

RF TEST REPORT

Test item : NFC Module
Model No. : WSNFM400A00
Order No. : DTNC1411-04750, DTNC1411-04957
Date of receipt : 2014-11-03, 2014-11-11
Test duration : 2014-11-03 ~ 2014-11-11, 2014-12-08
Date of issue : 2014-12-08
Use of report : Class II Permissive Change

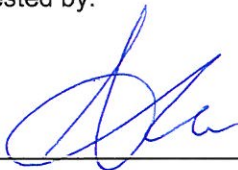
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Test specification : FCC Part 15.225
RSS-210 Issue 8 A2.6
Test environment : See appended test report
Test result : ☒ Pass ☐ Fail

The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of DT&C Co., Ltd.

Tested by:



Engineer
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Reviewed by:



Technical Manager
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Test Report Version

Test Report No.	Date	Description
DRTFCC1411-1442	Nov. 13. 2014	Initial issue
DRTFCC1411-1442(1)	Nov. 24. 2014	Update IC standard
DRTFCC1411-1442(2)	Dec. 08. 2014	Update test results

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1. Equipment information

1.1 Equipment description

FCC Equipment Class	Low Power Communications Device Transmitter(DXX)
Equipment type	NFC Module
Equipment model name	WSNFM400A00
Equipment add model name	NA
Equipment serial no.	Identical prototype
Frequency band	13.56MHz
Modulation type	ASK
Channel	1
Power	DC 3.3V
Antenna type	Loop Antenna

1.2 Ancillary equipment

Equipment	Model No.	Serial No.	Manufacturer	Note
-	-	-	-	-
-	-	-	-	-

2. Information about test items

2.1 Test mode

Test mode 1(TM 1)	Continuous transmitting mode with ASK 100%
Test mode 2(TM 2)	Continuous transmitting mode with ASK 10%

Note: For this test mode, a test program was supported by manufacturer.

2.2 Auxiliary equipment

Equipment	Model No.	Serial No.	Manufacturer	Note
Test Jig	N/A	N/A	Samsung Electronics Co Ltd	N/A
Laptop	P26F	HJXY0Z1	DELL	FCC DoC

The test jig was used for control of this device.

2.3 Tested frequency

	TX Frequency(MHz)	RX Frequency(MHz)
Lowest Channel	13.56	13.56
Middle Channel	-	-
Highest Channel	-	-

2.4 Tested environment

Temperature	: 20 °C ~ 22 °C
Relative humidity content	: 45 % ~ 48 % R.H.
Details of power supply	: DC 3.3V

2.5 EMI Suppression Device(s)/Modifications

EMI suppression device(s) added and/or modifications made during testing

→ None

3. Test report

3.1 Summary of tests

FCC part section(s)	RSS section(s)	Parameter	Limit	Test condition	Status Note 1
2.1049	RSS-Gen [6.6]	Occupied bandwidth	NA	Radiated	C
15.225 (a)	RSS-210 [A2.6 (a)]	In-band emissions	15,848 μ W/m @ 30m 15.553 – 13.567 MHz		C
15.225 (b)	RSS-210 [A2.6 (b)]	In-band emissions	334 μ W/m @ 30m 13.410 – 13.553 MHz 13.567 – 13.710 MHz		C
15.225 (c)	RSS-210 [A2.6 (c)]	In-band emissions	106 μ W/m @ 30m 13.110 – 13.410 MHz 13.710 – 14.010 MHz		C
15.225 (d) 15.205 15.209	RSS-210 [A2.6 (d)] RSS-Gen [8.9, 8.10]	Out-of band emissions	Emissions outside of the specified band (13.110-14.010 MHz) must meet the radiated limits detailed in 15.209		C
15.225 (e)	RSS-210 [A2.6]	Frequency stability	$\pm 0.01\%$ of operating frequency	Conducted	C
15.207	RSS-Gen [8.8]	AC conducted emissions	FCC Part 15.207	AC Line Conducted	C
15.203	-	Antenna requirements	FCC Part 15.203	-	C

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable

Note 2: The worst case data is reported in the test modes.(Worst case mode: Test mode 2)

The sample was tested according to the following specification:
ANSI C-63.10-2009, RSS-Gen Issue 4

3.2.2 In-band emissions

- Procedure:

The EUT was placed on a 0.8m high wooden table inside a 10m semi anechoic chamber. An antenna was placed at 3 m distance from the EUT. Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst-case orientation for maximum emissions. A loop antenna was used for this test item. And this test item was performed for both vertical and horizontal polarization.

