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Project Number: 15E5599-1c

Prepared for:

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By

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FCC Site Registration: 92592

Industry Canada Assigned Site Code(s): 8517A-1, 8517A-2

FCC ID: 2AFILTRNRMT1

IC: 20703-TRNRMT1

Date

25th Aug 2016

FCC EQUIPMENT AUTHORISATION

Test Report

EUT Description

Remote Control

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
15.207(a)	RSS Gen 7.2.4	CONDUCTED EMISSIONS ON THE MAINS	N/A

RSS Gen Issue 4 2014

RSS-210 Issue 8 2010

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

Exhibit A – Technical Report

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1.0 EUT Description

The EUT was a Remote control unit

Model:	TRNRMT1
Type:	Remote Control
FCC ID:	2AFILTRNRMT1
Company:	Heartsine Technologies
Contact	Allister McIntyre
Address:	121 Friends Lane Suite 400, Newtown, PA United States 18940
Phone:	+442890939400
e-mail:	allister.mcintyre@heartsine.com
Test Standards:	47 CFR, Part 15.231(a,e)
Type of radio:	Stand-alone
Transmitter Type:	GFSK
Operating Frequency Range(s):	2.466GHz
Number of Channels:	One
Antenna:	Integral
Transmitter power configuration:	3v DC Battery
Oper. Temp Range:	5° C to +35° C
Classification:	DSC
Test Methodology:	Measurements performed according to the procedures in ANSI C63.4-2014 ANSI C63.10-2013

1.1 EUT Operation

The EUT (TRN-350-1) was part of a family of items (TRN-350-1, TRN-360-1, TRN-450-1, TRN-500-1) each electrically identical, and each with its individual overlay.

Operating Conditions during Test:

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

The EUT was battery powered. A new battery was used for the tests.

The EUT was operated in test mode (EMC mode), where the EUT transmitted a burst of 16 frames of 230uS pulses separated by approx 7.6mS, every 2 secs approx for all tests except duty cycle.

The duty cycle test was performed on a standard sample.
Modulation was on for all tests.

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 (modified in software for continuous transmit) of the EUT and one standard sample of EUT on 26th Oct -13th Nov 2015.

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 C63.4-2014 and ANSI C63.10-2013.

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

. This test was not performed as the EUT was battery powered.

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.

2.2.1 General

Emissions below 1GHz were measured using a tri-log antenna with resolution bandwidth 100kHz at a measurement distance of 3 metres with EUT on a motorised turntable which allowed 360 degrees rotation.

Emissions above 1GHz were measured using a horn antenna with resolution bandwidth of 1MHz and video bandwidth of 10MHz at a measurement distance of 3 metres with EUT on a motorised turntable which allowed 360 degrees rotation.

2.2.2 Measurements in Transmit mode

A Radiated Emission pre-scan was performed which covered the x, y and z orientations in horizontal and vertical polarizations. In each case the emission was maximised.

The result of this pre-scan showed that the highest emission for vertical polarization was with the EUT on its side (orientation2 O2)

The EUT flat on the table (orientation1 O1) gave the highest emissions for horizontal polarization.

A full scan for radiated emission was performed in orientation O2 for vertical polarization and in orientation O1 for horizontal polarization.

An additional slow prescan (480secs) with RBW=VBW = 10MHz was performed to ensure that all peaks were captured between 30MHz and 1GHz.

Similarly a slow prescan (4700secs) with RBW=VBW = 10MHz was performed to ensure that all peaks were captured between 1GHz and 10GHz.

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.

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

Tests were carried out as per Ansi C63.10 -2013

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

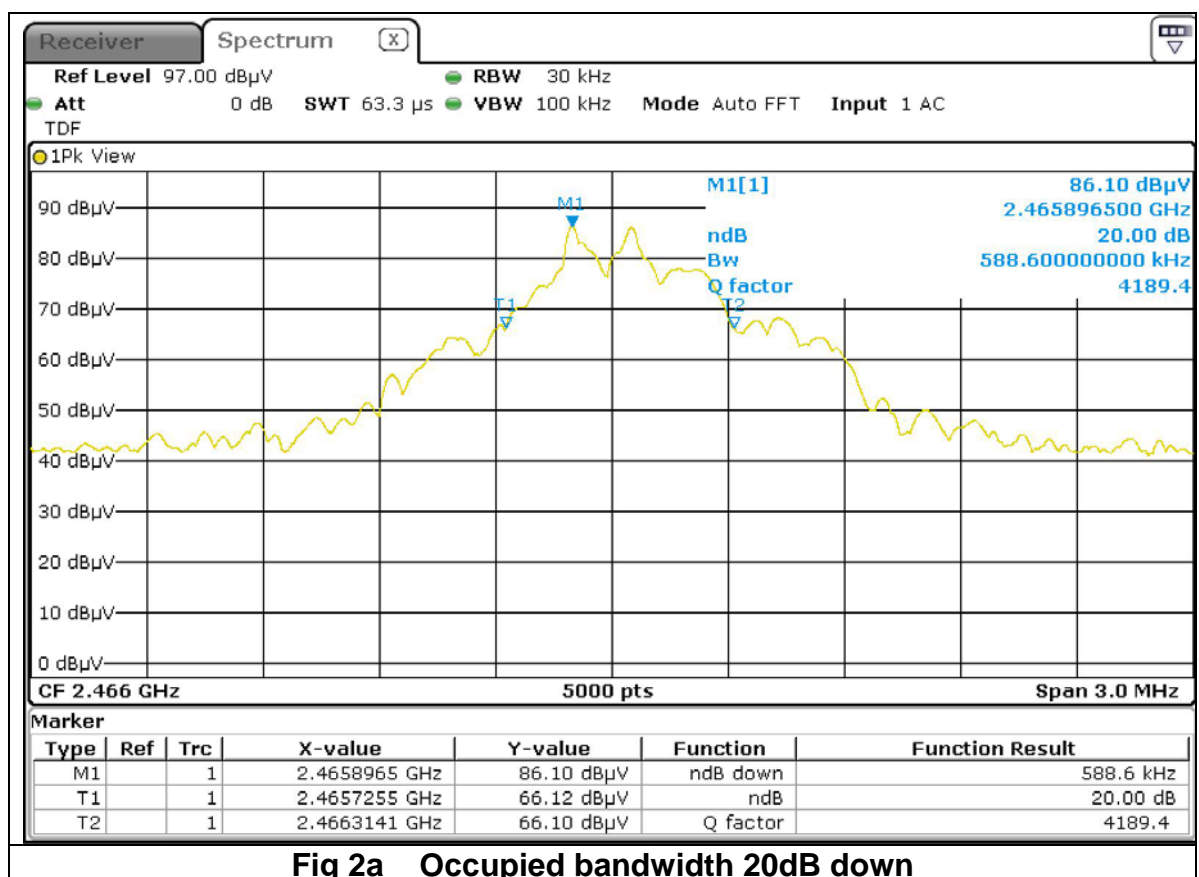
Test Criteria

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

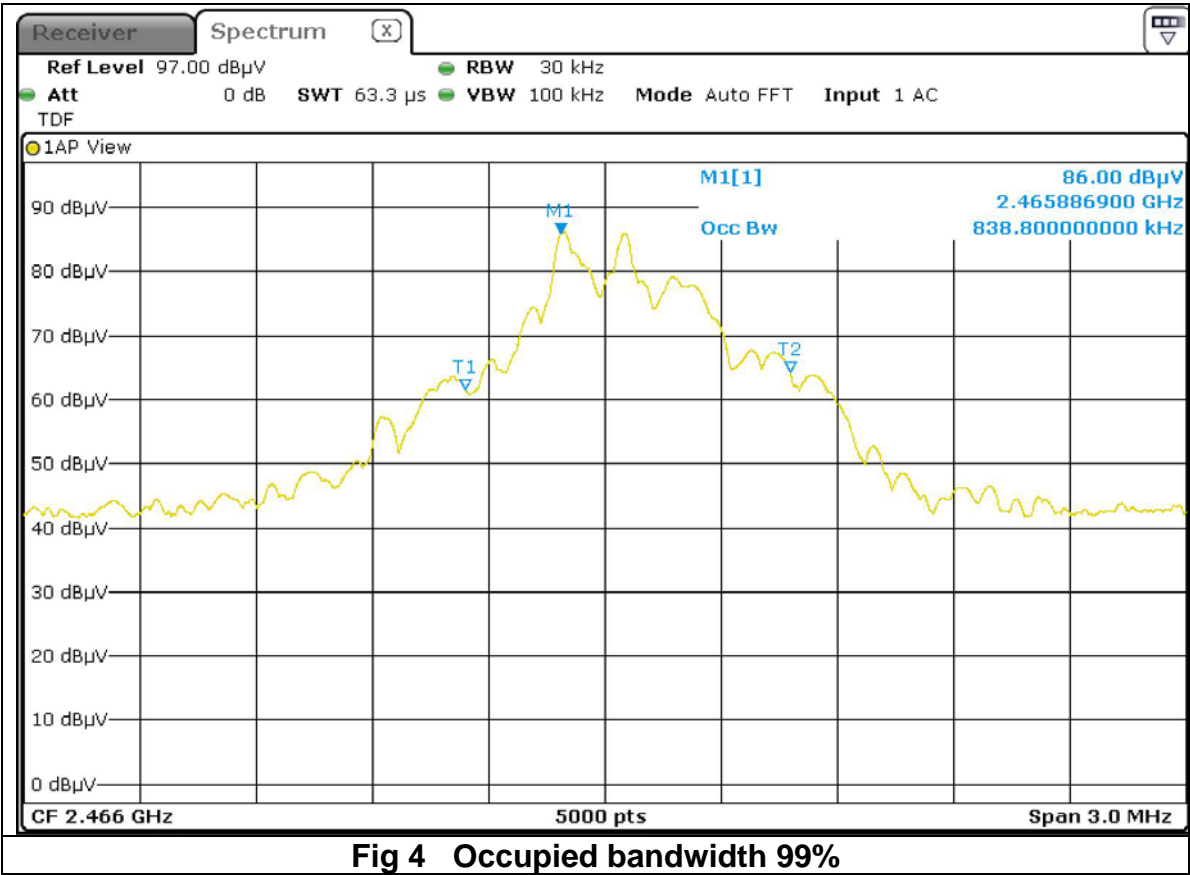
The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20dB down from the modulated carrier.

TEST PROCEDURE

The resolution bandwidth was set to 30 kHz. The video bandwidth was set to 100 kHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

RESULTS

Operating Frequency	20dB Bandwidth	Limit	Margin	Result
GHz	KHz	KHz	KHz	
2.466	588.6	12330	11836.5	Pass



Operating Frequency	99% Bandwidth
GHz	KHz
2.466	838.8

3.0 MAXIMUM MODULATION PERCENTAGE (M%)

LIMIT

15.231(a) 15.35 (c) & IC RSS-Gen 6.10

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 1MHz and the VBW is set to 10MHz. 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

MAXIMUM MODULATION PERCENTAGE

One Period(mS)	Pulse Width (mS)	No of Pulses	Duty Cycle	20 log duty cycle (dB)	Duty Cycle %	Test Result
100	0.234	13	0.0304	-30.3	3.0	Pass

