MEASUREMENT AND TECHNICAL REPORT ON THE MARCONI COMMERCE SYSTEMS TRIND™ MULTI 1™

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

Project 10-03628.01.001
Report Number EMCR 00/034

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1.0 GENERAL INFORMATION

1.1 Product Description

The Marconi Commerce Systems TRIND™ Multi 1™, FCC ID Number N6SGBIRA, allows customers wishing to purchase motor fuel to interface directly with a fuel dispenser via a handheld transponder. The TRIND™ Multi 1™ (TRIND: Transmitter/Receiver in Dispenser) transmits at 13.56 MHz which provides energy to the handheld transponder causing it to reflect a signal (also at 13.56 MHz) containing the customer's data back to the TRIND™ Multi 1. Essentially, Gilbarco is providing the packaging, power, displays, and antennae for two types of boards supplied by Texas Instruments (DCB: Data Control Board and MPR: Multi-Protocol Reader) – see Attachment 1 Block Diagram. These two Texas Instruments boards comprise a High Frequency (HF) Reader System. The MPR board is considered proprietary, and is the sole intentional radiator in the TRIND™ Multi 1™ product. The MPR schematic will be posted to the FCC website directly by Texas Instruments and treated confidentially.

The Texas Instruments HF Reader System is a Radio Frequency Identification Device (RFID) which is designed for use in conjunction with a handheld battery-less transponder. The hand-held transponder is carried by the user. The transmitter portion (MPR) of the HF Reader System operates at 13.56 MHz and is subject to FCC Part 15, Subpart C, "Intentional Radiator," paragraph 15.225 (13.553-13.567MHz). Radiated emissions from the intentional radiator portion of the device is subject to the limits in Section 15.209 of the Rules outside of the 13.56 +/- 0.007 MHz band. Radiated emissions from the digital electronics portion of the device is subject to FCC Part 15, Subpart B, Unintentional Radiator, paragraph 15.109, under the Class A limits and as such, the device is incorporated into an application that is subject to Class A limits. Conducted emissions from on the AC power line are subject to FCC Part 15, Subpart C, Intentional Radiator, paragraph 15.207. Table 1.1 lists the TRIND ™ Multi 1™ components.

1.2 Related Grants

There are no related grants.

1.3 Tested System Details

The HF Reader System is mounted into an enclosure such as, but not limited to, a fueling dispenser and includes two bezel mounted 13.563 MHz antennas, two Multi-Protocol Readers, two lightboards, a Data Control Board, a switched DC power supply, an EMI line filter and associated Class II energy-limiting transformer. These components are listed in Table 1.1, and their functional relationship is provided in a block diagram in Attachment 1.

The 13.563 MHz signal originates on the Multi-Protocol Reader from which the signal is sent to the bezel antennas where it is intentionally radiated. There are three possible bezel configurations: two ADVANTAGE™ styles and one ENCORE™ style. In the case of the two ADVANTAGE™ style setups the antenna is connected to the lightboard with an RG-316 coaxial cable to the bezel antenna. In the case of the ENCORE™ style setup, the Multi-Protocol Reader board is mechanically attached and electrically connected to the antenna board so that a cable is not required for the transmission of the intentionally radiated signal.

Both completed Light/Multi-Protocol Reader assemblies connect to the Data Control Board and the power supply via the same cables. Attachment 1 contains a detailed functional description of the reader system and its components.

TABLE 1.1 SYSTEM COMPONENTS

Component Description	Marconi Part No.	Texas Instruments Part No.
Data Control Board (1)	Q13563-03	RI-CTL-DCMA-03
Multi-Protocol Reader (2)	Q13786-02	RI-STU-TRDB-01
Light Board (2)	T20545-G1	N/A
Light Board (2)	M0155A001	N/A
13.563MHz Antenna (2) (Advantage Wide Frame)	T20582-G1	N/A
13.563MHz Antenna (2) (Advantage Narrow Frame)	T20609-G1	N/A
13.563MHz Antenna (2)(Encore)	M01058A001	N/A
Gateway Board(1)	T20128-GX	N/A
Voltage Regulating Board(1)	T20314-G1	N/A

1.4 Test Methodology

Radiated testing was performed according to the procedures in ANSI C63.4-1992 and the limits prescribed in CFR 47, FCC Parts 15.109, 15.207, 15.209 and 15.225. Radiated testing was performed at antenna to EUT distances of 3, 10 and 30 meters.

1.5 Test Facility

The Open Area Test Site and Conducted Measurement Facility used to collect data are located at Southwest Research Institute, 6220 Culebra Road, San Antonio, Texas. Details concerning these test sites are found in the report entitled, "Description of Measurement Facility," dated 28 April 1997, which is on file with the FCC Laboratory Division in Columbia, Maryland. On June 12, 1997, 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™ Multi 1™ will be incorporated in other devices such as a system housing. A label will be supplied with the TRIND™ Multi 1™ for placement on the exterior of the device in which the equipment is incorporated. This label is shown in the drawing in Attachment 3.

2.4 Supplemental Information to be in the Reader Manual

In addition to reiteration of required information as an intentional radiator, in keeping with sections 15.21 and 15.105 of the FCC rules, the manual supplied with the TRIND™ Multi 1™ will also include the following admonitions:

IMPORTANT NOTICE: 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. Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

3.0 SYSTEM TEST CONFIGURATION

3.1 Justification

Radiated tests were performed on the TRIND™ Multi 1™ intentional radiator from 13.56 MHz to 1 GHz for the highest fundamental and harmonics. Radiated tests were performed up to 1 GHz for harmonics of the fundamental emission and spurious emissions related to the digital electronics portion of the unit. Both vertical and horizontal polarizations were tested. Radiated signature scans were made at 3 meters in a shielded anechoic chamber.

3.2 EUT Exercise

The TRIND™ Multi 1™ is powered by 115 VAC. The TRIND™ Multi 1™ was exercised by establishing the interrogation reply sequence using a handheld transponder.

3.3 Special Accessories

The TRIND™ Multi 1™ was installed in a metal case with dimensions of 29.25 in. (w) x 13.5 in. (h) x 23.5 in. (d). In the Encore configuration, the TRIND™ Multi 1™ power supply was mounted outside the case, on the top of the case.

3.4 Equipment Modification

The need for the special accessories in paragraph 3.3 was discovered during radiated emissions testing at the OATS.

3.5 Configuration of Tested System

Refer to Attachment 1 for block diagram of tested configuration. Refer to Appendix D for photographs of the EUT test configuration.

3.6 Antenna Connector

This TRIND™ Multi 1™ is intended for incorporation into other devices. It is not a consumer device. It requires installation by a technician or assembly line worker trained in its installation in order to properly install it in other devices. Because this is a device that inherently requires professional installation, it complies with the requirements of Section 15.203 of the Commission's Rules. The written instructions packed with the device will explain the requirement for professional installation.

4.0 BLOCK DIAGRAM OF THE TRIND™ MULTI 1™

Refer to Attachment 1 for block diagram of tested configuration.

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 Section 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 5 dB				
Test Configuration	**Frequency (MHz)**	**Measured Level (dBΦV)** [1]		**Paragraph 15.207 Limit (dBΦV)**
		Line	**Neutral**	
Advantage	27.12		37	48
Advantage	27.12	34		48
Encore	13.56		43	48
Encore	13.56	43		48

[1] All 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

The data below are the corrected highest level EME measurements taken from the following radiated data sheets. The data sheets include the emission frequencies and the corrected level. An explanation of the field strength calculation is given in paragraph 7.3.

7.1 Radiated Measurement Data

Measurements were made of the fundamental frequency of 13.56 MHz at 30 meters. Additionally, the spectrum was investigated for harmonics and spurious emissions up to 30 MHz at 30 meters. No harmonics or other spurious emissions were detected. The measurement level of the fundamental at the center frequency, as well as the level of the fundamental at the band edges at 10 meters, is shown in Table 7.1.

TABLE 7.1
MEASUREMENTS OF FUNDAMENTAL FREQUENCY

Judgment: EUT Fundamental Passed by 29.1 dB				
Antenna Configuration	**Frequency (MHz)**	**Corrected Level[1] dB(µV/m)**	**Limit dB(µV/m)**	**dB Under Limit**
Advantage Wide Frame	13.56	50.4	80 (30 meters)	29.6
	13.5485	38.4	39 (10 meters)	0.6
	13.5715	37.9	39 (10 meters)	1.1
Advantage Narrow Frame	13.56	50.9	80 (30 meters)	29.1
	13.574	36.6	39 (10 meters)	2.4
	13.543	36.6	39 (10 meters)	2.4
Encore	13.56	49.4	80 (30 meters)	30.6
	13.548	38.4	39 (10 meters)	0.6
	13.569	38.4	39 (10 meters)	0.6

1 All readings are quasi-peak manual measurements made with a receiver.

The spectrum from 30 MHz to 1 GHz was investigated for spurious emissions. The worst case spurious emissions are given in Table 7.2. Peak signature scans are provided in Appendix B.

TABLE 7.2
MEASUREMENTS OF SPURIOUS EMISSIONS

Judgment EUT passed by 1.4 dB				
Antenna Configuration	**Frequency (MHz)**	**Corrected Level[1] dB(µV/m)**	**Limit dB(µV/m)**	**dB Under Limit**
Advantage	244.10	44.1	46.5	2.4
	271.22	42.6	46.5	3.9
	189.87	38.6	43.5	4.9
Encore	366.10	45.1	46.5	1.4
	271.17	44.6	46.5	1.9
	189.86	41.6	43.5	1.9
	352.54	43.9	46.5	2.6
	379.68	43.8	46.5	2.7

1 All readings are quasi-peak manual measurements made with a receiver.

TRIND™ MULTI 1™ ADVANTAGE OATS DATA SHEETS

Radiated Emissions Test Data

FREQUENCY (MHz)	13.56	13.56	13.56	13.5715	13.5485	13.56	13.56	13.56	13.574	13.543
TRANSDUCER	ALR-25	ALR-25	ALR-25	ALR-25	ALR-25	ALR-25	ALR-25	ALR-25	ALR-25	ALR-25
Antenna to DUT distance (meters)	30	30	30	10	10	30	30	30	10	10
Antenna height (meters)	1	1	1	1	1	1	1	1	1	1
POLARIZATION to DUT: (‖ Parallel, ⊥ Perpendicular, = Parallel to Ground)	⊥	‖	=	⊥	⊥	⊥	‖	=	⊥	⊥
SIGNAL DIRECTION (degrees)	174.4	177	230	223	223	304	330	330	304	304
RECEIVER ATTENUATION (dB)	0	0	0	0	0	0	0	0	0	0
METER (dBΦV)	14.5	2.5	-3.5	2	2.5	15	4.5	-6	2	2
TRANSDUCER FACTOR (dB)	34.6	34.6	34.6	34.6	34.6	34.6	34.6	34.6	34.6	34.6
EXTERNAL GAIN/CABLE LOSS (dB)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
CORRECTED LEVEL (dBΦV/m)	50.4[2]	38.4[2]	32.4[2]	37.9[2]	38.4[2]	50.9[3]	40.4[3]	29.9[3]	36.6[3]	36.6[3]
LIMIT (dBΦV/m)	80	80	80	39[1]	39[1]	80	80	80	39[1]	39[1]

Date: Detection Method: _X_ CISPR ___ PEAK ___ AVERAGE ___ Other
Project No.: 10-3628.01.001 EUT: Marconi Advantage
Test Category: FCC Part 15 OPR/Asst.: D.Smith
Temp, & %r.H:

Scanned 12.5 MHz to 30 MHz, 3 antenna polarizations. No other emissions detected.
Note 1: Used 20 dB per decade roll-off to adjust limit for closer distance.
Note 2: Advantage Wide Frame
Note 3: Advantage Narrow Frame

SwRI Open Area Test Site Radiated Emissions v2_1		**Project Number:**	10-0362801001
Device Under Test:	ADVANTAGE WIDE/NARROW METAL	**Detection Method:**	QP
Date / Time:	MAY 4 2000 15:18	**Test Receiver:**	Rohde & Schwarz ESV S/N 872/12/53
Test Standard(primary limit):	FCC Class A, Part 15 (10 m radiated)	**Antenna:**	9: BICON 3104 sn:2290 Cal due:29-Apr-00
Test Standard(optional limit):			
Test Sponsor:	MARCONI		
Test Technician:	D SMITH		
Temp.(°F)/Humidity(%):	95 49%		

