ENGINEERING TEST REPORT

Noggin Gold 100
Model No.: NG100
FCC ID: QJQ-NG100

Applicant:

Sensors & Software Inc.
1040 Stacey Court
Mississauga, ON
Canada, L4W 2X8

Tested in Accordance With

Federal Communications Commission (FCC)
PART 15, Subpart F, Section 15.509

UltraTech's File No.: SES-034_FCC15UWB_Rev1.0

This Test report is Issued under the Authority of Tri M. Luu, B.A.Sc., Vice President of Engineering UltraTech Group of Labs Date: January 14, 2010	
Report Prepared by: Dharmajit Solanki Issued Date: January 14, 2010	Tested by: Hung Trinh, RFI/EMI Technician Test Dates: November 8 & 9, 2010

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

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FCC	VCCI	Industry Canada / Industrie Canada Approved Test Facility	NVLAP	BSMI	Korea KCC-RRL
91038	1309	46390-2049	NVLAP Lab Code 200093-0	SL2-IN-E-1119R	CA2049

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart F, Section 15.509
Title:	Part 15 of the Commission's Rules regarding Ultra-Wideband Transmission Systems.
Purpose of Test:	To gain FCC Certification Authorization for Technical Requirements for Ground Penetrating Radar and Wall Imaging Systems.
Test Procedures:	FCC guidelines as stated in Appendix F of FCC 02-48, Sec 15.521 and KDB# 393764 for performing all measurements. Please refer to Exhibit 7 of this report for alternate test method used of the measurements as per Section 5 of Annex of Industry Canada RSS-220, Issue 1.
Imaging System Classification of EUT:	Ground penetrating radar (GPR) system. A field disturbance sensor that is designed to operate only when in contact with, or within one meter of, the ground for the purpose of detecting or obtaining the images of buried objects or determining the physical properties within the ground. The energy from the GPR is intentionally directed down into the ground for this purpose. Wall imaging system. A field disturbance sensor that is designed to detect the location of objects contained within a ''wall'' or to determine the physical properties within the ''wall.'' The ''wall'' is a concrete structure, the side of a bridge, the wall of a mine or another physical structure that is dense enough and thick enough to absorb the majority of the signal transmitted by the imaging system. This category of equipment does not include products such as ''stud locators'' that are designed to locate objects behind gypsum, plaster or similar walls that are not capable of absorbing the transmitted signal.

1.2. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-15	2009	Code of Federal Regulations – Telecommunication
FCC 02-48	2002	First Report & Order for UWB Devices
FCC KDB # 393764	2007	Guidance on Measurement Procedure for UWB Devices
RSS-220 Issue 1	2009	Devices Using Ultra-Wideband (UWB) Technology
ANSI C63.4	2009	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	2009	American National Standard for Testing Unlicensed Wireless Devices
CISPR 16-1-1	2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-2-3	2005	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-3: Radiated disturbance measurement

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Sensors & Software Inc.
Address:	1040 Stacey Court Mississauga, Ontario Canada, L4W 2X8
Contact Person:	Mr. Earl Close Phone #: 905-624-8909 Fax #: 905-624-9365 Email Address: ecloses@sensoft.ca

MANUFACTURER	
Name:	Sensors & Software Inc.
Address:	1040 Stacey Court Mississauga, Ontario Canada, L4W 2X8
Contact Person:	Mr. Earl Close Phone #: 905-624-8909 Fax #: 905-624-9365 Email Address: ecloses@sensoft.ca

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Sensors & Software Inc.
Product Name:	Noggin Gold 100
Model Name or Number:	NG100
Serial Number:	Pre-production
Type of Equipment:	Low Frequency Imaging Systems (100 MHz GPR)
Input Power Supply Type:	External 12V battery
Primary User Functions of EUT:	Ground Penetrating Radar (GPR) & Wall Imaging System

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Power Supply Requirement:	12 Vdc battery
Peak E-Field Level and Frequency of the Fundamental Emission in 1 MHz RBW:	60.21 dBµV/m @ 84.40 MHz at a distance of 3 meters
Operating Frequency Range:	7.48 MHz – 252.3 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	N/A
10 dB Bandwidth:	244.8 MHz
Modulation Type:	No modulation
***Emission Designation:**	245MP0N
Oscillators' Frequencies:	18.432 MHz and 8 MHz
Antenna Connector Type:	Dual SuperCon (Antenna detachable for transportation)
Antenna Description:	Manufacturer: Sensors & Software Inc. Model: NG100 Type: Half-wave Dipole Frequency Range: UWB – Center Frequency 100 MHz

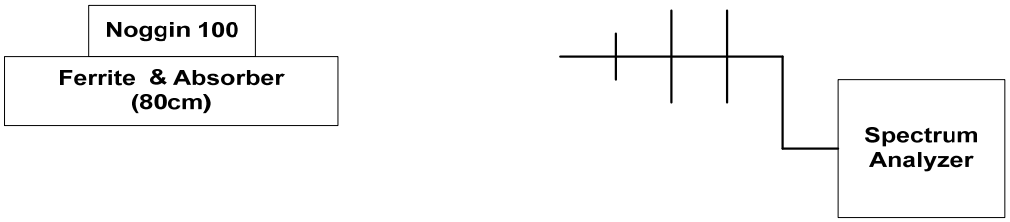
* Per 47 CFR § 2.201 and §2.202

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	12VDC external battery supply, RS-232, QSPI port	1	D-37pin	Shielded

2.5. GENERAL TEST SETUP

Remark: All tests were performed with the EUT placed with the emitter directed downwards at a height of 80cm directly on a solid block of wedge-shaped RF absorbers followed by a layer of ferrite tiles placed on the floor. Please refer to Exhibit 7 of this test report for detailed measurement procedure.



2.6. PULSE TRAIN

The EUT operation is pulsed. Please find below a graphical representation depicting a typical pulse train showing the pulse widths and amplitudes in time domain.

