MEASUREMENT AND TECHNICAL REPORT ON THE GILBARCO TRIND™ MULTI 1

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Project 10-3169-002
Report Number EMCR 99/103

Prepared for:

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1.0 GENERAL INFORMATION

1.1 Product Description

The Gilbarco 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 a fueling dispenser and includes two bezel-mounted 13.56 MHz low Q antennae, two Multi-Protocol Readers, two Light Boards (T20545-G1 Circuit Board Assemblies), a Data Control Board, a Switched DC Power Supply and associated transformer. These components are listed in Table 1.1, and the functional relationship is provided in block diagram in Attachment 1. The 13.56 MHz signal originates on the Multi-Protocol Reader board (Gilbarco part number Q13786-01/ Texas Instruments part number RI-STU-TRDA-01) from which the signal is sent via the Antenna Signal/Ground cable to the Bezel Antenna where it is intentionally radiated. Attachment 1 contains a detailed technical description and functionality of the reader system and its components.

TABLE 1.1 SYSTEM COMPONENTS

Component Description	Gilbarco Part No.	Texas Instruments Part No.
Data Control Board (DCB)	Q13563-03	RI-CTL-DCMA-02
Multi-Protocol Reader (2)	Q13786-01	RI-STU-TRDA-01
Light Board (2)	T20545-G1	NA
13.56 MHz Bezel Antenna (2)	T20551-G1	NA
Power Regulating Board	T20314-G1	NA

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, 20, 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

No special accessories were required.

3.4 Equipment Modification

No equipment modifications were required during testing.

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 2 dB			
FREQUENCY (MHz)	MEASURED LEVEL (dBΦV) [1]		CLASS B LIMIT (dBΦV)
	LINE	NEUTRAL	
13.56	43		48
13.56		46	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

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, is shown in Table 7.1.

TABLE 7.1
MEASUREMENTS OF FUNDAMENTAL FREQUENCY

Judgment: EUT Fundamental Passed by 44 dB Band Edges passed by 10.6 dB		
Frequency (MHz)	Corrected Level[1] dB(μV/m)	Limit dB(μV/m)
13.56	36	80 (30 meters)
13.5485	28.4	39 (10 meters)
13.5715	28.4	39 (10 meters)

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 6.6 dB			
Frequency (MHz)	Corrected Level [1] dB (μV/m)	Limit dB(μV/m)	“dB” Under limit
176.28	36.9	43.5	6.6
203.39	34.8	43.5	8.7
352.50	33.3	46.5	13.2

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

Radiated Emissions Test Data

FREQUENCY (MHz)	13.56	13.56	13.5485	13.5715	13.56	13.56	13.56	
TRANSDUCER	ALR-25	ALR-25	ALR-25	ALR-25	ALR-25	ALR-25	ALR-25	
Antenna to DUT distance (meters)	20	10	10	10	30	30	30	
Antenna height (meters)	1	1	1	1	1	1	1	
POLARIZATION to DUT: (‖ Parallel, ⊥ Perpendicular, = Parallel to Ground)	⊥	⊥	⊥	⊥	⊥	‖ ambient only	=	
SIGNAL DIRECTION (degrees)	306	297	297	297	306	35	35	
RECEIVER ATTENUATION (dB)	0	0	0	0	0	0	0	
METER (dBΦV)	2.7	8.5	-8.5	-8.5	-0.2	-7.7	-7.8	
TRANSDUCER FACTOR (dB)	34.9	34.9	34.9	34.9	34.9	34.9	34.9	
EXTERNAL GAIN/CABLE LOSS (dB)	1.3	1.3	2.0	2.0	1.3	1.3	1.3	
CORRECTED LEVEL (dBΦV/m)	38.9	44.7	28.4	28.4	36	28.5	28.4	
LIMIT (dBΦV/m)	83.5[1]	89.5[1]	39[1]	39[1]	80	80	80	

Date: 8/31/99 Detection Method: _X_ CISPR ___ PEAK ___ AVERAGE ___ Other
Project No.: 10-3169-002 EUT: Gilbarco
Test Category: FCC Part 15 OPR/Asst.: D.Smith
Temp, & %r.H: 90F/44RH Scanned 12.5 MHz to 30 MHz, 3 antenna polarizations. No other emissions detected.

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

Radiated Emissions Test Data

FREQUENCY (MHz)	30	54.24	176.28	203.39	433.88	203.39	352.50	
TRANSDUCER	BDA-25	BDA-25	BDA-25	T-2	T-2	T-2	T-2	
Antenna to DUT distance (meters)	3	3	3	3	3	3	3	
Antenna height (meters)	2.24	3.02	2.24	3.47	1.97	2.38	1.54	
POLARIZATION (V =Vertical H= Horizontal)	V	H	H	V	V	H	H	
SIGNAL DIRECTION	0E	0E	0E	159E	0E	322E	198E	
RECEIVER ATTENUATION (dB)	0	0	0	0	0	0	0	
METER (dBΦV)	6.2	11.9	14.5	32	25.6	36.2	33.2	
TRANSDUCER FACTOR (dB)	17.8	8.9	17.3	21.3	22.3	21.3	20.5	
EXTERNAL GAIN/CABLE LOSS (dB)	1.9	2.6	5.1	-22.7	-19.1	-22.7	-20.4	
CORRECTED LEVEL (dBΦV/m)	25.9 (ambient)	23.4	36.9	30.6	28.8	34.8	33.3	
LIMIT (dBΦV/m)	40	40	43.5	43.5	46.5	43.5	46.5	

Date: 8/31/99
Project No.: 10-3169-002
Test Category: FCC Part 15
Temp, & %r.H.: 90°F, 44%

Detection Method: _ X_ CISPR ___ PEAK ___ AVERAGE ___ Other
EUT: Gilbarco
OPR/Asst.: D.Smith

Radiated Emissions Test Data

FREQUENCY (MHz)	501.70	555.95							
TRANSDUCER	T-3	T-3							
Antenna to DUT distance (meters)	3	3							
Antenna height (meters)	1.77	2.05							
POLARIZATION (V =Vertical H= Horizontal)	V	H							
SIGNAL DIRECTION	360E	114E							
RECEIVER ATTENUATION (dB)	0	0							
METER (dBΦV)	16.7	16.1							
TRANSDUCER FACTOR (dB)	25.1	22.2							
EXTERNAL GAIN/CABLE LOSS (dB)	-18.3	-17.5							
CORRECTED LEVEL (dBΦV/m)	23.5	20.8							
LIMIT (dBΦV/m)	46.5	46.5							

