

FCC Test Report

Product Name	RFID Reader
Model No.	BF-IDU02
FCC ID.	2AGZY-BFIDU02

Applicant	Balluff GmbH
Address	Schurwaldstrasse 9, 73765 Neuhausen a.d.F., Germany

Date of Receipt	Oct. 26, 2016
Issued Date	Dec. 22, 2016
Report No.	16B0008R-RFUSP02V00
Report Version	V1.0



The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration report of the equipment and evaluated measurement uncertainty herein.

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Test Report

Issued Date: Dec. 22, 2016

Report No.: 16B0008R-RFUSP02V00



Product Name	RFID Reader
Applicant	Balluff GmbH
Address	Schurwaldstrasse 9, 73765 Neuhausen a.d.F., Germany
Manufacturer	Balluff GmbH
Model No.	BF-IDU02
FCC ID.	2AGZY-BFIDU02
EUT Rated Voltage	DC 24V
EUT Test Voltage	DC 24V
Trade Name	BALLUFF
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C: 2014 ANSI C63.4: 2014, ANSI C63.10: 2013
Test Result	Complied

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(Engineer / Kevin Liu)

Approved By : Vincent Lin
(Director / Vincent Lin)

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1. GENERAL INFORMATION

1.1. EUT Description

Product Name	RFID Reader
Trade Name	BALLUFF
Model No.	BF-IDU02
FCC ID.	2AGZY-BFIDU02
Frequency Range	902.25 – 927.75MHz
Channel Number	52
Type of Modulation	PSK
Antenna Type	LHCP Embedded Antenna
Channel Control	Auto
Antenna Gain	Refer to the table “Antenna List”
M12 Cable	Non-Shielded, 0.7m

Antenna List

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	Mti	MT – 241026/SLH/C	LHCP Embedded Antenna	1.35dBi for 865MHz-956MHz

Note:

1. The antenna of EUT conforms to FCC 15.203.

Center Frequency of Each Channel:

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 01:	902.25 MHz	Channel 14:	908.75 MHz	Channel 27:	915.25 MHz	Channel 40:	921.75 MHz
Channel 02:	902.75 MHz	Channel 15:	909.25 MHz	Channel 28:	915.75 MHz	Channel 41:	922.25 MHz
Channel 03:	903.25 MHz	Channel 16:	909.75 MHz	Channel 29:	916.25 MHz	Channel 42:	922.75 MHz
Channel 04:	903.75 MHz	Channel 17:	910.25 MHz	Channel 30:	916.75 MHz	Channel 43:	923.25 MHz
Channel 05:	904.25 MHz	Channel 18:	910.75 MHz	Channel 31:	917.25 MHz	Channel 44:	923.75 MHz
Channel 06:	904.75 MHz	Channel 19:	911.25 MHz	Channel 32:	917.75 MHz	Channel 45:	924.25 MHz
Channel 07:	905.25 MHz	Channel 20:	911.75 MHz	Channel 33:	918.25 MHz	Channel 46:	924.75 MHz
Channel 08:	905.75 MHz	Channel 21:	912.25 MHz	Channel 34:	918.75 MHz	Channel 47:	925.25 MHz
Channel 09:	906.25 MHz	Channel 22:	912.75 MHz	Channel 35:	919.25 MHz	Channel 48:	925.75 MHz
Channel 10:	906.75 MHz	Channel 23:	913.25 MHz	Channel 36:	919.75 MHz	Channel 49:	926.25 MHz
Channel 11:	907.25 MHz	Channel 24:	913.75 MHz	Channel 37:	920.25 MHz	Channel 50:	926.75 MHz
Channel 12:	907.75 MHz	Channel 25:	914.25 MHz	Channel 38:	920.75 MHz	Channel 51:	927.25 MHz
Channel 13:	908.25 MHz	Channel 26:	914.75 MHz	Channel 39:	921.25 MHz	Channel 52:	927.75 MHz

Note:

1. The EUT is a RFID Reader with a built-in 902-928MHz FHSS transceiver.
2. These tests were conducted on a sample for the purpose of demonstrating compliance of 902-928MHz transmitter with Part 15 Subpart C Paragraph 15.247 for spread spectrum devices.
3. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test.

Test Mode	Mode 1: Transmit
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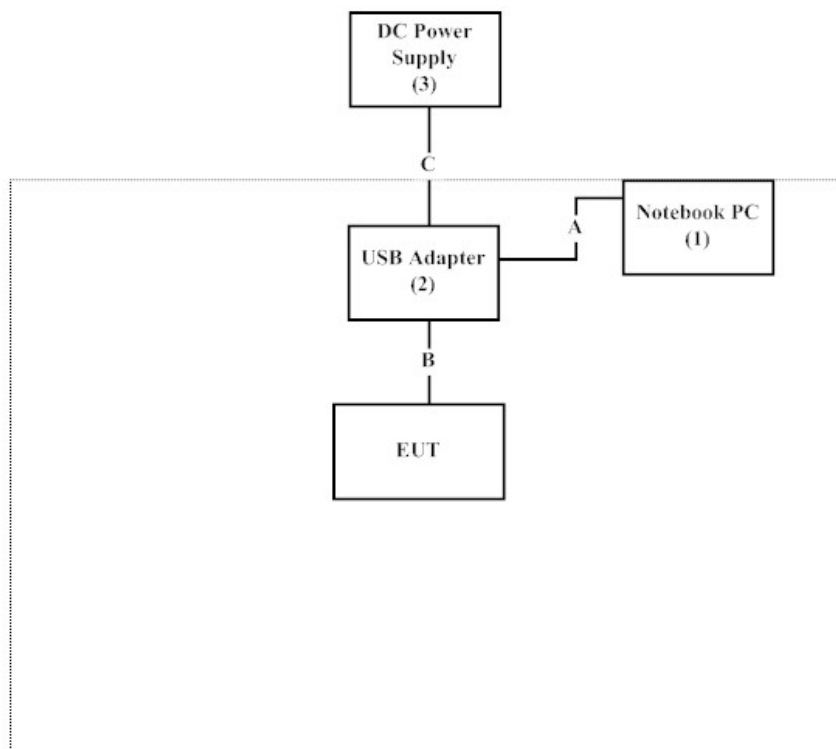
1.3. Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product	Manufacturer	Model No.	Serial No.	Power Cord	
1	Notebook PC	ASUS	S1300	24NP035390	Non-Shielded, 1.8m
2	USB Adapter	MOXA	N/A	N/A	N/A
3	DC Power Supply	GW	GPC-6030D	D921006	Non-Shielded, 1.8m

Signal Cable Type	Signal cable Description
A	USB Cable
B	M12 Cable
C	M12 Cable

1.4. Configuration of Tested System



1.5. EUT Exercise Software

1. Setup the EUT as shown in Section 1.4.
2. Execute software “Ralink MP Tool” on the EUT.
3. Configure the test mode, the test channel, and the data rate.
4. Press “OK” to start the continuous Transmit.
5. Verify that the EUT works properly.

1.6. Test Facility

Ambient conditions in the laboratory:

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	20-35
Humidity (%RH)	25-75	30-65
Barometric pressure (mbar)	860-1060	950-1000

The related certificate for our laboratories about the test site and management system can be downloaded from

Quietek Corporation's Web Site: <http://www.quietek.com/chinese/about/certificates.aspx?bval=5>

The address and introduction of Quietek Corporation's laboratories can be founded in our Web site:

<http://www.quietek.com/>

Site Description: File on
 Federal Communications Commission
 FCC Engineering Laboratory
 7435 Oakland Mills Road
 Columbia, MD 21046
 Registration Number: 92195

Site Name: Quietek Corporation
 Site Address: No.159, Sec. 2, Wenhua 1st Rd., Linkou Dist.,
 New Taipei City 24457, Taiwan.
 TEL: 886-2-2602-7968 / FAX : 866-2-2602-3286
 E-Mail : service@quietek.com

FCC Accreditation Number: TW1014

1.7. List of Test Equipment

For Conduction measurements /ASR1

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Data	Due. Data
X	EMI Test Receiver	R&S	ESR7	161601	2015.12.17	2016.12.16
X	Two-Line V-Network	R&S	ENV216	101306	2016.02.09	2017.02.08
X	Two-Line V-Network	R&S	ENV216	101307	2016.02.09	2017.02.08
X	Coaxial Cable	Quietek	RG400_BNC	RF001	2016.05.25	2017.05.24

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version : Quietek EMI 2.0 V2.1.113

For Conducted measurements /ASR4

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Data	Due. Data
X	Spectrum Analyzer	R&S	FSV30	103464	2015.12.04	2016.12.03
X	Spectrum Analyzer	R&S	FSV40	101146	2016.12.14	2017.12.13
X	Power Meter	Anritsu	ML2496A	1548003	2015.12.04	2016.12.03
X	Power Sensor	Anritsu	MA2411B	1531024	2015.12.10	2016.12.09
X	Power Sensor	Anritsu	MA2411B	1531025	2015.12.09	2016.12.08
	Bluetooth Tester	R&S	CBT	101238	2015.12.18	2016.12.17

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version : Quietek Conduction Test System V8.0.110

