FCC Part 15.249
Transmitter Certification

Test Report

FCC ID: SJS-380112WM

FCC Rule Part: 15.249

ACS Report Number: 06-0411-15C

Manufacturer: MARS Company
Model: 380112WM

Test Begin Date: October 25, 2006
Test End Date: October 26, 2006

Report Issue Date: March 5, 2007

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report is not be used to claim certification, approval, or endorsement by NVLAP, NIST or any government agency.

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This report contains 14 pages

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1.0 GENERAL

1.1 Purpose
The purpose of this report is to demonstrate compliance with Part 15, Subpart C of the FCC's Code of Federal Regulations.

1.2 Product Description

1.2.1 General
The Mars Company 380112WM is a transmitter to be used in the utility industry to transmit meter-reading data from a utility meter to a mobile data-collecting device.

The device operates in a 'regular transmit' mode. The utility meter is interrogated every 30 minutes to 1 hour, and the reading taken is transmitted every 4 seconds (maximum, in some instances the unit will transmit less often).

Applicant Information:
MARS Company
3925 SW 13th Stl
Ocala, FL 34477-2887

Detailed photographs of the EUT are filed separately with this filing.

1.2.2 Intended Use
The unit is intended to be used to transmit meter-reading data from a utility meter to a mobile data-collecting device.

1.3 Test Methodology and Considerations
The 380112WM utility meter transmitter is intended for wall mount installation above ground level. Testing was performed as typically installed on a wooden test fixture as described in section 6.0.

The device was modified for continuous transmission for testing purposes.

2.0 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment. In addition, ACS is compliant to ISO 17025 as certified by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 89450
Industry Canada Lab Code: IC 4175
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

