ENGINEERING TEST REPORT

PowerCost Monitor Sensor Unit
Model No.: PCMTX01

FCC ID SUE-PCMTX01

Applicant: **Blue Line Innovations Inc.**
187, Kenmount Road
St John's, New Foundland
Canada, A1B 3P9

In Accordance With

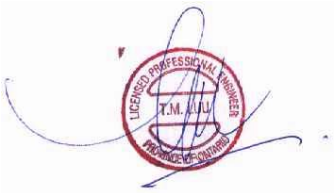
FEDERAL COMMUNICATIONS COMMISSION (FCC)
PART 15, SUBPART C, SEC. 15.231(e)

Momentarily Operated Transmitters in 433.92 MHz

UltraTech's File No.: BLUE001_F15.231

This Test report is Issued under the Authority of
Tri M. Luu, Professional Engineer,
Vice President of Engineering
UltraTech Group of Labs

Date: January 12, 2005



Report Prepared by: Dharmajit Solanki RFI Engineer	Tested by: Hung Trinh, RFI Technician
Issued Date: January 12, 2005	Test Dates: December 22 – January 11, 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.luu@sympatico.ca

TABLE OF CONTENTS

EXHIBIT 1: SUBMITTAL CHECK LIST

Exhibit #	Document Description	Description of Contents	Quality Check (OK)
1	Test Report	Test Report	
2	Test Setup Photos	Photos # 1 to 4	
3	External Photos of EUT	Photos # 1 to 2	
4	Internal Photos of EUT	Photos of 1 to 4	
5	Cover Letters	• Letter from Ultratech for Certification Request • Letter from the Applicant to appoint Ultratech to act as an agent • Letter from the Applicant to request for Confidentiality Filing	
6	ID Label/Location Info	• ID Label • Location of ID Label	
7	Block Diagrams	Block diagrams # 1	
8	Schematic Diagrams	Schematic diagrams # 1 to 6	
9	Parts List/Tune Up Info	Bill of Material	
10	Operational Description	Theory of Operation & Duty Cycle Calculation	
11	Users Manual	Instructions Manual	

EXHIBIT 2: INTRODUCTION

2.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.231(e)
Title	Telecommunication - Code of Federal Regulations, CFR 47, Part 15
Purpose of Test:	To gain FCC Certification Authorization for a Low Power Transmitter operating in the frequency band 433.92MHz.
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:	• Residential • Light-industry, Commercial • Industry

2.2. RELATED SUBMITAL(S)/GRANT(S)

None

2.3. NORMATIVE REFERENCES

Publication	YEAR	Title
FCC CFR Parts 0-19	2004	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 & EN 55022	2003 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

EXHIBIT 3: PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT:	
Name:	Blue Line Innovations Inc.
Address:	187, Kenmount Road St. John's, NF Canada, A1B 3P9
Contact Person:	Sainath Padinjare Phone #: (709) 757 3770 Fax #: (709) 757 3767 Email Address: sainath@bluelineinnovations.com

MANUFACTURER:	
Name:	Blue Line Innovations Inc.
Address:	187, Kenmount Road St. John's, NF Canada, A1B 3P9
Contact Person:	Maurice Tuff Phone #: (709) 757 3762 Cell #: (709) 690 1195 Email Address: mtuff@bluelineinnovations.com

3.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

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

Brand Name	Blue Line Innovations Inc.
Product Name	PowerCost Monitor Sensor Unit
Model Name or Number	PCMTX01
Serial Number	HN000027
Type of Equipment	Momentarily operated Transmitter
Input Power Supply Type	3.6V (Lithium Thionyl chloride Battery powered)
Primary User Functions of EUT:	Provide data communication link through air

3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	▪ Base station (fixed use)
Intended Operating Environment:	▪ Residential ▪ Commercial, light industry & heavy industry
Power Supply Requirement:	3.6V (Lithium Thionyl chloride Battery powered)
RF Output Power Rating:	0.0 Watts
Operating Frequency Range:	433.92 MHz
RF Output Impedance:	50 Ohms
Duty Cycle:	13.78%
20 dB Bandwidth:	5.97 KHz
Modulation Type:	ASK
Other Clock Frequencies:	4 MHz & 13.56 MHz
Antenna Connector Type:	Integral (the antenna component is soldered onto the radio printed circuit board and located inside the enclosure)
Antenna Description:	Manufacturer: Blue Line Innovations Type: Loop Antenna Model: Printed on circuit board (Rectangular) Frequency Range:433.92 MHz In/Out Impedance: 50 Ohms Gain: -25 dB

3.4. LIST OF EUT'S PORTS

None.

