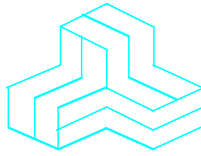


ENGINEERING TEST REPORT



Navigator MODEL NO.: RFMR-1C

FCC ID: PTT-RFMR1C

Applicant:

Gecko Electronics Inc.
450, des Canetons
Quebec, QC
Canada, G2E 5W6

Tested in Accordance With

**FCC Part 15, Subpart C, Section 15.249
Low Power Transmitters
Operating in the Frequency Band 902 - 928 MHz**

UltraTech's File No.: GEK-008F15C249

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

Date: September 1, 2005



Report Prepared by: Dharmajit Solanki

Tested by: Mr. Hung Trinh, EMC/RFI Technician

Issued Date: September 1, 2005

Test Dates: August 17-18, 2005

- The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.
- This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.

UltraTech

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4
Tel.: (905) 829-1570 Fax.: (905) 829-8050

Website: www.ultratech-labs.com, Email: vic@ultratech-labs.com, Email: tri@ultratech-labs.com



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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.249
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15
Purpose of Test:	To gain FCC Certification Authorization for Low Power Licensed-Exempt Transmitters operating in the Frequency Band 902 - 928 MHz.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 - American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
Environmental Classification:	Commercial, industrial or business environment residential

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

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19	2004	Code of Federal Regulations – Telecommunication
ANSI C63.4	2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
CISPR 22 +A1 EN 55022	2003-04-10 2004-10-14 2003	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-2-1	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-1: Conducted disturbance measurement
CISPR 16-2-3	2003	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-3: Radiated disturbance measurement

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Gecko Electronics Inc.
Address:	450, des Canetons Quebec, QC Canada G2E 5W6
Contact Person:	Benoit Laflamme Phone #: (418) 872-4411, Ext. 111 Fax #: (418) 872-6305 Email Address: blaflamme@gecko-electronic.com

MANUFACTURER	
Name:	Gecko Electronics Inc.
Address:	450, des Canetons Quebec, QC Canada G2E 5W6
Contact Person:	Benoit Laflamme Phone #: (418) 872-4411, Ext. 111 Fax #: (418) 872-6305 Email Address: blaflamme@gecko-electronic.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:	Gecko Electronics Inc.
Product Name:	Navigator
Model Name or Number:	RFMR-1C
Serial Number:	Test Sample
Type of Equipment:	Low Power RF Transceiver
Input Power Supply Type:	5 VDC through AC Mains of SPA Controller
Primary User Functions of EUT:	Provide data communication link through air.

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Mobile station (Remote use)
Intended Operating Environment:	Residential Commercial, light industry & heavy industry
Power Supply Requirement:	5 VDC
RF Output Power Rating:	90.53 Peak dBμV/m
Operating Frequency:	916.289 MHz
RF Output Impedance:	50 Ohms
26 dB Bandwidth:	155.11 kHz
Modulation Type:	FSK, 64KHz separation
Mode of Operation:	Simplex
Emission Designation:	F1D
Duty Cycle:	< 1%
Oscillator Frequencies:	14.7456 MHz
Antenna Connector Type:	Integral, permanently attached
Antenna Description:	Manufacturer: Linx Type: Helical Model: ANT-916 Heth Through-Hole Frequency Range: 910-920 MHz Gain: estimated to -6 dBi

2.4. LIST OF EUT'S PORTS

None

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:

Ancillary Equipment # 1	
Description:	SPA Control System
Brand name:	Invensys
Model Name or Number:	IQ2020
Serial Number:	Pre production
Connected to EUT's Port:	N/A

Ancillary Equipment # 2	
Description:	SPA Aux. Relay (Temperature Display)
Brand name:	Invensys
Part Number:	0974401
Connected to EUT's Port:	N/A

