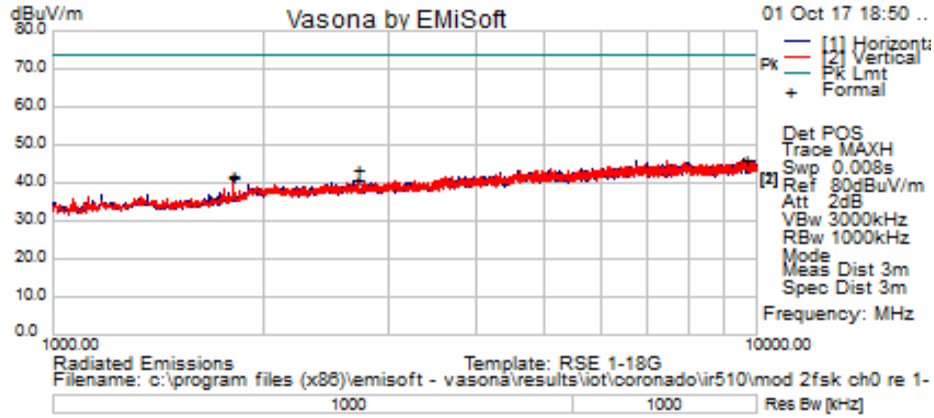
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
2783.469	47.04	4.4	-10.24	41.21	Average.	V	176	146	54	-12.79	Pass
2783.469	45.77	4.4	-10.24	39.93	Average.	H	100	240	54	-14.07	Pass
1855.594	49.78	3.52	-12.99	40.31	Average.	V	171	4	54	-13.69	Pass
1855.594	46.23	3.52	-12.99	36.76	Average.	H	152	306	54	-17.24	Pass
9541.563	33.72	9.14	-3.18	39.68	Average.	V	150	0	54	-14.32	Pass

Peak Measurements

Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Results	
Subtest Title	902.2 MHz RE 1-10GHz Peak plot
Subtest Result	Pass
Highest Frequency	10000.0
Lowest Frequency	1000.0
Comments on the above Test Results	**902.2 Mhz RE 1-10GHz Peak plot**

Graphical Test Results

Note that the data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements



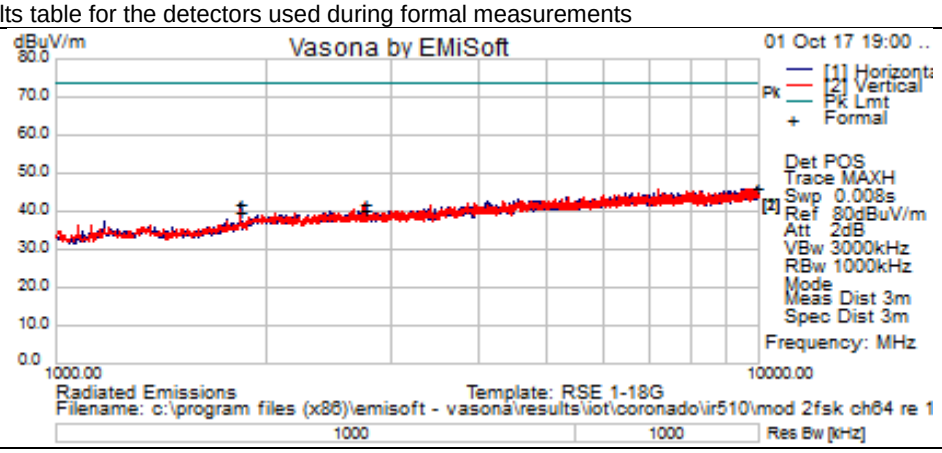
Test Results Table

Frequency MHz	Raw d BuV	Cable Loss	AF d B	Level dBu V/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBu V/m	Margin dB	Pass / Fail
1804.414	52.08	3.46	-13.48	42.06	Peak.	V	113	150	74	-31.94	Pass
1804.414	51.36	3.46	-13.48	41.34	Peak.	H	147	100	74	-32.66	Pass
2706.477	49.48	4.33	-10.33	43.49	Peak.	H	113	274	74	-30.52	Pass
2706.477	47.13	4.33	-10.33	41.14	Peak.	V	169	219	74	-32.86	Pass
9611.875	40.06	9.26	-3.17	46.15	Peak.	H	150	0	74	-27.85	Pass

Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Results	
Subtest Title	915 MHz RE 1-10GHz Peak plot
Subtest Result	Pass
Highest Frequency	10000.0
Lowest Frequency	1000.0
Comments on the above Test Results	**915 MHz RE 1-10GHz Peak plot**

Graphical Test Results

Note that the data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements



Title: **915 Mhz RE 1-10GHz Peak plot**

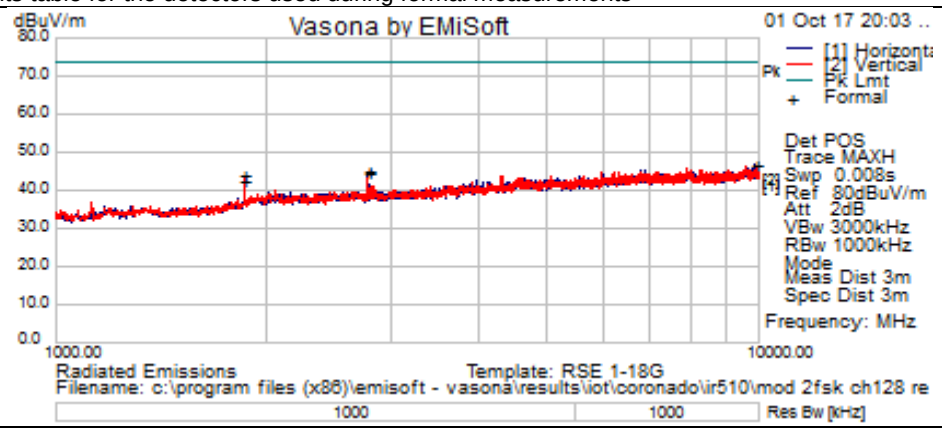
Test Results Table

Frequency MHz	Raw d BuV	Cable L oss	AF dB	Level dBu V/m	Measurement Type	Pol	Hgt cm	Azt D eg	Limit dBu V/m	Margin dB	Pass / Fail
1829.6875	51.7	3.5	-13.2	41.91	Peak.	H	150	42	74	-32.09	Pass
1829.6875	49.8	3.5	-13.2	40.1	Peak.	V	113	50	74	-33.9	Pass
2745.723	47.6	4.4	-10.2	41.8	Peak.	V	117	285	74	-32.2	Pass
2745.723	46.4	4.4	-10.2	40.58	Peak.	H	158	280	74	-33.42	Pass
9943.75	39.55	9.39	-2.83	46.11	Peak.	H	150	0	74	-27.9	Pass

Engineer	Jose Aguirre
Lab Information	Building P, 10m Anechoic
Subtest Results	
Subtest Title	927.8 Mhz RE 1-10GHz Peak plot
Subtest Result	Pass
Highest Frequency	10000.0
Lowest Frequency	1000.0
Comments on the above Test Results	**927.8 Mhz RE 1-10GHz Peak plot**

Graphical Test Results

Note that the data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements



Title: **927.8 Mhz RE 1-10GHz Peak plot**

Test Results Table

Frequency MHz	Raw d BuV	Cable Loss	AF d B	Level dBu V/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBu V/m	Margin dB	Pass / Fail
2783.469	51.25	4.4	-10.24	45.42	Peak.	V	176	146	74	-28.58	Pass
2783.469	50.73	4.4	-10.24	44.89	Peak.	H	100	240	74	-29.11	Pass
1855.594	53.73	3.52	-12.99	44.27	Peak.	V	171	4	74	-29.74	Pass
1855.594	51.81	3.52	-12.99	42.34	Peak.	H	152	306	74	-31.66	Pass
9893.125	40.35	9.37	-2.93	46.79	Peak.	H	150	0	74	-27.21	Pass

Receiver Spurious Emissions

RSS-Gen section 4.10 & 6.1
The receiver shall be operated in the normal receive mode near the mid-point of the band in which the receiver is designed to operate.

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator frequency, intermediate or carrier frequency), Or 30 MHz, whichever is higher, to at least 3 times the highest tuneable or local oscillator frequency whichever is higher, without exceeding 40 GHz.

