



Compliance Engineering Ireland Ltd

Clonross Lane, Derrockstown, Dunshaughlin, Co. Meath

Tel: +353 1 8256722 Fax: +353 1 8256733

Project Number: 15E5778-1b

Prepared for:

Tekelek Europe Ltd

By

Compliance Engineering Ireland Ltd

Clonross Lane

Derrockstown

Dunshaughlin

Co. Meath

FCC Site Registration: 92592

Industry Canada Assigned Site Code: 8517A-2

FCC ID: S6T687

IC: 20606-687

Date

20 Nov 2015

FCC EQUIPMENT AUTHORISATION

Test Report

EUT Description

SRD Liquid Level guage.

**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
15.249(a)	A.2.9(a)	RADIATED EMISSIONS	PASS
15.249(d)	A.2.9(b)	RADIATED EMISSIONS	PASS
15.249(e)	A.2.9(b)	RADIATED EMISSIONS	PASS
15.207(a)		CONDUCTED EMISSIONS ON THE MAINS	N/A

RSS 210 Issue 8

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 SRD using a short range 915 MHz band transmitter for liquid level gauge.

Model:	TEK 687
Type:	SRD liquid level gauge
FCC ID:	S6T687
Company:	Tekelek Europe Ltd
Contact	Martin Callinan
Address:	Unit 118 Shannon Co Clare Ireland
Phone:	+353 61 471511
e-mail:	Martin.callinan@tekelek.ie
Test Standards:	47 CFR, Part 15.249(a,d,e)
Type of radio:	Stand-alone
Transmitter Type:	FM
Operating Frequency Range(s):	914.5 MHz
Number of Channels:	1
Antenna:	Integral
Transmitter power configuration:	3.6v dc
Oper. Temp Range:	-40° C to +85° C
Classification:	DXX
Test Methodology:	Measurements performed according to the procedures in ANSI C63.10-2013

1.1 EUT Operation

Operating Conditions during Test:

The EUT had two modulation methods

a) Modulation1

USA standard (used on legacy products)	
Modulation reference:	referred to FSK in SiLabs
Modulation	FM
Transmit Center Frequency	Single channel, 914.5 MHz
Frequency Deviation	65KHz
Data Rate	1Kb/sec (2KHz Manchester encoded)

b) Modulation 2

USA standard (used on P4 structure)	
Modulation reference:	referred to FSK in SiLabs
Modulation	FM
Transmit Center Frequency	Single channel, 914.5 MHz
Frequency Deviation	210KHz
Data Rate	25kb/sec (NRZ)

A full test was carried out on both modulation methods, on one sample EUT (where a magnet held up to the side of the EUT allowed the switching between modulation methods)

The EUT was operated in test mode (with repeated transmissions every 500mS) with modulation on .

Note in normal operation the EUT transmits once every 30 -240mins

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 on the 4th and 7th Sept 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 C63.10-2013.

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

Test not performed as the EUT was powered 3.6v 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.

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. 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 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.

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 end (orientation1 O1)

The EUT in a flat orientation (orientation2 O2) gave the highest emissions for horizontal polarization.

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

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

2.4 Field Strength of Fundamental

Test Criteria

Requirement :- 15.249 (a)

Operation within the bands 902-928 MHz

The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902-928 MHz	50	500

RESULTS

2.4.1 Modulation 1

Frequency	Quasi peak Level	EUT Orientation	Antenna Polarity	Antenna Factor	Preamplifier Gain	Cable loss	Final Field Strength Quasi Peak	Quasi Peak Limit	Margin
MHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBuV/m	dB
914.500	61.4	O1	Vertical	22.6	0	1.4	85.4	94.0	8.6
914.496	62.4	O2	Horizontal	22.6	0	1.4	86.4	94.0	7.6

2.4.2 Modulation 2

Frequency	Quasi peak Level	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain	Cable loss	Final Field Strength Quasi Peak	Quasi Peak Limit	Margin
MHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBuV/m	dB
914.500	64.9	O1	Vertical	22.6	0	1.4	88.9	94.0	5.1
914.500	64.3	O2	Horizontal	22.6	0	1.4	88.3	94.0	5.7

Test Result Pass

3.2 Duty Cycle

15.35 (c)

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

EUT was tested in modulated mode.

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

3.2.1 Duty Cycle Modulation 1

One Period(mS)	Pulse Width (mS)	No of Pulses	Duty Cycle	20 log duty cycle (dB)	Duty Cycle %	Test Result
100	45.58	1	0.4558	-6.8	45.6	Pass

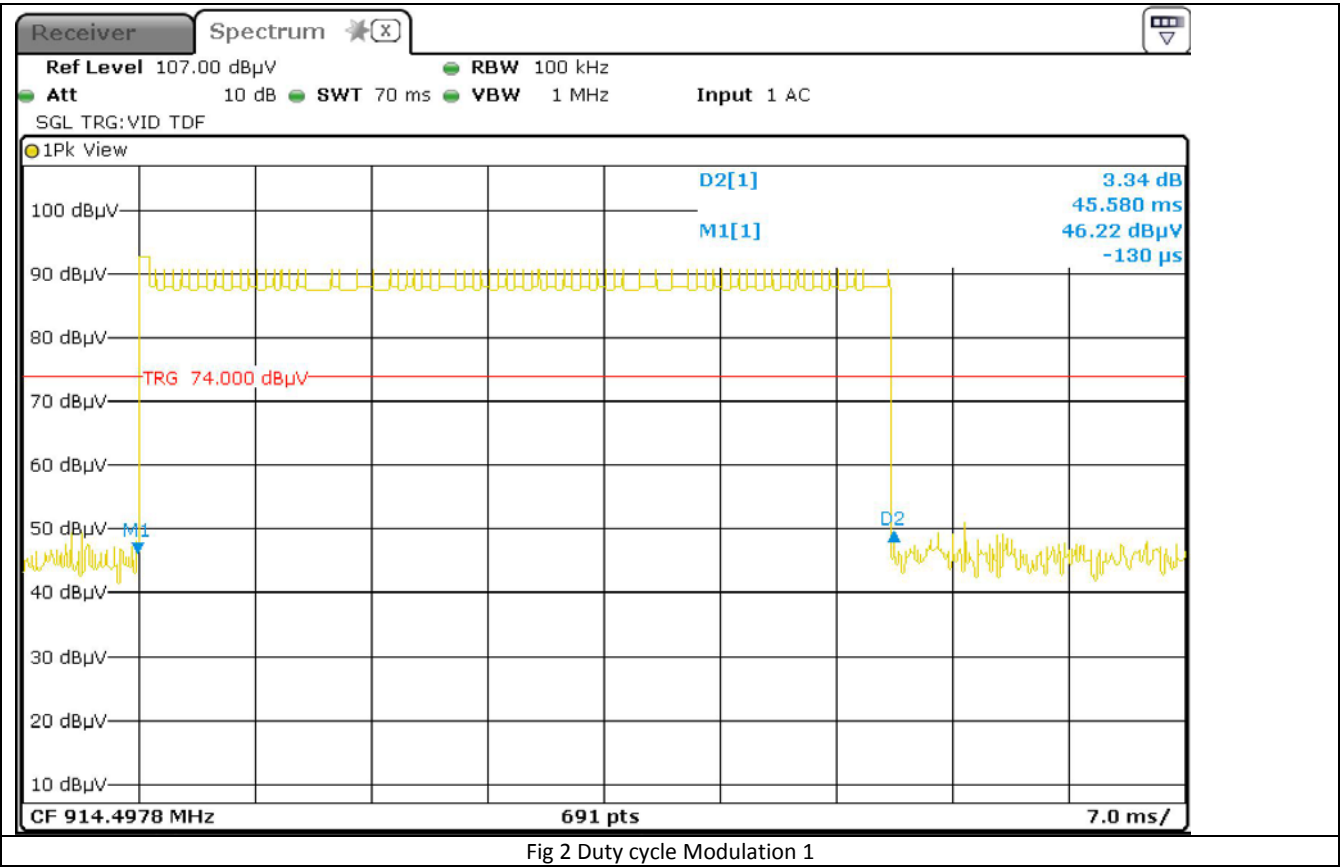
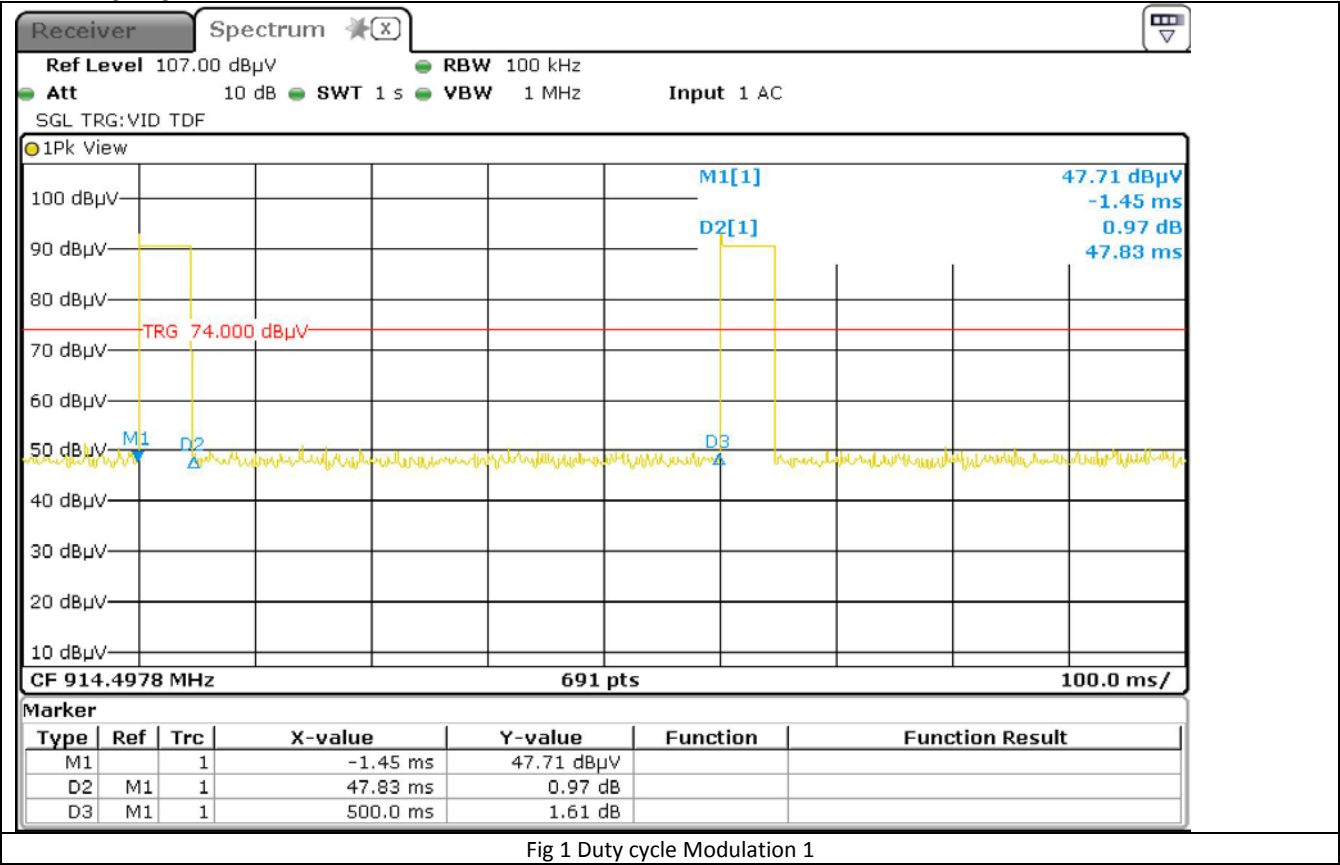
CALCULATION

*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)
-6.8

Duty Cycle Modulation 1



3.2.2 Duty Cycle Modulation 2

One Period(mS)	Pulse Width (mS)	No of Pulses	Duty Cycle	20 log duty cycle (dB)	Duty Cycle %	Test Result
100	7.974	1	0.0797	-22.0	8.0	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)
-22.0

