

Intertek

ETL SEMKO

TEST REPORT

Report Number: 3081256MIN-001

Project Number: 3081256

August 30, 2005

Evaluation of the
I-Class Encoder OEM300
FCC ID: JZ2OEM300

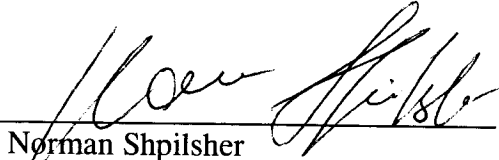
to
FCC Part 2
FCC Part 15, Subpart C, Section 15.225

For
Fargo Electronics Inc.

Test Performed by:
Intertek
7250 Hudson Blvd. Suite 100
Oakdale, MN 55128

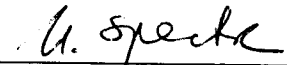
Test Authorized by:
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Date: August 30, 2005

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Date: August 30, 2005

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1.0 GENERAL DESCRIPTION

1.1 Related Submittals Grants

This is single application of the *I-Class Encoder OEM300* Transmitter for Certification under Part 15 Subpart C.

There are no other simultaneous applications.

1.2 Product Description

The *I-Class Encoder OEM300* Transmitter is operating at 13.56 MHz.

The *I-Class Encoder OEM300* Transmitter is incorporated in X001300 Printer and X001500 Printer (as an optional) manufactured by Fargo Electronics Inc. The Transmitters are identical for both devices. The intended use of the *I-Class Encoder OEM300* Transmitter is to generate and transmit a RF signal from the Antenna to the I-Class ID Card; the same antenna is used to receive modified by the I-Class ID Card signal (inductive coupling).

The *I-Class Encoder OEM300* Transmitter is powered at 12VDC from the host device (X001300 Printer and X001500 Printer). For purpose of testing the Transmitter was powered at 120VAC, 60 Hz through the AC/DC Power Adapter.

The *I-Class Encoder OEM300* Transmitter antenna is an integral antenna located on the same with the transmitter PCB.

Sample Submitted: August 4, 2005
Test Work Started: August 4, 2005
Test Work Completed: August 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 *I-Class Encoder OEM300* Transmitter compliance the transmitter was tested without enclosure on the metal plate, which is used for transmitter mounting in the host device.

2.2 EUT Setup

For simplicity of testing, the transmitter was set to transmit continuously.

2.3 EUT Exercising Software

The transmitter was exercised with I-Class Encoder OEM300 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

GlobTek 100-240VAC/50-60Hz to 12VDC Power Adapter
iClass 2K ID Card

2.7 Test Configuration Block Diagrams

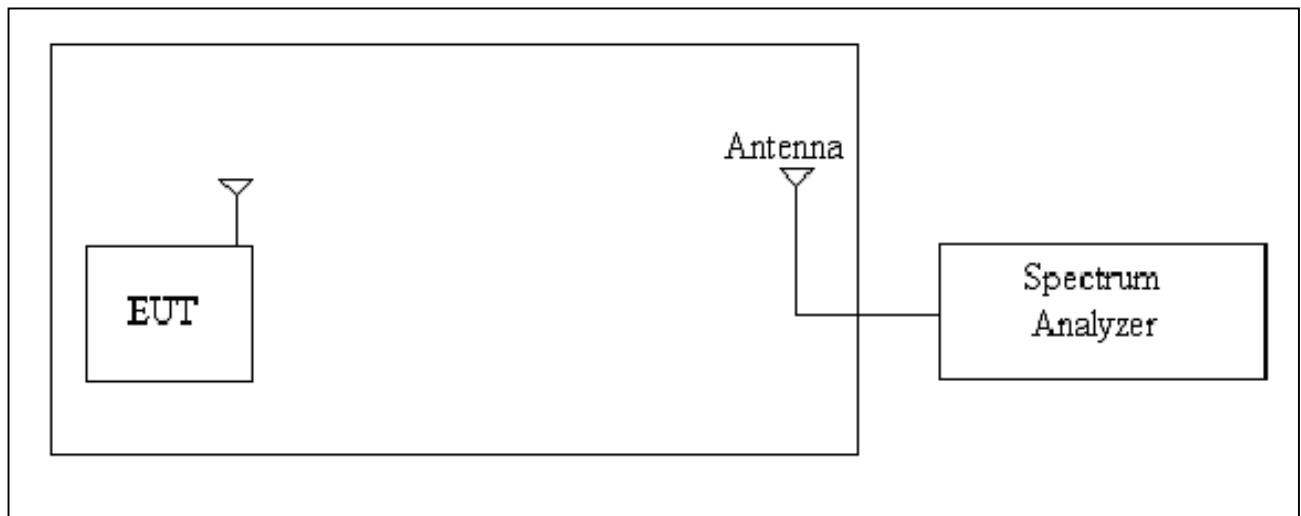
The EUT was setup as tabletop equipment.

