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**RADIO REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart C**

FCC ID: LXPP002

Test Sample: Automotive Passive Entry Passive Start (PEPS)
System

Model: P002

Client: Offer EMC Services

Report Number: M160612-1-R1
(This report replaces M160612-1)

Issue Date: 07 December 2016

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RADIO REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart C
EMC Technologies Report No.: M160612-1-R1
Issue Date: 07 December 2016

CONTENTS

1.0	INTRODUCTION
2.0	GENERAL INFORMATION
3.0	TEST RESULTS
3.1	§15.203 Antenna Requirement
3.2	§15.205 Restricted Bands of Operation
3.3	§15.207 Conducted Limits
3.4	§15.209 Radiated Emission Limits; General Requirements
3.5	§2.1049 Occupied bandwidth – 99% power
4.0	COMPLIANCE STATEMENT
5.0	MEASUREMENT UNCERTAINTY



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**RADIO REPORT FOR CERTIFICATION
TO
FCC PART 15 SUBPART C**

Report Number: M160612-1-R1
Issue Date: 07 December 2016

Sample: Automotive Passive Entry Passive Start (PEPS) System
Model: P002
Serial Number: Not provided
Manufacturer: Robert Bosch (Australia) Pty. Ltd.
Locked bag 66, Clayton South,
VIC 3169, Australia

FCC ID: LXPP002
Equipment Type: Intentional Radiator (125 kHz Transmitter and 315 MHz receiver)

Tested for: Offer EMC Services
Address: 9 Langdale Drive, Croydon Hills
VIC 3136, Australia
Phone: +61 (0)401 712 769
Contact: Steve Offer
Email: steve@offeremc.com.au

Standard: FCC Part 15 – *Radio Frequency Devices*
FCC Part 15 Subpart C – *Intentional Radiators*

Test Dates: 15th, 21st and 23rd June 2016

Test Engineer: 
Kevin Hansen
EMC Engineer

Attestation: *I hereby certify that the device(s) described herein were tested as described in this report and that the data included is that which was obtained during such testing.*

Authorised Signatory: 
Chris Zombolas
Technical Director
EMC TECHNOLOGIES PTY LTD

Issued by: EMC Technologies Pty. Ltd., 176 Harrick Road, Keilor Park, VIC 3042, Australia.
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RADIO REPORT FOR CERTIFICATION to FCC PART 15 SUBPART C

1.0 INTRODUCTION

Test results and procedures were performed in accordance with the following Federal Communications Commission (FCC) standards/regulations:

47 CFR, Part 15, Subpart C:	Rules for intentional radiators
Section 15.203:	Antenna requirements
Section 15.205:	Restricted bands of operation
Section 15.207:	Conducted Limits
Section 15.209:	Radiated Emission Limits (General requirements)

The sample **complied** with the applicable requirements of 47 CFR, Part 15 Subpart C.

The measurement procedure used was in accordance with ANSI C63.10: 2013. The instrumentation conformed to the requirements of ANSI C63.2: 2009.

1.1 Summary of Results

FCC Part 15 Subpart C	Test Performed	Results
15.203	Antenna requirement	Complied
15.205	Restricted bands of operation	Complied
15.207	Conducted limits	Not applicable
15.209	Radiated emissions limits; general requirements	Complied
2.1049	Occupied Bandwidth	750 Hz

1.2 Modifications by EMC Technologies

No modifications were performed.



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2.0 GENERAL INFORMATION

(Information supplied by the Client)

2.1 EUT (Transmitter) Details

Wireless Radio:	125 kHz Transmitter
Antenna type:	Integral loop
Wireless Radio:	315 MHz Receiver
Antenna type:	Integral monopole, PCB trace

2.2 EUT (Host) Details

Test Sample:	Automotive Passive Entry Passive Start (PEPS) System
Model Number:	P002
Serial Number:	Not Provided
Manufacturer:	Robert Bosch (Australia) Pty. Ltd. Locked bag 66, Clayton South, VIC 3169, Australia
Supply Rating:	13.8 VDC
Highest operating Frequency:	315 MHz

2.3 Test Configuration

The sample was configured to have the 125 kHz transmitting continuously with a modulated signal and the 315 MHz receiver was active.

2.4 Operational Description

The Automotive Passive Entry Passive Start (PEPS) System enable locks to change state remotely. Antennas located on the vehicle transmit at 125 kHz; on detection of a complimentary keyfob operating at 315 MHz the door could be locked or unlocked.



