TEST REPORT

Product Name : Tire Pressure Monitor System
Model Number : TPM167
Brand Name : Lite-On
FCC ID : LJL041201T

Applicant : LITE-ON AUTOMOTIVE CORPORATION
Address : 37, Chung Yang Road, N.E.P.Z. Kaohsiung 811, Taiwan, R.O.C.

Received Date : December 06, 2004
Tested Date : December 06 ~ 27, 2004

Notes :
1. This report will be invalid if duplicated or photocopied in part.
2. This report refers only to the specimen(s) submitted to testing, and be invalid as separately used.
3. This report is invalid without examination stamp and signature of this institute.
4. The tested specimen(s) will be preserved for thirty days from the data issued.
5. The report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

0240
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NVLAP LAB CODE 200118-0

Test Report Certification

Product Name : Tire Pressure Monitor System
Model Number : TPM167
Brand Name : Lite-On
FCC ID : LJL041201T
Applicant : LITE-ON AUTOMOTIVE CORPORATION

Measurement Standard :

47 CFR Part 15 Subpart C(Section 15.231)
ANSI C63.4-2003

Tested By : Ken Tu, **Date** : December 30, 2004
(Ken Tu)

Approved By : C.F.Wu, **Date** : Decmeber 30, 2004
(C.F.Wu, Manager)

WE HEREBY CERTIFY THAT: The measurements shown in the attachment were made in accordance with the procedures indicated, and the energy emitted by the equipment was found to be within the limits applicable. We assume full responsibility for the accuracy and completeness of these measurements and vouch for the qualifications of all persons taking them.

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1. GENERAL INFORMATION

1.1 General Statement

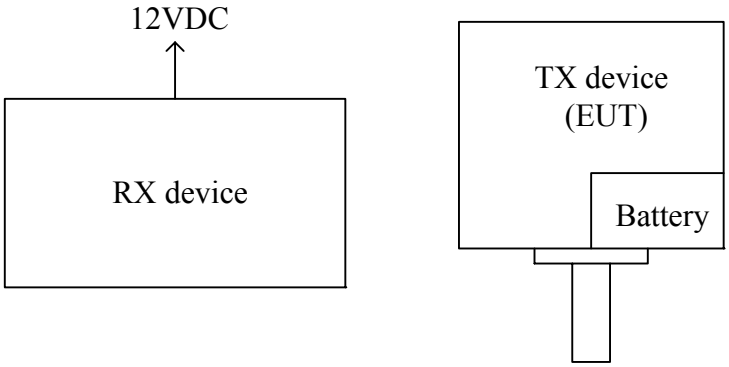
MEASUREMENT DEVIATION：Comply with standard in full

TRACEABILITY ：This test result is traceable to national or international std.

1.2 General Description of EUT & Power

Product Name	Tire Pressure Monitor System
Model Number	TPM167
Frequency Band	433.92MHz
Operating Frequency	433.90MHz
Type of Modulation	FSK Modulation
EUT Description	1. Normal Mode : When the tire pressure is normal, the transmitter will transmit a 10ms signal in 54.6 seconds time interval for polling the system integrity. 2. Alarm Mode : When 3 PSI tire pressure down is detected, the transmitter will transmit a 10ms signal which contains alarm codes in every 54.6 seconds.
Antenna Type	Transmitter : Soldered on PCB Antenna. Receiver : Monopole Antenna.
Power Source	3VDC (For Transmitter device) from a battery

1.3 EUT & Peripherals Setup Diagram



1.4 EUT Operating Condition

(1) Set up the EUT as described in set up diagram.
(2) Switch on the operation mode.
(3) Start test.

1.5 Description of Test Site

SITE DESCRIPTION

FCC Certificate NO.	: 90585
BSMI Certificate NO.	: SL2-IN-E-0002
NVLAP Lab Code	: 200118-0
CNLA Certificate NO.	: CNLA-ZL97018E
VCCI Certificate NO.	: R-1189, C-1250
TÜV Rheinland Certificate NO.	: 10008375

NAME OF SITE : Ecom Sertech Corp. Hsin-Chu Lab.
(Spin-off from ITRI / ERSO on Apr. 01, 2003)

SITE LOCATION : Rm.258, Bldg.17, NO.195 , Sec. 4, Chung Hsing Rd., Chu-Tung Chen. Hsin-Chu, Taiwan 310 R.O.C.