FREQ	Orient.	Antenna				UnCorr'd	Corr Factors		Corr'd	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)	Level	Ant	Cable	Level	dBuV	dBuV	(dB)	
189.87	37	9	H	3.04	10	16.5	16.7	5.4	38.6	43.5		-4.9	
189.67	311	9	V	1.15	10	9.5	16.8	5.4	31.7	43.5		-11.8	
135.57	360	9	V	1.07	10	15.5	11.1	4.2	30.9	43.5		-12.6	
135.57	21	9	H	3.76	10	19.0	11.1	4.2	34.4	43.5		-9.1	
122.06	0	9	V	1.52	10	11.0	11.4	4.0	26.4	43.5		-17.1	
108.46	7	9	V	2.21	10	13.0	11.7	3.7	28.5	43.5		-15.0	
108.46	37	9	H	4.00	10	14.0	11.7	3.7	29.5	43.5		-14.0	
40.67	360	9	V	1.07	10	13.5	10.8	2.3	26.6	39.0		-12.4	
40.67	55	9	H	4.00	10	7.0	10.8	2.3	20.1	39.0		-18.9	
216.97	352	5	V	1.11	10	39.5	20.5	-22.7	37.3	46.5		-9.2	
216.97	33	5	H	3.16	10	41.5	20.5	-22.7	39.3	46.5		-7.2	
244.10	117	5	H	3.90	10	45.0	21.3	-22.2	44.1	46.5		-2.4	
244.10	191	5	V	1.10	10	42.0	21.3	-22.2	41.1	46.5		-5.4	
257.65	193	5	V	1.06	10	39.0	20.8	-21.8	38.0	46.5		-8.5	
257.65	93	5	H	1.98	10	35.0	20.8	-21.8	34.0	46.5		-12.5	
271.22	123	5	H	3.17	10	40.0	20.4	-21.8	38.6	46.5		-7.9	
271.22	168	5	V	1.42	10	44.0	20.4	-21.8	42.6	46.5		-3.9	
284.76	192	5	V	1.31	10	42.0	19.2	-21.3	39.9	46.5		-6.6	
284.76	268	5	H	2.43	10	33.0	19.2	-21.3	30.9	46.5		-15.6	
298.36	160	5	V	1.09	10	44.5	18.0	-21.1	41.4	46.5		-5.1	
298.36	147	5	H	2.94	10	41.0	18.0	-21.1	37.9	46.5		-8.6	
325.40	172	5	H	1.74	10	40.0	18.5	-20.8	37.7	46.5		-8.8	
325.41	177	5	V	3.63	10	38.0	18.5	-20.8	35.7	46.5		-10.8	
393.20	162	5	H	1.83	10	38.0	22.1	-19.9	40.2	46.5		-6.3	
393.26	360	5	V	2.93	10	32.0	22.1	-19.9	34.2	46.5		-12.3	
650.84	353	7	V	2.28	10	24.0	24.0	-16.4	31.7	46.5		-14.8	
650.84	43	7	H	2.93	10	17.0	24.0	-16.4	24.7	46.5		-21.8	

TRIND™ MULTI 1™ ENCORE OATS DATA SHEETS

Radiated Emissions Test Data

FREQUENCY (MHz)	13.56	13.56	13.56		13.56	13.548	13.569	
TRANSDUCER (ALR-25, s/n 86)	ALR-25	ALR-25	ALR-25		ALR-25	ALR-25	ALR-25	
Antenna to DUT distance (meters)	30	30	30		10	10	10	
Antenna height (meters)	1	1	1		1	1	1	
POLARIZATION to DUT: (‖ Parallel, ⊥ Perpendicular, = Parallel to Ground)	⊥	‖	=		⊥	⊥	⊥	
SIGNAL DIRECTION (degrees)	103	180	152		120	120	120	
RECEIVER ATTENUATION (dB)	0	0	0		0	0	0	
METER (dBΦV)	13.5	1.5	-5.5		21.5	2.5	2.5	
TRANSDUCER FACTOR (dB)	34.6	34.6	34.6		34.6	34.6	34.6	
EXTERNAL GAIN/CABLE LOSS (dB)	1.3	1.3	1.3		1.3	1.3	1.3	
CORRECTED LEVEL (dBΦV/m)	49.4	37.4	30.4		57.4	38.4	38.4	
LIMIT (dBΦV/m)	80	80	80		89.5[1]	39[1]	39[1]	

Date: 5/5/00 Detection Method: _X_ CISPR ___ PEAK ___ AVERAGE ___ Other
Project No.: 10-03628.01.001 EUT: Marconi Encore with Metal Case
Test Category: FCC Part 15 OPR/Asst.: D.Smith
Temp, & %r.H: 88F/50RH

Scanned 12.5 MHz to 30 MHz, 3 antenna polarizations. No other emissions detected.

Note 1: Used 20 dB per decade roll-off to adjust limit for closer distance.

SwRI Open Area Test Site Radiated Emissions v2_1		**Project Number:**	
Device Under Test:	ENCORE METAL CASE	**Detection Method:**	
Date / Time:	MAY 5 2000 15:16	**Test Receiver:**	Rohde&Schwarz ESV EMI sn: 872142/53
Test Standard(primary limit):	FCC Class A, Part 15 (10 m radiated)	**Antenna:**	
Test Standard(optional limit):			
Test Sponsor:	MARCONI		
Test Technician:	D. Smith		
Temp.(°F)/Humidity(%):	88 50		

FREQ	Orient.	Antenna				UnCorr'd	Corr Factors		Corr'd	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)	Level	Ant	Cable	Level	dBuV	dBuV	(dB)	
54.27	0	9	V	1.59	10	13.5	10.1	2.6	26.2	39.0		-12.8	
54.27	282	9	H	3.92	10	17.0	10.1	2.6	29.7	39.0		-9.3	
108.50	122	9	V	1.48	10	17.0	11.7	3.7	32.5	43.5		-11.0	
122.04	139	9	V	1.36	10	10.0	11.4	4.0	25.4	43.5		-18.1	
135.58	11	9	V	1.03	10	19.5	11.1	4.2	34.9	43.5		-8.6	
135.57	347	9	H	3.80	10	23.5	11.1	4.2	38.9	43.5		-4.6	
189.86	360	9	V	1.00	10	19.5	16.7	5.4	41.6	43.5		-1.9	
189.86	93	9	H	3.82	10	19.0	16.7	5.4	41.1	43.5		-2.4	
216.97	210	5	V	1.00	10	36.0	20.5	-22.7	33.8	46.5		-12.7	
216.96	177	5	H	3.49	10	41.0	20.5	-22.7	38.8	46.5		-7.7	
230.52	200	5	V	1.00	10	29.5	21.0	-22.5	28.0	46.5		-18.5	
230.52	190	5	H	3.18	10	33.0	21.0	-22.5	31.5	46.5		-15.0	
244.11	289	5	H	3.16	10	33.0	21.3	-22.2	32.1	46.5		-14.4	
244.11	42	5	V	1.00	10	33.0	21.3	-22.2	32.1	46.5		-14.4	
257.61	0	5	V	1.00	10	33.0	20.8	-21.8	32.0	46.5		-14.5	
257.61	0	5	H	3.94	10	31.0	21.1	-21.8	30.3	46.5		-16.2	
271.17	154	5	H	3.47	10	41.0	20.4	-21.8	39.6	46.5		-6.9	
271.17	0	5	V	1.00	10	46.0	20.4	-21.8	44.6	46.5		-1.9	
284.73	360	5	V	1.00	10	44.0	19.2	-21.3	41.9	46.5		-4.6	
284.73	0	5	H	2.27	10	41.0	19.2	-21.3	38.9	46.5		-7.6	
298.34	162	5	H	2.54	10	46.5	18.0	-21.1	43.4	46.5		-3.1	
298.34	58	5	V	1.59	10	41.0	18.0	-21.1	37.9	46.5		-8.6	
325.41	182	5	V	1.06	10	42.0	18.5	-20.8	39.7	46.5		-6.8	
325.41	206	5	H	2.30	10	45.5	18.5	-20.8	43.2	46.5		-3.3	
352.54	174	5	H	2.15	10	41.0	20.2	-20.4	40.9	46.5		-5.6	
352.54	170	5	V	3.80	10	44.0	20.2	-20.4	43.9	46.5		-2.6	
366.10	169	5	V	3.86	10	44.5	21.0	-20.4	45.1	46.5		-1.4	

SwRI Open Area Test Site Radiated Emissions v2_1 **Project Number:**

Device Under Test: ENCORE METAL CASE **Detection Method:**

Date / Time: MAY 5 2000 15:16 **Test Receiver:** Rohde&Schwarz ESV EMI sn: 872142/53

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

Test Standard(optional limit):

Test Sponsor: MARCONI

Test Technician:

Temp.(°F)/Humidity(%): 88 50

FREQ	Orient.	Antenna				UnCorr'd	Corr Factors		Corr'd	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)	Level	Ant	Cable	Level	dBuV	dBuV	(dB)	
366.10	189	5	H	1.97	10	41.5	21.0	-20.4	42.1	46.5		-4.4	
379.68	170	5	H	2.09	10	39.5	21.8	-20.0	41.3	46.5		-5.2	
379.68	170	5	V	2.98	10	42.0	21.8	-20.0	43.8	46.5		-2.7	
393.27	163	5	V	3.01	10	38.0	22.1	-19.9	40.2	46.5		-6.3	
393.27	139	5	H	3.01	10	37.5	22.1	-19.9	39.7	46.5		-6.8	

The frequency tolerance of the TRIND™ Multi 1™ 13.56 MHz fundamental emission was verified to be within the +/-0.01% (+/-1.356 kHz) requirement from Part 15, paragraph 15.225, when exposed to temperature variations of –20 degrees to +50 degrees C. The fundamental emission was monitored on a spectrum analyzer as the TRIND™ Multi 1™ was exposed to +50 degrees C for 10 minutes, and then –20 degrees C for 10 minutes, in accordance with the procedure in ANSI C63.4-1992, paragraph 13.1.6.1. The frequency varied by approximately 117 Hz. In addition, the 115 VAC supply voltage was varied from 85% to 115% at room temperature in accordance with paragraph 15.225. The frequency of the fundamental emission did not vary more than approximately 40 Hz during the entire procedure.

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 13.56 MHz measurement on the data sheet on page 16 (first column) yields:

13.5 dB (µV)
34.6 dB (1/m)
1.3 dB (CF/AG FACTOR)
FS = 49.4 dB (µV/m)

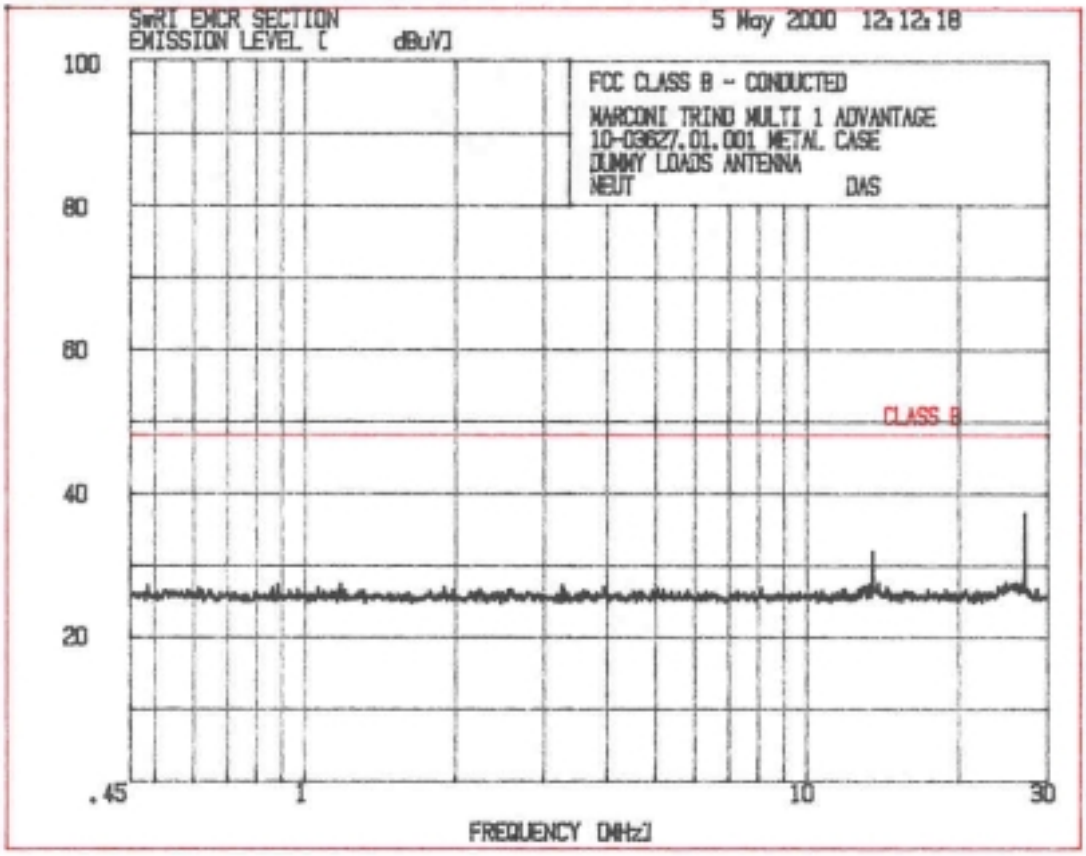
To equation convert the dB (µV/m) value to its corresponding level in µV/m is as follows:

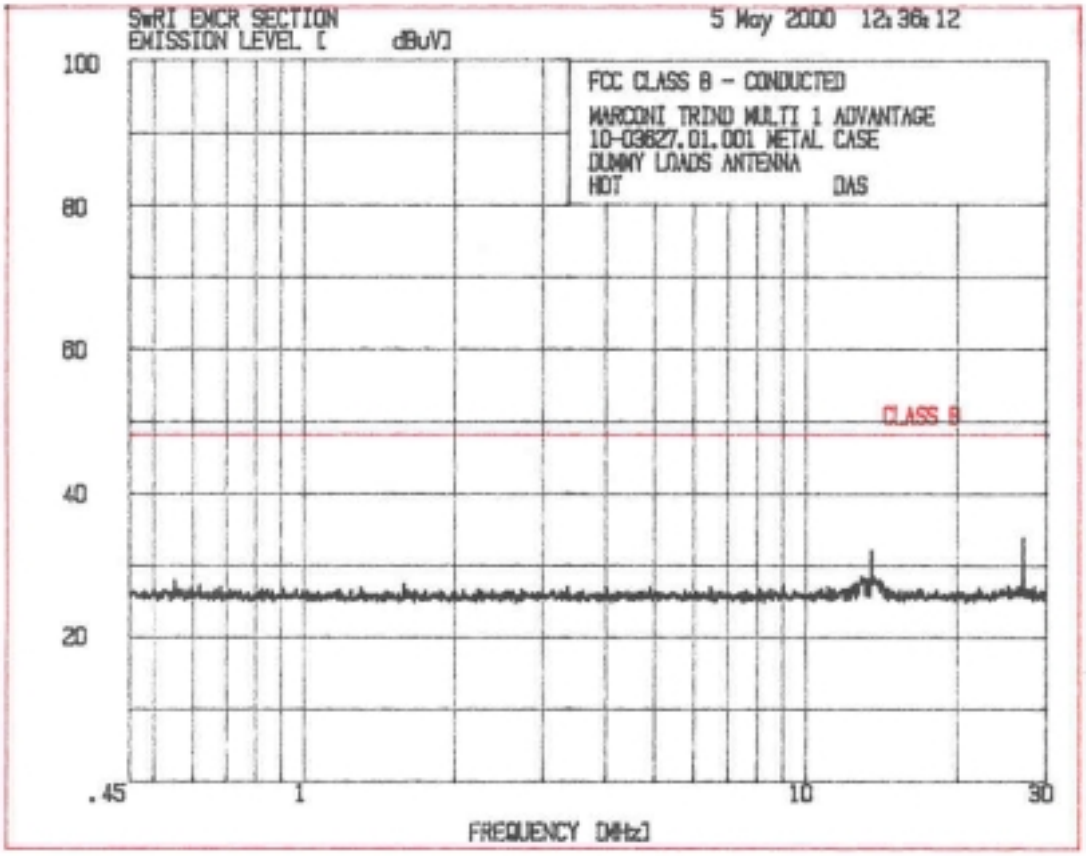
Level in µV/m Common Antilogarithm [(49.4 dB µV/m)/20] = 295.12 µV/m

APPENDIX A

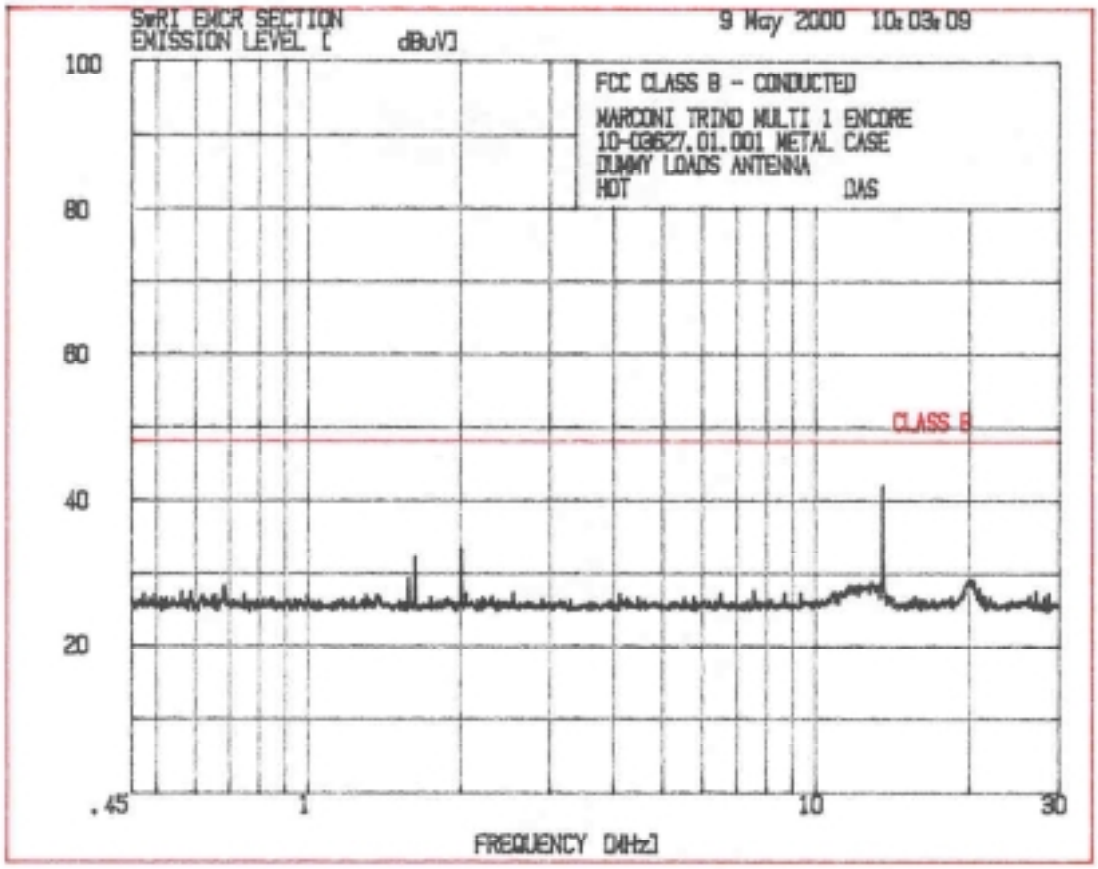
CONDUCTED EMISSIONS MEASUREMENTS PLOTS

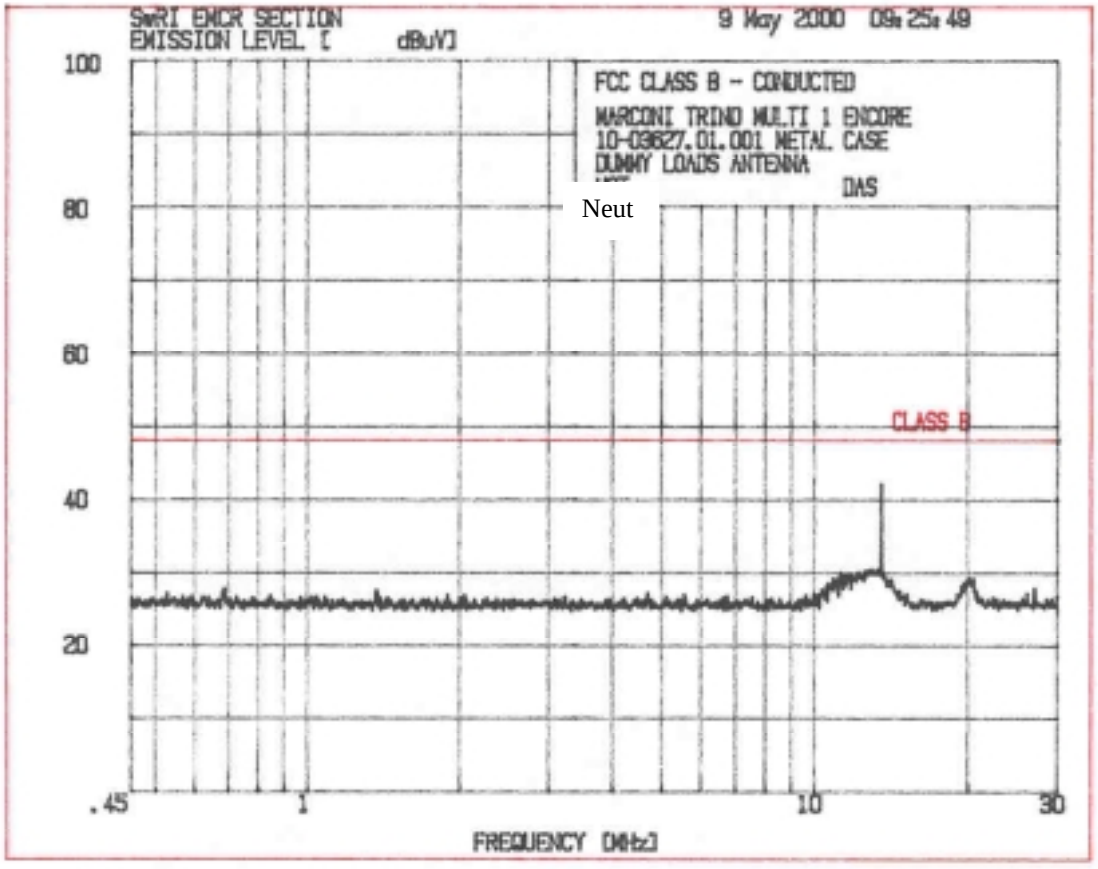
TRIND™ MULTI 1™ ADVANTAGE CONFIGURATION


SwRI EMCR SECTION
EMISSION LEVEL [dBuV]
5 May 2000 12:12:18
FCC CLASS B - CONDUCTED
MARCONI TRIND MULTI 1 ADVANTAGE
10-03627.01.001 METAL CASE
DUMMY LOADS ANTENNA
NEUT DAS
CLASS B
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]


SwRI EMCR SECTION
EMISSION LEVEL [dBuV]
5 May 2000 12:36:12
FCC CLASS B - CONDUCTED
MARCONI TRIND MULTI 1 ADVANTAGE
10-03627.01.001 METAL CASE
DUMMY LOADS ANTENNA
HOT DAS
CLASS B
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]

