

# ENGINEERING TEST REPORT



**RTMS K4**  
**MODEL NO.: K4**

**FCC ID: J7TRTMS-K4S**

*Applicant:*

**Image Sensing Systems, Inc.**  
500 Spruce Tree Centre, 1600 University Ave W,  
St Paul, Minnesota  
USA, 55104-3825

*Tested in Accordance With*

**FCC Part 15, Subpart C, Section 15.245**  
**Field Disturbance Sensor**  
**Operating in the Frequency Band 24075-24175 MHz**

**UltraTech's File No.: EIS-039\_F15C245**

This Test report is issued under the Authority of  
Tri M. Luu, BAsC,  
Vice President of Engineering  
UltraTech Group of Labs

Date: October 21, 2011

Report Prepared by: Dharmajit Solanki

Tested by: Mr. Hung & William, EMC/RFI Technicians

Issued Date: October 21, 2011

Test Dates: June 27 & Oct 17, 2011

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

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200093-0



SL2-IN-E-1119R



Korea KCC-RRL  
CA2049

## TABLE OF CONTENTS

<b>EXHIBIT 1. INTRODUCTION .....</b>	<b>2</b>
1.1. SCOPE.....	2
1.2. RELATED SUBMITTAL(S)/GRANT(S).....	2
1.3. NORMATIVE REFERENCES .....	2
<b>EXHIBIT 2. PERFORMANCE ASSESSMENT .....</b>	<b>3</b>
2.1. CLIENT INFORMATION .....	3
2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION.....	3
2.3. EUT’S TECHNICAL SPECIFICATIONS.....	4
2.4. LIST OF EUT’S PORTS .....	4
2.5. GENERAL TEST SETUP .....	5
<b>EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS .....</b>	<b>6</b>
3.1. CLIMATE TEST CONDITIONS.....	6
3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS.....	6
<b>EXHIBIT 4. SUMMARY OF TEST RESULTS.....</b>	<b>7</b>
4.1. LOCATION OF TESTS .....	7
4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS.....	7
4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES .....	7
<b>EXHIBIT 5. MEASUREMENTS, EXAMINATIONS &amp; TEST DATA FOR EMC EMISSIONS .....</b>	<b>8</b>
5.1. TEST PROCEDURES.....	8
5.2. MEASUREMENT UNCERTAINTIES .....	8
5.3. MEASUREMENT EQUIPMENT USED .....	8
5.4. POWER LINE CONDUCTED EMISSIONS [§ 15.107(A) & 15.207].....	9
5.5. 20 DB BANDWIDTH.....	12
5.6. FUNDAMETAL FIELD STRENGTH AND HARMONIC EMISSIONS AND BAND-EDGE RADIATED EMISSIONS (RADIATED @ 3 METERS) [§ 15.245, 15.209 & 15.205].....	15
<b>EXHIBIT 6. TEST EQUIPMENTS LIST.....</b>	<b>19</b>
<b>EXHIBIT 7. MEASUREMENT UNCERTAINTY .....</b>	<b>20</b>
7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY (0.15-30 MHZ).....	20
7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY.....	20

# EXHIBIT 1. INTRODUCTION

## 1.1. SCOPE

<b>Reference:</b>	FCC Part 15, Subpart C, Section 15.245
<b>Title:</b>	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15
<b>Purpose of Test:</b>	To gain FCC Certification Authorization for Field Disturbance Sensor operating in the Frequency Band 24075-24175 MHz.
<b>Test Procedures:</b>	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.
<b>Environmental Classification:</b>	Commercial, industrial or business environment

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

None

## 1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19	2010	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
ANSI C63.10	2009	American National Standard for Testing Unlicensed Wireless Devices
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 16-2-3	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	
<b>Name:</b>	Image Sensing Systems, Inc.
<b>Address:</b>	500 Spruce Tree Centre, 1600 University Ave W St. Paul, Minnesota US 55104-3825
<b>Contact Person:</b>	Chris Gosciniak Phone #: (416) 785-9248 Ext 226 Fax #: (416) 785-9332 Email Address: <a href="mailto:cgosciniak@imagesensingca.com">cgosciniak@imagesensingca.com</a>

