



NFC TEST REPORT

No.I19Z61557- IOT01

for

Multi-band GSM/WCDMA/LTE phone with Bluetooth, Wlan and NFC

LM-X540EMW

FCC ID: ZNFX540EMW

Issued Date: 2019-09-25



Note:

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REPORT HISTORY

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1. Test Laboratory

1.1. Introduction & Accreditation

Telecommunication Technology Labs, CAICT is an ISO/IEC 17025:2005 accredited test laboratory under NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM (NVLAP) with lab code 600118-0, and is also an FCC accredited test laboratory (CN5017), and ISED accredited test laboratory (CN0066). The detail accreditation scope can be found on NVLAP website.

1.2. Testing Location

Location 1: CTTL(huayuan North Road)

Address: No. 52, Huayuan North Road, Haidian District, Beijing,
P. R. China 100191

Location 2: CTTL(Shouxiang)

Address: No. 51 Shouxiang Science Building, Xueyuan Road,
Haidian District, Beijing, P. R. China 100191

Location 3: CTTL (BDA)

Address: No.18A, Kangding Street, Beijing Economic-Technology
Development Area, Beijing, P. R. China 100176

1.3. Testing Environment

Normal Temperature: 15-35°C
Extreme Temperature: -20/+55°C
Normal Relative Humidity: 20-75%
Normal Air Pressure 86Kpa-106Kpa

1.4. Project data

Testing Start Date: 2019-09-02
Testing End Date: 2019-09-24

1.5. Signature



Zhang Qiang
(Prepared this test report)



Pang Shuai
(Reviewed this test report)



Zhu Liang
(Approved this test report)



2. Client Information

2.1. Applicant Information

Company Name: LG Electronics USA, Inc
Address: 1000 Sylvan Avenue, Englewood Cliffs NJ 07632
City: Englewood
Postal Code: /
Country: United States
Telephone: /
Fax: /

2.2. Manufacturer Information

Company Name: Jiaxing Youngrui Electron Technology Co., Ltd.
Address: NO.777 Yazhong Road, Daqiao Town, Nanhu District, Jiaxing City,
Zhejiang
City: Jiaxing
Postal Code: /
Country: CHINA
Telephone: /
Fax: /

3. Equipment Under Test (EUT) and Ancillary Equipment (AE)

3.1. About EUT

Description	Multi-band GSM/WCDMA/LTE phone with Bluetooth, Wlan and NFC
Model name/HVIN	LM-X540EMW
Marketing Name/PMN	/
Brand name	LG
FCC ID	ZNFX540EMW
UMTS Frequency Band(s)	FDD I/II/V/VIII
GSM Frequency Band(s)	GSM900/1800/1900/850
E-UTRA Frequency Band(s)	FDD1/3/7/8/20/28/38
Extreme Temperature	-10/+55°C
Nominal Voltage	3.6V
Extreme High Voltage	4.2V
Extreme Low Voltage	3.85V

3.2. Internal Identification of EUT

EUT ID*	SN or IMEI	HW Version	SW Version	Date of receipt
22a	358945100024839& 358945100024847	/	/	/
16a	358945100022874& 358945100022882	/	/	/

3.3. Internal Identification of AE

AE ID*	Description		SN
AE1	Battery	/	/
AE2	Charger	/	/
AE3	USB Cable	/	/
AE1			
	Model	BL-T45	
	Manufacturer	Lishen	
	Capacitance	4000mAh	
	Nominal voltage	3.85v	
AE2			
	Model	MCS-V01WR	
	Manufacturer	Sunlin Electrocnis	
	Length of cable	/	
AE3			
	Model	DC15WB-G	
	Manufacturer	Ningbo	
	Length of cable	/	

*AE ID: is used to identify the test sample in the lab internally.

3.4. EUT Set-ups

EUT Set-up No.	Combination of EUT and AE	Remarks
Set. NFC01	UT16a+AE1+AE2+AE3	--
Set. NFC02	UT16a	--
Set. NFC03	UT22a	--

The Transmit State of NFC: the NFC function is on. The EUT will transmit the NFC data and command continuously during the test.

The Transmit state of without modulation: The EUT will transmit the CW signal at the operating frequency.



4. Reference Documents

4.1. Documents supplied by applicant

EUT parameters, referring to Annex A for detailed information, is supplied by the client or manufacturer, which is the basis of testing.

4.2. Reference Documents for testing

The following documents listed in this section are referred for testing.

Reference	Title	Version
CFR 47 Part 2	Part 2 — Frequency Allocations and Radio Treaty Matters; General Rules and Regulations.	2018
CFR 47 Part 15	Part 15 — Radio Frequency Devices. Subpart C — Intentional Radiators. § 15.35 Measurement detector functions and bandwidths. § 15.207 Conducted limits. § 15.209 Radiated emission limits, general requirements. § 15.215 Additional provisions to the general radiated emission limitations. § 15.225 Operation within the band 13.110–14.010 MHz.	2018
ANSI C63.10	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices	2013

5. Test Results

5.1. Summary of Test Results

No	Test Cases	Clause in Regulation	Section in This Report	Verdict
1	Electric Field Strength of Fundamental Emissions	CFR 47 § 15.225(a)	B.1	P(Set. NFC02)
2	Electric Field Strength of Outside the Allocated Bands	CFR 47 § 15.225(b) CFR 47 § 15.225(c)		P(Set. NFC02)
3	Electric Field Radiated Emissions	CFR 47 § 15.209	B.2	P(Set. NFC01)
		CFR 47 § 15.225(d)	B.3	P(Set. NFC01)
4	Frequency Tolerance	CFR 47 § 15.225(e)	B.4	P(Set. NFC03)
5	20dB Bandwidth	CFR 47 § 15.215(c)	B.5	P(Set. NFC03)
6	Conducted Emissions	CFR 47 § 15.207	B.6	P(Set. NFC01)

The measurement is carried out according to ANSI C63.10. See **ANNEX B** for details.

