FCC Part 15 & ISED Canada Certification Test Report

for the

Frederick Energy Products, LLC

DDAC-10P-WCHG

FCC ID: QUI-DDAC-10P-WCHG
ISED ID: 11625-DDAC10PWCHG

WLL REPORT# 19115-01 REV 1

Prepared for:

Frederick Energy Products, LLC

1769 Jeff Road

Huntsville, Alabama 35806

Prepared By:

Washington Laboratories, Ltd.

4840 Winchester Boulevard, Suite 5.

Frederick, Maryland 21703

Testing Certificate AT-1448

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FCC ID: QUI-DDAC-10P-WCHG

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April 7, 2025

WLL Report# 19115-01 Rev 1

Prepared by:

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Reviewed by:

Steven D. Koster
President

Abstract

This report has been prepared on behalf of Frederick Energy Products, LLC to support the attached Application for Equipment Authorization. The test report and application are submitted for a low power transmitter device under Part 15.209 of the FCC Rules and under Regulations and ISED Canada RSS-Gen, Issue 5 (4/2018). This certification test report documents the test configuration and test results for the Frederick Energy Products, LLC DDAC-10P-WCHG, 10-bay wireless charger. The information provided in this report is only applicable to the device herein documented, as the EUT.

Testing above 30 MHz was performed in the Free-space Anechoic Chamber Test-site (FACT) 3m chamber of Washington Laboratories, Ltd., located at 4840 Winchester Boulevard, Suite 5. Frederick, Maryland 21703 (USA). Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The ISED Canada number for Washington Laboratories, Ltd. is 3035A. Washington Laboratories, Ltd. has been accepted by the FCC and ISED Canada as an independent test laboratory; approved by ANAB under Certificate AT-1448.

The Frederick Energy Products, LLC DDAC-10P-WCHG complies with the limits for a transmitter device under FCC Part 15.209 and ISED Canada RSS-GEN.

Revision History	Description of Change	Issue Date
Rev 0	Initial Release	April 7, 2025
Rev 1	Retest OBW in the Near-Field	May 2, 2025

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1 Introduction

1.1 Compliance Statement

The Frederick Energy Products, LLC DDAC-10P-WCHG complies with the limits for a transmitter device under FCC Part 15.209 and ISED Canada RSS-GEN.

1.2 Test Scope

Tests for radiated emissions and AC powerline emissions were performed. All measurements were performed according with ANSI C63.4 & ANSI C63.10. The measurement equipment conforms to ANSI C63.4 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer: Frederick Energy Products LLC
1769 Jeff Drive,
Huntsville, AL, 35806

Quotation Number: 75087A

1.4 Testing Dates

Testing was performed during the following date(s): 2/27/2025 to 3/19/2025 & 5/2/2025.

1.5 Test and Support Personnel

Washington Laboratories, LTD	Ryan Mascaro and Richard Quarcoo
Customer Representative	Andrew Nicholas and Will Murrey

2 Equipment Under Test

2.1 EUT Identification & Description

The 10-Bay wireless charger is an accessory device for the larger Hit-Not® complete system. The charger is used to charge the Personal Alarm Device (PAD) worn by pedestrians in facilities utilizing the Hit-Not® system. PADs are placed on the charger after use and are recharged for the next pedestrian.

