

# FCC Test Report

Product Name	RFID Reader
Model No.	BF-IDU01
FCC ID.	2AGZY-BFIDU01

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

Date of Receipt	Nov. 18, 2015
Issued Date	Jan. 28, 2016
Report No.	15B0332R-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: Jan. 28, 2016

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Applicant	Balluff GmbH
Address	Schurwaldstrasse 9, Neuhausen a.d.F. 73765, Germany
Manufacturer	Balluff GmbH
Model No.	BF-IDU01
FCC ID.	2AGZY-BFIDU01
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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Tested By : Ken Chen  
( Assistant Engineer / Ken Chen )

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-IDU01
FCC ID.	2AGZY-BFIDU01
Frequency Range	902.25 – 927.75MHz
Channel Number	52
Type of Modulation	FHSS: PR-ASK
Channel Control	Auto
Antenna Type	LHCP Embedded Antenna
USB Cable	Shielded, 5.0m
M12 Cable	Non-Shielded, 2.0m
M12 Cable	Non-Shielded, 0.7m

**Antenna List**

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	MTI WIRELESS EDGE LTD.	MT-241026/SLH/C	LHCP Embedded Antenna	2.86 dBi for 865-956 MHz

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 902.25 – 927.75MHz RFID Reader.
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
-----------	------------------

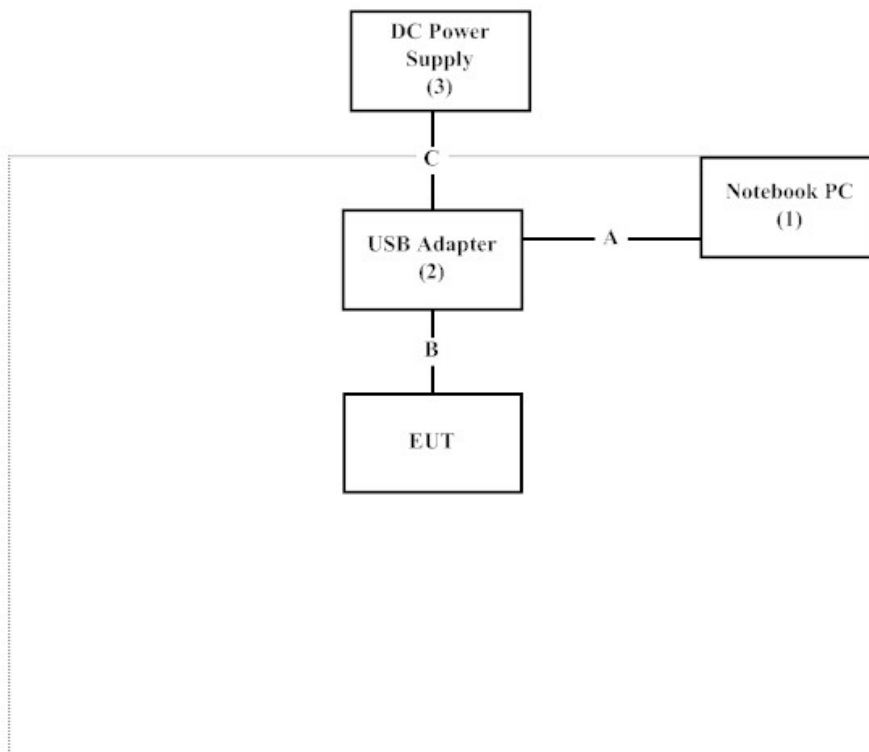
### 1.3. Tested System Details

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	DELL	Latitude E5440	74BTK32	Non-Shielded, 0.8m
2	USB Adapter	N/A	BISVM-3XX	N/A	N/A
3	DC Power Supply	GWINSTEK	SPD-3606	GN850216	N/A

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 “BISVx3\_Test V2.4” 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.5-22, Ruishukeng,  
 Linkou Dist. New Taipei City 24451,  
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 E-Mail : [service@quietek.com](mailto:service@quietek.com)

FCC Accreditation Number: TW1014



## 2. Conducted Emission

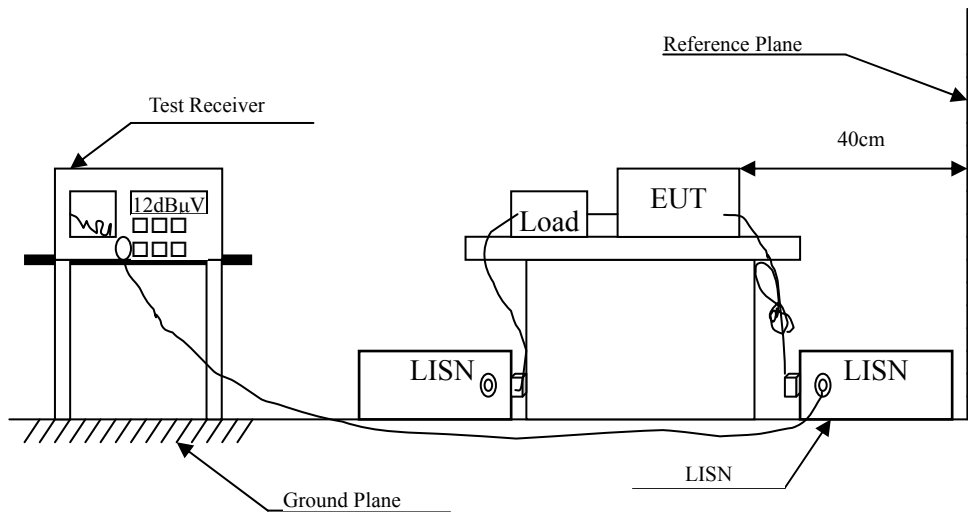
### 2.1. Test Equipment

	Equipment	Manufacturer	Model No. / Serial No.	Last Cal.	Remark
X	Test Receiver	R & S	ESCS 30 / 825442/018	Sep., 2015	
X	Artificial Mains Network	R & S	ENV4200 / 848411/10	Feb., 2015	Peripherals
X	LISN	R & S	ESH3-Z5 / 825562/002	Feb., 2015	EUT
	DC LISN	Schwarzbeck	8226 / 176	Mar., 2015	EUT
X	Pulse Limiter	R & S	ESH3-Z2 / 357.8810.52	Feb., 2015	
	No.1 Shielded Room				

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked by “X” are used to measure the final test results.

### 2.2. Test Setup



**2.3. Limits**

<b>FCC Part 15 Subpart C Paragraph 15.207 (dBμV) Limit</b>		
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.

**2.4. 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.

**2.5. Uncertainty**

± 2.26 dB

**2.6. Test Result of Conducted Emission**

Product : RFID Reader  
 Test Item : Conducted Emission Test  
 Power Line : Line 1  
 Test Mode : Mode 1: Transmit (915.25MHz)

Frequency MHz	Correct Factor dB	Reading Level dBµV	Measurement Level dBµV	Margin dB	Limit dBµV
<b>LINE 1</b>					
<b>Quasi-Peak</b>					
0.166	9.760	37.410	47.170	-18.373	65.543
0.300	9.762	32.690	42.452	-19.262	61.714
0.693	9.793	30.840	40.633	-15.367	56.000
1.834	9.891	26.280	36.171	-19.829	56.000
6.013	10.012	31.730	41.742	-18.258	60.000
10.013	10.081	27.680	37.761	-22.239	60.000
<b>Average</b>					
0.166	9.760	35.090	44.850	-10.693	55.543
0.300	9.762	28.540	38.302	-13.412	51.714
0.693	9.793	21.940	31.733	-14.267	46.000
1.834	9.891	17.630	27.521	-18.479	46.000
6.013	10.012	16.220	26.232	-23.768	50.000
10.013	10.081	9.330	19.411	-30.589	50.000

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 Mode : Mode 1: Transmit (915.25MHz)

Frequency MHz	Correct Factor dB	Reading Level dBμV	Measurement Level dBμV	Margin dB	Limit dBμV
<b>LINE 2</b>					
<b>Quasi-Peak</b>					
0.170	9.758	33.930	43.689	-21.740	65.429
0.232	9.757	31.790	41.547	-22.110	63.657
0.959	9.813	32.120	41.933	-14.067	56.000
1.240	9.835	28.960	38.795	-17.205	56.000
10.029	10.111	28.230	38.341	-21.659	60.000
14.318	10.215	27.230	37.445	-22.555	60.000
<b>Average</b>					
0.170	9.758	29.780	39.539	-15.890	55.429
0.232	9.757	28.460	38.217	-15.440	53.657
0.959	9.813	24.770	34.583	-11.417	46.000
1.240	9.835	19.370	29.205	-16.795	46.000
10.029	10.111	5.980	16.091	-33.909	50.000
14.318	10.215	26.450	36.665	-13.335	50.000

Note:

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

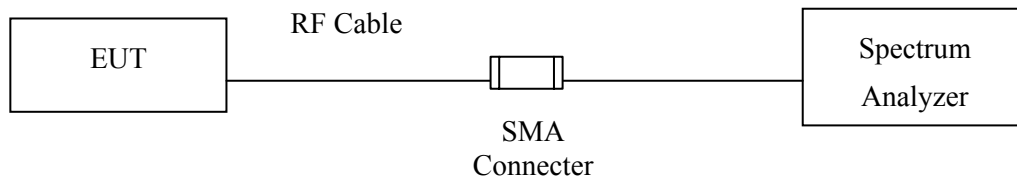
### 3. Occupied Bandwidth

#### 3.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun., 2015
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun., 2015
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2015

Note: 1. All equipments are calibrated every one year.  
2. The test instruments marked by “X” are used to measure the final test results.