NVLAP Lab Code: 200612-0

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

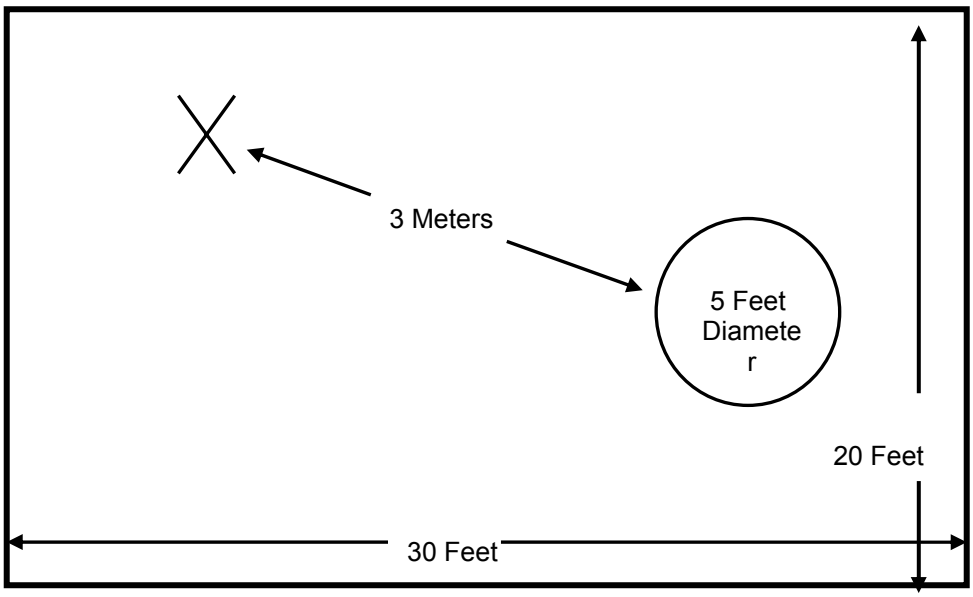

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

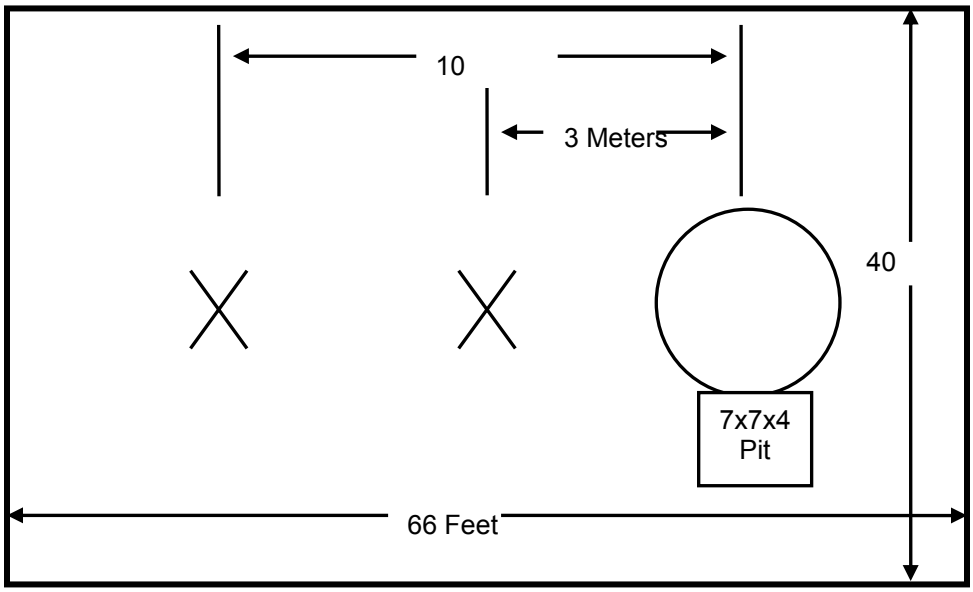

Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal group reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 4.1.3-1:

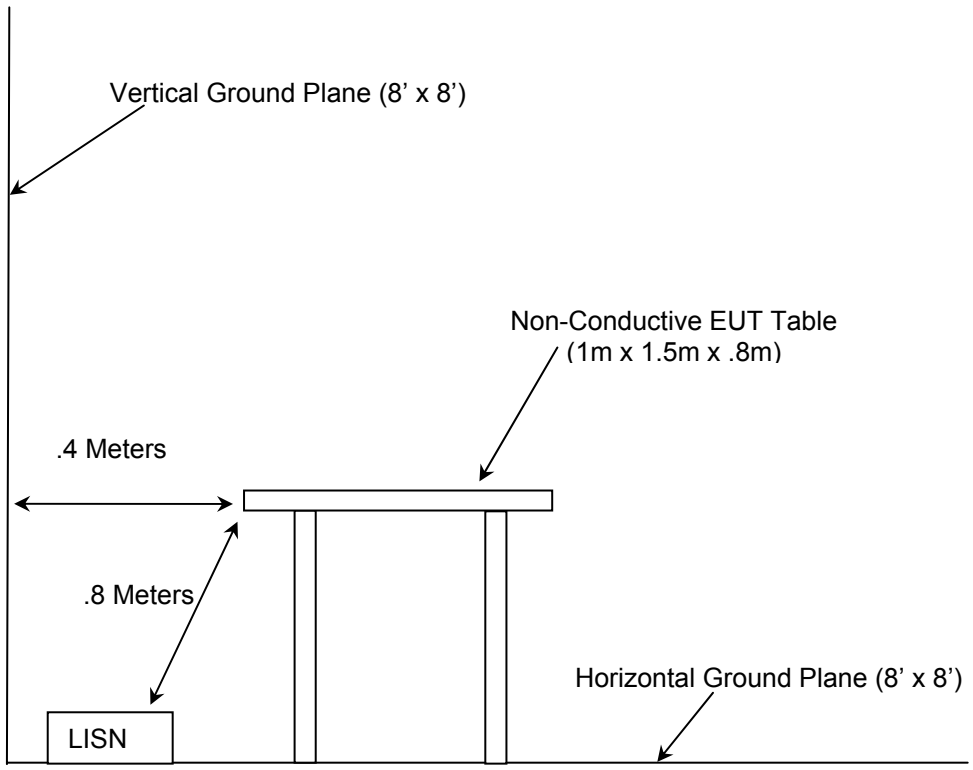

Figure 2.4-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2006
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2006

4.0 LIST OF TEST EQUIPMENT

All test equipment used for regulatory testing is calibrated yearly or according to manufacturer's specifications.

