



FCC RF Test Report

APPLICANT : Honeywell International Inc.
Honeywell Safety and Productivity Solutions
EQUIPMENT : DOLPHIN CT40
BRAND NAME : Honeywell
MODEL NAME : CT40-L1N
FCC ID : HD5-CT40L1N
STANDARD : FCC Part 15 Subpart C §15.225
CLASSIFICATION : (DXX) Low Power Communication Device Transmitter

The product was received on May 04, 2018 and testing was completed on Jun. 20, 2018. We, Sporton International (Kunshan) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in 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 (Kunshan) Inc., the test report shall not be reproduced except in full.

Approved by: James Huang /
Manager



Sporton International (Kunshan) Inc.
No. 1098, Pengxi North Road, Kunshan Economic Development Zone,
Jiangsu Province 215335, China



TABLE OF CONTENTS

REVISION HISTORY	3
SUMMARY OF THE TEST RESULT	4
1. GENERAL DESCRIPTION	5
1.1 Applicant.....	5
1.2 Manufacturer	5
1.3 Product Feature of Equipment Under Test.....	5
1.4 Product Specification of Equipment Under Test	6
1.5 Modification of EUT	6
1.6 Testing Location	7
1.7 Applicable Standards.....	7
2. TEST CONFIGURATION OF EQUIPMENT UNDER TEST	8
2.1 Descriptions of Test Mode.....	8
2.2 Connection Diagram of Test System.....	9
2.3 Table for Supporting Units.....	9
2.4 EUT Operation Test Setup	9
3. TEST RESULTS.....	10
3.1 AC Power Line Conducted Emissions Measurement	10
3.2 20dB and 99% OBW Spectrum Bandwidth Measurement.....	12
3.3 Frequency Stability Measurement	13
3.4 Field Strength of Fundamental Emissions and Mask Measurement.....	14
3.5 Radiated Emissions Measurement.....	16
3.6 Antenna Requirements.....	19
4. LIST OF MEASURING EQUIPMENT	20
5. UNCERTAINTY OF EVALUATION	21
APPENDIX A. TEST RESULTS OF CONDUCTED EMISSION TEST	
APPENDIX B. TEST RESULTS OF CONDUCTED TEST ITEMS	
B1. Test Result of 20dB Spectrum Bandwidth	
B2. Test Result of Frequency Stability	
APPENDIX C. TEST RESULTS OF RADIATED TEST ITEMS	
C1. Test Result of Field Strength of Fundamental Emissions	
C2. Results of Radiated Emissions (9 kHz~30MHz)	
C3. Results of Radiated Emissions (30MHz~1GHz)	
APPENDIX D. SETUP PHOTOGRAPHS	



REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR850409D	Rev. 01	Initial issue of report	Nov. 13, 2018



SUMMARY OF THE TEST RESULT

Report Section	FCC Rule	Description of Test	Result	Remark
3.1	15.207	AC Power Line Conducted Emissions	Complies	Under limit 16.63 dB at 0.474MHz
3.2	15.215(c)	20dB Spectrum Bandwidth	Complies	-
	-	99% OBW Spectrum Bandwidth	Complies	-
3.3	15.225(e)	Frequency Stability	Complies	-
3.4	15.225(a)(b)(c)	Field Strength of Fundamental Emissions	Complies	Max level 61.41 dB μ V/m at 13.56 MHz
3.5	15.225(d) & 15.209	Radiated Spurious Emissions	Complies	Under limit 3.70 dB at 39.70MHz
3.6	15.203	Antenna Requirements	Complies	-



1. General Description

1.1 Applicant

Honeywell International Inc.
Honeywell Safety and Productivity Solutions
9680 Old Bailes Rd. Fort Mill, SC 29707 United States

1.2 Manufacturer

Honeywell International Inc.
Honeywell Safety and Productivity Solutions
9680 Old Bailes Rd. Fort Mill, SC 29707 United States

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	DOLPHIN CT40
Brand Name	Honeywell
Model Name	CT40-L1N
FCC ID	HD5-CT40L1N
EUT supports Radios application	CDMA/EV-DO/GSM/GPRS/EGPRS/WCDMA/HSPA/ DC-HSDPA/ HSPA+(16QAM uplink is not supported)/LTE/NFC WLAN 2.4GHz 802.11b/g/n HT20/ WLAN 5GHz 802.11a/n HT20/HT40/ WLAN 5GHz 802.11ac VHT20/VHT40/VHT80/ Bluetooth BR EDR / LE
IMEI Code	Conducted: 990011960007085/990011960007001 Conduction: 990011960006541 Radiation: 990011960006061/990011960006001 990011960006061/990011960006002
HW Version	V1.0
SW Version	OS.01.010-HON.01.102
EUT Stage	Identical Prototype

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. There are two samples, the difference is the scanner from different suppliers, the difference has no influence on RF features, only sample 1 is assessed to perform full test.

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	13.553 ~ 13.567MHz
Channel Number	1
20dBW	2.48 KHz
99%OBW	2.10 KHz
Antenna Type	Loop Antenna
Type of Modulation	ASK

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.5 Modification of EUT

No modifications are made to the EUT during all test items.

1.6 Testing Location

Sporton International (Kunshan) Inc. is accredited to ISO 17025 by National Voluntary Laboratory Accreditation Program (NVLAP code: 600155-0) and the FCC designation No. is CN5013.

Test Site	Sporton International (Kunshan) Inc.			
Test Site Location	No.3-2 Ping-Xiang Rd, Kunshan Development Zone Kunshan City Jiangsu Province 215335 China TEL : +86-512-57900158 FAX : +86-512-57900958			
Test Site No.	Sporton Site No.			FCC Registration No.
	TH01-KS	03CH02-KS	CO01-KS	630927
Test Engineer	Silent Hai	Level Zhao	Amos Zhang	
Temperature	21~25	21~25	25.2~25.6	
Relative Humidity	49~51	41~44	45~48	

1.7 Applicable Standards

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

- ♦ FCC Part 15 Subpart C §15.225
- ♦ ANSI C63.10-2013

2. Test Configuration of Equipment Under Test

2.1 Descriptions of Test Mode

Investigation has been done on all the possible configurations.

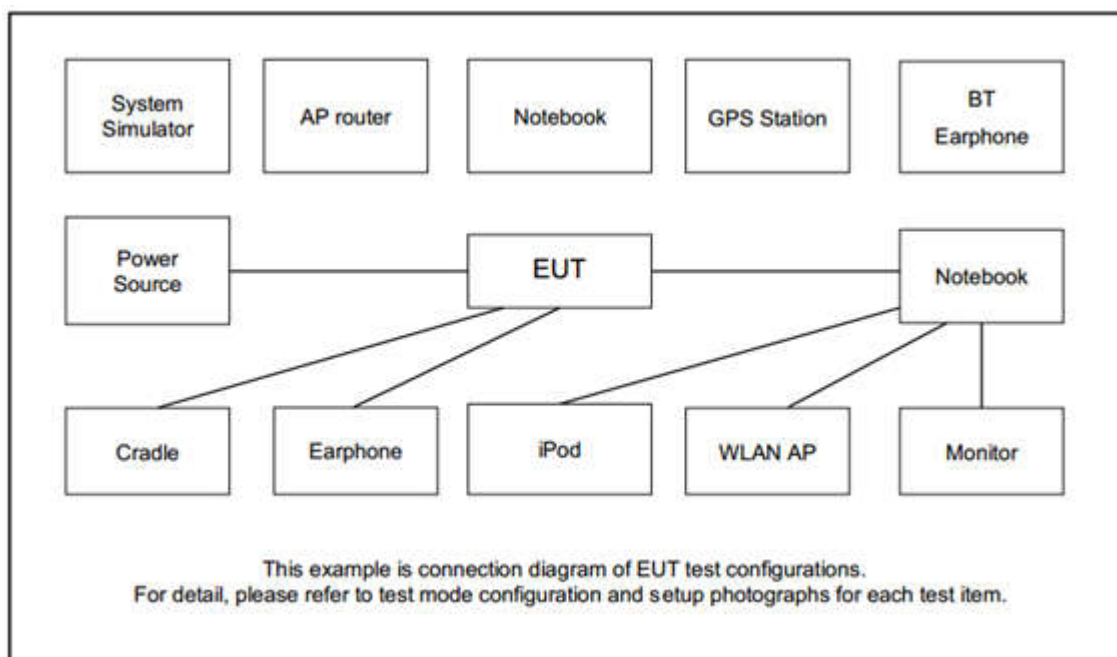
The following table is a list of the test modes shown in this test report.

Test Items	
AC Power Line Conducted Emissions	Field Strength of Fundamental Emissions
20dB Spectrum Bandwidth	Frequency Stability
Radiated Emissions 9kHz~30MHz	Radiated Emissions 30MHz~1GHz

The EUT pre-scanned in four NFC type, A, B, F, V. The worst type (type A) was recorded in this report. Pre-scanned tests, X, Y, Z in three orthogonal panels to determine the final configuration (Y plane as worst plane) from all possible combinations.

Test Cases	
AC Conducted Emission	Mode 1: GSM850 Idle + Bluetooth Link + WLAN Link(2.4G) + USB Cradle(Charging from Adapter) + NFC Tx
Remark: For Radiated Test Cases, The tests were performance with Adapter	

2.2 Connection Diagram of Test System



2.3 Table for Supporting Units

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	System Simulator	Anritsu	MT8820C	N/A	N/A	Unshielded, 1.8m
2.	WLAN AP	D-Link	DIR-855	KA2DIR855A2		Unshielded, 1.8m
3.	Notebook	Lenovo	G480	PRC4	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
4.	Bluetooth Earphone	Lenovo	LBH308	N/A	N/A	N/A
5.	NFC card	N/A	N/A	N/A	N/A	N/A

2.4 EUT Operation Test Setup

The EUT was programmed to be in continuously transmitting mode.

The ancillary equipment, NFC card, is used to make the EUT (NFC) continuously transmit at 13.56MHz and is placed around 3 cm gap to the EUT.

3. Test Results

3.1 AC Power Line Conducted Emissions Measurement

3.1.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	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.

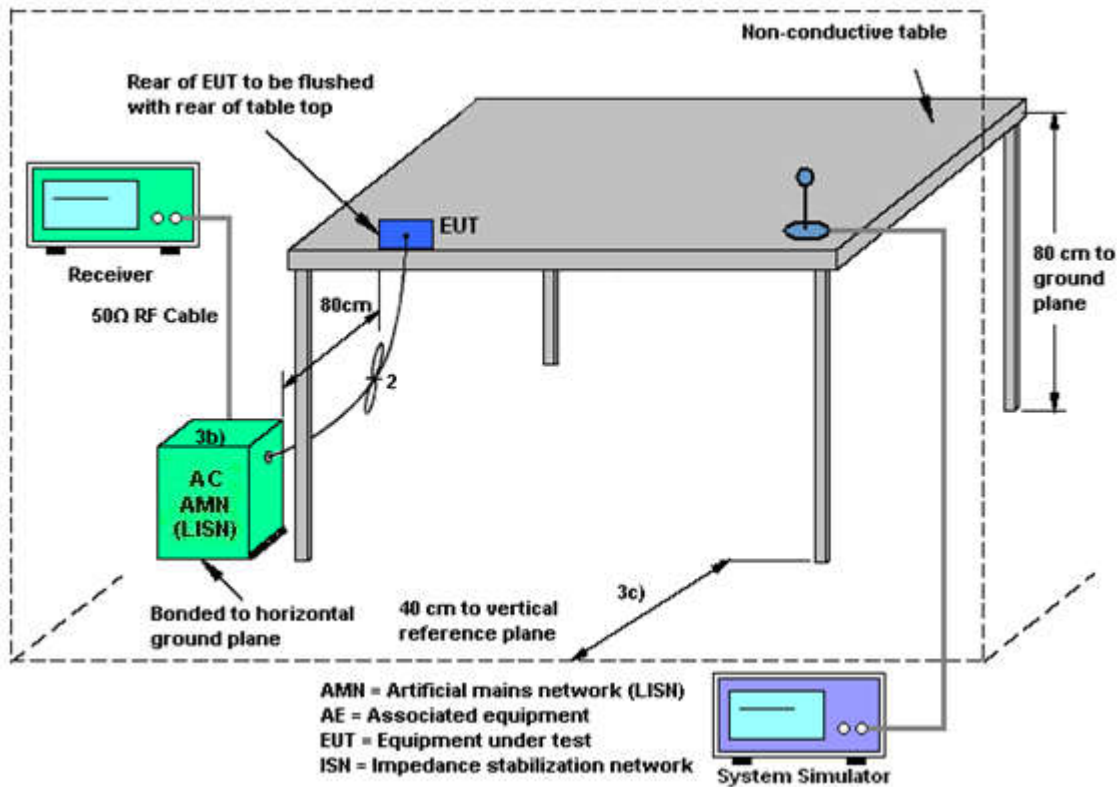
3.1.2 Measuring Instruments

See list of measuring instruments of this test report.

