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# Confidential ReportClient:Test of:Schrader Electronics LtdCRMJ1939 Receiver11 Technology ParkCRMJ1939 ReceiverBelfast RoadTo:AntrimTo:Northern IrelandFCC CFR 47 Part 15BT41 1QSRSS Gen

# FCC Site Registration: 92592 Industry Canada Assigned Code: 8517A

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REPORT REF:	15E5408-2	<b>TESTED BY:</b>	M Kirby
DATE RECEIVED:	7 <sup>th</sup> Jan 2015	REPORT BY:	M Kirby
ISSUE DATE:	6 <sup>th</sup> Feb 2015	APPROVED SIGNATORY:	J McAuley
		JOB TITLE:	Technical Manager
		SIGNATURE:	John the anley

# Executive Summary

Emissions Testing performed according to FCC Part 15

Result:	Test standard referenced:	Test Title
Complied	FCC Part 15.109	Radiated Emissions
Complied	RSS Gen,	Radiated Emissions

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Appendix A: Test Equipment Used

# <u>1</u> Equipment Under Test (EUT)

# 1.1 Identification of EUT

# 1.2

FCCID:	MRXCRMJ1939
Manufacturer:	Schrader Electronics Ltd
Model Name or Number:	CRMJ1939
Power Supply Requirement:	24 V Battery

# 1.2 Description of E.U.T.

The EUT purpose is to receive data from Schrader tyre sensors over a radio link and to relay this data onto a controller over CAN link.

## 1.3 Modifications

There were no modifications on the EUT

# 1.4 Date of Test

The tests were carried out on dates of the 8<sup>th</sup> and 9<sup>th</sup> January 2015.

# 2 Test Specification, Methods and Procedures

#### 2.1 Emissions

Emissions were assessed to the following standards:

FCC CFR 47 Part 15.109 Federal Communications Commission: Part 15 Radio Frequency Devices Radiated Emissions Limits

RSS Gen Issue 4 — General Requirements and Information for the Certification of Radio Apparatus

ANSI C63.4-2014

"Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electri-cal and Electronic Equipment in the Range of 9 kHz to 40 GHz"

# 3 Deviations and Exclusions from the Test Specifications

#### 3.1 Deviations

There were no deviations from the test specification.

## 3.2 Exclusions

There were no exclusions from the test specification.

# 4 Operation of E.U.T. During Testing

# 4.1 **Operating Environment**

The EUT was powered using a 24 Volt battery.

# 4.2 Operating Mode:

The EUT was connected to a laptop via a CAN connection and a Schrader tyre sensor (TMS truck sensor) provided pulses to the EUT over radio link.

Note the laptop was used solely to exercise the EUT and in normal operation, the EUT would not connect to or exchange data with a laptop.

#### 5 Results

## 5.1 Radiated Emissions

Compliant measurements of radiated emissions were carried out in a 10 metre anechoic chamber from 30 MHz to 6 GHz. The equipment and cable orientation were investigated to ensure that maximum emissions were obtained at critical frequencies.

The receiver bandwidth was set to 120 kHz for frequencies between 30 MHz and 1 GHz.

For frequencies between 1GHz and 6 GHz, the resolution bandwidth was 1MHz and video bandwidth was 1MHz. for peak measurements. The Video bandwidth was changed to 10Hz for Average measurements (as per ANSI 63.4-2014 Section 4.2.3 e).

#### 5.2.1 Measurement Uncertainty

The measurement uncertainty (with a 95% confidence level) for the radiated emissions test was  $\pm 5.3 \text{ dB}$  (from 30 to 100 MHz),  $\pm 4.7 \text{ dB}$  (from 100 to 300 MHz),  $\pm 3.9 \text{ dB}$  (from 300 to 1000 MHz) and  $\pm 3.8 \text{ dB}$  (from 1 to 12.75 GHz).

# 5.3 Radiated Emissions

Exploratory radiated emissions were carried out to determine the orientation that maximised the emissions.

Final radiated emissions measurements were carried out on the EUT in the orientation determined from the exploratory measurements.

For the spurious and harmonics measurements, below 1000 MHz, the EUT was set up at a 3 metre distance from the receiving antenna, in a semi Anechoic Chamber, with the EUT running in a receive mode. The EUT was rotated 360 degrees azimuth and the search antenna height varied 1 to 4m in order to maximize the emissions.

