

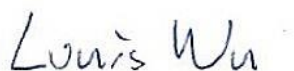


# FCC RADIO TEST REPORT

**FCC ID** : XRAFB421  
**Equipment** : Wireless Activity Tracker  
**Brand Name** : Fitbit  
**Model Name** : FB421  
**Applicant** : Fitbit, Inc.  
199 Fremont Street, 14th Floor, San  
Francisco, CA 94105 USA  
**Manufacturer** : Fitbit, Inc.  
199 Fremont Street, 14th Floor, San  
Francisco, CA 94105 USA  
**Standard** : FCC Part 15 Subpart C §15.225

The product was received on Apr. 07, 2021 and testing was started from Apr. 27, 2021 and completed on May 12, 2021. We, Sporton International Inc. Wensan Laboratory, 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. Wensan Laboratory, the test report shall not be reproduced except in full.



Approved by: Louis Wu

**Sporton International Inc. Wensan Laboratory**

No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)

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## History of this test report

Report No.	Version	Description	Issued Date
FR120111-01B	01	Initial issue of report	May 19, 2021
FR120111-01B	02	1. Revise remark description in section 2.1 2. Revise remark description in section 3.4.6	Jun. 09, 2021

## Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
-	15.207	AC Power Line Conducted Emissions	Not Required	-
3.1	15.215(c)	20dB Spectrum Bandwidth	Pass	-
	2.1049	99% OBW Spectrum Bandwidth	Reporting only	-
3.2	15.225(e)	Frequency Stability	Pass	-
3.3	15.225(a)(b)(c)	Field Strength of Fundamental Emissions	Pass	Max level 4.98 dBμV/m at 13.560 MHz
3.4	15.225(d) 15.209	Radiated Spurious Emissions	Pass	Under limit 10.42 dB at 53.280MHz
3.5	15.203	Antenna Requirements	Pass	-

**Note:**

- Not required means after assessing, test items are not necessary to carry out.
- The device is not able to do NFC transmission when charging mode. Therefore AC Power Line Conducted Emissions test is not required.

**Declaration of Conformity:**

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

**Comments and Explanations:**

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

**Reviewed by: Yun Huang**

**Report Producer: Ruby Zou**

## 1. General Description

### 1.1 Product Feature of Equipment Under Test

Bluetooth - LE, NFC and GPS.

Product Specification subjective to this standard	
Sample 1	EUT with ATL battery
Sample 2	EUT with highpower battery
Sample 3	EUT with VDL battery
Antenna Type	Bluetooth - LE: slot Antenna GPS: slot Antenna NFC: 3-turn coil Antenna

**Remark:** The above EUT's information was declared by manufacturer. Please refer to Comments and Explanations in report summary.

### 1.2 Modification of EUT

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

### 1.3 Testing Location

Test Site	Sporton International Inc. Wensan Laboratory	
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855	
Test Site No.	Sporton Site No.	
	TH05-HY	03CH11-HY
Test Engineer	Oscar Chi	Fu Chen, Troye Hsieh
Temperature	22-24°C	20.2~22.1°C
Relative Humidity	53-55%	66.5~68.5%

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

FCC designation No.: TW3786



## 1.4 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
- ♦ FCC KDB 414788 D01 Radiated Test Site v01r01
- ♦ ANSI C63.10-2013

**Remark:**

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. The TAF code is not including all the FCC KDB listed without accreditation.
3. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

## 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.

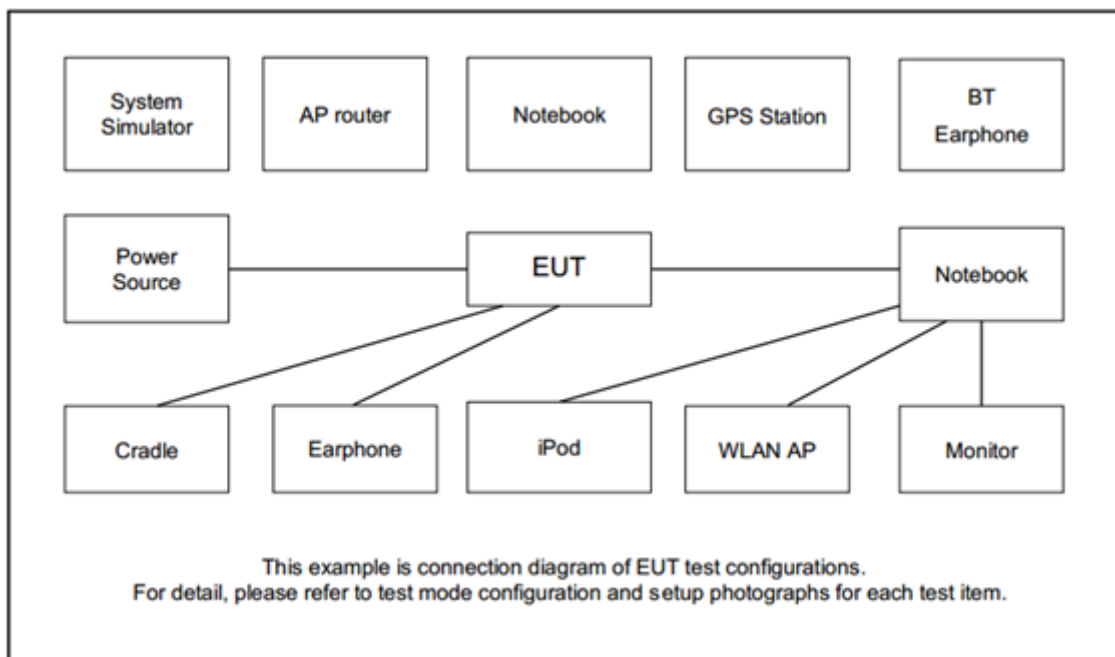
Test Items	
Field Strength of Fundamental Emissions	
20dB Spectrum Bandwidth	Frequency Stability
Radiated Emissions 9kHz~30MHz	Radiated Emissions 30MHz~1GHz

The NFC test is performed with app “Tera term” installed in the mobile phone. It can enable continuous transmission with type A/B/F tag respectively.

