Compliance Engineering Ireland Ltd

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Project Number: 13E4815-1b

Prepared for:

Itronik Interconnect Ltd.

By

Compliance Engineering Ireland Ltd

Clonross Lane

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Dunshaughlin

Co. Meath

FCC Site Registration: 92592

Industry Canada Assigned Site Code: 8517A-2

FCC ID: 2ABFL105TAG

IC: 11591A-105TAG

Date

25th April 2014

FCC EQUIPMENT AUTHORISATION

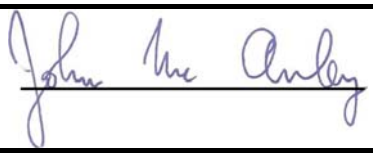
Test Report

EUT Description

RFID Tag pcb module

Authorised :

John McAuley



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

Exhibit A – Technical Report

Table of Contents

1.0 EUT Description

The EUT was a module using a short range 433 MHz band transceiver for RFID communication.

Model:	105TAG
Type:	RFID unit
FCC ID:	2ABFL105TAG
Company:	Itronik Interconnect Ltd.
Contact	Christopher Slattery
Address:	Itronik Interconnect Ltd Cloughaun,Kilchreest Loughrea, Co. Galway, Ireland
Phone:	+353921840055
e-mail:	c.slattery@higenx.com
Test Standards:	47 CFR, Part 15.231(a,e)
Type of radio:	Stand-alone
Transmitter Type:	FSK
Operating Frequency Range(s):	434.099 MHz
Number of Channels:	One
Antenna:	Integral
Transmitter power configuration:	3 v Battery.
Oper. Temp Range:	5° C to +35° C
Classification:	DSR
Test Methodology:	Measurements performed according to the procedures in ANSI C63.4-2003 ANSI C63.10-2009

1.1 EUT Operation

Operating Conditions during Test:

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

The EUT was battery powered.

The EUT was operated in normal operation mode for duty cycle test. In this mode the EUT was triggered to transmit by bringing a magnet close to it.

For all other tests, the EUT was operated in a test mode, where the EUT transmitted (duty cycle with Ton of 50uS and Toff of 30uS) in continuous modulated mode.

Environmental conditions

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

☒ Normal

Temperature:	+15 to +35 ° C
Humidity:	20-75 %

1.1 Modifications

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

1.2 Date of Test

The tests were carried out on one sample of the EUT during the month of November 2013.

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 C63.4-2003.

1.4.1 Measurement Uncertainty

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

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 GHz to 40 GHz).

2.0 Emissions Measurements

2.1 Conducted Emissions Measurements

No requirement as EUT was battery powered.

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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 metres 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 metres.

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.

A prescan was carried out in the x,y,z orientations to determine the orientation with maximum emission for the fundamental frequency for both vertical and horizontal polarizations. The turntable was rotated and measurement antenna raised to obtain the maximum emission for each orientation and polarity.

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

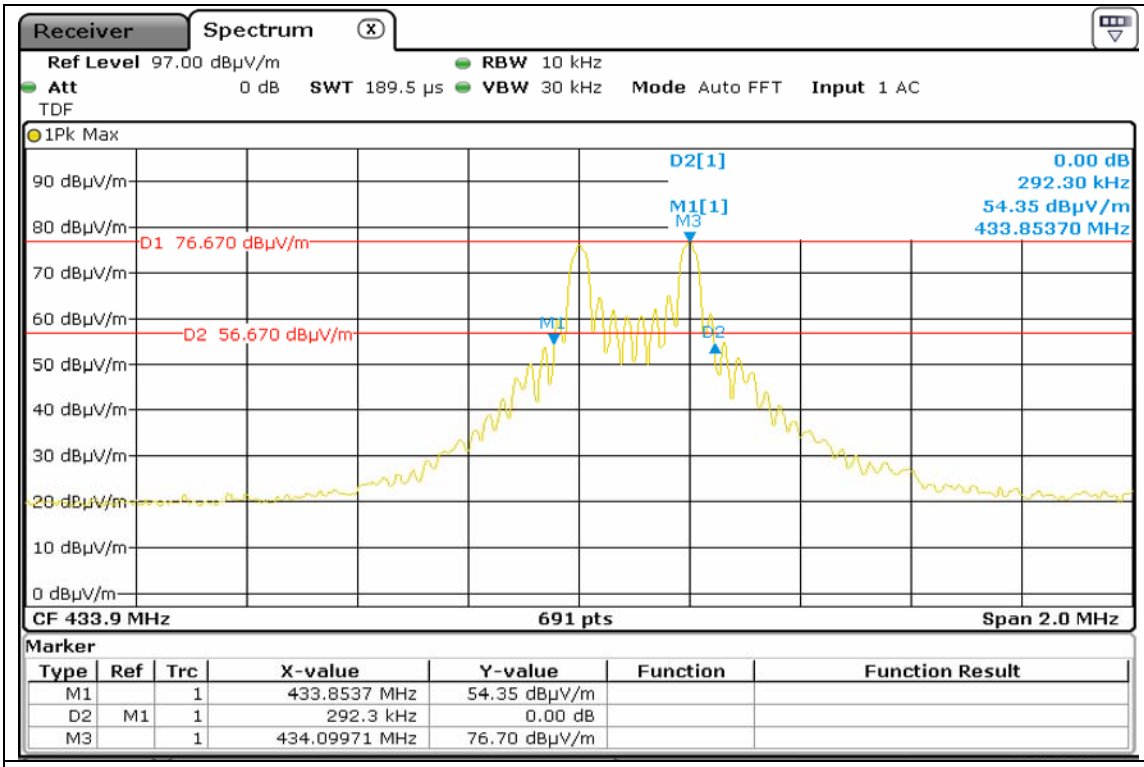


Fig 1a Occupied bandwidth 20dB

Operating Frequency (MHz)	20dB Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
434.099	292.36	1085.2475	792.8875	Pass

