

Advanced
Compliance Laboratory

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ELECTROMAGNETIC EMISSION COMPLIANCE REPORT

of

NX15

MODEL: NX15

FCC ID: QF7NX15 IC: 8498A-NX15

February 2, 2024

This report concerns (check one): Original grant ☒ Class II change ☐
Equipment type: Low Power Intentional Radiator

Deferred grant requested per 47 CF 0.457(d)(1)(ii)? yes ☐ no ☒
If yes, defer until: _____ (date)
Company agrees to notify the Commission by _____ (date)
of the intended date of announcement of the product so that the grant can be
issued on that date.

Transition Rules Request per 15.37? yes ☐ no ☒
If no, assumed Part 15, Subpart B for unintentional radiators - the new 47 CFR
[10-1-90 Edition] provision.

Report prepared for: GEOPHYSICAL SURVEY SYSTEMS, INC.
Report prepared by: Advanced Compliance Lab
Report number: 0048-240115-02-FCC-IC-NFC



Lab Code: 200101

The test result in this report IS supported and covered by the NVLAP accreditation

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1. GENERAL INFORMATION

1.1 Verification of Compliance

EUT: NX15

Model: NX15

Applicant: GEOPHYSICAL SURVEY SYSTEMS, INC.

Test Type: FCC Part 15C (15.225) & RSS-210 (issue 10)
CERTIFICATION
FCC Part 15B & ICES-003, Class A (for digital circuitry)

Result: PASS

Tested by: ADVANCED COMPLIANCE LABORATORY

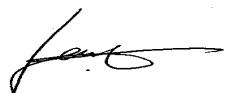
Test Date: January 15 -February 2, 2024

Report Number: 0048-240115-02-FCC-IC-NFC

The above equipment was tested by Compliance Laboratory, Advanced Technologies, Inc. for compliance with the requirement set forth in the FCC rules and regulations Part 15 subpart C. This said equipment in the configuration described in the report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

The estimated uncertainty of the test result is given as following. The method of uncertainty calculation is provided in Advanced Compliance Lab. Doc. No. 0048-01-01.

	Prob. Dist.	Uncertainty(dB)	Uncertainty(dB)	Uncertainty(dB)
		30-1000MHz	1-6.5GHz	Conducted
Combined Std. Uncertainty u_c	norm.	± 2.36	± 2.99	± 1.83



Wei Li
Lab Manager
Advanced Compliance Lab

Date: February 2, 2024

1.2 Equipment Modifications

N/A

1.3 Product Information

System Configuration

ITEM	DESCRIPTION	FCC ID	CABLE
Product	NX15 NX15 ⁽¹⁾	FCCID: QF7NX15 IC: 8498A-NX15	
Housing	Plastic		
Power Supply	7.2V Smart Li-on Battery		
Operation Freq.	13.56MHz		
Device Type	Sec. 15.225 & RSS-210 Operation		

(1) EUT submitted for grant.

1.4 Test Methodology

Radiated tests were performed according to the procedures in ANSI C63.4-2014 & ANSI C63.10-2013 at an antenna to EUT distance of 30 & 3 meters.

1.5 Test Facility

The open area test site and conducted measurement facility used to collect the radiated and conducted data are located at Hillsborough, New Jersey. This site is accepted by FCC to perform measurements under Part 15 or 18 (US5347) and also designated by IC as “ site IC 3130A”. ACL is recognized by ISED as a wireless testing laboratory (CAB ID: US0100) . The NVLAP Lab code for accreditation of FCC EMC Test Method is: 200101-0.

1.6 Test Equipment

Manufacture	Model		Serial No.	Description	Cal Due dd/mm/yy
Hewlett-Packard	HP8546A		3448A00290	EMI Receiver	25/09/24
Agilent	E4440A		US40420700	3Hz-26.5GHz Spectrum Analyzer	17/06/24
R & S	ESPI		100018	9KHz-7GHz EMI Receiver	25/08/24
EMCO	3104C		9307-4396	20-300MHz Biconical Antenna	15/01/25
EMCO	3146		9008-2860	200-1000MHz Log-Periodic Antenna	15/01/25
ARA	MWH- 1826/B		1013	18-26GHZ Horn Antena	10/02/25
EMCO	3115		49225	Double Ridge Guide Horn Antenna	15/01/25
Electro-Meterics	ALR- 25M/30		289	10KHz-30MHz Active Loop Antenna	28/05/24

All Test Equipment Used are Calibrated Traceable to NIST Standards.

