MEASUREMENT AND TECHNICAL REPORT ON THE MARCONI COMMERCE SYSTEMS TRIND™ TIRIS™ RADIO FREQUENCY IDENTIFICATION DEVICE

Southwest Research Institute
6220 Culebra Road
San Antonio, Texas 78228-0510

Project 10-04567.01.001
Report Number EMCR 01/021

Prepared for:

Marconi Commerce Systems
7300 West Friendly Avenue
P.O. Box 22087
Greensboro, NC 27420-2087

Prepared by:
David A. Carmony

April 2001

ISO/IEC GUIDE 25
EN 45001

MEASUREMENT AND TECHNICAL REPORT ON THE MARCONI COMMERCE SYSTEMS TRIND™ TIRIS™ RADIO FREQUENCY IDENTIFICATION DEVICE

Southwest Research Institute
6220 Culebra Road
San Antonio, Texas 78228-0510

Project 10-04567.01.001
Report Number EMCR 01/021

Prepared for:

Marconi Commerce Systems
7300 West Friendly Avenue
P.O. Box 22087
Greensboro, NC 27420-2087

Prepared by:
David A. Carmony

April 2001

Reviewed by:

Ismael Martinez, Jr.
Sr. Engineering Technologist
Electromagnetic Compatibility Research Section
Communications Engineering Department

Approved by:

James J. Polonis
Manager
Electromagnetic Compatibility Research Section
Communications Engineering Department

TABLE OF CONTENTS

Page

LIST OF TABLES

1.0 GENERAL INFORMATION

1.1 Product Description

The TRIND™ TIRIS™ (Part No. C00011-xxx) is a Radio Frequency Identification Device (RFID) which is designed for use in conjunction with both battery-powered vehicle transponders (Texas Instruments Part No. 9795101, FCC ID: A92VEHICLE) and handheld battery-less transponders (Texas Instruments RI-TRP-Series such as a key ring tag). The vehicle transponder is mounted in the back window of an automobile and the handheld transponder is carried by the user. The transmitter portion of the TRIND™ TIRIS™ 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 TRIND™ TIRIS™ is subject to FCC Part 15, Subpart B, "Unintentional Radiator," paragraph 15.109, under the Class A limits and as such, the TRIND™ TIRIS™ is incorporated into an application that is subject to Class A limits. Attachment 1 contains a detailed technical description and functionality of the TRIND™ TIRIS™ and its components. Photos of the TRIND™ TIRIS™ are provided in Appendix D.

1.2 Related Grants

A vehicle transponder (FCC ID: A92VEHICLE) and a handheld battery-less transponder (Texas Instruments RI-TRP-Series key ring tag) were used to exercise the TRIND™ TIRIS™ during the intentional radiator radiated and conducted tests. The microreader module (Texas Instruments part No. RI-STU-MRD1) which provides the 134.2 kHz fundamental emission is a component of the TRIND™ TIRIS™ and has previously received certification under FCC ID: A92MICRO.

1.3 Tested System Details

The TRIND™ TIRIS™ is intended to be mounted into an enclosure such as a fueling dispenser and includes two overhead 134.2 kHz low Q transmit antennas with tuning boards, a low frequency (LF) transmitter module (which includes two remote 134.2 kHz RF transmitters), a data control board, a UHF 902.858 MHz receiver, two UHF receiving antennas, two 134.2 kHz LF PCA (printed circuit assembly) antennas, and two light microreader/LED bezel assemblies. These components are assembled per the drawings in Attachment 1.

The TRIND™ TIRIS™ operates from 120 VAC converted to 22.5 Vdc and 5 Vdc using power supply Part No. T20314-G1. The system description, functionality and block diagrams are located in Attachment 1. Cabling is denoted in the dispenser block diagram located in Attachment 1. The components on the system are listed below in Table 1.1.

TABLE 1.1
TRIND™ TIRIS™ COMPONENTS

Component Description	Part Number
TIRIS Data Control Board with UHF Receiver	Q13563-04
TIRIS 134 kHz Transmitter Board with Remote Radio Frequency Module (two each) and Carrier Board	Q13579-01
TIRIS 902-928 MHz Receiver Board	RI-RFM-HREA (TI)
Marconi Power Supply	T20314-G1
TRIND Gateway Board	T20128-GX
134.2 kHz UHF Overhead Antennas (2 Per Installation)	T20231-G1
LF Bezel Antennas (2 Per Installation)	T20524-G1
Light/Microreader Board	T20601

The TRIND™ TIRIS™ is used with Marconi Commerce Systems Advantage and MPD-3 line of fuel dispensers. Each type of fuel dispenser uses an identical TRIND™ TIRIS™ system. The following TRIND™ TIRIS™ configuration was tested.

TABLE 1.2
ANTENNA CONFIGURATIONS TESTED

Dispenser	Overhead Antenna (for car tag)	Door Antenna (for hand-held tag)
Advantage and MPD-3	(2) T20231-G1 134 kHz Overhead Antennas	(2) T20524-G1 5.2” x 10.2” 134 kHz antennas mounted to the plastic bezel doors

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 antenna-to-EUT distances of 3, 10, and 30 meters.

A test fixture for the TRIND™ TIRIS™ system was used during radiated emissions testing to replicate the actual installation of the system in a high hose fueling dispenser (gas pump) with the 134kHz transmit antenna at the heights they would be in the field. The test fixture was constructed from materials which would not provide additional shielding (wood & PVC pipe). Pre-compliance testing demonstrated that this arrangement is "worst case" with respect to the radiated emissions limits, particularly when measuring the harmonics of the 134 kHz intentionally radiated signal at close distances (3 meters). Photographs of the radiated emissions test setup showing the test fixtures are provided in Appendix E.

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 Label for the Exterior of Devices Incorporating the EUT

The TRIND™ TIRIS™ will be incorporated in other devices such as a fuel dispenser (e.g., a fueling dispenser (gasoline pump) employed at a service station). A label will be supplied with the TRIND™ TIRIS™ for placement on the exterior of the device in which the equipment is incorporated. This label is shown in a drawing in Attachment 3.

2.4 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 TRIND™ TIRIS™ 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 TRIND™ TIRIS™ intentional radiator from 134 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 TRIND™ TIRIS™ from 450 kHz to 30 MHz.

3.2 EUT Exercise

The TRIND™ TIRIS™ is powered by 120VAC. During radiated and conducted tests, the unit was exercised by establishing the interrogation reply sequence using handheld transponders.

For radiated tests of the digital electronics, the 134 kHz overhead antenna transmitter and the microreader transmitter were disabled.

3.3 Special Accessories

No special accessories were required.

3.4 Equipment Modification

No modifications were made to the TRIND™ TIRIS™ during equipment testing.

3.5 Configuration of Tested System

Refer to Figure 4.1 for block diagram of tested configuration.

4.0 BLOCK DIAGRAM OF THE TRIND™ TIRIS™ SYSTEM

A block diagram of the TRIND™ TIRIS™ 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 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 10 dB			
FREQUENCY (MHz)	**MEASURED LEVEL (dBuV)**		**LIMIT (dBuV)**
	LINE	**NEUTRAL**	
10.5	37[1]		48
10.5		38[1]	48

[1] Readings are quasi-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 Radiated Measurement Data

The data below are the corrected highest level EME measurements taken from the radiated data sheets provided 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 7.3.

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 14.4 dB							
Receive Antenna Polarization	**Freq. (kHz)**	**Corrected Level**		**Limit 30 Meters[1]**		**dB Under Limit**	
		Peak dB(uV/m)	**Average dB(uV/m)**	**Peak dB(uV/m)**	**Average dB(uV/m)**	**Peak dB(uV/m)**	**Average dB(uV/m)**
Parallel to EUT	134	68.3	50.6	85	65	16.7	14.4
Perpendicular to EUT	134	60.6	42.5	85	65	24.4	22.5
Parallel to Ground	134	60.5	42.4	85	65	24.5	22.6

[1]Limits at 30 meters are calculated using a 40 dB/decade extrapolation factor, in accordance with FCC Part 15, Subpart C, Intentional Radiator, paragraph 15.31, (f), (2).

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

TABLE 7.2
MEASUREMENT OF SPURIOUS EMISSIONS

Judgment EUT passed by 2.6 dB			
Frequency (MHz)	**Corrected Level [1] dB(uV/m)**	**Limit[2] dB(uV/m)**	**dB under limit**
180.001	40.9	43.5	2.6
168.001	40.5	43.5	3.0
79.994	35.6	39	3.4
186.001	39.6	43.5	3.9
144.001	36.6	43.5	6.9
216.018	39.4	46.5	7.1
54.001	31.3	39	7.7
78.000	31.1	39	7.9

[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 and amplitude stability of the TRIND™ TIRIS™ 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 450 Hz.

7.2 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.

