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Project Number: 12E4186-3a

Prepared for:

**Schrader Electronics**

By

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Co. Meath

**FCC Site Registration: 92592**

**Industry Canada Assigned Site Code: 8517A-2**

FCC ID: MRXT3

IC: 2546A-T3

**Date**

22<sup>nd</sup> November 2012

FCC EQUIPMENT AUTHORISATION

Test Report

**EUT Description**

Tyre Pressure and Temperature Sensor and Transmitter Module.

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**Authorised :**

**John McAuley**

A handwritten signature in blue ink, reading 'John McAuley', written over a horizontal line.

**TEST SUMMARY**

The equipment complies with the requirements according to the following standards.

FCC Part Section(s)	RSS-210 Section	TEST PARAMETERS	Test Result
15.231(a)	A1.1.1(a)	MAXIMUM MODULATION PERCENTAGE (M%)	PASS
15.231(b)	A.1.1.2(1)	RADIATED EMISSIONS	PASS
15.231(c)	A1.1.3	20dB BANDWIDTH	PASS

THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF COMPLIANCE ENGINEERING IRELAND LTD

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**Exhibit A – Technical Report**

Table of Contents

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1.0	EUT DESCRIPTION .....	4
1.1	EUT OPERATION .....	5
1.2	MODIFICATIONS .....	5
1.3	DATE OF TEST .....	5
1.4.1	MEASUREMENT UNCERTAINTY .....	6
2.0	EMISSIONS MEASUREMENTS.....	7
2.1	CONDUCTED EMISSIONS MEASUREMENTS.....	7
2.2	RADIATED EMISSIONS MEASUREMENTS .....	7
2.3	TEST CRITERIA.....	9
3.0	MAXIMUM MODULATION PERCENTAGE (M%).....	10
4.0	FIELD STRENGTH OF SPURIOUS RADIATED EMISSIONS .....	13
5.0	LIST OF TEST EQUIPMENT .....	16

## 1.0 EUT Description

The EUT was a module using a short range 315 MHz band transceiver for reporting of tyre pressure and temperature in cars/trucks.

<b>Model:</b>	T3
<b>Type:</b>	315 MHz Tyre Pressure and Temperature Measurement System
<b>FCC ID:</b>	MRXT3
<b>Company:</b>	Schrader
<b>Contact</b>	Mr James Kyle
<b>Address:</b>	Schrader Electronics 11 Technology Park, Belfast Road, Antrim Northern Ireland BT41 1QS
<b>Phone:</b>	+44 28 9446 3067
<b>e-mail:</b>	jakyle@schrader.co.uk
<b>Test Standards:</b>	47 CFR, Part 15.231(a,e)
<b>Type of radio:</b>	Stand-alone
<b>Transmitter Type:</b>	ASK
<b>Operating Frequency Range(s):</b>	314.954 MHz
<b>Number of Channels:</b>	One
<b>Antenna:</b>	Integral
<b>Transmitter power configuration:</b>	3 VDC Lithium cell battery.
<b>Oper. Temp Range:</b>	-40° C to +85° C
<b>Classification:</b>	DSC
<b>Test Methodology:</b>	Measurements performed according to the procedures in ANSI C63.4-2003

## 1.1 EUT Operation

### **Operating Conditions during Test:**

The equipment under test was operated during the measurement under the following conditions:

A new battery was used in the EUT for test.

The EUT was operated in un-modulated (CW) mode for spurious emissions and radiated power tests.

The EUT was operated in EMC mode for modulation bandwidth test.

The EUT was operated in normal operation (roll mode) for the duty cycle test.

### **Environmental conditions**

During the measurement the environmental conditions were within the listed ranges:

Normal

Temperature: +15 to +35 ° C

Humidity: 20-75 %

## 1.2 Modifications

No modifications were required in order to pass the test specifications.

## 1.3 Date of Test

The tests were carried out on one sample of the EUT during the month of October 2012.

## **1.4 Electromagnetic Emissions Testing**

The guidelines of CISPR 16-4 were used for all uncertainty calculations, estimates and expressions thereof for EMC testing. A copy of Compliance Engineering Ireland Ltd.'s policy for EMC Measurement Uncertainty is available on request.

RF Requirements: Spurious emissions in accordance with FCC CFR 15.107, 15.109 and 15.209. Tests were carried out to the requirements of CISPR 16-4 and ANSI C63.4-2009.

### **1.4.1 Measurement Uncertainty**

The measurement uncertainty (with a 95% confidence level) for the conducted emissions test was  $\pm 3.5$  dB.

The measurement uncertainty (with a 95% confidence level) for the radiated emissions test was  $\pm 5.3$  dB (from 30 to 100 MHz),  $\pm 4.7$  dB (from 100 to 300 MHz),  $\pm 3.9$  dB (from 300 to 1000 MHz) and  $\pm 3.8$  dB (from 1 GHz to 40 GHz).

## **2.0 Emissions Measurements**

### **2.1 Conducted Emissions Measurements**

Test not performed as EUT is powered from 3 volt battery.

### **2.2 Radiated Emissions Measurements**

Radiated Power measurements were made at the Compliance Engineering Ireland Ltd anechoic chamber located in Dunshaughlin, Co. Meath, Ireland to determine the radio noise radiated from the EUT. A "Description of Measurement Facilities" has been submitted to the FCC and approved pursuant to Section 2.948 of CFR 47 of the FCC rules.

