

## ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

### INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

**Product Name:** UHF RFID Reader  
**Brand Name:** Szok-C  
**Model No.:** SRF-4160  
**Model Difference:** N/A  
**FCC ID:** 2ADGD-SRF4160US  
**Report No.:** ER/2017/10089  
**Issue Date:** Sep. 18, 2017  
**FCC Rule Part:** §15.247, Cat: DSS  
**Prepared for:** Szok Energy and Communication Co., Ltd  
17F.-1, No.104, Sec. 1, Xintai 5th Rd., Xizhi Dist,  
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SGS Taiwan Ltd.  
**Prepared by:** Electronics & Communication Laboratory  
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## VERIFICATION OF COMPLIANCE

**Applicant:** Szok Energy and Communication Co., Ltd  
Rm. 1, 17F., No. 104, Sec., 1, Xintai 5th Rd., Xizhi Dist., New Taipei City 22102, Taiwan(R.O.C.)

**Product Name:** UHF RFID Reader

**Brand Name:** Szok-C

**Model No.:** SRF-4160

**Model Difference:** N/A

**FCC ID:** 2ADGD-SRF4160US

**File Number:** ER/2017/10089

**Date of test:** Feb. 03, 2017 ~ Aug. 23, 2017

**Date of EUT Received:** Feb. 03, 2017

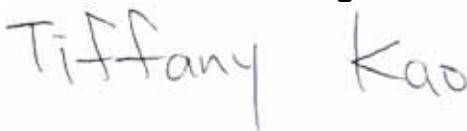
**We hereby certify that:**

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 C63.10:2013. 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.

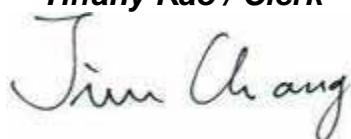
The test results of this report relate only to the tested sample identified in this report.

**Test By:****Date:**

Sep. 18, 2017

**Louis Chen / Sr. Engineer****Prepared By:****Date:**

Sep. 18, 2017

**Tiffany Kao / Clerk****Approved By:****Date:**

Sep. 18, 2017

**Jim Chang / Asst. Manager**

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## Revision History

Report Number	Revision	Description	Issue Date
ER/2017/10089	Rev.00	Initial creation of document	Sep. 18, 2017

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## 1. GENERAL INFORMATION

### 1.1. Product description

General:

Product Name:	UHF RFID Reader
Brand Name:	Szok-C
Model No.:	SRF-4160
Model Difference:	N/A
Hardware Version:	N/A
Software Version:	N/A
Power Supply:	DC 12V

RFID:

Frequency Range:	902.25 – 927.75MHz
Channel Number:	52 channels
Channel Space:	500 kHz steps
Modulation Type:	PR-ASK, ASK
Transmit Power:	25.37dBm (Peak)
Dwell Time:	<= 0.4s
Operating Mode:	Point-to-Point
Antenna Designation:	Patch Antenna, Gain: 9.88dBi

This test report applies for RFID function.

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## 1.2. Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

ANSI C63.10:2013

Note: All test items have been performed and record as per the above standards.

## 1.3. Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803 (TAF code 0513)

FCC Registration Numbers are: 509634

## 1.4. Special Accessories

There is no special accessory used while test was conducted.

## 1.5. Equipment Modifications

There was no modification incorporated into the EUT.

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## 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 placed on a turn table which is 0.8 m above ground plan. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz,. The CISPR Quasi-Peak and Average detector mode is employed according to §15.207. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

#### 2.3.2 Radiated Emissions

The EUT is placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plan. For emission measurements above 1 GHz, the table height shall be 1.5 m. 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 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.

### 2.4. Measurement Results Explanation Example

#### For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

**Note:** The spectrum analyzer offset is derived from RF cable loss 0.8dB and attenuator factor 20dB.

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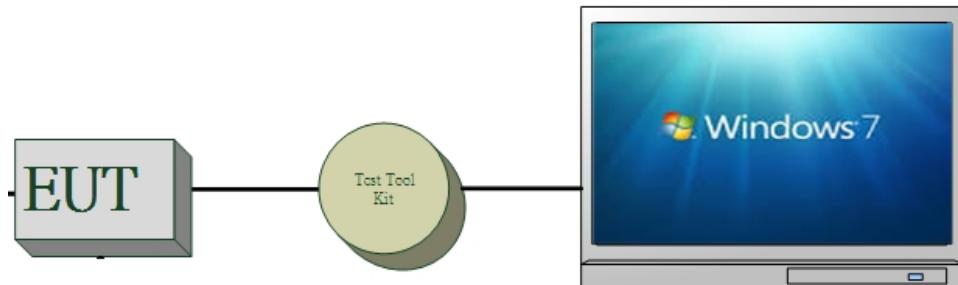
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## 2.5. Configuration of Tested System

**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 Software	N/A	N/A	N/A	N/A	N/A
2.	Notebook	Lenovo	L420	LR-7HXZA	Shielded	Unshielded
3.	Test Kit	N/A	N/A	N/A	N/A	N/A

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### 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

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## 4. DESCRIPTION OF TEST MODES

### 4.1 Operated in 902 ~ 928MHz Band

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.

A & B channel plan is set for this device, 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 RFID Transmitter for channel Low, Mid and High the worst case H position was reported.

Channel Low: channel 1 at 902.25MHz

Channel Mid: channel 25 at 914.75MHz

Channel High: channel 50 at 927.25MHz

52 channels are provided for RFID

A={ (906250), (923250), (907750), (924750), (903750), (920750), (909250), (904750), (925250), (904250) }

A={ (907250), (905250), (925750), (903250), (918750), (906750), (926750), (908250), (908750), (912750) }

A={ (909750), (910250), (922250), (910750), (916250), (911250), (914250), (911750), (924250), (912250) }

A={ (918250), (913250), (913750), (914750), (905750), (915750), (915250), (916750), (917250), (920250) }

A={ (917750), (919250), (921250), (919750), (921750), (922750), (926250), (923750), (902750), (902250) }

A={ (927750), (927250) }

B={ (906500), (923500), (908000), (925000), (904000), (921000), (909500), (905000), (925500), (904500) }

B={ (907500), (905500), (926000), (903500), (919000), (907000), (927000), (908500), (909000), (913000) }

B={ (910000), (910500), (922500), (911000), (916500), (911500), (914500), (912000), (924500), (912500) }

B={ (918500), (913500), (914000), (915000), (906000), (916000), (915500), (917000), (917500), (920500) }

B={ (918000), (919500), (921500), (920000), (922000), (923000), (926500), (924000), (903000), (902500) }

B={ (927600), (927500) }

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## 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 : <b>Vertical</b> )	9kHz – 30MHz: +/- 2.87 dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

Measurement uncertainty (Polarization : <b>Horizontal</b> )	9kHz – 30MHz: +/- 2.87 dB
	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.

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## 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	05/11/2017	05/10/2018
LISN	SCHWARZBECK	NSLK 8127	8127-649	05/22/2017	05/21/2018
LISN	MESS TEC	FCC-LISN-50/250-25-2-01	4034	03/19/2017	03/18/2018
Coaxial Cables	N/A	WK CE Cable	N/A	11/26/2016	11/25/2017

### 6.3. EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
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.

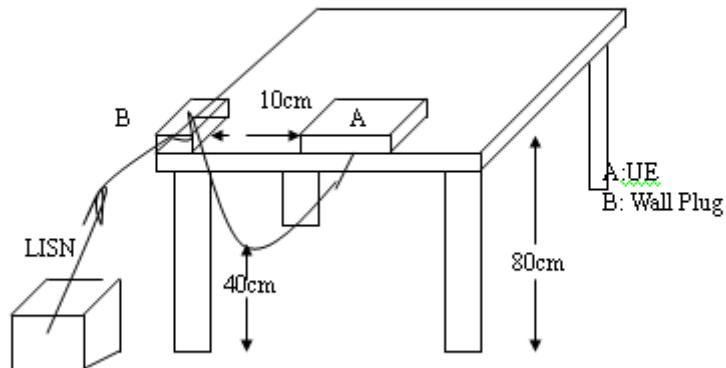
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## 6.4. Test SET-UP (Block Diagram of Configuration)



## 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

N/A, EUT powered from DC 12V.

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## 7. PEAK OUTPUT POWER MEASUREMENT

### 7.1. Standard Applicable

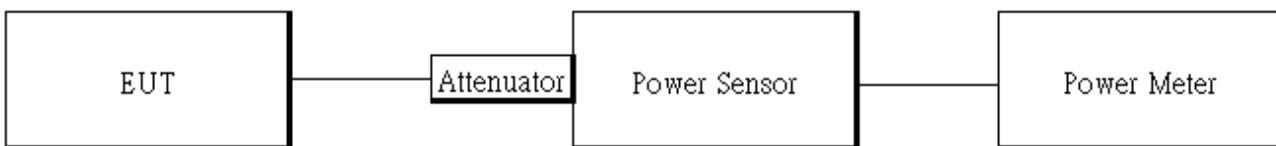
According to §15.247(b)(2), for frequency hopping systems operating in the 902-928 MHz band employing at least 50 hopping channels, The Limit: 1Watt. For systems employing less than 50 hopping channels, The Limit: 0.25 Watts. But at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of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

If the transmitting antenna of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi.

### 7.2. Measurement Equipment Used

SGS Conducted Room					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Power Meter	Anritsu	ML2495A	1005007	12/15/2016	12/14/2017
Power Sensor	Anritsu	MA2411B	917032	12/15/2016	12/14/2017
EXA Spectrum Analyzer	Agilent	N9030A	MY53120760	03/21/2017	03/20/2018
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2017	01/04/2018
Coaxial Cable	HUBER+SUHNER	SUCOFLEX 102	23670/2	01/05/2017	01/04/2018
Attenuator	Mini-Circuit	BW-S10W2+	2	01/05/2017	01/04/2018
Splitter	Agilent	11636B	N/A	01/05/2017	01/04/2018
DC Power Supply	Agilent	E3640A	MY52410006	11/21/2016	11/20/2017
Temperature Chamber	TERCHY	MHG-120LF	911009	05/19/2017	05/18/2018

### 7.3. Test Set-up:



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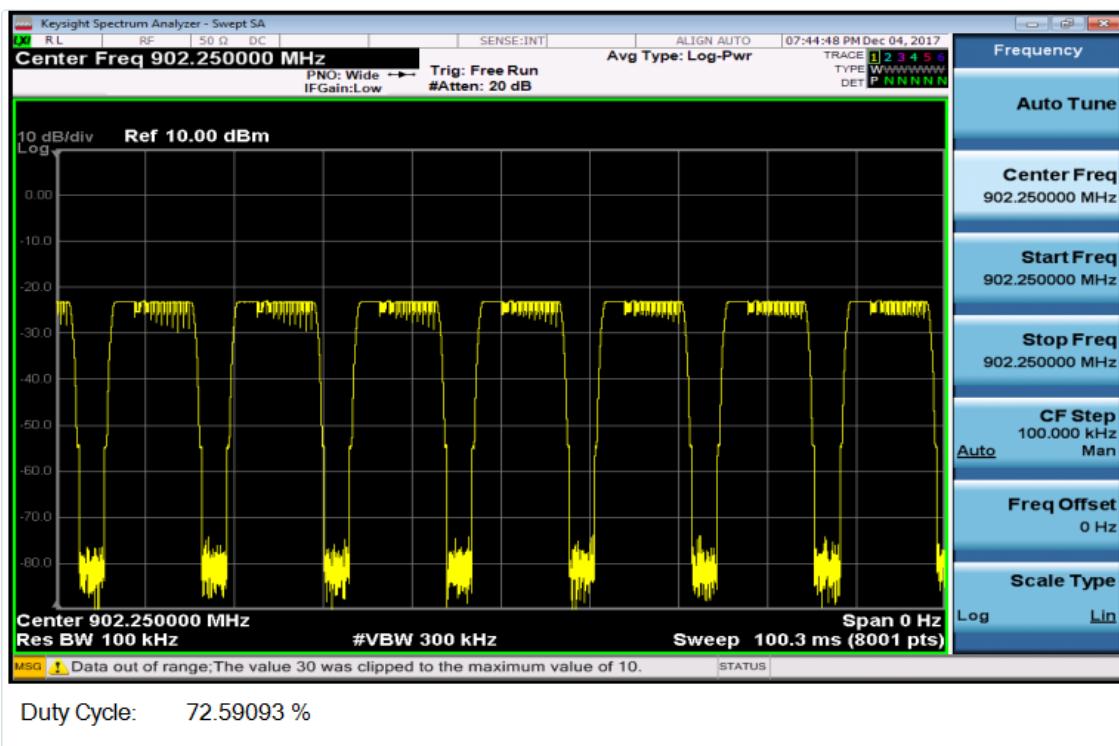
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## 7.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2013.
3. 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)
4. Record the max. reading.
5. Repeat above procedures until all default test channel is completed.

