

TEST RESULT SUMMARY

FCC PART 15 SUBPART C

Section 15.231(e)

MANUFACTURER'S NAME	Pacific Industrial Co LTD
NAME OF EQUIPMENT	Transmitter for monitoring air pressure and temperature in a vehicle's tires
MODEL NUMBER	PMV-1001
MANUFACTURER'S ADDRESS	Godō-cho, Anpachi Gifu, 503-2397 Japan
TEST REPORT NUMBER	W0312
TEST DATE	05 June 2000

According to testing performed at TÜV Product Service Inc, the above-mentioned unit is in compliance with the electromagnetic compatibility requirements defined in FCC Part 15.

It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics. Any modifications necessary for compliance made during testing on the above mentioned date(s) must be implemented in all production units for compliance to be maintained.

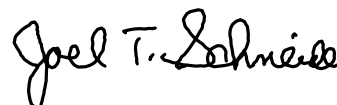
TÜV Product Service Inc, as an independent testing laboratory, declares that the equipment tested as specified above conforms to the requirements of FCC Part 15.

Date: 30 June 2000

Location: Taylors Falls MN
USA



G. S. Jakubowski
Test Engineer



J. T. Schneider
Lead Engineer

Not Transferable

EMC EMISSION - TEST REPORT

Test Report File No. : **WC1H031201** Date of issue: 30 June 2000

Model / Serial No. : **PMV-1001 /**

Product Type : Transmitter for monitoring air pressure and temperature in a vehicle's tires

Applicant : Pacific Industrial Co LTD

Manufacturer : Pacific Industrial Co LTD

License holder : Pacific Industrial Co LTD

Address : Godo-cho, Anpachi

: Gifu, 503-2397 Japan

Test Result : Positive Negative

Test Project Number :

Reference(s) : **W0312**

Total pages including Appendices : **22**

TÜV Product Service Inc is a subcontractor to TÜV Product Service, GmbH according to the principles outlined in ISO/IEC Guide 25 and EN 45001.

TÜV Product Service Inc reports apply only to the specific samples tested under stated test conditions. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. TÜV Product Service Inc shall have no liability for any deductions, inferences or generalizations drawn by the client or others from TÜV Product Service Inc issued reports.

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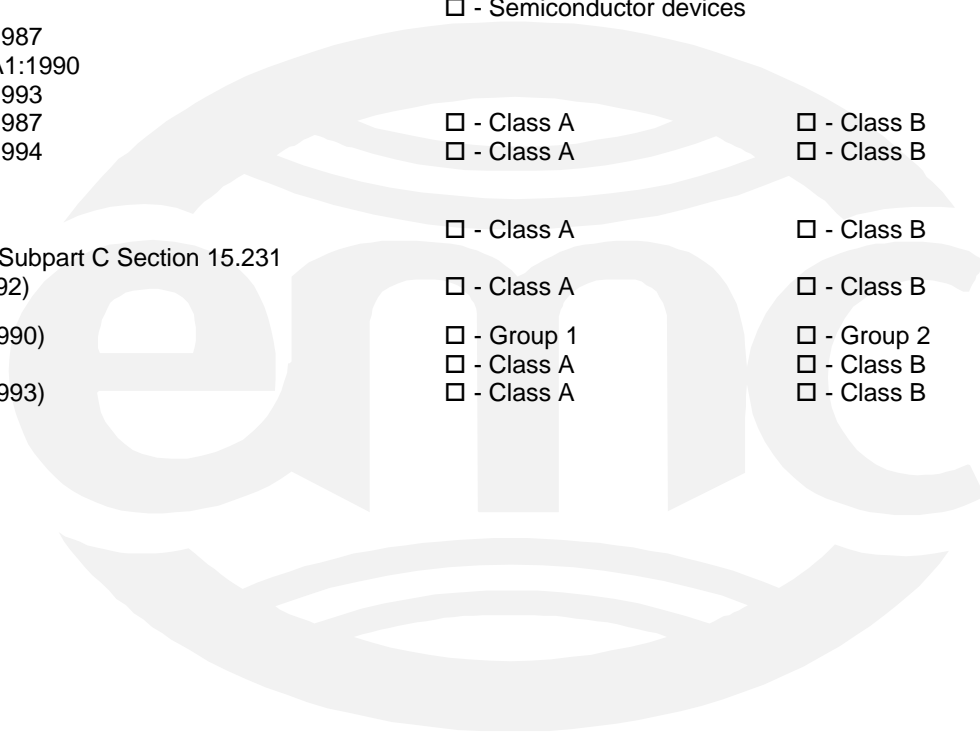
DIRECTORY - EMISSIONS