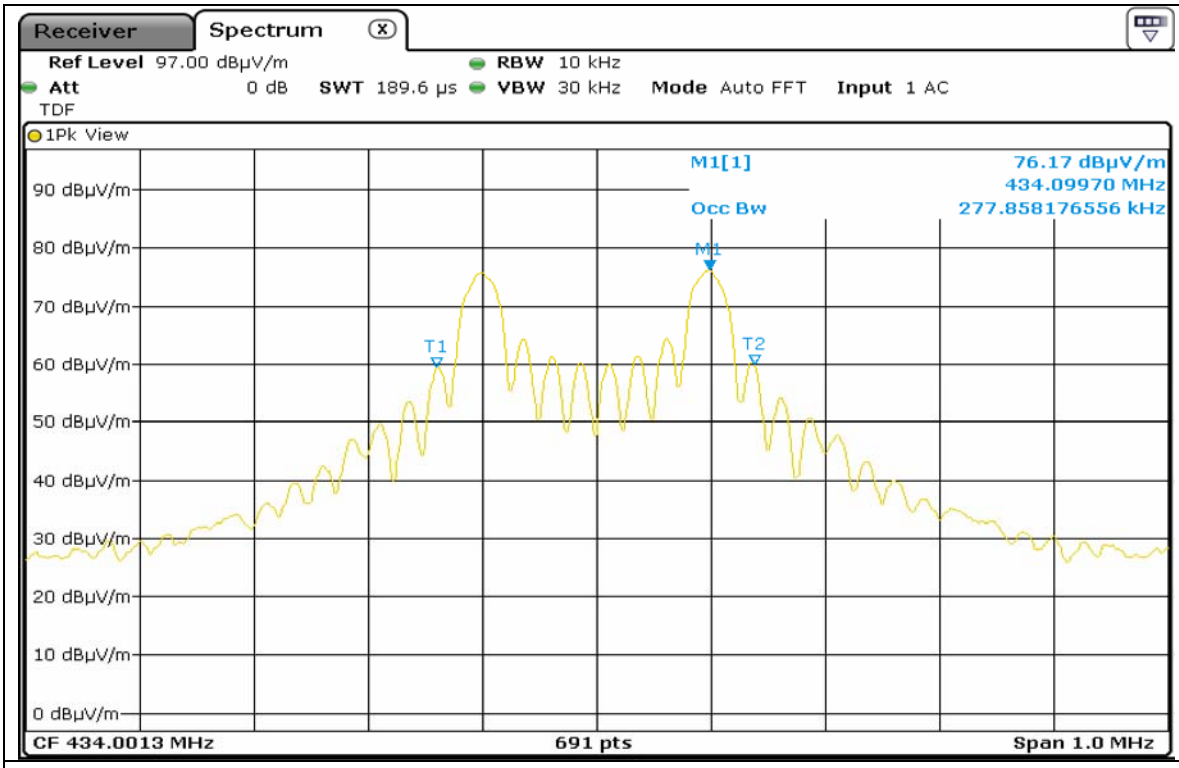


Fig 1b Occupied bandwidth 99%

Operating Frequency (MHz)	99% Bandwidth (kHz)
434.099	277.86

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 bilog antenna is connected to a spectrum analyzer for 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