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2.5 Test Facility

2.5.1 General

EMC Technologies Pty Ltd is listed by the FCC as a test laboratory able to perform compliance testing for the public. EMC Technologies is listed as an FCC part 47CFR2.948 test lab and may perform the testing required under Parts 15 and 18 – **FCC Registration Number 90560**

EMC Technologies Pty Ltd has also been accredited as a Conformity Assessment Body (CAB) by Australian Communications and Media Authority (ACMA) under the APECTEL MRA and is designated to perform compliance testing on equipment subject to Declaration of Conformity (DoC) and Certification under Parts 15 and 18 of the FCC Commission's rules – **Registration Number 494713 & Designation number AU0001.**

EMC Technologies indoor open area test site (iOATS) have been accepted by Industry Canada for the performance of radiated measurements in accordance with RSS-Gen, Issue 8 - **Industry Canada iOATS number - IC 3569B**

Measurements in this report were performed at EMC Technologies' laboratory in Keilor Park, Victoria Australia.

2.5.2 NATA Accreditation

NATA is the Australian National laboratory accreditation body and has accredited EMC Technologies to operate to the IEC/ISO17025 requirements. A major requirement for accreditation is the assessment of the company and its personnel as being technically competent in testing to the standards. This requires fully documented test procedures, continued calibration of all equipment to the National Standard at the National Measurements Institute (NMI) and an internal quality system to ISO 9002. NATA has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation (A²LA).

EMC Technologies is accredited in Australia by the National Association of Testing Authorities (NATA). All testing in this report has been conducted in accordance with EMC Technologies' scope of NATA accreditation.

The current full scope of accreditation can be found on the NATA website: www.nata.asn.au



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2.6 Test Equipment Calibration

Measurement instrumentation and transducers were calibrated in accordance with the applicable standards by an independent NATA registered laboratory such as Agilent Technologies (Australia) Pty Ltd or the National Measurement Institute (NMI) or in-house. All equipment calibration is traceable to Australian national standards at the National Measurements Institute.

Equipment Type	Make/Model/Serial Number	Last Cal. dd/mm/yyyy	Due Date dd/mm/yyyy	Cal. Interval
Chamber	Frankonia SAC-10-2 (R-139)	8/01/2016	8/01/2017	1 Year, *1
EMI Receiver	R&S ESU40 20 Hz – 40 GHz Sn: 100182 (R-037)	18/02/2016	18/02/2017	1 Year, *2
	R&S ESCI 9 kHz – 3 GHz Sn: 100011 (R-028)	25/05/2016	25/05/2017	1 Year, *2
Antennas	EMCO 6502 Active Loop 9 kHz – 30 MHz Sn. 9311-2801 (A-231)	20/07/2015	20/07/2018	3 Year, *2
	SUNOL JB6 Biconilog 30 – 6000 MHz Sn. A012312 (A-363)	26/05/2016	26/05/2018	2 Year, *2
	EMCO 3115 Double Ridge Horn 1 – 18 GHz Sn: 8908-3282 (A-004)	15/07/2016	15/07/2019	3 Year, *1
Cables	Room 12 inbuilt cable Panel 1 to 10 m (C-422)	09/05/2016	09/05/2017	1 Year, *1
	Room 12 inbuilt cable Panel 1 to 3 m (C-421)	09/05/2016	09/05/2017	1 Year, *1
	Room 12 Antenna cable (C-437)	09/05/2016	09/05/2017	1 Year, *1

Note *1. Internal NATA calibration.