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EMISSIONS TEST REGULATIONS :

The emissions tests were performed according to following regulations:

- | | | |
|--|---|------------------------------------|
| <input type="checkbox"/> - EN 50081-1 / 1991 | <input type="checkbox"/> - Group 1 | <input type="checkbox"/> - Group 2 |
| <input type="checkbox"/> - EN 55011 / 1991 | <input type="checkbox"/> - Class A | <input type="checkbox"/> - Class B |
| <input type="checkbox"/> - EN 55013 / 1990 | <input type="checkbox"/> - Household appliances and similar | |
| <input type="checkbox"/> - EN 55014 / 1987 | <input type="checkbox"/> - Portable tools | |
| | <input type="checkbox"/> - Semiconductor devices | |
| <input type="checkbox"/> - EN 55014 / A2:1990 | <input type="checkbox"/> - Household appliances and similar | |
| <input type="checkbox"/> - EN 55014 / 1993 | <input type="checkbox"/> - Portable tools | |
| | <input type="checkbox"/> - Semiconductor devices | |
| <input type="checkbox"/> - EN 55015 / 1987 | | |
| <input type="checkbox"/> - EN 55015 / A1:1990 | | |
| <input type="checkbox"/> - EN 55015 / 1993 | | |
| <input type="checkbox"/> - EN 55022 / 1987 | <input type="checkbox"/> - Class A | <input type="checkbox"/> - Class B |
| <input type="checkbox"/> - EN 55022 / 1994 | <input type="checkbox"/> - Class A | <input type="checkbox"/> - Class B |
| <input type="checkbox"/> - BS | | |
| <input type="checkbox"/> - VCCI | <input type="checkbox"/> - Class A | <input type="checkbox"/> - Class B |
| <input checked="" type="checkbox"/> - FCC Part 15 Subpart C Section 15.231 | | |
| <input type="checkbox"/> - AS 3548 (1992) | <input type="checkbox"/> - Class A | <input type="checkbox"/> - Class B |
| <input type="checkbox"/> - CISPR 11 (1990) | <input type="checkbox"/> - Group 1 | <input type="checkbox"/> - Group 2 |
| | <input type="checkbox"/> - Class A | <input type="checkbox"/> - Class B |
| <input type="checkbox"/> - CISPR 22 (1993) | <input type="checkbox"/> - Class A | <input type="checkbox"/> - Class B |



Environmental conditions in the lab:

	<u>Actual</u>
Temperature	: 23 °C
Relative Humidity	: 39 %
Atmospheric pressure	: 99 kPa
Power supply system	: 3 VDC

Sign Explanations:

- not applicable
- applicable



Emissions Test Conditions: CONDUCTED EMISSIONS (Interference Voltage)

The *CONDUCTED EMISSIONS (INTERFERENCE VOLTAGE)* measurements were performed at the following test location:

- Test not applicable

- Wild River Lab Large Test Site (Open Area Test Site)
- Wild River Lab Small Test Site (Open Area Test Site)
- Oakwood Lab (Open Area Test Site)
- Wild River Lab Screen Room
- New Brighton Lab Shielded Room

Emissions Test Conditions: RADIATED EMISSIONS (Magnetic Field)

The *RADIATED EMISSIONS (MAGNETIC FIELD)* measurements were performed at the following test location:

- Wild River Lab Large Test Site (Open Area Test Site)
- Wild River Lab Small Test Site (Open Area Test Site)
- Oakwood Lab (Open Area Test Site)

at a test distance of :

- 3 meters
- 30 meters

- Test not applicable

Emissions Test Conditions: RADIATED EMISSIONS (Electric Field)

The *RADIATED EMISSIONS (ELECTRIC FIELD)* measurements, in the frequency range of 30 MHz-1000 MHz, were tested in a horizontal and vertical polarization at the following test location :

- Test not applicable

- - Wild River Lab Large Test Site (Open Area Test Site) – NSA measurements made 6-20-99, due 6-20-00
- Wild River Lab Small Test Site (Open Area Test Site)
- Oakwood Lab (Open Area Test Site)

at a test distance of :

- - 3 meters
- 10 meters
- 30 meters

Test equipment used :

Model Number	Manufacturer	Description	Serial Number	Cal Due
■ - EM-6917B	Electro-Metrics	Biconicalog Antenna	101	9-00
■ - 8566B	Hewlett-Packard	Spectrum Analyzer	2221A01596	11-00
■ - 85662A	Hewlett-Packard	Analyzer Display	2152A03640	11-00
■ - 85650A	Hewlett-Packard	Quasi-Peak Adapter	2811A01127	11-00
■ - ZHL-1042J	Mini-Circuits	Preamplifier	H072294-11	3-01

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST) and is calibrated annually.