For emissions below 1000 MHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable CISPR quasi-peak bandwidth.

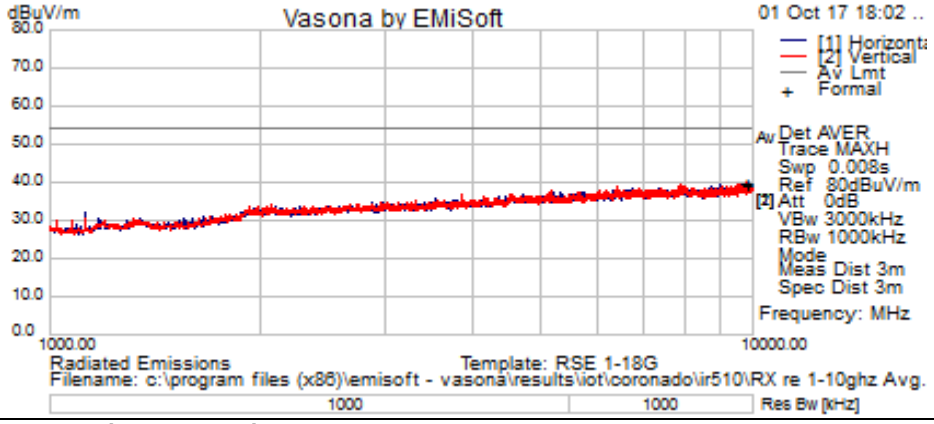
Above 1000 MHz, measurements shall be performed using an average detector with a minimum resolution bandwidth of 1 MHz.

Spurious emissions from receivers shall not exceed the radiated limits shown in the table 2 in section 6.1 of RSS-Gen.

Engineer	Jose Aguirre
Lab Information	Building P, 5m Anechoic
Subtest Results	
Subtest Title	Rx mode Average
Subtest Result	Pass
Highest Frequency	10000.0
Lowest Frequency	1000.0
Comments on the above Test Results	**Rx mode Average Plot**

Graphical Test Results

Note that the data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements



Title: **Rx mode Average plot**

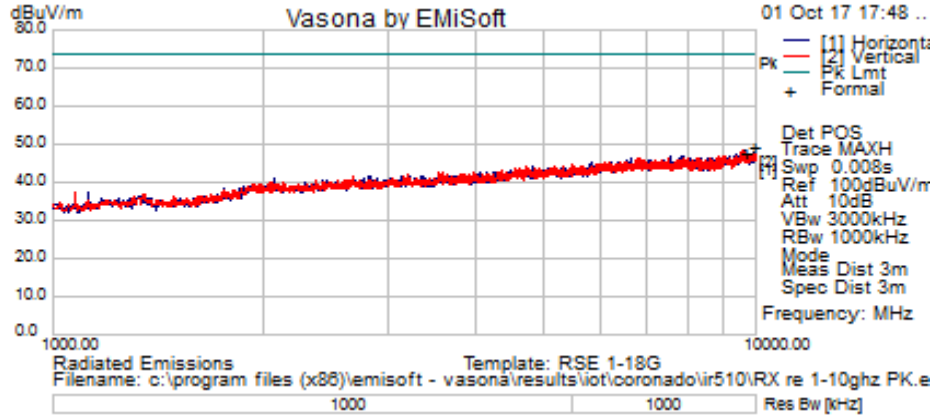
Test Results Table

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
9811.563	33.94	9.34	-3.33	39.95	Average.	V	150	0	54	-14.05	Pass
9811.563	33.3	9.3	-3.3	39.3	Average.	H	150	0	54	-14.7	Pass

Engineer	Jose Aguirre
Lab Information	Building P, 5m Anechoic
Subtest Results	
Subtest Title	Rx mode Peak plot
Subtest Result	Pass
Highest Frequency	10000.0
Lowest Frequency	1000.0
Comments on the above Test Results	

Graphical Test Results

Note that the data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements



Title: **Rx mode Peak plot**

Test Results Table

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
9651.25	42.31	9.23	-3.18	48.35	Peak.	H	150	0	74	-25.65	Pass
9651.25	42.9	9.2	-3.2	48.9	Peak.	V	150	0	74	-25.1	Pass