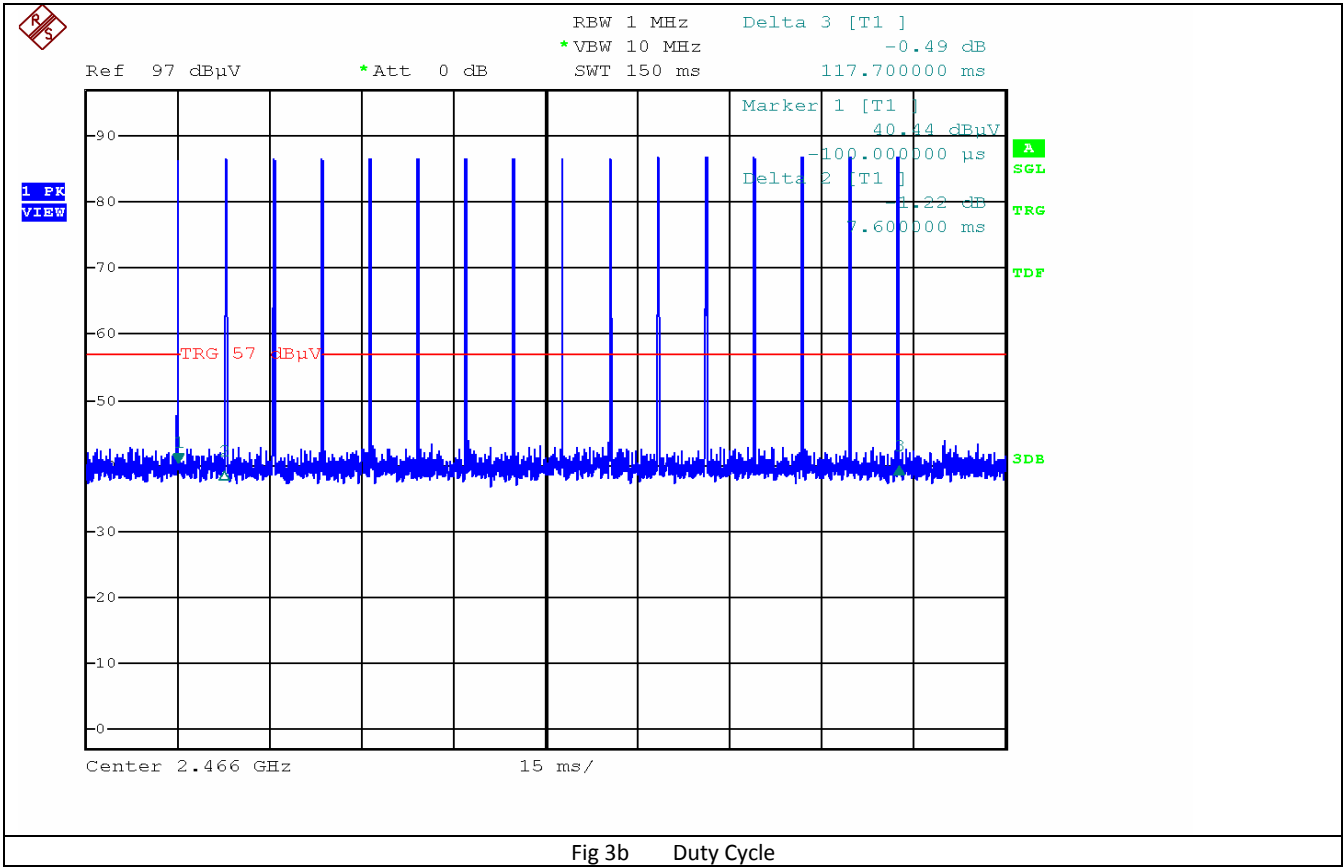
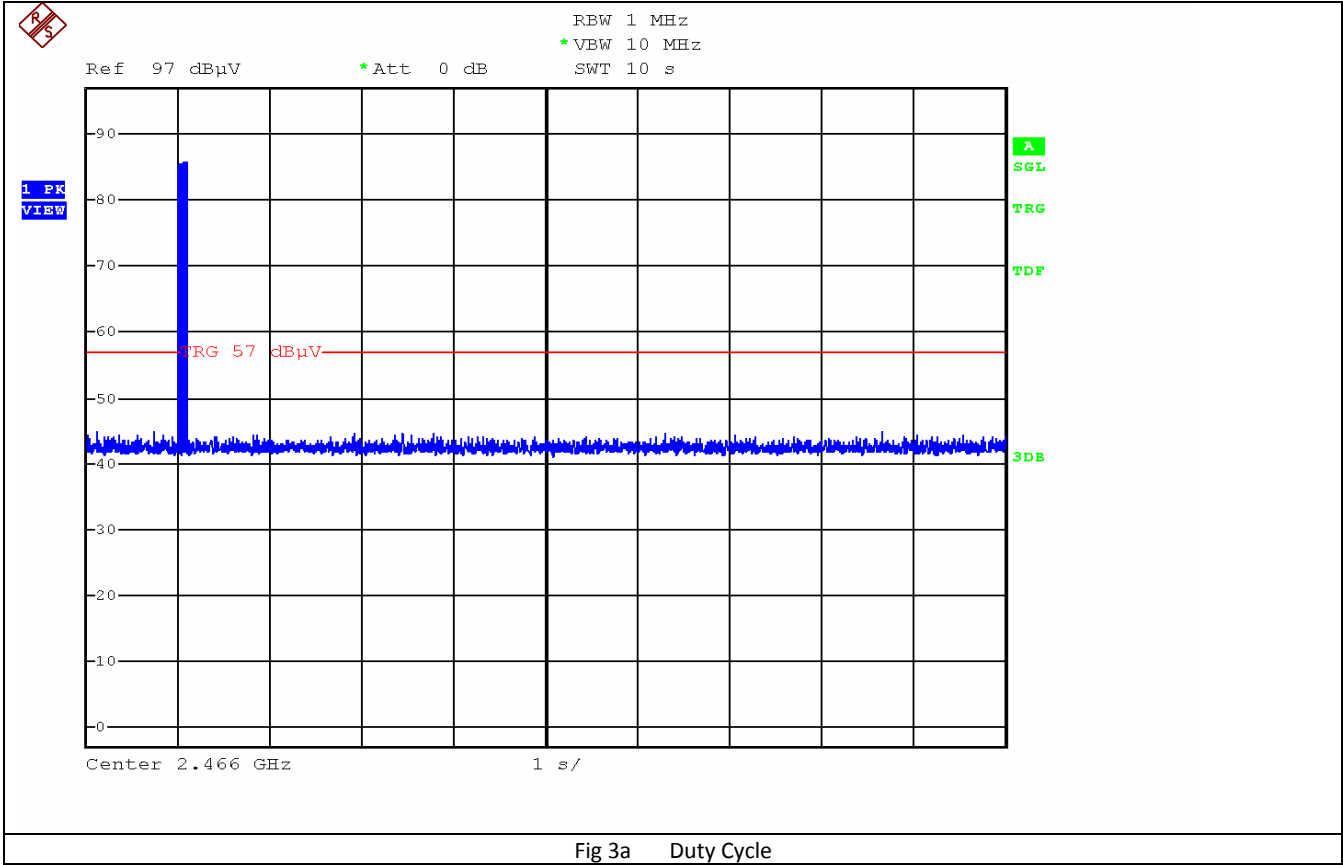
CALCULATION

Average Reading = Peak Reading dB(μ V/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)
-30.3



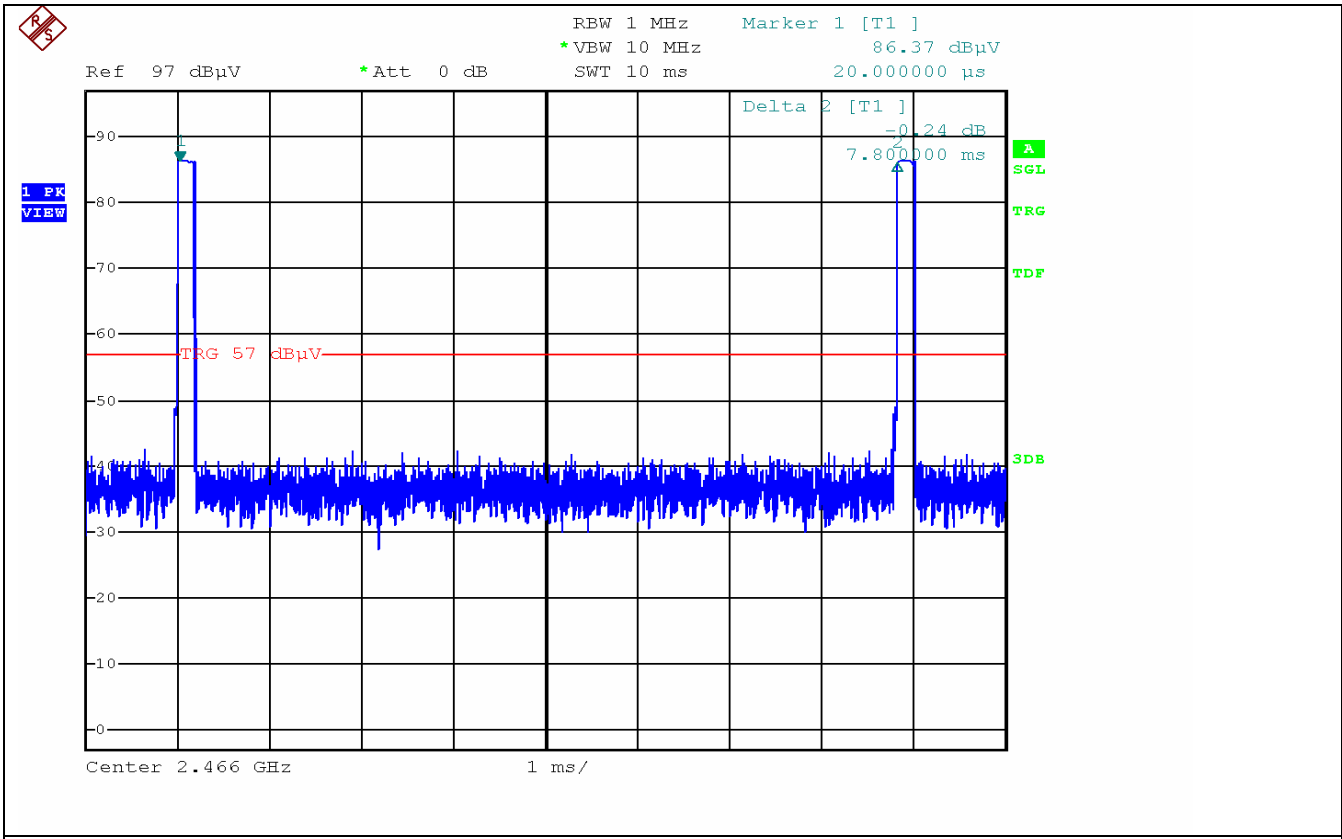


Fig 3c Duty Cycle

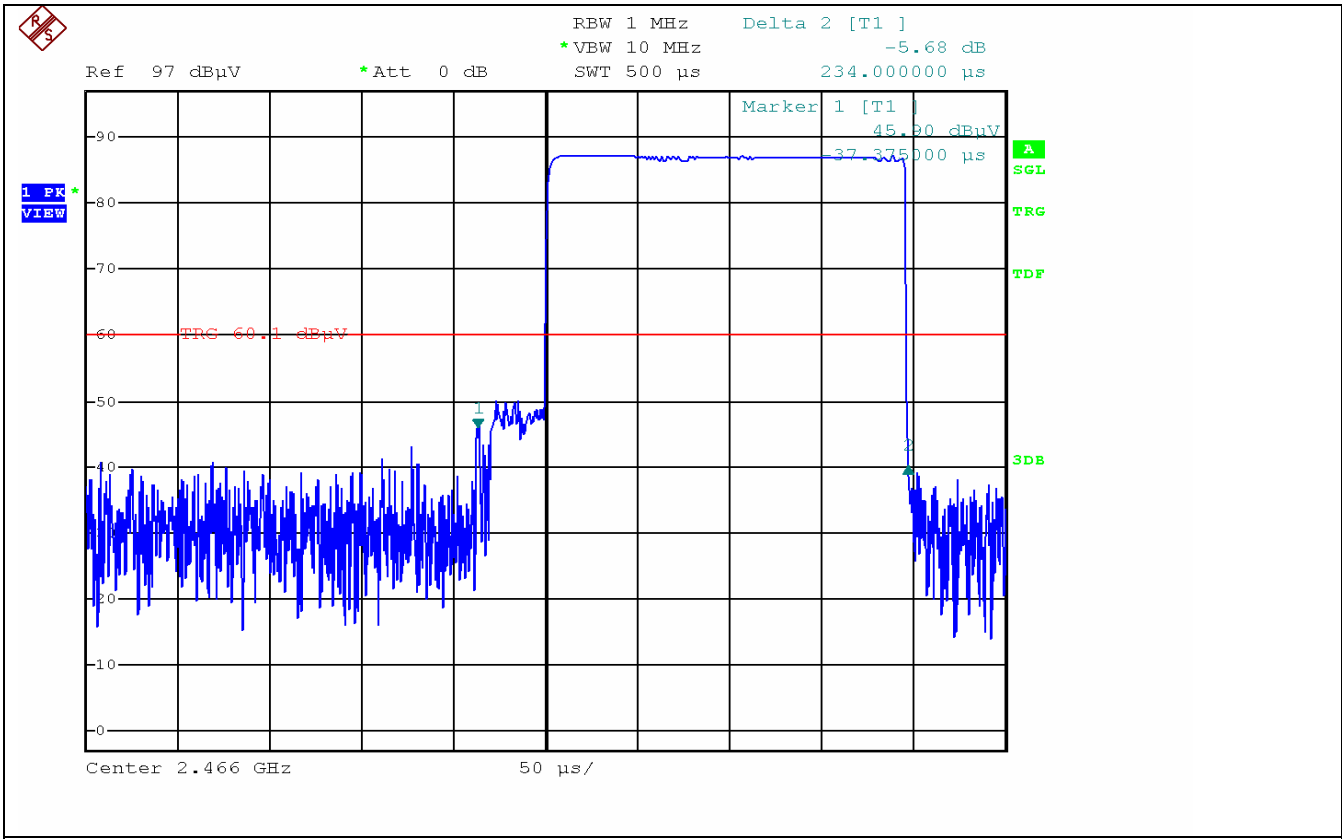


Fig 3d Duty Cycle

4.0 Field Strength of Radiated Emissions

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

Fundamental Frequency (MHz)	Field Strength of fundamental ($\mu\text{V/m}$)	Strength of Spurious Emissions ($\mu\text{V/m}$).
40.66 ~ 40.70	2250	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**

