FCC Test Report

FCC ID	:	**UZ7HFDOCK**
Equipment	:	**EMA DOCK NFC READER BOARD**
Brand Name	:	**ZEBRA**
Model Name	:	**HFDOCK**
Applicant/ Manufacturer	:	**Zebra Technologies Corporation 1 Zebra Plaza, Holtsville, NY 11742**
Standard	:	**47 CFR FCC Part 15.225**

The product was received on Oct. 31, 2019, and testing was started from Dec. 06, 2019 and completed on Dec. 11, 2019. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013 and shown compliance with the applicable technical standards.

The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of United States government.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Approved by: Allen Lin

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory

No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

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History of this test report

Report No.	Version	Description	Issued Date
FR9O3018AR	01	Initial issue of report	Dec. 16, 2019

Summary of Test Result

Report Clause	Ref. Std. Clause	Test Items	Result (PASS/FAIL)	Remark
1.1.2	15.203	Antenna Requirement	PASS	FCC 15.203
3.1	15.207	AC Power-line Conducted Emissions	PASS	FCC 15.207
3.2	15.215(c)	Emission Bandwidth	PASS	Fall in band $F_L \geq 13.553$ MHz $F_H \leq 13.567$ MHz
3.3	15.225(a)~(d)	Field Strength of Fundamental Emissions and Spectrum Mask	PASS	124 dBuV/m at 3m
3.4	15.225(d)	Transmitter Radiated Unwanted Emissions	PASS	FCC 15.209
3.5	15.225(e)	Frequency Stability	PASS	± 0.01% (100ppm)

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:
None

Reviewed by: Sam Tsai

Report Producer: Kate Lo

1 General Description

1.1 Information

1.1.1 RF General Information

RF General Information				
Frequency Range	**Modulation Mode**	**Ch. Frequency (MHz)**	**Channel Number**	**Field Strength (dBuV/m)**
13.553 – 13.567 MHz	ISO 15693 (ASK)	13.56	1	78.37
Note 1: Field strength performed peak level at 3m.				

1.1.2 Antenna Information

Antenna Category	
☐	Equipment placed on the market without antennas
☒	Integral antenna (antenna permanently attached)
	☐ Temporary RF connector provided
	☒ No temporary RF connector provided Transmit chains bypass antenna and soldered temporary RF connector provided for connected measurement. In case of conducted measurements the transmitter shall be connected to the measuring equipment via a suitable attenuator and correct for all losses in the RF path.
☐	External antenna (dedicated antennas)

Antenna General Information		
No.	**Ant. Cat.**	**Ant. Type**
1	Integral	Loop

1.1.3 EUT Information

Operational Condition		
EUT Power Type	From DC Power supply	
Type of EUT		
☒	Stand-alone	
☐	Combined (EUT where the radio part is fully integrated within another device)	
	Combined Equipment - Brand Name / Model No.:	
☐	Plug-in radio (EUT intended for a variety of host systems)	
	Host System - Brand Name / Model No.:	
☐	Other:	

1.1.4 Test Signal Duty Cycle

Duty Cycle Operation Restriction			
The transmitter is used for		The transmitter is operated	
☒	Inductive applications	☒	Automatically triggered
☐	Duty cycle fixed mode	☒	Duty cycle random mode
☐	**Duty cycle mode - NFC-A (ISO 14443-3A)**		
Declare transmitter duty cycle / 1 hour =		100%	
☐	**Duty cycle mode - NFC-B (ISO 14443-3B)**		
Declare transmitter duty cycle / 1 hour =		100%	
☐	**Duty cycle mode - NFC-F (ISO 18092)**		
Declare transmitter duty cycle / 1 hour =		100%	
☒	**Duty cycle mode - NFC-V (ISO 15693)**		
Declare transmitter duty cycle / 1 hour =		100%	

1.2 Testing Applied Standards

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

- 47 CFR FCC Part 15
- ANSI C63.10-2013
- KDB 174176 D01 v01r01

1.3 Testing Location Information

Testing Location			
☒	HWA YA	ADD : No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)	
		TEL : 886-3-327-3456	FAX : 886-3-327-0973
Test site Designation No. TW1190 with FCC.			

Test Condition	Test Site No.	Test Engineer	Test Environment	Test Date
AC Conduction	CO04-HY	Edward	20.1~21.3°C / 62%~66%	11/Dec/2019
RF Conducted	TH06-HY	Raven	22.5~23.7°C / 58~64%	06/Dec/2019
Radiated Emission	03CH03-HY	Justin	16.2~19.1°C / 53.7~56.8%	07/Dec/2019

1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Test Items	Uncertainty	Remark
Conducted Emission (150kHz ~ 30MHz)	3.54 dB	Confidence levels of 95%
Radiated Emission (9kHz ~ 30MHz)	1.6 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	4.3 dB	Confidence levels of 95%
Conducted Emission	1.3 dB	Confidence levels of 95%
Temperature	0.7 °C	Confidence levels of 95%
Humidity	4 %	Confidence levels of 95%

2 Test Configuration of EUT

2.1 Test Condition

Condition Item	Abbreviation/Remark	Remark
Frequency Stability	Tnom	20°C
-	Tmin	-20°C
-	Tmax	50°C
-	Vnom	12V
-	Vmin	10.8V
-	Vmax	13.5V

2.2 The Worst Case Modulation Configuration

Modulation Used for Conformance Testing	
Modulation Mode	**Field Strength (dBuV/m at 3 m)**
NFC	78.37

2.3 Test Channel Frequencies Configuration

Modulation Mode	Test Channel Frequencies (MHz)
NFC	13.56

2.4 The Worst Case Measurement Configuration

The Worst Case Mode for Following Conformance Tests	
Tests Item	AC power-line conducted emissions
Condition	AC power-line conducted measurement for line and neutral Test Voltage: 120Vac / 60Hz
Operating Mode	DC Power Supply mode

The Worst Case Mode for Following Conformance Tests	
Tests Item	Emission Bandwidth, Frequency Stability
Test Condition	Conducted measurement

The Worst Case Mode for Following Conformance Tests			
Tests Item	Field Strength of Fundamental Emissions Spectrum Mask, Transmitter Radiated Unwanted Emissions		
Test Condition	Radiated measurement		
Operating Mode	DC Power Supply mode		
Orthogonal Planes of EUT	**X Plane**	**Y Plane**	**Z Plane**
			