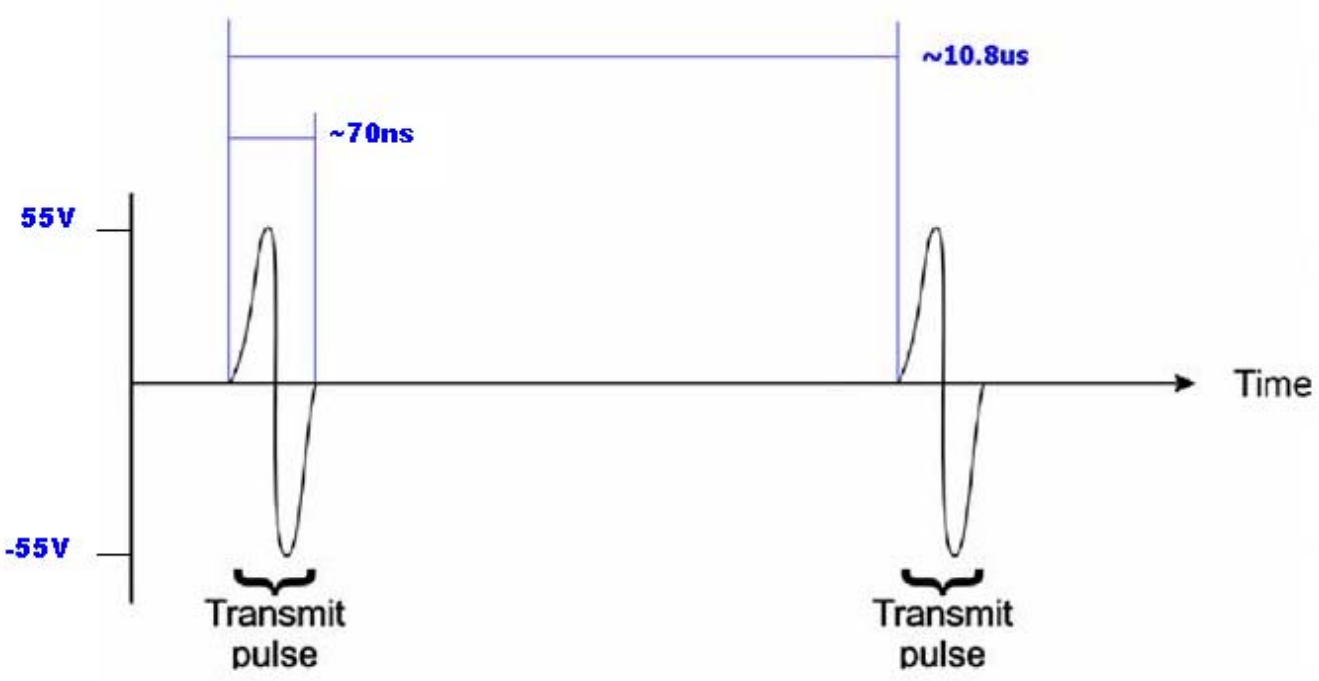


EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21^{o}C
Humidity:	50%
Pressure:	100 kPa
Power input source:	12 V DC from Power Supply

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	GPR device directly placed on solid block of Wedge shaped RF Absorbers and a layer of Ferrite tiles at a height of 80cm in a 10 meter semi-anechoic chamber.
Special Test Software:	Provided by Sensor & Software.
Special Hardware Used:	None
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as an integral antenna.

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada Site No.: 2049A-3, Expiry Date: May 1, 2011)

4.2. APPLICABILITY & SUMMARY OF EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.509(a),(b),(c)&(f) & 15.525	Compliance with General & Technical Requirements	Yes
15.207	AC Power Line Conducted Emissions Measurements (Transmit & Receive)	N/A for battery operated device
15.509(a)	UBW 10 dB Bandwidth	Yes
15.509(d)&(e)	Transmitter Radiated Emissions - Fundamental, Harmonic and Spurious	Yes
The Receiver & Digital portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class A Digital Devices. The engineering test report can be provided upon FCC requests.		

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

EXHIBIT 5. MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

5.1. COMPLIANCE WITH TECHNICAL REQUIREMENTS FOR GPR & WALL IMAGING SYSTEMS [§15.509 (A), (B) & (C)]

5.1.1. FCC Requirements & Compliance Statements

FCC 15.509	Requirements	Compliance Statements
(a)	The UWB bandwidth of an imaging system operating under the provisions of this Section must be below 10.6 GHz	Conforms Refer to Sec 5.2 for details
(b)	Operation under the provisions of this section is limited to GPRs and wall imaging systems operated for purposes associated with law enforcement, fire fighting, emergency rescue, scientific research, commercial mining, or construction. (1) Parties operating this equipment must be eligible for licensing under the provisions of part 90 of this chapter. (2) The operation of imaging systems under this section requires coordination, as detailed in § 15.525.	Conforms Please refer to Applicant's attestation for compliance with this rule
(c)	A GPR that is designed to be operated while being hand held and a wall imaging system shall contain a manually operated switch that causes the transmitter to cease operation within 10 seconds of being released by the operator. In lieu of a switch located on the imaging system, it is permissible to operate an imaging system by remote control provided the imaging system ceases transmission within 10 seconds of the remote switch being released by the operator.	Conforms Please refer to Applicant's attestation for compliance with this rule
(f)	For UWB devices where the frequency at which the highest radiated emission occurs, f_M, is above 960 MHz, there is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on f_M. That limit is 0 dBm EIRP.	N/A f_M, is 252.3 MHz which is below 960 MHz.

5.2. 10 DB OCCUPIED BANDWIDTH [§15.509 (A)]

5.2.1. Limits

§15.509(a); The upper 10 dB point of UWB bandwidth of an imaging system operating under the provisions of this section must be below 10.6 GHz.

5.2.2. Method of Measurements

The 10 dB BW was measured with the EUT placed with the emitter directed downwards at a height of 80cm directly on a solid block of wedge-shaped RF absorbers followed by a layer of ferrite tiles placed on the floor. Please refer to Exhibit 7 of this report for detailed procedure of measurement.

- The spectrum analyzer shall be se as follows:
  - Span: Minimum span to fully display the entire emission, approximately 3 x emissions BW.
  - Resolution RBW: 1 MHz
  - Video VBW: 3 MHz
  - EMI Detector: Peak
  - Sweep Time: AUTO
  - Trace: Max-hold
  - Frequency span is large enough to display a full spectrum of the RF emission (fundamental)

- The spectrum analyzer was pre-entered with the following correction factors:
  - Antenna correction factor
  - Cable loss
  - Pre-amplifier gain

  and all measurements were corrected to these calibrated values

The EUT was located at 3 meters distance away from the measuring antenna and the RF emissions bandwidth was maximized by the following methods:

(1) Place the measuring antenna in horizontal polarization
(2) The EUT was initially placed in the manner that its antenna is in parallel with the measuring antenna.
(3) The measuring antenna as moved up and down form 1 to 4 meters high to search more the maximum 10 dB BW.
(4) At the maximum 10 dB BW with respect to the antenna height, the EUT was manually rotated in 360 degrees until the maximum 10 dB BW was observed.
(5) The measuring antenna gain was moved up and down from 1 to 4 meters again to ensure the maximum 10 dB BW measured.
(6) Change measuring antenna to vertical polarization and repeated steps (1) through (6) while the Spectrum Analyzer was still in MAXHOLD.
(7) Plot the 10 dB rf emission bandwidth in both horizontal and vertical polarization.