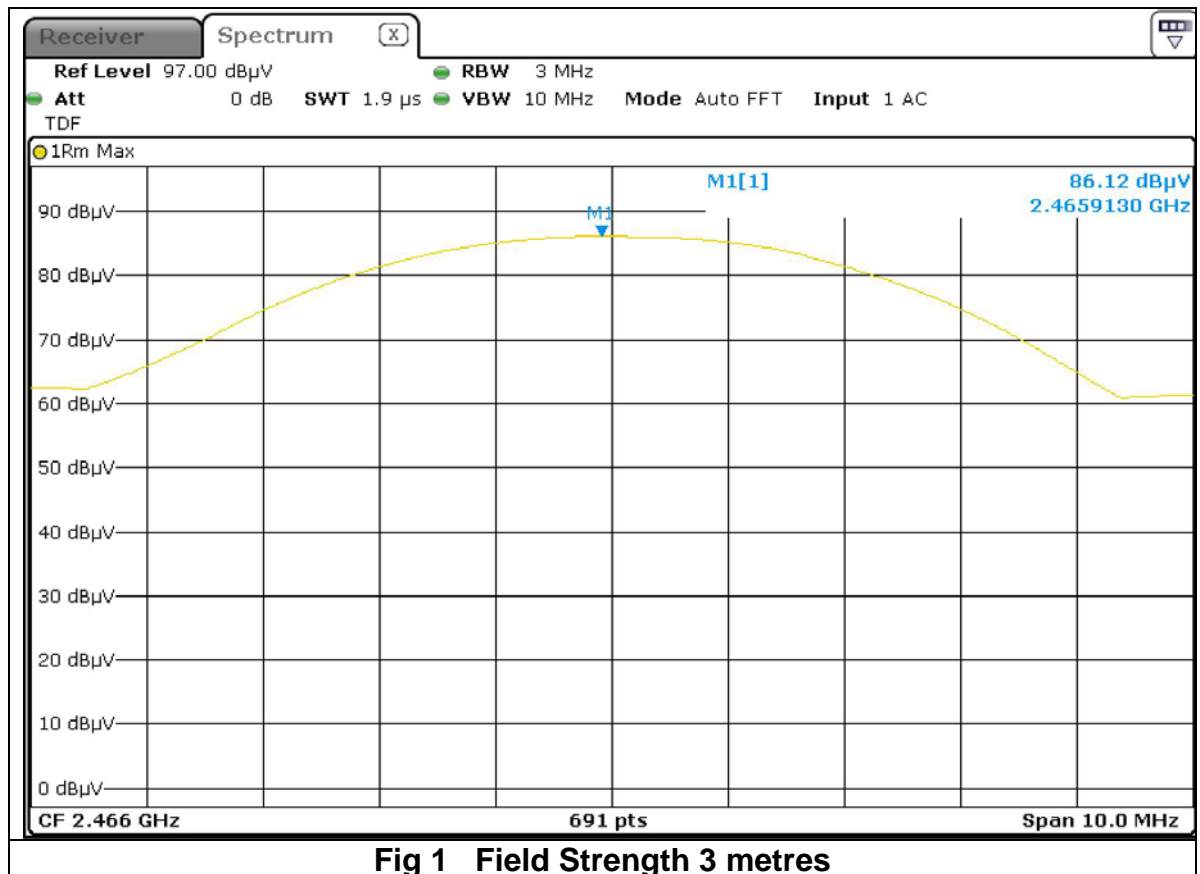
Note this is the Average limit for 3 metre measurement.

Test Specification: FCC PART 15, SECTION 47 CFR 15.209

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

4.1 Carrier Power



Frequency	Reading Peak	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain	Cable loss	Final Field Strength Peak	Average Limit	Margin for Peak v Average Limit +20dB
GHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBuV/m	dB
2.466	90.3	O2	Vertical	29.4	38.5	3.5	84.7	81.9	17.2
2.466	91.7	O1	Horizontal	29.4	38.5	3.5	86.1	81.9	15.8

Frequency	Final Field Strength Peak	EUT Orientation	Antenna Polarity	Average Level dBuV/m (Peak plus - 30.3dB Duty Cycle factor)	Average Limit	Margin
GHz	dBuV/m		V/H	dBuV/m	dBuV/m	dB
2.466	84.7	O2	Vertical	54.4	81.9	27.5
2.466	86.1	O1	Horizontal	55.8	81.9	26.1

4.2 Results for Radiated emissions

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

4.2.1 Harmonics of the fundamental

Frequency	Reading Peak	EUT Orientation	Antenna Polarity	Antenna Factor	Preamplifier Gain	Cable loss	Final Field Strength Peak	Average Limit	Margin for Peak v Average Limit +20dB
GHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBuV/m	dB
4.932	59.9	O2	Vertical	32.3	37.3	5.2	60.1	61.9	21.8
7.398	43.7	O2	Vertical	37.7	38	6.7	50.1	61.9	31.8
9.864	38.2	O2	Vertical	38.2	36.3	8.3	48.4	61.9	33.5
12.330	39.8	O2	Vertical	40.3	36.4	8.4	52.1	61.9	29.8
4.932	64.0	O1	Horizontal	32.3	37.3	5.2	64.2	61.9	17.7
7.398	45.0	O1	Horizontal	37.7	38	6.7	51.4	61.9	30.5
9.864	38.5	O1	Horizontal	38.2	36.3	8.3	48.7	61.9	33.2
12.330	33.1	O1	Horizontal	40.3	36.4	8.4	45.4	61.9	36.5

Frequency	Final Field Strength Peak	EUT Orientation	Antenna Polarity	Average Level dBuV/m (Peak plus - 30.3dB Duty Cycle factor)	Average Limit	Margin
GHz	dBuV/m		V/H	dBuV/m	dBuV/m	dB
4.932	60.1	O2	Vertical	29.7	61.9	32.2
7.398	50.1	O2	Vertical	19.8	61.9	42.1
9.864	48.4	O2	Vertical	18.1	61.9	43.8
12.330	52.1	O2	Vertical	21.8	61.9	40.1
4.932	64.2	O1	Horizontal	33.9	61.9	28
7.398	51.4	O1	Horizontal	21.0	61.9	40.9
9.864	48.7	O1	Horizontal	18.3	61.9	43.6
12.330	45.4	O1	Horizontal	15.1	61.9	46.8

Duty cycle correction = 20Log (duty cycle) dB

Duty Cycle correction for Average measurement of pulsed signal = Peak -30.3dB

as per ANSI C63.10-2013 Section 7.5

Result: Pass

4.2.2 Spurious (non Harmonics) of the fundamental

Frequency	Peak Level	Antenna Factor	Preamp Gain	Cable Loss	Antenna Polarity	EUT Orientation	Final Peak Level	Average Limit +20dB	Margin
GHz	dBuV/m	dB	dB	dB	V/H		dBuV/m	dBuV/m	dB
2.4765	66.6	29.4	38.5	3.5	Horizontal	O1	61.0	74.0	13.0
2.82	63.9	29.4	38.4	3.8	Horizontal	O1	58.7	74.0	15.3

Frequency	Average Level	Antenna Factor	Preamp Gain	Cable Loss	Antenna Polarity	EUT Orientation	Final Average Level	Average Limit	Margin
GHz	dBuV/m	dB	dB	dB	V/H		dBuV/m	dBuV/m	dB
2.4765	40.7	29.4	38.5	3.5	Horizontal	O1	35.1	54.0	38.9
2.82	41.5	29.4	38.4	3.8	Vertical	O1	36.3	54.0	37.7