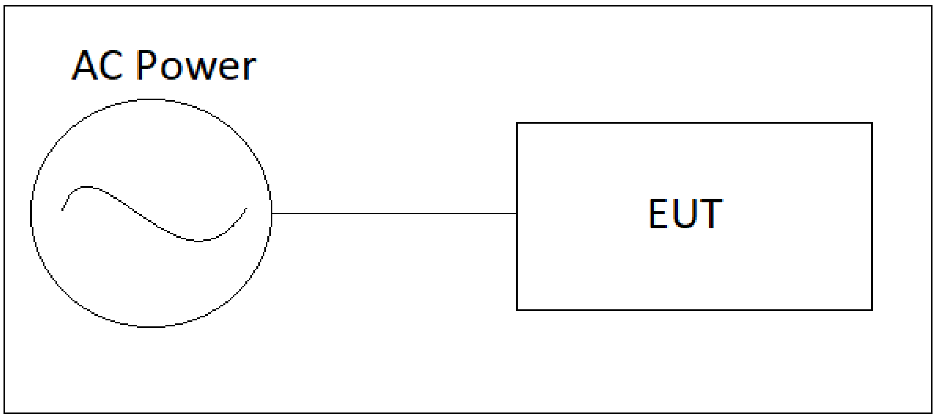
Table 1: EUT Device Summary

ITEM	DESCRIPTION
Manufacturer:	Frederick Energy Products, LLC
FCC ID:	QUI-DDAC-10P-WCHG
IC ID:	11625-DDAC10PWCHG
Model:	DDAC-10P-WCHG
Power Source & Voltage:	5VDC via 120VAC AC/DC power supply
FCC Rule Parts:	15.209
IC Rule Part:	RSS-GEN
TX Frequency:	145.0 kHz
TX Antenna Type:	Magnetic coil
Maximum Field Strength:	2.87 uV/m at 3-meters (Peak)
20dB Occupied Bandwidth:	6.589 kHz
99% Occupied Bandwidth:	7.503 kHz
FCC Emission Designator	6K59P0N
IC Emission Designator	7K50P0N
Modulation or Keying:	Pulsed, Automatic
Type of Information:	Proximity
Number of Channels:	*not declared by applicant*
EUT Software Version:	*not declared by applicant*
EUT Firmware Version:	*not declared by applicant*
Interface Cables:	AC/DC powerline
Worst-Case Spurious Emissions:	171.974 MHz, 42.755 dBuV/m (QP) @ 3-meters

2.2 Test Configuration

The EUT was tested in a stand-alone configuration, with the main input voltage supplied from the EUT's AC/DC power supply.

Figure 1: EUT Testing Configuration



2.3 Testing Algorithm

The EUT operates continuously when power is applied. The output of the transmitter is pulsed and has a very low duty cycle (~3% to 5%) when no PAD is present; this serves as a searching signal. As PADs are docked into the charging bank, the duty cycle of the transmitter increases as the charge circuit is enabled. The worst-case timing occurs when all ten PADs are charging simultaneously. In this mode, the typical duty cycle is expected to be ~85% to 99%. The EUT was evaluated in two operation modes; (1) idle/searching with no PADs docked, and (2) fully-loaded with all 10 PADs charging simultaneously. The active, fully loaded mode is worst-case. This mode was maintained during all final testing. The EUT was investigated for worst-case radiated emissions by varying the orthogonal axis of the EUT (x, y, z). For testing of frequencies below 30MHz, the active loop antenna was rotated about its vertical and horizontal axis in accordance with ANSI C63.10-2020, clause 6.4.6 and 6.11.2. The EUT was positioned on the testing site to produce the worst-case emissions. For all testing, the EUT was tested in a steady-state operational mode. When charging PADs, the EUT was allowed sufficient time to stabilize. Only the worst-case emission levels are reported.

2.4 Equipment Configuration

The EUT was comprised of the following equipment. (All Modules, PCBs, etc. listed were considered as part of the EUT, as tested.)

Table 2: Equipment Configuration

EUT	Manufacturer	Model	Serial Number	Revision
PAD Charger	FEPL	DDAC-10P-WCHG	--	--

Table 3: Support Equipment

Item	Model/Part Number	Serial Number
PAD x10	DDAC-PAD-WC	--

Table 4: Interface Cables

Port Identification	Connector Type	Cable Length	Shielded (Y/N)	Termination Point
5VDC Input	DC Jack	< 3-meters	N	AC Mains

2.5 EUT Modifications

No modifications were performed in order to meet the test requirements.

2.6 Test Location

Testing above 30 MHz was performed in the Free-space Anechoic Chamber Test-site (FACT) 3m chamber of Washington Laboratories, Ltd., located at 4840 Winchester Boulevard, Suite 5 Frederick MD 21703. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The ISED Canada number is 3035A for Washington Laboratories, Ltd. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Certificate AT-1448 as an independent FCC test laboratory.