7.3 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 22 (31.270 MHz):

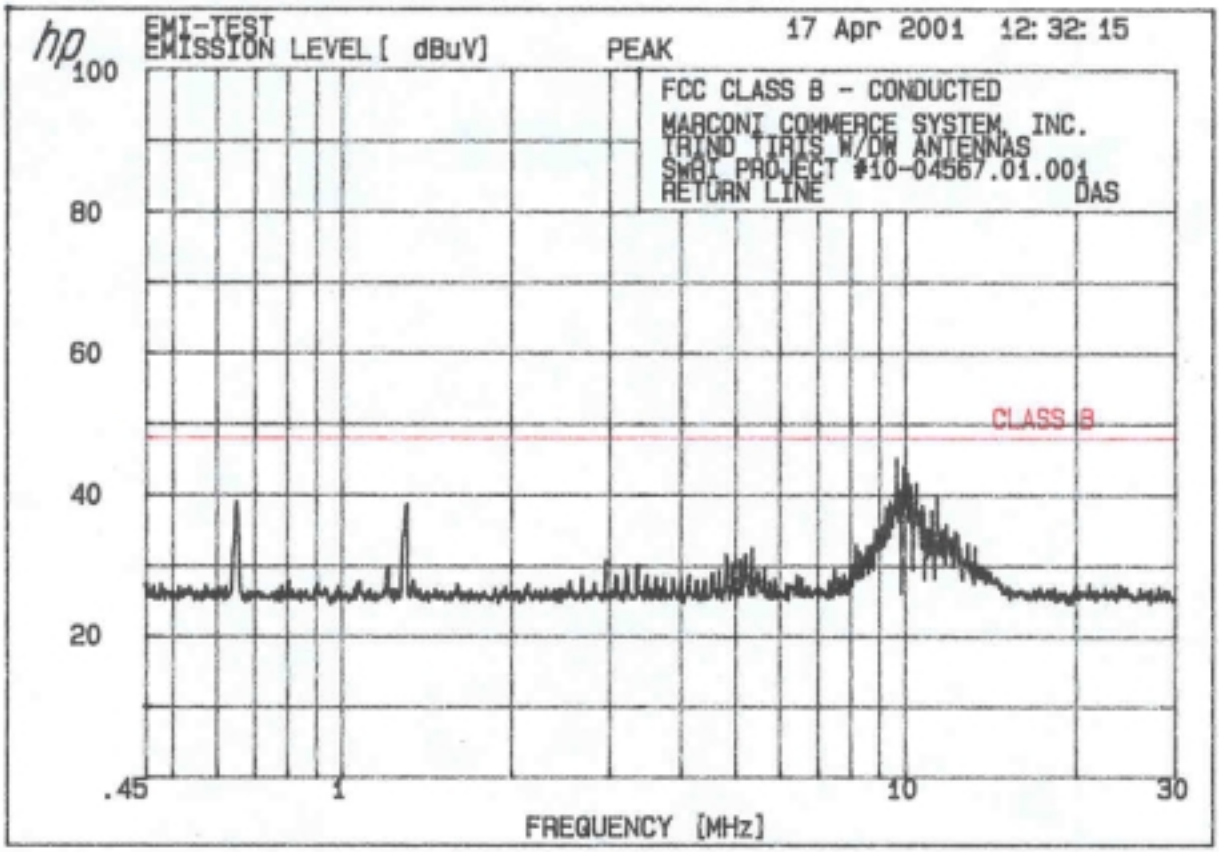
-0.6 dB(uV)
21.8 dB(1/m)
2.2 dB (CF/AG FACTOR)
FS = 23.4 dB(uV/m)

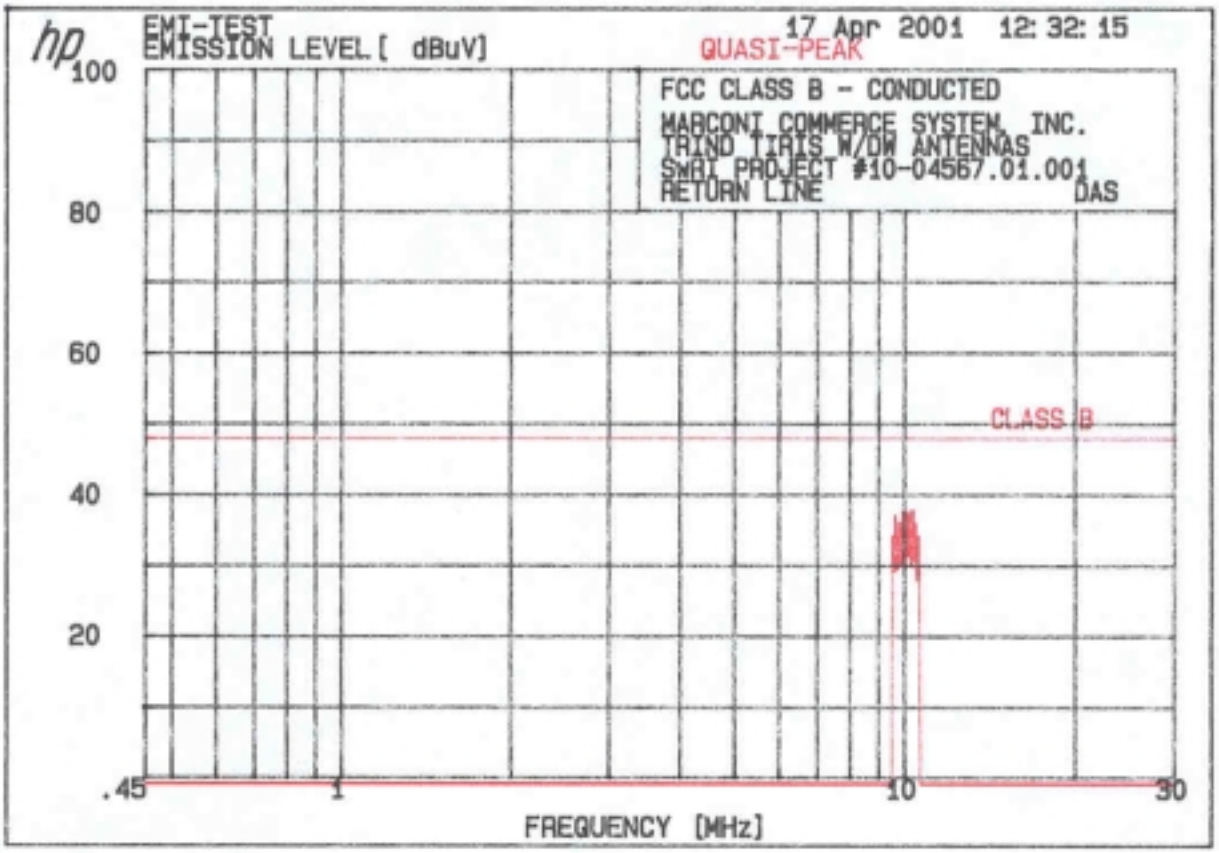
To convert the dB(uV/m) value to its corresponding level in uV/m is as follows:

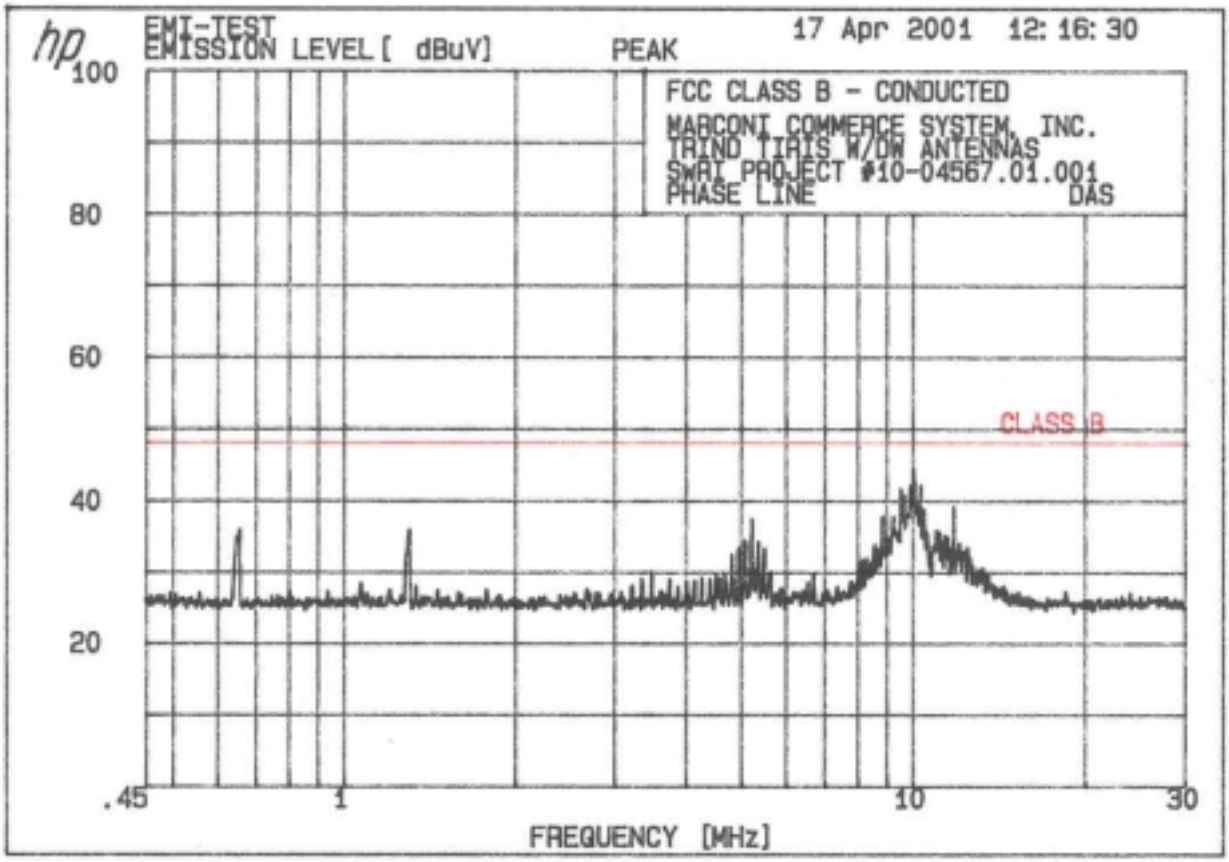
Level in uV/m Common Antilogarithm [(23.4 dBuV/m)/20] = 14.79 uV/m

