UltraTech
Group of Labs

Ultratech's Accreditations:

ANSI American National Standards Institute
0685

FC
31040/SIT

VCI
C-1376

Canada
46390-2049

NVLAP
200093-0

BSMI
SL2-IN-E-1119R

3000 Bristol Circle,
Oakville, Ontario,
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Email: vic@ultratech-labs.com

June 05, 2006

TIMCO ENGINEERING INC.
P.O. Box 370
849 N.W. State Road 45
Newberry, Florida
USA 32669

Subject: **Class II Permissive Change Authorization Application under FCC Part 15, Subpart C, Section 15.249, Low Power Transmitters Operating in the Frequency Band 2400-2483.5 MHz.**

Applicant: **Northern Digital Inc.**
Product: **Polaris**
Model: **Spectra**
FCC ID: **TJ8-VICRA**

Dear Sir/Madam,

As appointed agent for **Northern Digital Inc.**, we would like to submit this application for FCC Certification of the above product. Please review all necessary files uploaded to TIMCO Upload site.

Differences between the Family Models Vicra and Spectra:

The actual antenna is the same for the Vicra and Spectra position sensors. It's the GigaAnt 3030A5645-01. It is simply mounted on a different printed circuit board in each camera. The antenna gains therefore will be equal for both systems.

The Spectra and Vicra position sensors are conceptually very much the same. Each are intended to track infrared "target" markers in its field of view. The smaller Vicra system is designed for small measurement volumes for such applications as ear, nose & throat surgeries while the physically larger Spectra is designed for larger volumes, such as neuro and orthopedic surgeries. Although the systems do not share any printed circuit boards, the logic within each is very much the same. While the Spectra adds functionality like the ability to use IR-based wireless communications and an "aiming" (Class II) laser, the fundamentals of each system are essentially the same: The boards, while containing much the same logic, are designed to fit within their respective packages.

Both position sensors utilize the National Semiconductor LMX9820 Bluetooth radio module, the same ultraminiature coax connectors, the same type of coax cable and the same antenna. Both systems' radio modules are powered from each system's main board 3.3V logic supply which is produced by the same Texas Instruments silicon in each system.

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

Yours truly,

LICENSED PROFESSIONAL ENGINEER
T.M. LUU
PROVINCE OF ONTARIO

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

TML/DH

UltraTech
Group of Labs

3000 Bristol Circle,
Oakville, Ontario,
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Email: vic@ultratech-labs.com

June 05, 2006

Northern Digital Inc.
103 Randall Drive
Waterloo, Ontario
Canada N2V 1C5

Attn.: **Michael Palmer**

Subject: **Class II Permissive Change Authorization Application under FCC Part 15, Subpart C, Section 15.249, Low Power Transmitters Operating in the Frequency Band 2400-2483.5 MHz.**

Product: **Polaris**
Model: **VICRA**
FCC ID: **TJ8-VICRA**

Dear Mr. Palmer,

The product sample, as provided by you, has been tested and found to comply with **FCC Part 15, Subpart C, Section 15.249, Low Power Transmitters operating in the Frequency Band 2400-2483.5 MHz.**

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

Best Regards,

LICENSED PROFESSIONAL ENGINEER
T.M. LUU
PROVINCE OF ONTARIO

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

ENGINEERING TEST REPORT

Polaris
MODEL NO.: SPECTRA

FCC ID: TJ8-VICRA
(Class II Permissive Change)

Applicant:

Northern Digital Inc.
103 Randall Drive
Waterloo, Ontario
Canada N2V 1C5

Tested in Accordance With

FCC Part 15, Subpart C, Section 15.249
Low Power Transmitters
Operating in the Frequency Band 2400 - 2483.5 MHz

UltraTech's File No.: NDI-065F15C249

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: June 05, 2006	LICENSED PROFESSIONAL ENGINEER T.M. LUU PROVINCE OF ONTARIO
Report Prepared by: JaeWook Choi, RF Engineer Issued Date: June 05, 2006	Tested by: Mr. Hung Trinh, EMC/RFI Technician Test Dates: May 29-30, 2006

- *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

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ANSI American National Standards Institute	FC	VCI	Canada	NVLAP	BSMI
0685	31040/SIT	C-1376	46390-2049	200093-0	SL2-IN-E-1119R

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.249
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15
Purpose of Test:	To gain FCC Certification Authorization for Low Power Licensed-Exempt Transmitters operating in the Frequency Band 2400 - 2483.5 MHz.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with 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.
Environmental Classification:	Commercial, industrial or business environment residential

Differences between the Family Models Vicra and Spectra:

The actual antenna is the same for the Vicra and Spectra position sensors. It's the GigaAnt 3030A5645-01. It is simply mounted on a different printed circuit board in each camera. The antenna gains therefore will be equal for both systems.

The Spectra and Vicra position sensors are conceptually very much the same. Each are intended to track infrared "target" markers in its field of view. The smaller Vicra system is designed for small measurement volumes for such applications as ear, nose & throat surgeries while the physically larger Spectra is designed for larger volumes, such as neuro and orthopedic surgeries. Although the systems do not share any printed circuit boards, the logic within each is very much the same. While the Spectra adds functionality like the ability to use IR-based wireless communications and an "aiming" (Class II) laser, the fundamentals of each system are essentially the same: The boards, while containing much the same logic, are designed to fit within their respective packages.