3.5. ANCILLARY EQUIPMENT

None.

3.6. TEST SETUP BLOCK DIAGRAM

EXHIBIT 4: EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

4.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	3.6 V DC, Internal Battery

4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	The EUT is programmed to transmit continuously for testing purpose only
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.

Transmitter Test Signals:	
Frequency:	433.92 MHz

EXHIBIT 5: SUMMARY OF TEST RESULTS

5.1. 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, 16'(L) by 12'(W) by 12'(H).
- Radiated Emissions were performed at the Ultratech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario.

The above sites have 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 Open Field Test Site has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049). Last Date of Site Calibration: Feb. 17, 2004.

5.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Sections	Test Requirements	Compliance (Yes/No)
15.203	Antenna requirement	Yes. Integral antenna (part of the printed circuit board)
15.231(b)	Transmitter Radiated Emissions - Fundamental, Harmonic and Spurious	Yes
15.231(c)	Bandwidth of the emission.	Yes
15.231(d)	Frequency Stability for devices operating within the frequency band 40.66 - 40.70 MHz.	N/A
15.231(e)	Provisions for periodic operation within the band 40.66 - 40.70 MHz and above 70 MHz.	Yes
15.107(a)	AC Power Line Conducted Emissions Measurements	N/A (Battery operated device) See Note 1

Note 1: The digital circuits portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices. The engineering test report can be provided upon request.

5.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

EXHIBIT 6: MEASUREMENTS, EXAMINATIONS & TEST DATA FOR EMC EMISSIONS

6.1. TEST PROCEDURES

This section contains test results only. Details of test methods and procedures can be found in Exhibit 8 of this report

6.2. MEASUREMENT UNCERTAINTIES

The measurement uncertainties stated were calculated in accordance with requirements of UKAS Document NIS 81 with a confidence level of 95%. Please refer to Exhibit 7 for Measurement Uncertainties.

6.3. MEASUREMENT EQUIPMENT USED:

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C63.4, FCC 15.231(e) and CISPR 16-1-1.

6.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUACTURER:

The essential function of the EUT is to correctly communicate data to and from radios over RF link.

6.5. ANTENNA REQUIREMENTS @ FCC CFR 47, PARA 15.203

6.5.1. Limits

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

N**otes**: This requirement does not apply to carrier current devices operated under the provisions of @ 15.211, 15.213, 15.217, 17.219 or 15.221.

6.5.2. Method of Measurements

Refer to Exhibit 7, Sec. 7.2 of this test report & ANSI C63.4

6.5.3. Engineering Analysis

Internal integral antenna component mounted on the printed circuit board.

6.6. PERIODIC OPERATION PROVISIONS [§15.231(E)]

6.6.1. Engineering Analysis

FCC PROVISIONS	ANALYSIS ON COMPLIANCE
A transmitter automatically limits its operation so that the duration of each transmission shall not be greater than one second.	Complies. The transmitter automatically ceases its transmission and duration of each transmission is less than 1 second.
The silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.	Complies. The silent period between transmissions is 30 seconds.

6.7. TRANSMITTER RADIATED EMISSIONS @ 3 METERS, FCC CFR 47, PARA. 15.231(E), 15.209 & 15.205

6.7.1. Limits

The RF radiated emissions measured at 3 Meter distance shall not exceed the field strength below:

Fundamental Frequency (MHz)	Average Field Strength Limits (μV/m)	
	Fundamental	Harmonic/Spurious
260 - 470 MHz	1500 – 5000	150 to 500

[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 260-470 MHz, uV/m at 3 meters = 16.6667(F) - 2833.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

LIMIT @ 433.92 MHz = 72.9 dBμV/m at 3 meters
HARMONIC/SPURIOUS LIMIT = 52.9 dBμV/m

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this Section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in Section 15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of Section 15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in Section 15.209, whichever limit permits a higher field strength.

