ENGINEERING TEST REPORT

Handheld Computer with RFID
Model No.: 7535-OEM186

FCC ID: GM37535OEM186

Applicant:

Psion Teklogix Inc.
2100 Meadowvale Blvd.
Mississauga, ON
Canada, L5N 7J9

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.225
Unlicensed Low Power Transmitter
Operating in the Band 13.553 – 13.567 MHz

UltraTech's File No.: TEK-451FCC15C225

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: May 6, 2004	
Report Prepared by: Anca Dobre Issued Date: May 6, 2004	Tested by: Hung Trinh, RFI Technician Test Dates: March 30 – April 4, 2004

- *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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EXHIBIT 1: SUBMITTAL CHECK LIST

Annex No.	Exhibit Type	Description of Contents	Quality Check (OK)
--	Test Report	▪ Exhibit 1: Submittal check lists ▪ Exhibit 2: Introduction ▪ Exhibit 3: Performance Assessment ▪ Exhibit 4: EUT Operation and Configuration during Tests ▪ Exhibit 5: Summary of test Results ▪ Exhibit 6: Measurement Data ▪ Exhibit 7: Measurement Uncertainty ▪ Exhibit 8: Measurement Methods	OK
1	Test Setup Photos	Radiated Emissions Setup Photos	OK
2	External EUT Photos	External EUT Photos	OK
3	Internal EUT Photos	Internal EUT Photos	OK
4	Cover Letters	▪ Cover Letter	OK
5	Attestation Statements	▪ Letter from the Applicant to appoint Ultratech to act as an agent ▪ Letter from the Applicant to request for Confidentiality Filing	OK
6	ID Label/Location Info	▪ ID Label ▪ Location of ID Label	OK
7	Block Diagrams	Block diagram	OK
8	Schematic Diagrams	Schematics	OK
9	Parts List/Tune Up Info	Parts List	OK
10	Operational Description	Operational Description	OK
11	RF Exposure Info	N/A	N/A
12	Users Manual	User Manual	OK

EXHIBIT 2: INTRODUCTION

2.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.225 – Unlicensed Low Power Transmitter
Title:	Code of Federal Regulations (CFR), Title 47 - Telecommunication, Part 15
Purpose of Test:	To obtain FCC Certification Authorization for Unlicensed Low Power Transmitter Operating within the Band 13.553 – 13.567 MHz.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with TIA/EIA Standard TIA/EIA – 603 (01-Nov-2002) – Land Mobile FM or PM Communications equipment Measurement and Performance Standards.
Environmental Classification:	Commercial, industrial or business.

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

None.

2.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19	2003	Code of Federal Regulations, Title 47 – 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
TIA/EIA 603, Edition B	01-Nov 2002	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
CISPR 16-1	1999	Specification for Radio Disturbance and Immunity measuring apparatus and methods

EXHIBIT 3: PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT	
Name:	Psion Teklogix Inc.
Address:	2100 Meadowvale Blvd. Mississauga, ON Canada, L5N 7J9
Contact Person:	Mr. Sada Dharwarkar Phone #: 905-812-6200 (3358) Fax #: 905-812-6301 Email Address: sdharwar@teklogix.com

MANUFACTURER	
Name:	Psion Teklogix Inc.
Address:	2100 Meadowvale Blvd. Mississauga, ON Canada, L5N 7J9
Contact Person:	Mr. Sada Dharwarkar Phone #: 905-812-6200 (3358) Fax #: 905-812-6301 Email Address: sdharwar@teklogix.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:	Psion Teklogix
Product Name:	Handheld Computer with RFID
Model Name or Number:	7535-OEM186
Serial Number:	B012
Type of Equipment:	Low Power Communication Device Transmitter
Input Power Supply Type:	Internal battery
Primary User Functions of EUT:	Provide data communication link through air