Both position sensors utilize the National Semiconductor LMX9820 Bluetooth radio module, the same ultraminiature coax connectors, the same type of coax cable and the same antenna. Both systems' radio modules are powered from each system's main board 3.3V logic supply which is produced by the same Texas Instruments silicon in each system.

1.2. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19	2006	Code of Federal Regulations – Telecommunication
ANSI C63.4	2003	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 +A1 EN 55022	2003-04-10 2004-10-14 2003	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-2-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-1: Conducted disturbance measurement
CISPR 16-2-3	2003	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:	Northern Digital Inc.
Address:	103 Randall Drive Waterloo, Ontario Canada N2V 1C5
Contact Person:	Michael Palmer Phone #: (519) 884-5142 Fax #: (519) 884 5184 Email Address: mpalmer@ndigital.com

MANUFACTURER	
Name:	Northern Digital Inc.
Address:	103 Randall Drive Waterloo, Ontario Canada N2V 1C5
Contact Person:	Michael Palmer Phone #: (519) 884-5142 Fax #: (519) 884 5184 Email Address: mpalmer@ndigital.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

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

Equipment Identification:	Northern Digital Inc.
Brand or Trade Name:	Polaris
Model Name or Number:	Spectra
Serial Number:	Test Sample
Type of Equipment:	Low Power RF Transceiver
Input Power Supply Type:	System: Ault MW160XA2403F01 Medical grade AC/DC (24 Vdc output) Radio Module: 3.3 Vdc regulated on main board
Primary User Functions of EUT:	Medical, light-industrial, laboratory. Precision optically-based measurement

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Transceiver
Intended Operating Environment:	Residential Commercial, light industry & heavy industry
Power Supply Requirement:	System: 24.0 Vdc Radio Module: 3.3 Vdc regulated on main board
Field Strength Level @ 3meters:	80.9 dBµV/m average
Operating Frequency:	2402 ~ 2480 MHz
RF Output Impedance:	50 Ohms
20 dB Bandwidth:	797.60 kHz
Modulation Type:	IQ-modulation with bit-stream data that is Gaussian filtered
Mode of Operation:	Duplex
Duty Cycle:	≈ 75.5 %
Antenna Connector Type:	Hirose Electric U.FL-R-SMT ultra-miniature coaxial
Antenna Description:	Manufacturer: GigaAnt Type: Mica 2.4 GHz SMD antenna Frequency Range: 2.4-2.5GHz Gain: 2.7 dBi MAX

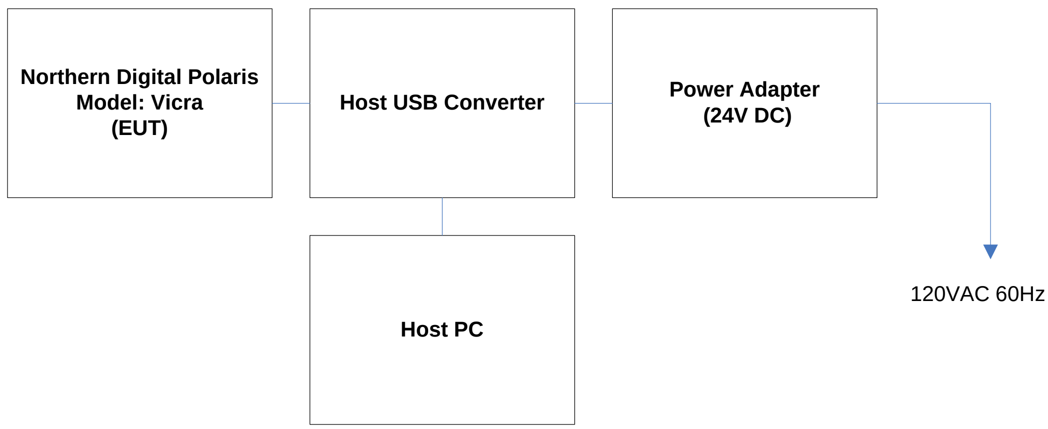
2.4. LIST OF EUT'S PORTS

Connector (LEMO) - A 14 pin connector that provides power to the Position Sensor and allows communications to/from the Position Sensor

2.5. ASSOCIATIVE DEVICE

Associative Device # 1	
Description:	Host USB Converter - Provide connections for data and power
Model Number:	Polaris USB Converter
Serial Number:	Test Sample
Connected to EUT's Port:	Connector (LEMO)

2.6. GENERAL TEST SETUP



All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

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:	55%
Pressure:	102 kPa
Power input source:	4.5 V DC

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	EUT was configured and put into built-in RF test mode to transmit burst with the designated duty cycle for measurements.
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 integral antenna equipment.

Transmitter Test Signals:	
Frequency Band(s):	2402-2480 MHz
Test Frequency(ies):	2402, 2441, 2480 MHz
Transmitter Wanted Output Test Signals:	
• Normal Test Modulation:	Bluetooth
• Modulating signal source:	Internal (either payload pattern data of 11110000 or PRBS-9 sequence)

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.

- AC Powerline Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).

- 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 File No.: IC2049-1). Last Date of Site Calibration: June. 20, 2005.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.107(a) & 15.207	Power Line Conducted Emissions	N/A. Not required to be repeated due to the nature of modification
--	20 dB Bandwidth	N/A. Not required to be repeated due to the nature of modification
15.249(a), 15.209, 15.205	Transmitter Radiated Emissions, Harmonic Emissions and Band Edge Radiated Emissions	Yes

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

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

5.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in ANSI C63.4 and ULTR-P001-2004.

