MEASUREMENT AND TECHNICAL REPORT ON THE MARCONI COMMERCE SYSTEMS TIRIS™ DRIVE-THRU READER RADIO FREQUENCY IDENTIFICATION DEVICE

Southwest Research Institute
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San Antonio, Texas 78228-0510

Project 10.04225.01.001
Report Number EMCR 00/082

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1.0 GENERAL INFORMATION

1.1 Product Description

The Marconi TIRIS™ Drive-Thru Reader (Part No. C00017-xxx) is a Radio Frequency Identification Device (RFID) which is designed for use with handheld battery-less transponders (Texas Instruments RI-TRP-Series such as a key ring tag). The handheld transponder is carried by the user. The Drive-Thru Reader allows customers wishing to purchase retail products to interface directly with a point of sale terminal via a handheld transponder. The Drive-Thru Reader transmits at 134.2kHz, which provides energy to the handheld tag. The handheld tags contain a unique and secure ID code so each customer can be identified by their individually registered tag. The low frequency antennas of the system create magnetic charge-up fields, known as "read-zones". As soon as a tag enters the "read-zone," the reader receives the unique ID code.

The transmitter portion of the TIRIS™ Drive-Thru Reader operates at 134.2 kHz and is subject to FCC Part 15, Subpart C, “Intentional Radiator,” paragraphs 15.207 and 15.209. The digital electronics portion of the TIRIS™ Drive-Thru Reader is subject to FCC Part 15, Subpart B, “Unintentional Radiator,” paragraph 15.109, under the Class A limits. Attachment 1 contains a detailed technical description and functionality of the TIRIS™ Drive-Thru Reader and its components. Photos of the TIRIS™ Drive-Thru Reader are provided in Appendix D.

1.2 Related Grants

The microreader module (Texas Instruments part No. RI-STU-MRD1) which provides the 134.2 kHz fundamental emission is a component of the TIRIS™ Drive-Thru Reader and has previously received certification under FCC ID: A92MICRO.

1.3 Tested System Details

The Marconi TIRIS™ Drive-Thru Reader System is mounted inside a QSR (Quick-Serve Restaurant) or similar industrial application. The system includes one Light/Beeper/Display/Gateway PCA (T20649), one 134.2kHz low 'Q' wound wire antenna (T20693-01), one Radio Frequency Module (RFM) (Texas Instruments part number RFM-007B), one RFM controller (T20656), one switched DC Power Supply (T20652), one Class II Energy Limiting transformer (R20719), and one EMI Line Filter (Q10895-01). The RFM controller can be either a T20656-G2 or T20656-G3. The Drive-Thru Reader components are listed in Table 1.1.

The 134.2 kHz transmit signal originates on the RFM located inside the distribution/interface sheet metal housing. The 134.2 kHz transmit signal is fed via the antenna cable to the loop antenna where it is intentionally radiated. The Marconi TIRIS™ Drive-Thru Reader operates from 120VAC converted to 24VAC using a Class II step-down energy limited transformer. The 24VAC is then rectified and converted to +22.5VDC, +8VDC, and -8VDC by means of a switching power supply. The system functional block diagram is provided in Attachment 1.

TABLE 1.1
TIRIS™ DRIVE-THRU READER COMPONENTS

Component Description	Marconi Part Number	Texas Instruments Part Number
Drive-Thru Reader Power Supply Circuit Board (1)	T20652	NA
RFM Controller Circuit Board Assembly (1)	T20656-G2 T20656-G3	NA
MicroReader (1) (one per T20656)	Q13551-01	RI-STU-MRD1
Drive-Thru Reader Antenna (1)	T20693-01	NA
The Drive-Thru RFID Light/Beeper/Display/Gateway PCA (1)	T20649	NA
Radio Frequency Module (1)	Q13899-01	RI-RFM-007B

1.4 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4-1992, and the limits prescribed in CFR 47, FCC 15.207, 15.109, and 15.209. Radiated testing was performed at an antenna-to-EUT distance of 3, 10, and 30 meters.

1.5 Test Facility

The Open Area Test Site (OATS) and the Radiated/Conducted Measurement Facility used to collect data are located at Southwest Research Institute, 6220 Culebra Road, San Antonio, Texas. Details concerning the test site and measurement facility are found in a letter from SwRI to the FCC dated 23 May 2000, which is on file with the FCC Laboratory Division in Columbia, Maryland. On June 2, 2000, the FCC approved the sites for the purpose of providing test results for submission with equipment authorization applications under the Commission's Equipment Authorization Program.

2.0 PRODUCT LABELING

2.1 FCC ID Label

The FCC ID label is shown in the drawing in Attachment 3.

2.2 Location of Label on EUT

The location of the label is shown in the drawing in Attachment 3.

2.3 Supplemental Information to be in the Reader Manual

In addition to reiteration of required information as on intentional radiator, in keeping with sections 15.21 and 15.105 of the FCC rules, the manual supplied with the TIRIS™ Drive-Thru Reader will also include the following admonitions:

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 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.

NO MODIFICATIONS: Modifications to this device shall not be made without the written consent of Marconi Commerce Systems. Unauthorized modifications may void the authority granted under Federal Communications Commission Rules permitting the operation of this device.

3.0 SYSTEM TEST CONFIGURATION

3.1 Justification

Radiated tests were performed on the TIRIS™ Drive-Thru Reader intentional radiator from 110 kHz to 30 MHz for the highest fundamental and harmonics. Three polarizations of the receive loop antenna were used. Radiated tests were performed up to 1 GHz for spurious emissions related to the digital electronics portion of the unit. Both vertical and horizontal polarizations of the receive dipoles were tested. Radiated signature scans were made at 3 meters in a shielded anechoic chamber.

Conducted tests were performed on the AC power of the TIRIS™ Drive-Thru Reader from 450 kHz to 30 MHz.

3.2 EUT Exercise

The TIRIS™ Drive-Thru Reader is powered by 120VAC. A handheld battery-less transponder (Texas Instruments RI-TRP-Series key ring tag) was used to demonstrate operation of the TIRIS™ Drive-Thru Reader during testing. For radiated tests of the digital electronics, the 134 kHz microreader transmitter was disabled by inserting a tag into the read field of the antenna.

3.3 Special Accessories

In order to meet the FCC radiated limit for spurious emissions, three ferrite beads were added to the Drive-Thru Reader. A ferrite bead (Steward p/n 28S2023-000) was installed on each of the two sync cables. A ferrite bead (Fair-Rite p/n 0444176451) was also installed on the antenna cable at the point where the cable exits the sheet metal enclosure of the interface box.

3.4 Equipment Modification

The need for the special accessories described in paragraph 3.3 was determined during radiated emission testing.

3.5 Configuration of Tested System

The TIRIS™ Drive-Thru Reader can be configured with either a T20656-G2 or T20656-G3 RFM controller. Radiated pre-scans were performed using each board to determine which configuration gave the highest emissions. Test results revealed that the emission levels from the Drive-Thru Reader were the same regardless of which version of RFM controller card was installed. OATS and conducted tests were performed with T20656-G2 installed. Refer to paragraph 4.1 for a block diagram of the tested configuration.

4.0 BLOCK DIAGRAM OF THE TIRIS™ DRIVE-THRU READER SYSTEM

A block diagram of the TIRIS™ Drive-Thru Reader system is provided in Attachment 1.

5.0 CONDUCTED AND RADIATED MEASUREMENT PHOTOS

Refer to Appendix E for photographs of the conducted and radiated test setups.

6.0 CONDUCTED EMISSION DATA

6.1 Conducted Measurement Data

The TIRIS™ Drive-Thru Reader system was tested for conducted emissions. The initial step in collecting conducted data was to perform a spectrum analyzer peak scan of the measurement range to determine worst case. A computer-controlled spectrum analyzer was used to produce a peak measurement data plot. Quasi-peak measurements were made on signals that were close to or above the paragraph 15.207 limit. The worst case emission levels are provided in Table 6.1. Appendix A contains conducted emission measurement plots.

