PCTEST Engineering Laboratory, Inc.
6660-B Dobbin Road · Columbia, MD 21045 · U.S.A.
TEL (410) 290-6652 · FAX (410) 290-6654
http://www.pctestlab.com

CERTIFICATE OF COMPLIANCE
FCC Part 15.231 Certification

Michelin Tire Corporation
Manufacturing Division
PO Box 5049
Spartanburg, SC 29304-5049

Dates of Tests: October 25-26, 2006
Test Report S/N: 0610230929-R1
Test Site: PCTEST Lab, MD U.S.A.

FCC ID:	**FI5-DBRPL10**
APPLICANT	**MICHELIN TIRE CORPORATION**

FCC Rule Part(s):	**§ 15.231 Subpart C – Intentional Radiator** **ANSI C-63.4-2003 (Predominantly following)**
FCC ID:	**FI5-DBRPL10**
Classification:	**Part 15 Security/ Remote Control Transmitter (DSC)**
EUT Type:	**Tire Pressure and Temperature Sensor**
Tx Frequency:	**433 MHz - 435 MHz**
Trade Name:	***MICHELIN eTire***

This device has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified is ANSI C63.4-2003.

***This revised Test Report (S/N: 0610230929-R1) supersedes and replaces the previously issued test report on the same subject EUT for the same type of testing as indicated. Please discard or destroy the previously issued report (S/N: 0610230929) and dispose of it accordingly.**

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

PCTEST certifies that no party to this application has been denied the FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 862.

Randy Ortanez
President

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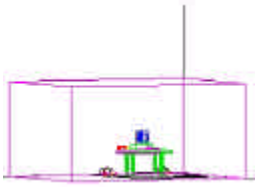
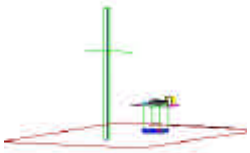
MEASUREMENT REPORT





Scope - Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission.

Company Name:	**Michelin Tire Corporation Manufacturing Division**
Address:	**PO Box 5049** **Spartanburg, SC 29304-5049**

- Model: **DBRPL1.0**
- FCC ID: **FI5-DBRPL10**
- Trade Name: ***MICHELIN***
- EUT Type: Tire Pressure and Temperature Sensor
- Application Type: Transceiver Certification
- Tx Frequency: 433 MHz - 435 MHz
- Serial No.: 001
- FCC Rule Part(s): § 15.231 Subpart C – Intentional Radiator/ Parts 15.231; ANSI C-63.4-2003
- Classification: Security/ Remote Control Transmitter (DSC)
- Dates of Tests: October 25-26, 2006
- Place of Tests: PCTEST Lab, Columbia, MD U.S.A.
- Test Report S/N: 0610230929-R1

1.1 INTRODUCTION

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C63.4-2003 – predominantly following) was used in determining radiated and conducted emissions emanating from **Michelin Tire Pressure and Temperature Sensor MODEL: DBRPL1.0**

These measurement tests were conducted at ***PCTEST Engineering Laboratory, Inc.*** facility in New Concept Business Park, Guilford Industrial Park, Columbia, Maryland. The site address is 6660-B Dobbin Road, Columbia, MD 21045. The test site is one of the highest points in the Columbia area with an elevation of 390 feet above mean sea level. The site coordinates are 39° 11'15" N latitude and 76° 49'38" W longitude. The facility is 1.5 miles North of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. There are no FM or TV transmitters within 15 miles of the site. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4 on January 27, 2006 and Industry Canada.

1.2 PCTEST Location

The map at right shows the location of the PCTEST Lab, its proximity to the FCC Lab, the Columbia vicinity area, the Baltimore-Washington International (BWI) airport, and the city of Baltimore, and the Washington, D.C. area. (see Figure1).

