

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Product Name: UHF RFID READER/WRITER MODULE

Brand Name: MARS

Model No.: FRU-4100Q

Model Difference: N/A

FCC ID: WK4FRU4100Q

Report No.: ER/2017/20010

Issue Date: Mar. 09, 2017

FCC Rule Part: §15.247, Cat: DSS

Prepared for: MARS TOHKEN SOLUTION CO. LTD
1-10-7 Shinjuku, Shinjuku-ku, Tokyo 160-0022

Prepared by: SGS Taiwan Ltd.
Electronics & Communication Laboratory
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VERIFICATION OF COMPLIANCE

Applicant: MARS TOHKEN SOLUTION CO. LTD
1-10-7, Shinjuku, Shinjuku-ku, Tokyo 160-0022

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Brand Name: MARS

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Model Difference: N/A

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File Number: ER/2017/20010

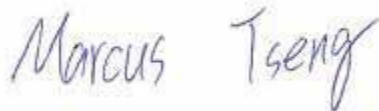
Date of test: Feb. 03, 2017 ~ Mar. 02, 2017

Date of EUT Received: Feb. 03, 2017

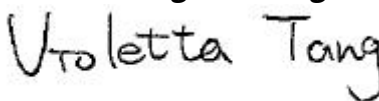
We hereby certify that:

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:**

Mar. 09, 2017

Marcus Tseng / Sr. Engineer**Prepared By:****Date:**

Mar. 09, 2017

Violetta Tang / Clerk**Approved By:****Date:**

Mar. 09, 2017

Jim Chang / Asst. Manager

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Revision History

Report Number	Revision	Description	Issue Date
ER/2017/20010	Rev.00	Initial creation of document	Mar. 09, 2017

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1. GENERAL INFORMATION

1.1. Product description

General:

Product Name:	UHF RFID READER/WRITER MODULE
Brand Name:	MARS
Model No.:	FRU-4100Q
Model Difference:	N/A
Hardware Version:	N/A
Software Version:	N/A
Power Supply:	5V from AC/DC Adapter

RFID:

Frequency Range:	902.75 – 927.25MHz
Channel Number:	50 channels
Channel Space:	500 kHz steps
Modulation Type:	PR-ASK, ASK
Transmit Power:	29.98dBm (Peak)
Dwell Time:	<= 0.4s
Operating Mode:	Point-to-Point
Antenna Designation:	1. Patch Antenna, Gain: 2.79dBi, Model No.: UAT-001 2. Patch Antenna, Gain: 2.2dBi, Model No.: UAT-006

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

FCC Public Notice DA 00-705 Measurement Guidelines

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.2, Keji 1st Rd.,
Guishan District, Taoyuan City, Taiwan 333 (TAF code 0513)

FCC Registration Numbers are: 735305

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 30 MHz. 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 0.6dB and attenuator factor 20dB.

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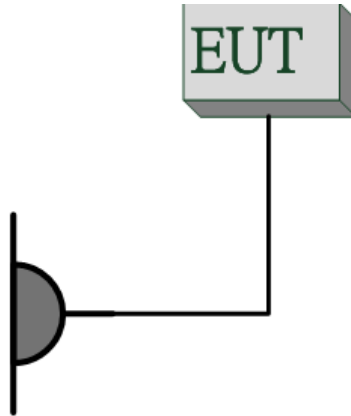
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2.5. Configuration of Tested System

Fig. 2-1 Radiated Emission & AC Power Line Conducted 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

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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.

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 902.75MHz
Channel Mid: channel 25 at 914.75MHz
Channel High: channel 50 at 927.25MHz

50 channels are provided for RFID

CH	FREQUENCY	CH	FREQUENCY	CH	FREQUENCY
1	902.75MHz	21	912.75MHz	41	922.75MHz
2	903.25MHz	22	913.25MHz	42	923.25MHz
3	903.75MHz	23	913.75MHz	43	923.75MHz
4	904.25MHz	24	914.25MHz	44	924.25MHz
5	904.75MHz	25	914.75MHz	45	924.75MHz
6	905.25MHz	26	915.25MHz	46	925.25MHz
7	905.75MHz	27	915.75MHz	47	925.75MHz
8	906.25MHz	28	916.25MHz	48	926.25MHz
9	906.75MHz	29	916.75MHz	49	926.75MHz
10	907.25MHz	30	917.25MHz	50	927.25MHz
11	907.75MHz	31	917.75MHz		
12	908.25MHz	32	918.25MHz		
13	908.75MHz	33	918.75MHz		
14	909.25MHz	34	919.25MHz		
15	909.75MHz	35	919.75MHz		
16	910.25MHz	36	920.25MHz		
17	910.75MHz	37	920.75MHz		
18	911.25MHz	38	921.25MHz		
19	911.75MHz	39	921.75MHz		
20	912.25MHz	40	922.25MHz		

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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 : Vertical)	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 : Horizontal)	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(μV)	
	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	ESC17	100760	05/10/2016	05/09/2017
LISN	SCHWARZBECK	NSLK 8127	8127-649	05/16/2016	05/15/2017
LISN	MESS TEC	FCC-LISN-50/250-25-2-01	4034	05/16/2016	05/15/2017
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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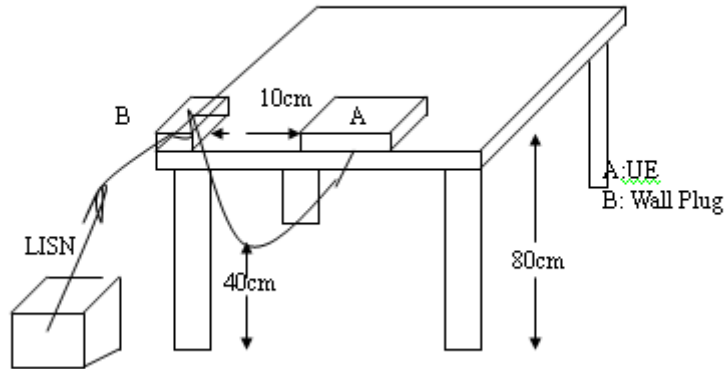
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6.4. Test SET-UP (Block Diagram of Configuration)



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

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit

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AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode (UAT-001)	Test Date:	Feb. 23, 2017
Temperature:	20		

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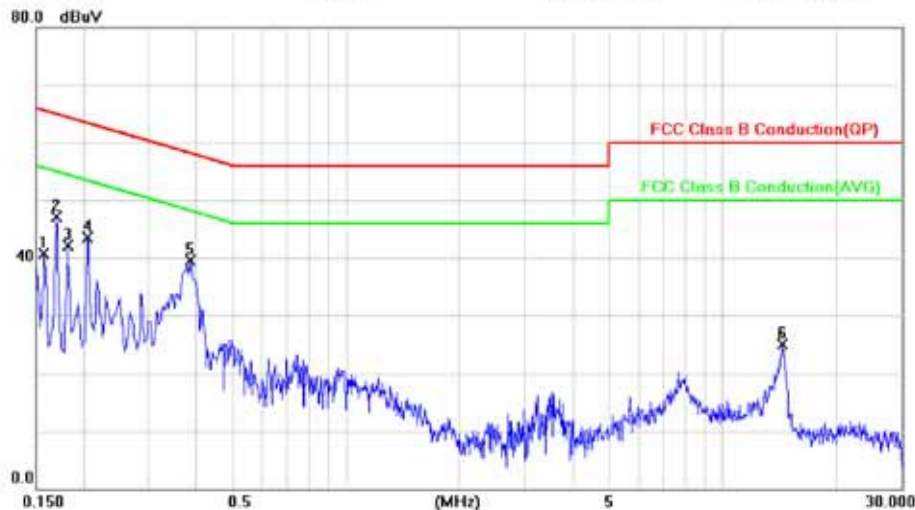
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Site: Conduction Room
Limit: FCC Class B Conduction(QP)
Mode: Operation
Note: Adapter:6A-181WP05

Phase: **N**
Power: AC 120V/60Hz
Temperature: 20 °C
Humidity: 58 %

Conducted Emission

File :20010 Data :#1 Date: 2017/2/23 Time: 下午 10:48:31



No.	Mk.	Freq.	Reading Level	Correct Factor	Measurement	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.1580	40.59	0.07	40.66	65.57	-24.91	peak	
2	*	0.1700	46.98	0.07	47.05	64.96	-17.91	peak	
3		0.1820	42.02	0.08	42.10	64.39	-22.29	peak	
4		0.2060	43.38	0.08	43.46	63.37	-19.91	peak	
5		0.3860	39.44	0.10	39.54	58.15	-18.61	peak	
6		14.4580	24.44	0.41	24.85	60.00	-35.15	peak	

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AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation mode (UAT-006)	Test Date:	Feb. 23, 2017
Temperature:	20		

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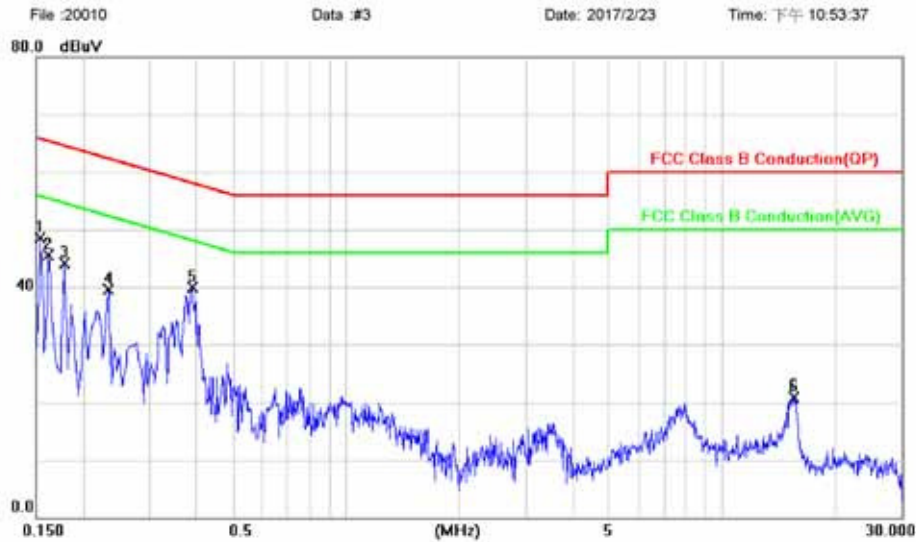
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Site: Conduction Room Phase: **N** Temperature: 20 ℃
Limit: FCC Class B Conduction(QP) Power: AC 120V/60Hz Humidity: 58 %
Mode: Operation
Note: Adapter:6A-181WP05

Conducted Emission



No.	Mk.	Freq. MHz	Reading Level dBuV	Correct Factor dB	Measure- ment dBuV	Limit dBuV	Over dB	Detector	Comment
1	*	0.1540	48.45	0.07	48.52	65.78	-17.26	peak	
2		0.1620	45.41	0.07	45.48	65.36	-19.88	peak	
3		0.1780	44.05	0.08	44.13	64.58	-20.45	peak	
4		0.2340	39.38	0.08	39.46	62.31	-22.85	peak	
5		0.3900	39.85	0.10	39.95	58.06	-18.11	peak	
6		15.5460	20.45	0.42	20.87	60.00	-39.13	peak	

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7. PEAK OUTPUT POWER MEASUREMENT

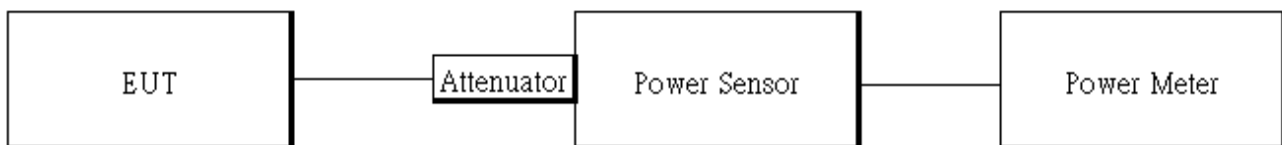
7.1. Standard Applicable

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.

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	02/26/2016	02/25/2017
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	05/17/2016	05/16/2017

7.3. Test Set-up:



7.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows FCC Public Notice DA 00-705 Measurement Guidelines.
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.

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7.5. Measurement Result

RFID					
CH	Freq. (MHz)	Peak Out-put Power (dBm)	Peak Out-put Power (mW)	Limit	RESULT
1	902.75	29.92	981.75	1 Watt = 30.00 dBm	PASS
25	914.75	29.89	974.99	1 Watt = 30.00 dBm	PASS
50	927.25	29.98	995.41	1 Watt = 30.00 dBm	PASS
RFID					
CH	Freq. (MHz)	Avg. Out-put Power (dBm)	Avg. Output Power (mW)	Limit	RESULT
1	902.75	28.16	654.64	1 Watt = 30.00 dBm	PASS
25	914.75	28.08	642.69	1 Watt = 30.00 dBm	PASS
50	927.25	28.16	654.64	1 Watt = 30.00 dBm	PASS

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8. 20DB BANDWIDTH

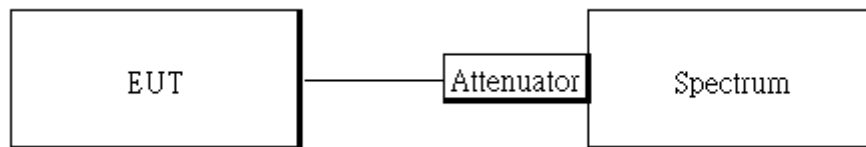
8.1. Standard Applicable

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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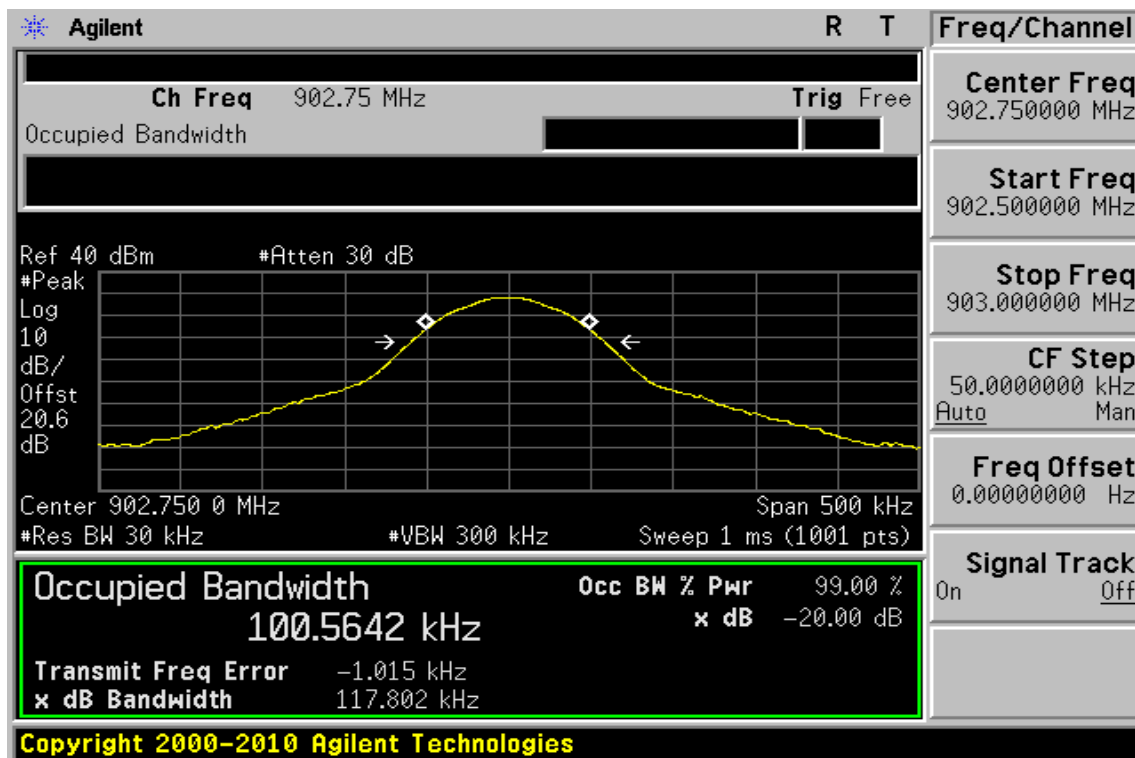
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8.5. Measurement Result:

CH	Freq. (MHz)	20dB BW (kHz)
Low	902.75	117.80
Mid	914.75	118.46
High	927.25	121.71

