MOTOROLA

Systems Solutions Group
8201 E. McDowell Road
Scottsdale, AZ 85252-1417

Report No. WSSD080600

Exhibit 6 – Test Report

Motorola M-Smart MultiPass™

13.56 MHz Smartcard

Access Control Reader

FCC ID: E9UMP1000

Model No. MP-1000

Equipment Manufacturer:	**Indala Corporation *(subsidiary of Motorola, Inc.)*** **3041 Orchard Parkway** **San Jose, CA 95134**
Tests Conducted By:	**Motorola SSG** **EMC Test Facility** **8201 E. McDowell Rd.** **Scottsdale, Arizona 85252**
Tests Period:	**May 15th to May 30th , 2000**
Test Summary:	**Complies with FCC Part 15, Subpart C, Unlicensed Low Power Transmitters operating within the band of 13.553 - 13.567 MHz.**

The Motorola SSG EMC/TEMPEST Laboratory is accredited through the

NVLAP®

NVLAP Lab Code 100405-0

6.0 Introduction

6.0.1 Product Description

The Motorola M-Smart MultiPass™ 13.56 MHz Smartcard Access Control Reader (codename: "Maui") provides all functions necessary to communicate with an ISO 14443 Type B contactless Smartcard and to an external control panel communicating using multiple data formats, including the standard 26-bit Wiegand™ protocol, Motorola Secure, and RS-232 pass through.

The purpose of the reader is access control. When the reader is powered, a low-power radio frequency (RF) field is continuously transmitted by the reader at 13.56 MHz. When a Smartcard is presented within the readers RF field, the microchip embedded in the card, is activated and transmits a unique Identification (ID) number back to the reader at a frequency of 847.5 kHz. The reader validates the identification number, and, if it is valid, converts it to a predefined data format and sends it to the control panel through a data cable. The control panel determines the action to be taken (e.g. open a door, update database, etc.).

The reader shall provide both a visual and audible feedback of an access attempt using a tri-color LED and beeper. Additionally, the control panel shall be able to control the LED and beeper via input lines into the reader.

Product Specifications:

Operating Frequency	-	13.56 MHz
Modulation Type	-	10% ASK
Effective Radiated Power	-	< 7.2 mW (+8.57 dBm)

The main subassembly consists of two printed circuit boards and referred to as the Serial Card Acceptance Device (CAD). The control board contains the microprocessor, non-volatile memory, and radio frequency transmitting and receiving circuitry. The board communicates with the smart cards via an RF link. The antenna board is a pcb with copper traces forming the transmit and receive antennas. This board is attached to a ferrite plate and a metal backplate which serves as a ground plane. This subassembly, Serial CAD, including the transmitter/receiver circuitry has been previously certified as a discrete component to be used in various other systems and carries the FCC ID: ABZ89FT7601.

6.0.2 Facility Description

EMI testing of the Maui Smartcard Reader was performed at the Motorola Systems Solutions Group's (SSG) EMI/TEMPEST Test Laboratory. This test laboratory is located in the southeast wing of the Hayden building at 8201 E. McDowell Road, Scottsdale, AZ.

Motorola SSG Test Facility Address:

Motorola, Inc.
Systems Solutions Group
Hayden EMC Facility
8201 E. McDowell Rd. M/D H2550
Scottsdale, AZ 85252

The facility has been found to be in compliance with the requirements of Section 2.948 of the FCC rules, per FCC letter 31040/SIT, 1300F2, dated October 6, 1998. The facility has also been issued a Certificate of Accreditation through the National Voluntary Laboratory Accreditation Program (NVLAP) by NIST. This is under NVLAP Code: 100405-0 and is effective through September 30, 2001.

6.0.3 Quality System

The EMI/TEMPEST Test Laboratory maintains a Quality Manual that describes the quality assurance program of the EMC/TEMPEST Facility to set forth procedures covering all quality assurance functions. This manual has been constructed to reflect a quality program in compliance with the requirements of the following:

- National Institute of Standards & Technology (NIST) National Voluntary Laboratory Accreditation Program (NVLAP)
- NIST/NVLAP EMC MIL-STD 462 Program Handbook (Apr. 1994)
- NVLAP EMC and Telecommunications FCC Methods Handbook 150-11 (Apr. 1995)
- MIL-Q-9858A, MIL-STD 461, 462, 463, 461D, 462D
- National Security Agency Technical and Security Requirements Document for the Endorsed TEMPEST Test Services Program, NSA TSRD No. 88-8B, 5 Oct. 1993
- System Solution Group of Motorola Quality Six Sigma Program.

6.0.4 Standard References

47 CFR 2	Code of Federal Regulations, Title 47, Part 2, "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations"
47 CFR 15	Code of Federal Regulations, Title 47, Part 15, "Radio Frequency Devices" Subpart C, "Intentional Radiators"
C63.4-1992	American National Standards Institute (ANSI), "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"

6.1 Test Procedures

6.1.1 Requirements

The Maui Smartcard reader is subject to FCC Part 15, Subpart C and Part 2 for FCC Certification for units marketed within the United States. The following tests, as specified in FCC Part 2, with limits as defined in FCC Part 15, and shown in Table 6.1-1 below were performed on the Maui Smartcard Reader.

Table 6.1-1 Tests Required for Certification of the 13.56 MHz Smartcard Reader

Test Parameter	FCC Part 2 Paragraph Number	FCC Part 15 Paragraph Number	FCC Part 15 Limit
RF Power Output	2.1046	15.225	10,000 uV/m @ 30 m (80 dBuV/m)
Field Strength of Spurious Emissions	2.1053	15.209	**Freq (MHz) Limit (uV/m) d (m)** .009-0.490 MHz 2400/F(kHz) 300m 0.490-1.705 MHz 24000/F 30 m 1.705-30 MHz 30 30 m 30-88 MHz 100 3 m 88-216 MHz 150 3m 216-960 MHz 200 3m Above 960 MHz 500 3m
Frequency Stability	2.1055	15.225	$\pm$ .01 %

6.1.2 Operational Configuration

The Maui Smartcard Reader was tested in its typical operational configuration. The Maui unit was set up and operated in a continuous transmit mode at the frequency of 13.56 MHz and at its maximum rated output power for all tests. All testing was done in a radiated test setup since the antenna is an integral part of the unit. There is no specification limit on modulation characteristics except that the modulation source shall be representative of that used in an actual installation. The unit utilizes 10% ASK modulation and was generated internal to the unit. A general test setup is shown as Figure 6.1-1.