Worst Planes of EUT		V	

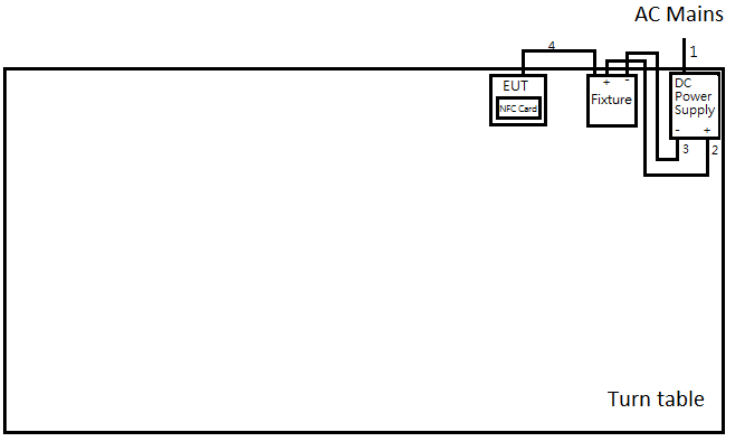
2.5 Support Equipment

Support Equipment - RF Conducted			
No.	**Equipment**	**Brand Name**	**Model Name**
1	DC Power Source	GW	APS-9102
2	EMA DOCKING STATION CONTROLLER BOARD	HannStar	K MV-4 E89382 94V-0
3	EMA_DM_NFC_READER_CABLE	ZEBRA	1414-0CTY000

Support Equipment - AC Conduction and Radiated			
No.	**Equipment**	**Brand Name**	**Model Name**
1	DC power supply	GW	GPS-3030DD
2	EMA DOCKING STATION CONTROLLER BOARD	HannStar	K MV-4 E89382 94V-0
3	EMA_DM_NFC_READER_CABLE	ZEBRA	1414-0CTY000

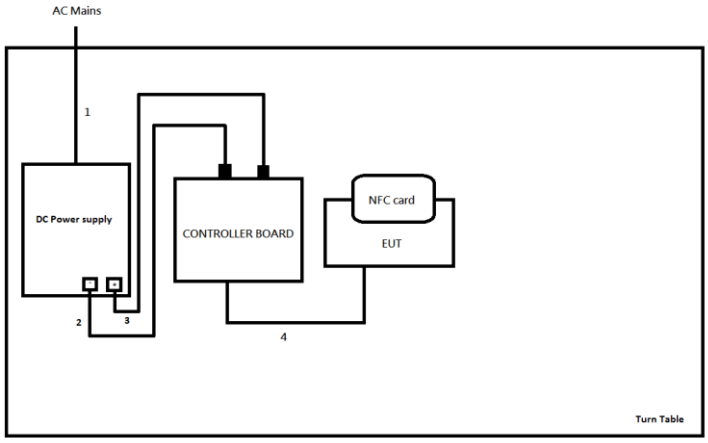
2.6 Test Setup Diagram

Test Setup Diagram – AC Line Conducted Emission Test



Item	Connection	Shielded	Length(m)	Remark
1	AC Power Cable	No	1.8	-
2	DC Power Cable	No	1.0	-
3	DC Power Cable	No	1.	-
4	EMA_DM_NFC_READER_CABLE	No	0.3	-

Test Setup Diagram - Radiated Test



Item	Connection	Shielded	Length(m)	Remark
1	AC power cable	No	1.8	-
2	DC power cable	No	1	-
3	DC power cable	No	1	-
4	EMA_DM_NFC_READER_CABLE	No	0.3	-

3 Transmitter Test Result

3.1 AC Power-line Conducted Emissions

3.1.1 AC Power-line Conducted Emissions Limit

AC Power-line Conducted Emissions Limit		
Frequency Emission (MHz)	**Quasi-Peak**	**Average**
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50
Note 1: * Decreases with the logarithm of the frequency.		

3.1.2 Measuring Instruments

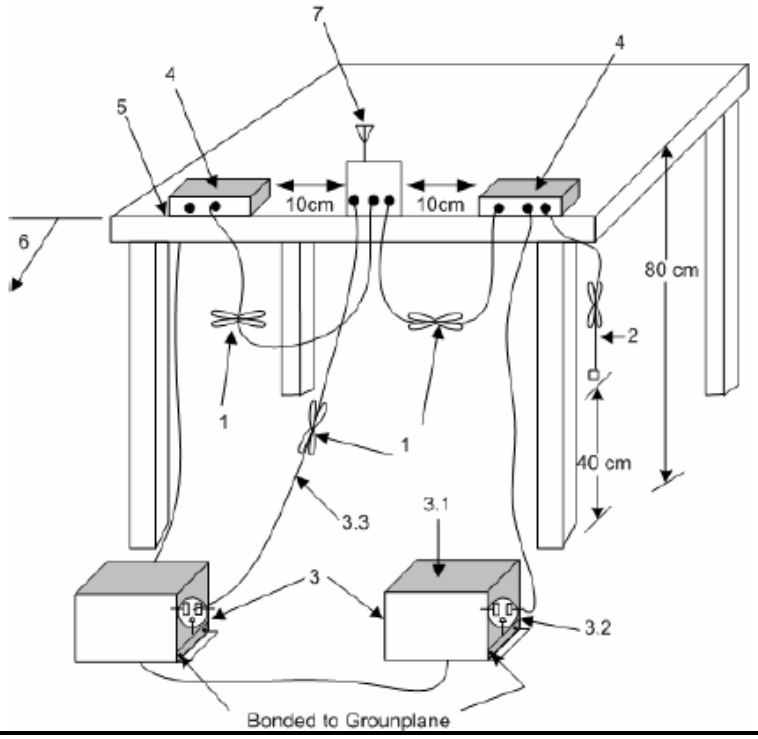
Refer a test equipment and calibration data table in this test report.

3.1.3 Test Procedures

Test Method	
☒	Refer as ANSI C63.10-2013, clause 6.2 for AC power-line conducted emissions.
☒	If AC conducted emissions fall in operating band, then following below test method confirm final result.
☐	Accept measurements done with a suitable dummy load replacing the antenna under the following conditions: (1) Perform the AC line conducted tests with the antenna connected to determine compliance with FCC 15.207 limits outside the transmitter's fundamental emission band; (2) Retest with a dummy load to determine compliance with FCC 15.207 limits within the transmitter's fundamental emission band.
☒	For a device with a permanent antenna operating at or below 30 MHz, accept measurements done with a suitable dummy load, in lieu of the permanent antenna under the following conditions: (1) Perform the AC line conducted tests with the permanent antenna to determine compliance with the FCC 15.207 limits outside the transmitter's fundamental emission band; (2) Retest with a dummy load in lieu of the permanent antenna to determine compliance with the FCC 15.207 limits within the transmitter's fundamental emission band.