1.6 Summary of Test Results

The EUT has been tested according to the following specifications :

APPLIED STANDARD：47 CFR Part 15, Subpart B and Subpart C			
Standard Section	Test Type and Limit	Result	REMARK
15.207	AC Power Conducted Emission Limit : Sec 15.207	N/A	Battery Power
15.209 15.231(e)	Transmitter Radiated Emissions Limit : 15.209；15.231(e)	PASS	Meet the requirement of limit
15.231(e)	Transmit periodically at a regular predetermined interval.	N/A	Automatically operated only
15.231(c)	Bandwidth Limit: Center frquency×0.25%	PASS	Meet the requirement of limit

2. TANSMITTER AUTO-OFF AND DUTY CYCLE

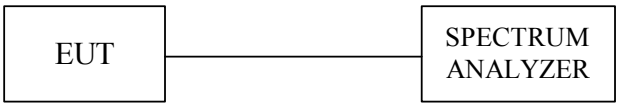
2.1 Test Equipments

The following test equipments are utilized in making the measurements contained in this report.

Description & Manufacturer	Model No.	Serial No.	Date Of Calibration
R/S SPECTRUM ANALYZER	FSEK30	835253/002	September 06, 2004

2.2 Test Setup

The diagram below shows the test setup that is utilized to perform the measurements for duty cycle and power off duration.



2.3 Test Procedures

1. The tests were performed with the equipment under test (EUT) connected to the spectrum directly.
2. The spectrum was turned to the center frequency of the emission and set to the zero span with proper sweep time.
3. The duration of transmission of ON/OFF was determined by the spectrum with the function of marker and cursor line.

2.4 Uncertainty of Radiated Emission

The uncertainty of time domain measurement is ± 1μs.

2.5 Test Result

For the frequency band (433.92MHz)

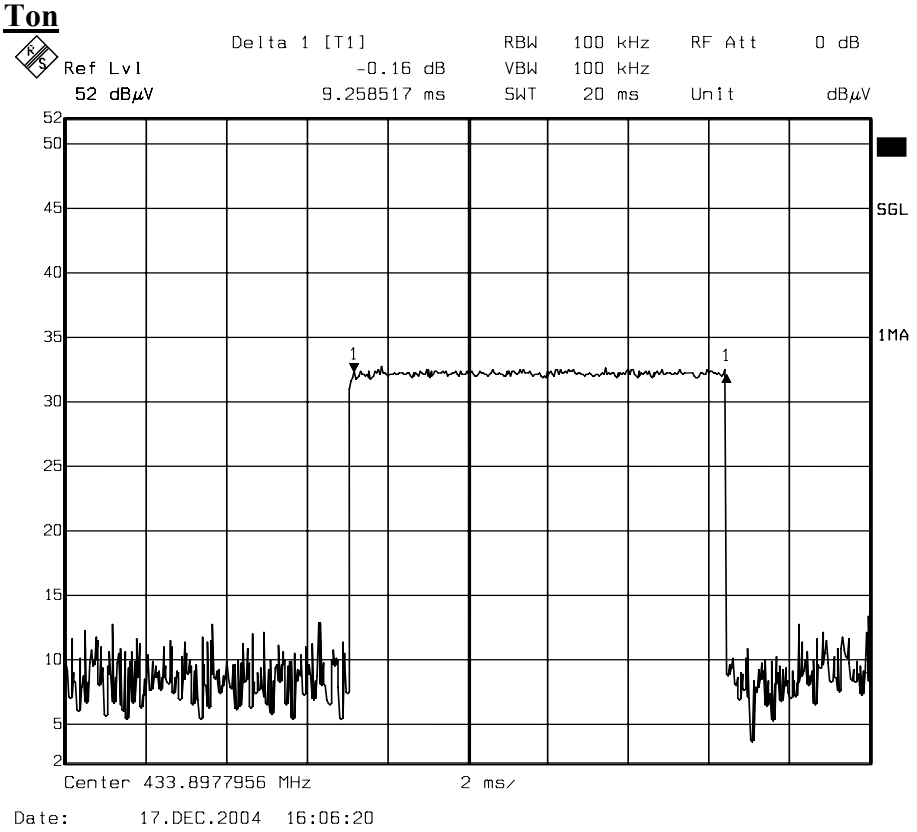
According to 15.231(a)(2), a transmitter activated automatically shall ceases transmission within 5 seconds after activation. The EUT activated automatically and the transmitting time is 10ms which comply with 15.231(a)(2).