Note *2. External NATA / A2LA calibration



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3.0 TEST RESULTS

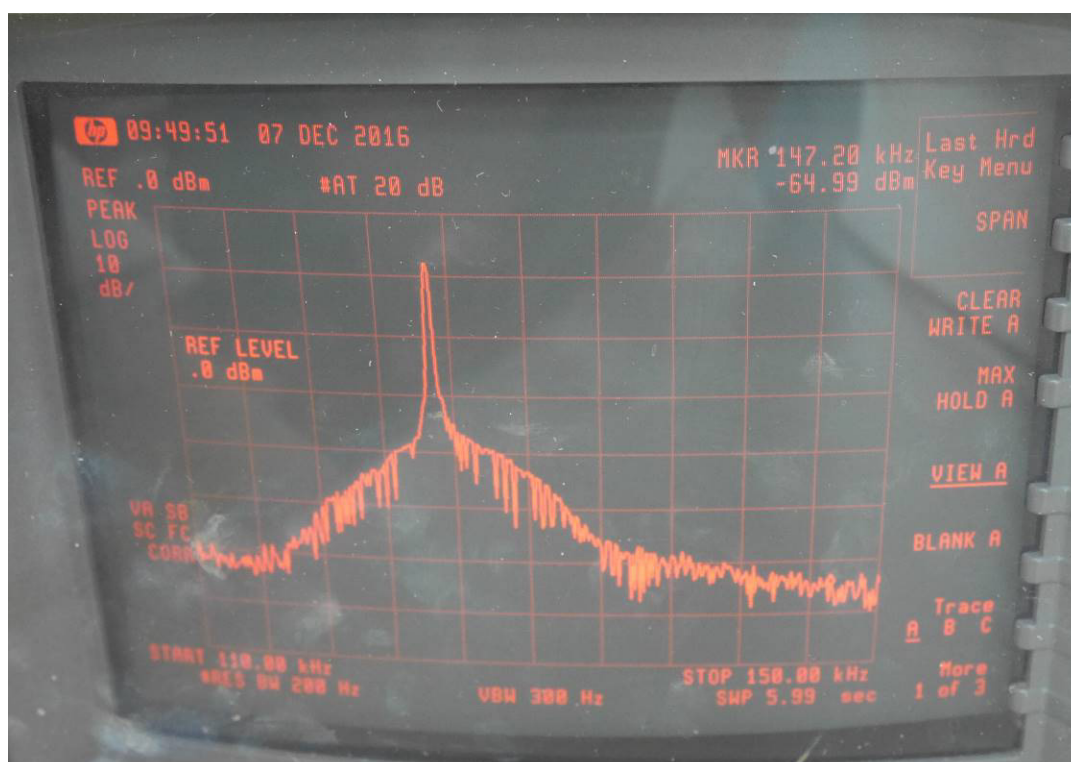
3.1 §15.203 Antenna Requirement

The antennas were internal to the device ensuring that they could not be replaced.

3.2 §15.205 Restricted Bands of Operation

The limits of §15.209 were applied across the applicable spectrum and therefore complied with the restricted band requirements.

The restricted band near the 125 kHz fundamental signal was investigated. The bandwidth of the signal did not fall within the restricted band (90 kHz to 110 kHz and 495 kHz to 505 kHz).



110kHz to 150 kHz scan

3.3 §15.207 Conducted Limits

The device was not connected directly or indirectly to the AC mains network.



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3.4 §15.209 Radiated emission limits; general requirements

Radiated EMI tests were performed in a semi-anechoic chamber compliant with CISPR16-1-4. The chamber allows a 2m x 2m x 2m test volume up to 6 GHz, at a test distance of 3 metres and 10 metres.

The test frequency range was sub-divided into smaller bands with sufficient frequency resolution to permit reliable display and identification of possible EMI peaks. Measurements between 9 kHz and 30 MHz were made at 10 metres using a 0.6 metre loop antenna and calibrated Biconilog antenna for measurements between 30 MHz and 1000 MHz. Calibrated EMCO 3115, EMCO 3116 and ETS standard gain horn antennas were used for measurements between 1 to 25 GHz as applicable.

The EUT was slowly rotated with the spectrum analyser was set to Max-Hold. This was performed for two antenna heights. When an emission was located, it was positively identified and its maximum level found by rotating the automated turntable and by varying the antenna height. The procedure was repeated with the device orientated in three orthogonal axis to further maximise the emission.

Each significant peak was investigated with the Peak/Average Detectors. The measurement data for each frequency range was corrected for cable losses, antenna factors and preamplifier gain. This process was performed for both horizontal and vertical antenna polarisations.

3.4.1 Calculation of field strength

The field strength was calculated automatically by the software using all the pre-stored calibration data. The method of calculation is shown below:

$$E = V + AF - G + L$$

Where:

- E** = Radiated Field Strength in dBμV/m.
- V** = EMI Receiver Voltage in dBμV. (measured value)
- AF** = Antenna Factor in dB. (stored as a data array)
- G** = Preamplifier Gain in dB. (stored as a data array)
- L** = Cable loss in dB. (stored as a data array of Insertion Loss versus frequency)



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3.4.2 Calculation of limit

9 kHz to 30 MHz applied ANSI C63.10 section 6.4.4 procedure for determining the equivalent limit when measuring at 10 metres. The dimensions of the device under test did not exceed 0.625λ (i.e. less than 6.3 metres).

