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Feb. 09, 2001

FEDERAL COMMUNICATIONS COMMISSION

7435 Oakland Mills Road
Columbia, MD 21046
USA

Subject: FCC Certification Authorization Application under FCC PART 15, Subpart C, Sec. 15.219 - Low Power Transmitters operating in the frequency band 1400 - 1690 kHz.

Product: TalkingSign
Model No.: TS100
FCC ID: PEPTS100

Dear Sir/Madam

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

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

Yours truly,



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

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Feb. 09, 2001

TalkingSign.com Inc.
18 Kingsgate Place
Bolton, Ontario
Canada, L7E 5Z5

Attn.: **Mr. Gerry Herlinger**

Subject: **FCC Certification Application Testing under FCC PART 15,
Subpart C, Sec. 15.219 – Low Power Transmitters
operating in the frequency band 1400 - 1690 kHz.**

Product: TalkingSign
Model No.: TS100
FCC ID: PEPTS100

Dear Mr. Herlinger,

The product sample, as provided by you, has been tested and found to comply with **FCC PART 15, Subpart C, Sec. 15.219 - Low Power Transmitters operating in the frequency band 1400 - 1690 kHz.**

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

Yours truly,

A red circular stamp with the text "ENGINEERING PROFESSIONAL ASSOCIATION OF ONTARIO" around the perimeter and "TM LUU" in the center.

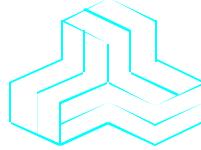
Tri Minh Luu, P. Eng.,
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3000 Bristol Circle
Oakville, Ontario, Canada
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ENGINEERING TEST REPORT



TalkingSign
Model No.: TS100

FCC ID: PEPTS100

Applicant: **TalkingSign.com Inc.**
18 Kingsgate Place
Bolton, Ontario
Canada, L7E 5Z5

In Accordance With

FEDERAL COMMUNICATIONS COMMISSION (FCC)
PART 15, SUBPART C, SEC. 15.219
Low Power Transmitters
operating in the frequency band 1400 - 1690 kHz

UltraTech's File No.: TSC-001TXFC

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

Date: Feb. 09, 2001



Report Prepared by: Tri M. Luu

Tested by: HungTrinh

Issued Date: Feb. 09, 2001

Test Dates: Feb. 10, 2001

The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.

UltraTech

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EXHIBIT 1. SUBMITTAL CHECK LIST

Exhibit No.	Exhibit Type	Description of Contents	Quality Check (OK)
1 through 8	Test Report	<ul style="list-style-type: none"> 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
9	Test Report - Plots of Measurement Data	Plots # 1 to 6	OK
10	Test Setup Photos	Photos # 1 to 4	OK
11	External Photos of EUT	Photos # 1 to 2	OK
12	Internal Photos of EUT	Photos # 1 to 3	OK
13	Cover Letters	<ul style="list-style-type: none"> 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 	OK OK OK
14	Attestation Statements	None	None
15	Application Forms	<ul style="list-style-type: none"> Form 731 Form 159 	OK OK
16	ID Label/Location Info	<ul style="list-style-type: none"> ID Label Location of ID Label 	OK OK
17	Block Diagrams	<ul style="list-style-type: none"> Block diagrams # 1 	
18	Schematic Diagrams	<ul style="list-style-type: none"> Schematic diagrams # 1 to 5 	
19	Parts List/Tune Up Info	None	None
20	Operational Description		OK
21	RF Exposure Info	None	None
22	Users Manual	Users Manual	OK

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.219:1998
Title	Telecommunication - Code of Federal Regulations, CFR 47, Part 15
Purpose of Test:	To gain FCC Certification Authorization for Low Power Transmitters operating in the Frequency Band 1400 - 1690 kHz .
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:	<ul style="list-style-type: none"> • Residential • Light-industry, Commercial • Industry

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

None

1.3. NORMATIVE REFERENCES

Publication	YEAR	Title
FCC CFR Parts 0-19	1999	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

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EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT:	
Name:	TalkingSign.com Inc.
Address:	18 Kingsgate Place Bolton, Ontario Canada, L7E 5Z5
Contact Person:	Mr. Gerry Herlinger Phone #: 416-402-6172 Fax #: 905-857-5457 Email Address: talkingsign@home.com

MANUFACTURER:	
Name:	TalkingSign.com Inc.
Address:	18 Kingsgate Place Bolton, Ontario Canada, L7E 5Z5
Contact Person:	Mr. Gerry Herlinger Phone #: 416-402-6172 Fax #: 905-857-5457 Email Address: talkingsign@home.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.