#### 3.2. Test Setup



#### 3.3. Limits

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

#### 3.4. 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.

#### 3.5. Uncertainty

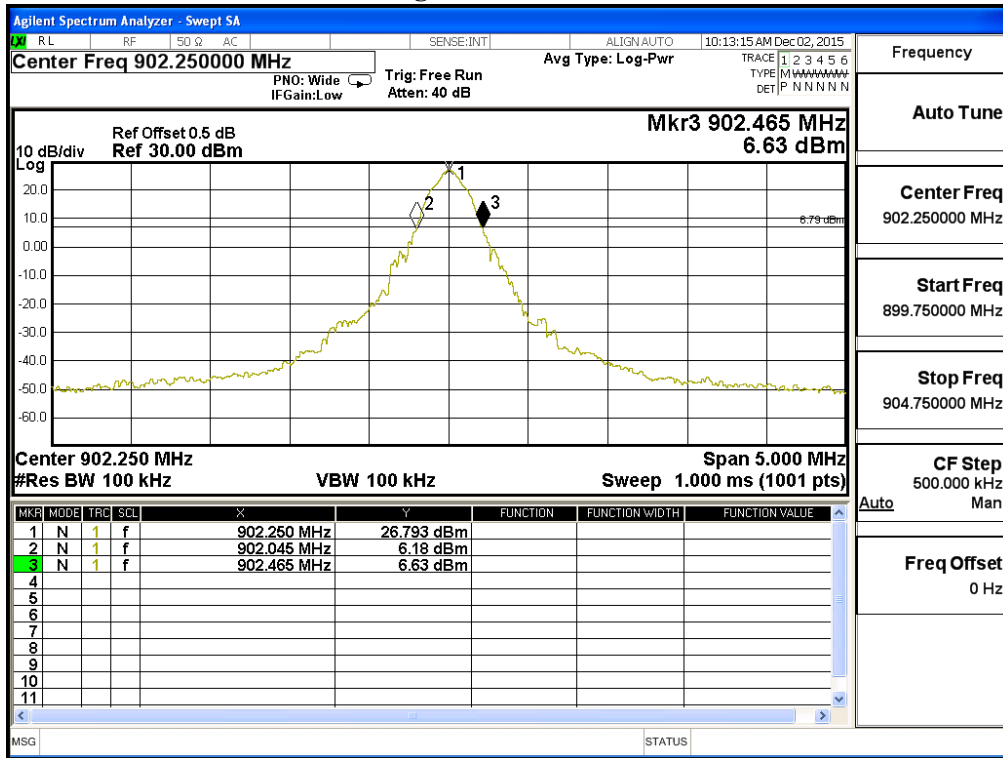
± 150Hz

### 3.6. Test Result of Occupied Bandwidth

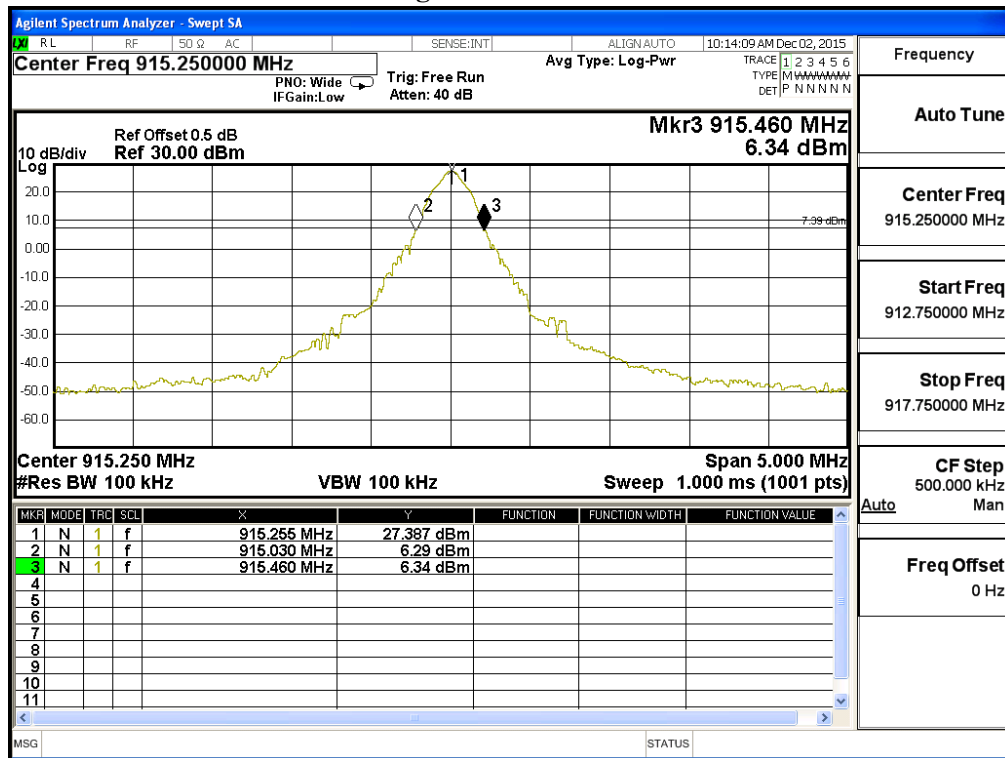
Product : RFID Reader  
 Test Item : Occupied Bandwidth Data  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
01	902.25	420	<500	PASS
27	915.25	430	<500	PASS
52	927.75	420	<500	PASS

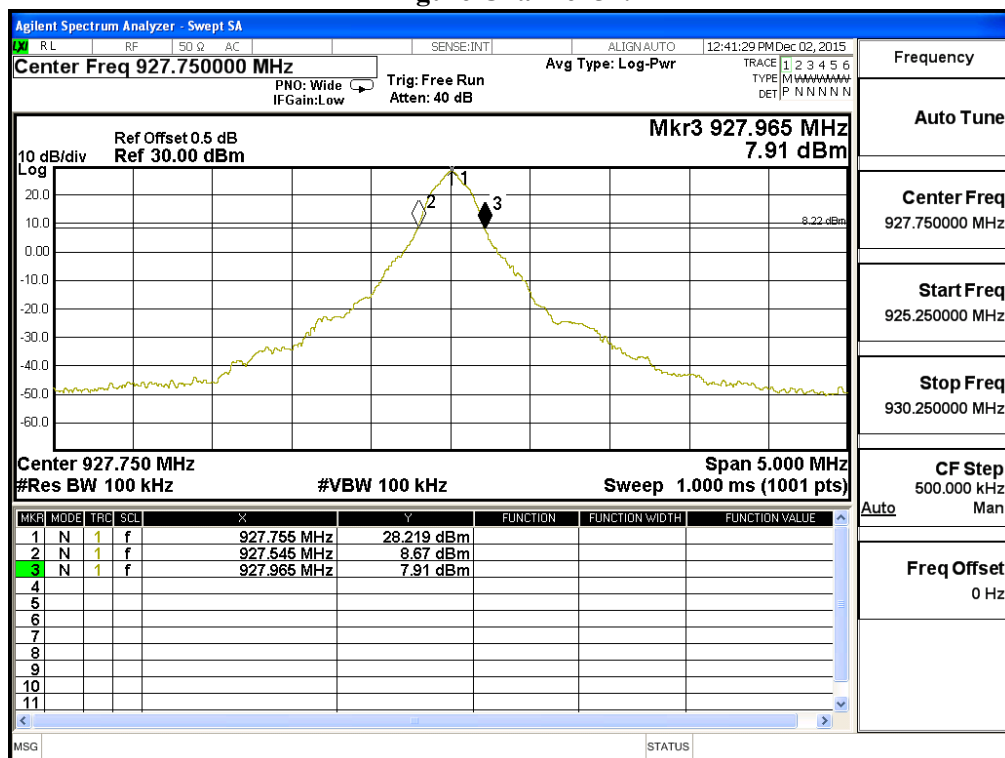
**Figure Channel 01:**



**Figure Channel 27:**



**Figure Channel 52:**



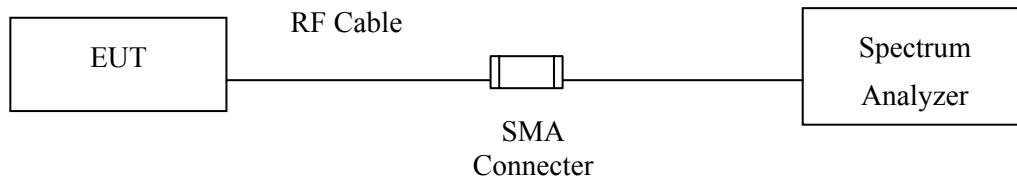
**4. Channel Number**

**4.1. Test Equipment**

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun., 2015
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun., 2015
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2015

Note: 1. All equipments are calibrated every one year.  
2. The test instruments marked by “X” are used to measure the final test results.