5.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document LAB 34 with a confidence level of 95%. Please refer to Exhibit 6 for Measurement Uncertainties.

5.3. MEASUREMENT EQUIPMENT USED

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4 and CISPR 16-1.

5.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUACTURER

The EUT is a remote control with 916.289 MHz RF link. The battery powered remote unit sends commands to an interface unit and receives command acknowledges and data from the same interface via RF link. The interface unit communicates via a serial link (I2C) with IQ2020 spa controller made by Invensys for Watkins. The interface unit is powered from the spa controller. The EUT incorporates and LCD graphic screen and 3 keys allowing spa control.

5.5. FUNDAMETAL FIELD STRENGTH AND HARMONIC EMISSIONS AND BAND-EDGE RADIATED EMISSONS (RADIATED @ 3 METERS) [§ 15.249(a), 15.209 & 15.205]

5.5.1. LIMITS

- The Field Strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (mV/m)	Field Strength of Harmonics (μV/m)
2400 - 2483.5	50	500

- The fundamental frequency shall not fall within any restricted frequency band specified in 15.205 All rf other emissions that fall in the restricted bands shall not exceed the general radiated emission limits specified in @ 15.209(a).

FCC 47 CFR 15.205(a)
-- Restricted Frequency Bands --

MHz	MHz	MHz	GHz
0.090 - 0.110	162.0125 - 167.17	2310 - 2390	9.3 - 9.5
0.49 – 0.51	167.72 - 173.2	2483.5 - 2500	10.6 - 12.7
2.1735 - 2.1905	240 - 285	2655 - 2900	13.25 - 13.4
8.362 - 8.366	322 - 335.4	3260 - 3267	14.47 - 14.5
13.36 - 13.41	399.9 - 410	3332 - 3339	14.35 - 16.2
25.5 – 25.67	608 - 614	3345.8 - 3358	17.7 - 21.4
37.5 – 38.25	960 - 1240	3600 - 4400	22.01 - 23.12
73 - 75.4	1300 - 1427	4500 - 5250	23.6 - 24.0
108 – 121.94	1435 - 1626.5	5350 - 5460	31.2 - 31.8
123 – 138	1660 - 1710	7250 - 7750	36.43 - 36.5
149.9 – 150.05	1718.8 - 1722.2	8025 - 8500	Above 38.6
156.7 – 156.9	2200 – 2300	9000 - 9200	

FCC 47 CFR 15.209(a)
-- Field Strength Limits within Restricted Frequency Bands --

Frequency (MHz)	Field Strength Limits (μV/m)	Distance (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / 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

5.5.2. METHOD OF MEASUREMENTS

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

5.5.3. 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
Biconilog Antenna	EMCO	3143	1029	20 MHz to 2 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz

5.5.4. TEST DATA

Duty Cycle Measurements: 75.5 % or Peak-Average Conversion factor = -2.44 dB

<u>CH00, Frequency 2402</u>

Frequency (MHz)	Peak E-Field @3m (dBμV/m)	Average (1) E-Field @3m (dBμV/m)	Antenna Plane (H/V)	Field Strength Limit of Fundamental/Harmonic (dBμV/m)	Field Strength Limit of § 15.209 (dBμV/m)	Margin (dB)
2402	91.3	77.9	V	94.0	--	-16.1
2402	94.3	80.9	H	94.0	--	-13.1
4804	51.8	42.2	V	54.0	54.0	-11.8
4804	55.7	43.7	H	54.0	54.0	-10.3
7206	55.8	45.3	V	54.0	54.0	-8.7
7206	56.0	45.7	H	54.0	54.0	-8.3

The emissions were scanned from 30 MHz to 25 GHz and all emissions within 20 dB below the limits were recorded.
Note (1): The above average measurement was performed using Average Detector. No correction with duty cycle was applied.