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:

15848 μ V/m, or 84.0dB μ V/m within the band 13.553-13.567MHz

334 μ V/m, or 50.5dB μ V/m within the bands 13.410-13.553MHz and 13.567-13.710MHz

106 μ V/m, or 40.5dB μ V/m within the bands 13.110-13.410MHz and 13.710-14.010MHz

The maximum emissions were measured at 13.56MHz with margin 50.3dB below the limits.

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

Radiated Emissions at Fundamental Frequency

Date: 08-04-2005

Company: Fargo Electronics Inc.
Model: OEM300, I-Class RFID Transmitter
Test Engineer: Norman Shpilsher
Special Info: Continuous operation mode
Fundamental 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 dB μ V	Antenna		Net at 10m. dB μ V/m	Distance Factor dB	Limit dB μ V/m	Margin dB
		Factor (dB/m)	Position				
13.560	42.5	7.2	Front	49.7	19.1	84.0	-53.4
13.560	45.6	7.2	Side	52.8	19.1	84.0	-50.3

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 $30\mu\text{V/m}$, or $29.5\text{dB}\mu\text{V/m}$

The maximum emissions were measured with margin 1.3dB 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: 08-04-2005

Company: Fargo Electronics Inc.
Model: OEM300, I-Class RFID Transmitter
Test Engineer: Norman Shpilsher
Special Info: Continuous operation mode
 Fundamental 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 $\text{dB}\mu\text{V}$	Antenna		Net at 10m. $\text{dB}\mu\text{V/m}$	Distance Factor dB	Limit $\text{dB}\mu\text{V/m}$	Margin dB
		Factor (dB/m)	Position				
13.553	32.8	7.2	Front	40.0	19.1	29.5	-8.6
13.567	35.1	7.2	Front	42.3	19.1	29.5	-6.3
13.553	39.2	7.2	Side	46.4	19.1	29.5	-2.2
13.567	40.1	7.2	Side	47.3	19.1	29.5	-1.3

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 $30\mu\text{V/m}$, or $29.5\text{dB}\mu\text{V/m}$
- 30-88MHz at 3m is $100\mu\text{V/m}$, or $40.0\text{dB}\mu\text{V/m}$
- 88-216MHz at 3m is $150\mu\text{V/m}$, or $43.5\text{dB}\mu\text{V/m}$
- 216-960MHz at 3m is $200\mu\text{V/m}$, or $46.0\text{dB}\mu\text{V/m}$
- above 960MHz at 3m is $500\mu\text{V/m}$, or $54.0\text{dB}\mu\text{V/m}$

The maximum emissions were measured with margin -22.2dB below limits.

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

Spurious Radiated Emissions

Date: 08-04-2005

Company: Fargo Electronics Inc.
Model: OEM300, I-Class RFID Transmitter
Test Engineer: Norman Shpilsher
Special Info: Continuous operation mode
Fundamental 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 $\text{dB}\mu\text{V}$	Antenna		Net at 10m. $\text{dB}\mu\text{V/m}$	Distance Factor dB	Limit $\text{dB}\mu\text{V/m}$	Margin dB
		Factor (dB/m)	Position				
27.120	8.4	14.3	Front	22.7	19.1	29.5	-25.9
27.120	12.1	14.3	Side	26.4	19.1	29.5	-22.2

Comments:

Radiated Emissions from 30MHz to 1GHz
Date: 08-12-2005

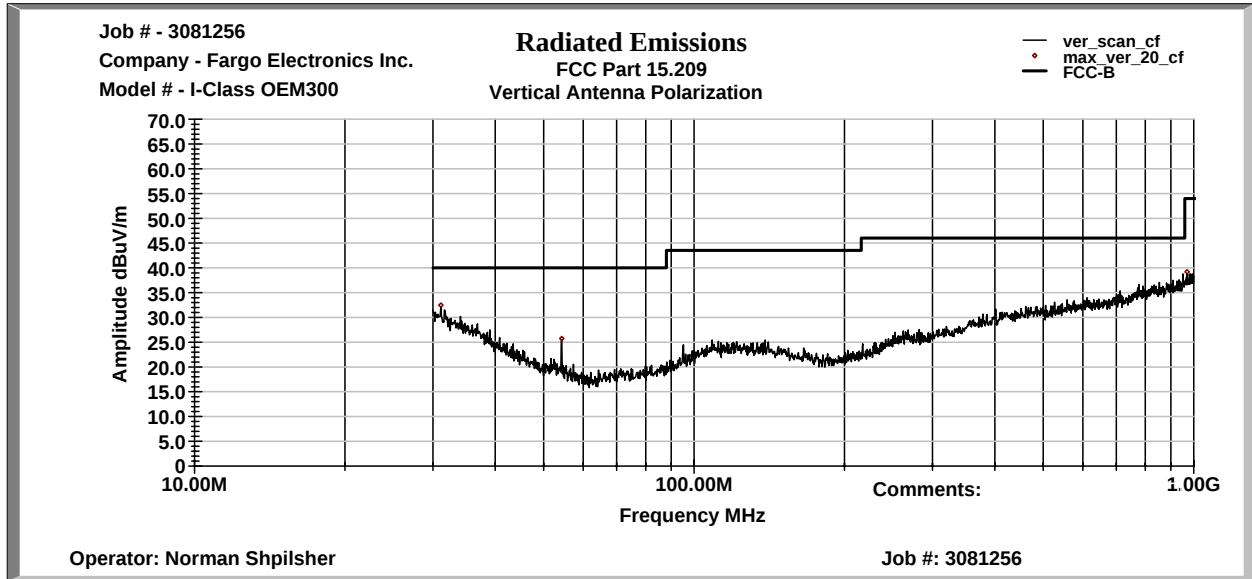
Company: Fargo Electronics
Model: OEM300, I-Class RFID Transmitter
Test Engineer: Norman Shpilsher
Special Info: Continuous operation mode
Standard: FCC Part 15.205, 15.209
Test Site: 3m Anechoic Chamber, 3m measurement distance
Note: The table shows the worst case radiated emissions
 All measurements were taken using a Peak detector

Table # 3-3-2

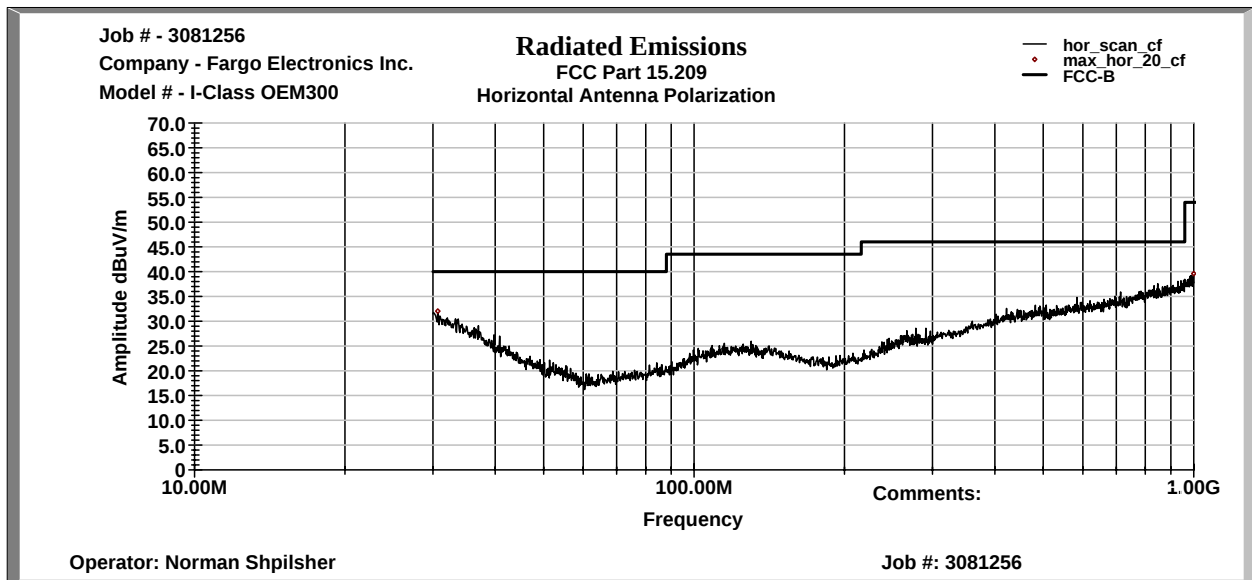
Frequency	Ant. Polarity	Reading dB μ V	Ant.Factor dB1/m	Total at 3m dB μ V/m	QP Limit dB μ V/m	Margin dB
31.126 MHz	V	12.5	19.9	32.5	40.0	-7.5
54.33 MHz	V	17.5	8.3	25.7	40.0	-14.3
95.04 MHz	V	13.5	10.8	24.3	43.5	-19.2
108.66 MHz	V	12.7	12.7	25.4	43.5	-18.1
268.25 MHz	V	12.7	14.8	27.5	46.0	-18.5
969.94 MHz	V	13.2	26.0	39.2	54.0	-14.8
30.693 MHz	H	11.9	20.2	32.0	40.0	-8.0
1.0 GHz	H	13.5	26.1	39.6	54.0	-14.4

