ENGINEERING TEST REPORT

HF RFID Reader Module
Model No.: MHF1

FCC ID: X7X-MHF1

Applicant: **Intelletto Technologies Inc.**
3555 – 14th Avenue unit 8
Markham, ON
Canada, L3R 0H5

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.: ILT-006_FCC15-Rev1

This Test report is Issued under the Authority of Tri M. Luu, Professional Engineer, Vice President of Engineering UltraTech Group of Labs Date: March 29, 2010	
Report Prepared by: Dharmajit Solanki Issued Date: March 29, 2010	Tested by: Hung Trinh, RFI Test Technician Test Dates: Jan 18 to Feb 25 & March 29, 2010

- *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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91038	1309	46390-2049	NVLAP Lab Code 200093-0	SL2-IN-E-1119R	Korea KCC-RRL CA2049

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Sec. 15.225 - Operation within the band 13.553-13.567 MHz.
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

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

None

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19	2009	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
KDB Publication No. 447498	2009	Mobile and Portable Device RF Exposure Procedure and Equipment Authorization Policies
CISPR 22 EN 55022	2005 2006	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
CISPR 16-1-1	2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-2-1	2005	Specification for radio disturbance and immunity measuring apparatus and methods. Part 2-1: Conducted disturbance measurement
CISPR 16-2-3	2005	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:	Intelletto Technologies Inc.
Address:	3555 – 14th Avenue unit 8 Markham, ON Canada, L3R 0H5
Contact Person:	Mr. Homayoun Ahmadi Phone #: 905 943 4260 Ext 244 Fax #: 905 943 4470 Email Address: hahmadi@intelletto.com

MANUFACTURER:	
Name:	Intelletto Technologies Inc.
Address:	3555 – 14th Avenue unit 8 Markham, ON Canada, L3R 0H5
Contact Person:	Mr. Homayoun Ahmadi Phone #: 905 943 4260 Ext 244 Fax #: 905 943 4470 Email Address: hahmadi@intelletto.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:	Intelletto Technologies Inc.
Product Name:	HF RFID Reader Module
Model Name or Number:	MHF1
Part Number:	N/A
Serial Number:	Preproduction
Oscillators' Frequencies:	13.56 MHz
Primary User Functions of EUT:	Reader Module for reading and writing 13.56MHz RFID tags
Power input source:	5V DC

2.3. EUT'S TECHNICAL SPECIFICATIONS

TRANSMITTER	
Equipment Type:	Module
Intended Operating Environment:	Commercial, Industrial or Business Environment
Power Supply Requirement:	+5V DC ± 5%
Field Strength at 3 Meters:	71.91 dBµV/m @ 13.56 MHz
Operating Frequency Range:	13.553-13.567 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	Single channel
Duty Cycle:	N/A
20 dB Bandwidth:	69.66 kHz
Modulation Type:	ASK
Antenna Connector Types:	1. U.FL 2. RP SMA
Antennas Description:	**Antenna 1**: Manufacturer: Intelletto Technologies Inc. Type: Desktop Model: ANTH100-BL Freq. Range: 13.553-13.567 MHz **Antenna 2**: Manufacturer: Intelletto Technologies Inc. Type: Embedded (small PCB Loop Antenna) Model: ANTH2 Freq. Range: 13.553-13.567 MHz **Antenna 3**: Manufacturer: Intelletto Technologies Inc. Type: Embedded (Big PCB Antenna) Model: ANTH-SP1 Freq. Range: 13.553-13.567 MHz

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	Data port	--	10 pin 0.1 Header	Non shielded wire or PCB trace
2	Ant port 1	--	RF U.FL	Less than 3 meters 50Ω Coaxial (shielded)
3	Ant port 2	--	2 pin 0.1" Header	Less than 50mm PCB trace (Not shielded)

2.5. ANCILLARY EQUIPMENT

None

2.6. GENERAL RADIATED EMISSION TEST SETUP

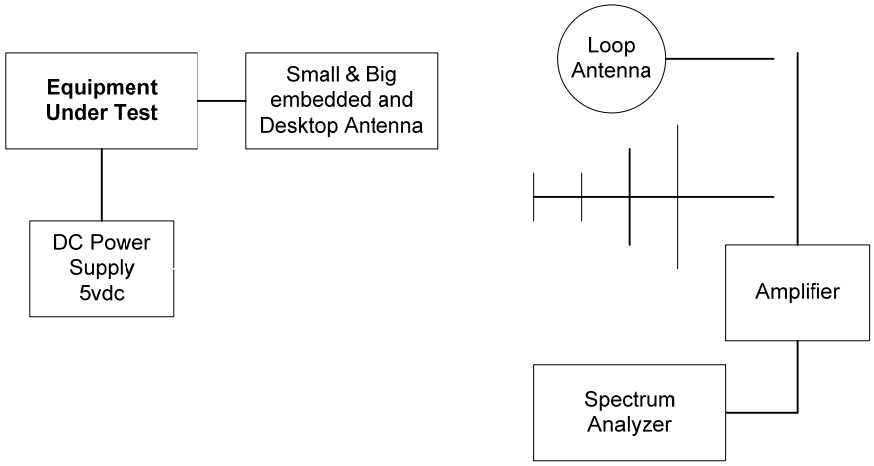


EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C
Humidity:	52%
Pressure:	102 kPa
Power input source:	5V DC from Power Supply

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	Transmit RF signal
Special Test Software:	None
Special Hardware Used:	The RF Module was tested standalone using the test jig provided by the applicant.
Transmitter Test Antenna:	The EUT was tested with three different antennas fitted in a manner typical of normal intended use.

Transmitter Test Signals:	
Frequencies:	13.56 MHz

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.

- Radiated Emissions were performed at the Ultratech's 3-10 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 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 31040/SIT 1300B3) and Industry Canada office (Industry Canada Site No.: 2049A-3, Expiry Date: May 1, 2011)

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).

4.2. 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 & 20 dB Bandwidth	Yes
15.225(a)	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	Class B - AC Power Conducted Emissions on Tx, Rx and standby modes	Yes
15.109(a)	Class B - Radiated Emissions from Unintentional Radiators	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. 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	All three antennas has either U.FL or RPSMA connector as declared by the applicant.
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	Details are as given in sec 2.3.

