

Washington Laboratories, Ltd.

FCC & ISED CANADA CERTIFICATION TEST REPORT

for the

Easy Locator Pro Widerange HDR

FCC ID: QLAWIDERANGE

IC ID: 9433A-WIDERANGE

REPORT# 15207-01 REV 3

Prepared for:

Mala GeoScience USA Inc

Skolgatan 11, S-93070

Mala, 29492 Sweden

Prepared By:

Washington Laboratories, Ltd.

7560 Lindbergh Drive

Gaithersburg, Maryland 20879



Testing Certificate AT-1448

FCC & ISED Canada Certification Test Report

for the

Mala GeoScience USA Inc

Easy Locator Pro Widerange HDR

FCC ID: QLAWIDERANGE

ISED ID: 9433A-WIDERANGE

AUGUST 31, 2017

Re-issued September 26, 2017

WLL REPORT# 15207-01 REV 3

Prepared by:



Michael Violette, P.E.

Test Engineer

Reviewed by:



Steven D. Koster

President

ABSTRACT

Revision History	Description of Change	Date
Rev 0	Initial Release	AUGUST 31, 2017
Rev 1	Edited to respond to ACB Comments	September 14, 2017
Rev 2	Edited to respond to additional ACB Comments	September 19, 2017
Rev 3	Corrected fractional bandwidth calculation	September 26, 2017

TABLE OF CONTENTS

Abstract.....2

Table of Contents3

List of Tables4

1 Introduction.....5

1.1 Compliance Statement 5

1.2 Contract Information..... 5

1.3 Test Dates..... 5

1.4 Test and Support Personnel 5

1.5 Abbreviations..... 6

2 Equipment Under Test7

2.1 EUT Identification & Description 7

2.2 Test Configuration 8

2.3 Testing Algorithm..... 8

2.4 Test Location 8

2.5 Measurements 8

2.5.1 References..... 8

2.6 Measurement Uncertainty 9

3 Test Equipment10

4 Test Results11

LIST OF TABLES

Table 1: Device Summary	7
Table 2: Expanded Uncertainty List	10
Table 3: Test Equipment List.....	10
Table 4. Radiated Emissions Results. 3 meter Test Distance < 1 GHz	11
Table 5. Radiated Emissions Results. 3 meter Test Distance>1 GHz	12

1 INTRODUCTION

1.1 COMPLIANCE STATEMENT

1.2 CONTRACT INFORMATION

Customer: Mala GeoScience USA Inc
Address **Skolgatan 11, S-93070**
Mala, 29492 Sweden

Purchase Order Number: Deposit
Quotation Number: 70279A

1.3 TEST DATES

Testing was performed on the following date(s): 7/31/2017

1.4 TEST AND SUPPORT PERSONNEL

Washington Laboratories, LTD John Reidell
Customer Representative Greg Djoboulian

1.5 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
LISN	Line Impedance Stabilization Network
M	Mega – prefix for 10^6 multiplier
m	Meter
μ	micro – prefix for 10^{-6} multiplier
NB	Narrowband
QP	Quasi-Peak
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

Table 1: Device Summary

Item	Geophysical Survey and Non-Destructive Measurement System
Manufacturer:	Mala GeoScience USA Inc
FCC ID:	QLAWIDERANGE
ISED ID:	9433A-WIDERANGE
Model:	Easy Locator Pro Widerange HDR
Serial Number of Unit Tested	N/A
FCC Rule Parts:	§15.509
Innovation, Science and Economic Development Canada:	RSS-210, Issue 9
Frequency Range Measured:	30MHz – 6 GHz
Maximum Field Strength:	38.1 dBuV/m @ 521.1 MHz.
Modulation:	Pulsed
Occupied Bandwidth:	N/A
Keying:	Automatic, Manual
Type of Information:	N/A
Number of Channels:	Two
Power Output Level	Fixed
Antenna Connector	N/A
Antenna Type	Fixed Dipole
Interface Cables:	Ethernet to PC
Maximum Data Rate	N/A
Power Source & Voltage:	12VDC battery, charged with 120VAC charger

The *EasyLocator WideRange* is a dual frequency ultra-wide band transducer intended for geophysical surveying and nondestructive testing. In use the system performs time domain reflectometry by radiating radio frequency impulses from two transmitting dipoles. Interfaces between materials with different wave impedances cause the wave to be reflected. These reflected waves are received by a pair of receiving dipoles and sampled inside the antenna units. Results may be presented in real time on the PC/monitor connected to the system and recorded on a hard drive on the same PC for later analysis. A rechargeable battery powers the system.

Note that the emissions measured are very broadband without a defined carrier.

2.2 TEST CONFIGURATION

The Easy Locator Pro Widerange HDR was configured on a turntable on an open area test site. The device was arranged on a bed of sand.