Peak readings were taken with RBW of 1MHz and VBW of 10MHz

Average readings were taken with RBW of 1MHz and VBW of 10Hz

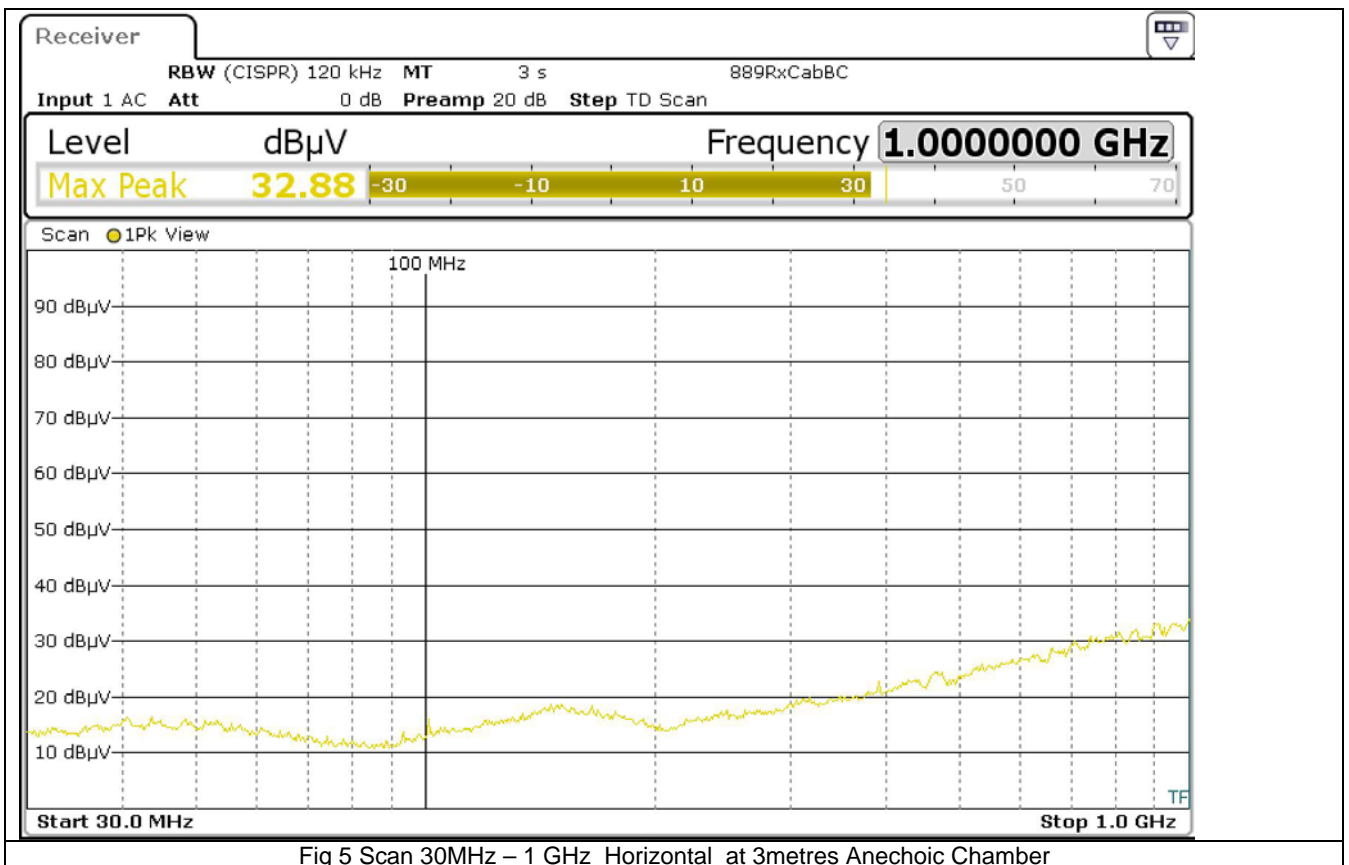
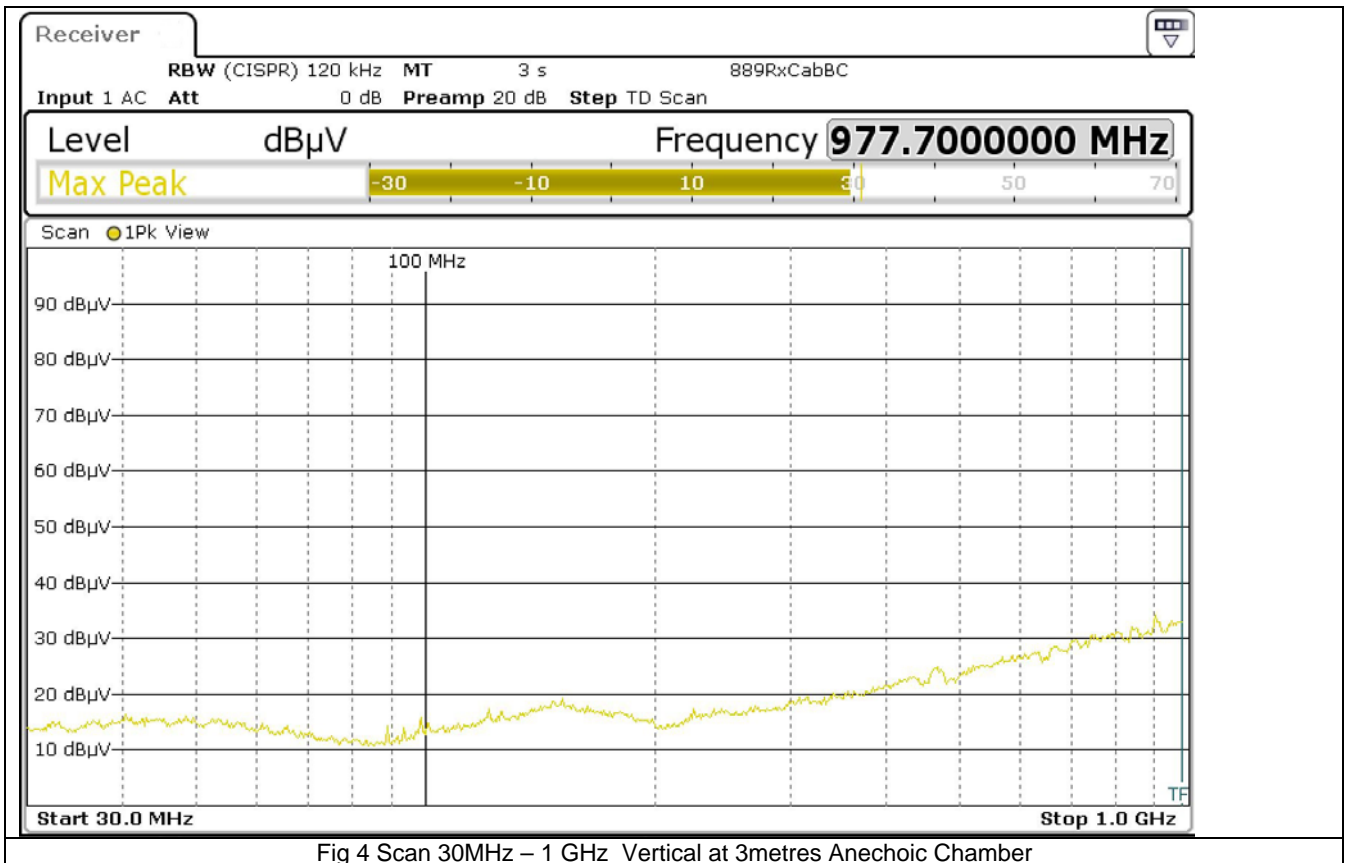
as per Ansi 63.10 Section 4.4.1.4.2.3

5.0 List of Test Equipment

Instrument	Manufacturer	Model	Serial Num	CEI Ref	Cal Due Date	Cal Interval Months
Microwave Preamplifier	Hewlett Packard	83017A	3123A00175	805	19/09/2016	12
Spectrum Analyser 30Hz-40GHz	Rohde& Schwarz	FSP40	100053	850	14/08/2017	36
Test Receiver 3.6GHz	Rohde& Schwarz	ESR	1316.3003k03-101625-s	869	06/06/2017	36
Antenna Bilog	Schaffner	CBL6111C	2549	690	08/09/2018	36
Anechoic Chamber	CEI	SAR 10M	845	845	23/09/2016	12
Antenna Horn	EMCO	3115	9905-5809	655	03/11/2017	24
Fully Anechoic Chamber	CEI	FAR 3M	906	906	22/03/2016	36
Antenna Horn Standard Gain 18-26.5GHz	A-info	LB-42-25-C-KF	J2021091103028	877	04/09/2016	12