Radiated Emissions 30MHz to 1GHz

15.205 / 15.209: Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Span:	30MHz – 1 GHz
Attenuation:	10 dB
Sweep Time:	Coupled
Resolution Bandwidth:	120kHz
Video Bandwidth:	300kHz
Detector:	Peak

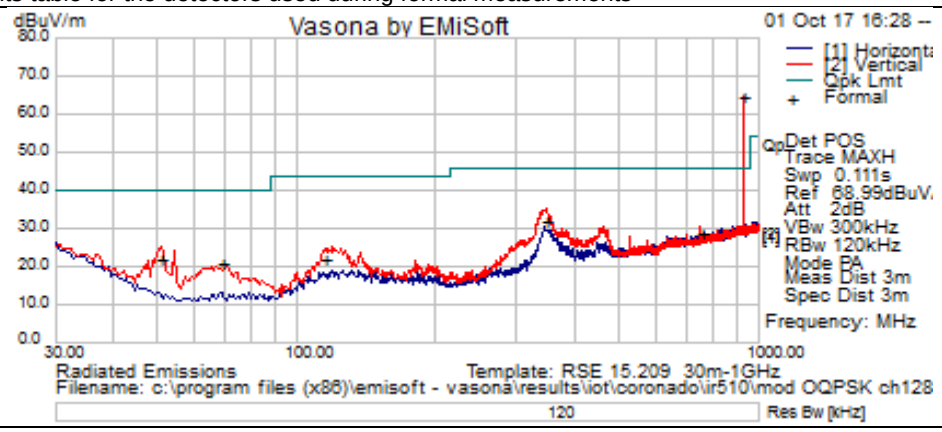
Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

This report represents the worst case data for all supported operating modes and antennas.

Engineer	Jose Aguirre
Lab Information	Building P, 5m Anechoic
Subtest Results	
Subtest Title	Radiated Emissions 30MHz to 1GHz
Subtest Result	Pass
Highest Frequency	1000.0
Lowest Frequency	30.0
Comments on the above Test Results	**Radiated Emissions 30MHz to 1GHz**

Graphical Test Results

Note that the data displayed on the plots detailed in this appendix were measured using a 'Peak Detector'. Please refer to the results table for the detectors used during formal measurements