3.1.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room, and it was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.1.4 Test setup



3.1.5 Test Result of AC Conducted Emission

Please refer to Appendix A.

3.2 20dB and 99% OBW Spectrum Bandwidth Measurement

3.2.1 Limit

Intentional radiators must be designed to ensure that the 20dB and 99% emission bandwidth in the specific band 13.553~13.567MHz.

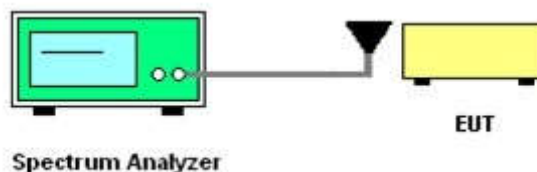
3.2.2 Measuring Instruments

See list of measuring instruments of this test report.

3.2.3 Test Procedures

1. The spectrum analyzer connected via a receive antenna placed near the EUT in peak Max hold mode.
2. The resolution bandwidth of 1 kHz and the video bandwidth of 3 kHz were used.
3. Measured the spectrum width with power higher than 20dB below carrier.
4. Measured the 99% OBW.

3.2.4 Test Setup



3.2.5 Test Result of Conducted Test Items

Please refer to Appendix B.

3.3 Frequency Stability Measurement

3.3.1 Limit

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% (100ppm) of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

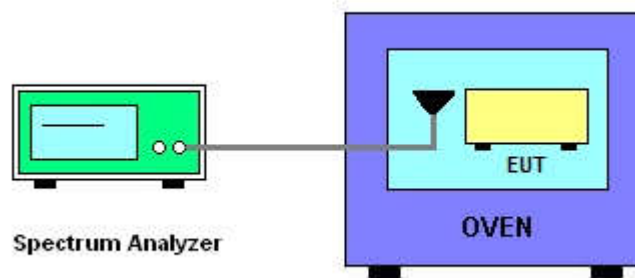
3.3.2 Measuring Instruments

See list of measuring instruments of this test report.

3.3.3 Test Procedures

1. The spectrum analyzer connected via a receive antenna placed near the EUT.
2. EUT have transmitted signal and fixed channelize.
3. Set the spectrum analyzer span to view the entire emissions bandwidth.
4. Set RBW = 1 kHz, VBW = 3 kHz with peak detector and max hold settings.
5. The f_c is declaring of channel frequency. Then the frequency error formula is $(f_c - f)/f_c \times 10^6$ ppm and the limit is less than ± 100 ppm.
6. Extreme temperature rule is -20°C~50°C.

3.3.4 Test Setup



3.3.5 Test Result of Conducted Test Items

Please refer to Appendix B.

3.4 Field Strength of Fundamental Emissions and Mask Measurement

3.4.1 Limit

Rules and specifications	FCC CFR 47 Part 15 section 15.225			
Description	Compliance with the spectrum mask is tested with RBW set to 9kHz.			
Freq. of Emission (MHz)	Field Strength (μ V/m) at 30m	Field Strength (dB μ V/m) at 30m	Field Strength (dB μ V/m) at 10m	Field Strength (dB μ V/m) at 3m
1.705~13.110	30	29.5	48.58	69.5
13.110~13.410	106	40.5	59.58	80.5
13.410~13.553	334	50.5	69.58	90.5
13.553~13.567	15848	84.0	103.08	124.0
13.567~13.710	334	50.5	69.58	90.5
13.710~14.010	106	40.5	59.58	80.5
14.010~30.000	30	29.5	48.58	69.5

3.4.2 Measuring Instruments

See list of measuring instruments of this test report.

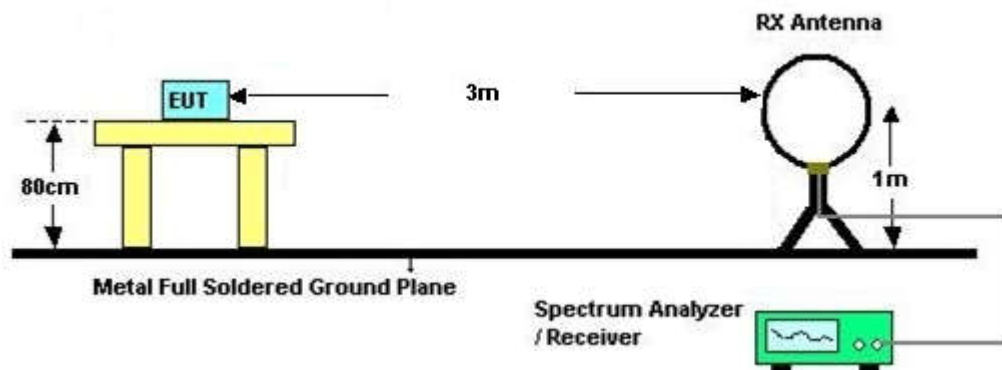
3.4.3 Test Procedures

1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the loop receiving antenna mounted antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the receiving antenna was fixed at one meter above ground to find the maximum emissions field strength.
4. For Fundamental emissions, use the receiver to measure QP reading.
5. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
6. Compliance with the spectrum mask is tested with RBW set to 9kHz.

Note: Emission level (dB μ V/m) = 20 log Emission level (μ V/m).

3.4.4 Test Setup

For radiated emissions below 30MHz



3.4.5 Test Result of Field Strength of Fundamental Emissions and Mask

Please refer to Appendix C.

3.5 Radiated Emissions Measurement

3.5.1 Limit

The field strength of any emissions which appear outside of 13.110 ~14.010MHz band shall not exceed the general radiated emissions limits.

Frequencies (MHz)	Field Strength (μ V/m)	Measurement Distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

3.5.2 Measuring Instruments

See list of measuring instruments of this test report.

3.5.3 Measuring Instrument Setting

The following table is the setting of receiver.

Receiver Parameter	Setting
Attenuation	Auto
Frequency Range: 9kHz~150kHz	RBW 200Hz for QP
Frequency Range: 150kHz~30MHz	RBW 9kHz for QP
Frequency Range: 30MHz~1000MHz	RBW 120kHz for Peak

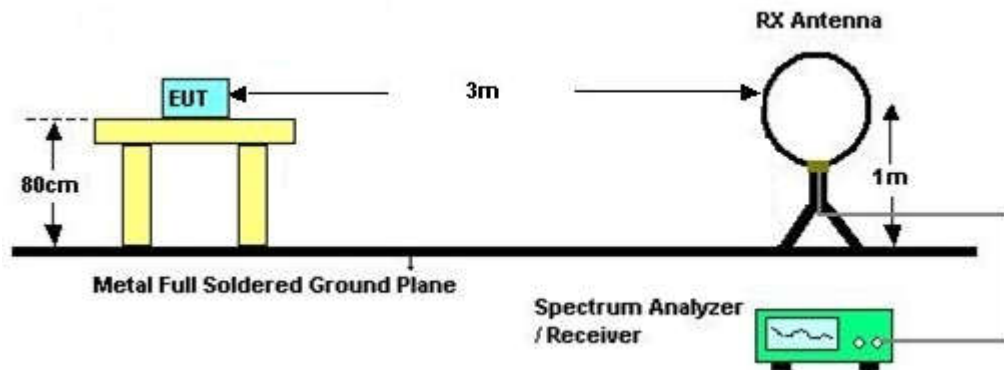
Note: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz. Radiated emission limits in these two bands are based on measurements employing an average detector.

3.5.4 Test Procedures

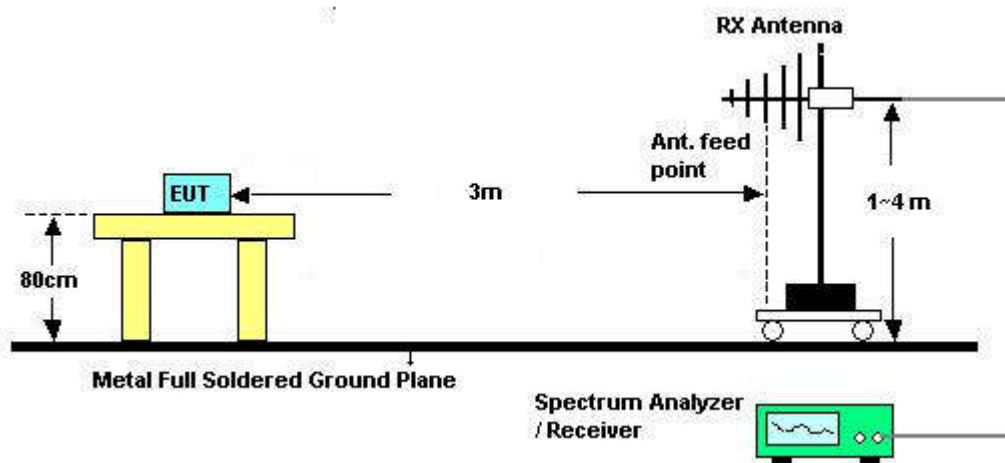
1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
7. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. Antenna Requirements

3.5.5 Test Setup

For radiated emissions below 30MHz



For radiated emissions above 30MHz



3.5.6 Test Result of Radiated Emissions Measurement

Please refer to Appendix C.

3.6 Antenna Requirements

3.6.1 Standard Applicable

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited.

The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.6.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.



4. List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Aug. 08, 2017	Jun. 13, 2018	Aug. 07, 2018	Conducted (TH01-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Jun. 13, 2018	NCR	Conducted (TH01-KS)
Temperature & humidity chamber	Hongzhan	LP-150U	H2014011440	-40~+150°C 20%~95%RH	Jun. 28, 2017	Jun. 13, 2018	Jun. 27, 2018	Conducted (TH01-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	Apr. 19, 2018	Jun. 07, 2018	Apr. 18, 2019	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060103	9kHz~30MHz	Oct. 13, 2017	Jun. 07, 2018	Oct. 12, 2018	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060105	9kHz~30MHz	Oct. 13, 2017	Jun. 07, 2018	Oct. 12, 2018	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP00000811	AC 0V~300V, 45Hz~1000Hz	Oct. 12, 2017	Jun. 07, 2018	Oct. 11, 2018	Conduction (CO01-KS)
RF Cable	WOKEN	Y5T	00100N1Q3N1	150kHz~30MHz	Aug. 25, 2017	Jun. 07, 2018	Aug. 24, 2018	Conduction (CO01-KS)
Transient limiter	COM-POWER	LIT-153	531040	150kHz~30MHz	Aug. 25, 2017	Jun. 07, 2018	Aug. 24, 2018	Conduction (CO01-KS)
EMI Test Receiver	R&S	ESR7	101403	9kHz~7GHz;Max 30dBm	Aug. 08, 2017	Jun. 20, 2018	Aug. 07, 2018	Radiation (03CH02-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 22, 2017	Jun. 20, 2018	Oct. 21, 2018	Radiation (03CH02-KS)
Bilog Antenna	TeseQ	CBL6112D	23182	30MHz~2GHz	Jan. 29, 2018	Jun. 20, 2018	Jan. 28, 2019	Radiation (03CH02-KS)
Amplifier	SONOMA	310N	187289	9KHz~1GHz	Aug. 07, 2017	Jun. 20, 2018	Aug. 06, 2018	Radiation (03CH02-KS)
AC Power Source	Chroma	61601	616010002473	N/A	NCR	Jun. 20, 2018	NCR	Radiation (03CH02-KS)
RF Cable	Rosnol	KIK50	K1K50-4M-002	30Mhz~40Ghz	Sep. 26, 2017	Jun. 20, 2018	Sep. 25, 2018	Radiation (03CH02-KS)
Low Pass Filter	Wainwright Instruments GmbH	WLK4-1000-1530-8000-40S	2	1G Low Pass	Jun.19, 2018	Jun. 20, 2018	Jun.18, 2019	Radiation (03CH02-KS)
Turn Table	MF	MF7802	N/A	0~360 degree	NCR	Jun. 20, 2018	NCR	Radiation (03CH02-KS)
Antenna Mast	MF	MF7802	N/A	1 m~4 m	NCR	Jun. 20, 2018	NCR	Radiation (03CH02-KS)

