FCC
Electromagnetic Compatibility
Test Report

For

3M™ Model 888 SmartCheck® System

Security Systems Division
Library Systems
St. Paul, MN 55144-1000

17 August 2004

Report Number F1003004

Prepared By:

CR-SEMS Product Safety
Building 76-1-01
410 East Fillmore Avenue
St. Paul, Minnesota 55144-1000

3M Product Safety 3M Center Building 76-1-01 St. Paul MN 55144-1000	Phone: 651 778 6279 Fax: 651 778 6252 E-mail: rdkuhn1@mmm.com	3 EMC Laboratory

CERTIFICATE OF COMPLIANCE

USA STANDARD 47 CODE OF FEDERAL REGULATIONS

Radiated Emissions (FCC Part 15, Subpart B, Class A)
Conducted Emissions (FCC Part 15, Subpart B, Class A)
Radiated Emissions (FCC Part 15, Subpart C)
Conducted Emissions (FCC Part 15, Subpart C)

MANUFACTURER'S NAME:	3M Company Security Systems Division Library Systems St. Paul, MN 55144-1000
NAME OF EQUIPMENT:	SmartCheck™ System
MODEL NUMBER:	888
SERIAL NUMBER	888000023
TEST REPORT NUMBER:	F1003004
DATE:	17 August 2004

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. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics.

Signatory: Roger Kuhn

Roger D. Kuhn
EMC Test Engineer

TABLE OF CONTENTS

1.0 TEST SUMMARY

Test Report Number:	F1003004
Requester:	Roger Westerberg
Company:	3M Safety and Security Systems Division Library Systems Building 209 St. Paul, MN 55144
Telephone Number:	(651) 733-8649
Test Dates:	17 and 22 October 2003
Equipment Under Test	Model 888 SmartCheck™ System
Date Of Receipt:	08 October 2003
Test Environment	Temperature: 20 to 30 degrees C Relative Humidity: 30 to 70 % RH
Test Results:	Passed the following tests: Conducted Emissions: FCC Part 15 Subpart B Class A; Radiated Emissions: FCC Part 15 Subpart B Class A; Conducted Emissions: FCC Part 15 Subpart C; Radiated Emissions: FCC Part 15 Subpart C;
Modifications:	No modification was required.
Test Location:	3M Product Safety EMC Laboratory Building 76 410 Fillmore Ave. St. Paul, MN 55144-1000

2.0 INTRODUCTION

2.1 Scope

This report is an addendum to EMC Technologies Pty Ltd Report Number: M021210R_Cert_Tx issued on 30 July 2004. This report contains results describing the conformance of the Equipment Under Test (EUT) to FCC Part 15, Subpart B, "Class A" rules for unintentional radiators and FCC Part 15, Subpart C 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 without the written approval of the testing laboratory. When approval has been granted, the report shall be reproduced in its entirety.

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 the Appendices. Equipment and documentation labeling information is contained in Section 7.0.

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

The 3M Product Safety EMC Laboratory is recognized under the United States Department of Commerce National Institute of Standards and Technology's National Voluntary Laboratory 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 25 and the relevant requirements of ISO 9002 (ANSI/ASQ 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 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.

2.2 EUT Descriptions and Operation

The Equipment Under Test (EUT) is the 3M ™ Model 888 SmartCheck™ System, Serial Number: 888000023.

The 3M™ Model 888 SmartCheck is an ATM-style self-return system intended for use by library patrons when returning library materials, and by library staff when receiving returned materials.

The system is designed for use in an indoor library environment and has not been evaluated for other locations or uses.

The reader has a transmit frequency of 13.56 MHz. And a power output level of 1.000 watts (30 dBm) as measured into a 50-ohm load. This maximum output of 1 watt (30 dBm) is factory preset.

The EUT contains 2 antennas with areas of 140.0 square inches each. The antennas are mounted horizontally on the same plane below the top portion of the conveyer belt. Each antenna is cabled into a switcher board, which connects to the reader. Antenna and board connections are via coax cable and SMA connectors. The switching board supplies the tuning circuitry and alternately polls each antenna.

All tests were made using an input of 120 V RMS, 60 Hz, and single-phase power. The EUT was tested with an EMC programs exercising all functions. The Reader was set to the fastest read time and was reading tags during all testing.

2.3 Block Diagram

Block Diagram is on a separate Exhibit.