Field strength decay assumption for measurements made at 10 metres:
9 kHz to 4.76 MHz = 40 dB/decade

$$\text{Adjusted Limit} = \text{Limit} - 40 \log \left(\frac{d_{\text{limit}}}{d_{\text{measure}}} \right)$$

4.76 MHz to 30 MHz = 20 dB/decade

$$\text{Adjusted Limit} = \text{Limit} - 20 \log \left(\frac{d_{\text{limit}}}{d_{\text{measure}}} \right)$$

d_{limit} = Reference distance
 d_{measure} = Measurement distance

The complete list of limits are as follows:

Frequency (MHz)	Limit ($\mu\text{V/m}$)	Distance (m)	Factor (dB)	10 m limit ($\text{dB}\mu\text{V/m}$)
0.009-0.490	$2400/f(\text{kHz})$	300	59.1	107.6-72.9
0.490-1.705	$24000/f(\text{kHz})$	30	19.1	52.9-42.1
1.705-4.76	30	30	19.1	49.1
4.76-30	30	30	9.5	39.5

30 MHz to 1000 MHz the 20 dB/decade extrapolation factor was applied as specified in Part 15 section 31e. The limits applied were as follows:

Frequency (MHz)	Limit ($\mu\text{V/m}$)	Distance (m)	Factor (dB)	10 m limit ($\text{dB}\mu\text{V/m}$)
30-88	100	3	-10.5	30.5
88-216	150	3	-10.5	33.5
216-960	200	3	-10.5	35.5
Above 960	500	3	-10.5	43.5

Above 1000 MHz the measurements were made at 3 metres and therefore the limits were not adjusted.

Frequency (MHz)	Limit ($\mu\text{V/m}$)	Distance (m)	3 m limit ($\text{dB}\mu\text{V/m}$)
Above 960	500	3	54.0

Example

The limit at 125 kHz is $(2400/125 \text{ kHz}) \mu\text{V/m}$ at 300 metres

$$\text{Limit} = 19.2 \mu\text{V/m} = 25.7 \text{ dB}\mu\text{V/m}$$

$$\text{Adjusted Limit} = 25.7 - 40 \log \left(\frac{300}{10} \right)$$

$$\text{Adjusted Limit} = 25.7 + 59.1 = \mathbf{84.8 \text{ dB}\mu\text{V/m}}$$



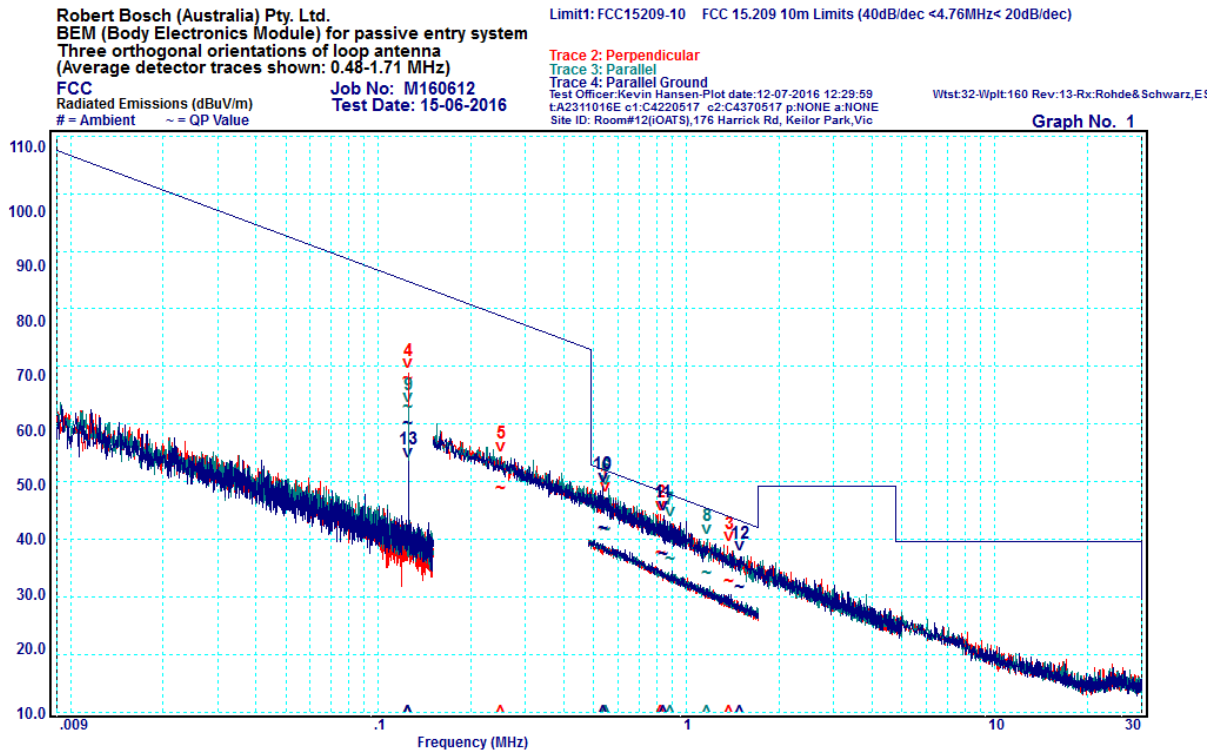
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3.4.3 Frequency Band: 9 kHz - 30 MHz

Measurements were made at a distance of 10 metres. The measurement of emissions between 9 kHz – 150 kHz were made with a resolution bandwidth (RBW) of 200 Hz and the video bandwidth (VBW) of 3 kHz, 150 kHz – 30 MHz were measured with the resolution bandwidth (RBW) of 9 kHz and the video bandwidth (VBW) of 30 kHz.