5.5. AC POWER LINE CONDUCTED EMISSIONS [§15.107(A) & 15.207(A)]

5.5.1. Limit(s)

The equipment shall meet the limits of the following table:

Frequency of emission (MHz)	Conducted Limits (dBμV)		Measuring Bandwidth
	Quasi-peak	Average	
0.15–0.5 .....……..	66 to 56*	56 to 46*	RBW = 9 kHz
0.5–5 .....……..	56	46	VBW ≥ 9 kHz for QP
5-30 ……..	60 ...……..	50	VBW = 1 Hz for Average

*Decreases linearly with the logarithm of the frequency

5.5.2. Method of Measurements

Details of test methods and procedures can be found in ANSI C63.4.

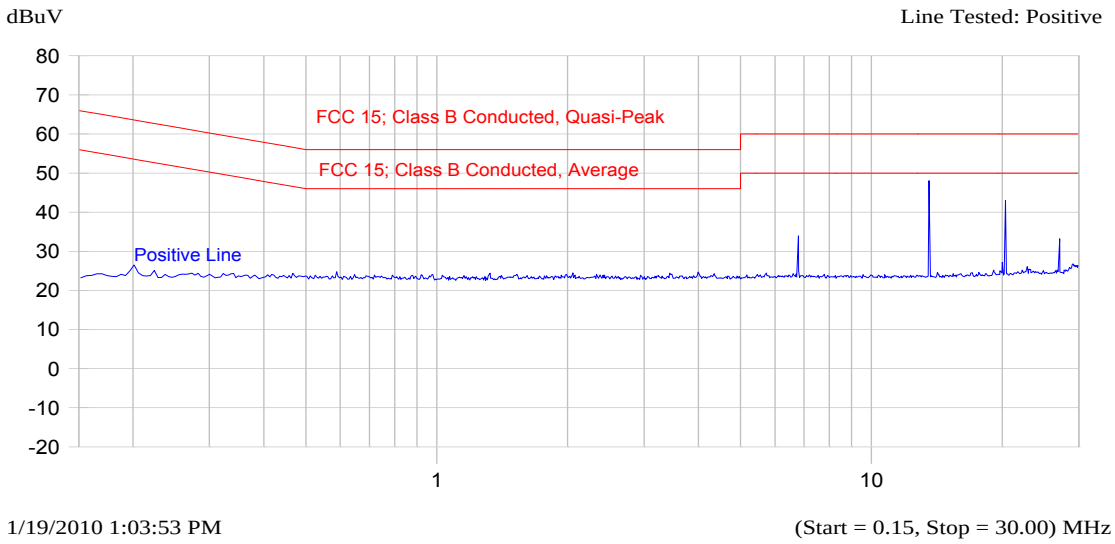
5.5.3. Test Data

Note: See the following test data plots for details.

Plot 6.5.5.1 Power Line Conducted Emissions
Line Tested: Positive

Description: Supply Voltage:5VDC
Antenna Port terminated with 50 Ohm Load.
Setup Name: FCC 15, Class B
Customer Name: Intelletto Technologies Inc.
Project Number: ILT-006Q
Operator Name: Satish
EUT Name: MHF1 Radio Module with 3 Antennas
Date Created: 1/19/2010 9:53:12 AM
Date Modified: 1/19/2010 1:12:29 PM

Current Graph



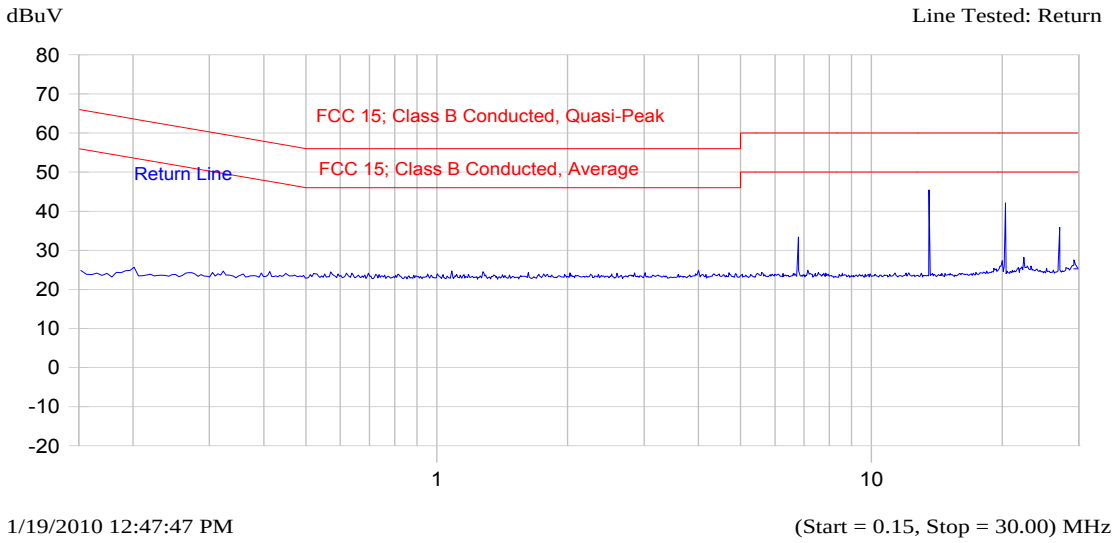
Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
6.779	34.9	33.2	-26.8	32.6	-17.4	Positive Line
13.560	48.4	47.9	-12.1	47.9	-2.1	Positive Line
20.339	43.3	42.3	-17.7	42.2	-7.8	Positive Line
27.120	34.7	32.9	-27.1	31.0	-19.0	Positive Line

Plot 6.5.5.2 Power Line Conducted Emissions
Line Tested: Negative

Description: Supply Voltage:5VDC
Antenna Port terminated with 50 Ohm Load.
Setup Name: FCC 15 Class B
Customer Name: Intelletto Technologies Inc.
Project Number: ILT-006Q
Operator Name: Satish
EUT Name: MHF1 Radio Module with 3 Antennas
Date Created: 1/19/2010 9:53:12 AM
Date Modified: 1/19/2010 1:14:10 PM

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta QP-QP Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
6.780	34.6	33.4	-26.6	32.8	-17.2	Return Line
13.559	45.7	45.3	-14.7	45.2	-4.8	Return Line
20.339	42.4	41.5	-18.5	41.3	-8.7	Return Line
27.119	36.4	35.1	-24.9	34.3	-15.7	Return Line

5.6. 20 DB BANDWIDTH & BANDEDGE EMISSIONS

5.6.1. Limits

The 20 dB bandwidth test was performed for reference only.

