UltraTech
Group of Labs

31040/SIT

C-1376

Canada
46390-2049

NVLAP
200093-0

00-034

SL2-IN-E-1119R

Nov 30, 2005

FEDERAL COMMUNICATIONS COMMISSION
7435 Oakland Mills Road
Columbia, MD 21046
USA

Subject: **FCC Certification Application under FCC ET Docket 98-153 & FCC Part 15, Subpart F, Section 15.509 – Technical Requirements for Low Frequency Imaging Systems operating at 1000 MHz (center frequency)**

Applicant: **Sensors & Software Inc.**
Product: **Conquest**
Model: **DE**
FCC ID: **QJQ-CONQ-DE1**

Dear Sir/Madam,

As appointed agent for **Sensors & Software Inc.**, we would like to submit the application to the Federal Communications Commission for certification of the above product. Please review all necessary files uploaded to FCC OET site for detailed information.

If you have any queries, please do not hesitate to contact us.

Yours truly,

Tri Minh Luu, P. Eng.,
V.P., Engineering

TML/AD

Encl.

3000 Bristol Circle,
Oakville, Ontario,
Canada L6H 6G4

Tel.: (905) 829-1570
Fax.: (905) 829-8050

Website: www.ultratech-labs.com
Email: vic@ultratech-labs.com

UltraTech
Group of Labs

31040/SIT

C-1376

Canada
46390-2049

NVLAP
200093-0

00-034

SL2-IN-E-1119R

Nov 30, 2005

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

Attn.: **Mr. David Redman**

Subject: **FCC Certification Application Testing under FCC ET Docket 98-153 & FCC Part 15, Subpart F, Section 15.509 – Technical Requirements for Low Frequency Imaging Systems operating at 1000 MHz (center frequency)**

Product: **Conquest**
Model: **DE**
FCC ID: **QJQ-CONQ-DE1**

Dear Mr. Redman,

The product sample, as provided by you, has been tested and found to comply with **FCC ET Docket 98-153 & FCC Part 15, Subpart F, Section 15.509 – Technical Requirements for Low Frequency Imaging Systems operating at 1000 MHz (center frequency),** and the results and observation were recorded in the engineering report, Our File No.: SES-029FCC15UWB.

Enclosed you will find copy of the engineering report. If you have any queries, please do not hesitate to contact us.

Yours truly,

Tri Minh Luu, P.Eng
Vice President - Engineering

Encl.

3000 Bristol Circle,
Oakville, Ontario,
Canada L6H 6G4

Tel.: (905) 829-1570
Fax.: (905) 829-8050

Website: www.ultratech-labs.com
Email: vic@ultratech-labs.com

ENGINEERING TEST REPORT

Conquest
Model No.: DE
FCC ID: QJQ-CONQ-DE1

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-029FCC15UWB

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: Nov 30, 2005	
Report Prepared by: Anca Dobre Issued Date: Nov 30, 2005	Tested by: Hung Trinh, RFI/EMI Technician & David Redman, Sensors & Software Inc. Test Dates: Nov. 23-28, 2005

- *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.*

UltraTech

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4
Tel.: (905) 829-1570 Fax: (905) 829-8050
Website: www.ultratech-labs.com, Email: vic@ultratech-labs.com, Email: tri@ultratech-labs.com

TABLE OF CONTENTS

EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC ET Docket 98-153 & FCC Part 15, Subpart F, Section 15.509
Title:	Revision of Part 15 of the Commission's Rules regarding Ultra-Wideband Transmission Systems.
Purpose of Test:	To gain FCC Certification Authorization for Technical Requirements for Low Frequency Imaging Systems operating at 1000 MHz (center frequency) .
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with FCC ET Docket 98-153 and American National Standards Institute 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.
Imaging System Classification of EUT:	Ground penetrating radar (GPR) system. A field disturbance sensor that is designed to operate only when in contact with 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.

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-15	2005	Code of Federal Regulations – Telecommunication
FCC ET Docket 98-153	April 22, 2002	FCC 02-48: Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems.
ANSI C63.4	2004	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
CISPR 22 CISPR 22 +A1 EN 55022	2003-04-10 2004-10-14 2003	Information Technology Equipment - Radio Disturbance Characteristics – Limits and Methods of Measurement
CISPR 16-1-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-2-1	2004	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-1: Conducted disturbance measurement
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval

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. David Redman Phone #: 905-624-8909 Fax #: 905-624-9365 Email Address: dr@sensoft.ca

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

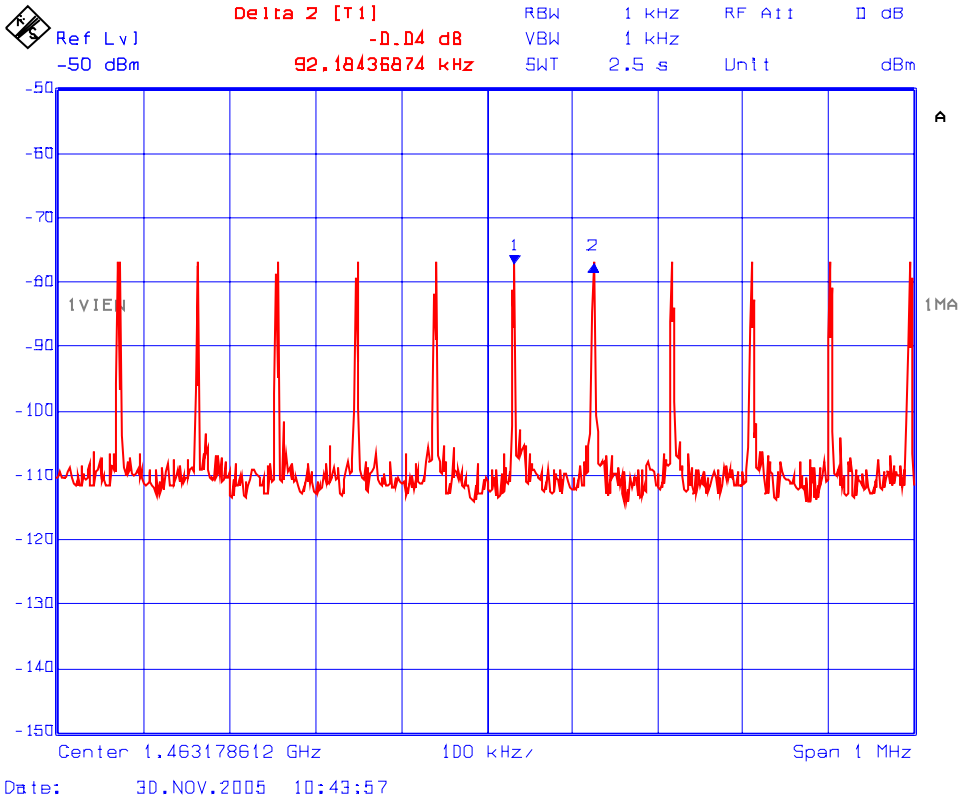
Brand Name:	Sensors & Software Inc.
Product Name:	Conquest
Model Name or Number:	DE
Serial Number:	Preproduction
Type of Equipment:	Low Frequency Imaging Systems (GPR)
Input Power Supply Type:	External 12 Vdc (from a host system)
Primary User Functions of EUT:	Ground penetrating radar (GPR) system. A field disturbance sensor that is designed to operate only when in contact with 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.

