

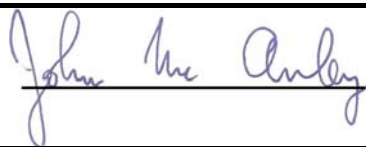


Confidential Report

Client: Schrader Electronics Ltd 11 Technology Park Belfast Road Antrim Northern Ireland BT41 1QS <u>Att: James Kyle</u>	Test of: CRMRS232 Receiver To: FCC CFR 47 Part 15 RSS Gen
--	---

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

COPIES TO: Files

REPORT REF:	15E5409-2	TESTED BY:	M Kirby
DATE RECEIVED:	7th Jan 2015	REPORT BY:	M Kirby
ISSUE DATE:	6th Feb 2015	APPROVED SIGNATORY:	J McAuley
		JOB TITLE:	Technical Manager
		SIGNATURE:	

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

Compliance Engineering Ireland Ltd Terms and Conditions

1. All quotations are submitted, orders are accepted and services supplied by Compliance Engineering Ireland Limited ("CEIL") subject to and upon the following express Terms and Conditions and all other Conditions, warranties and representations express or implied and statutory or otherwise are hereby excluded insofar as it is lawful to do so. No addition thereto or variation therefrom, contained or referred to in the Customers order form or otherwise effected shall apply unless specifically agreed in writing by a duly Authorised Officer of CEIL.
2. All orders including any based on a quotation previously submitted by CEIL are subject to acceptance in writing by CEIL.
- 3.(a) The prices set out in any quotation are based upon current costs and if there is any variation in the said costs between the date of the order or Contract and delivery of the final report CEIL shall be entitled to adjust prices to reflect such variations.
 - b) In the event of any suspension or variation of work arising from the Customer's instructions or lack of instructions the price set out in any quotation may be increased to cover any extra expense incurred by CEIL.
 - c) All prices quoted are strictly NET. The customer shall where applicable, in addition to the relevant price, pay a sum equal to the VAT chargeable in respect of the supply of services.
 - d) Accounts must be paid in full in advance or by way of an irrevocable letter of credit opened with a Bank approved by CEIL unless credit terms have been agreed by CEIL in which event accounts must be paid in full within 1 month from the date of the invoice. Time for payment is of the essence and the customer shall be liable to pay any outstanding amount from its due date until the date of payment at a rate of 2% per month or part thereof.
4. Any times quoted for the performance of services are to be treated as estimates only. CEIL shall not be liable in any manner whatsoever for failure to perform services within the time quoted, nor in such circumstances shall the Customer be entitled to cancel or terminate any order or contract.
5. The Customer is responsible for delivery to CEIL of test item(s) free of any duty, VAT, freight charges etc. unless otherwise agreed in writing by CEIL.
6. The Customer shall be responsible for collecting non-perishable samples received for testing or laboratory work upon completion of tests or laboratory work. If the Customer fails to collect such samples within 90 days from completion of the tests or laboratory work CEIL shall be entitled without further notice to dispose of the samples without liability.
7. No action or legal proceedings shall be taken (except in the case of wilful neglect or default) against CEIL by reason of or arising out of any research, investigation, test or analyses or the publication of the results thereof in the name of CEIL. Under no circumstances shall CEIL be liable to the Customer for any indirect, incidental, special or consequential damages of any nature whatsoever (including but not limited to loss of use, revenue, profit, data or business opportunity) either based upon a claim or action in Contract or in Tort, indemnity or contribution, or otherwise arising out of the Contract or performance of services by CEIL even if CEIL has been advised of the possibility of such damages. The limit of CEIL's aggregate liability (whether in Contract, Tort, strict liability in Tort or by statute or otherwise) to the Customer or to any third party for non-performance by CEIL and for any and all other claims shall not in the aggregate exceed the fees paid by the Customer to CEIL. The Customer shall indemnify CEIL against all claims made against CEIL by any third party arising from this Contract.
8. The copyright of any report is reserved to CEIL and it shall not be used either in whole or in part, for the purposes of advertising, publicity, litigation or otherwise without the prior written consent of a duly Authorised Officer of CEIL where such consent is given the Customer shall comply with any conditions attaching to the consent. In conformance with laboratory accreditation requirements reports shall only be produced in full. The test results tabulated shall relate only to the defined item(s) tested.
9. If in CEIL's judgment, the customer's financial condition is such as could adversely affect the customers ability to perform any of its obligations or if the customer is in default in any of its obligations to CEIL whether hereunder or under any other Contract CEIL may terminate this Contract and/ or any other Contract between CEIL and the Customer, cancel any uncompleted order or suspend performance of services or the delivery of any reports and if it does so the Customer shall indemnify CEIL against all costs, charges, expense and damages incurred thereby.
10. CEIL will not be liable for non-performance in whole or in part of its obligations if this is attributable to any cause beyond the control of CEIL including (without limitation) any act of god, force majeure, war, civil war, disturbance, rebellion, embargo, strike, labour dispute, illness, flood, fire, sabotage or government action or regulation. If a Contract or order or any part thereof shall become impossible of performance or otherwise frustrated CEIL shall be entitled to reasonable remuneration for any work done up to the date of such impossibility or frustration, due credit being given for any amounts in respect of the Contract or order paid by the Customer.
11. CEI agrees to keep confidential all matters relating to this contract. This includes but is not limited to products tested, methods used, results of the work and contents of any reports.
12. These Conditions and the Contract to which the document relates shall in all respects be governed by and construed in accordance with the laws of the Republic of Ireland and in accordance with the Republic of Ireland shall have exclusive jurisdiction to determine any disputes arising therefrom unless otherwise agreed.
13. CEI is an accredited test laboratory and relevant test reports are denoted by use of the accreditation logo. When the logo is not used, the report is outside our scope of accreditation.

