RF TEST REPORT

FCC / ISED

APPLICANT

Medtronic Inc.

MODEL NAME

P7850N

FCC ID

LF5P7850N

ISED ID

3408D-P7850N

REPORT NUMBER

HA221024-MED-007-R01-1

TEST REPORT

Date of Issue
August 17, 2023

Test Site
Hyundai C-Tech, Inc. dba HCT America, Inc.
1726 Ringwood Ave, San Jose, CA 95131, USA

Applicant	Medtronic Inc.
Applicant Address	710 Medtronic Parkway N.E., Minneapolis, MN 55432, U.S.A.
FCC ID	LF5P7850N
ISED ID	3408D-P7850N
Model Name	P7850N
EUT Type	Ultra Low Power Active Medical Implant (ULP-AMI)
Modulation Type	175 kHz (OOK burst)
FCC Classification	Low Power Transmitter Below 1705 kHz (DCD)
FCC Rule Part(s)	Part 15.209
ISED Rule Part(s)	RSS-GEN Issue 5 (February 2021), RSS-210 Issue 10 (April 2020)

The device bearing the trade name and model specified above, has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures required. The results of testing in this report apply only to the product which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Hyundai C-Tech, Inc. dba HCT America, Inc. certifies that no party to application has been denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C 862

Tested By

Tim Lee

Test Engineer

Reviewed By

Yongsoo Park

Technical Manager

REVISION HISTORY

The revision history for this document is shown in table.

TEST REPORT NO.	DATE	DESCRIPTION
HA221024-MED-007-R01	July 21, 2023	Initial Issue
HA221024-MED-007-R01-1	August 17, 2023	Page 15 of 22 : Added 20 dB bandwidth test result Page 16 of 22 : Divided the result table into a Radiated Fundamental Emission table and a Radiated Spurious Emission table Page 16 of 22 : Changed the method to apply a distance factor to the reding value at the measurement receiver instead of the limit value

TABLE OF CONTENTS

Hyundai C-Tech, Inc. dba HCT America, Inc., 1726 Ringwood Avenue, San Jose, CA 95131, USA TEL: +1-510-933-8848 FAX: +1-510-933-8849

1. GENERAL INFORMATION

EUT DESCRIPTION

Model	P7850N
EUT Type	Ultra Low Power Active Medical Implant (ULP-AMI)
Serial Number	NTI501245H
Power Supply	3 V d.c.
RF Specification	175 kHz
Transmitter Chain	1
Operating Environment	Implantable device
Operating Temperature	-20 °C ~ 50 °C

RF SPECIFICATION SUBJECT TO THE REPORT

RF Specification	175 kHz
Frequency Range	175 kHz
Max. RF Output Power	76.6 dBuV/m @3m
Modulation Type	OOK burst
Number of Channels	1 channel
Antenna Specification	Loop antenna
Firmware Version [1)]	NTI501245H
Hardware Version [1)]	NTI501245H
Date(s) of Tests	June 19, 2023 ~ July 17, 2023

Note :
1. Firmware and Hardware Version are as received by the client.

2. METHODOLOGY

The measurement procedure described in ANSI C63.10(Version : 2013) 'the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices'.

EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.209 under the FCC Rules Part 15 Subpart C and RSS-GEN issue 5, RSS-210 issue 10.

GENERAL TEST PROCEDURES

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz. Above 1GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. Also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. To find out the maximum emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 8 of ANSI C63.10. (Version: 2013)

DESCRIPTION OF TEST MODES

The EUT has been tested per test setup instruction provided by the manufacturer under continuous Tx operating condition. Testing was performed at the continuous Tx mode using the receiver provided by the manufacturer.

3. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment's, which is traceable to recognized national standards. Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

4. FACILITIES AND ACCREDITATIONS

FACILITIES

The SAC (Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at 1726 Ringwood Avenue, San Jose, California 95131, USA.
The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.

EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

5. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203:
"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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."

