Test Report # 3584 F (NFC)

Equipment Under Test:	A700x Series Devices (A710x, A720x, A730x)
Requirement(s):	FCC 15.225 | RSS-210
Test Date(s):	May 12th-June 8th, 2022
Prepared for:	Honeywell International Inc. Attn: Gretchen Bullen 9680 Old Bailes Road Fort Mill, SC 29707

Report Issued by: Adam Alger, Laboratory Manager

Signature: Adam O Alger Date: 9/15/2022

Report Reviewed by: Adam Alger, Laboratory Manager

Signature: Adam O Alger Date: 7/6/2022

Report Constructed by: Zach Wilson, EMC Engineer

Signature: Zach Wilson Date: 7/5/2022

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Laird Connectivity Test Services in Review

The Laird Connectivity, Inc. laboratory located at W66 N220 Commerce Court Cedarburg, Wisconsin, 53012 USA is recognized through the following organizations:

Certificate #1255.01

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025:2017 with Electrical (EMC) Scope

A2LA Certificate Number: 1255.01

Scope of accreditation includes all test methods listed herein unless otherwise noted

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Federal Communications Commission (FCC) – USA

Accredited Test Firm Registration Number: 953492

Recognition of two 3 meter Semi-Anechoic Chambers

Innovation, Science and Economic Development Canada

Accredited U.S. Identification Number: US0218

Recognition of two 3 meter Semi-Anechoic Chambers

1 TEST REPORT SUMMARY

During **June 15th-21st, 2022** the Equipment Under Test (EUT), **A700x Series Devices (A710x, 720x, 730x)**, as provided by **Honeywell International Inc.** was tested to the following requirements **Federal Communications Commission and Innovation, Science and Economic Development Canada**:

FCC 15.225, RSS-210

Requirements	Description	Specification	Method	Compliant
FCC: 15.209 IC: RSS-210	Intentional Radiated Emissions	30 – 1000 MHz	ANSI C63.10	Yes
FCC: 15.225 IC: RSS-210	Operation within the band 13.110 – 14.010 MHz	9 kHz – 30 MHz	ANSI C63.10	Yes
FCC: 2.1049 IC: RSS-GEN (6.7)	Occupied Bandwidth	Reported	ANSI C63.10	Reported
RSS-102	RF Exposure Compliance	Reported	RSS-102	Reported

Notice:

The results relate only to the item tested as configured and described in this report. Any additional configurations, modes of operation, or modifications made to the equipment under test after the specified test date(s) are at the decision of the client and may not apply to the data seen in this test report.

The decision rule for Pass / Fail assessment to the specification or standard listed in this test report has been agreed upon by the client and laboratory to be as follows:

Measurement Type	Rule
Emissions – Amplitude	1 dB below specified limit
Emissions – Frequency	1% less than the specification
Immunity	Tested at specified level

2 CLIENT INFORMATION

Company Name	Honeywell International Inc.
Contact Person	Gretchen Bullen
Address	9680 Old Bailes Road Fort Mill, SC 29707

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	A700x Series Devices (A710x, 720x, 730x)
Model Number	TAP1010-02, TAP1020-02, TAP1030-02
Serial Number	Engineering Sample
FCC ID	HD5-TAP1000-02
IC ID	1693B-TAP100002

2.2 Product Description

The EUT is a handheld communication device consisting of the Laird SU60-SIPT WLAN 2.4/5 GHz and BLE/BT module. The EUT also contains the NXP PN7150BOHN/C110xx NFC radio. The EUT was powered by a 3.7 VDC battery. The WLAN operates in SISO mode only.

The EUT has three different models:

- A710x - Contains the basic wireless functionality
- A720x - Contains an end cap with two external proprietary connectors that add on the ability to connect a wired headset and a peripheral device such as a printer or scanner.
- A730x - Contains an imager end cap that adds scanning functionality.

All models use identical radios and circuit boards in the “base unit” and the different A700x versions add additional (non-radio) capabilities through different, factory configurable “end caps”.

All conducted testing was completed on the A710x model. Radiated measurements completed for all three models.