MANUFACTURER	
<b>Name:</b>	Image Sensing Systems Canada Ltd.
<b>Address:</b>	150 Bridgeland Ave. Suite 204 Toronto, Ontario Canada, M6A 1Z5
<b>Contact Person:</b>	Chris Gosciniak Phone #: (416) 785-9248 Ext 226 Fax #: (416) 785-9332 Email Address: <a href="mailto:cgosciniak@imagesensingca.com">cgosciniak@imagesensingca.com</a>

### 2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

<b>Equipment Identification:</b>	Image Sensing Systems
<b>Brand or Trade Name:</b>	RTMS K4
<b>Model Name or Number:</b>	K4
<b>Serial Number:</b>	Test Sample
<b>Type of Equipment:</b>	Field Disturbance Sensor
<b>Input Power Supply Type:</b>	18 VDC using AC Adaptor, Make-Hammond Manufacturing, Model: A5-AC1820VA-2S
<b>Primary User Functions of EUT:</b>	Radar based vehicular traffic detector

### 2.3. EUT'S TECHNICAL SPECIFICATIONS

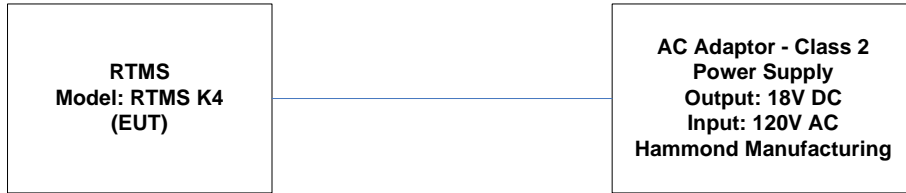
<b>TRANSMITTER</b>	
<b>Equipment Type:</b>	Transceiver
<b>Intended Operating Environment:</b>	Commercial, light industry & heavy industry
<b>Power Supply Requirement:</b>	12 to 24 V DC
<b>Operating Frequency:</b>	24104 – 24156 MHz
<b>RF Output Power Rating:</b>	10 mW
<b>RF Output Impedance:</b>	50 Ohms
<b>20 dB Bandwidth:</b>	53.62 MHz
<b>Modulation Type:</b>	FMCW (Frequency Modulated Continuous Wave)
<b>Duty Cycle:</b>	8.31 %
<b>Antenna Connector Type:</b>	Integral
<b>Antenna Description:</b>	Manufacturer: InnoSent GmbH, Germany Type: Phase array M/N: IVS-195 Frequency Range: 24.000 – 24.250 GHz Gain: 17 dBi

### 2.4. LIST OF EUT'S PORTS

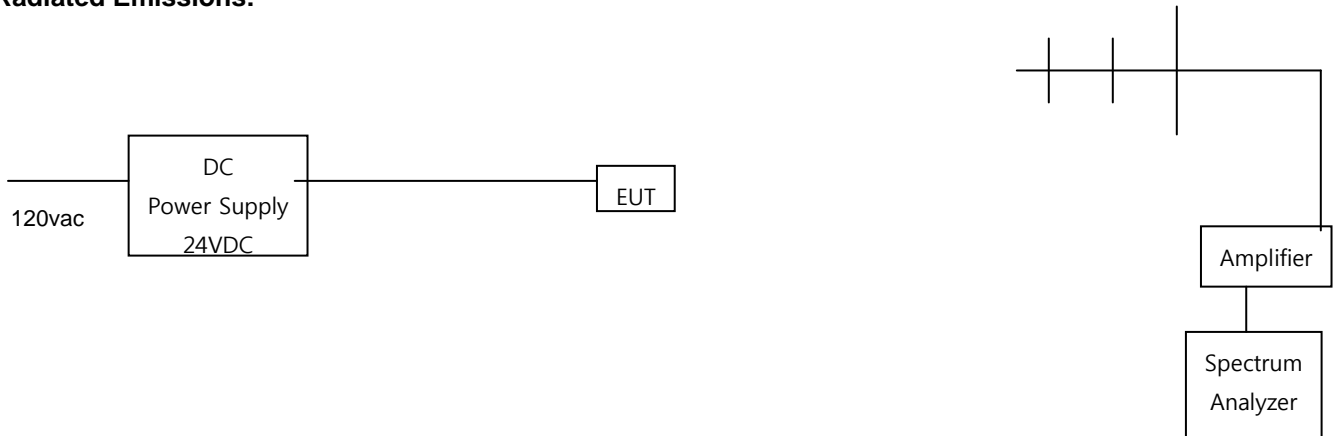
<b>Port Number</b>	<b>EUT's Port Description</b>	<b>Number of Identical Ports</b>	<b>Connector Type</b>	<b>Cable Type (Shielded/Non-shielded)</b>
1	Power	2	MS 32-pins	Shielded
2	Serial port RS232	5	MS 32-pins	Shielded