2.6. GENERAL TEST SETUP

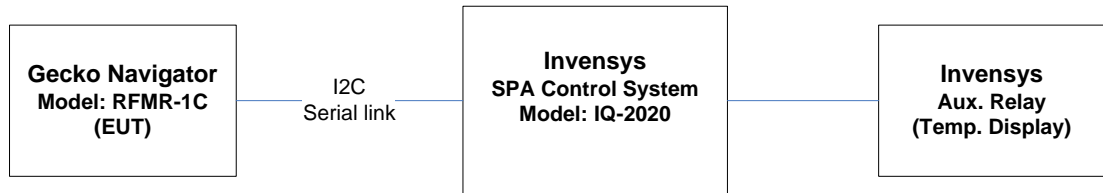


EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	54%
Pressure:	102 kPa
Power input source:	5 VDC through SPA Controller

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	EUT was configured to transmit continuously for emissions measurements.
Special Test Software:	None
Special Hardware Used:	None
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as integral antenna equipment.

Transmitter Test Signals:	
Frequency Band(s):	916.289 MHz
Test Frequency(ies):	916.289 MHz
Transmitter Wanted Output Test Signals:	
• RF Power Output (measured maximum output power):	90.53 Peak dB μ V/m @ 3m
• Normal Test Modulation:	FSK
• Modulating signal source:	Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

- All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.
- AC Powerline Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- Radiated Emissions were performed at the Ultratech's 3-10m TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10m TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada File No.: IC2049-1). Last Date of Site Calibration: June. 20, 2005.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.107(a) & 15.207	AC Power Conducted Emissions	Yes
--	26 dB Bandwidth	Yes
15.249(a), 15.209, 15.205	Transmitter Radiated Emissions, Harmonic Emissions	Yes

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

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

5.1. TEST PROCEDURES

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

5.2. MEASUREMENT UNCERTAINTIES

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

5.3. MEASUREMENT EQUIPMENT USED

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

5.4. ESSENTIAL/PRIMARY FUNCTIONS AS DECLARED BY THE MANUFACTURER

The interface unit is part of a 916.289 MHz RF remote control system. It receives commands from the battery powered remote control and sends command acknowledgements and data via RF to the remote unit. The RFMR-1C also communicates via a serial link (I2C) with a IQ2020 spa controller made by Invensys for Watkins Inc. The interface unit is powered from the spa controller.

5.5. AC POWER LINE CONDUCTED EMISSIONS [47 CFR § 15.107(A)]

5.5.1. Limits

The equipment shall meet the limits of the following table:

Test Frequency Range (MHz)	Class B Limits		Measuring Bandwidth
	Quasi-Peak (dB μ V)	Average (dB μ V)	
0.15 to 0.5	66 to 56*	56 to 46*	RBW = 9 kHz VBW \geq 9 kHz for QP VBW = 1 Hz for Average
0.5 to 5	56	46	RBW = 9 kHz VBW \geq 9 kHz for QP VBW = 1 Hz for Average
5 to 30	60	50	RBW = 9 kHz VBW \geq 9 kHz for QP VBW = 1 Hz for Average

* Decreasing linearly with logarithm of frequency

5.5.2. Method of Measurements

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

5.5.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	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
24'x16'x8' RF Shielded Chamber	RF Shielding	--	--	--

5.5.4. Test Data

Frequency (MHz)	RF Level (dBµV)	Receiver Detector (QP/AVG)	QP Limit (dBµV)	AVG Limit (dBµV)	Margin (dB)	Pass/Fail	Line Tested (L1/L2)
0.151	49.5	QP	65.8	55.8	-16.3	Pass	L1
0.151	40.4	AVG	65.8	55.8	-15.4	Pass	L1
0.51	43.5	QP	56.0	46.0	-12.5	Pass	L1
0.51	37.5	AVG	56.0	46.0	-8.5	Pass	L1
4.21	42.8	QP	56.0	46.0	-13.2	Pass	L1
4.21	37.6	AVG	56.0	46.0	-8.4	Pass	L1
12.17	56.3	QP	60.0	50.0	-3.7	Pass	L1
12.17	46.9	AVG	60.0	50.0	-3.1	Pass	L1
0.151	50.9	QP	65.8	55.8	-14.9	Pass	L2
0.151	42.0	AVG	65.8	55.8	-13.8	Pass	L2
0.51	45.2	QP	56.0	46.0	-10.8	Pass	L2
0.51	41.5	AVG	56.0	46.0	-4.5	Pass	L2
4.21	40.0	QP	56.0	46.0	-16.0	Pass	L2
4.21	35.2	AVG	56.0	46.0	-10.8	Pass	L2
12.22	56.2	QP	60.0	50.0	-3.8	Pass	L2
12.22	48.9	AVG	60.0	50.0	-1.1	Pass	L2