20dB Band Width Test Data CH-Low



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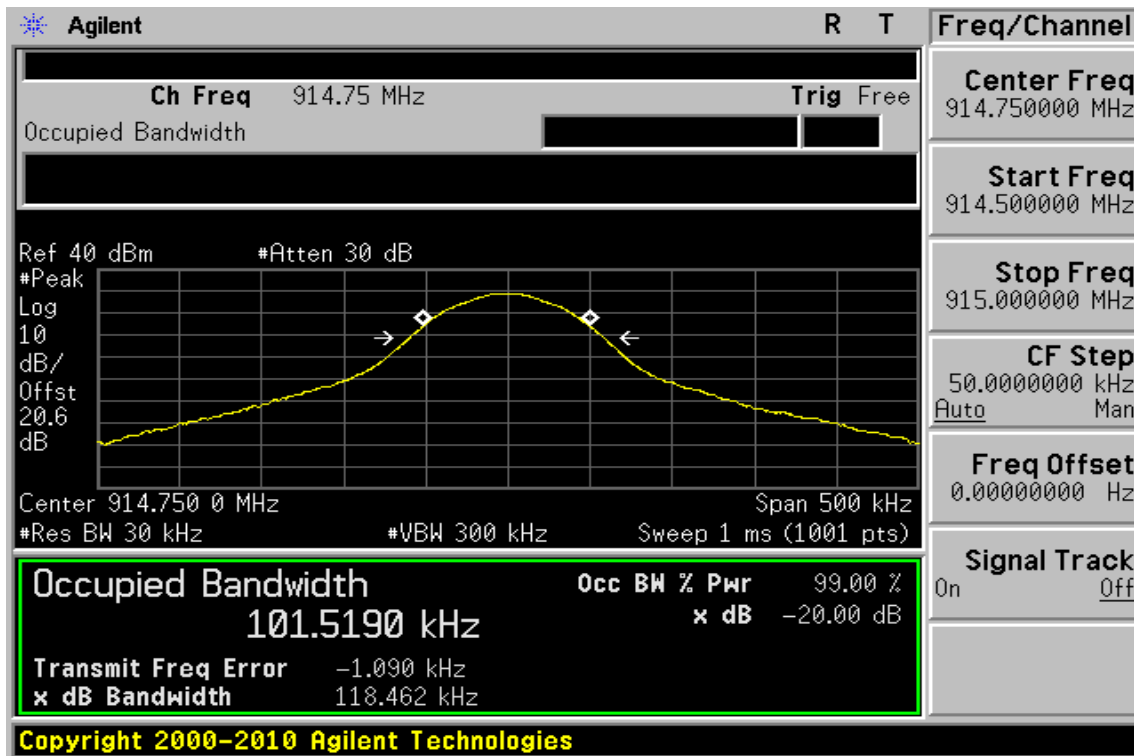
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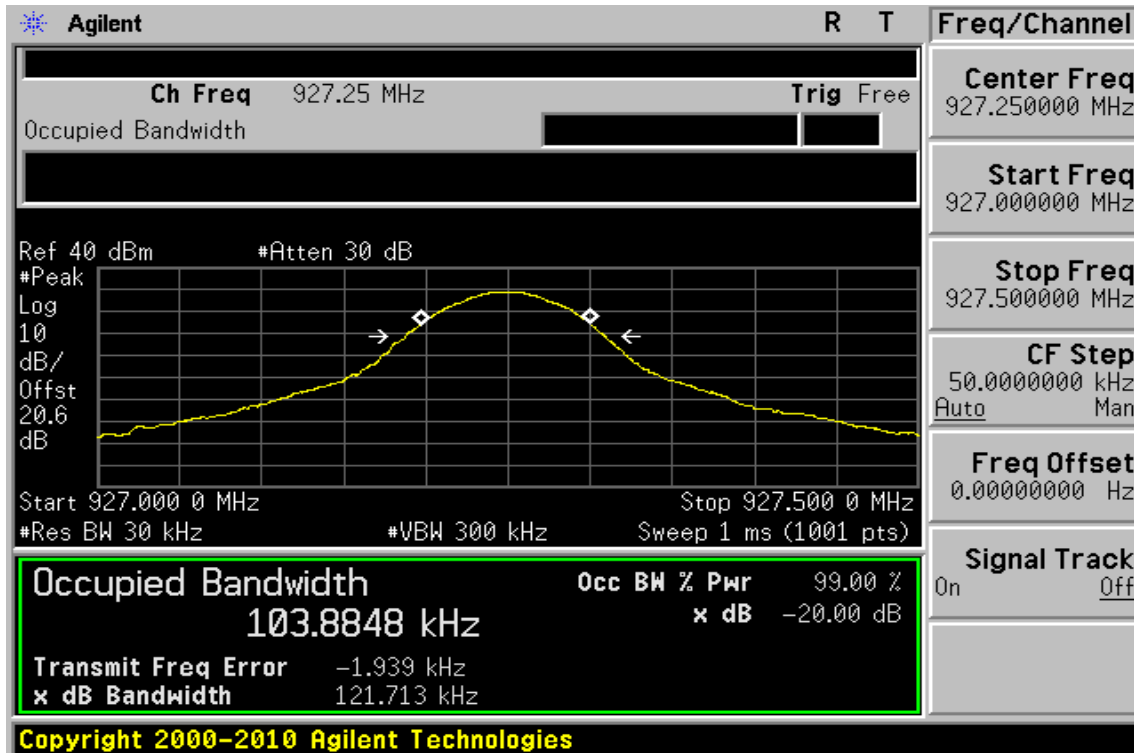
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20dB Band Width Test Data CH-Mid



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 FCC Public Notice DA 00-705 Measurement Guidelines.
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 FCC Public Notice DA 00-705 Measurement Guidelines.
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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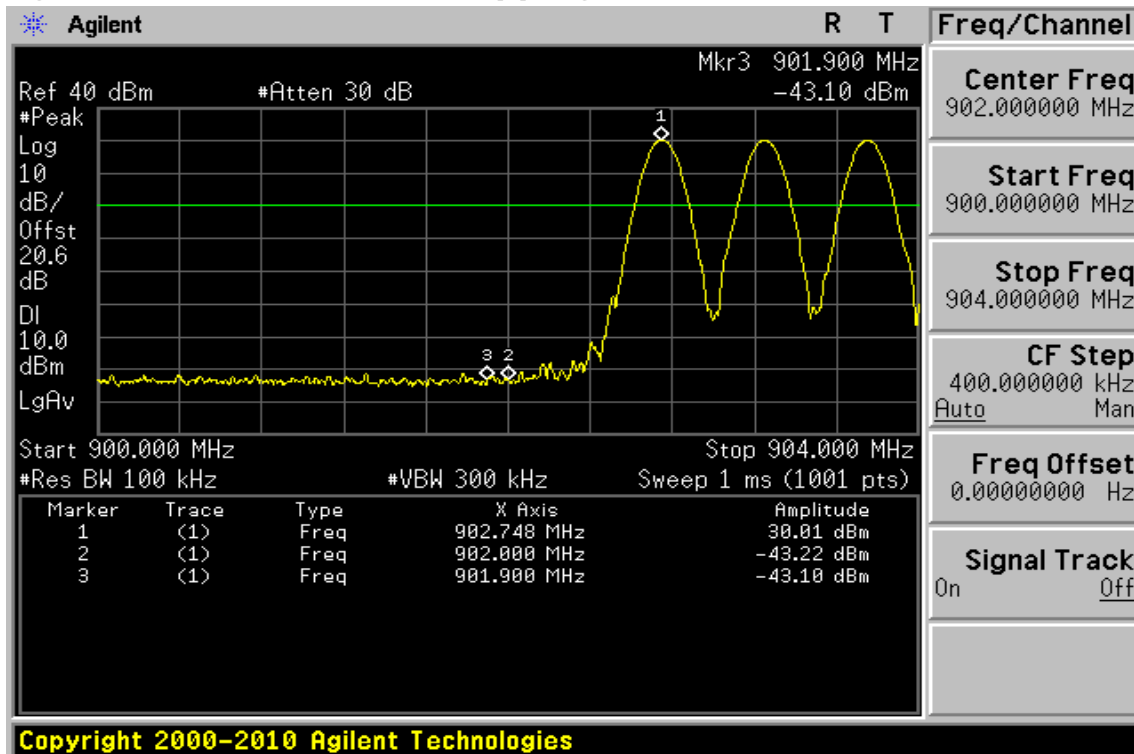
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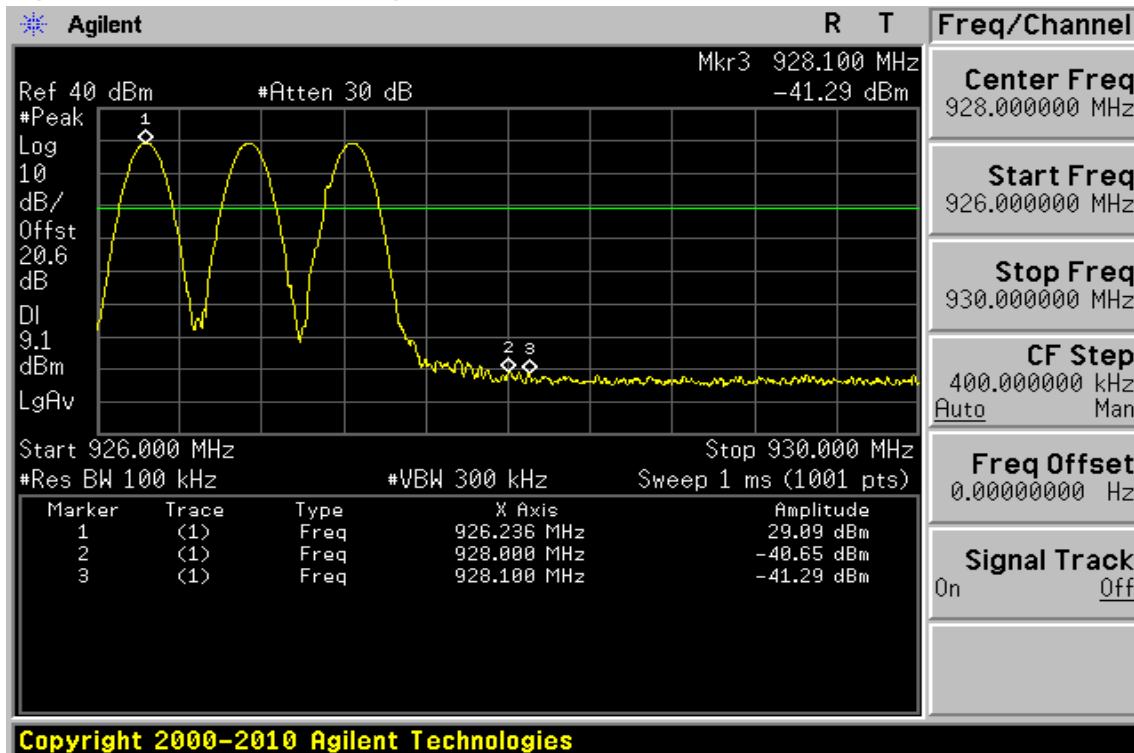
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9.7. Measurement Result: 100 kHz BANDWIDTH OF BNAD EDGE

Band Edges Test Data CH-Low (Hopping mode)



Band Edges Test Data CH-High



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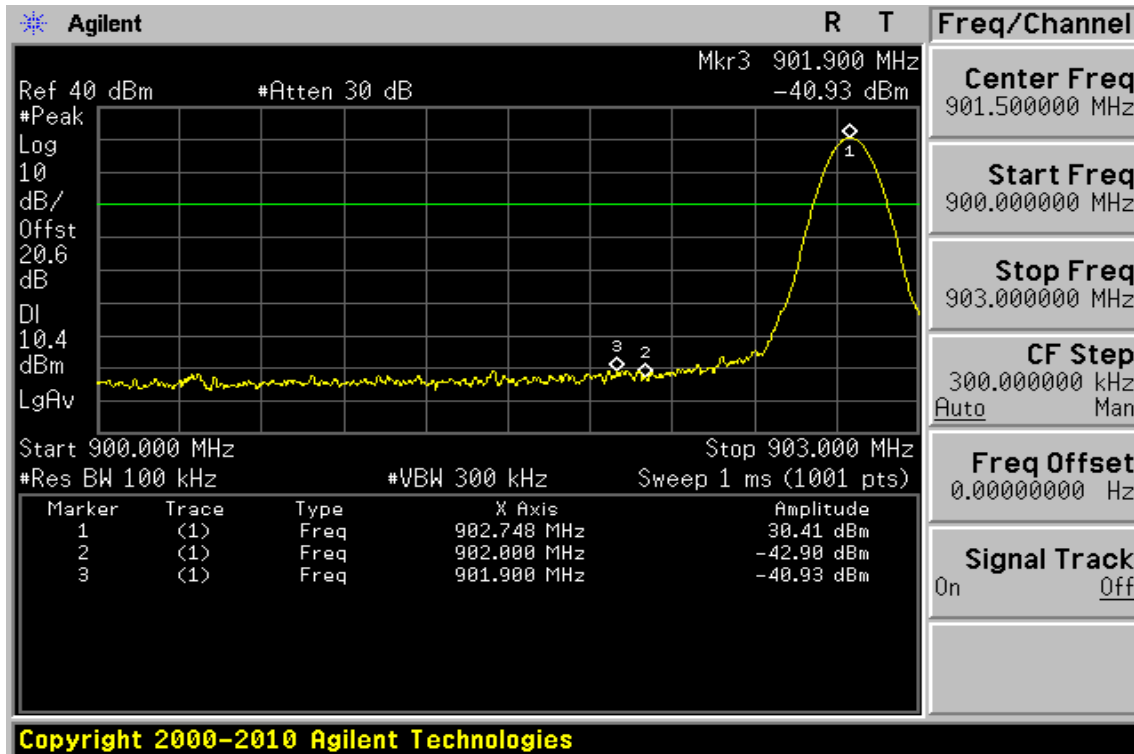
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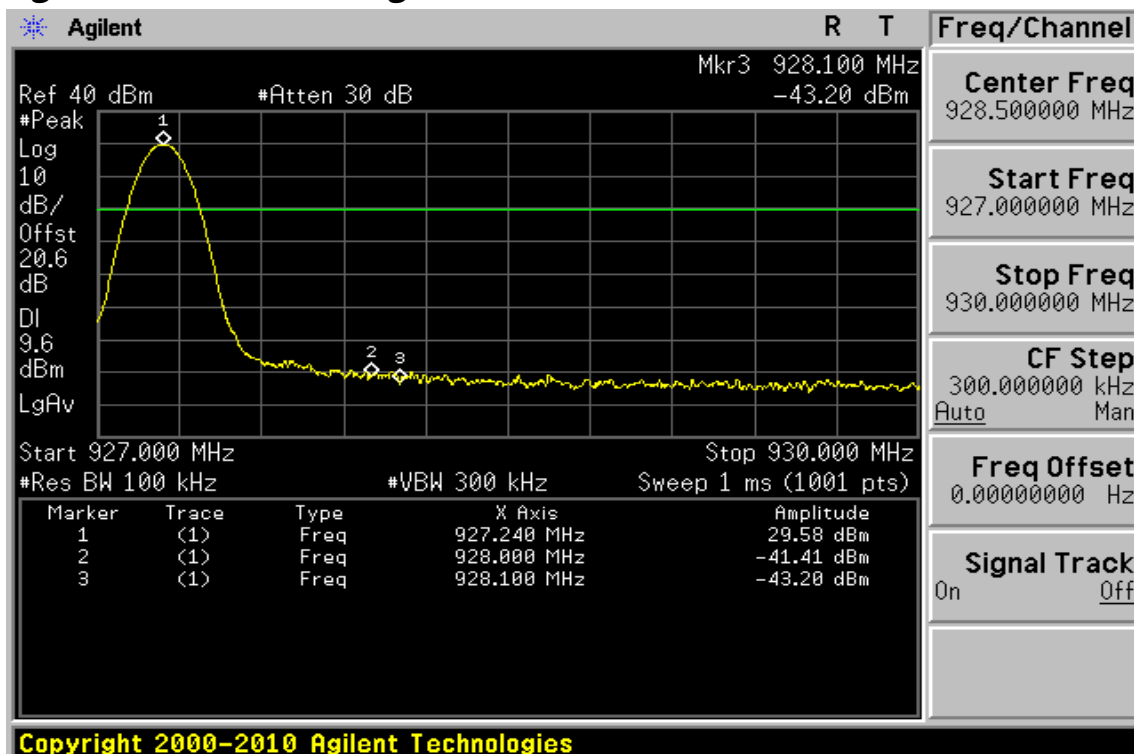
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Band Edges Test Data CH-Low (Non-Hopping mode)



