

FCC RF Test Report

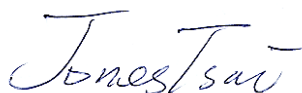
APPLICANT : Dell Inc.
EQUIPMENT : RFID 13.56MHz Wireless Module
BRAND NAME : DELL
MODEL NAME : DWRFID1602
FCC ID : E2K-DWRFID1602
STANDARD : FCC Part 15 Subpart C §15.225
CLASSIFICATION : (DXX) Low Power Communication Device Transmitter

The testing was completed on Oct. 14, 2016. We, SPORTON INTERNATIONAL 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 INC., the test report shall not be reproduced except in full.



Reviewed by: Joseph Lin / Supervisor



Approved by: Jones Tsai / Manager



SPORTON INTERNATIONAL INC.

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR681840	Rev. 01	Initial issue of report	Oct. 17, 2016
FR681840	Rev. 02	Adding radiated emissions testing plots in the Appendix D2 and D3.	Oct. 18, 2016



SUMMARY OF THE TEST RESULT

Applied Standard: 47 CFR FCC Part 15 Subpart C				
Part	FCC Rule	Description of Test	Result	Under Limit
3.1	15.207	AC Power Line Conducted Emissions	Complies	11.70 dB at 7.414MHz
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	71.01 dB at 13.560 MHz
3.5	15.225(d) 15.209	Radiated Emissions	Complies	5.30 dB at 40.800 MHz for Peak
3.6	15.203	Antenna Requirements	Complies	-

Test Items	Uncertainty	Remark
AC Power Line Conducted Emissions	$\pm 2.7\text{dB}$	Confidence levels of 95%
Radiated Emissions (30MHz~1000MHz)	$\pm 5.7\text{dB}$	Confidence levels of 95%



1. GENERAL INFORMATION

1.1 Applicant

Dell Inc.

One Dell Way, Round Rock, TX 78682, USA

1.2 Manufacturer

Dell Inc.

One Dell Way, Round Rock, TX 78682, USA

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	RFID 13.56MHz Wireless Module
Brand Name	DELL
Model Name	DWRFID1602
FCC ID	E2K-DWRFID1602
Sample 1	EUT with Host 1
Sample 2	EUT with Host 2
EUT supports Radios application	NFC
EUT Stage	Pre-production

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

The product was installed into Notebook (Brand Name: DELL, Model Name: P73G) during test.

Sample Information	
Host 1	Host with Antenna 1 (Brand Name: ACON; Model Name: AFP00-000003)
Host 2	Host with Antenna 2 (Brand Name: Speedwire; Model Name: F.0W.FH-6027-001-00)

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Frequency Range	13.553 ~ 13.567MHz
Channel Number	1
20dBW for Sample 1	2.64 KHz
20dBW for Sample 2	2.64 KHz
99%OBW for Sample 1	2.24 KHz
99%OBW for Sample 2	2.24 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 Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code : 1190) and the FCC designation No. TW1022 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC Test.

Test Site	SPORTON INTERNATIONAL INC.		
Test Site Location	No. 52, Hwa Ya 1 st Rd., Hwa Ya Technology Park, Kwei-Shan District, Tao Yuan City, Taiwan, R.O.C. TEL: +886-3-3273456 / FAX: +886-3-3284978		
Test Site No.	Sporton Site No.		
	TH03-HY	CO05-HY	03CH07-HY
Test Engineer	William Liao	Arthur Hsieh	James Chiu
Temperature	22~24°C	23~24°C	21~23°C
Relative Humidity	53~55%	51~52%	57~61%

Note: The test site complies with ANSI C63.4 2014 requirement.

Test Site	SPORTON INTERNATIONAL INC.		
Test Site Location	No. 30-2, Dingfu Tsuen, Linkou District, New Taipei City, Taiwan 244, R.O.C. TEL: +886-2-2603-5367 / +886-2-2601-1640 FAX: +886-2-2601-1695		
Test Site No.	Sporton Site No.		
	OS03-LK		
Test Engineer	Eric Jeng		
Temperature	25~26°C		
Relative Humidity	51~53%		

Note: The test site complies with ANSI C63.4 2014 requirement.

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 for searching the worst cases.

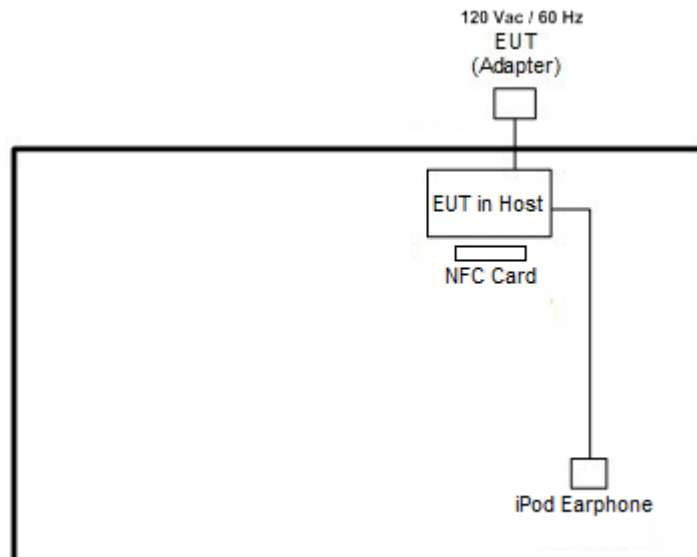
The following table is a list of the test modes shown in this test report.

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

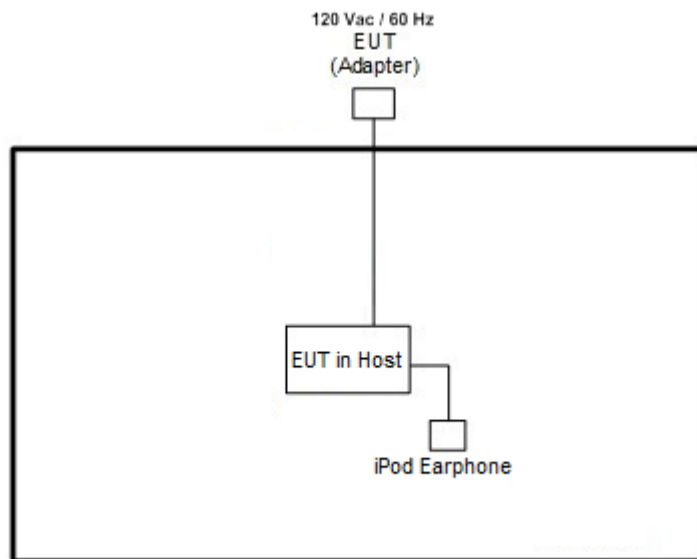
The EUT pre-scanned in four NFC type, A, B, F. The worst type (type F) was recorded in this report.

2.2 Connection Diagram of Test System

<AC Conducted Emissions>



< For Fundamental Emissions and Mask and Radiated Emissions Measurement >



2.3 Table for Supporting Units

Item	Equipment	Trade Name	Model Name	FCC ID
1.	iPod Earphone	Apple	A1285	FCC DoC
2.	NFC Card	Metro Taipei	Easy Card	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.

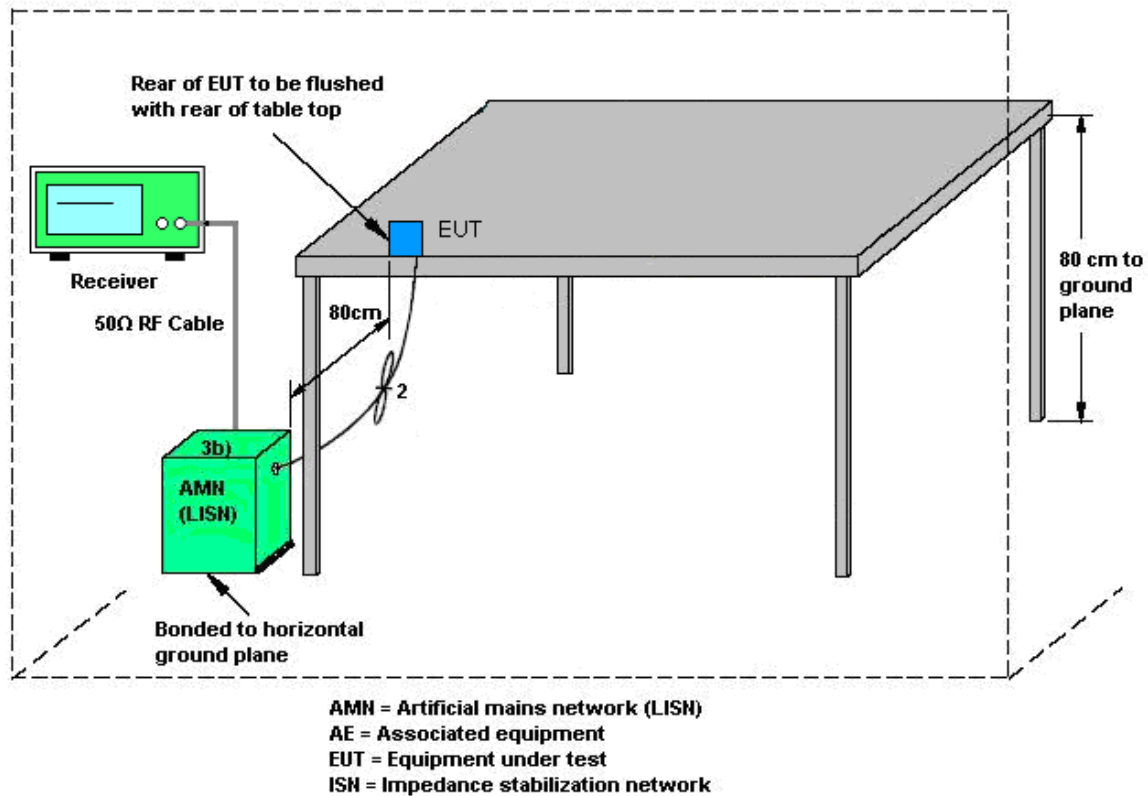
3.1.2 Measuring Instruments

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 B.

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.

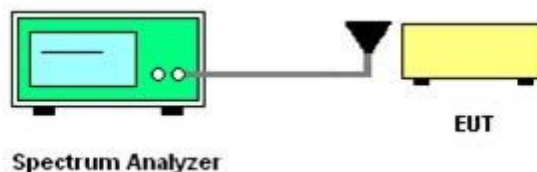
3.2.2 Measuring Instruments

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 C.

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.

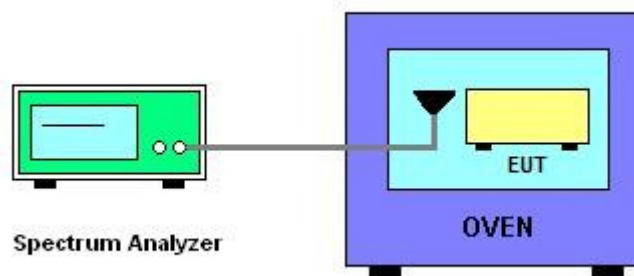
3.3.2 Measuring Instruments

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 maxhold 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 C.

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 IC RSS-210 B.6			
	Description			
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.

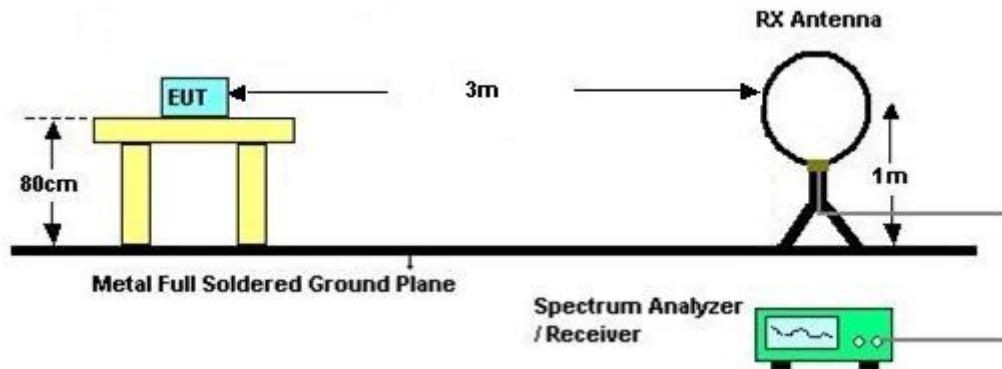
3.4.3 Test Procedures

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 D.

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.

