



FCC Test Report

Equipment : NFC Reader
Brand Name : TM-007-Mini
Model No. : TM-007-Mini-EVM
FCC ID : VZPTM-007-MINI
Standard : 47 CFR FCC Part 15.225
Operating Band : 13.553 – 13.567 MHz (channel freq. 13.56 MHz)
Equipment Class : DXX
Applicant : Jogtek Crop.
Manufacturer : 2F., No .39, Ln. 365, Yangguang St., Neihu Dist.,
Taipei City 114, Taiwan

The product sample received on Jan. 04, 2014 and completely tested on Jan. 10, 2014. We, SPORTON, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2009 and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by:


Wayne Hsu / Assistant Manager





Table of Contents

1	GENERAL DESCRIPTION	5
1.1	Information.....	5
1.2	Support Equipment.....	6
1.3	Testing Applied Standards	6
1.4	Testing Location Information	6
1.5	Measurement Uncertainty	7
2	TEST CONFIGURATION OF EUT	8
2.1	The Worst Case Modulation Configuration	8
2.2	Test Channel Frequencies Configuration.....	8
2.3	The Worst Case Measurement Configuration.....	8
2.4	Test Setup Diagram	9
3	TRANSMITTER TEST RESULT	10
3.1	AC Power-line Conducted Emissions	10
3.2	Emission Bandwidth	14
3.3	Field Strength of Fundamental Emissions and Spectrum Mask	16
3.4	Transmitter Radiated Unwanted Emissions	19
3.5	Frequency Stability	29
4	TEST EQUIPMENT AND CALIBRATION DATA	31
APPENDIX A. TEST PHOTOS		A1
APPENDIX B. PHOTOGRAPHS OF EUT		B1



Summary of Test Result

Conformance Test Specifications					
Report Clause	Ref. Std. Clause	Description	Measured	Limit	Result
1.1.2	15.203	Antenna Requirement	Antenna connector mechanism complied	FCC 15.203	Complied
3.1	15.207	AC Power-line Conducted Emissions	[dBuV]: 0.242932MHz 36.12 (Margin 15.88dB) - AV 51.41 (Margin 10.59dB) - QP	FCC 15.207	Complied
3.2	15.215(c)	Emission Bandwidth	20dB Bandwidth 2.64 [kHz] $F_L: 13.55864 \text{ MHz}$ $F_H: 13.56128 \text{ MHz}$	Fall in band $F_L \geq 13.553 \text{ MHz}$ $F_H \leq 13.567 \text{ MHz}$	Complied
3.3	15.225(a)~(d)	Field Strength of Fundamental Emissions and Spectrum Mask	Fundamental Emissions quasi peak: 35.57 dBuV/m at 3m Device complies with spectrum mask – refer to test data	103.1 dBuV/m at 3	Complied
3.4	15.225(d)	Transmitter Radiated Unwanted Emissions	[dBuV/m at 3m]: 75.59MHz 33.81 (Margin 6.19dB) - PK	FCC 15.209	Complied
3.5	15.225(e)	Frequency Stability	14.75 ppm	$\pm 0.01\% \text{ (100ppm)}$	Complied



Revision History



1 General Description

1.1 Information

1.1.1 RF General Information

RF General Information				
Frequency Range	Modulation	Ch. Frequency (MHz)	Channel Number	Field Strength (dBuV/m)
13.553 – 13.567 MHz	ISO 14443-2 (ASK)	13.56	1	35.57
Note 1: Field strength performed quasi peak level at 3m.				

1.1.2 Antenna Information

Antenna Category	
<input type="checkbox"/>	Equipment placed on the market without antennas
<input checked="" type="checkbox"/>	Integral antenna (antenna permanently attached)
<input type="checkbox"/>	External antenna (dedicated antennas)

1.1.3 Type of EUT

Identify EUT	
EUT Serial Number	N/A
Presentation of Equipment	<input checked="" type="checkbox"/> Production ; <input type="checkbox"/> Pre-Production ; <input type="checkbox"/> Prototype
Type of EUT	
<input checked="" type="checkbox"/>	Stand-alone
<input type="checkbox"/>	Combined (EUT where the radio part is fully integrated within another device) Combined Equipment - Brand Name / Model No.: ...
<input type="checkbox"/>	Plug-in radio (EUT intended for a variety of host systems) Host System - Brand Name / Model No.: ...
<input type="checkbox"/>	Other:

1.1.4 Test Signal Duty Cycle

Operated Mode for Worst Duty Cycle	
<input checked="" type="checkbox"/> Operated test mode for worst duty cycle	
Test Signal Duty Cycle (x)	Voltage Duty Factor [dB] – (20 log 1/x)
<input checked="" type="checkbox"/> 100%	0

1.1.5 EUT Operational Condition

Supply Voltage	<input type="checkbox"/> AC mains	<input checked="" type="checkbox"/> DC	<input checked="" type="checkbox"/> System
Type of DC Source	<input type="checkbox"/> Internal DC supply	<input checked="" type="checkbox"/> External DC from USB cable	<input type="checkbox"/> Li-on Battery



1.2 Support Equipment

Support Equipment			
No.	Equipment	Brand Name	Model Name
1	Notebook	Dell	E5520
2	Evaluation board	-	-

Note: The evaluation board was customer provided.

1.3 Testing Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ 47 CFR FCC Part 15
- ♦ ANSI C63.10-2009
- ♦ FCC KDB 174176

1.4 Testing Location Information

Testing Location			
<input checked="" type="checkbox"/>	HWA YA	ADD : No. 52, Hwa Ya 1 st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.	TEL : 886-3-327-3456 FAX : 886-3-327-0973
Test Condition		Test Site No.	Test Engineer
AC Conduction		CO04-HY	Zeus
RF Conducted		TH06-HY	Cain
Radiated Emission		03CH02-HY	Daniel



1.5 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty		
Test Item	Uncertainty	
AC power-line conducted emissions	± 2.26 dB	
Emission bandwidth	± 1.42 %	
Unwanted emissions, conducted	9 – 150 kHz	± 0.38 dB
	0.15 – 30 MHz	± 0.42 dB
	30 – 1000 MHz	± 0.51 dB
All emissions, radiated	9 – 150 kHz	± 2.49 dB
	0.15 – 30 MHz	± 2.28 dB
	30 – 1000 MHz	± 2.56 dB
Temperature	± 0.8 °C	
Humidity	± 3 %	
DC and low frequency voltages	± 3 %	
Time	± 1.42 %	
Duty Cycle	± 1.42 %	



2 Test Configuration of EUT

2.1 The Worst Case Modulation Configuration

Modulation Used for Conformance Testing	
Modulation Mode	Field Strength (dBuV/m at 3 m)
NFC-Read/Write	35.57

2.2 Test Channel Frequencies Configuration

Test Channel Frequencies Configuration	
Modulation Mode	Test Channel Frequencies (MHz) – FX (Frequencies Abbreviations)
NFC-Read/Write	13.56-(F1)

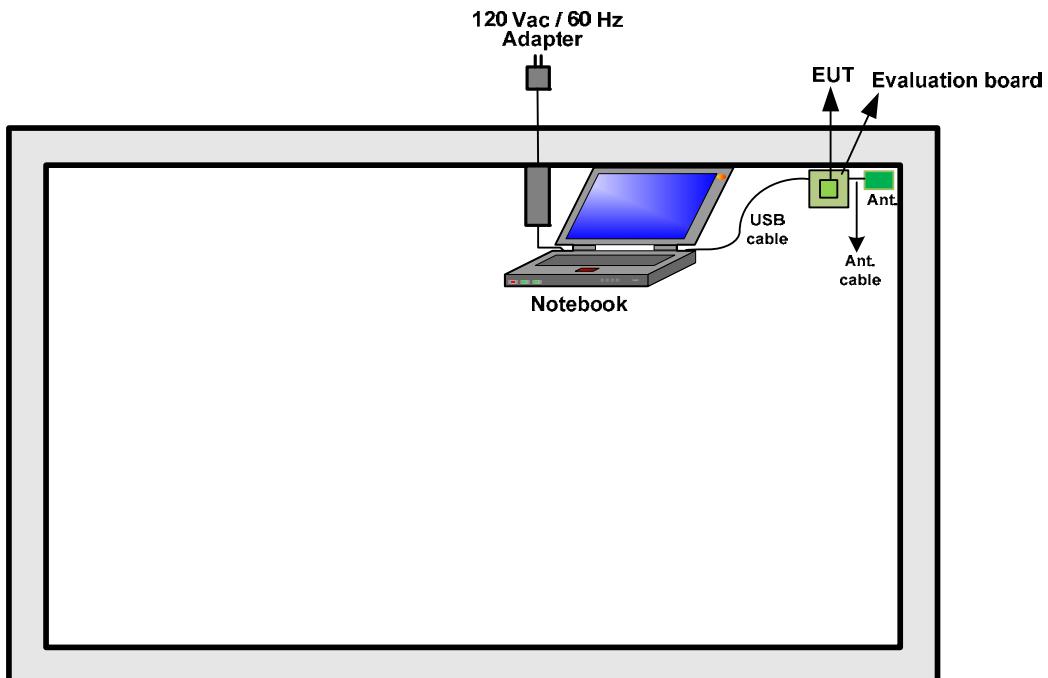
2.3 The Worst Case Measurement Configuration