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

**Remark:** For Radiated Test Cases, the tests were performed with Sample 1 since the only difference of Sample 1, Sample 2 and Sample 3 is battery. Except this, the hardware design and enclosure material are identical.

### 2.2 Connection Diagram of Test System





## **2.3 EUT Operation Test Setup**

The RF test items, utility “Tera term” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level (Power setting: Default), data rate (Type F Bit Rate: 424kbps) and the application type and for continuous transmitting signals.



### 3. Test Results

#### 3.1 20dB and 99% OBW Spectrum Bandwidth Measurement

##### 3.1.1 Limit

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

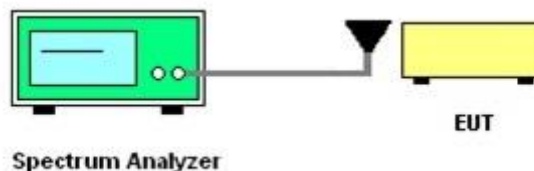
##### 3.1.2 Measuring Instruments

See list of measuring instruments of this test report.

##### 3.1.3 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 20 dB below carrier.
4. Measured the 99% OBW.

##### 3.1.4 Test Setup



##### 3.1.5 Test Result of Conducted Test Items

Please refer to Appendix A.

## 3.2 Frequency Stability Measurement

### 3.2.1 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 by using a new battery.

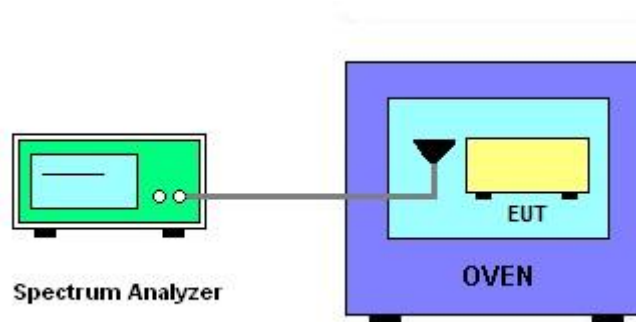
### 3.2.2 Measuring Instruments

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.
2. EUT has 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  $\pm 100$ ppm.
6. Extreme temperature rule is -20°C~50°C.

### 3.2.4 Test Setup



### 3.2.5 Test Result of Conducted Test Items

Please refer to Appendix A.

### 3.3 Field Strength of Fundamental Emissions and Mask Measurement

#### 3.3.1 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 ( $\mu$ V/m) at 30m	Field Strength (dB $\mu$ V/m) at 30m	Field Strength (dB $\mu$ V/m) at 10m	Field Strength (dB $\mu$ 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

**Remark:**

1. The field strength test result is in 3m test distance, follow test rules the test data use distance extrapolation factor and reported in this report at 30m test result.
2. Distance extrapolation factor =  $40 \log (\text{specific distance} / \text{test distance})$  (dB)

#### 3.3.2 Measuring Instruments

See list of measuring instruments of this test report.

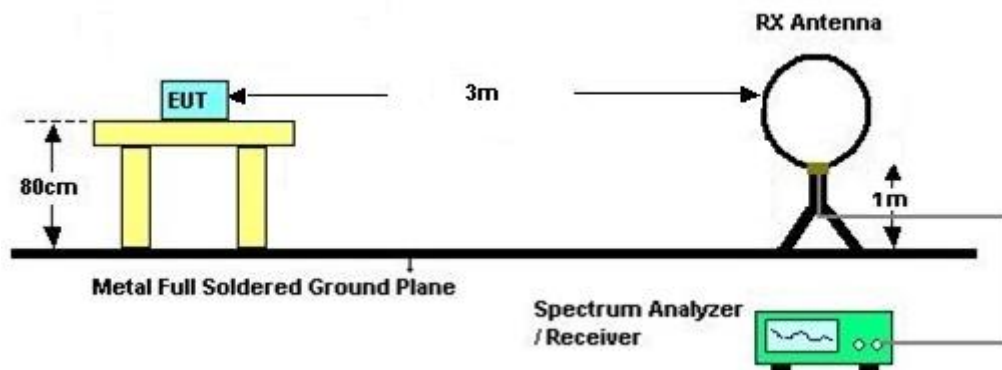
### 3.3.3 Test Procedures

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 9 kHz.

Note: Emission level (dBμV/m) = 20 log Emission level (μV/m).

### 3.3.4 Test Setup

For radiated test below 30MHz



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

Please refer to Appendix B.

### 3.4 Radiated Emissions Measurement

#### 3.4.1 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 ( $\mu$ 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

#### 3.4.2 Measuring Instruments

See list of measuring instruments of this test report.

