UltraTech
Group of Labs

31040/SIT

C-1376

46390-2049

200093-0

00-034

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Apr. 17, 2002

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

Attn.: **Mr. Sada Dhawarkar**

Subject: **FCC Certification Application Testing under FCC PART 15, Subpart C - Unlicensed Low Power Transmitter operating in the frequency band 13.553-13.567 MHz.**

Product: **Workabout RFID**
Model No.: **OEM187**
FCC ID: **GM3WAOEM187**

Dear Mr. Dhawarkar,

The product sample, as provided by you, has been tested and found to comply with **FCC PART 15, Subpart C - Unlicensed Low Power Transmitter operating in the frequency band 13.553-13.567 MHz.**

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

Yours truly,

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

Encl

ENGINEERING TEST REPORT

Workabout RFID
Model No.: OEM187

FCC ID: GM3WAOEM187

Applicant: **Psion Teklogix Inc.**
2100 Meadowvale Blvd.
Mississauga, Ontario
Canada, L5N 7J9

In Accordance With

FEDERAL COMMUNICATIONS COMMISSION (FCC)
PART 15, SUBPART C
Unlicensed Low Power Transmitter
operating in the band 13.553-13.567 MHz

UltraTech's File No.: TEK-374FCCTX

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: Apr. 17, 2002	
Report Prepared by: Tri M. Luu, P.Eng. Issued Date: Apr. 17, 2002	Tested by: Hung Trinh, RFI Technician Test Dates: Apr. 15-16, 2002

- *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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FC	VCCI	Canada	NVLAP	IT	UL	entela
31040/SIT	C-1376	46390-2049	200093-0	00-034		

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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	Photos # 1 to 3	OK
2	External Photos of EUT	Photos # 1 to 2	
3	Internal Photos of EUT	Photos of 1 to 13	
4	Cover Letters	• Letter from Ultratech for Certification Request	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 OK
6	ID Label/Location Info	• ID Label • Location of ID Label	OK OK
7	Block Diagrams	• Block diagrams	OK
8	Schematic Diagrams	• Schematic diagrams	OK
9	Parts List/Tune Up Info	N/A	N/A
10	Operational Description	Operational Description	OK
11	RF Exposure Info	N/A for low power transmitter	N/A
12	Users Manual	Users Manual	OK

EXHIBIT 2. INTRODUCTION

2.1. SCOPE

Reference:	FCC Part 15, Subpart C - Unlicensed Low Power Transmitter
Title	Telecommunication - Code of Federal Regulations, CFR 47, Part 15, Subpart C
Purpose of Test:	This report is covered test results for Certification compliance with FCC regulations for Unlicensed Low Power Transmitter operating in the 13.553-13.567 MHz band.
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:	• Light-industry, Commercial • Industry

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

None

2.3. NORMATIVE REFERENCES

Publication	YEAR	Title
FCC CFR Parts 0-19	2001	Code of Federal Regulations – Telecommunication
ANSI C63.4	1992	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	1997 1998	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1		Specification for Radio Disturbance and Immunity measuring apparatus and methods
FCC Public Notice DA 00-705	2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
FCC Public Notice DA 00-1407	2000	Part 15 Unlicensed Modular Transmitter Approval

EXHIBIT 3. PERFORMANCE ASSESSMENT

3.1. CLIENT INFORMATION

APPLICANT:	
Name:	Psion Teklogix Inc.
Address:	2100 Meadowvale Blvd. Mississauga, Ontario Canada, L5N 7J9
Contact Person:	Mr. Sada Dhawarkar Phone #: 905-812-6200 (x3358) Fax #: 905-812-6301 Email Address: sdharwar@teklogix.com

MANUFACTURER:	
Name:	Psion Teklogix Inc.
Address:	2100 Meadowvale Blvd. Mississauga, Ontario Canada, L5N 7J9
Contact Person:	Mr. Sada Dhawarkar Phone #: 905-812-6200 (x3358) 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.

Title:	Author:	File Name:	Date:
Radio Approval		Workabout RFID	02/04/11

Radio Approval

PRODUCT UNDER TEST	Workabout RFID
DESTINATION COUNTRY	US, Canada
APPLICABLE STANDARD	FCC Part 15.225 & RSS-210
EQUIPMENT CLASS	Class B Unintentional Radiators (but only for use in commercial/industrial areas)
EQUIPMENT TYPE	RFID
TESTER	Sada Dharwarkar
Remarks:	The Model OEM187 employ the 13.56 MHz Radio, Model MTE-HF, manufactured by i2R Ltd, located at Unit 10, Loughborough Tech Centre, Epinal Way, Loughborough, Leicestershire, UK, LE11 3GE.

