FCC Part 15 Subpart C

EMI TEST REPORT

of

E.U.T. : Tire Pressure Monitor (Tx)

FCC ID. : LJL011113T

MODEL : TPM315

Working Frequency : 315.011 MHz

for

APPLICANT : LITE-ON AUTOMOTIVE CORPORATION
ADDRESS : 37, Chung Yang Road, N.W.P.Z. Kaohsiung 811, Taiwan, R.O.C.

Test Performed by

ELECTRONICS TESTING CENTER, TAIWAN
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Report Number : ET90R-11-021-01

TEST REPORT CERTIFICATION

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

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

Description of EUT :

a) Type of EUT	: Tire Pressure Monitor (Tx)
b) Trade Name	: ----
c) Model No.	: TPM315
d) FCC ID	: LJL011113T
e) Working Frequency	: 3015.011MHz
f) Power Supply	: DC 3V Battery

Regulation Applied : FCC Rules and Regulations Part 15 Subpart C (1999)

I HEREBY CERTIFY THAT; The data shown in this report were made in accordance with the procedures given in ANSI C63.4 and the energy emitted by the device was founded to be within the limits applicable. I assume full responsibility for accuracy and completeness of these data.

Note : 1. The results of the testing report relate only to the items tested.
2. The testing report shall not be reproduced except in full, without the written approval of ETC.

Issued Date : Dec. 19, 2001

Test Engineer : Jeff Chuang
(Jeff Chuang)

Approve & Authorized Signer : Will Yauo
Will Yauo, Manager
EMC Dept. II of ELECTRONICS
TESTING CENTER, TAIWAN

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1. GENERAL INFORMATION

1.1 Product Description

a) Type of EUT	: Tire Pressure Monitor (Tx)
b) Trade Name	: ----
c) Model No.	: TPM315
d) FCC ID	: LJL011113T
e) Working Frequency	: 315.011 MHz
f) Power Supply	: DC 3V Battery

1.2 Characteristics of Device:

The EUT is a transmitter of Tire Pressure Monitor (Tx) for Remote Controller Car Security Systems. The working frequency is 315.011 MHz. It consumes DC 3Vdc power supplied by a battery.

1.3 Test Methodology

Both conducted and radiated testing were performed according to the procedures in chapter 13 of ANSI C63.4.
The Transmitter under test was operated continuously in its normal operating mode for the purpose of the measurements. In order to secure the continuous operation of the device under test, rewiring in the circuit was done by the manufacturer so as to affect its intended operation.
The receiving antenna polarized horizontally was varied from 1 to 4 meters and the wooden turntable was rotated through 360 degrees to obtain the highest reading on the field strength meter or on the display of the spectrum analyzer. And also, each emission was to be maximized by changing the orientation of the Transmitter under test.
In order to determining the average value during one pulse train of the radiated power generated from the Transmitter under test, the encoded wave form in the time domain was used.

1.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the roof top of Building at No.34, Lin 5, Ding Fu Tsun, Linkou Hsiang, Taipei Hsien, Taiwan, R.O.C.
This site has been fully described in a report submitted to your office, and accepted in a letter dated Feb. 10, 2000.

2. DEFINITION AND LIMITS

2.1 Definition

Intentional radiator:
A device that intentionally generates and emits radio frequency energy by radiation or induction.

2.2 Restricted Bands of Operation

Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42-16.423	399.9-410	4.5-5.25
0.495 - 0.505 **	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	3360-4400	Above 38.6
13.36-13.41			

Remark "**" : Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

2.3 Limitation

(1) Conducted Emission Limits:

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the conducted limit is the following:

Frequency (MHz)	Emission (μV)	Emission (dBμV)
0.45 - 30.0	250	48.0

(2) Radiated Emission Limits:

According to 15.231(e), Periodic operation in the band 40.66-40.70 MHz and above 70 MHz, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Frequency Band (MHz)	Field strength of Fundamental (uV/m)	Field strength of Spurious (uV/m)
40.66-40.70	1000	100
70-130	500	50
130-174	* 500-1500	* 50-150
174-260	1500	150
260-470	* 1500-5000	* 150-500
Above 470	5000	500

* Linear interpolations.