#### 3.4.3 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

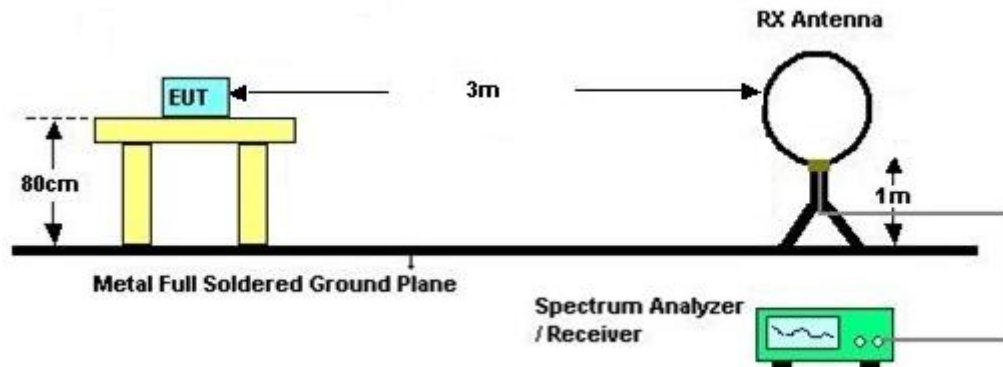
**Note:** The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz and 110-490 kHz. Radiated emission limits in these two bands are based on measurements employing an average detector.

### 3.4.4 Test Procedures

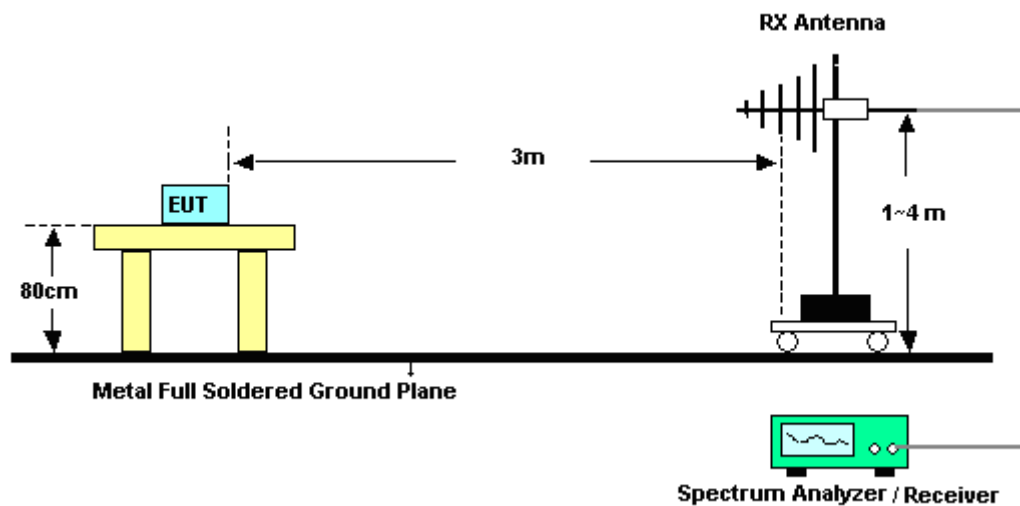
1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 0.8 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 3 meters far away from the turntable.
2. Power on the EUT and all the supporting 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 30 MHz, loop antenna has to be used for measurement and the recorded data shall be QP measured by receiver.

### 3.4.5 Test Setup

For radiated test below 30MHz



For radiated test above 30MHz



### 3.4.6 Test Result of Radiated Emissions Measurement

Please refer to Appendix B.

**Remark:**

1. There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.
2. According to C63.10 radiated Test, the EUT pre-scanned horizontal, vertical, and ground-parallel three polarization's, the worst case is horizontal & vertical polarization, test data of two mode was reported.



## **3.5 Antenna Requirements**

### **3.5.1 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.

### **3.5.2 Antenna Anti-Replacement Construction**

An embedded-in antenna design is used.



## 4. List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
AC Power Source	ChainTek	APC-1000W	N/A	N/A	N/A	May 11, 2021~ May 12, 2021	N/A	Conducted (TH05-HY)
Hygrometer	Testo	608-H1	34893241	N/A	Mar. 03, 2021	May 11, 2021~ May 12, 2021	Mar. 02, 2022	Conducted (TH05-HY)
Spectrum Analyzer	Rohde & Schwarz	FSP30	101329	9kHz~30GHz	Sep. 03, 2020	May 11, 2021~ May 12, 2021	Sep. 02, 2021	Conducted (TH05-HY)
Temperature Chamber	ESPEC	SH-641	92013720	-40°C ~90°C	Sep. 14, 2020	May 11, 2021~ May 12, 2021	Sep. 13, 2021	Conducted (TH05-HY)
Bilog Antenna	TESEQ	CBL 6111D & N-6-06	35414 & AT-N0602	30MHz~1GHz	Oct. 11, 2020	Apr. 27, 2021	Oct. 10, 2021	Radiation (03CH11-HY)
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100315	9 kHz~30 MHz	Jan. 04, 2021	Apr. 27, 2021	Jan. 03, 2022	Radiation (03CH11-HY)
Amplifier	SONOMA	310N	187312	9kHz~1GHz	Dec. 02, 2020	Apr. 27, 2021	Dec. 01, 2021	Radiation (03CH11-HY)
Spectrum Analyzer	Keysight	N9010A	MY542004 86	10Hz~44GHz	Oct. 23, 2020	Apr. 27, 2021	Oct. 22, 2021	Radiation (03CH11-HY)
Software	Audix	E3 6.2009-8-24	RK-00105 3	N/A	N/A	Apr. 27, 2021	N/A	Radiation (03CH11-HY)
Controller	EMEC	EM 1000	N/A	Control Turn table & Ant Mast	N/A	Apr. 27, 2021	N/A	Radiation (03CH11-HY)
Antenna Mast	EMEC	AM-BS-4500- B	N/A	1~4m	N/A	Apr. 27, 2021	N/A	Radiation (03CH11-HY)
Turn Table	EMEC	TT 2000	N/A	0~360 Degree	N/A	Apr. 27, 2021	N/A	Radiation (03CH11-HY)
Filter	Wainwright	WHK20/1000 C7/40SS	SN2	20M High Pass	Sep. 14, 2020	Apr. 27, 2021	Sep. 13, 2021	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4 PE	9kHz-30MHz	Mar. 11, 2021	Apr. 27, 2021	Mar. 10, 2022	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 104	MY9837/4 PE	30M-18G	Mar. 11, 2021	Apr. 27, 2021	Mar. 10, 2022	Radiation (03CH11-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102	MY2859/2	30MHz-40GHz	Mar. 11, 2021	Apr. 27, 2021	Mar. 10, 2022	Radiation (03CH11-HY)
Hygrometer	TECPEL	DTN-303B	TP200880	QA-3-031	Oct. 22, 2020	Apr. 27, 2021	Oct. 21, 2021	Radiation (03CH11-HY)
Hygrometer	TECPEL	DTN-303B	TP140325	N/A	Nov. 18, 2020	Apr. 27, 2021	Nov. 17, 2021	Radiation (03CH11-HY)