In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

Remarks:

- Applies to harmonics/spurious emissions that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209.
- **@ FCC CFR 47, Para. 15.237(c)** - The emission limits as specified above are based on measurement instrument employing an average detector. The provisions in **@15.35** for limiting peak emissions apply.

FCC CFR 47, Part 15, Subpart C, Para. 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 CFR 47, Part 15, Subpart C, Para. 15.209(a)
-- Field Strength Limits within Restricted Frequency Bands --

FREQUENCY (MHz)	FIELD STRENGTH LIMITS (microvolts/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

6.7.2. Method of Measurements

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

6.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Peak Power Meter & Peak Power Sensor	Hewlett Packard	8900 8481A	2131A00124 2551A01965	0.1-18 GHz 50 Ohms Input
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 GHz
Active Loop Antenna	EMCO	6507	8906-1167	1 kHz – 30 MHz
Log Periodic/Bow-Tie Antenna	EMCO	3143	1029	20 - 1000 MHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz

6.7.4. Photograph of Test Setup

Please refer to Photographs # 1 through #4 in Annex 1 for Measurements data.

6.7.5. Test Data

Duration of each transmission (t1): 397.1 miliseconds ≤ 1 Second
Silent period between transmissions (t2): 30 Seconds ≥ 30 * t1 ≥ 10 Seconds

Note: Devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

Please refer o the Plot # 1 to 3 for Plots of duty cycle measurements.

The emissions were scanned from 10 MHz to 10th harmonic of the highest oscillator frequency (433.92 MHz) and all emissions less 20 dB below the limits were recorded.
Note:

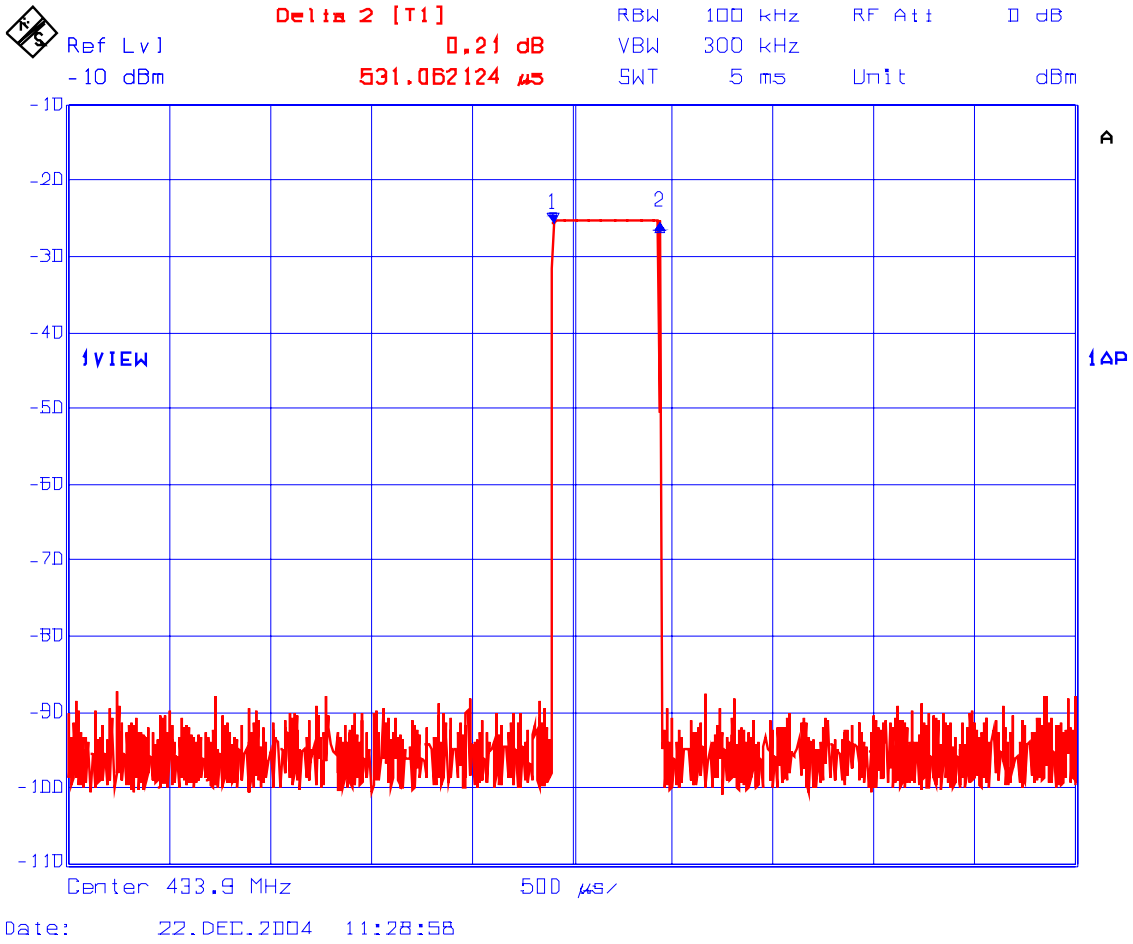
- For portable transmitter was placed in three different orthogonal position for searching maximum field strength level.
- Outside the restricted band per FCC 15.205: Limit (1) per FCC 15.231(e) or Limit (2) per 15.209 whichever allows higher field strength emission, is applied.

