COMPLIANCE ENGINEERING IRELAND LTD

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Project Number: 16E6009-1c

Prepared for:

Tekelek Europe Ltd.

By

Compliance Engineering Ireland Ltd

Clonross Lane

Derrockstown

Dunshaughlin

Co. Meath

FCC Site Registration: 92592

FCC ID: S6T750

Date

15th Nov 2016

FCC EQUIPMENT AUTHORISATION

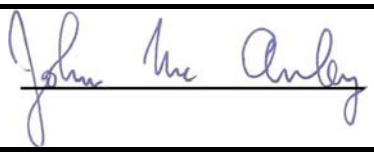
Test Report

EUT Description

SRD Liquid level Gauge

Authorised :

John McAuley



TEST SUMMARY

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

FCC Part Section(s)	TEST PARAMETERS	Test Result
15.247a 2	6dB bandwidth	Pass
15.247e	Power Spectral Density	Pass
15.247(b)1	Output power Conducted	Pass
15.247(d)1	Conducted Spurious Emissions	Pass
15.209	Radiated Spurious Emissions	Pass
15.247a	99% bandwidth	Pass

Exhibit A – Technical Report

Table of Contents

1.0 EUT Description

Model:	TEK 750 TEK750EXT
Type:	SRD Liquid level gauge
FCC ID:	S6T750
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 15.247
Type of radio:	Stand-alone
Transmitter Type:	802.11b, g, n
Operating Frequency Range(s):	2.412 GHz- 2.462GHz
Number of Channels:	11
Antenna:	Integral
Power configuration:	3.6 v Battery.
Ports:	None
Oper. Temp Range:	-40° C to +85° C
Classification:	DTS
Test Methodology:	Measurements performed according to the procedures in ANSI C63.10-2013

The TEK 750 is a tank monitor product with WiFi connectivity. The unit is battery powered, wakes up periodically and performs an ullage measurement and also periodically (once per day) connects to a remote server via a WiFi connection using Channels 1 to 11 to report the measurements.

There are two models
a)TEK750 with internal pcb antenna connection and
b)TEK750EXT with external antenna connection (max gain of 7dBi**)**.
Both models use the same artwork and firmware and changing the location of one capacitor switches between internal and external antenna connections.
Note the EUT case is made of plastic.

1.1 EUT Operation

Operating Conditions during Test:

The EUT was operated in test mode where the channel and modulation was set via USB connection to a laptop.
The EUT was powered from a bench PSU set to 3.6Vdc.
The tests were carried out on 2 samples of EUT
-one EUT (TEK750EXT) sample for conducted tests on the antenna port . The antenna port on this unit was terminated for radiated emissions testing.
and another sample TEK750 (where internal antenna was connected) for radiated tests.

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 4th ,16th of March and 20th May ; 24th and 25th Oct 2016.

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.

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).

1.5. Description of Test modes

Channel List

Channel	Freq MHz	Channel	Freq MHz
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437		

Available Data Rates

802.11 B	802.11 G	802.11 N
MB/s	MB/s	MB/s
1,2,5.5,11	6,9,12,18,24,36,48,54	6.5,13,19.5,26,39,52,58.5,65
1,2,5.5,11	6,9,12,18,24,36,48,54	6.5,13,19.5,26,39,52,58.5,65
1,2,5.5,11	6,9,12,18,24,36,48,54	6.5,13,19.5,26,39,52,58.5,65

Evaluation test for max power test carried out on the following

Channel	Freq	B	G	N
	MHz	MB/s	MB/s	MB/s
1	2412	1,2,5.5,11	6,9,12,18,24,36,48,54	6.5,13,19.5,26,39,52,58.5,65
6	2437	1,2,5.5,11	6,9,12,18,24,36,48,54	6.5,13,19.5,26,39,52,58.5,65
11	2462	1,2,5.5,11	6,9,12,18,24,36,48,54	6.5,13,19.5,26,39,52,58.5,65

Complete test was carried out on the worst cases for Ch1 B/G/N Ch6 B/G/N and Ch11 B/G/N

It was found that the highest output levels were recorded on the 802.11B modulation

2 Emissions Measurements

2.1 Conducted Emissions Measurements

The EUT artwork allowed the placement of a connector for conducted antenna measurements and changing the location of a capacitor removed the printed antenna from the circuit and permitted the conducted signal for the antenna to be routed to the antenna connector .

All results were measured as conducted on the antenna except radiated spurious emissions.

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.

Emissions below 1GHz were measured using a bi-log antenna positioned at a distance of 3 metres from the EUT (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.. 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 a fully anechoic chamber. The radiated emissions were maximised by configuring the EUT and by rotating the EUT In this case 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 63.10 2013 Section 4.1.4.2.3) .

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 Internal antenna complies with this requirement.

The option for external antenna has a reverse polarity SMA connector and thereby meets this requirement.

*The E.U.T Complies with the requirement of 15.203

3.0 Results for Conducted emissions on the mains

Test not performed as EUT is battery powered only and battery cannot be recharged while in the unit.

4. Conducted Measurements

4.1 Bandwidth

4.1.1 6dB bandwidth

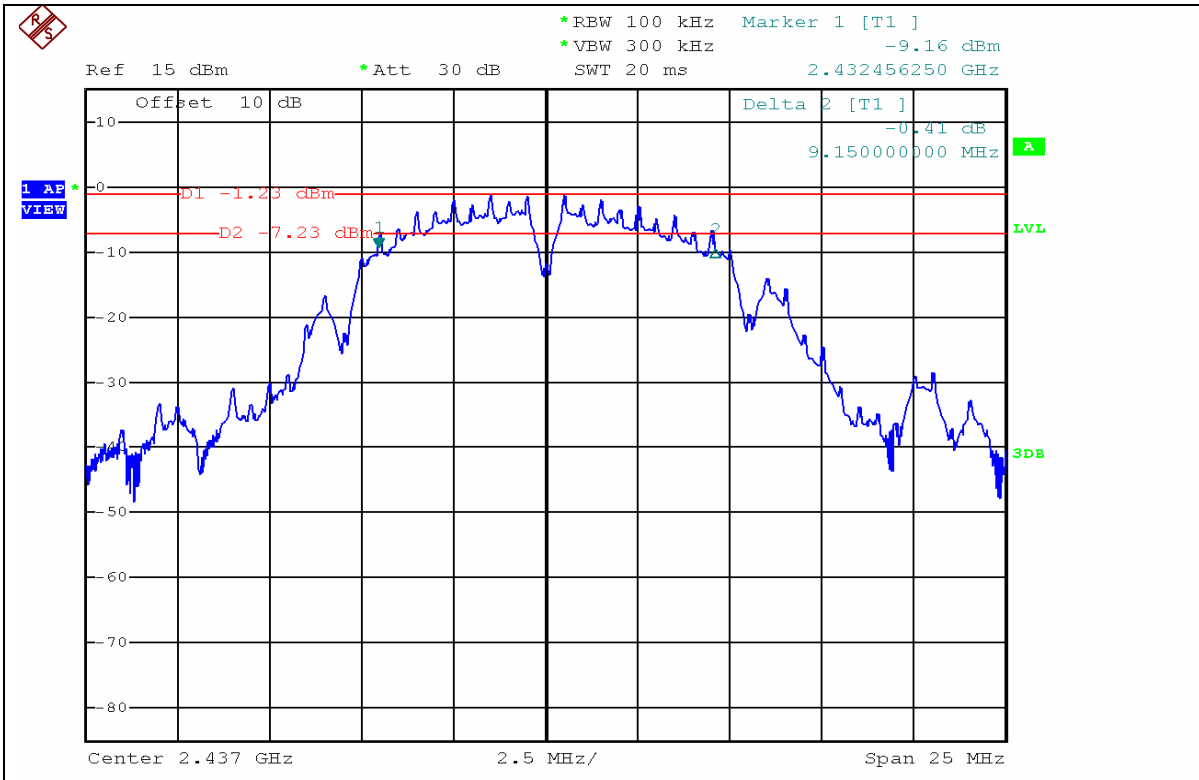


Fig 1 6dB Bandwidth

4.1.2 99% bandwidth

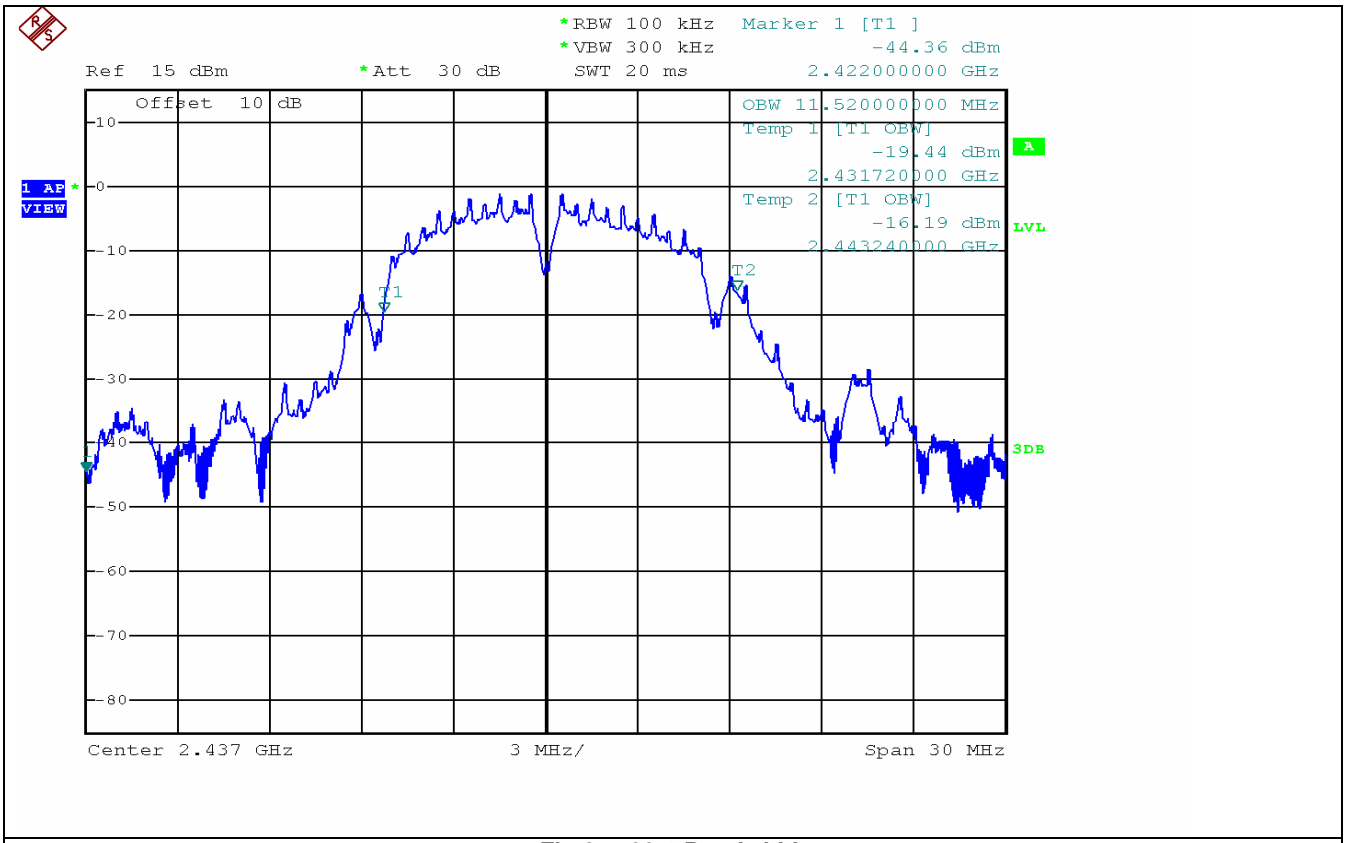


Fig 2 99% Bandwidth

Bandwidth

Channel	802.11	Frequency	6dB Bandwidth	99% Bandwidth
		GHz	MHz	MHz
Low	B	2.412	9.038	11.388
Mid	B	2.437	9.15	11.520
High	B	2.462	9.16	11.574
Low	G	2.412	16.662	20.316
Mid	G	2.437	16.662	17.64
High	G	2.462	16.752	19.128
Low	N	2.412	17.898	20.196
Mid	N	2.437	17.976	19.08
High	N	2.462	17.916	18.818

Limit for 6dB Bandwidth = 500KHz min

Result :- Pass

4.2 Power Spectral Density

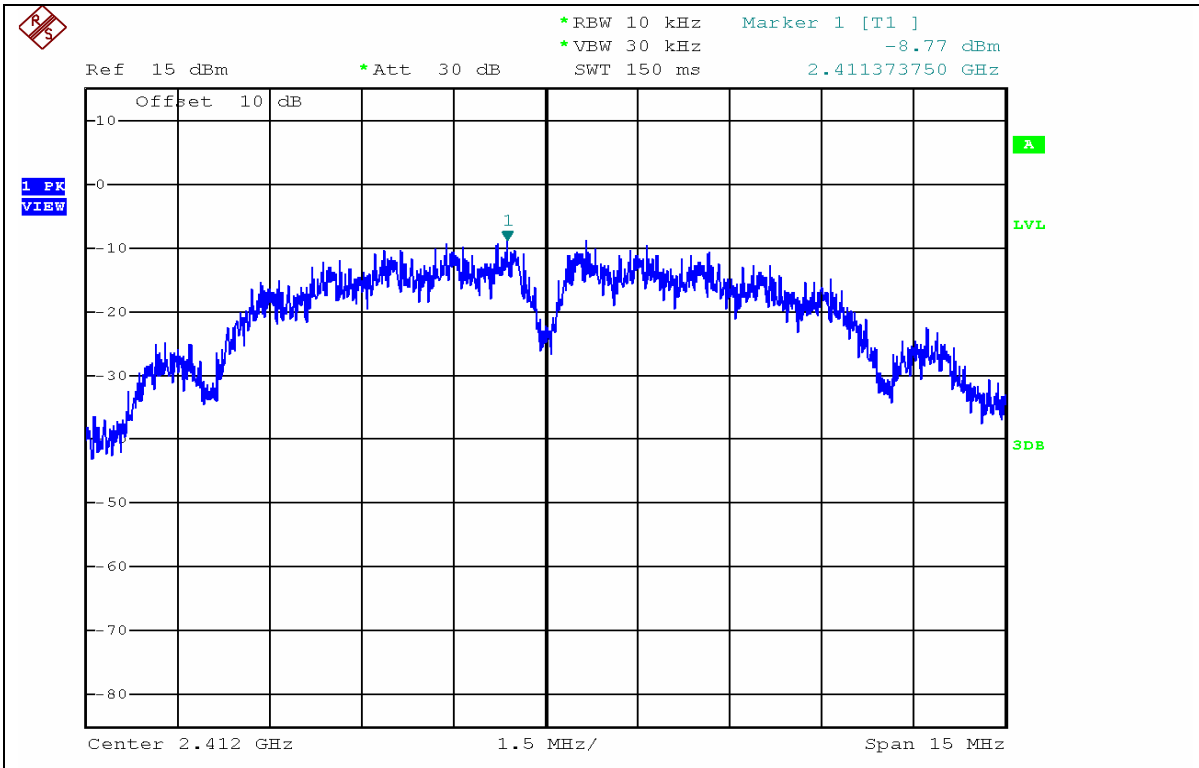


Fig 3 Power Spectral Density

Channel	802.11	Frequency	Power Spectral Density	Limit
		GHz	dBm	dBm
Low	B	2.412	-8.77	8
Mid	B	2.437	-8.95	8
High	B	2.462	-9.03	8
Low	G	2.412	-10.31	8
Mid	G	2.437	-11.79	8
High	G	2.462	-11.83	8
Low	N	2.412	-10.23	8
Mid	N	2.437	-10.75	8
High	N	2.462	-10.51	8

Result :- Pass

4.3 Output power Conducted

Channel	802.11	Frequency	Output Power Peak	Antenna Gain	Eirp	Limit	Margin
		GHz	dBm	dBi	dBm	dBm	dB
Low	B	2.412	12.9	7	19.9	29	9.1
Mid	B	2.437	12.4	7	19.4	29	9.6
High	B	2.462	11.8	7	18.8	29	10.2
Low	G	2.412	12.3	7	19.3	29	9.7
Mid	G	2.437	11.9	7	18.9	29	10.1
High	G	2.462	11.6	7	18.6	29	10.4
Low	N	2.412	12.3	7	19.3	29	9.7
Mid	N	2.437	11.8	7	18.8	29	10.2
High	N	2.462	11.5	7	18.5	29	10.5

Measured using peak power meter connected to the antenna port

Test Result :- Pass

5. Radiated Emissions

5.1 Output Power Radiated Results Internal Antenna

Channel	802.11	Frequency	Radiated Field Strength	Output Power	Limit
		GHz	dBuV/m	dBm	dBm
Low	B	2.412	98.40	3.17	30
Mid	B	2.437	97.80	2.57	30
High	B	2.462	97.10	1.87	30
Low	G	2.412	97.60	2.37	30
Mid	G	2.437	97.20	1.97	30
High	G	2.462	97.20	1.97	30
Low	N	2.412	97.70	2.47	30
Mid	N	2.437	97.40	2.17	30
High	N	2.462	97.00	1.77	30

Radiated Field Strength measured at 3 metres measured using peak power meter.

Output power calculated using

eirp = pt x gt = (E x d)2 /30

As per eq 1 KDB 412172 D01 Determining ERP and EIRP v01r01

Test Result :- Pass

5..2 Radiated Spurious Emissions Measurements (1GHz – 26 GHz)

5.2.1 Internal Antenna

Frequency GHz	Peak Level dBuV/m	Antenna Factor dB	Preamp Gain dB	Cable Loss	Antenna Polarity	Final Peak Level dBuV/m	Average Limit +20dB dBuV/m	Margin dB
4.824	57.2	32.5	38.6	6.6	Vertical	57.7	74.0	16.3
4.824	55.2	32.5	38.6	6.6	Horizontal	55.7	74.0	18.3
7.236	50.4	35.5	39	8.0	Vertical	54.9	74.0	19.1
7.236	45.6	35.5	39	8.0	Horizontal	50.1	74.0	23.8
4.874	56.4	32.5	38.6	6.6	Vertical	56.9	74.0	17.1
4.874	53.5	32.5	38.6	6.6	Horizontal	54.0	74.0	20.0
7.311	49.3	35.5	39	8.0	Vertical	53.8	74.0	20.2
7.311	50.7	35.5	39	8.0	Horizontal	55.2	74.0	18.8
4.924	57.8	32.5	38.6	6.6	Vertical	58.3	74.0	15.7
4.924	55.8	32.5	38.6	6.6	Horizontal	56.3	74.0	17.7
7.386	50.7	35.5	39	8.0	Vertical	55.2	74.0	18.7
7.386	50.3	35.5	39	8.0	Horizontal	54.8	74.0	19.2

Frequency GHz	Average Level dBuV/m	Antenna Factor dB	Preamp Gain dB	Cable Loss	Antenna Polarity	Final Average Level dBuV/m	Average Limit dBuV/m	Margin dB
4.824	52.7	32.5	38.6	6.6	Vertical	53.2	54.0	0.8
4.824	49.6	32.5	38.6	6.6	Horizontal	50.1	54.0	3.9
7.236	36.1	35.5	39	8.0	Vertical	40.6	54.0	13.4
7.236	36.2	35.5	39	8.0	Horizontal	40.7	54.0	13.3
4.874	53.0	32.5	38.6	6.6	Vertical	53.5	54.0	0.5
4.874	48.2	32.5	38.6	6.6	Horizontal	48.7	54.0	5.3
7.311	36.4	35.5	39	8.0	Vertical	40.9	54.0	13.1
7.311	36.3	35.5	39	8.0	Horizontal	40.8	54.0	13.2
4.924	52.8	32.5	38.6	6.6	Vertical	53.3	54.0	0.7
4.924	50.7	32.5	38.6	6.6	Horizontal	51.2	54.0	2.7
7.386	36.7	35.5	39	8.0	Vertical	41.2	54.0	12.8
7.386	36.6	35.5	39	8.0	Horizontal	41.1	54.0	12.8

Peak measurement performed with Resolution Bandwidth set to 1MHz as per ANSI C63.10-2013 Section 4.1.4.2.2

Average measurement performed with Video Bandwidth set to 10Hz as per ANSI C63.10-2013 Section 4.1.4.2.3