See the following plots (1 & 2) for actual measurement plots.

Plot 1: AC Power Line Conducted Emissions
 Line Tested: Line 1
 Line Voltage: 120VAC 60 Hz



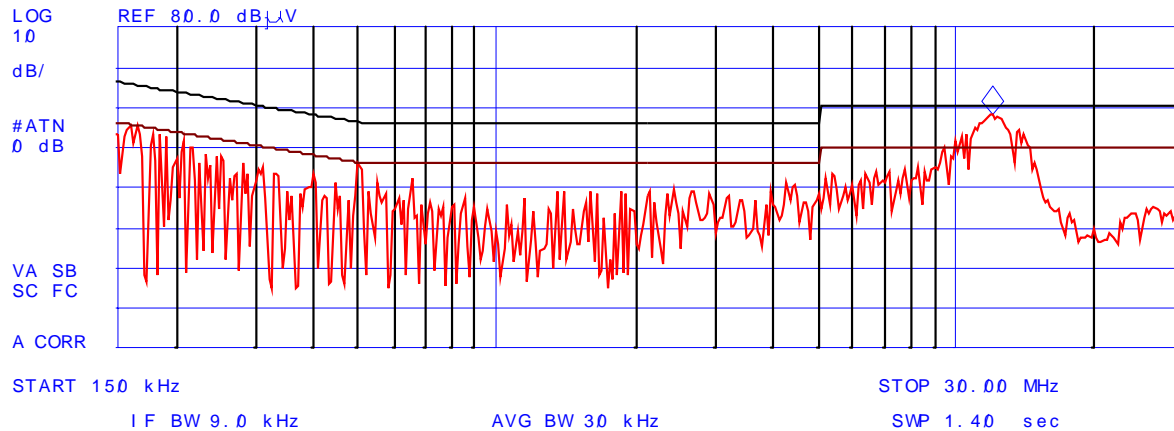
Signal	Freq (MHz)	PK Amp	QP Amp	AV Amp	AV Δ L2
1	0.150530	58.4	49.5	40.4	-15.5
2	0.507875	47.7	43.5	37.5	-8.5
3	4.209513	43.5	42.8	37.6	-8.4
4	12.172438	58.0	56.3	46.9	-3.1

ACTV DET: PEAK

MEAS DET: PEAK QP AVG

MKR 12.10 MHz

57.83 dB μ V



Plot 2: AC Power Line Conducted Emissions
 Line Tested: Line 2
 Line Voltage: 120VAC 60 Hz