The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in Sec 15.209.

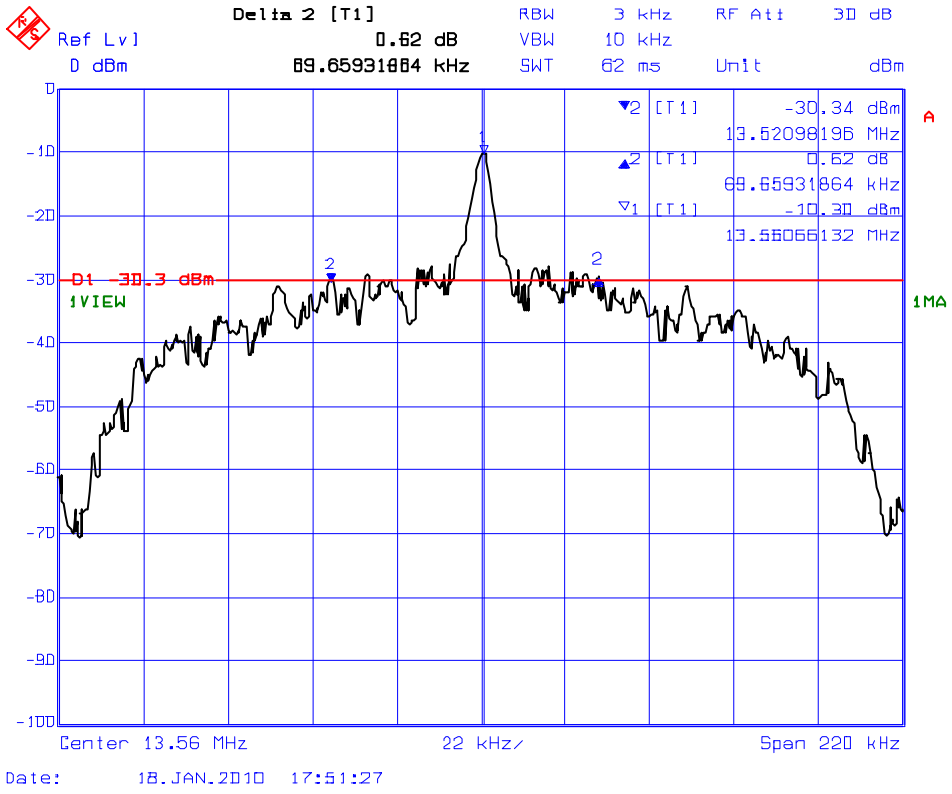
5.6.2. Method of Measurements

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

5.6.3. Test Data

Channel Frequency (MHz)	20 dB Bandwidth (kHz)
13.56	69.65

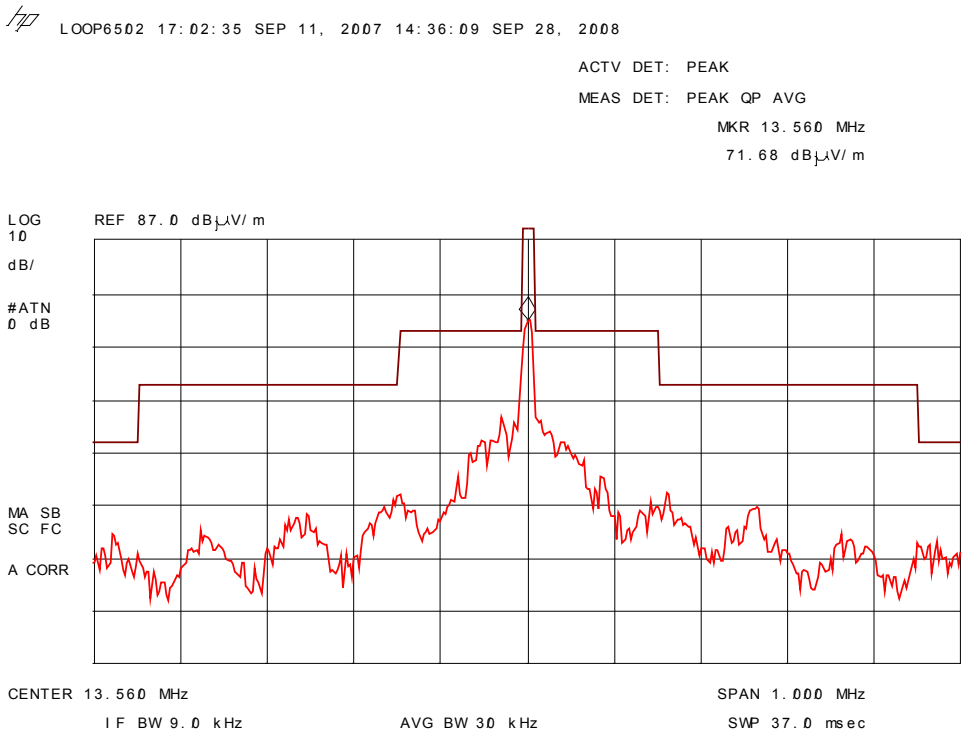
20 dB Bandwidth Measurement:



5.6.4. Band Edge Radiated Emissions Plots

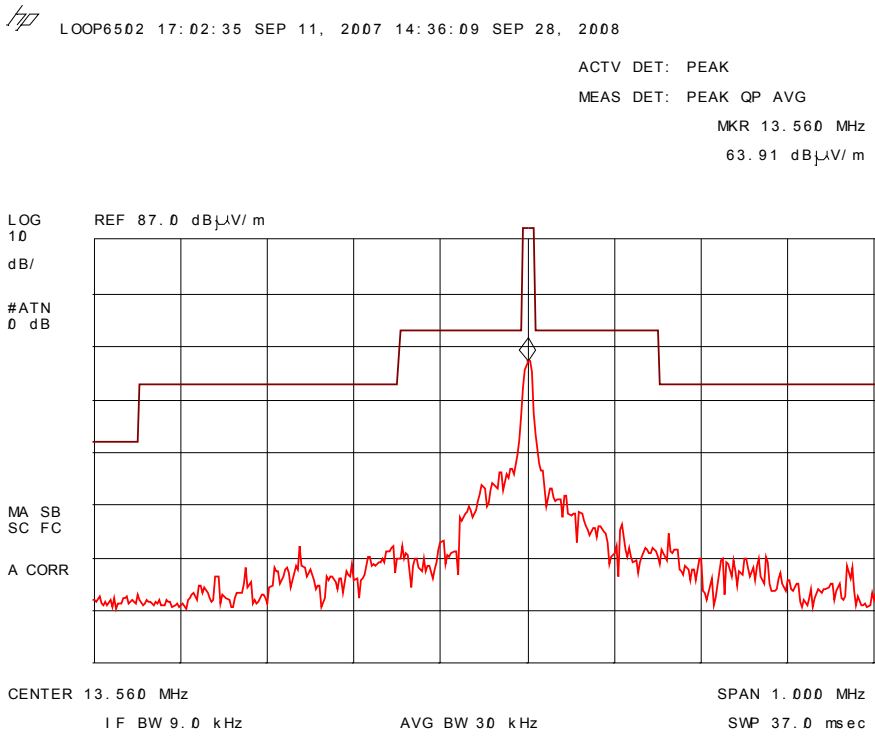
(a) Module connected with ANTH100-BL Desktop Antenna

File No.:	ILT-006Q
Client:	Intelletto Technologies Inc.
Product Description:	RFID Radio Module
Model(s):	MHF1
Test (specified rules):	FCC 15.225 & RSS 210, Band-Edge Radiated Emissions
Date:	February 29, 2010
Tested by: Name	Hung Trinh
Deviation:	None



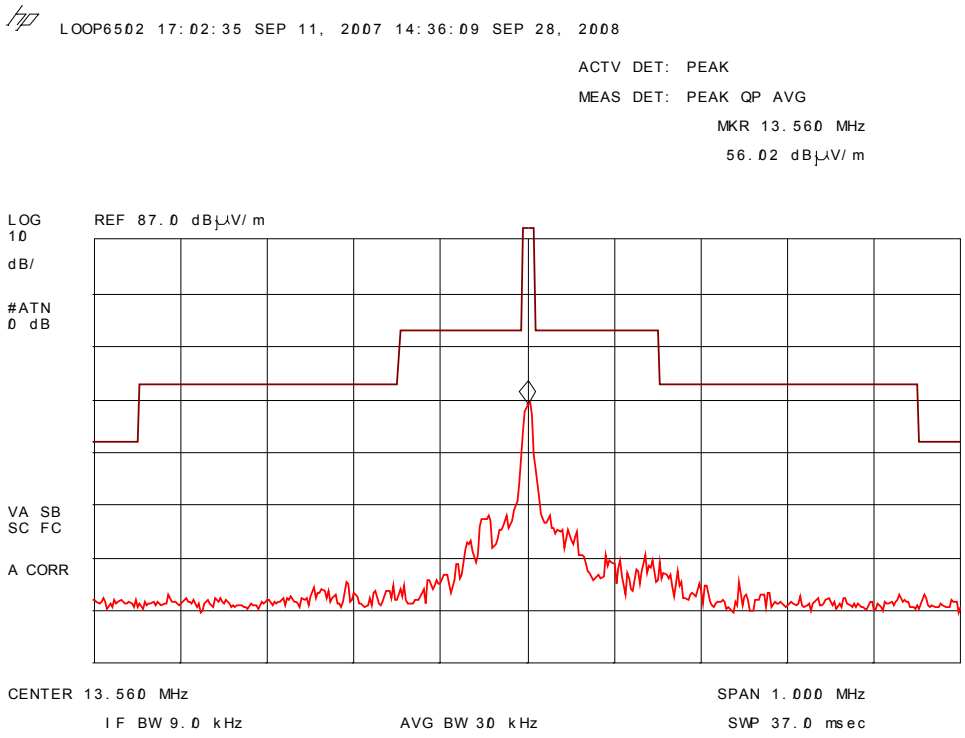
(b) Module connected with ANTH-SP1 PCB Antenna

File No.:	ILT-006Q
Client:	Intelletto Technologies Inc.
Product Description:	RFID Radio Module
Model(s):	MHF1
Test (specified rules):	FCC 15.225 & RSS 210, Band-Edge Radiated Emissions
Date:	February 29, 2010
Tested by: Name	Hung Trinh
Deviation:	None



(c) Module connected with ANTH2 PCB Loop Antenna

File No.:	ILT-006Q
Client:	Intelletto Technologies Inc.
Product Description:	RFID Radio Module
Model(s):	MHF1
Test (specified rules):	FCC 15.225 & RSS 210, Band-Edge Radiated Emissions
Date:	February 29, 2010
Tested by: Name	Hung Trinh
Deviation:	None



5.7. FIELD STRENGTH OF EMISSIONS INSIDE & OUTSIDE THE PERMITTED BAND 13.553-13.567 MHZ @ 10 METERS, FCC 15.225(A) & CLASS B UNINTENTIONAL EMISSIONS 15.109(A)

5.7.1. Limits

(a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
(b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
(c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz, the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
(d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in Sec 15.209.

Alternatively
(a) the limit @ 10 meters = 20*log(15,848) + 40*log(30/10) = 103.08 dBµV/m
(b) the limit @ 10 meters = 20*log(334) + 40*log(30/10) = 69.56 dBµV/m
(c) the limit @ 10 meters = 20*log(106) + 40*log(30/10) = 59.59 dBµV/m

Note: As per Sec 15.31(f)(2) : At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade).

FCC CFR 47, Part 15, Subpart C, Para. 15.205(a) - Restricted Frequency Bands

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

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

FREQUENCY (MHz)	FIELD STRENGTH LIMITS (microvolts/m)	DISTANCE (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / F (KHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

5.7.2. Method of Measurements

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

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 high-pass filters 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.

5.7.3. Photographs of Test Setup

Refer to test setup photos in Annex.

