



PCTEST ENGINEERING LABORATORY, INC.

6660-B Dobbin Road, Columbia, MD 21045 USA
Tel. 410.290.6652 / Fax 410.290.6554
<http://www.pctestlab.com>



CERTIFICATE OF COMPLIANCE FCC PART 15.231 Certification

Applicant Name:

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

Date of Testing:

May 31 - June 6, 2007

Test Site/Location:

PCTEST Lab. Columbia, MD, USA

Test Report Serial No.:

0703090170.FI5

FCC ID: FI5-HHR10

APPLICANT: Michelin Tire Corporation

Model(s): HHR1.0

EUT Type: Tire Pressure and Temperature Sensor

Frequency Range: 433.5 MHz, 434.5 MHz

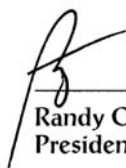
FCC Classification: Remote Control/ Security Device Transceiver (DSR)

FCC Rule Part(s): Part 15 Subpart C (15.231)

This equipment 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 in ANSI C63.4-2003.

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







FCC ID: FI5-HHR10		FCC Pt. 15.231 TEST REPORT (CERTIFICATION)		Reviewed by: Quality Manager
Test Report S/N: 0703090170.FI5	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor		Page 1 of 18

TABLE OF CONTENTS

FCC PART 15.231 MEASUREMENT REPORT.....	3
1.0 INTRODUCTION.....	4
1.1 EVALUATION PROCEDURE.....	4
1.2 SCOPE.....	4
1.3 PCTEST TEST LOCATION.....	4
2.0 PRODUCT INFORMATION.....	5
2.1 EQUIPMENT DESCRIPTION.....	5
2.2 EMI SUPPRESSION DEVICE(S)/MODIFICATIONS.....	5
2.3 LABELING REQUIREMENTS.....	5
3.0 DESCRIPTION OF TEST.....	6
3.1 CONDUCTED EMISSIONS.....	6
3.2 RADIATED EMISSIONS.....	7
4.0 ANTENNA REQUIREMENTS.....	8
5.0 TEST EQUIPMENT CALIBRATION DATA.....	9
6.0 TEST RESULTS.....	10
6.1 SUMMARY.....	10
6.2 LENGTH OF TRANSMISSION TIME AND DUTY CYCLE.....	11
6.3 OCCUPIED BANDWIDTH MEASUREMENT.....	12
6.4 RADIATED EMISSIONS - FUNDAMENTAL.....	13
6.5 RADIATED SPURIOUS EMISSION MEASUREMENTS.....	14
6.6 LINE-CONDUCTED TEST DATA.....	16
7.0 CONCLUSION.....	18

FCC ID: FI5-HHR10		FCC Pt. 15.231 TEST REPORT (CERTIFICATION)		Reviewed by: Quality Manager
Test Report S/N: 0703090170.FI5	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor	Page 2 of 18	



MEASUREMENT REPORT

FCC Part 15.231



§ 2.1033 General Information

APPLICANT: Michelin Tire Corporation
APPLICANT ADDRESS: PO Box 5049
 Spartanburg, SC 29304
TEST SITE: PCTEST ENGINEERING LABORATORY, INC.
TEST SITE ADDRESS: 6660-B Dobbin Road, Columbia, MD 21045 USA
FCC RULE PART(S): Part 15 Subpart C (15.231)
BASE MODEL: HHR1.0
FCC ID: FI5-HHR10
Test Device Serial No.: None Prototype ☐ Production ☒ Pre-Production ☐ Engineering
FCC CLASSIFICATION: Remote Control/ Security Device Transceiver (DSR)
DATE(S) OF TEST: May 31 - June 6, 2007
TEST REPORT S/N: 0703090170.FI5

Test Facility / Accreditations

Measurements were performed at PCTEST Engineering Lab located in Columbia, MD 21045, U.S.A.



- PCTEST facility is an FCC registered (PCTEST Reg. No. 90864) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules and Industry Canada (IC-2451).
- PCTEST Lab is accredited to ISO 17025 by U.S. National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP Lab code: 100431-0) in EMC, FCC and Telecommunications.
- PCTEST Lab is accredited to ISO 17025-2005 by the American Association for Laboratory Accreditation (A2LA) in Specific Absorption Rate (SAR) testing, Hearing Aid Compatibility (HAC) testing, CTIA Test Plans, and wireless testing for FCC and Industry Canada Rules.
- PCTEST Lab is a recognized U.S. Conformity Assessment Body (CAB) in EMC and R&TTE (n.b. 0982) under the U.S.-EU Mutual Recognition Agreement (MRA).
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC Guide 65 by the American National Standards Institute (ANSI) in all scopes of FCC Rules and Industry Canada Standards (RSS).
- PCTEST facility is an IC registered (IC-2451) test laboratory with the site description on file at Industry Canada.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for AMPS, CDMA, and EvDO wireless devices and for Over-the-Air (OTA) Antenna Performance testing for AMPS, CDMA, GSM, GPRS, EGPRS, UMTS (W-CDMA), CDMA 1xEVDO, and CDMA 1xRTT.