CONTENTS

Section 1:	Equipment Under Test (E.U.T.)
Section 2:	Test Specification, Methods and Procedures
Section 3:	Deviations and Exclusions from the Test Specifications
Section 4:	Operation of E.U.T. During Testing
Section 5:	Results
Section 6:	Analysis of Test Results, Conclusions

Appendix A: Test Equipment Used

1 Equipment Under Test (EUT)

1.1 Identification of EUT

FCCID :	MRXCRMRS232
Manufacturer:	Schrader Electronics Ltd
Model Name or Number:	CRMRS232
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 RS232 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 8th and 9th 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 Electrical 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 RS232 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 an anechoic chamber from 30 MHz to 4.5GHz. 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 ± 5.3 dB (from 30 to 100 MHz), ± 4.7 dB (from 100 to 300 MHz), ± 3.9 dB (from 300 to 1000 MHz) and ± 3.8 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.

Results

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
433.768	-3.3	Vertical	16.1	1.2	14	46.0	32.0
715.306	-3.35	Vertical	20.6	1.4	18.65	46.0	27.4
828.681	-4.6	Vertical	22.2	1.4	19	46.0	27.0
885.581	-0.17	Vertical	22	1.4	23.23	46.0	22.8
433.981	11.9	Horizontal	16.1	1.2	29.2	46.0	16.8
828.006	1.4	Horizontal	22.2	1.4	25	46.0	21.0
921.106	4.84	Horizontal	22.9	1.4	29.14	46.0	16.9

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

Frequency	Measured Peak Level	Antenna Factor	Preamp Gain	Cable Loss	Antenna Polarity	Final Peak Level	Average Limit+20dB	Margin
GHz	dBuV/m	dB	dB	dB		dBuV/m	dBuV/m	dB
2.113	42.7	28	39	3.2	Vertical	50.5	74.0	23.4
3.265	50.3	30.6	37.4	4.4	Vertical	52.7	74.0	21.3
3.895	53.0	30.6	37.7	4.8	Vertical	55.3	74.0	18.6
2.110	41.3	28	39	3.2	Horizontal	49.1	74.0	24.9
3.527	50.5	30.6	37.8	4.5	Horizontal	53.2	74.0	20.8
3.681	51.8	30.6	37.4	4.5	Horizontal	54.1	74.0	19.8