Duty Cycle Modulation 2

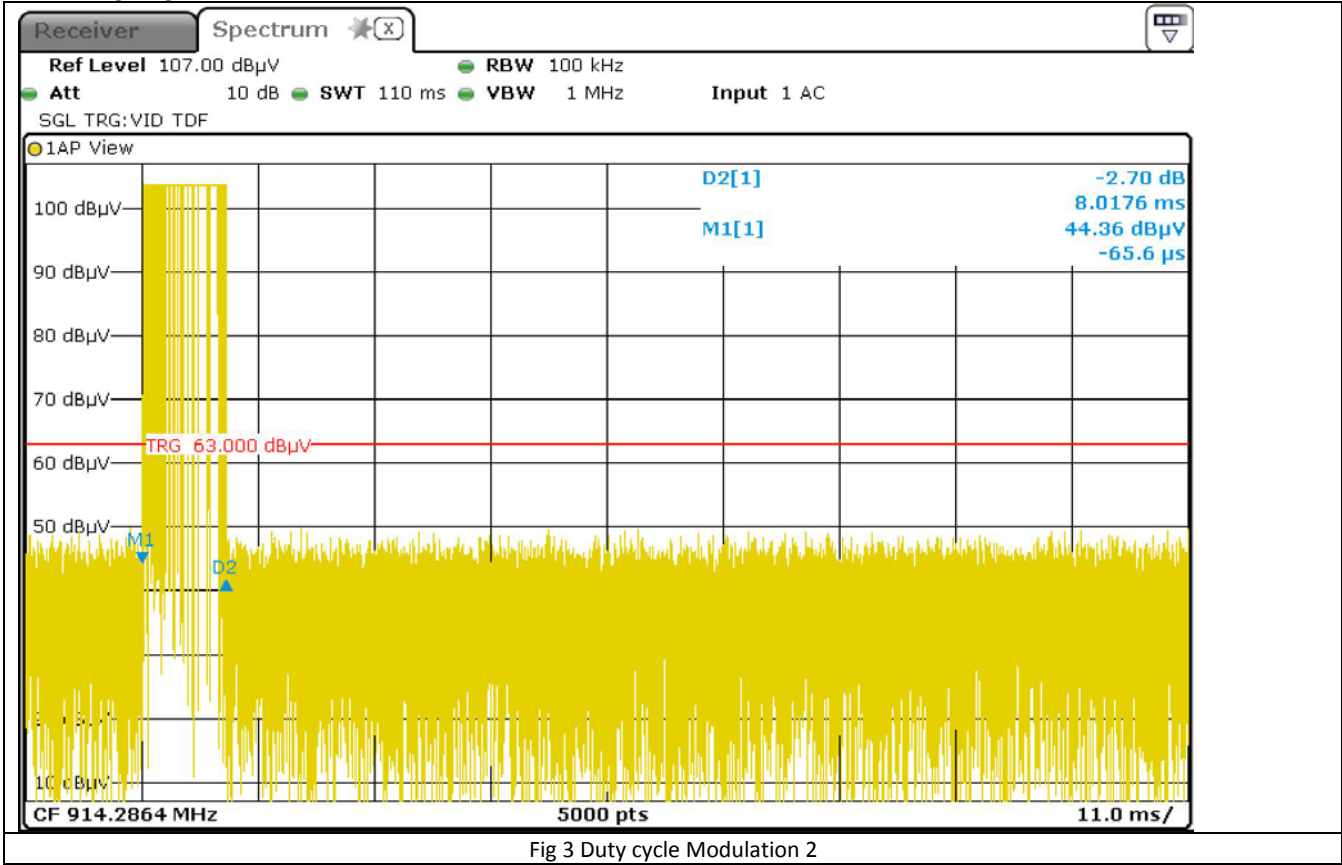


Fig 3 Duty cycle Modulation 2

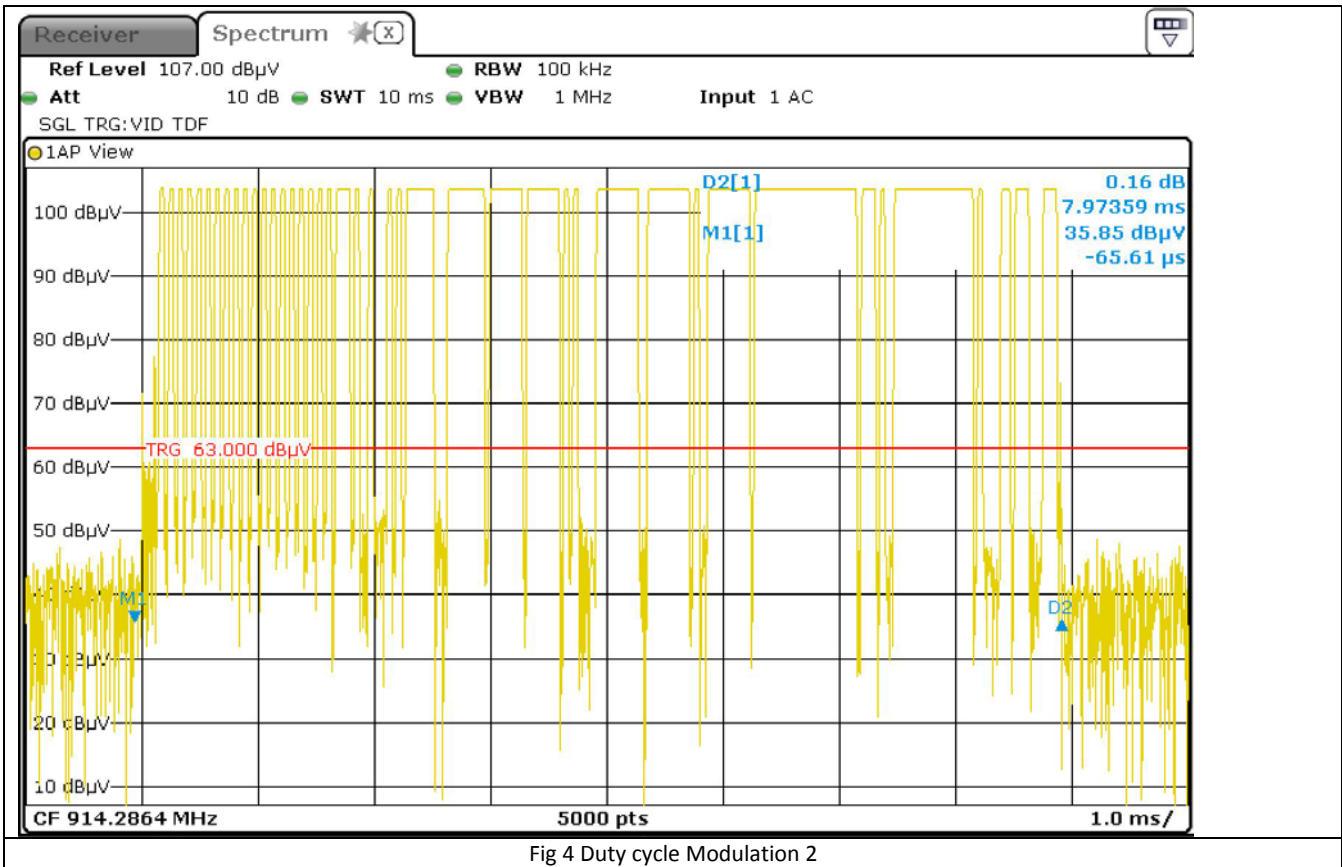


Fig 4 Duty cycle Modulation 2

3.3 Occupied Bandwidth

3.3.1 Occupied Bandwidth 20dB down

Test Criteria

Requirement :-

Bandwidth is determined at the points 20dB down from the modulated carrier.