Band Edges Test Data CH-High



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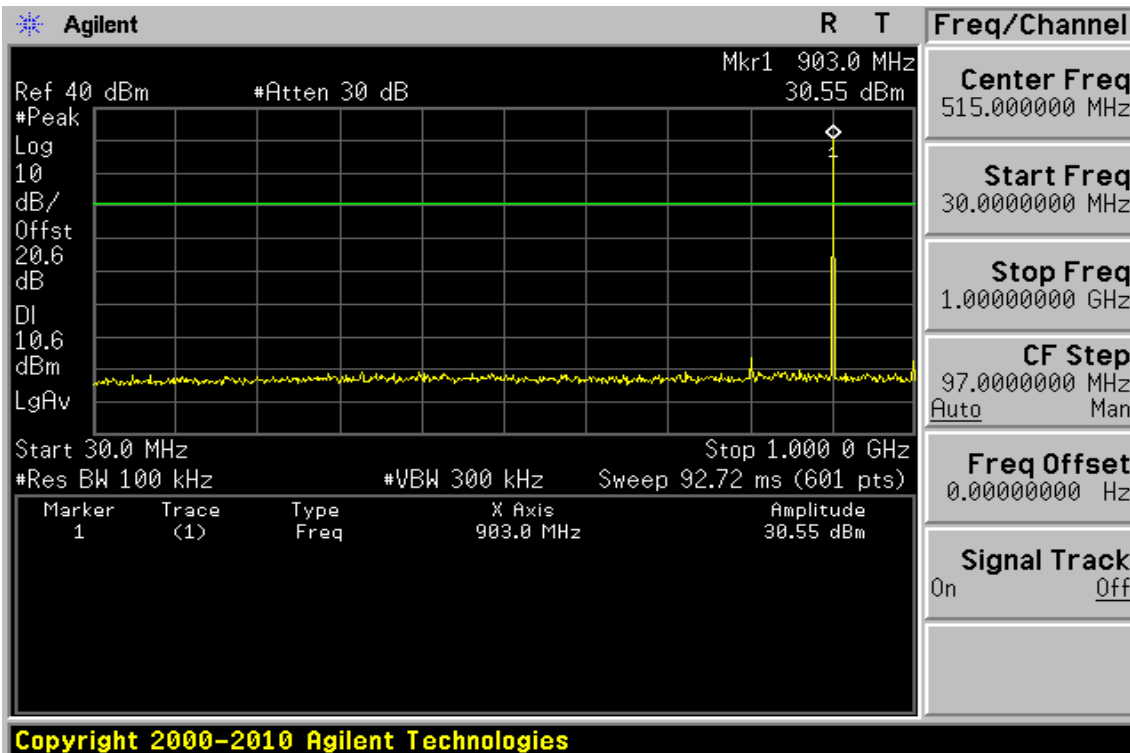
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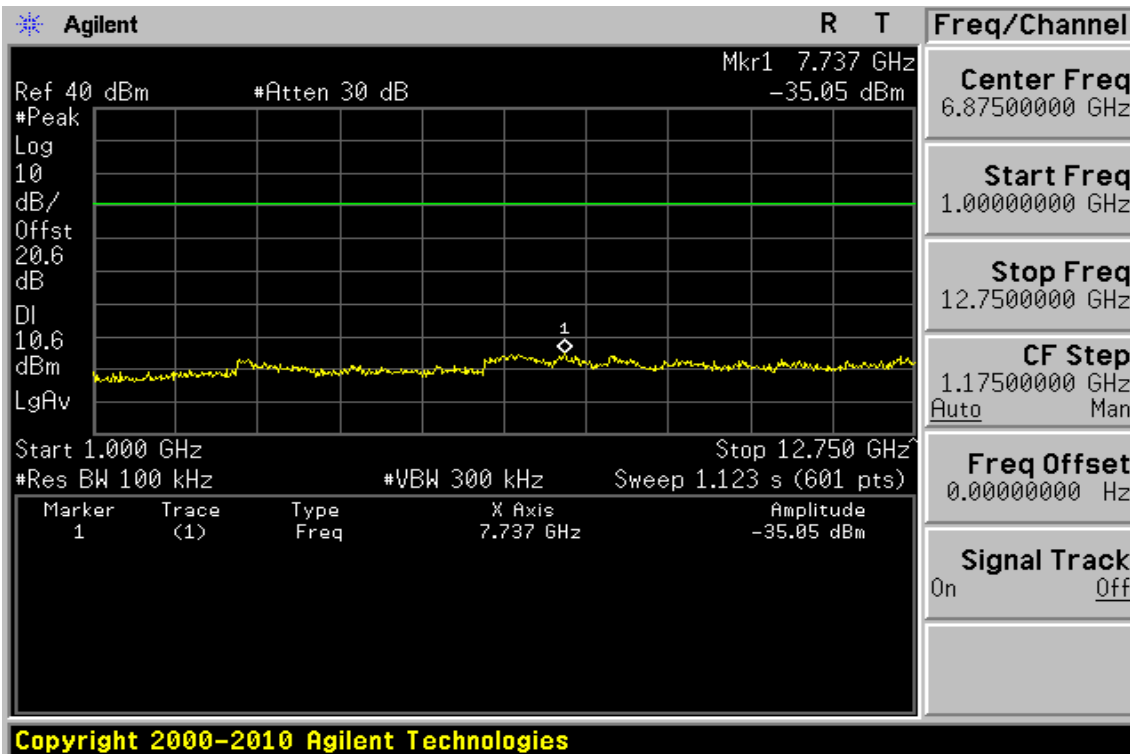
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9.8. Measurement Result: Conducted Spurious Emission Measurement Result

Ch Low 30MHz – 1GHz



Ch Low 3GHz – 12.5GHz



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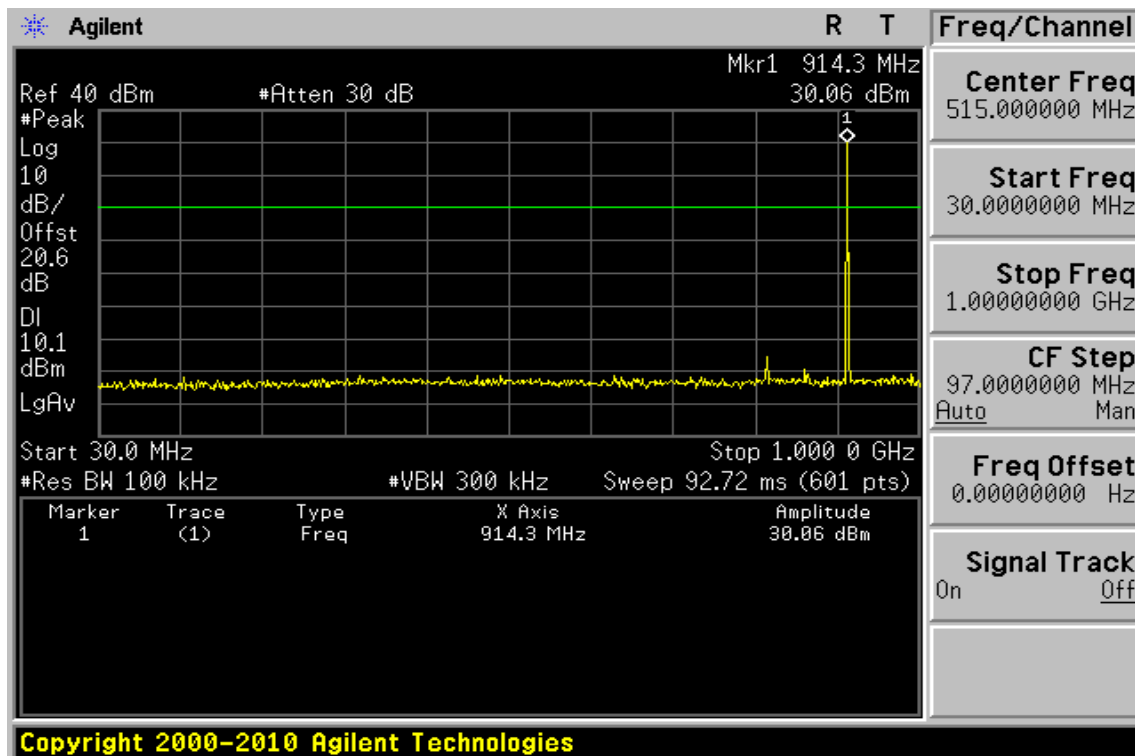
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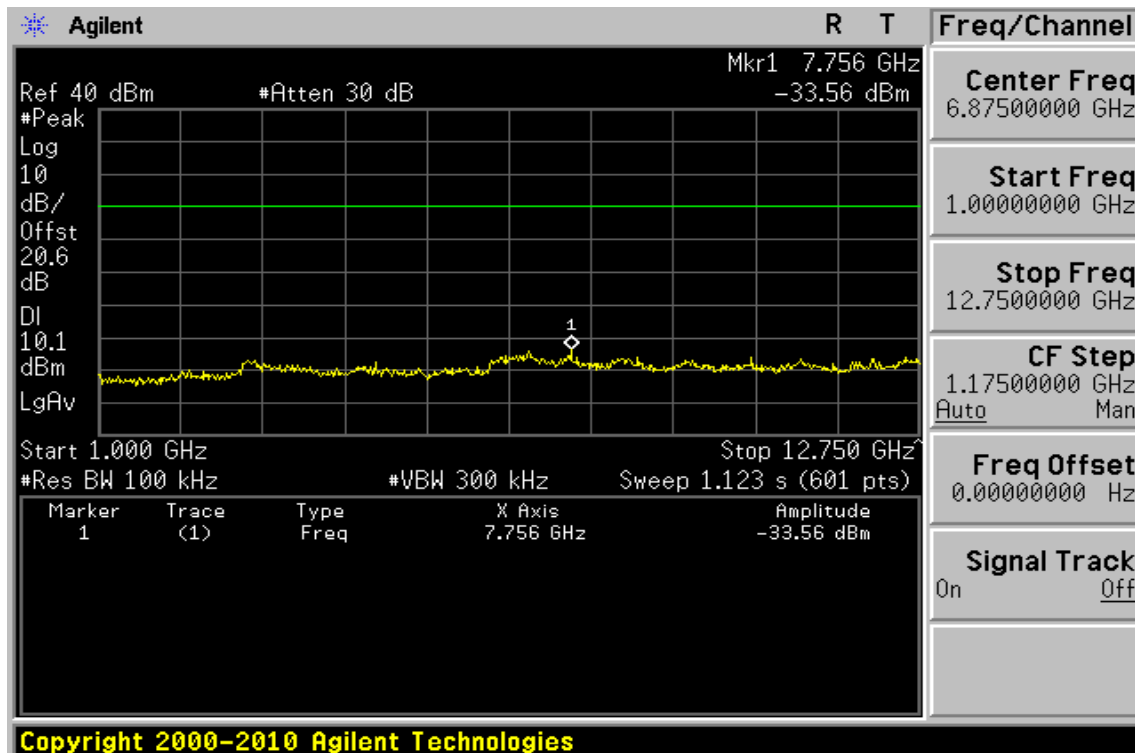
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Ch Mid 30MHz – 1GHz



Ch Mid 3GHz – 12.5GHz



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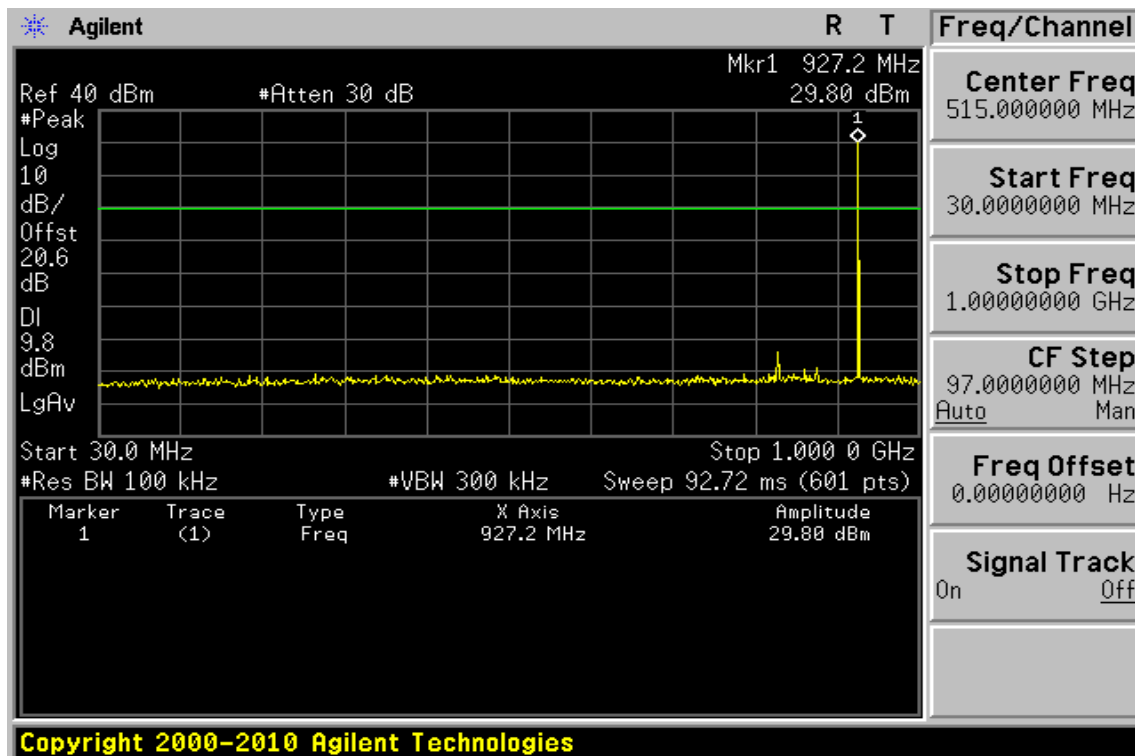
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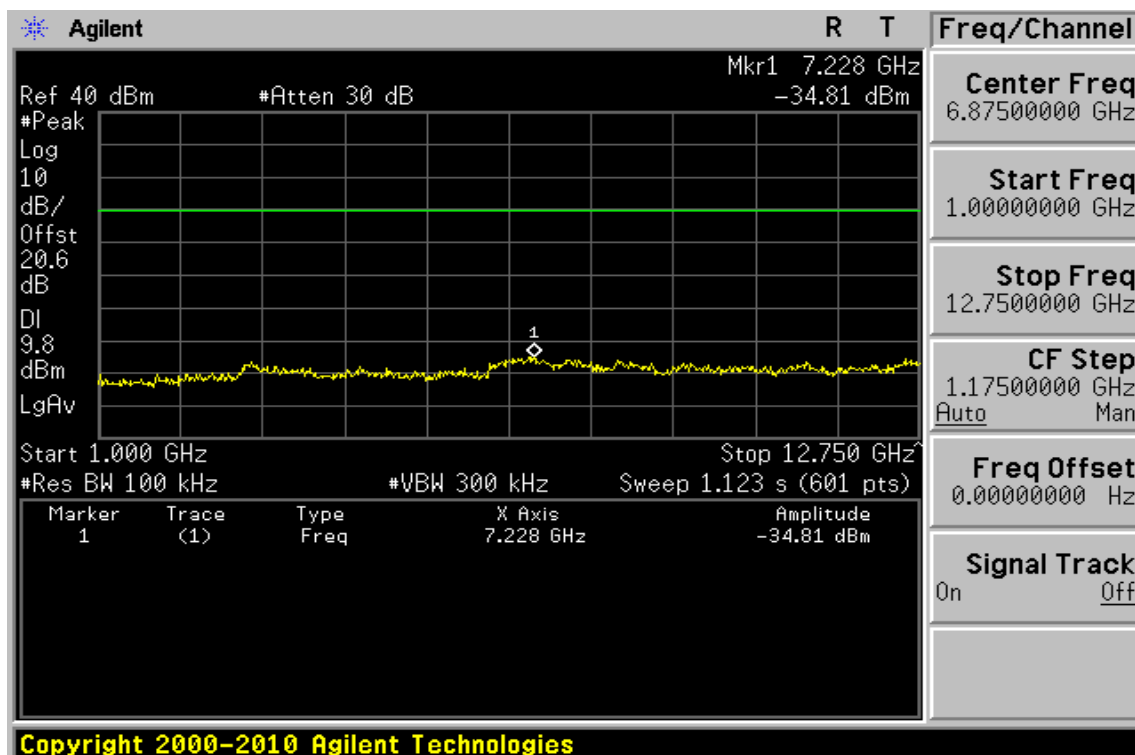
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Ch High 30MHz – 1GHz