hp

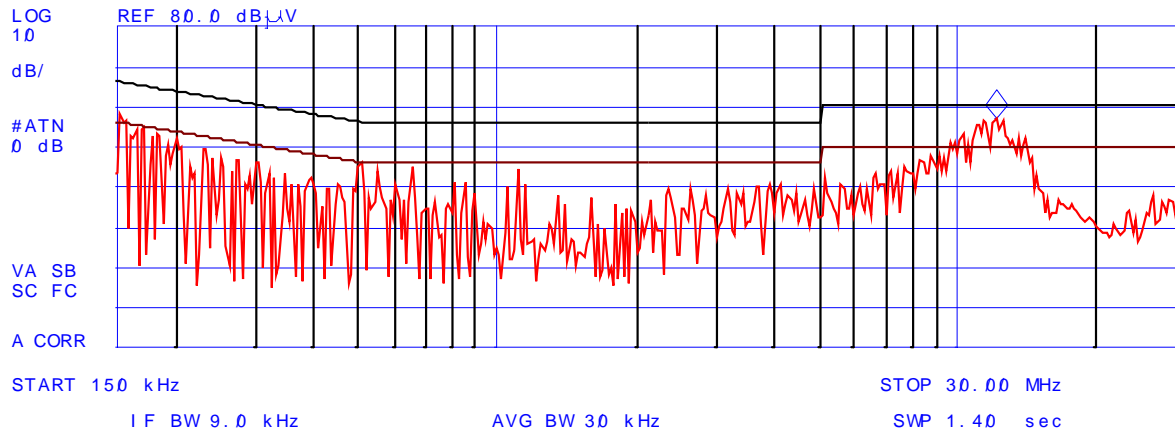
Signal	Freq (MHz)	PK Amp	QP Amp	AV Amp	AV Δ L2
1	0.150529	58.4	50.9	42.0	-14.0
2	0.507869	48.9	45.2	41.5	-4.4
3	4.209512	41.6	40.0	35.2	-10.9
4	12.223850	57.4	56.2	48.9	-1.1

ACTV DET: PEAK

MEAS DET: PEAK QP AVG

MKR 12.25 MHz

56.66 dB μ V



5.6. 26 dB BANDWIDTH

5.6.1. Limits

No limit. Test is performed for information only.

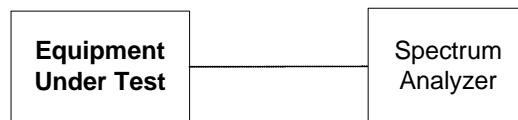
5.6.2. Method of Measurements

The transmitter output was loosely coupled to the spectrum analyzer through a receiving antenna and the bandwidth of the fundamental frequency was measured with the spectrum analyzer with the resolution bandwidth of the spectrum analyzer set per ANSI 63.4

5.6.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer	Rohde & Schwarz	FSEK20/B4/B21	834157/005	9 kHz- 40 GHz
Log Periodic	EMCO	3148	23845	200 MHz – 2 GHz