For measurements above 1000MHz, the EUT was set up at a 3 metre distance from the antenna, in a fully anechoic chamber, with the EUT running in receive mode. The EUT was rotated 360 degrees azimuth in order to maximize the emissions.

Significant peaks from the EUT were then recorded to determine margin to the limits.

Frequency MHz	Quasi Peak Level dBuV/m	Antenna Polarity	Antenna Factor dB	Cable loss dB	Final Field Strength Quasi Peak dBuV/m	Quasi Peak Limit dBuV/m	Margin dB
433.989	5.7	Vertical	16.1	1.2	23	46.0	23.0
658.344	-3.89	Vertical	19.8	1.2	17.11	46.0	28.9
685.293	-3.96	Vertical	20.1	1.2	17.34	46.0	28.7
884.968	-6.06	Vertical	22	1.4	17.34	46.0	28.7
728.781	-3.61	Horizontal	21.4	1.4	19.19	46.0	26.8
823.106	-5.17	Horizontal	22.2	1.4	18.43	46.0	27.6
886.193	-0.17	Horizontal	22	1.4	23.23	46.0	22.8

# Results

Table 1 Results for spurious emissions below 1 GHz (3 metre)

Frequency	Measured Peak Level dBuV/m	Antenna Factor dB	Preamp Gain dB	Cable Loss dB	Antenna Polarity	Final Peak Level dBuV/m	Average Limit+20dB dBuV/m	Margin dB
2.114	42.2	28	39	3.2	Vertical	50.0	74.0	23.9
3.058	47.4	30.6	39.3	4.1	Vertical	52.0	74.0	22.0
3.843	53.7	30.6	37.7	4.6	Vertical	56.2	74.0	17.8
2.113	43.4	28	39	3.2	Horizontal	51.2	74.0	22.8
2.931	46.6	29.4	38.3	3.6	Horizontal	51.9	74.0	22.1
3.838	52.3	30.6	37.7	4.6	Horizontal	54.8	74.0	19.2

Frequency	Measured Average Level	Antenna Factor	Preamp Gain	Cable Loss	Antenna Polarity	Final Average Level	Average Limit	Margin
GHz	dBuV/m	dB	dB	dB		dBuV/m	dBuV/m	dB
2.114	32.5	28	39	3.2	Vertical	40.3	54.0	13.7
3.058	34.8	30.6	39.3	4.1	Vertical	39.4	54.0	14.6
3.843	40.3	30.6	37.7	4.6	Vertical	42.8	54.0	11.2
2.113	32.6	28	39	3.2	Horizontal	40.4	54.0	13.6
2.931	33.3	29.4	38.3	3.6	Horizontal	38.6	54.0	15.4
3.838	40.2	30.6	37.7	4.6	Horizontal	42.7	54.0	11.3

Table 2 Results for spurious emissions above 1 GHz (3 metre)

The plots are shown on the following pages.