## 2.5. TEST SETUP

### Conducted Emissions:



### Radiated Emissions:



## 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:	55%
Pressure:	102 kPa
Power input source:	18V DC using AC Adaptor

### 3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

<b>Operating Modes:</b>	EUT was configured and put into built-in RF test mode to transmit burst with the designated duty cycle for measurements.
<b>Special Test Software:</b>	None
<b>Special Hardware Used:</b>	None
<b>Transmitter Test Antenna:</b>	The EUT is tested with the antenna fitted in a manner typical of normal intended use as integral antenna equipment.

<b>Transmitter Test Signals:</b>	
<b>Frequency Band(s):</b>	24104 – 24156 MHz
<b>Test Frequency(ies):</b>	24128 MHz
<b>Transmitter Wanted Output Test Signals:</b>	
<ul style="list-style-type: none"><li>Max. Field Strength @ 3 meters :</li></ul>	107.7 dBuV/m Peak
<ul style="list-style-type: none"><li>Normal Test Modulation:</li></ul>	FMCW

## 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 3-10 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 File No.: IC2049-1). Calibration Due date: April 04, 2014.

### 4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.107(b) & 15.207	Power Line Conducted Emissions	Yes
--	20 dB Bandwidth	Yes
15.245, 15.209, 15.205	Transmitter Radiated Emissions, Harmonic Emissions and Band Edge Radiated Emissions	Yes

\* Refer to the Original filing.

### 4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

2<sup>1/2</sup> turns ferrite shall be used on the main cable to comply out of band radiated spurious emissions with general field strength limits above 30 MHz.



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

### **5.1. TEST PROCEDURES**

The measurements were performed in accordance with Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4 & ANSI C63.10.

### **5.2. MEASUREMENT UNCERTAINTIES**

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

### **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. POWER LINE CONDUCTED EMISSIONS [§ 15.107(A) & 15.207]

### 5.4.1. LIMITS

The equipment shall meet the limits of the following table:

Test Frequency Range (MHz)	CLASS B LIMITS		Measuring Bandwidth
	Quasi-Peak (dBµV)	Average* (dBµV)	
0.15 to 0.5	66 to 56*	56 to 46*	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 to 5	56	46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
5 to 30	60	50	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average

\* Decreasing linearly with logarithm of frequency

### 5.4.2. METHOD OF MEASUREMENTS

Refer to Ultratech Test Procedures ULTR-P001-2004 & ANSI C63.4 for method of measurements.