TRIND™ MULTI 1™ ENCORE CONFIGURATION

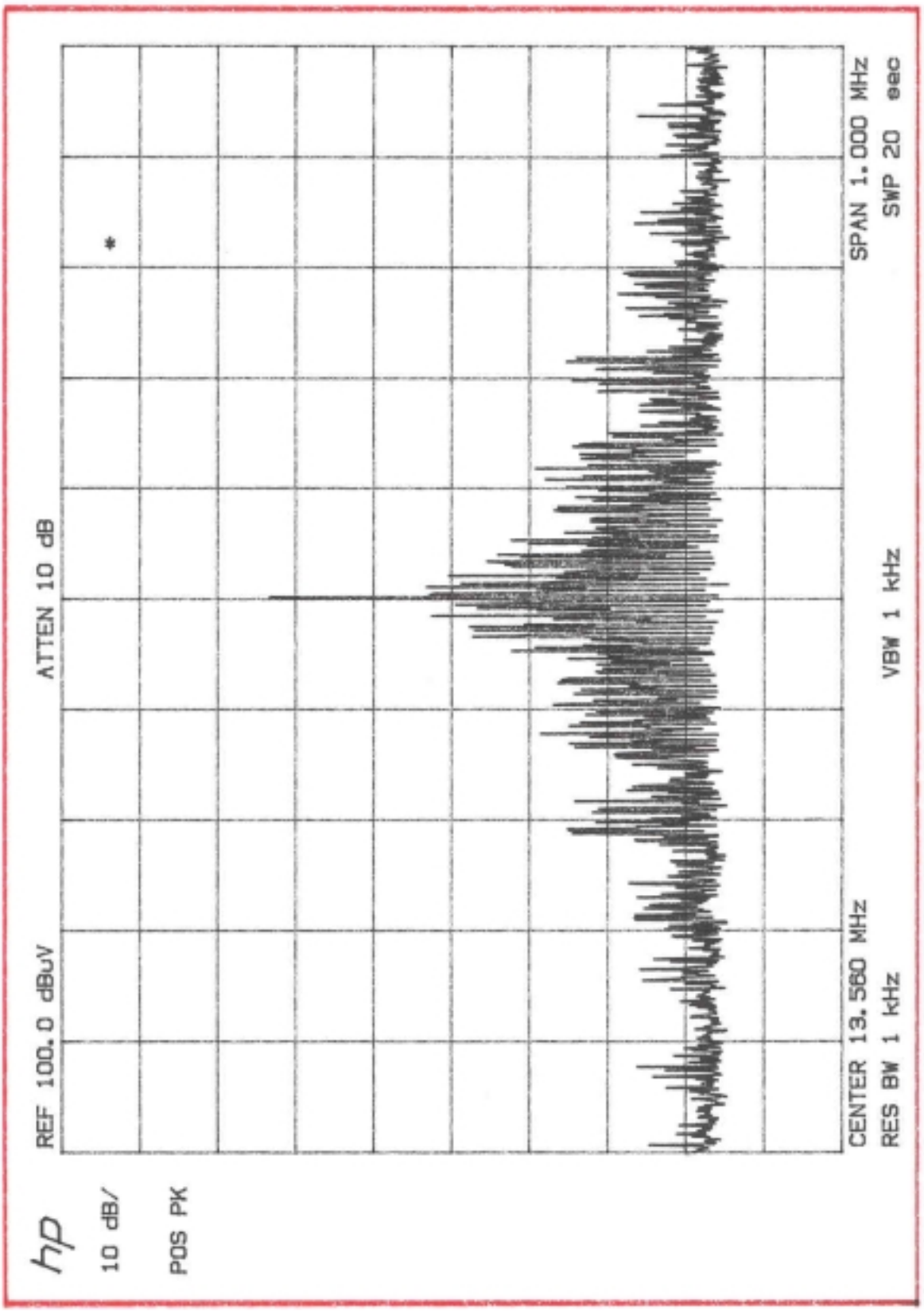

SwRI EMCR SECTION
EMISSION LEVEL [dBuV]
9 May 2000 10:03:09
FCC CLASS B - CONDUCTED
MARCONI TRIND MULTI 1 ENCORE
10-03627.01.001 METAL CASE
DUMMY LOADS ANTENNA
HOT
DAS
CLASS B
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]

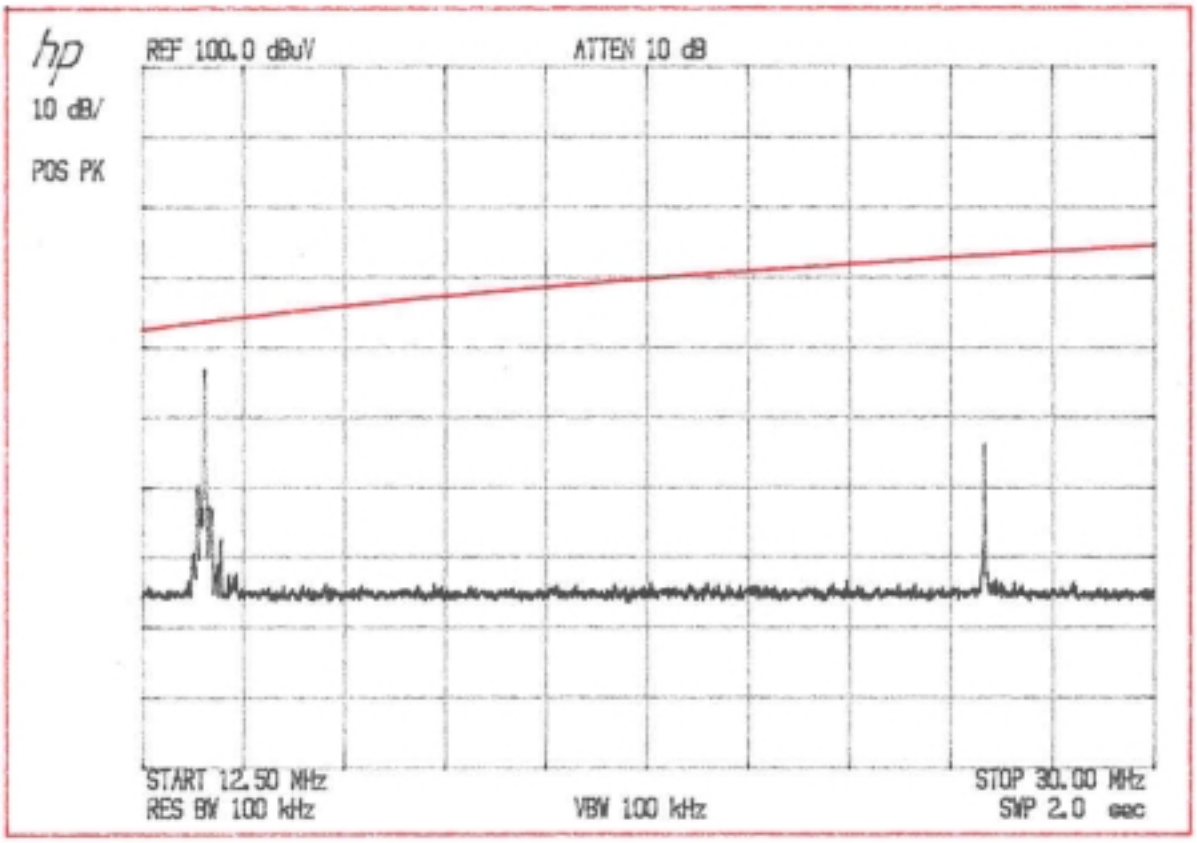

SwRI EMCR SECTION
EMISSION LEVEL [dBuV]
9 May 2000 09:25:49
FCC CLASS B - CONDUCTED
MARCONI TRIND MULTI 1 ENCORE
10-03627.01.001 METAL CASE
DUMMY LOADS ANTENNA
DAS
Neut
CLASS B
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]