TABLE 6.1
WORST CASE CONDUCTED EMISSION LEVELS

Judgment: EUT Passed By 6.5 dB			
FREQUENCY	**MEASURED LEVEL (dBuV)**		**LIMIT (dBuV)**
	LINE	**NEUTRAL**	
13 MHz		41.5[1]	48
12.9 MHz		40.5[1]	48
5.75 MHz		40[1]	48
5.75 MHz	41[1]		48
12.9 MHz	40[1]		48

[1] Readings are peak measurements made with a spectrum analyzer.

6.2 Conducted Test Instrumentation

The test instrumentation used to make conducted measurements is given in Appendix C.

7.0 RADIATED EMISSION DATA

7.1 Configurations Tested

The TIRIS™ Drive-Thru Reader system was tested for radiated emissions. The Reader test configuration is shown in Appendix E.

7.2 Radiated Measurement Data

The data in Table 7.1 are the corrected highest level EME measurements taken from the radiated data sheets in Appendix B. The data sheets include the emission frequencies and the corrected level. An explanation of the field strength calculation is given in paragraph 7.4. Measurements were made of the fundamental frequency of 134.2 kHz. Additionally, the spectrum was investigated for harmonics and spurious emissions to 30 MHz at 30 meters. No harmonics or spurious emissions were detected up to 30 MHz at 30 meters. The receive loop antenna was placed in three polarizations for the testing below 30 MHz. Scans were performed starting at 110 kHz to verify that the fundamental emission was not in the 90-110 kHz restricted band. The measurement level of the fundamental is shown in Table 7.1.

TABLE 7.1
MEASUREMENT OF FUNDAMENTAL FREQUENCY

Judgment: EUT Passed by 3 dB							
Frequency	**Receive Antenna Polarization**	**Corrected Level dB(uV/m)**		**Limit 30 Meters[1] dB(uV/m)**		**dB Under Limit**	
		Peak	**Average**	**Peak**	**Average**	**Peak**	**Average**
134 kHz	Parallel to EUT	84.1	75.3	92.8	78.3	8.7	3.0
134 kHz	Perpendicular to EUT	81.8	72.9	92.8	78.3	11	5.4
134 kHz	Parallel to Ground	77.2	68.1	92.8	78.3	15.6	10.2

1 The limit for the fundamental is calculated using a 47.8 dB/decade extrapolation factor for the peak measurements, and a 53.3 dB/decade extrapolation factor for the average measurements. The extrapolation factor was determined by making peak and average measurements at both 20 meters and 30 meters. These measurements are provided on the graph in Appendix B.

The spectrum from 30 MHz to 1000 MHz was investigated for spurious emissions. The worst case spurious emission levels, taken from the data sheets in Appendix B, are given in Table 7.2. Plots of the peak signature scans are provided in Appendix B.

TABLE 7.2
MEASUREMENT OF SPURIOUS EMISSIONS

Judgment EUT passed by 1.3 dB			
Frequency	**Corrected Level [1] dB(uV/m)**	**Limit[2] dB(uV/m)**	**dB under limit**
137.414 MHz	42.2	43.5	1.3
51.527 MHz	37.3	39	1.7
51.519 MHz	36.9	39	2.1
78.654 MHz	35.8	39	3.2
85.919 MHz	35.1	39	3.9

[1] All readings are quasi-peak manual measurements made with a receiver.
[2] These emissions are related to the digital electronics and are compared to the 15.109 Class A limit.

The frequency stability of the TIRIS™ Drive-Thru Reader fundamental emission was verified by varying the AC input voltage between 85% and 115% of the nominal 120 VAC. The frequency of the fundamental emission changed by a maximum of 50 Hz.

7.3 Test Instrumentation for Radiated Measurements

Scans were made at an open area test site (OATS) and in an RF semi-anechoic chamber 28' long x 16' wide x 16' high with its interior lined on the ceiling and four walls with pyramidal absorber material up to four feet in length. Measurements were made with a spectrum analyzer and a quasi-peak adapter in the anechoic chamber and with a receiver at the OATS. The list of test instrumentation used to perform the testing is shown in Appendix C.

7.4 Field Strength Calculation

The field strength was calculated by adding the antenna factor and cable factor, and subtracting the amplifier gain (when used) from the measured reading. The basic equation with a sample calculation is provided below:

FS = RA + AF + CF - AG

Where FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation
AG = Amplifier Gain

For example, reducing the first row of the enclosed radiated data sheet on page 20 (51.519 MHz):

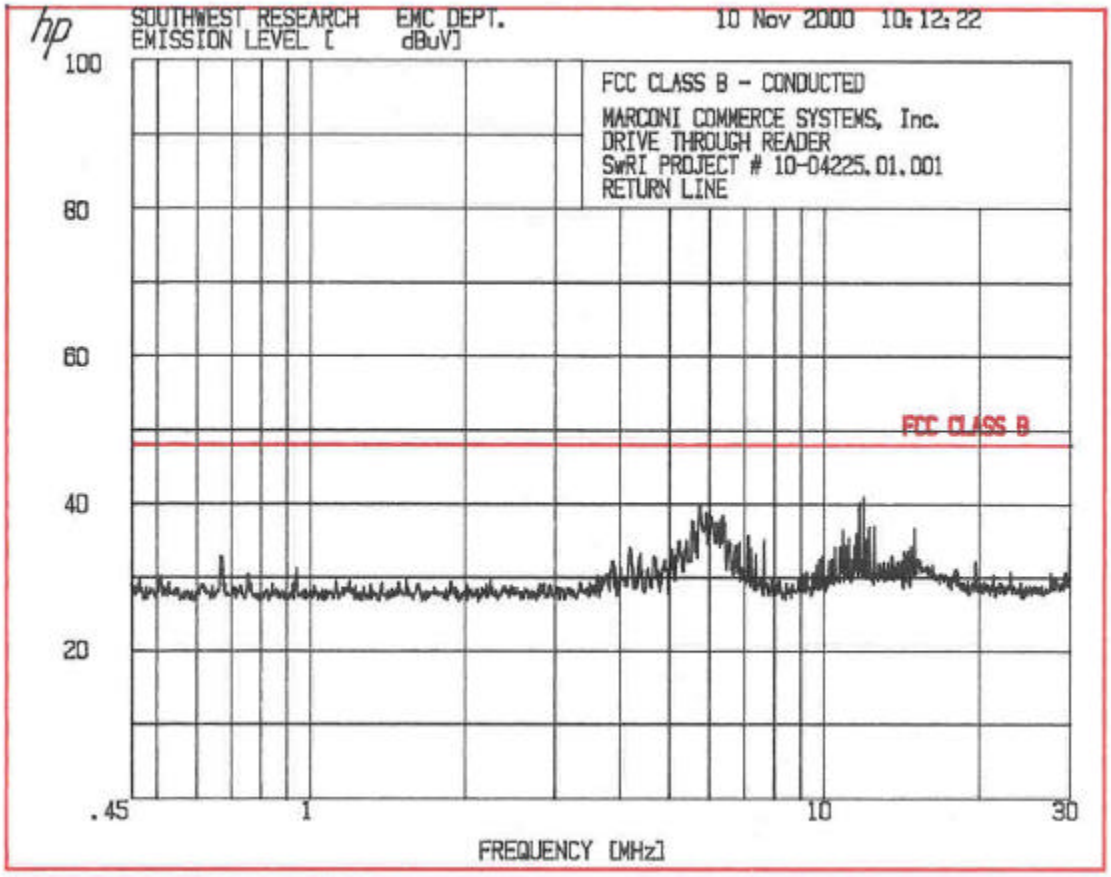
23.6 dB(uV)
10.4 dB(1/m)
2.9 dB (CF/AG FACTOR)
FS = 36.9 dB(uV/m)