5.7.4. Test Data

(a) Module connected with ANTH100-BL Desktop Antenna

FREQUENCY (MHz)	RF LEVEL (dBµV/m)	EMI DETECTOR	ANTENNA PLANE	LIMIT 15.209 (dBµV/m)	MARGIN (dB)	PASS/ FAIL	Distance (m)
13.56	**67.2**	**Peak**	**0º**	**103.0**	**-35.8**	**PASS**	**10**
13.56	**71.9**	**Peak**	**90º**	**103.0**	**-31.1**	**PASS**	**10**
37.70	26.9	Peak	H	40.0	-13.1	PASS	3
40.68	31.2	Peak	V	40.0	-8.8	PASS	3
54.23	28.1	Peak	V	40.0	-11.9	PASS	3
67.80	29.1	Peak	V	40.0	-10.9	PASS	3
67.80	23.1	Peak	H	40.0	-16.9	PASS	3
74.63	23.0	Peak	V	40.0	-17.0	PASS	3
74.63	32.9	Peak	H	40.0	-7.1	PASS	3
81.35	35.7	QP	V	40.0	-4.3	PASS	3
81.35	31.7	QP	H	40.0	-8.3	PASS	3
86.18	24.7	Peak	H	40.0	-15.3	PASS	3
94.91	30.6	Peak	V	43.5	-12.9	PASS	3
94.91	27.2	Peak	H	43.5	-16.3	PASS	3
102.00	31.8	Peak	V	43.5	-11.7	PASS	3
102.00	29.3	Peak	H	43.5	-14.2	PASS	3
108.47	36.4	Peak	V	43.5	-7.1	PASS	3
108.47	37.8	Peak	H	43.5	-5.7	PASS	3
122.03	23.9	Peak	V	43.5	-19.6	PASS	3
122.03	23.8	Peak	H	43.5	-19.7	PASS	3
135.59	33.2	Peak	V	43.5	-10.3	PASS	3
135.59	33.3	Peak	H	43.5	-10.2	PASS	3
142.40	26.1	Peak	V	43.5	-17.4	PASS	3
142.40	24.7	Peak	H	43.5	-18.8	PASS	3
149.50	28.1	Peak	V	43.5	-15.4	PASS	3
149.50	23.8	Peak	H	43.5	-19.7	PASS	3
155.80	30.0	Peak	V	43.5	-13.5	PASS	3
155.80	28.8	Peak	H	43.5	-14.7	PASS	3
163.00	28.9	Peak	V	43.5	-14.6	PASS	3
163.00	24.3	Peak	H	43.5	-19.2	PASS	3
190.00	39.6	Peak	V	43.5	-3.9	PASS	3
190.00	36.5	Peak	H	43.5	-7.0	PASS	3
203.50	33.2	Peak	V	43.5	-10.3	PASS	3
203.50	34.2	Peak	H	43.5	-9.3	PASS	3
217.30	32.1	Peak	V	46.0	-13.9	PASS	3
217.30	33.1	Peak	H	46.0	-12.9	PASS	3
230.80	32.5	Peak	V	46.0	-13.5	PASS	3
230.80	32.4	Peak	H	46.0	-13.6	PASS	3
244.30	33.5	Peak	H	46.0	-12.5	PASS	3
257.65	33.7	Peak	V	46.0	-12.3	PASS	3
257.65	42.7	QP	H	46.0	-3.3	PASS	3
271.50	36.4	Peak	H	46.0	-9.6	PASS	3
285.00	32.7	Peak	V	46.0	-13.3	PASS	3

FREQUENCY (MHz)	RF LEVEL (dBµV/m)	EMI DETECTOR	ANTENNA PLANE (V/H)	LIMIT 15.209 (dBµV/m)	MARGIN (dB)	PASS/ FAIL	Distance (m)
285.00	35.5	Peak	H	46.0	-10.5	PASS	3
301.60	38.2	Peak	H	46.0	-7.8	PASS	3
312.00	39.3	Peak	V	46.0	-6.8	PASS	3
312.00	38.1	Peak	H	46.0	-7.9	PASS	3
325.80	35.1	Peak	V	46.0	-10.9	PASS	3
325.80	32.4	Peak	H	46.0	-13.6	PASS	3
342.80	43.1	Peak	H	46.0	-2.9	PASS	3
352.80	34.3	Peak	V	46.0	-11.7	PASS	3
352.80	37.7	Peak	H	46.0	-8.3	PASS	3
369.50	42.9	Peak	V	46.0	-3.1	PASS	3
380.00	38.1	Peak	V	46.0	-7.9	PASS	3
380.00	39.1	Peak	H	46.0	-6.9	PASS	3
393.50	38.8	Peak	V	46.0	-7.2	PASS	3
393.50	37.0	Peak	H	46.0	-9.0	PASS	3
406.80	36.9	Peak	V	46.0	-9.1	PASS	3
406.80	43.1	Peak	H	46.0	-3.0	PASS	3
420.50	35.3	Peak	V	46.0	-10.7	PASS	3
420.50	38.4	Peak	H	46.0	-7.6	PASS	3
434.00	41.4	Peak	V	46.0	-4.6	PASS	3
434.00	42.2	QP	H	46.0	-3.9	PASS	3
447.80	36.7	Peak	H	46.0	-9.3	PASS	3
461.30	35.5	Peak	V	46.0	-10.5	PASS	3
488.30	36.0	Peak	H	46.0	-10.0	PASS	3
502.00	35.6	Peak	H	46.0	-10.4	PASS	3
529.00	36.1	Peak	V	46.0	-9.9	PASS	3
529.00	35.2	Peak	H	46.0	-10.8	PASS	3
542.80	35.8	Peak	V	46.0	-10.2	PASS	3
556.30	36.8	Peak	V	46.0	-9.3	PASS	3
556.30	34.4	Peak	H	46.0	-11.7	PASS	3
610.30	37.7	Peak	V	46.0	-8.3	PASS	3
610.30	35.7	Peak	H	46.0	-10.3	PASS	3
637.50	36.8	Peak	V	46.0	-9.2	PASS	3
637.50	36.2	Peak	H	46.0	-9.8	PASS	3
651.00	36.2	Peak	H	46.0	-9.8	PASS	3
664.80	34.6	Peak	V	46.0	-11.4	PASS	3
664.80	39.4	Peak	H	46.0	-6.6	PASS	3
691.80	39.8	Peak	H	46.0	-6.2	PASS	3
719.00	34.8	Peak	H	46.0	-11.2	PASS	3
759.50	34.7	Peak	V	46.0	-11.3	PASS	3
868.00	32.4	Peak	V	46.0	-13.6	PASS	3
868.00	37.7	Peak	H	46.0	-8.3	PASS	3
895.30	35.3	Peak	H	46.0	-10.7	PASS	3
936.00	32.6	Peak	V	46.0	-13.4	PASS	3
The emissions were scanned from 1 MHz to 1 GHz and all emissions less 20 dB below the limits were recorded.							