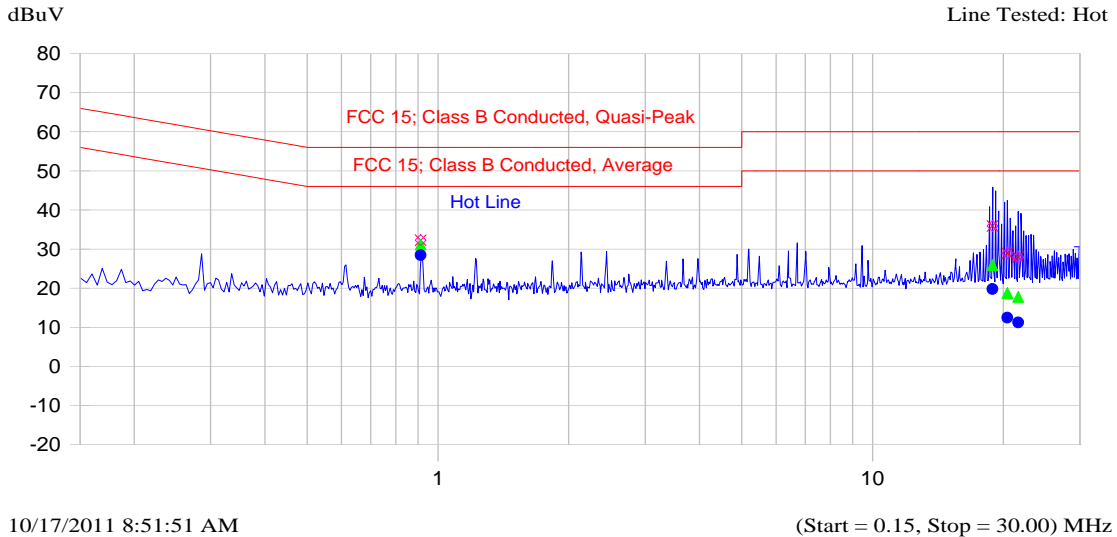
**5.4.3. TEST DATA**

Note: See the following test data plots for detailed measurements.

Plot 1:  
 AC Power Line Conducted Emissions  
 Test Configuration: Transmitter Mode, Line: Positive

Description: Power Input: 120 Vac, Output: 18-20 V, Manufacturing : Hammond, Model: A5-AC1820VA-2S  
 Setup Name: FCC15B  
 Customer Name: Image Sensing Systems Canada Inc  
 Project Number: EIS-040Q  
 Operator Name: William Truong  
 EUT Name: 24 GHz Field Disturbance Sensor  
 Date Created: 10/17/2011 8:46:53 AM  
 Date Modified: 10/17/2011 8:46:53 AM

**Current Graph**



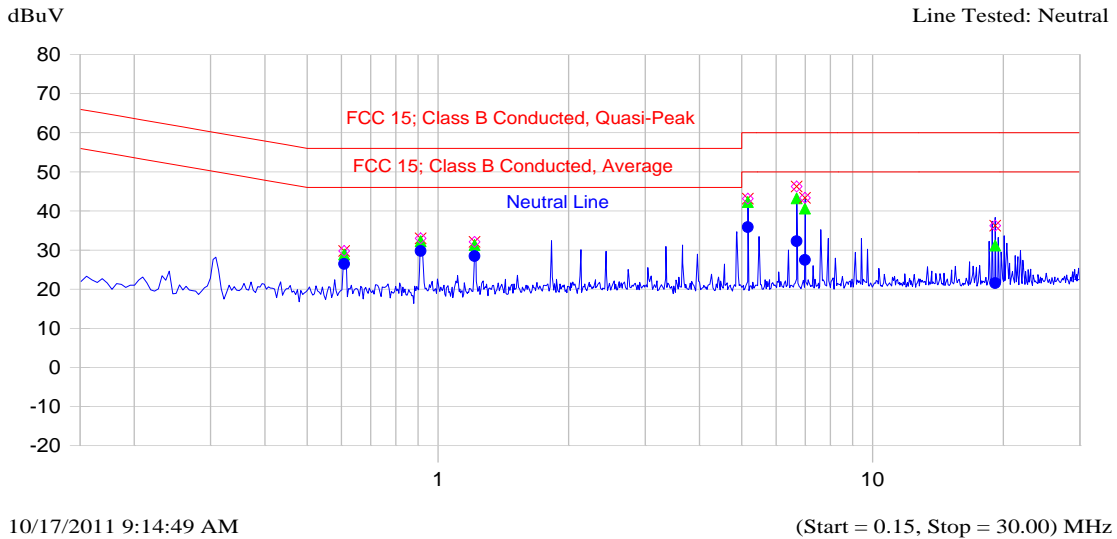
**Current List**

Frequency MHz	Peak dBuV	QP dBuV	Delta Qp-Qp Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.913	32.3	31.2	-24.8	28.4	-17.6	Hot Line
18.883	35.9	25.9	-34.1	19.8	-30.2	Hot Line
20.411	28.9	18.8	-41.2	12.5	-37.5	Hot Line
21.632	27.9	17.8	-42.2	11.2	-38.8	Hot Line