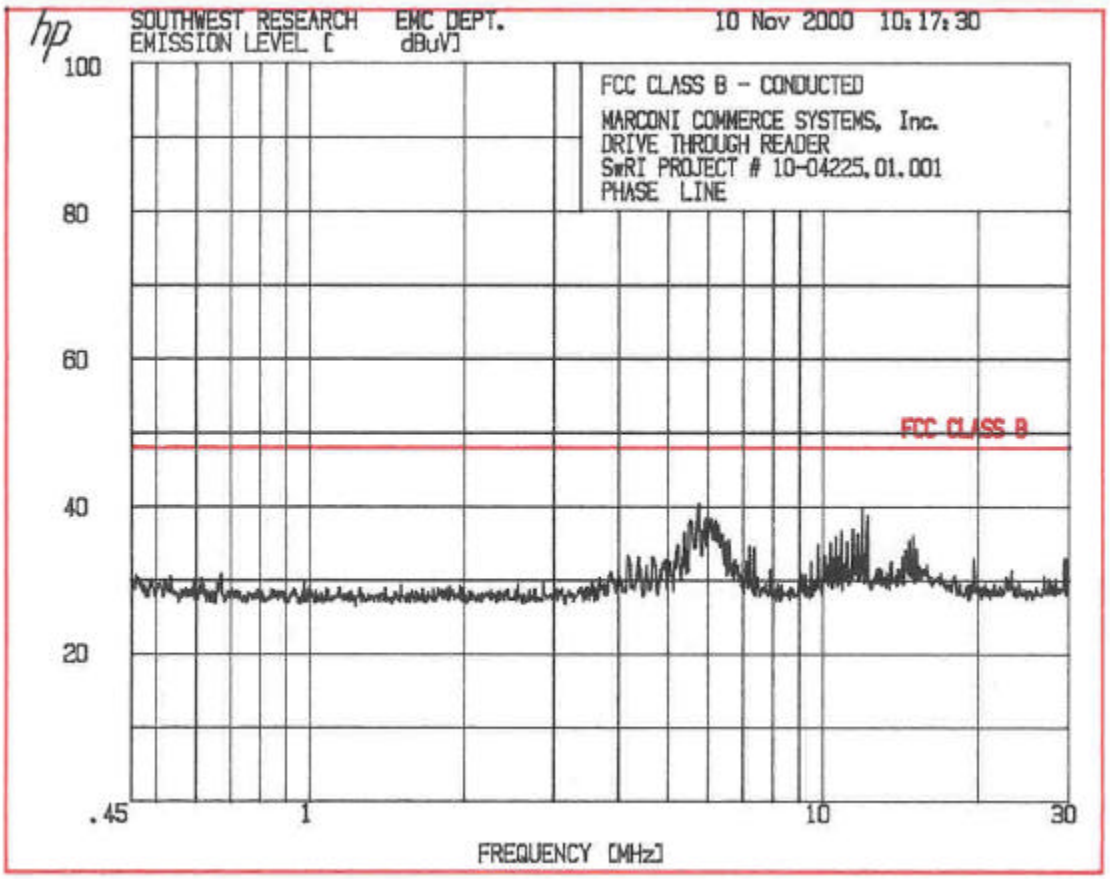
To convert the dB(uV/m) value to its corresponding level in uV/m is as follows:

Level in uV/m Common Antilogarithm [(36.9 dBuV/m)/20] = 69.98 uV/m

APPENDIX A

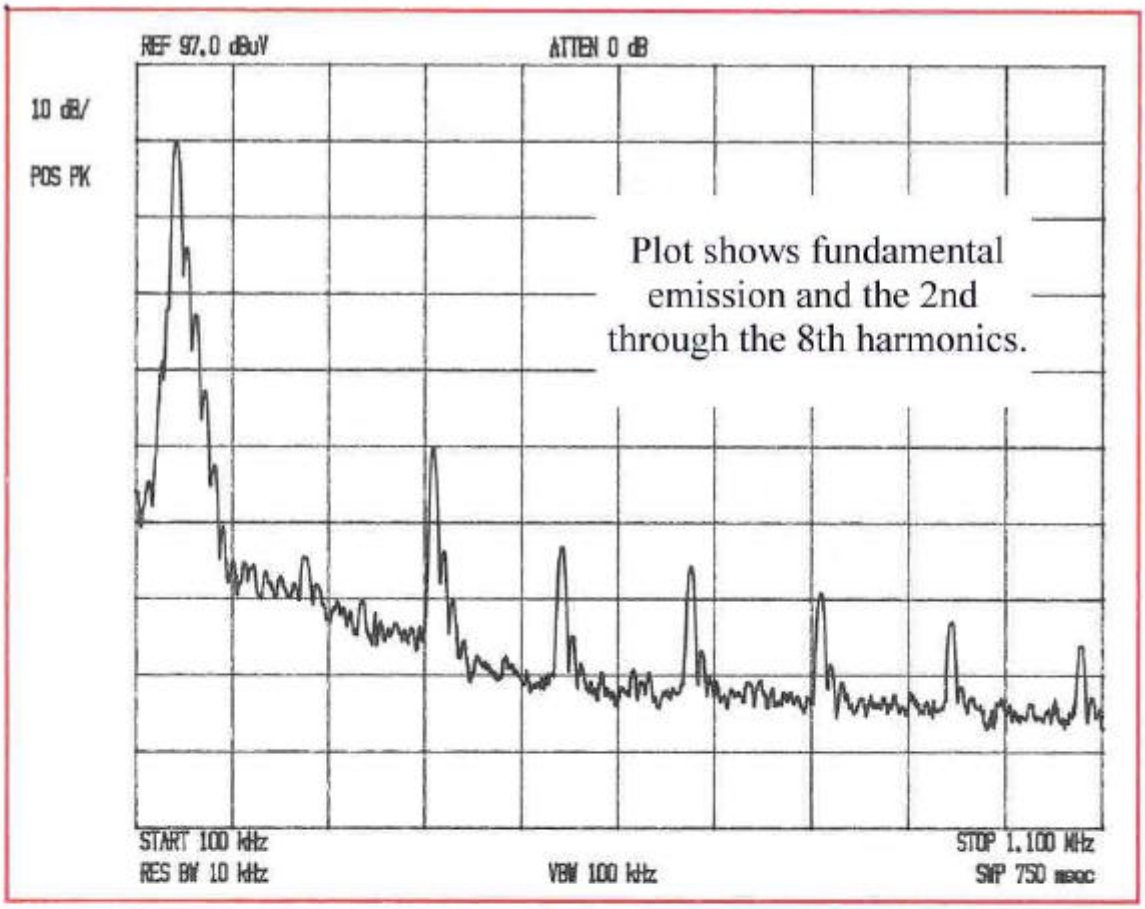
CONDUCTED MEASUREMENT PLOTS

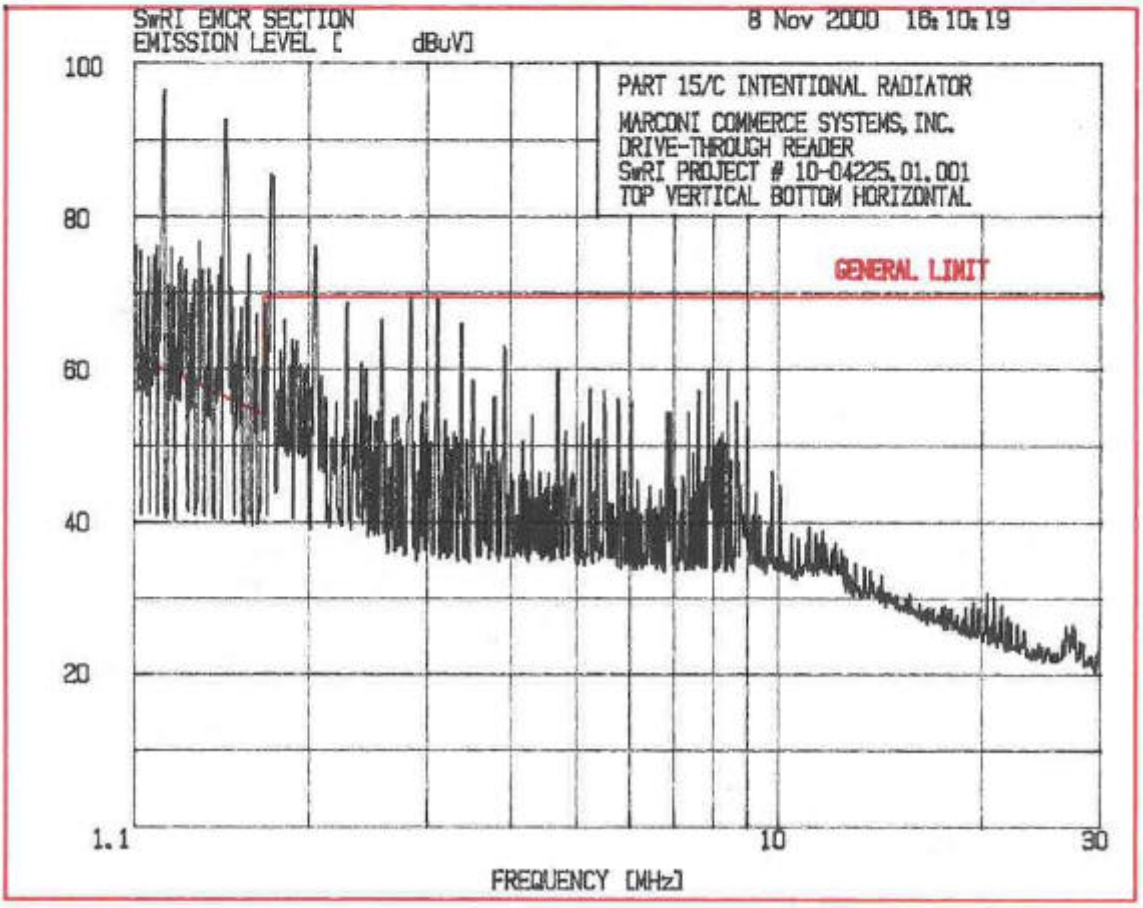

SOUTHWEST RESEARCH EMC DEPT.
10 Nov 2000 10:12:22
EMISSION LEVEL [dBuV]
FCC CLASS B - CONDUCTED
MARCONI COMMERCE SYSTEMS, Inc.
DRIVE THROUGH READER
SwRI PROJECT # 10-04225.01.001
RETURN LINE
FCC CLASS B
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]

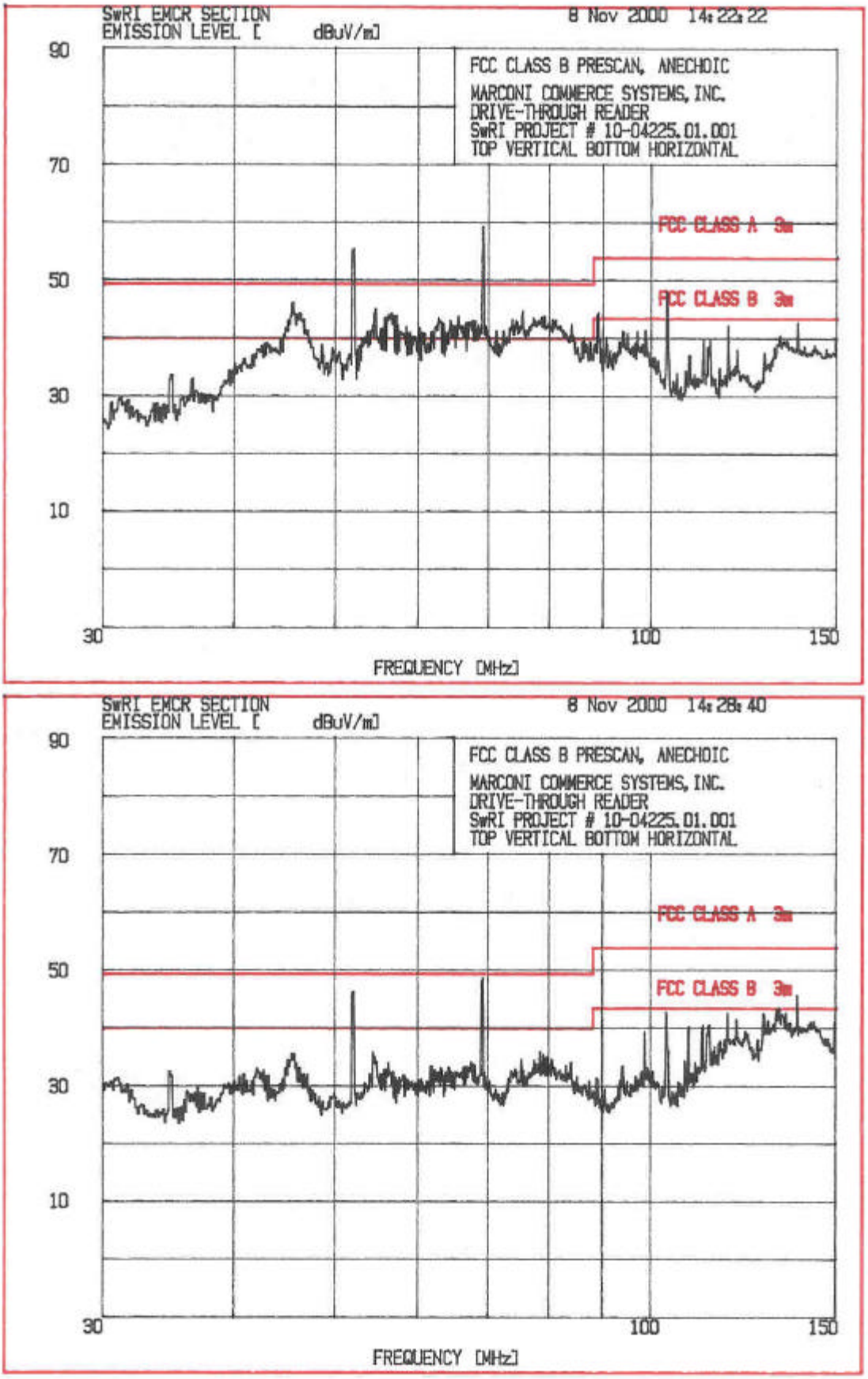

SOUTHWEST RESEARCH EMC DEPT.
10 Nov 2000 10:17:30
EMISSION LEVEL [dBuV]
FCC CLASS B - CONDUCTED
MARCONI COMMERCE SYSTEMS, Inc.
DRIVE THROUGH READER
SwRI PROJECT # 10-04225.01.001
PHASE LINE
FCC CLASS B
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]