1.7 Statement for the Document Use

This report shall not be reproduced except in full, without the written approval of the laboratory. And this report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S. Government.

2. PRODUCT LABELING

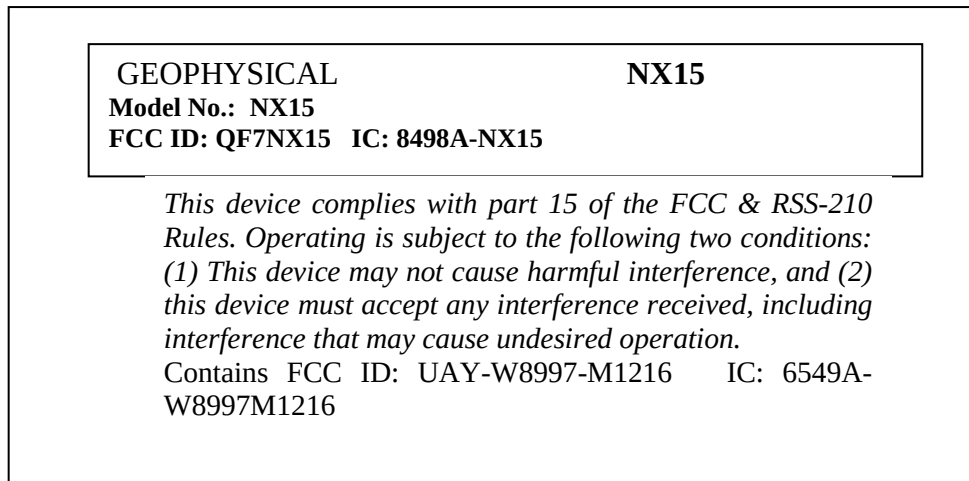


Figure 2.1 FCC ID Label (statement shown in user manual)

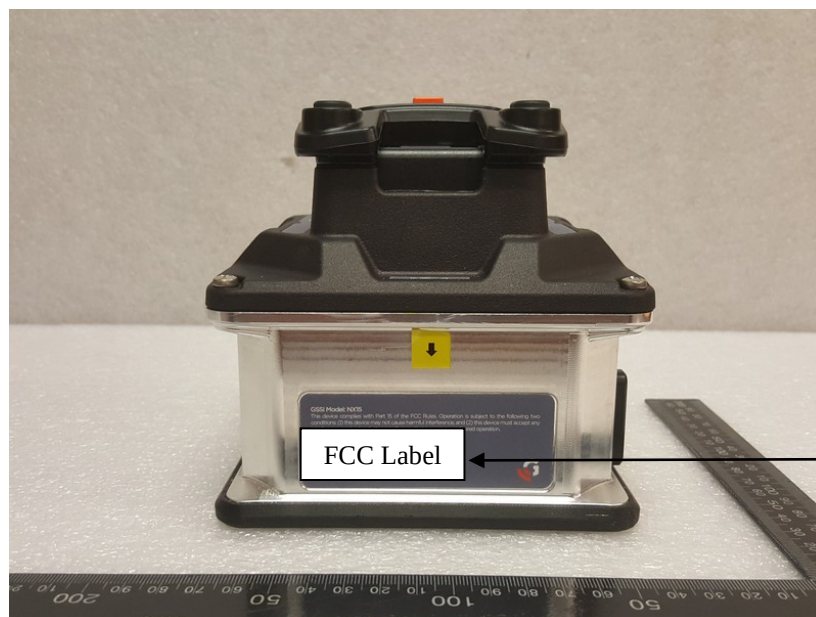


Figure 2.2 FCC ID Label Location

3. SYSTEM TEST CONFIGURATION

3.1 Justification

The system was configured for testing in a typical fashion (as a customer would normally use it) . Testing was performed as EUT TX transmission was operated continuously.

3.2 Special Accessories

N/A

3.3 Configuration of Tested System

Figure 3.1 to Figure 3.3 illustrate the system setup for testing.



Figure 3.1 Radiated Emission Test Setup

N/A

Figure 3.2 Conducted Emission Test Setup



Figure 3.3 Frequency Tolerance Test Setup

4. SYSTEM SCHEMATICS

See Attachment.