RESULTS

3.3.1.1 Modulation 1

Operating Frequency (MHz)	20dB Bandwidth (kHz)
914.496	201.8

3.3.1.2 Modulation 2

Operating Frequency (MHz)	20dB Bandwidth (kHz)
914.496	539.6

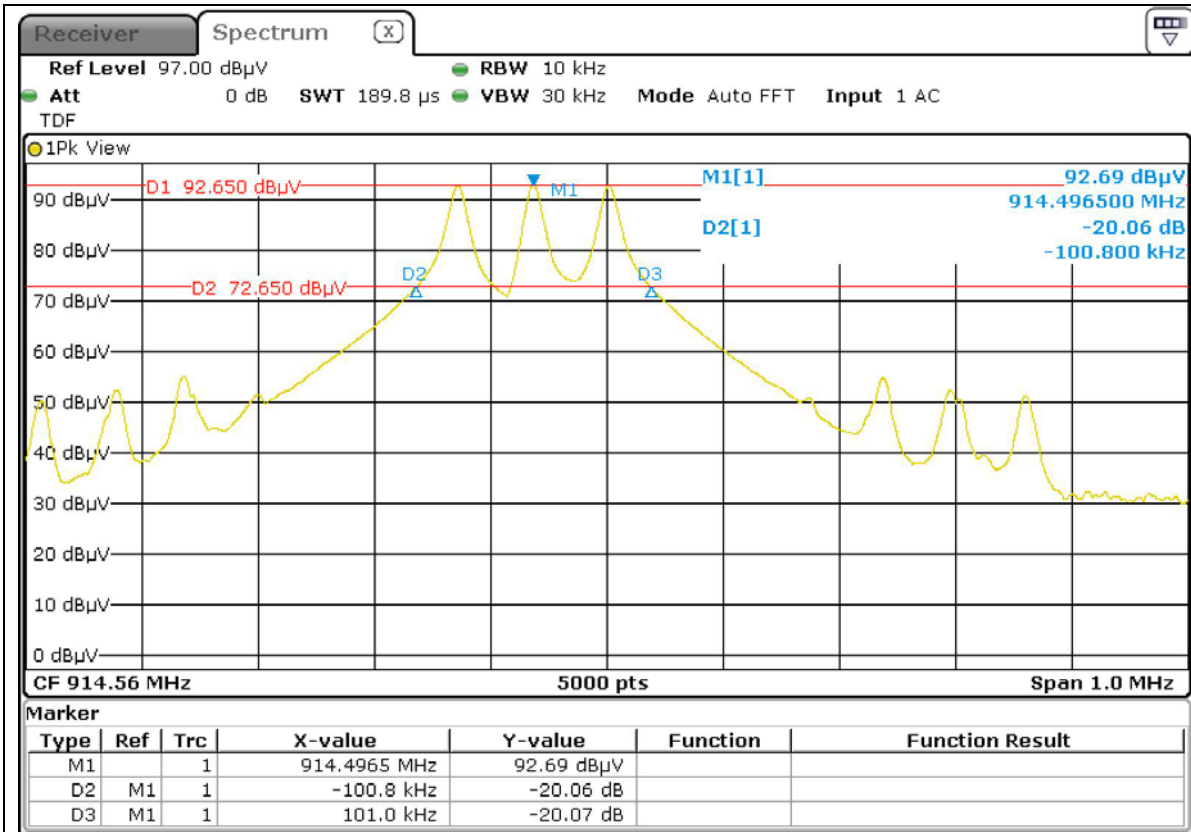


Fig 5 Occupied bandwidth 20dB Modulation 1

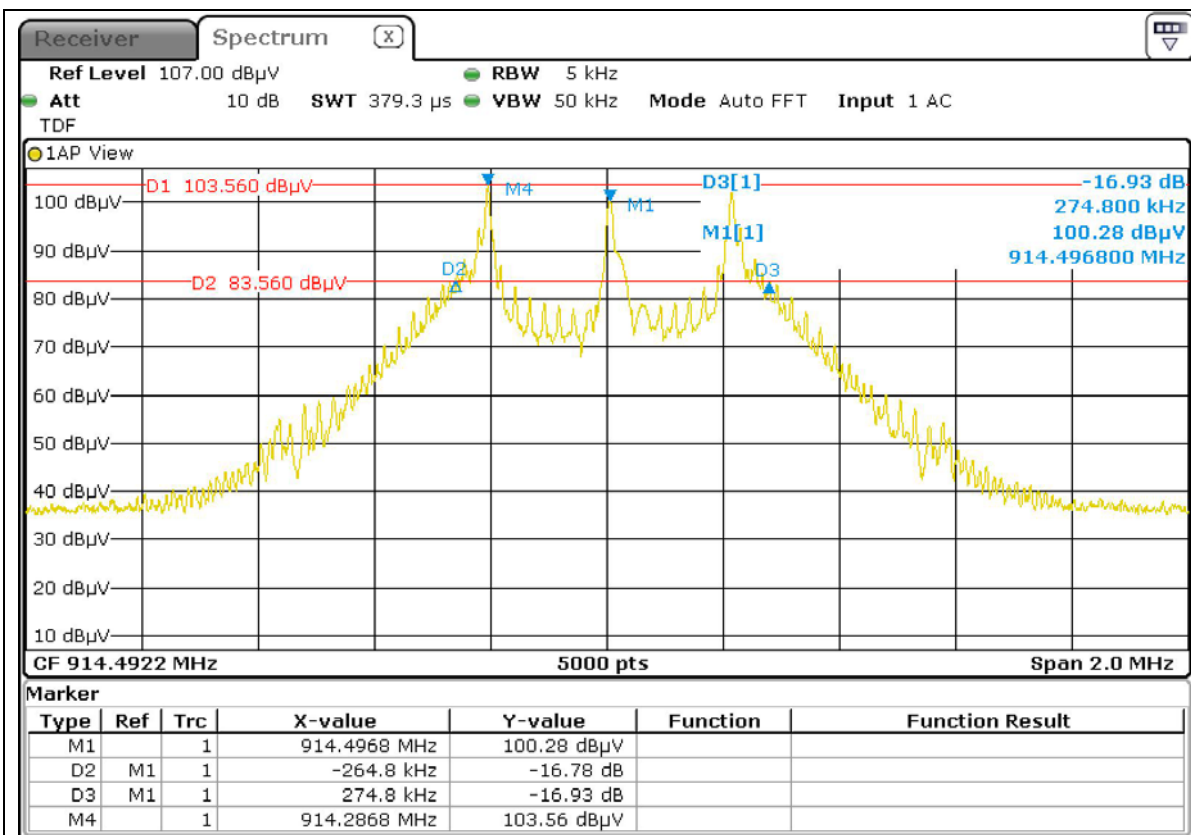


Fig 6 Occupied bandwidth 20dB Modulation 2

3.3.2 Occupied Bandwidth 99%

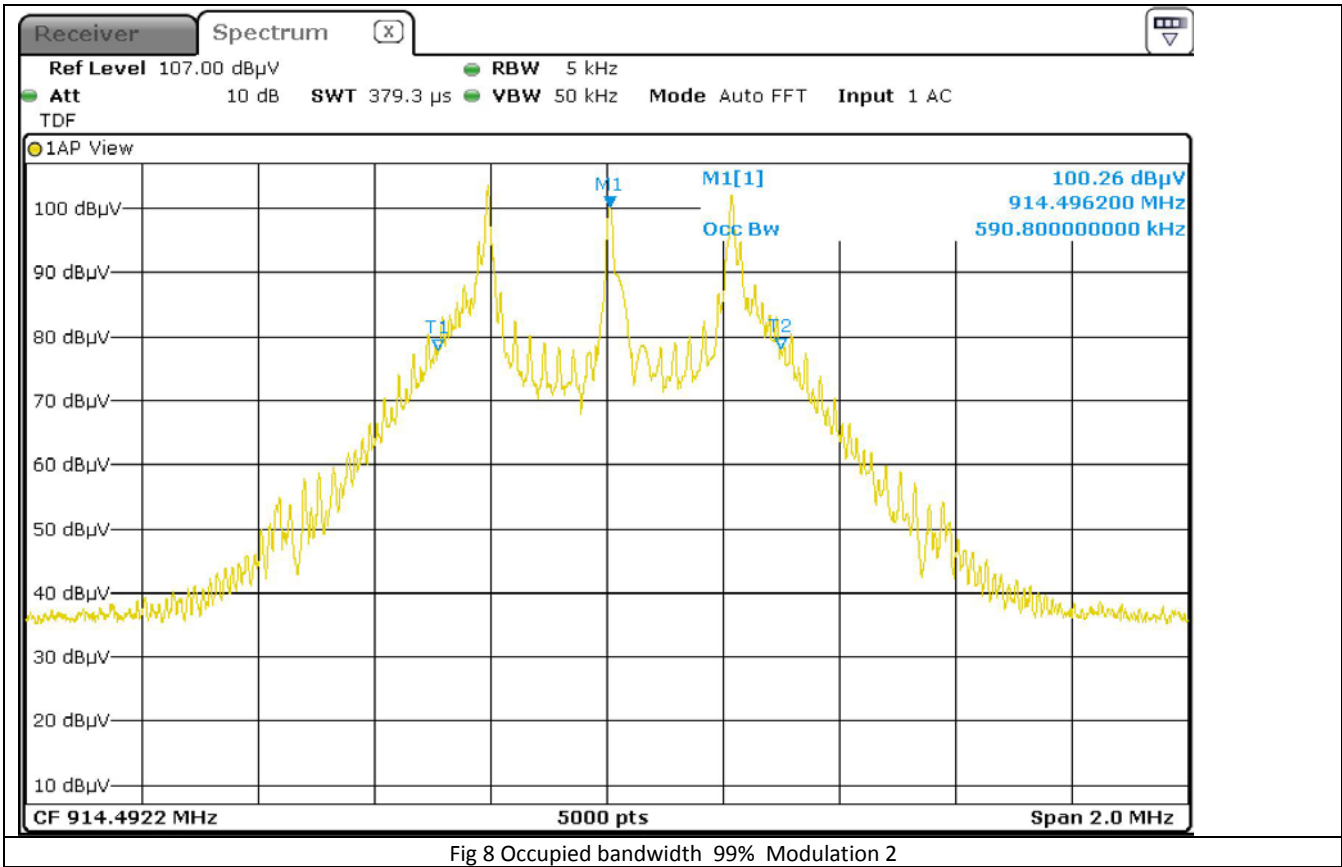
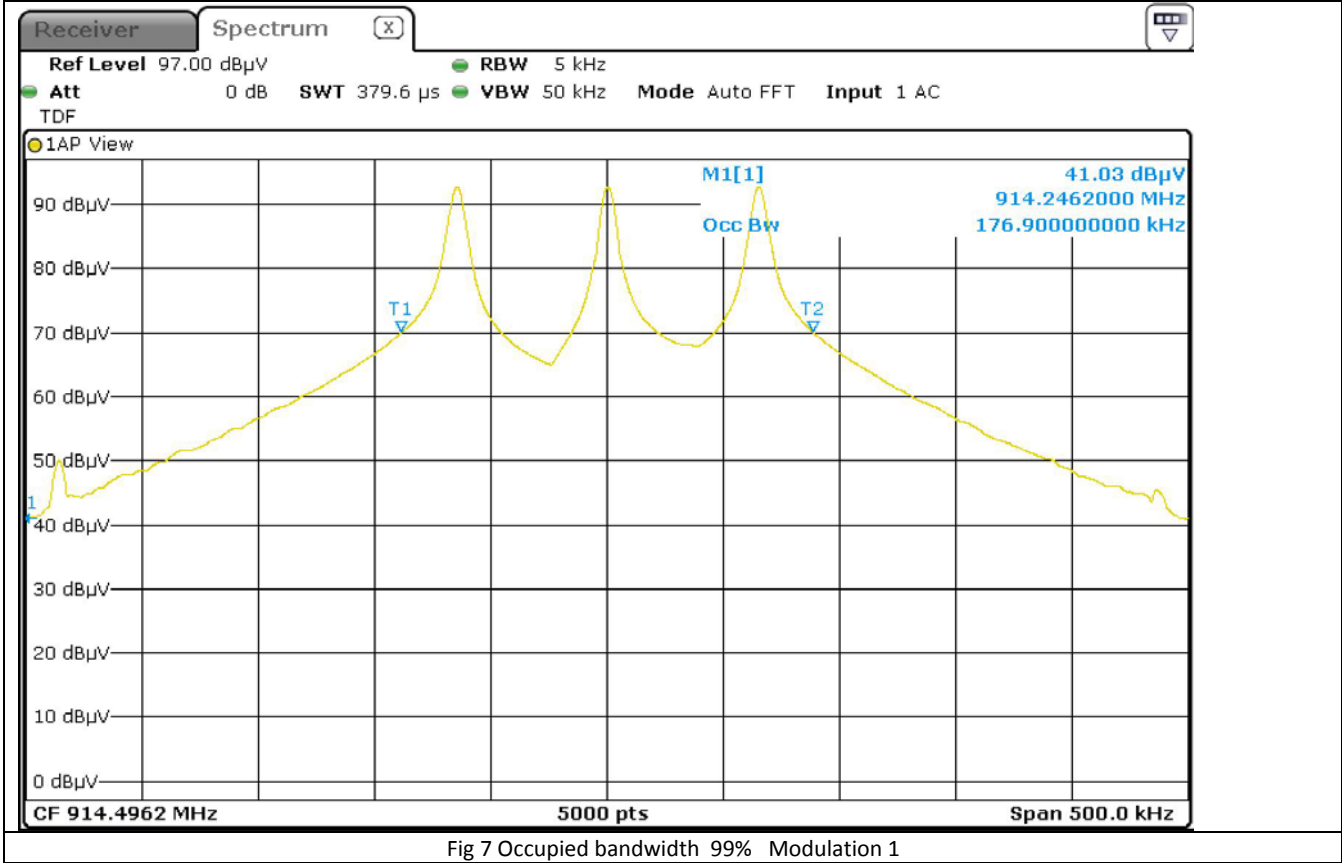
3.3.2.1 Modulation 1

Operating Frequency (MHz)	20dB Bandwidth (kHz)
914.496	176.9

3.3.2.2 Modulation 2

Operating Frequency (MHz)	20dB Bandwidth (kHz)
914.496	590.8

3.2 Occupied Bandwidth 99%



4 Field Strength of Spurious Radiated Emissions

Test Specification: FCC PART 15, SECTION 47 CFR 15.249(d) & IC RSS-210 Issue 8 A2.9

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation

Note this is the Average limit for 3 metre measurement.

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 Spurious Emissions Measurements (30MHz to 1GHz)

4.1.1.1 Modulation 1

No peaks evident

4.1.1.2 Modulation 2

No peaks evident

Result: Pass

4.1.2 Horn antenna measurements >1GHz

4.1.2.1 Modulation1 Harmonic Spurious Emissions

Frequency	Reading Peak	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain	Cable loss	Final Field Strength Peak	Average Limit	Margin for Peak v Ave Limit +20dB
GHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBuV/m	dB
1.839	53.6	O1	Vertical	24.8	38.6	1.6	41.4	54.0	32.6
2.743	56.6	O1	Vertical	29.4	38.4	3.8	51.4	54.0	22.6
3.658	53.0	O1	Vertical	30.6	37.6	4.6	50.6	54.0	23.4
4.572	49.9	O1	Vertical	32.3	37	5	50.2	54.0	23.8
5.487	54.2	O1	Vertical	34.2	37.5	5.6	56.5	54.0	17.5
6.402	52.3	O1	Vertical	34.2	36.8	6.8	56.5	54.0	17.5
7.316	47.5	O1	Vertical	37.7	38	6.7	53.9	54.0	20.1
8.230	51.2	O1	Vertical	37.3	37.5	6.7	57.7	54.0	16.3
9.145	50.0	O1	Vertical	37.9	37	7.1	58.0	54.0	16.0
1.839	53.0	O2	Horizontal	24.8	38.6	1.6	40.8	54.0	33.2
2.743	58.5	O2	Horizontal	29.4	38.4	3.8	53.3	54.0	20.7
3.658	51.5	O2	Horizontal	30.6	37.6	4.6	49.1	54.0	24.9
4.572	50.6	O2	Horizontal	32.3	37	5	50.9	54.0	23.1
5.487	49.9	O2	Horizontal	34.2	37.5	5.6	52.2	54.0	21.8
6.402	48.0	O2	Horizontal	34.2	36.8	6.8	52.2	54.0	21.8
7.316	48.6	O2	Horizontal	37.7	38	6.7	55.0	54.0	19.0
8.230	48.1	O2	Horizontal	37.3	37.5	6.7	54.6	54.0	19.4
9.145	48.6	O2	Horizontal	37.9	37	7.1	56.6	54.0	17.4

Frequency	Final Field Strength Peak	EUT Orientation	Antenna Polarity	Average Level (Peak plus - 6.8dB Duty Cycle factor)	Average Limit	Margin
GHz	dBuV/m		V/H	dBuV/m	dBuV/m	dB
1.839	41.4	O1	Vertical	34.6	54.0	19.4
2.743	51.4	O1	Vertical	44.6	54.0	9.4
3.658	50.6	O1	Vertical	43.8	54.0	10.2
4.572	50.2	O1	Vertical	43.3	54.0	10.7
5.487	56.5	O1	Vertical	49.7	54.0	4.3
6.402	56.5	O1	Vertical	49.6	54.0	4.4
7.316	53.9	O1	Vertical	47.1	54.0	6.9
8.230	57.7	O1	Vertical	50.9	54.0	3.1
9.145	58.0	O1	Vertical	51.2	54.0	2.8
1.839	40.8	O2	Horizontal	34.0	54.0	20
2.743	53.3	O2	Horizontal	46.5	54.0	7.5
3.658	49.1	O2	Horizontal	42.3	54.0	11.7
4.572	50.9	O2	Horizontal	44.0	54.0	10
5.487	52.2	O2	Horizontal	45.4	54.0	8.6
6.402	52.2	O2	Horizontal	45.4	54.0	8.6
7.316	55.0	O2	Horizontal	48.1	54.0	5.9
8.230	54.6	O2	Horizontal	47.7	54.0	6.3
9.145	56.6	O2	Horizontal	49.8	54.0	4.2

Result: Pass

4.1.2.2 Modulation1 Non-Harmonic Spurious Emissions

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
1.8869	57.5	24.8	38.6	1.6	Horizontal	O2	45.3	74.0	28.7

Note as the peak reading was lower than the Average limit (54dBuV/m) the Average test was not carried out.