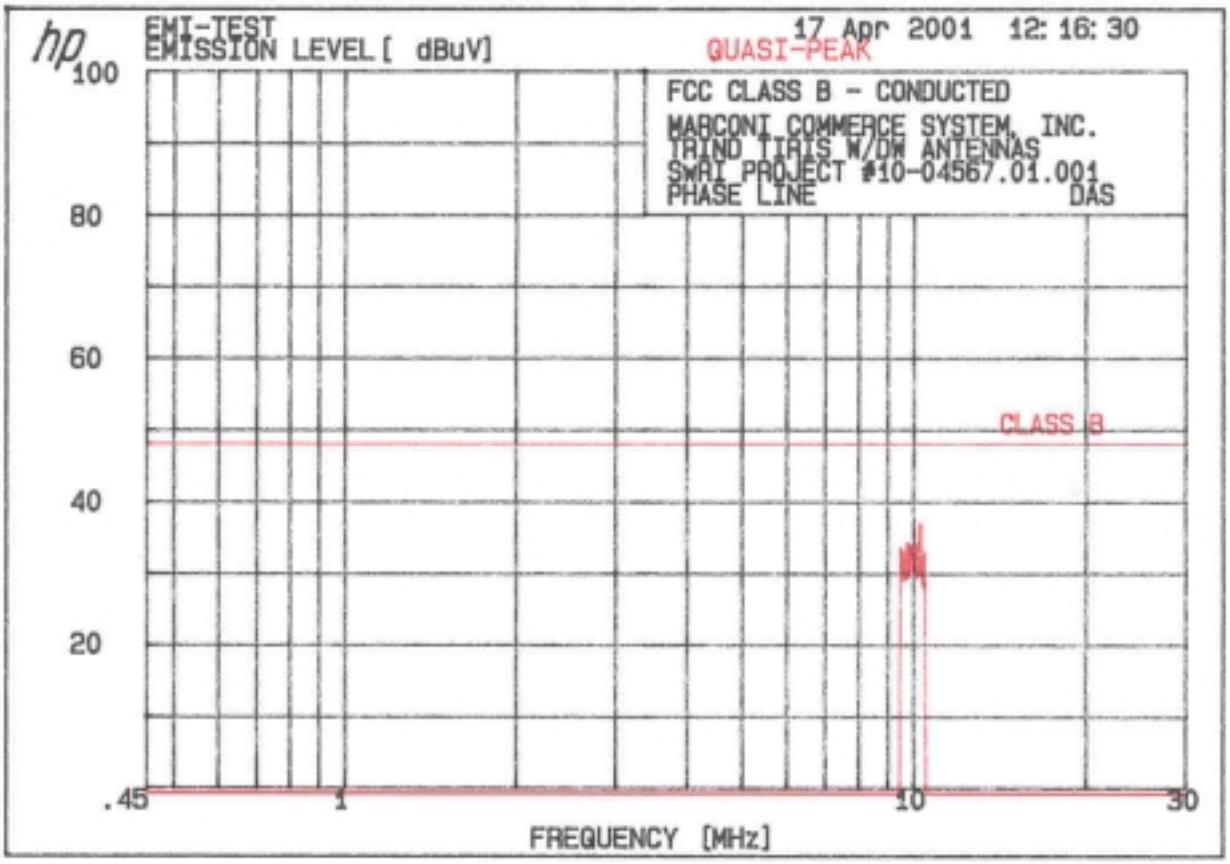
APPENDIX A

CONDUCTED MEASUREMENT PLOTS


EMI-TEST
EMISSION LEVEL [dBuV]
PEAK
17 Apr 2001 12:32:15
FCC CLASS B - CONDUCTED
MARCONI COMMERCE SYSTEM, INC.
TRIND TIRIS W/DW ANTENNAS
SWRI PROJECT #10-04567.01.001
RETURN LINE
DAS
CLASS B
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]

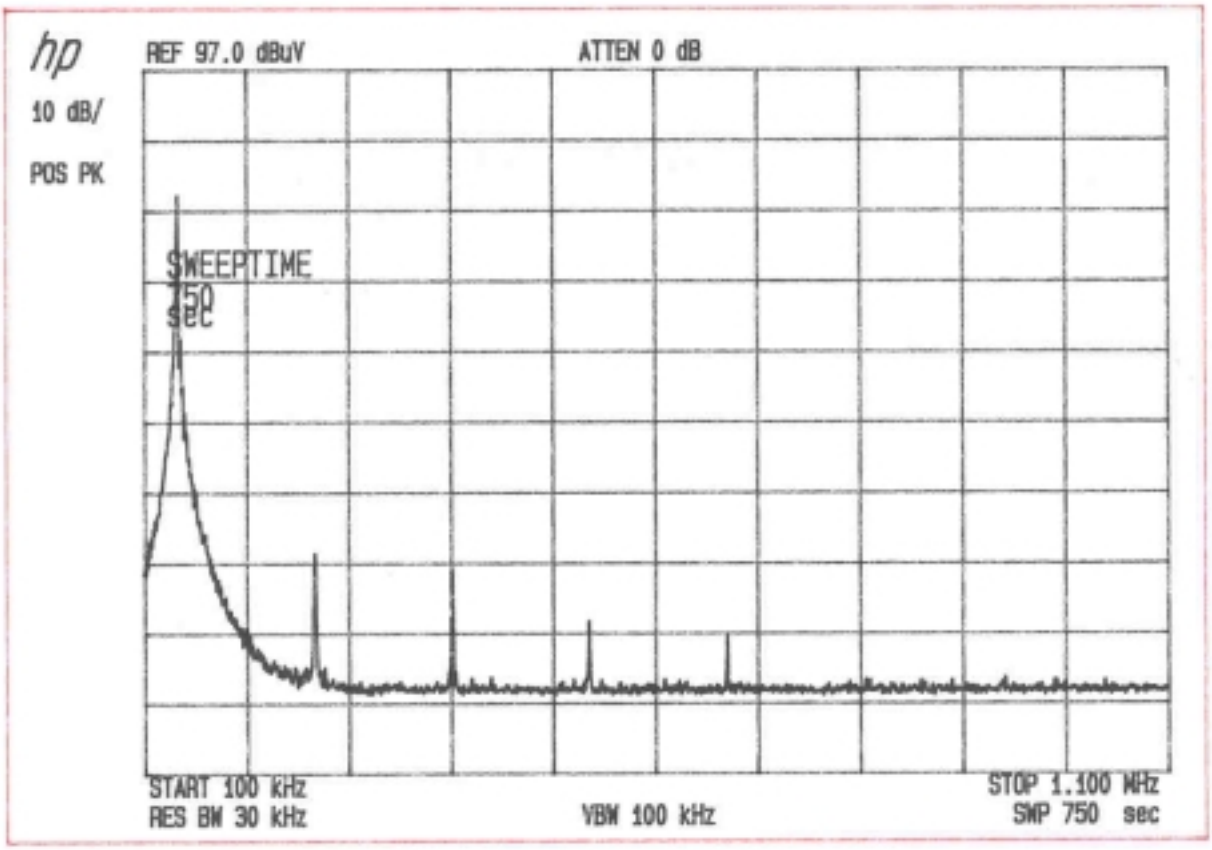

EMI-TEST
EMISSION LEVEL [dBuV]
QUASI-PEAK
17 Apr 2001 12:32:15
FCC CLASS B - CONDUCTED
MARCONI COMMERCE SYSTEM, INC.
TRIND TIRIS W/DW ANTENNAS
SWRI PROJECT #10-04567.01.001
RETURN LINE
DAS
CLASS B
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]