FREQUENCY (MHz)	Peak E-FIELD @3m (dBµV/m)	Average E-FIELD @3m (dBµV/m)	ANTENNA PLANE (H/V)	Average (1) LIMIT @3m (dBµV/m)	Restricted (2) Band Limits @3m (dBµV/m)	MARGIN (dB)	PASS/ FAIL
433.92	88.8	71.8	V	72.9	--	-1.1	Pass
433.92	88.9	71.8	H	72.9	--	-1.1	Pass
867.84	43.6	26.5	V	52.9	- 46.0	-19.5	Pass
867.84	37.9	20.9	H	52.9	- 46.0	-25.1	Pass
1301.76	62.6	45.5	V	52.9	- 54.0	-7.4	Pass
1301.76	60.7	43.6	H	52.9	- 54.0	-9.3	Pass
1735.68	57.2	40.1	V	52.9	- 54.0	-13.9	Pass
1735.68	55.2	38.1	H	52.9	- 54.0	-15.9	Pass

Duty Cycle Measurements:

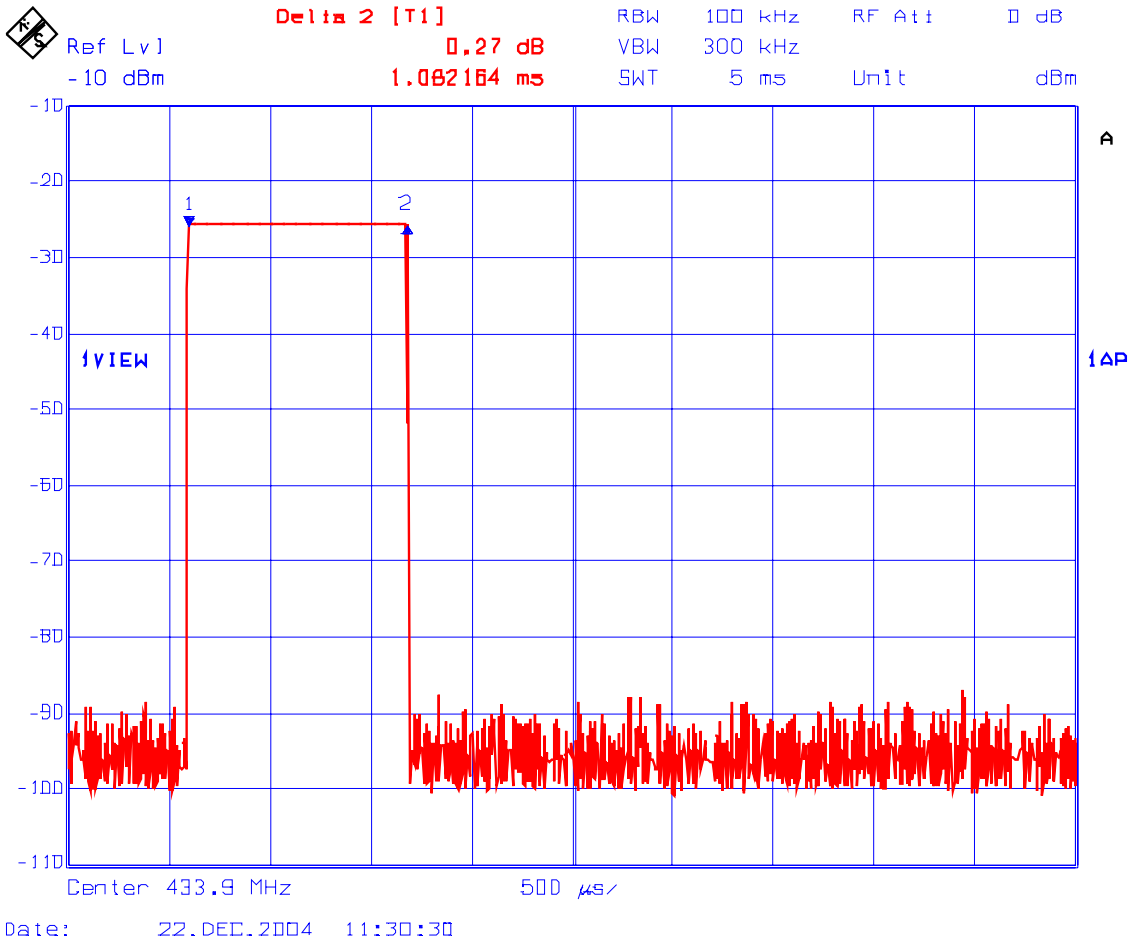
Duty Cycle in 100 ms
Tx On: (8 x 531.062 µs) + (9 x 1.082 ms)= 4.248 ms + 9.738 ms= 13.986 ms
Duty Cycle: TxOn/ TxOn+TxOff= 13.986/ 100= 0.14%
Duty Cycle Factor: 20*log (0.14)= -17.08 dB
Peak-Average Conversion factor = -17.08 dB