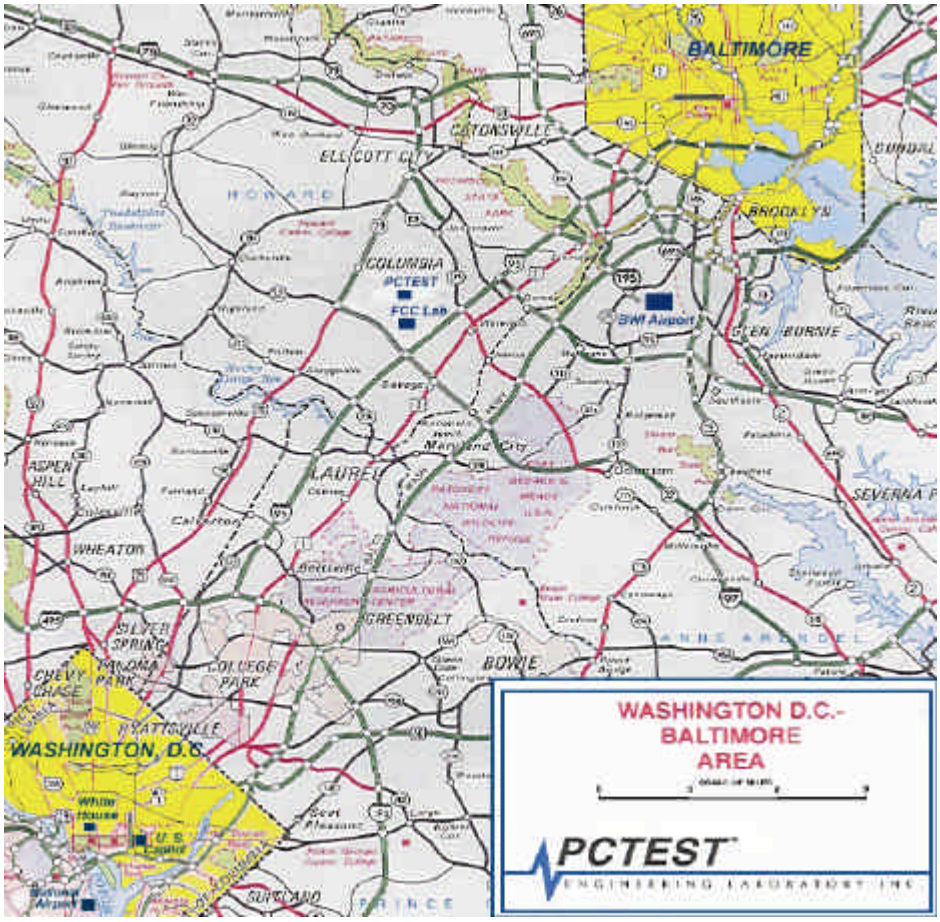


Figure 1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area.

2.1 Product Information

2.2 Equipment Description

The Equipment Under Test (EUT) is the ***MICHELIN*** **Tire Pressure and Temperature Sensor**
Model: DBRPL1.0

3.1 Description of Test

3.2 Conducted Emissions

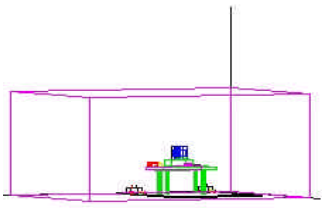


Figure 3.2-1. Shielded Enclosure Line-Conducted Test Facility

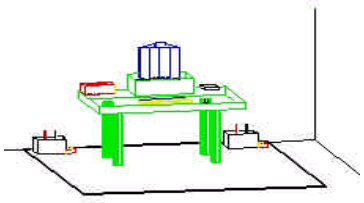


Figure 3.2-2. Line Conducted Emission Test Set-Up

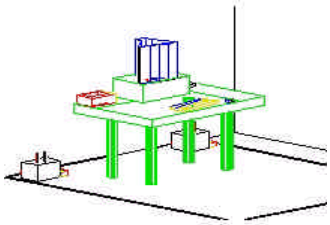


Figure 3.2-3. Wooden Table & Bonded LISNs

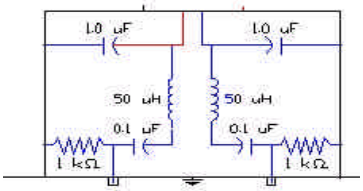


Figure 3.2-4. LISN Schematic Diagram

The line-conducted facility is located inside a 16'x20'x10' shielded enclosure. It is manufactured by Ray Proof Series 81 (see Figure 3.1-1). The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 65-5. A 1m x 1.5m wooden table 80cm high is placed 40cm away from the vertical wall and 1.5m away from the sidewall of the shielded room (see Figure 3.1-2). Solar Electronics and EMCO Model 3725/2 (10kHz-30MHz) 50Ω/50µH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room (See Figure 3.1-3). The EUT is powered from the Solar LISN and the support equipment is powered from the EMCO LISN. Power to the LISNs are filtered by a high-current high-insertion loss Ray Proof power line filters (100dB 14Hz-10GHz). The purpose of the filter is to attenuate ambient signal interference and this filter is also bonded to the shielded enclosure. All electrical cables are shielded by braided tinned copper zipper tubing with an inner diameter of ½". If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to the Solar LISN. The LISN schematic diagram is shown (See Figure 3.1-4). All interconnecting cables more than 1 meter were shortened by non-inductive bundling (serpentine fashion) to a 1-meter length. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer to determine the frequency producing the maximum EME from the EUT. The spectrum was scanned from 150kHz to 30Mhz with a 20msec. sweep time. The frequencies producing the maximum level were re-examined using an EMI/Field Intensity Meter and Quasi-Peak adapter. The detector function was set to CISPR quasi-peak mode and average mode. The bandwidth of the receiver was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission.