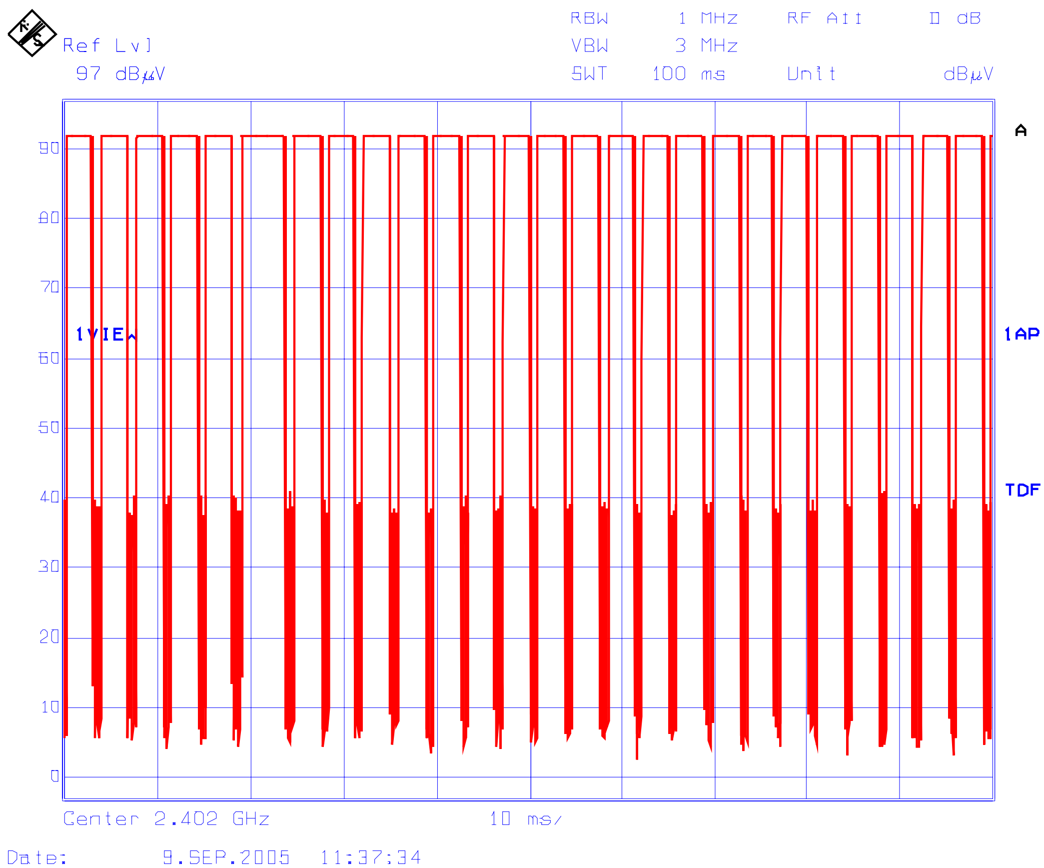
CH39, Frequency 2441

Frequency (MHz)	Peak E-Field @3m (dBµV/m)	Average (1) E-Field @3m (dBµV/m)	Antenna Plane (H/V)	Field Strength Limit of Fundamental/Harmonic (dBµV/m)	Field Strength Limit of § 15.209 (dBµV/m)	Margin (dB)
2441	90.6	77.2	V	94.0	--	-16.8
2441	94.1	80.8	H	94.0	--	-13.2
4882	52.0	42.2	V	54.0	54.0	-11.8
4882	54.2	43.2	H	54.0	54.0	-10.8
7323	56.0	46.1	V	54.0	54.0	-7.9
7323	56.8	44.9	H	54.0	54.0	-9.1
The emissions were scanned from 30 MHz to 25 GHz and all emissions within 20 dB below the limits were recorded. Note (1): The above average measurement was performed using Average Detector. No correction with duty cycle was applied.						

CH78, Frequency 2480

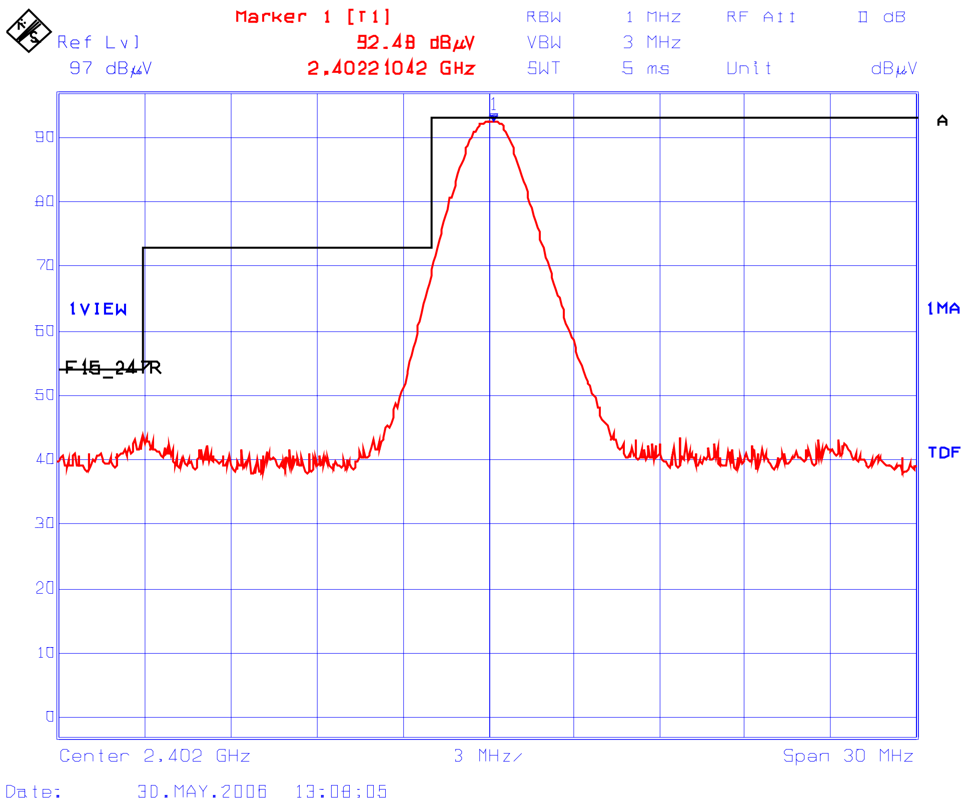
Frequency (MHz)	Peak E-Field @3m (dBµV/m)	Average (1) E-Field @3m (dBµV/m)	Antenna Plane (H/V)	Field Strength Limit of Fundamental/Harmonic (dBµV/m)	Field Strength Limit of § 15.209 (dBµV/m)	Margin (dB)
2480	90.7	77.4	V	94.0	--	-16.6
2480	94.2	80.9	H	94.0	--	-13.1
4960	55.1	45.0	V	54.0	54.0	-9.0
4960	56.3	44.1	H	54.0	54.0	-9.9
7440	55.9	45.3	V	54.0	54.0	-8.7
7440	56.7	46.2	H	54.0	54.0	-7.8
The emissions were scanned from 30 MHz to 25 GHz and all emissions within 20 dB below the limits were recorded. Note (1): The above average measurement was performed using Average Detector. No correction with duty cycle was applied.						