The Worst Case Mode for Following Conformance Tests	
Tests Item	AC power-line conducted emissions
Condition	AC power-line conducted measurement for line and neutral Test Voltage: 120Vac / 60Hz
Operating Mode	Operating Mode Description
1	EUT with notebook via USB cable

The Worst Case Mode for Following Conformance Tests							
Tests Item	Emission Bandwidth, Field Strength of Fundamental Emissions Spectrum Mask, Transmitter Radiated Unwanted Emissions Frequency Stability						
Test Condition	Radiated measurement						
User Position	<input type="checkbox"/> EUT will be placed in fixed position. <input checked="" type="checkbox"/> EUT will be placed in mobile position and operating multiple positions. EUT shall be performed three orthogonal planes. The worst plane is Y. <input type="checkbox"/> EUT will be a hand-held or body-worn battery-powered devices and operating multiple positions. EUT shall be performed three orthogonal planes.						
Operating Mode	<input checked="" type="checkbox"/> 1. EUT with notebook via USB cable						
Modulation Mode	NFC-Read/Write						
Orthogonal Planes of EUT	<table border="1"> <thead> <tr> <th>X Plane</th> <th>Y Plane</th> <th>Z Plane</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> </tr> </tbody> </table>	X Plane	Y Plane	Z Plane			
X Plane	Y Plane	Z Plane					

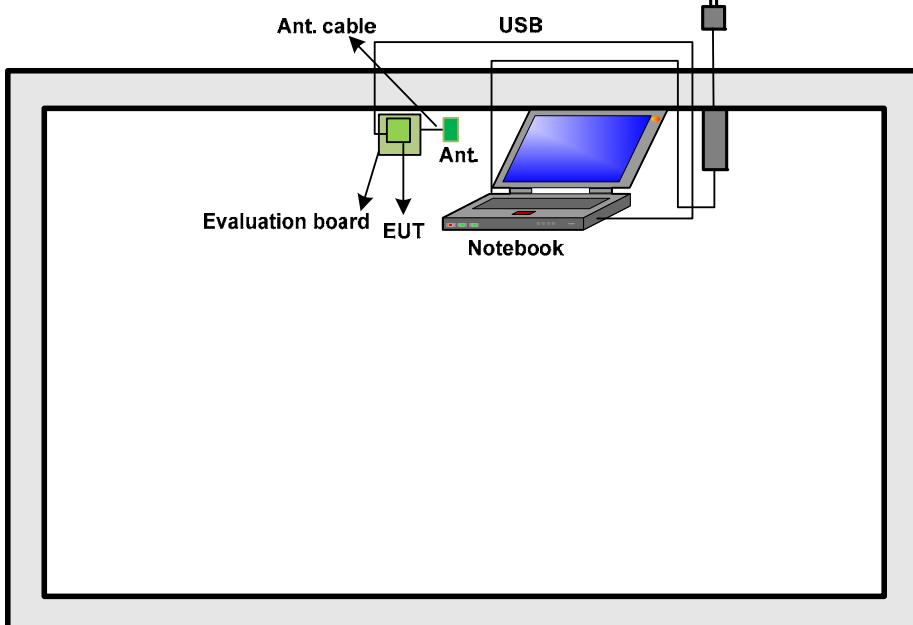
2.4 Test Setup Diagram

Test Setup Diagram – AC Line Conducted Emission Test



Test Setup Diagram - Radiated Test

120 Vac / 60 Hz Adapter





3 Transmitter Test Result

3.1 AC Power-line Conducted Emissions

3.1.1 AC Power-line Conducted Emissions Limit

AC Power-line Conducted Emissions Limit		
Frequency Emission (MHz)	Quasi-Peak	Average
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50

Note 1: * Decreases with the logarithm of the frequency.

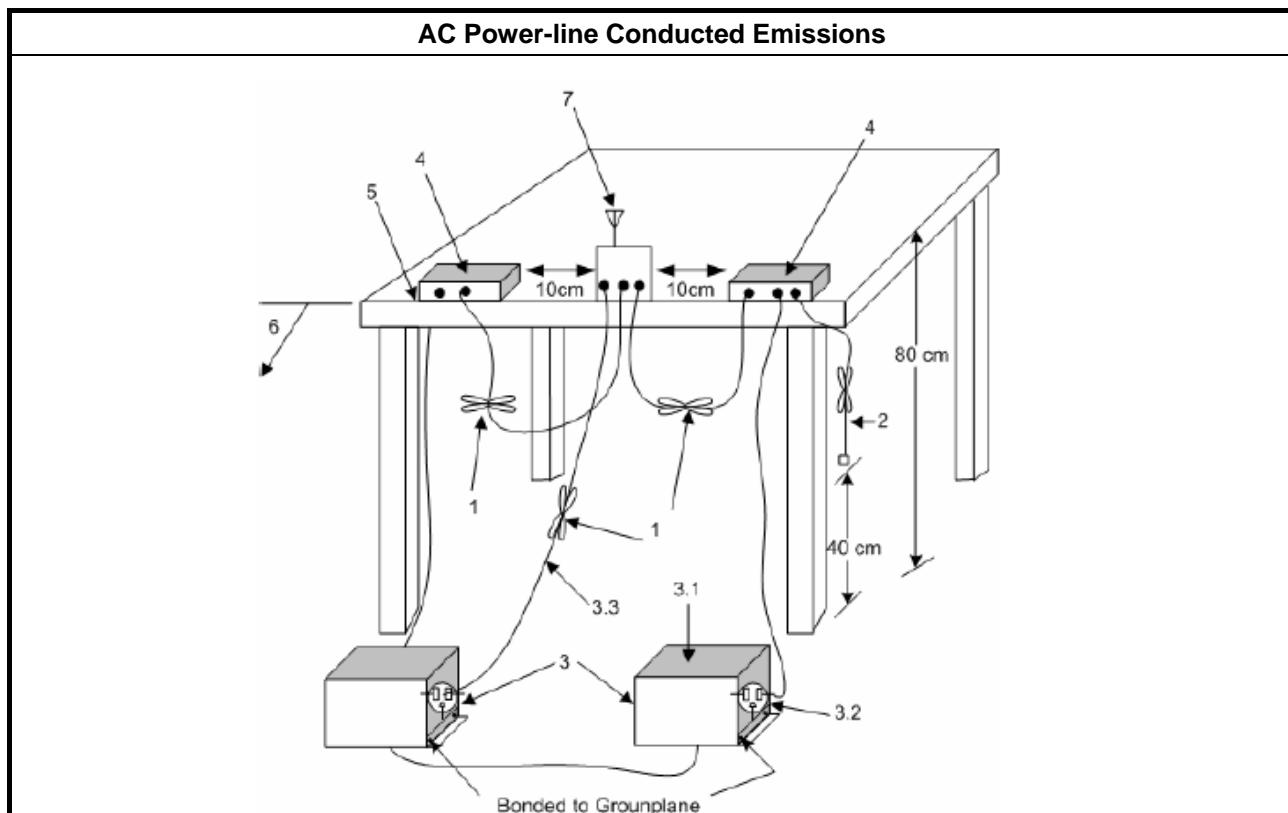
3.1.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.1.3 Test Procedures