The EUT was centred on a motorized turntable, which allows 360 degree rotation. A measurement antenna was positioned at a distance of 3 meters as measured from the closest point of the EUT. The radiated emissions were maximised by configuring the EUT, by rotating the EUT, and by raising and lowering the antenna from 1 to 4 meters.

Emissions below 1GHz were measured using a bi-log antenna. In this case the resolution bandwidth was 100kHz.

Emissions above 1GHz were measured using a horn antenna located at 3 metres distance from the EUT. In this case the resolution bandwidth was 1MHz and video bandwidth was 1MHz.

## 2.3 Antenna Requirements

### **According to FCC 47 CFR 15.203:**

*“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 this E.U.T are permanently attached.

\*The E.U.T Complies with the requirement of 15.203



## 2.4 Test Criteria

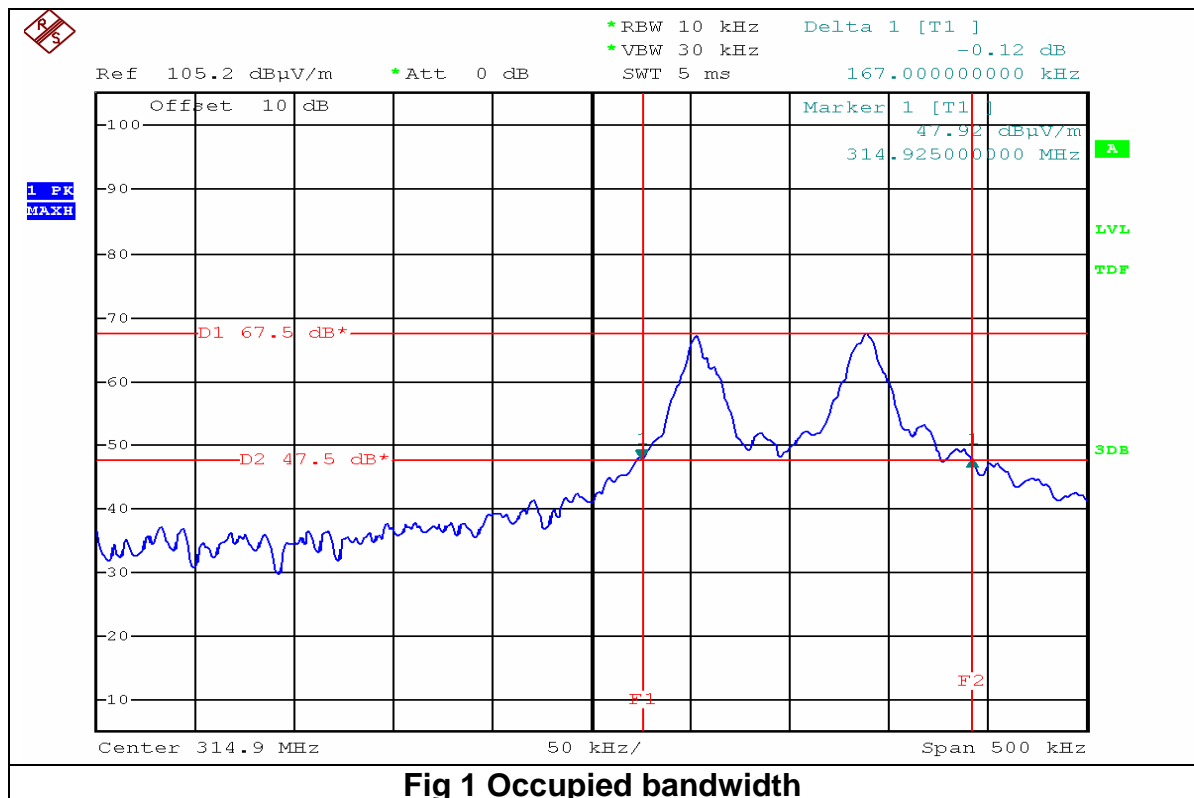
### Requirement :-15.231 (c) & IC RSS-210 Issue 6 A1.1.3

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.

### TEST PROCEDURE

The resolution bandwidth was set to 10 kHz. The video bandwidth was set to 30 kHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

### RESULTS



Operating Frequency (MHz)	20dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
314.954	167	787.385	620.385	Pass

