FCC & ISED CANADA CERTIFICATION TEST REPORT

for the

FREDERICK ENERGY PRODUCTS, LLC
MAGNETIC FIELD SXL GENERATOR

FCC ID: QUI-DDAC-PDS-SXLC

IC ID: 11625A-DDACPDSSXLC

WLL REPORT# 16938-01 REV 2

Prepared for:

Frederick Energy Products, LLC

1769 Jeff Road

Huntsville, Alabama 35806

Prepared By:

Washington Laboratories, Ltd.

4840 Winchester Boulevard

Frederick, Maryland 21703

Testing Certificate AT-1448

FCC & ISED Canada Certification Test Report

for the

Frederick Energy Products, LLC

Magnetic Field SXL Generator

FCC ID: QUI-DDAC-PDS-SXLC

ISED ID: 11625A-DDACPDSSXLC

April 5, 2021

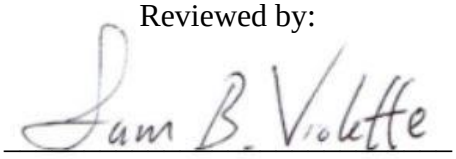
WLL Report# 16938-01 Rev 2

Prepared by:

Richard Quarcoo

Compliance Engineer

Reviewed by:



Samuel B. Violette

Vice President of Operations

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 an Intentional Radiator under Part 15.231 of the FCC Rules and Regulations current at the time of testing and Innovation, Science and Economic Development (ISED) Canada Spectrum Management and Telecommunications Policy. This Certification Test Report documents the test configuration and test results for the Frederick Energy Products, LLC MAGNETIC FIELD SXL GENERATOR. The information provided on this report is only applicable to device herein documented.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 4840 Winchester Boulevard, 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.

Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Certificate AT-1448 as an independent FCC test laboratory (ISED Canada number 3035A).

The Frederick Energy Products, LLC MAGNETIC FIELD SXL GENERATOR complies with the limits for an Intentional Radiator under FCC Part 15.231 and RSS-210 Issue 10 (6/2019).

Revision History	Description of Change	Date
Rev 0	Initial Release	April 5, 2021
Rev 1	ACB Comments # ATCB026997	July 9, 2021
Rev 2	TCB Comments	July 23, 2021

Table of Contents

Abstract iii
Table of Contents iv
List of Tables v
List of Figures v
1 Introduction 6
1.1 Compliance Statement 6
1.2 Test Scope 6
1.3 Contract Information 7
1.4 Test and Support Personnel 7
1.5 Test Dates 7
2 Equipment Under Test 8
2.1 EUT Identification & Description 8
2.2 Test Configuration 8
2.3 Support Equipment 10
2.4 Interface Cables 10
2.5 Testing Algorithm 10
2.6 Test Location 10
2.7 Measurements 11
2.7.1 References 11
2.8 Measurement Uncertainty 11
3 Test Equipment 13
4 Test Results 14
4.1 Transmission Cessation from Time of Release (FCC Part §15.231(a), RSS210 A2.9) 14
4.2 Occupied Bandwidth (FCC Part §2.1049 and RSS-Gen [4.6.1]): 15
4.3 Radiated Spurious Emissions: (FCC Part §15.231(a), RSS210 A.1.2) 17
4.3.1 Test Procedure 17

List of Tables

Table 1: Device Summary 8
Table 2: System Configuration List 9
Table 3: Support Equipment 10
Table 4: Cable Configuration 10
Table 5: Expanded Uncertainty List 12
Table 6: Test Equipment List 13
Table 7: Occupied Bandwidth Spectrum Analyzer Settings 15
Table 8: 20dB Occupied Bandwidth Results 15
Table 9: 99% Occupied Bandwidth Results 15
Table 10: Spectrum Analyzer Settings 17
Table 11: Radiated Emission Test Data, Transmitter (<1GHz) 18
Table 12: Radiated Emission Test Data, Harmonics 19

List of Figures

Figure 1: EUT Power and Test Configuration 9
Figure 2: Time Period: Release to Termination of Transmission 14
Figure 3: Occupied Bandwidth, Low Channel 16
Figure 4: SXL Generator, TX Pulse Train 21
Figure 5: SXL Generator, Single TX Pulse 22

1 Introduction

1.1 Compliance Statement

The Frederick Energy Products, LLC MAGNETIC FIELD SXL GENERATOR complies with the limits for an Intentional Radiator device under FCC Part 15.231 and ISED Canada RSS-210 Issue 10 (6.2019).