2.3 Modifications Incorporated for Compliance

None noted at time of test

2.4 Deviations and Exclusions from Test Specifications

None noted at time of test

2.5 Channels and Data Rates

Single channel and data rate

2.6 Radio Programming

The WLAN radios were programmed using the Laird Regulatory Tool v 9.32.0.6. BLE and BT radios were programmed using default HCI commands via the windows command prompt. The NFC radio was programmed using Honeywell's CBOB program V1.0.

2.7 Simultaneous Transmission

The EUT radio combinations that are capable of simultaneous transmission are shown below:

- WLAN 5 GHz + BT/BLE + NFC
- WLAN 2.4 GHz + NFC

2.8 Antennas

The device contains three antennas:

- Custom dual band PCB inverted F type antenna with a peak gain of
  - +4.7 dBi in 2400-2484 MHz
  - +6.4 dBi in 5150-5350 MHz
  - +6.9 dBi in 5470-5725 MHz
  - +7.3 dBi in 5725-5850 MHz
- Custom PCB inverted F type antenna with a peak gain of +0.2 dBi for the BT/BLE radios.
- Flex circuit magnetic loop antenna, P/N 1002403 for the NFC radio.

3 REFERENCES

Publication	Edition	Date	AMD 1	AMD 2
FCC eCFR	-	2022	-	-
RSS-GEN	5	2018-04	2019-03	2021-02
RSS-210	10	2019-12	2020-04	-
ANSI C63.10	-	2013	-	-
RSS-102	5	3/19/2015	2/2/2021	

4 UNCERTAINTY SUMMARY

Using the guidance of the following publications the calculated measurement uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k = 2.

References	Version / Date
CISPR 16-4-1	Ed. 2 (2009-02)
CISPR 16-4-2	Ed. 2 (2011-06)
CISPR 32	Ed. 1 (2012-01)
ANSI C63.23	2012
A2LA P103	February 4, 2016
A2LA P103c	August 10, 2015
ETSI TR 100-028	V1.3.1 (2001-03)

Measurement Type	Configuration	Uncertainty ±
Radiated Emissions	Biconical Antenna	5.0 dB
Radiated Emissions	Log Periodic Antenna	5.3 dB
Radiated Emissions	Horn Antenna	4.7 dB
AC Line Conducted Emissions	Artificial Mains Network	3.4 dB
Telecom Conducted Emissions	Asymmetric Artificial Network	4.9 dB
Disturbance Power Emissions	Absorbing Clamp	4.1 dB
Radiated Immunity	3 Volts/meter	2.2 dB
Conducted Immunity	CDN/EM/BCI	2.4/3.5/3.4 dB
EFT Burst/Surge	Peak pulse voltage	164 volts
ESD Immunity	15 kV level	1377 Volts

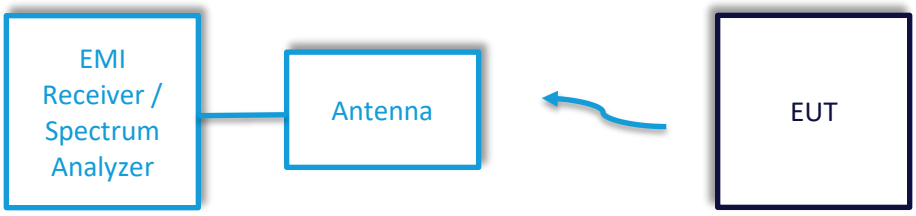
Parameter	ETSI U.C. ±	U.C. ±
Radio Frequency, from F0	$1x10^{-7}$	$0.55x10^{-7}$
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

5 TEST DATA

5.1 Radiated Emissions

Description of Measurement	The frequency spectrum is investigated for intentional and / or unintentional signals emanating from the EUT by use of a standardized test site and measurement antenna. The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed allowing the data to be gathered and reported as corrected values. The maximum emissions from the EUT are determined by turn-table azimuth rotation (360°) and scanning of the measurement antenna. Maximized levels are noted at degree values of azimuth, measurement antenna height, and measurement antenna polarity.
Example Calculations	Measurement (dBµV) + Cable factor (dB) + Other (dB) + Antenna Factor (dB/m) = Corrected Reading (dBµV/m) Margin (dB) = Limit (dBµV/m) - Corrected Reading (dBµV/m) Example at 4000 MHz: Reading = 40 dBµV + 3.4 dB + 0.9 dB + 6.5 dB/m = 50.8 dBµV/m Average Limit = 20 log (500) = 54 dBµV/m Margin = 54 dBµV/m - 50.8 dBµV/m = 3.2 dB