3.4.3.1 Results



Fundamental transmitter peak levels:

Point	Frequency (MHz)	Loop Orientation	Peak (dBμV/m)	Average Limit (dBμV/m)	Margin (dB)
4	0.125	Perpendicular	68.8	84.8	-16.0
9	0.125	Parallel	62.9	84.8	-21.9
13	0.125	Parallel Ground	60.1	84.8	-24.7

Note: As the peak detector measurements were below the 15.209 limits it was deemed the average detector measurements would also comply.

Spurious emissions:

Point	Frequency (MHz)	Loop Orientation	Quasi-Peak (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1	0.546	Perpendicular	41.7	52.0	-10.3
2	0.827	Perpendicular	37.5	48.4	-10.9
3	1.375	Perpendicular	32.6	44.0	-11.4
5	0.250	Perpendicular	48.7	78.7	-30.0
6	0.547	Parallel	41.6	52.0	-10.4
7	0.885	Parallel	36.6	47.8	-11.2
8	1.164	Parallel	34.1	45.4	-11.3
10	0.536	Parallel Ground	41.8	52.1	-10.3
11	0.842	Parallel Ground	37.3	48.2	-10.9
12	1.492	Parallel Ground	31.6	43.3	-11.7



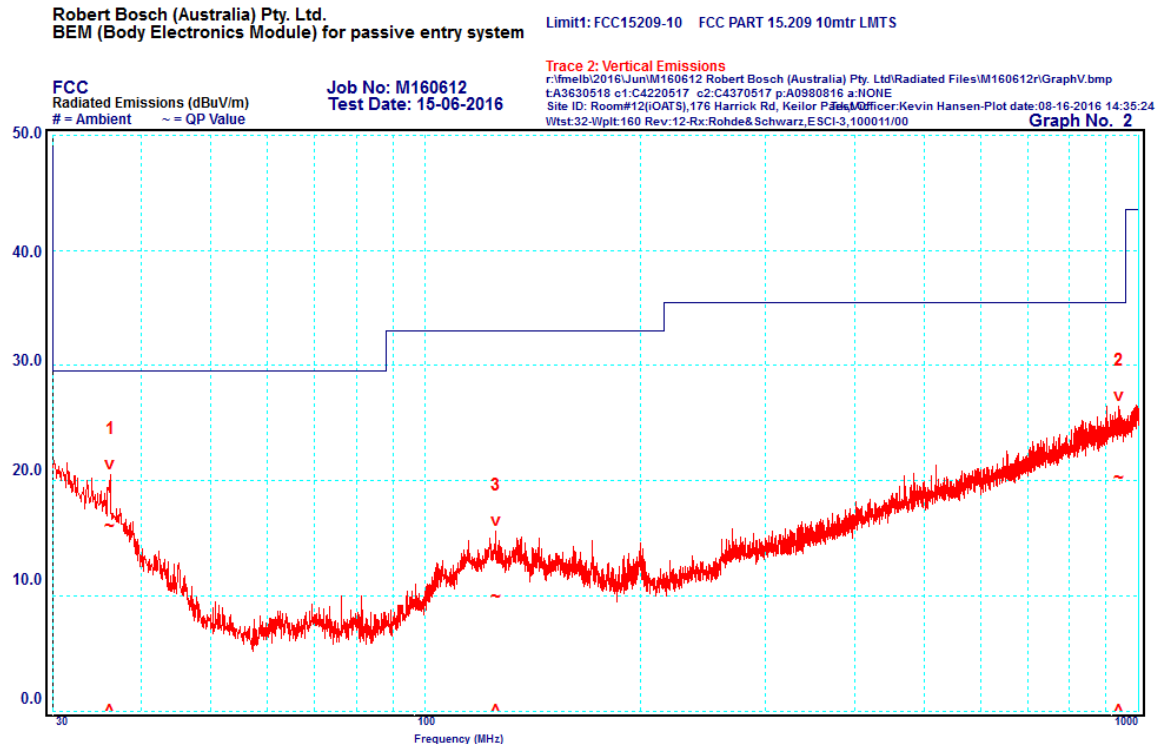
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3.4.4 Frequency Band: 30 - 1000 MHz

Measurements were made at a distance of 10 metres. The measurement of emissions between 30 - 1000 MHz were made with a resolution bandwidth (RBW) of 120 kHz and the video bandwidth (VBW) of 300 kHz.