FCC ID: FI5-HHR10		FCC Pt. 15.231 TEST REPORT (CERTIFICATION)		Reviewed by: Quality Manager
Test Report S/N: 0703090170.FI5	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor		Page 3 of 18

1.0 INTRODUCTION

1.1 Evaluation Procedure

The measurement procedure described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz (ANSI C63.4-2003) was used in the measurement of the **Michelin eTire Tire Pressure and Temperature Sensor FCC ID: FI5-HHR10**.

Deviation from measurement procedure.....

1.2 Scope

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

1.3 PCTEST Test Location

The map at the right shows the location of the PCTEST LABORATORY, its proximity to the FCC Laboratory, the Columbia vicinity area, the Baltimore-Washington Intern'l (BWI) airport, the city of Baltimore and the Washington, DC area. (see Figure 1-1).

These measurement tests were conducted at the 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 C63.4-2003 on January 27, 2006 and Industry Canada.

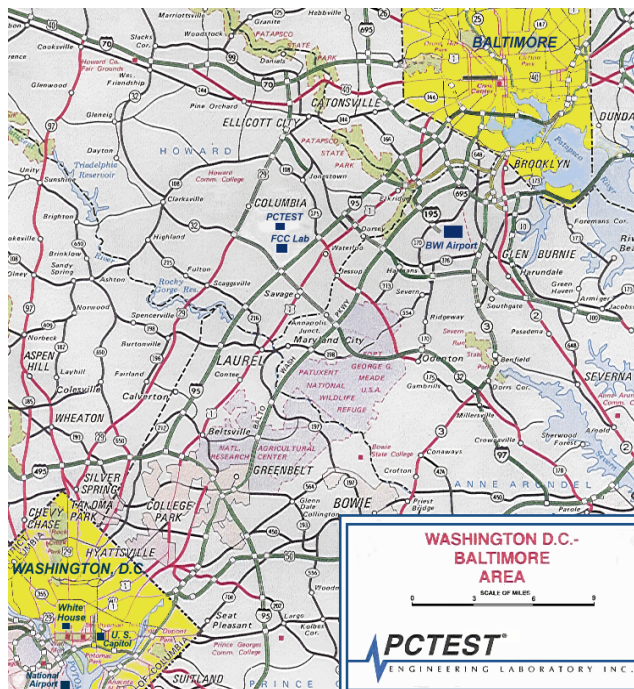




Figure 1-1. Map of the Greater Baltimore and Metropolitan Washington, D.C. area

FCC ID: FI5-HHR10		FCC Pt. 15.231 TEST REPORT (CERTIFICATION)		Reviewed by: Quality Manager
Test Report S/N: 0703090170.FI5	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor		Page 4 of 18

2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Michelin eTire Tire Pressure and Temperature Sensor FCC ID: FI5-HHR10**. The HHR10 is used to measure tire air pressure and tire air temperature for commercial vehicle fleet operations. The EUT consisted of the following component(s):

Manufacturer / Base Model	FCC ID	Description
Michelin eTire / Model: HHR1.0	FI5-HHR10	Low Power Transceiver

Table 2-1. EUT Equipment Description

The EUT also contains an RFID device operating in the 902 – 928 MHz band. Test results for the RFID function are documented in another test report. This test report pertains only to the Low Power Transmitter operating under §15.231.

2.2 EMI Suppression Device(s)/Modifications



No EMI suppression device(s) were added and no modifications were made during testing.

2.3 Labeling Requirements

Per 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the trade name and FCC ID must be displayed on the device per Section 15.19(b)(2).

Please see attachment for FCC ID label and label location.

FCC ID: FI5-HHR10		FCC Pt. 15.231 TEST REPORT (CERTIFICATION)		Reviewed by: Quality Manager
Test Report S/N: 0703090170.FI5	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor		Page 5 of 18

3.0 DESCRIPTION OF TEST

3.1 Conducted Emissions

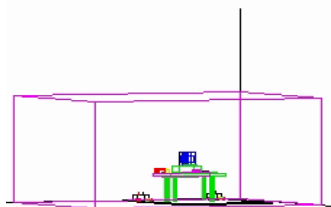


Figure 3-1. Shielded Enclosure Line-Conducted Test Facility

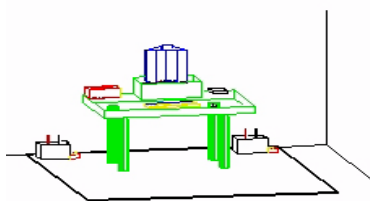


Figure 3-2. Line Conducted Emission Test Set-Up

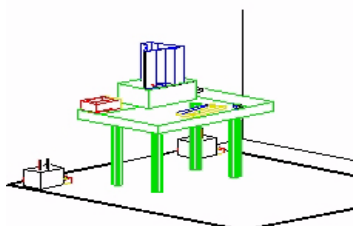


Figure 3-3. Wooden Table & Bonded LISNs

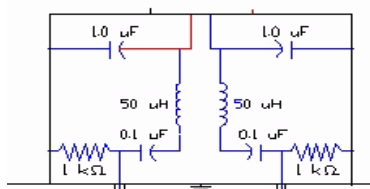




Figure 3-4. LISN Schematic Diagram

The line-conducted facility is located inside a 16'x20'x10' shielded enclosure, manufactured by Ray Proof Series 81 (see *Figure 3-1*). 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 3-2*). Solar Electronics and EMCO Model 3725/2 (10kHz-30MHz) 50Ω/50μH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room (see *Figure 3-3*). 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 filter (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 3-4*). All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion). 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 spectrum analyzer. The detector function was set to CISPR quasi-peak and average mode. The bandwidth of the analyzer was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission. Each emission was maximized by: switching power lines; varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and/or support equipment, and powering the monitor from the floor mounted outlet box and the computer aux AC outlet, if applicable; whichever determined the worst-case emission. Photographs of the worst-case emission can be seen in the test setup photographs. Each EME reported was calibrated using the Agilent E8257D (250kHz – 20GHz) PSG Signal Generator.

