

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

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**Project 10-3084.01.006
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The results of this test report apply only to the specific samples tested. If the manufacturer extends the test results to apply to other samples of the same model, or from the same lot or batch, the manufacturer should ensure the additional samples are manufactured using identical electrical and mechanical components.

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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 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 DCB 1	Q13563-04
TIRIS Data Control Board with UHF Receiver DCB 2	Q13563-01
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
Antenna Specialist 902-928 MHz Receive Antenna (.50"x3.0" PCB)	Q13851-01
LF Bezel Antennas (2 Per Installation)	T20524-G1
Overhead Antenna Tuning Board	T20579-GX
Light/Microreader Board	T20601 (Advantage) M001218 (Encore)

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) 9.5" x 42.34" single-loop antenna, 3/8" diameter aluminum tubing (tested configuration had this antenna on one side)	(2) 5.2" x 10.2" 134 kHz antennas mounted to the plastic bezel doors	T20579 bareboard C1= 15nF C2= 10nF C3= 1800pF
	(2) 9.5" x 30.34" single-loop antenna, 3/8" diameter aluminum tubing (tested configuration had this antenna on other side)		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 10.25" 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 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 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. For the Advantage configuration 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.

In order to meet the FCC limits for conducted emissions shielded power cables were used for both the Encore and the Advantage configurations. Additionally, the Encore configuration, when tested with the digital circuit board, DCB 1, required ferrites on both cable harnesses.

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. Each TRIND™ TIRIS™ configuration was also tested with two different versions of the Data Control Board, DCB 1 and DCB 2. A complete conducted emissions test was performed with each version of the Data Control Board installed.

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 0.5 dB				
TRIND™ TIRIS™ Configuration	FREQUENCY (MHz)	MEASURED LEVEL (dBuV)		LIMIT (dBuV)
		LINE	NEUTRAL	
Advantage/MPD-3 no overhead antenna – DCB 1	0.75	43 ¹		48
	0.75		43 ¹	48
Advantage/MPD-3 no overhead antenna – DCB 2	1.3	47.5 ¹		48
	18		46.5 ²	48
Encore no overhead antenna – DCB 1	15	46.5 ¹		48
	16		44 ¹	48
Encore no overhead antenna – DCB 2	18	47 ²		48
	18.5		45 ²	48

¹ Readings are quasi-peak measurements made with a spectrum analyzer.

² Readings are peak measurements made with a spectrum analyzer, which are under the 15.207 (equivalent class B) limit.

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. The Encore system was tested with a DCB 1 (Data Control Board) installed and then the test was repeated with a DCB 2 installed. The Advantage system was also tested first with the DCB 1 installed and then tested again with the DCB 2 installed. Both the Encore and Advantage systems were also tested with the overhead antenna(s) replaced with a dummy load(s) leaving only the hand-held configuration active. All tested configurations are listed in Table 7.1.

As can be seen in the table, full prescans from 134 kHz to 1000 MHz were performed on the Advantage/MPD-3 system with both overhead antennas installed. OATS tests from 30 MHz to 1000 MHz were performed with DCB 2 installed because prescans confirmed the Advantage had higher levels of emissions with DCB 2 installed than it had with DCB 1 installed. Measurements at the OATS of the signals from the printed circuit assembly antennas were made from 134 kHz to 30 MHz, including the measurement of the fundamental emission. During measurement of the printed circuit assembly antenna emissions, the overhead antennas were replaced with a dummy load.

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. All measurements at the OATS were made with DCB 2 installed which had been found to be worse case during the prescans in the anechoic chamber.

TABLE 7.1
CONFIGURATIONS TESTED FOR RADIATED EMISSIONS

Dispenser	Overhead Antenna (for car tag)	Pre-scan	OATS
Advantage and MPD-3	1 ea 9.5” X 42.34” single loop antenna, made from 3/8” diameter tubing mounted on one side. <i>And</i> 1 ea 9.5” X 30.34” single loop antenna, made from 3/8” diameter tubing mounted on the other side. <i>With DCB 1</i>	Full (134 kHz- 1000 MHz)	During pre scans it was determined that the configuration with DCB 2 installed was the worse case. A full scan from 134.2 kHz to 1000 MHz was performed at the OATS with DCB 2 installed.
	1 ea 9.5” X 42.34” single loop antenna, made from 3/8” diameter tubing mounted on one side. <i>And</i> 1 ea 9.5” X 30.34” single loop antenna, made from 3/8” diameter tubing mounted on the other side. <i>With DCB 2</i>	Full (134 kHz- 1000 MHz)	
	No overhead antenna (hand-held only configuration). “Dummy” resistive loads were connected to the Transmitter Board outputs.	Bandpass of 134.2 kHz carrier only.	Partial (134 kHz- 30 MHz)

TABLE 7.1 (Cont)
CONFIGURATIONS TESTED FOR RADIATED EMISSIONS

Dispenser	Overhead Antenna (for car tag)	Pre-scan	OATS
Encore	1 ea 9.5" X 35.42" single loop antenna, made from 3/8" diameter tubing. <i>With DCB 1</i>	Full (134 kHz- 1000 MHz)	During pre scans it was determined that the configuration with DCB 2 installed was the worse case. A full scan from 134.2 kHz to 1000 MHz was performed at the OATs with DCB 2 installed.
	1 ea 9.5" X 35.42" single loop antenna, made from 3/8" diameter tubing. <i>With DCB 2</i>	Full (134 kHz- 1000 MHz)	
	No overhead antenna (hand-held only configuration). "Dummy" resistive loads were connected to the Transmitter Board outputs.	Bandpass of 134.2 kHz carrier only.	Partial (134 kHz- 30 MHz)

7.2 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 7.4.

Measurements were made of the fundamental frequency of 134.2 kHz on each of the configurations listed in Table 7.1. 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 on any configuration at 30 meters. The measurement level of the fundamental of each configuration is shown in Table 7.2.

TABLE 7.2
MEASUREMENT OF FUNDAMENTAL FREQUENCY

Judgment: EUT Passed by 4.0 dB							
Configuration	Freq. (kHz)	Corrected Level		Limit 10 Meters ¹		Limit 3 Meters ¹	
		Peak dB(uV/m)	Average dB(uV/m)	Peak dB(uV/m)	Average dB(uV/m)	Peak dB(uV/m)	Average dB(uV/m)
Advantage 9.5" x 42.34" And 9.5" x 30.34"	134	100.6	81.0	104	85	N/A	N/A
Advantage No OH antenna	134	92.5	84.4	NA	NA	125	105
Encore 9.5" x 35.42"	134	100.3	78.1	104	85	N/A	N/A
Encore No OH antenna	134	88.1	77.2	NA	NA	125	105

¹Limits at 10 and 3 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). Fundamental emissions could not be detected beyond the 3 and 10 meter distance.

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 7.3. Prescans revealed emission levels were highest with DCB 2 installed. OATS testing was performed only with DCB 2 installed. Plots of the peak signature scans of the Advantage/MPD-3 9.5" x 42.34" and 9.5x30.34" and Encore 9.5" x 35.42" configurations, with DCB 2 and DCB1 installed are not included in the report but are on file at Southwest Research Institute.

TABLE 7.3
MEASUREMENT OF SPURIOUS EMISSIONS

Judgment EUT passed by 2.1 dB				
Configuration	Frequency (MHz)	Corrected Level ¹ dB(uV/m)	Limit² dB(uV/m)	dB under limit
Advantage/MPD-3	72.025	33.6	39	5.4
	48	35.8	39	3.2
	36	36.9	39	2.4
Encore	36	36.6	39	2.1
	103.071	38.8	43.5	4.7
	108.011	36.9	43.5	6.6

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 were 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 1000 Hz.