Test Result :- Pass

5.3 Spurious Emissions in Restricted bands

5.3.1 Antenna-port conducted measurements

As per KDB 558074 section 12.2

Freq	Peak	Antenna Gain	EIRP	20log(D)	Conversion factor	Max Ground Reflection	**E**	Limit	Margin	Pass/Fail
GHz	dBm	dBi	dBm	dB		dB	dBuV/m	dBuV/m		
4.824	**-67.6**	**7**	**-60.6**	**-9.54**	**104.80**	**0.0**	34.66	74	39.34	Pass
7.236	**-74.3**	**7**	**-67.3**	**-9.54**	**104.80**	**0.0**	27.96	74	46.04	Pass
12.06	**-73.3**	**7**	**-66.3**	**-9.54**	**104.80**	**0.0**	28.96	74	45.04	Pass
4.874	**-72.1**	**7**	**-65.1**	**-9.54**	**104.80**	**0.0**	30.16	74	43.84	Pass
7.311	**-76.1**	**7**	**-69.1**	**-9.54**	**104.80**	**0.0**	26.16	74	47.84	Pass
12.185	**-76.6**	**7**	**-69.6**	**-9.54**	**104.80**	**0.0**	25.66	74	48.34	Pass
4.924	**-72.6**	**7**	**-65.6**	**-9.54**	**104.80**	**0.0**	29.66	74	44.34	Pass
7.386	**-76.1**	**7**	**-69.1**	**-9.54**	**104.80**	**0.0**	26.16	74	47.84	Pass
12.31	**-76.2**	**7**	**-69.2**	**-9.54**	**104.80**	**0.0**	26.06	74	47.94	Pass

5.3.2 Radiated Emissions with antenna port terminated

Frequency GHz	Peak Level dBuV/m	Antenna Factor dB	Preamp Gain dB	Cable Loss	Antenna Polarity	EUT Orientation	Final Peak Level dBuV/m	Average Limit +20dB dBuV/m	Margin dB
4.824	57.7	32.5	38.6	6.6	Vertical	O1	58.2	74.0	15.8
4.824	56.4	32.5	38.6	6.6	Horizontal	O1	56.9	74.0	17.0
7.236	40.1	35.5	39	8.0	Vertical	O1	44.6	74.0	29.4
7.236	35.3	35.5	39	8.0	Horizontal	O1	39.8	74.0	34.1
4.874	58.7	32.5	38.6	6.6	Vertical	O1	59.2	74.0	14.8
4.874	57.5	32.5	38.6	6.6	Horizontal	O1	58.0	74.0	15.9
7.311	40.8	35.5	39	8.0	Vertical	O1	45.3	74.0	28.7
7.311	40.3	35.5	39	8.0	Horizontal	O1	44.8	74.0	29.1
4.924	50.9	32.5	38.6	6.6	Vertical	O1	51.4	74.0	22.6
4.924	49.8	32.5	38.6	6.6	Horizontal	O1	50.3	74.0	23.7
7.386	40.1	35.5	39	8.0	Vertical	O1	44.6	74.0	29.4
7.386	39.5	35.5	39	8.0	Horizontal	O1	44.0	74.0	29.9

Frequency GHz	Average Level dBuV/m	Antenna Factor dB	Preamp Gain dB	Cable Loss	Antenna Polarity	EUT Orientation	Final Average Level dBuV/m	Average Limit dBuV/m	Margin dB
4.824	50.8	32.5	38.6	6.6	Vertical	O1	51.3	54.0	2.7
4.824	50.8	32.5	38.6	6.6	Horizontal	O1	51.3	54.0	2.7
7.236	29.4	35.5	39	8.0	Vertical	O1	33.9	54.0	20.1
7.236	24.8	35.5	39	8.0	Horizontal	O1	29.3	54.0	24.7
4.874	52.8	32.5	38.6	6.6	Vertical	O1	53.3	54.0	0.7
4.874	51.4	32.5	38.6	6.6	Horizontal	O1	51.9	54.0	2.1
7.311	30.4	35.5	39	8.0	Vertical	O1	34.9	54.0	19.1
7.311	31.1	35.5	39	8.0	Horizontal	O1	35.6	54.0	18.4
4.924	50.9	32.5	38.6	6.6	Vertical	O1	51.4	54.0	2.6
4.924	49.8	32.5	38.6	6.6	Horizontal	O1	50.3	54.0	3.7
7.386	30.3	35.5	39	8.0	Vertical	O1	34.8	54.0	19.2
7.386	30.2	35.5	39	8.0	Horizontal	O1	34.7	54.0	19.3

Peak measurement performed with Resolution Bandwidth set to 1MHz as per ANSI C63.10-2013 Section 4.1.4.2.2

Average measurement performed with Video Bandwidth set to 10Hz as per ANSI C63.10-2013 Section 4.1.4.2.3

Test Result :- Pass

List of Test Equipment

Instrument	Manufacturer	Model	Serial Num	CEI Ref	Cal Due Date	Cal Interval Months
Microwave Preamplifier	Hewlett Packard	83017A	3123A00175	805	19/09/2017	12
Spectrum Analyser 30Hz-40GHz	Rohde& Schwarz	FSP40	100053	850	09/11/2018	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	AH Systems	SAS-200/571	373	839	20/11/2017	36
Power Meter USB	Dare	Radipower 3600	14I00889SNO05	913	12/05/2017	12