5.2.3. Test Setup Diagram

5.2.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20 Hz – 40 GHz	March 09. 2011
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	2 Nov. 2011
RF Amplifier	AH System	PAM-0118	225	20 MHz – 18 GHz	18 Apr.2011
Loop antenna	EMCO	6502	2611	10 kHz – 30 MHz	27 July 2011
Biconi-Log Antenna	Emco	3142C	00026873	26 – 3000 MHz	18 April 2011

5.2.5. Test Data

Rx Antenna Polarization	Zoom-in Peak Frequency (MHz)	Peak E-field @ 3m (V+H) (dBµV/m) Per 1 MHz RBW	Lower and Upper Frequencies at 10 dB Down Markers		10 dB Bandwidth	Pass/Fail
			Lower (MHz)	Upper (MHz)	(MHz)	
0° & 90° (Loop) V&H (Biconilog)	84.40	60.21	7.48	252.30	244.8	Pass*

* The upper 10 dB point was found to be below 10.6 GHz.

See plots # 1 & 2 for measurement details.

Plot 1: 10 dB Lower BW Measurements for Model NG100 (Antenna at Vertical & Horizontal Polarizations)

ROHDE&SCHWARZ

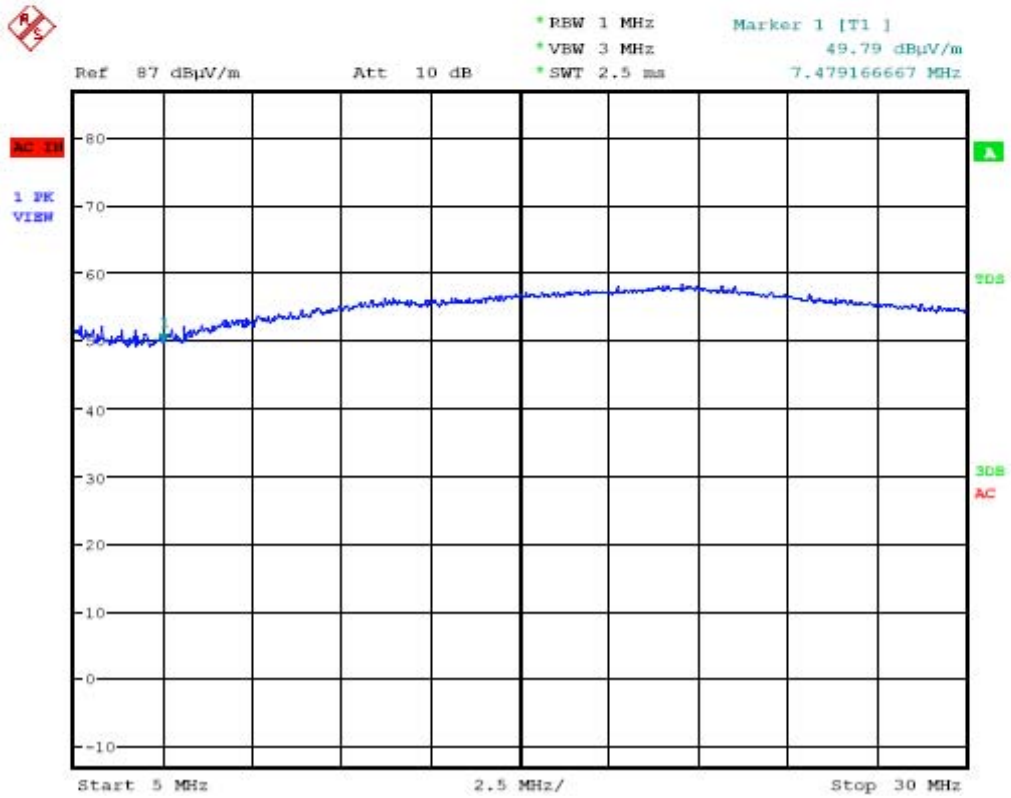
Utratech Engineering Lab 08.Nov 10 14:52

Meas Type	0 and 90 degree 3m TDK
Equipment under Test	Noggin Gold100
Manufacturer	Sensor and Software
OP Condition	12Vdc Battery
Operator	Hung Trinh

Test Spec
FCC 15.509 10dB BW Lower

Sweep Settings Screen A

Center Frequency	17.500000 MHz	Ref Level	87.000 dBµV/m
Frequency Offset	0.000000 Hz	Ref Level Offset	0.000 dB
Span	25.000000 MHz	Ref Position	100.000 %
Start Frequency	5.000000 MHz	Level Range	100.000 dB
Stop Frequency	30.000000 MHz	RF Att	10.000 dB
RBW	1.000000 MHz		
VBW	3.000000 MHz	X-Axis	LIN
Sweep Time	2.50 ms	Y-Axis	LOG



Plot 2: 10 dB BW Measurements for Model NG100 with Noise Floor (Antenna at Vertical & Horizontal Polarizations)

