EXHIBIT E: REPORT OF MEASUREMENTS [2.1033(B6)]

Test Report for FCC ID: RMDAPS1

FCC Part 2.1031, Part 15 Subpart C(15.231)

Report #0300652FT
Issued 12/12/03

MODEL APS1
ELECTRONIC TIRE PRESSURE SENSOR
433.92MHZ TRANSMITTER

Prepared for: Advantage PressurePro, LLc
205 W. Wall St.
Harrisonville, MO 64701

Mr. Harry Derks
Fleetwood Group Inc.
P.O. Box 1259
Holland, MI 49422-1259

Test Date(s): November 13,14, 2003

data recorded by

Ted Chaffee, NCE
Test Engineer, AHD

witnessed by

This report prepared by:

Ted Chaffee, NCE
Technical Manager/Test Engineer, AHD

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Statements Concerning this Report

NVLAP Accreditation: NVLAP Lab Code 200129-0
The scope of AHD accreditation is the conducted emissions, radiated emissions test methods of:

IEC/CISPR 22: Limits and methods measurement of radio disturbance characteristics of information technology equipment.
FCC Method – 47 CFT Part 15 – Digital Devices.
AS/NZS 3548: Electromagnetic Interference – Limits and Methods of Measurement of Information Technology Equipment.
IEC61000-4-2 and Amend.1: ElectroStatic Discharge Immunity

Test Data:
This test report contains data covered by the NVLAP accreditation.

Subcontracted Testing:
This report does not contain data produced under subcontract.

Test Traceability:
The calibration of all measuring and test equipment and the measured data using this equipment are traceable to the National Institute for Standards and Technology (NIST).

Limitations on results:
The test results contained in this report relate only to the Item(s) tested. Any electrical or mechanical modification made to the test item subsequent to the test date shall invalidate the data presented in this report. Any electrical or mechanical modification made to the test item subsequent to this test date shall require an evaluation to verify continued compliance.

Limitations on copying:
This report shall not be reproduced, except in full, without the written approval of AHD.

Limitations of the report:
This report shall not be used to claim product endorsement by NVLAP, FCC, or any agency of the US Government.

Statement of Test Results Uncertainty: Following the guidelines of NAMAS publication NIS81 and NIST Technical Note 1297, the Measurement Uncertainty at a 95% confidence level is determined to be: ± 1.4 dB

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Manufacturer/Applicant [2.1033(b1)]

Applicant:

Advantage PressurePro, LLC
205 W. Wall St.
Harrisonville, MO 64701

Manufacturer:

Fleetwood Group Inc.
P.O. Box 1259
Holland, Michigan 49422-1259

Measurement/Test Site Facility & Equipment

Test Site [2.948, 2.1033(b6)]

The AHD test facility is centered on 9 acres of rural property near Sister Lakes, Michigan. The mailing address is 92723 M-152, Dowagiac, Michigan 49047. This test facility is NVLAP accredited (LabCode 200129-0). It has been fully described in a report filed with the FCC and Industry Canada. The original report filed with the FCC is, dated November 5, 1996, was accepted by the FCC in a letter dated January 15, 1997 and reconfirmed July 14, 2000, (31040/SIT 1300F2). The original report filed with Industry Canada, dated August 11, 1998, was accepted via a letter dated September 1, 1998, (file:IC3161).

Measurement Equipment Used [2.947(d), 15.31(b)]

Equipment	Model	S/N	Last Cal Date	Calibration Interval
HP EMI Receiver system	HP 8546A			
RF Filter Section	HP-85460A	3448A00283	27-Aug-03	12 months
RF Receiver Section	HP-85462A	3625A00342	27-Aug-03	12 months
EMCO BiconiLog Antenna	3142	1077	26-Aug-03	12 months
Solar LISN	8012-50-R-24-BNC	962137	25-Aug-03	12 months
Solar LISN	8012-50-R-24-BNC	962138	25-Aug-03	12 months
(3-M) Type 129FF Ultra Flex LowLoss	RG58/U	9910-12	23-May-03	6 months
(3-M) LMR-400 Ultra Flex	LMR400	9812-11	23-May-03	6 months
(10-M) Amelco 50ohm Coax	RG213/U	9903-10ab	23-May-03	6 months
Double Ridged Horn	ONO91202-2	A00329	17-Apr-01	36 months

Measurement Environment

The tests were performed with the equipment under test, and measurement equipment inside the all-weather enclosure. Ambient temperature was 22deg.C., the relative humidity 35%.