3.4.4.1 Vertical Polarisation



Point	Frequency (MHz)	Quasi-Peak (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1	36.15	16.0	29.5	-13.5
2	937.75	20.2	35.5	-15.3
3	125.50	9.9	33.0	-23.1



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3.4.4.2 Horizontal Polarisation

Robert Bosch (Australia) Pty. Ltd.
BEM (Body Electronics Module) for passive entry system

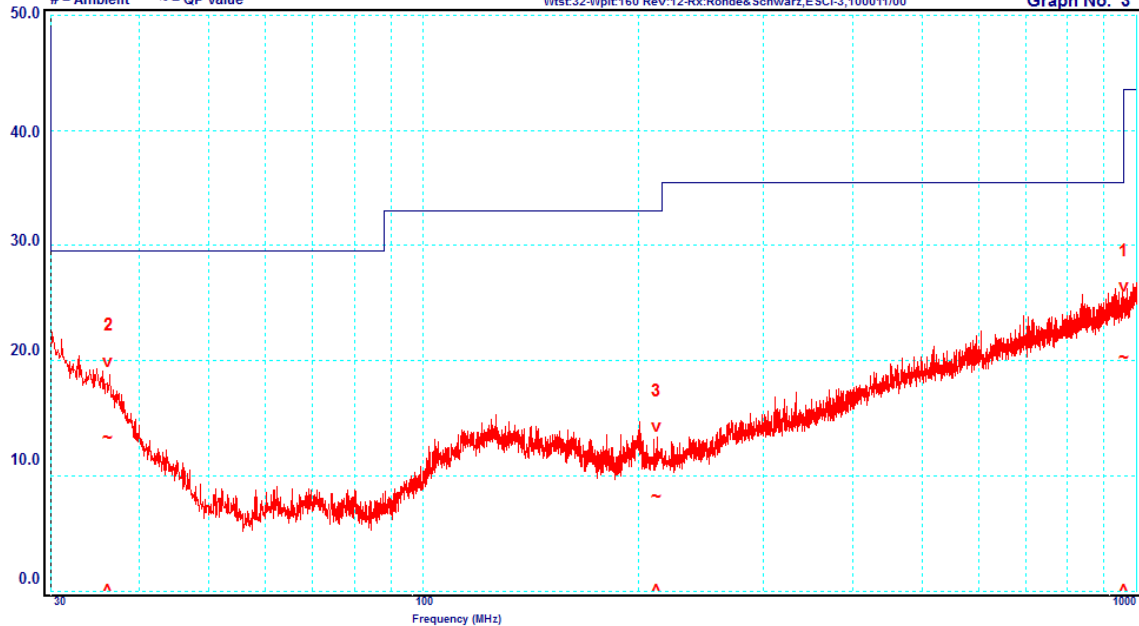
Limit1: FCC15209-10 FCC PART 15.209 10mtr LMTS

FCC
Radiated Emissions (dBuV/m)
= Ambient ~ = QP Value

Job No: M160612
Test Date: 15-06-2016

Trace 2: Horizontal Emissions
r:\fmeib\2016\Jun\M160612 Robert Bosch (Australia) Pty. Ltd\Radiated Files\M160612n\GraphH.bmp
t:A3630518 c1:C4220517 c2:C4370517 p:A0980816 a:NONE
Site ID: Room#12(jOATS),176 Harrick Rd, Keilor Park, Vic 3049
Officer: Kevin Hansen-Plot date:08-16-2016 14:38:30
Wkst:32-Wplt:160 Rev:12-Rx:Rohde&Schwarz,ESCI-3,100011/00

Graph No. 3



Point	Frequency (MHz)	Quasi-Peak (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1	959.13	20.2	35.5	-15.3
2	36.15	13.2	29.5	-16.3
3	212.36	8.1	33.0	-24.9



