FCC Part 15 Subpart C
Transmitter Certification

Test Report

FCC ID: SJS-380101WM

FCC Rule Part: 15.249

ACS Report Number: 05-0301-15C

Manufacturer: MARS Company
Model: 380101WM

Test Begin Date: November 23, 2005
Test End Date: November 23, 2005

Report Issue Date: March 9, 2006

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612

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This report contains 13 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 380101WM is a low power transmitter to be used in the utility industry to transmit meter-reading data from a utility meter to a mobile data-collecting device.

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. 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).

The unit is intended for above ground use and as such is limited in RF power.

1.2.3 Manufacturer

Floyd S. Salser, Jr. and Assoc, DBA: MARS Company
PO Box 772887
Ocala, FL 34477-2887

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

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:

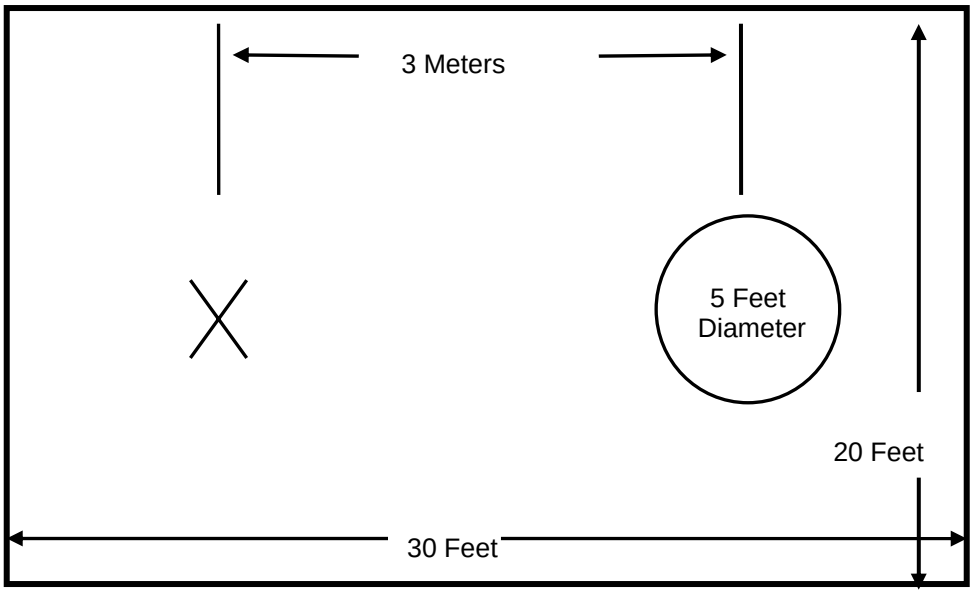

Figure 2.3-1: Semi-Anechoic Chamber Test Site

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:

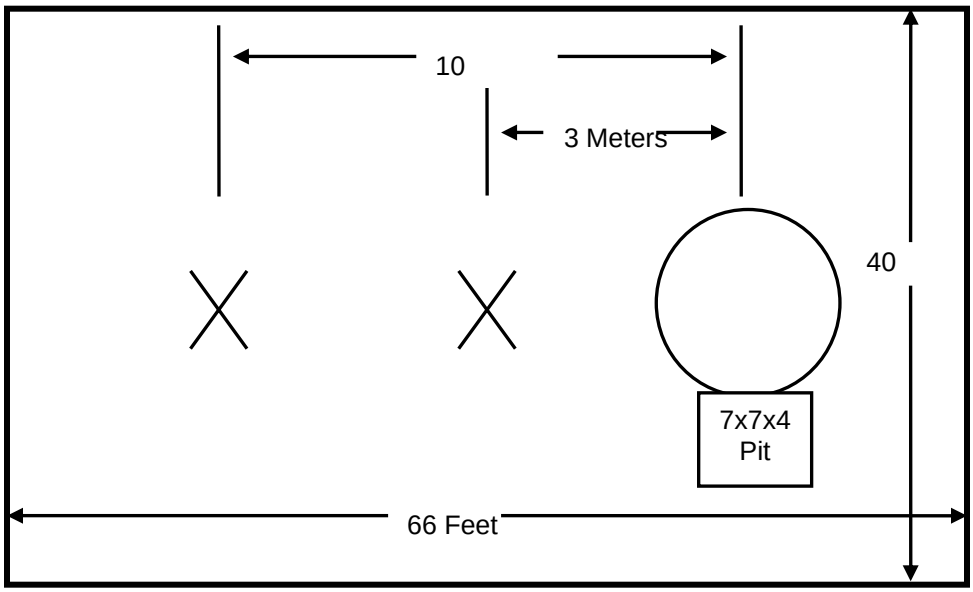

Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description
The AC mains conducted EMI site is a shielded room with the following dimensions:

- Height: 3.0 Meters
- Width: 3.6 Meters
- Length: 4.9 Meters

The room is manufactured by Rayproof Corporation and installed by Panashield, Inc. Earth ground is provided to the room via an 8' copper ground rod. Each panel of the room is connected electrically at intervals of 4".