Table 4-1: Test Equipment

Equipment Calibration Information					
ACS#	**Mfg.**	**Eq. type**	**Model**	**S/N**	**Cal. Due**
☒ 090	ElectroMetrics	LPA Antenna	LPA-25	1476	5/25/07
☒ 225	Andrew	OATS RF cable	Heliax	225	1/07/07
☒ 213	Test Equipment Corp.	Pre-Amplifier	PA-102	44927	12/5/06
☒ 167	ACS	Chamber EMI Cable Set	RG6	167	1/7/07
☒ 22	Agilent	Pre-Amplifier	8449B	3008A00526	5/06/07
☒ 73	Agilent	Pre-Amplifier	8447D	272A05624	5/18/07
☒ NA	Agilent	Spectrum Analyzer	E7405A	MY42000128	2/28/07
☒ 30	Spectrum Technologies	Horn Antenna	DRH-0118	970102	5/12/07
☒ 331	Microwave Circuits	High Pass Filter	H1G513G1	31417 DC0633	08/29/07
☒ 1	Rohde & Schwarz	Receiver Display	804.8932.52	833771/007	3/01/07
☒ 2	Rohde & Schwarz	ESMI Receiver	1032.5640.53	839587/003	3/01/07
☒ 283	Rohde & Schwarz	Spectrum Analyzer	FSP-40	1000033	3/24/07
☒ 290	Florida RF Labs	HF RF Cable	SMSE-200-72.0-SMRE	NA	5/08/07
☒ 291	Florida RF Labs	HF RF Cable	SMRE-200W-12.0-SMRE	NA	5/08/07
☒ 292	Florida RF Labs	HF RF Cable	SMR-280AW-480.0-SMR	NA	5/24/07

5.0 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number	FCC ID
The EUT was tested as a stand alone device and no support equipment was utilized.					

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

The EUT was tested in a stand alone configuration which utilized an internal battery for operation. Consistent with the typical installation, all measurements were made with the EUT affixed to a wooden test fixture to facilitate mounting of the EUT.