Brand Name	TalkingSign.com Inc.
Product Name	TalkingSign
Model Name or Number	TS100
Serial Number	Preproduction
Type of Equipment	Low Power Transmitters
Input Power Supply Type	AC Mains
Primary User Functions of EUT:	AM radio transmitter that transmits repeating audio messages to regular AM radios

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2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	▪ Fixed use
Intended Operating Environment:	▪ Residential ▪ Commercial, light industry & heavy industry
Power Supply Requirement:	External power supply, by Globtek Inc., Model No.: SYS1089-1512-W3, S/N: 006A030027, input: 120V 60 Hz, output 12 Vdc.
RF Output Power Rating:	90 mWatts average
Operating Frequency Range:	1400 - 1690 kHz
RF Output Impedance:	50 Ohms
Number of Channels	30
Duty Cycle:	Continuous
26 dB Bandwidth:	6.8kHz
Modulation Type:	AM
Emission Designation:	6K8K3A
Oscillator Frequencies:	1 MHz, 4 MHz, 10.24 MHz
Antenna Connector Type:	• Standard RCA connector
Antenna Description:	3m wire lead

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	Antenna port	1	RCA	3 long wire lead
2	Power IN port	1	Non-shielded
3	Line IN port	1	Phono	Non-shielded
4	Microphone IN port	1	Phono	Non-shielded

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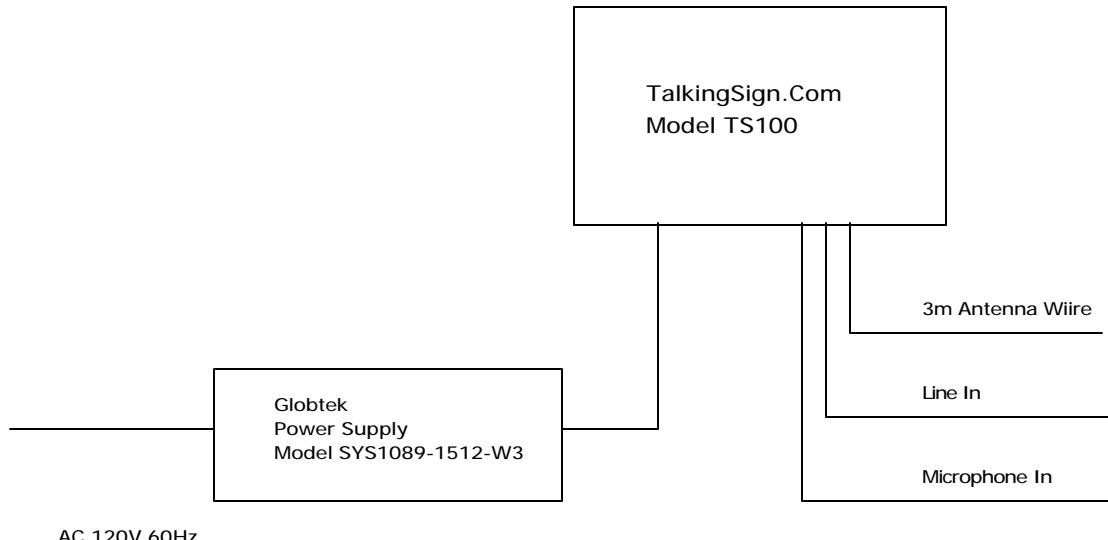
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2.5. ANCILLARY EQUIPMENT

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

Microphone and wire leads were connected to the interface ports as shown in the following drawing of General test setup.