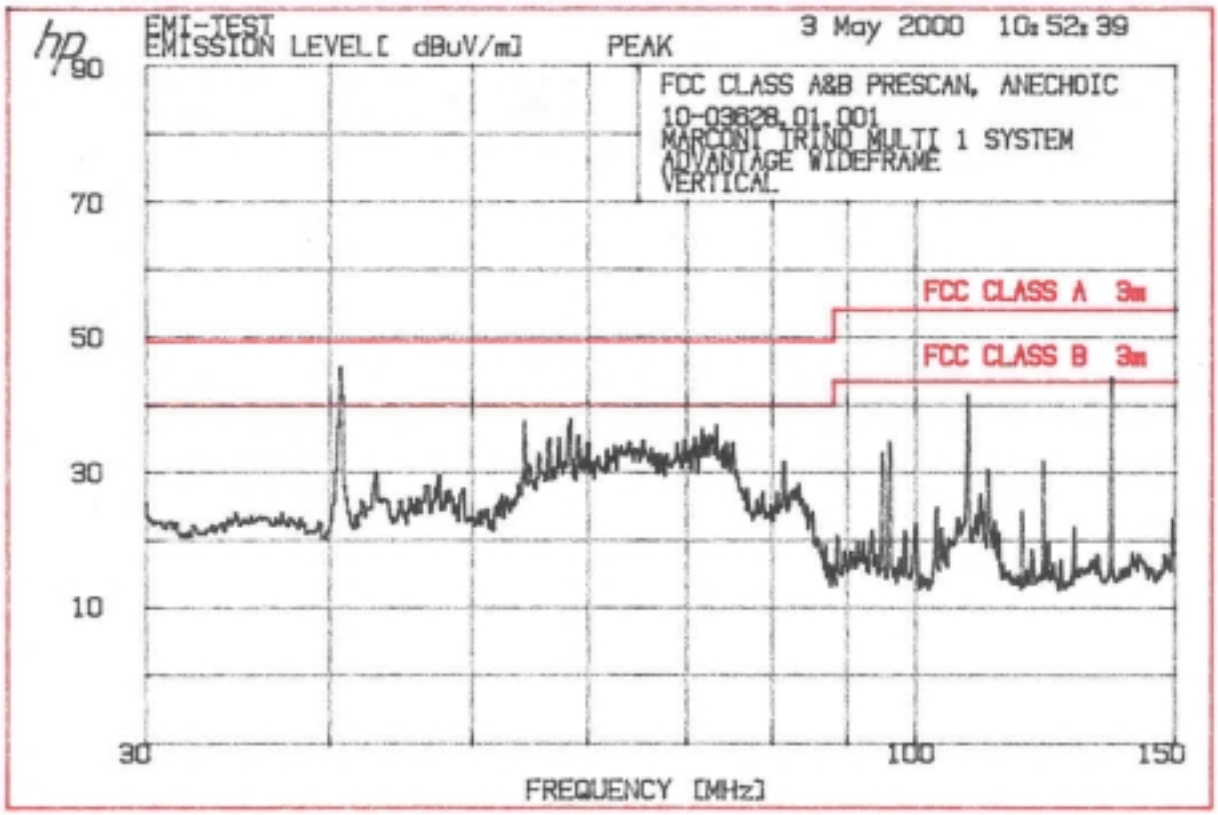
APPENDIX B

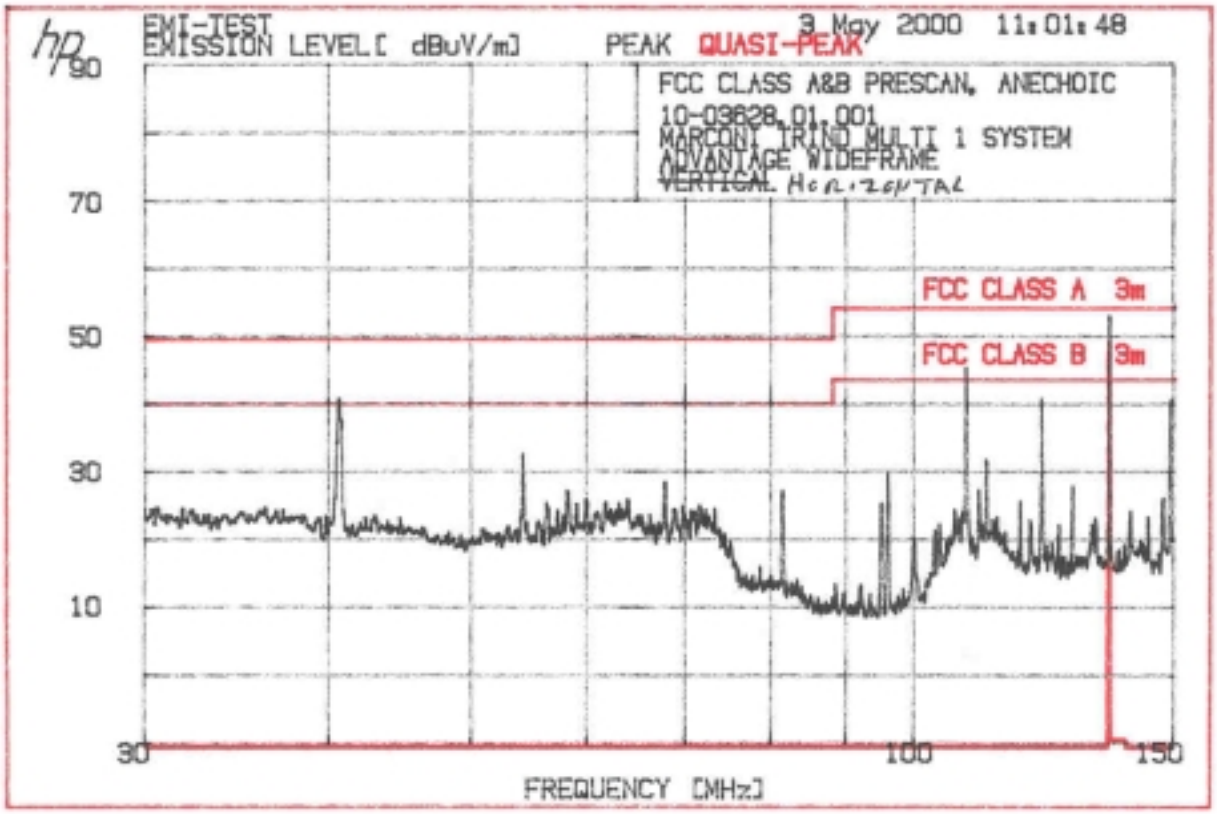
RADIATED SIGNATURE MEASUREMENTS PLOTS

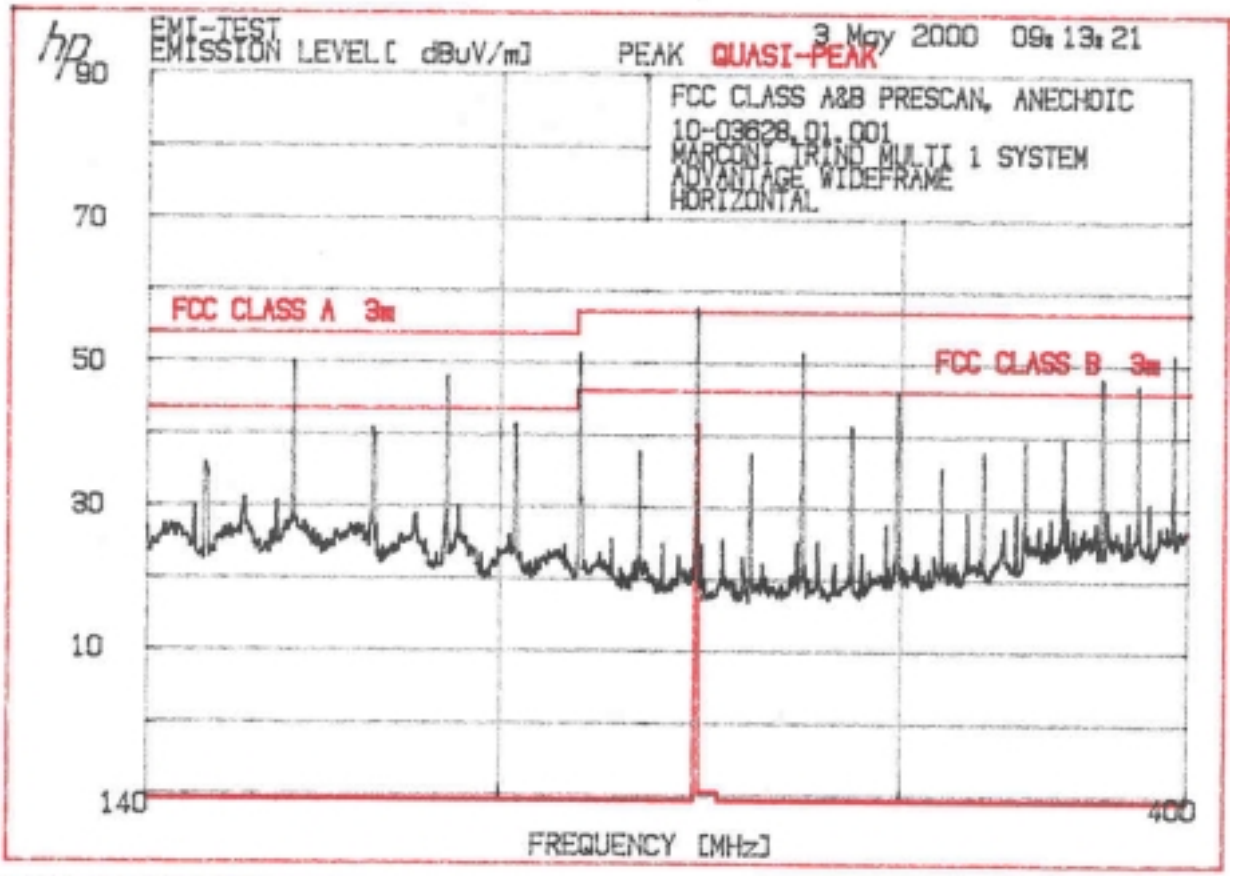
TRIND™ MULTI 1™ ADVANTAGE CONFIGURATION

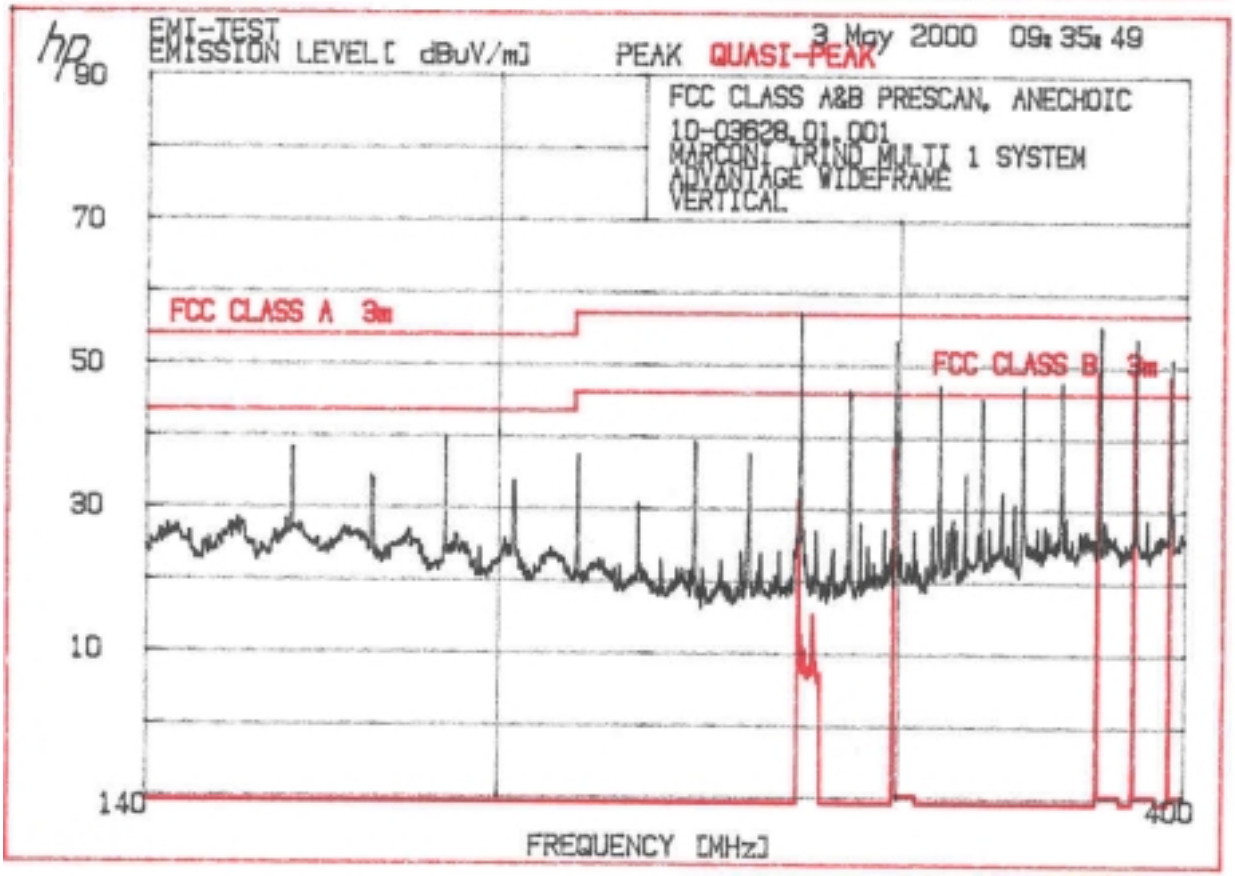

hp
10 dB/
POS PK
REF 100.0 dBuV
ATTEN 10 dB
CENTER 13.560 MHz
RES BW 1 kHz
VBW 1 kHz
SPAN 1.000 MHz
SWP 20 sec

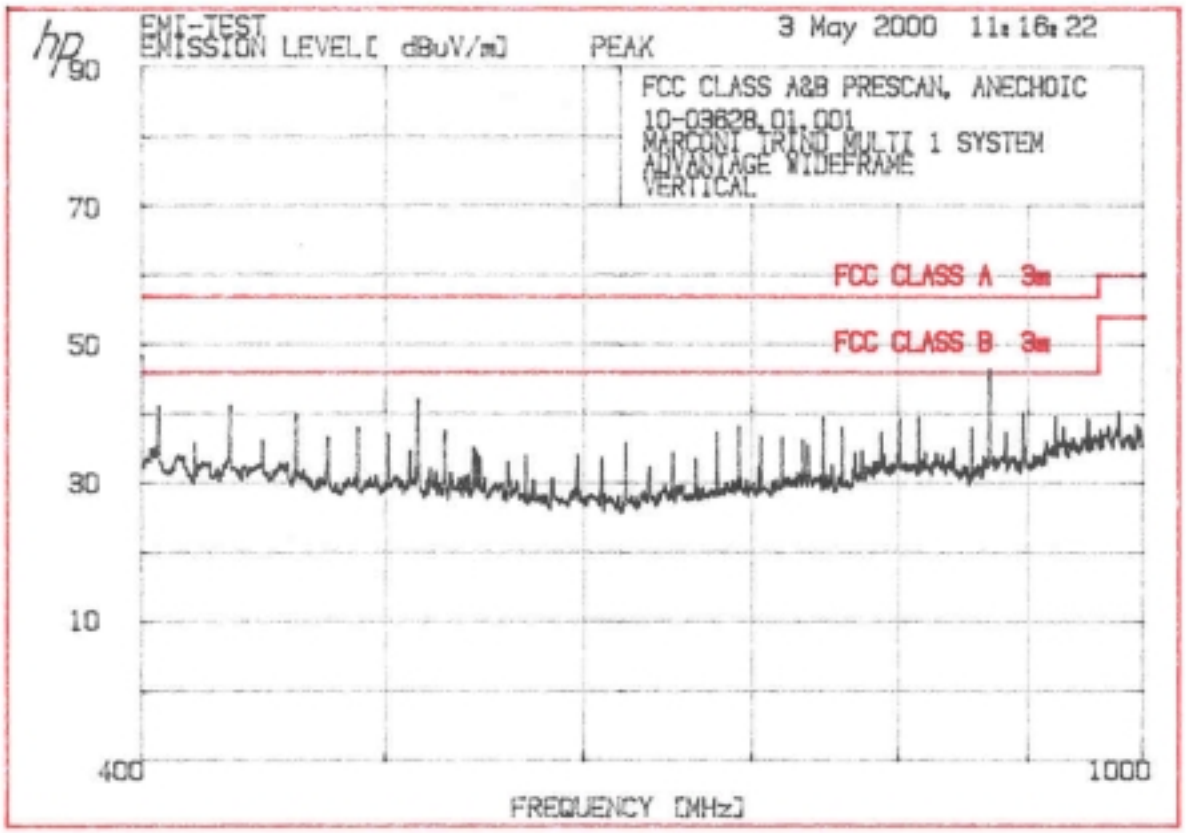

hp
REF 100.0 dBuV
ATTEN 10 dB
10 dB/
POS PK
START 12.50 MHz
RES BW 100 kHz
VBW 100 kHz
STOP 30.00 MHz
SWP 2.0 sec

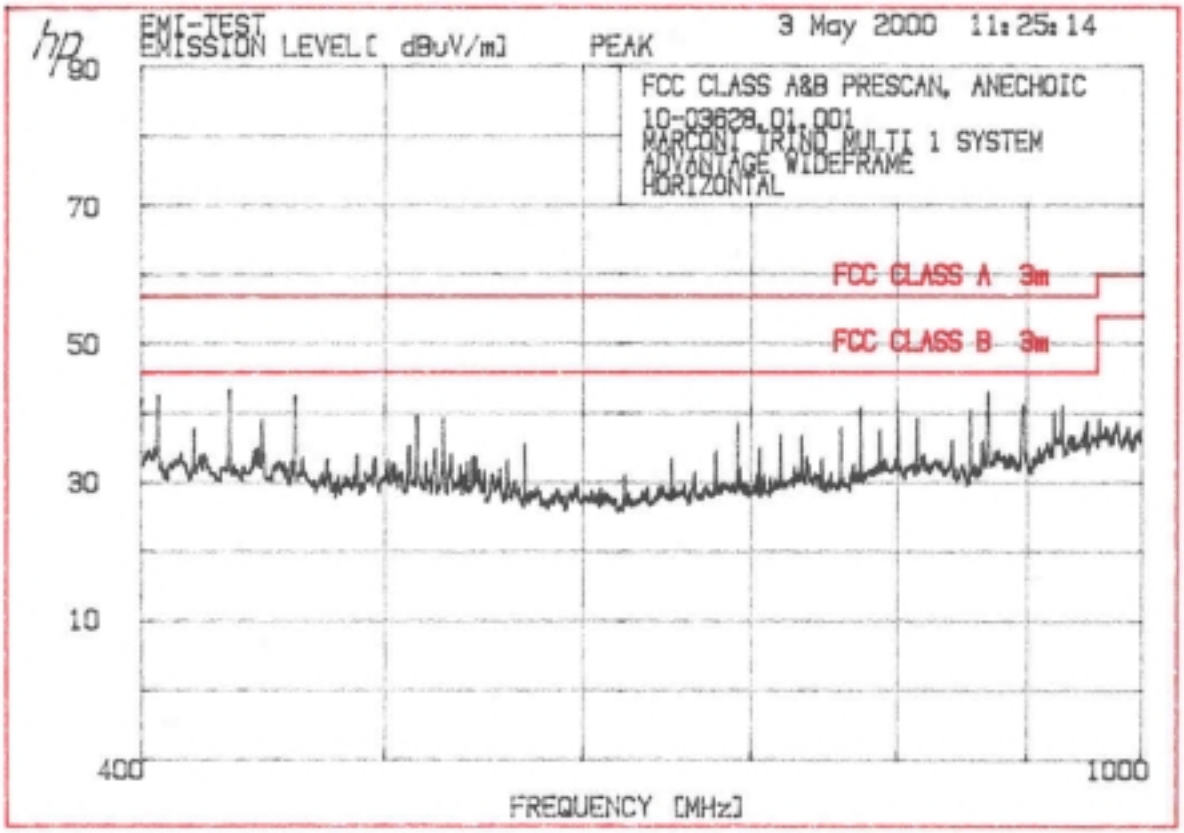

EMI-TEST
EMISSION LEVEL[dBuV/m]
PEAK
3 May 2000 10:52:39
FCC CLASS A&B PRESCAN, ANECHOIC
10-03628.01.001
MARCONI IRIND MULTI 1 SYSTEM
ADVANTAGE WIDEFRAME
VERTICAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
30
100
150
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL[dBuV/m]
PEAK QUASI-PEAK
3 May 2000 11:01:48
FCC CLASS A&B PRESCAN, ANECHOIC
10-03628.01.001
MARCONI IRIND MULTI 1 SYSTEM
ADVANTAGE WIDEFRAME
VERTICAL HORIZONTAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
30
100
150
FREQUENCY [MHz]