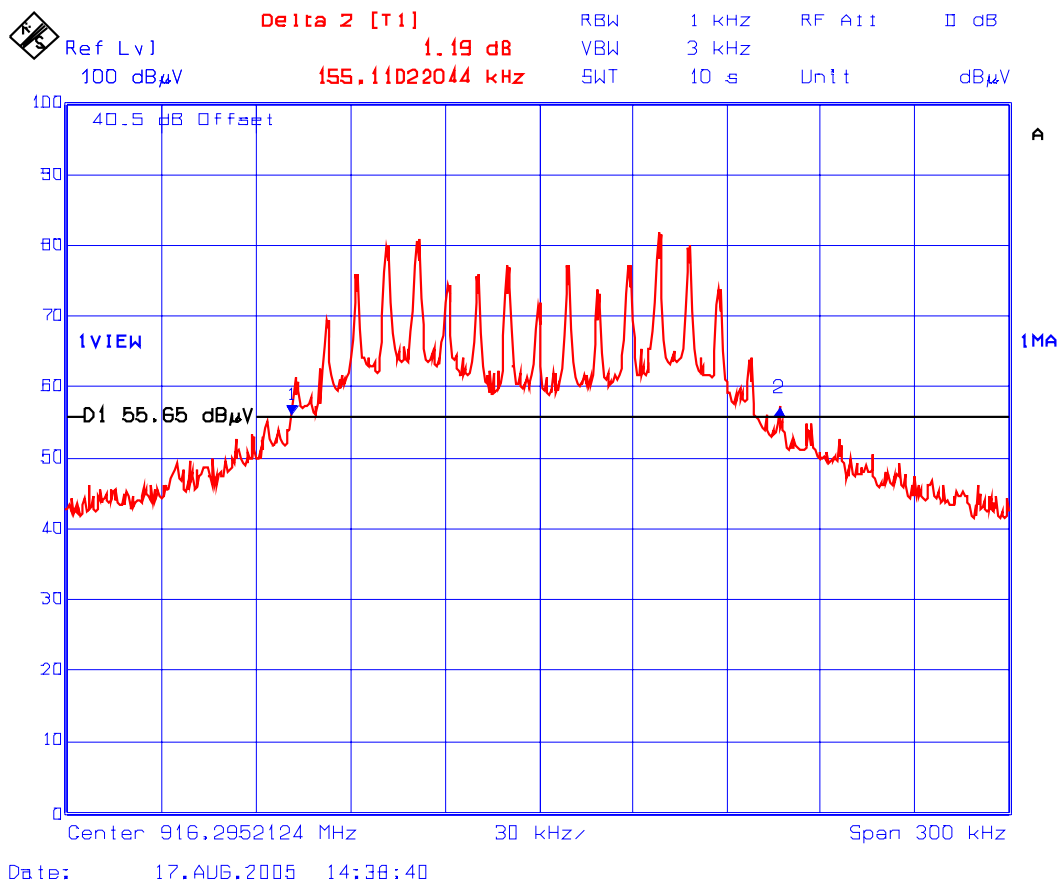
5.6.4. Test Arrangement



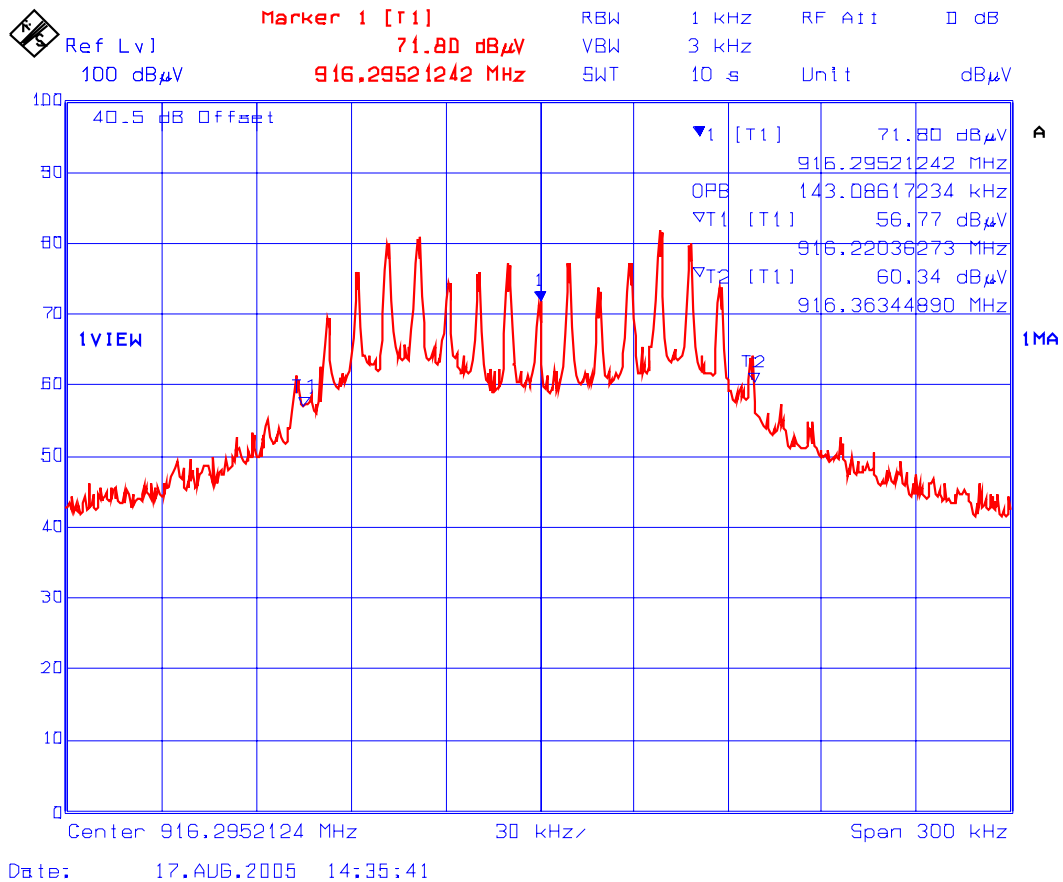
5.6.5. Test Data

Channel Frequency (MHz)	Bandwidth	(kHz)
916.289	26 dB	155.11
916.289	99%	143.08

Plot 3: 26 dB Bandwidth
Test Frequency: 916.289 MHz



Plot 4: 99% Occupied Bandwidth
 Test Frequency: 916.289 MHz



5.7. FUNDAMENTAL FIELD STRENGTH AND HARMONIC EMISSIONS (RADIATED @ 3 METERS) [47 CFR 15.249(a), 15.209 & 15.205]

5.7.1. Limits

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

Fundamental Frequency (MHz)	Field Strength of Fundamental (mV/m)	Field Strength of Harmonics (µV/m)
902 - 928	50	500

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

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

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

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

Frequency (MHz)	Field Strength Limits (µV/m)	Distance (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / F (KHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

5.7.2. Method of Measurements

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

5.7.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Rohde & Schwarz	FSEK20/B4/B21	834157/005	9 kHz – 40 GHz with external mixer
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 GHz
Biconilog Antenna	EMCO	3143	1029	20 MHz to 2 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz

5.7.4. Test Data

Frequency (MHz)	Peak E-Field @3m (dB μ V/m)	Average E-Field @3m (dB μ V/m)	Antenna Plane (H/V)	Field Strength Limit of Fundamental/Harmonic (dB μ V/m)	Field Strength Limit of § 15.209 (dB μ V/m)	Margin (dB)
916.289	90.53	--	V	94.0	--	-4.5
916.289	85.70	--	H	94.0	--	-8.3
1832.578	44.37	42.28	V	54.0	54.0	-9.6
1832.578	45.26	43.12	H	54.0	54.0	-8.7
2748.867	48.95	41.12	V	54.0	54.0	-5.0
2748.867	51.29	43.71	H	54.0	54.0	-2.7
The emissions were scanned from 30 MHz to 10 GHz and all emissions within 20 dB below the limits were recorded.						

EXHIBIT 6. MEASUREMENT UNCERTAINTY