Test Conditions:

For this report, all the test cases listed above were tested under normal Temperature, Voltage, humidity, and Air Pressure except the Frequency Tolerance test case. The specific conditions of Frequency Tolerance test case are as following:

Temperature	T min	-20
	T nom	20°C
	T max	-50
Voltage	V min	3.6V
	V nom	3.85 V
	V max	4.2 V
Humidity	H nom	20%-75%
Air Pressure	A nom	86Kpa-106Kpa

5.2. Terms Used in the Summary of Test Results

Terms Used in Condition Column:

T nom	Normal Temperature
T min	Low Temperature
T max	High Temperature
V nom	Normal Voltage
V min	Low Voltage
V max	High voltage
H nom	Norm Humidity
A nom	Norm Air Pressure

Terms Used in Verdict Column:

P	Pass, The EUT complies with the essential requirements in the standard.
NP	Not Perform, The test was not performed by CTTL
NA	Not Applicable, The test was not applicable
F	Fail, The EUT does not comply with the essential requirements in the standard

5.3. Statements

The test cases listed in Section 5.1 of this report for the EUT specified in Section 3 were performed by CTTL according to the reference documents in Section 4.

The EUT meets all applicable requirements of the regulations and standards in Section 4.2.

6. Test Facilities Utilized

NO.	NAME	TYPE	SERIES NUMBER	PRODUCER	CAL. DUE DATE	CAL. INTERVAL
1.	Vector Signal Analyzer	FSQ40	200089	Rohde & Schwarz	2020-05-15	1 Year
2.	Spectrum Analyzer	RSA3408A	B010277	Tektronix	2019-09-20	1 Year
3.	Climatic chamber	SH242	93008658	ESPEC	2020-02-27	1 Year
4.	H-field Antenna	HFH2-Z2	829324/007	R&S	2019-12-03	1 Year
5.	LISN	ENV216	101459	R&S	2020-04-10	1 Year
6.	Test Receiver	ESCI	100766	R&S	2020-03-20	1 Year
7.	Test Receiver	ESU26	100376	Rohde & Schwarz	2019-11-27	1 Year
8.	BiLog Antenna	VULB9163	9163-514	Schwarzbeck	2020-02-03	1 Year
9.	Dual-Ridge Waveguide Horn Antenna	3117	00139065	ETS-Lindgren	2019-10-15	1 Year
<p>Note: The 20dB Bandwidth test using the Spectrum Analyzer RSA3408A was finished at Sep 2,2019,before the calibration due date.</p>						

7. Measurement Uncertainty

<u>Item</u>	<u>Uncertainty</u>
Frequency Tolerance	$U = 60.80 \text{ Hz}$, $k=1.96$
20dB Bandwidth	$U = 77 \text{ Hz}$, $k=2$
Radiated Emissions (<1GHz)	$U = 5.40 \text{ dB}$, $k=2$
Radiated Emissions (>1GHz)	$U = 4.32 \text{ dB}$, $k=2$
Conducted emission	$U = 3.10 \text{ dB}$, $k=2$



ANNEX A: EUT parameters

/

ANNEX B: Detailed Test Results

B.1. Electric Field Strength of Fundamental and Outside the Allocated bands

B.1.1. Reference

See Clause 4, Clause 5 of ANSI C63.10-2013 generally.

B.1.2. Measurement Methods

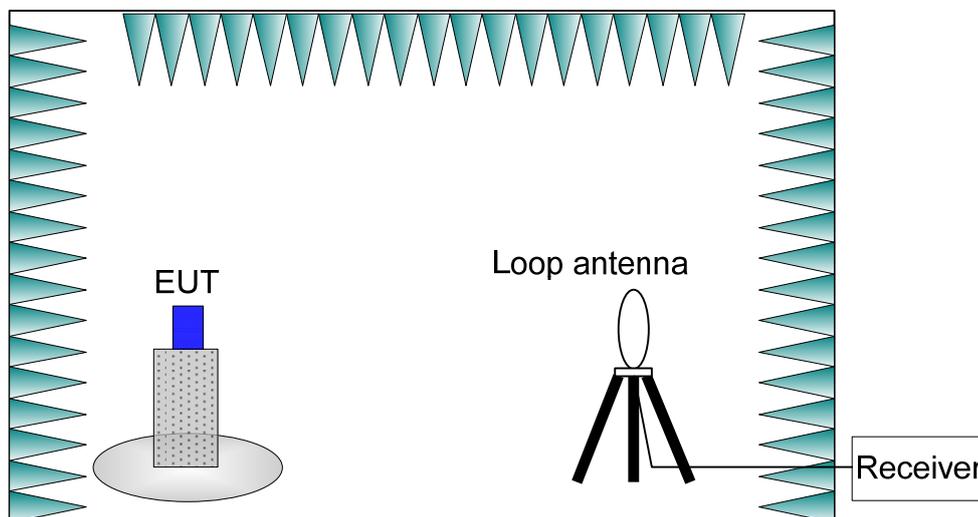
The transmitter carrier output levels (E-Field) from the EUT are measured in a semi-anechoic chamber. The EUT is placed on a non-conductive stand of 80cm high, and at a measurement distance of 3m from the receiving antenna. The center of the receiving loop antenna is 1.0 meter above the ground. The E-field is measured with a shielded loop antenna connected to a measurement receiver. Detected E-field was maximized by rotating the EUT through 360° and adjusting the receiving antenna polarizations. The maximization processes were repeated with the EUT positioned respectively in its three orthogonal axes. The measurements were performed with the peak detector and if required, the quasi-peak detector.