3.3 Radiated Emissions

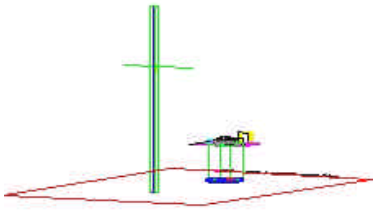


Figure 3.3-1. Meter Test Site

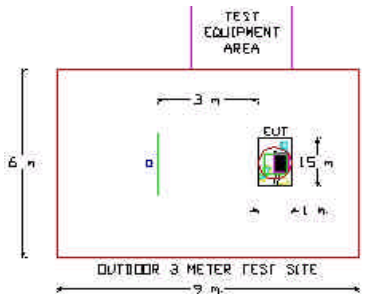


Figure 3.3-2. Dimensions of Outdoor Test Site

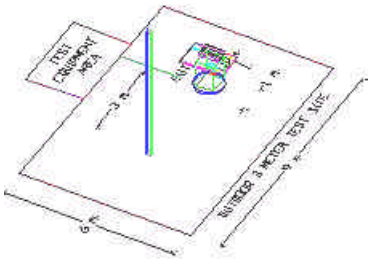


Figure 3.3-3. Turntable and System Setup

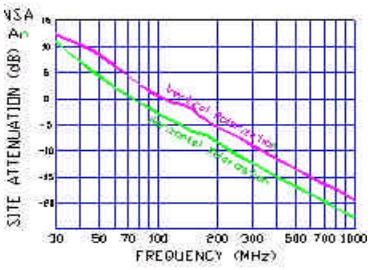


Figure 3.3-4. Normalized Site Attenuation Curves (H&V)

Preliminary measurements were made indoors at 1 meter using broadband antennas, broadband amplifier, and spectrum analyzer to determine the frequency producing the maximum EME. Appropriate precaution was taken to ensure that all EME from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, turntable azimuth with respect to the antenna was noted for each frequency found. The spectrum was scanned from 30 to 200 MHz using biconical antenna and from 200 to 1000 MHz using log-spiral antenna. Above 1 GHz, linearly polarized double ridge horn antennas were used.

Final measurements were made outdoors at 3-meter test range using Roberts™ Dipole antennas or horn antenna (see Figure 3.3-2). The test equipment was placed on a wooden and plastic bench situated on a 1.5 x 2 meter area adjacent to the measurement area (see Figure 3.3-3). Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. Each frequency found during pre-scan measurements was re-examined and investigated using EMI/Field Intensity Meter and Quasi-Peak Adapter. The detector function was set to CISPR quasi-peak mode and the bandwidth of the receiver was set to 100kHz or 1 MHz depending on the frequency or type of signal.

The half-wave dipole antenna was tuned to the frequency found during preliminary radiated measurements. The receive antenna was placed at 45° intervals on the perimeter of the area under test until the entire 360°circumferce on the Area under Test was cover. The EUT, support equipment and interconnecting cables were re-configured to the set-up producing the maximum emission for the frequency and were placed on the ground screen to simulate the site setup for normal operation of the system. The antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission. Each EME reported was calibrated using the HP8640B signal generator. The Theoretical Normalized Site Attenuation Curves for both horizontal and vertical polarization are shown in Figure 3.3-4 according to ANSI C63.4.

4.1 §15.203 Antenna Requirement

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the applicant can be used with the device. The use of permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with this requirement.

CONCLUSION

The MICHELIN Tire Pressure and Temperature Sensor complies with the requirement of §15.203 with a reverse SMA connector that is professionally installed.

5.1 Occupied Bandwidth Measurement

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70MHz and below 900MHz. The bandwidth is determined at the points 20 dB down from the modulated carrier.

433.5 MHz x 0.0025 = 1.083 MHz

A sample transmitter output was fed into the R&S Spectrum Analyzer and was plotted.

Span:	10.0 MHz
Vertical Scale:	5.0 dB/div
Center Frequency:	434.5 MHz, 433.5 MHz

The bandwidth at 20 dB is **564 kHz**, which is within the allowable limit of **1083 kHz** at 433.5 MHz.

6.1 Part 15.231 Bandwidth Test

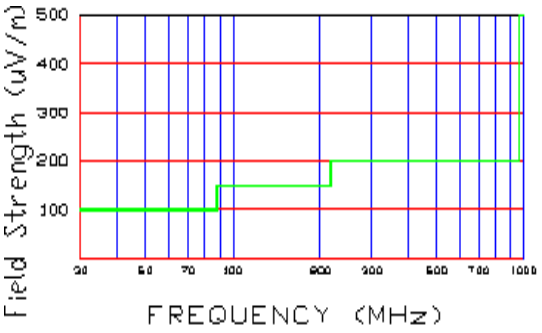
**** See Attachment A***

6.2 Frequency Measurements (Fundamental)

Operating Frequencies: 433.5 MHz
Distance of Measurements: 3 meters

FREQ. (MHz)	Level (dBm)	AFCL (dB)	POL (H/V)	(dBmV/m) (PEAK)	F/S (Peak)	Avg. (uv/M)	Avg. (dBuV/m)	MARGIN (dB)
433.5	-31.2	23.8	V	99.6	95499.3	3628.97	71.20	-9.59
434.5	-30.5	23.8	H	100.3	103514	3933.54	71.90	-8.89
869.0	-77.9	31.8	V	60.9	1109.17	42.15	32.50	-21.50
1303.5	-80.0	31.3	V	58.3	822.243	31.25	29.90	-24.10
1738.0	-83.3	34.5	V	58.2	812.831	30.89	29.80	-24.20
2172.5	-86.5	36.7	V	57.2	724.436	27.53	28.80	-25.20

Table 1. Radiated Measurements at 3-meters.