Appendix A

Additional Test Results

For

Conducted Measurements on the Antenna Port

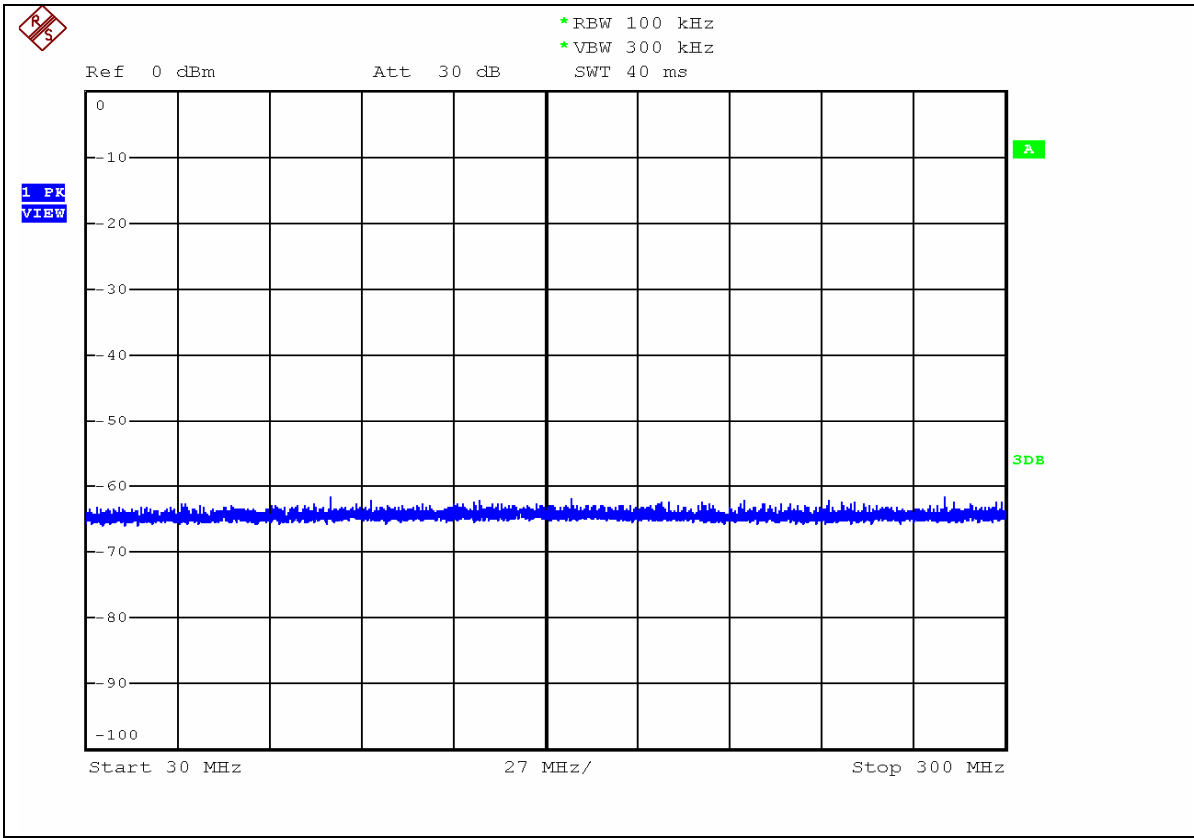


Fig A1 Low Channel Conducted Spurious Emissions 30MHz -300MHz

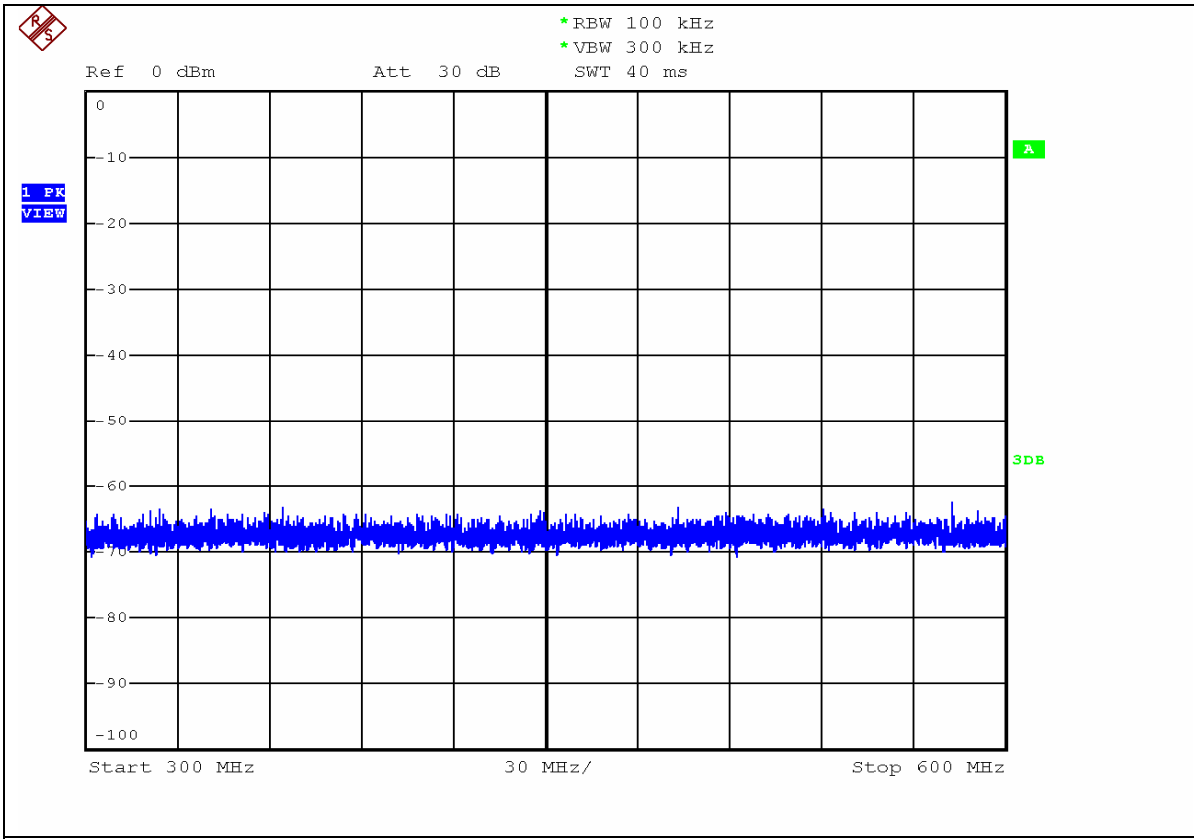


Fig A2 Low Channel Conducted Spurious Emissions 300MHz -600MHz

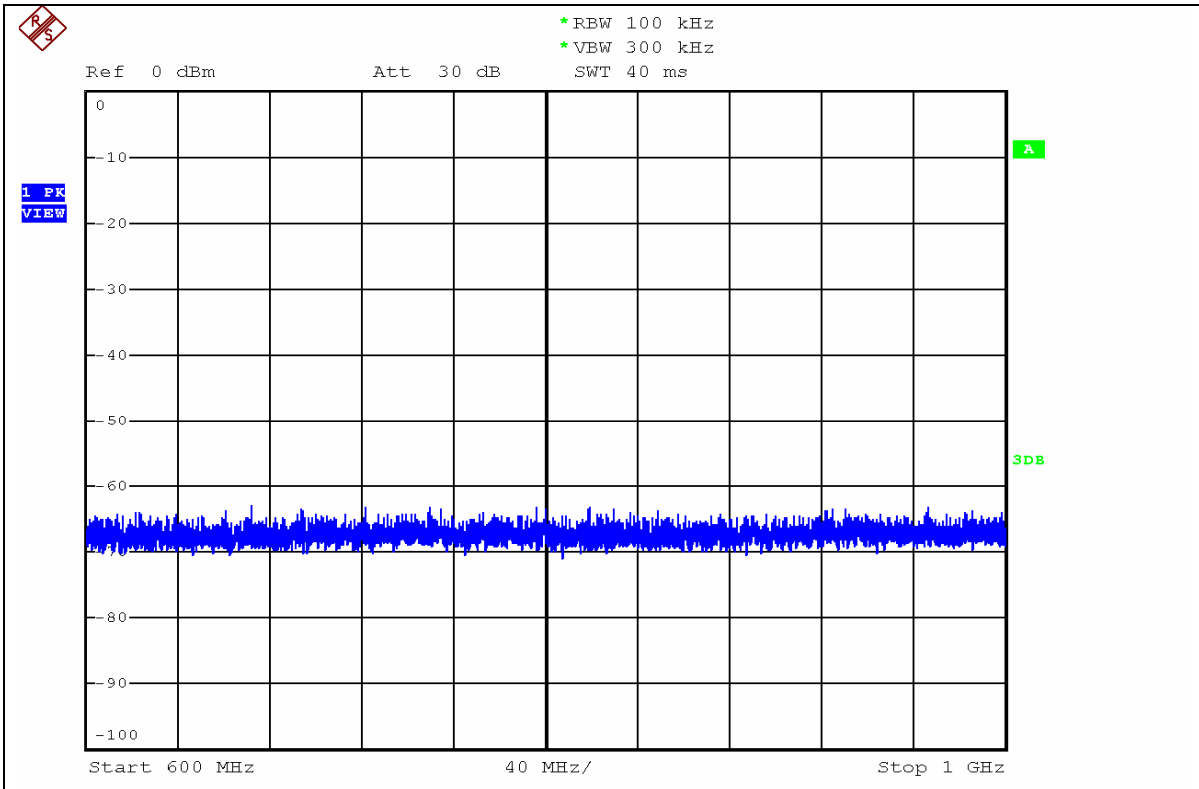


Fig A3 Low Channel Conducted Spurious Emissions 600MHz -1000MHz

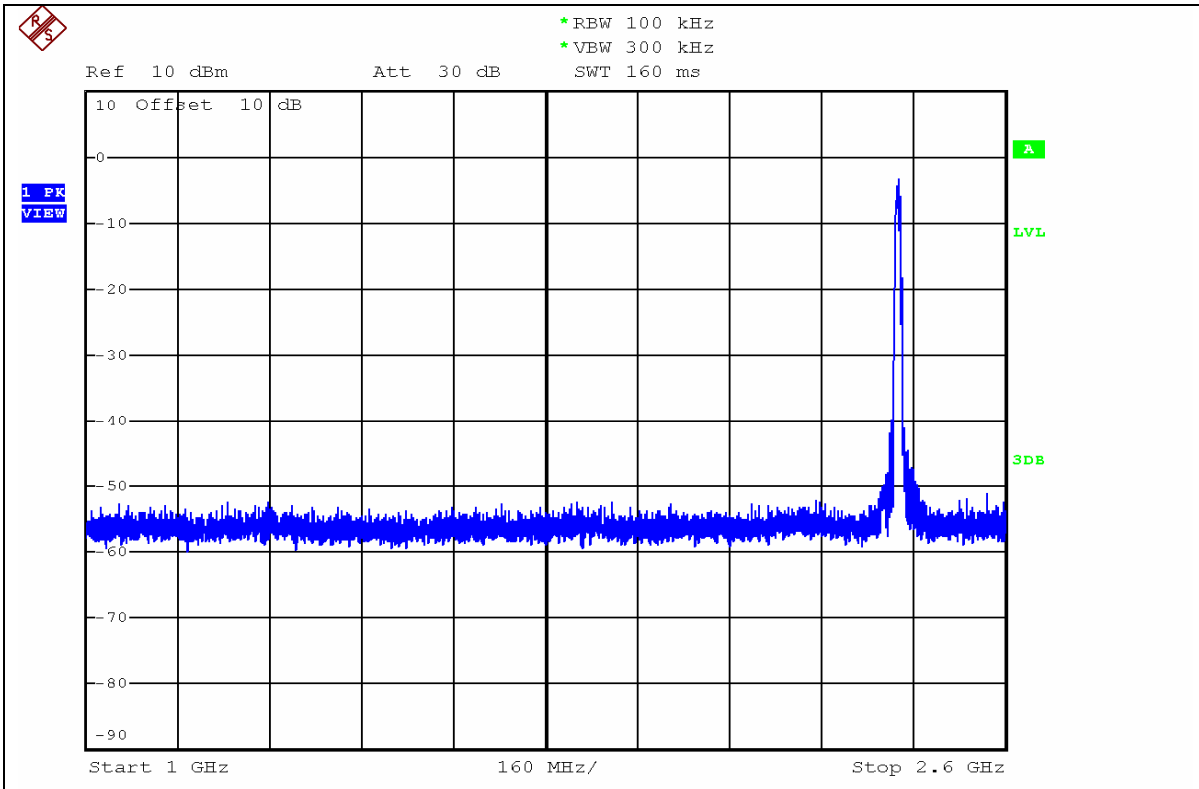


Fig A4 Low Channel Conducted Spurious Emissions 1GHz -2.6 GHz

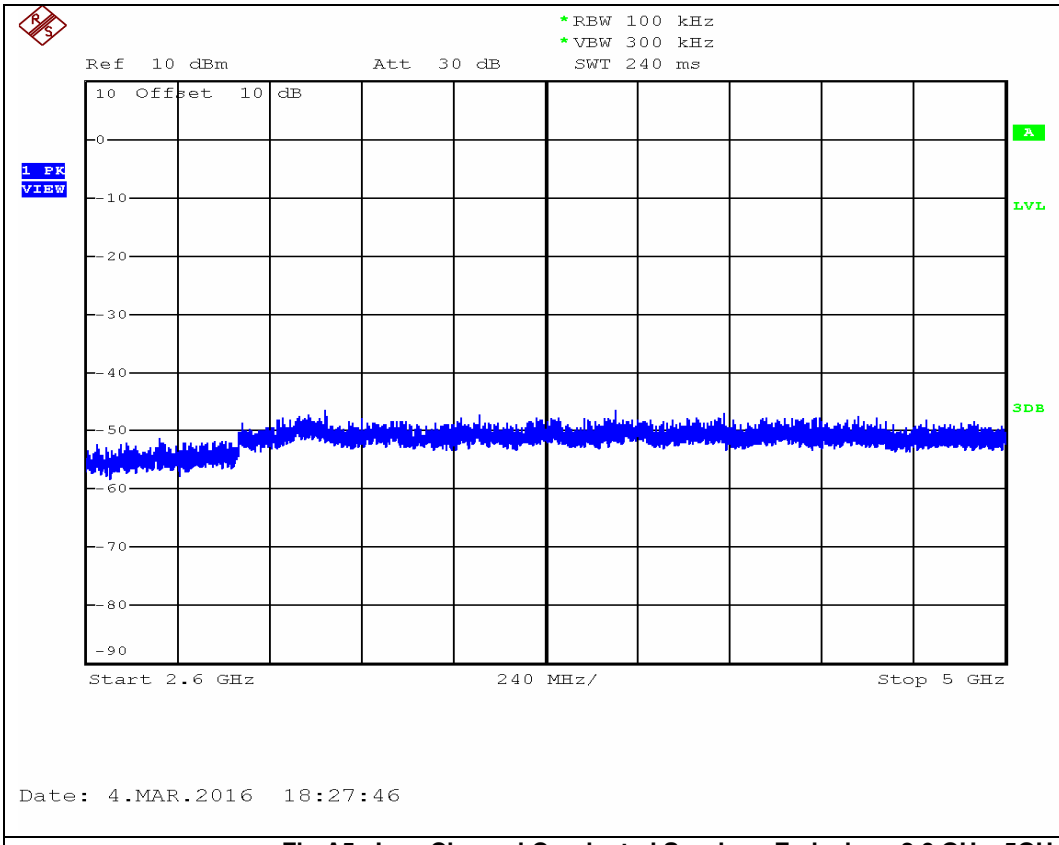


Fig A5 Low Channel Conducted Spurious Emissions 2.6 GHz -5GHz

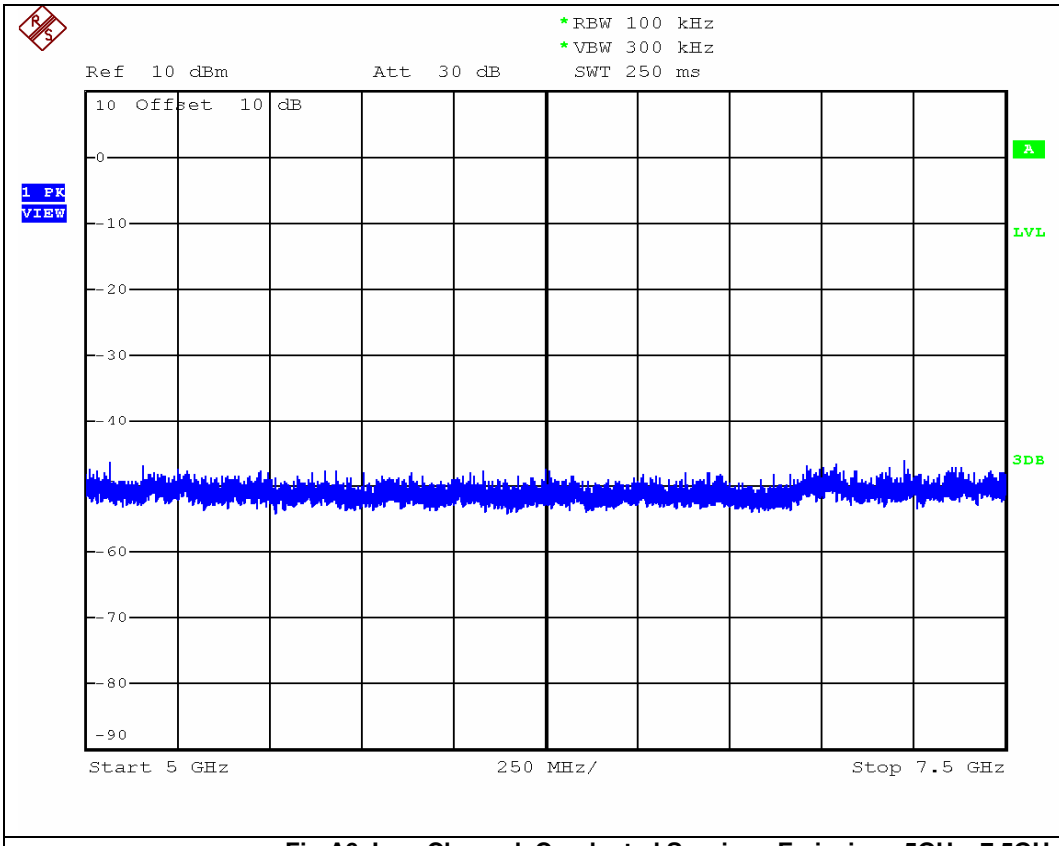


Fig A6 Low Channel Conducted Spurious Emissions 5GHz -7.5GHz

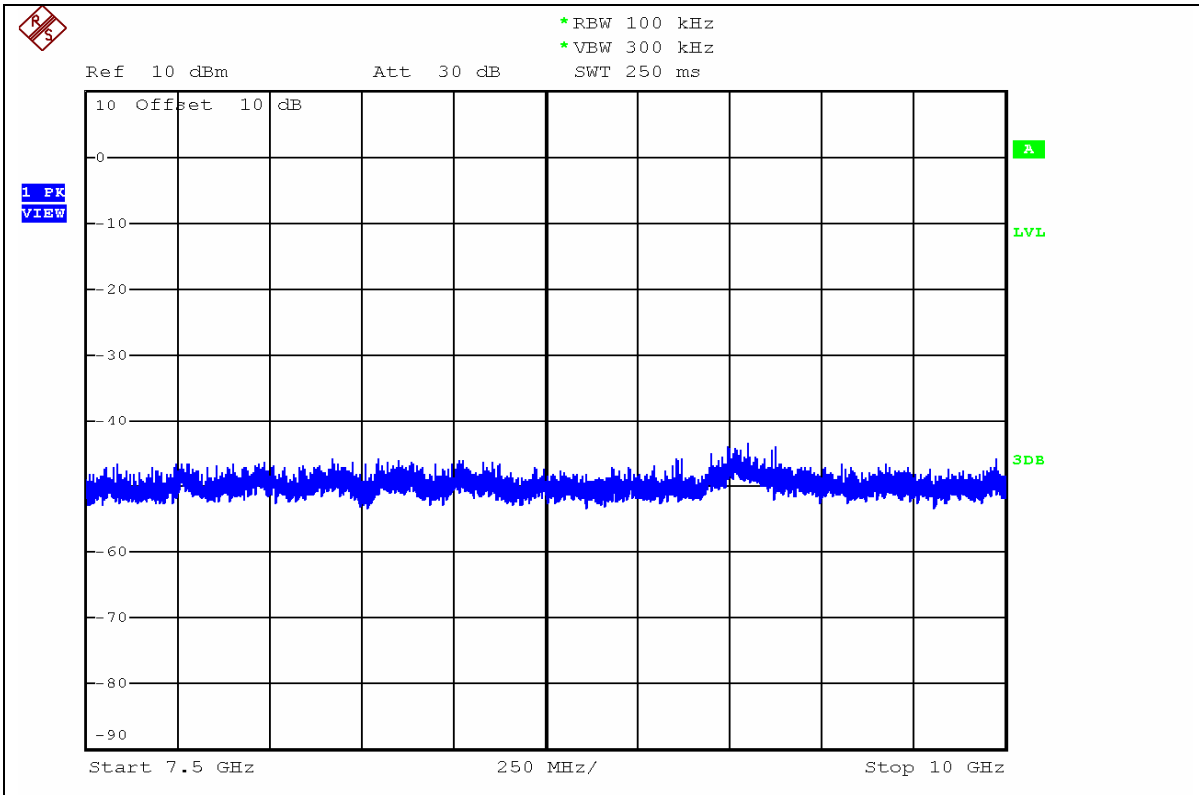


Fig A7 Low Channel Conducted Spurious Emissions 7.5GHz-10 GHz

