

**FCC  
Electromagnetic Compatibility  
Test Report**

**For**

**Intelligent Return and Sorter System**

**Models 2820, 2810, 2812, 2822, 2830**

**FCC ID: DGFTTS2820**

**IC: 458A-TTS2820**

**3M™ Track and Trace Systems Division**

**St. Paul, MN**

**May 19, 2009**

**Report Number: F1208003**

**Prepared By:  
3M Regulatory Engineering and Quality  
EMC Laboratory  
410 Fillmore Avenue, Building 76  
St. Paul, Minnesota 55144-1000**

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 2 of 53

## CERTIFICATE OF COMPLIANCE

MANUFACTURER'S NAME:	3M™ Company
NAME OF EQUIPMENT:	Intelligent Return and Sorter System
MODEL NUMBER:	2820, 2810, 2812, 2822, 2830
FCC ID	DGFTTS2820
IC	IC: 458A-TTS2820
TEST REPORT NUMBER:	F1208003
DATE OF ISSUE:	May 19, 2009

**USA (FCC) - Title 47, Code of Federal Regulations (2007)  
Industry Canada (IC) – ICES, RSS**

**EMISSIONS:**

**Radiated / Conducted**

**FCC Part 15, Subpart B, Class A  
IC, ICES-003**

**Radiated / Conducted**

**FCC Part 15, Subpart C  
IC, RSS-210, RSS-GEN**

**RF Exposure**

**FCC - Exempt, IC - Complies with RSS-102**

As the responsible EMC Project Engineer, I hereby declare that the equipment tested, as specified in the test report, at the 3M Product Safety EMC Laboratory is in compliance with 47 CFR, Part 15, Subpart B and Subpart C, and IC RSS & ICES Standards. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics.

Robert E. Heller



Robert E. Heller  
Senior EMC Engineer



NVLAP Lab Code 200033

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 3 of 53

## TABLE OF CONTENTS

	Title Page
	Certificate of Compliance
	Table of Contents
1.0	Test Summary
2.0	Introduction
2.1	Scope
2.2	EUT Description and Operation
2.3	Modifications to EUT
2.4	Measurement Uncertainty
3.0	Applicable Documents
4.0	Conducted Emissions
4.1	Test Procedure
4.2	Test Criteria
4.3	Test Results
4.4	Test Setup Photo
5.0	Radiated Emissions
5.1	Frequency Stability
5.1.1	Test Procedure
5.1.2	Test Criteria
5.1.3	Test Results
5.1.4	Test Setup Photo
5.2	Emissions Bandwidth
5.2.1	Test Procedure
5.2.2	Test Criteria
5.2.3	Test Results
5.2.4	Test Setup Photo
5.2.5	99% Occupied Bandwidth Test Procedure and Test Results
5.3	Spurious Emissions (9KHz to 30 MHz)
5.3.1	Test Procedure
5.3.2	Test Criteria
5.3.3	Test Results
5.3.4	Test Setup Photo
5.4	Spurious Emissions (30 MHz to 1000 MHz)
5.4.1	Test Procedure
5.4.2	Test Criteria
5.4.3	Test Results

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 4 of 53

5.5 Radiated Emissions (30 MHz - 40 GHz)

5.5.1 Test Procedure

5.5.2 Test Criteria

5.5.3 Test Results

5.5.4 Test Setup photo

5.6 Human Exposure (EMF)

5.6.1 Test Procedure

5.6.2 Test Criteria

5.6.3 Test Results

5.6.4 Test Setup Photo

6.0 List of Test Equipment

7.0 Labeling Information

8.0 Signatures

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 5 of 53

## **1.0 TEST SUMMARY**

Test Report Number:	F1208003
Requester:	Seth Lieffort
Company:	3M Company Trace and Trace Systems Division St. Paul, MN 55144
Telephone Number:	651-736-6939
Test Dates:	Feb 11, 17,2009
Equipment Under Test:	Intelligent Return and Sorter System Models 2820, 2810, 2812, 2822, 2830
Date Of Receipt:	February 2, 2009
Condition upon receipt	Device was in good working condition
Test Environment:	See individual test sheets.
Test Results:	Passed the following tests: Conducted Emissions: FCC Part 15 Subpart B, ICES-003 Radiated Emissions: FCC Part 15 Subpart B, ICES-003 Conducted Emissions: FCC Part 15 Subpart C, IC RSS-210, RSS-Gen Radiated Emissions: FCC Part 15 Subpart C, IC RSS-210, RSS-Gen IC RSS-102
Modifications:	Modifications were required, see paragraph 2.3.
Test Location:	3M Product Safety EMC Laboratory Building 76-1-01 410 Fillmore Ave. St. Paul, MN 55144-1000

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 6 of 53

## **2.0 INTRODUCTION**

### **2.1 Scope**

This report contains results describing the conformance of the Equipment Under Test (EUT) to FCC Part 15, Subpart B and IC ICES-003 rules for unintentional radiators and FCC Part 15, Subpart C and IC RSS rules for intentional radiators.

This report is the confidential property of the client and applies only to the specific item tested under the stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics. This report shall not be reproduced except in full without the written approval of the testing laboratory. The appropriate testing standards and references that were used are contained in Section 3.0. Worst case test data, test configuration, and photographs (worst case configuration) are provided in Sections 4.0 and 5.0. Equipment information is contained in Section 6.0. Documentation labeling information is contained in Section 7.0.

Subsequent tests are necessary from time to time on equipment taken at random from production. Retesting of the EUT is also required when the EMC profile has been changed or is suspected of being changed.

The 3M Regulatory Engineering and Quality EMC Laboratory is recognized under the United States Department of Commerce National Institute of Standards and Technology's National Voluntary Laboratory Accreditation Program (NVLAP) for satisfactory compliance with criteria established in Title 15, Part 285 Code of Federal Regulations. These criteria encompass the requirements of ISO/IEC Guide 17025 and the relevant requirements of ISO 9002 (ANSI/ASQC Q92-1987) as suppliers of test results. Accreditation by the National Voluntary Laboratory Accreditation Program is awarded for specific services, listed on the Scope of Accreditation for: Electromagnetic Compatibility and Telecommunications FCC under Lab Code 200033. A complete copy of the Scope of Accreditation is available upon request.

The FCC Site Registration Number is 93334. The Industry Canada (IC) Site Registration Number is 458A-1.

The NVLAP accreditation or this test report does not in any way constitute or imply product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 7 of 53

## 2.2 EUT Description and Operation

The Equipment Under Test (EUT) was the 3M™ Intelligent Return and Sorter System. The system consists of modular components. The system capabilities include guided check-in and return of library materials and automatic sorting of items when library patrons return materials unassisted by library staff. The system is designed to be mounted into an interior or exterior wall. The 3M™ Intelligent Return and Sorter System is designed for an indoor library environment and has not been evaluated for other locations or uses.

The EUT contains two RFID readers. Both readers have a transmit frequency of 13.5599 MHz and each has a measured power output level of 1 watt (30 dBm) measured into a 50-ohm load. This maximum output is factory preset.

Each reader contains an internal antenna. The front antenna, located at the front shelf, has an area of 206mm (6.3mm X 32.7mm). The rear reader, located under the conveyor belt, has an area of 529.5mm (15mm X 35.3mm). The antennas are cabled to the readers via a SMA cables.

All tests were made using an input of 120 V RMS, 60 Hz, single-phase power. The EUT was tested while exercising all functions.

The unit tested in this report was the 2820, the Advanced Patron Induction Unit. The 2820 contained all available options. This report also covers four other models. The models are identical except for certain options as indicated in the following table:

Model	Description	Options
2810	Basic Patron Induction Unit	RFID, EM, no Monitor
2812	Basic Patron Induction Unit (outdoor)	RFID, EM, no Monitor, weatherproofing
2820	Advanced Patron Induction Unit	RFID, EM, Touchscreen Monitor
2822	Advanced Patron Induction Unit (outdoor)	RFID, EM, non-Touchscreen Monitor, weatherproofing
2830	Staff Induction Unit	RFID, EM, Touchscreen Monitor

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 8 of 53

### 2.3 Modifications to EUT

The following modifications were required on the EUT.

	<b>Type of Mod</b>	<b>Location</b>
1	Ferrite 28A2029 (2T)	DC power cable of patron monitor at monitor end
2	Ferrite 28A2025 (1T)	Weather door motor cable at motor end
3	Ferrite 28A2029 (1T)	8-wire cable of PAC-3100 at conn marked 'Main'
4	Ferrite 28A2029 (2T)	Power cable of patron printer at printer
5	Ferrite 28A2025 (1T)	Scanner cable at Interconnect Box enc
6	Ferrite 28A2025 (1T)	Door power cable at Control Box end
7	Ferrite 28A2025 (1T)	8-pin cable from Ctrl Box to Belt Motor at Ctrl Box
7a	Ferrite 28A2025 (1T)	8-pin cable from Ctrl Box to Belt Motor at Ctrl Box
8	Ferrite 28A2025 (1T)	Belt Motor at Motor end
9	Ferrite 28A2025 (1T)	Output cable of 24v power supply in Ctrl Box

### 2.4 Measurement Uncertainty

The data and test results referenced in this report are true and accurate. However, there may be deviations within the calibration limits of the test equipment and facilities that can account for deviations. The following table lists the measurement uncertainty for the emissions testing. Furthermore, EUT component and manufacturing process variables may result in additional deviation.

<b>Emission test</b>	<b>Confidence (95%)</b>	<b>Measurement Uncertainty</b>	<b>CISPR Limit</b>
Radiated Emissions (30 MHz – 5 GHz)	k=2.0	4.11 dB	5.20 dB
Conducted Emissions (150 kHz – 30 MHz)	k=2.0	3.29 dB	3.60 dB



<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 9 of 53

### **3.0 APPLICABLE DOCUMENTS**

The following documents were used as references. The dates that are referenced are the dates of the latest amendments. All 3M Test Procedures can be found in the Document Center of the SEMS QDS System.

CFR 47: 2007	Part 15 Radio Frequency Devices, Subpart B Unintentional Radiators and Subpart C, Intentional Radiators.	
CISPR 16-1	Specification for radio disturbance and immunity measuring apparatus and methods	
	-1 Measuring Apparatus	2003
	-2 Ancillary Equipment – Conducted Disturbance	2004
	-3 Ancillary Equipment – Disturbance Power	2004
	-4 Ancillary Equipment – Radiated Disturbance	2004
CISPR 16-2	Specification for radio disturbance and immunity measuring apparatus and methods	
	-1 Conducted Disturbance Measurements	2003
	-2 Measurements of Disturbance Power	2004
	-3 Radiated Disturbance Measurements	2003
CISPR 16-4	-1 Uncertainties in Standardized EMC Tests	2005
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.	
ICES-003	Industry Canada, Interference-Causing Equipment Standard, 2004 Issue 4	
RSS-GEN	Industry Canada, Radio Standards Specification Issue 2 2007	
RSS-210	Industry Canada, Radio Standards Specification Issue 7 2007	
RSS-102	Industry Canada, Radio Frequency Exposure Compliance, Issue 2 2005	
3M Test Procedure:	Radiated Emissions Test (30 MHz – 1 GHz), PBLI-6SHLK2: Issue 1 – Released Effective – 08/09/2006	
3M Test Procedure:	Radiated Emissions Test (1 GHz – 5 GHz), PBLI-6SNHFY: Issue 1 – Released Effective – 08/14/2006	
3M Test Procedure:	Conducted Emissions Test (150 kHz – 30 MHz), PBLI-6S8LR2: Issue 1 – Released Effective – 07/31/2006	
3M Test Procedure:	13.56 MHz RFID Emissions Test, PBLI-6WHLEM: Issue 1 Released Effective 12/18/2006	
3M Test Procedure:	99% Power Bandwidth Test, PBLI-7C9JVN: Issue 1 Released Effective 03/04/2008	

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 10 of 53

#### **4.0 CONDUCTED EMISSIONS TESTING**

Conducted emissions testing was performed in accordance with ANSI C63.4, FCC Part 15 and 3M Test Procedures: Conducted Emissions Test (150 kHz – 30 MHz), PBLI-6S8LR2 and 13.56 MHz RFID Emissions Test, PBLI-6WHLEM. Conducted emissions tests were made to determine the level of electromagnetic noise that is conducted onto the power mains from the EUT.