*Spurious Radiated Limits at 3 meters

NOTES:

1. All channels were investigated and the worst-case is reported.

2. Radiated Limits per §15.231:

Fund. Freq. (MHz)	F/S (mV/m)	F/S Spurious (mV/m)
40.66 ~ 40.70	2250	225
70 ~ 130	1250	125
130 ~ 174	1250 ~ 3750	125 ~ 375
174 ~ 260	3750	375
260 ~ 470	3750 ~ 12500	375 ~ 1250
470 & above	12500	1250

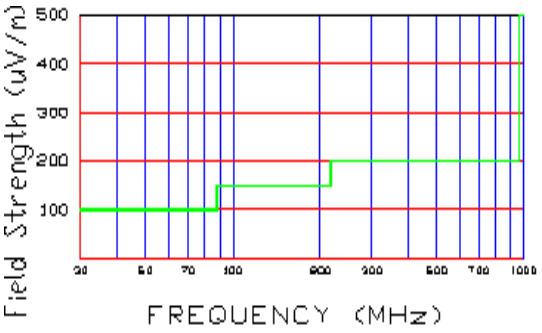
3. The EUT was scanned between the 8 radials by moving the receive antenna between the intervals while observing the emission levels for the fundamental and the spurious emissions on the spectrum analyzer. The worst-case emissions were reported.

6.2 Frequency Measurements (Fundamental)

Operating Frequencies: 434.5 MHz
Distance of Measurements: 3 meters

FREQ. (MHz)	Level (dBm)	AFCL (dB)	POL (H/V)	(dBmV/m) (PEAK)	F/S (Peak)	Avg. (uV/m)	Avg. (dBuV/m)	MARGIN (dB)
434.5	-30.5	23.8	V	100.3	103514	3933.54	71.90	-8.89
434.5	-30.1	23.8	H	100.7	108393	4118.92	72.30	-8.49
869	-77.8	31.8	V	61	1122.02	42.64	32.60	-21.40
1303.5	-79	31.3	V	59.3	922.571	35.06	30.90	-23.10
1738	-83.3	34.5	V	58.2	812.831	30.89	29.80	-24.20
2172.5	-86.2	36.7	V	57.5	749.894	28.50	29.10	-24.90

Table 2. Radiated Measurements at 3-meters.



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130 ~ 174	1250 ~ 3750	125 ~ 375
174 ~ 260	3750	375
260 ~ 470	3750 ~ 12500	375 ~ 1250
470 & above	12500	1250

3. The EUT was scanned between the 8 radials by moving the receive antenna between the intervals while observing the emission levels for the fundamental and the spurious emissions on the spectrum analyzer. The worst-case emissions were reported.

7.1 Support Equipment Used

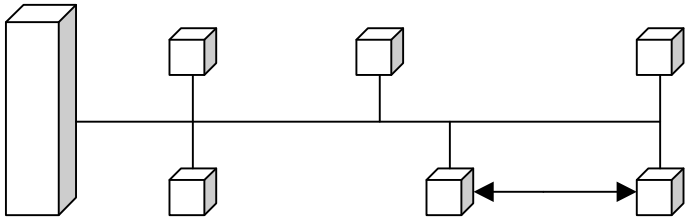
1. MICHELIN Tire Pressure & Temp. Sensor	**Model: DBRPL1.0 (EUT)**	**S/N: N/A**

(Please see "Attachment E - Test Setup Photographs" for actual system

8.1 Test Area Layout

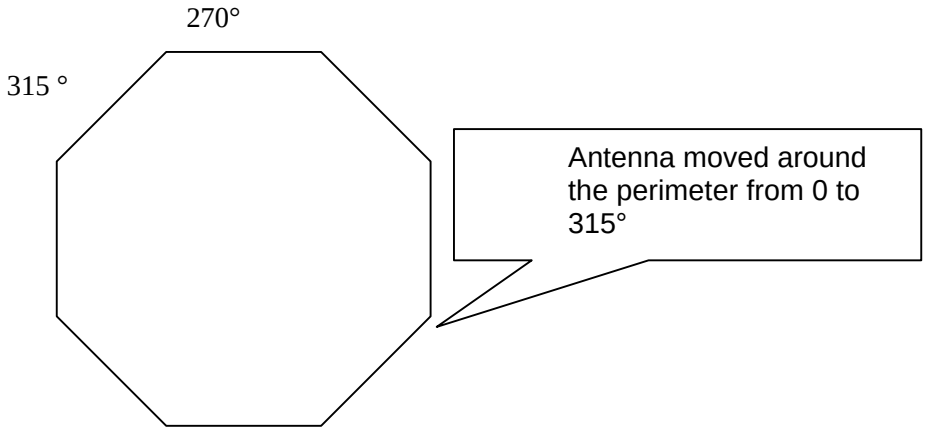
Main Controller **Antenna Array detail inside perimeter**

Tire way1 Tire way 2



39 inches

Perimeter with angle sides is drawn below. 3 meter spacing is maintained between the receive antenna and the perimeter of the Array Area under test.