## 5. Uncertainty of Evaluation

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

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	3.4
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### Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	4.4
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## Appendix A. Test Results of Conducted Test Items

### A1. Test Result of 20dB Spectrum Bandwidth

Test mode	NFC Tx	Test Frequency (MHz)	13.56
<p>Ref 0 dBm Att 30 dB RBW 1 kHz VSW 3 kHz SWT 20 ms Marker 1 [T1] -13.10 dBm 13.560420000 MHz</p> <p>20dB [T1] 20.00 dB BW 2.660000000 kHz Temp 1 [T1] dBm -33.47 dBm 13.559060000 MHz Temp 2 [T1] dBm -33.39 dBm 13.561720000 MHz</p> <p>Center 13.56 MHz 1 kHz/ Span 10 kHz</p> <p>Date: 11.MAY.2021 15:56:00</p>		<p>Ref 0 dBm Att 30 dB RBW 1 kHz VSW 3 kHz SWT 20 ms Marker 1 [T1] -13.01 dBm 13.560420000 MHz</p> <p>99% [T1] 20.00 dB BW 2.260000000 kHz Temp 1 [T1] dBm -33.74 dBm 13.559260000 MHz Temp 2 [T1] dBm -33.39 dBm 13.561520000 MHz</p> <p>Center 13.56 MHz 1 kHz/ Span 10 kHz</p> <p>Date: 11.MAY.2021 15:54:31</p>	
20dB Bandwidth (kHz)	2.660	99% OccupiedBW(kHz)	2.260
Frequency range (MHz)	$f_L > 13.553$	13.55906	Test Result
	$f_H < 13.567$	13.56172	Complies

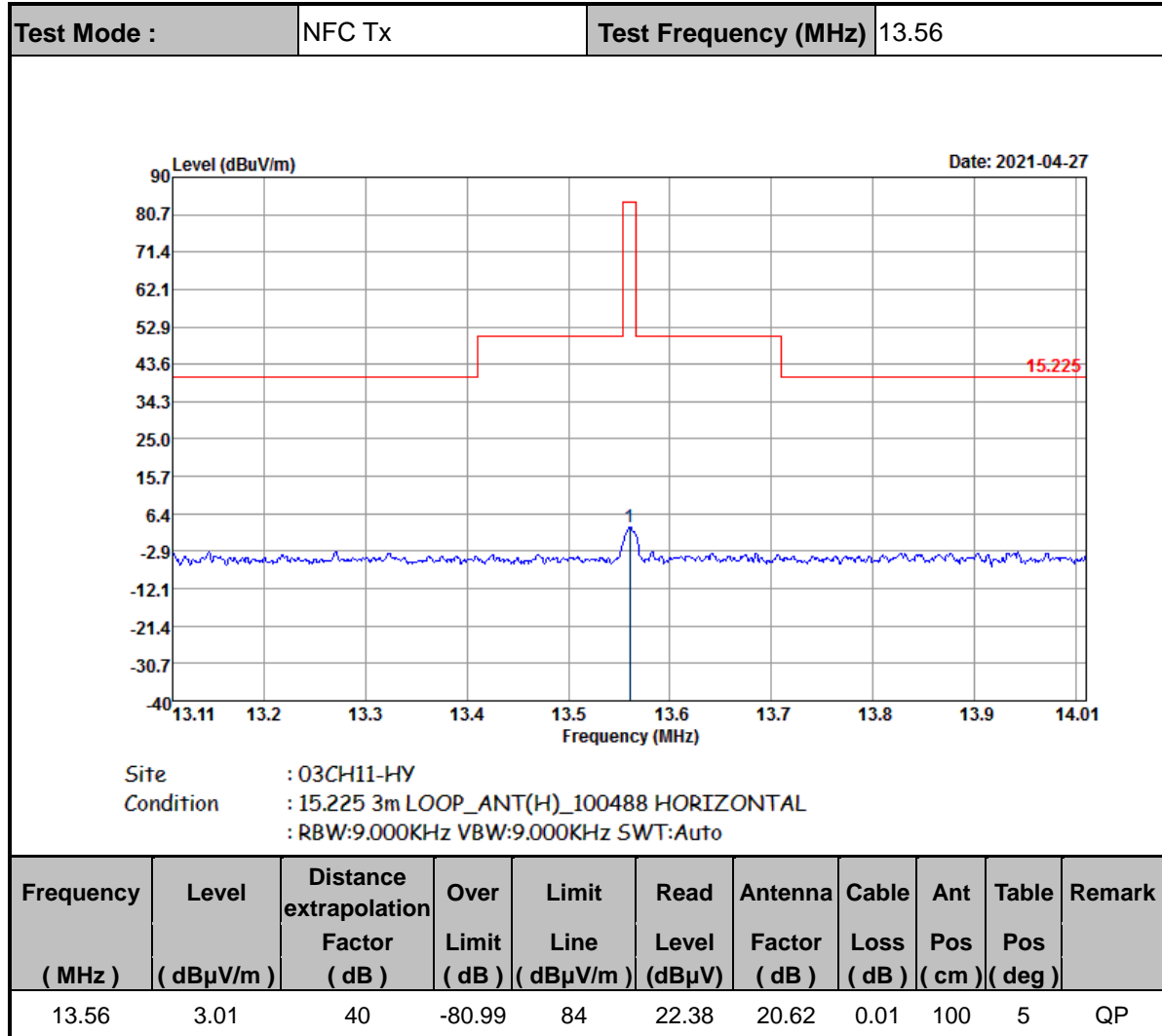
**Remark:** Because the measured signal is CW adjusting the RBW per C63.10 would not be practical since measured bandwidth will always follow the RBW and the result will be approximately twice the RBW.

