COMPLIANCE ENGINEERING IRELAND LTD

ISO 17025 INAB ACCREDITED TESTING

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Project Num	16E6430-1b
Quotation	Q16-2806-3c
Prepared For	Brim Brothers Ltd
Prepared By	Compliance Engineering Ireland
Tested By	Michael Kirby
Test Report By	Michael Kirby
FCC Site Registration	92592
Date	26th Aug 2016
FCC Equipment Authorisation	Test Report
EUT Description	Zone DPMX Power Meter
FCC ID	2ACC9001
Authorised by	**John McAuley**
Authorised Signature :	

TEST SUMMARY

The equipment complies with the requirements according to the following standards.

FCC Part Section(s)	TEST PARAMETERS	Test Result
15.249(a)	RADIATED EMISSIONS	PASS
15.249(d)	RADIATED EMISSIONS	PASS
15.249(e)	RADIATED EMISSIONS	PASS
15.207(a)	CONDUCTED EMISSIONS ON THE MAINS	PASS

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 an SRD using a short range 2.4GHz band transmitter for reporting of performance for cyclists.

Model:	001
Type:	Zone DPMX Power Meter
FCC ID:	2ACC9001
Company:	Brim Brothers Ltd
Contact	Barry Redmond
Address:	B3 Nutgrove Enterprise Park Nutgrove Way Dublin D02 VY52 Ireland
Phone:	+353 1 4916977
e-mail:	Barry.redmond@brimbrothers.com
Test Standards:	47 CFR, Part 15.249(a,d,e)
Type of radio:	Stand-alone
Transmitter Type:	GFSK
Operating Frequency Range(s):	2.451 GHz and 2.457GHz
Number of Channels:	2
Antenna:	Integral
Transmitter power configuration:	3.75 v dc
Oper. Temp Range:	-10° C to +60° 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 (Pod) is a small radio transceiver which fits onto a cyclist shoe and it reports measurements from a pad underneath the shoe to record cyclist performance.
Note there is an option to connect a pod to each of the cyclists shoes.

The EUT has two transmit frequencies
a) In “Master mode” the EUT transmits at 2.457GHz for Pod to Pod communications
b) “Slave mode” the EUT transmits at 2.451GHz for Pod to cycle computer communications.

A full test was carried out on both transmit frequencies, on two sample EUT
The EUT was operated in test mode with continuous transmissions with modulation on.

A duty cycle test for normal operation was carried out on 2 standard samples operating in master and slave mode.
Note in normal operation the EUT transmits 4 times per sec in master mode and 8 times per sec in slave mode

Environmental conditions

	Temperature	**Relative Humidity**
Test	°C	%
Conducted Emissions mains	19	50
Radiated Emissions <1GHz	19	49
Radiated Emissions >1GHz	22	51

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 the 5th, 15th and 19th Aug 2016 on the samples stated above.

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:

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

As the EUT contains a rechargeable battery, a test for conducted Emissions on the mains was performed with 2 pods inserted in a dual charging dock which was connected to a USB mains adapter 5v 2A. which in turn was connected to the mains through a LISN.

USB adapter manufacturer is: Cheng Uei Precision Industry Co. Ltd, Taiwan.
The model number is: 8395-UW01-1070

Two samples of EUT one programmed for continuous transmit at 2.451 GHz and the other programmed for continuous transmit at 2.457GHz were inserted into the dual charger dock.

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 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 1GHz -3.6GHz 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.

Emissions above 3.6GHz were measured using a horn antenna with resolution bandwidth of 1MHz and video bandwidth of 10MHz at a measurement distance of 1 metre 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 (orientation3 O3) gave the highest emissions for horizontal polarization.
A full scan for radiated emission was performed in orientation O1 for vertical polarization and in orientation O3 for horizontal polarization.

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 2.4-2.4835 GHz

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)***
2400-24835 MHz	*50*	*500*

RESULTS

2.4.1 2.451 GHz

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**
2.451	95.3	O1	Vertical	28.9	39.7	3.5	88.0	94.0	26.0
2.451	96.9	O3	Horizontal	28.9	39.7	3.5	89.6	94.0	24.4

Frequency	Final Field Strength Peak	EUT Orientation	Antenna Polarity	Average Level (Peak plus - 53.9dB Duty Cycle factor)	Average Limit	Margin
GHz	**dBuV/m**		**V/H**	**dBuV/m**	**dBuV/m**	**dB**
2.451	88.0	O1	Vertical	34.1	94.0	59.9
2.451	89.6	O3	Horizontal	35.7	94.0	58.3

2.4.2 2.457GHz

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
2.457	98.3	O1	Vertical	28.9	39.7	3.5	91.0	94.0	23.0
2.457	96.0	O3	Horizontal	28.9	39.7	3.5	88.7	94.0	25.3

Frequency	Final Field Strength Peak	EUT Orientation	Antenna Polarity	Average Level (Peak plus - 53.9dB Duty Cycle factor)	Average Limit	Margin
GHz	dBuV/m		V/H	dBuV/m	dBuV/m	dB
2.457	91.0	O1	Vertical	37.1	94.0	56.9
2.457	88.7	O3	Horizontal	34.8	94.0	59.2

Test Result Pass

3 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

3.1 Duty Cycle 2.451GHz

One Period(mS)	Pulse Width (mS)	No of Pulses	Duty Cycle	20 log duty cycle (dB)	Duty Cycle %	Test Result
100	**0.202**	**1**	**0.002**	**-53.9**	**0.2**	**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)
-53.9

Duty Cycle 1

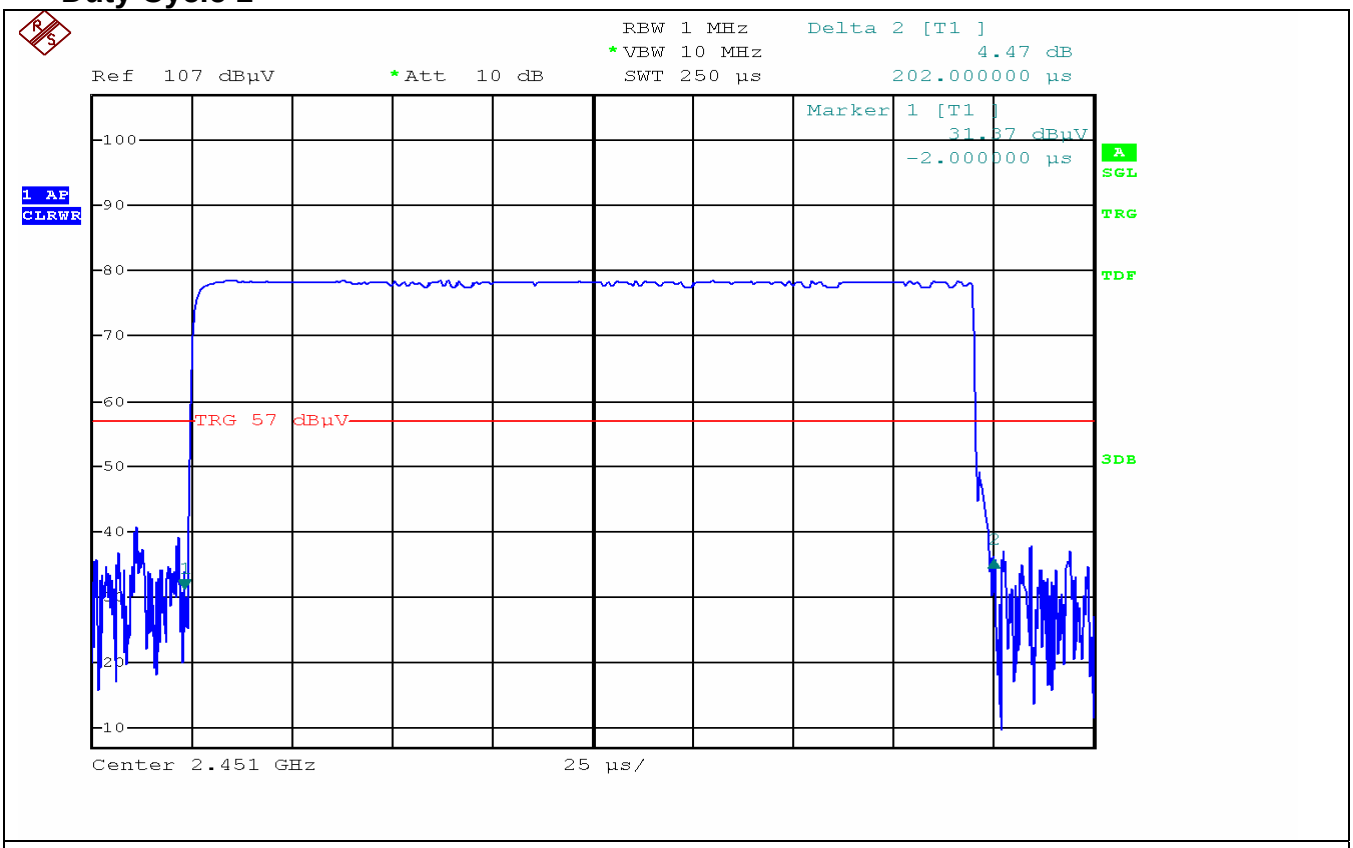

Fig 1 Duty cycle 2.451GHz

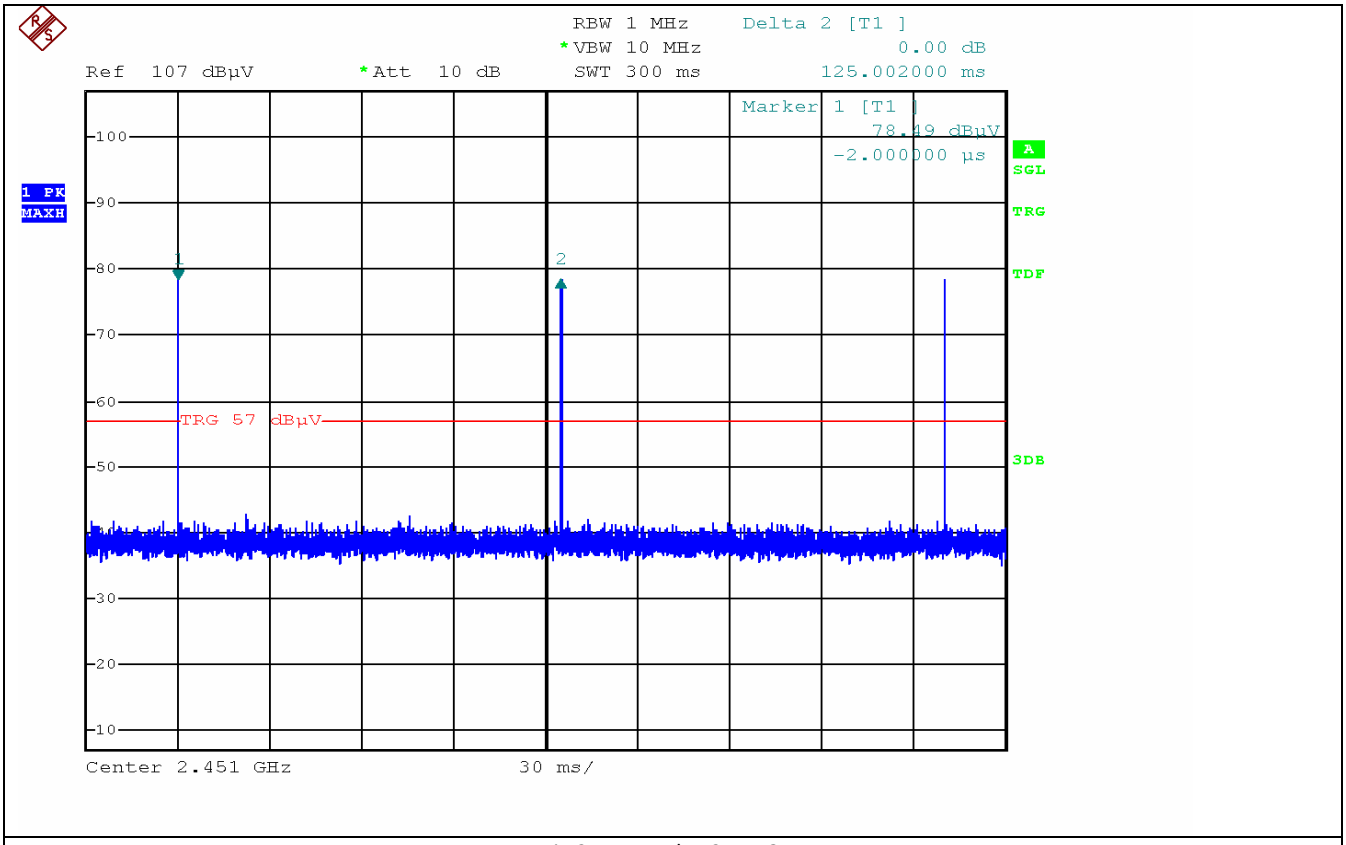

Fig 2 Duty cycle 2.451GHz

3.2 Duty Cycle 2.457GHz

One Period(mS)	Pulse Width (mS)	No of Pulses	Duty Cycle	20 log duty cycle (dB)	Duty Cycle %	Test Result
100	**0.202**	**1**	**0.002**	**-53.9**	**0.2**	**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)
-53.9