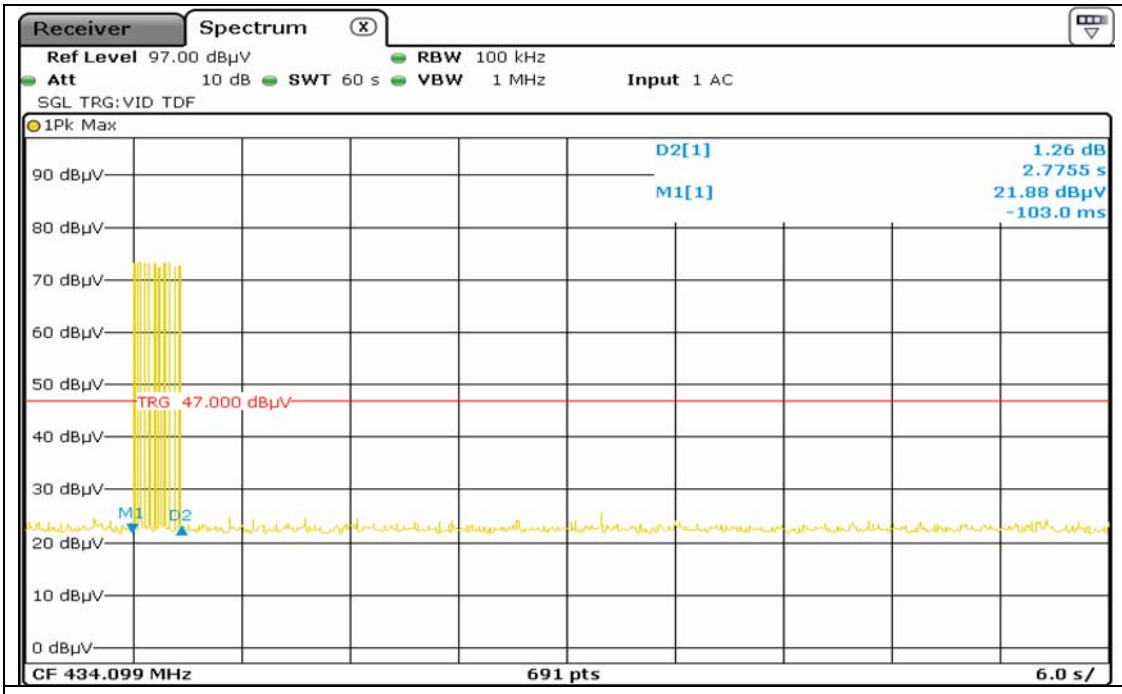


Fig 2 Repetition of transmitted pulse

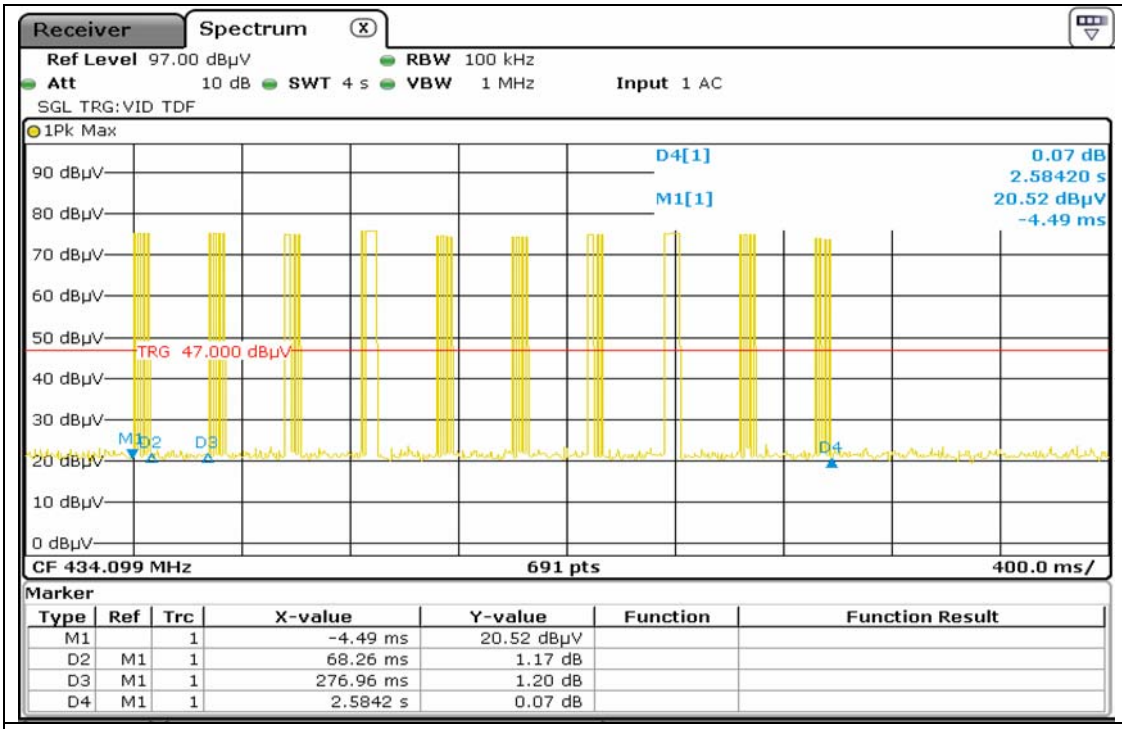


Fig 3 Transmitted pulses

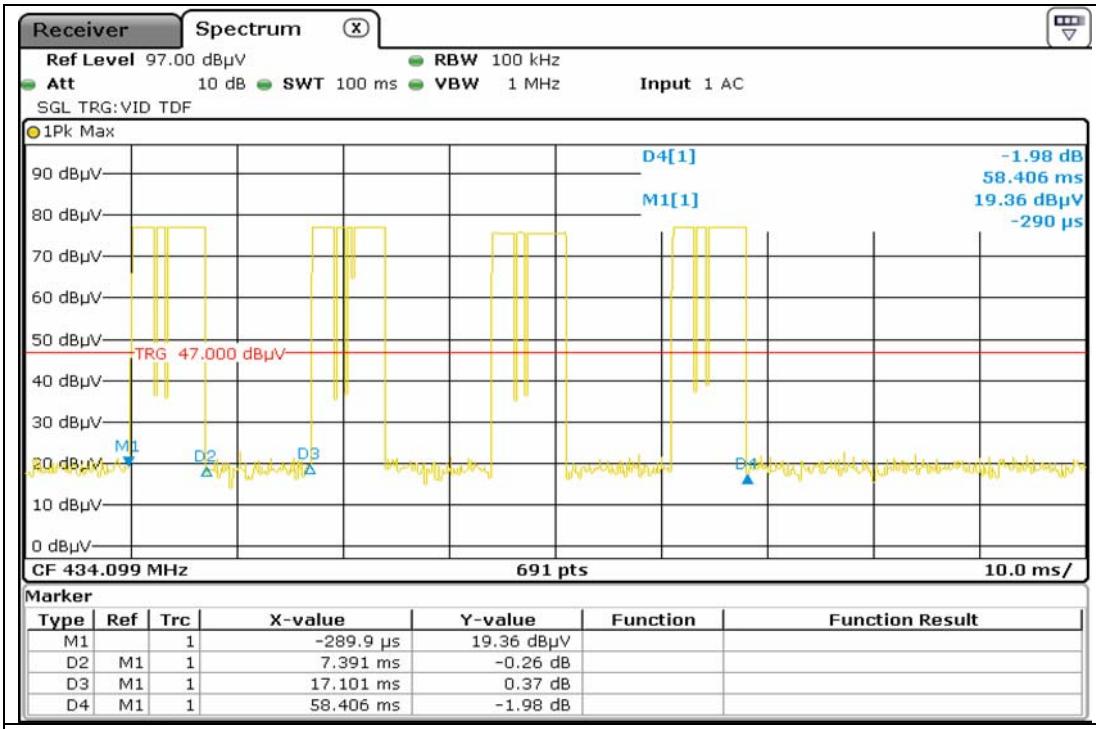


Fig 4 Transmitted pulses

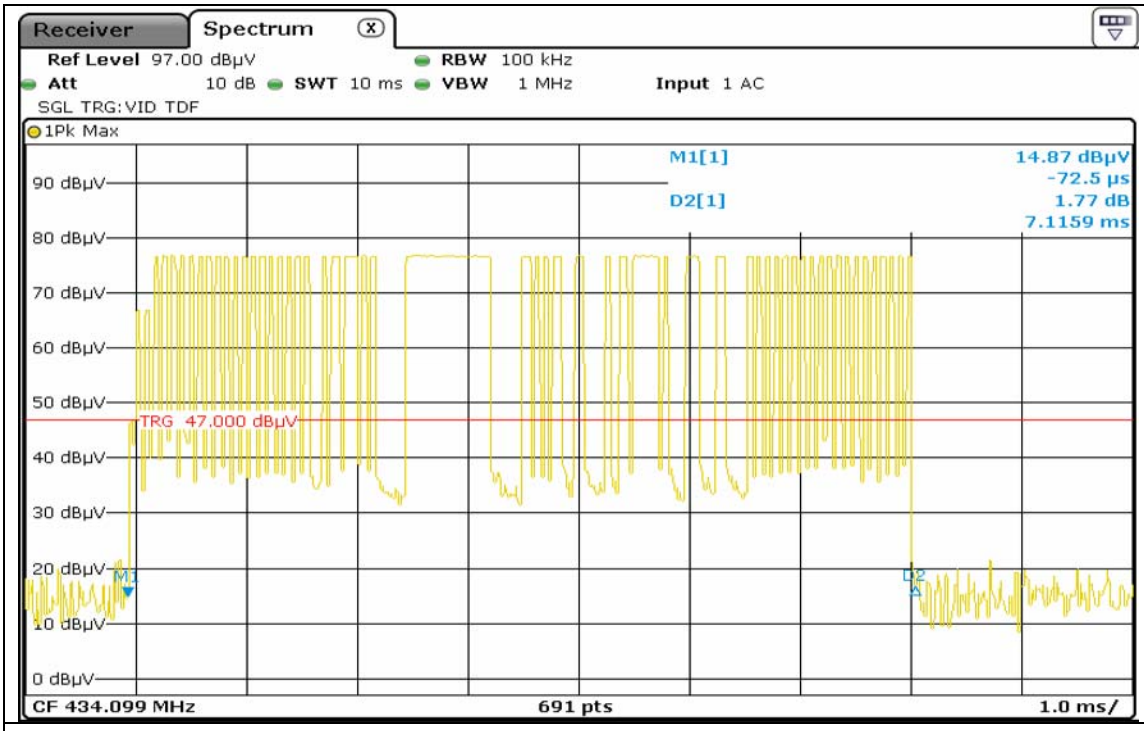


Fig 5 Individual pulse width

MAXIMUM MODULATION PERCENTAGE

One Period(mS)	Pulse Width (mS)	No of Pulses	Duty Cycle	Duty Cycle %	Test Result
100	7.39	4	0.2956	29.6	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)
-10.6

4.0 Field Strength of Spurious Radiated Emissions

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

Fundamental Frequency (MHz)	Field Strength of fundamental (µV/m)	Strength of Spurious Emissions (µV/m).
40.66 ~ 40.70	2,250	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 = 41.67 x Freq MHz - 7083

For operating frequency of 434.099 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	µV/m	dBµV/m	µV/m	dBµV/m
434.099	11005.9	80.8	1100.6	60.8

Note this is the Average limit for 3 metre measurement.

Test Specification: FCC PART 15, SECTION 47 CFR 15.209

Frequency (MHz)	Field Strength (µV/m)	Field Strength (dBµV/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.

Result: Pass

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

