ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Product Name:	**UHF RFID Reader**
Brand Name:	**GeoVision**
Model No.:	**GV-RU9003**
Model Difference:	**N/A**
FCC ID:	**PWQ-RU9003**
Report No.:	**ER/2016/A0116**
Issue Date:	**Nov. 30, 2016**
FCC Rule Part:	**§15.247, Cat: DSS**
Prepared for:	**GeoVision Inc. 9F, No.246, Sec. 1, Neihu Rd., Neihu Dist., Taipei 114, Taiwan**
Prepared by:	**SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803**

ilac-MRA TAF Testing Laboratory 0513

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VERIFICATION OF COMPLIANCE

Applicant:	GeoVision Inc. 9F, No.246, Sec. 1, Neihu Rd., Neihu Dist., Taipei 114, Taiwan
Product Name:	UHF RFID Reader
Brand Name:	GeoVision
Model No.:	GV-RU9003
Model Difference:	N/A
FCC ID:	PWQ-RU9003
File Number:	ER/2016/A0116
Date of test:	Oct. 21, 2014 ~ Dec. 01, 2014
Date of EUT Received:	Oct. 21, 2014

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4:2009 the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247.
The test results of this report relate only to the tested sample identified in this report.

Test By:	Marcus Tseng	***Date:***	Nov. 30, 2016
	Marcus Tseng / Sr.Engineer		
Prepared By:	Allen Tsai	***Date:***	Nov. 30, 2016
	Allen Tsai / Engineer		
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Version

Report Number	Revision	Description	Issue Date
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1. GENERAL INFORMATION

1.1. Product description

General:

Product Name:	UHF RFID Reader
Brand Name:	GeoVision
Model No.:	GV-RU9003
Model Difference:	N/A
Hardware Version:	V1.0
Software Version:	V1.0
Power Supply:	12Vdc from AC/DC Adapter
Brace:	Model No.: N/A Supplier: GeoVision Inc.

RFID:

Frequency Range:	902.25 – 927.75MHz
Channel number:	52 channels
Modulation type:	PR-ASK, ASK
Transmit Power:	27.778 dBm (Peak)
Dwell Time:	<= 0.4s
Operating Mode:	Point-to-Point
Antenna Designation:	Patch Antenna , Gain: 7.71dBi

This test report applies for RFID function.

Channel list	Frequencies.[0]= 906.250MHz; Frequencies.[1]= 923.250MHz; Frequencies.[2]= 907.750MHz; Frequencies [3]= 924.750MHz; Frequencies [4]= 903.750MHz; Frequencies [5]= 920.750MHz; Frequencies [6]= 909.250MHz; Frequencies [7]= 904.750MHz; Frequencies [8]= 925.250MHz; Frequencies [9]= 904.250MHz; Frequencies [10]= 907.250MHz; Frequencies [11]= 905.250MHz; Frequencies [12]= 925.750MHz; Frequencies [13]= 903.250MHz; Frequencies [14]= 918.750MHz; Frequencies [15]= 906.750MHz; Frequencies [16]= 926.750MHz; Frequencies [17]= 908.250MHz; Frequencies [18]= 908.750MHz; Frequencies [19]= 912.750MHz; Frequencies [20]= 909.750MHz; Frequencies [21]= 910.250MHz; Frequencies [22]= 922.250MHz; Frequencies [23]= 910.750MHz; Frequencies [24]= 916.250MHz; Frequencies [25]= 911.250MHz; Frequencies [26]= 914.250MHz; Frequencies [27]= 911.750MHz; Frequencies [28]= 924.250MHz; Frequencies [29]= 912.250MHz; Frequencies [30]= 918.250MHz; Frequencies [31]= 913.250MHz; Frequencies [32]= 913.750MHz; Frequencies [33]= 914.750MHz; Frequencies [34]= 905.750MHz; Frequencies [35]= 915.750MHz; Frequencies [36]= 915.250MHz; Frequencies [37]= 916.750MHz; Frequencies [38]= 917.250MHz; Frequencies [39]= 920.250MHz; Frequencies [40]= 917.750MHz; Frequencies [41]= 919.250MHz; Frequencies [42]= 921.250MHz;Frequencies [43]= 919.750MHz; Frequencies [44]= 921.750MHz; Frequencies [45]= 922.750MHz; Frequencies [46]= 926.250MHz; Frequencies [47]= 923.750MHz; Frequencies [48]= 902.750MHz; Frequencies [49]= 902.250MHz; Frequencies [50]= 927.750MHz; Frequencies [51]= 927.250MHz;

1.2. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: PWQ-RU9003** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules. The composite system (digital device) is compliance with FCC part 15; Subpart B is authorized under the DoC procedure.

1.3. Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4:2009. Radiated testing was performed at an antenna to EUT distance 3 meters. Tested in accordance with FCC Public Notice DA 00-705 – Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

1.4. Test Facility

The measurement facilities used to collect the 3m Radiated Emission and AC power line conducted data are located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, Wuku Industrial Zone, Taipei County, Taiwan which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4:2009. FCC Registration Number is: 990257. Canada Registration Number: 4620A-4.

The 10 m Open Area Test Sites located on the address of SGS Taiwan Ltd. Electronics & Communication Laboratory No.2, Keji 1st Rd., Guishan Township, Taoyuan County,Taiwan which is constructed and calibrated to meet the CISPR 22/EN 55022 requirements. FCC Registration Number: 455997. The address of SGS Taiwan Ltd. Electronics & Communication Laboratory 1F, No.134, Wukung Road New Taipei City TAIWAN 24803, IC Registration Number: 4620A-6.

1.5. Special Accessories

There is no special accessory used while test was conducted.

1.6. Equipment Modifications

There was no modification incorporated into the EUT.

2. SYSTEM TEST CONFIGURATION

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3. Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the general criterion in Section 7.1 of ANSI C63.4:2009. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz, and the measurement procedure 7.3 in ANSI 63.4:2009 is followed to carry out the test. The CISPR Quasi-Peak and Average detector mode is employed according to §15.107

2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna according to the requirements in Section 8 and 13 and of ANSI C63.4:2009 and DA 00-705.

2.4. Configuration of Tested System

Fig. 2-1 Radiated Emission & Conducted (Antenna Port) Configuration

Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	NFC Test Soft-ware	N/A	N/A	N/A	N/A	N/A
2.	Test Tool Kit	N/A	N/A	N/A	N/A	N/A

3. SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b)(2)	Peak Output Power	Compliant
§15.247(a)(1)(i)	20dB Bandwidth	Compliant
§15.247(d)	100 kHz Bandwidth Of Frequency Band Edges	Compliant
§15.247(d) §15.209(a) (f)	Spurious Emission	Compliant
§15.247(a)(1)	Frequency Separation	Compliant
§15.247(a)(1)(i)	Number of hopping frequency	Compliant
§15.247(a)(1)(i)	Time of Occupancy	Compliant
§15.203	Antenna Requirement	Compliant

4. DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel Low, Mid and High with highest rated data rate were chosen as worst case for full testing. The field strength of spurious radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth Transmitter for channel Low, Mid and High the worst case E2 position was reported.

Channel Low: channel 1 at 902.25MHz
Channel Mid: channel 26 at 914.75MHz
Channel High: channel 52 at 927.75MHz

5. MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 1.55 dB
20dB Bandwidth	+/- 123.36 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 1.55 dB
Frequency Separation	+/- 123.36 Hz
Number of hopping frequency	+/- 123.36 Hz
Time of Occupancy	+/- 123.36 Hz
Temperature	+/- 0.8 °C
Humidity	+/- 4.7 %
DC / AC Power Source	DC= +/- 1%, AC= +/- 0.2%

Radiated Spurious Emission:

Measurement uncertainty (Polarization : **Vertical**)	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

Measurement uncertainty (Polarization : **Horizontal**)	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

6. CONDUCTED EMISSION TEST

6.1. Standard Applicable

According to §15.207, frequency within 150 kHz to 30MHz shall not exceed the limit table as below.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

6.2. Measurement Equipment Used:

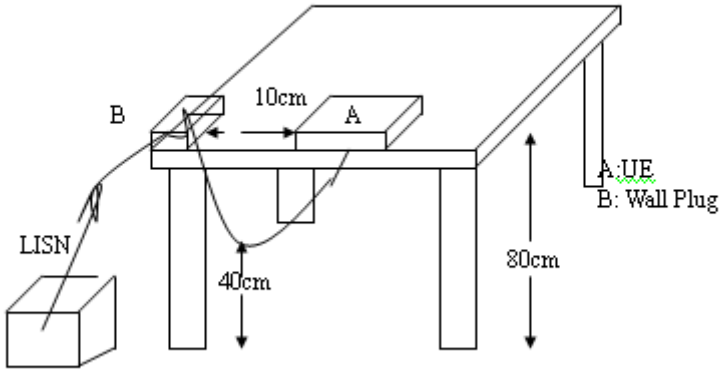
Conducted Emission Test Site					
EQUIPMENT TYPE	**MFR**	**MODEL NUMBER**	**SERIAL NUMBER**	**LAST CAL.**	**CAL DUE.**
EMI Test Receiver	R&S	ESCI7	100760	05/26/2014	05/25/2015
LISN	Rolf-Heine	NNB-2/16Z	99012	03/26/2014	03/25/2015
LISN	FCC	FCC-LISN-50/250-25-2-01	04034	03/19/2014	03/18/2015
Coaxial Cables	N/A	WK CE Cable	N/A	11/26/2014	11/25/2015

6.3. EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the
   ANSI C63.4:2009.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.

3. The LISN was connected with 120Vac/60Hz power source.

6.4. Test SET-UP (Block Diagram of Configuration)



6.5. Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

6.6. Measurement Result

Note: Refer to next page for measurement data and plots.
Note2: The * reveals the worst-case results that closet to the limit

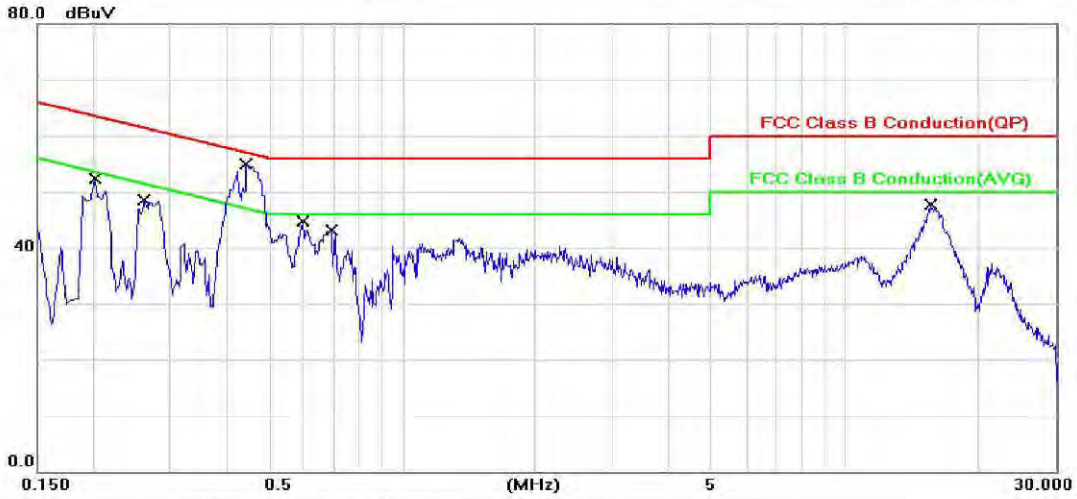
AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode	Test Date:	Nov. 26, 2014
Temperature:	26		