Emissions Test Conditions: INTERFERENCE POWER

The *INTERFERENCE POWER* measurements were performed by using the absorbing clamp on the mains and interface cables in the frequency range 30 MHz - 300 MHz at the following test location :

■ - Test not applicable

- Wild River Lab Large Test Site (Open Area Test Site)
- Wild River Lab Small Test Site (Open Area Test Site)
- Oakwood Lab (Open Area Test Site)
- Wild River Lab Screen Room
- New Brighton Lab Shielded Room

Emissions Test Conditions: RADIATED EMISSIONS (Electric Field)

The *EQUIVALENT RADIATED EMISSIONS* measurements in the frequency range 1 GHz - 3.2 GHz were performed in a horizontal and vertical polarization at the following test location :

- Wild River Lab Large Test Site (Open Area Test Site)
- Wild River Lab Small Test Site (Open Area Test Site)
- Oakwood Lab (Open Area Test Site)
- Wild River Lab Screen Room

at a test distance of:

- 1 meters
- 3 meters
- 10 meters

- Test not applicable

Test equipment used :

Model Number	Manufacturer	Description	Serial Number	Cal Date
■ - EM-6917B	Electro-Metrics	Biconicalog Antenna	101	9-00
■ - 8566B	Hewlett-Packard	Spectrum Analyzer	2221A01596	11-00
■ - 85662A	Hewlett-Packard	Analyzer Display	2152A03640	11-00
■ - 85650A	Hewlett-Packard	Quasi-Peak Adapter	2811A01127	11-00
■ - ZHL-1042J	Mini-Circuits	Preamplifier	H072294-11	3-01

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST) and is calibrated annually.

Equipment Under Test (EUT) Test Operation Mode - Emission tests :

The device under test was operated under the following conditions during emissions testing:

- Standby
- Test program (H - Pattern)
- Test program (color bar)
- Test program (customer specific)
- Practice operation
- Normal Operating Mode
- Transmitter on.

Configuration of the device under test:

- See Constructional Data Form in Appendix B - Page B2
- See Product Information Form in Appendix B - beginning on Page B3

The following peripheral devices and interface cables were connected during the measurement:

- _____ Type : _____
- _____ Type : _____
- _____ Type : _____
- _____ Type : _____
- _____ Type : _____
- _____ Type : _____
- _____ Type : _____
- _____ Type : _____
- unshielded power cable
- unshielded cables
- shielded cables MPS.No.: _____
- customer specific cables
- _____
- _____

Emission Test Results:

Conducted emissions 10/150 kHz - 30 MHz

The requirements are - MET - NOT MET
Minimum limit margin _____ dB at _____ MHz
Maximum limit exceeding _____ dB at _____ MHz
Remarks: _____

Radiated emissions (magnetic field) 10 kHz - 30 MHz

The requirements are - MET - NOT MET
Minimum limit margin _____ dB at _____ MHz
Maximum limit exceeding _____ dB at _____ MHz
Remarks: _____

Radiated emissions (electric field) 30 MHz - 1000 MHz

The requirements are - MET - NOT MET
Minimum limit margin for fundamental _____ 5 dB at 314.94 MHz
Minimum limit margin for spurious _____ 8 dB at 629.9 MHz
Remarks: The fundamental was measured to be 62.1 dBuV/m (1273 uV/m) in quasi-peak mode compared to a limit of 67.6 dBuV/m (2416 uV/m). The second harmonic was measured to be 38.7 dBuV/m (86 uV/m) in quasi-peak mode compared to an average limit of 47.6 dBuV/m (241.6 uV/m).