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:	08/11-12/2005
Company:	Fargo Electronics Inc.	
Model:	OEM300, I-Class RFID 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 Deviation Hz	Max. Deviation +/- 0.01 % Hz	Test Result
-20	13.56	120	1356	Pass
-10	13.56	80	1356	Pass
0	13.56	24	1356	Pass
10	13.56	12	1356	Pass
20	13.56	0	1356	Pass
30	13.56	10	1356	Pass
40	13.56	36	1356	Pass
50	13.56	79	1356	Pass
55	13.56	88	1356	Pass
Input Power AC Voltage V	Output Frequency MHz	Frequency Deviation 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.

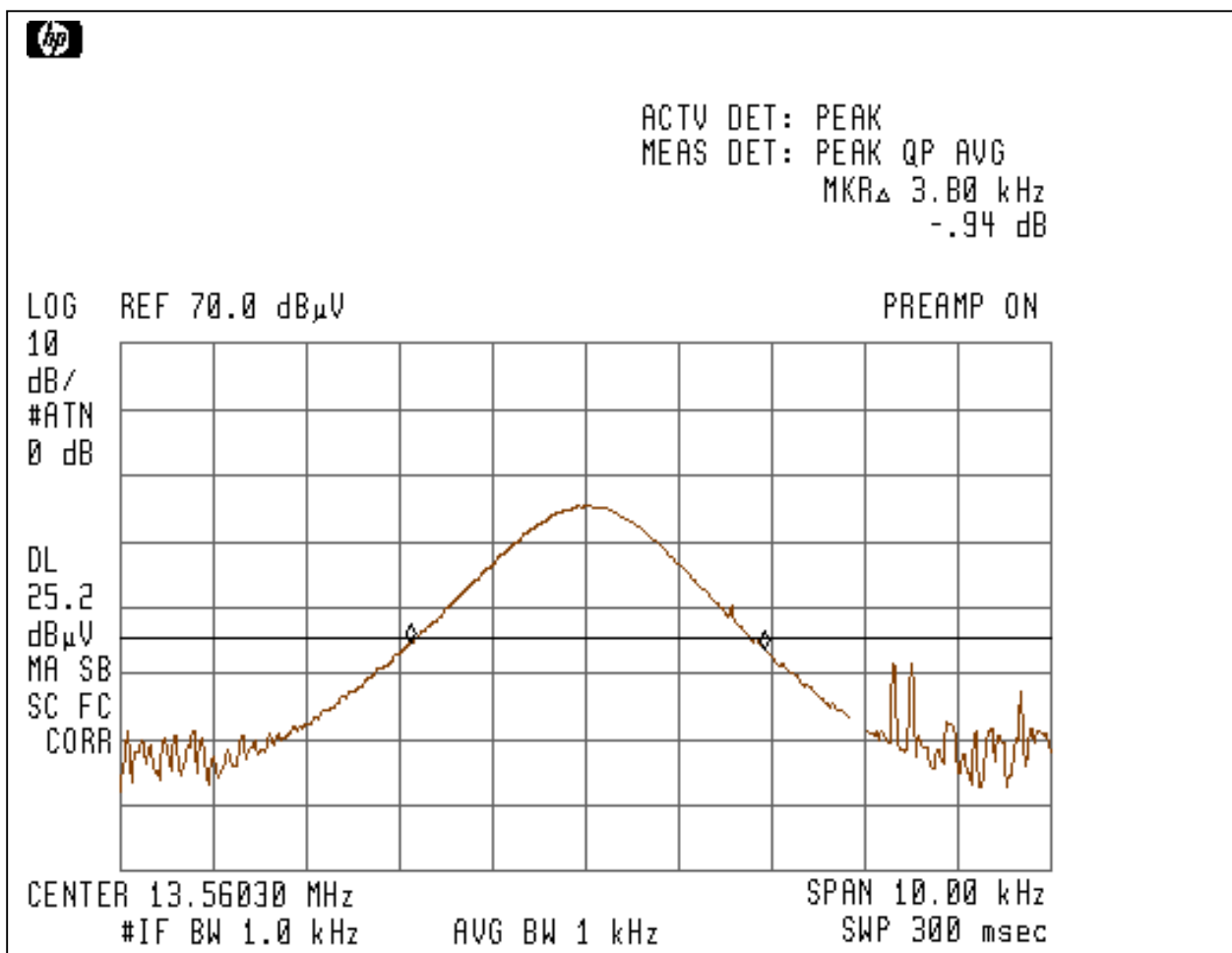
The Specified by FCC Part 15.225 frequency band is 13.553-13.567MHz, or $13560 \pm 7\text{kHz}$.