**4.2. Test Setup**



**4.3. 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.

**4.4. 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.

**4.5. Uncertainty**

N/A

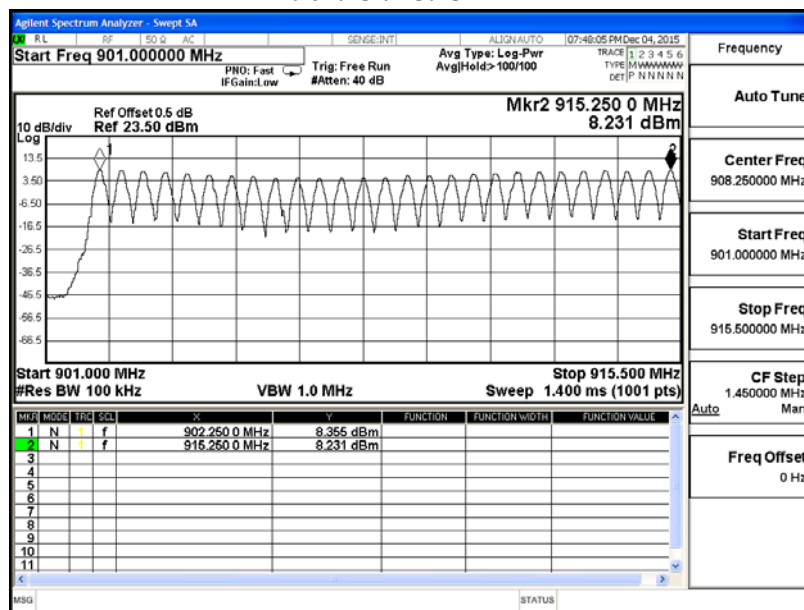


#### 4.6. Test Result of Channel Number

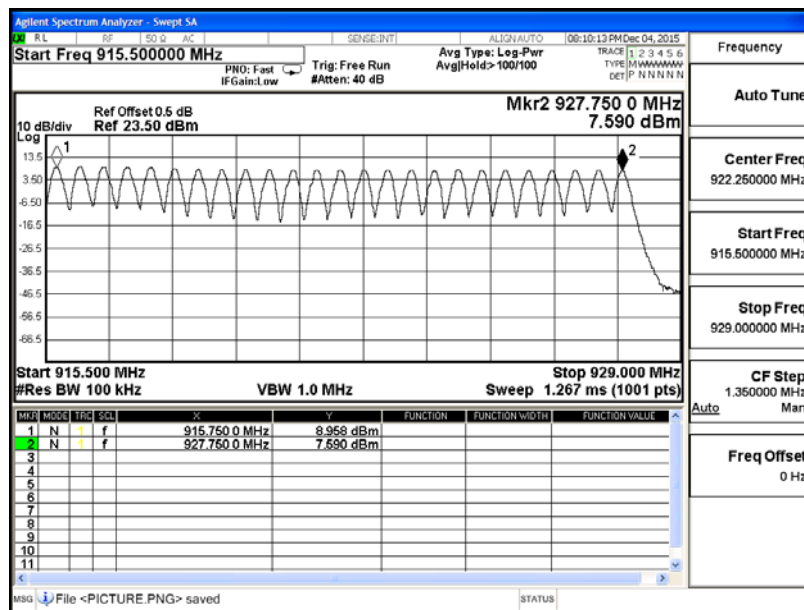
Product : RFID Reader  
 Test Item : Channel Number  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit

Frequency Range (MHz)	Measurement (Hopping Channel)	Required Limit (Hopping Channel)	Result
902.25 ~ 927.75	52	>20	Pass

#### 902.25-915.25MHz



#### 902.25-915.25MHz



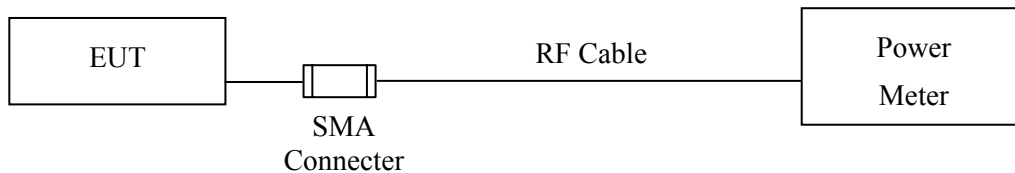
**5. Peak Power Output**

**5.1. Test Equipment**

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
X	Power Meter	Anritsu	ML2495A/6K00003357	May, 2015
X	Power Sensor	Anritsu	MA2411B/0738448	Jun., 2015

Note: 1. All equipments are calibrated every one year.  
2. The test instruments marked by “X” are used to measure the final test results.

**5.2. Test Setup**



**5.3. 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.

**5.4. 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.

**5.5. Uncertainty**

± 1.27 dB

**5.6. 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	27.67	1 Watt= 30 dBm	Pass
Channel 27	915.25	27.94	1 Watt= 30 dBm	Pass
Channel 52	927.75	27.91	1 Watt= 30 dBm	Pass

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

## 6. Radiated Emission

### 6.1. Test Equipment

The following test equipments are used during the radiated emission test:

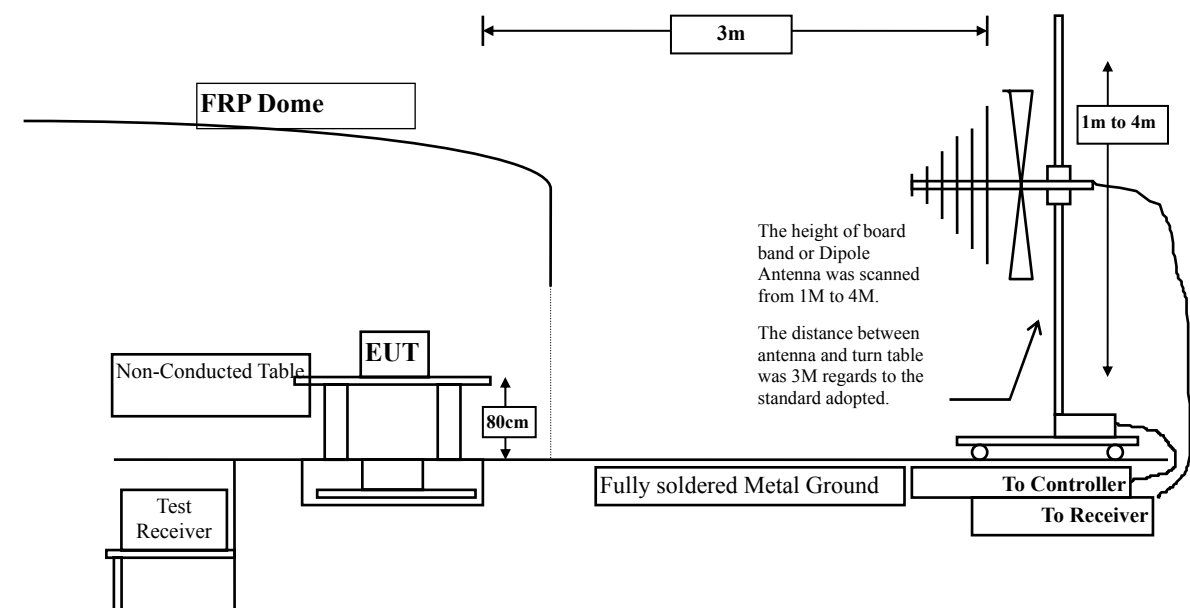
Test Site	Equipment	Manufacturer	Model No./Serial No.	Last Cal.	
☒ Site # 3	X	Magnetic Loop Antenna	Teseq	HLA6121/ 37133	Sep, 2015
	X	Bilog Antenna	Schaffner Chase	CBL6112B/ 2707	Jun., 2015
	X	EMI Test Receiver	R&S	ESCS 30/838251/ 001	Jun., 2015
	X	Coaxial Cable	QTK(Arnist)	RG 214/ LC003-RG	Jun., 2015
	X	Coaxial signal switch	Arnist	MP59B/ 6200798682	Jun., 2015

Test Site	Equipment	Manufacturer	Model No./Serial No.	Last Cal.	
☒ CB # 8	X	Spectrum Analyzer	R&S	FSP40/ 100339	Oct., 2015
	X	Horn Antenna	ETS-Lindgren	3117/ 35205	Mar., 2015
	X	Horn Antenna	Schwarzbeck	BBHA9170/209	Jan., 2015
	X	Horn Antenna	TRC	AH-0801/95051	Aug., 2015
	X	Pre-Amplifier	EMCI	EMC012630SE/980210	Jan., 2015
	X	Pre-Amplifier	MITEQ	JS41-001040000-58-5P/153945	Jul., 2015
	X	Pre-Amplifier	NARDA	DBL-1840N506/013	Jul., 2015