Date: 8/31/99 Detection Method: _ X_ CISPR ___ PEAK ___ AVERAGE ___ Other
Project No.: 10-3169-002 EUT: Gilbarco
Test Category: FCC Part 15 OPR/Asst.: D.Smith
Temp, & %r.H.: 90°F, 44%

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 +/-1.000 kHz. 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 260 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 12 (last column) yields:

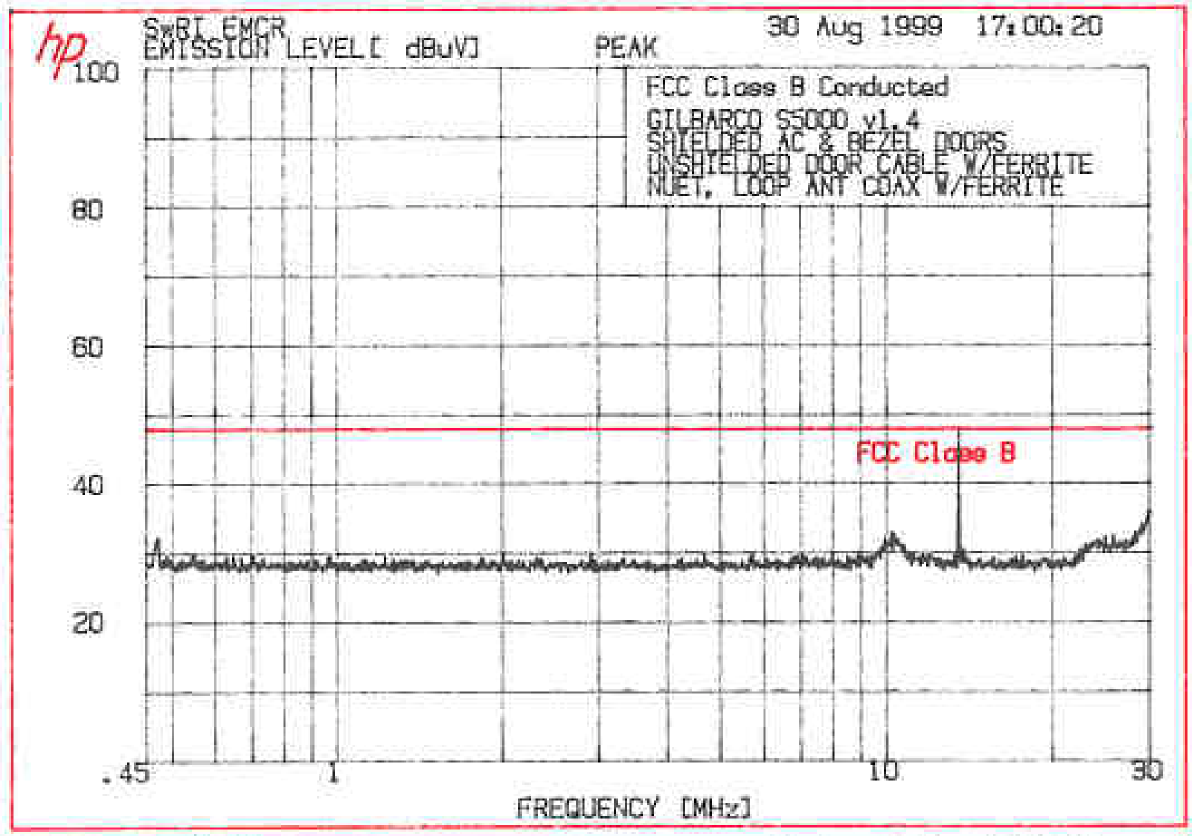
-7.8 dB (µV)
34.9 dB (1/m)
1.3 dB (CF/AG FACTOR)
FS = 28.4 dB (µV/m)

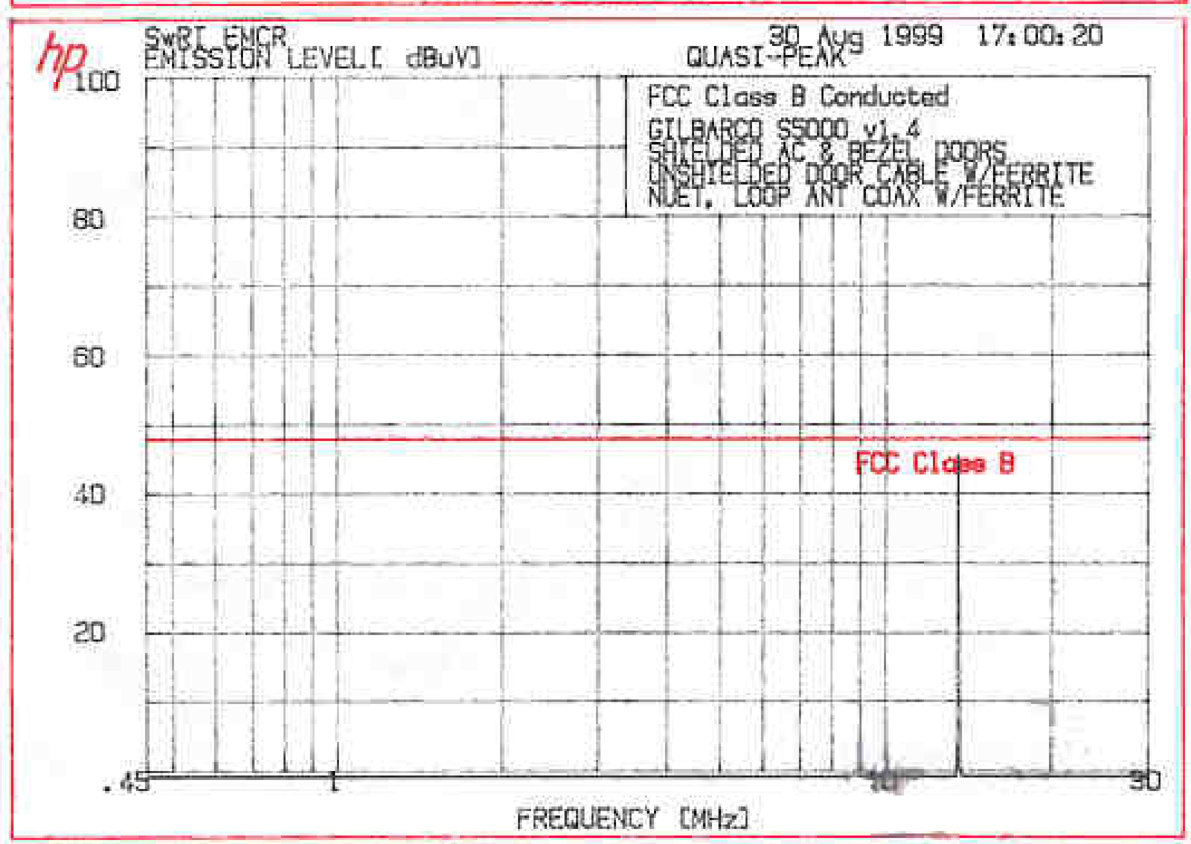
To equation convert the dB (µV/m) value to its corresponding level in µV/m is as follows:

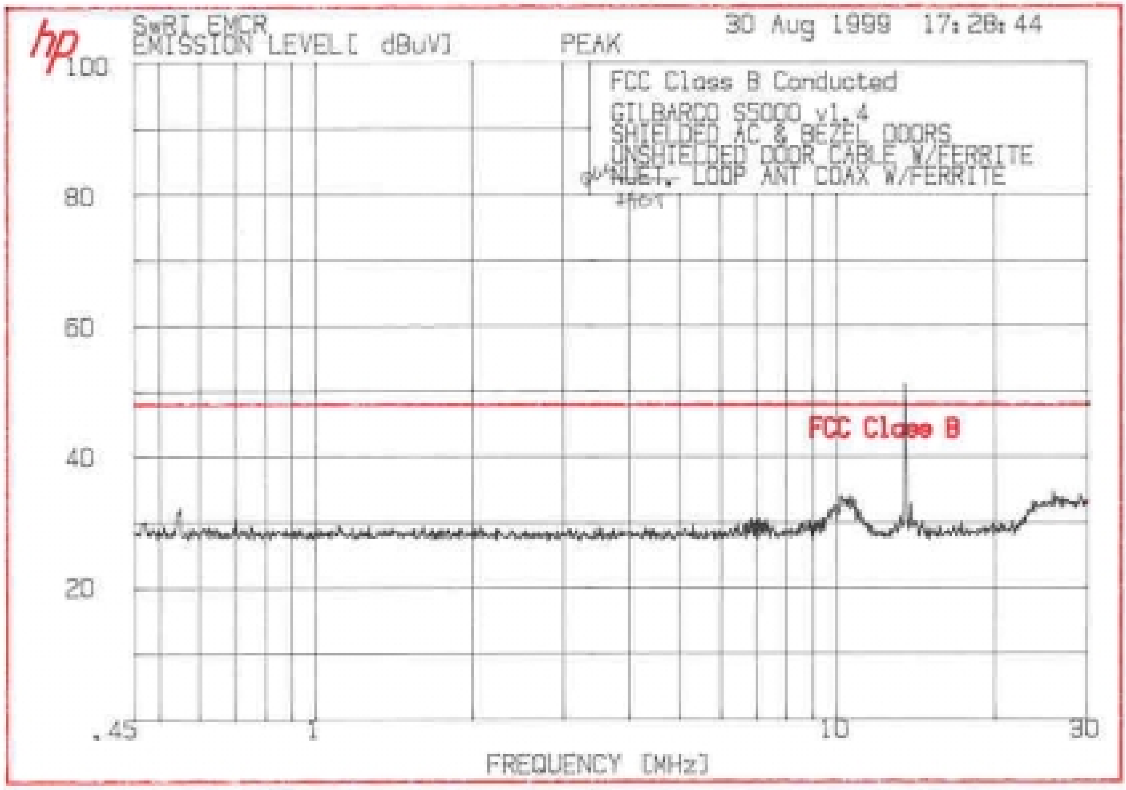
Level in µV/m Common Antilogarithm [(28.4 dB µV/m)/20] = 26.3 µV/m

APPENDIX A

CONDUCTED EMISSIONS MEASUREMENTS PLOTS


SwRI EMCR
EMISSION LEVEL [dBuV]
PEAK
30 Aug 1999 17:00:20
FCC Class B Conducted
GILBARCO S5000 v1.4
SHIELDED AC & BEZEL DOORS
UNSHIELDED DOOR CABLE W/FERRITE
NUET, LOOP ANT COAX W/FERRITE
100
80
60
40
20
FCC Class B
.45
1
10
30
FREQUENCY [MHz]


SwRI EMCR
EMISSION LEVEL [dBuV]
QUASI-PEAK
30 Aug 1999 17:00:20
FCC Class B Conducted
GILBARCO S5000 v1.4
SHIELDED AC & BEZEL DOORS
UNSHIELDED DOOR CABLE W/FERRITE
NUET, LOOP ANT COAX W/FERRITE
100
80
60
40
20
FCC Class B
.45
1
30
FREQUENCY [MHz]