2.3 TESTING ALGORITHM

The Easy Locator Pro Widerange HDR was tested in continuous transmit mode.

2.4 TEST LOCATION

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, 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 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.

2.5 MEASUREMENTS

2.5.1 References

ANSI C63.4-2014 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 C63.10-2014 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

2.6 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

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

Where u_c = standard uncertainty

$a, b, c, \dots$ = 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 2 below.

Table 2: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Conducted Emissions	FCC Part 15, ANSI C63.10	±2.63 dB
Radiated Emissions	FCC Part 15, ANSI C63.10	±4.55 dB

3 TEST EQUIPMENT

Table 3 shows a list of the test equipment used for measurements along with the calibration information.

Table 3: Test Equipment List

Test Name:	Radiated Emissions	Test Date:	07/31/2017
Asset #	Manufacturer/Model	Description	Cal. Due
823	AGILENT - N9010A	EXA SPECTRUM ANALYZER	12/21/2017
644	SUNOL SCIENCES CORPORATION - JB1 925-833-9936	BICONALOG ANTENNA	8/14/2017
65	HP - 8447D	RF PRE-AMPLIFIER	1/16/2018
425	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	11/23/2017
627	AGILENT - 8449B	AMPLIFIER 1-26GHZ	11/7/2017

4 TEST RESULTS

The EUT complied with the emissions limits of FCC 15.509.

Emissions were measured from 30 MHz to 6.5 GHz. Results are provided in the following tables.

Table 4. Radiated Emissions Results. 3 meter Test Distance < 1 GHz

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)
37.62	V	235.00	1.00	33.96	-8.9	17.9	100.0	-14.9
42.06	V	310.00	1.00	37.02	-12.1	17.6	100.0	-15.1
50.82	V	215.00	1.00	43.37	-16.6	21.7	100.0	-13.3
69.66	V	270.00	1.00	44.85	-15.7	28.7	100.0	-10.8
79.68	V	235.00	1.00	40.56	-15.8	17.3	100.0	-15.2
114.52	V	280.00	1.00	41.79	-9.8	39.6	150.0	-11.6
132.71	V	215.00	1.00	42.49	-9.4	45.3	150.0	-10.4
138.35	V	180.00	1.00	41.82	-9.8	39.8	150.0	-11.5
160.31	V	180.00	1.00	44.21	-10.6	47.9	150.0	-9.9
209.79	V	190.00	1.00	45.55	-11.5	50.1	150.0	-9.5
225.57	V	0.00	1.00	42.79	-11.0	38.8	200.0	-14.2
234.98	V	315.00	1.00	41.19	-10.4	34.8	200.0	-15.2
250.04	V	135.00	1.00	43.37	-10.1	45.9	200.0	-12.8
325.67	V	235.00	1.50	43.27	-6.9	65.5	200.0	-9.7
430.76	V	0.00	1.50	38.64	-3.7	55.7	200.0	-11.1
521.16	V	0.00	1.00	44.79	-1.5	146.7	200.0	-2.7
716.58	V	90.00	1.00	37.19	2.2	92.8	200.0	-6.7
43.96	H	45.00	4.00	33.95	-13.4	10.7	100.0	-19.4
53.96	H	0.00	4.00	36.43	-17.2	9.2	100.0	-20.8
64.63	H	0.00	4.00	39.32	-16.2	14.3	100.0	-16.9
66.51	H	0.00	4.00	42.59	-16.0	21.4	100.0	-13.4
77.20	H	0.00	4.00	40.37	-15.6	17.2	100.0	-15.3
114.51	H	170.00	4.00	36.25	-9.8	20.9	150.0	-17.1
127.07	H	270.00	4.00	39.60	-9.1	33.3	150.0	-13.1
132.70	H	190.00	4.00	41.69	-9.4	41.4	150.0	-11.2
135.20	H	235.00	4.00	41.70	-9.6	40.4	150.0	-11.4
159.05	H	0.00	4.00	38.02	-10.5	23.7	150.0	-16.0
221.18	H	315.00	4.00	40.07	-11.2	27.9	200.0	-17.1
229.03	H	135.00	4.00	39.80	-10.8	28.3	200.0	-17.0
250.02	H	135.00	4.00	42.24	-10.1	40.3	200.0	-13.9
325.72	H	270.00	4.00	40.90	-6.9	49.9	200.0	-12.1

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)
430.42	H	315.00	3.50	36.14	-3.7	41.7	200.0	-13.6
521.13	H	270.00	1.50	41.81	-1.5	104.1	200.0	-5.7
716.56	H	270.00	1.00	37.33	2.2	94.3	200.0	-6.5

Note: 4.7dB was added to the results per ANSI C63.10-2013 10.2.2. The corrected results are shown in the table above.

Note: All readings are Peak readings.