TX Test Summary (Low Power Transmitter)			
FCC Rule Part	**IC Rule Part**	**Description**	**Result**
15.231 (a)	RSS-210	Transmission Length	Pass
15.231 (b)	RSS-210	Field Strength Limits	Pass
15.231 (c)	RSS-210	20dB Bandwidth	Pass
15.207	RSS-Gen [7.2.2]	AC Conducted Emissions	Pass
RX/Digital Test Summary (Low Power Transmitter)			
FCC Rule Part	**IC Rule Part**	**Description**	**Result**
15.107	RSS-Gen [7.2.2]	AC Conducted Emissions	Pass
15.109	RSS-Gen [7.2.3.2]	General Field Strength Limits (Restricted Bands & RE Limits)	Pass

1.2 Test Scope

Tests for radiated emissions were performed. All measurements were performed in accordance with ANSI C63.10. 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
Purchase Order Number:	9141
Quotation Number:	72568

1.4 Test and Support Personnel

Washington Laboratories, LTD	Richard Quarcoo
Customer Representative	Andrew Nichols

1.5 Test Dates

The EUT was tested during the following dates: 2/3/2021 to 2/23/2021

2 Equipment Under Test

2.1 EUT Identification & Description

The Frederick Energy Products, LLC MAGNETIC FIELD SXL GENERATOR is used to activate a PAD when a PAD is within a certain range of the generator. The PAD generates a continuous tone when it is within about 50' of the generator and generates a beeping tome at about 67' of the generator. So, there are two zones for the PAD. A warning zone and a danger zone. The generator is supplied power by the vehicle. The generator can operate with power as low as 12V, but the field is reduced in that case. Optimally the generator requires 24VDC for optimal field generation.

Table 1: Device Summary

Manufacturer:	Frederick Energy Products, LLC
FCC ID:	QUI-DDAC-PDS-SXLC
ISED ID:	11625A-DDACPDSSXLC
EUT Name:	MAGNETIC FIELD SXL GENERATOR
FCC Rule Parts:	§15.231
ISED Rule Parts:	RSS-210
FCC Emission Designator:	152KF1DXN
IC Emission Designator:	247KF1DXN
Modulation	FM
20dB Occupied Bandwidth:	151.6 kHz
99% Occupied Bandwidth:	247.41 kHz
Number of Channels:	1
Power Output Level:	Fixed
Software/Firmware:	FEPL Proprietary Test Mode, REV A
Antenna Type:	Monopole
Interface Cables:	N/A
Power Source & Voltage:	24 VDC

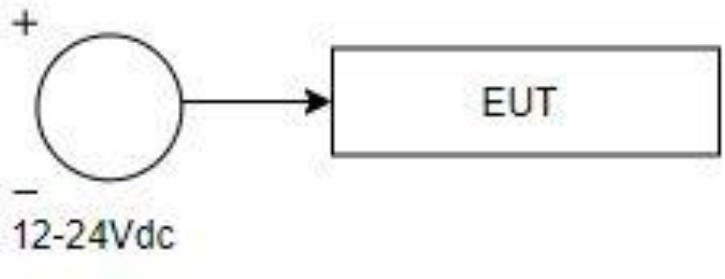
2.2 Test Configuration

The MAGNETIC FIELD SXL GENERATOR was configured in a stand-alone configuration. The EUT was powered via 24 VDC and all transmitters were enabled.

Table 2: System Configuration List

Name / Description	Model Number	Part Number	Serial Number	Revision
SXL Generator	MAGNETIC FIELD SXL GENERATOR	Not Listed	Not Listed	Not Listed

Figure 1: EUT Power and Test Configuration



2.3 Support Equipment

Table 3: Support Equipment

Item	Model/Part Number	Serial Number
DC Power Supply	EVENTEK	KPS3010D

2.4 Interface Cables

Table 4: Cable Configuration

Port Identification	Connector Type	Cable Length	Shielded (Y/N)	Termination Point
Power Input (24Vdc)	Multi-Pin	>3m	N	Power Supply

2.5 Testing Algorithm

The MAGNETIC FIELD SXL GENERATOR was tested was tested ina continuous tramsmit operation. in a continuous tramsmit operation. The EUT was scanned up to the 10th harmonic. During all testing all EUT transmitters, including the BT radio, were set to enabled (TX On). Worst case emissions are reported.