Frequency MHz	Reading Peak dBuV/m	EUT Orientation	Antenna Polarity	Antenna Factor dB	Cable loss dB	Final Field Strength Peak dBuV/m	Margin for Peak v Average Limit +20dB
434.099	55.7	O3	Vertical	16.1	1.2	73.0	27.8
434.099	65.1	O2	Horizontal	16.1	1.2	82.4	18.4
868.200	17.9	O3	Vertical	22.2	1.4	41.5	39.4
868.200	22.7	O2	Horizontal	22.2	1.4	46.3	34.5

Frequency MHz	Final Field Strength Peak dBuV/m	EUT Orientation	Antenna Polarity	Average Level dBuV/m (Peak plus - 10.6dB Duty Cycle factor)	Average Limit dBuV/m	Margin dB
434.099	73.0	O3	Vertical	62.5	80.8	18.4
434.099	82.4	O2	Horizontal	71.8	80.8	9
868.200	41.5	O3	Vertical	30.9	60.8	30
868.200	46.3	O2	Horizontal	35.7	60.8	25.1

Fundamental and first harmonic

Ref Appendix B for EUT Orientation

Spurious Emissions

Frequency MHz	Quasi peak Level dBuV/m	EUT Orientation	Antenna Polarity	Antenna Factor dB	Cable loss dB	Final Field Strength Quasi Peak dBuV/m
80.10	21.4	O3	Vertical	8.4	0.2	30.0
97.26	20.4	O3	Vertical	10.3	0.2	30.9
385.77	13.1	O3	Vertical	14.6	1.2	28.9
385.77	21.8	O2	Horizontal	14.6	1.2	37.6
771.54	18.4	O2	Horizontal	21.6	1.4	41.4

Frequency MHz	Final Field Strength Quasi Peak dBuV/m	EUT Orientation	Antenna Polarity	Average Limit dBuV/m	Margin dB
80.10	30.0	O3	Vertical	60.8	30.8
97.26	30.9	O3	Vertical	60.8	29.9
385.77	28.9	O3	Vertical	60.8	31.9
385.77	37.6	O2	Horizontal	60.8	23.2
771.54	41.4	O2	Horizontal	60.8	19.5