Plot# 1 : Duty cycle analysis

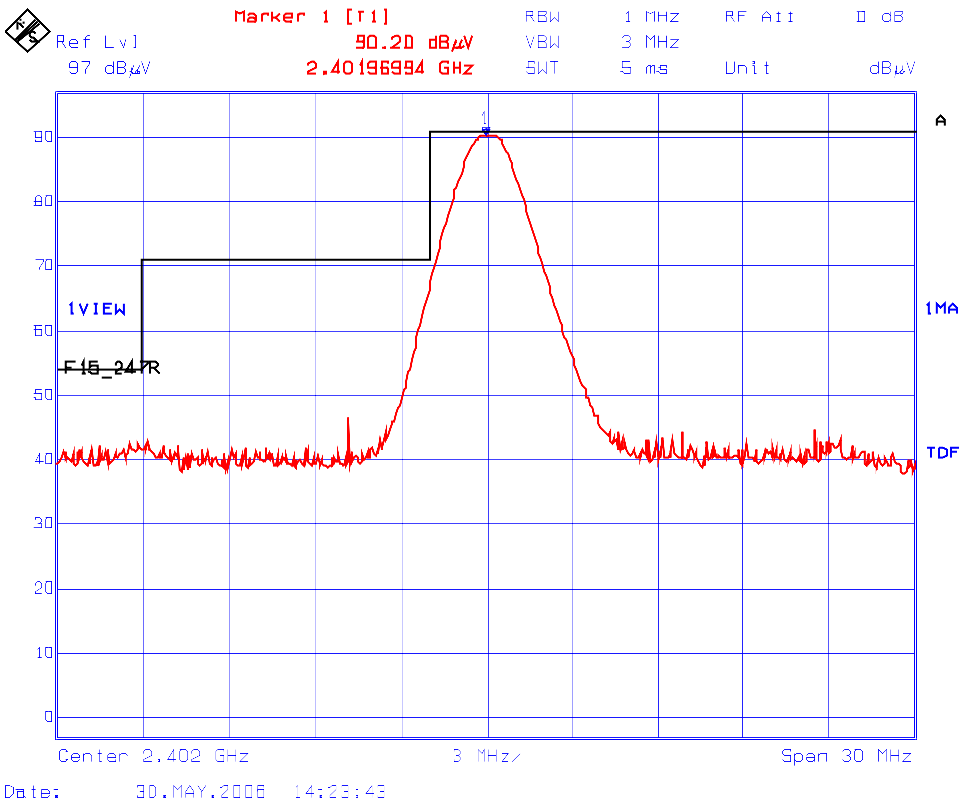


$TX_{ON} / (TX_{ON} + TX_{OFF}) = (26 \times 2.905812 \text{ ms}) / 100 \text{ ms} = 0.75551112 \approx 20 \log (0.75551112) = -2.44 \text{ dB}$

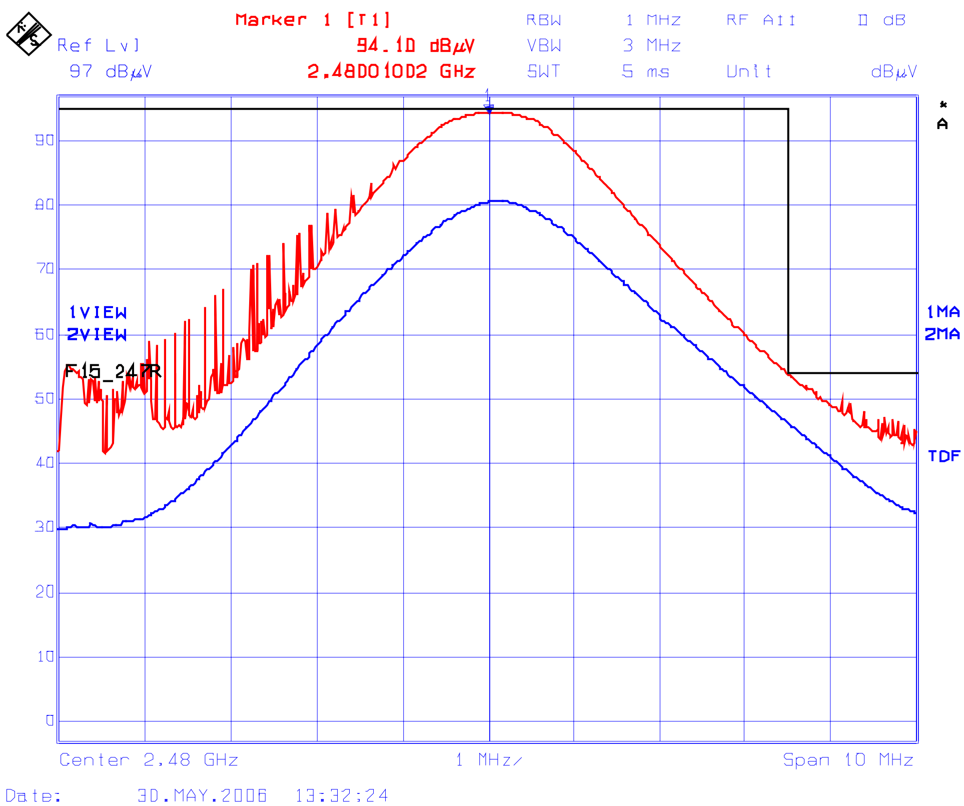
Plot # 2(a): Band-Edge RF Radiated Emissions, Horizontal Polarization
Lower Transmitter Frequency: 2402 MHz, Mode: Test mode (continuous transmission of a single channel)
Trace 1 (peak): RBW= 1 MHz, RBW= 3 MHz, Trace: Maxhold