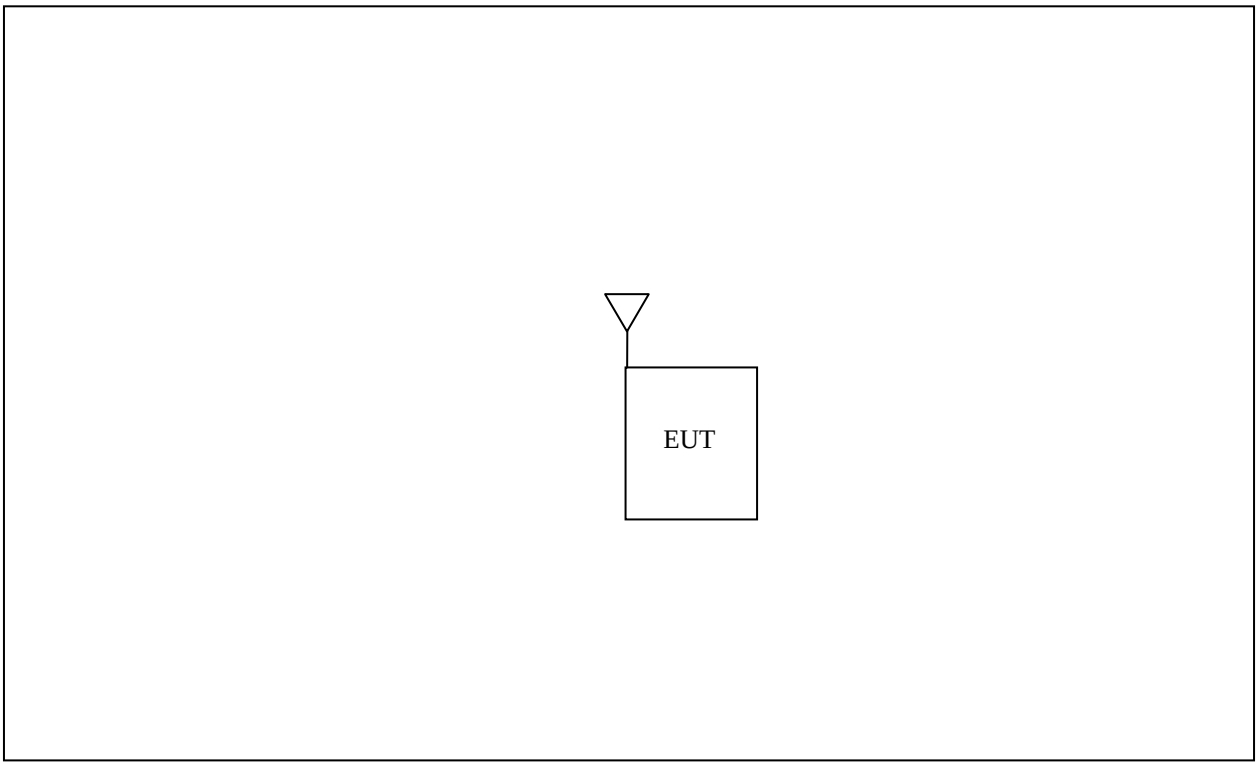

Figure 6-1: EUT Test Setup

*See Test Setup photographs for additional detail.

7.0 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement - FCC Section 15.203

The EUT employs a permanently attached internal integral antenna which can not be modified. The product uses a quarter wave 0dBi gain antenna.

7.2 Power Line Conducted Emissions - FCC Section 15.207

The EUT is powered by an internal battery and is therefore not designed to be connected to the public utility (AC) power line. No Power line conducted emissions testing was performed.

7.3 Radiated Emissions - FCC Section 15.109(Unintentional Radiation)

7.3.1 Test Methodology

Radiated emissions tests were performed over the frequency range of 30MHz to 1000 MHz. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test (EUT) and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. A Quasi-peak detector was enabled and measurements were taken with the Spectrum Analyzer's resolution bandwidth set to 120 KHz.

7.3.2 Test Results

Results of the test are given in Table 7.3-1 below:

Table 7.3-1 – Radiated Emissions (Unintentional)

Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Polarization (H/V)
30.00	13.9	40.0	26.2	338	177	HORIZONTAL
44.88	6.6	40.0	33.4	190	54	HORIZONTAL
85.44	4.2	40.0	35.8	110	322	VERTICAL
95.44	12.2	43.5	31.3	150	57	VERTICAL
132.40	7.5	43.5	36.0	210	15	HORIZONTAL
207.12	6.7	43.5	36.8	270	263	HORIZONTAL
351.12	12.8	46.0	33.2	170	66	HORIZONTAL
499.36	17.0	46.0	29.0	210	354	HORIZONTAL
693.28	20.8	46.0	25.2	390	99	HORIZONTAL
960.00	25.5	46.0	20.5	110	217	HORIZONTAL

* Note: All emissions above 960.00 MHz were attenuated below the permissible limit.

7.4 Fundamental Field Strength – FCC Section 15.249(a)

7.4.1 Test Methodology

Radiated emissions tests were made on the 3 channels in the 902MHz to 928MHz frequency range, the low channel being 905 MHz, the middle channel being 915 MHz, and the high channel being 925 MHz.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Quasi-peak measurements were made using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz.