The measurement bandwidth is:

Frequency of Emission (MHz)	RBW/VBW
12.56-14.56	10/30 kHz

The E-field measured at 3m is calculated as:

$$\text{E-field (dB}\mu\text{V/m)} = \text{Rx (dB}\mu\text{V)} + \text{Cable Loss (dB)} + \text{AF@3m (dB/m)}$$



B.1.3. EUT Operating Mode and Test Conditions

The measurement of EUT is carried out under the transmit state of NFC(See 3.4).

The EUT is powered by a travel adapter.

During the measurements, the ambient temperature of the electromagnetic anechoic chamber is in the range of 15 ~ 25 °C.

B.1.4. Limits

Frequency Range (MHz)	E-field Strength Limit @ 30 m (μV/m)	E-field Strength Limit @ 3 m (dBμV/m)
13.560 ± 0.007	+15,848	124
13.410 to 13.553 13.567 to 13.710	+334	90
13.110 to 13.410 13.710 to 14.010	+106	81

Note: Where the limits have been defined at one distance, and a signal level measured at another, the limits have been extrapolated using the following formula:

$$\text{Extrapolation(dB)} = 40\log_{10}(\text{Measurement Distance} / \text{Specification Distance})$$

B.1.5. Measurement Results

Measurement results of normal conditions see Figure B-1 for different set-ups of EUT. The result displayed take into account applicable antenna factors and cable losses.

Conclusions: Set.NFC02, **PASS.**

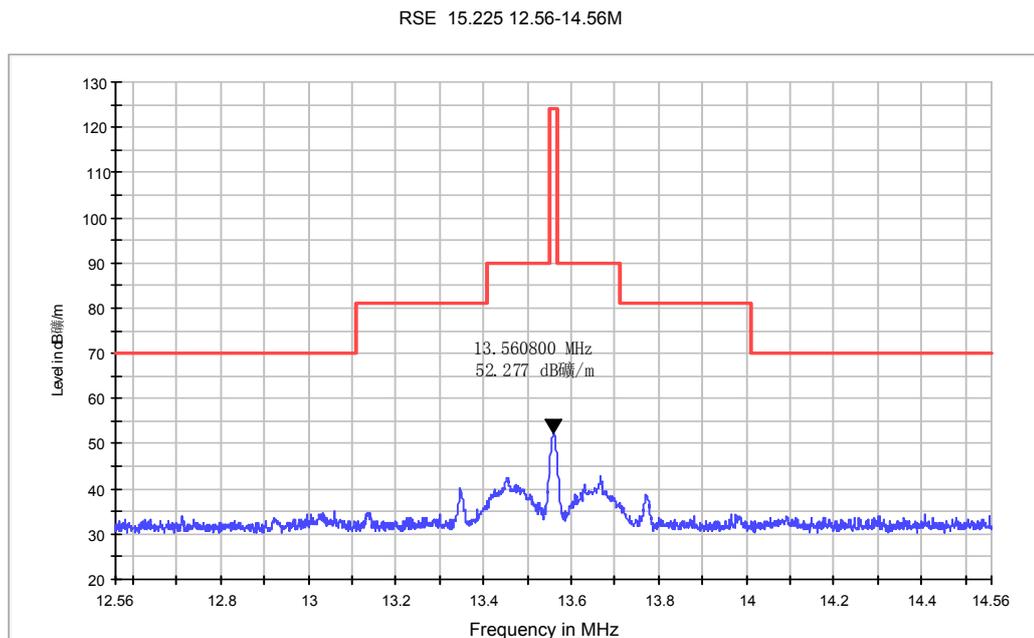


Figure B-1: Set.NFC02

B.2. Electric Field Radiated Emissions (< 30MHz)

B.2.1. Reference

See Clause 6.4 of ANSI C63.10-2013 specifically.

See Clause 4 and Clause 5 of ANSI C63.10-2013 generally.

B.2.2. Measurement Methods

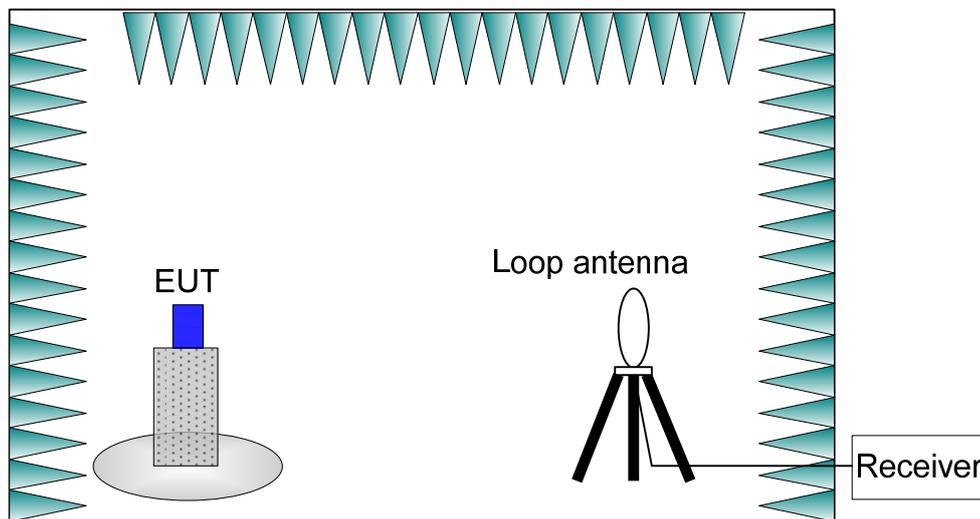
The transmitter carrier output levels (E-Field) from the EUT are measured in a semi-anechoic chamber. The EUT is placed on a non-conductive stand of 80cm high, and at a measurement distance of 3m from the receiving antenna. The center of the receiving loop antenna is 1.0 meter above the ground. The E-field is measured with a shielded loop antenna connected to a measurement receiver. Detected E-field was maximized by rotating the EUT through 360° and adjusting the receiving antenna polarizations. The maximization processes were repeated with the EUT positioned respectively in its three orthogonal axes. The measurements were performed with the peak detector and if required, the quasi-peak detector.