Interference Power at the mains and interface cables 30 MHz - 300 MHz

The requirements are - MET - NOT MET
Minimum limit margin _____ dB At _____ MHz
Maximum limit exceeding _____ dB At _____ MHz
Remarks: _____

Equivalent Radiated emissions 1 GHz - 3.15 GHz

The requirements are - MET - NOT MET
Minimum limit margin _____ 16 dB At 1260.1 MHz
Maximum limit exceeding _____ dB At _____ MHz
Remarks: The fourth harmonic was measured to be 37.1 dBuV/m (71.6 uV/m) in peak mode compared to an average limit of 54 dBuV/m (500 uV/m).

DEVIATIONS FROM STANDARD:

None.

GENERAL REMARKS:

The bandwidth of the fundamental must be less than 0.25% of the center frequency, or 787 kHz. Page A5 of A5 shows the bandwidth to be less than 170 kHz. Basically this transmitter sends the signals as described in the following table. The transmission is less than 1 second, and the intervals are greater than 10 seconds.

table 4. Explanation of transmitting

	Typical transmission interval	Minimum number of transmission
Normal	617s	
Pressure alert	14.7s	
Slow puncture alert	14.7s	
High temperature alert	14.7s	16

Note; The time of 1 transmitting frame is about 300ms.

SUMMARY:

The requirements according to the technical regulations are

- met

- **not** met.

The device under test does

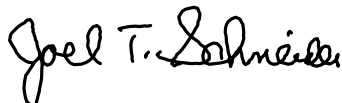
- fulfill the general approval requirements mentioned on page 3.

- **not** fulfill the general approval requirements mentioned on page 3.

Testing Start Date: 05 June 2000

Testing End Date: 05 June 2000

- TÜV PRODUCT SERVICE INC -



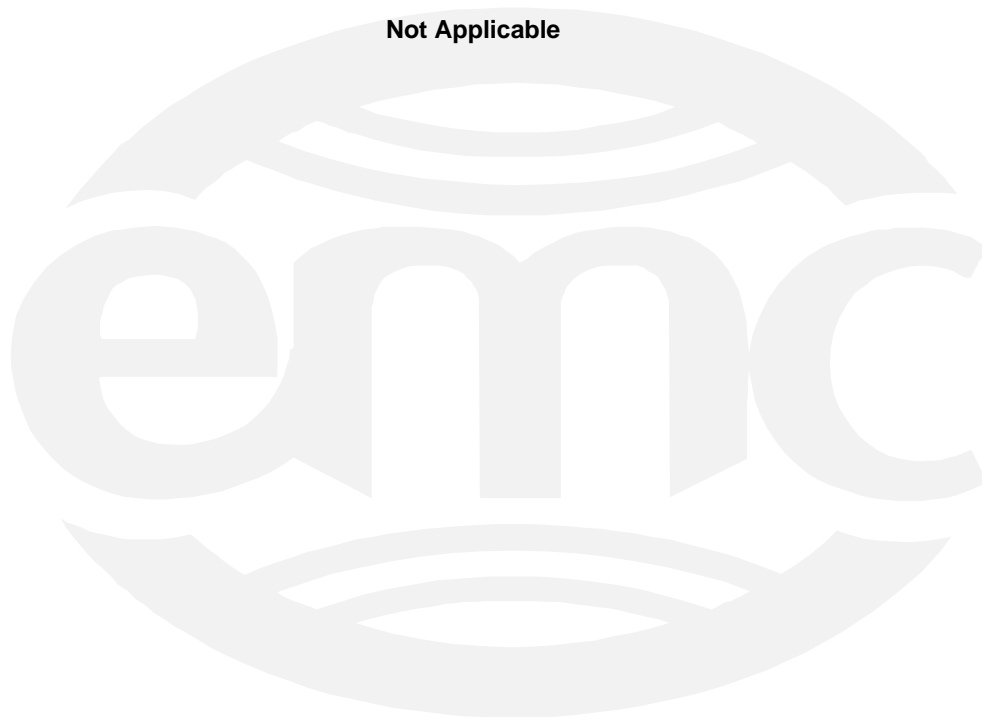
J. T. Schneider
Lead Engineer



Tested By:
G. S. Jakubowski

Test-setup photo(s):
Conducted emission 10/150 kHz - 30 MHz

Not Applicable



Test-setup photo(s):
Radiated emission 30 MHz - 3.15 GHz

See Test-Setup Exhibit



Appendix A

Test Data Sheets
and
Test Setup Drawing(s)