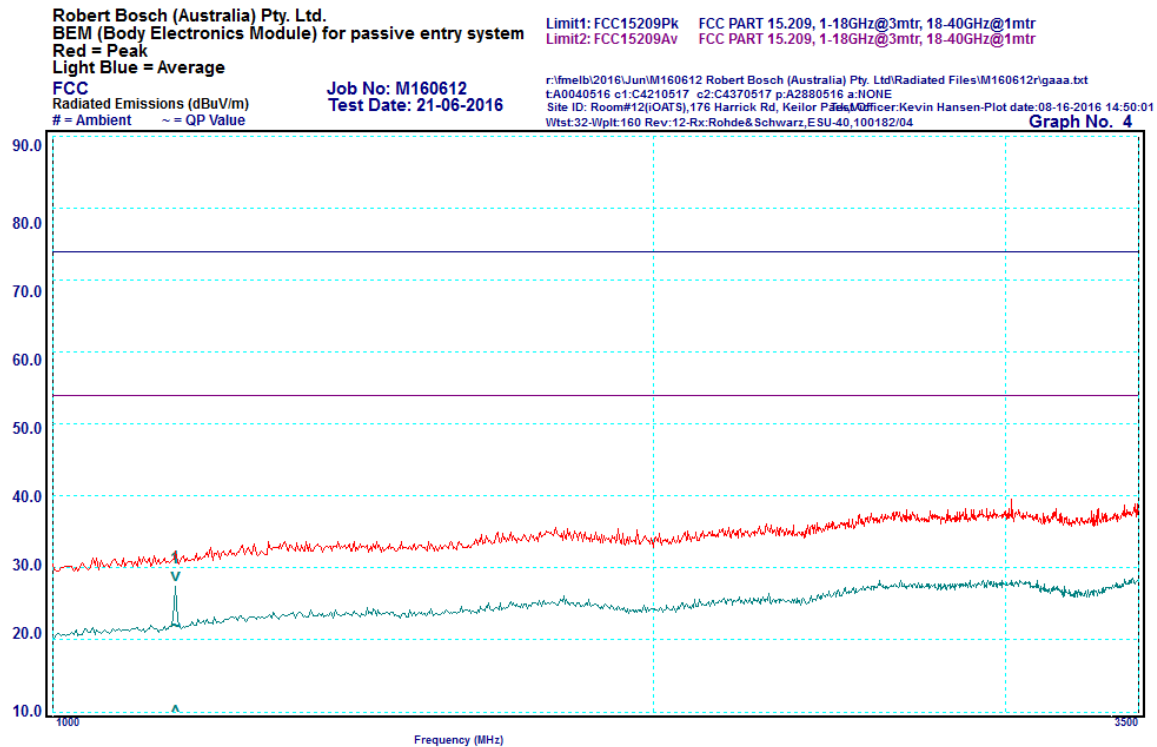
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3.4.5 Frequency Band: 1000 - 3500 MHz

Measurements were made at a distance of 3 metres. The measurement of emissions between 1000 - 3500 MHz were made with a resolution bandwidth (RBW) of 1000 kHz and the video bandwidth (VBW) of 1000 kHz for peak and a video bandwidth (VBW) of 10 Hz for average.

3.4.5.1 Vertical Polarisation



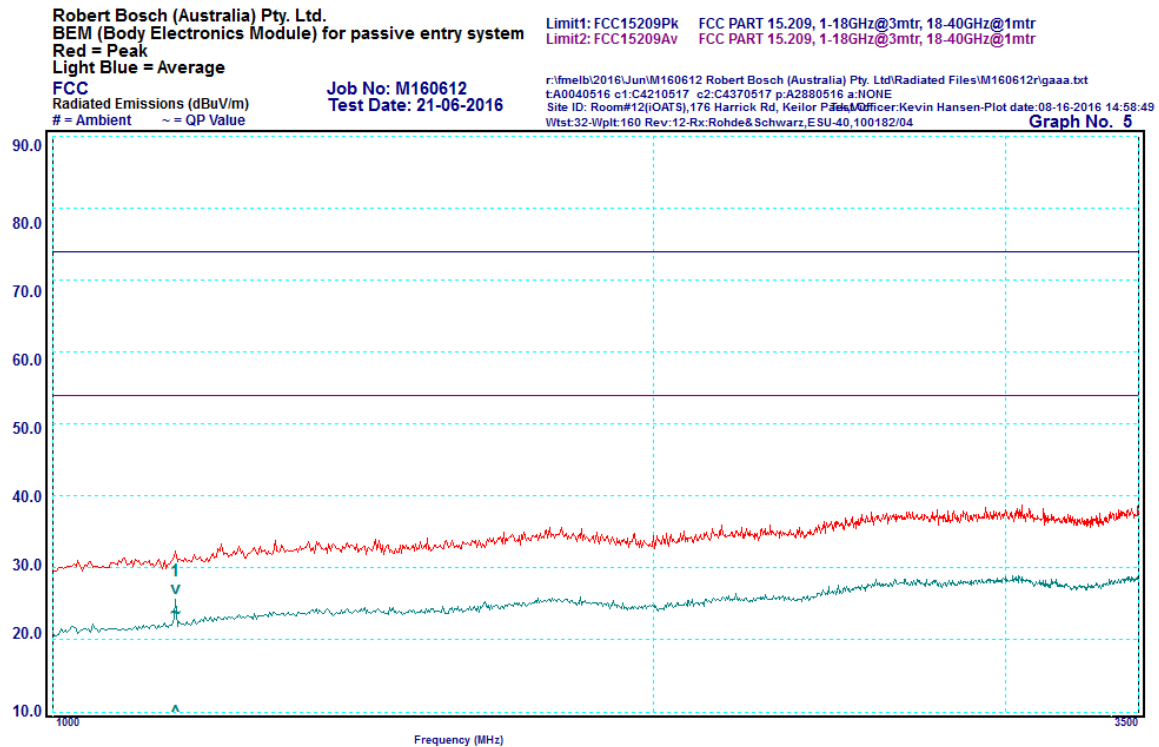
Point	Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1	1152.56	21.9	54	-32.1



