Intertek ETL SEMKO

TEST REPORT

Report Number: 3080651MIN-002
Project Number: 3080651
July 28, 2005

Evaluation of the
Ribbon RF ID
FCC ID: JZ2-X001500

to
FCC Part 2
FCC Part 15, Subpart C, Section 15.225

For
Fargo Electronics Inc.

Test Performed by:	Test Authorized by:
Intertek	Fargo Electronics Inc.
7250 Hudson Blvd. Suite 100	6533 Flying Cloud Drive, Suite 1000
Oakdale, MN 55128	Eden Prairie, MN 55344-3307

Prepared by: _____ Date: July 28, 2005
Norman Shpilsher

Reviewed by: _____ Date: July 28, 2005
Uri Spector

CONTENTS

1.0 GENERAL DESCRIPTION

1.1 Related Submittals Grants

This is single application of the *Ribbon RF ID* Transmitter for Certification under Part 15 Subpart C. There are no other simultaneous applications.

1.2 Product Description

The *Ribbon RF ID* Transmitter is operating at 13.56 MHz.
The *Ribbon RF ID* Transmitter is incorporated in X001500 Printer and X001600 Media Programmer manufactured by Fargo Electronics Inc. The Transmitters are identical for both devices and located on the Main Boards with slight differences in components layout.
The intended use of the *Ribbon RF ID* Transmitter is to generate and transmit a RF signal from the Antenna to the RF ID Tag; the same antenna is used to receive modified by Tag RF signal (inductive coupling).
The *Ribbon RF ID* Transmitter powered at 120 VAC, 60 Hz through the AC/DC Power Adapter.
The *Ribbon RF ID* Transmitter antenna is an integral antenna p/n A000365 Rev. A located on the separate PCB and connected to the transmitter output via the four-wire Antenna Cable.
The Antenna Cable is 21cm long for X001500 Printer and 31cm long with a Ferrite (Steward Corp., p/n 28A2432) with one turn for X001600 Media Programmer.

Sample Submitted: July 18, 2005
Test Work Started: July 18, 2005
Test Work Completed: July 29, 2005

1.3 Test Methodology

Emission measurements were performed according to the procedures in ANSI C63.4-2003. All field strength radiated emissions measurements were performed in the semi-anechoic chamber, and for each scan, the procedure for maximizing emissions in were followed. All field strength radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Justification Section**" of this Application.

1.4 Test Facility

The test site facility used to collect the radiated and conducted measurement data is located at 7250 Hudson Blvd., Suite 100, Oakdale, Minnesota. This test facility has been fully described in a report dated on March 2003 submitted to FCC. Please reference the site registration number: 90706, dated April 18, 2003.

2.0 SYSTEM TEST CONFIGURATION

2.1 Justification

To demonstrate the *Ribbon RF ID* Transmitter compliance the transmitter of the X001600 Media Programmer was tested with 21cm antenna cable, the Field Strength of Fundamental frequency and Out of Band Spurious Emissions were tested for both 21cm and 31cm (with Ferrite) antenna cables; testing was performed with or without RF ID Tag to obtain the worst emissions.
The Conducted Emissions test was performed with terminated antenna output.

2.2 EUT Setup

For simplicity of testing, the transmitter was set to transmit continuously under the exercising software.
The Radiated Emissions measurements were performed on the EUT without the X001600 plastic enclosure.

2.3 EUT Exercising Software

Ribbon RF ID Test Firmware.

2.4 Special Accessories

There are no special accessories necessary for compliance of these products.

2.5 Equipment Modification

No modifications were installed during the testing.

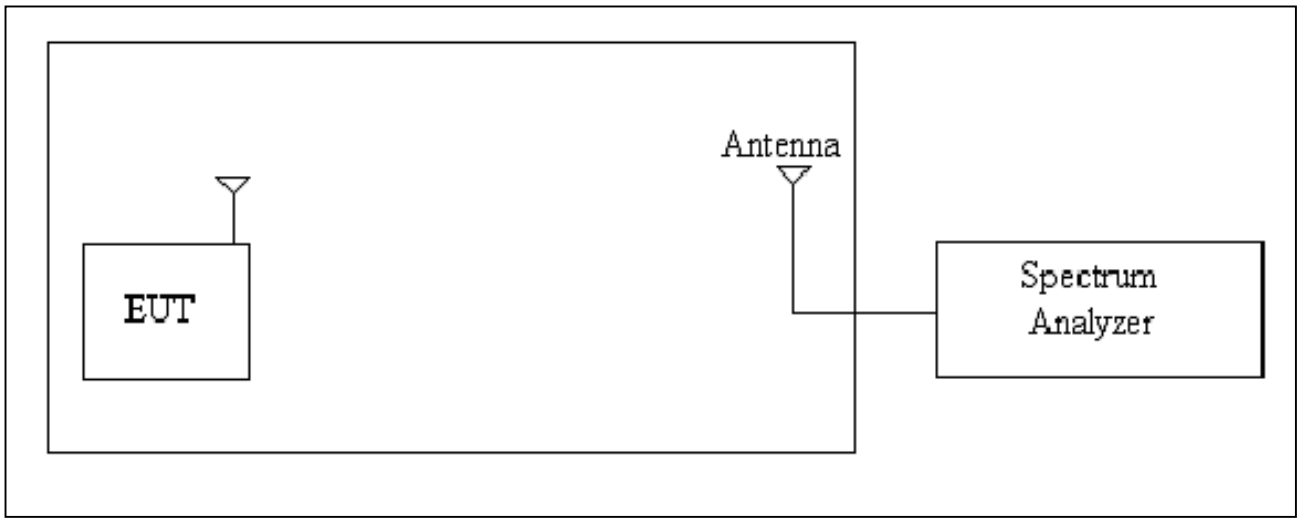
2.6 Support Equipment List and Description