Site ConductionRoom	Phase:	*N*	Temperature: 24 ℃
Limit: FCC Class B Conduction(QP)	Power:	AC 120V/60Hz	Humidity: 66%
Mode: Operation			
Note: Adapter:GS18U12			

ConductedEmission

File :A0058 Data :#2 Date: 2014/11/26 Time : 下午 12:09:26



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.2020	51.03	0.03	51.06	63.53	-12.47	QP	
2		0.2020	40.70	0.03	40.73	53.53	-12.80	AVG	
3		0.2620	47.30	0.03	47.33	61.37	-14.04	QP	
4		0.2620	36.40	0.03	36.43	51.37	-14.94	AVG	
5	*	0.4460	54.30	0.03	54.33	56.95	-2.62	QP	
6		0.4460	39.90	0.03	39.93	46.95	-7.02	AVG	
7		0.5980	41.31	0.03	41.34	56.00	-14.66	QP	
8		0.5980	31.10	0.03	31.13	46.00	-14.87	AVG	
9		0.6900	40.62	0.03	40.65	56.00	-15.35	QP	
10		0.6900	26.90	0.03	26.93	46.00	-19.07	AVG	
11		15.5780	43.84	0.10	43.94	60.00	-16.06	QP	
12		15.5780	37.40	0.10	37.50	50.00	-12.50	AVG	

7. PEAK OUTPUT POWER MEASUREMENT

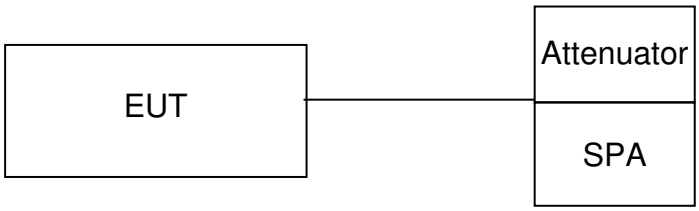
7.1. Standard Applicable

According to §15.247(b)(2), for frequency hopping systems operating in the 902-928 MHz band employing at least 50 hopping channels, The Limit: 1Watt. For systems employing less than 50 hopping channels, The Limit: 0.25 Watts. But at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

7.2. Measurement Equipment Used

Conducted Emission Test Site					
Name of Equip-ment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Power Meter	Anritsu	ML2495A	1005007	01/13/2014	01/12/2015
Power Sensor	Anritsu	MA2411B	917032	01/13/2014	01/12/2015
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/19/2014	05/18/2015
Spectrum Analyzer	Agilent	E4440A	MY45304525	03/08/2014	03/07/2015
DC Block	Mini-Circuits	BLK-18-S+	1	02/27/2014	02/26/2015
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	01/03/2014	01/02/2015
Attenuator	Mini-Circuit	BW-S10W2+	002	02/27/2014	02/26/2015
Splitter	Agilent	11636B	N/A	02/27/2014	02/26/2015

7.3. Test Set-up:



7.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the

   power meter or spectrum. (Max Hold, Detector = Peak, RBW >=20dB bandwidth)
3. Record the max. reading.
4. Repeat above procedures until all default test channel is completed.

   NOTE: cable loss as 10.5dB that offsets in the spectrum

7.5. Measurement Result

Frequency (MHz)	Reading Power (dBm)	Output Power (W)	Limit (W)
902.25	**27.778**	0.59951	0.67
914.75	27.769	0.59827	0.67
927.75	27.559	0.57003	0.67

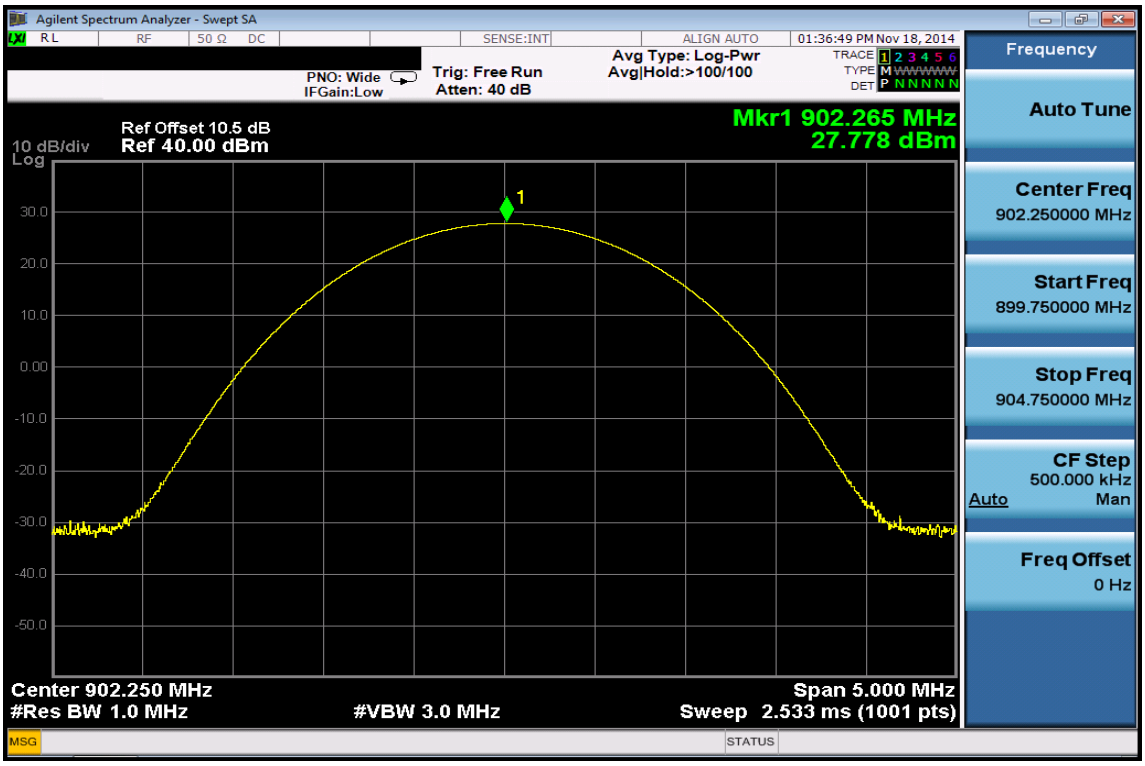
Note:

The antenna gain is greater than 6 dBi so the limit reduce as below:

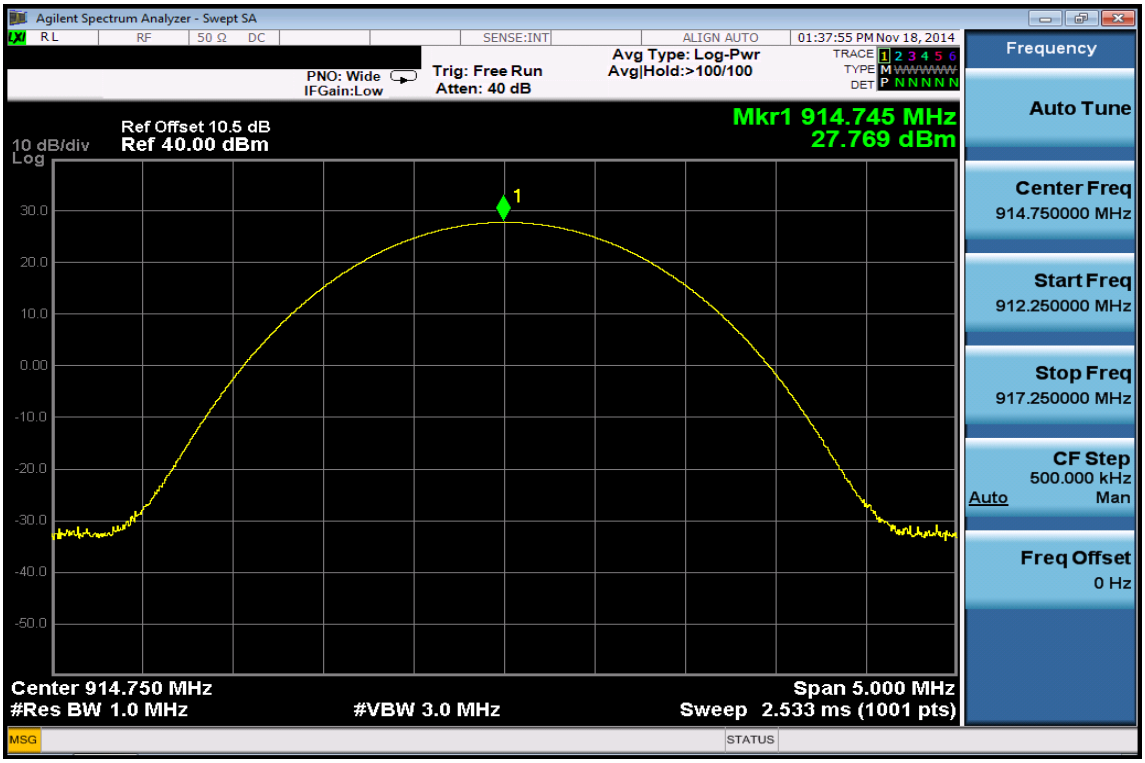
Antenna Gain= 7.71dBi,

Power limit= 30 dBm–(7.71-6)= 28.29dBm= 0.67W

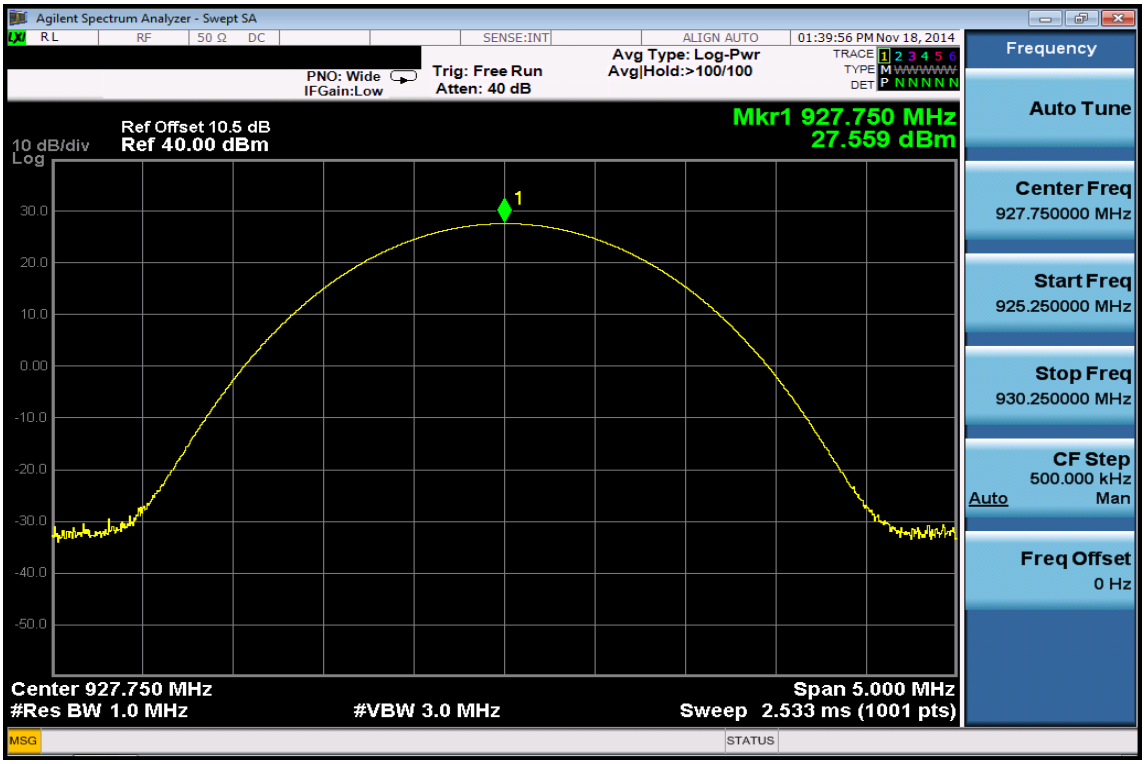
Peak Power Output Data Plot (CH Low)



Peak Power Output Data Plot (CH Mid)



Peak Power Output Data Plot (CH High)



8. 20DB BANDWIDTH

8.1. Standard Applicable

According to §15.247(a)(1)(i), for frequency hopping systems operating in the 902 MHz-928 MHz : if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies.