Revision	Date	Change Description	by	Comments
Draft 1	02/04/11	Initial Draft	S Dharwarkar	

HARDWARE	
MANUFACTURER	PSION Teklogix Inc.
PRODUCT	Workabout RFID
MODEL NUMBER	Workabout
PSION PART NUMBER	N/A
SERIAL NUMBER	
MLB PART NUMBER	N/A
MLB SERIAL NUMBER	N/A
RAM SIZE	N/A
MEMORY EXPANSION BOARD	N/A
POWER SUPPLY REQUIREMENT	2.4 VDC Battery
OPTIONS	RFID, IrDA BTM GREY Alphanumeric
MISCELANEOUS HARDWARE	
MANUFACTURER	N/A
PRODUCT	N/A
MODEL NUMBER	N/A
SERIAL NUMBER	N/A
TYPE	N/A
MANUFACTURER	N/A
PRODUCT	N/A
MODEL NUMBER	N/A
SERIAL NUMBER	N/A
TEKLOGIX PART NUMBER	N/A

SOFTWARE	
SOFTWARE VERSION	Epoc/Os V4.31F
STARTUP SHELL	V1.23F
COMMAND PROCESSOR	V1.37F
PIC COMPILE DATE	N/A
APPLICATION TYPE	N/A
APPLICATION VERSION	N/A
CLOCK SPEED	N/A
OSCILLATOR FREQUENCIES	N/A
IP ADDRESS	N/A
ESSID	N/A

ADD ON CARDS	
LOCATION	Removable Memory Slot
MANUFACTURER	Psion
PRODUCT	Solid State Disk
MODEL NUMBER	2M RAM
SERIAL NUMBER	N/A
PSION PART NUMBER	1000369

ADD ON CARDS	
LOCATION	Removable Memory Slot
MANUFACTURER	Psion
PRODUCT	Solid State Disk
MODEL NUMBER	1MB FLASH II
SERIAL NUMBER	BCJ267412
PSION PART NUMBER	2300 0183 02

RADIO	
LOCATION	
MANUFACTURER:	Id Systems
PRODUCT	RFID
MODEL NUMBER	OEM - 187
TEKLOGIX MODEL NUMBER	N/A
TEKLOGIX PART NUMBER	N/A
SERIAL NUMBER	
FCC ID	GM3WAOEM187
FREQUENCY RANGE	13.56 MHz
DATA RATES	9600 baud
CHANNELS	1
MODULATION	Angle Modulated
EMISSION DESIGNATION	4K0D1D
INTERNAL/EXTRENAL ANTENNA	Internal
RF CABLE TYPE	N/A
TEKLOGIX PART NUMBER	N/A
ANTENNA TYPE + GAIN	N/A
TEKLOGIX PART NUMBER	N/A

RADIO	
LOCATION	N/A
MANUFACTURER:	N/A
PRODUCT	N/A
MODEL NUMBER	N/A
TEKLOGIX MODEL NUMBER	N/A
TEKLOGIX PART NUMBER	N/A
SERIAL NUMBER	N/A
ID NUMBER (FCC/ETSI)	N/A
POWER	N/A
FREQUENCY RANGE	N/A
DATA RATES	N/A
CHANNELS	N/A
L.O. FREQUENCIES	N/A
REF. OSC. FREQUENCIES	N/A
INTERNAL/EXTRENAL ANTENNA	N/A
RF CABLE TYPE	N/A
TEKLOGIX PART NUMBER	N/A
ANTENNA TYPE + GAIN	N/A
TEKLOGIX PART NUMBER	N/A

NB - INTERFACE BOARD	
TEKLOGIX PART NUMBER	N/A
SERIAL NUMBER	N/A

NB - DSP CARD	
TEKLOGIX PART NUMBER	N/A
SERIAL NUMBER	N/A
SOFTWARE VERSION	N/A

ACCESSORIES	
TYPE	N/A
MANUFACTURER	N/A
MODEL NUMBER	N/A
TEKLOGIX PART NUMBER	N/A
SERIAL NUMBER	N/A
TYPE	N/A
MANUFACTURER	N/A
MODEL NUMBER	N/A
TEKLOGIX PART NUMBER	N/A
SERIAL NUMBER	N/A
TYPE	N/A
MANUFACTURER	N/A
MODEL NUMBER	N/A
TEKLOGIX PART NUMBER	N/A
SERIAL NUMBER	N/A

TEST CONFIGURATION				
INTERFACE PORT	CABLE TYPE	CABLE LENGTH	SHIELDED (S/NS)	COMMENTS

3.3. BLOCK DIAGRAM OF TEST SETUP

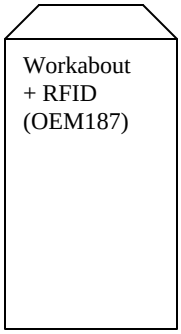


EXHIBIT 4. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

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:	2.4 Vdc battery

4.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	Continuous transmission
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 equipment.