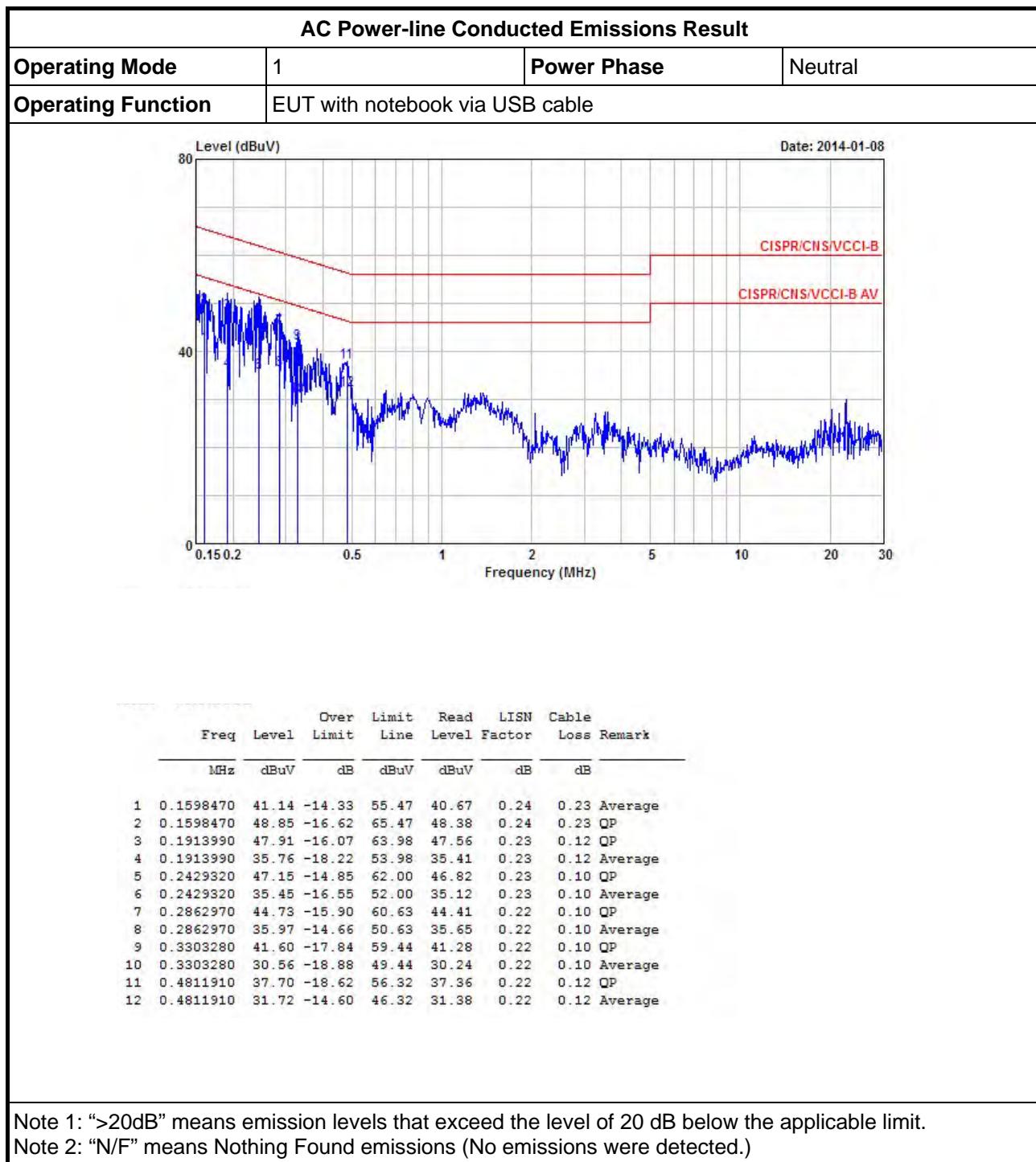
Test Method	
<input checked="" type="checkbox"/>	Refer as ANSI C63.10-2009, clause 6.2 for AC power-line conducted emissions.
<input checked="" type="checkbox"/>	If AC conducted emissions fall in operating band, then following below test method confirm final result.
<input type="checkbox"/>	Accept measurements done with a suitable dummy load replacing the antenna under the following conditions: (1) Perform the AC line conducted tests with the antenna connected to determine compliance with FCC 15.207 limits outside the transmitter's fundamental emission band; (2) Retest with a dummy load to determine compliance with FCC 15.207 limits within the transmitter's fundamental emission band.
<input checked="" type="checkbox"/>	For a device with a permanent antenna operating at or below 30 MHz, accept measurements done with a suitable dummy load, in lieu of the permanent antenna under the following conditions: (1) Perform the AC line conducted tests with the permanent antenna to determine compliance with the FCC 15.207 limits outside the transmitter's fundamental emission band; (2) Retest with a dummy load in lieu of the permanent antenna to determine compliance with the FCC 15.207 limits within the transmitter's fundamental emission band.

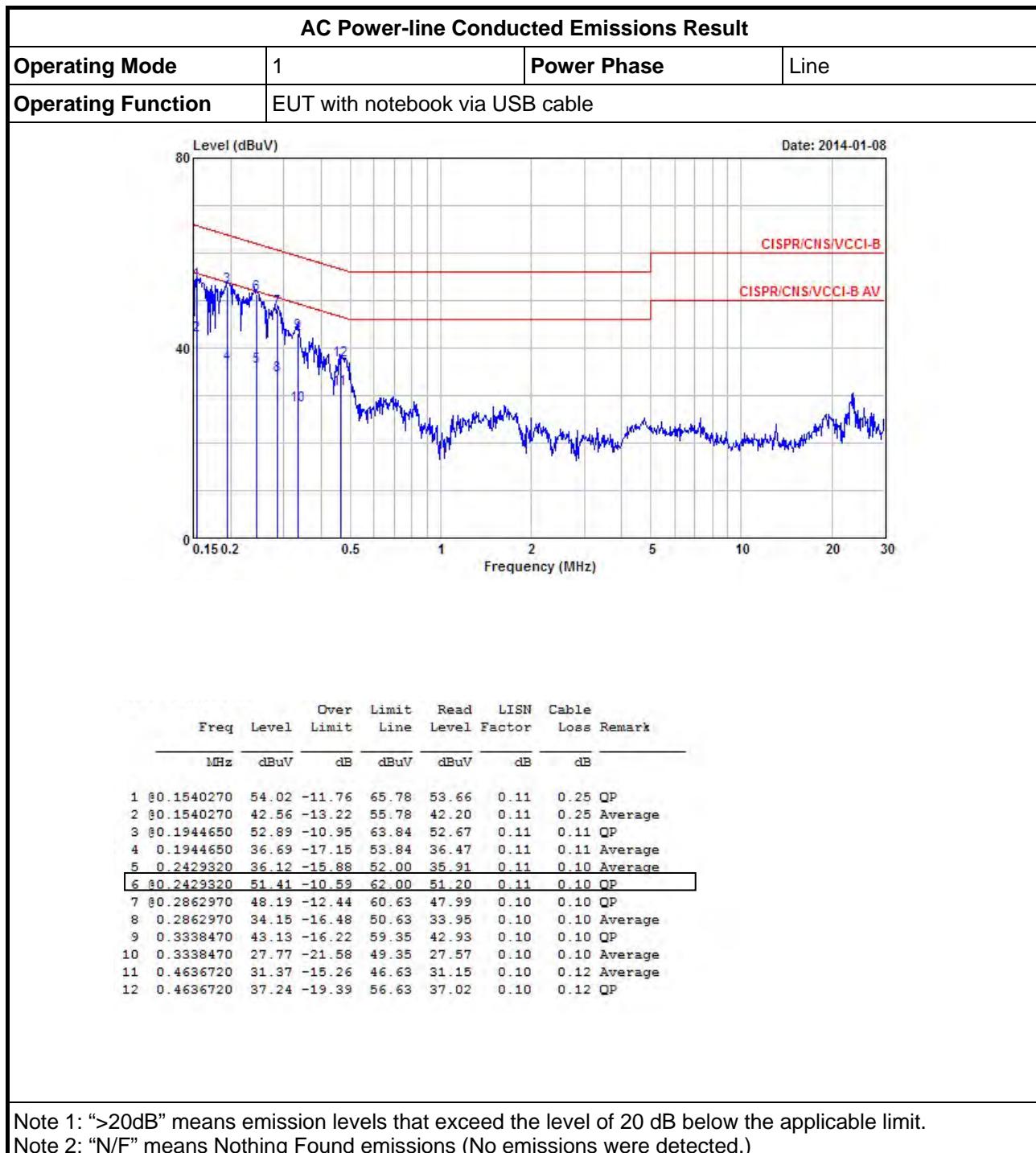
3.1.4 Test Setup





3.1.5 Test Result of AC Power-line Conducted Emissions





3.2 Emission Bandwidth

3.2.1 Emission Bandwidth Limit

20dB Bandwidth Limit

- Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emissions in the specific band (13.553 – 13.567 MHz).

3.2.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

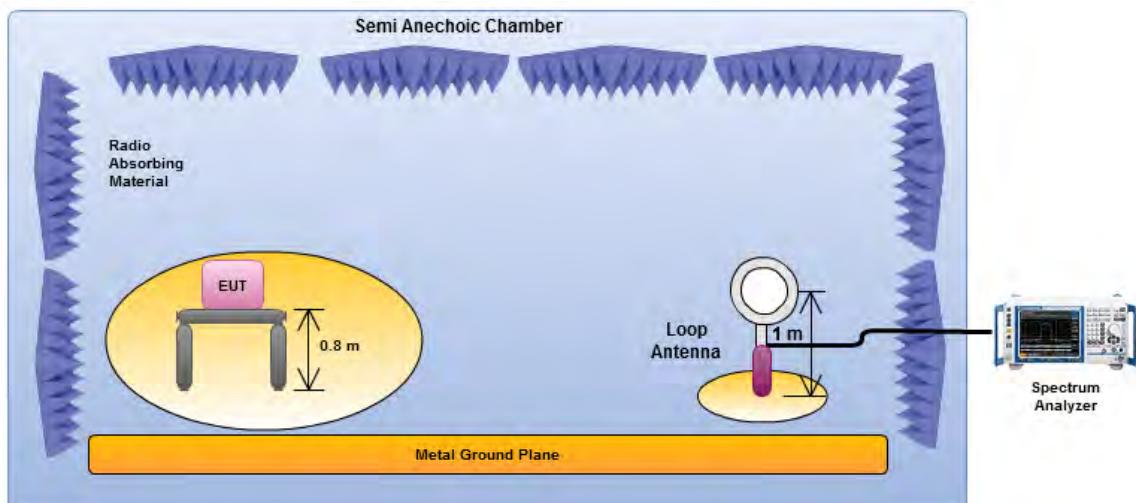
3.2.3 Test Procedures

Test Method

- For the emission bandwidth refer ANSI C63.10, clause 6.9.1 for occupied bandwidth testing.
- For radiated measurement. Loop antenna was rotated about the horizontal and vertical axis and the equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted field strength level.