2.7 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

ANSI C63.10 (9/2020) American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

2.8 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm\sqrt{\frac{a^2}{div_a{}^2} + \frac{b^2}{div_b{}^2} + \frac{c^2}{div_c{}^2} + \ldots\ldots}$$

where,

u_c	= standard uncertainty
a, b, c,..	= individual uncertainty elements
$Div_{a,\, b,\, c}$	= the individual uncertainty element divisor based on probability distribution
Divisor	= 1.732 for rectangular distribution
Divisor	= 2 for normal distribution
Divisor	= 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

where,

U	= expanded uncertainty
k	= coverage factor
k	$\leq$ 2 for 95% coverage (ANSI/NCSL Z540-2 Annex G)
u_c	= standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 5 below.

Table 5: Expanded Uncertainty List

Scope	**Standard(s)**	**Expanded Uncertainty**
Conducted Emissions	CISPR11, CISPR32, CISPR14, FCC Part 15	± 2.63 dB
Radiated Emissions	CISPR11, CISPR32, CISPR14, FCC Part 15	± 4.55 dB

3 Test Equipment

Table 6 shows a list of the test equipment used for measurements along with the calibration information

Table 6: Test Equipment List

Test Name:	**Radiated Emissions**	Test Dates: 2/27/2025 to 3/19/2025	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00823	AGILENT, EXA	SPECTRUM ANALYZER	6/21/2026
00993	KEYSIGHT N9020B	MXA SIGNAL ANALYZER	11/6/2025
00644	SUNOL SCIENCES CORP.	ANTENNA, LOGPERIOD	12/2/2026
00977	JUNKOSHA, USA MX-322	6M COAXIAL CABLE, SMA/N	2/11/2026
00031	EMCO 6502	ANTENNA ACTIVE LOOP	6/17/2027
00065	ELECTRO-METRICS	RF PRE-AMPLIFIER	8/23/2025
00806	MINI-CIRCUITS, 3061	HF COAX CABLE, SMA	12/18/2025
00825	CABLE ASSOCIATES	SMA, COAXIAL CABLE	6/14/2025
00065	HP, 8447D	RF PRE-AMPLIFIER	8/23/2025
00731	NARDA 4779-3	2W, 3DB ATTENUATOR	6/20/2025