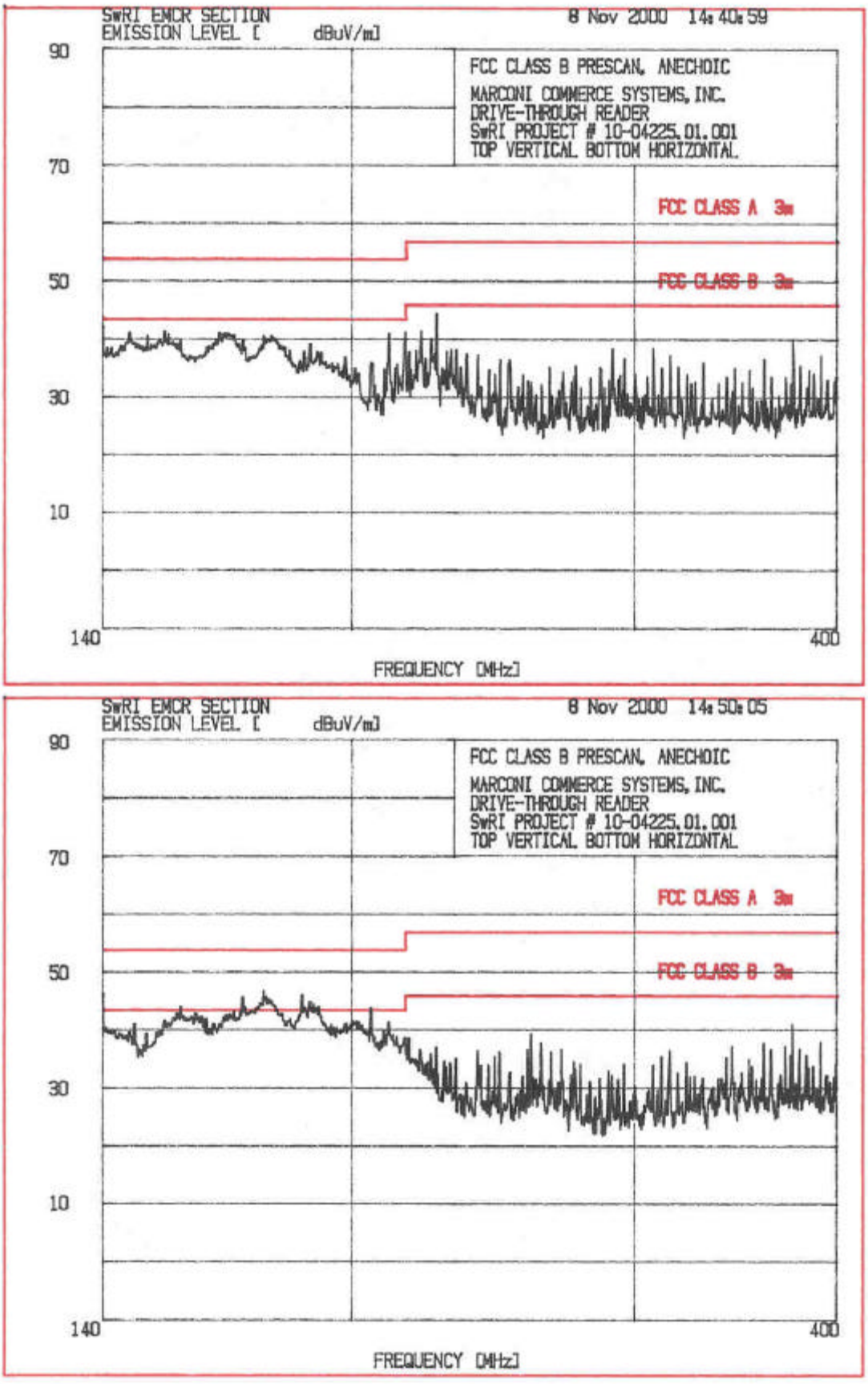
APPENDIX B

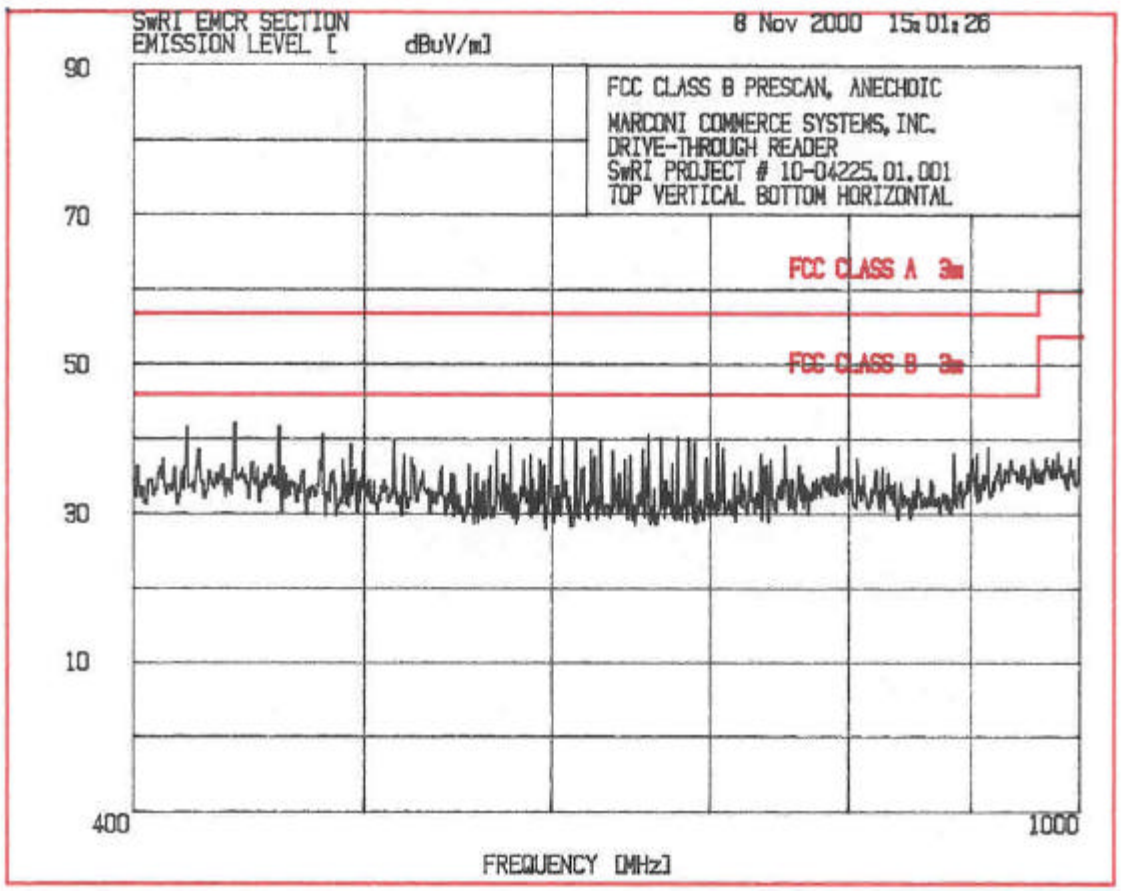
RADIATED MEASUREMENT PLOTS AND DATA SHEETS


REF 97.0 dBuV
ATTEN 0 dB
10 dB/
POS PK
Plot shows fundamental emission and the 2nd through the 8th harmonics.
START 100 kHz
RES BW 10 kHz
VBW 100 kHz
STOP 1.100 MHz
SWP 750 msec


SwRI EMCR SECTION
EMISSION LEVEL [dBuV]
8 Nov 2000 16:10:19
PART 15/C INTENTIONAL RADIATOR
MARCONI COMMERCE SYSTEMS, INC.
DRIVE-THROUGH READER
SwRI PROJECT # 10-04225.01.001
TOP VERTICAL BOTTOM HORIZONTAL
GENERAL LIMIT
100
80
60
40
20
1.1
10
30
FREQUENCY [MHz]