The measurement bandwidth is:

Frequency of Emission (MHz)	RBW/VBW
0.009-0.15	100/300 Hz
0.15-30	10/30 kHz

The E-field measured at 3m is calculated as:

$$\text{E-field (dB}\mu\text{V/m)} = \text{Rx (dB}\mu\text{V)} + \text{Cable Loss (dB)} + \text{AF@3m (dB/m)}$$



B.2.3. EUT Operating Mode and Test Conditions

The measurement of EUT is carried out under the transmit state of NFC(See 3.4).

The EUT is powered by a travel adapter.

During the measurements, the ambient temperature of the electromagnetic anechoic chamber is in the range of 15 ~ 25 °C.

B.2.4. Limits

Frequency Range (MHz)	E-field Strength Limit @ 30m (mV/m)	E-field Strength Limit @ 3m (dB μ V/m)
0.009-0.490	2400/F(kHz)	129-94
0.490-1.705	24000/F(kHz)	74-63
1.705-30	30	70

Note: Where the limits have been defined at one distance, and a signal level measured at another, the limits have been extrapolated using the following formula:
 Extrapolation(dB) = $40 \log_{10}(\text{Measurement Distance} / \text{Specification Distance})$

B.2.5. Measurement Results

Measurement results of normal conditions see Figure B-2 for different set-ups of EUT. The result displayed take into account applicable antenna factors and cable losses.

Conclusions: Set.NFC01, **PASS.**

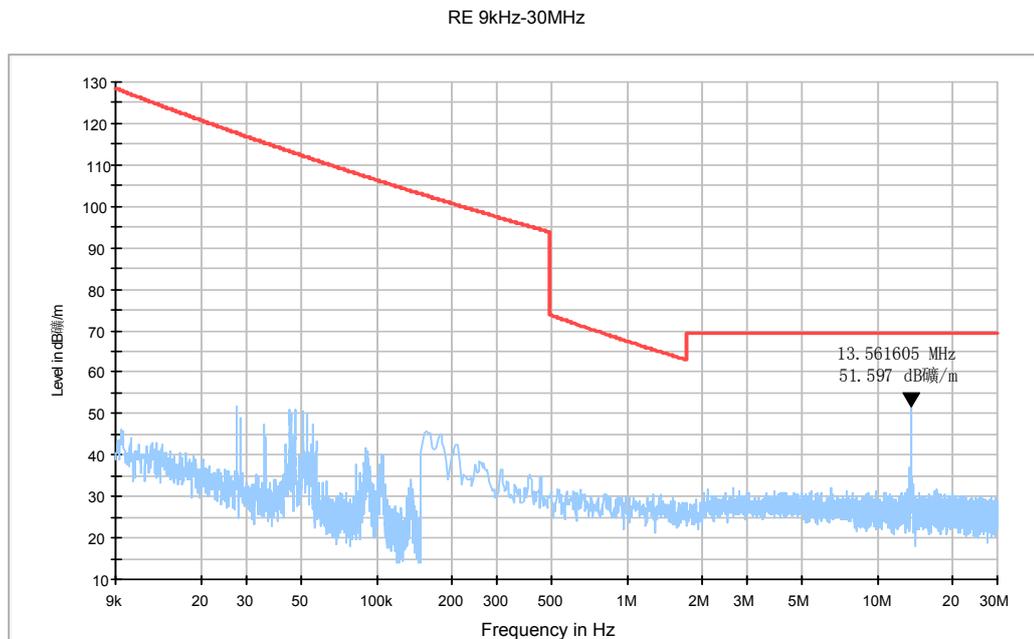


Figure B-2: Set.NFC01

B.3. Electric Field Radiated Emissions (≥30MHz)

B.3.1. Reference

See Clause 6.5 of ANSI C63.10-2013 specifically.

See Clause 4 and Clause 5 of ANSI C63.10-2013 generally.