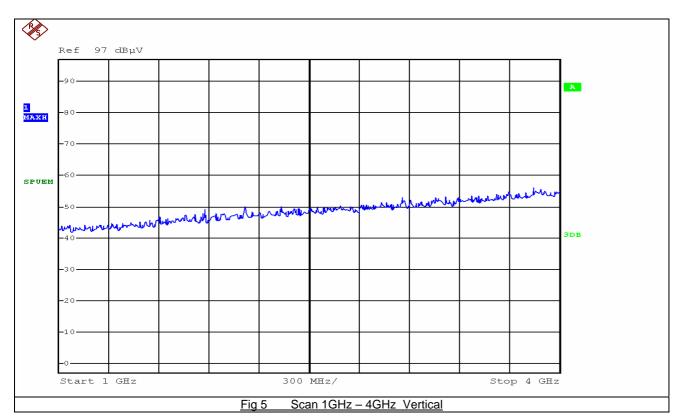
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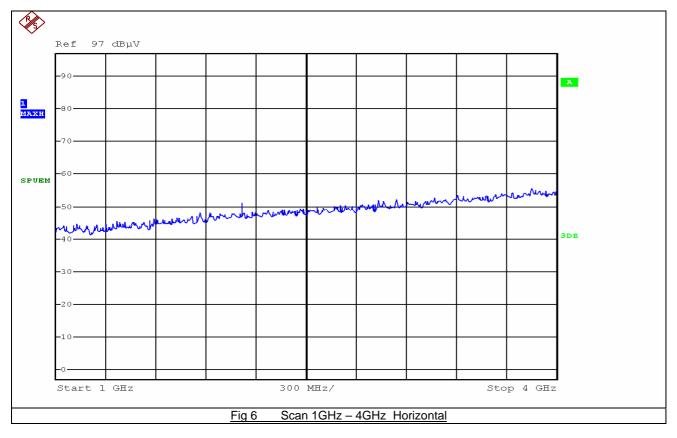
Receiver S					[ <b></b>
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Range Low	Range Up	RBW	Frequency	Power Abs	<u>∆Limit</u>
30.000 MHz 47.000 MHz	47.000 MHz 74.000 MHz	100.000 kHz 100.000 kHz	30.90312 MHz 51.26938 MHz	30.93 dBµV 26.21 dBµV	-9.07 d -13.79 d
74.000 MHz	88.000 MHz	100.000 kHz	87.85125 MHz	20.46 dBµV	-13.79 d -19.54 d
88.000 MHz	118.000 MHz	100.000 kHz	112.01875 MHz	23.34 dBµV	-19.54 u -20.16 d
55,000 MHZ				25.60 dBµV	-17.90 d
	174.000 MHz	1UU.UUU KHZ I	159.96500 MHz	25.00 UBUV I	
118.000 MHz	174.000 MHz 216.000 MHz	100.000 kHz 100.000 kHz	159.96500 MHz 176.02125 MHz		
	216.000 MHz 300.000 MHz	100.000 kHz 100.000 kHz	159,96500 MHz 176.02125 MHz 239,99250 MHz //Hz – 300MHz Vertical	25.80 dBµV 22.70 dBµV 26.42 dBµV	-20.80 d
118.000 MHz 174.000 MHz 216.000 MHz	216.000 MHz 300.000 MHz	100.000 kHz 100.000 kHz Fig 1 Scan 30N	176.02125 MHz 239.99250 MHz	22.70 dBµV	-20.80 d -19.58 d
118.000 MHz 174.000 MHz 216.000 MHz Receiver S	216.000 MHz 300.000 MHz	100.000 kHz 100.000 kHz Fig 1 Scan 30M	176.02125 MHz 239.99250 MHz /Hz – 300MHz Vertical	22.70 dBµV	-20.80 d -19.58 d
118.000 MHz 174.000 MHz 216.000 MHz Receiver S Ref Level 77.00 db	216.000 MHz 300.000 MHz	100.000 kHz 100.000 kHz Fig 1 Scan 30M	176.02125 MHz 239.99250 MHz	22.70 dBµV	-20.80 d -19.58 d
118.000 MHz 174.000 MHz 216.000 MHz Receiver S Ref Level 77.00 de STOP	216.000 MHz 300.000 MHz	100.000 kHz 100.000 kHz Fig 1 Scan 30M	176.02125 MHz 239.99250 MHz /Hz – 300MHz Vertical	22.70 dBµV	-20.80 d -19.58 d
118.000 MHz 174.000 MHz 216.000 MHz Receiver S Ref Level 77.00 dE STOP 1 Max	216.000 MHz 300.000 MHz	100.000 kHz 100.000 kHz Fig 1 Scan 30N Mode Auto FFT	176.02125 MHz 239.99250 MHz /Hz – 300MHz Vertical	22.70 dBµV	-20.80 d -19.58 d
118.000 MHz 174.000 MHz 216.000 MHz Receiver S Ref Level 77.00 dE STOP 1 Max Limit check	216.000 MHz 300.000 MHz Spectrum (Х) ВµV	100.000 kHz 100.000 kHz Fig 1 Scan 30M Mode Auto FFT PASS	176.02125 MHz 239.99250 MHz /Hz – 300MHz Vertical	22.70 dBµV	-20.80 d -19.58 d
118.000 MHz 174.000 MHz 216.000 MHz Receiver S Ref Level 77.00 dE STOP 1 Max Limit Check	216.000 MHz 300.000 MHz Spectrum (Х) ВµV	100.000 kHz 100.000 kHz Fig 1 Scan 30N Mode Auto FFT	176.02125 MHz 239.99250 MHz /Hz – 300MHz Vertical	22.70 dBµV	-20.80 d -19.58 d
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118.000 MHz 174.000 MHz 216.000 MHz Receiver S Ref Level 77.00 de STOP 1 Max Limit Check 70 dBHY SPURIOU 60 dBHV	216.000 MHz 300.000 MHz Spectrum (Х) ВµV	100.000 kHz 100.000 kHz Fig 1 Scan 30M Mode Auto FFT PASS	176.02125 MHz 239.99250 MHz /Hz – 300MHz Vertical	22.70 dBµV	-20.80 d -19.58 d
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118.000 MHz 174.000 MHz 216.000 MHz 216.000 MHz Receiver S Ref Level 77.00 dE STOP 1 Max Limit Check 70 dB <sub>H</sub> Y 50 dB <sub>H</sub> V 50 dB <sub>H</sub> V 50 dB <sub>H</sub> V 50 dB <sub>H</sub> V	216.000 MHz 300.000 MHz Spectrum (Х ВµV JS_LINE_ABS_	100.000 kHz 100.000 kHz Fig 1 Scan 30M Mode Auto FFT PASS	176.02125 MHz 239.99250 MHz /Hz – 300MHz Vertical	22.70 dBµV	-20.80 d -19.58 d
