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FCC Certification Test Report
For the
Strata Proximity Systems
Underground Proximity Generator
Model SA221160-001

FCC ID: ZQ3-SPS-UPROX

WLL JOB# **12036-01 Rev 1**
October 14, 2011

Re-issued October 31, 2011

Prepared for:

Strata Proximity Systems
1769 Jeff Road
Huntsville, AL 35806

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

ACCREDITED TESTING

Testing Certificate AT-1448

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Prepared by:

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Reviewed by:

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Abstract

This report has been prepared on behalf of Strata Proximity Systems to support the attached Application for Equipment Authorization. The test report and application are submitted for a Transmitter under Part 15.209 (10/2009) of the FCC Rules and Regulations. This Certification Test Report documents the test configuration and test results for the Strata Proximity Systems Underground Proximity Generator.

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 Industry Canada 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 ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

The Strata Proximity Systems Underground Proximity Generator complies with the limits for a Transmitter device under FCC Part 15.209.

Revision History	Description of Change	Date
Rev 0	Initial Release	October 14, 2011
Rev 1	Updated description and added technical measurement information	October ??, 2011

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1 Introduction

1.1 Compliance Statement

The Strata Proximity Systems Underground Proximity Generator complies with the limits for an Intentional Radiator device under Part 15.209 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for radiated emissions were performed. All measurements were performed according to the 2003 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Strata Proximity Systems 1769 Jeff Road Huntsville, AL 35806
Purchase Order Number:	SP5195
Quotation Number:	66219

1.4 Test Dates

Testing was performed on the following date(s):	7/7/11

1.5 Test and Support Personnel

Washington Laboratories, LTD	Steven Dovell
Client Representative	Stephen Gilbert

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

2.1 EUT Identification & Description

The Underground Proximity Generator Module is part of a complete HazardAvert proximity warning system from Strata Proximity Systems. The system provides warnings to both individuals and to machinery equipped with the HazardAvert system to alert them that an individual or another piece of machinery 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 Underground Proximity Module is mounted on a vehicle or piece of machinery and is connected to a central control unit.

The functions of the Underground Proximity Generator Module are:

To generate and transmit a 73kHz field around a vehicle or piece of machinery to act as a protection zone for collision avoidance and for proximity detection for the protection of individuals.

To receive a 916.48MHz RF signal from other vehicles or Personal Alarm Devices (PAD).

The Underground Proximity Generator Module generates a 73 kHz signal at the rate of 3mS on and 3mS off at a repetition rate of approximately 200mS. This 73 kHz signal is fed to a wire / ferrite radiator element which is integral to the Underground Proximity Generator Module. The radiator produces a 73 kHz field that is emitted from the Underground Proximity Generator Module. This field creates a protection zone around the vehicle or machine that can be detected by other HazardAvert system components equipped with 73 kHz receivers. The Underground Proximity Generator Module also has an internal 916.48MHz receiver for the detection and demodulation of RF signals from other HazardAvert System components equipped with a 916.48MHz transmitter. As the Underground Proximity Generator Module is transmitting the 73 kHz field, other system devices are receiving the field and making determinations as to their distance from the Underground Proximity Generator Module. If the Underground Proximity Generator Module receives a 916.48 MHZ transmission in response to its 73 kHz transmission, it analyzes the 916.48 MHz signal and determines if the transmitting device is in what is considered a “Warning Zone” or a “Danger Zone”. If the Underground Proximity Generator Module determines that the transmitting device is in a Warning or Danger Zone area, it will turn on the appropriate LED’s to give a visual indication to individuals operating or near the machine that the Warning or Danger condition exists. Information regarding the received 916.48 MHz signal is also passed to a central controller on the vehicle or piece of machinery.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Strata Proximity
FCC ID:	ZQ3-SPS-UPROX
EUT Name:	Underground Proximity Generator
Model:	SA221160-001
FCC Rule Parts:	15.209
Frequency Range:	73kHz
Occupied Bandwidth:	N/A CW
Keying:	Automatic
Type of Information:	CW
Number of Channels:	1
Power Output Level	Fixed
Antenna Type	Integral Magnetic Induction
Interface Cables:	Power
Power Source & Voltage:	Battery

2.2 Test Configuration

The Strata Proximity Systems Underground Proximity Generator, Equipment Under Test (EUT), was operated from a 24VDC via a 120V AC/DC power supply.