Block Diagram



5.1.1 Radiated Emissions: 150 kHz – 30 MHz

Operator	Jon Dilley	**QA**	Adam Alger
Temperature	21.9°C	**R.H. %**	51.70%
Test Date	5/12/2022	**Location**	Chamber 5
Requirement	FCC 15.225/209	**Method**	ANSI C63.10

FCC 15.209 Limits:

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m) (d_{limit})	Field Strength (dBµV/m) @ measurement distance
0.009-0.490	2400/F(kHz) [1]	300 [3]	Use F (kHz) [2]
0.490-1.705	24000/F(kHz) [1]	30 [3]	Use F (kHz) [2]
1.705-30	30	30 [3]	29.5

Note 1: F = measured frequency.

Note 2: Eq. 1 used to convert Field Strength (FS) to limit in dBµV/m.

Note 3: Conversion of measurement distance made using a combination of Eq. 2, Eq. 3, and Eq. 4.

FCC 15.225 Limits:

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m) (d_{limit})	Field Strength (dBµV/m) @ measurement distance
13.553-13.567	15848	30	84.0
13.410-13.553	334	30	50.5
13.567-13.710	334	30	50.5
13.110-13.410	106	30	40.5
13.710-14.010	106	30	40.5
13.110-14.010 outside	15.209 limits	see 15.209	see 15.209

Test Parameters

Frequency	9 kHz – 30 MHz	**Distance**	3 m ($d_{measure}$)
Detector(s)	Quasi-Peak, Average	**Table height**	80 cm
RBW	200 Hz, 9 kHz	**VBW**	2 kHz, 90 kHz
Example Calculations	Eq. 1 | dBµV/m field strength conversion: $20 * \log\left(FS\left(\frac{\mu V}{m}\right)\right)$ Eq. 2 | $d_{near\ field} = \frac{\lambda}{2\pi} distance = {}^{47.77}/_{f_{MHz}}$ If $d_{measure} < \frac{\lambda}{2\pi}$ and $d_{limit} > \frac{\lambda}{2\pi}$, the measurement shall be extrapolated using Eq. 3 Eq. 3 | $FS_{limit} = FS - 40 * \log\left(\frac{d_{near\ field}}{d_{emasure}}\right) - 20 * \log\left(\frac{d_{limit}}{d_{near\ field}}\right)$ If $d_{measure} \leq \frac{\lambda}{2\pi}$ and $d_{limit} \leq \frac{\lambda}{2\pi}$, the measurement shall be extrapolated using Eq. 4 Eq. 4 | $FS_{limit} = FS - 40 * \log\left(\frac{d_{limit}}{d_{emasure}}\right)$		
Loop Antenna	Parallel, Perpendicular, Skew refers to 3 orthogonal planes of antenna for maximizing emissions		

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960206	Antenna - Loop	A.H. Systems, Inc.	SAS-565-H	2758	9/3/2021	9/3/2023	Active Calibration
EE 960085	Analyzer - EMI Receiver	Agilent	N9038A	MY51210148	4/11/2022	4/11/2023	Active Calibration
LSC-500	Cable	Chamber 5 Emissions	-	-	4/25/2022	4/25/2023	Active Verification