4.1.2.3 Modulation2 Harmonic Spurious Emissions

Frequency	Reading Peak	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain	Cable loss	Final Field Strength Peak	Average Limit	Margin for Peak v Ave Limit +20dB
GHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBuV/m	dB
1.829	48.6	O1	Vertical	24.8	38.6	1.6	36.4	54.0	37.6
2.743	60.8	O1	Vertical	29.4	38.4	3.8	55.6	54.0	18.4
3.654	65.2	O1	Vertical	30.6	37.6	4.6	62.8	54.0	11.2
4.572	59.6	O1	Vertical	32.3	37	5	59.9	54.0	14.1
5.484	53.6	O1	Vertical	34.2	37.5	5.6	55.9	54.0	18.1
6.402	56.5	O1	Vertical	34.2	36.8	6.8	60.7	54.0	13.3
7.314	53.9	O1	Vertical	37.7	38	6.7	60.3	54.0	13.7
8.223	47.9	O1	Vertical	37.3	37.5	6.7	54.4	54.0	19.6
9.145	46.9	O1	Vertical	37.9	37	7.1	54.9	54.0	19.1
1.829	55.2	O2	Horizontal	24.8	38.6	1.6	43.0	54.0	31.0
2.743	72.6	O2	Horizontal	29.4	38.4	3.8	67.4	54.0	6.6
3.654	66.5	O2	Horizontal	30.6	37.6	4.6	64.1	54.0	9.9
4.572	60.3	O2	Horizontal	32.3	37	5	60.6	54.0	13.4
5.484	55.2	O2	Horizontal	34.2	37.5	5.6	57.5	54.0	16.5
6.402	52.3	O2	Horizontal	34.2	36.8	6.8	56.5	54.0	17.5
7.314	51.6	O2	Horizontal	37.7	38	6.7	58.0	54.0	16.0
8.223	53.2	O2	Horizontal	37.3	37.5	6.7	59.7	54.0	14.3
9.145	52.9	O2	Horizontal	37.9	37	7.1	60.9	54.0	13.1

Frequency	Final Field Strength Peak	EUT Orientation	Antenna Polarity	Average Level (Peak plus -22dB Duty Cycle factor)	Average Limit	Margin
GHz	dBuV/m		V/H	dBuV/m	dBuV/m	dB
1.829	36.4	O1	Vertical	14.4	54.0	39.6
2.743	55.6	O1	Vertical	33.6	54.0	20.4
3.654	62.8	O1	Vertical	40.8	54.0	13.2
4.572	59.9	O1	Vertical	37.9	54.0	16.1
5.484	55.9	O1	Vertical	34.0	54.0	20
6.402	60.7	O1	Vertical	38.8	54.0	15.2
7.314	60.3	O1	Vertical	38.4	54.0	15.6
8.223	54.4	O1	Vertical	32.4	54.0	21.6
9.145	54.9	O1	Vertical	33.0	54.0	21
1.829	43.0	O2	Horizontal	21.0	54.0	33
2.743	67.4	O2	Horizontal	45.4	54.0	8.6
3.654	64.1	O2	Horizontal	42.2	54.0	11.8
4.572	60.6	O2	Horizontal	38.6	54.0	15.4
5.484	57.5	O2	Horizontal	35.5	54.0	18.5
6.402	56.5	O2	Horizontal	34.6	54.0	19.4
7.314	58.0	O2	Horizontal	36.0	54.0	18
8.223	59.7	O2	Horizontal	37.7	54.0	16.3
9.145	60.9	O2	Horizontal	38.9	54.0	15.1

4.1.2.4 Modulation2 Non-Harmonic Spurious Emissions

Frequency	Peak Level	Antenna Factor	Preamplifier 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
1.89387	56.5	24.8	38.6	1.6	Vertical	O1	44.3	74.0	29.6
1.89387	57.2	24.8	38.6	1.6	Horizontal	O2	45.0	74.0	29.0

Note as the peak readings were lower than the Average limit (54dBuV/m) the Average test was not carried out.

List of Test Equipment

Instrument	Manufacturer.	Model	CEI Ref No.	Cal Due Date
Preamplifier	Hewlett Packard	83017A	805	19/09/2016
Spectrum Analyser	Rohde & Schwarz	FSP 40	850	14/08/2017
Spectrum Analyser/Receiver	Rohde & Schwarz	ESR	869	03/06/2016
Antenna Trilog	Schwarzbeck	VULB 9160	889	29/07/2016
Anechoic Chamber	CEI	10M	845	23/09/2016
Antenna Log Periodic	Chase	UPA6108	609	11/09/2016
Horn Antenna	EMCO	3115	655	14/11/2015