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Power Supply Requirement:	External 12 Vdc (from a host system)
E-Field of the Fundamental RF Carrier:	< 30 dBµV/m @ 3 meters
Operating Frequency Range:	84 – 2295 MHz
Pulse Voltage Rating:	Setting is 185 V which produces pulse voltage of 120 V
RF Output Impedance:	50 Ohms
Channel Spacing:	N/A
Pulse Repetition Frequency (PRF):	92.2 kHz. Please refer to the Pulse Repetition Frequency measurement below for details of measurements.
Pulse Width:	500 ps
10 dB Bandwidth:	2211 MHz
Modulation Type:	No modulation
***Emission Designation:**	2G21N0N
Oscillators' Frequencies:	7.37 MHz
Antenna Connector Type:	Integral, permanently attached (the module to be certified incorporates both transmitter and antenna) and sealed inside the final product.
Antenna Description:	Manufacturer: Sensors & Software Inc. Type: Dipole Frequency Range: UWB – Center Frequency 1000 MHz

* Per 47 CFR § 2.201 and §2.202

Plot 1: Pulse Repetition Frequency measurement



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	12 Vdc Input & RS-232, QSPI (high speed serial) Port	1	DB15	Shielded

2.5. ANCILLARY EQUIPMENT

Pulse Ekko Pro Control Module, Model No.: 1100, with Elpac AC/DC Power Supply, Model WR4212

2.6. GENERAL TEST SETUP

Remark: All tests were performed with the EUT's antenna placed on the 20" thick sand as its intended operation configuration.

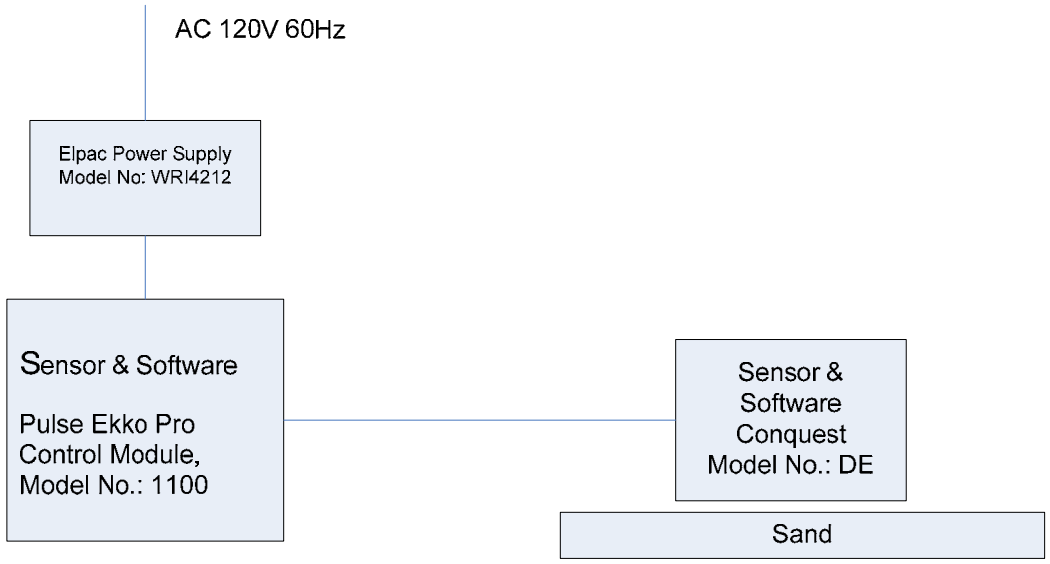


EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	External 12 Vdc (from a host system)

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The transmitter was turned and placed on the sand.
Special Test Software:	None.
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. APPLICABILITY & SUMMARY OF EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.509(a), (b), (c)&(g)	Compliance with General Requirements for Low Frequency Imaging Systems	Yes @ host system AC Mains
15.207	AC Power Line Conducted Emissions Measurements (Transmit & Receive)	Yes
15.509(a)	UBW 10 dB Bandwidth	Yes
15.509(d)&(e)	Transmitter Radiated Emissions - Fundamental, Harmonic and Spurious	Yes
The digital circuit 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.		

4.2. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

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

5.1. COMPLIANCE WITH GENERAL REQUIREMENTS FOR LOW FREQUENCY 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
(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. This device is a GPR operated for purposes associated with law enforcement, fire fighting, emergency rescue, scientific research, commercial mining, or construction Please refer to Manufacturer's acknowledgement of compliance with this rule. Please refer to Manufacturer's acknowledgement of 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.	Not applicable since this GPR is not a handheld device.

