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

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

Project 10-3083.01.005
Report Number EMCR 00/012

Prepared for:

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March 2000

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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 Section 8.0.

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	----
Antenna Specialist 902-928 MHz Receive Antenna (.50”x3.0” PCB) Note 1	Q13851-01
M/A-COM 902-928 MHz Receive Dipole Antenna Note 1	Q13868-01
Overhead Antenna Tuning Board	T20579-GX
Light/Microreader Board	T20601

Note 1: Although a normal installation would have two M/A-COM or two Antenna Specialists receive antennas, one of each antenna was used during FCC compliance testing.

The TRIND™ TIRIS™ is used with Marconi Commerce Systems Advantage, MPD-3, and Encore line of fuel dispensers. Each type of fuel dispenser uses an identical TRIND™ TIRIS™ system with the exception of slight differences in the overhead antennas, door antennas, and tuning board. The following TRIND™ TIRIS™ configurations were tested.

TABLE 1.2
ANTENNA CONFIGURATIONS TESTED

Dispenser	Overhead Antenna (for car tag)	Door Antenna (for hand-held tag)	Tuning Board Note 1
Advantage and MPD-3	(2) 12" x 45" single-loop antenna, 3/8" diameter aluminum tubing	(2) 5.2” x 10.2” 134 kHz antennas mounted to the plastic bezel doors	T20579 bareboard C1= 15nF C2= 10nF C3= not populated
	(2) 9.5” x 42.34” single-loop antenna, 3/8" diameter aluminum tubing		Same as above except C3= 1800pF
	(2) 9.5” x 30.34” single-loop antenna, 3/8" diameter aluminum tubing		Same as above except C3= 3900pF
	No overhead antenna (hand-held only configuration). “Dummy” resistive loads were connected to the Transmitter Board outputs.		N/A
Encore	9.5” x 35.42” single-loop antenna, 3/8" diameter aluminum tubing	(2) 3.5” x 4.5” 134 kHz antennas mounted to the plastic bezel doors	Same as above except C3= 2700pF
	No overhead antenna (hand-held only configuration). “Dummy” resistive loads were connected to the Transmitter Board outputs.		N/A

Note 1: Each overhead antenna size variation uses the same PC board-based tuning circuitry with the only difference being capacitor values which customizes that board for the inductance required for a given antenna size/geometry.

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.

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 antennae 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 fixture are provided in Appendix E.

1.5 Test Facility

The Open Area Test Site (OATS) 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™ 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 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 conducted tests, the unit was exercised by establishing the interrogation reply sequence using handheld transponders. Dummy loads were used in place of the overhead antennas during conducted tests.

During radiated tests of the intentional radiator, the unit was exercised by establishing the interrogation reply sequence using both vehicle and handheld transponders.

For radiated tests of the digital electronics, the 134 kHz overhead antenna transmitter and the microreader transmitter were disabled. L2 was lifted from the Vcc side to disable the microreader. The overhead antenna transmitters were disabled by removing the fuse on each of the LF transmitter modules' carrier boards, which removed Vcc from the final stage of the transmitter.

3.3 Special Accessories

In order to meet the FCC radiated limit for the spurious emissions, three ferrite beads were added to the TRIND™ TIRIS™. A ferrite bead (Fair-Rite p/n 0431167281) was installed on each of the two Light/MicroReader data/power cables. A ferrite bead (Fair-Rite p/n 0444164181) was also installed on the overhead antenna cable assembly at the point where the cable exits the card cage. See the photo in Appendix D (file: ferrite bead installation.jpg) which shows the location of the ferrite beads.

3.4 Equipment Modification

The need for special accessories noted in 3.3 above was determined 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

Two configurations of the TRIND™ TIRIS™ system were tested for conducted emissions. Both the Advantage/MPD-3 system and the Encore system were tested for conducted emissions in the "no overhead antenna" (hand-held only configuration - see Table 1.2). In accordance with C63.4, Appendix I, "dummy" resistive loads were connected to the Transmitter Board outputs in place of the overhead antennas.

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 2 dB

TRIND™ TIRIS™ Configuration	**FREQUENCY (MHz)**	**MEASURED LEVEL (dBuV)** [1]		**LIMIT (dBuV)**
		LINE	**NEUTRAL**	
Advantage/MPD-3 no overhead antenna	12 MHz	46		48
	11 MHz		46	48
Encore no overhead antenna	12 MHz	46		48
	12 MHz		45	48

[1] All 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 Configurations Tested

Both the TRIND™ TIRIS™ Advantage/MPD-3 system and the TRIND™ TIRIS™ Encore system were tested for radiated emissions. Each system was tested with the overhead antenna configurations listed in Table 7.1.

As can be seen in the table, full prescans from 134 kHz to 1000 MHz were performed on each Advantage/MPD-3 system that uses an overhead antenna. OATS tests from 30 MHz to 1000 MHz were performed on the configuration that showed the highest emissions during the prescans (12" x 45" single-loop antenna). Measurements at the OATS from 134 kHz to 30 MHz, including the measurement of the fundamental emission, were made on all four configurations.

Prescans and OATS testing from 134 kHz to 1000 MHz were performed on the Encore system that uses an overhead antenna. Measurements at the OATS from 134 kHz to 30 MHz, including the measurement of the fundamental emission, were also made on the "no overhead antenna" configuration.

TABLE 7.1
CONFIGURATIONS TESTED FOR RADIATED EMISSIONS

Dispenser	Overhead Antenna (for car tag)	Pre-scan	OATS
Advantage and MPD-3	(2) 12" x 45" single-loop antenna, 3/8" diameter aluminum tubing	Full (134 kHz- 1000 MHz)	Full (134 kHz- 1000 MHz)
	(2) 9.5" x 42.34" single-loop antenna, 3/8" diameter aluminum tubing	Full (134 kHz- 1000 MHz)	Partial (134 kHz- 30 MHz)
	(2) 9.5" x 30.34" single-loop antenna, 3/8" diameter aluminum tubing	Full (134 kHz- 1000 MHz)	Partial (134 kHz- 30 MHz)
	No overhead antenna (hand-held only configuration). "Dummy" resistive loads were connected to the Transmitter Board outputs.	Partial (134 kHz- 30 MHz)	Partial (134 kHz- 30 MHz)
Encore	9.5" x 35.42" single-loop antenna, 3/8" diameter aluminum tubing	Full (134 kHz- 1000 MHz)	Full (134 kHz- 1000 MHz)
	No overhead antenna (hand-held only configuration). "Dummy" resistive loads were connected to the Transmitter Board outputs.	Partial (134 kHz- 30 MHz)	Partial (134 kHz- 30 MHz)

7.2 Radiated Measurement 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 7.4.

Measurements were made of the fundamental frequency of 134.2 kHz on each of the six configurations listed in Table 7.1. Additionally, the spectrum was investigated for harmonics and spurious emissions to 30 MHz at 3 meters. No harmonics or spurious emissions were detected up to 30 MHz on any configuration. The measurement level of the fundamental of each configuration is shown in Table 7.2.

TABLE 7.2
MEASUREMENTS OF FUNDAMENTAL FREQUENCY

Judgment: EUT Passed by 24.3 dB					
Configuration	**Frequency (kHz)**	**Corrected Peak Level dB(uV/m)**	**Corrected Avg Level dB(uV/m)**	**Peak Limit 10 Meters dB(uV/m)** [1]	**Avg Limit 10 Meters dB(uV/m)** [1]
Advantage/MPD-3 12" x 45"	134	76.5	58.4	104	84
Advantage/MPD-3 9.5” x 42.34”	134	78.1	59.7	104	84
Advantage/MPD-3 9.5” x 30.34”	134	75.7	57.4	104	84
Advantage/MPD-3 No OH antenna	134	68.3	49.2	104	84
Encore 9.5” x 35.42”	134	74.7	52.5	104	84
Encore No OH antenna	134	67.5	56.5	104	84

[1] Limit at 10 meters is 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 emissions are given in Table 7.3. Plots of the peak signature scans of the Advantage/MPD-3 12" x 45" and Encore 9.5” x 35.42” configurations are provided in Appendix A. Plots of the peak signature scans of the other TRIND™ TIRIS™ configurations are not included in the report but are on file at Southwest Research Institute.

TABLE 7.3
MEASUREMENTS OF SPURIOUS EMISSIONS

Judgment EUT passed by 2.1 dB				
Configuration	**Frequency (MHz)**	**Corrected Level** [1] **dB(uV/m)**	**Limit dB(uV/m)**	**dB under limit**
Advantage/MPD-3 12" x 45"	36	36.5	39	2.5
	80 (horizontal)	33.7	39	5.3
	60	31.4	39	7.6
	80 (vertical)	30.9	39	8.1
Encore 9.5” x 35.42”	48	36.9	39	2.1
	80	34.3	39	4.7
	64	28.7	39	10.3

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

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. Both the TRIND™ TIRIS™ Encore and Advantage/MPD-3 configurations were tested. The amplitude of the fundamental emission changed by a maximum of 0.4 dB. The frequency of the fundamental emission changed by a maximum of 80 Hz. Refer to Table 7.4.

FREQUENCY (MHz)	1 134K	2 134K	3 2M	1 134K	2 134K	2M 3 ~~134K~~	1 134K	2 134K	3 2M	
TRANSDUCER ARL	Band 4	—	Band ~~4~~ 7	Band 4	—	Band ~~4~~ 7	Band 4	—	Band 7	
TRANSDUCER DIST. from EUT(m)/HEIGHT(m)	30 / 1	— / —	— / —	— / —	— / —	— / —	— / —	— / —	— / —	
POLARIZATION (V,H) AMBIENT NOISE (A)	Para	—	— / A	Perp	—	— / A	H	—	— / A	
SIGNAL DIRECTION	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	°
RECEIVER ATTENUATION (dB)										
METER READING (dBμV)	-24.6	-6.7	-17.2	-31.1	-12.7	-16.5	-21	-33	-12.4	
TRANSDUCER FACTOR (dB)	53.7	53.7	44.7	53.7	53.7	44.7	53.7	53.7	44.7	
EXTERNAL GAIN/ CABLE LOSS (dB)	1.1	1.1	2.0	1.1	1.1	2.0	1.1	1.1	2.0	
CORRECTED LEVEL (dBμV/m)	30.2 ~~33.8~~	41.8 ~~21.8~~	29.5 ~~34.3~~	23.7	42.1	29.3	33.8 ④	21.8 ④	34.3	
LIMIT (dBμV/m)	65	85	29.5	65	85	29.5	65	85	29.5	

Date: 2/18/2006

Detection Method: ___ CISPR ___ PEAK ___ AVERAGE ___ Other

OPR/Asst.: G Vinson / J Hansen

EUT ADVANTAGE 12X45

Conf. ______ Run _____ of ______

Page _______ of _______

Notes, ①AV ②PK ③QP ④ fundamental emission buried in random noise

NO Measurable Harmonics

Project No.: 10-03083-01.005

Test Category: FCC

Time, Temp., & % r.H.: 11:30, 74°, 73%

Approved: David A Carmony

FREQUENC (MHz)	1 134 K	2 134K	1 134K	2 134K	1 134K	2 134K				
TRANSDUCER ARL	Band 4	—	—	—	—	—				
TRANSDUCER DIST. from EUT(m)/HEIGHT(m)	20 / 1	— / —	10 / —	— / —	5 / —	— / —				
POLARIZATION (V,H) AMBIENT NOISE (A)	Para	—	—	—	—	—				
SIGNAL DIRECTION	0 °	0 °	0 °	0 °	0 °	0 °	°	°	°	°
RECEIVER ATTENUATION (dB)										
METER READING (dBμV)	-17.4	-1	3.6	21.7	22.7	41.3				
TRANSDUCER FACTOR (dB)	53.7	53.7	53.7	53.7	53.7	53.7				
EXTERNAL GAIN/ CABLE LOSS (dB)	1.1	1.1	1.1	1.1	1.1	1.1				
CORRECTED LEVEL (dBμV/m)	37.4	53.8	58.4	76.5	77.5	96.1				
LIMIT (dBμV/m)	72	92	84	104	133.5	153.5				

Date: 2/18/2000

Detection Method: ___ CISPR ___ PEAK ___ AVERAGE ___ Other

OPR/Asst.: GVinson / JHarrison

EUT ADVANTAGE 12X45

Conf. ______ Run _____ of _______

Page _______ of _______

Notes, ①AV ②PK

NO Measurable Harmonics

Project No.: 10-03083-01.005

Test Category: FCC

Time, Temp., & % r.H.: 11:30, 74°, 73%

Approved: David A Carmany

SwRI Open Area Test Site Radiated Emissions v2_1

Project Number: 10-03083-01.005

Device Under Test: ADVANTAGE 12 X 45

Detection Method: QP

Date / Time: 2/17/2000 / 16:30

Test Receiver: Rohde&Schwarz ESS EMI sn: DE31157 Cal due: 3/23/00

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

Antenna:

Test Standard(optional limit):

Test Sponsor: Marconi Commerce Systema Inc

Antenna #10 Bicon 3104 S/N 2107 Cal Due 29 Apr 2000

Test Technician: G Vinson

Antenna #5 T2 S/N L178 Cal Due 29 Apr 2000

Temp.(°F)/Humidity(%): 75 Deg / 62%

Antenna #7 T3 S/N L108 Cal Due 29 Apr 2000

FREQ MHz	Orient. θ°	Antenna I.D.	Antenna Pol.	Antenna Ht(m)	Antenna Dis(m)	UnCorr'd Level	Corr Factors Ant	Corr Factors Cable	Corr'd Level	Primary Limit dBuV	Optional Limit dBuV	Margin (Primary) (dB)	Comments (** denotes a measurement above the primary limit) Note: Cable factor includes preamplifier gain at frequencies above 200 MHz.
36.00	224	10	V	1.62	10	24.1	10.3	2.1	36.5	39.0		-2.5	
48.00	236	10	V	1.77	10	17.0	9.5	2.4	28.9	39.0		-10.1	
60.00	288	10	V	1.70	10	21.4	7.3	2.7	31.4	39.0		-7.6	
64.00	224	10	V	1.64	10	19.1	6.1	2.7	27.9	39.0		-11.1	
80.00	303	10	V	1.63	10	20.5	7.3	3.1	30.9	39.0		-8.1	
36.00	125	10	H	1.63	10	8.2	10.3	2.1	20.6	39.0		-18.4	
64.00	186	10	H	2.75	10	14.6	6.1	2.7	23.4	39.0		-15.6	
64.00	186	10	H	2.75	10	14.5	6.1	2.7	23.3	39.0		-15.7	
80.00	186	10	H	2.75	10	23.4	7.3	3.1	33.7	39.0		-5.3	
85.90	172	10	H	2.03	10	16.4	8.9	3.2	28.4	39.0		-10.6	
137.44	348	10	H	2.51	10	17.5	11.0	4.3	32.8	43.5		-10.7	
300.00	348	5	V	1.64	10	18.7	17.9	-21.2	15.4	46.5		-31.1	Ambient
400.00	348	5	V	1.64	10	18.2	22.0	-19.8	20.5	46.5		-26.0	Ambient
500.00	348	5	V	1.64	10	19.2	27.5	-18.3	28.4	46.5		-18.1	Ambient
300.00	348	5	H	1.64	10	23.6	17.9	-21.2	20.3	46.5		-26.2	
304.00	333	5	H	1.27	10	26.5	17.7	-21.2	22.9	46.5		-23.6	
384.00	300	5	H	1.63	10	27.3	21.8	-20.0	29.1	46.5		-17.4	
500.00	300	5	H	1.63	10	11.5	27.5	-18.3	20.7	46.5		-25.8	Ambient
700.00	300	7	V	1.63	10	11.2	28.1	-15.7	23.6	46.5		-22.9	Ambient
800.00	300	7	V	1.63	10	11.4	27.2	-15.8	22.8	46.5		-23.7	Ambient
950.00	300	7	V	1.63	10	17.2	31.5	-14.8	33.9	46.5		-12.6	Ambient
700.00	300	7	H	1.63	10	10.8	28.1	-15.7	23.2	46.5		-23.3	Ambient
960.00	300	7	H	1.63	10	9.8	31.6	-14.6	26.8	49.5		-22.7	Ambient