(1) The antenna of this E.U.T is permanently attached and there is no provision for connection to an external antenna.
(2) The E.U.T Complies with the requirement of §15.203

According to RSS-Gen Issue 5 (Section 6.8) :
The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

6. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence. The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (±dB)
Occupied Bandwidth	± 16.78 kHz
Radiated Emissions (below 1 GHz)	± 5.70 dB

7. DESCRIPTION OF TESTS

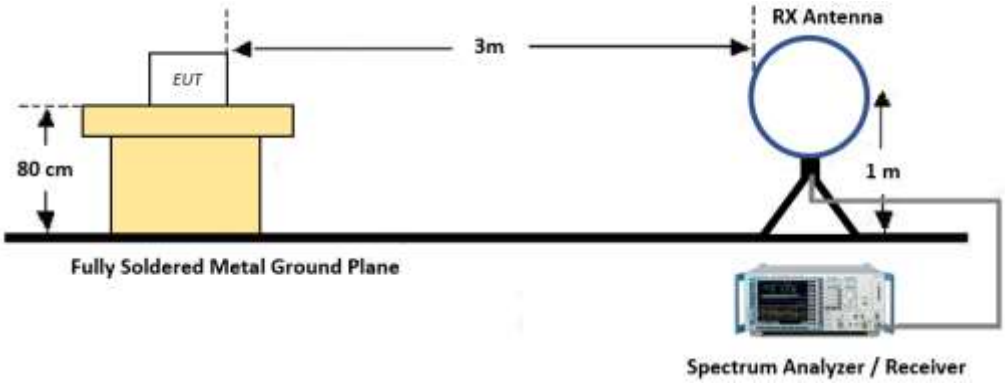
7.1. 20 dB BANDWIDTH / 99 % BANDWIDTH

Limit

20 dB bandwidth : According to §15.215(c), the bandwidth at 20 dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

99% Bandwidth : Section 6.7, RSS-Gen Issue 5

Test Configuration



Test Procedure (20 dB Bandwidth)

The Spectrum Analyzer setting :

- RBW = 1 kHz
- VBW ≥ 3 x RBW
- Detector = Peak
- Trace mode = max hold
- Sweep = auto couple
- Allow the trace to stabilize

Test Procedure (99 % Bandwidth)

The transmitter output is connected to the spectrum analyzer.

- RBW = 1 kHz
- VBW ≒ 3 x RBW
- Detector = Peak
- Trace mode = max hold
- Sweep = auto couple
- Allow the trace to stabilize

Note :
Bandwidth measurement feature in the spectrum analyzer was used to measure 99 % bandwidth.

7.2. RADIATED EMISSION

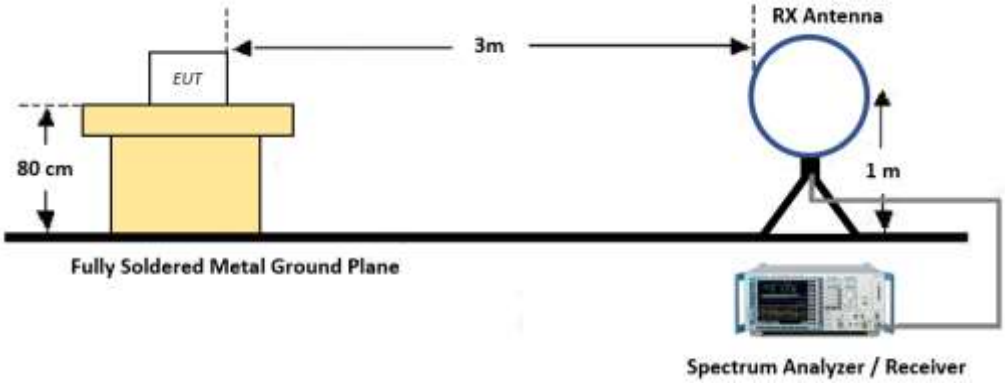
RADIATION EMISSION LIMIT

FCC : 47 CFR § 15.209		
Frequency (MHz)	**Field Strength (uV/m)**	**Measurement Distance (m)**
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

ISED : RSS-GEN Section 8.9		
Frequency (MHz)	**Field Strength (uA/m)**	**Measurement Distance (m)**
0.009 – 0.490	6.37/F(kHz)	300
0.490 – 1.705	63.7/F(kHz)	30
1.705 – 30	0.08	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

Below 30 MHz



Test Procedure of Radiated spurious emissions (Below 30 MHz)