##### **4.1 Test Procedure:**

A Line Impedance Stabilization Network (LISN) with 50Ω /50μH characteristic was used to isolate the EUT and give accurate and repeatable readings. An EMI test receiver was used for the emissions measurements in the range from 150 KHz to 30 MHz. Initial measurements were taken with the receiver in continuous frequency overview mode utilizing peak level signal detection. Initial results were measured at discrete frequencies utilizing quasi-peak detection. Measurement results were automatically calculated via software running the EMI receiver. The final quasi-peak and average measurements recorded were determined by the following: Result (dBμV) = receiver reading (μV) + LISN (dB) + cable loss (dB)

##### **4.2 Test Criteria:**

The FCC Part 15 Subpart C conducted limits are given below. The lower limit shall apply at the transition frequency.

Mains Terminal Disturbance Limits		
Frequency (MHz)	Quasi-Peak (dBμV)	Average (dBμV)
0.15 to 0.50	66 to 56 (decreasing with log of freq)	56 to 46 (decreasing with log of freq)
0.50 to 5.0	56	46
5.0 to 30.0	60	50

##### **4.3 Test Results**

The EUT met the conducted emission and discontinuous requirements.

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 11 of 53

<b>Report Number</b>	F1208003	<b>Date</b>	17 Feb 2009
<b>EUT Name</b>	Intelligent Return and Sorter System	<b>EUT Power</b>	230, 120
<b>EUT Model</b>	2820, 2810, 2812, 2822, 2830	<b>Test Std</b>	FCC C, 300 330
<b>EUT Serial #</b>	n/a	<b>Temperature (°C)</b>	25
<b>EUT Description</b>	Book Sorter	<b>Humidity (%)</b>	23
		<b>Air Pressure (kPa)</b>	98.5

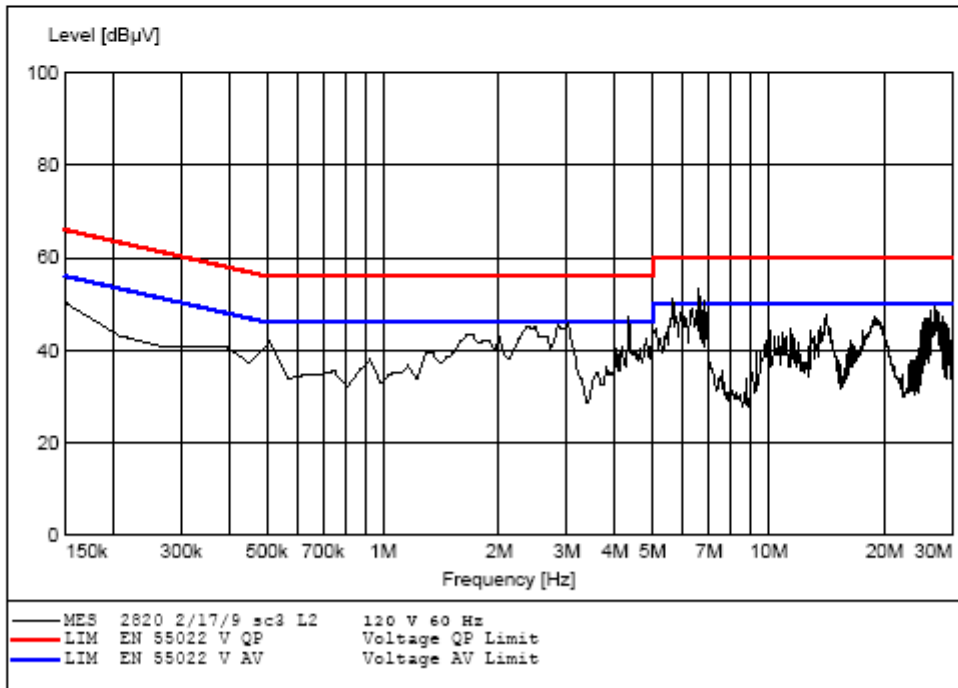
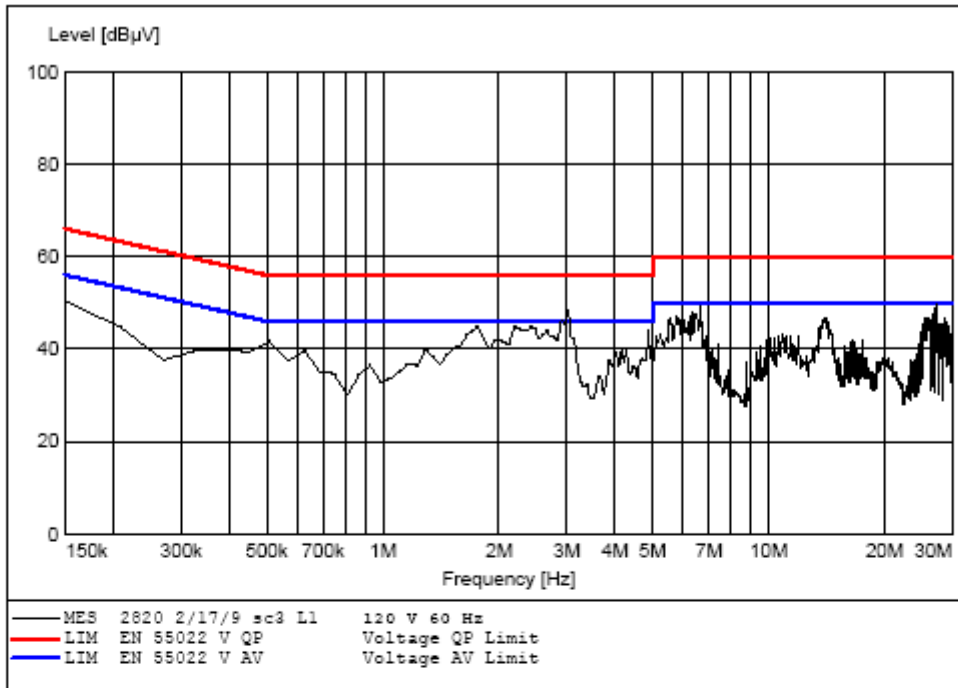
2820 2/17/9 sc1 L1,L2 (230V)  
 MAXIMIZED FILES 2820 2/17/9 sc3 L1,L2 (120V)

FREQUENCY (MHz)	PEAK (dBµV)		QUASI-PEAK (dBµV)				AVERAGE (dBµV)			
	L1 Line	L2 N	L1 Line	L2 N	Limit	Passing Margin	L1 Line	L2 N	Limit	Passing Margin
			230	volt	50hz					
.151			47.6	47.7	66.0	18.3	43.4	43.6	56.0	12.4
.399			38.0	37.6	57.9	19.9	37.2	36.8	47.9	10.7
.974			35.9	35.8	56.0	20.1	34.9	34.9	46.0	11.1
**2.390			44.5	44.3	56.0	11.5	42.4	42.2	46.0	3.6
13.56			39.6	38.6	60.0	20.4	31.2	29.0	50.0	18.8
14.10			43.9	44.0	60.0	16.0	39.1	38.9	50.0	10.9
19.132			29.1	43.3	60.0	16.7	18.6	31.6	50.0	18.4
26.070			43.3	44.0	60.0	10.0	41.2	42.0	50.0	8.0
			120	volt	60hz					
.151			46.3	46.0	66.0	19.7	44.0	44.0	56.0	12.0
.488			34.1	34.5	56.2	21.7	32.2	31.9	46.2	14.0
1.770			36.1	38.8	56.0	17.2	32.8	33.8	46.0	25.2
**2.519			44.5	44.2	56.0	11.5	40.5	40.9	46.0	5.1
3.041			39.1	39.8	56.0	16.2	24.5	26.6	46.0	19.4
4.414			26.2	25.6	56.0	29.8	16.1	15.5	46.0	29.9
5.645			32.9	30.5	60.0	27.1	21.7	20.1	50.0	22.9
6.766			35.6	35.0	60.0	24.4	26.2	24.7	50.0	23.8
14.10			43.7	42.0	60.0	16.3	33.4	34.8	50.0	15.2
19.017			37.2	45.3	60.0	14.7	27.9	35.8	50.0	14.2
27.122			46.1	46.3	60.0	13.7	43.3	43.1	50.0	6.7

\*\* Worst Case

Test Engineer: Bruce Jungwirth	Date: 17 Feb 2009
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<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 12 of 53