Plot # 1: Duty Cycle Measurement, Tx1 ON Time



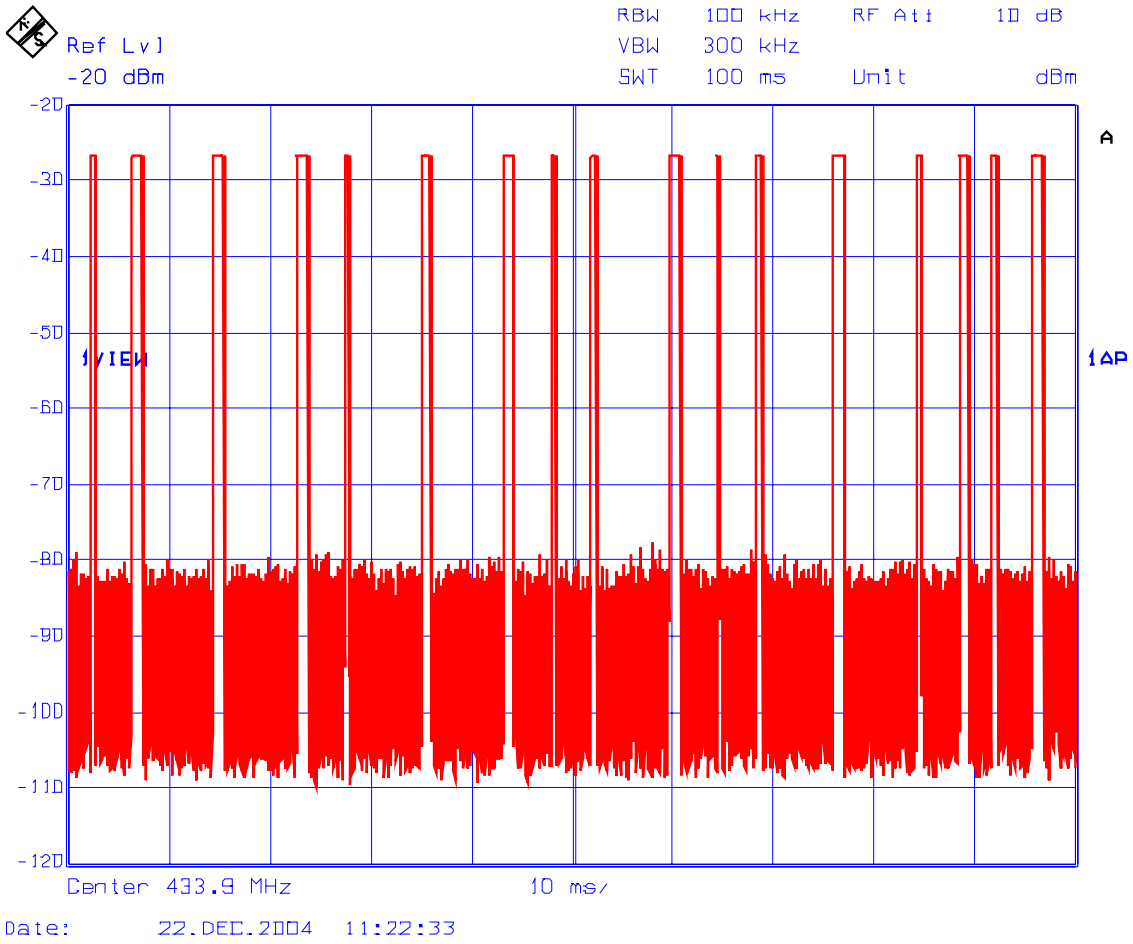
- *All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)*

