NFC (Near Field Communications)

FCC/IC Test Report

FOR:

Honeywell

Model Name: 75eL0N

Product Description: Dolphin 75eL0N Handheld Computer

47 CFR Part 15 Subpart C Section 15.225
RSS-210 Issue 8, Annex 2, Section 6, RSS-Gen Issue 4

TEST REPORT #: EMC_HONEY_0134_14001_15.225_NFC_75E

DATE: 2015-02-02

ACCREDITED TESTING LABORATORY Certificate #2135.01

Bluetooth Qualification Test Facility (BQTF)

CTIA Authorized Test Lab LAB CODE 20020328-00

FCC listed
A2LA Accredited

IC recognized #
3462B

CETECOM Inc.

411 Dixon Landing Road ◆ Milpitas, CA 95035 ◆ U.S.A.

Phone: + 1 (408) 586 6200 ◆ Fax: + 1 (408) 586 6299 ◆ E-mail: info@cetecomusa.com ◆ http://www.cetecom.com

CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

TABLE OF CONTENTS

1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.225 of Title 47 of the Code of Federal Regulations and Industry Canada Standards RSS-210 Issue 8, Annex 2 and no deviations were ascertained during the course of the tests performed.

Company	Description	Model #
Honeywell International, Inc	Dolphin 75e Handheld Computer	75eL0N

This report is reviewed by:

Date	Section	Name	Signature
2015-02-02	Compliance	Franz Engert (Compliance Manager)	Digitally signed by Franz Engert DN: cn=Franz Engert, c=US, o=CETECOM, ou=Compliance, email=franz.engert@cetecom.com Date: 2015.02.04 10:08:00 -08'00'

Responsible for the Report:

Date	Section	Name	Signature
2015-02-02	Compliance	James Donnellan (Sr. EMC Test Engineer)	James Donnellan Digitally signed by James Donnellan DN: cn=James Donnellan, c=US, o=Cetecom Inc., ou=Compliance, email=james.donnellan@cetecom.com Date: 2015.02.05 13:27:23 -08'00'

The test results of this test report relate exclusively to the test item specified in Section3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM Inc USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Address:	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Compliance Manager:	Franz Engert
Responsible Project Leader:	James Donnellan

2.2 Identification of the Client

Applicant's Name:	Honeywell International Inc.
Street Address:	9680 Old Bailes Road
City/Zip Code	Fort Mill SC 29707
Country	USA
Contact Person:	Mandana Salahshour
Phone No.:	(803)835-8190; (803)835-8097
Fax No.:	----------
e-mail:	mandana.salahshour@honeywell.com

2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as Client
Manufacturers Address:	
City/Zip Code:	
Country:	

2.4 Environmental conditions during Test:

The following environmental conditions were maintained during the course of testing:
Ambient Temperature: 20 - 25°C
Relative humidity: 40-60%

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name / Model No:	75eL0N
Product Description:	Dolphin 75e, Handheld Computer
Product Type:	NFC (Near Field Communications) / Type A, B & F
FCC-ID :	HD5-75EL0N
IC-ID:	1693B-75EL0N
Operating Frequency:	13.56 MHz
Type(s) of Modulation:	ASK (Amplitude Shift Keying)
Data Rate:	Type A and B = approximate 106 kbps & 212 kbps Type F = approximate 212 kbps & 424 kbps
Number of channels:	1
Antenna Info:	Magnetic Loop antenna
Rated Operating Voltage Range (DC):	Li-ion Battery 3.3V (Low) / 3.7V (Nominal) / 4.2V (Max)
Operating Temperature Range:	-20°C to +50°C
Test Sample status:	Prototype
Other Radios included in the device:	1. BT Basic/EDR, BT LE (2.4 GHz band of operation) 2. Wi-Fi 802.11a/ac/b/g/n (Band of operation: 2.4 GHz & 5.0 GHz)

3.2 Identification of the Equipment under Test (EUT)

EUT #	Serial Number	HW Version	SW Version	Notes/Comments
1	14270J002C	2.0	54.0	Radiated RF Sample

3.3 Identification of Accessory equipment

AE #	Type	Manufacturer	Model	Serial Number
1	AC/DC Adapter	PhiHong	PSA105R-050Q	P142302633A1
2	Li-ion Battery	BTEC	70e-BTEC	TGMX142071852

4 Subject of Investigation

The objective of the evaluation documented in this report was to assess if the performance of the EUT meets the relevant requirements specified by ...