3.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Portable
Intended Operating Environment:	Commercial, industrial or business
Power Supply Requirement:	7.4 V Battery
RF Output Power Rating:	44.51 dBμV/m (at 3 meters distance)
Operating Frequency Range:	13.56 MHz
Data Rate	9600 baud
26 dB Bandwidth:	4.90 kHz
Modulation Type:	AM 10%
Emission Designation:	14K0A1X
Oscillator Frequencies:	32.768 kHz, 6.0 MHz, 3.6864 MHz, 7.3728 MHz, 95.846 MHz, 147.46 MHz, 47.923 MHz, 31.949 MHz, 19.169 MHz, 14.746 MHz, 100 MHz, 200 MHz, 400 MHz
Antenna Connector Type:	Integral (the antenna component is soldered onto the radio printed circuit board and located inside the enclosure)
Antenna Description:	Manufacturer: SIRIT Type: 3 turn induction coil Model: OEM-186 antenna Frequency Range: 13.56 MHz In/Out Impedance: 50 Ohms Gain: Negative

3.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	Tether Port	1	8pin Circular Mini DIN	8' long, shielded decoded scanner cable terminated with scanner

NOTE:

1. *Ports of the EUT which in normal operation were connected to ancillary equipment through interconnecting cables via a representative interconnecting cable to simulate the input/output characteristics. RF input/output was correctly terminated to the associated antenna.*
2. *Ports which are not connected to cables during normal intended operation since it is only provided for Service Uses*

3.5. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Ancillary Equipment # 1	
Description:	Decoded Laser Scanner
Brand name:	PSC
Model Name or Number:	Powerscan
Serial Number:	N/A
Connected to EUT's Port:	Decoded scanner cable

3.6. BLOCK DIAGRAM OF TEST SETUP

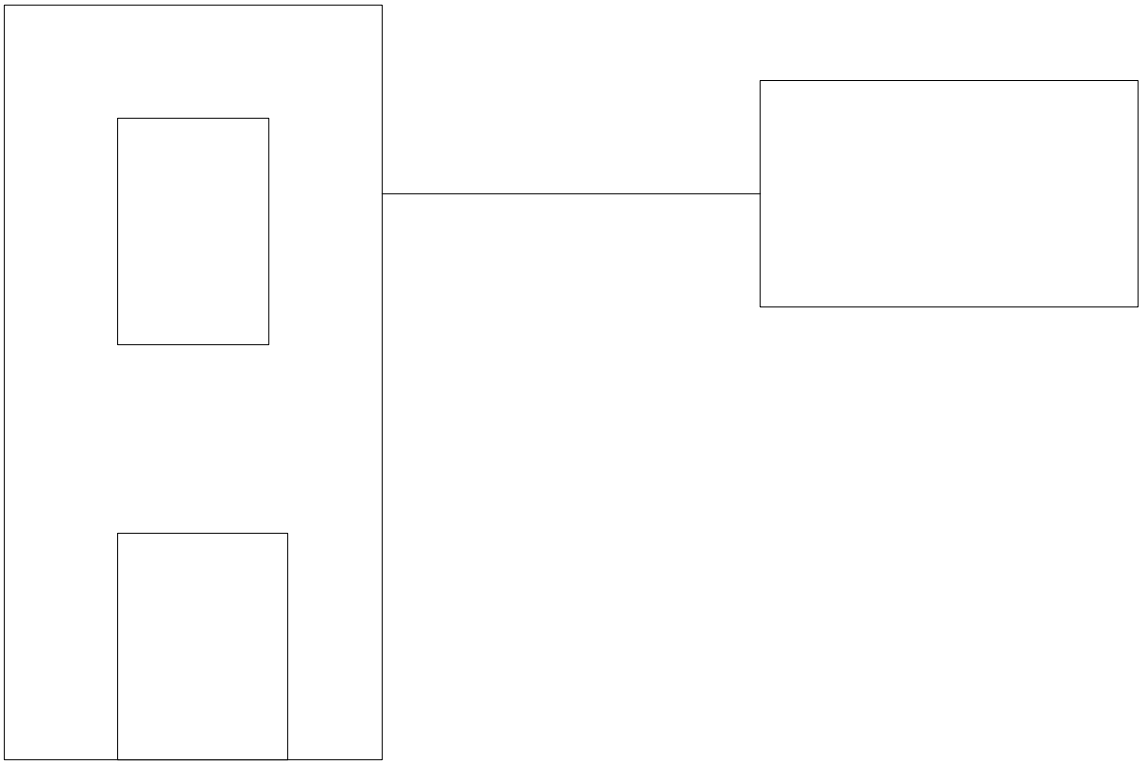


EXHIBIT 4: EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

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:	7.4 V Battery

4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	The transmitter was operated continuously.
Special Test Software:	Special software was provided by Psion Teklogix to operate the EUT continuously.
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):	13.56 MHz
Frequency(ies) Tested:	13.56 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, 24'(L) x 16'(W) x 8'(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: February 17, 2004.