FREQUENCY (MHz)	1 134K	2 134K	3 2M	1 134K	2 134K	3 2M	1 134K	2 134K ~~2M~~	3 2M	2 ~~x~~ 134K	1 ~~3~~ 134K
TRANSDUCER ARL	Band 4	–	Band 7	Band 4	–	Band 7	Band 4	–	Band 7	Band 4	–
TRANSDUCER DIST. from EUT(m)/HEIGHT(m)	30 / 1	– / –	– / –	– / –	– / –	– / –	– / –	– / –	– / –	10 / –	– / –
POLARIZATION (V,H) AMBIENT NOISE (A)	Para /	– /	– / A	Perp /	– /	– / A	H /	– /	– / A	Para /	– /
SIGNAL DIRECTION	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0 °	0
RECEIVER ATTENUATION (dB)											
METER READING (dBμV)	-25 ~~-12~~	-12	-2.6	-25.4	-15.4	-2.4	-26.2	-15.3	-22	19.9	-23
TRANSDUCER FACTOR (dB)	53.7	53.7	44.7	53.7	53.7	44.7	53.7	53.7	44.7	53.7	53.7
EXTERNAL GAIN/ CABLE LOSS (dB)	1.1	1.1	2.0	1.1	1.1	2.0	1.1	1.1	2.0	1.1	1.1
CORRECTED LEVEL (dBμV/m)	29.8	42.8	44.1	29.4	39.4	44.3	28.6	39.5	44.5	74.7	52.5 ~~31.8~~
LIMIT (dBμV/m)	65	85	25.5	65	85	25.5	65	85	25.5	104	~~85~~ 54

Date: 2/18/2000 Detection Method: ___ CISPR ___ PEAK ___ AVERAGE ___ Other

OPR/Asst.: G Vinson/J Homan EUT ENCORE 9.5X35.42

Conf. ______ Run _____ of _______ Notes, ①AV ②PK ③QP

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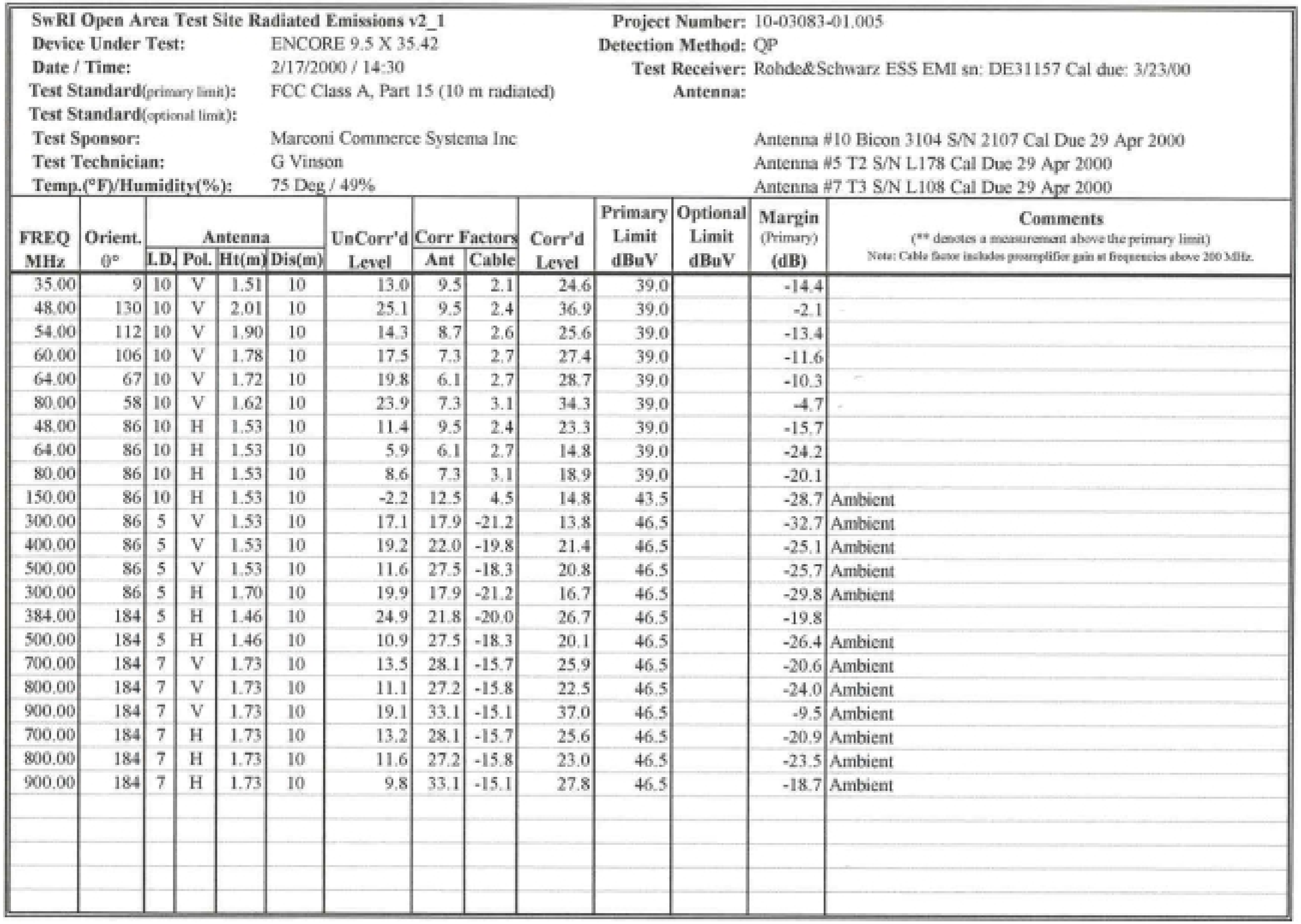
Project No.: 10-03083-01.005 no harmonics detected

Test Category: FCC

Time, Temp., & % r.H.: 16:17, 86°, 46%

Approved: David A Carmany



SwRI Open Area Test Site Radiated Emissions v2_1

Device Under Test: ENCORE 9.5 X 35.42
Date / Time: 2/17/2000 / 14:30
Test Standard(primary limit): FCC Class A, Part 15 (10 m radiated)
Test Standard(optional limit):
Test Sponsor: Marconi Commerce Systema Inc
Test Technician: G Vinson
Temp.(°F)/Humidity(%): 75 Deg / 49%

Project Number: 10-03083-01.005
Detection Method: QP
Test Receiver: Rohde&Schwarz ESS EMI sn: DE31157 Cal due: 3/23/00
Antenna:
Antenna #10 Bicon 3104 S/N 2107 Cal Due 29 Apr 2000
Antenna #5 T2 S/N L178 Cal Due 29 Apr 2000
Antenna #7 T3 S/N L108 Cal Due 29 Apr 2000

FREQ MHz	Orient. 0°	Antenna				UnCorr'd Level	Corr Factors		Corr'd Level	Primary Limit dBuV	Optional Limit dBuV	Margin (Primary) (dB)	Comments (** denotes a measurement above the primary limit) Note: Cable factor includes preamplifier gain at frequencies above 200 MHz.
		I.D.	Pol.	Ht(m)	Dis(m)		Ant	Cable					
35.00	9	10	V	1.51	10	13.0	9.5	2.1	24.6	39.0		-14.4	
48.00	130	10	V	2.01	10	25.1	9.5	2.4	36.9	39.0		-2.1	
54.00	112	10	V	1.90	10	14.3	8.7	2.6	25.6	39.0		-13.4	
60.00	106	10	V	1.78	10	17.5	7.3	2.7	27.4	39.0		-11.6	
64.00	67	10	V	1.72	10	19.8	6.1	2.7	28.7	39.0		-10.3	
80.00	58	10	V	1.62	10	23.9	7.3	3.1	34.3	39.0		-4.7	
48.00	86	10	H	1.53	10	11.4	9.5	2.4	23.3	39.0		-15.7	
64.00	86	10	H	1.53	10	5.9	6.1	2.7	14.8	39.0		-24.2	
80.00	86	10	H	1.53	10	8.6	7.3	3.1	18.9	39.0		-20.1	
150.00	86	10	H	1.53	10	-2.2	12.5	4.5	14.8	43.5		-28.7	Ambient
300.00	86	5	V	1.53	10	17.1	17.9	-21.2	13.8	46.5		-32.7	Ambient
400.00	86	5	V	1.53	10	19.2	22.0	-19.8	21.4	46.5		-25.1	Ambient
500.00	86	5	V	1.53	10	11.6	27.5	-18.3	20.8	46.5		-25.7	Ambient
300.00	86	5	H	1.70	10	19.9	17.9	-21.2	16.7	46.5		-29.8	Ambient
384.00	184	5	H	1.46	10	24.9	21.8	-20.0	26.7	46.5		-19.8	
500.00	184	5	H	1.46	10	10.9	27.5	-18.3	20.1	46.5		-26.4	Ambient
700.00	184	7	V	1.73	10	13.5	28.1	-15.7	25.9	46.5		-20.6	Ambient
800.00	184	7	V	1.73	10	11.1	27.2	-15.8	22.5	46.5		-24.0	Ambient
900.00	184	7	V	1.73	10	19.1	33.1	-15.1	37.0	46.5		-9.5	Ambient
700.00	184	7	H	1.73	10	13.2	28.1	-15.7	25.6	46.5		-20.9	Ambient
800.00	184	7	H	1.73	10	11.6	27.2	-15.8	23.0	46.5		-23.5	Ambient
900.00	184	7	H	1.73	10	9.8	33.1	-15.1	27.8	46.5		-18.7	Ambient

TABLE 7.4
FREQUENCY AND AMPLITUDE STABILITY vs. INPUT VOLTAGE

AC Input Voltage	Startup		2 minutes		5 minutes		10 minutes	
	Frequency (kHz)	Amplitude (dB)	Frequency (kHz)	Amplitude (dB)	Frequency (kHz)	Amplitude (dB)	Frequency (kHz)	Amplitude (dB)
Encore								
100% (120 VAC)	134.21	34.8	134.23	34.8	134.20	34.8	134.23	34.8
85% (102 VAC)	134.24	34.8	134.19	34.8	134.24	34.7	134.22	34.8
115% (138 VAC)	134.24	34.8	134.26	35.0	134.22	34.6	134.27	34.9
Advantage								
100% (120 VAC)	134.24	40.8	134.24	40.8	134.26	40.8	134.23	40.8
85% (102 VAC)	134.26	40.8	134.26	40.8	134.24	40.7	134.24	40.7
115% (138 VAC)	134.24	40.8	134.24	40.8	134.25	40.9	134.24	40.8

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 with 35 MHz in the first row (page 18):

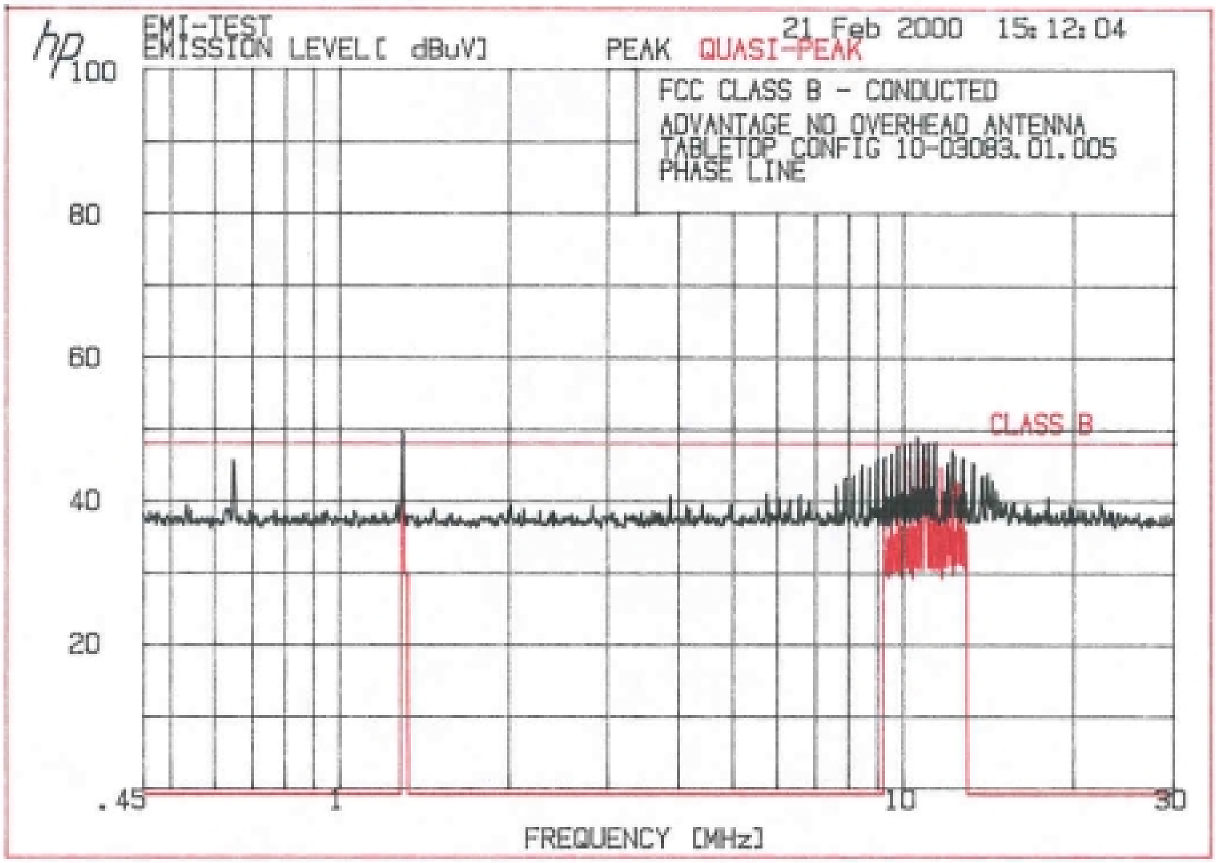
13.0 dB(mV)
9.5 dB(1/m)
2.1 dB (CF/AG FACTOR)
FS = 24.6 dB(mV/m)