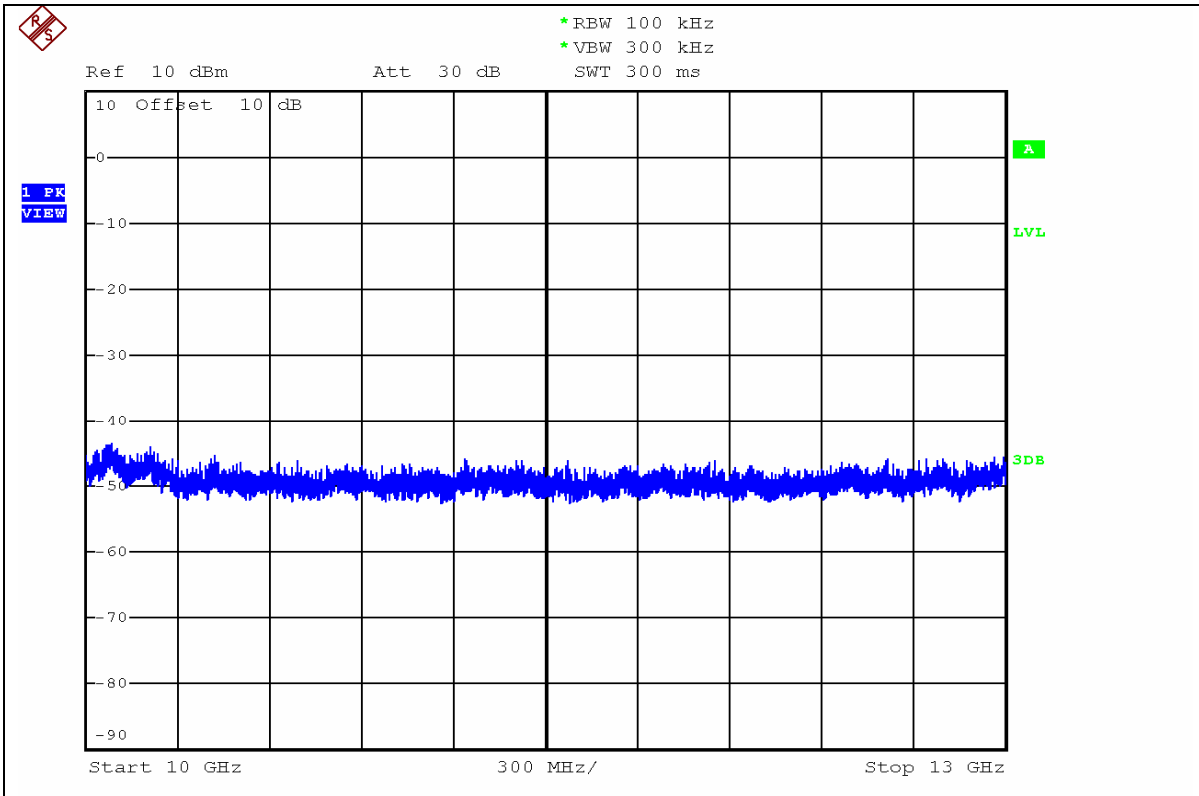


Fig A8 Low Channel Conducted Spurious Emissions 10 GHz -13GHz

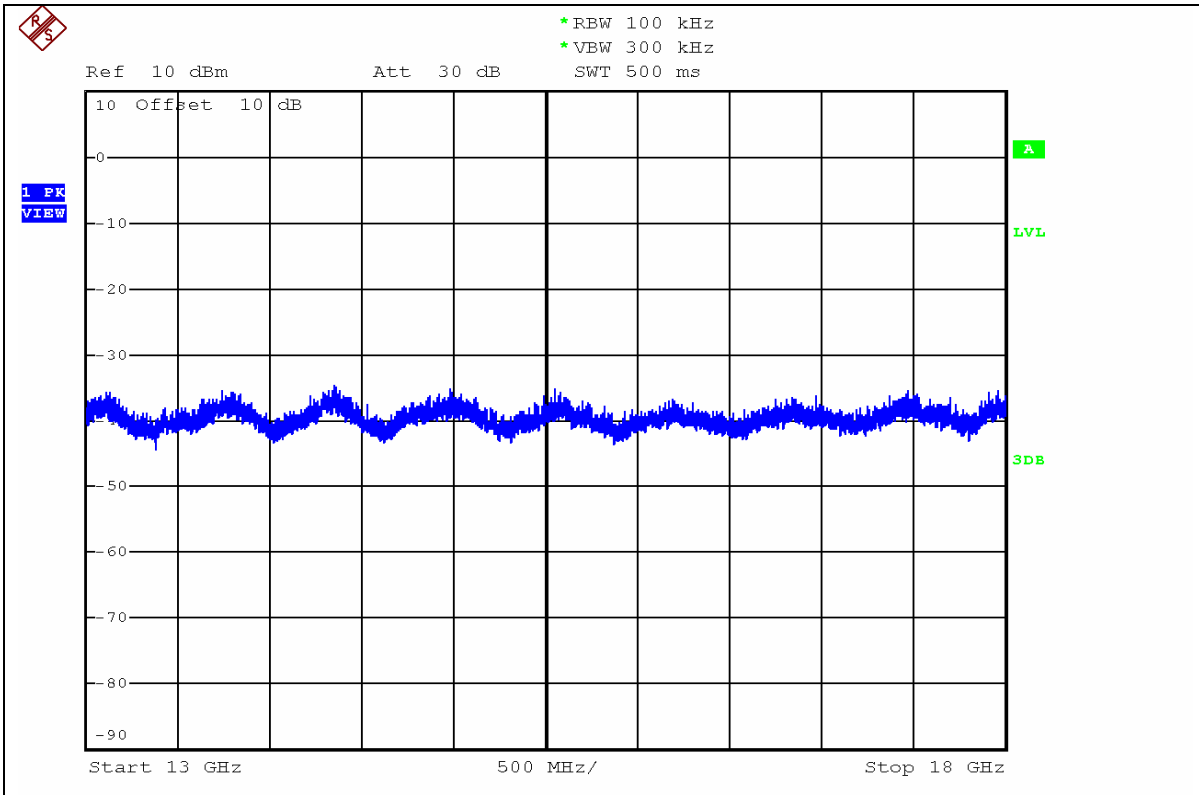


Fig A9 Low Channel Conducted Spurious Emissions 13GHz -18 GHz

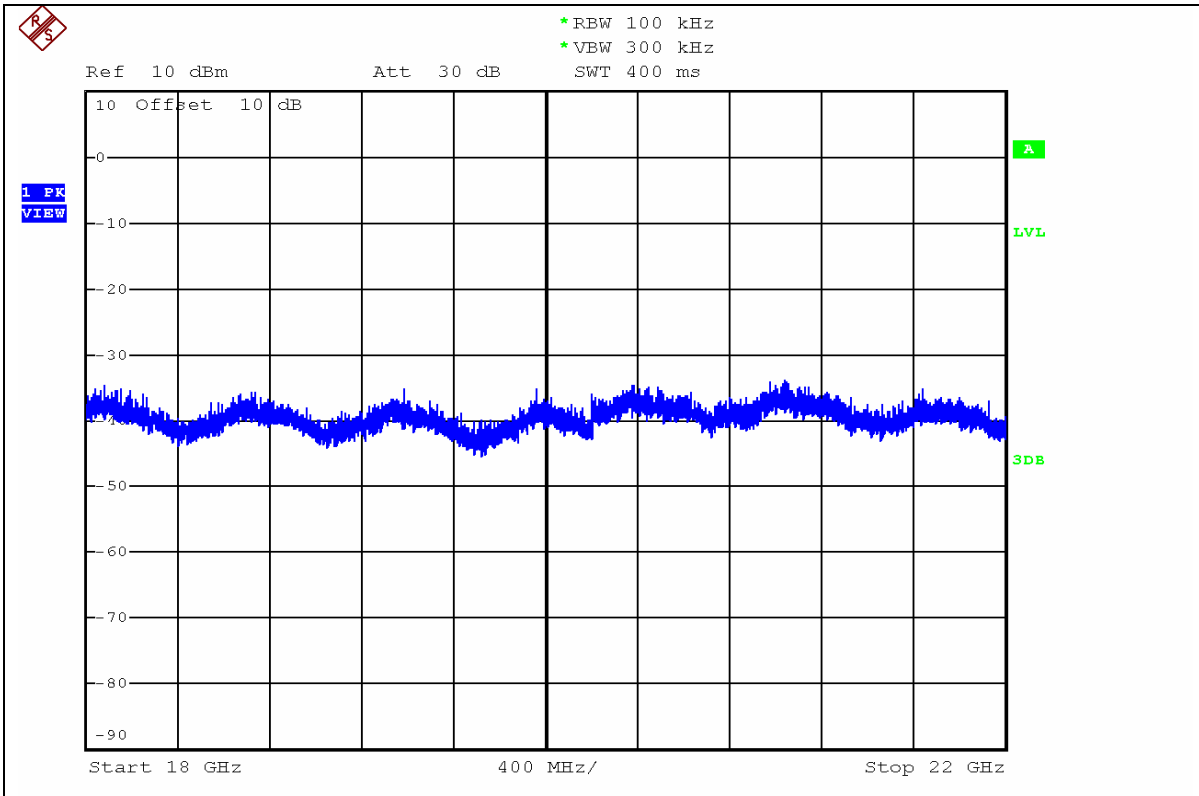


Fig A10 Low Channel Conducted Spurious Emissions 18GHz -22GHz

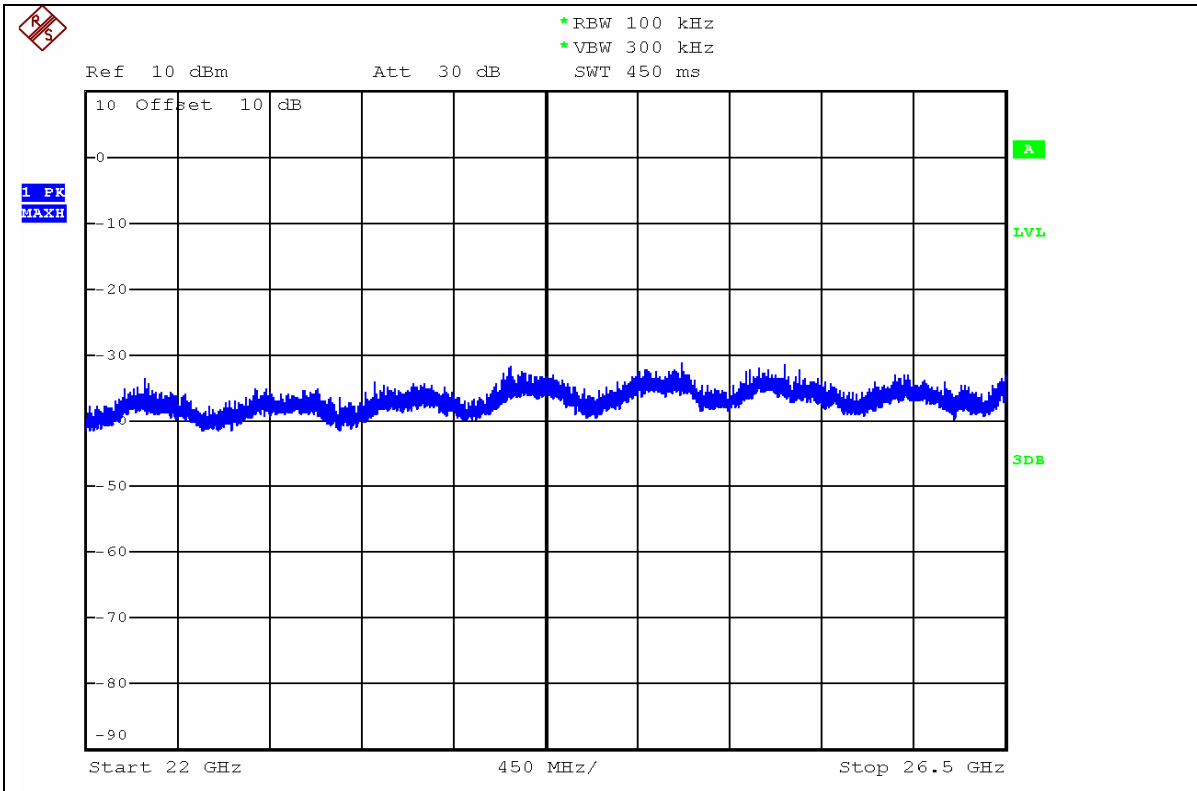


Fig A11 Low Channel Conducted Spurious Emissions 22GHz-26.5GHz

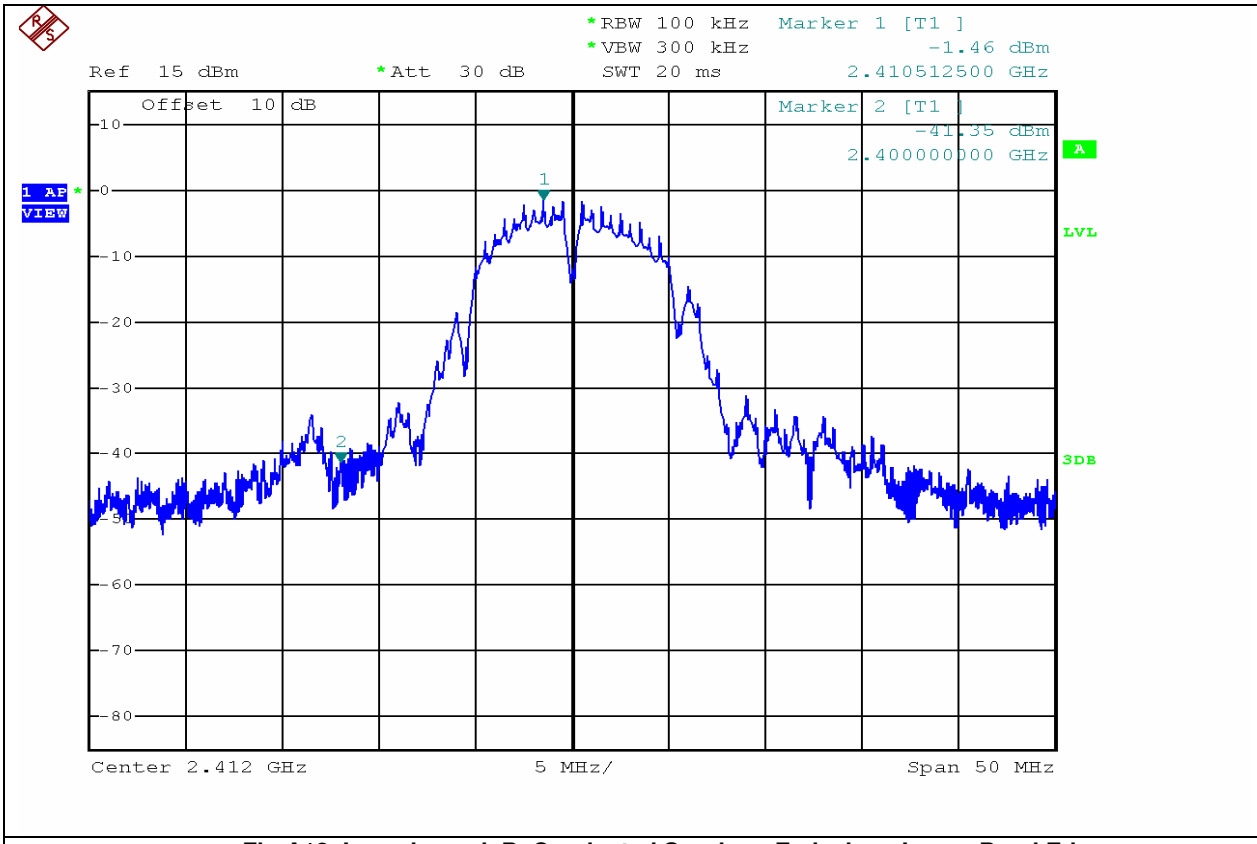


Fig A12 Low channel B Conducted Spurious Emissions Lower Band Edge

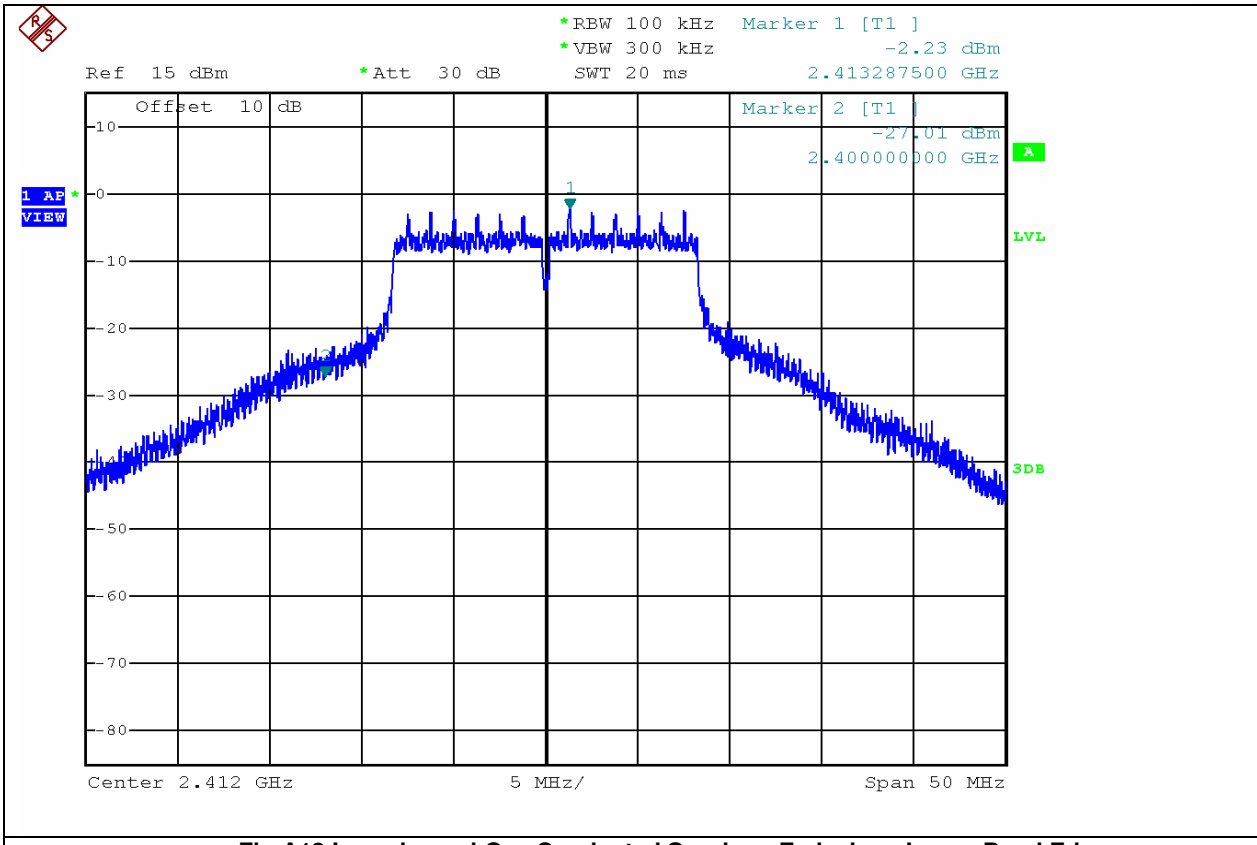


Fig A13 Low channel G Conducted Spurious Emissions Lower Band Edge

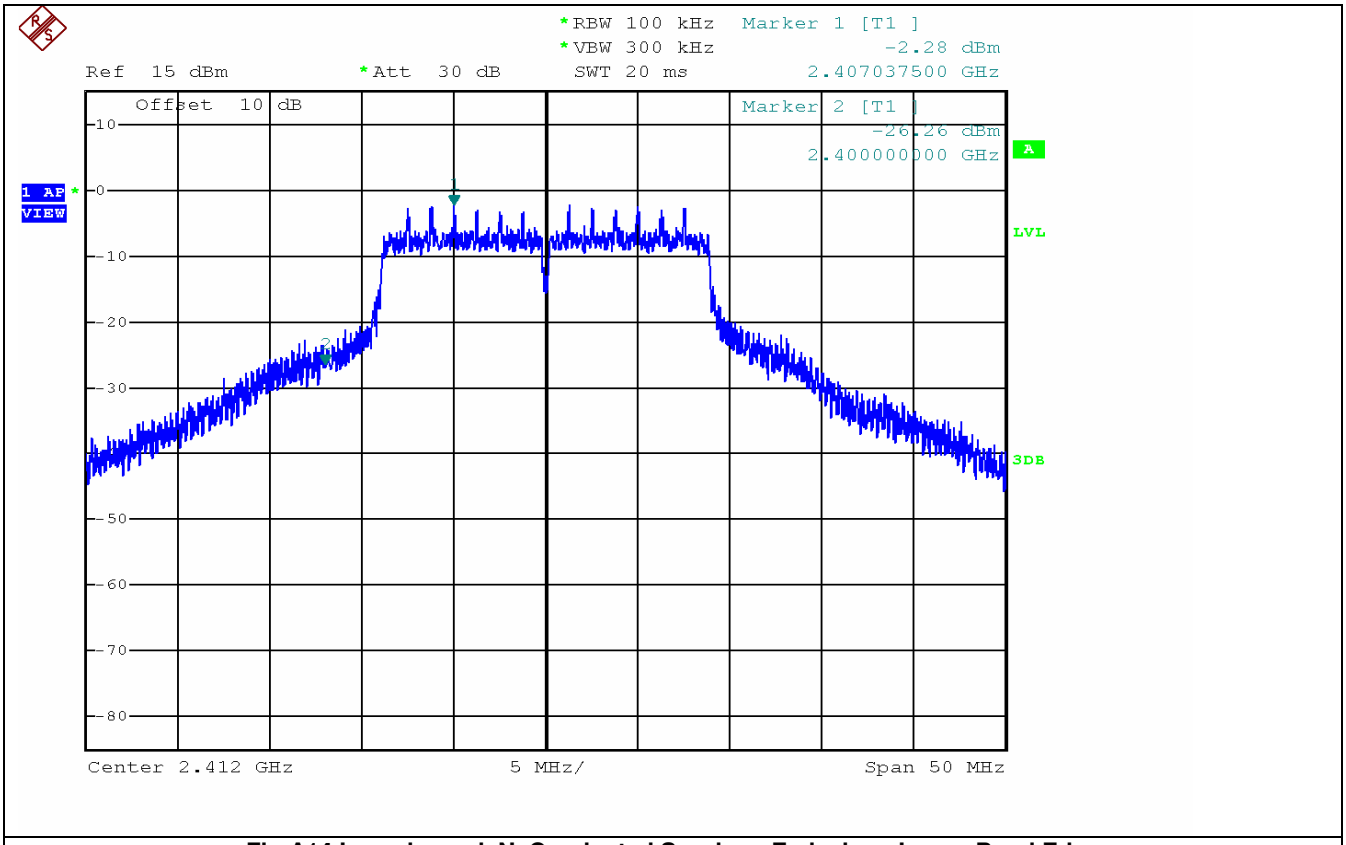


Fig A14 Low channel N Conducted Spurious Emissions Lower Band Edge