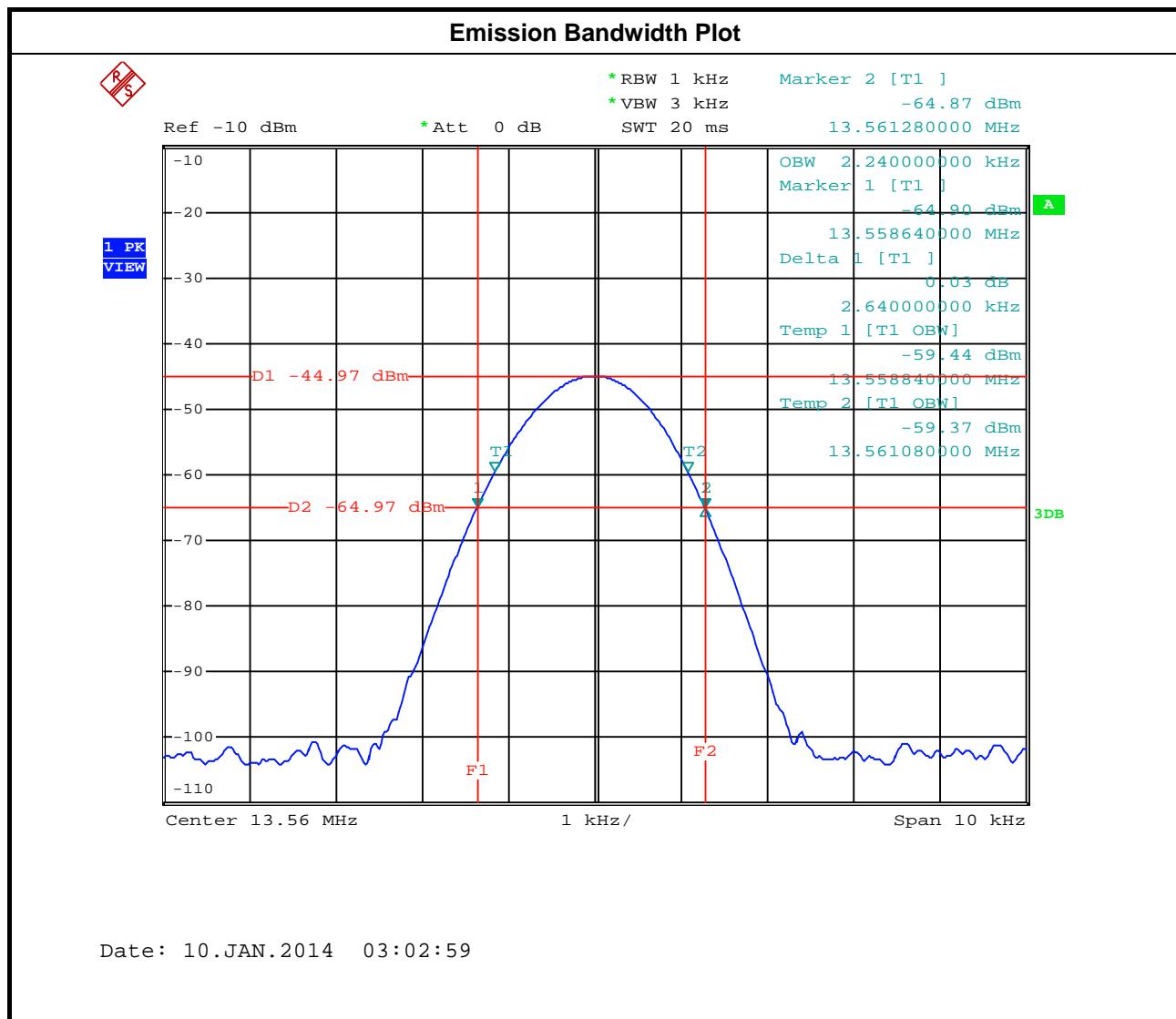
3.2.4 Test Setup

Emission Bandwidth



3.2.5 Test Result of Emission Bandwidth

Occupied Channel Bandwidth Result					
Modulation Mode	Frequency (MHz)	20dB Bandwidth (kHz)	F_L at 20dB BW (kHz)	F_H at 20dB BW (MHz)	99% Bandwidth (kHz)
NFC-Read/Write	13.56	2.64	13.55864	13.56128	2.24
Limit	N/A	13.553	13.567	N/A	
Result	Complied				





3.3 Field Strength of Fundamental Emissions and Spectrum Mask

3.3.1 Field Strength of Fundamental Emissions and Spectrum Mask Limit

Field Strength of Fundamental Emissions					
Emissions	(uV/m)@30m	(dBuV/m)@30m	(dBuV/m)@10m	(dBuV/m)@3m	(dBuV/m)@1m
Fundamental	15848	84.0	103.1	124.0	143.1
Quasi peak measurement of the fundamental.					

Spectrum Mask					
Freq. of Emission (MHz)	(uV/m)@30m	(dBuV/m)@30m	(dBuV/m)@10m	(dBuV/m)@3m	(dBuV/m)@1m
1.705~13.110	30	29.5	48.6	69.5	88.6
13.110~13.410	106	40.5	59.6	80.5	99.6
13.410~13.553	334	50.5	69.6	90.5	109.6
13.553~13.567	15848	84.0	103.1	124.0	143.1
13.567~13.710	334	50.5	69.6	90.5	109.6
13.710~14.010	106	40.5	59.6	80.5	99.6
14.010~30.000	30	29.5	48.6	69.5	88.6

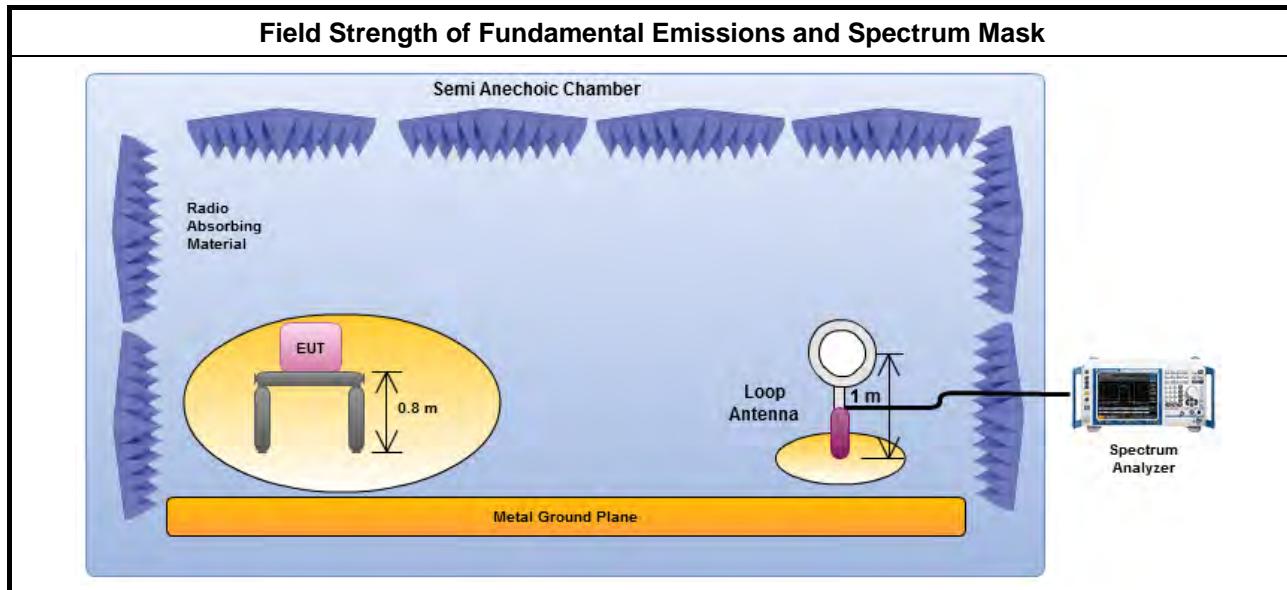
3.3.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.3.3 Test Procedures

Test Method	
<input checked="" type="checkbox"/>	Refer as ANSI C63.10, clause 6.4 for radiated emissions from below 30 MHz. quasi peak measurement of the fundamental.
<input checked="" type="checkbox"/>	At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the requirements; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be following below methods.
<input type="checkbox"/>	The results shall be extrapolated to the specified distance by making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor.
<input checked="" type="checkbox"/>	The results shall be by using the square of an inverse linear distance extrapolation factor (40 dB/decade).
<input checked="" type="checkbox"/>	For radiated measurement. Loop antenna was rotated about the horizontal and vertical axis and the equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted field strength level.