- 47 CFR 2: Title 47 of the Code of Federal Regulations: Chapter I-Federal Communication Commission: Frequency allocations and radio treaty matters; general rules and regulations.
- 47 CFR 15: Title 47 of the Code of Federal Regulations: Chapter I-Federal Communication Commission: Part 15 – Radio Frequency Devices – Subpart C – Intentional Radiators – Section 15.225: Operation within the band 13.110-14.010 MHz.
- 47 CFR 15: Title 47 of the Code of Federal Regulations: Chapter I-Federal Communication Commission: Part 15 – Radio Frequency Devices – Subpart C – Intentional Radiators – Section 15.209: Radiated emissions limits; general requirements.
- RSS-GEN- Issue 4: General Requirements for Compliance of Radio Apparatus.
- RSS-210- Issue 8: Licence-exempt Radio Apparatus (All Frequency Bands): Category 1 Equipment –Annex 2, section 6: Band 13.110-14.010 MHz

4.1 Dates of Testing:

10/28/2014 -12/30/2014

5 Summary of Measurement Results

Test Specification	Test Case	Temperature and Voltage Conditions	Pass	Fail	NA	NP	Model(s) Tested	Result
FCC §15.225 (a) RSS-210 A2.6 (a)	In-band Emissions	Nominal	■	☐	☐	☐	75eL0N	Complies
FCC §15.225 (e) RSS-210 A2.6	Frequency Tolerance	Nominal & Extreme	■	☐	☐	☐	75eL0N	Complies
§15.209 §15.225 (d) RSS-Gen 6.13	TX Radiated Spurious Emissions	Nominal	■	☐	☐	☐	75eL0N	Complies
RSS-Gen 6.6	Occupied Bandwidth	Nominal	■	☐	☐	☐	75eL0N	Reference

Note: NA = Not Applicable; NP = Not Performed

6 NFC transmitter measurements general

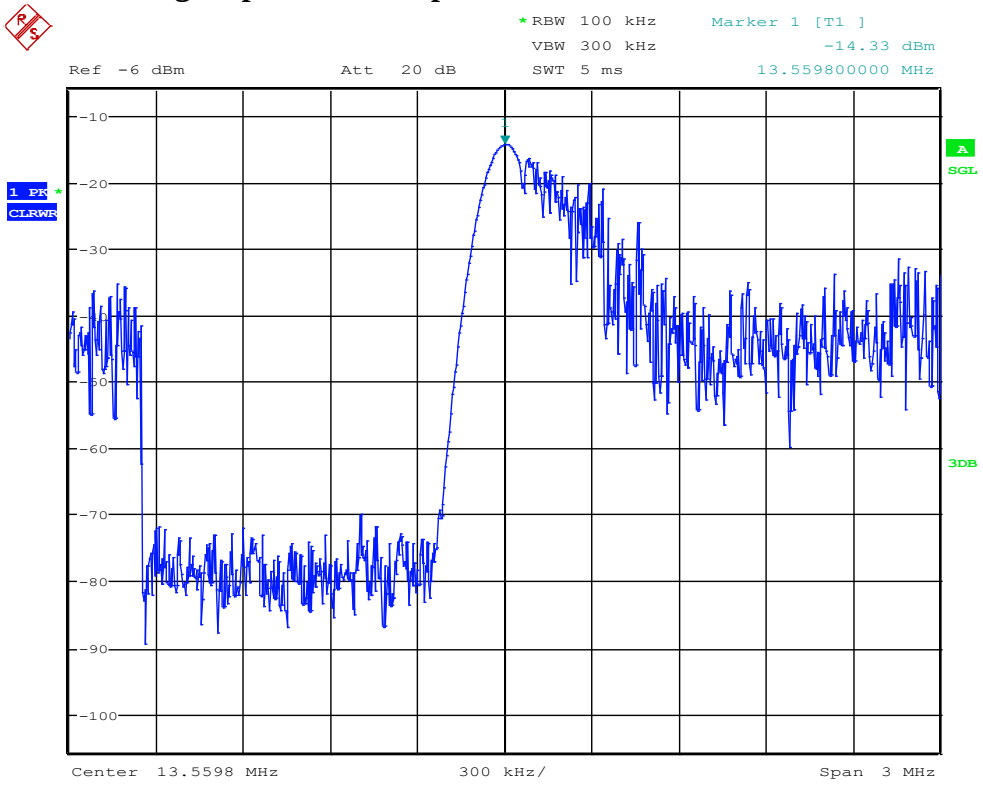
For NFC radios the Carrier at 13.56MHz conveys all the power available to the transmitter.

This power is either radiated off as
a) a CW signal to carry energy to any NFC tags in the vicinity of the NFC transmitter or
b) the CW carrier is modulated via ASK modulation to carry any information to the tags or other NFC receivers.

In case a) the bandwidth of the CW signals only a few Hz. See 6.1.
In case b) the bandwidth of the modulated signal is about 4MHz. See 6.2.

For this reason the peak emission of the NFC transmit signal must stay below the spurious emission limit 70dBuV/m measured with a 9kHz RBW. Otherwise the modulated signal would violate the emission mask.