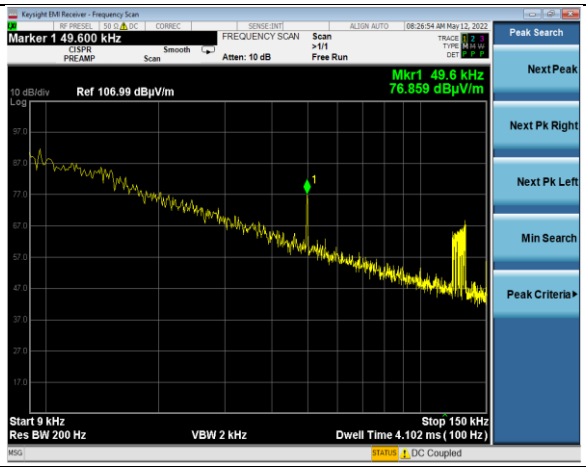
EUT Parameters

Input Power	3.7 VDC battery	**Mode**	NFC

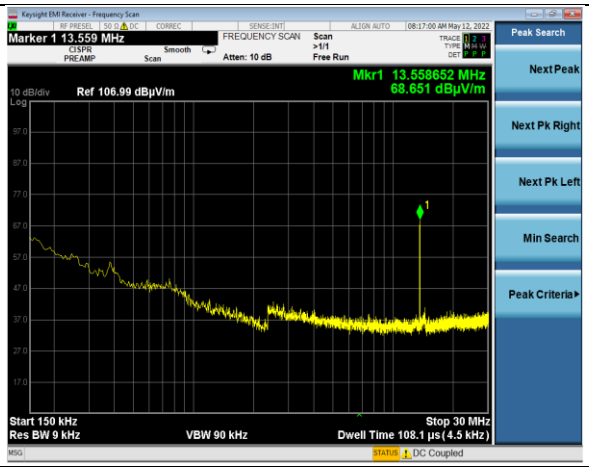
Table

Frequency (MHz)	Antenna Polarity	Height (cm)	Azimuth (degree)	Quasi-Peak Reading @ 3m	Correction to Quasi-Peak Reading	Corrected Quasi-Peak @ Limit Distance	Quasi-Peak Limit @ Limit Distance	Quasi-Peak Margin (dB)
				(dBµV/m)				
13.56	Parallel	100	0	68.7	-21.4	47.3	84.0	36.7

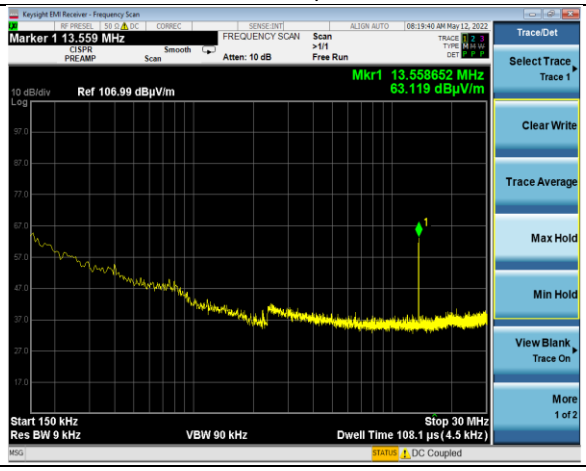
Plots (worst case)



9 kHz – 150 kHz (Ambient emissions, not from EUT)



150 kHz – 30 MHz Horizontal EUT, Parallel Antenna



150 kHz – 30 MHz Horizontal EUT, Perpendicular Antenna

150 kHz – 30 MHz Horizontal EUT, Skew Antenna

5.1.2 Radiated Emissions: 30 – 25000 MHz

Operator	Jon Dilley	**QA**	Adam Alger
Temperature	21.9°C	**R.H. %**	51.70%
Test Date	5/12/2022	**Location**	Chamber 5
Requirement	FCC 15.225/209	**Method**	ANSI C63.10

Limits:

Frequency (MHz)	Quasi-Peak Limit (dBµV/m)	Average Limit (dBµV/m)	Peak Limit (dBµV/m)
30-88	40.0	-	-
88-216	43.5	-	-
216-960	46.0	-	-
960-1000	54.0	-	-
1000-25000	-	54.0	74.0

Test Parameters

Frequency	30 – 1000 MHz	**Distance**	3 m
Detector(s)	Quasi-Peak	**Table height**	80 cm
RBW	120 kHz	**VBW**	1.2 MHz
Notes	Emissions determined to not be a product of the transmitter.		