2.6. GENERAL TEST SETUP



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EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	51%
Pressure:	102 kPa
Power input source:	AC 120V 60Hz

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	Set to transmit the middle frequency channel
Special Test Software:	None
Special Hardware Used:	None
Transmitter Test Antenna:	3 meter long wire lead

Transmitter Test Signals:	
Frequencies: <ul style="list-style-type: none">▪ 1400 - 1690 kHz band:	middle channel frequency tested: 1.55 MHz
Transmitter Wanted Output Test Signals: <ul style="list-style-type: none">▪ RF Power Output (measured maximum output power):▪ Normal Test Modulation▪ Modulating signal source:	<ul style="list-style-type: none">▪ 90 mWatts Average▪ AM▪ Internal

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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, 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: Sep.20, 1999.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC PARAGRAPH.	TEST REQUIREMENTS	COMPLIANCE (YES/NO)
15.107(a)	AC Power Line Conducted Emissions Measurements (Transmit & Receive)	Yes
15.219(a) 15.219(b)	<ul style="list-style-type: none">• Total Input Power to the Final Radio Frequency Stage• Total length of the transmission line, antenna and ground lead	Yes
15.219	Transmitter Conducted Spurious/Hamronic Emissions	Yes
1.1307, 1.1310, 2.1091 & 2.1093	RF Exposure Limit	N/A

The digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices, the associated Radio Receiver operating in 1400 - 1690 kHz is exempted from FCC authorization . The engineering test report can be provided upon FCC requests.

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

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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 Exhibit 8 of this report, ANSI C63-4:1992 and FCC Public Notice @ DA 00-705 (March 30, 2000) – Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

5.2. 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.

5.3. MEASUREMENT EQUIPMENT USED:

The measurement equipment used complied with the requirements of the Standards referenced in the Methods & Procedures ANSI C64-3:1992, FCC 15.219 and CISPR 16-1.

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5.4. AC POWERLINE CONDUCTED EMISSIONS @ FCC PART 15, SUBPART B, PARA.15.107(A)

5.4.1. Limits

The equipment shall meet the limits of the following table:

Test Frequency Range	Test Limits	EMI Detector Used	Measuring Bandwidth
0.45 to 30 MHz	48 dB μ V 51 dB μ V	Quasi-Peak (Narrow band) Quasi-Peak (Broad band)	B = 10 kHz B = 10 kHz

5.4.2. Method of Measurements

Refer to Exhibit 8, Sec. 8.2 of this test report & ANSI C63.4:1992

5.4.3. 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
Transient Limiter	Hewlett Packard	11947A	310701998	9 kHz – 200 MHz 10 dB attenuation
L.I.S.N.	EMCO	3825/2	89071531	9 kHz – 200 MHz 50 Ohms / 50 μ H
12'x16'x12' RF Shielded Chamber	RF Shielding

5.4.4. Plots

The following plots graphically represent the test results recorded in the above Test Data Table.

Refer to Plots # 1 & 2 in Exhibit 9 for actual measurement plots

5.4.5. Photographs of Test Setup

Refer to the Photographs #1 & #2 in Exhibit 10 for setup and arrangement of equipment under tests and its ancillary equipment.

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5.4.6. Test Data

FREQUENCY (MHz)	RF LEVEL (dBuV)	RECEIVER DETECTOR (P/QP/AVG)	QP/NB LIMIT	QP/BB LIMIT	MARGIN (dB)	PASS/ FAIL	LINE TESTED (L1/L2)
0.687	36.6	QP	48.0	61.0	-11.4	PASS	L1
0.841	40.3	QP	48.0	61.0	-7.7	PASS	L1
0.981	39.2	QP	48.0	61.0	-8.8	PASS	L1
1.369	38.7	QP	48.0	61.0	-9.3	PASS	L1
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0.684	38.6	QP	48.0	61.0	-9.4	PASS	L2
0.827	41.4	QP	48.0	61.0	-6.6	PASS	L2
0.982	40.1	QP	48.0	61.0	-7.9	PASS	L2
1.922	38.5	QP	48.0	61.0	-9.5	PASS	L2

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5.5. TOTAL INPUT POWER TO THE FINAL RADIO FREQUENCY STAGE@ FCC 15.219(A) & (B)

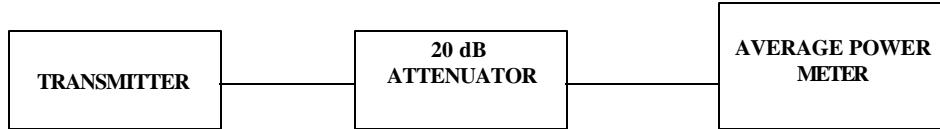
5.5.1. Limits

- FCC 15.219(a) - total input power to the final radio frequency stage (exclusive of filament or heater power) shall not exceed **100 milliwatts or 20 dBm**.
- FCC 15.219(b) – the total length of the transmission line, antenna and ground lead (if used) shall not exceed 3 meters.