Ref Appendix B for EUT Orientation

Result: Pass

4.1.2 Horn antenna measurements (1GHz - 6 GHz)

Frequency GHz	Peak Level dBuV/m	Antenna Factor dB	Preamp Gain dB	Cable Loss dB	Antenna Polarity	EUT Orientation	Final Peak Level dBuV/m	Average Limit +20dB dBuV/m	Margin dB
1.302	40.3	23.6	20	3.8	Vertical	O3	47.7	80.8	33.1
1.7365	45.5	24.8	20	2.8	Vertical	O3	53.1	80.8	27.8
2.17	44.9	28	20	3.2	Vertical	O3	56.1	80.8	24.8
2.604	42.6	29.4	20	3.6	Vertical	O3	55.6	80.8	25.2
3.039	44.2	30.6	20	3.8	Vertical	O3	58.6	80.8	22.2
3.473	43.9	30.6	20	4.5	Vertical	O3	59.0	80.8	21.8
1.302	41.5	23.6	20	3.8	Horizontal	O2	48.9	80.8	31.9
1.736	45.1	24.8	20	2.8	Horizontal	O2	52.7	80.8	28.2
2.17	44.8	28	20	3.2	Horizontal	O2	56.0	80.8	24.8
2.604	43.4	29.4	20	3.6	Horizontal	O2	56.4	80.8	24.5
3.039	43.7	30.6	20	3.8	Horizontal	O2	58.1	80.8	22.8
3.473	44.6	30.6	20	4.5	Horizontal	O2	59.7	80.8	21.2

Frequency GHz	Final Peak Level dBuV/m	EUT Orientation	Antenna Polarity	Duty Cycle Correction dB	Average Level dBuV/m	Average Limit dBuV/m	Margin dB
1.302	47.7	O3	Vertical	-10.6	37.1	60.8	23.7
1.7365	53.1	O3	Vertical	-10.6	42.5	60.8	18.4
2.17	56.1	O3	Vertical	-10.6	45.5	60.8	15.4
2.604	55.6	O3	Vertical	-10.6	45.0	60.8	15.8
3.039	58.6	O3	Vertical	-10.6	48.0	60.8	12.8
3.473	59.0	O3	Vertical	-10.6	48.5	60.8	12.4
1.302	48.9	O2	Horizontal	-10.6	38.3	60.8	22.5
1.736	52.7	O2	Horizontal	-10.6	42.1	60.8	18.7
2.17	56.0	O2	Horizontal	-10.6	45.4	60.8	15.4
2.604	56.4	O2	Horizontal	-10.6	45.8	60.8	15.1
3.039	58.1	O2	Horizontal	-10.6	47.5	60.8	13.4
3.473	59.7	O2	Horizontal	-10.6	49.1	60.8	11.7

Ref Appendix B for EUT Orientation

Result: Pass

5.0 List of Test Equipment

Instrument	Mftr.	Model	CEI Ref No.	Cal Due Date
Bilog Antenna	Chase	CBL 6140	690	03/10/2015
Preamplifier	Hewlett Packard	83017A	805	10/04/2014
Horn Antenna	AH Systems	SAS 200 571	839	16/05/2016
Spectrum Analyser	Rohde & Schwarz	FSP 40	850	18/06/2014
Spectrum Analyser/Receiver	Rohde & Schwarz	ESR	869	25/05/2014
LISN	Rohde & Schwarz	ESH3-Z5	604	14/12/2015