Appendix A

Additional Test Results



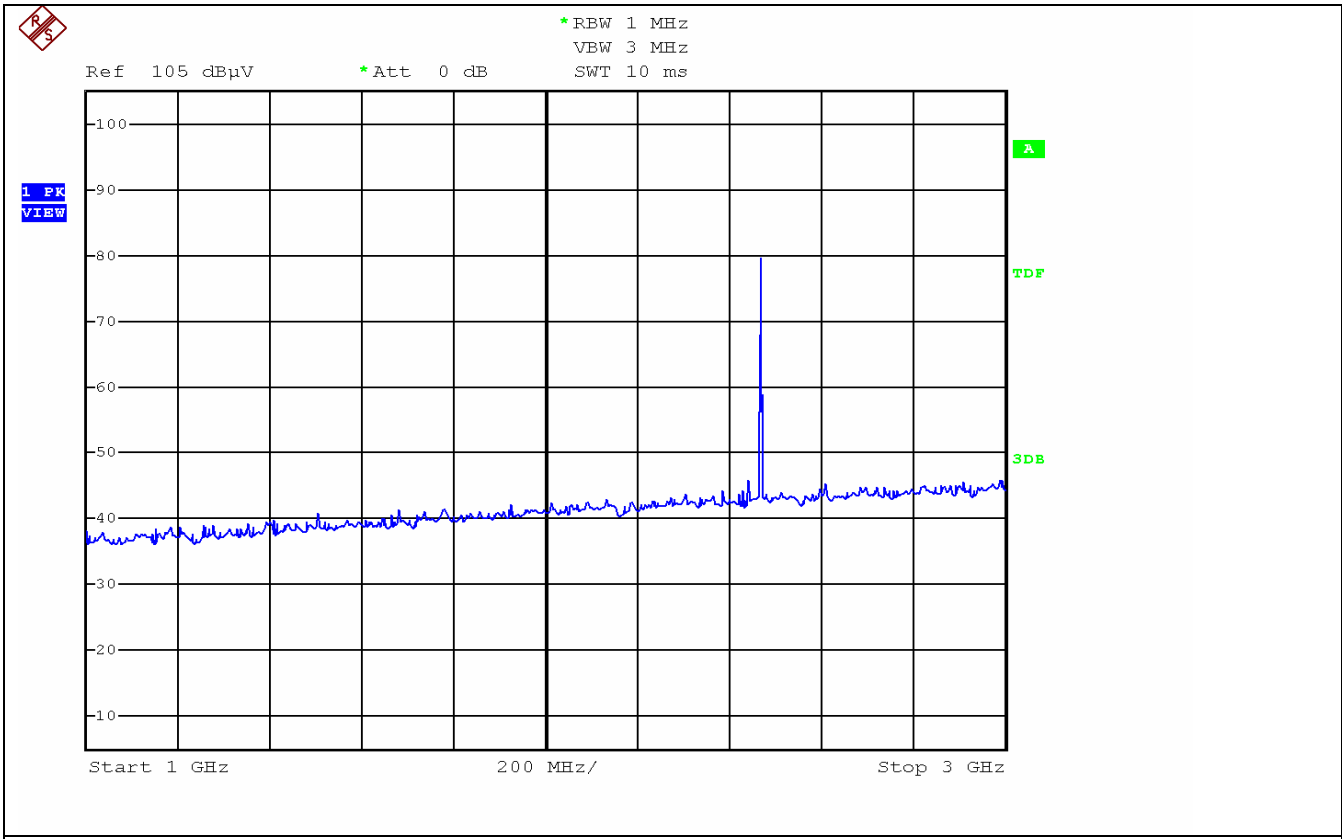


Fig 6 Scan 1 GHz -3GHz Vertical at 3metres Anechoic Chamber

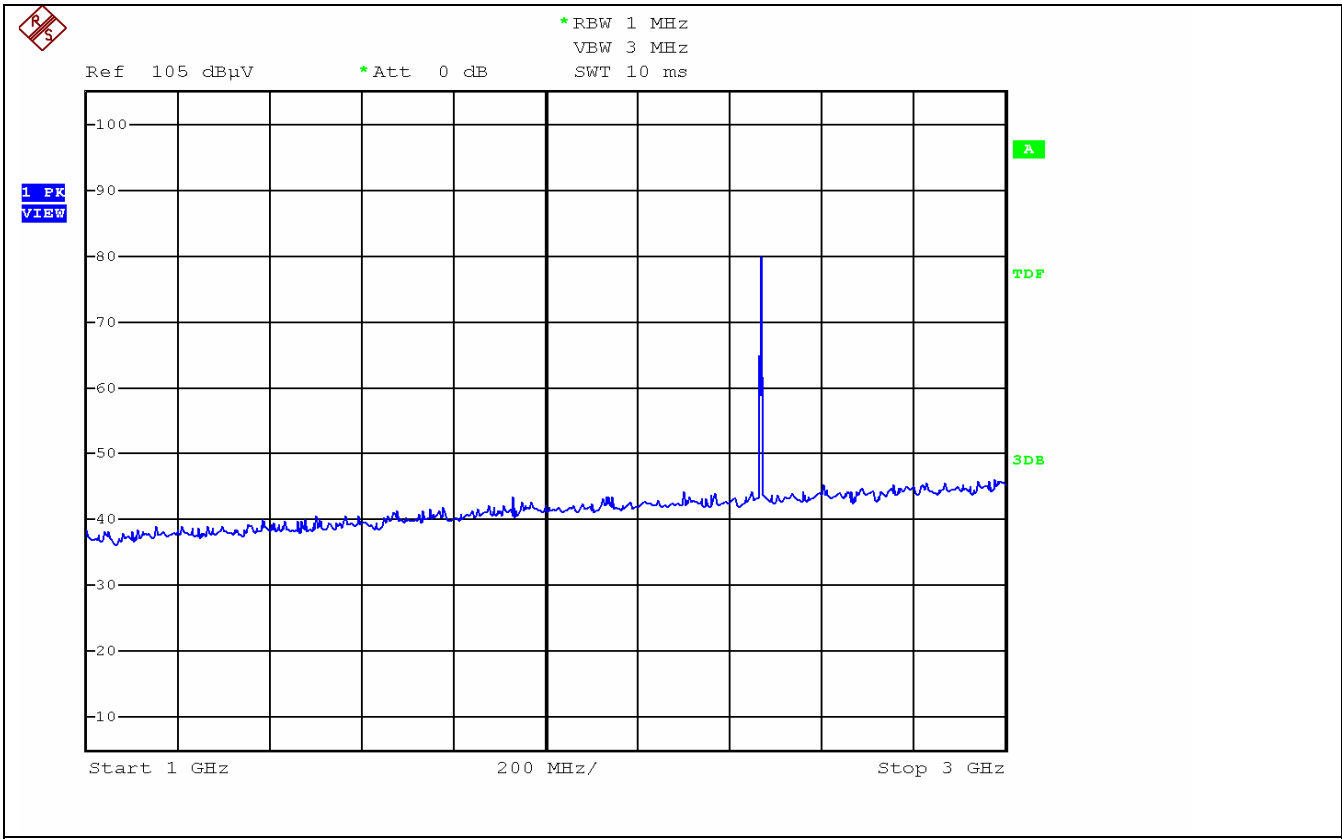


Fig 7 Scan 1 GHz -3GHz Horizontal at 3metres Anechoic Chamber

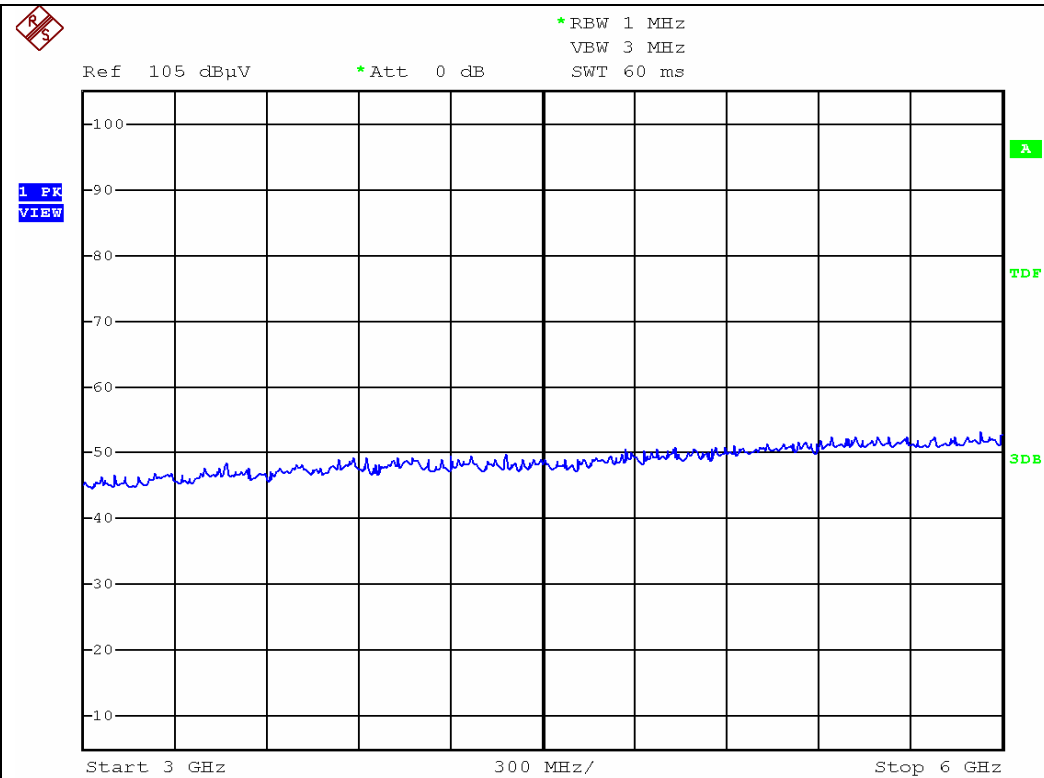


Fig 8 Scan 3 GHz -6GHz Vertical at 3metres Anechoic Chamber

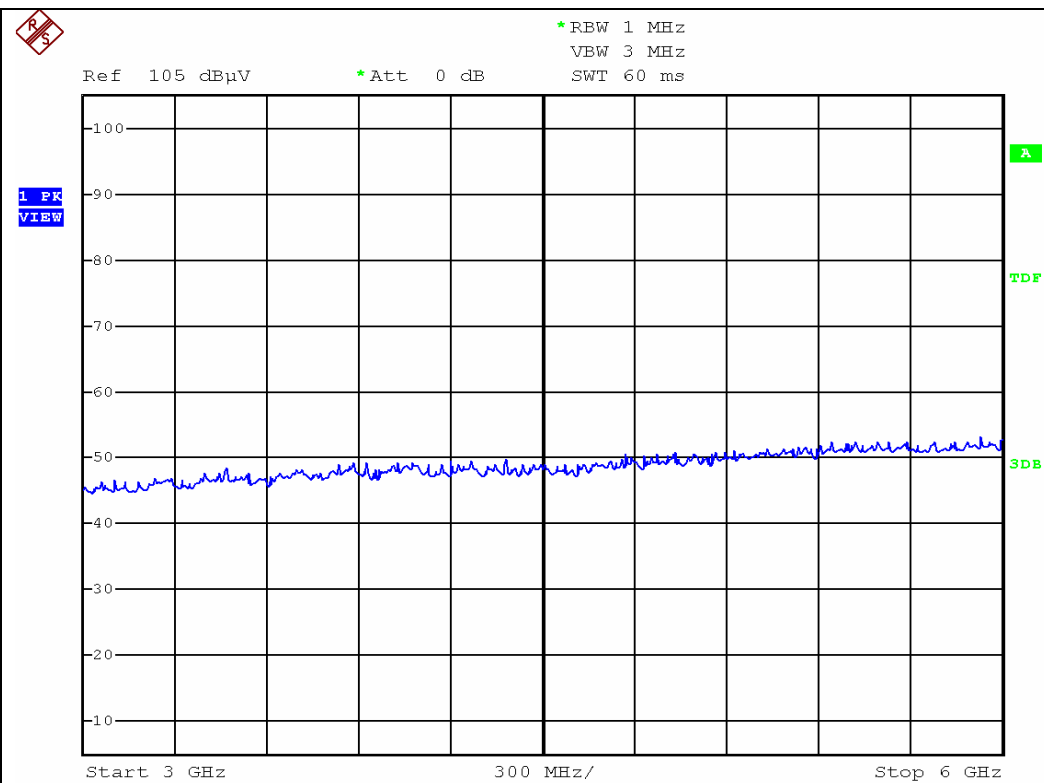
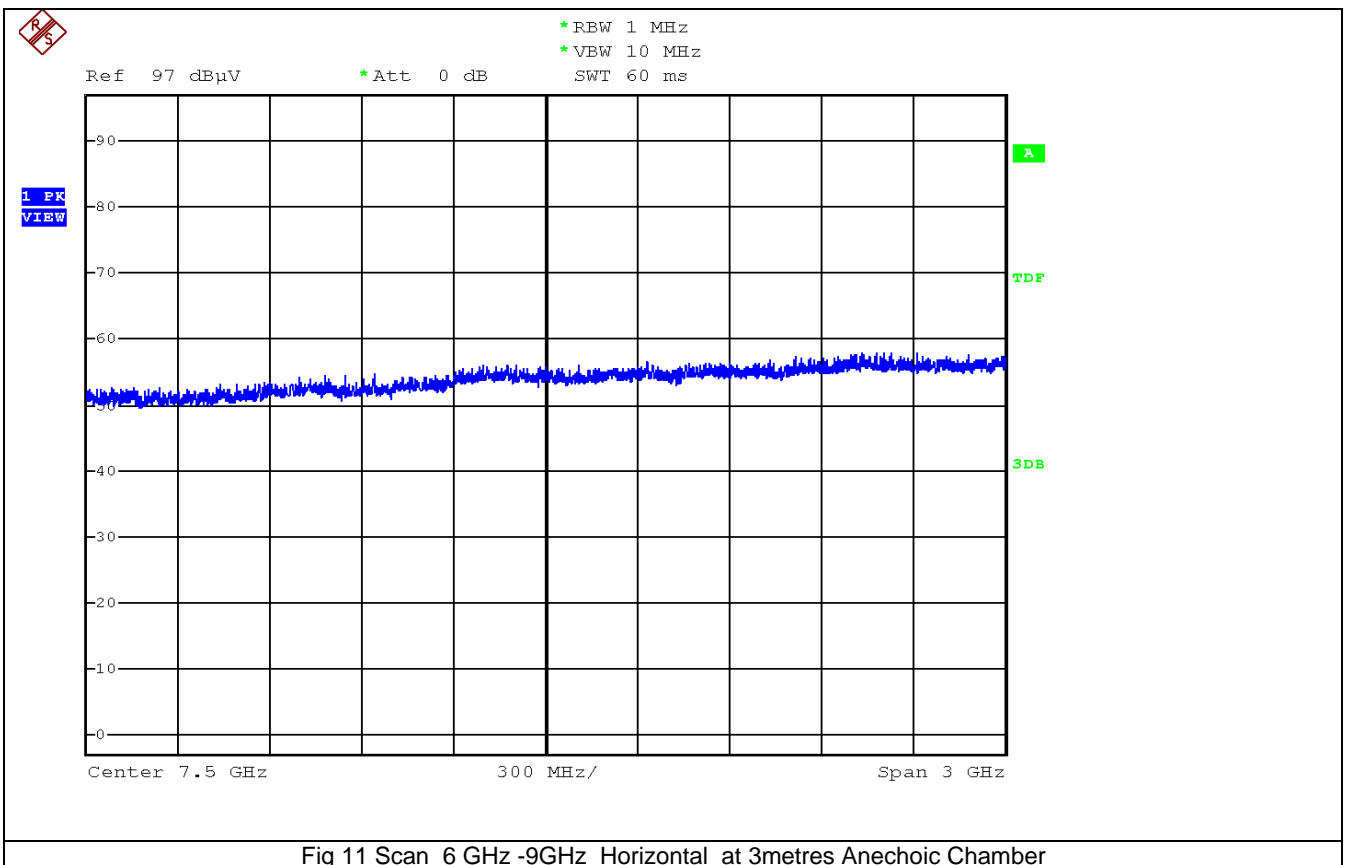
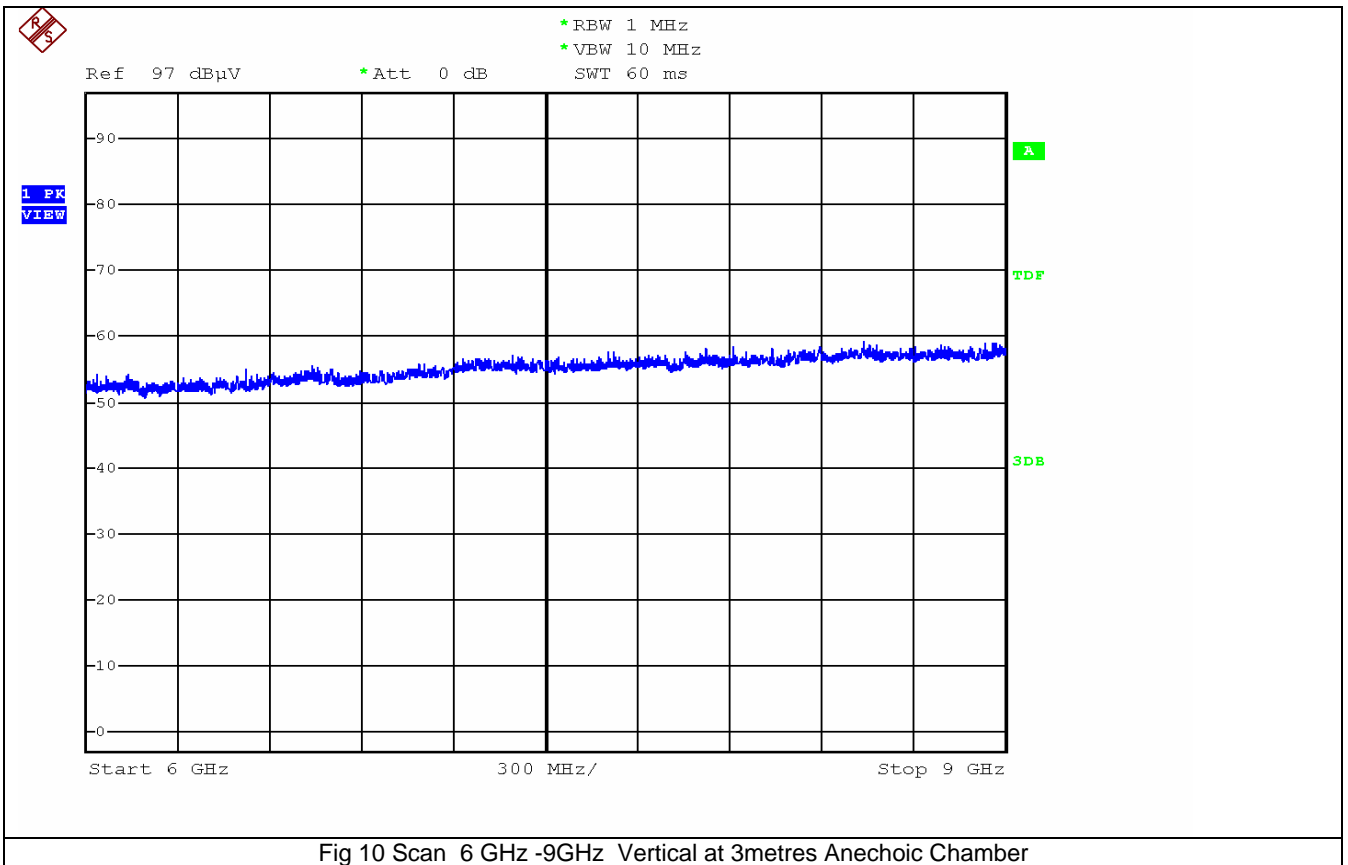