For Radiated measurements /ACB1

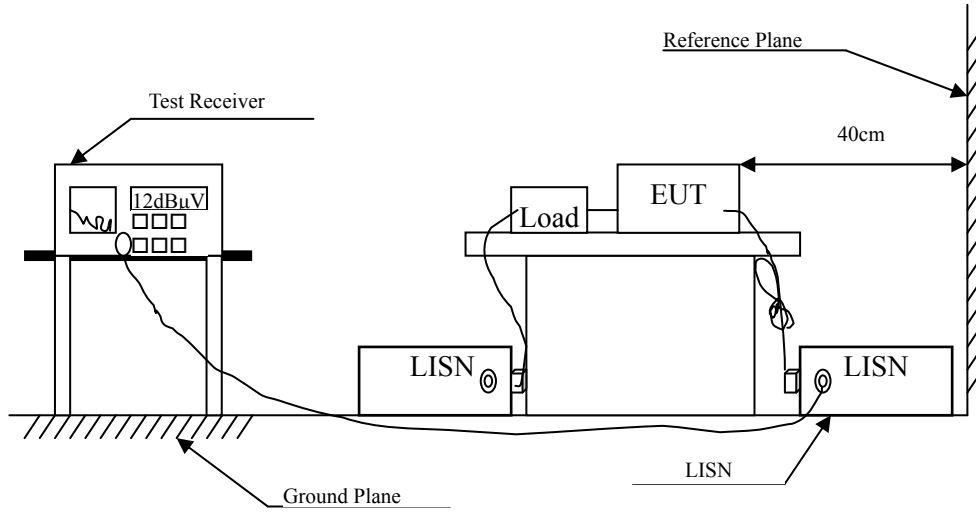
	Equipment	Manufacturer	Model No.	Serial No.	Cali. Data	Due. Data
X	Loop Antenna	A.H.	SAS-562B	272	2016.07.21	2017.07.20
X	Bi-Log Antenna	SCHWARZBECK	VULB9168	9168-674	2016.02.20	2017.02.19
X	Horn Antenna	ETS-Lindgren	3117	00203800	2016.10.13	2017.10.12
X	Horn Antenna	Com-Power	AH-840	101087	2016.05.03	2017.05.02
X	Pre-Amplifier	EMCI	EMC001330	980316	2016.04.27	2017.04.26
X	Pre-Amplifier	EMCI	EMC051835SE	980311	2016.04.27	2017.04.26
X	Pre-Amplifier	EMCI	EMC05820SE	980310	2016.04.28	2017.04.27
X	Pre-Amplifier	EMCI	EMC184045SE	980314	2016.05.12	2017.05.11
X	Filter	MICRO TRONICS	BRM50702	G251	2016.08.11	2017.08.10
	Filter	MICRO TRONICS	BRM50716	G188	2016.08.11	2017.08.10
X	EMI Test Receiver	R&S	ESR7	101602	2015.12.16	2016.12.15
X	Spectrum Analyzer	R&S	FSV40	101146	2016.12.14	2017.12.13
X	Spectrum Analyzer	R&S	FSV40	101149	2015.12.04	2016.12.03
X	Coaxial Cable	SUHNER	SUCOFLEX 106	RF002	2016.05.25	2017.05.24
X	Mircoflex Cable	HUBER SUHNER	SUCOFLEX 102	MY3381/2	2016.08.11	2017.08.10

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version : Quietek EMI 2.0 V2.1.113

2. Conducted Emission

2.1. Test Setup



2.2. Limits

FCC Part 15 Subpart C Paragraph 15.207 (dBµV) Limit		
Frequency MHz	Limits	
	QP	AV
0.15 - 0.50	66-56	56-46
0.50-5.0	56	46
5.0 - 30	60	50

Remarks: In the above table, the tighter limit applies at the band edges.

2.3. Test Procedure

The EUT and Peripherals are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all the interface cables must be changed according to ANSI C63.4: 2014 on conducted measurement.

Conducted emissions were investigated over the frequency range from 0.15MHz to 3 MHz using a receiver bandwidth of 9kHz.

The EUT was setup to ANSI C63.4, 2014; tested to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements.

2.4. Uncertainty

± 2.35 dB

2.5. Test Result of Conducted Emission

Product : RFID Reader
 Test Item : Conducted Emission Test
 Power Line : Line 1
 Test Date : 2016/09/01
 Test Mode : Mode 1: Transmit (915.25MHz)

Frequency MHz	Correct Factor dB	Reading Level dBμV	Measurement Level dBμV	Margin dB	Limit dBμV
LINE 1					
Quasi-Peak					
0.159	9.705	34.887	44.592	-21.151	65.743
0.501	9.737	27.019	36.757	-19.243	56.000
0.836	9.750	20.567	30.317	-25.683	56.000
1.115	9.754	11.972	21.726	-34.274	56.000
2.731	9.819	27.406	37.225	-18.775	56.000
10.190	10.002	20.187	30.189	-29.811	60.000
Average					
0.159	9.705	34.887	44.592	-21.151	65.743
0.501	9.737	27.019	36.757	-19.243	56.000
0.836	9.750	20.567	30.317	-25.683	56.000
1.115	9.754	11.972	21.726	-34.274	56.000
2.731	9.819	27.406	37.225	-18.775	56.000
10.190	10.002	20.187	30.189	-29.811	60.000

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. "█" means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

Product : RFID Reader
 Test Item : Conducted Emission Test
 Power Line : Line 2
 Test Date : 2016/09/01
 Test Mode : Mode 1: Transmit (915.25MHz)

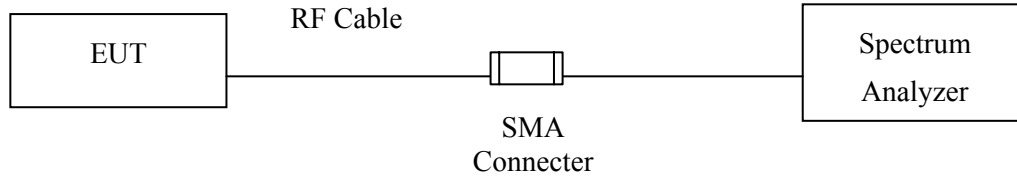
Frequency MHz	Correct Factor dB	Reading Level dBμV	Measurement Level dBμV	Margin dB	Limit dBμV
LINE 2					
Quasi-Peak					
0.157	9.697	34.873	44.571	-21.229	65.800
0.503	9.728	23.204	32.933	-23.067	56.000
0.821	9.752	20.290	30.041	-25.959	56.000
2.310	9.805	22.248	32.053	-23.947	56.000
2.735	9.819	25.664	35.483	-20.517	56.000
3.439	9.843	23.335	33.179	-22.821	56.000
Average					
0.157	9.697	23.976	33.673	-22.127	55.800
0.503	9.728	15.702	25.431	-20.569	46.000
0.821	9.752	14.946	24.698	-21.302	46.000
2.310	9.805	16.010	25.815	-20.185	46.000
2.735	9.819	20.053	29.872	-16.128	46.000
3.439	9.843	14.086	23.930	-22.070	46.000

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. "█" means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

3. Occupied Bandwidth

3.1. Test Setup



3.2. Limits

According to FCC Section 15.247(a)(1)(i). The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz

3.3. Test Procedure

The EUT was setup to ANSI C63.4, 2014; tested to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements.

3.4. Uncertainty

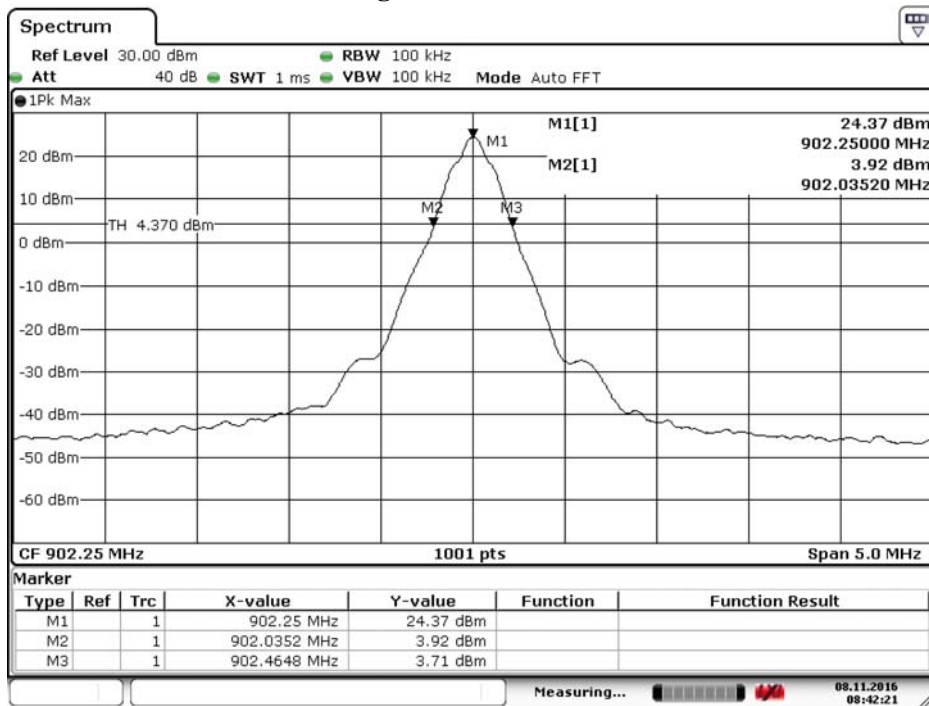
$\pm 279.2\text{Hz}$

3.5. Test Result of Occupied Bandwidth

Product : RFID Reader
 Test Item : Occupied Bandwidth Data
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit

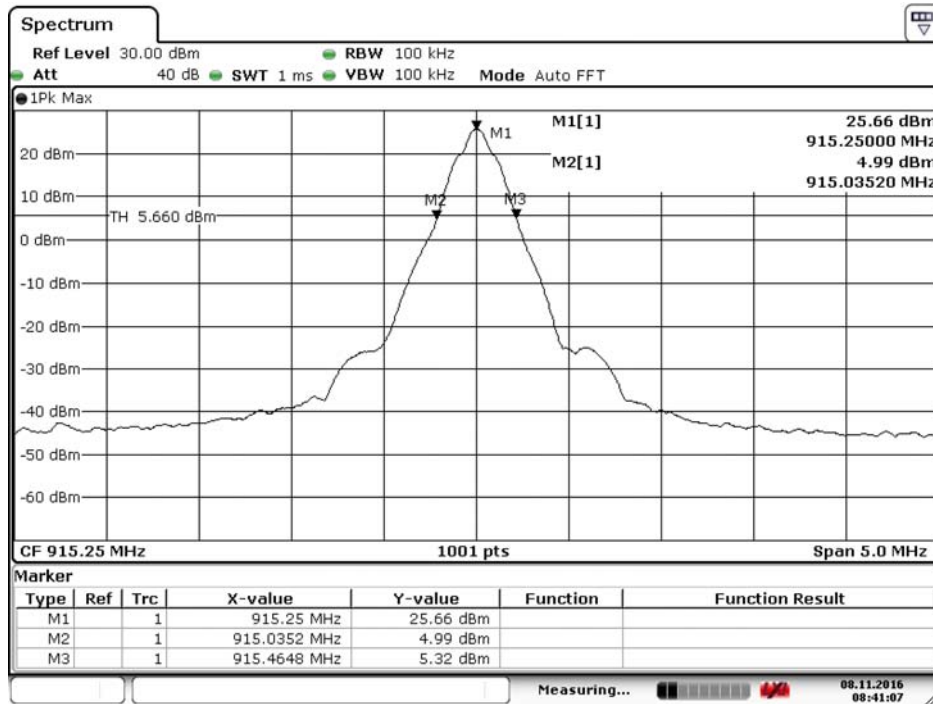
Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
01	902.25	429.6	<500	PASS
27	915.25	429.6	<500	PASS
52	927.75	429.6	<500	PASS

Figure Channel 01:



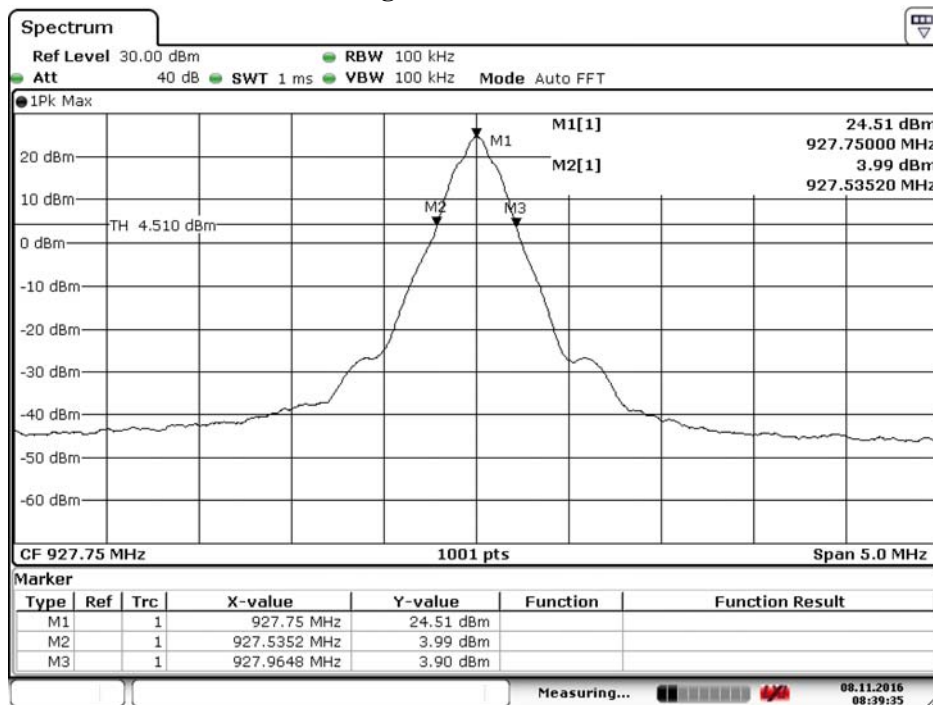
Date: 8.NOV.2016 08:42:22

Figure Channel 27:



Date: 8.NOV.2016 08:41:07

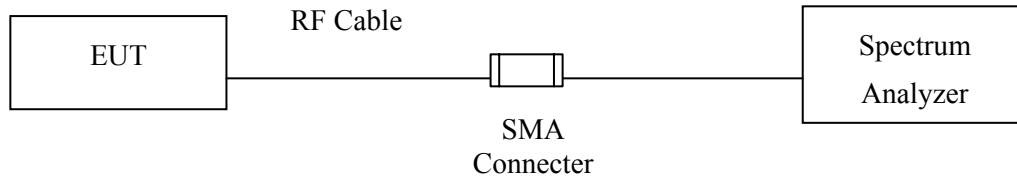
Figure Channel 52:



Date: 8.NOV.2016 08:39:35

4. Channel Number

4.1. Test Setup



4.2. Limit

According to FCC Section 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; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

4.3. Test Procedure

The EUT was setup to ANSI C63.4, 2014; tested to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements.

4.4. Uncertainty

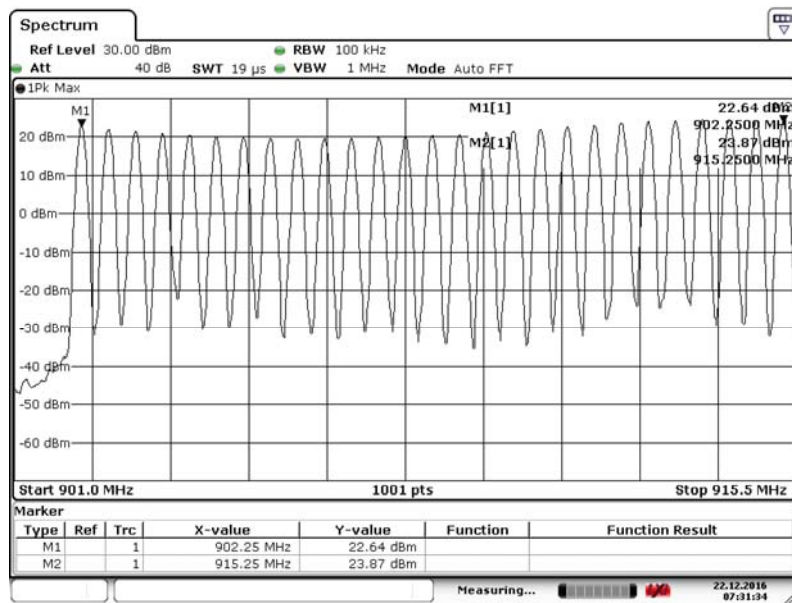
N/A

4.5. Test Result of Channel Number

Product : RFID Reader
 Test Item : Channel Number
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit

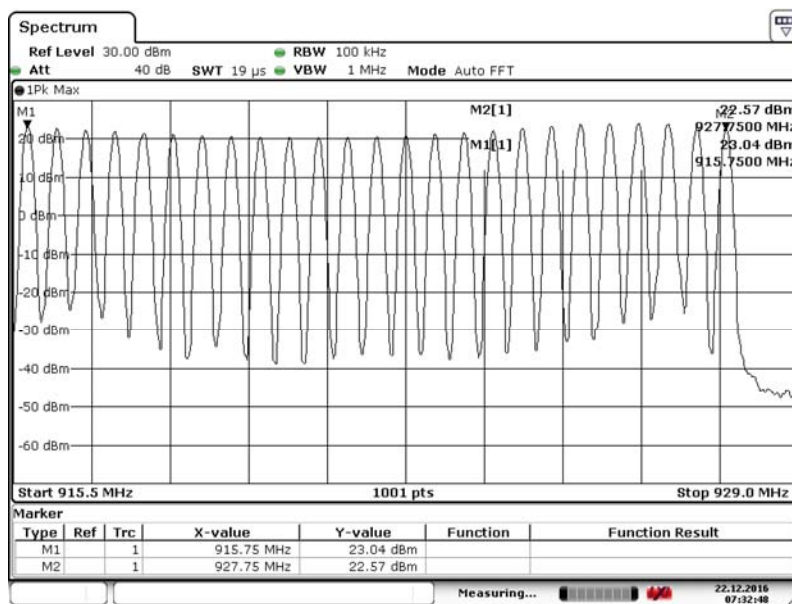
Frequency Range (MHz)	Measurement (Hopping Channel)	Required Limit (Hopping Channel)	Result
902.25 ~ 927.75	52	>25	Pass

902.25-915.25MHz



Date: 22.DEC.2016 07:31:34

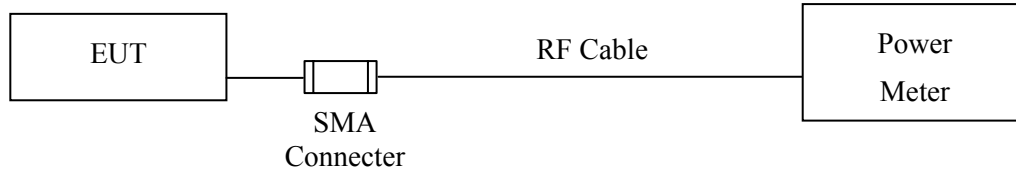
902.25-915.25MHz



Date: 22.DEC.2016 07:32:49

5. Peak Power Output

5.1. Test Setup



5.2. Limit

According to FCC Section 15.247(b)(2). For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

5.3. Test Procedure

The EUT was setup to ANSI C63.4, 2014; tested to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements.

