CERTIFICATION TEST REPORT

FOR THE

TIRE PRESSURE MONITORING SYSTEM (TRANSMITTER), AETM-1

FCC PART 15 SUBPART C

COMPLIANCE

DATE OF ISSUE: MARCH 11, 1999

PREPARED FOR:

Advantage Enterprises, Inc.
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Harrisonville, MO 64701

P.O. No: 3504
W.O. No: 70536

Report No: FC99-015

PREPARED BY:

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CKC Laboratories, Inc.
5473A Clouds Rest
Mariposa, CA 95338

Dates of test: January 6,15,
February 16, 24, March 1, 1999

DOCUMENTATION CONTROL:

Tracy Phillips
Documentation Control Supervisor
CKC Laboratories, Inc.

APPROVED BY:

Dennis Ward
Director of Laboratories
CKC Laboratories, Inc.

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ADMINISTRATIVE INFORMATION

DATE OF TEST:	January 6,15, February 16, 24, March 1, 1999
PURPOSE OF TEST:	To demonstrate the compliance of the Tire Pressure Monitoring System, AETM-1, with the requirements for FCC Part 15 Subpart C devices.
MANUFACTURER:	Automotive Safety Devices, Inc. C/O CM Automotive Systems, Inc. 120 Commerce Way Walnut, CA 91789
REPRESENTATIVE:	Phil Zaroor
TEST LOCATION:	CKC Laboratories, Inc. 110 Olinda Place Brea, CA 92621
TEST PERSONNEL:	Skip Doyle & Eddie Wong
TEST METHOD:	ANSI C63.4 1992
FREQUENCY RANGE TESTED:	30 MHz – 4.4 GHz
EQUIPMENT UNDER TEST:	**Tire Pressure Monitoring System** Manuf: CM Automotive Systems, Inc. Model: AETM-1 Serial: NA FCC ID: (pending)

SUMMARY OF RESULTS

The Advantage Enterprises, Inc. Tire Pressure Monitoring System, AETM-1, was tested in accordance with ANSI C63.4 1992 for compliance with FCC 15 Subpart C.

As received, the above equipment was found to be fully compliant with the limits of FCC 15 Subpart C. The results in this report apply only to the items tested, as identified herein.

EQUIPMENT UNDER TEST (EUT) DESCRIPTION

Wireless tire pressure sensor transmitter.

MEASUREMENT UNCERTAINTY

Associated with data in this report is a ±4dB measurement uncertainty.

EUT OPERATING FREQUENCY

The EUT was operating at 433.8 MHz.

TEMPERATURE AND HUMIDITY DURING TESTING

The temperature during testing was within +15°C and + 35°C.
The relative humidity was between 20% and 75%.

PERIPHERAL DEVICES

The EUT was not tested with the any peripheral devices.

REPORT OF MEASUREMENTS

The following tables report the highest worst case levels recorded during the tests performed on the Tire Pressure Monitoring System, AETM-1. All readings taken are peak readings unless otherwise noted by a "Q" or "A". The data sheets from which these tables were compiled are contained in Appendix B.

Table 1: Fundamental Emission Levels

FREQUENCY MHz	METER READING dBµV	CORRECTION FACTORS Log dB	Pream dB	Cable DB	Dist dB	CORRECTED READING dBµV/m	SPEC LIMIT dBµV/m	MARGIN dB	NOTES
433.765	76.9	18.4	-27.6	4.2		71.9	80.5	-8.6	H
433.855	82.1	18.4	-27.6	4.2		77.1	80.5	-3.4	V

Test Method: ANSI C63.4 1992
Spec Limit : FCC 15.231
Test Distance: 3 Meters

NOTES:
H = Horizontal Polarization
V = Vertical Polarization
N = No Polarization
D = Dipole Reading
Q = Quasi Peak Reading
A = Average Reading

COMMENTS: Transmitter operating on 9VDC via battery and activates at tire pressure of less than 18 PSI. Transmitter operating frequency is 433.8 MHz. This data is taken with new EUT sent from Joe at CM.