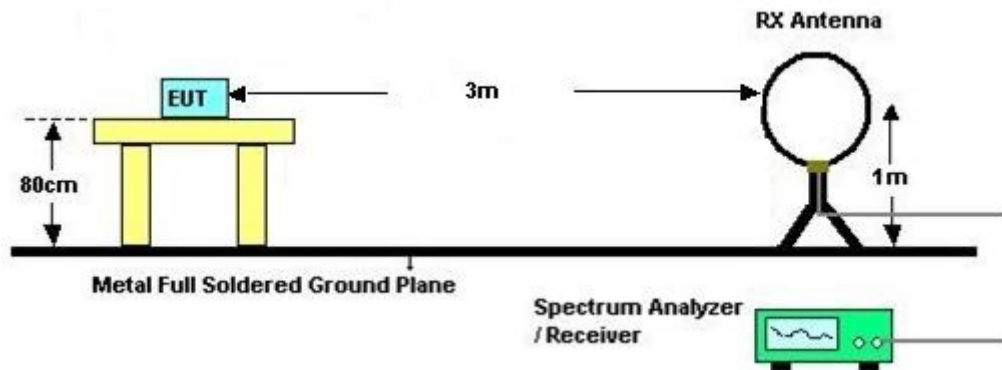


3.5.4 Test Procedures

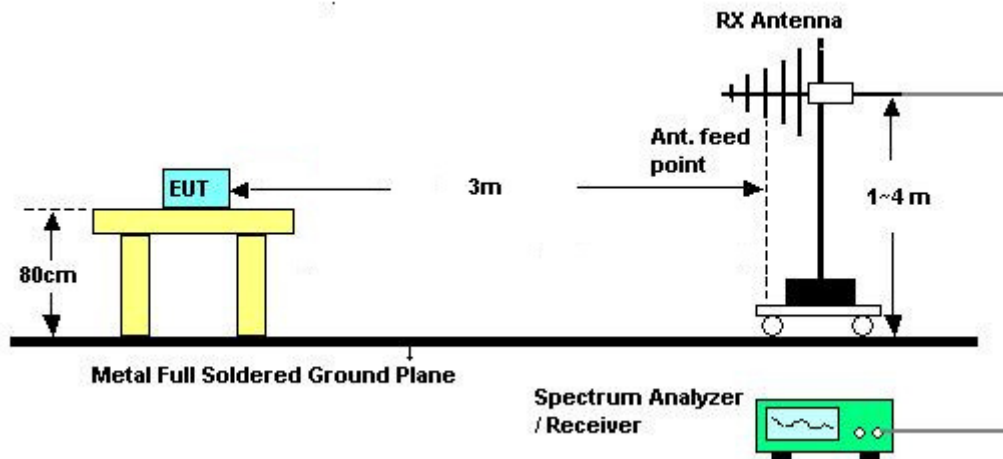
1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
1. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
2. 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.
3. 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.
4. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
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. 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 D.



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 FCC rule.

3.6.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

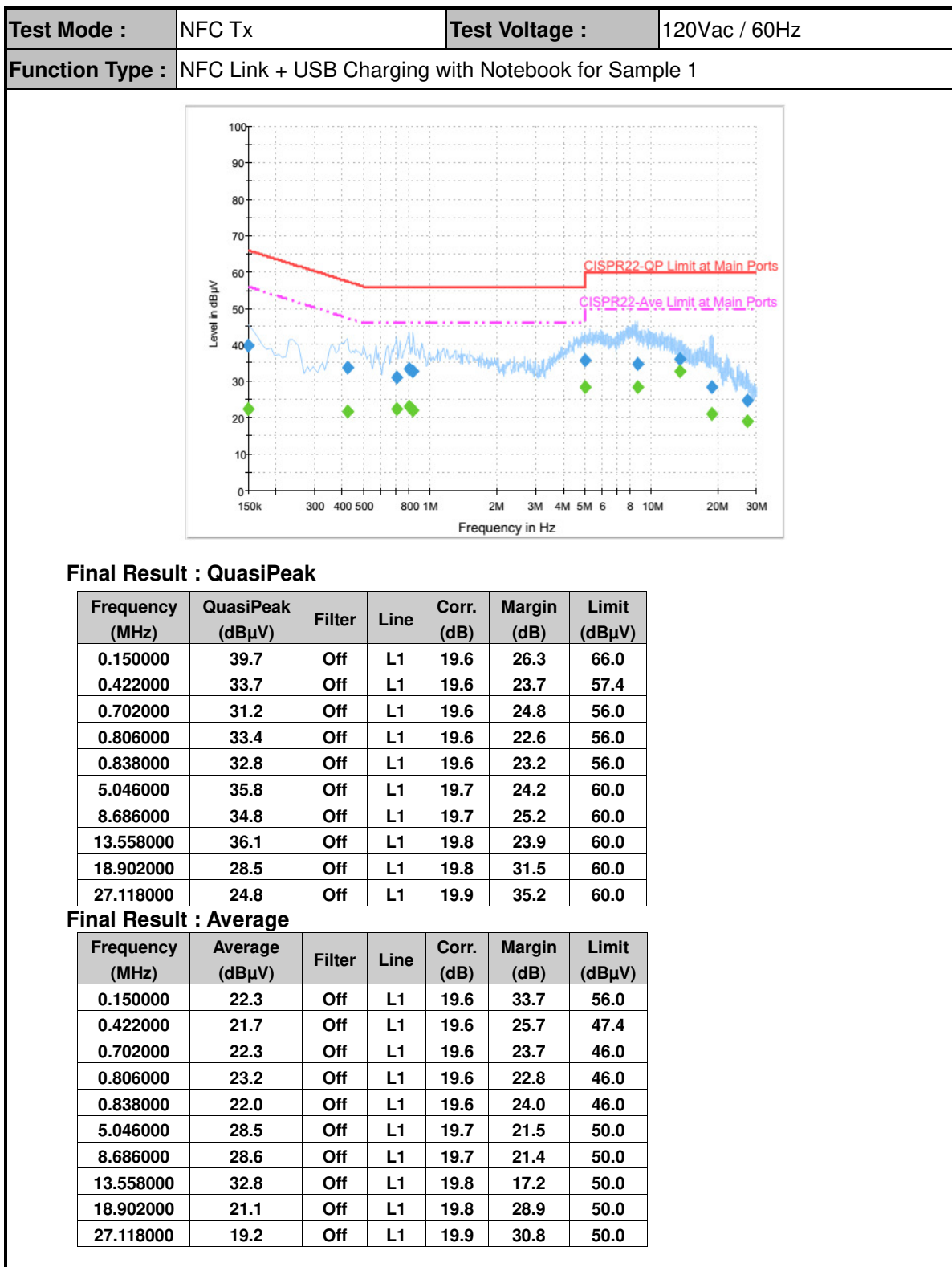


4. LIST OF MEASURING EQUIPMENT

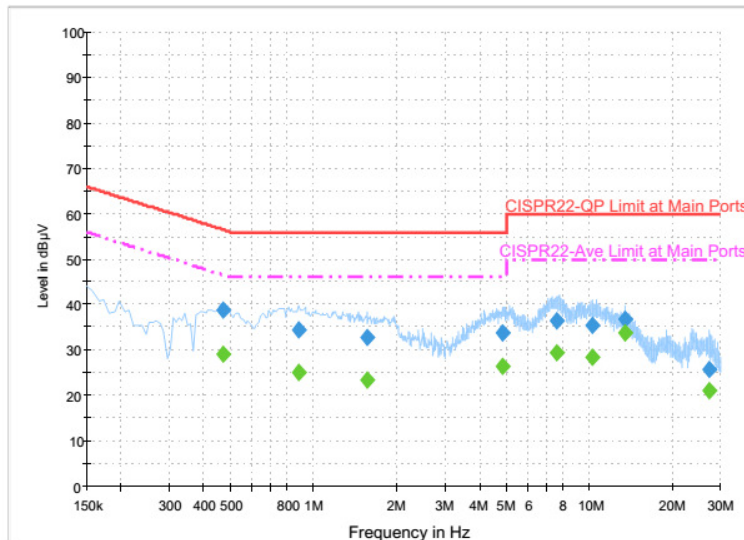
Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
AC Power Source	AC POWER	AFC-500W	F104070011	50Hz~60Hz	Dec. 02, 2015	Sep. 05, 2016	Dec. 01, 2016	Conducted (TH03-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP30	101329	9kHz~30GHz	Jun. 27, 2016	Sep. 05, 2016	Jun. 26, 2017	Conducted (TH03-HY)
Temperature Chamber	ESPEC	SU-641	92013721	-30℃ ~70℃	Nov. 20, 2015	Sep. 05, 2016	Nov. 19, 2016	Conducted (TH03-HY)
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	Sep. 10, 2016	N/A	Conduction (CO05-HY)
EMI Test Receiver	Rohde & Schwarz	ESCI 7	100724	9kHz~7GHz	Aug. 30, 2016	Sep. 10, 2016	Aug. 29, 2017	Conduction (CO05-HY)
LISN	Rohde & Schwarz	ENV216	100080	9kHz~30MHz	Dec. 02, 2015	Sep. 10, 2016	Dec. 01, 2016	Conduction (CO05-HY)
Bilog Antenna	TESEQ	CBL 6111D	35419	30MHz to 1GHz	Jan. 13, 2016	Sep. 14, 2016	Jan. 12, 2017	Radiation (03CH07-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY54130085	20Hz ~ 8.4GHz	Nov. 04, 2015	Sep. 14, 2016	Nov. 03, 2016	Radiation (03CH07-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Sep. 02, 2015	Sep. 14, 2016	Sep. 01, 2017	Radiation (03CH07-HY)
Preamplifier	COM-POWER	PA-103A	161241	10MHz-1GHz	Mar. 18, 2016	Sep. 14, 2016	Mar. 17, 2017	Radiation (03CH07-HY)
Spectrum Analyzer	Agilent	N9010A	MY53470118	10Hz~44GHz	Feb. 27, 2016	Sep. 14, 2016	Feb. 26, 2017	Radiation (03CH07-HY)
Antenna Mast	Max-Full	MFA520BS	N/A	1m~4m	N/A	Sep. 14, 2016	N/A	Radiation (03CH07-HY)
Turn Table	ChainTek	Chaintek 3000	N/A	0~360 Degree	N/A	Sep. 14, 2016	N/A	Radiation (03CH07-HY)
Loop Cable	Rohde & Schwarz	N/A	N/A	9KHz~30MHz	Dec. 03, 2015	Sep. 14, 2016	Dec. 02, 2016	Radiation (03CH07-HY)



Appendix B. Test Results of Conducted Emission Test



Test Mode :	NFC Tx	Test Voltage :	120Vac / 60Hz
Function Type :	NFC Link + USB Charging with Notebook for Sample 1		


Final Result : QuasiPeak

Frequency (MHz)	QuasiPeak (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.470000	38.8	Off	N	19.6	17.7	56.5
0.886000	34.3	Off	N	19.6	21.7	56.0
1.566000	32.8	Off	N	19.6	23.2	56.0
4.870000	33.8	Off	N	19.7	22.2	56.0
7.598000	36.4	Off	N	19.7	23.6	60.0
10.254000	35.3	Off	N	19.8	24.7	60.0
13.558000	36.8	Off	N	19.8	23.2	60.0
27.118000	25.8	Off	N	20.1	34.2	60.0

Final Result : Average

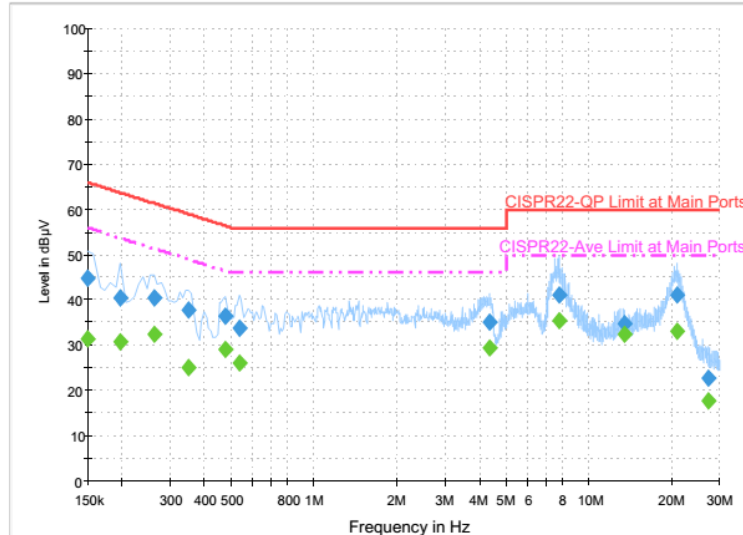
Frequency (MHz)	Average (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.470000	28.9	Off	N	19.6	17.6	46.5
0.886000	24.9	Off	N	19.6	21.1	46.0
1.566000	23.5	Off	N	19.6	22.5	46.0
4.870000	26.5	Off	N	19.7	19.5	46.0
7.598000	29.5	Off	N	19.7	20.5	50.0
10.254000	28.5	Off	N	19.8	21.5	50.0
13.558000	33.7	Off	N	19.8	16.3	50.0
27.118000	20.9	Off	N	20.1	29.1	50.0

with antenna

Remark: 13.558MHz is the NFC RF fundamental signal.