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: Aug. 08, 2001.

5.2. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

5.3. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC PARAGRAPH.	TEST REQUIREMENTS	COMPLIANCE (YES/NO)
15.203 & 15.204	The transmitter shall use a transmitting antenna that is an integral part of the device	Yes
	Power Limits & 26 dB Bandwidth	Yes
15.225(a) & (b)	Field Strength of Emissions inside and outside the permitted band 13.553-13.567 MHz	Yes
15.225(c)	Frequency Stability	Yes
15.107 & 15.207	AC Power Conducted Emissions on Tx, Rx and standby modes	N/A for battery operated device
15.209(b)	Class A - Radiated Emissions from Unintentional Radiators	Yes. A separate test report will be provided upon request.

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 7 of this report and ANSI C63-4:1992

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 6 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 C64-3:1992, FCC 15.407 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	
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	Integral, permanently attached and located inside the plastic enclosure
15.204	Provided the information for every antenna proposed for use with the EUT: (a) type (e.g. Yagi, patch, grid, dish, etc…), (b) manufacturer and model number (c) gain with reference to an isotropic radiator	N/A

6.6. 26 DB BANDWIDTH @ FCC 15.407(A)

6.6.1. Limits

N/A. The 26 dB bandwidth shall be less than 14 kHz.

6.6.2. Method of Measurements

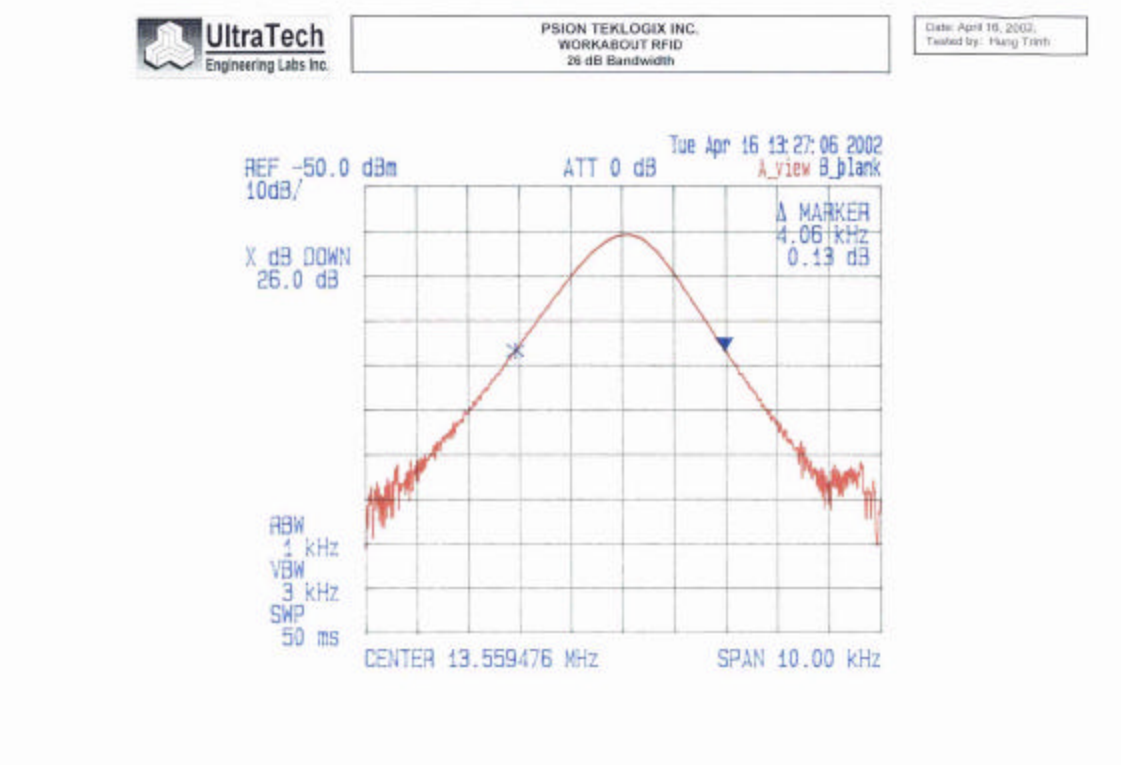
Refer to Exhibit 8.3 of this test report

6.6.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8546A	…	9 kHz to 5.6 GHz with built-in 30 dB Gain Pre-selector, QP, Average & Peak Detectors.
Biconilog Antenna	EMCO	3142	10005	30 MHz to 2 GHz

6.6.4. Test Data

CHANNEL FREQUENCY (MHz)	26 dB BANDWIDTH (kHz)
13.56 MHz	4.06


UltraTech
Engineering Labs Inc.
PSION TEKLOGIX INC.
WORKABOUT RFID
26 dB Bandwidth
Tue Apr 16 13:27:06 2002
REF -50.0 dBm
ATT 0 dB
A_view B_blank
10dB/
Δ MARKER
4.06 kHz
0.13 dB
X dB DOWN
26.0 dB
RBW
1 kHz
VBW
3 kHz
SWP
50 ms
CENTER 13.559476 MHz
SPAN 10.00 kHz