Table 2: Highest Spurious Emission Levels									
	METER	CORRECTION FACTORS				CORRECTED	SPEC		
FREQUENCY MHz	READING dBµV	Amp dB	Horn dB	Cable dB	Dist dB	READING dBµV/m	LIMIT dBµV/m	MARGIN dB	NOTES
1301.411	46.5	-35.6	25.3	6.2		42.4	61.9	-19.5	V
1735.211	51.7	-35.2	26.6	7.2		50.3	61.9	-11.6	V
2168.947	46.7	-33.9	28.8	9.0		50.6	61.9	-11.3	VA
2602.703	37.9	-31.8	31.3	11.2		48.6	61.9	-13.3	VA
3036.461	41.0	-31.6	31.9	11.9		53.2	61.9	-8.7	V
3470.335	39.8	-32.8	32.6	12.7		52.3	61.9	-9.6	V

Test Method: ANSI C63.4 1992
Spec Limit : FCC 15.231
Test Distance: 3 Meters

NOTES:
H = Horizontal Polarization
V = Vertical Polarization
N = No Polarization
D = Dipole Reading
Q = Quasi Peak Reading
A = Average Reading

COMMENTS: Transmitter operating on 9VDC via battery and activates at tire pressure of less than 18 PSI. Transmitter operating frequency is 433.8 MHz. This data is taken with new EUT sent from Joe at CM.

TABLE A

LIST OF TEST EQUIPMENT

VCCI Acceptance No. R-301 & C-314

1. Spectrum Analyzer, Hewlett Packard, Model No. 8568A, S/N 2049A01287. Calibration date: October 14, 1998. Calibration due date: October 14, 1999.
2. Display, Hewlett Packard, Model No. 85680A, S/N 2106A02109. Calibration date: October 14, 1998. Calibration due date: October 14, 1999.
3. Quasi-Peak Adapter, Hewlett Packard, Model No. 8565A, S/N 2430A00532. Calibration date: October 14, 1998. Calibration due date: October 14, 1999.
4. Spectrum Analyzer, Hewlett Packard, Model No. 8566B, S/N 2532A02509/2542A11184. Calibration due date: September 16, 1999.
5. Quasi-Peak Adapter, Hewlett Packard, Model No. 85650A, S/N 3303A01884. Calibration date: September 16, 1998. Calibration due date: September 16, 1999.
6. Horn Antenna, Emco, Model No. 3115, S/N 9603-4683. Calibration date: February 27, 1998. Calibration due date: February 27, 1999.
7. Log Periodic Antenna, A & H Systems, Model No. SAS-200/516, S/N 331. Calibration date: October 8, 1998. Calibration due date: October 8, 1999.
8. Preamp, Hewlett Packard, Model No. 8447D, S/N 1937A02548, 1937A02403. Calibration date: April 1, 1998. Calibration date due: April 1, 1999.
9. Biconical Antenna, A & H Systems, Model No. SAS-200/540, S/N 220. Calibration date: October 5, 1998. Calibration due date: October 5, 1999.
10. Brea site calibration date: May 8, 1998. Brea site calibration due date: May 8, 1999.
11. Test software, EMI Test 2.91.

EUT SETUP

The equipment under test (EUT) was set up in a manner that represented its normal use. Any special conditions required for the EUT to operate normally are identified in the comments that accompany Table 1 for fundamental radiated emissions and Table 2 for spurious emissions. Additionally, a complete description of all the ports and I/O cables is included on the information sheets contained in Appendix A.

During radiated emissions testing, the EUT was mounted on a nonconductive, rotating table 80 cm above the conductive grid. The nonconductive table dimensions were 1 meter by 1.5 meters. This configuration is typical for radiated emissions testing of table top devices.

The I/O cable was connected to the EUT in the manner required for normal operation of the system.

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed in Table A were used to collect the radiated emissions data for the Tire Pressure Monitoring System, AETM-1. For radiated measurements below 300 MHz, the biconical antenna was used. For frequencies from 300 to 1000 MHz, the log periodic antenna was used. For frequencies above 1 GHz the horn antenna was used. All antennas were located at a distance of 3 meters from the edge of the EUT.

The HP spectrum analyzer was used for all measurements. Table B shows the analyzer bandwidth settings that were used in designated frequency bands. During radiated testing, the measurements were made with 0 dB of attenuation, a reference level of 97 dBµV, and a vertical scale of 10 dB per division.

TABLE B : ANALYZER BANDWIDTH SETTINGS PER FREQUENCY RANGE

TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	4.4 GHz	1 MHz

SPECTRUM ANALYZER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in Tables 1 and 2 indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "Peak" mode. Whenever a "Quasi-Peak" or "Average" reading is listed as one of the six highest readings, this is indicated as a "Q" or an "A" in the appropriate table. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data for the Tire Pressure Monitoring System, AETM-1.