<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 13 of 53

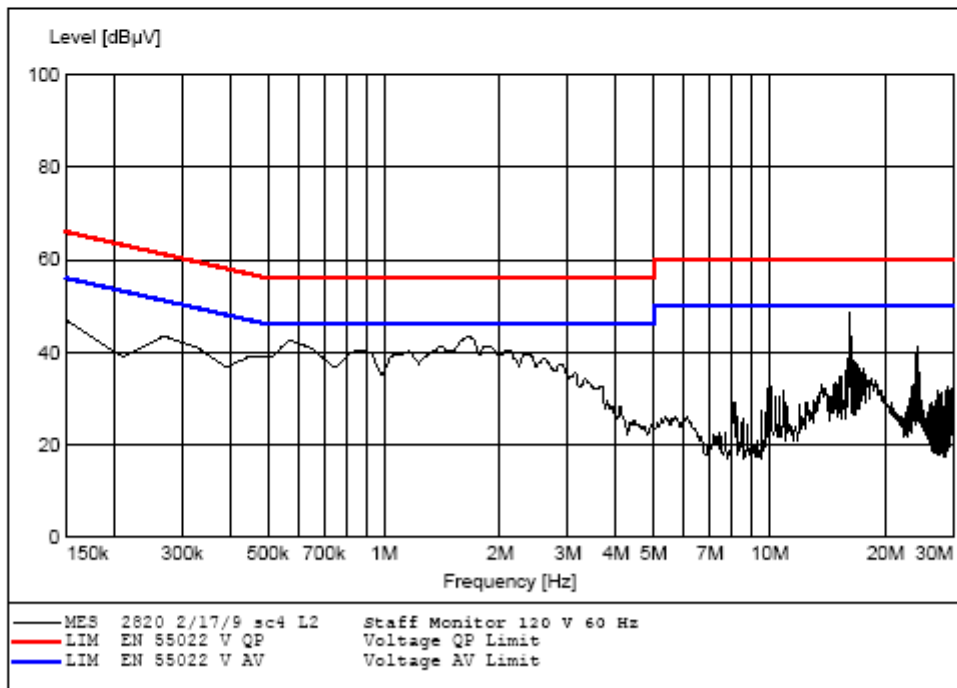
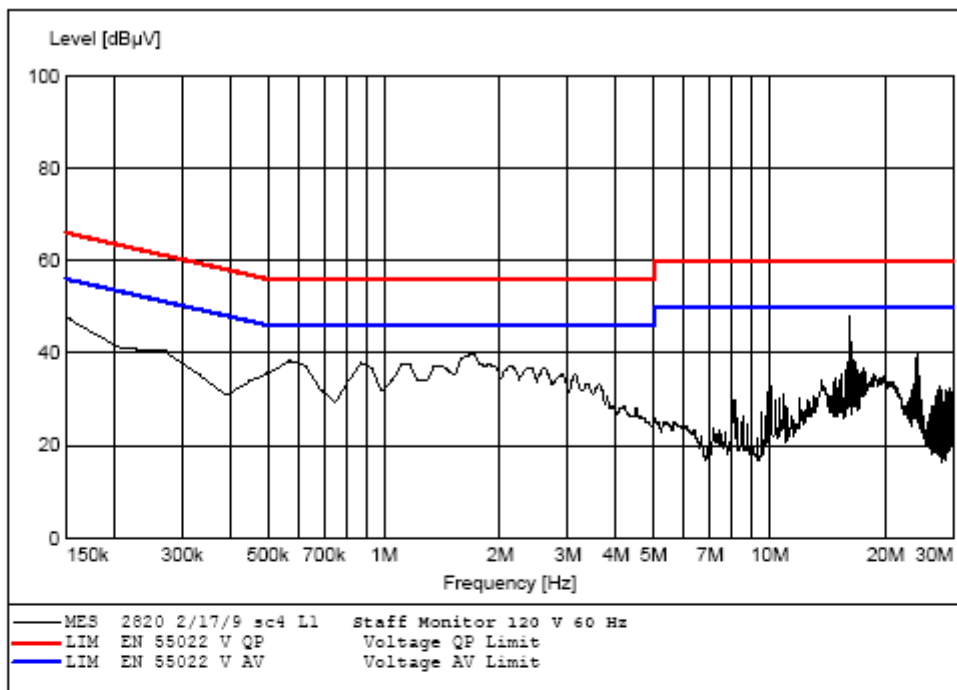
<b>Report Number</b>	F1208003	<b>Date</b>	17 Feb 2009
<b>EUT Name</b>	Intelligent Return and Sorter System	<b>EUT Power</b>	230, 120
<b>EUT Model</b>	2820, 2810, 2812, 2822, 2830	<b>Test Std</b>	FCC C, 300 330
<b>EUT Serial #</b>	n/a	<b>Temperature (°C)</b>	25
<b>EUT Description</b>	Staff Monitor	<b>Humidity (%)</b>	23
Note: Monitor was tested with scrolling H's		<b>Air Pressure (kPa)</b>	985

2820 2/17/9 sc2 L1,L2 (230V)  
 MAXIMIZED FILES 2820 2/17/9 sc4 L1,L2 (120V)

FREQUENCY (MHz)	PEAK (dBµV)		QUASI-PEAK (dBµV)				AVERAGE (dBµV)			
	L1 Line	L2 N	L1 Line	L2 N	Limit	Passing Margin	L1 Line	L2 N	Limit	Passing Margin
			230	volt	50hz					
.151			46.5	50.7	66.0	15.3	40.5	46.2	56.0	9.8
.635			34.0	43.5	56.0	12.5	21.9	35.8	46.0	10.2
1.165			39.3	42.2	56.0	13.8	29.4	32.7	46.0	13.3
1.580			40.5	42.9	56.0	13.1	35.2	36.4	46.0	9.6
**1.705			43.4	44.4	56.0	11.6	40.1	40.4	46.0	5.6
16.202			46.4	46.3	60.0	13.6	38.9	38.8	50.0	11.1
24.302			37.5	37.8	60.0	22.2	30.1	30.4	50.0	19.6
			120	volt	60hz					
.151			41.1	46.2	66.0	19.8	38.5	45.4	56.0	10.6
.307			41.1	44.0	60.1	16.1	37.1	39.5	50.1	10.6
.611			39.1	41.9	56.0	14.1	33.3	36.0	46.0	10.0
1.645			37.2	39.5	56.0	16.5	32.6	33.8	46.0	12.2
**16.200			48.1	48.1	60.0	11.9	40.7	40.7	50.0	9.3
24.300			40.2	40.3	60.0	19.7	33.0	33.0	50.0	17.0

\*\* Worst Case

Test Engineer: Bruce Jungwirth	Date: 17 Feb 2009
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NOTE: Plots show Max Peak values only (Staff Monitor)

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 15 of 53

#### 4.4 Test Setup Photo



Conducted Emissions

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 16 of 53

## 5.0 Radiated Emissions Testing

The EUT was placed in an anechoic chamber and radiated emissions testing was performed in accordance with FCC Part 15.225 and 3M Test Procedures: Radiated Emissions Test (30 MHz – 1 GHz), PBLI-6SHLK2, Radiated Emissions Test (1 GHz – 5 GHz), PBLI-6SNHFY and 13.56 MHz RFID Emissions Test, PBLI-6WHLEM. Radiated emissions measurements were made to determine the level of electromagnetic energy radiating from the EUT.

### 5.1 Frequency Stability

The Frequency Stability testing was performed in accordance with ANSI C63.4 and FCC Part 15.225 (e) to insure that the intentional radiator frequency stability was within the allowable limits for input power and temperature variations.

#### 5.1.1 Test Procedure

The Frequency Stability was measured using the radiated signals from the EUT so that the measurement equipment would not load the radio frequency circuits. A frequency counter was used for the frequency stability measurements. A close field probe was attached to the counter and placed near the antenna of the reader for measurement. The Reader was put into a continuous output mode through instructions from the host computer (test mode of operation). 1) The frequency was measured while the input DC power to the Intentional Radiator (RFID Reader) was varied over the required input voltage range. 2) The frequency was also measured while the ambient air temperature was varied over the required ambient temperature range (measurements are taken within 1 minute of startup, and after 10 minutes of operation at each test condition).

#### 5.1.2 Test Criteria

The FCC Part 15, Subpart C for Frequency Stability Limits versus Supply Voltage are given as:

Carrier Frequency (MHz)	Voltage Range % of Nominal Supply (85 % to 115 %)	Max. Frequency Change (%)
13.56	102 to 138 V AC	+/- 0.01 %

The FCC Part 15, Subpart C for Frequency Stability Limits versus Temperature is given as:

Carrier Frequency (MHz)	Temperature Range (degrees C)	Max. Frequency Change (%)
13.56	-20 to +50	+/- 0.01 %



<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 17 of 53

### 5.1.3 Test Results

The EUT met all FCC Part 15, Subpart C Frequency Stability requirements.

Carrier Frequency Stability versus Supply Voltage			
Carrier Frequency (MHz)	Lowest Frequency (MHz)	Highest Frequency (MHz)	Max. Frequency Change (%)
13.5599	13.5599	13.5599	+/- 0.0

Carrier Frequency Stability versus Temperature			
Carrier Frequency (MHz)	Lowest Frequency (MHz)	Highest Frequency (MHz)	Max. Frequency Change (%)
13.5599	13.55927	13.55997	- 0.0046, + 0.0005

#### Carrier Frequency (MHz) vs. Supply Voltage at 20° C

Voltage	Freq. at Startup	Freq. after 10 Min.
102 VAC	13.55990	13.55990
120 VAC	13.55990	13.55990
138 VAC	13.55990	13.55990

#### Carrier Frequency (MHz) vs. Temperature at nominal supply voltage

Temp. ° C	Freq. at Startup	Freq. after 10 min.
-20°	13.55988	13.55927
0°	13.55995	13.55997
20°	13.55990	13.55990
50°	13.55986	13.55986

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 18 of 53

### 5.1.3 Test Setup Photo



Frequency Stability

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 19 of 53

## 5.2 Emission Bandwidth

The EUT was placed in a semi-anechoic chamber and the Emission Bandwidth testing was performed in accordance with ANSI C63.4, FCC Part 15.225 and 3M Test Procedure: 13.56 MHz RFID Emissions Test, PBLI-6WHLEM The Emission Bandwidth measurements were made to determine the intentional radiator frequency and determine the level of electromagnetic energy radiated at that frequency and at the band edges from the EUT.

### 5.2.1 Test Procedure

A measurement antenna (loop) was positioned at a distance of 5 meters (to insure far field measurements) from the center of the EUT. An EMI receiver was used for the emissions measurements. Initial sweep measurements were taken with the receiver in continuous frequency overview mode utilizing peak level signal detection. The intentional radiator frequency and band edge frequencies utilizing quasi-peak detection were then maximized. Maximizing a frequency involves finding the angle of the highest emission levels by rotating the EUT 360 degrees (sampling at least every 4 degrees). Then the antenna, which was fixed at 1-meter height, was rotated until the highest emissions levels found. Measurement results were automatically calculated via software running the EMI receiver. The final quasi-peak measurements recorded were determined by the following formula:

$$\text{Result (dB}\mu\text{V/m)} = \text{receiver level (}\mu\text{V)} + \text{antenna factor (dB/m)} + \text{cable loss (dB)} - \text{preamp gain (dB)} + \text{lineal conversion (dB)}.$$

### 5.2.2 Test Criteria

The FCC Part 15 Subpart C, Paragraph 15.225 Carrier Frequency Limits are given as:

Lower Band Edge: 13.553 MHz  
Upper Band Edge: 13.567 MHz

The FCC Part 15, Subpart C radiated limits are given as:

Frequency (MHz)	Distance (Meters)	Field Strength (dB $\mu$ V/m)
1.705 to 13.110	10	48.62
13.110 to 13.410	10	59.58
13.410 to 13.553	10	69.55
13.553 to 13.567	10	103.00
13.567 to 13.710	10	69.55
13.710 to 14.010	10	59.58
14.010 to 30.000	10	48.62

Note: 40 dB/decade extrapolation factor was used per 15.31.

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 20 of 53

### 5.2.3 Test Results

The EUT met the FCC Part 15, Subpart C Emission Bandwidth requirements. The intentional radiator frequencies were within the allowed band and all maximized quasi-peak measurements for the EUT were below the quasi-peak limits. Measurements were made with the front reader only on, the rear reader only on, and with both readers on at the same time.