Field strength limits are at the distance of 3 meters, emissions radiated within restricted bands specified in section 15.205, shall be according to the general radiated limits in 15.209,as following table:

Other Frequencies (MHz)	Field Strength of Fundamental	
	μV/meter	dBμV/meter
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

(3) Limit of transmission time

According to 15.231 (e), devices operated under this provisions 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.

2.4 Labeling Requirement

The device shall bear the following statement in a conspicuous location on the device:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2.5 User Information

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

3 SYSTEM TEST CONFIGURATION

3.1 Justification

All measurement were intentional to maximum the emissions from EUT by varying the connection cables, therefore, the test result is sure to meet the applicable requirement.

3.2 Devices for Tested System

Device	Manufacture	Model / FCC ID.	Description
Tire Pressure Monitor (Tx)	LITE-ON AUTOMOTIVE CORPORATION	TPM315 LJL011113T	----

Remark “*” means equipment under test.

4. RADIATED EMISSION MEASUREMENT

4.1 Applicable Standard

For periodic operation intentional radiator, the radiated emission shall comply with § 15.231(e).

4.2 Measurement Procedure

1. Setup the configuration per figure 1 and 2 for frequencies measured below and above 1 GHz respectively. Turn on EUT and make sure that it is in normal function.
2. For emission frequencies measured below 1 GHz, a pre-scan is performed in a shielded chamber to determine the accurate frequencies of higher emissions will be checked on a open test site. As the same purpose, for emission frequencies measured above 1 GHz, a pre-scan also be performed with a 1 meter measuring distance before final test.
3. For emission frequencies measured below and above 1 GHz, set the spectrum analyzer on a 100 kHz and 1 MHz resolution bandwidth respectively for each frequency measured in step 2.
4. The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position the highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from 0° to 360° with a speed as slow as possible, and keep the azimuth that highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading. A RF test receiver is also used to confirm emissions measured.
5. Repeat step 4 until all frequencies need to be measured were complete.
6. Repeat step 5 with search antenna in vertical polarized orientations.
7. Check the three frequencies of highest emission with varying the placement of cables (if any) associated with EUT to obtain the worse case and record the result.

Figure 1 : Frequencies measured below 1 GHz configuration

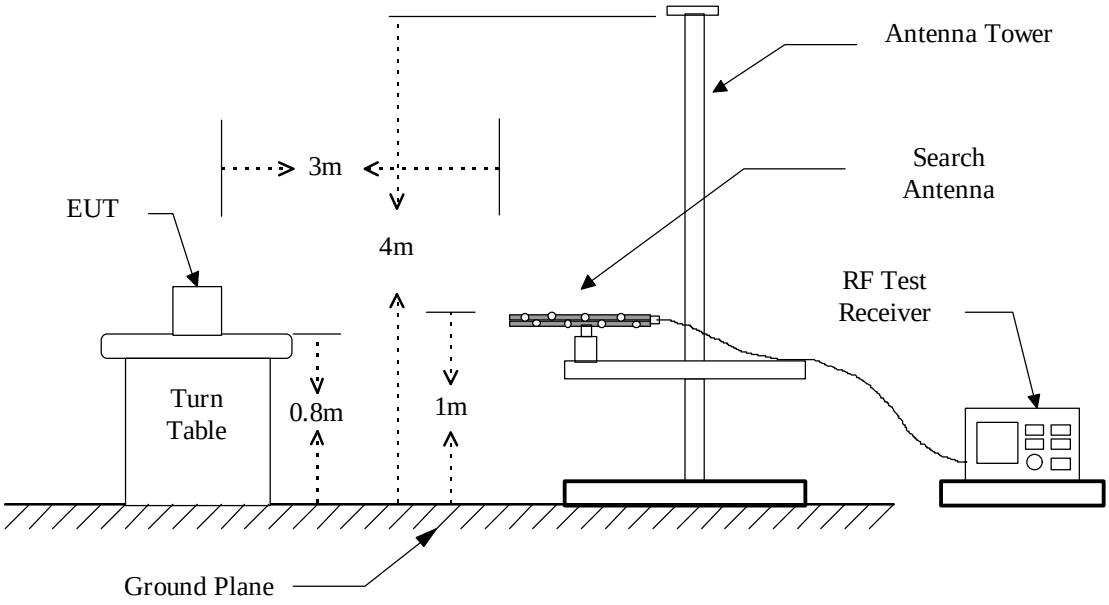
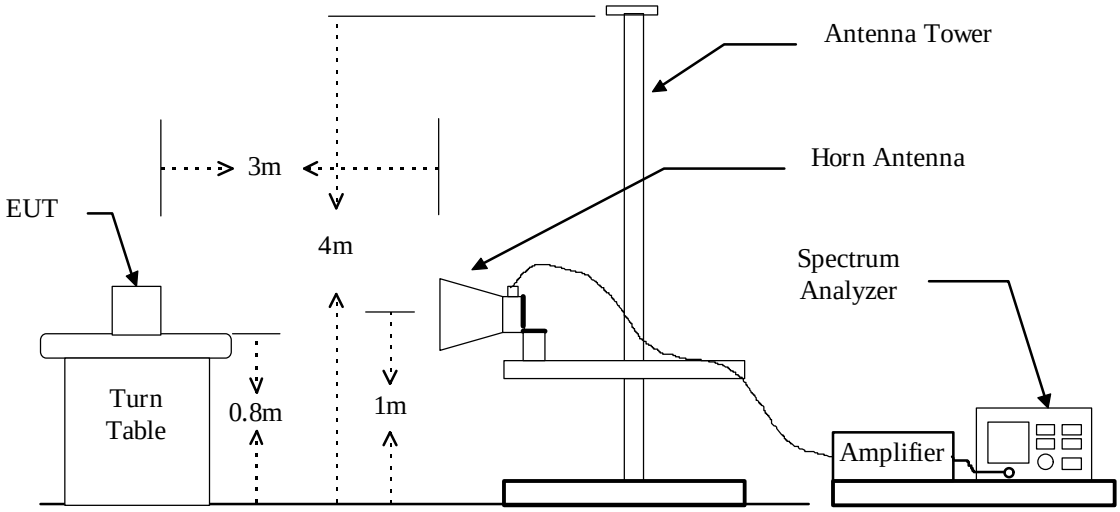