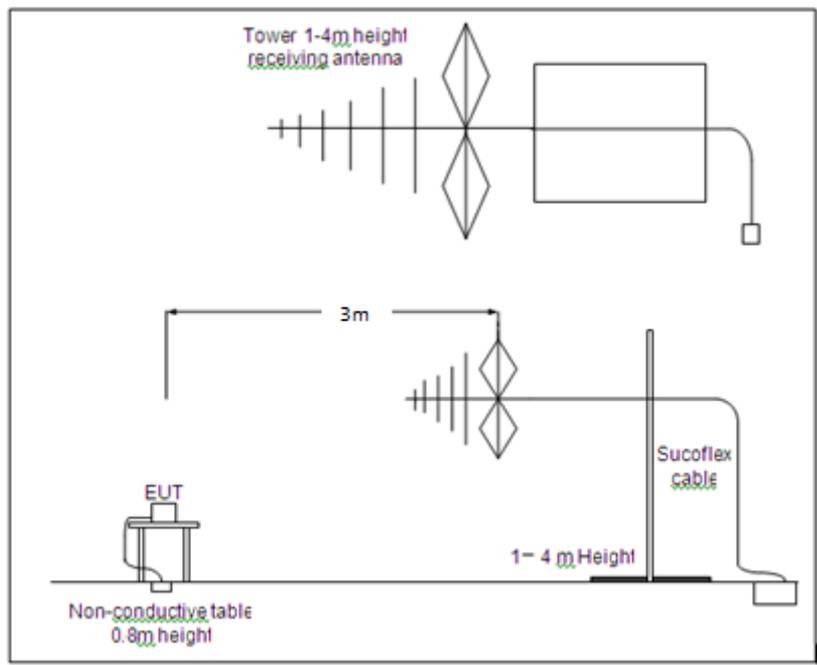
B.3.2. Measurement Methods

The electric field radiated emissions from the EUT are measured in a semi-anechoic chamber. The EUT is placed on a non-conductive stand of 80cm high, and at a measurement distance of 10m from the receiving antenna. The receiving antennas connected to a measurement receiver. In order to search for maximum field strength emitted from the EUT, the receiving antenna can be

moved between the height of 1.0 m to 4.0 m. Detected E-field was maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna positions for both vertical and horizontal antenna polarizations. The maximization processes were repeated with the EUT positioned respectively in its three orthogonal axes. The measurements were performed with the peak detector and if required, the quasi-peak detector.

The measurement bandwidth is:

Frequency of Emission (MHz)	RBW/VBW
30-1000	120kHz



B.3.3. EUT Operating Mode and Test Conditions

The measurement of EUT is carried out under the transmit state of NFC(See 3.4).

EUT1 had been connected to a travel adapter.

During the measurements, the ambient temperature of the electromagnetic anechoic chamber is in the range of 15 ~ 25 °C.

B.3.4. Limits

Frequency Range (MHz)	E-field Strength Limit @ 3m (mV/m)	E-field Strength Limit @ 3m (dB μ V/m)	E-field Strength Limit @ 10m (dB μ V/m)
30-88	100	40	30
88-216	150	43.5	33.5
216-960	200	46	36
960-1000	500	54	44

B.3.5. Measurement Results

Measurement results of normal conditions see Figure B-3 for different set-ups of EUT. The result

displayed take into account applicable antenna factors and cable losses.

Conclusions: Set.NFC01, **PASS.**

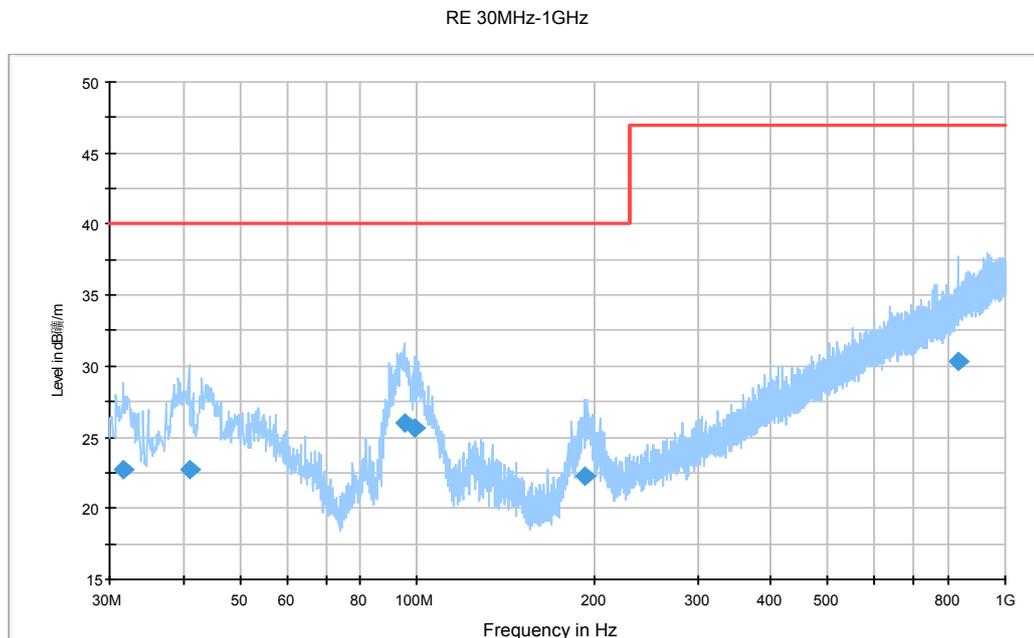


Figure B-3: Set.NFC01

Final Result 1

Frequency (MHz)	QuasiPeak (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
31.649000	22.8	110.0	V	189.0	-0.7	17.2	40.0
40.961000	22.7	125.0	V	22.0	0.6	17.3	40.0
94.990000	26.0	100.0	V	171.0	-1.9	14.0	40.0
99.258000	25.7	125.0	V	192.0	-1.0	14.3	40.0
192.572000	22.2	100.0	H	292.0	-2.0	17.8	40.0
834.033000	30.3	110.0	V	82.0	11.6	16.7	47.0