ROHDE&SCHWARZ

Utratech Engineering Lab

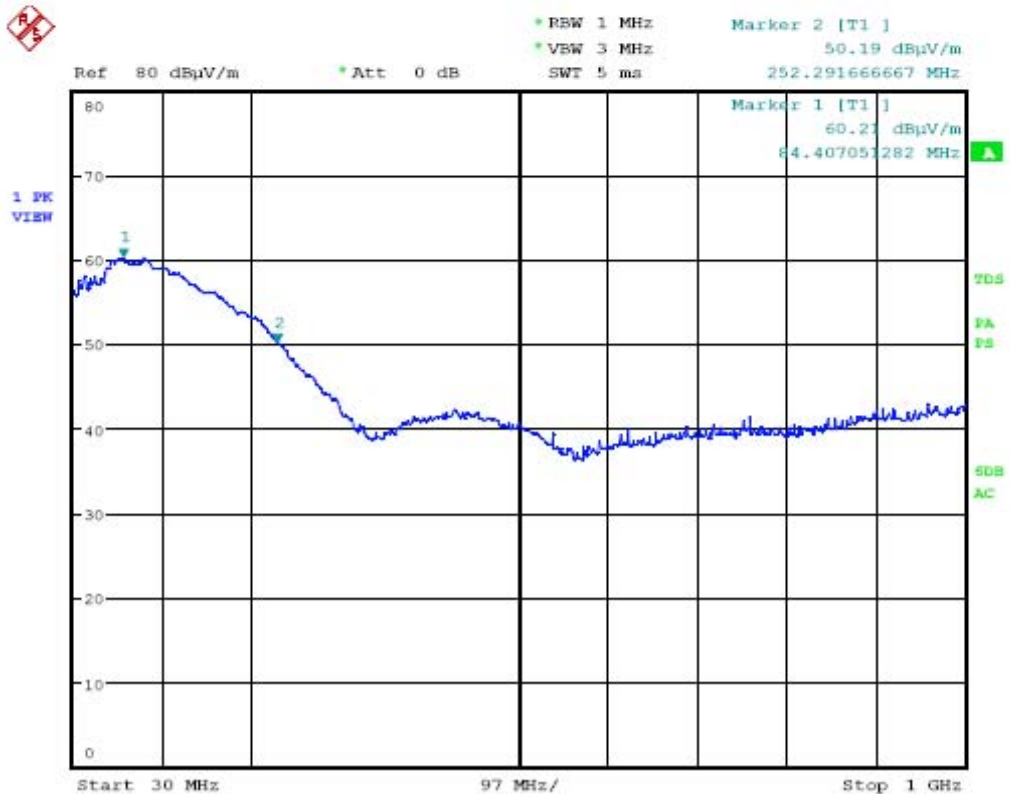
08.Nov 10 12:08

Meas Type	Vertical & Horizontal 10m TDK
Equipment under Test	Noggin Gold100
Manufacturer	Sensor and Software
OP Condition	12Vdc Battery
Operator	Hung Trinh

Test Spec
FCC 15.509 10dB BW Upper

Sweep Settings **Screen A**

Center Frequency	515.000000 MHz	Ref Level	80.000 dBµV/m
Frequency Offset	0.000000 Hz	Ref Level Offset	0.000 dB
Span	970.000000 MHz	Ref Position	100.000 %
Start Frequency	30.000000 MHz	Level Range	80.000 dB
Stop Frequency	1.000000 GHz	RF Att	0.000 dB
RBW	1.000000 MHz		
VBW	3.000000 MHz	X-Axis	LIN
Sweep Time	5.00 ms	Y-Axis	LOG



5.3. TRANSMITTER RADIATED EMISSIONS @ 3 METERS [§15.509 (D)(E)(F)]

5.3.1. Limits

§15.509(d): The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels is Section 15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits measured using a resolution bandwidth of 1 MHz.

FCC CFR 47, Part 15, Subpart C, Sec. 15.209 (a) - Limits for Frequency below 960 MHz

Frequency (MHz)	Field strength Limits (microvolts/m)	Measuring RBW	Distance (Meters)
0.009 - 0.490	2,400 / F (KHz)	1 kHz	300
0.490 - 1.705	24,000 / F (KHz)	9 kHz	30
1.705 - 30.0	30	9 kHz	30
30 - 88	100	120 kHz	3
88 - 216	150	120 kHz	3
216 - 960	200	120 kHz	3

FCC CFR 47, Part 15, Subpart F, Sec. 15.509 (d) - Limits for Frequency above 960 MHz

Frequency in MHz	EIRP Limits in dBm (1 MHz BW)	Alternative E-Field Limits in dBµV @ 3m (1 MHz BW)
960-1610	-65.3	29.9
1610-1990	-53.3	41.9
1990-3100	-51.3	43.9
3100-10600	-41.3	53.9
Above 10600	-51.3	43.9

§15.509(e): In addition to the radiated emissions limits specified in the above table, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz.

FCC CFR 47, Part 15, Subpart F, Sec. 15.509 (e) - Limits for Frequency above 960 MHz

Frequency in MHz	EIRP Limits in dBm (1 kHz BW)	Alternative E-Field Limits in dBµV @ 3m (1 KHz BW)
1164-1240	-75.3	19.9
1559-1610	-75.3	19.9

5.3.2. Method of Measurements

Please refer to Exhibit 7 of this report for detailed procedure of measurement, Sec15.521, FCC 02-48 and ANSI 63.10 for detailed radiated emissions measurement procedures.

5.3.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20 Hz – 40 GHz	March 09. 2011
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	2 Nov. 2011
RF Amplifier	AH System	PAM-0118	225	20 MHz – 18 GHz	18 Apr.2011
Loop antenna	EMCO	6502	2611	10 kHz – 30 MHz	27 July 2011
Biconi-Log Antenna	Emco	3142C	00026873	26 – 3000 MHz	18 April 2011
Horn Antenna	Emco	3155	9701-6570	1 – 18 GHz	20 Nov 2010

5.3.4. Test Data

Remark: All tests were performed with the EUT placed with the emitter directed downwards at a height of 80cm directly on a solid block of wedge-shaped RF absorbers followed by a layer of ferrite tiles placed on the floor.

5.3.4.1. Radiated Emissions at 3 meters distance

- **Test Site**: The radiated emissions tests were performed at Ultratech's 10-meter TDK Chamber registered with FCC; File No.: 31040/SIT 1300B3
- The emissions were scanned from 150 kHz to 6 GHz and all emissions within 20 dB below the limits were recorded.
- For frequency below 30 MHz, the emissions were measured at distance of 10 meter using the CISPR Quasi-Peak Detector.
- For frequency between 30 to 960 MHz, the emissions were measured at distance of 3 meter using the CISPR Quasi-Peak Detector.
- For frequencies fall inside 960-6000 MHz bands, the emissions were measured using RMS Average Detector, RBW = 1 MHz, VBW = 3 MHz. The averaging time set was 1 millisecond. The measurements were performed at 3 meter distance.
- For frequencies fall inside 1164-1240 and 1559-1610 MHz, the emissions were measured using RMS Detector, RBW = 1 KHz, VBW = 3 KHz.

FREQUENCY (MHz)	RF LEVEL LEVEL (dBuV/m)	EMI DETECTOR (PEAK/QP/ RMS)	ANTENNA PLANE (H/V)	LIMIT 15.209 * 15.509 (dBuV/m)	LIMIT MARGIN (dB)	PASS/ FAIL	Distance (m)
22.22	24.54	Peak	0°	48.6	- 24.1	Pass	10
22.22	28.08	Peak	90°	48.6	- 20.5	Pass	10
32.32	34.40	QP	V	40.0	- 5.6	Pass	3
32.32	34.90	Peak	H	40.0	- 5.1	Pass	3
37.29	35.60	QP	V	40.0	- 4.4	Pass	3
37.29	35.18	Peak	H	40.0	- 4.8	Pass	3
43.46	36.30	QP	V	40.0	- 3.7	Pass	3
43.46	36.58	Peak	H	40.0	- 3.4	Pass	3
50.19	35.90	QP	V	40.0	- 4.1	Pass	3
50.19	37.27	Peak	H	40.0	- 2.7	Pass	3
55.24	36.20	QP	V	40.0	- 3.8	Pass	3
55.24	37.41	Peak	H	40.0	- 2.6	Pass	3
84.21	38.20	QP	V	40.0	- 1.8	Pass	3
84.21	39.00	QP	H	40.0	- 1.0	Pass	3
101.28	38.97	Peak	V	43.5	- 4.5	Pass	3
101.28	37.95	QP	H	43.5	- 5.5	Pass	3
113.14	37.15	Peak	V	43.5	- 6.3	Pass	3
113.14	38.25	QP	H	43.5	- 5.2	Pass	3
135.73	35.02	Peak	V	43.5	- 8.5	Pass	3
135.73	37.36	QP	H	43.5	- 6.1	Pass	3
200.00	31.53	Peak	V	43.5	- 12.0	Pass	3
200.00	35.83	Peak	H	43.5	- 7.7	Pass	3
2022.75	36.89	RMS	V	43.9	- 7.0	Pass	3
2022.75	39.59	RMS	H	43.9	- 4.3	Pass	3

No significant emissions were found within 1164-1240 MHz & 1559-1610 MHz frequency bands and up to 6 GHz except as per above. Please refer to plots # 3 and 8 for measurement details (the scans shows a Peak detector measurement).