Plot 2:  
 AC Power Line Conducted Emissions  
 Test Configuration: Transmitter Mode, Line: Neutral

Description: Power Input: 120 Vac, Output: 18-20 V, Manufacturing : Hammond, Model: A5-AC1820VA-2S  
 Setup Name: FCC15B  
 Customer Name: Image Sensing Systems Canada Inc  
 Project Number: EIS-040Q  
 Operator Name: William Truong  
 EUT Name: 24 GHz Field Disturbance Sensor  
 Date Created: 10/17/2011 8:46:53 AM  
 Date Modified: 10/17/2011 9:47:57 AM

Current Graph



Current List

Frequency MHz	Peak dBuV	QP dBuV	Delta Qp-Qp Limit dB	Avg dBuV	Delta Avg-Avg Limit dB	Trace Name
0.608	29.8	28.9	-27.1	26.4	-19.6	Neutral Line
0.912	33.0	32.3	-23.7	29.7	-16.3	Neutral Line
1.214	32.1	31.3	-24.7	28.4	-17.6	Neutral Line
5.165	43.1	42.3	-17.7	35.8	-14.2	Neutral Line
6.684	46.2	43.2	-16.8	32.3	-17.7	Neutral Line
6.989	43.3	40.6	-19.4	27.5	-22.5	Neutral Line
19.142	36.2	31.2	-28.8	21.6	-28.4	Neutral Line

## 5.5. 20 dB BANDWIDTH

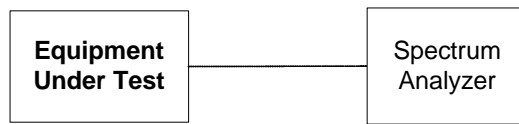
### 5.5.1. LIMITS

No limit. Test is performed for information only.