2.4 Parts List

Parts List is on a separate Exhibit.

2.5 Modifications to the EUT

No modifications were required.

2.6 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 a nominal measurement deviation of ± 2 dB. Furthermore, EUT component and manufacturing process variables may result in additional deviation. The calculated confidence level is 95 %.

3.0 APPLICABLE DOCUMENTS

The following documents were used as reference for the limits and test procedures specified herein.

CFR 47	Part 15 Radio Frequency Devices	2002
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.	2000
CISPR 16-1	Specification for radio disturbance and immunity measuring apparatus and methods Part 1: Radio disturbance and immunity measuring apparatus	1998
CISPR 16-2	Specification for radio disturbance and immunity measuring apparatus and methods Part 2: Methods of measurements of disturbances and immunity	1996

4.0 CONDUCTED EMISSIONS

Conducted emissions testing was performed in accordance with ANSI C63.4. The limits are prescribed in FCC Part 15, Subpart B and in FCC Part 15, Subpart C.

4.1 Test Procedure

Refer to EMC Laboratory Pty Ltd Report Number M021210R_Cert_Tx.

4.2 Test Criteria

The FCC Part 15, Subpart B, "Class A" conducted limits are given below.

Frequency (MHz)	Limit Quasi-Peak (dBµV)
0.150 to 0.500	79.00
0.500 to 30.00	73.00

The lower limit shall apply at the transition frequency.

4.3 Test Results

The EUT met conducted emission requirements for FCC Part 15, Subpart B, "Class A" and met FCC Part 15, Subpart C. All the conducted emissions test data is shown in EMC Technologies Pty Ltd Report Number: M021210R_Cert_Tx issued on 30 July 2004. The worst-case peak and quasi-peak emissions were as follows:

Frequency (MHz)	Limit (dBµV)	L1- Line Q-P (dBµV)	L2 - Neutral Q-P (dBµV)	Passing Margin (dB)
27.12	60.00	23.9	29.3	30.7
29.49	60.00	28.5	32.4	27.6

FCC Part 15, Subpart C limit is shown.

5.0 RADIATED EMISSIONS

Radiated emissions testing was performed in accordance with ANSI C63.4. The limits are prescribed in FCC Part 15, Subpart B and in FCC Part 15, Subpart C.

5.1 Frequency Stability

The Frequency Stability testing was preformed in accordance with ANSI C63.4 and FCC Part 15 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. An EMI receiver was used for the frequency stability measurements. 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 AC power to the External Power Supply 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 (at startup, 2 minutes, 5 minutes, and 10 minutes).

5.1.2 Test Criteria

The FCC Part 15, Subpart C for Frequency Stability Limits versus Supply Voltage is given below.

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

The FCC Part 15, Subpart C for Frequency Stability Limits versus Temperature is given below.

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

5.1.3 Test Results

The EUT met the FCC Part 15, Subpart C Frequency Stability requirement.

Carrier Frequency Stability versus Supply Voltage

Carrier Frequency (MHz)	Lowest Frequency (MHz)	Highest Frequency (MHz)	Frequency Change (%)
13.5601	13.5599	13.5602	+/- 0.0015 %

Carrier Frequency Stability versus Temperature

Carrier Frequency (MHz)	Lowest Frequency (MHz)	Highest Frequency (MHz)	Frequency Change (%)
13.5601	13.5599	13.5602	+/- 0.0015 %

Frequency Stability Test Results

	Input Voltage		
Temperature	10.8 VDS	12.0 VDC	13.2 VDC
-20° C	13.5601	13.5601	13.5601
0° C	13.5602	13.5602	13.5602
23° C	13.5601	13.5601	13.5601
50° C	13.5601	13.5599	13.5601
55° C	13.5599	13.5599	13.5599

5.2 Emission Bandwidth

The EUT was placed in an anechoic chamber and the Emission Bandwidth testing was preformed in accordance with ANSI C63.4 and FCC Part 15, Paragraph 15.225. 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:

Result (dBµV/m) = receiver level (µV) + antenna factor (dB/m) + cable loss (dB) - preamp gain (dB) + lineal conversion (dB).

5.2.2 Test Criteria

The FCC Part 15 Subpart C, Paragraph 15.225 Carrier Frequency Limits are given below.

Lower Band Edge (MHz)	Upper Band Edge (MHz)
13.553	13.567

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

Frequency (MHz)	Distance (m)	Field Strength (dB µV/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: A 40 dB/decade extrapolation factor was used per 15.31.