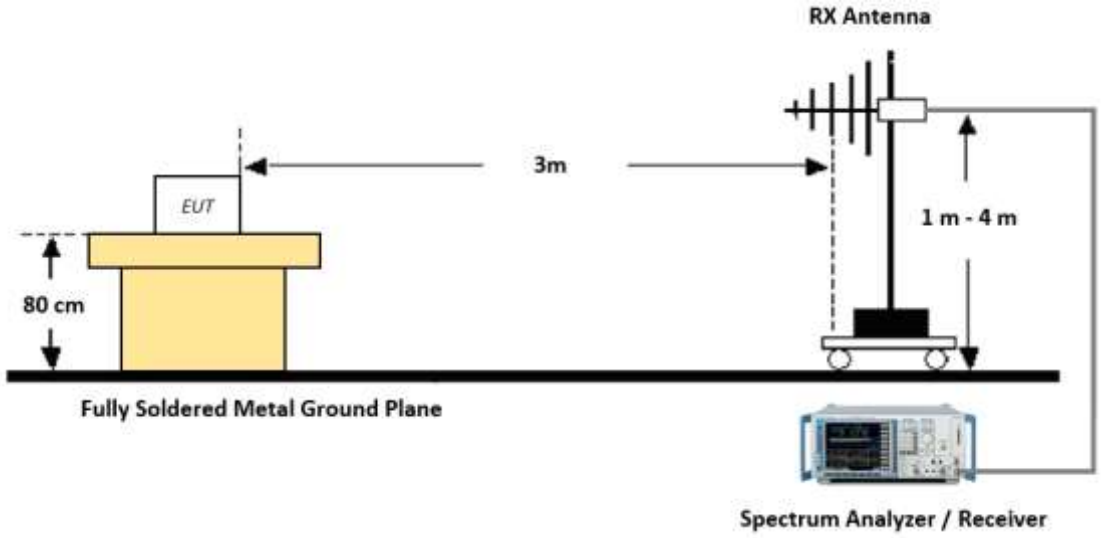
1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The loop antenna was placed at a location 3m from the EUT
3. The EUT is placed on a turntable, which is 0.8m above ground plane.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Distance Correction Factor (0.009 MHz – 0.490 MHz) = 40*log(3 m/300 m) = - 80 dB
   Measurement Distance: 3 m
7. Distance Correction Factor (0.490 MHz – 30 MHz) = 40*log(3 m/30 m) = - 40 dB
   Measurement Distance: 3 m
8. Spectrum Setting

   - Frequency Range = 9 kHz ~ 30 MHz
   - Detector = Peak
   - Trace = Max hold
   - RBW = 9 kHz
   - VBW ≥ 3*RBW

9. Total = Reading Value + Antenna Factor (A.F) + Cable Loss (C.L) + Distance Factor (D.F)

Adequate comparison measurements were confirmed against an open field site since the test was performed at alternative site (3m SAC) other than the open area test site. Sufficient test was made to demonstrate that the alternative site produces result that correlate with the one of test made at the open field site based on KDB 414788.

30 MHz - 1 GHz



Test Procedure of Radiated spurious emissions (Below 1GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8m above ground plane.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
4. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
5. Spectrum Setting

(1) Measurement Type (Peak):
- Measured Frequency Range: 30 MHz – 1 GHz
- Detector = Peak
- Trace = Max hold
- RBW = 100 kHz
- VBW ≥ 3*RBW

(2) Measurement Type(Quasi-peak):
- Measured Frequency Range: 30 MHz – 1 GHz
- Detector = Quasi-Peak
- RBW = 120 kHz

In general, the method (1) is mainly used

6. Total = Reading Value + Antenna Factor (A.F) + Cable Loss (C.L)

8. SUMMARY OF TEST RESULTS

Test Description	FCC Part Section(s)	IC Part Section(s)	Test Limit	Test Condition	Test Result
Occupied Bandwidth	-	Section 6.7 RSS-GEN	N/A		PASS
Radiated Spurious Emissions and Fundamental Emission	15.209	Section 8.9 RSS-GEN	cf. Section 7.3		PASS