Fig 9 Scan 3 GHz -6GHz Horizontal at 3metres Anechoic Chamber



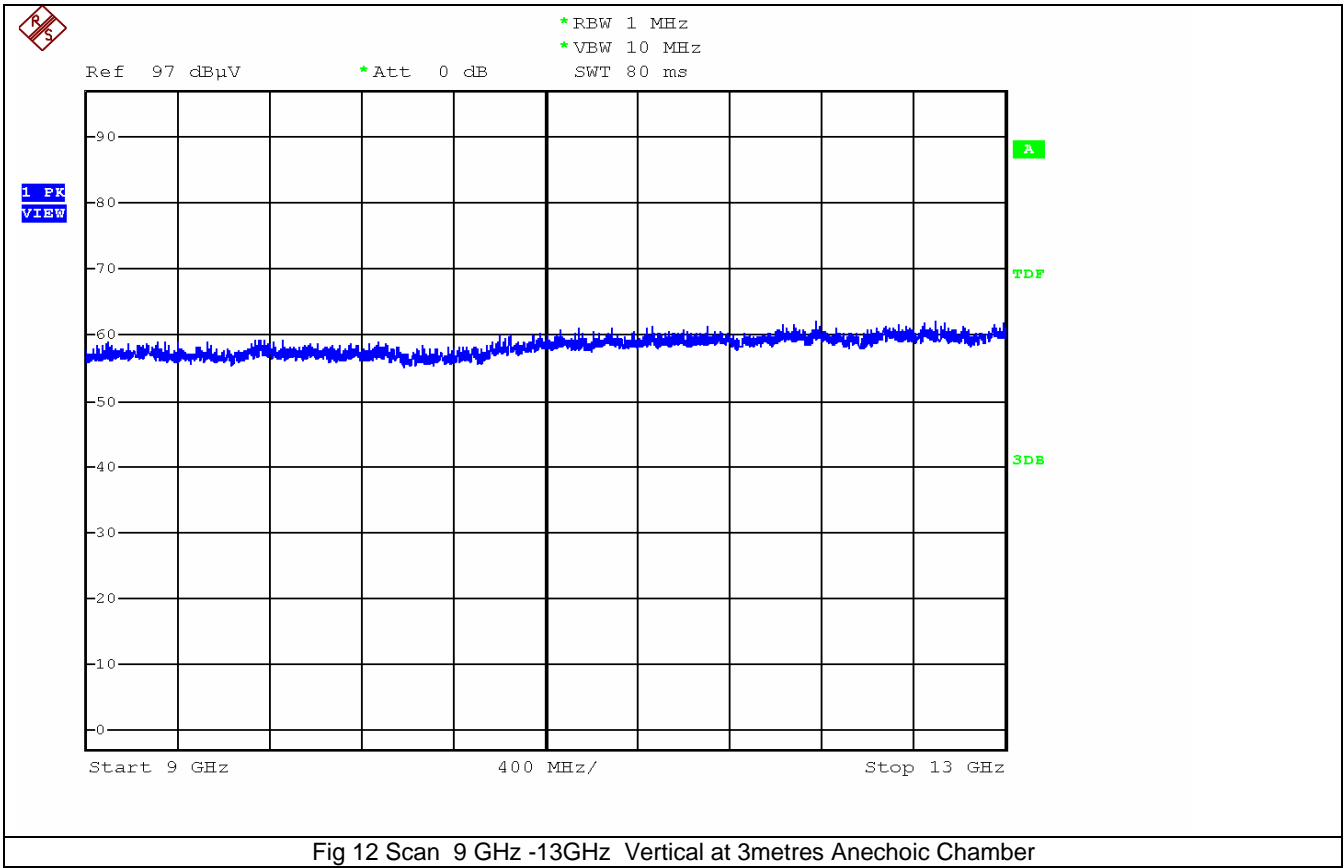


Fig 12 Scan 9 GHz -13GHz Vertical at 3metres Anechoic Chamber

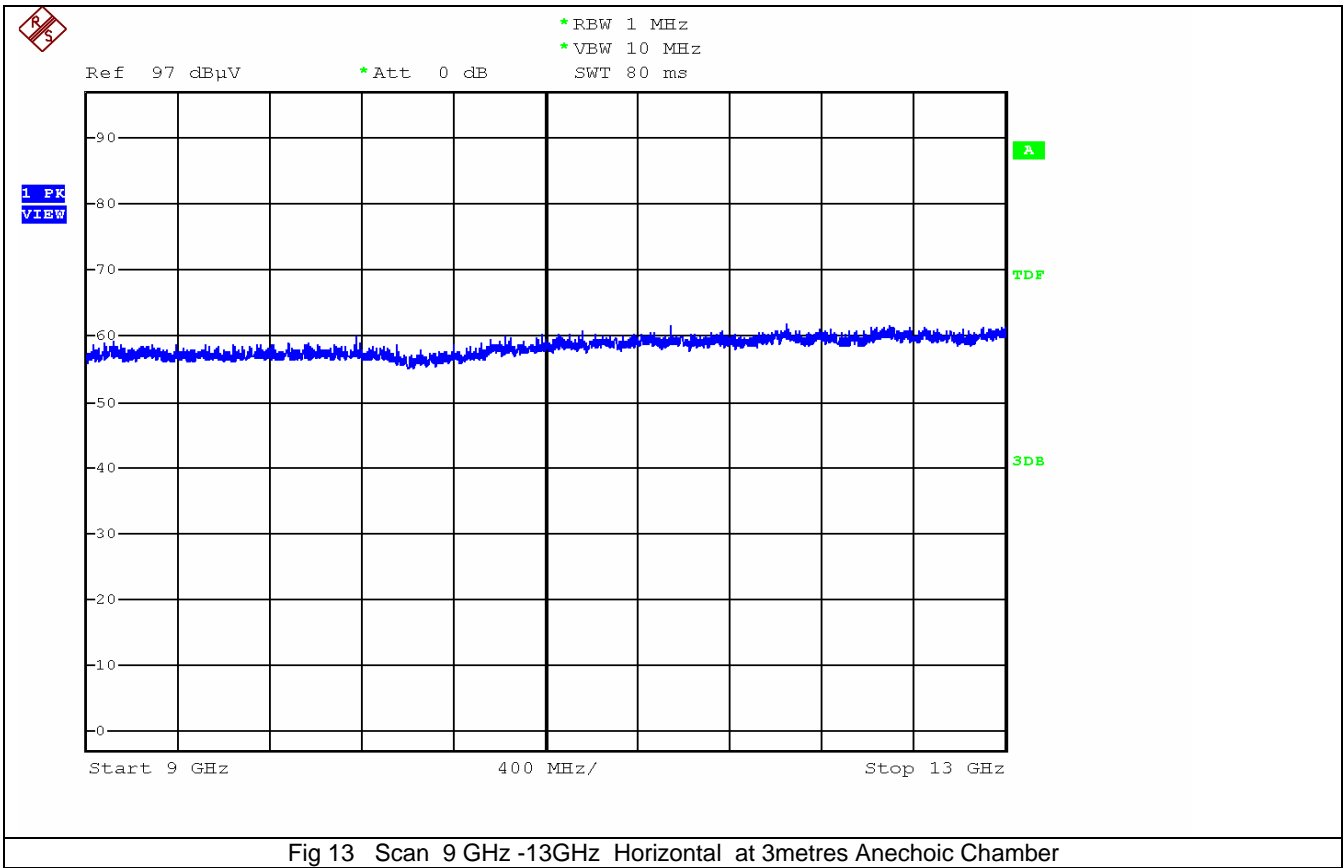


Fig 13 Scan 9 GHz -13GHz Horizontal at 3metres Anechoic Chamber