5.2. AC POWERLINE CONDUCTED Emissions @ FCC PART 15, SUBPART B, PARA. 15.107(A) & 15.207

5.2.1. Limits

The equipment shall meet the limits of the following table:

	CLASS B LIMITS		
Test Frequency Range (MHz)	**Quasi-Peak (dBμV)**	**Average* (dBμV)**	**Measuring Bandwidth**
0.15 to 0.5	66 to 56*	56 to 46*	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 to 5	56	46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
5 to 30	60	50	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average

* Decreasing linearly with logarithm of frequency

5.2.2. Method of Measurements

Refer to Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4 for measurement methods

5.2.3. Test Equipment List

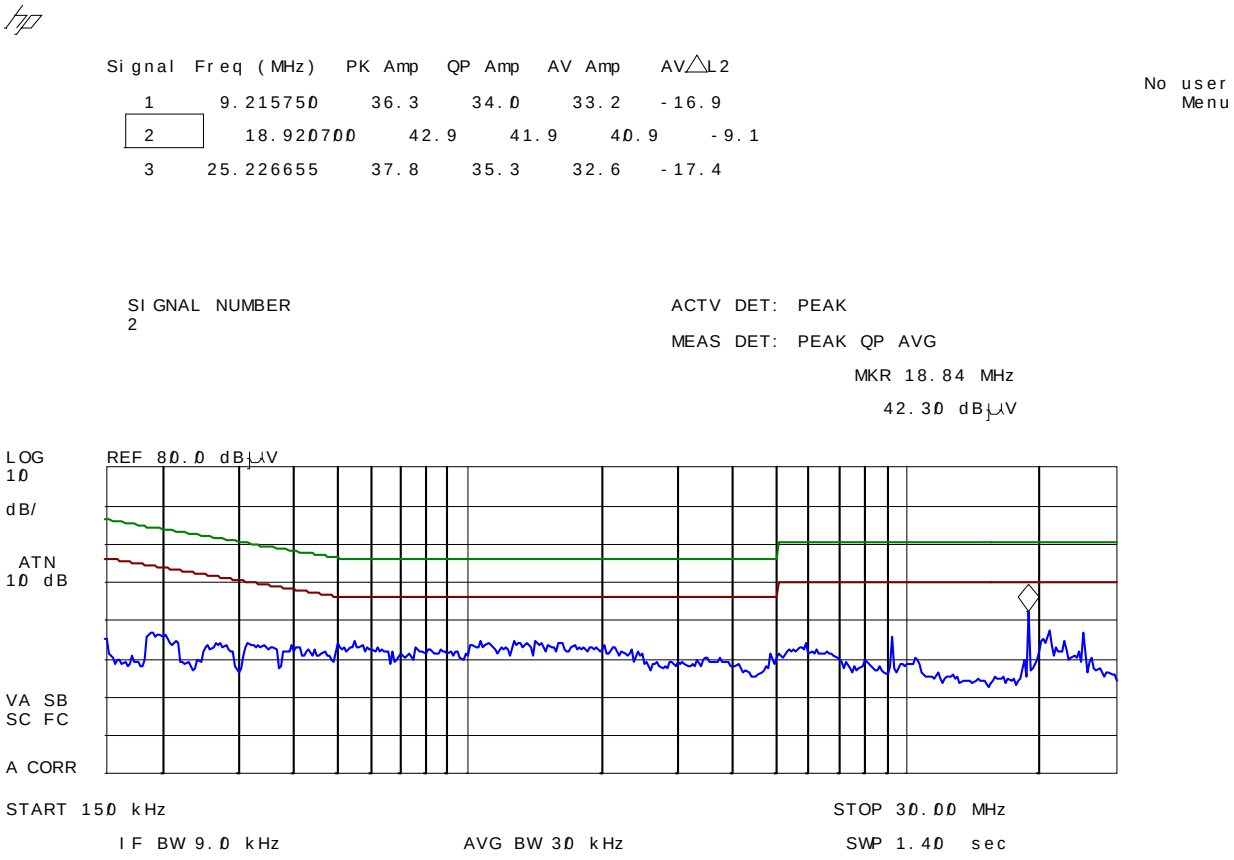
Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
EMI Receiver System/Spectrum Analyzer with built-in Amplifier	Hewlett Packard	HP 8546A	3520A00248	9KHz-5.6GHz, 50 Ohms
Transient Limiter	Hewlett Packard	11947A	310701998	9 kHz – 200 MHz 10 dB attenuation
L.I.S.N.	EMCO	3825/2	89071531	9 kHz – 200 MHz 50 Ohms / 50 μH
12'x16'x12' RF Shielded Chamber	RF Shielding	…	..	…

5.2.4. Test Data

Conforms. Please refer to Plots # 2 and 3

Plot #2: AC Powerline Conducted Emissions Measurement Plot

Detector:[**X**] PEAK [ ] QUASI-PEAK [ ] AVERAGE		Temp: 23°C	Humidity :	File #: SES-029
Line Tested: 1	Line Voltage : 120Vac, 60 Hz @ AC mains of a Host System	Test Tech: Toan	Test Date: Nov 29, 2005	
Standard : FCC B	Comments: Transmitter mode & Receiver Mode			

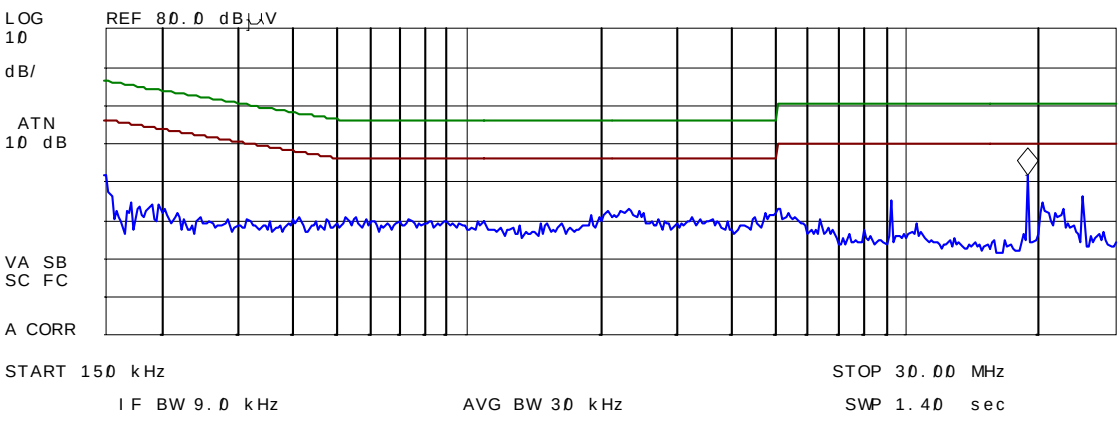


Plot #3: AC Powerline Conducted Emissions Measurement Plot

Detector:[**X**] PEAK [ ] QUASI-PEAK [ ] AVERAGE		Temp: 23°C	Humidity :	File #: SES-029
Line Tested: 2	Line Voltage : 120Vac, 60 Hz @ AC mains of a Host System	Test Tech: Toan	Test Date: Nov 29, 2005	
Standard : FCC B	Comments: Transmitter mode & Receiver Mode			

Signal	Freq (MHz)	PK Amp	QP Amp	AV Amp	AV△L2
1	9.215829	35.8	34.2	33.2	-16.8
2	18.920138	42.8	42.1	41.1	-8.9
3	25.226275	37.4	35.4	32.8	-17.2

No user Menu



5.3. 10 dB OCCUPIED BANDWIDTH [§15.509 (a)]

5.3.1. Limits

§15.509 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.