According to 15.231(e), devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds. The EUT transmits 10ms in every 54.6 second which comply with 15.231(e). The duty factor is calculated with following formula :

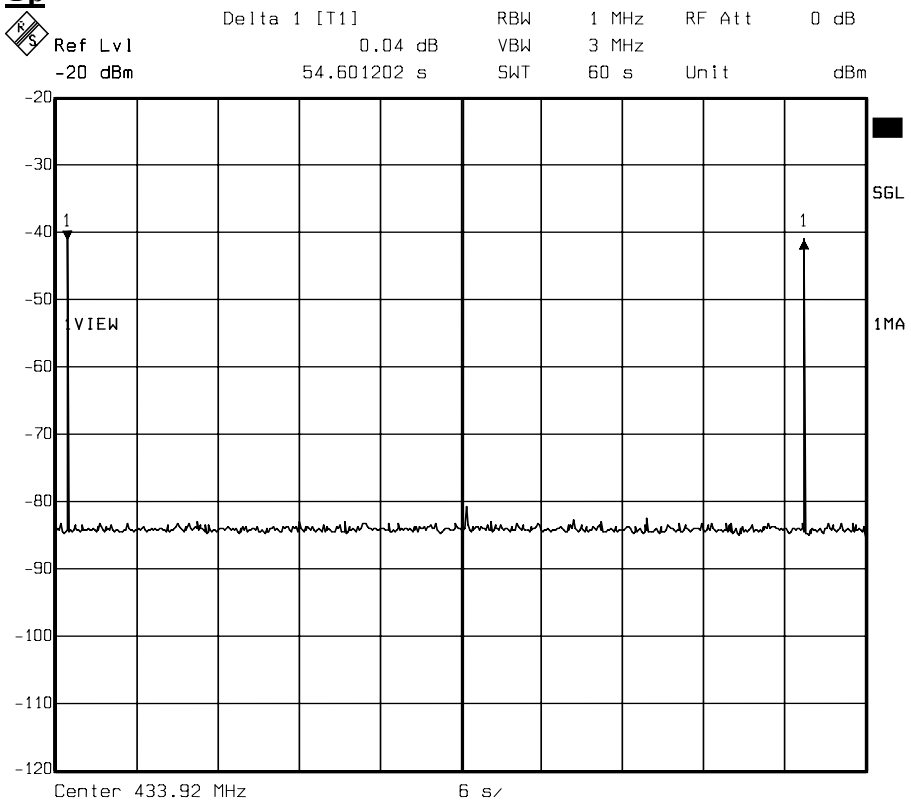
$$20 \log \frac{\text{Total Duty}}{\text{Period of Pulse Train}}$$

$$\text{Duty Factor} = 20 \log \frac{9.3\text{ms(Ton)}}{100\text{ms(Tp)}} = -20.63\text{dB}$$

Ton


Delta 1 [T1]
RBW 100 kHz
RF Att 0 dB
Ref Lvl
-0.16 dB
VBW 100 kHz
52 dBμV
9.258517 ms
SWT 20 ms
Unit dBμV
SGL
1MA
Center 433.8977956 MHz
2 ms/
Date: 17.DEC.2004 16:06:20

Tp


Delta 1 [T1]
RBW 1 MHz
RF Att 0 dB
Ref Lvl
0.04 dB
VBW 3 MHz
-20 dBm
54.601202 s
SWT 60 s
Unit dBm
SGL
1MA
VIEW
Center 433.92 MHz
6 s/

3. CONDUDED EMISSION MEASUREMENT

3.1 Standard Applicable

This EUT is excused from investigation of conducted emission for it is powered by cell phone only. According to § 15.207 (c), measurement to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