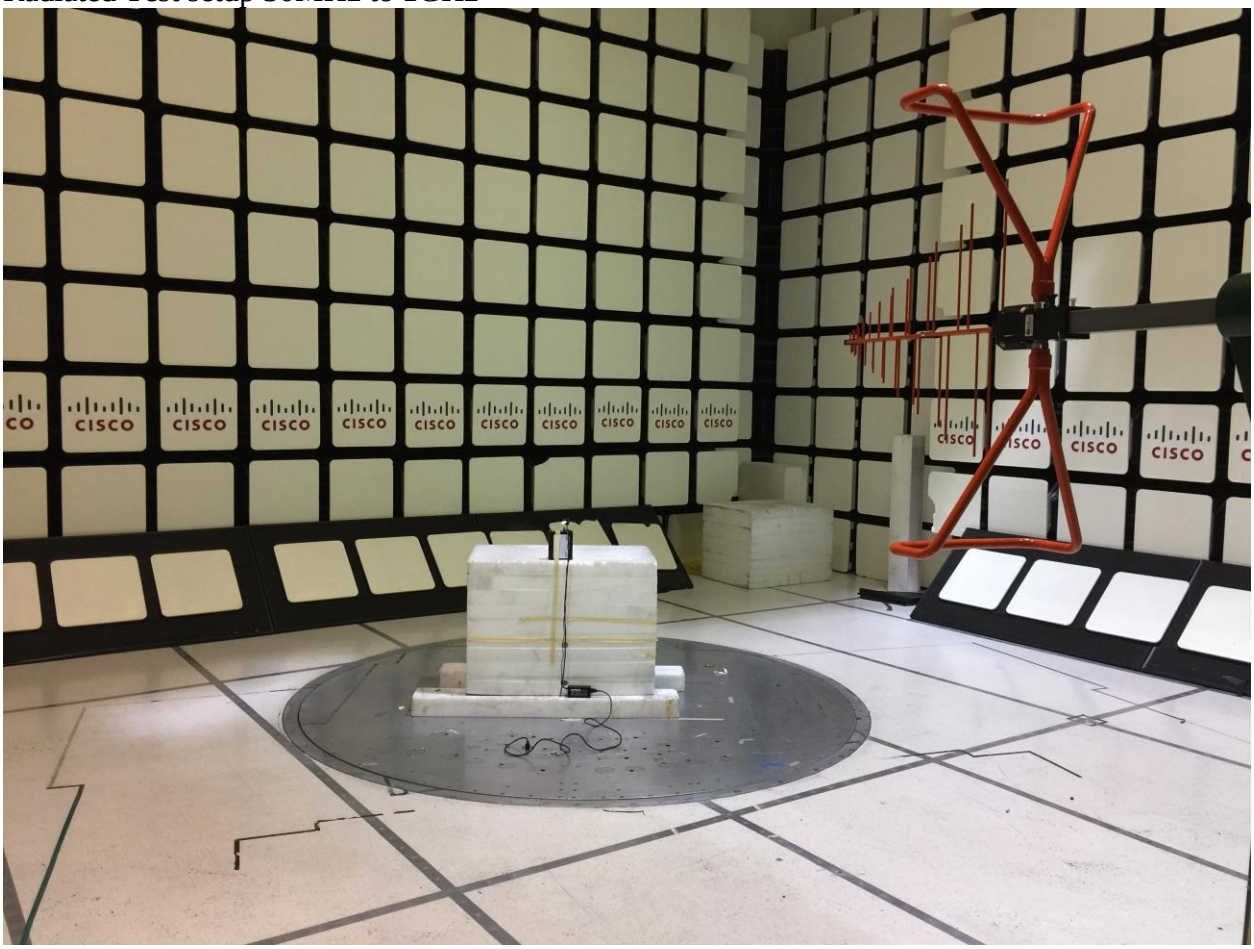
Title: **Spurious Emissions 30MHz to 1GHz**