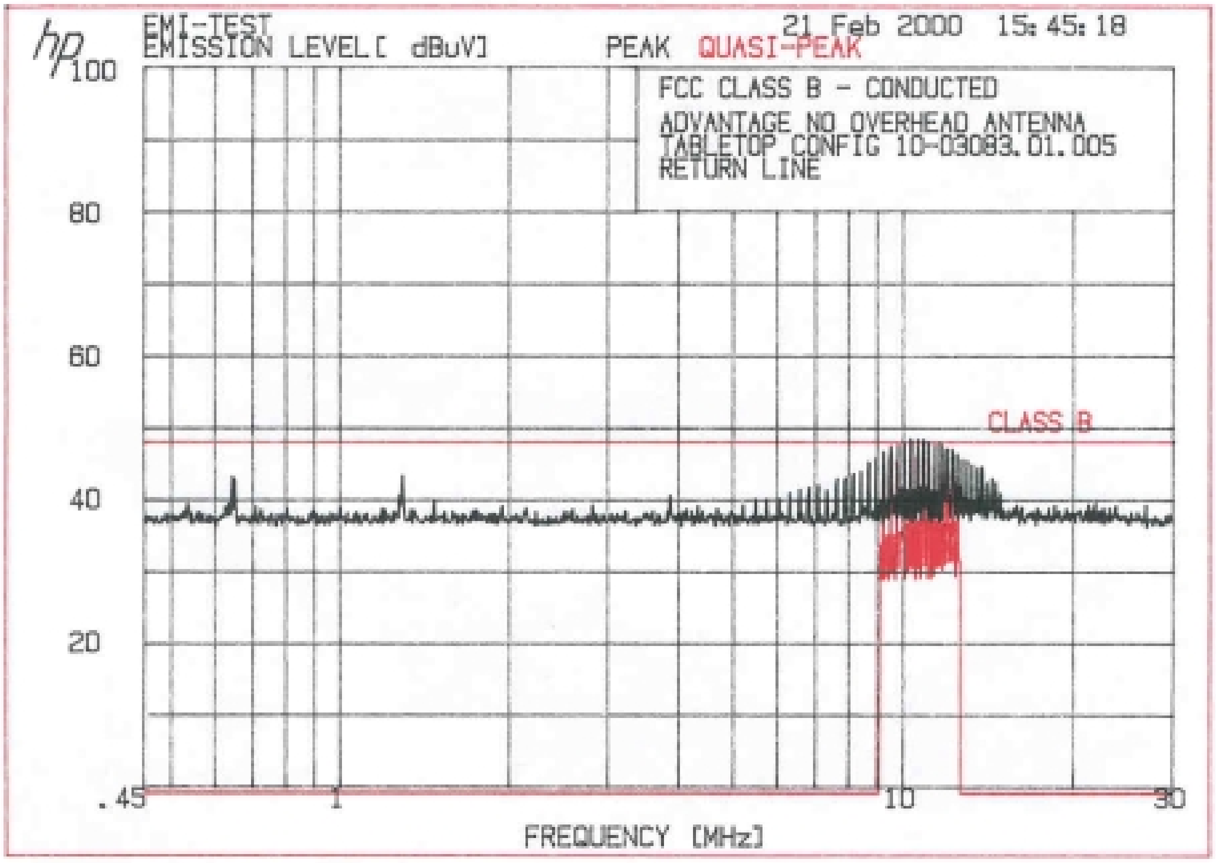
To convert the dB(mV/m) value to its corresponding level in mV/m is as follows:

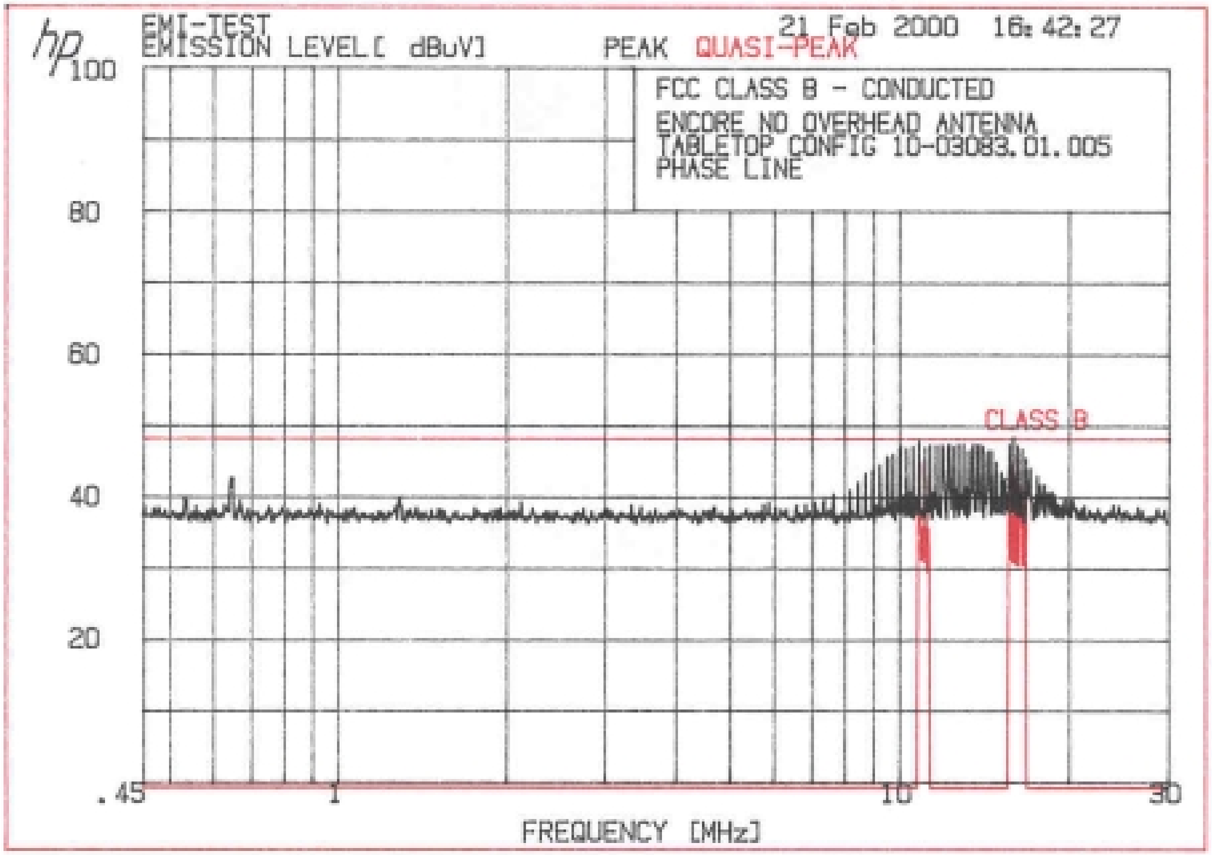
Level in mV/m Common Antilogarithm [(24.6 dBmV/m)/20] = 16.98 mV/m

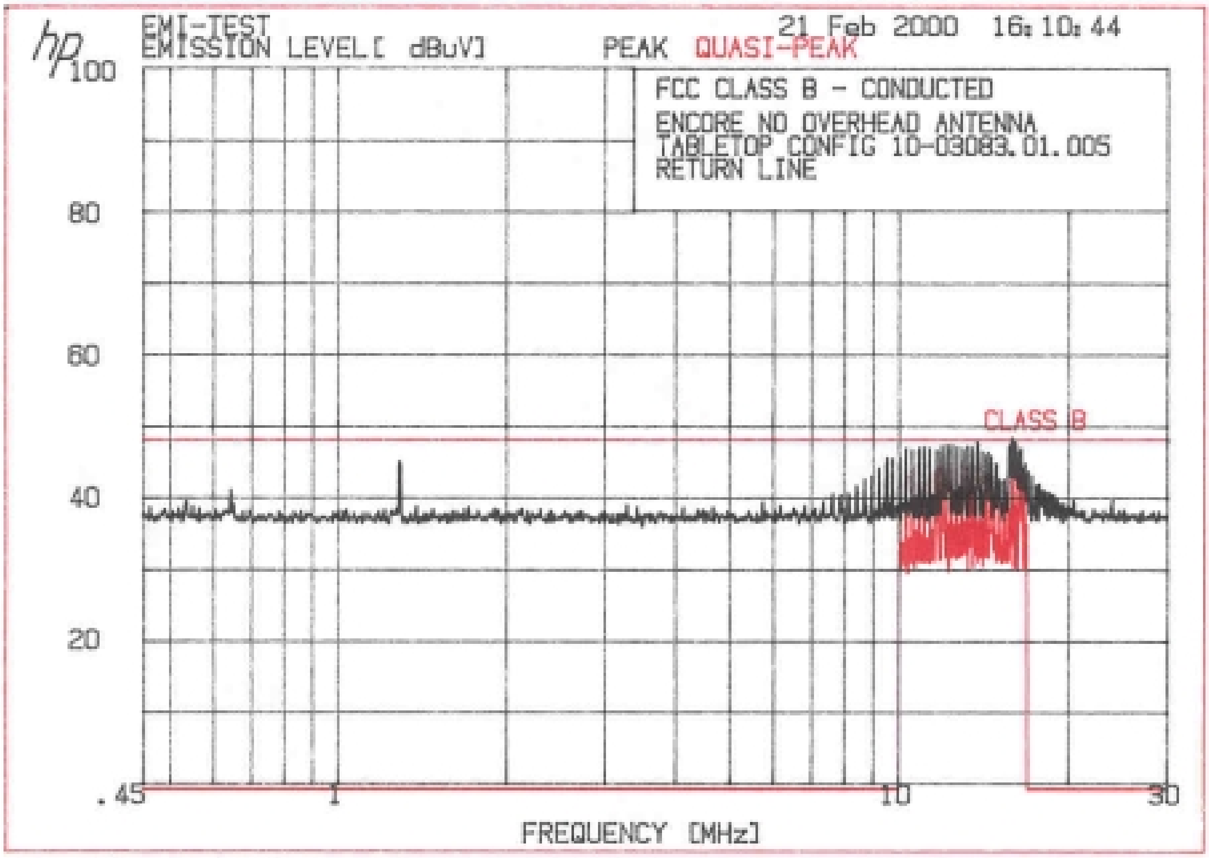
APPENDIX A

CONDUCTED MEASUREMENT PLOTS


EMI-TEST
21 Feb 2000 15:12:04
EMISSION LEVEL[dBuV]
PEAK
QUASI-PEAK
100
FCC CLASS B - CONDUCTED
ADVANTAGE NO OVERHEAD ANTENNA
TABLETOP CONFIG 10-03083.01.005
PHASE LINE
80
60
CLASS B
40
20
.45
1
10
30
FREQUENCY [MHz]

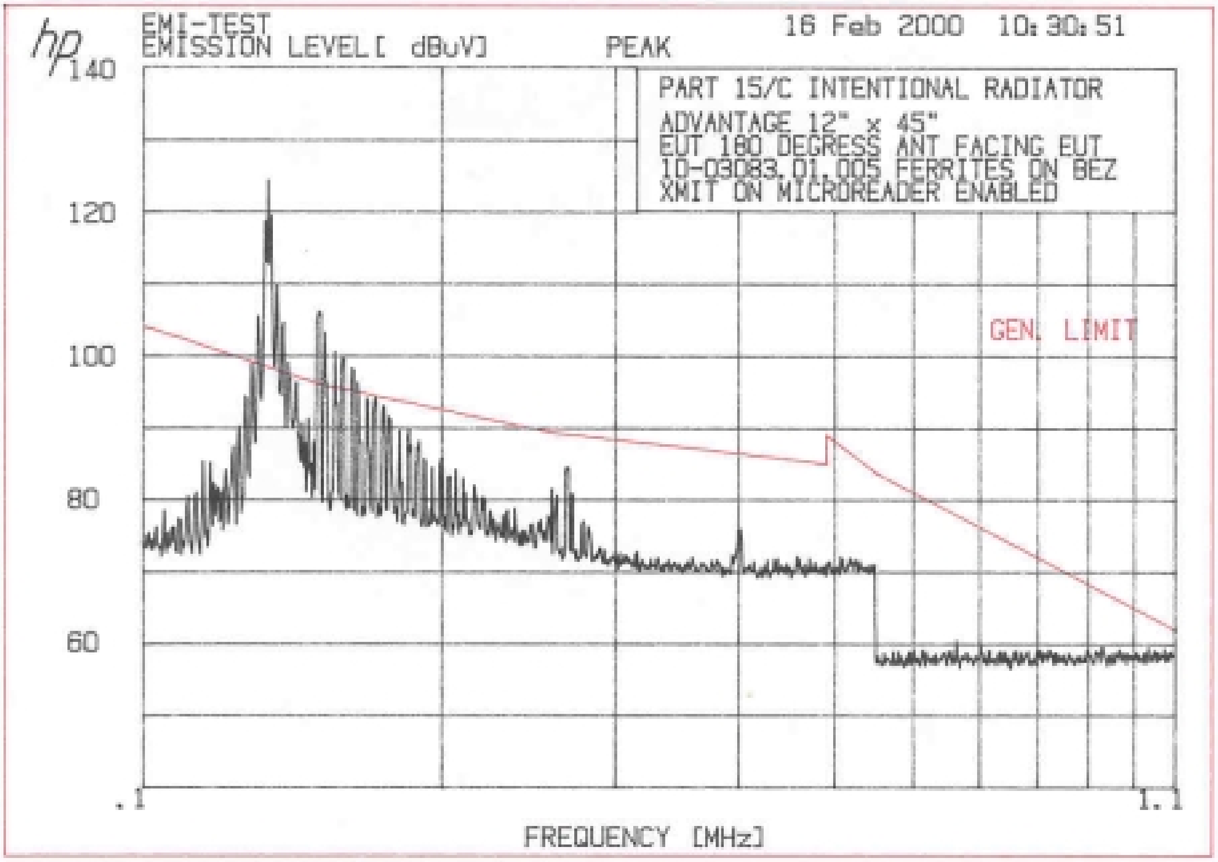

EMI-TEST
21 Feb 2000 15:45:18
EMISSION LEVEL[dBuV]
PEAK
QUASI-PEAK
100
FCC CLASS B - CONDUCTED
ADVANTAGE NO OVERHEAD ANTENNA
TABLETOP CONFIG 10-03083.01.005
RETURN LINE
80
60
CLASS B
40
20
.45
1
10
30
FREQUENCY [MHz]