Plot 3: Radiated emissions scanned from 150 kHz – 30 MHz (Antenna at 0 Degree)

ROHDE&SCHWARZ

Utratech Engineering Lab

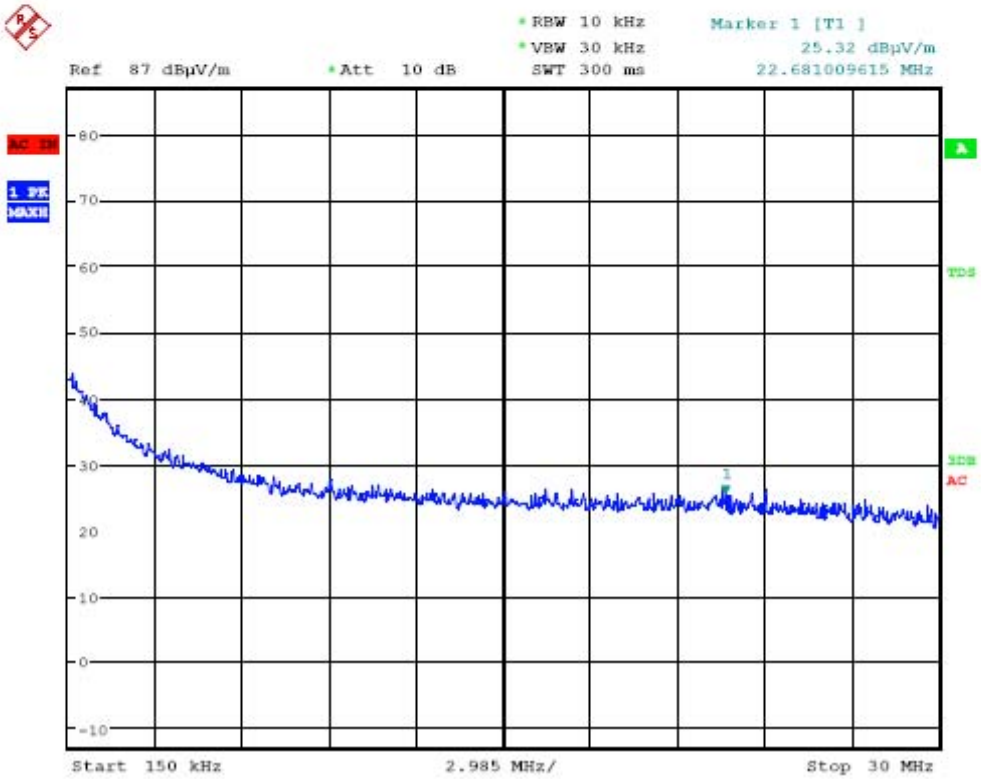
08.Nov 10 15:09

Meas Type	0 degree 10m TDK
Equipment under Test	Noggin Gold100
Manufacturer	Sensor and Software
OP Condition	12Vdc Battery
Operator	Hung Trinh

Test Spec
FCC 15.509 Radiated 150 kHz-30 MHz

Sweep Settings Screen A

Center Frequency	15.075000 MHz	Ref Level	87.000 dBµV/m
Frequency Offset	0.000000 Hz	Ref Level Offset	0.000 dB
Span	29.850000 MHz	Ref Position	100.000 %
Start Frequency	150.000000 kHz	Level Range	100.000 dB
Stop Frequency	30.000000 MHz	RF Att	10.000 dB
RBW	10.000000 kHz		
VBW	30.000000 kHz	X-Axis	LIN
Sweep Time	300.00 ms	Y-Axis	LOG



Plot 4: Radiated emissions scanned from 150 kHz – 30 MHz (Antenna at 90 Degree)

ROHDE&SCHWARZ

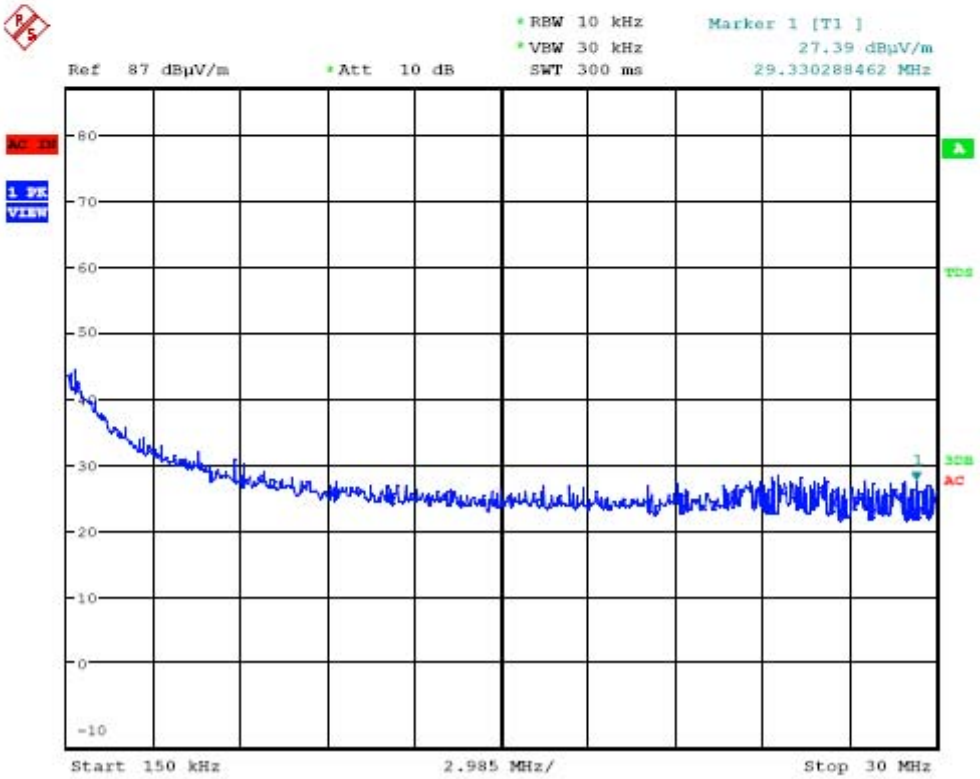
Utratech Engineering Lab 08.Nov 10 15:06