Peak

In this mode, the Spectrum Analyzer or test engineer recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature of the analyzer called "peak hold," the analyzer had the ability to measure transients or low duty cycle transient emission peak levels. In this mode the analyzer made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

When the true peak values exceeded or were within 2 dB of the specification limit, quasi-peak measurements were taken using the HP Quasi-Peak Adapter for the HP Spectrum Analyzer. The detailed procedure for making quasi peak measurements contained in the HP Quasi-Peak Adapter manual were followed.

Average

When the frequencies exceed 1 GHz, average measurements may be made using the spectrum analyzer. To make these measurements, the test engineer reduces the video bandwidth on the analyzer until the modulation of the signal is filtered out. At this point the analyzer is set into the linear mode and the scan time is reduced.

TEST METHODS

The radiated emissions data of the Tire Pressure Monitoring System, AETM-1, was taken with the HP Spectrum Analyzer. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the "Sample Calculations". The corrected data was then compared to the FCC Part 15, Subpart C emissions limits to determine compliance.

Preliminary and final measurements were taken in order to better ensure that all emissions from the EUT were found and maximized.

Radiated Emissions Testing

During the preliminary radiated scan, the EUT was powered up and operating in its defined FCC test mode with the I/O cable facing the antenna. The frequency range of 30 MHz - 88 MHz was then scanned with the biconical antenna located about 1.5 meter above the ground plane in the vertical configuration. During this scan, the turntable was rotated and all peaks, which were at or near the limit, were recorded. The frequency range of 100 - 300 MHz was scanned with the biconical antenna in the same manner, and the peaks recorded. Lastly, a scan of the FM band from 88 - 110 MHz was made, using a reduced resolution bandwidth and a reduced frequency span. The biconical antenna was changed to the horizontal polarity and the above steps were repeated. After changing to the log periodic antenna in the horizontal configuration, the frequency range of 300 - 1000 MHz was scanned. The log periodic antenna was changed to the vertical polarity and the frequency range of 300 - 1000 MHz was again scanned. For frequencies above 1000 MHz the horn antenna was used. Care was taken to ensure that no frequencies were missed within the FM and TV bands. An analysis was performed to determine if the signals that were at or near the limit were caused by an ambient transmission. If unable to determine by analysis, the equipment was powered down to make the final determination if the EUT was the source of the emission.

For the final radiated scan, the equipment was again positioned with its I/O cable facing the antenna. A thorough scan of all frequencies was manually made using a small frequency span, rotating the turntable as needed. Comparison with the previously recorded measurements was then made.

Using the peak readings from both scans as a guide, the test engineer then maximized the readings with respect to the table rotation and antenna height. Maximizing of the cables was achieved by monitoring the spectrum analyzer on a closed circuit television monitor while the EUT cable was being moved and rearranged on the EUT table for maximum emissions. Photographs showing the final worst case configuration of the EUT are contained in Appendix A.

FCC Part 15.231(c) - Occupied Bandwidth Measurements

In accordance with Part 15.231(c), the bandwidth of the emissions was no wider than 0.25% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

SAMPLE CALCULATIONS

The basic spectrum analyzer reading was converted using correction factors as shown in the emissions readings in Tables 1 and 2. For radiated emissions in dBµV/m, the spectrum analyzer reading in dBµV was corrected by using the following formula:

Meter reading (dBµV)
+ Antenna Factor (dB)
+ Cable Loss (dB)
- Distance Correction (dB)
- Pre-amplifier Gain (dB)

= Corrected Reading(dBµV/m)

This reading was then compared to the applicable specification limit to determine compliance.

A typical data sheet will display the following in column format:

#	Freq MHz	Rdng dBuV	Cable	Pream or Amp	Horn	Log	Dist	Corr dBuV/m	Spec	Margin	Polar

means reading number
Freq MHz is the frequency in MHz of the obtained reading.
Rdng dBuV is the reading obtained on the spectrum analyzer in dBµV.
Preamp or Amp is short the preamplifier factor or gain in dB.
Log is the log periodic antenna factor in dB.
Horn is the horn antenna factor in dB.
Cable is the cable loss in dB of the coaxial cable on the OATS.
Dist is the distance factor (in dB). It is used when testing at a different test distance than the one stated in the spec.
Corr dBµV/m is the corrected reading which is now in dBµV/m (field strength).
Spec is the specification limit (dB) stated in the agency's regulations.
Margin is the closeness to the specified limit in dB; + is over and - is under the limit.
Polar is the Polarity of the antenna with respect to earth.