3.3.4 Test Setup



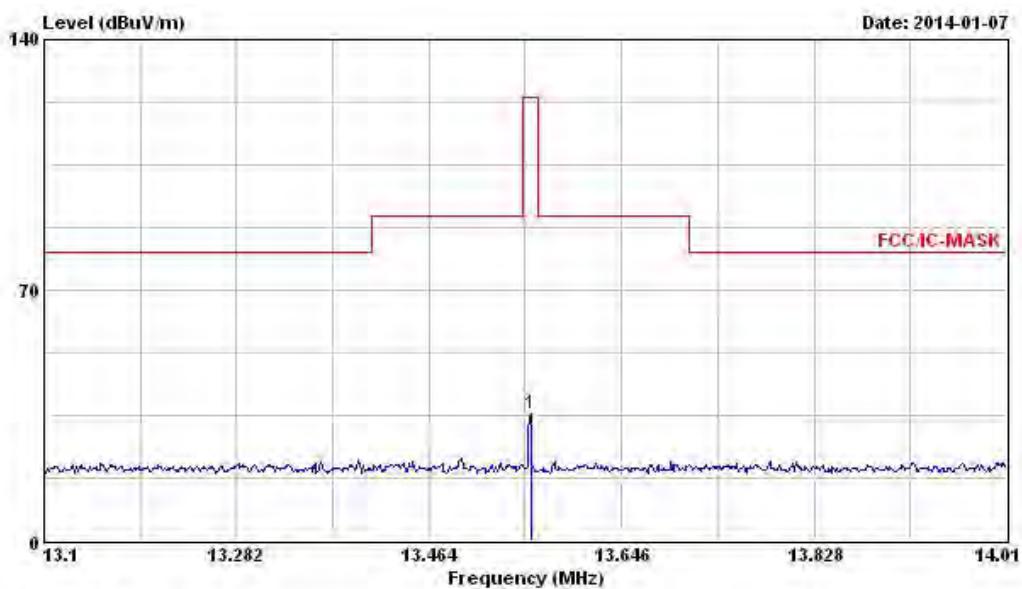
3.3.5 Test Result of Field Strength of Fundamental Emissions and Spectrum Mask

Field Strength of Fundamental Emissions Result					
Modulation Mode	Frequency (MHz)	Fundamental (dBuV/m)@3m	Polarization	Margin (dB)	Limit (dBuV/m)@3m
NFC-Read/Write	F1	35.57	H	88.43	124
Result		Complied			

Note 1: Measurement worst emissions of receive antenna polarization: H (Horizontal).



Spectrum Mask Plot



Freq MHz	Level dBuV/m	Over Limit dB	Limit Line dBuV/m	Read Level dBuV	Antenna Factor	Cable Loss dB	Preamp Factor	Remark	Ant Pos	Table Pos
									cm	deg
13.560	35.57	-88.43	124.00	14.99	20.10	0.48	0.00	Peak	---	---



3.4 Transmitter Radiated Unwanted Emissions

3.4.1 Transmitter Radiated Unwanted Emissions Limit

Transmitter Radiated Unwanted Emissions Limit			
Frequency Range (MHz)	Field Strength (uV/m)	Field Strength (dBuV/m)	Measure Distance (m)
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.

3.4.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

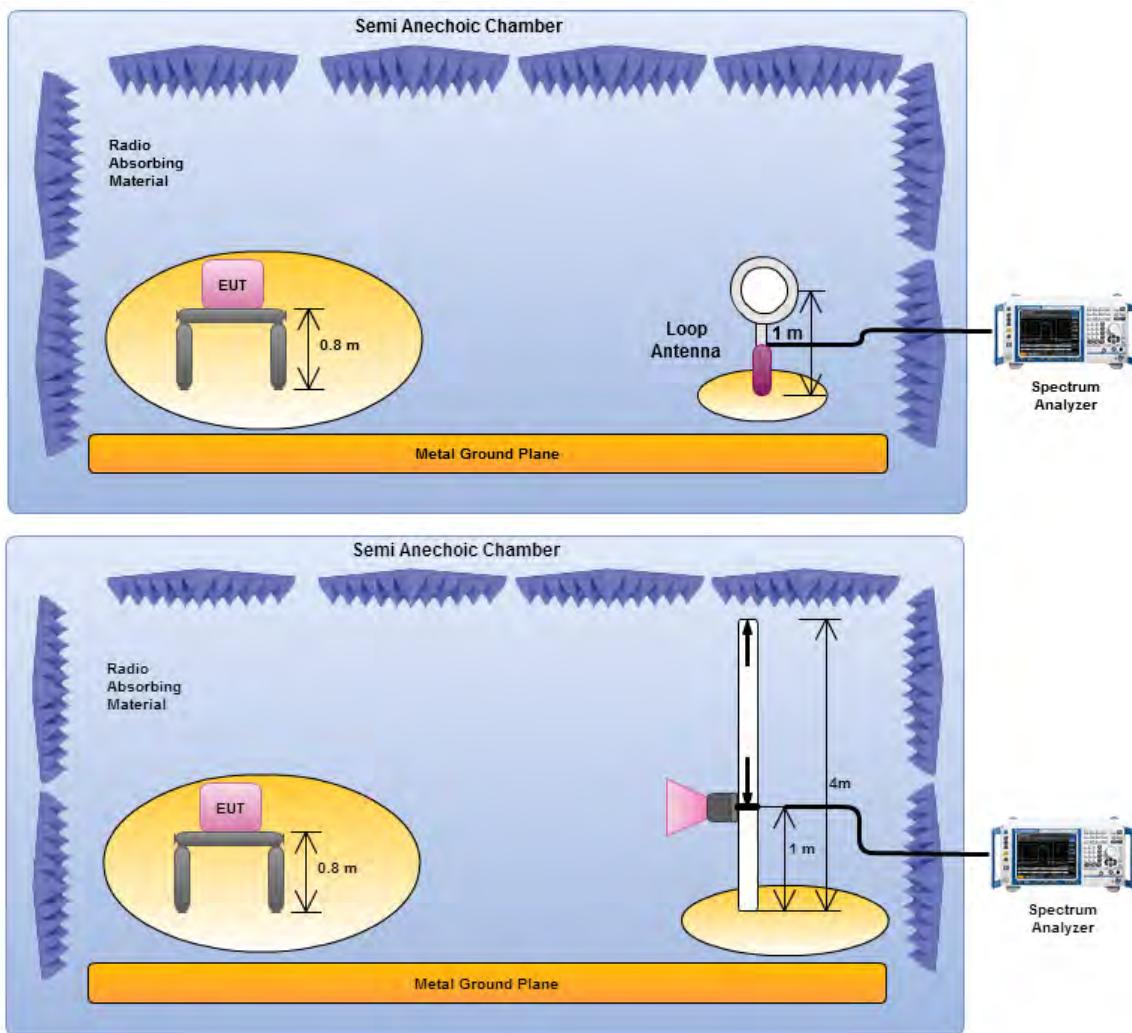


3.4.3 Test Procedures

Test Method
<input checked="" type="checkbox"/> Refer as ANSI C63.10, clause 6.5 for radiated emissions from 30 MHz to 1000 MHz.
<input checked="" type="checkbox"/> Refer as ANSI C63.10, clause 6.4 for radiated emissions from below 30 MHz. quasi peak measurement of the fundamental.
<input checked="" type="checkbox"/> At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the requirements; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be following below methods. <ul style="list-style-type: none"><input type="checkbox"/> The results shall be extrapolated to the specified distance by making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor.<input checked="" type="checkbox"/> The results shall be by using the square of an inverse linear distance extrapolation factor (40 dB/decade).
<input checked="" type="checkbox"/> For radiated measurement. Loop antenna was rotated about the horizontal and vertical axis and the equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted field strength level.

