FCC Test Report

FCC ID	:	2AEIM-1509518D
Equipment	:	B-pillar Endpoint
Brand Name	:	Tesla
Model Name	:	1509518D
Applicant/ Manufacturer	:	Tesla Motors, Inc. 3500 Deer Creek Road Palo Alto, California US 94304 United States Of America
Standard	:	47 CFR FCC Part 15.225

The product was received on Dec. 26, 2019, and testing was started from Jan. 14, 2020 and completed on Jan. 14, 2020. 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: Phoenix Chen

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
FR9O2512-01AR	01	Initial issue of report	Jan. 22, 2020

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 14443-3A (ASK)	13.56	1	78.56
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
- KDB 414788 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	22.2~23.5°C / 53~55%	14/Jan/2020
RF Conducted	TH01-HY	Barry	23.5~24.3°C / 61~64%	14/Jan/2020
Radiated Emission	03CH03-HY	Patrick	25.3~26.6°C / 52.9~55.1%	14/Jan/2020

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	-40°C
-	Tmax	85°C
-	Vnom	12V
-	Vmin	10.8V
-	Vmax	13.2V

2.2 The Worst Case Modulation Configuration

Modulation Used for Conformance Testing	
Modulation Mode	**Field Strength (dBuV/m at 3 m)**
NFC	78.56

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
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 - AC Conduction			
No.	**Equipment**	**Brand Name**	**Model Name**
1	AC Power Cable	Power sync	PW-GPC180-3
2	DC Power Supply	GW	GPS-3030DD

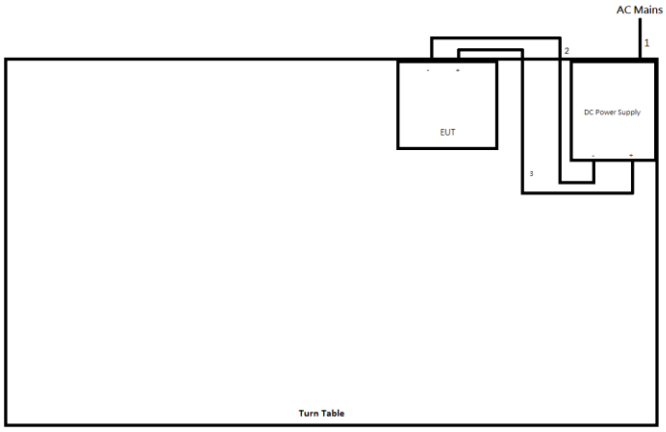
Support Equipment - RF Conducted			
No.	**Equipment**	**Brand Name**	**Model Name**
1	Notebook	HP	-
2	Adapter for NB	HP	-
3	DC Power Supply	GW	GPS-3030DD
4	Fixture	-	-

Note: Support equipment No.1 & No.2 & No.4 were provided by customer.

Support Equipment - Radiated			
No.	**Equipment**	**Brand Name**	**Model Name**
1	AC Power Cable	Power sync	PW-GPC180-3
2	DC Power Supply	GW	GPS-3030DD

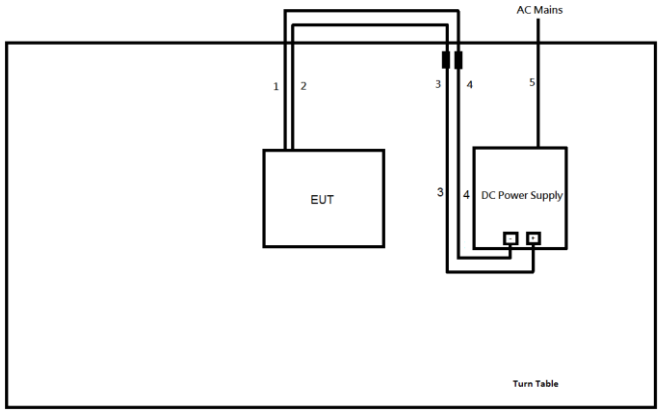
2.6 Test Setup Diagram

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	1.0	-

Test Setup Diagram - Radiated Test



Item	Connection	Shielded	Length(m)	Remark
1	DC Power Cable	No	2.0	-
2	DC Power Cable	No	2.0	-
3	DC Power Cable	No	1.0	-
4	DC Power Cable	No	1.0	-
5	AC Power Cable	No	1.8	-

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

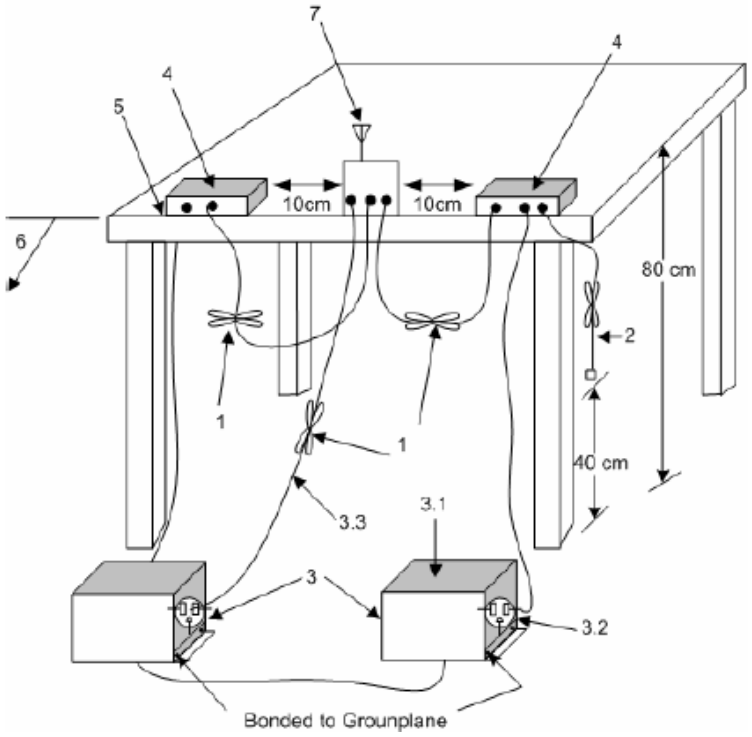
Refer a test equipment and calibration data table in this test report.