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(b) Module connected with ANTH-SP1 PCB Antenna

FREQUENCY (MHz)	RF LEVEL (dBµV/m)	EMI DETECTOR	ANTENNA PLANE	LIMIT 15.209 (dBµV/m)	MARGIN (dB)	PASS/ FAIL	Distance (m)
13.56	**53.4**	**Peak**	**0º**	**103.0**	**-49.6**	**PASS**	**10**
13.56	**64.4**	**Peak**	**90º**	**103.0**	**-38.6**	**PASS**	**10**
40.68	28.9	Peak	V	40.0	-11.1	PASS	3
40.68	27.4	Peak	H	40.0	-12.6	PASS	3
57.13	23.6	Peak	V	40.0	-16.4	PASS	3
67.80	28.6	Peak	V	40.0	-11.4	PASS	3
67.80	25.3	Peak	H	40.0	-14.7	PASS	3
81.35	33.2	Peak	V	40.0	-6.8	PASS	3
81.35	22.4	Peak	H	40.0	-17.7	PASS	3
94.91	26.1	Peak	V	43.5	-17.4	PASS	3
94.91	24.2	Peak	H	43.5	-19.3	PASS	3
102.00	24.5	Peak	H	43.5	-19.0	PASS	3
108.47	39.3	Peak	V	43.5	-4.2	PASS	3
108.47	37.2	Peak	H	43.5	-6.3	PASS	3
122.03	23.6	Peak	V	43.5	-19.9	PASS	3
122.03	23.7	Peak	H	43.5	-19.8	PASS	3
136.70	26.0	Peak	V	43.5	-17.5	PASS	3
136.70	41.4	Peak	H	43.5	-2.1	PASS	3
146.80	30.8	Peak	V	43.5	-12.7	PASS	3
163.00	30.0	Peak	V	43.5	-13.5	PASS	3
163.00	34.5	Peak	H	43.5	-9.0	PASS	3
190.00	26.9	Peak	V	43.5	-16.6	PASS	3
190.00	39.2	Peak	H	43.5	-4.3	PASS	3
217.30	27.2	Peak	V	46.0	-18.8	PASS	3
217.30	39.7	Peak	H	46.0	-6.4	PASS	3
244.30	32.5	Peak	V	46.0	-13.6	PASS	3
244.30	42.1	Peak	H	46.0	-3.9	PASS	3
258.00	33.0	Peak	H	46.0	-13.0	PASS	3
271.50	27.7	Peak	V	46.0	-18.3	PASS	3
271.50	34.5	Peak	H	46.0	-11.5	PASS	3
285.00	29.3	Peak	V	46.0	-16.7	PASS	3
285.00	40.0	Peak	H	46.0	-6.0	PASS	3
298.50	36.5	Peak	V	46.0	-9.5	PASS	3
298.50	38.6	Peak	H	46.0	-7.4	PASS	3
312.00	34.9	Peak	V	46.0	-11.1	PASS	3
312.00	36.8	Peak	H	46.0	-9.2	PASS	3
339.30	35.7	Peak	V	46.0	-10.3	PASS	3
339.30	38.6	Peak	H	46.0	-7.4	PASS	3
352.80	34.6	Peak	V	46.0	-11.4	PASS	3
352.80	38.1	Peak	H	46.0	-7.9	PASS	3
366.50	38.8	Peak	V	46.0	-7.2	PASS	3
366.50	34.7	Peak	H	46.0	-11.3	PASS	3
380.00	36.9	Peak	V	46.0	-9.1	PASS	3

FREQUENCY (MHz)	RF LEVEL (dBµV/m)	EMI DETECTOR	ANTENNA PLANE (V/H)	LIMIT 15.209 (dBµV/m)	MARGIN (dB)	PASS/ FAIL	Distance (m)
380.00	32.2	Peak	H	46.0	-13.8	PASS	3
393.50	31.9	Peak	V	46.0	-14.1	PASS	3
393.50	34.7	Peak	H	46.0	-11.3	PASS	3
420.50	31.1	Peak	V	46.0	-14.9	PASS	3
420.50	35.6	Peak	H	46.0	-10.4	PASS	3
437.40	38.2	Peak	V	46.0	-7.8	PASS	3
461.30	29.9	Peak	V	46.0	-16.1	PASS	3
461.30	35.8	Peak	H	46.0	-10.2	PASS	3
488.50	32.7	Peak	V	46.0	-13.3	PASS	3
488.50	27.3	Peak	H	46.0	-18.8	PASS	3
502.00	36.6	Peak	V	46.0	-9.5	PASS	3
502.00	29.1	Peak	H	46.0	-16.9	PASS	3
505.30	38.4	Peak	V	46.0	-7.6	PASS	3
529.00	31.8	Peak	V	46.0	-14.2	PASS	3
529.00	34.6	Peak	H	46.0	-11.4	PASS	3
556.30	34.7	Peak	V	46.0	-11.3	PASS	3
556.30	37.2	Peak	H	46.0	-8.8	PASS	3
569.80	35.2	Peak	H	46.0	-10.8	PASS	3
583.50	34.8	Peak	V	46.0	-11.2	PASS	3
583.50	40.3	Peak	H	46.0	-5.7	PASS	3
610.30	33.9	Peak	V	46.0	-12.2	PASS	3
610.30	40.2	Peak	H	46.0	-5.8	PASS	3
624.00	36.0	Peak	H	46.0	-10.1	PASS	3
636.30	39.4	Peak	V	46.0	-6.6	PASS	3
636.30	38.3	Peak	H	46.0	-7.7	PASS	3
651.00	35.5	Peak	H	46.0	-10.5	PASS	3
664.80	37.9	Peak	V	46.0	-8.1	PASS	3
664.80	39.4	Peak	H	46.0	-6.6	PASS	3
678.30	35.7	Peak	V	46.0	-10.4	PASS	3
678.30	37.3	Peak	H	46.0	-8.7	PASS	3
691.80	39.6	Peak	V	46.0	-6.4	PASS	3
691.80	39.6	Peak	H	46.0	-6.4	PASS	3
719.00	38.2	Peak	V	46.0	-7.8	PASS	3
719.00	38.6	Peak	H	46.0	-7.4	PASS	3
732.50	35.5	Peak	H	46.0	-10.5	PASS	3
746.30	35.6	Peak	V	46.0	-10.4	PASS	3
746.30	34.8	Peak	H	46.0	-11.2	PASS	3
813.50	35.2	Peak	H	46.0	-10.8	PASS	3
841.00	34.3	Peak	H	46.0	-11.7	PASS	3
868.00	32.6	Peak	V	46.0	-13.4	PASS	3
868.00	33.4	Peak	H	46.0	-12.6	PASS	3
The emissions were scanned from 1 MHz to 1 GHz and all emissions less 20 dB below the limits were recorded.							