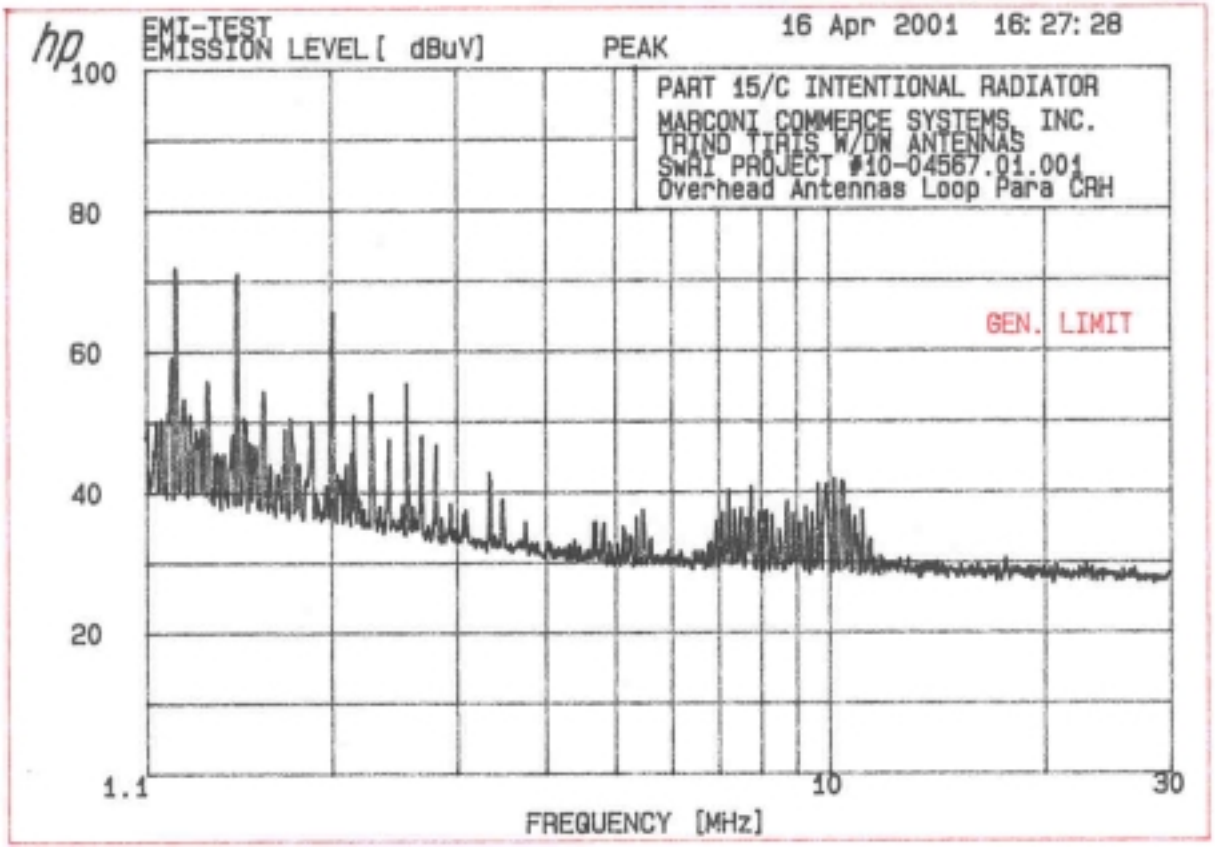

EMI-TEST
EMISSION LEVEL [dBuV]
PEAK
17 Apr 2001 12:16:30
FCC CLASS B - CONDUCTED
MARCONI COMMERCE SYSTEM, INC.
TRIND TIRIS W/DW ANTENNAS
SwRI PROJECT #10-04567.01.001
PHASE LINE
DAS
CLASS B
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]

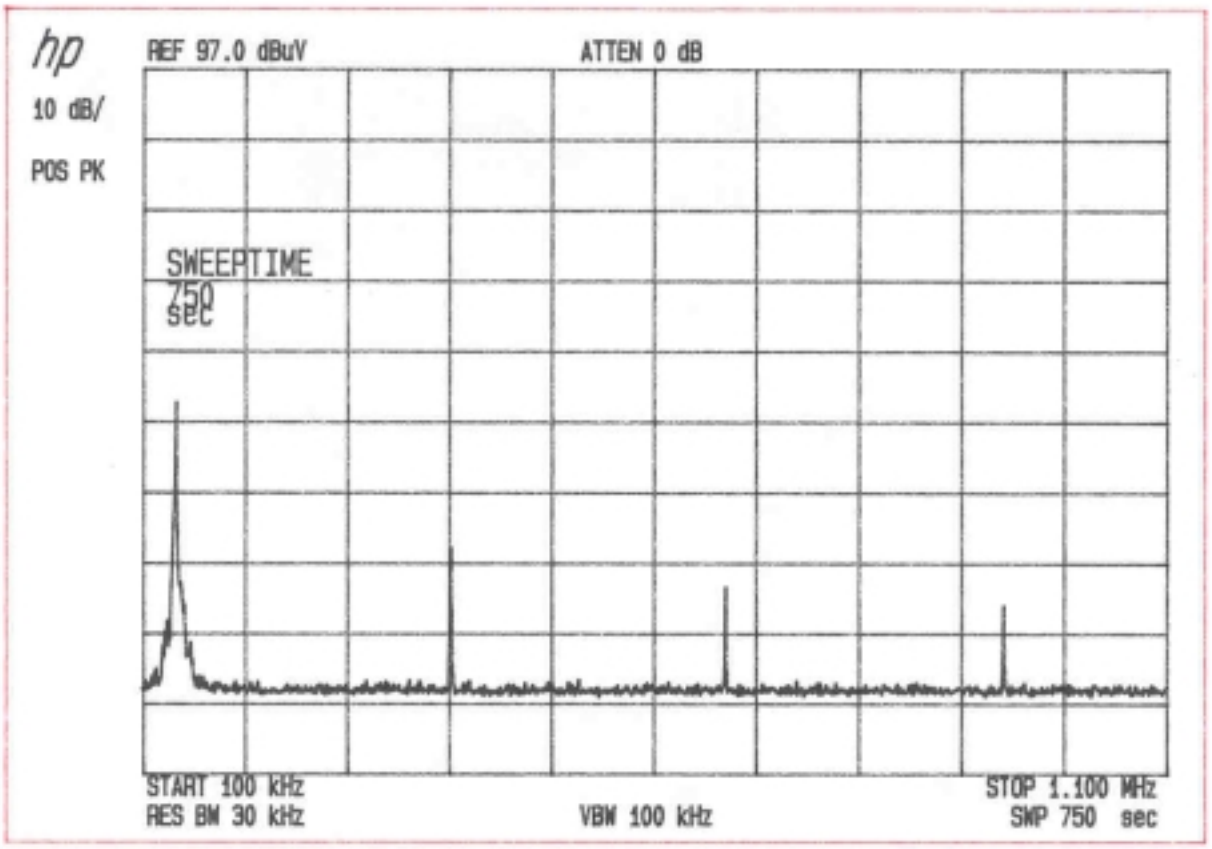

EMI-TEST
EMISSION LEVEL [dBuV]
QUASI-PEAK
17 Apr 2001 12:16:30
FCC CLASS B - CONDUCTED
MARCONI COMMERCE SYSTEM, INC.
TRIND TIRIS W/DW ANTENNAS
SwRI PROJECT #10-04567.01.001
PHASE LINE
DAS
CLASS B
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]