Duty Cycle 2

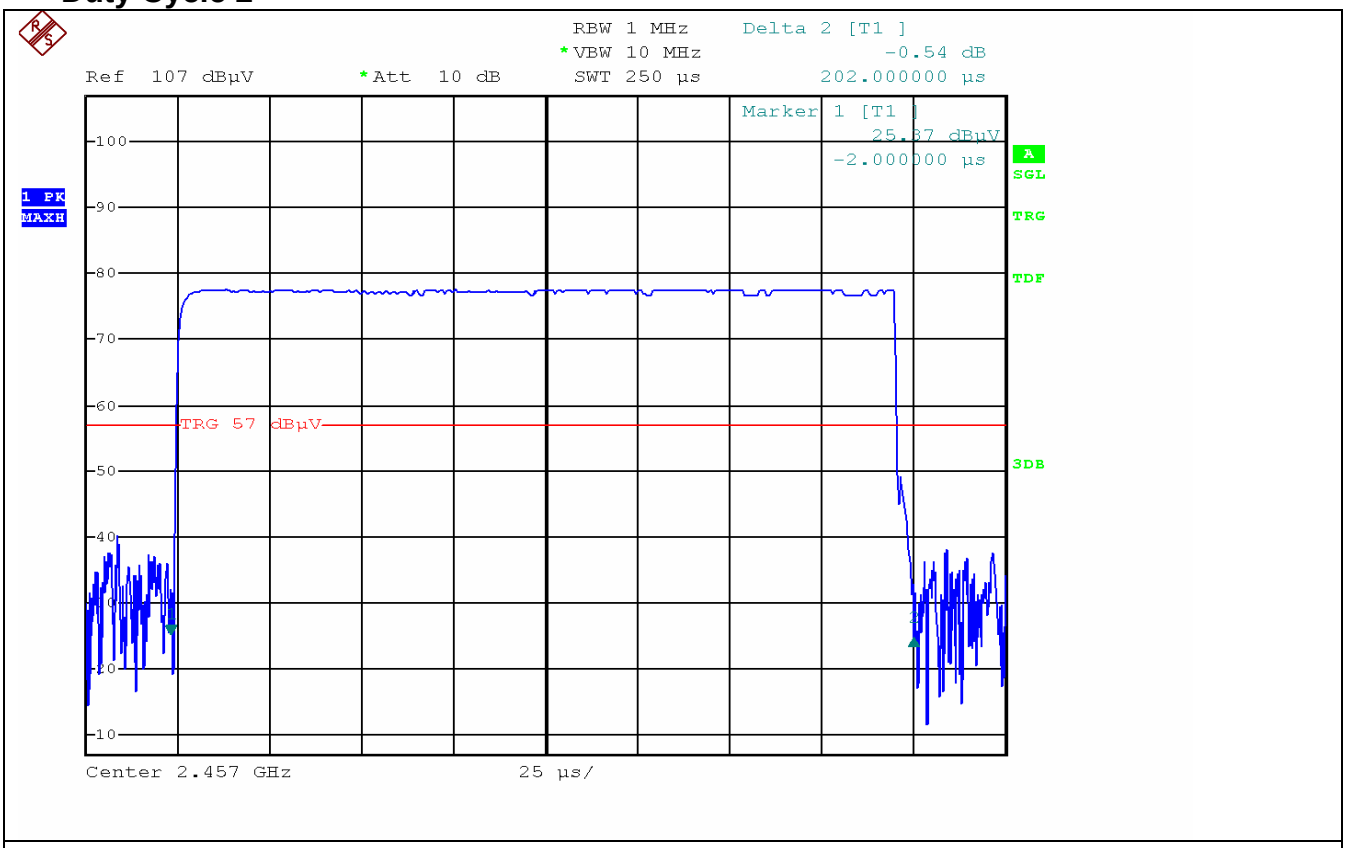

Fig 3 Duty cycle 2.457GHz

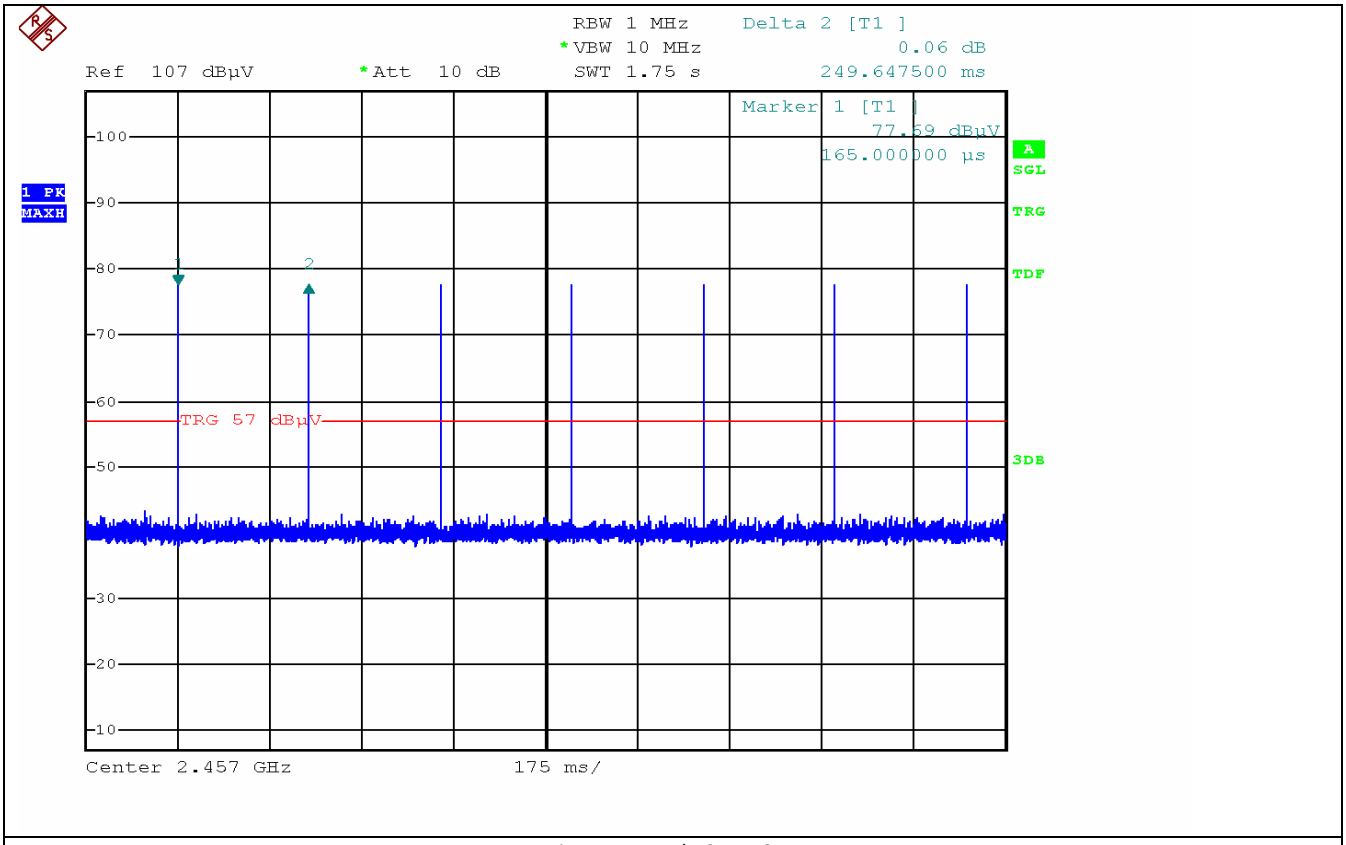

Fig 4 Duty cycle 2.457GHz

3.3 Occupied Bandwidth

3.3.1 Occupied Bandwidth 99%

3.3.1.2 2.451GHz

Operating Frequency (MHz)	99% Bandwidth (kHz)
2.451	**125**

3.3.1.3 2.457GHz

Operating Frequency (MHz)	99% Bandwidth (kHz)
2.457	**106.35**

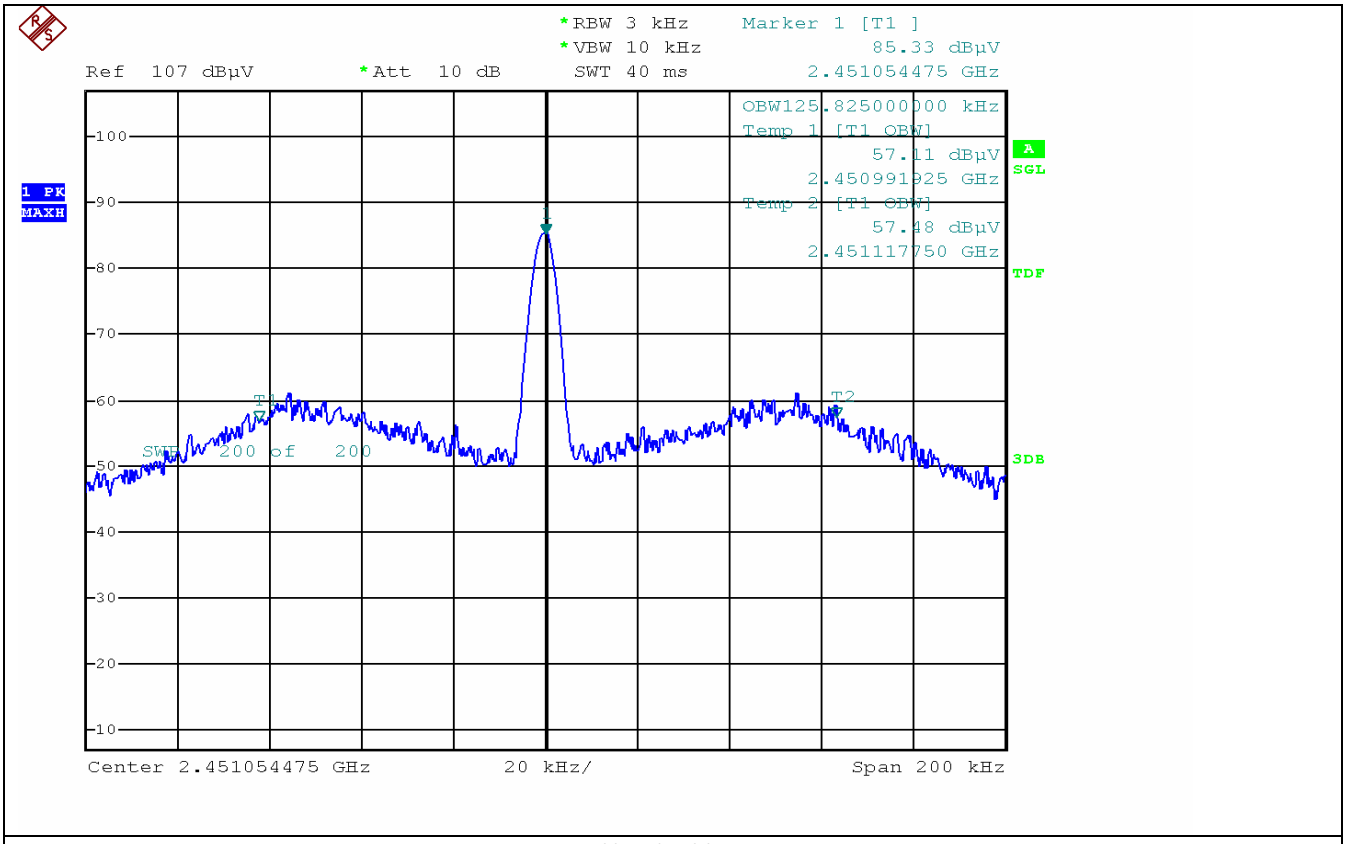

Fig 7 Occupied bandwidth 99% 2.451GHz

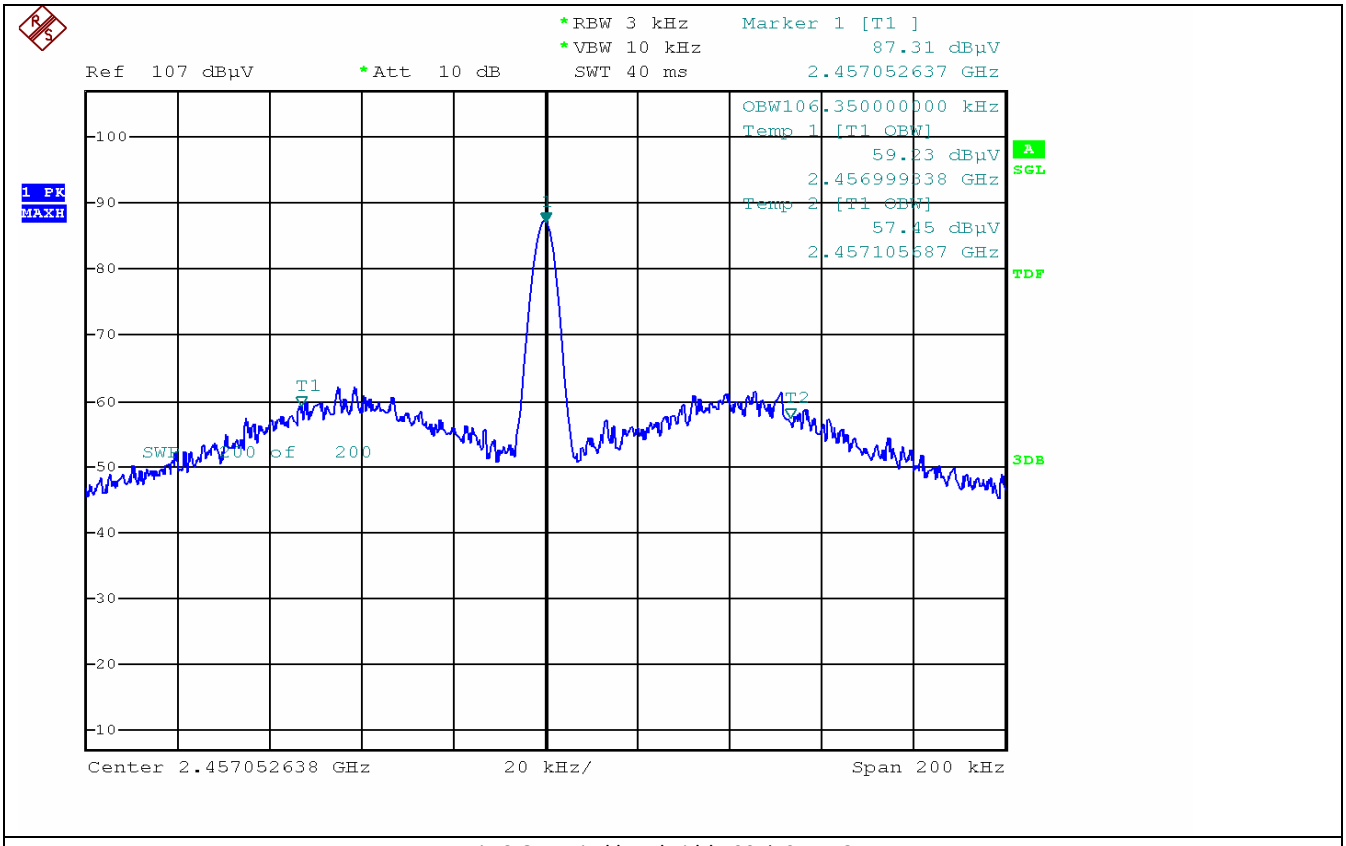

Fig 8 Occupied bandwidth 99% 2.457GHz

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 2.451 GHz transmit frequency

No peaks evident

4.1.1.2 2.457 GHz transmit frequency

No peaks evident

Result: Pass

4.1.2 Horn antenna measurements >1GHz

4.1.2.1 2.451GHz 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 Average Limit +20dB
GHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBuV/m	dB
4.902	44.2	O1	Vertical	32.5	38.6	3.6	41.7	54.0	32.3
7.353	47.2	O1	Vertical	35.5	39	3.9	47.6	54.0	26.4
9.804	45.5	O1	Vertical	37.8	37.6	4.5	50.2	54.0	23.8
4.902	45.8	O3	Horizontal	32.5	38.6	3.6	43.3	54.0	30.7
7.353	47.3	O3	Horizontal	35.5	39	3.9	47.7	54.0	26.3
9.804	44.7	O3	Horizontal	37.8	37.6	4.5	49.4	54.0	24.6

Frequency	Final Field Strength Peak	EUT Orientation	Antenna Polarity	Average Level (Peak plus -53.9dB Duty Cycle factor)	Average Limit	Margin
GHz	dBuV/m		V/H	dBuV/m	dBuV/m	dB
4.902	41.7	O1	Vertical	-2.6	54.0	56.6
7.353	47.6	O1	Vertical	3.2	54.0	50.8
9.804	50.2	O1	Vertical	5.8	54.0	48.2
4.902	43.3	O3	Horizontal	-1.0	54.0	55
7.353	47.7	O3	Horizontal	3.3	54.0	50.7
9.804	49.4	O3	Horizontal	5.0	54.0	49

Note Peak level includes a distance correction factor of -9.54 dB as measurements were carried out at 1 metre distance.

Result: Pass

4.1.2.2 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
3.676	43.9	30.6	37.6	2.2	Vertical	O1	39.1	74.0	25.4

Note Peak level includes a distance correction factor of -9.54 dB as measurements were carried out at 1 metre distance.

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

4.1.2.3 2.457GHz 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 Average Limit +20dB
GHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBuV/m	dB
4.915	42.0	O1	Vertical	32.5	38.6	3.6	39.5	54.0	34.5
7.371	48.0	O1	Vertical	35.5	39	3.9	48.4	54.0	25.6
9.828	44.2	O1	Vertical	37.8	37.6	4.5	48.9	54.0	25.1
4.914	46.2	O3	Horizontal	32.5	38.6	3.6	43.7	54.0	30.3
7.371	48.3	O3	Horizontal	35.5	39	3.9	48.7	54.0	25.3
9.828	44.6	O3	Horizontal	37.8	37.6	4.5	49.3	54.0	24.7

Frequency	Final Field Strength Peak	EUT Orientation	Antenna Polarity	Average Level (Peak plus -53.9dB Duty Cycle factor)	Average Limit	Margin
GHz	dBuV/m		V/H	dBuV/m	dBuV/m	dB
4.915	39.5	O1	Vertical	-4.8	54.0	58.8
7.371	48.4	O1	Vertical	4.0	54.0	50
9.828	48.9	O1	Vertical	4.5	54.0	49.5
4.914	43.7	O3	Horizontal	-0.6	54.0	54.6
7.371	48.7	O3	Horizontal	4.3	54.0	49.7
9.828	49.3	O3	Horizontal	4.9	54.0	49.1

Note Peak level includes a distance correction factor of -9.54 dB as measurements were carried out at 1 metre distance.

4.1.2.4 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
3.685	46.4	30.6	37.6	2.2	Vertical	O1	41.6	74.0	22.9
3.685	45.2	30.6	37.6	2.2	Horizontal	O3	40.4	74.0	24.0

Note Peak level includes a distance correction factor of -9.54 dB as measurements were carried out at 1 metre distance.

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

5.0 Results for Conducted emissions on the mains

Mains Conducted Emissions results

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Detector	Frequency	Reading	Margin	Phase
QP/ Ave	MHz	dBuV	dB	L/N
Quasi-Peak	0.1500	42.02	-23.98	Live
Quasi-Peak	0.1793	42.51	-22.65	Live
Quasi-Peak	0.2085	42.19	-22.14	Live
Quasi-Peak	0.5955	44.28	-11.72	Live
Average	0.600	35.72	-10.28	Live
Average	0.692	28.03	-17.97	Live
Average	1.662	26.22	-19.78	Live
Quasi-Peak	1.664	35.63	-20.37	Live
Quasi-Peak	2.776	33.78	-22.22	Live
Quasi-Peak	3.890	32.16	-23.84	Live

Detector	Frequency	Reading	Margin	Phase
QP/ Ave	MHz	dBuV	dB	L/N
Quasi-Peak	0.6000	39.33	-16.67	Neutral
Average	0.6023	31.53	-14.47	Neutral
Quasi-Peak	0.7530	32.68	-23.32	Neutral
Quasi-Peak	1.8173	30.72	-25.28	Neutral
Quasi-Peak	3.0233	29.47	-26.53	Neutral
Quasi-Peak	4.4340	25.95	-30.05	Neutral

Ref Appendix D for scans

Result: Pass

6 List of Test Equipment

Instrument	Manufacturer	Model	Serial Num	CEI Ref	Cal Due Date	Cal Interval Months
Barometric Pressure Humidity & Temp Datalogger	Extech	SD700	Q752722	181	11/09/2016	24
Microwave Preamplifier	Hewlett Packard	83017A	3123A00175	805	19/09/2016	12
Spectrum Analyser 30Hz-40GHz	Rohde& Schwarz	FSP40	100053	850	09/11/2018	36
Test Receiver 3.6GHz	Rohde& Schwarz	ESR	1316.3003k03-101625-s	869	06/06/2017	36
Anechoic Chamber	CEI	SAR 10M	845	845	16/03/2019	36
Antenna Horn	EMCO	3115	9905-5809	655	03/11/2017	24
Fully Anechoic Chamber	CEI	FAR 3M	906	906	22/03/2018	36
Antenna Horn Standard Gain 18-26.5GHz	A-info	LB-42-25-C-KF	J2021091103028	877	12/09/2016	12
Antenna Bilog	Schaffner	CBL6111C	2549	690	08/09/2018	36
Antenna Trilog	Schwarzbeck	VULB 9160	9160-3361	889	04/08/2018	24
Antenna Log Periodic	Chase	UPA6108	1072	609	06/10/2018	36