2.6 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Frederick, MD. 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 OATS number for Washington Laboratories, Ltd. is 3035A. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory.

2.7 Measurements

2.7.1 References

ANSI C63.2 (Jan-2016) Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 (Jan 2014) 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 (Jun 2013) 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 (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 uc = standard uncertainty
a, b, c,.. = individual uncertainty elements
Diva, 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)
uc = 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, CISPR32, CISPR14, FCC Part 15	±2.63 dB
Radiated Emissions	CISPR11, CISPR22, 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 Date:	**See Section 1.5**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00382	SUNOL SCIENCES CORP.	LOG PERIOD ANTENNA	6/1/2021
00425	ARA, DRG-118/A	HORN ANTENNA	8/18/2022
00823	AGILENT N9010A	SPECTRUM ANALYZER	5/7/2021
00276	ELECTRO-METRICS	RF PRE-AMP	6/19/2021
00031	EMCO 6502	ANTENNA, LOOP	3/17/2021

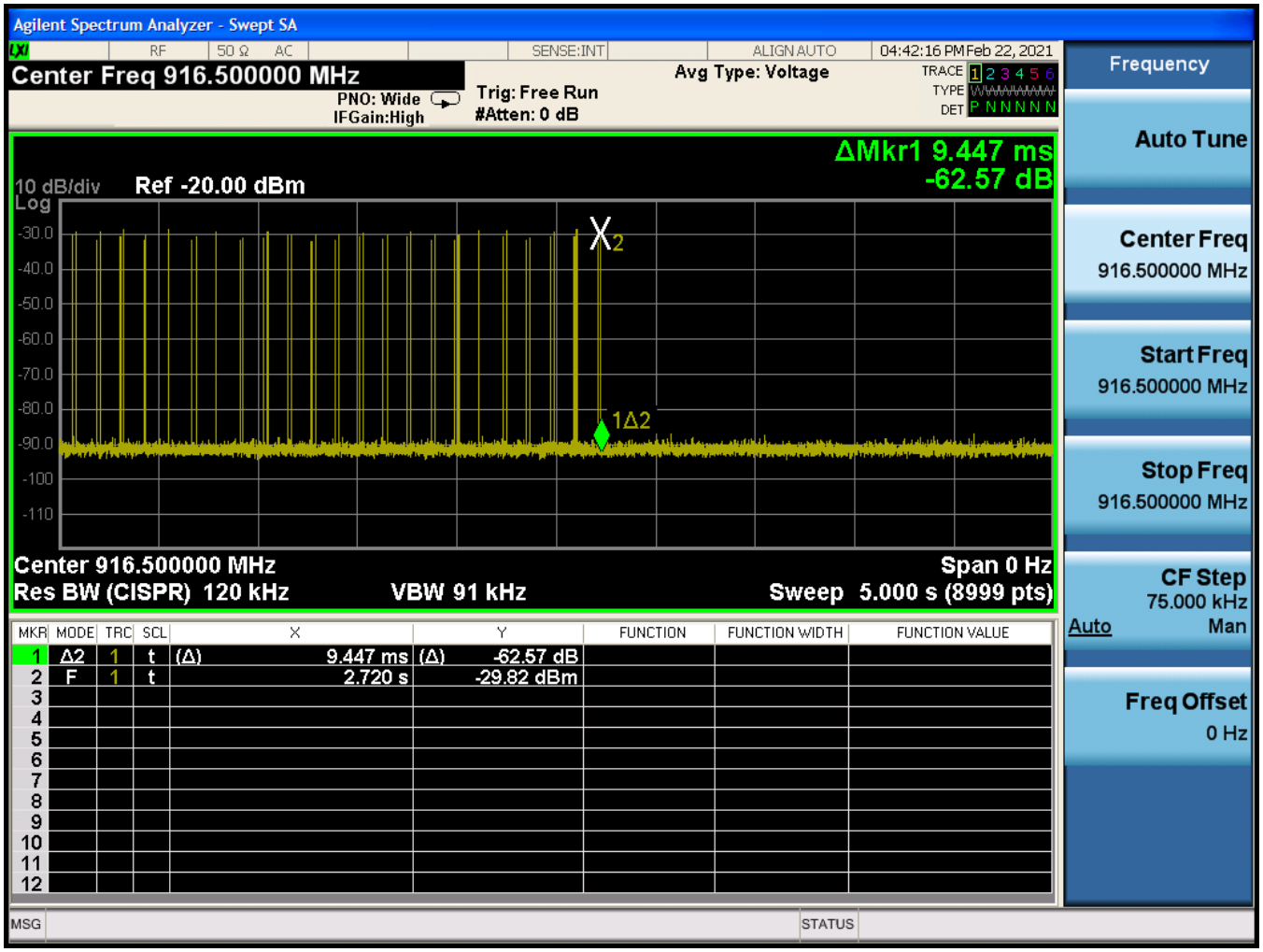