8.2. Measurement Equipment Used

Refer to section 7.2 for the plot.

8.3. Test Set-up

Refer to section 7.3 for the plot.

8.4. Measurement Procedure:

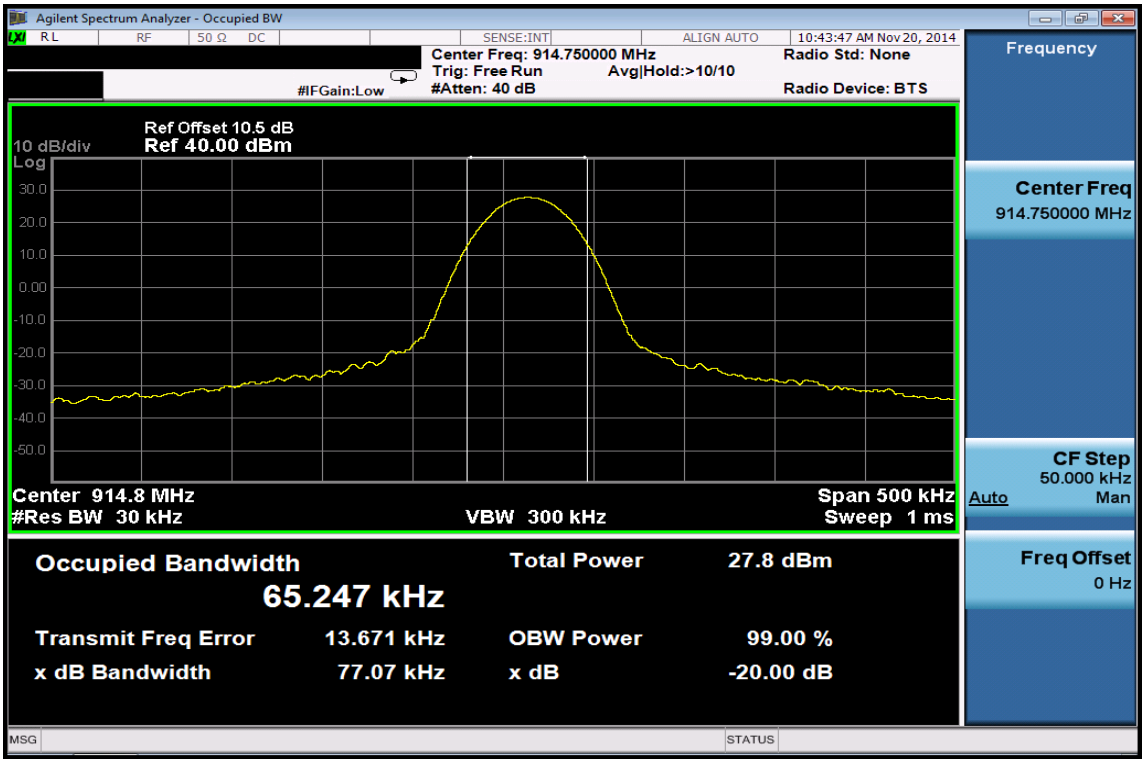
1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW=30 kHz, VBW = 300 kHz, Span= 500kHz, Sweep=auto, Detector = Peak, and Max hold for 20dB Bandwidth test.
4. Mark the peak frequency and –20dB (upper and lower) frequency and Turn on the 99% bandwidth function, max reading.
5. Repeat above procedures until all test default channel is completed

NOTE: cable loss as 10.5dB that offsets in the spectrum

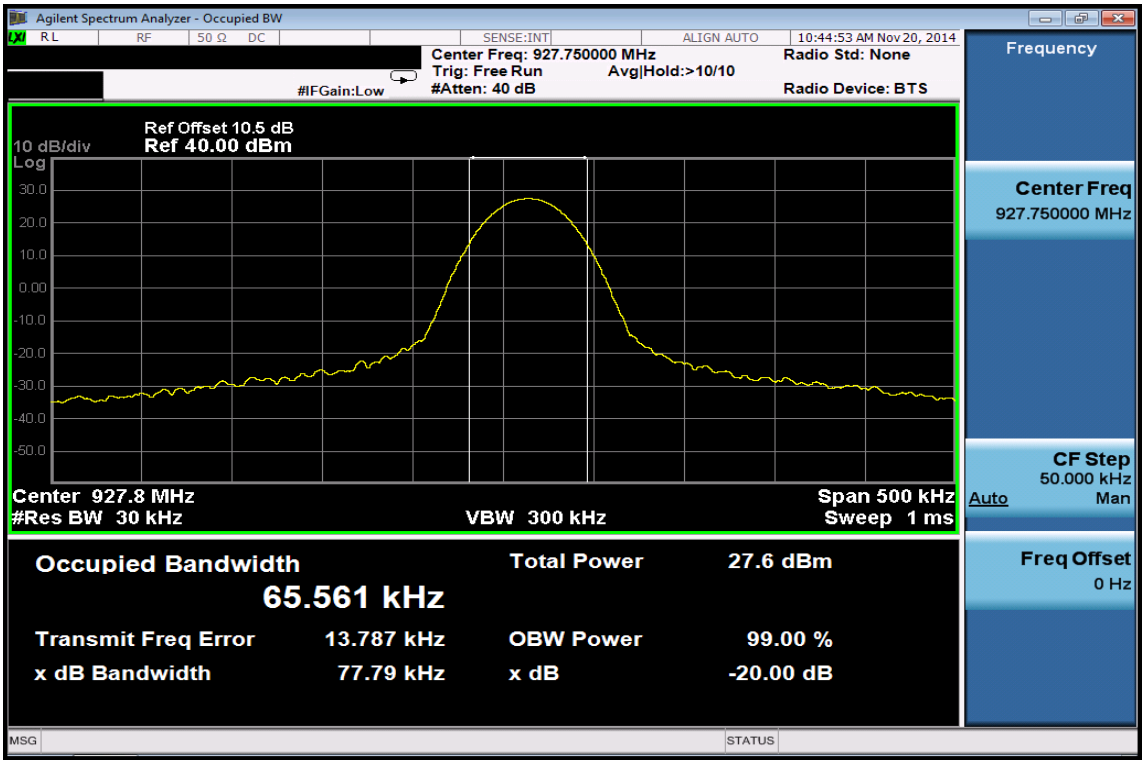
8.5. Measurement Result:

CH	Bandwidth

20dB Band Width Test Data CH-Mid



20dB Width Test Data CH-High



9. BAND EDGES EMISSION MEASUREMENT

9.1. Standard Applicable

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

9.2. Measurement Equipment Used

9.2.1. Conducted Emission at antenna port:

Refer to section 7.2 for the plot.

9.3. Test SET-UP:

9.3.1. Conducted Emission at antenna port:

Refer to section 7.3 for the plot.

9.4. Measurement Procedure

100 kHz BANDWIDTH OF BAND EDGES:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Sweep = auto
5. Mark Peak, 902MHz and 928MHz and record the max. level.
6. Repeat above procedures until all frequency measured were complete.

Out-Of-Band EMISSION

1. To connect Antenna Port of EUT to Spectrum.
2. Set RBW = 100K & VBW = 300K on Spectrum.
3. Sweep the frequency to determine spurious emission as seen on spectrum from span of 30MHz to 3G, 3G to 8G, 8G to 13G, 13G to 18G and 18G to 26.5GHz
4. Via Software, combine 5 spans of frequency range into two plots containing the range of 30MHz to 3GHz, and 3GHz to 26.5GHz.

9.5. Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

9.6. Measurement Result : Out-Of-Band EMISSION:

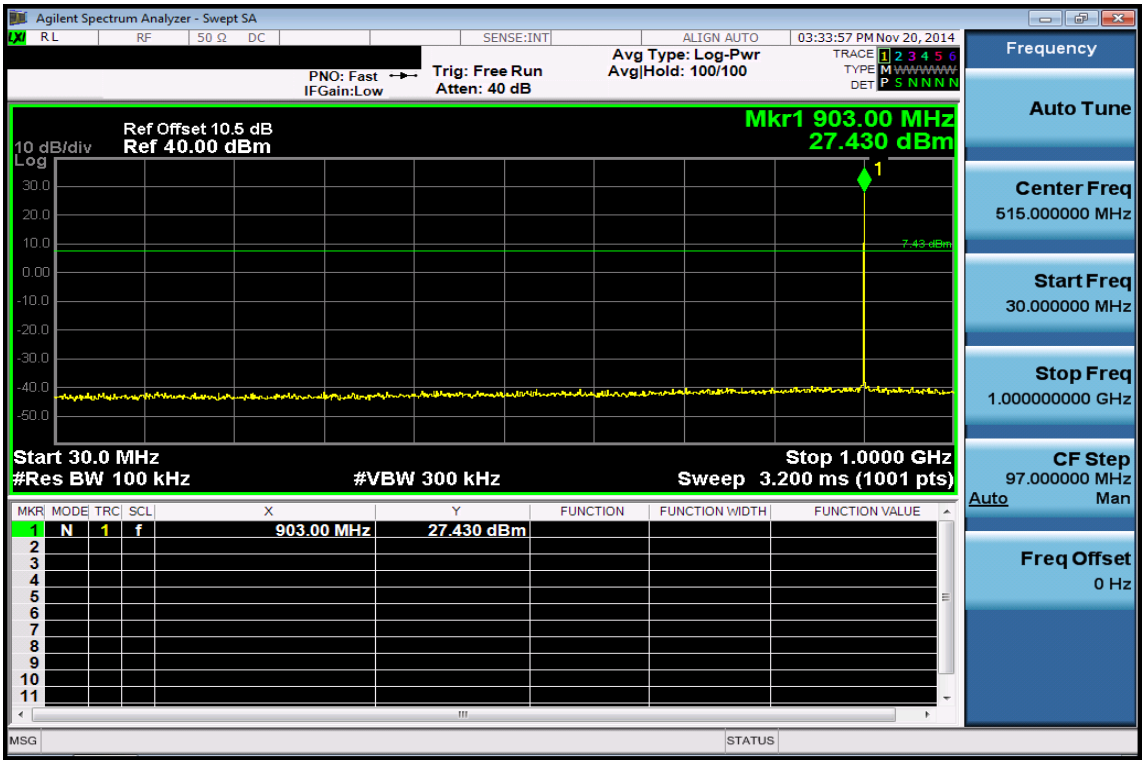
Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

