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FCC/ISED Certification Test Report

For the

Frederick Energy Products LLC

DDAC Cab Silencer

FCC ID: QUI-DDAC-CBS
ISED: 11625A-DDACCBS

WLL JOB# 14654-01 Rev 0

October 25, 2016

Prepared for:

Frederick Energy Products LLC
1769 Jeff Road
Huntsville, AL 35806

Prepared By:

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7560 Lindbergh Drive
Gaithersburg, Maryland 20879

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

Testing Certificate AT-1448

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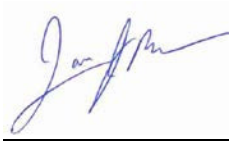
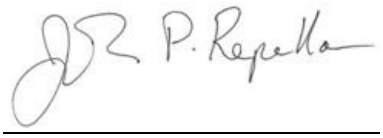


James Ritter
Compliance Engineer

Reviewed by:



John P. Repella
Manager, EMC & Wireless Services

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 Transmitter under Part 15.209 (10/2014) of the FCC Rules and Regulations and ISED RSS-210 issue 9 (8/2016) and RSS-Gen issue 4 (11/ 2014). This Certification Test Report documents the test configuration and test results for the Frederick Energy Products LLC DDAC Cab Silencer.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. 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 OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory.

The Frederick Energy Products LLC DDAC Cab Silencer complies with the limits for a Transmitter device under FCC Part 15.209 and RSS210.

Revision History	Description of Change	Date
Rev 0	Initial Release	October 25, 2016

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1 Introduction

1.1 Compliance Statement

The Frederick Energy Products LLC DDAC Cab Silencer complies with the limits for an Intentional Radiator device under Part 15.209 of the FCC Rules and Regulations and ISED RSS-210 issue 9 (RSS-GEN Issue 4).

1.2 Test Scope

Tests for radiated were performed. All measurements were performed in accordance with FCC part 15.209, IC RSS 210, RSS-GEN, & ANSI C63.10: 2013. The measurement equipment conforms to ANSI C63.2 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:	69576D
PO Number	6877

1.4 Test Dates

Testing was performed on the following date(s):	9/26/2016-10/13/2016

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter
Customer Representative	David Estill, Ishmael Chigumira

1.6 Abbreviations

A	Ampere
Ac	alternating current
AM	Amplitude Modulation
Amps	Amperes
b/s	bits per second
BW	Bandwidth
CE	Conducted Emission
Cm	centimeter
CW	Continuous Wave
dB	decibel
Dc	direct current
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	giga - prefix for 10^9 multiplier
Hz	Hertz
IF	Intermediate Frequency
K	kilo - prefix for 10^3 multiplier
M	Mega - prefix for 10^6 multiplier
M	Meter
μ	micro - prefix for 10^{-6} multiplier
NB	Narrowband
LISN	Line Impedance Stabilization Network
RE	Radiated Emissions
RF	Radio Frequency
Rms	root-mean-square
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt

2 Equipment Under Test

The DDAC Cab Silencer is part of a proximity warning system from Frederick Energy Products LLC which provides warnings to both individuals and to machinery to alert them that the individual has entered too close to an operating piece of equipment and is in a dangerous situation or that vehicles or machinery are getting close enough that a collision possibility exists. The Cab Silencer is mounted on the vehicle or machinery in an area near where the operator would normally be while operating the vehicle or machinery.

The function of the Cab Silencer is:

1) To transmit a 73 kHz "Cab Silencer" field around a small portion of the vehicle or piece of machinery in which the operator is allowed to work or enter as part of his normal activities.

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	Frederick Energy Products LLC
FCC ID:	QUI-DDAC-CBS
IC:	11625A-DDACCBS
EUT Name:	DDAC Cab Silencer
Model:	DDAC-CAB-SI
FCC Rule Parts:	15.209
ISED Rule Part	RSS-210 Issue 8 (RSS-Gen Issue 4)
ISED Emission Designator	NON
TX Frequency Range:	73kHz
TX Emission Level	73kHz , 0.5 uV/m @300m
RX Frequency Range	NA
Occupied Bandwidth:	N/A CW non modulated signal
Keying:	Automatic
Type of Information:	CW (illumination)
Number of Channels:	1
Power Output Level	Fixed
Antenna Type	Integral Magnetic Induction
Interface Cables:	Power, warning module cable
Power Source & Voltage:	Battery (13 VDC)
Highest Spurious TX emission	944MHz , 139.5 uV/m @3m
Highest Spurious RX emission	NA

2.1 Test Configuration

The Frederick Energy Products LLC DDAC Cab Silencer, Equipment Under Test (EUT), was operated from 13VDC via a Lab AC/DC power supply.