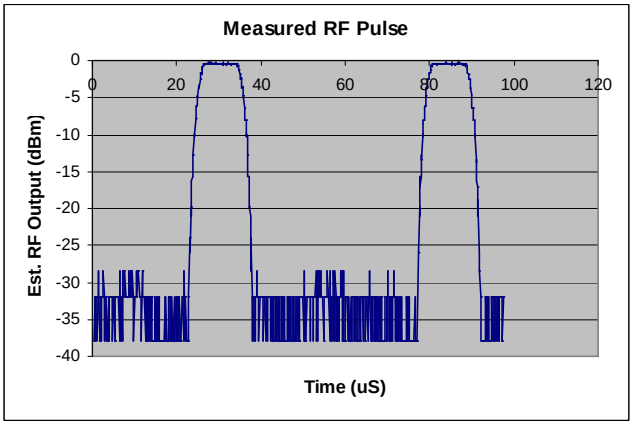


Data for 8 radial locations with four antennas being driven simultaneously at maximum power is reported. Subintervals were scanned and found have levels less than the eight redial positions. The EUT was tested with the antennas configured in accordance with the manufactures installation instructions. The EUT was tested without truck tires which would have reduced the levels of emissions. This condition produced worst case radiated emissions.

8.1 Duty Cycle Calculation

Duty cycle measurement for pressure sensor interrogation

The following figure shows the measured transmission of interrogation pulses at one frequency in the 433Mhz to 435Mhz band. Each transmission pulse duration is 10.25 microseconds, with a period of 54 microseconds. A maximum of 16 of these pulses can occur consecutively.

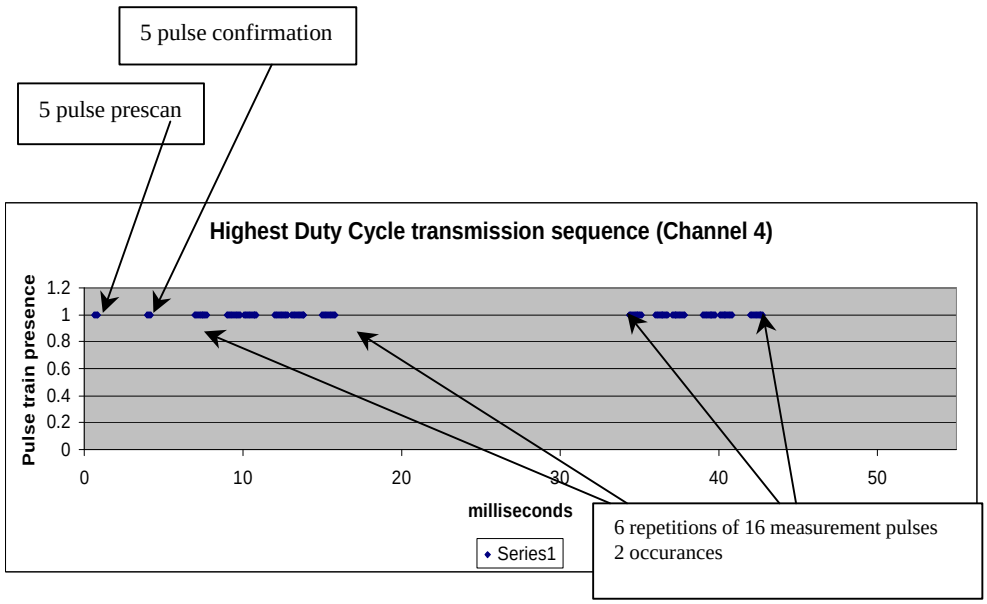


The highest duty cycle occurs when a sensor is in proximity to the interrogation antenna for multiple measurement cycles. A sensor prescan phase is initiated, which includes 5 pulses transmitted at the target frequency. This is followed by a set 5 confirmation pulses, then by 6 sets of measurement sequences, each containing 16 pulses, with 220 microseconds calculation delay between each set of 16. The set of 6 measurement sequences can be repeated one time before the entire sequence restarts with a new prescan phase. For the duty cycle calculation, the timing build-up is:

Total transmission time =
10.25microSeconds/pulse x
(5prescan + 5confirmation + 2 x (16measurement x 6repetitions))pulses = **2.705milliseconds**

Total time period = 54.81milliseconds

Duty Cycle = 3.8%



9.1 Sample Calculations

$$dBmV = 0 \log_{10} (mV/m)$$

$$dBmV = dBm + 107$$

9.2 Example 1:

Calculation of Limit @ 433.5 MHz per Section 15.231

260 MHz Limit=3750uV/m @ 3m
470 MHz Limit=12500uV/m @ 3m

(12,500-3750)/(470-260) = 8750/210

(433-260)(8750)/210= 7108 uV/m

7208+3750=10,958uV/m Limit @ 433.5 MHz or 80.80 dBuV/m

10.1 Accuracy of Measurement

10.2 Measurement Uncertainty Calculations:

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994).