NOTE: cable loss as 10.5dB that offsets in the spectrum

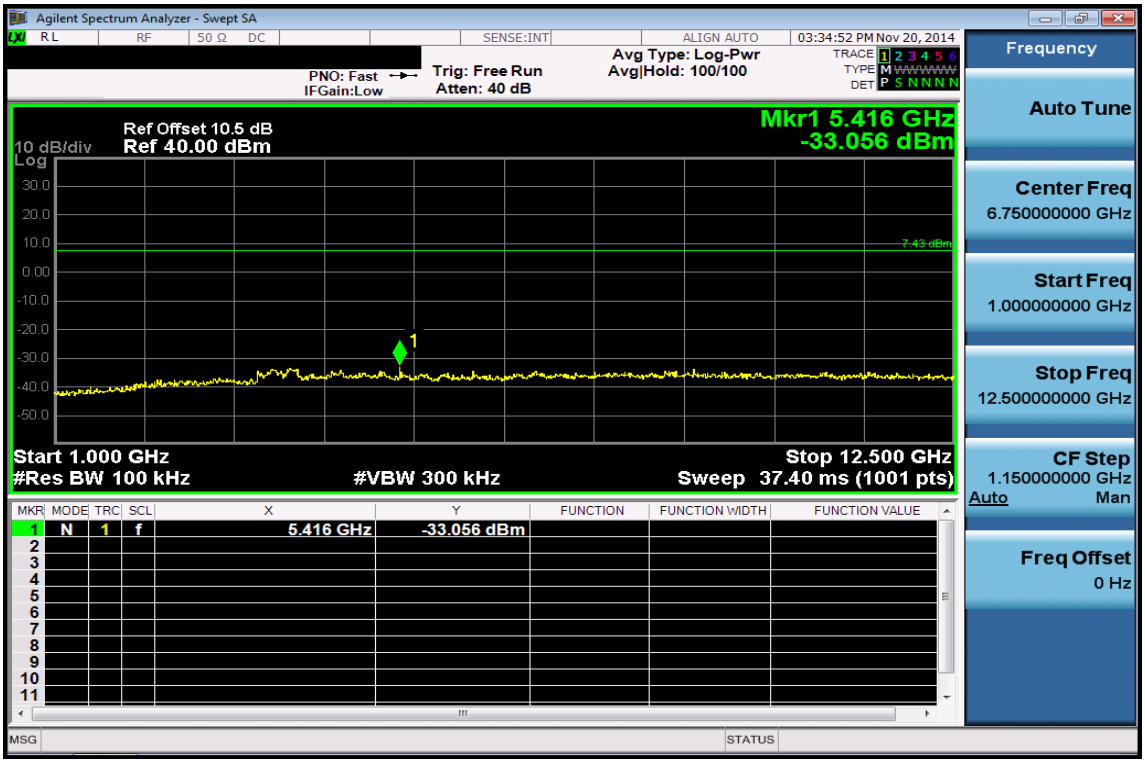
NOTE: the occurrence of the spike on the conducted emission is the signal of the fundamental emission.