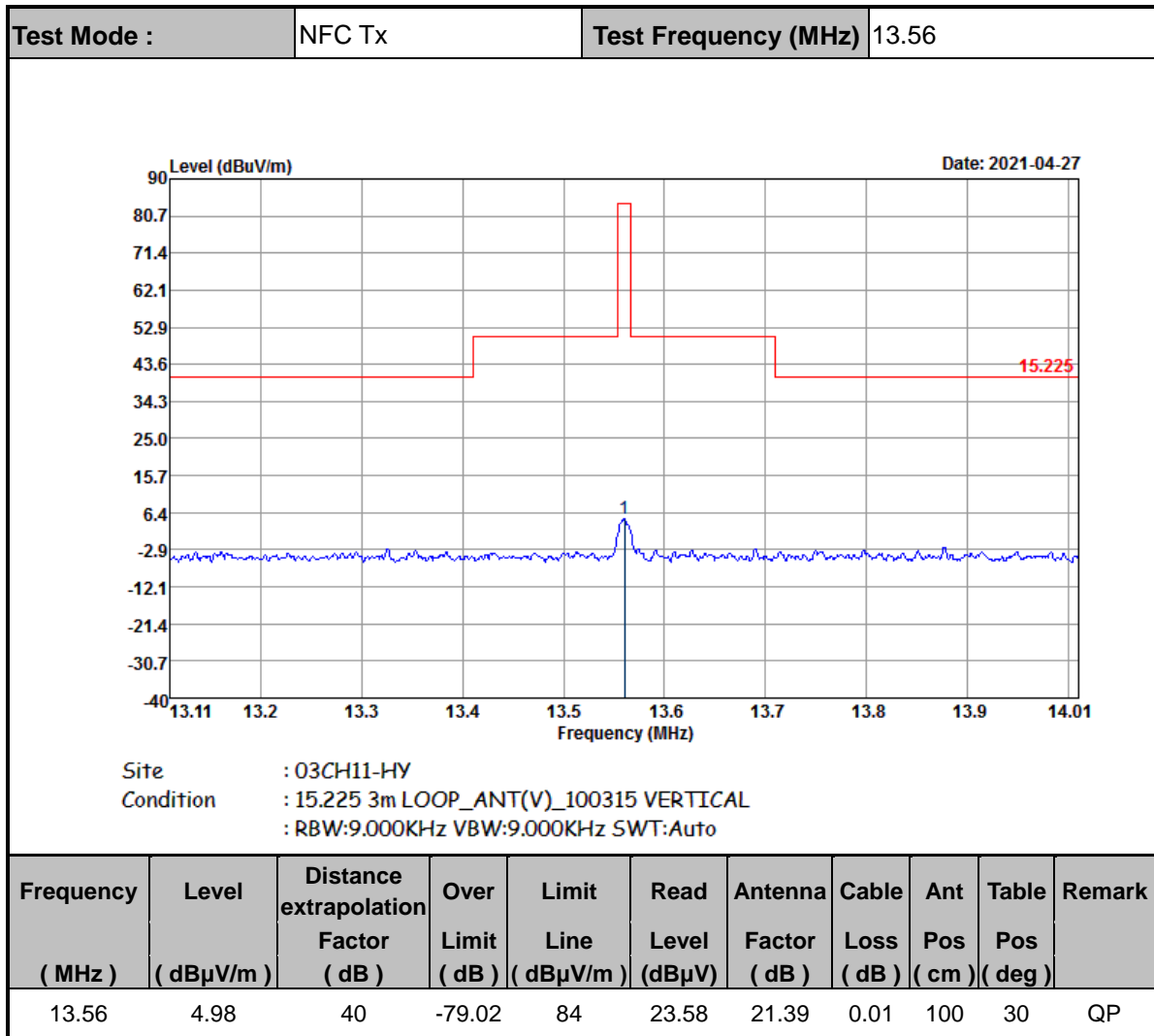
**A2. Test Result of Frequency Stability**