5.4. Uncertainty

± 0.86 dB

5.5. Test Result of Peak Power Output

Product : RFID Reader
 Test Item : Peak Power Output
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit

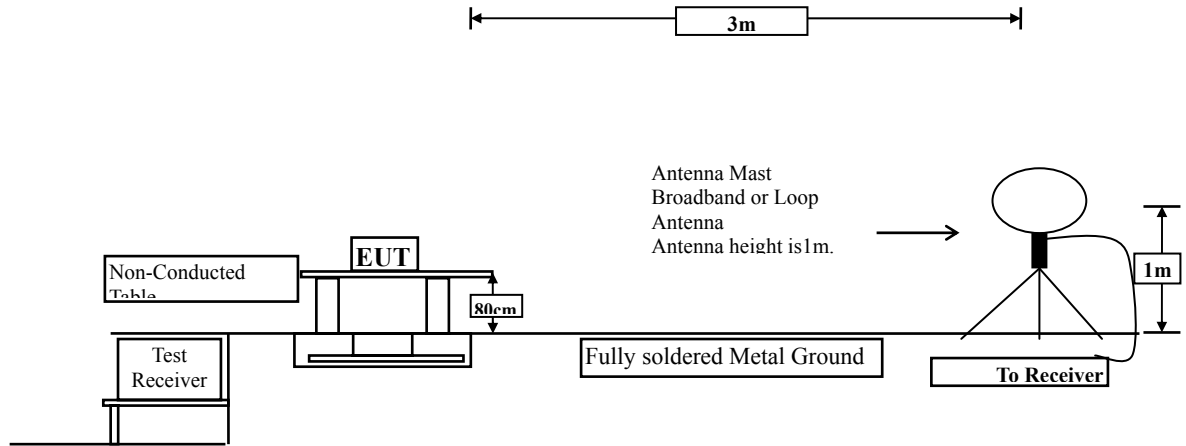
Channel No.	Frequency (MHz)	Measurement (dBm)	Required Limit	Result
Channel 01	902.25	25.49	1 Watt= 30 dBm	Pass
Channel 27	915.25	25.58	1 Watt= 30 dBm	Pass
Channel 52	927.75	25.50	1 Watt= 30 dBm	Pass

Note: Peak Power Output Value =Reading value on power meter + cable loss

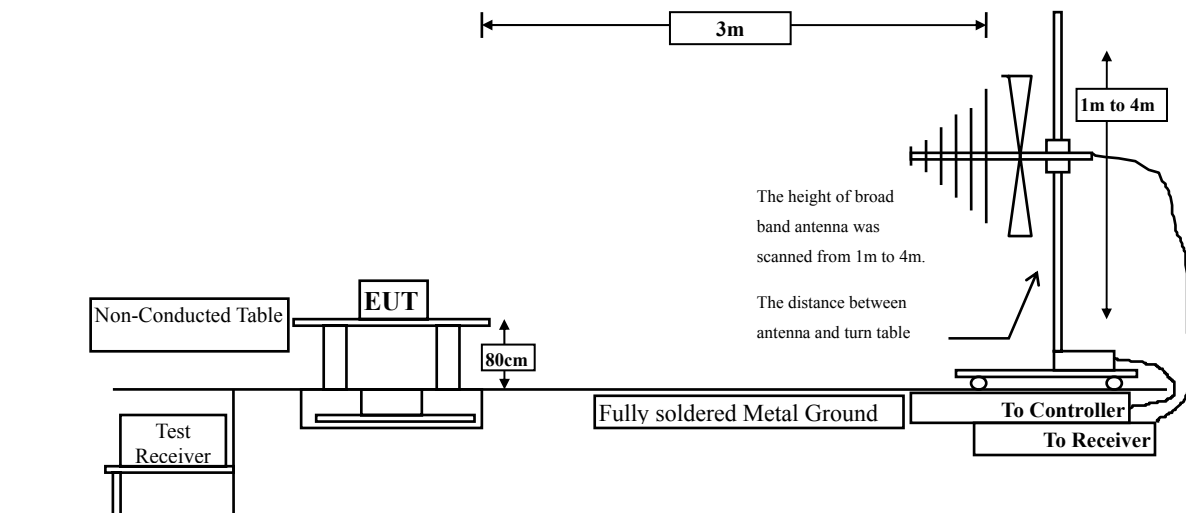
6. Radiated Emission

6.1. Test Setup

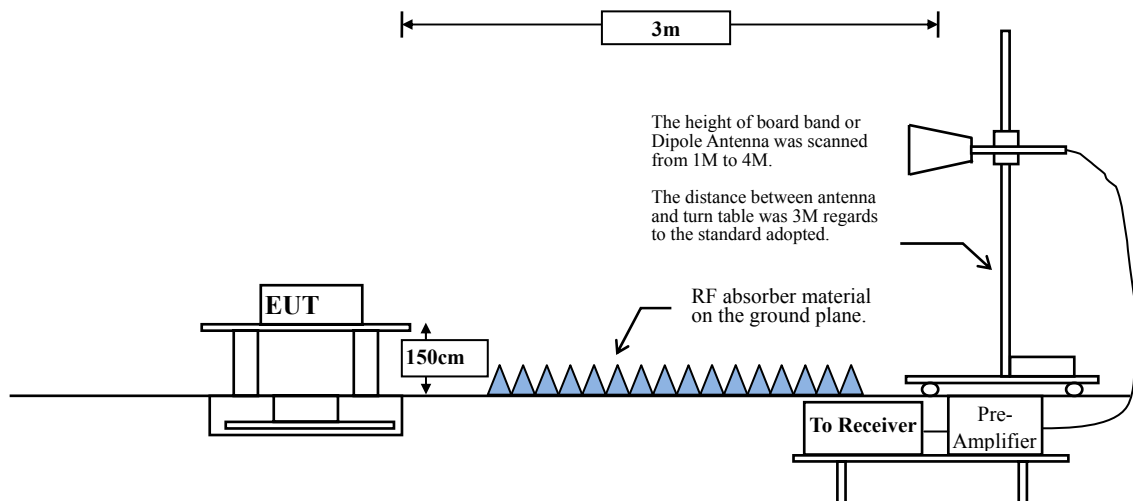
Radiated Emission Under 30MHz



Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



6.2. Limits

➤ **General Radiated Emission Limits**

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209 Limits		
Frequency MHz	uV/m @3m	dBµV/m@3m
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

- Remarks:
1. RF Voltage (dBµV) = 20 log RF Voltage (uV)
 2. In the Above Table, the tighter limit applies at the band edges.
 3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

6.3. Test Procedure

The EUT was setup according to ANSI C63.10, 2013 and tested compliance to FCC 47CFR 15.247 requirements.

Measuring the frequency range below 1GHz, the EUT is placed on a turn table which is 0.8 meter above ground, when measuring the frequency range above 1GHz, the EUT is placed on a turn table which is 1.5 meter above ground.

The turn table is rotated 360 degrees to determine the position of the maximum emission level.

The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned between 1 meter and 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10: 2013 on radiated measurement.

The resolution bandwidth below 3 MHz setting on the field strength meter is 9kHz and 3 MHz~1GHz is 120kHz and above 1GHz is 1MHz.

Radiated emission measurements below 3 MHz are made using Loop Antenna and 3 MHz~1GHz are made using broadband Bilog antenna and above 1GHz are made using Horn Antennas.

The measurement is divided into the Preliminary Measurement and the Final Measurement.

The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna.

The worst radiated emission is measured in the Open Area Test Site on the Final Measurement.

The measurement frequency range from 9kHz - 10th Harmonic of fundamental was investigated.

6.4. Uncertainty

Horizontal :

30-300MHz: ± 4.08 dB ; 300M-1GHz: ± 3.86 dB ; 1-18GHz: ± 3.77 dB ; 18-40GHz: ± 3.98 dB ◦

Vertical :

30-300MHz: ± 4.81 dB ; 300M-1GHz: ± 3.87 dB ; 1-18GHz: ± 3.83 dB ; 18-40GHz: ± 3.98 dB ◦

6.5. Test Result of Radiated Emission

Product : RFID Reader
 Test Item : Harmonic Radiated Emission
 Test Site : No.3 OATS
 Test Date : 2016/12/02
 Test Mode : Mode 1: Transmit(902.25MHz)

Frequency MHz	Correct Factor dB	Reading Level dBµV	Measurement Level dBµV/m	Margin dB	Limit dBµV/m
Horizontal					
Peak Detector:					
1804.500	-8.941	57.650	48.709	-25.291	74.000
2706.750	-6.150	45.920	39.770	-34.230	74.000
3609.000	-5.514	45.730	40.217	-33.783	74.000
4511.250	-3.904	45.380	41.476	-32.524	74.000
5413.500	-3.171	45.620	42.450	-31.550	74.000
6315.750	-1.524	44.860	43.336	-30.664	74.000
7218.000	-0.773	44.930	44.156	-29.844	74.000
8120.250	-0.380	44.940	44.560	-29.440	74.000
9022.500	0.382	44.940	45.322	-28.678	74.000
Average Detector:					
--	--	--	--	--	54.000
Vertical					
Peak Detector:					
1804.500	-8.941	55.100	46.159	-27.841	74.000
2706.750	-6.150	46.180	40.030	-33.970	74.000
3609.000	-5.514	45.760	40.247	-33.753	74.000
4511.250	-3.904	45.240	41.336	-32.664	74.000
5413.500	-3.171	45.450	42.280	-31.720	74.000
6315.750	-1.524	44.770	43.246	-30.754	74.000
7218.000	-0.773	45.520	44.746	-29.254	74.000
8120.250	-0.380	45.650	45.270	-28.730	74.000
9022.500	0.382	45.510	45.892	-28.108	74.000
Average Detector:					
--	--	--	--	--	54.000