20dB Bandwidth of Emissions at fundamental frequency was measured at 3.8kHz.

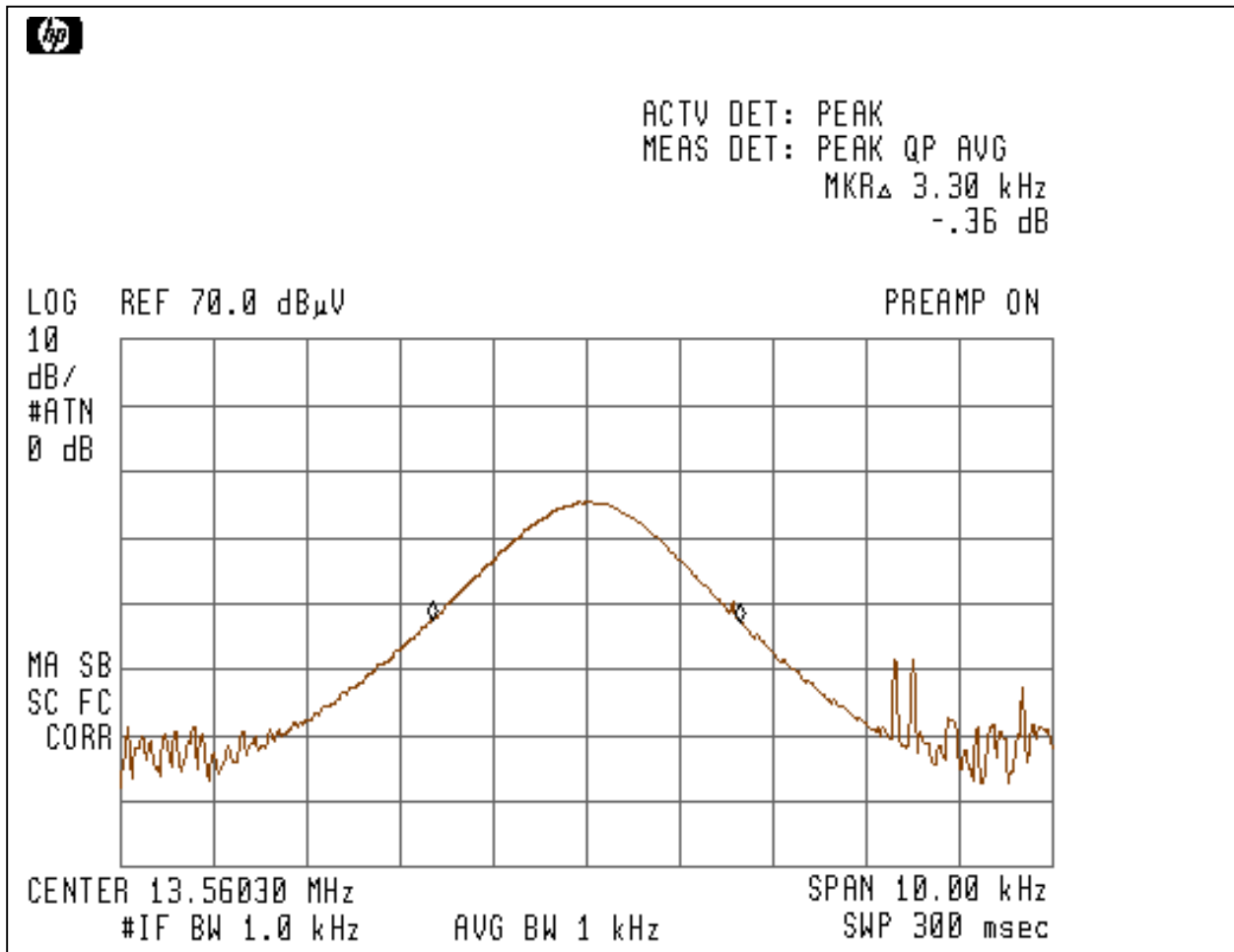
99% Bandwidth of Emissions at fundamental frequency was measured at 3.3kHz.