Contribution (Line Conducted)	Probability Distribution	Uncertainty (± dB)	
		9kHz-150MHz	150-30MHz
Receiver specification	Rectangular	1.5	1.5
LISN coupling specification	Rectangular	1.5	1.5
Cable and input attenuator calibration	Normal (k=2)	0.3	0.5
Mismatch: Receiver VRC ? $_1$ = 0.03 LISN VRC ? $_R$ = 0.8 (9kHz) 0.2 (30MHz) Uncertainty limits 20Log(1 ±? $_1$? $_R$)	U-Shaped	0.2	0.35
System repeatability	Std. deviation	0.2	0.05
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	1.26	1.30
Expanded uncertainty	Normal (k=2)	2.5	2.6

Calculations for 150kHz to 30MHz:

$$u_C(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)} = \pm\sqrt{\frac{1.5^2 + 1.5^2}{3} + (\frac{0.5}{2})^2 + 0.35} = \pm 1.298\text{dB}$$

$U = 2U_C(y) = \pm 2.6$dB

Contribution (Radiated Emissions)	Probability Distribution	Uncertainties (± dB)	
		3 m	10 m
Ambient Signals		-	-
Antenna factor calibration	Normal (k=2)	± 1.0	± 1.0
Cable loss calibration	Normal (k=2)	± 0.5	± 0.5
Receiver specification	Rectangular	± 1.5	±1.5
Antenna directivity	Rectangular	+ 0.5 / - 0	+ 0.5
Antenna factor variation with height	Rectangular	± 2.0	± 0.5
Antenna phase centre variation	Rectangular	0.0	± 0.2
Antenna factor frequency interpolation	Rectangular	±. 0.25	± 0.25
Measurement distance variation	Rectangular	± 0.6	± 0.4
Site imperfections	Rectangular	± 2.0	± 2.0
Mismatch: Receiver VRC ? $_1$ = 0.2 Antenna VRC ? $_R$ = 0.67 (Bi) 0.3 (Lp) Uncertainty limits 20Log(1 ±? $_1$? $_R$)	U-Shaped	+ 1.1 - 1.25	± 0.5
System repeatability	Std. Deviation	± 0.5	± 0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+ 2.19 / - 2.21	+ 1.74 / - 1.72
Expanded uncertainty U	Normal (k=2)	+ 4.38 / - 4.42	+ 3.48 / - 3.44

Calculations for 3m biconical antenna. Coverage factor of k=2 will ensure that the level of confidence will be approximately 95%, therefore:

$U=2u_C(y) = 2 \times \pm 2.19 = \pm 4.38$dB

11.1 Test Equipment

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST).

TYPE	MODEL	CAL. DUE DATE	CAL. INTERVAL	SERIAL No.
Microwave Spectrum Analyzer	Agilent E4448A (3Hz-50GHz)	09/19/07	Annual	US42510244
Spectrum Analyzer	HP 8566B (100Hz-22GHz)	12/22/06	Annual	3638A08713
PSG Analog Signal Generator	Agilent E8257D (250kHz-20GHz)	02/11/07	Annual	MY45470194
Universal Power Meter	Gigatronics 8651A (50MHz-18GHz)	07/28/07	Annual	1834052
Power Sensor	Gigatronics 80701A	04/11/07	Annual	1833460
Quasi-Peak Adapter	HP 85650A	12/22/06	Annual	2043A00301
Preamplifier	HP 8449B (1-26.5GHz)	12/22/06	Annual	3008A00985
Attenutation/Switch Driver	HP 11713A	12/22/06	Annual	N/A
Preselector	HP 85685A (20Hz-2GHz)	12/22/06	Annual	N/A
6dB Resolution Bandwidth Spectrum Analyzer Display	OPT 462	12/22/06	Annual	3701A22204
Ailtech/Eaton Adapter	CCA-7 CISPR/ANSI QP Adapter	12/19/06	Annual	0194-04082
Ailtech/Eaton Receiver	NM 37/57A (30MHz – 1GHz)	06/07/07	Annual	0805-03334
Broadband Amplifier (2)	HP 8447D (0.1 – 1300MHz)	N/A	N/A	2443A01900, 1937A03348
Horn Antenna	EMCO Model 3115 (1-18GHz)	08/25/07	Bi-Annual	9704-5182
Horn Antenna	EMCO Model 3116 (18-40GHz)	08/25/07	Bi-Annual	9203-2178
Roberts Dipoles (2)	Compliance Design (1 set) A100	08/31/07	Bi-Annual	5118
EMCO LISN (3)	3816/2 (2), 3725/2	10/26/07	Annual	1077, 1079, 2099
SOLAR LISN (2)	8012-50	11/18/07	Bi-Annual	0313233, 0310234
10dB Attenuator	HP 8493B	N/A	N/A	N/A
Microwave Cables	MicroCoax (1.0-26.5GHz)	02/26/07	Annual	N/A
Bi-Directional Coax Coupler	PE2208-6	N/A	Annual	N/A

Table 11-2. Annual Test Equipment Calibration Schedule

12.1 Conclusion

The data collected shows that the ***MICHELIN*** **Tire Pressure and Temperature Sensor Model: DBRPL1.0** complies with §15.231 Subpart C of the FCC Rules.