Appendix A
Additional Test Results

Transmitter Spurious Emissions Modulation 1

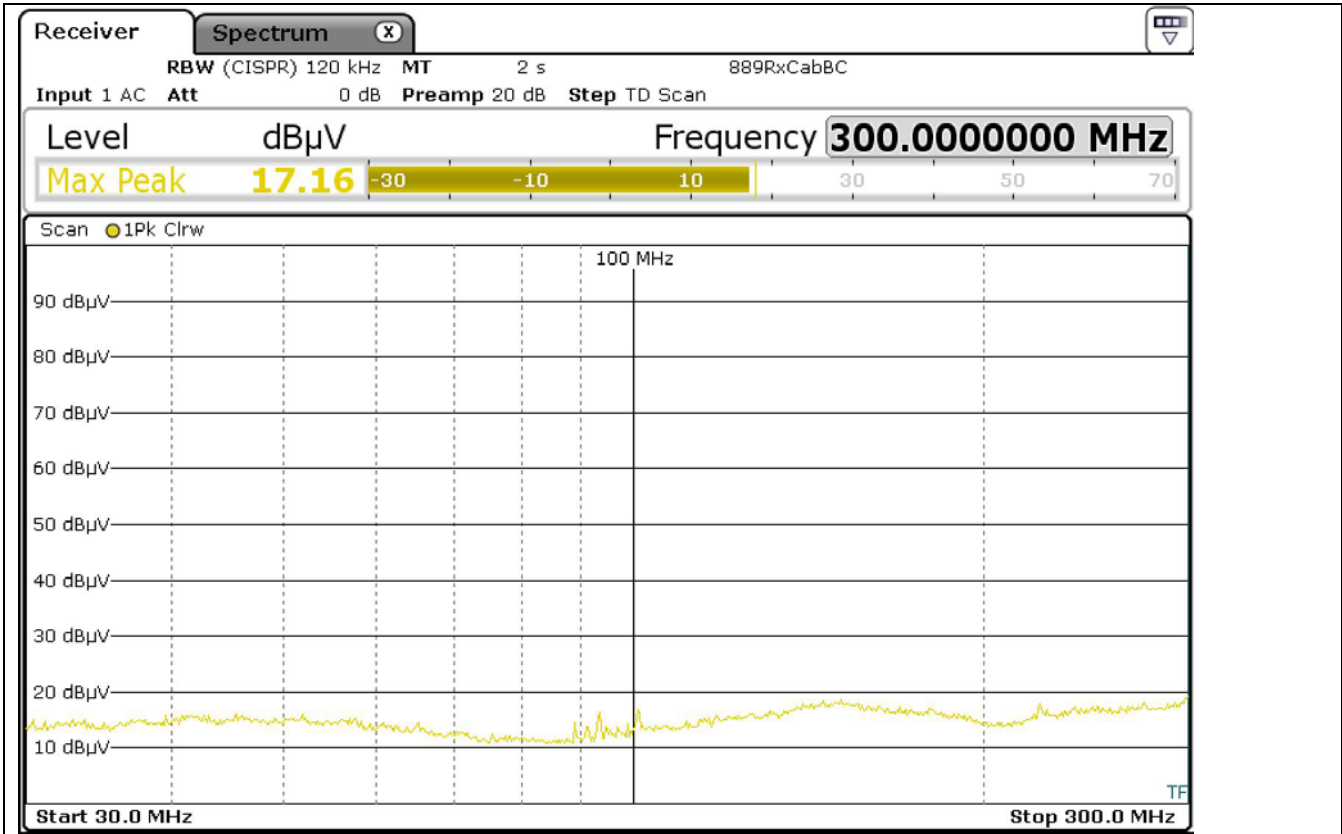


Fig A1 Scan 30MHz – 300MHz Vertical

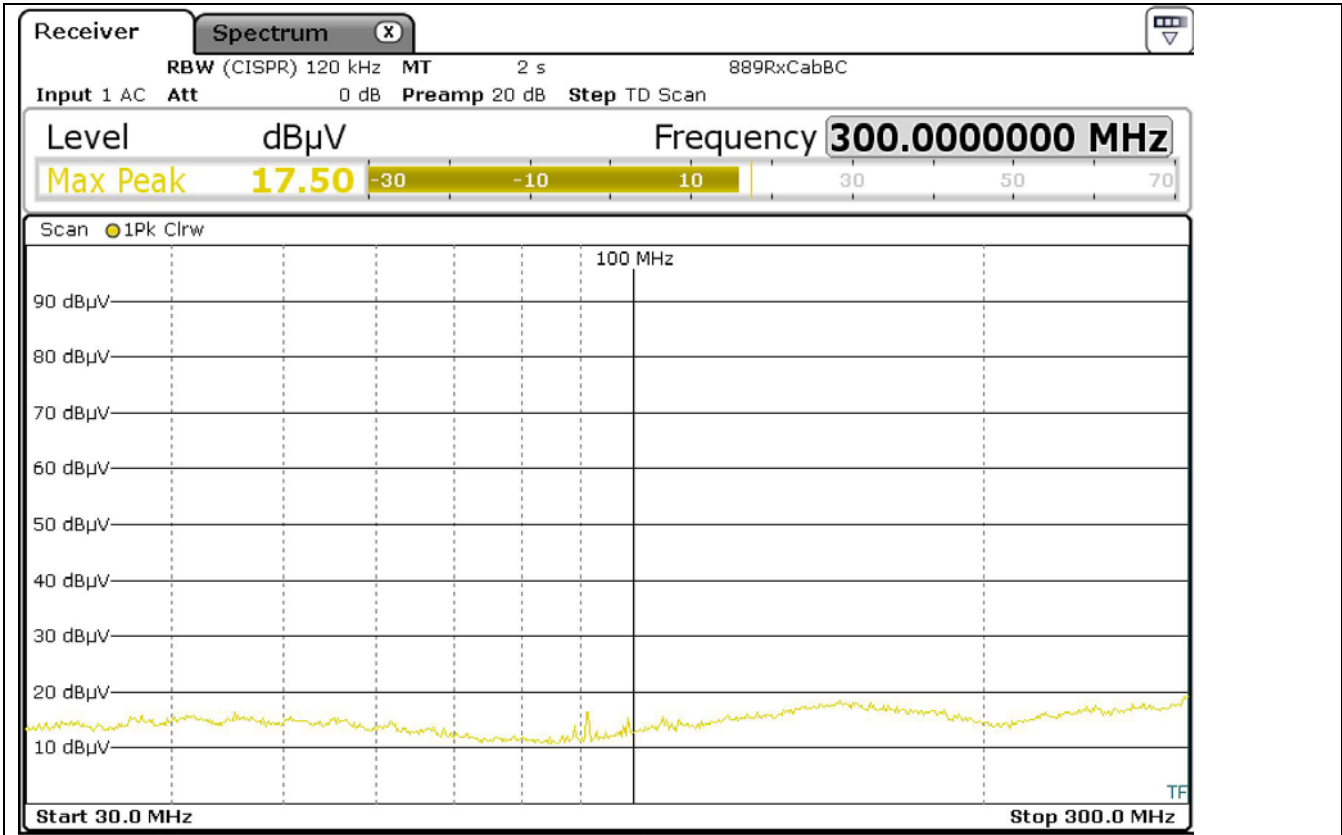
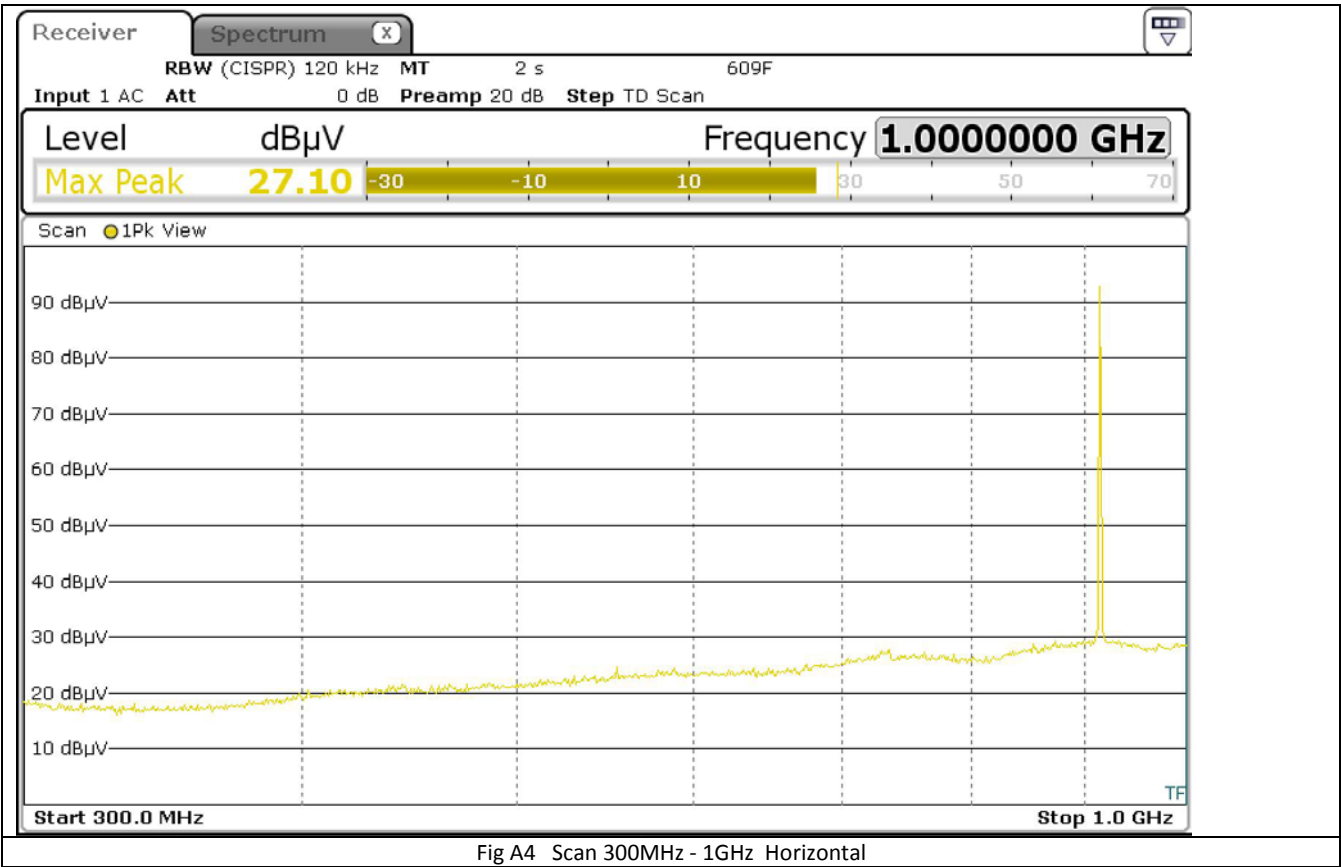
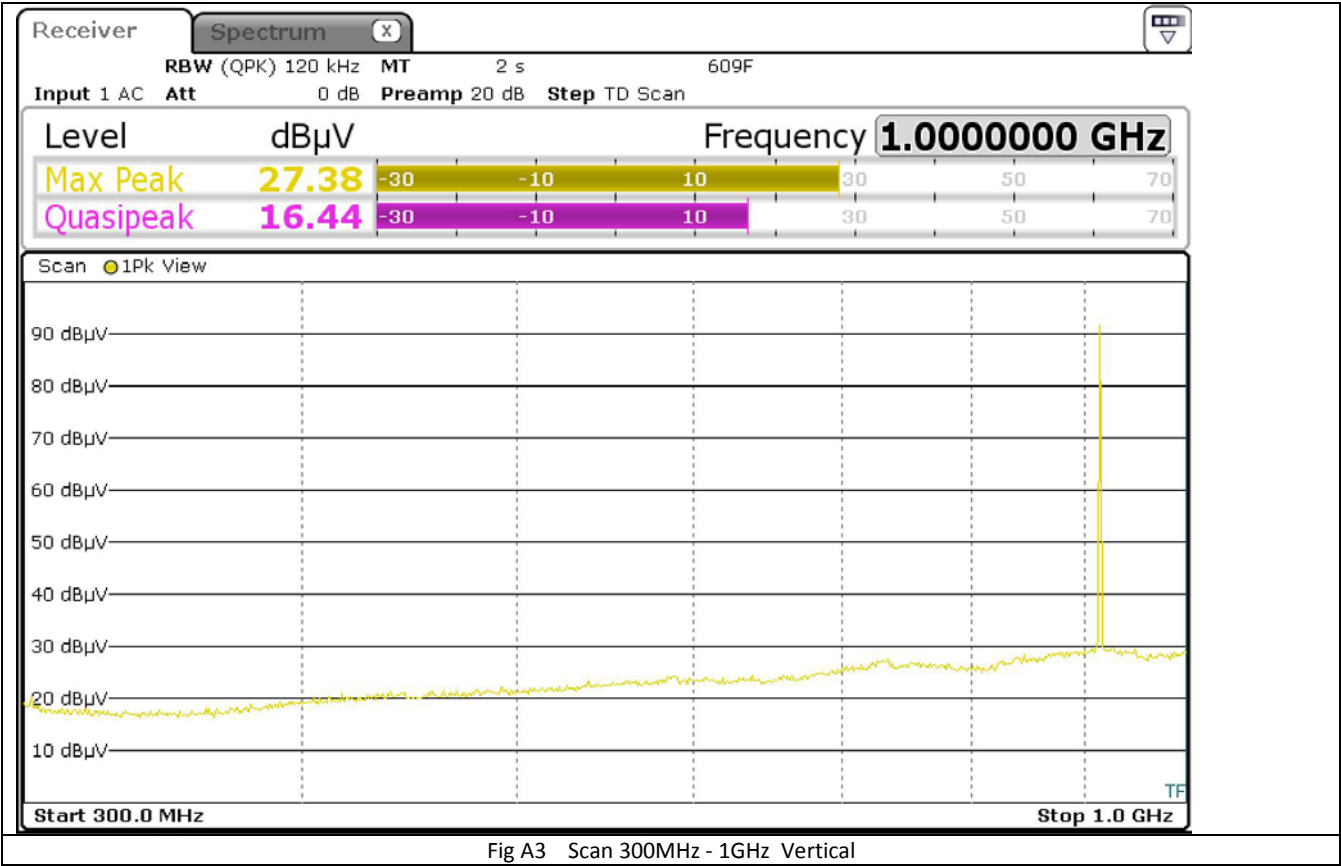
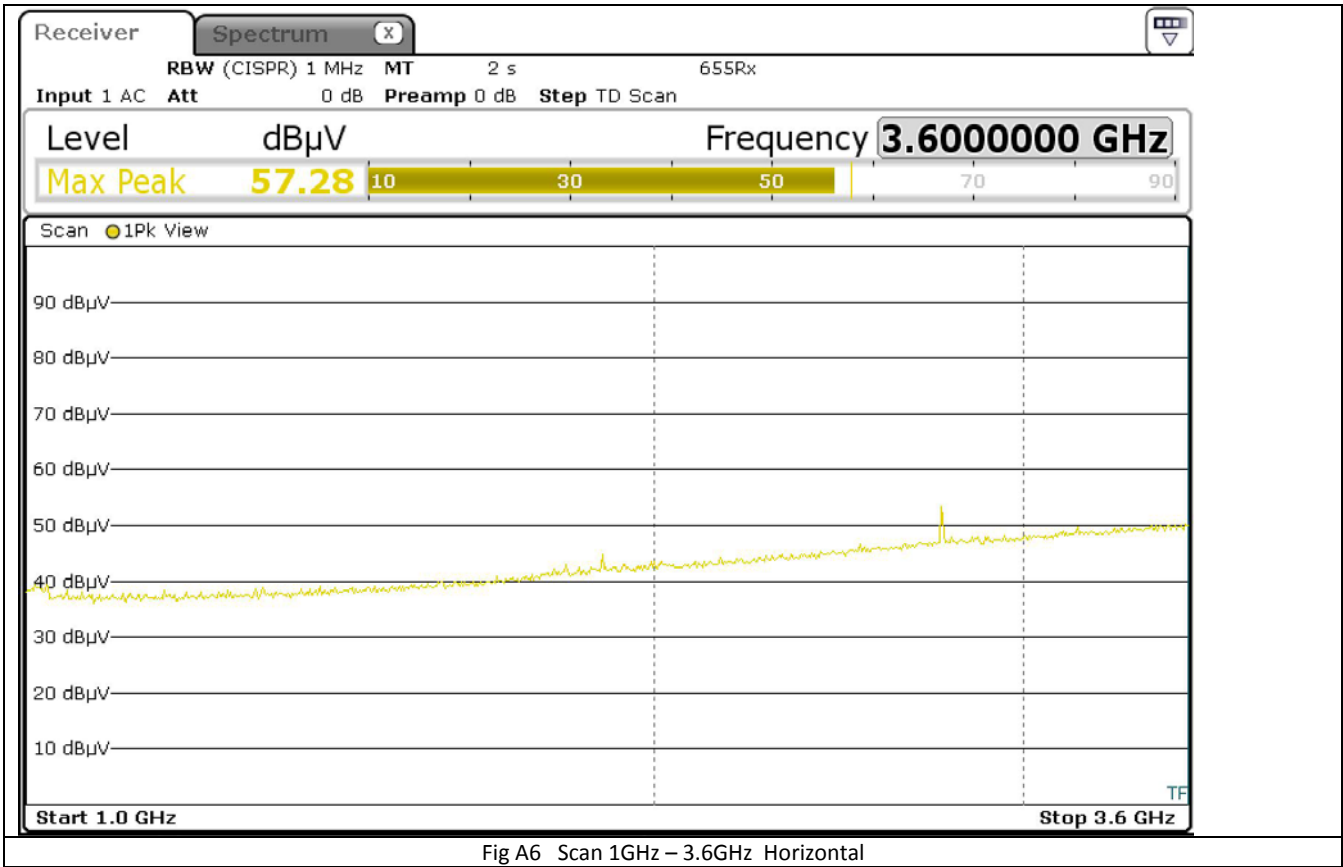
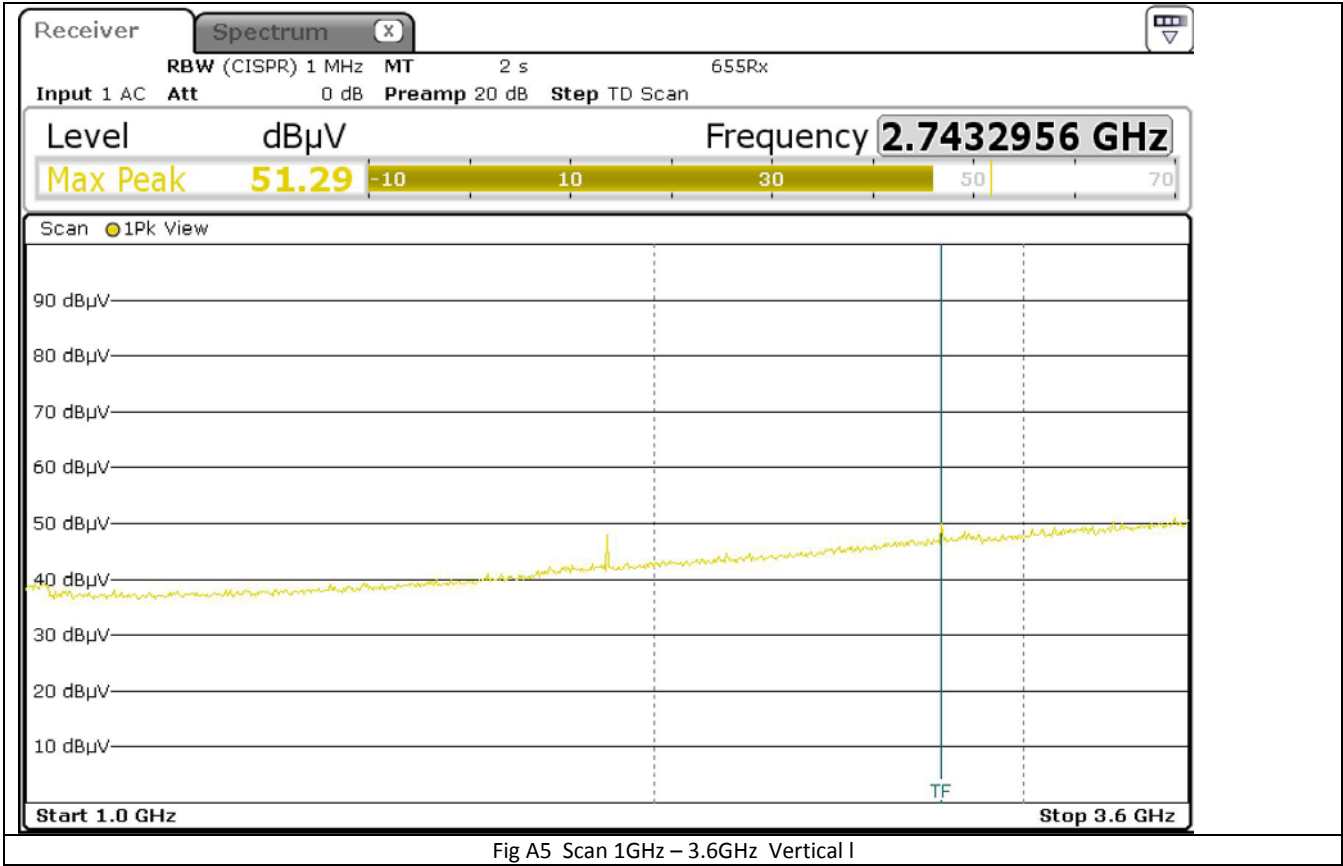