Figure 4.1 System Schematics

5. CONDUCTED EMISSION DATA

5.1 Test Methods and Conditions

The EUT was under normal operational mode during the conducted emission test. EMI Receiver was scanned from 150KHz to 30MHz with maximum hold mode for maximum emission. Recorded data was sent to the plotter to generate output in linear format. At the input of the spectrum analyzer, a HP transient limiter is inserted for protective purpose. This limiter has a 10 dB attenuation in the range of 150KHz to 30MHz. That factor was automatically compensated by the receiver, so the readings are the corrected readings. The reference of the plot is the CISPR 22 Class B limit in Figure 5.1 through Figure 5.2.

Conducted Emission Technical Requirements				
Frequency Range	Class A		Class B	
	Quasi-Peak dBuV	Average dBuV	Quasi-Peak DBuV	Average dBuV
150kHz -0.5MHz	79 (8912uV)	66 (1995uV)	66-56	56-46
0.5MHz-30MHz	73 (4467uV)	60 (1000uV)	---	---
0.5MHz- 5MHz	---	---	56	46 (250uV)
5MHz-30MHz	---	---	60	50

Emissions that have peak values close to the specification limit (if any) may be also measured in the quasi-peak mode to determine compliance.

5.2 Test Data

Figure 5.1-5.2 show the neutral and line conducted emissions for the standard operation with antenna output attenuated.

Highest Data for AC Line Conducted Emissions, 120Vac Battery Charging Mode						
Frequency (MHz)	(Line)	(Line)	(Line)	(Neutral)	(Neutral)	(Neutral)
Peak/QP Reading (dBuV)*						
Average Reading (dBuV)*						
Under FCC Part 15 Limit						

Test Personnel:

Tester Signature: _____ Date: _____

Typed/Printed Name: _____

Line Conducted Emission 150kHz-30MHz

N/A

Fig. 5.1 Conducted Emission-Line

Neutral Conducted Emission 150kHz-30MHz

N/A

Fig. 5.2 Conducted Emission- Neutral

----- **Section 5 is not applicable to this EUT .**

6. RADIATED EMISSION DATA

6.1 Field Strength Calculation

The corrected field strength is automatically calculated by EMI Receiver using following:

$$FS = RA + AF + CF + AG$$

where FS: Corrected Field Strength in dB μ V/m

RA: Amplitude of EMI Receiver before correction in dB μ V

AF: Antenna Factor in dB/m

CF: Cable Attenuation Factor in dB

AG: Built-in Preamplifier Gain in dB (Stored in receiver as part of the calibration data)

6.2 Test Methods and Conditions

The initial step in collecting radiated data is a EMI Receiver scan of the measurement range below 30MHz using peak/quasi-peak detector and 9KHz IF bandwidth / 30KHz video bandwidth with loop antenna. For the range 30MHz - 1GHz, 120KHz IF bandwidth / 120KHz video bandwidth are used. Both bandwidths are 1MHz for above 1GHz measurement. Frequency range from EUT's lowest crystal frequency to 10th harmonics of fundamental was investigated.

EUT was rotated all around and cables and equipment were placed and moved within the range of positions likely to find their maximum emissions. Antenna must be rotated about its Horizontal and Vertical positions to maximize emissions.

6.3 Test Data

The following data lists the significant emission frequencies, polarity and position, peak reading of the EMI Receiver, the FCC limit, and the difference between the peak reading and the limit. Explanation of the correction and calculation are given in section 6.1.

Test Personnel: David Tu

Typed/Printed Name: David Tu

Date: February 2, 2024

Radiated Test Data

Emissions from 13.56MHz Transmitter for Part 15C

Frequency (MHz)	Polarity [H or V]	Height (m)	Azimuth (Degree)	Quasi- Peak Reading (dBμV/m)	FCC 30m & 3m Limit (dBμV/m)	Difference from limit (dB)
13.56	H/V	1.0	000	43.5	84.0(1)	-40.5
27.12	H/V	1.0	000	18.2(3)	29.5(2)	-11.3
40.6	H	1.8	090	32.0	40.0	-8.0
67.7	H	1.8	045	23.4	40.0	-16.6
94.9	H	1.8	045	30.6	40.0	-9.4
122.1	H	1.8	090	23.8	40.0	-16.2
149.2	H	1.8	090	29.4	40.0	-10.6
176.3	H	1.8	045	26.2	40.0	-13.8
40.6	V	1.2	225	26.4	40.0	-13.6
67.7	V	1.2	225	25.9	40.0	-14.1
94.9	V	1.1	270	33.7	40.0	-6.3
122.1	V	1.1	225	25.5	40.0	-14.5
149.2	V	1.1	270	31.4	40.0	-8.6
176.3	V	1/1	270	29.6	40.0	-10.4

(1) Per 15.225(a): The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter (84dBuV/m) at 30 meters.