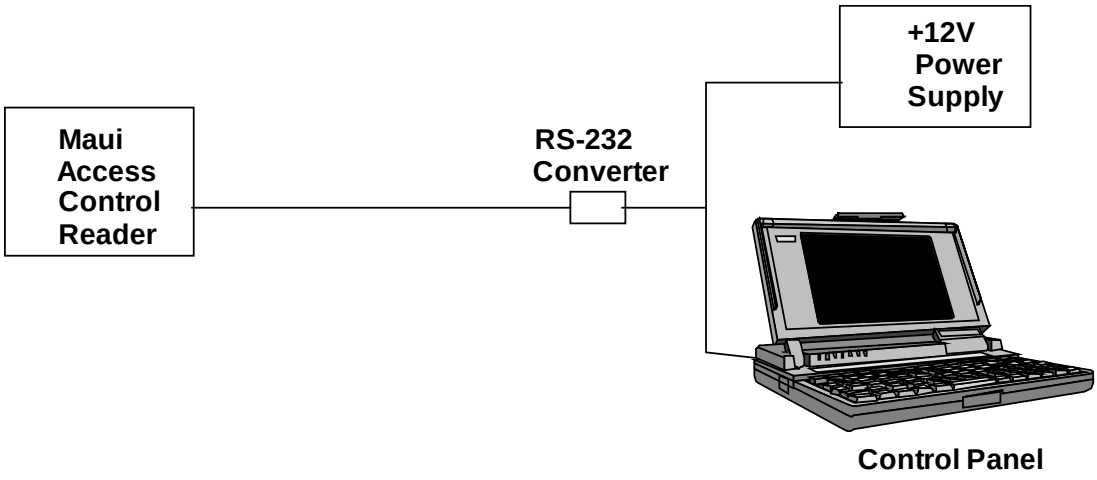

Figure 6.1-1 General Test Setup for Tests

6.1.3 Measurement Equipment

Test Equipment Nomenclature	Motorola Item Number	Manufacturer	Model Number	Cal. Date	Cal. Due
Biconilog Antenna	T47085	EMCO	3142B	9/03/99	9/30/00
Biconilog Antenna	T47086	EMCO	3142B	9/03/99	9/30/00
H-Field Loop Antenna	T36610	Electro Metrics	ALP-70	NCR	NCR
Rod Antenna	T10065	Singer	94607-1	11/05/99	11/30/00
Antenna Mast	0003-2246	EMCO	2070-2	NCR	NCR
Antenna Controller	G72315	EMCO	2090	NCR	NCR
Spectrum Analyzer	G38015	Hewlett Packard	HP8562A	6/28/99	6/30/00
Spectrum Analyzer/ EMI Receiver	G68094	Rhode & Schwarz	ESI40	5/01/00	5/31/01
Receiver	G53133	Rhode & Schwarz	ESMI	9/15/99	9/30/00
Quasi-Peak Detector	G63127	Hewlett Packard	HP85650A	10/18/99	10/31/00
Spectrum Analyzer	G17008	Hewlett Packard	HP8566B	4/17/00	10/31/00
Preselector	G30259	Hewlett Packard	HP85685A	10/20/99	10/31/00

6.1.4 Radiated Spurious Emissions Procedure

Radiated spurious emission were measured over the frequency range of 9 kHz to 1 GHz in an anecohic chamber (20ft x 24ft x 16ft) and an open area test site (OATS). Refer to Figure 6.1-2 and 6.1-3 for test setups.

The radiated emissions between 9 kHz and 30 MHz, including the carrier level, were measured in an anechoic chamber using both a rod antenna and a shielded magnetic loop antenna at a 3 meter distance. The levels were extrapolated to the required test distance defined in 47 CFR Part 15 using the square of an inverse linear distance formula. These emissions were maximized by rotating the equipment on the turntable. When the using the magnetic loop antenna it was also rotated along its vertical axis.

The radiated emissions above 30 MHz were initially measured in a semi-anechoic shield room in order to identify the emissions before proceeding to the open area test site (OATS). This provides the capability of taking accurate measurements in a higher ambient environment such as at the rooftop OATS. The Rohde & Schwarz EMI Receiver System was used for the pre-scans. Typically, signals within approximately 10 dB of the limit are noted for measurements on the OATS.

Final measurements on the OATS were taken with an HP8566B receiver system with preselector at a 3 meter test distance from the receiving antenna. The Smartcard Reader was placed on a .8 meter high non-conductive table on a rotating turntable which is flush with the site ground plane. The receiving antenna was scanned over a height range from 1 to 4 meters in both antenna polarities, and the turntable was rotated 360 degrees. The highest emissions were recorded and the final field strength level determined using the following formula:

Field Strength (dBuV/m) = Measured Level (dBuV) + Cable Loss (dB) + Antenna Factor (dB)