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 (dBμV/m) = 20 log Emission level (dBμV/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	05/10/2016	05/09/2017
Spectrum Analyzer	Agilent	E4446A	MY51100003	04/21/2016	04/20/2017
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	08/01/2016	07/31/2017
Pre-Amplifier	Agilent	8447D	2944A07676	01/05/2017	01/04/2018
Pre-Amplifier	EMC Instruments Corp.	EMC0126530	980038	01/05/2017	01/04/2018
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	07/01/2016	06/30/2017
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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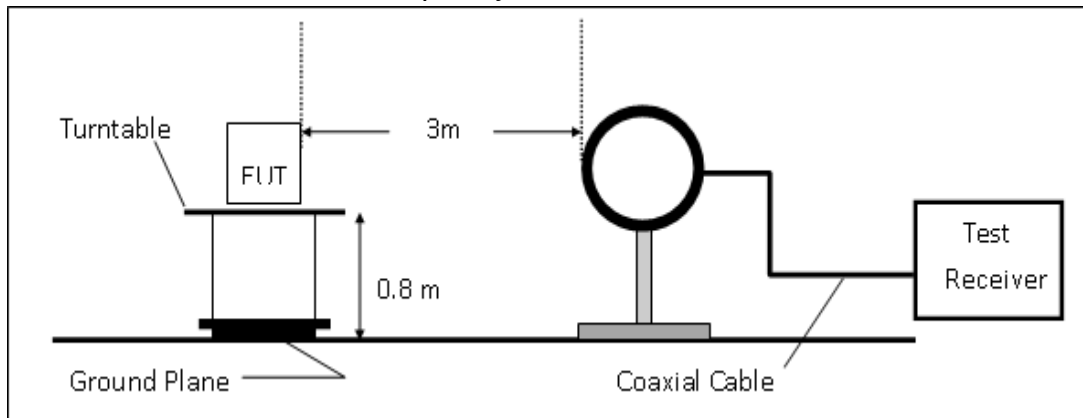
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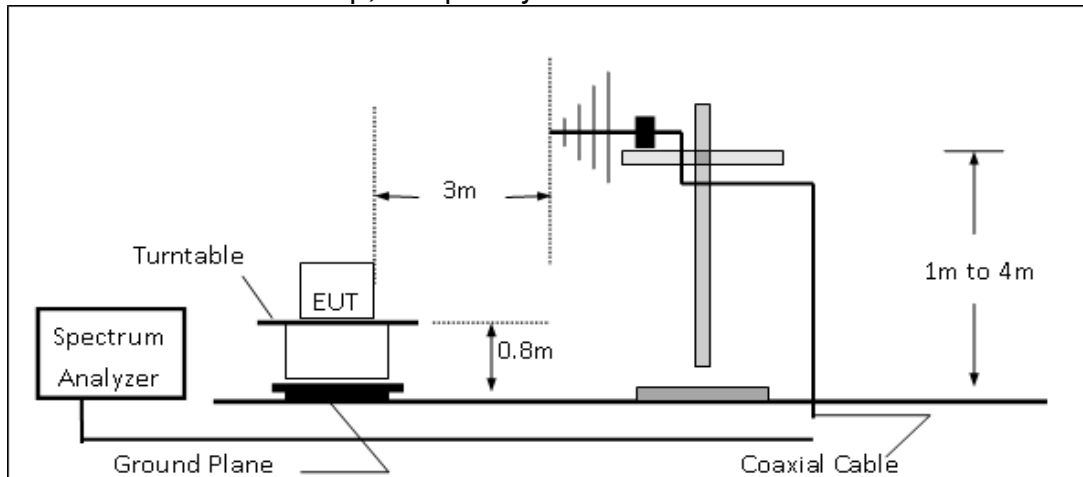
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10.3. Test SET-UP:

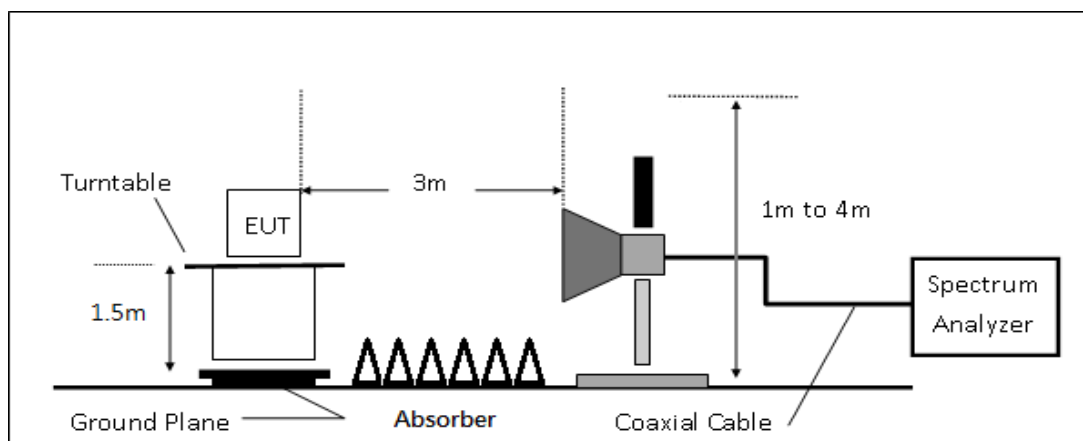
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(B) Radiated Emission Test Set-UP, Frequency form 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 FCC Public Notice DA 00-705 Measurement Guidelines.
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)

$$\text{Duty Cycle} = \text{On time} / 100 \text{ milliseconds}$$

$$\text{On time} = N1 * L1 + N2 * L2 + \dots + N(n-1) * L(n-1) + N(n) * L(n)$$
 Where N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.
 Average Emission Level = Peak Emission Level + 20*log (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:

$$FS = RA + AF + CL - AG$$

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 dBuV/m, which converts $20 \cdot \log(\mu\text{V/m})$

Actual FS(dBuV/m) = SPA. Reading level(dBuV) + Factor(dB)

Factor(dB) = Antenna Factor(dBuV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

10.6. Test Results of Radiated Spurious Emissions form 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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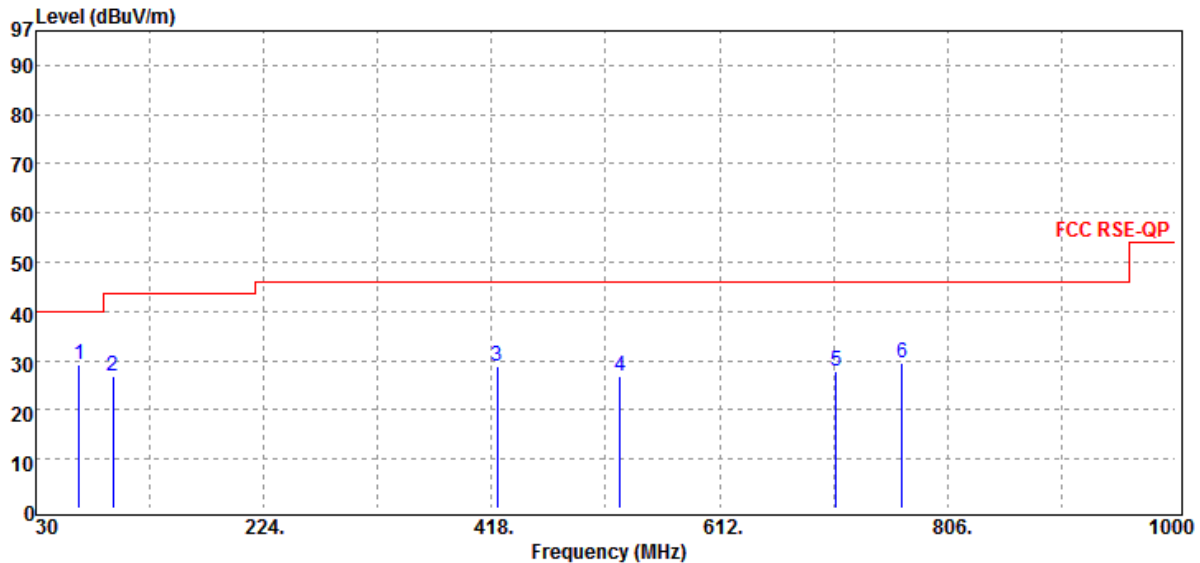
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10.7.1. Radiated Spurious Emission Measurement Result

For Frequency from 30MHz to 1000MHz (UAT-001)

Operation Band	:900M	Test Date	:2017-02-14
Fundamental Frequency	:902.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
66.86	S	Peak	38.91	-9.58	29.33	40.00	-10.67
95.96	S	Peak	39.91	-13.04	26.87	43.50	-16.63
422.85	S	Peak	32.01	-3.17	28.84	46.00	-17.16
527.61	S	Peak	28.33	-1.32	27.01	46.00	-18.99
710.94	S	Peak	26.50	1.33	27.83	46.00	-18.17
767.20	S	Peak	26.50	3.14	29.64	46.00	-16.36

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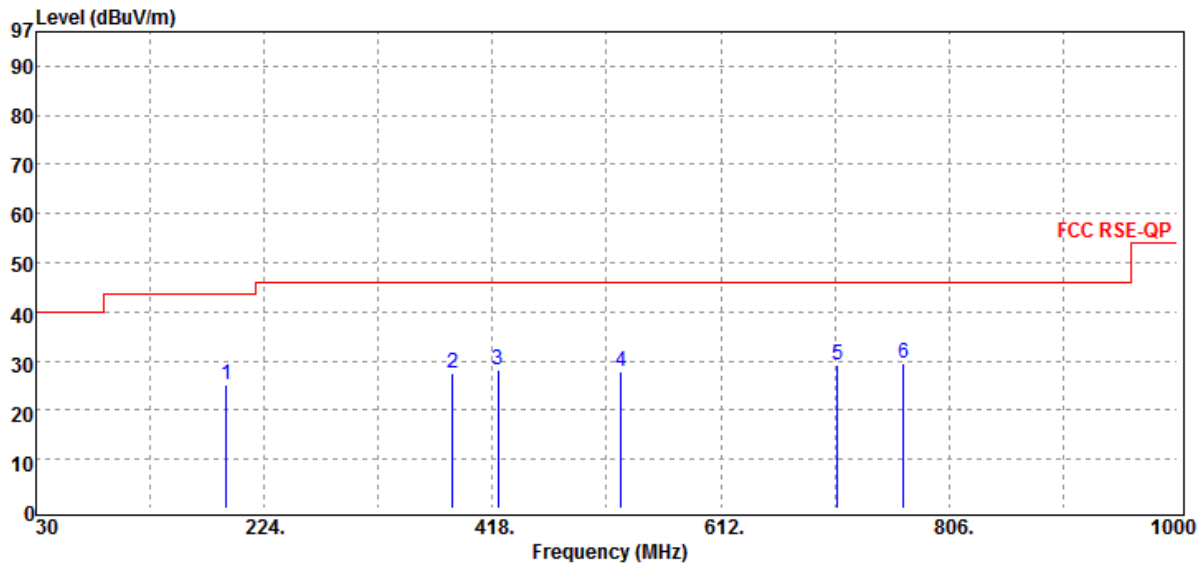
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Operation Band :900M
Fundamental Frequency :902.75 MHz
Operation Mode :Tx CH LOW
EUT Pol. :H Plane

Test Date :2017-02-14
Temp./Humi. :21 deg_C / 61 RH
Engineer :Mike
Measurement Antenna Pol. :HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
191.99	S	Peak	34.72	-9.42	25.30	43.50	-18.20
384.05	S	Peak	31.87	-4.35	27.52	46.00	-18.48
422.85	S	Peak	31.49	-3.17	28.32	46.00	-17.68
527.61	S	Peak	29.11	-1.32	27.79	46.00	-18.21
710.94	S	Peak	27.86	1.33	29.19	46.00	-16.81
767.20	S	Peak	26.35	3.14	29.49	46.00	-16.51

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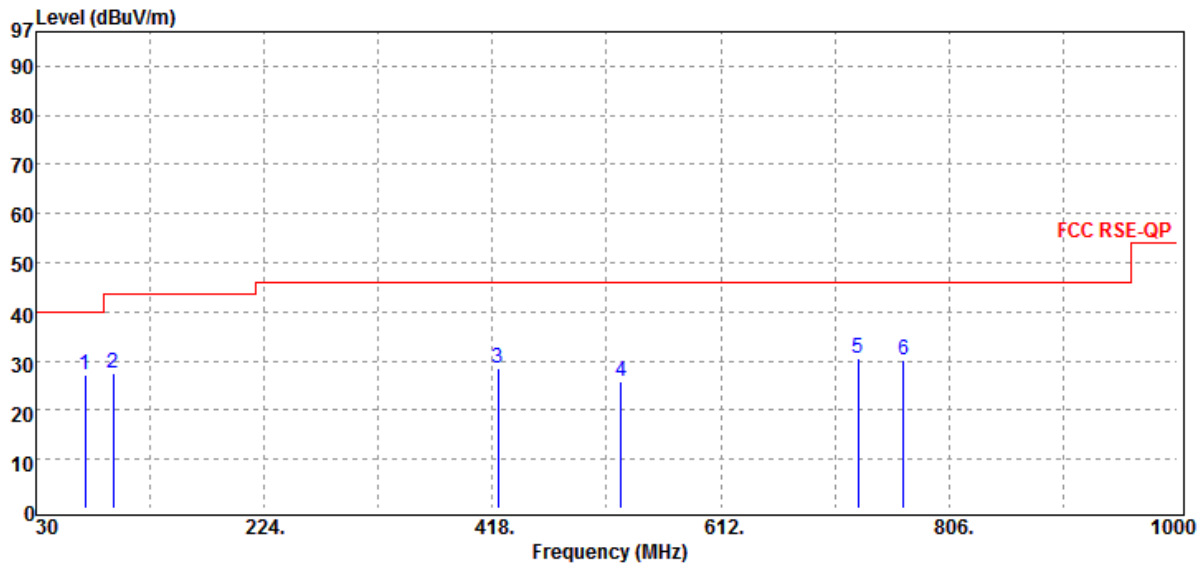
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Operation Band	:900M	Test Date	:2017-02-14
Fundamental Frequency	:914.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
71.71	S	Peak	37.85	-10.62	27.23	40.00	-12.77
95.96	S	Peak	40.53	-13.04	27.49	43.50	-16.01
422.85	S	Peak	31.83	-3.17	28.66	46.00	-17.34
527.61	S	Peak	27.20	-1.32	25.88	46.00	-20.12
728.40	S	Peak	28.82	1.65	30.47	46.00	-15.53
767.20	S	Peak	27.00	3.14	30.14	46.00	-15.86

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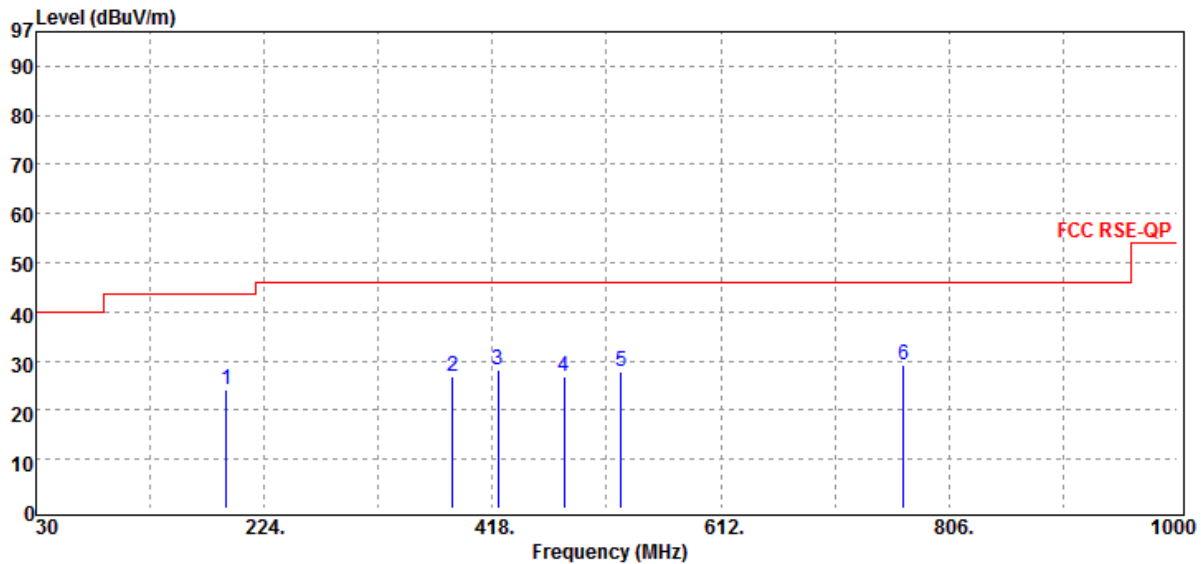
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Operation Band	:900M	Test Date	:2017-02-14
Fundamental Frequency	:914.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
191.99	S	Peak	33.64	-9.42	24.22	43.50	-19.28
384.05	S	Peak	31.05	-4.35	26.70	46.00	-19.30
422.85	S	Peak	31.29	-3.17	28.12	46.00	-17.88
479.11	S	Peak	29.16	-2.39	26.77	46.00	-19.23
527.61	S	Peak	29.15	-1.32	27.83	46.00	-18.17
767.20	S	Peak	25.93	3.14	29.07	46.00	-16.93