TEST SETUP FOR EMISSIONS TESTING

WILD RIVER LAB
Large Test Site

See Test-Setup Exhibit



Radiated Electromagnetic Emissions

Test Report #:	W0312 Run 1	Test Area:	LTS 3m	Temperature:	23	°C
Test Method:	FCC 15 C, Para 15.231(e)	Test Date:	05-Jun-2000	Relative Humidity:	39	%
EUT Model #:	PMV-1001, Type 2 A	EUT Power:	Internal Battery	Air Pressure:		kPa
EUT Serial #:				Page:	1	of 2
Manufacturer:	Pacific Industrial Co Ltd					
EUT Description:	Tire pressure monitor / transmitter					
Notes:	RBW & VBW = 100 kHz below 1 GHz					
	RBW & VBW = 1 MHz above 1 GHz					

FREQ (MHz)	LEVEL (dBuV)	CABLE / ANT / PREAMP (dB) (dB/m) (dB)	FINAL (dBuV/m)	POL / HGT / AZ (m) (DEG)	DELTA1 Denso <1GHz	DELTA2 Denso >1GHz
EUT Nozzle horizontal						
Lines 3 & 4 open						
Maxed						
315.10	62.7 Qp	2.1 / 13.8 / 25.9	52.6	V / 1.7 / 289.0	-15.0	N/A
315.10	71.6 Qp	2.1 / 13.8 / 25.9	61.5	H / 1.0 / 256.0	-6.1	N/A
EUT Nozzle vertical						
Maxed						
315.10	65.3 Qp	2.1 / 13.8 / 25.9	55.2	H / 1.0 / 330.0	-12.4	N/A
315.10	68.0 Qp	2.1 / 13.8 / 25.9	57.9	V / 1.7 / 293.0	-9.7	N/A
EUT Nozzle horizontal						
Lines 3 & 4 jumped						
Maxed						
314.94	72.2 Qp	2.1 / 13.8 / 25.9	62.1	H / 1.0 / 247.0	-5.5	N/A
20dB BW of fundamental = 161.5 kHz (see plot)						
Maxed Harmonics						
629.90	42.4 Qp	2.8 / 19.6 / 26.1	38.7	H / 1.1 / 181.0	-8.9	N/A
944.84	33.9 Qp	3.5 / 22.0 / 25.6	33.8	H / 1.0 / 36.0	-13.8	N/A
1260	33.5 Pk	4.0 / 24.5 / 25.2	37.1	H / 1.0 / 80.0	N/A	-16.9
LAST MEASUREMENT MADE WITH 1 MHZ RBW, 1 MHZ VBW.						
No other significant emissions detected 30-3150 MHz						
End scan 30-3150 MHz						

Radiated Electromagnetic Emissions

Test Report #: W0312 Run 1	Test Area: LTS 3m	Temperature: 23 °C
Test Method: FCC 15 C, Para 15.231(e)	Test Date: 05-Jun-2000	Relative Humidity: 39 %
EUT Model #: PMV-1001, Type 2 A	EUT Power: Internal Battery	Air Pressure: kPa
EUT Serial #:		Page: 2 of 2
Manufacturer: Pacific Industrial Co Ltd		
EUT Description: Tire pressure monitor / transmitter		
Notes: RBW & VBW = 100 kHz below 1 GHz		
RBW & VBW = 1 MHz above 1 GHz		

FREQ	LEVEL	CABLE / ANT / PREAMP	FINAL	POL / HGT / AZ	DELTA1	DELTA2
(MHz)	(dBuV)	(dB) (dB/m) (dB)	(dBuV/m)	(m) (DEG)	Denso <1GHz	Denso >1GHz

***** MEASUREMENT SUMMARY *****						
314.94	72.2 Qp	2.1 / 13.8 / 25.9	62.1	H / 1.0 / 247.0	-5.5	N/A
315.10	71.6 Qp	2.1 / 13.8 / 25.9	61.5	H / 1.0 / 256.0	-6.1	N/A
629.90	42.4 Qp	2.8 / 19.6 / 26.1	38.7	H / 1.1 / 181.0	-8.9	N/A
944.84	33.9 Qp	3.5 / 22.0 / 25.6	33.8	H / 1.0 / 36.0	-13.8	N/A
1260	33.5 Pk	4.0 / 24.5 / 25.2	37.1	H / 1.0 / 80.0	N/A	-16.9