### 3.0 MAXIMUM MODULATION PERCENTAGE (M%)

#### LIMIT

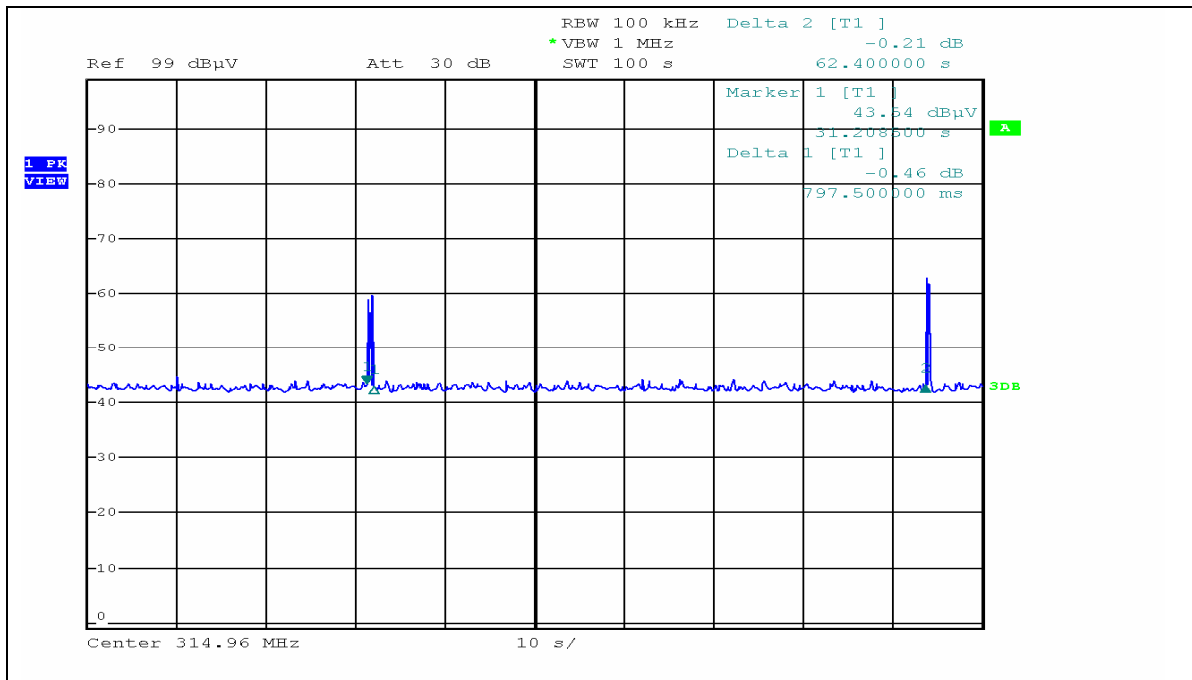
#### 15.35 (c) & IC RSS-Gen Issue 1 4.3

The measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 seconds interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

#### TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer or radiated field strength. The RBW is set to 100 kHz and the VBW is set to 1MHz. The sweep time is coupled and the span is set to 0 Hz. The number of pulses is measured and calculated in a 100 ms scan.