Power to the room is filtered to prevent ambient noise from coupling to the EUT and measurement equipment. Filters are models 1B42-60P manufactured by Rayproof Corporation.

The room 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 2.4-1:

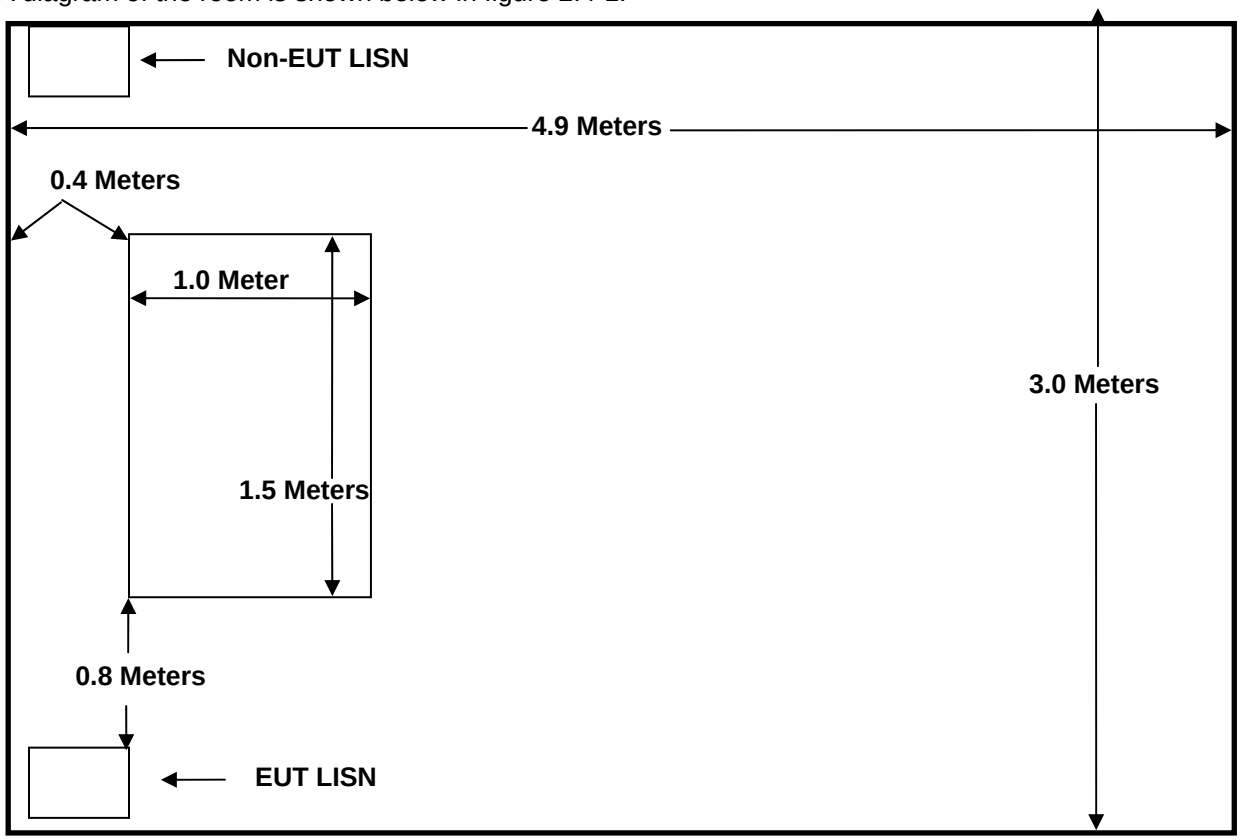

Figure 2.4-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES
The following standards were used:

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

4.0 LIST OF TEST EQUIPMENT

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

Table 4.0-1: Test Equipment

Equipment Calibration Information					
ACS#	**Mfg.**	**Eq. type**	**Model**	**S/N**	**Cal. Due**
☐ 25	Chase	Bi-Log Antenna	CBL6111	1043	5/23/06
☐ 26	Chase	Bi-Log Antenna	CBL6111	1044	6/2/06
☐ 193	ACS	OATS Cable Set	RG8	193	1/07/06
☐ 225	Andrew	OATS RF cable	Heliax	225	1/06/06
☐ 22	Agilent	Pre-Amplifier	8449B	3008A00526	5/06/06
☐ 73	Agilent	Pre-Amplifier	8447D	272A05624	5/18/06
☐ 30	Spectrum Technologies	Horn Antenna	DRH-0118	970102	5/09/06
☐ 105	Microwave Circuits	High Pass Filter	H1G810G1	2123-01 DC0225	9/13/06
☐ 209	Microwave Circuits	High Pass Filter	H3G020G2	4382-01 DC0421	9/20/06
☐ 1	Rohde & Schwarz	Receiver Display	804.8932.52	833771/007	3/07/06
☐ 2	Rohde & Schwarz	ESMI Receiver	1032.5640.53	839587/003	3/07/06
☐ 3	Rohde & Schwarz	Receiver Display	804.8932.52	839379/011	12/15/05
☐ 4	Rohde & Schwarz	ESMI Receiver	1032.5640.53	833827/003	12/15/05
☐ 213	Test Equipment Corp.	Pre-Amplifier	PA-102	44927	6/29/06
☐ 211	Eagle	Band Reject Filter	C7RFM3NFNM	n/a	1/06/06
☐ 204	ACS	Cable	RG8	204	12/29/05
☐ 6	Harbour Industries	HF RF Cable	LL-335	00006	3/16/06
☐ 7	Harbour Industries	HF RF Cable	LL-335	00007	3/16/06
☐ 208	Harbour Industries	HF RF Cable	LL142	00208	6/24/06
☐ 167	ACS	Chamber EMI Cable Set	RG6	167	12/29/05
☐ 204	ACS	Chamber EMI RF cable	RG8	204	1/07/06

5.0 SUPPORT EQUIPMENT

Table 5.0-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number	FCC ID
The device operates and was tested in a stand alone configuration					