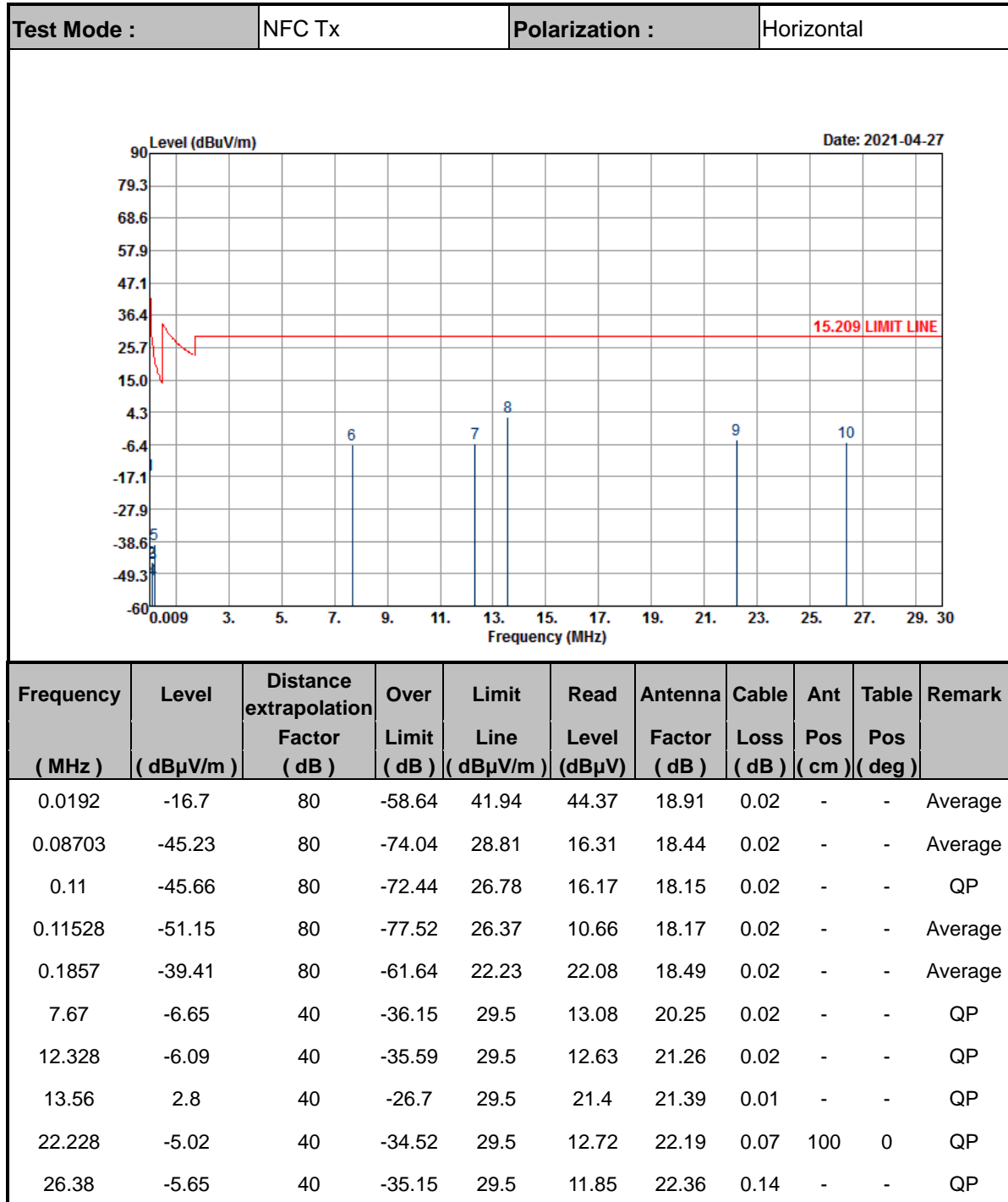
Voltage vs. Frequency Stability		Temperature vs. Frequency Stability		
Voltage (Vdc)	Measurement Frequency (MHz)	Temperature (°C)	Time	Measurement Frequency (MHz)
3.85	13.560390	-10	0	13.560400
3.6	13.560380		2	13.560390
4.4	13.560380		5	13.560390
			10	13.560390
		0	0	13.560380
			2	13.560390
			5	13.560390
			10	13.560390
		10	0	13.560390
			2	13.560390
			5	13.560390
			10	13.560400
		20	0	13.560390
			2	13.560380
			5	13.560390
			10	13.560390
		30	0	13.560390
			2	13.560390
			5	13.560380
			10	13.560380
		40	0	13.560400
			2	13.560400
			5	13.560400
			10	13.560400
Max.Deviation (MHz)	0.000390	Max.Deviation (MHz)	0.000400	
Max.Deviation (ppm)	28.7611	Max.Deviation (ppm)	29.4985	
Limit	FS < ±100 ppm	Limit	FS < ±100 ppm	
Test Result	PASS	Test Result	PASS	