Test Mode :	NFC Tx	Test Voltage :	120Vac / 60Hz
Function Type :	NFC Link + USB Charging with Notebook for Sample 2		

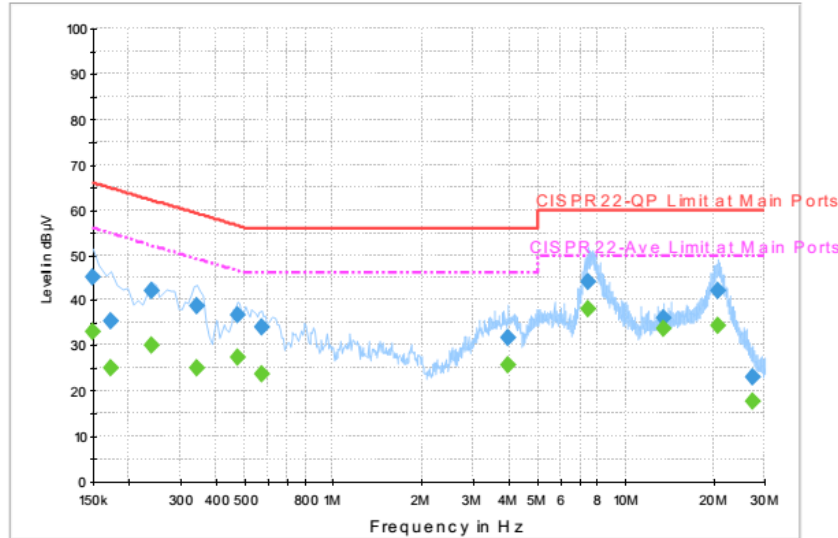
**Final Result : QuasiPeak**

Frequency (MHz)	QuasiPeak (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	44.7	Off	L1	19.6	21.3	66.0
0.198000	40.6	Off	L1	19.6	23.1	63.7
0.262000	40.6	Off	L1	19.6	20.8	61.4
0.350000	37.8	Off	L1	19.6	21.2	59.0
0.478000	36.4	Off	L1	19.6	20.0	56.4
0.534000	33.8	Off	L1	19.6	22.2	56.0
4.350000	35.0	Off	L1	19.7	21.0	56.0
7.774000	41.0	Off	L1	19.7	19.0	60.0
13.558000	34.8	Off	L1	19.8	25.2	60.0
20.910000	41.3	Off	L1	19.8	18.7	60.0
27.118000	22.6	Off	L1	19.9	37.4	60.0

Final Result : Average

Frequency (MHz)	Average (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.150000	31.3	Off	L1	19.6	24.7	56.0
0.198000	30.8	Off	L1	19.6	22.9	53.7
0.262000	32.5	Off	L1	19.6	18.9	51.4
0.350000	25.0	Off	L1	19.6	24.0	49.0
0.478000	29.3	Off	L1	19.6	17.1	46.4
0.534000	26.2	Off	L1	19.6	19.8	46.0
4.350000	29.3	Off	L1	19.7	16.7	46.0
7.774000	35.4	Off	L1	19.7	14.6	50.0
13.558000	32.3	Off	L1	19.8	17.7	50.0
20.910000	33.2	Off	L1	19.8	16.8	50.0
27.118000	17.6	Off	L1	19.9	32.4	50.0

Test Mode :	NFC Tx	Test Voltage :	120Vac / 60Hz
Function Type :	NFC Link + USB Charging with Notebook for Sample 2		


Final Result : QuasiPeak

Frequency (MHz)	QuasiPeak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	45.1	Off	N	19.6	20.9	66.0
0.174000	35.6	Off	N	19.6	29.2	64.8
0.238000	42.0	Off	N	19.6	20.2	62.2
0.342000	38.9	Off	N	19.6	20.3	59.2
0.470000	36.9	Off	N	19.6	19.6	56.5
0.566000	34.0	Off	N	19.6	22.0	56.0
3.958000	31.7	Off	N	19.6	24.3	56.0
7.414000	44.3	Off	N	19.7	15.7	60.0
13.558000	36.3	Off	N	19.8	23.7	60.0
20.790000	42.2	Off	N	19.9	17.8	60.0
27.118000	23.0	Off	N	20.1	37.0	60.0

Final Result : Average

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	33.1	Off	N	19.6	22.9	56.0
0.174000	25.1	Off	N	19.6	29.7	54.8
0.238000	30.1	Off	N	19.6	22.1	52.2
0.342000	25.1	Off	N	19.6	24.1	49.2
0.470000	27.4	Off	N	19.6	19.1	46.5
0.566000	23.6	Off	N	19.6	22.4	46.0
3.958000	25.8	Off	N	19.6	20.2	46.0
7.414000	38.3	Off	N	19.7	11.7	50.0
13.558000	33.9	Off	N	19.8	16.1	50.0
20.790000	34.3	Off	N	19.9	15.7	50.0
27.118000	17.7	Off	N	20.1	32.3	50.0

with antenna

Remark: 13.558MHz is the NFC RF fundamental signal.



Appendix C. Test Results of Conducted Test Items

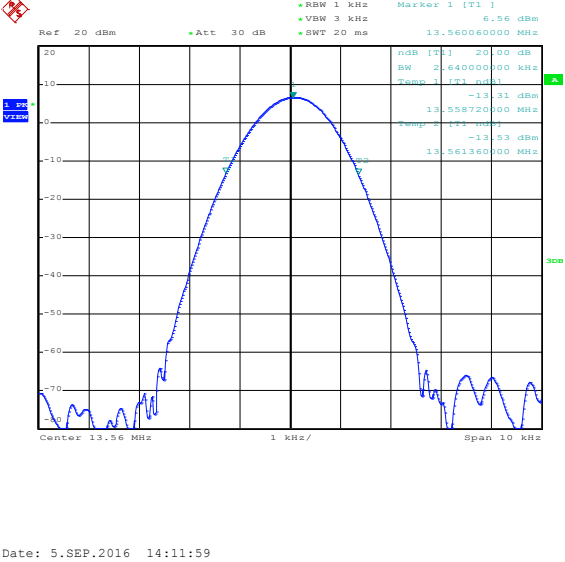
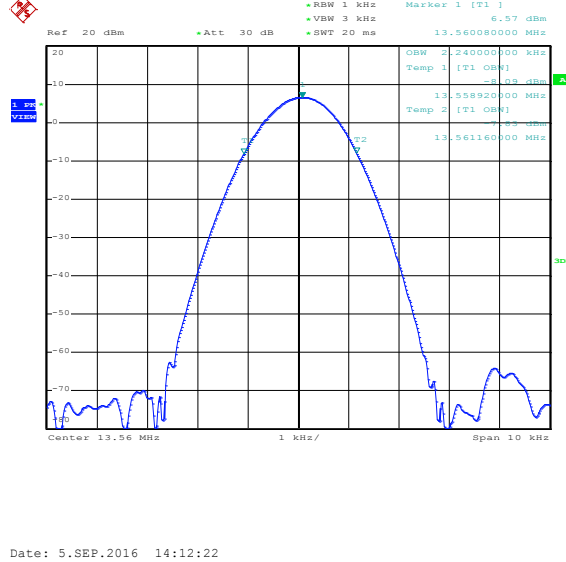
C1. Test Result of 20dB Spectrum Bandwidth

<Sample 1>

Test mode	NFC Tx	Test Frequency (MHz)	13.56
Date: 5.SEP.2016 11:47:23		Date: 5.SEP.2016 11:47:01	
20dB Bandwidth (kHz)	2.64	99% OccupiedBW(kHz)	2.24
Frequency range (MHz)	$f_L > 13.553$	13.55876	Test Result
	$f_H < 13.567$	13.56140	Complies



<Sample 2>

Test mode		Test Frequency (MHz)	
NFC Tx		13.56	
			
20dB Bandwidth (kHz)	2.64	99% OccupiedBW(kHz)	2.24
Frequency range (MHz)	$f_L > 13.553$	13.55872	Test Result
	$f_H < 13.567$	13.56136	Complies



C2. Test Result of Frequency Stability

<Sample 1>

Voltage vs. Frequency Stability		Temperature vs. Frequency Stability		
Voltage (Vac)	Measurement Frequency (MHz)	Temperature (°C)	Time	Measurement Frequency (MHz)
120	13.560040	-20	0	13.560080
102	13.560040		2	13.560080
138	13.560020		5	13.560080
			10	13.560080
		-10	0	13.560080
			2	13.560080
			5	13.560080
			10	13.560080
		0	0	13.560080
			2	13.560080
			5	13.560080
			10	13.560080
		10	0	13.560080
			2	13.560080
			5	13.560080
			10	13.560080
		20	0	13.560040
			2	13.560020
			5	13.560030
			10	13.560040
		30	0	13.560040
			2	13.560040
			5	13.560020
			10	13.560040



Voltage vs. Frequency Stability		Temperature vs. Frequency Stability		
Voltage (Vac)	Measurement Frequency (MHz)	Temperature (°C)	Time	Measurement Frequency (MHz)
		40	0	13.560030
			2	13.560040
			5	13.560040
			10	13.560040
		50	0	13.559280
			2	13.560030
			5	13.559280
			10	13.560030
Max.Deviation (MHz)	0.000040	Max.Deviation (MHz)		-0.000720
Max.Deviation (ppm)	2.9499	Max.Deviation (ppm)		-53.0973
Limit	FS < ±100 ppm	Limit		FS < ±100 ppm
Test Result	PASS	Test Result		PASS



<Sample 2>

Voltage vs. Frequency Stability		Temperature vs. Frequency Stability		
Voltage (Vac)	Measurement Frequency (MHz)	Temperature (°C)	Time	Measurement Frequency (MHz)
120	13.560060	-20	0	13.560040
102	13.560060		2	13.560040
138	13.560060		5	13.560040
			10	13.560040
		-10	0	13.560040
			2	13.560050
			5	13.560040
			10	13.560040
		0	0	13.560040
			2	13.560060
			5	13.560060
			10	13.560060
		10	0	13.560050
			2	13.560050
			5	13.560060
			10	13.560060
		20	0	13.560040
			2	13.560040
			5	13.560040
			10	13.560040
		30	0	13.560050
			2	13.560040
			5	13.560040
			10	13.560040