SwRI EMCR SECTION
EMISSION LEVEL [dBuV/m]
8 Nov 2000 14:22:22
FCC CLASS B PRESCAN, ANECHOIC
MARCONI COMMERCE SYSTEMS, INC.
DRIVE-THROUGH READER
SwRI PROJECT # 10-04225.01.001
TOP VERTICAL BOTTOM HORIZONTAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
30
100
150
FREQUENCY [MHz]
SwRI EMCR SECTION
EMISSION LEVEL [dBuV/m]
8 Nov 2000 14:28:40
FCC CLASS B PRESCAN, ANECHOIC
MARCONI COMMERCE SYSTEMS, INC.
DRIVE-THROUGH READER
SwRI PROJECT # 10-04225.01.001
TOP VERTICAL BOTTOM HORIZONTAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
30
100
150
FREQUENCY [MHz]


SwRI EMCR SECTION
EMISSION LEVEL [dBuV/m]
8 Nov 2000 14:40:59
FCC CLASS B PRESCAN, ANECHOIC
MARCONI COMMERCE SYSTEMS, INC.
DRIVE-THROUGH READER
SwRI PROJECT # 10-04225.01.001
TOP VERTICAL BOTTOM HORIZONTAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
140
400
FREQUENCY [MHz]
SwRI EMCR SECTION
EMISSION LEVEL [dBuV/m]
8 Nov 2000 14:50:05
FCC CLASS B PRESCAN, ANECHOIC
MARCONI COMMERCE SYSTEMS, INC.
DRIVE-THROUGH READER
SwRI PROJECT # 10-04225.01.001
TOP VERTICAL BOTTOM HORIZONTAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
140
400
FREQUENCY [MHz]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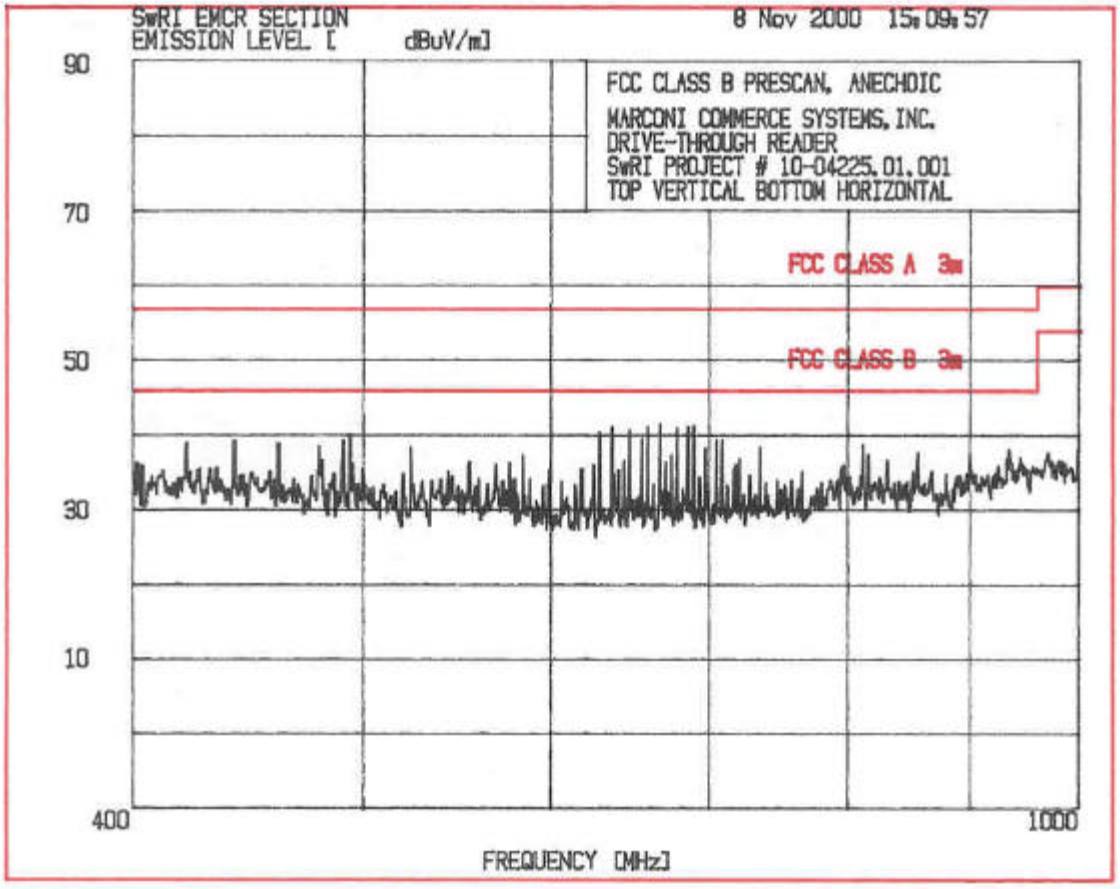
8 Nov 2000 15:01:26
FCC CLASS B PRESCAN, ANECHOIC
MARCONI COMMERCE SYSTEMS, INC.
DRIVE-THROUGH READER
SwRI PROJECT # 10-04225.01.001
TOP VERTICAL BOTTOM HORIZONTAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
400
1000
FREQUENCY [MHz]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8 Nov 2000 15:09:57
FCC CLASS B PRESCAN, ANECHOIC
MARCONI COMMERCE SYSTEMS, INC.
DRIVE-THROUGH READER
SwRI PROJECT # 10-04225.01.001
TOP VERTICAL BOTTOM HORIZONTAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
400
1000
FREQUENCY [MHz]

SwRI Open Area Test Site Radiated Emissions v2_2 **Project Number:** 10-04225.01.001

Device Under Test: DRIVE THROUGH READER **Detection Method:** QP **EUT Mode:**

Date / Time: 11/10/00 0:00 **Test Receiver:** Rohde&Schwarz ESS EMI sn: DE31157

Test Standard(primary limit): FCC , Part 15 (15.109, A, and 15.209) **Antenna:** 3: BDA25S, s/n 535