## 7.5. Measurement Result

### Duty Factor:



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RFID					
CH	Freq. (MHz)	Peak Out-put Power (dBm)	Peak Out-put Power (mW)	Limit	RESULT
1	902.25	25.28	337.29	26.12 dBm	PASS
25	914.75	<b>25.37</b>	344.59	26.12 dBm	PASS
50	927.75	24.69	294.58	26.12 dBm	PASS

RFID					
CH	Freq. (MHz)	Avg. Out-put Power (dBm)	Avg. Output Power (mW)	Limit	RESULT
1	902.25	<b>23.05</b>	201.74	26.12 dBm	PASS
25	914.75	22.86	193.37	26.12 dBm	PASS
50	927.75	22.15	163.95	26.12 dBm	PASS

**Note:**

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

Limit:  $30\text{dBm} - (9.88 - 6\text{dBi}) = 26.12\text{dBm}$

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## 8. 20DB BANDWIDTH

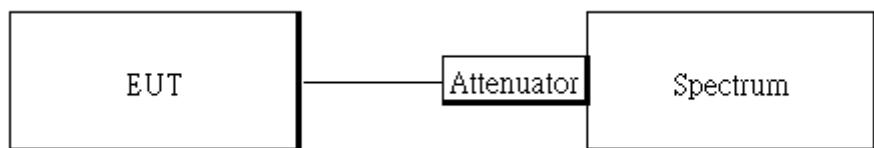
### 8.1. Standard Applicable

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



### 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

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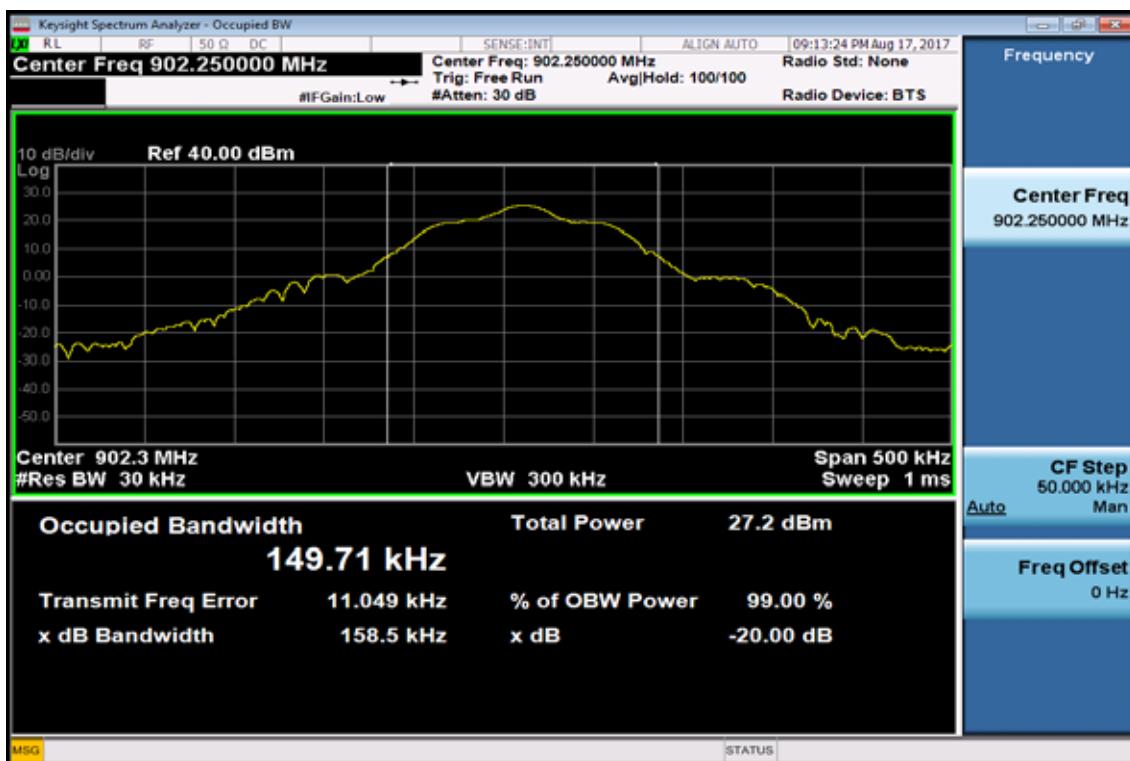
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## 8.5. Measurement Result:

CH	Freq. (MHz)	20dB BW (kHz)
Low	902.25	158.50
Mid	914.75	160.50
High	927.75	<b>160.50</b>

### 20dB Band Width Test Data CH-Low

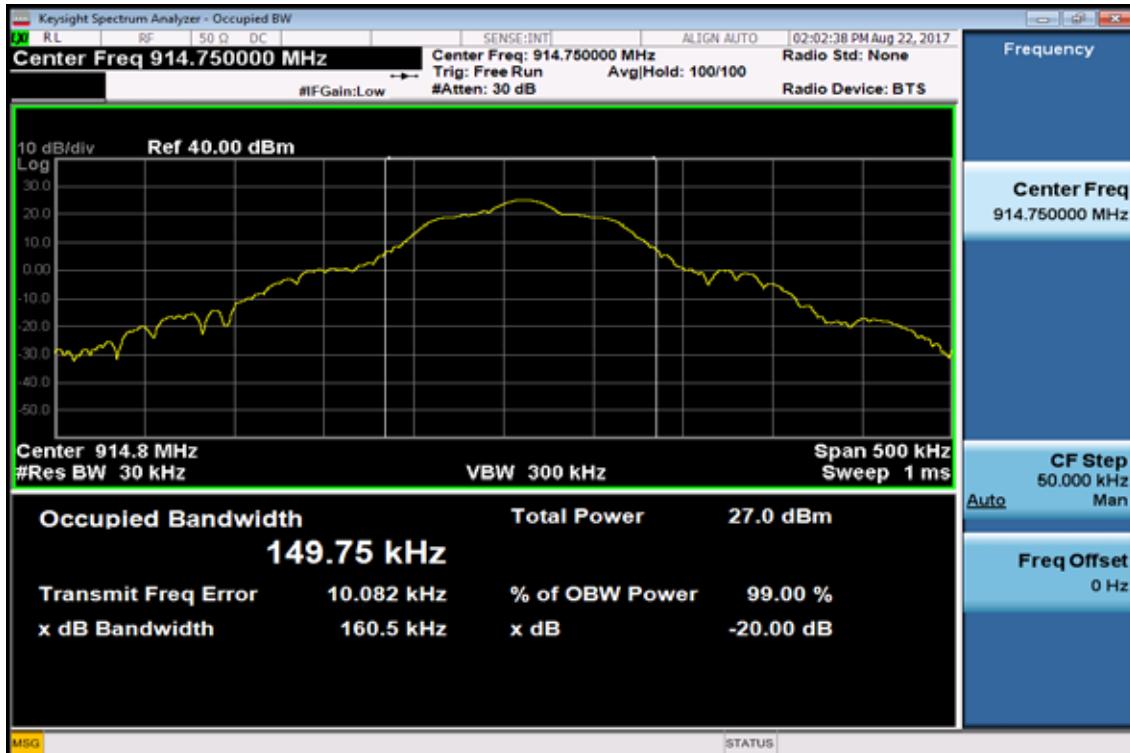


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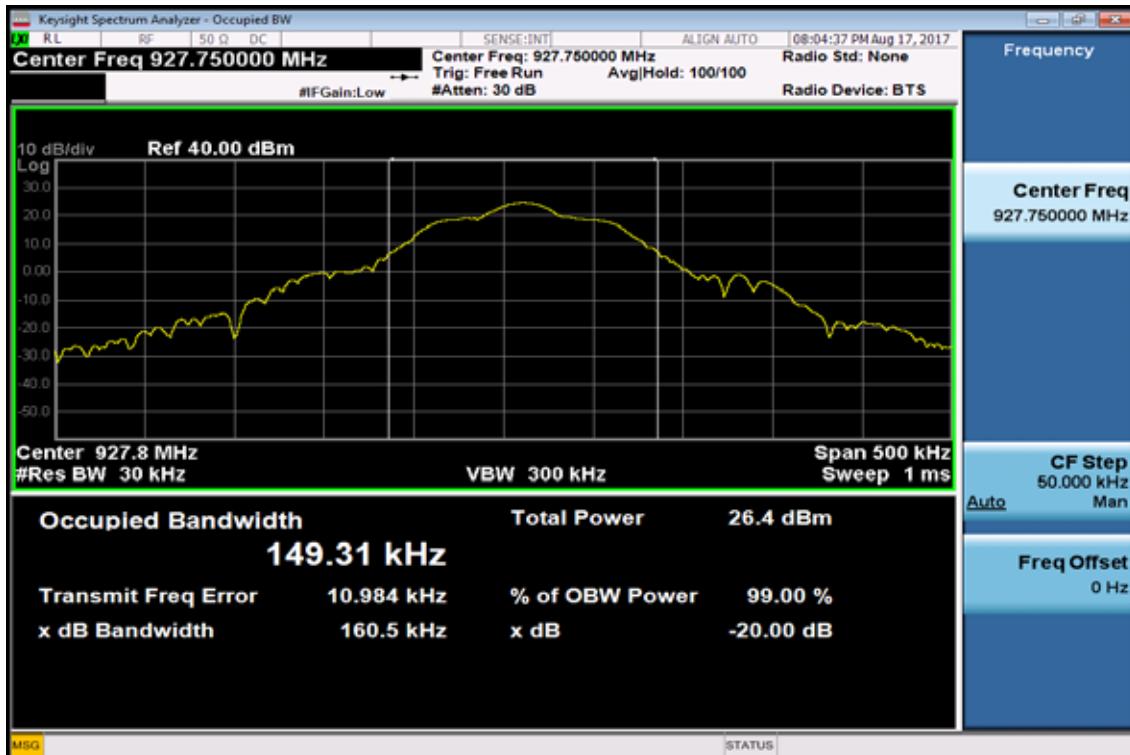
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## 20dB Band Width Test Data CH-Mid



## 20dB Width Test Data CH-High



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## 9. CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

### 9.1. Standard Applicable

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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

### 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 8.3 for the plot.

### 9.4. Measurement Procedure

#### Conducted Band Edge:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2013.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set center frequency of spectrum analyzer = operating frequency.
5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Sweep = auto
6. Mark Peak, 902MHz and 928MHz and record the max. level.
7. Repeat above procedures until all frequency measured were complete.

#### Conducted Spurious Emission:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows ANSI C63.10:2013.
3. Set RBW = 100 kHz & VBW = 300 kHz, Detector =Peak, Sweep = Auto
4. Allow trace to fully stabilize.
5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

Repeat above procedures until all default test channel measured were complete.

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

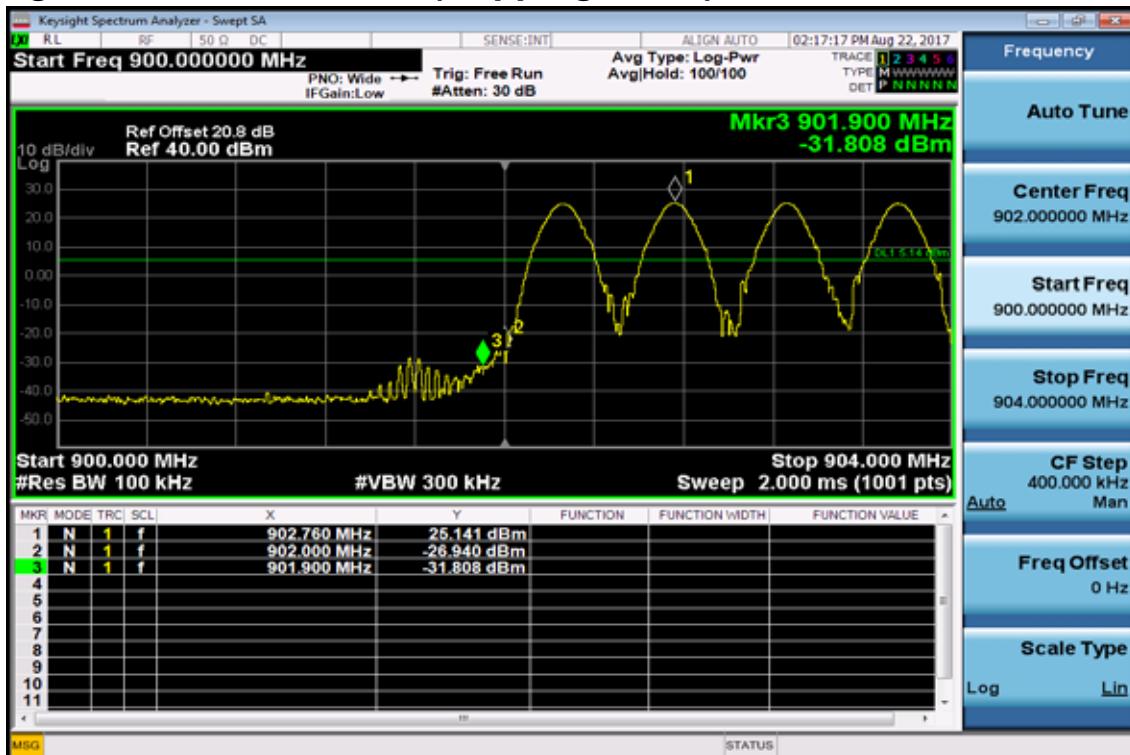
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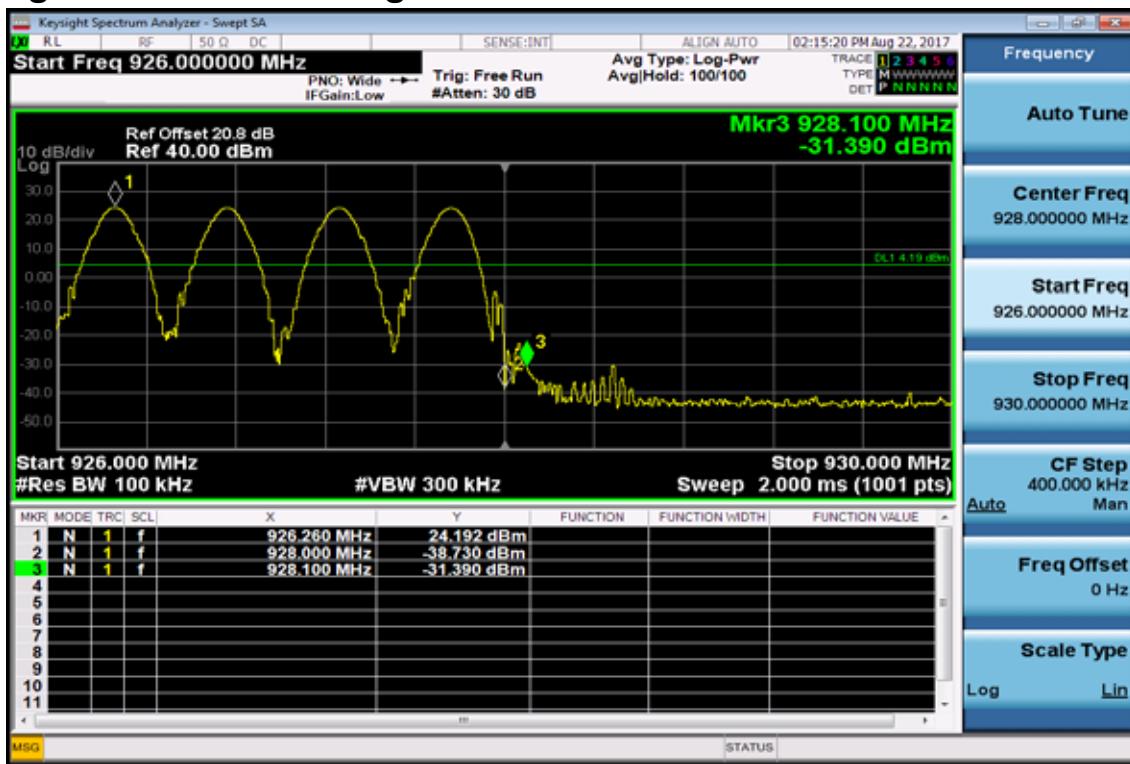
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## 9.7. Measurement Result: 100 kHz BANDWIDTH OF BNAD EDGE Band Edges Test Data CH-Low (Hopping mode)