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

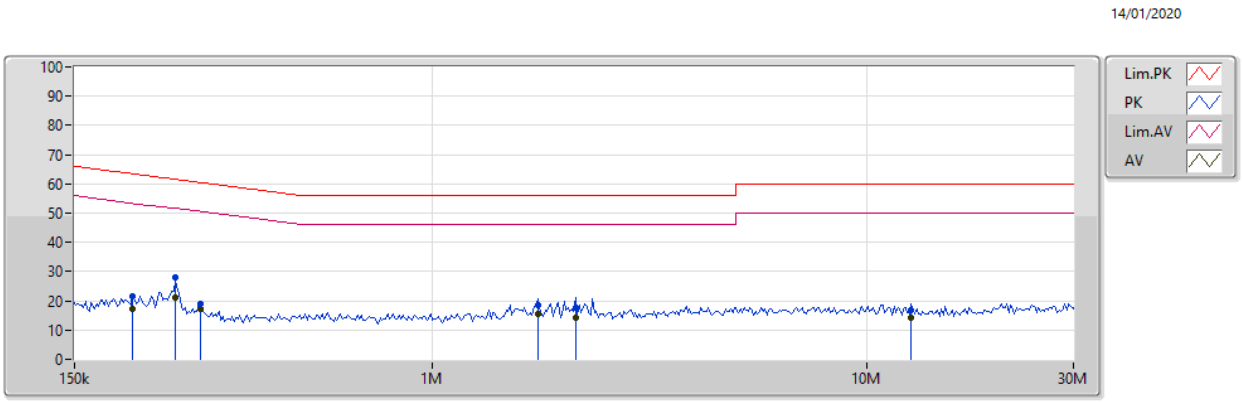
AC Power-line Conducted Emissions



1—Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long.
2—The I/O cables that are not connected to an accessory shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
3—EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50Ω loads. LISN may be placed on top of, or immediately beneath, reference ground plane.
3.1—All other equipment powered from additional LISN(s).
3.2—A multiple-outlet strip may be used for multiple power cords of non-EUT equipment.
3.3—LISN at least 80 cm from nearest part of EUT chassis.
4—Non-EUT components of EUT system being tested.
5—Rear of EUT, including peripherals, shall all be aligned and flush with edge of tabletop.
6—Edge of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane.
7—Antenna can be integral or detachable. If detachable, then the antenna shall be attached for this test.

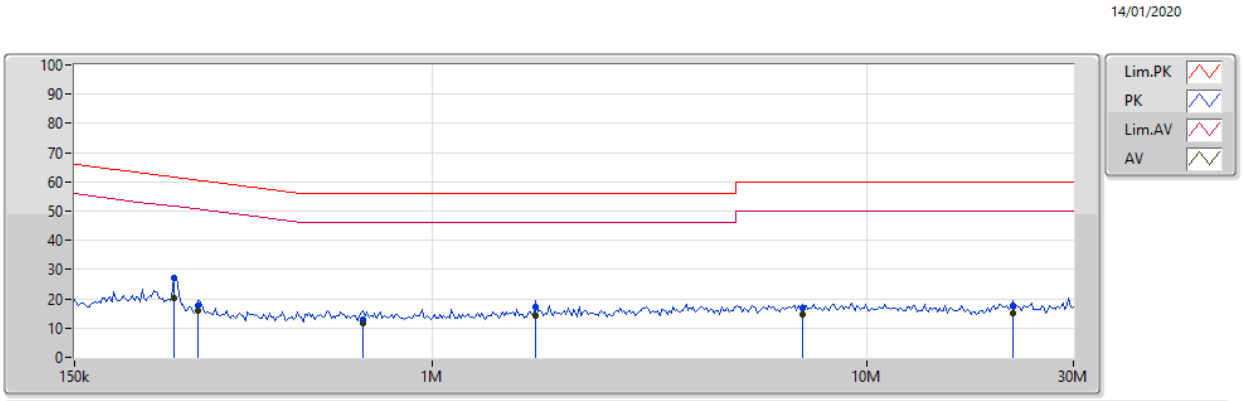
3.1.5 Test Result of AC Power-line Conducted Emissions

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	204.199k	21.76	63.44	-41.68	19.57	Neutral	-	2.19	9.59	0.11	9.87
AV	204.199k	17.37	53.44	-36.07	19.57	Neutral	-	-2.20	9.59	0.11	9.87
QP	256.712k	28.02	61.54	-33.52	19.58	Neutral	-	8.44	9.59	0.12	9.87
AV	256.712k	20.91	51.54	-30.63	19.58	Neutral	-	1.33	9.59	0.12	9.87
QP	292.162k	18.96	60.46	-41.50	19.59	Neutral	-	-0.63	9.59	0.12	9.88
AV	292.162k	17.40	50.46	-33.06	19.59	Neutral	-	-2.19	9.59	0.12	9.88
QP	1.752M	18.64	56.00	-37.36	19.64	Neutral	-	-1.00	9.61	0.14	9.89
AV	1.752M	15.46	46.00	-30.54	19.64	Neutral	"Worst"	-4.18	9.61	0.14	9.89
QP	2.137M	17.47	56.00	-38.53	19.65	Neutral	-	-2.18	9.61	0.15	9.89
AV	2.137M	14.11	46.00	-31.89	19.65	Neutral	-	-5.54	9.61	0.15	9.89
QP	12.689M	16.68	60.00	-43.32	19.86	Neutral	-	-3.18	9.67	0.29	9.90
AV	12.689M	14.42	50.00	-35.58	19.86	Neutral	-	-5.44	9.67	0.29	9.90