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
2.113	31.0	28	39	3.2	Vertical	38.8	54.0	15.1
3.265	38.0	30.6	37.4	4.4	Vertical	40.4	54.0	13.6
3.895	40.4	30.6	37.7	4.8	Vertical	42.7	54.0	11.3
2.110	32.2	28	39	3.2	Horizontal	40.0	54.0	14.0
3.527	37.8	30.6	37.8	4.5	Horizontal	40.5	54.0	13.5
3.681	39.7	30.6	37.4	4.5	Horizontal	42.0	54.0	12.0

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

The plots are shown on the following pages.

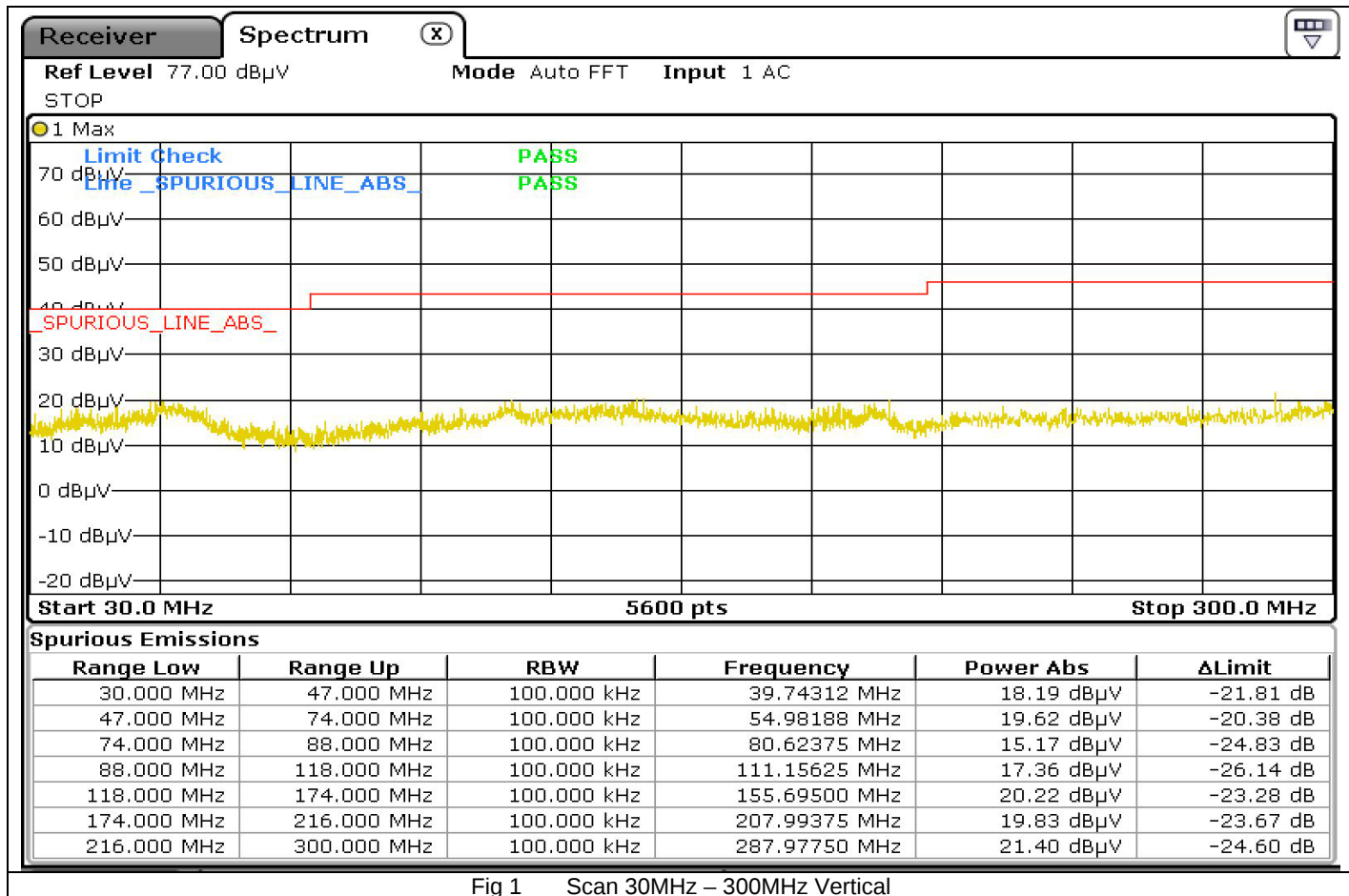