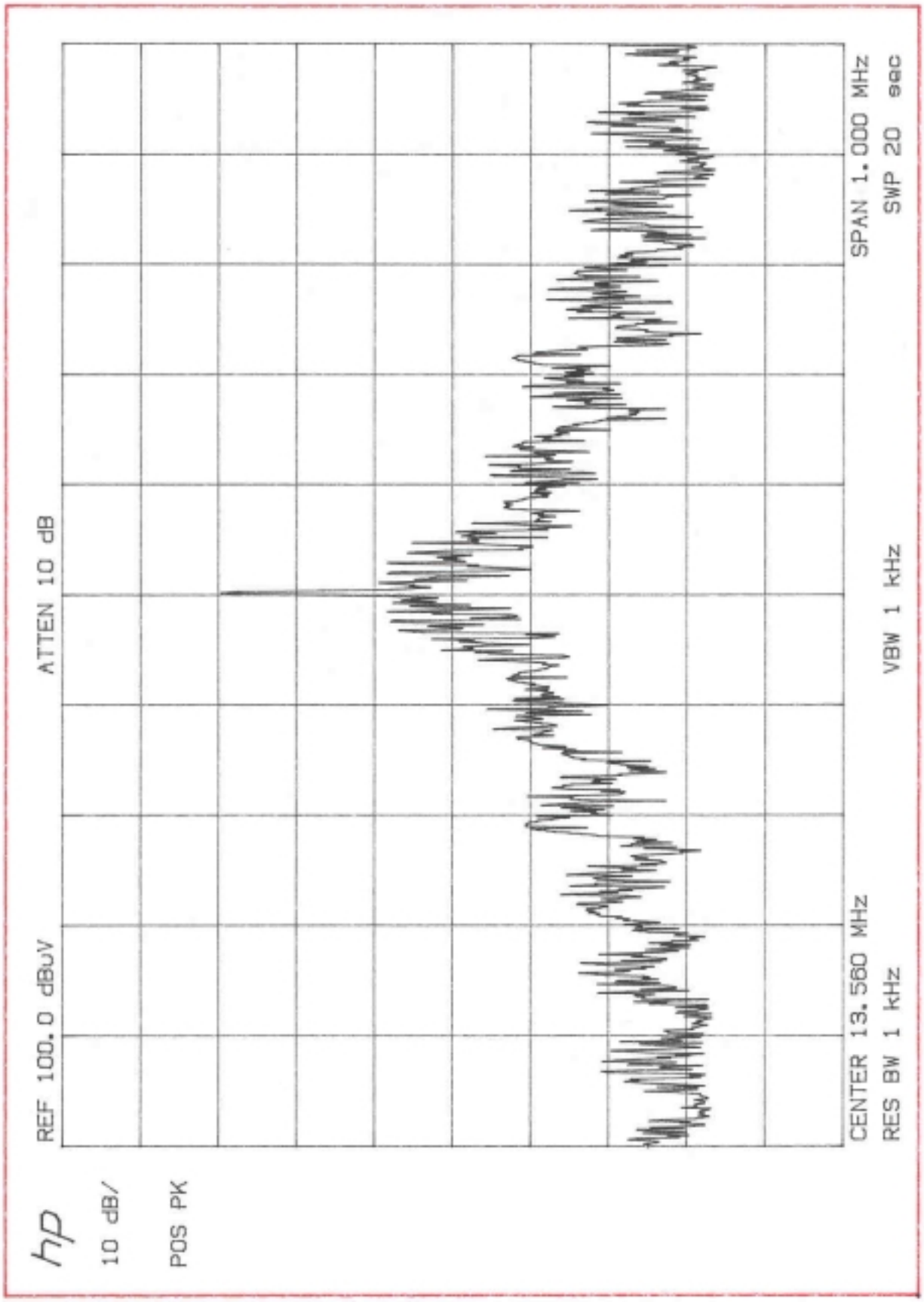

EMI-TEST
EMISSION LEVEL[dBuV/m]
PEAK QUASI-PEAK
3 May 2000 09: 13: 21
FCC CLASS A&B PRESCAN, ANECHOIC
10-03628.01.001
MARCONI IRIND MULTI 1 SYSTEM
ADVANTAGE WIDEFRAME
HORIZONTAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
140
400
FREQUENCY [MHz]

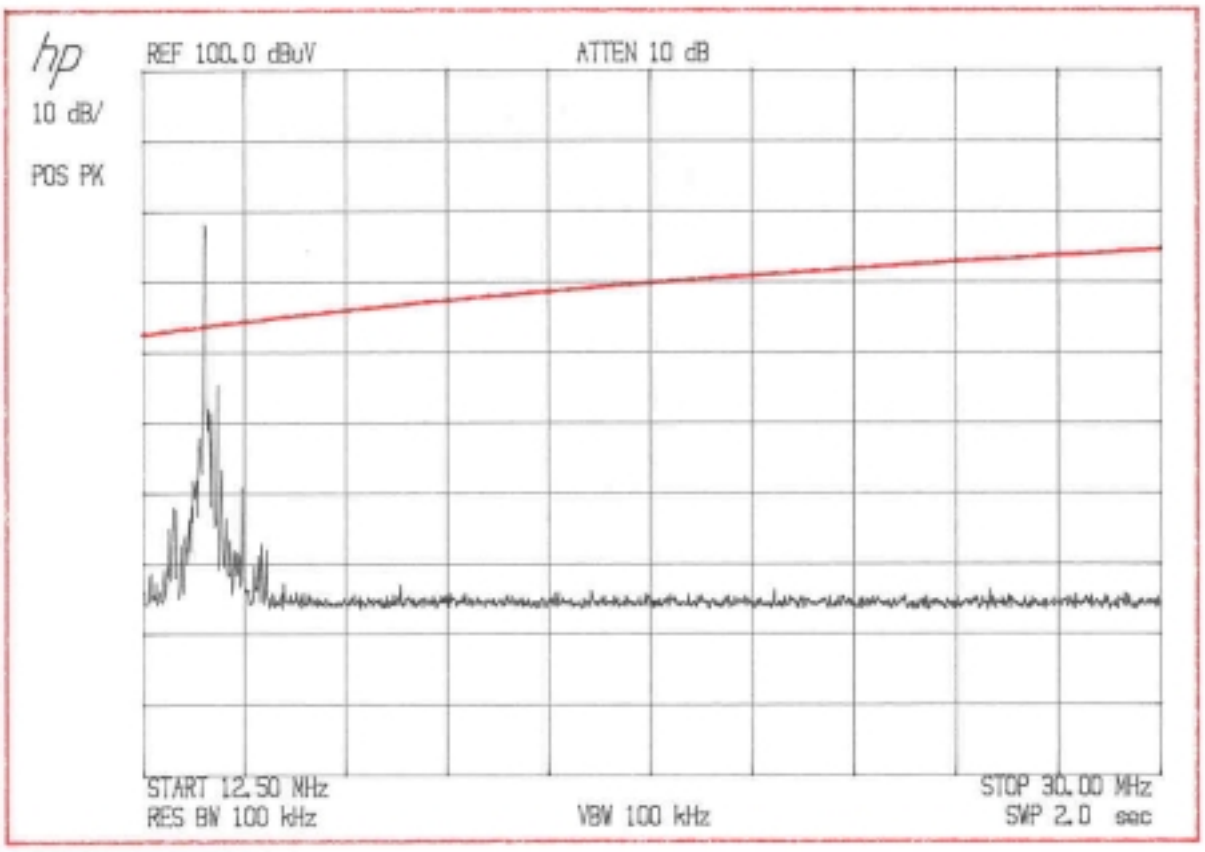

EMI-TEST
EMISSION LEVEL[dBuV/m]
PEAK QUASI-PEAK
3 May 2000 09: 35: 49
FCC CLASS A&B PRESCAN, ANECHOIC
10-03628.01.001
MARCONI IRIND MULTI 1 SYSTEM
ADVANTAGE WIDEFRAME
VERTICAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
140
400
FREQUENCY [MHz]

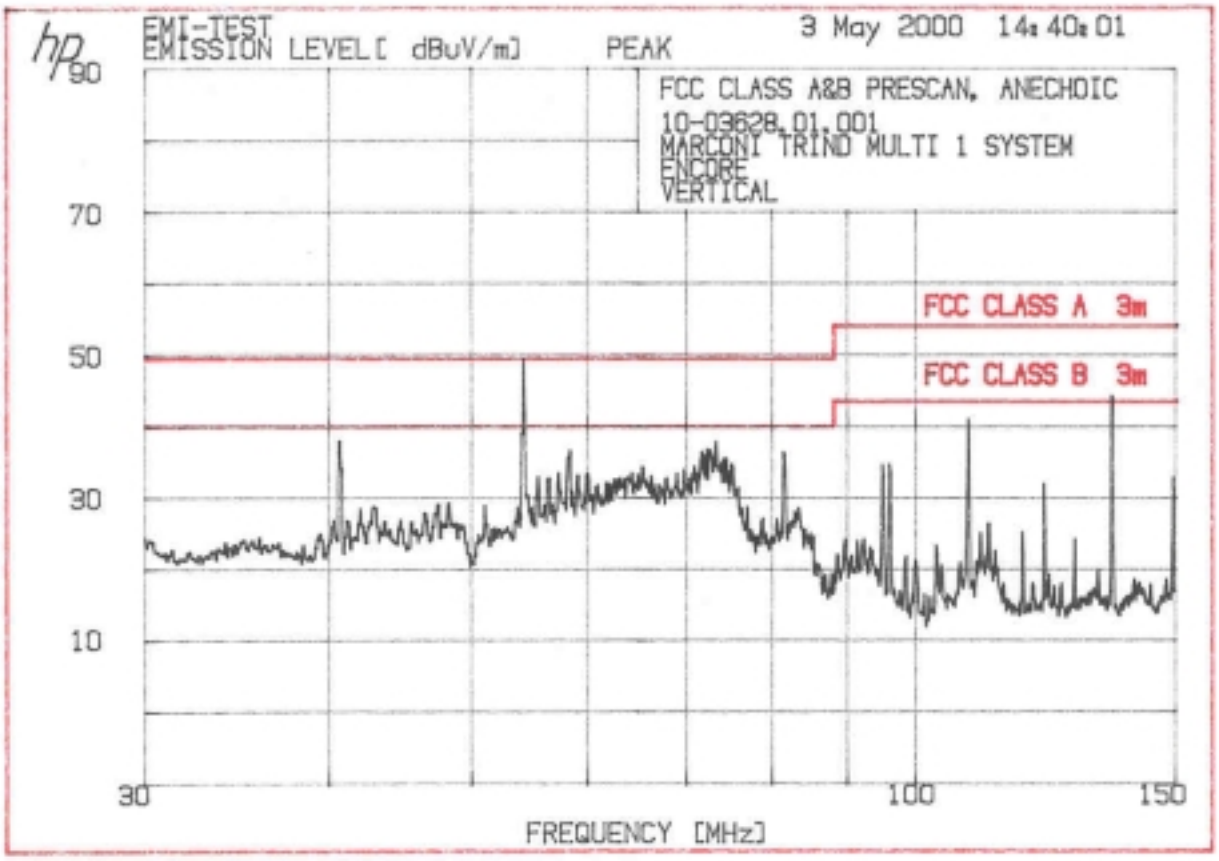

EMI-TEST
EMISSION LEVEL[dBuV/m]
PEAK
3 May 2000 11:16:22
FCC CLASS A&B PRESCAN, ANECHOIC
10-03628.01.001
MARCONI IRIND MULTI 1 SYSTEM
ADVANTAGE WIDEFRAME
VERTICAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
400
1000
FREQUENCY [MHz]