Note:

- All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
- Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
- Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
- Measurement Level = Reading Level + Correct Factor.
- Correct Factor = Antenna factor + Cable loss – Amplifier gain.
- The average measurement was not performed when the peak measured data under the limit of average detection.
- The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : RFID Reader
 Test Item : Harmonic Radiated Emission
 Test Site : No.3 OATS
 Test Date : 2016/12/02
 Test Mode : Mode 1: Transmit(915.25MHz)

Frequency MHz	Correct Factor dB	Reading Level dBμV	Measurement Level dBμV/m	Margin dB	Limit dBμV/m
Horizontal Peak Detector:					
1830.500	-8.744	55.770	47.026	-26.974	74.000
2745.750	-6.101	47.600	41.498	-32.502	74.000
3661.000	-5.467	45.970	40.502	-33.498	74.000
4576.250	-3.881	47.860	43.979	-30.021	74.000
5491.500	-3.066	45.110	42.043	-31.957	74.000
6406.750	-1.354	44.440	43.087	-30.913	74.000
7322.000	-0.713	45.500	44.787	-29.213	74.000
8237.250	-0.320	45.020	44.700	-29.300	74.000
9152.500	0.497	44.120	44.617	-29.383	74.000
Average Detector:					
--	--	--	--	--	54.000
Vertical Peak Detector:					
1830.500	-8.744	53.010	44.266	-29.734	74.000
2745.750	-6.101	46.780	40.678	-33.322	74.000
3661.000	-5.467	46.290	40.822	-33.178	74.000
4576.250	-3.881	47.150	43.269	-30.731	74.000
5491.500	-3.066	45.740	42.673	-31.327	74.000
6406.750	-1.354	44.320	42.967	-31.033	74.000
7322.000	-0.713	44.610	43.897	-30.103	74.000
8237.250	-0.320	45.220	44.900	-29.100	74.000
9152.500	0.497	44.190	44.687	-29.313	74.000
Average Detector:					
--	--	--	--	--	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : RFID Reader
 Test Item : Harmonic Radiated Emission
 Test Site : No.3 OATS
 Test Date : 2016/12/02
 Test Mode : Mode 1: Transmit(927.75MHz)

Frequency MHz	Correct Factor dB	Reading Level dB μ V	Measurement Level dB μ V/m	Margin dB	Limit dB μ V/m
Horizontal					
Peak Detector:					
1855.500	-8.560	52.840	44.280	-29.720	74.000
2783.250	-6.056	46.290	40.234	-33.766	74.000
3711.000	-5.438	45.880	40.443	-33.557	74.000
4638.750	-3.867	45.330	41.463	-32.537	74.000
5566.500	-2.929	47.180	44.250	-29.750	74.000
6494.250	-1.221	44.460	43.238	-30.762	74.000
7422.000	-0.659	44.740	44.080	-29.920	74.000
8349.750	-0.249	44.790	44.541	-29.459	74.000
9277.500	0.621	43.670	44.291	-29.709	74.000
Average Detector:					
--	--	--	--	--	54.000
Vertical					
Peak Detector:					
1855.500	-8.560	49.500	40.940	-33.060	74.000
2783.250	-6.056	48.120	42.064	-31.936	74.000
3711.000	-5.438	45.760	40.323	-33.677	74.000
4638.750	-3.867	45.420	41.553	-32.447	74.000
5566.500	-2.929	46.550	43.620	-30.380	74.000
6494.250	-1.221	44.780	43.558	-30.442	74.000
7422.000	-0.659	44.770	44.110	-29.890	74.000
8349.750	-0.249	45.940	45.691	-28.309	74.000
9277.500	0.621	43.260	43.881	-30.119	74.000
Average Detector:					
--	--	--	--	--	54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : RFID Reader
 Test Item : General Radiated Emission
 Test Site : No.3 OATS
 Test Date : 2016/11/09
 Test Mode : Mode 1: Transmit (902.25MHz)

Frequency MHz	Correct Factor dB	Reading Level dB μ V	Measurement Level dB μ V/m	Margin dB	Limit dB μ V/m
Horizontal					
71.909	-13.945	49.197	35.252	-4.748	40.000
107.998	-14.620	49.515	34.895	-8.605	43.500
263.965	-11.521	49.881	38.360	-7.640	46.000
360.173	-8.733	47.998	39.265	-6.735	46.000
396.052	-7.876	47.552	39.675	-6.325	46.000
729.046	-1.847	39.177	37.330	-8.670	46.000
Vertical					
84.269	-16.417	52.944	36.527	-3.473	40.000
108.028	-14.615	51.407	36.792	-6.708	43.500
150.958	-10.911	42.270	31.359	-12.141	43.500
359.993	-8.738	44.295	35.558	-10.442	46.000
527.930	-5.339	37.414	32.075	-13.925	46.000
746.505	-1.508	40.268	38.760	-7.240	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : RFID Reader
 Test Item : General Radiated Emission
 Test Site : No.3 OATS
 Test Date : 2016/11/09
 Test Mode : Mode 1: Transmit (915.25MHz)

Frequency MHz	Correct Factor dB	Reading Level dBμV	Measurement Level dBμV/m	Margin dB	Limit dBμV/m
Horizontal					
53.610	-11.344	43.865	32.521	-7.479	40.000
108.028	-14.615	47.919	33.304	-10.196	43.500
263.995	-11.520	46.542	35.023	-10.977	46.000
360.413	-8.728	48.393	39.666	-6.334	46.000
396.082	-7.876	44.041	36.165	-9.835	46.000
859.633	-0.123	30.169	30.046	-15.954	46.000
Vertical					
107.878	-14.640	54.501	39.860	-3.640	43.500
359.993	-8.738	43.785	35.048	-10.952	46.000
408.022	-7.596	41.350	33.754	-12.246	46.000
528.770	-5.323	39.834	34.511	-11.489	46.000
959.981	1.109	30.907	32.016	-13.984	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : RFID Reader
 Test Item : General Radiated Emission
 Test Site : No.3 OATS
 Test Date : 2016/11/09
 Test Mode : Mode 1: Transmit (927.75MHz)

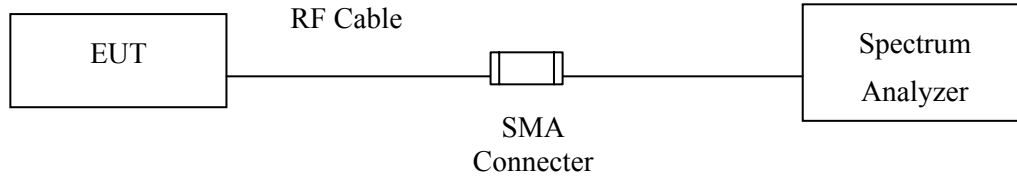
Frequency MHz	Correct Factor dB	Reading Level dBμV	Measurement Level dBμV/m	Margin dB	Limit dBμV/m
Horizontal					
71.939	-13.950	48.097	34.146	-5.854	40.000
263.965	-11.521	46.917	35.396	-10.604	46.000
335.964	-9.314	47.169	37.854	-8.146	46.000
348.083	-9.021	49.196	40.175	-5.825	46.000
360.053	-8.735	52.136	43.400	-2.600	46.000
938.441	0.854	30.003	30.857	-15.143	46.000
Vertical					
108.118	-14.599	55.525	40.926	-2.574	43.500
168.057	-10.962	42.500	31.538	-11.962	43.500
336.054	-9.312	41.284	31.971	-14.029	46.000
359.693	-8.744	45.235	36.491	-9.509	46.000
528.050	-5.337	36.932	31.595	-14.405	46.000
946.961	0.947	29.633	30.579	-15.421	46.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. Measurement Level = Reading Level + Correct Factor.
5. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The emission levels of other frequencies are very lower than the limit and not show in test report.

7. RF Antenna Conducted Test

7.1. Test Setup



7.2. Limits

According to FCC Section 15.247(d). 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 measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

7.3. Test Procedure

The EUT was setup to ANSI C63.4, 2014; tested to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements.