#### RESULTS



**Fig 2 Repetition of transmitted pulse**

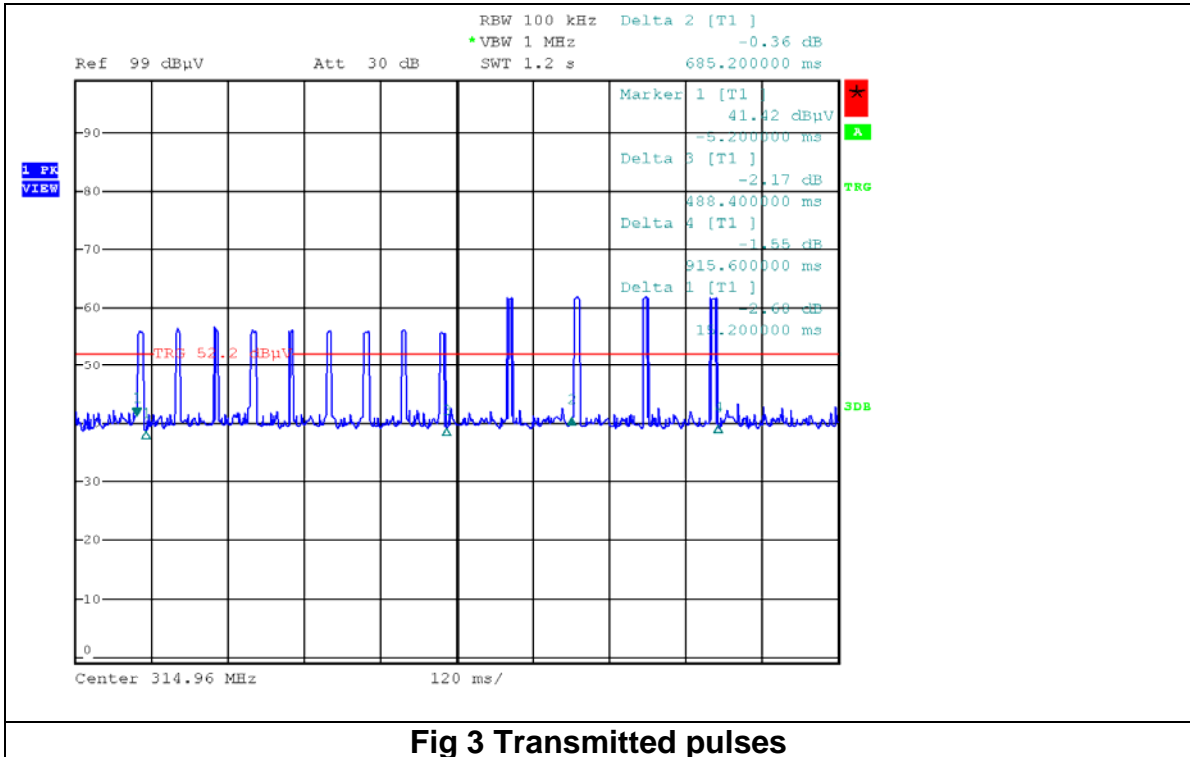


Fig 3 Transmitted pulses

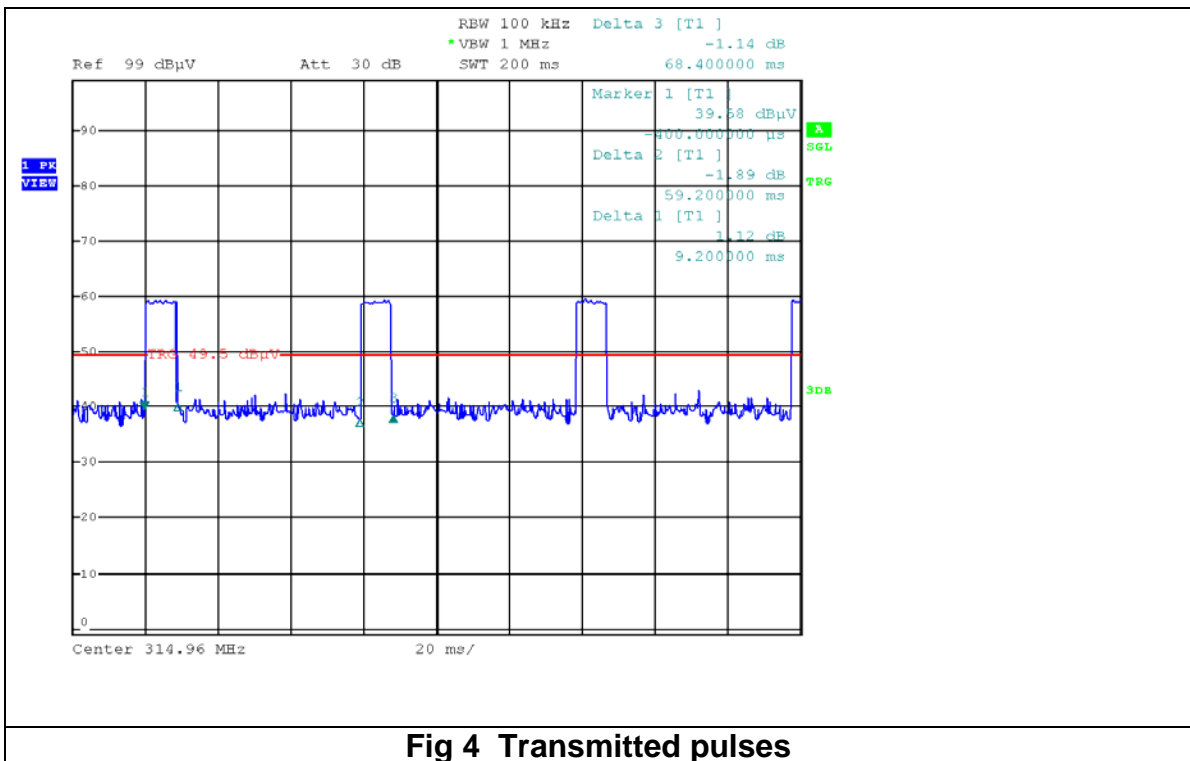
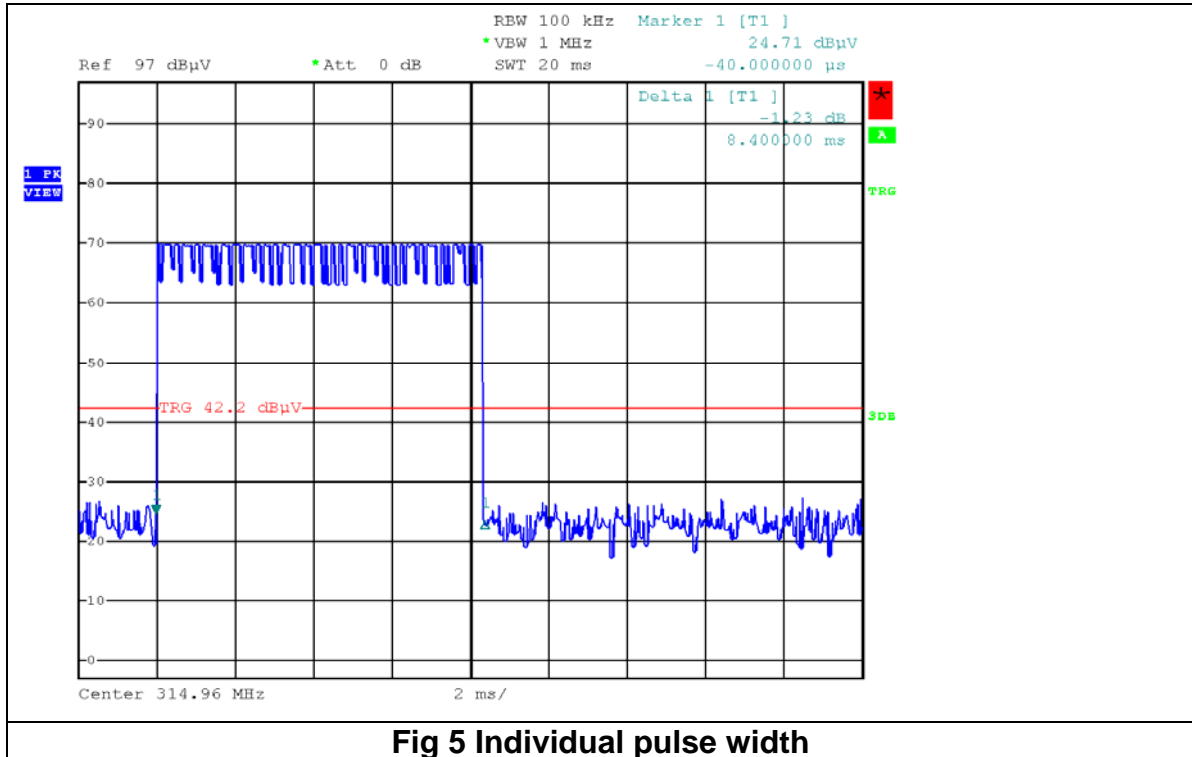