Test Standard(optional limit): 5: T2, s/n L178

Test Sponsor: MARCONI 7: T3, s/n L108

Test Technician: D. SMITH

Temp.(°F)/Humidity(%): 65 F 43%

FREQ	Orient.	Antenna				UnCorr'd Level	Correction Factors (dB)		Corr'd Level	Primary Limit	Optional Limit	Margin (Primary)	Comments (** denotes a measurement above the primary limit) Note: Cable factor includes preamplifier gain at frequencies above 200 MHz.
MHz	θ°	I.D.	Pol.	Ht(m)	Dis(m)	(dBuV)	Ant	Cable	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	
51.519	323	3	V	2.31	10	23.6	10.4	2.9	36.9	39.0		-2.1	FERRITE ANTENNA CABLE; DIGITAL EMISSION
68.705	0	3	V	2.31	10	16.3	7.4	3.5	27.2	39.0		-11.8	
49.157	0	3	V	1.47	10	14.4	11.9	3.0	29.3	39.0		-9.7	DIGITAL EMISSION
51.527	311	3	V	1.47	10	24.1	10.4	2.9	37.3	39.0		-1.7	DIGITAL EMISSION
54.074	359	3	V	1.35	10	17.7	9.4	3.1	30.1	39.0		-8.9	DIGITAL EMISSION
58.999	0	3	V	1.45	10	16.5	7.6	3.3	27.3	39.0		-11.7	
60.002	340	3	V	1.45	10	16.0	7.2	3.3	26.5	39.0		-12.5	
63.906	5	3	V	1.74	10	16.9	6.9	3.4	27.2	39.0		-11.8	
68.712	360	3	V	1.63	10	19.5	7.4	3.5	30.4	39.0		-8.6	DIGITAL EMISSION
68.827	190	3	V	2.18	10	18.6	7.4	3.5	29.5	39.0		-9.5	DIGITAL EMISSION
78.654	289	3	V	1.67	10	23.5	8.4	3.8	35.8	39.0		-3.2	DIGITAL EMISSION
85.919	360	3	V	1.45	10	21.2	9.8	4.1	35.1	39.0		-3.9	DIGITAL EMISSION
134.997	74	3	V	1.44	10	17.3	14.8	5.4	37.6	43.5		-5.9	DIGITAL EMISSION
137.414	264	3	V	1.31	10	21.7	15.0	5.5	42.2	43.5		-1.3	DIGITAL EMISSION
85.886	53	3	H	4.00	10	14.1	9.8	4.1	27.9	39.0		-11.1	
51.531	109	3	H	4.00	10	18.4	10.4	2.9	31.7	39.0		-7.3	DIGITAL EMISSION
202.500	47	5	V	1.07	10	34.0	20.0	-21.1	32.9	43.5		-10.6	DIGITAL EMISSION
210.000	138	5	V	1.00	10	37.7	19.8	-20.8	36.6	43.5		-6.9	DIGITAL EMISSION
217.508	141	5	V	1.00	10	37.7	20.2	-20.9	37.1	46.5		-9.4	DIGITAL EMISSION
228.755	112	5	V	1.09	10	35.5	20.6	-20.4	35.7	46.5		-10.8	DIGITAL EMISSION
240.008	121	5	V	1.09	10	32.6	21.9	-20.2	34.3	46.5		-12.2	
255.008	116	5	V	1.22	10	31.3	21.7	-20.1	32.8	46.5		-13.7	
292.513	229	5	V	1.32	10	24.0	19.3	-19.3	24.0	46.5		-22.5	
345.013	137	5	V	1.25	10	26.7	20.9	-18.3	29.4	46.5		-17.1	
422.807	216	5	V	2.96	10	21.9	22.6	-17.0	27.6	46.5		-18.9	
427.518	139	5	H	2.00	10	23.5	22.7	-17.1	29.1	46.5		-17.4	
367.512	36	5	H	1.84	10	20.9	22.5	-17.9	25.5	46.5		-21.0	

SwRI Open Area Test Site Radiated Emissions v2_2

Project Number: 10-04225.01.001

Device Under Test: DRIVE THROUGH READER

Detection Method: QP **EUT Mode:**

Date / Time: 11/10/00 0:00

Test Receiver: Rohde&Schwarz ESS EMI sn: DE31157

Test Standard(primary limit): FCC , Part 15 (15.109, A, and 15.209)

Antenna: 3: BDA25S, s/n 535

5: T2, s/n L178

Test Standard(optional limit):

7: T3, s/n L108

Test Sponsor: MARCONI

Test Technician: D. SMITH

Temp.(°F)/Humidity(%): 65 F 43%

FREQ	Orient.	Antenna				UnCorr'd Level	Correction Factors (dB)		Corr'd Level	Primary Limit	Optional Limit	Margin (Primary)	Comments (** denotes a measurement above the primary limit) Note: Cable factor includes preamplifier gain at frequencies above 200 MHz.
MHz	θ°	I.D.	Pol.	Ht(m)	Dis(m)	(dBuV)	Ant	Cable	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	
337.512	169	5	H	2.33	10	26.3	20.0	-18.5	27.8	46.5		-18.7	
315.013	184	5	H	2.71	10	31.9	18.3	-18.9	31.3	46.5		-15.2	
255.010	124	5	H	2.71	10	32.2	21.7	-20.1	33.8	46.5		-12.7	
240.007	107	5	H	4.00	10	31.3	21.9	-20.2	33.0	46.5		-13.5	
221.278	102	5	H	3.60	10	32.5	20.1	-20.6	32.0	46.5		-14.5	
210.010	0	5	H	3.35	10	36.9	19.8	-20.8	35.8	43.5		-7.7	DIGITAL EMISSION
530.956	319	7	V	2.22	10	21.8	24.7	-15.4	31.1	46.5		-15.4	
549.676	7	7	V	1.58	10	14.5	24.3	-15.3	23.5	46.5		-23.0	
999.570	257	7	V	2.34	10	16.6	33.1	-11.1	38.5	49.5		-11.0	AMBIENT
999.570	257	7	H	4.00	10	11.5	33.1	-11.1	33.4	49.5		-16.1	AMBIENT
0.134	35		PER	1.00	30	21.9	59.5	0.4	81.8	92.8		-11.0	PEAK ALR25 S/N 86
0.134	35		PER	1.00	30	13.0	59.5	0.4	72.9	78.3		-5.4	AVER ALR25 S/N 86
0.134	65		PAR	1.00	30	15.4	59.5	0.4	75.3	78.3		-3.0	AVER ALR25 S/N 86
0.134	65		PAR	1.00	30	24.2	59.5	0.4	84.1	92.8		-8.7	PEAK ALR25 S/N 86
0.134	214		PG	1.00	30	17.3	59.5	0.4	77.2	92.8		-15.6	PEAK ALR25 S/N 86
0.134	214		PG	1.00	30	8.2	59.5	0.4	68.1	78.3		-10.2	AVER ALR25 S/N 86
0.110	65		PAR	1.00	30	-17.0	65.9	0.4	49.3	67.0		-17.7	AVER EMCO 6512
0.403	65		PAR	1.00	30	-12.0	54.0	0.4	42.4	55.0		-12.6	AVER EMCO 6512
0.403	65		PAR	1.00	30	-17.0	54.0	0.4	37.4	75.0		-37.6	PEAK EMCO 6512
0.110	65		PAR	1.00	30	-9.7	65.9	0.4	56.6	87.0		-30.4	PEAK EMCO 6512
0.110	35		PER	1.00	30	-8.7	65.9	0.4	57.6	87.0		-29.4	PEAK EMCO 6512
0.110	35		PER	1.00	30	-17.5	65.9	0.4	48.8	67.0		-18.2	AVER EMCO 6512
0.403	35		PER	1.00	30	-19.0	54.0	0.4	35.4	75.0		-39.6	PEAK EMCO 6512
0.403	35		PER	1.00	30	-25.0	54.0	0.4	29.4	55.0		-25.6	AVER EMCO 6512
0.110	214		PG	1.00	30	-18.6	65.9	0.4	47.7	67.0		-19.3	AVER EMCO 6512
0.110	214		PG	1.00	30	-10.5	65.9	0.4	55.8	87.0		-31.2	PEAK EMCO 6512
0.403	214		PG	1.00	30	-19.7	54.0	0.4	34.7	75.0		-40.3	PEAK EMCO 6512

SwRI Open Area Test Site Radiated Emissions v2_2

Project Number: 10-04225.01.001

Device Under Test: DRIVE THROUGH READER

Detection Method: QP

EUT Mode:

Date / Time: 11/10/00 0:00

Test Receiver: Rohde&Schwarz ESS EMI sn: DE31157

Test Standard(primary limit): FCC , Part 15 (15.109, A, and 15.209)

Antenna: 3: BDA25S, s/n 535

5: T2, s/n L178

Test Standard(optional limit):