EUT Parameters

Input Power	3.7 VDC battery	**Mode**	NFC

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960158	Antenna - Double Ridge Horn	ETS Lindgren	3117	109300	9/27/2021	9/27/2022	Active Calibration
AA 960171	Cable	A.H. Systems, Inc.	SAC-26G-6	386	3/22/2022	3/22/2023	Active Verification
AA 960174	Antenna - Small Horn	ETS Lindgren	3116C-PA	00206880	9/1/2021	9/1/2022	Active Calibration
AA 960194	Antenna - Biconical	A.H. Systems, Inc.	SAS-540	780	9/2/2021	9/2/2022	Active Calibration
AA 960195	Antenna - Log Periodic	A.H. Systems, Inc.	SAS-512-2	557	8/17/2021	8/17/2022	Active Calibration
AA 960211	Antenna - Low Noise Amplifier	Mini-Circuits	ZVA-213X-S+	977711030	9/27/2021	9/27/2022	Active Calibration
EE 960085	Analyzer - EMI Receiver	Agilent	N9038A	MY51210148	4/11/2022	4/11/2023	Active Calibration
LSC-500	Cable	Chamber 5 Emissions	-	-	4/25/2022	4/25/2023	Active Verification

Data Tables

30-1000 MHz

Frequency (MHz)	Antenna Polarity	EUT Orientation	Height (cm)	Azimuth (degree)	Quasi-Peak Reading (dBµV/m)	Quasi-Peak Limit (dBµV/m)	Quasi-Peak Margin (dB)
192.6	Horizontal	Horizontal	100	0	24.3	43.5	19.3
196.9	Vertical	Horizontal	100	0	24.5	43.5	19.0
601.9	Horizontal	Horizontal	100	0	25.2	46.0	20.8
600.0	Vertical	Horizontal	100	260	35.0	46.0	11.0

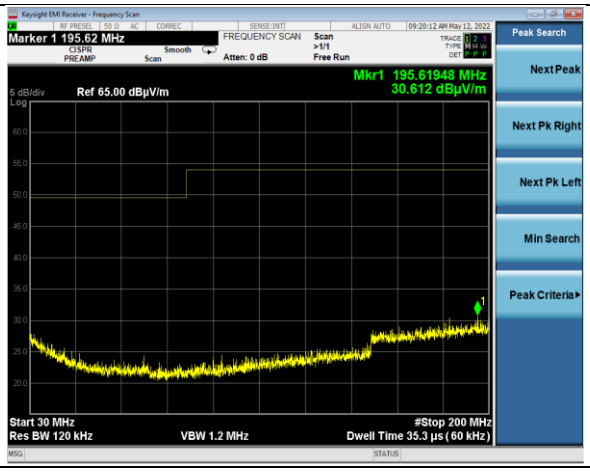
Note: Emissions determined to not be a product of the transmitter.

1000-25000 MHz

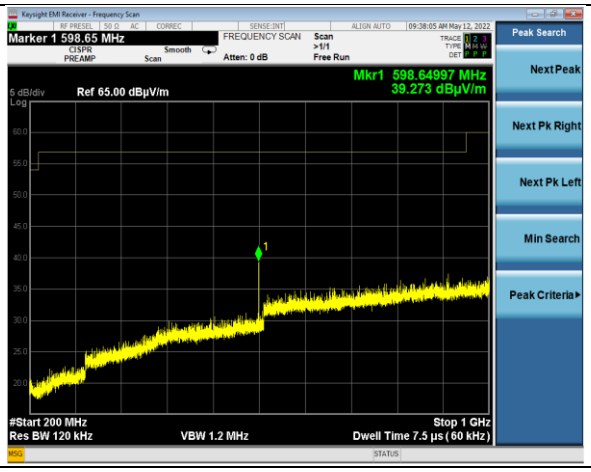
Frequency (MHz)	Antenna Polarity	EUT Orientation	Height (cm)	Azimuth (degree)	Average Reading (dBµV/m)	Average Limit (dBµV/m)	Average Margin (dB)	Peak Reading (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)
1199.8	Vertical	Horizontal	145	78	25.7	54.0	28.3	42.2	74.0	31.8
1200.0	Horizontal	Horizontal	150	0	24.1	54.0	29.9	41.8	74.0	32.2

Note: Emissions determined to not be a product of the transmitter.