NCR: No Calibration Required

5. Uncertainty of Evaluation

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	2.9 dB
---	--------

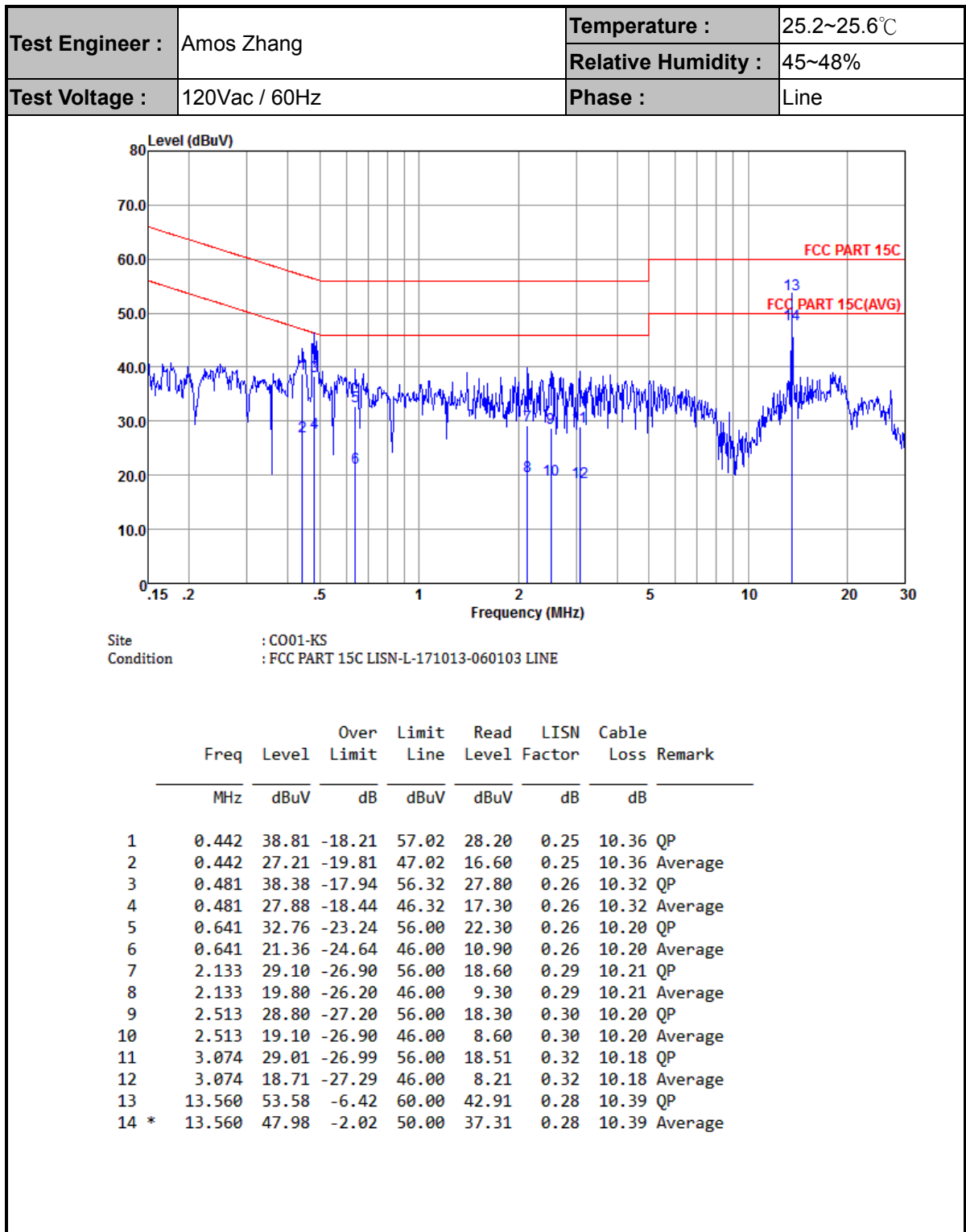
Uncertainty of Radiated Emission Measurement (9 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	4.8 dB
---	--------

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	5.2 dB
---	--------

Appendix A. Test Results of Conducted Emission Test

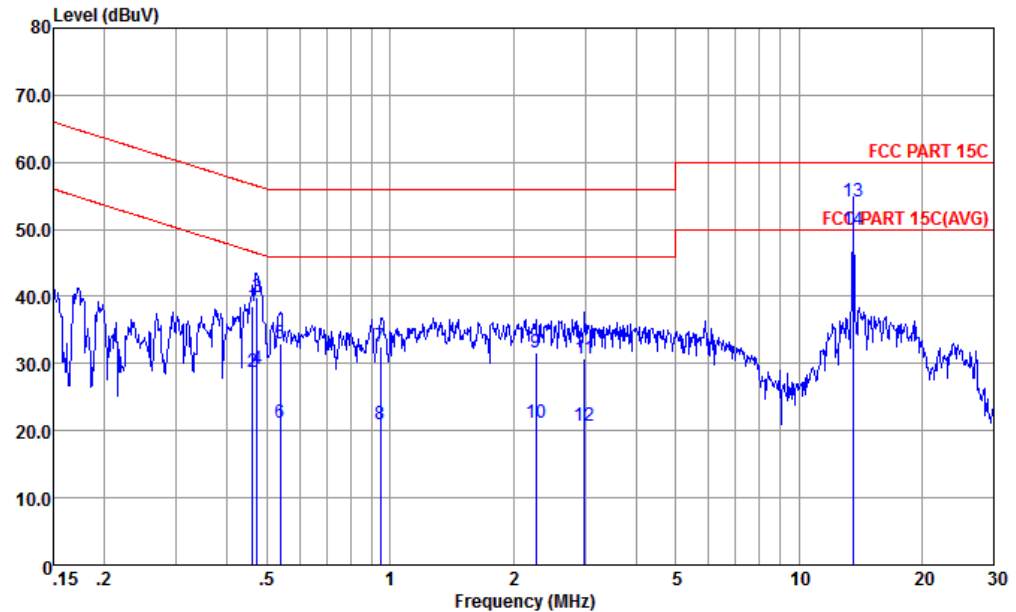


(1) with antenna

Remark: 13.560MHz is the NFC RF fundamental signal.



Test Engineer :	Amos Zhang	Temperature :	25.2~25.6℃
		Relative Humidity :	45~48%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral

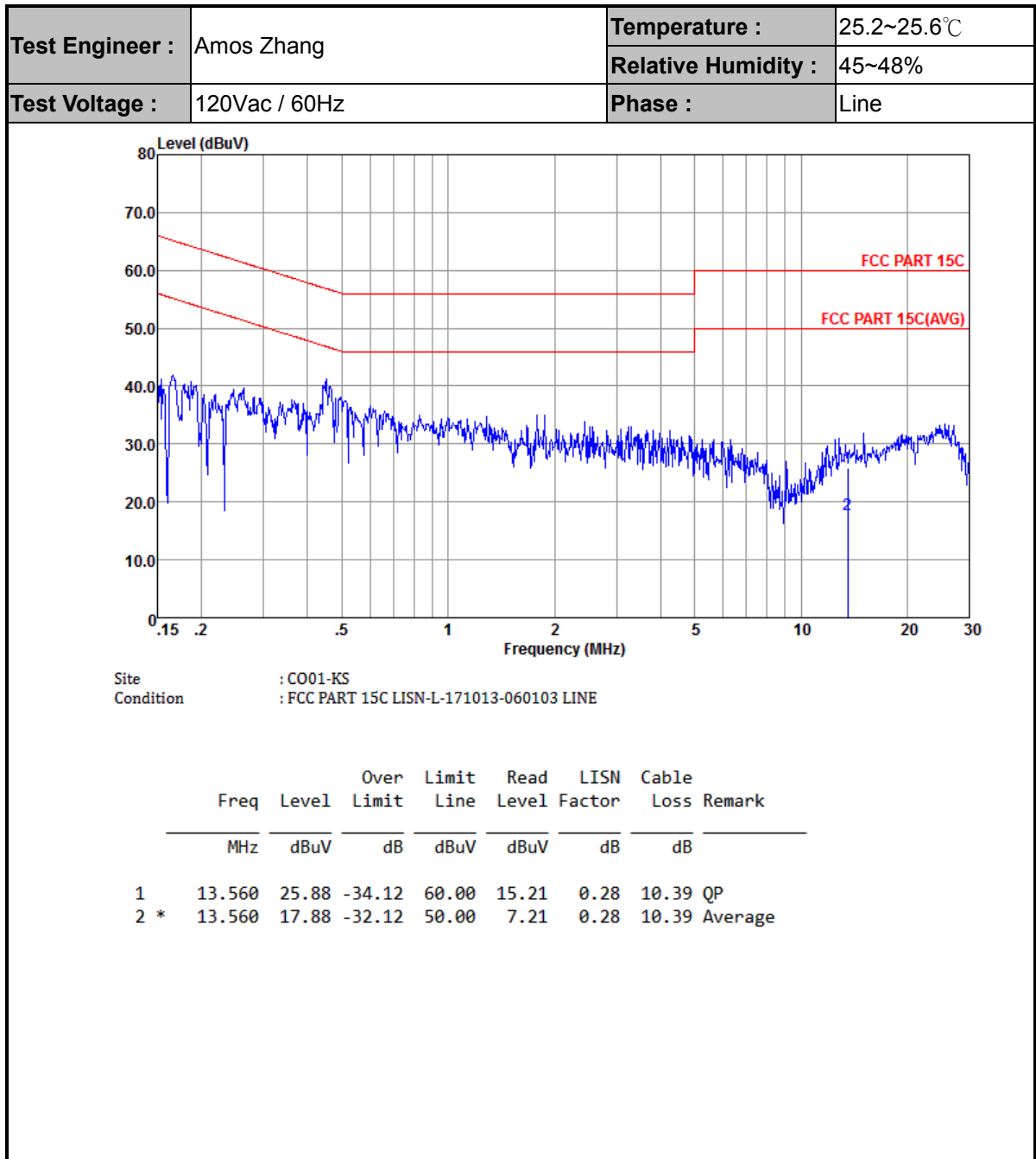


Site : CO01-KS
Condition : FCC PART 15C LISN-N-171013-060103 NEUTRAL

	Freq	Level	Over	Limit	Read	LISN	Cable	
	MHz	dBuV	Limit	Line	Level	Factor	Loss	Remark
			dB	dBuV	dBuV	dB	dB	
1	0.461	38.53	-18.14	56.67	27.90	0.29	10.34	QP
2	0.461	28.83	-17.84	46.67	18.20	0.29	10.34	Average
3	0.474	39.82	-16.63	56.45	29.20	0.29	10.33	QP
4	0.474	29.22	-17.23	46.45	18.60	0.29	10.33	Average
5	0.538	33.07	-22.93	56.00	22.51	0.29	10.27	QP
6	0.538	21.17	-24.83	46.00	10.61	0.29	10.27	Average
7	0.948	32.51	-23.49	56.00	22.09	0.31	10.11	QP
8	0.948	21.01	-24.99	46.00	10.59	0.31	10.11	Average
9	2.273	31.73	-24.27	56.00	21.21	0.32	10.20	QP
10	2.273	21.13	-24.87	46.00	10.61	0.32	10.20	Average
11	2.993	30.81	-25.19	56.00	20.29	0.33	10.19	QP
12	2.993	20.81	-25.19	46.00	10.29	0.33	10.19	Average
13	13.560	54.23	-5.77	60.00	43.61	0.23	10.39	QP
14 *	13.560	49.93	-0.07	50.00	39.31	0.23	10.39	Average

(1) with antenna

Remark: 13.560MHz is the NFC RF fundamental signal.

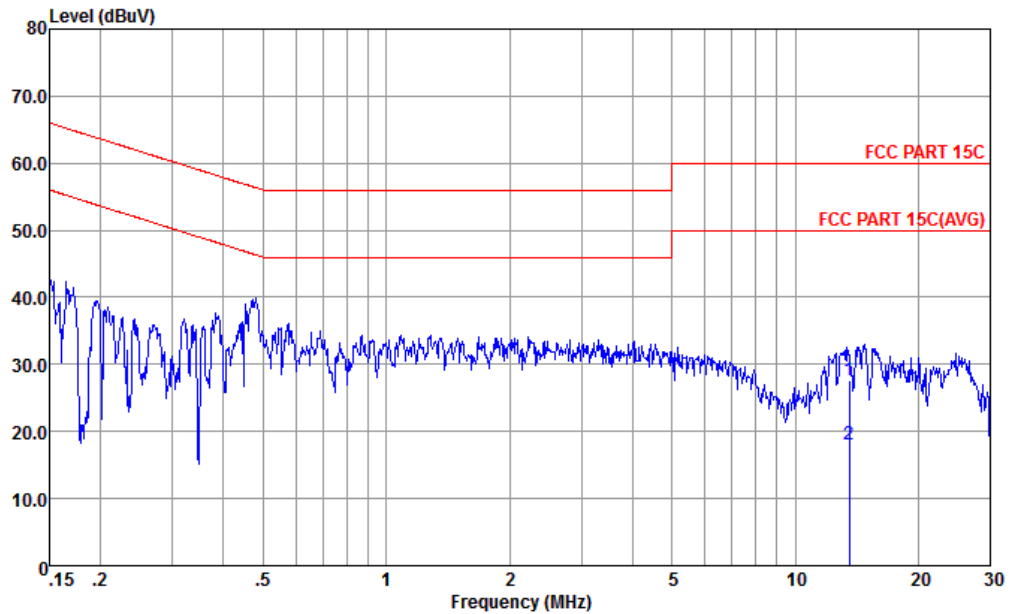


(2) With dummy load

Remark: Only the fundamental NFC signal needs to be retested per KDB 174176.