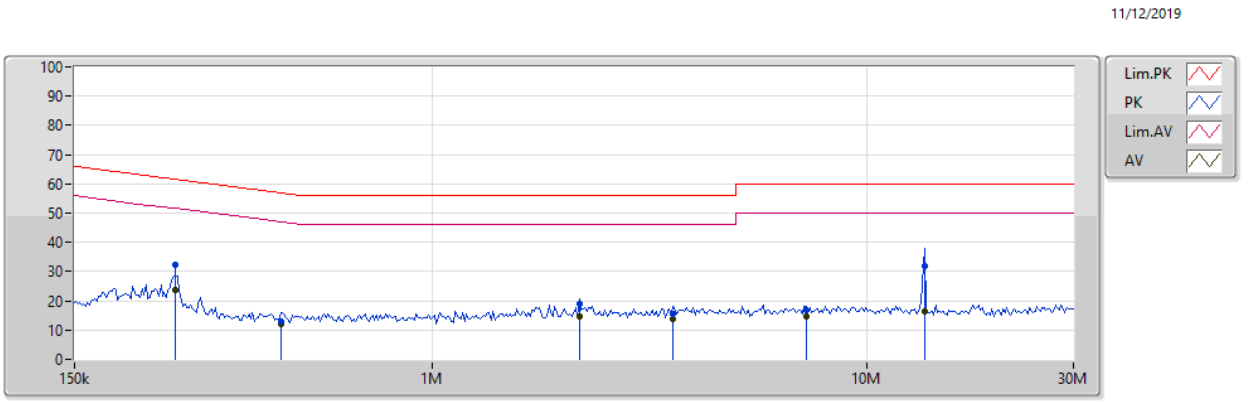
3.1.4 Test Setup

AC Power-line Conducted Emissions



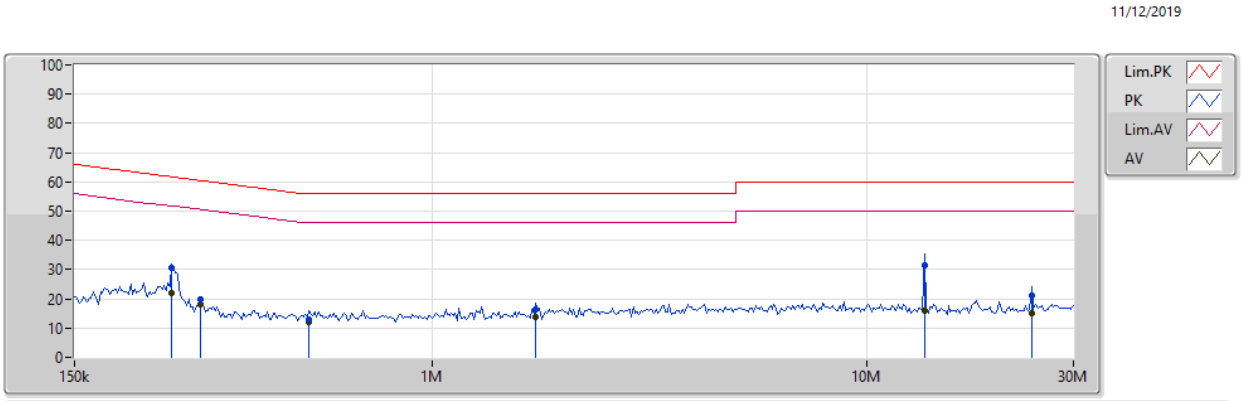
3.1.5 Test Result of AC Power-line Conducted Emissions

AC Power-line Conducted Emissions Result			
Operating Mode	1	**Power Phase**	Neutral
Operating Function	DC Power Supply mode		



Type	Freq	Level	Limit	Margin	Factor	Condition	Comment	Raw	LISN	CL	AT
	(Hz)	(dBuV)	(dBuV)	(dB)	(dB)			(dBuV)	(dB)	(dB)	(dB)
QP	256.712k	32.39	61.54	-29.15	19.63	Neutral	-	12.76	9.64	0.12	9.87
AV	256.712k	23.77	51.54	-27.77	19.63	Neutral	"Worst"	4.14	9.64	0.12	9.87
QP	448.17k	12.87	56.92	-44.05	19.63	Neutral	-	-6.76	9.63	0.13	9.87
AV	448.17k	12.14	46.92	-34.78	19.63	Neutral	-	-7.49	9.63	0.13	9.87
QP	2.18M	19.16	56.00	-36.84	19.67	Neutral	-	-0.51	9.65	0.15	9.87
AV	2.18M	14.85	46.00	-31.15	19.67	Neutral	-	-4.82	9.65	0.15	9.87
QP	3.586M	15.57	56.00	-40.43	19.72	Neutral	-	-4.15	9.66	0.18	9.88
AV	3.586M	13.76	46.00	-32.24	19.72	Neutral	-	-5.96	9.66	0.18	9.88
QP	7.268M	16.61	60.00	-43.39	19.81	Neutral	-	-3.20	9.69	0.24	9.88
AV	7.268M	14.59	50.00	-35.41	19.81	Neutral	-	-5.22	9.69	0.24	9.88
QP	13.604M	31.91	60.00	-28.09	19.89	Neutral	-	12.02	9.71	0.30	9.88
AV	13.604M	16.34	50.00	-33.66	19.89	Neutral	-	-3.55	9.71	0.30	9.88

AC Power-line Conducted Emissions Result			
Operating Mode	1	**Power Phase**	Line
Operating Function	DC Power Supply mode		



Type	Freq	Level	Limit	Margin	Factor	Condition	Comment	Raw	LISN	CL	AT
	(Hz)	(dBuV)	(dBuV)	(dB)	(dB)			(dBuV)	(dB)	(dB)	(dB)
QP	251.653k	30.42	61.70	-31.28	19.64	Line	-	10.78	9.65	0.12	9.87
AV	251.653k	22.11	51.70	-29.59	19.64	Line	-	2.47	9.65	0.12	9.87
QP	292.162k	19.67	60.46	-40.79	19.63	Line	-	0.04	9.64	0.12	9.87
AV	292.162k	17.90	50.46	-32.56	19.63	Line	-	-1.73	9.64	0.12	9.87
QP	520.311k	13.06	56.00	-42.94	19.64	Line	-	-6.58	9.64	0.13	9.87
AV	520.311k	12.11	46.00	-33.89	19.64	Line	-	-7.53	9.64	0.13	9.87
QP	1.734M	16.55	56.00	-39.45	19.66	Line	-	-3.11	9.65	0.14	9.87
AV	1.734M	13.76	46.00	-32.24	19.66	Line	-	-5.90	9.65	0.14	9.87
QP	13.604M	31.67	60.00	-28.33	19.85	Line	"Worst"	11.82	9.67	0.30	9.88
AV	13.604M	15.86	50.00	-34.14	19.85	Line	-	-3.99	9.67	0.30	9.88
QP	23.988M	21.30	60.00	-38.70	19.86	Line	-	1.44	9.58	0.40	9.88
AV	23.988M	15.20	50.00	-34.80	19.86	Line	-	-4.66	9.58	0.40	9.88

3.2 Emission Bandwidth

3.2.1 Emission Bandwidth Limit

20dB Bandwidth Limit
☒ Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emissions in the specific band (13.553 – 13.567 MHz).