(2) Per 15.225(d): The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in 15.209.

(3) The distance factor 19.1dB was applied to the this testing value as the measurement was adjusted from 30m to 10m distance in order to obtain the significant reading per 15.31(f).

For reference only:

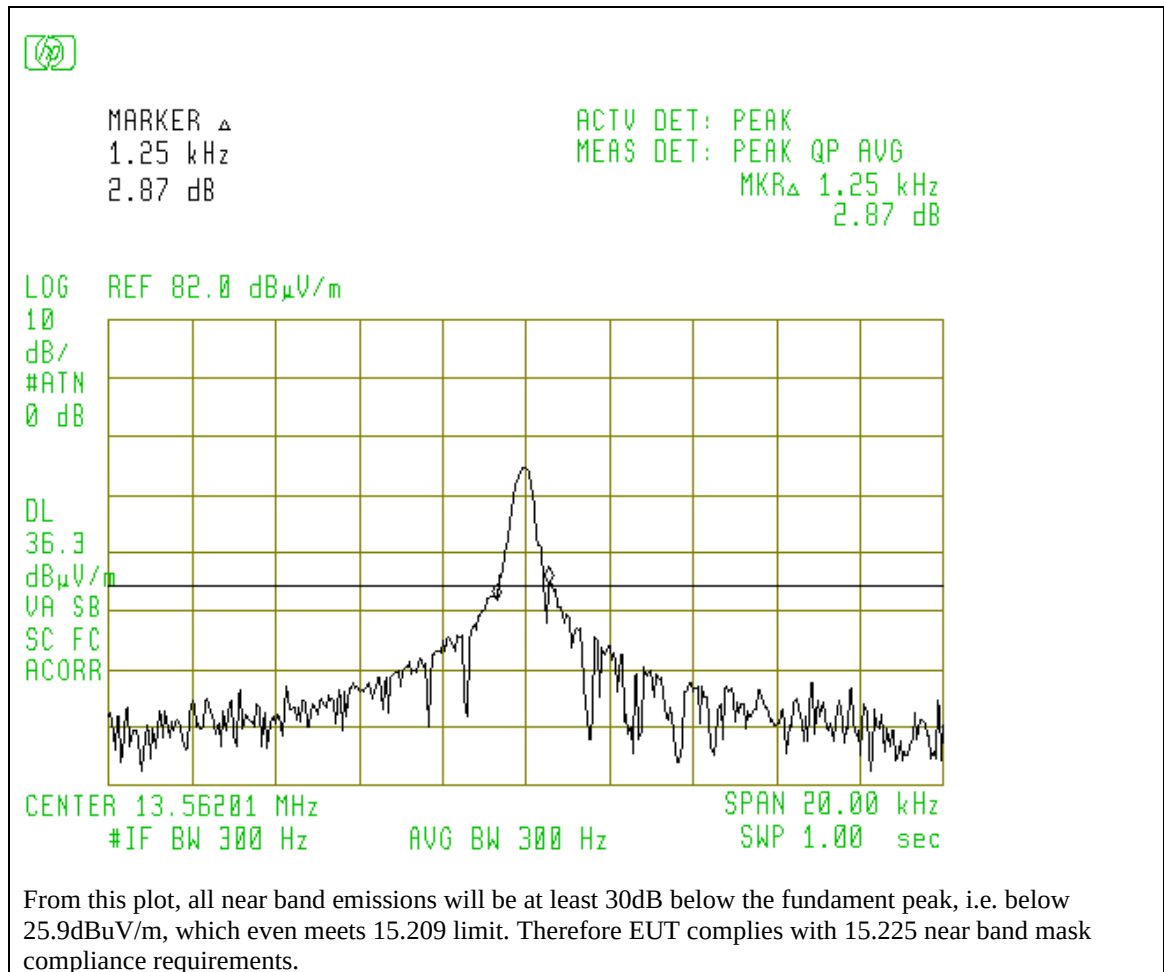
Spurious Radiated Emissions from Digital Circuitry (RF off) complies with FCC Part 15.109 (Class A), measured per ANSI C63.4 with standard setup.