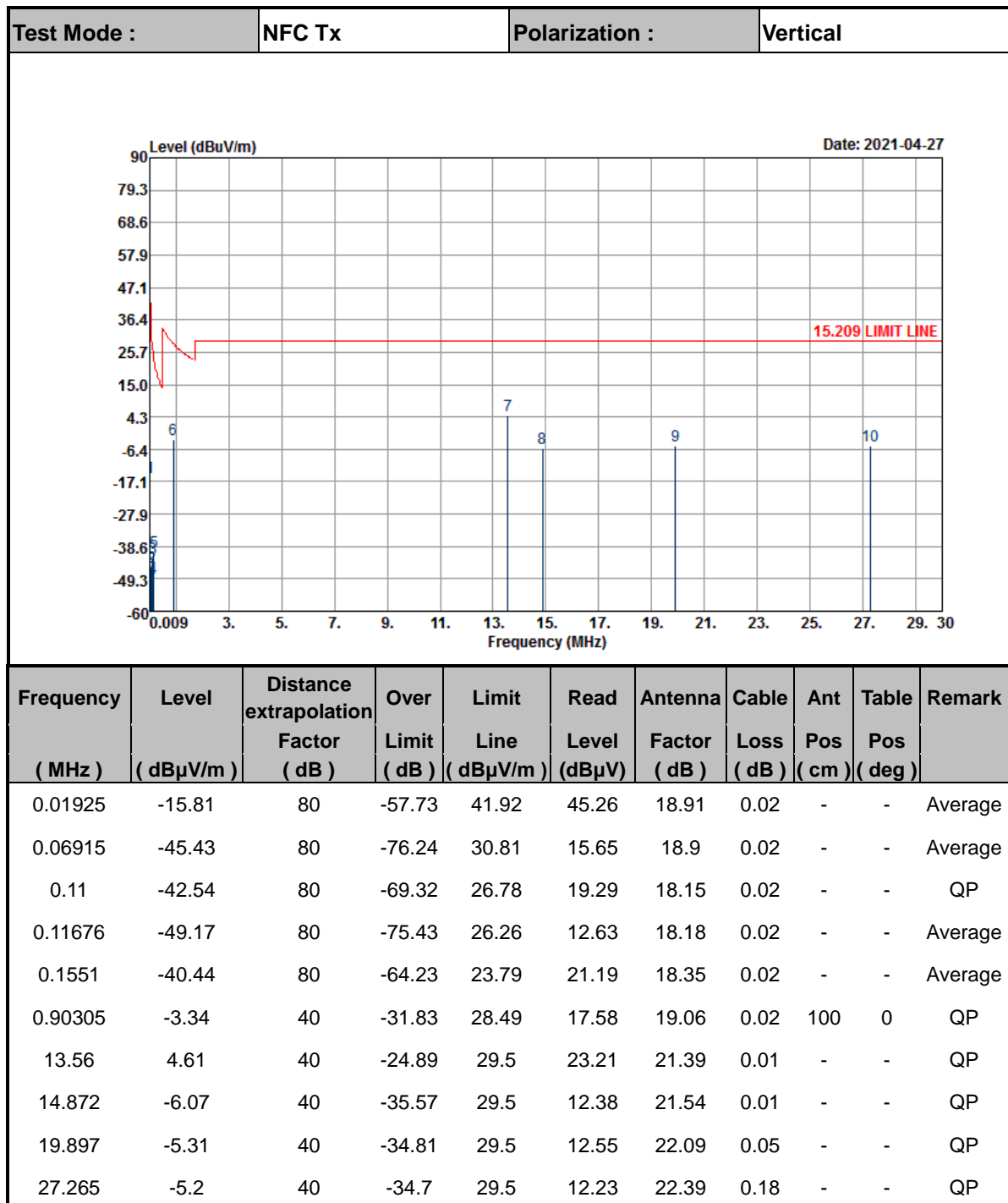
## Appendix B. Test Results of Radiated Test Items