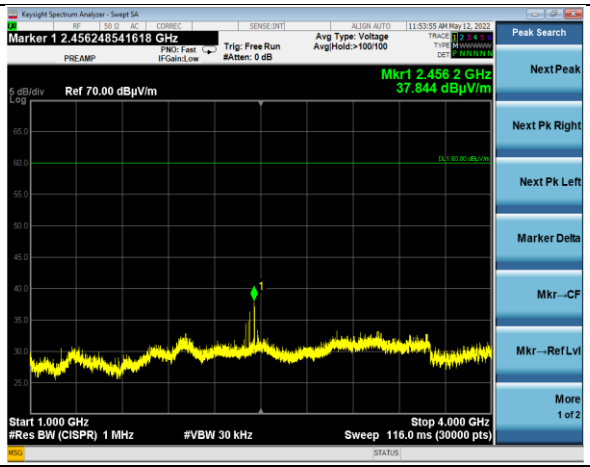
Plots (worst case)



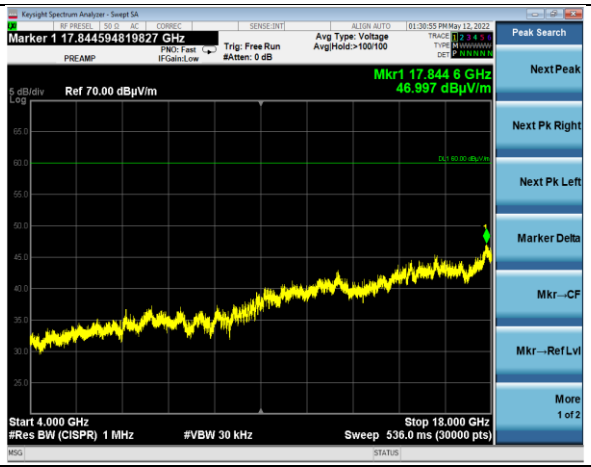
30-200 MHz Horizontal



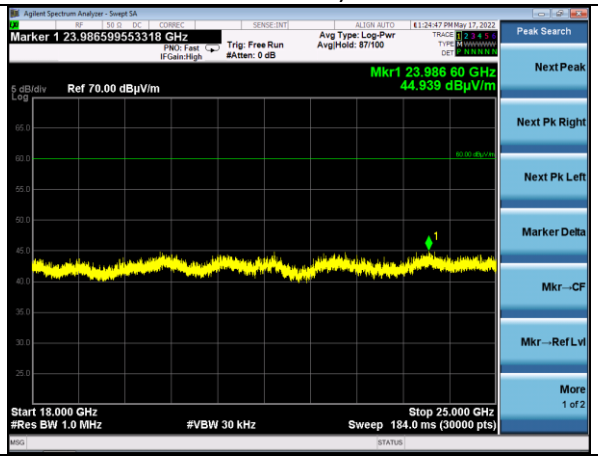
200-1000 MHz Horizontal



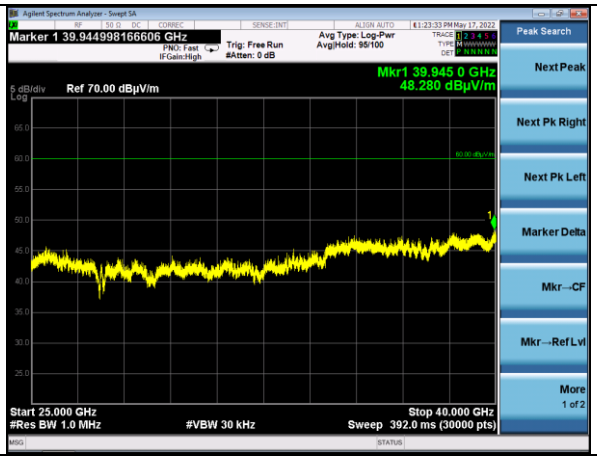
1-4 GHz Horizontal (ambient emission noted at marker)