Figure 2 : Frequencies measured above 1 GHz configuration



4.3 Test Data

Operation Mode : Tx On

Test Date : Oct. 31, 2001 Temperature : 25 ℃ Humidity: 60 %

Frequency (MHz)	Reading (dBuV) Peak H	Reading (dBuV) Peak V	Factor (dB) C	Factor (dB) D	Result @3m (dBuV/m) Peak	Result @3m (dBuV/m) Ave.	Limit @3m (dBuV/m) Peak	Limit @3m (dBuV/m) Ave.	Margin (dB)	Table Degree (Deg.)	Ant. High (m)
315.011	77.6	75.6	-6.8	-20.0	70.8	50.8	87.7	67.7	-16.9	360	1.80
630.022	62.8	61.2	-3.2	-20.0	59.6	39.6	67.7	47.7	-8.1	145	1.70
945.033	60.8	46.9	3.1	-20.0	63.9	43.9	67.7	47.7	-3.8	150	1.80
1260.044	74.0	70.8	-8.6	-20.0	65.4	45.4	67.7	47.7	-2.3	170	1.70
*1575.055	72.5	69.0	-7.1	-20.0	65.4	45.4	74.0	54.0	-8.6	190	2.00
1890.066	55.7	55.7	-5.2	-20.0	50.5	30.5	67.7	47.7	-17.2	180	1.80
*2205.077	---	---	-3.8	-20.0	---	---	74.0	54.0	---	---	---
2520.088	---	---	-2.6	-20.0	---	---	67.7	47.7	---	---	---
*2835.099	---	---	-1.7	-20.0	---	---	74.0	54.0	---	---	---
3150.110	---	---	-0.8	-20.0	---	---	67.7	47.7	---	---	---

Note :

1. *Factor C means "corrected", and that includes antenna factor, cable loss, amplifier gain (if any). And Factor D means "Duty", that is for calculating the average value and derived from section 3.6 in this test report.*
2. *Peak Result = Reading + C. Factor*
   Ave. Result = Peak Value + D Factor
3. *"*" means the frequency fall in the restricted frequency band, and the limit of emission is referred to FCC class B*
4. *The limit for spurious emissions refers to FCC § 15.231.*
5. *Remark "---" means that the emissions from EUT are too weak to be measured.*
6. *The expanded uncertainty of the radiated emission tests is 3.53 dB.*

If the measured frequencies fall in the restricted frequency band, the limit employed is § 15.209 general requirement when frequencies are below or equal to 1 GHz. And the measuring instrument is set to quasi peak detector function, no duty factor applied.