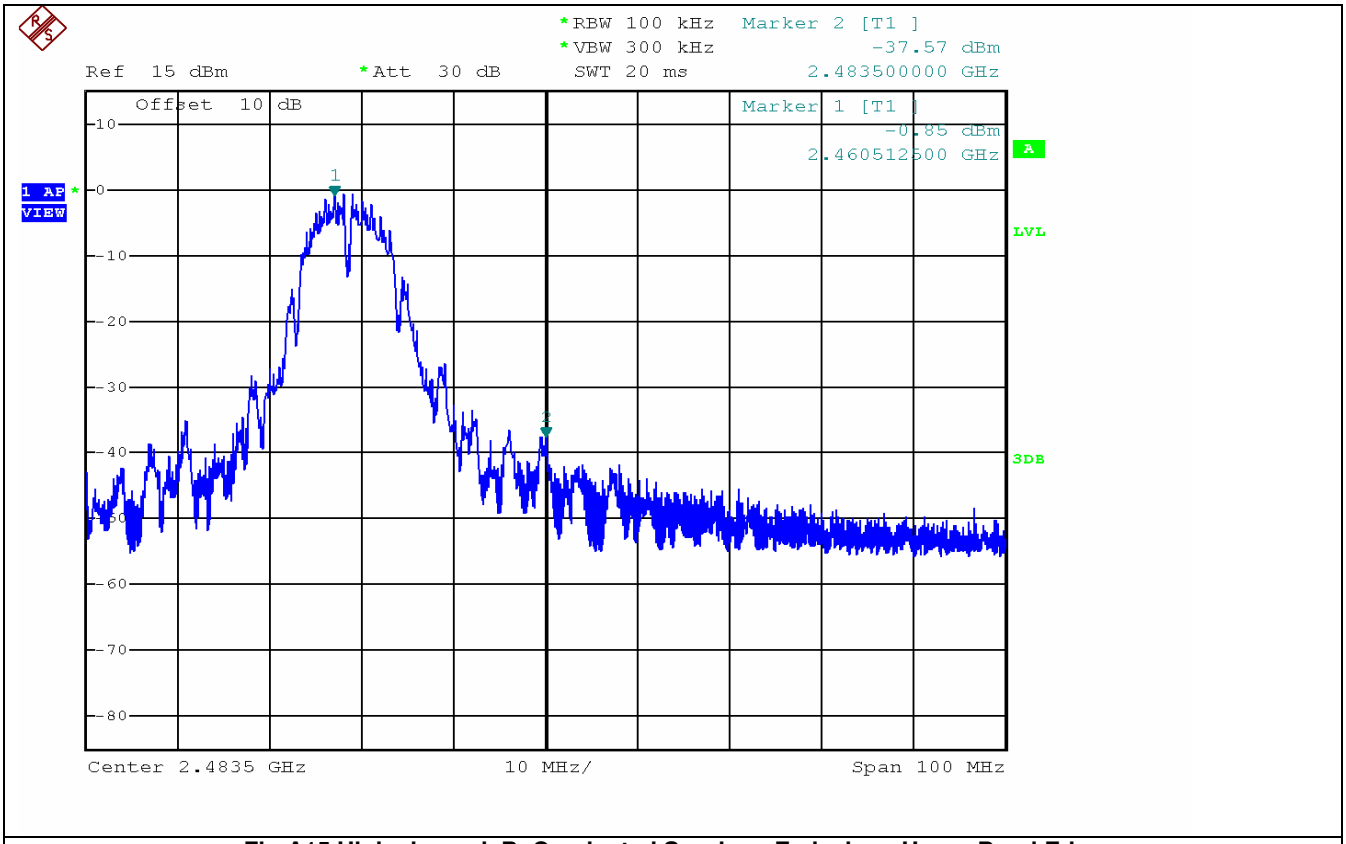


Fig A15 High channel B Conducted Spurious Emissions Upper Band Edge

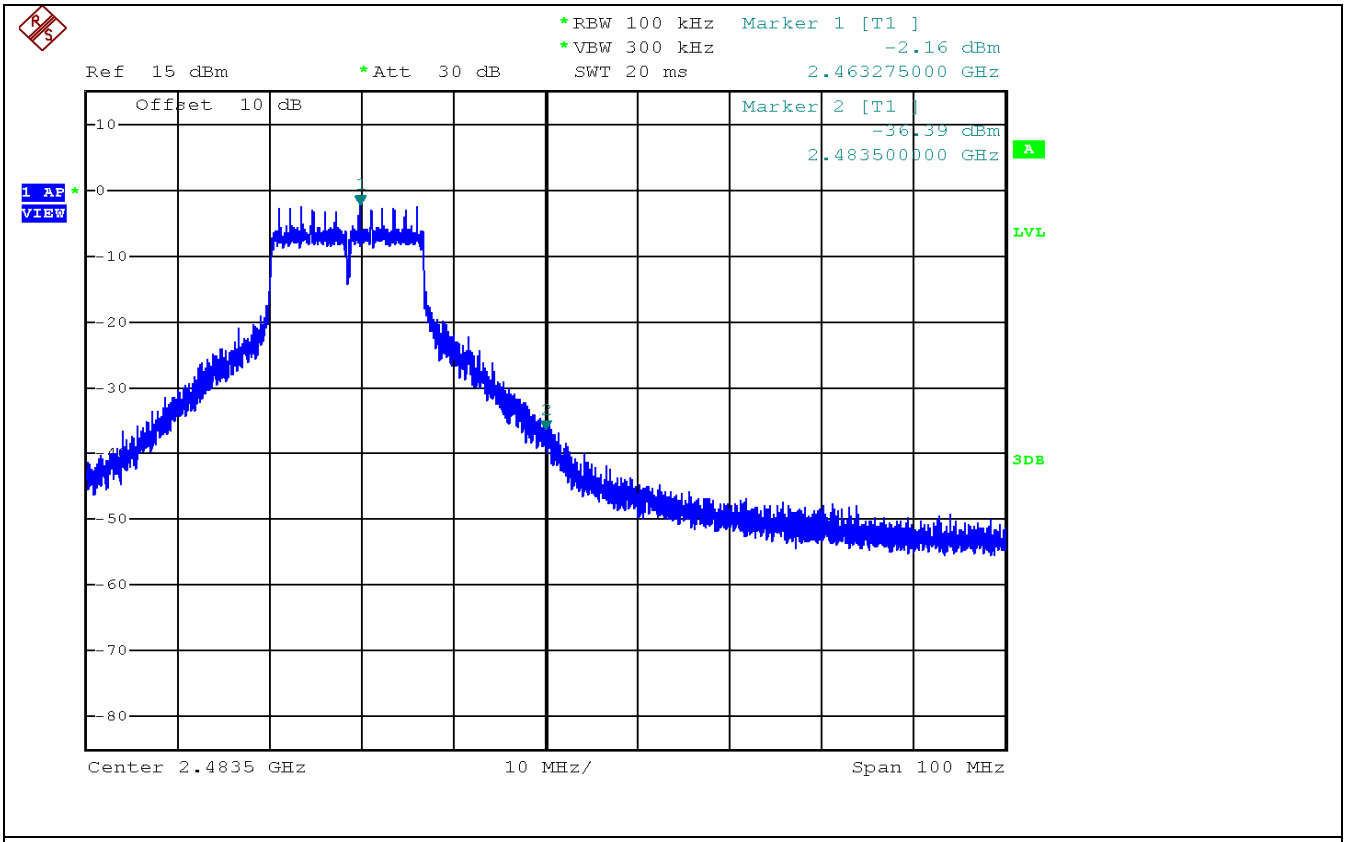


Fig A16 High channel G Conducted Spurious Emissions Upper Band Edge

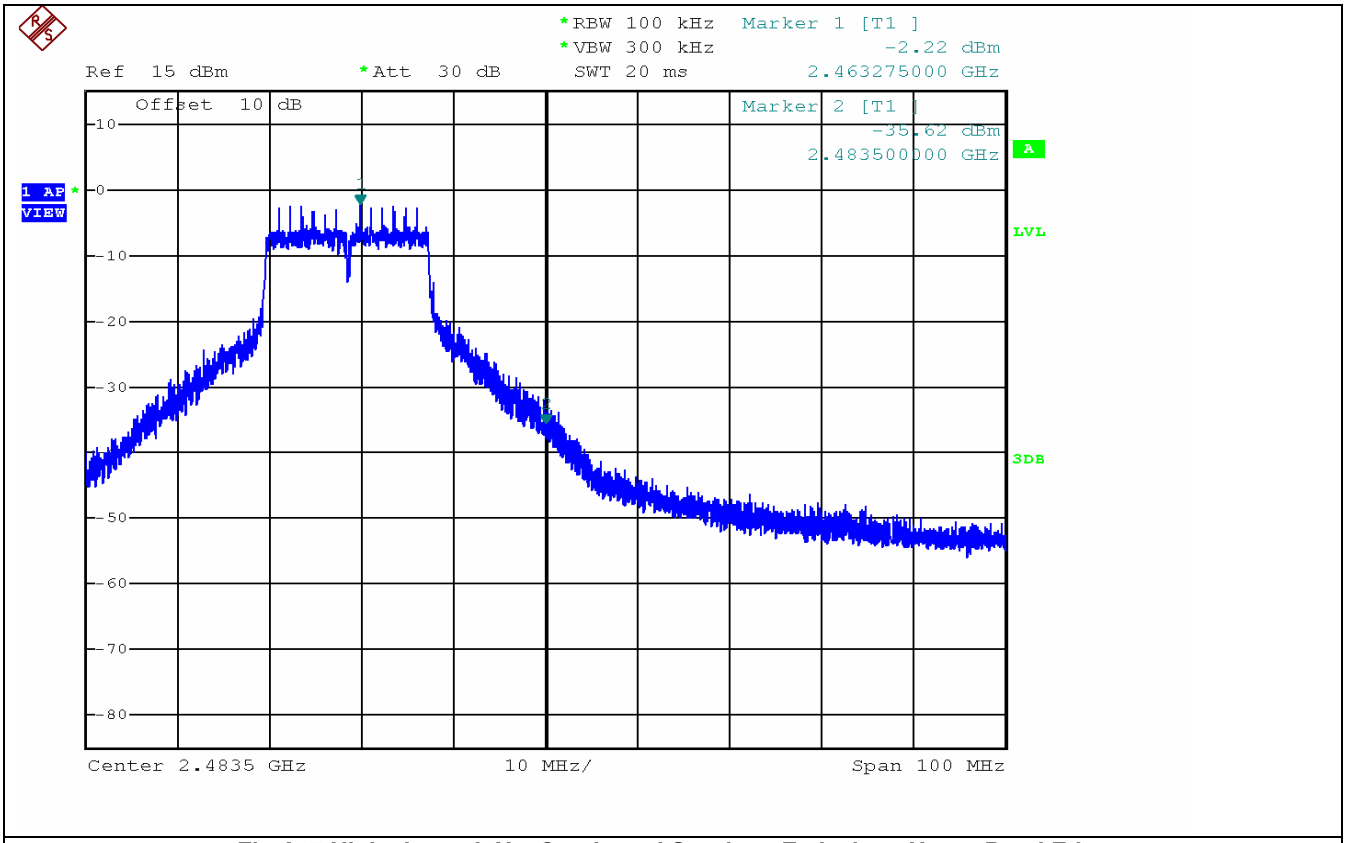


Fig A17 High channel N Conducted Spurious Emissions Upper Band Edge

Appendix B

Radiated tests for Band Edges /Restricted band

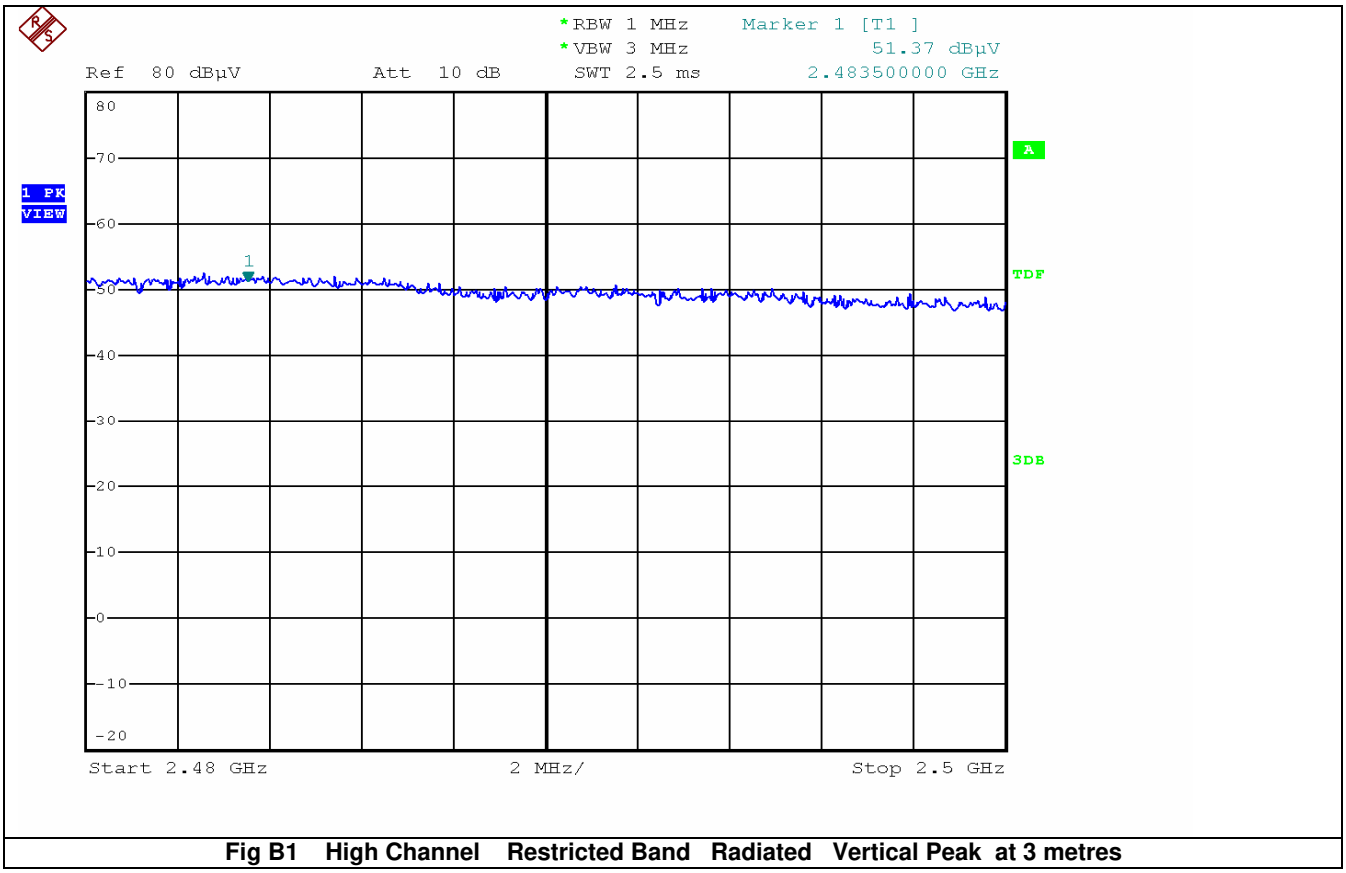


Fig B1 High Channel Restricted Band Radiated Vertical Peak at 3 metres

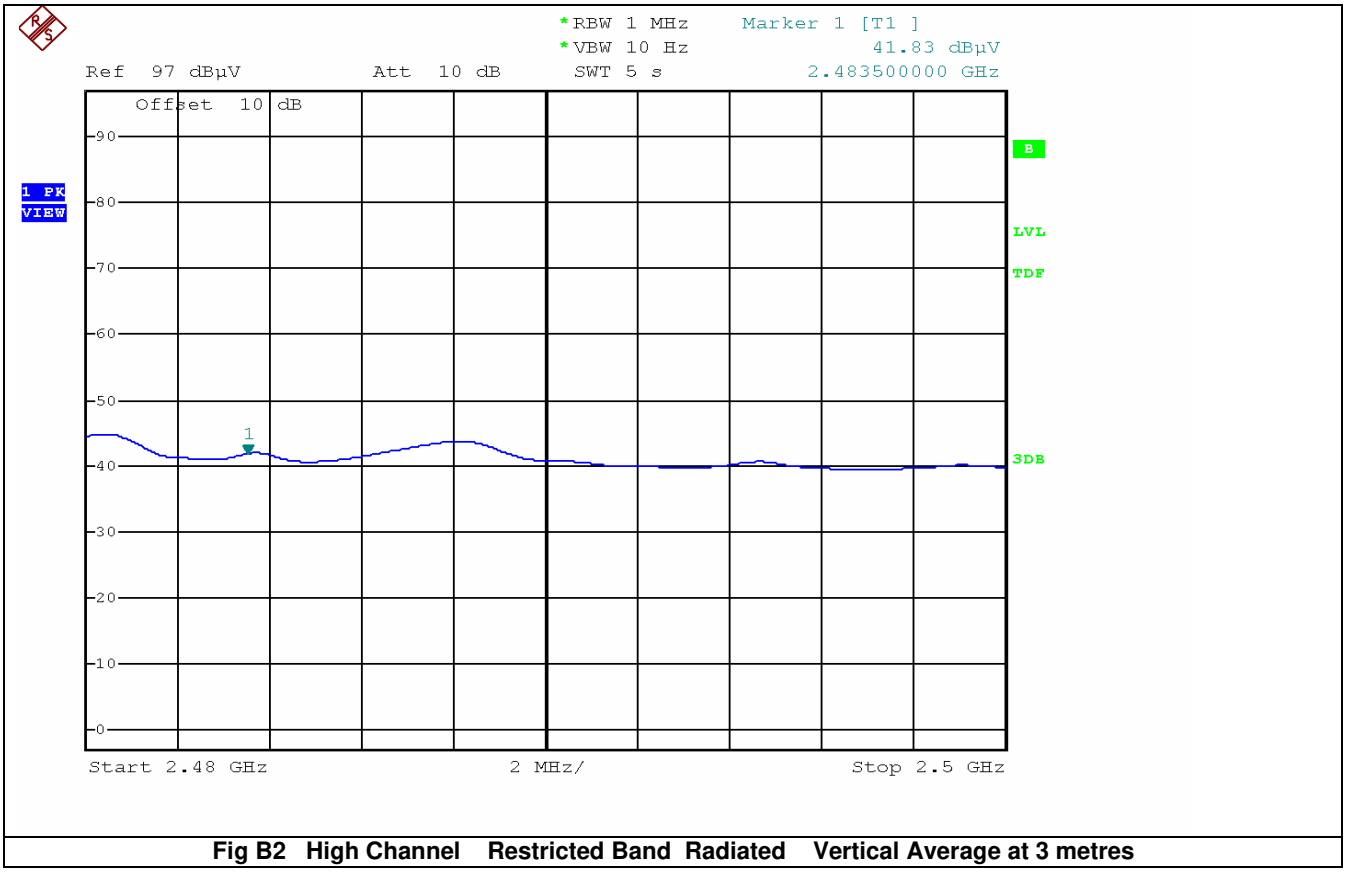


Fig B2 High Channel Restricted Band Radiated Vertical Average at 3 metres

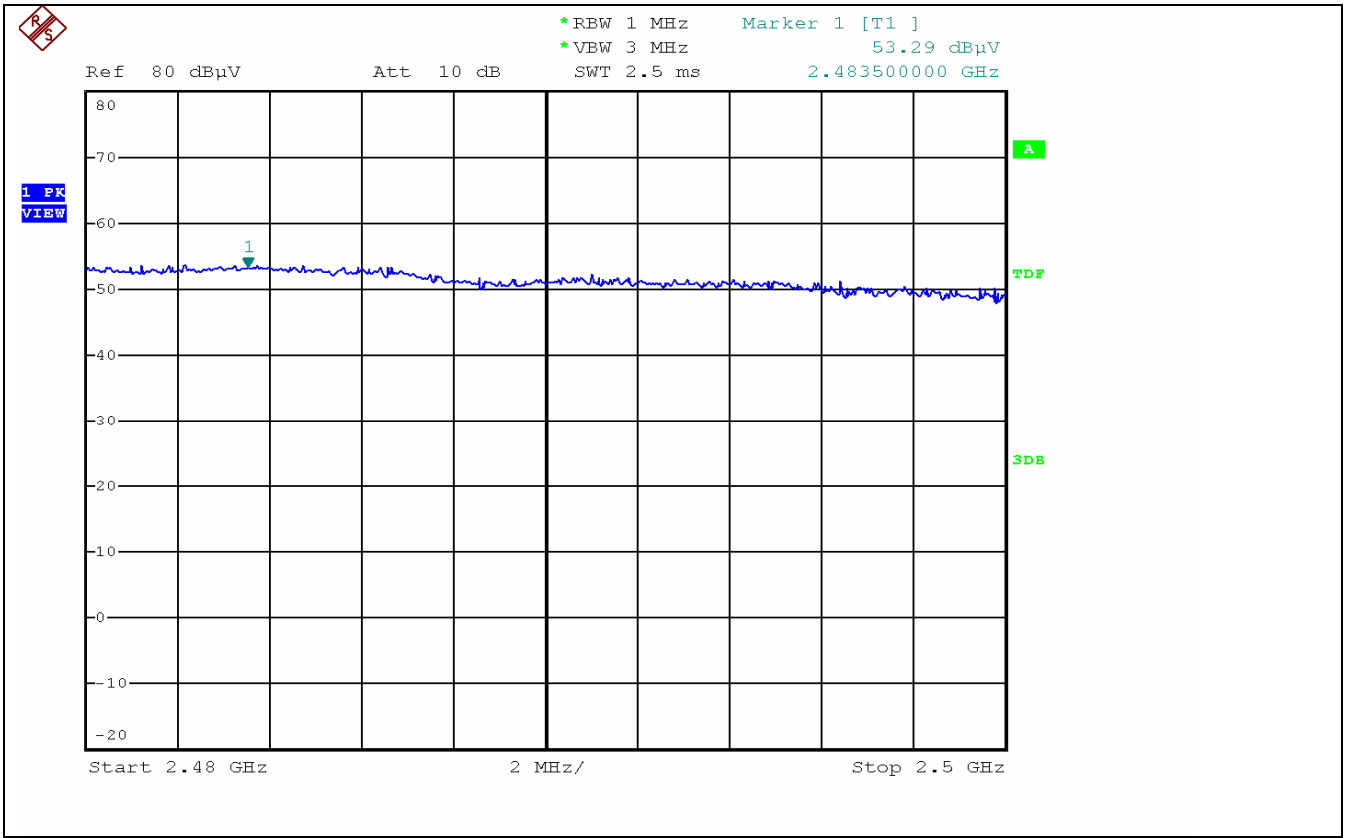


Fig B3 High Channel Restricted Band Radiated Horizontal Peak at 3 metres

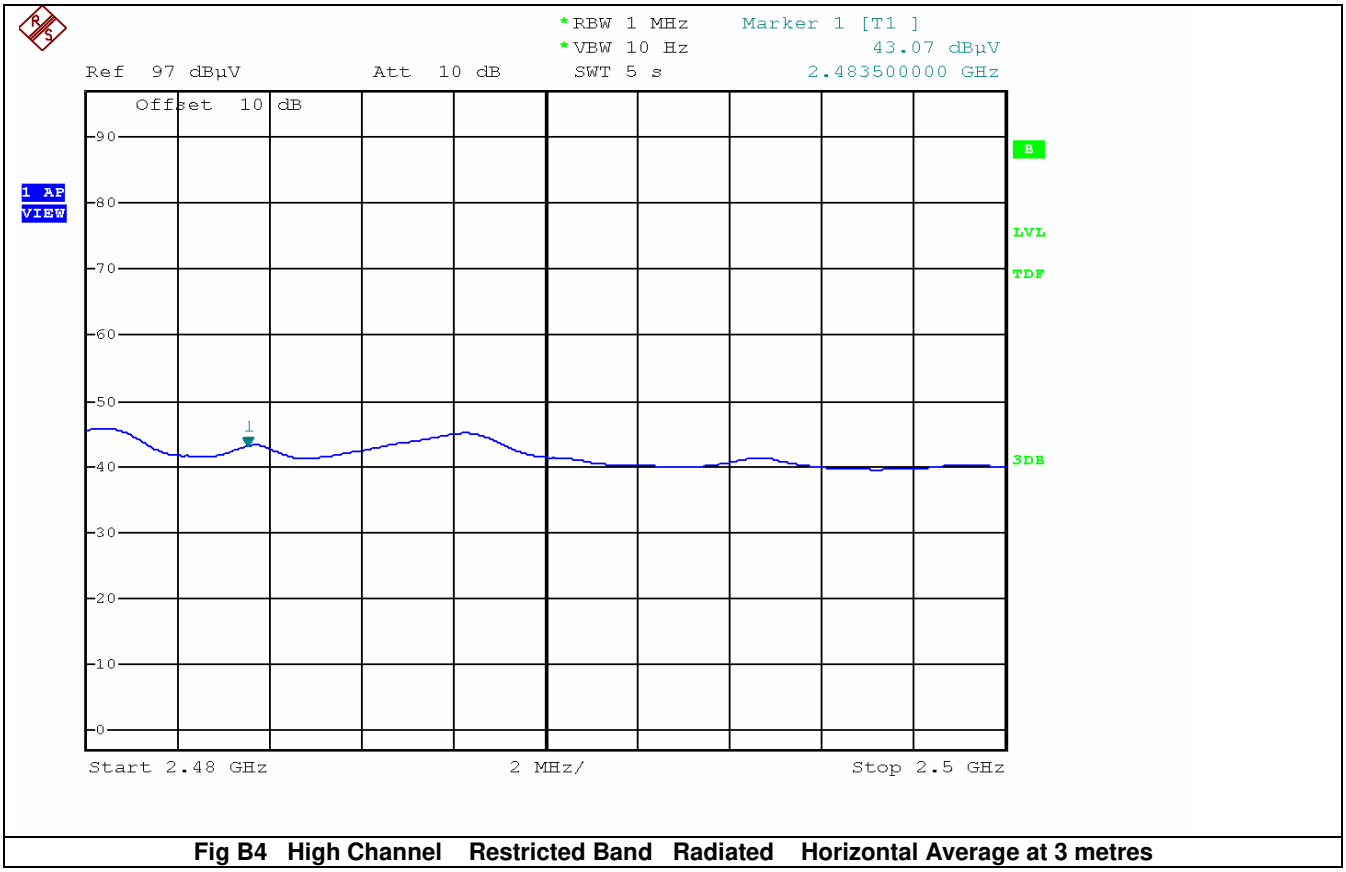