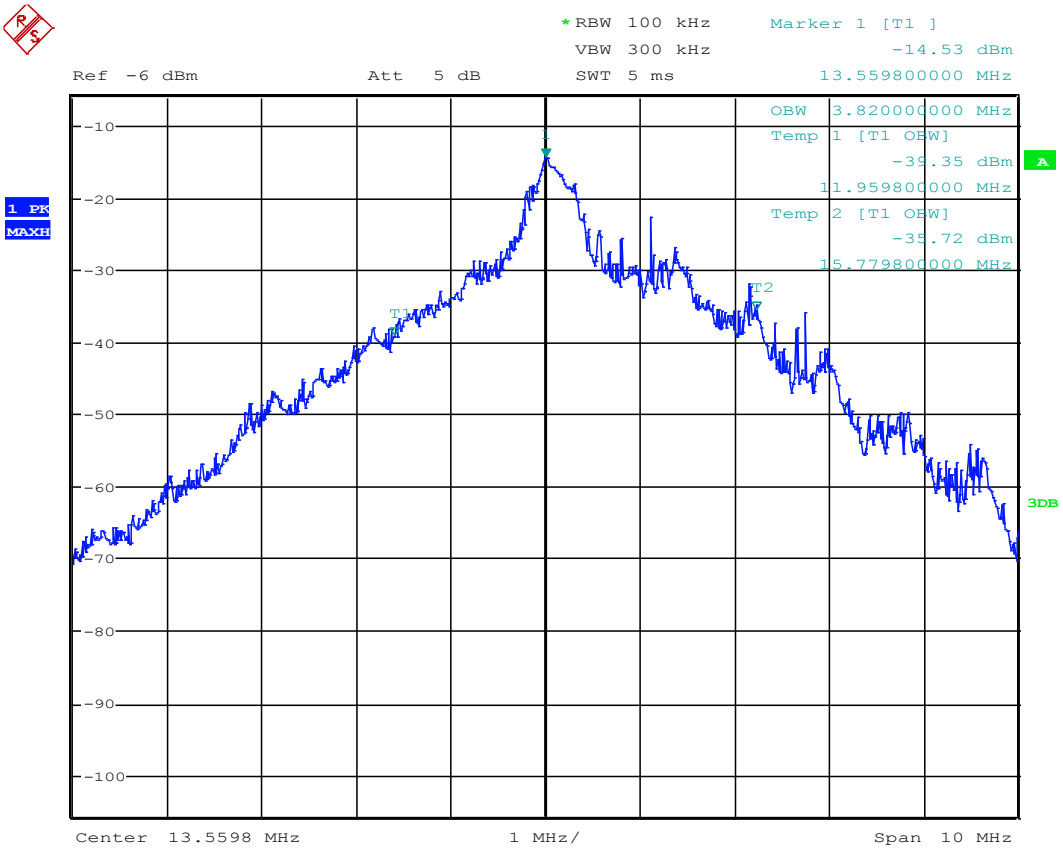
6.1 NFC signal part CW and part modulated



low
Date: 2.FEB.2015 10:58:36

Note: This is not a calibrated result. It is meant to convey the effect of NFC modulation only.

6.2 NFC signal modulated OBW



low

Date: 2.FEB.2015 11:02:57

Note: This is not a calibrated result. It is meant to convey the effect of NFC modulation only.

7 In-band Field Strength (Fundamental)

7.1 References

FCC: 215.225 (a)
RSS 210: A2.6 (a)

7.2 Limits

FCC: The field strength of any emissions within band 13.553 – 13.567 MHz shall not exceed 15,848 microvolts/meter (84 dBuV/m) at 30 meters distance.

RSS 210: The field strength of any emission shall not exceed the following limits:
(a) 15.848 millivolts/m (84 dBμV/m) at 30 meters, within the band 13.553-13.567 MHz.

The 30m limit is converted to 3m, using the 40 dB/decade extrapolation factor formula as specified by FCC part 15.31 (f)(2) for frequencies below 30MHz.

Therefore, 40 dB shall be added to the specified limit (84 dBuV @ 30 m) to convert to actual test limit **124 dBuV** @ 3m.