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

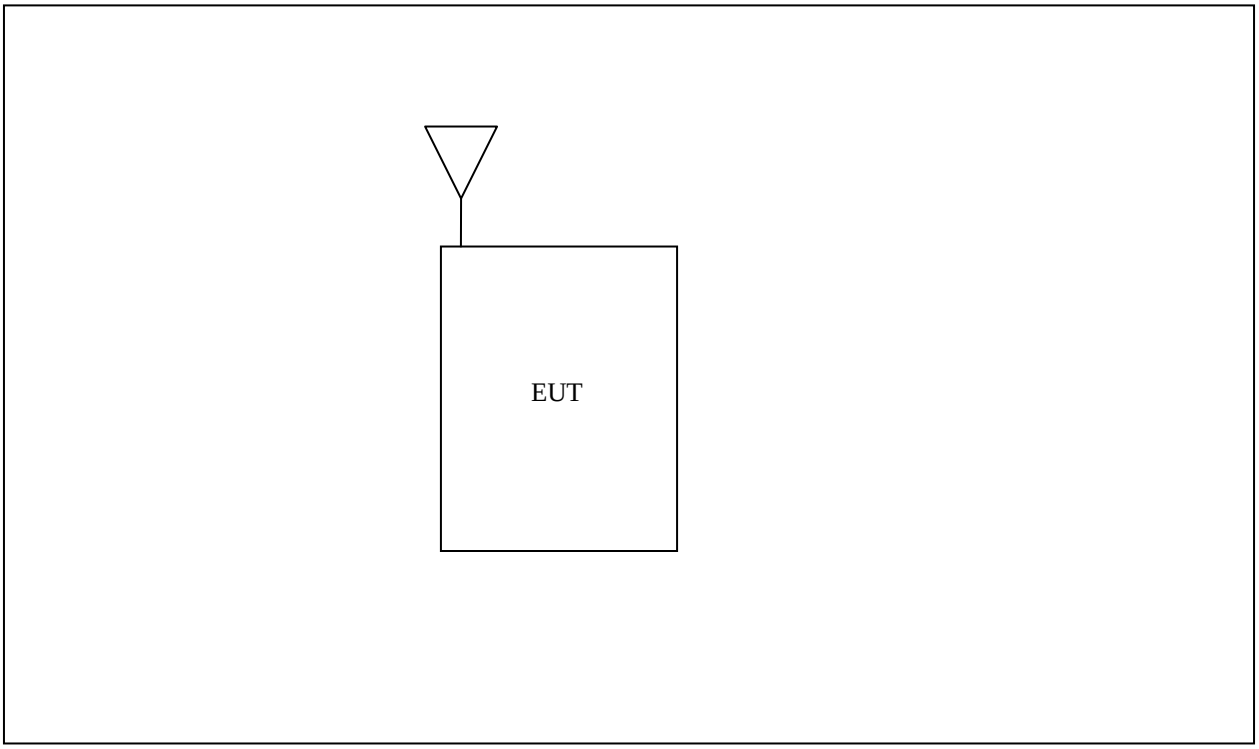

Figure 6.0-1: EUT Test Setup

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 an internal ¼ wave whip antenna, often referred to as a half-dipole, that cannot be removed, modified or otherwise disturbed without damage to the unit. The antenna gain is 3.6dBi.

7.2 Power Line Conducted Emissions - FCC Section 15.207

The EUT is battery powered and therefore Power Line conducted emissions was not 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 1 GHz. 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. Radiated measurements were made with the Spectrum Analyzer's resolution bandwidth set to 120 KHz for measurements above 30MHz. Average measurements are taken with the RBW and VBW were set to 1MHz and 10 Hz respectively for measurements above 1000MHz.

7.3.2 Test Results

Results of the test are given below in Table 7.3.2-1:

Table 7.3.2-1: Radiated Emissions

Frequency (MHz)	Polarization (H/V)	Height (cm)	Azimuth (deg)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30.00	HORIZONTAL	309	108	13.0	40.0	27.0
43.52	HORIZONTAL	218	192	5.1	40.0	34.9
85.52	HORIZONTAL	227	357	3.5	40.0	36.5
95.44	VERTICAL	270	212	14.6	43.5	28.9
152.08	HORIZONTAL	198	60	7.6	43.5	35.9
199.36	HORIZONTAL	389	221	7.0	43.5	36.5
340.32	HORIZONTAL	177	21	12.9	46.0	33.1
499.28	HORIZONTAL	105	133	18.9	46.0	27.1
591.20	VERTICAL	238	102	32.0	46.0	14.0
929.60	HORIZONTAL	350	14	30.7	46.0	15.3

Note: All emissions above 929.6 MHz were attenuated at least 20 dB below the permissible limit.
* Emissions reports were at or below the noise floor of the measurement equipment.

7.4 Field Strength of Radiated Emissions - FCC Section 15.249

7.4.1 Test Methodology

Radiated emissions tests were made over the frequency range of 30MHz to 10GHz, 10 times the highest fundamental frequency. The field strength of the fundamental frequency and spurious emission were evaluated.

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 calculated based on the peak measurements made with RBW of 1 MHz and a VBW of 1 MHz. The average emissions were calculated by applying the duty cycle correction of the EUT to the average measurements for comparison to the average limit.

Emissions at the band-edge were also evaluated to ensure that the requirements of 15.249(d) were met. The marker delta method was used to determine the emission levels at the band-edges for comparison to the limit of 50dB below the fundamental or to the limits of 15.209 which ever is the lesser attenuation.

7.4.2 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 27.96 dB to account for the duty cycle of the EUT. The duty cycle was determined to be 4% or 4ms with a 100ms period. The duty cycle correction factor is determined using the formula: 20log (0.04) = -27.96 dB.

7.4.3 Test Results

Radiated emissions found in the band of 30MHz to 10GHz are reported in Table 7.4.3-1 to Table 7.4.3-3. Compliance at the band-edge is shown in table 7.4.3-4 and figures 7.4.3-1 to 7.4.3-2.

Table 7.4.3-1: Radiated Spurious Emissions – Low Channel 905MHz

Frequency	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
(MHz)	pk	avg	(H/V)	(dB)	pk	avg	pk	avg	pk	avg
Fundamental Frequency										
905	63.97	----------	H	27.55	91.52	----------	94	----------	2.48	----------
905	58.86	----------	V	28.35	87.21	----------	94	----------	6.79	----------
Spurious Emissions										
1810	66.43	65.44	H	-2.63	63.80	34.85	74	54	10.20	19.15
1810	75.15	74.62	V	-2.63	72.52	44.03	74	54	1.48	9.97
2715	64.28	63.46	H	1.45	65.73	36.95	74	54	8.27	17.05
2715	64.93	64.30	V	1.45	66.38	37.79	74	54	7.62	16.21
3620	56.16	54.98	H	4.74	60.90	31.76	74	54	13.10	22.24
3620	52.25	48.17	V	4.74	56.99	24.95	74	54	17.01	29.05
4525	53.05	49.31	H	6.53	59.58	27.89	74	54	14.42	26.11
4525	49.26	45.21	V	6.53	55.79	23.79	74	54	18.21	30.21
5430	48.02	43.04	H	9.96	57.98	25.04	74	54	16.02	28.96
5430	49.38	44.16	V	9.96	59.34	26.16	74	54	14.66	27.84
6335	42.54	34.79	H	11.22	53.76	18.06	74	54	20.24	35.94
6335	44.48	36.69	V	11.22	55.70	19.96	74	54	18.30	34.04