5.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section (s)	Test Requirements	Compliance (Yes/No)
15.203	The transmitter shall use a transmitting antenna that is an integral part of the device.	Yes
2.1049	26 dB Bandwidth	Yes
15.225(a) & (d)	Transmitter Radiated Emissions - Fundamental, Harmonic and Spurious	Yes
15.225(e)	Frequency Stability	Yes
15.107	AC Power Conducted Emissions	Not applicable for battery operated device.
15.109(a)	Radiated Emissions from Digital Devices	Yes (See Note)

Note: 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 requests.

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 C64-3: 2003, FCC 15.225 and CISPR 16-1.

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. COMPLIANCE WITH FCC PART 15 – GENERAL TECHNICAL REQUIREMENTS

FCC Section	FCC Rules	Comments
15.203	Described how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT. The exception is in those cases where EUT must be professionally installed. In order to demonstrate that professional installation is required, the following 3 points must be addressed: • The application (or intended use) of the EUT • The installation requirements of the EUT • The method by which the EUT will be marketed	Conform. Antenna is an integral component mounted on the printed circuit board and located inside the enclosure.

6.6. 26 dB BANDWIDTH [§ 2.1049]

6.6.1. Limits

The 26dB bandwidth of the emission shall be within the authorized bandwidth for devices operating within the band 13.553-13.567 MHz.

6.6.2. Method of Measurements

Refer to Exhibit 8, Section 8.3 and FCC Section 2.1049 & ANSI C63-4: 2003

The transmitter output was loosely coupled to the spectrum analyzer through a receiving antenna and the bandwidth of bandwidth of the fundamental frequency was measured with the spectrum analyzer with the resolution bandwidth of the spectrum analyzer set per ANSI 63-4: 2003

6.6.3. Test Equipment List

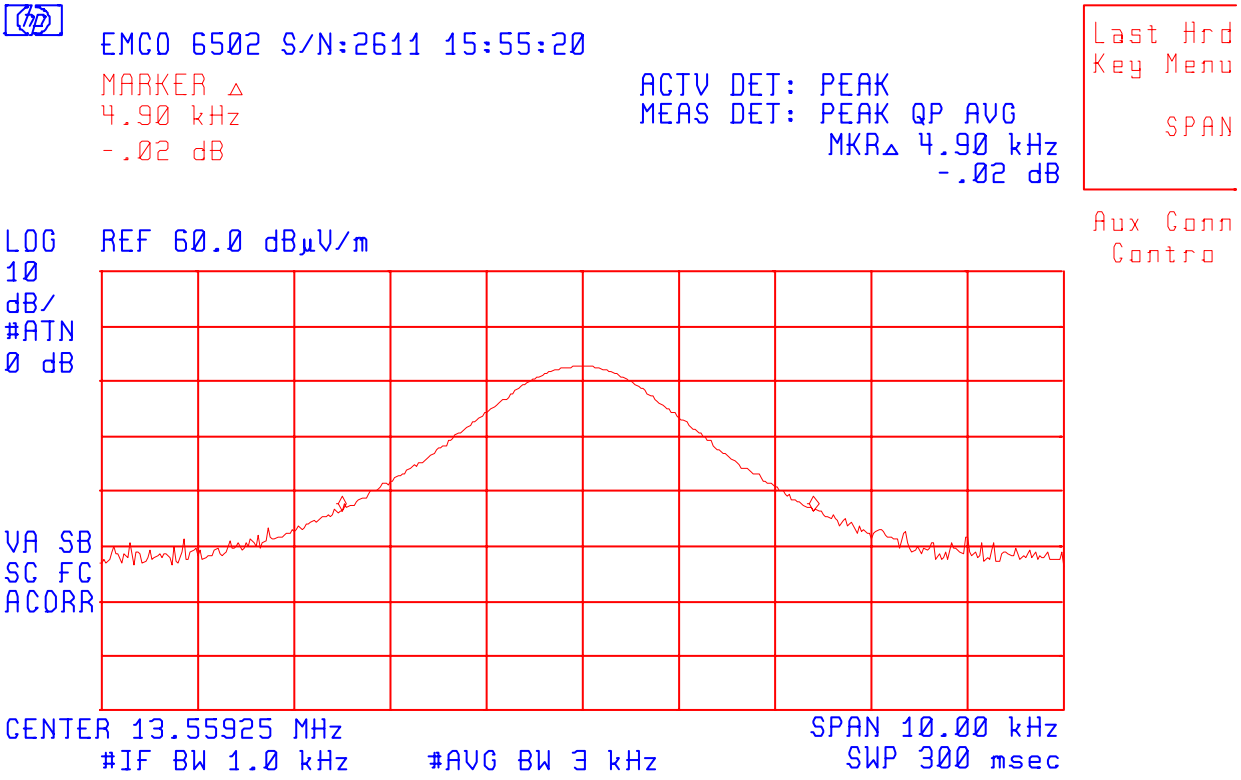
Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Hewlett Packard	HP 8546A	3325A00141	9 kHz – 6.5 GHz