Plot # 2: Duty Cycle Measurement, Tx2 ON Time



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

Plot # 3: Duty Cycle Measurement in 100ms



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

6.8. 20 DB BANDWIDTH @ FCC CFR 47, PARA. 15.231(E)(C)

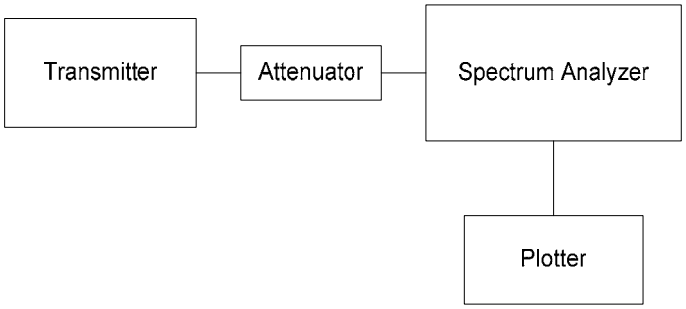
6.8.1. Limits

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

6.8.2. Method of Measurements

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

6.8.3. Test Arrangement



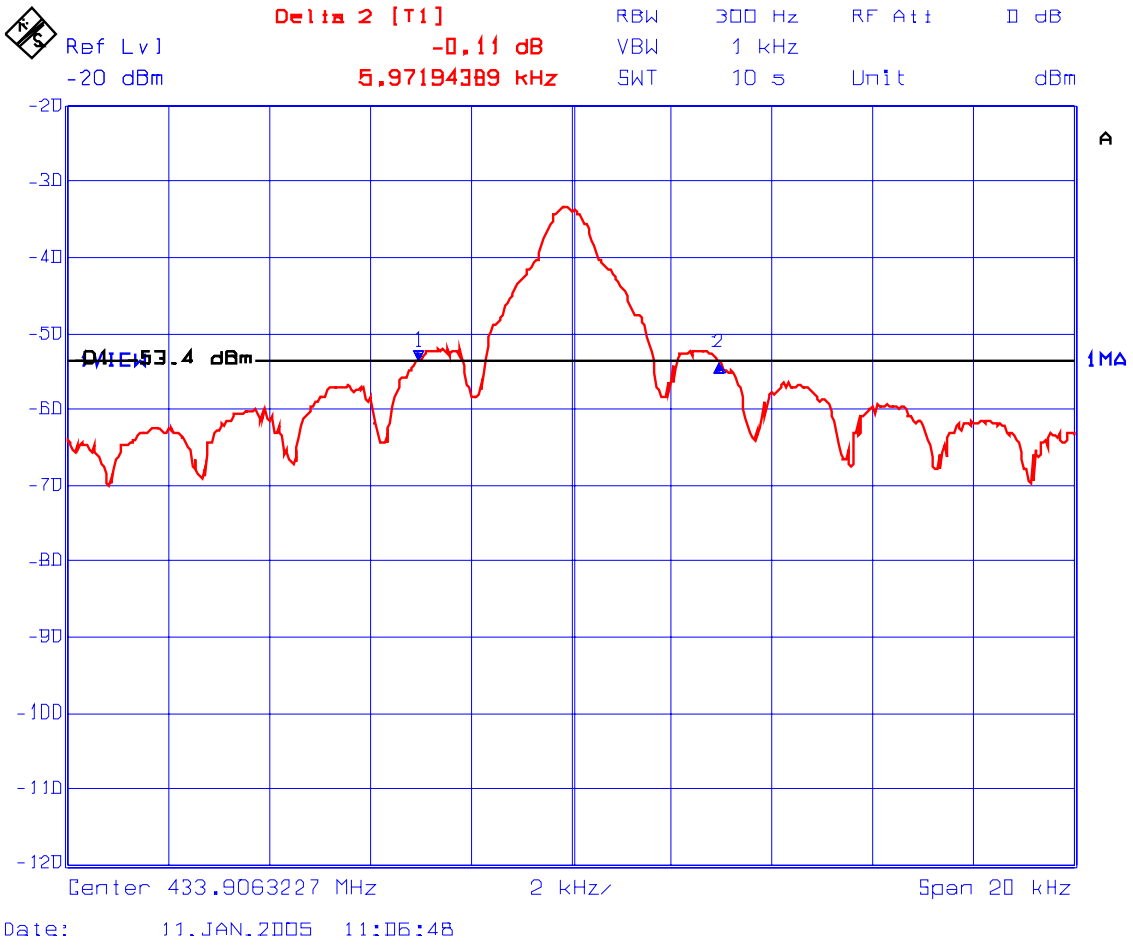
6.8.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz

6.8.5. Test Data

Frequency (MHz)	20 dB Bandwidth (kHz)	Maximum Limit (kHz)	Pass/Fail
433.92	5.97	1085	Pass

Plot # 4: 20 dB Bandwidth Of Emission, Test Frequency: 433.92 MHz



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

EXHIBIT 7: MEASUREMENT UNCERTAINTY

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

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Line Conducted)	PROBABILITY DISTRIBUTION	UNCERTAINTY (dB)	
		9-150 kHz	0.15-30 MHz
EMI Receiver specification	Rectangular	±1.5	±1.5
LISN coupling specification	Rectangular	±1.5	±1.5
Cable and Input Transient Limiter calibration	Normal (k=2)	±0.3	±0.5
Mismatch: Receiver VRC $\Gamma_1 = 0.03$ LISN VRC $\Gamma_R = 0.8$(9 kHz) 0.2 (30 MHz) Uncertainty limits $20\text{Log}(1\pm\Gamma_1\Gamma_R)$	U-Shaped	±0.2	±0.3
System repeatability	Std. deviation	±0.2	±0.05
Repeatability of EUT	--	--	--
Combined standard uncertainty	Normal	±1.25	±1.30
Expanded uncertainty U	Normal (k=2)	±2.50	±2.60

Sample Calculation for Measurement Accuracy in 450 kHz to 30 MHz Band:

$u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)} = \pm \sqrt{(1.5^2 + 1.5^2)/3 + (0.5/2)^2 + (0.05/2)^2 + 0.35^2} = \pm 1.30$ dB

$U = 2u_c(y) = \pm 2.6$ dB

7.2. 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 $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67$(Bi) 0.3 (Lp) Uncertainty limits $20\text{Log}(1\pm\Gamma_1\Gamma_R)$	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 8: MEASUREMENT METHODS

8.1. GENERAL TEST CONDITIONS

The following test conditions shall be applied throughout the tests covered in this report.

8.1.1. Normal temperature and humidity

- Normal temperature: +15°C to +35°C
- Relative Humidity: +20% to 75%

The actual values during tests shall be recorded in the test report.

8.1.2. Normal power source

8.1.2.1. Mains Voltage

The nominal test voltage of the equipment to be connected to mains shall be the nominal mains voltage which is the declared voltage or any of the declared voltages for which the equipment was designed.

The frequency of test power source corresponding to the AC mains shall be between 59 Hz and 61 Hz.