ELPAC W1512 AC Power adapter
Adapter Board p/n A000368
Display Board p/n P16204X-REV-A
I-Code1 RF ID Tag

2.7 Test Configuration Block Diagrams

The EUT was setup as tabletop equipment.
Measurements below 30MHz were performed at 10-m measurement distance with Loop Antenna.
Measurements from 30MHz to 1GHz were performed at 3-m measurement distance with Bicono-Log Antenna.
The EUT was powered at 120VAC/60Hz through the Power Adapter.

Field Strength Measurements



3.0 TEST RESULTS

Data is included of the worst-case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs, data tables and graphical representations of the emissions are included.

The EUT is intended for operation under the requirements of Part 15 Subpart C. Specific test requirements include the following:

47 CFR 15.225(a)(b)(c)	Field Strength of Fundamental
47 CFR 15.225(d), 15.209	Out of Band Spurious Emissions
47 CFR 15.225(d), 15.209	Field Strength of Spurious Emissions
47 CFR 15.225(e)	Frequency Tolerance
47 CFR 15.215	Bandwidth of the Emission
47 CFR 15.207	Conducted Emissions

3.1 Field Strength of Radiated Emissions, FCC 15.225(a)(b)(c), 15.209

Field Strength of Fundamental and Harmonics Emissions measurements were made at Fundamental frequency of 13. 56 MHz.

FCC Part 15.225 limits at 30m are:

15848μV/m, or 84.0dBμV/m within the band 13.553-13567MHz
334μV/m, or 50.5dBμV/m within the bands 13.410-13.553MHz and 13.567-13.710MHz
106μV/m, or 40.5dBμV/m within the bands 13.110-13.410MHz and 13.710-14.010MHz

The maximum emissions were measured at 13.56MHz with margin 51.4dB below the limits.

The Table 3-1-1 below shows the Field Strength of Fundamental Radiation.

Radiated Emissions at Fundamental Frequency **Date:** 07-18-2005

Company: Fargo Electronics
Model: Ribbon RF ID
Test Engineer: Norman Shpilsher
Special Info: Continuous operation mode
Fundumental operating frequency 13.56MHz
Standard: FCC Part15, Subpart C, 15.209, 15.225
Note: Measurement distance 10m with Loop antenna SAS 200/562B
Distance Factor is 40dB per decade from 490kHz to 30MHz.
The table shows the worst case radiated emissions.
All measurements were taken using a CISPR Quasi-Peak detector with RBW 10kHz.

Table # 3-1-1

Frequency MHz	Reading dBμV	Antenna		Net at 10m. dBμV/m	Distance Factor dB	Limit dBμV/m	Margin dB
		Factor (dB/m)	Position				
			21cm Antenna Cable				
13.560	37.4	7.2	Front	44.6	19.1	84.0	-58.5
13.560	43.8	7.2	Side	51.0	19.1	84.0	-52.1
			31cm Antenna Cable				
13.560	36.1	7.2	Front	43.3	19.1	84.0	-59.8
13.560	44.5	7.2	Side	51.7	19.1	84.0	-51.4

Comments:

3.2 Out of Band Spurious Emissions, FCC 15.225(d), 15.209

To demonstrate the EUT compliance with the Out of band spurious emissions, measurements were made for frequencies 15.553 and 15.567MHz and the general limits FCC Part 15.209 were applied.

The EUT operating frequency is 13.560MHz

FCC Part 15.209 limits at 30m is 30μV/m, or 29.5dBμV/m

The maximum emissions were measured with margin 8.0dB below the FCC Part 15.209 limits.

The Table 3-2-1 below shows the Out of Band Spurious Emissions.

Out Of Band Spurious Emissions **Date:** 07-18-2005

Company: Fargo Electronics
Model: Ribbon RF ID
Test Engineer: Norman Shpilsher
Special Info: Continuous operation mode
Fundumental operating frequency 13.56MHz
Standard: FCC Part15, Subpart C, 15.209, 15.225
Note: Measurement distance 10m with Loop antenna SAS 200/562B
Distance Factor is 40dB per decade from 490kHz to 30MHz.
The table shows the worst case radiated emissions.
All measurements were taken using a CISPR Quasi-Peak detector with RBW 10kHz.