Appendix A

Additional Test Results

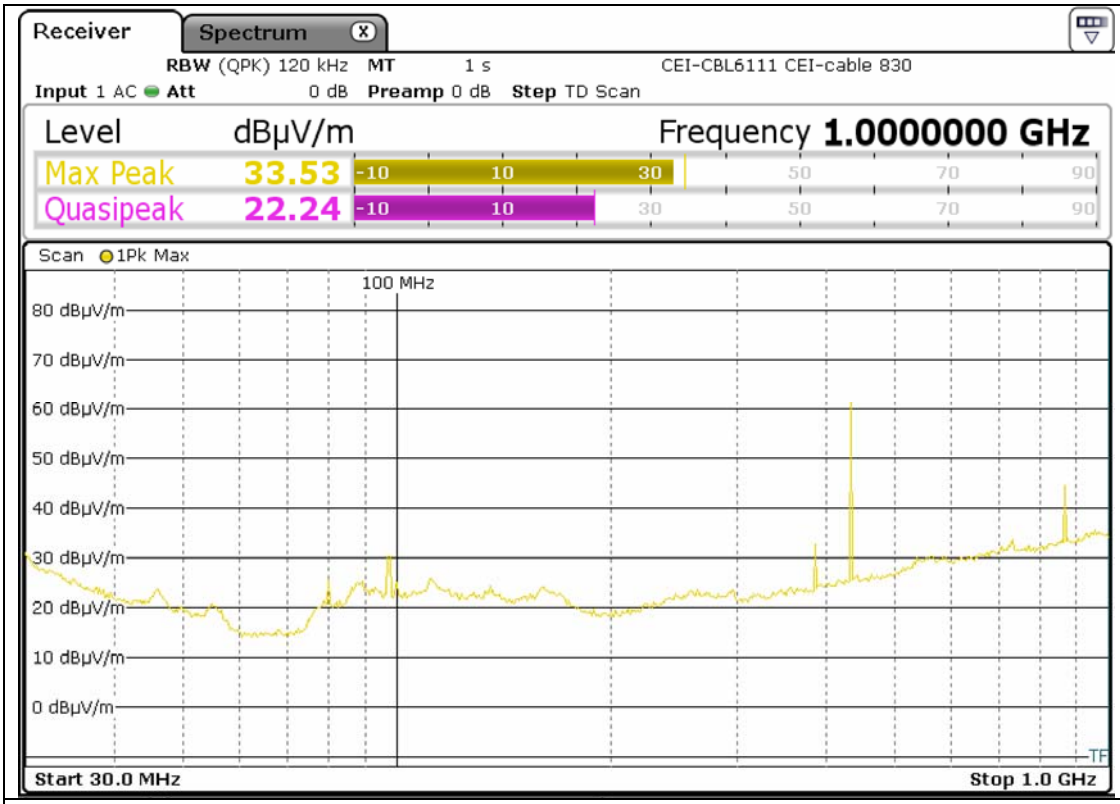


Fig 6 Scan 30MHz – 1 GHz Vertical at 3metres Anechoic Chamber

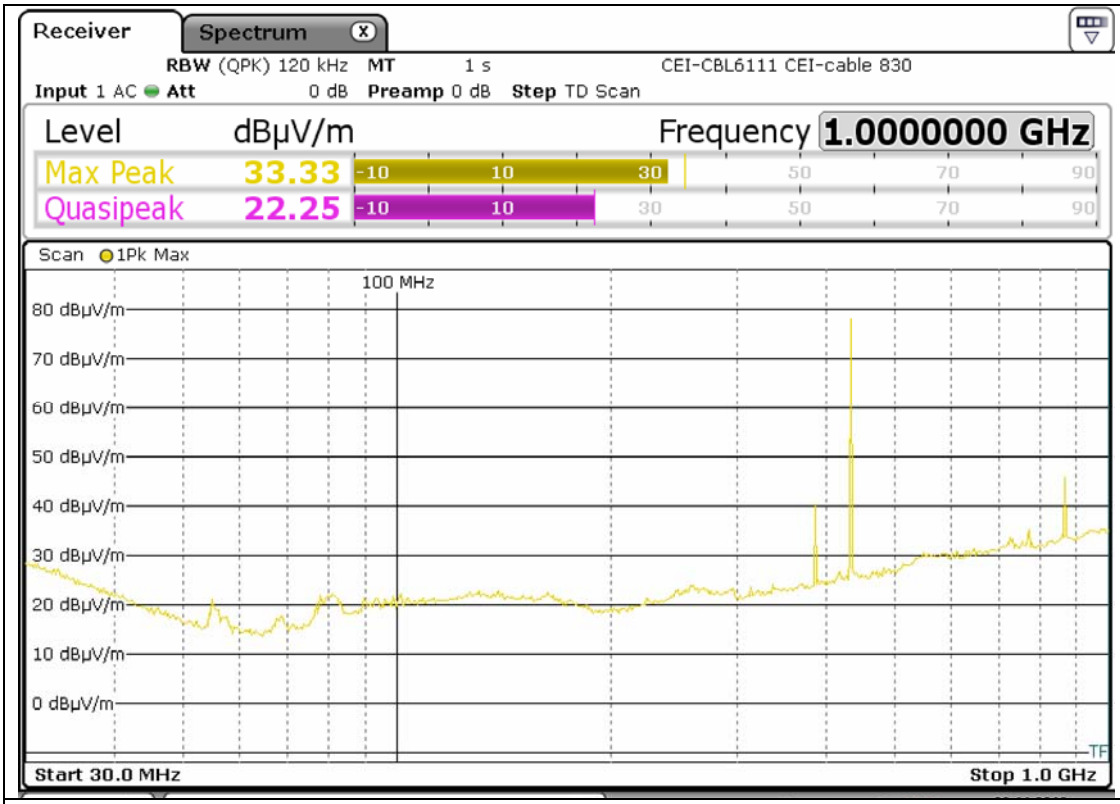


Fig 7 Scan 30MHz – 1 GHz Horizontal at 3metres Anechoic Chamber