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	254.17k	26.98	61.62	-34.64	19.59	Line	-	7.39	9.60	0.12	9.87
AV	254.17k	20.07	51.62	-31.55	19.59	Line	"Worst"	0.48	9.60	0.12	9.87
QP	289.269k	17.54	60.55	-43.01	19.59	Line	-	-2.05	9.59	0.12	9.88
AV	289.269k	15.95	50.55	-34.60	19.59	Line	-	-3.64	9.59	0.12	9.88
QP	694.357k	13.05	56.00	-42.95	19.60	Line	-	-6.55	9.60	0.12	9.88
AV	694.357k	11.76	46.00	-34.24	19.60	Line	-	-7.84	9.60	0.12	9.88
QP	1.734M	17.26	56.00	-38.74	19.65	Line	-	-2.39	9.62	0.14	9.89
AV	1.734M	14.26	46.00	-31.74	19.65	Line	-	-5.39	9.62	0.14	9.89
QP	7.125M	16.84	60.00	-43.16	19.79	Line	-	-2.95	9.66	0.24	9.89
AV	7.125M	14.75	50.00	-35.25	19.79	Line	-	-5.04	9.66	0.24	9.89
QP	21.716M	17.83	60.00	-42.17	19.89	Line	-	-2.06	9.61	0.38	9.90
AV	21.716M	14.89	50.00	-35.11	19.89	Line	-	-5.00	9.61	0.38	9.90

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

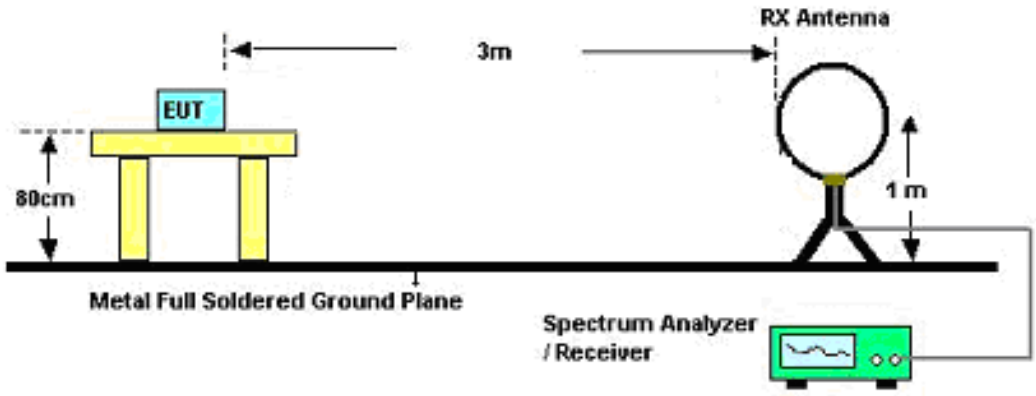
Refer a test equipment and calibration data table in this test report.

3.2.3 Test Procedures

Test Method
☒ Because the measured signal is CW or CW-like 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.
☒ 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



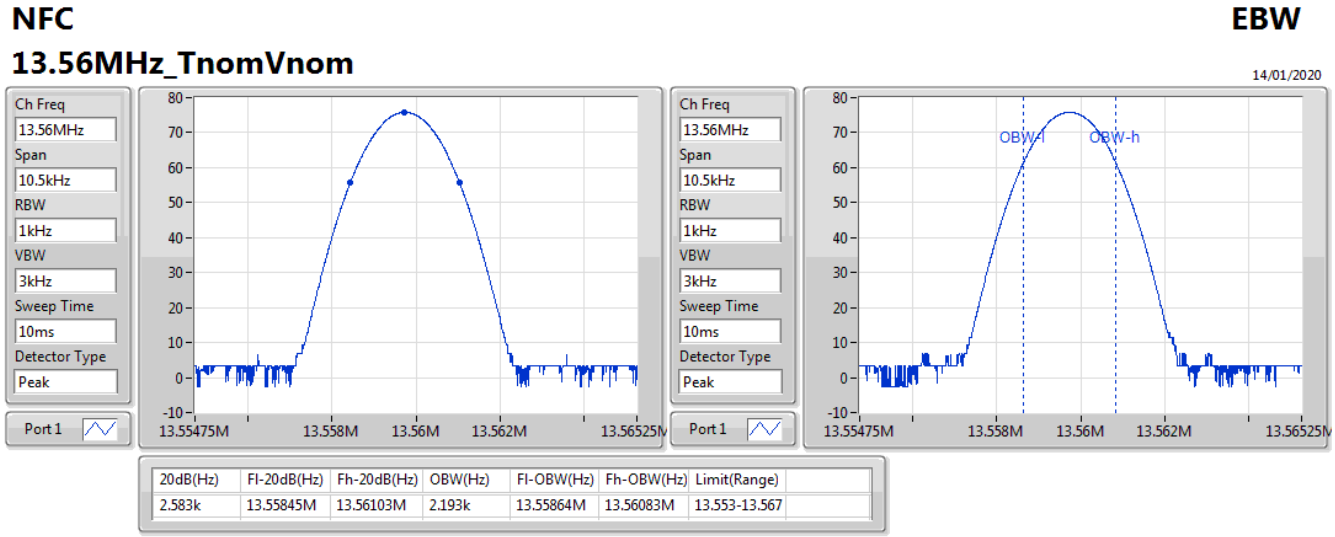
3.2.5 Test Result of Emission Bandwidth

Summary

Mode	20dB (Hz)	OBW (Hz)
13.553-13.567MHz	-	-
NFC	2.583k	2.193k

Result

Mode	Result	20dB (Hz)	Fl-20dB (Hz)	Fh-20dB (Hz)	OBW (Hz)	Fl-OBW (Hz)	Fh-OBW (Hz)	Limit (Range)
NFC	-	-	-	-	-	-	-	-
13.56MHz_TnomVnom	Pass	2.583k	13.55845M	13.56103M	2.193k	13.55864M	13.56083M	13.553-13.567