Test Engineer :	Amos Zhang	Temperature :	25.2~25.6℃
		Relative Humidity :	45~48%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral



Site : CO01-KS
Condition : FCC PART 15C LISN-N-171013-060103 NEUTRAL

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	13.560	27.73	-32.27	60.00	17.11	0.23	10.39	QP
2 *	13.560	18.13	-31.87	50.00	7.51	0.23	10.39	Average

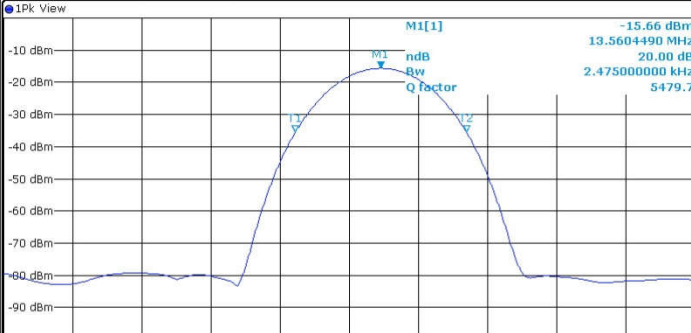
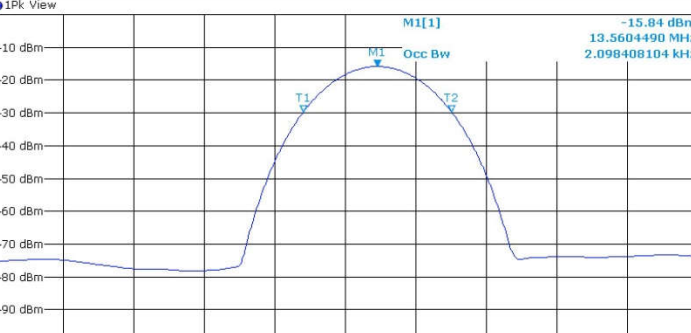
(2) With dummy load

Remark: Only the fundamental NFC signal needs to be retested per KDB 174176.



Appendix B. Test Results of Conducted Test Items

B1. Test Result of 20dB Spectrum Bandwidth

Test mode		NFC Tx																																																									
Spectrum Ref Level 0.00 dBm Att 30 dB RBW 1 kHz SWT 20 ms VBW 3 kHz Mode Auto FFT 1Pk View  CF 13.56 MHz 691 pts Span 10.0 kHz Marker <table><thead><tr><th>Type</th><th>Ref</th><th>Trc</th><th>X-value</th><th>Y-value</th><th>Function</th><th>Function Result</th></tr></thead><tbody><tr><td>M1</td><td>1</td><td></td><td>13.560449 MHz</td><td>-15.66 dBm</td><td>ndB down</td><td>2.475 kHz</td></tr><tr><td>T1</td><td>1</td><td></td><td>13.559219 MHz</td><td>-35.48 dBm</td><td>ndB</td><td>20.00 dB</td></tr><tr><td>T2</td><td>1</td><td></td><td>13.561693 MHz</td><td>-35.54 dBm</td><td>Q factor</td><td>5479.7</td></tr></tbody></table> Measuring...		Type	Ref	Trc	X-value	Y-value	Function	Function Result	M1	1		13.560449 MHz	-15.66 dBm	ndB down	2.475 kHz	T1	1		13.559219 MHz	-35.48 dBm	ndB	20.00 dB	T2	1		13.561693 MHz	-35.54 dBm	Q factor	5479.7	Spectrum Ref Level 0.00 dBm Att 30 dB RBW 1 kHz SWT 20 ms VBW 3 kHz Mode Auto FFT 1Pk View  CF 13.56 MHz 691 pts Span 10.0 kHz Marker <table><thead><tr><th>Type</th><th>Ref</th><th>Trc</th><th>X-value</th><th>Y-value</th><th>Function</th><th>Function Result</th></tr></thead><tbody><tr><td>M1</td><td>1</td><td></td><td>13.560449 MHz</td><td>-15.84 dBm</td><td></td><td></td></tr><tr><td>T1</td><td>1</td><td></td><td>13.5594067 MHz</td><td>-29.59 dBm</td><td>Occ Bw</td><td>2.098408104 kHz</td></tr><tr><td>T2</td><td>1</td><td></td><td>13.5615051 MHz</td><td>-29.73 dBm</td><td></td><td></td></tr></tbody></table> Measuring...		Type	Ref	Trc	X-value	Y-value	Function	Function Result	M1	1		13.560449 MHz	-15.84 dBm			T1	1		13.5594067 MHz	-29.59 dBm	Occ Bw	2.098408104 kHz	T2	1		13.5615051 MHz	-29.73 dBm		
Type	Ref	Trc	X-value	Y-value	Function	Function Result																																																					
M1	1		13.560449 MHz	-15.66 dBm	ndB down	2.475 kHz																																																					
T1	1		13.559219 MHz	-35.48 dBm	ndB	20.00 dB																																																					
T2	1		13.561693 MHz	-35.54 dBm	Q factor	5479.7																																																					
Type	Ref	Trc	X-value	Y-value	Function	Function Result																																																					
M1	1		13.560449 MHz	-15.84 dBm																																																							
T1	1		13.5594067 MHz	-29.59 dBm	Occ Bw	2.098408104 kHz																																																					
T2	1		13.5615051 MHz	-29.73 dBm																																																							
Date: 13 JUN 2018 17:12:58		Date: 13 JUN 2018 17:14:36																																																									
20dB Bandwidth (kHz)	2.48	99% OccupiedBW(kHz)	2.10																																																								
Frequency range (MHz)	$f_L > 13.553$	13.559219	Test Result																																																								
	$f_H < 13.567$	13.561693	Pass																																																								

Remark: Because the measured signal is CW adjusting the RBW per C63.10 would not be practical since measured bandwidth will always follow the RBW and the result will be approximately twice the RBW.

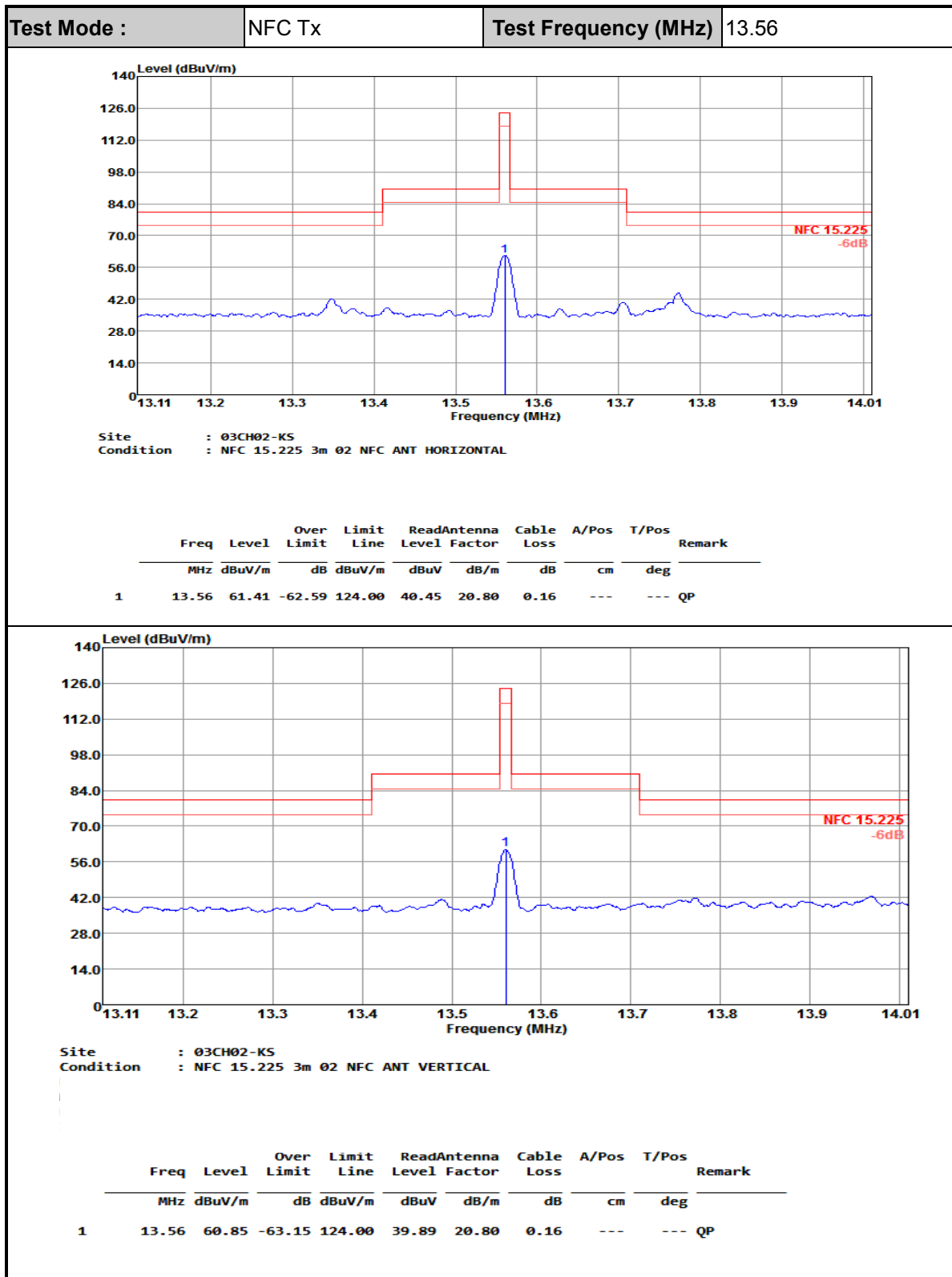
**B2. Test Result of Frequency Stability**

Voltage vs. Frequency Stability		Temperature vs. Frequency Stability	
Voltage (Vac)	Measurement Frequency (MHz)	Temperature (°C)	Measurement Frequency (MHz)
120	13.560456	-20	13.560456
102	13.560456	-10	13.560456
138	13.560456	0	13.560464
		10	13.560456
		20	13.560456
		30	13.560456
		40	13.560456
		50	13.560456
Max.Deviation (MHz)	0.000456	Max.Deviation (MHz)	0.000464
Max.Deviation (ppm)	33.6283	Max.Deviation (ppm)	34.1814
Limit	FS < ±100 ppm	Limit	FS < ±100 ppm
Test Result	PASS	Test Result	PASS



Appendix C. Test Results of Radiated Test Items

C1. Test Result of Field Strength of Fundamental Emissions



C2. Results of Radiated Spurious Emissions (9 kHz~30MHz)

Test Mode :		NFC Tx			Polarization :		Horizontal		
Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
0.02254	60.55	-59.99	120.54	40.44	20.1	0.01	-	-	Average
0.0451	58.72	-55.79	114.51	39.31	19.4	0.01	-	-	Average
1.258	54.08	-11.52	65.6	33.31	20.75	0.02	-	-	QP
1.319	53.33	-11.86	65.19	32.61	20.7	0.02	-	-	QP
7.184	44.75	-24.79	69.54	24.28	20.38	0.09	-	-	QP
25.71	40.12	-29.42	69.54	18.56	21.27	0.29	-	-	QP

Test Mode :		NFC Tx			Polarization :		Vertical		
Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
0.00971	53.82	-74.04	127.86	33.71	20.1	0.01	-	-	Average
0.01929	52.88	-69.01	121.89	32.77	20.1	0.01	-	-	Average
1.256	52.86	-12.75	65.61	32.09	20.75	0.02	-	-	QP
1.319	52.51	-12.68	65.19	31.79	20.7	0.02	-	-	QP
7.088	44.51	-25.03	69.54	24.03	20.39	0.09	-	-	QP
25.402	43.52	-26.02	69.54	21.91	21.32	0.29	-	-	QP

Note:

1. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
2. Distance extrapolation factor = 40 log (specific distance / test distance) (dB);
3. Limit line = specific limits (dBμV) + distance extrapolation factor.