Table # 3-2-1

Frequency MHz	Reading dBμV	Antenna		Net at 10m. dBμV/m	Distance Factor dB	Limit dBμV/m	Margin dB
		Factor (dB/m)	Position				
			21cm Antenna Cable				
13.553	26.5	7.2	Front	33.7	19.1	29.5	-14.9
13.567	23.6	7.2	Front	30.8	19.1	29.5	-17.8
13.553	33.1	7.2	Side	40.3	19.1	29.5	-8.3
13.567	29.9	7.2	Side	37.1	19.1	29.5	-11.5
			31cm Antenna Cable				
13.553	25.2	7.2	Front	32.4	19.1	29.5	-16.2
13.567	22.3	7.2	Front	29.5	19.1	29.5	-19.1
13.553	33.4	7.2	Side	40.6	19.1	29.5	-8.0
13.567	30.6	7.2	Side	37.8	19.1	29.5	-10.8

Comments:

3.3 Field Strength of Spurious Emissions, FCC 15.205, 15.209

Field Strength of Spurious Emissions measurements were made in frequency range from the EUT operating frequency of 13.560MHz up to 1000MHz.

FCC Part 15.209 limits are:

1.705-30MHz at 30m is 30μV/m, or 29.5dBμV/m
30-88MHz at 3m is 100μV/m, or 40.0dBμV/m
88-216MHz at 3m is 150μV/m, or 43.5dBμV/m
216-960MHz at 3m is 200μV/m, or 46.0dBμV/m
above 960MHz at 3m is 500μV/m, or 54.0dBμV/m

The maximum emissions were measured with margin 5.3dB below limits.

The Tables 3-3-1 and 3-2-2 and Graph 3-3-1 show the Spurious Emissions

Spurious Radiated Emissions **Date:** 07-18-2005

Company: Fargo Electronics
Model: Ribbon RF ID
Test Engineer: Norman Shpilsher
Special Info: Continuous operation mode
Fundumental operating frequency 13.56MHz
Standard: FCC Part15, Subpart C, 15.205, 15.209
Note: Measurement distance 10m with Loop antenna SAS 200/562B
Distance Factor is 40dB per decade from 490kHz to 30MHz.
The table shows the worst case radiated emissions.
All measurements were taken using a CISPR Quasi-Peak detector with RBW 10kHz.

Table # 3-3-1

Frequency MHz	Reading dBμV	Antenna		Net at 10m. dBμV/m	Distance Factor dB	Limit dBμV/m	Margin dB
		Factor (dB/m)	Position				
			21cm Antenna Cable				
27.120	7.0	14.3	Front	21.3	19.1	29.5	-27.3
27.120	6.8	14.3	Side	21.1	19.1	29.5	-27.5

Comments:

Radiated Emissions from 30MHz to 1GHz **Date:** 07-19-2005

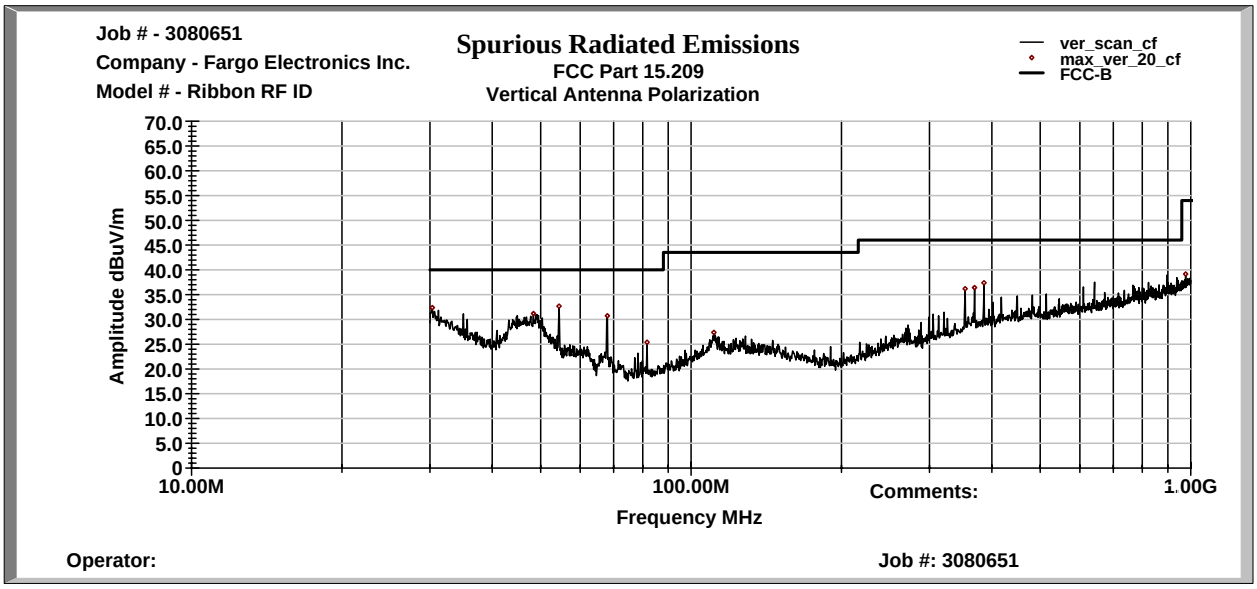
Company: Fargo Electronics
Model: Ribbon RF ID
Test Engineer: Norman Shpilsher
Special Info: Continuous operation mode
Standard: FCC Part 15.205, 15.209
Test Site: 3m Anechoic Chamber, 3m measurement distance
Note: The table shows the worst case radiated emissions
All measurements were taken using a Peak detector