5.3.2. Method of Measurements

The 10 dB BW was measured with the EUT's antenna placed on the 20" thick sand as its intended operation configuration.

- 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.

5.3.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Rohde & Schawrz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz with external mixer
Biconilog Antenna	EMCO	3142	10005	30 MHz to 2 GHz
Active Loop Antenna	EMCO	6502	9104-2611	1 kHz – 30 MHz

5.3.4. Test Data

Transmitter's Antenna Type	Rx Antenna Polarization (V/H)	10 dB Bandwidth V + H (MHz)	Lower and Upper Frequencies at 10 dB Down Markers	
			Lower (MHz)	Upper (MHz)
1000 MHz	V & H	2211	84.0	2295

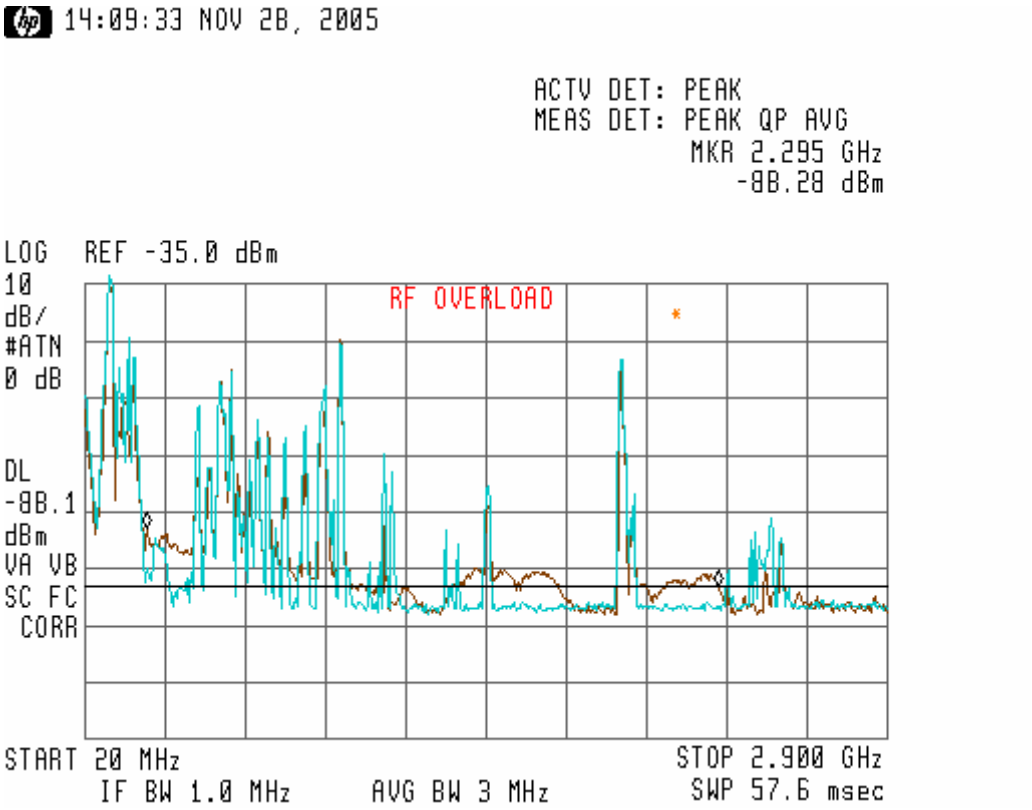
See Plots #4 & 5 for measurement details.

Plot #4: 10 dB BW Measurements @ 1 Meter Distance
for Model DE (Antenna at Vertical & Horizontal Polarizations)

Notes:

(1) The rf emissions from the EUT is too low to be measured at 3 meters. Therefore, the 10 dB BW measurement was conducted at 1 meter distance. From the Plot #3 below, we found:
Lower 10 dB Point: cannot be determined because of the ambient noise from 20-240 MHz
Higher 10 dB Point: 2295MHz

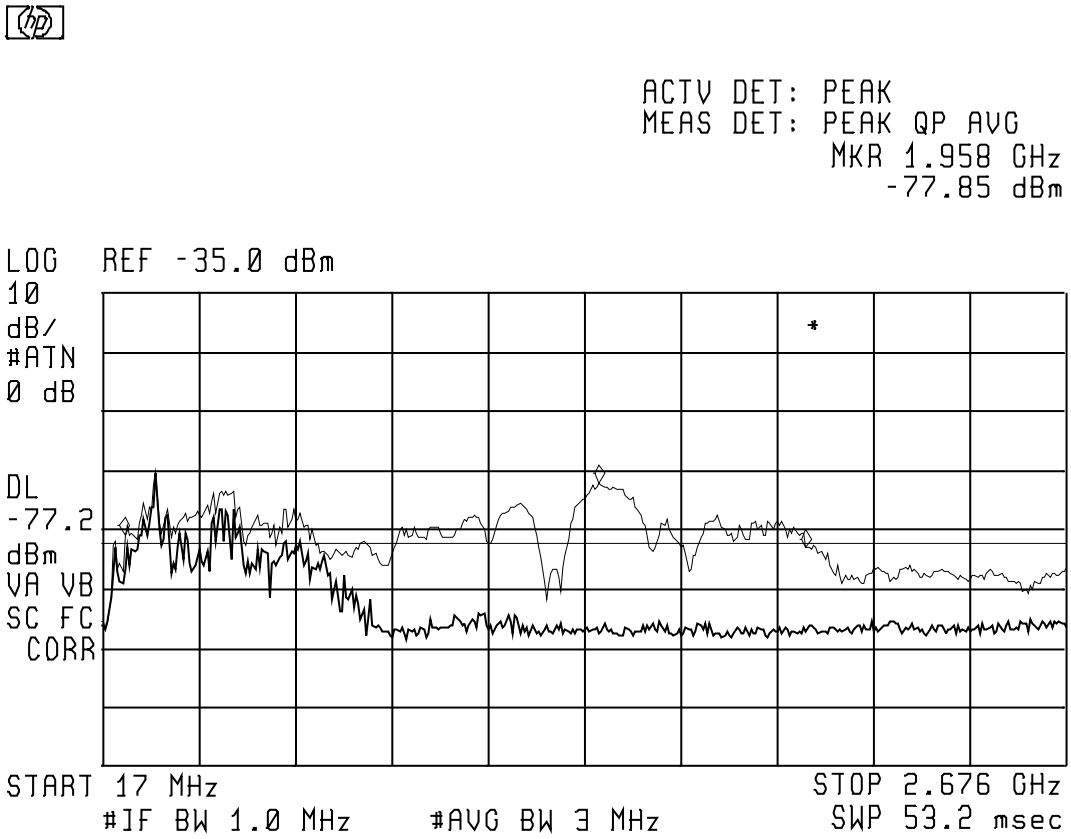
(2) Since the lower 10 dB point can not be measured at the open area test site with the EUT placed on the sand pit. We have to check this lower 10dB point in the semi-anechoic chamber with the EUT's antenna faced to the measuring receiving antenna. The result is shown in Plot #4.