4. RADIATED EMISSION TEST

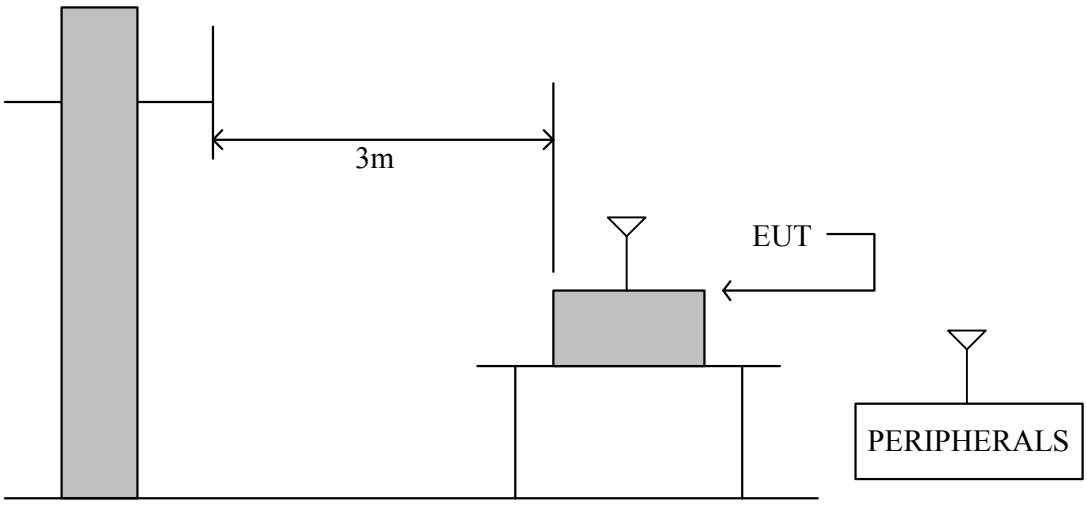
4.1 Test Equipments

The following test equipments are utilized in making the measurements contained in this report.

Manufacturer or Type	Model No	Serial No	Date of Calibration	Calibration Period	Remark
CHASE BI-LOG ANTENNA	CBL6112B	2421	June 15, 2004	1 Year	FINAL
R/S SPECTRUM ANALYZER	FSEK30	835253/002	September 06, 2004	1 Year	FINAL
OPEN SITE	----------	No.2	May 07, 2004	1 Year	FINAL
N TYPE COAXIAL CABLE	CHA9525	4	June 03, 2004	1 Year	FINAL
Horn Antenna	AH-118	10089	April 09, 2004	1 Year	FINAL
HP Pre-amplifier	8449B	3008A01471	November 24, 2004	1 Year	FINAL
HP High pass filter	84300/80038	002	CAL. ON USE	1 Year	FINAL
Horn Antenna	AH-840	3077	February 25, 2004	1 Year	FINAL

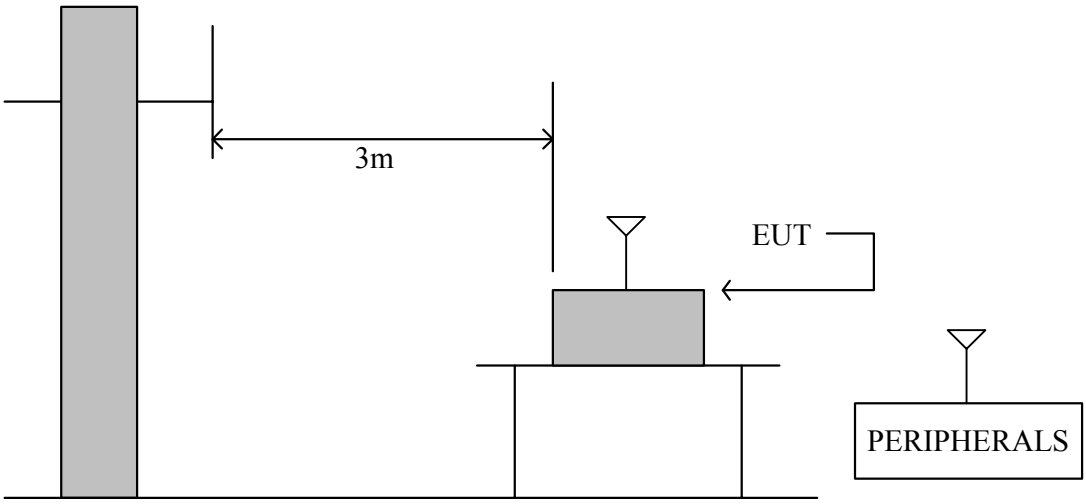
4.2 Test Setup

1. The diagram below shows the test setup that is utilized to make the measurements for emission below 1GHz.(For Transmitter device)



Antenna Elevation Variable

2. The diagram below shows the test setup that is utilized to make the measurements for emission above 1GHz.(For Transmitter device)



Antenna Elevation Variable

4.3 Radiation Limit

For unintentional device, according to § 15.209(a), except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/M)	Radiated (μV/M)
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

For intentional device, according to § 15.231(e), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following table.