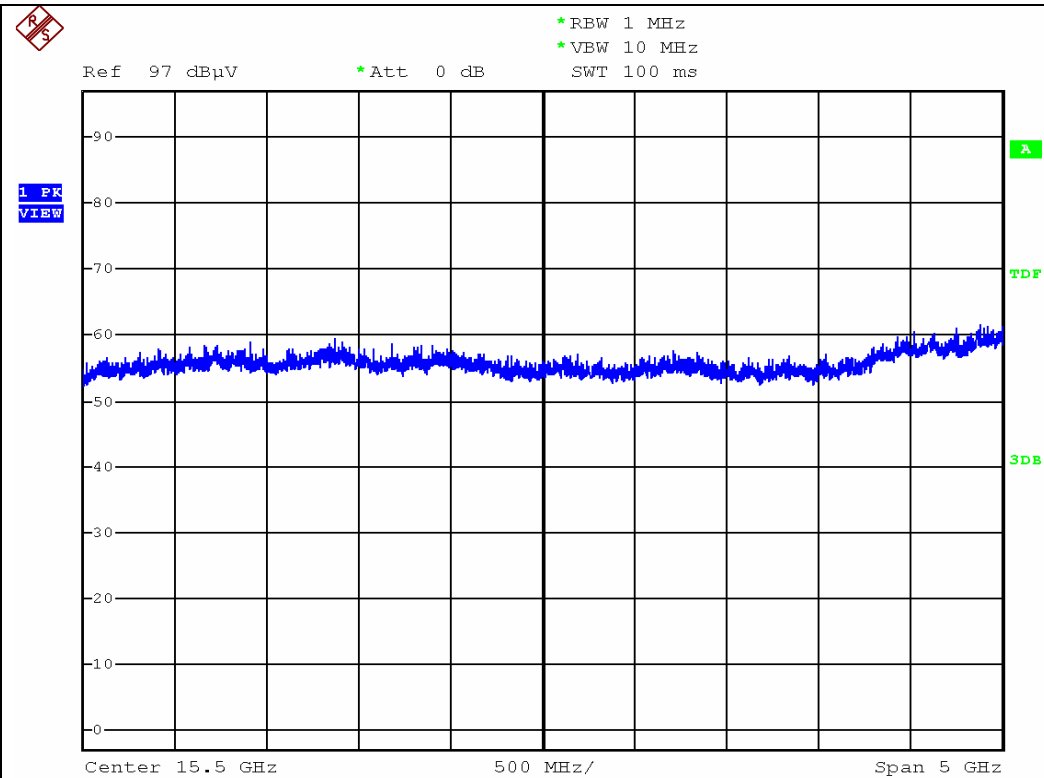


Fig 14 Scan 13 GHz -18GHz Vertical at 3metres Anechoic Chamber

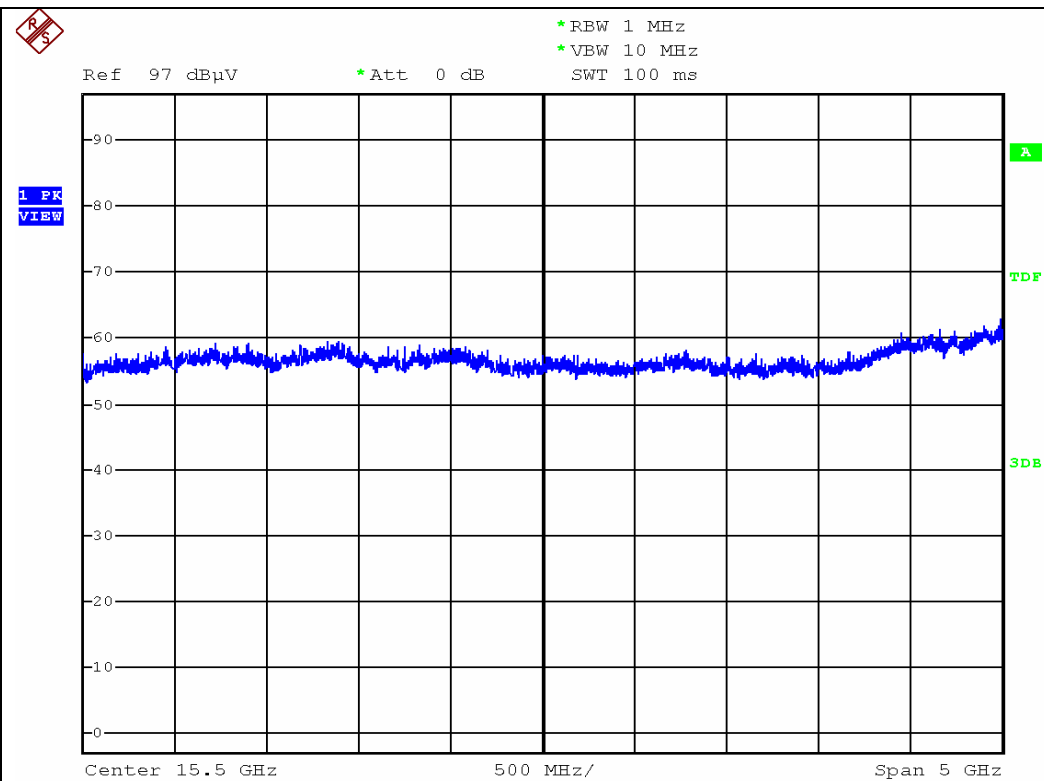
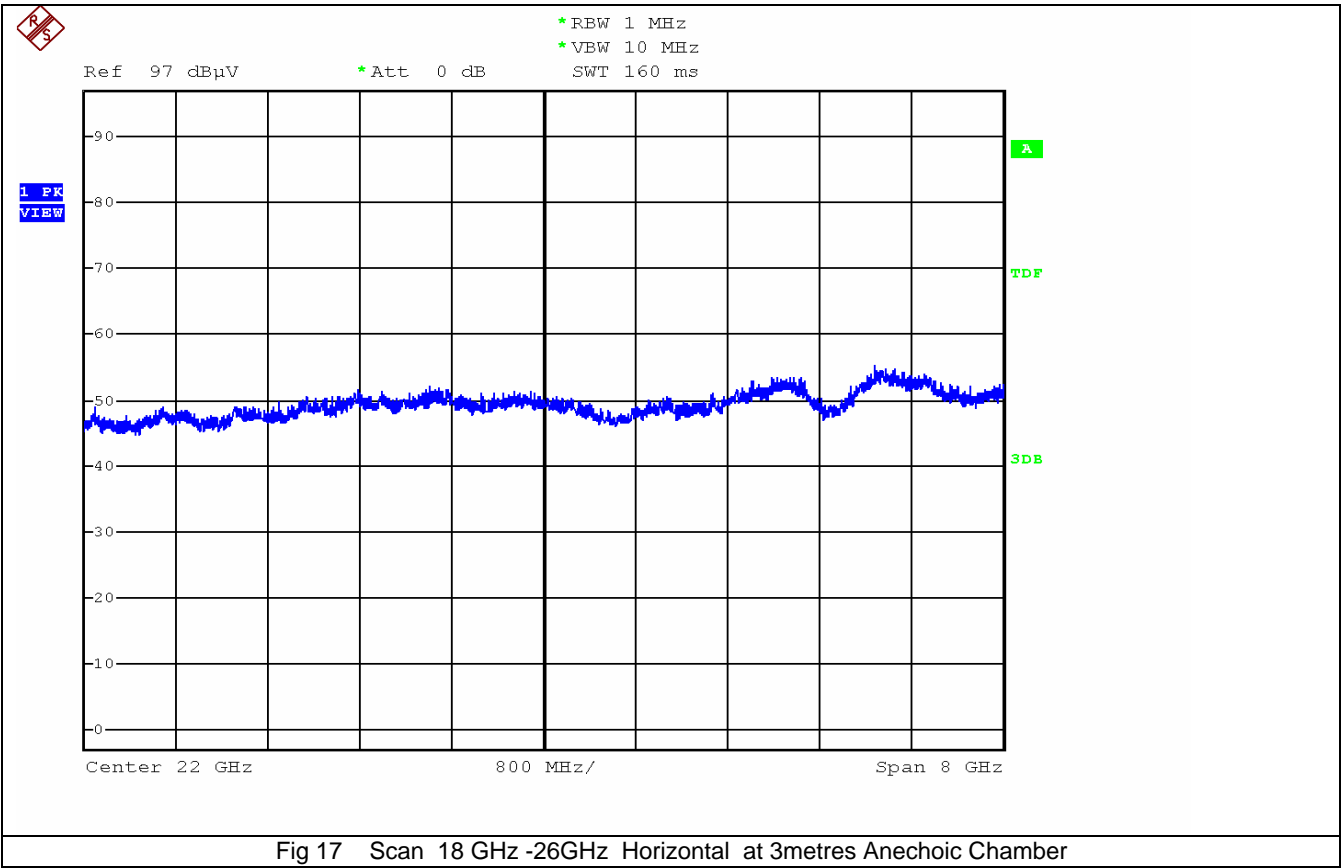
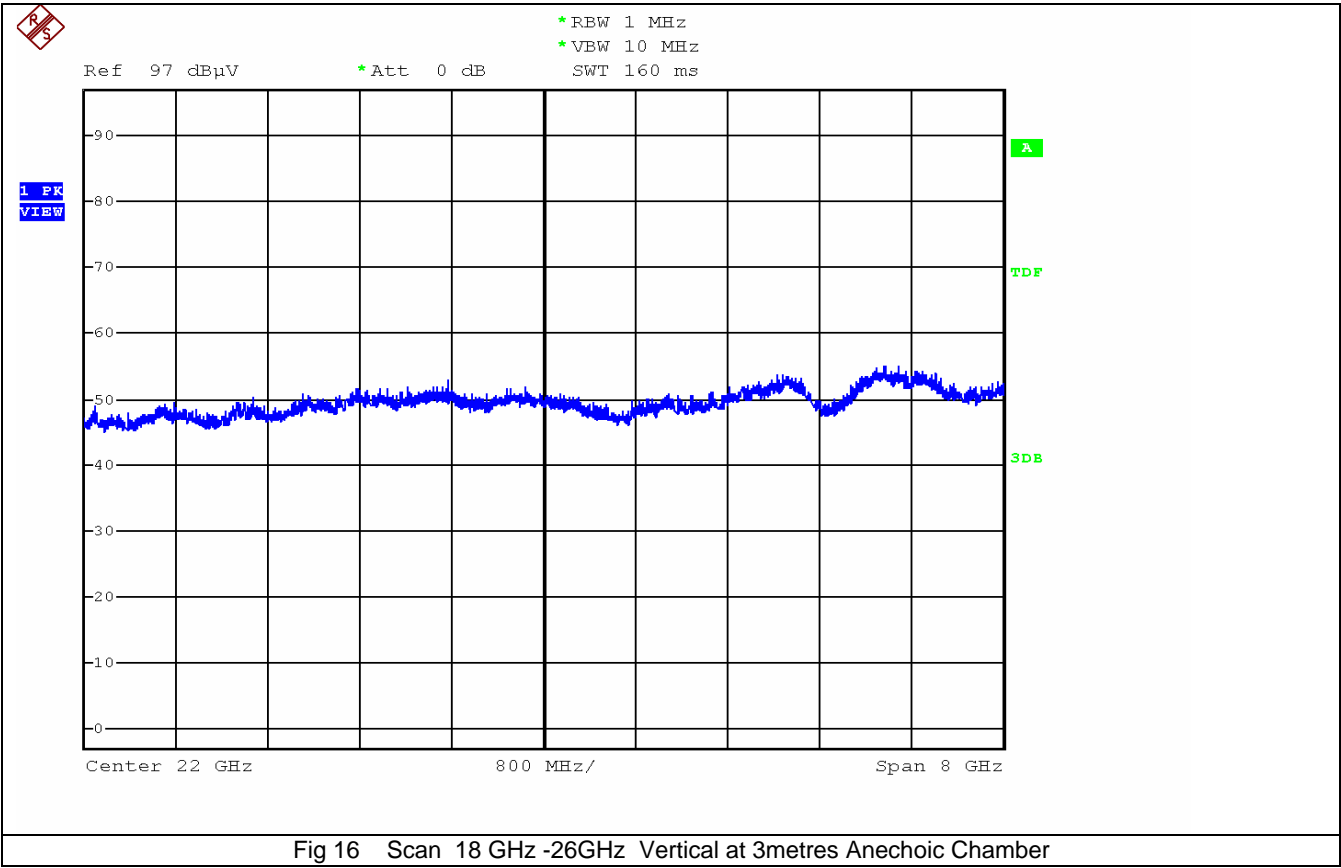