Fig B4 High Channel Restricted Band Radiated Horizontal Average at 3 metres

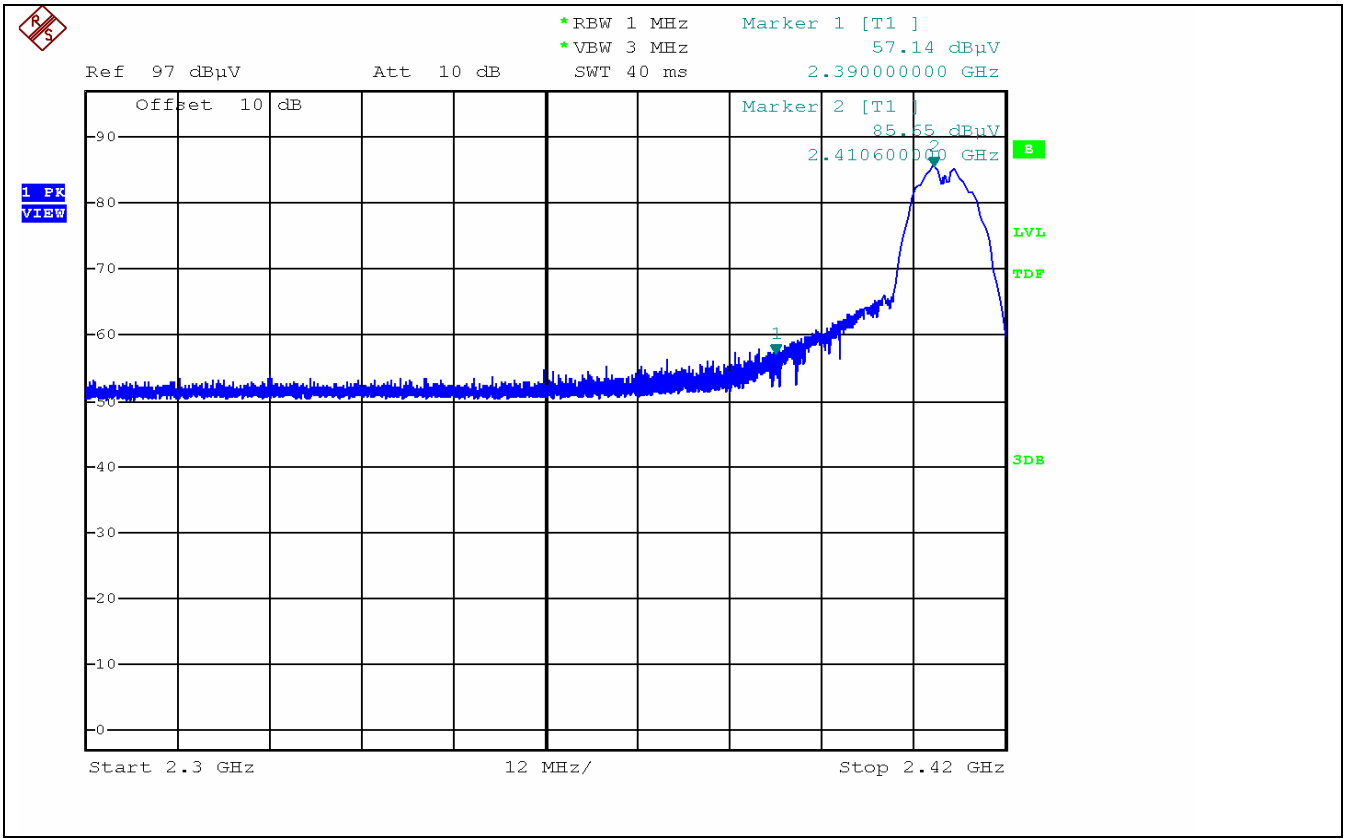


Fig B5 Low Channel Band Edge Vertical Peak at 3 metres

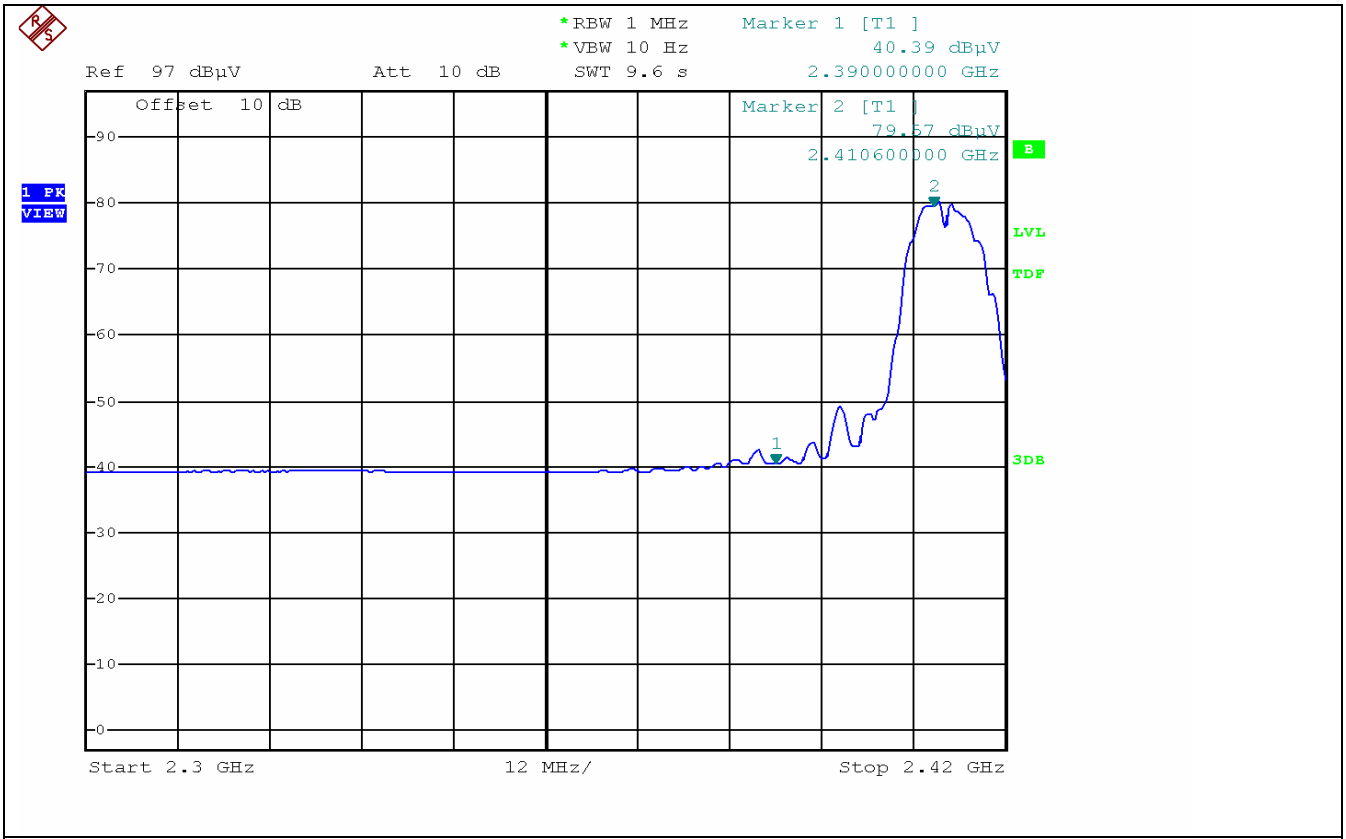


Fig B6 Low Channel Band Edge Vertical Average at 3 metres

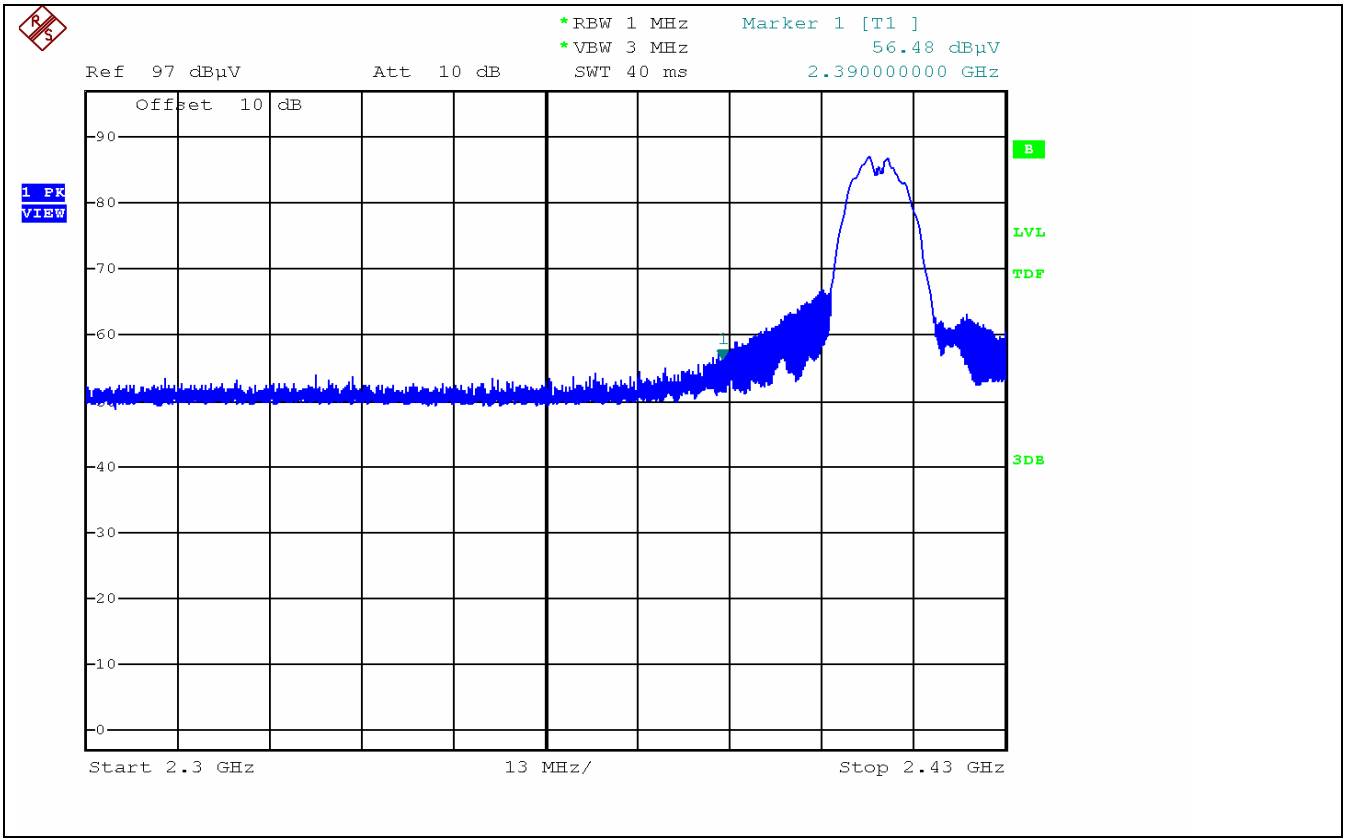


Fig B7 Low Channel Band Edge Horizontal Peak at 3 metres

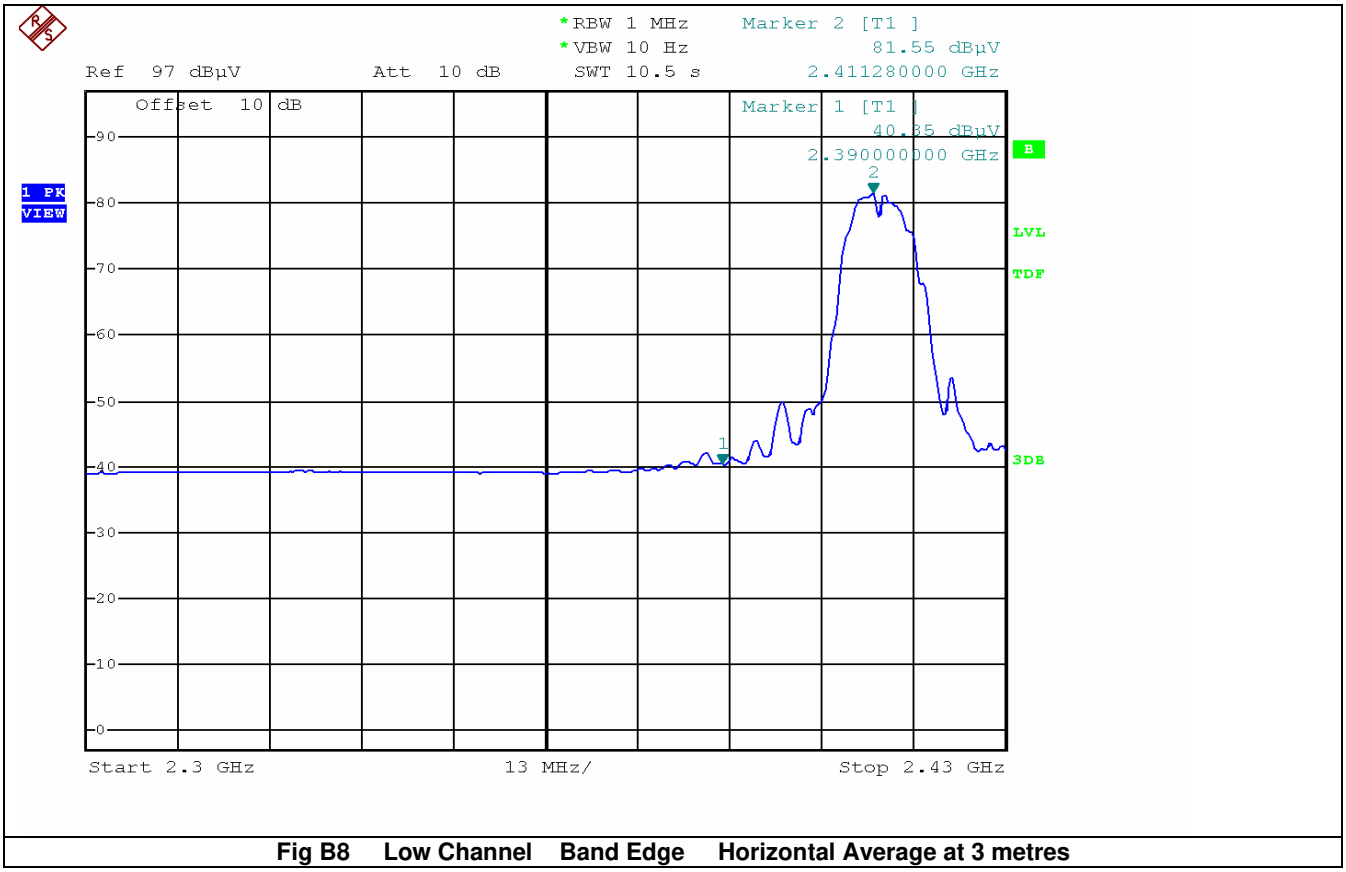


Fig B8 Low Channel Band Edge Horizontal Average at 3 metres

Appendix C

Radiated Spurious Emissions

Conducted sample with antenna port terminated

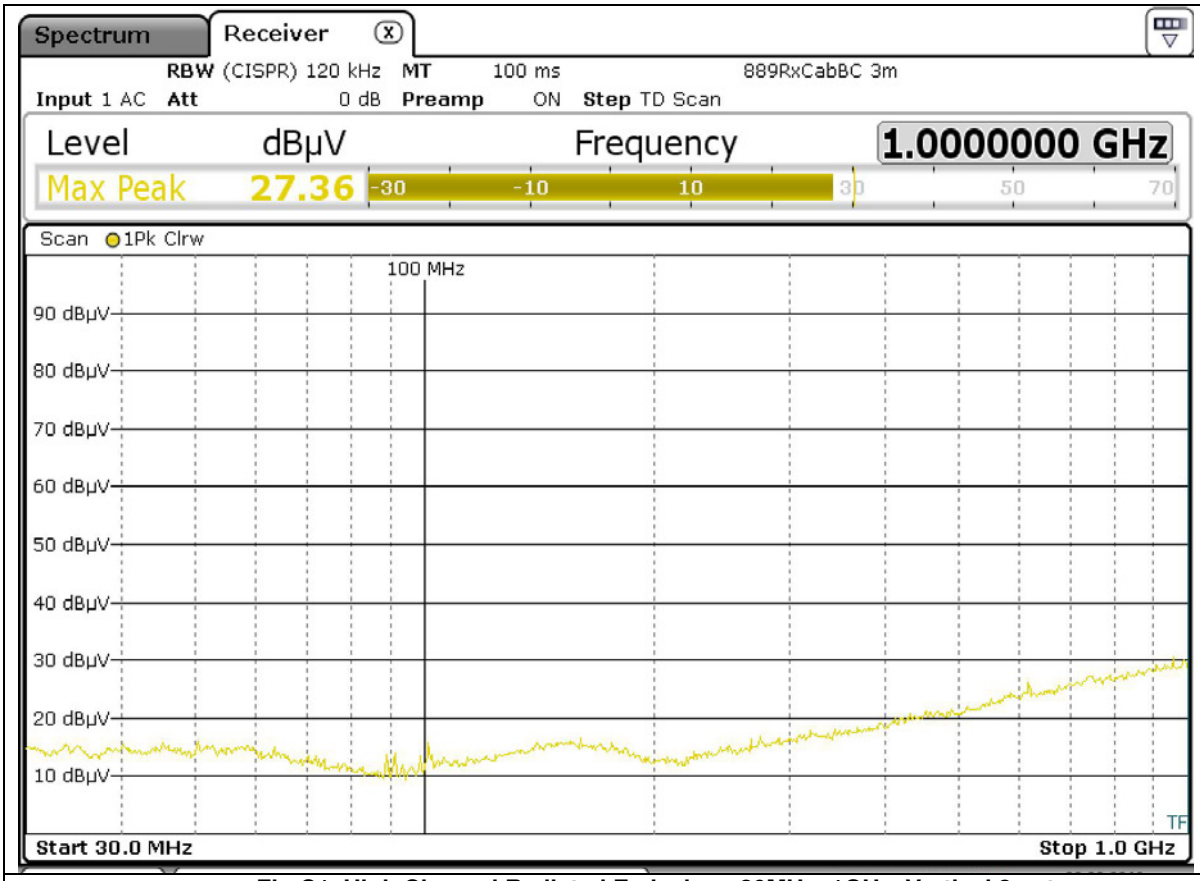


Fig C1 High Channel Radiated Emissions 30MHz -1GHz Vertical 3metres

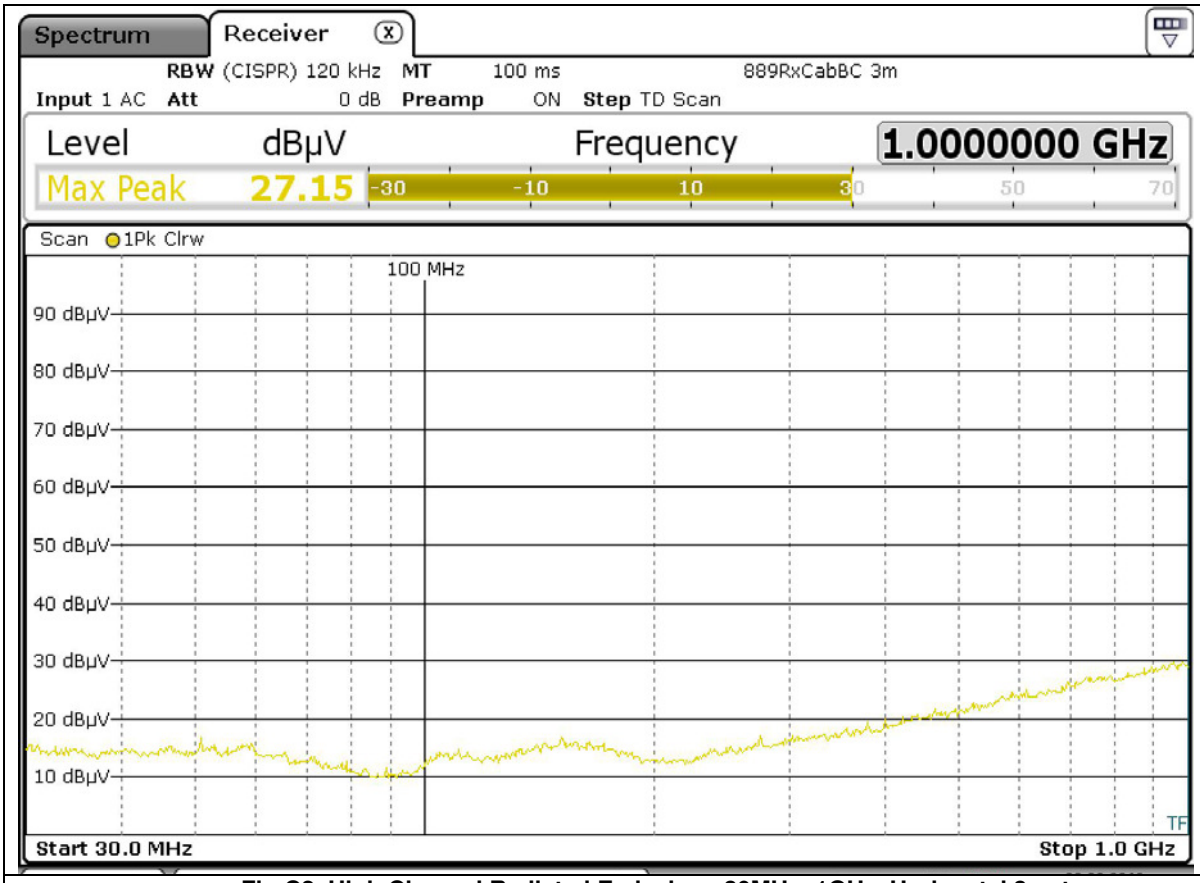


Fig C2 High Channel Radiated Emissions 30MHz -1GHz Horizontal 3metres

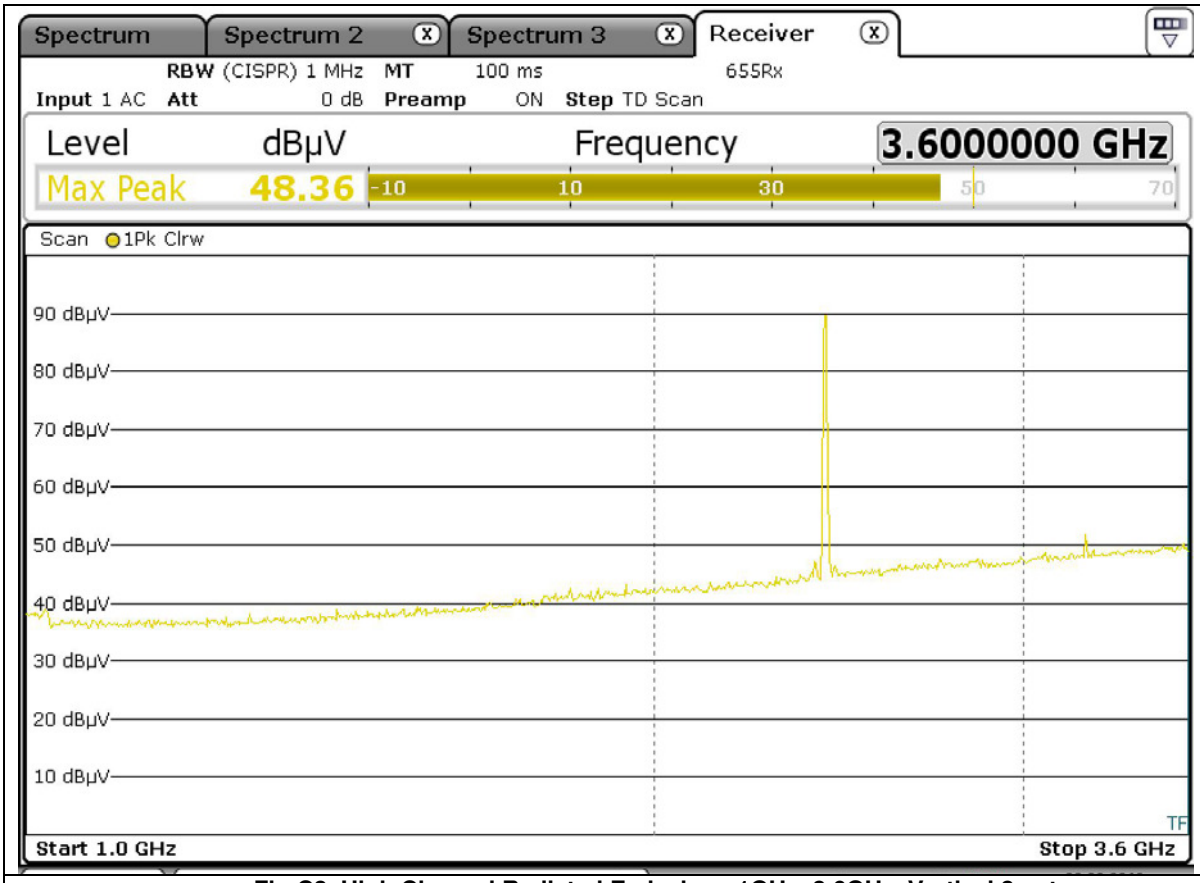