Table 5. Radiated Emissions Results. 3 meter Test Distance>1 GHz

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)
1302.87	V	45.00	1.00	33.87	-6.9	22.3	500.0	-27.0
1823.95	V	0.00	1.00	38.69	-4.7	50.4	500.0	-19.9
2501.01	V	0.00	1.00	29.99	-0.4	30.1	500.0	-24.4
4873.65	V	0.00	1.00	37.78	7.4	180.8	500.0	-8.8
1200.00	V	0.00	1.00	22.43	-7.6	5.5	500.0	-39.2
1575.00	V	0.00	1.00	9.50	-6.2	1.5	500.0	-50.7

10 dB Bandwidth Measurements

Occupied Bandwidth measurements were collected in an anechoic room. The emissions are extremely low (below FCC 15.209) levels. The EUT was set up in normal operating condition with transmitters running simultaneously.

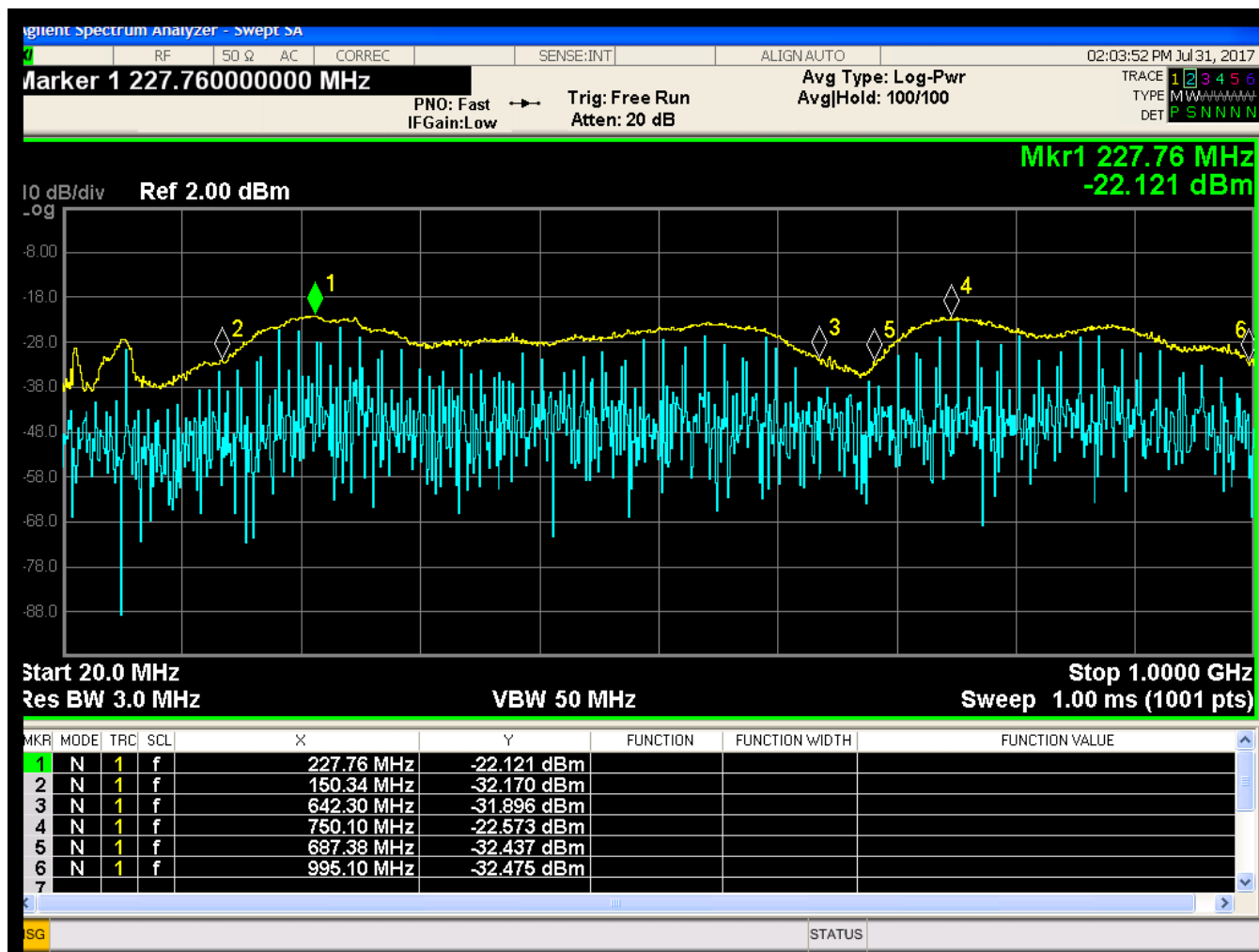
The emissions are notionally centered around 160 MHz and 650 MHz.