9.7. Measurement Result: Conducted Spurious Emission Measurement Result

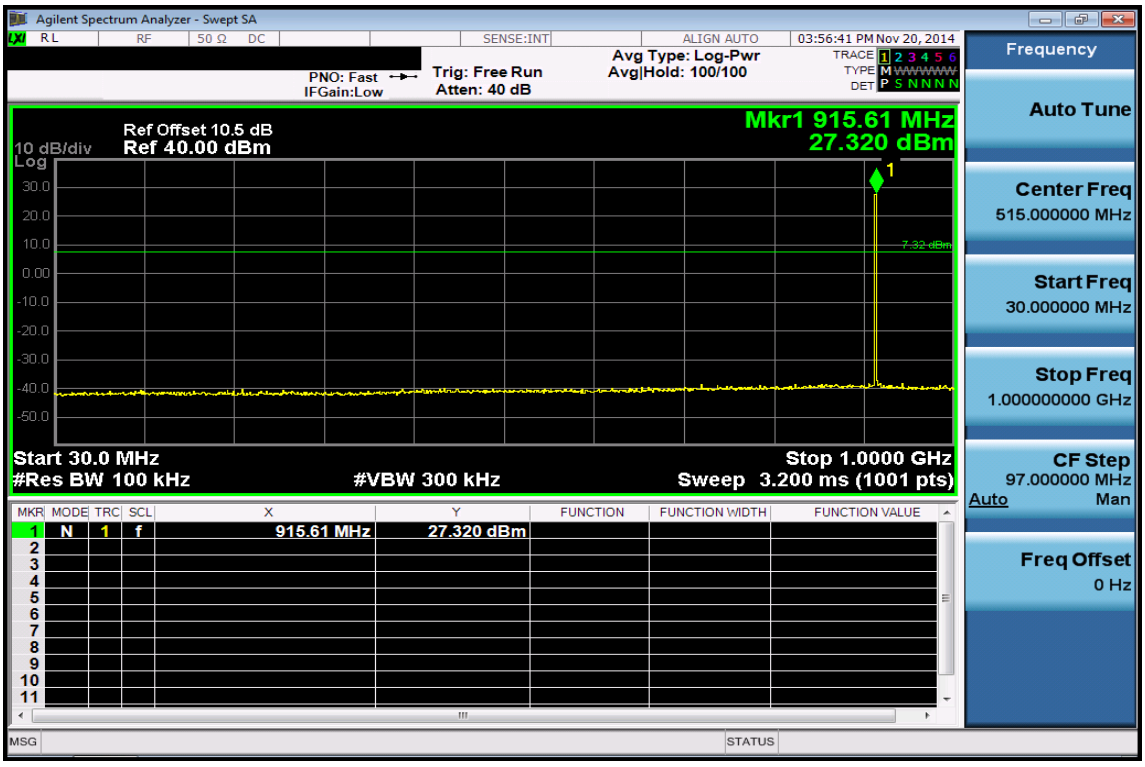
Ch Low 30MHz – 1GHz



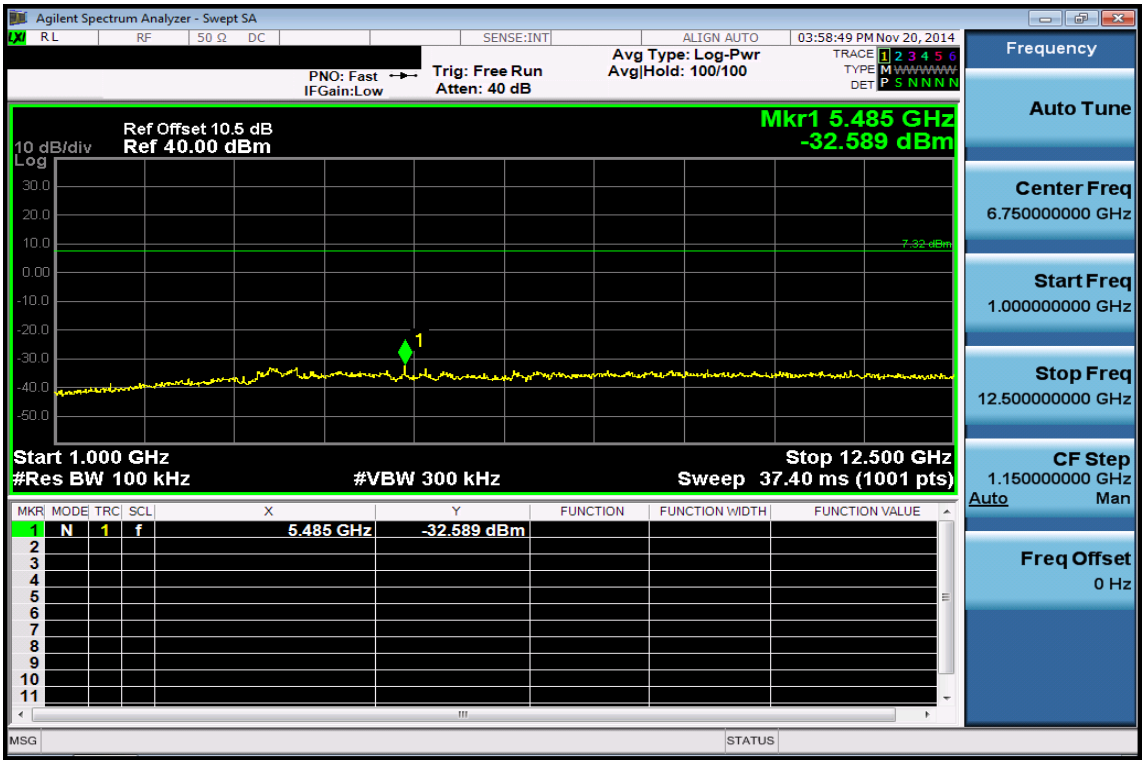
Ch Low 3GHz – 12.5GHz



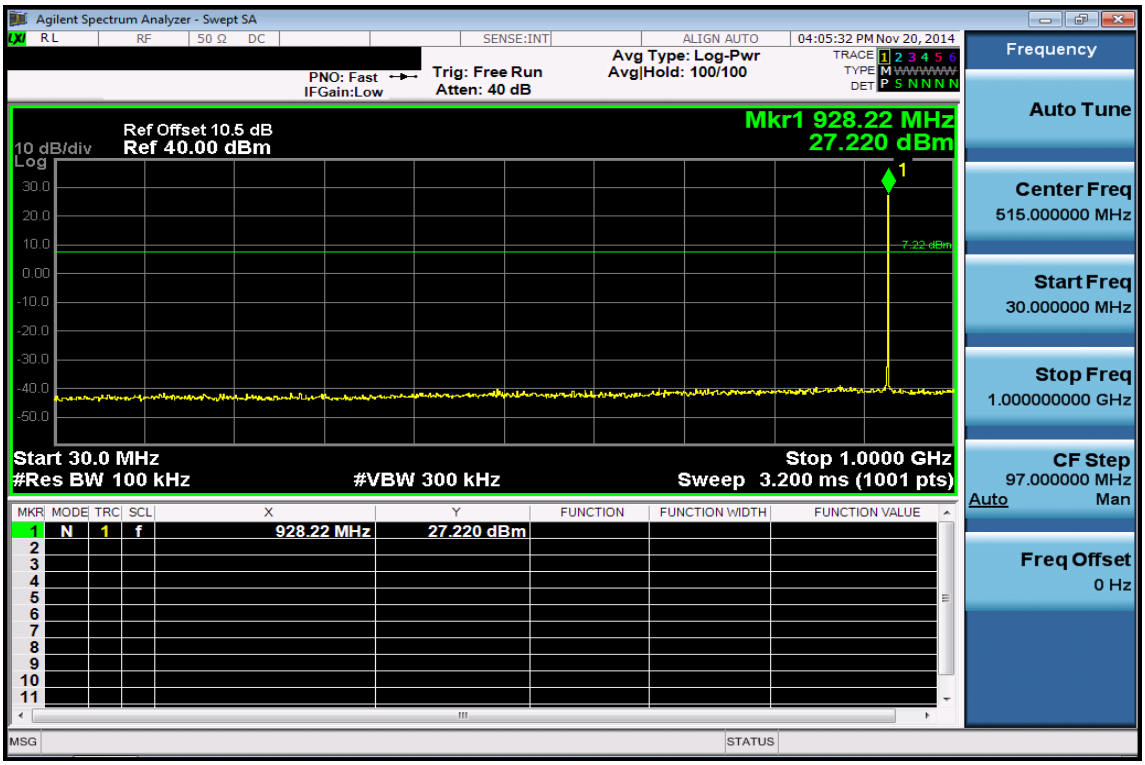
Ch Mid 30MHz – 1GHz



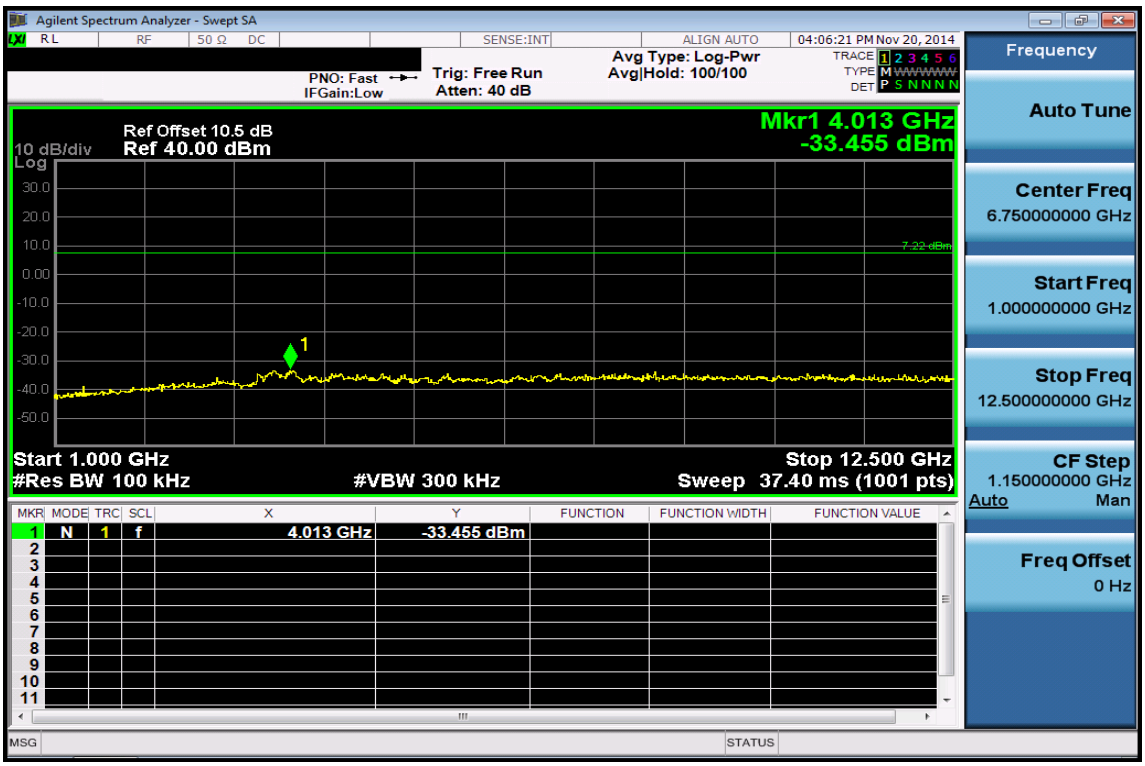
Ch Mid 3GHz – 12.5GHz



Ch High 30MHz – 1GHz

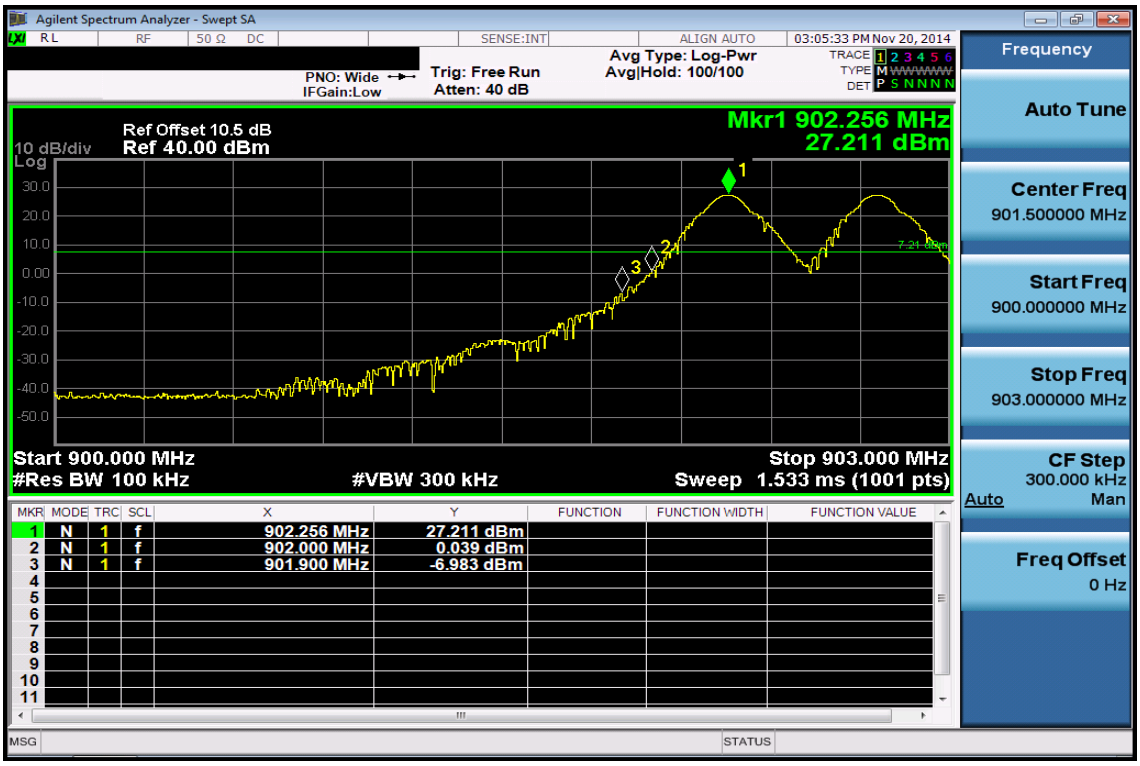


Ch High 3GHz –12.5GHz



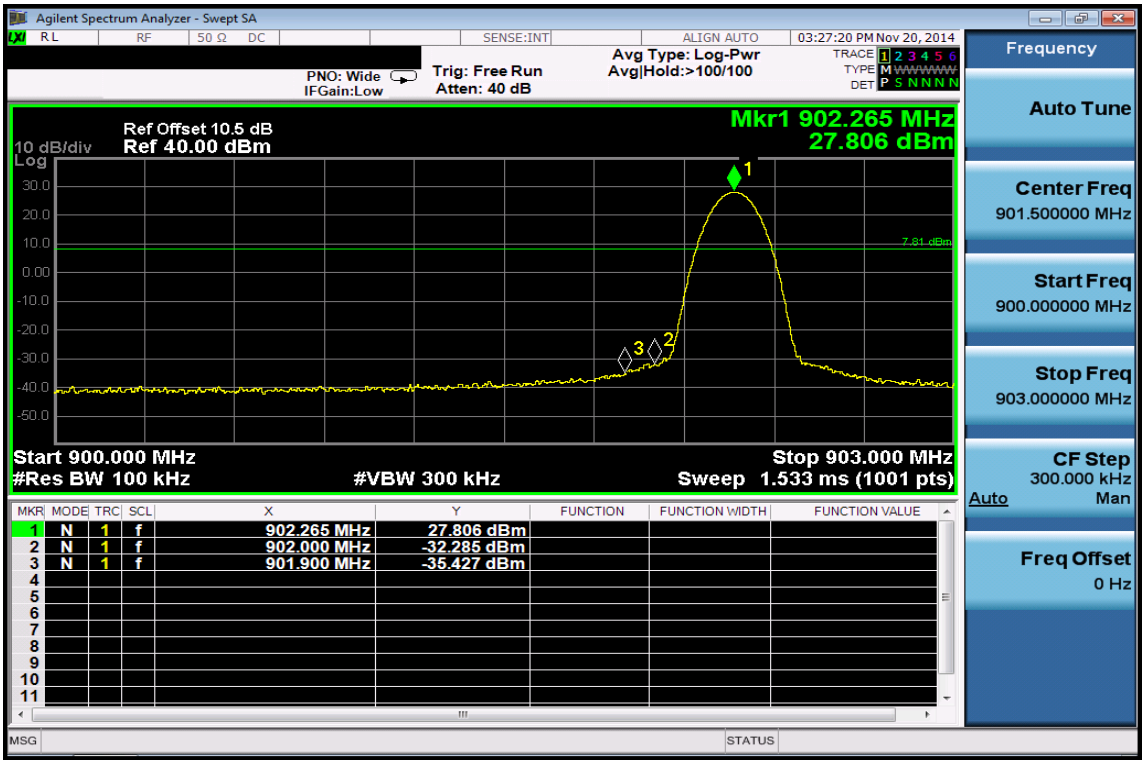
9.8. Measurement Result: 100 kHz BANDWIDTH OF BNAD EDGE:

Band Edges Test Data CH-Low (Hopping mode)

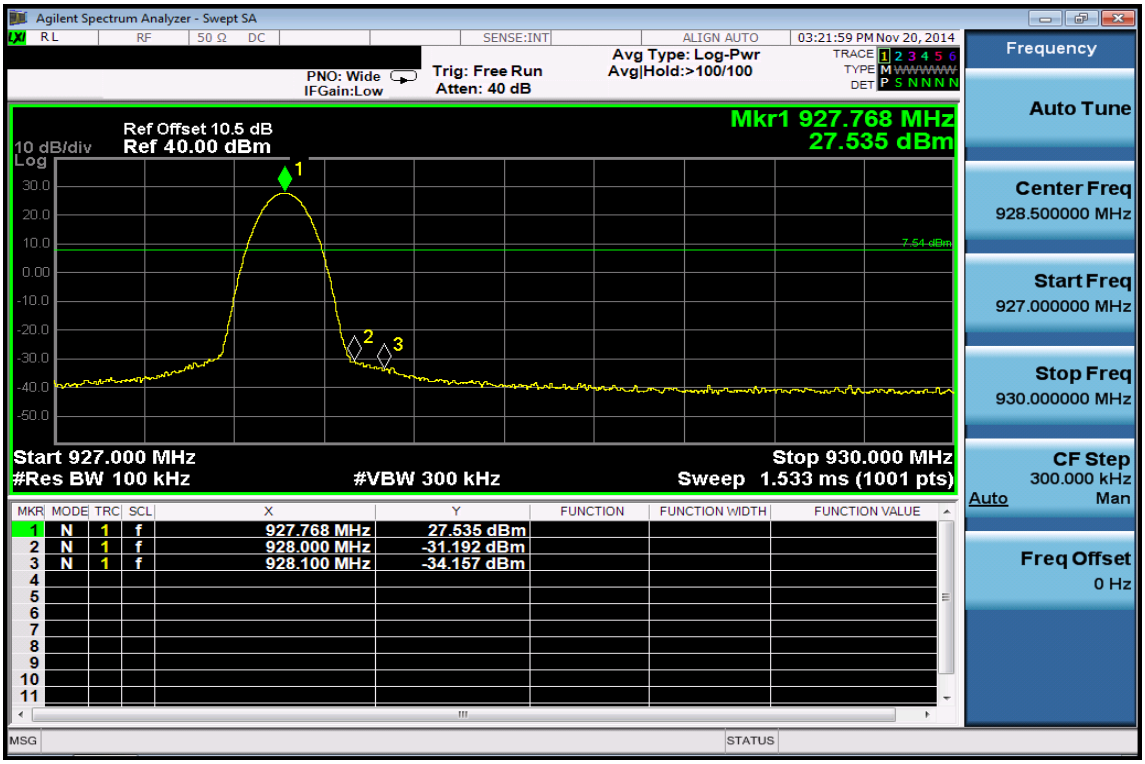


Band Edges Test Data CH-High

Band Edges Test Data CH-Low (Non-Hopping mode)



Band Edges Test Data CH-High



10. SPURIOUS RADIATED EMISSION TEST

10.1. Standard Applicable

According to §15.247(d),

Emission at antenna port:

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.