SwRI EMCR
EMISSION LEVEL[dBuV]
PEAK
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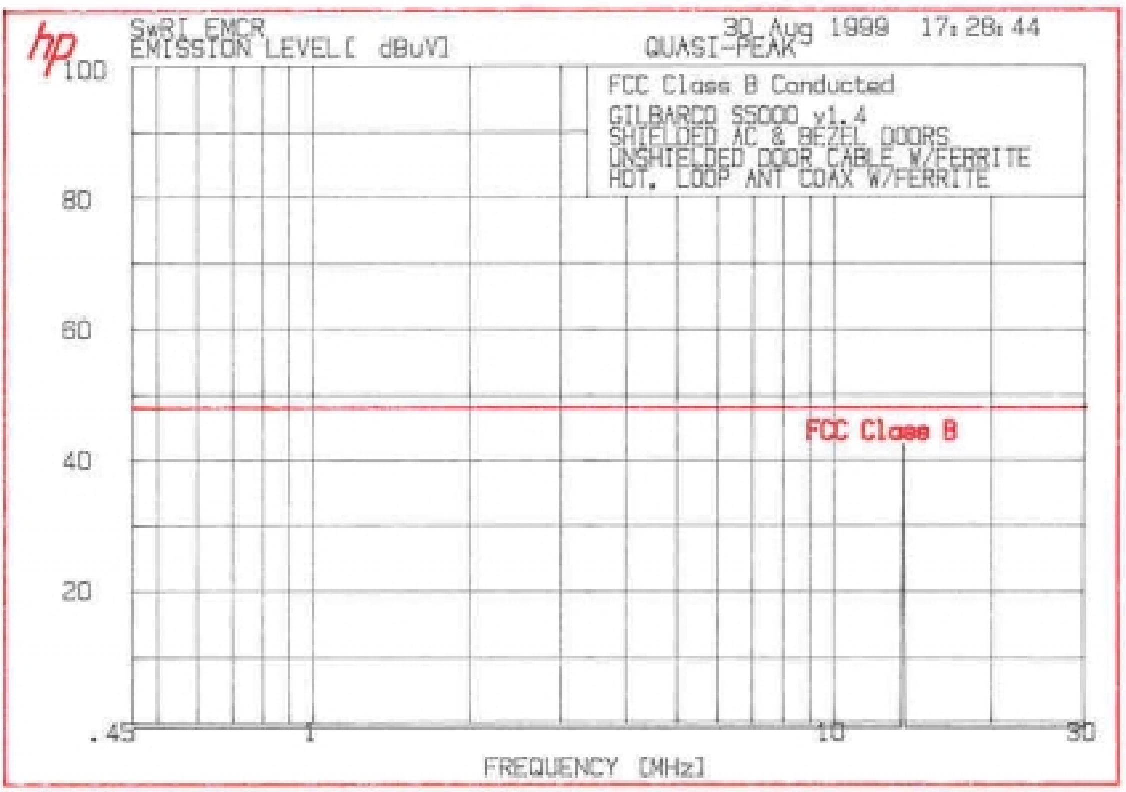
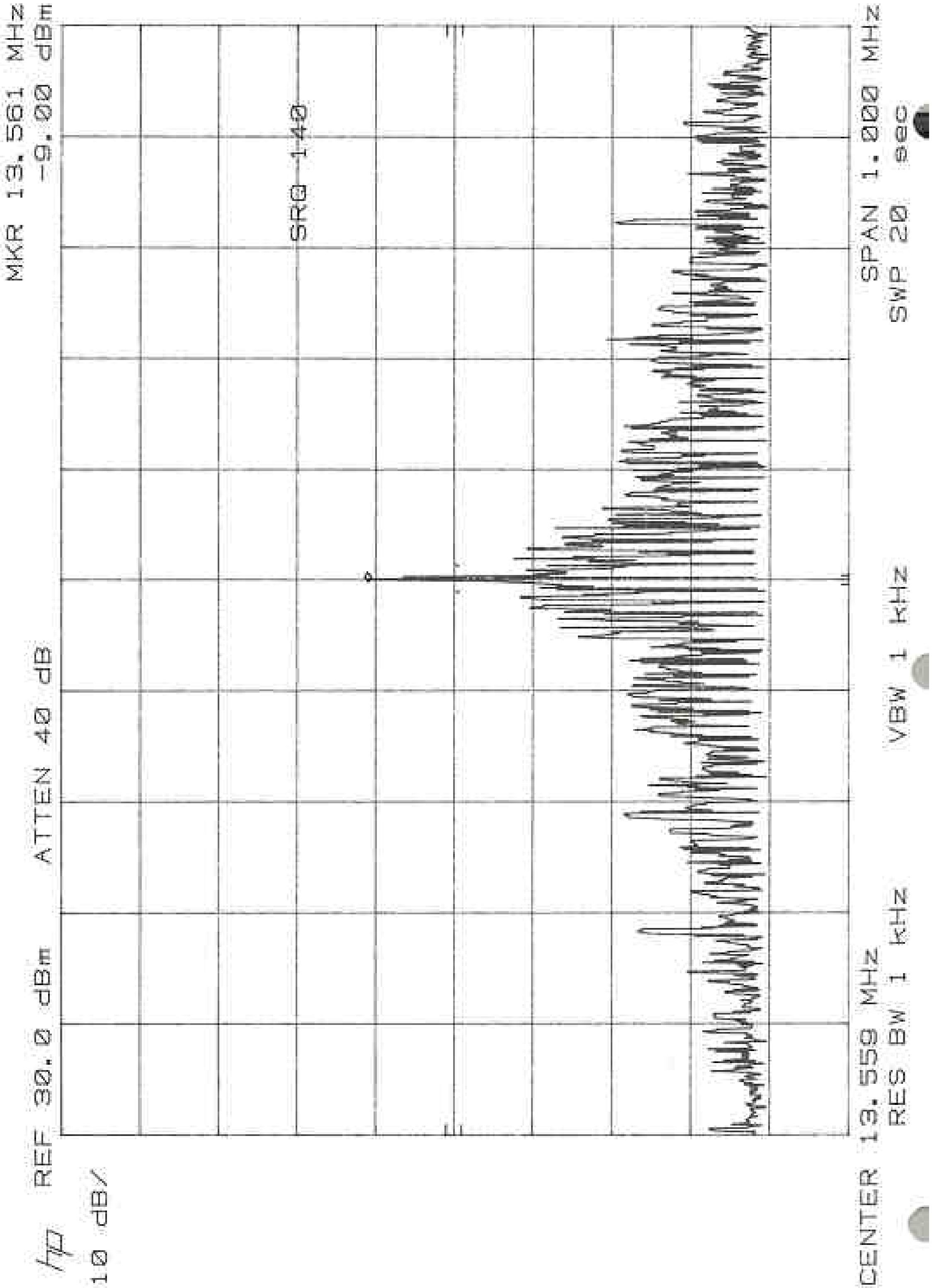
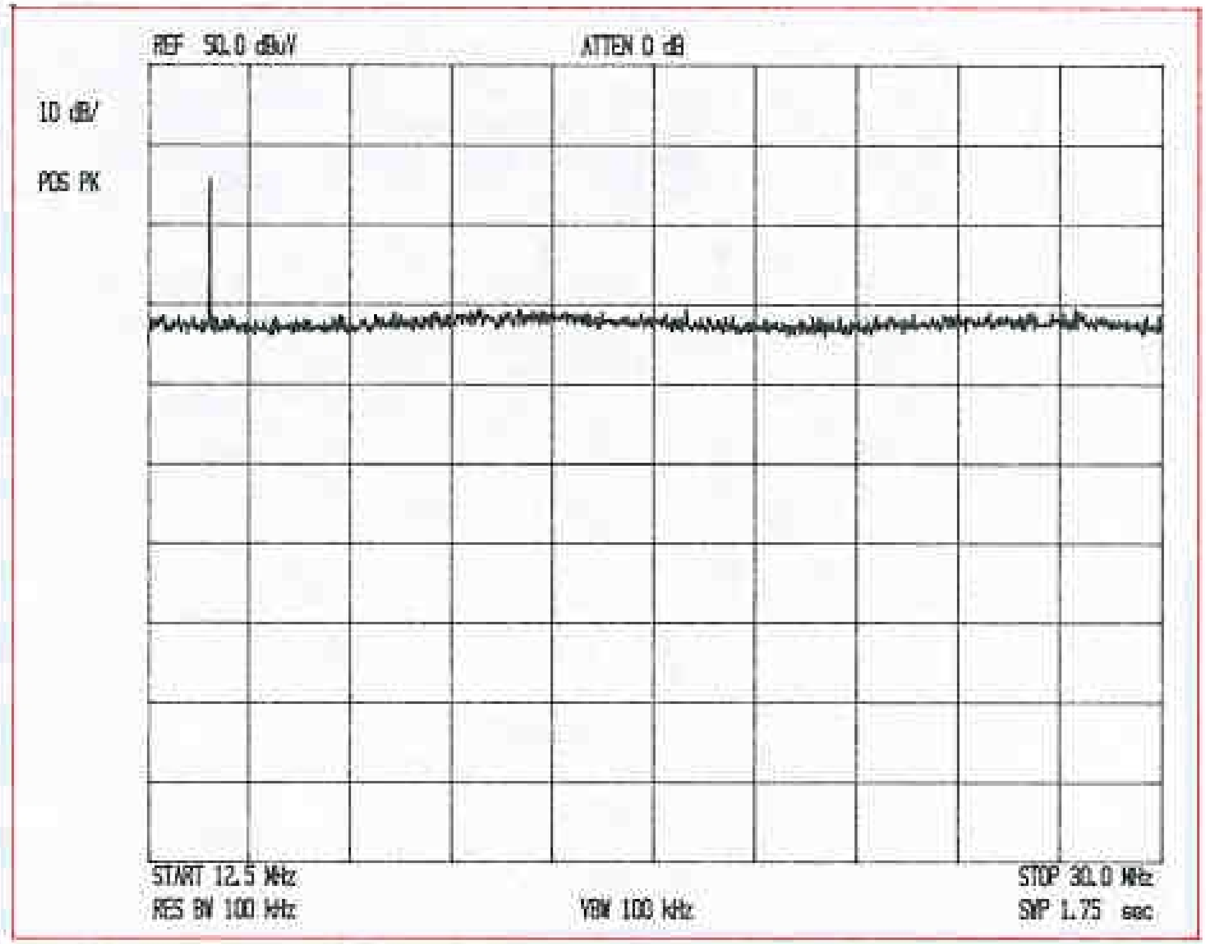
FCC Class B Conducted
GILBARCO S5000 v1.4
SHIELDED AC & BEZEL DOORS
UNSHIELDED DOOR CABLE W/FERRITE
LOOP ANT COAX W/FERRITE
FCC Class B
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]