## Band Edges Test Data CH-High

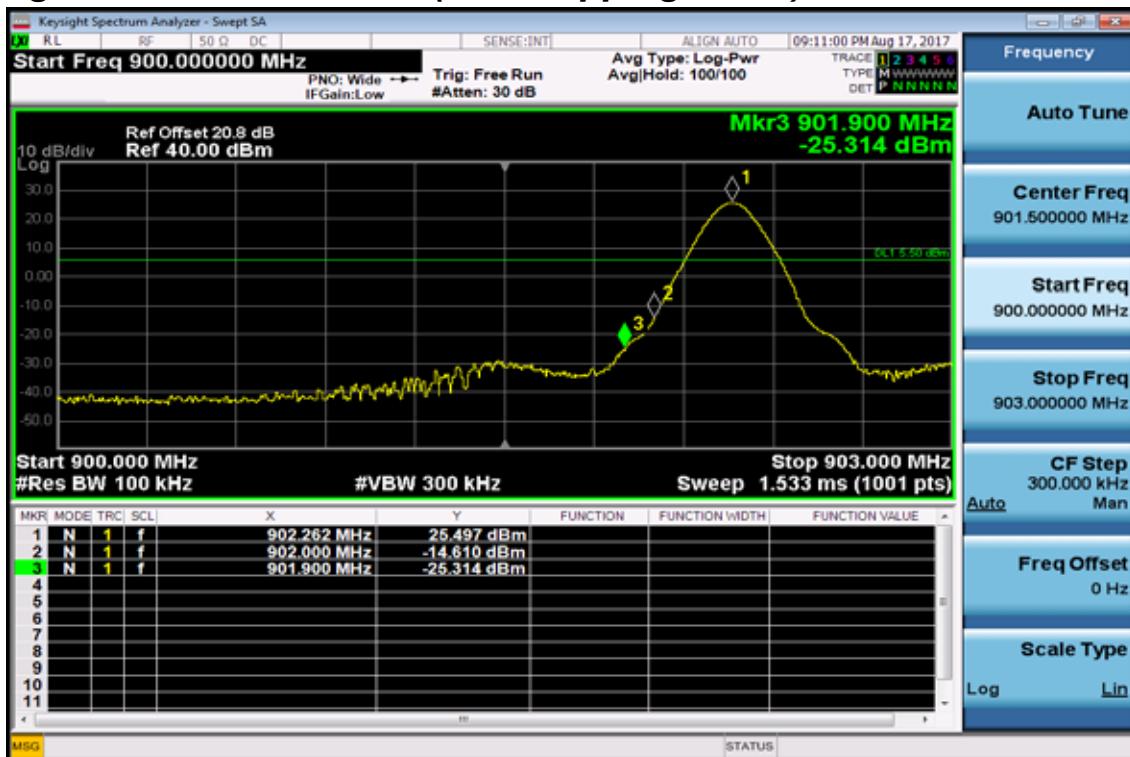


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## Band Edges Test Data CH-Low (Non-Hopping mode)



## Band Edges Test Data CH-High



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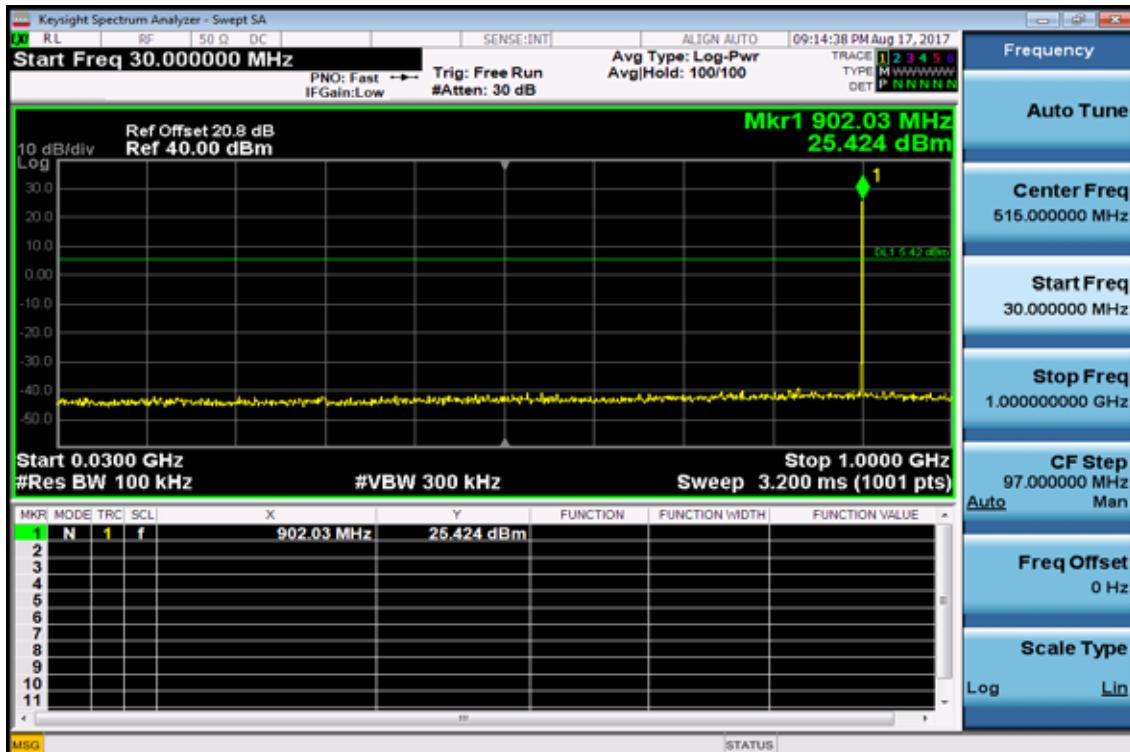
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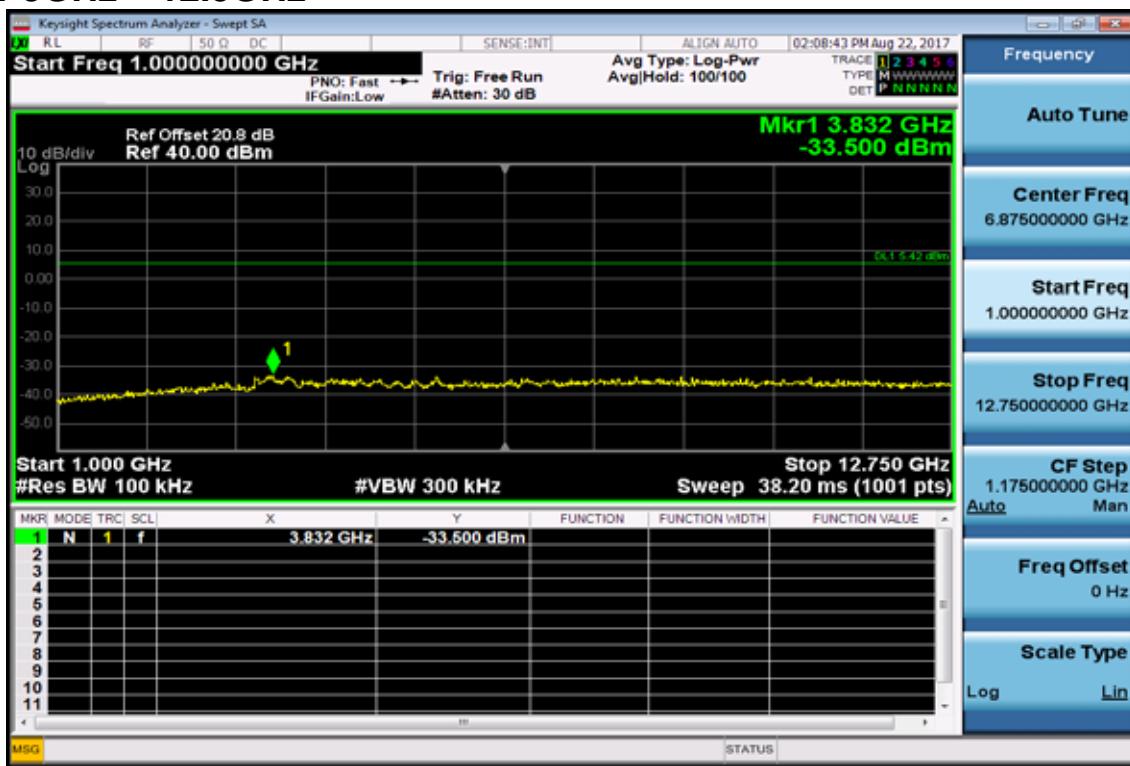
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## 9.8. Measurement Result: Conducted Spurious Emission Measurement Result