Fig 4 Transmitted pulses



MAXIMUM MODULATION PERCENTAGE

One Period(mS)	Pulse Width (mS)	No of Pulses	Duty Cycle	Duty Cycle %	Test Result
100	8.4	2	0.168	16.8	Pass

CALCULATION

Average Reading = Peak Reading dB(μV/m) +20log (Duty Cycle),

where Duty Cycle is (No of pulses\*pulse width)/100 or T

Note correction for pulse mode operation is

20 log duty cycle (dB)
-15.5

#### 4.0 Field Strength of Spurious Radiated Emissions

##### Test Specification: FCC PART 15, SECTION 47 CFR 15.231(e)

Fundamental Frequency (MHz)	Field Strength of fundamental ( $\mu\text{V/m}$ )	Strength of Spurious Emissions ( $\mu\text{V/m}$ ).
40.66 ~ 40.70	22.50	225
70 ~ 130	1250	125
130 ~ 174	1250 to 3750 **	125 to 375 **
174 ~ 260	3750	375
260 ~ 470	3750 to 12500 **	375 to 1250 **
Above 470	12500	1250

\*\* Linear interpolations

**Interpolation Formula =  $16.67 \times \text{Freq MHz} - 2833.33$**

For operating frequency of 314.954 MHz the following limits apply (using interpolation formula above)

Fundamental Frequency	Field Strength of fundamental	Field Strength of fundamental	Field Strength of Spurious Emissions	Field Strength of Spurious Emissions
MHz	$\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$	$\mu\text{V/m}$	$\text{dB}\mu\text{V/m}$
314.954	2417.28	67.7	241.728	47.7

Note this is the Average limit for 3 metre measurement.

##### Test Specification: FCC PART 15, SECTION 47 CFR 15.109

Frequency (MHz)	Field Strength ( $\mu\text{V/m}$ )	Field Strength ( $\text{dB}\mu\text{V/m}$ )
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
Above 960	500	54.0

\*\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., Sections 15.231 and 15.241

For the spurious and harmonics measurements, the EUT was set up in an anechoic chamber. The EUT was rotated 360 degrees azimuth and the search antenna height was varied 1 to 4m in order to maximize the emissions. Significant peaks from the EUT were then recorded to determine margin to the limits. Distance of EUT to the measurement antenna was 3m.

#### 4.1 Results for Radiated emissions

Appendix A shows the results of the scans in the anechoic chamber.

Ref Appendix B Fig 9, 10,11 for EUT orientation

**Result: Pass**

##### 4.1.1 Measurements with Bilog Antenna (30MHz to 1GHz)

	Peak Level dBuV/m	EUT Orientation	Antenna Polarity	Antenna Loss dB	Cable loss dB	Final Field Strength Peak dBuV/m
314.954	54	O1	Vertical	13.6	0.8	68.4
314.954	57.1	O2	Horizontal	13.6	0.8	71.5
629.908	21.14	O1	Vertical	19.82	1.8	42.76
629.908	20.42	O2	Horizontal	19.82	1.8	42.04
943.862	21.21	O1	Vertical	24.5	2.4	48.11
943.862	18.9	O2	Horizontal	24.5	2.4	45.8

Frequency MHz	Peak Level dBuV/m	EUT Orientation	Antenna Polarity	Average Level dBuV/m	Average Limit dBuV/m	Margin dB
314.954	68.4	O1	Vertical	52.91	67.7	14.82
314.954	71.5	O2	Horizontal	56.01	67.7	11.72
629.908	42.76	O1	Vertical	27.27	47.7	20.46
629.908	42.04	O2	Horizontal	26.55	47.7	21.18
943.862	48.11	O1	Vertical	32.62	47.7	15.11
943.862	45.8	O2	Horizontal	30.31	47.7	17.42

**Result: Pass**

## 4.1.2 Horn antenna measurements (1GHz - 4 GHz)

Frequency GHz	Measured Peak Level dBuV/m	Antenna Loss dB	Preamp Gain dB	Cable Loss	Antenna Polarity	EUT Orientation	Final Peak Level dBuV/m
1.2598	53.5	24.2	40.8	1.5	Vertical	O1	38.4
1.57475	58.2	25.4	40.8	1.8	Vertical	O1	44.6
1.88967	67.0	25.4	40.8	1.8	Vertical	O1	53.4
2.208	50.7	27.4	38.3	2.1	Vertical	O1	41.9
2.5198	52.7	28.7	38.3	2.5	Vertical	O1	45.6
2.8348	57.0	28.7	38.3	2.5	Vertical	O1	49.9
3.1497	56.3	30.4	38.3	2.6	Vertical	O1	51.0
1.2598	54.6	24.2	40.8	1.5	Vertical	O1	39.5
1.57475	52.8	25.4	40.8	1.8	Horizontal	O2	39.3
1.88967	63.5	25.4	40.8	1.8	Horizontal	O2	49.9
2.208	51.4	27.4	38.3	2.1	Horizontal	O2	42.6
2.5197	53.8	28.7	38.3	2.5	Horizontal	O2	46.7
2.8345	53.4	28.7	38.3	2.5	Horizontal	O2	46.3
3.1497	54.1	30.4	38.3	2.6	Horizontal	O2	48.8