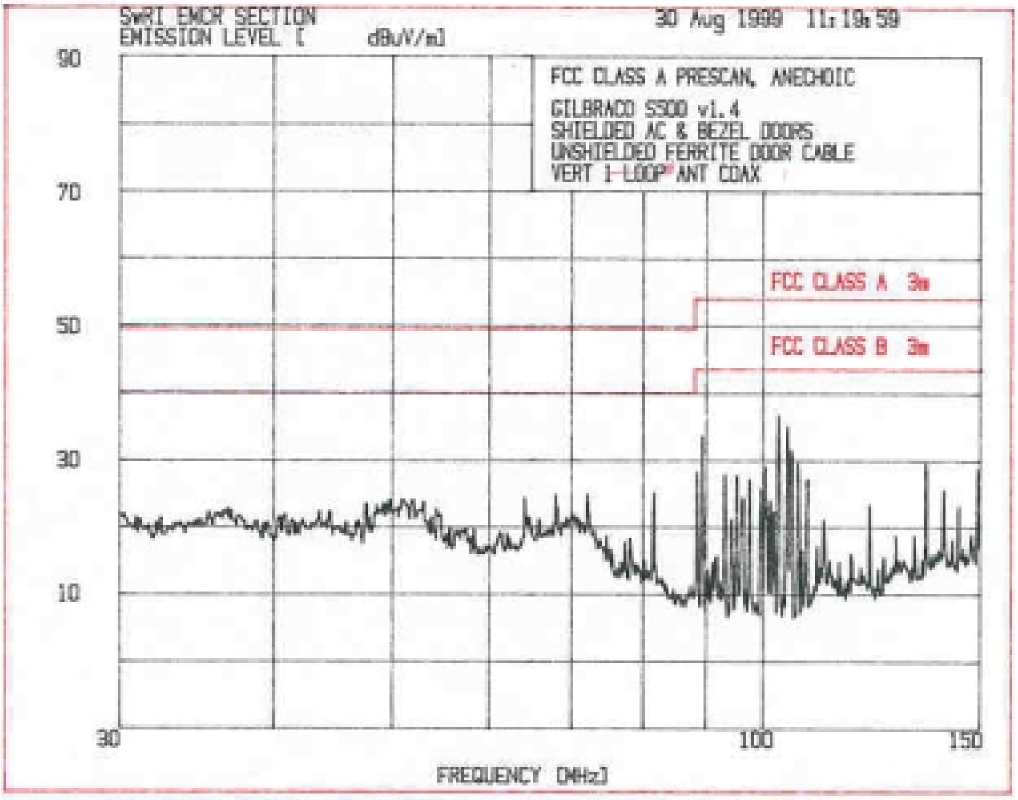

SwRI EMCR
EMISSION LEVEL[dBuV]
QUASI-PEAK
30 Aug 1999 17:28:44
FCC Class B Conducted
GILBARCO S5000 v1.4
SHIELDED AC & BEZEL DOORS
UNSHIELDED DOOR CABLE W/FERRITE
HOT, LOOP ANT COAX W/FERRITE
FCC Class B
100
80
60
40
20
.45
1
10
30
FREQUENCY [MHz]