7.3 Test Instrumentation for Radiated Measurements

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

7.4 Field Strength Calculation

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

$$FS = RA + AF + CF - AG$$

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

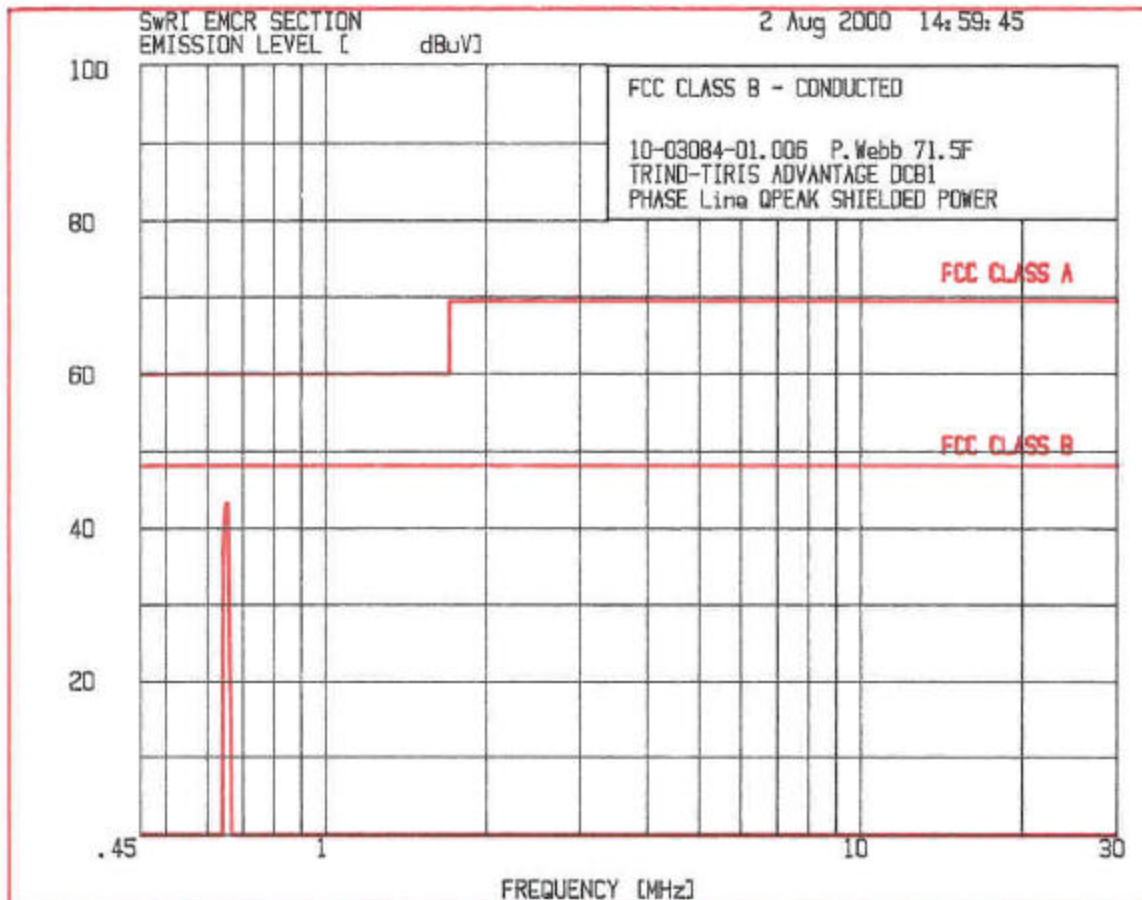
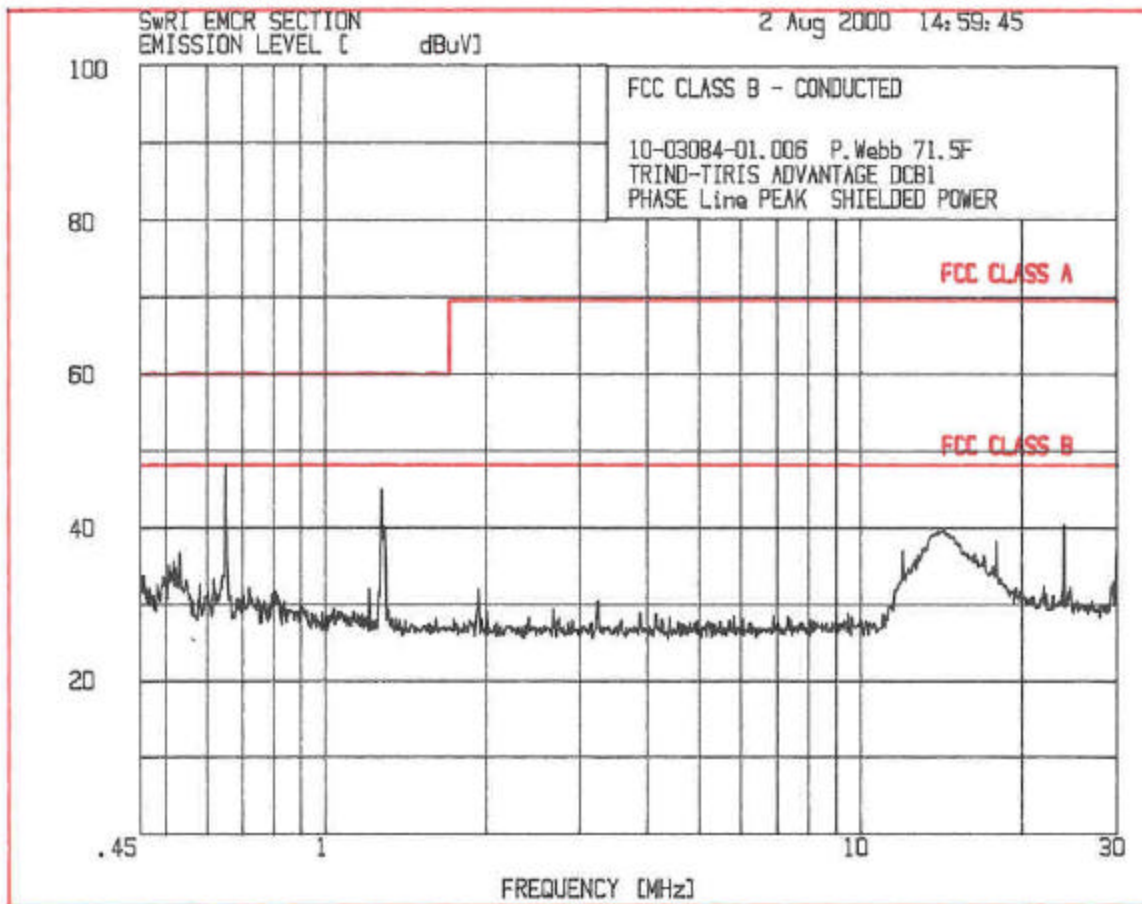
For example, reducing the first row of the enclosed radiated data sheet on page 27 (36 MHz):

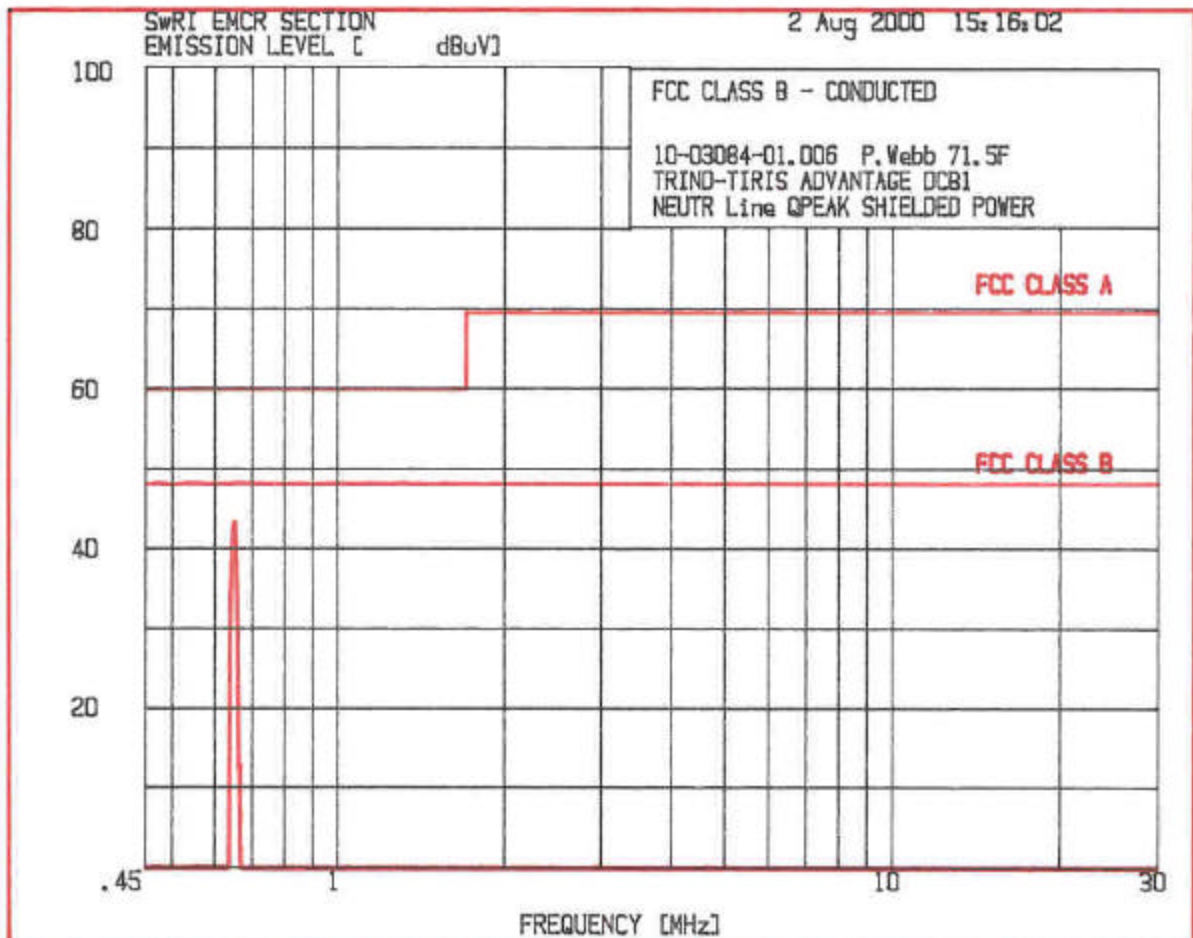
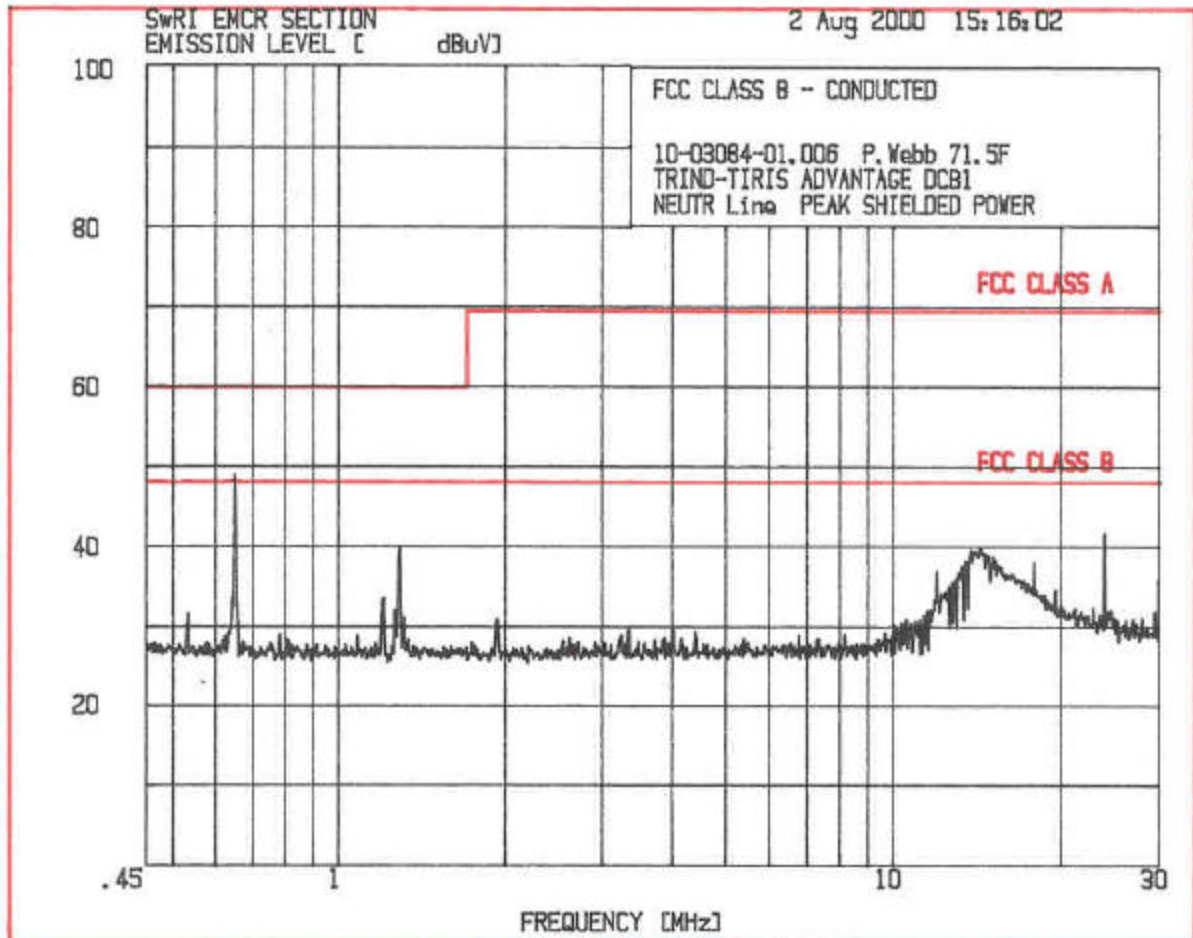
$$\begin{array}{r} 15.3 \text{ dB(uV)} \\ 19.2 \text{ dB(1/m)} \\ \underline{2.4 \text{ dB (CF/AG FACTOR)}} \\ \text{FS} = 36.9 \text{ dB(uV/m)} \end{array}$$