- Measurement Data: **Comply**

Test Frequency Band [MHz]	Freq. [MHz]	EUT Posi.	Reading Level [dBuV]	T.F	Field Strength @3m [dBuV/m]	Field Strength @30m [dBuV/m]	Limit [dBuV/m]	Margin [dB]
13.110 ~ 13.410	13.396	Z	9.80	20.40	30.20	-9.80	40.51	50.31
13.410 ~ 13.553	13.551	Z	34.60	20.40	55.00	15.00	50.47	35.47
13.553 ~ 13.567	13.560	Z	40.60	20.40	61.00	21.00	84.00	63.00
13.567 ~ 13.710	13.569	Z	33.60	20.40	54.00	14.00	50.47	36.47
13.710 ~ 14.010	13.807	Z	7.70	20.40	28.10	-11.90	40.51	52.41

Note 1. This test item was performed using a loop antenna.

Note 2. This test item was performed at 3m and the data were extrapolated to the specified measurement distance of 30m using the square of an inverse linear distance extrapolation factor (40 dB/decade) as specified in §15.31(f)2.

$$\text{Extrapolation Factor} = 20 \log_{10}(30/3)^2 = 40\text{dB}$$

Note 3. All data were recorded using a spectrum analyzer employing a peak detector.
If PK results were meet Quasi-peak limit, Quasi-peak measurements were omitted.

Note 4. Sample Calculation.

$$\text{Margin} = \text{Limit} - \text{Field Strength @ 30m} \quad / \quad \text{Field Strength @ 30m} = \text{Field Strength @ 3m} - 40\text{dB}$$

$$\text{Field Strength @ 3m} = \text{Reading} + \text{T.F} \quad / \quad \text{T.F} = \text{AF} + \text{CL} - \text{AG}$$

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain

- Minimum Standard: Part 15.225(a), (b), (c)& RSS-210 A2.6(a), (b), (c)

Frequency Band [MHz]	Limit	
	[uV/m]	[dBuV/m]
13.553-13.567	15,848	84.00
13.410-13.553 13.567-13.710	334	50.47
13.110-13.410 13.710-14.010	106	40.51

3.2.3 Out-of-band emissions

- Procedure:

The EUT was tested from 9kHz up to the 1GHz excluding the band 13.110-14.010MHz. All measurements were recorded with spectrum analyzer employing a peak detector for emissions below 30MHz. Above 30MHz a Quasi-peak detector was used. All out-of-band emissions must not exceed the limits §15.209. A loop antenna was used for searching for emissions below 30MHz.

- Measurement Data: Comply (refer to the next page)**- Minimum Standard: Part 15. 205, 209, 225(d) & RSS-210 A2.6 (d), RSS-Gen 8.9, RSS-Gen 8.10****• FCC Part 15.205 (a):** Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	3.6 ~ 4.4	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	4.5 ~ 5.15	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~ 12.52025	149.9 ~ 150.05	1645.5 ~ 1646.5	5.35 ~ 5.46	17.7 ~ 21.4
4.125 ~ 4.128	12.57675 ~ 12.57725	156.52475 ~ 156.52525	1660 ~ 1710	7.25 ~ 7.75	22.01 ~ 23.12
4.17725 ~ 4.17775	13.36 ~ 13.41	156.7 ~ 156.9	1718.8 ~ 1722.2	8.025 ~ 8.5	23.6 ~ 24.0
4.20725 ~ 4.20775	16.42 ~ 16.423	162.0125 ~ 167.17	2200 ~ 2300	9.0 ~ 9.2	31.2 ~ 31.8
6.215 ~ 6.218	16.69475 ~ 16.69525	167.72 ~ 173.2	2310 ~ 2390	9.3 ~ 9.5	36.43 ~ 36.5
6.26775 ~ 6.26825	16.80425 ~ 16.80475	240 ~ 285	2483.5 ~ 2500	10.6 ~ 12.7	Above 38.6
6.31175 ~ 6.31225	25.5 ~ 25.67	322 ~ 335.4	2655 ~ 2900	13.25 ~ 13.4	
8.291 ~ 8.294	37.5 ~ 38.25	399.90 ~ 410	3260 ~ 3267		
8.362 ~ 8.366	73 ~ 74.6	608 ~ 614	3332 ~ 3339		
8.37625 ~ 8.38675	74.8 ~ 75.2	960 ~ 1240	3345.8 ~ 3358		