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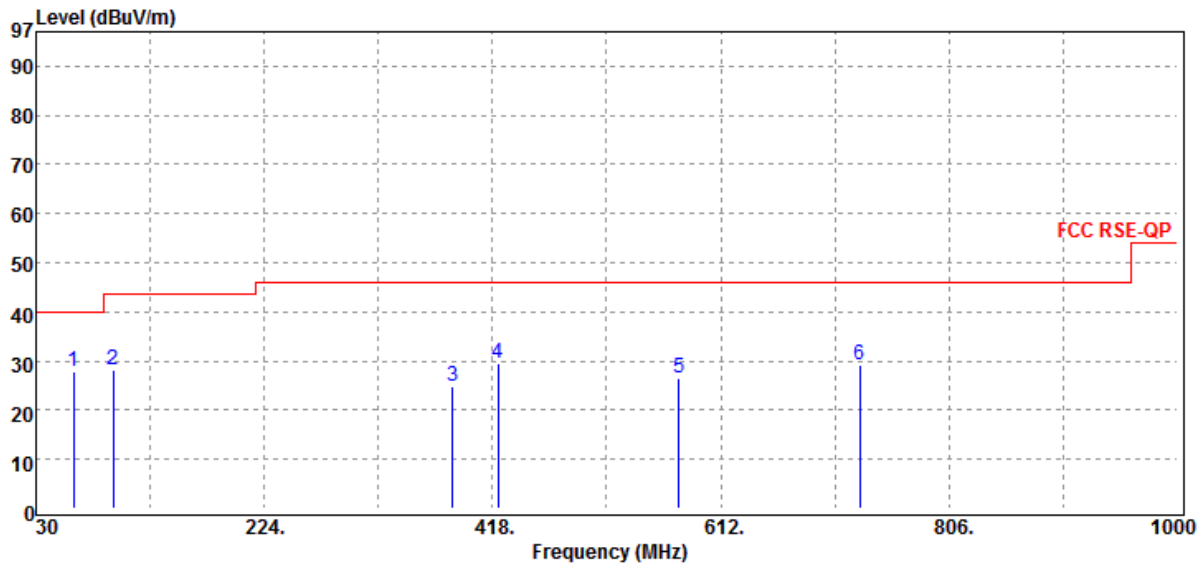
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Operation Band	:900M	Test Date	:2017-02-14
Fundamental Frequency	:927.25 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
62.01	S	Peak	36.21	-8.47	27.74	40.00	-12.26
95.96	S	Peak	41.08	-13.04	28.04	43.50	-15.46
384.05	S	Peak	29.14	-4.35	24.79	46.00	-21.21
422.85	S	Peak	32.55	-3.17	29.38	46.00	-16.62
576.11	S	Peak	27.03	-0.64	26.39	46.00	-19.61
730.34	S	Peak	27.47	1.67	29.14	46.00	-16.86

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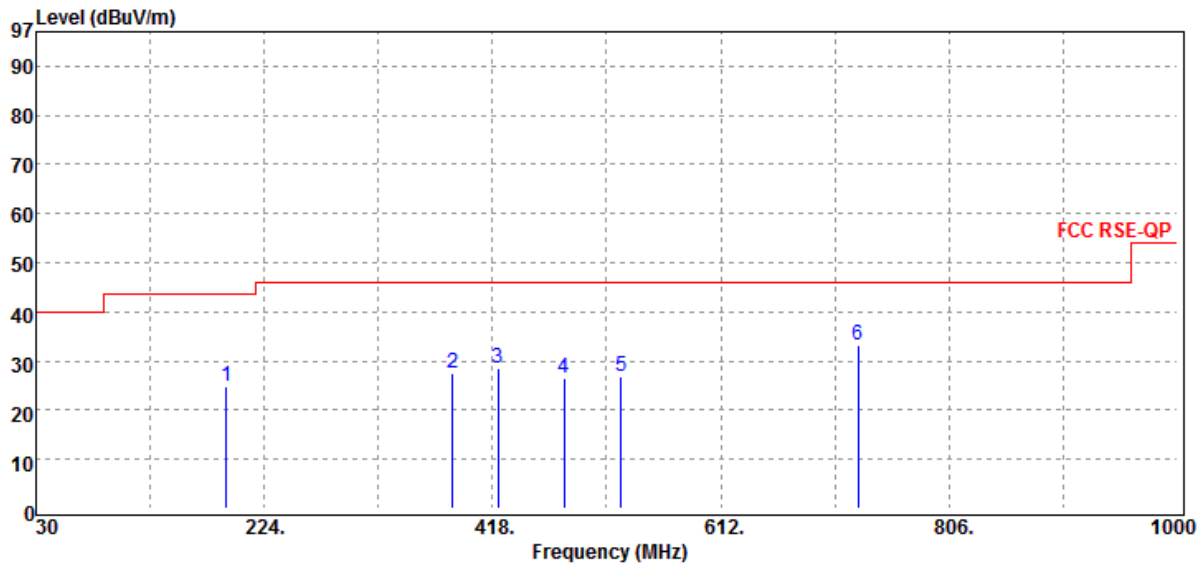
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Operation Band :900M
Fundamental Frequency :927.25 MHz
Operation Mode :Tx CH HIGH
EUT Pol. :H Plane

Test Date :2017-02-14
Temp./Humi. :21 deg_C / 61 RH
Engineer :Mike
Measurement Antenna Pol. :HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
191.99	S	Peak	34.14	-9.42	24.72	43.50	-18.78
384.05	S	Peak	31.86	-4.35	27.51	46.00	-18.49
422.85	S	Peak	31.77	-3.17	28.60	46.00	-17.40
479.11	S	Peak	28.95	-2.39	26.56	46.00	-19.44
527.61	S	Peak	28.02	-1.32	26.70	46.00	-19.30
728.40	S	Peak	31.46	1.65	33.11	46.00	-12.89

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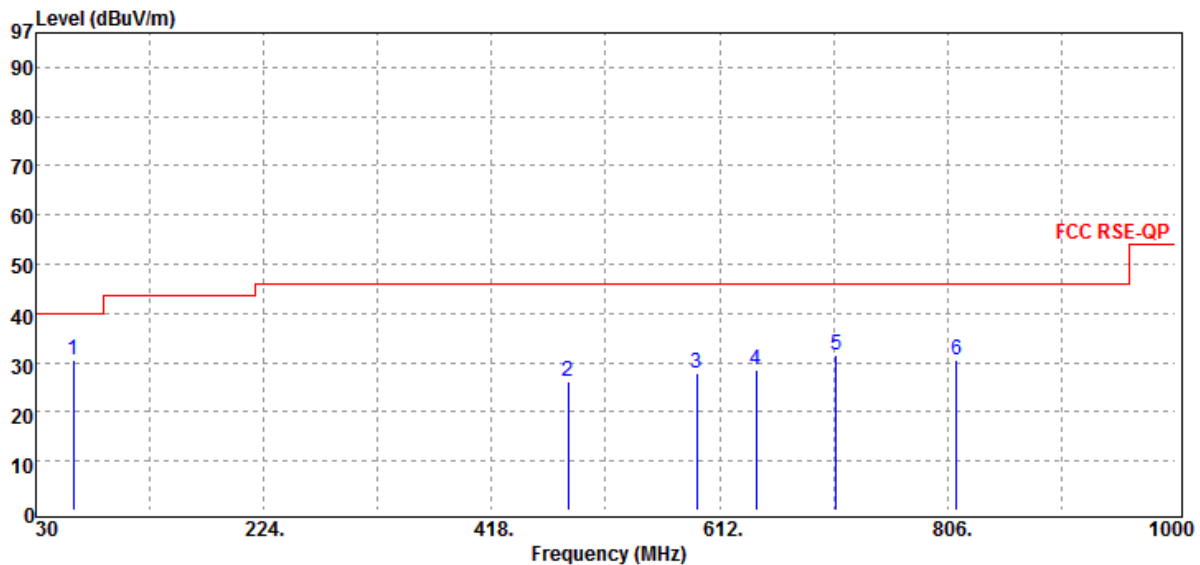
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For Frequency from 30MHz to 1000MHz (UAT-006)

Operation Band	:900M	Test Date	:2017-02-14
Fundamental Frequency	:902.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level		FS	@3m	
		PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
62.01	S	Peak	39.04	-8.47	30.57	40.00	-9.43
482.99	S	Peak	28.58	-2.47	26.11	46.00	-19.89
592.60	S	Peak	27.79	0.00	27.79	46.00	-18.21
643.04	S	Peak	27.86	0.65	28.51	46.00	-17.49
710.94	S	Peak	30.37	1.33	31.70	46.00	-14.30
813.76	S	Peak	27.13	3.36	30.49	46.00	-15.51

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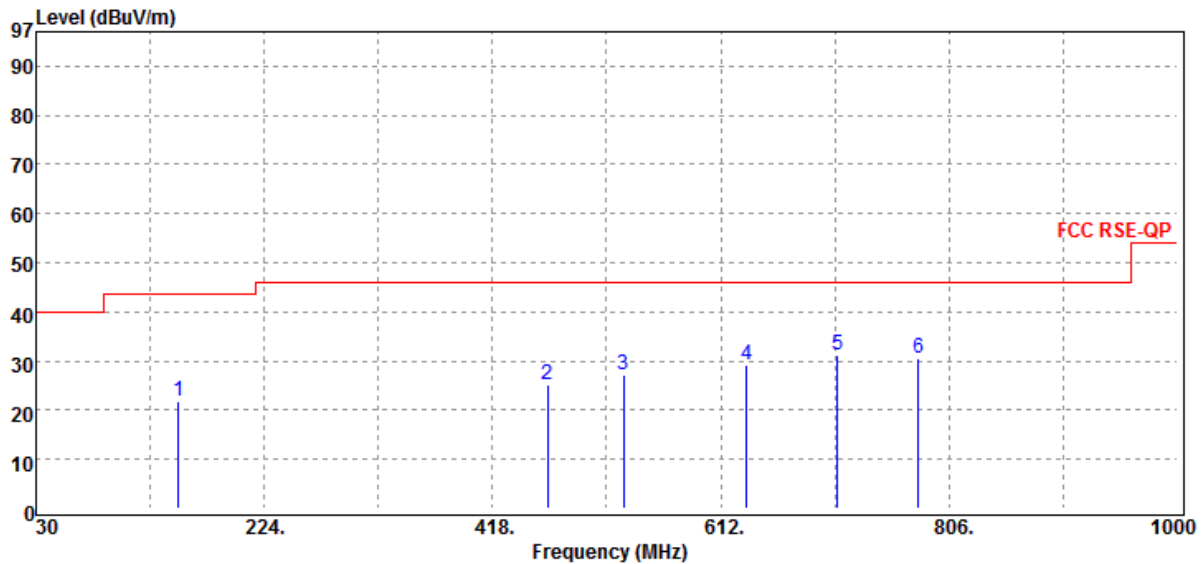
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Operation Band :900M
Fundamental Frequency :902.75 MHz
Operation Mode :Tx CH LOW
EUT Pol. :H Plane

Test Date :2017-02-14
Temp./Humi. :21 deg_C / 61 RH
Engineer :Mike
Measurement Antenna Pol. :HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
151.25	S	Peak	29.48	-7.71	21.77	43.50	-21.73
464.56	S	Peak	27.64	-2.58	25.06	46.00	-20.94
529.55	S	Peak	28.39	-1.25	27.14	46.00	-18.86
634.31	S	Peak	28.55	0.51	29.06	46.00	-16.94
710.94	S	Peak	29.93	1.33	31.26	46.00	-14.74
779.81	S	Peak	27.90	2.58	30.48	46.00	-15.52

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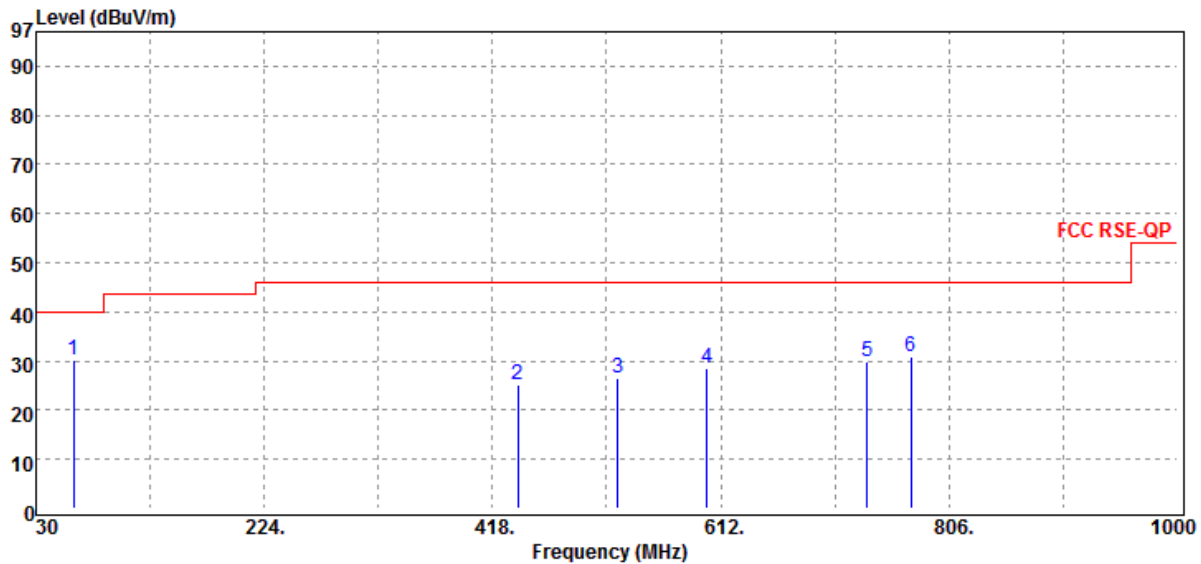
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Operation Band :900M
Fundamental Frequency :914.75 MHz
Operation Mode :Tx CH MID
EUT Pol. :H Plane

Test Date :2017-02-14
Temp./Humi. :21 deg_C / 61 RH
Engineer :Mike
Measurement Antenna Pol. :VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
62.01	S	Peak	38.77	-8.47	30.30	40.00	-9.70
439.34	S	Peak	28.28	-3.23	25.05	46.00	-20.95
524.70	S	Peak	28.19	-1.68	26.51	46.00	-19.49
600.36	S	Peak	28.79	-0.14	28.65	46.00	-17.35
736.16	S	Peak	27.92	1.94	29.86	46.00	-16.14
773.99	S	Peak	28.00	2.78	30.78	46.00	-15.22

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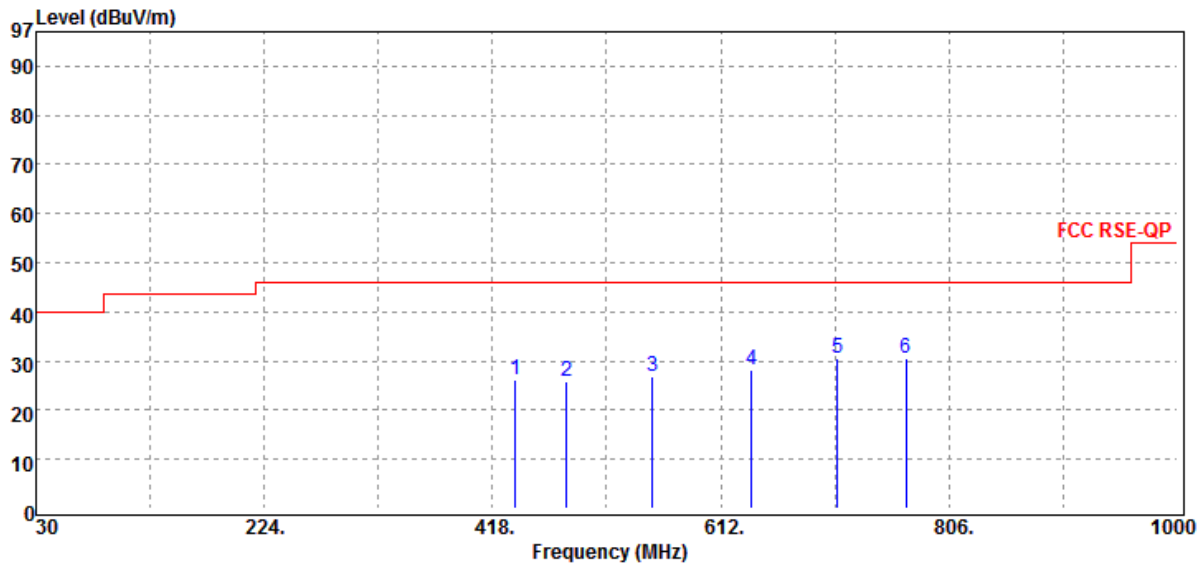
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Operation Band	:900M	Test Date	:2017-02-14
Fundamental Frequency	:914.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
437.40	S	Peak	29.33	-3.32	26.01	46.00	-19.99
481.05	S	Peak	28.36	-2.37	25.99	46.00	-20.01
553.80	S	Peak	28.15	-1.39	26.76	46.00	-19.24
638.19	S	Peak	27.90	0.40	28.30	46.00	-17.70
710.94	S	Peak	29.18	1.33	30.51	46.00	-15.49
769.14	S	Peak	27.67	2.77	30.44	46.00	-15.56