### Ch Low 30MHz – 1GHz



### Ch Low 3GHz – 12.5GHz

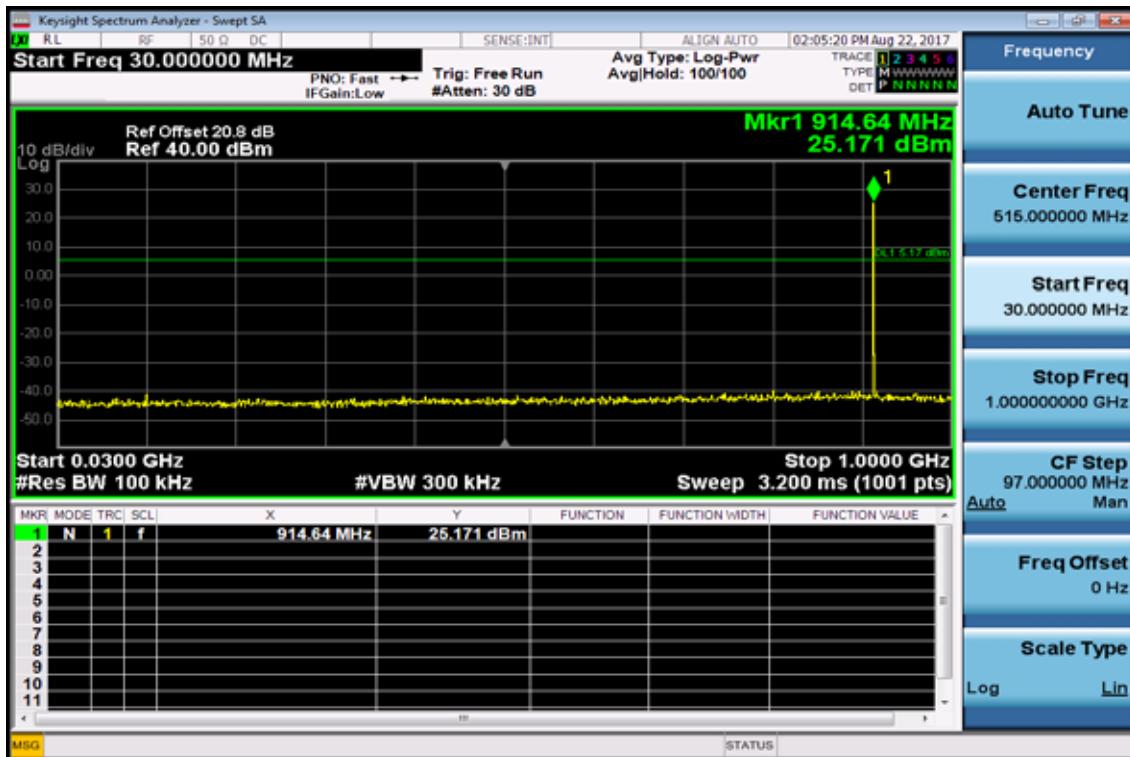


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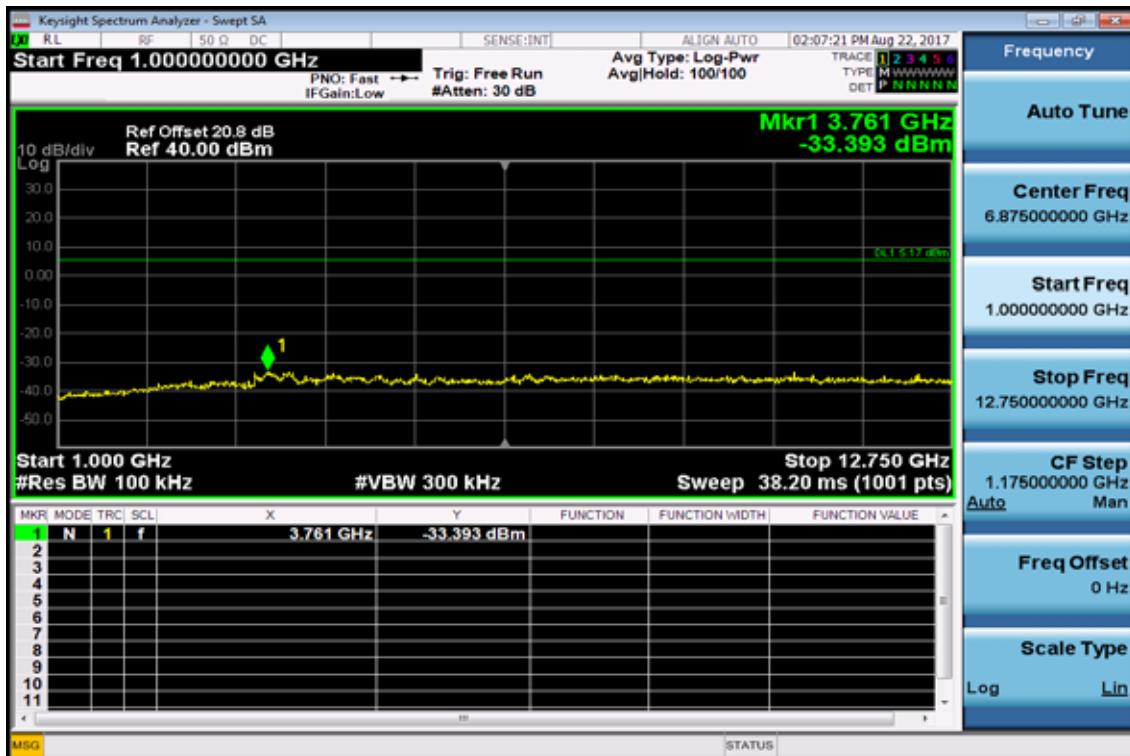
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## Ch Mid 30MHz – 1GHz



## Ch Mid 3GHz – 12.5GHz



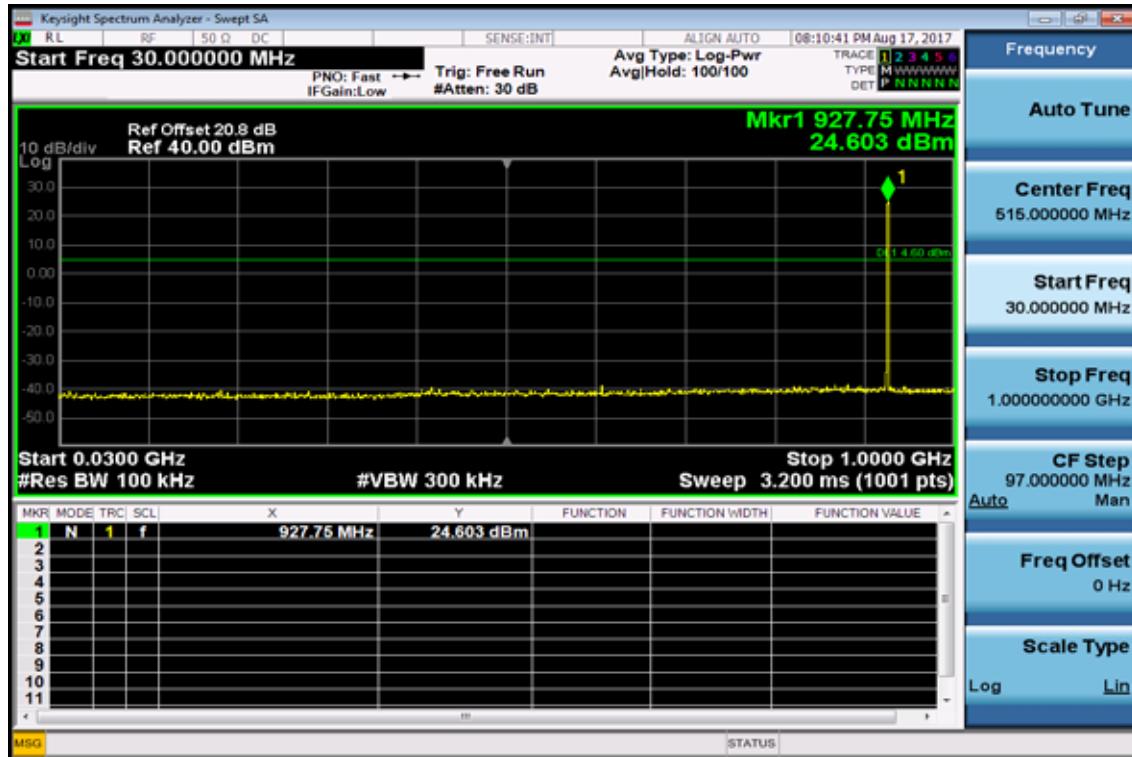
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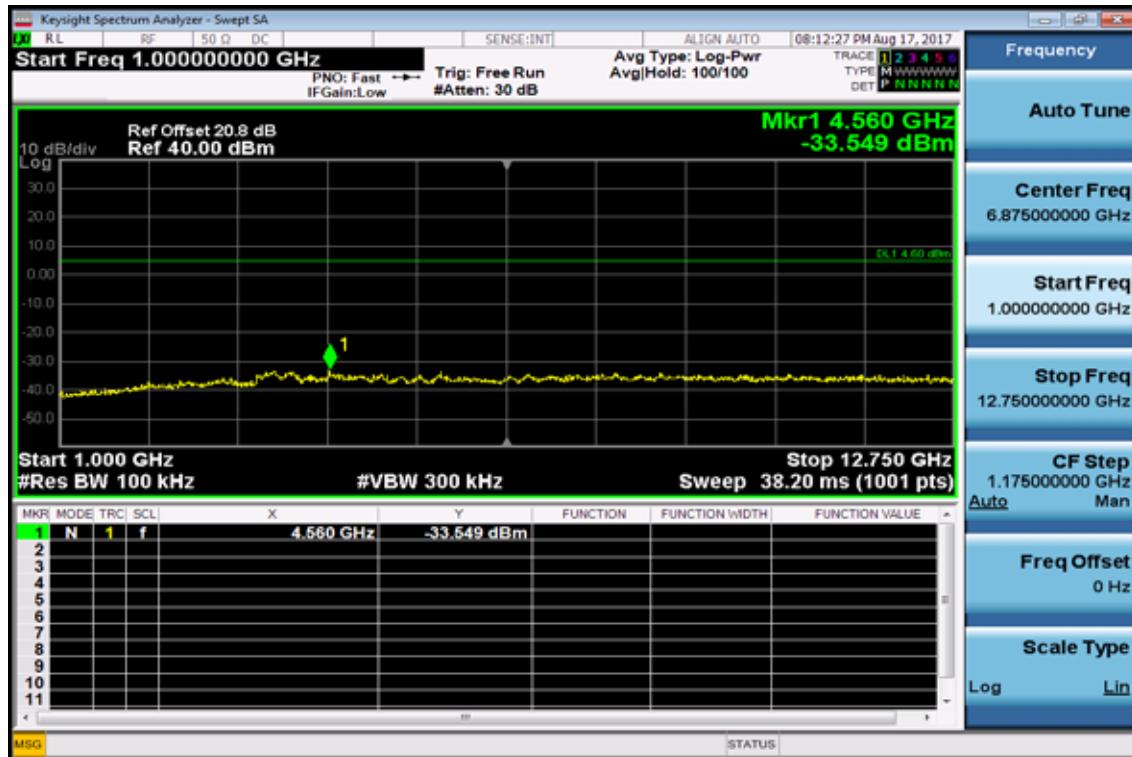
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## Ch High 30MHz – 1GHz



## Ch High 3GHz – 12.5GHz



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## 10. SPURIOUS RADIATED EMISSION TEST

### 10.1. Standard Applicable

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. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 limit as below.

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.

Frequency (MHz)	Field strength (microvolts/meter)	Distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

**Note:**

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dB $\mu$ V/m) = 20 log Emission level (dB $\mu$ V/m)

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## 10.2. Measurement Equipment Used:

SGS SAC-III					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
EMI Test Receiver	R&S	ESCI7	100760	05/11/2017	05/10/2018
Spectrum Analyzer	Agilent	E4446A	MY51100003	04/25/2017	04/24/2018
Loop Antenna	ETS-Lindgren	6502	148045	09/20/2016	09/19/2017
Bilog Antenna	SCHWAZBECK	VULB9168	378	12/19/2016	12/18/2017
Horn Antenna	Schwarzbeck	BBHA9120D	1441	08/04/2017	08/03/2018
Pre-Amplifier	Agilent	8447D	2944A07676	01/03/2017	01/02/2018
Pre-Amplifier	EMC Instruments Corp.	EMC0126530	980038	01/03/2017	01/02/2018
Turn Table	HD	DT420	N/A	N.C.R	N.C.R
Antenna Tower	ChamPro	AM-BS-4500-B	060776-ABS	N.C.R	N.C.R
Controller	ChamPro	EM1000	60776	N.C.R	N.C.R
Low Loss Cable	Huber Suhner	966_RX	9	01/05/2017	01/04/2018
3m Site NSA	SGS	966 chamber	N/A	07/01/2017	06/30/2018
Low Loss Cable	Huber Suhner	966 TX	1	01/05/2017	01/04/2018
Horn Antenna	Schwarzbeck	BBHA9170	184	12/12/2016	12/11/2017
Pre-Amplifier	EMC Instruments Corp.	EMC184045	980135	01/05/2017	01/04/2018

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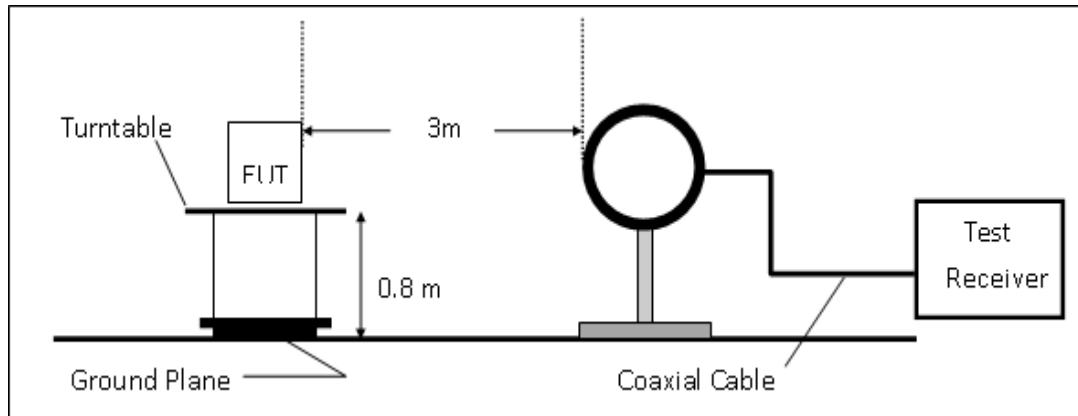
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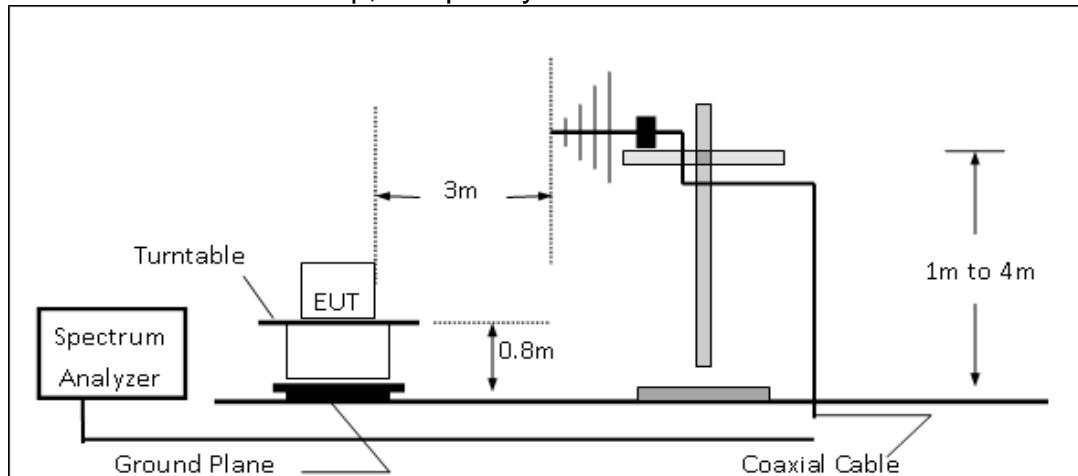
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### 10.3. Test SET-UP:

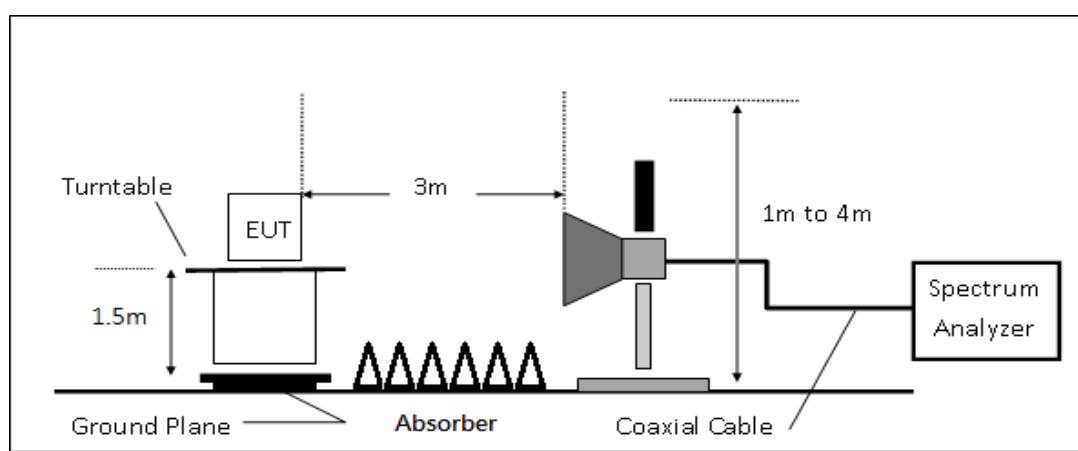
#### (A) Radiated Emission Test Set-UP Frequency Below 30MHz.



#### (B) Radiated Emission Test Set-Up, Frequency from 30MHz to 1000MHz



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



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## 10.4. Measurement Procedure:

### Radiated Emission:

1. The testing follows ANSI C63.10:2013.
2. The EUT was placed on a turn table with 0.8m for frequency < 1GHz and 1.5m for frequency > 1GHz above ground plan.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. Use the follow spectrum analyzer setting:
  - (1) Span = wide enough to fully capture the emission being measured
  - (2) RBW = 1 MHz for  $f \geq 1$  GHz, 100 kHz for  $f < 1$  GHz, VBW  $\geq$  RBW, Sweep = auto, Detector function = peak, Trace = max hold
  - (3) For average measurement: use duty cycle correction factor method per 15.35(c)  
Duty Cycle = On time/100 milliseconds  
On time =  $N_1 \cdot L_1 = N_2 \cdot L_2 + \dots + N(n-1) \cdot L(n-1) + N(n) \cdot L(n)$   
Where  $N_1$  is number of type 1 pulses,  $L_1$  is length of type 1 pulses, etc.  
Average Emission Level = Peak Emission Level +  $20 \cdot \log_{10}$  (duty Cycle)
6. 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.
7. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
8. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

Repeat above procedures until all frequency of the interest measured were complete.

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## 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:

$$\mathbf{FS = RA + AF - CL - AG}$$

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

The limit of the emission level is expressed in dB $\mu$ V/m, which converts  $20 * \log(\mu\text{V}/\text{m})$

Actual FS(dB $\mu$ V/m) = SPA. Reading level(dB $\mu$ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB $\mu$ V/m) + Cable Loss(dB) – Pre\_Amplifier Gain(dB)

## 10.6. Test Results of Radiated Spurious Emissions from 9 kHz to 30 MHz

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported

## 10.7. 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

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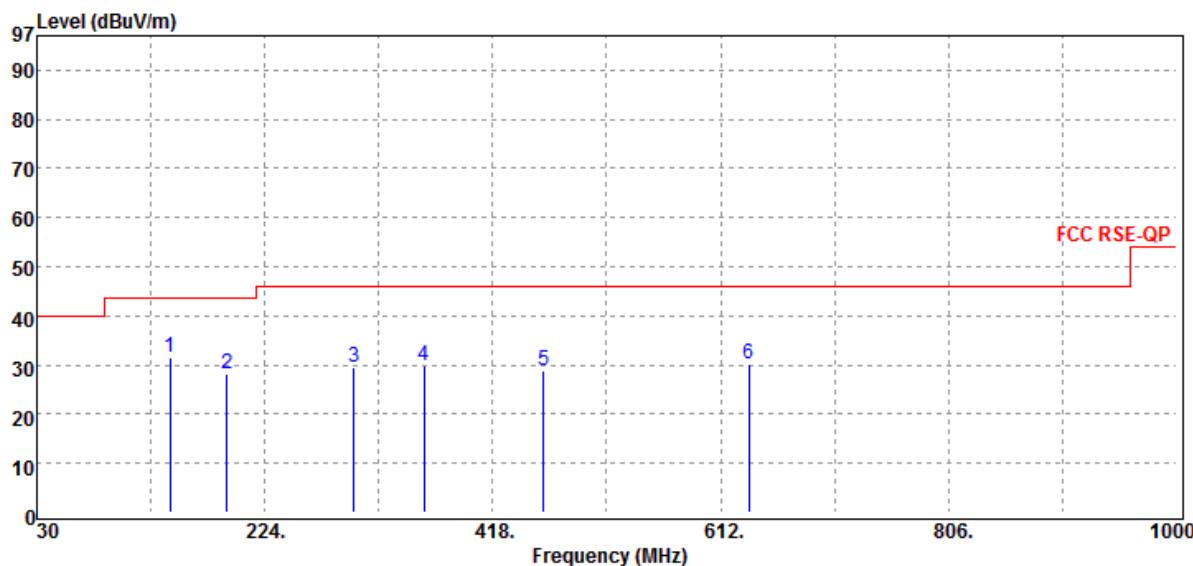
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### 10.7.1. Radiated Spurious Emission Measurement Result

#### For Frequency from 30MHz to 1000MHz

Operation Band	:900M	Test Date	:2017-08-23
Fundamental Frequency	:902.25 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



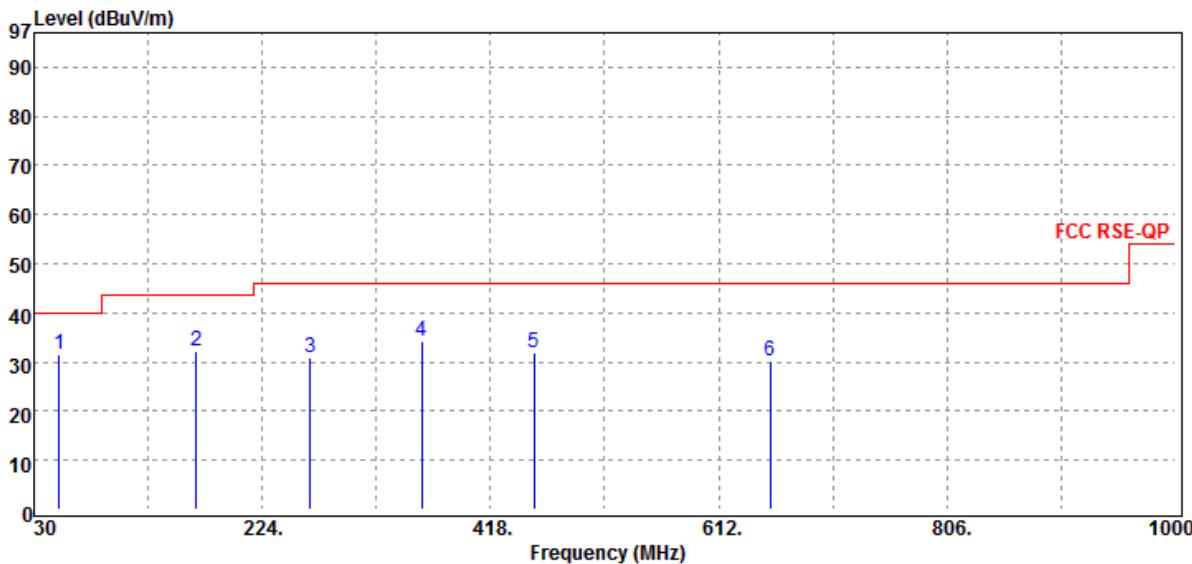
Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading Level		Factor	Actual FS	Limit @3m	Margin
			PK/QP/AV	dB $\mu$ V				
143.49	S	Peak	39.50	39.50	-8.09	31.41	43.50	-12.09
191.99	S	Peak	37.57	37.57	-9.42	28.15	43.50	-15.35
299.66	S	Peak	35.58	35.58	-5.93	29.65	46.00	-16.35
359.80	S	Peak	34.80	34.80	-4.79	30.01	46.00	-15.99
461.65	S	Peak	31.51	31.51	-2.60	28.91	46.00	-17.09
636.25	S	Peak	29.64	29.64	0.53	30.17	46.00	-15.83

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Operation Band	:900M	Test Date	:2017-08-23
Fundamental Frequency	:902.25 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



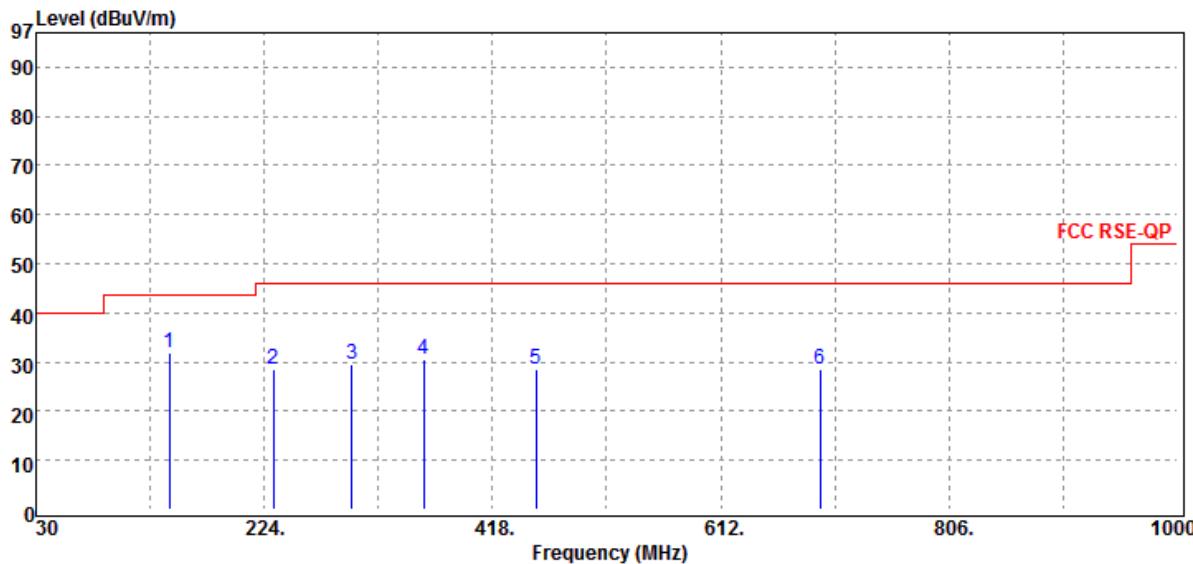
Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
			PK/QP/AV	Reading Level dB $\mu$ V				
51.34	S	Peak	39.34	-7.75	31.59	40.00	-8.41	
167.74	S	Peak	39.58	-7.46	32.12	43.50	-11.38	
264.74	S	Peak	37.97	-7.05	30.92	46.00	-15.08	
359.80	S	Peak	39.08	-4.79	34.29	46.00	-11.71	
454.86	S	Peak	34.61	-2.65	31.96	46.00	-14.04	
655.65	S	Peak	29.86	0.27	30.13	46.00	-15.87	

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Operation Band	:900M	Test Date	:2017-08-23
Fundamental Frequency	:914.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
			PK/QP/AV	Reading Level dB $\mu$ V				
143.49	S	Peak	40.04	-8.09	31.95	43.50	-11.55	
231.76	S	Peak	37.22	-8.85	28.37	46.00	-17.63	
298.69	S	Peak	35.46	-5.95	29.51	46.00	-16.49	
359.80	S	Peak	35.21	-4.79	30.42	46.00	-15.58	
454.86	S	Peak	31.05	-2.65	28.40	46.00	-17.60	
696.39	S	Peak	27.26	1.35	28.61	46.00	-17.39	