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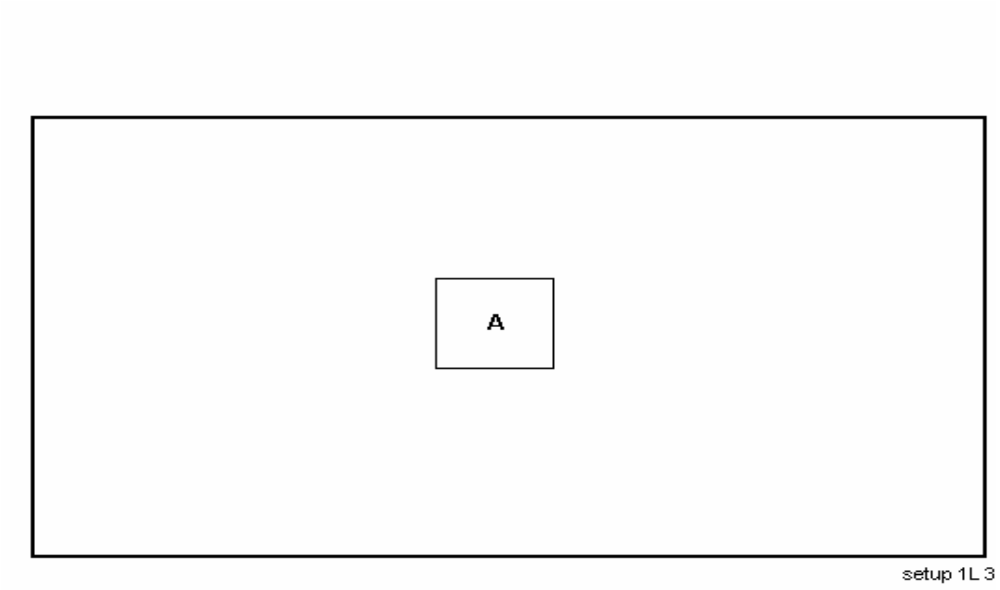
Tested Configuration /Setup: [2.1033(b8)]

Support Equipment & Cabling

Setup Diagram Legend	Description	Model	Serial No. / Part No.	EMC Consideration
A	[EUT] Electronic Tire Pressure Sensor 433.92MHz Transmitter	[Advantage PressurePro, LLC] APS1	Pre-production	FCC ID: RMDAPS1

Setup Diagram

Note: Setup photographs are located in Attached Electronic File, Exhibit E.



BASIC EUT SETUP
(Legend designation is above)

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Description of Equipment Under Test

The tested unit is an automotive Tire Pressure Sensor that will transmit an encoded signal to the driver when it senses a low-pressure condition.

There are two printed circuit boards.

1. Antenna PCB.
2. Transmitter PCB. 13.56MHz oscillator. Microprocessor: PIC12F675F.

Summary of Results:

1. This test series evaluated the Equipment Under Test to FCC Part 15, SubPart C.
2. The system tested is compliant to the requirement of CFR 47, FCC Part 15, SubPart C for periodic operation in the allowed frequency bands above 70MHz, (Part 15.231).
3. The system tested is compliant to the requirement of CFR 47, FCC Part 15, SubPart B as a digital device.
4. The equipment under test was received on November 12, 2003 and this test series commenced on November 13, 2003.
5. The line conducted emission testing does not apply to this product. The device is powered from a 3-volt lithium battery only.
7. Occupied Band Width of the transmitted signal, at the 20dB point, was measured to be 638KHz. This measurement is within the allowed 1.084MHz bandwidth.
8. The preliminary scan for spurious emissions performed in a shielded room showed no observable emissions from the unit other than the fundamental and its associated harmonics.
10. The field strength level of the fundamental showed the emission nearest the limit occurred with the EUT was positioned on the 'side' with the feed point of its antenna to the side and the receive antenna oriented in the horizontal polarization. This signal was calculated to be 11.1dB below the 15.231(e) limit of 72.9dBuV/m (4,399uV/m) which is 19.0dB below the 15.231(a) limit of 80.8dBuV/m (10,997uV/m).
11. The evaluation of the field strength levels of the harmonics showed the emission nearest the limit occurred at the third harmonic. The EUT was positioned on the 'side' with the feed point of its antenna to the top and the receive antenna oriented in the vertical polarization. This signal, at 1302MHz, was measured to be 22.5dB below the 15.231(e) and 15.231(a) limit of 54.0dBuV/m (500uV/m)