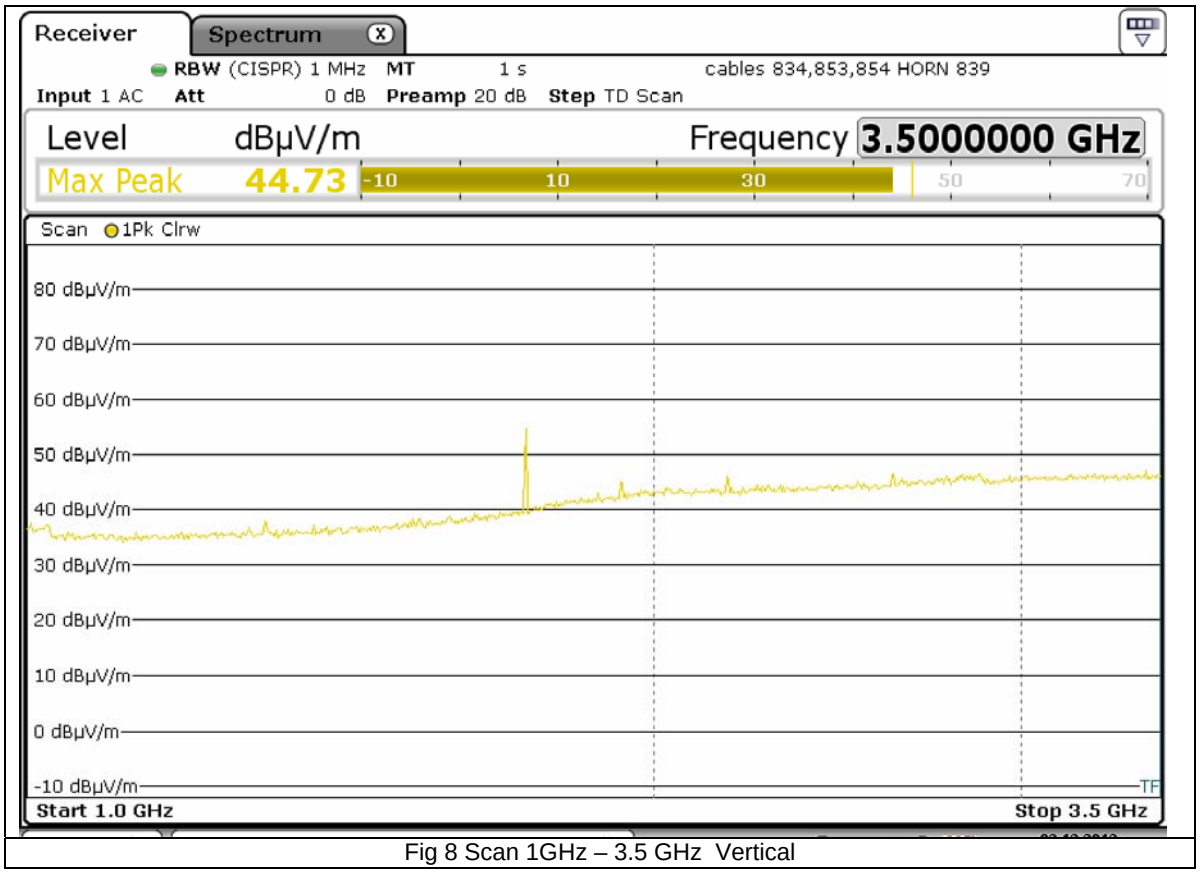


Fig 8 Scan 1GHz – 3.5 GHz Vertical

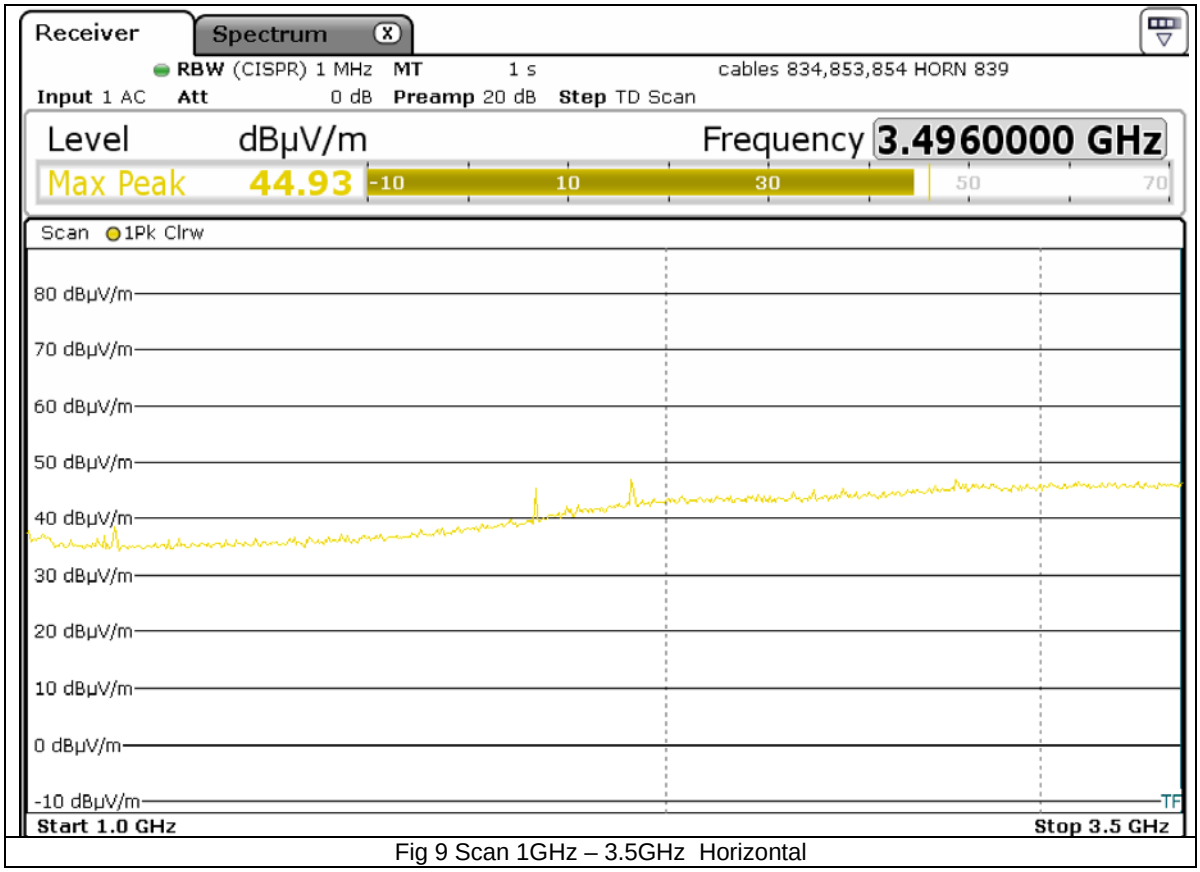


Fig 9 Scan 1GHz – 3.5GHz Horizontal

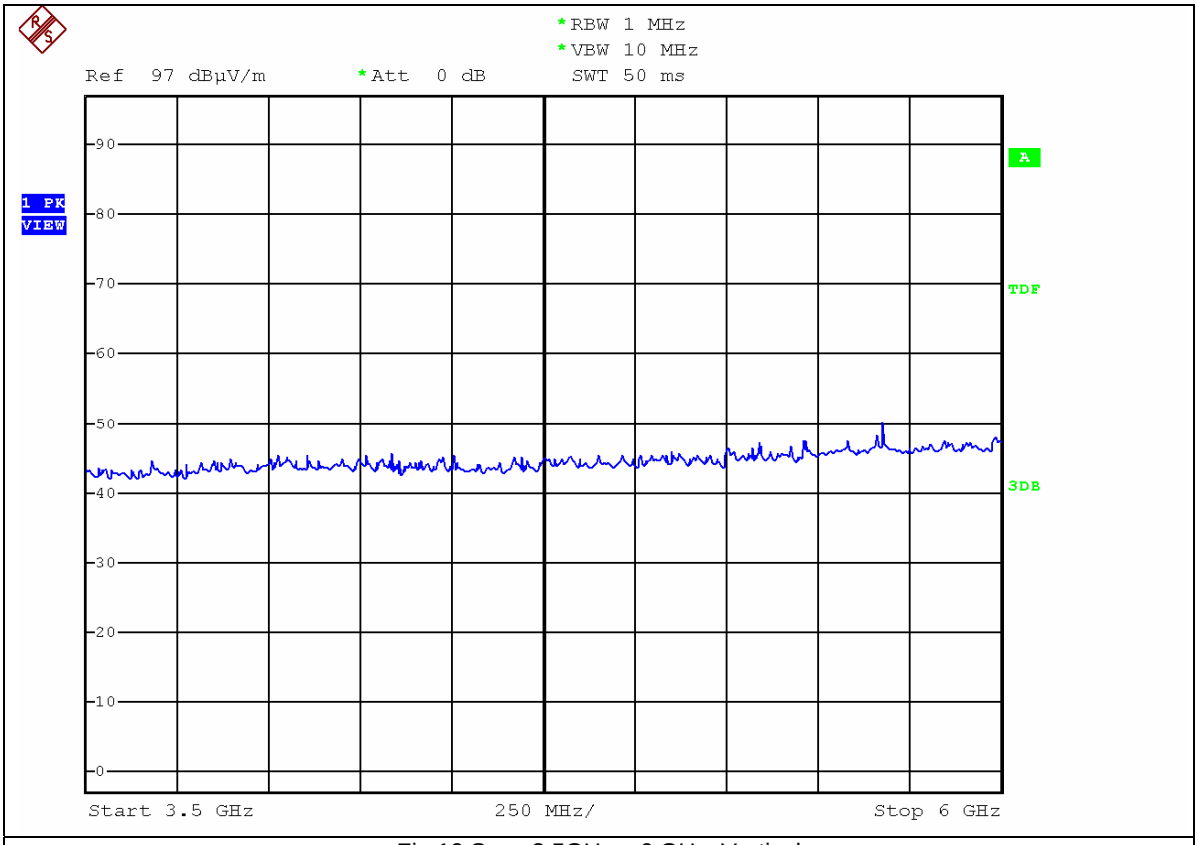


Fig 10 Scan 3.5GHz – 6 GHz Vertical