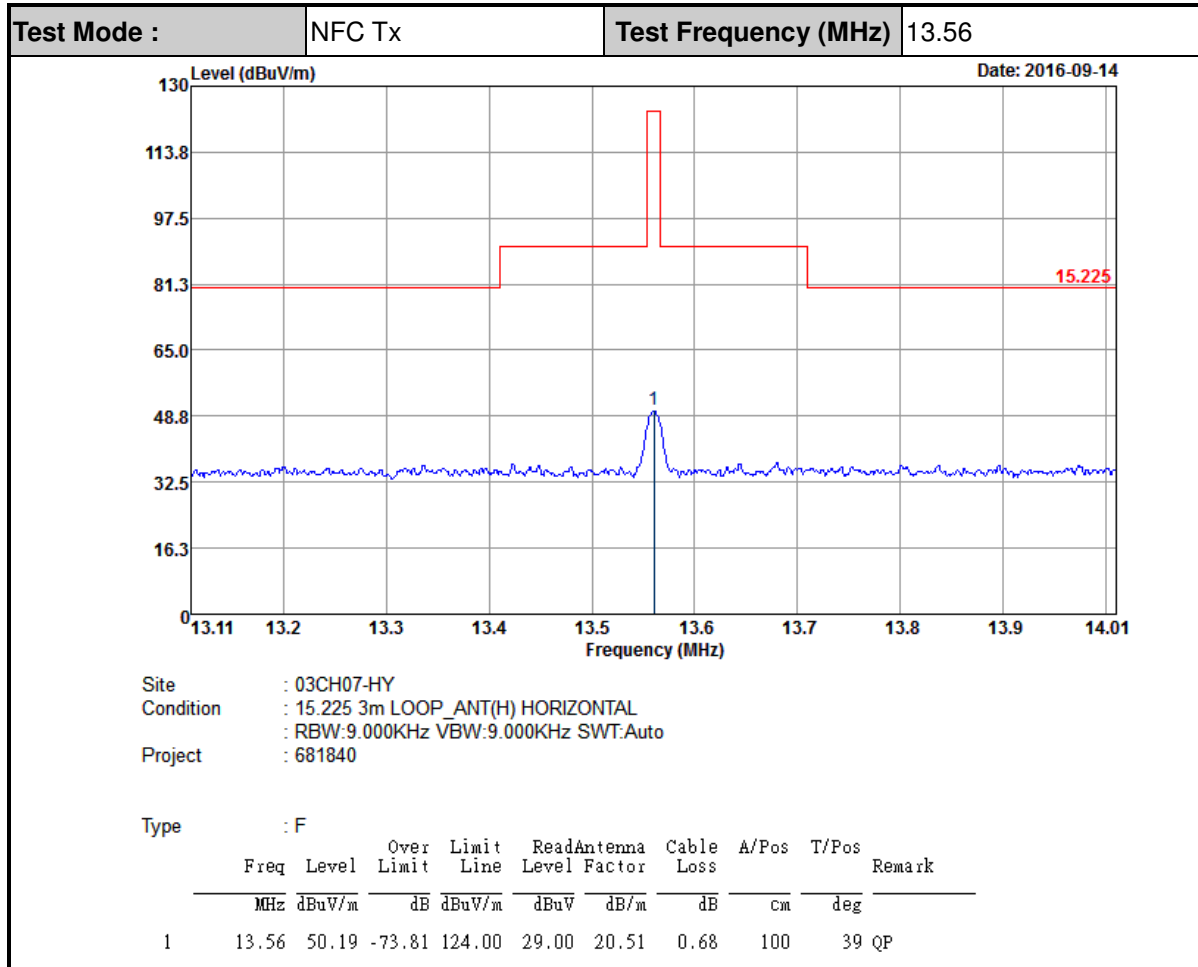


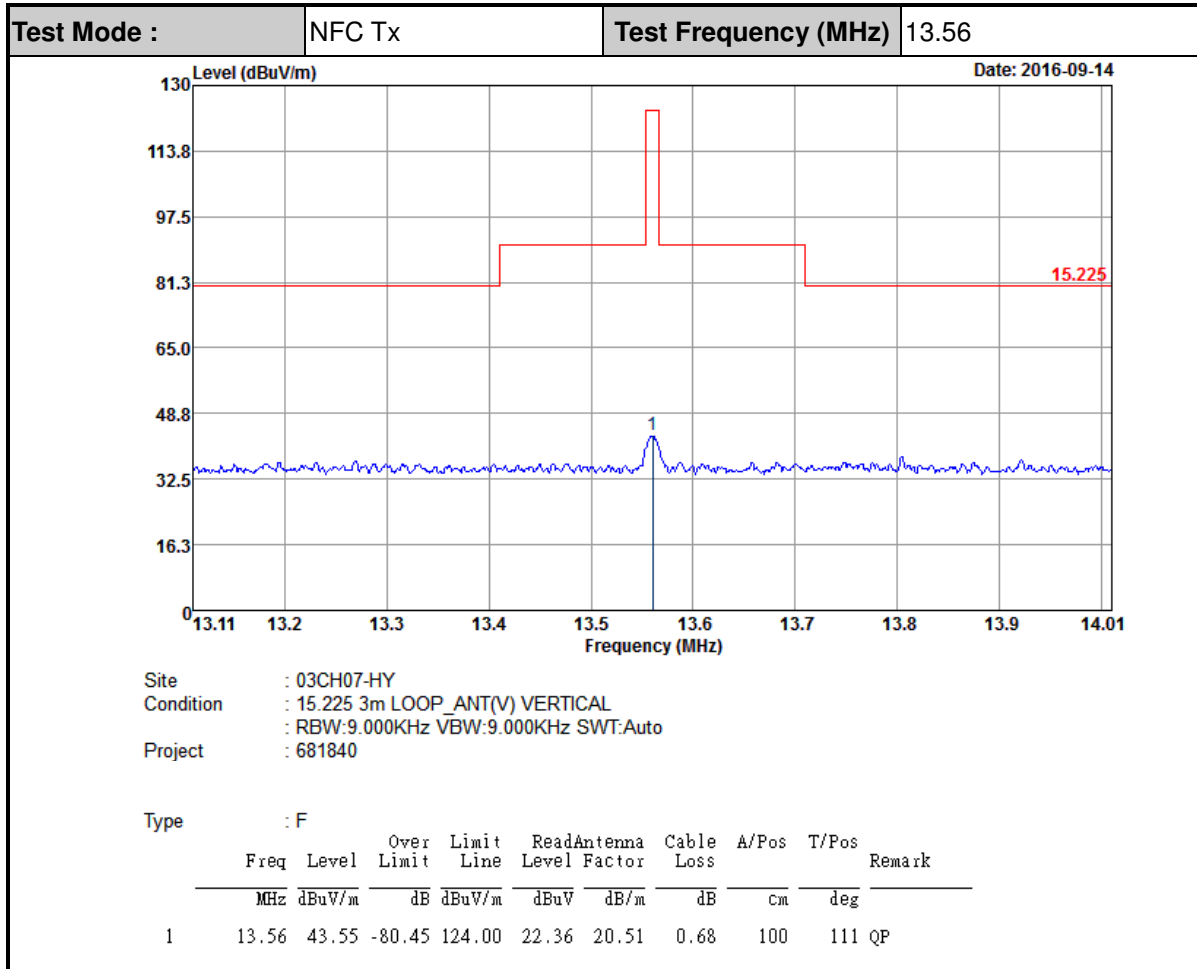
Voltage vs. Frequency Stability		Temperature vs. Frequency Stability		
Voltage (Vac)	Measurement Frequency (MHz)	Temperature (°C)	Time	Measurement Frequency (MHz)
		40	0	13.560040
			2	13.560040
			5	13.560040
			10	13.560040
		50	0	13.560050
			2	13.560050
			5	13.560050
			10	13.560060
Max.Deviation (MHz)	0.000060	Max.Deviation (MHz)		0.000060
Max.Deviation (ppm)	4.4248	Max.Deviation (ppm)		4.4248
Limit	FS < ±100 ppm	Limit		FS < ±100 ppm
Test Result	PASS	Test Result		PASS