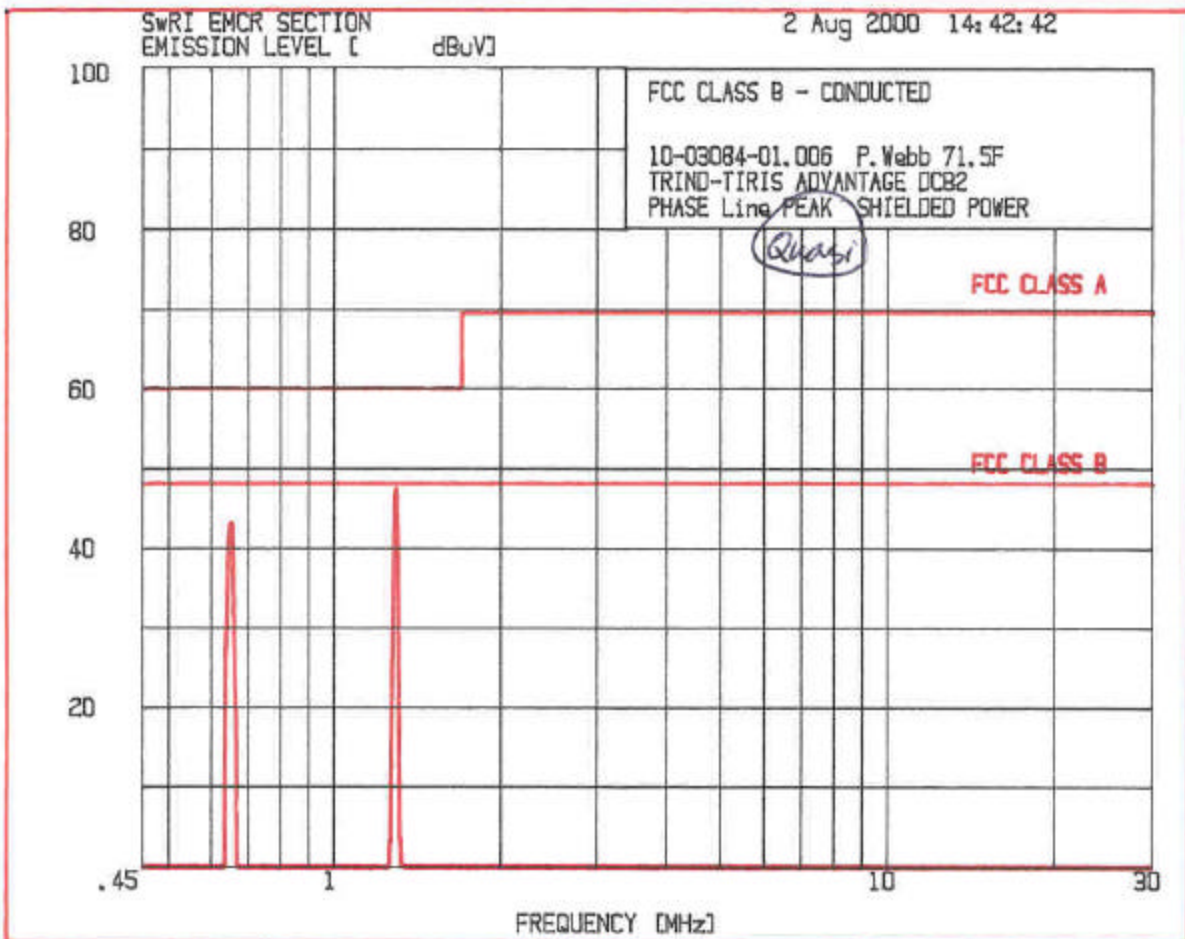
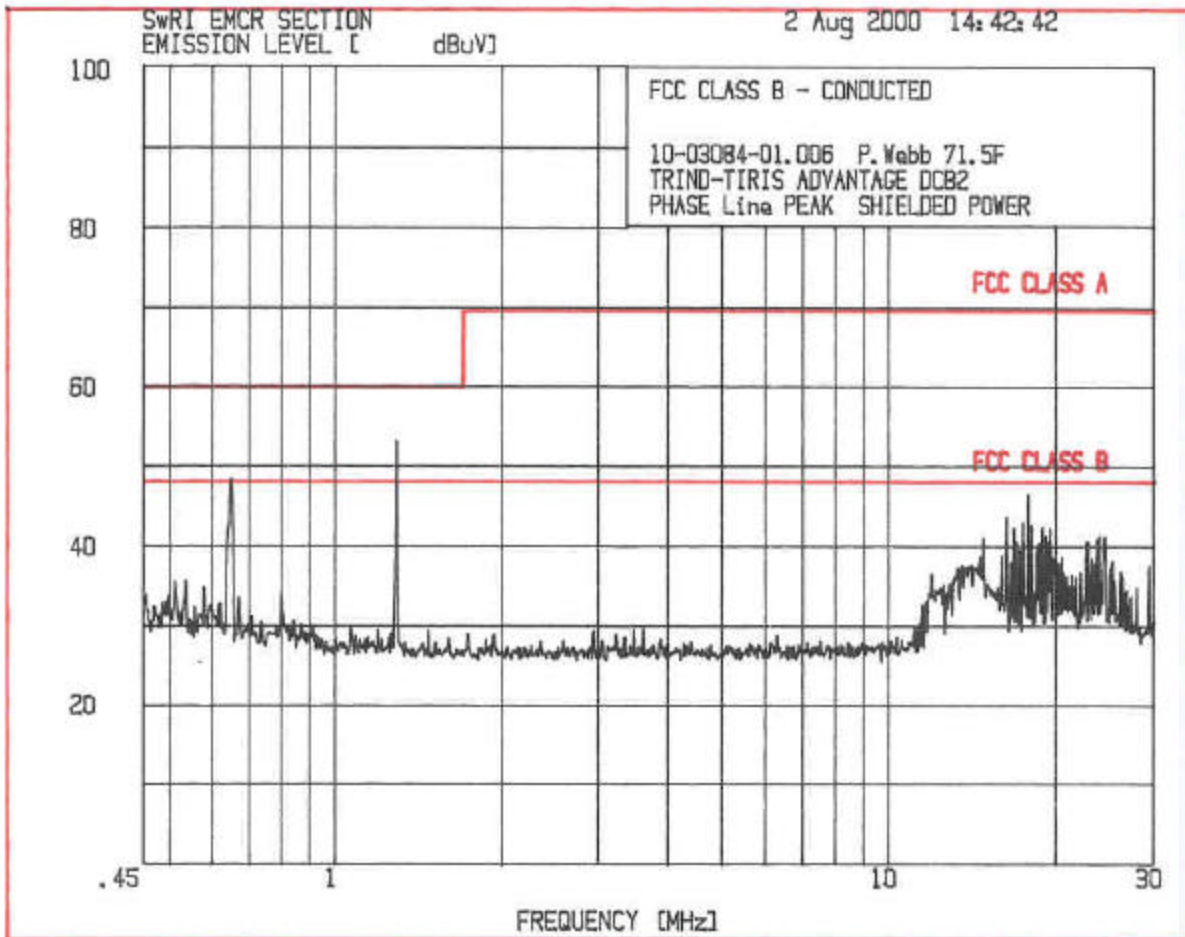
To convert the dB(uV/m) value to its corresponding level in uV/m is as follows:

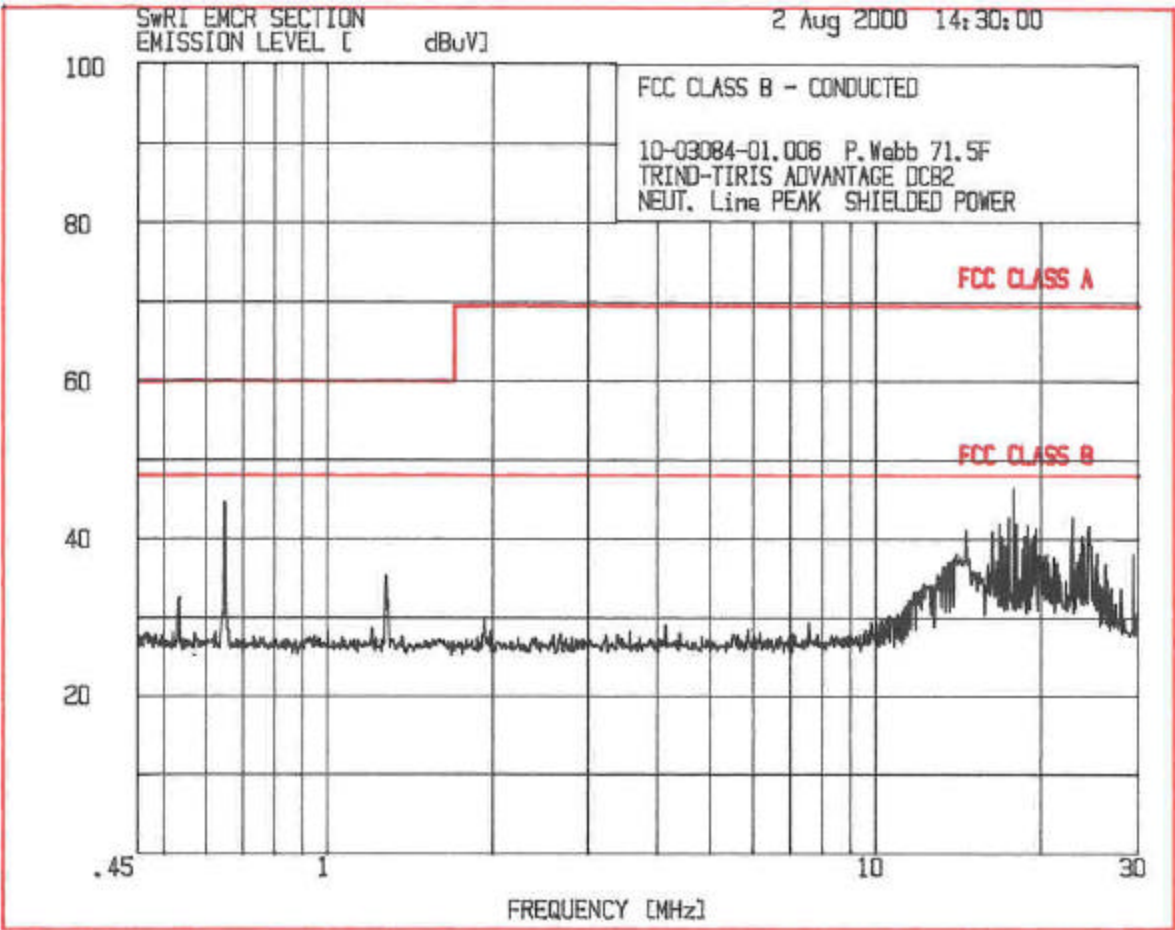
$$\text{Level in uV/m Common Antilogarithm } [(36.9 \text{ dBuV/m})/20] = 69.98 \text{ uV/m}$$

APPENDIX A
CONDUCTED MEASUREMENT PLOTS

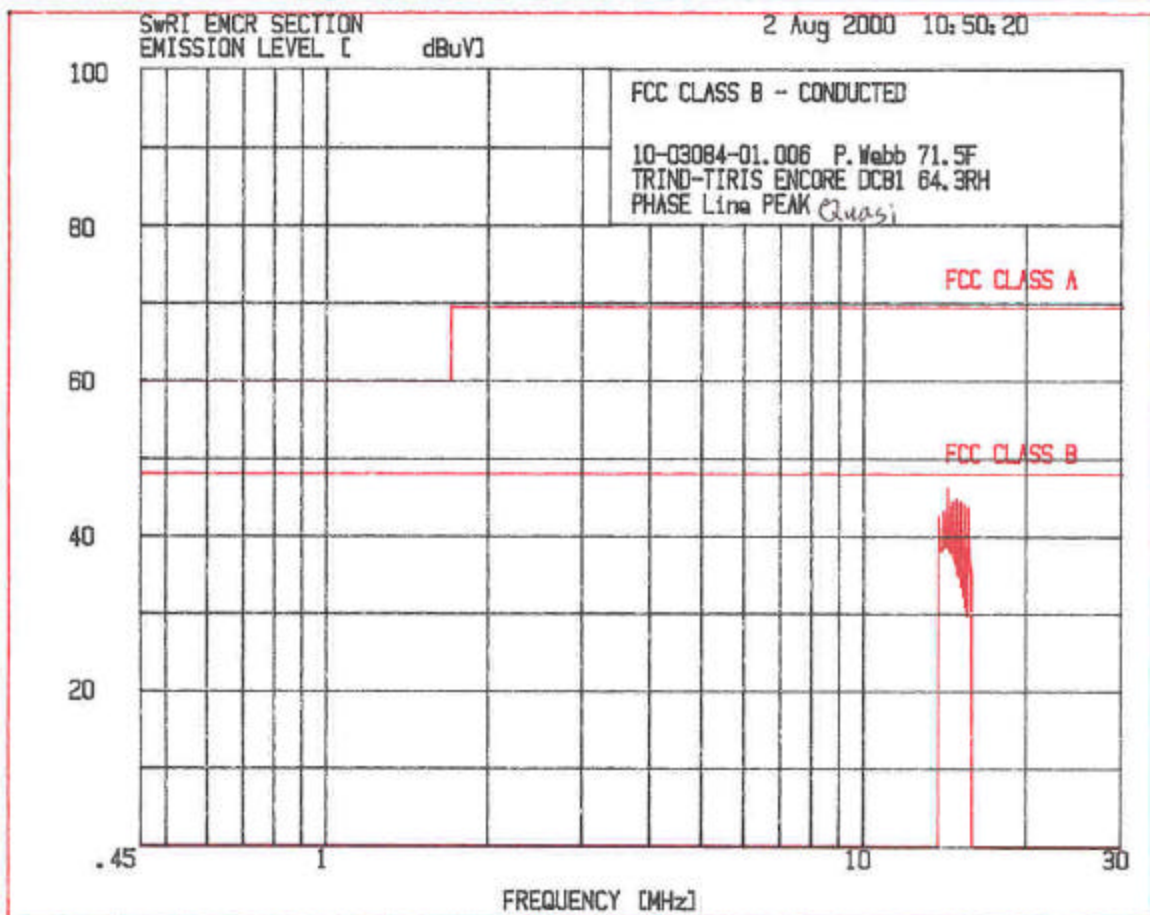
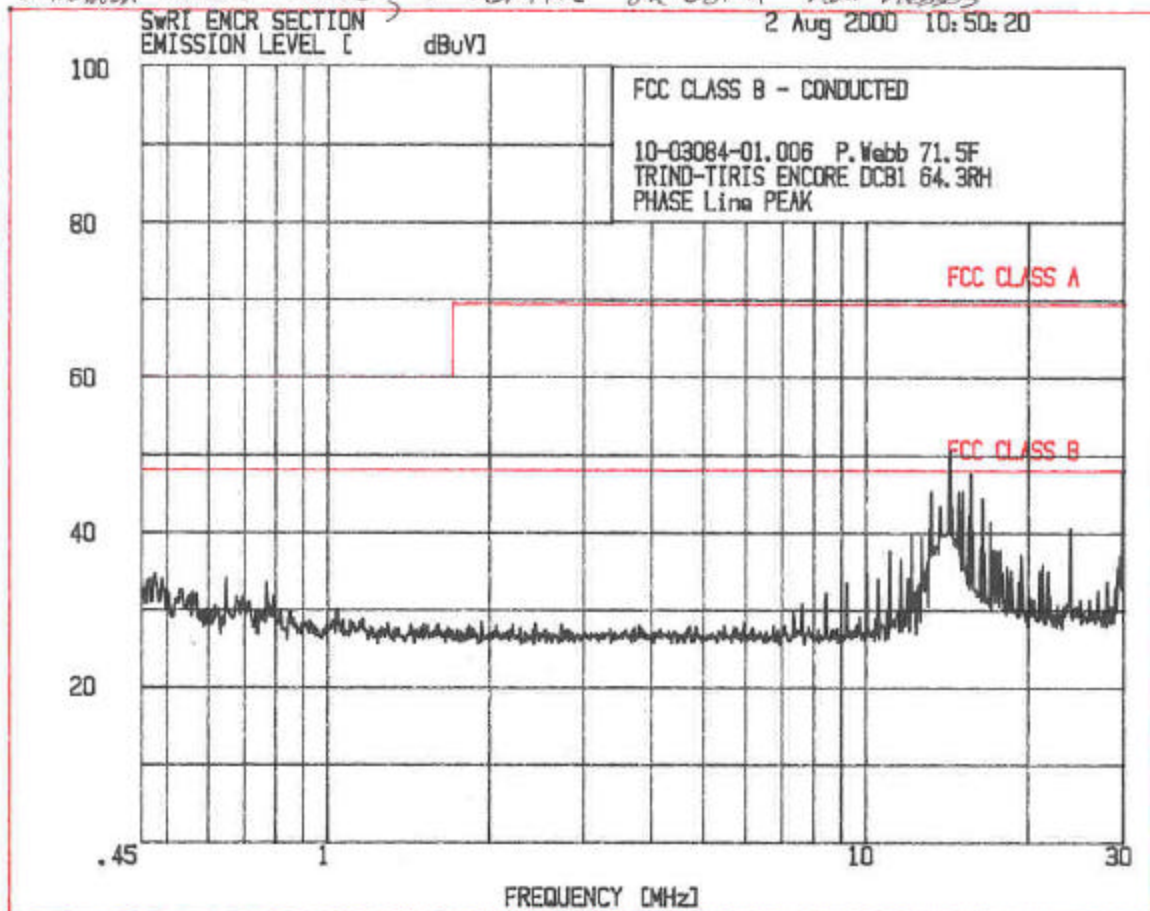