3.4.4 Test Setup

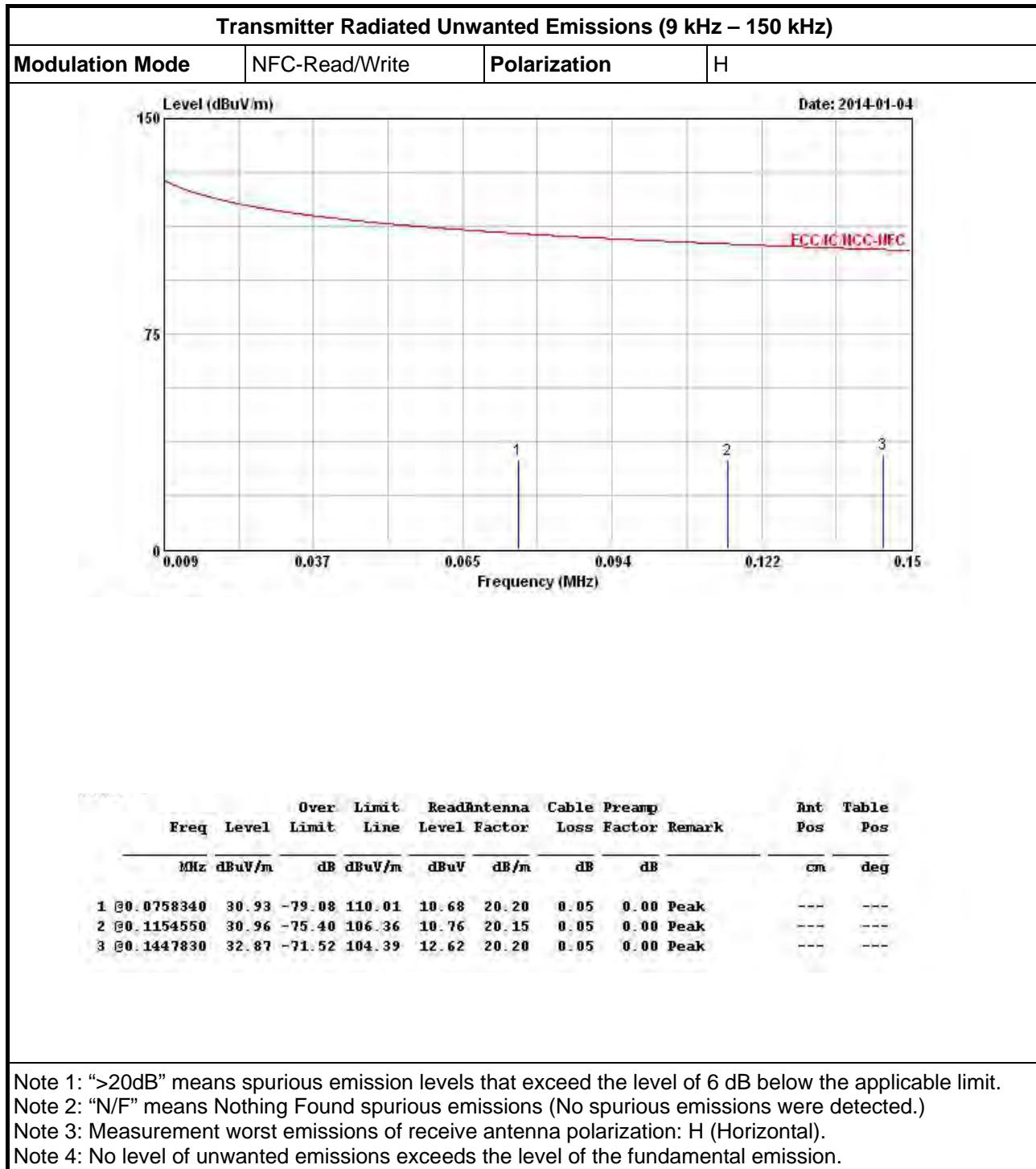
Transmitter Radiated Unwanted Emissions



Magnetic field tests shall be performed in the frequency range of 9 kHz to 30 MHz using a calibrated loop antenna. The center of the loop shall be 1 m above the ground. Electric field tests shall be performed in the frequency range of 30 MHz to 1000 MHz using a calibrated bi-log antenna. the antenna height shall be varied from 1 m to 4 m.

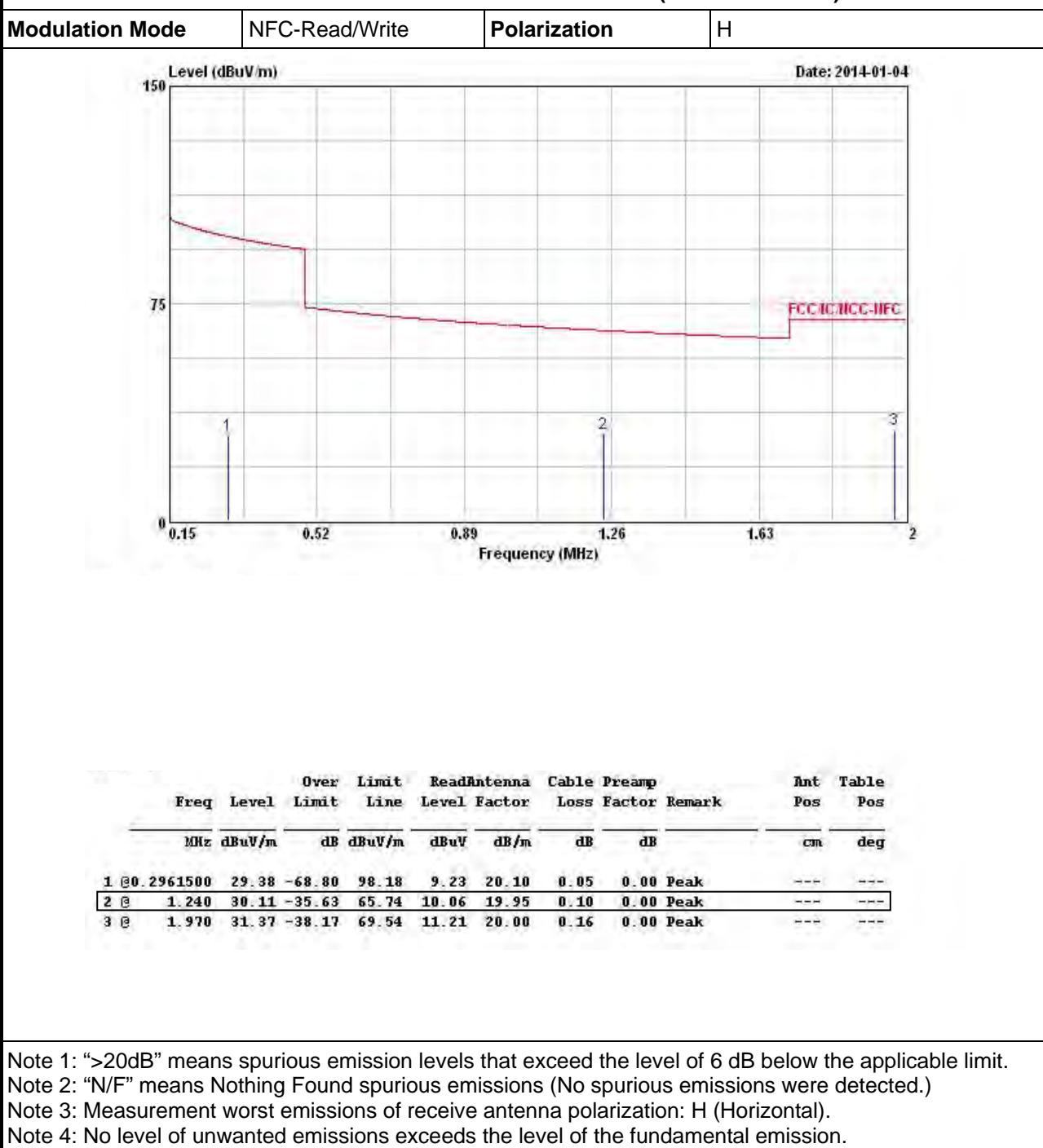


3.4.5 Transmitter Radiated Unwanted Emissions (Below 30MHz)



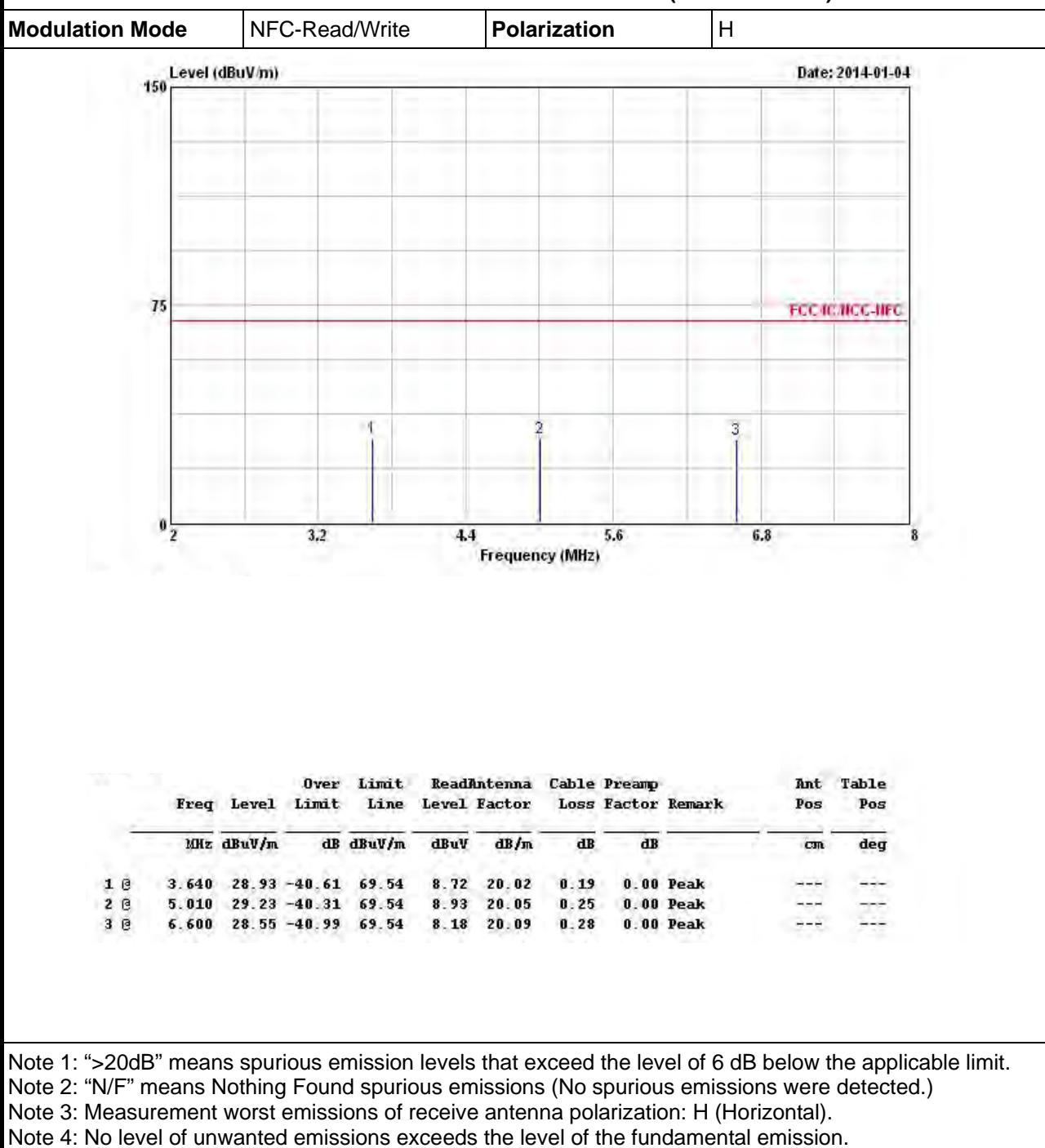


Transmitter Radiated Unwanted Emissions (150 kHz – 2 MHz)