8.1.2.2. Battery Power Source

For operation from battery power sources, the nominal test voltage shall be as declared by the equipment manufacturer. This shall be recorded in the test report.

8.1.3. Operating Condition of Equipment under Test

- All tests were carried out while the equipment operated at the following frequencies:
  - The lowest operating frequency,
  - The middle operating frequency and
  - The highest operating frequency

- Modulation were applied using the Test Data sequence
- The transmitter was operated at the highest output power, or in the case the equipment able to operate at more than one power level, at the lowest and highest output powers

8.2. RADIATED EMISSIONS

For both conducted and radiated measurements, the spurious emissions were scanned from the lowest frequency generated by the EUT or 10 MHz whichever is lower to 10th harmonic of the highest frequency generated by the EUT.

- The radiated emission measurements were performed at the UltraTech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario. The Attenuation Characteristics of OFTS have been filed to FCC, Industry Canada, ACA/Austel, NVLap and ITI.
- Radiated emissions measurements were made using the following test instruments:

1. Calibrated EMCO BiconiLog antenna in the frequency range from 30 MHz to 2000 MHz.
2. Calibrated Emco Horn antennas in the frequency range above 1000 MHz (1GHz - 40 GHz).
3. The test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

   - RBW = 100 kHz for f < 1GHz and RBW = 1 MHz for f ≥ 1 GHz
   - VBW = RBW
   - Sweep = auto
   - Detector function = peak
   - Trace = max hold
   - Follows the guidelines in ANSI C63.4-2003 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc.. A pre-amp and highpass filter are required for this test, in order to provide the measuring system with sufficient sensitivity.
   - Allow the trace to stabilize.
   - The peak reading of the emission, after being corrected by the antenna correction factor, cable loss, pre-amp gain, etc…. is the peak field strength which comply with the limit specified in Section 15.35(b)

   Calculation of Field Strength:

   The field strength is calculated by adding the calibrated antenna factor and cable factor, and subtracting the Amplifier gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where FS = Field Strength
RA = Receiver/Analyzer Reading
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain

Example: If a receiver reading of 60.0 dBµV is obtained, the antenna factor of 7.0 dB/m and cable factor of 1.0 dB are added, and the amplifier gain of 30 dB is subtracted. The actual field strength will be:

Field Level = 60 + 7.0 + 1.0 - 30 = 38.0 dBµV/m.
Field Level = $10^{(38/20)}$ = 79.43 µV/m.

- Submit this test data
- Now set the VBW to 10Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100ms, then the reading obtained may be further adjusted by a "duty cycle correction factor", derived from 10log(dwell time/100mS) in an effort to demonstrate compliance with the 15.209.
- Submit test data

Maximizing The Radiated Emissions:

- The frequencies of emissions was first detected. Then the amplitude of the emissions was measured at the specified measurement distance using required antenna height, polarization, and detector characteristics.
- During this process, cables and peripheral devices were manipulated within the range of likely configuration.
- For each mode of operation required to be tested, the frequency spectrum was monitored. Variations in antenna heights (from 1 meter to 4 meters above the ground plane), antenna polarization (horizontal plane and vertical plane), cable placement and peripheral placement were explored to produce the highest amplitude signal relative to the limit.

The maximum radiated emission for a given mode of operation was found by using the following step-by-step procedure:

Step1: Monitor the frequency range of interest at a fixed antenna height and EUT azimuth.

Step2: Manipulate the system cables to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

Step3: Rotate the EUT 360 degrees to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, go back to the azimuth and repeat Step 2. Otherwise, orient the EUT azimuth to repeat the highest amplitude observation and proceed.

Step4: Move the antenna over its full allowable range of travel (1 to 4 meters) to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, return to Step 2 with the highest amplitude observation and proceed.

Step5: Change the polarization of the antenna and repeat Step 2 through 4. Compare the resulting suspected highest amplitude signal with that found for the other polarization. Select and note the higher of the two signals. This signal is termed the highest observed signal with respect to the limit for this EUT operational mode.

Step6: The effect of various modes of operation is examined. This is done by varying the equipment modes as steps 2 through 5 are being performed.

After completing steps 1 through 6, record the final highest emission level, frequency, antenna polarization and detector mode of the measuring instrument.