Fig C3 High Channel Radiated Emissions 1GHz -3.6GHz Vertical 3metres

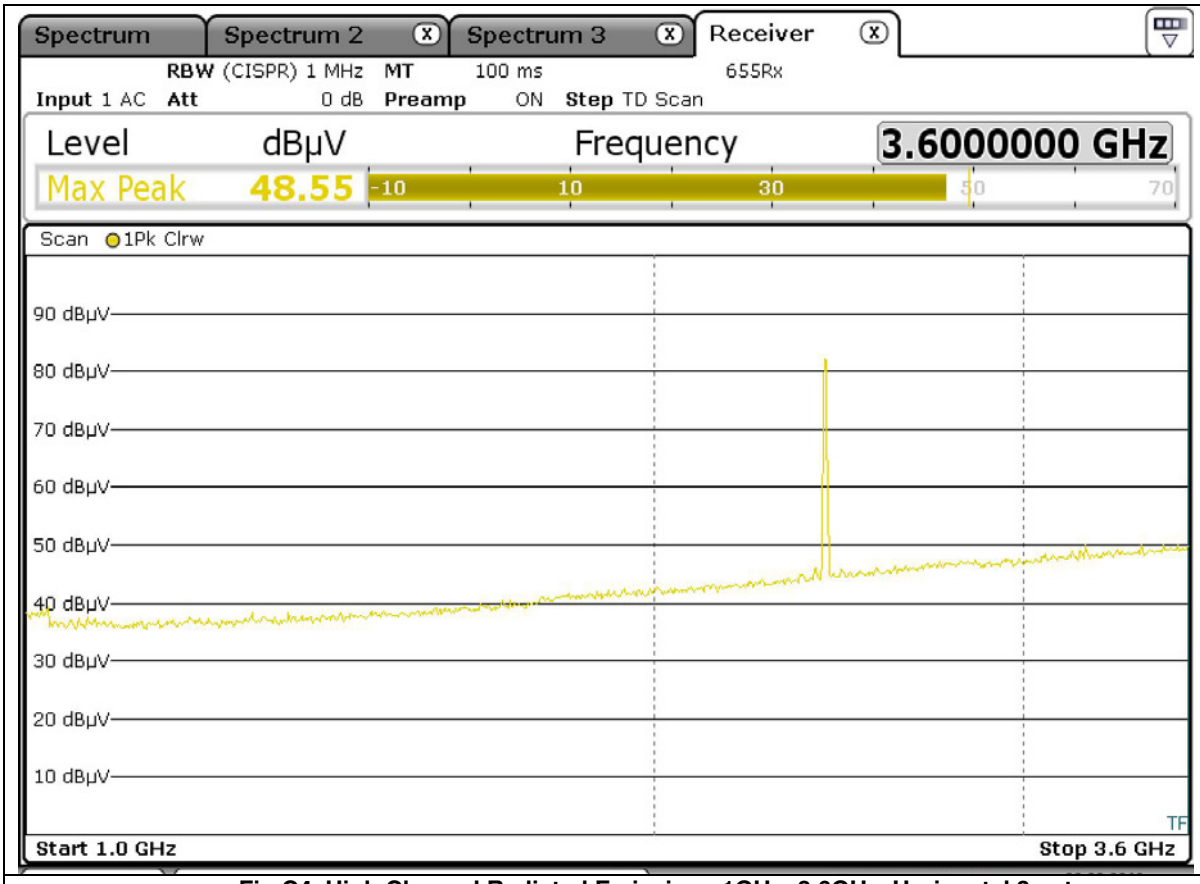


Fig C4 High Channel Radiated Emissions 1GHz -3.6GHz Horizontal 3metres

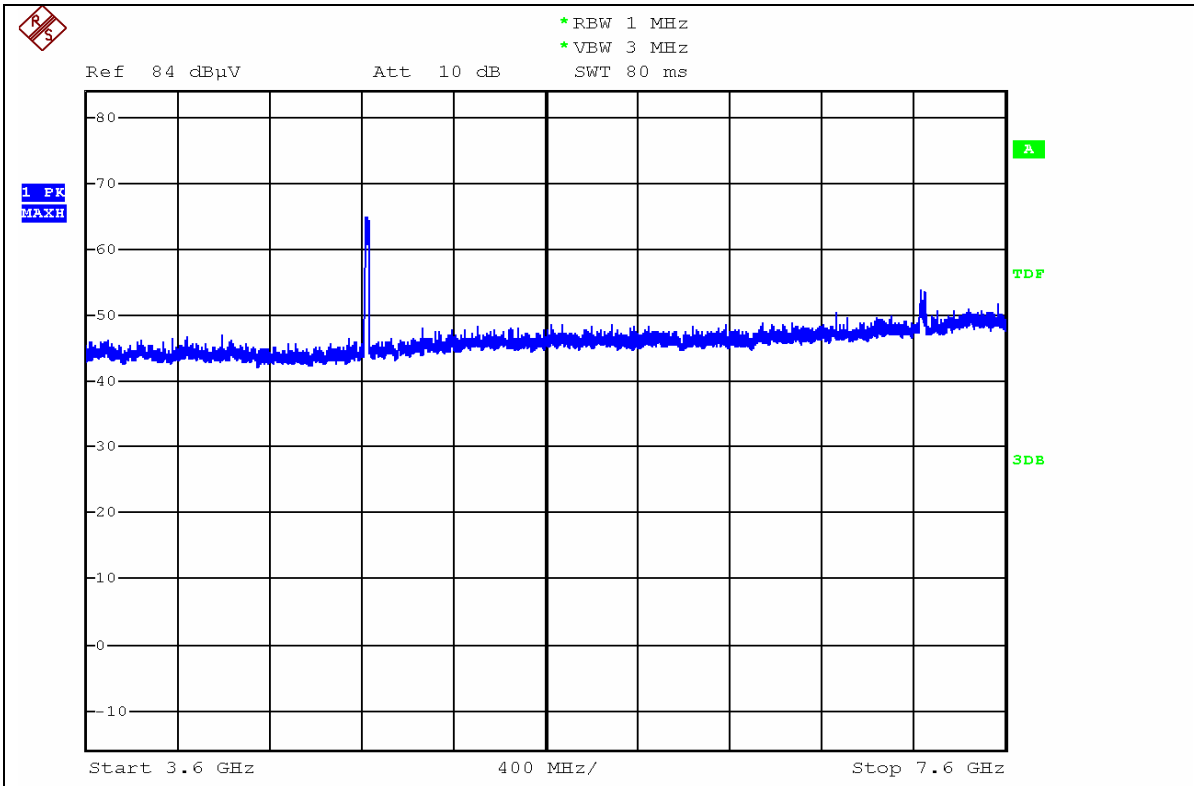


Fig C5 High Channel Radiated Emissions 3.6GHz -7.6GHz Vertical 1metre

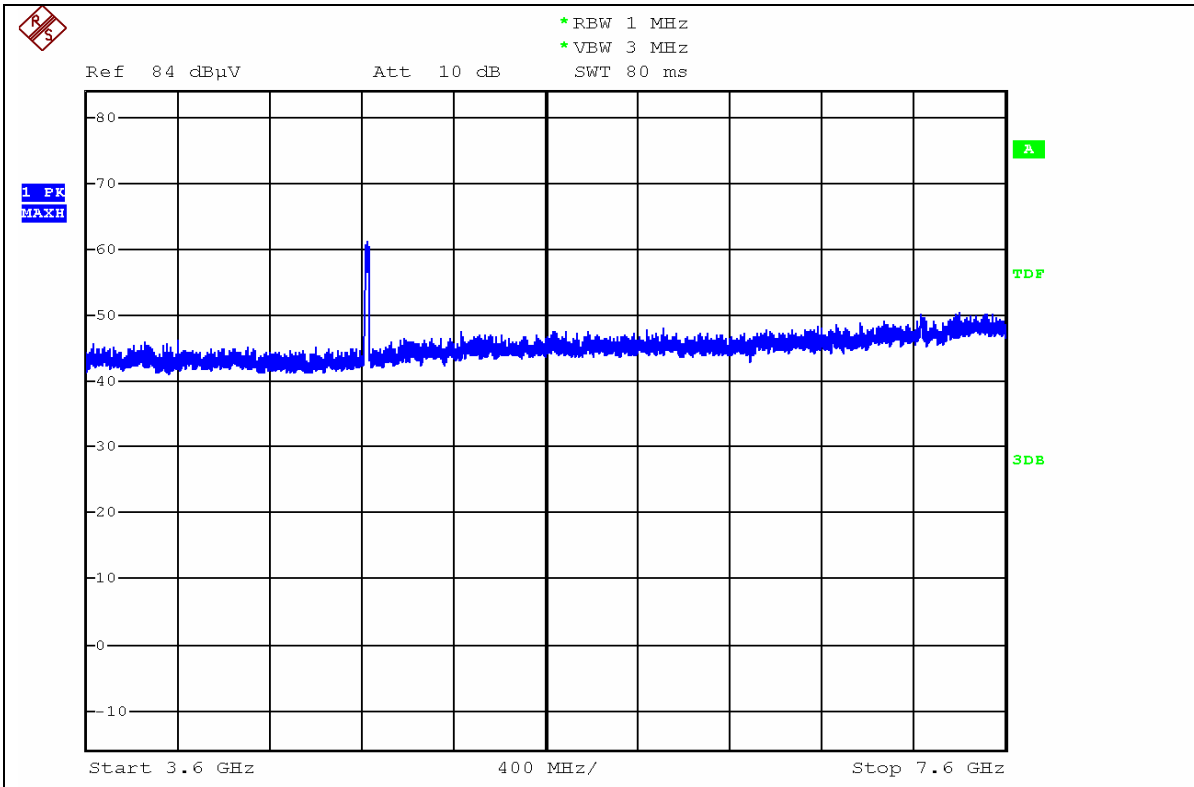


Fig C6 High Channel Radiated Emissions 3.6GHz -7.6GHz Horizontal 1metre

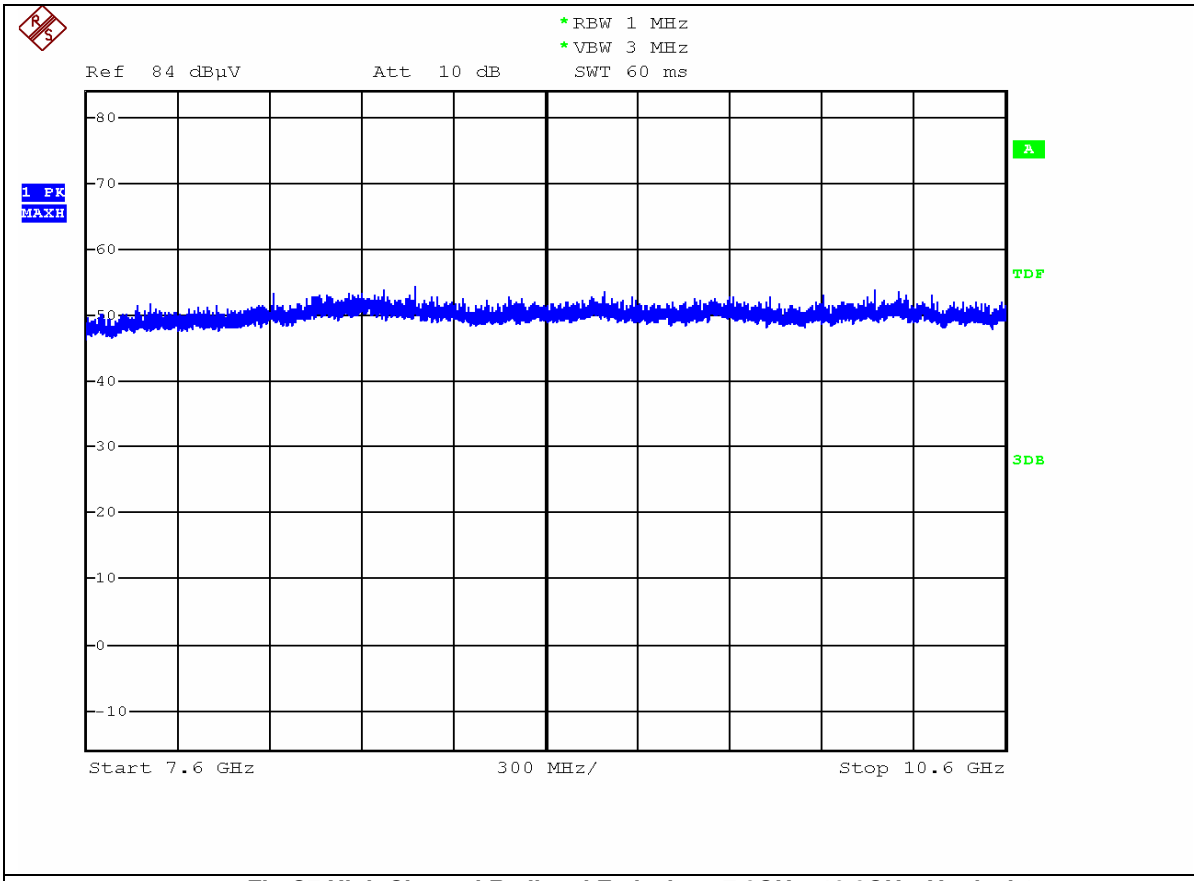


Fig C7 High Channel Radiated Emissions 7.6GHz -10.6GHz Vertical 1metre

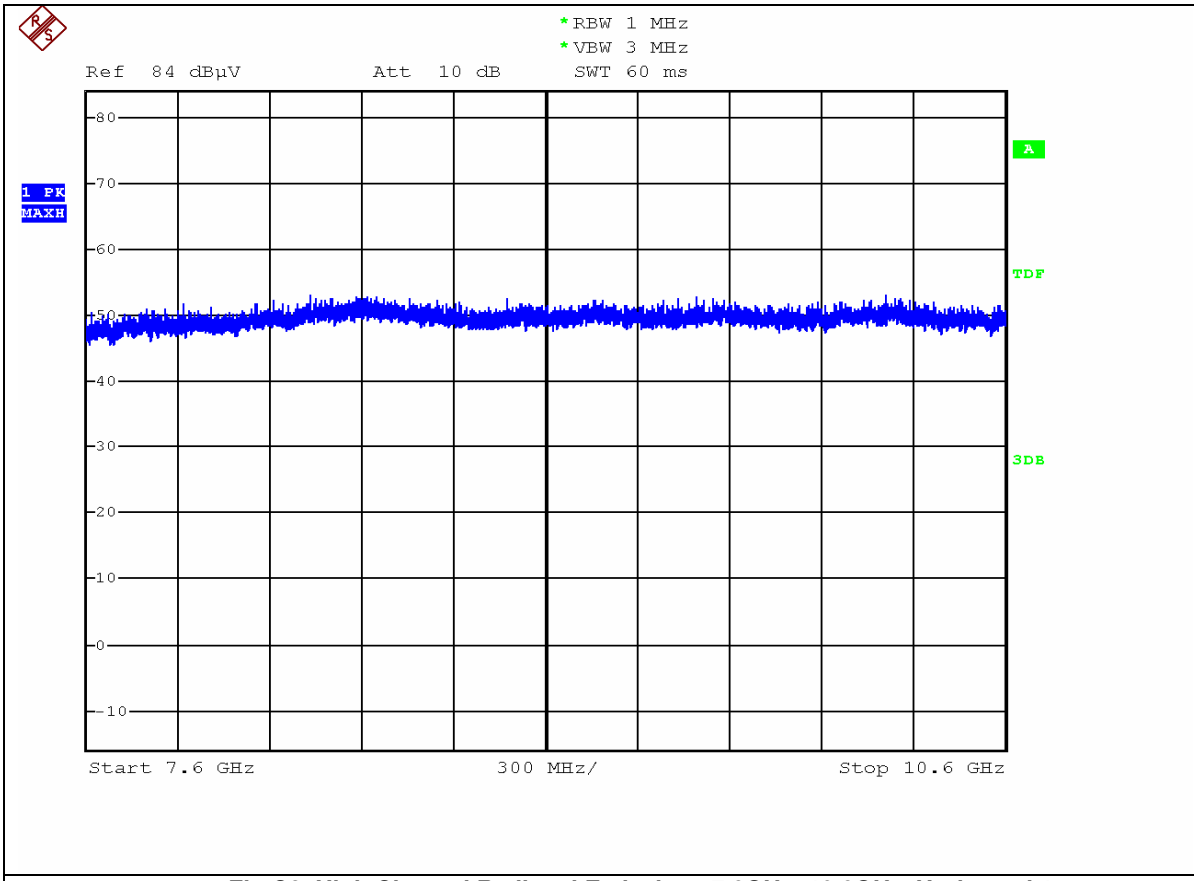


Fig C8 High Channel Radiated Emissions 7.6GHz -10.6GHz Horizontal 1metre

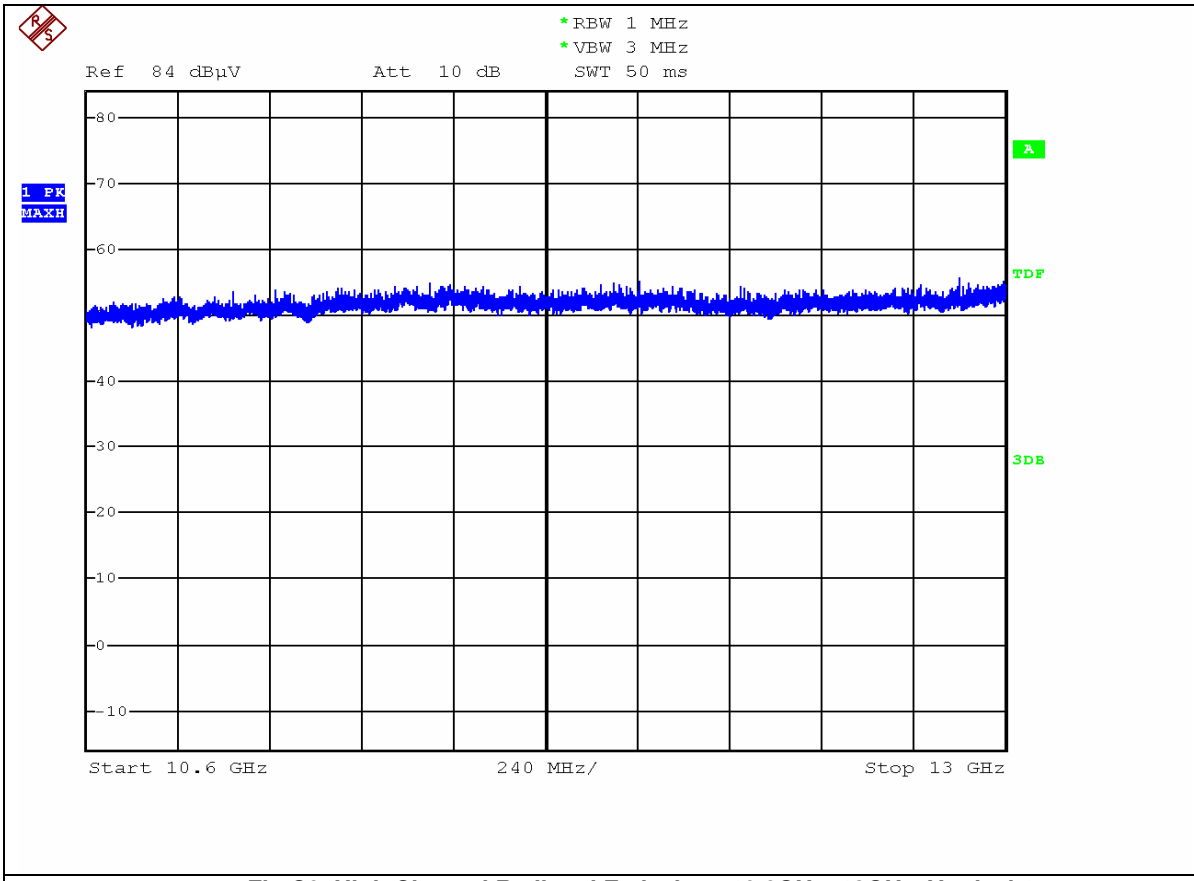


Fig C9 High Channel Radiated Emissions 10.6GHz -13GHz Vertical 1metre