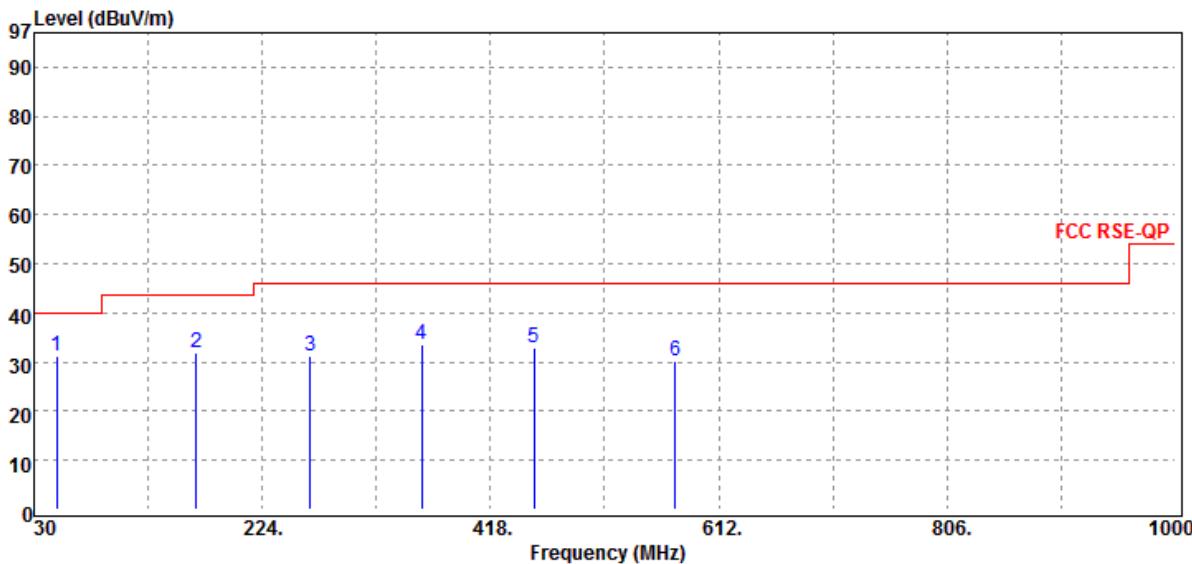
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Operation Band	:900M	Test Date	:2017-08-23
Fundamental Frequency	:914.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



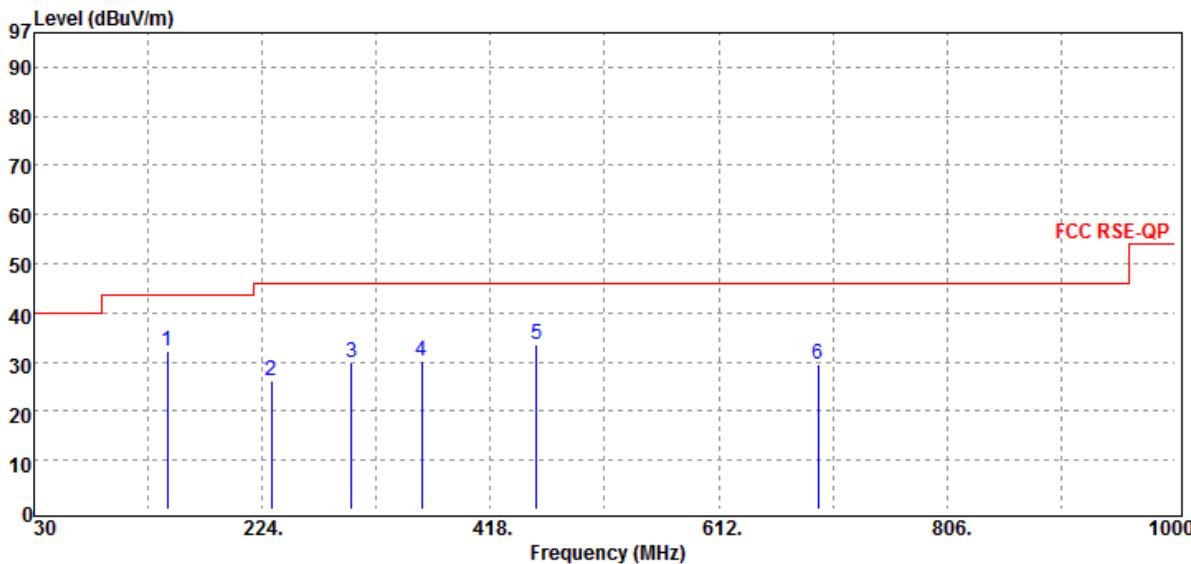
Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
			PK/QP/AV	Reading Level dB $\mu$ V				
49.40	S	Peak	39.11	-7.74	31.37	40.00	-8.63	
167.74	S	Peak	39.38	-7.46	31.92	43.50	-11.58	
264.74	S	Peak	38.18	-7.05	31.13	46.00	-14.87	
359.80	S	Peak	38.46	-4.79	33.67	46.00	-12.33	
454.86	S	Peak	35.41	-2.65	32.76	46.00	-13.24	
575.14	S	Peak	30.94	-0.80	30.14	46.00	-15.86	

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Fundamental Frequency	:927.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
			PK/QP/AV	Reading Level dB $\mu$ V				
143.49	S	Peak	40.17	-8.09	32.08	43.50	-11.42	
231.76	S	Peak	34.99	-8.85	26.14	46.00	-19.86	
299.66	S	Peak	35.89	-5.93	29.96	46.00	-16.04	
359.80	S	Peak	35.06	-4.79	30.27	46.00	-15.73	
456.80	S	Peak	36.11	-2.65	33.46	46.00	-12.54	
696.39	S	Peak	28.06	1.35	29.41	46.00	-16.59	

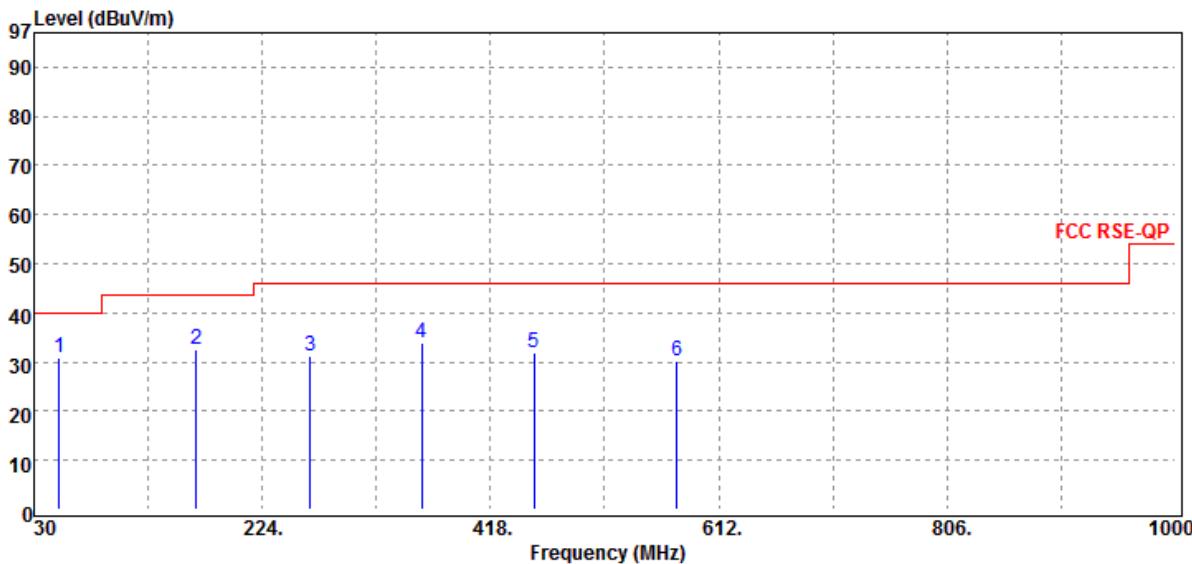
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Operation Band :900M  
 Fundamental Frequency :927.75 MHz  
 Operation Mode :Tx CH HIGH  
 EUT Pol. :H Plane

Test Date :2017-08-23  
 Temp./Humi. :21 deg\_C / 61 RH  
 Engineer :Mike  
 Measurement Antenna Pol. :HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Margin dB
			PK/QP/AV	Reading Level dB $\mu$ V				
51.34	S	Peak	38.78	-7.75	31.03	40.00	-8.97	
167.74	S	Peak	39.96	-7.46	32.50	43.50	-11.00	
264.74	S	Peak	38.21	-7.05	31.16	46.00	-14.84	
359.80	S	Peak	38.69	-4.79	33.90	46.00	-12.10	
454.86	S	Peak	34.50	-2.65	31.85	46.00	-14.15	
576.11	S	Peak	30.69	-0.64	30.05	46.00	-15.95	

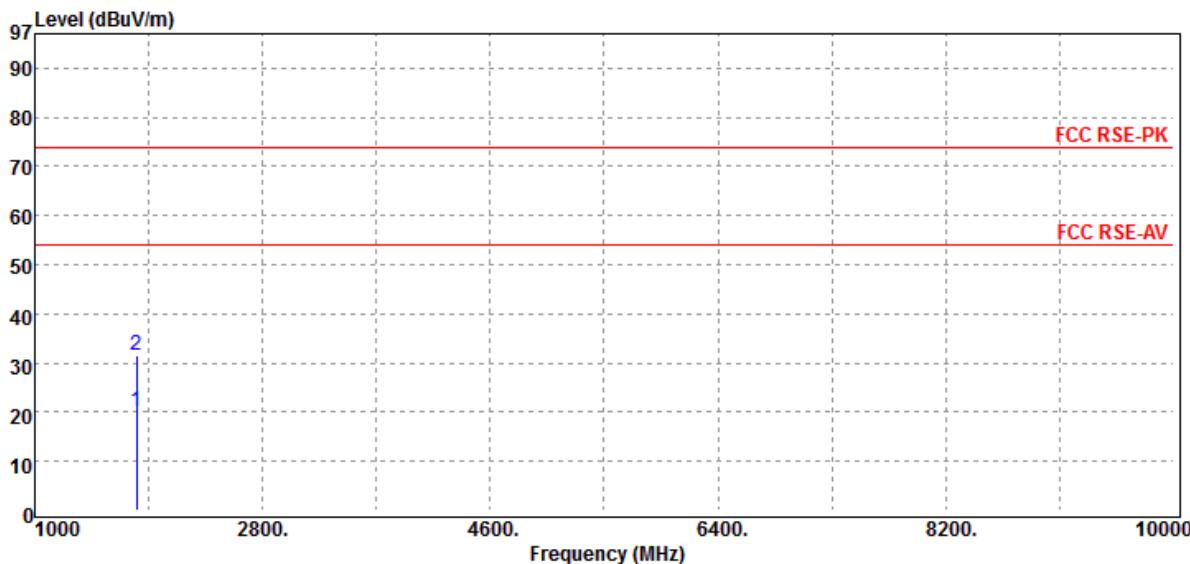
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**For Frequency above 1GHz**

Operation Band :900M Test Date :2017-08-23  
Fundamental Frequency :902.25 MHz Temp./Humi. :21 deg\_C / 61 RH  
Operation Mode :Tx CH LOW Engineer :Mike  
EUT Pol. :H Plane Measurement Antenna Pol. :VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading Level	Factor dB	Actual FS dB $\mu$ V	Limit @3m dB $\mu$ V/m	Safe Margin dB
						dB $\mu$ V/m	dB
1804.50	H	Average	24.81	-4.67	20.14	54.00	-33.86
1804.50	H	Peak	36.18	-4.67	31.51	74.00	-42.49

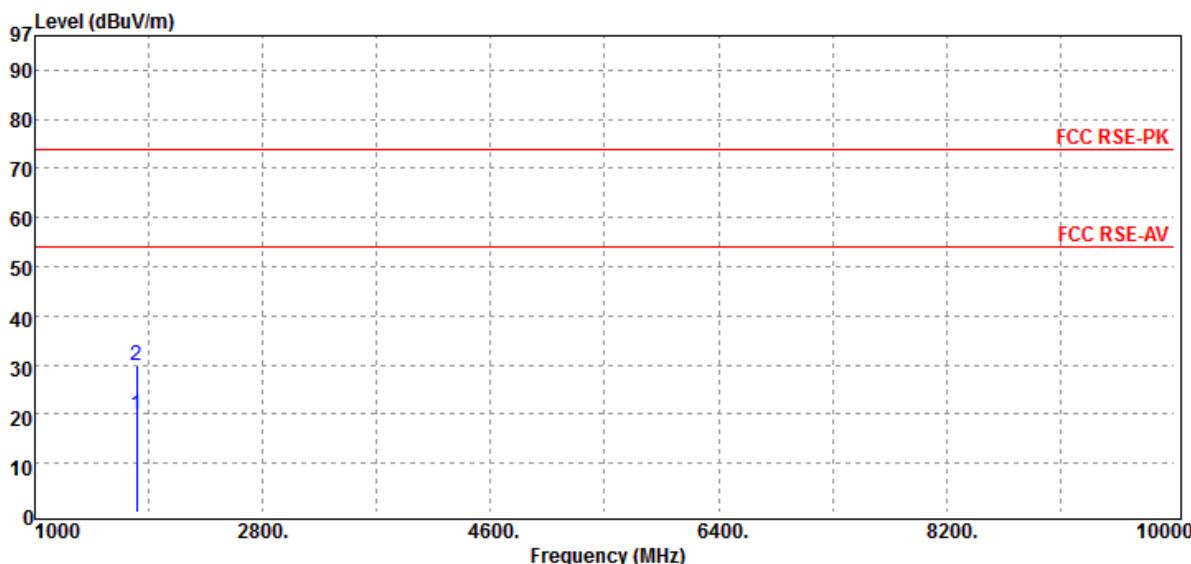
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Operation Band :900M  
 Fundamental Frequency :902.25 MHz  
 Operation Mode :Tx CH LOW  
 EUT Pol. :H Plane