C3. Results of Radiated Spurious Emissions (30MHz~1GHz)

Test Mode :		NFC Tx			Polarization :		Horizontal			
Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
33.88	26.85	-13.15	40	36.04	22.22	0.63	32.04	-	-	Peak
40.67	28.57	-11.43	40	41.63	18.35	0.64	32.05	100	0	Peak
175.5	25.28	-18.22	43.5	40.33	15.34	1.36	31.75	-	-	Peak
703.18	24.99	-21.01	46	26.47	24.63	2.76	28.87	-	-	Peak
879.72	29.06	-16.94	46	27.38	26.28	3.08	27.68	-	-	Peak
908.82	31.11	-14.89	46	28.94	26.5	3.11	27.44	-	-	Peak

Test Mode :		NFC Tx			Polarization :		Vertical			
Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
33.88	31.14	-8.86	40	40.33	22.22	0.63	32.04	-	-	Peak
39.7	36.3	-3.7	40	48.9	18.8	0.64	32.04	100	112	QP
44.55	32.94	-7.06	40	47.86	16.53	0.66	32.11	-	-	Peak
58.13	29.41	-10.59	40	48.09	12.68	0.78	32.14	-	-	Peak
752.65	25.64	-20.36	46	26.24	25.23	2.81	28.64	-	-	Peak
880.69	27.93	-18.07	46	26.24	26.28	3.08	27.67	-	-	Peak

Note:

1. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
2. Emission level (dBμV/m) = 20 log Emission level (μV/m).
3. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor= Level.



TABLE OF CONTENTS

REVISION HISTORY	3
SUMMARY OF THE TEST RESULT	4
1. GENERAL DESCRIPTION	5
1.1 Applicant.....	5
1.2 Manufacturer	5
1.3 Product Feature of Equipment Under Test.....	5
1.4 Product Specification of Equipment Under Test	6
1.5 Modification of EUT	6
1.6 Testing Location	7
1.7 Applicable Standards.....	7
2. TEST CONFIGURATION OF EQUIPMENT UNDER TEST	8
2.1 Descriptions of Test Mode.....	8
2.2 Connection Diagram of Test System.....	9
2.3 Table for Supporting Units.....	9
2.4 EUT Operation Test Setup	9
3. TEST RESULTS.....	10
3.1 AC Power Line Conducted Emissions Measurement	10
3.2 20dB and 99% OBW Spectrum Bandwidth Measurement.....	12
3.3 Frequency Stability Measurement	13
3.4 Field Strength of Fundamental Emissions and Mask Measurement.....	14
3.5 Radiated Emissions Measurement.....	16
3.6 Antenna Requirements.....	19
4. LIST OF MEASURING EQUIPMENT	20
5. UNCERTAINTY OF EVALUATION	21
APPENDIX A. TEST RESULTS OF CONDUCTED EMISSION TEST	
APPENDIX B. TEST RESULTS OF CONDUCTED TEST ITEMS	
B1. Test Result of 20dB Spectrum Bandwidth	
B2. Test Result of Frequency Stability	
APPENDIX C. TEST RESULTS OF RADIATED TEST ITEMS	
C1. Test Result of Field Strength of Fundamental Emissions	
C2. Results of Radiated Emissions (9 kHz~30MHz)	
C3. Results of Radiated Emissions (30MHz~1GHz)	
APPENDIX D. SETUP PHOTOGRAPHS	



REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR850409D	Rev. 01	Initial issue of report	Nov. 13, 2018



SUMMARY OF THE TEST RESULT

Report Section	FCC Rule	Description of Test	Result	Remark
3.1	15.207	AC Power Line Conducted Emissions	Complies	Under limit 16.63 dB at 0.474MHz
3.2	15.215(c)	20dB Spectrum Bandwidth	Complies	-
	-	99% OBW Spectrum Bandwidth	Complies	-
3.3	15.225(e)	Frequency Stability	Complies	-
3.4	15.225(a)(b)(c)	Field Strength of Fundamental Emissions	Complies	Max level 61.41 dB μ V/m at 13.56 MHz
3.5	15.225(d) & 15.209	Radiated Spurious Emissions	Complies	Under limit 3.70 dB at 39.70MHz
3.6	15.203	Antenna Requirements	Complies	-



1. General Description

1.1 Applicant

Honeywell International Inc.

Honeywell Safety and Productivity Solutions

9680 Old Bailes Rd. Fort Mill, SC 29707 United States

1.2 Manufacturer

Honeywell International Inc.

Honeywell Safety and Productivity Solutions

9680 Old Bailes Rd. Fort Mill, SC 29707 United States

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	DOLPHIN CT40
Brand Name	Honeywell
Model Name	CT40-L1N
FCC ID	HD5-CT40L1N
EUT supports Radios application	CDMA/EV-DO/GSM/GPRS/EGPRS/WCDMA/HSPA/ DC-HSDPA/ HSPA+(16QAM uplink is not supported)/LTE/NFC WLAN 2.4GHz 802.11b/g/n HT20/ WLAN 5GHz 802.11a/n HT20/HT40/ WLAN 5GHz 802.11ac VHT20/VHT40/VHT80/ Bluetooth BR EDR / LE
IMEI Code	Conducted: 990011960007085/990011960007001 Conduction: 990011960006541 Radiation: 990011960006061/990011960006001 990011960006061/990011960006002
HW Version	V1.0
SW Version	OS.01.010-HON.01.102
EUT Stage	Identical Prototype

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. There are two samples, the difference is the scanner from different suppliers, the difference has no influence on RF features, only sample 1 is assessed to perform full test.

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	13.553 ~ 13.567MHz
Channel Number	1
20dBW	2.48 KHz
99%OBW	2.10 KHz
Antenna Type	Loop Antenna
Type of Modulation	ASK

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.5 Modification of EUT

No modifications are made to the EUT during all test items.

1.6 Testing Location

Sporton International (Kunshan) Inc. is accredited to ISO 17025 by National Voluntary Laboratory Accreditation Program (NVLAP code: 600155-0) and the FCC designation No. is CN5013.

Test Site	Sporton International (Kunshan) Inc.			
Test Site Location	No.3-2 Ping-Xiang Rd, Kunshan Development Zone Kunshan City Jiangsu Province 215335 China TEL : +86-512-57900158 FAX : +86-512-57900958			
Test Site No.	Sporton Site No.			FCC Registration No.
	TH01-KS	03CH02-KS	CO01-KS	630927
Test Engineer	Silent Hai	Level Zhao	Amos Zhang	
Temperature	21~25	21~25	25.2~25.6	
Relative Humidity	49~51	41~44	45~48	

1.7 Applicable Standards

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

- ♦ FCC Part 15 Subpart C §15.225
- ♦ ANSI C63.10-2013

2. Test Configuration of Equipment Under Test

2.1 Descriptions of Test Mode

Investigation has been done on all the possible configurations.

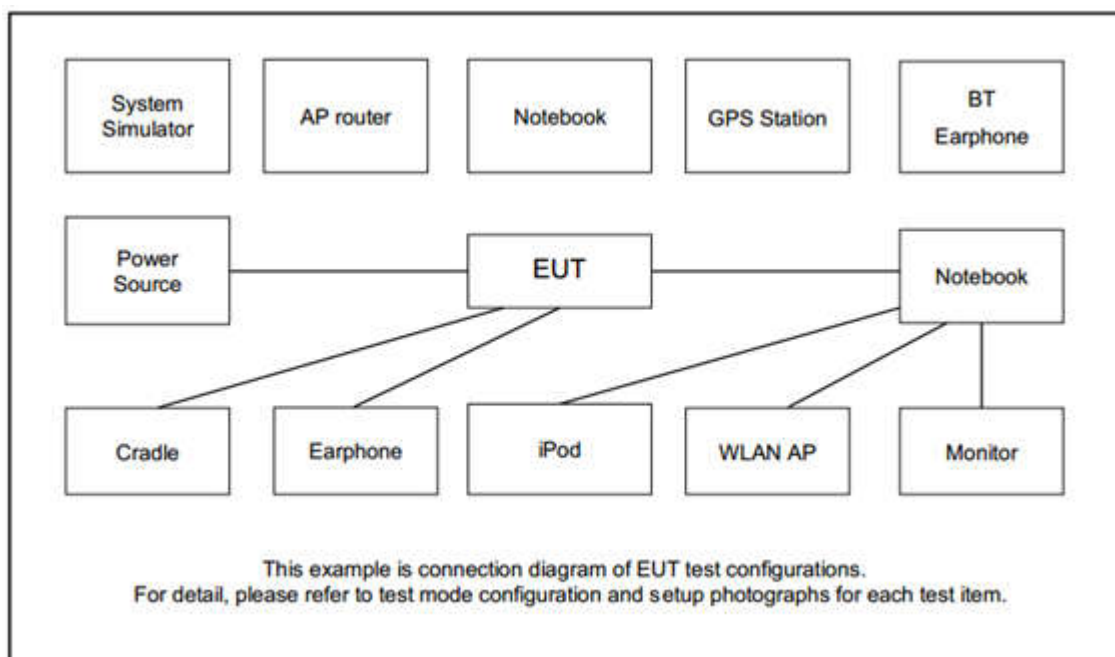
The following table is a list of the test modes shown in this test report.

Test Items	
AC Power Line Conducted Emissions	Field Strength of Fundamental Emissions
20dB Spectrum Bandwidth	Frequency Stability
Radiated Emissions 9kHz~30MHz	Radiated Emissions 30MHz~1GHz

The EUT pre-scanned in four NFC type, A, B, F, V. The worst type (type A) was recorded in this report. Pre-scanned tests, X, Y, Z in three orthogonal panels to determine the final configuration (Y plane as worst plane) from all possible combinations.

Test Cases	
AC Conducted Emission	Mode 1: GSM850 Idle + Bluetooth Link + WLAN Link(2.4G) + USB Cradle(Charging from Adapter) + NFC Tx
Remark: For Radiated Test Cases, The tests were performance with Adapter	

2.2 Connection Diagram of Test System



2.3 Table for Supporting Units

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	System Simulator	Anritsu	MT8820C	N/A	N/A	Unshielded, 1.8m
2.	WLAN AP	D-Link	DIR-855	KA2DIR855A2		Unshielded, 1.8m
3.	Notebook	Lenovo	G480	PRC4	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
4.	Bluetooth Earphone	Lenovo	LBH308	N/A	N/A	N/A
5.	NFC card	N/A	N/A	N/A	N/A	N/A

2.4 EUT Operation Test Setup

The EUT was programmed to be in continuously transmitting mode.

The ancillary equipment, NFC card, is used to make the EUT (NFC) continuously transmit at 13.56MHz and is placed around 3 cm gap to the EUT.

3. Test Results

3.1 AC Power Line Conducted Emissions Measurement

3.1.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	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.

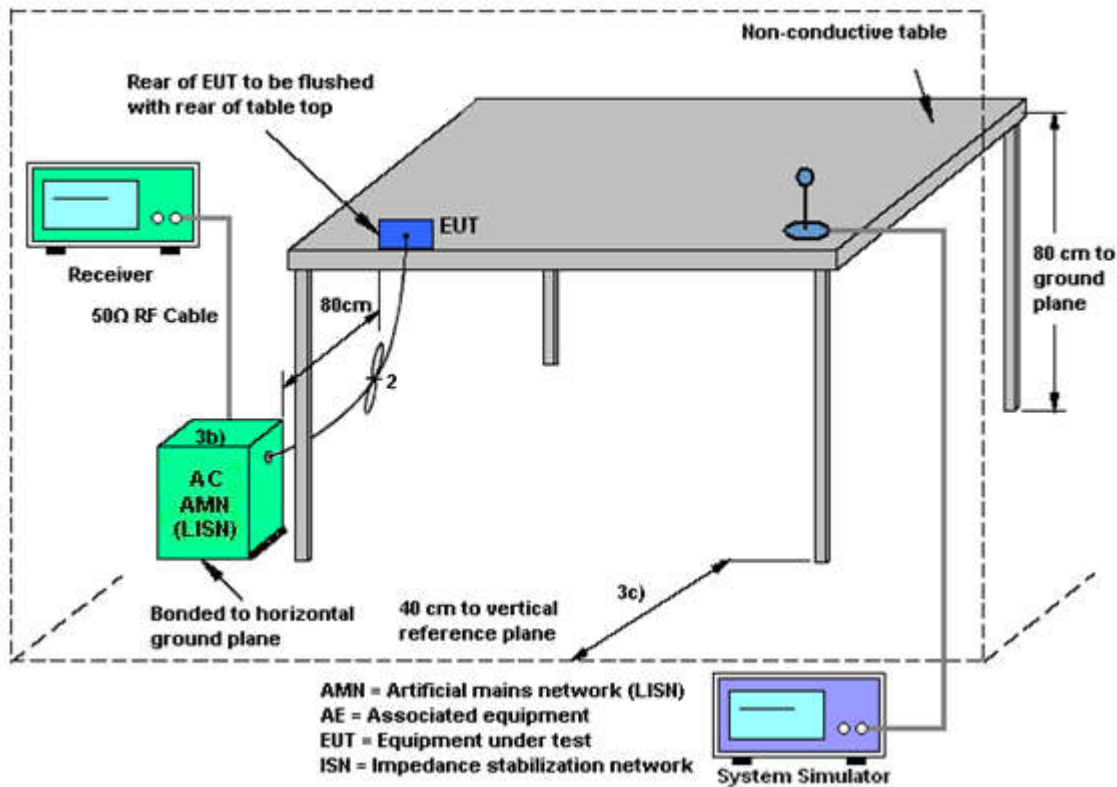
3.1.2 Measuring Instruments

See list of measuring instruments of this test report.