Radiated Spurious Emission

Attenuation below the general limits specified in § 15.209(a) is not required.

And according to §15.33(a) (1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

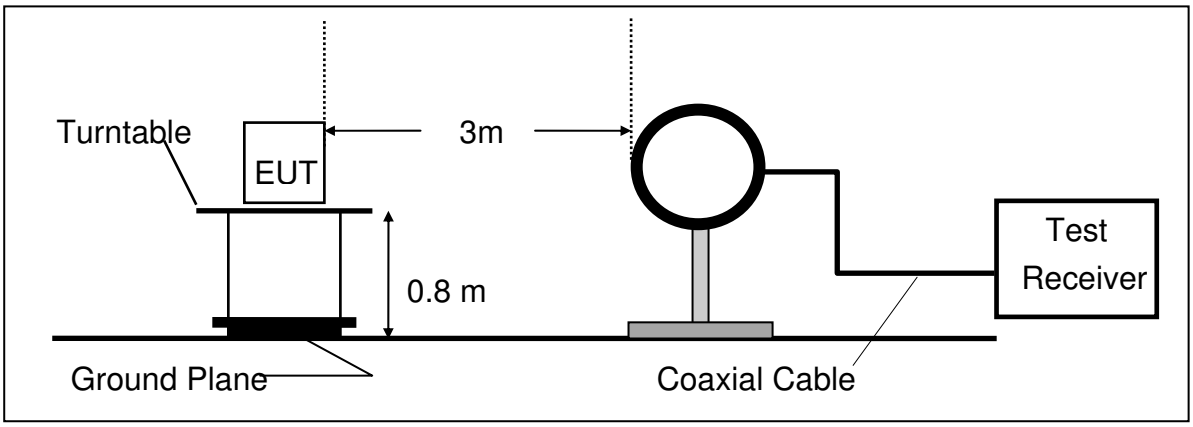
10.2. Measurement Equipment Used:

966 Chamber					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
EMI Test Receiver	R&S	ESCI7	100760	05/26/2014	05/25/2015
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/19/2014	05/18/2015
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	01/20/2014	01/19/2015
Spectrum Analyzer	R&S	FSV-30	101398	10/07/2014	10/06/2015
Loop Antenna	ETS.LINDGREN	6502	00148045	07/03/2014	07/02/2015
Bilog Antenna	SCHWAZBECK	VULB9168	378	01/02/2014	01/01/2015
Horn antenna	ETS.LINDGREN	3117	123995	05/19/2014	05/18/2015
Horn Antenna	Schwarzbeck	BBHA9170	184	01/23/2014	01/22/2015
Pre-Amplifier	Agilent	8447D	2944A07676	01/03/2014	01/02/2015
Pre-Amplifier	Agilent	8449B	3008A00578	01/03/2014	01/02/2015
Pre-Amplifier	EMC Instruments Corp.	EMC184045	980135	01/24/2014	01/23/2015
Filter 800-1000	Micro-Tronics	EWT	M2	02/27/2014	02/26/2015
Attenuator	Mini-Circuit	BW-S10W2+	004	02/27/2014	02/26/2015
Turn Table	HD	DT420	N/A	N.C.R	N.C.R
Antenna Tower	HD	MA240-N	240/657	N.C.R	N.C.R
Controller	HD	HD100	N/A	N.C.R	N.C.R
Low Loss Cable	Huber Suhner	966_Rx	9	01/03/2014	01/02/2015
3m Site NSA	SGS	966 chamber	N/A	07/15/2014	07/14/2015
EMI Test Receiver	R&S	ESCI7	100760	05/26/2014	05/25/2015

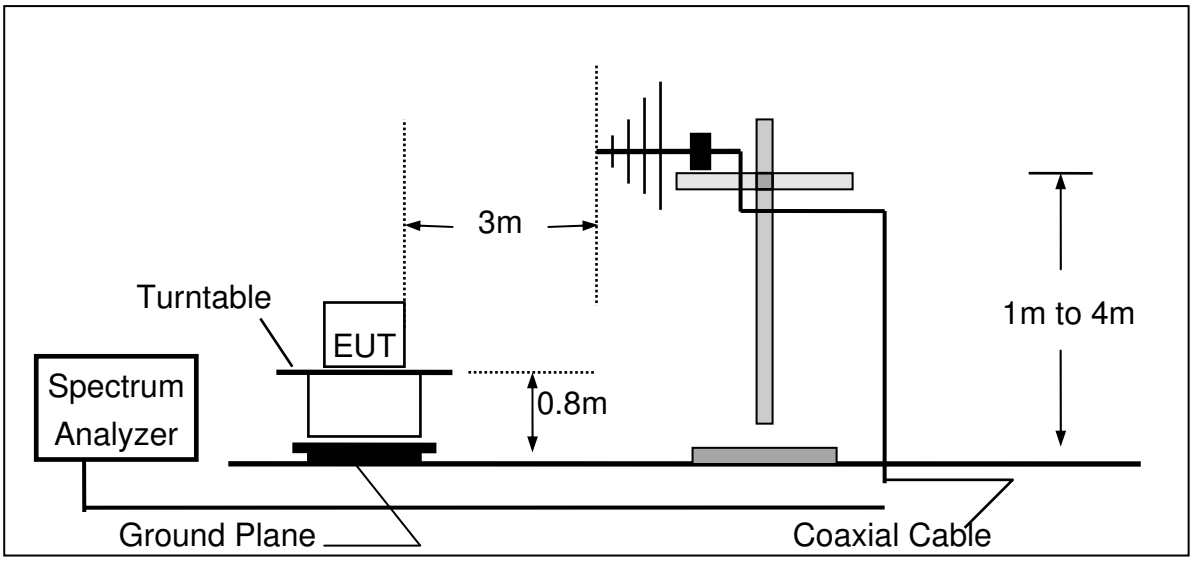
10.3. Test SET-UP:

10.3.1. Radiated emission:

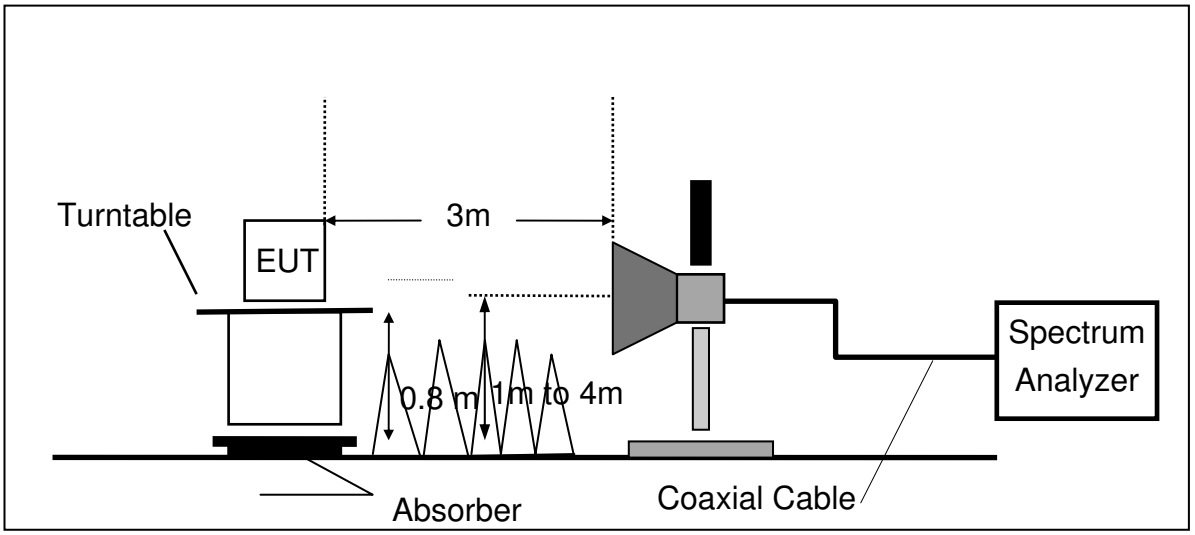
(A)Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz



10.4. Measurement Procedure:

Radiated Emission:

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
4. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Repeat above procedures until all frequency of the interest measured were complete.

Auxiliary Procedure (Setting on Spectrum to capture the reading of emission level):

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

10.5. Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

Remark:

1. The limit of the emission level is expressed in dBuV/m, which converts 20*log(uV/m)
2. Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

10.6. Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

Note: For the tabular table as presents below, “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency. “E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---“ : denotes Noise Floor

10.6.1. Radiated Spurious Emission Measurement Result

Operation Band	:	Test Date	:2014-11-25
Fundamental Frequency	:902.25 MHz	Temp./Humi.	:21 deg_C / 60 RH
Operation Mode	:TX LOW	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
34.85	S	QP	36.14	-13.86	22.28	40.00	-17.72
103.72	S	Peak	50.75	-17.20	33.55	43.50	-9.95
294.81	S	Peak	35.08	-11.29	23.79	46.00	-22.21
721.61	S	Peak	36.59	-4.05	32.54	46.00	-13.46
773.02	S	QP	37.65	-2.68	34.97	46.00	-11.03
937.92	S	Peak	35.74	0.09	35.83	46.00	-10.17
1804.50	H	---					
2706.75	H	---					
3609.00	H	---					
4511.25	H	---					
5413.50	H	Average	19.65	7.79	27.44	54.00	-26.56
5413.50	H	Peak	47.61	7.79	55.40	74.00	-18.60
6315.75	H	Average	13.44	9.38	22.82	54.00	-31.18
6315.75	H	Peak	41.40	9.38	50.78	74.00	-23.22
7218.00	H	Average	15.00	10.01	25.01	54.00	-28.99
7218.00	H	Peak	42.97	10.01	52.98	74.00	-21.02
8120.25	H	Average	11.32	10.78	22.10	54.00	-31.90
8120.25	H	Peak	39.30	10.78	50.08	74.00	-23.92
9022.50	H	---					

Operation Band	:	Test Date	:2014-11-25
Fundamental Frequency	:902.25 MHz	Temp./Humi.	:21 deg_C / 60 RH
Operation Mode	:TX LOW	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
102.75	S	Peak	53.25	-17.39	35.86	43.50	-7.64
216.24	S	Peak	38.33	-14.59	23.74	46.00	-22.26
307.42	S	Peak	39.57	-10.97	28.60	46.00	-17.40
713.85	S	Peak	35.77	-4.18	31.59	46.00	-14.41
772.05	S	QP	38.50	-2.68	35.82	46.00	-10.18
937.92	S	Peak	37.70	0.09	37.79	46.00	-8.21
1804.50	H	---					
2706.75	H	---					
3609.00	H	---					
4511.25	H	---					
5413.50	H	Average	25.75	7.79	33.54	54.00	-20.46
5413.50	H	Peak	53.71	7.79	61.50	74.00	-12.50
6315.75	H	Average	21.48	9.38	30.86	54.00	-23.14
6315.75	H	Peak	49.44	9.38	58.82	74.00	-15.18
7218.00	H	Average	25.63	10.01	35.64	54.00	-18.36
7218.00	H	Peak	53.60	10.01	63.61	74.00	-10.39
8120.25	H	Average	22.00	10.78	32.78	54.00	-21.22
8120.25	H	Peak	49.97	10.78	60.75	74.00	-13.25
9022.50	H	Average	19.11	11.61	30.72	54.00	-23.28
9022.50	H	Peak	47.07	11.61	58.68	74.00	-15.32