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118.000 MHz   174.000 MHz   216.000 MHz   216.000 MHz   Receiver S   Ref Level 77.00 dB   1 Max STOP   1 Max Limit Check   70 dBµV SPURIOUS   60 dBµV SPURIOUS_LINE_ABS   30 dBµV SURIOUS_LINE_ABS   10 dBµV SURIOUS_LINE_ABS   0 dBµV SURIOUS_LINE_ABS	216.000 MHz 300.000 MHz Spectrum (Х) ВµV JS_LINE_ABS_ S_	100.000 kHz 100.000 kHz Fig 1 Scan 30M Mode Auto FFT PASS PASS	176.02125 MHz 239.99250 MHz /Hz – 300MHz Vertical Input 1 AC	22.70 dBµV 26.42 dBµV	-20.80 d -19.58 d
118.000 MHz   174.000 MHz   216.000 MHz   216.000 MHz   Receiver S   Ref Level 77.00 dB   STOP 1 Max   Limit Check 70 dBuV   60 dBuV S   50 dBuV S   SPURIOUS_LINE_ABS 30 dBuV   10 dBuV 0 dBuV   -10 dBuV -10 dBuV	216.000 MHz 300.000 MHz Spectrum (Х) ВµV JS_LINE_ABS_ S_	100.000 kHz 100.000 kHz Fig 1 Scan 30M Mode Auto FFT PASS PASS	176.02125 MHz 239.99250 MHz /Hz – 300MHz Vertical Input 1 AC	22.70 dBµV 26.42 dBµV	-20.80 d -19.58 d
118.000 MHz   174.000 MHz   216.000 MHz   216.000 MHz   Receiver S   Ref Level 77.00 dB   STOP 1 Max   Limit Check 70 dBµV   60 dBµV 50 dBµV   50 dBµV 50 dBµV   20 dBµV 10 dBµV   10 dBµV -10 dBµV   -20 dBµV -20 dBµV	216.000 MHz 300.000 MHz Spectrum (Х) ВµV JS_LINE_ABS_ S_	100.000 kHz 100.000 kHz Fig 1 Scan 30M Mode Auto FFT PASS PASS	176.02125 MHz 239.99250 MHz /Hz – 300MHz Vertical Input 1 AC	22.70 dBµV 26.42 dBµV	-20.80 d -19.58 d
118.000 MHz   174.000 MHz   216.000 MHz   216.000 MHz   Ref Level   77.00 dB   1 Max   Limit Check   70 dB <sub>H</sub> Y   50 dB <sub>H</sub> V   50 dB <sub>H</sub> V   50 dB <sub>H</sub> V   20 dB <sub>H</sub> V   10 dB <sub>H</sub> V   -10 dB <sub>H</sub> V   -20 dB <sub>H</sub> V   -20 dB <sub>H</sub> V   -20 dB <sub>H</sub> V	216.000 MHz 300.000 MHz Spectrum S_ S_ S_ S_ S_ S_ S_ S_ S_ S_	100.000 kHz 100.000 kHz Fig 1 Scan 30M Mode Auto FFT PASS PASS	176.02125 MHz 239.99250 MHz /Hz – 300MHz Vertical Input 1 AC	22.70 dBµV 26.42 dBµV	-20.80 d -19.58 d
118.000 MHz   174.000 MHz   216.000 MHz   216.000 MHz   Ref Level   77.00 dB   1 Max   Limit Check   70 dB   1 Max   Limit Check   70 dB   91 Max   Limit Check   70 dB   91 Max   Sportious Emissions	216.000 MHz 300.000 MHz Spectrum Spectrum S	100.000 kHz 100.000 kHz Fig 1 Scan 30M Mode Auto FFT PASS PASS PASS 560	176.02125 MHz 239.99250 MHz //Hz – 300MHz Vertical Input 1 AC	22.70 dBµV 26.42 dBµV	-20.80 d -19.58 d
118.000 MHz   174.000 MHz   216.000 MHz   216.000 MHz   Ref Level   77.00 dB   1 Max   Limit Check   70 dB   1 Max   Limit Check   70 dB   1 Max   CodB   50 dB   50 dB   20 dB   20 dB   10 dB   10 dB   -10 dB   -20 dB   Spurious Emissions   Range Low	216.000 MHz 300.000 MHz Spectrum (Χ) BμV JS_LINE_ABS_ S_ S_ S_ Range Up	100.000 kHz 100.000 kHz Fig 1 Scan 30M Mode Auto FFT PASS PASS PASS 560 RBW	176.02125 MHz 239.99250 MHz //Hz – 300MHz Vertical Input 1 AC	22.70 dBµV 26.42 dBµV	-20.80 d -19.58 d
118.000 MHz   174.000 MHz   216.000 MHz   216.000 MHz   Receiver S   Ref Level 77.00 dB   1 Max STOP   1 Max STOP   1 Max STOP   1 Max STOP   1 Max SPURIOUS   60 dBµV SPURIOUS   50 dBµV SPURIOUS   20 dBµV SPURIOUS   10 dBµV SURIOUS   -10 dBµV Start 30.0 MHz   Spurious Emissions Range Low   30.000 MHz Start 30.00 MHz	216.000 MHz 300.000 MHz Spectrum Spectr	100.000 kHz 100.000 kHz Fig 1 Scan 30M Mode Auto FFT PASS PASS 560 RBW 100.000 kHz	176.02125 MHz 239.99250 MHz //Hz – 300MHz Vertical ////////////////////////////////////	22.70 dBμV 26.42 dBμV	-20.80 d -19.58 d