Table # 3-3-2

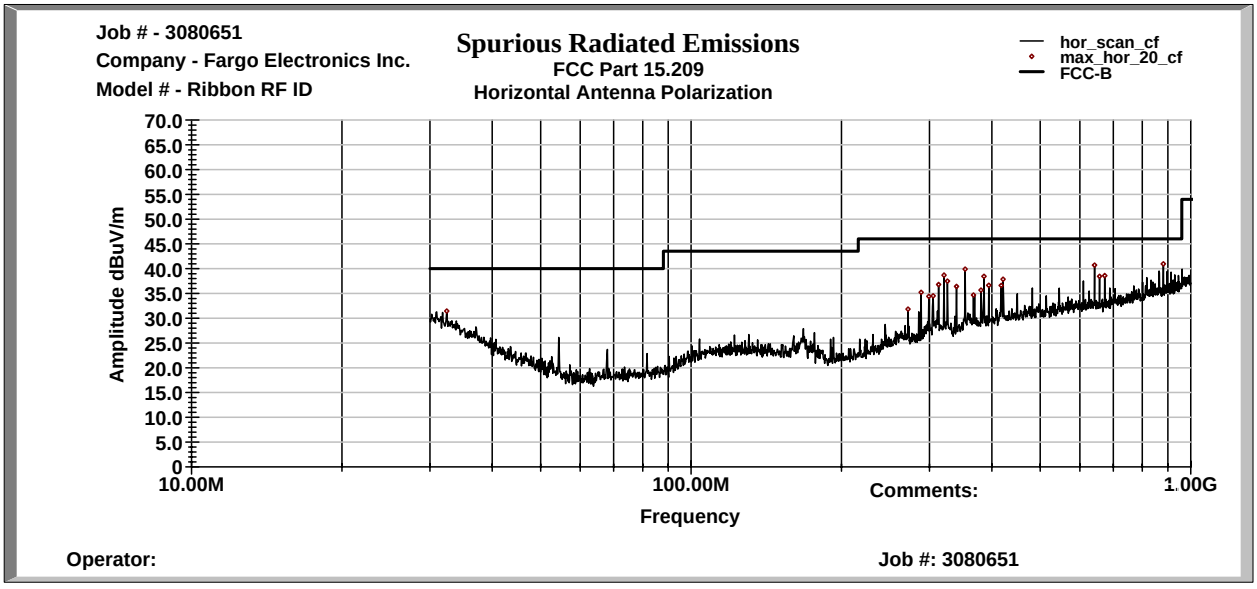
Frequency	Ant. Polarity	Reading dBμV	Ant.Factor dB1/m	Total at 3m dBμV/m	QP Limit dBμV/m	Margin dB
30.346 MHz	V	12.0	20.4	32.4	40.0	-7.6
48.356 MHz	V	20.6	10.6	31.2	40.0	-8.8
54.416 MHz	V	24.5	8.2	32.7	40.0	-7.3
67.991 MHz	V	23.7	7.1	30.7	40.0	-9.3
353.68 MHz	V	19.0	17.2	36.2	46.0	-9.8
369.27 MHz	V	18.9	17.6	36.4	46.0	-9.6
385.72 MHz	V	19.5	17.9	37.4	46.0	-8.6
977.01 MHz	V	13.1	26.1	39.2	54.0	-14.9
32.424 MHz	H	12.3	19.2	31.4	40.0	-8.6
288.75 MHz	H	20.0	15.2	35.2	46.0	-10.8
312.99 MHz	H	21.1	15.7	36.8	46.0	-9.2
320.78 MHz	H	22.7	16.0	38.7	46.0	-7.3
325.97 MHz	H	21.4	16.1	37.5	46.0	-8.5
339.83 MHz	H	19.8	16.6	36.4	46.0	-9.6
353.68 MHz	H	22.7	17.2	39.9	46.0	-6.1
385.72 MHz	H	20.6	17.9	38.5	46.0	-7.5
421.22 MHz	H	18.5	19.3	37.9	46.0	-8.2
642.0 MHz	H	18.6	22.1	40.7	46.0	-5.3
656.94 MHz	H	16.4	22.0	38.5	46.0	-7.6
672.86 MHz	H	16.4	22.2	38.6	46.0	-7.4

Graph # 3-3-1
Spurious Radiated Emissions from 30MHz to 1GHz

Vertical Antenna Polarization



Horizontal Antenna Polarization



3.4 Frequency Tolerance, FCC 15.225(e)

Frequency Stability with variation of ambient temperature was measured from –20 degrees C to +50 degrees C at frequency 13.56 MHz and rated power input 120VAC/60Hz.

Frequency Stability with variation of primary supply voltage was measured at 85% (102V) and 115% (138V) of rated AC Power Supply input voltage of 120V at frequency 13.56 MHz.

The Table 3-4-1 below shows the frequency stability vs. temperature ambient and supply voltage.