4 Test Results

4.1 Transmission Cessation from Time of Release (FCC Part §15.231(a), RSS210 A2.9)

FCC Part 15.231 states that a periodic intentional radiator shall cease transmission within a five second period from release of automatic or manual keying of operation.

Testing was done to verify that the MAGNETIC FIELD SXL GENERATOR stopped transmitting within the required time period. A 6 second sweep was made, during which the control toggle was activated and released, and the time to transmission end was measured Figure 2 shows the indicated time period from un-keying the device until cessation of transmission. The EUT complies with the requirements for this section.

Figure 2: Time Period: Release to Termination of Transmission



4.2 Occupied Bandwidth (FCC Part §2.1049 and RSS-Gen [4.6.1]):

15.231 (c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Table 7: Occupied Bandwidth Spectrum Analyzer Settings

Resolution Bandwidth	Video Bandwidth
9.1 kHz	91 kHz

At full modulation, the occupied bandwidth was measured as shown:

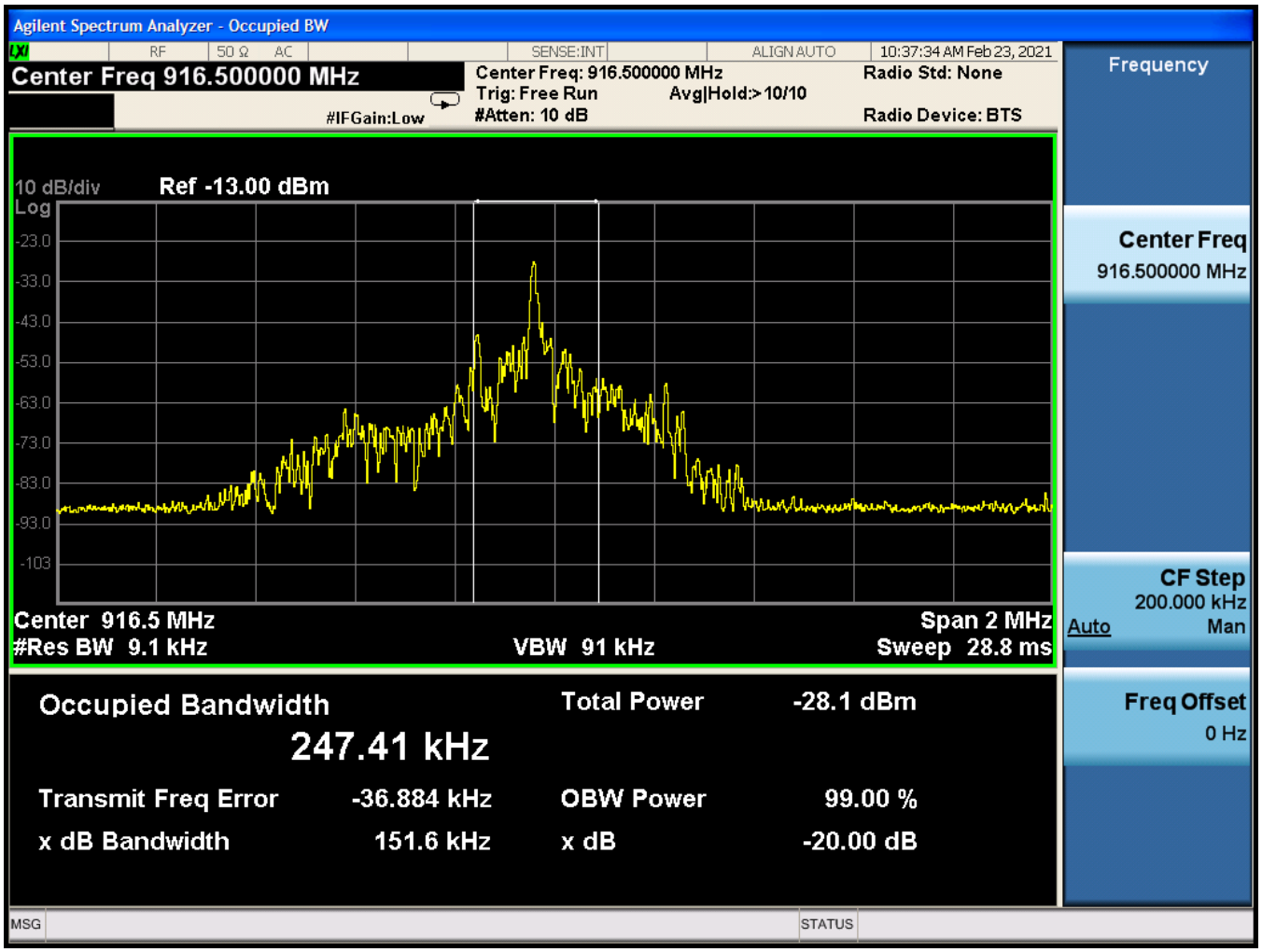
Table 8: 20dB Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Fixed Channel: 916.5	151.6 kHz	4.58 MHz	Pass