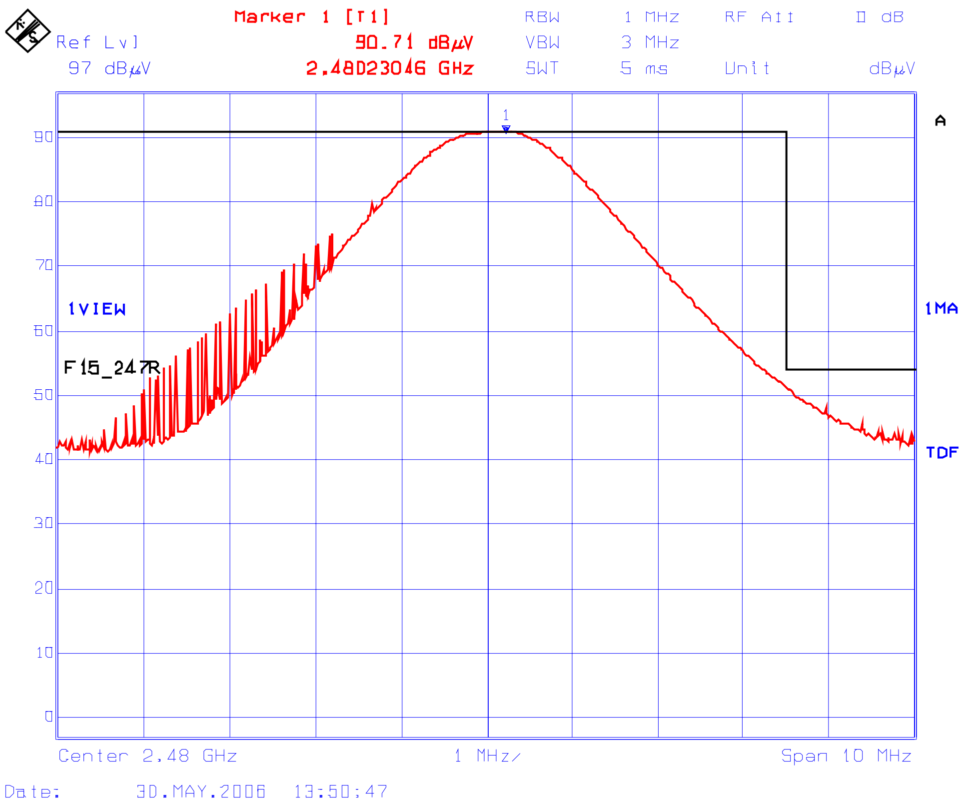
Plot # 2(b): **Band-Edge RF Radiated Emissions, Vertical Polarization**
Lower Transmitter Frequency: 2402 MHz, Mode: Test mode (continuous transmission of a single channel)
Trace 1 (peak): RBW= 1 MHz, RBW= 3 MHz, Trace: Maxhold



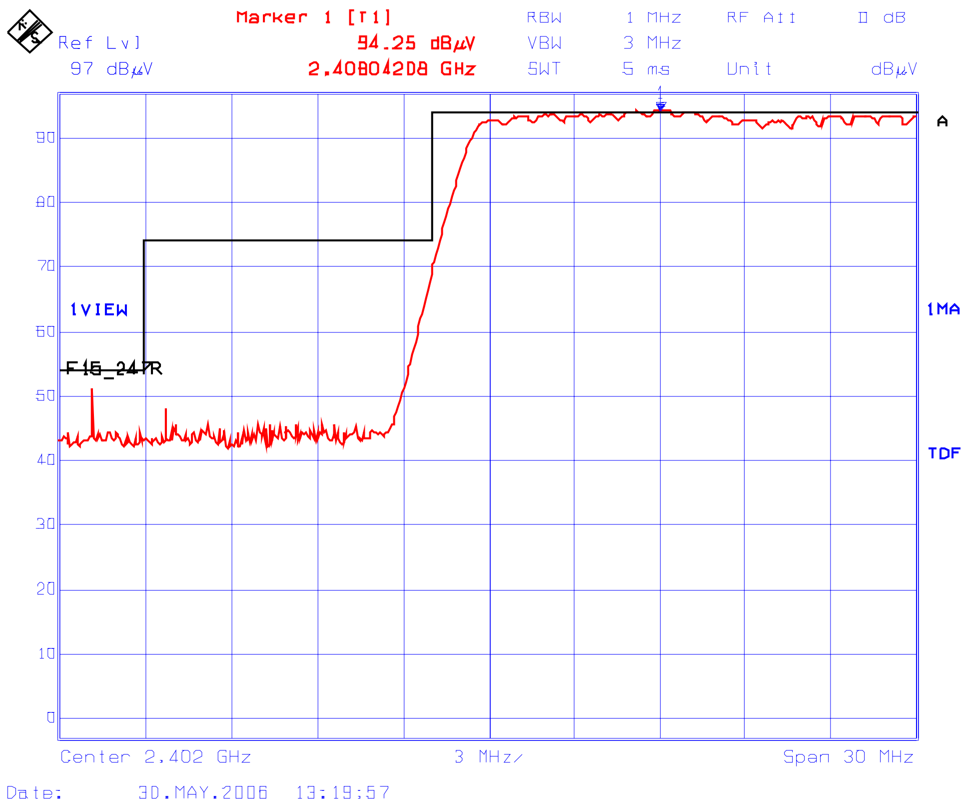
Plot # 3(a): **Band-Edge RF Radiated Emissions, Horizontal Polarization**
Lower Transmitter Frequency: 2480 MHz, Mode: Test mode (continuous transmission of a single channel)
Trace 1 (peak): RBW= 1 MHz, RBW= 3 MHz, Trace: Maxhold
Trace 2 (average): RBW= 1 MHz, VBW= 10 Hz, Trace: Maxhold