### B1. Test Result of Field Strength of Fundamental Emissions



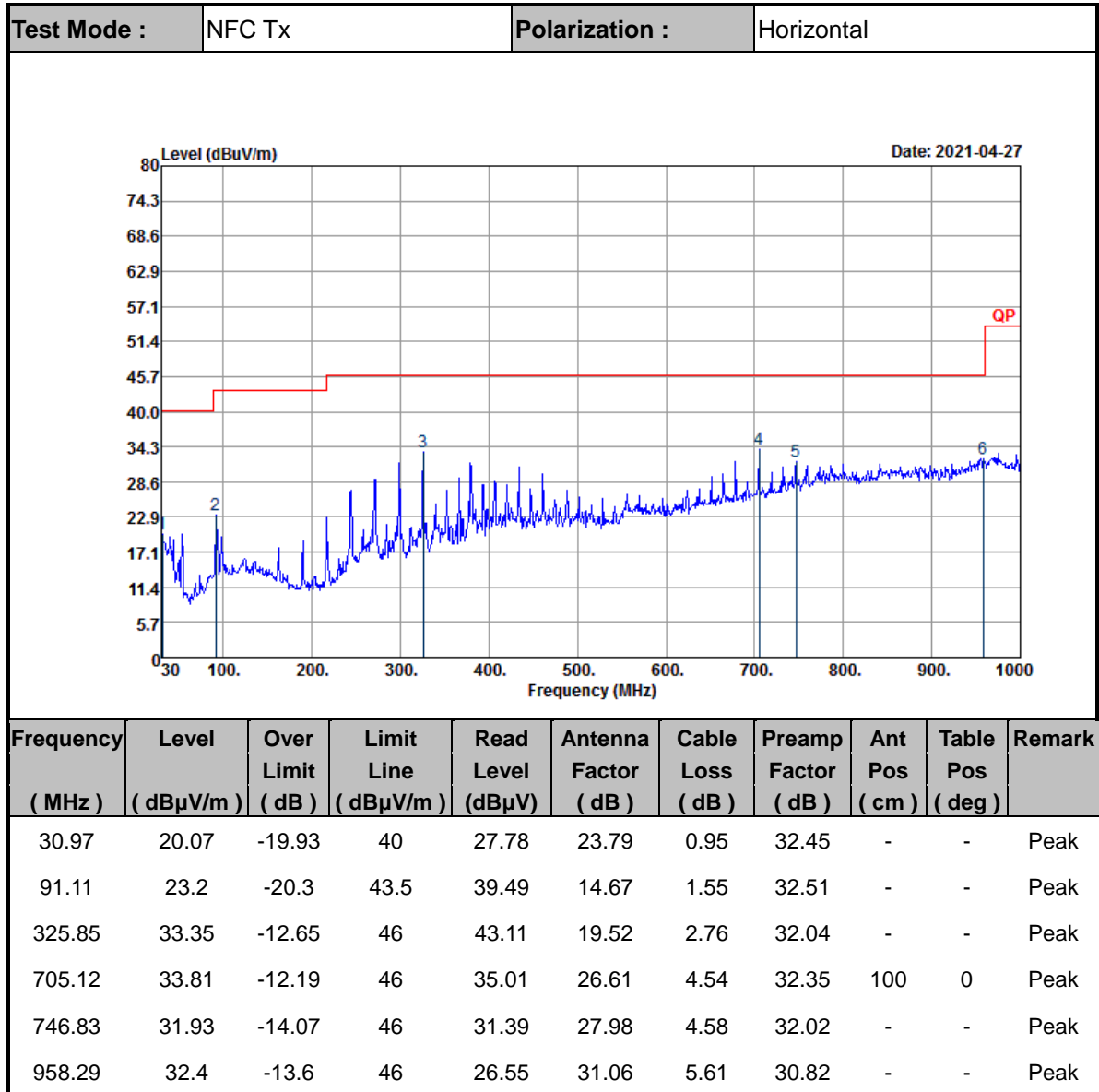


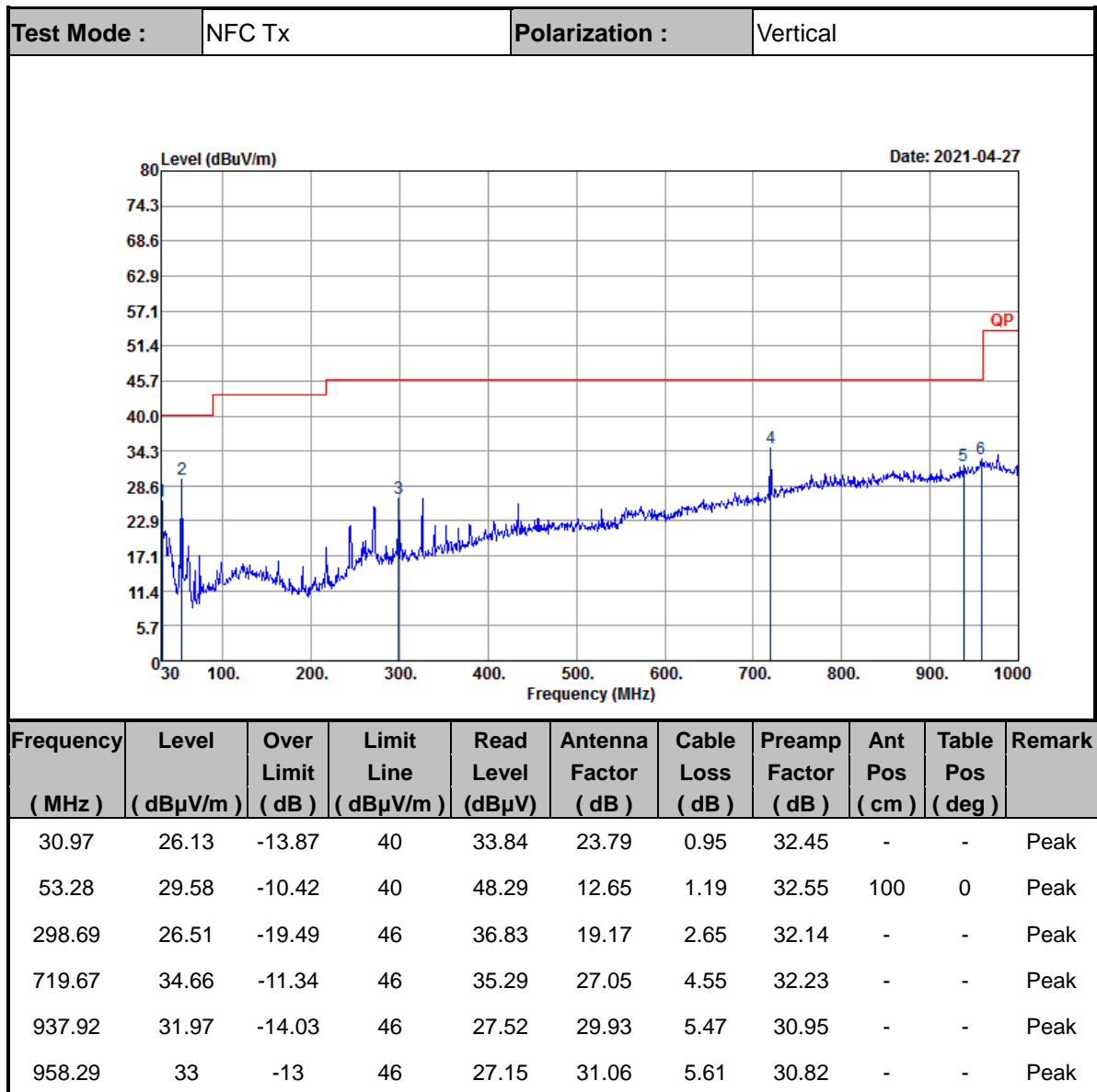
**B2. Results of Radiated Spurious Emissions (9 kHz~30MHz)**



**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
4. 13.56 MHz is fundamental signal which can be ignored



**B3. Results of Radiated Spurious Emissions (30MHz~1GHz)**



**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.