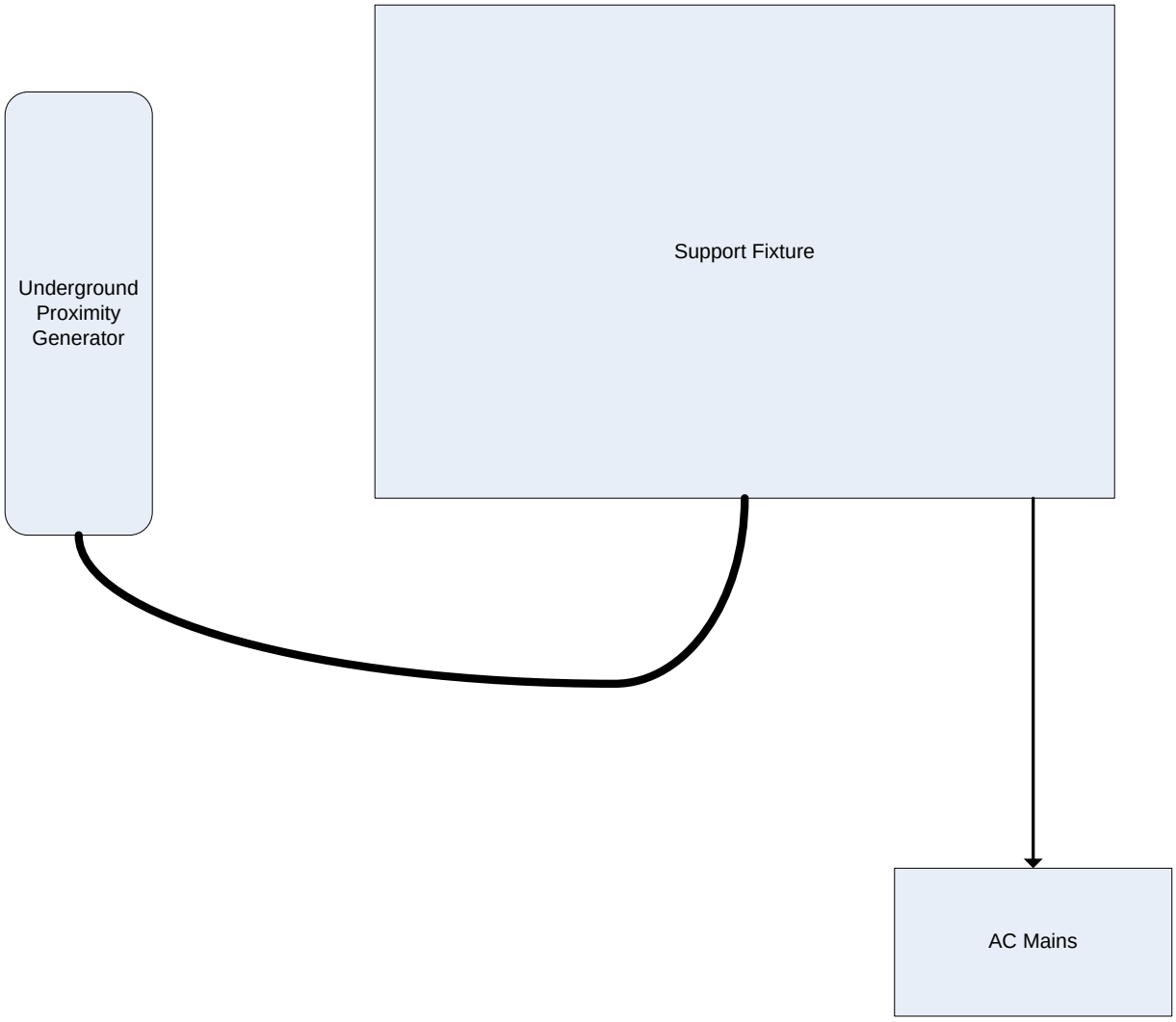

Figure 1: Test Configuration

2.3 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	Model Number	Part Number	Serial Number	Revision
Underground Proximity Generator	SA221160-001	N/A	GA12F006101	N/A

2.4 Testing Algorithm

The EUT was operated continuously by being placed into a continuous transmit mode.

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

2.5 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 Industry Canada 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 ACLASS under Certificate AT-1448 as an independent FCC test laboratory

2.6 Measurements

2.6.1 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

2.7 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

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

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

$k \leq 2$ 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 3 below.

Table 3: 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

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3 Test Equipment

Table 4 shows a list of the test equipment used for measurements along with the calibration information.