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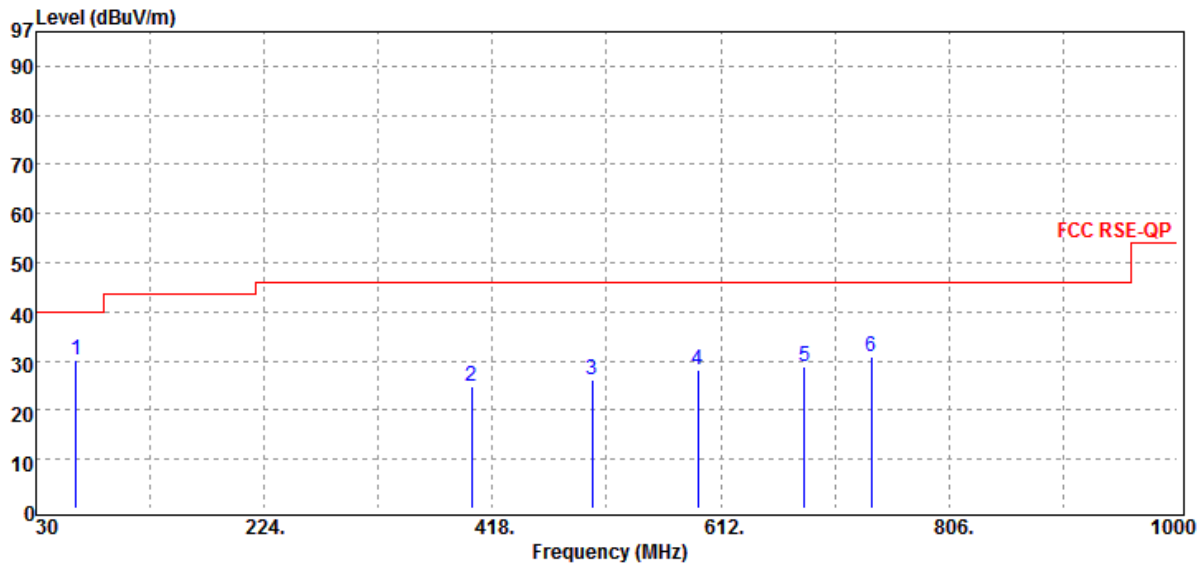
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Operation Band	:900M	Test Date	:2017-02-14
Fundamental Frequency	:927.25 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
63.95	S	Peak	39.09	-8.93	30.16	40.00	-9.84
400.54	S	Peak	28.81	-3.94	24.87	46.00	-21.13
502.39	S	Peak	28.73	-2.55	26.18	46.00	-19.82
592.60	S	Peak	28.23	0.00	28.23	46.00	-17.77
682.81	S	Peak	27.85	1.10	28.95	46.00	-17.05
740.04	S	Peak	28.85	2.03	30.88	46.00	-15.12

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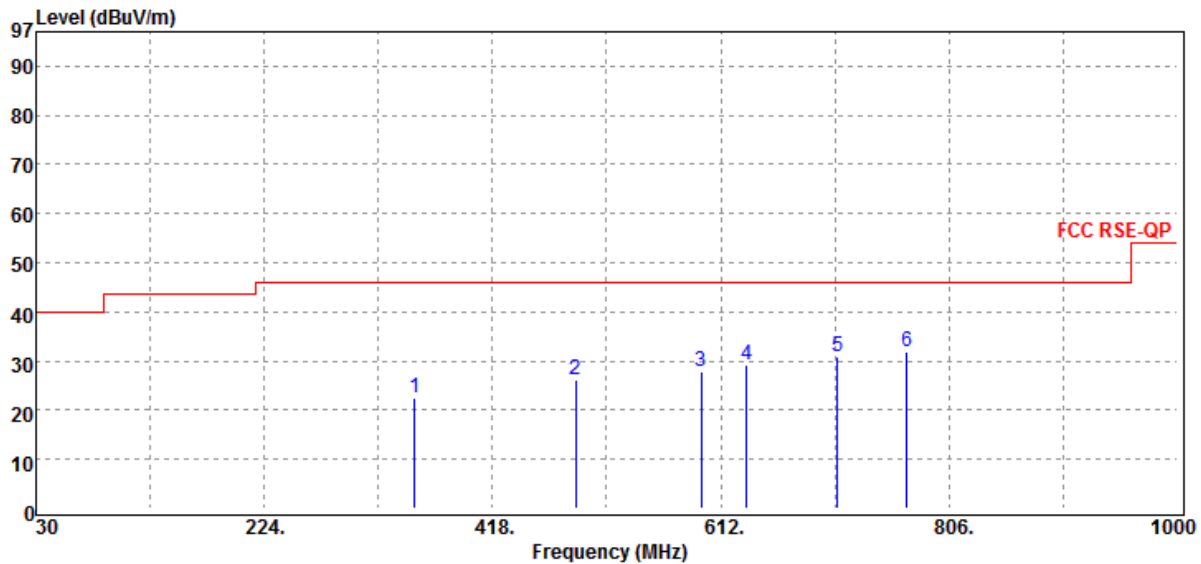
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Operation Band	:900M	Test Date	:2017-02-14
Fundamental Frequency	:927.25 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
352.04	S	Peak	27.46	-4.94	22.52	46.00	-23.48
488.81	S	Peak	28.49	-2.38	26.11	46.00	-19.89
595.51	S	Peak	27.85	0.05	27.90	46.00	-18.10
634.31	S	Peak	28.65	0.51	29.16	46.00	-16.84
710.94	S	Peak	29.43	1.33	30.76	46.00	-15.24
770.11	S	Peak	29.29	2.68	31.97	46.00	-14.03

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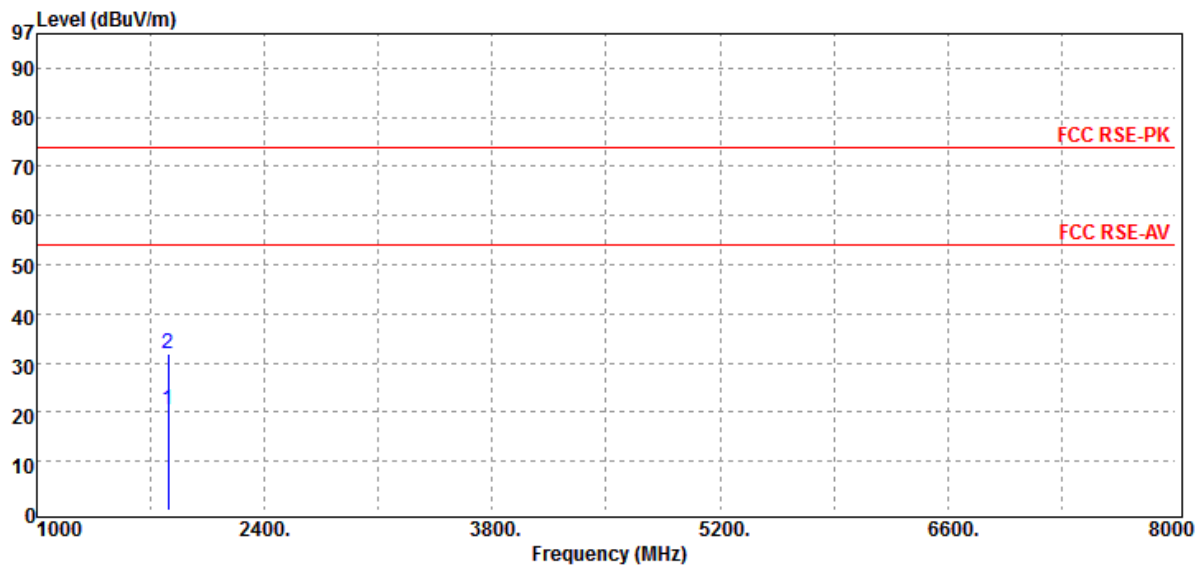
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For Frequency above 1GHz (UAT-001)

Operation Band	:900M	Test Date	:2017-02-17
Fundamental Frequency	:902.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
1805.50	H	Average	29.74	-9.35	20.39	54.00	-33.61
1805.50	H	Peak	41.10	-9.35	31.75	74.00	-42.25

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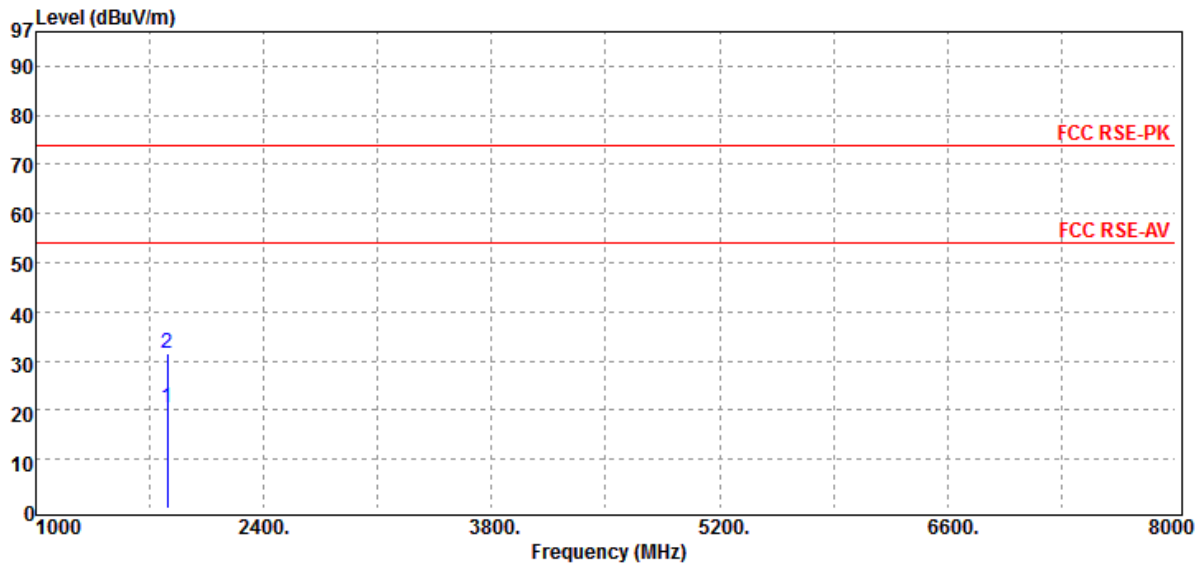
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Operation Band	:900M	Test Date	:2017-02-17
Fundamental Frequency	:902.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
1805.50	H	Average	29.76	-9.35	20.41	54.00	-33.59
1805.50	H	Peak	40.84	-9.35	31.49	74.00	-42.51

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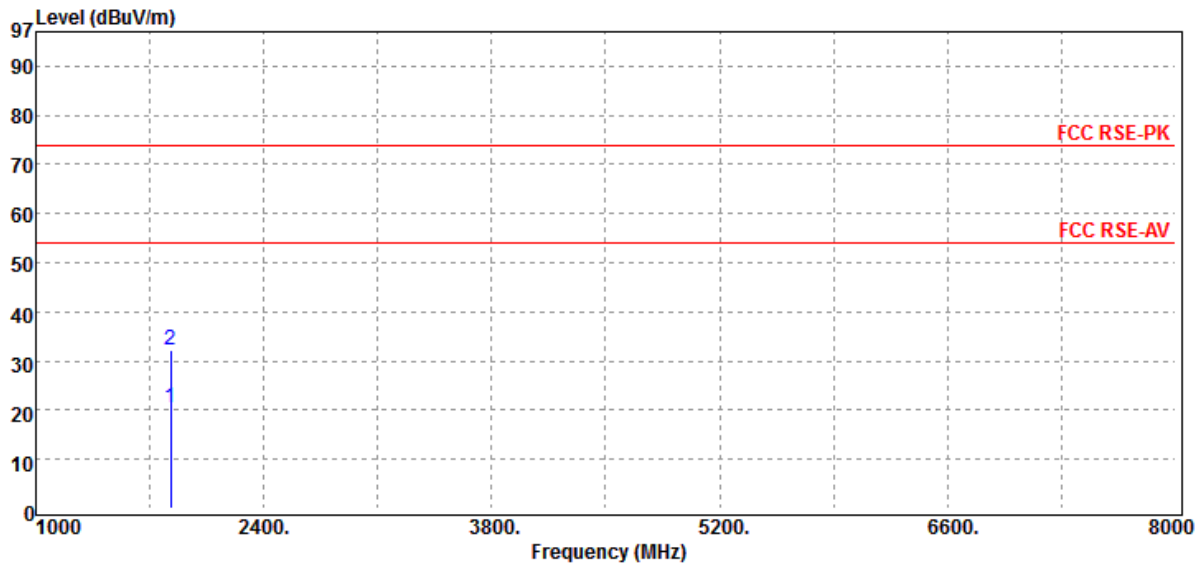
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Operation Band	:900M	Test Date	:2017-02-17
Fundamental Frequency	:914.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
1829.50	H	Average	29.76	-9.22	20.54	54.00	-33.46
1829.50	H	Peak	41.60	-9.22	32.38	74.00	-41.62

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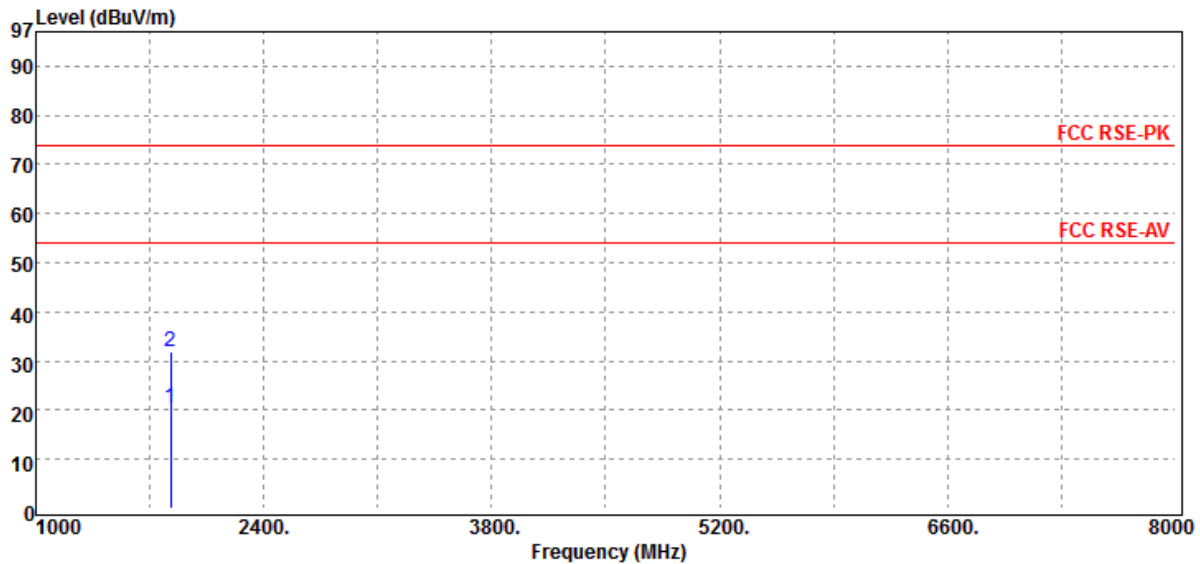
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Operation Band	:900M	Test Date	:2017-02-17
Fundamental Frequency	:914.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
1829.50	H	Average	29.77	-9.22	20.55	54.00	-33.45
1829.50	H	Peak	41.22	-9.22	32.00	74.00	-42.00