### 5.5.2. 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

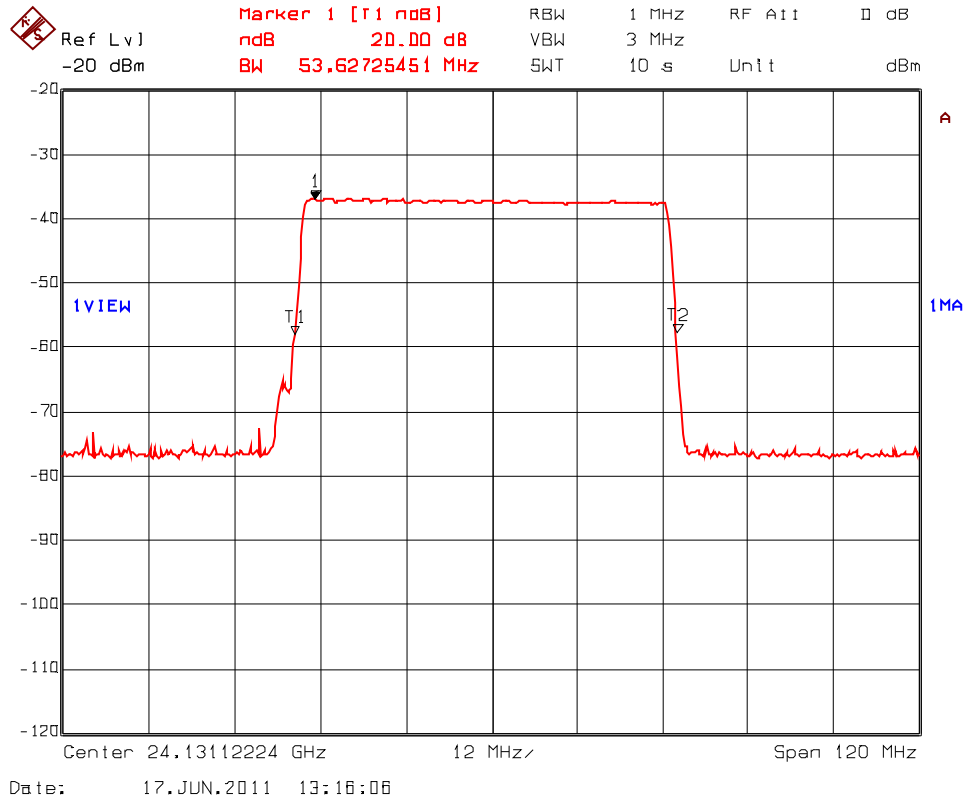
### 5.5.3. TEST ARRANGEMENT



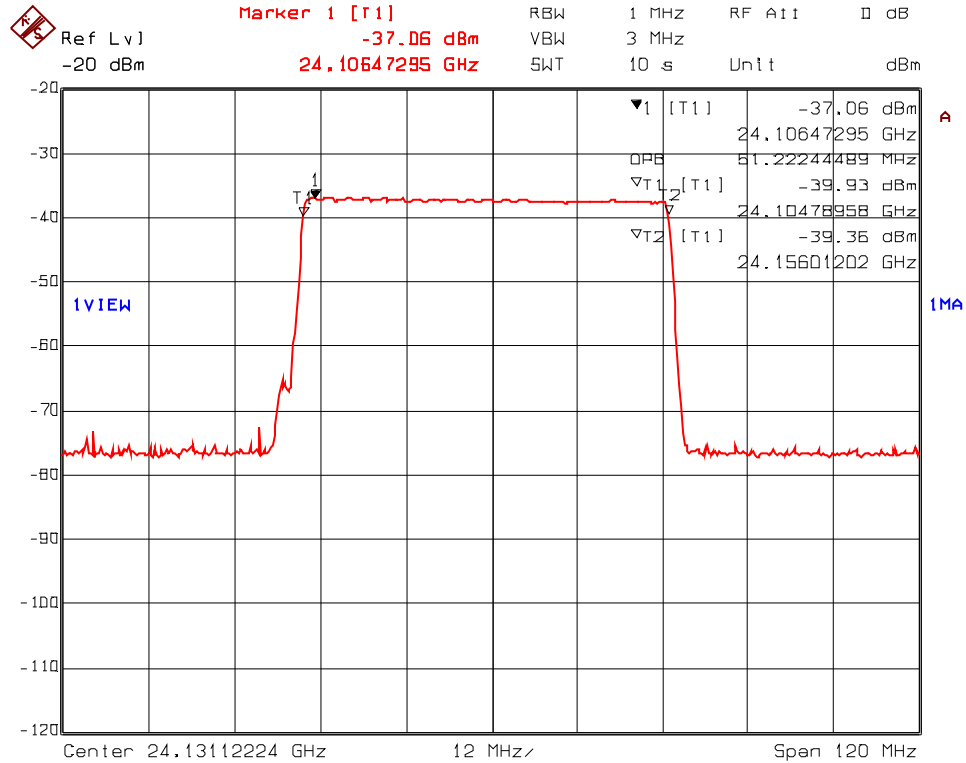
### 5.5.4. TEST DATA

Bandwidth	Channel Frequency (MHz)	(MHz)
20 dB	24140	53.62
99 %	24140	51.22

Plot 3: 20 dB Bandwidth  
Test Frequency: 24128 MHz



Plot 4: 99% Occupied Bandwidth  
 Test Frequency: 24128 MHz



Date: 17.JUN.2011 13:20:44

**5.6. FUNDAMENTAL FIELD STRENGTH AND HARMONIC EMISSIONS AND BAND-EDGE RADIATED EMISSIONS (RADIATED @ 3 METERS) [§ 15.245, 15.209 & 15.205]**

**5.6.1. 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)
24075-24175	2500	25

- Regardless of the limits shown in the above table, harmonic emissions in the restricted bands below 17.7 GHz, as specified in 15.205, shall not exceed the field strength limits shown in 15.209. Harmonic emissions in the restricted bands at and above 17.7 GHz shall not exceed the following field strength limits:

(i) For the second and third harmonics of field disturbance sensors operating in the 24075-24175 MHz band and for other field disturbance sensors designed for use only within a building or to open building doors, 25.0 mV/m.