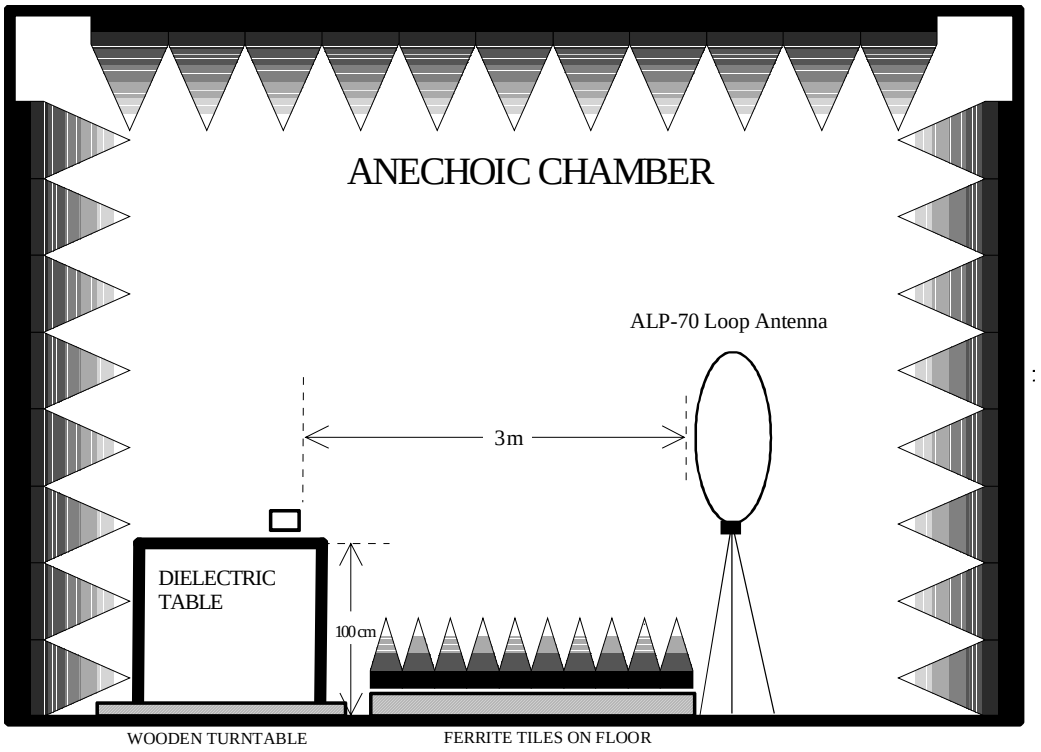

Figure 6.1-2 Radiated Spurious Emissions Test Setup - Chamber

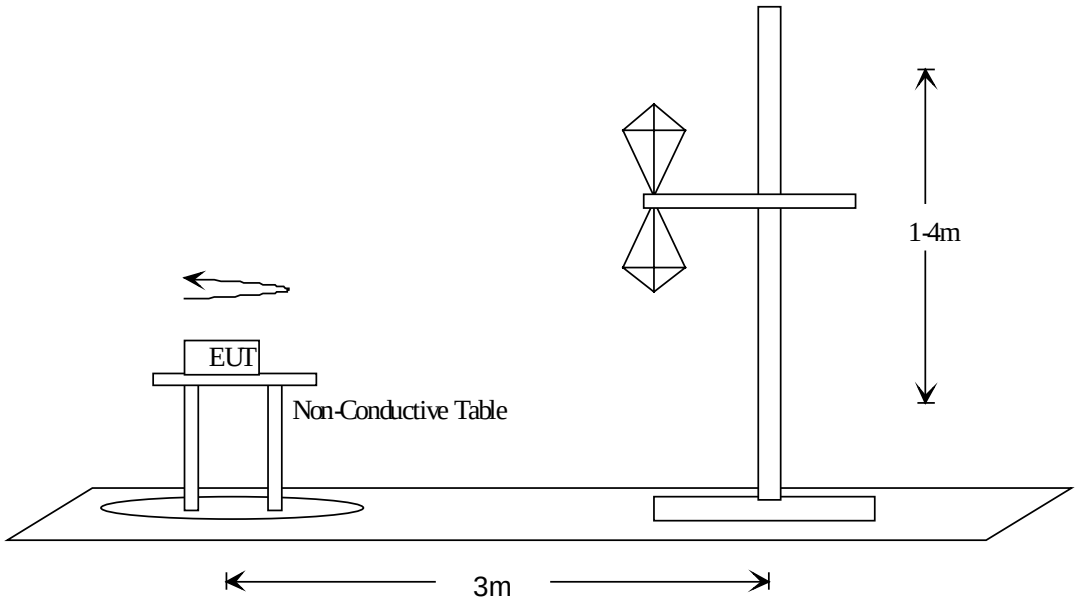

Figure 6.1-3 Radiated Spurious Emissions Test Setup -OATS

6.1.5 Frequency Stability Procedure

The Maui Smartcard Reader transmitter was tested for frequency stability when operated at maximum rated power over the temperature range of -30^{o} to $+55^{o}$ C and over an input power voltage range of +/- 15% or from +10.2 Vdc to +13.8 Vdc.

6.2 Test Results

6.2.1 Radiated Spurious Emissions Measurement Test Results

All measurements were made with the Smartcard Reader transmitting at its maximum rated output power. The antenna is an integral part of the unit and the unit is continuously transmitting at 13.56 MHz. Most of the measurements displayed significant margin to the limits and, therefore, were not re-measured using a Quasi-Peak detector but, rather, displayed as a worst case, max peak emission. The exception were emissions which were within 6 dB of the limit. These were re-measured using the Quasi-Peak detector and noted as such in the data sheet.

The radiated emission at the frequency of operation was 36.23 dBuV/m (76.23 dBuV/m @ 3 meters) worst case using a shielded magnetic loop antenna. This was well below the 80 dBuV/m (10,000 uV/m) limit at 30 meters specified in 47 CFR Section 15.225 at the operating frequency of 13.56 MHz. Measurements were performed in an anechoic chamber at a distance of 3 meters with the measured data corrected to the 30 meter distance using a 40 dB/decade factor. The antenna factor, cable loss, H-field to E-field conversion (51.5 dB), and distance correction factors are already included on the plot as an amplitude level offset. Rod Antenna measurements were also performed for "information only" and included in the report. Refer to Figures A-1 through A-5 for the measurement plots and the test setup photographs in the anechoic chamber.

The radiated emissions for the frequency range of 9 kHz to 30 MHz were all below the applicable limits of 47 CFR 15.209 including the second harmonic. The second harmonic at 27.12 MHz was in the noise when measured using a shielded magnetic loop antenna. A rod antenna measurement was also performed for "information only" and measured at 10 dBuV/m, 19.5 dB below the limit. These measurements were also performed in an anechoic chamber at a distance of 3 meters and extrapolated to the required distance defined in 15.209. These scans were taken with an automated EMI Receiver system using scan tables setup specifically for the requirement conditions including bandwidth, transducer factors, and distance correction. These worst case graphs and the test setup photos are shown in Figures B-1 and B-2. The test setup is also representative by the previous photos of Figures A-3 through A-5.

Measurements for 30 MHz to 1 GHz were taken first in the semi-anechoic chamber in order to identify the critical frequencies. Signals which were within 10 dB of the limit were recorded and their final measurement was taken on the OATS. The measurements were taken at a test distance of 3 meters per the specification. The final results of the measurements are shown in Figure C-1. The test setup photos are shown as Figures C-2 and C-3. All emissions in this range were below the specification limits of 47 CFR Section 15.209. The 11^{th} harmonic of the carrier was the worst case emission measuring -3.0 dB below the specification limit.

6.2.2 Frequency Stability Measurement Test Results

The Maui Smartcard Reader was tested for transmitter frequency stability under temperature and voltage variation. The unit was placed in an environmental chamber and tested over a range of -20°C to +55°C allowing enough time at each temperature for the frequency to stabilize.

The unit was also operated while the supply voltage was varied between 85% to 115% of the nominal supply voltage of +12 Vdc.

The frequency shift was 0.000590% or less under all conditions which is well below the $\pm$ 0.01% specification of 15.225 (c). All measurements were taken on May 18, 2000. The tabulated data as well as graphs are shown in Appendix D, Figures D-1 through D-4.