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Changes made to achieve compliance

1. NONE

Standards Applied to Test: [2.1033(b6)]

ANSI C63.4 - 1992, Appendix I
CFR47 FCC Part 2, Part 15, SubPart C, 15.231 Intentional Radiator; SubPart B, Digital Device
Public Notice DA 02-2850

Test Methodology: [2.1033(b6)]

The pictures in this report, showing test setups, indicate the agreed upon configuration of testing for this product-type.

For the testing, the APS1 was placed at the center of the table 80cm above the ground plane pursuant to ANSI C63.4 for stand-alone equipment. The unit was placed in an engineering mode, which allowed it to continuously transmit for testing.

The line conducted emission testing was not performed on this product. In its final configuration the product is powered from an automobile 12 volt system only.

Radiated

The system was placed upon a 1 x 1.5 meter non-metallic table 80cm above the open field site ground plane in the prescribed setup per ANSI C63.4, Figure 9(c).

The table sits upon a remote controlled turntable. The receiving antenna, located at the appropriate standards distance of 3 or 10 meters from the table center, is also remote controlled.

The principle settings of the EMI Receiver for radiated testing include:

IF Bandwidth:	120KHz for frequencies less than 1GHz.
	1 MHz for frequencies greater than 1GHz.
Detector Function:	Peak Mode
	The Average levels were determined mathematically based upon the duty cycle of the pulsed modulation of the transmitted signal.

At frequencies up to 1000MHz a BiconiLog broadband antenna was used for measurements.

At frequencies above 1000MHz a double-ridge Horn broadband antenna was used for measurements.

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During the evaluation the EUT was transmitting continuously.

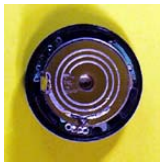
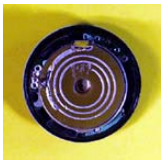
The turntable was rotated 360 degrees and the receiving antenna height varied from 1 to 4 meters to search out the highest emissions.

The final measurements were made with the EUT placed in three orthogonal positions. At each position the receive antenna was placed in vertical and horizontal positions.

The unit was evaluated up to the tenth harmonic of the fundamental as an intentional radiator, and up to 1000MHz as a digital device.

The orthogonal positions of EUT are:

Flat	Side	End
Antenna up	Antenna feed at side	Antenna feed at top

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FORMULAS AND SAMPLE CALCULATIONS:

THE HP8546A EMI Receiver has stored in memory the antenna and coax correction factors used in this test. The resultant Field Strength (FS) in dBuV/m presented by the HP8546A is the summation in decibels (dB) of the Received Level (RF), the Antenna Correction Factor (AF), and the Cable Loss Factor (CF).

Formula 1: FS(dBuV/m) = RF(dBuV) + AF(dB/m) +CF(dB)

The resultant Field Strength measurement is recorded using the peak hold detector of the HP8546A.

This recorded peak level is further corrected, by calculation, to an average level by a factor determined by the duty cycle of the pulsed transmission. The duty cycle factor is determined as outlined in ANSI C63.4:2001.

Formula 2: Average Level(uV/m) = [Peak Level(uV/m)] x [duty cycle factor].

Formula 2a: Average Level(dBuV/m) = Peak Level(dBuV/m) + duty cycle factor(dB).

Model APS1:
In any 100mSec period the transmitter will have at most two pulses. The greatest on time of each pulse will be 4.65mSec. This is 9.3mSec for the two pulses. This calculates to 9.3% duty cycle.

For 9.3% (0.093): duty cycle factor(dB) = 20*Log(0.093) = -20.6
Because only a maximum 20dB difference between peak and average levels is allowed. A 20dB correction factor is applied to the peak levels recorded.