Plot #5: Lower 10 dB BW Measurements for Model DE in Semi-Anecohic Chamber (Antenna at Vertical & Horizontal Polarizations)

Note: Since the lower 10 dB point can not be measured at the open area test site with the EUT placed on the sand pit. We have to check this lower 10dB point in the semi-anechoic chamber with the EUT's antenna faced to the measuring receiving antenna. The result is fiound below:

Lower 10 dB Point: 84 MHz



5.4. TRANSMITTER SPURIOUS RADIATED EMISSIONS @ 3 METERS [§15.509 (d)(e)(f)]

5.4.1. 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 dBm @ 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 dBm @ 3m (1 KHz BW)
1164-1240	-75.3	19.9
1559-1610	-75.3	19.9

§15.509(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. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in § 15.521.

§15.521(g): When a peak measurement is required, it is acceptable to use a resolution bandwidth other than the 50 MHz specified in this subpart. This resolution bandwidth shall not be lower than 1 MHz or greater than 50 MHz, and the measurement shall be centered on the frequency at which the highest radiated emission occurs, f_M. If a resolution bandwidth other than 50 MHz is employed, the peak EIRP limit shall be 20 log (RBW/50) dBm where RBW is the resolution bandwidth in megahertz that is employed. This may be converted to a peak field strength level at 3 meters using E(dBμV/m) = P(dBm EIRP) + 95.2. If RBW is greater than 3 MHz, the application for certification filed with the Commission must contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.

5.4.2. Method of Measurements

Refer to Exhibit 8 of this test report, FCC ET Docket 98-152 and ANSI 63.4 for detailed radiated emissions measurement procedures.

5.4.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Rohde & Schwarz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz with external mixer
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 GHz
Active Loop Antenna	EMCO	6502	9104-2611	1 kHz – 30 MHz
Log Periodic	EMCO	3142C	00026873	10 MHz to 2 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz

5.4.4. Test Data

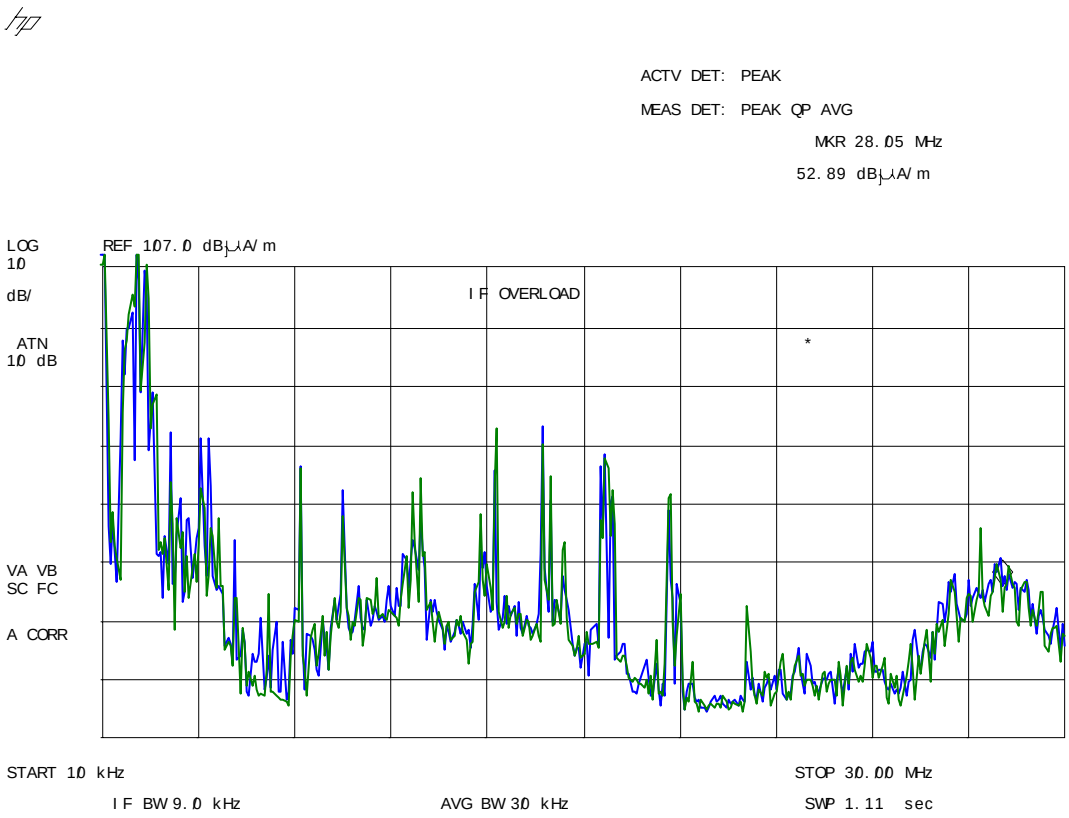
Remark: All tests were performed with the EUT's antenna placed on the 20" thick sand as its intended operation configuration.