Fig 1 Scan 30MHz – 300MHz Vertical

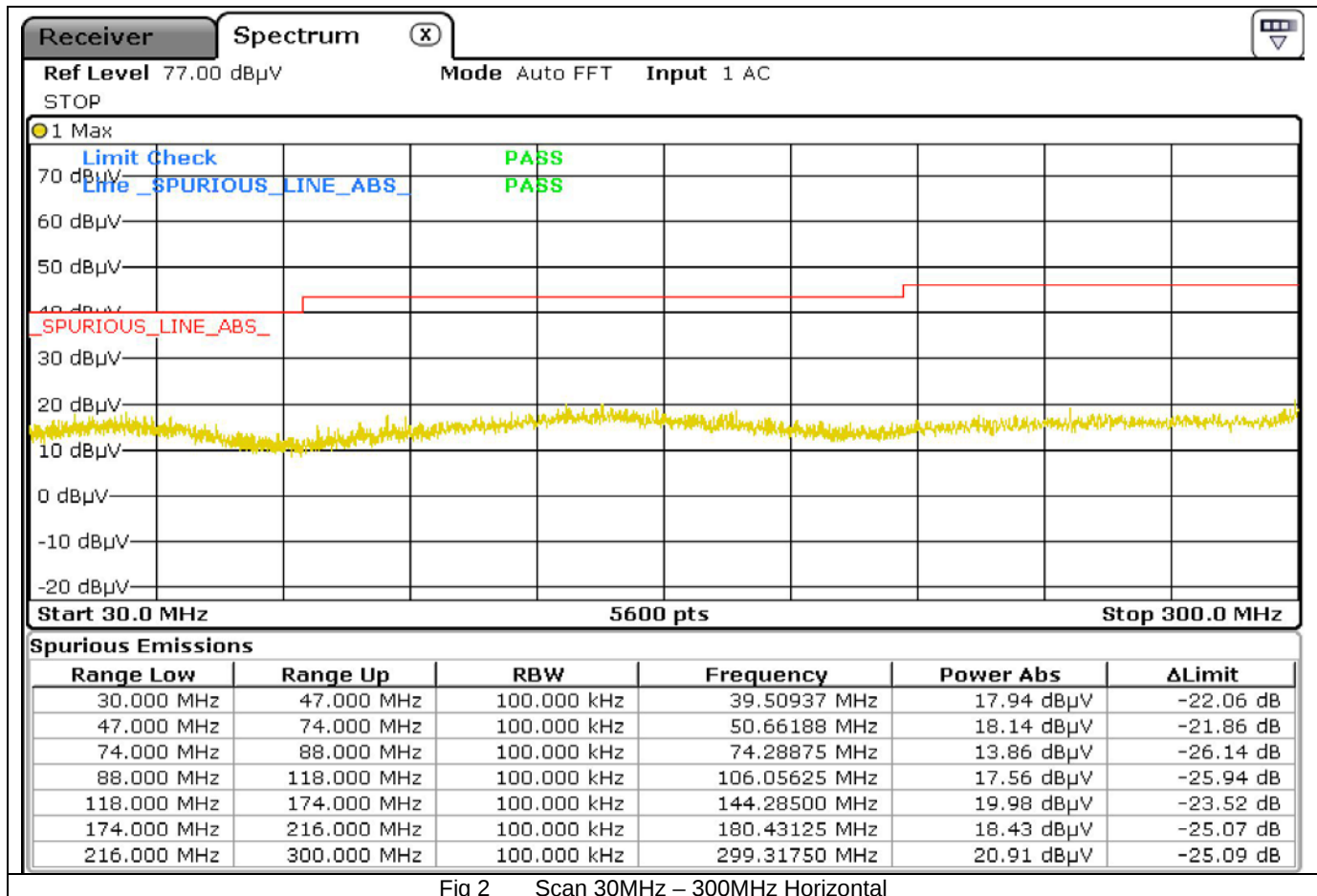


Fig 2 Scan 30MHz – 300MHz Horizontal

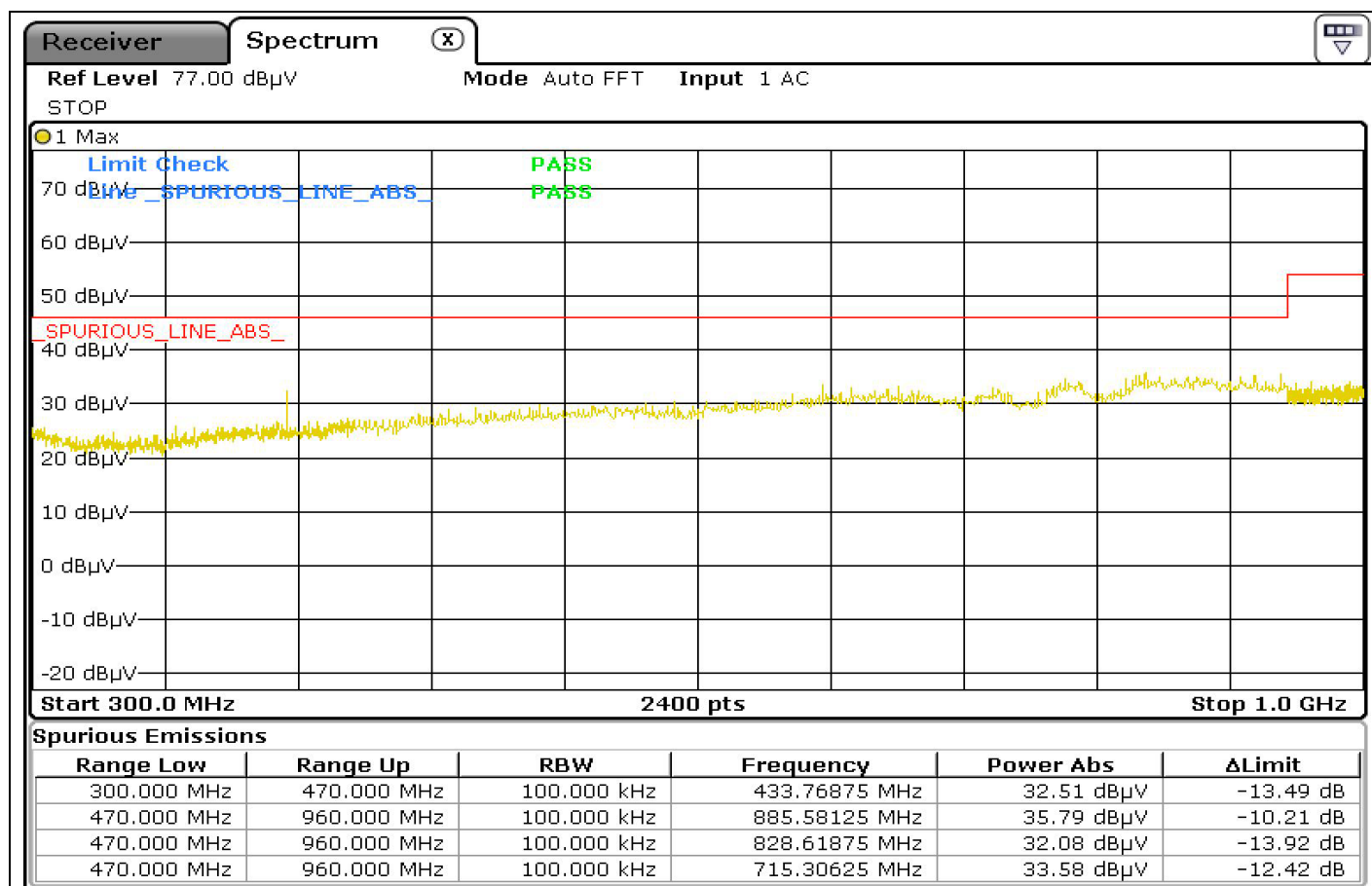