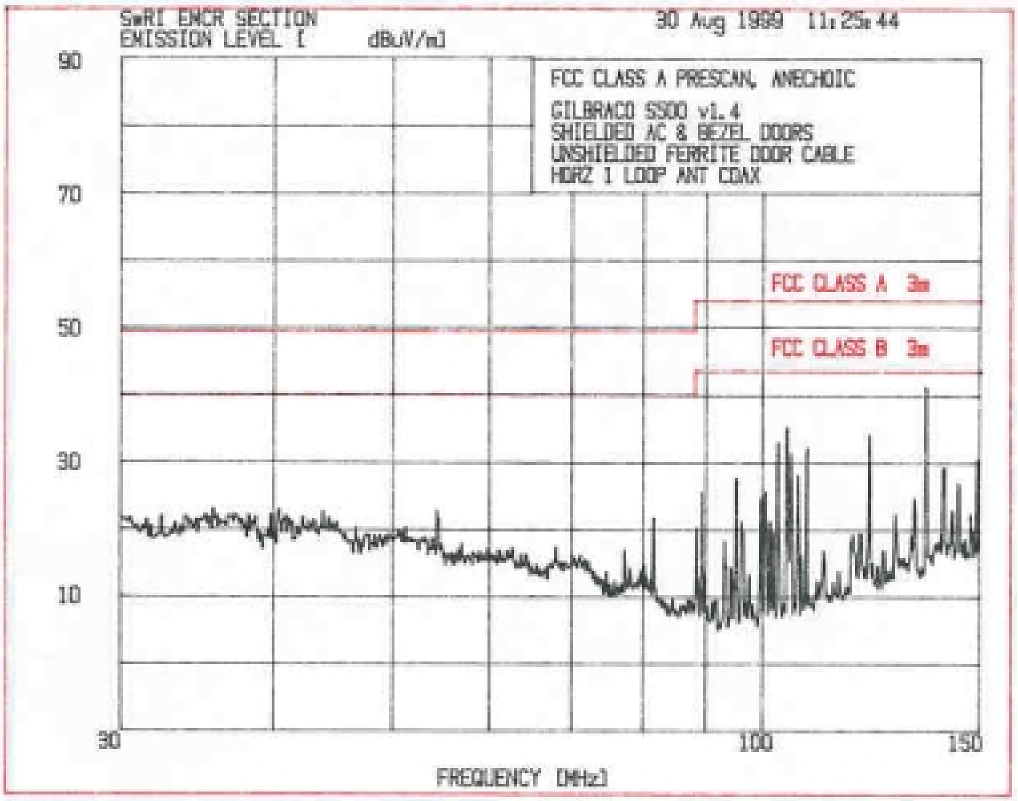
APPENDIX B

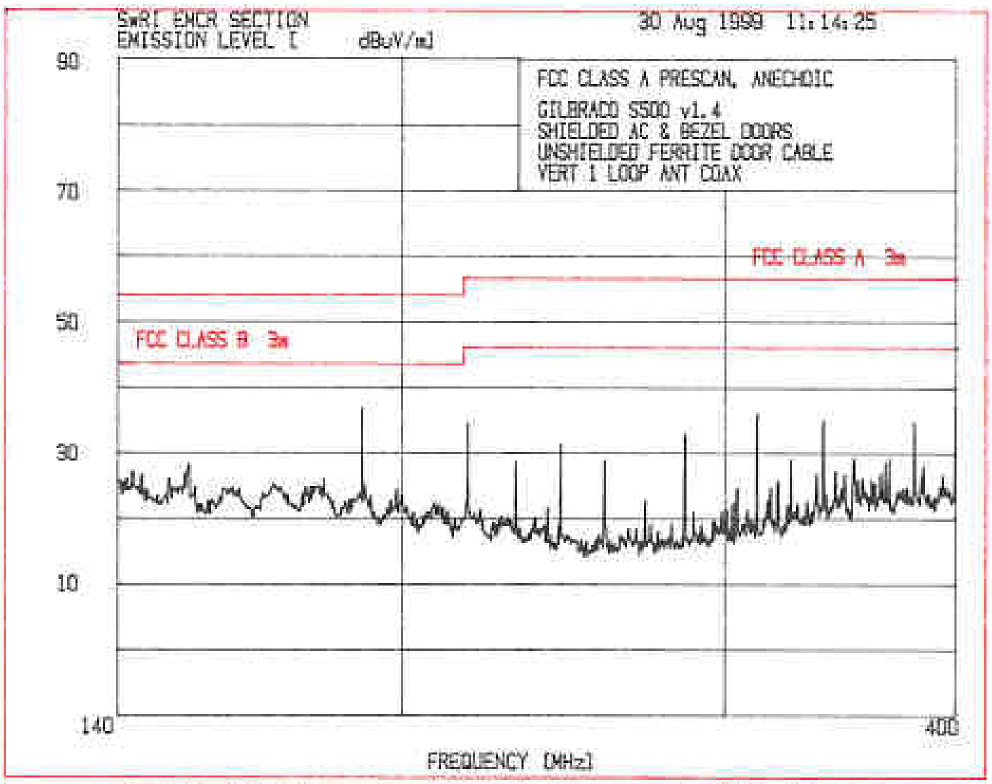
RADIATED SIGNATURE MEASUREMENTS PLOTS

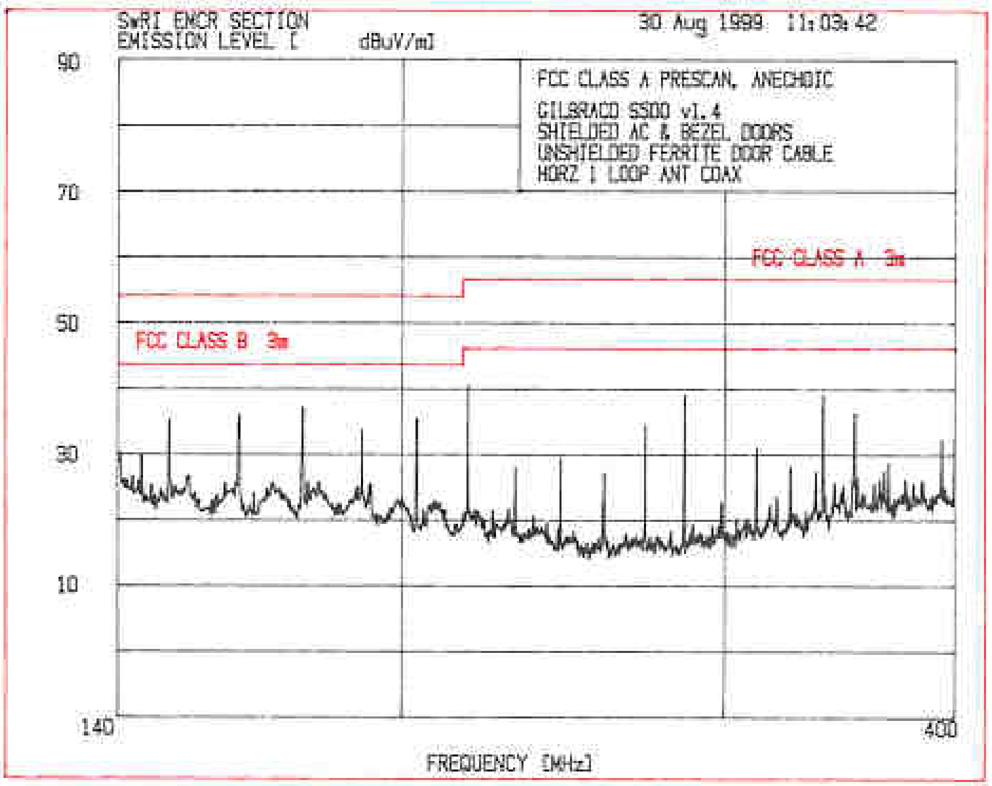

MKR 13.561 MHz
-9.00 dBm
SRQ 140
REF 30.0 dBm
ATTEN 40 dB
10 dB/
CENTER 13.559 MHz
RES BW 1 kHz
VBW 1 kHz
SPAN 1.000 MHz
SWP 20 sec