5.4.4.1. Radiated Emissions at 3 meters distance

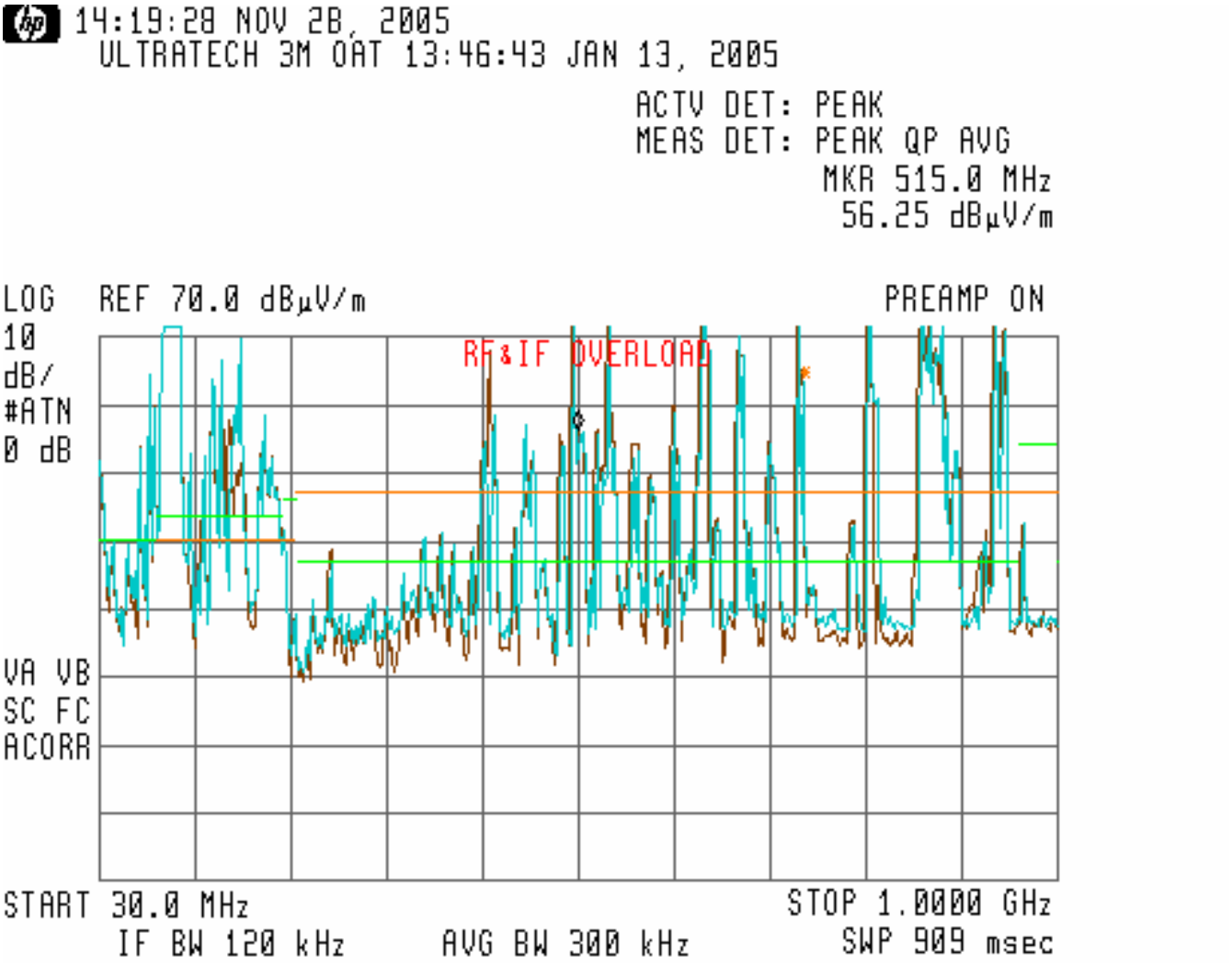
- **Test Site**: The radiated emissions tests were performed at Ultratech's OATS. The EUT was placed on 20" thick medium fine sand.
- Tests were performed with the EUT in contact with the ground as its intended use. Operation of EUT, which is elevated above the ground, is not permitted by manufacturer. Please prefer to Users Manual for operation instruction.
- The emissions were scanned from 10 kHz to 2 GHz and all emissions within 20 dB below the limits were recorded.
- For frequency below 960 MHz, the emissions were measured using the EMI Quasi-Peak Detector, RBW =120 kHz, VBW = 1 MHz
- For Frequency above 960 MHz and outside the below frequency bands, the emissions were measured using RMS Detector, RBW = 1MHz, VBW = 1MHz
- For frequencies fall inside 960-1610, 1610-1990 MHz bands, the emissions were measured using RMS Detector, RBW = 1 MHz, VBW = 1 MHz. The measurements were performed at 1 meter distance since they were not measurable at 3 meters; the results were converted to equivalence at 3 meters by a correction factor of -9.5 dB.
- For frequencies fall inside 1164-1240 and 1559-1610 MHz, the emissions were measured using RMS Detector, RBW = 1 KHz, VBW = 1 MHz. The measurements were performed at 1 meter distance since they were not measurable at 3 meters; the results were converted to equivalence at 3 meters by a correction factor of -9.5 dB.

No significant emissions were found from 9 kHz to 2 GHz. Please refer to Plots # 6 to 9 for measurement details.