Appendix D. Test Results of Radiated Test Items

D1. Test Result of Field Strength of Fundamental Emissions

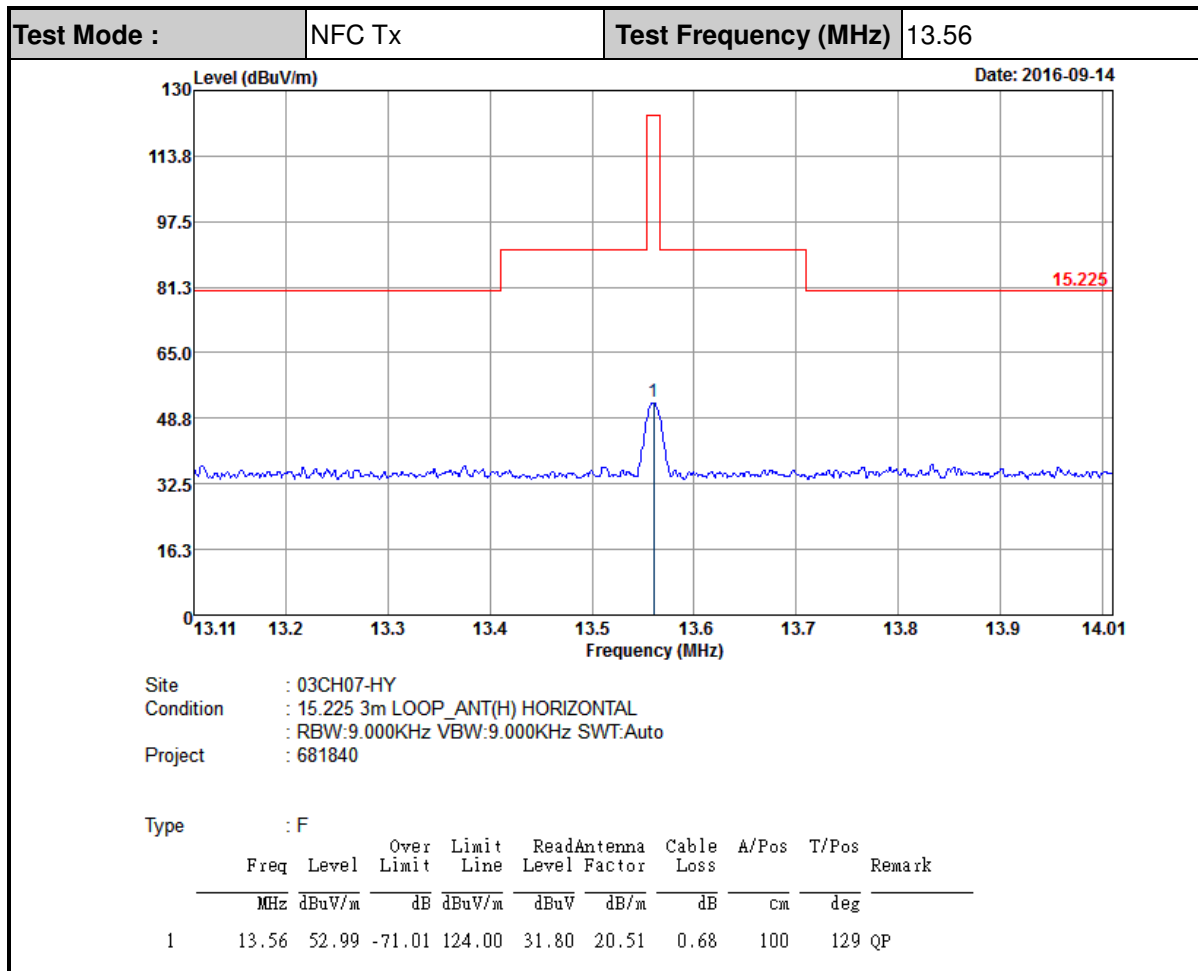
<Sample 1>

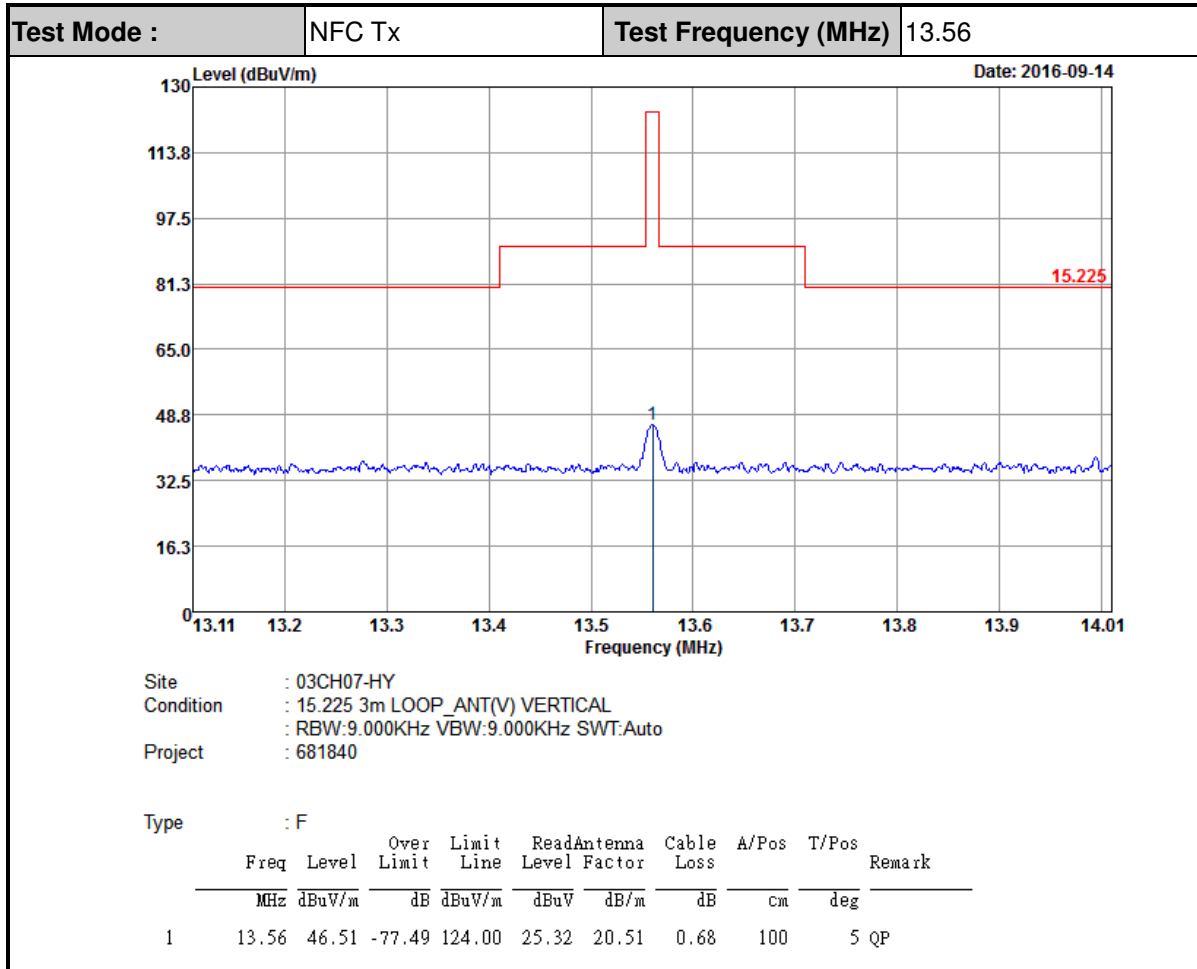


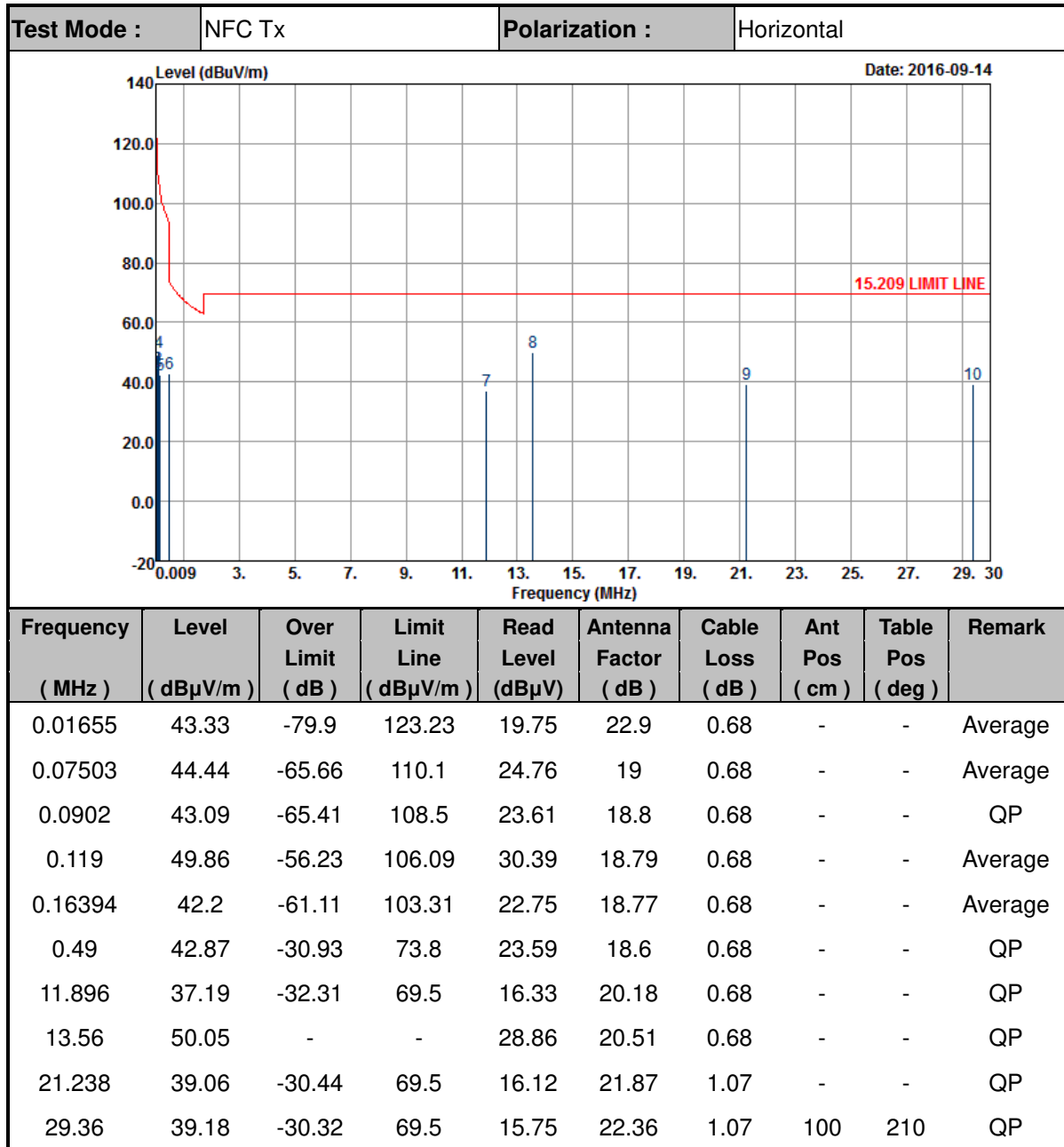


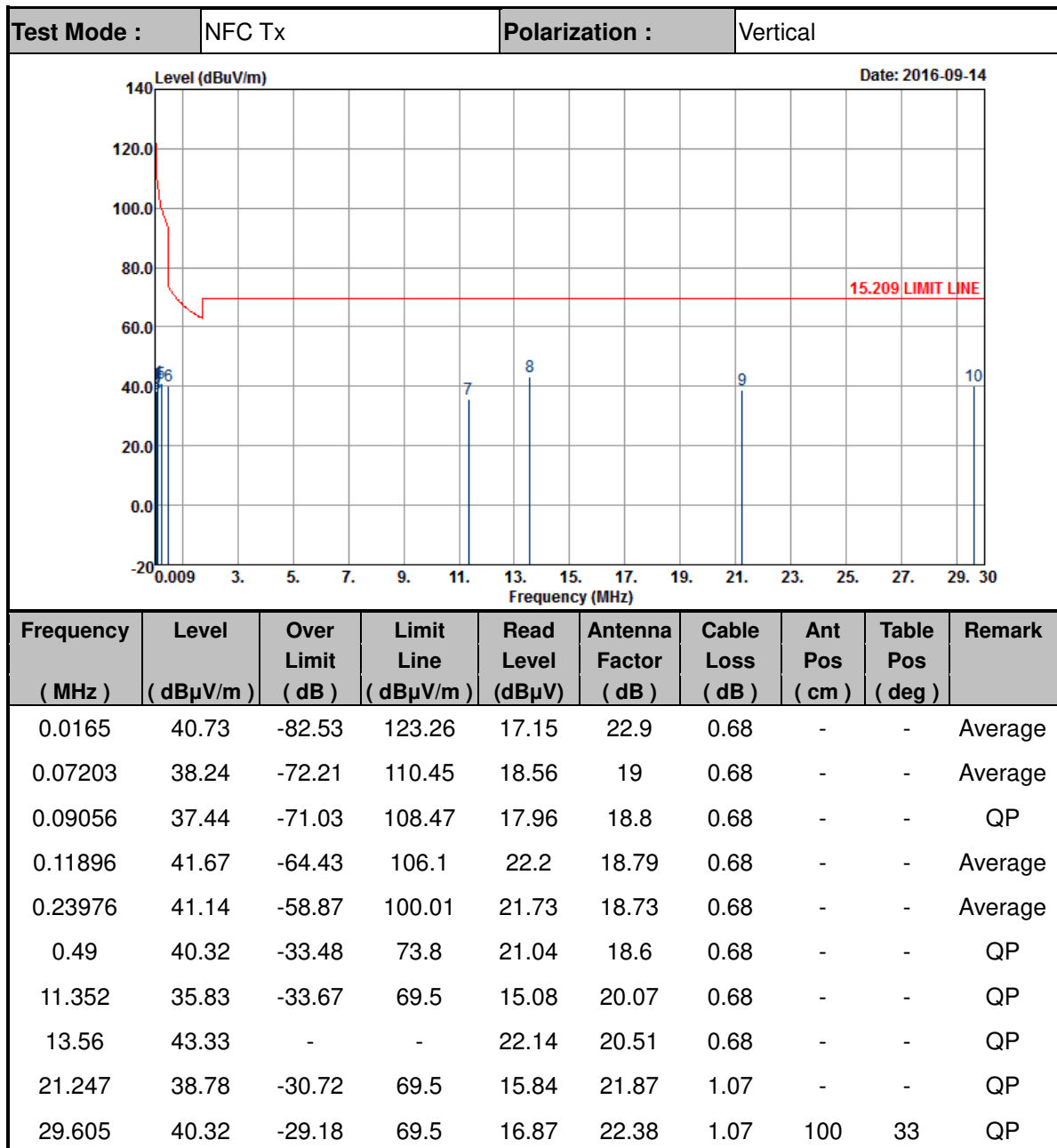


<Sample 2>

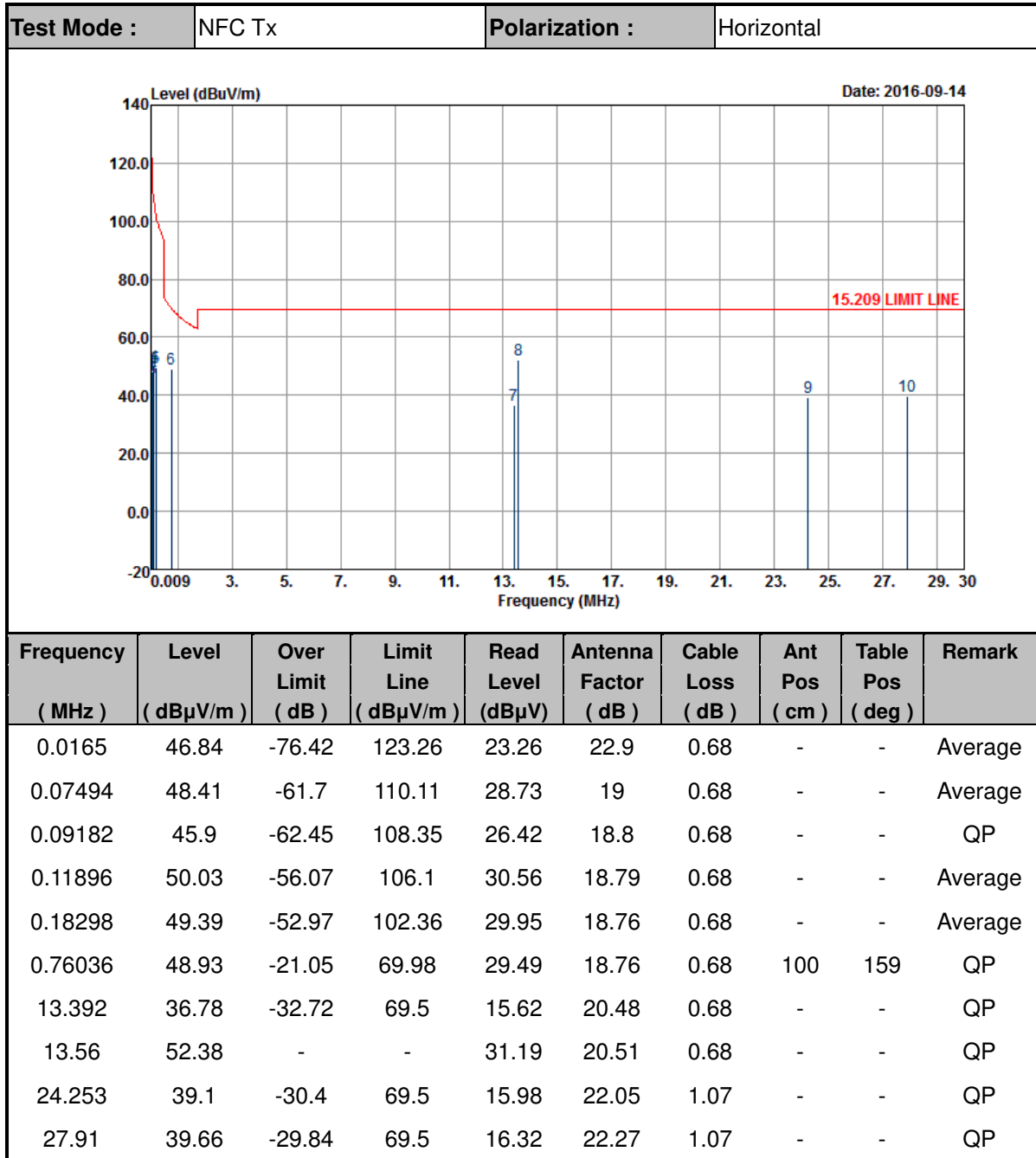


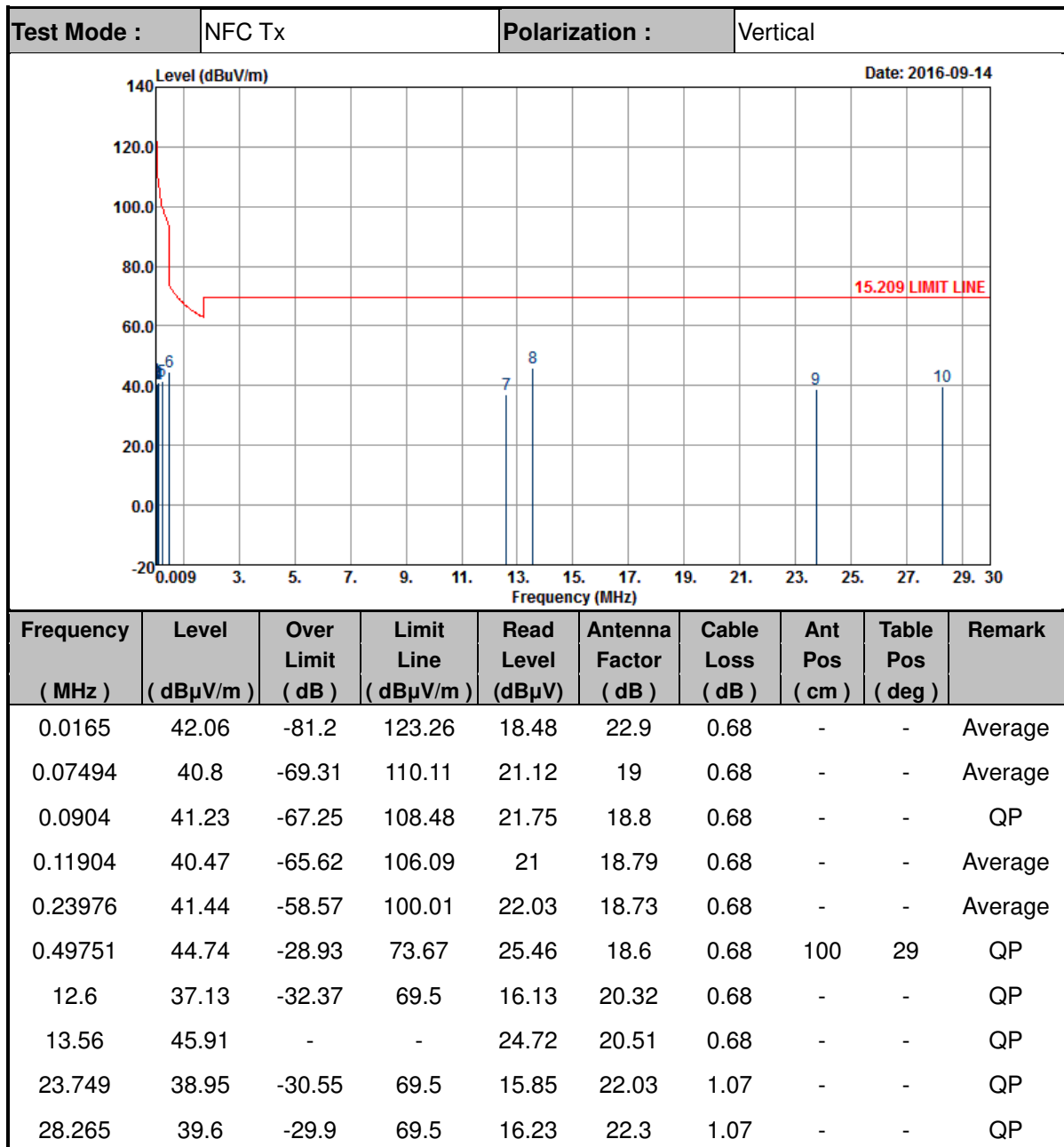