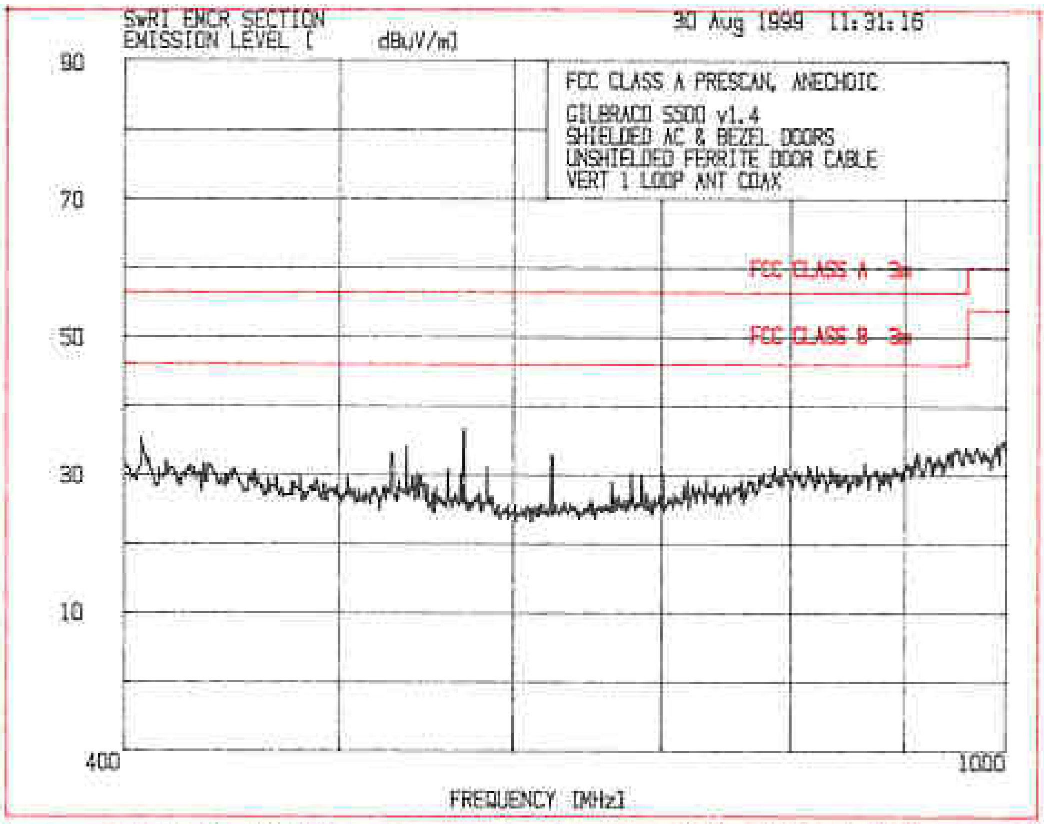

REF 50.0 dBuV
ATTEN 0 dB
10 dB/
POS PK
START 12.5 MHz
RES BW 100 kHz
VBW 100 kHz
STOP 30.0 MHz
SWP 1.75 sec

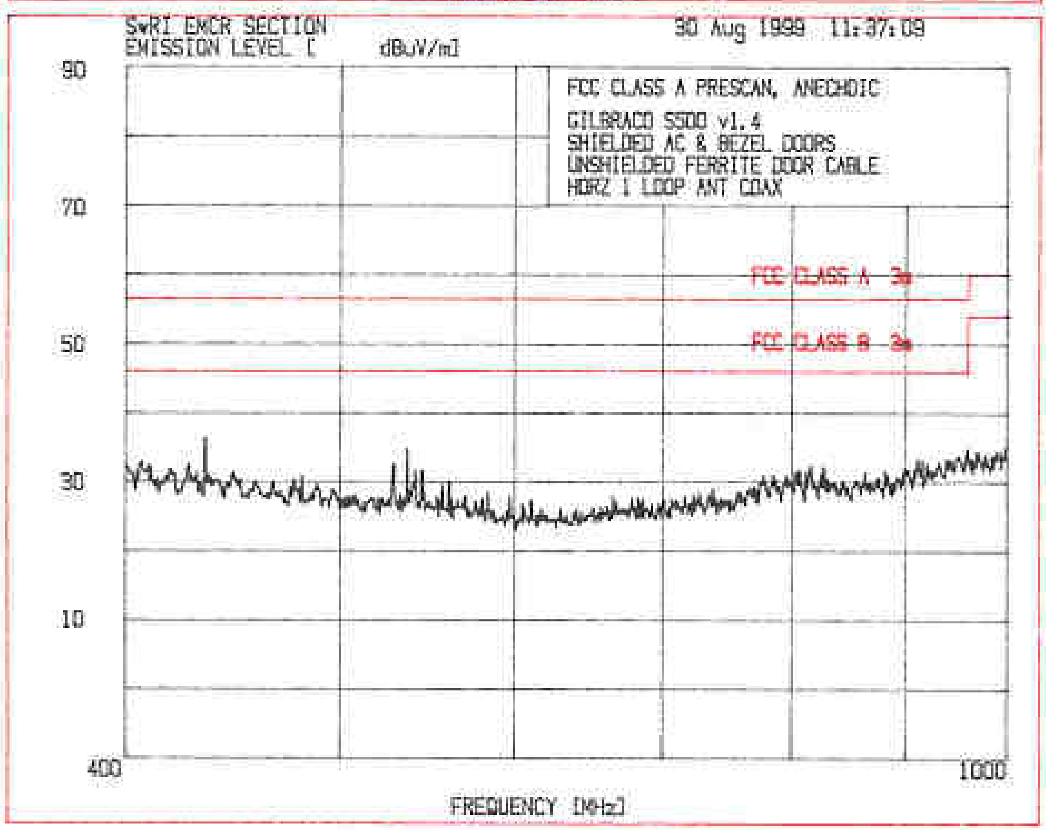

SwRI EMCR SECTION
EMISSION LEVEL [dBuV/m]
30 Aug 1999 11:19:59
FCC CLASS A PRESCAN, ANECHOIC
GILBRACO 5500 v1.4
SHIELDED AC & BEZEL DOORS
UNSHIELDED FERRITE DOOR CABLE
VERT 1 LOOP ANT COAX
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
30
100
150
FREQUENCY [MHz]