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

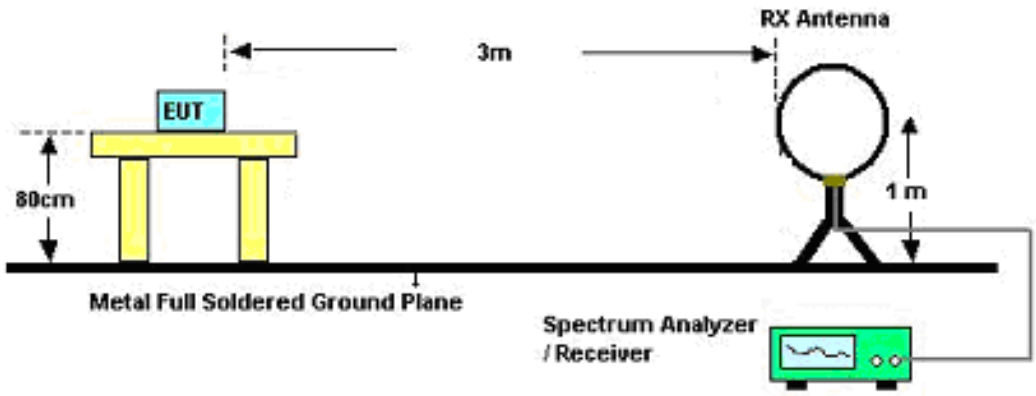
3.3.2 Measuring Instruments

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

3.3.3 Test Procedures

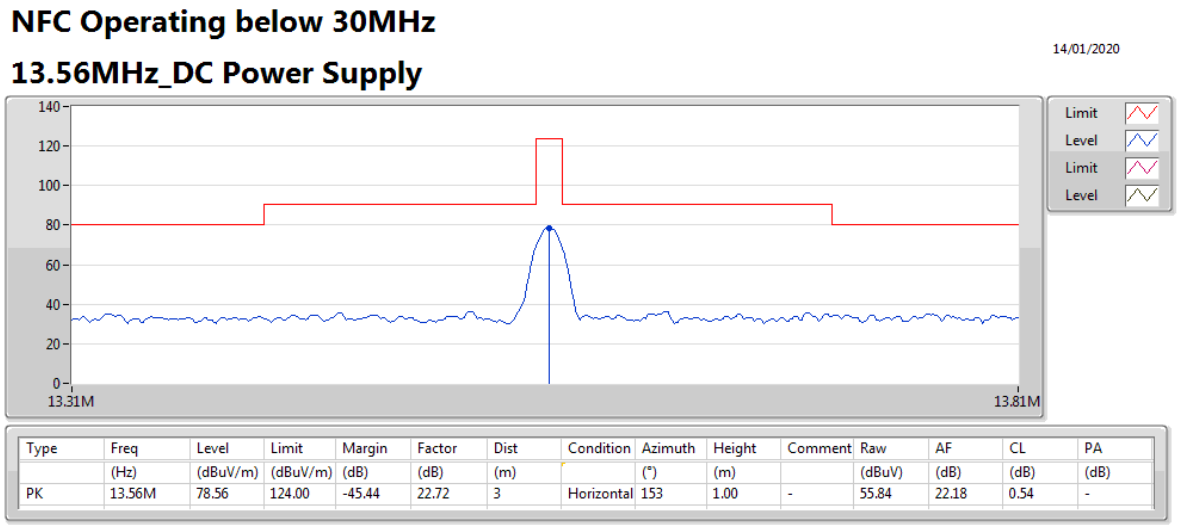
Test Method	
☒	Refer as ANSI C63.10, clause 6.4 for radiated emissions from below 30 MHz and test distance is 3m.
☒	At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the requirements; however, an attempt should be made to avoid making measurements 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	78.56	H	45.44	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	78.56	124.00	-45.44	22.72	3	Horizontal	153	1.00	-	55.84	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

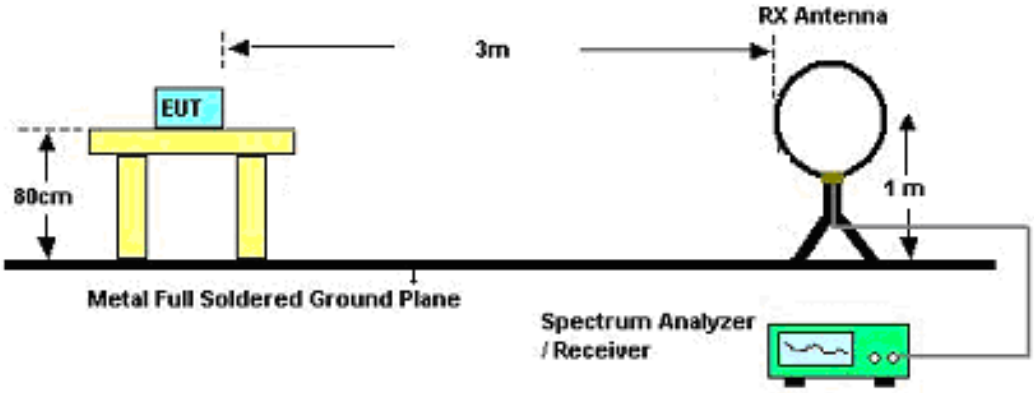
Refer a test equipment and calibration data table in this test report.