Fig A2 Scan 30MHz – 300MHz Horizontal





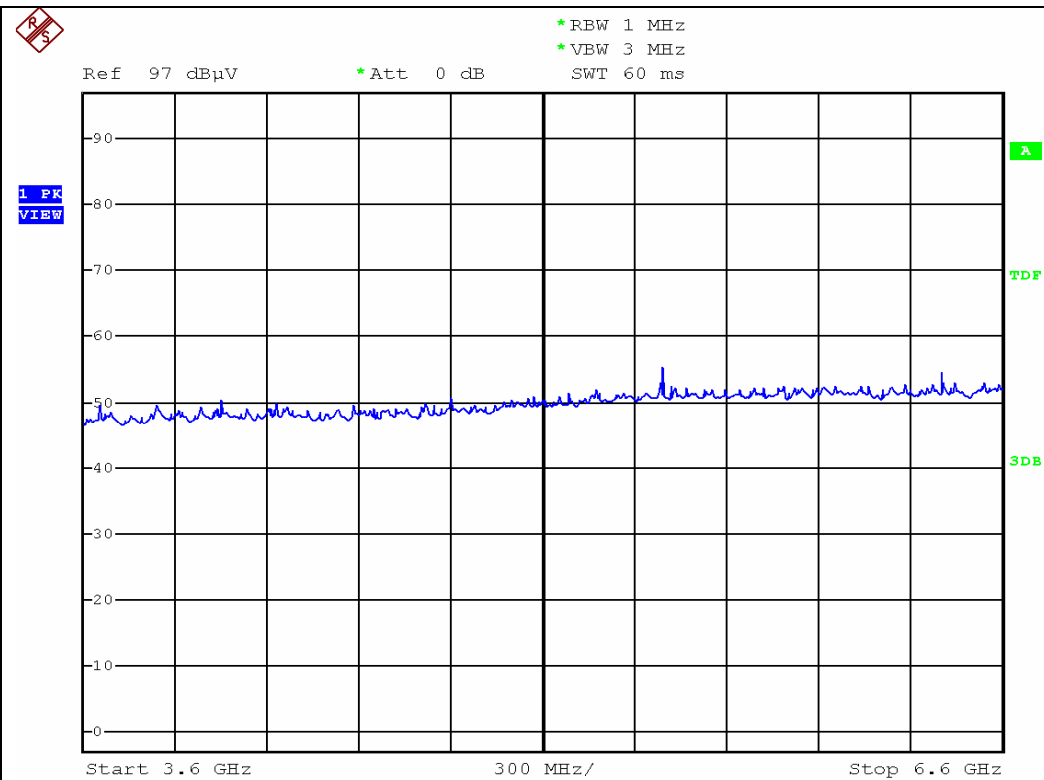


Fig A7 Scan 3.6 –6.6 GHz Vertical I

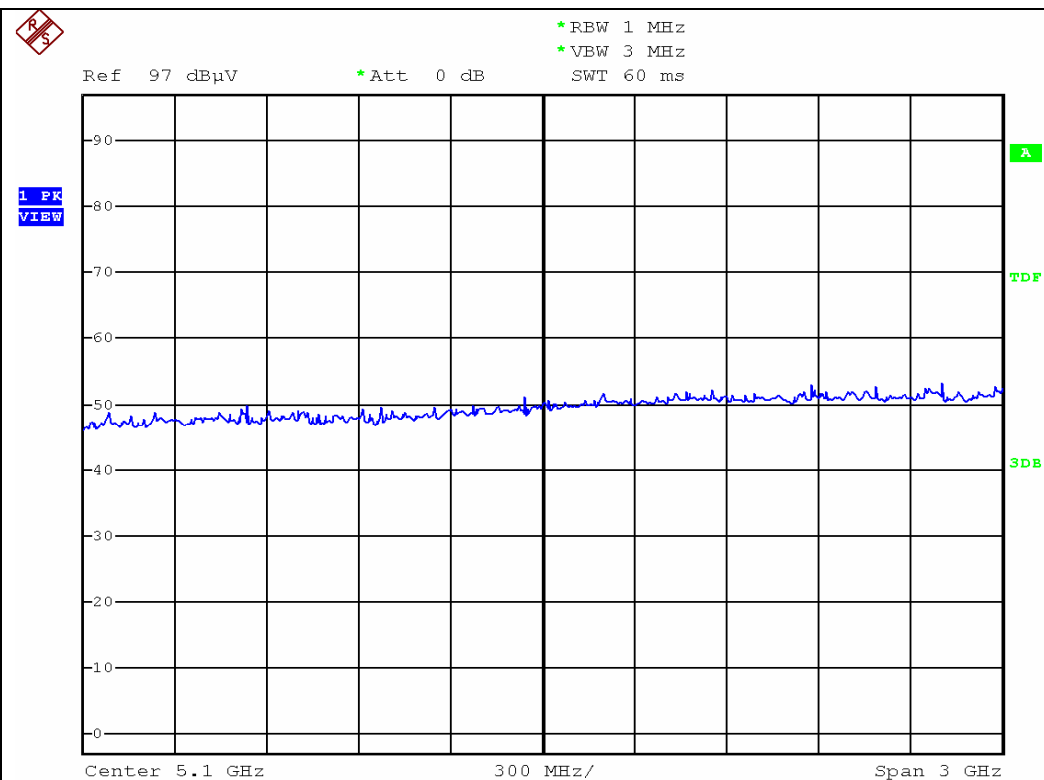


Fig A8 Scan 3.6 – 6.6GHz Horizontal

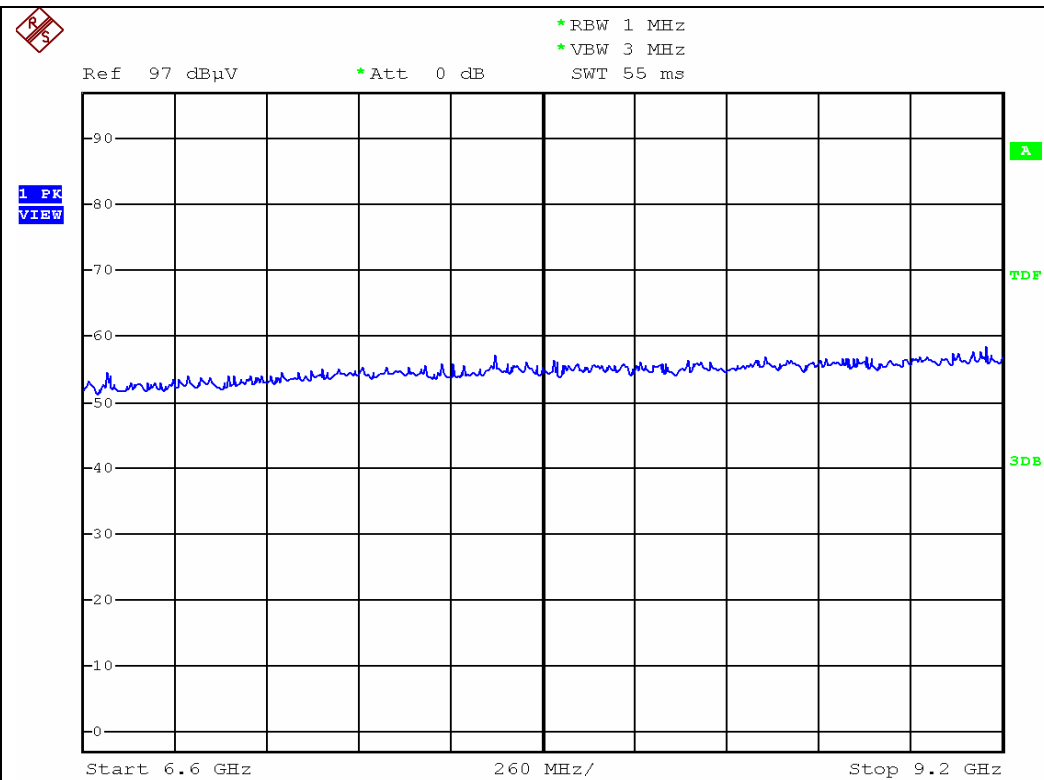


Fig A9 Scan 6.6–9.2 GHz Vertical I

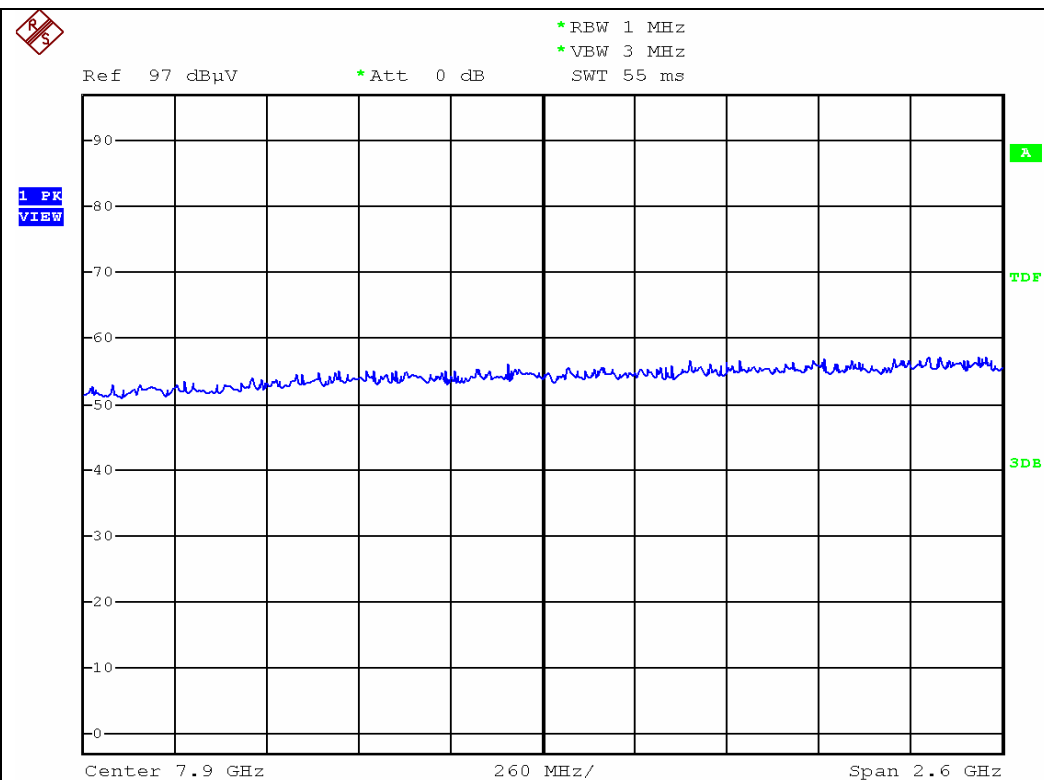


Fig A10 Scan 6.6–9.2GHz Horizontal