Freq.* (MHz)	H,V	SA QP Reading (dBuV/m)	Height (m)	Angle (degree)	Refer to Part 15.209 10m Limit (dBuV/m)	Margin (dB)	Result
42.8	H	29.1	1.5	180	40.0	-10.9	Pass
104.1	H	30.7	1.5	180	40.0	-9.3	Pass
220.0	H	31.2	1.1	180	46.0	-14.8	Pass
260.0	H	28.8	1.1	135	46.0	-17.2	Pass
400.0	H	36.4	1.1	135	46.0	-9.6	Pass
1050.0	H	40.8	1.1	180	49.5	-8.7	Pass
1150.0	H	37.2	1.1	180	49.5	-12.3	Pass
1500.0	H	36.7	1.1	135	49.5	-12.8	Pass
30.4	V	32.2	1.1	000	40.0	-7.8	Pass
112.0	V	27.5	1.1	000	40.0	-12.5	Pass
158.8	V	32.0	1.1	000	40.0	-8	Pass
184.2	V	32.8	1.1	000	40.0	-7.2	Pass
350.0	V	28.9	1.1	000	46.0	-17.1	Pass
500.0	V	38.8	1.1	000	46.0	-7.2	Pass
1050.0	V	39.0	1.1	315	49.5	-10.5	Pass
1150.0	V	35.8	1.1	315	49.5	-13.7	Pass
1500.0	V	32.4	1.1	315	49.5	-17.1	Pass

*Quasi-peak reading. For emissions that have peak values close to (or over) the specification limit (if any) will be also measured in the quasi-peak or average mode to determine the compliance.

6.4 Occupied Bandwidth

Bandwidth is determined at the points 20dB down from the modulated carrier. Figure 6.1 shows the occupied bandwidth plot.