6.6.4. Test Data

Frequency (MHz)	26 dB Bandwidth (kHz)
13.56	4.90

*See Plot # 1 for details of measurement.

Plot # 1:
26 dB Bandwidth
Test Frequency: 13.56 MHz; Modulation: AM 10%



6.7. TRANSMITTER RADIATED EMISSIONS @ 3 METERS [§§ 15.225(a),(d), 15.209 & 15.205]

6.7.1. Limits

§15.225 (a) The field strength of any emissions within this band shall not exceed 15,848 microvolts/meter at 30 meters.

§15.225 (d) The field strength of any emissions appearing outside of this band shall not exceed the general radiated emission limits shown in § 15.209.

Section 15.209(a) – General Radiated Emission Limits

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/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
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 MHz, 76– 88 MHz, 174–216 MHz or 470–806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.		

6.7.2. Method of Measurements

Refer to Exhibit 8, Section 8.3 of this test report & ANSI C63-4: 2003

Applies to harmonics/spurious that fall in the restricted bands listed in Section 15.205. the maximum permitted average field strength is listed in Section 15.209. A Pre-Amp and highpass filter are used for this measurement.

- For measurements from 9 KHz to 150 KHz, set RBW = 200 Hz, VBW $\geq$ RBW, SWEEP=AUTO.
- For measurements from 150 KHz to 30 MHz, set RBW = 10 KHz, VBW $\geq$ RBW, SWEEP=AUTO.
- For measurements from 30 MHz to 1 GHz, set RBW = 100 KHz, VBW $\geq$ RBW, SWEEP=AUTO.
- For measurement above 1 GHz, set RBW = 1 MHz, VBW = 1 MHz, SWEEP=AUTO.

If the emission is pulsed, modified the unit for continuous operation, then use the settings above for measurements, then correct the reading by subtracting the peak-average correction factor derived from the appropriate duty cycle calculation. See Section 15.35(b) and (c).

6.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Hewlett Packard	HP 8546A	3325A00141	9 kHz – 6.5 GHz
Microwave Amplifier	Hewlett Packard	HP 85460A		1 GHz to 6.5 GHz
Active Loop Antenna	EMCO	6507	8906-1167	1 kHz – 30 MHz
Log Periodic/Bow-Tie Antenna	EMCO	3143	1029	20 - 1000 MHz

6.7.4. Test Data

6.7.4.1. Field Strength Within the 13.553-13.567 MHz

Frequency (MHz)	Peak E-Field @3m (dBμV/m)	Antenna Orientation	[2] Limit 15.225(a) @3m (dBμV/m)	Margin (dB)	Pass/ Fail
13.56	37.40	0 degree	104	-67	Pass
13.56	44.51	90 degree	104	-59	Pass

Notes:

1. Portable transmitter was placed in three different orthogonal positions for searching maximum field strength level.
2. The converted limit from 30 meters distance to 3 meters.