FCC ID: F15-HHR10		FCC Pt. 15.231 TEST REPORT (CERTIFICATION)		Reviewed by: Quality Manager
Test Report S/N: 0703090170.F15	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor		Page 6 of 18

3.2 Radiated Emissions

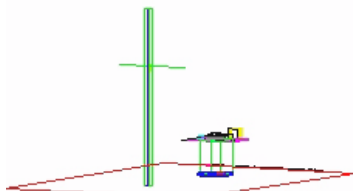


Figure 3-5. 3-Meter Test Site

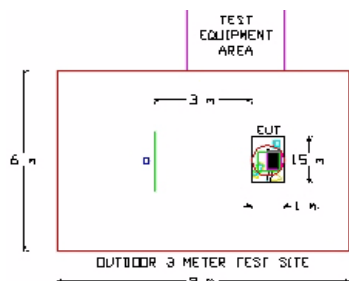


Figure 3-6. Dimensions of Outdoor Test Site

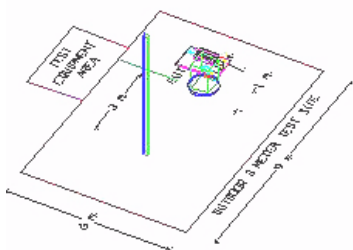


Figure 3-7. Turntable and System Setup

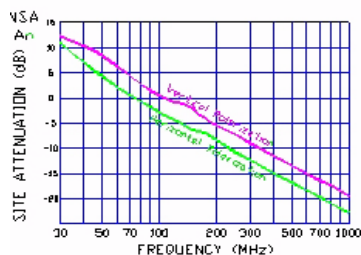




Figure 3-8. Normalized Site Attenuation Curves (H&V)

Preliminary measurements were made indoors at 1-meter using broadband antennas, broadband amplifiers, and spectrum analyzers 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, and turntable azimuth with respect to the antenna was noted for each frequency found. The spectrum was scanned from 30 to 200 MHz using a bi-conical antenna and from 200 to 1000 MHz using a 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 RobertsTM Dipole antennas or horn antennas (see Figure 3-5). The test equipment was placed on a wooden and plastic bench situated on a 1.5m x 2m area adjacent to the measurement area (see Figure 3-6). 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 detector function was set to CISPR quasi-peak mode and the bandwidth of the spectrum analyzer was set to 100kHz for frequencies below 1GHz or 1MHz for frequencies above 1GHz. Above 1GHz the detector function was set to average mode (RBW = 1MHz, VBW = 10Hz).

The half-wave dipole antenna was tuned to the frequency found during preliminary radiated measurements. 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 top of a 0.8-meter high non-metallic 1 x 1.5 meter table (see Figure 3-7). The EUT, support equipment, and interconnecting cables were re-arranged and manipulated to maximize each EME emission. The turntable containing the system was rotated and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by: varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and/or support equipment, and powering the monitor from the floor mounted outlet box and the computer aux AC outlet, if applicable; and changing the polarity of the antenna, whichever determined the worst-case emission. Photographs of the worst-case emission can be seen in the test setup photographs. Each EME reported was calibrated using the Agilent E8257D (250kHz – 20GHz) PSG Signal Generator. The Theoretical Normalized Site Attenuation Curves for both horizontal and vertical polarization are shown in Figure 3-8.

FCC ID: F15-HHR10		FCC Pt. 15.231 TEST REPORT (CERTIFICATION)		Reviewed by: Quality Manager
Test Report S/N: 0703090170.F15	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor		Page 7 of 18

4.0 ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:



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

- The antennas of the Michelin eTire Hand-Held Reader are **permanently attached**.
- There are no provisions for connection to an external antenna.

The Michelin eTire Tire Pressure and Temperature Sensor has two different configurations of antennas. Both antennas are the same design however one antenna is mounted directly to the hand-held unit while another antenna offered is mounted on an extension for convenience in reaching around tires. Both antennas have a unique antenna adapter and are permanently attached.

Conclusion:

The **Michelin eTire Tire Pressure and Temperature Sensor FCC ID: FI5-HHR10** unit complies with the requirement of §15.203.