7.4.2 Test Results

Results are shown below in table 7.4.2-1 below:

Table 7.4.2-1: Fundamental Field Strength

Frequency [MHz]	Uncorrected Level [dBuV/m]	Correction Factors [dB]	Corrected Level [dBuV/m]	Limit [dBuV/m]	Margin [dB]
905	87.96	2.85	90.81	94.00	3.17
915	87.82	2.80	90.62	94.00	3.36
925	90.22	2.90	93.12	94.00	0.86

7.5 Radiated Spurious Emissions – FCC Section 15.249(a)

7.5.1 Test Methodology

Radiated emissions tests were made over the frequency range of 30MHz to 10 GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz. For frequencies above 1000MHz, average measurements were made using an RBW of 1 MHz and a VBW of 10 Hz and peak measurements were made with RBW of 1 MHz and a VBW of 1 MHz.

7.5.2 Duty Cycle Correction

Under normal operation the unit will transmit its data every 4 seconds. The Radio transmitter is only turned on during this transmission, and is in power down state at all other times. The maximum duration of the RF transmission is 4ms (Nominally 3.5ms, but have added 0.5ms to allow for any tolerances, power up / power down delays).

For average radiated measurements, the measured level was reduced by a factor 27.95dB to account for the duty cycle of the EUT. The EUT transmits for 4mS on a channel followed by a 4 second rest period before the next transmission. Therefore the duty cycle is 4%. The duty cycle correction factor is determined using the formula: 20log (.04)=-27.95 dB.

7.5.3 Test Results

Results are shown below in Table 7.5.3-1.

Table 7.5.3-1 - Radiated Spurious Emissions

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Spurious Emissions										
1810	71.59	69.60	V	-9.04	62.55	32.60	74.0	54.0	11.45	21.40
1810	68.18	66.50	H	-9.15	59.03	29.39	74.0	54.0	14.97	24.61
2715	68.07	66.26	V	-5.34	62.73	32.96	74.0	54.0	11.27	21.04
2715	67.99	66.10	H	-5.11	62.88	33.03	74.0	54.0	11.12	20.97
3620	53.53	43.97	V	-2.40	51.13	13.61	74.0	54.0	22.87	40.39
3620	52.93	44.25	H	-2.37	50.56	13.92	74.0	54.0	23.44	40.08
4525	53.53	45.41	H	-0.17	53.36	17.28	74.0	54.0	20.64	36.72
5430	52.34	43.90	H	3.00	55.34	18.94	74.0	54.0	18.66	35.06
				Spurious Emissions						
1830	67.55	66.89	V	-8.70	58.85	30.23	74.0	54.0	15.15	23.77
1830	67.62	66.70	H	-8.60	59.02	30.14	74.0	54.0	14.98	23.86
2745	64.29	63.30	V	-4.87	59.42	30.48	74.0	54.0	14.58	23.52
2745	66.30	64.91	H	-4.96	61.34	31.99	74.0	54.0	12.66	22.01
3660	52.78	47.72	V	-3.13	49.65	16.63	74.0	54.0	24.35	37.37
3660	52.24	43.86	H	-3.09	49.15	12.81	74.0	54.0	24.85	41.19
4575	50.47	39.94	V	-0.30	50.17	11.68	74.0	54.0	23.83	42.32
4575	51.55	41.74	H	-0.60	50.95	13.18	74.0	54.0	23.05	40.82
				Spurious Emissions						
1850	69.23	68.85	V	-8.52	60.71	32.37	74.0	54.0	13.29	21.63
1850	68.72	68.29	H	-8.42	60.30	31.91	74.0	54.0	13.70	22.09
2775	65.62	65.04	V	-4.78	60.84	32.31	74.0	54.0	13.16	21.69
2775	66.84	65.78	H	-4.89	61.95	32.94	74.0	54.0	12.05	21.06
3700	50.84	45.23	V	-2.89	47.95	14.38	74.0	54.0	26.05	39.62
3700	50.92	45.38	H	-2.87	48.05	14.55	74.0	54.0	25.95	39.45
4625	48.91	41.25	V	-0.05	48.86	13.24	74.0	54.0	25.14	40.76
4625	51.48	46.71	H	-0.35	51.13	18.40	74.0	54.0	22.87	35.60
5550	48.25	37.64	V	2.41	50.66	12.09	74.0	54.0	23.34	41.91
5550	49.88	42.85	H	2.32	52.20	17.21	74.0	54.0	21.80	36.79

The magnitude of all emissions not reported were below the noise floor of the measurement system.