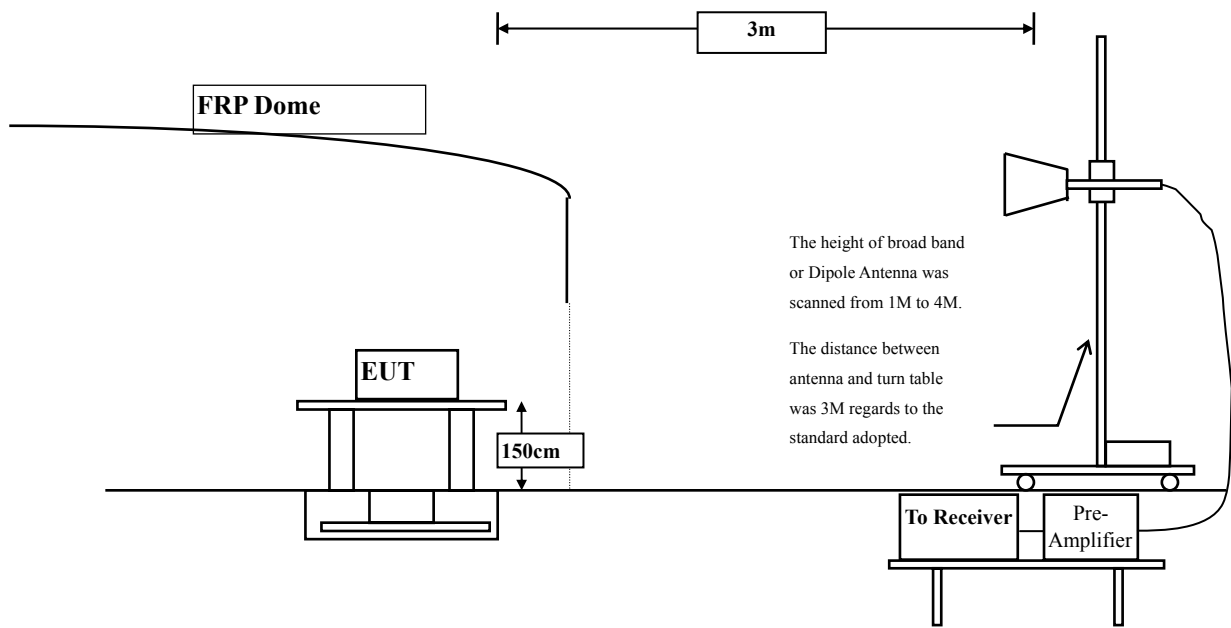
- Note: 1. All equipments are calibrated with traceable calibrations. Each calibration is traceable to the national or international standards.  
2. The test instruments marked with "X" are used to measure the final test results.

### 6.2. Test Setup

Below 1GHz



Above 1GHz



### 6.3. 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.

#### **6.4. Test Procedure**

The EUT was setup according to ANSI C63.10, 2013 and tested compliance to FCC 47CFR 15.249 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.

#### **6.5. Uncertainty**

± 3.9 dB above 1GHz

± 3.8 dB below 1GHz

**6.6. Test Result of Radiated Emission**

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

Frequency MHz	Correct Factor dB	Reading Level dBμV	Measurement Level dBμV/m	Margin dB	Limit dBμV/m
<b>Horizontal</b>					
<b>Peak Detector:</b>					
1804.500	-4.452	53.900	49.447	-24.553	74.000
2706.750	-1.199	39.340	38.142	-35.858	74.000
3609.000	-0.141	46.550	46.408	-27.592	74.000
4511.250	1.828	37.150	38.979	-35.021	74.000
5413.500	3.735	39.120	42.855	-31.145	74.000
6315.750	6.145	43.280	49.425	-24.575	74.000
7218.000	10.247	35.325	45.573	-28.427	74.000
8120.250	14.034	36.299	50.333	-23.667	74.000
9022.500	13.135	34.188	47.323	-26.677	74.000
<b>Average Detector:</b>					
--					
<b>Vertical</b>					
<b>Peak Detector:</b>					
1804.500	-2.480	55.960	53.480	-20.520	74.000
2706.750	-1.339	53.650	52.311	-21.689	74.000
3609.000	0.472	50.040	50.512	-23.488	74.000
4511.250	5.159	39.511	44.670	-29.330	74.000
5413.500	3.735	38.299	42.034	-31.966	74.000
6315.750	6.145	41.350	47.495	-26.505	74.000
7218.000	10.247	36.951	47.199	-26.801	74.000
8120.250	14.034	31.590	45.624	-28.376	74.000
9022.500	13.050	39.850	52.900	-21.100	74.000
<b>Average Detector:</b>					
--					

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 Mode : Mode 1: Transmit(915.25MHz)

Frequency MHz	Correct Factor dB	Reading Level dB $\mu$ V	Measurement Level dB $\mu$ V/m	Margin dB	Limit dB $\mu$ V/m
<b>Horizontal</b>					
<b>Peak Detector:</b>					
1830.500	-4.314	52.110	47.796	-26.204	74.000
2745.750	-0.940	45.530	44.591	-29.409	74.000
3661.000	-0.677	48.440	47.764	-26.236	74.000
4576.250	1.979	44.840	46.819	-27.181	74.000
5491.500	4.755	43.354	48.110	-25.890	74.000
6406.750	6.903	45.650	52.553	-21.447	74.000
7322.000	11.778	40.610	52.389	-21.611	74.000
8237.250	15.831	37.230	53.062	-20.938	74.000
9152.500	13.119	38.460	51.579	-22.421	74.000
<b>Average Detector:</b>					
--					
<b>Vertical</b>					
<b>Peak Detector:</b>					
1830.500	-2.767	55.300	52.533	-21.467	74.000
2745.750	-1.107	52.880	51.774	-22.226	74.000
3661.000	0.275	51.830	52.105	-21.895	74.000
4576.250	5.679	42.800	48.479	-25.521	74.000
5491.500	6.248	42.810	49.059	-24.941	74.000
6406.750	8.339	45.520	53.859	-20.141	74.000
7322.000	12.656	41.240	53.896	-20.104	74.000
8237.250	15.771	36.770	52.541	-21.459	74.000
9152.500	13.050	40.720	53.770	-20.230	74.000
<b>Average Detector:</b>					
--					

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 Mode : Mode 1: Transmit(927.75MHz)

Frequency MHz	Correct Factor dB	Reading Level dB $\mu$ V	Measurement Level dB $\mu$ V/m	Margin dB	Limit dB $\mu$ V/m
<b>Horizontal</b>					
<b>Peak Detector:</b>					
1855.500	-4.177	49.470	45.292	-28.708	74.000
2783.250	-0.691	43.650	42.960	-31.040	74.000
3711.000	-0.945	46.440	45.494	-28.506	74.000
4638.750	2.181	44.520	46.701	-27.299	74.000
5566.500	4.356	41.960	46.316	-27.684	74.000
6494.250	7.747	43.460	51.206	-22.794	74.000
7422.000	12.314	41.151	53.466	-20.534	74.000
8349.750	15.149	37.750	52.898	-21.102	74.000
9277.500	12.609	41.229	53.838	-20.162	74.000
<b>Average Detector:</b>					
--					
<b>Vertical</b>					
<b>Peak Detector:</b>					
1855.500	-3.047	52.960	49.912	-24.088	74.000
2783.250	-0.691	53.850	53.160	-20.840	74.000
3711.000	0.243	48.730	48.972	-25.028	74.000
4638.750	6.047	43.240	49.287	-24.713	74.000
5566.500	5.902	41.770	47.672	-26.328	74.000
6494.250	8.872	44.290	53.162	-20.838	74.000
7422.000	13.318	40.550	53.869	-20.131	74.000
8349.750	15.108	38.790	53.898	-20.102	74.000
9277.500	12.780	39.920	52.700	-21.300	74.000
<b>Average Detector:</b>					
--					

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 Mode : Mode 1: Transmit (902.25MHz)

Frequency MHz	Correct Factor dB	Reading Level dBμV	Measurement Level dBμV/m	Margin dB	Limit dBμV/m
<b>Horizontal</b>					
115.754	-21.771	43.496	21.725	-21.775	43.500
295.696	-16.722	45.321	28.600	-17.400	46.000
429.246	-15.245	45.656	30.411	-15.589	46.000
558.580	-12.958	46.491	33.532	-12.468	46.000
644.333	-12.283	45.560	33.277	-12.723	46.000
703.377	-11.793	43.474	31.681	-14.319	46.000
<b>Vertical</b>					
183.232	-21.134	44.786	23.652	-19.848	43.500
361.768	-17.572	46.316	28.744	-17.256	46.000
513.594	-14.413	43.882	29.469	-16.531	46.000
671.043	-12.605	48.056	35.451	-10.549	46.000
800.377	-11.293	46.997	35.705	-10.295	46.000
907.217	-11.052	47.144	36.092	-9.908	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.
8. No emission found between lowest internal used/generated frequency to 30MHz.