4-18 GHz Horizontal



18-25 GHz Horizontal



25-40 GHz Horizontal

5.1.3 99% Occupied Bandwidth

Operator	Zach Wilson	**QA**	Adam Alger
Temperature	21.1 °C	**R.H. %**	48.3 %
Test Date	6/8/2022	**Location**	Conducted Bench
Requirement	FCC 2.1049 IC: RSS-GEN 6.7	**Method**	ANSI C63.10

Test Parameters

Frequency	13.56 MHz	**Detector(s)**	Peak
RBW	10 kHz	**VBW**	100 kHz

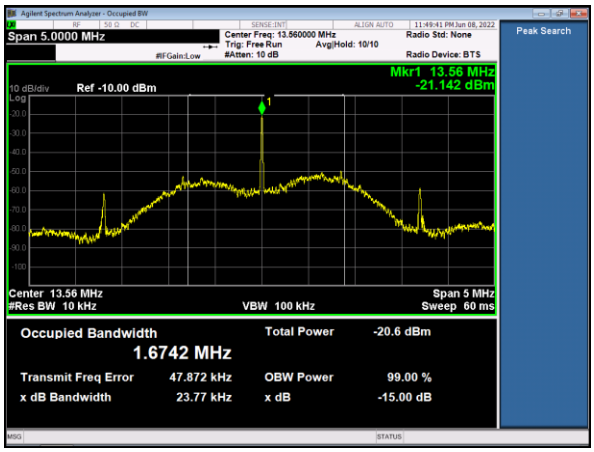
Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960030	Probe - Near Field Kit	EMCO	7405	9509/1152	XXX	XXX	Indication Only
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/12/2022	4/12/2023	Active Calibration

EUT Parameters

Input Power	3.7 VDC battery	**Mode**	NFC

Plot



Note: Measured Occupied Bandwidth is 1.6742 MHz

5.1.4 Frequency Stability

Operator	Zach Wilson	QA	Adam Alger
Temperature	21.1 °C	R.H. %	48.3 %
Test Date	6/8/2022	Location	Temp Chamber
Requirement	FCC 15.225 (e) IC: RSS-GEN 6.11	Method	ANSI C63.10

Limit = ±0.01% over -20 degrees to +50 degrees C

Test Parameters

RBW	1.1 kHz	VBW	11 kHz
Example Calculation	$\frac{\lvert f_{max} - f_{min} \rvert}{f_{max}} * 100 = \% \, Variation$		

Instrumentation

Asset #	Description	Manufacturer	Model #	Serial #	Date	Due Date	Status
AA 960030	Probe - Near Field Kit	EMCO	7405	9509/1152	XXX	XXX	Indication Only
CC 000210C	Chamber - Environmental	Thermotron	S-8C	28133	4/19/2022	4/19/2023	Active Verification
EE 960087	Analyzer - Spectrum	Agilent	N9010A	MY53400296	4/12/2022	4/12/2023	Active Calibration

EUT Parameters

Input Power	3.7 VDC battery	Mode	NFC

Temperature Variation

Temp (°C)	Center Frequency (Hz)
20	13559718.5
-20	13559744.1
50	13559709.5

Frequency Tolerance = 0.000255167 %

6 RF EXPOSURE EVALUATION

ISED

Frequency (MHz)	Average Reading @ 3m (dBµV/m)	Field Strength converted to dBm[1]	EUT Output power (mw)	SAR Test Exclusion (mw)[2]	MPE Distance (mm)
13.56	68.7	-26.5	0.00224	71.0	≤ 5

1: Output power converted from 3m field strength measurement (FS dBµV/m – 95.2)

2: RSS-102 2.5.1

Result: EUT power of 0.00224 mW is less than the exclusion threshold of 71 mW at the minimum distance of 5 mm.

7 REVISION HISTORY

Version	Date	Notes	Person
0	7/6/2022	Initial Draft	Zach Wilson
1	7/6/2022	Final	Zach Wilson
2	8/11/2022	TCB Comments addressed	Adam Alger
3	9/15/2022	Antenna gain updated	Adam Alger

END OF REPORT