FCC ID: FI5-HHR10		FCC Pt. 15.231 TEST REPORT (CERTIFICATION)		Reviewed by: Quality Manager
Test Report S/N: 0703090170.FI5	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor		Page 8 of 18

5.0 TEST EQUIPMENT CALIBRATION DATA

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

Manufacturer	Model / Equipment	Calibration Date	Cal Interval	Calibration Due	Serial No.
Agilent	E4407B ESA Spectrum Analyzer	04/29/07	Annual	04/28/08	US39210313
Agilent	N4010A Wireless Connectivity Test Set	06/11/07	Annual	06/10/08	GB46170464
EMCO	Model 3115 (1-18GHz) Horn Antenna	08/24/06	Biennial	08/23/08	9203-2178
EMCO	Model 3115 (1-18GHz) Horn Antenna	08/25/06	Biennial	08/24/08	9704-5182
Rohde & Schwarz	NRVS Power Meter	07/03/07	Biennial	07/02/09	835360/079
Rohde & Schwarz	NRV-Z53 Power Sensor	07/03/07	Biennial	07/02/09	846076/007
Rohde & Schwarz	CMU200 Base Station Simulator	05/24/07	Annual	05/23/08	836371/079
Agilent	HP 8566B (100Hz-22GHz) Spectrum Analyzer	12/21/06	Annual	12/21/07	3638A08713
Agilent	HP 8591A (9kHz-1.8GHz) Spectrum Analyzer	09/20/06	Annual	09/20/07	3144A02458
Agilent	E4448A (3Hz-50GHz) Spectrum Analyzer	09/22/06	Annual	09/22/07	US42510244
Agilent	HP 8591A (9kHz-1.8GHz) Spectrum Analyzer	09/20/06	Annual	09/20/07	3108A02053, 3034A01395
Agilent	E8257D (250kHz-20GHz) Signal Generator	03/08/07	Annual	03/07/08	MY45470194
CCA-7	CISPR QP Adapter	12/21/06	Annual	12/21/07	0194-04082
Agilent	HP 85650A Quasi-Peak Adapter	12/21/06	Annual	12/21/07	2043A00301
CCA-7	CISPR QP Adapter	12/21/06	Annual	12/21/07	0194-04082
Agilent	HP 85650A Quasi-Peak Adapter	12/21/06	Annual	12/21/07	2043A00301
Agilent	HP 8449B (1-26.5GHz) Pre-Amplifier	12/12/06	Annual	12/12/07	3008A00985
Agilent	HP 11713A Attenuation/Switch Driver	12/12/06	Annual	12/12/07	N/A
Agilent	HP 85685A (20Hz-2GHz) Preselector	12/12/06	Annual	12/12/07	N/A
Agilent	HP 8566B Opt. 462 Impulse Bandwidth	12/12/06	Annual	12/12/07	3701A22204
EMCO	3115 (1-18GHz) Horn Antenna	08/25/05	Biennial	08/25/07	9205-3874
Compliance Design	A100 Roberts Dipoles	08/31/05	Biennial	08/31/07	5118
EMCO	Dipole Pair	09/21/06	Biennial	09/20/08	23951
SOLAR	8012-50 LISN (2)	11/18/05	Biennial	11/18/07	0313233, 0310234
Agilent	HP 8495A (0-70dB) DC-4GHz Attenuator	N/A		N/A	N/A
-	263-10dB (DC-18GHz) 10 dB Attenuator	N/A		N/A	N/A
Pasternack	PE7000-6 6 dB Attenuator	N/A		N/A	N/A
Pasternack	PE2209-10 Bidirectional Coupler	N/A		N/A	N/A
-	No.165 (30MHz - 1000MHz) RG58 Coax Cable	N/A		N/A	N/A
-	No.166 (1000-26500MHz) Microwave RF Cable	N/A		N/A	N/A
-	No.167 (100kHz - 100MHz) RG58 Coax Cable	N/A		N/A	N/A

Table 5-1. Annual Test Equipment Calibration Schedule

FCC ID: F15-HHR10	 FCC Pt. 15.231 TEST REPORT (CERTIFICATION)			Reviewed by: Quality Manager
Test Report S/N: 0703090170.F15	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor		Page 9 of 18



6.0 TEST RESULTS

6.1 Summary

Company Name: Michelin Tire Corporation
 FCC ID: F15-HHR10
 Method/System: Low Power Periodic Transmitter, §15.231

FCC Part Section(s)	RSS Section	Test Description	Test Limit	Test Condition	Test Result	Reference
TRANSMITTER MODE (Tx)						
15.231(a)	RSS-210	Transmission Length	<5 seconds after deactivation	RADIATED	Pass	Section 6.2
15.231(b)	RSS-210	Field Strength Limits	§15.231 Table of Limits		Pass	Section 6.4
15.231(c)	RSS-210	20dB Bandwidth	<0.25% of the center frequency		Pass	Section 6.3
15.207	RSS-Gen [7.2.2]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits or < RSS-Gen table 2 limits	LINE CONDUCTED	Pass	Section 6.6
RECEIVER MODE (Rx) / DIGITAL DEVICE						
15.107	RSS-Gen [7.2.2]	AC Conducted Emissions 150kHz – 30MHz	< FCC 15.207 limits or < RSS-Gen table 2 limits	LINE CONDUCTED	Pass	Part 15B Test Report
15.109	RSS-Gen [7.2.3.2]	General Field Strength Limits (Restricted Bands and Radiated Emissions Limits)	< FCC 15.209 limits or < RSS-Gen limits [Section 6; Table1]	RADIATED (30MHz-1GHz) (1-25 GHz)	Pass	Part 15B Test Report