Appendix A
Additional Test Results

Transmitter Spurious Emissions 2.451 GHz

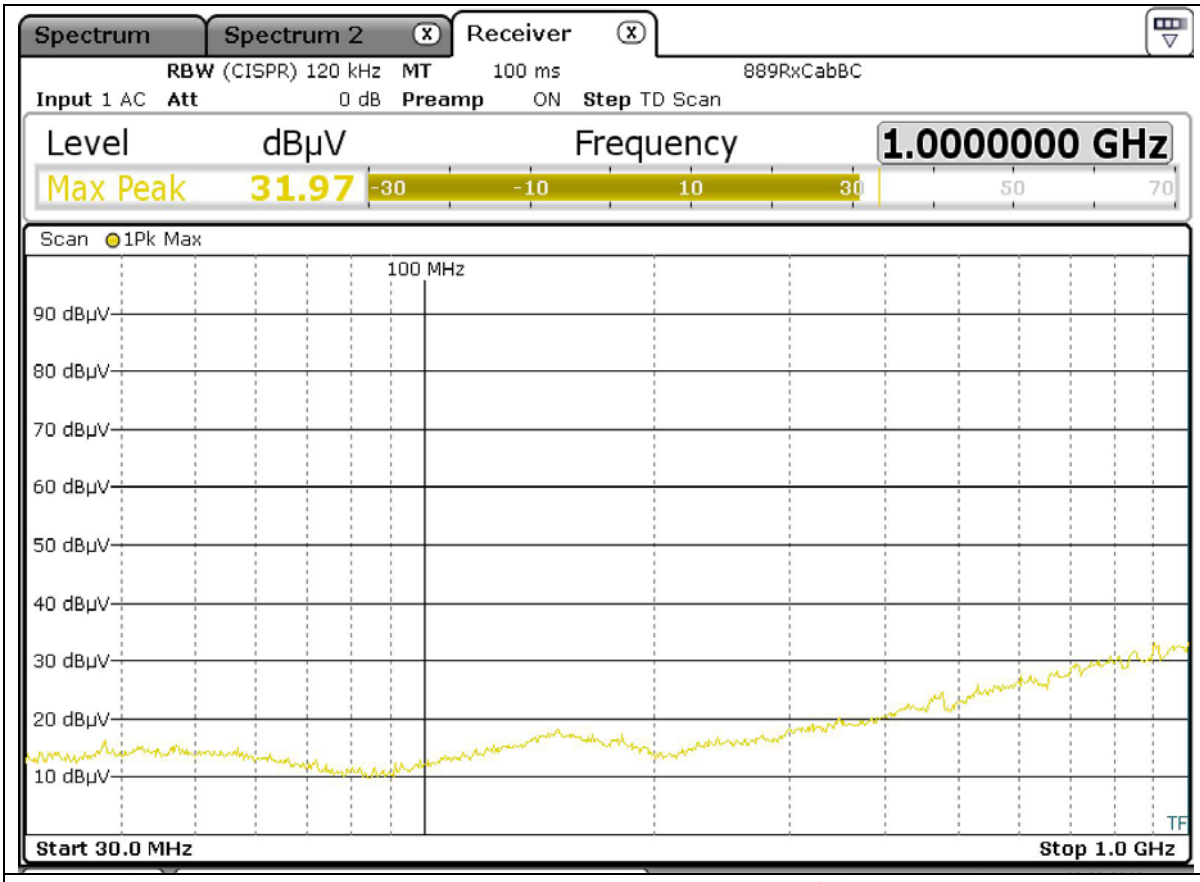

Fig A1 Scan 30MHz – 1GHz Vertical 3m

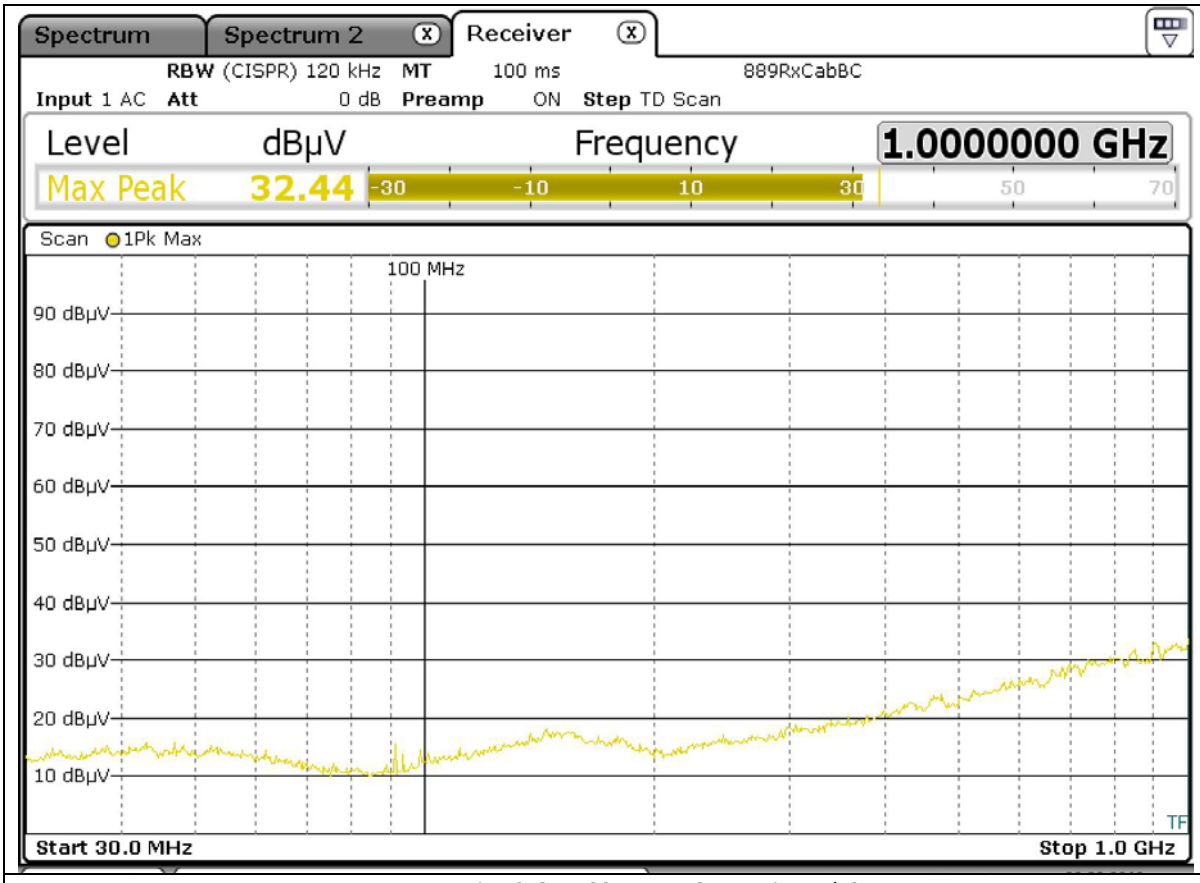

Fig A2 Scan 30MHz – 1GHz Horizontal 3m

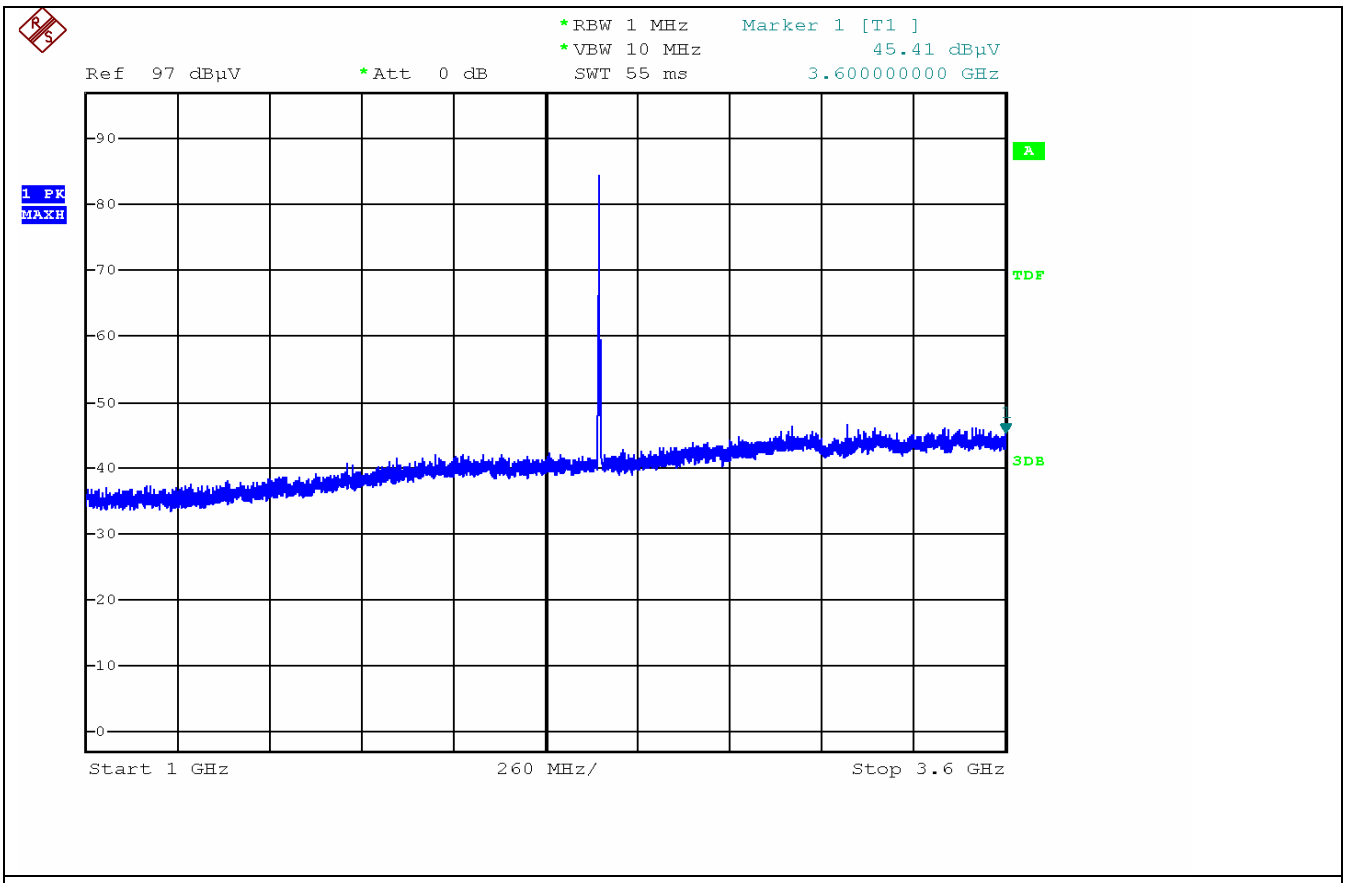

Fig A5 Scan 1GHz – 3.6GHz Vertical 3m

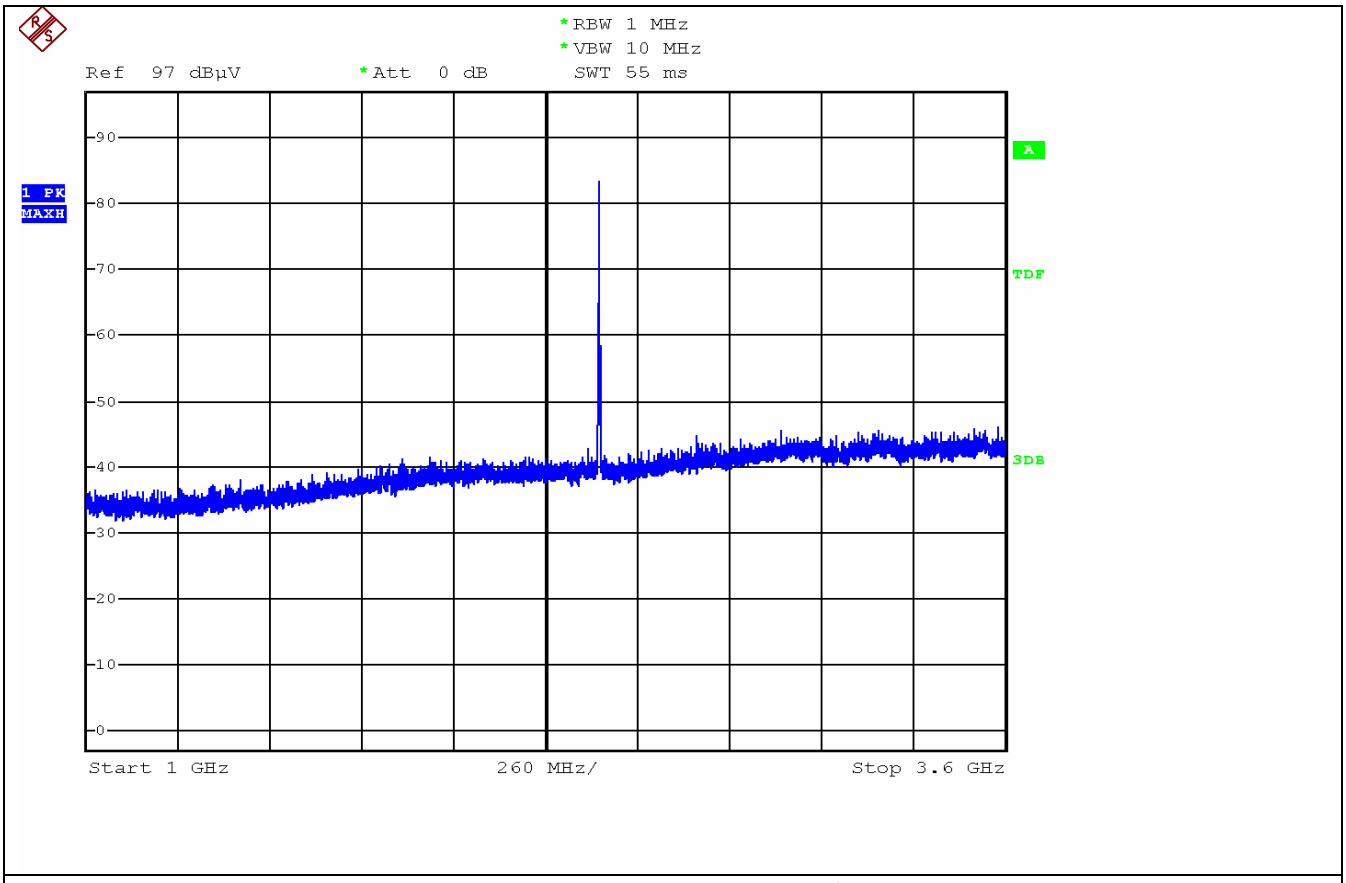

Fig A6 Scan 1GHz – 3.6GHz Horizontal 3m

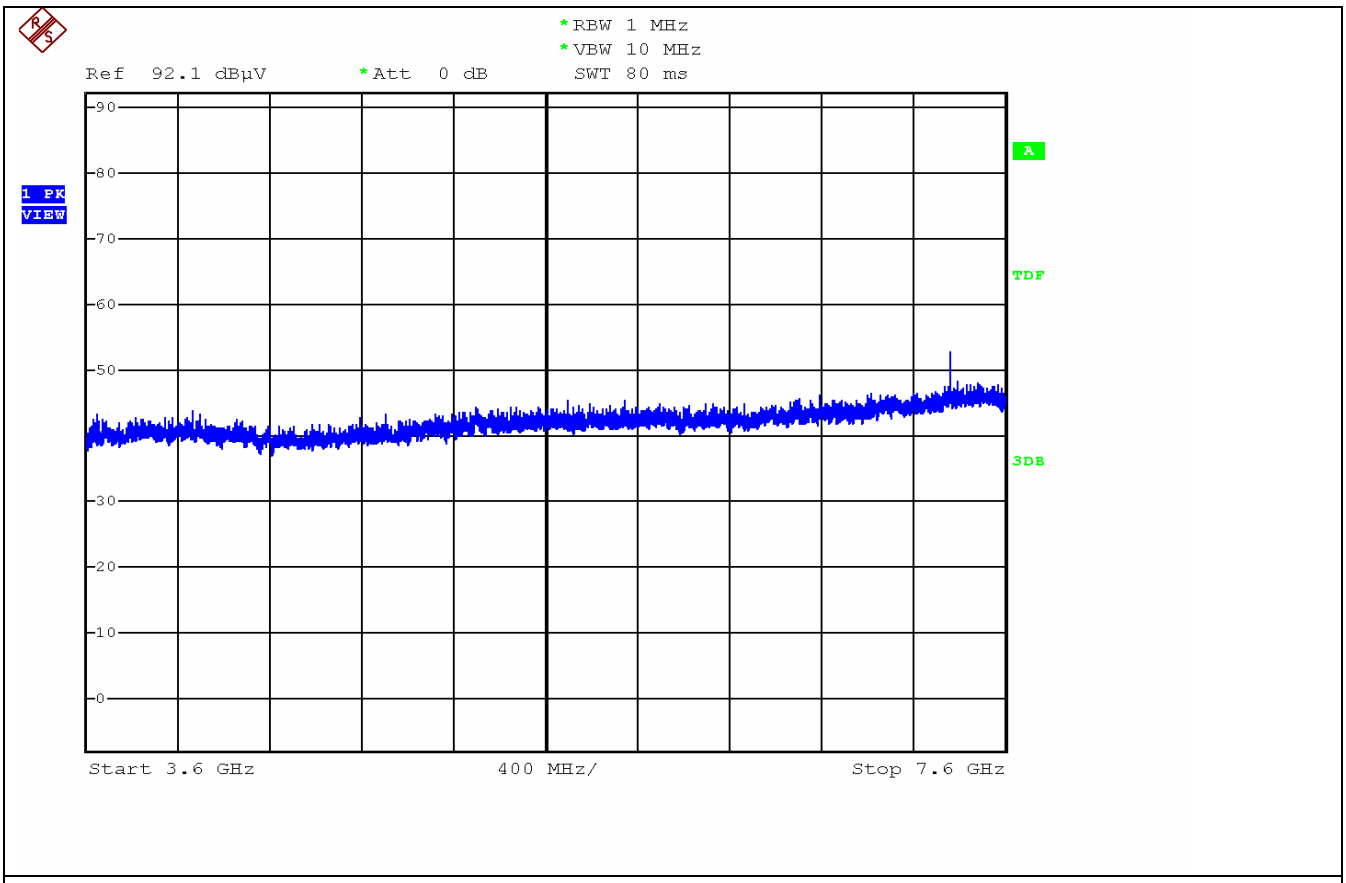

Fig A7 Scan 3.6 – 7.6GHz Vertical 1m

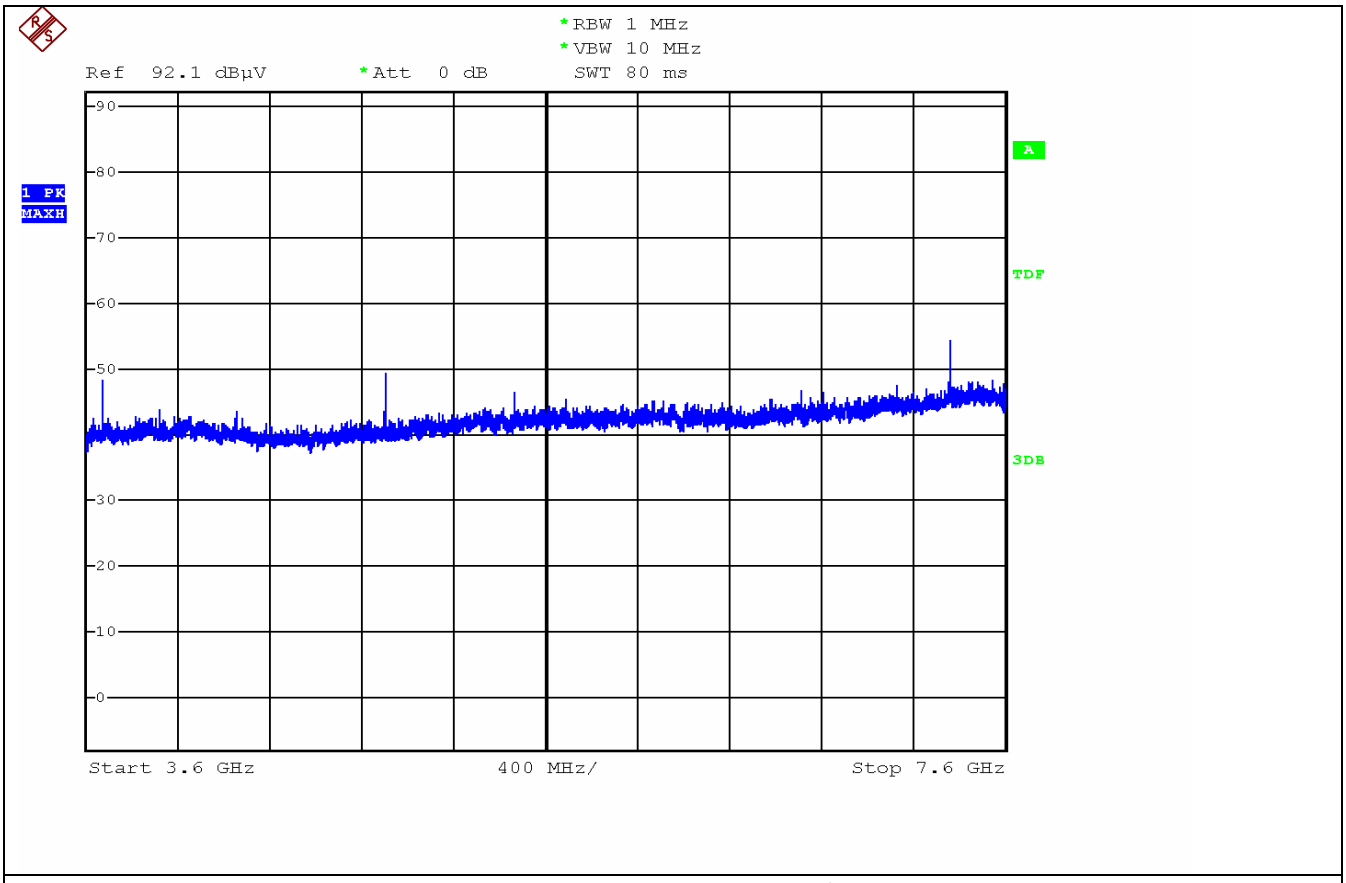