Fundamental Frequency (MHz)	Field Strength of Fundamental (μV/M)	Field Strength of Spurious Emission (μV/M)
40.66-40.70	1000	100
70-130	500	50
130-174	500 to 1500**	50 to 150**
174-260	1500	150
260-470	1500 to 5000**	150 to 500**
Above 470	5000	500

Note :

1. " ※※ " linear interpolations.
2. Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz, uV/m at 3 meters = 22.72727(F) - 2454.545; for the band 260-470 MHz, uV/m at 3 meters = 16.6667(F) – 2833.3333. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.

4.4 Test Procedures

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 10 meter open area test site. The table was rotated 360 degrees to determine the position of the highest radiation.
b. During performing radiated emission below 1GHz, the EUT (Transmitter device) was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1GHz, the EUT (Transmitter device) was set 3 meters away from the interference-receiving antenna.
c. The antenna is a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarization of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. If the emission level of the EUT in peak mode was 10 dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

4.5 Uncertainty of Radiated Emission

The uncertainty of radiated emission is ±2.72dB.

4.6 Radiated RF Noise Measurement Results

The frequency spectrum from 30 MHz to 4339 MHz for Transmitter was investigated. All emissions not reported are much lower than the prescribed limits.

Company	LITE-ON AUTOMOTIVE CORPORATION	**Test Date**	2004/12/18
Product Name	Tire Pressure Monitor System	**Test By**	Ken Tu
Model Name	TPM167	**TEMP & Humidity**	27.1℃, 67%

Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading at 3m(dBμV)		Limits (dBμV/m)	Emission Level at 3m(dBμV/m)		Detector Mode
			Horizontal	Vertical		Horizontal	Vertical	
30.00	17.01	0.97	*	*	40.00	*	*	PK
▲433.90	18.21	4.97	38.80	50.30	92.87	61.98	73.48	PK
▲433.90	18.21	4.97	—	—	72.87	41.35	52.85	AVG
867.78	21.18	7.10	16.70	22.70	72.87	44.98	50.98	PK
867.78	21.18	7.10	—	—	52.87	24.35	30.35	AVG
※1301.67	23.67	9.02	15.80	16.40	74.00	48.49	49.09	PK
※1301.67	23.67	9.02	—	—	54.00	27.86	28.46	AVG
1735.56	26.16	10.86	13.90	14.00	72.87	50.91	51.01	PK
1735.56	26.16	10.86	—	—	52.87	30.28	30.38	AVG
4338.90	*	*	*	*	74.00	*	*	PK
4338.90	*	*	*	*	54.00	*	*	AVG

REMARKS：

1. * Undetectable
2. Emission level (dBμV/m) = Antenna Factor (dB/m) + Cable loss (dB) + Meter Reading (dBμV).
3. Remark "▲" means operating frequency for Transmitter device.
4. The emission value below 1GHz is quasi-peak value and the emission value above 1GHz is both peak and average value.
   PK : Peak value; AVG : Average value.
5. The measurement was searched to 10th harmonic, Remark "---" means that the emissions level is too low to be measured.
6. Remark "※"means the Restricted band.
7. For the frequency band (433.92MHz), X-axis direction, detailed in setup photo.
8. Average = Peak Value + Duty Factor (Duty Factor = -20.63dB)

The frequency spectrum from 30 MHz to 4339 MHz for Transmitter was investigated. All emissions not reported are much lower than the prescribed limits.