Fig 3 Scan 300MHz - 1GHz Vertical

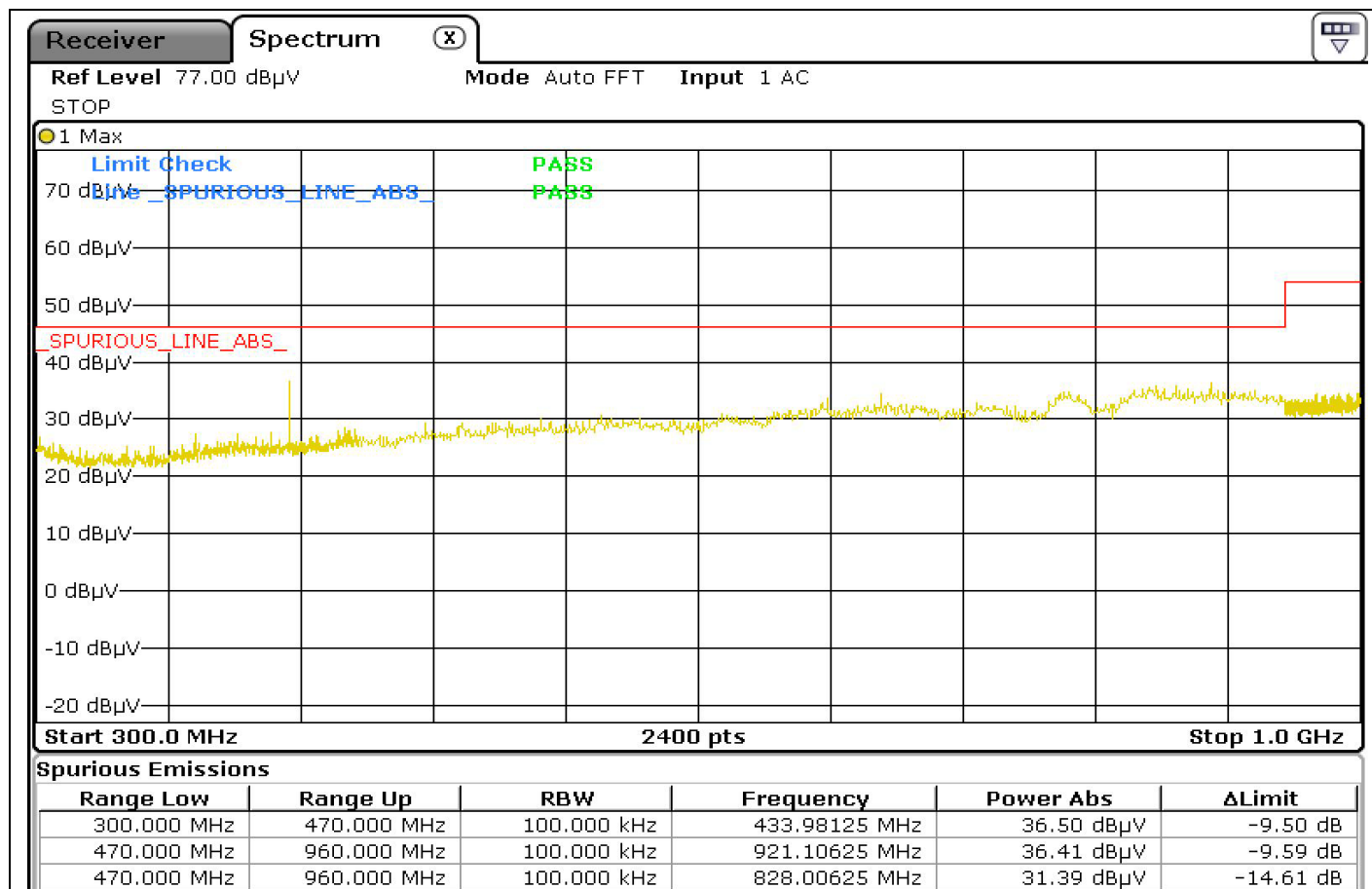
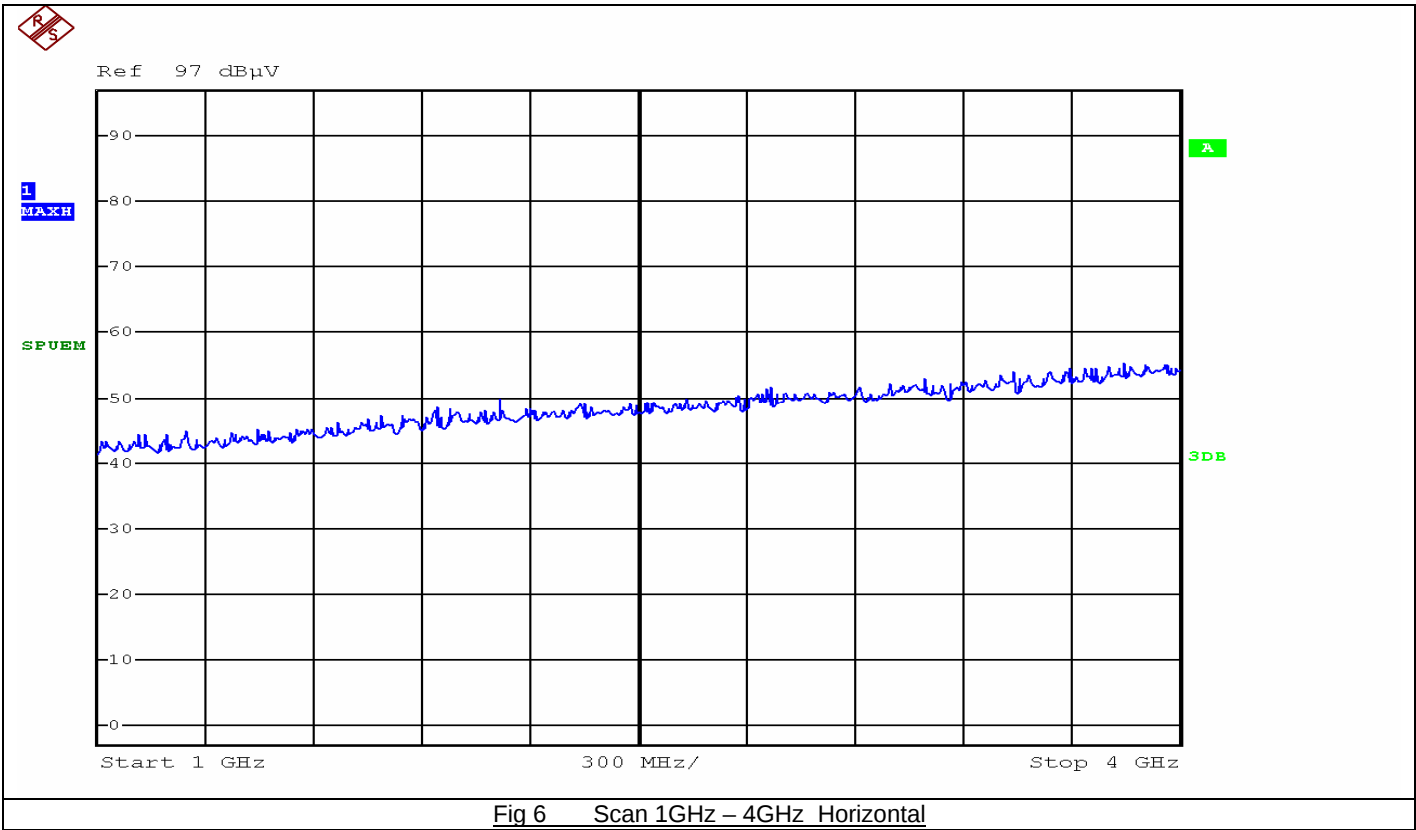
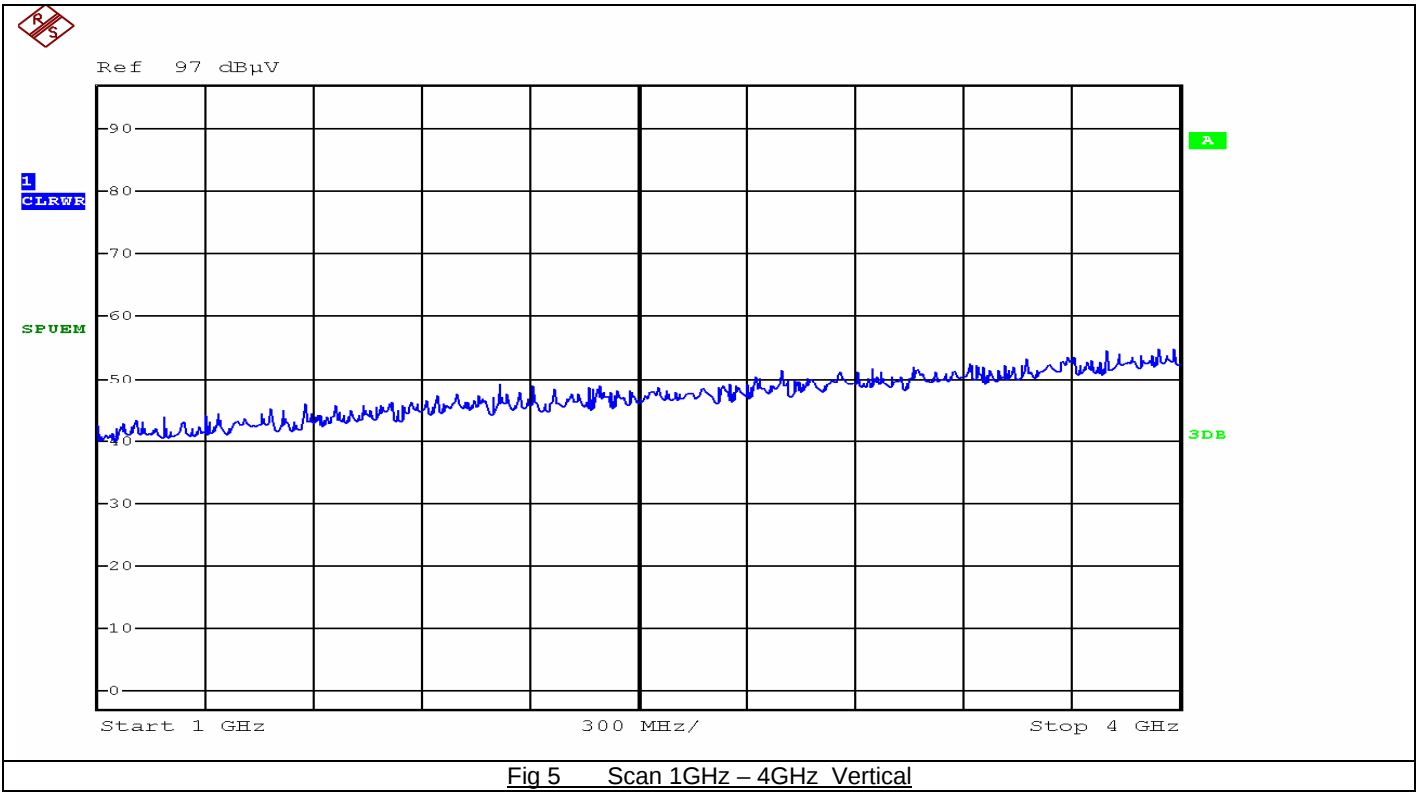


Fig 4 Scan 300MHz - 1GHz Horizontal



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	Manufacturer.	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