Fig A8 Scan 3.6 – 7.6GHz Horizontal 1m

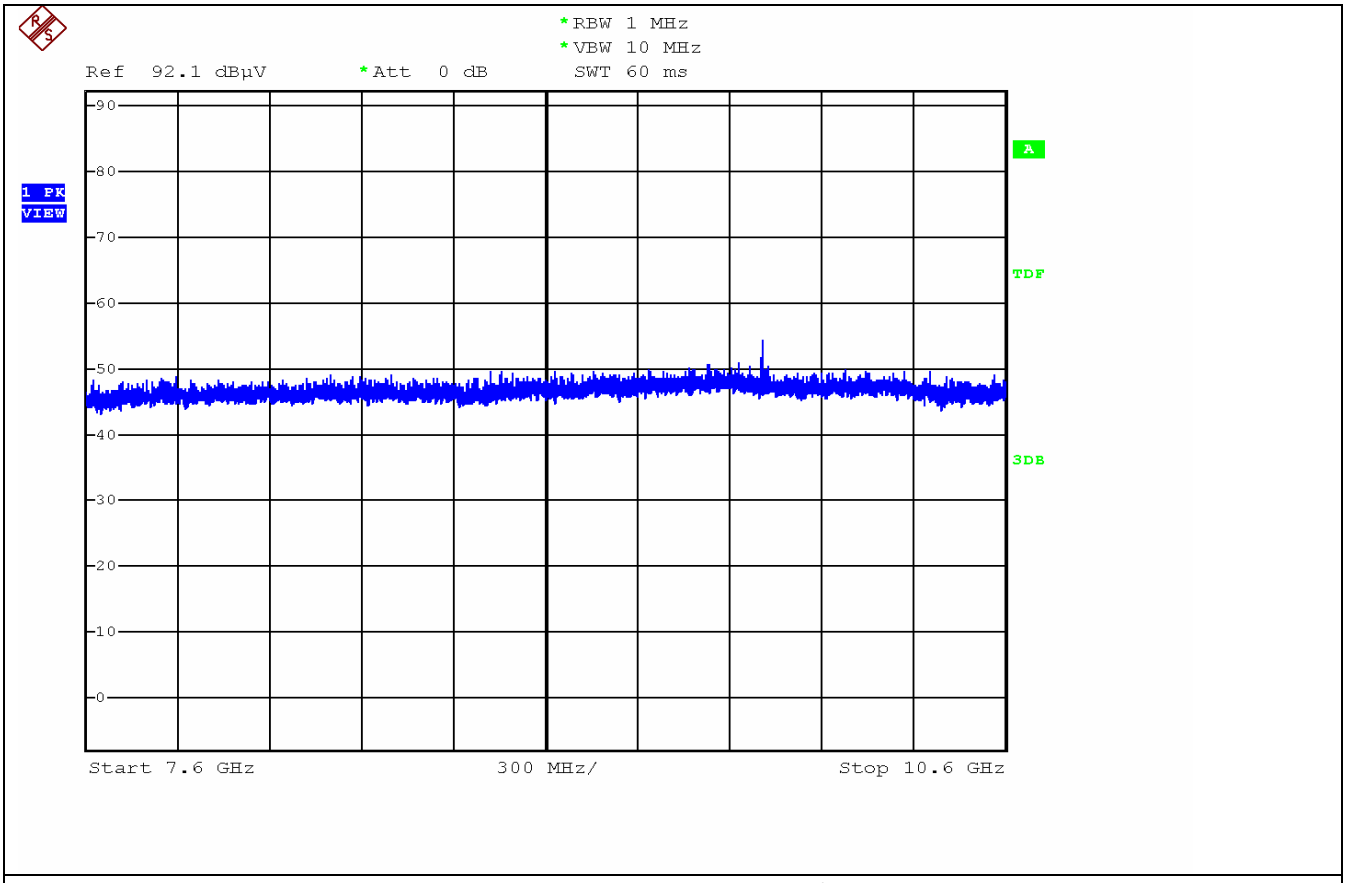

Fig A9 Scan 7.6 – 10.6 GHz Vertical 1m

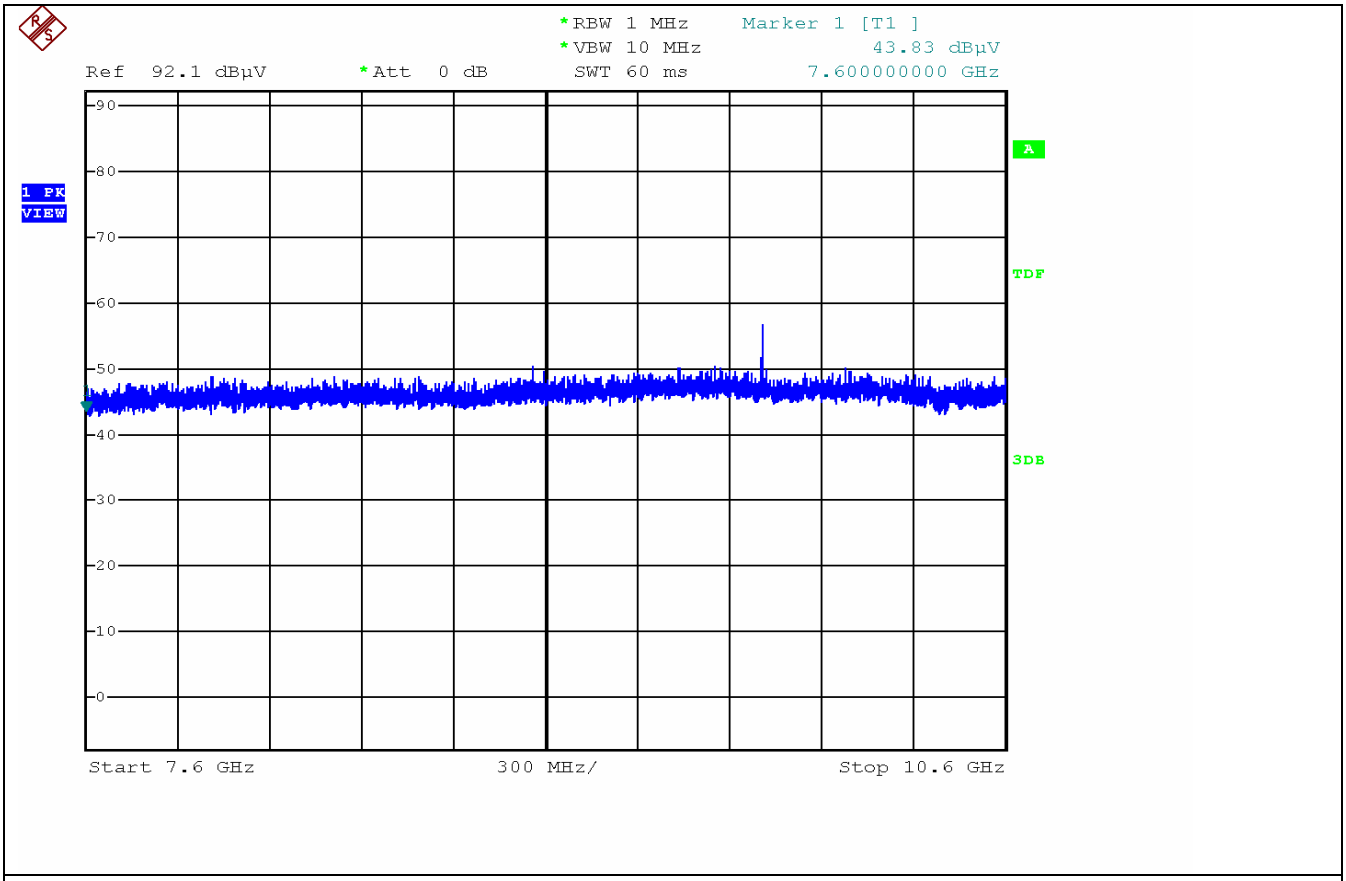

Fig A10 Scan 7.6 – 10.6GHz Horizontal 1m

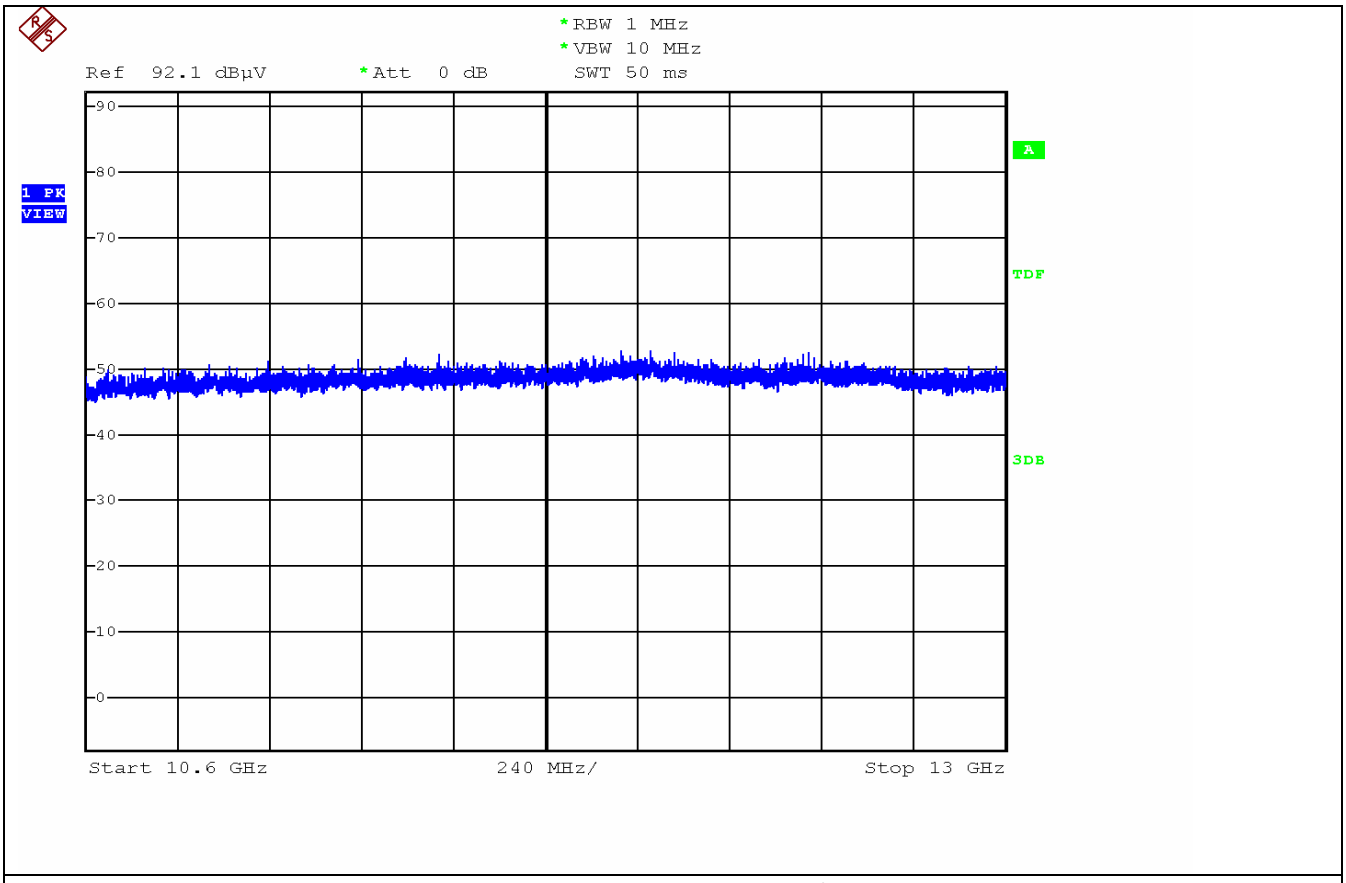

Fig A11 Scan 10.6 – 13GHz Vertical 1m

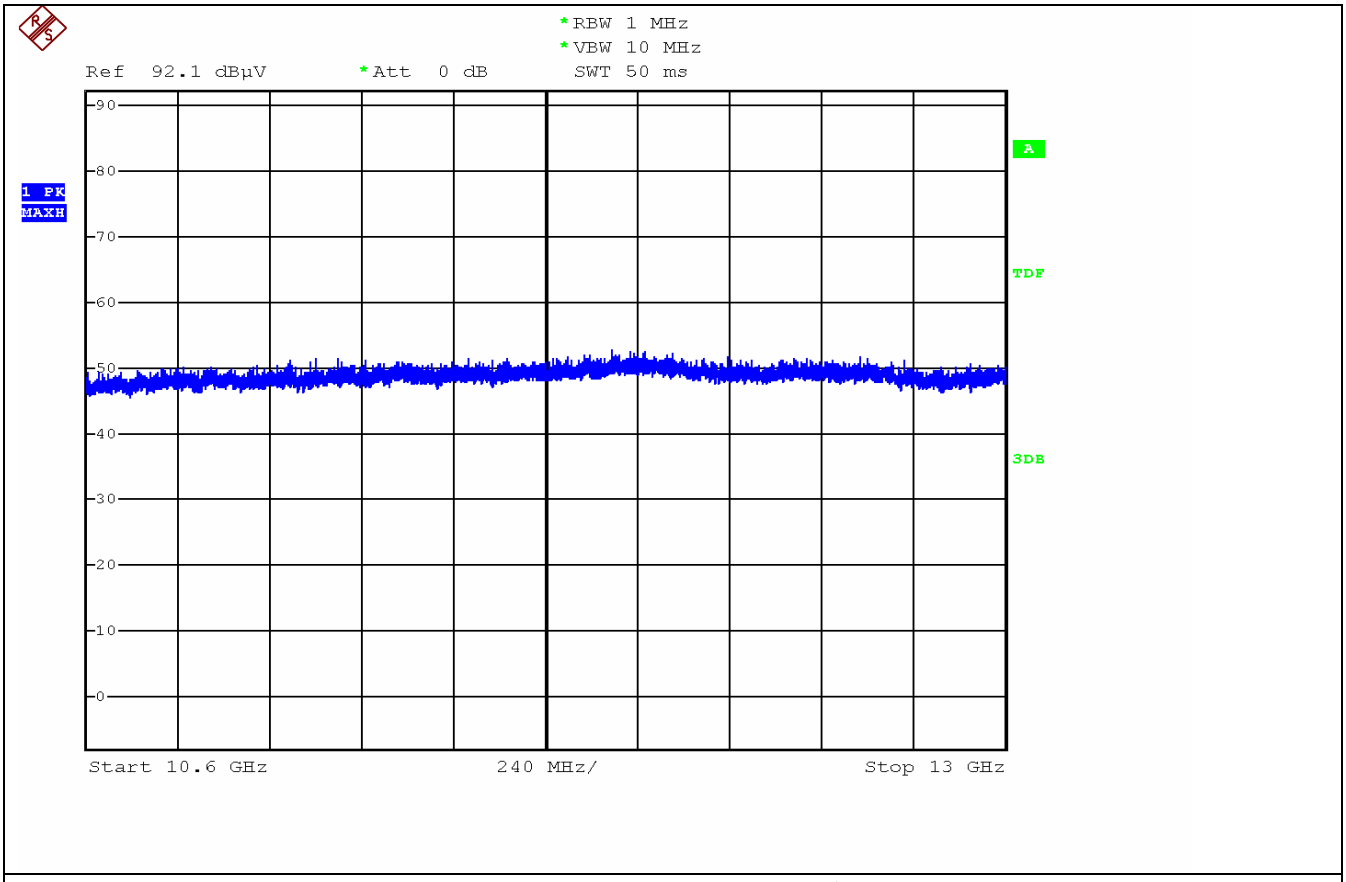

Fig A12 Scan 10.6 – 13GHz Horizontal 1m

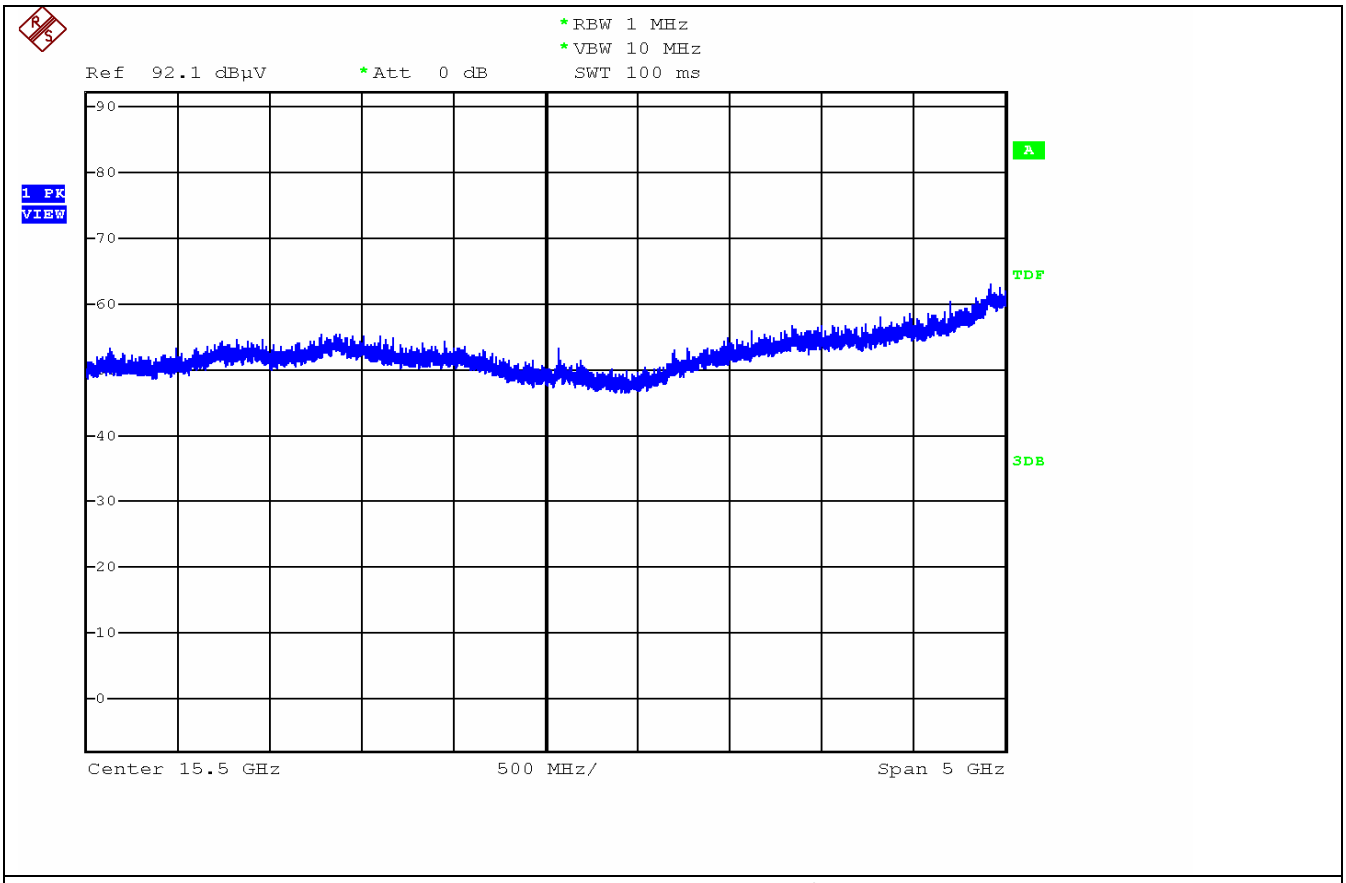

Fig A13 Scan 13 – 18GHz Vertical 1m

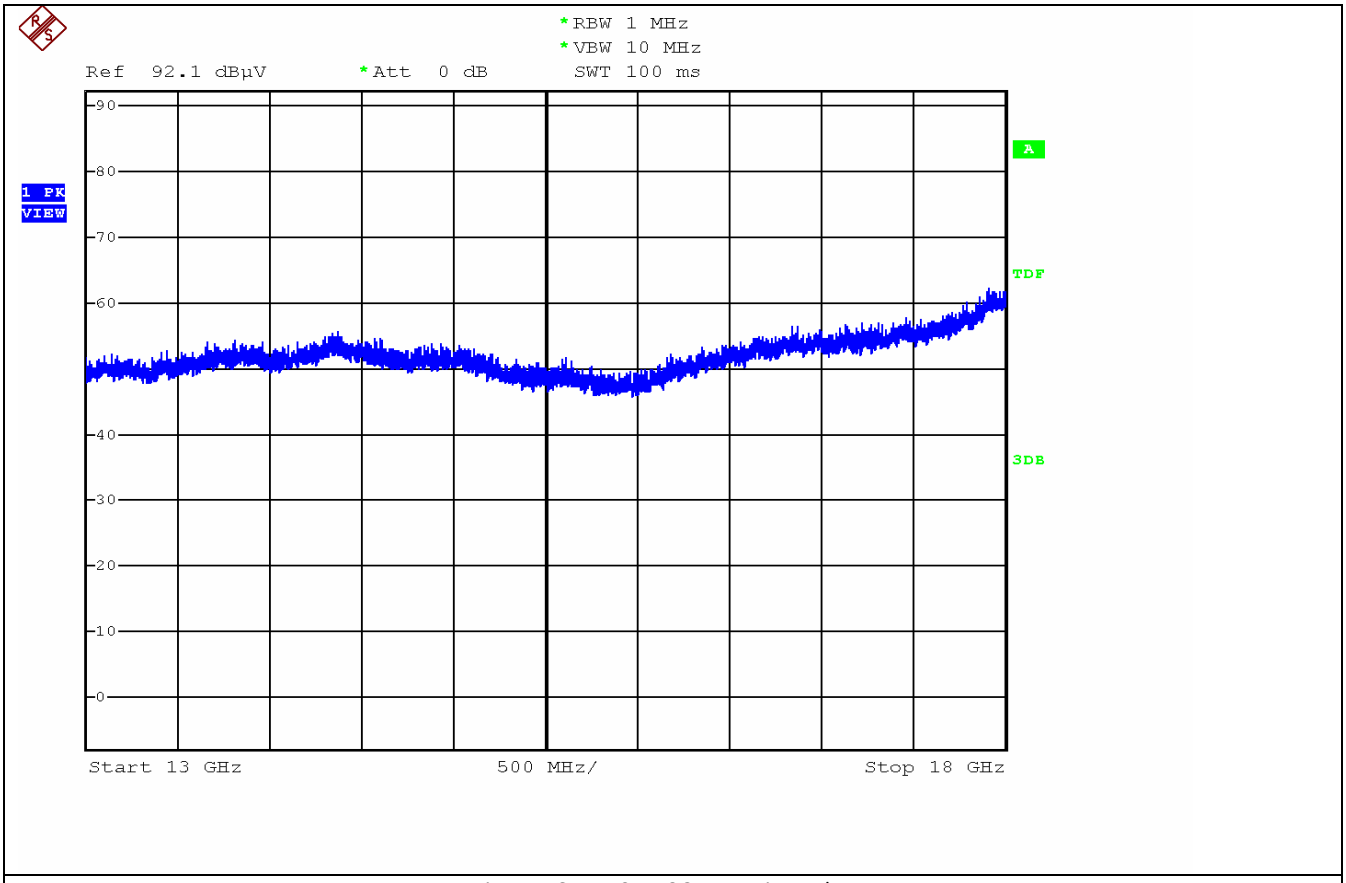