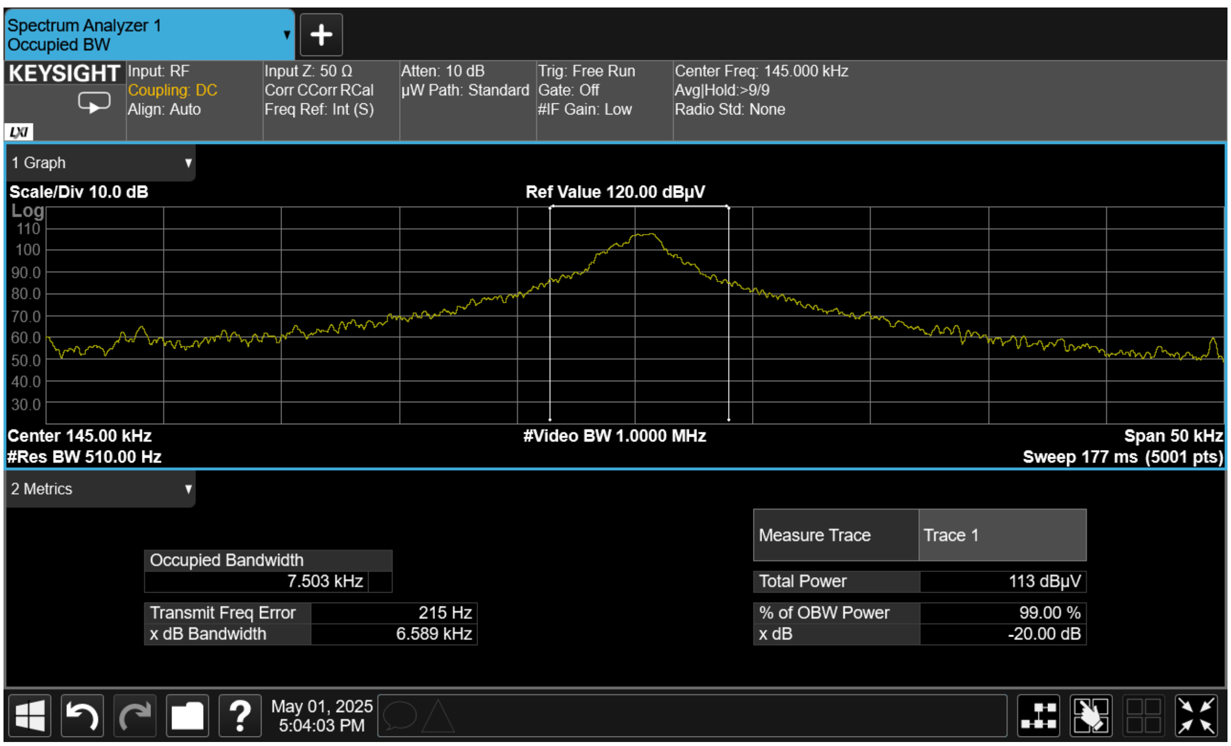
Test Name:	**AC Power Emissions**	Test Date: 2/27/2025	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00823	AGILENT, N9010A	EXA SPECTRUM ANALYZER	6/21/2026
00330	WLL CE SITE CABLE	BNC COAXIAL CABLE	6/25/2025
00125	SOLAR 8028-50-TS-24-BNC	LISN	4/18/2025
00126	SOLAR 8028-50-TS-24-BNC	LISN	4/18/2025

4 Test Results

4.1 Occupied Bandwidth (Part §2.1049; RSS-Gen, 6.7)

The occupied bandwidth measurement was performed in accordance with ANSI C63.10 (2020), clause 6.9.2. The EUT was positioned 10-cm from an active loop antenna. The EUT was positioned on the test site to produce the worst-case emissions. For OBW, the EUT was configured in the fully-loaded mode, charging all 10 PADs simultaneously; this is worst-case. The trace was provided sufficient time to stabilize. The final test result is provided below.

Figure 2: Occupied Bandwidth Test Results, Worst-Case



20dB BW = 6.589 kHz

99% BW = 7.503 kHz

4.2 Radiated Emissions (FCC Part §15.209)

Transmitters operating under §15.209 must comply with the radiated emission limitations listed in the following table:

Table 7: Radiated Emissions Limits, FCC

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

4.2.1 Test Procedure

The EUT was investigated in three orthogonal axes (x, y, z). The worst-case positioning was maintained during the final measurements. For all testing below 30MHz, the EUT was configured in the fully-loaded mode, charging all 10 PADs simultaneously; this is worst-case.

For frequencies between 9 kHz and 30 MHz, a loop antenna was mounted at a fixed-height of 1-meter and rotated about its vertical and horizontal axis in accordance with ANSI C63.10-2020, clause 6.4.6 and 6.11.2. For frequencies above 30MHz the receiving antenna was mounted on a mast and the height of the antenna was varied between 1 and 4 meters to determine the maximum emissions. Both the horizontal and vertical field components were measured.

For all radiated testing, the EUT was placed on an 80 cm high 1 X 1.5 meters non-conductive motorized turntable. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. The output of the antenna was connected to the input of the spectrum analyzer and the emissions in the frequency range of 9 kHz to 1 GHz were measured, which covers the 10th harmonic of the fundamental. Cables were varied in position to produce maximum emissions.

Test Procedure Continued

Because the magnetic transmit signal is pulsed, the fundamental and harmonics were tested for Peak emissions. The average field strength is mathematically averaged using DCCF, then compared to the Average limits defined in Table 7.