D2. Results of Radiated Spurious Emissions (9 kHz~30MHz)
<Sample 1>


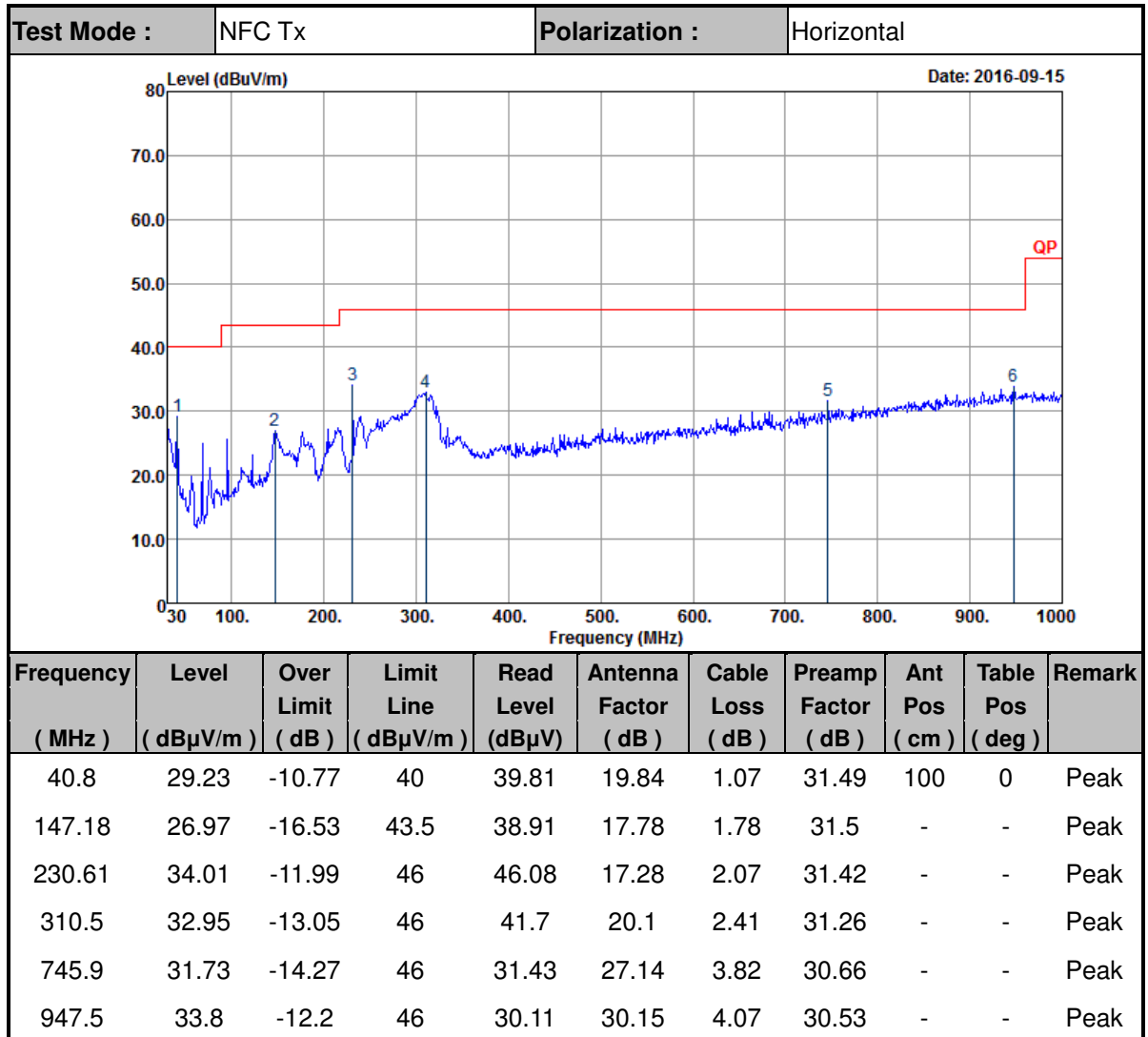

Note:

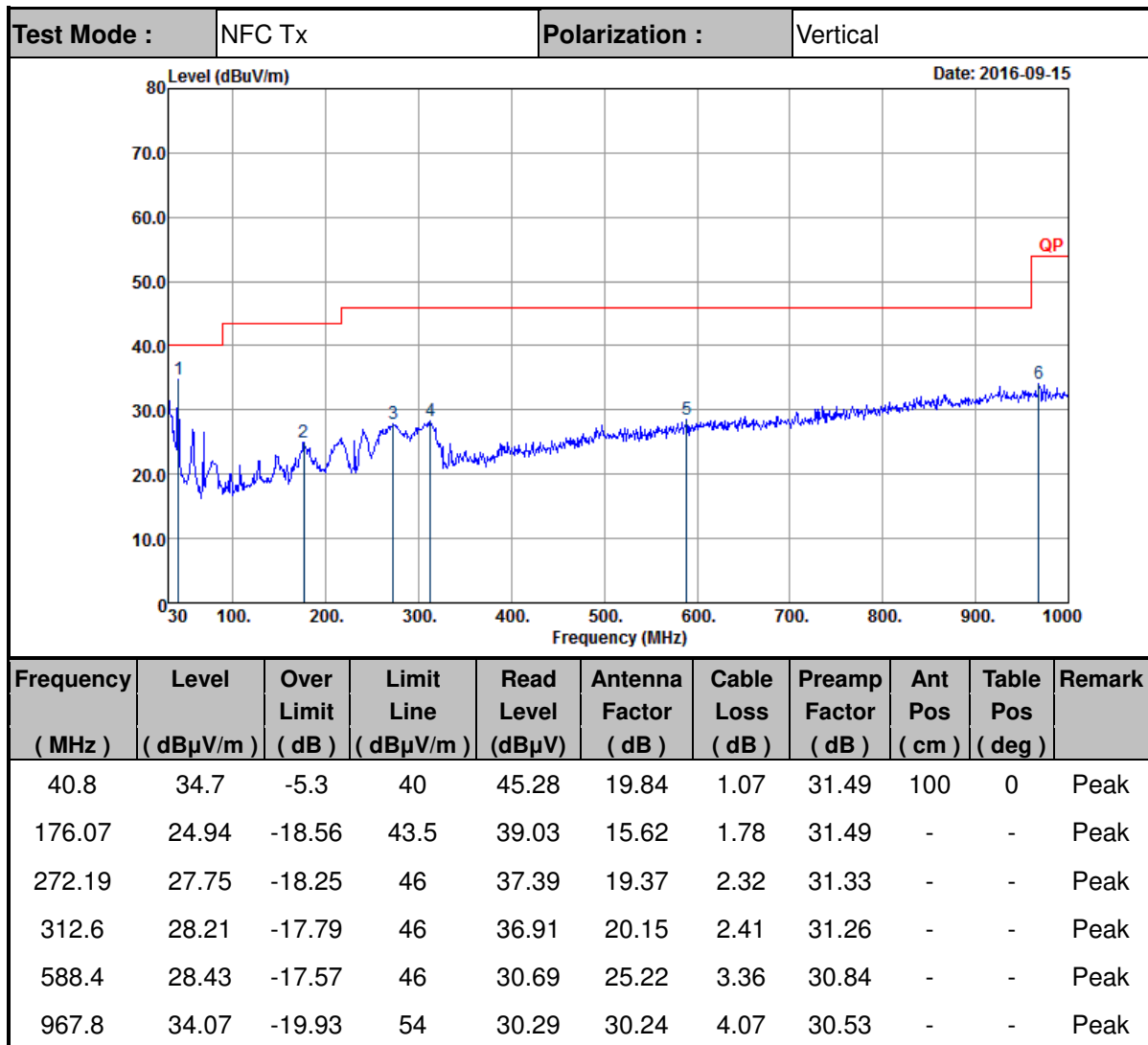
1. 13.56 MHz is fundamental signal which can be ignored.
2. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
3. Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB);
4. Limit line = specific limits (dBμV) + distance extrapolation factor.