Table 6-1 Summary of Test Results

FCC ID: F15-HHR10	 FCC Pt. 15.231 TEST REPORT (CERTIFICATION)			Reviewed by: Quality Manager
Test Report S/N: 0703090170.F15	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor		Page 10 of 18

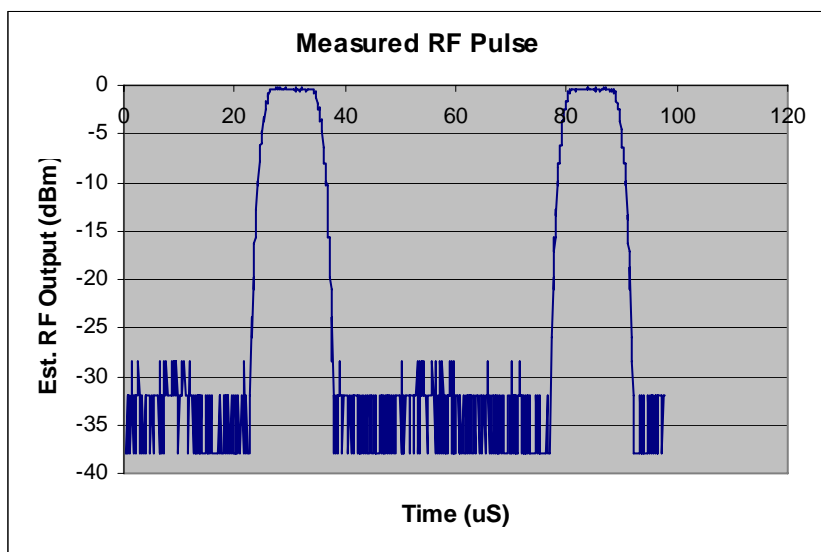
6.2 Length of Transmission Time and Duty Cycle

§15.231 (a); RSS-210

The following describes the duty cycle and transmission time for the Michelin Tire Pressure and Temperature Sensor Model: HHR-10.

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 =

$$10.25\text{microSeconds/pulse} \times (5\text{prescan} + 5\text{confirmation} + 2 \times (16\text{measurement} \times 6\text{repetitions}))\text{pulses} = 2.705\text{milliseconds}$$

$$\text{Total time period} = 54.81\text{milliseconds}$$

$$\text{Duty Cycle} = 3.8\%$$

In accordance with 15.231(a)(1) the HHR-10 automatically deactivates the transmitter within 5 seconds of being released.

FCC ID: FI5-HHR10		FCC Pt. 15.231 TEST REPORT (CERTIFICATION)		Reviewed by: Quality Manager
Test Report S/N: 0703090170.FI5	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor	Page 11 of 18	

6.3 Occupied Bandwidth Measurement

§15.231 (c); RSS-210

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. The occupied bandwidth is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

$$\text{Limit} = 0.25\% \times 433.5\text{MHz} = 1.08375\text{MHz}$$

Measured: 675kHz

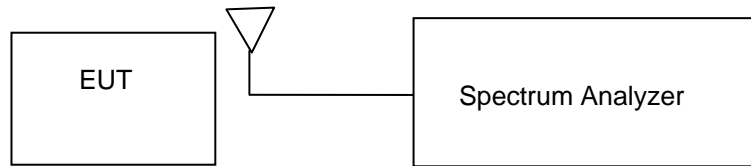
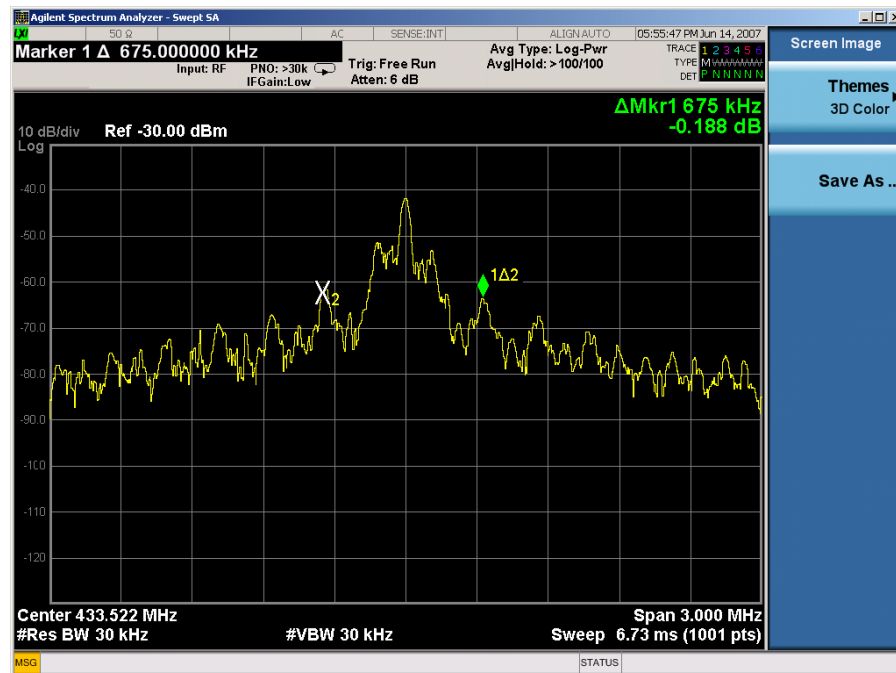