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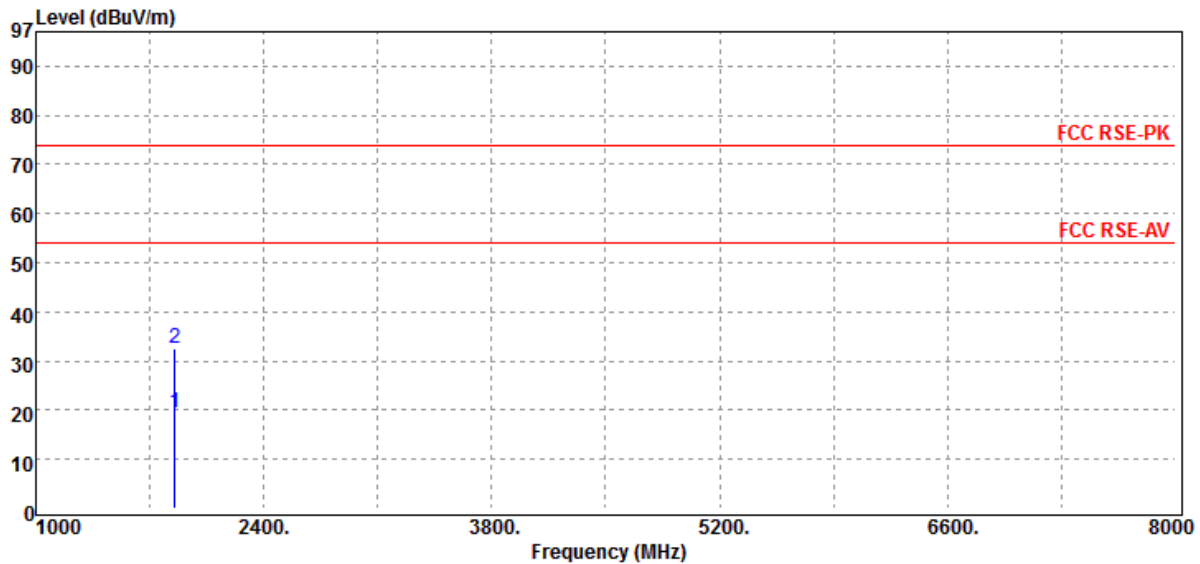
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Operation Band	:900M	Test Date	:2017-02-17
Fundamental Frequency	:927.25 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
1854.50	H	Average	28.55	-9.10	19.45	54.00	-34.55
1854.50	H	Peak	41.75	-9.10	32.65	74.00	-41.35

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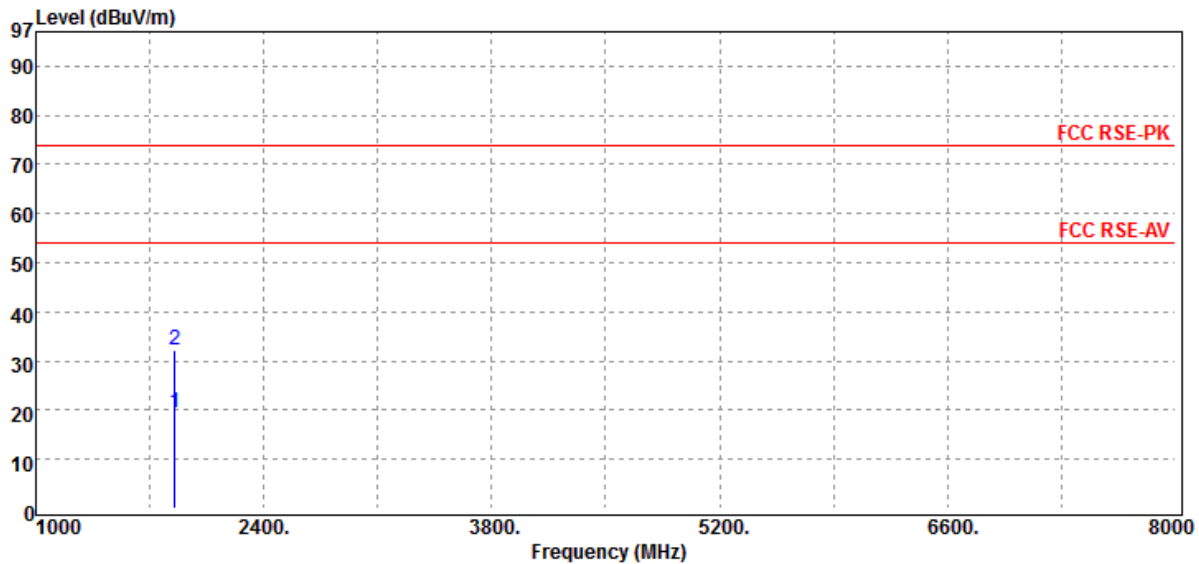
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Operation Band :900M
Fundamental Frequency :927.25 MHz
Operation Mode :Tx CH HIGH
EUT Pol. :H Plane

Test Date :2017-02-17
Temp./Humi. :21 deg_C / 61 RH
Engineer :Mike
Measurement Antenna Pol. :HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
1854.50	H	Average	28.56	-9.10	19.46	54.00	-34.54
1854.50	H	Peak	41.16	-9.10	32.06	74.00	-41.94

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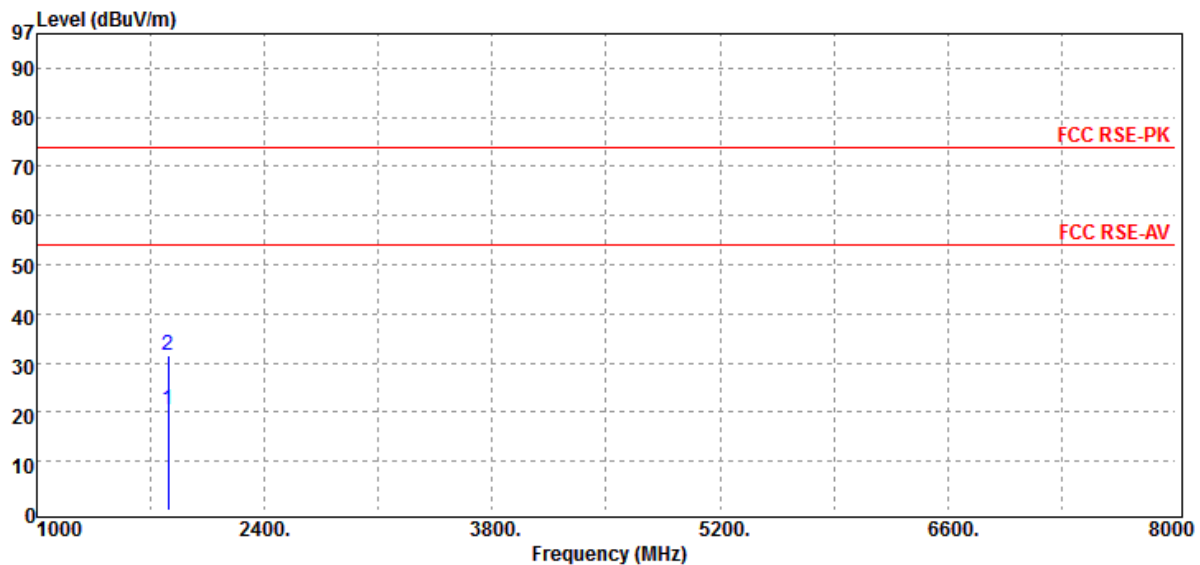
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For Frequency above 1GHz (UAT-006)

Operation Band	:900M	Test Date	:2017-02-17
Fundamental Frequency	:902.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
1805.50	H	Average	29.69	-9.35	20.34	54.00	-33.66
1805.50	H	Peak	40.95	-9.35	31.60	74.00	-42.40

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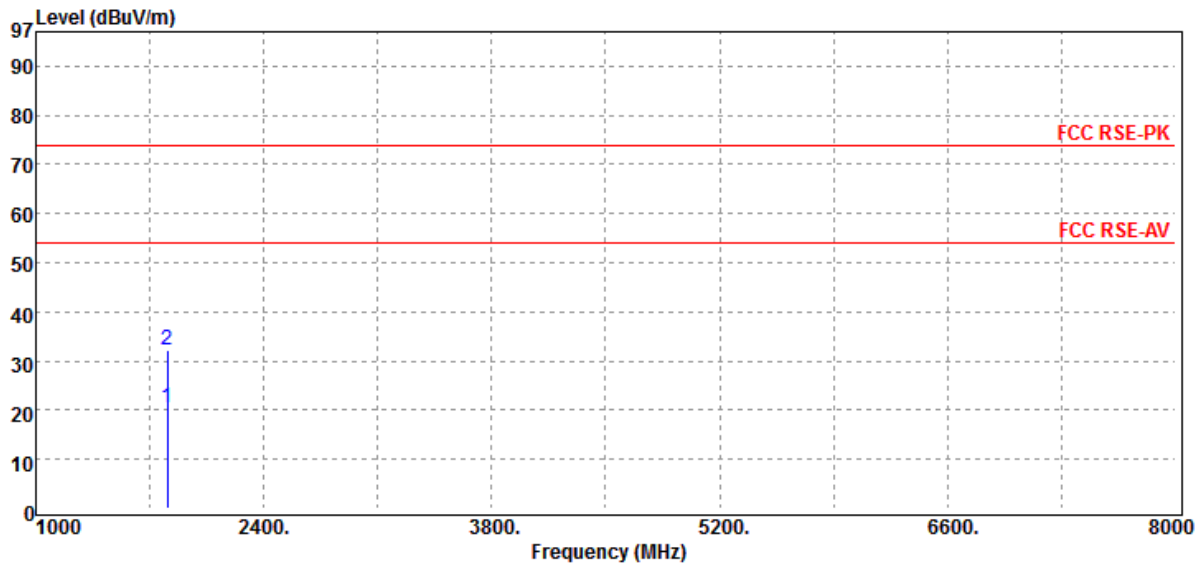
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Operation Band	:900M	Test Date	:2017-02-17
Fundamental Frequency	:902.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH LOW	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
1805.50	H	Average	29.67	-9.35	20.32	54.00	-33.68
1805.50	H	Peak	41.69	-9.35	32.34	74.00	-41.66

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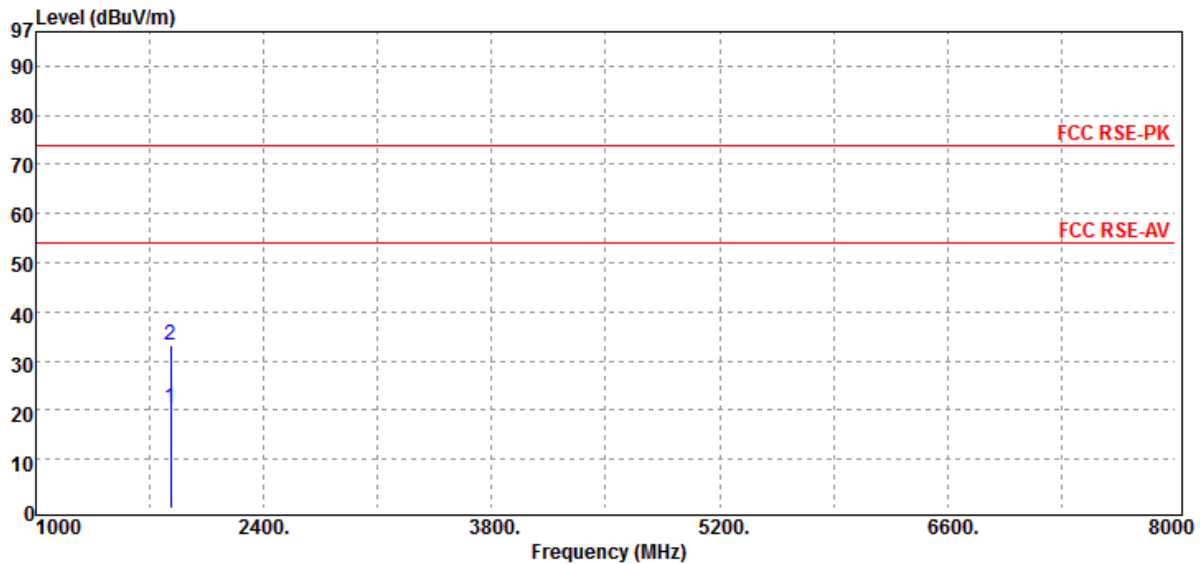
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Operation Band	:900M	Test Date	:2017-02-17
Fundamental Frequency	:914.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
1829.50	H	Average	29.72	-9.22	20.50	54.00	-33.50
1829.50	H	Peak	42.53	-9.22	33.31	74.00	-40.69

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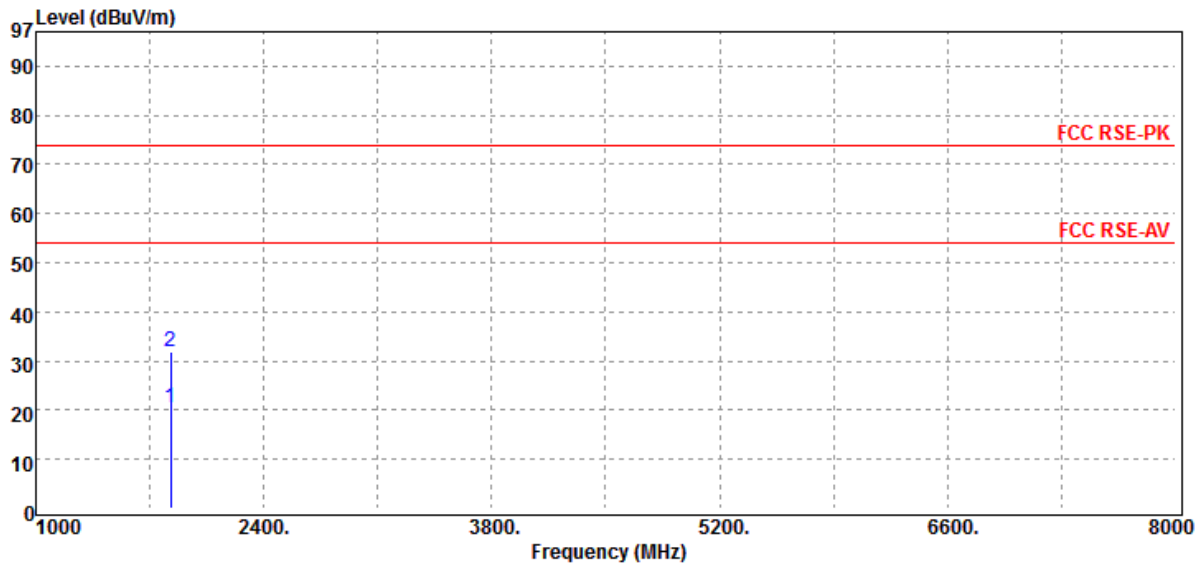
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Operation Band	:900M	Test Date	:2017-02-17
Fundamental Frequency	:914.75 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH MID	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
1829.50	H	Average	29.74	-9.22	20.52	54.00	-33.48
1829.50	H	Peak	41.19	-9.22	31.97	74.00	-42.03

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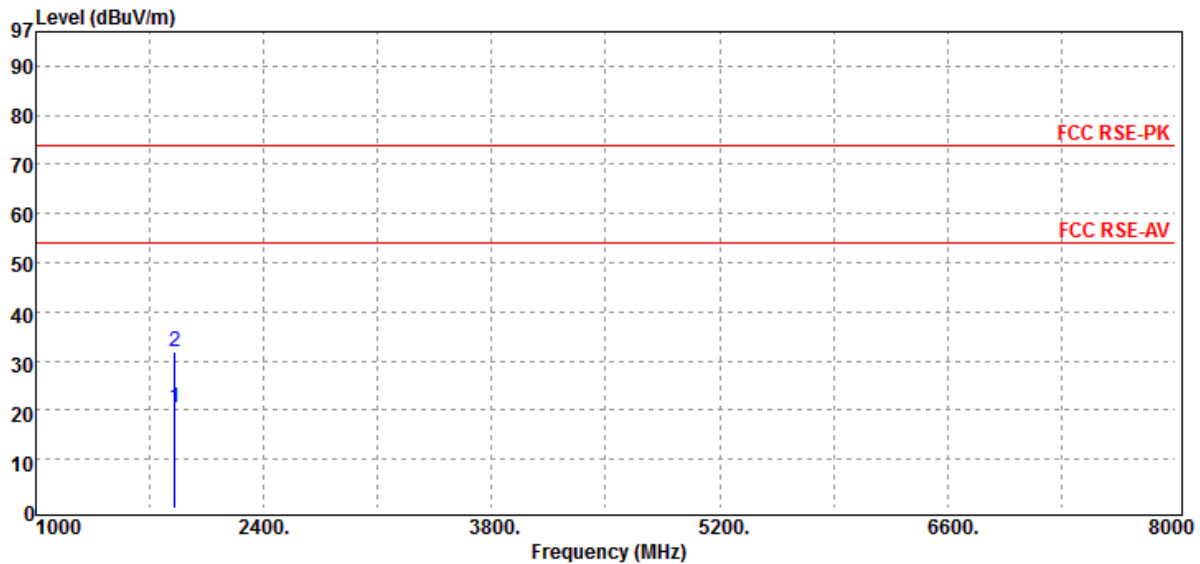
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Operation Band	:900M	Test Date	:2017-02-17
Fundamental Frequency	:927.25 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
1854.50	H	Average	29.71	-9.10	20.61	54.00	-33.39
1854.50	H	Peak	41.01	-9.10	31.91	74.00	-42.09