3.2.2 Measuring Instruments

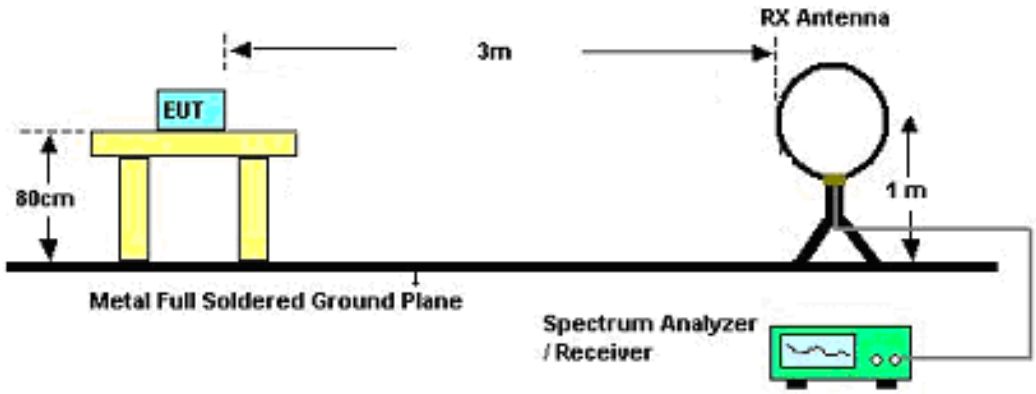
Refer a test equipment and calibration data table in this test report.

3.2.3 Test Procedures

Test Method
☒ For the emission bandwidth refer ANSI C63.10, clause 6.9.1 for occupied bandwidth testing.
☒ For radiated measurement. Loop antenna was rotated about the horizontal and vertical axis and the equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted field strength level.

3.2.4 Test Setup

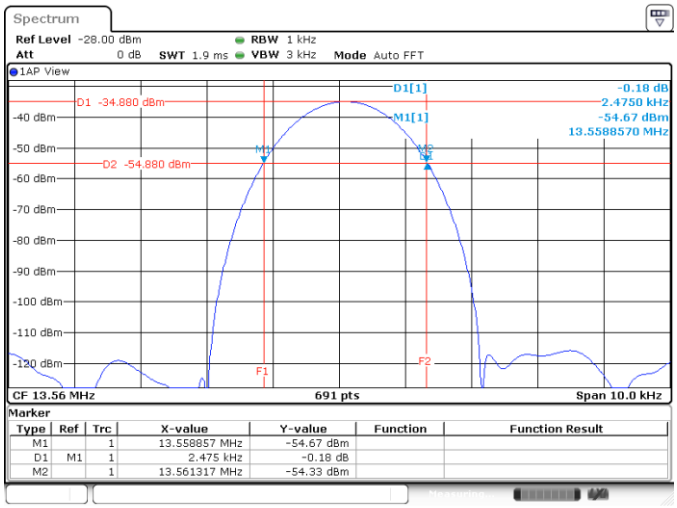
Emission Bandwidth



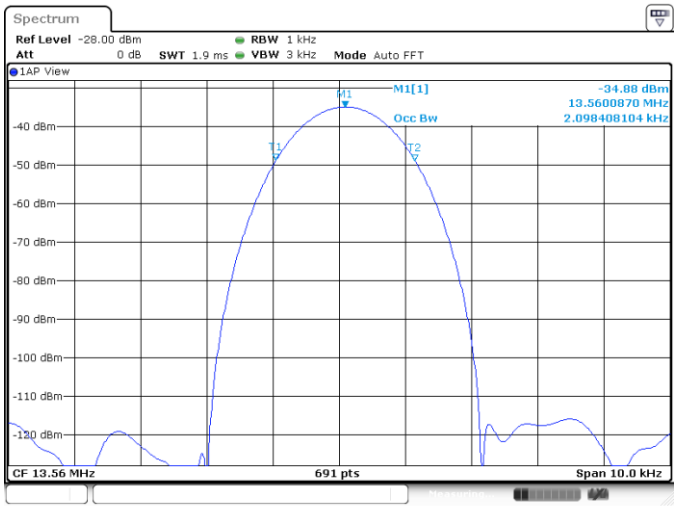
3.2.5 Test Result of Emission Bandwidth

Occupied Channel Bandwidth Result					
Modulation Mode	Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)	F_L at 20dB BW (MHz)	F_H at 20dB BW (MHz)
NFC	13.56	2.475	2.098	13.559	13.561
Limit		**N/A**	**N/A**	**13.553**	**13.567**
Result		**Complied**			

Emission Bandwidth Plot - 20dB Bandwidth



Emission Bandwidth Plot - 99% Bandwidth



3.3 Field Strength of Fundamental Emissions and Spectrum Mask

3.3.1 Field Strength of Fundamental Emissions and Spectrum Mask Limit

Field Strength of Fundamental Emissions For FCC					
Emissions	**(uV/m)@30m**	**(dBuV/m)@30m**	**(dBuV/m)@10m**	**(dBuV/m)@3m**	**(dBuV/m)@1m**
fundamental	15848	84.0	103.1	124.0	143.1
Quasi peak measurement of the fundamental.					

Spectrum Mask For FCC					
Freq. of Emission (MHz)	**(uV/m)@30m**	**(dBuV/m)@30m**	**(dBuV/m)@10m**	**(dBuV/m)@3m**	**(dBuV/m)@1m**
1.705~13.110	30	29.5	48.6	69.5	88.6
13.110~13.410	106	40.5	59.6	80.5	99.6
13.410~13.553	334	50.5	69.6	90.5	109.6
13.553~13.567	15848	84.0	103.1	124.0	143.1
13.567~13.710	334	50.5	69.6	90.5	109.6
13.710~14.010	106	40.5	59.6	80.5	99.6
14.010~30.000	30	29.5	48.6	69.5	88.6

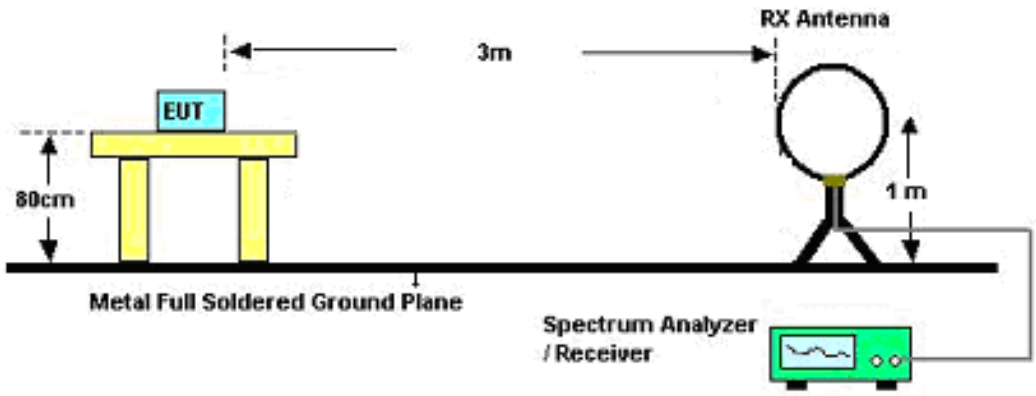
3.3.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.3.3 Test Procedures