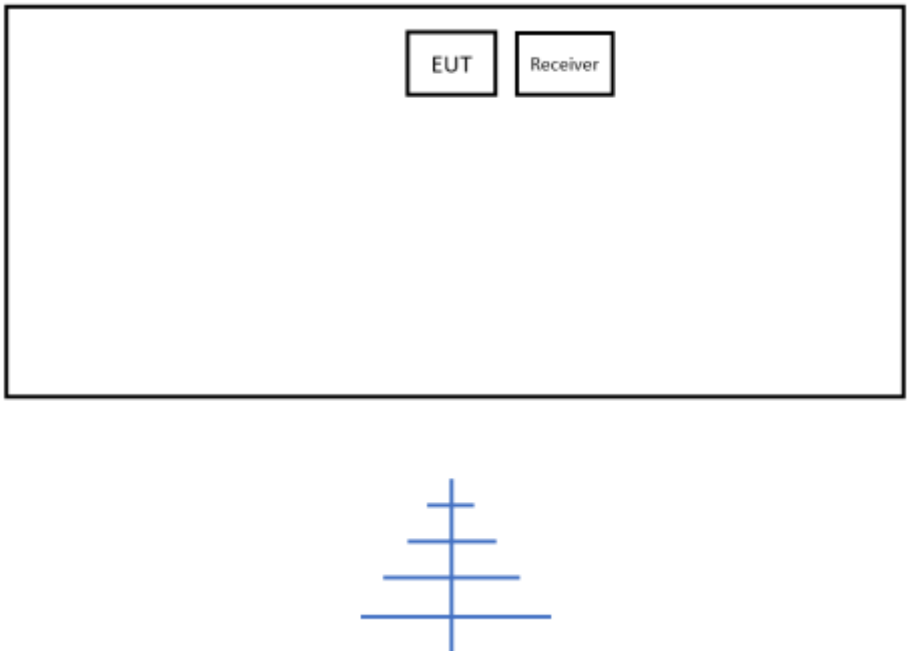
WORST CASE CONFIGURATION

RADIATED TEST

All X, Y, and Z positions for horizontal / vertical antenna polarization were investigated to find the worst-case position.
Y position was selected for the final evaluation.

TEST CONFIGURATION

Radiated Emission



LIST OF SUPPORT EQUIPMENT

Equipment Type	Model No.	Serial Number	Manufacturer	Qty	Note
Receiver	7439	NPG030970N	Medtronic	1	175 kHz RX Only

9. TEST RESULT

9.1 20 dB BANDWIDTH / 99% BANDWIDTH

Frequency (kHz)	Modulation	99% Bandwidth (kHz)	20 dB Bandwidth (kHz)	Limit
		Result	Result	
175	OOK burst	28.874	12.96	N/A

▣ TEST PLOTS

99% OBW	20 dB OBW
	

9.2 RADIATED SPURIOUS EMISSIONS AND FUNDAMENTAL EMISSION

Test Mode OOK burst

Operating Frequency 175 kHz

Radiated Fundamental Emission

Frequency (MHz)	Polarization	Reading (dBuV)	Corr. [1] (dB)	Dis. [2] (dB)	Total (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Measurement Type
0.175	B	57.3	19.3	80	-3.4	22.7	26.1	QP
0.175	180°	53.9	19.3	80	-6.8	22.7	29.5	QP
0.176	90°	33.1	19.3	80	-27.6	22.7	50.3	QP

Notes:
1. Correction Factor: Antenna Factor + Cable loss
2. Limit = specific Limits (dBuV) + Distance extrapolation factor
   - The measurement distance is 3 meters.
   - Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
3. Max. fundamental level at 3 m is 76.6 dBuV/m

Radiated Spurious Emission

Frequency Range : 9 kHz – 30MHz

Frequency (MHz)	Polarization	Reading (dBuV)	Corr. [1] (dB)	Dis. [2] (dB)	Total (dBuV/m)	Limit (dBuV/m) [2]	Margin (dB)	Measurement Type
0.526	B	16.3	19.3	40	-4.4	33.2	37.6	QP
0.527	180°	12.8	19.3	40	-7.9	33.2	41.1	QP