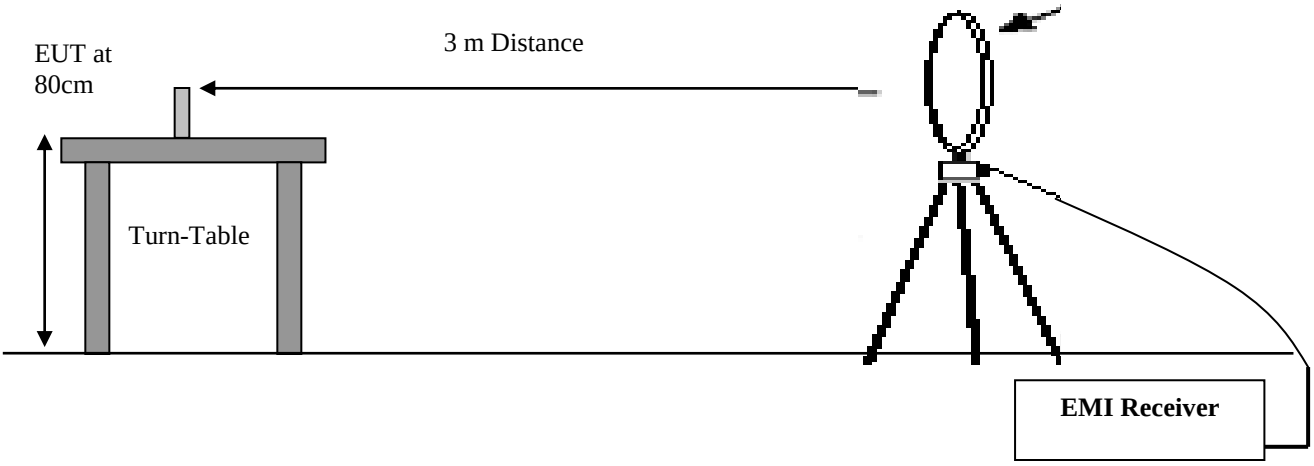
7.3 Test Conditions

Tnom: 21°C
Vnom: 3.7 V dc

7.4 Radiated Measurement Procedure

Ref: ANSI C63.10 Section 6.4
Field Strength measurement

Test Setup for Below 30MHz Measurements



1. Connect the equipment as shown in the above diagram with the EUT's antenna in a vertical orientation.
2. Set the EUT in continuous transmission mode with its maximum power @ 98% - 100% duty cycle.
3. Set the spectrum analyzer to the channel frequency of interest.
4. Maximize the emission amplitude by rotating the turntable 0 - 360°, adjusting the measuring antenna height from 1 – 4 m & changing antenna polarity.
5. Repeat steps 4 with all antennas different polarity and determine the maximized polarity for measurement. Measure and record the peak level of field strength (**LVL**) in dBuV.
6. Adjust correction factors to the measured field strength (**LVL**) and using the field strength approach calculation to convert (**LVL**) from dBuV to transmitter output power (EIRP) in Watts using the following equations:
7. Correction factors (**CF**) in dB = Antenna factor (dB) + Cable loss (dB).
   LVLc (dBuV) = **LVL** (dBdBuV) + **Correction Factors** (dB)

7.5 Measurement Settings

Ref: ANSI C63.10 Section 4.1.4

RBW = 9kHz (see section 6); VBW = 3 x RBW
Span wide enough to capture bandwidth of emission being measured
Detector = Peak; Trace = Max Hold
Sweep time: Auto.

7.6 Measurement Uncertainty

+/- 3 dB

7.7 Test Data Results

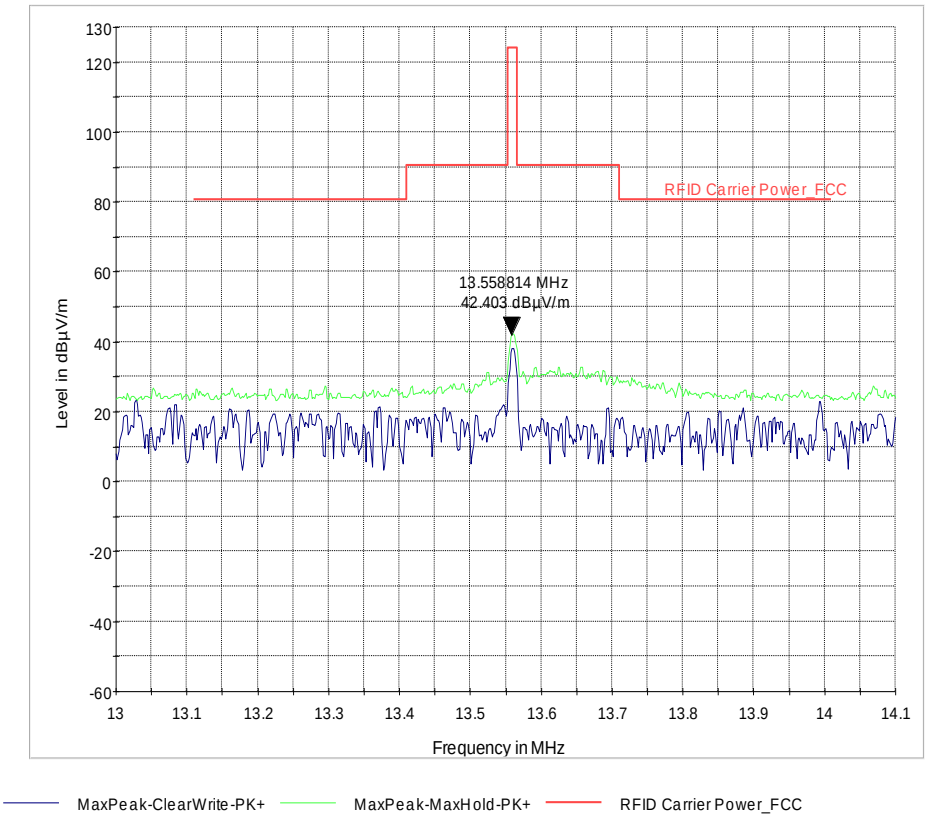
Modulation: A							
Frequency (MHz)	**Antenna Polarity (H/V)**	**Antenna Height (m)**	**Angle (^{o})**	**Corr. F (dB)**	**FS Level (dBuV/m)**	**Limit @ 3m (dBuV)**	**Results**
13.559	H	1	0	34.6	42.40	124	Pass

7.8 Measurement Verdict

Pass.