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 2.2dB below limits.

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

Conducted Emissions From 150kHz to 30MHz

Date: 08-11-2005

Company: Fargo Electronics
Model: OEM300, I-Class RFID Transmitter
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 detector

Table # 3-6-1

Line 1

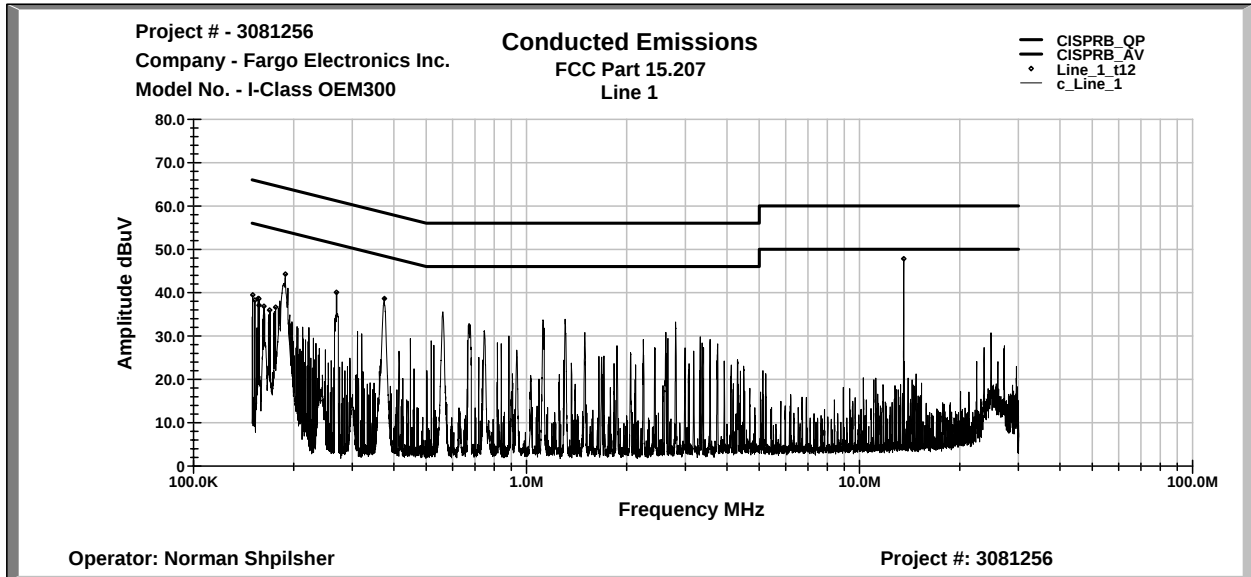
Frequency	Peak dB μ V	QP Limit dB μ V	AVG Limit dB μ V	QP Margin dB	AVG Margin dB
150.58 KHz	39.460	66.0	56.0	-26.5	-16.5
152.82 KHz	38.280	65.9	55.9	-27.6	-17.6
156.41 KHz	38.620	65.7	55.7	-27.0	-17.0
157.09 KHz	38.600	65.6	55.6	-27.0	-17.0
157.38 KHz	37.080	65.6	55.6	-28.5	-18.5
162.82 KHz	36.850	65.3	55.3	-28.5	-18.5
169.32 KHz	35.970	65.0	55.0	-29.0	-19.0
176.41 KHz	36.640	64.7	54.7	-28.0	-18.0
188.74 KHz	44.270	64.1	54.1	-19.8	-9.8
268.82 KHz	40.060	61.2	51.2	-21.1	-11.1
374.26 KHz	38.630	58.4	48.4	-19.8	-9.8
13.565 MHz	47.830	60.0	50.0	-12.2	-2.2