7.5.4 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation

PEAK:
Corrected Level: 71.59 - 9.04 = 62.55dBuV
Margin: 74dBuV – 62.55dBuV = 11.45dB

AVERAGE:
Corrected Level: 69.60 - 9.04 - 27.95= 32.60dBuV
Margin: 54dBuV – 32.60dBuV = 21.40dB

7.6 20dB Bandwidth FCC Section 15.215

7.6.1 Test Methodology

The spectrum analyzer span was set to 2 to 3 times the estimated 20 dB bandwidth of the emission. The RBW was to ≥ 1% of the estimated 20 dB bandwidth. The trace was set to max hold with a peak detector active. The Delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emission. The span and RBW were examined and re-adjusted if necessary to meet the requirements of 2 to 3 times the 20 bandwidth for the span and ≥ 1% of the 20 dB bandwidth for the RBW.

7.6.2 Test Results

The maximum 20dB bandwidth was found to be approximately 147.50kHz. Results are shown below in Table 7.6.2-1 and Figures 7.6.2-1 through 7.6.2-3.

Table 7.6.2-1

Frequency (MHz)	20dB Bandwidth (kHz)
905	133.75
915	147.50
925	143.75

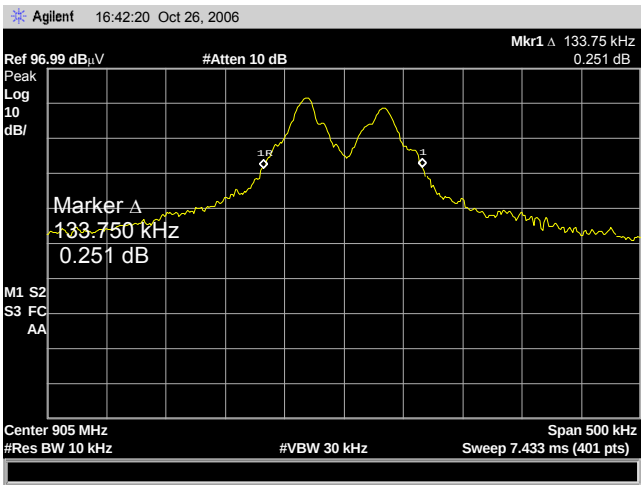

Figure 7.6.2-1: 20dB Bandwidth Low Channel

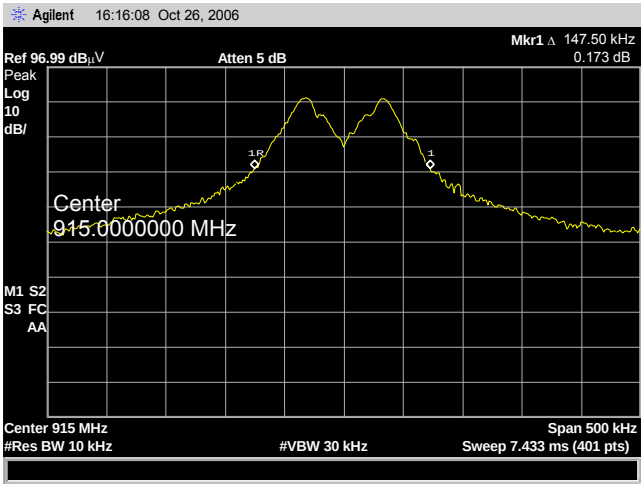

Figure 7.6.2-2: 20dB Bandwidth Mid Channel

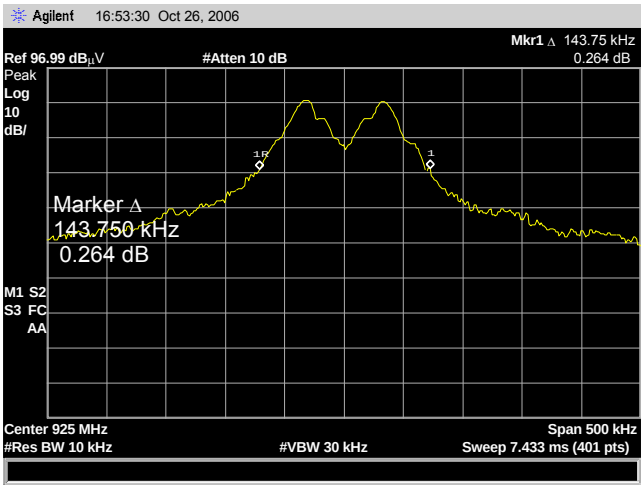

Figure 7.6.2-3: 20dB Bandwidth High Channel

7.7 Band-Edge Compliance and Spurious Emissions - FCC Section 15.249(d)

7.7.1 Test Methodology