Fig A14 Scan 13 – 18GHz Horizontal 1m

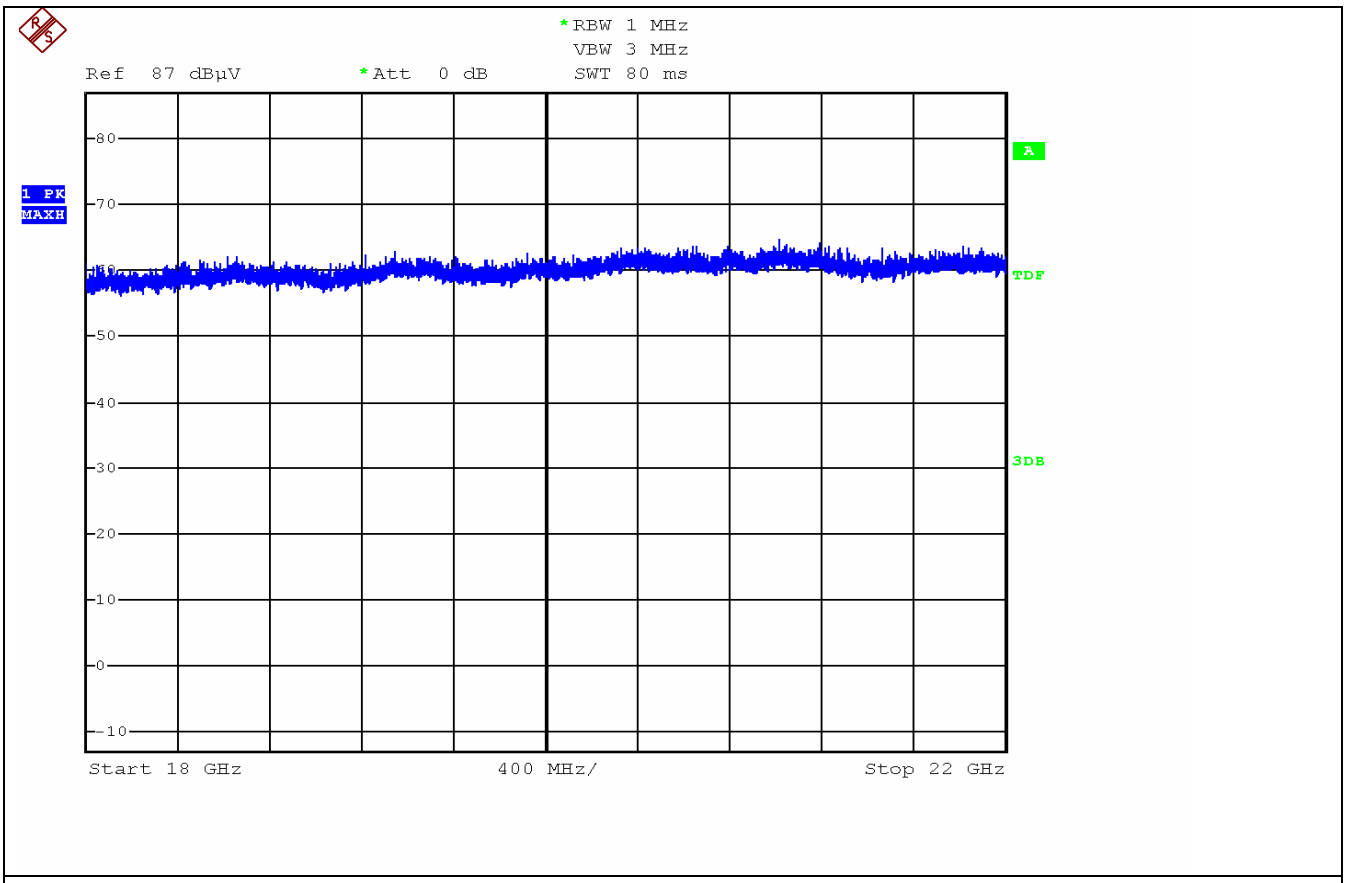

Fig A15 Scan 18 – 22GHz Vertical 1m

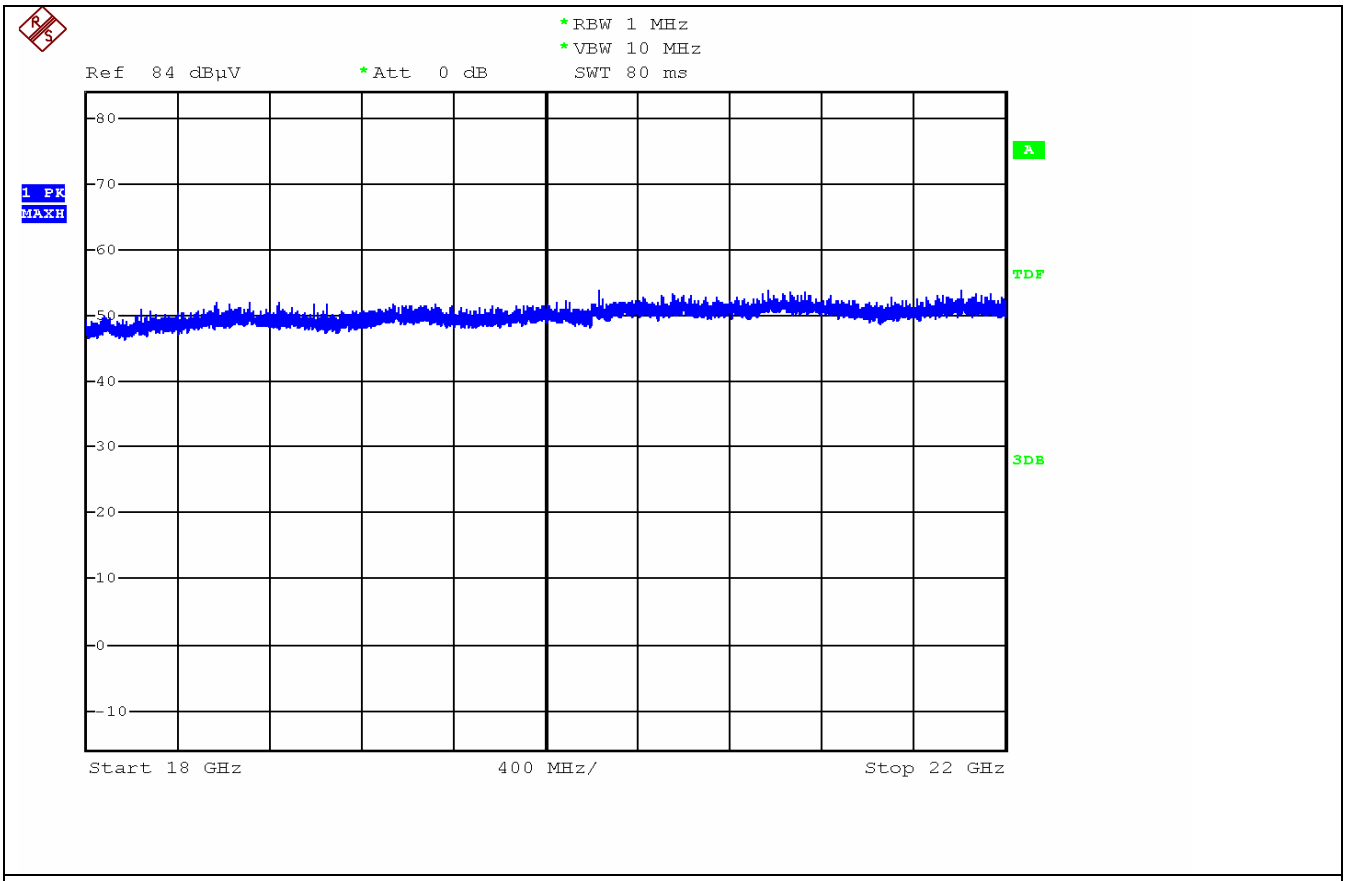

Fig A16 Scan18 – 22GHz Horizontal 1m

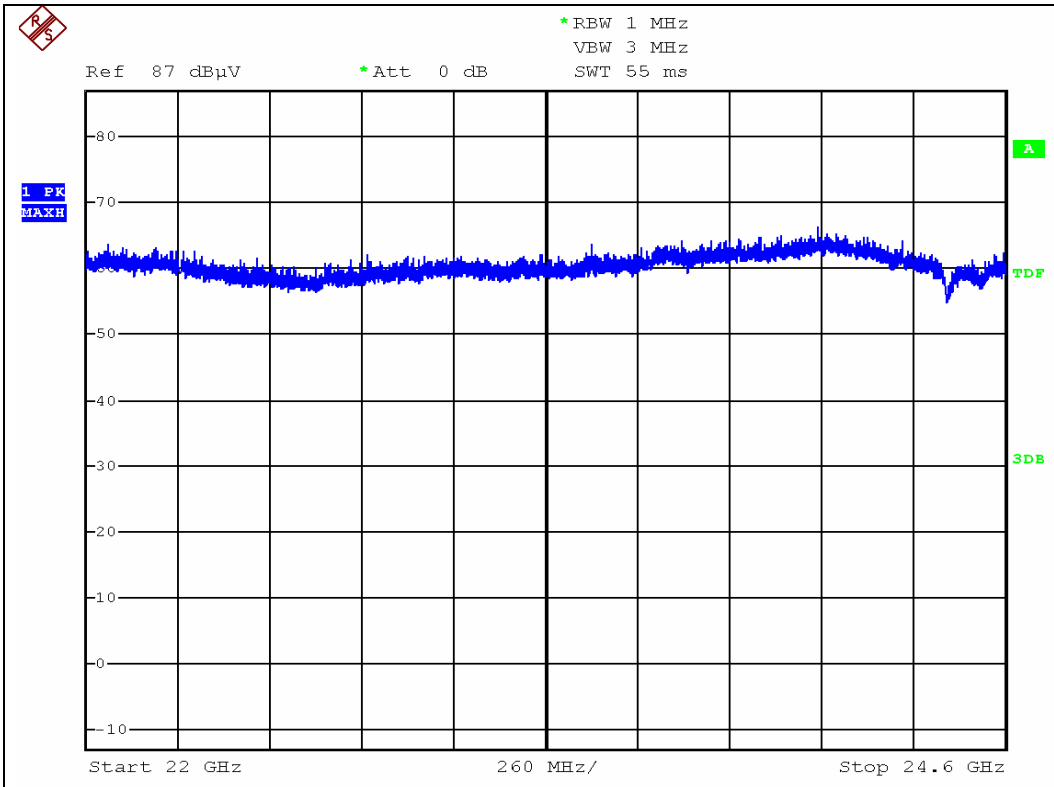

Fig A17 Scan 22 – 24.6GHz Vertical 1m

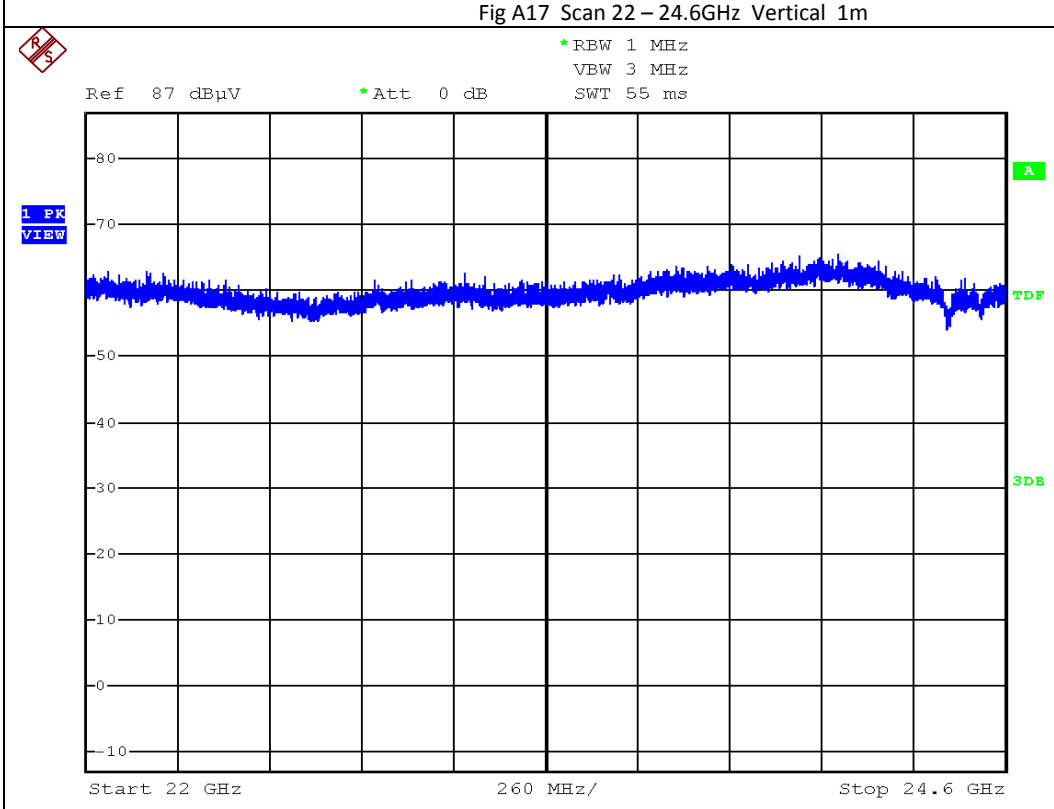

Fig A18 Scan22 – 24.6GHz Horizontal 1m

Appendix B

Additional Test Results

Receiver Spurious Emissions

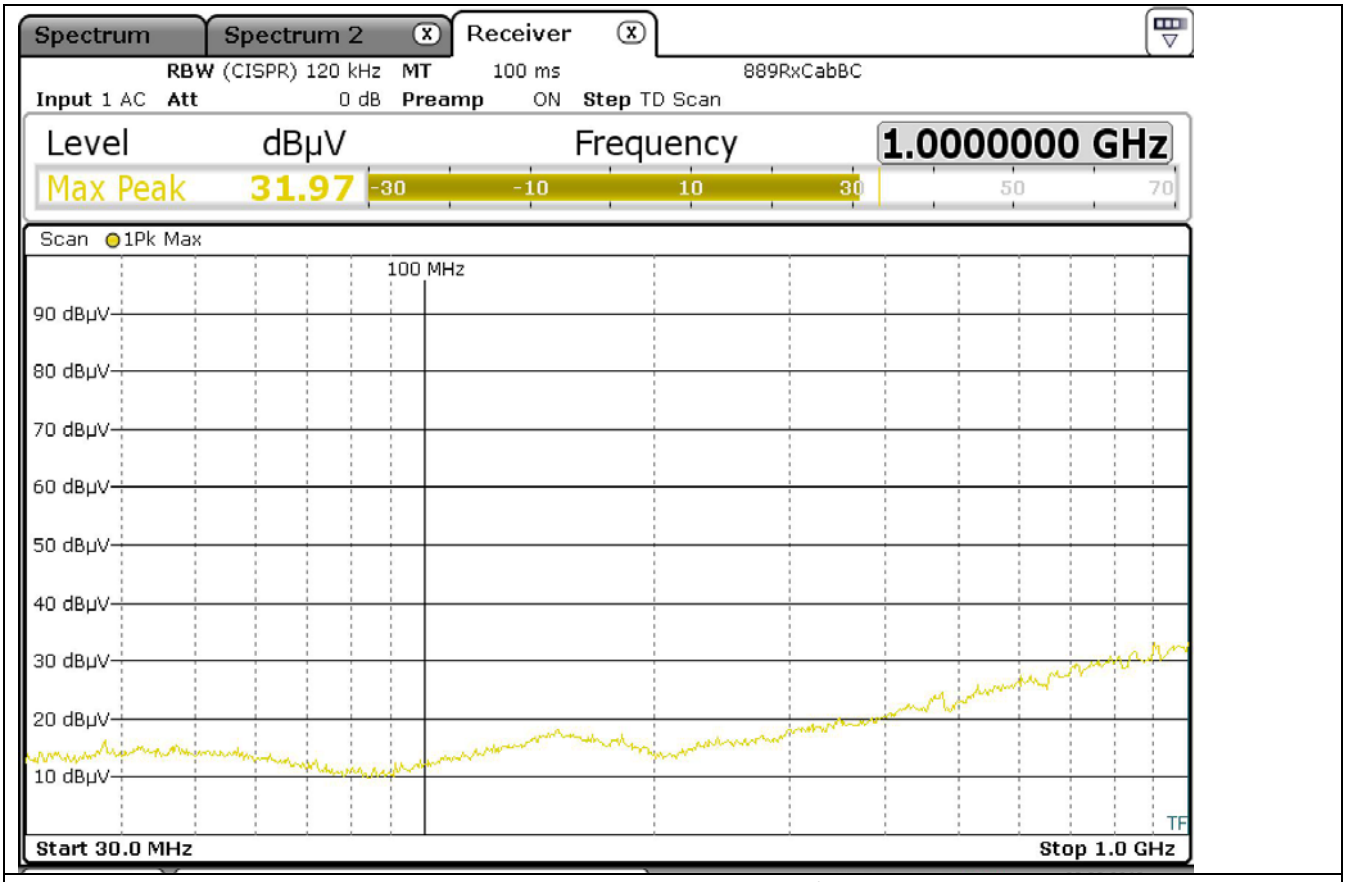

Fig B1 Scan 30MHz – 1GHz Vertical 3m