Frequency Stability **Date:** 07/22-25/2005
Company: Fargo Electronics Inc.
Model: RF ID Card Transmitter
Special Info: Enviromental Chamber (Frequency Stability testing)
Test Engineer: Norman Shpilsher
Standard: FCC 15.225(e)

Table # 3-4-1

Temperature Degree C	Output Frequency MHz	Frequency Stability Hz	Max. Deviation +/- 0.01% Hz	Test Result
-20	13.56	110	1356	Pass
-10	13.56	75	1356	Pass
0	13.56	48	1356	Pass
10	13.56	16	1356	Pass
20	13.56	0	1356	Pass
30	13.56	18	1356	Pass
40	13.56	33	1356	Pass
50	13.56	56	1356	Pass
55	13.56	82	1356	Pass
Input Power AC Voltage V	Output Frequency MHz	Frequency Stability Hz	Freq. Tolerance +/- 0.01% Hz	Test Result
102	13.56	0	1356	Pass
110	13.56	0	1356	Pass
120	13.56	0	1356	Pass
130	13.56	0	1356	Pass
138	13.56	0	1356	Pass

3.5 Bandwidth of Emissions, FCC 15.215

Bandwidth of Emissions measurements was made for the Fundamental frequency of 13.56MHz.

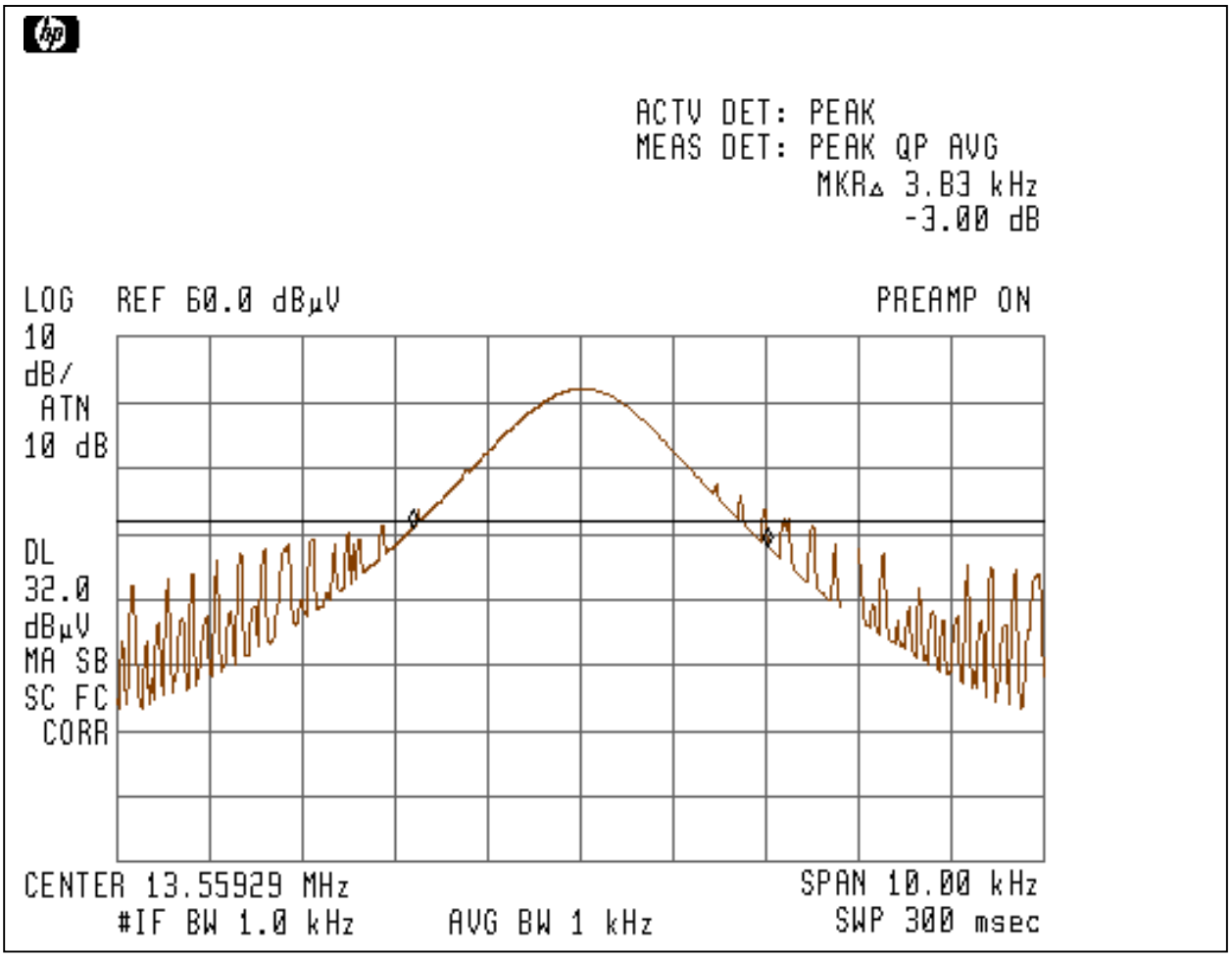
The Specified by FCC Part 15.225 frequency band is 13.553-13.567MHz, or 13560±7kHz.

20dB Bandwidth of Emissions at fundamental frequency was measured at 3.83kHz.