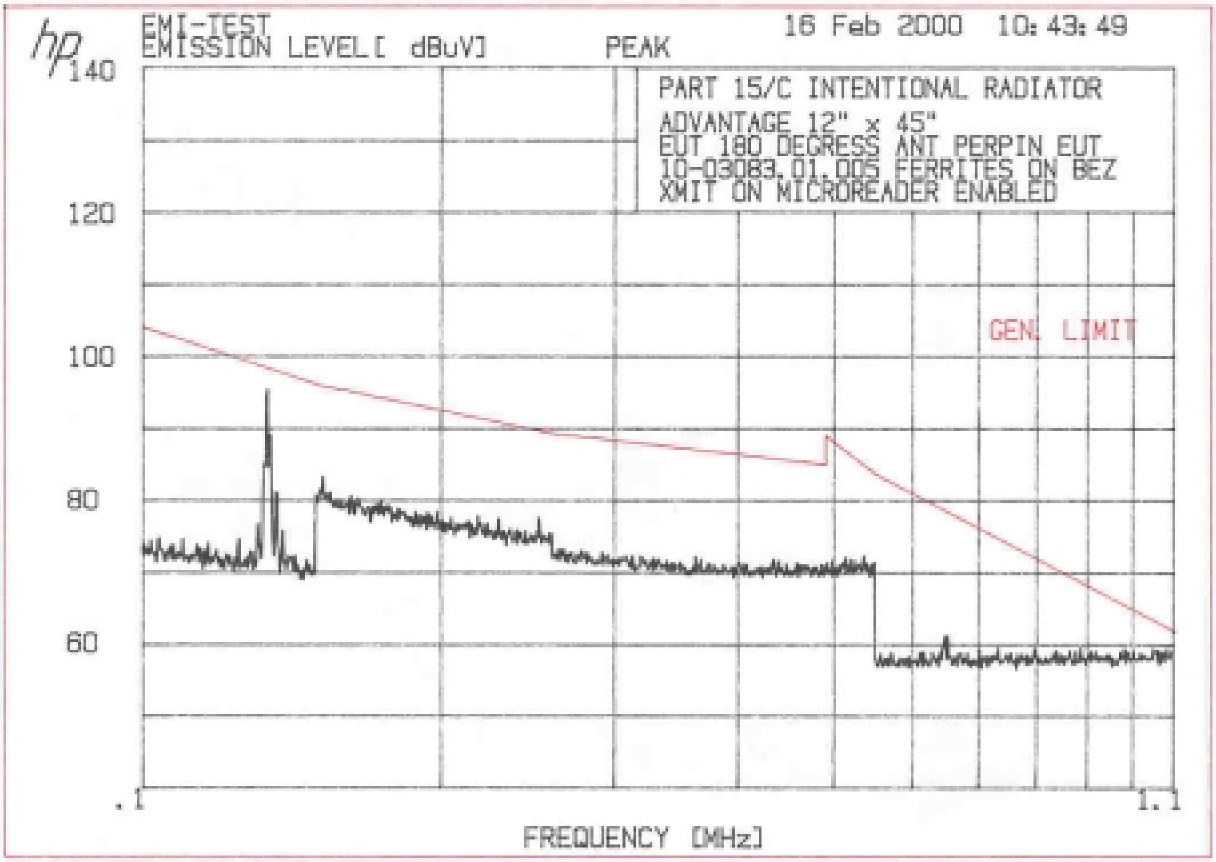

EMI-TEST
EMISSION LEVEL [dBuV]
PEAK
QUASI-PEAK
21 Feb 2000 16:42:27
FCC CLASS B - CONDUCTED
ENCORE NO OVERHEAD ANTENNA
TABLETOP CONFIG 10-03083.01.005
PHASE LINE
CLASS B
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]

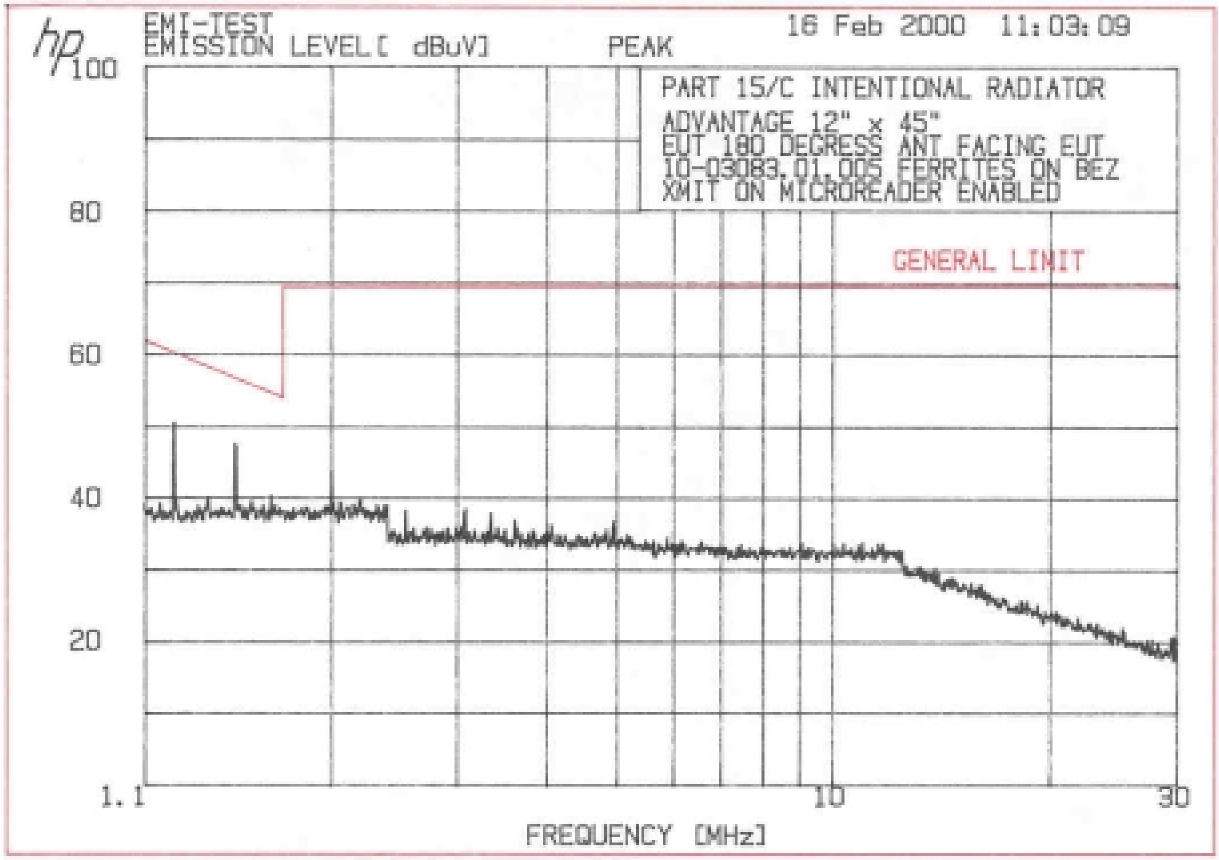

EMI-TEST
EMISSION LEVEL [dBuV]
PEAK
QUASI-PEAK
21 Feb 2000 16:10:44
FCC CLASS B - CONDUCTED
ENCORE NO OVERHEAD ANTENNA
TABLETOP CONFIG 10-03083.01.005
RETURN LINE
CLASS B
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]

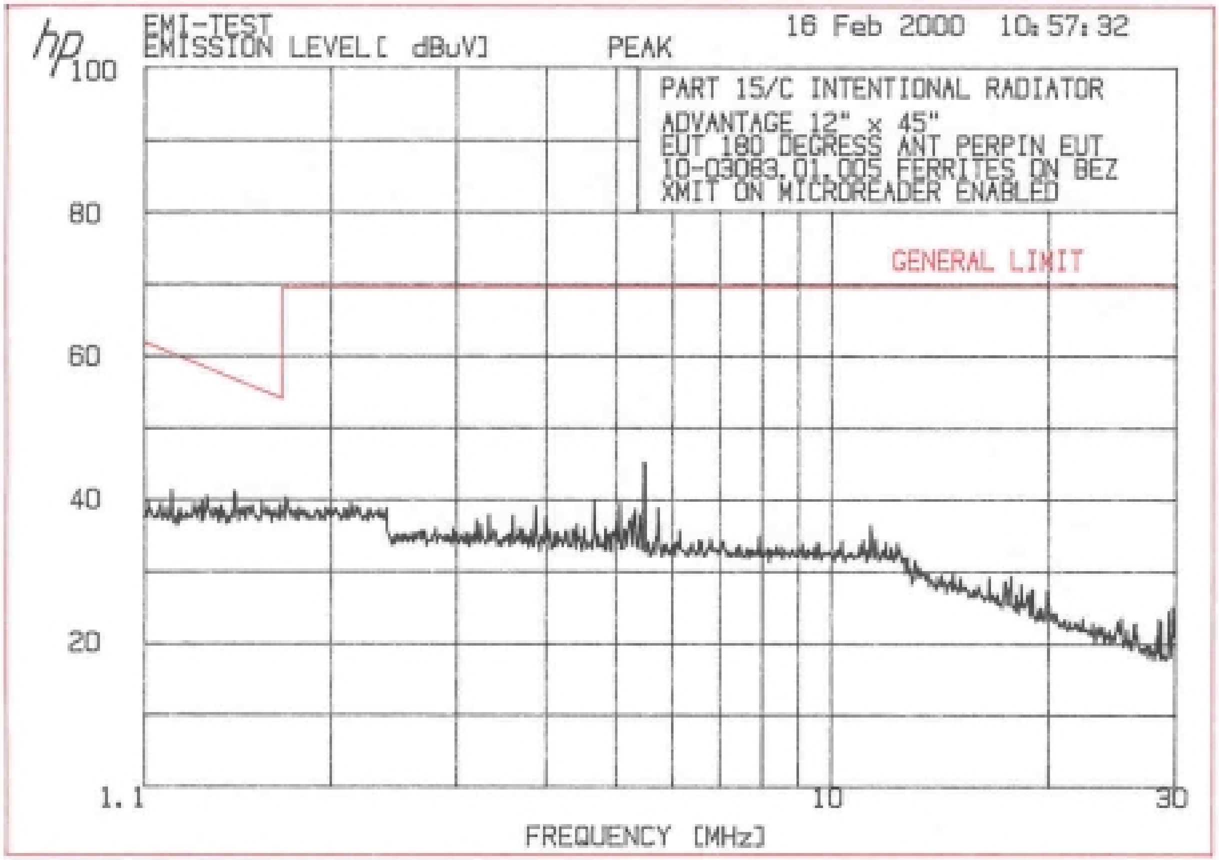
APPENDIX B

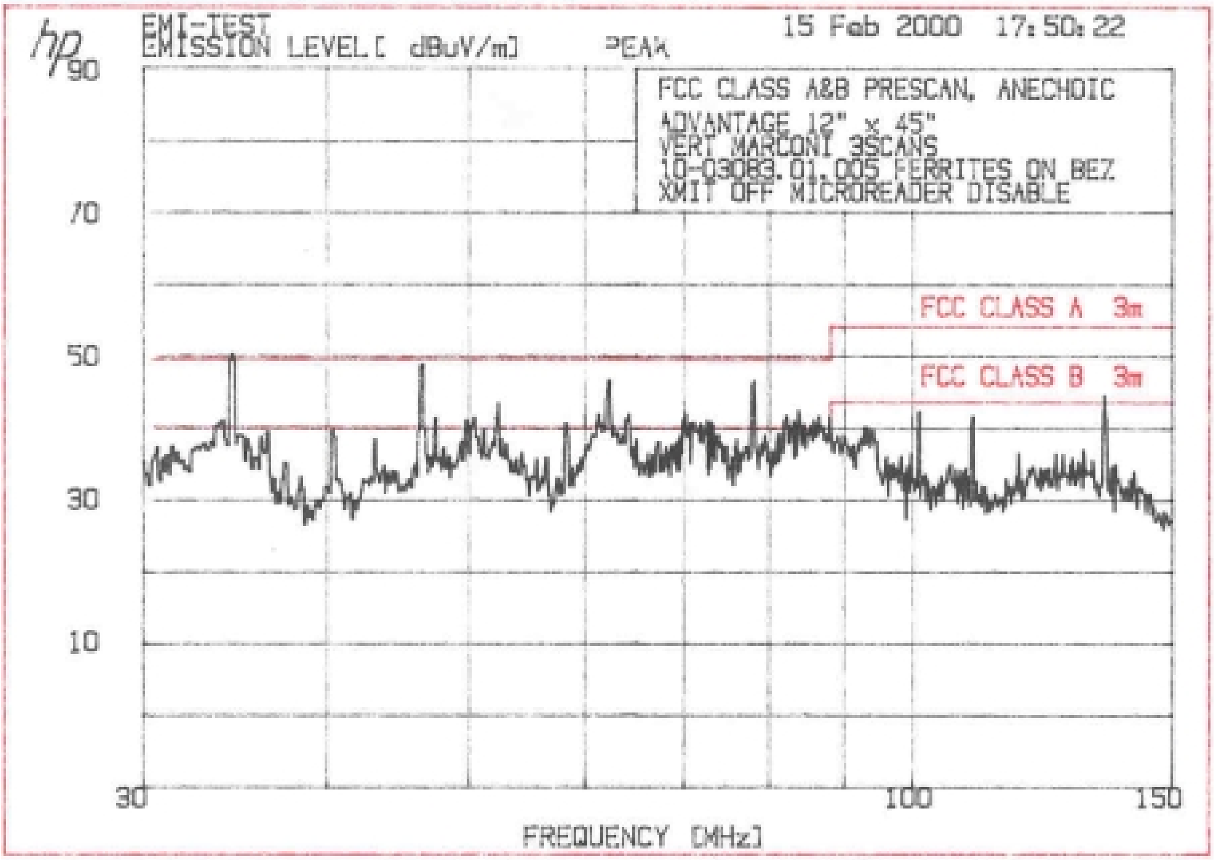
RADIATED MEASUREMENT PLOTS

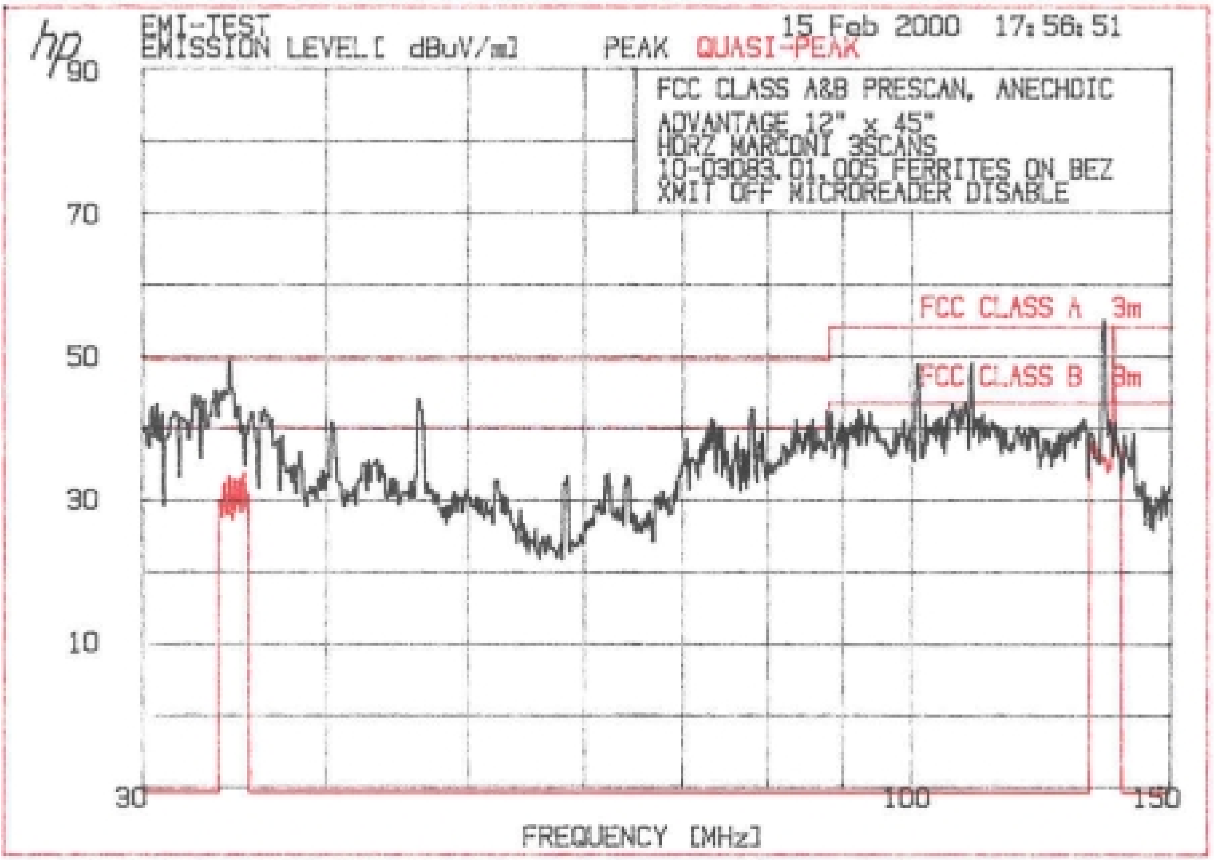

hp
EMI-TEST
EMISSION LEVEL[dBuV]
PEAK
16 Feb 2000 10:30:51
PART 15/C INTENTIONAL RADIATOR
ADVANTAGE 12" x 45"
EUT 180 DEGRESS ANT FACING EUT
10-03083.01.005 FERRITES ON BEZ
XMIT ON MICROREADER ENABLED
GEN. LIMIT
140
120
100
80
60
.1
1.1
FREQUENCY [MHz]