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.	
☒	KDB 414788 D01 v01r01 Open-Field Test Sites and Chamber Correlation Justification.	
	▪	Based on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in regulations; however, an attempt should be made to avoid making measurements in the near field.
	▪	Open-field site and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

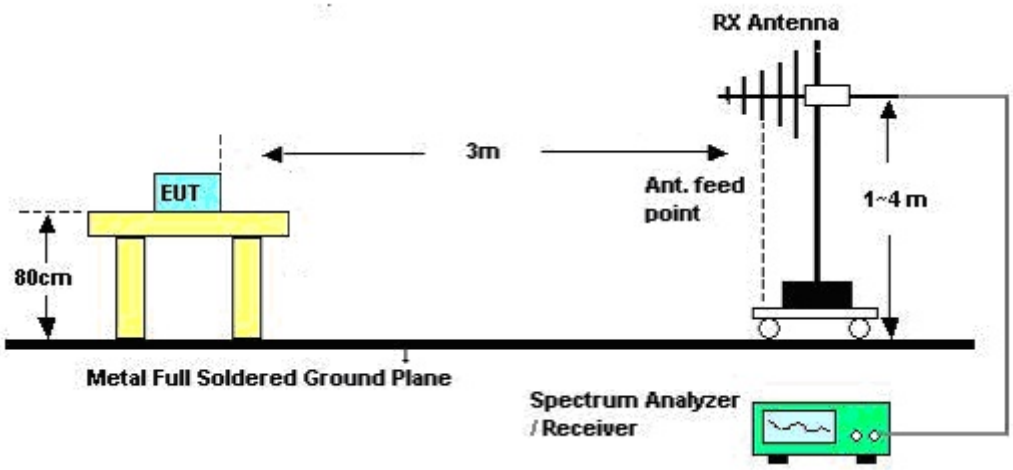
3.4.4 Test Setup

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	1.225M	41.21	65.87	-24.66	20.27	3	0	1.00	-

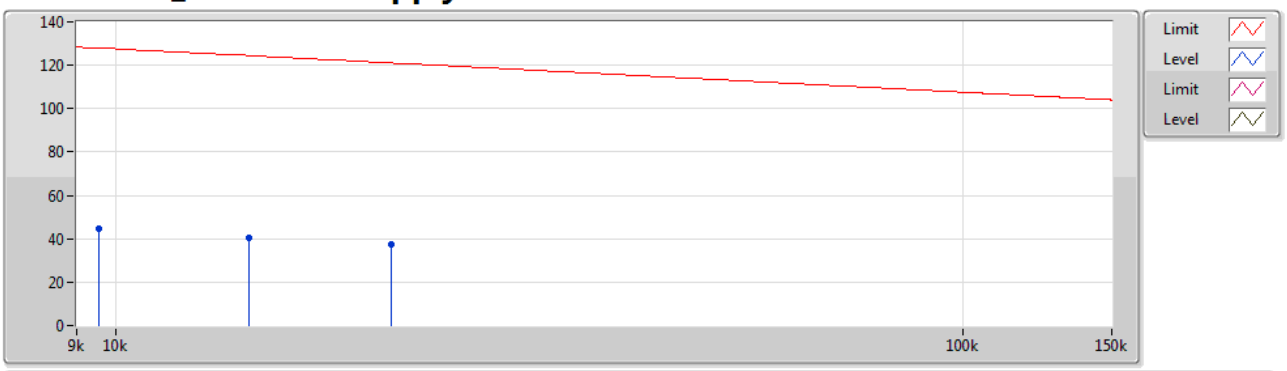
Result

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	13.56M	78.56	124.00	-45.44	22.72	3	153	1.00	-
13.56MHz_DC Power Supply	Pass	PK	9.564k	44.72	127.96	-83.24	19.42	3	360	1.00	-
13.56MHz_DC Power Supply	Pass	PK	14.358k	40.72	124.44	-83.72	19.69	3	360	1.00	-
13.56MHz_DC Power Supply	Pass	PK	21.126k	37.71	121.08	-83.37	19.97	3	360	1.00	-
13.56MHz_DC Power Supply	Pass	PK	388.8k	49.96	95.80	-45.84	20.19	3	0	1.00	-
13.56MHz_DC Power Supply	Pass	PK	1.225M	41.21	65.87	-24.66	20.27	3	0	1.00	-
13.56MHz_DC Power Supply	Pass	PK	8.21M	42.36	69.50	-27.14	21.81	3	0	1.00	-