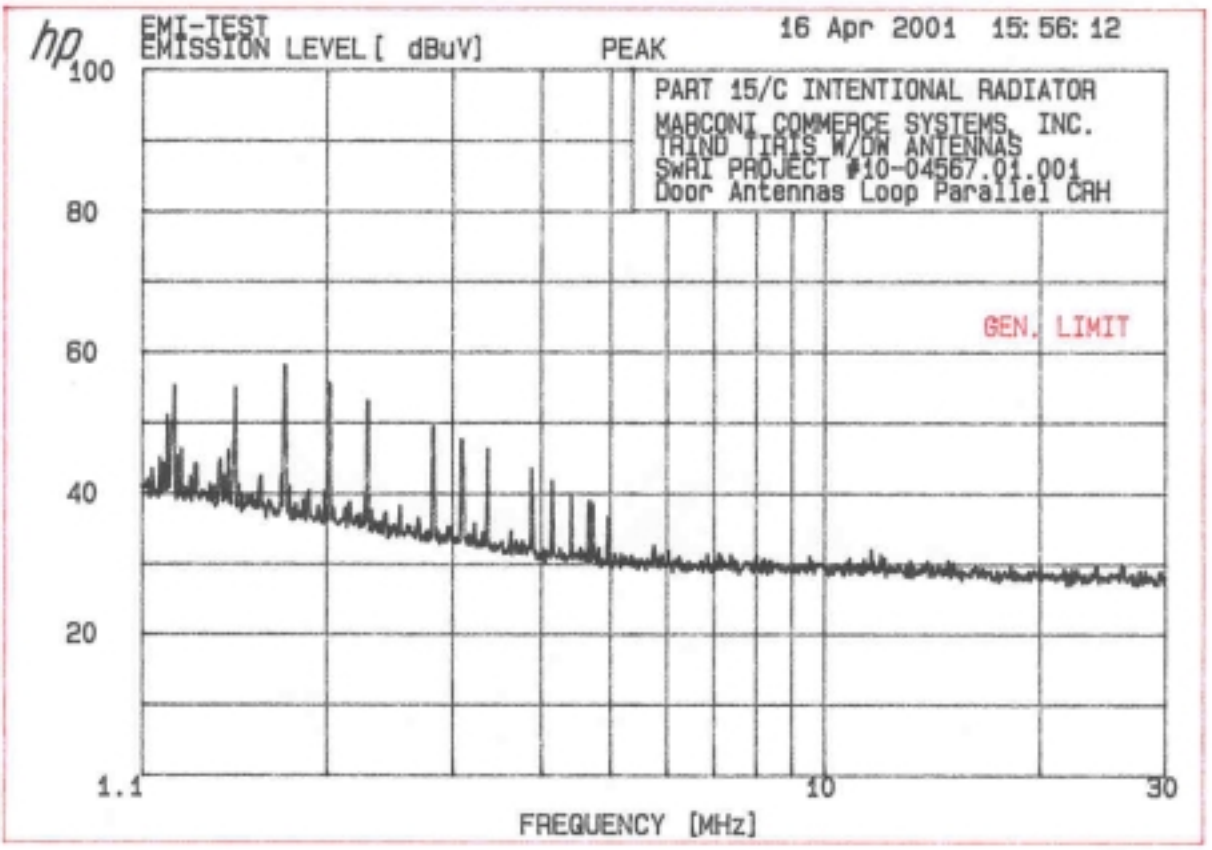
APPENDIX B

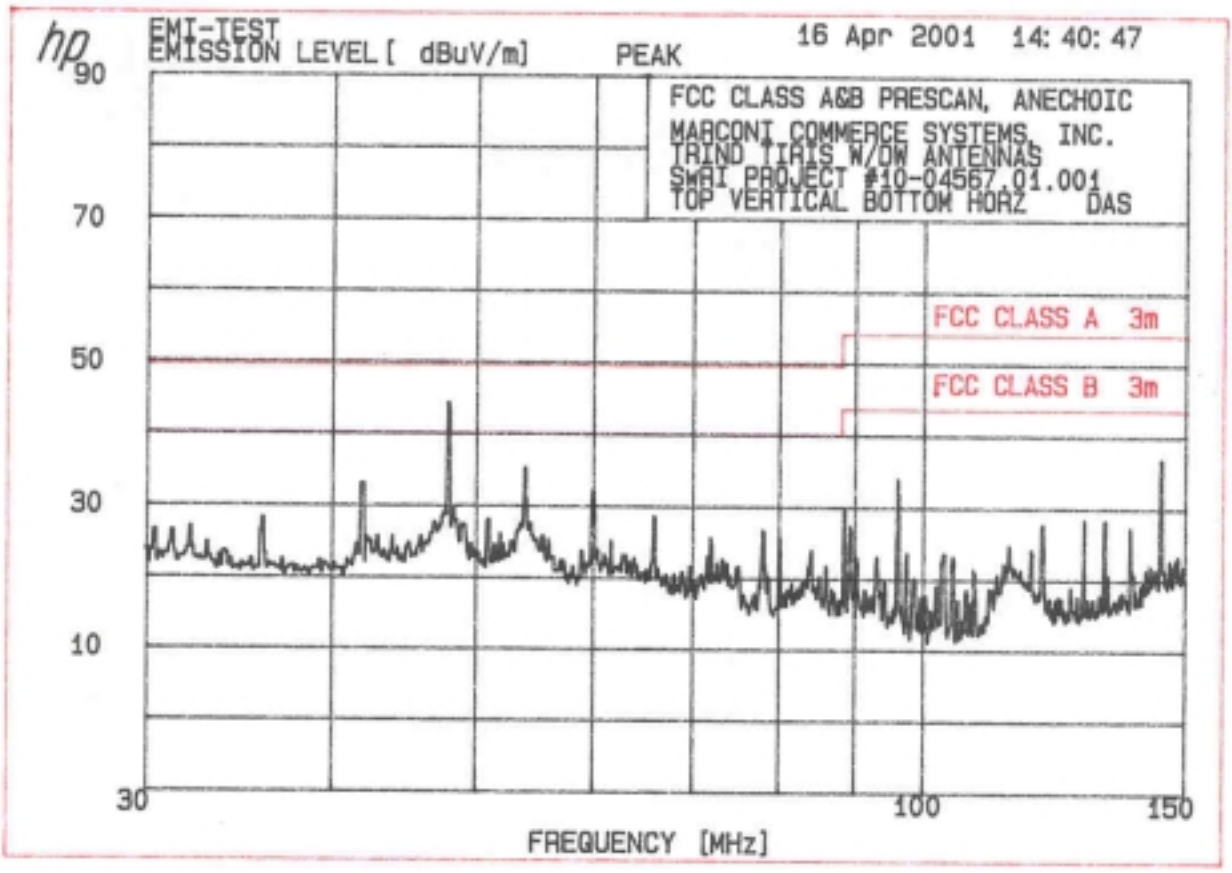
RADIATED MEASUREMENT PLOTS AND DATA SHEETS

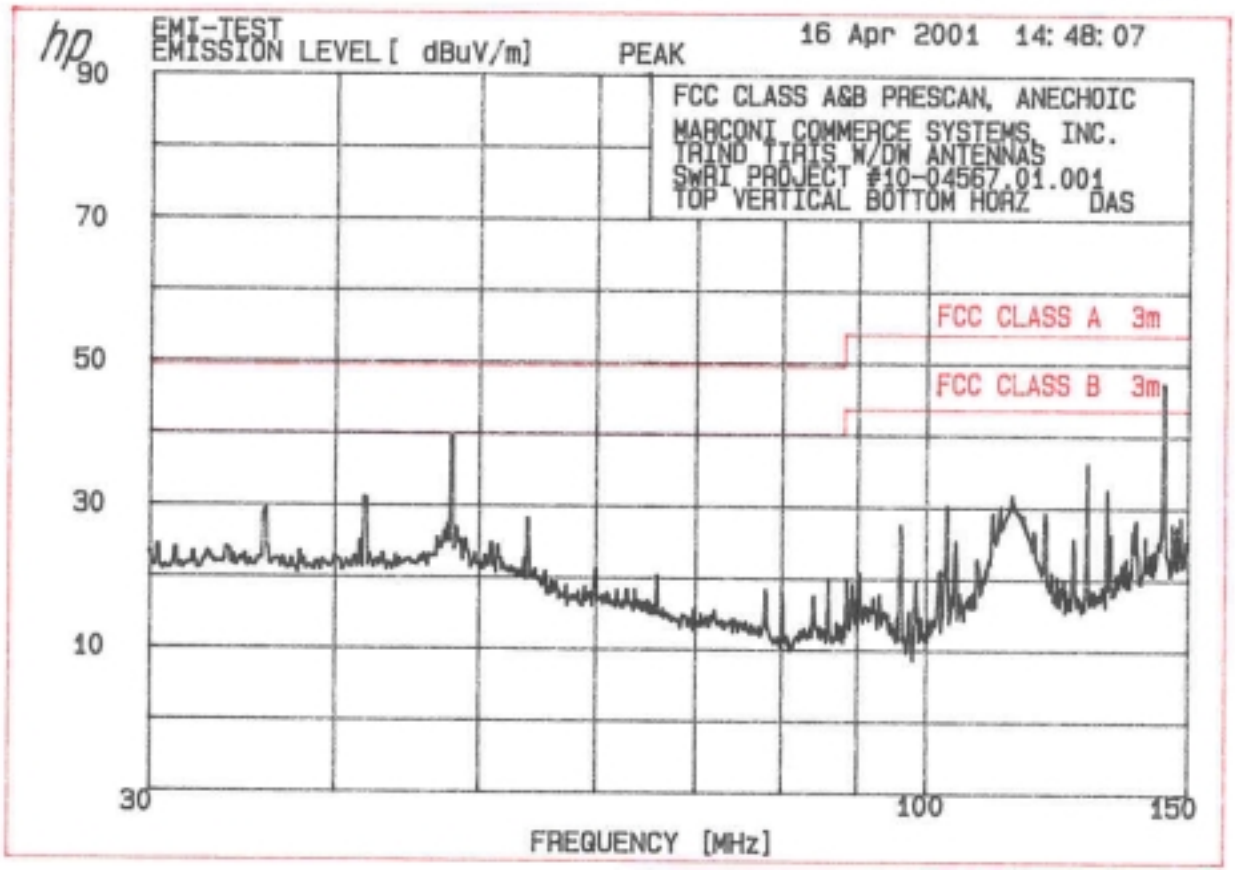

hp
REF 97.0 dBuV
ATTEN 0 dB
10 dB/
POS PK
SWEEPTIME
750
sec
START 100 kHz
RES BW 30 kHz
VBW 100 kHz
STOP 1.100 MHz
SWP 750 sec