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

Frequency MHz	Correct Factor dB	Reading Level dBμV	Measurement Level dBμV/m	Margin dB	Limit dBμV/m
<b>Horizontal</b>					
134.029	-22.143	45.884	23.741	-19.759	43.500
287.261	-17.453	48.113	30.660	-15.340	46.000
410.971	-15.820	46.024	30.203	-15.797	46.000
592.319	-13.104	46.376	33.272	-12.728	46.000
789.130	-11.524	46.770	35.246	-10.754	46.000
911.435	-9.778	45.792	36.014	-9.986	46.000
<b>Vertical</b>					
117.159	-18.948	45.226	26.278	-17.222	43.500
298.507	-18.030	45.105	27.075	-18.925	46.000
394.101	-16.765	46.311	29.546	-16.454	46.000
533.275	-14.305	46.876	32.571	-13.429	46.000
652.768	-12.540	45.856	33.316	-12.684	46.000
841.145	-10.584	46.959	36.375	-9.625	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.
8. No emission found between lowest internal used/generated frequency to 30MHz.

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

Frequency MHz	Correct Factor dB	Reading Level dB $\mu$ V	Measurement Level dB $\mu$ V/m	Margin dB	Limit dB $\mu$ V/m
<b>Horizontal</b>					
129.812	-22.125	45.194	23.069	-20.431	43.500
295.696	-16.722	45.724	29.003	-16.997	46.000
446.116	-15.129	46.091	30.963	-15.037	46.000
572.638	-13.063	46.267	33.204	-12.796	46.000
658.391	-11.951	46.359	34.408	-11.592	46.000
753.986	-11.889	47.325	35.435	-10.565	46.000
<b>Vertical</b>					
141.058	-20.537	46.495	25.958	-17.542	43.500
298.507	-18.030	44.359	26.329	-19.671	46.000
465.797	-14.232	44.898	30.666	-15.334	46.000
616.217	-12.490	44.638	32.148	-13.852	46.000
800.377	-11.293	46.510	35.218	-10.782	46.000
946.580	-11.210	48.069	36.860	-9.140	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.
8. No emission found between lowest internal used/generated frequency to 30MHz.

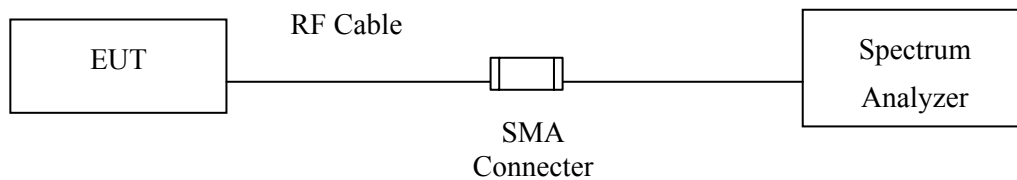
## 7. RF Antenna Conducted Test

### 7.1. Test Equipment

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun., 2015
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun., 2015
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2015

Note: 1. All equipments are calibrated every one year.  
2. The test instruments Marked “X” are used to measure the final test results.

### 7.2. Test Setup



### 7.3. 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.

### 7.4. 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.

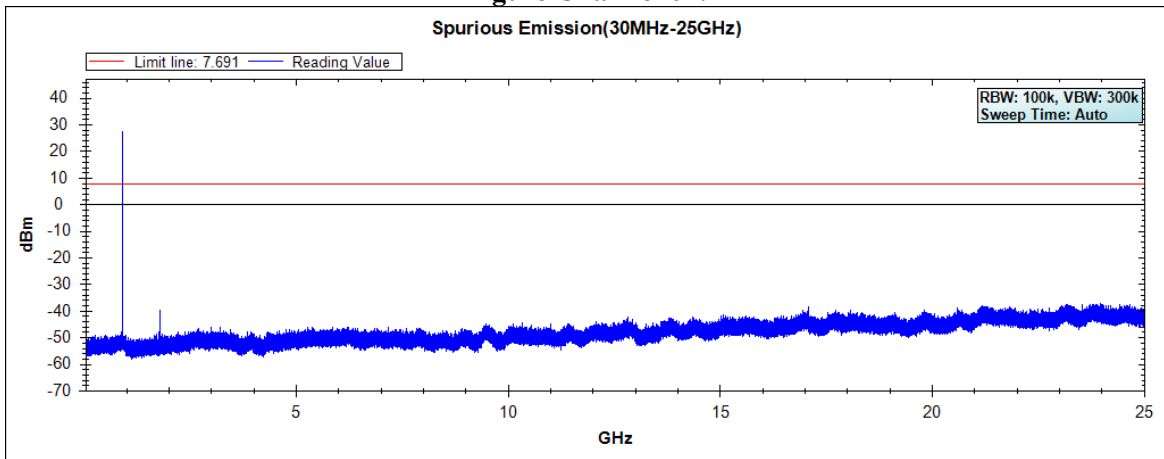
### 7.5. Uncertainty

± 150Hz

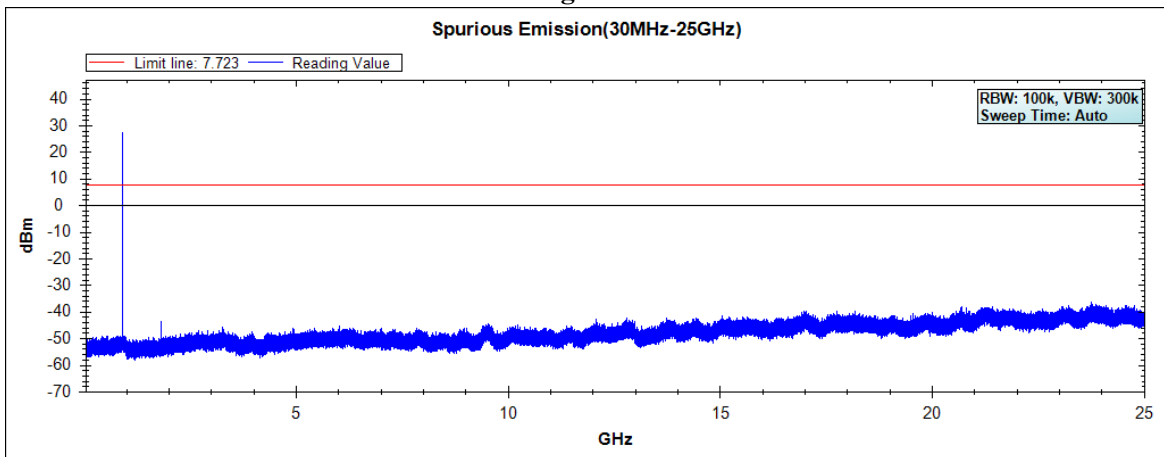
### 7.6. Test Result of RF Antenna Conducted Test

Product : RFID Reader  
 Test Item : RF Antenna Conducted Test  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit

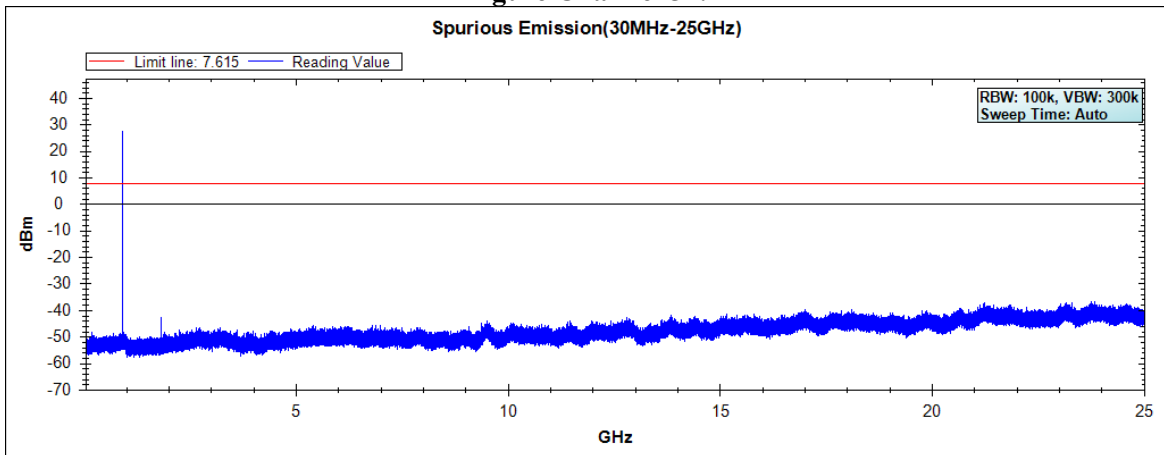
**Figure Channel 01:**



**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 Equipment**

**RF Conducted Measurement**

The following test equipments are used during the band edge tests:

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun, 2015
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun, 2015
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2015

- Note: 1. All instruments are calibrated every one year.  
2. The test instruments marked by “X” are used to measure the final test results.