6.7. FIELD STRENGTH OF EMISSIONS INSIDE & OUTSIDE THE PERMITTED BAND 13.553-13.567 MHZ @ 3 METERS, FCC 15.225(A) & (B)

6.7.1. Limits

(a) The field strength of any emissions within this band shall not exceed 10,000 microvolts/meter at 30 meters.
(b) The field strength of any emissions appearing outside of this band shall not exceed the general radiated emission limits shown in Sec. 15.209.

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 Exhibit 8, Sec. 8.2 of this test report and **ANSI 63.4-1992, Para. 8** for detailed radiated emissions measurement procedures.

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 ≥ RBW, SWEEP=AUTO.
- For measurements from 150 KHz to 30 MHz, set RBW = 10 KHz, VBW ≥ RBW, SWEEP=AUTO.
- For measurements from 30 MHz to 1 GHz, set RBW = 100 KHz, VBW ≥ 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/ 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

6.7.4. Photographs of Test Setup

Refer to photos # 1 and 3 in Annex 1 for photos of test setup.

6.7.5. Test Data

FREQUENCY (MHz)	RF PEAK LEVEL (dBuV/m)	EMI DETECTOR	ANTENNA PLANE (H/V)	LIMIT 15.225& 15.209 (dBuV/m)	LIMIT MARGIN (dB)	PASS/ FAIL	Distance (m)
0.01 - 13.553	No significant	PEAK	V & H	@ FCC 15.209	--	PASS	10
13.560	39.9	PEAK	V	89.5	-49.6	PASS	10
13.560	39.0	PEAK	H	89.5	-50.5	PASS	10
13.567 - 10000	No significant	PEAK	V & H	@ FCC 15.209	--	PASS	3
• The EUT was placed in 3 different orthogonal positions while scanning for maximum emission level. • The emissions were scanned from 10 kHz to 1 GHz and all emissions less 30 dB below the limits were recorded.							

6.8. FREQUENCY STABILITY @ FCC §15.225(C)

6.8.1. Limits

The frequency tolerance of the carrier signal shall be maintained within <plus-minus>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. For battery operated equipment, the equipment tests shall be performed using a new battery

6.8.2. Method of Measurements

This following frequency tolerance was measured by RFI in UK and documented in the FCC test report # RFI/EMCB2/RP42898A. The measurement was performed on the i2R Modular Transmitter, Model MTE-HF.

6.8.3. Test Data

Operating Frequency:	13.56 MHz
Full Power Level:	39.9 dBuV/m at 10m
Frequency Tolerance Limit:	Stay within the permitted bands
Max. Frequency Tolerance Measured:	± 0.01% or ±1.356 kHz
Input Voltage Rating:	5 V dc nominal (rated for the i2R Model MTE-HF Radio)

Ambient Temperature (°C)	**Center Frequency & RF Power Output Variation**		
	Supply Voltage (Nominal) 5.0 Volts	**Supply Voltage (85 % of Nominal) 4.25 Volts**	**Supply Voltage (115% of Nominal) 5.75 Volts**
	Hz	**Hz**	**Hz**
-20	671	664	678
-10	681	674	688
0	674	664	678
+10	651	638	654
+20	604	578	609
+30	571	571	581
+40	537	521	544
+50	501	492	523

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 $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67$(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. SPURIOUS 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 $\geq$ 1 GHz
- VBW = RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Follows the guidelines in ANSI C63.4-1992 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 dBuV 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 dBuV/m.

Field Level = $10^{(38/20)}$ = 79.43 uV/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 effects of various modes of operation is examined. This is done by varying the equipment modes as steps 2 through 5 are being performed.

Step7: After completing steps 1 through 6, record the final highest emission level, frequency, antenna polarization and detector mode of the measuring instrument.

8.3. 26 DB BANDWIDTH MEASUREMENTS

- Couple the RF output signal to the spectrum analyzer by means of direct connection or by a receiving antenna.
- The spectrum analyzer shall be se as follows:
  - Span: Minimum span to fully display the entire emission, approximately 3 x emission BW.
  - Resolution RBW: 1% to 3% of the approximate emission BW
  - Video VBW: 3 x RBW
  - EMI Detector: Peak
  - Sweep Time: Coupled or set to a slow rate
  - Trace: Max-hold
- Place the marker at both sides of the emission slope and at -20 dB down from the peak value.
- The difference of frequencies of 2 markers will be the 20 dB bandwidth
- Record and plot the test results.

8.4. FREQUENCY STABILITY

(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.