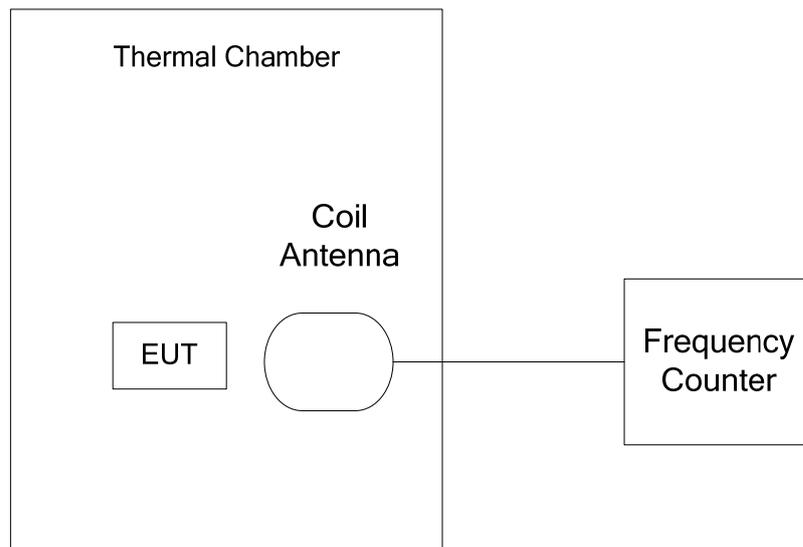
B.4. Frequency Tolerance

B.4.1. Reference

See Clause 13.6 of ANSI C63.10-2013 specifically.

See Clause 4, Clause 5, and Clause 6 of ANSI C63.10-2013 generally.

B.4.2. Measurement Methods



The transmitter output signal was picked up by coil antenna connected to the frequency counter. The center frequency was measured with 30Hz RBW and 1kHz span. During the test, the EUT was placed in a thermal chamber until thermal balance and lasting appropriate time.

B.4.3. EUT Operating Mode and Test Conditions

The measurement of EUT is carried out under the transmit state of without modulation(See 3.4). EUT had been not connected to a travel adapter.
Operation Temperature: T min, T nom, and T max with V nom.
Operation Voltage: V min and V max with T nom.

B.4.4. Test Layouts

See B.4.2.

B.4.5. Limits

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency.

B.4.6. Measurement Results

Measurement results see Table B-1 for different test conditions.

Conclusions: Set.NFC03, **PASS**.

TableB-1: Frequency Stability VS Temperature and Voltage

Temperature	Voltage	Frequency Error (MHz)			
		Startup	2 Min Later	5 Min Later	10 Min Later
T min	V nom	13.56043269	13.56044231	13.56013782	13.56046795
T max	V nom	13.56023718	13.56004487	13.56007372	13.56040224
T nom	V nom	13.56024359	13.56049038	13.56033333	13.56038462
T nom	V min	13.56001282	13.56043269	13.56048558	13.56038301
T nom	V max	13.556022596	13.56010417	13.56014103	13.56034615

Temperature	Voltage	Frequency Error (%)			
		Startup	2 Min Later	5 Min Later	10 Min Later
T min	V nom	0.003	0.003	0.001	0.003
T max	V nom	0.002	0.000	0.001	0.003
T nom	V nom	0.002	0.004	0.002	0.003
T nom	V min	0.000	0.003	0.004	0.003
T nom	V max	-0.029	0.001	0.001	0.003

B.4.7. Measurement Uncertainty

Measurement uncertainty: $U = 60.80$ Hz, $k=1.96$

B.5. 20dB Bandwidth

B.5.1. Reference

See Clause 13.7 of ANSI C63.10-2013 specifically.

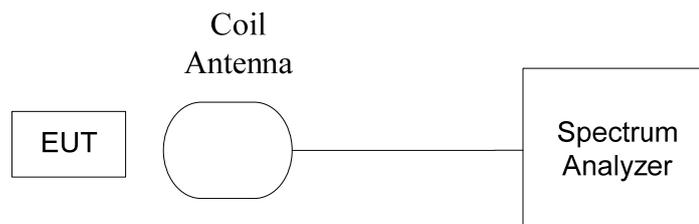
See Clause 4, Clause 5, and Clause 6 of ANSI C63.10-2013 generally.

B.5.2. Measurement Methods

The transmitter output signal was picked up by coil antenna to the spectrum analyzer.

The transmitter output signal was picked up by coil antenna connected to the spectrum analyzer.

The bandwidth of the center frequency was measured with 140Hz RBW, 420Hz VBW and 14kHz span.



B.5.3. EUT Operating Mode and Test Conditions

The measurement of EUT is carried out under the transmit state of NFC and without modulation(See 3.4).

EUT had been not connected to a travel adapter..

During the measurements, the ambient temperature is in the range of 15 ~ 25 °C.

B.5.4. Test Layouts

See B.5.2.

B.5.5. Limits

The 20dB bandwidth shall be less than 80% of the permitted frequency band. For 13.56 MHz NFC, the permitted frequency band is 14kHz, so the limit is 11.2 kHz.

B.5.6. Measurement Results

Measurement results see Figure B-4.

Conclusions: Set.NFC03, PASS.