Table 7.4.3-2: Radiated Spurious Emissions – Middle Channel 915 MHz

Frequency (MHz)	Level (dBuV) pk	Level (dBuV) avg	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m) pk	Corrected Level (dBuV/m) avg	Limit (dBuV/m) pk	Limit (dBuV/m) avg	Margin (dB) pk	Margin (dB) avg
Fundamental Frequency										
915	64.92	---------	H	27.90	92.82	---------	94	---------	1.18	---------
915	57.15	---------	V	28.30	85.45	---------	94	---------	8.55	---------
Spurious Emissions										
1830	66.84	66.14	H	-2.50	64.34	35.68	74	54	9.66	18.32
1830	74.22	73.68	V	-2.50	71.72	43.22	74	54	2.28	10.78
2745	63.19	62.19	H	1.54	64.73	35.77	74	54	9.27	18.23
2745	64.60	63.08	V	1.54	66.14	36.66	74	54	7.86	17.34
3660	56.15	54.43	H	4.88	61.03	31.35	74	54	12.97	22.65
3660	49.07	44.17	V	4.88	53.95	21.09	74	54	20.05	32.91
4575	50.26	46.22	H	6.75	57.01	25.01	74	54	16.99	28.99
4575	47.14	42.03	V	6.75	53.89	20.82	74	54	20.11	33.18
5490	54.32	50.92	H	10.16	64.48	33.12	74	54	9.52	20.88
5490	50.21	46.03	V	10.16	60.37	28.23	74	54	13.63	25.77
6405	45.33	36.76	H	11.41	56.74	20.21	74	54	17.26	33.79

Table 7.4.3-3: Radiated Spurious Emissions – High Channel 925 MHz

Frequency (MHz)	Level (dBuV) pk	Level (dBuV) avg	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m) pk	Corrected Level (dBuV/m) avg	Limit (dBuV/m) pk	Limit (dBuV/m) avg	Margin (dB) pk	Margin (dB) avg
Fundamental Frequency										
925	64.12	---------	H	28.25	92.37	---------	94	---------	1.63	---------
925	57.22	---------	V	28.25	85.47	---------	94	---------	8.53	---------
Spurious Emissions										
1850	69.02	68.07	H	-2.37	66.65	37.74	74	54	7.35	16.26
1850	74.93	74.40	V	-2.37	72.56	44.07	74	54	1.44	9.93
2775	61.81	60.58	H	1.63	63.44	34.25	74	54	10.56	19.75
2775	64.09	62.27	V	1.63	65.72	35.94	74	54	8.28	18.06
3700	57.77	56.32	H	5.01	62.78	33.38	74	54	11.22	20.62
3700	52.36	49.53	V	5.01	57.37	26.59	74	54	16.63	27.41
4625	50.33	46.62	H	6.96	57.29	25.62	74	54	16.71	28.38
4625	50.01	45.69	V	6.96	56.97	24.69	74	54	17.03	29.31
5550	52.57	49.56	H	10.20	62.77	31.80	74	54	11.23	22.20
5550	47.26	42.73	V	10.20	57.46	24.97	74	54	16.54	29.03
6475	43.73	33.16	H	11.60	55.33	16.80	74	54	18.67	37.20

Table 7.4.3-4: Band-edge Marker Delta Method

Frequency (MHz)	Fundamental Field Strength (dBuV/m)	Delta-Marker (dB)	Band-edge Field Strength (dBuV/m)	Limit (dBuV/m)	Margin to Limit (dBuV/m)
905	91.52	52.19	39.33	46.00	6.67
925	92.37	50.87	40.18	46.00	5.82