Line 2

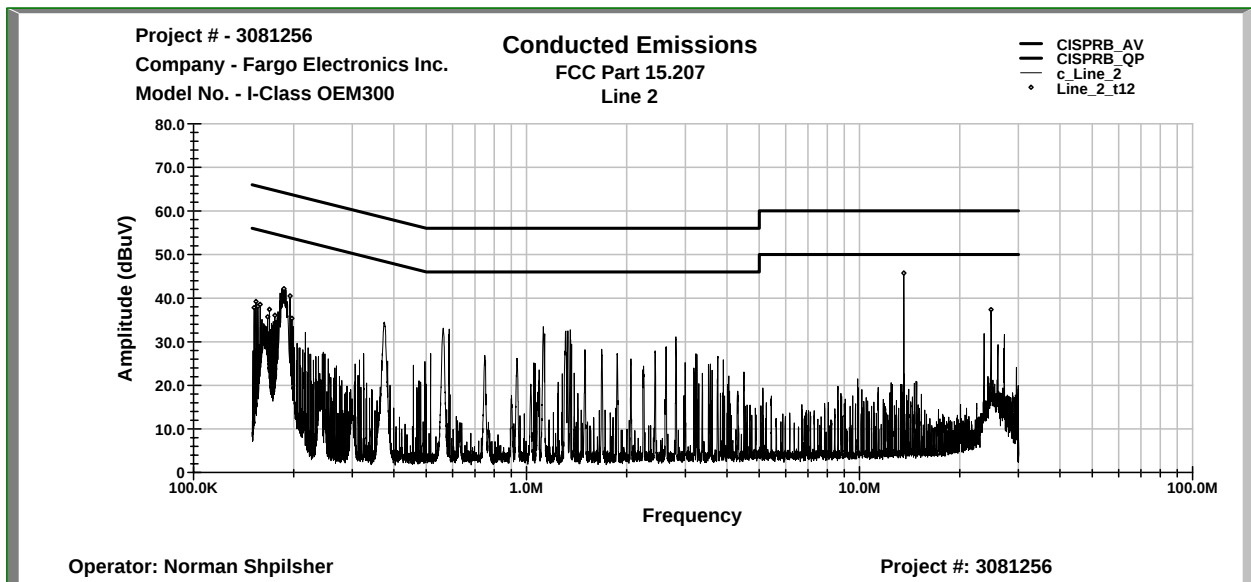
Frequency		QP Limit dBmV	AVG Limit dBmV	QP Margin dB	AVG Margin dB
152.14 KHz	37.810	65.9	55.9	-28.1	-18.1
154.08 KHz	39.200	65.8	55.8	-26.6	-16.6
156.12 KHz	38.140	65.7	55.7	-27.5	-17.5
158.54 KHz	38.550	65.5	55.5	-27.0	-17.0
166.99 KHz	35.690	65.1	55.1	-29.4	-19.4
169.03 KHz	37.390	65.0	55.0	-27.6	-17.6
175.54 KHz	36.050	64.7	54.7	-28.6	-18.6
186.9 KHz	42.140	64.2	54.2	-22.0	-12.0
194.95 KHz	40.480	63.8	53.8	-23.3	-13.3
197.52 KHz	35.340	63.7	53.7	-28.4	-18.4
13.573 MHz	45.730	60.0	50.0	-14.3	-4.3
24.82 MHz	37.350	60.0	50.0	-22.7	-12.7

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(μ V/m)

RA = Receiver Amplitude in dB(μ V)

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(μ V) 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(μ V/m).

$$RA = 48.1 \text{ dB}(\mu V)$$

$$AF = 7.4 \text{ dB}(m^{-1})$$

$$CF = 1.6 \text{ dB}$$

$$AG = 16.0 \text{ dB}$$

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

$$FS = 48.1 + 7.4 + 1.6 - 16.0$$

$$FS = 41.1 \text{ dB}(\mu V/m)$$

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:
 $\pm 4 \text{ dB at } 10m \pm 5.4 \text{ dB at } 3m$

The expanded uncertainty ($k = 2$) for emissions from 150 kHz to 30 MHz has been determined to be:
 $\pm 2.6 \text{ dB}$

Tested by:

Norman Shpilsher
Sr. EMC Engineer
Intertek ETL SEMKO

Signature



Date: August 30, 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	