Table 9: 99% Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Fixed Channel: 916.5	247.4 kHz	N/a	N/a

Figure 3: Occupied Bandwidth, Low Channel



4.3 Radiated Spurious Emissions: (FCC Part §15.231(a), RSS210 A.1.2)

4.3.1 Test Procedure

The EUT was placed on 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. 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.

The peripherals were placed on the table in accordance with ANSI C63.4-2014. Cables were varied in position to produce maximum emissions.

Both the horizontal and vertical field components were measured. All three orthogonal planes were evaluated; maximum fundamental amplitude was recorded for reported horizontal and vertical polarities.

The emissions were measured using the following resolution bandwidths:

Table 10: Spectrum Analyzer Settings

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	10 Hz (Avg.), 1MHz (Peak)

Table 11: Radiated Emission Test Data, Transmitter (<1GHz)

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)	Detector Type
60.00	V	180.0	1.3	54.4	-17.5	69.4	100.0	-3.2	QP
71.35	V	180.0	1.3	48.5	-16.7	38.8	100.0	-8.2	QP
86.23	V	135.0	1.3	46.5	-17.3	28.8	100.0	-10.8	QP
129.23	V	135.0	1.3	44.2	-11.0	46.1	150.0	-10.3	QP
143.36	V	135.0	1.3	47.3	-12.0	58.1	150.0	-8.2	QP
300.00	V	135.0	1.3	36.9	-10.6	20.6	200.0	-19.8	QP
916.50	V	0.0	1.8	77.3	-34.43	139.2	12500.0	-39.1	Peak *
916.50	V	0.0	1.8	77.3	2.4	9640.4	125000.0	-22.3	Peak
48.93	H	180.0	1.0	55.8	-16.8	89.0	100.0	-1.0	QP
58.53	H	180.0	1.0	55.5	-17.7	77.4	100.0	-2.2	QP
77.31	H	180.0	1.0	55.3	-17.0	82.6	100.0	-1.7	QP
129.23	H	180.0	1.0	44.1	-11.0	45.3	150.0	-10.4	QP
143.36	H	180.0	1.0	46.3	-12.0	51.8	150.0	-9.2	QP
300.00	H	180.0	1.0	38.7	-10.6	25.4	200.0	-17.9	QP
916.50	H	0.0	1.8	89.4	-34.43	560.4	12500.0	-27.0	Peak *
916.50	H	0.0	1.8	89.4	2.4	38823.7	125000.0	-10.2	916.50

* DCCF applied to the 916.5 MHz fundamental data only.