NFC Operating below 30MHz

13.56MHz_DC Power Supply

14/01/2020

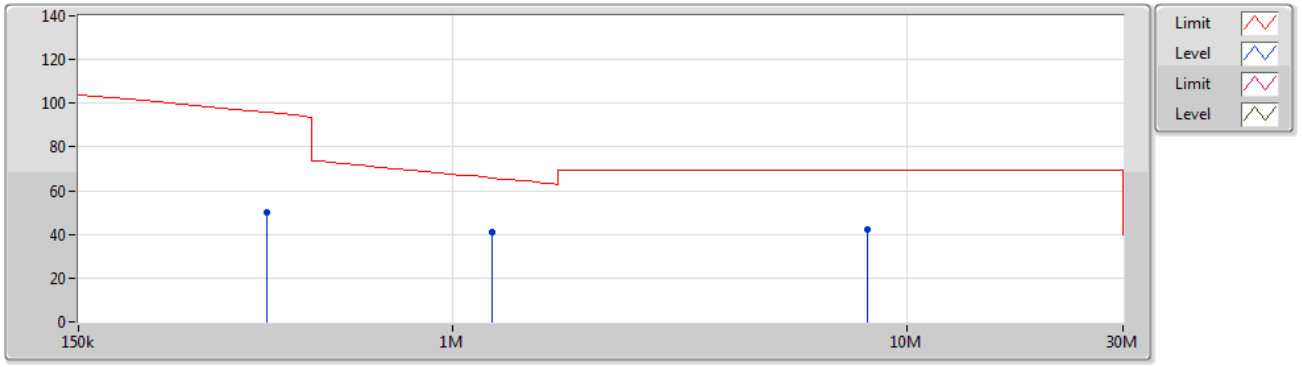


Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV)	(dB)	(dB)	(dB)
PK	9.564k	44.72	127.96	-83.24	19.42	3	Horizontal	360	1.00	-	25.30	19.37	0.05	-
PK	14.358k	40.72	124.44	-83.72	19.69	3	Horizontal	360	1.00	-	21.03	19.63	0.06	-
PK	21.126k	37.71	121.08	-83.37	19.97	3	Horizontal	360	1.00	-	17.74	19.91	0.06	-

NFC Operating below 30MHz

13.56MHz_DC Power Supply

14/01/2020



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	388.8k	49.96	95.80	-45.84	20.19	3	Horizontal	0	1.00	-	29.77	20.07	0.12	-
PK	1.225M	41.21	65.87	-24.66	20.27	3	Horizontal	0	1.00	-	20.94	20.10	0.17	-
PK	8.21M	42.36	69.50	-27.14	21.81	3	Horizontal	0	1.00	-	20.55	21.42	0.39	-

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	QP	365.62M	42.88	46.00	-3.12	-4.18	3	159	1.00	-

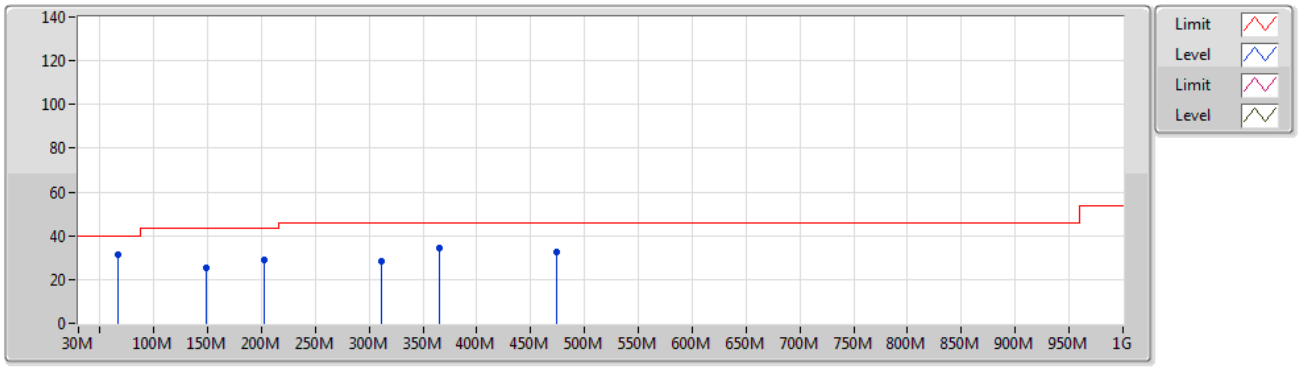
Result

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	66.86M	31.49	40.00	-8.51	-14.92	3	360	1.00	-
13.56MHz_DC Power Supply	Pass	PK	148.34M	25.21	43.50	-18.29	-9.66	3	360	1.00	-
13.56MHz_DC Power Supply	Pass	PK	202.66M	28.77	43.50	-14.73	-10.33	3	360	1.00	-
13.56MHz_DC Power Supply	Pass	PK	311.3M	28.63	46.00	-17.37	-5.34	3	360	1.00	-
13.56MHz_DC Power Supply	Pass	PK	365.62M	34.49	46.00	-11.51	-4.18	3	360	1.00	-
13.56MHz_DC Power Supply	Pass	PK	474.26M	32.56	46.00	-13.44	-1.69	3	360	1.00	-
13.56MHz_DC Power Supply	Pass	PK	66.86M	29.27	40.00	-10.73	-14.92	3	0	1.00	-
13.56MHz_DC Power Supply	Pass	PK	121.18M	29.95	43.50	-13.55	-8.37	3	0	1.00	-
13.56MHz_DC Power Supply	Pass	PK	202.66M	36.75	43.50	-6.75	-10.33	3	0	1.00	-
13.56MHz_DC Power Supply	Pass	PK	474.26M	35.58	46.00	-10.42	-1.69	3	0	1.00	-
13.56MHz_DC Power Supply	Pass	PK	528.58M	32.61	46.00	-13.39	-1.46	3	0	1.00	-
13.56MHz_DC Power Supply	Pass	QP	365.62M	42.88	46.00	-3.12	-4.18	3	159	1.00	-