Appendix B
Additional Test Results

Transmitter Spurious Emissions Modulation 2

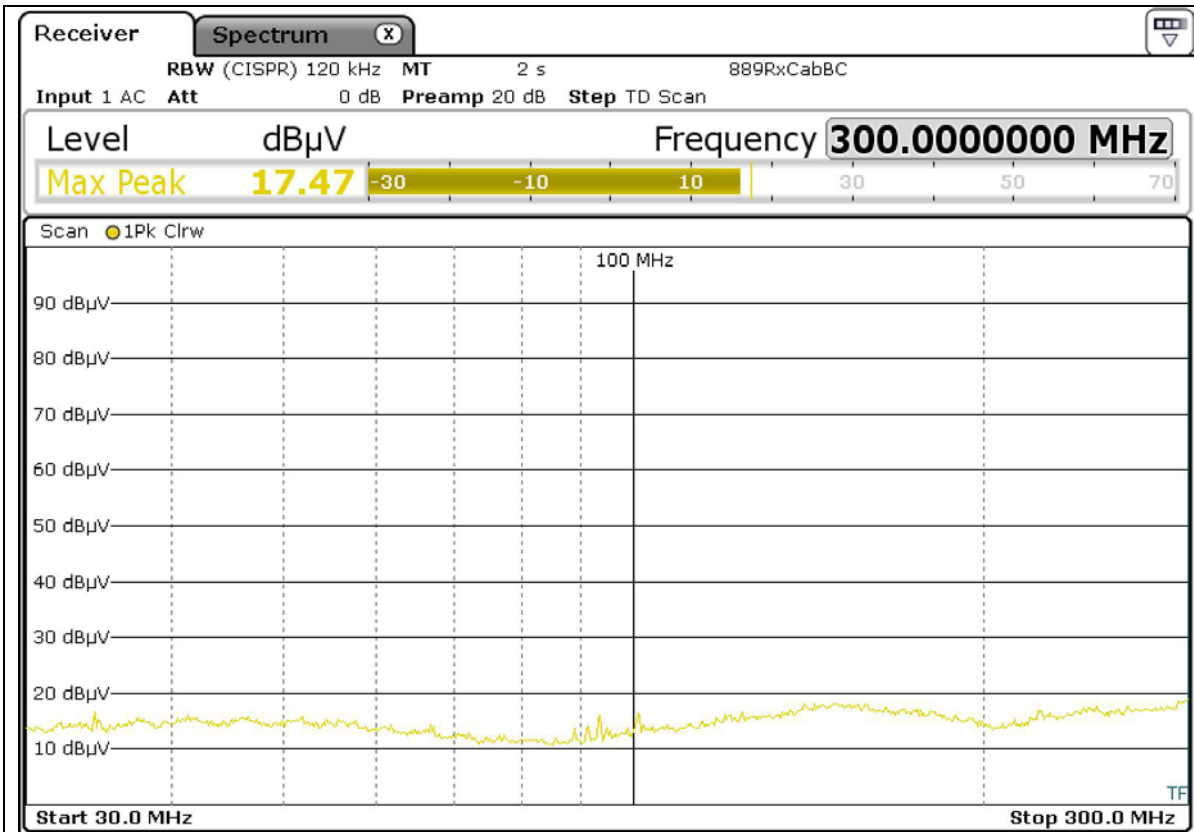


Fig B1 Scan 30MHz – 300MHz Vertical

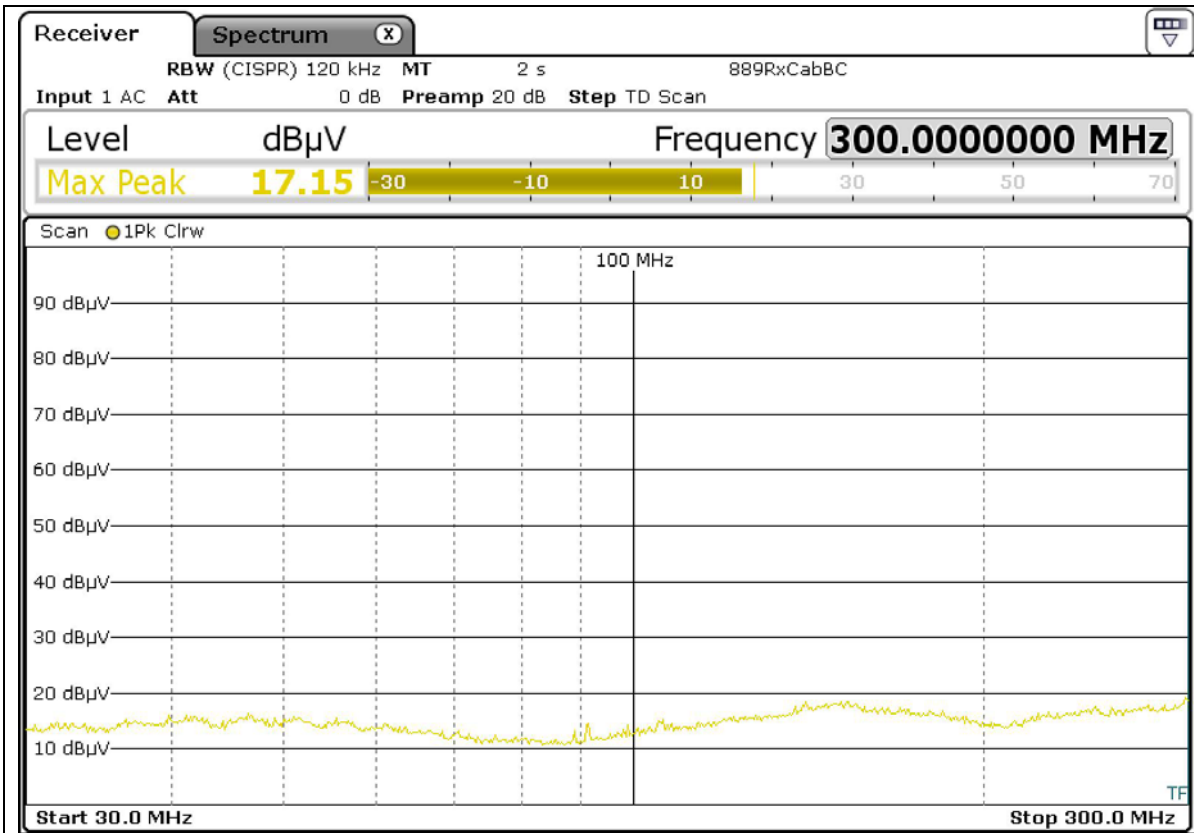
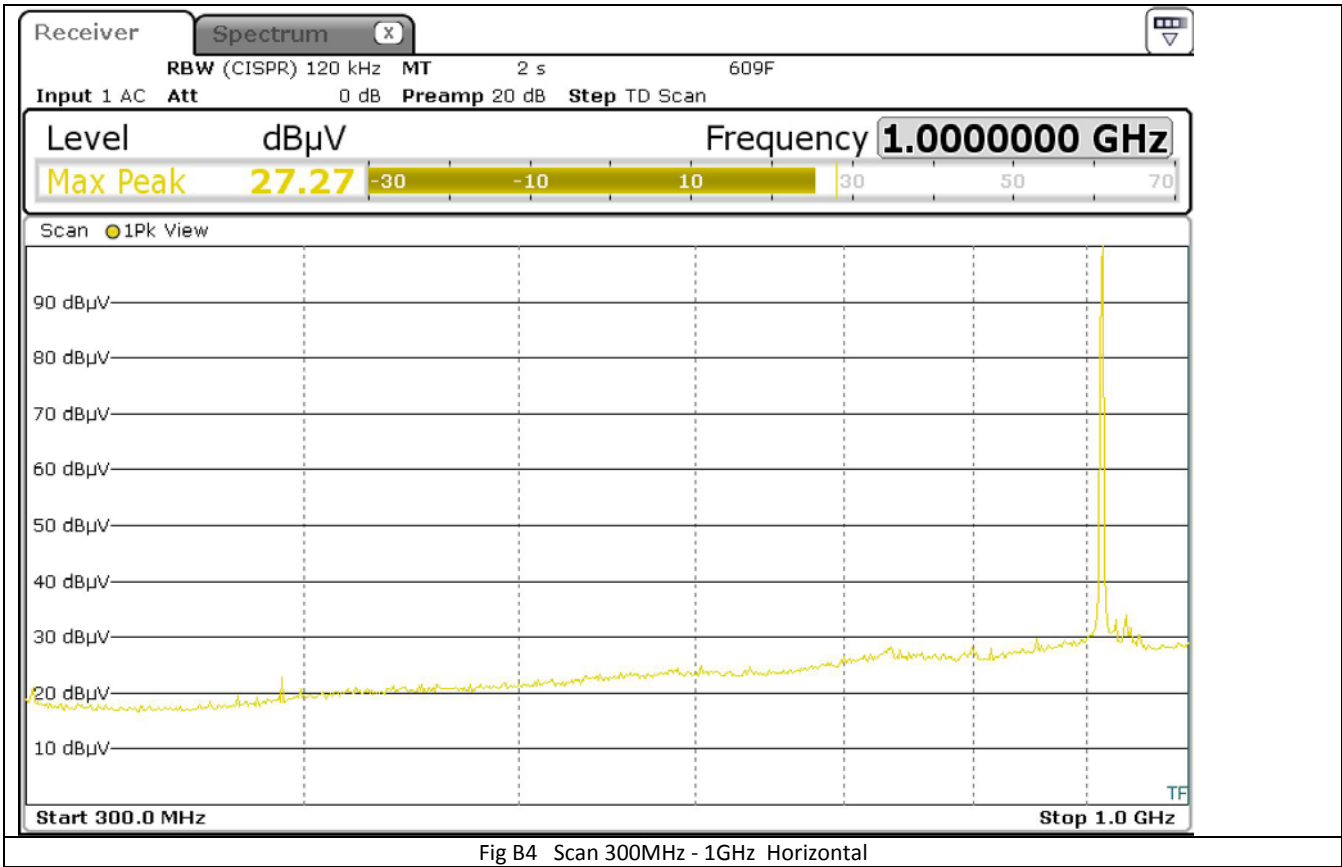
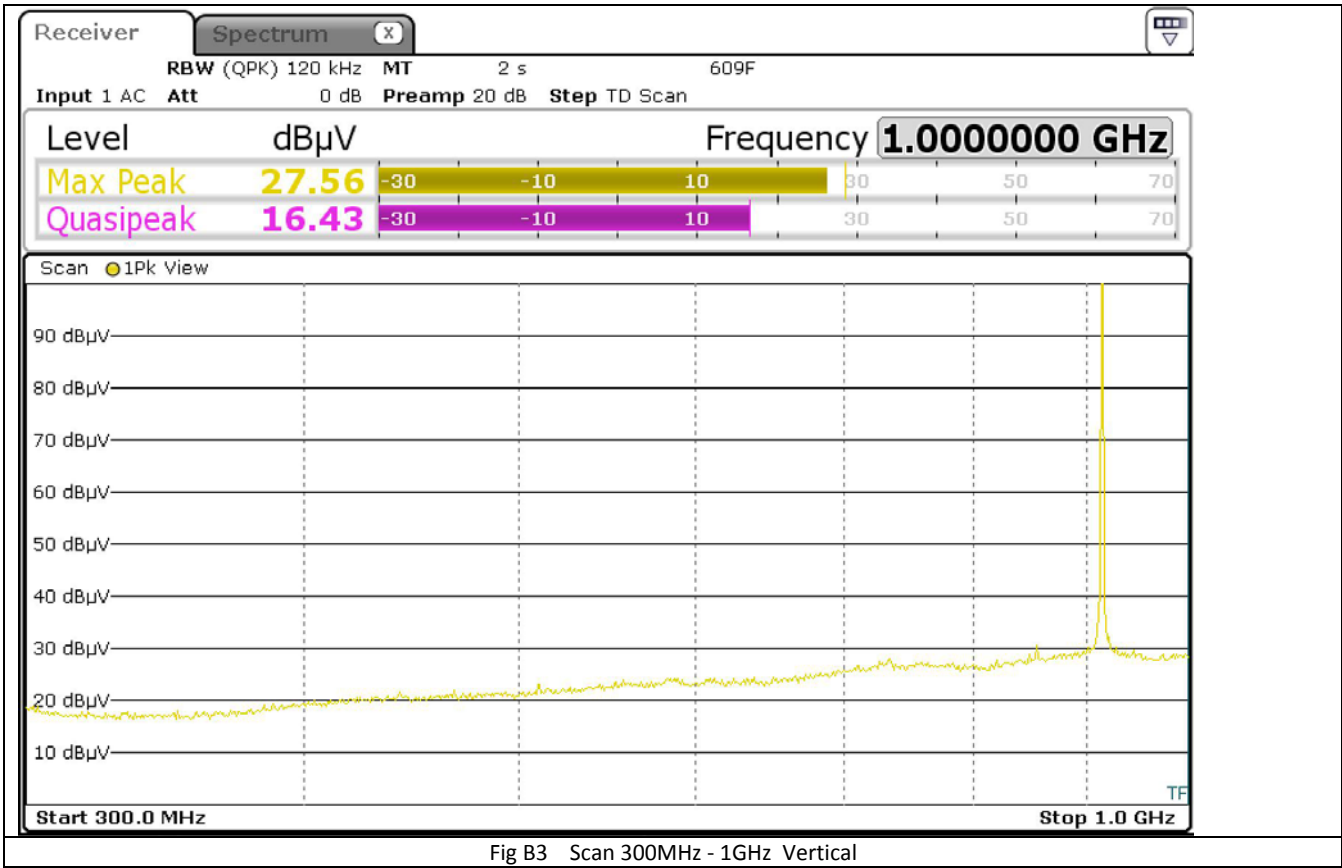
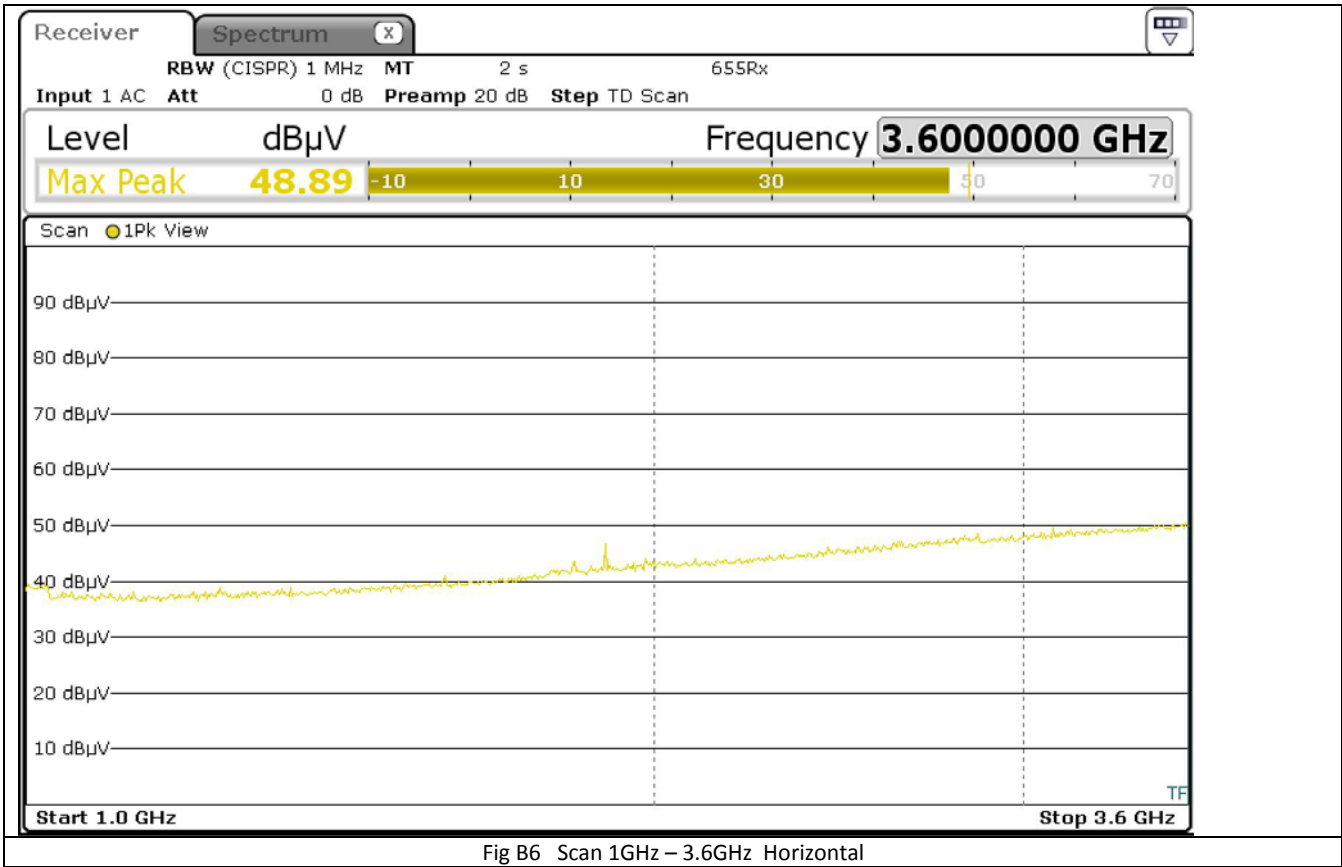
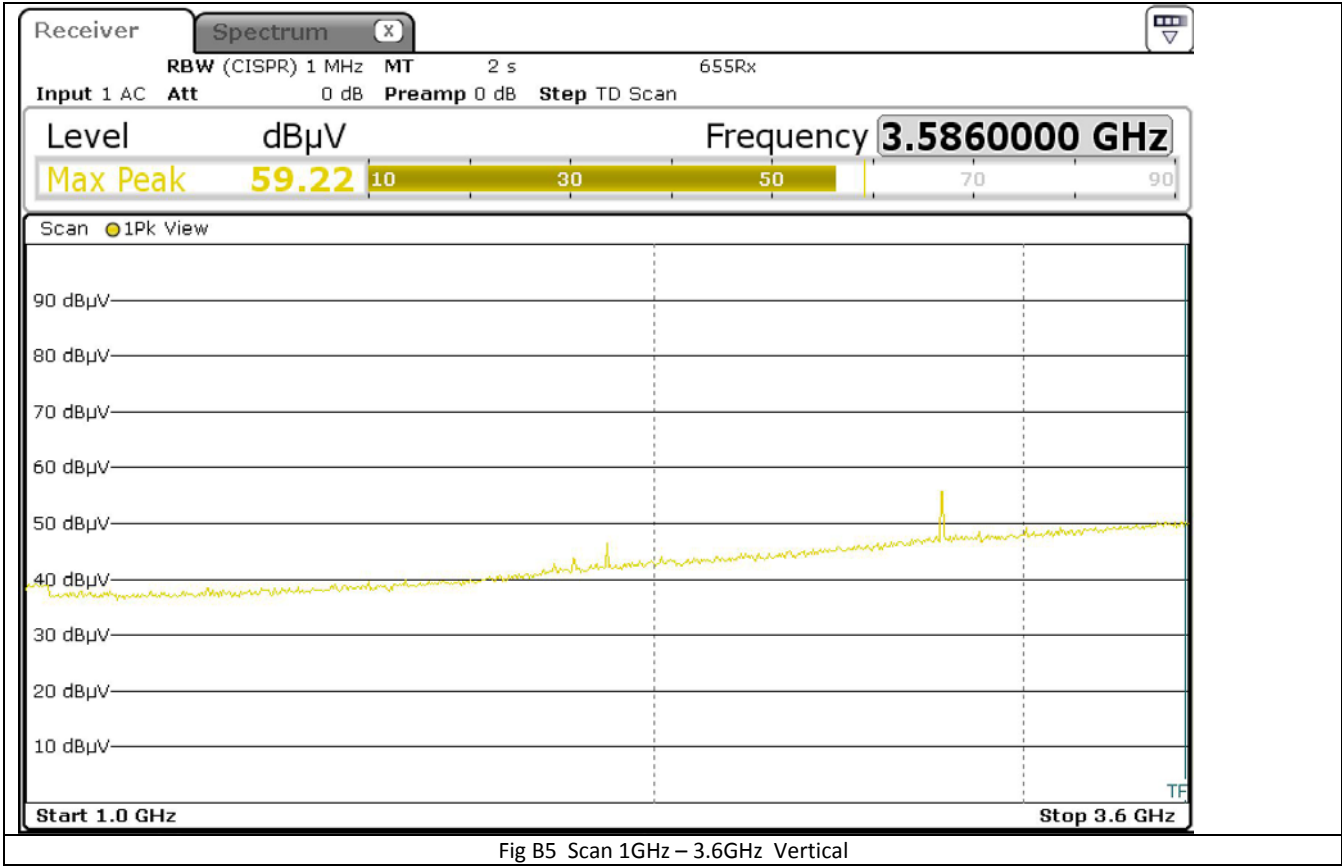