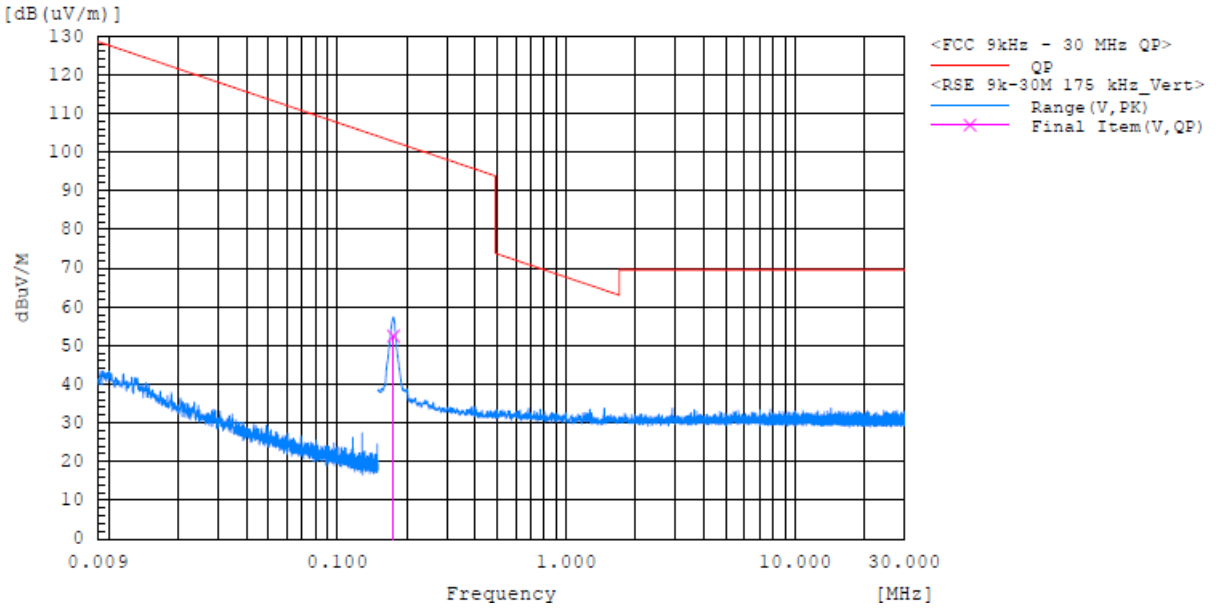
Notes:
1. Correction Factor: Antenna Factor + Cable loss
2. Limit = specific Limits (dBuV) + Distance extrapolation factor
   - The measurement distance is 3 meters.
   - Distance extrapolation factor = 40 log (specific distance / test distance) (dB)