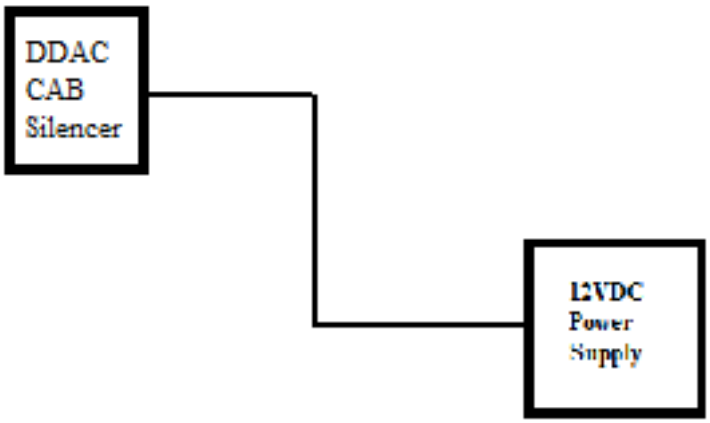

Figure 1: Test Configuration

2.2 Equipment Configuration

The EUT was set up as outlined in Figure 1. 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

Name / Description	Manufacturer	Model	Serial Number	Revision
DDAC Cab Silencer	Frederick Energy Products	DDAC-CAB-SI	__	--

2.3 Support Equipment

The following support equipment was used during testing:

Table 3: Support Equipment

Item	Model/Part Number	Serial Number
Power Supply	1337 DC Power Supply/ 12VDC Battery	N/A

2.4 Interface Cables

Table 4: Interface Cables

Port Identification	Connector Type	Cable Length	Shielded (Y/N)	Termination Point
13Vdc input	4 wire Circular (only 2 connected)	>1 m	N	Power source to EUT

2.5 EUT Modifications

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

2.6 Testing Algorithm

The EUT operates continuously when power is applied.

Worst case emission levels are provided in the test results data.

2.7 Test Location

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. 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 OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory.

2.8 Measurements

2.8.1 References

- ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation
- ANSI C63.10: 2013 Procedures for Compliance Testing of Unlicensed Wireless Devices

2.9 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 (R2002) 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

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

Where u_c = standard uncertainty

a, b, c,.. = individual uncertainty elements

$Div_{a, b, c}$ = the individual uncertainty element divisor based on the 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 ≤ 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, CISPR22, CISPR14, FCC Part 15	±2.63 dB
Radiated Emissions	CISPR11, CISPR22, 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 Date: **10/13/2016**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
856	EMCO - 6507	ACTIVE LOOP 1KHZ - 30MHZ	11/12/2017
823	AGILENT - N9010A	EXA SPECTRUM ANALYZER	10/31/2016
522	HP - 8449B	PRE-AMPLIFIER 1-26.5GHZ	10/31/2016
276	ELECTROMETRICS - BPA-1000	PRE-AMPLIFIER RF 50KHZ-1GHZ	10/30/2016
626	ARA - DRG-118/A	ANTENNA HORN	4/7/2018
382	SUNOL SCIENCES CORPORATION - JB1	ANTENNA BICONLOG	8/31/2017

4 Test Results

4.1 Occupied Bandwidth: (FCC Part §2.1049, RSS –Gen sect 4.6.1)

The transmit signal is a 73 kHz non-modulated CW signal; therefore there is no measurable bandwidth.

4.2 Radiated Spurious Emissions: (FCC Part §15.209, RSS-Gen Table 6)

Transmitters operating under §15.209 & ISED RSS 210 (RSS-GEN) must comply with the radiated emissions listed in the following table:

Measurements were conducted in accordance with ANSI C63.10 section 6.4 "Radiated emissions from unlicensed wireless devices below 30 MHz"

Table 7: Radiated Emissions Limits

Frequency (MHz)	Field Strength (microvolts/meter)	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 placed on motorized turntable for radiated testing on a 30-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable

For frequencies between 10 kHz and 30 MHz, a loop antenna was mounted of a tripod at height of 1 m. The Loop antenna was rotated about its vertical and horizontal axis to determine the highest emissions.

For frequencies above 30MHz the receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. Both the horizontal and vertical field components were measured.

Frequencies below 30MHz were tested at 3 meters (due to low signal levels) with the measurement results corrected ANSI C63.10 section 6.4 using a 40dB per decade correction.

Measurements of frequencies above 30MHz were made at a distance of 3m in accordance with ANSI C63.10 section 6.5 "Radiated emissions from unlicensed wireless devices in the frequency range of 30 MHz to1000 MHz".
The EUT was scanned from 10k to 1GHz.

The EUT was examined in three orthogonals and the orthogonal that demonstrated the highest emissions was reported.