As an example:
A measured peak level of an emission is 500uV/m.
Calculated to dBuV/m is 20*Log(500) = 53.98dBuV/m Peak level.
Applying the duty cycle factor: Avg. Level(dBuV/m) = 53.98 – 20.0dB = 33.95dBuV/m.

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Calculation of FCC limits. Part 15.231

15.231(a)
For the frequency range 260MHz - 470MHz, the limit is a linear interpolation between 3750uV/m and 12500uV/m where the limit at 260MHz is 3750uV/m and the limit at 470MHz is 12500uV/m.

15.231(e)
For the frequency range 260MHz - 470MHz, the limit is a linear interpolation between 1500uV/m and 5000uV/m where the limit at 260MHz is 1500uV/m and the limit at 470MHz is 5000uV/m.

A formula to calculate the limit is established with a ratio linearly equating the frequency range to the limit range.

$$(F_0 - F_L) / (F_H - F_L) = (L_0 - L_L) / (L_H - L_L)$$

where F_0 and L_0 represent the frequency in question and its limit
where F_L and L_L represent the lower frequency and its respective limit.
Where F_H and L_H represent the higher frequency and its respective limit.

The calculations for 433.92MHz

15.231(a)

$(433.92 - 260) / (470 - 260) = (L_0 - 3750) / (12500 - 3750)$
$(173.92 / 210) * (8750) = L_0 - 3750$
$L_0 = 7246.7 + 3750$
$L_0 = 10996.7$ uV/m is LIMIT at 433.92MHz

The limit in dB terms is calculated as the result of 20 times the log of the uV/m limit.
dB limit is 20 * LOG(10996.7 uV/m) = 80.8 dBuV/m

15.231(e)

$(433.92 - 260) / (470 - 260) = (L_0 - 1500) / (5000 - 1500)$
$(173.92 / 210) * (3500) = L_0 - 1500$
$L_0 = 2898.7 + 1500$
$L_0 = 4398.7$ uV/m is LIMIT at 433.92MHz

The limit in dB terms is calculated as the result of 20 times the log of the uV/m limit.
dB limit is 20 * LOG(4398.7 uV/m) = 72.9 dBuV/m

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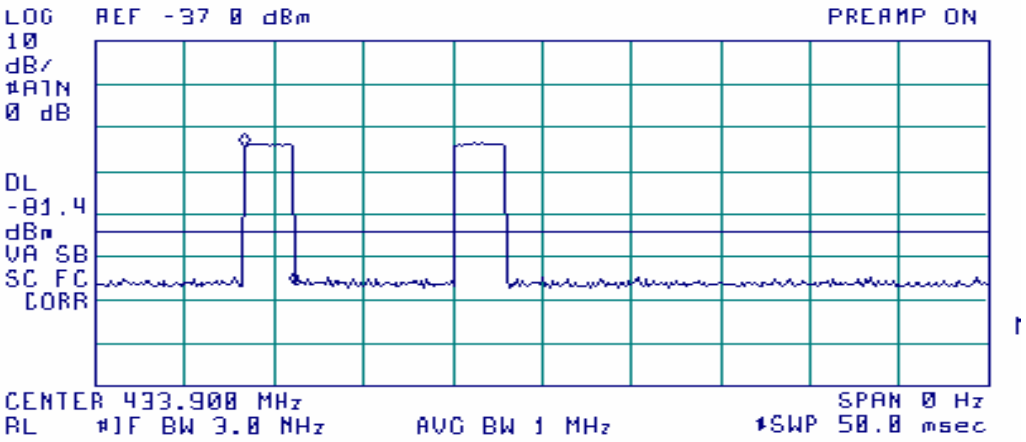
Test Data [2.1033(b6)]