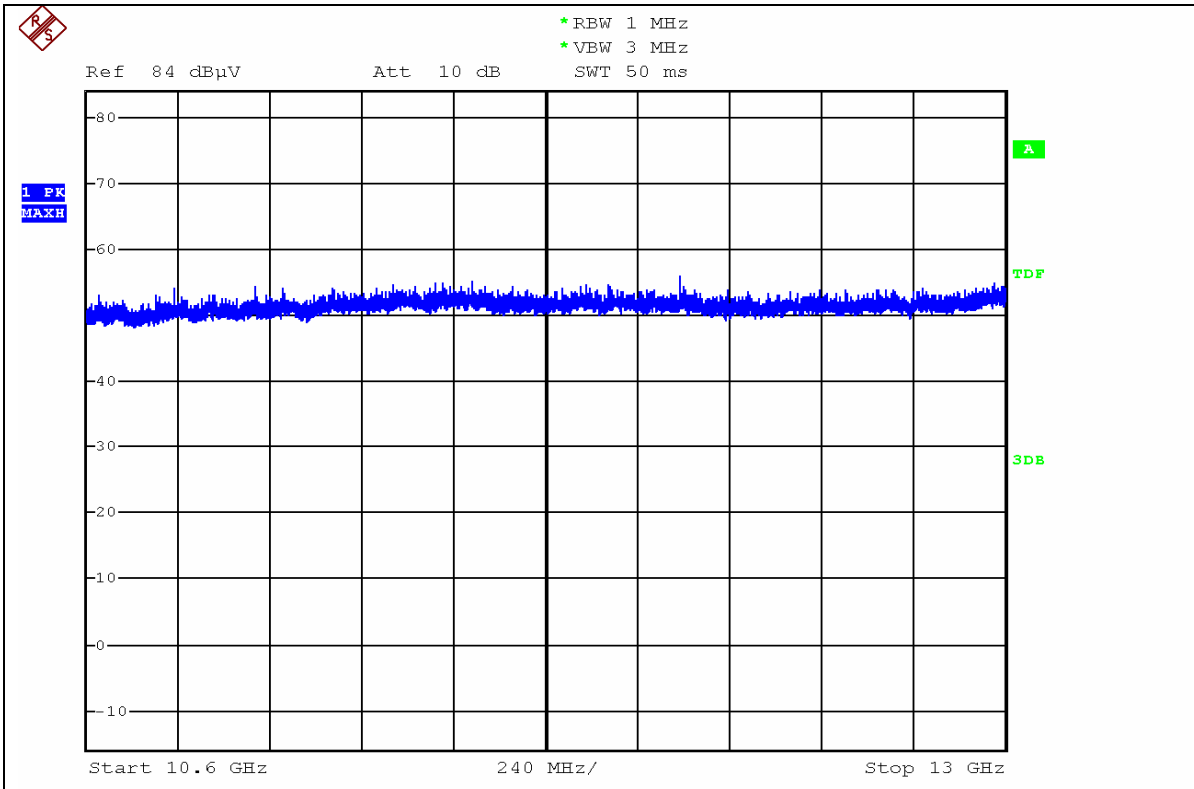


Fig C10 High Channel Radiated Emissions 10.6GHz -13GHz Horizontal 1metre

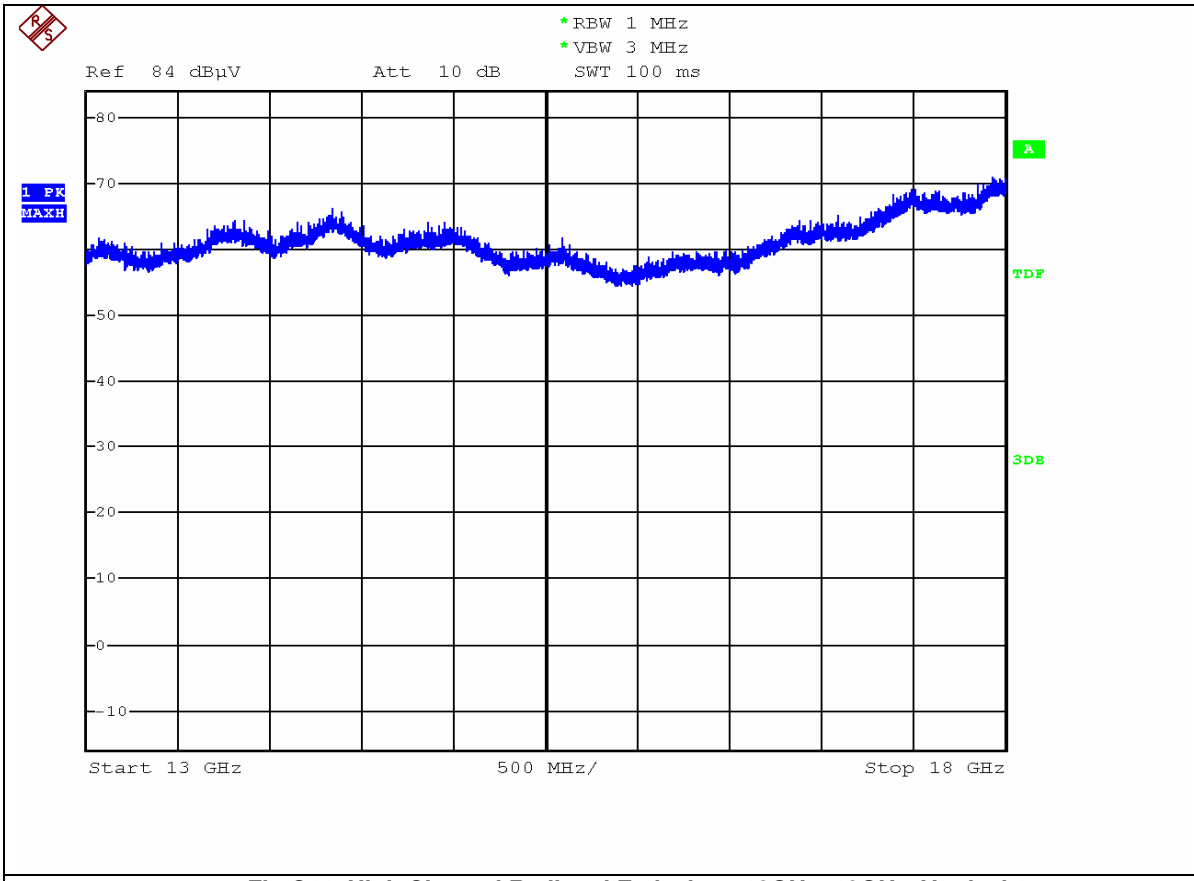


Fig C11 High Channel Radiated Emissions 13GHz -18GHz Vertical 1 metre

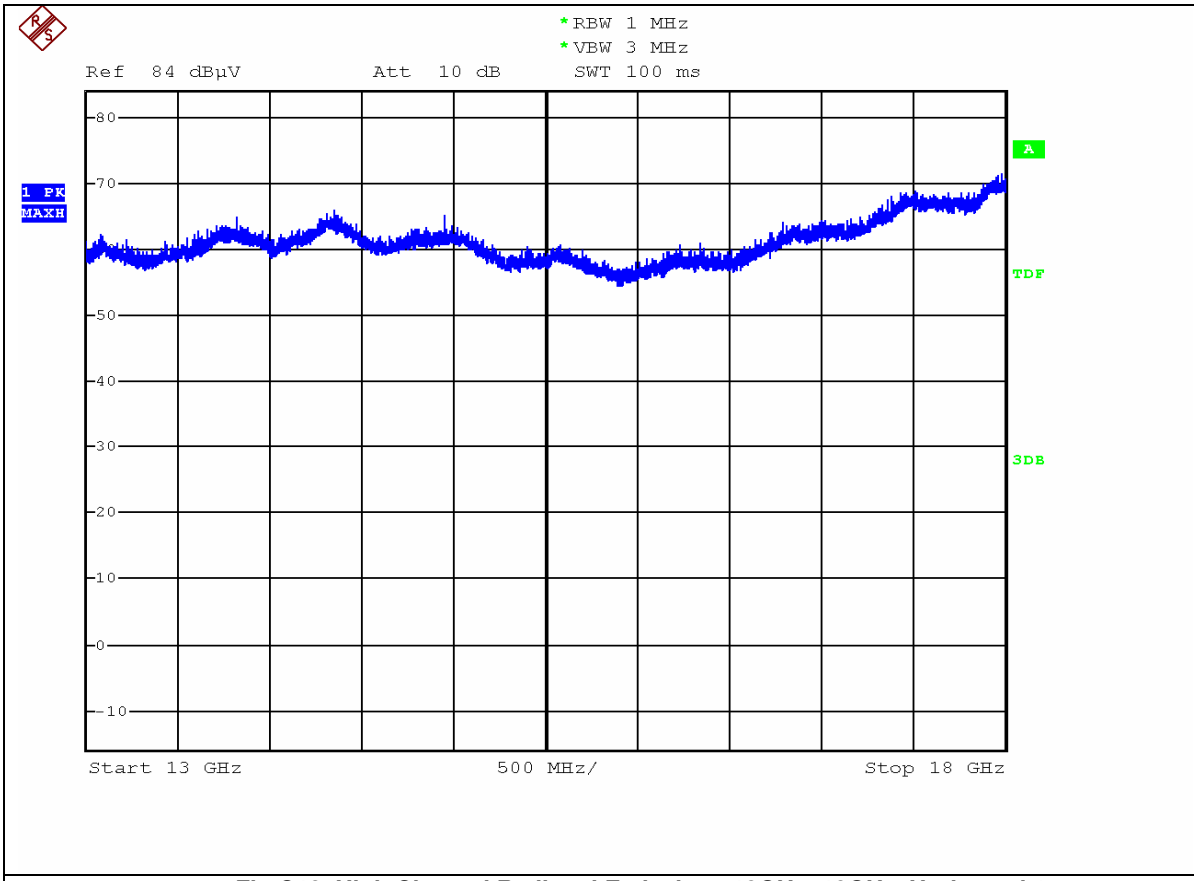


Fig C12 High Channel Radiated Emissions 13GHz -18GHz Horizontal 1metre

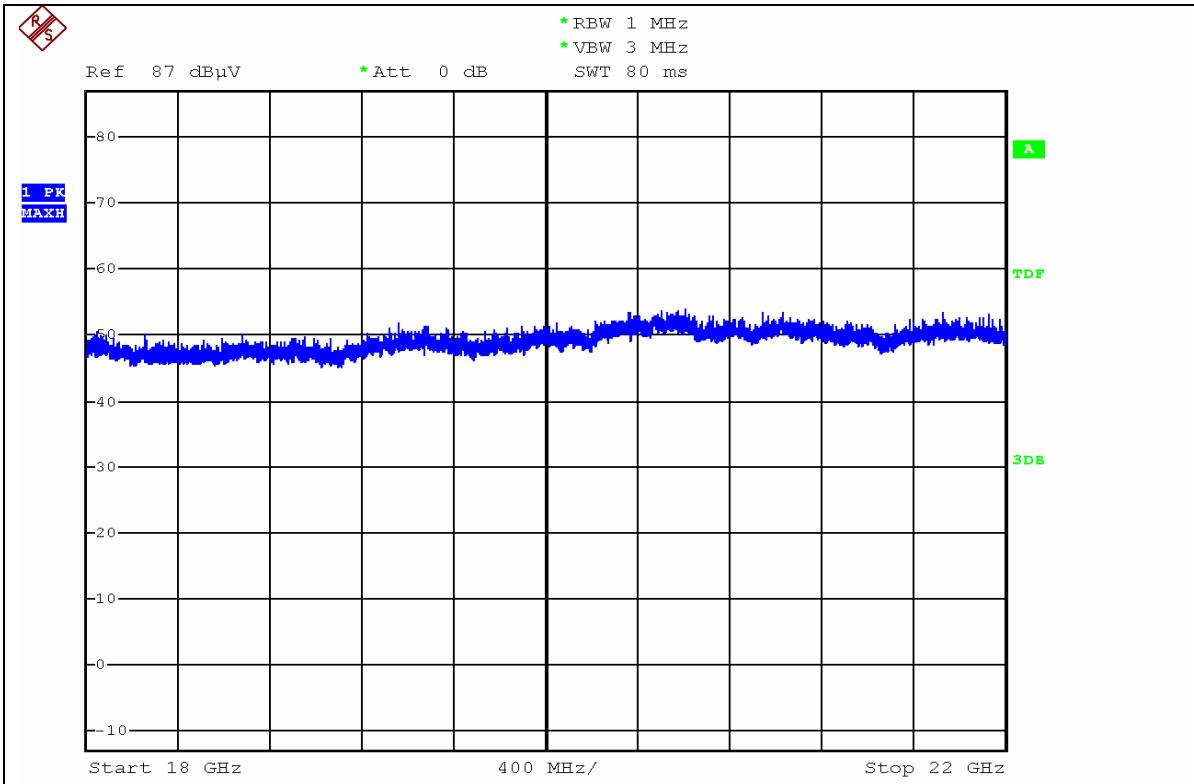


Fig C13 High Channel Radiated Emissions 18GHz -22GHz Vertical 1 metre

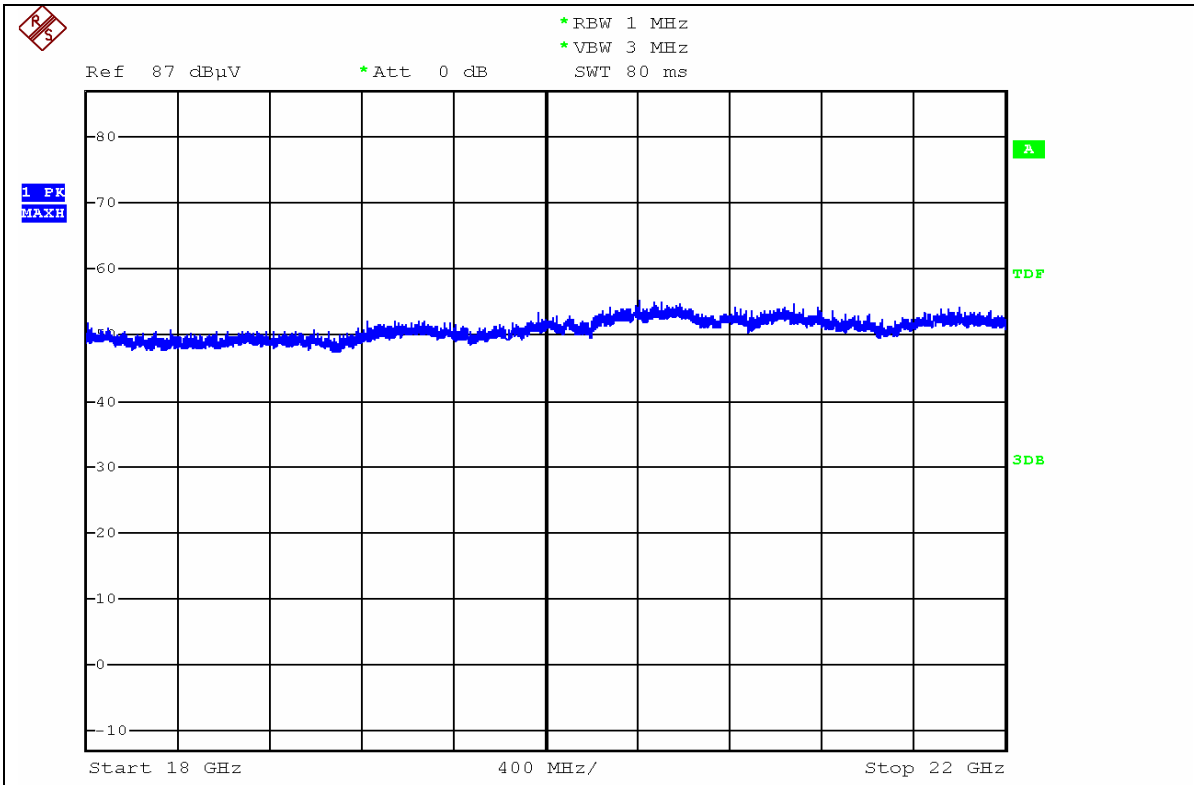


Fig C14 High Channel Radiated Emissions 18GHz -22GHz Horizontal 1metre

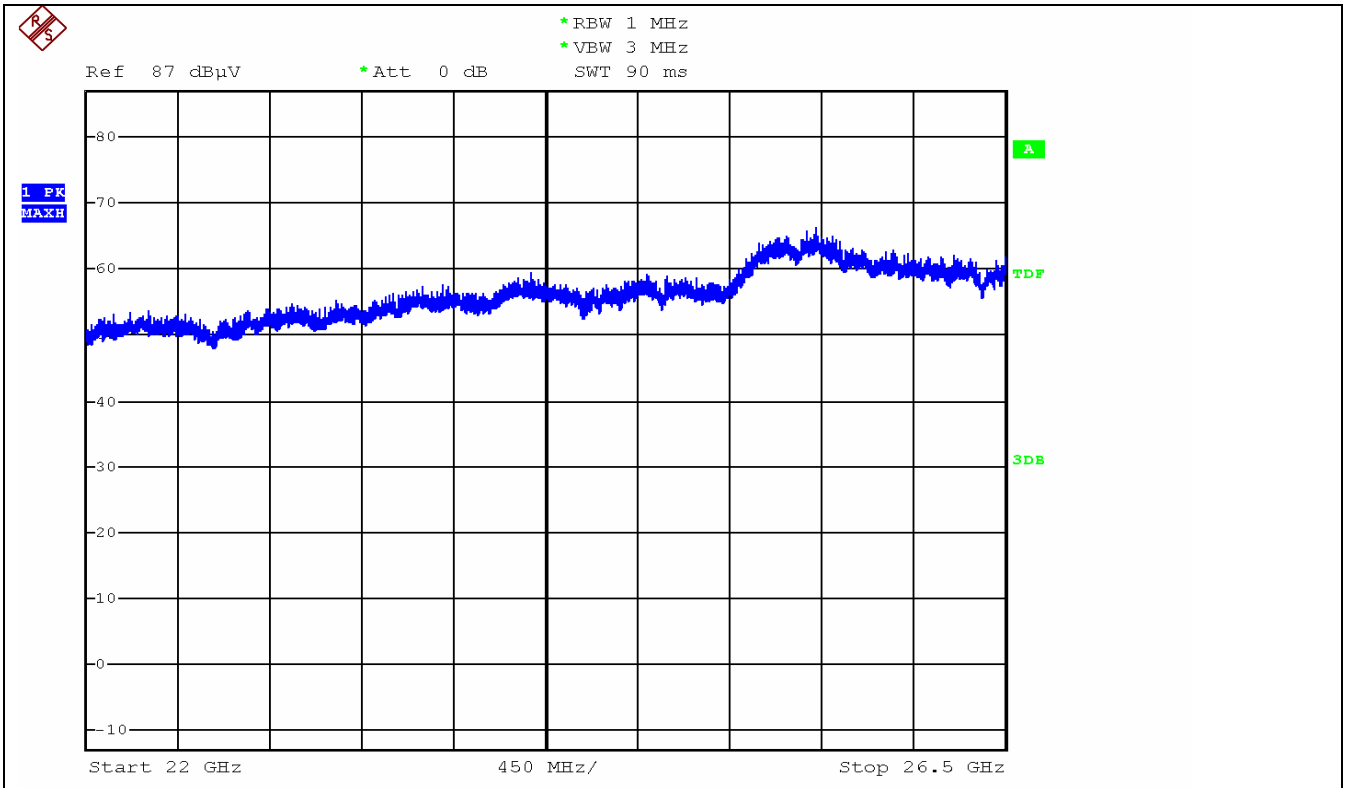


Fig C15 High Channel Radiated Emissions 22GHz -26.5GHz Vertical 1 metre

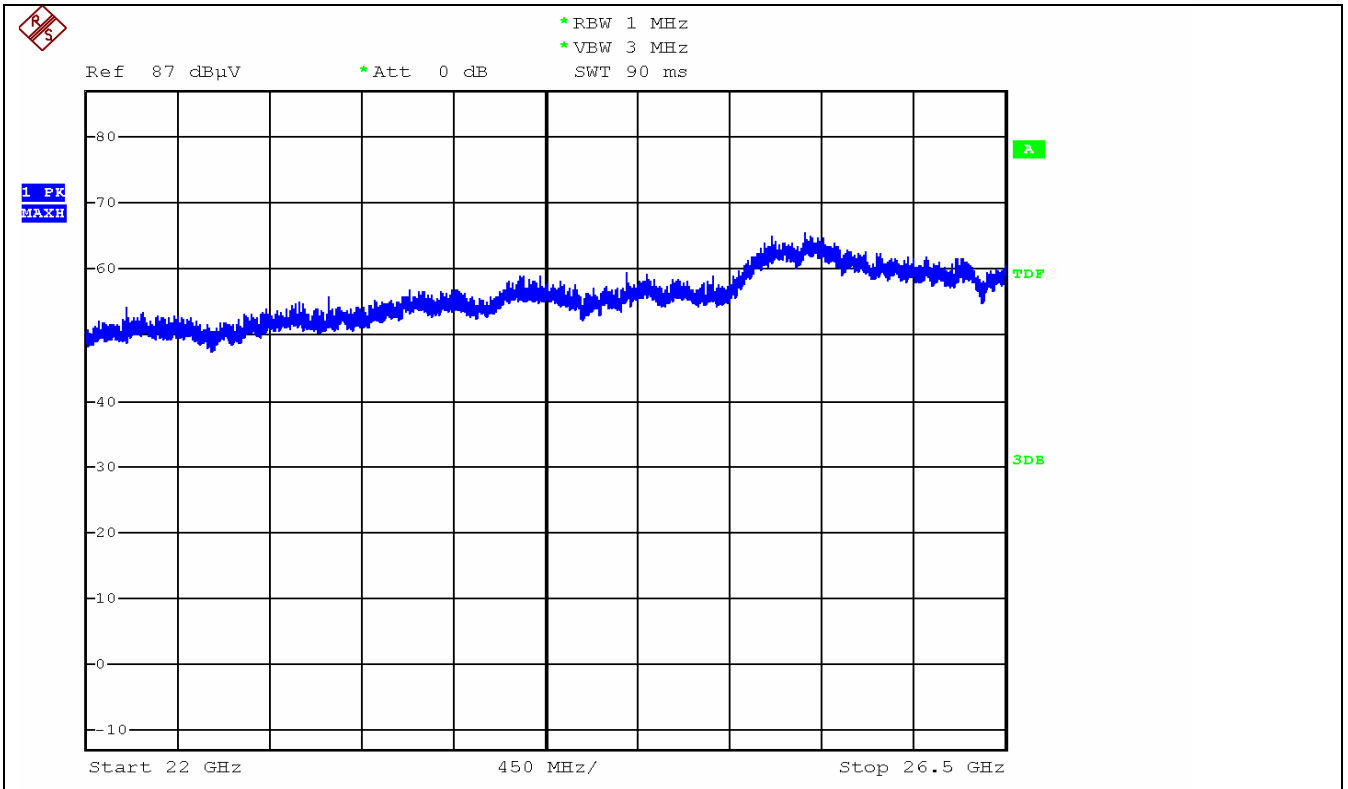


Fig C16 High Channel Radiated Emissions 22GHz -26.5GHz Horizontal 1metre

End of Report