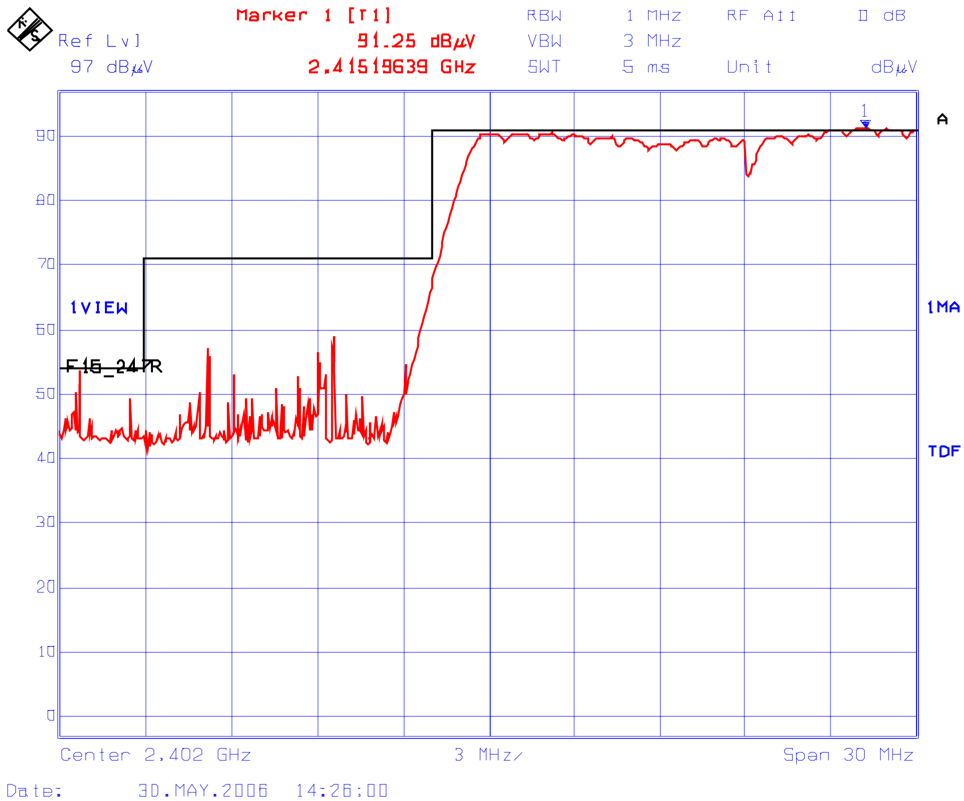
Plot # 3(b): Band-Edge RF Radiated Emissions, Vertical Polarization
Lower Transmitter Frequency: 2480 MHz, Mode: Test mode (continuous transmission of a single channel)
Trace 1 (peak): RBW= 1 MHz, RBW= 3 MHz, Trace: Maxhold