MKR Δ 161.5 KHZ
0.00 dB

ATTEN 10 dB

REF 75.0 dB μ V

75.0 dB μ V

hp

5 dB/

POS PK

MARKER Δ
161.5 KHZ
0.00 dB

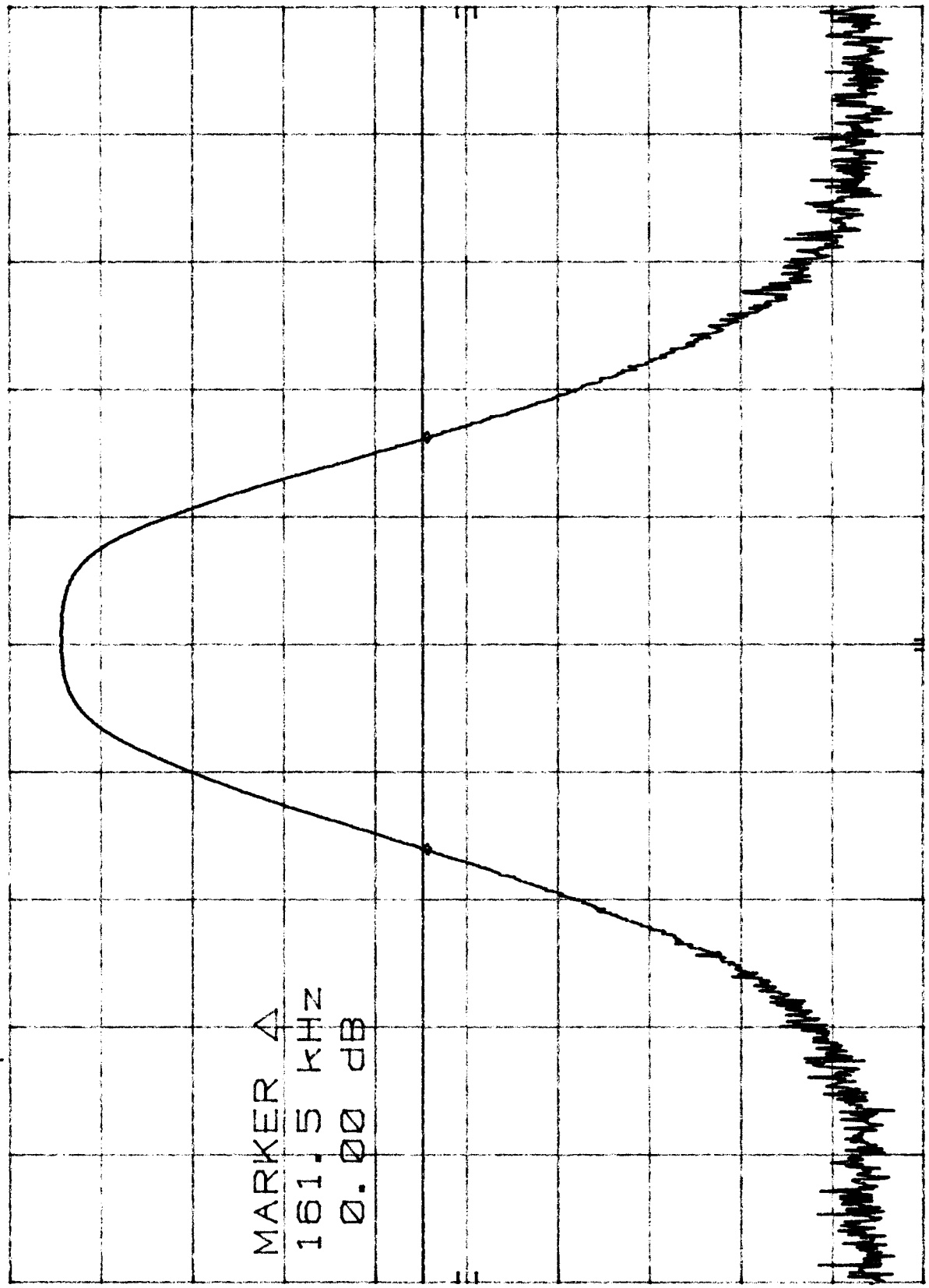
DL
52.4
dB μ V

CORR'D

SPAN 500 KHZ
SWP 20.0 msec

VBW 300 KHZ

CENTER 314.944 MHZ
RES BW 100 KHZ



Appendix B

Constructional Data Form
and
Product Information Form(s)