3M™ 2820 Front Reader						
Freq. (MHz)	BW (kHz)	QP Level (dBµV/m)	QP Limit (dBµV/m)	Passing Margin (dB)	Turntable (degrees)	Antenna Orientation/Angle (Polarity/degrees)
13.5599 <sup>1</sup>	9	55.22	103.00	47.78	29	Y + 5° CW
13.553 <sup>2</sup>	1	16.21	69.60	53.39	29	Y + 5° CW
13.567 <sup>2</sup>	1	16.22	69.60	53.38	29	Y + 5° CW
13.5485	9	34.44	69.60	35.16	29	Y + 5° CW
13.5715	9	34.14	69.60	35.46	29	Y + 5° CW
13.41 <sup>2</sup>	1	1.20	59.60	58.40	29	Y + 5° CW
13.71 <sup>2</sup>	1	0.79	59.60	58.81	29	Y + 5° CW
13.4055	9	15.97	59.60	43.63	29	Y + 5° CW
13.7141	9	15.02	59.60	44.58	29	Y + 5° CW
13.11 <sup>2</sup>	1	1.26	48.60	47.34	29	Y + 5° CW
14.01	1	0.15	48.60	48.45	29	Y + 5° CW
13.1055	9	15.65	48.60	32.95	29	Y + 5° CW
14.0145	9	14.58	48.60	34.02	29	Y + 5° CW

1 - Intentional Radiator Frequency

2 - Band edges measured with a receiver bandwidth setting of 1 KHz. Per ANSI C63.4 Paragraph 13.1.7.

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 21 of 53

3M™ 2820 Rear Reader						
Freq. (MHz)	BW (kHz)	QP Level (dBμV/m)	QP Limit (dBμV/m)	Passing Margin (dB)	Turntable (degrees)	Antenna Orientation/Angle (Polarity/degrees)
13.5599 <sup>1</sup>	9	60.87	103.00	42.13	31	Y + 20° CW
13.553 <sup>2</sup>	1	21.14	69.60	48.46	31	Y + 20° CW
13.567 <sup>2</sup>	1	20.97	69.60	48.63	31	Y + 20° CW
13.5485	9	39.13	69.60	30.47	31	Y + 20° CW
13.5715	9	38.92	69.60	30.68	31	Y + 20° CW
13.41 <sup>2</sup>	1	3.63	59.60	55.97	31	Y + 20° CW
13.71 <sup>2</sup>	1	6.09	59.60	53.51	31	Y + 20° CW
13.4055	9	21.26	59.60	38.34	31	Y + 20° CW
13.7141	9	24.62	59.60	34.98	31	Y + 20° CW
13.11 <sup>2</sup>	1	1.40	48.60	47.20	31	Y + 20° CW
14.01	1	2.81	48.60	45.79	31	Y + 20° CW
13.1055	9	15.25	48.60	33.35	31	Y + 20° CW
14.0145	9	16.36	48.60	32.24	31	Y + 20° CW

1 - Intentional Radiator Frequency

2 - Band edges measured with a receiver bandwidth setting of 1 KHz. Per ANSI C63.4 Paragraph 13.1.7.

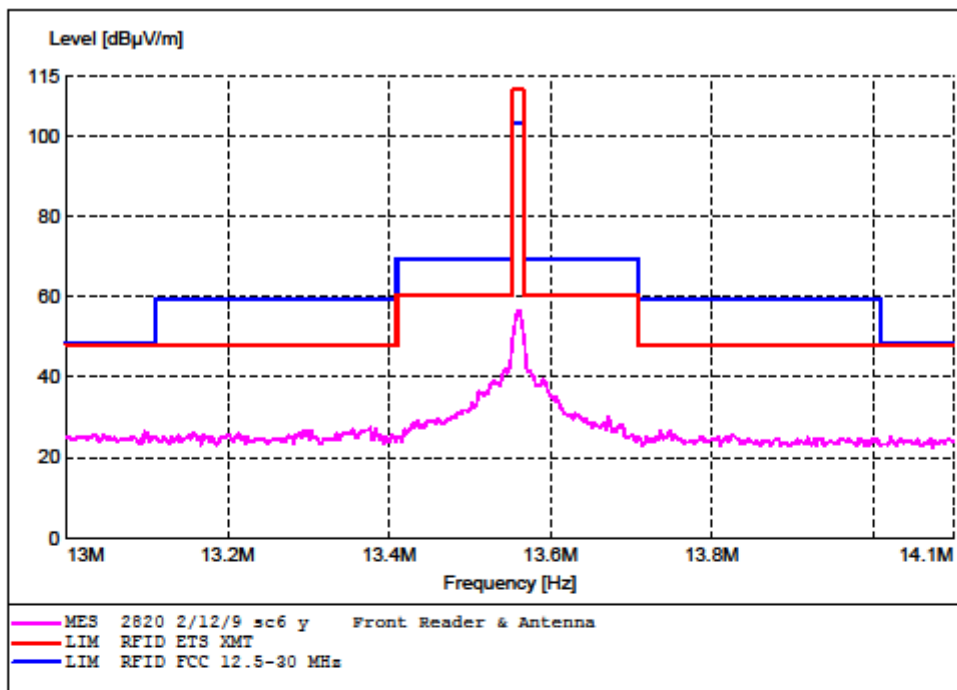
<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 22 of 53

3M™ 2820 Both Readers						
Freq. (MHz)	BW (kHz)	QP Level (dBμV/m)	QP Limit (dBμV/m)	Passing Margin (dB)	Turntable (degrees)	Antenna Orientation/Angle (Polarity/degrees)
13.5599 <sup>1</sup>	9	63.05	103.00	39.95	34	Y + 15° CW
13.553 <sup>2</sup>	1	22.20	69.60	47.40	34	Y + 15° CW
13.567 <sup>2</sup>	1	22.29	69.60	47.31	34	Y + 15° CW
13.5485	9	40.01	69.60	29.59	34	Y + 15° CW
13.5715	9	39.86	69.60	29.74	34	Y + 15° CW
13.41 <sup>2</sup>	1	4.31	59.60	55.29	34	Y + 15° CW
13.71 <sup>2</sup>	1	6.55	59.60	53.05	34	Y + 15° CW
13.4055	9	21.97	59.60	37.63	34	Y + 15° CW
13.7141	9	24.65	59.60	34.95	34	Y + 15° CW
13.11 <sup>2</sup>	1	2.85	48.60	45.75	34	Y + 15° CW
14.01	1	3.31	48.60	45.29	34	Y + 15° CW
13.1055	9	15.69	48.60	32.91	34	Y + 15° CW
14.0145	9	16.60	48.60	32.00	34	Y + 15° CW

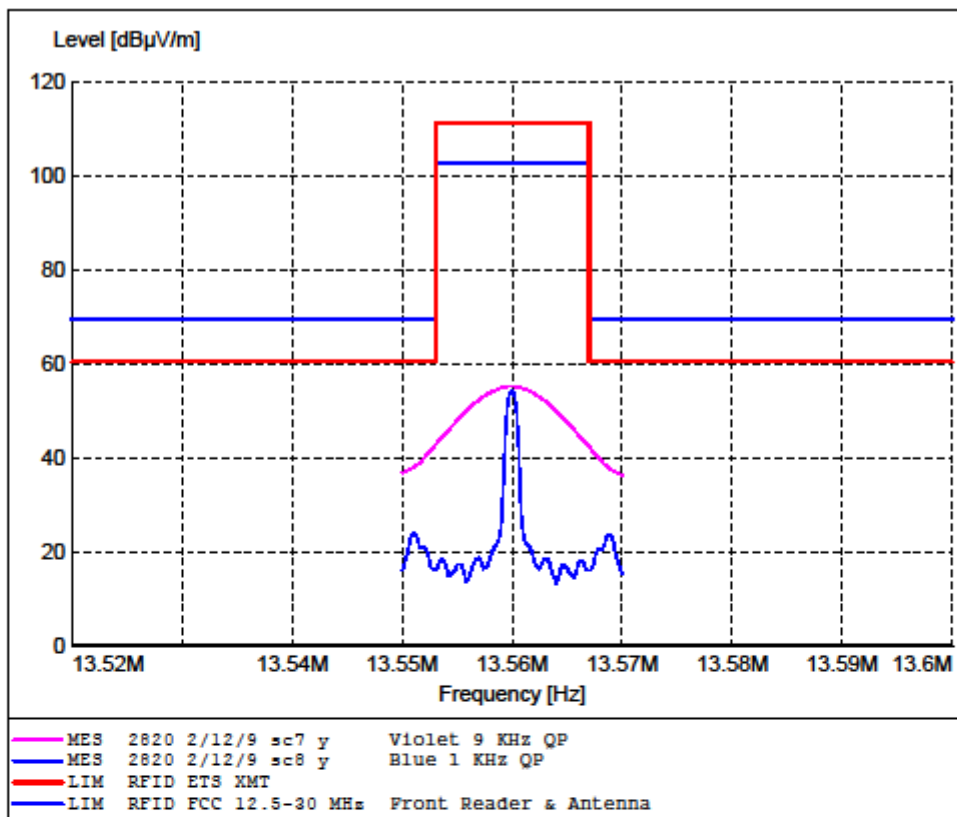
1 - Intentional Radiator Frequency

2 - Band edges measured with a receiver bandwidth setting of 1 KHz. Per ANSI C63.4 Paragraph 13.1.7.

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 23 of 53



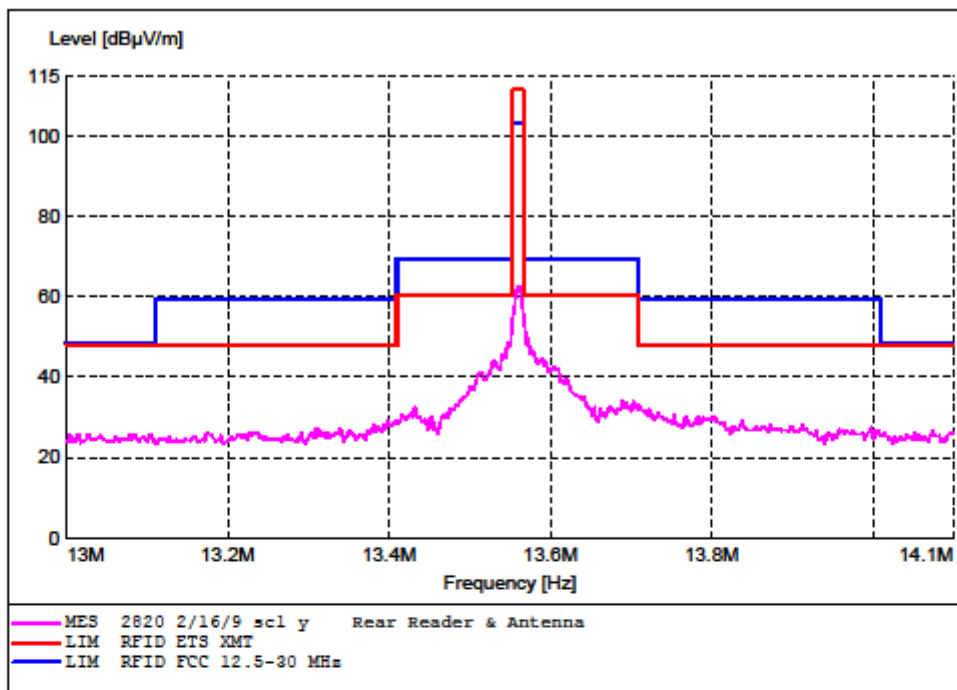
<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 24 of 53