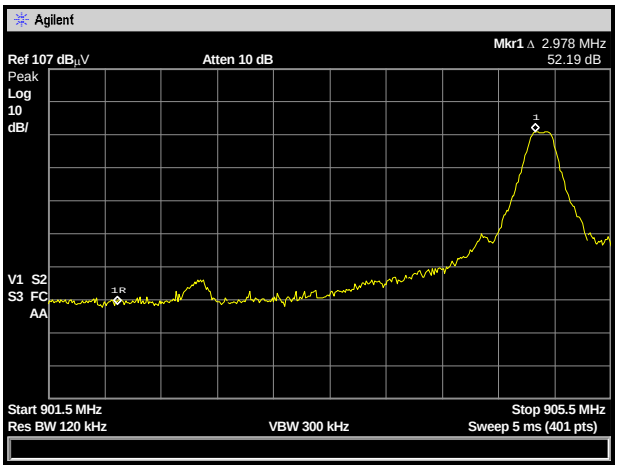

Figure 7.4.3-1: Lower Band-edge – Delta Marker Method

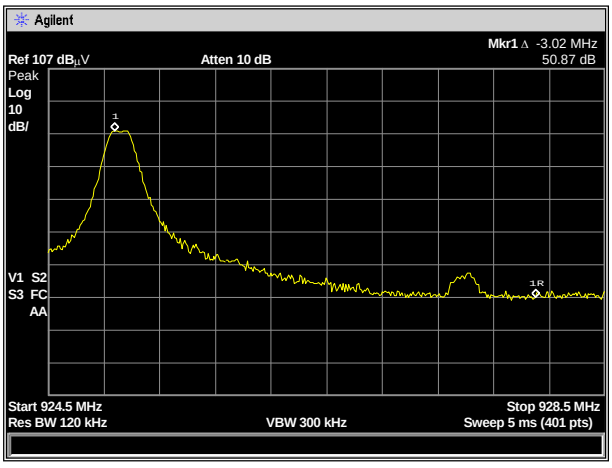

Figure 7.4.3-2: Upper Band-edge – Delta Marker Method

7.4.4 Sample Calculation (Radiated Emissions):

$R_C = R_U + CF_T$

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: 66.43 – 2.63 = 63.80 dBuV
Margin: 74dBuV – 63.80 dBuV = 10.20 dB

Example Calculation: Average
Corrected Level: 65.44 – 2.63 -27.96 = 34.85 dBuV
Margin: 54dBuV – 34.85 dBuV = 19.15 dB

7.5 20dB Bandwidth - FCC Section 15.215

7.5.1 Test Methodology

Intentional radiators operating under provisions of 15.249 must be designed to ensure the 20dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operating.

The measurement was made with a resolution bandwidth of 30kHz which is in accordance with section 13.1.7 of ANSI C63.4-2003.

7.5.2 Test Results

The 20dB bandwidth of the fundamental emission is shown in Figure 7.5.2-1 below.

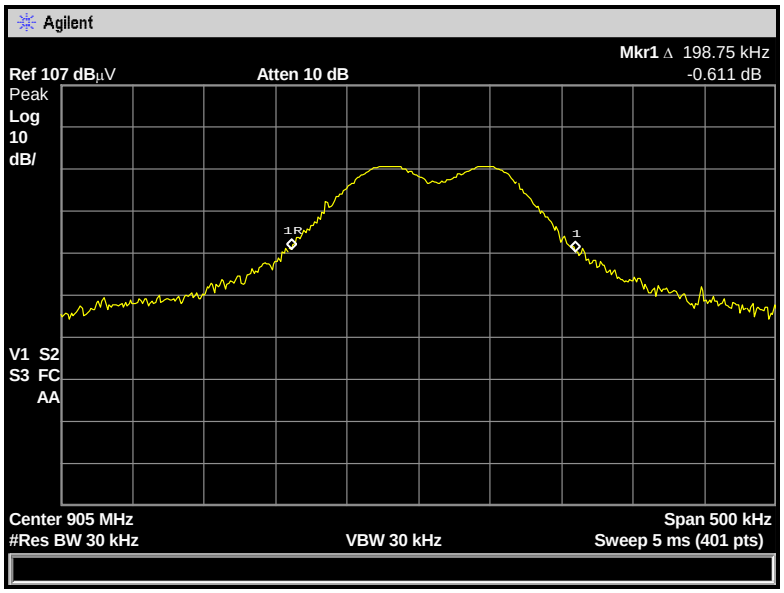

Figure 7.5.2-1: 20dB Bandwidth

8.0 CONCLUSION

In the opinion of ACS, Inc. the 380101WM manufactured by Mars Company, does meet the requirements of FCC Part 15 subpart C.