Operation Band	:	Test Date	:2014-11-25
Fundamental Frequency	:914.75 MHz	Temp./Humi.	:21 deg_C / 60 RH
Operation Mode	:TX MID	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
35.82	S	QP	45.56	-13.81	31.75	40.00	-8.25
102.75	S	Peak	50.78	-17.39	33.39	43.50	-10.11
212.36	S	Peak	38.37	-14.87	23.50	43.50	-20.00
297.72	S	Peak	34.95	-11.20	23.75	46.00	-22.25
769.14	S	QP	38.58	-2.67	35.91	46.00	-10.09
937.92	S	Peak	36.81	0.09	36.90	46.00	-9.10
1829.50	H	---					
2744.25	H	---					
3659.00	H	---					
4573.75	H	---					
5488.50	H	Average	18.22	7.90	26.12	54.00	-27.88
5488.50	H	Peak	46.19	7.90	54.09	74.00	-19.91
6403.25	H	Average	15.25	9.30	24.55	54.00	-29.45
6403.25	H	Peak	43.20	9.30	52.50	74.00	-21.50
7318.00	H	Average	14.82	10.17	24.99	54.00	-29.01
7318.00	H	Peak	42.78	10.17	52.95	74.00	-21.05
8232.75	H	---					
9147.50	H	---					

Operation Band	:	Test Date	:2014-11-25
Fundamental Frequency	:914.75 MHz	Temp./Humi.	:21 deg_C / 60 RH
Operation Mode	:TX MID	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
102.75	S	Peak	53.79	-17.39	36.40	43.50	-7.10
213.33	S	Peak	38.42	-14.80	23.62	43.50	-19.88
307.42	S	Peak	39.03	-10.97	28.06	46.00	-17.94
721.61	S	Peak	35.26	-4.05	31.21	46.00	-14.79
771.08	S	QP	39.24	-2.69	36.55	46.00	-9.45
937.92	S	Peak	36.38	0.09	36.47	46.00	-9.53
1829.50	H	---					
2744.25	H	---					
3659.00	H	---					
4573.75	H	---					
5488.50	H	Average	25.38	7.90	33.28	54.00	-20.72
5488.50	H	Peak	53.35	7.90	61.25	74.00	-12.75
6403.25	H	Average	22.93	9.30	32.23	54.00	-21.77
6403.25	H	Peak	50.88	9.30	60.18	74.00	-13.82
7318.00	H	Average	23.38	10.17	33.55	54.00	-20.45
7318.00	H	Peak	51.34	10.17	61.51	74.00	-12.49
8232.75	H	Average	18.30	10.86	29.16	54.00	-24.84
8232.75	H	Peak	46.25	10.86	57.11	74.00	-16.89
9147.50	H	Average	18.18	11.44	29.62	54.00	-24.38
9147.50	H	Peak	46.13	11.44	57.57	74.00	-16.43

Operation Band	:	Test Date	:2014-11-25
Fundamental Frequency	:927.75 MHz	Temp./Humi.	:21 deg_C / 60 RH
Operation Mode	:TX HIGH	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
34.85	S	QP	46.35	-13.86	32.49	40.00	-7.51
102.75	S	Peak	51.09	-17.39	33.70	43.50	-9.80
713.85	S	Peak	39.08	-4.18	34.90	46.00	-11.10
735.19	S	Peak	39.33	-3.28	36.05	46.00	-9.95
769.14	S	QP	38.99	-2.67	36.32	46.00	-9.68
936.95	S	Peak	35.94	0.08	36.02	46.00	-9.98
1855.50	H	Average	18.53	0.02	18.55	54.00	-35.45
1855.50	H	Peak	46.49	0.02	46.51	74.00	-27.49
2783.25	H	---					
3711.00	H	---					
4638.75	H	---					
5566.50	H	Average	15.90	7.94	23.84	54.00	-30.16
5566.50	H	Peak	43.86	7.94	51.80	74.00	-22.20
6494.25	H	Average	15.33	9.47	24.80	54.00	-29.20
6494.25	H	Peak	43.29	9.47	52.76	74.00	-21.24
7422.00	H	Average	12.64	10.04	22.68	54.00	-31.32
8349.75	H	---					
9277.50	H	---					

Operation Band	:	Test Date	:2014-11-25
Fundamental Frequency	:927.75 MHz	Temp./Humi.	:21 deg_C / 60 RH
Operation Mode	:TX HIGH	Engineer	:Curry
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
108.57	S	Peak	52.38	-16.28	36.10	43.50	-7.40
211.39	S	Peak	39.37	-14.93	24.44	43.50	-19.06
306.45	S	Peak	39.76	-10.98	28.78	46.00	-17.22
717.73	S	Peak	41.18	-4.14	37.04	46.00	-8.96
769.14	S	QP	39.55	-2.67	36.88	46.00	-9.12
942.77	S	Peak	34.91	0.17	35.08	46.00	-10.92
1855.50	H	Average	15.01	0.02	15.03	54.00	-38.97
1855.50	H	Peak	42.97	0.02	42.99	74.00	-31.01
2783.25	H	---					
3711.00	H	---					
4638.75	H	---					
5566.50	H	Average	22.73	7.94	30.67	54.00	-23.33
5566.50	H	Peak	50.69	7.94	58.63	74.00	-15.37
6494.25	H	Average	23.31	9.47	32.78	54.00	-21.22
6494.25	H	Peak	51.27	9.47	60.74	74.00	-13.26
7422.00	H	Average	23.30	10.04	33.34	54.00	-20.66
7422.00	H	Peak	51.26	10.04	61.30	74.00	-12.70
8349.75	H	Average	18.98	11.05	30.03	54.00	-23.97
8349.75	H	Peak	46.94	11.05	57.99	74.00	-16.01
9277.50	H	Average	15.43	11.85	27.28	54.00	-26.72
9277.50	H	Peak	43.38	11.85	55.23	74.00	-18.77

11. FREQUENCY SEPARATION

11.1. Standard Applicable

According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25 kHz or 20dB bandwidth of the hopping channel, whichever is greater.

11.2. Measurement Equipment Used:

Refer to section 7.2 for the plot.

11.3. Test Set-up:

Refer to section 7.3 for the plot.

11.4. Measurement Procedure:

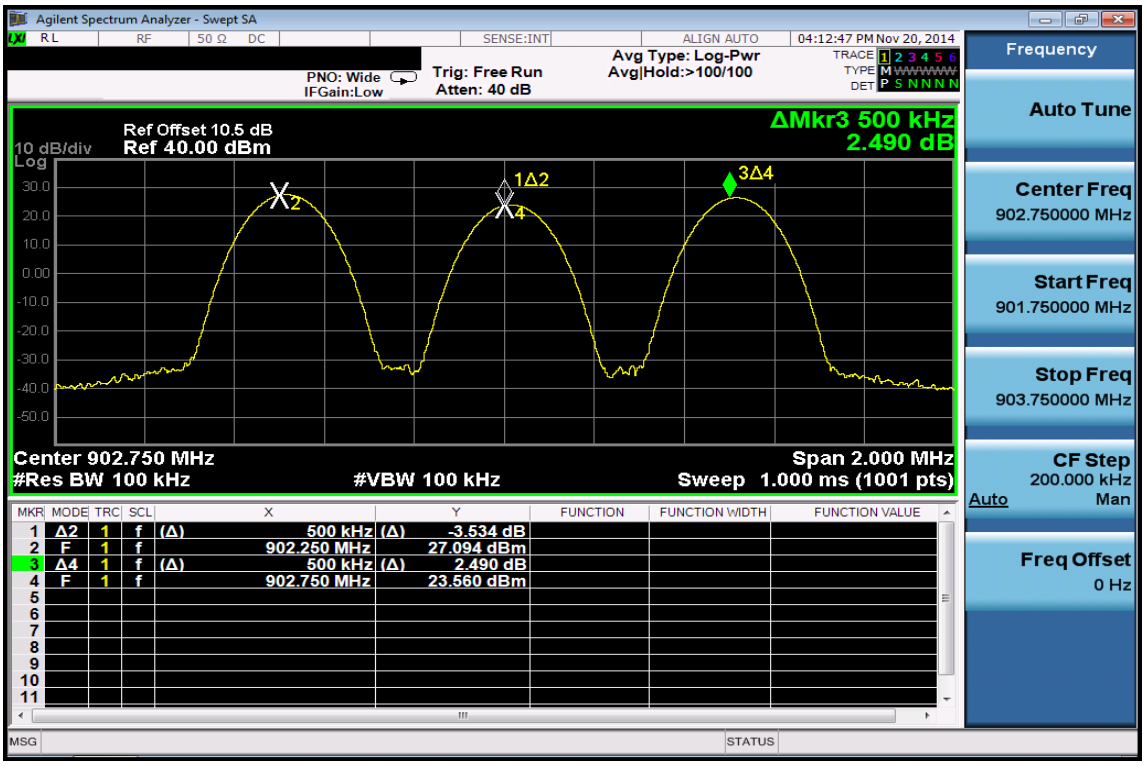
1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = middle of hopping channel.
4. Set the spectrum analyzer as RBW, VBW=100 kHz, Adjust Span to 2MHz, Sweep = auto.
5. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

11.5. Measurement Result:

Channel separation (MHz)	Limit	Result
1	>=25 kHz or 20dB bandwidth	PASS

Note: Refer to next page for plots.

Frequency Separation Test Data



12. NUMBER OF HOPPING FREQUENCY

12.1. Standard Applicable

According to §15.247(a)(1)(i), Frequency hopping systems operating in the 902MHz-928 MHz bands shall use at least 50 hopping frequencies.

12.2. Measurement Equipment Used:

Refer to section 7.2 for the plot.

12.3. Test Set-up:

Refer to section 7.3for the plot.