NFC Operating above 30MHz

14/01/2020

13.56MHz_DC Power Supply

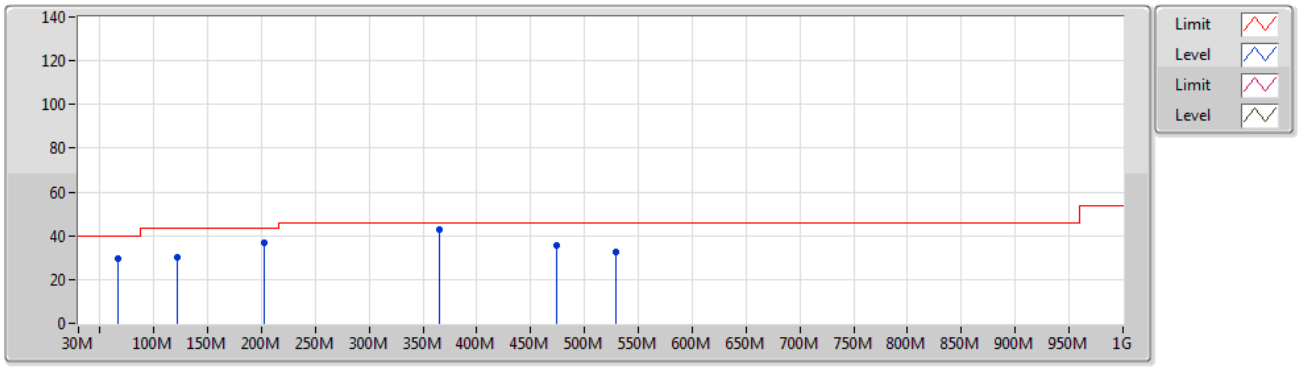


Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV)	(dB)	(dB)	(dB)
PK	66.86M	31.49	40.00	-8.51	-14.92	3	Vertical	360	1.00	-	46.41	11.32	1.23	27.47
PK	148.34M	25.21	43.50	-18.29	-9.66	3	Vertical	360	1.00	-	34.87	15.65	1.88	27.19
PK	202.66M	28.77	43.50	-14.73	-10.33	3	Vertical	360	1.00	-	39.10	14.37	2.22	26.92
PK	311.3M	28.63	46.00	-17.37	-5.34	3	Vertical	360	1.00	-	33.97	18.63	2.80	26.77
PK	365.62M	34.49	46.00	-11.51	-4.18	3	Vertical	360	1.00	-	38.67	19.86	3.03	27.07
PK	474.26M	32.56	46.00	-13.44	-1.69	3	Vertical	360	1.00	-	34.25	22.57	3.50	27.76

NFC Operating above 30MHz

13.56MHz_DC Power Supply

14/01/2020



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	66.86M	29.27	40.00	-10.73	-14.92	3	Horizontal	0	1.00	-	44.19	11.32	1.23	27.47
PK	121.18M	29.95	43.50	-13.55	-8.37	3	Horizontal	0	1.00	-	38.32	17.25	1.69	27.31
PK	202.66M	36.75	43.50	-6.75	-10.33	3	Horizontal	0	1.00	-	47.08	14.37	2.22	26.92
PK	474.26M	35.58	46.00	-10.42	-1.69	3	Horizontal	0	1.00	-	37.27	22.57	3.50	27.76
PK	528.58M	32.61	46.00	-13.39	-1.46	3	Horizontal	0	1.00	-	34.07	22.79	3.70	27.95
QP	365.62M	42.88	46.00	-3.12	-4.18	3	Horizontal	159	1.00	-	47.06	19.86	3.03	27.07

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

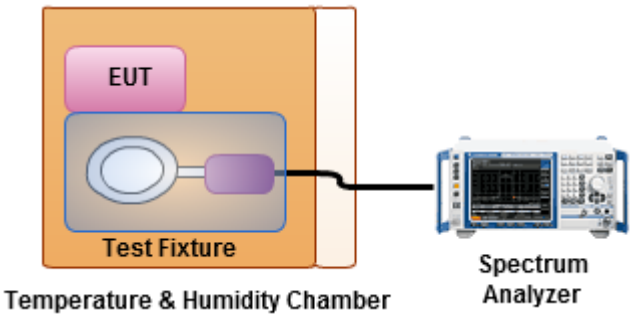
Refer a test equipment and calibration data table in this test report.

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

Summary

Mode	Result	Ch (Hz)	Center (Hz)	ppm	Limit (ppm)	Port	Remark
13.553-13.567MHz	-	-	-	-	-	-	-
NFC	Pass	13.56M	13.559696M	22.3884	100	1	0 min