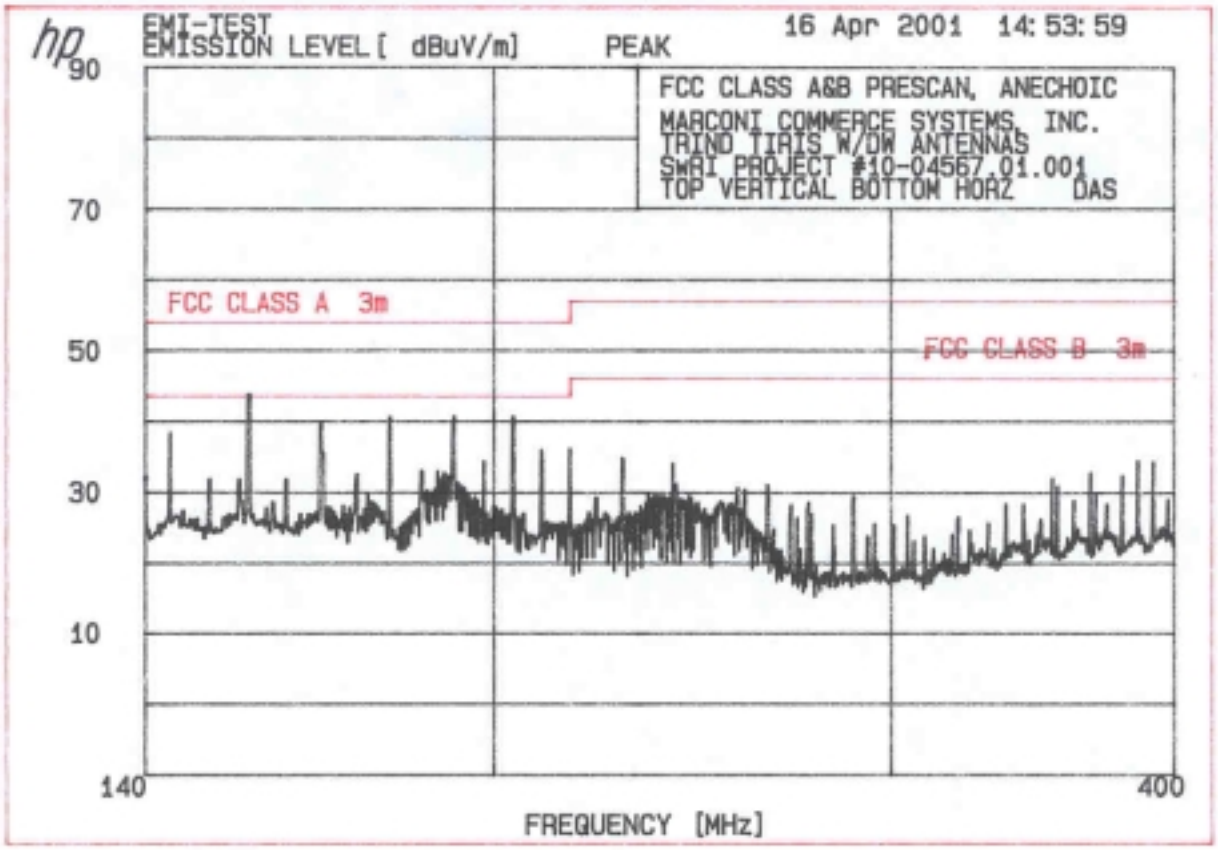

hp
EMI-TEST
EMISSION LEVEL [dBuV]
PEAK
16 Apr 2001 16:27:28
PART 15/C INTENTIONAL RADIATOR
MARCONI COMMERCE SYSTEMS, INC.
TRIND TIRIS W/DN ANTENNAS
SwRI PROJECT #10-04567.01.001
Overhead Antennas Loop Para CRH
GEN. LIMIT
100
80
60
40
20
1.1
10
30
FREQUENCY [MHz]

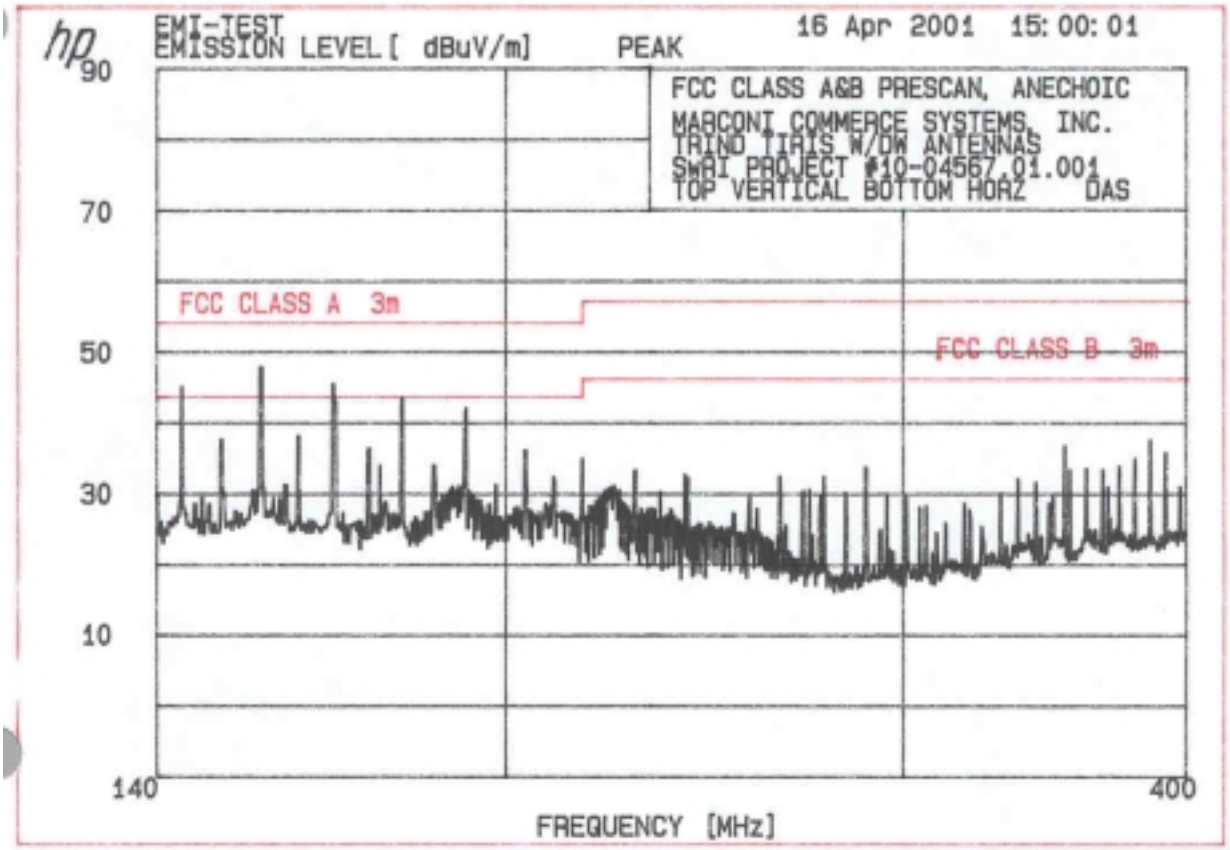

hp
REF 97.0 dBuV
ATTEN 0 dB
10 dB/
POS PK
SWEEPTIME
750
sec
START 100 kHz
RES BW 30 kHz
VBW 100 kHz
STOP 1.100 MHz
SWP 750 sec

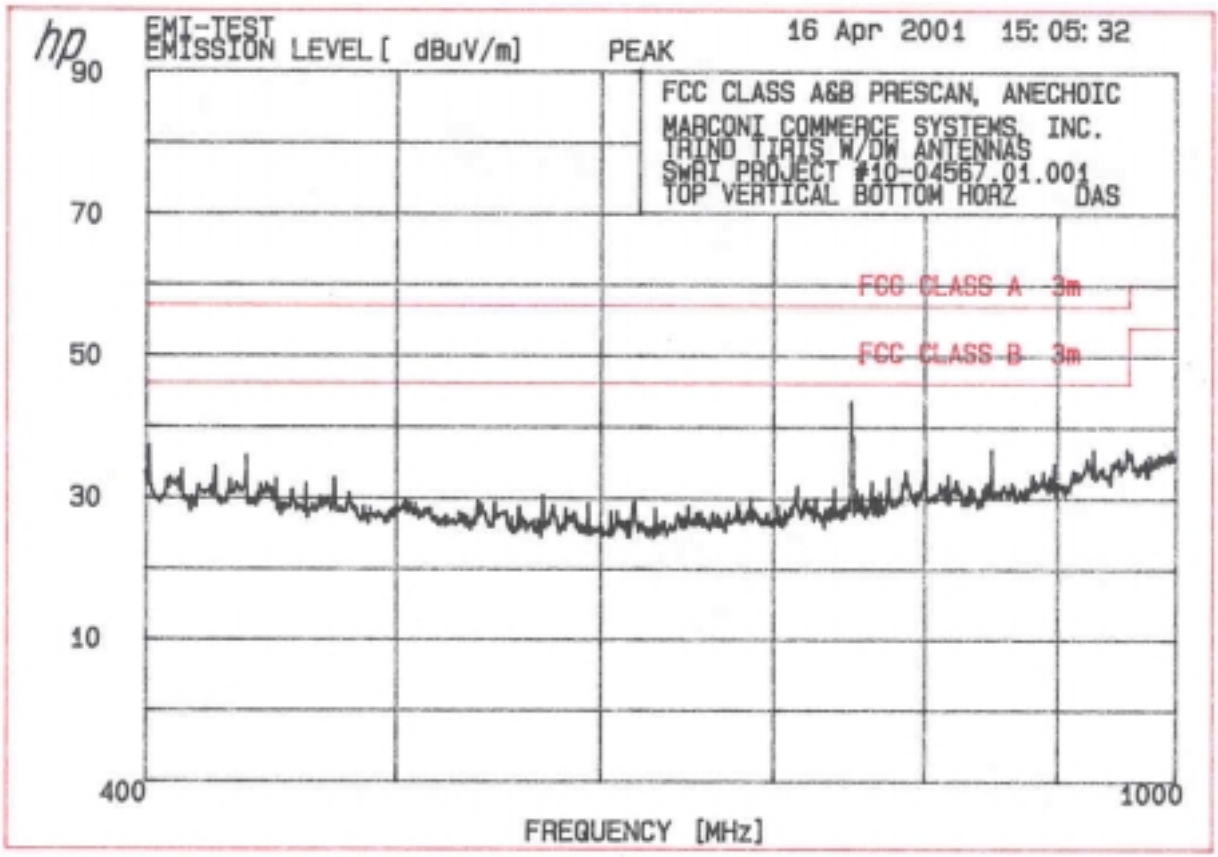

hp
EMI-TEST
EMISSION LEVEL [dBuV]
PEAK
16 Apr 2001 15:56:12
PART 15/C INTENTIONAL RADIATOR
MARCONI COMMERCE SYSTEMS, INC.
TRIND TIRIS W/DN ANTENNAS
SwRI PROJECT #10-04567.01.001
Door Antennas Loop Parallel CRH
GEN. LIMIT
100
80
60
40
20
1.1
10
30
FREQUENCY [MHz]