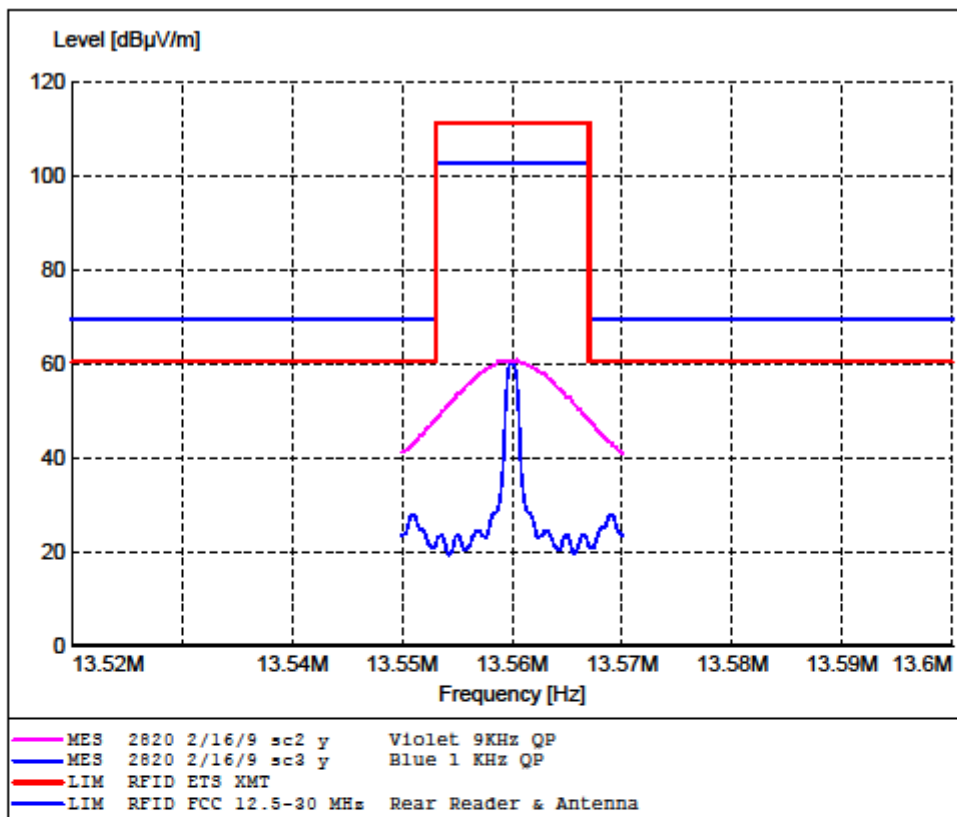
Violet 9 KHz BW QP Scan (front reader)  
Blue 1 KHz BW QP Scan (front reader)



<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 25 of 53

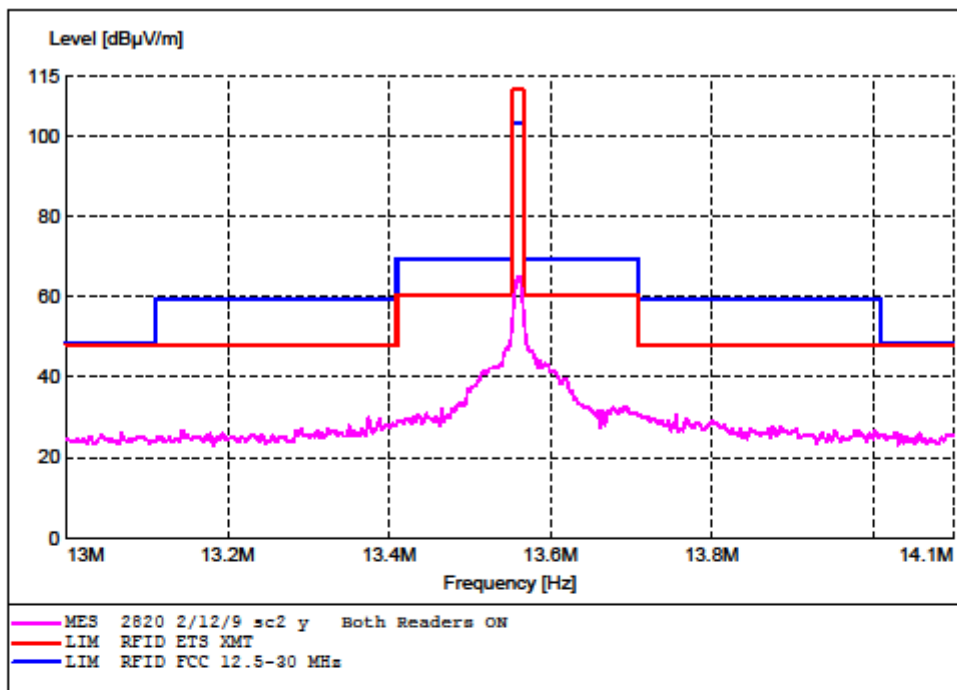


<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 26 of 53

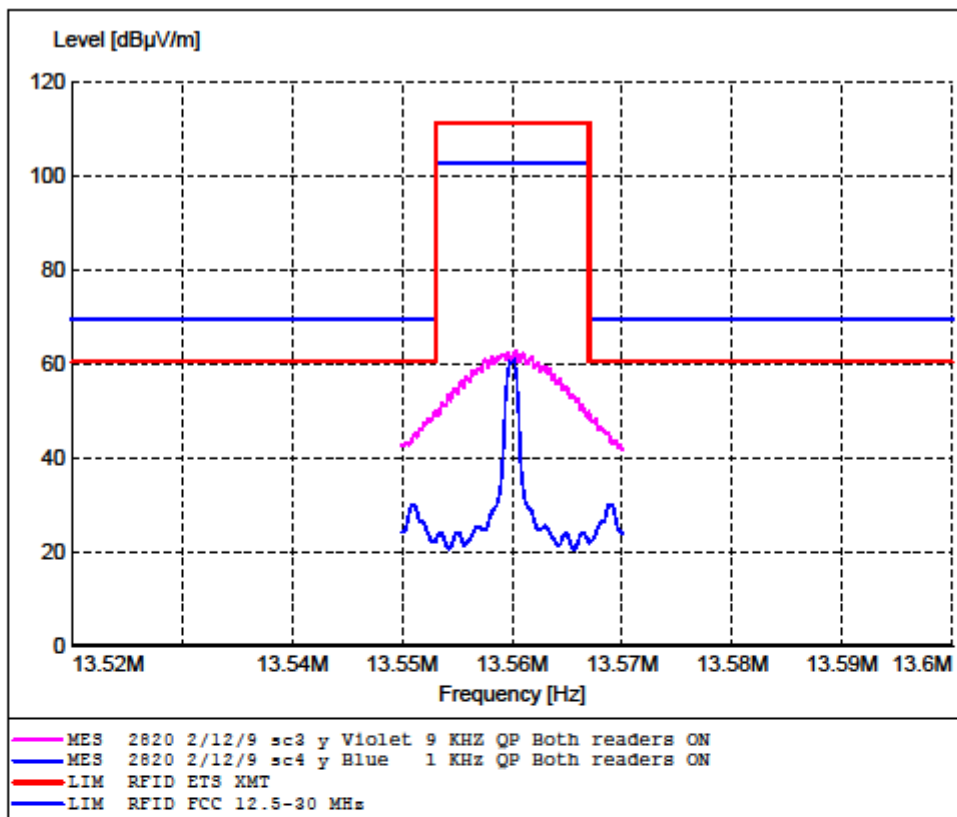


Violet 9 KHz BW QP Scan (rear reader)  
Blue 1 KHz BW QP Scan (rear reader)

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 27 of 53



<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 28 of 53



Violet 9 KHz BW QP Scan (both readers)  
Blue 1 KHz BW QP Scan (both readers)

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 29 of 53

### 5.2.4 Test Setup Photo



2820

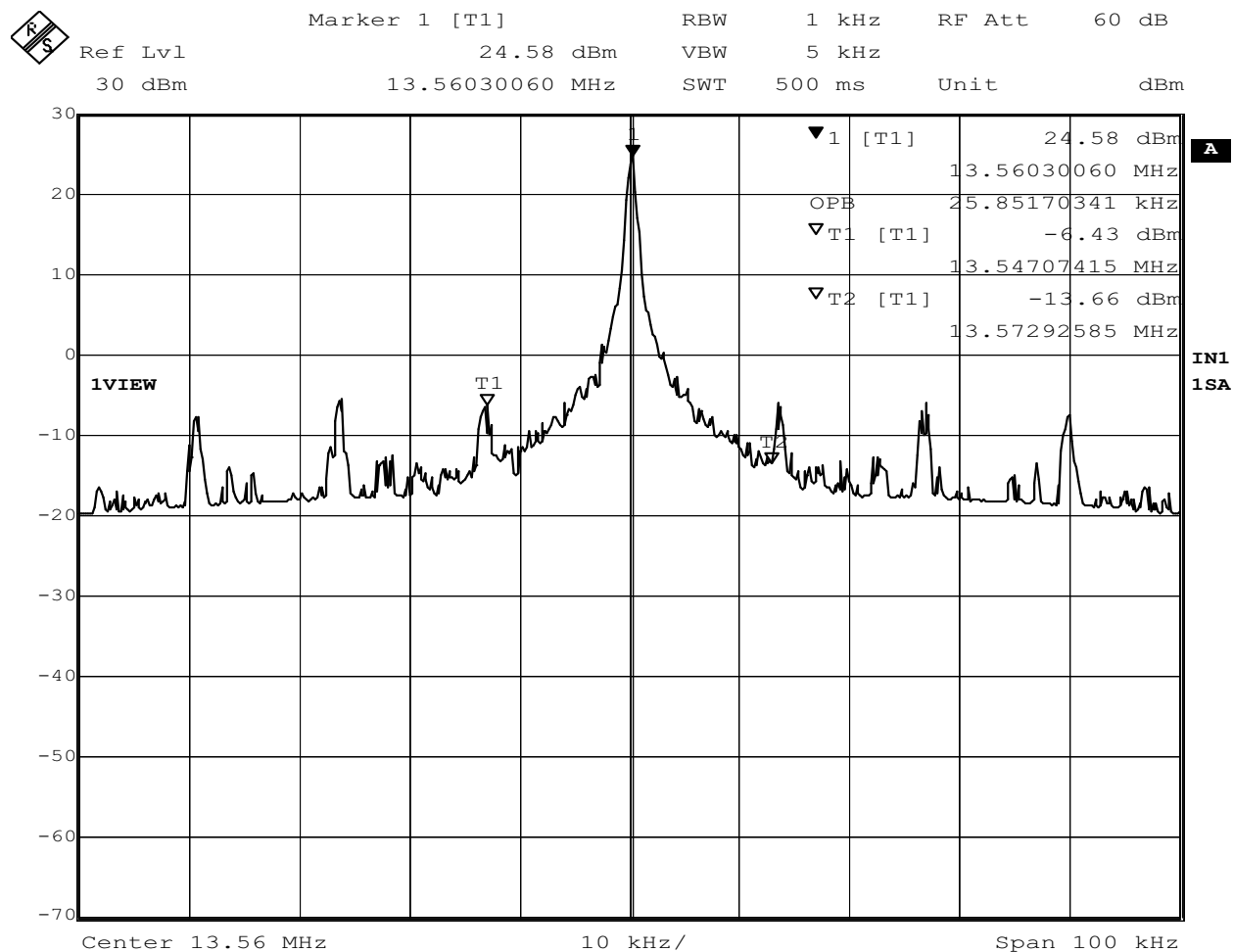
Carrier Frequency / Emissions Bandwidth / Spurious Emissions 9KHz to 30 MHz

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 30 of 53

### 5.2.5 Power Bandwidth Test Procedure (99%)

The EUT was placed in a shielded room and connected directly to the input of an EMI Receiver. The receiver was operated in the analyzer mode with a center frequency of 13.56 MHz. The transmitter was operated at its maximum carrier output with modulation applied under normal test conditions. The receiver's span and bandwidths were set in accordance with Industry Canada RSS-GEN (section 4.6.1). The receiver has an internal function that can be selected for the measurement of the 99% Bandwidth, and automatic placement of the markers. 3M Test Procedure: 13.56 MHz RFID Emissions Test, PBLI-6WHLEM contains the procedure for selecting the Bandwidth function and output of the result plot.