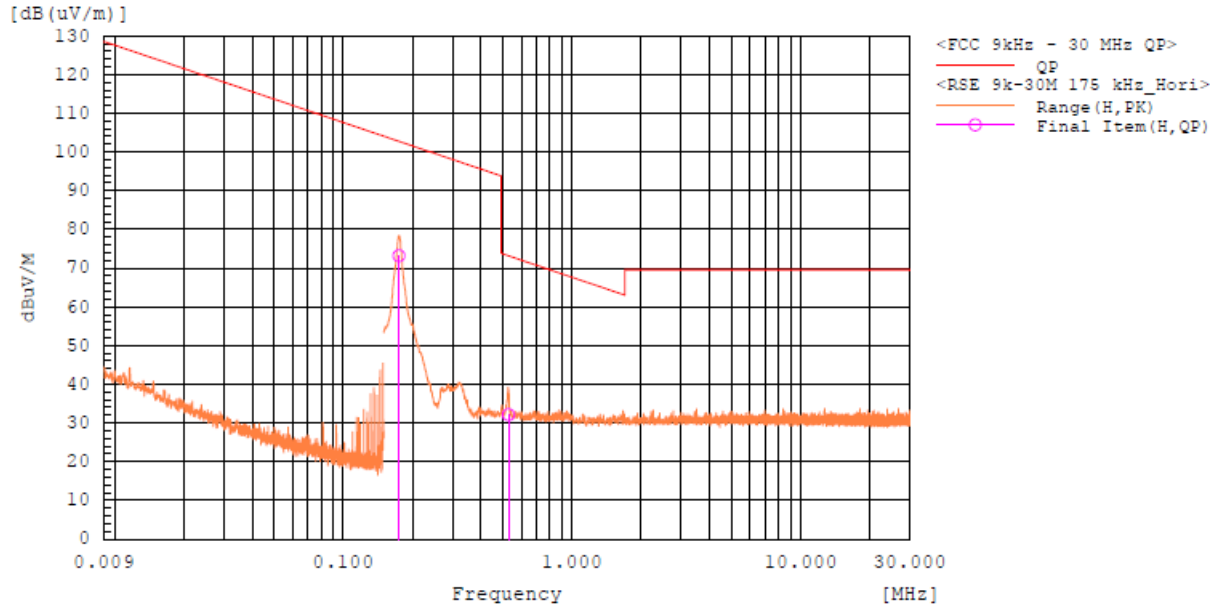
Frequency Range : Below 1 GHz

Frequency (MHz)	Polarization	Reading (dBuV)	Corr. (1) (dB)	Total (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Measurement Type
565.283	V	0.1	25.5	25.6	46	20.4	QP
771.742	H	-4.6	28.1	23.5	46	22.5	QP

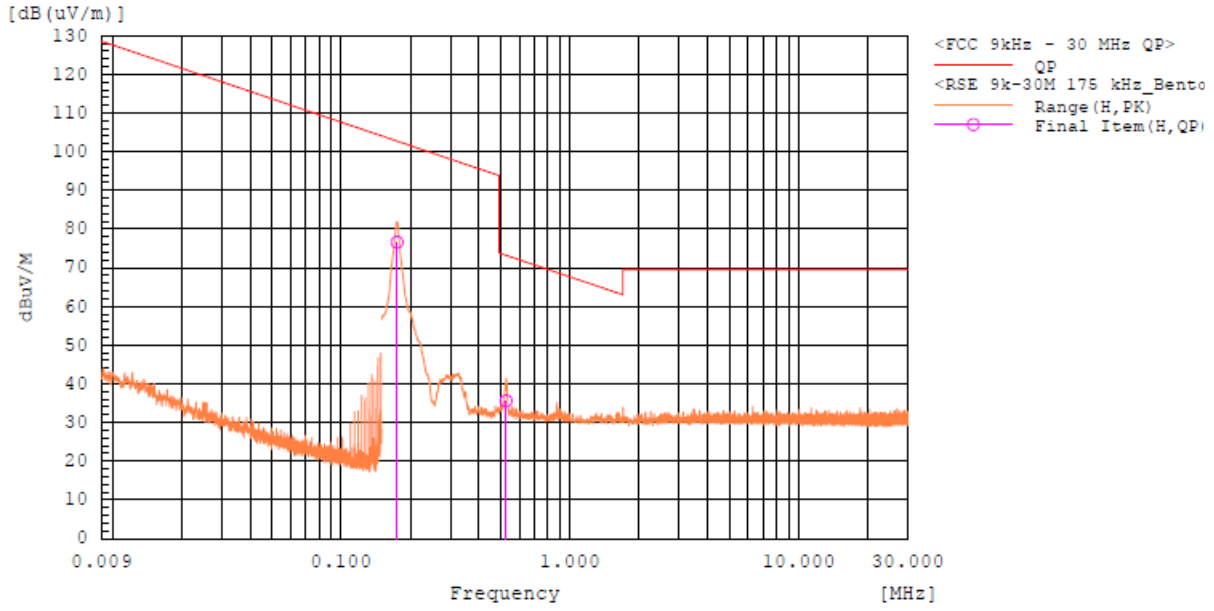
Notes:
1. Correction Factor: Antenna Factor + Cable loss