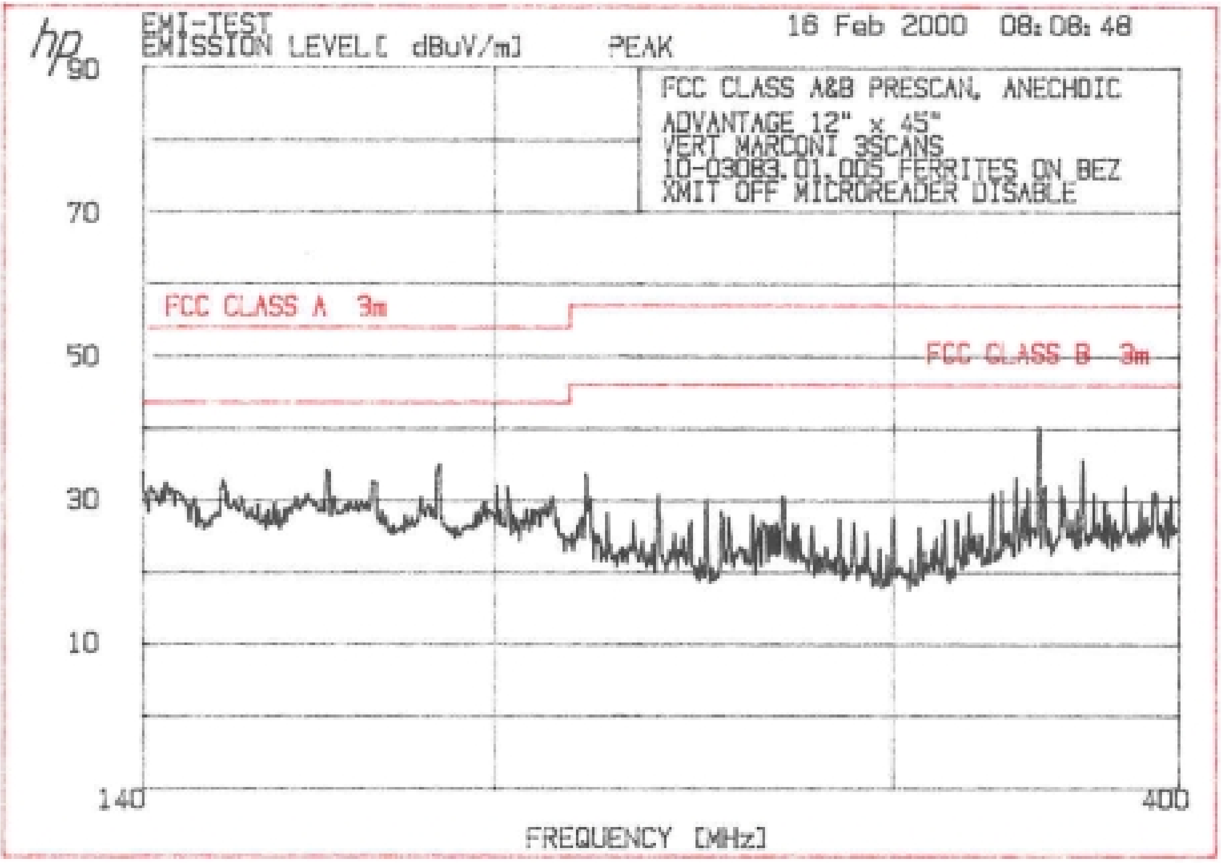

hp
EMI-TEST
EMISSION LEVEL[dBuV]
PEAK
16 Feb 2000 10:43:49
PART 15/C INTENTIONAL RADIATOR
ADVANTAGE 12" x 45"
EUT 180 DEGRESS ANT PERPIN EUT
10-03083.01.005 FERRITES ON BEZ
XMIT ON MICROREADER ENABLED
GEN. LIMIT
140
120
100
80
60
.1
1.1
FREQUENCY [MHz]

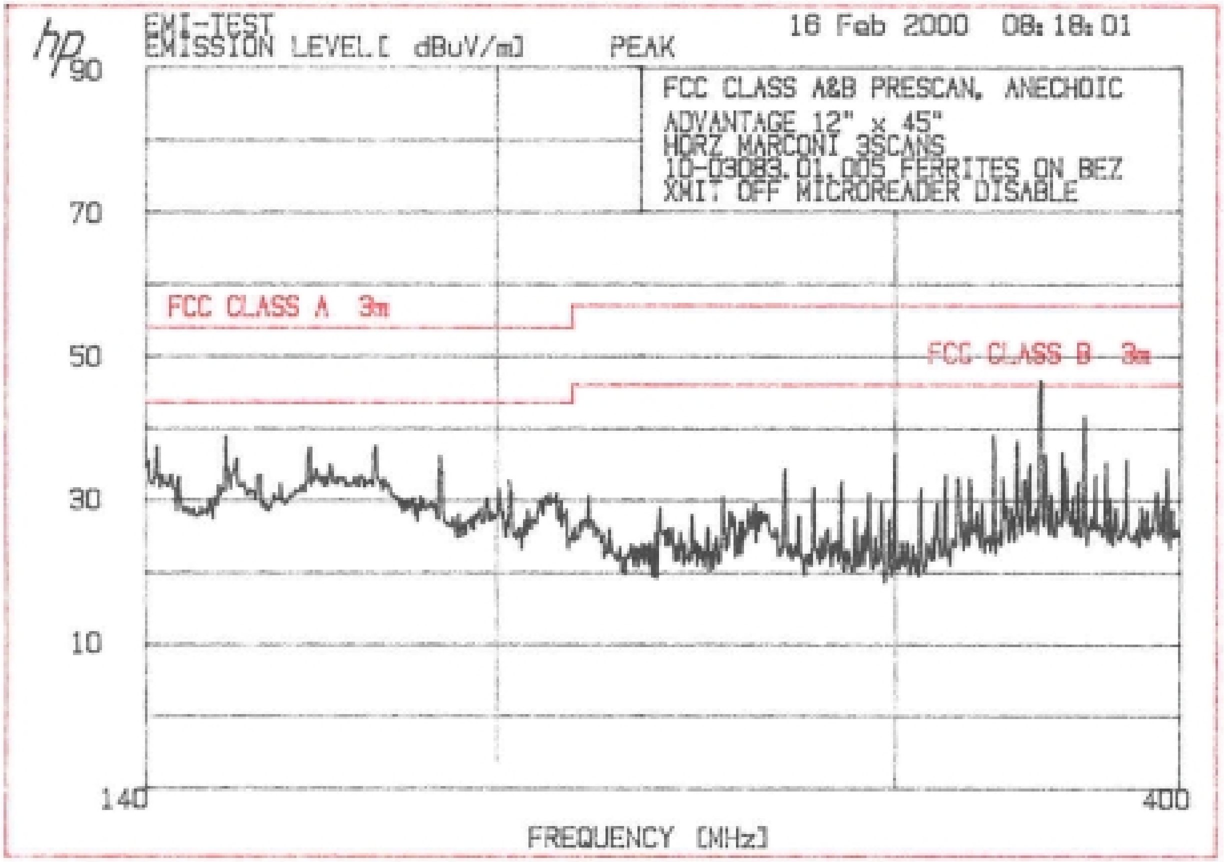

hp
EMI-TEST
EMISSION LEVEL[dBuV]
PEAK
16 Feb 2000 11:03:09
PART 15/C INTENTIONAL RADIATOR
ADVANTAGE 12" x 45"
EUT 180 DEGRESS ANT FACING EUT
10-03083.01.005 FERRITES ON BEZ
XMIT ON MICROREADER ENABLED
GENERAL LIMIT
100
80
60
40
20
1.1
10
30
FREQUENCY [MHz]

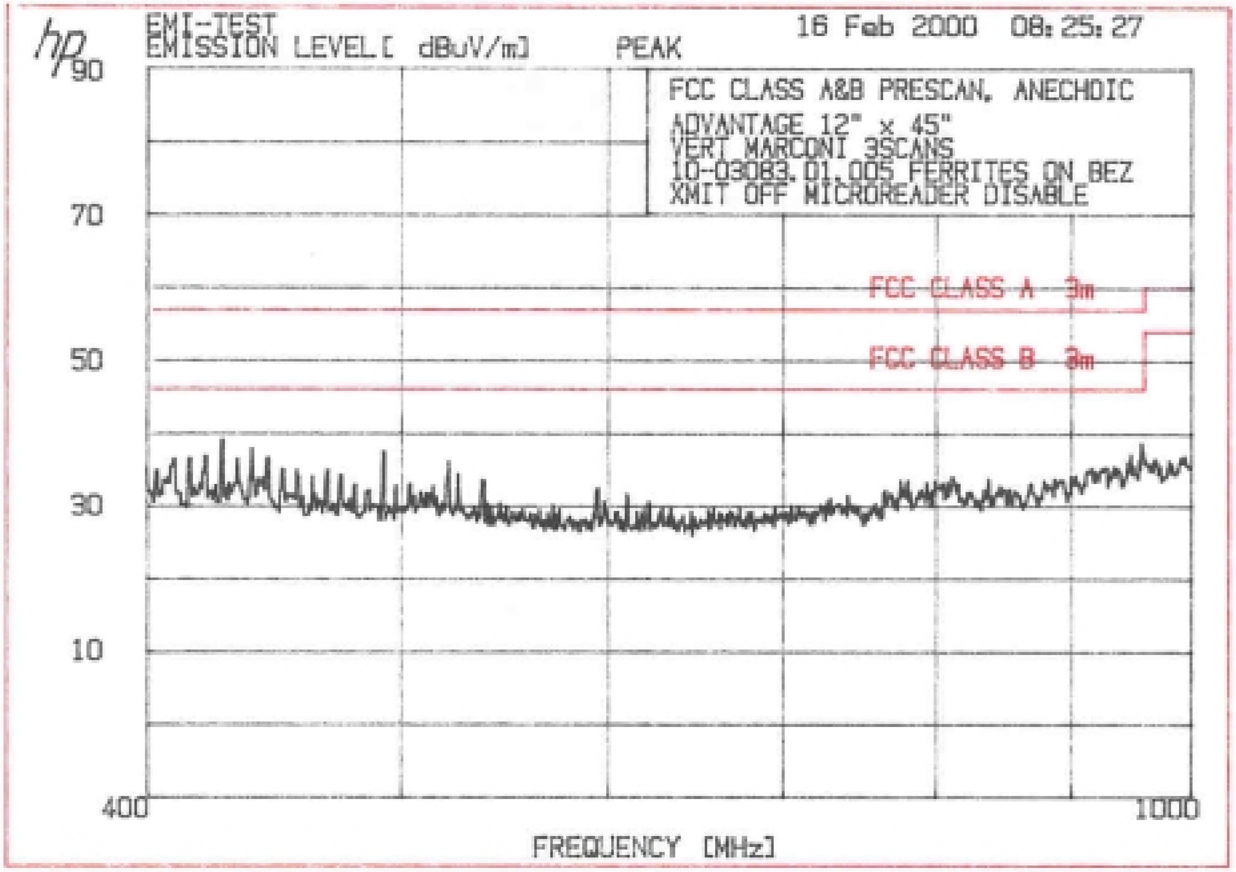

hp
EMI-TEST
EMISSION LEVEL[dBuV]
PEAK
16 Feb 2000 10:57:32
PART 15/C INTENTIONAL RADIATOR
ADVANTAGE 12" x 45"
EUT 180 DEGRESS ANT PERPIN EUT
10-03083.01.005 FERRITES ON BEZ
XMIT ON MICROREADER ENABLED
GENERAL LIMIT
100
80
60
40
20
1.1
10
30
FREQUENCY [MHz]

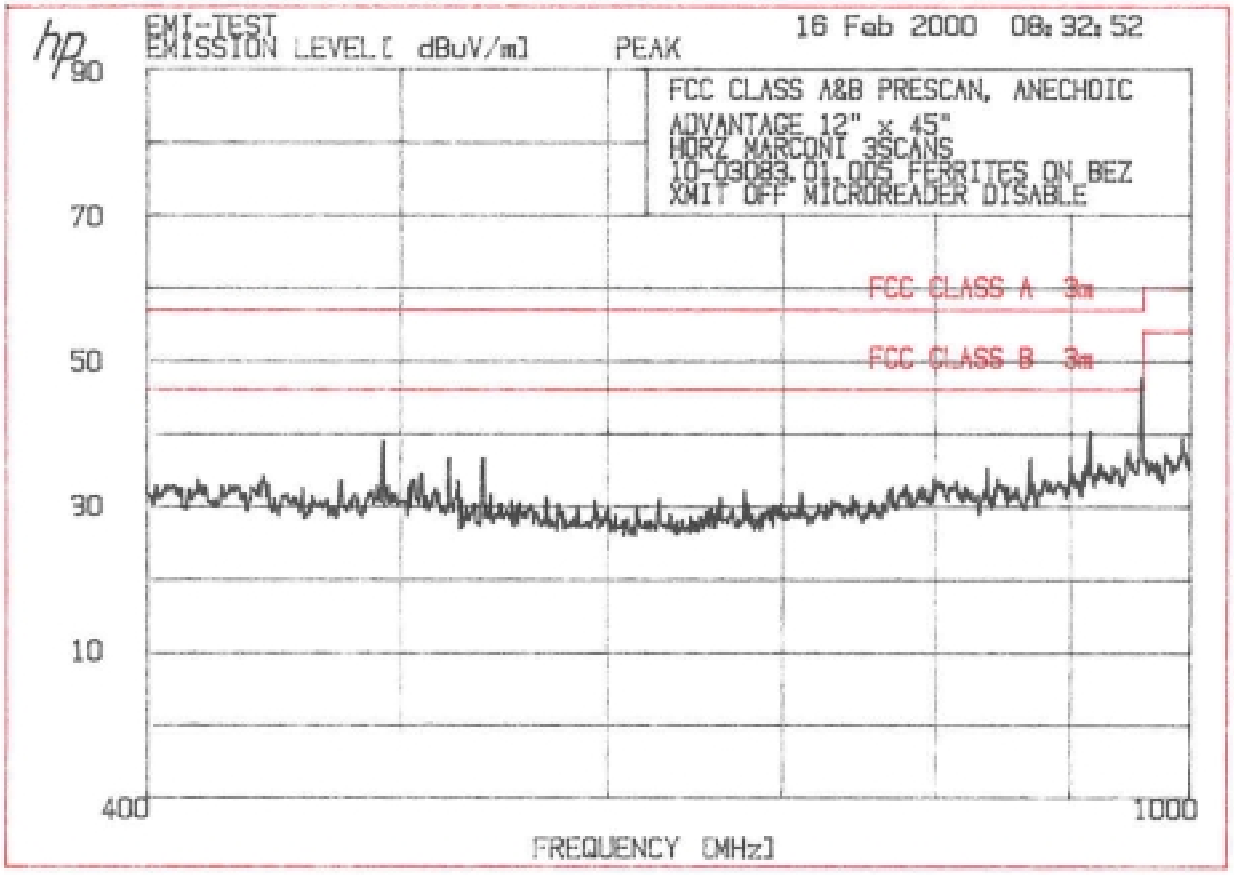

hp
EMI-TEST
EMISSION LEVEL[dBuV/m] PEAK
15 Feb 2000 17:50:22
FCC CLASS A&B PRESCAN, ANECHOIC
ADVANTAGE 12" x 45"
VERT MARCONI 3SCANS
10-03083.01.005 FERRITES ON BEZ
XMIT OFF MICROREADER DISABLE
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
30
100
150
FREQUENCY [MHz]