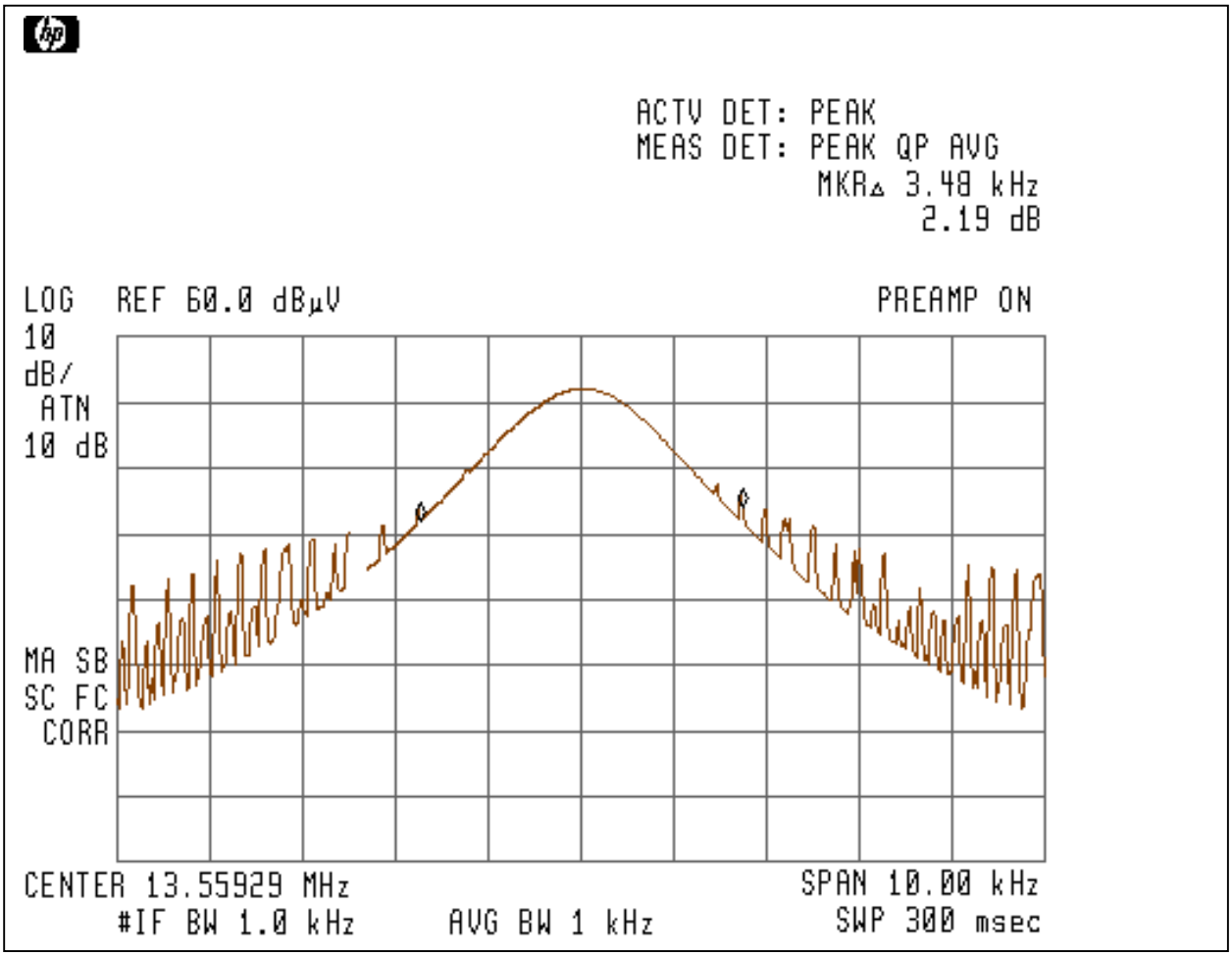
99% Bandwidth of Emissions at fundamental frequency was measured at 3.48kHz.

The Graphs 3-5-1 and 3-5-2 show the Bandwidth of Emissions.

Graph # 3-5-1
20dB Bandwidth



Graph # 3-5-2
99% Bandwidth



3.6 Line Conducted Emissions, FCC 15.207

Conducted Emissions testing was performed in frequency range from 150kHz to 30MHz.
The Conducted Emissions test was performed with terminated antenna output.

The maximum emissions were measured with margin 5.5dB below limits.

The Table # 3-6-1and Graph # 3-6-1 shows the Conducted Emissions.

Conducted Emissions From 150kHz to 30MHz **Date:** 07-28-2005
Company: Fargo Electronics
Model: Ribbon RF ID
Test Engineer: Norman Shpilsher
Special Info: Continuous operation mode
Standard: FCC Part 15.207
Note: The table shows the worst case conducted emissions
Measurements were taken using a Peak or CISPR Quasi-peak detector