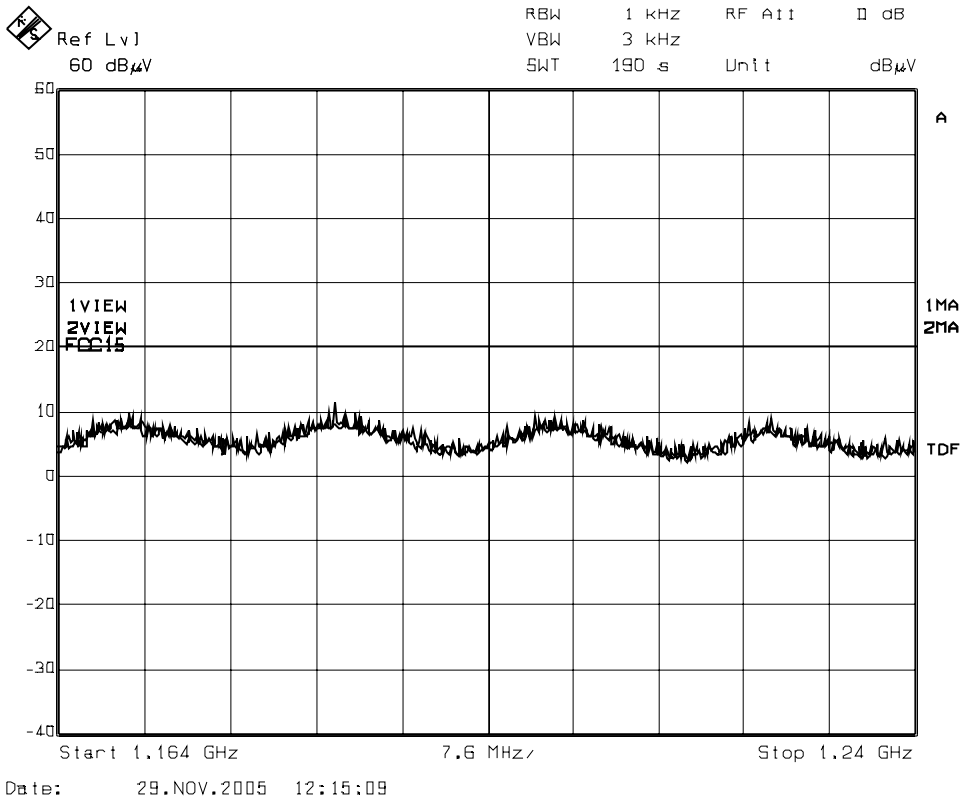
Plot 6: Radiated emissions @ 3 meters (Max Hold for both V & H)



Plot 7: Radiated emissions @ 3 meters (Max Hold for both V & H)



Plot 8: Radiated emissions scanned within 1164 – 1240 MHz (Antenna at Vertical & Horizontal Polarizations)



Plot 9: Radiated emissions scanned within 1559-1610 MHz (Antenna at Vertical & Horizontal Polarizations)

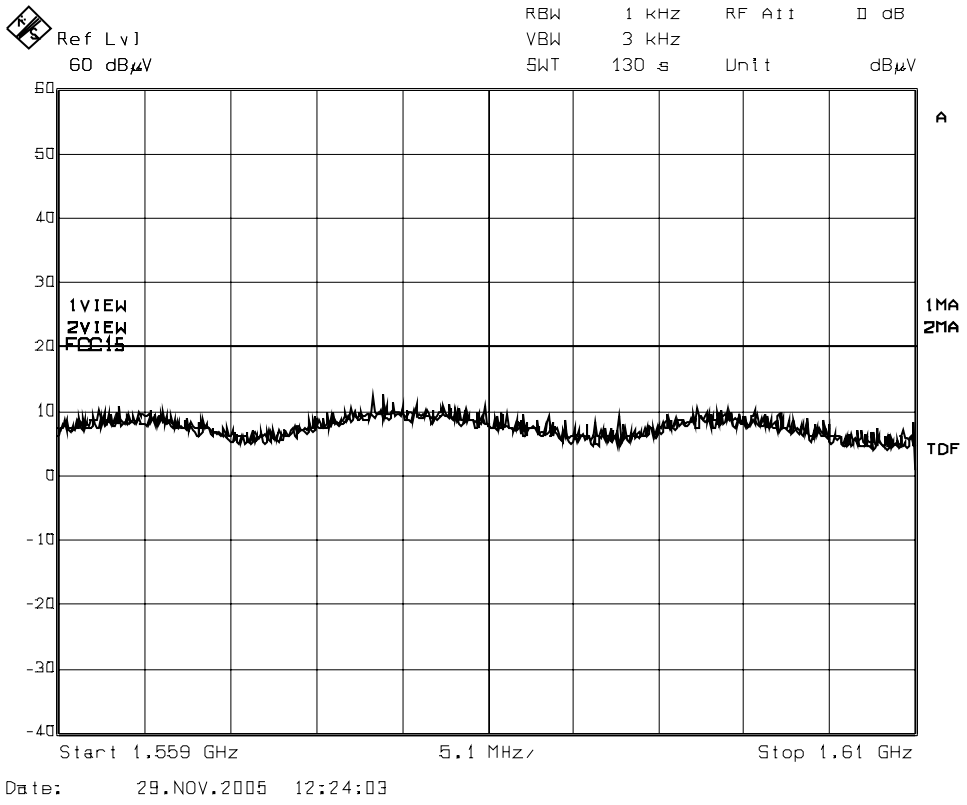


EXHIBIT 6. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

6.1. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (± dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	±1.0	±1.0
Cable Loss Calibration	Normal (k=2)	±0.3	±0.5
EMI Receiver specification	Rectangular	±1.5	±1.5
Antenna Directivit	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	±2.0	±0.5
Antenna phase center variation	Rectangular	0.0	±0.2
Antenna factor frequency interpolation	Rectangular	±0.25	±0.25
Measurement distance variation	Rectangular	±0.6	±0.4
Site imperfections	Rectangular	±2.0	±2.0
Mismatch: Receiver VRC Γ_1 = 0.2 Antenna VRC Γ_R = 0.67(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	+1.1 -1.25	±0.5
System repeatability	Std. Deviation	±0.5	±0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k = 2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

EXHIBIT 7. MEASUREMENT METHODS

7.1. BACKGROUND

This section describes the procedures and equipment used to perform the emissions testing performed by Ultratech Engineering Labs Inc. The focus of this measurement program was to characterize the complete emissions spectra.

Measurements were performed with the GPR transmitting antenna directly on the ground sand surface as the EUT's intended operation for measuring the unintentional radiated emissions.

7.2. TEST SITES

The radiated emissions tests were performed on a medium to fine sand test site at the facility of Ultratech Engineering Labs Inc. The emissions testing equipment was setup using a configuration similar to that shown in Figure 2-1 and Figure 2-2.