Meas Type	90 degree 10m TDK
Equipment under Test	Noggin Gold100
Manufacturer	Sensor and Software
OP Condition	12Vdc Battery
Operator	Hung Trinh

Test Spec
FCC 15.509 Radiated 150 kHz-30 MHz

Sweep Settings Screen A

Center Frequency	15.075000 MHz	Ref Level	87.000 dBµV/m
Frequency Offset	0.000000 Hz	Ref Level Offset	0.000 dB
Span	29.850000 MHz	Ref Position	100.000 %
Start Frequency	150.000000 kHz	Level Range	100.000 dB
Stop Frequency	30.000000 MHz	RF Att	10.000 dB
RBW	10.000000 kHz		
VBW	30.000000 kHz	X-Axis	LIN
Sweep Time	300.00 ms	Y-Axis	LOG



Plot 5: Radiated emissions scanned from 30 MHz – 1 GHz (Antenna - Vertical Polarization)

ROHDE&SCHWARZ

Utratech Engineering Lab

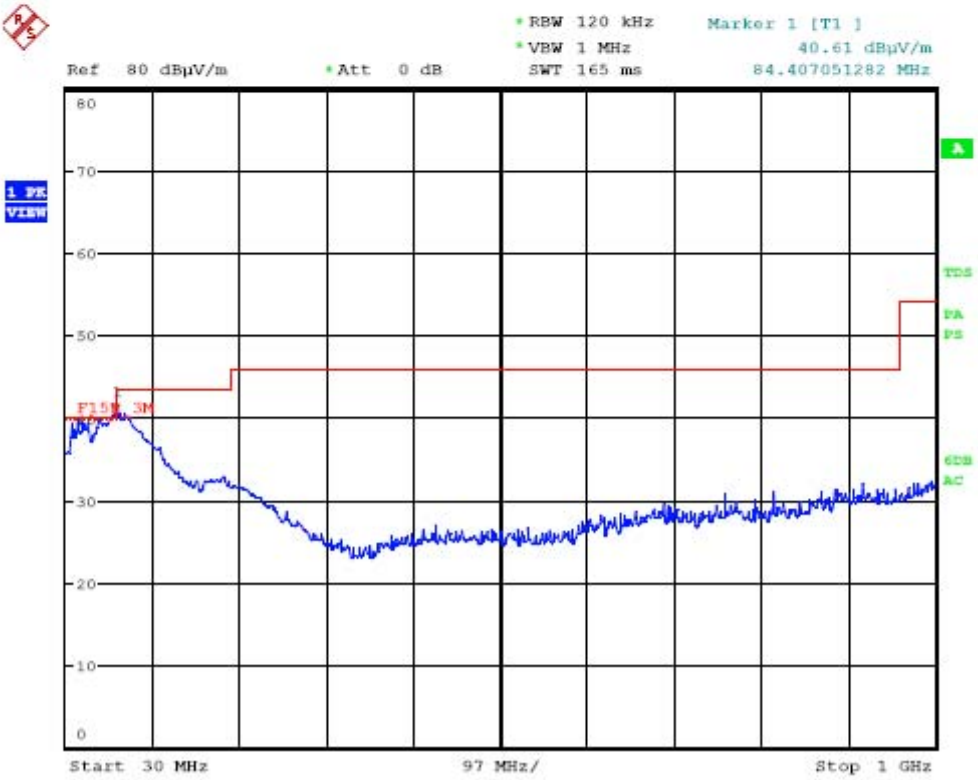
08.Nov 10 11:58

Meas Type	Vertical 10m TDK
Equipment under Test	Noggin Gold100
Manufacturer	Sensor and Software
OP Condition	12Vdc Battery
Operator	Hung Trinh

Test Spec
FCC 15.509 Radiated 30-1000 MHz

Sweep Settings Screen A

Center Frequency	515.000000 MHz	Ref Level	80.000 dBµV/m
Frequency Offset	0.000000 Hz	Ref Level Offset	0.000 dB
Span	970.000000 MHz	Ref Position	100.000 %
Start Frequency	30.000000 MHz	Level Range	80.000 dB
Stop Frequency	1.000000 GHz	RF Att	0.000 dB
RBW	120.000000 kHz		
VBW	1.000000 MHz	X-Axis	LIN
Sweep Time	165.00 ms	Y-Axis	LOG



Plot 6: Radiated emissions scanned from 30 MHz – 1 GHz (Antenna - Horizontal Polarization)

ROHDE&SCHWARZ

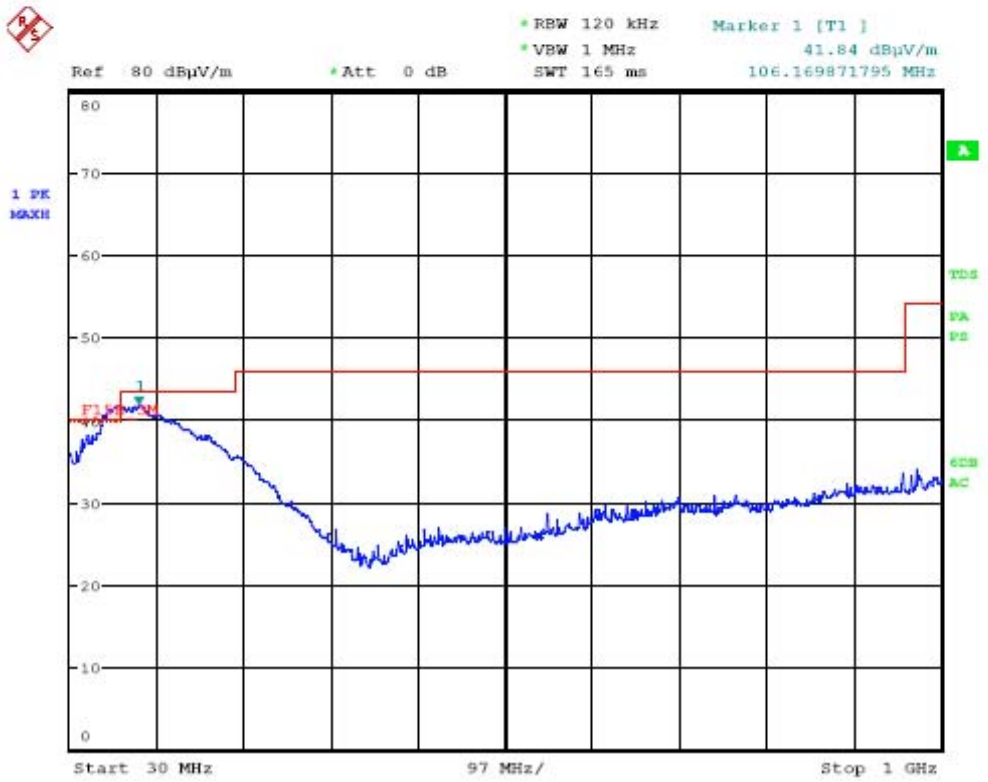
Utratech Engineering Lab 08.Nov 10 13:11