118.000 MHz   174.000 MHz   216.000 MHz   216.000 MHz   Ref Level   77.00 dB   1 Max   Limit Check   70 dB   1 Max   Limit Check   70 dB   1 Max   Code   50 dB   SPURIOUS_LINE_ABS   30 dB   10 dB   10 dB   -10 dB   -20 dB   Spurious Emissions   Range Low   30.000 MHz   47.000 MHz	216.000 MHz 300.000 MHz Spectrum (Χ) BμV JS_LINE_ABS S S Range Up 47.000 MHz 74.000 MHz	100.000 kHz 100.000 kHz Fig 1 Scan 30M Mode Auto FFT PASS PASS PASS 560 RBW 100.000 kHz 100.000 kHz	176.02125 MHz 239.99250 MHz //Hz - 300MHz Vertical ////////////////////////////////////	22.70 dBμV 26.42 dBμV 26.42 dBμV	-20.80 d -19.58 d
118.000 MHz   174.000 MHz   216.000 MHz   216.000 MHz   Ref Level   77.00 dB   1 Max   Limit Check   70 dB   1 Max   Limit Check   70 dB   91 Max   Limit Check   70 dB   91 Max   Sportous   60 dB   91 Max   50 dB   50 dB   90 dB   10 dB   10 dB   -10 dB   -20 dB   Spurious Emissions   Range Low   30.000 MHz   47.000 MHz   74.000 MHz	216.000 MHz 300.000 MHz Spectrum (Χ) BμV JS_LINE_ABS S S Range Up 47.000 MHz 74.000 MHz 88.000 MHz	100.000 kHz 100.000 kHz Fig 1 Scan 30M Mode Auto FFT PASS PASS PASS 560 RBW 100.000 kHz 100.000 kHz 100.000 kHz	176.02125 MHz 239.99250 MHz //Hz - 300MHz Vertical ////////////////////////////////////	22.70 dBμV 26.42 dBμV 26.42 dBμV	-20.80 d -19.58 d
118.000 MHz   174.000 MHz   216.000 MHz   216.000 MHz   Ref Level   77.00 dB   1 Max   Limit Check   70 dB   1 Max   Limit Check   70 dB   91 Max   Limit Check   70 dB   91 Max   Limit Check   70 dB   91 Max   Spurious LINE_AB   30 dB   10 dB   10 dB   -10 dB   -20 dB   Spurious Emissions   Range Low   30.000 MHz   47.000 MHz   74.000 MHz   88.000 MHz	216.000 MHz 300.000 MHz Spectrum S S S Range Up 47.000 MHz 74.000 MHz 74.000 MHz 118.000 MHz	100.000 kHz 100.000 kHz Fig 1 Scan 30M Mode Auto FFT PASS PASS PASS 560 RBW 100.000 kHz 100.000 kHz 100.000 kHz 100.000 kHz	176.02125 MHz 239.99250 MHz //Hz - 300MHz Vertical ////////////////////////////////////	22.70 dBμV 26.42 dBμV 26.42 dBμV	-20.80 d -19.58 d
118.000 MHz   174.000 MHz   216.000 MHz   216.000 MHz   Ref Level   77.00 dB   1 Max   Limit Check   70 dB   1 Max   Limit Check   70 dB   91 Max   Limit Check   70 dB   91 Max   Sportous   60 dB   91 Max   50 dB   50 dB   90 dB <td< td=""><td>216.000 MHz 300.000 MHz Spectrum (Χ) BμV JS_LINE_ABS S S Range Up 47.000 MHz 74.000 MHz 88.000 MHz</td><td>100.000 kHz 100.000 kHz Fig 1 Scan 30M Mode Auto FFT PASS PASS PASS 560 RBW 100.000 kHz 100.000 kHz 100.000 kHz</td><td>176.02125 MHz 239.99250 MHz //Hz - 300MHz Vertical ////////////////////////////////////</td><td>22.70 dBμV 26.42 dBμV 26.42 dBμV</td><td>-20.80 d -19.58 d</td></td<>	216.000 MHz 300.000 MHz Spectrum (Χ) BμV JS_LINE_ABS S S Range Up 47.000 MHz 74.000 MHz 88.000 MHz	100.000 kHz 100.000 kHz Fig 1 Scan 30M Mode Auto FFT PASS PASS PASS 560 RBW 100.000 kHz 100.000 kHz 100.000 kHz	176.02125 MHz 239.99250 MHz //Hz - 300MHz Vertical ////////////////////////////////////	22.70 dBμV 26.42 dBμV 26.42 dBμV	-20.80 d -19.58 d