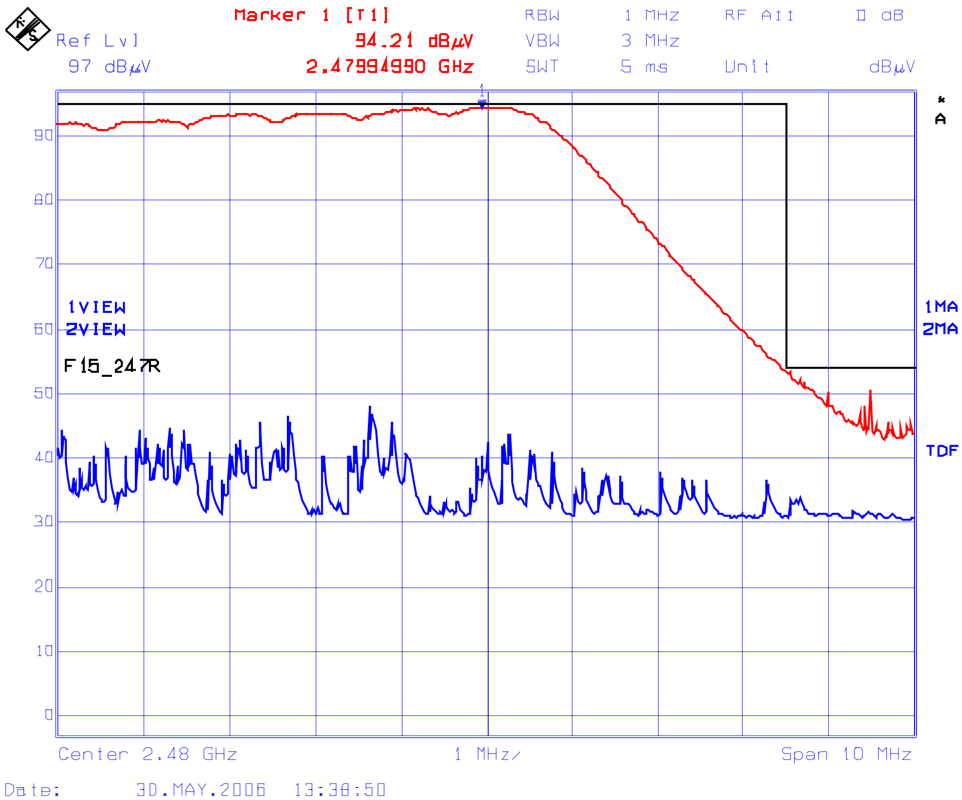
Plot # 4(a): Band-Edge RF Radiated Emissions, Horizontal Polarization
Lower Transmitter Frequency: 2402 MHz, Mode: normal mode (hopping)
Trace 1 (peak): RBW= 1 MHz, RBW= 3 MHz, Trace: Maxhold



Plot # 4(b): **Band-Edge RF Radiated Emissions, Vertical Polarization**
Lower Transmitter Frequency: 2402 MHz, Mode: normal mode (hopping)
Trace 1 (peak): RBW= 1 MHz, RBW= 3 MHz, Trace: Maxhold



Plot # 5(a): **Band-Edge RF Radiated Emissions, Horizontal Polarization**
Lower Transmitter Frequency: 2480 MHz, Mode: normal mode (hopping)
Trace 1 (peak): RBW= 1 MHz, RBW= 3 MHz, Trace: Maxhold
Trace 2 (average): RBW= 1 MHz, VBW= 10 Hz, Trace: Maxhold



Plot # 5(b): Band-Edge RF Radiated Emissions, Vertical Polarization
Lower Transmitter Frequency: 2480 MHz, Mode: normal mode (hopping)
Trace 1 (peak): RBW= 1 MHz, RBW= 3 MHz, Trace: Maxhold

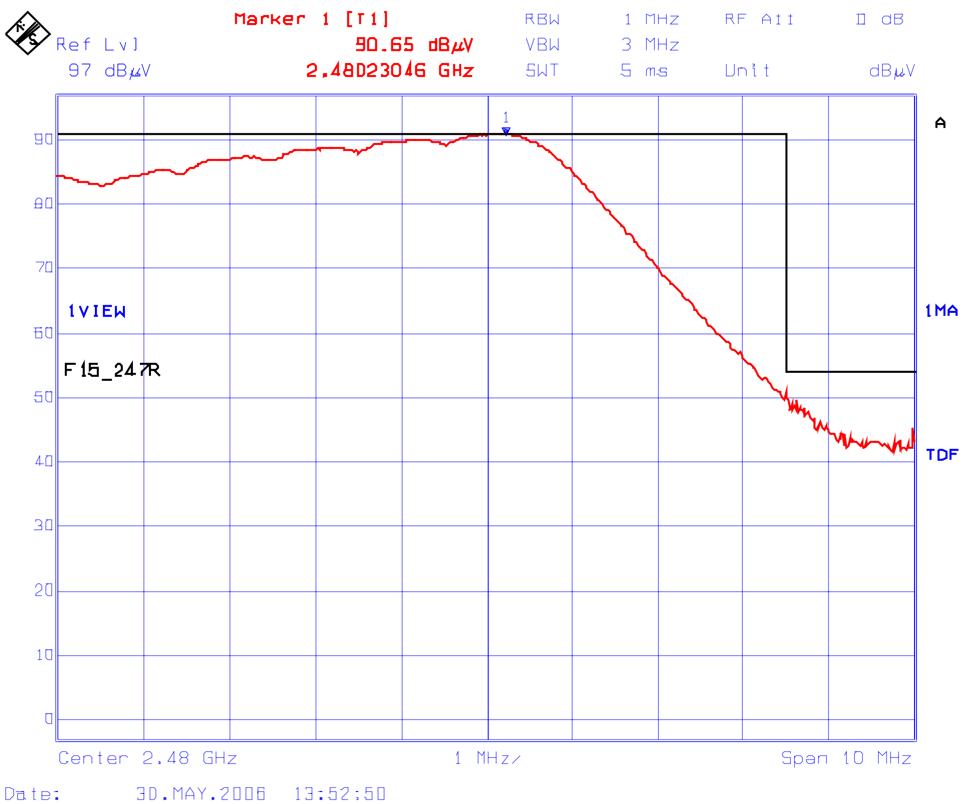


EXHIBIT 6. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and LAB 34

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 Directivity	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