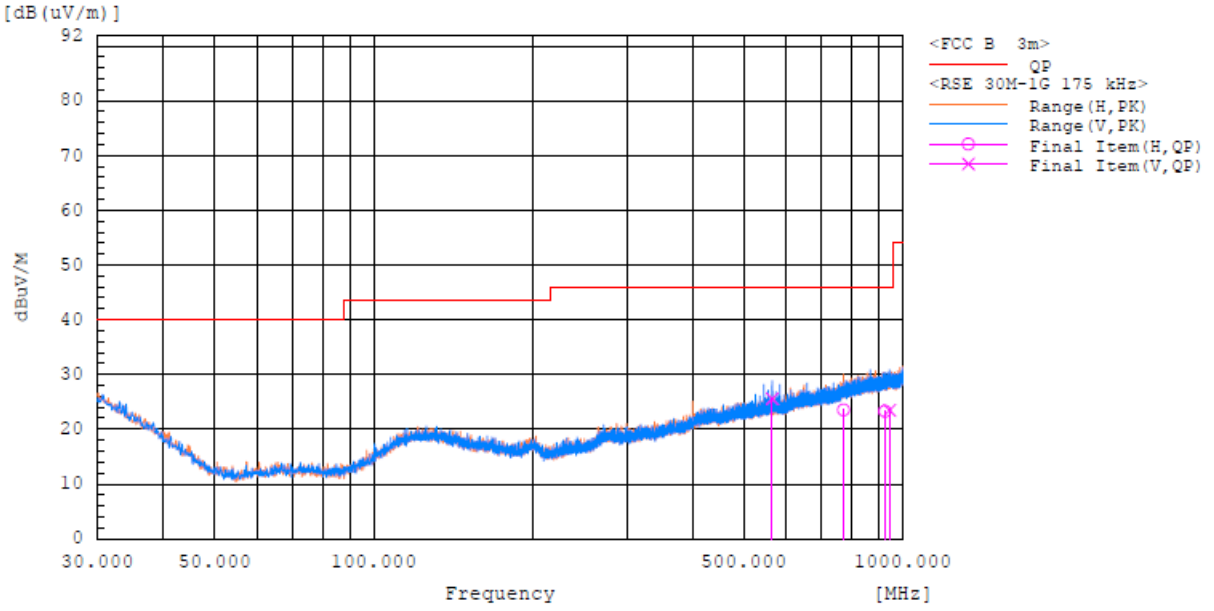
▣ TEST PLOTS

Radiated Spurious Emission 9 kHz – 30 MHz (Antenna Position 90°)


Radiated Spurious Emission 9 kHz – 30 MHz (Antenna Position 180°)


▣ TEST PLOTS

Radiated Spurious Emission 9 kHz – 30 MHz (Antenna Position Bent Over)


Radiated Spurious Emission 30 MHz – 1 GHz


10. LIST OF TEST EQUIPMENT

No.	Instrument	Model No.	Calibration Due (mm/dd/yy)	Manufacture	Serial No.
☒	Signal Analyzer (1 Hz ~ 44 GHz)	ESW44	10/25/2023	Rohde & Schwarz	102015
☒	Signal Analyzer (10 Hz ~ 40.0 GHz)	ESU40	12/02/2023	Rohde & Schwarz	102363
☐	Signal Analyzer (10 Hz ~ 26.5 GHz)	N9020A	12/05/2023	Keysight	MY52091291
☐	Attenuator (10 dB, DC ~ 26.5 GHz)	CFADC261002	01/10/2024	CERNEX	None
☒	Loop Antenna (0.009 ~ 30 MHz)	HLA 6121	09/15/2023	TESEQ	43964
☒	BI-LOG Antenna (30 MHz ~ 6 GHz)	JB6	10/28/2024	Sunol	A071116
☒	LNA (30 MHz ~ 1GHz)	8447D	09/23/2023	HP	2944A07773
☐	EMI Test Receiver	ESR3	12/02/2023	Rohde & Schwarz	102363
☐	LISN	ENV216	01/17/2024	Rohde & Schwarz	101349

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date

APPENDIX A. TEST SETUP PHOTOS

The setup photos are provided as a separate document

Hyundai C-Tech, Inc. dba HCT America, Inc., 1726 Ringwood Avenue, San Jose, CA 95131, USA TEL: +1-510-933-8848 FAX: +1-510-933-8849

APPENDIX B. PHOTOGRAPHS OF EUT

B.1. EXTERNAL PHOTOS

The external photos are provided as a separate document

B.2. INTERNAL PHOTOS

The internal photos are provided as a separate document

Hyundai C-Tech, Inc. dba HCT America, Inc., 1726 Ringwood Avenue, San Jose, CA 95131, USA TEL: +1-510-933-8848 FAX: +1-510-933-8849

END OF TEST REPORT

Hyundai C-Tech, Inc. dba HCT America, Inc., 1726 Ringwood Avenue, San Jose, CA 95131, USA TEL: +1-510-933-8848 FAX: +1-510-933-8849