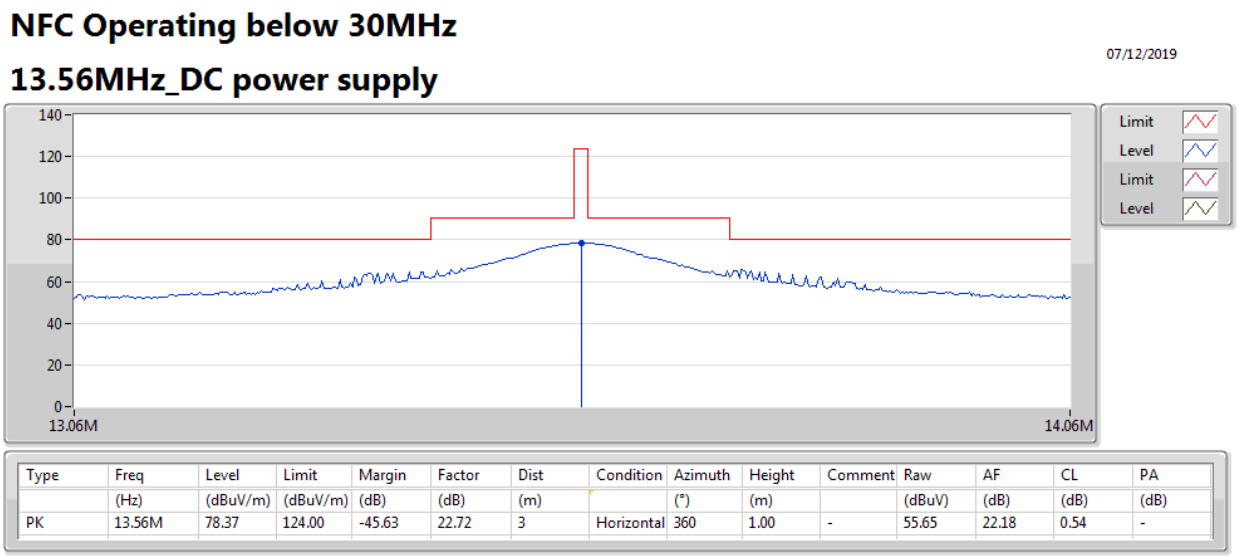
Test Method	
☒	Refer as ANSI C63.10, clause 6.4 for radiated emissions from below 30 MHz and test distance is 3m.
☒	At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the requirements; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be following below methods.
☐	The results shall be extrapolated to the specified distance by making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor.
☒	The results shall be by using the square of an inverse linear distance extrapolation factor (40 dB/decade).
☒	For radiated measurement. Loop antenna was rotated about the horizontal and vertical axis and the equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted field strength level.

3.3.4 Test Setup

Field Strength of Fundamental Emissions and Spectrum Mask


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

Field Strength of Fundamental Emissions Result					
Modulation Mode	**Frequency (MHz)**	**Fundamental (dBuV/m)@3m**	**Polarization**	**Margin (dB)**	**Limit (dBuV/m)@3m**
NFC	13.56	78.37	H	-45.63	124.00
Result		**Complied**			
Note 1: Measurement worst emissions of receive antenna polarization: H(Horizontal).					

Spectrum Mask Plot


Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV)	(dB)	(dB)	(dB)
PK	13.56M	78.37	124.00	-45.63	22.72	3	Horizontal	360	1.00	-	55.65	22.18	0.54	-

3.4 Transmitter Radiated Unwanted Emissions

3.4.1 Transmitter Radiated Unwanted Emissions Limit

Transmitter Radiated Unwanted Emissions Limit			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.

3.4.2 Measuring Instruments

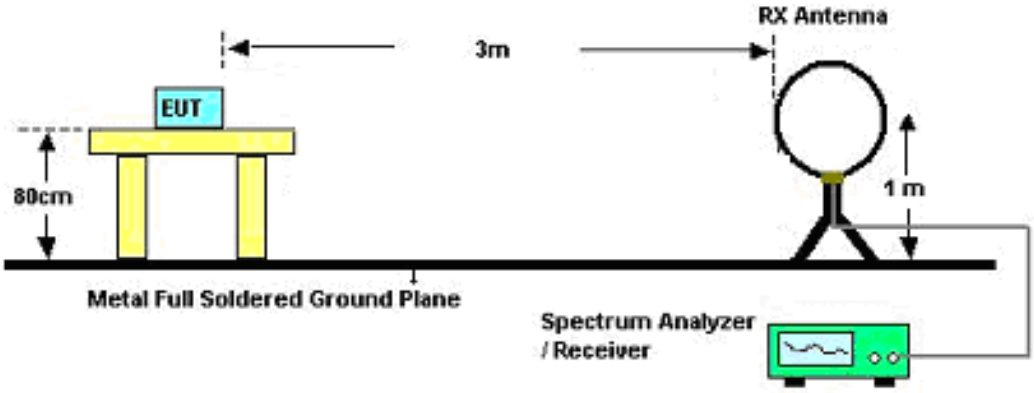
Refer a test equipment and calibration data table in this test report.