5.2.3 Test Results

The EUT met the FCC Part 15, Subpart C Emission Bandwidth requirements. The intentional radiator frequency was within the allowed band and all maximized quasi-peak measurements for the EUT were below the quasi-peak limits. The test scan is shown in Appendix B.

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Passing Margin (dB)	Turntable (degrees)	Antenna Orientation/Angle (Polarity/degrees)
13.5601[1]	53.3	103.00	49.7	70	Antenna was at +45 degrees from the X-axis.
13.553[2]	23.3	69.55	46.25	70	Antenna was at +45 degrees from the X-axis.
13.567[2]	22.0	69.55	47.55	70	Antenna was at +45 degrees from the X-axis.

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

5.3 Spurious Emissions (12.5 to 30 MHz.)

The EUT was placed in an anechoic chamber and the Spurious Emissions testing was preformed in accordance with ANSI C63.4 and FCC Part 15, Subpart C. The Spurious Emission measurements were made to determine the level of 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 (dBµV/m) = receiver level (µV) + antenna factor (dB/m) + cable loss (dB) - preamp gain (dB) + lineal conversion (dB).

5.2.2 Test Criteria

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

Frequency (MHz)	Distance (m)	Field Strength (dB µV/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: A 40 dB/decade extrapolation factor was used per 15.31.

5.3.3 Test Results

The EUT met the FCC Part 15, Subpart C Spurious Emissions (12.5 to 30 MHz.) requirements. All maximized quasi-peak measurements for the EUT were below the quasi-peak limits. Test data is shown in Appendix C. The worst-case quasi-peak emission was as follows:

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Passing Margin (dB)	Turntable (degrees)	Antenna Orientation/Angle (Polarity/degrees)
13.5485	34.6	69.55	34.95	70	Antenna was at +45 degrees from the X-axis.

5.4 Radiated Emissions (30 to 5000 MHz)

All test data for 30 to 5000 MHz can be referenced in EMC Technologies Pty Ltd Report Number: M021210R_Cert_Tx issued on 30 July 2004.

6.0 LIST OF TEST EQUIPMENT

The following test equipment was used to perform the indicated tests. All of the 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 the 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.

FREQUENCY STABILITY/POWER OUTPUT

Advantest Spectrum Analyzer, Model R3272A, Serial No. J00233 (cal due date: 09 Sep 04)
Thermotron Environmental Chamber, Model SM-3SS, Serial No. 19972-S (cal due date: 17 June 04)

RADIATED EMISSIONS

ElectroMetrics Large Loop Antenna. Model ALR25M, Serial No. 603 (cal due date: 08 Sep 04)
HP Pre-Amplifier, Model 8447D, Serial No. 2944A08064 (cal due date: 09 Sep 04)
Rohde & Schwarz EMI Receiver, Model ESBI 52, S/N 835387/003 (cal due date: 09 Sep 04)
Rohde & Schwarz EMI Receiver Display, Serial No. 835518/001 (cal due date: 09 Sep 04)
Rohde & Schwarz ES-K1, ES-K2, & ES-K12 EMI Software, Version 1.60

TEST FACILITY

Lindgren Semi-Anechoic Chamber, Model 11867A, serial No. 01211 (verification due date: 28 Apr 04)

The radiated and conducted emission measurements were performed in our Anechoic Chamber located at 3M Building 76, 410 Fillmore Street, St. Paul, MN. Details concerning the site are on file with the FCC laboratory Division in Columbia Maryland.

The Facility Registration Number is 93334, 31-March – 2003.

7.0 LABELING INFORMATION

The FCC (Federal Communications Commission) requires the following labeling information. Since the equipment has intentional and unintentional radiators, it must be labeled as a digital device and as an intentional radiator.