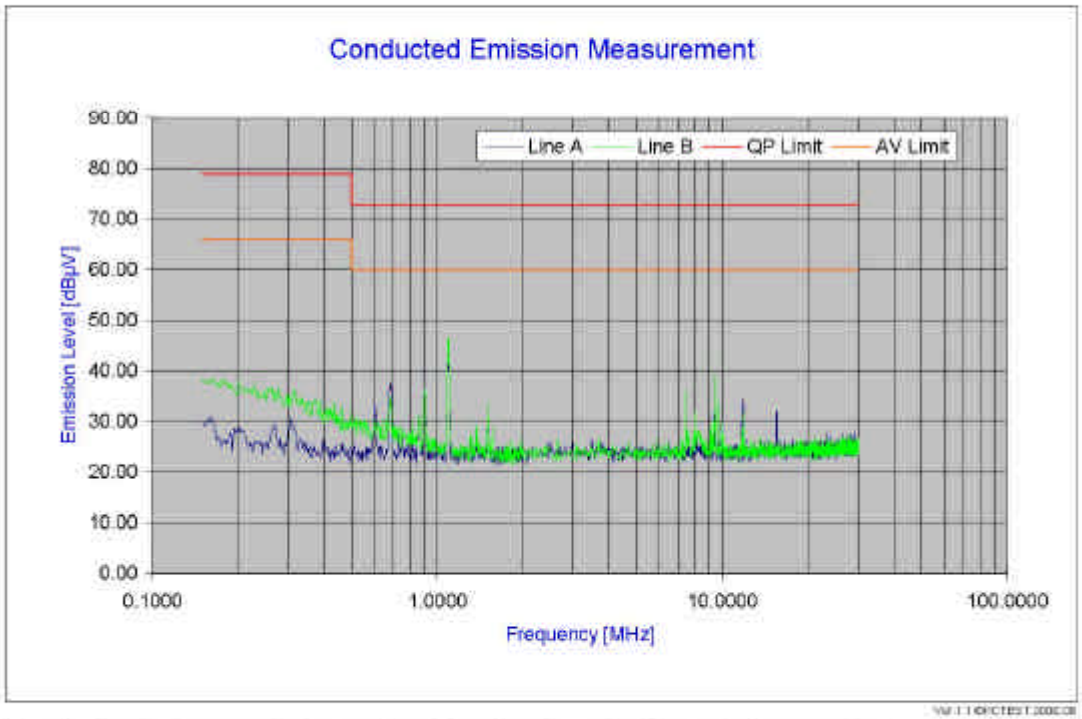
No modifications were made to the device.

ATTACHMENT A – TEST PLOTS

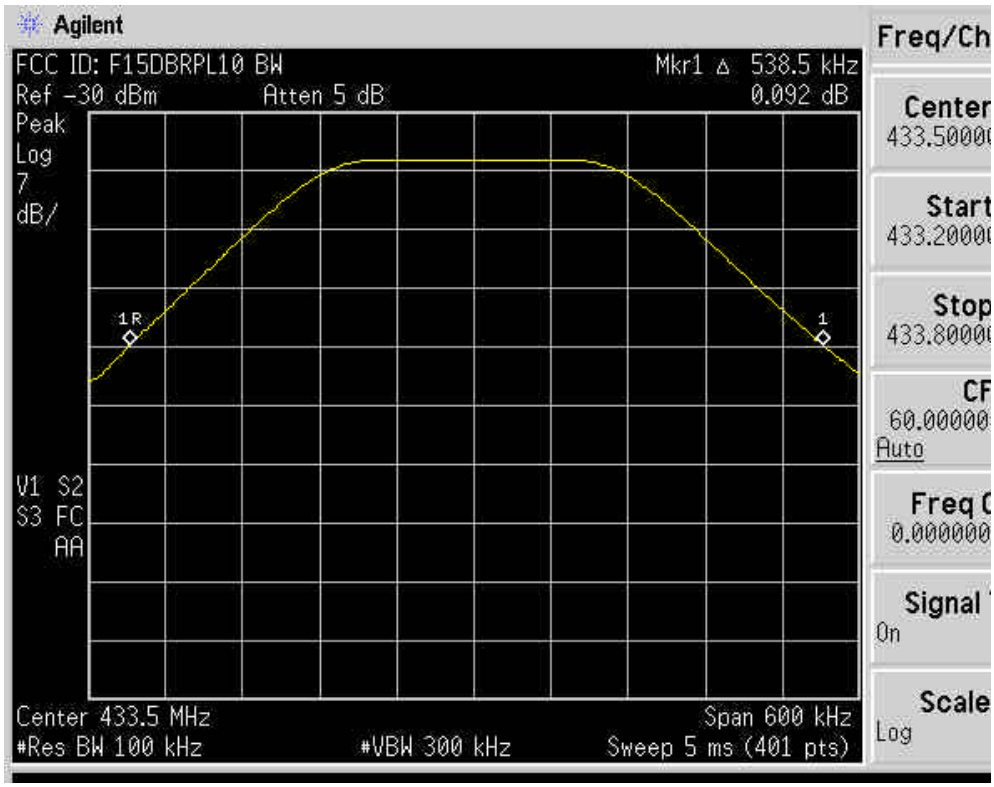
PCTEST Engineering Laboratory Inc.