7.9 Measurement Plots

Field Strength		
Frequency: 13.56 MHz	**NFC –Type A**	**Modulation: ASK**



8 Transmitter Spurious Emissions – Radiated

8.1 Limits

FCC: 15.225 (d)
FCC: 15.209
RSS-Gen 6.13

FCC 15.209 & RSS-Gen Section 7.2.5

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (m)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30 (29.5 dBµV/m)	30
30–88	100 (40dBµV/m)	3
88–216	150 (43.5 dBµV/m)	3
216–960	200 (46 dBµV/m)	3
Above 960	500 (54 dBµV/m)	3

The 300m and 30m limit is converted to 3m, using the 40 dB/decade extrapolation factor formula as specified by FCC part 15.31 (f)(2) for frequencies below 30MHz.

8.2 Measurement Settings

Ref: ANSI C63.10 Section 4.1.4

RBW=9 kHz for measurements below 30 MHz
RBW=100 kHz for measurements from 30 MHz – 1 GHz
RBW=1 MHz for measurements above 1GHz
VBW≥ 3x RBW
Span= Entire range of measuring antenna or in segment
Detector: Quasi-Peak from 30 MHz – 1 GHz
1GHz < Average < 30 MHz

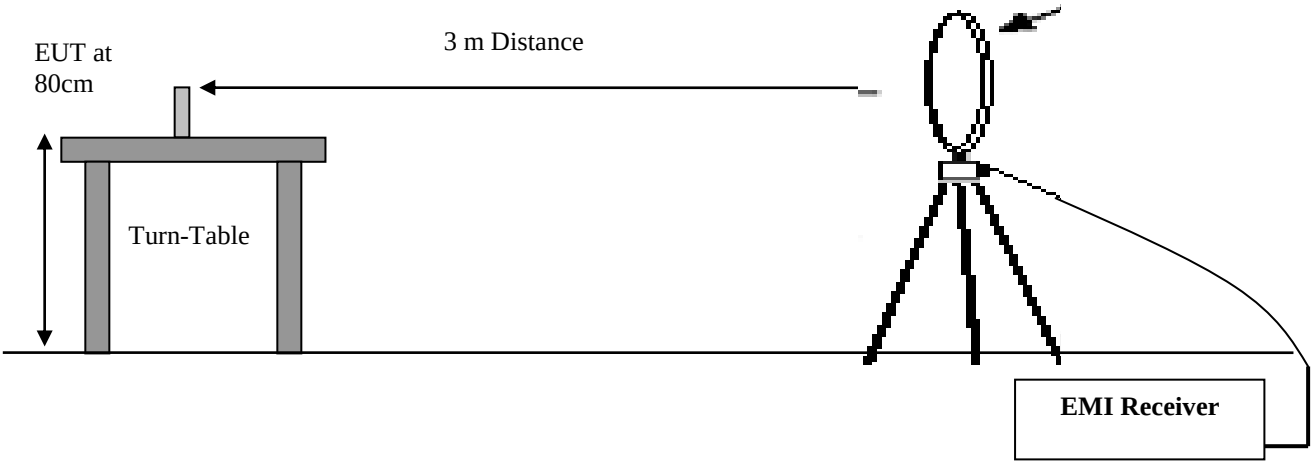
8.3 Test Conditions

Tnom: 24°C
Vnom: 3.7 V dc