- Field strength limits are specified at a distance of 3 meters.
- Emissions radiated outside of the specified frequency bands, except for the harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits specified in @ 15.209, whichever is the lesser attenuation.
- The emissions limits shown above are based on the measurement instrumentation employing an average detector. The provisions in Sec. 15.35 for limiting peak emissions apply.

**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

**5.6.2. METHOD OF MEASUREMENTS**

Refer to Ultratech Test Procedures, File # ULTR P001-2004 and ANSI C63.4 & ANSI C63.10 for measurement methods.

**5.6.3. TEST DATA**

**Fundamental & Harmonic Emissions:-**

Frequency (MHz)	Peak E-Field @3m (dBµV/m)	Average E-Field @3m (dBµV/m)	Antenna Plane (H/V)	Field Strength Limit for Fundamental/Harmonic (dBµV/m)	Field Strength Limit of § 15.209 (dBµV/m)	Margin (dB)
24128	107.70	71.82	V	127.96	--	-20.26
24128	107.46	70.97	H	127.96	--	-20.50
48256	63.58	52.25	V	97.5(Peak)/77.5(Avg)	--	-25.25
48256	63.82	53.21	H	97.5(Peak)/77.5(Avg)	--	-24.29

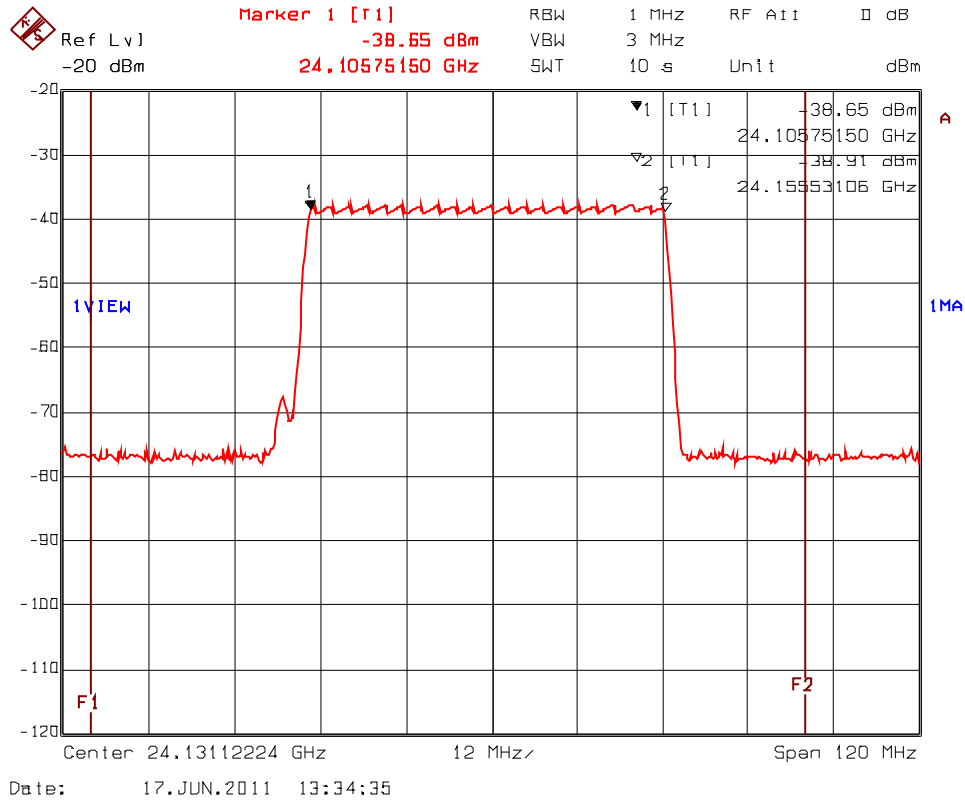
The emissions were scanned from 30 MHz to 100 GHz and all emissions within 25 dB below the limits were recorded.

**Fundamental & Harmonic Emissions:-**

The emissions were scanned from 30 MHz to 100 GHz at 3 Meters distance and all emissions less than 20 dB below the limits were recorded.