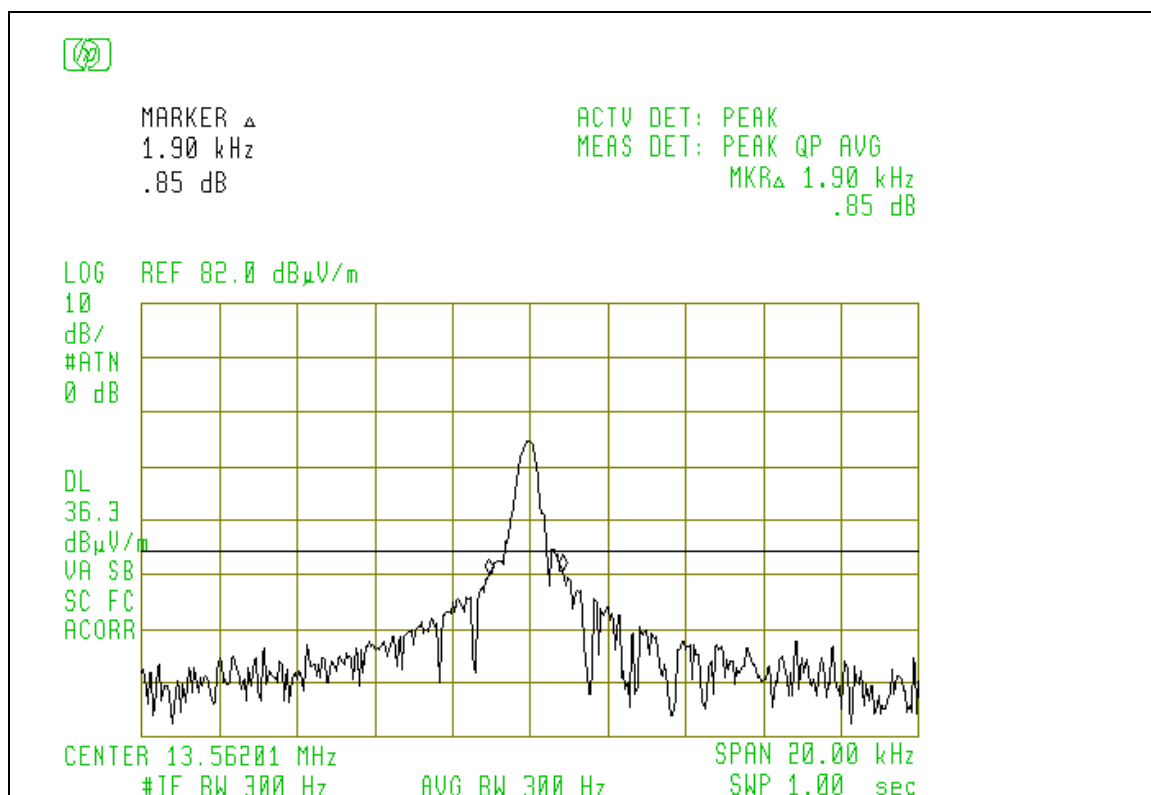


Figure 6.1 Occupied Bandwidth

7. FREQUENCY TOLERANCE

Name of Test:	<i>Frequency Tolerance</i>	Test Standard:	15.225
Tested By:	WEI LI	Test Date:	February 2, 2024

Minimum Standard:	Para 15.225(e) The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% 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.
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Method of Measurement:	Frequency Stability With Voltage Variation: The E.U.T. is placed in an environmental chamber and allowed to stabilize at +20 degrees Celsius for at least 15 minutes. Set SA resolution bandwidth low enough (30Hz) to obtain the desired frequency resolution. (Using frequency counter method: The frequency counter and signal generator are phase locked with the same 10 MHz reference frequency by connecting the 10 MHz ref. out of the counter to the 10MHz ref, in of the signal generator). With the voltage input to the E.U.T. set to 85% S.T.V., the frequency is measured in 30 second intervals for a period of 5 minutes. This procedure is repeated at 100% S.T.V. and 115% S.T.V.
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Frequency Stability With Temperature Variation:

The input voltage to the E.U.T. is set to S.T.V. and the temperature of the environmental chamber is varied from -20 degrees C to +50 degrees C. The E.U.T. is allowed to stabilize at each temperature and the frequency is measured in 30 second intervals for a period of 5 minutes.

Test Result:

Complies

Test Data:

See Attached Table(s)

- temperature variation: -20°C to +50°C
- voltage variation 7.2 Vdc
- frequency tolerance: +/- 135.6Hz (+/- 0.01%)

Frequency Stability versus Environmental Temperature

Reference Frequency @ 7.2Vdc & +20°C		
Temperature & Direction (°C)	Frequency (MHz)	Deviation (Hz)
-20	13.5619243	+6.4
+20	13.5619179	-
+50	13.5619053	-12.6

8. MAXIMUM PERMISSIBLE EXPOSURE

Name of Test:	<i>Radio Frequency Exposure</i>	Test Standard:	<i>FCC OET Bulletin 65 & RSS-GEN& RSS-102</i>
Tested By:	WEI LI	Test Date:	08/27/2019-10/01/2019

Minimum Standard: For FCC, per Public Exposure to Radio Frequency Energy Levels (1.1307 (b)(1)) Limits:

From §1.1310 Table 1 (B), for Public $S = 1.0 \text{ mW/cm}^2$;
for Professional, $S = 5.0 \text{ mW/cm}^2$.

For IC: per RSS-102, Sec. 2.5.2, Exemption Limits for Routine Evaluation, below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance).

Method of Measurement:

$$d = 0.282 * 10^{((P + G) / 20) / \sqrt{S}}$$

Equation (1)

$$S = 0.0795 * 10^{((P + G) / 10) / d^2}$$

Equation (2)

where

d = MPE distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW/cm^2

Equation (1) and the measured peak power is used to calculate the MPE distance.

Equation (2) and the measured peak power is used to calculate the Power density.

Test Result:

For NFC Transmitter:

1-mW Test Exemption:

Per § 1.1307(b)(3)(i)(A), a single RF source is exempt RF device (from the requirement to show data demonstrating compliance to RF exposure limits, as previously mentioned) if the available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption applies to all operating configurations and exposure conditions, for the frequency range 100 kHz to 100 GHz, regardless of fixed, mobile, or portable device exposure conditions.

For this EUT, max emission level is under the 1-mW (0dBm or 95.2dBuV/3m) limit base on measurement result. No RF hazard need to be concerned.