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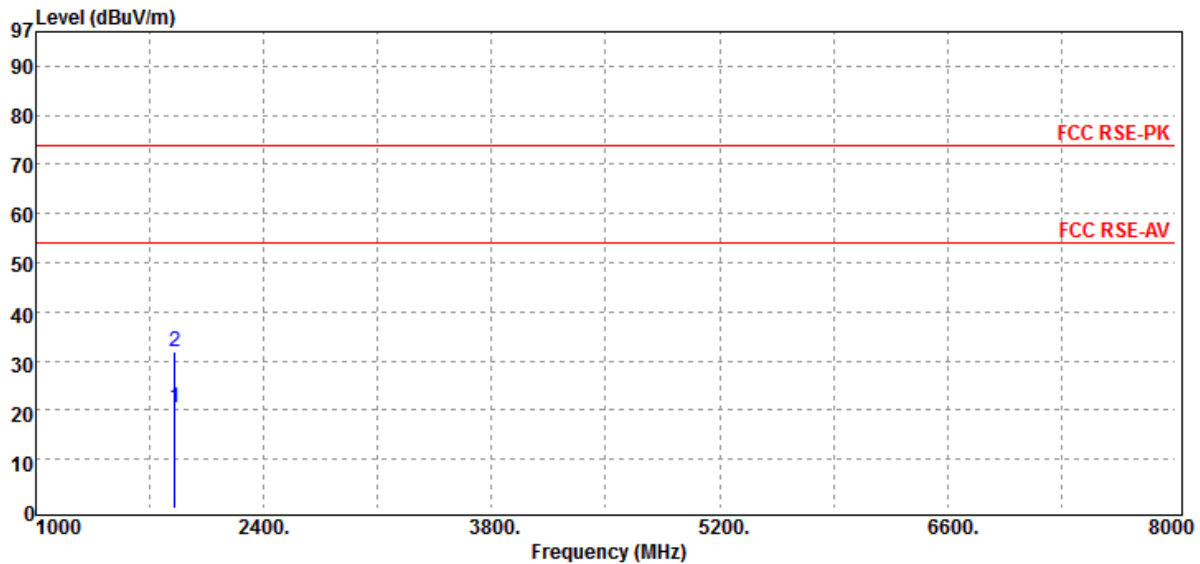
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Operation Band	:900M	Test Date	:2017-02-17
Fundamental Frequency	:927.25 MHz	Temp./Humi.	:21 deg_C / 61 RH
Operation Mode	:Tx CH HIGH	Engineer	:Mike
EUT Pol.	:H Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV/m	dBμV/m	dB
1854.50	H	Average	29.69	-9.10	20.59	54.00	-33.41
1854.50	H	Peak	40.98	-9.10	31.88	74.00	-42.12

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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 $2/3 \times 20\text{dB}$ 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 FCC Public Notice DA 00-705 Measurement Guidelines.
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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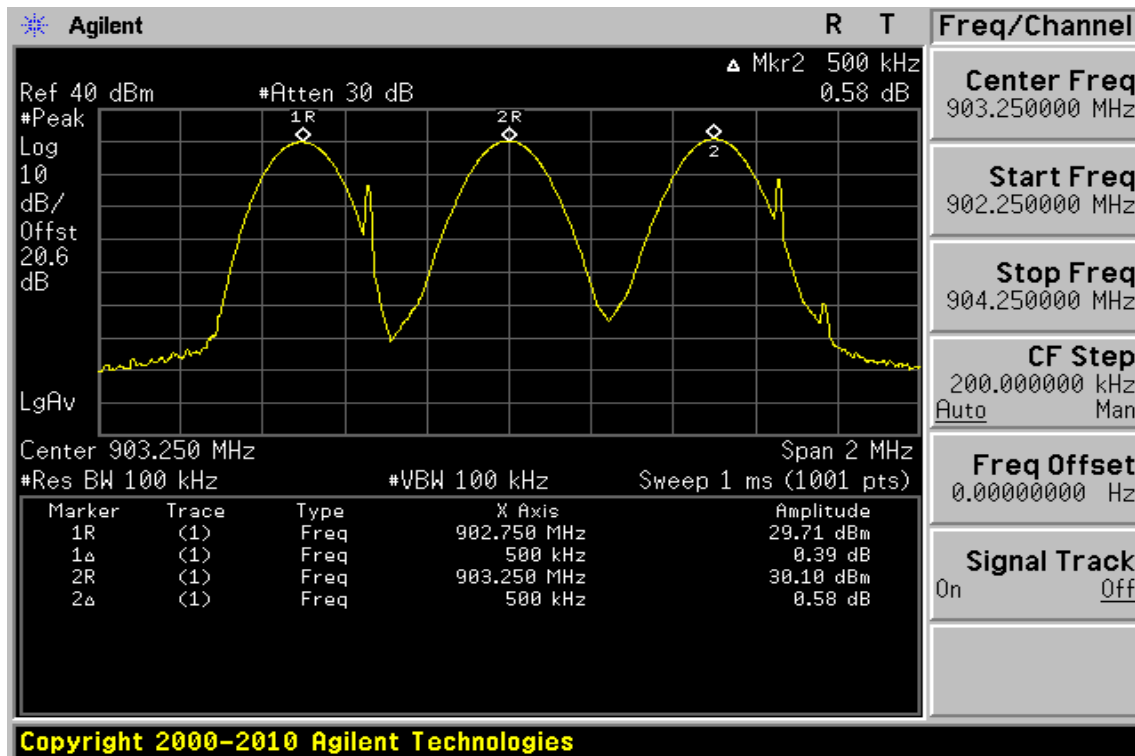
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11.5. Measurement Result:

Channel separation (MHz)	Limit	Result
1	≥ 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 FCC Public Notice DA 00-705 Measurement Guidelines.
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=200 kHz, VBW= 620 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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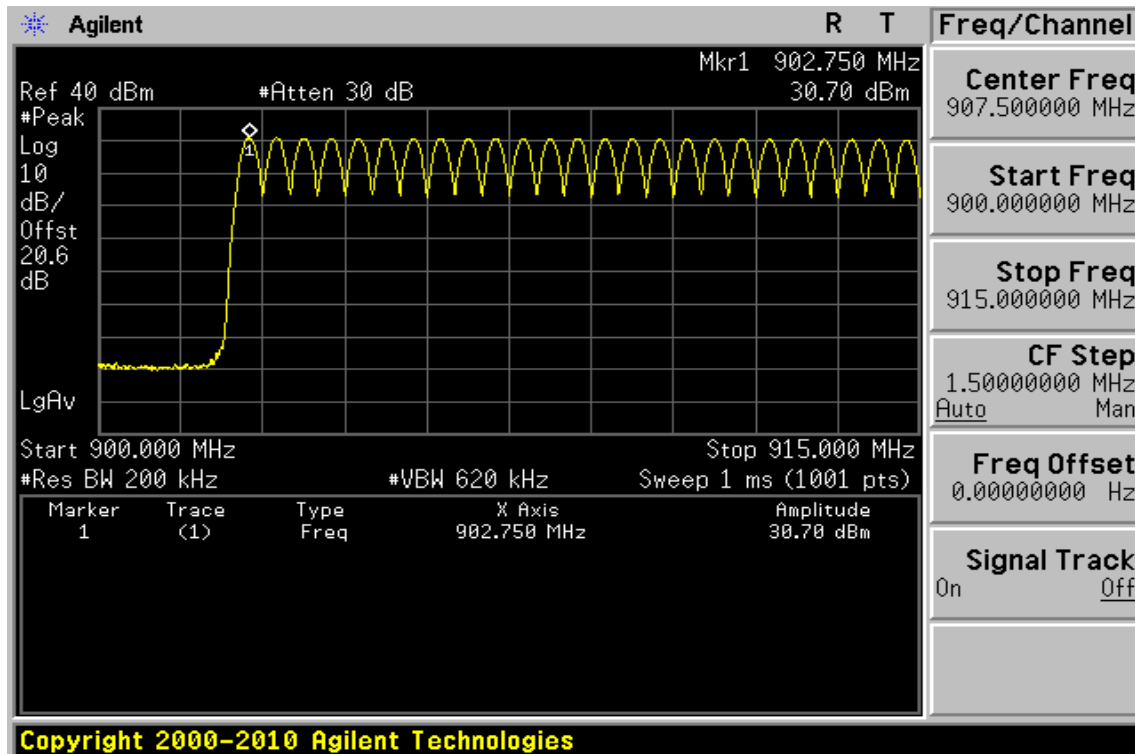
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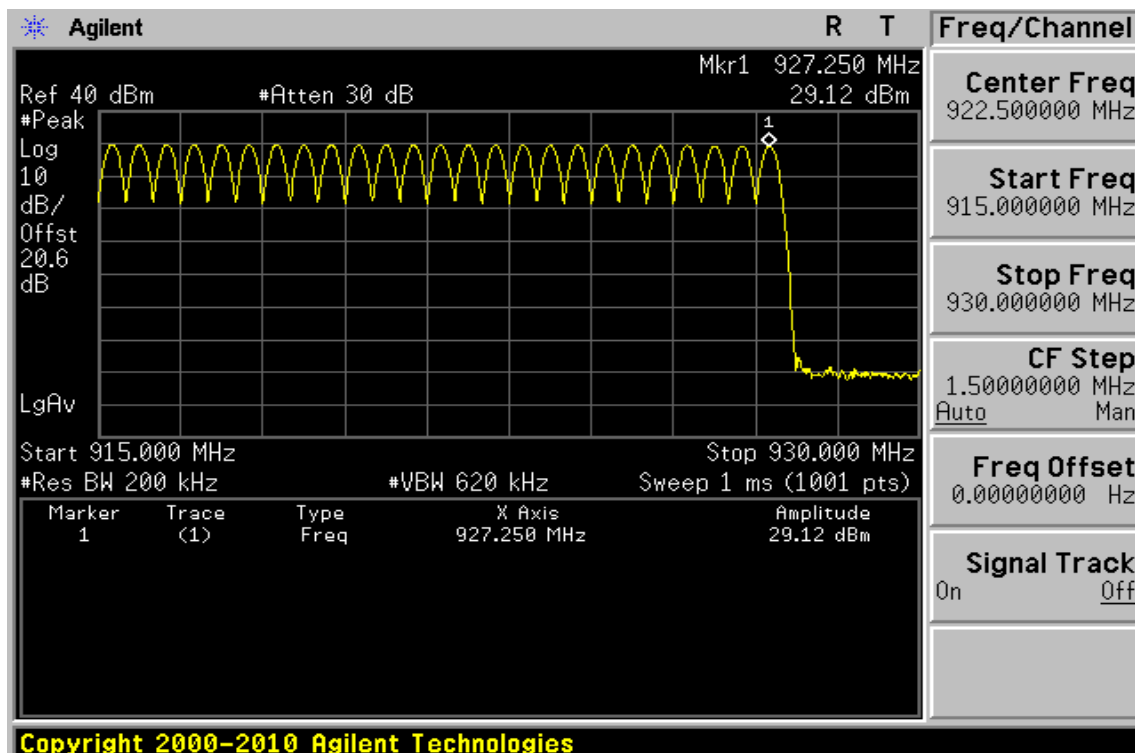
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Channel Number

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 FCC Public Notice DA 00-705 Measurement Guidelines.
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 transmis- sion in a 20s	Length of transmis- sion time (ms):	Measurement Result (ms):	Limit (ms):
1	399	399	400ms

13.6. Measurement Result:

Note: Refer to next page for plots.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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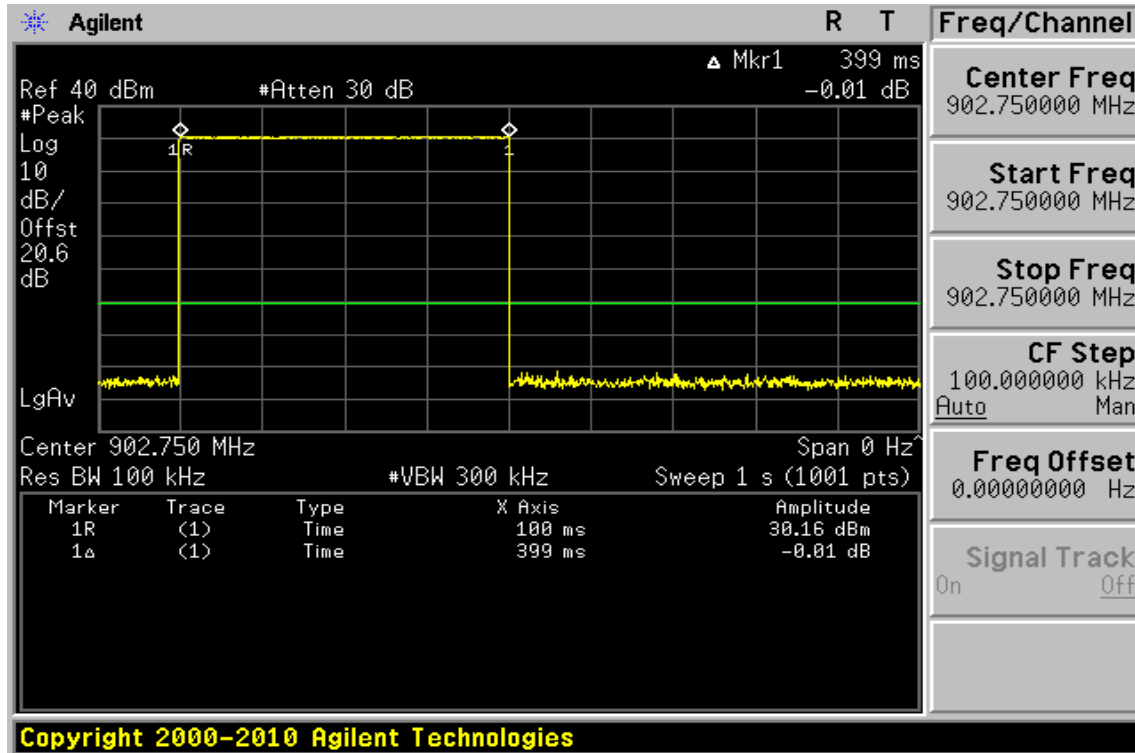
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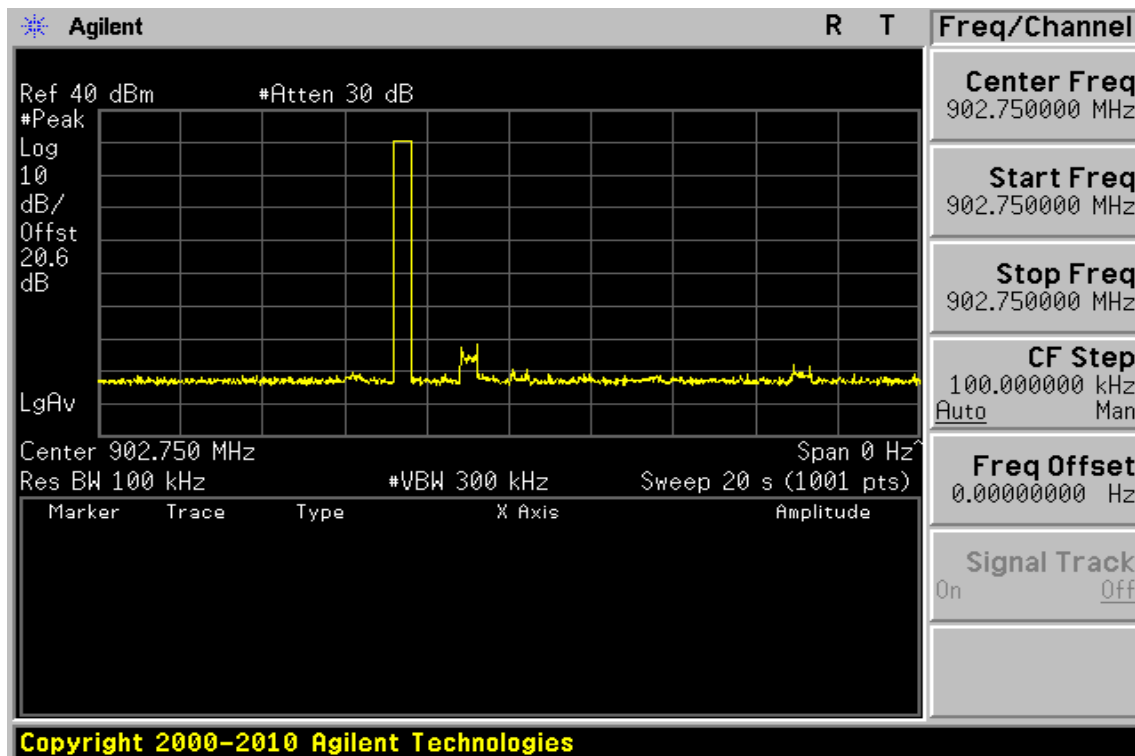
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Length of transmission time



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.

~ End of Report ~

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