SwRI EMCR SECTION
EMISSION LEVEL [dBuV/m]
30 Aug 1999 11:25:44
FCC CLASS A PRESCAN, ANECHOIC
GILBRACO 5500 v1.4
SHIELDED AC & BEZEL DOORS
UNSHIELDED FERRITE DOOR CABLE
HORZ 1 LOOP ANT COAX
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
30
100
150
FREQUENCY [MHz]


SwRI EMCR SECTION
EMISSION LEVEL [dBuV/m]
30 Aug 1999 11:14:25
FCC CLASS A PRESCAN, ANECHOIC
GILBRACO S500 v1.4
SHIELDED AC & BEZEL DOORS
UNSHIELDED FERRITE DOOR CABLE
VERT 1 LOOP ANT COAX
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
140
400
FREQUENCY [MHz]


SwRI EMCR SECTION
EMISSION LEVEL [dBuV/m]
30 Aug 1999 11:03:42
FCC CLASS A PRESCAN, ANECHOIC
GILBRACO S500 v1.4
SHIELDED AC & BEZEL DOORS
UNSHIELDED FERRITE DOOR CABLE
HORZ 1 LOOP ANT COAX
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
140
400
FREQUENCY [MHz]


SwRI EMCR SECTION
EMISSION LEVEL [dBuV/m]
30 Aug 1999 11:31:16
FCC CLASS A PRESCAN, ANECHOIC
GILBRACO S500 v1.4
SHIELDED AC & BEZEL DOORS
UNSHIELDED FERRITE DOOR CABLE
VERT 1 LOOP ANT COAX
FCC CLASS A 3m
FCC CLASS B 3m
90
70
50
30
10
400
1000
FREQUENCY [MHz]


SwRI EMCR SECTION
EMISSION LEVEL [dBuV/m]
30 Aug 1999 11:37:09
FCC CLASS A PRESCAN, ANECHOIC
GILBRACO S500 v1.4
SHIELDED AC & BEZEL DOORS
UNSHIELDED FERRITE DOOR CABLE
HORZ 1 LOOP ANT COAX
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	891362	9APR00
HP	8566B	SPECTRUM ANALYZER	2209A01333	12FEB00
HP	85650A	QUASI_PEAK ADAPTER	2043A00213	16FEB00
ANECHOIC CHAMBER				
SWRI	UTC 10 221-1	PREAMP 10-1000 MHz 35dB GAIN	9112SN15	verified
HP	8568B	SPECTRUM ANALYZER	2415A00464	27OCT99
HP	85650A	QUASI-PEAK ADAPTER	2043A00259	3DEC99
HP	8447F	PREAMP	2727A00226	verified
EMCO	3121-DB3	ANTENNA, DIPOLE	148	verified
EMCO	3121-DB4	ANTENNA, DIPOLE	1097	verified
EMCO	3121-DB2	ANTENNA, DIPOLE	147	verified
OATS				
RHODE & SWARTZ	ESS	TEST RECEIVER	848588/033	23SEP00
EMCO	2090	TURNABLE/MAST CONTROLLER	9808-1348	Verified
SWRI	2 MHz-1GHz	OATS PRE-AMP	1	NCR
ELECTROMETRICS	BDA25S	ANTENNA, DIPOLE	535	29APR00
EMPIRE	DM-105-T2	ANTENNA, DIPOLE	L-000178	29APR00
EMPIRE	DM-105-T3	ANTENNA, DIPOLE	L-000108	30APR00
ELECTROMETRICS	ALR-25	LOOP ANTENNA	086	3FEB00
TEMPERATURE AND VOLTAGE VARIATION				
HP	8568B	SPECTRUM ANALYZER	2415A00464	27OCT99
FLUKE	K/J	THERMOMETER	3910515	1OCT99
FLUKE	87	DVM	5260059	4MAY00
TENNY	TEMP GUARD III	TEMPERATURE CHAMBER	NSN	NCR
HP	8566B	SPECTRUM ANALYZER	2209A01333	12FEB00

APPENDIX D

PHOTOS OF TESTED EUT

File Name	EUT Photo
gilbarcoantb.jpg	T20551-G1 (back side) of 13.56 MHz Antenna Board (mounted on bezel options board)
gilbarcoantfilter.jpg	Harmonic filter (for production product, these are mounted on the T20551-G1 antenna board)
gilbarcoantt.jpg	T20551-G1 (top side) of 13.56 MHz Antenna Board (mounts on bezel board)
gilbarcoliteb.jpg	T20545-G1 Light Board Assembly (back side)
gilbarcolitet.jpg	T20545-G1 Light Board Assembly (front side)
Pic00029.jpg	Test Box housing TRIND Multi 1 (side A)
Pic00030.jpg	Test Box housing TRIND Multi 1 (side B)
Pic00031.jpg	T20537-G1 Bezel Options Door Assembly
Pic00032.jpg	T20537-G1 Bezel Options Door Assembly with E-field shield off
Pic00033.jpg	T20538-G1 TRIND Multi 1 Card Cage Assembly (front)
Pic00036.jpg	Left half of T20538-G1 TRIND Multi 1 Card Cage Assembly
Pic00037.jpg	Right half of T20538-G1 TRIND Multi 1 Card Cage Assembly (power supply section)
Pic00039.jpg	Left half of T20538-G1 TRIND Multi 1 Card Cage Assembly (mounting plate removed exposing Q13563-03 Data Control Board- rear))
Pic00040.jpg	Right side of T20538-G1 TRIND Multi 1 Card Cage Assembly (with metal safety shield taken loose)
Tiboard1.jpg	Texas Instruments part number RI-CTL-DCMA-02/Gilbarco part number Q13563-03 Data Control Board (component side)
Tiboard1b.jpg	Texas Instruments part number RI-CTL-DCMA-02/Gilbarco part number Q13563-03 Data Control Board (back side)
Timprv14b.jpg	Texas Instruments part number RI-STU-TRDA-01/Gilbarco part number Q13786-01 Multi-Protocol Reader Board (back side)
Timprv14t.jpg	Texas Instruments part number RI-STU-TRDA-01/Gilbarco part number Q13786-01 Multi-Protocol Reader Board (front side)

APPENDIX E

PHOTOS OF TEST SETUP

Test Setup	**File Name**
Radiated Emissions – Anechoic	Anechoic_1.jpg
Radiated Emissions – Anechoic	Anechoic_2.jpg
Radiated Emissions – OATS	OATS_1.jpg
Radiated Emissions – OATS	OATS_2.jpg
Conducted Emissions	Conducted_1.jpg
Conducted Emissions	Conducted_2.jpg