The EUT had a measured bandwidth of **25.8317 kHz**.



Date: 28.JAN.2008 13:51:50

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 31 of 53

### 5.3 Spurious Emissions (12 kHz to 30 MHz.)

The EUT was placed in a semi-anechoic chamber and the Spurious Emissions testing was performed in accordance with ANSI C63.4, FCC Part 15, Subpart C and 3M Test Procedure: 13.56 MHz RFID Emissions Test, PBLI-6WHLEM. The Spurious Emission measurements were made to determine the level of spurious electromagnetic energy radiated from the EUT.

#### 5.3.1 Test Procedure

A measurement antenna (loop) was positioned at a distance of 5 meters (to insure far field measurements) from the center of the EUT. An EMI receiver was used for the emissions measurements. Initial sweep measurements were taken with the receiver in continuous frequency overview mode utilizing peak level signal detection. Acceptance analysis of these sweeps was used to determine which discrete frequencies, other than the intentional radiator frequency and band edge frequencies were to be maximized. Maximizing a frequency involves finding the angle of the highest emission levels by rotating the EUT 360 degrees (sampling at least every 4 degrees). Then the antenna, which was fixed at 1-meter height, was rotated until the highest emissions levels found. Final measurements were taken utilizing quasi-peak detection. Measurement results were automatically calculated via software running the EMI receiver. The final measurements recorded were determined by the following formula:

Result (dB $\mu$ V/m) = receiver level ( $\mu$ V) + antenna factor (dB/m) + cable loss (dB) - preamp gain (dB) + lineal conversion (dB).

#### 5.3.2 Test Criteria

The FCC Part 15, Subpart C radiated limits are given below.

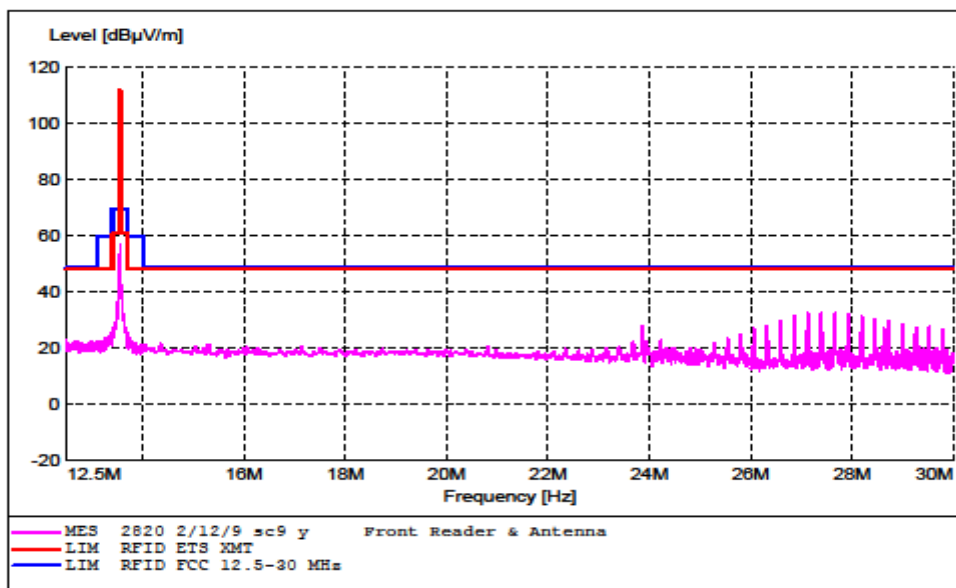
Frequency (MHz)	Distance (Meters)	Field Strength (dB $\mu$ V/m)
12.000 to 13.110	10	48.62
13.110 to 13.410	10	59.58
13.410 to 13.553	10	69.55
13.553 to 13.567	10	103.00
13.567 to 13.710	10	69.55
13.710 to 14.010	10	59.58
14.010 to 30.000	10	48.62

Note: A 40 dB/decade extrapolation factor was used per 15.31.

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 32 of 53

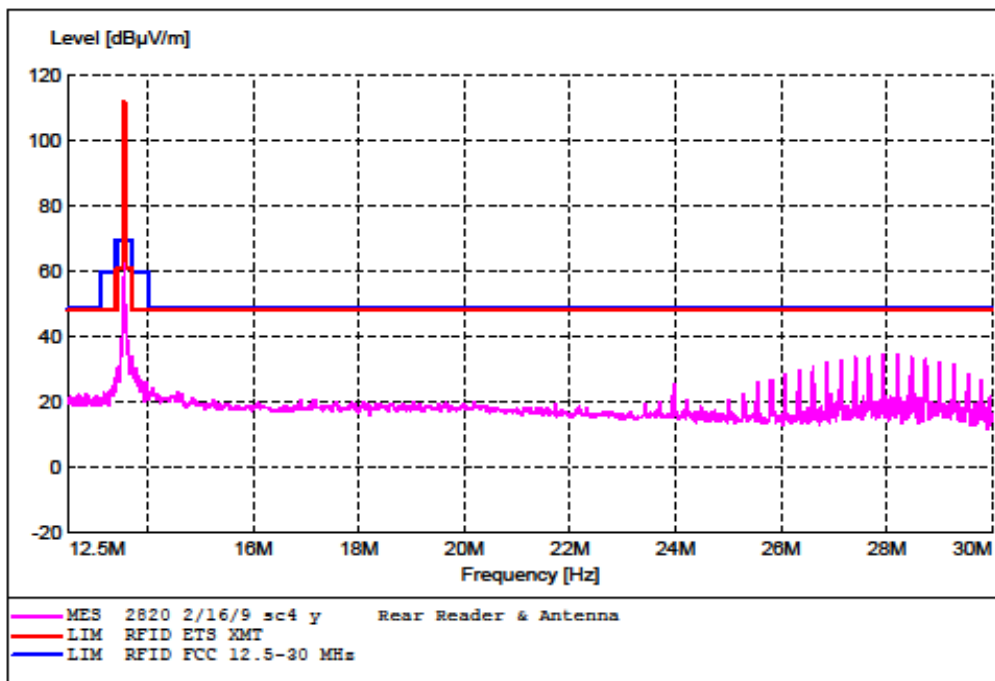
### 5.3.3 Test Results

The EUT met the FCC Part 15, Subpart C Spurious Emissions (12 kHz to 30 MHz.) requirements. No measurable spurious emissions were detected below 12.5MHz. All spurious emissions from the readers were below the noise floor. The emissions shown from 24 MHz to 30 MHz are from the power supply.

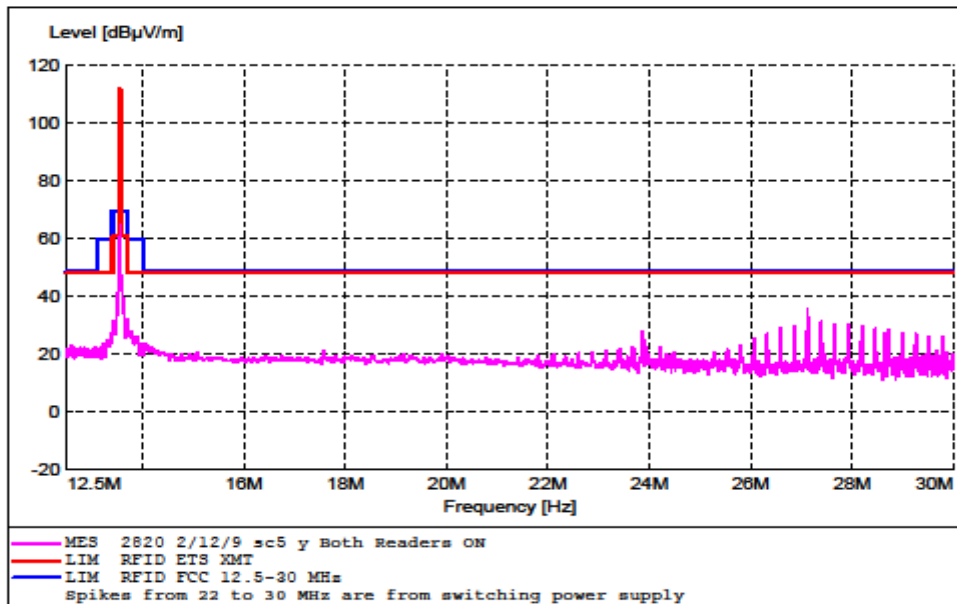




<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 33 of 53



<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 34 of 53



Both Readers

**5.3.4 Test Setup Photo**  
See Section 5.2.4

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 35 of 53

#### 5.4 Spurious Emissions (30 to 1000 MHz.)

The EUT was placed in a semi-anechoic chamber for spurious emissions testing in accordance with ANSI C63.4, FCC Part 15, Subpart C and 3M Test Procedures: 13.56 MHz RFID Emissions Test, PBLI-6WHLEM and Radiated Emissions Test (30 MHz – 1 GHz), PBLI-6SHLK2. The Spurious Emission measurements were made to determine the level of spurious electromagnetic energy radiated from the EUT while in the transmit mode.

##### 5.4.1 Test Procedure

The EUT was placed in the center of a turntable. An EMI receiver was used for the emissions measurements in the range of 30MHz to 1000MHz. Initial measurements were taken with the receiver in continuous frequency overview mode utilizing peak level signal detection. Peak results were maximized at discrete frequencies utilizing quasi-peak detection. Maximizing a frequency involves finding the angle of the highest emission levels by rotating the EUT 360 degrees (sampling every 4 degrees) and varying the antenna height between 1 and 4 meters at the angles of the highest emissions levels found. Measurements were taken in both vertical and horizontal antenna polarization. The final measurements recorded were determined by the following formula:

Result (dB $\mu$ V /m) = receiver level ( $\mu$ V) + antenna factor (dB/m) + cable loss (dB) - preamp gain (dB) + lineal conversion (dB)

##### 5.4.2 Test Criteria

The FCC Part 15, Subpart C radiated limits are given below.