3.1.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room, and it was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

3.1.4 Test setup



3.1.5 Test Result of AC Conducted Emission

Please refer to Appendix A.

3.2 20dB and 99% OBW Spectrum Bandwidth Measurement

3.2.1 Limit

Intentional radiators must be designed to ensure that the 20dB and 99% emission bandwidth in the specific band 13.553~13.567MHz.

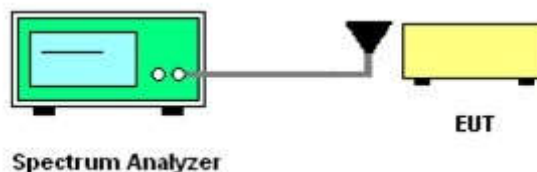
3.2.2 Measuring Instruments

See list of measuring instruments of this test report.

3.2.3 Test Procedures

1. The spectrum analyzer connected via a receive antenna placed near the EUT in peak Max hold mode.
2. The resolution bandwidth of 1 kHz and the video bandwidth of 3 kHz were used.
3. Measured the spectrum width with power higher than 20dB below carrier.
4. Measured the 99% OBW.

3.2.4 Test Setup



3.2.5 Test Result of Conducted Test Items

Please refer to Appendix B.

3.3 Frequency Stability Measurement

3.3.1 Limit

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% (100ppm) of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

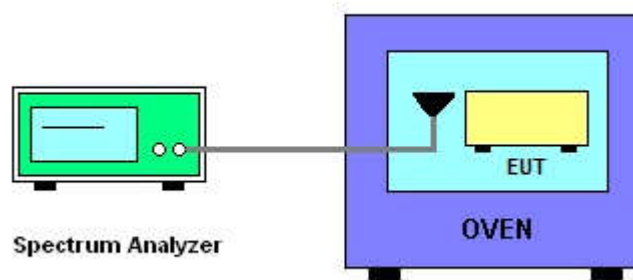
3.3.2 Measuring Instruments

See list of measuring instruments of this test report.

3.3.3 Test Procedures

1. The spectrum analyzer connected via a receive antenna placed near the EUT.
2. EUT have transmitted signal and fixed channelize.
3. Set the spectrum analyzer span to view the entire emissions bandwidth.
4. Set RBW = 1 kHz, VBW = 3 kHz with peak detector and max hold settings.
5. The f_c is declaring of channel frequency. Then the frequency error formula is $(f_c - f)/f_c \times 10^6$ ppm and the limit is less than ± 100 ppm.
6. Extreme temperature rule is -20°C~50°C.

3.3.4 Test Setup



3.3.5 Test Result of Conducted Test Items

Please refer to Appendix B.

3.4 Field Strength of Fundamental Emissions and Mask Measurement

3.4.1 Limit

Rules and specifications	FCC CFR 47 Part 15 section 15.225			
Description	Compliance with the spectrum mask is tested with RBW set to 9kHz.			
Freq. of Emission (MHz)	Field Strength (μ V/m) at 30m	Field Strength (dB μ V/m) at 30m	Field Strength (dB μ V/m) at 10m	Field Strength (dB μ V/m) at 3m
1.705~13.110	30	29.5	48.58	69.5
13.110~13.410	106	40.5	59.58	80.5
13.410~13.553	334	50.5	69.58	90.5
13.553~13.567	15848	84.0	103.08	124.0
13.567~13.710	334	50.5	69.58	90.5
13.710~14.010	106	40.5	59.58	80.5
14.010~30.000	30	29.5	48.58	69.5

3.4.2 Measuring Instruments

See list of measuring instruments of this test report.

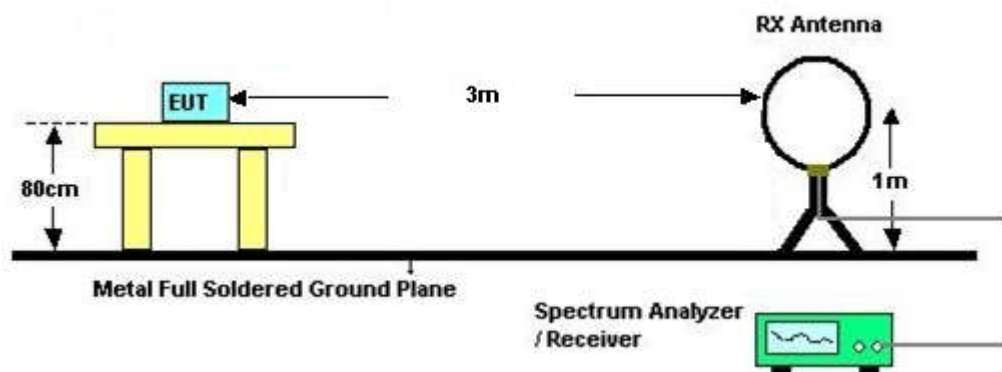
3.4.3 Test Procedures

1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the loop receiving antenna mounted antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the receiving antenna was fixed at one meter above ground to find the maximum emissions field strength.
4. For Fundamental emissions, use the receiver to measure QP reading.
5. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
6. Compliance with the spectrum mask is tested with RBW set to 9kHz.

Note: Emission level (dB μ V/m) = 20 log Emission level (μ V/m).

3.4.4 Test Setup

For radiated emissions below 30MHz



3.4.5 Test Result of Field Strength of Fundamental Emissions and Mask

Please refer to Appendix C.

3.5 Radiated Emissions Measurement

3.5.1 Limit

The field strength of any emissions which appear outside of 13.110 ~14.010MHz band shall not exceed the general radiated emissions limits.

Frequencies (MHz)	Field Strength (μ V/m)	Measurement Distance (meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

3.5.2 Measuring Instruments

See list of measuring instruments of this test report.

3.5.3 Measuring Instrument Setting

The following table is the setting of receiver.

Receiver Parameter	Setting
Attenuation	Auto
Frequency Range: 9kHz~150kHz	RBW 200Hz for QP
Frequency Range: 150kHz~30MHz	RBW 9kHz for QP
Frequency Range: 30MHz~1000MHz	RBW 120kHz for Peak

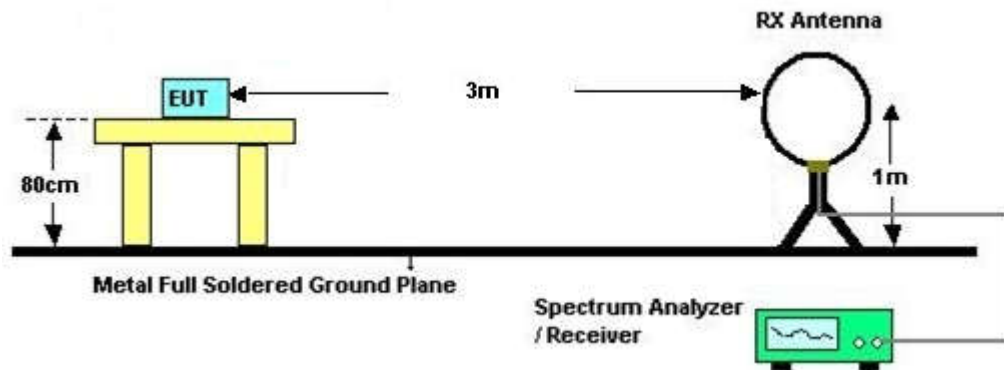
Note: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz. Radiated emission limits in these two bands are based on measurements employing an average detector.

3.5.4 Test Procedures

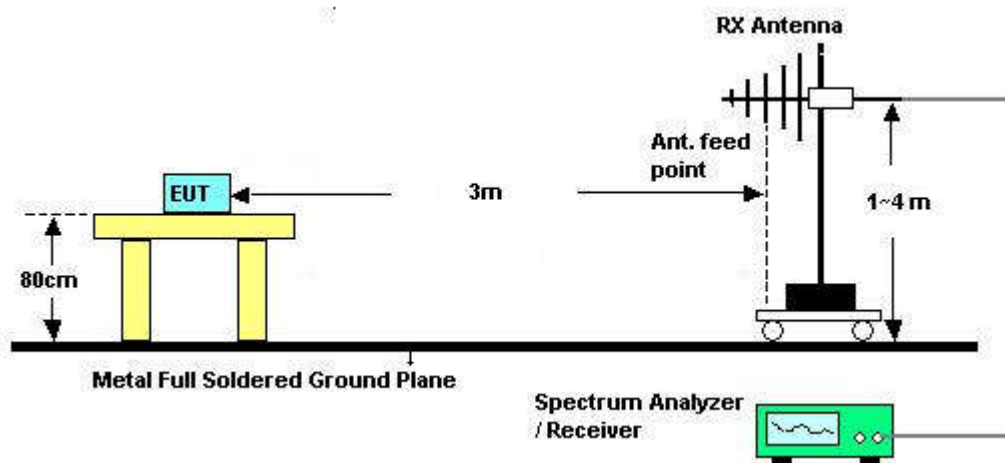
1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. When the radiated emissions limits are expressed in terms of the average value of the emissions, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.
7. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. Antenna Requirements

3.5.5 Test Setup

For radiated emissions below 30MHz



For radiated emissions above 30MHz



3.5.6 Test Result of Radiated Emissions Measurement

Please refer to Appendix C.



3.6 Antenna Requirements

3.6.1 Standard Applicable

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited.

The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the rule.

3.6.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.



4. List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Aug. 08, 2017	Jun. 13, 2018	Aug. 07, 2018	Conducted (TH01-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Jun. 13, 2018	NCR	Conducted (TH01-KS)
Temperature & humidity chamber	Hongzhan	LP-150U	H2014011440	-40~+150°C 20%~95%RH	Jun. 28, 2017	Jun. 13, 2018	Jun. 27, 2018	Conducted (TH01-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	Apr. 19, 2018	Jun. 07, 2018	Apr. 18, 2019	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060103	9kHz~30MHz	Oct. 13, 2017	Jun. 07, 2018	Oct. 12, 2018	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060105	9kHz~30MHz	Oct. 13, 2017	Jun. 07, 2018	Oct. 12, 2018	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP00000811	AC 0V~300V, 45Hz~1000Hz	Oct. 12, 2017	Jun. 07, 2018	Oct. 11, 2018	Conduction (CO01-KS)
RF Cable	WOKEN	Y5T	00100N1Q3N1	150kHz~30MHz	Aug. 25, 2017	Jun. 07, 2018	Aug. 24, 2018	Conduction (CO01-KS)
Transient limiter	COM-POWER	LIT-153	531040	150kHz~30MHz	Aug. 25, 2017	Jun. 07, 2018	Aug. 24, 2018	Conduction (CO01-KS)
EMI Test Receiver	R&S	ESR7	101403	9kHz~7GHz;Max 30dBm	Aug. 08, 2017	Jun. 20, 2018	Aug. 07, 2018	Radiation (03CH02-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 22, 2017	Jun. 20, 2018	Oct. 21, 2018	Radiation (03CH02-KS)
Bilog Antenna	TeseQ	CBL6112D	23182	30MHz~2GHz	Jan. 29, 2018	Jun. 20, 2018	Jan. 28, 2019	Radiation (03CH02-KS)
Amplifier	SONOMA	310N	187289	9KHz~1GHz	Aug. 07, 2017	Jun. 20, 2018	Aug. 06, 2018	Radiation (03CH02-KS)
AC Power Source	Chroma	61601	616010002473	N/A	NCR	Jun. 20, 2018	NCR	Radiation (03CH02-KS)
RF Cable	Rosnol	KIK50	K1K50-4M-002	30Mhz~40Ghz	Sep. 26, 2017	Jun. 20, 2018	Sep. 25, 2018	Radiation (03CH02-KS)
Low Pass Filter	Wainwright Instruments GmbH	WLK4-1000-1530-8000-40S	2	1G Low Pass	Jun.19, 2018	Jun. 20, 2018	Jun.18, 2019	Radiation (03CH02-KS)
Turn Table	MF	MF7802	N/A	0~360 degree	NCR	Jun. 20, 2018	NCR	Radiation (03CH02-KS)
Antenna Mast	MF	MF7802	N/A	1 m~4 m	NCR	Jun. 20, 2018	NCR	Radiation (03CH02-KS)