Frequency GHz	Final Peak Level dBuV/m	EUT Orientation	Antenna Polarity	Average Level dBV/m	Average Limit dBuV/m	Margin dB
1.2598	38.4	O1	Vertical	22.9	54	31.1
1.57475	44.6	O1	Vertical	29.1	54	24.9
1.88967	53.4	O1	Vertical	38.0	54	16.0
2.208	41.9	O1	Vertical	26.4	54	27.6
2.5198	45.6	O1	Vertical	30.1	54	23.9
2.8348	49.9	O1	Vertical	34.4	54	19.6
3.1497	51.0	O1	Vertical	35.5	54	18.5
1.2598	39.5	O1	Vertical	24.0	54	30.0
1.57475	39.3	O2	Horizontal	23.8	54	30.2
1.88967	49.9	O2	Horizontal	34.5	54	19.5
2.208	42.6	O2	Horizontal	27.1	54	26.9
2.5197	46.7	O2	Horizontal	31.2	54	22.8
2.8345	46.3	O2	Horizontal	30.8	54	23.2
3.1497	48.8	O2	Horizontal	33.3	54	20.7

**Result: Pass**

## 5.0 List of Test Equipment

<b>Instrument</b>	<b>Mfr.</b>	<b>Model</b>	<b>CEI Ref No.</b>	<b>Cal Due Date</b>
Measuring Receiver	Rohde & Schwarz	ESVS30	607	19/04/2014
Bilog Antenna	Chase	CBL 6140	690	03/10/2015
Horn Antenna	EMCO	3115	655	26/10/2014
Preamplifier	Hewlett Packard	83017A	805	10/04/2013
Spectrum Analyser	Rohde & Schwarz	FSP 40	850	10/05/2013



**Appendix A**  
**Additional Test Results**

## RADIATED EMISSIONS

Op Cond: Normal  
 Operator: J McAuley

### Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30M	1000M	120k	120k	PK	5ms	0dB	BLN OFF	60dB

Final Measurement: x Hor-Max / + Vert-Max  
 Meas Time: 1 s  
 Subranges:  
 8 Acc Margin: 0dB

Transducer No.	Start	Stop	Name	
4	11	20M	1000M	CEI_BLA
19	30M	1000M	BILOG	

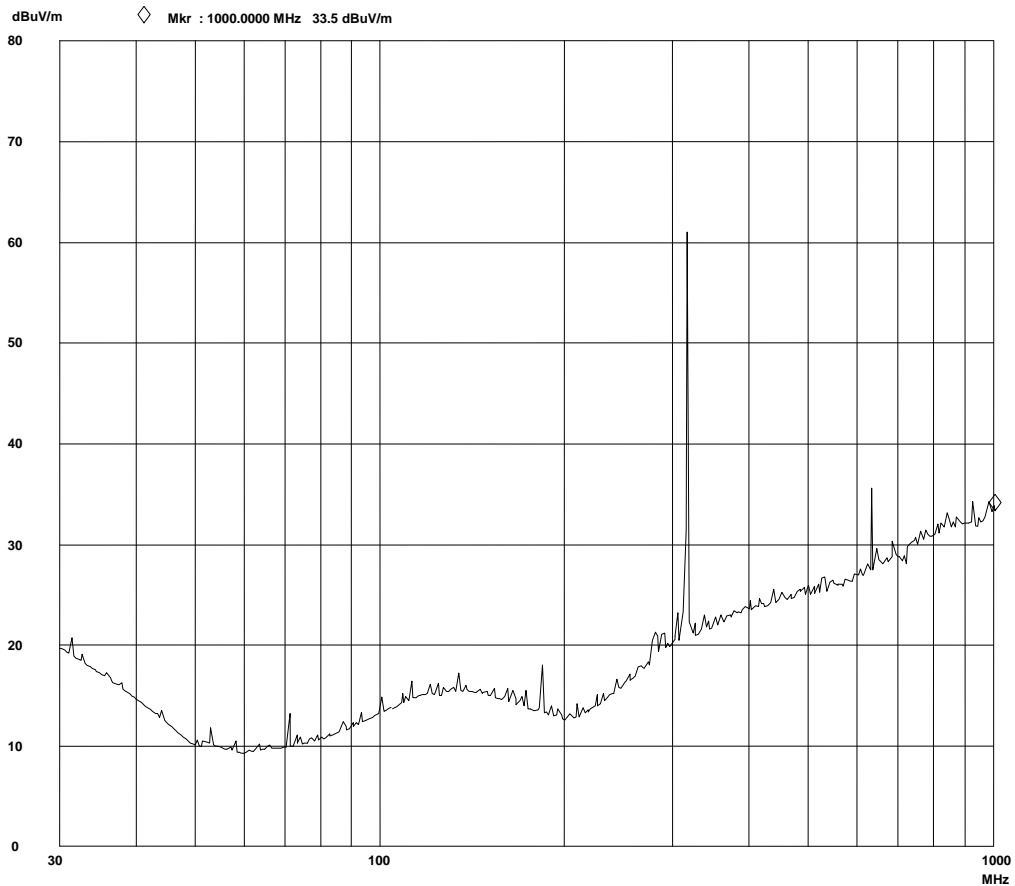


Fig 1 Radiated Emissions Vertical 30MHz -1GHz @ 3 metres Anechoic chamber

### RADIATED EMISSIONS

Op Cond: Normal  
Operator: J McAuley

#### Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30M	1000M	120k	120k	PK	5ms	0dB	LN OFF	60dB