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

6.1. 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 $20\text{Log}(1 \pm \Gamma_1 \Gamma_R)$	U-Shaped	± 0.2	± 0.3
System repeatability	Std. deviation	± 0.2	± 0.05
Repeatability of EUT	--	--	--
Combined standard uncertainty	Normal	± 1.25	± 1.30
Expanded uncertainty U	Normal (k=2)	± 2.50	± 2.60

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

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

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

6.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (+ dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	± 1.0	± 1.0
Cable Loss Calibration	Normal (k=2)	± 0.3	± 0.5
EMI Receiver specification	Rectangular	± 1.5	± 1.5
Antenna 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 $\Gamma_R = 0.67(\text{Bi}) 0.3 (\text{Lp})$ Uncertainty limits $20\text{Log}(1 \pm \Gamma_1 \Gamma_R)$	U-Shaped	± 1.1 -1.25	± 0.5
System repeatability	Std. Deviation	± 0.5	± 0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	$+2.19 / -2.21$	$+1.74 / -1.72$
Expanded uncertainty U	Normal (k=2)	$+4.38 / -4.42$	$+3.48 / -3.44$

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k = 2 is used:

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

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

7.2. 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 $f < 1\text{GHz}$ and $\text{RBW} = 1\text{ MHz}$ 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:

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

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

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 15.209. 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 $10\log(\text{dwell time}/100\text{mS})$ 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.

7.3. 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 set 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.

7.4. 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 provided 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).