Labels on the Product

The following statement 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: _____

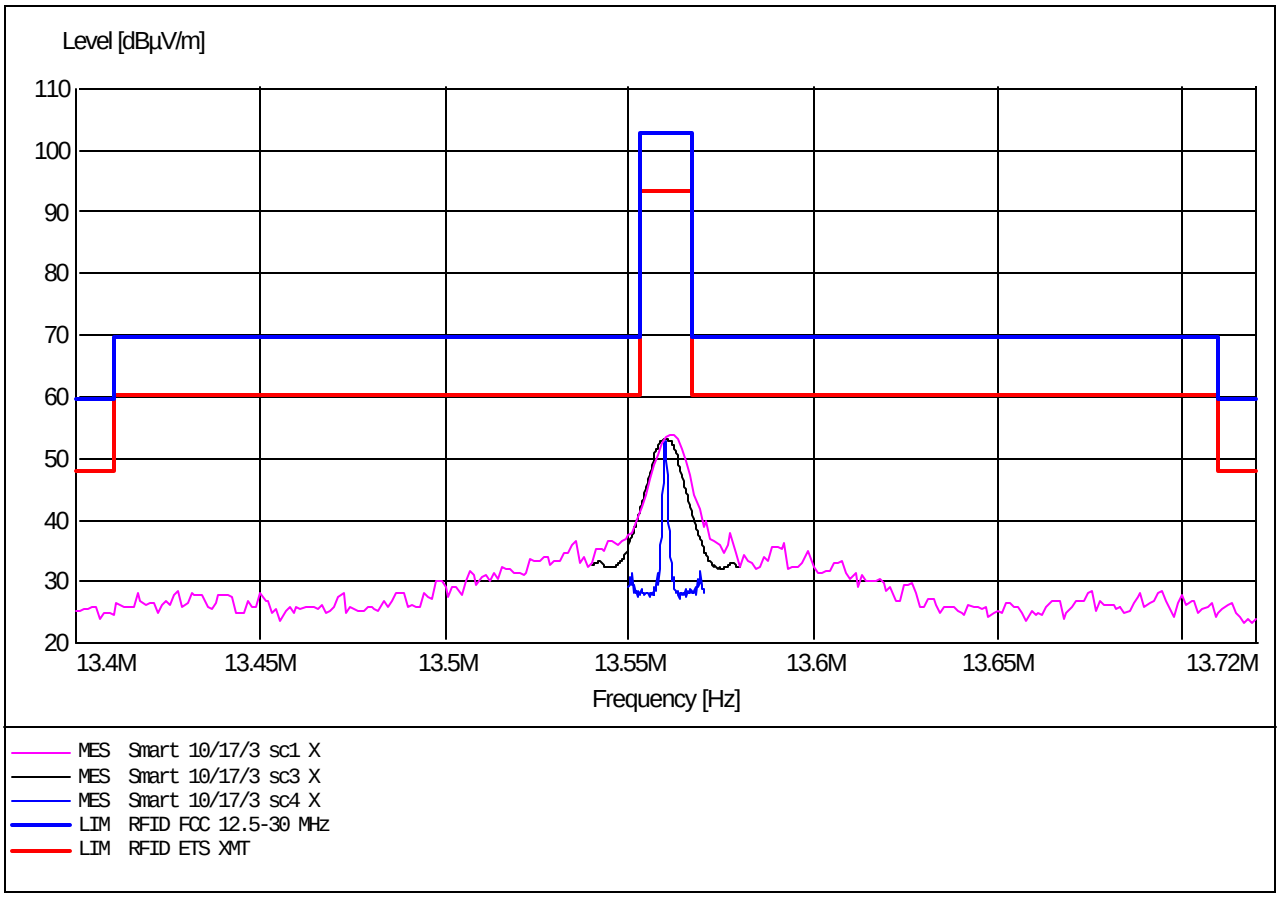
Labels in the Manuals

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 own expense.
>
> FCC ID: _____
>
> NO MODIFICATIONS. Modifications to this device shall not be made without the written consent of 3M, Incorporated. Unauthorized modifications may void the authority granted under Federal Communications Commission Rules permitting the operation of this device.

Appendix A

Emission Bandwidth



888 SmartCheck Emissions Bandwidth Graph

Appendix B

Spurious Emissions
(12.5 to 30 MHz.)