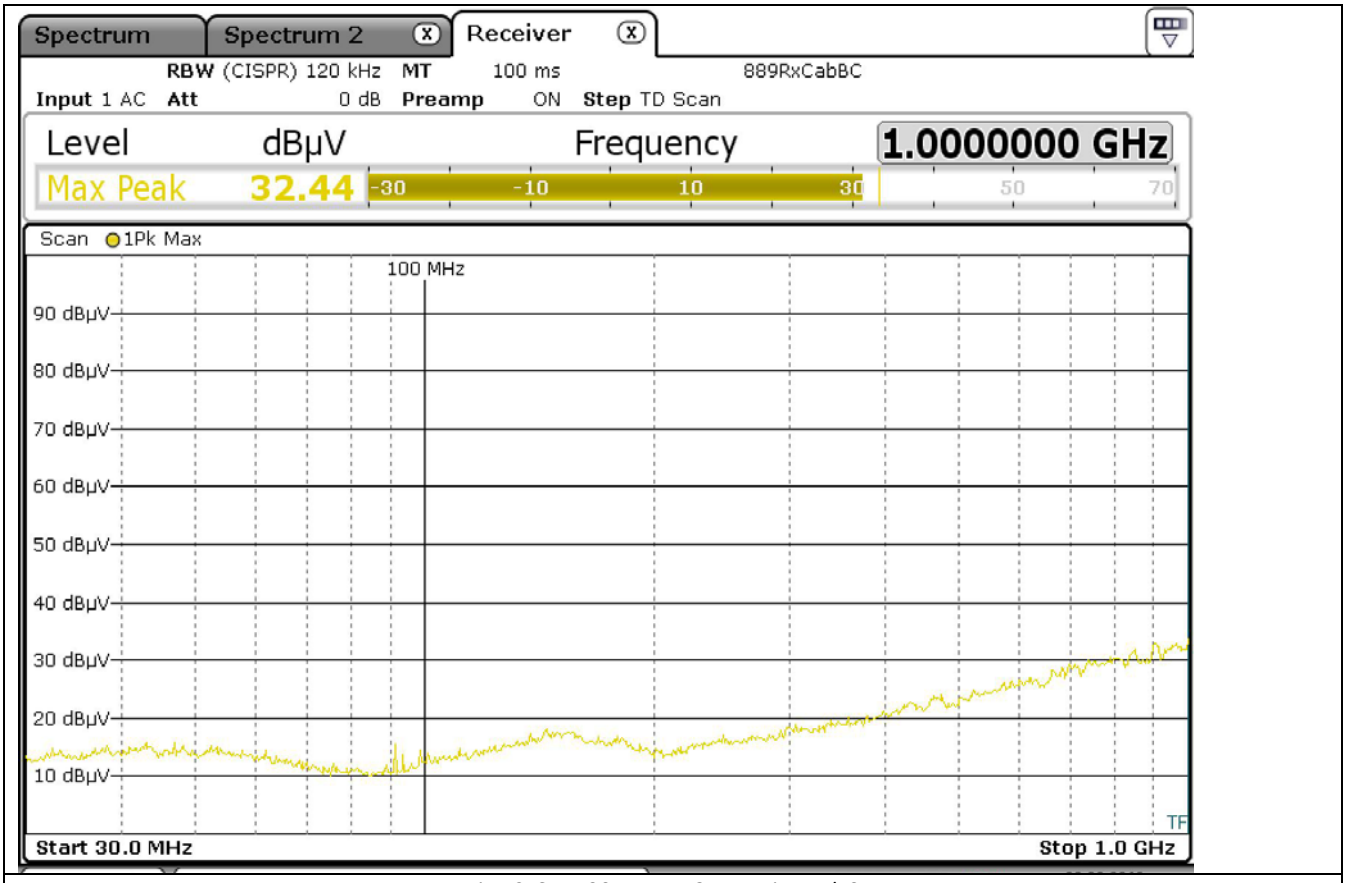

Fig B2 Scan 30MHz – 1GHz Horizontal 3m

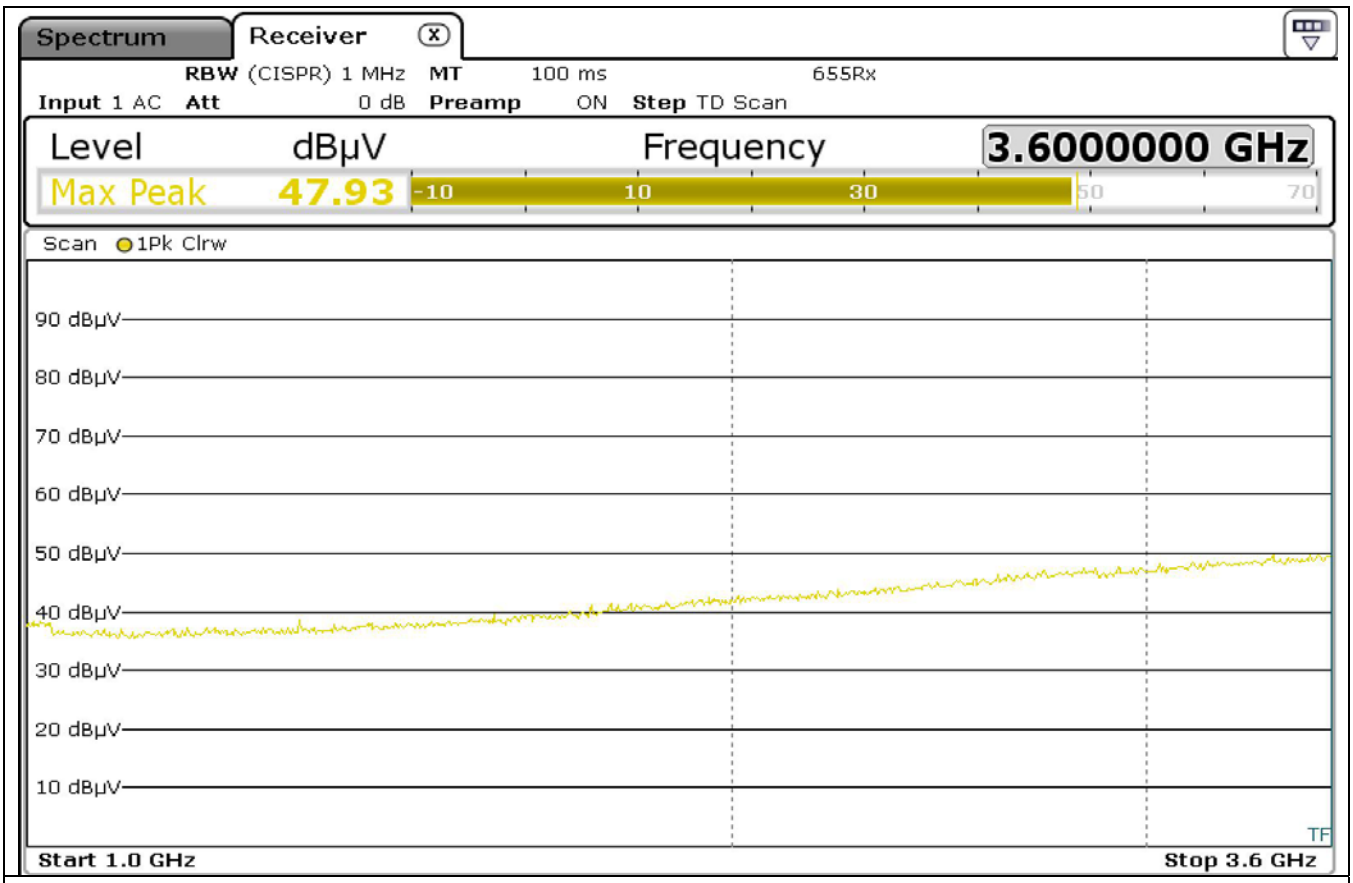

Fig B5 Scan 1GHz – 3.6GHz Vertical 3m

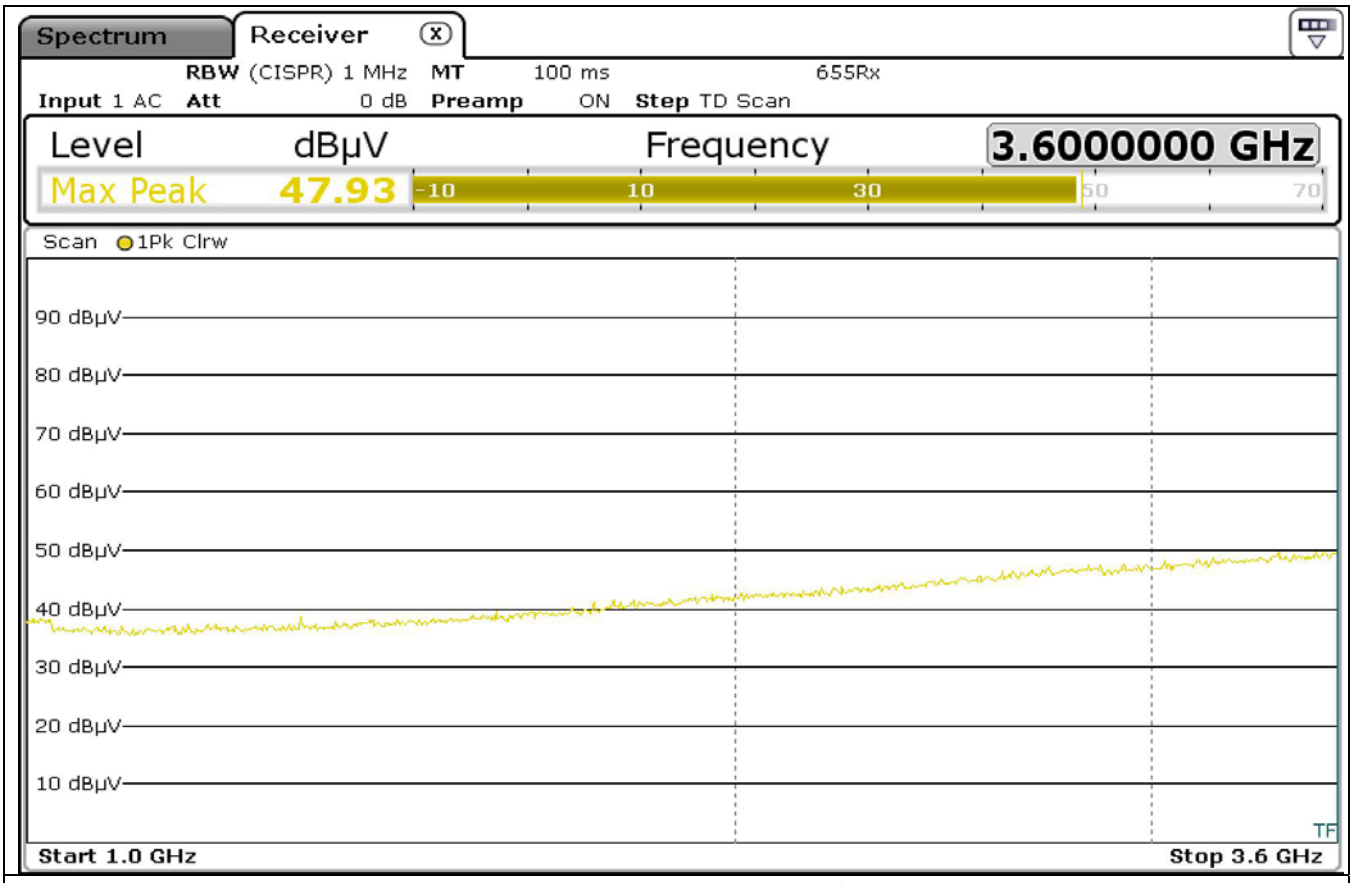

Fig B6 Scan 1GHz – 3.6GHz Horizontal 3m

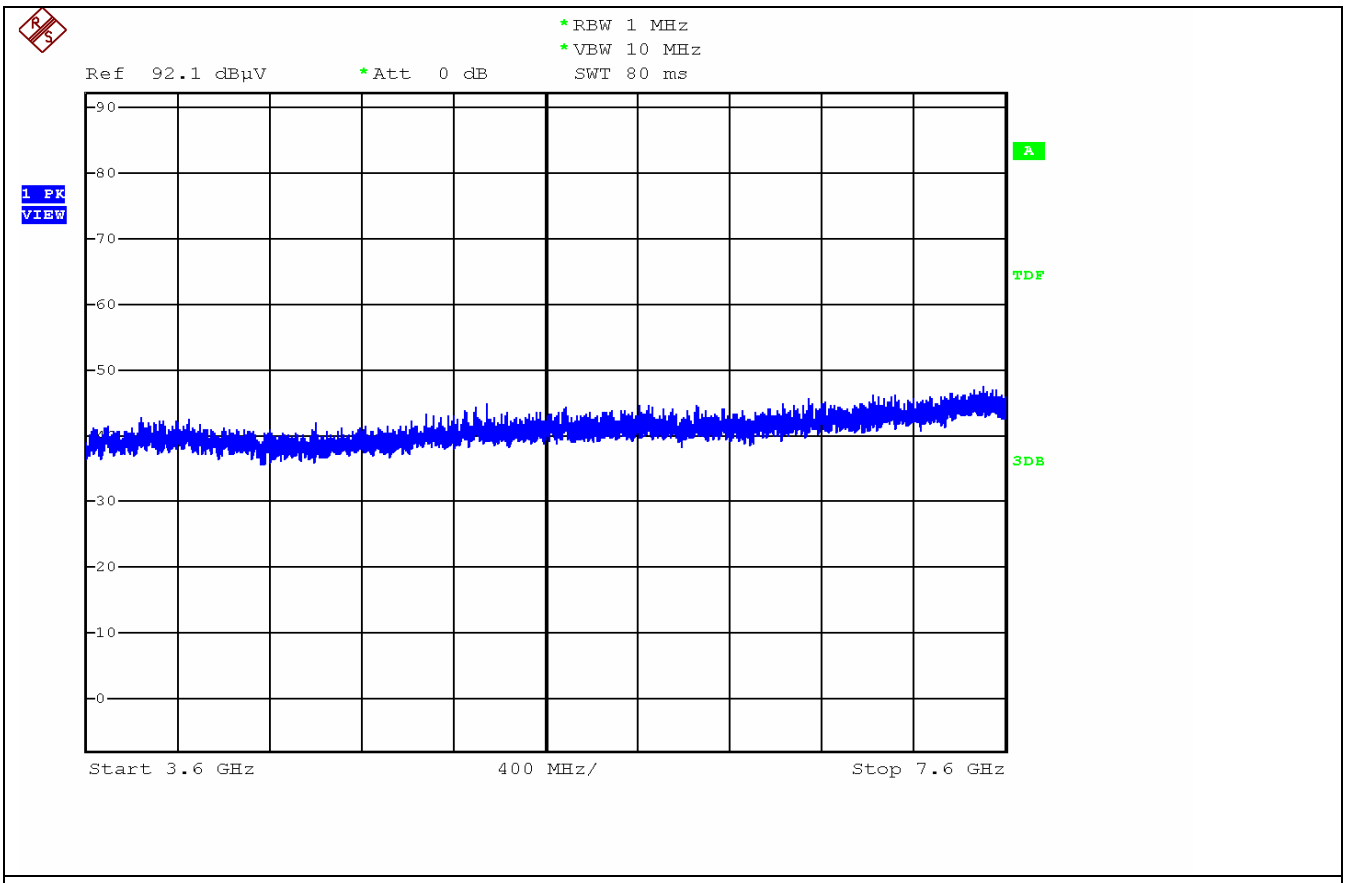

Fig B7 Scan 3.6 – 7.6GHz Vertical 1m

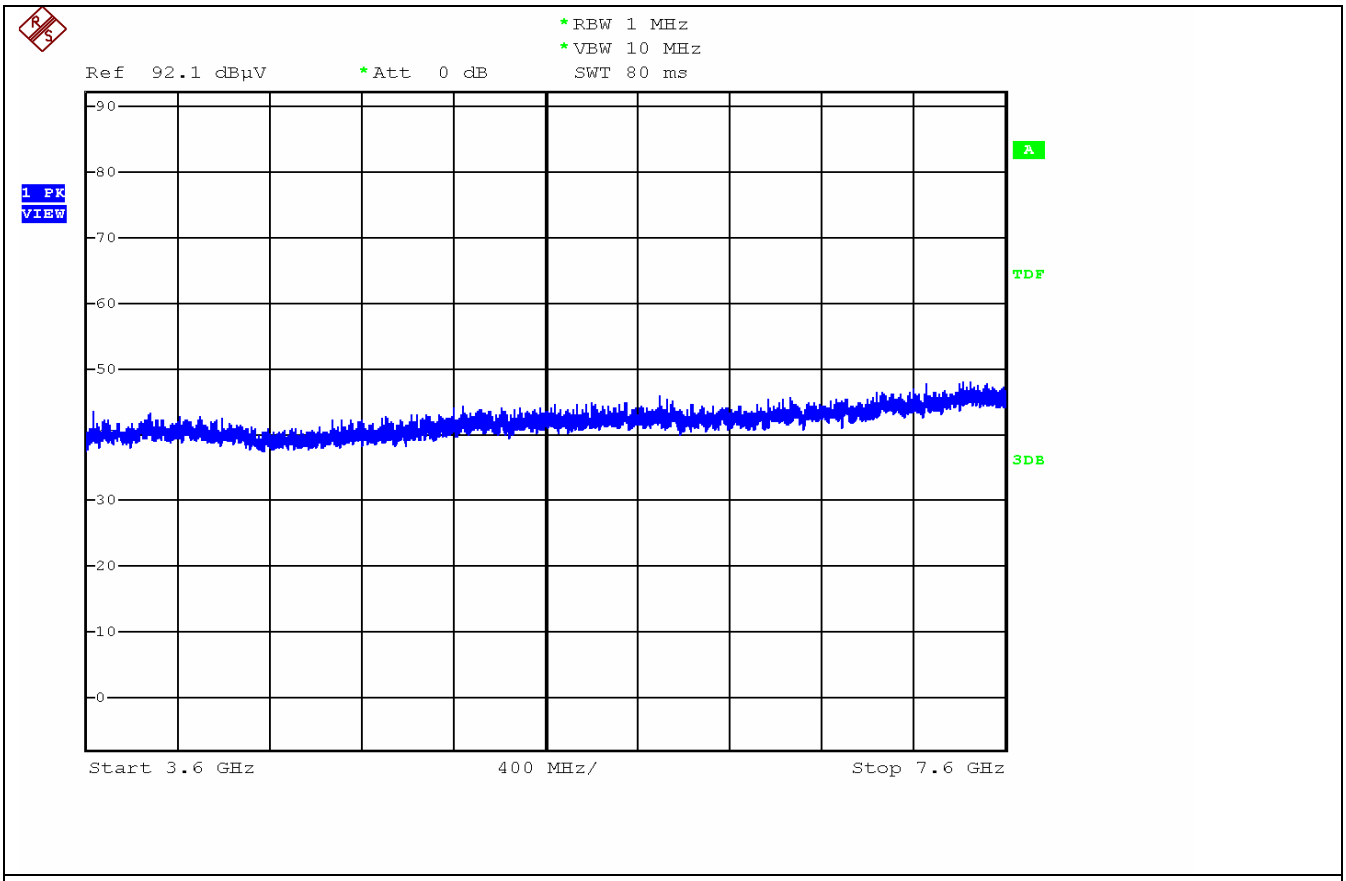

Fig B8 Scan 3.6 – 7.6GHz Horizontal 1m

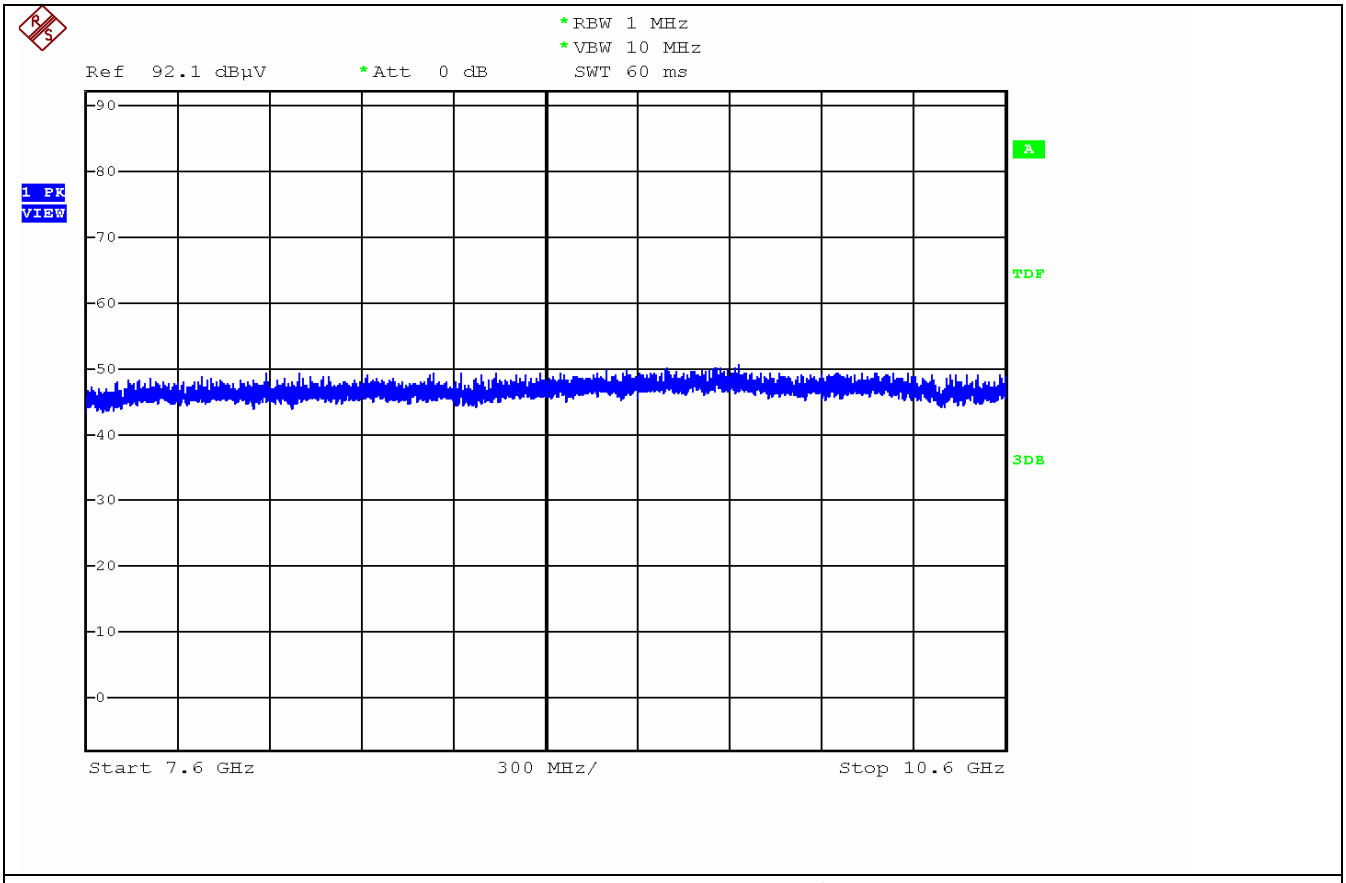

Fig B9 Scan 7.6 – 10.6 GHz Vertical 1m

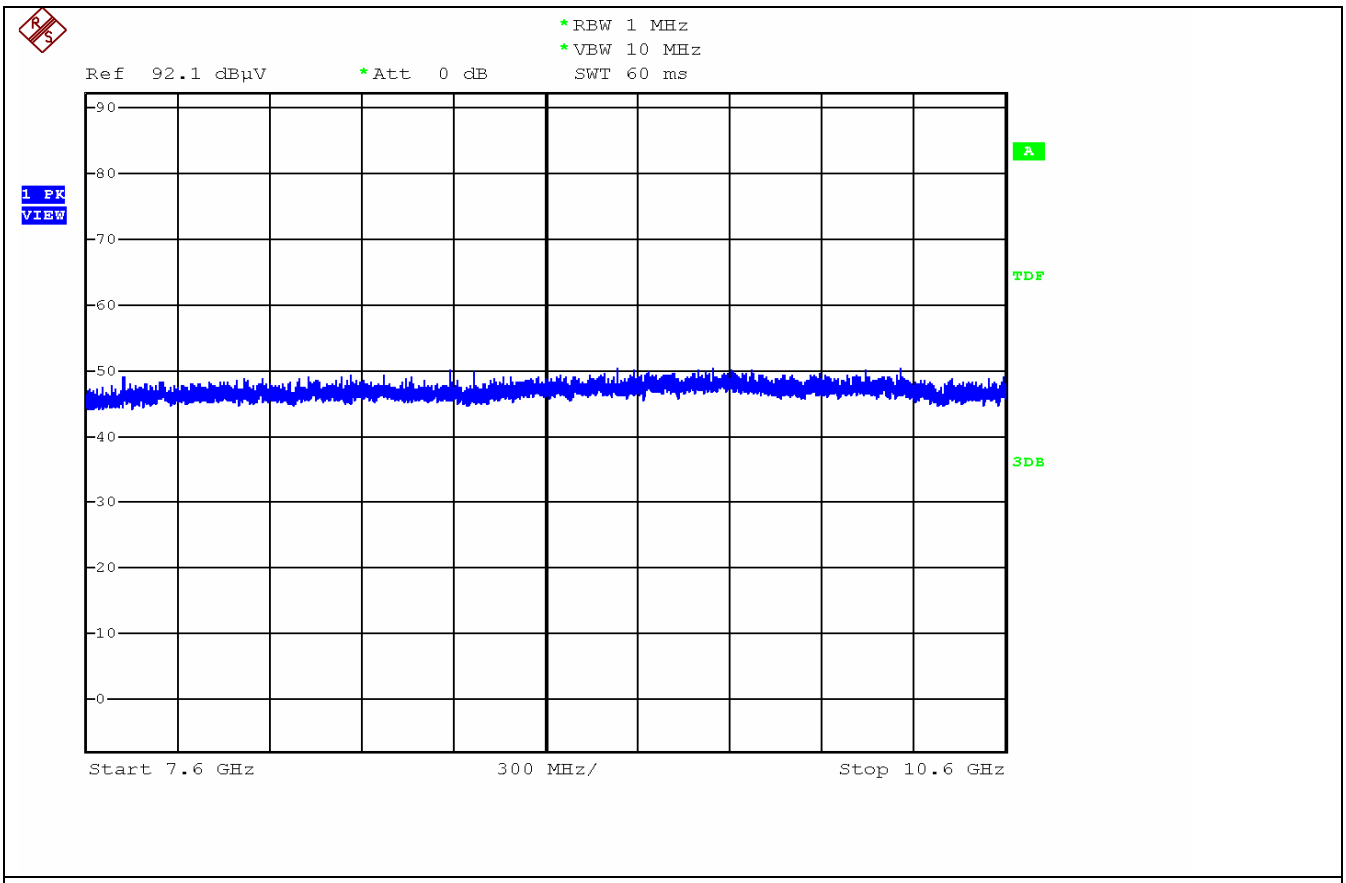