Test Date :2017-08-23  
 Temp./Humi.  
 Engineer  
 Measurement Antenna Pol. :HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Safe
						dB $\mu$ V/m	dB $\mu$ V/m
1804.50	H	Average	24.46	-4.67	19.79	54.00	-34.21
1804.50	H	Peak	34.43	-4.67	29.76	74.00	-44.24

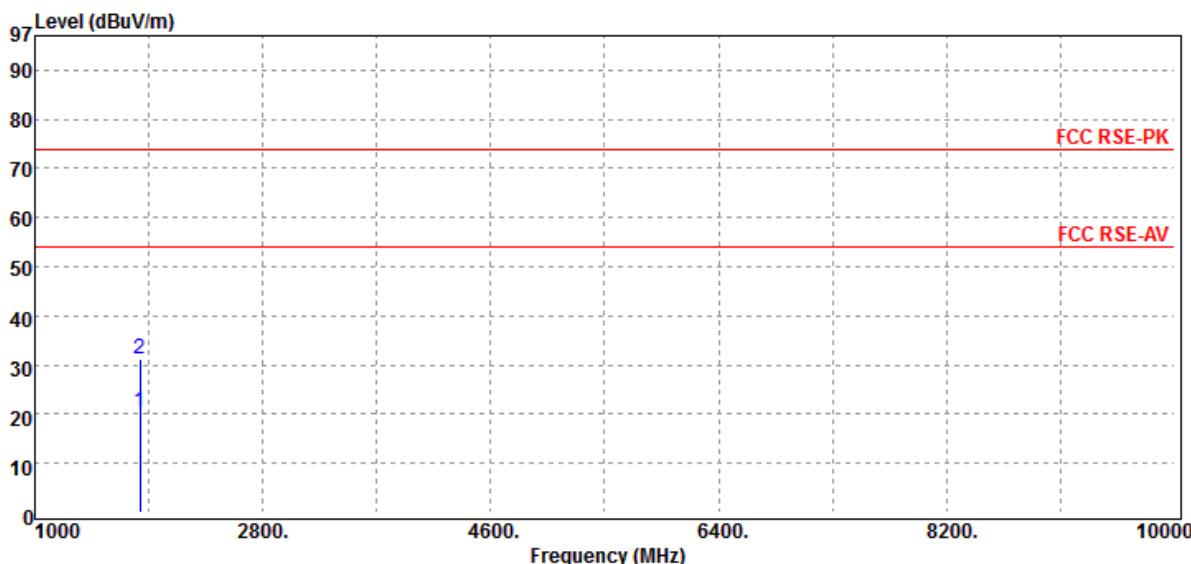
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Operation Band	:900M	Test Date	:2017-08-23
Fundamental Frequency	:914.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Safe Margin dB
			PK/QP/AV	Reading Level dB $\mu$ V				
1829.50	H	Average		24.94	-4.50	20.44	54.00	-33.56
1829.50	H	Peak		35.62	-4.50	31.12	74.00	-42.88

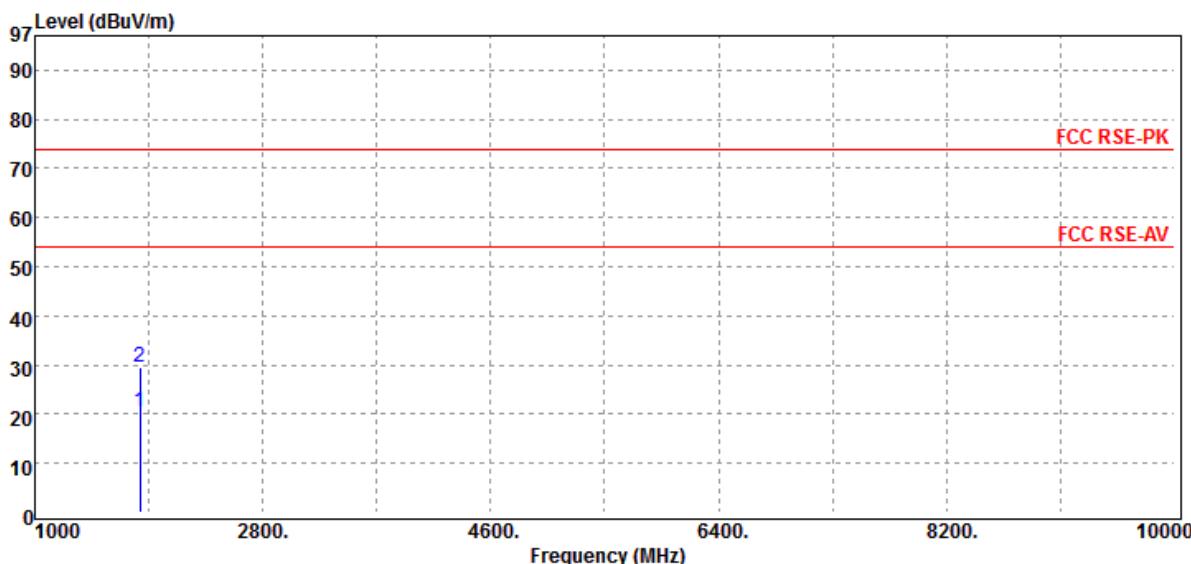
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Fundamental Frequency	:914.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor dB	Actual FS dB $\mu$ V/m	Limit @3m dB $\mu$ V/m	Safe Margin dB
			PK/QP/AV	Reading Level dB $\mu$ V				
1829.50	H	Average		24.82	-4.50	20.32	54.00	-33.68
1829.50	H	Peak		34.03	-4.50	29.53	74.00	-44.47

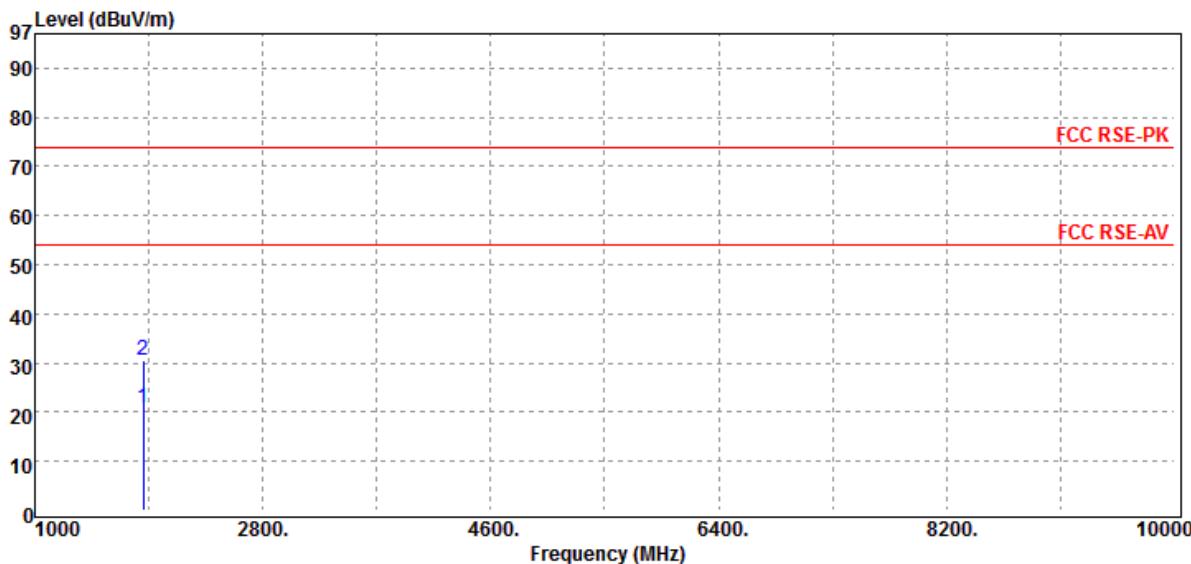
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Operation Band :900M  
 Fundamental Frequency :927.75 MHz  
 Operation Mode :Tx CH HIGH  
 EUT Pol. :H Plane

Test Date :2017-08-23  
 Temp./Humi. :21 deg\_C / 61 RH  
 Engineer :Mike  
 Measurement Antenna Pol. :VERTICAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Safe
						dB $\mu$ V/m	dB $\mu$ V/m
1855.50	H	Average	25.01	-4.36	20.65	54.00	-33.35
1855.50	H	Peak	34.91	-4.36	30.55	74.00	-43.45

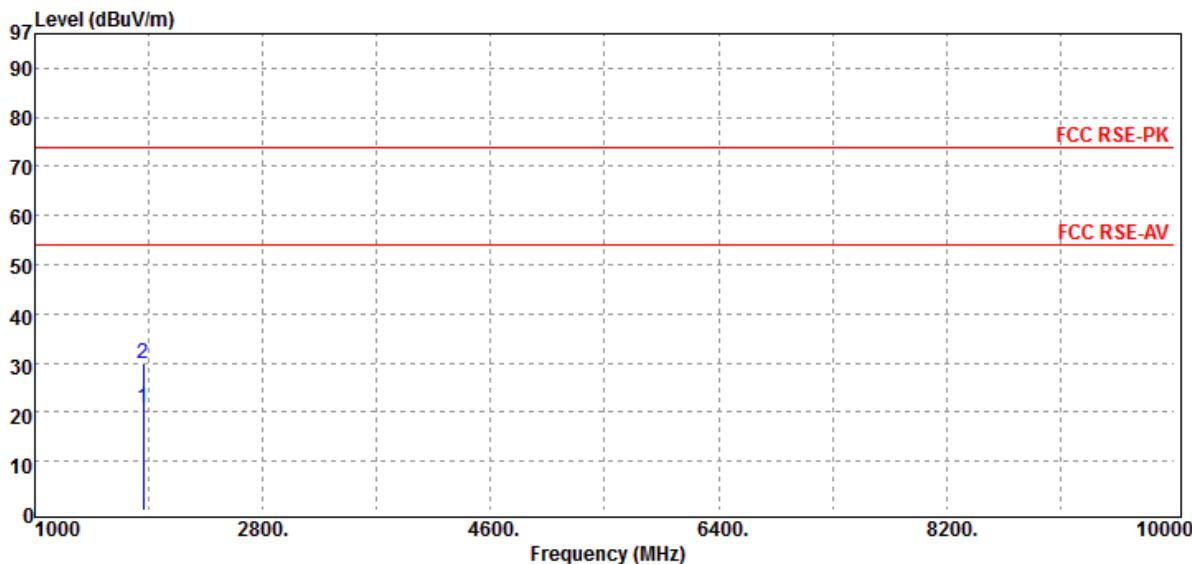
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Operation Band	:900M	Test Date	:2017-08-23
Fundamental Frequency	:927.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq. MHz	Note F/H/E/S	Detector Mode	Spectrum		Factor	Actual FS	Limit @3m	Safe Margin
			PK/QP/AV	Reading Level dB $\mu$ V				
1855.50	H	Average		25.14	-4.36	20.78	54.00	-33.22
1855.50	H	Peak		34.20	-4.36	29.84	74.00	-44.16

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## 11. FREQUENCY SEPARATION

### 11.1. Standard Applicable

Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25 kHz or the  $2/3 \times 20$  dB 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 8.3 for the plot.

### 11.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2015.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set center frequency of spectrum analyzer = middle of hopping channel.
5. Set the spectrum analyzer as RBW, VBW=100 kHz, Adjust Span to 1.5MHz, Sweep = auto.
6. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

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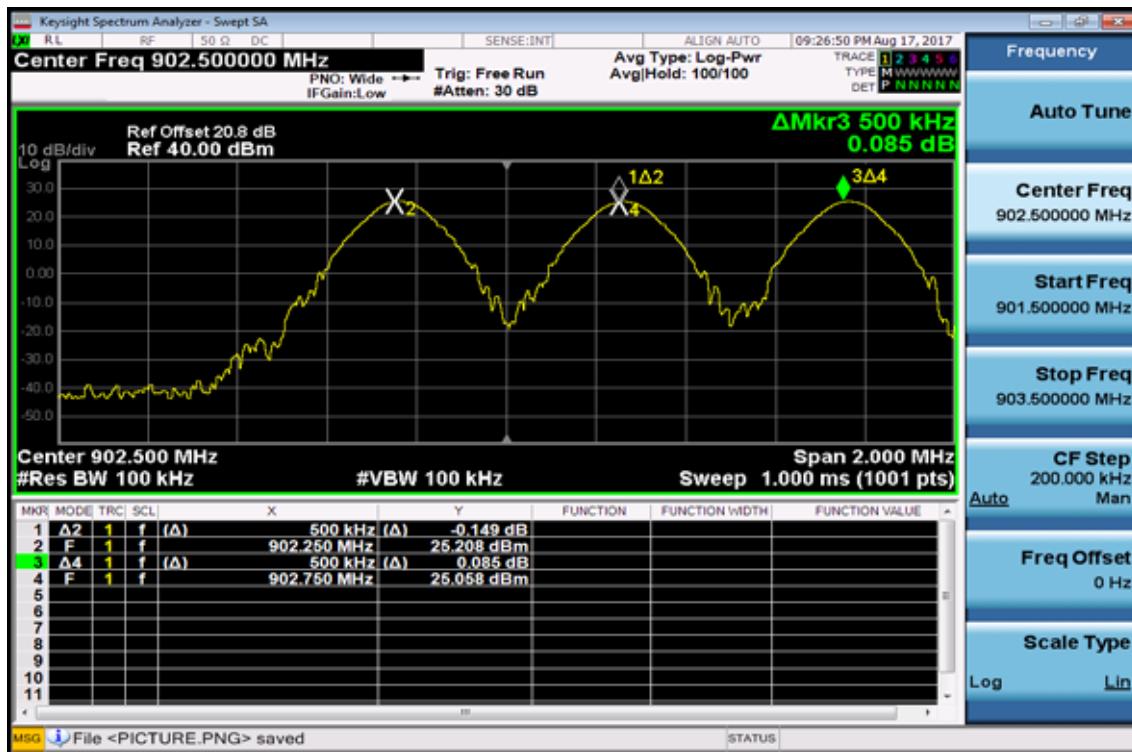
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## 11.5. Measurement Result:

Channel separation (MHz)	Limit	Result
0.5	>=25 kHz or 20dB bandwidth	PASS

Note: Refer to next page for plots.