Table # 3-6-1

Line 1

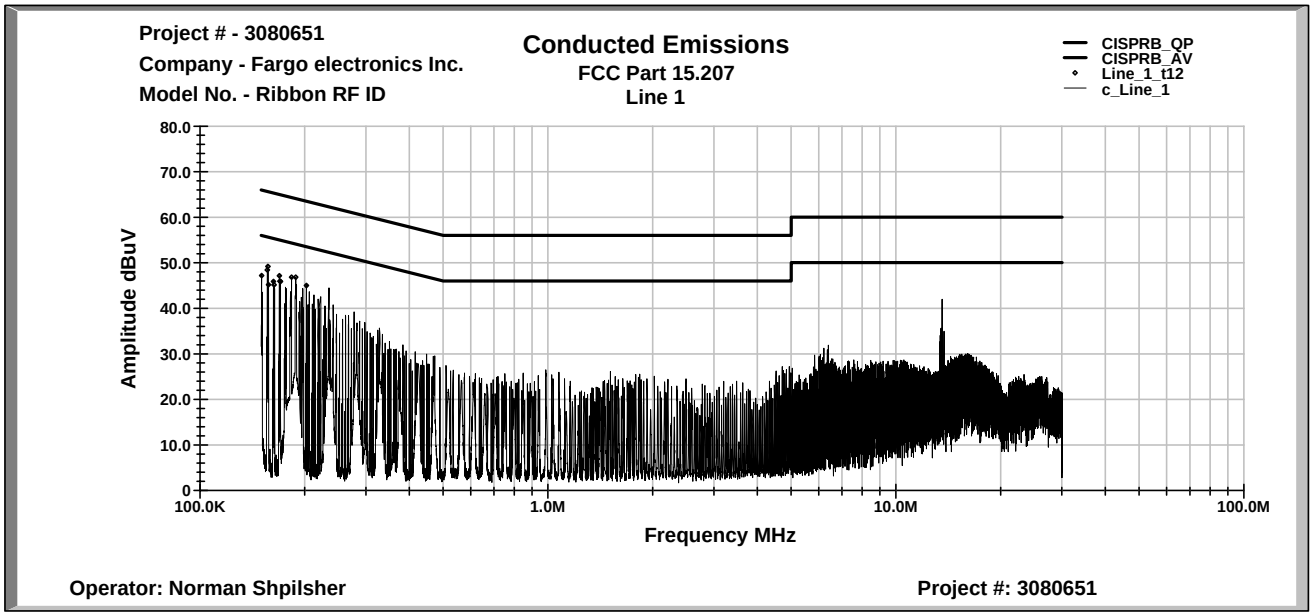
Frequency	Peak dBμV	QP Limit dBμV	AVG Limit dBμV	QP Margin dB	AVG Margin dB
150.39 KHz	47.160	66.0	56.0	-18.8	-8.8
156.21 KHz	48.390	65.7	55.7	-17.3	-7.3
156.8 KHz	49.170	65.6	55.6	-16.5	-6.5
157.48 KHz	45.170	65.6	55.6	-20.4	-10.4
162.72 KHz	45.880	65.3	55.3	-19.4	-9.4
163.3 KHz	45.140	65.3	55.3	-20.2	-10.2
169.13 KHz	47.140	65.0	55.0	-17.9	-7.9
169.81 KHz	45.950	65.0	55.0	-19.0	-9.0
170.39 KHz	45.880	64.9	54.9	-19.1	-9.1
183.3 KHz	46.840	64.3	54.3	-17.5	-7.5
188.55 KHz	46.800	64.1	54.1	-17.3	-7.3
202.28 KHz	44.980	63.5	53.5	-18.5	-8.5

Line 2

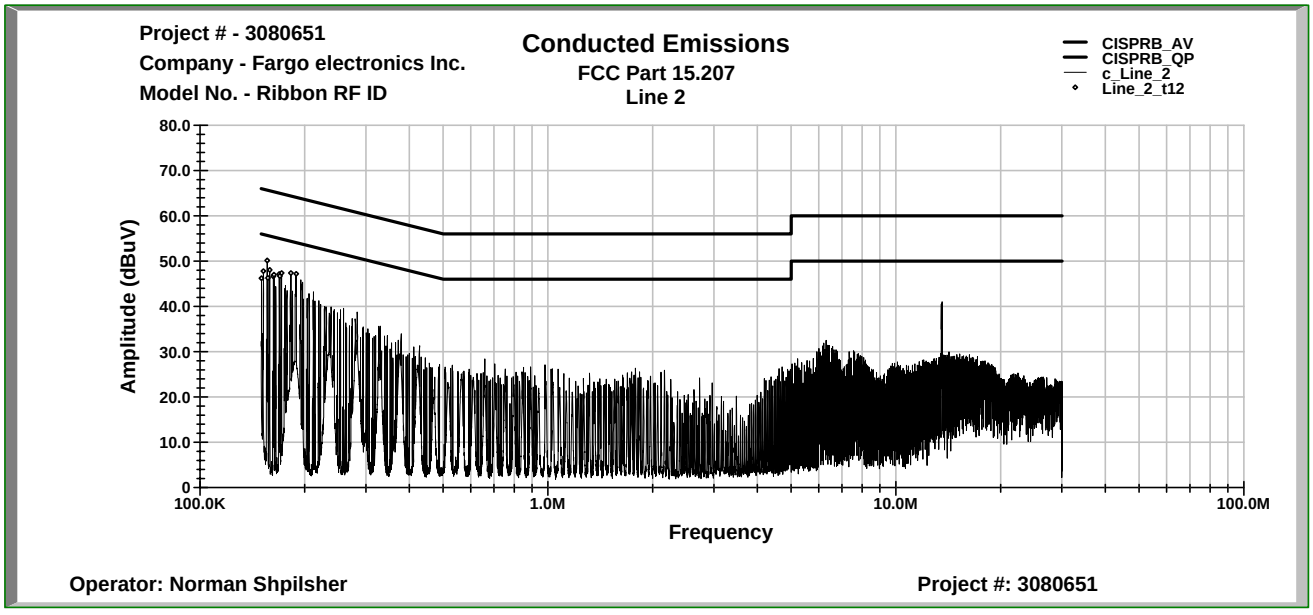
Frequency		QP Limit dBmV	AVG Limit dBmV	QP Margin dB	AVG Margin dB
150.29 KHz	46.210	66.0	56.0	-19.8	-9.8
152.23 KHz	47.780	65.9	55.9	-18.1	-8.1
156.12 KHz	50.140	65.7	55.7	-15.5	-5.5
156.8 KHz	46.280	65.6	55.6	-19.4	-9.4
158.74 KHz	48.040	65.5	55.5	-17.5	-7.5
162.53 KHz	46.630	65.3	55.3	-18.7	-8.7
163.21 KHz	46.980	65.3	55.3	-18.3	-8.3
169.03 KHz	47.140	65.0	55.0	-17.9	-7.9
169.71 KHz	46.700	65.0	55.0	-18.3	-8.3
171.65 KHz	47.350	64.9	54.9	-17.5	-7.5
182.62 KHz	47.350	64.4	54.4	-17.0	-7.0
189.08 KHz	47.180	64.1	54.1	-16.9	-6.9