APPENDIX A

INFORMATION ABOUT THE EQUIPMENT UNDER TEST

INFORMATION ABOUT THE EQUIPMENT UNDER TEST	
Test Software/Firmware:	**Not provided by the customer**
CRT was displaying:	
Power Supply Manufacturer:	
Power Supply Part Number:	
AC Line Filter Manufacturer:	
AC Line Filter Part Number:	
The EUT has no power cord.	

I/O PORTS	
Type	#
None	

CRYSTAL OSCILLATORS	
Type	Freq. In MHz
AT	4.0

PRINTED CIRCUIT BOARDS				
Function	Model & Rev	Clocks, MHz	Layers	Location
CPU		4 MHz	2	Sensor
Transmitter		N/A	2	Sensor
Amplifier		N/A	2	Sensor

REQUIRED EUT CHANGES TO COMPLY:
None.

PHOTOGRAPH SHOWING RADIATED EMISSIONS

Radiated Emissions - Front View

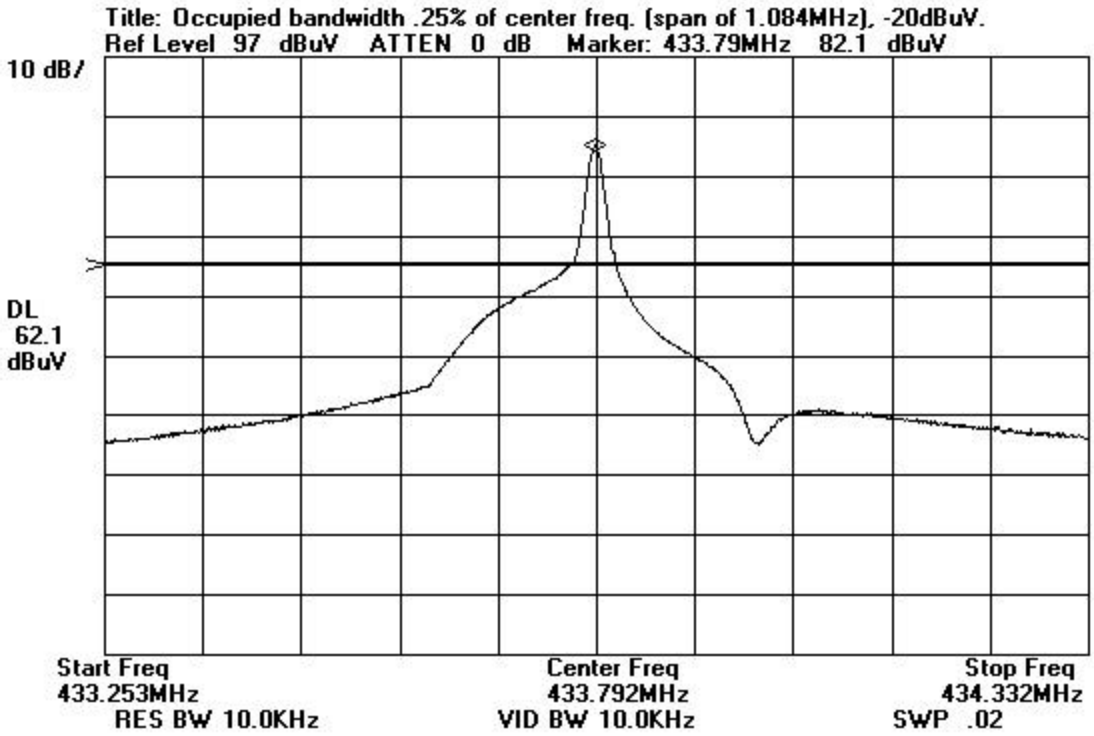
PHOTOGRAPH SHOWING RADIATED EMISSIONS

Radiated Emissions - Back View

APPENDIX B

MEASUREMENT DATA SHEETS

Occupied Bandwidth Plot



Test Location: CKC Laboratories, Inc. • 5473A Clouds Rest Rd, Barn • Mariposa, CA 95338 • (800)-500-4EMC