The following figure shows the nominal lower channel 10 dB BW and upper channel 10 dB BW.

Fractional bandwidth. The fractional bandwidth equals: $2(f_H - f_L) / (f_H + f_L)$

Lower Channel OBW: $2(642.3 - 227.76) / (642.3 + 227.76) =$
 $2(414.54) / (870.06) = .953$ or **95.3%**

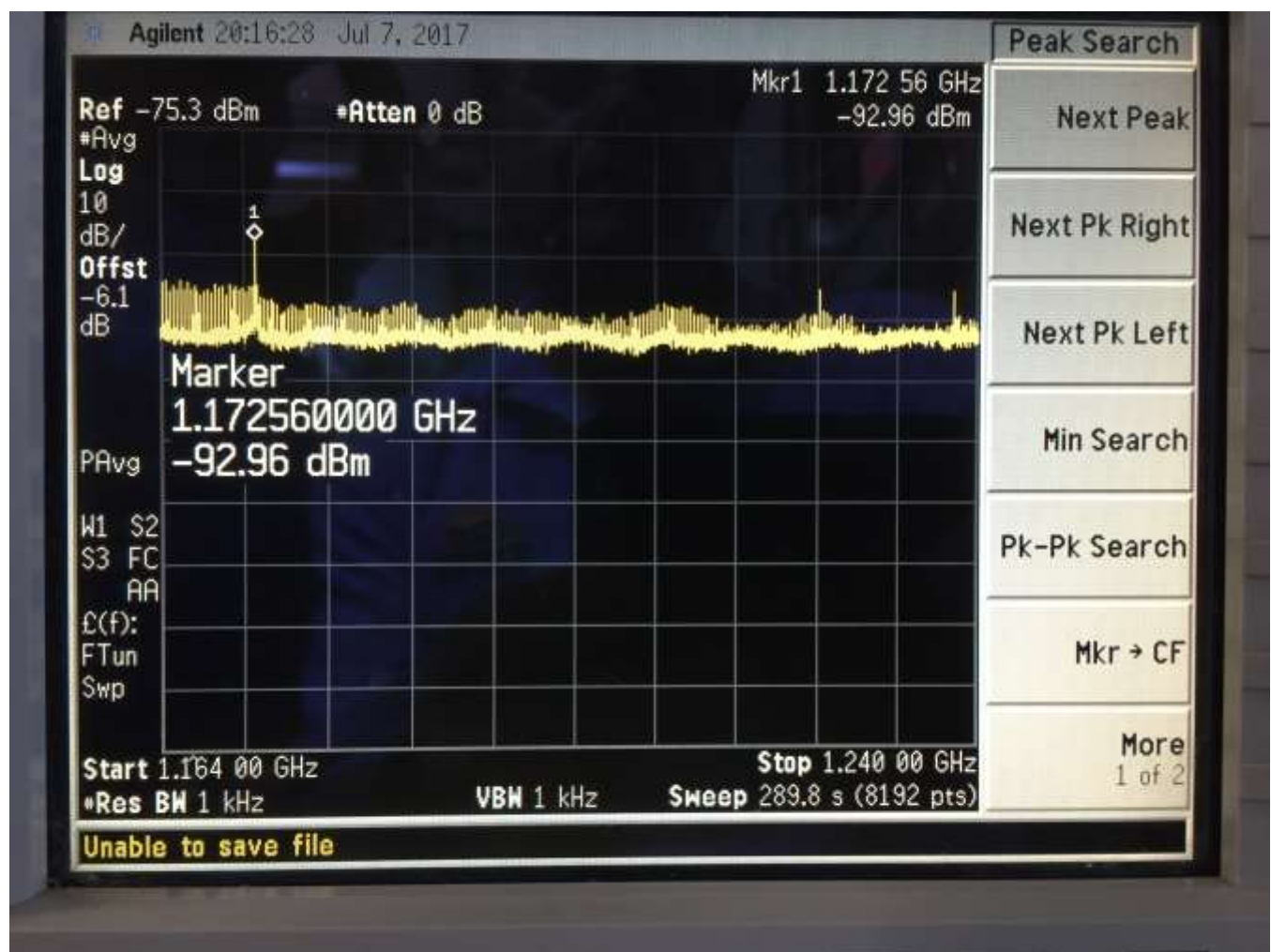
Upper Channel OBW: $2(995.1 - 687.38) / (995.1 + 687.38) =$
 $2(307.72) / (1682.48) = .367$ or **36.7%**



Radiated emissions in the bands of 1164-1240 and 1559-1620 MHz.

Frequency in MHz	EIRP Limit in dBm
1164 - 1240	-75.3
1559 - 1620	-75.3

See the plots below, note that the 6.1 dB offset is for the combined correction factors of the system. Reference level is the limit.





Note: No emissions were detected between 1600 to 1610 MHz.