3.4.3 Test Procedures

Test Method	
☒	Refer as ANSI C63.10, clause 6.5 for radiated emissions from 30 MHz to 1 GHz and test distance is 3m.
☒	Refer as ANSI C63.10, clause 6.4 for radiated emissions from below 30 MHz and test distance is 3m.
☒	At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the requirements; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be following below methods.
☐	The results shall be extrapolated to the specified distance by making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor.
☒	The results shall be by using the square of an inverse linear distance extrapolation factor (40 dB/decade).
☒	For radiated measurement. Loop antenna was rotated about the horizontal and vertical axis and the equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted field strength level.
☒	The any unwanted emissions level shall not exceed the fundamental emission level.
☒	All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

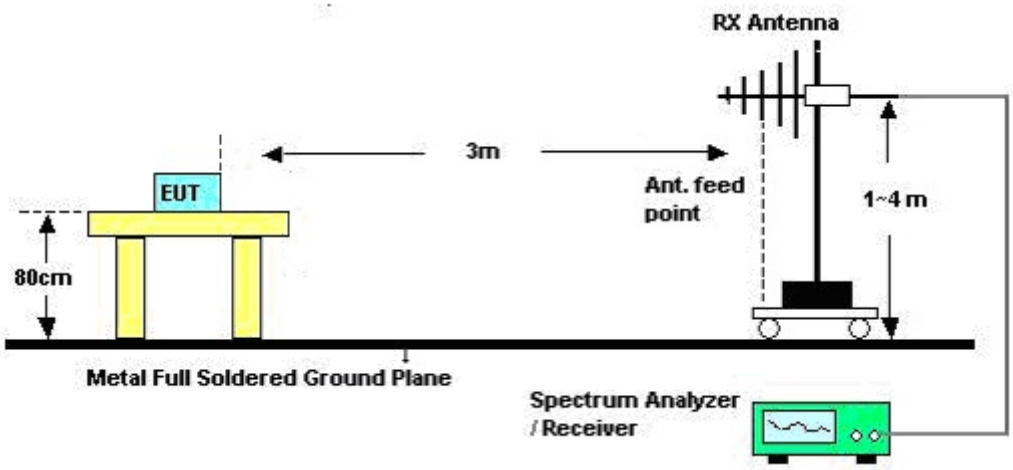
3.4.4 Test Setup

Transmitter Radiated Unwanted Emissions



Magnetic field tests shall be performed in the frequency range of 9 kHz to 30 MHz using a calibrated loop antenna. The center of the loop shall be 1 m above the ground.

Transmitter Radiated Bandedge Emissions



Electric field tests shall be performed in the frequency range of 30 MHz to 1000 MHz using a calibrated bi-log antenna. the antenna height shall be varied from 1 m to 4 m.

3.4.5 Transmitter Radiated Unwanted Emissions (Below 30MHz)

Summary

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Azimuth (°)	Height (m)	Comments
13.553-13.567MHz	-	-	-	-	-	-	-	-	-	-	-
NFC	Pass	PK	3.493M	35.95	69.50	-33.55	20.40	3	0	1.00	-

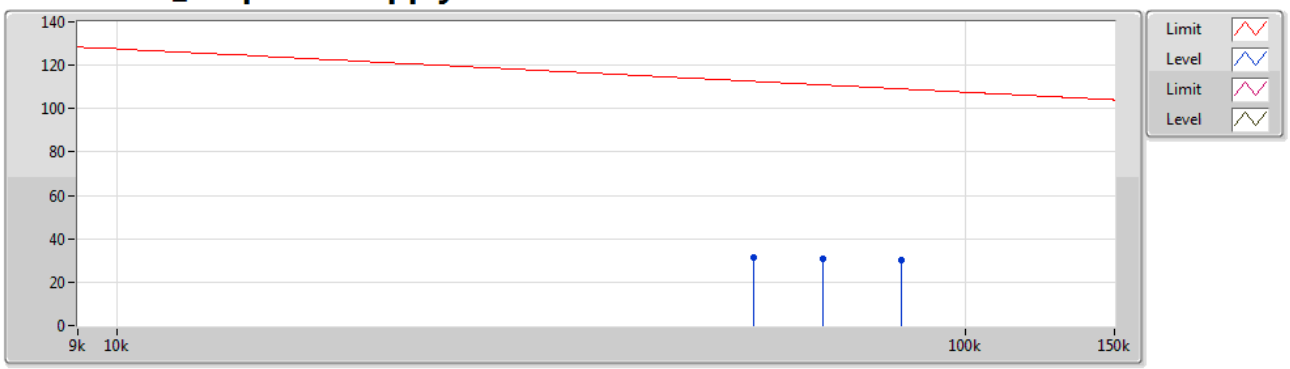
Result

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Azimuth (°)	Height (m)	Comments
NFC	-	-	-	-	-	-	-	-	-	-	-
13.56MHz_DC power supply	Pass	PK	56.376k	31.18	112.57	-81.39	20.47	3	360	1.00	-
13.56MHz_DC power supply	Pass	PK	67.938k	30.87	110.95	-80.08	20.29	3	360	1.00	-
13.56MHz_DC power supply	Pass	PK	84.012k	30.31	109.11	-78.80	20.04	3	360	1.00	-
13.56MHz_DC power supply	Pass	PK	3.016M	34.45	69.50	-35.05	20.31	3	0	1.00	-
13.56MHz_DC power supply	Pass	PK	3.493M	35.95	69.50	-33.55	20.40	3	0	1.00	-
13.56MHz_DC power supply	Pass	PK	5.702M	34.44	69.50	-35.06	20.92	3	0	1.00	-

NFC Operating below 30MHz

07/12/2019

13.56MHz_DC power supply

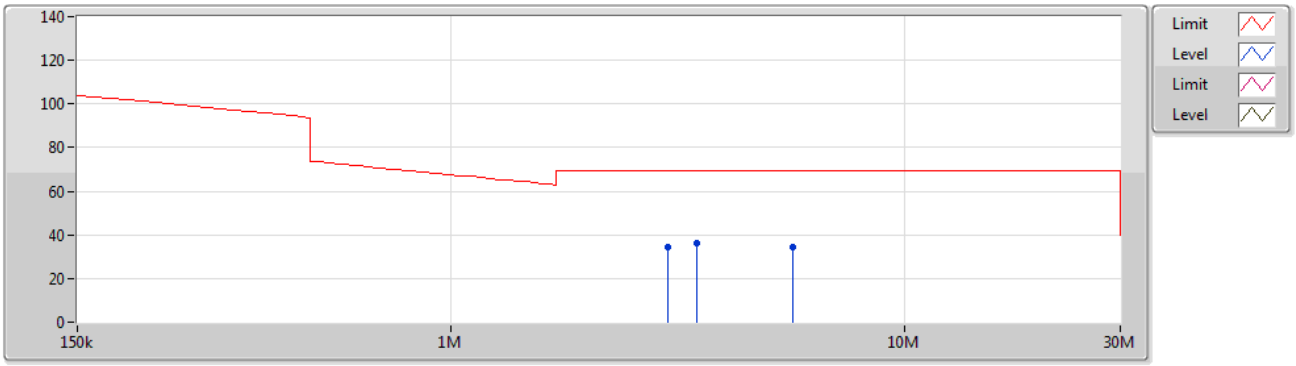


Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV)	(dB)	(dB)	(dB)
PK	56.376k	31.18	112.57	-81.39	20.47	3	Horizontal	360	1.00	-	10.71	20.39	0.08	-
PK	67.938k	30.87	110.95	-80.08	20.29	3	Horizontal	360	1.00	-	10.58	20.21	0.08	-
PK	84.012k	30.31	109.11	-78.80	20.04	3	Horizontal	360	1.00	-	10.27	19.95	0.09	-