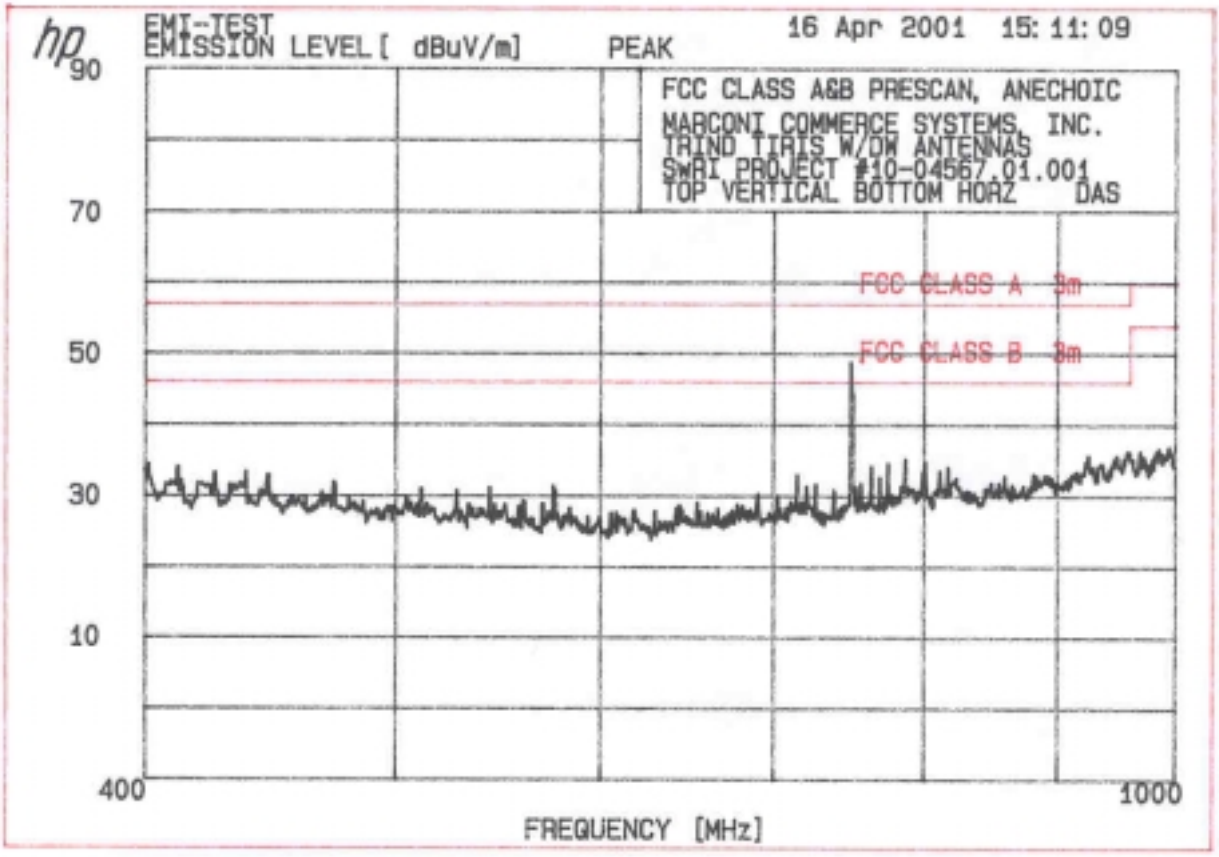

hp
EMI-TEST
EMISSION LEVEL [dBuV/m]
PEAK
16 Apr 2001 14:40:47
FCC CLASS A&B PRESCAN, ANECHOIC
MARCONI COMMERCE SYSTEMS, INC.
TRIND TIRIS W/DW ANTENNAS
SWRI PROJECT #10-04567.01.001
TOP VERTICAL BOTTOM HORZ DAS
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
30
100
150
FREQUENCY [MHz]


hp
EMI-TEST
EMISSION LEVEL [dBuV/m]
PEAK
16 Apr 2001 14:48:07
FCC CLASS A&B PRESCAN, ANECHOIC
MARCONI COMMERCE SYSTEMS, INC.
TRIND TIRIS W/DW ANTENNAS
SWRI PROJECT #10-04567.01.001
TOP VERTICAL BOTTOM HORZ DAS
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
30
100
150
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL [dBuV/m]
PEAK
16 Apr 2001 14:53:59
FCC CLASS A&B PRESCAN, ANECHOIC
MARCONI COMMERCE SYSTEMS, INC.
TRIND TIRIS W/DW ANTENNAS
SwRI PROJECT #10-04567.01.001
TOP VERTICAL BOTTOM HORZ DAS
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
140
400
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL [dBuV/m]
PEAK
16 Apr 2001 15:00:01
FCC CLASS A&B PRESCAN, ANECHOIC
MARCONI COMMERCE SYSTEMS, INC.
TRIND TIRIS W/DW ANTENNAS
SwRI PROJECT #10-04567.01.001
TOP VERTICAL BOTTOM HORZ DAS
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
140
400
FREQUENCY [MHz]


hp
EMI-TEST
EMISSION LEVEL [dBuV/m]
PEAK
16 Apr 2001 15:05:32
FCC CLASS A&B PRESCAN, ANECHOIC
MARCONI COMMERCE SYSTEMS, INC.
TRIND TIRIS W/DW ANTENNAS
SwRI PROJECT #10-04567.01.001
TOP VERTICAL BOTTOM HORZ DAS
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
400
1000
FREQUENCY [MHz]


hp
EMI-TEST
EMISSION LEVEL [dBuV/m]
PEAK
16 Apr 2001 15:11:09
FCC CLASS A&B PRESCAN, ANECHOIC
MARCONI COMMERCE SYSTEMS, INC.
TRIND TIRIS W/DW ANTENNAS
SwRI PROJECT #10-04567.01.001
TOP VERTICAL BOTTOM HORZ DAS
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:** 10-04567.01.001

Device Under Test: TRIND TIRIS W/DW Antennas — **Detection Method:** QP — **EUT Mode:** Transmit

Date / Time: 4/18/01 13:42 — **Test Receiver:** Rohde&Schwarz ESS EMI sn: DE31157

Test Standard(primary limit): FCC Class A, Part 15 (10 m radiated) — **Antenna:**

Test Standard(optional limit):

Test Sponsor: Marconi

Test Technician: Das

Temp.(°F)/Humidity(%):

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)	
31.270	353	3	V	1.29	10	-0.6	21.8	2.2	23.4	39.0		-15.6	
32.475	-1	3	V	1.29	10	3.1	21.3	2.3	26.7	39.0		-12.3	
37.701	360	3	V	1.36	10	8.0	18.3	2.4	28.7	39.0		-10.3	
47.992	354	3	V	2.82	10	13.7	12.6	2.7	29.1	39.0		-9.9	DIGITAL
54.001	0	3	V	2.96	10	18.8	9.4	3.1	31.3	39.0		-7.7	DIGITAL
59.998	360	3	V	2.96	10	16.7	7.2	3.3	27.2	39.0		-11.8	
63.999	0	3	V	2.57	10	9.0	6.9	3.4	19.3	39.0		-19.7	
66.001	360	3	V	1.47	10	16.1	7.2	3.5	26.8	39.0		-12.2	
75.000	160	3	V	1.47	10	13.4	7.8	3.9	25.0	39.0		-14.0	
78.000	232	3	V	1.79	10	19.0	8.3	3.8	31.1	39.0		-7.9	DIGITAL
79.994	291	3	V	1.27	10	23.2	8.5	3.9	35.6	39.0		-3.4	DIGITAL
119.994	196	3	V	1.59	10	13.8	13.8	5.0	32.7	43.5		-10.8	
131.998	227	3	V	1.88	10	10.6	14.6	5.4	30.6	43.5		-12.9	
143.998	196	3	V	1.83	10	10.7	15.5	5.7	31.9	43.5		-11.6	
156.001	86	3	V	1.83	10	11.3	16.1	5.9	33.4	43.5		-10.1	
168.001	89	3	V	1.78	10	13.9	17.3	6.3	37.4	43.5		-6.1	DIGITAL
186.001	329	3	H	2.82	10	14.4	18.6	6.6	39.6	43.5		-3.9	DIGITAL
180.001	334	3	H	3.37	10	16.0	18.4	6.5	40.9	43.5		-2.6	DIGITAL
168.001	352	3	H	2.78	10	17.0	17.3	6.3	40.5	43.5		-3.0	DIGITAL
144.001	2	3	H	3.11	10	15.4	15.5	5.7	36.6	43.5		-6.9	DIGITAL
119.998	360	3	H	3.42	10	13.4	13.8	5.0	32.2	43.5		-11.3	
60.001	74	3	H	3.42	10	11.7	7.2	3.3	22.2	39.0		-16.8	
48.005	270	3	H	4.00	10	11.6	12.6	2.8	26.9	39.0		-12.1	
203.991	360	4	V	1.14	10	34.3	19.6	-20.9	33.0	43.5		-10.5	
209.989	127	4	V	1.02	10	34.7	19.5	-20.8	33.4	43.5		-10.1	DIGITAL
216.018	114	4	V	1.00	10	40.2	19.9	-20.7	39.4	46.5		-7.1	DIGITAL
228.015	346	4	V	1.25	10	30.4	21.4	-20.4	31.4	46.5		-15.1	