Figure 6-1. Test Instrument & Measurement Setup



Plot 6-1. 20dB Bandwidth Plot – Low Channel

FCC ID: FI5-HHR10	 FCC Pt. 15.231 TEST REPORT (CERTIFICATION)			Reviewed by: Quality Manager
Test Report S/N: 0703090170.FI5	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor		Page 12 of 18



6.4 Radiated Emissions - Fundamental

§15.231 (b); RSS-210

Radiated spurious emissions were measured and verified to be in compliance with the limits specified in §15.231(b).

Client: Michelin
EUT: Hand-held Unit
FCC ID: FI5-HHR10

Mode of operation: 433.5 and 434.5 MHz
Configuration: Extended antenna

Tester: Greg Snyder
Test Date: 3/9/2007



Standard: FCC15_231
Test Distance: 3m

Frequency (MHz)	Polarity H/V H/V	Azimuth Degree	Ant. Height (m)	SA Level (Peak) (dBm)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Duty Cycle Corr. (dB)	Corr. Level (dBuV/m)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
Position 1											
433.500	V	0.0	1.0	-43.1	16.7	2.2	20.0	62.9	1392.4	11305.2	-18.2
433.500	H	270.0	1.0	-46.2	16.7	2.2	20.0	59.8	974.4	11305.2	-21.3
Position 2											
433.500	H	45.0	1.0	-35.9	16.7	2.2	20.0	70.1	3189.7	11305.2	-11.0
433.500	V	45.0	1.0	-53.1	16.7	2.2	20.0	52.9	440.3	11305.2	-28.2
Position 3											
433.500	V	225.0	1.2	-45.1	16.7	2.2	20.0	60.9	1106.0	11305.2	-20.2
433.500	H	22.5	1.0	-37.4	16.7	2.2	20.0	68.5	2671.5	11305.2	-12.5
Position 1											
434.500	V	90.0	1.5	-44.6	16.7	2.2	20.0	61.4	1171.5	11020.9	-19.5
434.500	H	0.0	2.0	-47.2	16.7	2.2	20.0	58.8	868.5	11020.9	-22.1
Position 2											
434.500	H	180.0	1.5	-38.7	16.7	2.2	20.0	67.3	2310.8	11020.9	-13.6
434.500	V	180.0	1.5	-49.7	16.7	2.2	20.0	56.3	651.3	11020.9	-24.6
Position 3											
434.500	V	90.0	1.5	-37.9	16.7	2.2	20.0	68.1	2533.7	11020.9	-12.8
434.500	H	0.0	1.5	-36.7	16.7	2.2	20.0	69.3	2909.1	11020.9	-11.6

Table 6-2. Radiated Emissions Measurements – Fundamental

NOTES:

- 1) All measurements were made at a distance of 3m.
- 2) Worst case emissions are reported. Evaluation showed that the Extended Antenna was worst case.
- 3) All emissions shown were measured with a peak detector.
- 4) The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
- 5) The EUT is supplied with nominal AC voltage and/or a new/fully-recharged battery.

FCC ID: FI5-HHR10		FCC Pt. 15.231 TEST REPORT (CERTIFICATION)		Reviewed by: Quality Manager
Test Report S/N: 0703090170.FI5	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor	Page 13 of 18	

6.5 Radiated Spurious Emission Measurements

§15.231 (b) / §15.205 & §15.209; RSS-210

The field strength of spurious emissions were measured up to the 10th harmonic of the fundamental and compared to the limit specified in §15.231 or §15.209 if the emission occurs in a restricted band. Emissions were measured within a 100 kHz bandwidth. For emissions that fall in the restricted bands emissions were measured using a Quasi-Peak detector below 1GHz. Above 1 GHz, average and peak measurements were used, using RBW = 1MHz, VBW = 10Hz and linearly polarized horn antennas. All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table 6-3 per Section 15.209.

Frequency	Field Strength [μV/m]	Measured Distance [Meters]
0.009 – 0.490 MHz	2400/F (kHz)	300
0.490 – 1.705 MHz	24000/F (kHz)	30
1.705 – 30.00 MHz	30	30
30.00 – 88.00 MHz	100	3
88.00 – 216.0 MHz	150	3
216.0 – 960.0 MHz	200	3
Above 960.0 MHz	500	3



Table 6-3. Radiated Limits – Restricted Bands

Sample Calculation

- Field Strength Level [dBμV/m] = Analyzer Level [dBm] + 107 + AFCL [dB] + Duty Cycle Correction [dB]

Notes:

- AFCL = Antenna Factor [dB] + Cable Loss [dB]
- Duty Cycle Correction = 20log(worst case dwell time / 100ms) [dB]
 - This value is 0 dB if not applied
 - Maximum applied duty cycle correction is 20dB.