Graph # 5-6-1
Conducted Emissions from 150kHz to 30MHz

Line 1



Line 2



3.6 Test Procedure

Field Strength Measurements

The EUT was placed on a non-conductive table 0.8m above the ground plane. The table was centered on a motorized turntable, which allows 360-degree rotation. The measurement antenna was positioned at 3m distance. The Bicono-Log antenna was used in frequency range from 30MHz to 1GHz. The radiated emissions were maximized by configuring the EUT, by rotating the EUT, by changing antenna polarization, and by changing antenna height from 1 to 4m.
In frequency range below 30MHz the Loop antenna was used at 10m measurement distance with antenna heights of 1m and antenna loop and side faced to the EUT.
Method of the direct Field Strength Calculation is shown in Section 3.4.

Frequency Tolerance

The EUT was placed in an environmental test chamber and powered such that control element received normal voltage and the transmitter provided maximum RF output. The Chamber was programmed to cool from room temperature to minus 20 degrees C and then step in 10-degree increments to plus 55 degrees C.
For Frequency Stability testing with variation of primary supply voltage the EUT power supply was powered at rated supply voltage at 120VAC/60Hz and then at 102VAC/60Hz and 138VAC/60Hz

Conducted Emissions

For conducted emissions testing, the equipment is moved to an insulating platform over the ground plane, and the EUT is powered from a LISN. Both sides of the AC line are measured and the results are compared to the applicable limits. Measurements are taken using CISPR quasi-peak and average detectors when the peak readings approach or exceed the average limit. Only quasi-peak readings are taken when the emissions from the EUT meet the average limit as measured with the quasi-peak detector. Only peak readings might be taken when the emissions from the EUT meet the average limit as measured with the peak detector.

3.7 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured emissions reading on the EMI Receiver.
The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG

Where: FS = Field Strength in dB(μV/m)
RA = Receiver Amplitude in dB(μV)
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB(m^{-1})
AG = Amplifier Gain in dB

Assume a receiver reading of 48.1 dB(μV) is obtained. The antenna factor of 7.4 dB(m^{-1}) and cable factor of 1.6 dB is added and amplifier gain of 16.0 dB is subtracted giving field strength of 41.1 dB(μV/m).

RA = 48.1 dB(μV)
AF = 7.4 dB(m^{-1})
CF = 1.6 dB
AG = 16.0 dB
FS = RA + AF + CF - AG
FS = 48.1 + 7.4 + 1.6 – 16.0
FS = 41.1 dB(μV/m)

In the tables the Cable correction factors are included to the Antenna Factors.

3.8 Measurement Uncertainty

The expanded uncertainty (k = 2) for radiated emissions from 30 to 1000 MHz has been determined to be:
±4 dB at 10m ±5.4 dB at 3m

The expanded uncertainty (k = 2) for emissions from 150 kHz to 30 MHz has been determined to be:
±2.6 dB

Tested by:

Norman Shpilsher
Sr. EMC Engineer
Intertek ETL SEMKO

Signature

Date: July 28, 2005

4.0 TEST EQUIPMENT

Receivers/Spectrum Analyzers and Test Software

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
HP85462A Receiver RF Section	3325A00106	09/04	09/05	X
HP85460A RF Filter Section	3330A00109	09/04	09/05	X
HP85462A Receiver RF Section	3549A00306	01/05	01/06	X
HP85460A RF Filter Section	3448A00276	01/05	01/06	X
TILE! Instrument Control System	Ver. 3.4.G.3	N/A	N/A	X

Antennas

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
Schaffner-Chase Bicono-Log Antenna	2468	01/05	01/06	X
A.H.Systems SAS-200/562B 18" Active Loop Antenna	215	04/05	04/06	X
EMCO Horn Antenna 3115	9507-4513	12/03	12/04	
EMCO Horn Antenna 3115	6579	01/04	01/05	

Artificial Mains Networks/Absorbing Clamps

DESCRIPTION	SERIAL NO.	LAST CAL	CAL DUE	USED
FCC LISN-2	316	04/05	04/06	X
FCC-LISN-50-25-2	2014	05/05	05/06	