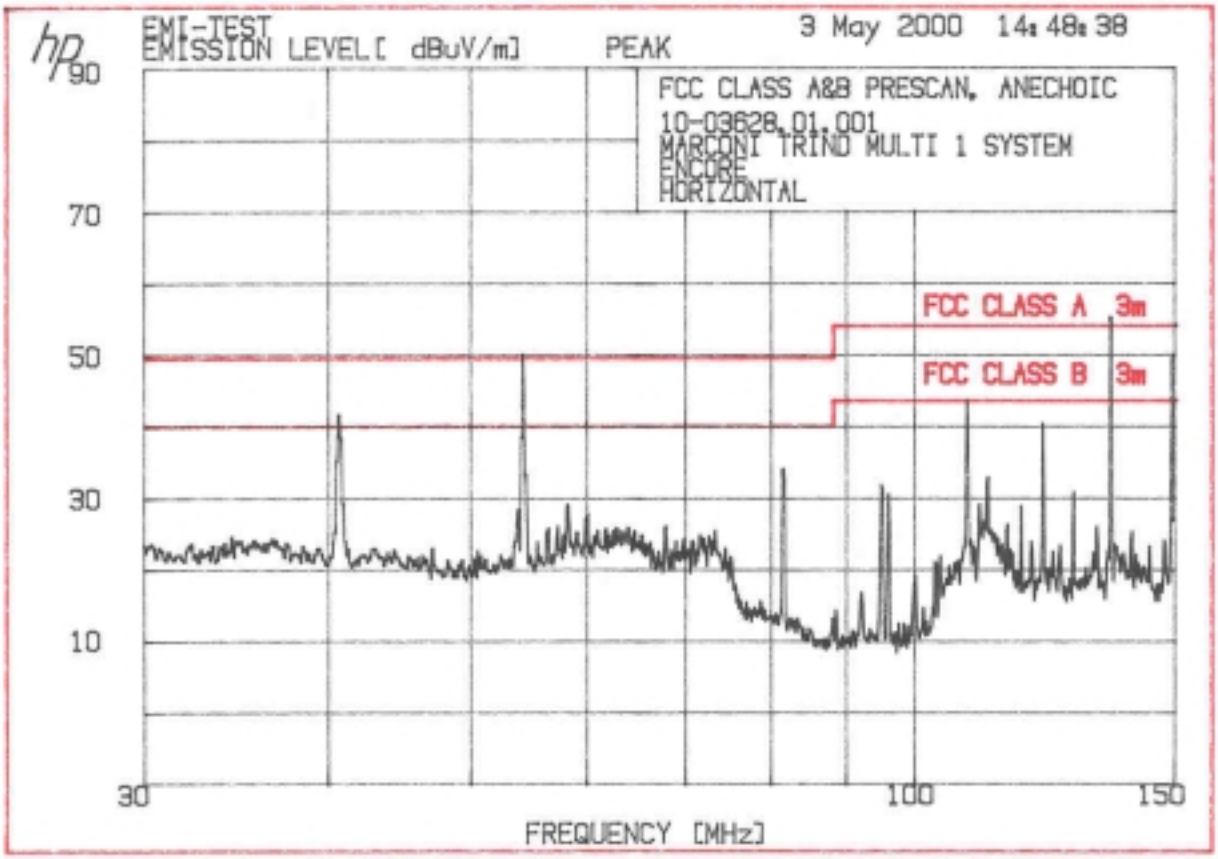

EMI-TEST
EMISSION LEVEL[dBuV/m]
PEAK
3 May 2000 11:25:14
FCC CLASS A&B PRESCAN, ANECHOIC
10-03628.01.001
MARCONI IRIND MULTI 1 SYSTEM
ADVANTAGE WIDEFRAME
HORIZONTAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
400
1000
FREQUENCY [MHz]

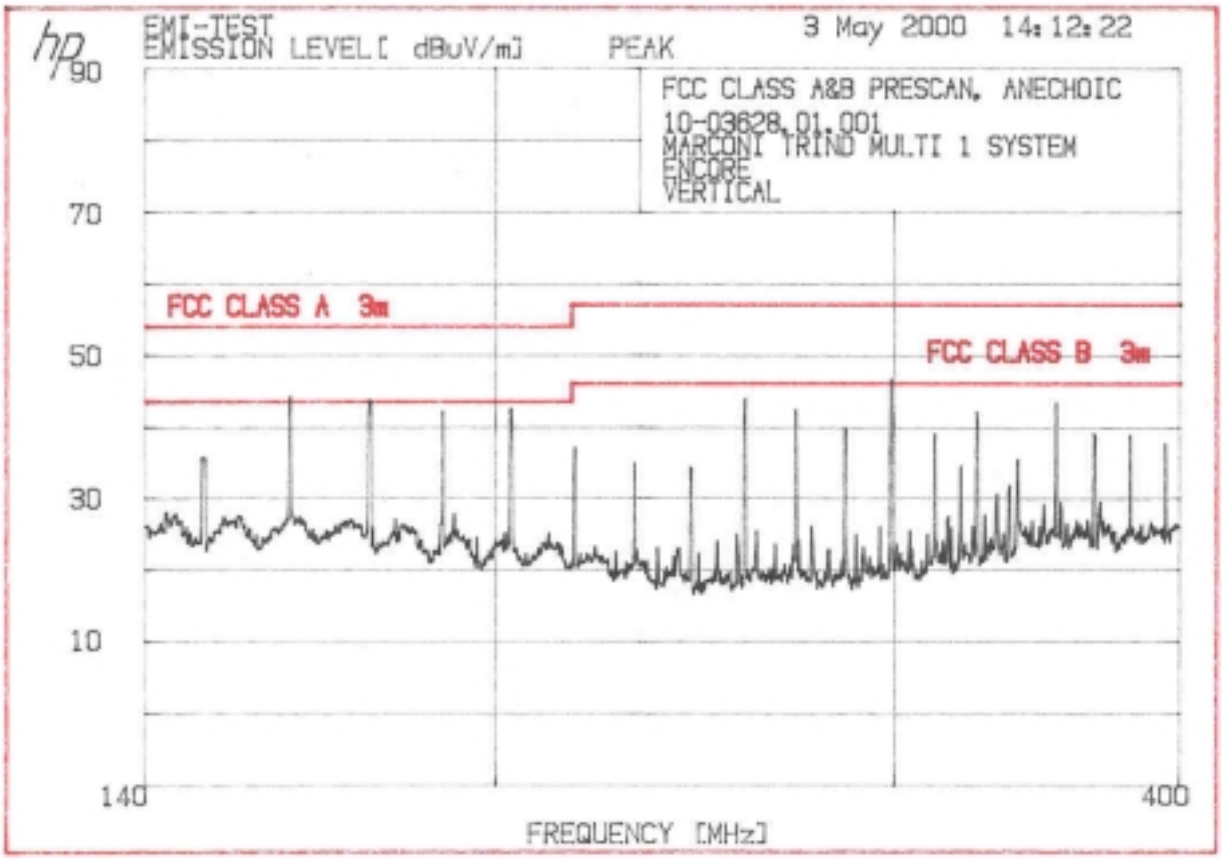
TRIND™ MULTI 1™ ENCORE CONFIGURATION

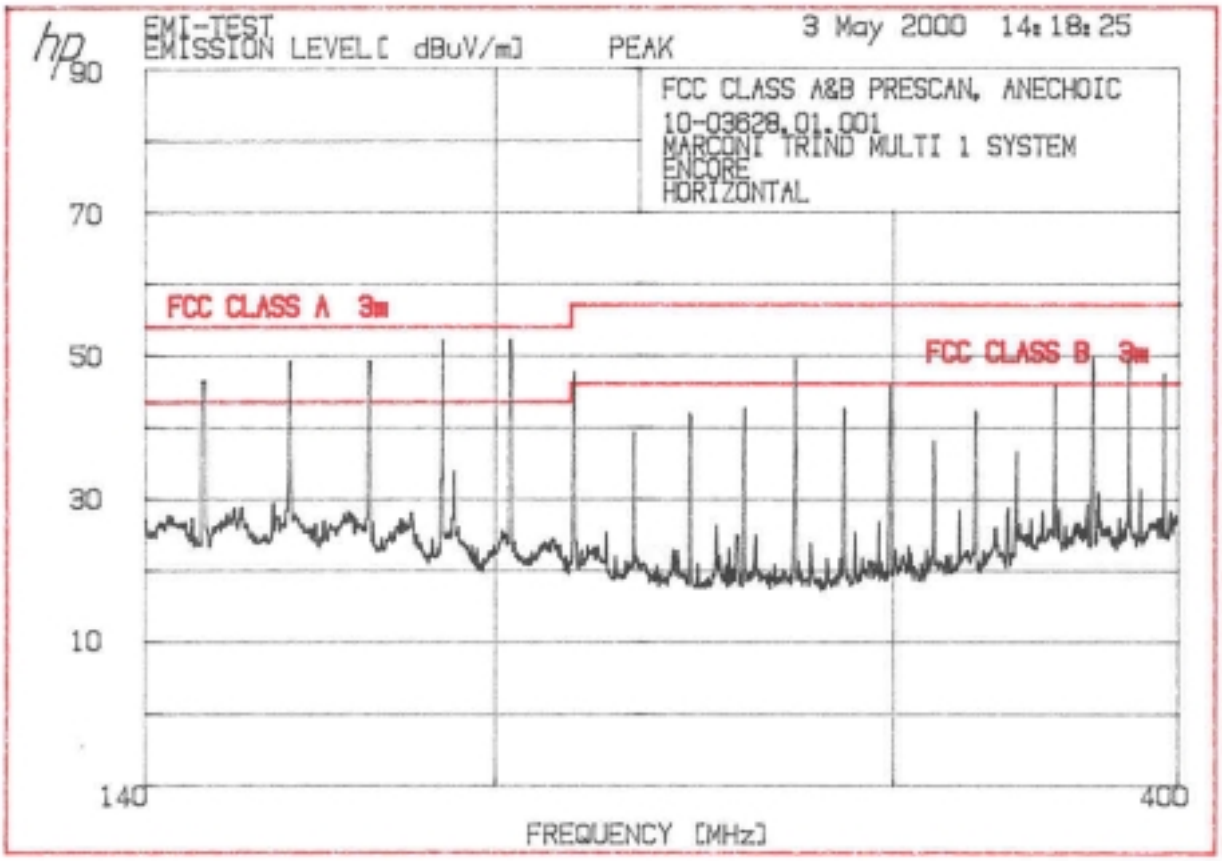

hp
10 dB/
POS PK
REF 100.0 dBuV
ATTEN 10 dB
CENTER 13.560 MHz
RES BW 1 kHz
VBW 1 kHz
SPAN 1.000 MHz
SWP 20 sec