Fig B10 Scan 7.6 – 10.6GHz Horizontal 1m

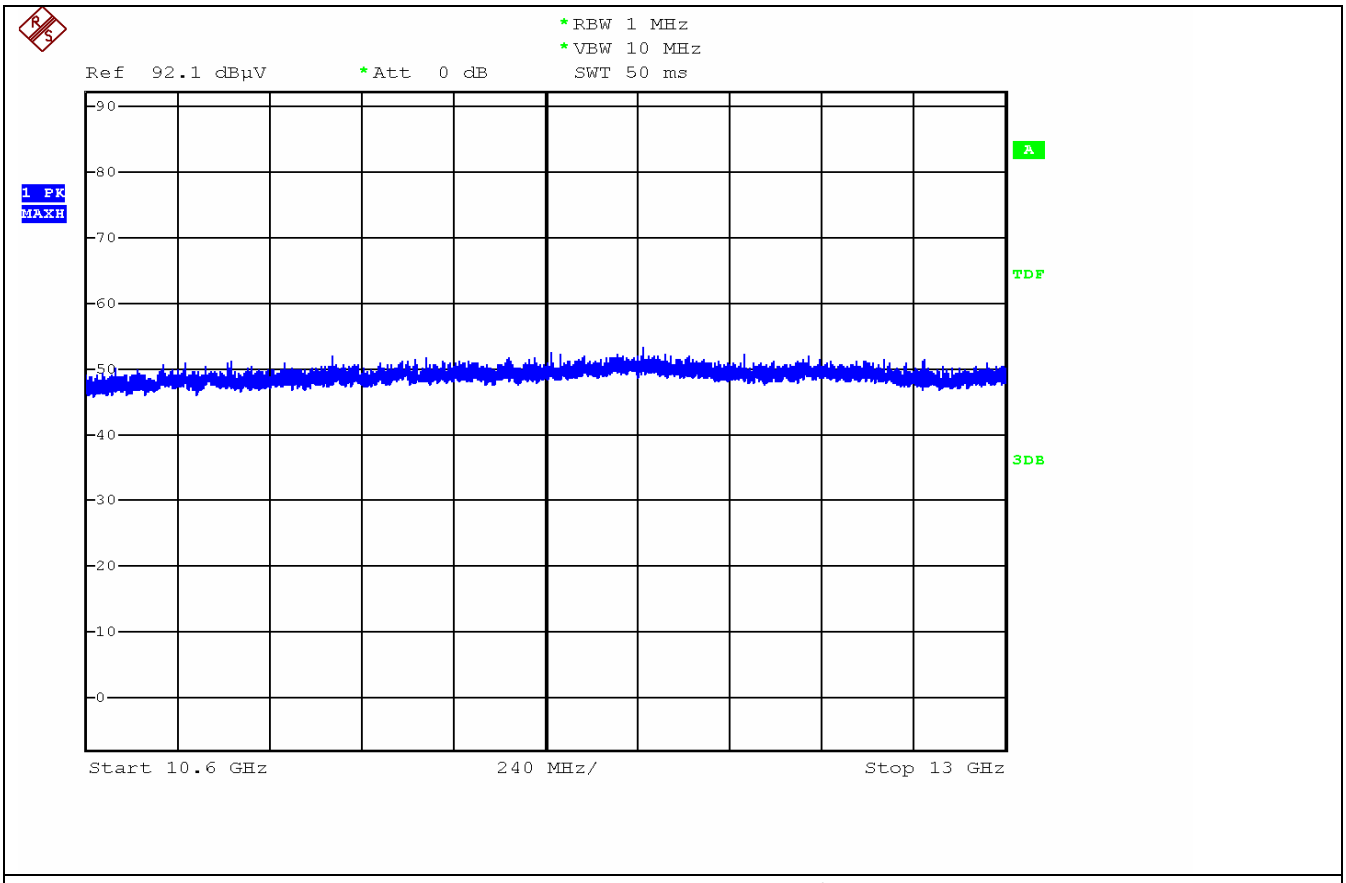

Fig B11 Scan 10.6 – 13GHz Vertical 1m

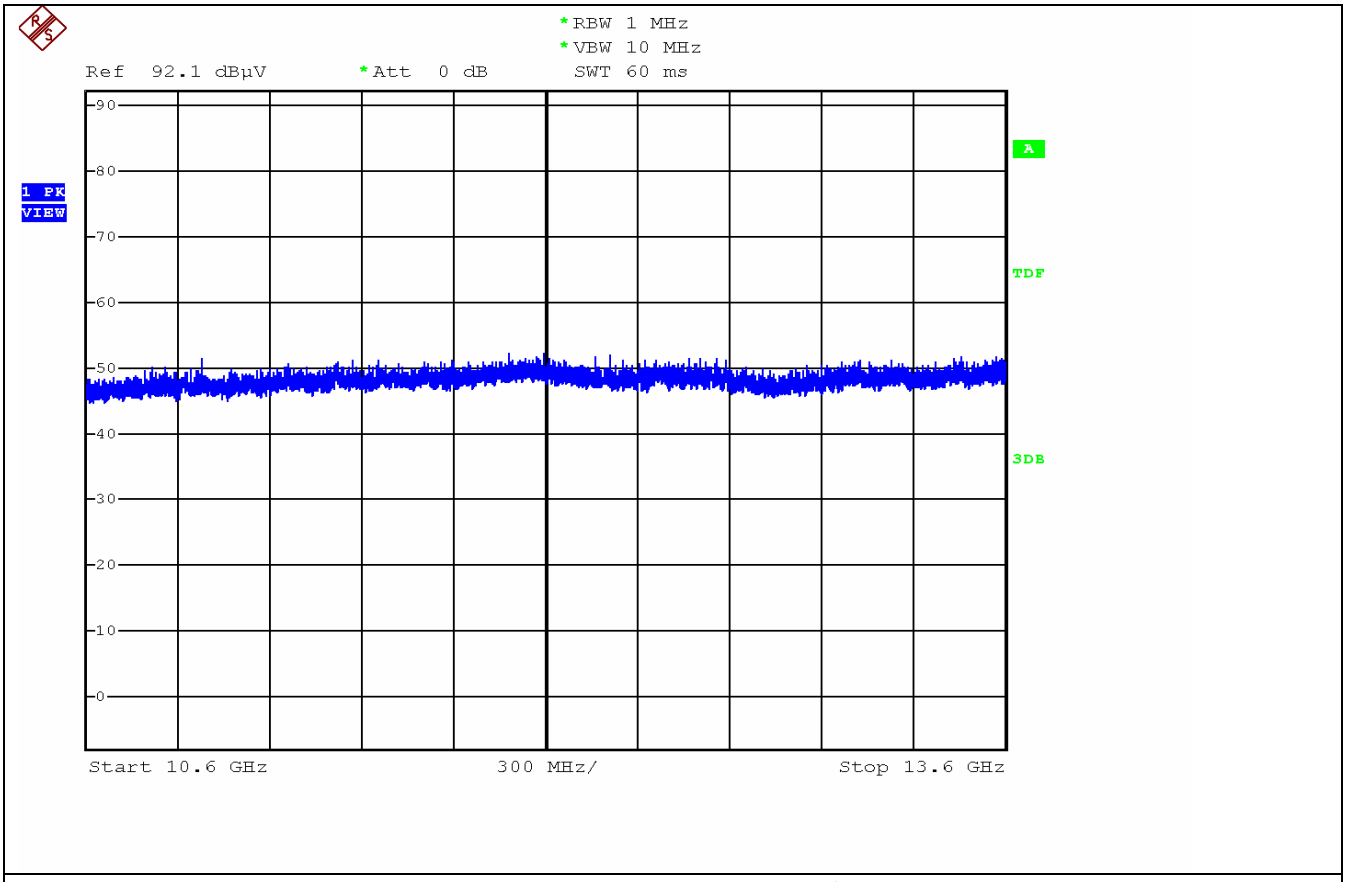

Fig B12 Scan 10.6 – 13GHz Horizontal 1m

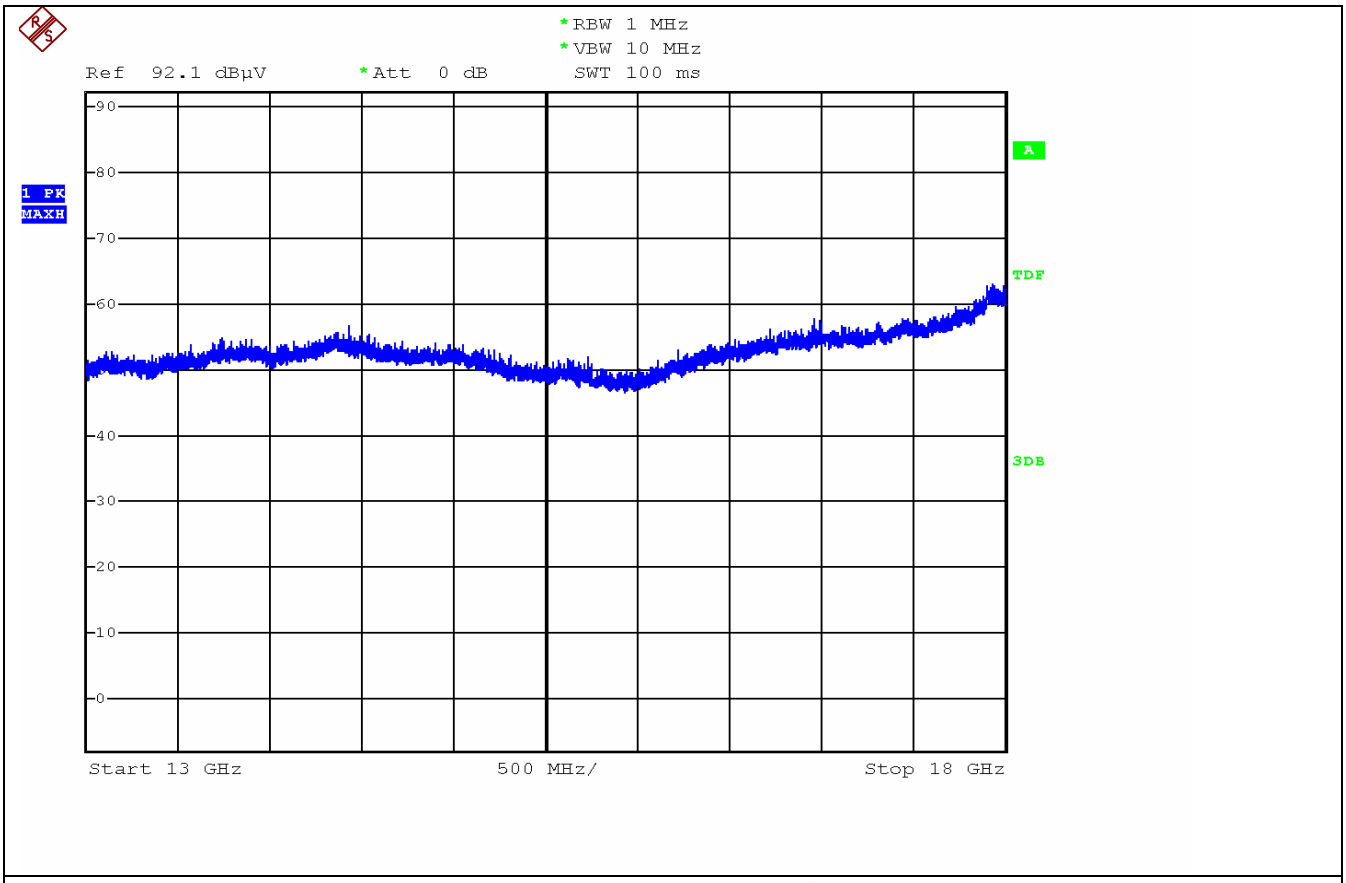

Fig B13 Scan 13 – 18GHz Vertical 1m

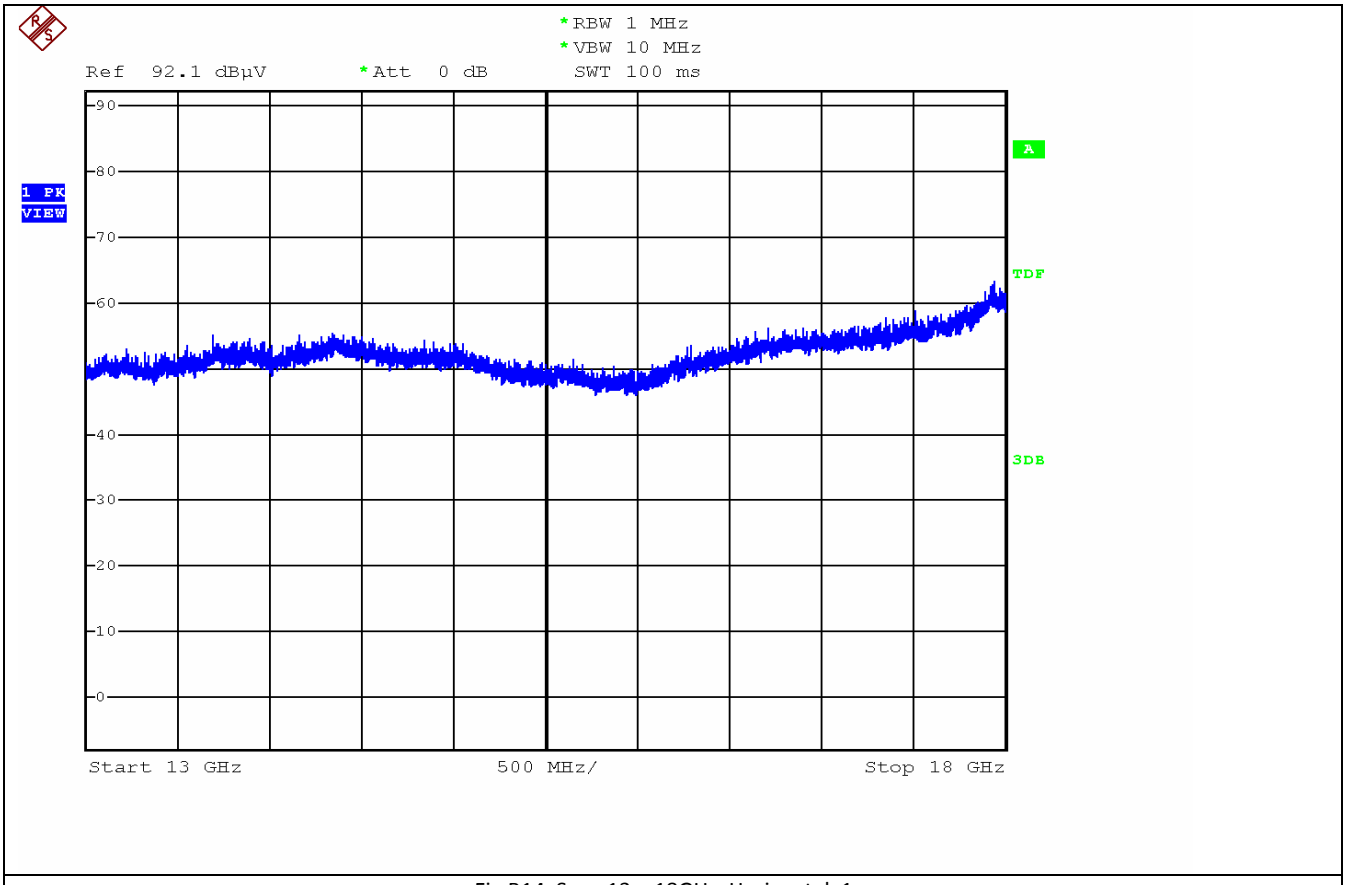

Fig B14 Scan 13 – 18GHz Horizontal 1m

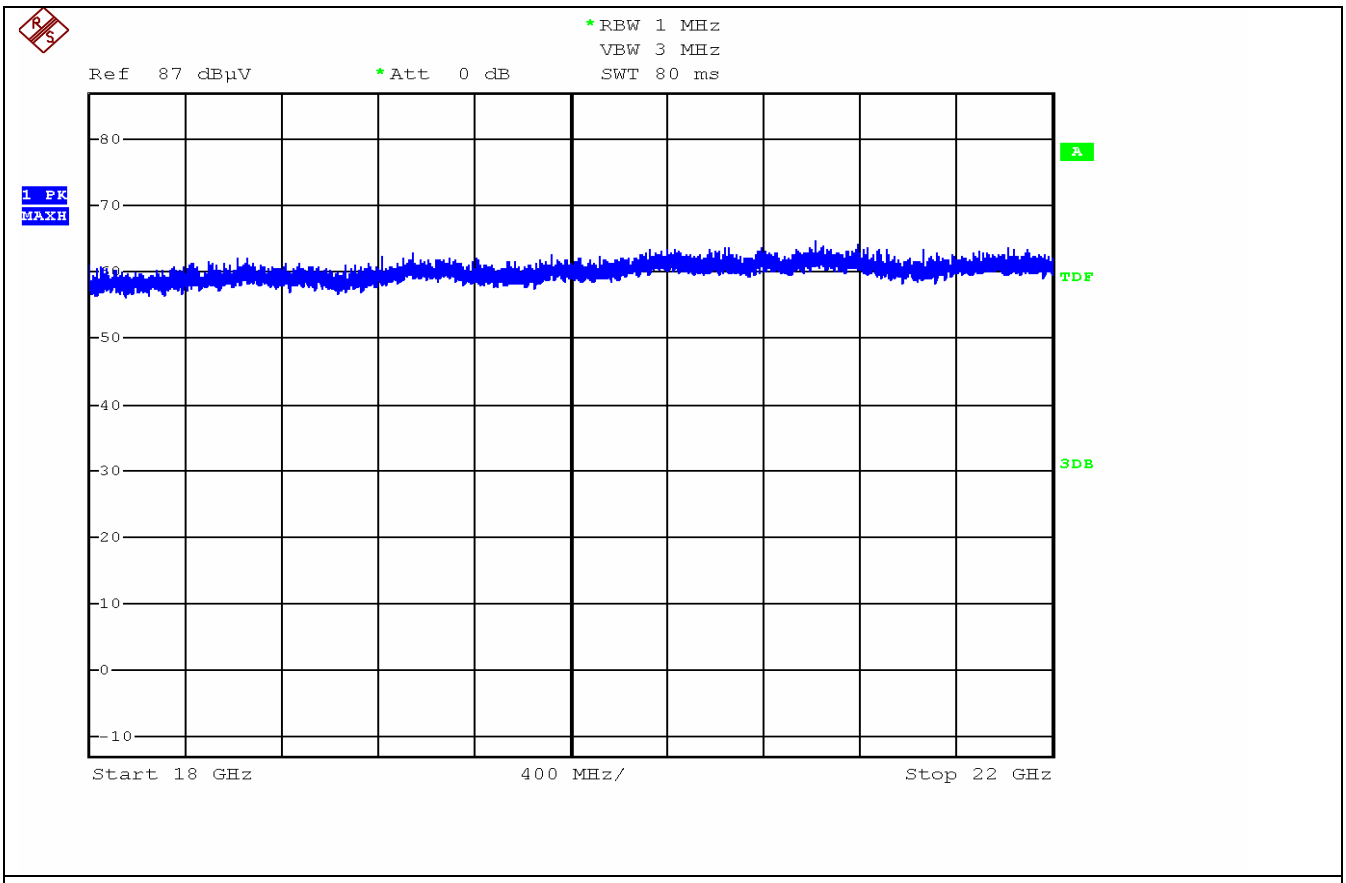

Fig B15 Scan 18 – 22GHz Vertical 1m

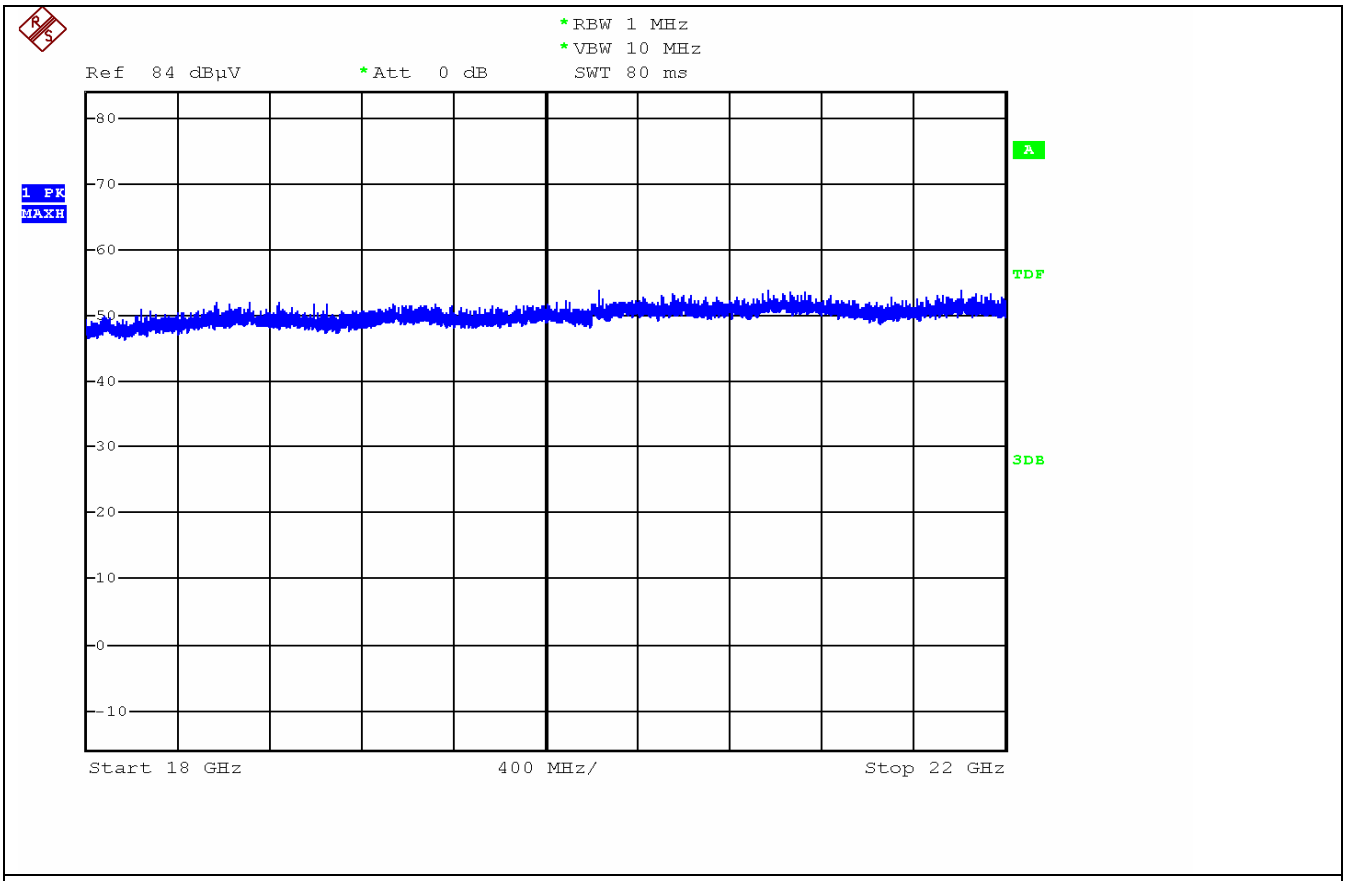

Fig B16 Scan18 – 22GHz Horizontal 1m