**RF Radiated Measurement**

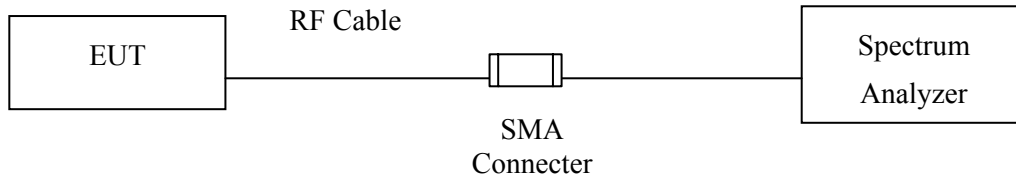
The following test equipments are used during the radiated emission test:

Test Site		Equipment	Manufacturer	Model No./Serial No.	Last Cal.
☒ Site # 3	X	Magnetic Loop Antenna	Teseq	HLA6121/ 37133	Sep, 2015
	X	Bilog Antenna	Schaffner Chase	CBL6112B/ 2707	Jun, 2015
	X	EMI Test Receiver	R&S	ESCS 30/838251/ 001	Jun, 2015
	X	Coaxial Cable	QTK(Arnist)	RG 214/ LC003-RG	Jun, 2015
	X	Coaxial signal switch	Arnist	MP59B/ 6200798682	Jun, 2015

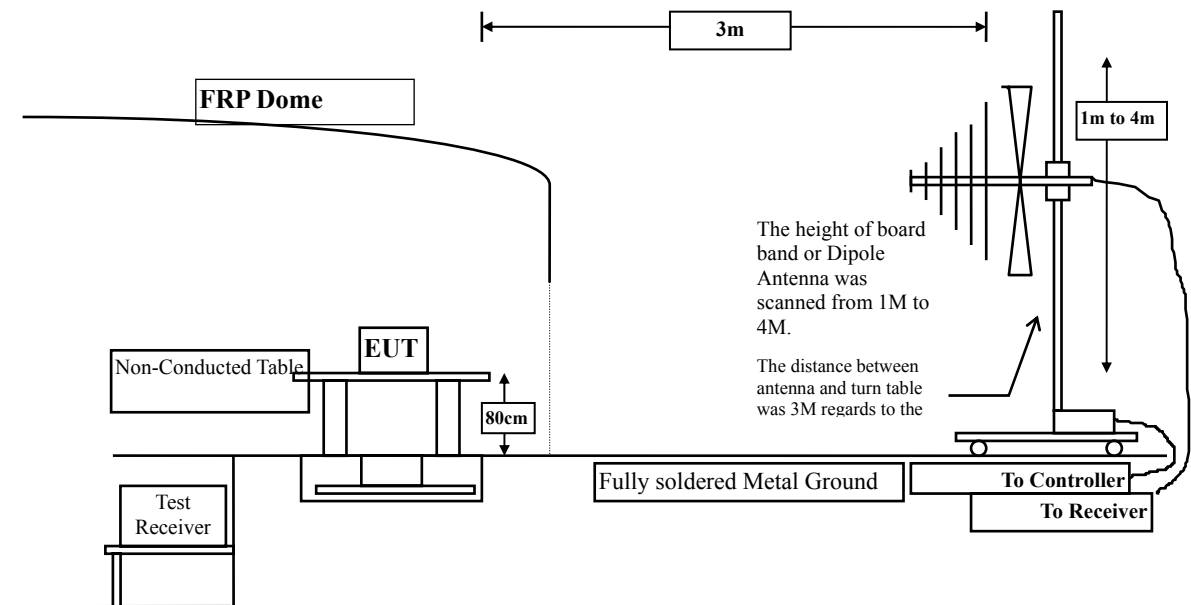
- Note: 1. All instruments are calibrated every one year.  
2. The test instruments marked by “X” are used to measure the final test results.

## 8.2. Test Setup

### RF Conducted Measurement



### RF Radiated Measurement





### 8.3. 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.

<b>FCC Part 15 Subpart C Paragraph 15.209 Limits</b>		
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)).

#### **8.4. Test Procedure**

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 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.

#### **8.5. Uncertainty**

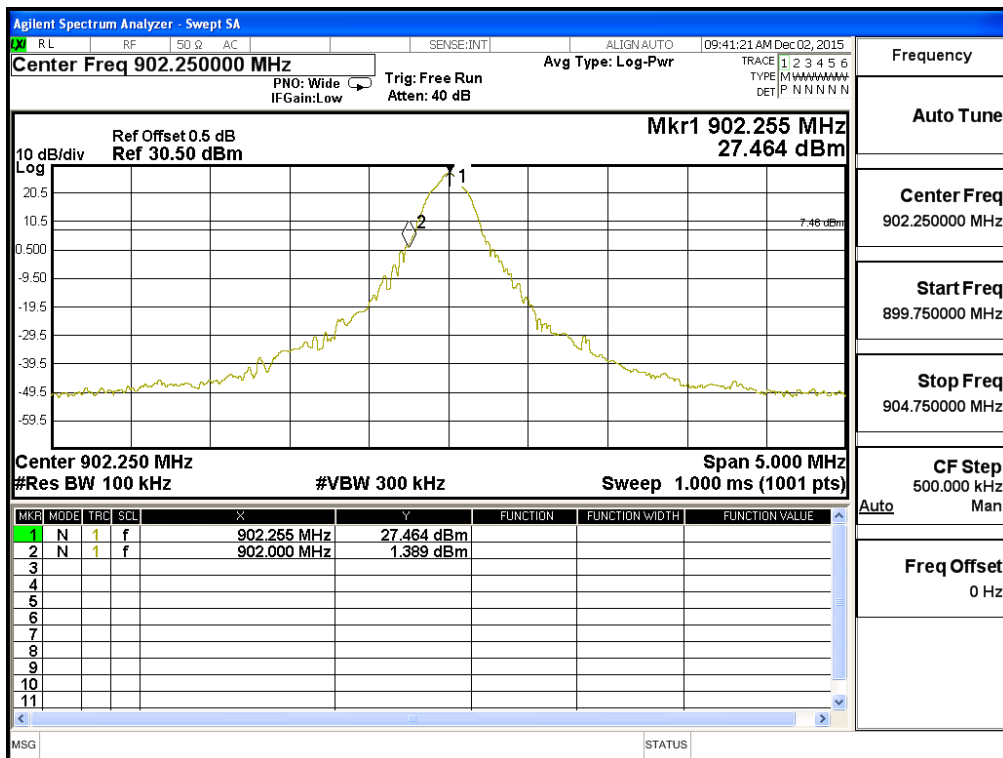
± 3.9 dB above 1GHz

± 3.8 dB below 1GHz

### 8.6. Test Result of Band Edge

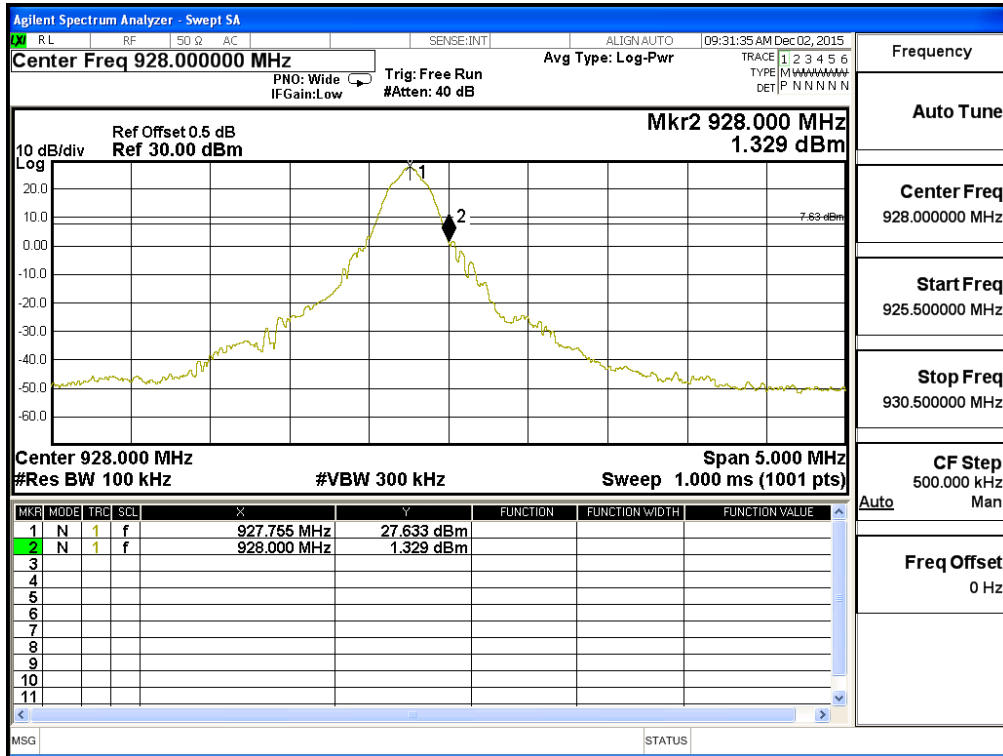
Product : RFID Reader  
 Test Item : Band Edge  
 Test Site : No.3 OATS  
 Test Mode : Mode 1: Transmit (902.25MHz)

Test Frequency (MHz)	Measurement Level $\Delta$ (dB)	Limit $\Delta$ (dB)	Result
902	26.075	>20	PASS



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

Test Frequency (MHz)	Measurement Level $\Delta$ (dB)	Limit $\Delta$ (dB)	Result
928	26.304	>20	PASS



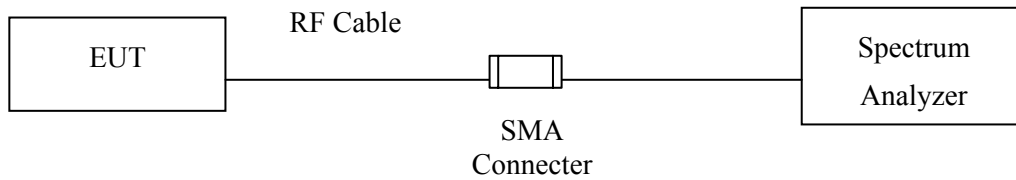
**9. Channel Separation**

**9.1. Test Equipment**

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun., 2015
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun., 2015
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2015

Note: 1. All equipments are calibrated every one year.  
2. The test instruments mark by “X” are used to measure the final test results.