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Receiver	Spectrum 🛛 🗷	)				
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O1 Max						
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10 dBµV						
0 dBµV						
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Start 300.0 MHz		1	2400 pts		1 1	Stop 1.0 GHz
Spurious Emission	IS					]
Range Low	Range Up	RBW	Frequ		Power Abs	∆Limit
300.000 MHz	470.000 MHz	100.000 kH		8125 MHz	32.09 dBµV	-13.91 dB
470.000 MHz	960.000 MHz	100.000 kH		6875 MHz	36.31 dBµV	-9.69 dB
470.000 MHz	960.000 MHz	100.000 kH		9375 MHz	30.86 dBµV	-15.14 dB
470.000 MHz	960.000 MHz	100.000 kF Fig 3 Scan	iz 658.3 300MHz - 1GHi	4375 MHz	31.71 dBµV	-14.29 dB

Ref Level 77.00 dBµV Mode Auto FFT Input 1 AC	[₩
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70 dBµVeAB3PAB3	
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50 dBµV	
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10 dBµV	
0 dBµV	
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CF 658.344 MHz 3200 pts Span 700.0 M Spurious Emissions Range Low Range Up RBW Frequency Power Abs ALimit	
CF 658.344 MHz 3200 pts Span 700.0 M Spurious Emissions Range Low Range Up RBW Frequency Power Abs ALimit	dB





# 6 Analysis of Test Results, Conclusions

#### 6.1 Measurement Uncertainties

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4 with a confidence level of 95%.

# 6.2 Radiated Emissions to FCC Part 15, Class B

The E.U.T. complied with the radiated emission specification.

# Appendix A Test Equipment Used:

Instrument	Mftr.	Model	CEI Ref No.	Cal Due Date
Preamplifier	Hewlett Packard	83017A	805	19/09/2015
Spectrum Analyser	Rohde & Schwarz	FSP 40	850	14/08/2015
Spectrum Analyser/Receiver	Rohde & Schwarz	ESR	869	06/06/2017
Antenna Trilog	Schwarzbeck	VULB 9160	889	29/07/2017
Anechoic Chamber	CEI	10M	845	23/09/2015
Antenna Log Periodic	Chase	UPA6108	609	11/09/2015
Horn Antenna	EMCO	3115	655	14/11/2015

Table A1

End of Report