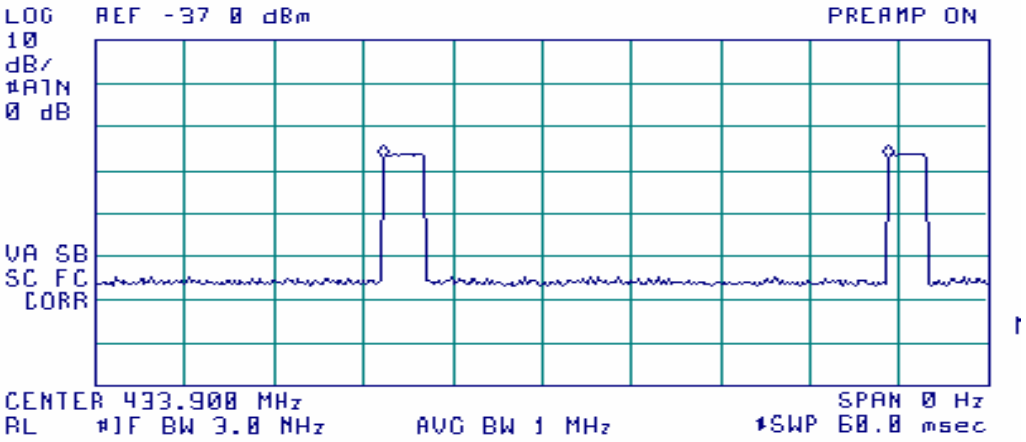
Modulation Characteristics

The transmitter is FSK modulated. The frequency shift is 35KHz.
At time 0.0mSec the transmitter is turned on.
At time 0.1mSec the transmitter stabilizes.
From 0.1mSec through approximately 4mSec the transmitter communicates using FSK

Typical pulses spaced approximately 10 milliseconds.



Typical pulses spaced approximately 30 milliseconds.



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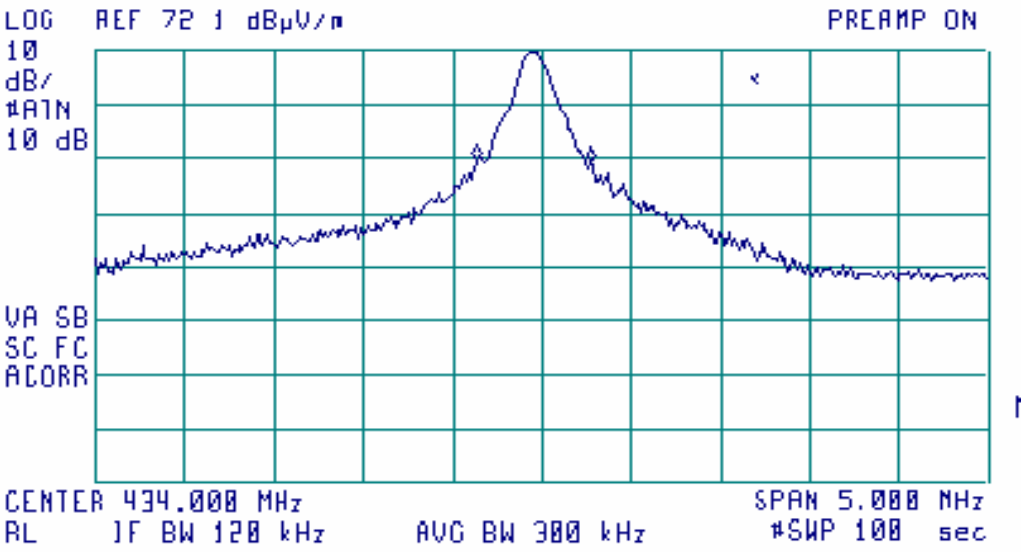
Occupied Bandwidth [15.231(c)]

The maximum allowed 20dB bandwidth is determined pursuant to 15.23(c). For fundamental signals between 70MHz and 900MHz the bandwidth allowed is 0.25% of the fundamental.

Formula 2: Allowed bandwidth = [Fundamental] x [.0025]

Fundamental (MHz)	Measured 20dB Bandwidth	LIMIT Fundamental * .0025
433.92	638 KHz	1.084MHz

This chart shows a typical measured bandwidth signal.



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Restricted Bands: [15.205]

The following frequency bands are restricted. Only spurious emissions are permitted at levels limited by 15.209:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.25
0.490-0.510	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41			

LIMIT @ 3meter: [15.209(a)]

30-88MHz	100uV/m	40dBuV/m
88-216MHz	150uV/m	43.5dBuV/m
216-960MHz	200uV/m	46dBuV/m
above 960MHz	500uV/m	54dBuV/m

The spurious emissions observed in the restricted bands did not exceed the allowed limits for the restricted bands.