Fig 15 Scan 13 GHz -18GHz Horizontal at 3metres Anechoic Chamber



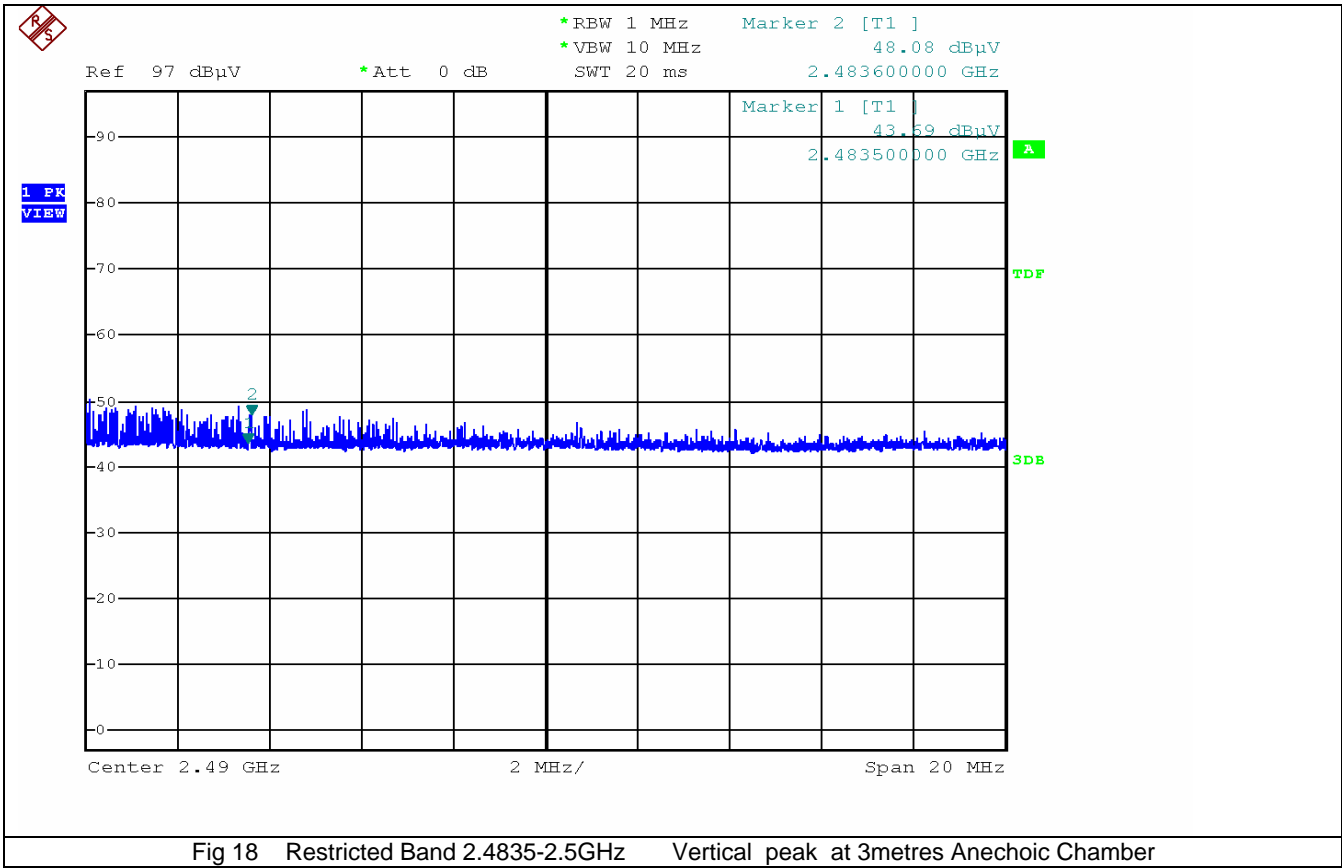


Fig 18 Restricted Band 2.4835-2.5GHz Vertical peak at 3metres Anechoic Chamber

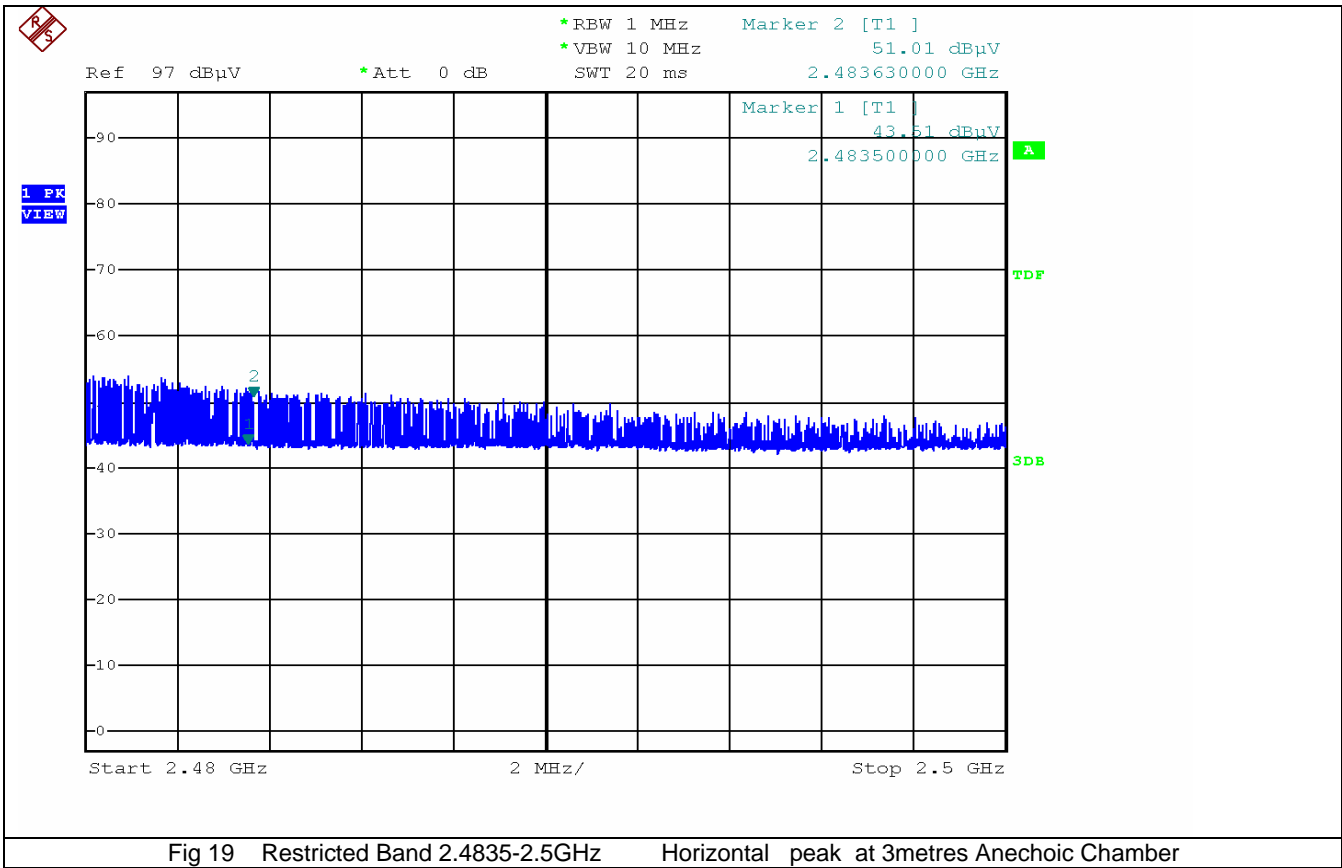


Fig 19 Restricted Band 2.4835-2.5GHz Horizontal peak at 3metres Anechoic Chamber

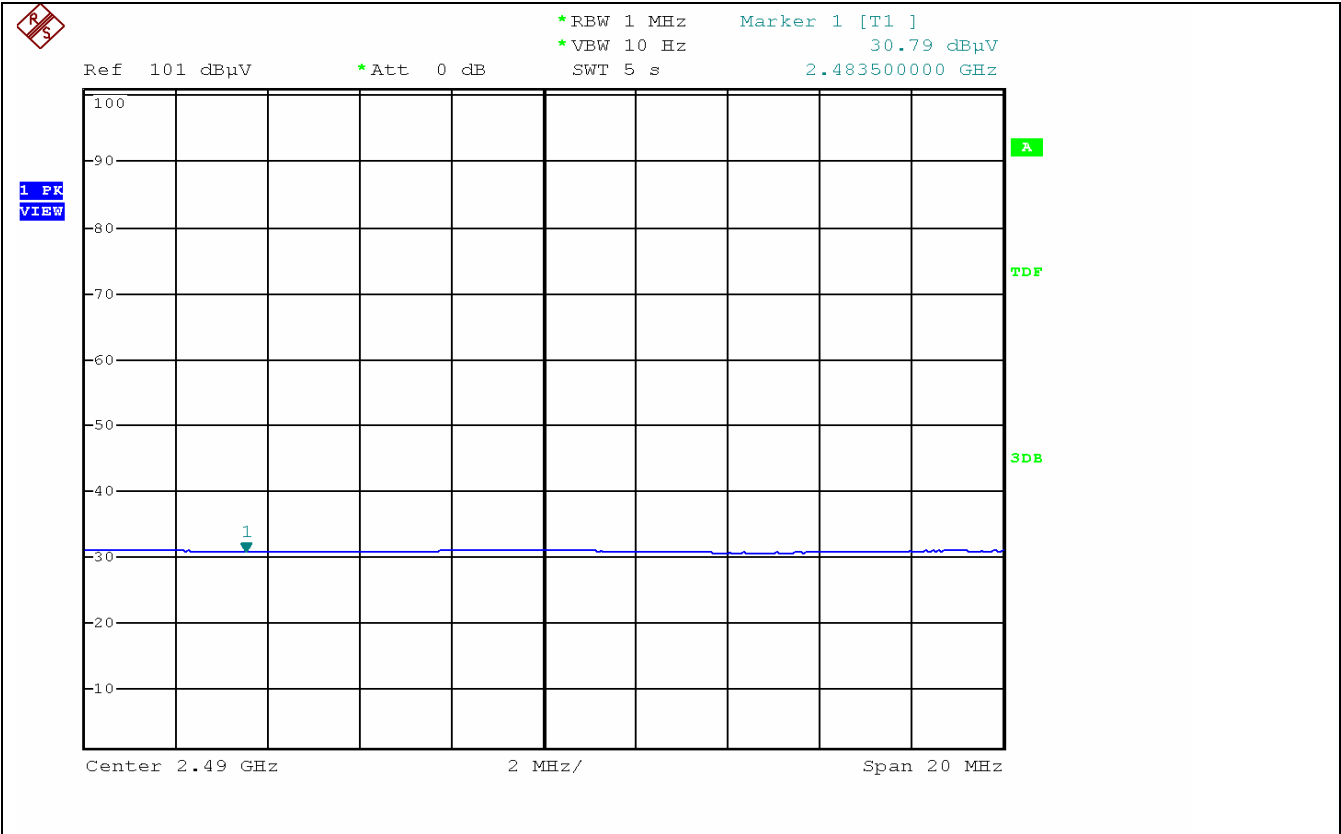


Fig 20 Restricted Band 2.4835-2.5GHz Vertical Average at 3metres Anechoic Chamber

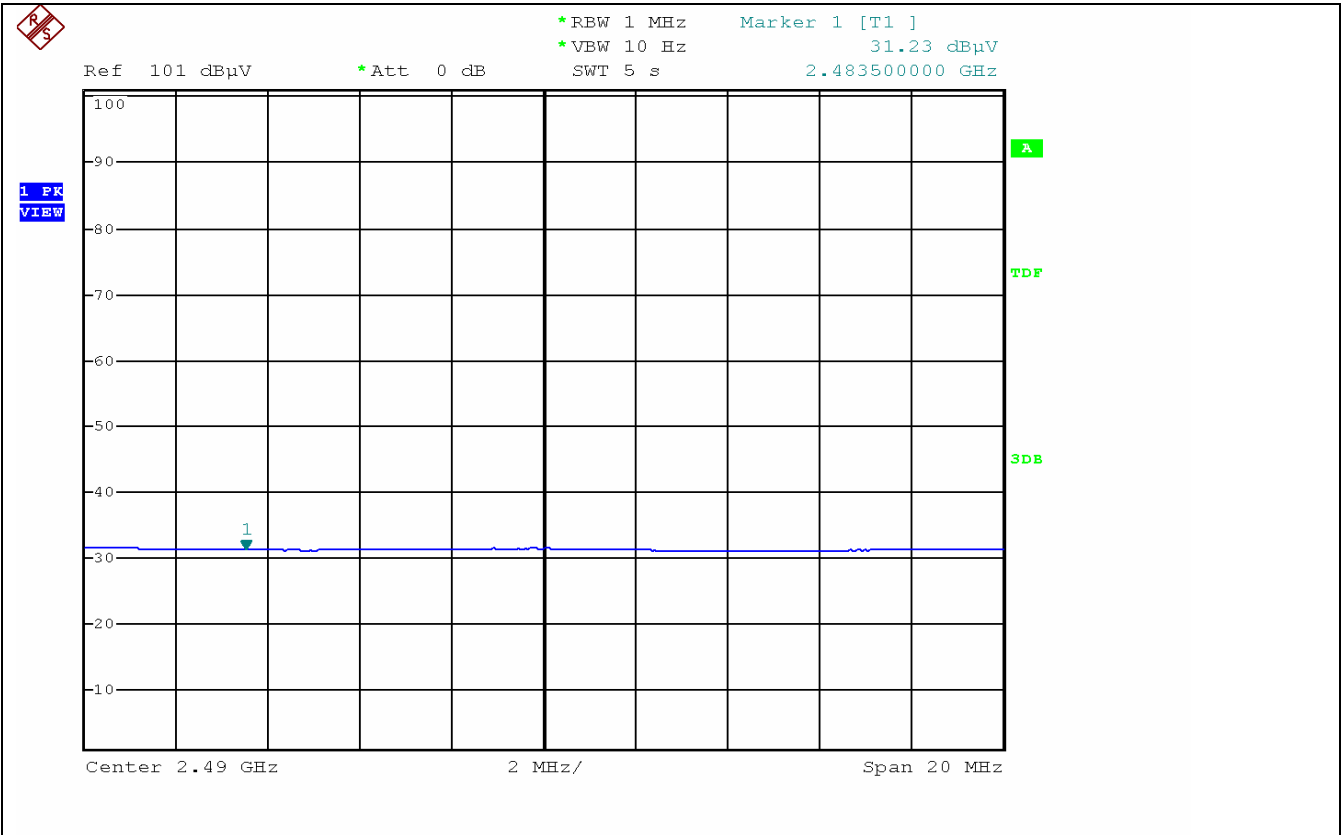


Fig 21 Restricted Band 2.4835-2.5GHz Horizontal Average at 3metres Anechoic Chamber

Appendix C

		
Fig C1 EUT orientation "O1"	Fig C2 EUT orientation "O2"	Fig C3 EUT orientation "O3"

End of Report

End of report