8.4 Radiated test procedure for transmitter spurious emissions below 30MHz

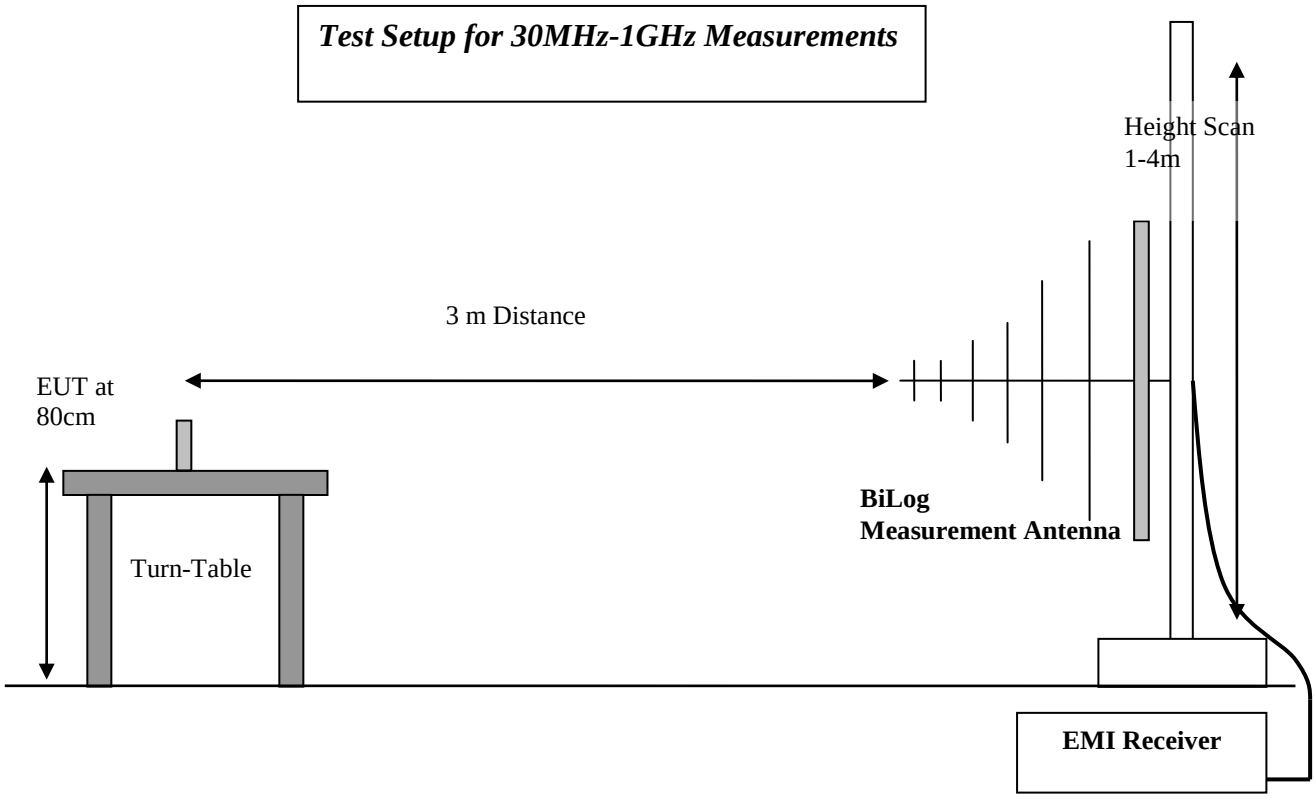
Ref: ANSI C63.10-2013 Section 6.4

Test Setup for Below 30MHz Measurements



1. Connect the equipment as shown in the above diagram with the EUT's antenna in a vertical orientation.
2. Set the EUT in continuous transmission mode with its maximum power @ 98% - 100% duty cycle.
3. Set the spectrum analyzer to the channel frequency of interest.
4. Maximize the emission amplitude by rotating the turntable 0 - 360°, adjusting the measuring antenna height from 1 – 4 m & changing antenna polarity.
5. Repeat steps 4 with all antennas different polarity and determine the maximized polarity for measurement. Measure and record the peak level of field strength at 50Ohm of receiver (**LVL**) in dBuV.
6. Adjust correction factors to the measured voltage (**LVL**) to convert (**LVL**) from dBuV to dBuV/m.
7. Correction factors (**CF**) in dB/m = Antenna factor (dB/m) + Cable losses (dB).
   LVLc (dBuV/m) = **LVL** (dBuV) + **Correction Factors** (dB/m)