All Fundamental and Harmonics were tested for peak emissions and compared to the Average limits as this is a CW signal. As the CW complies with the average limits it also complies with the peak limits of part 15.35. All other spurious signals were tested using average or quasi-peak detectors as specified.

In accordance with FCC part15.209 (d) emissions in the bands 9-90 kHz and 110-490 kHz are performed using an average detector. All other readings below 1000MHz were taken with a quasi-peak detector.

Resolution bandwidths used for frequencies measured between:

- 9 kHz – 150kHz, RBW = 200Hz
- 150kHz – 30MHz, RBW = 9kHz
- 30MHz – 1GHz, RBW = 120kHz

Table 8: Emissions below 30MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Correction Factor for 300 to 3m testing below 490kHz (dB)	Adjusted Level (uV/m)	Limit (uV/m)	Margin (dB)
0.073	X	90.00	1.00	55.25	19.3	5351.4	-80.0	0.535	32.88	-35.8
0.073	Y	180.00	1.00	49.96	19.3	2911.5	-80.0	0.291	32.88	-41.1
0.073	Z	45.00	1.00	41.05	0.2	115.8	-80.0	0.012	32.88	-69.1
0.146	X	180.00	1.00	37.80	18.9	684.1	-80.0	0.068	16.44	-47.6
0.146	Y	180.00	1.00	36.20	18.9	569.0	-80.0	0.057	16.44	-49.2
0.146	Z	0.00	1.00	35.80	0.3	63.8	-80.0	0.006	16.44	-68.2
0.219	X	19.00	1.00	36.06	18.9	563.1	-80.0	0.056	10.96	-45.8
0.219	Y	180.00	1.00	37.20	18.9	641.8	-80.0	0.064	10.96	-44.6
0.219	Z	180.00	1.00	35.20	0.3	59.9	-80.0	0.006	10.96	-65.2

No other harmonic or spurious emissions were detectable below 30MHz

Note: Since the peak readings are below the applicable 15.209 average limits the peak measurements do not exceed the part 15.35 limit (average limit plus 20dB). Therefore the unit was not tested using an average detector in these ranges and is assumed to comply with the peak and average requirements.

Table 9: Radiated Emissions Test Data > 30MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
32.000	V	190.00	1.00	29.80	-6.8	14.2	100.0	-17.0	
48.000	V	0.00	1.00	40.79	-17.8	14.1	100.0	-17.0	
64.000	V	165.00	1.00	42.90	-18.5	16.6	100.0	-15.6	
80.000	V	90.00	1.00	42.03	-18.1	15.7	100.0	-16.1	
144.000	V	180.00	1.20	34.29	-12.9	11.7	150.0	-22.2	
208.000	V	10.00	1.60	37.40	-14.0	14.8	150.0	-20.1	
288.000	V	10.00	2.00	44.84	-10.9	49.8	200.0	-12.1	
320.000	V	10.00	2.00	46.60	-10.2	66.3	200.0	-9.6	
720.000	V	45.00	1.50	31.47	-1.3	32.3	200.0	-15.8	
784.000	V	90.00	1.40	32.41	-0.4	39.7	200.0	-14.0	
816.000	V	190.00	1.20	35.63	0.1	61.4	200.0	-10.3	
848.000	V	45.00	1.20	38.70	0.2	88.1	200.0	-7.1	
912.000	V	45.00	1.00	40.10	1.6	121.3	200.0	-4.3	qp
928.000	V	90.00	1.00	35.80	1.2	71.2	200.0	-9.0	
944.000	V	0.00	1.00	41.20	1.7	139.5	200.0	-3.1	qp
976.000	V	0.00	1.00	39.70	2.2	124.8	500.0	-12.1	
64.000	H	10.00	4.00	36.86	-18.5	8.3	100.0	-21.6	
80.000	H	0.00	4.00	46.90	-18.1	27.5	100.0	-11.2	
144.000	H	190.00	3.80	39.50	-12.9	21.3	150.0	-16.9	
160.000	H	10.00	3.80	33.80	-13.3	10.6	150.0	-23.0	
288.000	H	180.00	3.40	41.20	-10.9	32.8	200.0	-15.7	
320.000	H	90.00	2.80	45.20	-10.2	56.4	200.0	-11.0	
784.000	H	10.00	1.90	32.10	-0.4	38.3	200.0	-14.4	
848.000	H	90.00	1.60	31.20	0.2	37.2	200.0	-14.6	
912.000	H	90.00	1.20	34.02	1.6	60.2	200.0	-10.4	
928.000	H	180.00	1.20	29.20	1.2	33.3	200.0	-15.6	
944.000	H	45.00	1.20	36.50	1.7	81.2	200.0	-7.8	
976.000	H	10.00	1.20	34.45	2.2	68.2	500.0	-17.3	