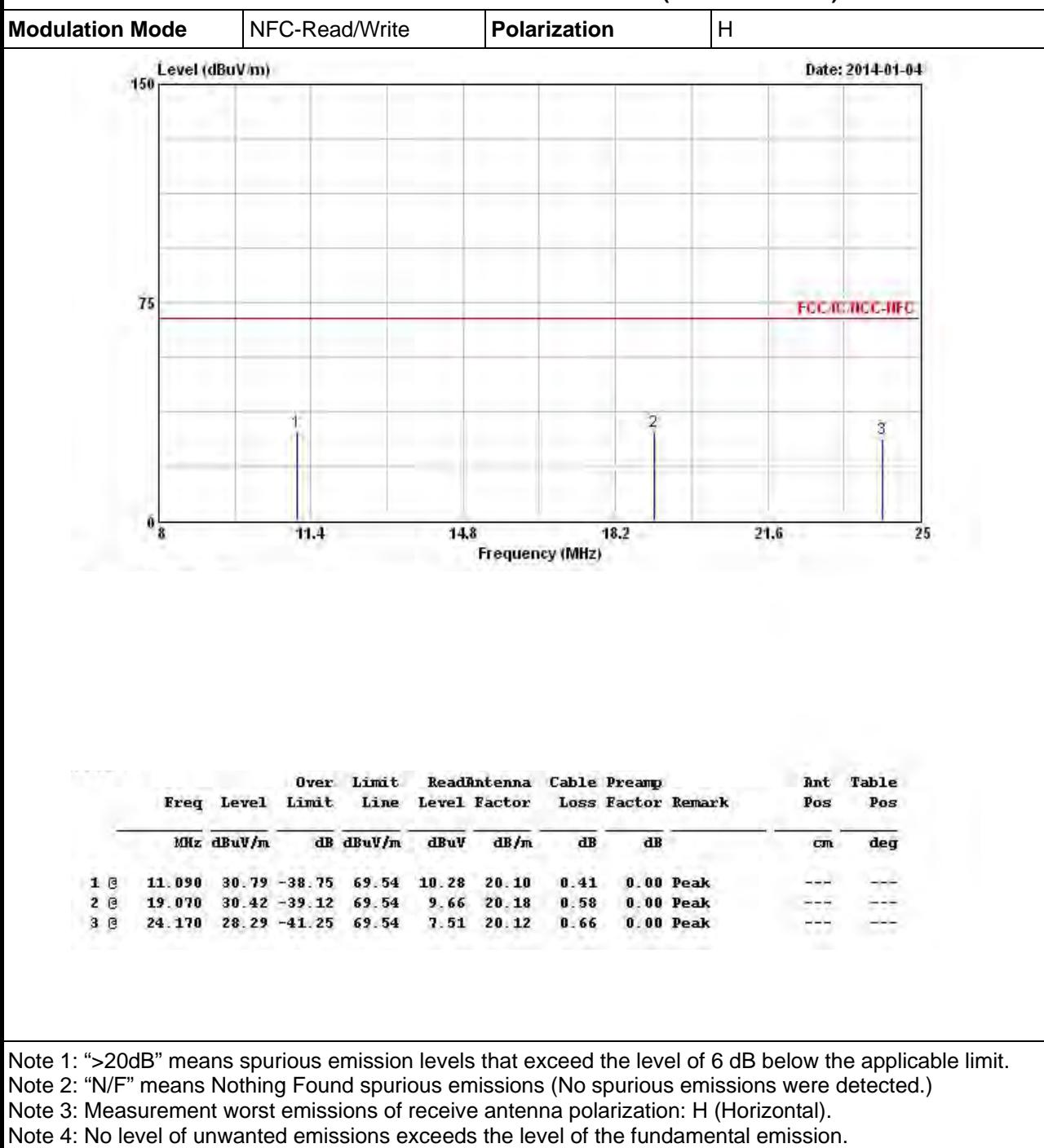


Transmitter Radiated Unwanted Emissions (2 MHz – 8 MHz)



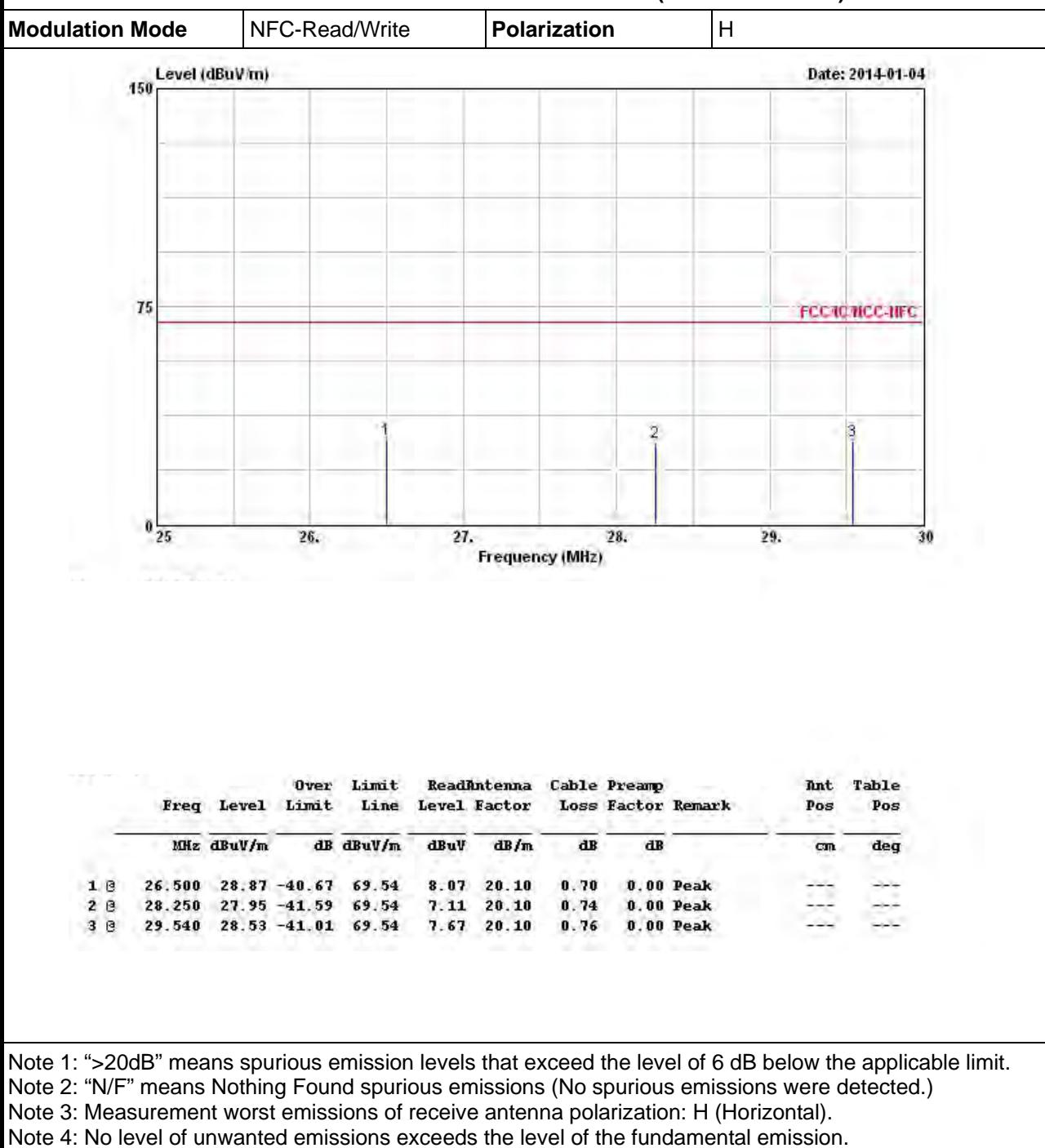


Transmitter Radiated Unwanted Emissions (8 MHz – 25 MHz)





Transmitter Radiated Unwanted Emissions (25 MHz – 30 MHz)