Final Measurement: x Hor-Max / + Vert-Max  
Meas Time: 1 s  
Subranges:  
8  
0dB

Transducer No.	Start	Stop	Name
4	11 20M	1000M	CEL_BLA
19	30M	1000M	

BILOG

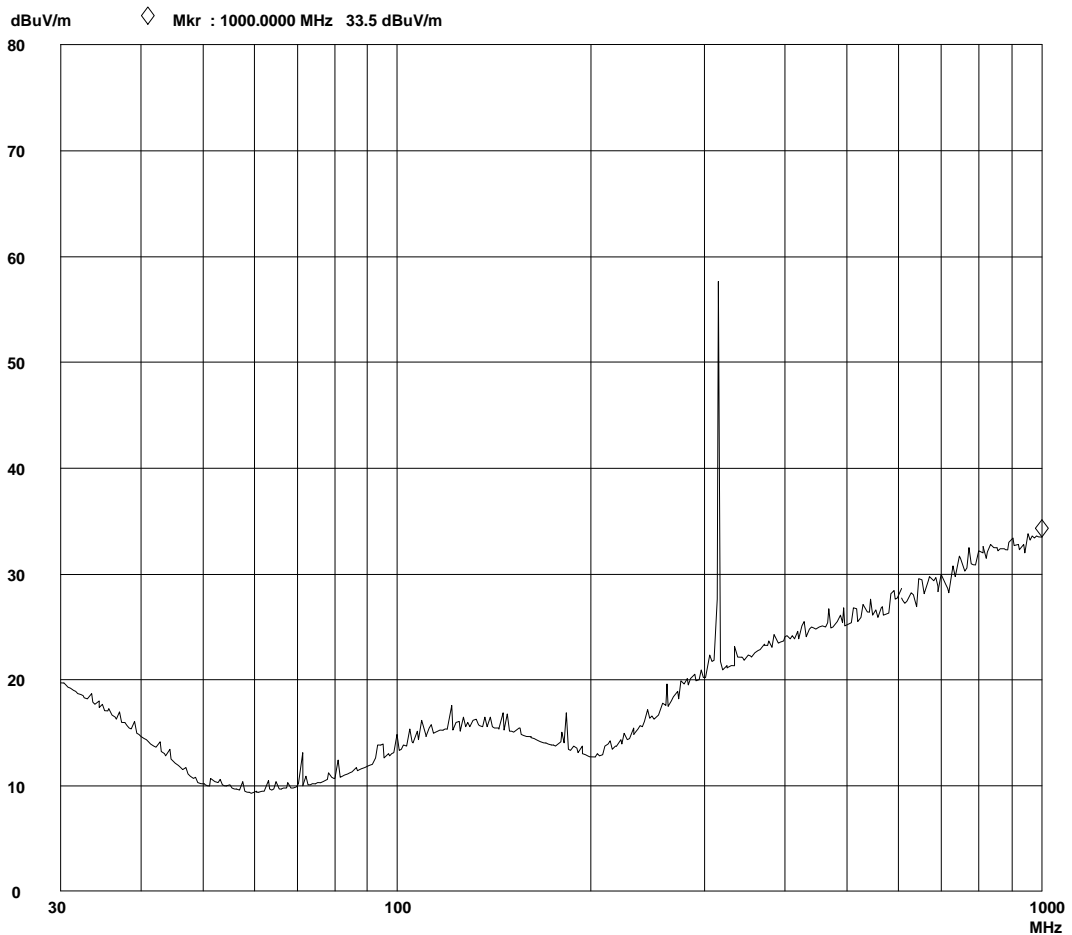


Fig 2 Radiated Emissions Horizontal 30MHz -1GHz @ 3 metres Anechoic chamber