• FCC Part 15.205(b):

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

• FCC Part 15.209(a):

Frequency [MHz]	Field Strength [uV/m]	Measurement 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	200	3

** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88MHz, 174-216MHz or 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

• FCC Part 15.209(b):

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

- Measurement Data:

Tested Frequency : 13.56MHz
 Measurement Distance : 3 Meters

Frequency [MHz]	EUT Posi.	ANT Pol	Reading [dBuV]	T.F [dB/m]	Distance factor	Field Strength [dBuV/m]	Limit [dBuV/m]	Margin [dB]
1.198	X	H	23.8	19.3	40	3.1	26.0	22.9
1.198	Y	H	24.8	19.3	40	4.1	26.0	21.9
1.198	Z	H	25.2	19.3	40	4.5	26.0	21.5
119.966	Z	H	31.2	-9.3	0	21.9	43.5	21.6
119.966	X	H	31.3	-9.3	0	22.0	43.5	21.5
399.802	X	V	37.3	-5.7	0	31.6	46.0	14.4
836.977	Y	H	20.5	4.1	0	24.6	46.0	21.4
838.554	Y	V	18.6	4.1	0	22.7	46.0	23.3
830.550	Z	V	18.2	3.8	0	22.0	46.0	24.0

Note 1. All measurements were recorded using a spectrum analyzer employing a peak detector for below 30MHz and a Quasi-peak detector for above 30MHz.

Note 2. Both Vertical and Horizontal polarities of the receiver antenna were evaluated with the worst case emissions being reported. The worst-case emissions are reported.

Note 3. No other spurious and harmonic emissions were reported greater than listed emissions above table.

Note 4. Sample calculation

Margin = Limit – Field Strength

Field Strength = Reading + T.F – Distance factor

T.F = AF + CL – AG

Distance factor = $20\log(\text{Measurement distance} / \text{The measured distance})^2$

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain

3.2.4 Frequency Stability

- Procedure:

Part 15.225 requires that devices operating in the 13.553 – 13.567 MHz shall maintain the carrier frequency within 0.01% of the operating frequency over the temperature variation of -20 degrees to + 50 degrees C at normal supply voltage.

- Measurement Data: Comply

Operating Frequency : 13,559,958Hz

VOLTAGE (%)	POWER (V _{DC})	TEMP (°C)	Frequency (Hz)	Freq. Dev. (Hz)	Deviation (%)
100%	3.300	+20(ref)	13,559,958	-42	-0.000310
100%		-20	13,559,977	-23	-0.000170
100%		-10	13,559,987	-13	-0.000096
100%		0	13,559,946	-54	-0.000398
100%		+10	13,559,959	-41	-0.000302
100%		+20	13,559,977	-23	-0.000170
100%		+30	13,559,967	-33	-0.000243
100%		+40	13,559,895	-105	-0.000774
100%		+50	13,559,898	-102	-0.000752
85%	2.805	+20	13,559,976	-24	-0.000177
115%	3.795	+20	13,559,942	-58	-0.000428
BATT.ENDPOINT	N/A	N/A	N/A	N/A	N/A

- Minimum Standard: Part 15. 225(e) & RSS-210 A2.6

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency.

3.2.5 AC Line Conducted Emissions

- Procedure:

The conducted emissions are measured in the shielded room with a spectrum analyzer in peak hold. While the measurement, EUT had its hopping function disabled at the middle channels in line with Section 15.21(m). Emissions closest to the limit are measured in the quasi-peak and average detector mode with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation and Exerciser operation. The highest emissions relative to the limit are listed.