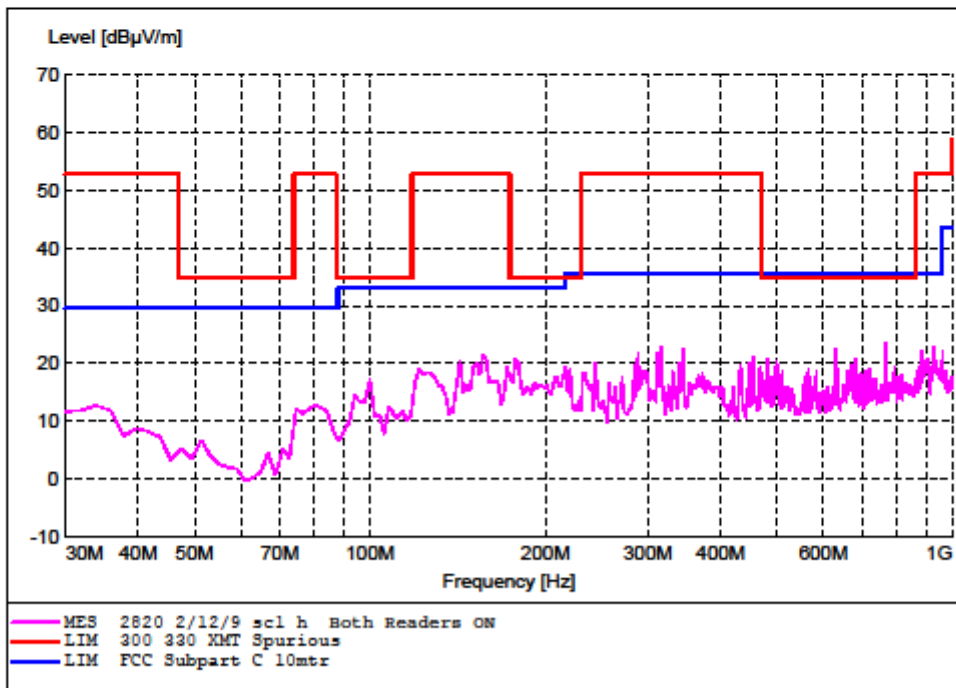
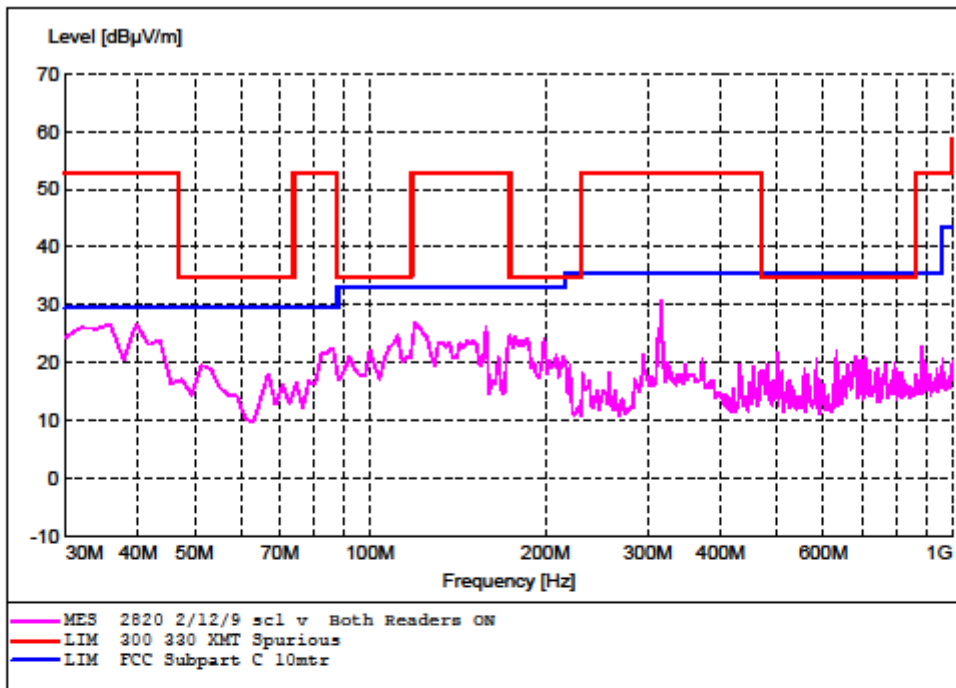
Frequency (MHz)	Distance (Meters)	Field Strength (dB $\mu$ V/m)
30 - 88	10	29.54
88 - 216	10	33.06
216 - 960	10	35.56
960 and higher	10	43.52

##### 5.4.3 Test Results

The EUT met the FCC Part 15, Subpart C Spurious Emissions (30 to 1000 MHz.) requirements.



<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 37 of 53



2820 Spurious Emissions (both readers on) (peak detector scan)

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 38 of 53

#### 5.4.4 Test Setup Photo



Spurious Emissions above 30 MHz

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 39 of 53

## 5.5 Digital Radiated Emissions (30 MHz - 18000 MHz)

The EUT was placed in an anechoic chamber and radiated emissions testing was performed in accordance with ANSI C63.4, FCC Part 15 and 3M Test Procedures: Radiated Emissions Test (30 MHz – 1 GHz), PBLI-6SHLK2, and Radiated Emissions Test (1 GHz – 5 GHz), PBLI-6SNHFY. Radiated emissions measurements were made to determine the level of electromagnetic energy radiating from the EUT.

### 5.5.1 Test Procedure

The EUT was placed in the center of a turntable. An EMI receiver was used for the emissions measurements in the range of 30MHz to 40GHz (the upper limit of measurement is determined by the 5<sup>th</sup> harmonic of the highest frequency generated in the device or 40 GHz whichever is lower). Initial measurements were taken with the receiver in continuous frequency overview mode utilizing peak level signal detection. Peak results were maximized at discrete frequencies utilizing quasi-peak detection. Maximizing a frequency involves finding the angle of the highest emission levels by rotating the EUT 360 degrees (sampling every 4 degrees) and varying the antenna height between 1 and 4 meters at the angles of the highest emissions levels found. Measurements were taken in both vertical and horizontal antenna polarization. The final quasi-peak measurements recorded were determined by the following (the detector used above 1000 MHz is both average and peak):

Result (dB $\mu$ V /m) = receiver level ( $\mu$ V) + antenna factor (dB/m) + cable loss (dB) - preamp gain (dB) + lineal conversion (dB)

### 5.5.2 Test Criteria

The FCC Class 'A' radiated limits are given below. The lower limit shall apply at the transition frequency.

Frequency (MHz)	Distance (Meters)	Field Strength (dB $\mu$ V/m)
30 - 88	10	39.08
88 - 216	10	43.52
216 - 960	10	46.44
960 - 1000	10	49.54
1000 – 40000	10	49.54 AVG 69.54 PEAK

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 40 of 53

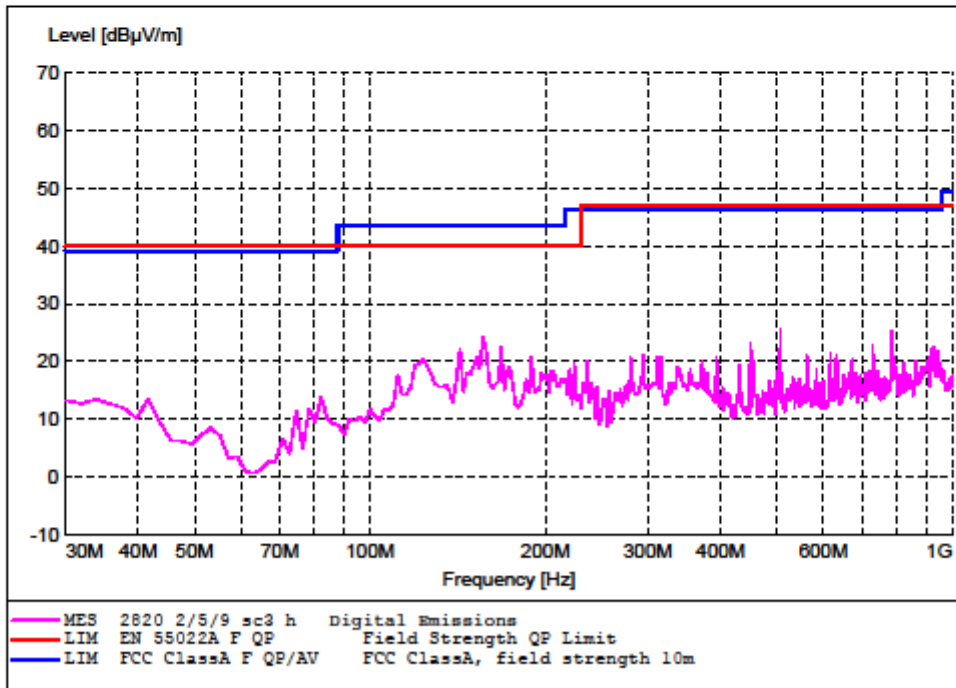
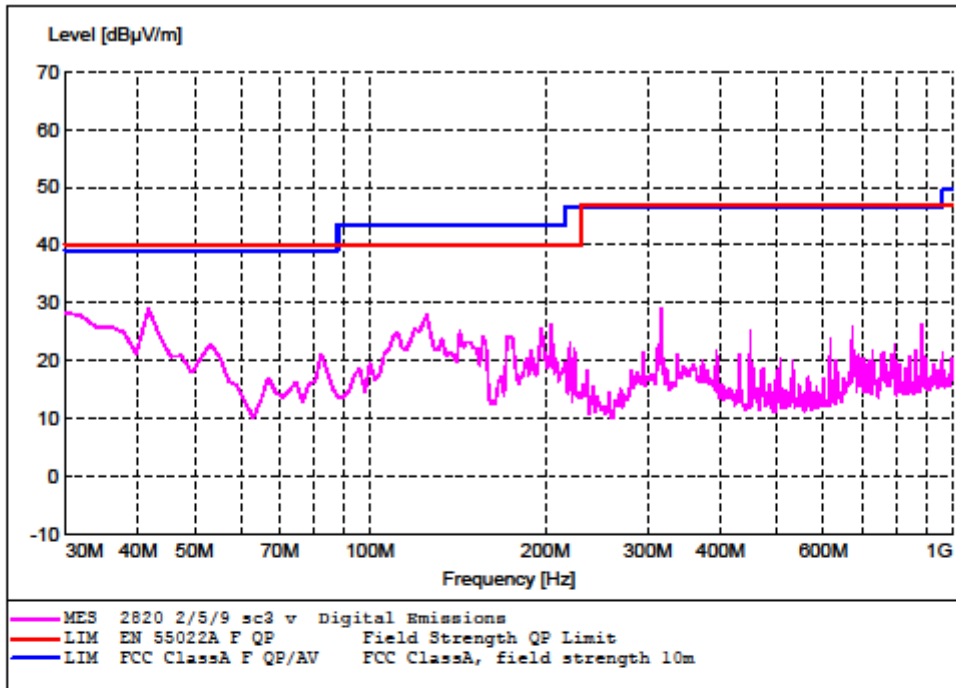
### 5.5.3 Test Results

The EUT met the FCC Class 'A' radiated emission requirements. The upper Limit of testing was 15000 MHz. All maximized quasi-peak measurements for the EUT were below the quasi-peak limit.