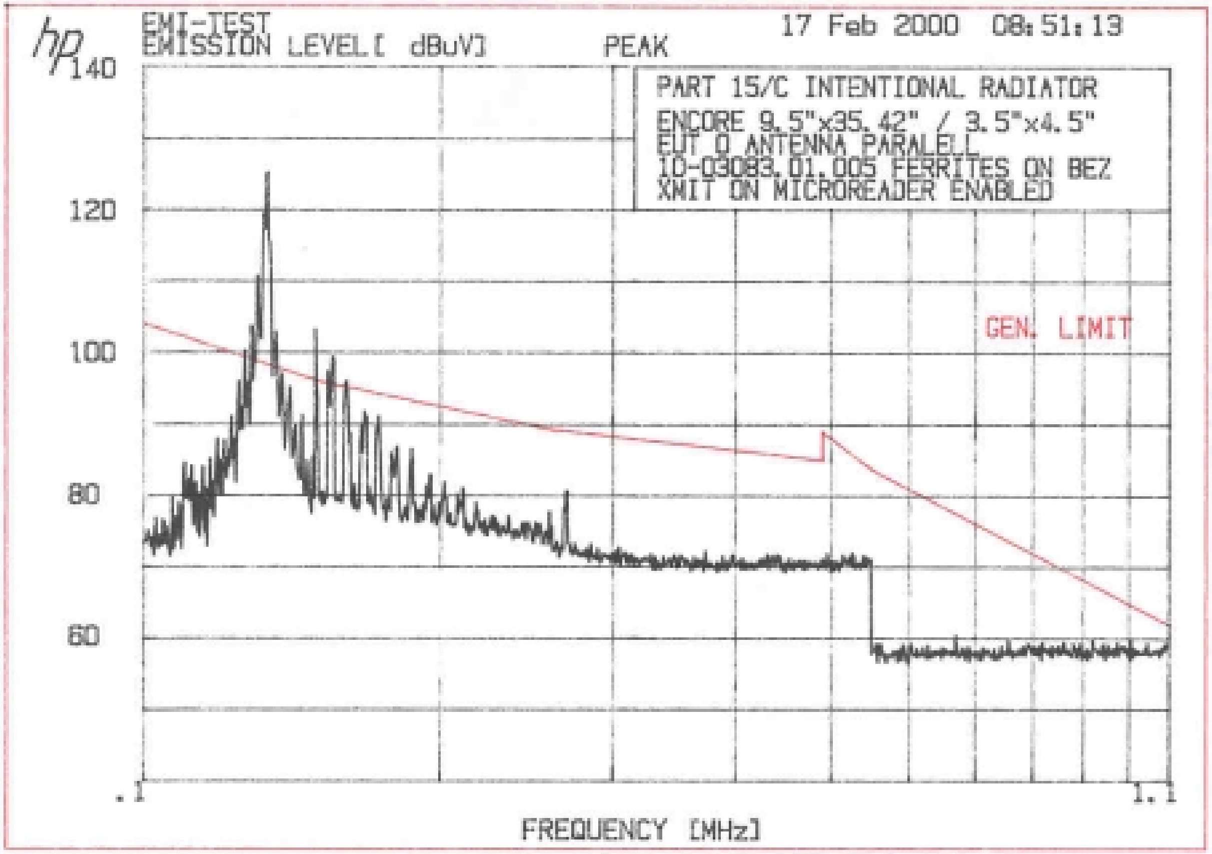

hp
EMI-TEST
EMISSION LEVEL[dBuV/m] PEAK QUASI-PEAK
15 Feb 2000 17:56:51
FCC CLASS A&B PRESCAN, ANECHOIC
ADVANTAGE 12" x 45"
HORZ MARCONI 3SCANS
10-03083.01.005 FERRITES ON BEZ
XMIT OFF MICROREADER DISABLE
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
30
100
150
FREQUENCY [MHz]

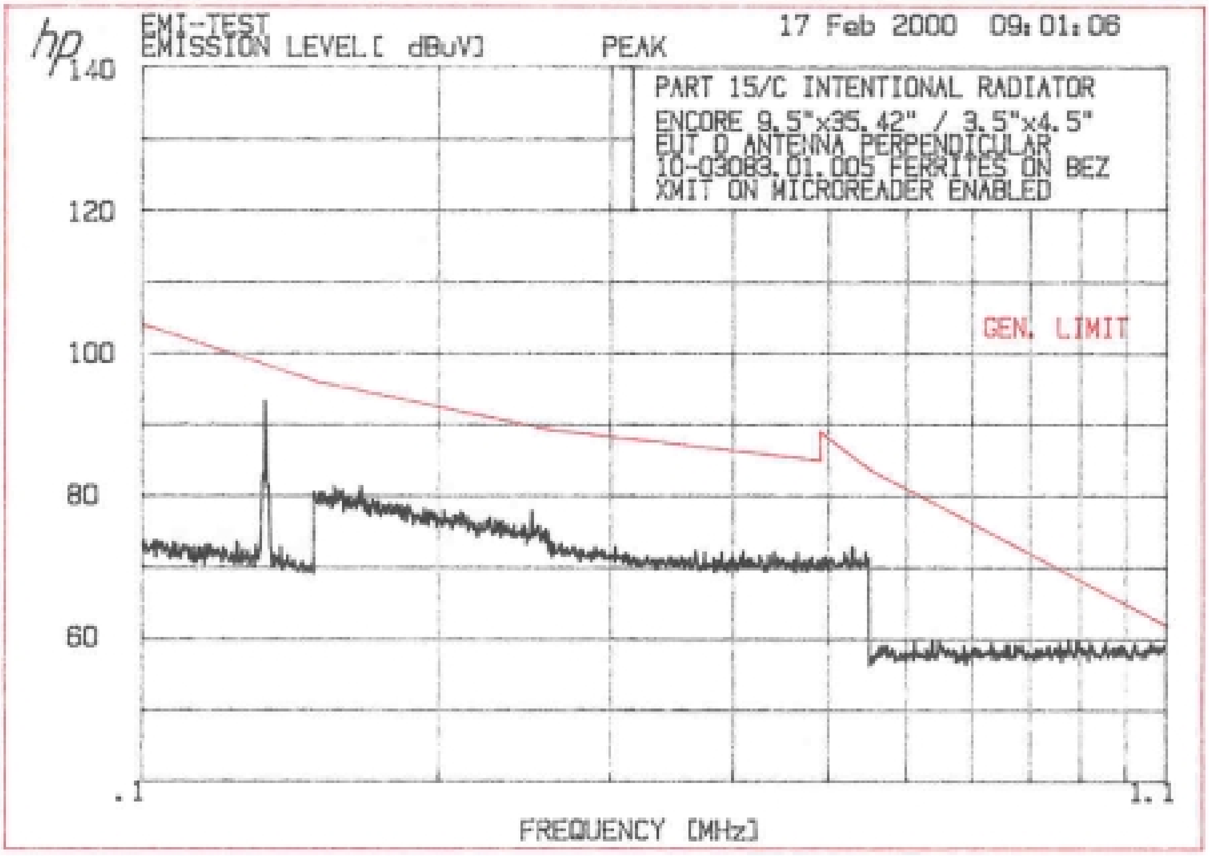

hp
EMI-TEST
EMISSION LEVEL[dBuV/m] PEAK
16 Feb 2000 08:08:48
FCC CLASS A&B PRESCAN, ANECHOIC
ADVANTAGE 12" x 45"
VERT MARCONI 3SCANS
10-03083.01.005 FERRITES ON BEZ
XMIT OFF MICROREADER DISABLE
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
140
400
FREQUENCY [MHz]

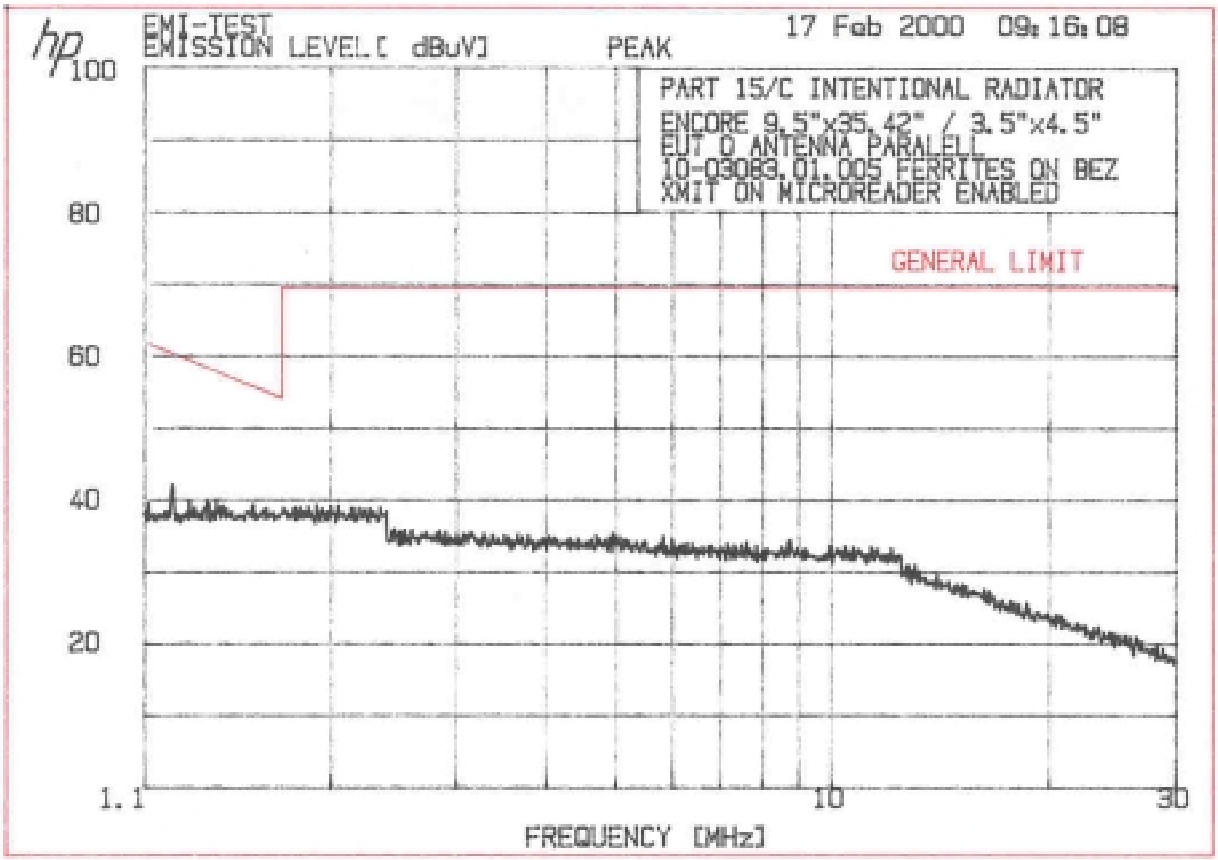

hp
EMI-TEST
EMISSION LEVEL[dBuV/m] PEAK
16 Feb 2000 08:18:01
FCC CLASS A&B PRESCAN, ANECHOIC
ADVANTAGE 12" x 45"
HORZ MARCONI 3SCANS
10-03083.01.005 FERRITES ON BEZ
XMIT OFF MICROREADER DISABLE
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
140
400
FREQUENCY [MHz]

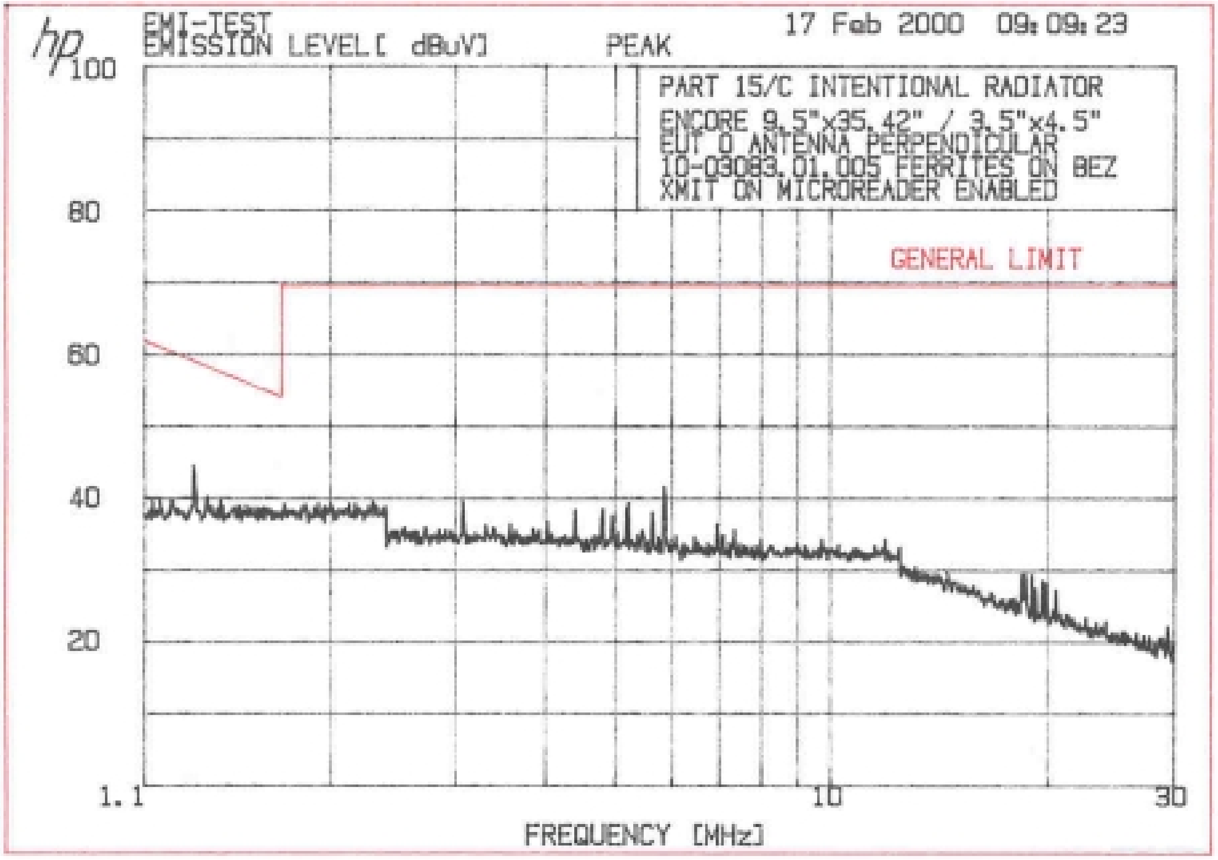

hp
EMI-TEST
EMISSION LEVEL[dBuV/m]
PEAK
16 Feb 2000 08:25:27
FCC CLASS A&B PRESCAN, ANECHOIC
ADVANTAGE 12" x 45"
VERT MARCONI 3SCANS
10-03083.01.005 FERRITES ON BEZ
XMIT OFF MICROREADER DISABLE
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
400
1000
FREQUENCY [MHz]

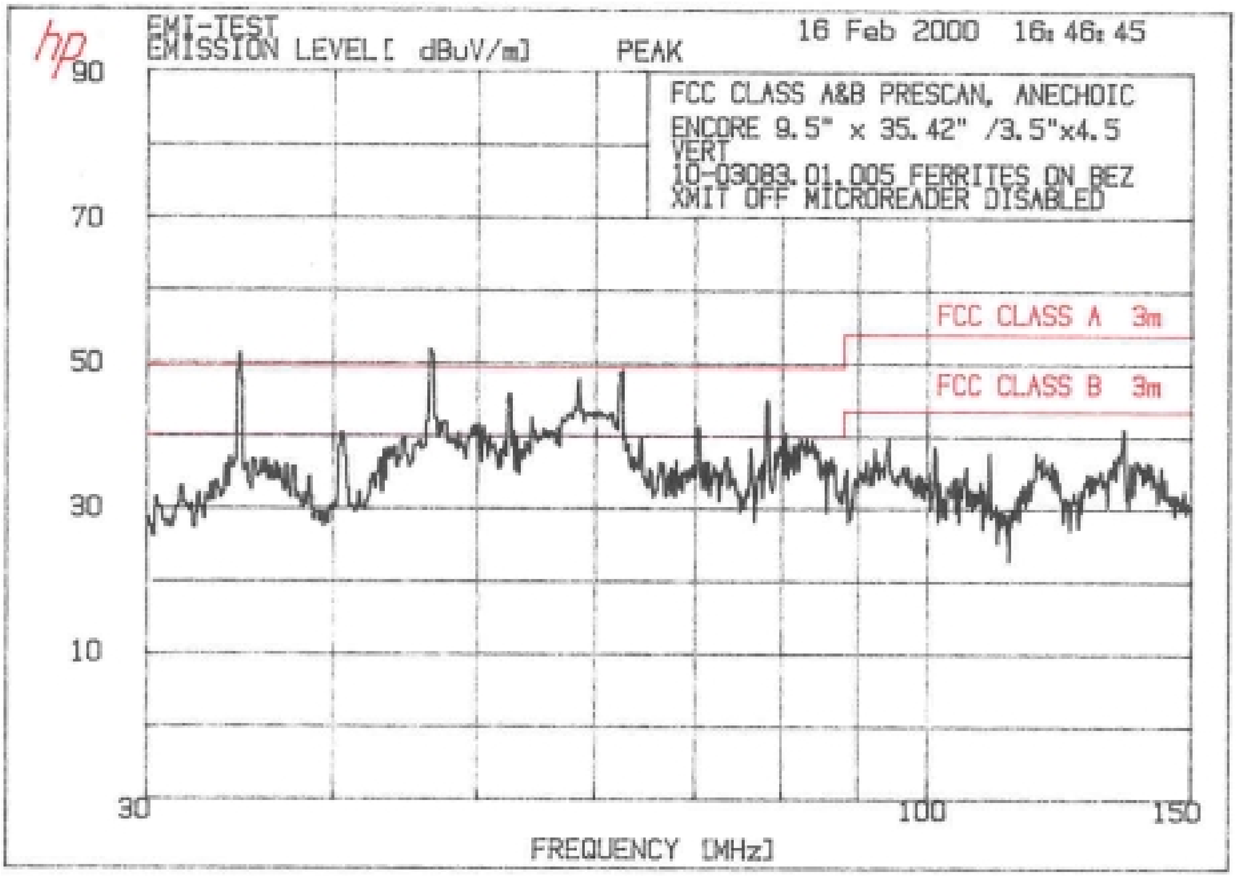

hp
EMI-TEST
EMISSION LEVEL[dBuV/m]
PEAK
16 Feb 2000 08:32:52
FCC CLASS A&B PRESCAN, ANECHOIC
ADVANTAGE 12" x 45"
HORZ MARCONI 3SCANS
10-03083.01.005 FERRITES ON BEZ
XMIT OFF MICROREADER DISABLE
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
400
1000
FREQUENCY [MHz]

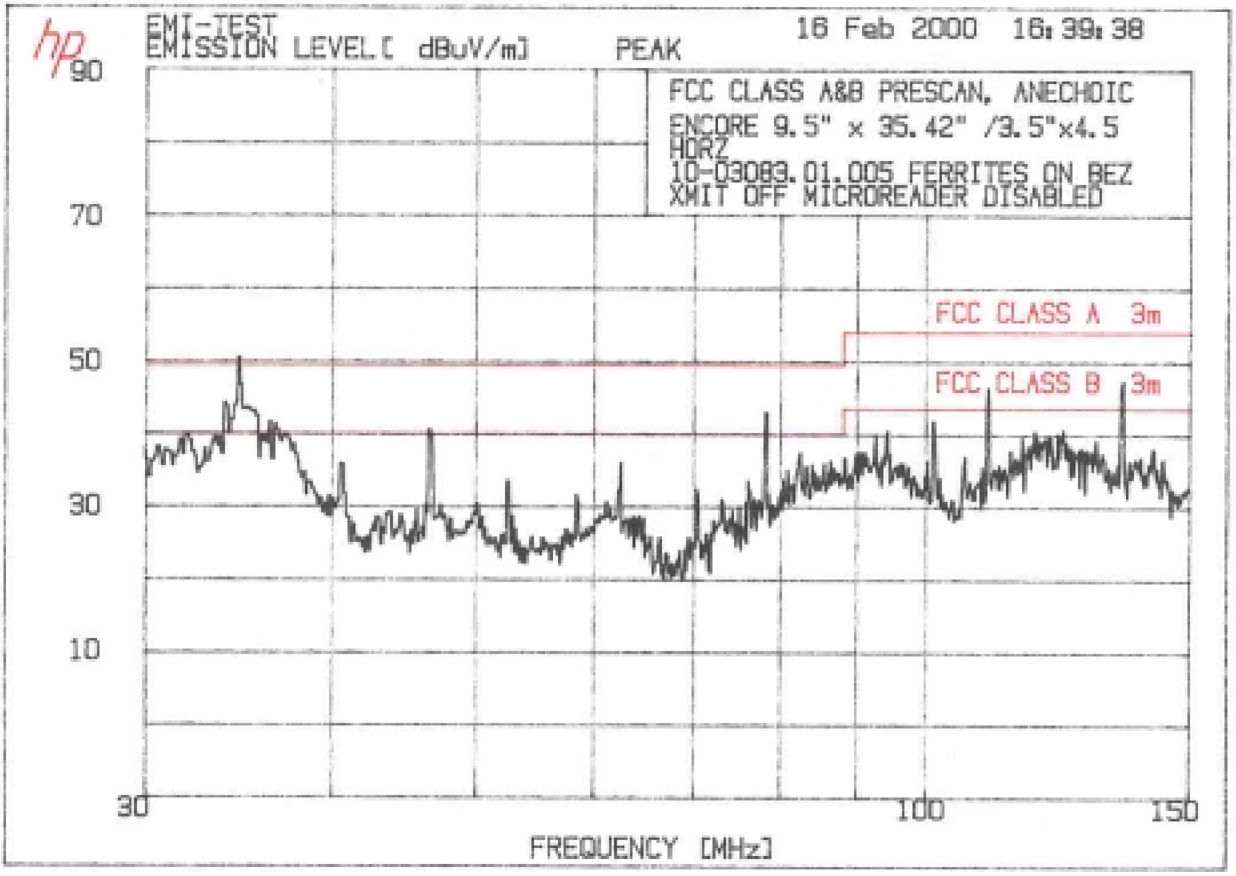

hp
EMI-TEST
EMISSION LEVEL[dBuV]
PEAK
17 Feb 2000 08:51:13
PART 15/C INTENTIONAL RADIATOR
ENCORE 9.5"x35.42" / 3.5"x4.5"
EUT D ANTENNA PARALELL
10-03083.01.005 FERRITES ON BEZ
XMIT ON MICROREADER ENABLED
GEN. LIMIT
140
120
100
80
60
.1
1.1
FREQUENCY [MHz]

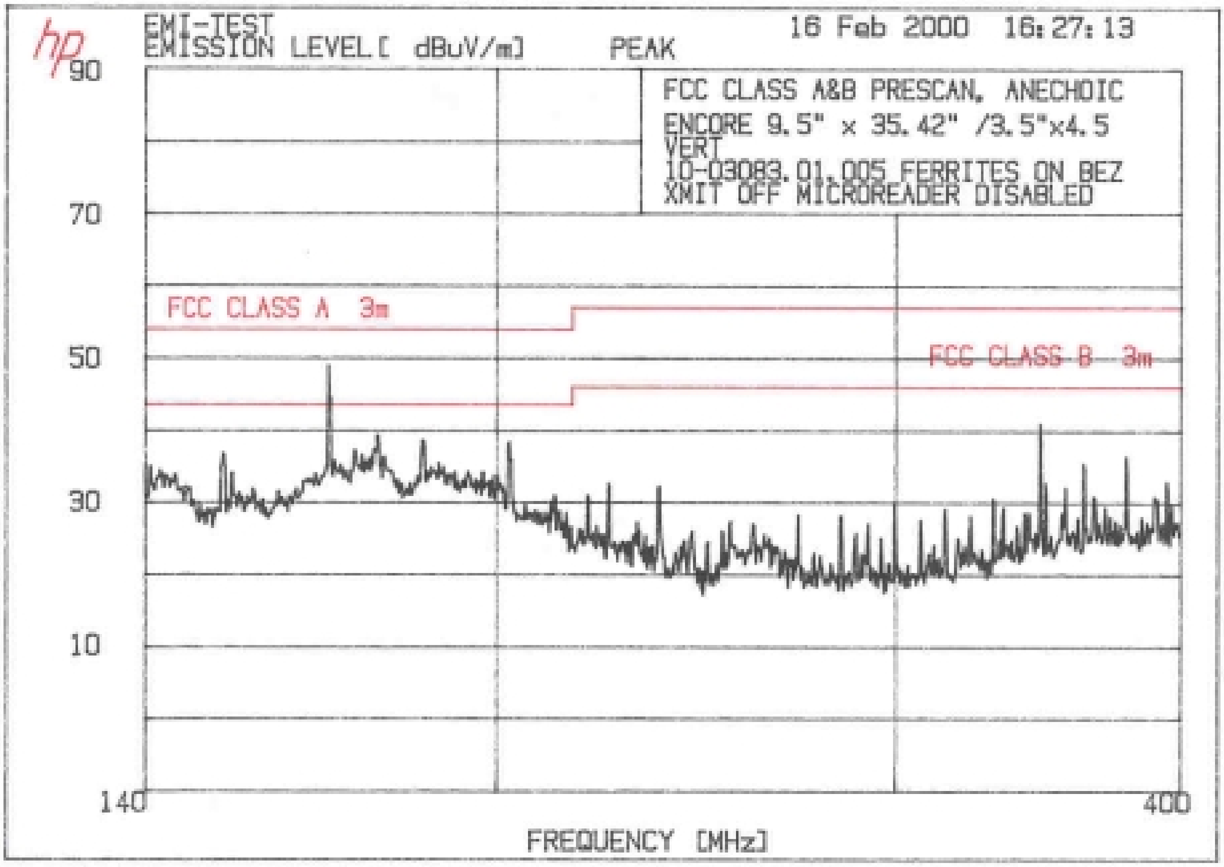

hp
EMI-TEST
EMISSION LEVEL[dBuV]
PEAK
17 Feb 2000 09:01:06
PART 15/C INTENTIONAL RADIATOR
ENCORE 9.5"x35.42" / 3.5"x4.5"
EUT D ANTENNA PERPENDICULAR
10-03083.01.005 FERRITES ON BEZ
XMIT ON MICROREADER ENABLED
GEN. LIMIT
140
120
100
80
60
.1
1.1
FREQUENCY [MHz]

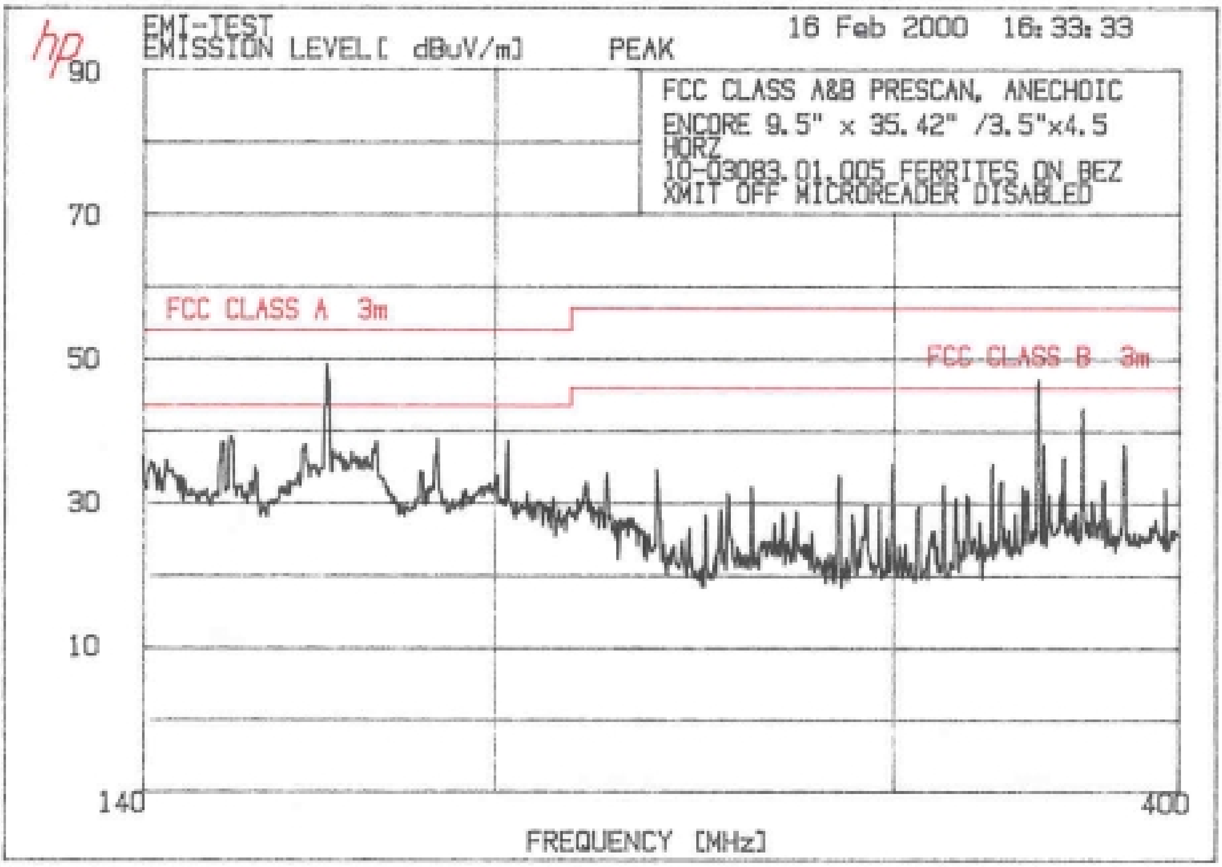

hp
EMI-TEST
EMISSION LEVEL[dBuV]
PEAK
17 Feb 2000 09:16:08
PART 15/C INTENTIONAL RADIATOR
ENCORE 9.5"x35.42" / 3.5"x4.5"
EUT 0 ANTENNA PARALELL
10-03083.01.005 FERRITES ON BEZ
XMIT ON MICROREADER ENABLED
GENERAL LIMIT
100
80
60
40
20
1.1
10
30
FREQUENCY [MHz]