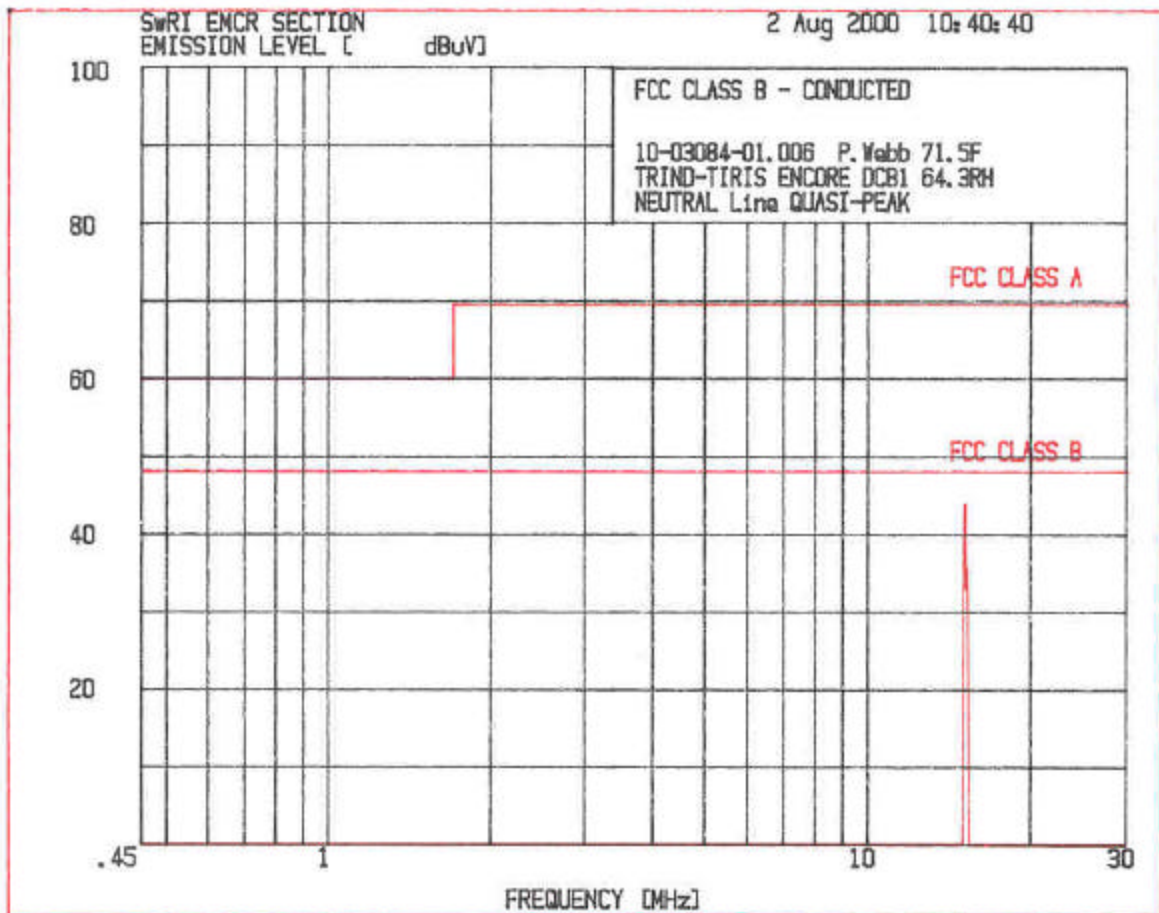
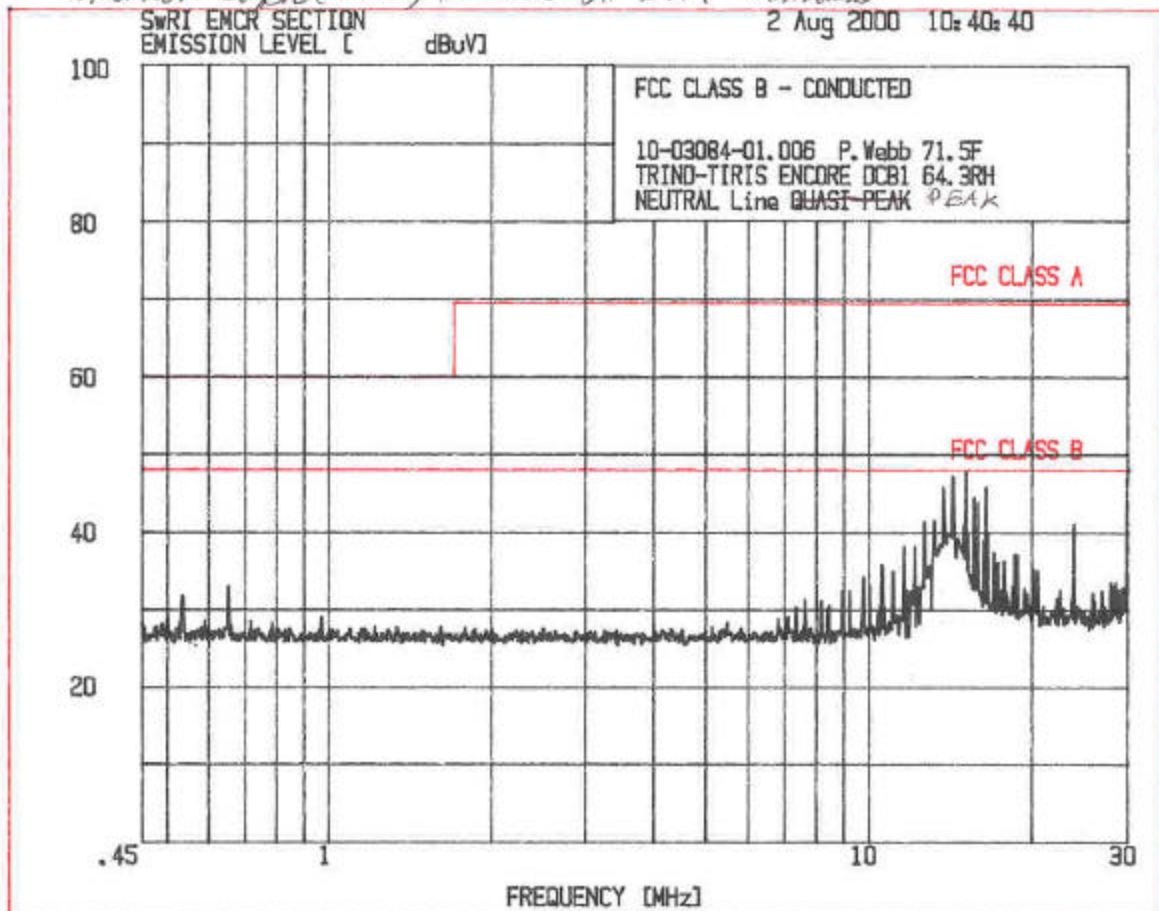