Company	LITE-ON AUTOMOTIVE CORPORATION	**Test Date**	2004/12/18
Product Name	Tire Pressure Monitor System	**Test By**	Ken Tu
Model Name	TPM167	**TEMP & Humidity**	27.1℃, 67%

Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading at 3m(dBμV)		Limits (dBμV/m)	Emission Level at 3m(dBμV/m)		Detector Mode
			Horizontal	Vertical		Horizontal	Vertical	
30.00	17.01	0.97	＊	＊	40.00	＊	＊	PK
▲433.90	18.21	4.97	48.30	40.50	92.87	71.48	63.68	PK
▲433.90	18.21	4.97	—	—	72.87	50.85	43.05	AVG
867.78	21.18	7.10	23.10	21.60	72.87	51.38	49.88	PK
867.78	21.18	7.10	—	—	52.87	30.75	29.25	AVG
※1301.67	23.67	9.02	16.20	17.50	74.00	48.89	50.19	PK
※1301.67	23.67	9.02	—	—	54.00	28.26	29.56	AVG
1735.56	26.16	10.86	15.80	18.20	72.87	52.81	55.21	PK
1735.56	26.16	10.86	—	—	52.87	32.18	34.58	AVG
4338.90	＊	＊	＊	＊	74.00	＊	＊	PK
4338.90	＊	＊	＊	＊	54.00	＊	＊	AVG

REMARKS：

1. ＊ Undetectable
2. Emission level (dBμV/m) = Antenna Factor (dB/m) + Cable loss (dB) + Meter Reading (dBμV).
3. Remark "▲" means operating frequency for Transmitter device.
4. The emission value below 1GHz is quasi-peak value and the emission value above 1GHz is both peak and average value.
   PK : Peak value; AVG : Average value.
5. The measurement was searched to 10th harmonic, Remark "---" means that the emissions level is too low to be measured.
6. Remark "※"means the Restricted band.
7. For the frequency band (433.92MHz), Y-axis direction, detailed in setup photo.
8. Average = Peak Value + Duty Factor (Duty Factor = -20.63dB)

The frequency spectrum from 30 MHz to 4339 MHz for Transmitter was investigated. All emissions not reported are much lower than the prescribed limits.

Company	LITE-ON AUTOMOTIVE CORPORATION	**Test Date**	2004/12/18
Product Name	Tire Pressure Monitor System	**Test By**	Ken Tu
Model Name	TPM167	**TEMP & Humidity**	27.1℃, 67%

Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading at 3m(dBμV)		Limits (dBμV/m)	Emission Level at 3m(dBμV/m)		Detector Mode
			Horizontal	Vertical		Horizontal	Vertical	
30.00	17.01	0.97	∗	∗	40.00	∗	∗	PK
▲433.90	18.21	4.97	51.00	43.20	92.87	74.18	66.38	PK
▲433.90	18.21	4.97	—	—	72.87	53.55	45.75	AVG
867.78	21.18	7.10	24.50	23.20	72.87	52.78	51.48	PK
867.78	21.18	7.10	—	—	52.87	32.15	30.85	AVG
※1301.67	23.67	9.02	16.40	17.10	74.00	49.09	49.79	PK
※1301.67	23.67	9.02	—	—	54.00	28.46	29.16	AVG
1735.56	26.16	10.86	16.20	15.90	72.87	53.21	52.91	PK
1735.56	26.16	10.86	—	—	52.87	32.58	32.28	AVG
4338.90	∗	∗	∗	∗	74.00	∗	∗	PK
4338.90	∗	∗	∗	∗	54.00	∗	∗	AVG