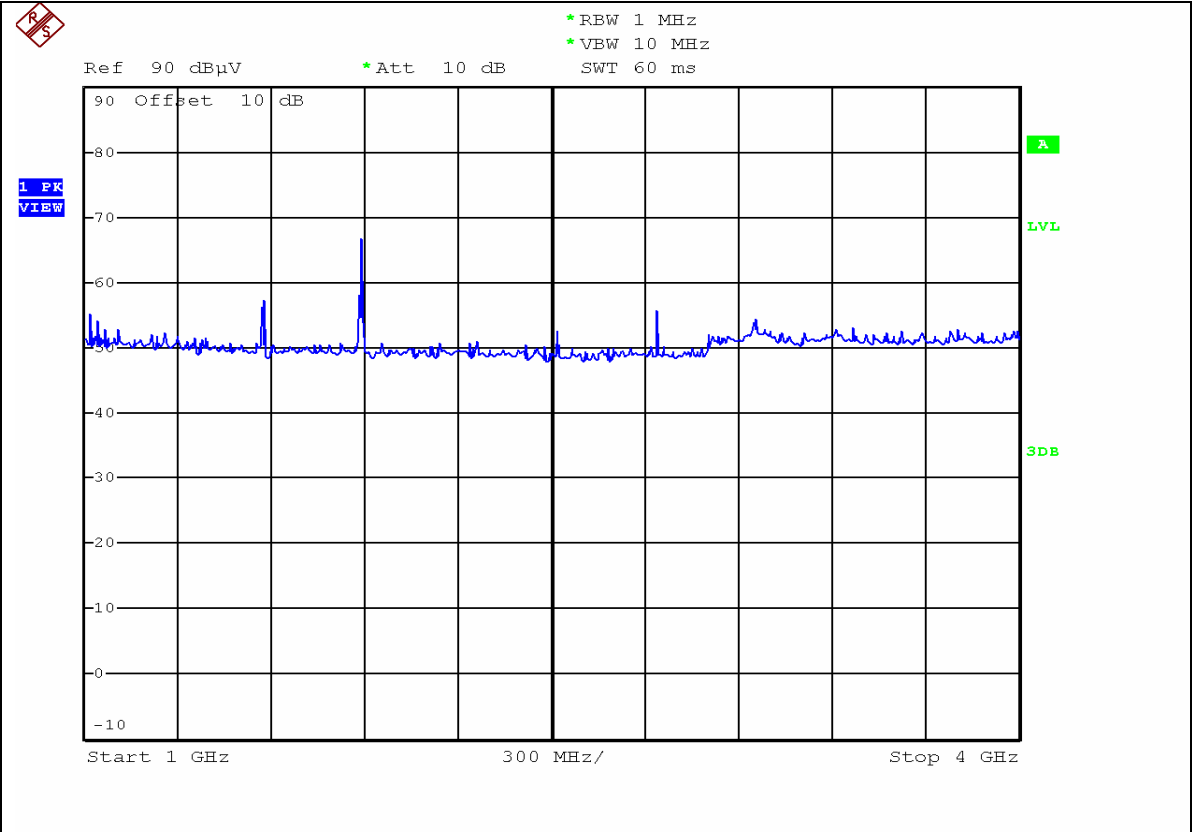


Fig 3 Scan 1GHz – 4 GHz Vertical

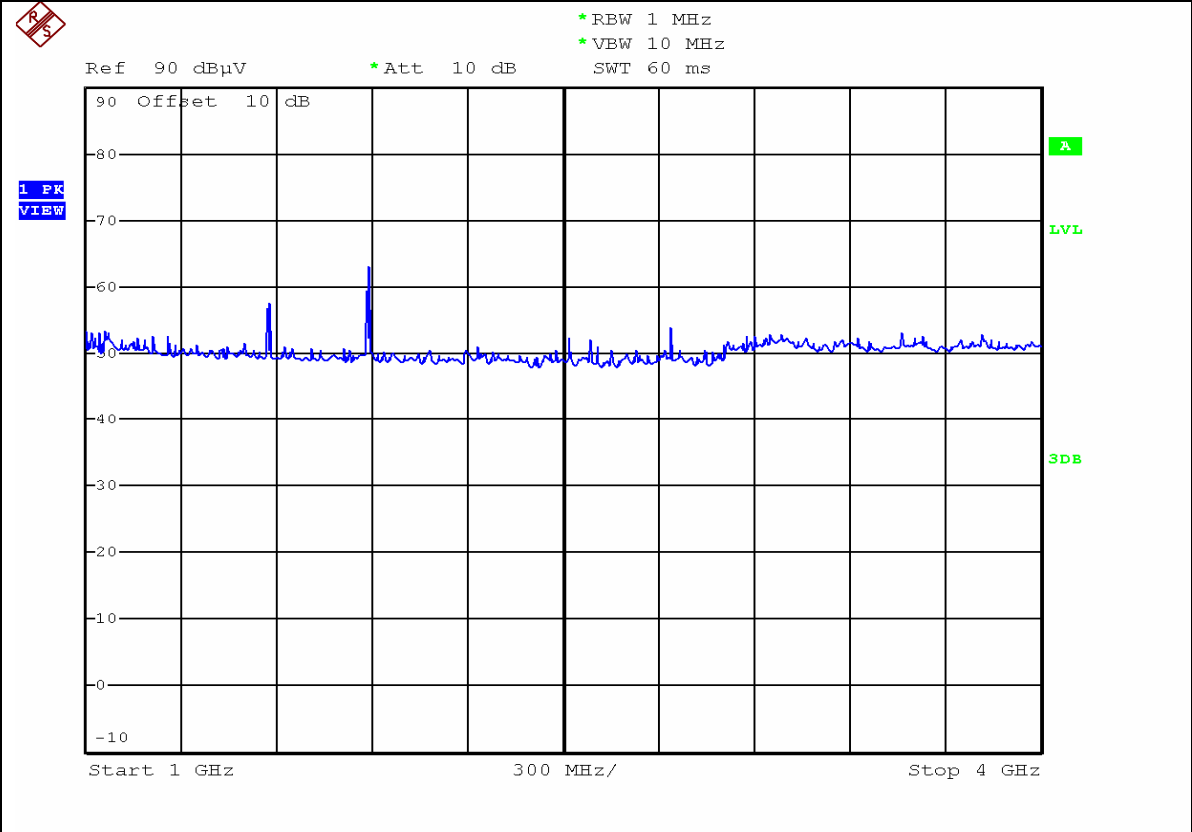


Fig 4 Scan 1GHz – 4GHz Horizontal

## Appendix B

EUT orientation



Fig 8 EUT orientation "O1"



Fig 9 EUT orientation "O2"



Fig 10 EUT orientation "O3"