Meas Type	Horizontal 10m TDK
Equipment under Test	Noggin Gold100
Manufacturer	Sensor and Software
OP Condition	12Vdc Battery
Operator	Hung Trinh

Test Spec
FCC 15.509 Radiated 30-1000 MHz

Sweep Settings **Screen A**

Center Frequency	515.000000 MHz	Ref Level	80.000 dBµV/m
Frequency Offset	0.000000 Hz	Ref Level Offset	0.000 dB
Span	970.000000 MHz	Ref Position	100.000 %
Start Frequency	30.000000 MHz	Level Range	80.000 dB
Stop Frequency	1.000000 GHz	RF Att	0.000 dB
RBW	120.000000 kHz		
VBW	1.000000 MHz	X-Axis	LIN
Sweep Time	165.00 ms	Y-Axis	LOG



Plot 7: Radiated emissions scanned from 1 GHz – 6 GHz (Antenna - Vertical Polarization)

ROHDE&SCHWARZ

Utratech Engineering Lab

08.Nov 10 13:50

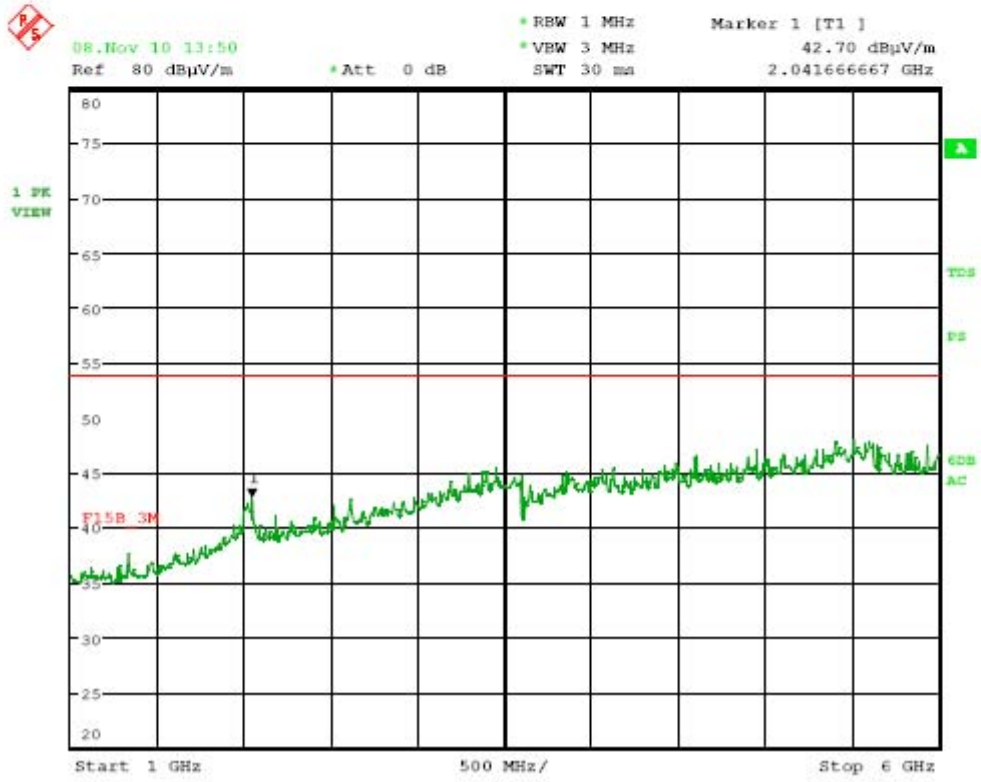
Meas Type	Vertical 3m TDK
Equipment under Test	Noggin Gold100
Manufacturer	Sensor and Software
OP Condition	12Vdc Battery
Operator	Hung Trinh

Test Spec

FCC 15.509 Radiated 1-6 GHz

Sweep Settings Screen A

Center Frequency	3.500000 GHz	Ref Level	80.000 dBµV/m
Frequency Offset	0.000000 Hz	Ref Level Offset	0.000 dB
Span	5.000000 GHz	Ref Position	100.000 %
Start Frequency	1.000000 GHz	Level Range	60.000 dB
Stop Frequency	6.000000 GHz	RF Att	0.000 dB
RBW	1.000000 MHz		
VBW	3.000000 MHz	X-Axis	LIN
Sweep Time	30.00 ms	Y-Axis	LOG



Plot 8: Radiated emissions scanned from 1 GHz – 6 GHz (Antenna - Horizontal Polarization)

ROHDE&SCHWARZ

Utratech Engineering Lab

08.Nov 10 13:55

Meas Type	Horizontal 3m TDK
Equipment under Test	Noggin Gold100
Manufacturer	Sensor and Software
OP Condition	12Vdc Battery
Operator	Hung Trinh

Test Spec
FCC 15.509 Radiated 1-6 GHz

Sweep Settings Screen A

Center Frequency	3.500000 GHz	Ref Level	80.000 dBµV/m
Frequency Offset	0.000000 Hz	Ref Level Offset	0.000 dB
Span	5.000000 GHz	Ref Position	100.000 %
Start Frequency	1.000000 GHz	Level Range	60.000 dB
Stop Frequency	6.000000 GHz	RF Att	0.000 dB
RBW	1.000000 MHz		
VBW	3.000000 MHz	X-Axis	LIN
Sweep Time	30.00 ms	Y-Axis	LOG