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

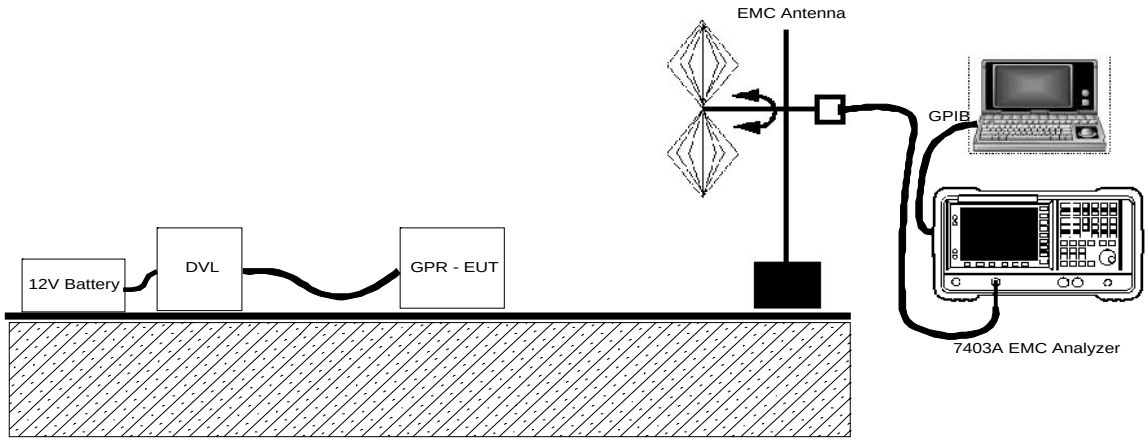
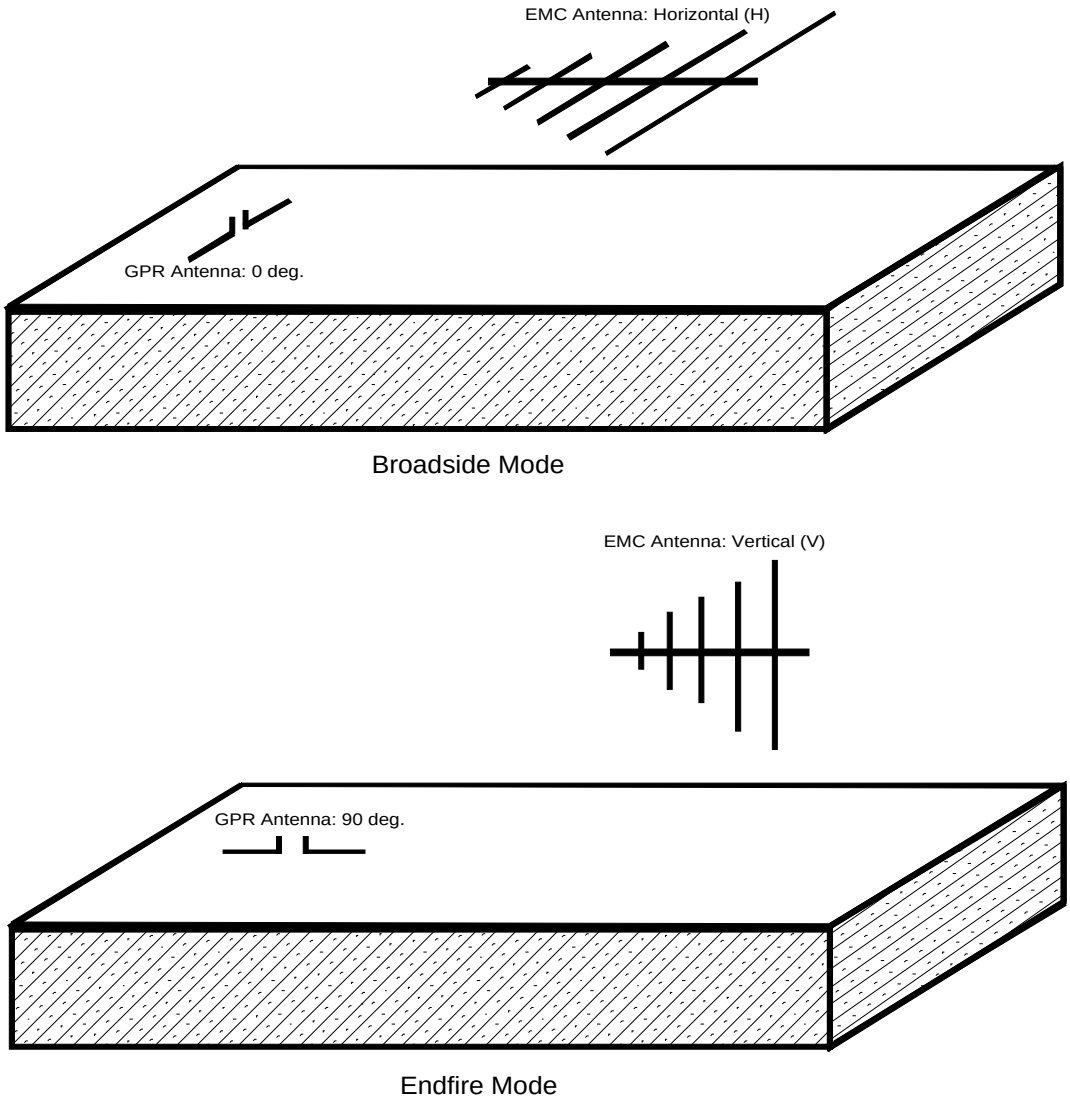


Figure 2-2: Endfire and broadside measurement modes



7.3. EMISSIONS TEST CONFIGURATIONS

All tested GPR systems were measured using these test configurations with the GPR transmitter on (transmitting) and off (not transmitting). The GPR transmitters were operated at their highest pulse repetition frequencies (PRF). Two main antenna orientation configurations were employed during the EMC testing. In the broadside configuration the EMC antenna direction is horizontal and parallel to the GPR transmitting dipole direction In the endfire mode the GPR transmitting dipole is horizontal and rotated 90° with respect to the direction in the broadside mode and the EMC antenna is oriented in the vertical direction as indicated in Figure 2-3.

The GPR transmitting antenna was rotated in the horizontal plane to confirm that the indicated endfire and broadside modes produced the highest emissions.

To meet the limit requirements of part 15.509(f) (0 dBm in a resolution bandwidth (RBW) of 50 MHz) a 3 MHz RBW was used. As stated in 15.521 (g) this is acceptable if the peak EIRP limit is reduced to 20 log(RBW/50). The limit is reduced from 0 dBm for a 50 MHz RBW to -24.4 dBm for a 3 MHz RBW or 70.8 dBμV/m in 3 MHz BW measured at 3 meters.