5.5.2. Method of Measurements

Refer to ANSI C63-4:1992

5.5.3. Test Arrangement



5.5.4. 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

5.5.5. Test Data

Transmitter Channel	Frequency (MHz)	Average Conducted Power (dBm)	Average Limit (dBm)
Middle	1.55 MHz	19.5	20.0

Total Length of transmission line/antenna: 3 meters

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5.6. RF EXPOSURE REQUIREMENTS @ FCC 15.209(B)(4), 1.1310 & 2.1091

5.6.1. Limits

- FCC 15.209(b)(4):** Systems operating under provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See @ 1.1307(b)(1).
- FCC 1.1310:-** The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (minutes)
(A) Limits for Occupational/Control Exposures				
0.3-3.0	614	1.63	100	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-3.0	614	1.63	100	30

5.6.2. Method of Measurements

Refer to FCC @ 1.1310, 2.1091 and Public Notice DA 00-705 (March 30, 2000)

- In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:
 - Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
 - Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
 - Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
 - Any other RF exposure related issues that may affect MPE compliance

Calculation Method of RF Safety Distance:

$$S = PG/4\pi r^2 = EIRP/4\pi r^2$$

Where:

P: power input to the antenna in mW

EIRP: Equivalent (effective) isotropic radiated power.

S: power density mW/cm²

G: numeric gain of antenna relative to isotropic radiator

r: distance to centre of radiation in cm

FCC radio frequency exposure limits may be exceeded at distances closer than r cm from the antenna of this device

$$r = \sqrt{\frac{PG}{4\pi S}}$$

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FCC radio frequency exposure limits may not be exceeded at distances closer than r cm from the antenna of this device

- For portable transmitters (see Section 2.1093), or devices designed to operate next to a person's body, compliance is determined with respect to the SAR limit (define in the body tissues) for near-field exposure conditions. If the maximum average output power, operating condition configurations and exposure conditions are comparable to those of existing cellular and PCS phones., an SAR evaluation may be required in order to determine if such a device complies with SAR limit. When SAR evaluation data is not available, and the additional supporting information cannot assure compliance, the Commission may request that an SAR evaluation be performed, as provided for in Section 1.1307(d)

5.6.3. Test Data

The minimum separation distance between the antenna and bodies of users are calculated using the following formula:

$$\text{RF EXPOSURE DISTANCE LIMITS: } r = (PG/4\pi S)^{1/2} = (EIRP/4\pi S)^{1/2}$$

Where: $S = 100 \text{ mW/cm}^2$
 $G = 0 \text{ dBi or 1 numeric}$
 $EIRP (\text{in mW}) = P \cdot G$

Frequency (MHz)	Maximum Measured Average EIRP (mWatts)	Laboratory's Recommended Minimum RF Safety Distance r (cm)	Manufacturer's specification in User's Manual
1.55	90.0	0.27 cm	None

Remarks: Since the power is too low and the calculated RF safety distance is too small, the FCC RF Exposure Requirement is not necessary to be complied.

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5.7. TRANSMITTER SPURIOUS EMISSIONS, FCC CFR 47, PARA. 15.219(C)

5.7.1. Limits

All emissions below 510 kHz or above 1705 kHz shall be attenuated at least 20 dB below the level of the unmodulated carrier.

5.7.2. Method of Measurements

Determination of compliance with the 20 dB below attenuation specifications may be based on measurements at the intentional radiator's antenna output terminal unless the intentional radiator uses a permanently attached antenna, in which case compliance shall be demonstrated by measuring the radiated emissions.

The following measurement procedures were also applied:

- For measurement from 9 kHz to 150 kHz, set RBW = 200 Hz minimum, VBW \geq RBW, SWEEP=AUTO.
- For measurement from 150 kHz to 30 MHz, set RBW = 10 kHz minimum, VBW \geq RBW, SWEEP=AUTO.
- For measurement from 30 – 1000 MHz, set RBW = 100 kHz minimum, VBW \geq RBW, 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).

5.7.3. Test Arrangement

Please refer to Test Arrangement in Sec. 5.5.3 for details of test setup for emission measurements.

5.7.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100 Hz to 32 GHz with external mixer for frequency above 32 GHz
Biconilog Antenna	EMCO	3143	1029	20 MHz to 2 GHz

5.7.5. Plots

Refer to Plot # 3 to # 6 in Exhibit 9 for measurement data.