## Frequency Separation Test Data



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## 12. NUMBER OF HOPPING FREQUENCY

### 12.1. Standard Applicable

According to §15.247(a)(1)(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 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.

### 12.2. Measurement Equipment Used:

Refer to section 7.2 for the plot.

### 12.3. Test Set-up:

Refer to section 8.3 for the plot.

### 12.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2015.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set spectrum analyzer Start=900MHz, Stop = 930MHz, Sweep = auto.
5. Set the spectrum analyzer as RBW=100 kHz, VBW= 300 kHz., Detector = Peak
6. Max hold, view and count how many channel in the band.

### 12.5. Measurement Result:

Note: Refer to next page for plots.

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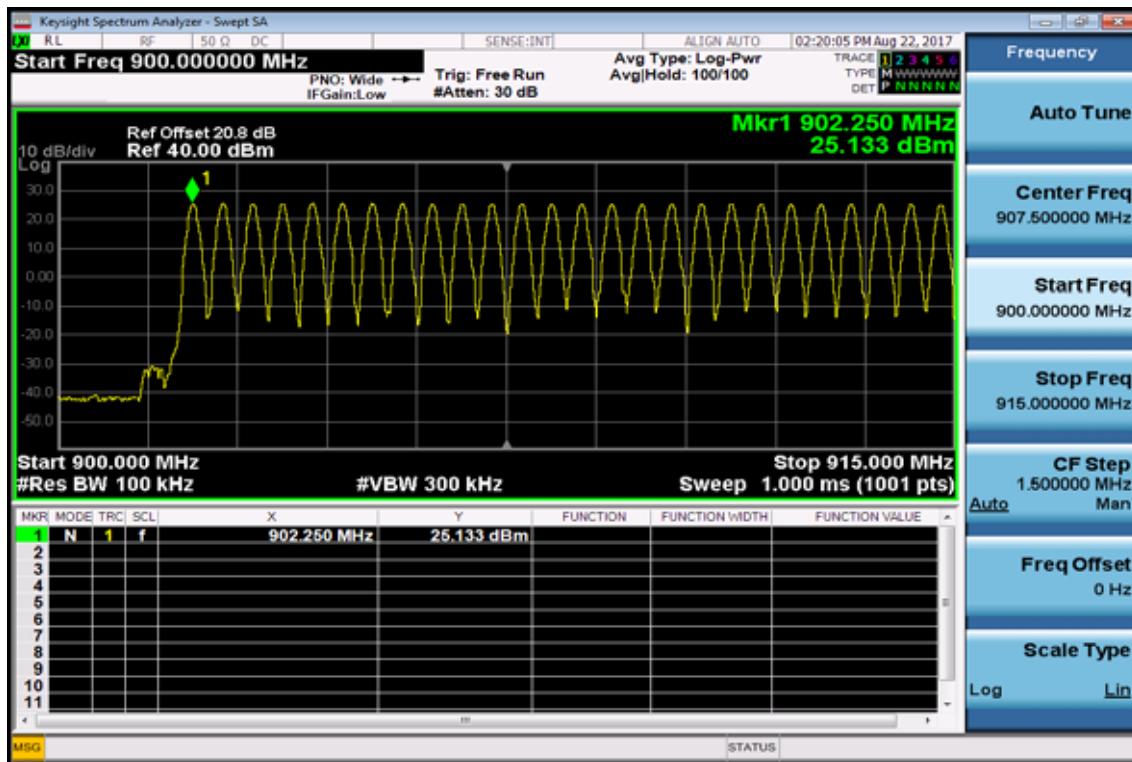
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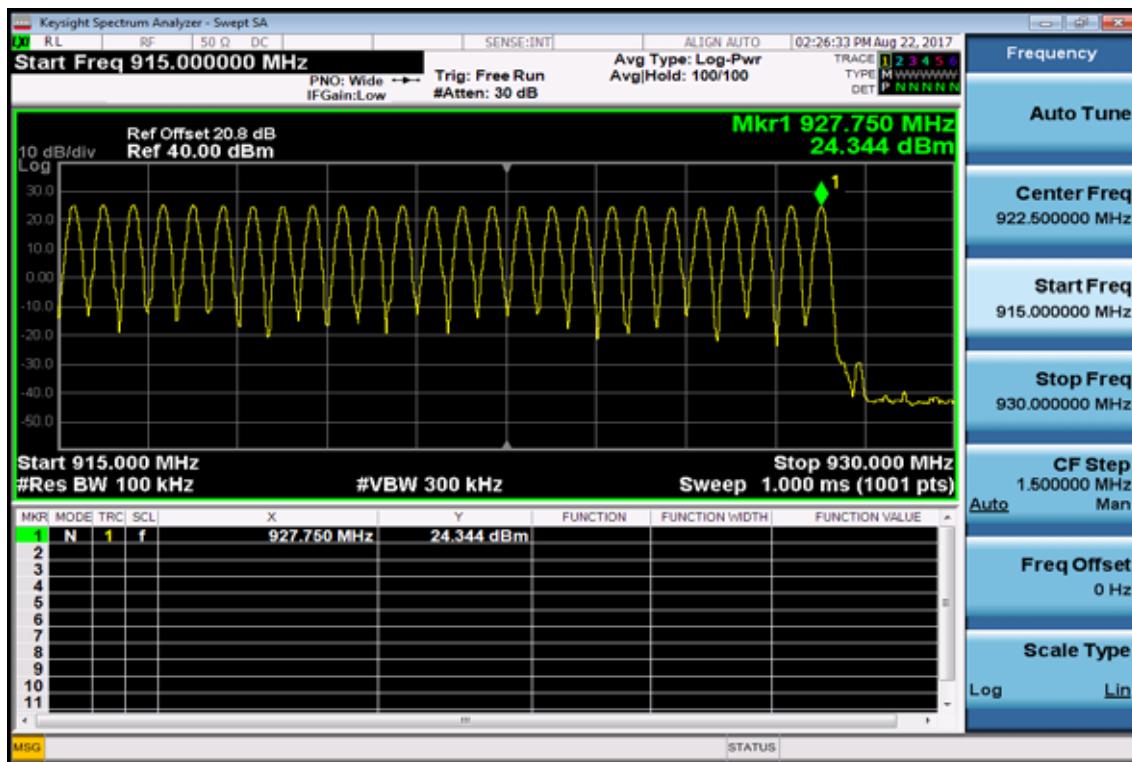
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## Channel Number

902 MHz – 915 MHz



915 MHz – 928 MHz



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## 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 8.3 for the plot.

### 13.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows ANSI C63.10:2013.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set center frequency of spectrum analyzer = operating frequency.
5. Set the spectrum analyzer as RBW, VBW=100kHz, 300kHz, Span = 0Hz, Detector = Peak.
6. Repeat above procedures until all frequency of the interest measured were complete.

### 13.5. Tabular Result of the Measurement:

Number of transmission in a 20s	Length of transmission time (ms):	Measurement Result (ms):	Limit (ms):
21	11	231	400ms

### 13.6. Measurement Result:

Note: Refer to next page for plots.

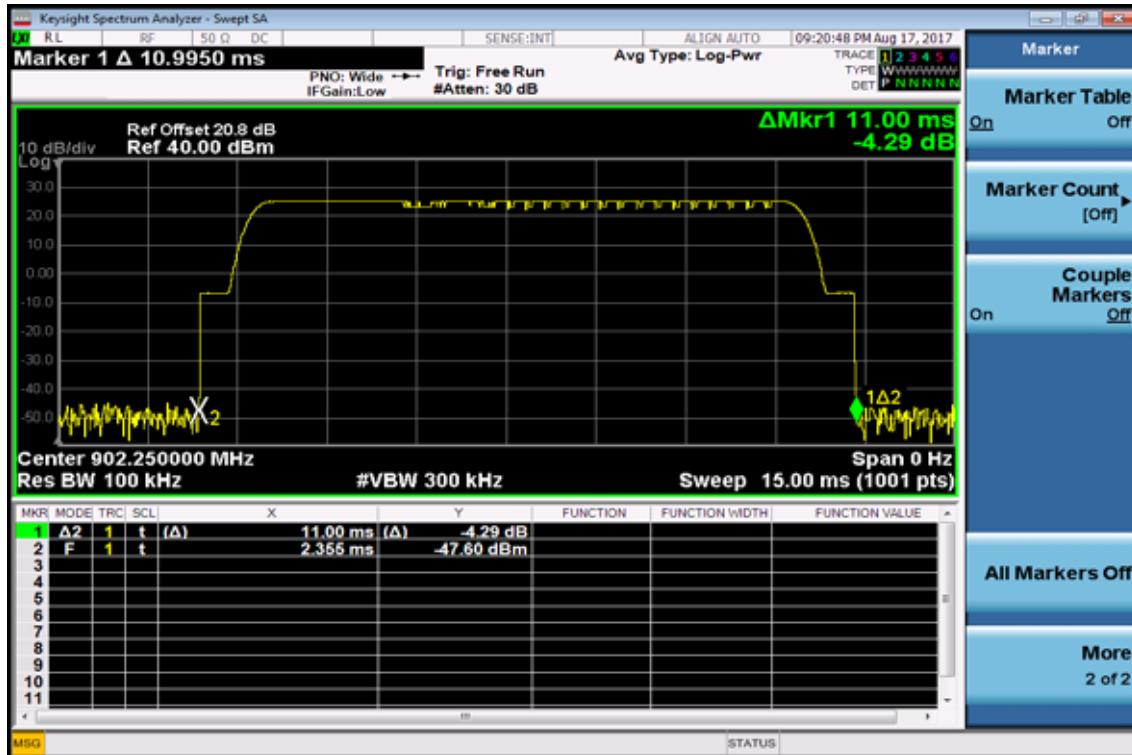
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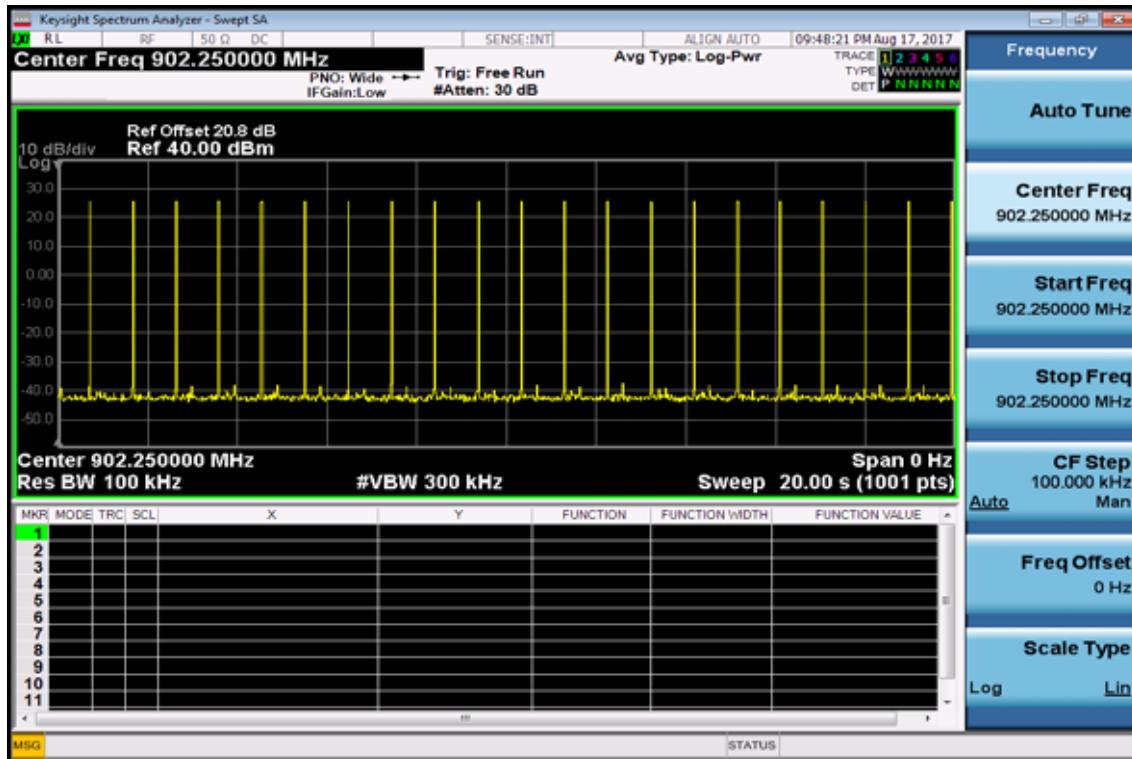
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## Length of transmission time



## Number of transmission in a 20s



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## 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

An embedded-in antenna design is used.

The antenna connector is designed with unique type RF connector and no consideration of replacement. Please see EUT photo and antenna spec. for details.

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