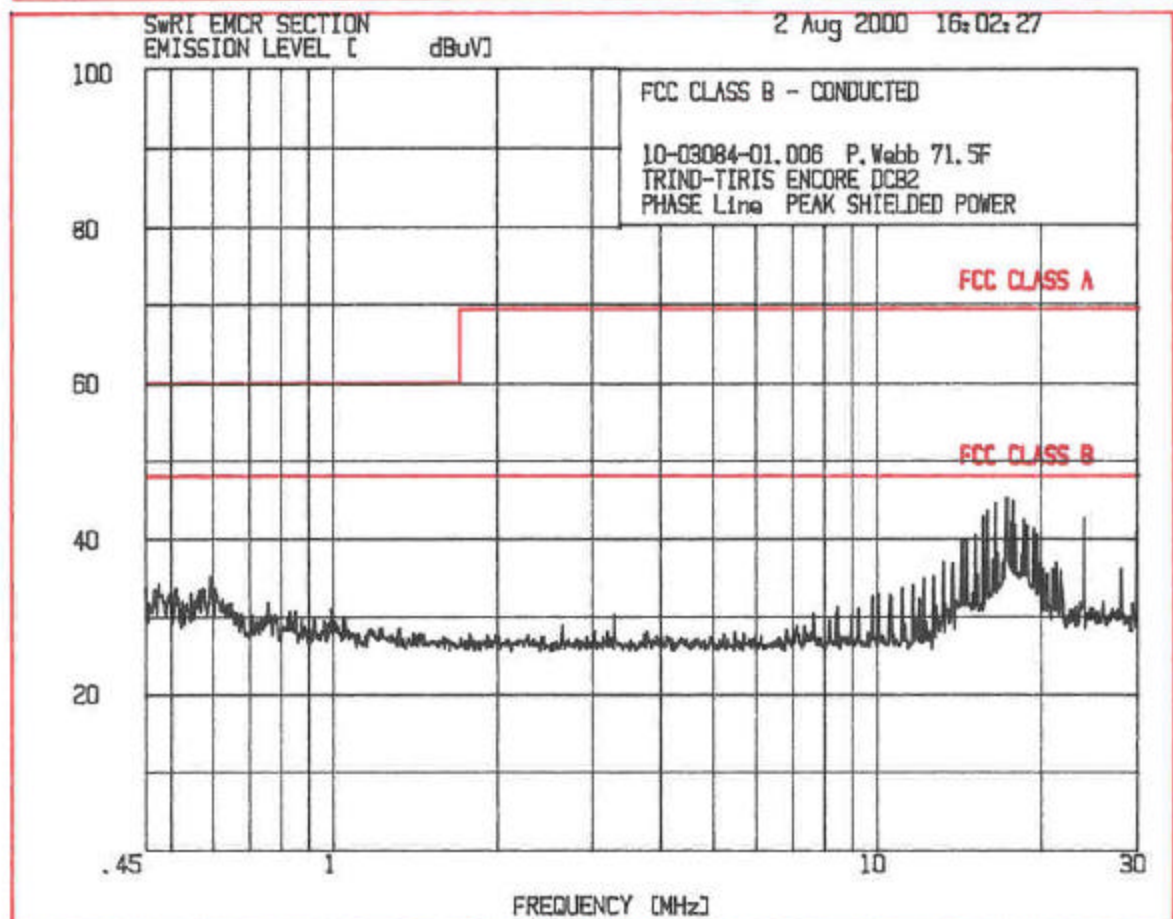
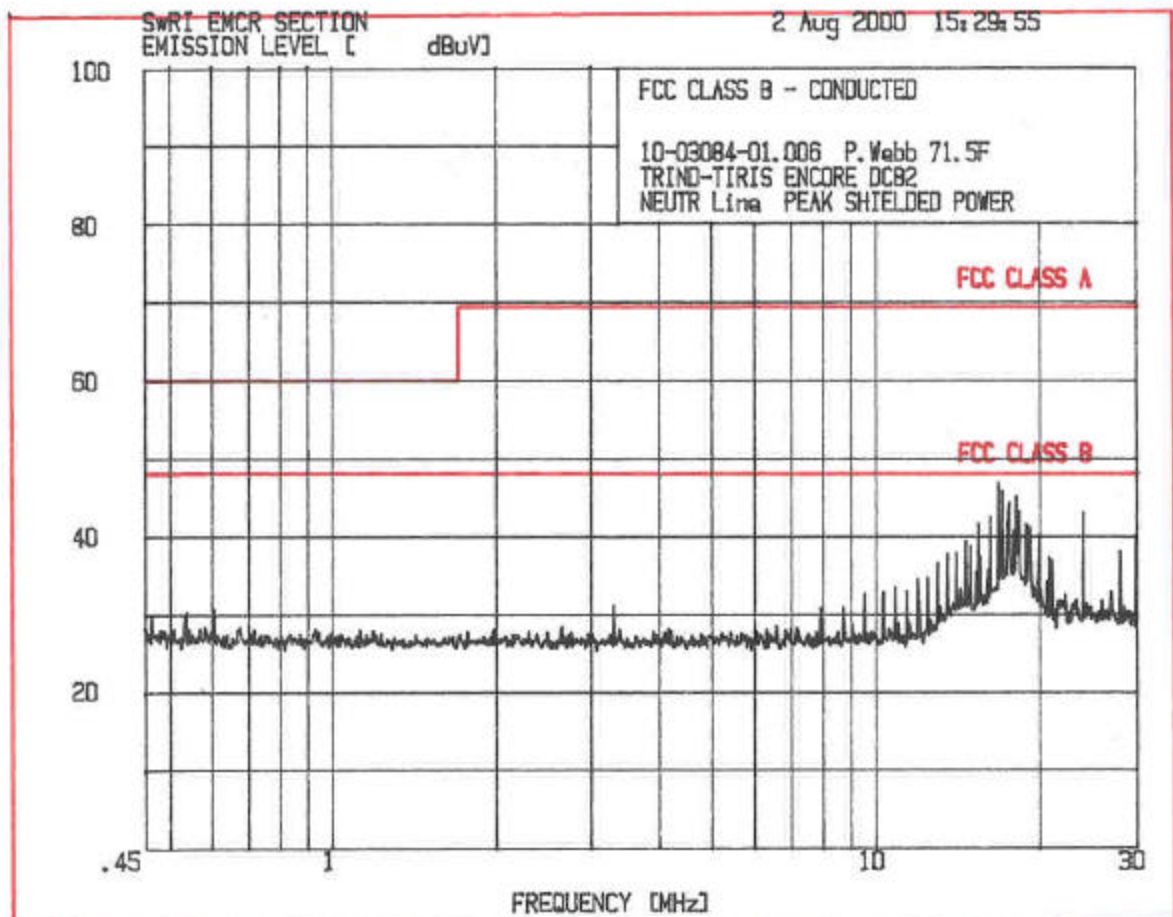


Shielded Power Cable, + ferrite on bot h harnesses



Shielded cable (Amer) ferrite on both harnesses





APPENDIX B
RADIATED MEASUREMENT DATA SHEETS

FREQUENCY (MHz)	⑥	⑥	⑥	⑥	⑥	⑦	⑦
0.134	0.134	.403	.403	.403	0.134	0.134	
EMCO	6512				EMCO	6512	
TRANSUDUCER DIST. from EUT(m)/HEIGHT(m)	3 1	3 1	3 1	3 1	10 1	10 1	
POLARIZATION (V.H) AMBIENT NOISE (A)	Parallel to EUT				Parallel to EUT		Parallel to EUT Had highest Emissions
SIGNAL DIRECTION	217 °	217 °	217 °	217 °	193 °	193 °	
RECEIVER ATTENUATION (dB)							Fundamental Frequencies could not be seen at 30 meters
METER READING (dB μ V)	27.8	19.7	6.8	-3.4	35.9	16.3	
TRANSUDUCER FACTOR (dB)	64.3	64.3	64.3	64.3	64.3	64.3	
EXTERNAL GAIN/ CABLE LOSS (dB)	0.4	0.4	0.4	0.4	0.4	0.4	
CORRECTED LEVEL (dB μ V/m)	92.5	84.4	71.5	61.3	100.6	81.0	
LIMIT (dB μ V/m)	125	105	125	105	104 125 104	85	

Date: 4 Aug 00 Detection Method: ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫ ⑬ ⑭ ⑮ ⑯ ⑰ ⑱ ⑲ ⑳ ㉑ ㉒ ㉓ ㉔ ㉕ ㉖ ㉗ ㉘ ㉙ ㉚ ㉛ ㉜ ㉝ ㉞ ㉟ ㊱ ㊲ ㊳ ㊴ ㊵ ㊶ ㊷ ㊸ ㊹ ㊺ ㊻ ㊼ ㊽ ㊾ ㊿ Other

OPR/Asst.: C Hale EUT Advantage and MPD-3 DCB2

Conf. Run of Notes, ① Peak measurement ② Average measurement ③ P measurement
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Test Category: FCC Part 15, 15.209 ④ Peak Limit at 30 meters = 85 dB μ V/m, at 10 meters = 104 dB μ V/m at 3 meters = 125 dB μ V/m ⑤ Avg Limit at 30 meters = 65 dB μ V/m, at 10 meters = 84 dB μ V/m, at 3 meters = 105 dB μ V/m. ⑥ Door Antenna ⑦ Overhead Antenna