<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 42 of 53



2820 (Digital) (RFID off) (peak detector scan)

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 43 of 53

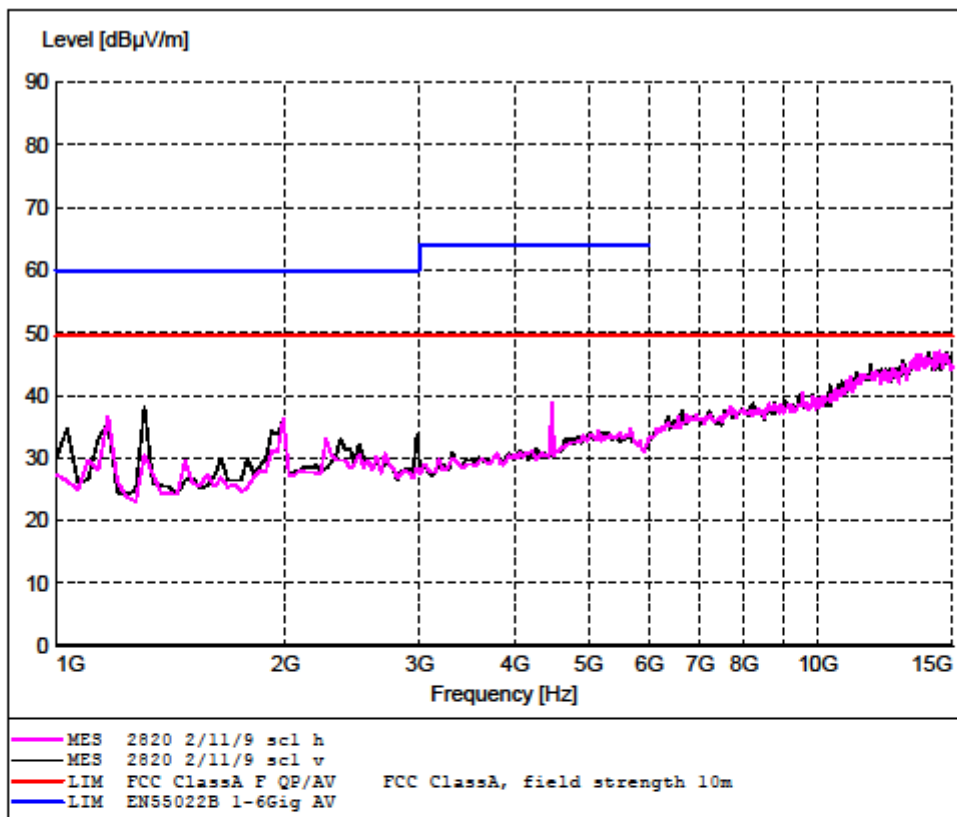
<b>Report Number</b>	F1208003	<b>Date</b>	9 Feb 2009
<b>EUT Name</b>	Intelligent Return/Sorter Sys	<b>EUT Power</b>	120, 60 Hz
<b>EUT Model</b>	2820, 2810, 2812, 2822, 2830	<b>Test Std</b>	FCC Part B
<b>EUT Serial #</b>	n/a	<b>Temperature (°C)</b>	24
<b>EUT Description</b>	Book Sorter	<b>Humidity (%)</b>	24
		<b>Air Pressure (kPa)</b>	985

MAXIMIZED FILES 2820 2/11/9 sc1 V & H

FREQ. (GHz)	MAXIMIZED AVG SIGNAL		LIMIT LINE (dBµV/m)	PASSING MARGIN (dB)	MAXIMIZED PEAK SIGNAL		LIMIT LINE (dBµV/m)	PASSING MARGIN (dB)	TURN TABLE (degrees)	ANTENNA HEIGHT (m)
	H/V	(dBµV/ m)			H/V	(dBµV/m)				
1.066	V	27.28	49.54	22.26	V	36.36	69.54	33.18	0	1.0
1.194	V	14.26	49.54	35.28	V	38.22	69.54	31.32	180	1.42
1.194	H	17.75	49.54	31.79	H	44.96	69.54	24.58	180	1.15
1.329	V	22.27	49.54	27.27	V	37.72	69.54	31.82	269	1.0
1.995	H	23.43	49.54	26.11	H	39.96	69.54	29.58	263	1.0
1.995	V	21.27	49.54	28.27	V	38.57	69.54	30.97	279	1.0

Test Engineer: Bruce Jungwirth	Date: 11 Feb 2009
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<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 44 of 53



<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 45 of 53

#### 5.5.4 Test Setup Photo



Radiated Emissions 1 to 15 GHz

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 46 of 53

## 5.6 Human Exposure (EMF)

This procedure is for the evaluation of human exposure to electromagnetic fields (EMF) from devices containing RFID. The testing is in accordance with RSS-102 and 3M Test Procedure: EMF Test w/EMR-300, PBLI-7FAM2G.

### 5.6.1 Test Procedure

The EUT was setup in a shielded room and measurements were made of both the electric and magnetic fields at 13.56 MHz at a distance of 20 cm around the equipment using EMF exposure meters.

### 4.10.2 Performance Criteria

For general public exposure, the results shall be compared with the exposure limits 4.2 of RSS-102. For 13.56 MHz, the limits are as follows:

Freq Range	V/m	A/m	W/m <sup>2</sup>	EUT Power
10-30 MHz	28.0	0.162	-	1000 mw

### 4.10.3 Test Results

The EUT met the general public exposure criteria for both the electric field and the magnetic field.

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 47 of 53

<b>Report Number</b>	1208003	<b>Date</b>	4 March 2009
<b>EUT Name</b>	Intelligent Return/Sorter Sys	<b>EUT Power</b>	120, 60 Hz
<b>EUT Model</b>	2820, 2810, 2812, 2822, 2830	<b>Test Std</b>	RSS-102
<b>EUT Serial #</b>	n/a	<b>Temperature (°C)</b>	24
<b>EUT Description</b>	Book Sorter	<b>Humidity (%)</b>	23
		<b>Air Pressure (kPa)</b>	99.8

Test Position	Frequency	Distance	Measurement	Limit	Margin
Front, Left end of antenna location	13.56 MHz	20 CM	0.0374 A/m	0.073 A/m	.0356 A/m
Front, Right end of antenna location	13.56 MHz	20 CM	2.10 V/m	28 V/m	25.9 V/m
Rear Antenna above belt 2 cm rear of center on right side	13.56 MHz	20 CM	3.5 V/m	28 V/m	24.5 V/m
Rear antenna above belt on left side	13.56 MHz	20 CM	0.0353 A/m	0.073 A/m	.0377 A/m

Note: Both Readers operational during measurements.

Test Engineer: Bruce Jungwirth	Date: 4 March 2009
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<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 48 of 53

#### 4.10.4 Test Setup Photo



**E-Field Measurement (front)**



**H-Field Measurement (front)**



<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 49 of 53



**E-Field Measurement (rear)**



**H-Field Measurement (rear)**

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 50 of 53

## **6.0 LIST OF TEST EQUIPMENT**

The following test equipment was used to perform the indicated tests. All test equipment was calibrated by an accredited calibration laboratory or by the manufacturer. All calibration intervals are one year. All equipment calibrations, test procedures, and test facility are traceable to the standards of the National Institute of Standards and Technology (NIST). The test facility site attenuation verification results fall within the normalized site attenuation (NSA) criteria for open area test sites using volumetric measurements.

### **RADIATED EMISSIONS**

Electro Metrics Large Loop Antenna, Model ALR25M, Serial No. 603 (cal due date: 20 Oct 09)  
Schaffner Biconilog Antenna, Model CBL6112B, Serial No. 27491 (cal due date: 21 Oct 09)  
A. H Systems Horn Antenna, Model SAS\_200/571 Serial No: 234 (cal due date: 22 Oct 09)  
HP Pre-Amplifier, Model 8447D, Serial No. 1937A03090 (cal due date: 21 Oct 09)  
HP Pre-Amplifier, Model 83017A, Serial No. 3123A00259 (cal due date: 20 Oct 09)  
Rohde & Schwarz EMI Receiver, Model ESIB 40, S/N 100235 (cal due date: 23 Oct 09)  
Rohde & Schwarz ESIB 40 Firmware Version 4.34.3

### **CONDUCTED EMISSIONS**

EMCO LISN, Model 3825-2, Serial No. 1039 (cal due date: 20 Oct 09)  
Solar High Pass Filter, Model 8131 - 5.0 (cal due date: 30 Aug 09)  
Rohde & Schwarz EMI Receiver, Model ESIB 40, S/N 100235 (cal due date: 23 Oct 09)  
Rohde & Schwarz ESIB 40 Firmware Version 4.34.3

### **FREQUENCY STABILITY / POWER OUTPUT**

Agilent Frequency Counter Model 53131A, Serial No. MY40012264 (cal due date: 21 Oct 09)  
HP Spectrum Analyzer Model 8591A, Serial No. 3108A02041 (cal due date: 9 Oct 09)  
Envirotronics Environ. Chamber, EH16-1-1.5AC, SN:10066639 (cal due date: 1 Nov 09)

### **OCCUPIED BANDWIDTH**

Rohde & Schwarz EMI Receiver, Model ESIB 40, S/N 100235 (cal due date: 23 Oct 09)  
Rohde & Schwarz ESIB 40 Firmware Version 4.34.3

### **EMF MEASUREMENT**

Narda EMR 300 Exposure Meter, Model 2244/31 (cal due date: 15 Jan 10)  
Narda Type 8 E-Probe, s/n BG0030 (cal due date: 13 Jan 10)  
Narda Type 12 H-Probe, s/n AE0020 (cal due date: 13 Jan 10)

### **TEST FACILITY**

Lindgren Semi-Anechoic Chamber, (verification due date: 30 Aug 09)  
FCC Site Registration Number: 93334  
Canadian Site Registration Number: 458A-1

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 51 of 53

## 7.0 LABELING INFORMATION

The following labeling information is required by the FCC (Federal Communications Commission) and IC (Industry Canada) for Class A digital devices. Since the equipment contains both intentional and unintentional radiators, it must be labeled as a digital device and as an intentional radiator.

### **Labels on the Product**

The following statements shall be placed in a conspicuous location on the device:

**This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.**

**FCC ID: DGFTTS2820  
IC ID: 458A-TTS2820**

**"This Class A digital apparatus complies with Canadian ICES-003."**

**"Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada."**

### **Statements in the Manuals**

The following statement shall be placed in a prominent location in the text of the user manual:

**NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide a reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own expense.**

**FCC ID: DGFTTS2820**

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 52 of 53

**NO MODIFICATIONS. Modifications to this device shall not be made without the written consent of 3M, Company. Unauthorized modifications may void the authority granted under Federal Communications Commission and Industry Canada Rules permitting the operation of this device.**

**"This Class A digital apparatus complies with Canadian ICES-003."**

**"Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada."**

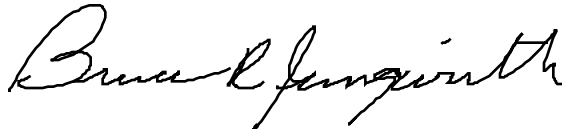
**IC ID: 458A-TTS2820**

<b>3M</b>	Model 2820	Report # F1208003	<b>3M</b>
EMC Laboratory	Reg. Eng. And Quality	May 19, 2009	Page 53 of 53

### 8.0 REPORT SIGNATURES

This page contains the secured digital signatures of the parties responsible for reviewing and approving the contents of this report:

Bruce R. Jungwirth

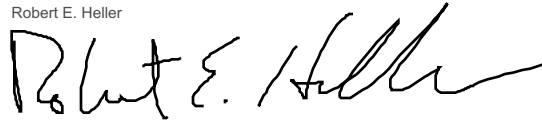


**TEST ENGINEER:**

\_\_\_\_\_  
Bruce Jungwirth

DATE: May 19, 2009

Robert E. Heller



**APPROVER:**

\_\_\_\_\_  
Robert E. Heller

DATE: May 19, 2009

**This is the last page of the Test Report**