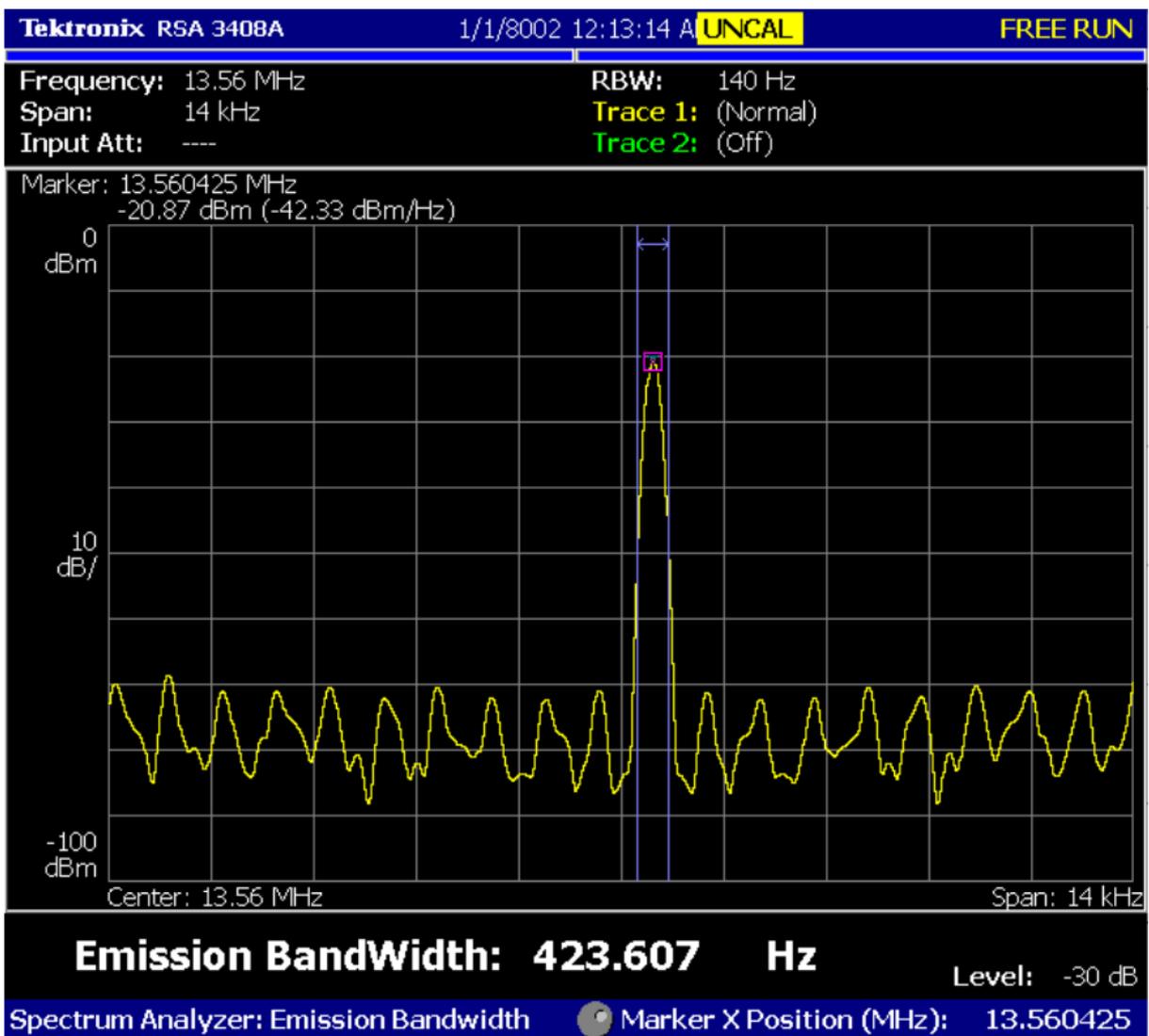


Figure B-4: Set.NFC03

B.5.7. Measurement Uncertainty

Measurement uncertainty: $U = 77 \text{ Hz}$, $k=2$

B.6. Conducted emission

B.6.1. Reference

See Clause 6.2 of ANSI C63.10-2013 specifically.

See Clause 4 and Clause 5 of ANSI C63.10-2013 generally.

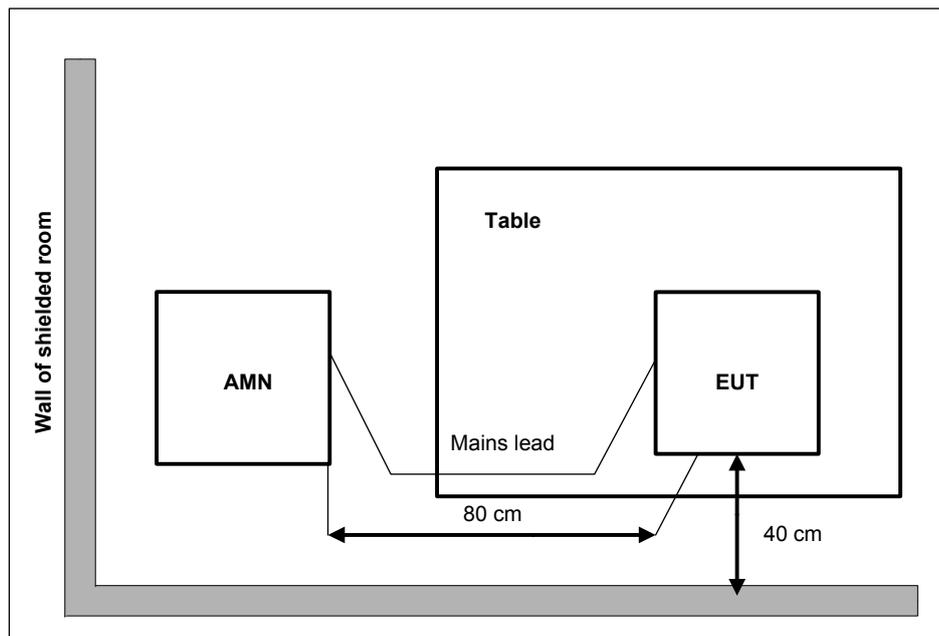
B.6.2. Measurement Methods

The conducted emissions from the AC port of the EUT are measured in a shielding room. The EUT is connected to a Line Impedance Stabilization Network (LISN). An overview sweep with peak detection was performed. The measurements were performed with a quasi-peak detector and if required, an average detector.