The EUT was investigated at the low and high channels of operation to determine band-edge compliance. Band-edge compliance for the lower and upper band-edge was determined using the radiated mark-delta method as outlined in FCC DA 00-705. The radiated field strength of the fundamental emission was first determined and then the mark-delta method was used to determine the field strength of the band-edge emissions as compared to the emission limits of 15.209.

7.7.2 Test Results

Band-edge compliance is displayed in Tables 7.7.2-1 to 7.7.2-2 and Figures 7.7.2-1 – 7.7.2-2.

Table 7.7.2-1: Lower Band-edge Marker Delta Method

Frequency (MHz)	Level (dBuV)	Antenna Polarity (H/V)	Correction Factors (dB)	Fundamental Field Strength (dBuV/m)	Delta-Marker (dB)	Band-edge Field Strength (dBuV/m)	Band-edge Margin to Limit (dBuV/m)
Fundamental Frequency							
905	87.96	H	2.85	90.81	47.13	43.68	2.32

Table 7.7.2-2: Upper Band-edge Marker Delta Method

Frequency (MHz)	Level (dBuV)	Antenna Polarity (H/V)	Correction Factors (dB)	Fundamental Field Strength (dBuV/m)	Delta-Marker (dB)	Band-edge Field Strength (dBuV/m)	Band-edge Margin to Limit (dBuV/m)
Fundamental Frequency							
925	90.22	H	2.90	93.12	52.95	40.17	5.83

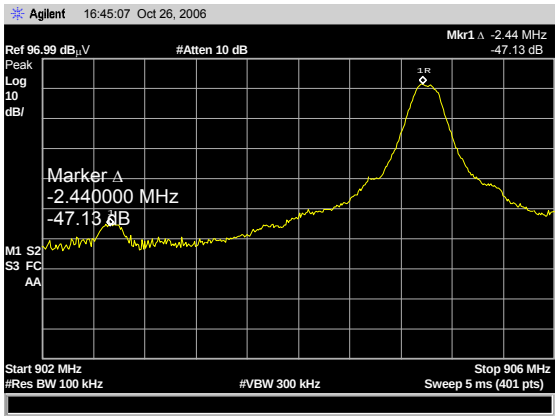

Figure 7.7.2-1: Lower Band-edge

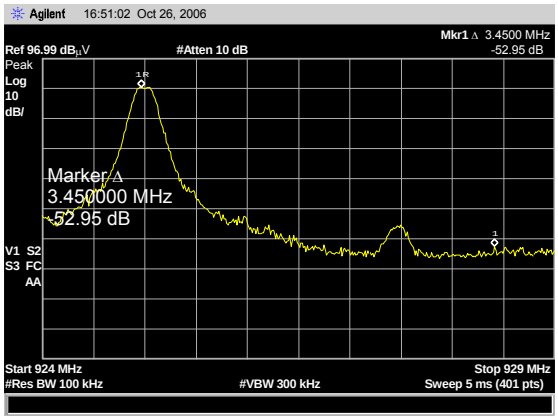

Figure 7.7.2-2: Upper Band-edge

8.0 CONCLUSION

In the opinion of ACS, Inc. the 380112WM, manufactured by MARS Company meets the requirements of FCC Part 15 subpart C.

END REPORT