FREQUENCY (MHz)	RF LEVEL (dBuV/m)	DETECTOR USED (PEAK/QP)	ANTENNA PLANE (H/V)	LIMIT (dBuV/m)	MARGIN (dB)	PASS/ FAIL
36.44	32.8	QP	V	40.0	-7.2	PASS
36.44	24.8	Peak	H	40.0	-15.2	PASS
42.37	33.6	Peak	V	40.0	-6.4	PASS
42.37	21.4	Peak	H	40.0	-18.6	PASS
46.08	30.5	Peak	V	40.0	-9.5	PASS
46.08	16.4	Peak	H	40.0	-23.6	PASS
48.04	32.2	Peak	V	40.0	-7.8	PASS
48.04	18.7	Peak	H	40.0	-21.3	PASS
49.77	33.3	Peak	V	40.0	-6.7	PASS
49.77	20.7	Peak	H	40.0	-19.3	PASS
52.64	36.9	Peak	V	40.0	-3.1	PASS
52.64	20.8	Peak	H	40.0	-19.2	PASS
64.90	29.7	Peak	V	40.0	-10.3	PASS
64.90	17.0	Peak	H	40.0	-23.0	PASS
133.90	38.2	Peak	V	43.5	-5.3	PASS
133.90	23.5	Peak	H	43.5	-20.0	PASS

Plot 5: Band-Edge RF Radiated Emissions, Horizontal Polarization  
 Transmitter Frequency: 24128 MHz



## EXHIBIT 6. TEST EQUIPMENTS LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Calibration Due Date
Spectrum Analyzer	Rohde & Schwarz	ESU40	100037	20 Hz – 40 GHz	15 Mar 2012
Spectrum Analyzer	Rohde & Schwarz	FSEK	834157/005	9 kHz – 40 GHz	18 Jul 2012
Spectrum Analyzer	Agilent	E7401A	US40240432	9.5KHz-1.3GHz	10 Jan 2012
RF Amplifier	AH System	PAM-0118	225	20 MHz – 18 GHz	15 Mar 2012
LISN	ECMO	3825/2	8907-1531	10KHz-100MHz	30 Mar 2012
Horn Antenna	Emco	3155	6570	1 – 18 GHz	22 Feb 2012
Biconi-Log Antenna	Emco	3142C	00034792	26 – 3000 MHz	26 April 2012
Horn Antenna	ETS Lindgren	3160-09	00118385	18 – 26.5 GHz	30 May 2012
Horn Antenna	ETS Lindgren	3160-10	00102686	26.5 - 40 GHz	30 May 2012
Horn Antenna	OML	M19HWD	U30625-1	40 – 60 GHz	-
Horn Antenna	OML	M12HWD	E30625-1	60 – 90 GHz	-
Horn Antenna	OML	M08HWD	F30625-1	90 – 110 GHz	-

## EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

### 7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY (0.15-30 MHz)

	Line Conducted Emission Measurement Uncertainty (150 kHz – 30 MHz):	Measured	Limit
$u_c$	<b>Combined standard uncertainty:</b> $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	$\pm 1.57$	$\pm 1.8$
<b>U</b>	<b>Expanded uncertainty U:</b> $U = 2u_c(y)$	$\pm 3.14$	$\pm 3.6$

### 7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	Measured	Limit
$u_c$	<b>Combined standard uncertainty:</b> $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	$\pm 2.15$	$\pm 2.6$
<b>U</b>	<b>Expanded uncertainty U:</b> $U = 2u_c(y)$	$\pm 4.30$	$\pm 5.2$

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	Measured	Limit
$u_c$	<b>Combined standard uncertainty:</b> $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	$\pm 2.39$	$\pm 2.6$
<b>U</b>	<b>Expanded uncertainty U:</b> $U = 2u_c(y)$	$\pm 4.78$	$\pm 5.2$

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal & Vertical (1 – 18 GHz):	Measured	Limit
$u_c$	<b>Combined standard uncertainty:</b> $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$	$\pm 1.87$	Under consideration
<b>U</b>	<b>Expanded uncertainty U:</b> $U = 2u_c(y)$	$\pm 3.75$	Under consideration