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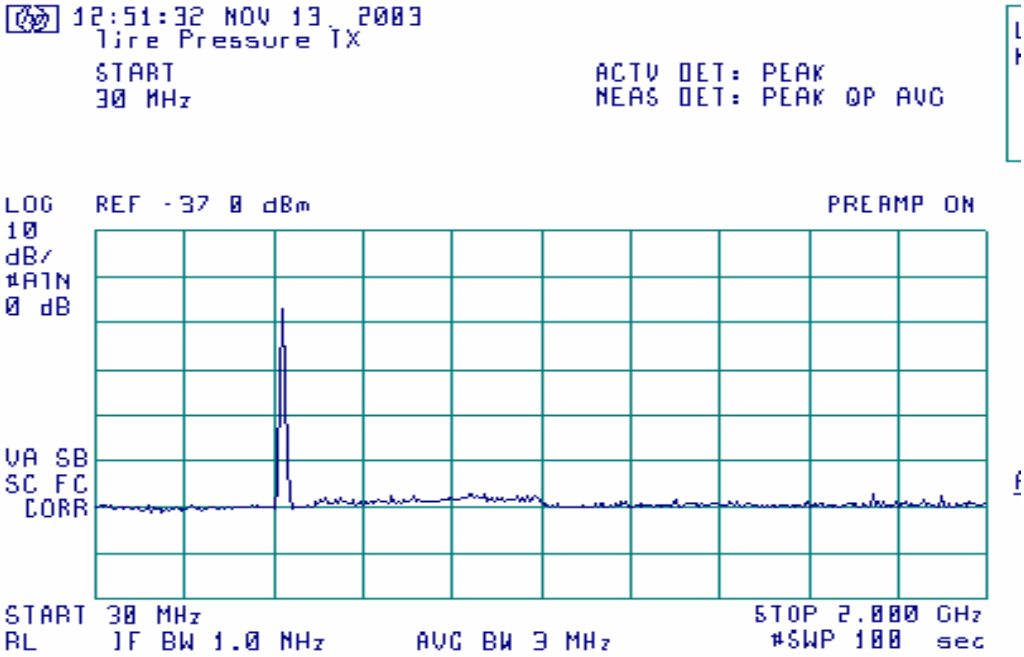
Radiated Field Strength Measurements: [15.231(b), 15.205]

A scan of the APS1 was made in a shielded room to study the emission profile of the EUT. These scans indicates no spurious emissions from the unit other than the fundamental and its associated harmonics.

EUT transmitting at 433.92MHz



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Field Strength Measurements of Fundamental & Harmonics

MEASUREMENT PROCEDURE:

1. The EUT was setup to one of the three orthogonal positions.
2. The receiving antenna was placed in vertical and horizontal polarities.
4. Steps 1-2 were repeated to cover all positions and polarities.

DUT Tuned to transmit at 288MHz

Freq. MHz	DUT position	Ant. Pol.	Corrected Data Peak Detector dBuV/m	Duty Cycle Factor dB	Calculated Average Level dBuV/m	FCC 15.231a Limit dBuV/m	FCC 15.231e Limit dBuV/m	Margin dB	Cable +Ant. Factor dB+dB/m
433.92	Side, side feed	H	81.8	-20.0	61.8	80.8	72.9	**11.1**	19.1
867.8	Side, top feed	H	38.4	-20.0	18.4	60.8	52.9	**34.5**	25.4
1302	Side, top feed	V	51.5	-20.0	31.5	54.0	54.0	**22.5**	29.9
1736	Flat	V	49.2	-20.0	29.2	60.8	54.0	**24.8**	31.4
2170	Flat	V	44.0	-20.0	24.0	60.8	54.0	**30.0**	33.3
2604	-	-	45 noise floor	-20.0	<25	60.8	54.0	**>29**	35.0
3037	-	-	46 noise floor	-20.0	<26	60.8	54.0	**>28**	36.1
3471	-	-	47 noise floor	-20.0	<27	60.8	54.0	**>27**	37.6
3905	-	-	47 noise floor	-20.0	<27	54.0	54.0	**>27**	38.0
4339	-	-	48 noise floor	-20.0	<28	54.0	54.0	**>26**	38.7

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