NFC Operating below 30MHz

07/12/2019

13.56MHz_DC power supply



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV)	(dB)	(dB)	(dB)
PK	3.016M	34.45	69.50	-35.05	20.31	3	Horizontal	0	1.00	-	14.14	20.10	0.21	-
PK	3.493M	35.95	69.50	-33.55	20.40	3	Horizontal	0	1.00	-	15.55	20.18	0.22	-
PK	5.702M	34.44	69.50	-35.06	20.92	3	Horizontal	0	1.00	-	13.52	20.62	0.30	-

3.4.6 Transmitter Radiated Unwanted Emissions (Above 30MHz)

Summary

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Azimuth (°)	Height (m)	Comments
13.553-13.567MHz	-	-	-	-	-	-	-	-	-	-	-
NFC	Pass	PK	406.36M	42.25	46.00	-3.75	-2.85	3	360	1.00	-

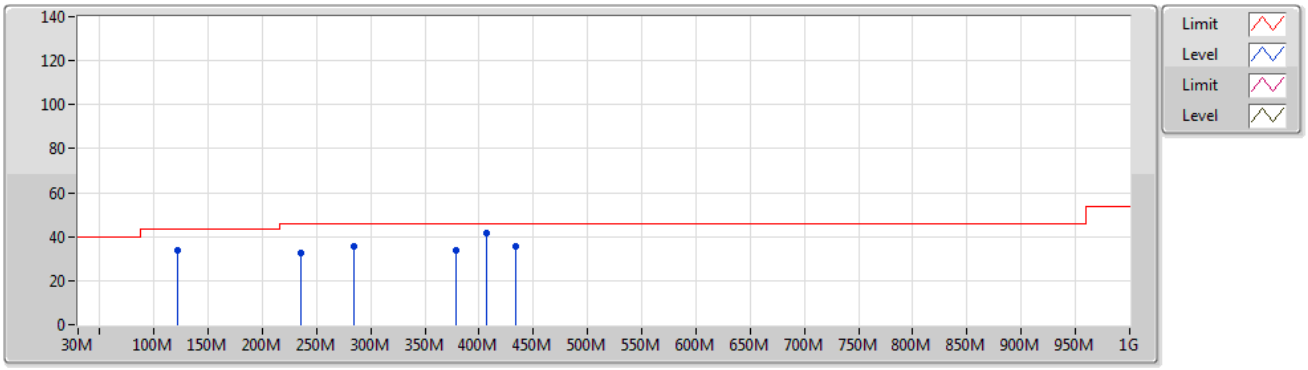
Result

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Factor (dB)	Dist (m)	Azimuth (°)	Height (m)	Comments
NFC	-	-	-	-	-	-	-	-	-	-	-
13.56MHz_DC power supply	Pass	PK	121.18M	33.93	43.50	-9.57	-8.37	3	0	1.00	-
13.56MHz_DC power supply	Pass	PK	235.64M	32.36	46.00	-13.64	-8.47	3	0	1.00	-
13.56MHz_DC power supply	Pass	PK	284.14M	35.73	46.00	-10.27	-6.04	3	0	1.00	-
13.56MHz_DC power supply	Pass	PK	379.2M	34.04	46.00	-11.96	-4.07	3	0	1.00	-
13.56MHz_DC power supply	Pass	PK	406.36M	41.89	46.00	-4.11	-2.85	3	0	1.00	-
13.56MHz_DC power supply	Pass	PK	433.52M	35.53	46.00	-10.47	-2.60	3	0	1.00	-
13.56MHz_DC power supply	Pass	PK	121.18M	35.29	43.50	-8.21	-8.37	3	360	1.00	-
13.56MHz_DC power supply	Pass	PK	233.7M	40.24	46.00	-5.76	-8.73	3	360	1.00	-
13.56MHz_DC power supply	Pass	PK	284.14M	39.95	46.00	-6.05	-6.04	3	360	1.00	-
13.56MHz_DC power supply	Pass	PK	379.2M	41.40	46.00	-4.60	-4.07	3	360	1.00	-
13.56MHz_DC power supply	Pass	PK	406.36M	42.25	46.00	-3.75	-2.85	3	360	1.00	-
13.56MHz_DC power supply	Pass	PK	433.52M	40.16	46.00	-5.84	-2.60	3	360	1.00	-

NFC Operating above 30MHz

07/12/2019

13.56MHz_DC power supply

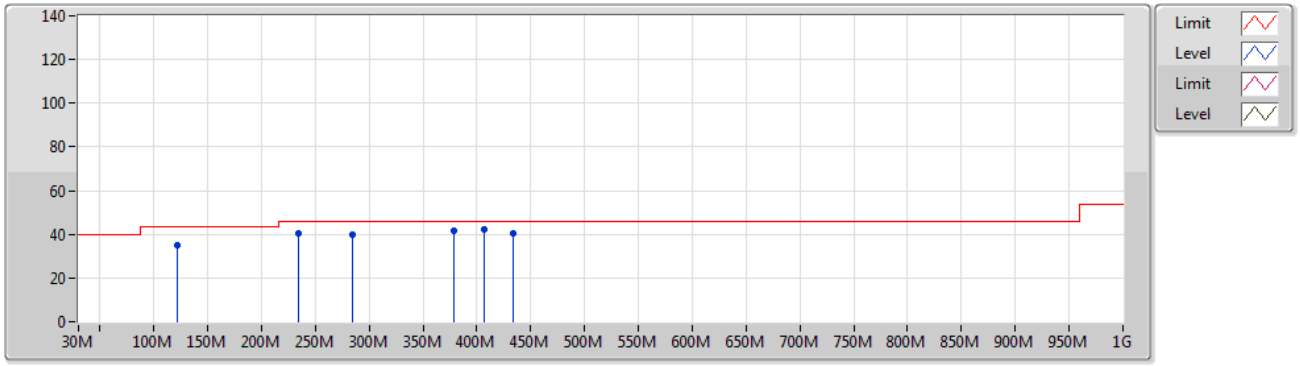


Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV)	(dB)	(dB)	(dB)
PK	121.18M	33.93	43.50	-9.57	-8.37	3	Vertical	0	1.00	-	42.30	17.25	1.69	27.31
PK	235.64M	32.36	46.00	-13.64	-8.47	3	Vertical	0	1.00	-	40.83	15.93	2.40	26.80
PK	284.14M	35.73	46.00	-10.27	-6.04	3	Vertical	0	1.00	-	41.77	18.02	2.66	26.72
PK	379.2M	34.04	46.00	-11.96	-4.07	3	Vertical	0	1.00	-	38.11	19.99	3.10	27.16
PK	406.36M	41.89	46.00	-4.11	-2.85	3	Vertical	0	1.00	-	44.74	21.28	3.21	27.34
PK	433.52M	35.53	46.00	-10.47	-2.60	3	Vertical	0	1.00	-	38.13	21.65	3.32	27.57