The following measurement bandwidths were employed:

- 9 kHz to 150 kHz = 200 Hz
- 150 kHz to 30 MHz = 9 kHz
- 30 MHz to 1 GHz = 120 kHz

The following final test distances were employed:

- 9 kHz to 30 MHz = 3-meters
- 30 MHz to 1 GHz = 3-meters

In accordance with FCC Part §15.31(f)(2): for measurements of frequencies below 30 MHz, the measurement distance is permitted to be less than specified in the applicable limitation tables, with the field strength levels corrected using an extrapolated calculation to the specified measurement distance. This extrapolated distance-calculation is defined by making measurements at two separate distances, on the same radial, to determine the proper extrapolation factor. As such, the field strength of the EUT transmit signal was evaluated at 10m, 3m, and 1m. The measured field strength values are as follows:

10-meters: <u>not detected in a 200Hz RBW</u>

3-meters: 52.91 dBµV (uncorrected, single radial)

1-meter: 80.24 dBµV (uncorrected, single radial)

80.24 – 52.91 = 27.33

27.33 shall be rounded to 20 dB, as a worst-case fall-off factor for these two evaluation distances.

Distance Correction Factor Explained

The use of 40 dB/decade for factoring the ratio of the two distances produces the equivalent sum of 20dB as follows:

40LOG(3/1) = 19.1 (shall be rounded to 20 dB).

therefore,

40LOG(300/3) shall be used to calculate the distance correction from 300-meters to 3-meters.

40LOG(300/3) = 80.00 dB

Table 8: Fundamental Transmitter Test Data, FCC (3-meters)

TX Frequency (kHz)	RX Antenna Polarity	EUT Polarity	SA Level (dBuV)	Antenna Factor (dB/m)	DCCF (dB)	Distance Corr. Factor (dB)	Corr. F/S (uV/m)	Limit (uV/m)	Margin (dB)	Emission Type
145.0	Y	Y	78.26	10.70	0.00	80.0	2.87	160.0	-34.92	Peak
	Y	Y	78.26	10.70	-0.09	80.0	2.84	16.6	-15.31	AVG *

Calculations Expanded:

uV/m = $10^{(dBuV/m \div 20)}$

dBuV/m = SA $Level_{dBuV}$ + $AF_{dB/m}$ + $DCCF_{dB}$ – DF_{dB}

= 78.26 + 10.70 + -.09 – 80.0 = 9.07 dBuV/m = 2.84 uV/m (AVG)

Table 9: Radiated Emissions Test Data < 30MHz, FCC (3-meters)

Frequency (MHz)	SA Level (dBuV)	AF (dB/m)	DCCF (dB)	Distance Factor (dB)	Corr. FS (uV/m)	Limit uV/m	Margin (dB)	Emission Type
0.0281	52.22	14.8	0.00	80.0	0.224	854.1	-71.6	Peak
0.0281	52.22	14.8	-0.09	80.0	0.222	85.4	-51.7	AVG *
0.0672	53.74	11.2	0.00	80.0	0.180	357.1	-66.1	Peak
0.0672	53.74	11.2	-0.09	80.0	0.170	35.7	-46.2	AVG *
0.4239	52.25	10.7	0.00	80.0	0.140	56.6	-52.1	Peak
0.4239	52.25	10.7	-0.09	80.0	0.139	5.7	-32.2	AVG *
1.656	37.79	10.7	--	40.0	2.66	--	--	Peak
1.656	30.99	10.7	--	40.0	1.21	14.5	-21.5	QP
2.051	28.95	10.7	--	40.0	0.96	--	--	Peak
2.051	23.88	10.7	--	40.0	0.54	30.0	-35.0	QP
29.126	32.88	7.8	--	40.0	1.08	--	--	Peak
29.126	23.73	7.8	--	40.0	0.38	30.0	-38.0	QP

Please note the following:

1. * indicates the average value is mathematically obtained using DCCF
2. the EUT was investigated for emissions in the range of 9kHz to 1GHz
3. only emissions detected from the EUT are reported
4. dBuV/m = 20LOG(uV/m)
6. all Peak emissions meet the QP and AVG limits