5.7.6. Photographs of Test Setup

Refer to the Photographs #3 & #4 in Exhibit 10 for setup and arrangement of equipment under tests and its ancillary equipment.

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5.7.7. Test Data

5.7.7.1. Middle Frequency (1.55 MHz)

FREQUENCY (MHz)	Peak RF Level (dBm)	Peak LIMIT (dBm)	MARGIN (dB)	PASS/ FAIL
0.065	-50.2	1.9	-52.1	PASS
3.100	-13.9	1.9	-15.8	PASS
4.650	-31.5	1.9	-33.4	PASS
6.200	-50.5	1.9	-52.4	PASS
7.750	-50.0	1.9	-51.9	PASS
455.4	-54.3	1.9	-56.2	PASS

The emissions were scanned from 10 kHz to 1 GHz and all emissions less 50 dB below the limits were recorded.

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EXHIBIT 6. MEASUREMENT UNCERTAINTY

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

6.1. 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 $\Gamma_R = 0.8(9 \text{ kHz}) 0.2 (30 \text{ MHz})$ Uncertainty limits $20\text{Log}(1+\Gamma_1\Gamma_R)$	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:

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

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

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6.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (\pm 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 $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67(Bi)$ 0.3 (Lp) Uncertainty limits $20\log(1 \pm \Gamma_1 \Gamma_R)$	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:

$$U = 2u_c(y) = 2x(+2.19) = +4.38 \text{ dB} \quad \text{And} \quad U = 2u_c(y) = 2x(-2.21) = -4.42 \text{ dB}$$

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EXHIBIT 7. MEASUREMENT METHODS

7.1. GENERAL TEST CONDITIONS

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

7.1.1. 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.

7.1.2. Normal power source

7.1.2.1. *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.

7.1.2.2. *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.

7.1.3. 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

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7.2. 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, 16'(L) by 16'(W) by 12'(H).
- The test was performed over the frequency range from 450 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 450 kHz to 30 MHz.
- The maximum conducted 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 EUT azimuth.
 - Step2. 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.
 - Step3. The effects of various modes of operation is examined. This is done by varying equipment operation modes as step 2 is being performed.
 - Step4. 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.

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7.3. SPURIOUS EMISSIONS (CONDUCTED & RADIATED)

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.

7.3.1. Band-edge and Spurious Emissions (Conducted)

Band-edge Compliance of RF Conducted Emissions:

Use the following spectrum analyzer settings:

- The radio was connected to the measuring equipment via a suitable attenuator.
- Span = wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
- RBW = 1 % of the span
- VBW = RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize
- Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge
- Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission.
- The marker-delta value now displayed must comply with the limit specified
- Now, using the same instrument settings, enable the hopping function of the EUT
- Allow the trace to stabilize
- Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limits.
- Submit this plot

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Spurious RF Conducted Emissions:

Use the following spectrum analyzer settings:

- The radio was connected to the measuring equipment via a suitable attenuator.
- Span = wide enough to capture the peak level of the in-band-emission and all spurious emissions (e.g. harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
- RBW = 100 kHz
- VBW = RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize
- Set the marker on the any spurious emission recorded. The level displayed must comply with the limit specified in this Section.
- Submit this plot

7.3.2. Spurious Emissions (Radiated)

- 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 $f < 1\text{GHz}$ and RBW = 1 MHz for $f \geq 1\text{GHz}$
- 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:

$$\boxed{FS = RA + AF + CF - AG}$$

Where FS = Field Strength
 RA = Receiver/Analyzer Reading

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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:

$$\text{Field Level} = 60 + 7.0 + 1.0 - 30 = 38.0 \text{ dBuV/m.}$$

$$\text{Field Level} = 10^{(38/20)} = 79.43 \text{ uV/m.}$$

- 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 15.219. 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 $10\log(\text{dwell time}/100\text{mS})$ in an effort to demonstrate compliance with the 15.219.
- 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.

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- Assessed by ITI (UK) Competent Body, NVLAP (USA) Accreditation Body & ACA/AUSTEL (Australia), VCCI (Japan)
- Accredited by Industry Canada (Canada) under ACC-LAB (Europe/Canada MRA and APEC/Canada MRA)
- Recognized/Listed by FCC (USA)
- All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)