Time, Temp., & % r.H.: 11:10, 84°, 61%

Approved: Daniel Conway

[illegible]Detection Method: X CISPR — PEAK — AVERAGE — Other _____

Date: 4 Aug 00

OPRI/Asst.: Hab EUT Advantage and MPD-3 DCB2

Conf. _____ Run _____ of _____
Notes, Alt 3 orthogonal planes scanned from

134 kHz To 30 MHz

Project No.: 10-03084.01.006

Test Category: FCC Part 15, 15209

Time, Temp., & % r.H.: 14:00 81° 80%

Approved: David A. Carmona

SwRI Open Area Test Site Radiated Emissions v2_2												
Project Number: 10-03084.01.006												
Detection Method: QP												
Test Receiver: Rohde&Schwarz ESS EMI sn: DE31157												
Antenna: 3: BDA25S sn:535 (primary)												
5: T2 sn:L178 (primary)												
7: T3 sn:L108 (primary)												
Ferrite added to cable Harness Assembly leading to O'head Antennas.												
FREQ MHz	Orient. θ°	Antenna		UnCorr'd Level (dBuV)	Correction Factors (dB)		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.	
		I.D.	Pol.		Ht(m)	Dis(m)						Ant
36,000	360	3	V	1.42	10	15.3	19.2	2.4	36.9	39.0	-2.1	Digital Emission
48,000	360	3	V	1.42	10	20.4	12.6	2.8	35.8	39.0	-3.2	Digital Emission
60,000	360	3	V	1.42	10	17.4	7.2	3.3	27.9	39.0	-11.1	
66,000	34	3	V	1.52	10	16.6	7.2	3.5	27.3	39.0	-11.7	
69,921	358	3	V	1.61	10	14.7	7.4	3.6	25.7	39.0	-13.3	
72,035	-3	3	V	1.42	10	22.5	7.5	3.7	33.6	39.0	-5.4	Digital Emission
150,000	-3	3	V	1.42	10	8.0	15.9	5.8	29.6	43.5	-13.9	Ambient
119,995	179	3	H	4.01	10	12.4	13.8	5.0	31.2	43.5	-12.3	
203,991	183	5	H	4.01	10	31.3	19.4	-20.9	29.9	43.5	-13.6	
221,991	253	5	H	3.15	10	30.7	20.2	-20.6	30.2	46.5	-16.3	
203,990	53	5	V	1.04	10	32.3	19.4	-20.9	30.8	43.5	-12.7	
224,000	69	5	V	1.00	10	25.8	20.2	-20.5	25.5	46.5	-21.0	
524,100	69	7	V	1.82	10	22.0	25.6	-15.4	32.2	46.5	-14.3	Ambient
960,000	69	7	V	1.82	10	16.6	35.9	-11.1	41.3	49.5	-8.2	Ambient
960,000	69	7	H	1.82	10	16.6	35.9	-11.1	41.4	49.5	-8.1	Ambient
524,000	0	7	H	1.82	10	24.3	25.7	-15.4	34.6	46.5	-11.9	Ambient
216,000	65	5	H	2.68	10	29.5	20.5	-20.7	29.3	46.5	-17.2	
275,991	363	5	H	2.82	10	25.8	21.2	-19.7	27.3	46.5	-19.2	
304,001	30	5	V	2.03	10	28.9	18.4	-19.1	28.2	46.5	-18.3	
320,000	30	5	V	2.03	10	29.4	18.5	-18.7	29.2	46.5	-17.3	

FREQUENCY (MHz)	134 KHz	134 KHz	(3rd harmonic) 403 KHz	134 KHz	134 KHz	134 KHz
TRANSDUCER	EMCO 6512	3/4	1265			
TRANSDUCER DIST. from EUT(m)/HEIGHT(m)	3	1	3	1	10	1
POLARIZATION (V,H) AMBIENT NOISE (A)	PARALLEL TO EUT				PARALLEL TO EUT	
SIGNAL DIRECTION	345°	345°	345°	345°	0°	0°
RECEIVER ATTENUATION (dB)	-	-	-	-	-	-
METER READING (dB μ V)	23.4	12.4	16.3	-0.7	35.6	13.3
TRANSDUCER FACTOR (dB)	64.3	64.3	54.6	54.6	64.3	64.3
EXTERNAL GAIN/ CABLE LOSS (dB)	0.4	0.4	0.4	0.4	0.4	0.4
CORRECTED LEVEL (dB μ V/m)	88.1	77.2	71.3	54.3	100.3	78.1
LIMIT (dB μ V/m)	125 ^④	105 ^⑤	115.5	95.5	104	85

Date: Aug 3, 2000 ^① _② Detection Method: CISPR ^① _② PEAK AVERAGE ^① _② Other

OPR/Asst.: C. HALE EUT ENCORE DCB 2

Conf. Run of Notes, ^① _② PEAK MEASUREMENT ^② _③ AVERAGE MEASUREMENT ^③ _④ ^⑤ _⑥ ^⑦ _⑧ ^⑨ _⑩ ^⑪ _⑫ ^⑬ _⑭ ^⑮ _⑯ ^⑰ _⑱ ^⑲ _⑳ ^㉑ _㉒ ^㉓ _㉔ ^㉕ _㉖ ^㉗ _㉘ ^㉙ _㉚ ^㉛ _㉜ ^㉝ _㉞ ^㉟ _㊱ ^㊲ _㊳ ^㊴ _㊵ ^㊶ _㊷ ^㊸ _㊹ ^㊺ _㊻ ^㊼ _㊽ ^㊾ _㊿ ¹ ₂ ³ ₄ ⁵ ₆ ⁷ ₈ ⁹ ₁₀ ¹¹ ₁₂ ¹³ ₁₄ ¹⁵ ₁₆ ¹⁷ ₁₈ ¹⁹ ₂₀ ²¹ ₂₂ ²³ ₂₄ ²⁵ ₂₆ ²⁷ ₂₈ ²⁹ ₃₀ ³¹ ₃₂ ³³ ₃₄ ³⁵ ₃₆ ³⁷ ₃₈ ³⁹ ₄₀ ⁴¹ ₄₂ ⁴³ ₄₄ ⁴⁵ ₄₆ ⁴⁷ ₄₈ ⁴⁹ ₅₀ ⁵¹ ₅₂ ⁵³ ₅₄ ⁵⁵ ₅₆ ⁵⁷ ₅₈ ⁵⁹ ₆₀ ⁶¹ ₆₂ ⁶³ ₆₄ ⁶⁵ ₆₆ ⁶⁷ ₆₈ ⁶⁹ ₇₀ ⁷¹ ₇₂ ⁷³ ₇₄ ⁷⁵ ₇₆ ⁷⁷ ₇₈ ⁷⁹ ₈₀ ⁸¹ ₈₂ ⁸³ ₈₄ ⁸⁵ ₈₆ ⁸⁷ ₈₈ ⁸⁹ ₉₀ ⁹¹ ₉₂ ⁹³ ₉₄ ⁹⁵ ₉₆ ⁹⁷ ₉₈ ⁹⁹ ₁₀₀

Project No.: 10-03084-01.006

Test Category: FCC PART 15, 15.209

Time, Temp., & % r.H.: 83.4°F, 59.1%

Approved: Doris A. Conway

Notes, ^① _② PEAK MEASUREMENT ^② _③ AVERAGE MEASUREMENT ^③ _④ ^⑤ _⑥ ^⑦ _⑧ ^⑨ _⑩ ^⑪ _⑫ ^⑬ _⑭ ^⑮ _⑯ ^⑰ _⑱ ^⑲ _⑳ ^㉑ _㉒ ^㉓ _㉔ ^㉕ _㉖ ^㉗ _㉘ ^㉙ _㉚ ^㉛ _㉜ ^㉝ _㉞ ^㉟ _㊱ ^㊲ _㊳ ^㊴ _㊵ ^㊶ _㊷ ^㊸ _㊹ ^㊺ _㊻ ^㊼ _㊽ ^㊾ _㊿ ¹ ₂ ³ ₄ ⁵ ₆ ⁷ ₈ ⁹ ₁₀ ¹¹ ₁₂ ¹³ ₁₄ ¹⁵ ₁₆ ¹⁷ ₁₈ ¹⁹ ₂₀ ²¹ ₂₂ ²³ ₂₄ ²⁵ ₂₆ ²⁷ ₂₈ ²⁹ ₃₀ ³¹ ₃₂ ³³ ₃₄ ³⁵ ₃₆ ³⁷ ₃₈ ³⁹ ₄₀ ⁴¹ ₄₂ ⁴³ ₄₄ ⁴⁵ ₄₆ ⁴⁷ ₄₈ ⁴⁹ ₅₀ ⁵¹ ₅₂ ⁵³ ₅₄ ⁵⁵ ₅₆ ⁵⁷ ₅₈ ⁵⁹ ₆₀ ⁶¹ ₆₂ ⁶³ ₆₄ ⁶⁵ ₆₆ ⁶⁷ ₆₈ ⁶⁹ ₇₀ ⁷¹ ₇₂ ⁷³ ₇₄ ⁷⁵ ₇₆ ⁷⁷ ₇₈ ⁷⁹ ₈₀ ⁸¹ ₈₂ ⁸³ ₈₄ ⁸⁵ ₈₆ ⁸⁷ ₈₈ ⁸⁹ ₉₀ ⁹¹ ₉₂ ⁹³ ₉₄ ⁹⁵ ₉₆ ⁹⁷ ₉₈ ⁹⁹ ₁₀₀