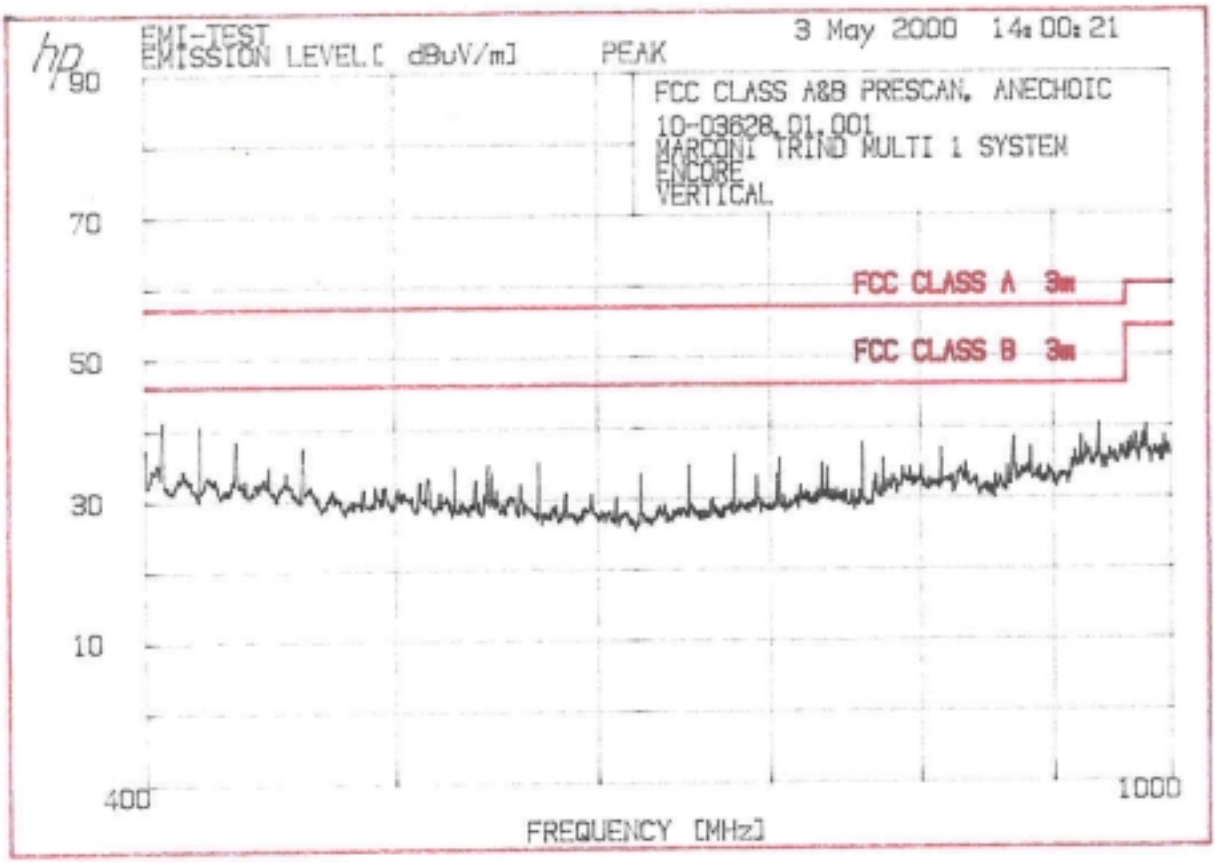

hp
REF 100.0 dBuV
ATTEN 10 dB
10 dB/
POS PK
START 12.50 MHz
RES BW 100 kHz
VBW 100 kHz
STOP 30.00 MHz
SWP 2.0 sec

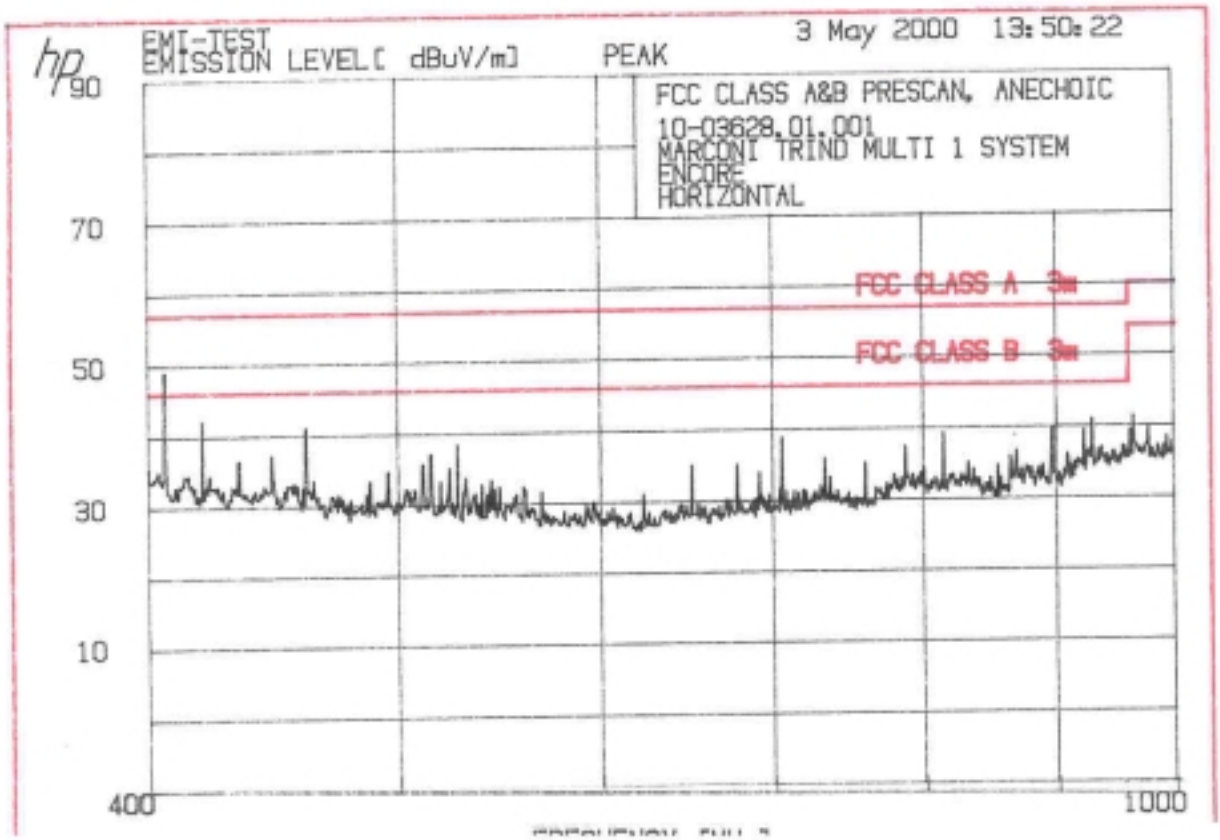

EMI-TEST
EMISSION LEVEL[dBuV/m]
PEAK
3 May 2000 14:40:01
FCC CLASS A&B PRESCAN, ANECHOIC
10-03628.01.001
MARCONI TRIND MULTI 1 SYSTEM
ENCORE
VERTICAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
30
100
150
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL[dBuV/m]
PEAK
3 May 2000 14:48:38
FCC CLASS A&B PRESCAN, ANECHOIC
10-03628.01.001
MARCONI TRIND MULTI 1 SYSTEM
ENCORE
HORIZONTAL
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
3 May 2000 14:12:22
FCC CLASS A&B PRESCAN, ANECHOIC
10-03628.01.001
MARCONI TRIND MULTI 1 SYSTEM
ENCORE
VERTICAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
140
400
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL[dBuV/m]
PEAK
3 May 2000 14:18:25
FCC CLASS A&B PRESCAN, ANECHOIC
10-03628.01.001
MARCONI TRIND MULTI 1 SYSTEM
ENCORE
HORIZONTAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
140
400
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL[dBuV/m]
PEAK
3 May 2000 14:00:21
FCC CLASS A&B PRESCAN, ANECHOIC
10-03628.01.001
MARCONI TRIND MULTI 1 SYSTEM
ENCORE
VERTICAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
400
1000
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL[dBuV/m]
PEAK
3 May 2000 13:50:22
FCC CLASS A&B PRESCAN, ANECHOIC
10-03628.01.001
MARCONI TRIND MULTI 1 SYSTEM
ENCORE
HORIZONTAL
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
400
1000

APPENDIX C

TEST INSTRUMENTATION

EQUIPMENT USE REPORT

MANUFACTURER	MODEL NO.	DESCRIPTION	SERIAL NO.	CAL DATE
CONDUCTED EMISSIONS				
RHODE & SCHWARTZ	ESH2-Z5	LISN	872461/021	26APR01
HP	8568B	SPECTRUM ANALYZER	2152A03081	13OCT00
RHODE & SCHWARTZ	ESH2	RECEIVER	879014/018	01FEB01
HP	85650A	QUASI PEAK ADAPTER	2043A00213	13OCT00
ANECHOIC CHAMBER				
SWRI	UTC 10 221-1	PREAMP 10-1000 MHz 35dB GAIN	9112SN15	verified
HP	8568B	SPECTRUM ANALYZER	2344A05883	01SEP00
HP	85650A	QUASI-PEAK ADAPTER	2043A00254	1AUG00
HP	8447D	PREAMP	1529A00617	verified
ELECTROMETRICS	ALR-25	LOOP ANTENNA	371	04APR01
EMCO	3121-DB3	ANTENNA, DIPOLE	148	verified
EMCO	3121-DB4	ANTENNA, DIPOLE	1097	verified
EMCO	3121-DB2	ANTENNA, DIPOLE	147	verified
OATS				
POLARAD	ESV	TEST RECEIVER	872147/53	4APR01
RHODE & SCHWARTZ	ESH2	RECEIVER	879014/018	01FEB01
SWRI	2 MHz-1GHz	OATS PRE-AMP	14-82-020	Verified
EMCO	3104	ANTENNA, BICON	2290	19MAY00
EMPIRE	DM-105-T2	ANTENNA, DIPOLE	L-000178	19MAY00
EMPIRE	DM-105-T3	ANTENNA, DIPOLE	L-000108C	19MAY00
FAIRCHILD	ALR-25	LOOP ANTENNA	086	4APR01
ROTRONIC	PA1	HYGROMER	60858	2DEC00
TEMPERATURE AND VOLTAGE VARIATION				
FLUKE	52	THERMOMETER	3910515	8SEP00
ELECTROMETRICS	ALR-25	LOOP ANTENNA	371	NCR
SENCORE	PR-57	AC SUPPLY	none	Verified
FLUKE	87	DVM	64330494	30NOV00
TENNY	none	TEMPERATURE CHAMBER	7011	NCR
HP	8568B	SPECTRUM ANALYZER	2344A05883 2152A03081	01SEP00 13OCT00

APPENDIX D

PHOTOS OF TESTED EUT

File Name	EUT Photo
Adv_ant_wide_top.jpg	T20582-G1Advantage Wide Frame Antenna PCB, Top View
Adv_ant_wide_bottom.jpg	T20582-G1Advantage Wide Frame Antenna PCB, Bottom View
Adv_ant_narrow_top.jpg	T20609-G1Advantage Narrow Frame Antenna PCB, Top View
Adv_ant_narrow_bottom.jpg	T20609-G1Advantage Narrow Frame Antenna PCB, Bottom View
encore_ant_top.jpg	M01058A001 Encore Antenna PCB, Top View
encore_ant_bottom.jpg	M01058A001 Encore Antenna PCB, Bottom View
T20545-G1 Light bottom.jpg	T20545-G1 Light Board, Bottom View
T20545-G1 Light top.jpg	T20545-G1 Light Board, Top View
MPR_board_top.jpg	Multi-Protocol Reader Board Top View
MPR_board_bottom.jpg	Multi-Protocol Reader Board Bottom View
Data Control Board bottom.jpg	Data Control Board Bottom View
Data Control Board top.jpg	Data Control Board Top View
Encore Lightboard bottom.jpg	M0155A001 Lightboard (Encore) Bottom View
Encore Lightboard top.jpg	M0155A001 Lightboard (Encore) Top View
Gateway board bottom.jpg	Gateway Board, p/n T20128-GX, Bottom View
Gateway board top.jpg	Gateway Board, p/n T20128-GX, TopView
power supply bottom.jpg	Power Supply Board, Bottom View
power supply top.jpg	Power Supply Board, Top View
Pic00028.jpg	TRIND Multi 1 (Encore) in Case
Pic00032.jpg	TRIND Multi 1 (Advantage) in Case
Pic00029.jpg	Encore Antenna Mounted in Door
Pic00026.jpg	Advantage Wide Frame Door Assembly
Pic00021.jpg	Advantage Narrow Frame Door Assembly
AC Power Filter.jpg	AC Power Line Filter
Pic00013.jpg	Power Supply With Shield Over PCB
Pic00014.jpg	Power Supply With Shield Over PCB Removed
Pic00010.jpg	Assembly With Gateway Board and Data Control Board
Pic00015.jpg	Assembly With Power Supply, Data Control Board, and Gateway Board

APPENDIX E

PHOTOS OF TEST SETUP

Test Setup	File Name
Radiated Emissions – Anechoic Encore Configuration	encore 1a.jpg
Radiated Emissions – Anechoic Encore Configuration	encore 2a.jpg
Radiated Emissions – Anechoic Advantage Configuration	advantage 1a.jpg
Radiated Emissions – Anechoic Advantage Configuration	advantage 2a.jpg
Radiated Emissions – OATS Advantage Configuration	OATS Advantage 1.jpg
Radiated Emissions – OATS Advantage Configuration	OATS Advantage 2.jpg
Radiated Emissions – OATS Encore Configuration	OATS Encore 1.jpg
Radiated Emissions – OATS Encore Configuration	OATS Encore 2.jpg
Conducted Emissions Encore Configuration	Conducted encore 1.jpg
Conducted Emissions Encore Configuration	Conducted encore 2.jpg
Conducted Emissions Advantage Configuration	Conducted advantage 1.jpg
Conducted Emissions Advantage Configuration	Conducted advantage 2.jpg