FCC ID: FI5-HHR10	 FCC Pt. 15.231 TEST REPORT (CERTIFICATION)			Reviewed by: Quality Manager
Test Report S/N: 0703090170.FI5	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor		Page 14 of 18

Radiated Spurious Emission Measurements (Cont'd)



§15.231 (b) / §15.205 & §15.209; RSS-210

FREQ [MHz]	LEVEL [dBm]	Antenna Factor [dBm]	AFCL [dBm]	POL [H/V]	Field Strength [dBuV/m]	Field Strength [uV/m]	Limit [dBuV/m]	Margin [dB]
433.5								
867	-76.7	21.87	21.87	H	52.2	405.98	1130.524	-8.90
1300.5	-82.7	25.54	25.54	V	49.8	310.32	500.000	-4.14
1734	-86.3	26.89	26.89	V	47.6	239.60	1130.524	-13.48
2167.5	-90.6	28.06	28.06	V	44.5	167.04	1130.524	-16.61
2601	-92.8	29.18	29.18	H	43.4	147.57	1130.524	-17.69
434.5								
869	-78.6	22.75	22.75	H	51.1	360.80	1133.930	-9.95
1303.5	-81.7	25.55	25.55	V	50.8	348.62	500.000	-3.13
1738	-88.4	26.90	26.90	V	45.5	188.37	1133.930	-15.59
2172.5	-90.4	28.07	28.07	H	44.7	171.21	1133.930	-16.42
2607	-91.7	29.19	29.19	H	44.5	167.76	1133.930	-16.60

Table 6-4. Radiated Emissions Measurements

NOTES:

- 1) All measurements were made at a distance of 3m.
- 2) The spectrum is measured from 9kHz to the 10th harmonic and the worst-case emissions are reported. No significant emissions were found beyond the fifth harmonic for this device.
- 3) All emissions shown were measured with a peak detector. Above 1Ghz the RBW and VBW were set to 1MHz.
- 4) The antenna is manipulated through typical positions, polarity and length during the tests. The EUT is manipulated through three orthogonal planes.
- 5) The EUT is supplied with nominal AC voltage and/or a new/fully-recharged battery.
- 6) Worst case emissions were detected with the Extended Antenna configuration.

FCC ID: FI5-HHR10	 FCC Pt. 15.231 TEST REPORT (CERTIFICATION)			Reviewed by: Quality Manager
Test Report S/N: 0703090170.FI5	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor		Page 15 of 18