- Measurement Data: **Comply** (refer to the next page)

- Minimum Standard: FCC Part 15.207(a) & RSS-Gen 8.8

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

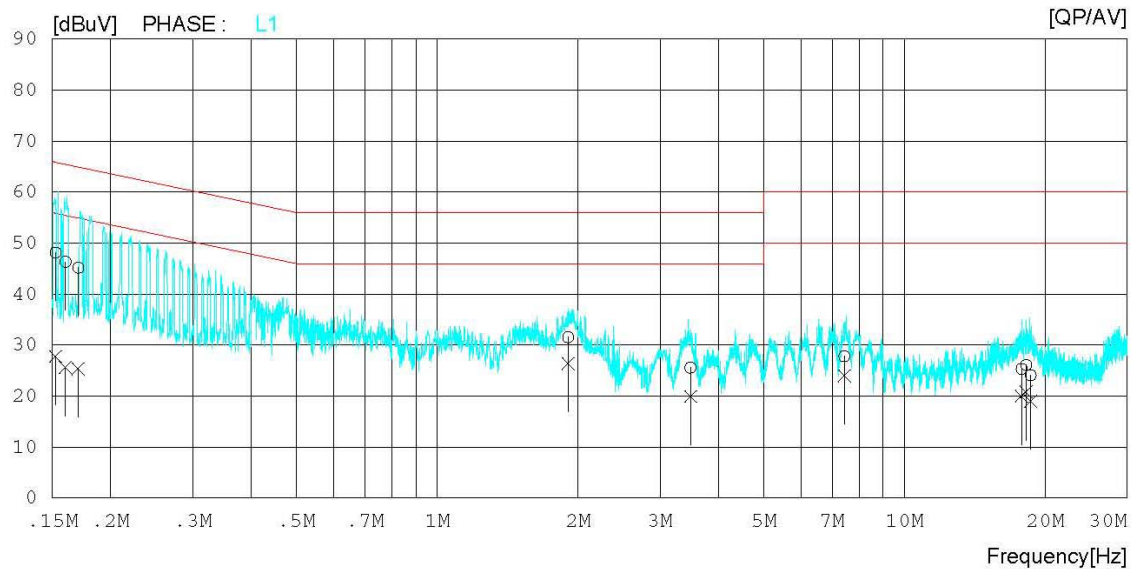
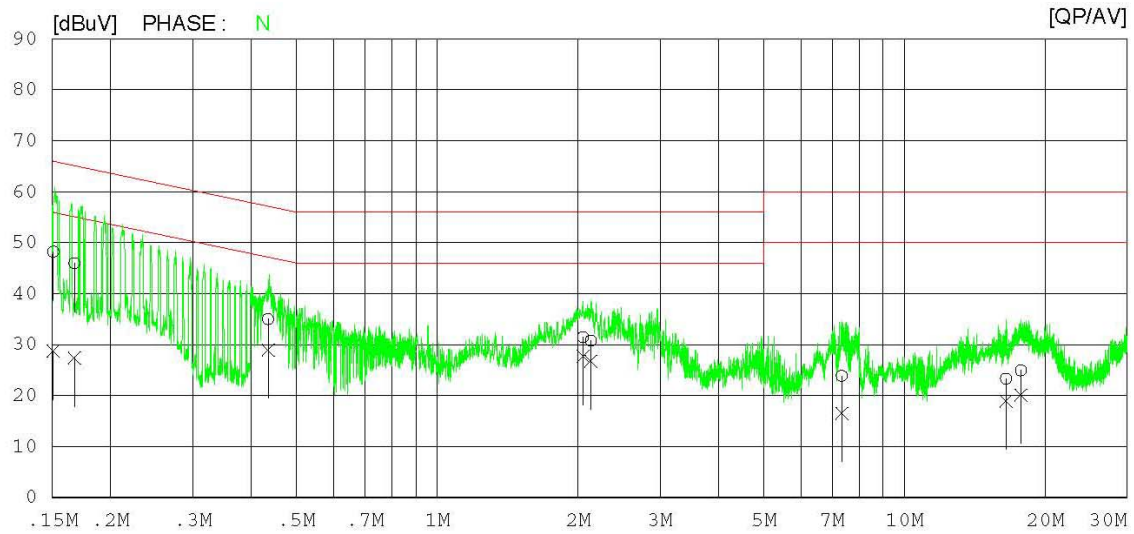
Measurement Data