Fig B2 Scan 30MHz – 300MHz Horizontal





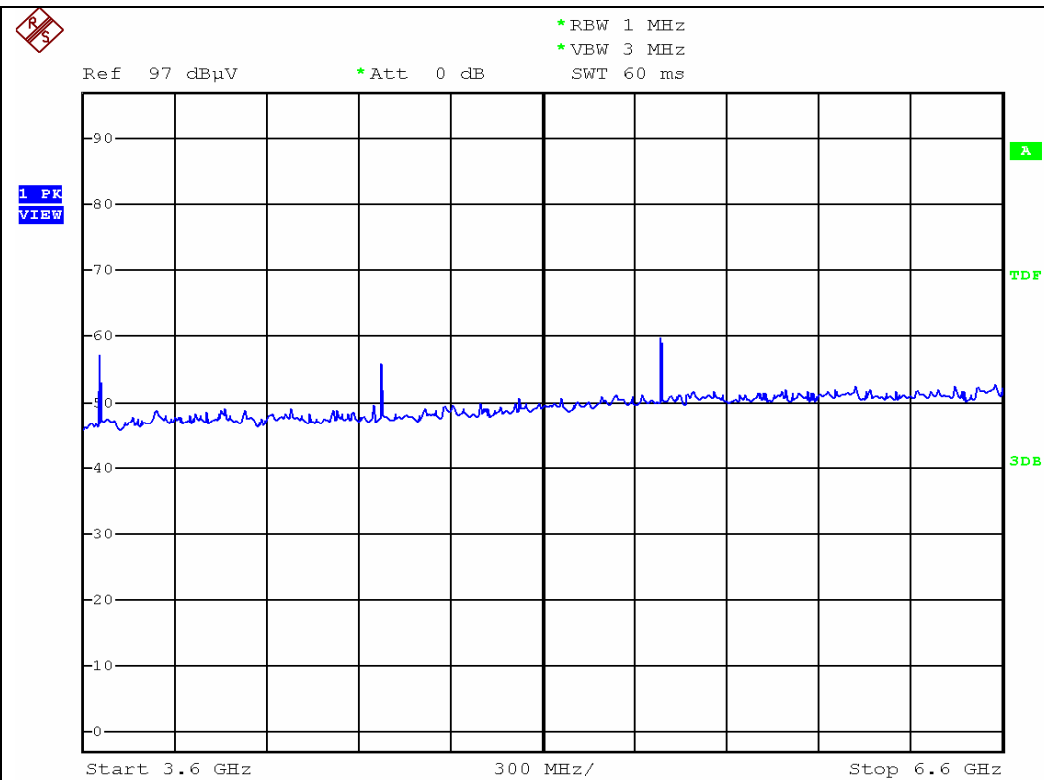


Fig B7 Scan 3.6 – 6.6GHz Vertical

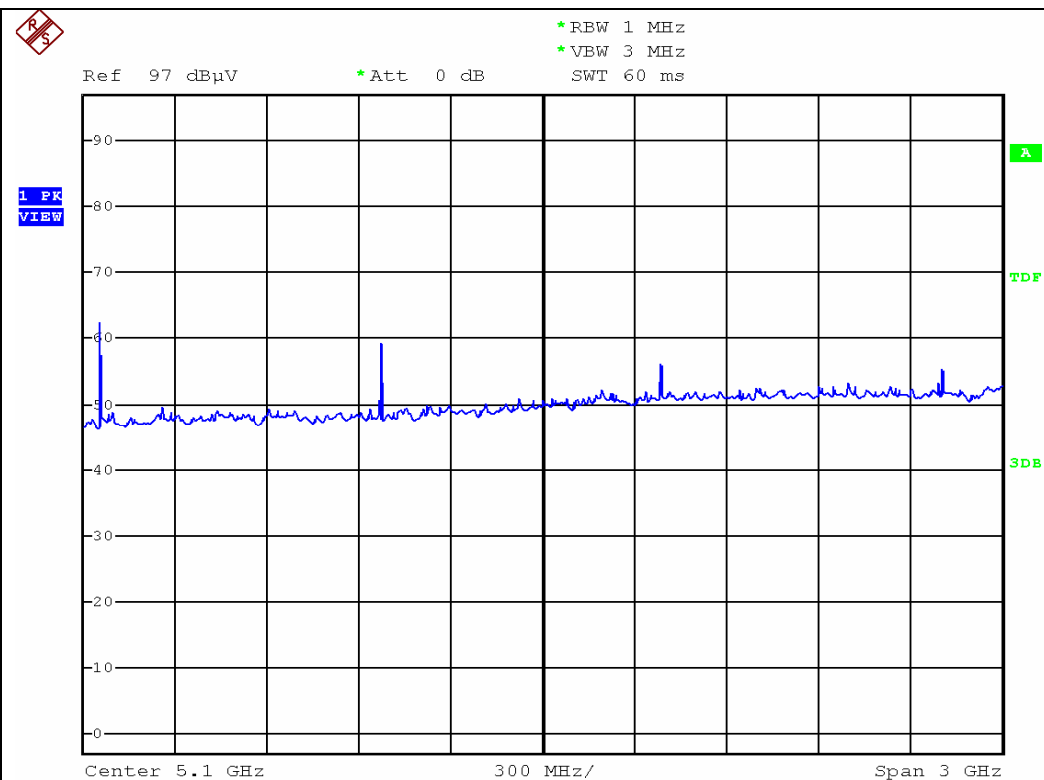


Fig B8 Scan 3.6 – 6.6GHz Horizontal

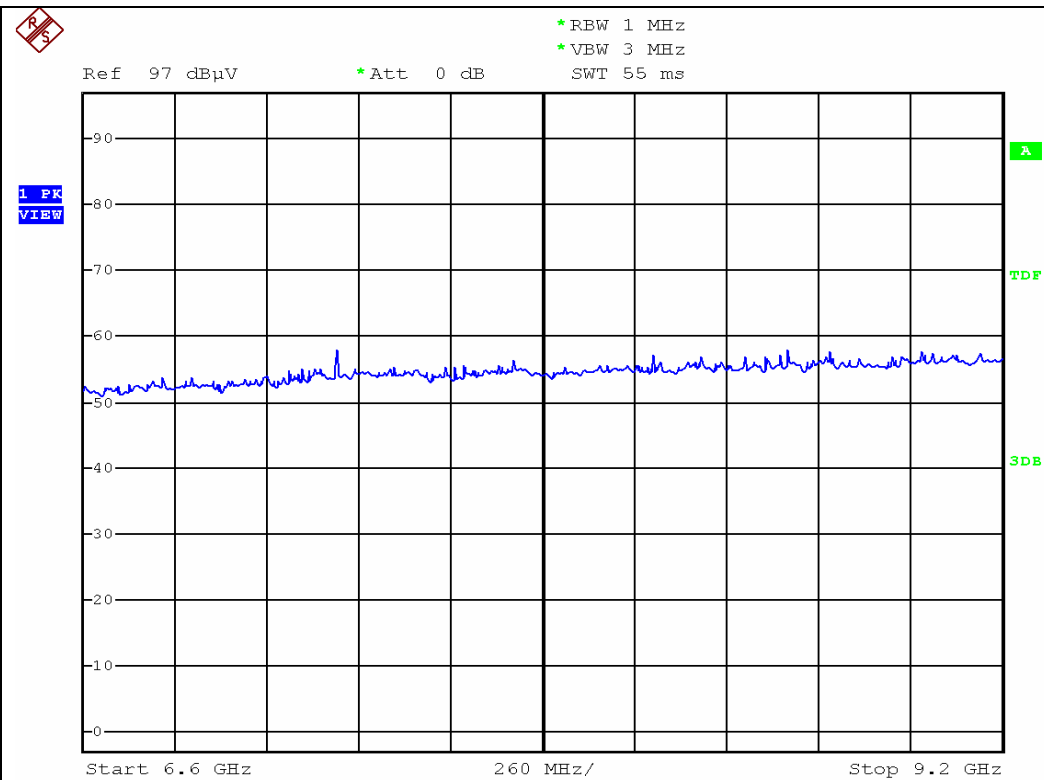


Fig B9 Scan 6.6 – 9.2GHz Vertical

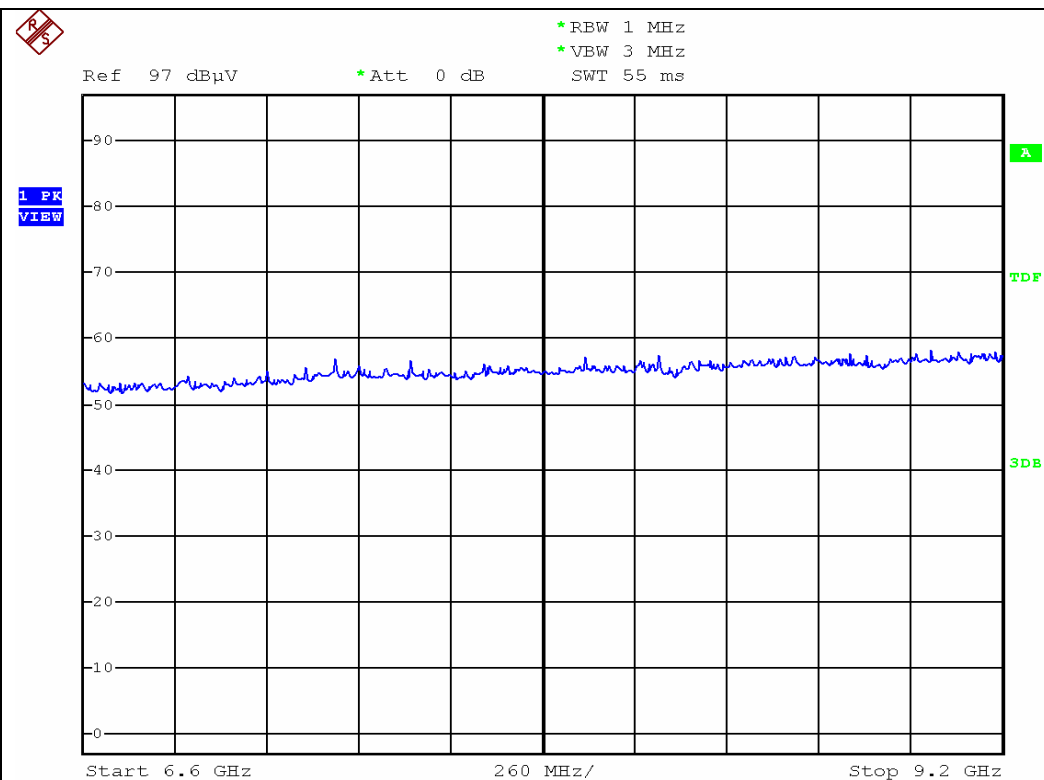


Fig B10 Scan 6.6 – 9.2GHz Horizontal

Appendix C

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

End of Report