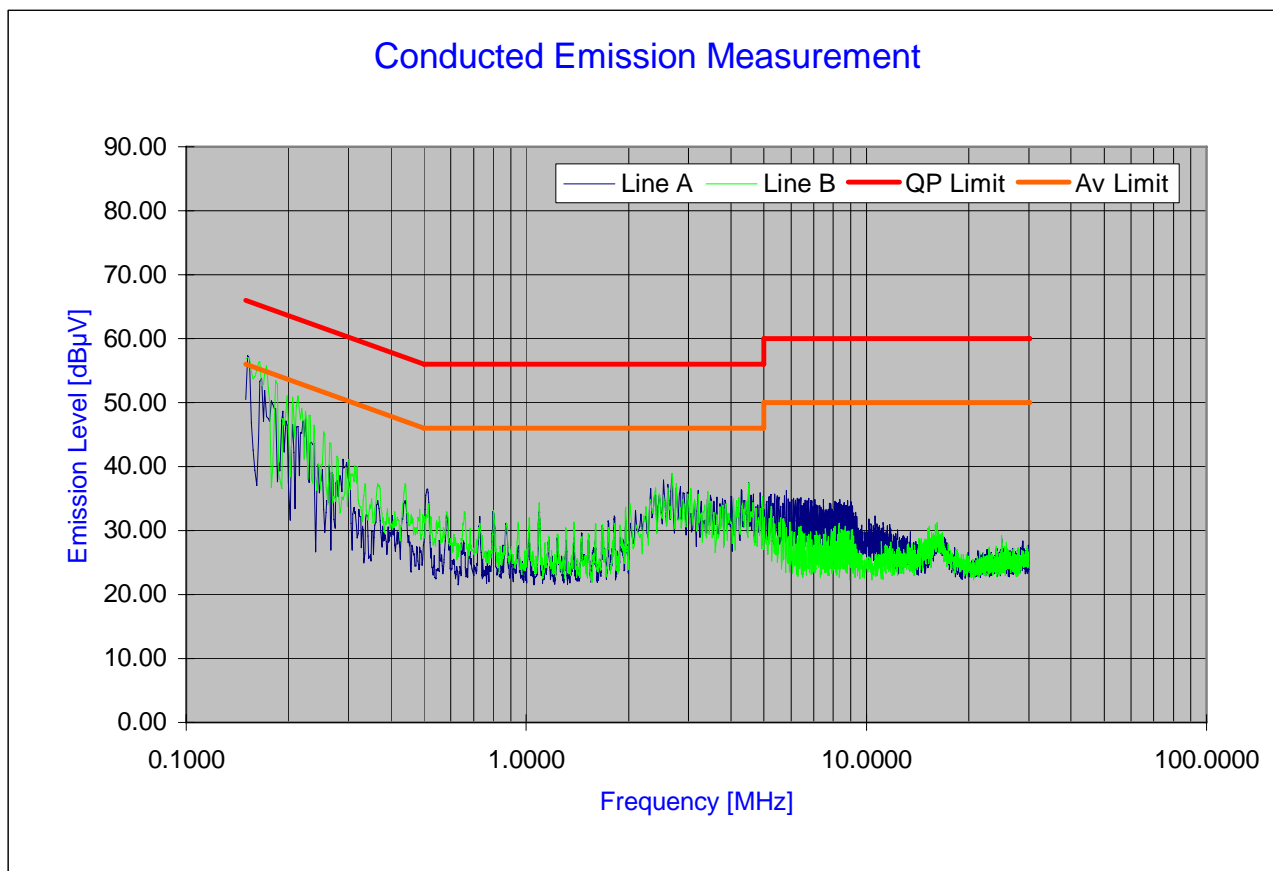
6.6 Line-Conducted Test Data

§15.207; RSS-Gen (7.2.2)

PCTEST Engineering Laboratory Inc.

Company : Michelin
Model Number : HHR-10
Standard : FCC Part 15C, 15.207

Power Source : AC120V/60Hz
Tested Date : 06/21/2007
Test Engineer : Joel San Buenaventura
Note : 433.5MHz Operation





Ver.1.1 ©PCTEST 2006.08

Plot 6-2. Line Conducted Plot

Notes:

1. All Modes of operation were investigated and the worst-case emissions are reported.
2. The limit for Class B device(s) from 150kHz to 30MHz are specified in Section 15.207 of the Title 47 CFR.
3. Line A = Phase; Line B = Neutral
4. Traces shown in plot are made using a peak detector.
5. Deviations to the Specifications: None.

FCC ID: FI5-HHR10		FCC Pt. 15.231 TEST REPORT (CERTIFICATION)		Reviewed by: Quality Manager
Test Report S/N: 0703090170.FI5	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor	Page 16 of 18	

Line-Conducted Test Data (Cont'd)



§15.207; RSS-Gen (7.2.2)

No.	Line	Frequency [MHz]	Factor [dB]	QP [dBμV]	Limit [dBμV]	Margin [dB]	Average [dBμV]	Limit [dBμV]	Margin [dB]
1	A	0.150	8.20	56.56	66.00	-9.44	40.14	56.00	-15.86
2	A	0.153	8.20	53.77	66.00	-12.23	35.75	56.00	-20.25
3	A	0.175	8.05	48.76	64.70	-15.94	31.93	54.70	-22.77
4	A	0.188	7.99	46.62	64.12	-17.50	30.70	54.12	-23.42
5	A	0.216	7.86	43.16	62.85	-19.69	29.33	52.85	-23.52
6	A	0.219	7.86	43.29	62.84	-19.55	34.77	52.84	-18.07
7	A	2.541	7.42	34.22	56.00	-21.78	29.21	46.00	-16.79
8	A	2.686	7.43	34.68	56.00	-21.32	31.83	46.00	-14.17
9	A	2.831	7.44	35.01	56.00	-20.99	28.47	46.00	-17.53
10	A	4.500	7.50	33.73	56.00	-22.27	29.07	46.00	-16.93
11	B	0.150	8.20	55.26	66.00	-10.74	48.04	56.00	-7.96
12	B	0.153	8.20	53.54	66.00	-12.46	46.52	56.00	-9.48
13	B	0.166	8.10	50.67	65.16	-14.49	44.06	55.16	-11.10
14	B	0.181	8.03	48.39	64.45	-16.06	42.00	54.45	-12.45
15	B	0.196	7.95	46.24	63.76	-17.52	40.25	53.76	-13.51
16	B	0.219	7.86	43.68	62.85	-19.17	37.34	52.85	-15.51
17	B	0.236	7.80	41.72	62.24	-20.52	35.48	52.24	-16.76
18	B	0.247	7.76	40.57	61.86	-21.29	34.34	51.86	-17.52
19	B	2.688	7.43	36.68	56.00	-19.32	34.46	46.00	-11.54
20	B	4.507	7.50	34.01	56.00	-21.99	27.03	46.00	-18.97

Table 6-5. Line Conducted Data



Notes:

1. All Modes of operation were investigated and the worst-case emissions are reported.
2. The limit for Class B device(s) from 150kHz to 30MHz are specified in Section 15.207 of the Title 47 CFR.
3. Line A = Phase; Line B = Neutral
4. Traces shown in plot are made using a peak detector.
5. Deviations to the Specifications: None.

FCC ID: FI5-HHR10			FCC Pt. 15.231 TEST REPORT (CERTIFICATION)		Reviewed by: Quality Manager
Test Report S/N: 0703090170.FI5	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor			Page 17 of 18

7.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Michelin eTire Tire Pressure and Temperature Sensor FCC ID: FI5-HHR10** is in compliance with Part 15 Subpart C (15.231) of the FCC Rules.

FCC ID: FI5-HHR10		FCC Pt. 15.231 TEST REPORT (CERTIFICATION)		Reviewed by: Quality Manager
Test Report S/N: 0703090170.FI5	Test Dates: May 31 - June 6, 2007	EUT Type: Tire Pressure and Temperature Sensor	Page 18 of 18	