4.3 Radiated Emissions (ISED-Canada, RSS-Gen)

Transmitters operating under the provisions of RSS-Gen must comply with the radiated emission limitations listed in the following table:

Table 10: Radiated Emissions Limits, ISED Canada

Frequency (MHz)	**Field Strength (µA/m)**	**Measurement Distance (meters)**
0.009 - 0.490	6.37/F(kHz)	300
0.490 - 1.705	63.7/F(kHz)	30
1.705 - 30.0	0.08	30
> 30MHz		
Frequency (MHz)	**Field Strength (µV/m)**	**Measurement Distance (meters)**
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

4.3.1 Test Procedure

The procedures outlined in Section 4.2.1 of this report were employed.

For frequencies below 30MHz, the measurements from the previous section, expressed as electric field strength, were converted to magnetic field strength, for comparison to the limits provided in RSS-Gen, Clause 8.9.

Table 11: Fundamental Transmitter Test Data, ISED Canada (3-meters)

TX Frequency (kHz)	SA Level (dBuV)	Antenna Factor (dB)	DCCF (dB)	Distance Factor (dB)	H-Field Corr. Factor (dBΩ)	Corr. Level (uA/m)	Limit (uA/m)	Margin (dB)	Emission Type
145.0	78.26	10.7	0.00	80.0	51.5	0.0075	0.44	-35.2	Peak
	78.26	10.7	-0.09	80.0	51.5	0.0074	0.044	-15.3	AVG *

Calculations Expanded:

dBµA = dBµV – 51.5

dBµA/m = SA Level$_{dBuV}$ + AF$_{dB/m}$ + DCCF$_{dB}$ – DF$_{dB}$ – HCF$_{dB\Omega}$

= 78.26 + 10.7 + -0.09 – 80.0 – 51.5 = -42.63 dBµA/m = 0.0074 µA/m (Average)

µA/m = $10^{(dBuA/m \div 20)}$

E-Field to H-field conversion = 20LOG(120pi) = 20LOG(377Ω) = 51.5 dBΩ

The 300-meter average limit for 145kHz is 6.37 ÷ 146 = 0.044 uA/m

Table 12: Radiated Emissions Test Data < 30MHz, ISED Canada (3-meters)

Frequency (MHz)	**SA Level (dBuV)**	**CF (dB/m)**	**DCCF (dB)**	**H-Field Corr. Factor (dBΩ)**	**Corr. FS (uA/m)**	**Limit uA/m**	**Margin (dB)**	**Emission Type**
0.0281	52.22	-65.2	0.00	51.5	0.00060	2.267	-71.59	Peak
0.0281	52.22	-65.2	-0.09	51.5	0.00059	0.227	-51.68	AVG *
0.0672	53.74	-68.8	0.00	51.5	0.000470	0.948	-66.10	Peak
0.0672	53.74	-68.8	-0.09	51.5	0.000465	0.095	-46.19	AVG *
0.4239	52.25	-69.3	0.00	51.5	0.000374	0.150	-52.09	Peak
0.4239	52.25	-69.3	-0.09	51.5	0.000370	0.015	-32.18	AVG *
1.656	37.79	-29.3	--	51.5	0.0071	--	--	Peak
1.656	30.99	-29.3	--	51.5	0.0032	0.038	-21.51	QP
2.051	28.95	-29.3	--	51.5	0.0026	--	--	Peak
2.051	23.88	-29.3	--	51.5	0.0014	0.08	-34.98	QP
29.126	32.88	-32.2	--	51.5	0.0029	--	--	Peak
29.126	23.73	-32.2	--	51.5	0.0010	0.08	-38.03	QP

Please note the following:

1. * indicates the average value is mathematically obtained using DCCF
2. the EUT was investigated for emissions in the range of 9kHz to 1GHz
3. only emissions detected from the EUT are reported
4. the limit for 29.126MHz is written at 30m; therefore, 40LOG(30/3) = 40.0dB
5. Corr. Factors: 7.8 – 40 = -32.2 dB/m *(example for 29.126MHz)*
6. all Peak emissions meet the QP and AVG limits