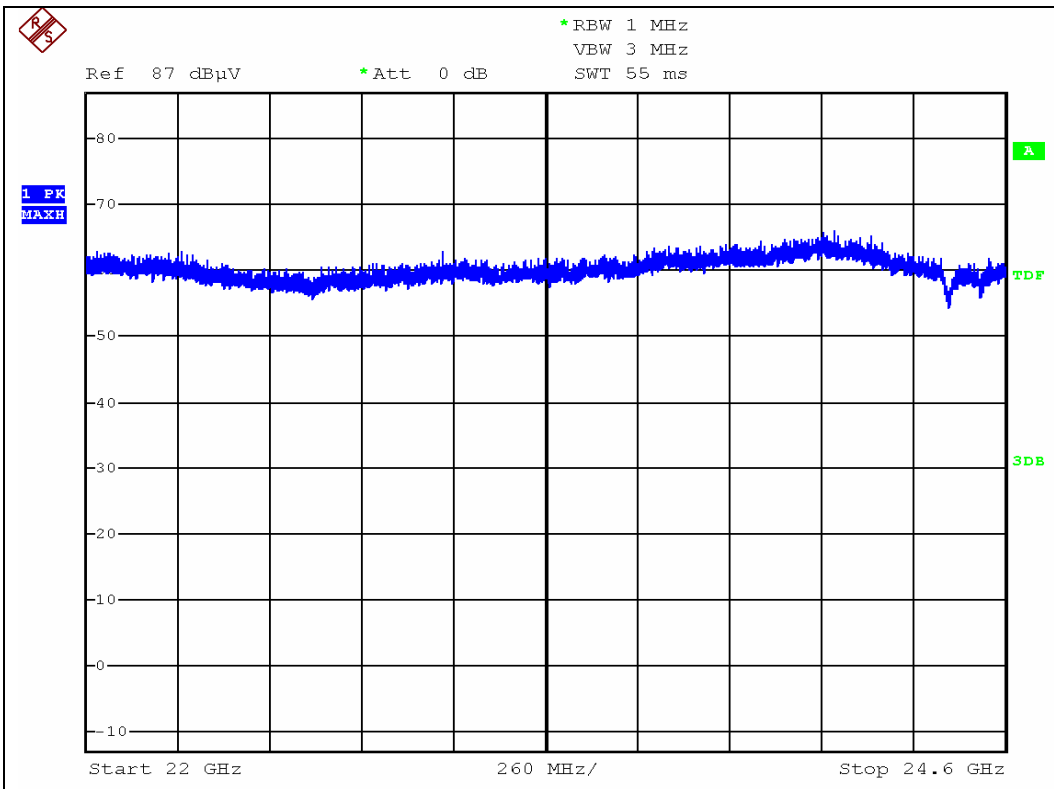

Fig B17 Scan 22 – 24.6GHz Vertical 1m

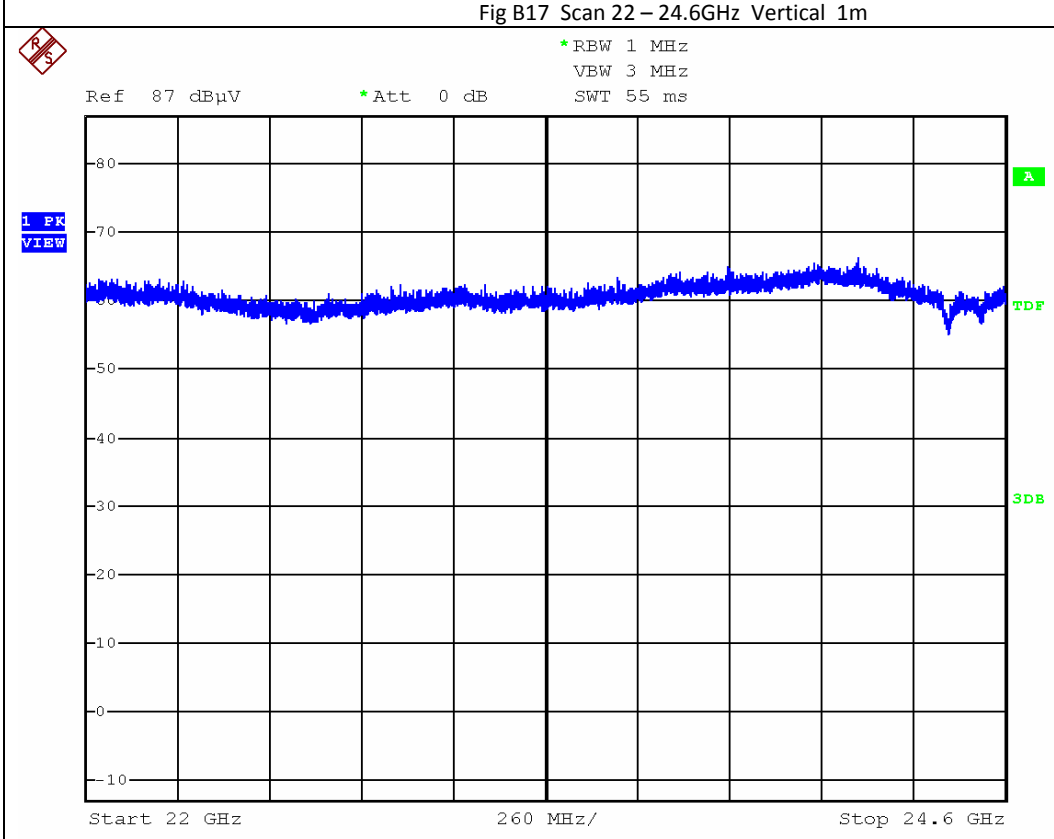

Fig B18 Scan22 – 24.6GHz Horizontal 1m

Appendix C

Conducted Emissions on the Mains

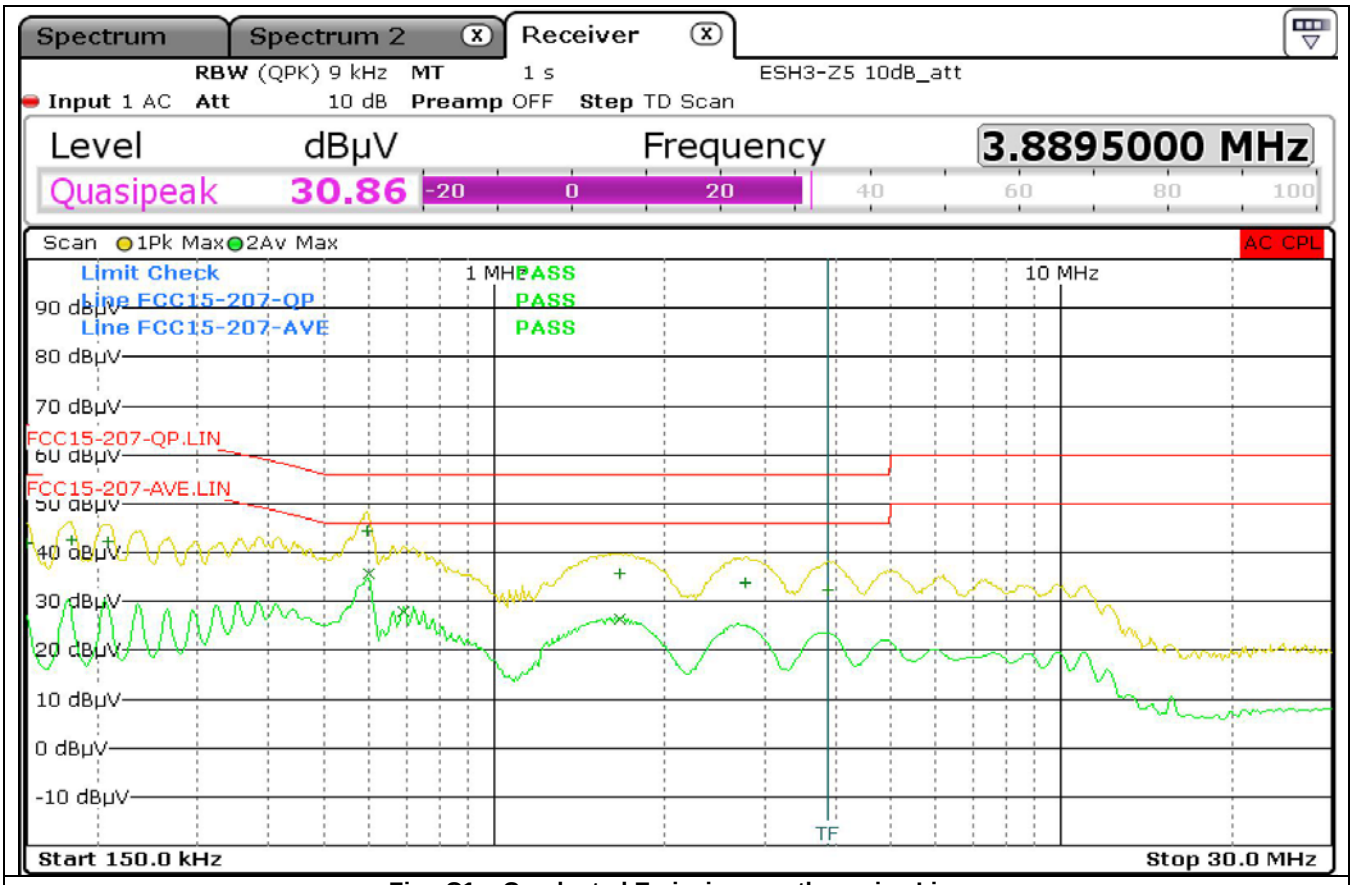

Fig C1 Conducted Emissions on the mains Live

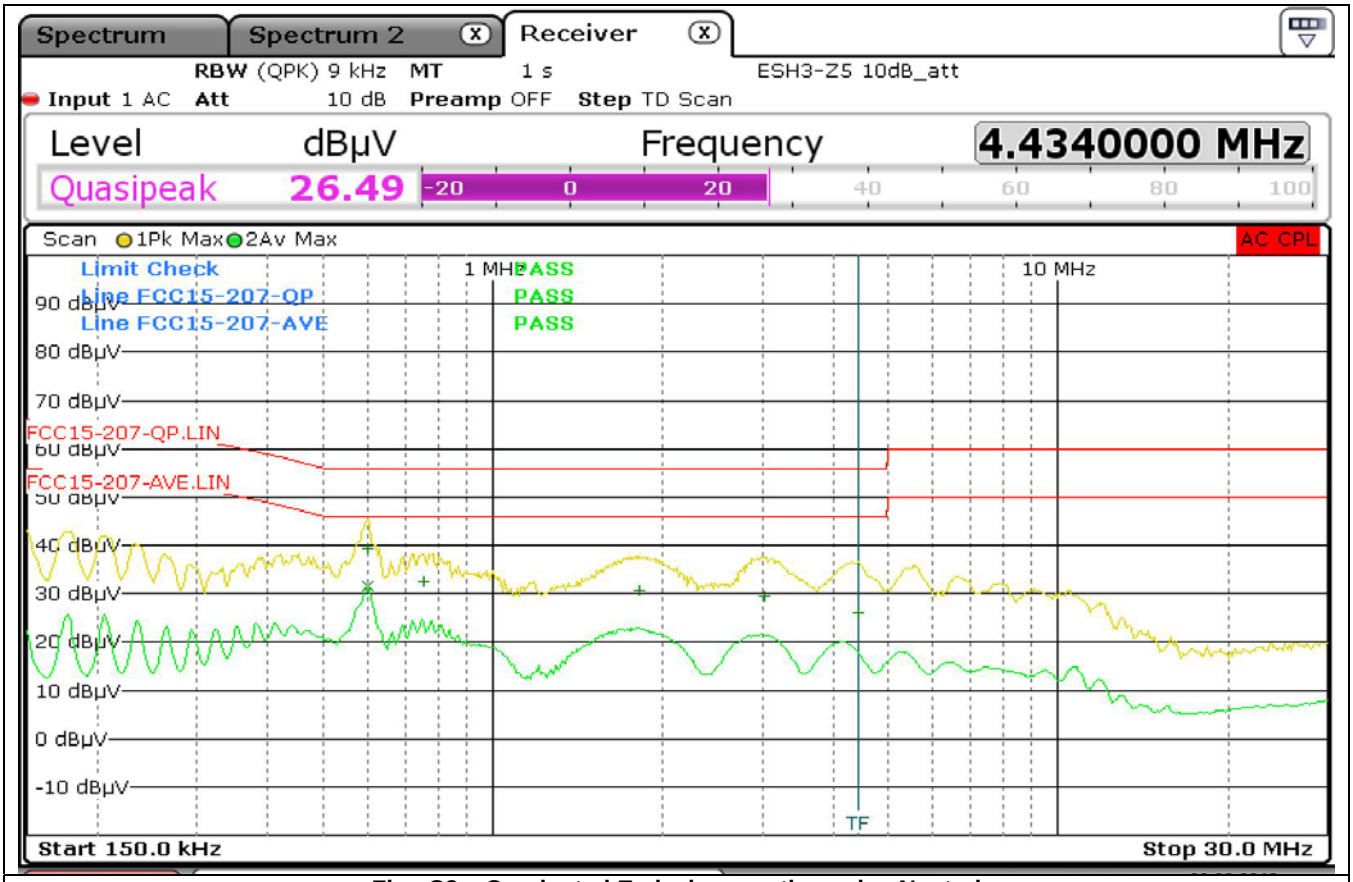

Fig C2 Conducted Emissions on the mains Neutral

Appendix D

Fig C1 EUT orientation “O1”	Fig C2 EUT orientation “O2”	Fig C3 EUT orientation “O3”

End of Report