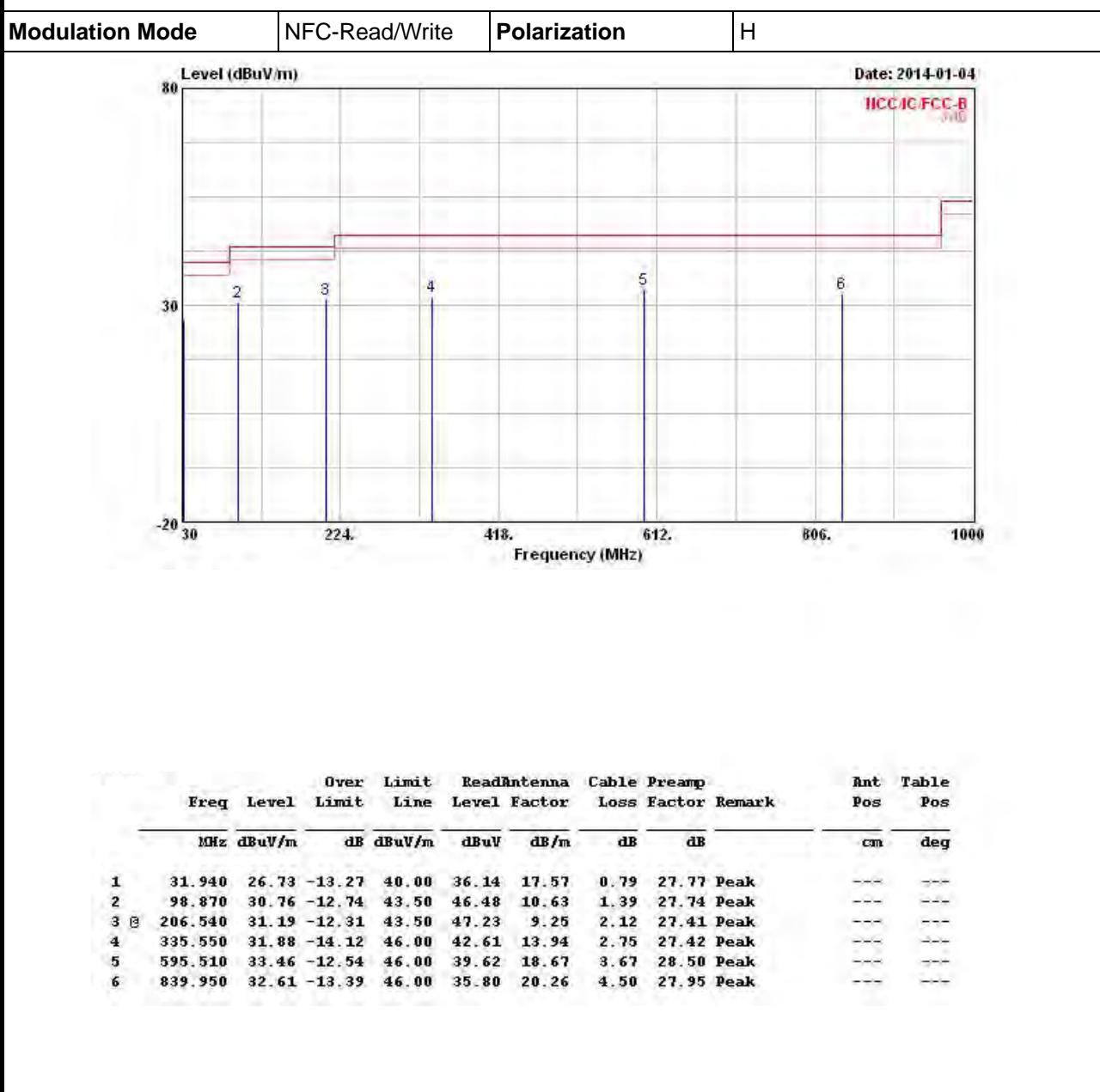


3.4.6 Transmitter Radiated Unwanted Emissions (Below 1GHz)





Transmitter Radiated Unwanted Emissions



3.5 Frequency Stability

3.5.1 Frequency Stability Limit

Frequency Stability Limit
<input checked="" type="checkbox"/> Carrier frequency stability shall be maintained to $\pm 0.01\%$ (± 100 ppm).

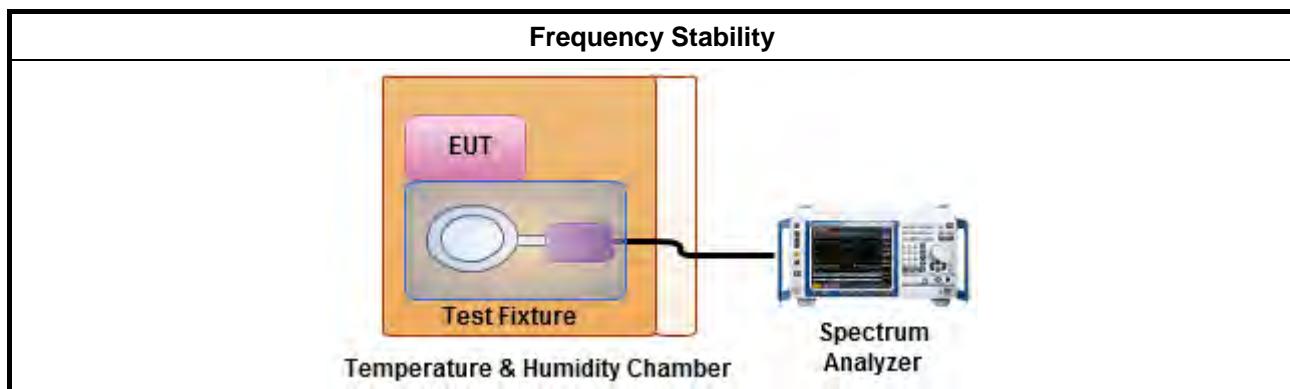
3.5.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.5.3 Test Procedures

Test Method
<input checked="" type="checkbox"/> Refer as ANSI C63.10, clause 6.8 for frequency stability tests
<input checked="" type="checkbox"/> Frequency stability with respect to ambient temperature
<input checked="" type="checkbox"/> Frequency stability when varying supply voltage
<input type="checkbox"/> For conducted measurement.
<input checked="" type="checkbox"/> For radiated measurement. The equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted power level.

3.5.4 Test Setup





3.5.5 Test Result of Frequency Stability

Frequency Stability Result			
Power Level	1	Frequency Stability (ppm)	
Condition	Freq. (MHz)	10 min	Limit
T _{20°C} Vmax	13.56	-1.47	100.0
T _{20°C} Vmin	13.56	-2.95	100.0
T _{50°C} Vnom	13.56	-14.75	100.0
T _{40°C} Vnom	13.56	-11.80	100.0
T _{30°C} Vnom	13.56	-5.90	100.0
T _{20°C} Vnom	13.56	-1.47	100.0
T _{10°C} Vnom	13.56	1.47	100.0
T _{0°C} Vnom	13.56	5.90	100.0
T _{-10°C} Vnom	13.56	8.85	100.0
T _{-20°C} Vnom	13.56	8.85	100.0
Result		Complied	
Note 1: Measure at 85 % [Vmin] and 115 % [Vmax] of the nominal voltage [Vnom]. The nominal voltage refer test report clause 1.1.5 for EUT operational condition.			



4 Test Equipment and Calibration Data

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
EMC Receiver	R&S	ESCS 30	100174	9kHz ~ 2.75GHz	Mar. 26, 2013	Conduction (CO04-HY)
LISN	SCHWARZBECK MESS-ELEKTRONIK	NSLK 8127	8127-477	9kHz ~ 30MHz	Jan. 21, 2013	Conduction (CO04-HY)
RF Cable-CON	HUBER+SUHNER	RG213/U	7.61183201e+012	9kHz ~ 30MHz	Oct. 30, 2013	Conduction (CO04-HY)
EMI Filter	LINDGREN	LRE-2030	2651	< 450 Hz	N/A	Conduction (CO04-HY)

Note: Calibration Interval of instruments listed above is one year.

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Spectrum Analyzer	R&S	FSP 40	100305	9KHz~40GHz	Mar. 20, 2013	Conducted (TH01-HY)
AC Power Source	G.W	APS-9102	EL920581	AC 0V ~ 300V	Jul. 16, 2013	Conducted (TH06-HY)
Temp. and Humidity Chamber	Giant Force	GTH-225-20-S	MAB0103-001	-20 ~ 100°C	Nov. 20, 2013	Conducted (TH06-HY)

Note: Calibration Interval of instruments listed above is one year.



Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Spectrum Analyzer	R&S	FSP40	100593	9kHz ~ 40GHz	Sep. 13, 2013	Radiation (03CH02-HY)
3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH02-HY	30MHz ~ 1GHz 3m	May 11, 2013	Radiation (03CH02-HY)
Amplifier	Agilent	8447D	2944A11149	100kHz ~ 1.3GHz	Jul. 18, 2013	Radiation (03CH02-HY)
RF Cable-R03m	Jye Bao	RG142	CB021	9kHz ~ 1GHz	Nov. 09, 2013	Radiation (03CH02-HY)
Bilog Antenna	SCHAFFNER	CBL61128	2723	30MHz ~ 2GHz	Oct. 10, 2013	Radiation (03CH02-HY)
Turn Table	Chaintek Instruments	3000	MF7802058	0~ 360 degree	N/A	Radiation (03CH02-HY)
Antenna Mast	MF	MF7802	MF780208205	1 ~ 4 m	N/A	Radiation (03CH02-HY)

Note: Calibration Interval of instruments listed above is one year.

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
Loop Antenna	TESEQ	HLA 6120	31244	9 kHz - 30 MHz	Dec. 02, 2012	Radiation (03CH02-HY)

Note: Calibration Interval of instruments listed above is two year.