The 34.5 dB DCCF was applied to the “Correction Factors” cell in the Row containing the 916.5 MHz data.

example: the original “Corr. Factors” for 916.5 MHz is 0.7 dB.
0.07 – 34.5 = -34.43 dB (as shown in the table above)

See explanation on Page 20.

Table 12: Radiated Emission Test Data, Harmonics

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
1833.00	V	180.0	1.8	43.1	1.1	162.4	5000.0	-29.8	PK
1833.00	V	135.0	1.8	43.1	-33.4	3.1	500.0	-44.3	PK *
2749.00	V	0.0	1.8	41.8	6.8	269.2	5000.0	-25.4	PK
2749.00	V	180.0	1.8	41.8	-27.7	5.1	500.0	-39.9	PK *
3666.00	V	180.0	1.8	45.0	10.9	620.7	5000.0	-18.1	PK
3666.00	V	270.0	1.8	45.0	-23.6	11.7	500.0	-32.6	PK *
4582.00	V	0.0	1.8	42.9	14.8	767.8	5000.0	-16.3	PK
4582.00	V	135.0	1.8	42.9	-19.7	14.5	500.0	-30.8	PK *
5499.00	V	90.0	1.8	43.4	18.7	1268.6	5000.0	-11.9	PK
5499.00	V	180.0	1.8	43.4	-15.8	24.0	500.0	-26.4	PK *
6415.00	V	135.0	1.8	41.6	20.7	1299.2	5000.0	-11.7	PK
6415.00	V	180.0	1.8	41.6	-13.8	24.5	500.0	-26.2	PK *
1833.00	H	180.0	1.8	44.2	1.1	184.1	5000.0	-28.7	PK
1833.00	H	90.0	1.8	44.2	-33.4	3.5	500.0	-43.2	PK *
2749.00	H	135.0	1.8	43.5	6.8	327.3	5000.0	-23.7	PK
2749.00	H	90.0	1.8	43.5	-27.7	6.2	500.0	-38.2	PK *
3666.00	H	135.0	1.8	42.3	10.9	456.6	5000.0	-20.8	PK
3666.00	H	90.0	1.8	42.3	-23.6	8.6	500.0	-35.3	PK *
4582.00	H	180.0	1.8	42.7	14.8	749.9	5000.0	-16.5	PK
4582.00	H	180.0	1.8	42.7	-19.7	14.1	500.0	-31.0	PK *
5499.00	H	270.0	1.8	42.1	18.7	1092.7	5000.0	-13.2	PK
5499.00	H	0.0	1.8	42.1	-15.8	20.6	500.0	-27.7	PK *
6415.00	H	180.0	1.8	42.1	20.7	1376.8	5000.0	-11.2	PK
6415.00	H	270.0	1.8	42.1	-13.8	25.9	500.0	-25.7	PK *

* DCCF applied to the Peak SA reading, to calculate the AVG F/S.

The 34.5 dB DCCF was applied to the “Correction Factors” in the Rows containing an *

As depicted in Figure 4, the cycle time (Tcycle) shall be declared as 100 ms.

The pulsed transmitter On-Time shall be declared as 2 x 0.9407 = 1.88 ms.

The duty cycle can be calculated from the following formula:

$t$on ÷ Tcycle = Δ

1.88 ÷ 100 = 0.0188

Δ = 0.0188 %

Where Δ is the final duty cycle.

The duty cycle correction factor can be calculated from the following formula:

20LOG(Δ) = δ

20LOG(0.0188) = –34.5

δ = 34.5 dB

Where δ is the final DCCF

(Reference ANSI C63.10-2013, Section 7.5)

FCC Rule Part §15.35(b) allows the correctly calculated DCCF to be applied, in full, to the measured Peak Field Strength, in order to calculate the Average Field Strength.