Ref: ANSI C63.10-2013 Section 6.5



8.5 Measurement Uncertainty

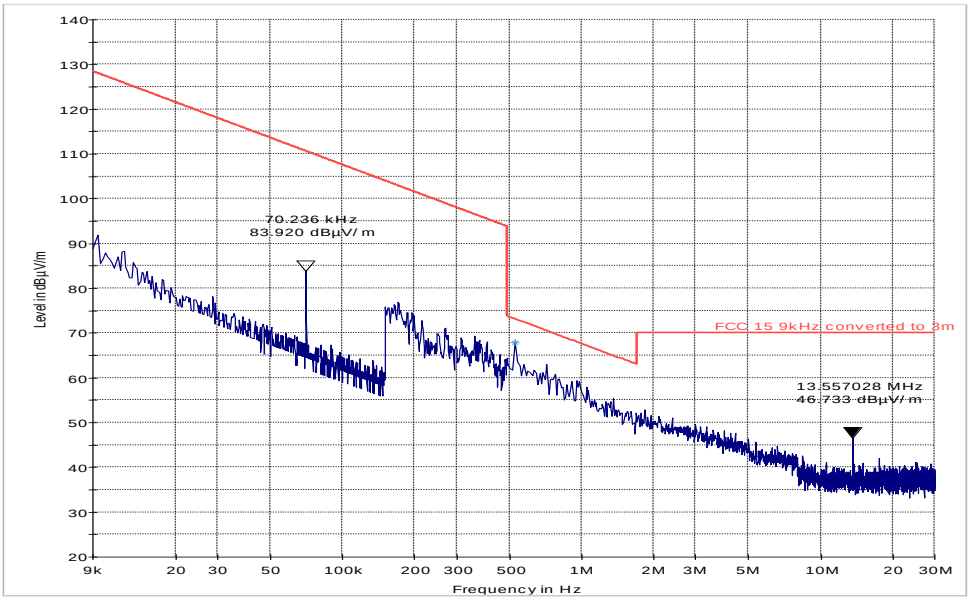
+/- 3dB

8.6 Measurement Verdict

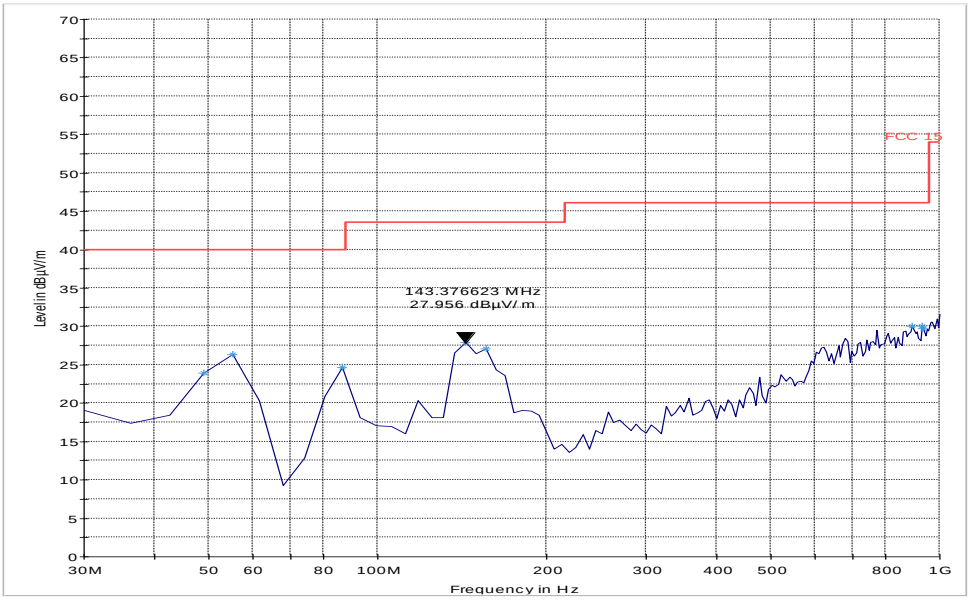
Pass.

8.7 Measurement Plots:

TX Radiated Spurious Emissions: 9kHz – 30MHz			
Frequency:15.56 MHz	**NFC TX**	**Modulation: ASK**	



TX Radiated Spurious Emissions: 30MHz – 1 GHz			
Frequency:15.56 MHz	**NFC TX**	**Modulation: ASK**	



9 Frequency Tolerance

9.1 References

FCC: 15.225 (e)
RSS-210 A2.6

9.2 Limits

FCC: ± 0.01 %
RSS-210: ± 0.01 %

9.3 Test Conditions

Tnom: 21°C
Vnom: 3.7V dc

9.4 Test Data

Frequency Tolerance vs. Voltage Source Test Mode: NFC Type A		
Voltage Source (Vdc)	**Measured Frequency (MHz)**	**Tolerance Deviation (%)**
Vnom = 3.7	13,559711	-0.0021
Vmax = 4.2	13,560820	0.0055
Vmin = 3.3	13,559520	-0.0022

Frequency Tolerance vs. Temperature Test Mode: NFC Type A			
Voltage Source (Vdc)	**Temperature (ºC)**	**Measured Frequency (MHz)**	**Tolerance Deviation (%)**
Vmax = 4.2	**50**	13,561125	0.0083
	40	13,560220	0.0016
	30	13,560774	0.0057
	20	13,560830	0.0061
	10	13,560114	0.0008
	0	13,560588	0.0043
	-10	13,559369	-0.0047
	-20	13,559487	-0.0038

Frequency Tolerance vs. Temperature Test Mode: NFC Type A			
Voltage Source (Vdc)	**Temperature (ºC)**	**Measured Frequency (MHz)**	**Tolerance Deviation (%)**
Vmin = 3.3	**50**	13,560788	0.0058
	40	13,560544	0.0040
	30	13,561120	0.0083
	20	13,560920	0.0068
	10	13,559880	-0.0009
	0	13,559557	-.0033
	-10	13,559519	-0.0035
	-20	13,5589000	-0.0081

9.5 Measurement Verdict

Pass

10 Occupied Bandwidth

The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth of the 99 %.

10.1 References
RSS-Gen 6.6

10.2 Limits
RSS-Gen section 6.6
When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

10.3 Measurement Settings
Measurement according to RSS-Gen section 6.6

For 99% occupied Bandwidth, use the occupied bandwidth measurement function with the band set equal to 99% emission bandwidth.

Span = wide enough to capture all products of the modulation process, including the emission skirts.
RBW = 1% to 5 % of the OBW
VBW = 3X RBW
Sweep = auto
Detector function = peak
Trace = max hold