Results of Conducted Emission

Date : 2014-11-04

Model No. : WSNFM400A00
Type :
Serial No. :
Test Condition : TM2Reference No. :
Power Supply : 120 V 60 Hz
Temp/Humi. : 20 'C 48 % R.H.
Operator :

Memo :

LIMIT : FCC P15.207 QP
FCC P15.207 AV

Measurement Data**Results of Conducted Emission**

Date : 2014-11-04

Model No. : WSNFM400A00
Type :
Serial No. :
Test Condition : TM2Reference No. :
Power Supply : 120 V 60 Hz
Temp/Humi. : 20 'C 48 % R.H.
Operator :

Memo :

LIMIT : FCC P15.207 QP
FCC P15.207 AV

NO	FREQ [MHz]	READING		C. FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.15071	38.3	18.8	9.9	48.2	28.7	66.0	56.0	17.8	27.3	N
2	0.16721	36.1	17.5	9.9	46.0	27.4	65.1	55.1	19.1	27.7	N
3	0.43450	25.1	19.1	9.9	35.0	29.0	57.2	47.2	22.2	18.2	N
4	2.05240	21.5	17.7	10.0	31.5	27.7	56.0	46.0	24.5	18.3	N
5	2.13120	20.8	16.7	10.0	30.8	26.7	56.0	46.0	25.2	19.3	N
6	7.34620	13.7	6.3	10.2	23.9	16.5	60.0	50.0	36.1	33.5	N
7	16.50220	13.0	8.6	10.3	23.3	18.9	60.0	50.0	36.7	31.1	N
8	17.75880	14.5	9.7	10.4	24.9	20.1	60.0	50.0	35.1	29.9	N
9	0.15249	38.2	17.9	9.9	48.1	27.8	65.9	55.9	17.8	28.1	L1
10	0.16005	36.4	15.7	9.9	46.3	25.6	65.5	55.5	19.2	29.9	L1
11	0.17055	35.3	15.4	9.9	45.2	25.3	64.9	54.9	19.7	29.6	L1
12	1.90740	21.5	16.4	10.0	31.5	26.4	56.0	46.0	24.5	19.6	L1
13	3.48520	15.4	9.8	10.1	25.5	19.9	56.0	46.0	30.5	26.1	L1
14	7.43740	17.6	13.8	10.2	27.8	24.0	60.0	50.0	32.2	26.0	L1
15	17.82720	14.9	9.6	10.4	25.3	20.0	60.0	50.0	34.7	30.0	L1
16	18.24440	15.6	10.4	10.4	26.0	20.8	60.0	50.0	34.0	29.2	L1
17	18.65160	13.7	8.6	10.4	24.1	19.0	60.0	50.0	35.9	31.0	L1

APPENDIX

TEST EQUIPMENT FOR TESTS

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent	N9020A	14/01/07	15/01/07	MY49100833
Multimeter	HP	34401A	14/02/27	15/02/27	3146A13475
Dynamic Measurement DC Source	Agilent	66332A	14/10/20	15/10/20	US37474353
Vector Signal Generator	Rohde Schwarz	SMJ100A	14/01/07	15/01/07	100148
Thermohygrometer	BODYCOM	BJ5478	14/05/13	15/05/13	120612-1
Temp & Humi Test Chamber	JISICO	KR-100/J-RHC2	14/09/12	15/09/12	30604493/021031
Loop Antenna	ETS	6502	12/12/11	14/12/11	3471
Loop Antenna	Schwarzbeck	FMZB1513	14/04/29	16/04/29	1513-128
TRILOG Broadband Test Antenna (30MHz-1GHz)	SCHWARZBECK	VULB9160	14/07/31	16/07/31	2737
Amplifier (22dB)	HP	8447E	14/01/08	15/01/08	2945A02865
EMI TEST RECEIVER	R&S	ESU	14/01/08	15/01/08	100014
EMI TEST RECEIVER	R&S	ESCI	14/02/27	15/02/27	100364
LISN	SCHWARZBECK	NNLK8121	14/08/18	15/08/18	NNLK8121-580