SPURIOUS EMISSIONS

3 EMC Lab

TEST REPORT # F1003004 SHEET 1 OF 1

EUT MODEL # 888 EUT SERIAL # 888000023

DESCRIPTION SmartCheck

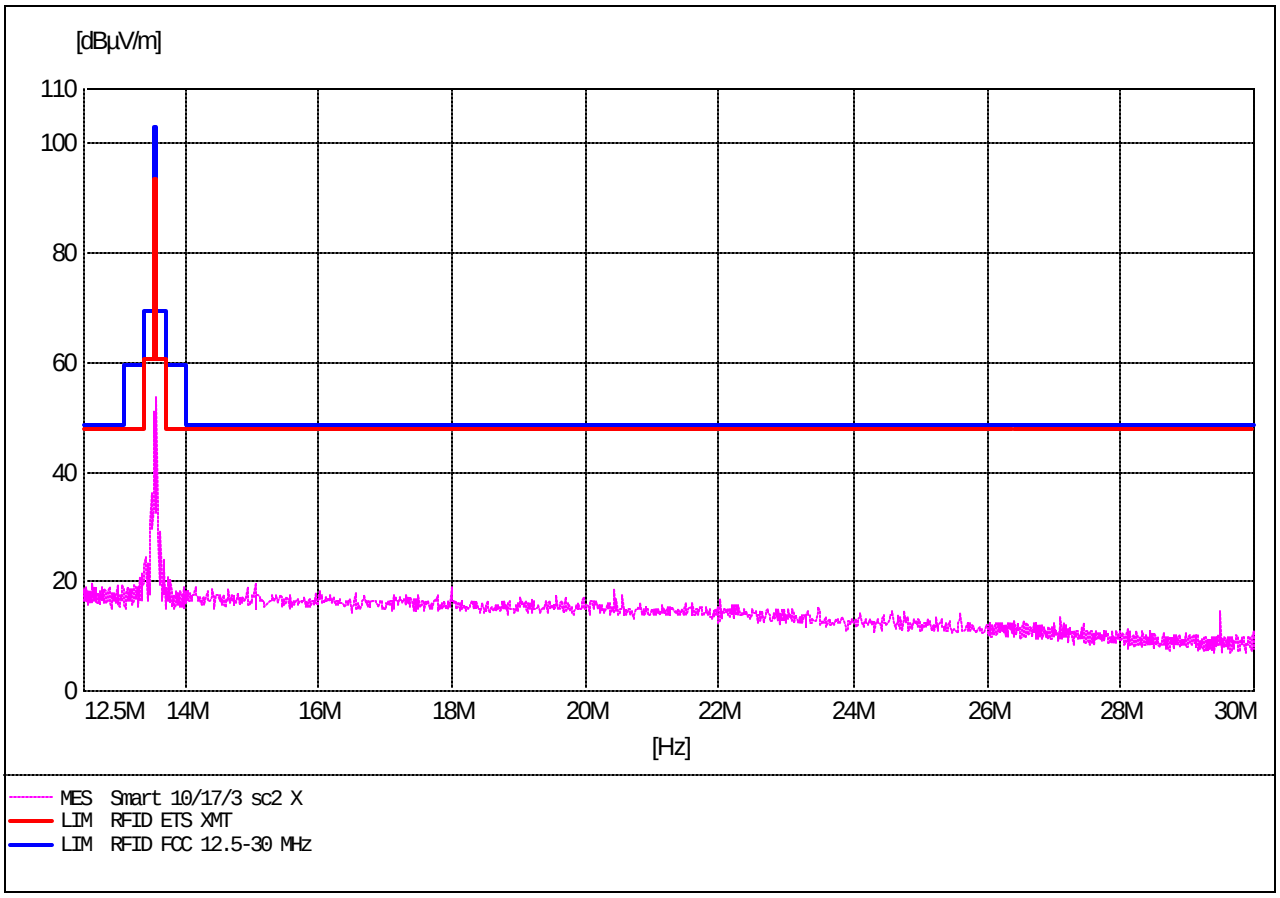
FREQ. (MHz)	MAXIMIZED QP SIGNAL H/V	MAXIMIZED QP SIGNAL (dBµV/m)	LIMIT LINE (dBµV/m)	PASSING MARGIN (dB)	MAXIMIZED POSITION TURNTABLE (degrees)	MAXIMIZED POSITION ANTENNA (meters)	REMARKS
13.5485	V	34.6	49.54	14.94	70	1	
13.5715	V	34.3	49.54	15.24	70	1	
27.1202	V	8.3	30.00	21.7	70	1	

Signatory: Bruce R. Jungwirth

Test Engineer: Bruce R Jungwirth Date: 10-17-2003

Signatory: Roger Kuhn

Reviewed by: Roger D. Kuhn Date: 18 August 2004



888 SmartCheck Spurious Emissions Graph

Appendix C

Photographs

Resolution Bandwidth and Spurious Emissions Test Setup

End of Report