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(c) Module connected with ANTH2 PCB Loop Antenna

FREQUENCY (MHz)	RF LEVEL (dBµV/m)	EMI DETECTOR	ANTENNA PLANE	LIMIT 15.209 (dBµV/m)	MARGIN (dB)	PASS/ FAIL	Distance (m)
13.56	**42.9**	**Peak**	**0º**	**103.0**	**-60.1**	**PASS**	**10**
13.56	**56.0**	**Peak**	**90º**	**103.0**	**-47.0**	**PASS**	**10**
33.85	30.5	Peak	V	40.0	-9.6	PASS	3
40.68	23.6	Peak	V	40.0	-16.4	PASS	3
40.68	20.9	Peak	H	40.0	-19.1	PASS	3
57.30	23.5	Peak	V	40.0	-16.5	PASS	3
108.47	38.3	Peak	V	43.5	-5.2	PASS	3
108.47	34.3	Peak	H	43.5	-9.2	PASS	3
115.30	25.9	Peak	V	43.5	-17.6	PASS	3
120.00	23.6	Peak	V	43.5	-19.9	PASS	3
122.03	24.5	Peak	V	43.5	-19.0	PASS	3
135.59	28.9	Peak	V	43.5	-14.6	PASS	3
135.59	27.2	Peak	H	43.5	-16.3	PASS	3
163.00	29.0	Peak	V	43.5	-14.5	PASS	3
163.00	26.9	Peak	H	43.5	-16.6	PASS	3
183.30	26.8	Peak	V	43.5	-16.7	PASS	3
183.30	27.4	Peak	H	43.5	-16.1	PASS	3
190.00	34.6	Peak	V	43.5	-8.9	PASS	3
190.00	36.5	Peak	H	43.5	-7.0	PASS	3
217.30	34.3	Peak	V	46.0	-11.7	PASS	3
217.30	36.2	Peak	H	46.0	-9.8	PASS	3
230.80	27.8	Peak	H	46.0	-18.2	PASS	3
244.30	30.8	Peak	V	46.0	-15.2	PASS	3
244.30	33.6	Peak	H	46.0	-12.4	PASS	3
258.00	38.3	Peak	V	46.0	-7.7	PASS	3
258.00	40.4	Peak	H	46.0	-5.6	PASS	3
271.50	37.7	Peak	H	46.0	-8.3	PASS	3
278.50	31.3	Peak	V	46.0	-14.7	PASS	3
285.00	31.1	Peak	V	46.0	-14.9	PASS	3
285.00	39.3	Peak	H	46.0	-6.7	PASS	3
298.00	30.6	Peak	V	46.0	-15.5	PASS	3
298.50	36.3	Peak	H	46.0	-9.7	PASS	3
312.00	37.1	Peak	V	46.0	-8.9	PASS	3
312.00	37.2	Peak	H	46.0	-8.8	PASS	3
325.80	39.2	Peak	H	46.0	-6.8	PASS	3
339.30	27.4	Peak	V	46.0	-18.6	PASS	3
339.30	40.9	Peak	H	46.0	-5.1	PASS	3
352.80	31.5	Peak	H	46.0	-14.5	PASS	3
379.80	30.9	Peak	V	46.0	-15.1	PASS	3
379.80	31.8	Peak	H	46.0	-14.2	PASS	3
396.20	39.0	Peak	V	46.0	-7.0	PASS	3
396.20	39.7	Peak	H	46.0	-6.3	PASS	3

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FREQUENCY (MHz)	RF LEVEL (dBµV/m)	EMI DETECTOR	ANTENNA PLANE (V/H)	LIMIT 15.209 (dBµV/m)	MARGIN (dB)	PASS/ FAIL	Distance (m)
410.70	42.1	Peak	V	46.0	-3.9	PASS	3
410.70	42.1	Peak	H	46.0	-3.9	PASS	3
420.50	32.6	Peak	V	46.0	-13.4	PASS	3
420.50	34.0	Peak	H	46.0	-12.0	PASS	3
434.30	31.6	Peak	H	46.0	-14.4	PASS	3
461.30	36.4	Peak	V	46.0	-9.6	PASS	3
467.30	35.9	Peak	V	46.0	-10.1	PASS	3
467.30	30.2	Peak	H	46.0	-15.8	PASS	3
474.80	32.5	Peak	V	46.0	-13.5	PASS	3
488.50	31.7	Peak	V	46.0	-14.3	PASS	3
515.50	30.9	Peak	H	46.0	-15.1	PASS	3
556.30	31.3	Peak	V	46.0	-14.8	PASS	3
583.50	31.5	Peak	V	46.0	-14.5	PASS	3
597.00	31.0	Peak	V	46.0	-15.0	PASS	3
597.00	31.0	Peak	H	46.0	-15.0	PASS	3
610.30	35.2	Peak	V	46.0	-10.8	PASS	3
610.30	34.0	Peak	H	46.0	-12.0	PASS	3
624.00	33.6	Peak	H	46.0	-12.4	PASS	3
664.80	32.0	Peak	V	46.0	-14.0	PASS	3
664.80	32.0	Peak	H	46.0	-14.0	PASS	3
691.80	30.5	Peak	V	46.0	-15.6	PASS	3
691.80	34.1	Peak	H	46.0	-12.0	PASS	3
718.80	31.8	Peak	V	46.0	-14.2	PASS	3
718.80	32.9	Peak	H	46.0	-13.1	PASS	3
813.80	32.2	Peak	H	46.0	-13.8	PASS	3
868.00	30.6	Peak	V	46.0	-15.4	PASS	3
868.00	30.9	Peak	H	46.0	-15.1	PASS	3
895.30	31.0	Peak	V	46.0	-15.0	PASS	3
935.80	32.5	Peak	H	46.0	-13.5	PASS	3
The emissions were scanned from 1 MHz to 1 GHz and all emissions less 20 dB below the limits were recorded.							