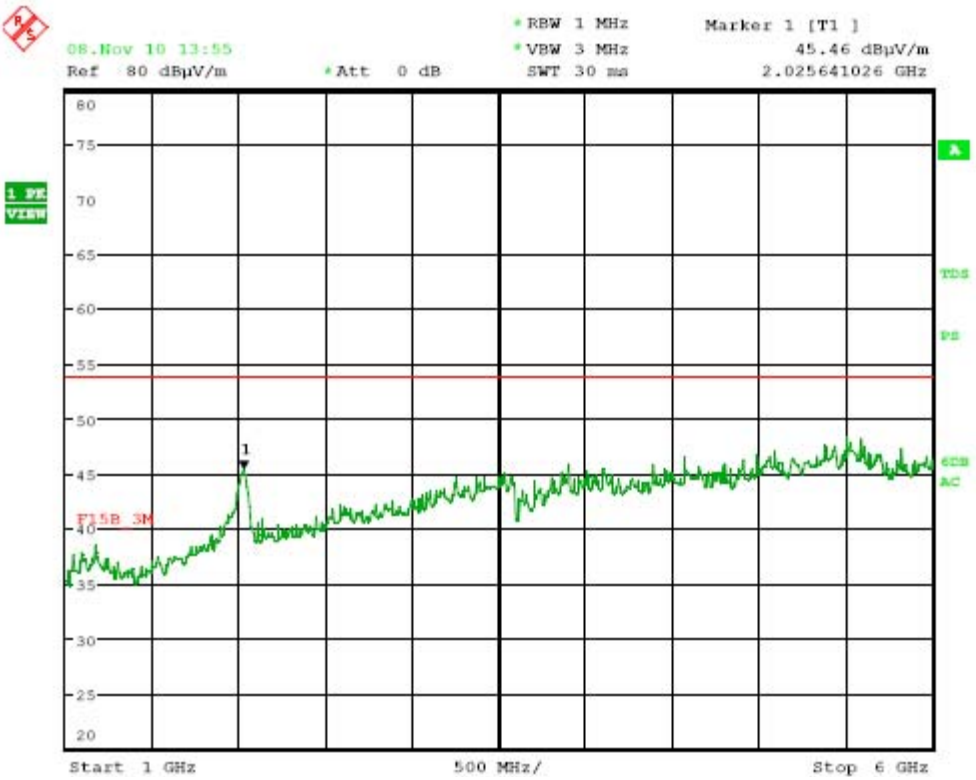


EXHIBIT 6. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC: 2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement with a confidence level of 95%.

6.1. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 2.15**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.30**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.78**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)}$	**± 1.87**	Under consideration
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.75**	Under consideration

EXHIBIT 7. MEASUREMENT METHOD

7.1. BACKGROUND

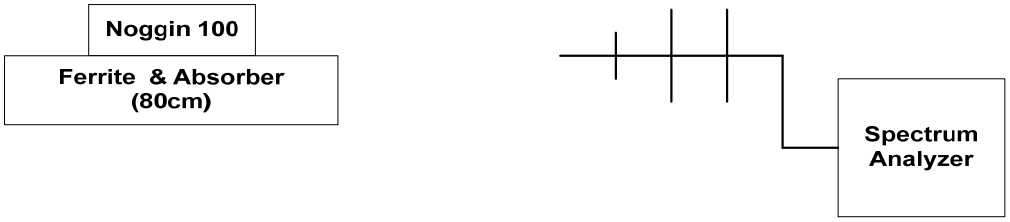
As per general guidance for compliance measurements of UWB devices provided in Appendix F of FCC 02-48 Rule & Order, Ground penetrating radars (GPRs) and wall imaging systems shall be tested under conditions that are representative of actual operating conditions; i.e. shall be tested with the transducer at an operationally representative height above a twenty-inch thick bed of dry sand.

We tried to test the DUT with above suggested method in our 10 meter OATS but found very high level of ambient noise signals in the freq range of 30 MHz to 2.5 GHz hence were unable to complete our measurements. As an alternative we choose another test method to test the device in a semi-anechoic chamber as per Section 5 of Annex of Industry Canada RSS-220, Issue 1, also described here in Sec 7.4. Please note that other than this alternate test method we have followed complete FCC guidelines as stated in Appendix F of FCC 02-48, Sec 15.521 and KDB# 393764 for measurements.

7.2. TEST SITES

The radiated emissions tests were performed at 10-meter TDK Chamber registered with FCC; File No.: 31040/SIT 1300B3 located at the facility of Ultratech Engineering Labs Inc. The emissions testing equipment was setup using a configuration as shown in Figure 2-1

Figure 2-1: Block diagram of EMC measurement configuration for radiated emissions testing



7.3. MEASUREMENT ENVIRONMENT

Measuring transmissions from devices using UWB technology requires a measurement system that comprises a receiving antenna and a test receiver. Several receiving antennas, each optimized over a distinct frequency range, are required when measuring the complete spectrum of the UWB device. The measurement receiver may be a spectrum analyzer, an electromagnetic interference test receiver, a vector signal analyzer or an oscilloscope. Due to possible receiver bandwidth dependent variations, measuring a UWB spectrum requires using several signal detectors, including a peak detector for determining the peak power in the spectrum above 960 MHz.

The low power levels of UWB transmissions make it desirable to take the measurement in an anechoic or a semi-anechoic chamber.3 A measurement taken in an anechoic chamber must correlate with a measurement taken in a semi-anechoic chamber. This is usually done by adjusting for the effect of the ground screen in a semi-anechoic environment or an open area test site. For frequencies above 960 MHz, there is no need for a propagation correction factor given that ground reflection is not significant when directional antennas are employed and when the floor is treated with radio frequency (RF) absorbers.

In cases where the transmission level from the UWB device is too weak to overcome the noise of a conventional spectrum analyzer, a low-noise amplifier (LNA) shall be used. The LNA shall have sufficient bandwidth at the output of the measurement antenna to reduce the effective noise figure of the overall measurement system. This increased sensitivity of the measurement system can make it particularly vulnerable to ambient environmental signals. If strong ambient signals are present in the measurement environment, an appropriate RF filter shall be placed ahead of the LNA. Doing so will provide the pre-selection necessary to prevent amplifier overload while permitting signals in the frequency range of interest to pass through the measurement system. The insertion loss associated with this filter shall be minimal and shall also be considered when determining the overall sensitivity of the measurement system.

7.4. ALTERNATE MEASUREMENT METHOD USED FOR GROUND PENETRATING RADAR AND WALL IMAGING RADAR DEVICES

An alternative method for testing GPR devices is to place the DUT at a height of 80 cm on a non-conducting support with the emitter directed downwards. If the DUT emissions are expected to have components below 500 MHz, a layer of ferrite tile should be placed directly on the floor below the DUT. Pyramidal or wedge-shaped RF absorbers not less than 60 cm in height should be placed directly below the DUT. Some sections of absorber may be inverted and placed over other absorbers to form a solid block. Care shall be taken not to place any RF absorber between the device and the search antenna, as this would prevent energy not directed downwards from reflecting from the ground screen. The placement of the absorber shall not be disturbed when the device is rotated. This arrangement prevents energy directed downwards from consideration in the measurement. A search in azimuth and elevation for indirect emissions may now be performed.