**9.2. Test Setup**



**9.3. 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.

**9.4. 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.

**9.5. Uncertainty**

± 150Hz

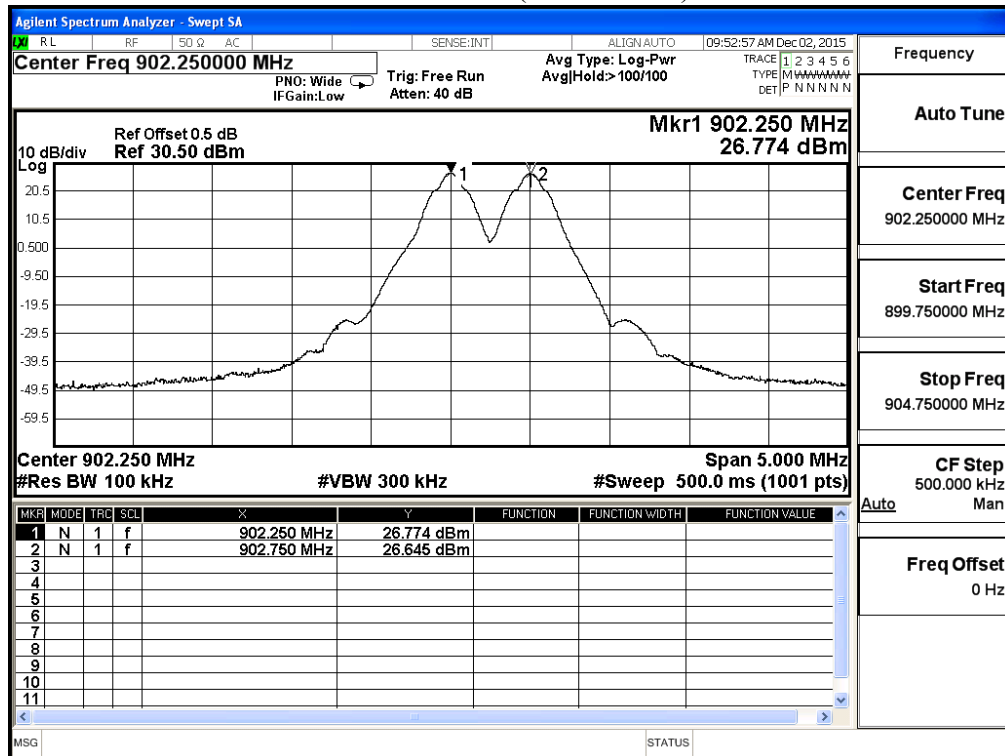
**9.6. Test Result of Channel Separation**

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

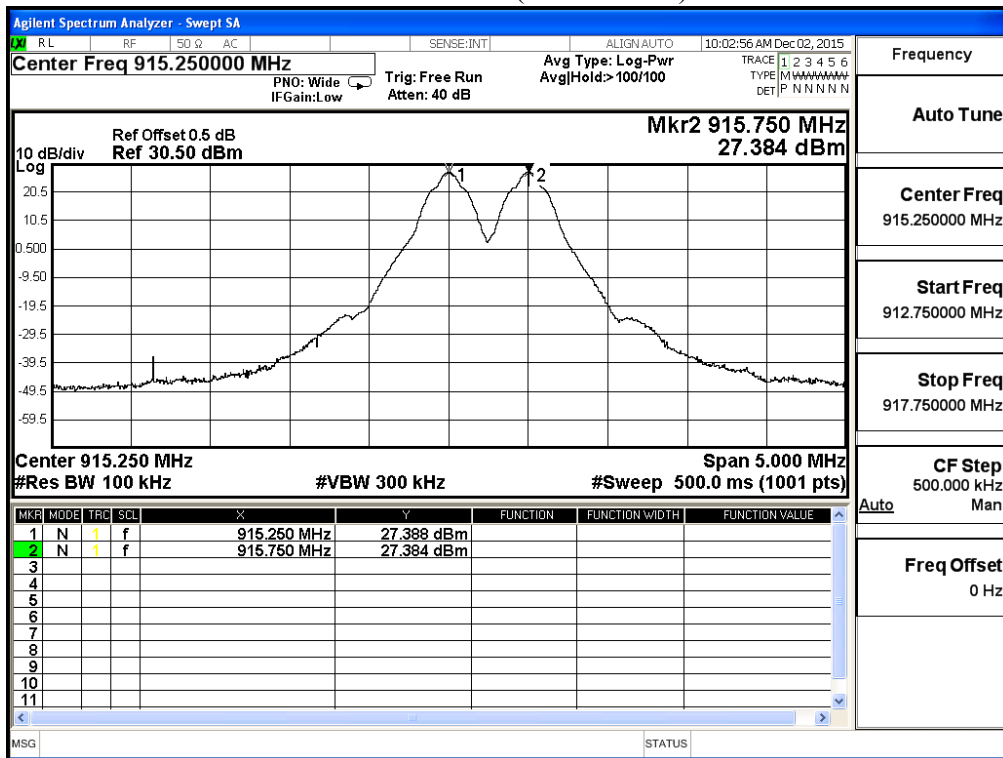
Channel No.	Frequency (MHz)	Measurement Level (kHz)	Limit (kHz)	Limit of 20dB Bandwidth (kHz)	Result
01	902.25	500	>25 kHz	420.0	Pass
27	915.25	500	>25 kHz	430.0	Pass
52	927.75	500	>25 kHz	420.0	Pass

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

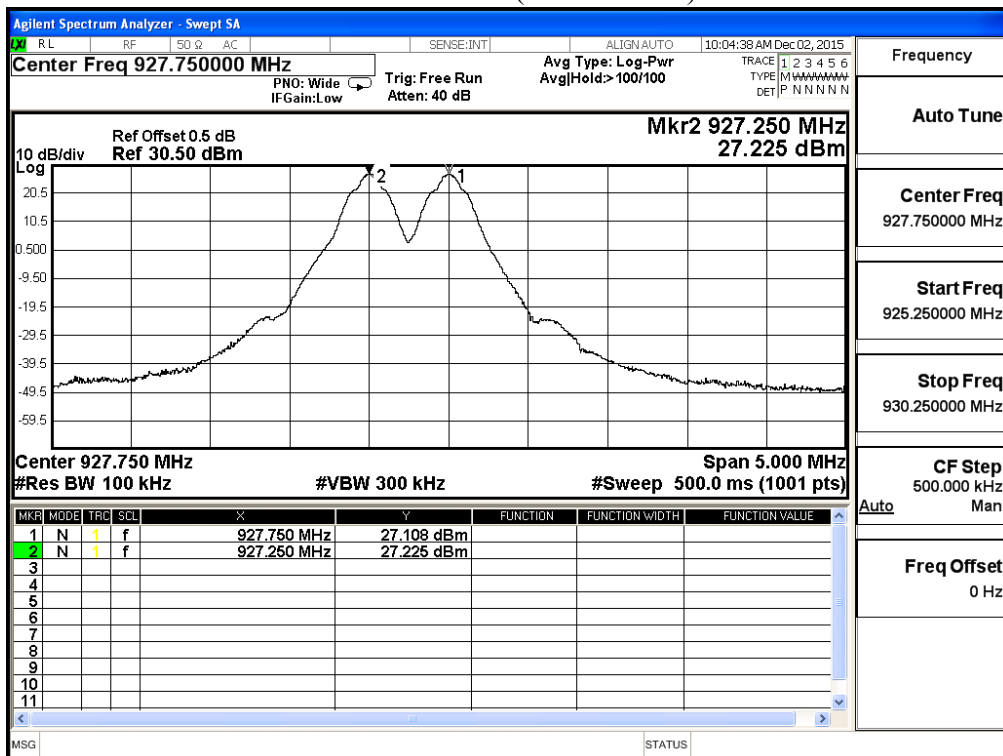
Channel 01 (902.25MHz)



### Channel 27 (915.25MHz)



### Channel 52 (927.75 MHz)



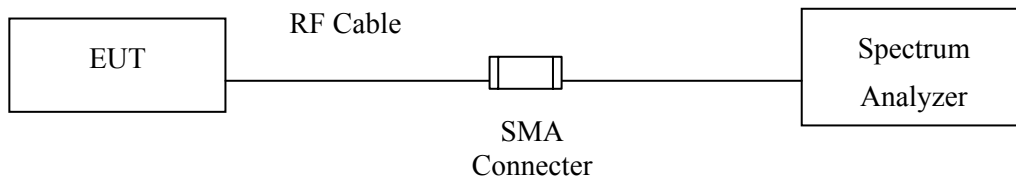
**10. Dwell Time**

**10.1. Test Equipment**

	Equipment	Manufacturer	Model No./Serial No.	Last Cal.
	Spectrum Analyzer	R&S	FSP40 / 100170	Jun., 2015
	Spectrum Analyzer	Agilent	E4407B / US39440758	Jun., 2015
X	Spectrum Analyzer	Agilent	N9010A / MY48030495	Apr., 2015

Note: 1. All equipments are calibrated every one year.  
2. The test instruments marked by “X” are used to measure the final test results.