4.4 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. For the limit is employed average value, therefore the peak value can be transferred to average value by subtracting the duty factor. The basic equation with a sample calculation is as follows:

Peak = Reading + Corrected Factor

where

Corr. Factor = Antenna Factor + Cable Factor - Amplifier Gain (if any)

And the average value is

Average = Peak Value + Duty Factor

Note : If the measured frequencies are fall in the restricted frequency band, the limit employed must be quasi peak value when frequencies are below or equal to 1 GHz. And the measuring instrument is set to quasi peak detector function.

4.5 Activating Time

The Tire Pressure Monitor is for automatical operation. There is an ASIC (U1) to process the timing of transmitting. When the tire pressure is in normal range (normal mode), the interval between two transmissions (every transmission is 10 ms) is about 54.6 seconds. And when the tire pressure is over the specific range (in alart mode, may cause dengrous situation with the car), the transmitting timing is 10ms transmission per 10 seconds and after 280 seconds will automatically reset to normal mode.

4.6 Calculation of Duty Factor

The duty factor is calculated with following formula :

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

Note : Please see appendix 1 for Plotted Data

4.7 Radiated Test Equipment

Equipment	Manufacturer	Model No.	Next Cal. Date
Spectrum Analyzer	Hewlett-Packard	8568B	12/21/2001
Pre-selector	Hewlett-Packard	85685A	01/01/2002
Quasi Peak Detector	Hewlett-Packard	85650A	01/01/2002
Spectrum Analyzer	Hewlett-Packard	8564E	04/22/2002
RF Test Receiver	Rohde & Schwarz	ESVS 30	08/06/2002
Horn Antenna	EMCO	3115	05/14/2002
Log periodic Antenna	EMCO	3146	11/02/2002
Biconical Antenna	EMCO	3110B	11/02/2002
EMI Test Receiver	Rohde & Schwarz	ESBI	05/10/2002
Preamplifier	Hewlett-Packard	8449B	05/10/2002
Preamplifier	Hewlett-Packard	8447D	12/29/2001

4.8 Measuring Instrument Setup

Explanation of measuring instrument setup in frequency band measured is as following:

Frequency Band (MHz)	Instrument	Function	Resolution bandwidth	Video Bandwidth
30 to 1000	RF Test Receiver	Quasi Peak	120 kHz	N/A
	Spectrum Analyzer	Peak	100 kHz	100 kHz
Above 1000	Spectrum Analyzer	Peak	1 MHz	1 MHz

4.9 Radiated Measurement Photos

5. BANDWIDTH OF EMISSION

5.1 Applicable Standard Plot Graphic of Bandwidth

Per FCC rule §15.231(c), the permitted emission bandwidth is no wider than 0.25%of the center frequency for devices operating above 70 MHz and below 900 MHz.

5.2 Bandwidth Test Equipment

Equipment	Manufacturer	Model No.	Next Cal. Date
EMI Test Receiver	Rohde & Schwarz	ESBI	05/10/2002
Plotter	Hewlett-Packard	7550A	N/A

5.3 Plot Graphic of Bandwidth

The emission bandwidth limit for this transmitter is

315.011 MHz×0.25%＝787.5275 KHz
20 dB bandwidth = 377.7 KHz
Test Result: 787.5275 KHz > 377.7KHz.

Note : Please see appendix 2 for Plotted Data

6. CONDUCTED EMISSION MEASUREMENT

6.1 Description

This EUT is excused from investigation of conducted emission, for it is powered by DC 3V only. According to § 15.207 (d), measurements 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.

7 ANTENNA REQUIREMENT

7.1 Standard Applicable

According to § 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.

7.2 Antenna Construction

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

Please see photos submitted in Exhibit B.

APPENDIX 1 : PLOTTED DATA FOR DUTY FACTOR

$$20\log\frac{10ms\times 1}{100ms} = -20.0\ \text{dB}$$

APPENDIX 2 : PLOTTED DATA FOR BANDWIDTH

Bandwidth Limit = 315.011 MHz × 0.25% = 787.5275 KHz