5.8. FREQUENCY STABILITY @ FCC §15.225(E)

5.8.1. Limits

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of –20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

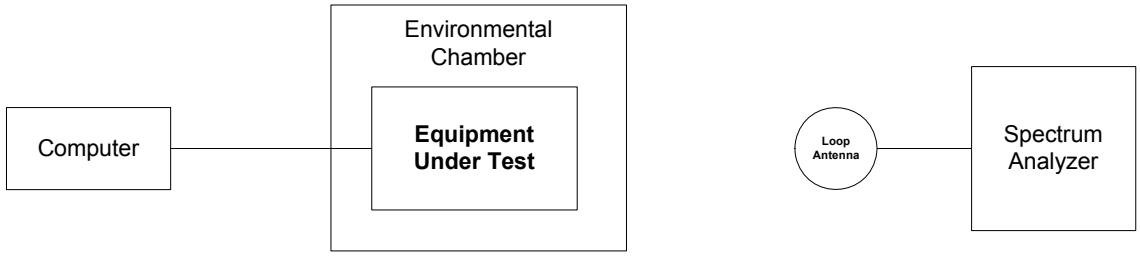
5.8.2. Method of Measurements

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

5.8.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Expired Date
Spectrum Analyzer	Rohde&Schwarz	FSEK	100077	20 Hz – 40 GHz	08 October 2010
Temperature & Humidity Chamber	Tenney	T5	9723B	-40° to +80° C range	N/A
Loop Antenna	EMCO	6502	2611	10kHz – 30MHz	12 May 2010

5.8.4. Test Arrangement



5.8.5. Test Data

Frequency Band:	13.553-13.567 MHz
Center Frequency:	13.56 MHz
Frequency Tolerance Limit:	+/- 0.01% of the 13.56 MHz or ± 1356 Hz
Max. Frequency Tolerance Measured:	+ 837 Hz
Input Voltage Rating:	5V DC

Temperature (ºC)	Nominal Voltage (5vdc)	85% of Supply Voltage (4.25vdc)	115% of Supply Voltage (5.75vdc)
-30	837	N/A	N/A
-20	561	N/A	N/A
-10	405	N/A	N/A
0	287	N/A	N/A
10	153	N/A	N/A
20	0	-285	8
30	-111	N/A	N/A
40	-292	N/A	N/A
50	-383	N/A	N/A

5.9. RF EXPOSURE REQUIRMENTS [§§ 1.1307(B)(1) & 2.1093]

The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation.

FCC 47 CFR § 1.1310:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500	.....	.....	f/300	6
1500–100,000	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30
30–300	27.5	0.073	0.2	30
300–1500	.....	.....	f/1500	30
1500–100,000	.....	.....	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

5.9.1. Method of Measurements

Refer to Sections 1.1310, 2.1091.

RFID transmitters operating under section 15.225 are categorically excluded from routine environmental evaluation to demonstrating RF exposure compliance with respect to MPE and/or SAR limits. These devices are not exempted from compliance as exposure to public users and nearby persons does not exceed the commission's RF exposure guidelines (see Section 1.1307 and 2.1093). Unless a device operates at substantially low power levels, with a low gain antenna(s), supporting information is generally needed to establish the various potential operating configurations and exposure conditions of a transmitter and its antenna(s) in order to determine compliance with the RF exposure guidelines.

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, 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).

5.9.2. RF Evaluation

This device is categorically excluded form routine environmental evaluation for RF Exposure requirement as per section 2.1093.

This module may be used in portable exposure conditions with no restrictions on host platforms when the source-based time-averaged output power is ≤ $60/f_{(GHz)}$ mW as per 2(a)(1) of FCC KDB 447498 v04.

Measured Maximum E-field = 71.91dBµV/m @ 10m

Using formula for converting measured e-field in dBµV/m to EIRP in dBm,

EIRP dBm = E dBµV/m - 104.77 + 20*log(D)

for D = 10 m, EIRP dBm = E dBµV/m – 84.77dB = 71.91 – 84.77 = -12.86 dBm = 0.05 mW

Total Peak Power (0.05 mW) is well below the low threshold value calculated as per below.

Threshold Value = [60/f(GHz)] mW
= (60/0.1356) mW
= 4424 mW

5.10. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Operating Range	Calibration Due Date
Attenuator	Narda	4768-20	0702	DC – 40 GHz	N/A
Loop Antenna	EMCO	6502	2611	10 kHz – 30 MHz	12 May 2010
BiConiLog Antenna	Emco	3142	10005	0.03 – 2 GHz	18 April 2010
Horn Antenna	Emco	3155	9911-5955	1 – 18 GHz	9 Oct. 2010
DC-Block	Hewlett Packard	11742A	12460	0.045-26.5 GHz	N/A
Power Meter	Hewlett Packard	436A	2709427515	100 kHz – 50 GHz	10 Aug. 2010
Power Sensor	Hewlett Packard	8481A	1550A15143	10 MHz – 18 GHz	27 May 2010
Power Meter	Hewlett Packard	8900D	2131A01044	100 kHz – 18 GHz	19 May 2010
Power Sensor	Hewlett Packard	84811A	2551A01484	100 kHz – 18 GHz	19 May 2010
RF Amplifier	Com-Power	PA-103A	161243	10 MHz – 1 GHz	2 Nov. 2011
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	2 Nov. 2011
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20 Hz – 40 GHz	10 Aug 2010
Spectrum Analyzer	Hewlett Packard	8593EM	3412A00103	9 kHz – 26.5 GHz	05 Oct. 2010
Temperature & Humidity Chamber	Tenney	T5	9723B	-40 ºC – +80 ºC range	N/A

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. 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 Γ_1 = 0.2 Antenna VRC Γ_R = 0.67(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	+1.1 -1.25	±0.5
System repeatability	Std. Deviation	±0.5	±0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

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

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

EXHIBIT 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 < 1GHz and RBW = 1 MHz for f ≥ 1 GHz
   - VBW = RBW
   - Sweep = auto
   - Detector function = peak
   - Trace = max hold
   - Follows the guidelines in ANSI C63.4-1992 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.

7.3. 20 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: Min span to fully display the entire emission, approx. 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 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).