7.4. Uncertainty

$\pm 1.23\text{dB}$

7.5. Test Result of RF Antenna Conducted Test

Product : RFID Reader
 Test Item : RF Antenna Conducted Test
 Test Site : No.3 OATS
 Test Date : 2016/11/08
 Test Mode : Mode 1: Transmit

Figure Channel 01:

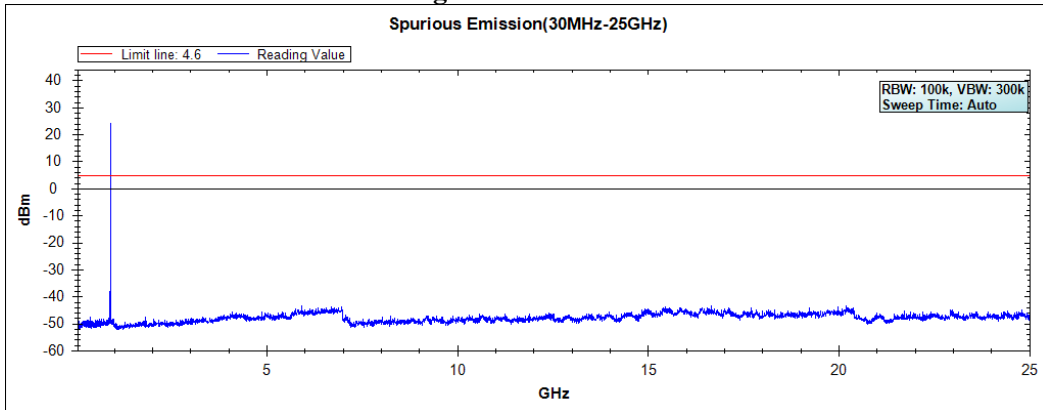


Figure Channel 27:

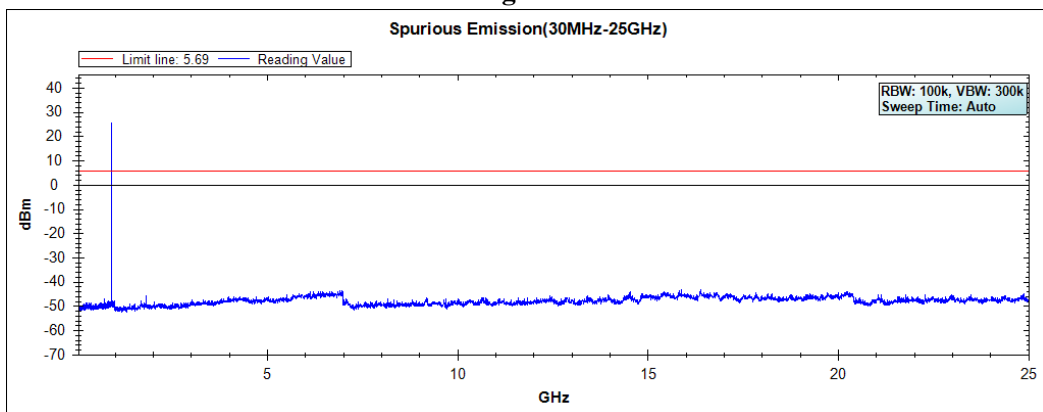
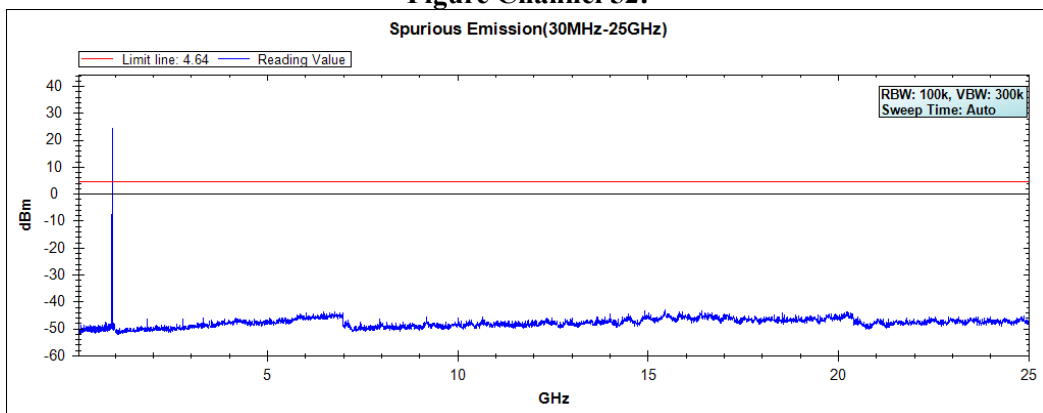


Figure Channel 52:

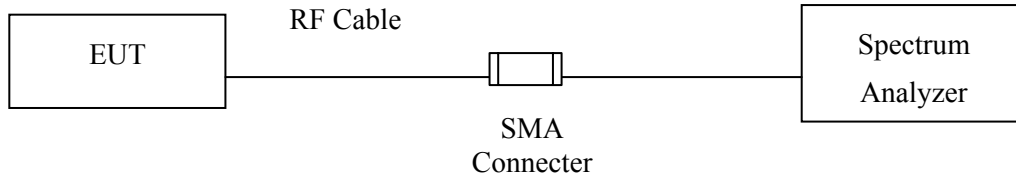


Note: The above test pattern is synthesized by multiple of the frequency range.

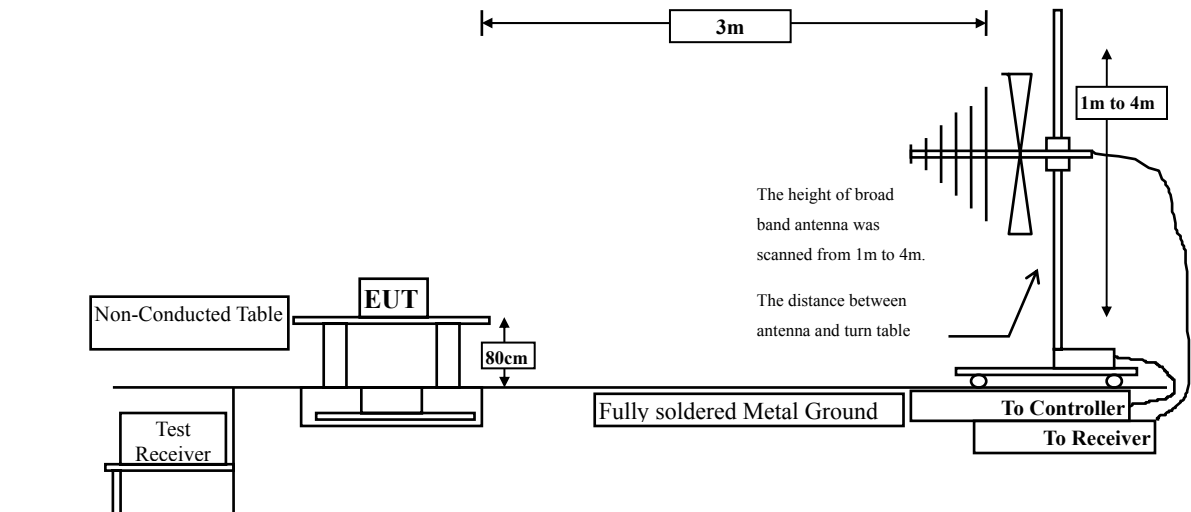
8. Band Edge

8.1. Test Setup

RF Conducted Measurement



RF Radiated Measurement



8.2. Limit

➤ General Radiated Emission Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209 Limits		
Frequency MHz	uV/m @3m	dBµV/m@3m
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

- Remarks:
1. RF Voltage (dBµV) = 20 log RF Voltage (uV)
 2. In the Above Table, the tighter limit applies at the band edges.
 3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

8.3. Test Procedure

The EUT is placed on a turn table which is 0.8 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.10: 2013 on radiated measurement.

The bandwidth setting below 1GHz and above 1GHz on the field strength meter is 120 kHz and 1MHz, respectively.

8.4. Uncertainty

Conducted: $\pm 1.23\text{dB}$

Radiated:

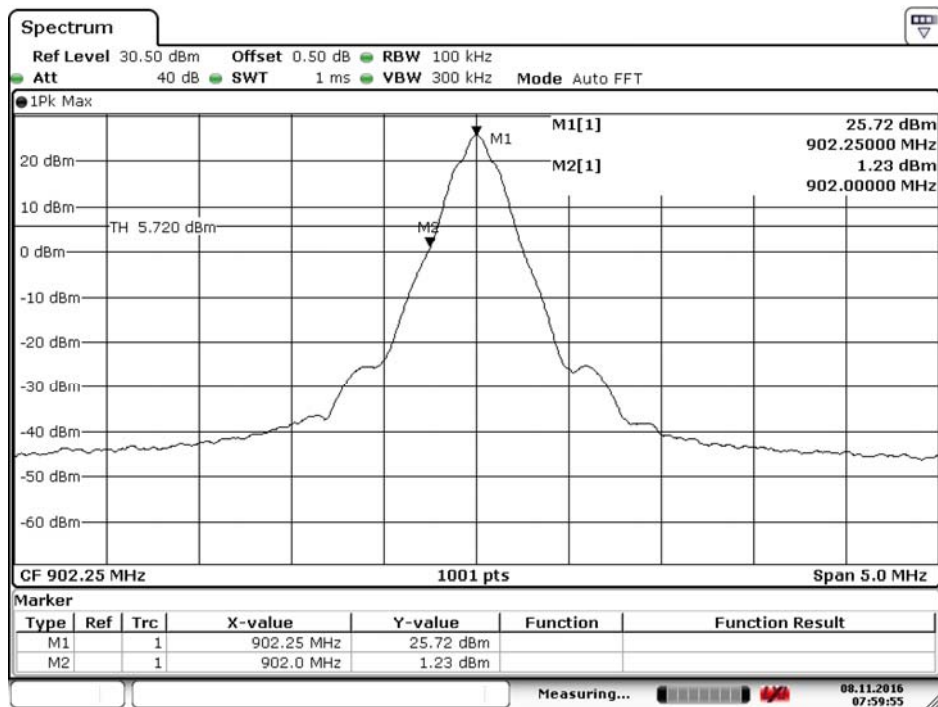
Horizontal polarization : 30-300MHz: $\pm 4.08\text{dB}$; 300M-1GHz: $\pm 3.86\text{dB}$

Vertical polarization : 30-300MHz: $\pm 4.81\text{dB}$; 300M-1GHz

8.5. Test Result of Band Edge

Product : RFID Reader
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit (902.25MHz)