REMARKS：

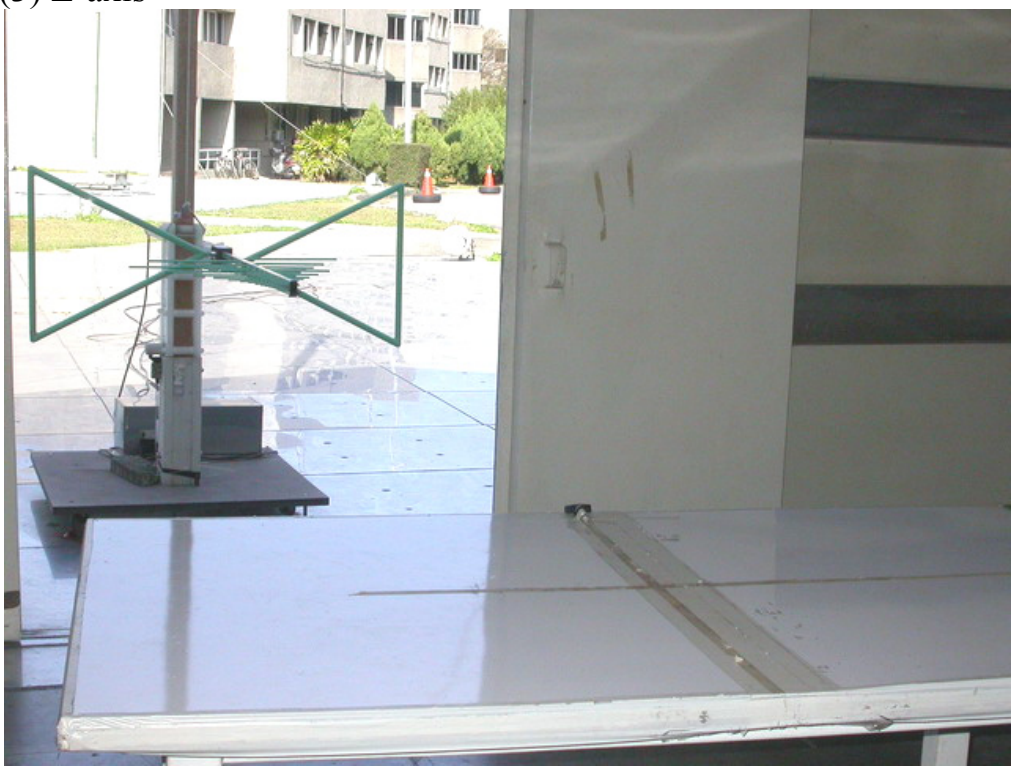
1. ∗ Undetectable
2. Emission level (dBμV/m) = Antenna Factor (dB/m) + Cable loss (dB) + Meter Reading (dBμV).
3. Remark "▲" means operating frequency for Transmitter Device.
4. The emission value below 1GHz is quasi-peak value and the emission value above 1GHz is both peak and average value.
   PK : Peak value; AVG : Average value.
5. The measurement was searched to 10th harmonic, Remark "---" means that the emissions level is too low to be measured.
6. Remark "※"means the Restricted band.
7. For the frequency band (433.92MHz), Z-axis direction, detailed in setup photo.
8. Average = Peak Value + Duty Factor (Duty Factor = -20.63dB)