FREQUENCY (MHz)	3 MHz	30 MHz	30 MHz	30 MHz	30 MHz	30 MHz	30 MHz	30 MHz	30 MHz
TRANSDUCER	3 MHz EUT 6012 5/14	30 MHz	30 MHz	30 MHz	30 MHz	30 MHz	30 MHz	30 MHz	30 MHz
TRANSDUCER DIST. from EUT(m)/HEIGHT(m)	30 1	30 1	30 1	30 1	30 1	30 1	30 1	30 1	30 1
POLARIZATION (V,H) AMBIENT NOISE (A)	PARALLEL TO EUT	→	→	PERPENDICULAR TO EUT	→	PARALLEL TO GROUND	→	→	→
SIGNAL DIRECTION	0°	0°	0°	0°	0°	0°	0°	0°	0°
RECEIVER ATTENUATION (dB)	-	-	-	-	-	-	-	-	-
METER READING (dBμV)	-15.6	-3.7	-15.6	-3.3	-16	-3.8	-3.8	-3.8	-3.8
TRANSDUCER FACTOR (dB)	39.2	33.8	39.2	33.8	39.2	33.8	33.8	33.8	33.8
EXTERNAL GAIN/ CABLE LOSS (dB)	0.7	2.2	0.7	2.2	0.7	2.2	2.2	2.2	2.2
CORRECTED LEVEL (dBμV/m)	24.3	32.3	24.3	32.7	24	32.2	32.2	32.2	32.2
LIMIT (dBμV/m)	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5

Date: Aug 3, 2000 Detection Method: (1) CISPR (1) PEAK Other
 OPR/Asst.: L. HALE EUT ENCORE DCB 2 : BOTH OVERHEAD AND DUAL ANTENNAS CONNECTED

Conf. Run of Notes (1) AMBIENT ONLY
 Page of

Project No.: 10-03084.01.006 Scanner 1344Hz to 30MHz, 3 polarizations

Test Category: FULL PWR 15, 15.209

Time, Temp., & % r.H.: 83.9°F, 57.17% Approved: Daniel A. Carrington

SwRI Open Area Test Site Radiated Emissions v2.2											
Project Number: 10-03084.01.006				EUT Mode: Normal							
Device Under Test: Encore DCB2				Detection Method: QP							
Date / Time: 3 Aug 00, 9:00				Test Receiver: Rohde&Schwarz ESS EMI sn: DE31157							
Test Standard(primary limit): FCC Class A, Part 15 (10 m radiated)				Antenna: 3: BDA25S sn:535 (primary)							
Test Standard(optional limit): none				5: T2 sn:L178 (primary)							
Test Sponsor: Marconi Commerce Systems				8: T3 sn:L175							
Test Technician: C. Hale											
Temp.(°F)/Humidity(%): 83.9F, 59.1%											
FREQ MHz	Orient. θ°	Antenna		UnCorr'd Level (dBuV)	Correction Factors (dB)		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.
		L.D	Pol		Ht(m)	Dis(m)					
36,000	266	3	V	2.34	10		15.0	19.2	2.4	36.6	-2.4 EUT Related (DIGITAL EMISSION)
48,000	160	3	V	1.62	10		8.0	12.6	2.8	23.4	-15.6 EUT Related
68,712	246	3	V	2.60	10		14.3	7.4	3.5	25.3	-13.7 EUT Related
80,000	-1	3	V	1.53	10		14.4	8.5	3.9	26.8	-12.2 EUT Related
81,432	300	3	V	1.56	10		16.2	8.8	3.9	28.9	-10.1 EUT Related
137,426	295	3	V	1.58	10		11.9	15.0	5.5	32.5	-11.0 EUT Related
171,800	0	3	V	1.54	10		10.7	17.8	6.3	34.7	-8.8 EUT Related (DIGITAL EMISSION)
60,000	229	3	H	4.01	10		9.3	7.2	3.3	19.8	-19.2 EUT Related
85,889	179	3	H	4.01	10		17.6	9.8	4.1	31.4	-7.6 EUT Related (DIGITAL EMISSION)
103,071	182	3	H	3.46	10		21.9	12.3	4.7	38.8	-4.7 EUT Related plus FM station (DIGITAL EMISSION)
103,071	182	3	H	3.46	10		16.6	12.3	4.7	33.5	-10.0 FM station only
108,011	360	3	H	4.01	10		19.1	13.0	4.8	36.9	-6.6 EUT Related (DIGITAL EMISSION)
119,993	360	3	H	4.01	10		15.1	13.8	5.0	34.0	-9.5 EUT Related (DIGITAL EMISSION)
126,000	0	3	H	2.71	10		10.1	14.2	5.2	29.5	-14.0 EUT Related
131,997	360	3	H	4.01	10		13.0	14.6	5.4	32.9	-10.6 EUT Related
144,000	92	3	H	4.01	10		12.2	15.5	5.7	33.4	-10.1 EUT Related
150,000	90	3	H	4.01	10		7.3	15.9	5.8	28.9	-14.6 EUT Related
221,993	91	5	V	1.00	10		30.2	20.2	-20.6	29.7	-16.8 EUT Related
257,995	81	5	V	1.00	10		23.8	21.8	-19.9	25.6	-20.9 EUT Related
288,000	360	5	V	4.00	10		30.4	20.0	-19.5	30.9	-15.6 EUT Related
304,000	191	5	V	4.00	10		27.8	18.4	-19.1	27.0	-19.5 EUT Related
216,000	0	5	H	3.03	10		36.8	20.5	-20.7	36.6	-9.9 EUT Related (DIGITAL EMISSION)
222,000	360	5	H	3.01	10		32.4	20.2	-20.6	32.0	-14.5 EUT Related
227,994	0	5	H	3.01	10		32.5	20.5	-20.5	32.5	-14.0 EUT Related
540,000	0	8	V	2.35	10		13.5	24.1	-15.3	22.3	-24.2 Ambient
700,000	0	8	V	2.35	10		11.2	27.7	-13.6	25.2	-21.3 Ambient

SwRI Open Area Test Site Radiated Emissions v2_2										Project Number: 10-03084.01.006		EUT Mode: Normal	
Device Under Test:										Encore DCB2		Detection Method: QP	
Date / Time:										3 Aug 00, 9:00		Test Receiver: Rohde&Schwarz ESS EMI sn: DE31157	
Test Standard(primary limit):										FCC Class A, Part 15 (10 m radiated)		Antenna: 3: BDA25S sn:535 (primary)	
Test Standard(optional limit):										none		5: T2 sn:L178 (primary)	
Test Sponsor:										Marconi Commerce Systems		8: T3 sn:L175	
Test Technician:										C. Hale			
Temp.(°F)/Humidity(%):										83.9F, 59.1%			
FREQ MHz	Orient. θ°	Antenna				UnCorr'd Level (dBuV)	Correction Factors (dB)		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.
		L.D.	Pol.	Ht(m)	Dis(m)		Ant	Cable					
975.000	0	8	V	2.35	10	21.8	35.0	-10.7	46.2	49.5		-3.3	Ambient
540.000	0	8	H	2.35	10	11.7	24.1	-15.3	20.5	46.5		-26.0	Ambient
700.000	0	8	H	2.35	10	11.1	27.7	-13.6	25.1	46.5		-21.4	Ambient
975.000	0	8	H	2.35	10	9.1	35.0	-10.7	33.4	49.5		-16.1	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	---	---
Rotronic	PA1	Hygrometer	60857	02 Dec 00
Rhode & Schwarz	ESH-2	Receiver	879014/018	01 Feb 01
HP	8566B	Spectrum Analyzer	2421A00543	27 Oct 00
HP	85650A	Quasi-Peak Adapter	2043A00213	13 Oct 00
ANECHOIC CHAMBER				
SwRI	UTC10-221-1	RF Amplifier	9112SN15	Checked
Hewlett Packard	8568B	Spectrum Analyzer	2152A03081	13 Oct 00
Hewlett Packard	85650A	Quasi Peak Adapter	2043A00254	01 Sep 00
EMCO	3121-DB3	Dipole Antenna	148	Verified
EMCO	3121-DB4	Dipole Antenna	1097	Verified
EMCO	3121-DB2	Dipole Antenna	147	Verified
EMCO	6512	Passive loop Antenna	1265	Verified
OATS				
Rhode & Schwarz	ESS	EMI Test Receiver	848588/003	16 May 01
SwRI	2 MHz-1GHz	OATS Pre-Amp	14-82-020	Verified
Electro Metrics	BDA-25S	Dipole Antenna	535	28 May 01
Electro Metrics	DM-105-T2	Dipole Antenna	L-000178	30 May 01
Electro Metrics	DM-105-T3	Dipole Antenna	L-000108	30 May 01
EMCO	6512	Loop Antenna	0001-1265	31 Jul 01
VOLTAGE VARIATION				
HP	8568B	Spectrum Analyzer	2152A03881	13 Oct 00
EMCO	6512	Loop Antenna	1265	31 July 00
Rhode & Schwarz	ESH 2	Test Receiver	879014/018	01 Feb 01

APPENDIX D

PHOTOS OF TESTED EUT

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

APPENDIX E
PHOTOS OF TEST SETUPS

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

ATTACHMENT 1

FUNCTIONAL DESCRIPTION AND BLOCK DIAGRAM

ATTACHMENT 2
INSTALLATION INSTRUCTIONS

ATTACHMENT 3

FCC ID LABEL

ATTACHMENT 4
SCHEMATICS