**10.2. Test Setup**



**10.3. 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.

**10.4. 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.

**10.5. Uncertainty**

± 25msec



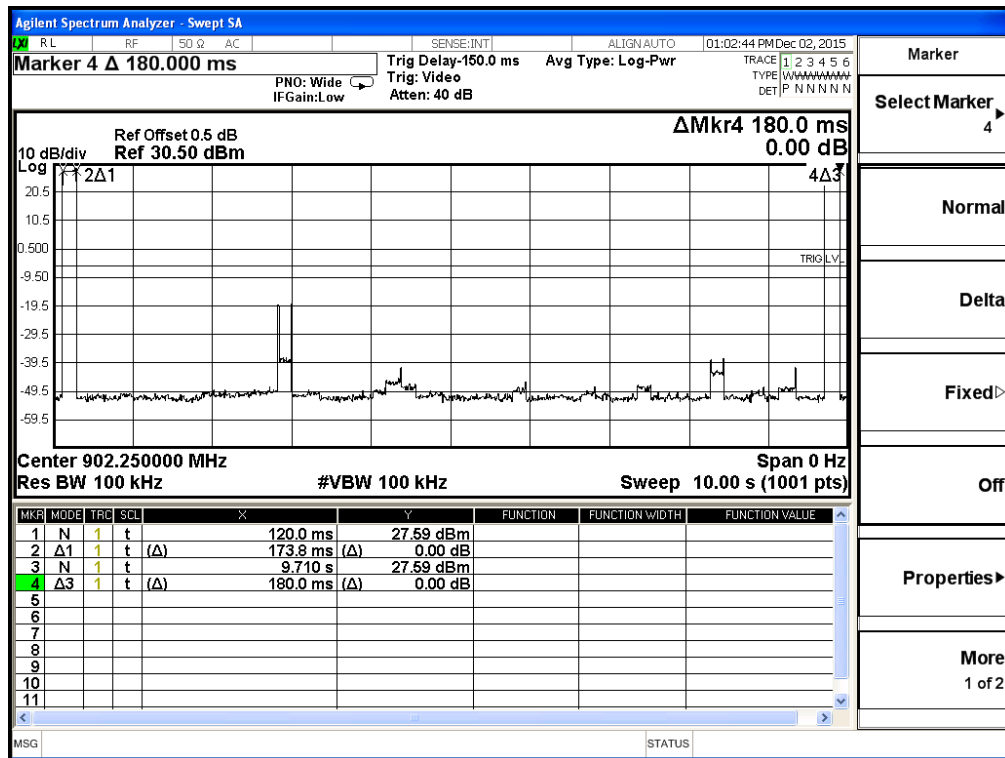
### 10.6. Test Result of Dwell Time

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

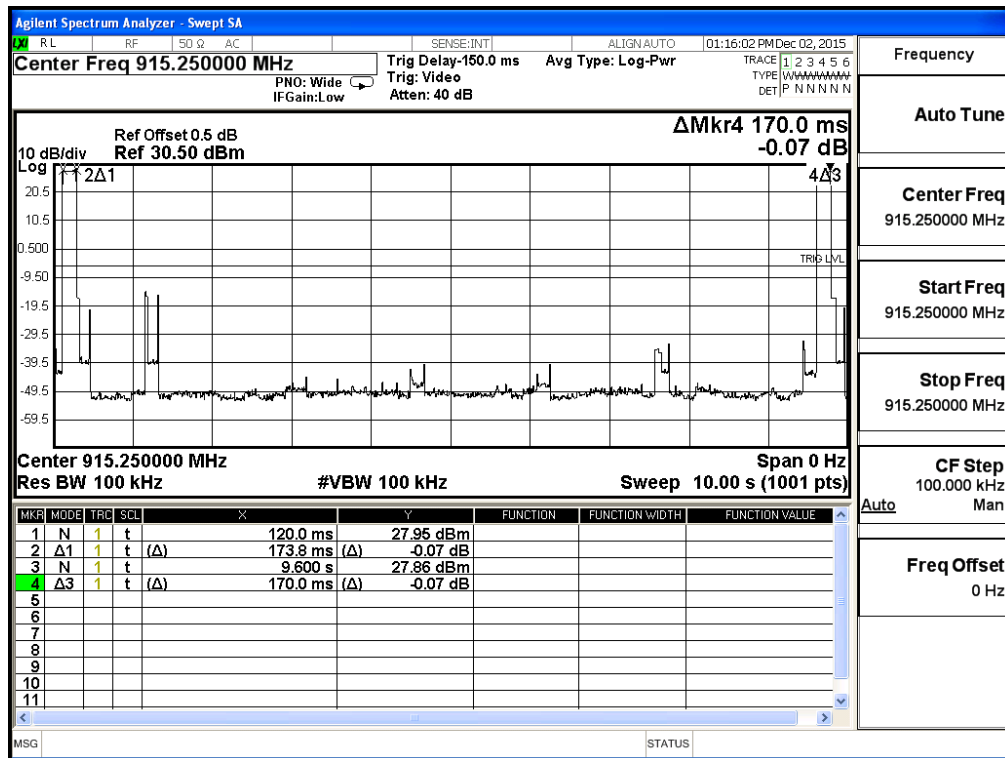
Frequency (MHz)	Dwell Time (Sec)	Limit (Sec)	Result
902.25	0.354	0.4	Pass
915.25	0.344	0.4	Pass
927.75	0.294	0.4	Pass

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.

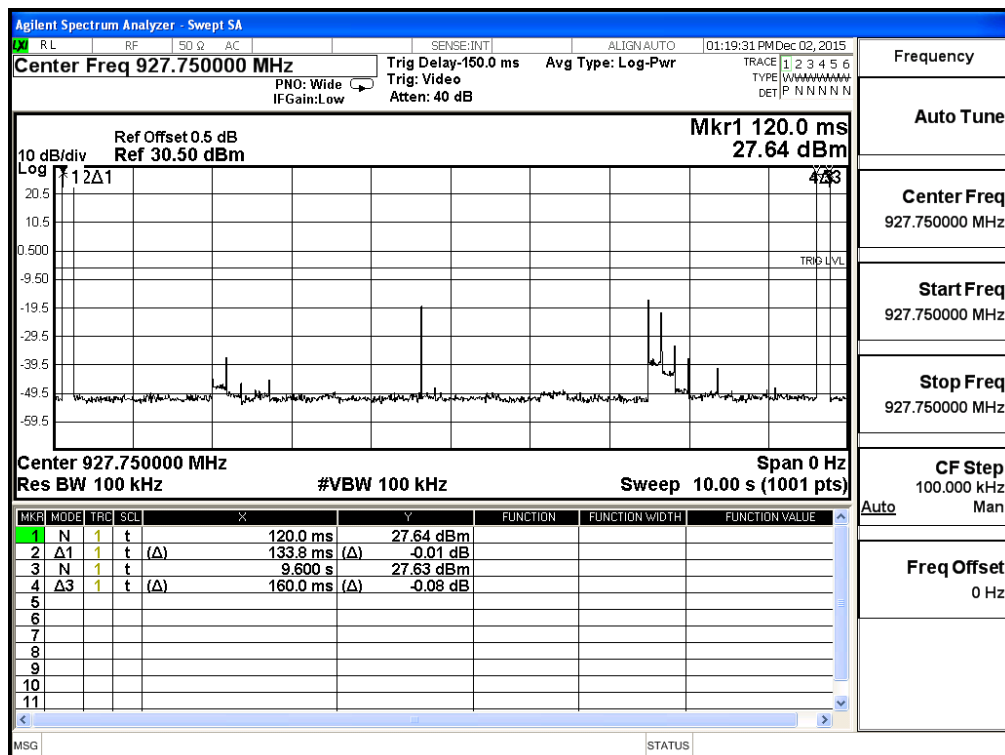
#### Channel 01



### Channel 27



### Channel 52



## **11. EMI Reduction Method During Compliance Testing**

No modification was made during testing.

## Attachment 1: EUT Test Photographs

## Attachment 2: EUT Detailed Photographs