Test Results Table

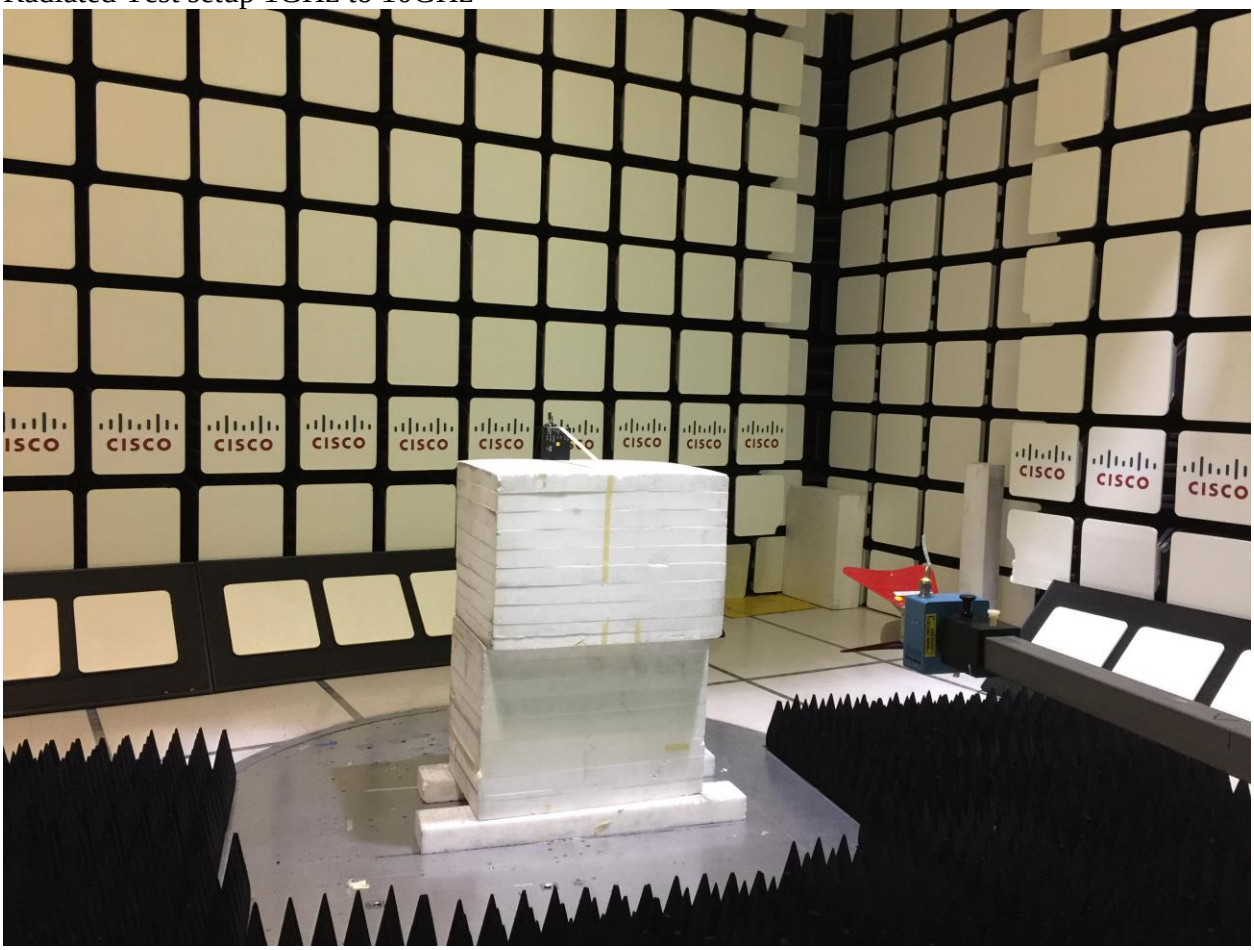
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
50.587	13.5	0.6	7.7	21.8	Quasi Peak.	V	245	143	40	-18.2	Pass
68.557	12.1	0.6	8	20.8	Quasi Peak.	V	165	96	40	-19.2	Pass
114.426	8.1	0.8	13.2	22.1	Quasi Peak.	V	152	123	43.5	-21.4	Pass
347.048	16.3	1.5	14.2	31.9	Quasi Peak.	V	172	191	46	-14.1	Pass
750.018	5.7	2.2	20.8	28.7	Quasi Peak.	V	119	12	46	-17.3	Pass
927.8563	40.03	2.42	22.4	64.85	Quasi Peak.	V	100	0	46		TX

Physical Test arrangement Photos:

Radiated Test setup 30MHz to 1GHz



Radiated Test setup 1GHz to 10GHz



Appendix B: Abbreviation Key and Definitions

The following table defines abbreviations used within this test report.

Abbreviation	Description	Abbreviation	Description
EMC	Electro Magnetic Compatibility	°F	Degrees Fahrenheit
EMI	Electro Magnetic Interference	°C	Degrees Celsius
EUT	Equipment Under Test	Temp	Temperature
ITE	Information Technology Equipment	S/N	Serial Number
TAP	Test Assessment Schedule	Qty	Quantity
ESD	Electro Static Discharge	emf	Electromotive force
EFT	Electric Fast Transient	RMS	Root mean square
EDCS	Engineering Document Control System	Qp	Quasi Peak
Config	Configuration	Av	Average
CIS#	Cisco Number (unique identification number for Cisco test equipment)	Pk	Peak
Cal	Calibration	kHz	Kilohertz ($1x10^3$)
EN	European Norm	MHz	MegaHertz ($1x10^6$)
IEC	International Electro technical Commission	GHz	Gigahertz ($1x10^9$)
CISPR	International Special Committee on Radio Interference	H	Horizontal
CDN	Coupling/Decoupling Network	V	Vertical
LISN	Line Impedance Stabilization Network	dB	decibel
PE	Protective Earth	V	Volt
GND	Ground	kV	Kilovolt ($1x10^3$)
L1	Line 1	µV	Microvolt ($1x10^{-6}$)
L2	Line2	A	Amp
L3	Line 3	µA	Micro Amp ($1x10^{-6}$)
DC	Direct Current	mS	Milli Second ($1x10^{-3}$)
RAW	Uncorrected measurement value, as indicated by the measuring device	µS	Micro Second ($1x10^{-6}$)
RF	Radio Frequency	µS	Micro Second ($1x10^{-6}$)
SLCE	Signal Line Conducted Emissions	m	Meter
Meas dist	Measurement distance	Spec dist	Specification distance
N/A or NA	Not Applicable	SL	Signal Line (or Telecom Line)
P	Power Line	L	Live Line
N	Neutral Line	R	Return
S	Supply	AC	Alternating Current