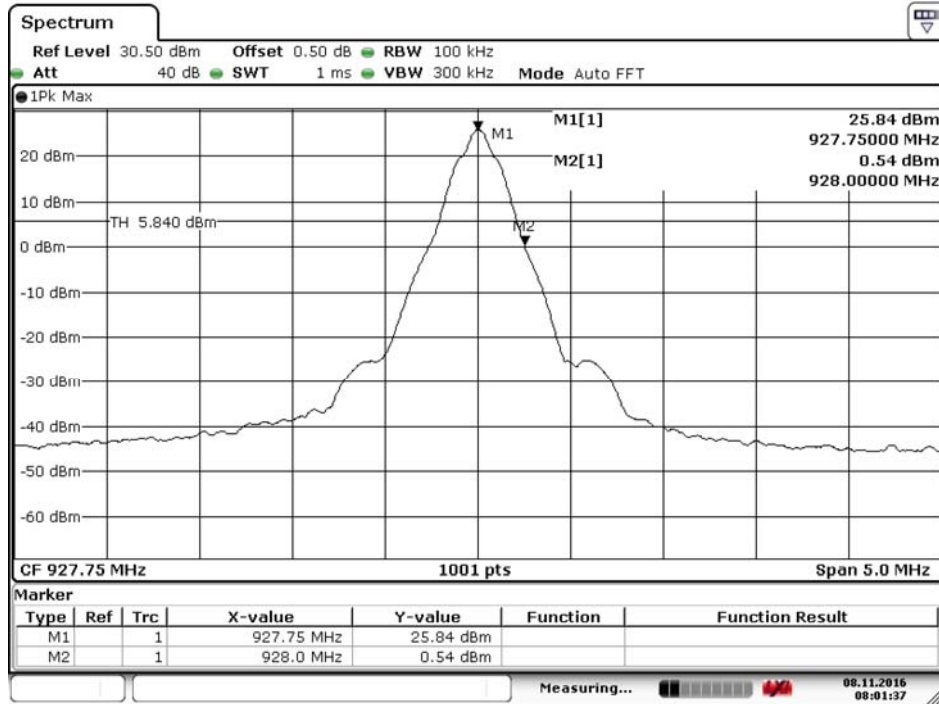
Test Frequency (MHz)	Measurement Level Δ (dB)	Limit Δ (dB)	Result
902	24.49	>20	PASS



Date: 8.NOV.2016 07:59:55

Product : RFID Reader
 Test Item : Band Edge
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit (927.75MHz)

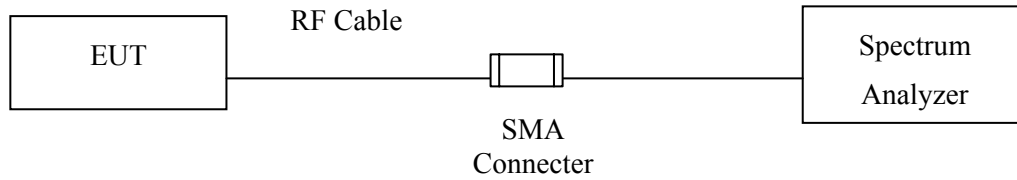
Test Frequency (MHz)	Measurement Level Δ (dB)	Limit Δ (dB)	Result
928	25.3	>20	PASS



Date: 8.NOV.2016 08:01:38

9. Channel Separation

9.1. Test Setup



9.2. Limit

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

9.3. Test Procedure

The EUT was setup to ANSI C63.4, 2014; tested to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements.

9.4. Uncertainty

$\pm 279.2\text{Hz}$

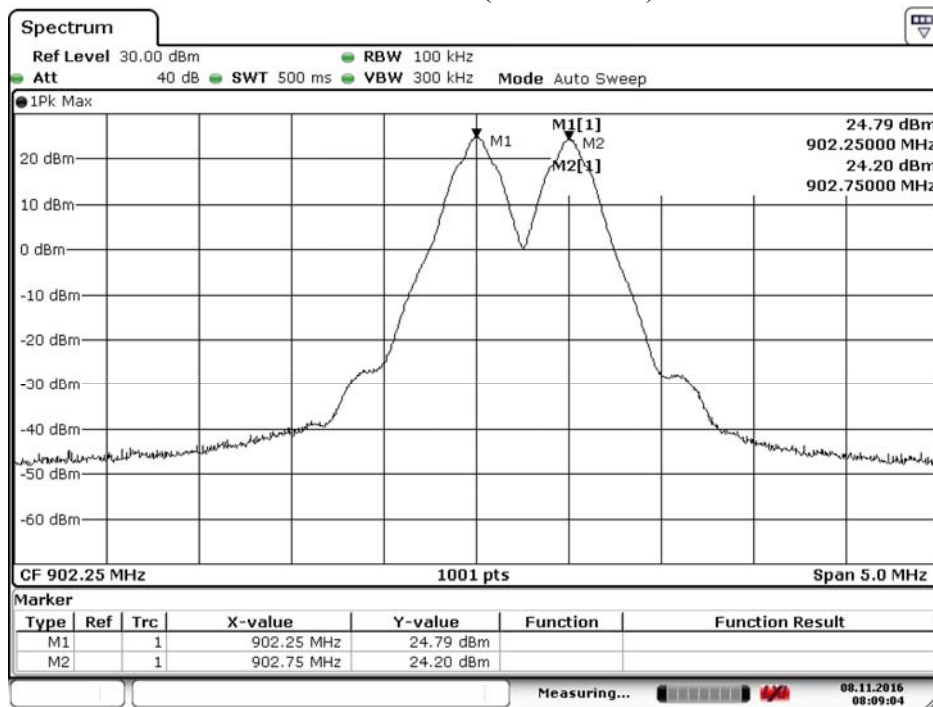
9.5. Test Result of Channel Separation

Product : RFID Reader
 Test Item : Channel Separation
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Limit (kHz)	Limit of 20dB Bandwidth (kHz)	Result
01	902.25	500	>25 kHz	429.6	Pass
27	915.25	500	>25 kHz	429.6	Pass
52	927.75	500	>25 kHz	429.6	Pass

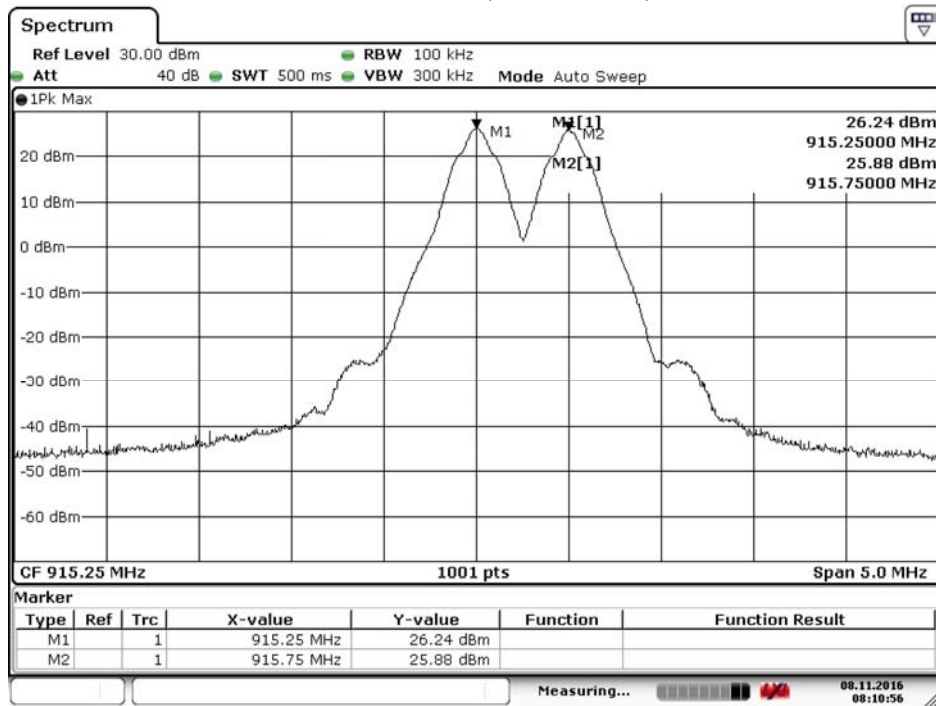
NOTE: The 20dB Bandwidth is refer to section 3.