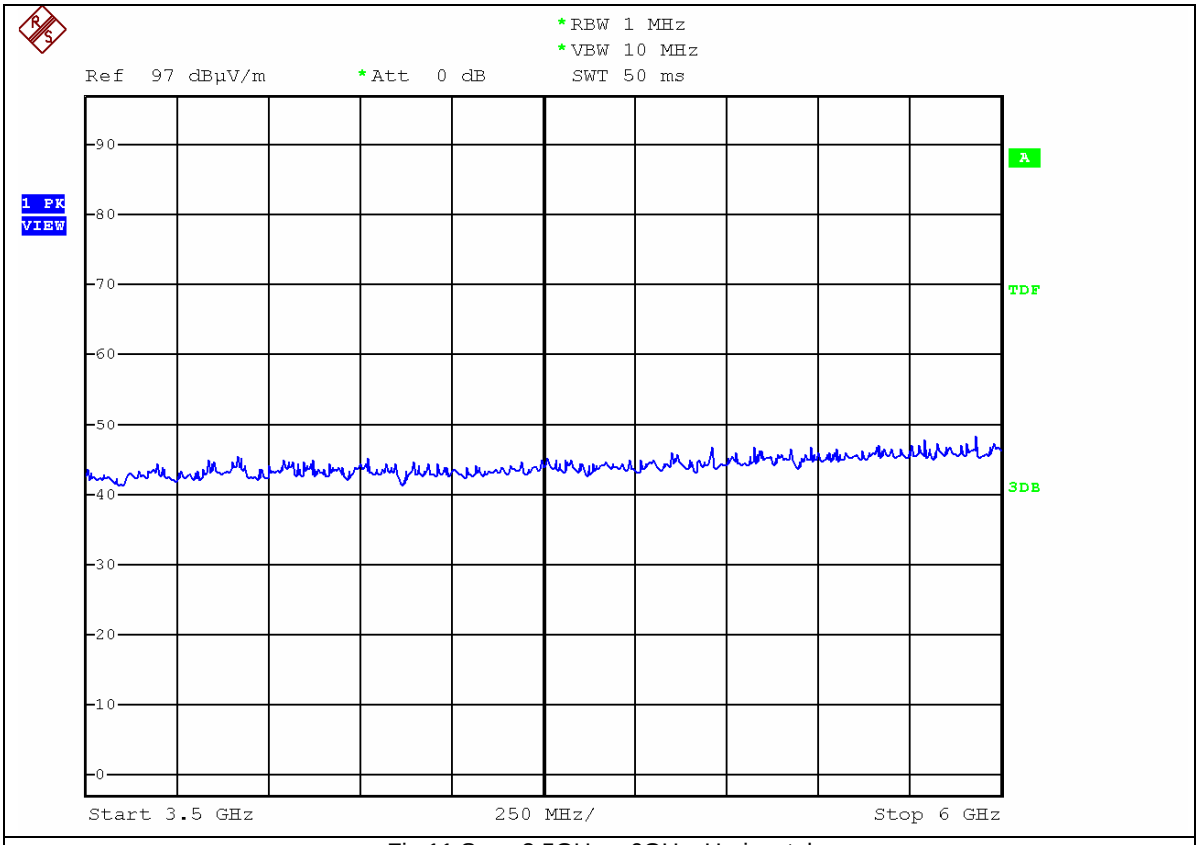
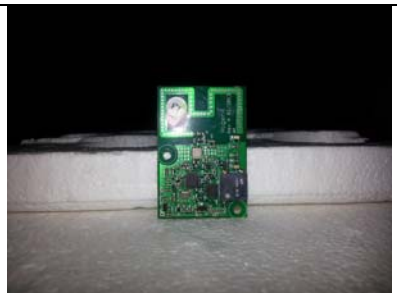


Fig 11 Scan 3.5GHz – 6GHz Horizontal

Appendix B

EUT Orientation

		
Fig 1 EUT orientation “O1”	Fig 2 EUT orientation “O2”	Fig 3 EUT orientation “O3”