NFC Operating above 30MHz

07/12/2019

13.56MHz_DC power supply



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV)	(dB)	(dB)	(dB)
PK	121.18M	35.29	43.50	-8.21	-8.37	3	Horizontal	360	1.00	-	43.66	17.25	1.69	27.31
PK	233.7M	40.24	46.00	-5.76	-8.73	3	Horizontal	360	1.00	-	48.97	15.69	2.39	26.81
PK	284.14M	39.95	46.00	-6.05	-6.04	3	Horizontal	360	1.00	-	45.99	18.02	2.66	26.72
PK	379.2M	41.40	46.00	-4.60	-4.07	3	Horizontal	360	1.00	-	45.47	19.99	3.10	27.16
PK	406.36M	42.25	46.00	-3.75	-2.85	3	Horizontal	360	1.00	-	45.10	21.28	3.21	27.34
PK	433.52M	40.16	46.00	-5.84	-2.60	3	Horizontal	360	1.00	-	42.76	21.65	3.32	27.57

3.5 Frequency Stability

3.5.1 Frequency Stability Limit

Frequency Stability Limit
☒ Carrier frequency stability shall be maintained to ±0.01% (±100 ppm).

3.5.2 Measuring Instruments

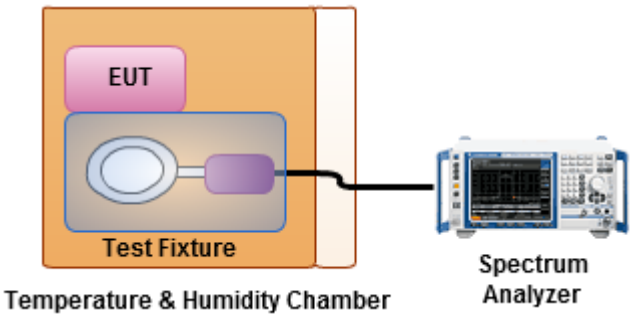
Refer a test equipment and calibration data table in this test report.

3.5.3 Test Procedures

Test Method	
☒	Refer as ANSI C63.10, clause 6.8 for frequency stability tests
	☒ Frequency stability with respect to ambient temperature
	☒ Frequency stability when varying supply voltage
☐	For conducted measurement.
☒	For radiated measurement. The equipment to be measured and the test antenna shall be oriented to obtain the maximum emitted power level.

3.5.4 Test Setup

Frequency Stability



3.5.5 Test Result of Frequency Stability

Frequency Stability Result									
Condition	Ch. Freq. (MHz)	Frequency Stability (ppm)							
		Test Frequency (MHz)				Frequency Stability (ppm)			
		0 min	2 min	5 min	10 min	0 min	2 min	5 min	10 min
$T_{20°C}$Vmax	13.56	13.56004	13.56055	13.55948	13.56016	2.73	40.34	-38.13	11.80
$T_{20°C}$Vmin	13.56	13.55978	13.56007	13.56001	13.56016	-16.22	5.31	0.37	11.43
$T_{50°C}$Vnom	13.56	13.56038	13.56000	13.56044	13.56004	28.10	0.07	32.45	2.73
$T_{40°C}$Vnom	13.56	13.56004	13.56012	13.56024	13.56004	2.73	9.14	17.40	2.95
$T_{30°C}$Vnom	13.56	13.56029	13.56005	13.56054	13.55970	21.53	3.32	39.97	-22.27
$T_{20°C}$Vnom	13.56	13.56009	13.56021	13.55968	13.56002	6.71	15.12	-23.45	1.77
$T_{10°C}$Vnom	13.56	13.55996	13.56003	13.56016	13.56036	-3.24	2.29	11.58	26.62
$T_{0°C}$Vnom	13.56	13.56004	13.55945	13.56001	13.55981	3.02	-40.63	1.03	-14.16
$T_{-10°C}$Vnom	13.56	13.55965	13.56030	13.56051	13.56080	-25.88	22.05	37.76	59.07
$T_{-20°C}$Vnom	13.56	13.55998	13.56004	13.56042	13.56004	-1.77	2.65	31.19	2.88
Limit (ppm)		-				100			
Result		Complied							

Note 1: Measure at 85 % [Vmin] and 115 % [Vmax] of the nominal voltage [Vnom]. The nominal voltage refer test report clause 2.1 for EUT operational condition.
Note 2: Measure maximum deviation frequency at operating frequency at startup and two, five, and ten min.

4 Test Equipment and Calibration Data

Instrument for AC Conduction

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date
EMC Receiver	R&S	ESR3	102052	9kHz~3.6GHz	09/Apr/2019	08/Apr/2020
LISN	R&S	ENV216	101295	9kHz~30MHz	04/Nov/2019	05/Nov/2020
RF Cable-CON	MTJ	RG142	CB002-CO	9kHz~200MHz	12/Sep/2019	11/Sep/2020
AC POWER	APC	AFC-11005G	F310050055	47Hz~63Hz 5~300V	NCR	NCR
Impuls Begrenzer Pulse Limiter	SCHWARZBECK	VTSD 9561-F	9561-F041	9kHz~30MHz	24/Sep/2019	23/Sep/2020

Instrument for Conducted Test

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date
Spectrum Analyzer	R&S	FSV 40	101013	10Hz~40GHz	13/Mar/2019	12/Mar/2020
Loop Antenna	TESEQ	HLA 6120	31244	9kHz~30MHz	15/Mar/2019	14/Mar/2020
Temp. and Humidity Chamber	Giant Force	GTH-225-20-SP-SD	MAA1112-007	-20~100℃	21/May/2019	20/May/2020

Instrument for Radiated Test

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date
3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	30MHz~1GHz 3m	30/ Aug/2019	29/ Aug/2020
3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	1GHz~18GHz 3m	30/ Aug/2019	29/ Aug/2020
Amplifier	HP	8447D	2944A08033	10kHz~1.3GHz	22/Apr/2019	21/Apr/2020
EMI Test Receiver	R&S	ESR3	102052	9kHz~3.6GHz	09/Apr/2019	08/Apr/2020
Bilog Antenna & 5dB Attenuator	SCHAFFNER / MTJ	CBL 6112B / MTJ6102-05	2723 / 2	30MHz~2GHz	11/Oct/2019	10/Oct//2020
Signal Analyzer	R&S	FSP40	100305	9kHz~40GHz; -140-+30dBm	10/Jun/2019	09/Jun/2020
RF Cable-R03m	Jye Bao	RG142	CB021	9kHz~1GHz	22/Mar/2019	21/Mar/2020
Loop Antenna	TESEQ	HLA 6120	31244	9k~30MHz	15/Mar/2019	14/Mar/2020