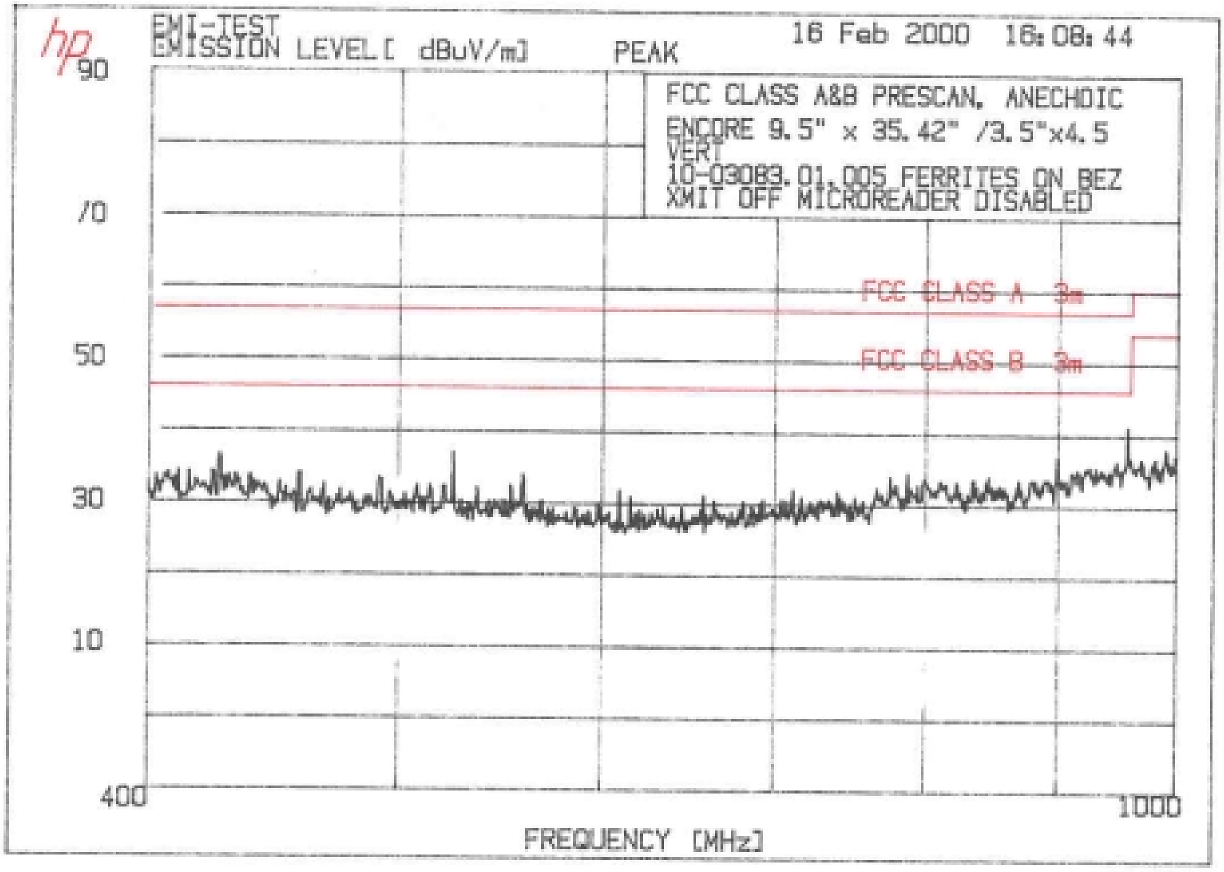

hp
EMI-TEST
EMISSION LEVEL[dBuV]
PEAK
17 Feb 2000 09:09:23
PART 15/C INTENTIONAL RADIATOR
ENCORE 9.5"x35.42" / 3.5"x4.5"
EUT 0 ANTENNA PERPENDICULAR
10-03083.01.005 FERRITES ON BEZ
XMIT ON MICROREADER ENABLED
GENERAL LIMIT
100
80
60
40
20
1.1
10
30
FREQUENCY [MHz]

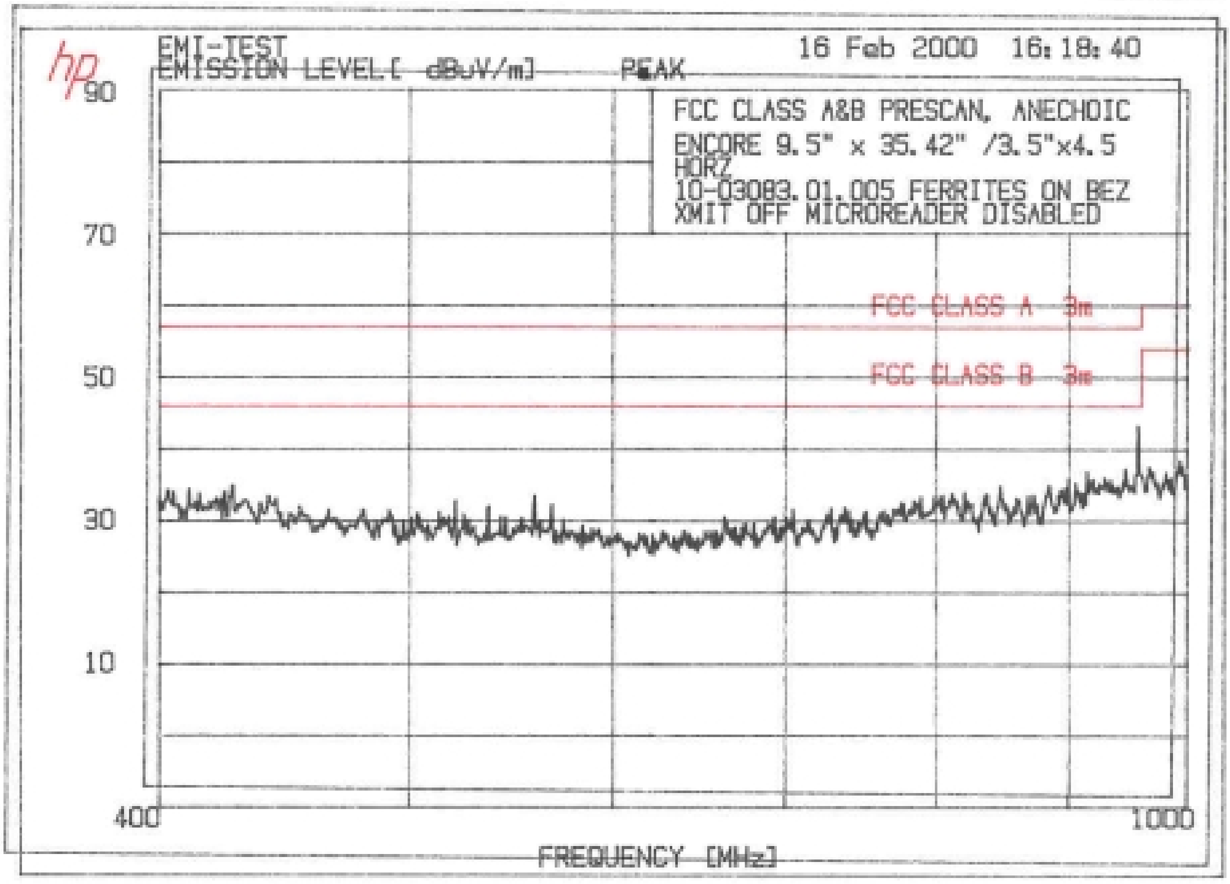

hp
EMI-TEST
EMISSION LEVEL[dBuV/m]
PEAK
16 Feb 2000 16:46:45
FCC CLASS A&B PRESCAN, ANECHOIC
ENCORE 9.5" x 35.42" /3.5"x4.5
VERT
10-03083.01.005 FERRITES ON BEZ
XMIT OFF MICROREADER DISABLED
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
30
100
150
FREQUENCY [MHz]


hp
EMI-TEST
EMISSION LEVEL[dBuV/m]
PEAK
16 Feb 2000 16:39:38
FCC CLASS A&B PRESCAN, ANECHOIC
ENCORE 9.5" x 35.42" /3.5"x4.5
HORZ
10-03083.01.005 FERRITES ON BEZ
XMIT OFF MICROREADER DISABLED
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 Feb 2000 16:27:13
FCC CLASS A&B PRESCAN, ANECHOIC
ENCORE 9.5" x 35.42" /3.5"x4.5
VERT
10-03083.01.005 FERRITES ON BEZ
XMIT OFF MICROREADER DISABLED
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 Feb 2000 16:33:33
FCC CLASS A&B PRESCAN, ANECHOIC
ENCORE 9.5" x 35.42" /3.5"x4.5
HORZ
10-03083.01.005 FERRITES ON BEZ
XMIT OFF MICROREADER DISABLED
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 Feb 2000 16:08:44
FCC CLASS A&B PRESCAN, ANECHOIC
ENCORE 9.5" x 35.42" /3.5"x4.5
VERT
10-03083.01.005 FERRITES ON BEZ
XMIT OFF MICROREADER DISABLED
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 Feb 2000 16:18:40
FCC CLASS A&B PRESCAN, ANECHOIC
ENCORE 9.5" x 35.42" /3.5"x4.5
HORZ
10-03083.01.005 FERRITES ON BEZ
XMIT OFF MICROREADER DISABLED
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
400
1000
FREQUENCY [MHz]

APPENDIX C

TEST INSTRUMENTATION

EQUIPMENT USE REPORT

MANUFACTURER	MODEL NO.	DESCRIPTION	SERIAL NO.	CAL DATE
CONDUCTED EMISSIONS				
RHODE & SCHWARTZ	ESH2-Z5	LISN	881362/017	9APR00
HP	8568B	SPECTRUM ANALYZER	2415A00464	10MAY00
HP	85650A	QUASI-PEAK ADAPTER	2043A00254	01AUG00
ANECHOIC CHAMBER				
SWRI	UTC 10 221-1	PREAMP 10-1000 MHz	9112SN15	verified
HP	8568B	SPECTRUM ANALYZER	2152A03081	13MAR00
HP	85650A	QUASI-PEAK ADAPTER	2043A00213	13MAR00
HP	85650A	QUASI-PEAK ADAPTER	2043A00254	16FEB00
HP	8447F	PREAMP	2727A02261	verified
EMCO	3121-DB3	ANTENNA, DIPOLE	148	verified
EMCO	3121-DB4	ANTENNA, DIPOLE	1097	verified
EMCO	3121-DB2	ANTENNA, DIPOLE	147	verified
ELECTROMETRICS	L-000123	ANTENNA, LOOP	371	02MAR00
OATS				
RHODE & SWARTZ	ESS	TEST RECEIVER	DE31157	23MAR00
SWRI	2 MHz-1GHz	OATS PRE-AMP	14-82-020	verified
EMCO	3104	ANTENNA, BICON	2107	29APR00
ELECTROMETRICS	DM-105-T2	ANTENNA, DIPOLE	L-000178	29APR00
ELECTROMETRICS	DM-105-T3	ANTENNA, DIPOLE	L-000108	29APR00
ROTRONIC	PA1	HYGROMETER	60856	02DEC00
FAIRCHILD	ALR-25	LOOP ANTENNA	093	02MAR00
VOLTAGE VARIATION				
HP	8568B	SPECTRUM ANALYZER	2415A00464	10MAY00
ELECTROMETRICS	ALR-25	LOOP ANTENNA	372	02MAR00
FLUKE	89	DVM	74330134	22NOV00
SENCORE	PR57	AC VARIABLE SUPPLY	-	verified

APPENDIX D

PHOTOS OF TESTED EUT

File Name

TRIND TIRIS System Mounted in Test Fixture.jpg
TRIND TIRIS Card Cage and Bezel Antennas.jpg
TRIND TIRIS Card Cage.jpg
Card Cage (Rear).jpg
DBC and LF Transmitter Side of Card Cage.jpg
Power Supply Side of Card Cage.jpg
Data Control Board (frontside).jpg
Data Control Board (backside).jpg
T20314-G1 Power Supply (frontside).jpg
T20314-G1 Power Supply (backside).jpg
T20128 Gateway Board (frontside).jpg
T20128 Gateway Board (backside).jpg
Q13579 LF Transmitter (frontside).jpg
Q13579 LF Transmitter (backside).jpg
Q13579 LF Transmitter with fuse removed (disables overhead antenna).jpg
12 X 45 Advantage Overhead Antenna.jpg
12 X 45 Advantage Overhead.jpg
12 X 45 Advantage Overhead Antenna.jpg
9.5 X 42.34 Wide Frame Advantage Overhead Antenna.jpg
9.5 X 30.34 Narrow Frame Advantage Overhead Antenna.jpg
T20524 Advantage Bezel Antenna (Frontside).jpg
T20524 Advantage Bezel Antenna (Backside).jpg
Advantage Bezel Assembly.jpg
9.5 X 35.42 Encore Overhead Antenna.jpg
Encore Overhead Antenna.jpg
Encore Bezel Antenna.jpg
3.5 X 4.5 Encore Bezel Antenna.jpg
Overhead Antenna Mounting Box Assembly.jpg
Tuning Board in Mounting Box.jpg
T20579 Advantage 12 x 45 Overhead Antenna Tuning Board (Frontside).jpg
T20579 Advantage 9.5 X 42.34 Overhead Antenna Tuning Board (Frontside).jpg
T20579 Advantage 9.5 X 30.34 Overhead Antenna Tuning Board (Frontside).jpg
T20579 Antenna Tuning Board (Backside).jpg
T20579 Encore 9.5 X 35.42 Overhead Antenna Tuning Board (Frontside).jpg
T20601 LightMicroreader Board (Frontside).jpg
T20601 LightMicroreader Board (Backside).jpg
T20601 LightMicroreader with L2 lifted (removes Vcc from Microreader).jpg
MACom UHF Receive Antenna.jpg
Antenna Specialists UHF Receive Antenna.jpg
Overhead Antenna cable assembly with ferrite bead.jpg
Dummy Load.jpg
Ferrite Bead Installation.jpg

APPENDIX E

PHOTOS OF TEST SETUPS

Test Setup	File Name
Radiated Emissions – Anechoic	Anechoic1.jpg
Radiated Emissions – Anechoic	Anechoic2.jpg
Radiated Emissions – Anechoic	Anechoic5.jpg
Radiated Emissions – OATS	OATS1.jpg
Radiated Emissions – OATS	OATS2.jpg
Radiated Emissions – OATS	OATS3.jpg
Radiated Emissions – OATS	OATS4.jpg
Radiated Emissions – OATS	OATS5.jpg
Conducted Emissions	Conducted2.jpg
Conducted Emissions	Conducted3.jpg
Conducted Emissions	Conducted4.jpg

ATTACHMENT 1

FUNCTIONAL DESCRIPTION AND BLOCK DIAGRAM

ATTACHMENT 2

INSTALLATION INSTRUCTIONS

ATTACHMENT 3

FCC ID LABEL

ATTACHMENT 4

SCHEMATICS