Constructional Data Form

Not Applicable



Technical Description of the system

Type number

- Transmitter :PMV-1001

Specifications

- Nominal frequency :314.98 MHz obtained by SAW resonator

- Radio frequency output power :67.6 dBuV/m or less

- Type of modulation :F2D

- Power supply

- Nominal supply voltage :3 VDC
- Type of battery :One lithium battery

- Antenna :Built-in type (fixed)

Description of the system operation

This system is used for monitoring and indicating about information of air pressure and temperature in vehicle's tires. This transmitter sends to receiver the data that are information of air pressure and temperature in vehicle's tires. The data also include battery voltage and identity code of transmitter. The receiver judges if the data of air pressure and temperature from transmitter are not normal conditions. And then the receiver sends communication signals to a warning lamp through gateway ECU which is an intermediate ECU to divide signals. The warning lamp warns drivers.

Installation in vehicle

The transmitter is installed on tire wheel rim.(see Fig 3.2 Transmitter of installation)

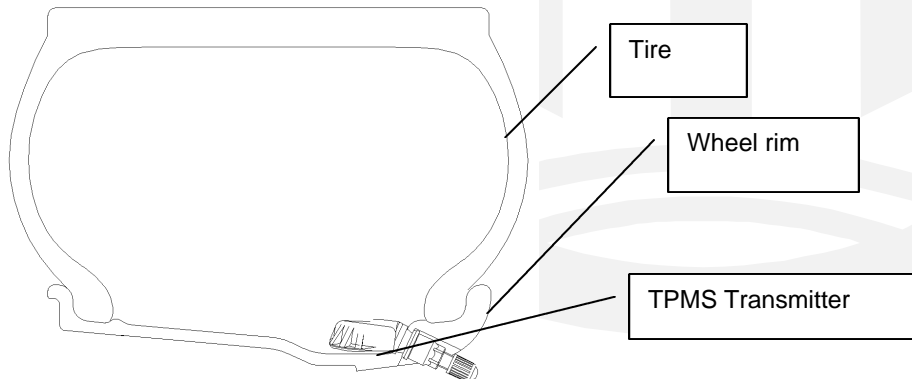


Fig 3.2 Transmitter of installation

Appendix C

MEASUREMENT PROTOCOL

GENERAL INFORMATION

Measurement Uncertainty

The test system for conducted emissions is defined as the LISN, tuned receiver or spectrum analyzer, and coaxial cable. The test system for radiated emissions is defined as the antenna, the pre-amplifier, the spectrum analyzer and the coaxial cable. These test systems have a measurement uncertainty of ± 4.5 dB. The equipment comprising the test systems are calibrated on an annual basis.

Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral into its characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum emissions from the unit.

CONDUCTED EMISSIONS

The final level, expressed in dB μ V, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the FCC limit.

To convert between dB μ V and μ V, the following conversions apply:

$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

RADIATED EMISSIONS

The final level, expressed in dB μ V/m, is arrived at by taking the reading from the spectrum analyzer (Level dB μ V) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has the FCC limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets in Attachment B. The amplifier gain is automatically accounted for by using an analyzer offset.

Example:

Frequency (MHz)	Level (dB μ V)	+	Factor & Cable (dB)	=	Final (dB μ V/m)	-	FCC Limit (dB μ V/m)	=	Delta FCC (dB)
32.21	13.9	+	16.3	=	30.2	-	40.0	=	-9.8

DETAILS OF TEST PROCEDURES

General Standard Information

The test methods used comply with ANSI C63.4-1992 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

Conducted Emissions

Conducted emissions on the 60 Hz power interface of the EUT are measured in the frequency range of 450 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection, and a Line Impedance Stabilization Network (LISN), with 50 Ω /50 μ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeters above the floor and is positioned 40 centimeters from the vertical ground plane (wall) of the screen room. In some cases, a pre-scan using a spectrum analyzer is initially performed on the units comprising the system under test to locate the highest emissions. If the minimum passing margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver or spectrum analyzer with quasi-peak and average detection and recorded on the data sheets.

Radiated Emissions

Radiated emissions from the EUT are measured in the frequency range of 30 to 1000 MHz using a spectrum analyzer and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and peak detection and measurements above 1000 MHz are made with a 1 MHz/6 dB bandwidth and peak detection. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimeters above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Interface cables that are closer than 40 centimeters to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimeters from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna is positioned 3 meters horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarizations and the EUT are rotated 360 degrees. Intentional radiators are rotated through three orthogonal axes to determine the attitude that maximizes the emissions.