4.3.2 General Unwanted Radiated Emissions (Part §15.209; RSS-Gen)

Devices operating under §15.209 and RSS-Gen must comply with the radiated emission limitations listed in the following table:

Table 13: Radiated Emissions Limits, 30MHz to 1GHz

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (meters)
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

4.3.3 Test Procedure

The requirements of FCC Part 15 and RSS-Gen call for the EUT to be placed on an 80 cm high 1 X 1.5 meters non-conductive motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Bi-conical and log periodic antennas were mounted on a mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The output of the antenna was connected to the input of the spectrum analyzer and the emissions in the frequency range of 30 MHz to 1 GHz were measured. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured. The detector function was set to quasi-peak or peak, as appropriate. The measurement bandwidth of the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth.

4.3.4 Radiated Data Reduction and Reporting

To convert the raw spectrum analyzer radiated data into a form that can be compared with the limits, it is necessary to account for various calibration factors that are supplied with the antenna(s) and other measurement equipment. These factors include the antenna factor ((AF)(in dB/m)), cable loss factors ((CF)(in dB)), and the pre-amplifier gain [if applicable] ((G)(in dB)). These correction values are algebraically added to the raw Spectrum Analyzer Voltage (in dBµV) to obtain the corrected radiated electric field, which shall be the final corrected logarithm amplitude ((Corr. Meas.)(in µV/m or dBµV/m)). This amplitude is then compared to the limit.

Table 14: Radiated Emissions Test Data > 30MHz (Worst-Case)

Frequency (MHz)	Detector	Corr. Meas. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Turn Table (deg)	Antenna (cm)
48.422	Peak	37.119	--	--	35	Vert, 120
	QP	32.291	40	-7.71	35	Vert, 120
158.053	Peak	45.572	--	--	90	Horiz, 160
	QP	40.601	43.5	-2.89	90	Horiz, 160
166.934	Peak	38.356	--	--	35	Vert, 160
	QP	33.867	43.5	-9.63	35	Vert, 160
171.974	Peak	47.020	--	--	90	Horiz, 160
	QP	42.755	43.5	-0.75	90	Horiz, 120
182.235	Peak	45.156	--	--	90	Horiz, 120
	QP	40.433	43.5	-3.07	90	Horiz, 160

3-meter Radiated Emissions note:

for 30MHz to 1GHz testing: the EUT was evaluated in both the idle and charging mode. The worst-case mode is the fully-loaded mode, while charging 10 PADs. This data is presented above.

Formulas:

Spectrum Analyzer Voltage:	VdBµV (SA)
Antenna Correction Factor:	AFdB/m
Cable Correction Factor:	CFdB
Pre-Amplifier Gain (if applicable):	GdB
Electric Field:	EdBµV/m = V dBµV (SA) + AFdB/m + CFdB - GdB
To convert from linear units:	dBuV/m = 20LOG(uV/m)
To convert limit, based on DMeasure:	3m Limit = 10m Limit + 20LOG(10/3)

4.4 Transmitter Duty Cycle (DCCF)

The following table provides a summary of the EUT transmit modes and the respective timing.

EUT Mode	TX On-Time Per 100ms	Duty Cycle	Final DCCF	PADs Charging
Idle/Searching	~3 ms	3%	-30.46 dB	0
Fully-Loaded	~99 ms	~ 99%	-0.09 dB	10

The fully-loaded mode (charging 10 PADs) is the worst-case mode for TX PWR, OBW, and DCCF.

Final Data:

99 ÷ 100 = 0.99 = 99 %

20LOG(0.99) = -0.09

-0.09 dB is the final DCCF.