Appendix A

Transmitter Carrier Measurements

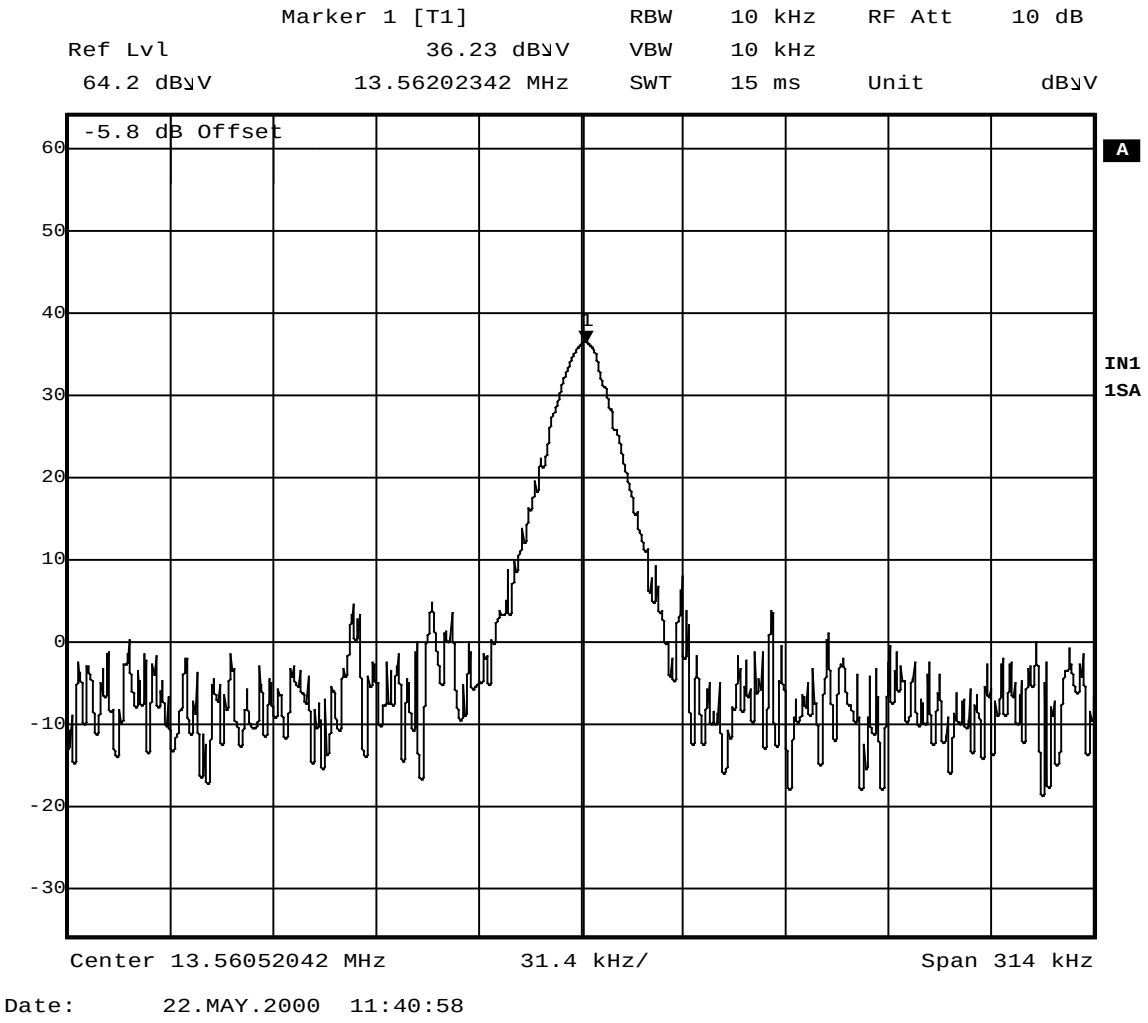

Figure A – 1 Transmitter Carrier Level Measurement - Loop Antenna

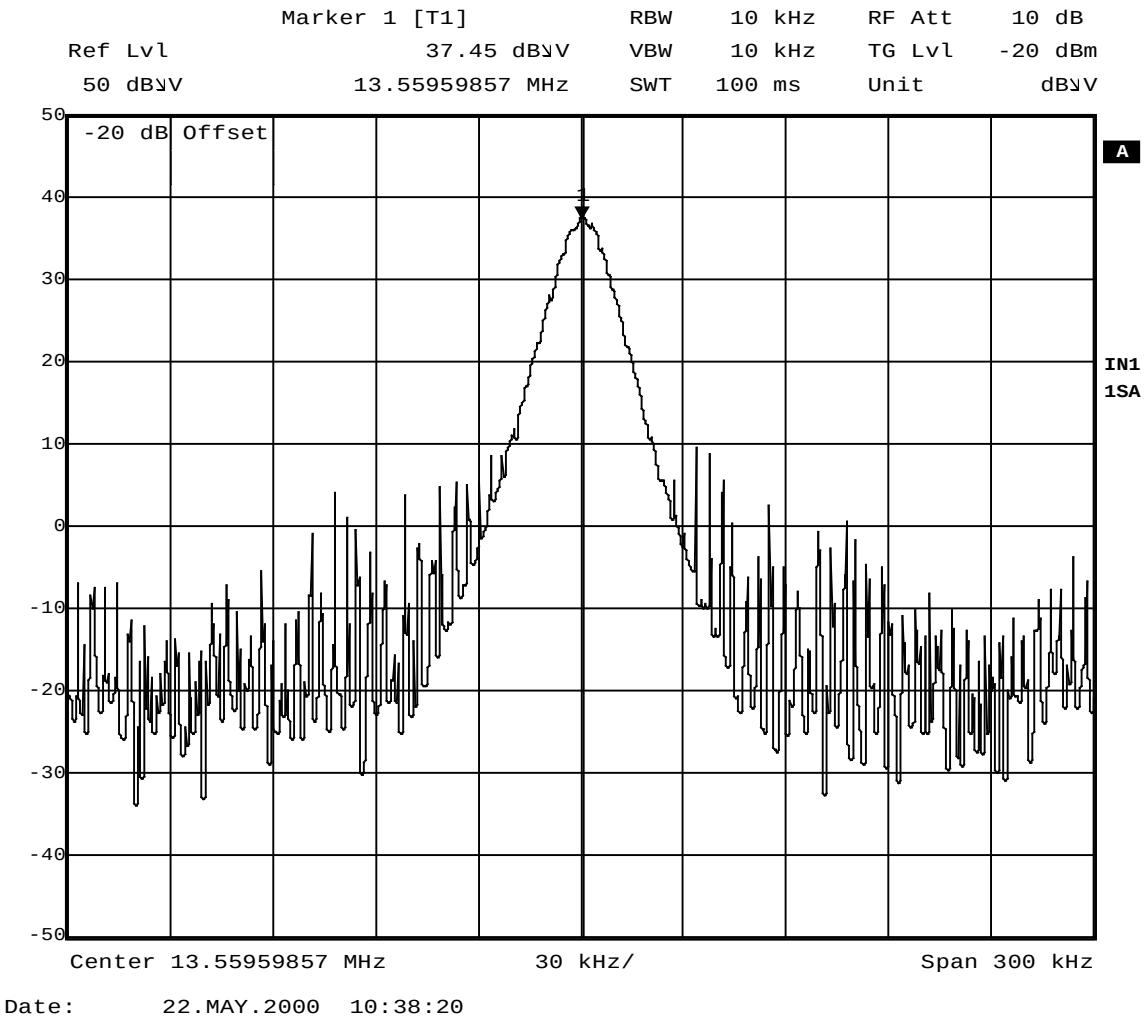

Figure A – 2 Transmitter Carrier Level Measurement - Rod Antenna

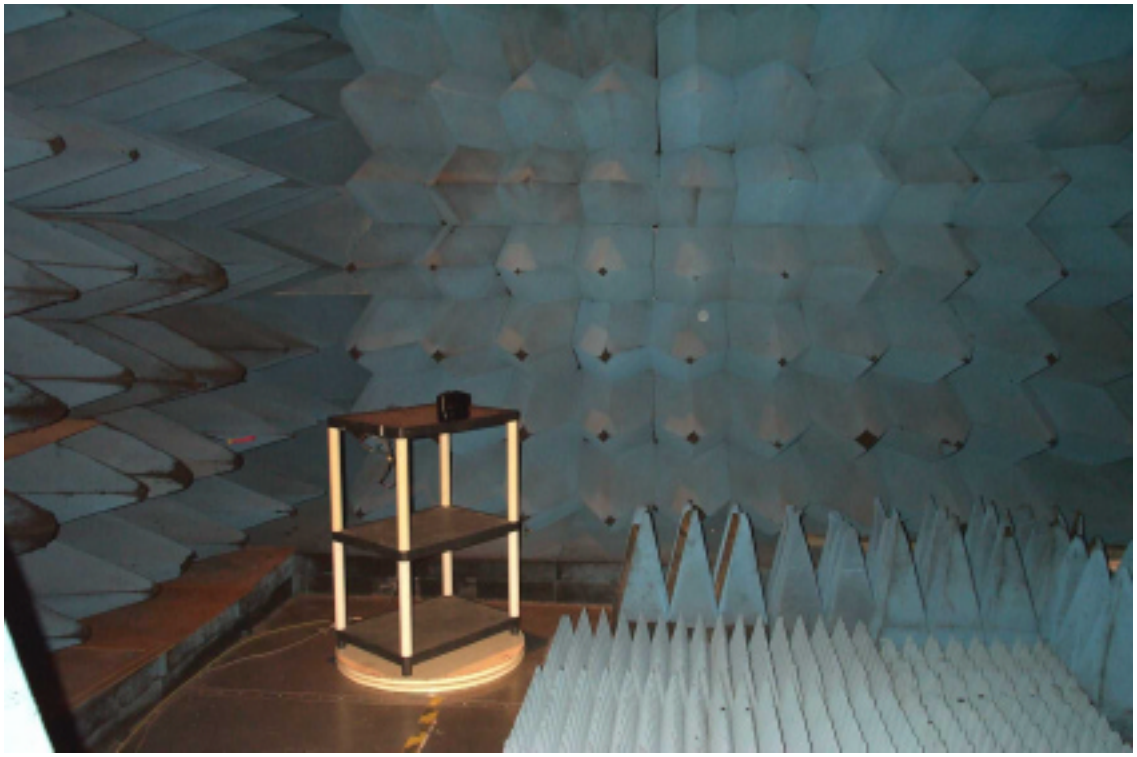

Figure A – 3 Radiated Emissions Test Setup

Figure A – 4 Radiated Emissions Test Setup - Loop Antenna

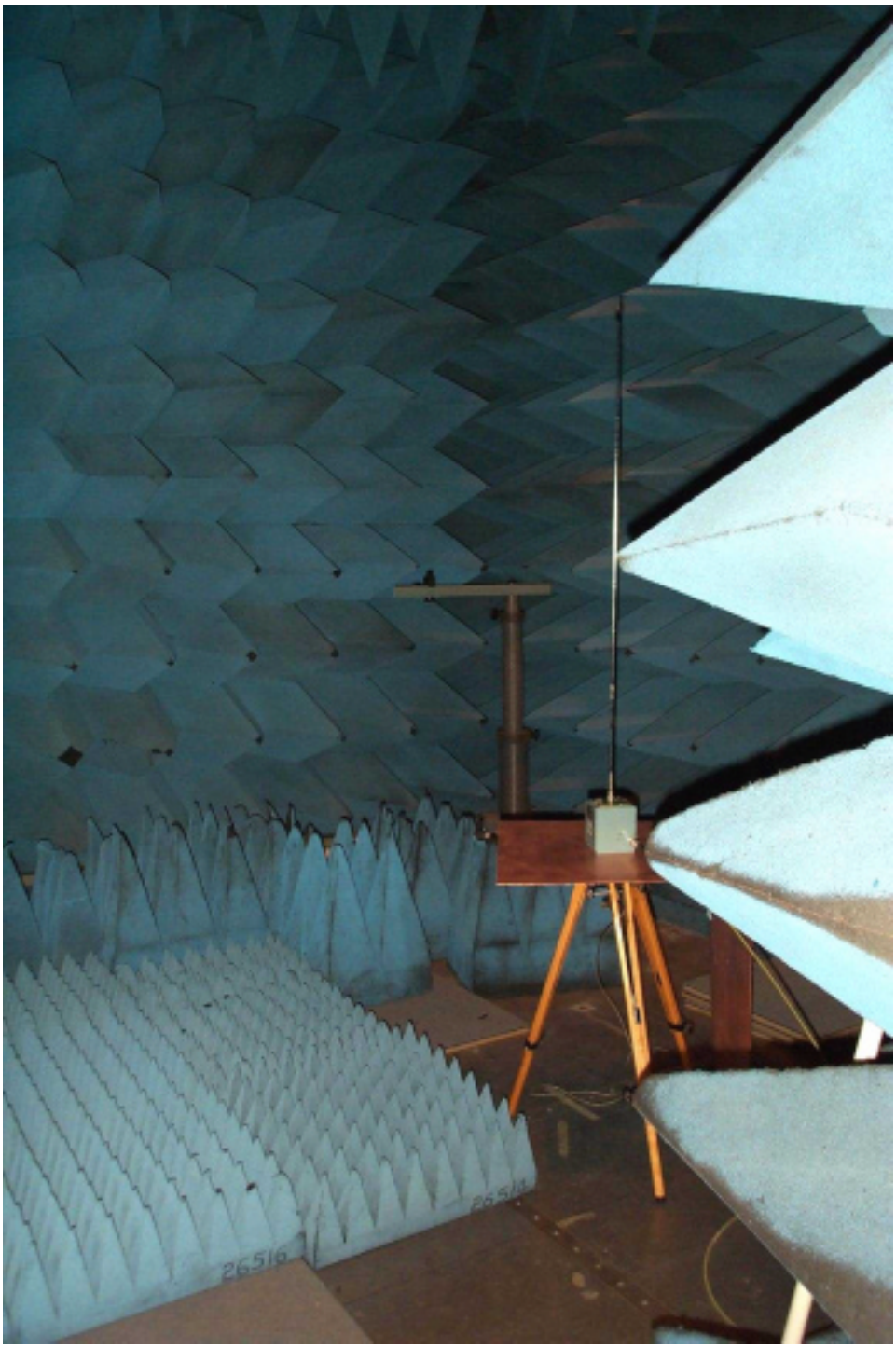

Figure A – 5 Radiated Emissions Test Setup - Rod Antenna

Appendix B

Radiated Spurious Emission Measurements

9kHz to 30 MHz

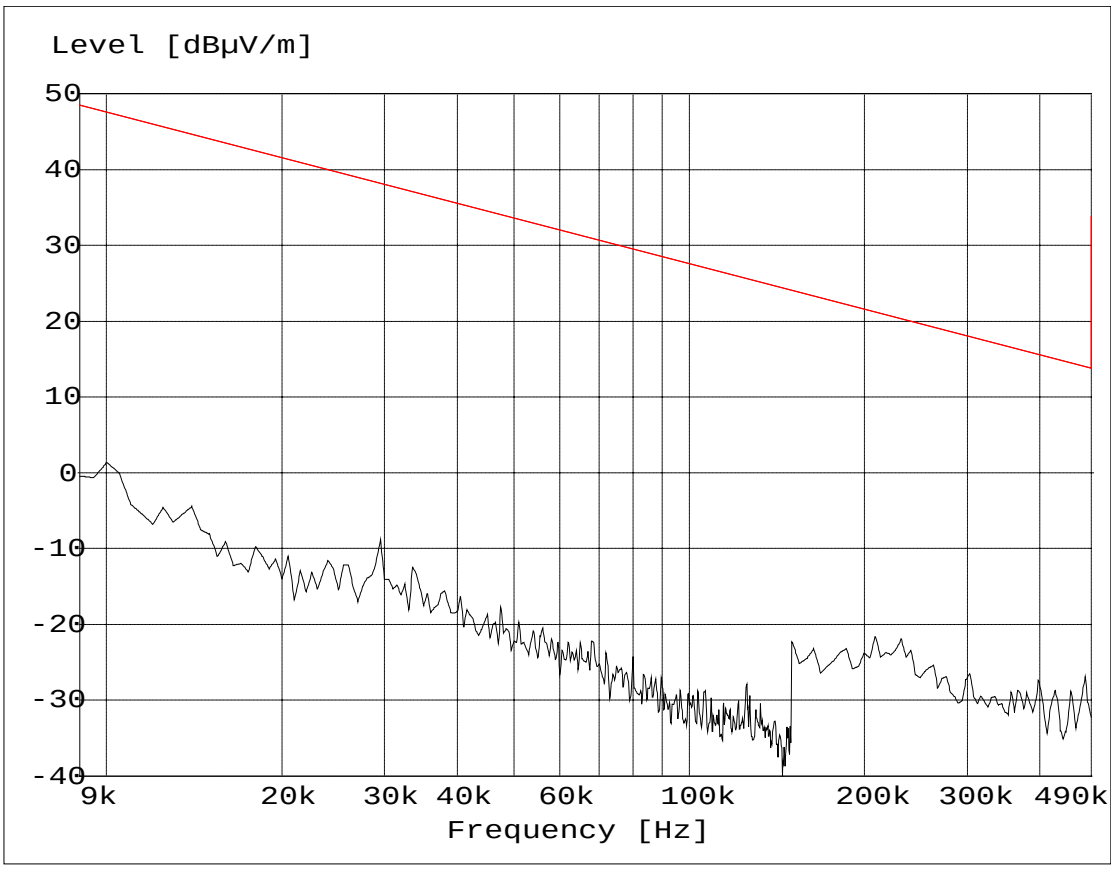

Figure B – 1 Radiated Spurious Emissions, 9 kHz to 490 kHz, Loop Antenna

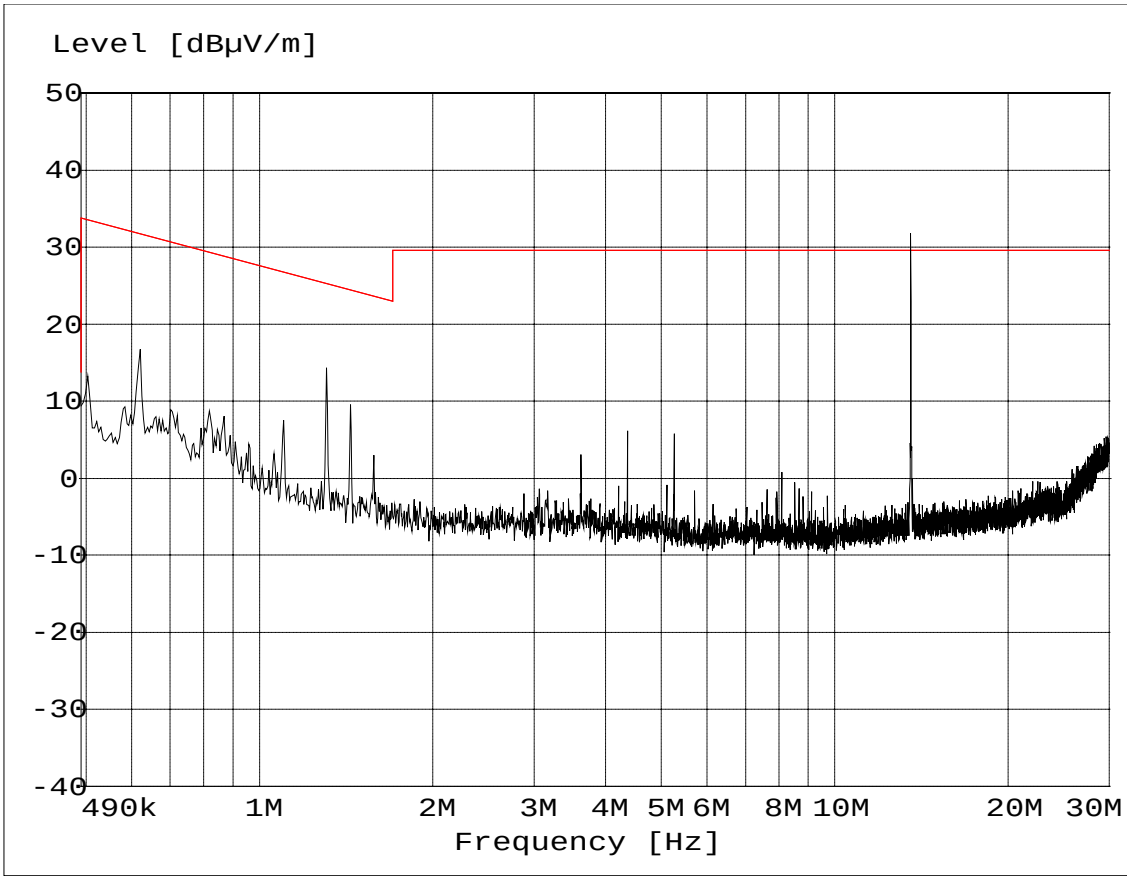

Figure B – 2 Radiated Spurious Emissions, 490 kHz to 30 MHz, Loop Antenna

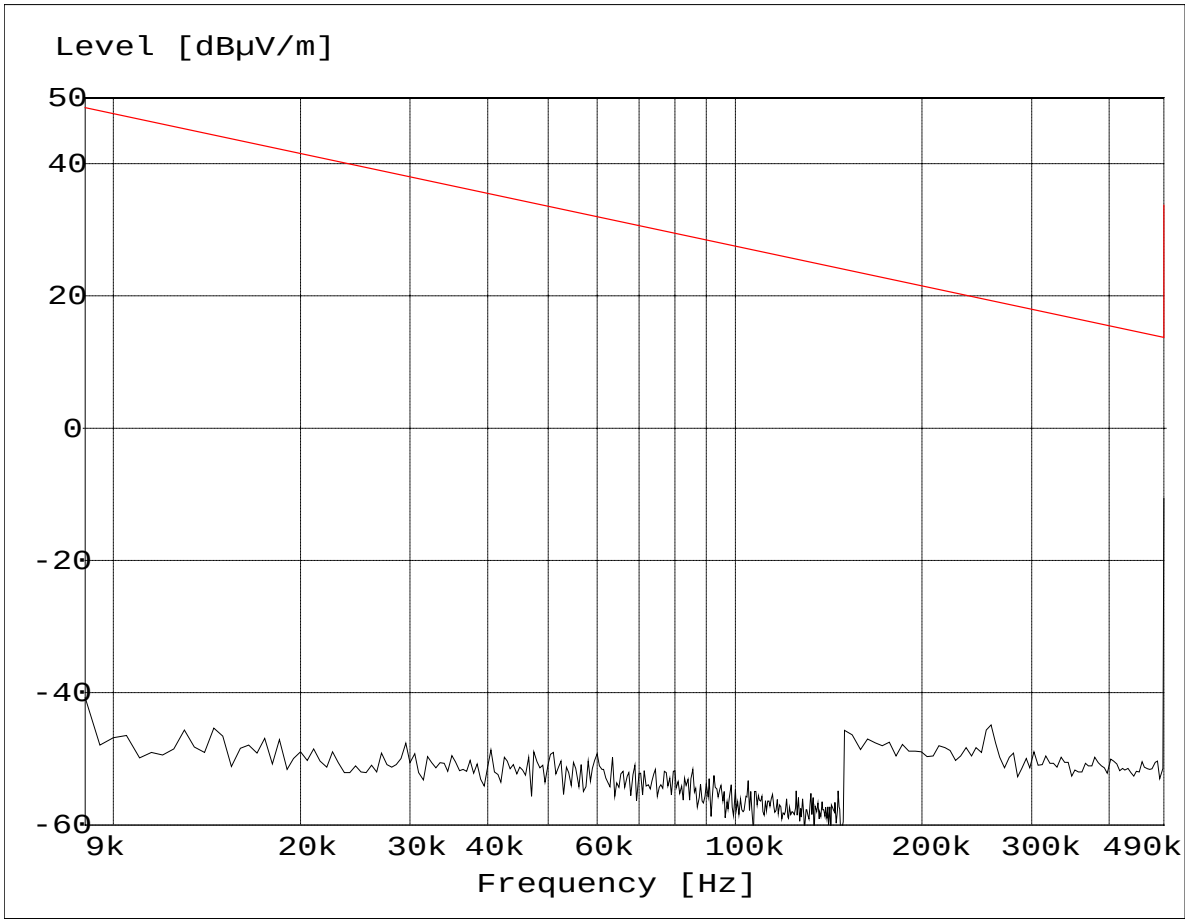