Result

Mode	Result	Ch (Hz)	Center (Hz)	ppm	Limit (ppm)	Port	Remark
NFC	-	-	-	-	-	-	-
13.56MHz_-40°C	Pass	13.56M	13.560171M	12.6459	100	1	0 min
13.56MHz_-40°C	Pass	13.56M	13.560173M	12.775	100	1	2 min
13.56MHz_-40°C	Pass	13.56M	13.560173M	12.775	100	1	5 min
13.56MHz_-40°C	Pass	13.56M	13.560172M	12.7104	100	1	10 min
13.56MHz_-30°C	Pass	13.56M	13.560173M	12.775	100	1	0 min
13.56MHz_-30°C	Pass	13.56M	13.560174M	12.8395	100	1	2 min
13.56MHz_-30°C	Pass	13.56M	13.560173M	12.775	100	1	5 min
13.56MHz_-30°C	Pass	13.56M	13.560174M	12.8395	100	1	10 min
13.56MHz_-20°C	Pass	13.56M	13.559915M	6.2584	100	1	0 min
13.56MHz_-20°C	Pass	13.56M	13.559916M	6.1939	100	1	2 min
13.56MHz_-20°C	Pass	13.56M	13.559915M	6.2584	100	1	5 min
13.56MHz_-20°C	Pass	13.56M	13.559915M	6.2584	100	1	10 min
13.56MHz_-10°C	Pass	13.56M	13.559858M	10.4522	100	1	0 min
13.56MHz_-10°C	Pass	13.56M	13.559859M	10.3877	100	1	2 min
13.56MHz_-10°C	Pass	13.56M	13.559858M	10.4522	100	1	5 min
13.56MHz_-10°C	Pass	13.56M	13.559859M	10.3877	100	1	10 min
13.56MHz_0°C	Pass	13.56M	13.55978M	16.259	100	1	0 min
13.56MHz_0°C	Pass	13.56M	13.559776M	16.5171	100	1	2 min
13.56MHz_0°C	Pass	13.56M	13.559775M	16.5816	100	1	5 min
13.56MHz_0°C	Pass	13.56M	13.559776M	16.5171	100	1	10 min
13.56MHz_10°C	Pass	13.56M	13.559774M	16.6461	100	1	0 min
13.56MHz_10°C	Pass	13.56M	13.559773M	16.7107	100	1	2 min
13.56MHz_10°C	Pass	13.56M	13.559774M	16.6461	100	1	5 min
13.56MHz_10°C	Pass	13.56M	13.559773M	16.7107	100	1	10 min
13.56MHz_20°C	Pass	13.56M	13.559727M	20.1302	100	1	0 min
13.56MHz_20°C	Pass	13.56M	13.55973M	19.9367	100	1	2 min
13.56MHz_20°C	Pass	13.56M	13.55973M	19.9367	100	1	5 min
13.56MHz_20°C	Pass	13.56M	13.559731M	19.8076	100	1	10 min
13.56MHz_30°C	Pass	13.56M	13.559763M	17.4849	100	1	0 min
13.56MHz_30°C	Pass	13.56M	13.559761M	17.6139	100	1	2 min
13.56MHz_30°C	Pass	13.56M	13.559761M	17.6139	100	1	5 min

Mode	Result	Ch (Hz)	Center (Hz)	ppm	Limit (ppm)	Port	Remark
13.56MHz_30°C	Pass	13.56M	13.55976M	17.6785	100	1	10 min
13.56MHz_40°C	Pass	13.56M	13.559743M	18.9689	100	1	0 min
13.56MHz_40°C	Pass	13.56M	13.559744M	18.9043	100	1	2 min
13.56MHz_40°C	Pass	13.56M	13.559743M	18.9689	100	1	5 min
13.56MHz_40°C	Pass	13.56M	13.559743M	18.9689	100	1	10 min
13.56MHz_50°C	Pass	13.56M	13.559696M	22.3884	100	1	0 min
13.56MHz_50°C	Pass	13.56M	13.559697M	22.3239	100	1	2 min
13.56MHz_50°C	Pass	13.56M	13.559698M	22.2594	100	1	5 min
13.56MHz_50°C	Pass	13.56M	13.559698M	22.2594	100	1	10 min
13.56MHz_60°C	Pass	13.56M	13.560173M	12.775	100	1	0 min
13.56MHz_60°C	Pass	13.56M	13.560176M	12.9685	100	1	2 min
13.56MHz_60°C	Pass	13.56M	13.560176M	12.9685	100	1	5 min
13.56MHz_60°C	Pass	13.56M	13.560176M	12.9685	100	1	10 min
13.56MHz_70°C	Pass	13.56M	13.560176M	12.9685	100	1	0 min
13.56MHz_70°C	Pass	13.56M	13.560176M	12.9685	100	1	2 min
13.56MHz_70°C	Pass	13.56M	13.560176M	12.9685	100	1	5 min
13.56MHz_70°C	Pass	13.56M	13.560171M	12.5814	100	1	10 min
13.56MHz_80°C	Pass	13.56M	13.560176M	12.9685	100	1	0 min
13.56MHz_80°C	Pass	13.56M	13.560176M	12.9685	100	1	2 min
13.56MHz_80°C	Pass	13.56M	13.560175M	12.904	100	1	5 min
13.56MHz_80°C	Pass	13.56M	13.560176M	12.9685	100	1	10 min
13.56MHz_85°C	Pass	13.56M	13.560176M	12.9685	100	1	0 min
13.56MHz_85°C	Pass	13.56M	13.560176M	12.9685	100	1	2 min
13.56MHz_85°C	Pass	13.56M	13.560176M	12.9685	100	1	5 min
13.56MHz_85°C	Pass	13.56M	13.560177M	13.033	100	1	10 min
13.56MHz_20°C-10.8V	Pass	13.56M	13.559729M	20.0012	100	1	0 min
13.56MHz_20°C-10.8V	Pass	13.56M	13.559729M	20.0012	100	1	2 min
13.56MHz_20°C-10.8V	Pass	13.56M	13.55973M	19.9367	100	1	5 min
13.56MHz_20°C-10.8V	Pass	13.56M	13.55973M	19.9367	100	1	10 min
13.56MHz_20°C-13.2V	Pass	13.56M	13.55973M	19.9367	100	1	0 min
13.56MHz_20°C-13.2V	Pass	13.56M	13.559734M	19.6141	100	1	2 min
13.56MHz_20°C-13.2V	Pass	13.56M	13.559729M	20.0012	100	1	5 min
13.56MHz_20°C-13.2V	Pass	13.56M	13.559729M	20.0012	100	1	10 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

NCR: Non-Calibration required.

Instrument for Conducted Test

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Calibration Due Date
Spectrum Analyzer	R&S	FSV 40	101029	10KHz~40GHz	01/Oct/2019	30/Sep/2020
Loop Antenna	TESEQ	HLA 6120	31244	9kHz~30MHz	15/Mar/2019	14/Mar/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
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