Channel 01 (902.25MHz)



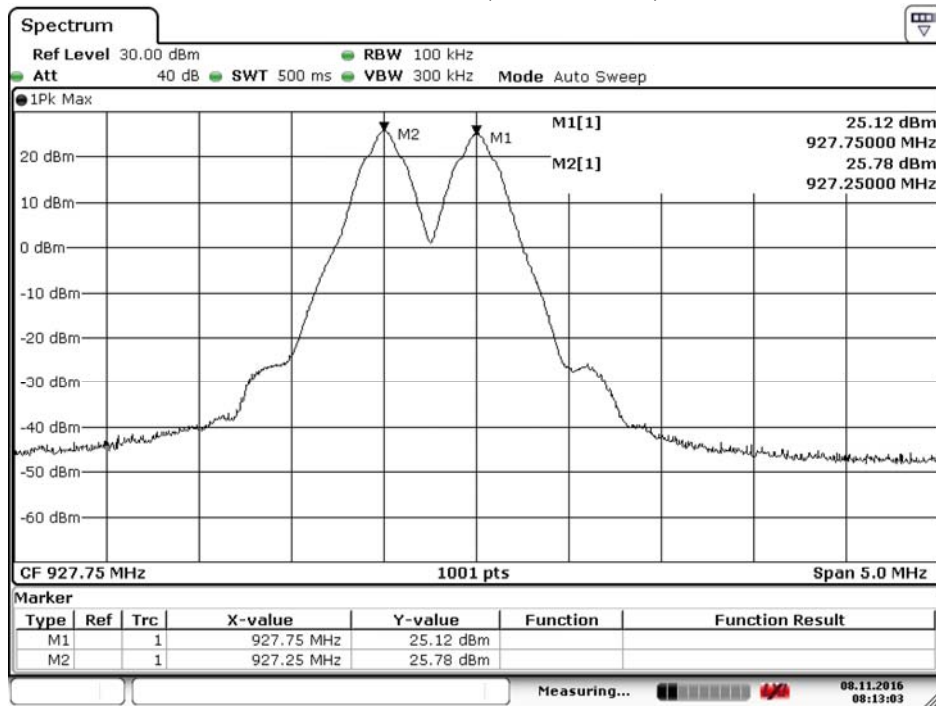
Date: 8.NOV.2016 08:09:03

Channel 27 (915.25MHz)



Date: 8.NOV.2016 08:10:56

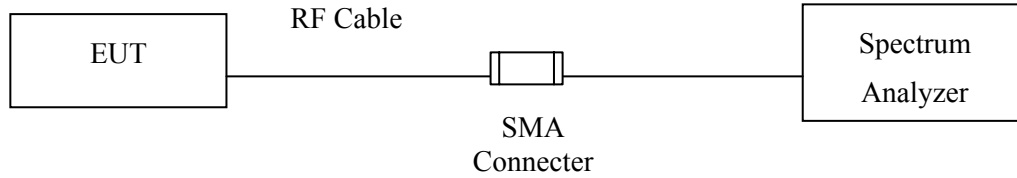
Channel 52 (927.75 MHz)



Date: 8.NOV.2016 08:13:03

10. Dwell Time

10.1. Test Setup



10.2. Limit

According to FCC Section 15.247(a)(1)(i). 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.

10.3. Test Procedure

The EUT was setup to ANSI C63.4, 2014; tested to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements.

10.4. Uncertainty

$\pm 2.31\text{msec}$

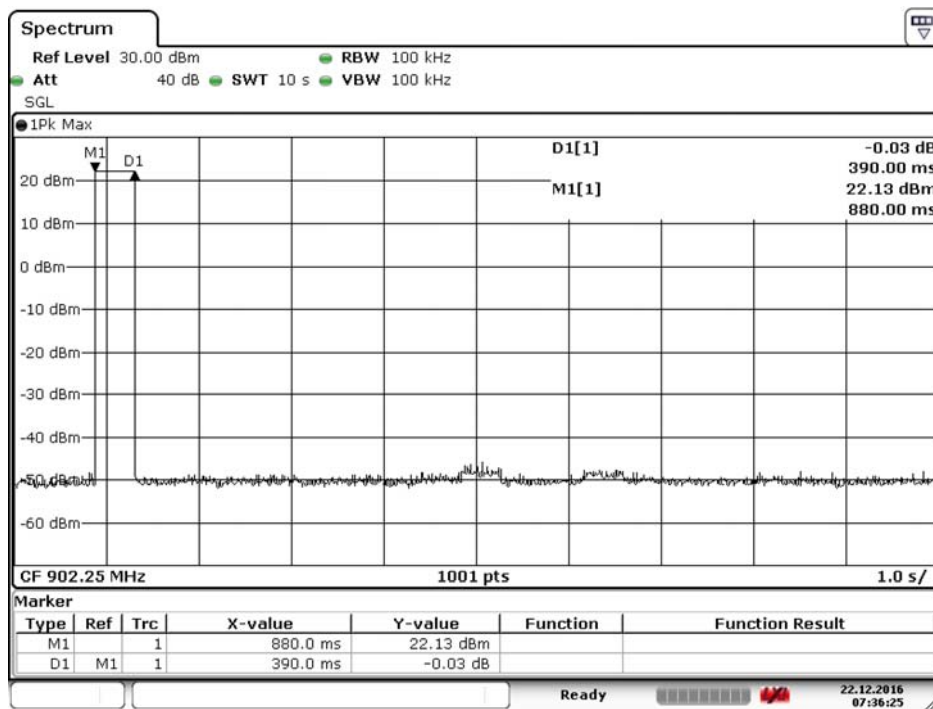
10.5. Test Result of Dwell Time

Product : RFID Reader
 Test Item : Dwell Time
 Test Site : No.3 OATS
 Test Mode : Mode 1: Transmit

Frequency (MHz)	Dwell Time (Sec)	Limit (Sec)	Result
902.25	0.390	0.4	Pass
915.25	0.390	0.4	Pass
927.75	0.390	0.4	Pass

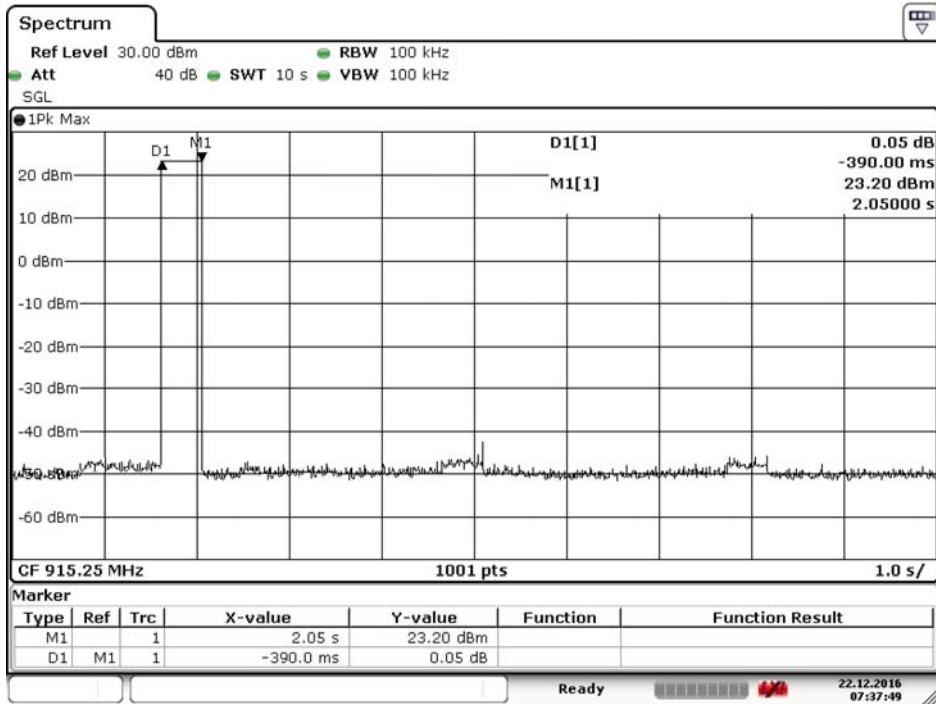
Note: The dwell time shall be the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

Channel 01



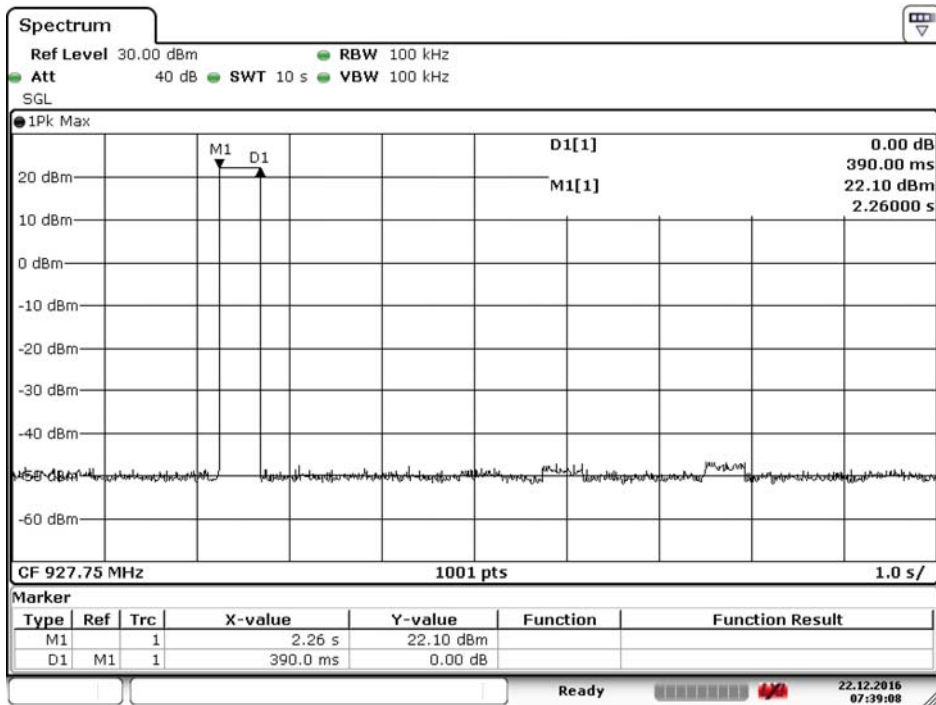
Date: 22.DEC.2016 07:36:25

Channel 27



Date: 22.DEC.2016 07:37:49

Channel 52



Date: 22.DEC.2016 07:39:08

11. EMI Reduction Method During Compliance Testing

No modification was made during testing.

Attachment 1: EUT Test Photographs

Attachment 2: EUT Detailed Photographs