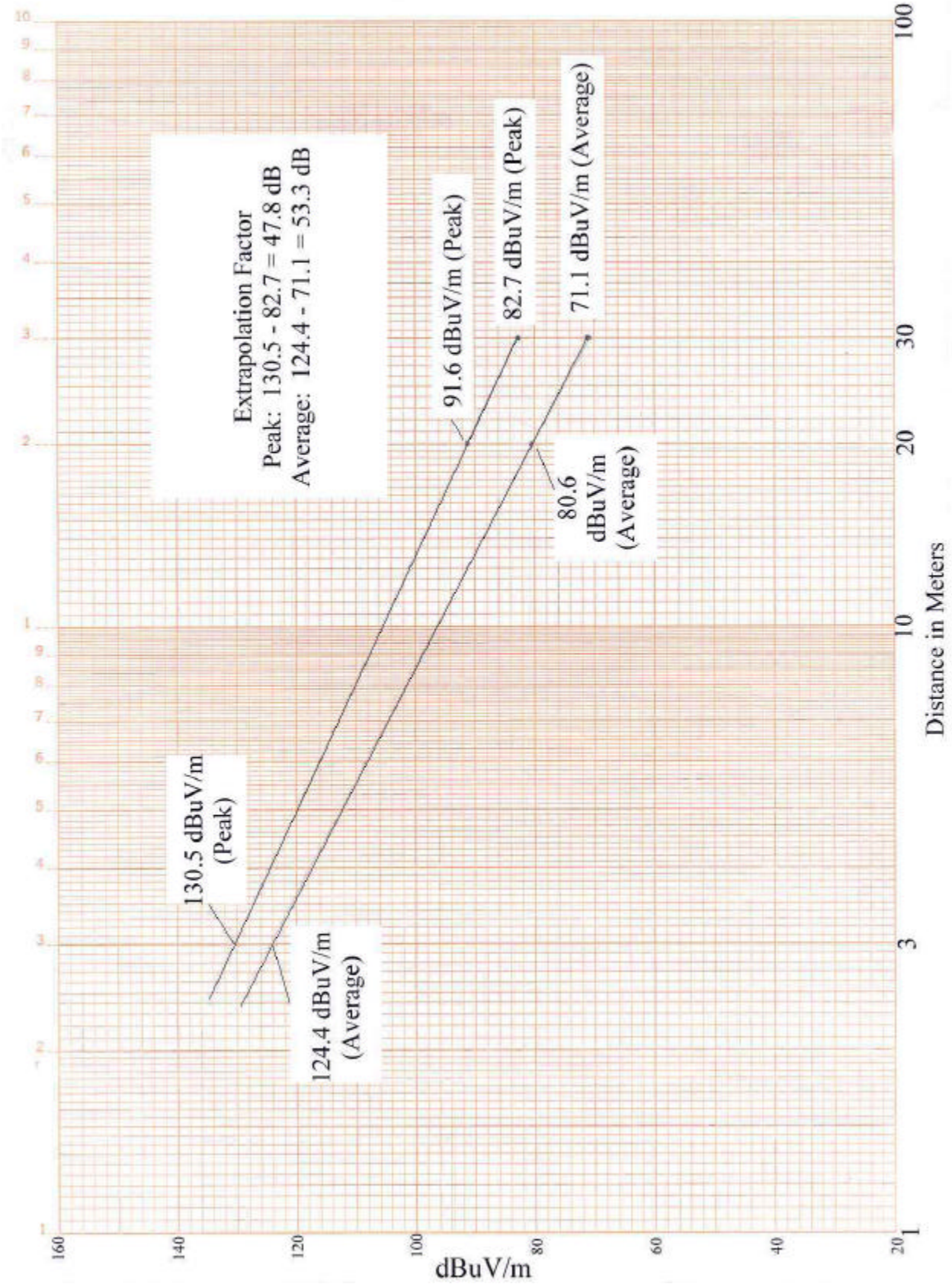
7: T3, s/n L108

Test Sponsor: MARCONI

Test Technician: D. SMITH

Temp.(°F)/Humidity(%): 65 F 43%

FREQ	Orient.	Antenna				UnCorr'd Level	Correction Factors (dB)		Corr'd Level	Primary Limit	Optional Limit	Margin (Primary)	Comments (** denotes a measurement above the primary limit) Note: Cable factor includes preamplifier gain at frequencies above 200 MHz.
MHz	θ°	I.D.	Pol.	Ht(m)	Dis(m)	(dBuV)	Ant	Cable	(dBuV/m)	(dBuV/m)	(dBuV/m)	(dB)	
0.403	214		PG	1.00	30	-25.4	54.0	0.4	29.0	55.0		-26.0	AVER EMCO 6512
3.000	214		PG	1.00	30	-11.8	33.4	0.4	22.0	29.5		-7.5	QP EMCO 6512
30.000	214		PG	1.00	30	-18.5	33.8	0.4	15.7	29.5		-13.8	QP EMCO 6512
30.000	65		PAR	1.00	30	-18.1	33.8	0.4	16.1	29.5		-13.4	QP EMCO 6512
3.000	65		PAR	1.00	30	-12.0	33.4	0.4	21.8	29.5		-7.7	QP EMCO 6512
3.000	35		PER	1.00	30	-10.8	33.4	0.4	23.0	29.5		-6.5	QP EMCO 6512
30.000	35		PER	1.00	30	-17.8	33.4	0.4	16.0	29.5		-13.5	QP EMCO 6512


Extrapolation Factor
Peak: 130.5 - 82.7 = 47.8 dB
Average: 124.4 - 71.1 = 53.3 dB
130.5 dBuV/m (Peak)
124.4 dBuV/m (Average)
91.6 dBuV/m (Peak)
82.7 dBuV/m (Peak)
80.6 dBuV/m (Average)
71.1 dBuV/m (Average)
dBuV/m
Distance in Meters

APPENDIX C

TEST INSTRUMENTATION

EQUIPMENT USE REPORT

MANUFACTURER	MODEL NO.	DESCRIPTION	SERIAL NO.	CAL DATE
CONDUCTED EMISSIONS				
HP	85650A	Quasi-Peak Adapter	2043A00254	01 May 01
HP	8568B	Spectrum Analyzer	2140A01685	24 Apr 01
SwRI	---	3 dB Transient Suppressor	L2	Verified
Rhode & Schwartz	ESH2-Z5	LISN	872461/021	26 Apr 01
ANECHOIC CHAMBER				
Hewlett Packard	8568B	Spectrum Analyzer	1839A00395	21 Aug 01
Hewlett Packard	9836C	Computer/Controller	2441A03889	NCR
Hewlett Packard	85650A	Quasi-Peak Adapter	2043A00254	01 May 01
Hewlett Packard	7470A	Plotter	2308A47732	NCR
Hewlett Packard	2225A	Printer	2448S3097	NCR
Electro Metrics	ALR-25	Loop Antenna	371	4 Apr 01
EMCO	3121-DB4	Dipole Antenna	1097	Checked
EMCO	3121-DB4	Dipole Antenna	148	Checked
EMCO	3121-DB2	Dipole Antenna	148	Checked
OATS				
Rhode & Schwarz	ESS	EMI Test Receiver	848588/003	16 May 01
SwRI	2 MHz-1GHz	OATS Pre-Amp	14-82-020	verified
Electro Metrics	BDA-25S	Dipole Antenna	535	28 May 01
Electro Metrics	DM-105-T2	Dipole Antenna	L-000178	30 May 01
Electro Metrics	DM-105-T3	Dipole Antenna	L-000108	30 May 01
EMCO	6512	Loop Antenna	0001-1265	31 Jul 01
VOLTAGE VARIATION				
Hewlett Packard	8568B	Spectrum Analyzer	1839A00395	21 Aug 01
Electro Metrics	ALR-25	Loop Antenna	371	4 Apr 01
Behlman	150C	AC Power Source	6946	NCR
Fluke	8060A	True RMS Voltmeter	3925140	11 Feb 01

APPENDIX D

PHOTOS OF TESTED EUT

The photos of the tested EUT are in the electronic file “Appendix D Photos of Tested EUT.jpg”

APPENDIX E

PHOTOS OF TEST SETUPS

The test setup photos are in the electronic file “Appendix E Test Setup Photos.jpg”

ATTACHMENT 1

FUNCTIONAL DESCRIPTION AND BLOCK DIAGRAM

ATTACHMENT 2

INSTALLATION INSTRUCTIONS

ATTACHMENT 3

FCC ID LABEL

ATTACHMENT 4

SCHEMATICS