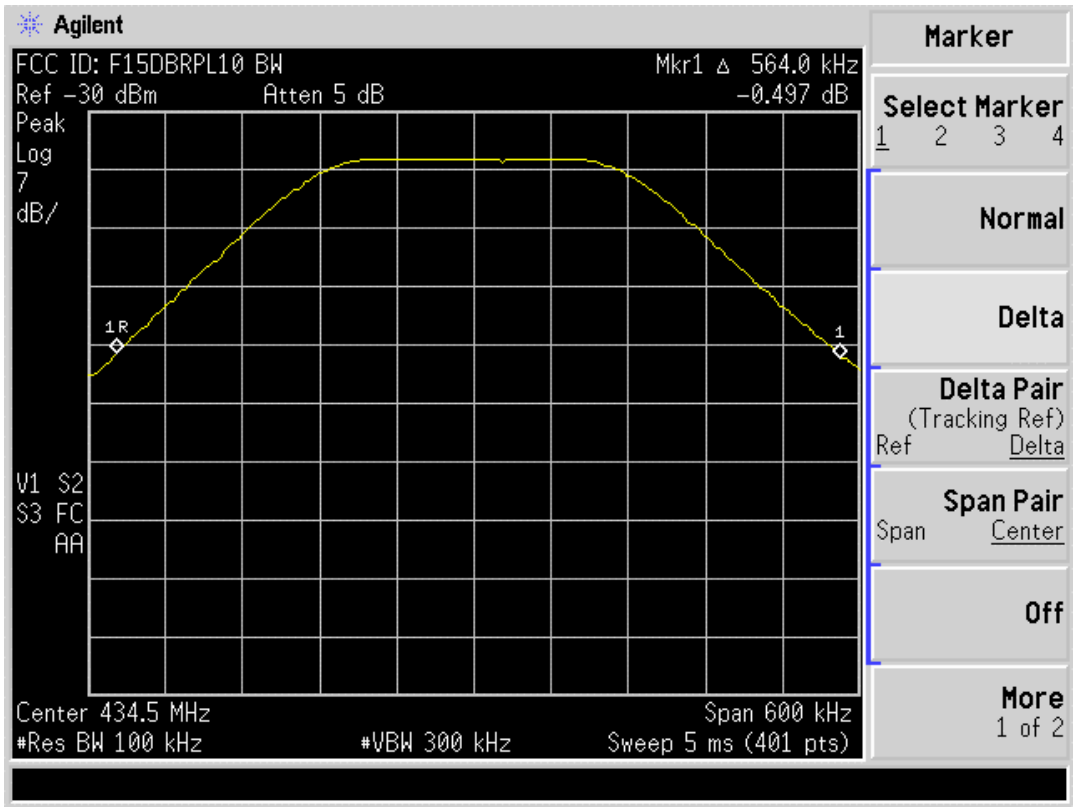
Company : Michelin Americas R & D
FCC ID Code : F15DBRPL10
Standard : FCC Part 15B class A

Power Source : AC120V/60Hz
Tested Date : 10/27/2006



No	Line	Frequency [MHz]	Factor [dB]	QP [dBµV]	Limit [dBµV]	Margin [dB]	Average [dBµV]	Limit [dBµV]	Margin [dB]
1	A	1.092	7.31	41.82	73.00	-31.18	40.25	60.00	-19.75
2	A	0.683	7.35	36.17	73.00	-36.83	31.98	60.00	-28.02
3	A	0.904	7.34	33.74	73.00	-39.26	30.64	60.00	-29.36
4	A	11.672	7.71	26.41	73.00	-46.59	19.85	60.00	-40.15
5	A	0.603	7.40	32.06	73.00	-40.94	27.68	60.00	-32.32
6	A	11.872	7.72	28.37	73.00	-44.63	26.99	60.00	-33.01
7	A	9.362	7.69	28.44	73.00	-44.56	24.53	60.00	-35.47
8	A	1.503	7.35	29.10	73.00	-43.90	25.77	60.00	-34.23
9	A	15.443	7.90	29.53	73.00	-43.47	29.48	60.00	-30.52


Agilent
FCC ID: F15DBRPL10 BW
Mkr1 Δ 538.5 kHz
Ref -30 dBm
Atten 5 dB
0.092 dB
Peak
Log
7
dB/
1R
1
V1 S2
S3 FC
AA
Center 433.5 MHz
Span 600 kHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 5 ms (401 pts)
Freq/Ch
Center
433.50000
Start
433.20000
Stop
433.80000
CF
60.00000
Auto
Freq C
0.000000
Signal
On
Scale
Log


Agilent
FCC ID: F15DBRPL10 BW
Mkr1 Δ 564.0 kHz
Ref -30 dBm
Atten 5 dB
-0.497 dB
Peak
Log
7
dB/
1R
1
V1 S2
S3 FC
AA
Center 434.5 MHz
Span 600 kHz
#Res BW 100 kHz
#VBW 300 kHz
Sweep 5 ms (401 pts)
Marker
Select Marker
1 2 3 4
Normal
Delta
Delta Pair
(Tracking Ref)
Ref Delta
Span Pair
Span Center
Off
More
1 of 2

ATTACHMENT B – TEST SETUP PHOTOGRAPHS

ATTACHMENT C – EXTERNAL / INTERNAL PHOTOGRAPHS