12.4. Measurement Procedure:

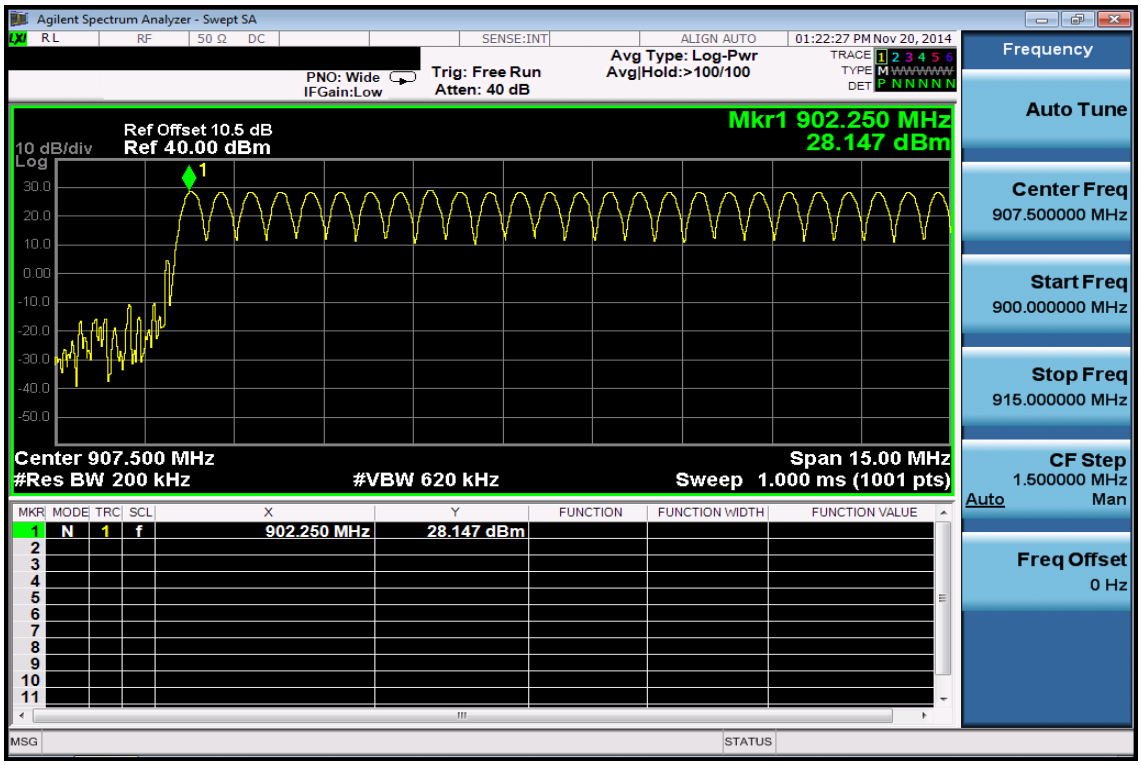
1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set spectrum analyzer Start=900MHz, Stop = 930MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW=200 kHz, VBW=620KHz., Detector = Peak
5. Max hold, view and count how many channel in the band.

12.5. Measurement Result:

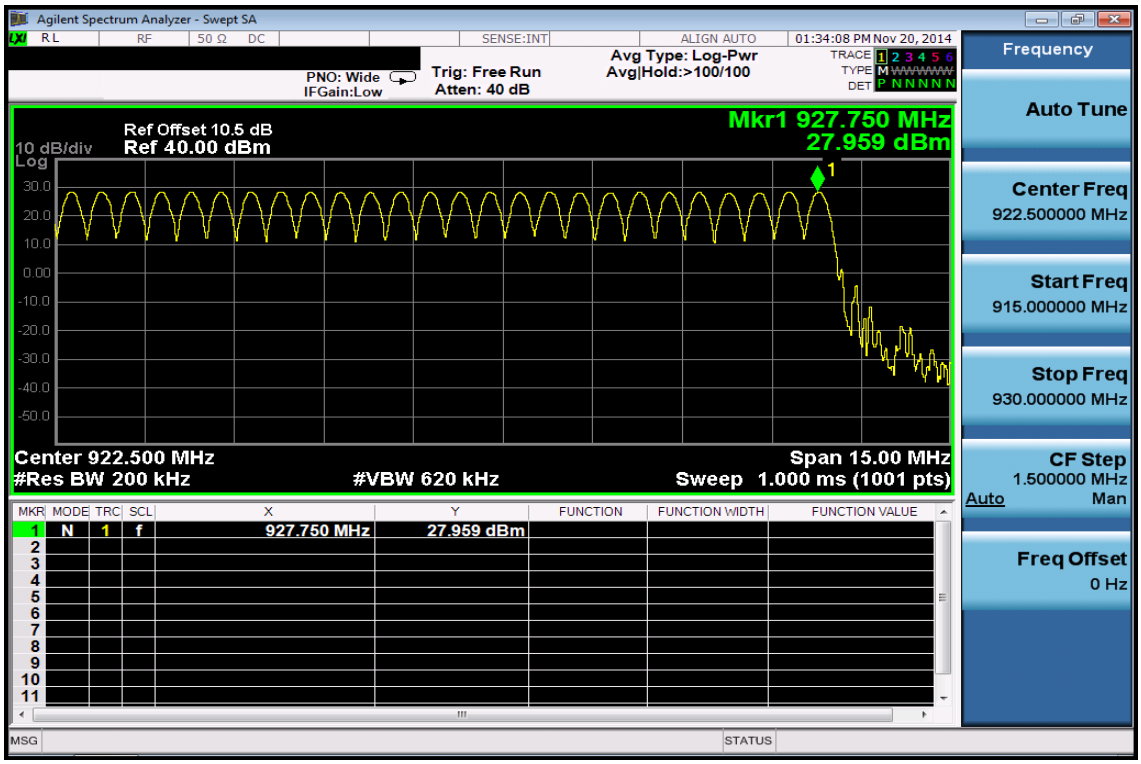
Note: Refer to next page for plots.

Channel Number

900 MHz – 915 MHz



915 MHz – 930 MHz



13. TIME OF OCCUPANCY (DWELL TIME)

13.1. Standard Applicable

According to §15.247(a)(1)(i), Frequency hopping systems operating in the 902MHz-928MHz. The average time of occupancy on any frequency shall not greater than 0.4 s within a period of 20 seconds.

13.2. Measurement Equipment Used:

Refer to section 7.2 for the plot.

13.3. Test Set-up:

Refer to section 7.3for the plot.

13.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=100KHz, 300KHz, Span = 0Hz, Detector = Peak, Adjust Sweep = 50ms.
5. Repeat above procedures until all frequency of the interest measured were complete.

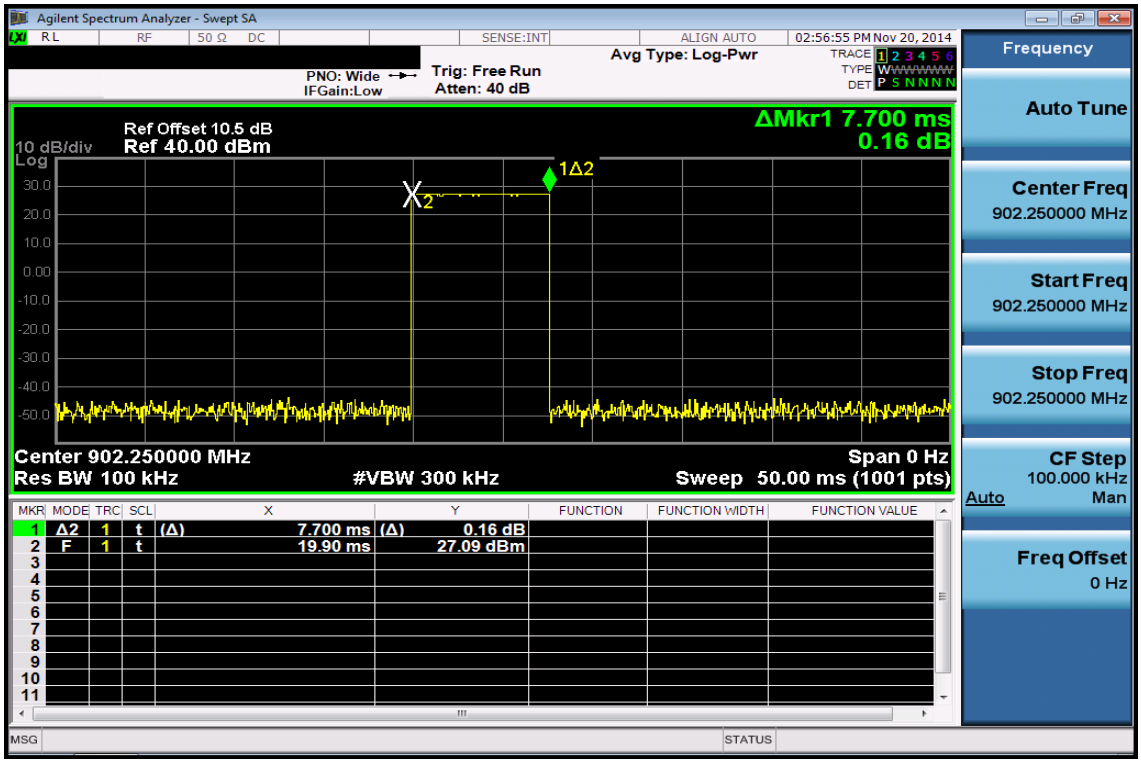
13.5. Tabular Result of the Measurement:

Number of transmis-sion in a 20s	Length of transmis-sion time (ms):	Measurement Result (ms):	Limit (ms):
6	7.700	46.2	400ms

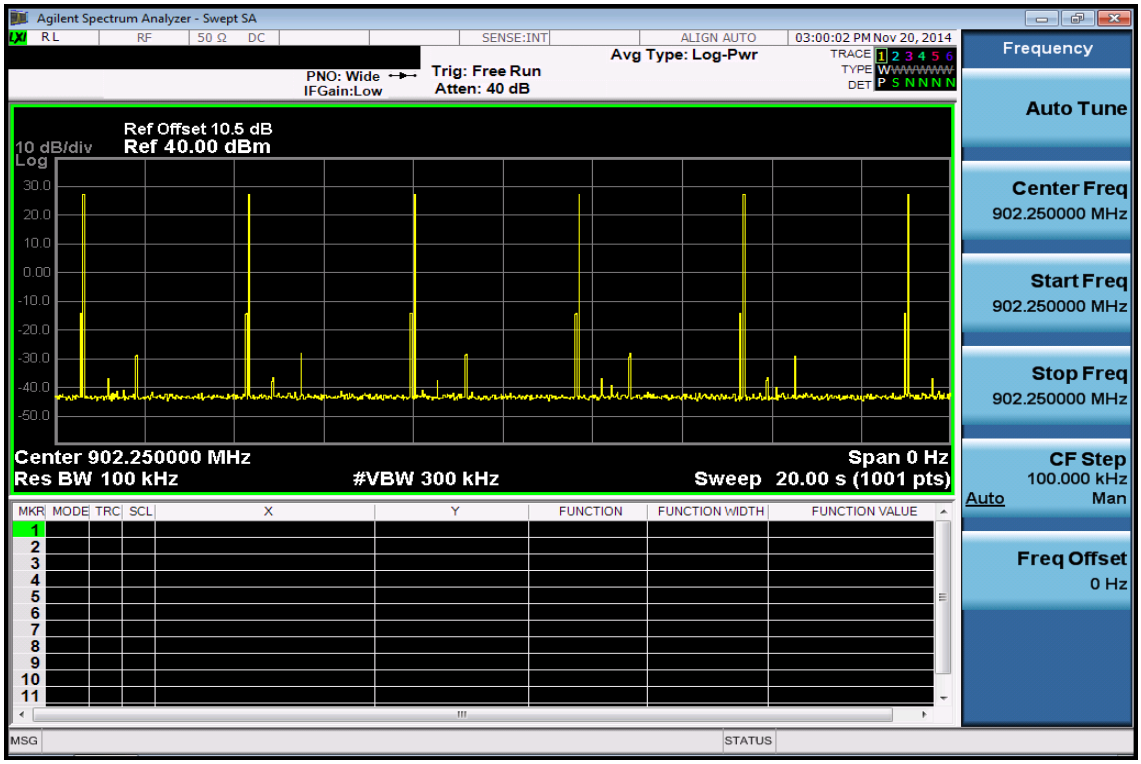
13.6. Measurement Result:

Note: Refer to next page for plots.

Length of transmission time



Number of transmission in a 20s



14. ANTENNA REQUIREMENT

14.1. Standard Applicable

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

14.2. Antenna Connected Construction

The directional gain of antenna used for transmitting is 7.71dBi, and the antenna connector is designed with unique type and no consideration of replacement. Please see EUT photo and antenna spec. for details.