(Reference ANSI C63.10-2020, clause 7.5)

4.5 AC Powerline Conducted Emissions

4.5.1 Requirements

Compliance Standard: FCC Part 15.207(a)

Frequency Range	AC Powerline Emission Limits	
	Quasi-peak	Average
0.15 – 0.5 MHz	66 to 56 dBµV	56 to 46 dBµV
0.5 – 5 MHz	56 dBµV	46 dBµV
0.5 – 30 MHz	60 dBµV	50 dBµV

4.5.2 Test Procedure

The requirements of FCC Part 15 and ICES-003 call for the EUT to be placed on an 80cm-high non-conductive table above a ground plane. Power to the EUT was provided through a Solar Corporation 50 Ω/50 µH Line Impedance Stabilization Network bonded to a 3 X 2-meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power was supplied to the peripherals through a second LISN. The peripherals were placed on the table in accordance with ANSI C63.4. Power and data cables were moved about to obtain maximum emissions.

The 50 Ω output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 150 kHz to 30 MHz were measured. The detector function was set to quasi-peak, peak, or average as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth. For average measurements, the post-detector filter was set to 10 Hz.

These emissions must meet the limits specified in §15.207 for quasi-peak and average measurements.

<u>AC Powerline Conducted Emissions note:</u>

for powerline testing: the EUT was evaluated in both the idle and charging mode. The worst-case mode is the fully-loaded mode, while charging 10 PADs. This data is presented below.

4.5.3 Conducted Data Reduction and Reporting

The comparison between the Conducted emissions level and the FCC limit is calculated as shown in the following example:

Spectrum Analyzer Voltage: V dBµV(raw)

LISN Correction Factor: LISN dB

Cable Correction Factor: CF dB

Voltage: $V_{dB\mu V} = V_{dB\mu V}\text{ (raw)} + LISN_{dB} + CF_{dB}$

4.5.4 Test Data

The EUT complies with the Powerline Emissions requirements.

The EUT couples directly to the public mains network.

The worst-case emission test data is provided below.

Table 15: AC Powerline Conducted Emissions Test Data (Worst-Case)

NEUTRAL (N)										
Frequency (MHz)	**Level QP (dBµV)**	**Level AVG (dBµV)**	**Cable Loss (dB)**	**LISN Corr (dB)**	**Level QP Corr (dBµV)**	**Level Avg Corr (dBµV)**	**Limit QP (dBµV)**	**Limit AVG (dBµV)**	**Margin QP (dB)**	**Margin AVG (dB)**
0.184	37.1	22.7	10.0	0.5	47.7	33.3	64.3	54.3	-16.6	-18.0
0.261	38.7	29.1	10.0	0.4	49.2	39.6	61.4	51.4	-12.2	-11.8
0.304	34.0	22.8	10.0	0.4	44.4	33.2	60.1	50.1	-15.7	-17.0
0.440	28.3	19.6	10.0	0.3	38.6	30.0	57.1	47.1	-18.5	-17.1
4.693	27.4	14.5	10.0	0.5	37.9	25.0	56.0	46.0	-18.1	-21.0
PHASE (LINE)										
Frequency (MHz)	**Level QP (dBµV)**	**Level AVG (dBµV)**	**Cable Loss (dB)**	**LISN Corr (dB)**	**Level QP Corr (dBµV)**	**Level Avg Corr (dBµV)**	**Limit QP (dBµV)**	**Limit AVG (dBµV)**	**Margin QP (dB)**	**Margin AVG (dB)**
0.184	39.4	23.3	10.0	0.4	49.8	33.7	64.3	54.3	-14.5	-20.6
0.266	40.1	28.6	10.0	0.3	50.4	38.9	61.2	51.2	-10.8	-12.3
0.307	36.2	24.7	10.0	0.3	46.6	35.0	60.1	50.1	-13.5	-15.0
0.430	28.8	17.9	10.0	0.3	39.1	28.2	57.3	47.3	-18.2	-19.0
4.686	27.2	13.8	10.0	0.4	37.7	24.2	56.0	46.0	-18.3	-21.8
15.520	26.0	16.0	10.1	0.7	36.8	26.9	60.0	50.0	-23.2	-23.1