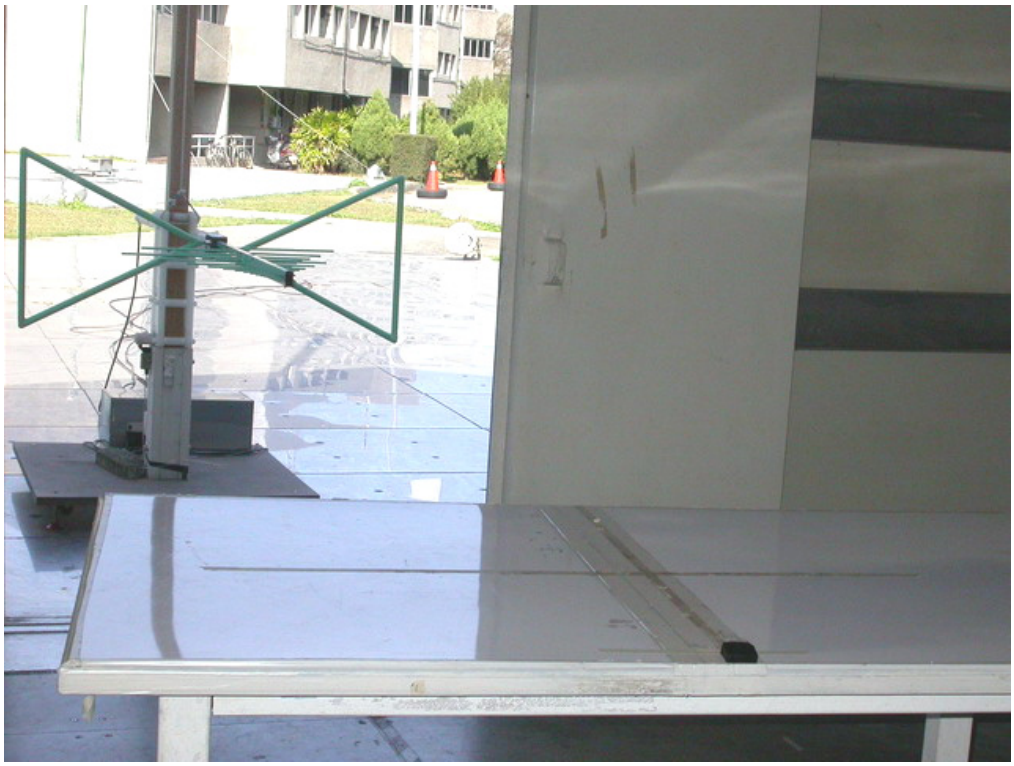
4.7 Photos of Radiated Test

TX mode :
(1) X-axis

(2) Y-axis

(3) Z-axis





5. BANDWIDTH MEASUREMENT

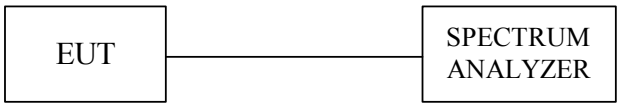
5.1 Test Equipments

Description & Manufacturer	Model No.	Serial No.	Date Of Calibration
ROHDE & SCHWARZ SPECTRUM ANALYZER	FSEK30	835253/002	September 06, 2004

Note：

1. The measurement uncertainty is less than +/- 2.6dB, which is calculated as per the NAMAS document NIS81.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

5.2 Test Setup



5.3 Limits of Bandwidth Measurement

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. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20dB down from the modulated carrier.

5.4 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 3 KHz RBW and 100KHz VBW. The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

5.5 Uncertainty of Conducted Emission

The uncertainty of conducted emission is ± 200KHz.

5.6 Test Results

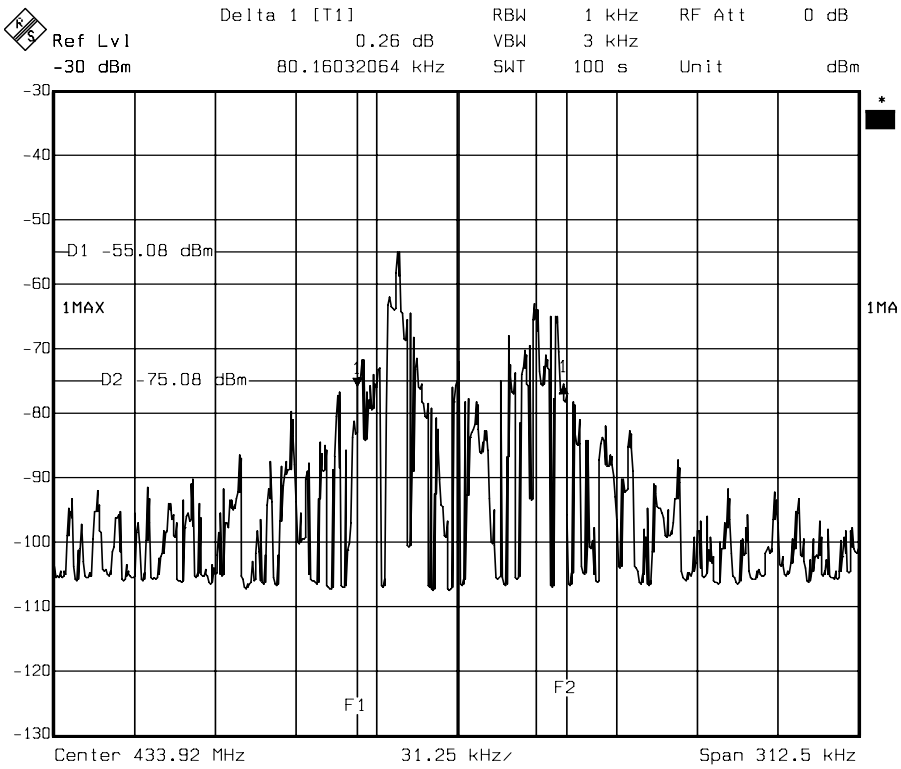
Input Power (System)	3VDC (For Transmitter device) from a battery	**Environmental Conditions**	27.1℃, 67%RH
Tested By	Ken Tu		

For the frequency band(433.92MHz)

Center Frequency (MHz)	Bandwidth (kHz)	Max Limit (kHz)	Pass / Fail
433.90	80.16	1084.75	PASS

Note : The operating frequency of EUT is 433.90MHz. The max bandwidth limit will be the 0.25% of the center frequency that is 433.90MHz × 0.25% = 1084.75 kHz.

5.7 Photo of Bandwidth Measurement



6. ANTENNA REQUIREMENT

6.1 Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

6.2 Antenna Construction

The antenna is permanently mounted on RF Board, no consideration of replacement.