The conducted emission measurements were made with the following detector of the test receiver: Quasi-Peak / Average Detector.

The measurement bandwidth is:

Frequency of Emission (MHz)	RBW/VBW
0.15-30	9kHz



B.6.3. EUT Operating Mode and Test Conditions

The measurement of EUT is carried out under the transmit state of NFC(See 3.4).

The EUT is powered by a travel adapter.

During the measurements, the ambient temperature is in the range of 15 ~ 25 °C.

B.6.4. Limits

Frequency range (MHz)	Quasi-peak Limit (dB μ V)	Average Limit (dB μ V)
0.15 to 0.5	66 to 56	56 to 46
0.5 to 5	56	46
5 to 30	60	50

B.6.5. Measurement Results

Measurement results see Figure B-5.

Conclusions: Set.NFC01, PASS.

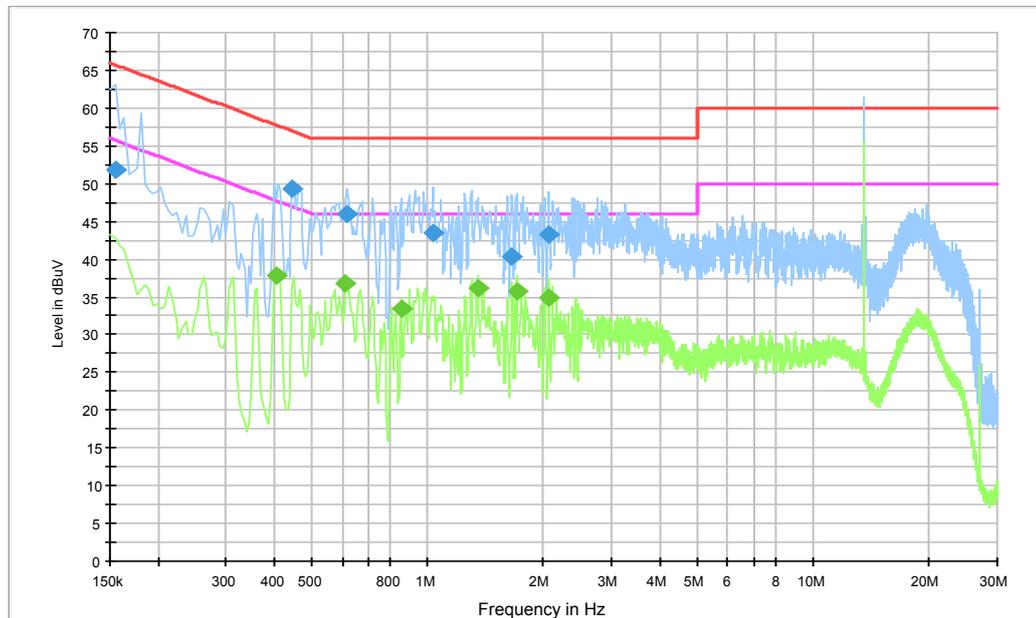


Figure B-5: Conducted Emission

Final Result 1

Frequency (MHz)	QuasiPeak (dBuV)	Meas. Time	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)
0.154500	51.8	10000.	9.000	On	N	28.0	13.9	65.8
0.447000	49.3	10000.	9.000	On	L1	20.0	7.6	56.9
0.618000	46.0	10000.	9.000	On	L1	20.0	10.0	56.0
1.032000	43.5	10000.	9.000	On	L1	19.9	12.5	56.0
1.657500	40.3	10000.	9.000	On	L1	19.8	15.7	56.0
2.058000	43.3	10000.	9.000	On	L1	19.8	12.7	56.0

Final Result 2

Frequency (MHz)	Average (dBuV)	Meas. Time	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBuV)
0.406500	37.9	10000.	9.000	On	L1	20.0	9.9	47.7
0.613500	36.9	10000.	9.000	On	L1	20.0	9.1	46.0
0.852000	33.5	10000.	9.000	On	L1	19.9	12.5	46.0
1.347000	36.1	10000.	9.000	On	L1	19.8	9.9	46.0
1.702500	35.7	10000.	9.000	On	L1	19.8	10.3	46.0
2.058000	34.9	10000.	9.000	On	L1	19.8	11.1	46.0

ANNEX C: Persons involved in this testing

Test Item	Tester
20dB Bandwidth	Zhou Bin
Frequency Tolerance	Zhou Bin
Electric Field Strength of Fundamental and Outside the Allocated bands	Li Zongliang
Electric Field Radiated Emissions (< 30MHz)	Li Zongliang
Electric Field Radiated Emissions (≥ 30 MHz)	Li Zongliang
Conducted Emissions	Guo Qian

ANNEX D: Accreditation Certificate

<p>United States Department of Commerce National Institute of Standards and Technology</p> 	
<hr/> <p>Certificate of Accreditation to ISO/IEC 17025:2005</p> <hr/>	
<p>NVLAP LAB CODE: 600118-0</p>	
<p>Telecommunication Technology Labs, CAICT Beijing China</p>	
<p><i>is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:</i></p>	
<p>Electromagnetic Compatibility & Telecommunications</p>	
<p><i>This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).</i></p>	
<hr/> <p>2018-09-28 through 2019-09-30 <i>Effective Dates</i></p>	 <hr/> <p><i>[Signature]</i> For the National Voluntary Laboratory Accreditation Program</p>

END OF REPORT