Figure B – 3 Radiated Spurious Emissions, 9 kHz to 490 kHz, Rod Antenna

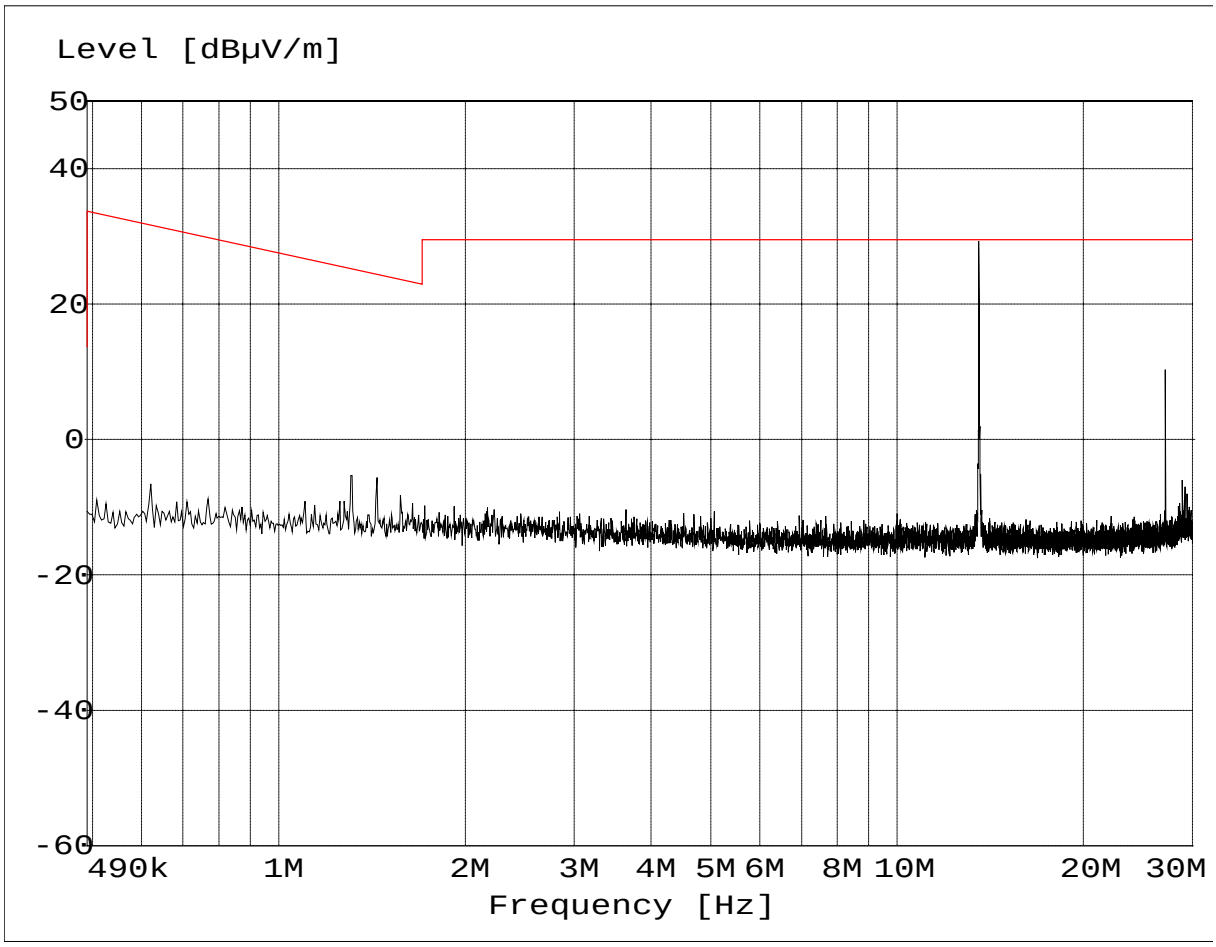

Figure B – 4 Radiated Spurious Emissions, 490 kHz to 30 MHz, Rod Antenna

Appendix C

Radiated Spurious Emission Measurements

30 MHz to 1000 MHz

Motorola SSG Test Data Sheet

FCC Radiated Test Results

Comments:

Equip. Maui Smartcard Reader — Test Date: 5/31/00
Mode: Transmit — Test Technician: J. Dykema /R. Johnston
Model#: T641 — Measurement Distance (m) 3
Serial #: N*06500105 — Equipment Class B
Bold Reading are Quasi Peak — 40° Hum 15.% BP 75.24 R

Frequency MHz	SA Reading (dBuV)	Az	Ht cm	Pol	Antenna Factor	Cable/Attn. Loss	Pre Amp dB	Emission (dBuV/m)	Spec Limit (dBuV/m)	Deviation from Spec. Limit (dB)	
40.680	12.0	f	100	v	11.1	7.5	0.0	30.6	40.0	-9.4	3rd Harmonic
54.240	4.0	r	100	v	7.9	7.8	0.0	19.7	40.0	-20.3	4th Harmonic
135.600	**16.3**	r	180	v	11.4	8.8	0.0	36.5	43.5	-7.0	10th Harmonic