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3.4.5.2 Horizontal Polarisation



Point	Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)
1	1152.52	23.7	54	-30.3

3.4.6 Conclusion

The spurious emissions complied with the general limits of §15.209 by a margin of 10.3 dB.

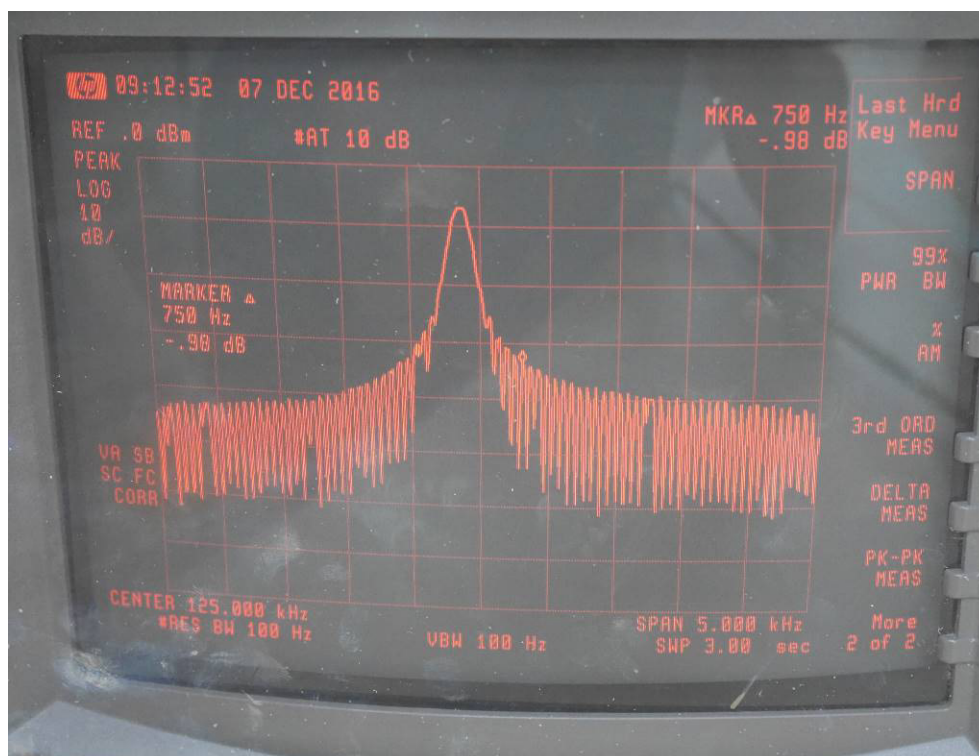


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3.5 §2.1049 Occupied bandwidth – 99% power

The bandwidth containing 99% power of the transmitted signal was measured using the procedure from ANSI C63.10 section 6.9.



The 99% power bandwidth was **750 Hz**.

4.0 COMPLIANCE STATEMENT

The P002 Automotive Passive Entry Passive Start (PEPS) System, tested on behalf of Offer EMC Services **complied** with the requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators).

Results were as follows:

FCC Part 15 Subpart C	Test Performed	Results
15.203	Antenna requirement	Complied
15.205	Restricted bands of operation	Complied
15.207	Conducted limits	Not applicable
15.209	Radiated emissions limits; general requirements	Complied
2.1049	Occupied Bandwidth	750 Hz



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5.0 MEASUREMENT UNCERTAINTY

EMC Technologies has evaluated the equipment and the methods used to perform the emissions testing. The estimated measurement uncertainties for emissions tests shown within this report are as follows:

Conducted Emissions:	9 kHz to 30 MHz	± 3.2 dB
Radiated Emissions:	9 kHz to 30 MHz	± 4.1 dB
	30 MHz to 300 MHz	± 5.1 dB
	300 MHz to 1000 MHz	± 4.7 dB
	1 GHz to 18 GHz	± 4.6 dB

The above expanded uncertainties are based on standard uncertainties multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95%.



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