SwRI Open Area Test Site Radiated Emissions v2_2 **Project Number:** 10-04567.01.001

Device Under Test: TRIND TIRIS W/DW Antennas **Detection Method:** QP **EUT Mode:** Transmit

Date / Time: 4/18/01 13:42 **Test Receiver:** Rohde&Schwarz ESS EMI sn: DE31157

Test Standard(primary limit): FCC Class A, Part 15 (10 m radiated) **Antenna:**

Test Standard(optional limit):

Test Sponsor: Marconi

Test Technician: Das

Temp.(°F)/Humidity(%):

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)	
239.975	127	4	V	1.14	10	28.8	21.6	-20.2	30.1	46.5		-16.4	
276.013	360	4	V	1.06	10	27.0	20.4	-19.7	27.7	46.5		-18.8	
288.012	0	4	V	1.05	10	28.4	19.0	-19.5	27.9	46.5		-18.6	
304.002	360	4	V	1.08	10	28.0	18.0	-19.1	26.9	46.5		-19.6	
320.003	8	4	V	1.25	10	24.8	18.8	-18.7	24.9	46.5		-21.6	
384.003	156	4	V	3.53	10	26.4	22.3	-17.8	30.9	46.5		-15.6	
432.003	3	4	V	2.54	10	22.9	23.2	-16.9	29.1	46.5		-17.4	
474.003	326	4	V	2.74	10	18.7	27.3	-16.3	29.8	46.5		-16.7	
438.003	325	4	H	3.17	10	16.7	24.1	-16.7	24.0	46.5		-22.5	
401.982	314	4	H	1.77	10	25.7	21.7	-17.4	30.0	46.5		-16.5	
368.032	333	4	H	1.92	10	24.7	22.0	-17.9	28.8	46.5		-17.7	
351.985	0	4	H	1.44	10	30.0	21.2	-18.2	33.0	46.5		-13.5	
319.988	324	4	H	1.71	10	30.4	18.8	-18.7	30.5	46.5		-16.0	
304.038	0	4	H	2.83	10	30.7	18.0	-19.1	29.6	46.5		-16.9	
215.988	360	4	H	2.60	10	35.4	19.9	-20.7	34.6	43.5		-8.9	DIGITAL
521.950	343	7	H	1.34	10	14.4	26.1	-15.5	24.9	46.5		-21.6	

SwRI Open Area Test Site Radiated Emissions v2_2 — **Project Number:** 10-04567.01.001

Device Under Test: TRIND TIRIS W/DW Antennas — **Detection Method:** — **EUT Mode:** Transmit

Date / Time: 4/18/01 13:42 — **Test Receiver:** Rohde&Schwarz ESS EMI sn: DE31157

Test Standard(primary limit): Custom — **Antenna:**

Test Standard(optional limit):

Test Sponsor: Marconi

Test Technician: Das

Temp.(°F)/Humidity(%):

FREQ MHz	Orient. θ°	Antenna I.D.	Pol.	Ht(m)	Dis(m)	UnCorr'd Level (dBuV)	Correction Factors (dB) Ant	Cable	Corr'd Level (dBuV/m)	Primary Limit (dBuV/m)	Optional Limit (dBuV/m)	Margin (Primary) (dB)	Comments (** denotes a measurement above the primary limit) Note: Cable factor includes preamplifier gain at frequencies above 200 MHz.
0.134	0		par	1.00	30	2.2	65.7	0.4	68.3	85.0		-16.7	peak
0.134	0		par	1.00	30	-15.5	65.7	0.4	50.6	65.0		-14.4	average
0.134	270		per	1.00	30	-23.6	65.7	0.4	42.5	65.0		-22.5	average
0.134	270		per	1.00	30	-5.5	65.7	0.4	60.6	85.0		-24.4	peak
0.134	102		pg	1.00	30	-5.6	65.7	0.4	60.5	85.0		-24.5	peak
0.134	102		pg	1.00	30	-23.7	65.7	0.4	42.4	65.0		-22.6	average
0.110	0		par	1.00	30	-29.5	65.9	0.4	36.8	67.0		-30.2	average ambient
0.110	0		par	1.00	30	-21.5	65.9	0.4	44.8	87.0		-42.2	peak ambient
0.110	0		per	1.00	30	-19.5	65.9	0.4	46.8	87.0		-40.2	peak ambient
0.110	0		per	1.00	30	-29.2	65.9	0.4	37.1	67.0		-29.9	average ambient
0.110	0		pg	1.00	30	-30.2	65.9	0.4	36.1	67.0		-30.9	average ambient
0.110	0		pg	1.00	30	-21.5	65.9	0.4	44.8	87.0		-42.2	peak ambient
0.403	0		par	1.00	30	-21.4	54.0	0.4	33.0	75.0		-42.0	peak ambient
0.403	0		par	1.00	30	-27.9	54.0	0.4	26.5	55.0		-28.5	average ambient
3.000	0		par	1.00	30	-18.1	39.2	0.4	21.5	29.5		-8.0	qp ambient
30.000	0		par	1.00	30	-17.3	33.8	0.4	16.9	29.5		-12.6	qp ambient
30.000	0		per	1.00	30	-17.7	33.8	0.4	16.5	29.5		-13.0	qp ambient
3.000	0		per	1.00	30	-17.5	39.2	0.4	22.1	29.5		-7.4	qp ambient
0.403	0		per	1.00	30	-23.2	54.0	0.4	31.2	75.0		-43.8	peak ambient
0.403	0		per	1.00	30	-29.1	54.0	0.4	25.3	55.0		-29.7	average ambient
0.403	0		pg	1.00	30	-22.1	54.0	0.4	32.3	75.0		-42.7	peak ambient
0.403	0		pg	1.00	30	-27.3	54.0	0.4	27.1	55.0		-27.9	average ambient
3.000	0		pg	1.00	30	-19.5	39.2	0.4	20.1	29.5		-9.4	qp ambient
30.000	0		pg	1.00	30	-18.0	33.8	0.4	16.2	29.5		-13.3	qp ambient

APPENDIX C

TEST INSTRUMENTATION

EQUIPMENT USE REPORT

MANUFACTURER	MODEL NO.	DESCRIPTION	SERIAL NO.	CAL DATE
CONDUCTED EMISSIONS				
Rhode & Schwarz	ESH2-Z5	LISN	872461/021	26 Apr 01
SwRI	---	3 dB Transient Suppressor	---	---
Hewlett Packard	8568B	Spectrum Analyzer	2403A07074 2415A00464	20 Apr 01
Hewlett Packard	85650A	Quasi Peak Adapter	2043A00254	27 May 01
ANECHOIC CHAMBER				
SwRI	UTC10-221-1	RF Amplifier	9112SN15	Checked
Hewlett Packard	8568B	Spectrum Analyzer	2403A07074 2415A00464	20 Apr 01
Hewlett Packard	85650A	Quasi Peak Adapter	2043A00254	27 May 01
Hewlett Packard	8447F	RF Amplifier	2727A02261	Verified
EMCO	3121-DB2	Dipole Antenna	148	Verified
EMCO	3121-DB3	Dipole Antenna	148	Verified
EMCO	3121-DB4	Dipole Antenna	1097	Verified
EMCO	6512	Passive Loop Antenna	0001-1265	31 Jul 01
OATS				
Rhode & Schwarz	ESS	EMI Test Receiver	DE31157	16 May 01
SwRI	2 MHz-1GHz	OATS Pre-Amp	14-82-020	Verified
Electro Metrics	BDA-25S	Dipole Antenna	535	30 Apr 02
Electro Metrics	DM-105-T2	Dipole Antenna	176	30 Apr 02
Electro Metrics	DM-105-T3	Dipole Antenna	108	30 Apr 02
EMCO	6512	Loop Antenna	0001-1265	31 Jul 01
SwRI	RG-223	Coax, 2.5 meter	40	Verified
SwRI	-	Coax, underground	-	Verified
SwRI	RG-223	Coax, OATS cable 2	2	Verified
SwRI	RG-214	Coax, OATS cable 1	1	Verified
VOLTAGE VARIATION				
Hewlett Packard	8568B	Spectrum Analyzer	2403A07074 2415A00464	20 Apr 01
Hewlett Packard	85650A	Quasi Peak Adapter	2043A00254	27 May 01
EMCO	6512	Passive Loop Antenna	0001-1265	31 Jul 01
GR	V2020A	Variable AC Source	1	Verified
Fluke	87	Digital Voltmeter	64330-494	5 Feb 02

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