6.7.4.2. Field Strength Emissions Appearing Outside of 13.110-14.010 MHz

The emissions were scanned from 10 kHz to 1 GHz; all emissions were more than 20 dB below the permissible limits.

6.8. FREQUENCY STABILITY [§§ 2.1055 & 15.225(e)]

6.8.1. Limits

The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C.

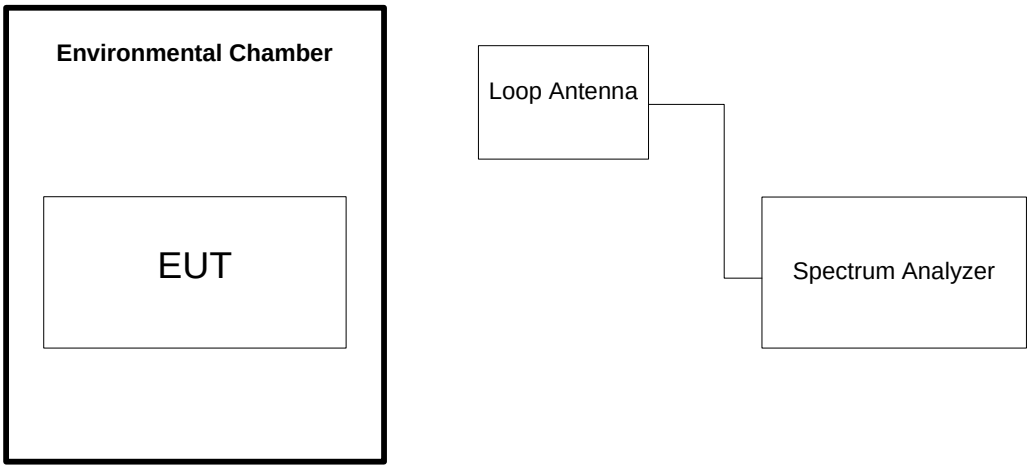
6.8.2. Method of Measurements

Refer to Exhibit 8, Section 8.4 of this report for measurement details

6.8.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Hewlett Packard	HP 8546A	3325A00141	9 kHz – 6.5 GHz
Active Loop Antenna	EMCO	6507	8906-1167	1 kHz – 30 MHz
Temperature & Humidity Chamber	Tenney	T5	9723B	-40° to +60° C range

6.8.4. Test Arrangement



6.8.5. Test Data

Product Name: **Model No.:**	**Handheld Computer with RFID** **7535-OEM186**
Center Frequency:	13.56 MHz
Full Power Level:	44.51 dBµV/m at 3m
Frequency Tolerance Limit:	± 0.01% or 1356 Hz
Max. Frequency Tolerance Measured:	132 Hz or 9.7 ppm
Input Voltage Rating:	7.4 V Battery

CENTER FREQUENCY & RF POWER OUTPUT VARIATION			
Ambient Temperature	**Supply Voltage (Nominal) 7.4 Volts**	**Supply Voltage (85% of Nominal) 6.29 Volts**	**Supply Voltage (115% of Nominal) 8.51 Volts**
(°C)	**Hz**	**Hz**	**Hz**
-20	132	N/A	N/A
-10	109	N/A	N/A
0	43	N/A	N/A
+10	8	N/A	N/A
+20	0	N/A	N/A
+30	-23	N/A	N/A
+40	-34	N/A	N/A
+50	-48	N/A	N/A

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. 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 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. METHOD OF MEASUREMENTS - AC MAINS CONDUCTED EMISSIONS