NCR: No Calibration Required

5. Uncertainty of Evaluation

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	2.9 dB
---	--------

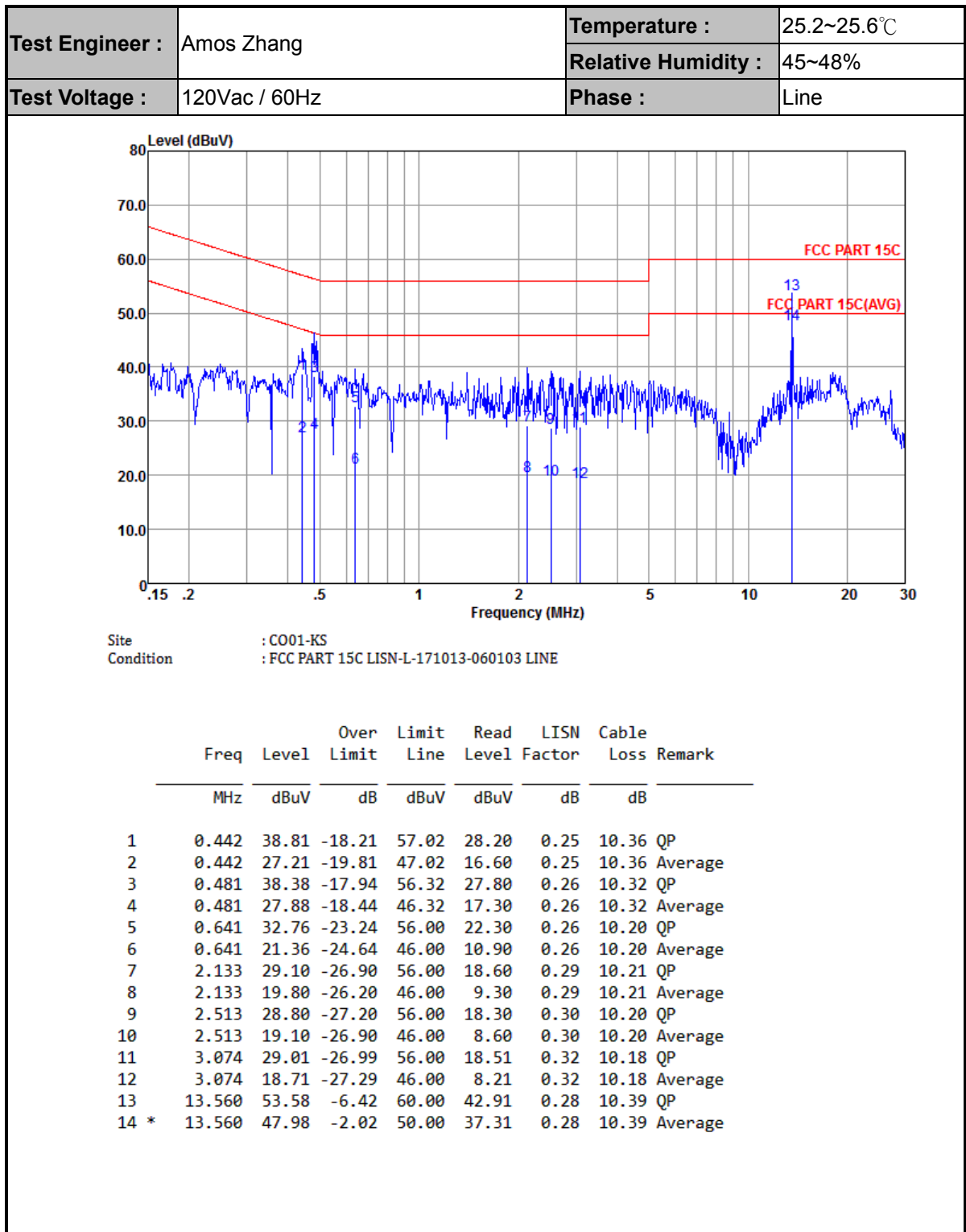
Uncertainty of Radiated Emission Measurement (9 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	4.8 dB
---	--------

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	5.2 dB
---	--------

Appendix A. Test Results of Conducted Emission Test

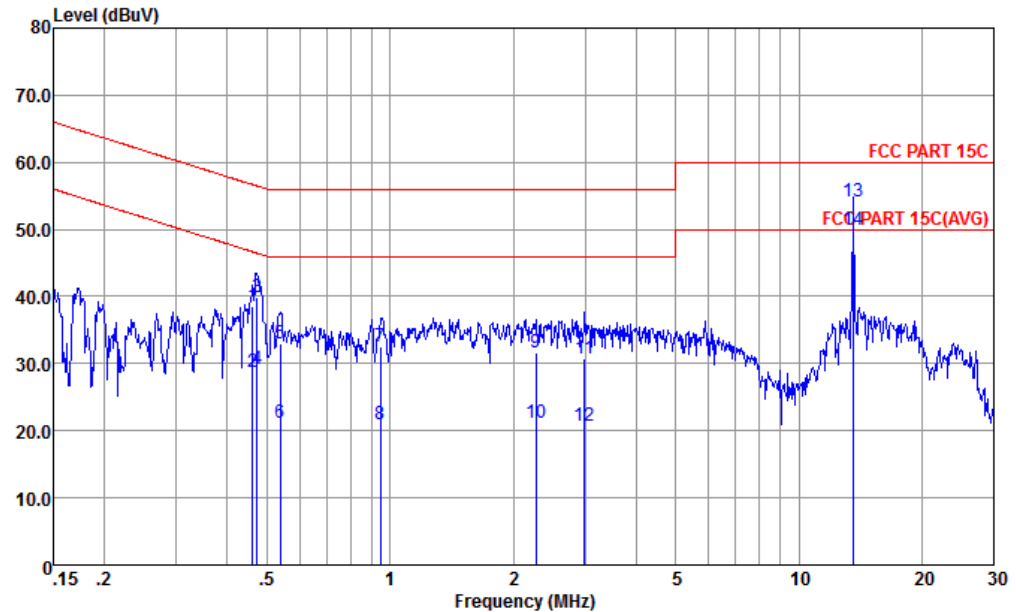


(1) with antenna

Remark: 13.560MHz is the NFC RF fundamental signal.



Test Engineer :	Amos Zhang	Temperature :	25.2~25.6℃
		Relative Humidity :	45~48%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral

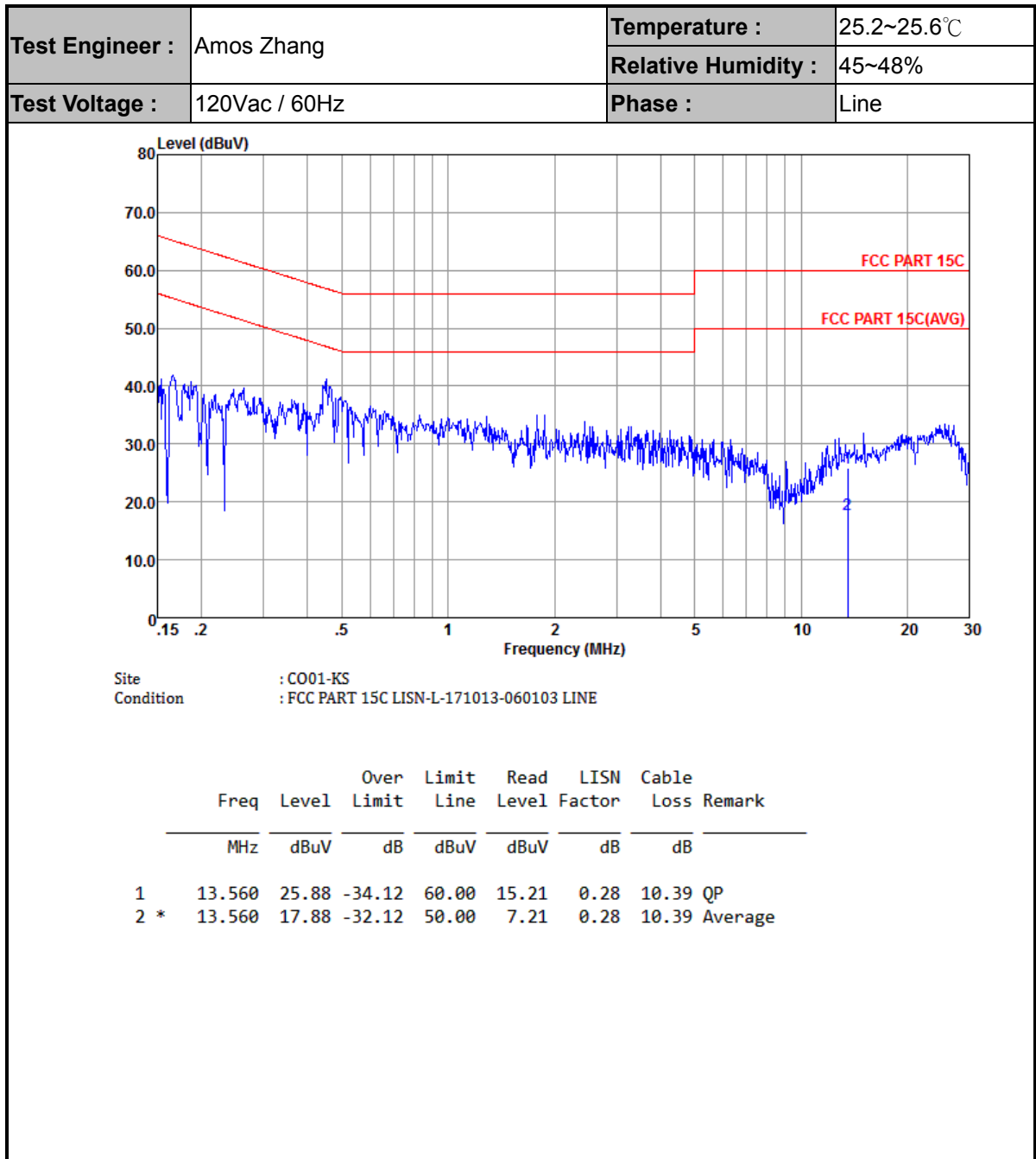


Site : CO01-KS
Condition : FCC PART 15C LISN-N-171013-060103 NEUTRAL

	Freq	Level	Over	Limit	Read	LISN	Cable	
	MHz	dBuV	Limit	Line	Level	Factor	Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.461	38.53	-18.14	56.67	27.90	0.29	10.34	QP
2	0.461	28.83	-17.84	46.67	18.20	0.29	10.34	Average
3	0.474	39.82	-16.63	56.45	29.20	0.29	10.33	QP
4	0.474	29.22	-17.23	46.45	18.60	0.29	10.33	Average
5	0.538	33.07	-22.93	56.00	22.51	0.29	10.27	QP
6	0.538	21.17	-24.83	46.00	10.61	0.29	10.27	Average
7	0.948	32.51	-23.49	56.00	22.09	0.31	10.11	QP
8	0.948	21.01	-24.99	46.00	10.59	0.31	10.11	Average
9	2.273	31.73	-24.27	56.00	21.21	0.32	10.20	QP
10	2.273	21.13	-24.87	46.00	10.61	0.32	10.20	Average
11	2.993	30.81	-25.19	56.00	20.29	0.33	10.19	QP
12	2.993	20.81	-25.19	46.00	10.29	0.33	10.19	Average
13	13.560	54.23	-5.77	60.00	43.61	0.23	10.39	QP
14 *	13.560	49.93	-0.07	50.00	39.31	0.23	10.39	Average

(1) with antenna

Remark: 13.560MHz is the NFC RF fundamental signal.

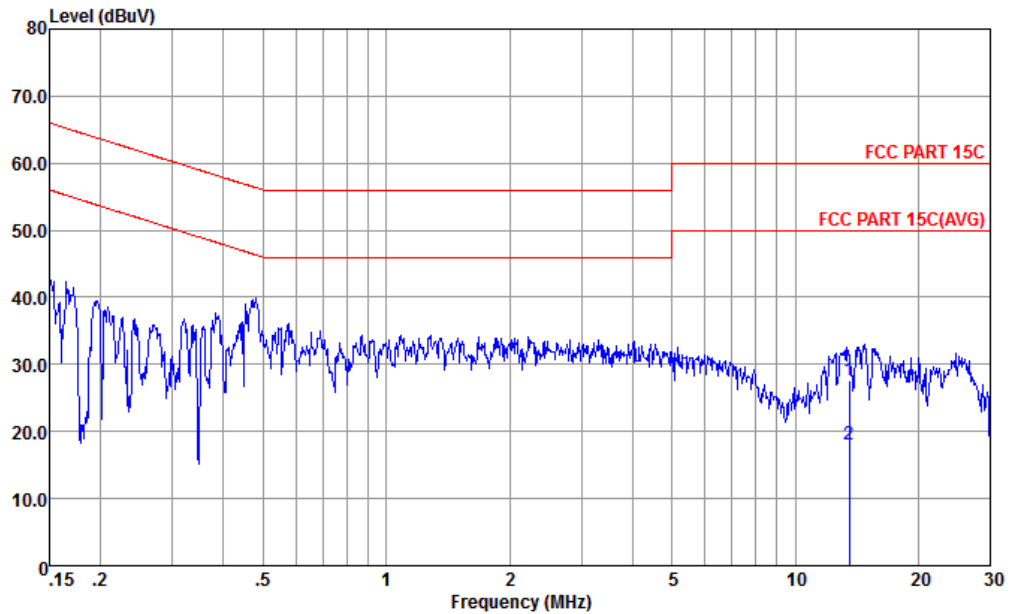


(2) With dummy load

Remark: Only the fundamental NFC signal needs to be retested per KDB 174176.



Test Engineer :	Amos Zhang	Temperature :	25.2~25.6℃
		Relative Humidity :	45~48%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral



Site : CO01-KS
Condition : FCC PART 15C LISN-N-171013-060103 NEUTRAL

	Freq	Level	Over	Limit	Read	LISN	Cable	
	MHz	dBuV	Limit	Line	Level	Factor	Loss	Remark
		dBuV	dB	dBuV	dBuV	dB	dB	
1	13.560	27.73	-32.27	60.00	17.11	0.23	10.39	QP
2 *	13.560	18.13	-31.87	50.00	7.51	0.23	10.39	Average

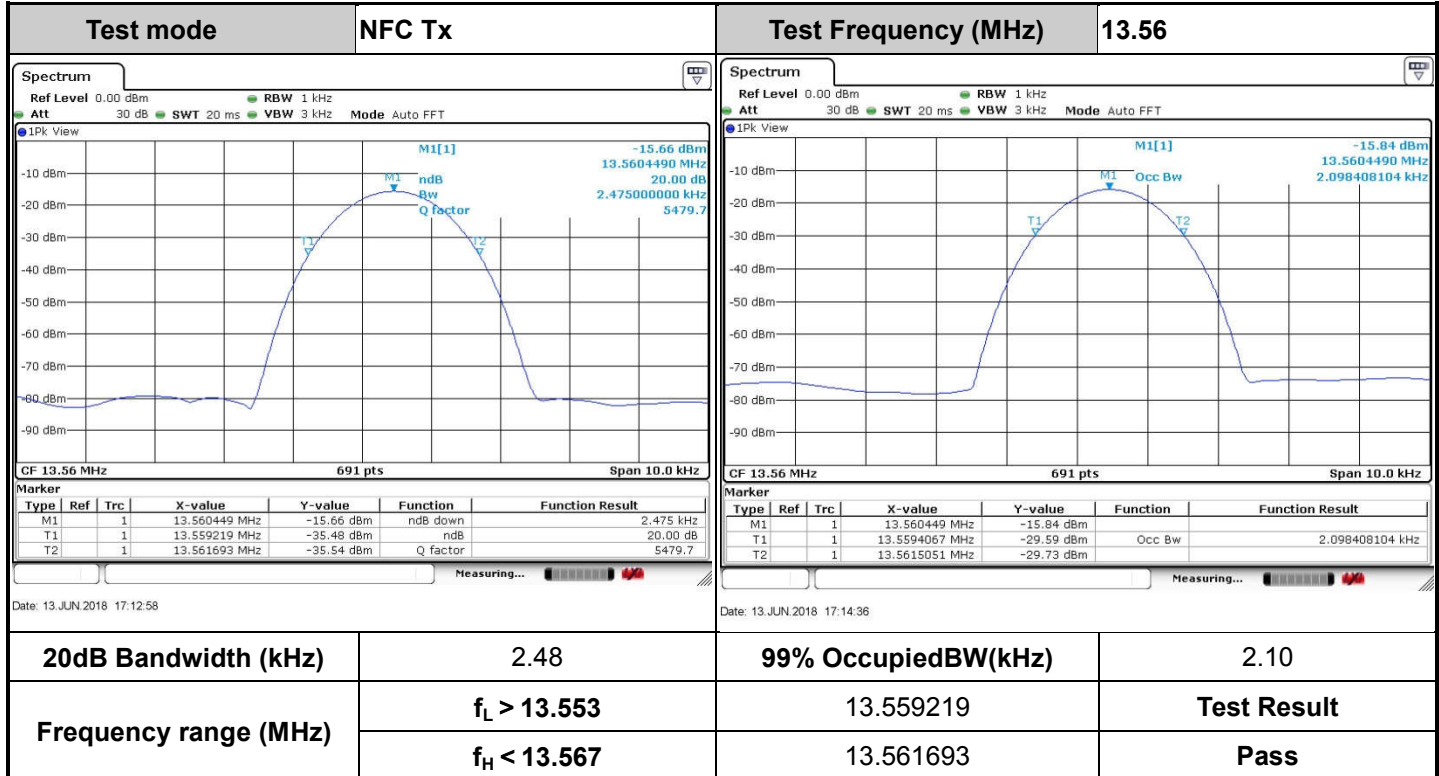
(2) With dummy load

Remark: Only the fundamental NFC signal needs to be retested per KDB 174176.



Appendix B. Test Results of Conducted Test Items

B1. Test Result of 20dB Spectrum Bandwidth



Remark: Because the measured signal is CW adjusting the RBW per C63.10 would not be practical since measured bandwidth will always follow the RBW and the result will be approximately twice the RBW.

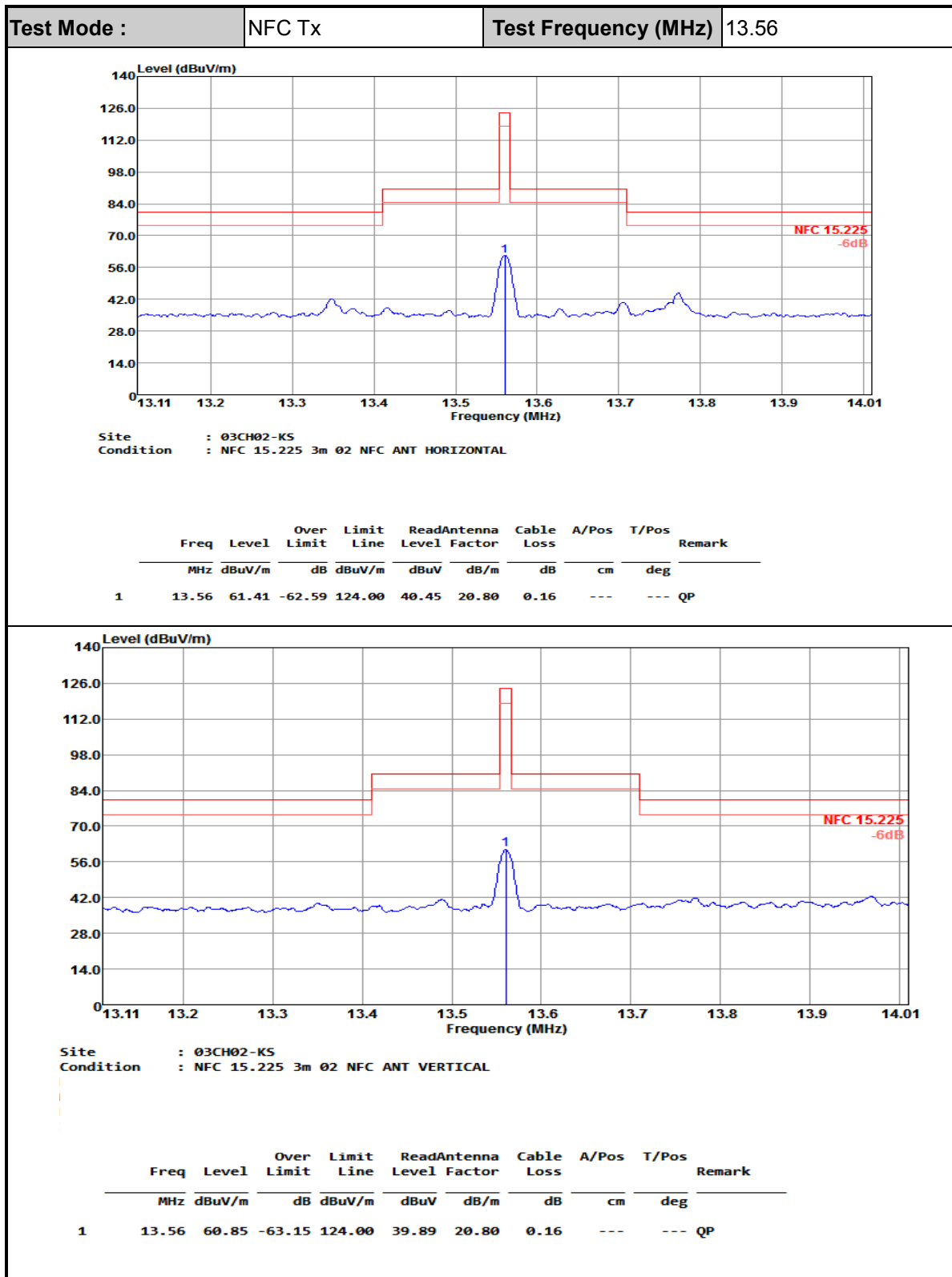
**B2. Test Result of Frequency Stability**

Voltage vs. Frequency Stability		Temperature vs. Frequency Stability	
Voltage (Vac)	Measurement Frequency (MHz)	Temperature (°C)	Measurement Frequency (MHz)
120	13.560456	-20	13.560456
102	13.560456	-10	13.560456
138	13.560456	0	13.560464
		10	13.560456
		20	13.560456
		30	13.560456
		40	13.560456
		50	13.560456
Max.Deviation (MHz)	0.000456	Max.Deviation (MHz)	0.000464
Max.Deviation (ppm)	33.6283	Max.Deviation (ppm)	34.1814
Limit	FS < ±100 ppm	Limit	FS < ±100 ppm
Test Result	PASS	Test Result	PASS



Appendix C. Test Results of Radiated Test Items

C1. Test Result of Field Strength of Fundamental Emissions



C2. Results of Radiated Spurious Emissions (9 kHz~30MHz)

Test Mode :		NFC Tx			Polarization :		Horizontal		
Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
0.02254	60.55	-59.99	120.54	40.44	20.1	0.01	-	-	Average
0.0451	58.72	-55.79	114.51	39.31	19.4	0.01	-	-	Average
1.258	54.08	-11.52	65.6	33.31	20.75	0.02	-	-	QP
1.319	53.33	-11.86	65.19	32.61	20.7	0.02	-	-	QP
7.184	44.75	-24.79	69.54	24.28	20.38	0.09	-	-	QP
25.71	40.12	-29.42	69.54	18.56	21.27	0.29	-	-	QP

Test Mode :		NFC Tx			Polarization :		Vertical		
Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
0.00971	53.82	-74.04	127.86	33.71	20.1	0.01	-	-	Average
0.01929	52.88	-69.01	121.89	32.77	20.1	0.01	-	-	Average
1.256	52.86	-12.75	65.61	32.09	20.75	0.02	-	-	QP
1.319	52.51	-12.68	65.19	31.79	20.7	0.02	-	-	QP
7.088	44.51	-25.03	69.54	24.03	20.39	0.09	-	-	QP
25.402	43.52	-26.02	69.54	21.91	21.32	0.29	-	-	QP

Note:

1. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
2. Distance extrapolation factor = 40 log (specific distance / test distance) (dB);
3. Limit line = specific limits (dBμV) + distance extrapolation factor.

C3. Results of Radiated Spurious Emissions (30MHz~1GHz)

Test Mode :		NFC Tx			Polarization :		Horizontal			
Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
33.88	26.85	-13.15	40	36.04	22.22	0.63	32.04	-	-	Peak
40.67	28.57	-11.43	40	41.63	18.35	0.64	32.05	100	0	Peak
175.5	25.28	-18.22	43.5	40.33	15.34	1.36	31.75	-	-	Peak
703.18	24.99	-21.01	46	26.47	24.63	2.76	28.87	-	-	Peak
879.72	29.06	-16.94	46	27.38	26.28	3.08	27.68	-	-	Peak
908.82	31.11	-14.89	46	28.94	26.5	3.11	27.44	-	-	Peak

Test Mode :		NFC Tx			Polarization :		Vertical			
Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
33.88	31.14	-8.86	40	40.33	22.22	0.63	32.04	-	-	Peak
39.7	36.3	-3.7	40	48.9	18.8	0.64	32.04	100	112	QP
44.55	32.94	-7.06	40	47.86	16.53	0.66	32.11	-	-	Peak
58.13	29.41	-10.59	40	48.09	12.68	0.78	32.14	-	-	Peak
752.65	25.64	-20.36	46	26.24	25.23	2.81	28.64	-	-	Peak
880.69	27.93	-18.07	46	26.24	26.28	3.08	27.67	-	-	Peak

Note:

1. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
2. Emission level (dBμV/m) = 20 log Emission level (μV/m).
3. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor= Level.