Because there is no minimum requirement for the Duty Cycle, nor a maximin limit on the DCCF, a correction of 34.5 dB shall be applied to the fundamental (916.5 MHz) field strength levels, in Table 11.

Figure 4: SXL Generator, TX Pulse Train

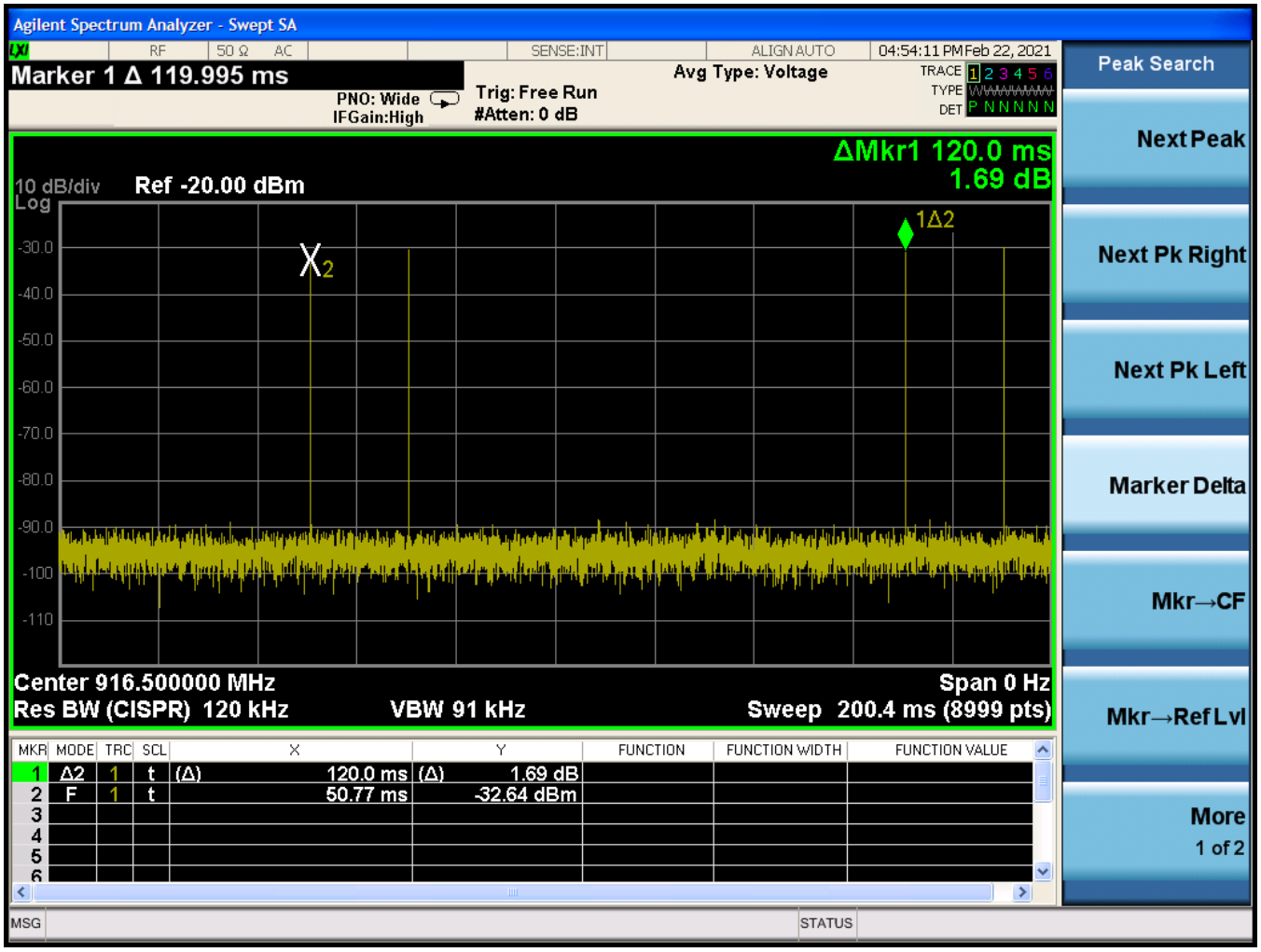


Figure 5: SXL Generator, Single TX Pulse