Table 4: Test Equipment List

Test Name:	**Radiated Emissions**	Test Date:	**07/07/2011**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
68	HP - 85650A	ADAPTER QP	6/22/2012
70	HP - 85685A	PRESELECTOR RF W/OPT 8ZE	6/22/2012
72	HP - 8568B	ANALYZER SPECTRUM	6/22/2012
382	SUNOL SCIENCES CORPORATION - JB1	ANTENNA BICONLOG	1/12/2012
31	EMCO - 6502	ANTENNA ACTIVE LOOP	3/8/2012

4 Test Results

4.1 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by setting the EUT near the loop antenna to allow for sufficient pickup of the signal.

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)

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

Table 5. 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 a 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. Measurements of frequencies above 30MHz were made at a distance of 3m.

The EUT was scanned from 10k to 1GHz. The limit has been interpolated to 30m.

The roll-off was determined as specified in FCC part 15.31 (f)(2) two measurements were made at two distances, 3m and 30m.

The level of the fundamental frequency at 3m was measured as 113.6dBuV/m

The level of the fundamental frequency at 30m was measured as 60.9dBuV/m

The difference between the two readings is 52.7dB therefore the roll-off is 52.7dB/decade.

This offset was added to the 300m limit to adjust the limit to 30m:

Example @ 73kHz:

300m limit = 2400/73 = 32.9uV/m = 20*LOG(32.9) = 30.3dBuV/m

30m limit = 30.3dBuV/m +52.7dB = 83dBuV/m = 10^(83/20) = 14186.9uV/m

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

In accordance with FCC part15.209(d) emissions in the bands 9-90kHz and 110-490kHz 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 9kHz – 150kHz RBW = 200Hz

For frequencies measured between 150kHz – 30MHz, RBW = 9kHz

For frequencies measured between 30MHz – 1GHz, RBW = 120kHz

Table 6. Radiated Emissions Test Data < 30MHz @ 30m

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)
0.0730	X	0.00	1.00	60.90	10.9	3898.0	14,186.9	-11.2
0.0730	Y	90.00	1.00	57.80	10.9	2728.0	14,186.9	-14.3
0.0730	Z	15.00	1.00	54.60	10.9	1887.3	14,186.9	-17.5
0.1460	X	180.00	1.00	40.10	10.8	350.0	7,093.5	-26.1
0.2190	X	0.00	1.00	37.90	10.8	271.1	4,729.0	-24.8
0.2920	X	125.00	1.00	47.60	10.7	824.9	3,546.7	-12.7
0.3650	X	200.00	1.00	35.10	10.7	196.1	2,837.4	-23.2
0.4380	X	0.00	1.00	37.40	10.8	256.2	2,364.5	-19.3

Table 7. Radiated Emissions Test Data > 30MHz @ 3m

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)
30.60	V	185.00	1.00	12.70	20.3	44.6	100.0	-7.0
45.41	V	185.00	1.00	26.80	10.3	71.6	100.0	-2.9
59.53	V	90.00	1.00	25.70	8.1	48.9	100.0	-6.2
80.00	V	200.00	1.00	28.00	9.0	70.8	100.0	-3.0
88.75	V	270.00	1.00	13.60	9.3	14.0	150.0	-20.6
91.67	V	270.00	1.00	15.40	9.9	18.4	150.0	-18.2
100.00	V	200.00	1.00	28.10	11.1	91.2	150.0	-4.3
150.00	V	125.00	1.00	13.40	13.9	23.2	150.0	-16.2
250.00	V	180.00	1.00	19.30	13.6	44.2	200.0	-13.1
300.00	V	180.00	1.00	14.50	15.6	32.0	200.0	-15.9
500.00	V	180.00	1.00	10.50	20.6	35.9	200.0	-14.9
42.50	H	125.00	4.00	23.60	12.0	60.6	100.0	-4.4
60.00	H	125.00	4.00	25.60	8.1	48.4	100.0	-6.3
80.00	H	180.00	4.00	29.00	9.0	79.4	100.0	-2.0
80.62	H	350.00	4.00	25.60	8.9	53.3	100.0	-5.5
84.67	H	350.00	4.00	20.60	9.0	30.3	100.0	-10.4
100.00	H	125.00	4.00	30.10	11.1	114.8	150.0	-2.3
149.38	H	345.00	4.00	17.20	13.9	35.9	150.0	-12.4
150.64	H	345.00	4.00	15.60	13.9	29.9	150.0	-14.0
250.00	H	160.00	4.00	14.80	13.6	26.3	200.0	-17.6
300.00	H	270.00	4.00	16.50	15.6	40.3	200.0	-13.9