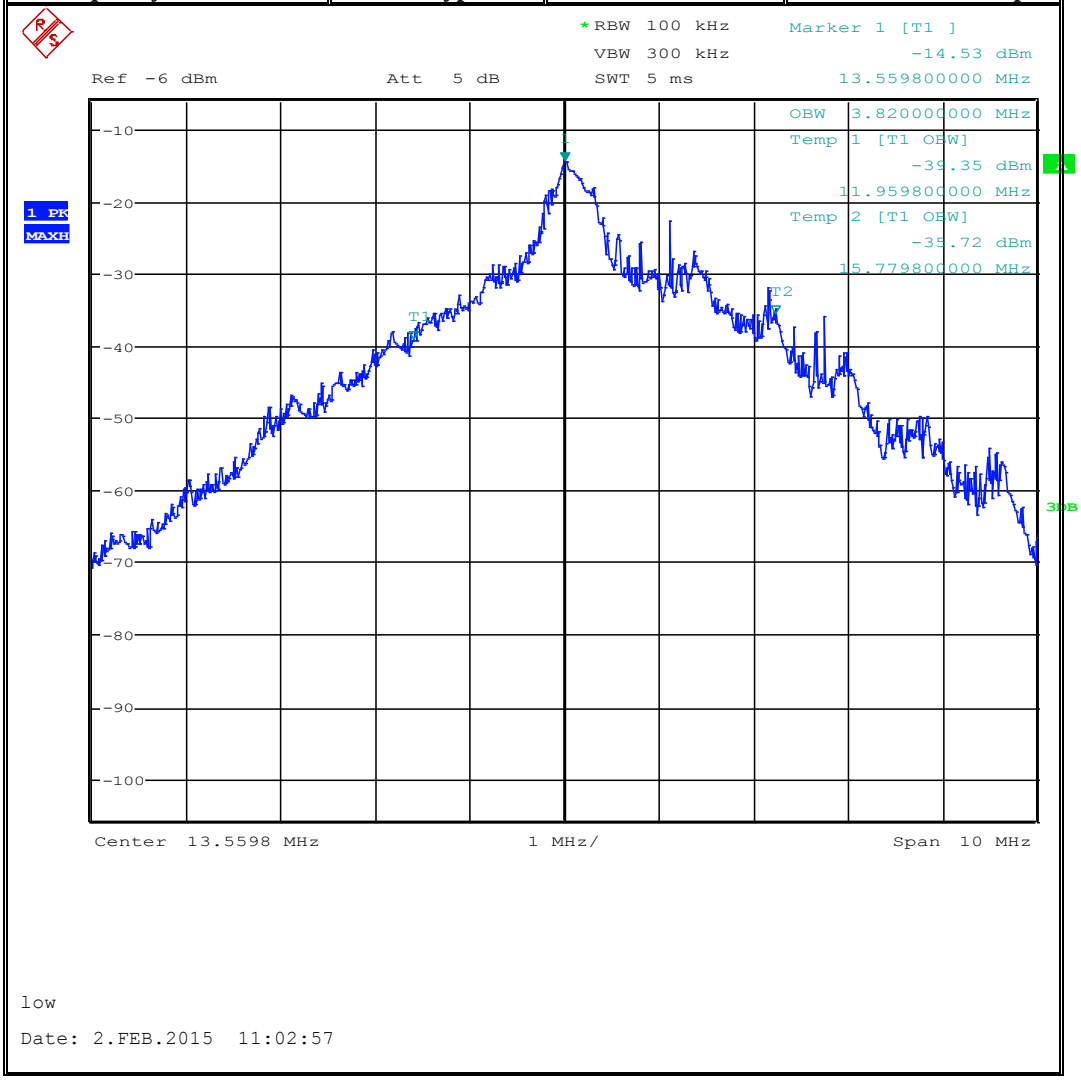
10.4 Test Data

Modulation: ASK **Date Rate: 212 kbps**				
NFC Type	**Frequency (MHz)**	**99% BW (MHz)**	**Limit (KHz)**	**Result**
A	13.56	3.82	None, as levels are below part 15.209 restricted band limits. (see sect. 6)	

10.5 Measurement Plot:

99% Occuppied Bandwidth

Frequency:13.56 MHz	NFC Type A	Modulation: ASK	Data Rate: 212 kbps



11 Test Equipment

No.	Equipment Name	Manufacturer	Type/model	Serial No.	Cal Date	Cal Interval
3m Semi- Anechoic Chamber:						
	Turn table	EMCO	2075	N/A	N/A	N/A
	MAPS Position Controller	ETS Lindgren	2092	0004-1510	N/A	N/A
	Antenna Mast	EMCO	2075	N/A	N/A	N/A
	Relay Switch Unit	Rohde&Schwarz	RSU	338964/001	N/A	N/A
	EMI Receiver/Analyzer	Rohde&Schwarz	ESU 40	100251	Sept 2013	2 Years
	Spectrum Analyzer	Rohde&Schwarz	FSU	200302	Jun 2013	2 Years
	1500MHz HP Filter	Filtek	HP12/1700	14c48	N/A	N/A
	2800 MHz HP Filter	Filtek	HP12/2800	14C47	N/A	N/A
	Pre-Amplifier	Miteq	JS40010260	340125	N/A	N/A
	Loop Antenna	EMCO	6512	00049838	Apr 2012	3 years
	Binconilog Antenna	EMCO	3141	0005-1186	Apr 2012	3 Years
	Binconilog Antenna	ETS	3149	J000123908	Feb 2012	3 years
	Horn Antenna	EMCO	3115	35114	Mar 2012	3 Years
	LISN	R&S	ESH3-Z5	836679/003	Jun 2013	3 Years
	Temp Hum Logger	TM325	Dickson	5285354	Apr 2013	2 Year
	Climatic Chamber	Votsch	VT4004	G1115	N/A	N/A

Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels.
Calibration due dates, unless defined specifically, falls on the last day of the month.
Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

12 Revision History

Date	Report Name	Changes to report	Report prepared by
2015-02-02	EMC_INTEL-039- 14001_15.225_NFC_75E	First version	Franz Engert