Appendix C: Test Equipment Used to perform the test

Equip No	Model	Manufacturer	Description	Cal Last	Cal Next
CIS042627	PE6072	Pasternack	SMA 50 Ohm Termination	8-Mar-17	8-Mar-18
CIS047300	N9038A	Agilent Technologies	MXE EMI Receiver 20Hz to 26.5 Ghz	28-Mar-17	28-Mar-18
CIS004729	77 III	Fluke	Digital Multimeter	26-May-17	26-May-18
CIS054013	JB1	Sunol Sciences		15-Jun-17	15-Jun-18
CIS046385	HPM16310	Micro-Tronics	Highpass Filter	26-Jun-17	26-Jun-18
CIS055603	BW-S10-2W263	Mini-Circuits	SMA 10dB Attenuator	31-Aug-17	31-Aug-18
CIS043124	Above 1GHz Site Cal	Cisco	Above 1GHz Cispr Site Verification	26-Sep-17	26-Sep-18
CIS008447	NSA 10m Chamber	Cisco	NSA 10m Chamber	1-Oct-17	1-Oct-18
CIS054666	RA08-S1S1-18	MegaPhase	SMA 18" Cable	23-Oct-17	23-Oct-18
CIS035284	3117	ETS-Lindgren	Double Ridged Waveguide Horn Antenna	27-Oct-17	27-Oct-18
CIS045096	TH0118	Cisco	Mast Mount Preamplifier Array, 1-18GHz	31-Oct-17	31-Oct-18
CIS049516	N9030A-550	Keysight (Agilent/HP)	Spectrum Analyzer	2-Nov-17	2-Nov-18
CIS033988	E4446A	Agilent	PSA Spectrum Analyzer	17-Nov-17	17-Nov-18
CIS042004	BWS30W2+	Mini-Circuits	SMA 30dB Attenuator	29-Nov-17	29-Nov-18
CIS056037	33-428	Stanley	Tape Measure	Cal not required	Cal not required
CIS038375	TH0118-PS	Cisco	Power Supply for TH0118 1-18GHz Preamplifier	Cal not required	Cal not required
CIS037237	50CB-015	JFW	GPIB Control Box	Cal not required	Cal not required
CIS034075	RSG 2000	Schaffner	Reference Spectrum Generator, 1-18GHz	Cal not required	Cal not required
CIS004883	3115	EMC Test Systems	Double Ridged Guide Horn Antenna	Cal not required	Cal not required
CIS042627	PE6072	Pasternack	SMA 50 Ohm Termination	8-Mar-17	8-Mar-18
CIS046385	HPM16310	Micro-Tronics	Highpass Filter	26-Jun-17	26-Jun-18
CIS055603	BW-S10-2W263	Mini-Circuits	SMA 10dB Attenuator	31-Aug-17	31-Aug-18
CIS054666	RA08-S1S1-18	MegaPhase	SMA 18" Cable	23-Oct-17	23-Oct-18
CIS033988	E4446A	Agilent	PSA Spectrum Analyzer	17-Nov-17	17-Nov-18
CIS042004	BWS30W2+	Mini-Circuits	SMA 30dB Attenuator	29-Nov-17	29-Nov-18
CIS050721	N9030A-550	Keysight	PXA Signal Analyzer	18-Apr-17	18-Apr-18
CIS054621	RA08-S1S1-18	Megaphase	SMA cable 18"	27-Jul-17	27-Jul-18
CIS021117	UFB311A-0-2484-520520	Micro-Coax	RF Coaxial Cable, to 18GHz, 248.4 in	16-Aug-17	16-Aug-18

CIS055936	Sucoflex 106PA	Huber + Suhner	N-type 8m 18GHz Antenna cable	19-Oct-17	19-Oct-18
CIS045016	Sucoflex 106PA	Huber + Suhner	Sucoflex N Type Black 7ft cable	2-Jan-18	2-Jan-19

END