149.160	**19.6**	lf	105	v	12.1	8.8	0.0	40.5	43.5	-3.0	11th Harmonic
189.840	13.0	r	164	h	10.5	9.2	0.0	32.6	43.5	-10.9	14th Harmonic
284.760	6.6	r	120	h	13.0	9.9	0.0	29.5	46.0	-16.5	21st Harmonic
294.900	10.3	r	108	h	13.4	10.0	0.0	33.7	46.0	-12.3	
571.380	**-0.4**	lf	238	v	24.2	11.5	0.0	35.3	46.0	-10.7	
840.720	4.1	b	275	h	22.5	12.9	0.0	39.4	46.0	-6.6	100 kHz BW
894.960	-10.0		154	h	23.3	13.1	0.0	26.4	46.0	-19.6	10 kHz BW, Noise Floor
908.520	-10.0		154	h	23.5	13.2	0.0	26.7	46.0	-19.3	10 kHz BW, Noise Floor
922.080	-10.0		154	h	23.4	13.3	0.0	26.7	46.0	-19.3	10 kHz BW, Noise Floor
949.200	-10.0		154	h	23.9	13.5	0.0	27.4	46.0	-18.6	10 kHz BW, Noise Floor

Figure C – 1 Radiated Spurious Emissions Data, 30 MHz to 1 GHz

Figure C – 2 Radiated Spurious Emissions Test Setup, OATS

Figure C – 3 Radiated Spurious Emissions Test Setup, OATS

Appendix D

Frequency Stability Measurements

°C	f @ rated voltage in MHz	f @ -15% rated voltage in MHz	f @ +15% rated voltage in MHz	% Error @ -15% rated voltage	% Error @ +15% rated voltage	FCC Limit
-30	13.56050000	13.56050000	13.56050000	0.000369%	0.000369%	+/- 0.01%
-20	13.56052000	13.56052000	13.56052000	0.000516%	0.000516%	+/- 0.01%
-10	13.56050000	13.56050000	13.56050000	0.000369%	0.000369%	+/- 0.01%
0	13.56050000	13.56050000	13.56050000	0.000369%	0.000369%	+/- 0.01%
10	13.56048000	13.56048000	13.56048000	0.000221%	0.000221%	+/- 0.01%
20	13.56048000	13.56048000	13.56050000	0.000221%	0.000369%	+/- 0.01%
30	13.56050000	13.56048000	13.56048000	0.000221%	0.000221%	+/- 0.01%
40	13.56052000	13.56052000	13.56050000	0.000516%	0.000369%	+/- 0.01%
50	13.56053000	13.56053000	13.56053000	0.000590%	0.000590%	+/- 0.01%
55	13.56052000	13.56053000	13.56053000	0.000590%	0.000590%	+/- 0.01%