Customer:	**CM Automotive Systems, Inc.**	Date:	Mar-05-99
Specification:	**FCC 15.231**	Time:	11:43
Test Type:	**Maximized Emissions**	Sequence#:	6
Equipment:	**Tire Pressure Monitoring System**		
Manufacturer:	CM Automotive Systems, Inc.	Tested By:	Skip Doyle
Model:	AETM-1		
S/N:	NA		

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Tire Pressure Monitoring System*	CM Automotive Systems, Inc.	AETM-1	NA

Support Devices:

Function	Manufacturer	Model #	S/N
None			

Test Conditions / Notes:

Transmitter operating on 9VDC via battery and activates at tire pressure of less than 18 PSI. Transmitter operating frequency is 433.8 MHz. This data is taken with new EUT sent from Joe at CM.

Measurement Data: Sorted by Margin Test Distance: 3 Meters

#	Freq MHz	Rdng dBµV	Pream DB	Log dB	Cable dB	dB	Dist dB	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar
1	433.855	82.1	-27.6	+18.4	+4.2		+0.0	77.1	80.5	-3.4	Vert
2	433.765	76.9	-27.6	+18.4	+4.2		+0.0	71.9	80.5	-8.6	Horiz

Test Location: CKC Laboratories, Inc. • 5473A Clouds Rest Rd, Barn • Mariposa, CA 95338 • (800)-500-4EMC

Customer:	**CM Automotive Systems, Inc.**	Date:	Feb-24-99
Specification:	**FCC 15.231 Spurious Emission**	Time:	18:54
Test Type:	**Maximized Emissions**	Sequence#:	7
Equipment:	**Tire Pressure Monitoring System**		
Manufacturer:	CM Automotive Systems, Inc.	Tested By:	Skip Doyle
Model:	AETM-1		
S/N:	NA		

***Equipment Under Test* (* = EUT):**

Function	Manufacturer	Model #	S/N
Tire Pressure Monitoring System*	CM Automotive Systems, Inc.	AETM-1	NA

Support Devices:

Function	Manufacturer	Model #	S/N
None			

Test Conditions / Notes:

Transmitter operating on 9VDC via battery and activates at tire pressure of less than 18 PSI. Transmitter operating frequency is 433.8 MHz. This data is taken with new EUT sent from Joe at CM.

Measurement Data: Sorted by Margin Test Distance: 3 Meters

#	Freq MHz	Rdng dBµV	Amp dB	Horn dB	Cable dB	dB	Dist dB	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar
1	3036.461	41.0	-31.6	+31.9	+11.9	+0.0	+0.0	53.2	61.9	-8.7	Vert
	7th harm		+0.0	+0.0							
2	3470.335	39.8	-32.8	+32.6	+12.7	+0.0	+0.0	52.3	61.9	-9.6	Vert
	8th harm		+0.0	+0.0							
3	2168.947	46.7	-33.9	+28.8	+9.0	+0.0	+0.0	50.6	61.9	-11.3	Vert
	Average		+0.0	+0.0							
^	2168.975	53.0	-33.9	+28.8	+9.0	+0.0	+0.0	56.9	61.9	-5.0	Vert
	5th harm		+0.0	+0.0							
5	1735.211	51.7	-35.2	+26.6	+7.2	+0.0	+0.0	50.3	61.9	-11.6	Vert
	4th harm		+0.0	+0.0							
6	2602.703	37.9	-31.8	+31.3	+11.2	+0.0	+0.0	48.6	61.9	-13.3	Vert
	Average		+0.0	+0.0							
^	2602.761	45.4	-31.8	+31.3	+11.2	+0.0	+0.0	56.1	61.9	-5.8	Vert
	6th harm		+0.0	+0.0							

8	1735.078	48.1	-35.2 +0.0	+26.6 +0.0	+7.2	+0.0	+0.0	46.7	61.9	-15.2	Horiz
9	1301.411	46.5	-35.6 +0.0	+25.3 +0.0	+6.2	+0.0	+0.0	42.4	61.9	-19.5	Vert
3rd											
10	1301.365	45.1	-35.6 +0.0	+25.3 +0.0	+6.2	+0.0	+0.0	41.0	61.9	-20.9	Horiz
11	867.638	38.4	+0.0 +23.1	+0.0 -27.6	+0.0	+6.0	+0.0	39.9	61.9	-22.0	Vert
2nd harm											