<Sample 2>


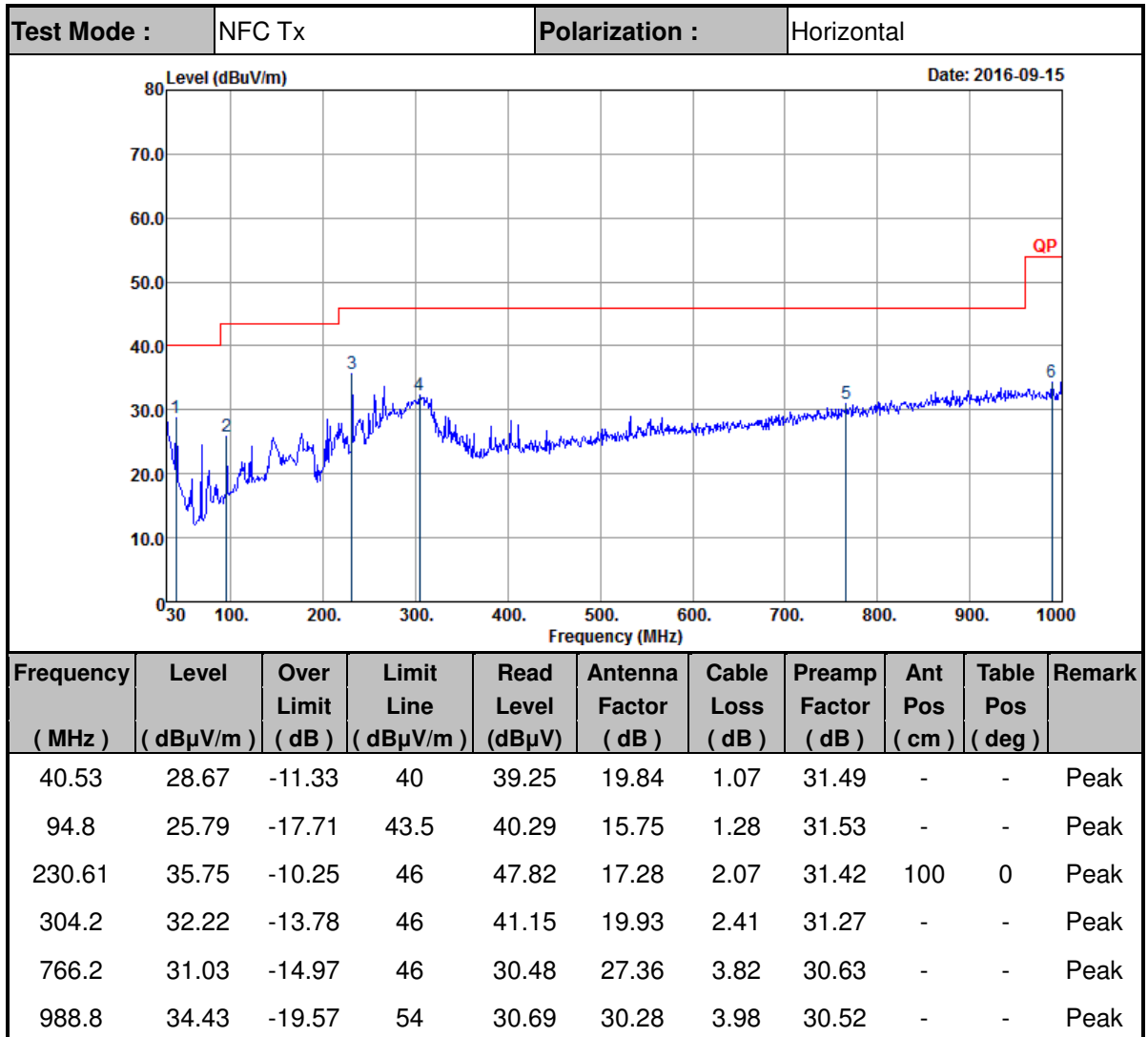

Note:

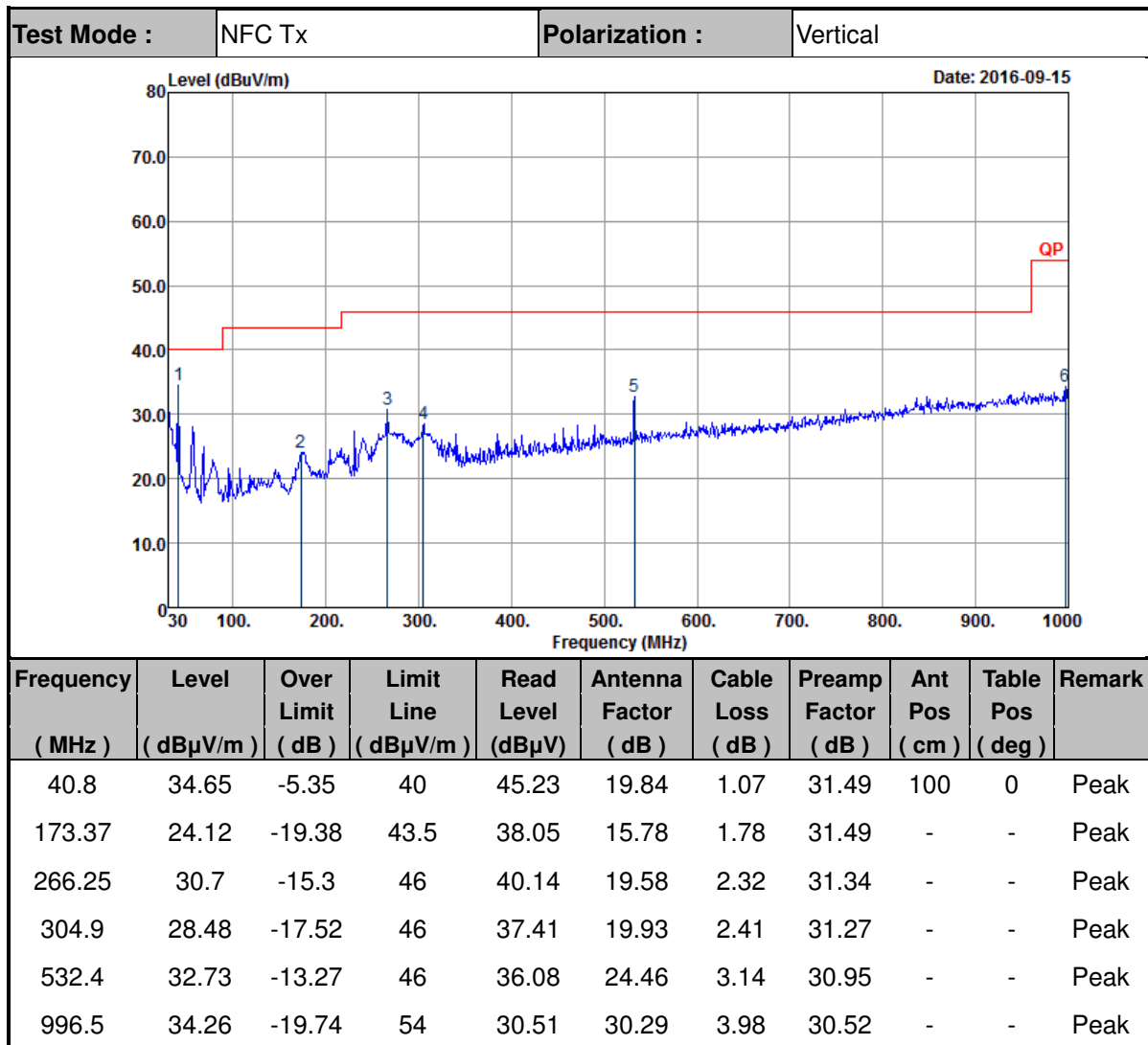
1. 13.56 MHz is fundamental signal which can be ignored.
2. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
3. Distance extrapolation factor = 40 log (specific distance / test distance) (dB);
4. Limit line = specific limits (dBμV) + distance extrapolation factor.

D3. Results of Radiated Spurious Emissions (30MHz~1GHz)
<Sample 1>



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.

<Sample 2>


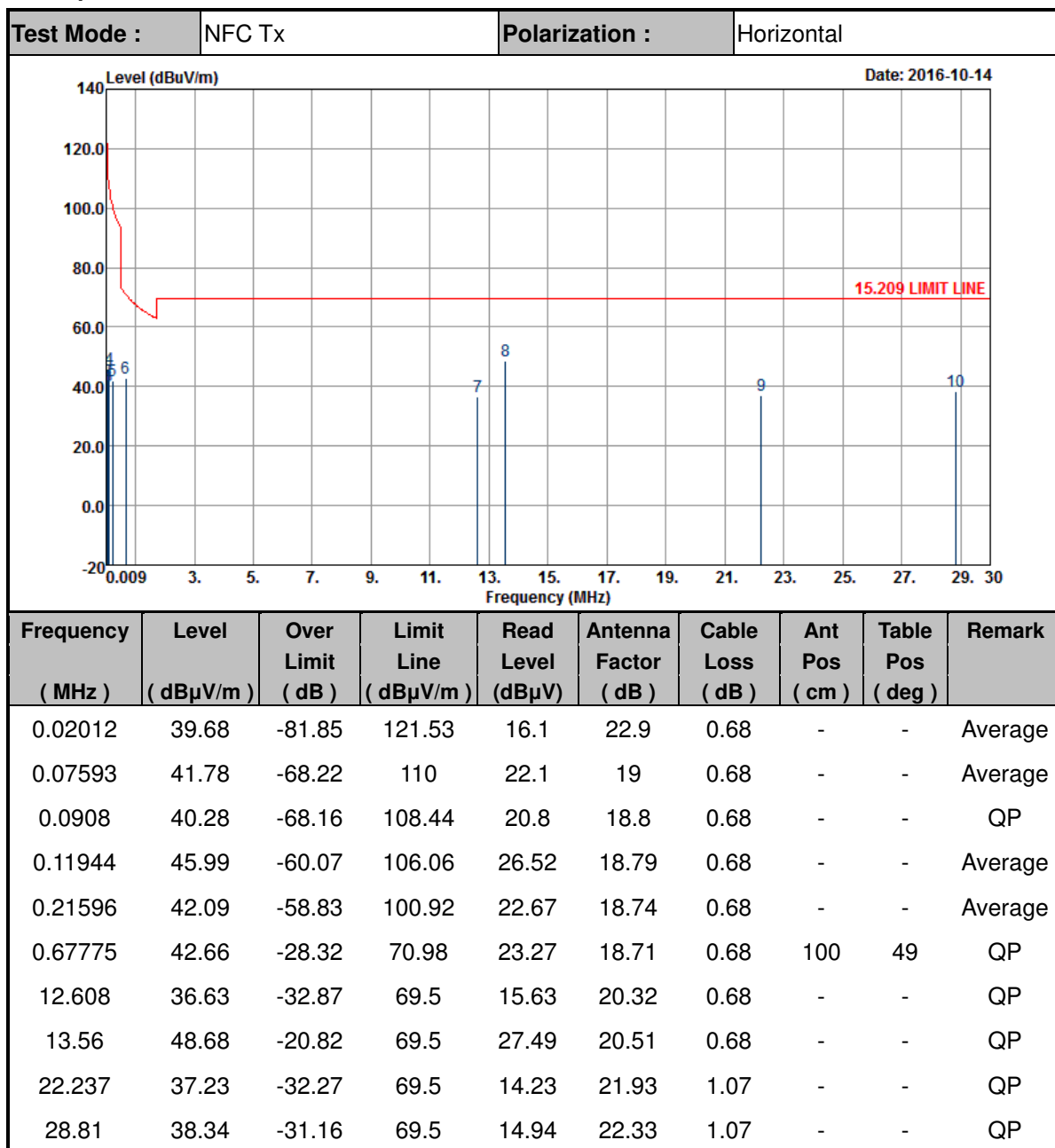

Note:

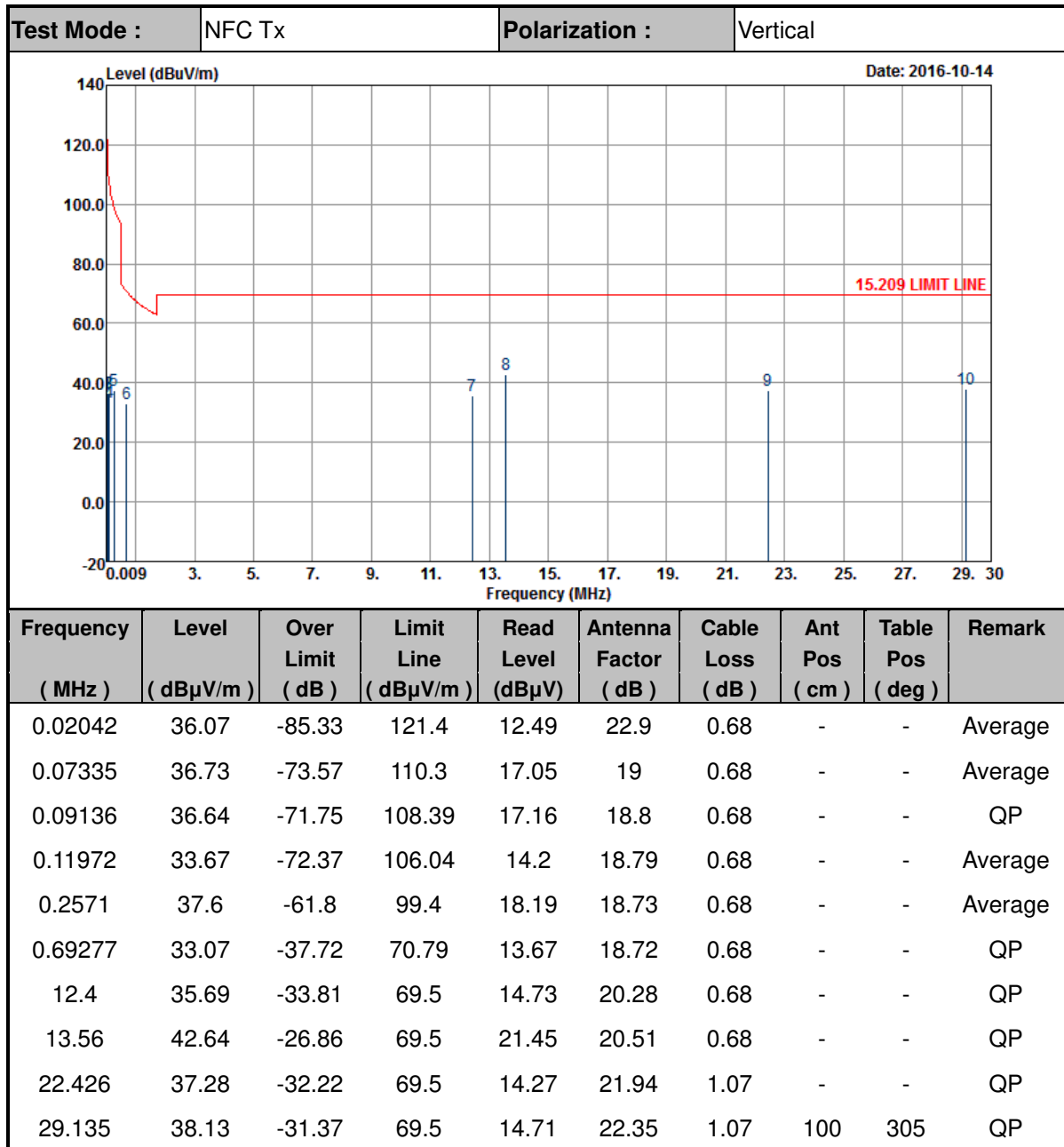
1. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
2. Emission level (dBμV/m) = 20 log Emission level (μV/m).
3. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor= Level.

Appendix E. Verification of Radiated Spurious Emissions at open-area test site

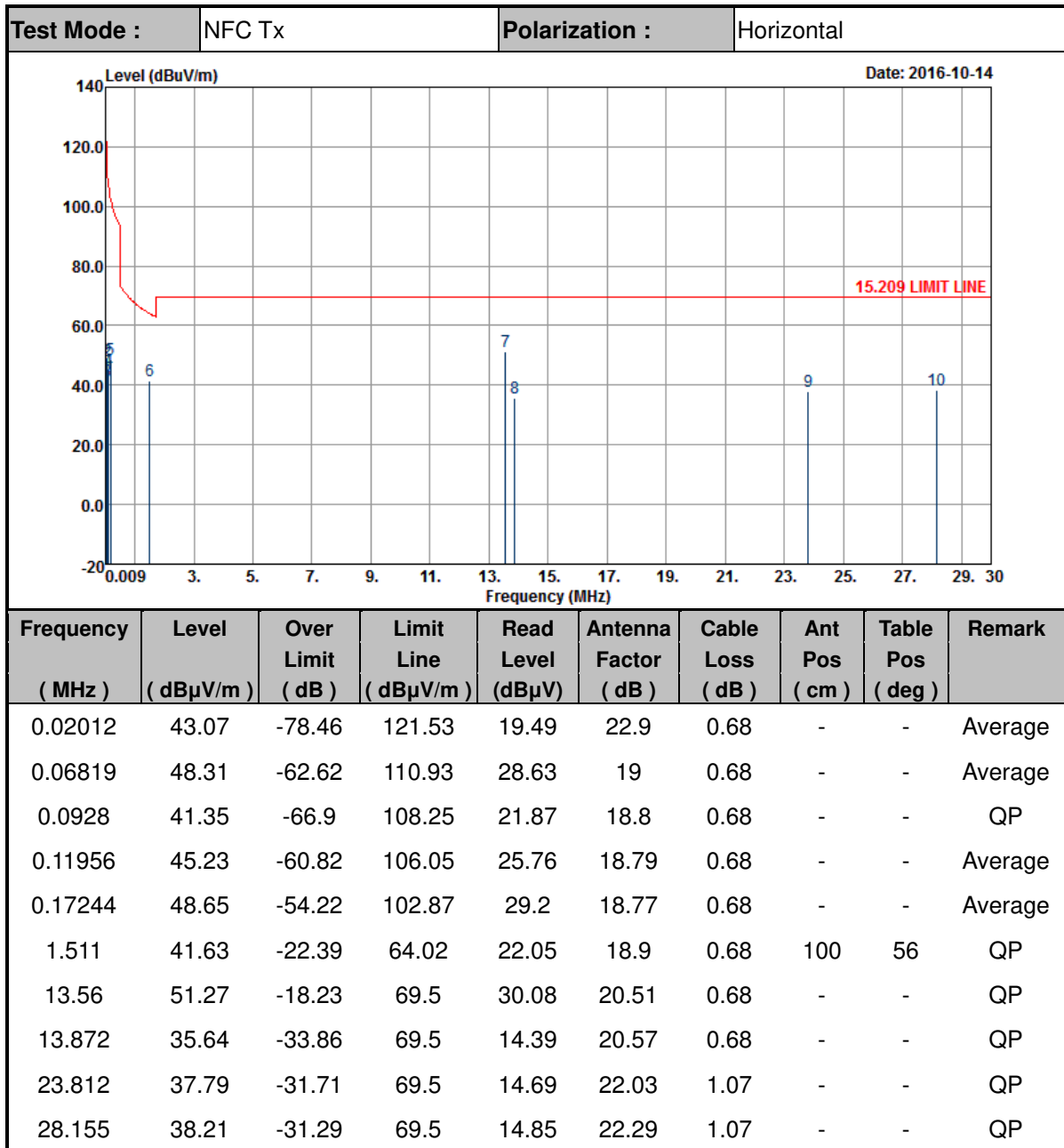
E1.Results of Radiated Emissions (9 kHz~30MHz)

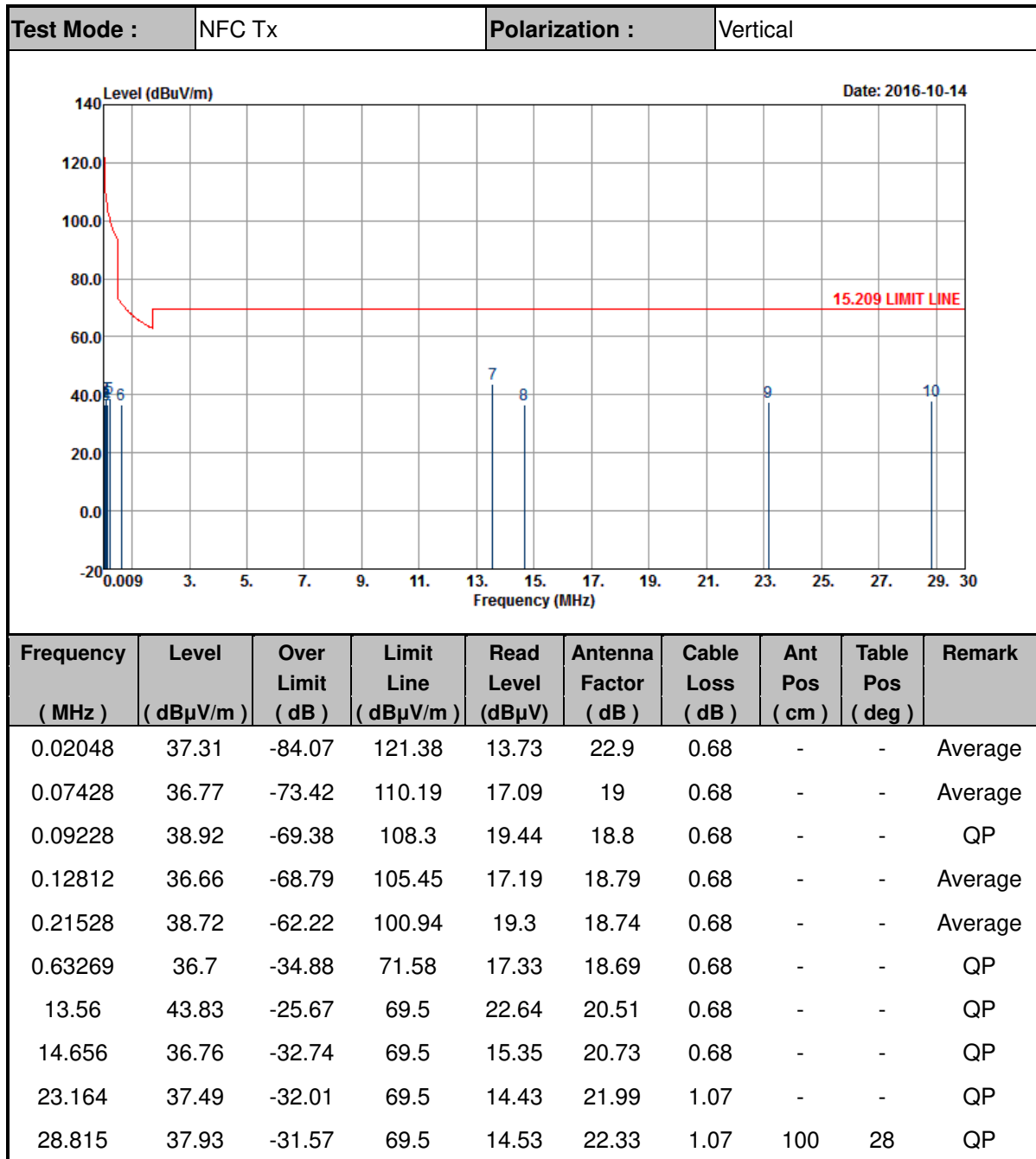
<Sample 1>




Note:

1. 13.56 MHz is fundamental signal which can be ignored.
2. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
3. Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB);
4. Limit line = specific limits (dBμV) + distance extrapolation factor.
5. The test distance between the receiving antenna and the EUT is 3meter.

<Sample 2>



Note:

1. 13.56 MHz is fundamental signal which can be ignored.
2. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
3. Distance extrapolation factor = 40 log (specific distance / test distance) (dB);
4. Limit line = specific limits (dBμV) + distance extrapolation factor.
5. The test distance between the receiving antenna and the EUT is 3meter.

**E2.List of Measuring Equipment**

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Loop Antenna	R&S	HFH2-Z2	25236	9 kHz ~ 30MHz	Sep. 02, 2015	Oct. 14, 2016	Sep. 01, 2017	Radiation (OS03-LK)
Amplifier	HP	8447D	2944A09068	0.1MHz ~ 1.3GHz	Dec. 11, 2015	Oct. 14, 2016	Dec. 10, 2016	Radiation (OS03-LK)
Spectrum Analyzer	R&S	FSP 7	100641	9 kHz ~ 7 GHz	Jun. 23, 2016	Oct. 14, 2016	Jun. 22, 2017	Radiation (OS03-LK)
Test Receiver	R&S	ESCS 30	836858/024	9 kHz ~ 2.75 GHz	Jun. 24, 2016	Oct. 14, 2016	Jun. 23, 2017	Radiation (OS03-LK)
Turn Table	EMCO	2080	9711-2021	0 ~ 360 degree	NCR	Oct. 14, 2016	NCR	Radiation (OS03-LK)
Antenna Mast	EMCO	2075	9711-2115	1 m ~ 4 m	NCR	Oct. 14, 2016	NCR	Radiation (OS03-LK)