Figure D – 1 Frequency Stability vs. Temperature Test Data

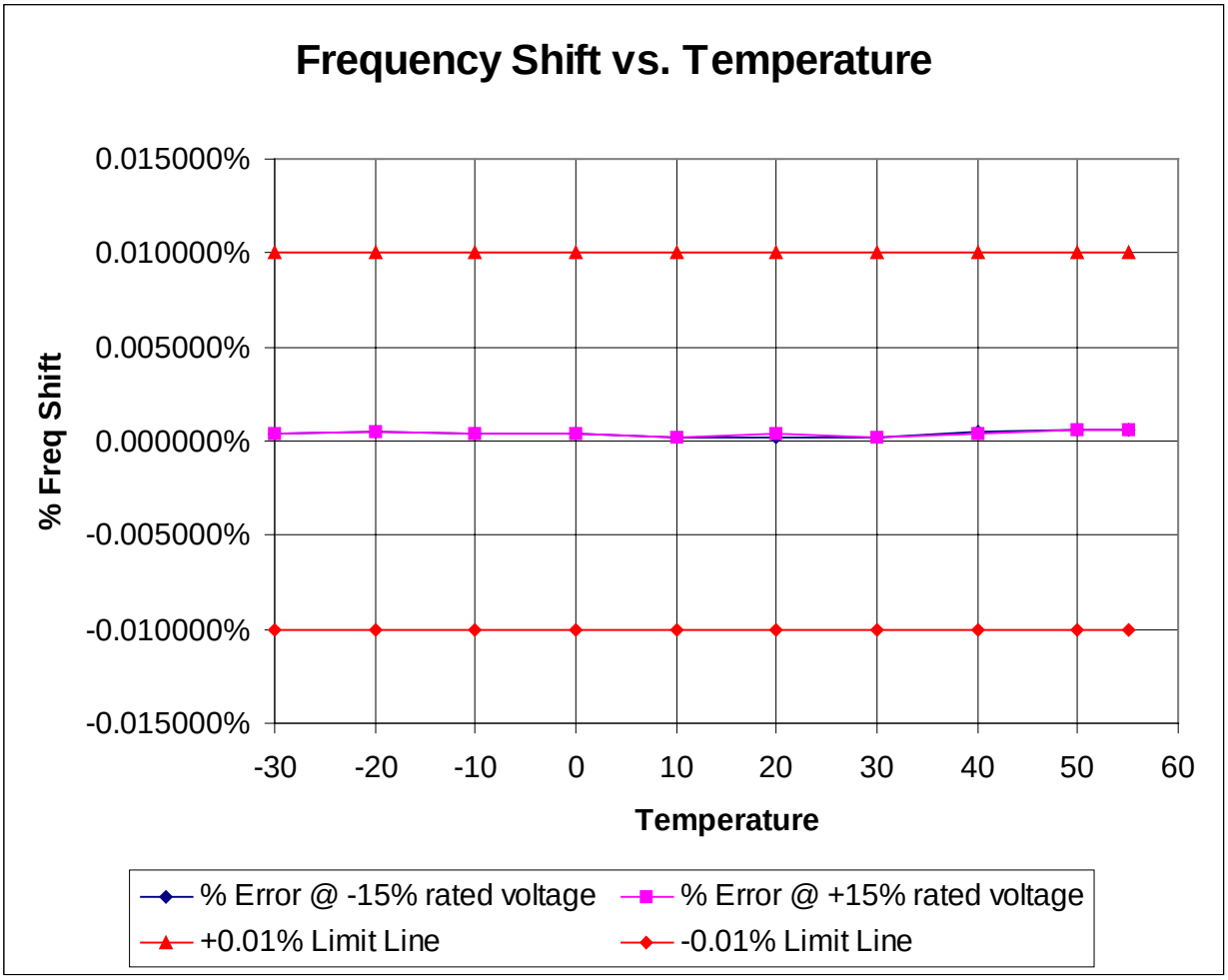

Figure D – 2 Frequency Stability vs. Temperature Graph

Voltage %	Voltage	f @ specified voltage in MHz	% Freq Shift @ specified voltage	FCC Limit
85	10.2	13.56045000	0.000074%	+/- 0.01%
90	10.8	13.56052000	0.000590%	+/- 0.01%
95	11.4	13.56051000	0.000516%	+/- 0.01%
100	12	13.56044000	0.000000%	+/- 0.01%
105	12.6	13.56044000	0.000000%	+/- 0.01%
110	13.2	13.56052000	0.000590%	+/- 0.01%
115	13.8	13.56050000	0.000442%	+/- 0.01%

Figure D – 3 Frequency Stability vs. Voltage Test Data

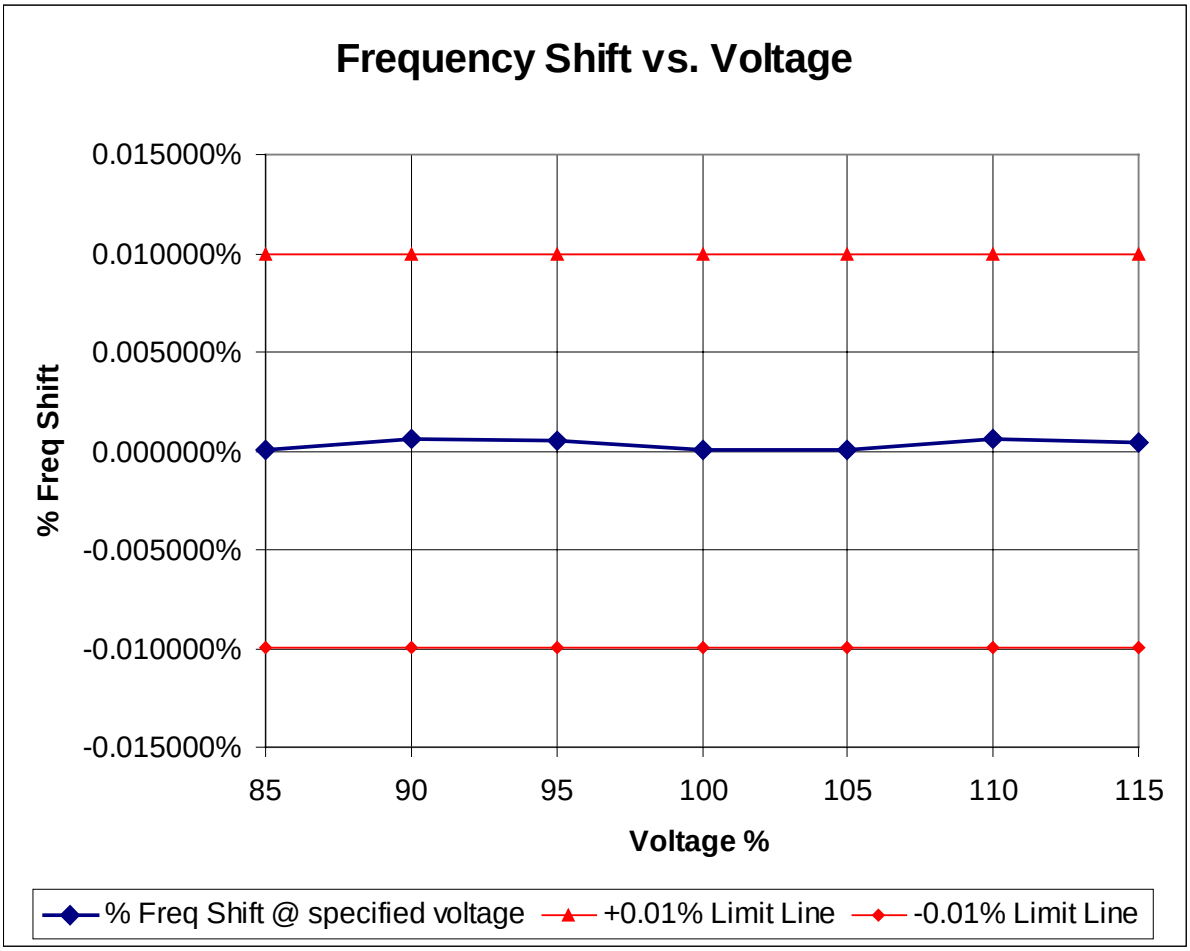

Figure D – 4 Frequency Stability vs. Voltage Graph