- AC Mains conducted emissions measurements were performed in accordance with the standard against appropriate limits for each detector function.
- The test was performed in the shielded room, 24'(L) by 16'(W) by 8'(H).
- The test was performed were made over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio noise voltage which was conducted from the EUT power-input terminals that were directly connected to a public power network.
- The EUT normally received power from another device that connects to the public utility ac power lines, measurements would be made on that device with the EUT in operation to ensure that the device continues to comply with the appropriate limits while providing the EUT with power.
- If the EUT operates only from internal or dedicated batteries, with no provisions for connection to the public utility ac power lines, AC Mains conducted measurements are not required.
- Table-top devices were placed on a platform of nominal size 1 m by 1.5m raised 80 cm above the conducting ground plane.
- The EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN to the power source. All unused 50-Ohm connectors of the LISN was terminated in 50-ohm when not connected to the measuring instruments.
- The line cord of the EUT connected to one LISN which was connected to the measuring instrument. Those power cords for the units of devices not under measurement were connected to a separate multiple ac outlet. Drawings and photographs of typically conducted emission test setups were shown in the Test Report. Each current-carrying conductor of the EUT shall be individually tested.
- The EUT was normally operated with a ground (safety) connection, the EUT was connected to the ground at the LISN through a conductor provided in the lead from the ac power mains to the LISN.
- The excess length of the power cord was folded back and forth in an 8-shape on a wooden strip with a vertical prong located on the top of the LISN case.
- The EUT was set-up in its typical configuration and operated in its various modes as described in 3.2 of the test report.
- A preliminary scan was made by using spectrum analyzer system with the detector function set to PEAK mode (9 KHz RBW, VBW > RBW), frequency span 150 kHz to 30 MHz.

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

- Monitor the frequency range of interest at a fixed EUT azimuth.
- Manipulate the system cables and peripheral devices to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.
- The effects of various modes of operation is examined. This is done by varying equipment operation modes as step 2 is being performed.
- After completing step 1 through 3, record EUT and peripheral device configuration, mode of operation, cable configuration, signal levels and frequencies for final test.

- Each highest signal level at the maximized test configuration was zoomed in a small frequency span on the spectrum analyzer's display (the manipulation of cables and peripheral devices and EUT operation modes might have to be repeated to obtain the highest signal level with the spectrum analyzer set to PEAK detector mode 10 KHz RBW and VBW > RBW). The spectrum analyzer was then set to CISPR QUASI-PEAK detector mode (9 KHz RBW, 1 MHz VBW) and AVERAGE detector mode (10 kHz RBW, 1 Hz VBW). The final highest RF signal levels and frequencies were record.

- ***Broad-band ac Powerline conducted emissions***:- If the EUT exhibits ac Powerline conducted emissions that exceed the limit with the instrument set to the quasi-peak mode, then measurements should be made in the average mode. If the amplitude measured in the quasi-peak mode is at least 6 dB higher than the amplitude measured in the average mode, the level measured in quasi peak mode may be reduced by 13 dB before comparing it to the limit.

8.3. SPURIOUS EMISSIONS (RADIATED)

For 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. Calibrated Advantest spectrum analyzer and pre-selector were used. The spectrum analyzer would be used as follows:

   For frequencies below 1 GHz:

   - Resolution BW: 100 kHz
   - Video BW: same or greater
   - Detector Mode: Positive Peak
   - Averaging: Off
   - Span: 100 MHz
   - Amplitude: Adjust for middle of the instrument's range
   - Sweep Time: Auto

   For frequencies above 1 GHz:
   - Resolution BW: 1 MHz
   - Video BW: same or greater
   - Detector Mode: Positive Peak
   - Averaging: Off
   - Span: 500 MHz
   - Amplitude: Adjust for middle of the instrument's range
   - Sweep Time: Auto

- 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:

  Step 1: Monitor the frequency range of interest at a fixed antenna height and EUT azimuth.

  Step 2: Manipulate the system cables to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

Step 3: 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.

Step 4: 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.

Step 5: 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.

Step 6: The effects of various modes of operation is examined. This is done by varying the equipment modes as steps 2 through 5 are being performed.

Step 7: After completing steps 1 through 6, record the final highest emission level, frequency, antenna polarization and detector mode of the measuring instrument.

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.

8.4. FREQUENCY STABILITY

Refer to FCC @ 2.1055.

(a) The frequency stability shall be measured with variation of ambient temperature as follows: From -30 to +50 centigrade except that specified in subparagraph (2) & (3) of this paragraph.

(b) Frequency measurements shall be made at extremes of the specified temperature range and at intervals of not more than 10 centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short-term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stability circuitry need be subjected to the temperature variation test.

(d) The frequency stability supply shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provide with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c) and (d) of this section. (For example, measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment).