

Test Report

Test Report Num	24E10359-2a Part 1 of 2
Quotation	Q24-2607-1
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FCC Test Firm Designation	IE0002
ISED Cab Identifier	IE0001
Date	28 th Nov 2024
EUT Description	Nordic ID HH86 Model 837-5A
Authorised by	Paul Reilly
Authorised Signature:	

TEST SUMMARY

Emissions were assessed to the following standards:

FCC CFR 47 Part 15

Federal Communications Commission: Part 15 Radio Frequency Devices

RSS Gen Issue 5 Amendment 1 Mar 2019 Amd 2 Feb 2021

RSS-210 Issue 11 Jun 2024

RSS-247 Issue 3 Aug 2023

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

FCC Part Section(s)	RSS Part Section(s)	TEST PARAMETERS	Test Result
15.203		Antenna Requirement all antennas internal	Pass
15.209,15.247,15.407	RSS-Gen 8.9, RSS 247	Spurious Emissions	Pass
15.207	RSS-Gen 8.8	Conducted Emissions on the mains	Pass

Measurements performed according to the procedures in ANSI C63.10-2013

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

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Ref 24E10359-2a Part 2 of 2 for the remaining Appendices below

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1.0 EUT Description

The Nordic ID HH86 which is a battery powered handheld product for inventory scanning which contains functionality for, NFC, UHF RFID, WLAN and Bluetooth

All modules except NFC are pre-certified.

1.1 EUT Operation

Operating Conditions during Test:

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

The EUT was operated with all radios on while powered from its internal battery.

Note for Conducted Emissions on the mains, the HH86 host (containing the EUT) was placed on a charging cradle which was plugged directly into the LISN

Environmental conditions

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

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 dates 30th Oct ,5th 6th ,7th 8th 18th 19th 20th 21st Nov 2024.

1.4 Description of Test Methods

Tests were performed manually, and no special software was used

2 Emissions Measurements

2.1.1 Conducted Emissions Measurements

The EUT was connected to a 12v DC adapter Manufacturer Kings Model KSS12_120_1000B, which was connected to the mains through a LISN and measurements were carried out using a Receiver over the frequency range 150KHz to 30MHz.

2.2 Radiated Emissions Measurements

Radiated Power measurements were made at the Compliance Engineering Ireland Ltd anechoic chamber located in Dunshaughlin, Co. Meath, Ireland to determine the radio noise radiated from the EUT. A "Description of Measurement Facilities" has been submitted to the FCC and approved pursuant to Section 2.948 of CFR 47 of the FCC rules.

The EUT was centred on a motorized turntable, which allows 360 degree rotation. A measurement antenna was positioned at a distance of 3 metres as measured from the closest point of the EUT. The radiated emissions were maximised by configuring the EUT, by rotating the EUT and by raising and lowering the antenna from 1 to 4 meters. Emissions below 30MHz were measured using a loop antenna. In this case the resolution bandwidth was 200Hz for frequencies below 150KHz and RBW was 9KHz for frequencies above 150KHz.

Emissions between 30MHz and 300MHz were measured using a bi-conical antenna. Emissions between 300MHz and 1GHz were measured using a bi-log antenna. In both cases the resolution bandwidth was 120KHz.

3.0 Results for Conducted emissions

Mains Conducted Emissions results

Detector	Frequency	Reading	Margin	Phase
QP/ Ave	MHz	dBuV	dB	L/N
Quasi-Peak	0.1500	43.07	-22.93	Live
Average	0.1568	21.35	-34.46	Live
Average	0.5348	5.55	-40.45	Live
Average	1.3065	15.56	-30.44	Live
Average	1.309	15.58	-30.42	Live
Average	1.311	15.65	-30.35	Live
Average	4.038	13.83	-32.17	Live
Average	8.493	2.16	-47.84	Live
Average	11.974	4.06	-45.94	Live
Quasi-Peak	18.551	17.60	-42.4	Live

Detector	Frequency	Reading	Margin	Phase
QP/ Ave	MHz	dBuV	dB	L/N
Quasi-Peak	0.1500	40.43	-25.57	Neutral
Average	0.1568	21.65	-34.16	Neutral
Average	0.5348	6.74	-39.26	Neutral
Average	1.3065	14.79	-31.21	Neutral
Average	1.3088	14.63	-31.37	Neutral
Average	1.3110	14.33	-31.67	Neutral
Average	4.0380	10.37	-35.63	Neutral
Average	8.4930	1.42	-48.58	Neutral
Average	11.9738	4.83	-45.17	Neutral
Quasi-Peak	18.5505	17.38	-42.62	Neutral

Ref Appendix B for scans

Result: Pass

4. Spurious Emissions

4.1 Spurious Emissions with NFC , BLE and Wifi 2.4 GHz band active

Frequency	Quasi peak Level	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain	Cable loss	Final Field Strength Quasi Peak	Average Limit	Margin	Result
MHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBuV/m	dB	P/F
279.990	-9.5	O2	Vertical	17.8	0	2.8	11.1	46.0	34.9	Pass
131.640	-2.4	O2	Horizontal	11.2	0	1.9	10.7	43.5	32.8	Pass
263.310	-1.3	O2	Horizontal	16.6	0	2.7	18.0	46.0	28.0	Pass
978.090	-30.2	O2	Vertical	24.6	0	5.6	0.0	54.0	54.0	Pass

Final Field Strength Quasi Peak (dBuV/m) =Quasi peak Level (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)

Calculation Example 11.1 = -9.5 + 17.8 - 0 + 2.8

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	Result
GHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBuV/m	dB	P/F
4.804	45.1	O3	Vertical	33.1	39.3	7.8	46.7	54.0	27.3	Pass
3.659	44.9	O3	Vertical	31.8	38.3	6	44.4	54.0	29.6	Pass
4.573	45.6	O3	Vertical	32.7	39.7	8.1	46.7	54.0	27.3	Pass
7.318	45.9	O3	Vertical	36.4	40.6	10.1	51.8	54.0	22.2	Pass
8.232	46.2	O3	Vertical	36.8	40.9	11	53.1	54.0	20.9	Pass
9.148	43.9	O3	Vertical	37.8	38.8	10.1	53.0	54.0	21.0	Pass
4.804	46.0	O3	Horizontal	33.1	39.3	7.8	47.6	54.0	26.4	Pass
3.659	45.9	O3	Horizontal	31.8	38.3	6	45.4	54.0	28.6	Pass
4.573	45.3	O3	Horizontal	32.7	39.7	8.1	46.4	54.0	27.6	Pass
7.318	45.3	O3	Horizontal	36.4	40.6	10.1	51.2	54.0	22.8	Pass
8.232	45.6	O3	Horizontal	36.8	40.9	11	52.5	54.0	21.5	Pass
9.148	43.6	O3	Horizontal	37.8	38.8	10.1	52.7	54.0	21.3	Pass

Final Field Strength Peak (dBuV/m) =Reading Peak (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)

Calculation Example 46.7 = 45.1 + 33.1 - 39.3 + 7.8

Test Result Pass

4.2 Spurious Emissions with NFC , BLE and Wifi 5GHz band active

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	Result
GHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBuV/m	dB	P/F
4.880	59.6	O3	Vertical	33.2	39	7.8	61.6	54.0	12.4	Pass
7.320	45.7	O3	Vertical	36.4	40.6	10.1	51.6	54.0	22.4	Pass
4.880	66.5	O3	Horizontal	33.2	39	7.8	68.5	54.0	5.5	Pass
7.320	46.0	O3	Horizontal	36.4	40.6	10.1	51.9	54.0	22.1	Pass
3.659	45.7	O3	Vertical	31.8	38.3	6	45.2	54.0	28.8	Pass
4.573	46.1	O3	Vertical	32.7	39.7	8.1	47.2	54.0	26.8	Pass
7.318	45.7	O3	Vertical	36.4	40.6	10.1	51.6	54.0	22.4	Pass
8.232	45.6	O3	Vertical	36.8	40.9	11	52.5	54.0	21.5	Pass
9.147	44.6	O3	Vertical	37.8	38.8	10.1	53.7	54.0	20.3	Pass
3.659	45.5	O3	Horizontal	31.8	38.3	6	45.0	54.0	29.0	Pass
4.573	46.0	O3	Horizontal	32.7	39.7	8.1	47.1	54.0	26.9	Pass
7.318	45.7	O3	Horizontal	36.4	40.6	10.1	51.6	54.0	22.4	Pass
8.232	45.5	O3	Horizontal	36.8	40.9	11	52.4	54.0	21.6	Pass
9.147	45.5	O3	Horizontal	37.8	38.8	10.1	54.6	54.0	19.4	Pass

Final Field Strength Peak (dBuV/m) =Reading Peak (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)
Calculation Example $61.6 = 59.6 + 33.2 - 39 + 7.8$

Frequency	Reading Average	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain	Cable loss	Final Field Strength Average	Average Limit	Margin	Result
GHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBuV/m	dB	P/F
4.880	44.8	O3	Vertical	33.2	39	7.8	46.8	54.0	7.2	Pass
4.880	48.4	O3	Horizontal	33.2	39	7.8	50.4	54.0	3.6	Pass
9.147	38.0	O3	Horizontal	37.8	38.8	10.1	47.1	54.0	6.9	Pass

Final Field Strength Average (dBuV/m) =Reading Average (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)
Calculation Example $46.8 = 44.8 + 33.2 - 39 + 7.8$

Test Result Pass

4.3 Co-location

Ref appendix D

Test Result Pass

4.4 Carrier Power

4.4.1 BLE

Frequency	Reading Peak	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain	Cable loss	Final Field Strength Peak	Transmitted Power	Limit	Margin	Result
GHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBm	dBm	dB	P/F
2.440	66.8	O2	Vertical	28.6	0	4.8	100.2	5.0	36.0	31	Pass
2.440	66.8	O3	Horizontal	28.6	0	4.8	100.2	5.0	36.0	31	Pass

Final Field Strength Peak (dBuV/m) =Reading Peak (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) + Cable Loss (dB)
Calculation Example $100.2 = 66.8 + 28.6 - 0 + 4.8$

Transmitted power (dBm) =Final Field Strength Peak (dBuV/m) -95.2 dB
Calculation Example $5 = 100.2 - 95.2$

Note the Radiated field strength was measured at 3 metres and the conversion formula below was used to determine the EIRP in dBm
 $EIRP (dBm) = E3m (dBuV/m) - 95.2$

Test Result Pass

4.4.2 Wifi 2.4G

Frequency	Reading Peak	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain	Cable loss	Final Field Strength Peak	Transmitted Power	Limit	Margin	Result
GHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBm	dBm	dB	P/F
2.437	81.7	O2	Vertical	28.6	0	4.8	115.1	19.9	36.0	16.1	Pass
2.437	82.6	O3	Horizontal	28.6	0	4.8	116.0	20.8	36.0	15.2	Pass

Final Field Strength Peak (dBuV/m) =Reading Peak (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) + Cable Loss (dB)
Calculation Example $115.1 = 81.7 + 28.6 - 0 + 4.8$

Transmitted power (dBm) =Final Field Strength Peak (dBuV/m) -95.2 dB
Calculation Example $19.9 = 115.1 - 95.2$

Note the Radiated field strength was measured at 3 metres and the conversion formula below was used to determine the EIRP in dBm
 $EIRP (dBm) = E3m (dBuV/m) - 95.2$

Test Result Pass

4.4.3 Wifi 5G

Frequency	Reading Peak	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain	Cable loss	Final Field Strength Peak	Transmitted Power	Limit	Margin	Result
GHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBm	dBm	dB	P/F
5.500	114.2	O2	Vertical	34.5	38.8	8.2	118.1	22.9	36.0	13.1	Pass
5.500	111.2	O3	Horizontal	34.5	38.8	8.2	115.1	19.9	36.0	16.1	Pass

Final Field Strength Peak (dBuV/m) =Reading Peak (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)
Calculation Example 118.1 = 114.2 + 34.5 - 38.8 + 8.2

Transmitted power (dBm) =Final Field Strength Peak (dBuV/m) -95.2 dB
Calculation Example 22.9 = 118.1 - 95.2

Note the Radiated field strength was measured at 3 metres and the conversion formula below was used to determine the EIRP in dBm
EIRP (dBm) = E3m (dBuV/m) - 95.2

Test Result Pass

4.4.4 UHF RFID

Frequency	Reading Peak	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain	Cable loss	Final Field Strength Peak	Transmitted Power	Limit	Margin	Result
GHz	dBuV/m		V/H	dB	dB	dB	dBuV/m	dBm	dBm	dB	P/F
914.750	97.7	O3	Vertical	23.5	0	5.4	126.6	31.4	36.0	4.6	Pass
914.750	99.3	O3	Horizontal	23.5	0	5.4	128.2	33.0	36.0	3	Pass

Final Field Strength Peak (dBuV/m) =Reading Peak (dBuV/m) + Antenna Factor (dB)- Pre-amp Gain (dB) +Cable Loss (dB)
Calculation Example 126.6 = 97.7 + 23.5 - 0 + 5.4

Transmitted power (dBm) =Final Field Strength Peak (dBuV/m) -95.2 dB
Calculation Example 31.4 = 126.6 - 95.2

Note the Radiated field strength was measured at 3 metres and the conversion formula below was used to determine the EIRP in dBm
EIRP (dBm) = E3m (dBuV/m) - 95.2

Test Result Pass

4.4.5 Calculation of the conducted carrier power Wifi

a) Wifi in 2.4 GHz band

Frequency	Measurement	Antenna gain	Conducted Peak	Limit	Margin
GHz	EIRP dBm	dBi	dBm	dBm	dB
2.437	20.8	3	17.8	30	12.2

EIRP measurement taken from section 4.4.2

Conducted peak =Measurement (EIRP dBm) - Antenna Gain (dBi)

Calculation example $17.8 = 20.8 - 3$

b) Wifi in 5 GHz band

Frequency	Measurement	Antenna gain	Conducted Peak	Limit	Margin
GHz	EIRP dBm	dBi	dBm	dBm	dB
5.5	22.9	4.2	18.7	30	11.3

EIRP measurement taken from section 4.4.3

Conducted peak =Measurement (EIRP dBm) - Antenna Gain (dBi)

Calculation example $18.7 = 22.9 - 4.2$

Test Result Pass

5. Measurement Uncertainties

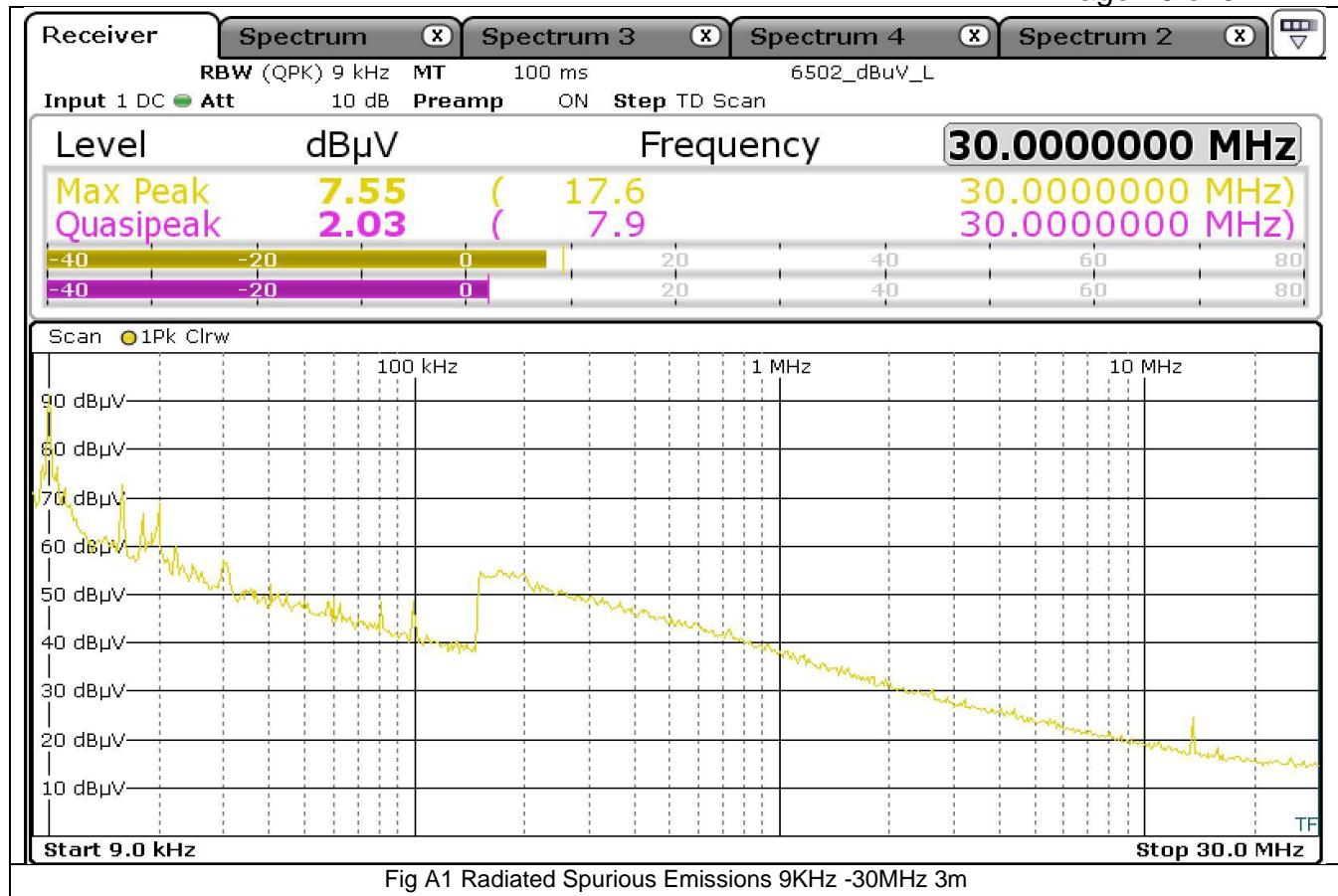
Measurement	Uncertainty
Radio Frequency	+/- 5×10^{-7}
Maximum Frequency Deviation	+/- 1.7 %
Radiated Emission 30MHz-100MHz	+/- 5.3 dB
Radiated Emission 100MHz-300MHz	+/- 4.7 dB
Radiated Emission 300MHz-1GHz	+/- 3.9 dB
Radiated Emission 1GHz-40GHz	+/- 3.8 dB
Occupied Bandwidth	\pm 5%
Conducted RF power	\pm 1.23 dB
Conducted Spurious Emission of transmitter	\pm 2.14 dB
Conducted Emissions of Receivers	\pm 2.14 dB
RF level of uncertainty for a given BER	\pm 1.23 dB
Temperature	\pm 0.2°C
Humidity	\pm 4% RH
Frequency	\pm 0.01 ppm
Duty Cycle	+/- 5 %

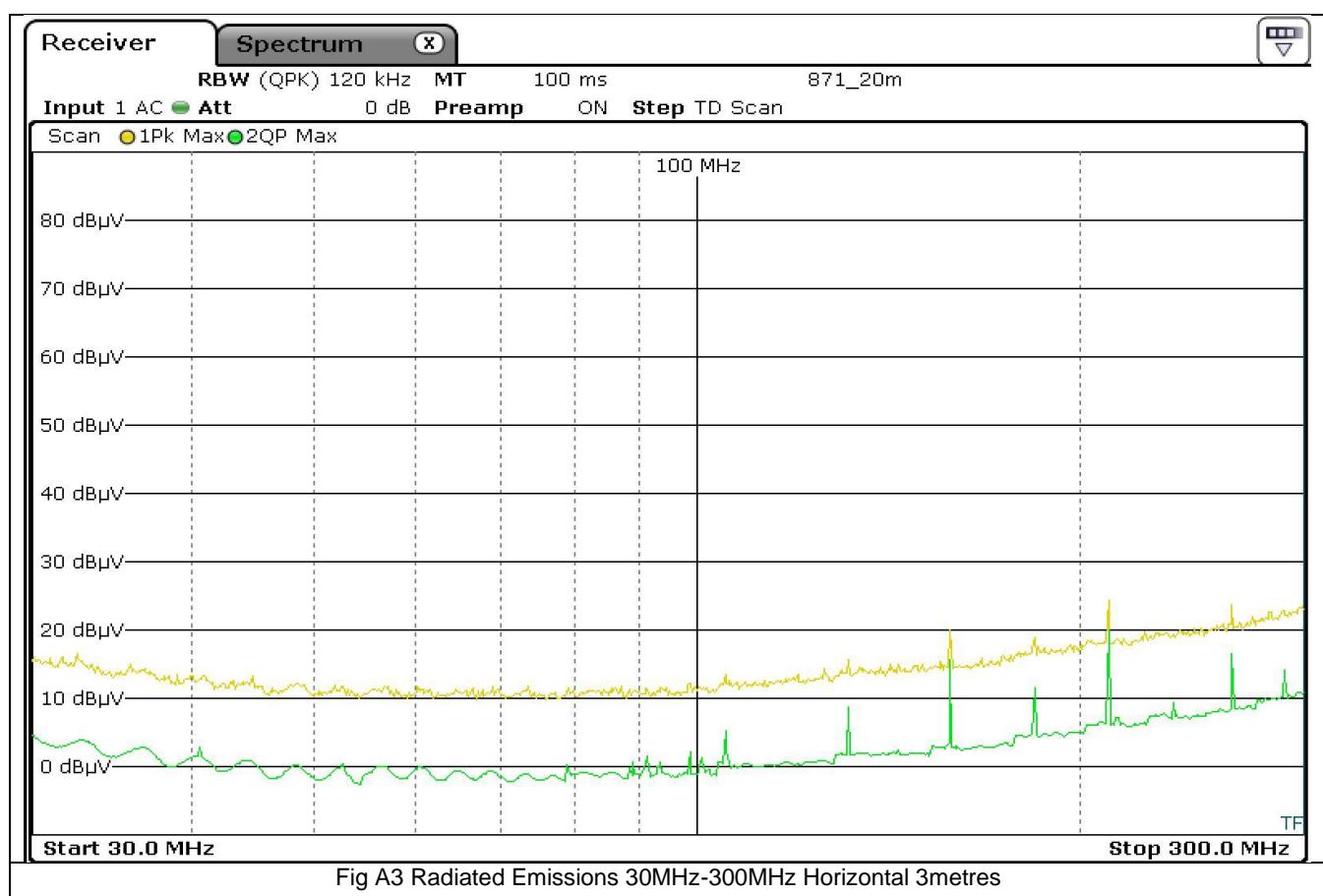
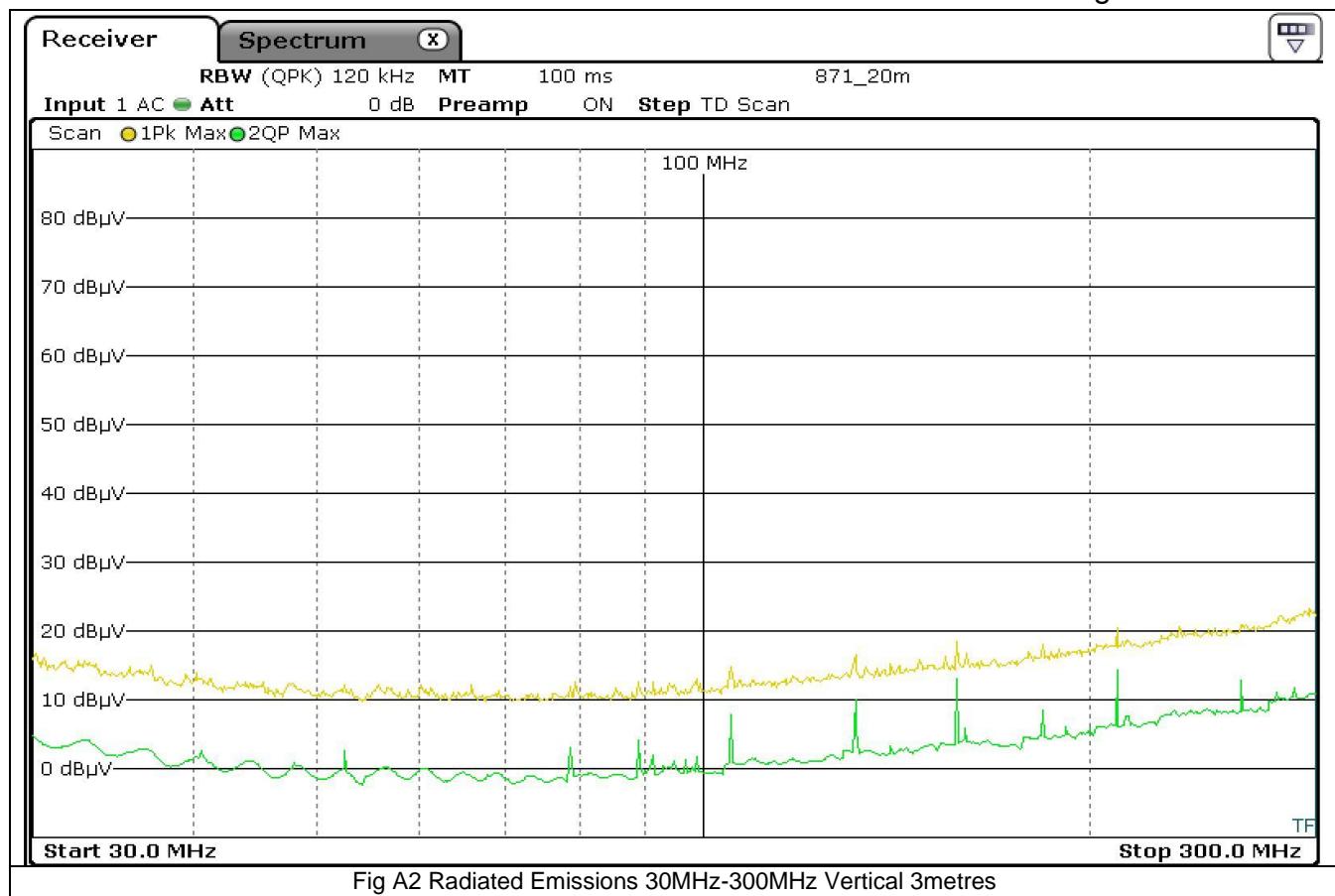
Table 1: Measurement Uncertainties

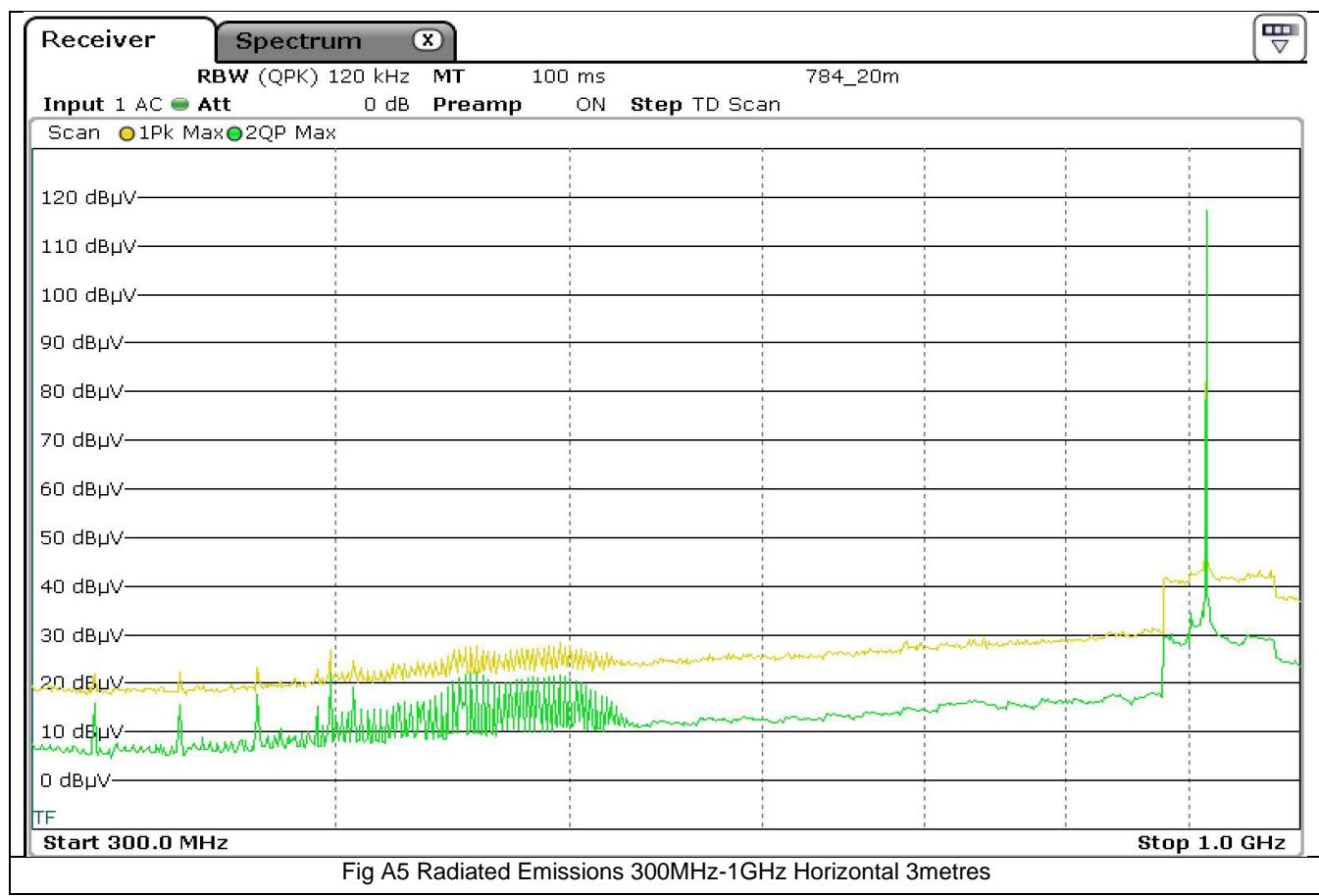
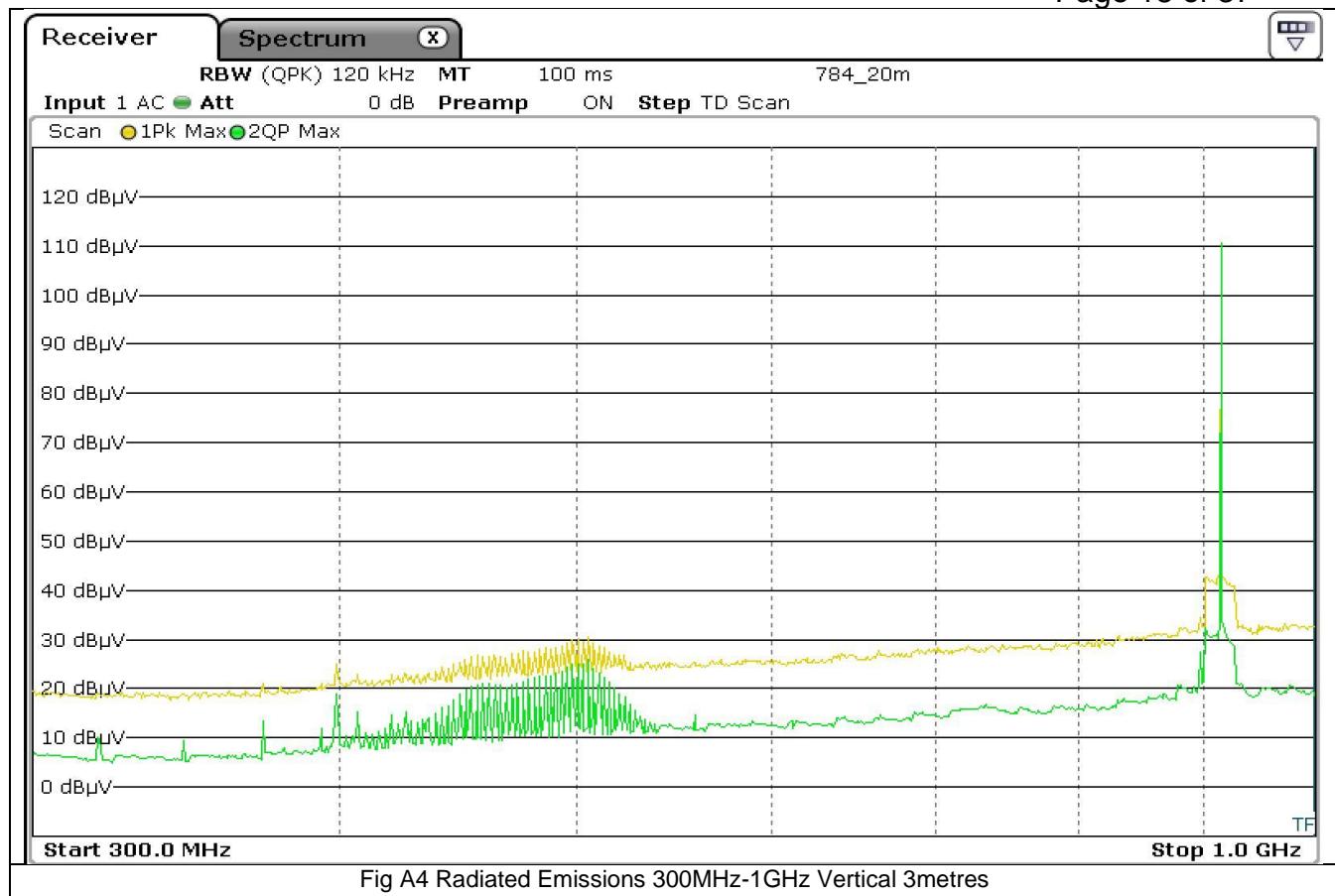
The measurement uncertainties stated were calculated with a $k=2$ for a confidence level of 95.45%.

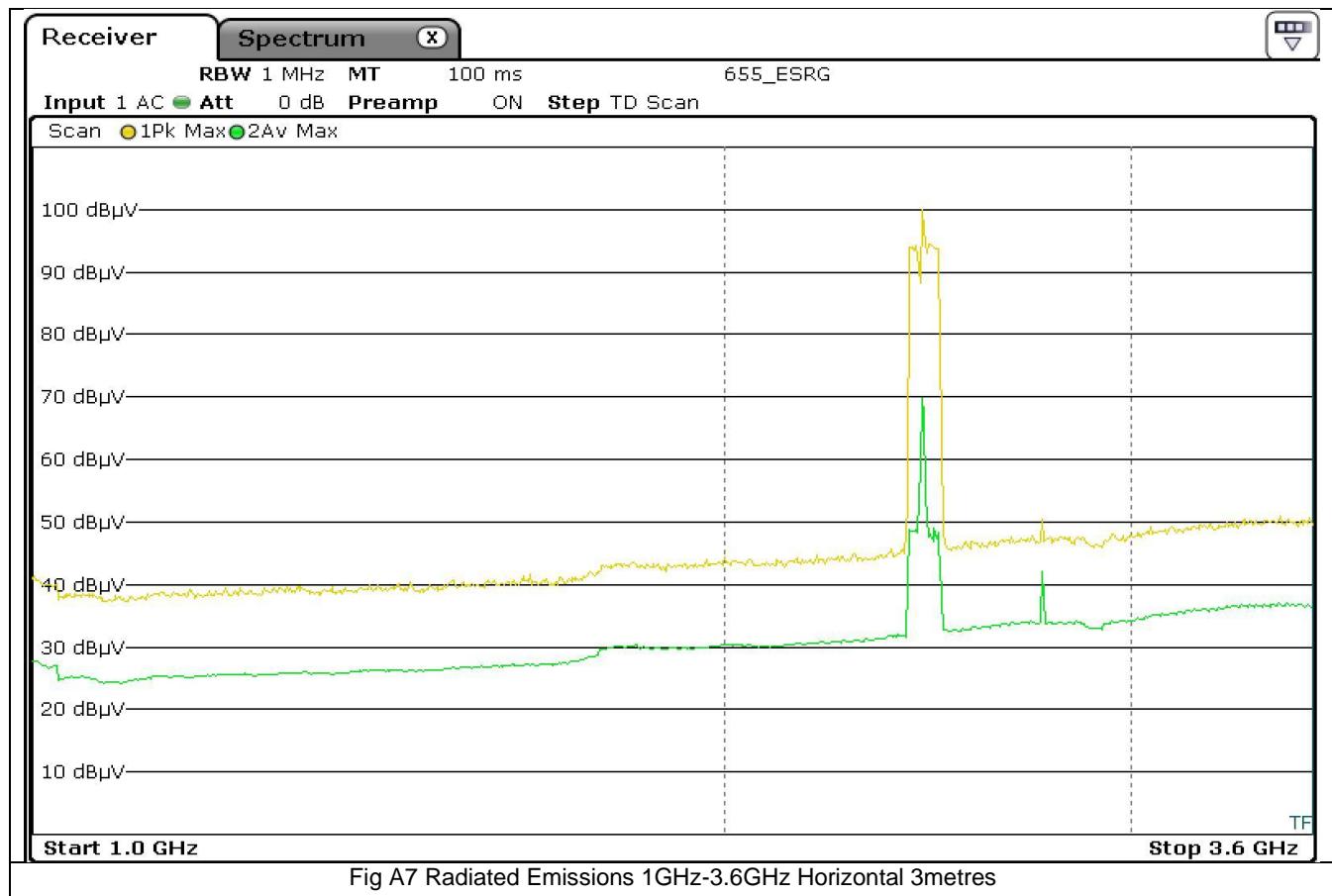
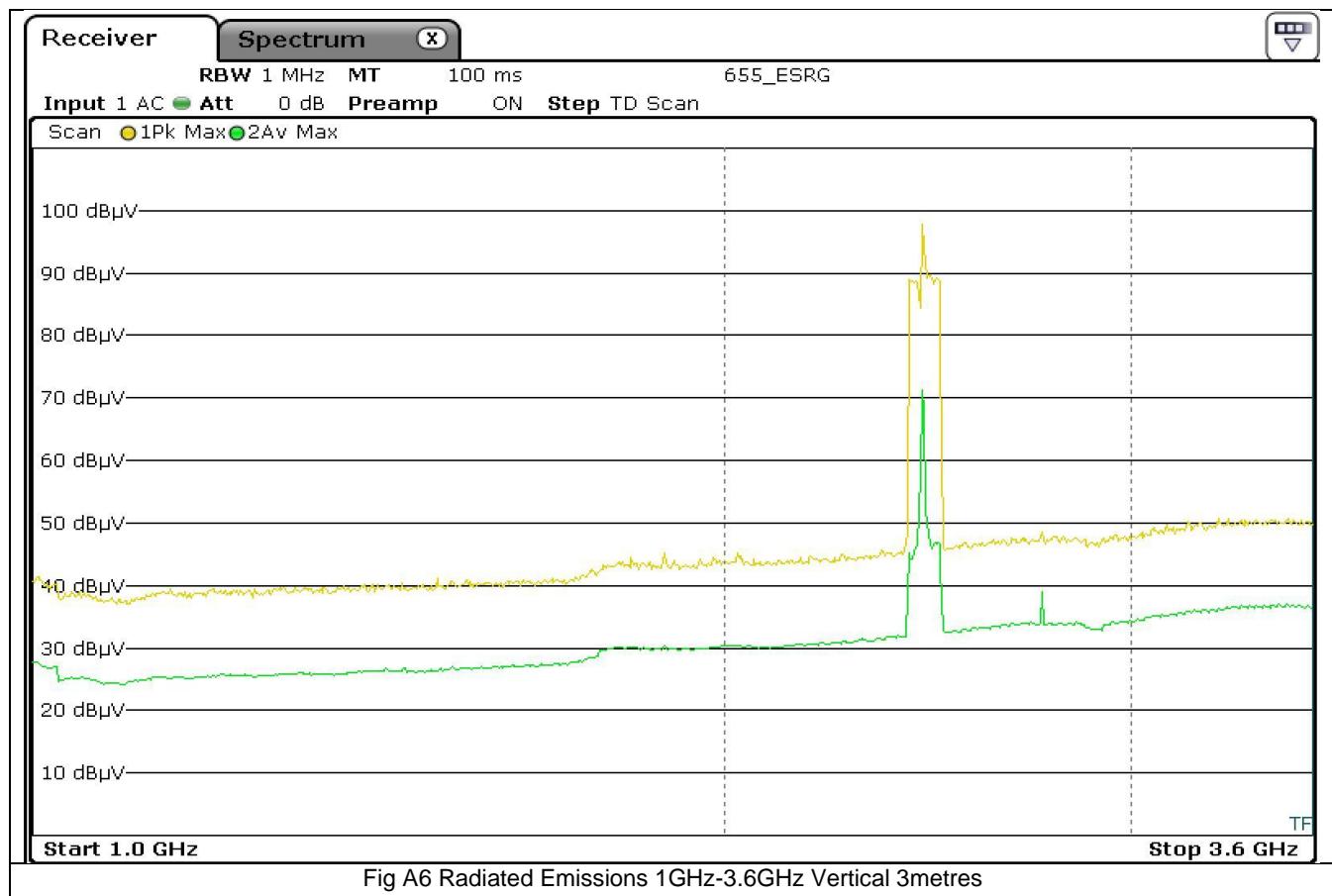
The test data can be compared directly to the specification limit to determine compliance, as the calculated measurement uncertainty meets the requirements of the applicable specification.

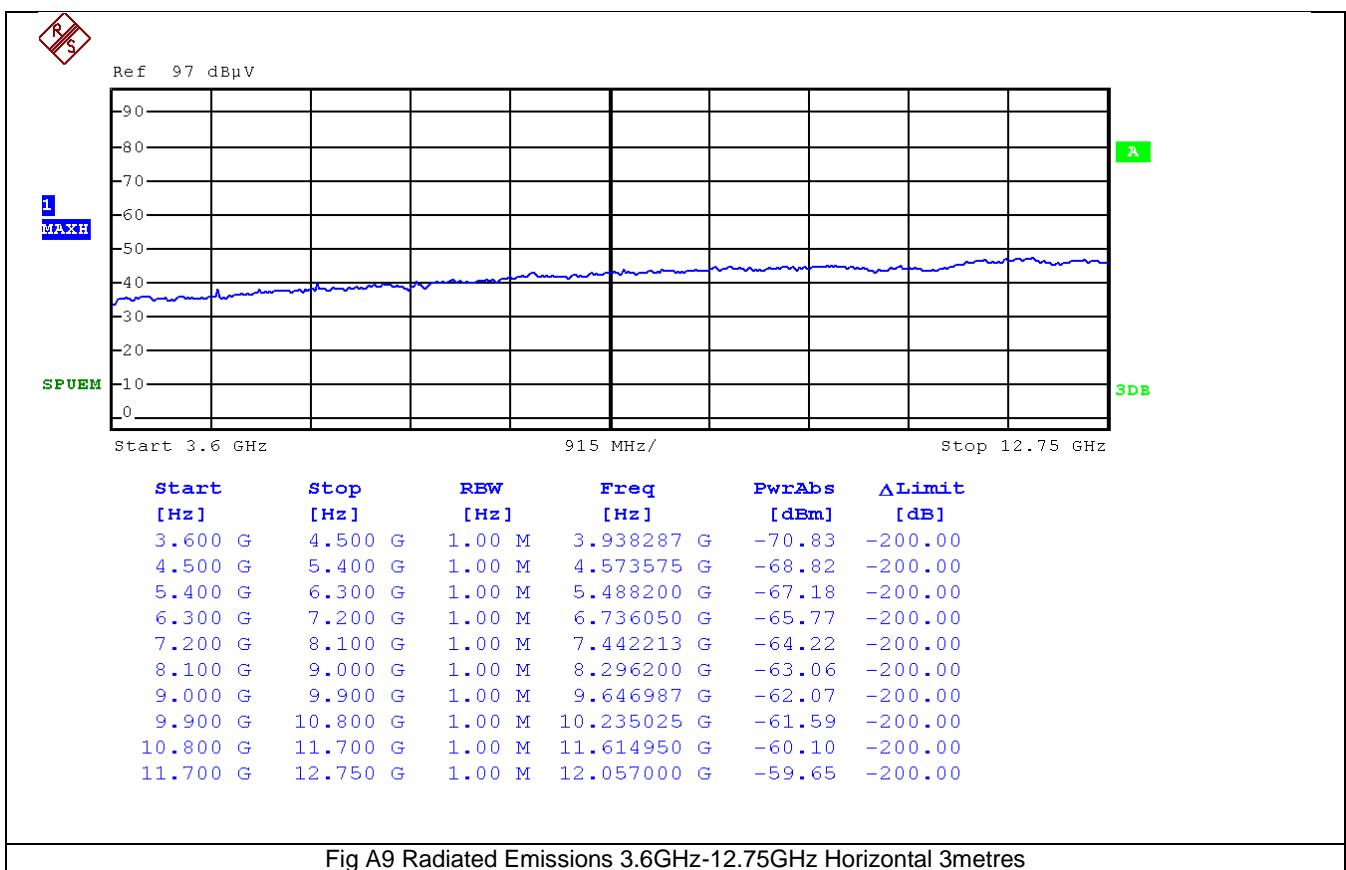
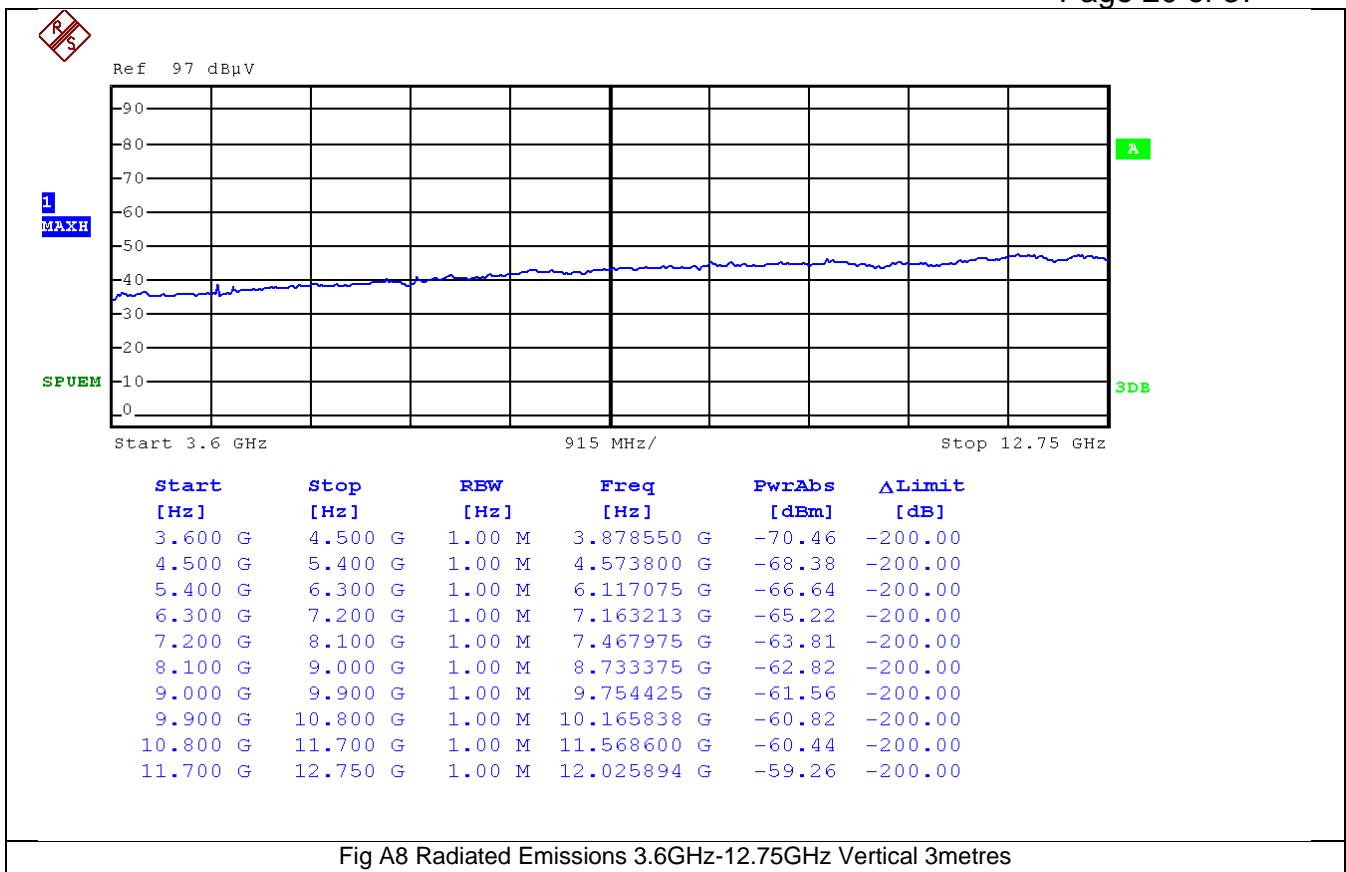
Appendix A: Radios NFC, BLE, RFID with Wifi in 2.4GHz band

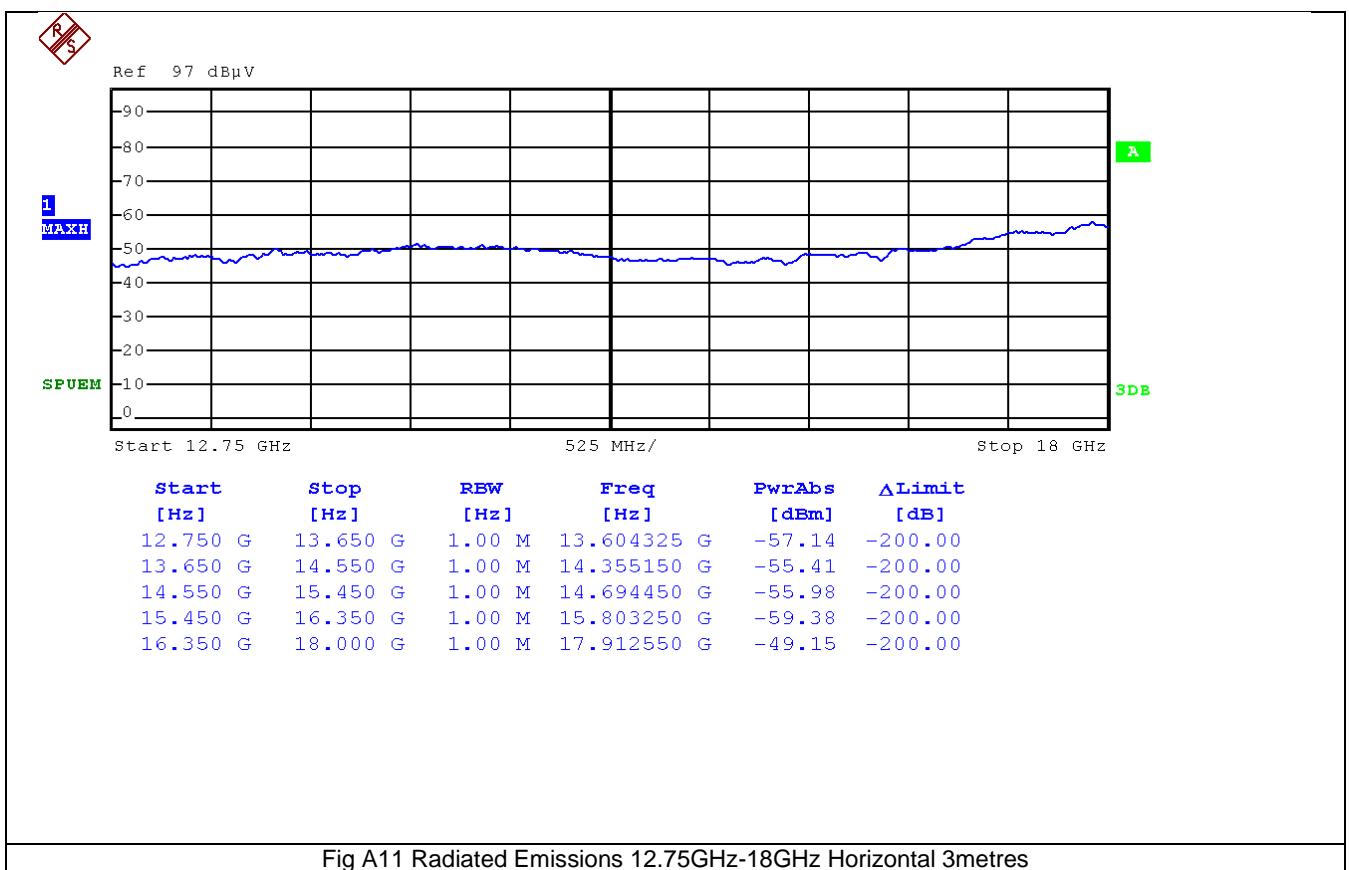
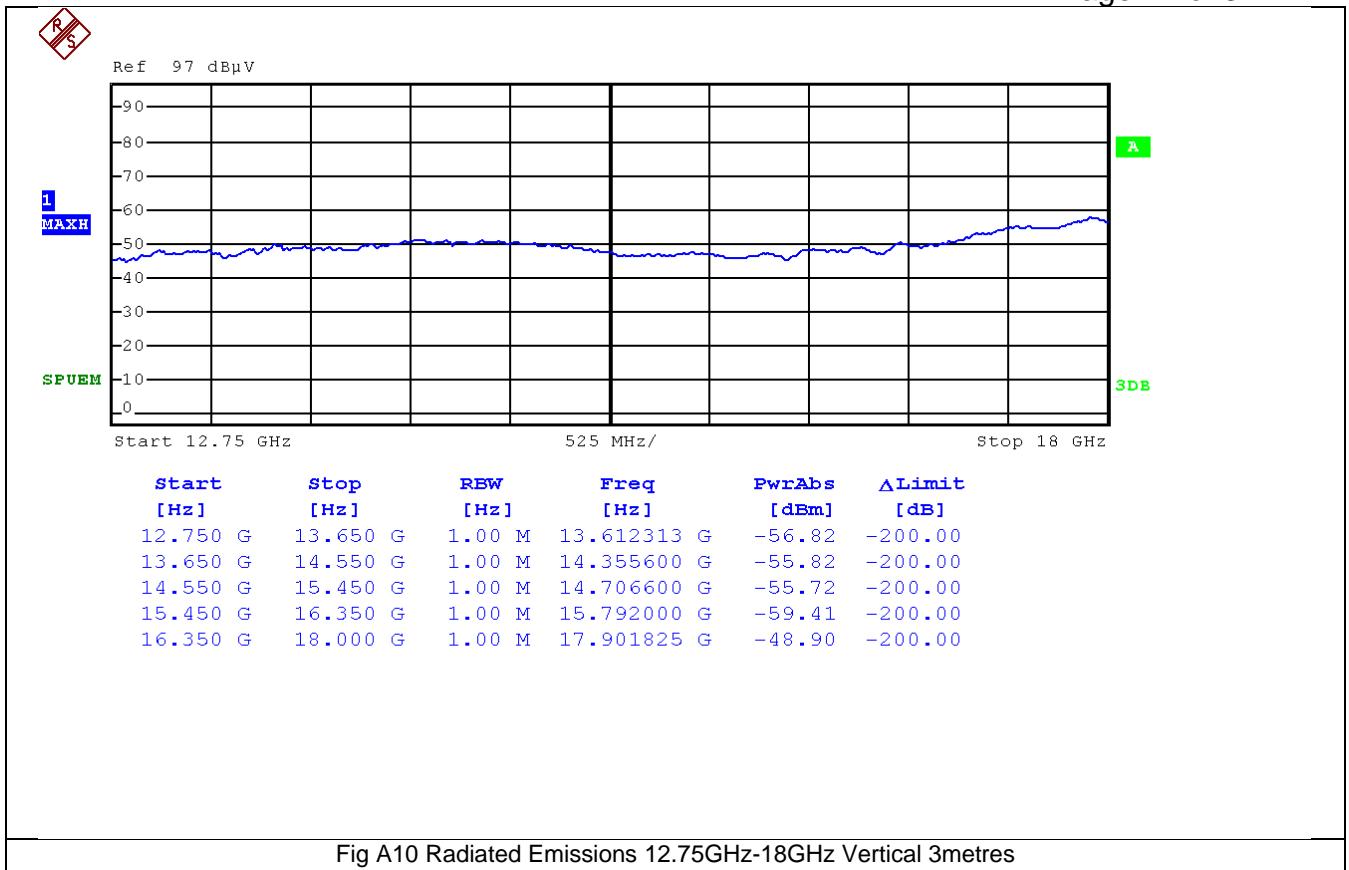












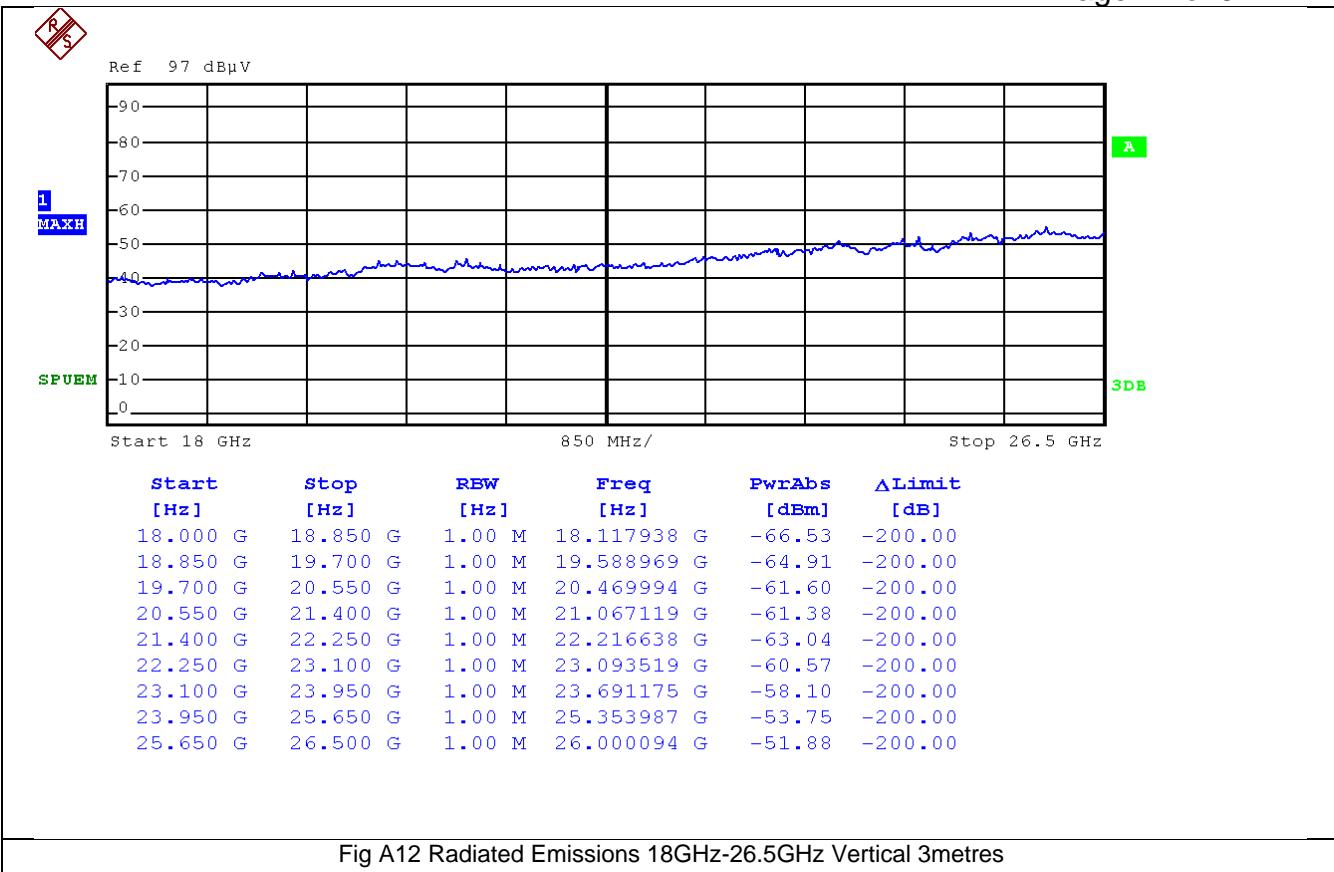
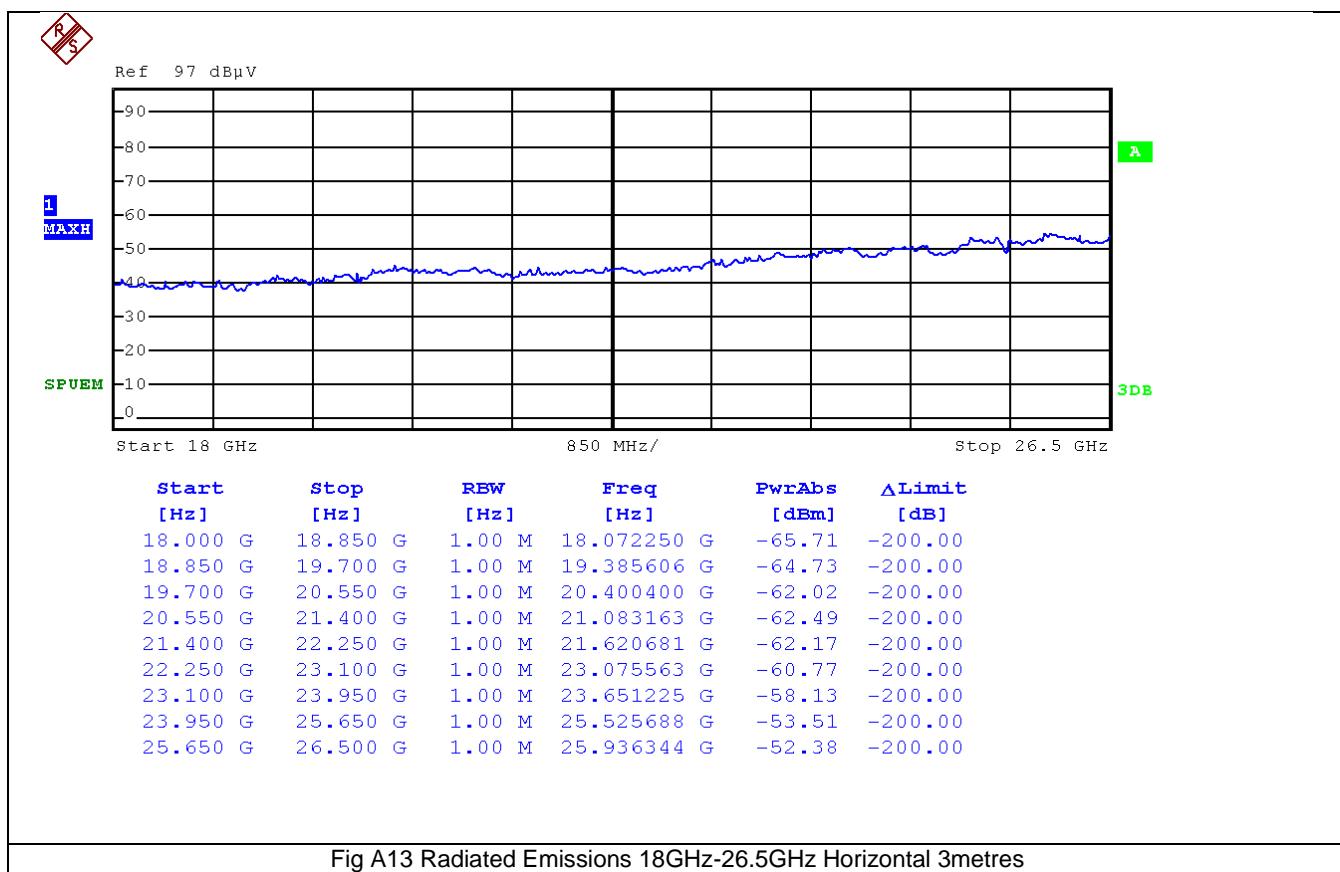
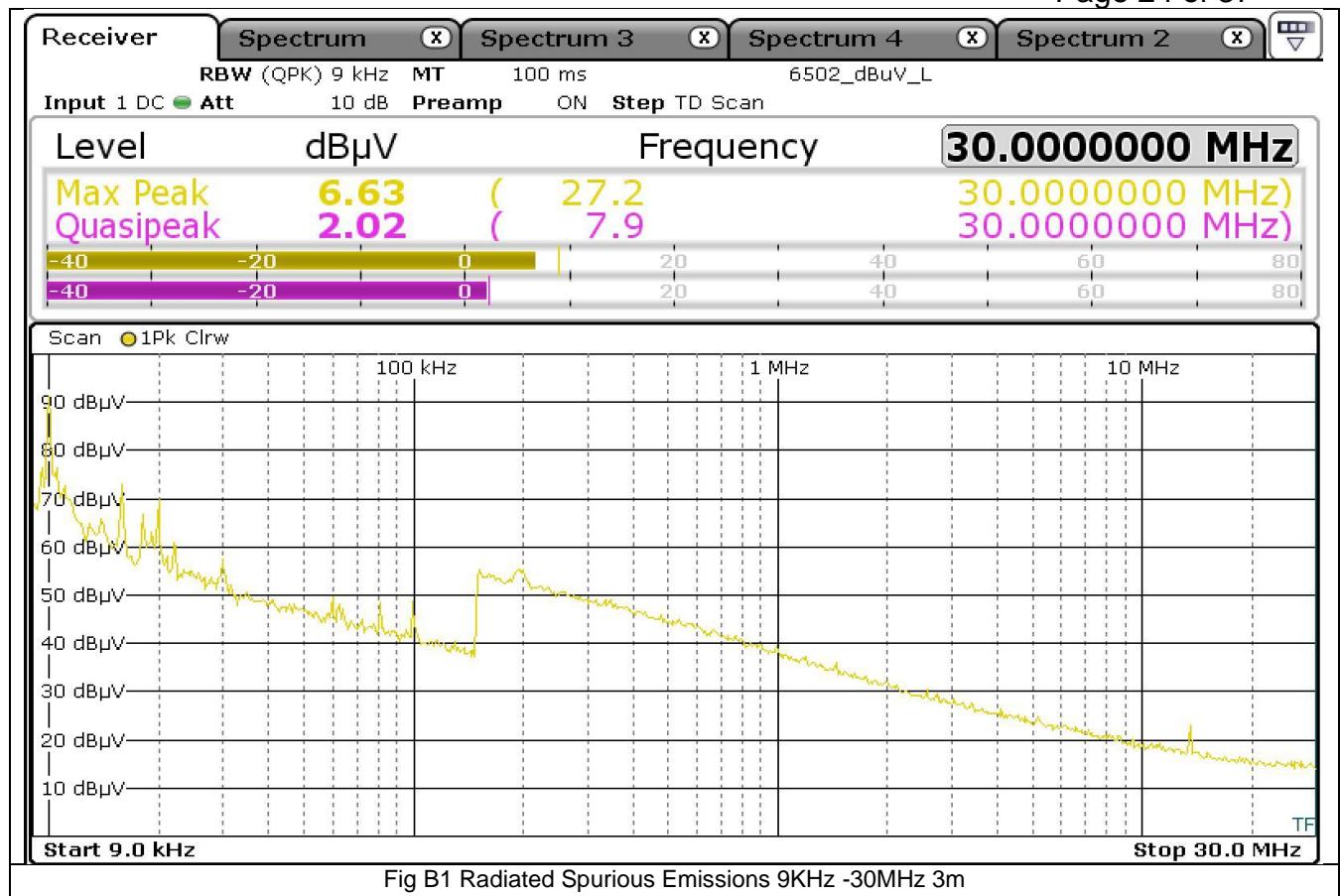
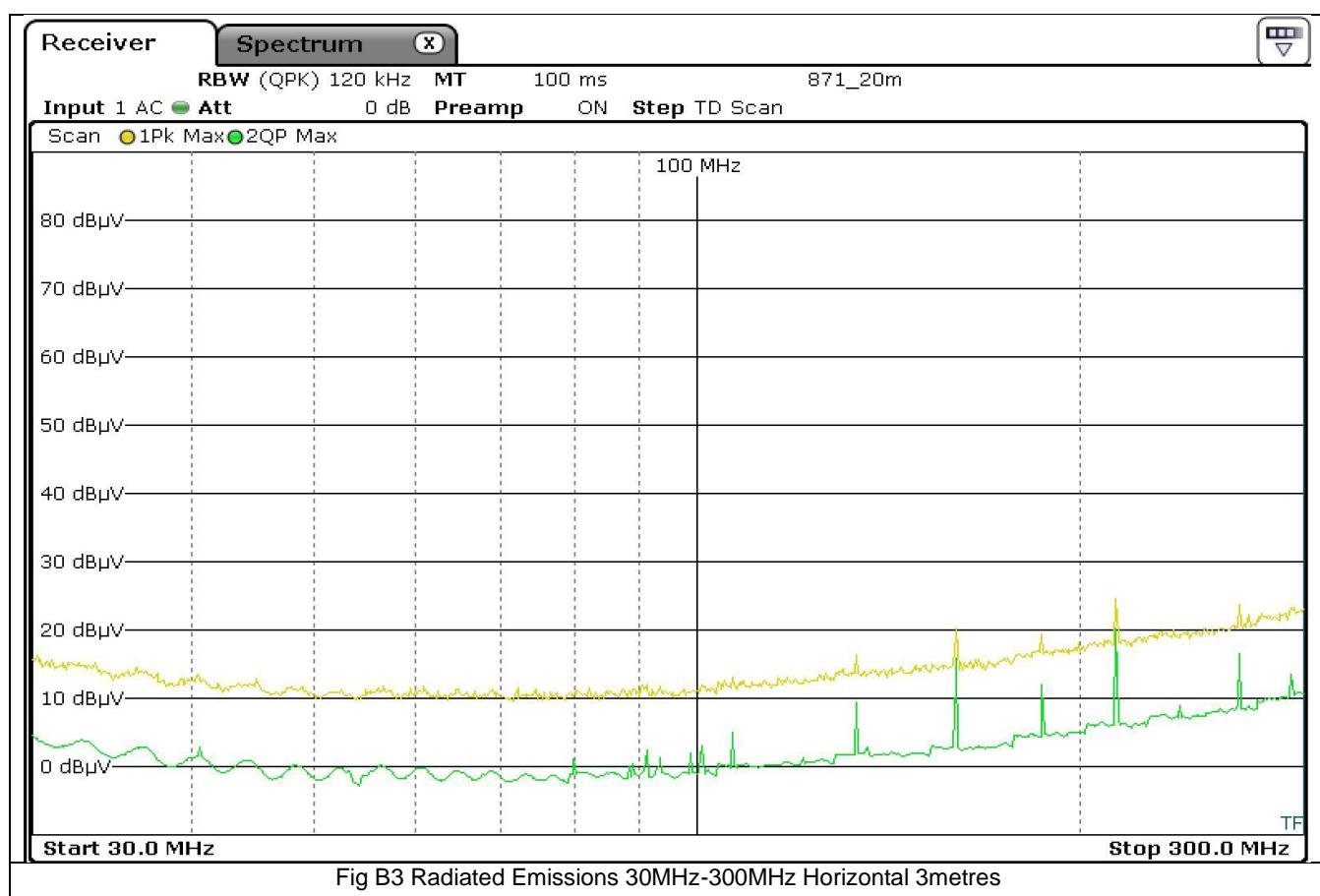
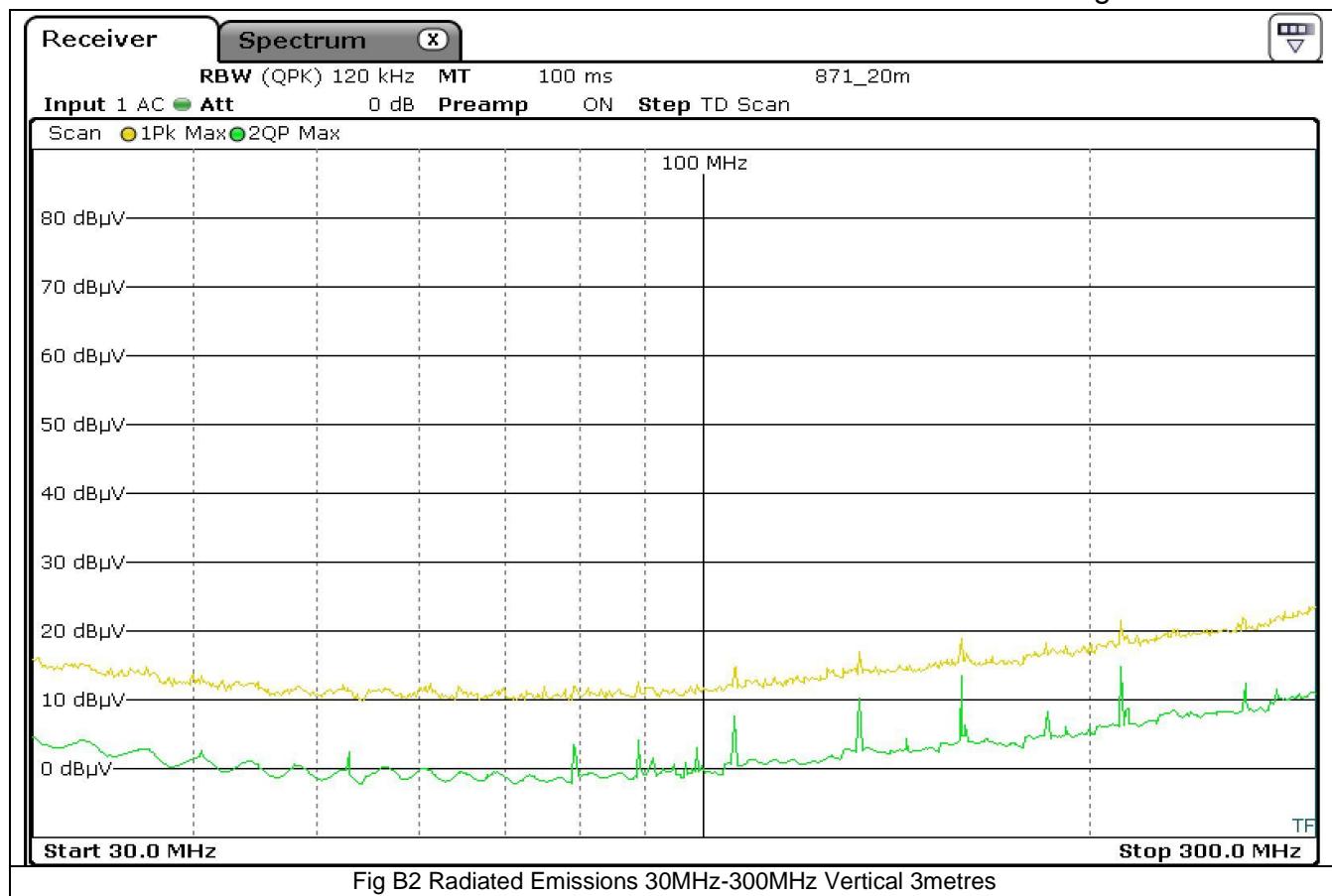


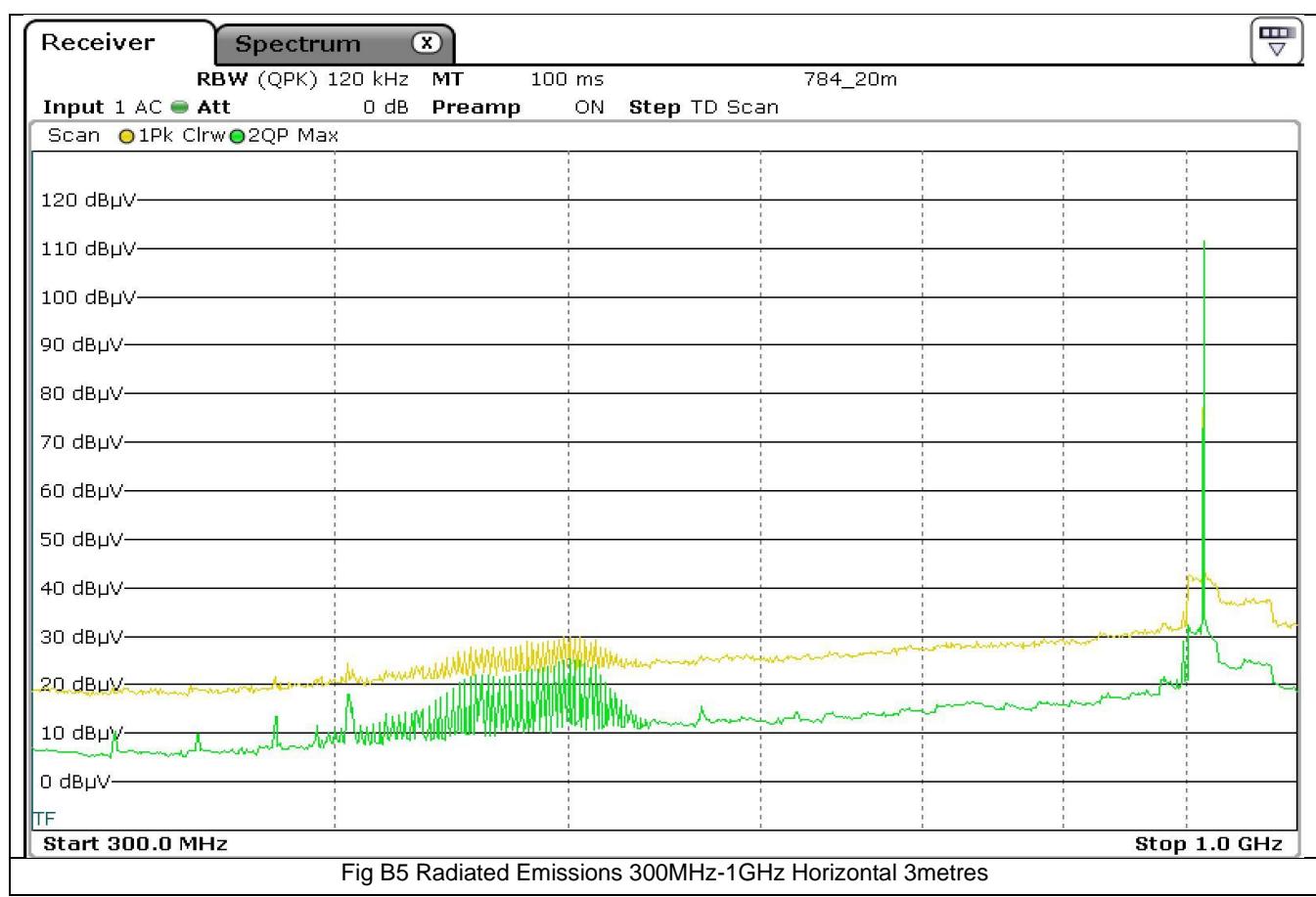
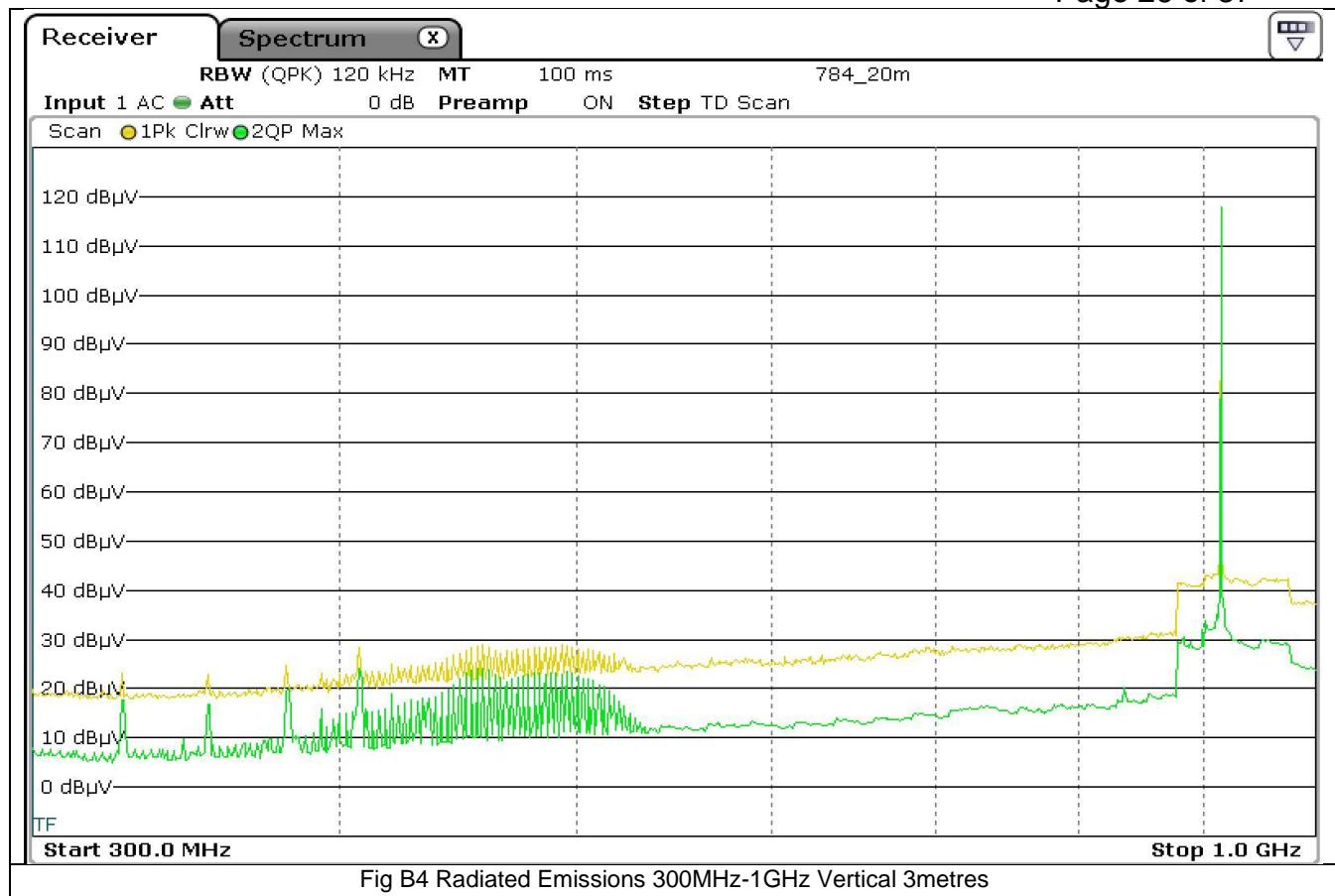
Fig A12 Radiated Emissions 18GHz-26.5GHz Vertical 3metres

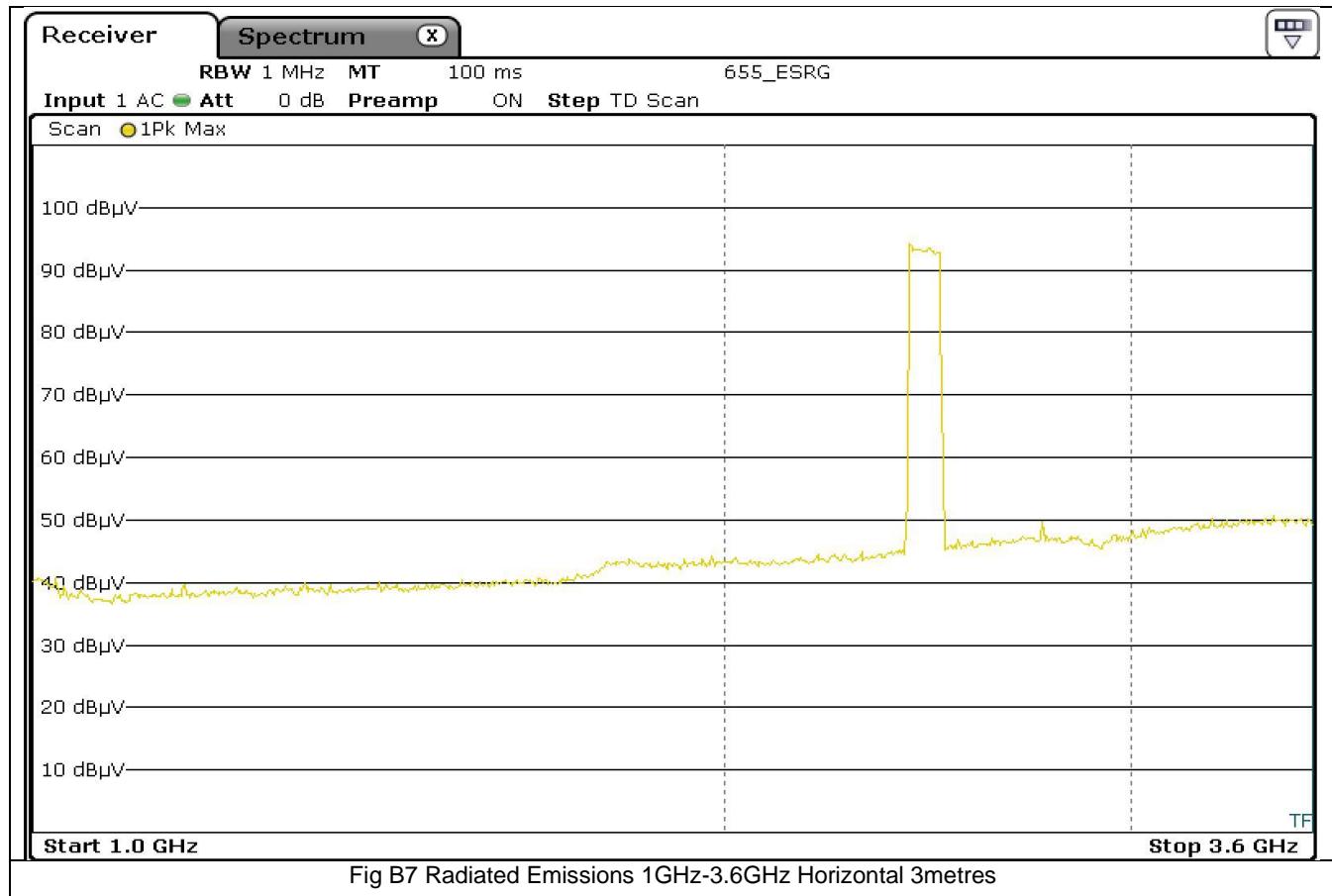
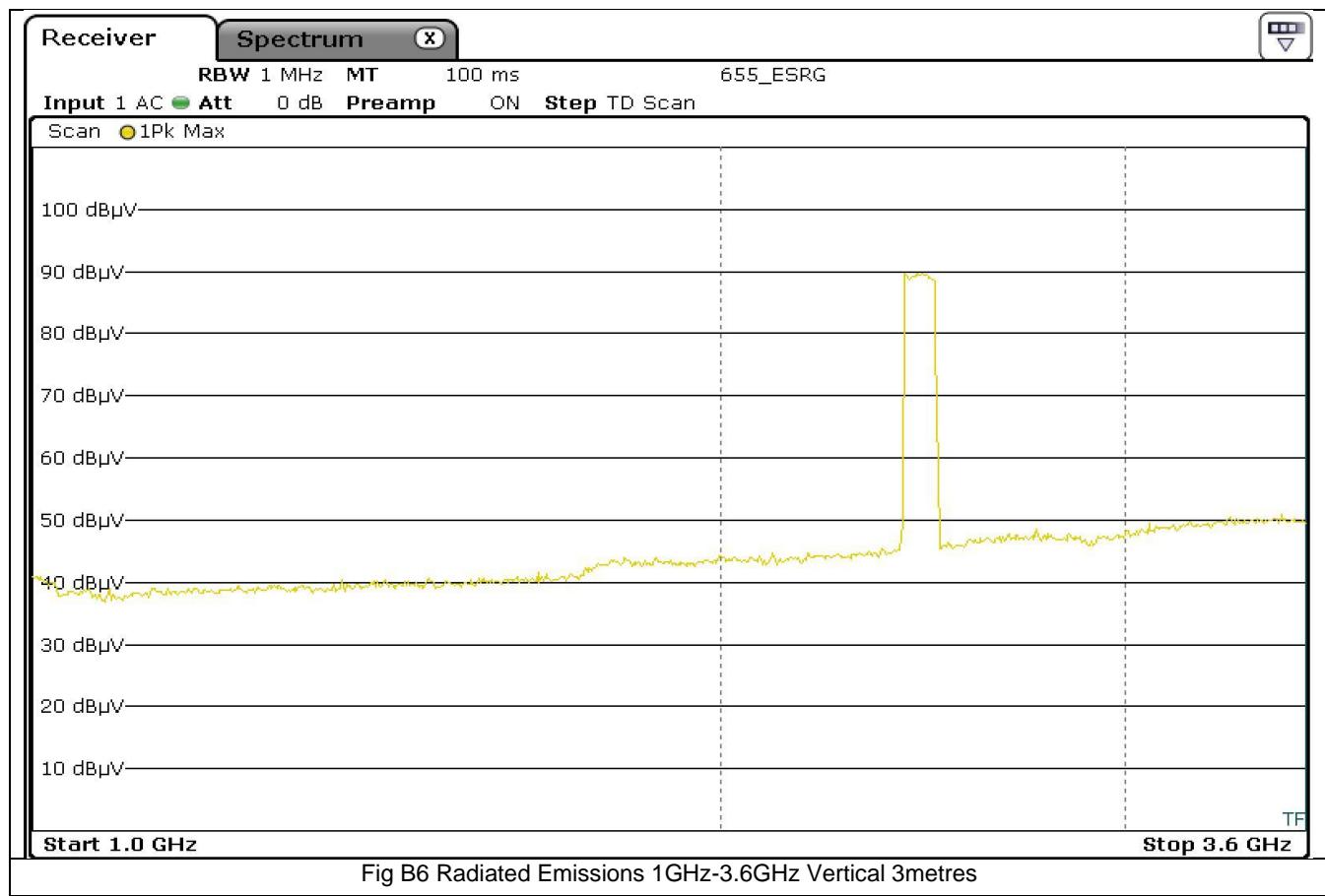


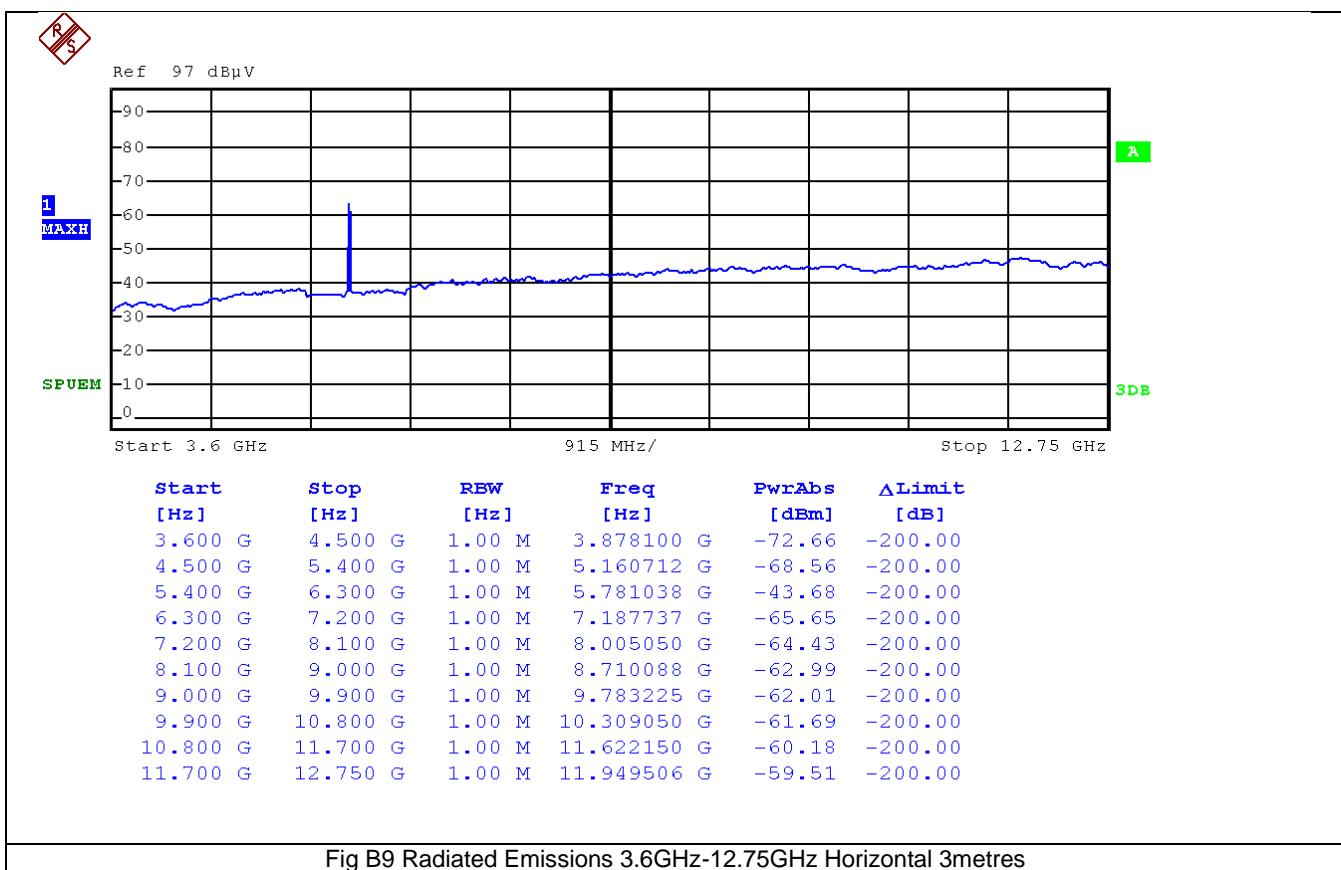
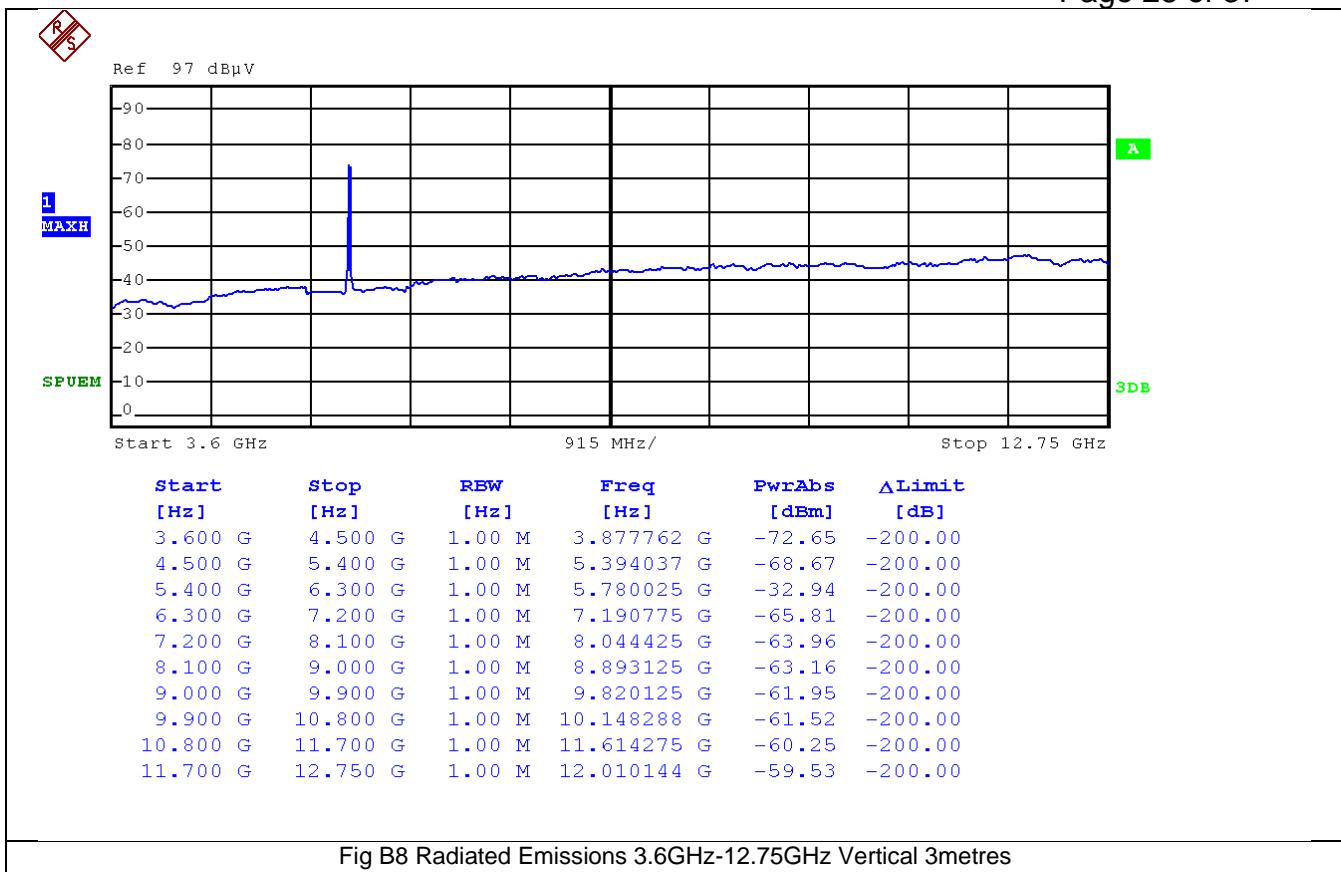
Appendix B: Radios on NFC, BLE, RFID with Wifi in 5GHz band

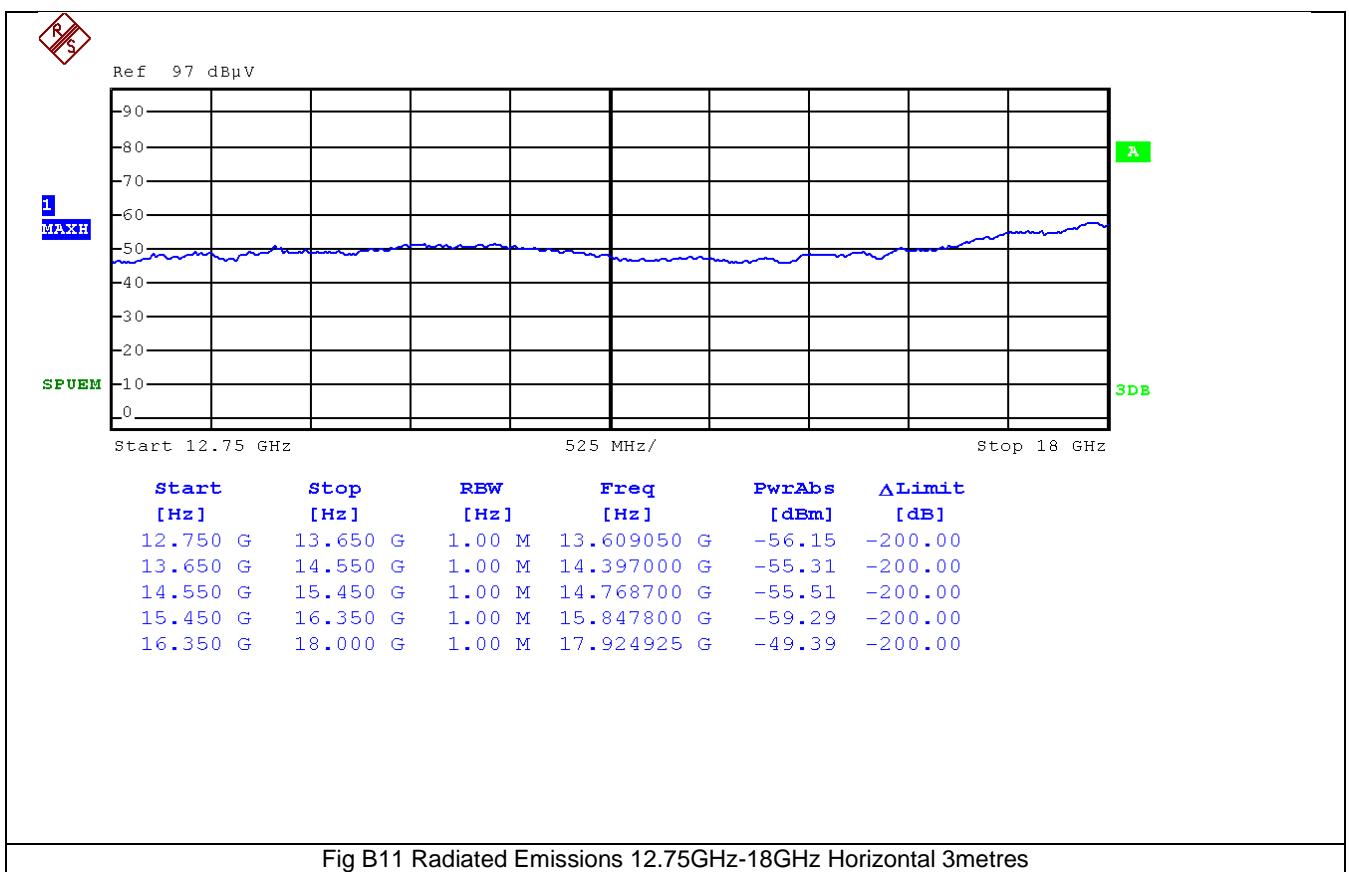
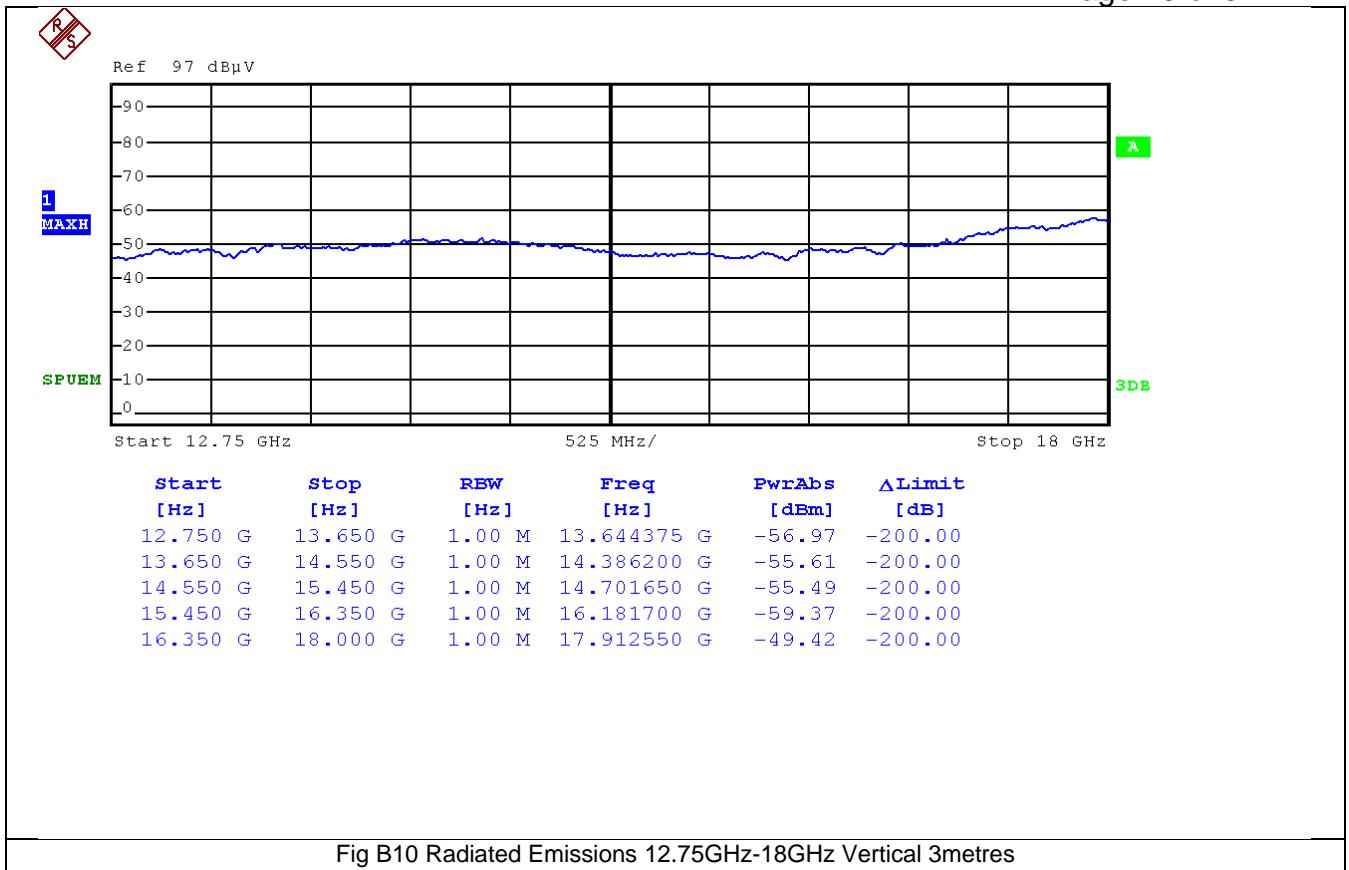












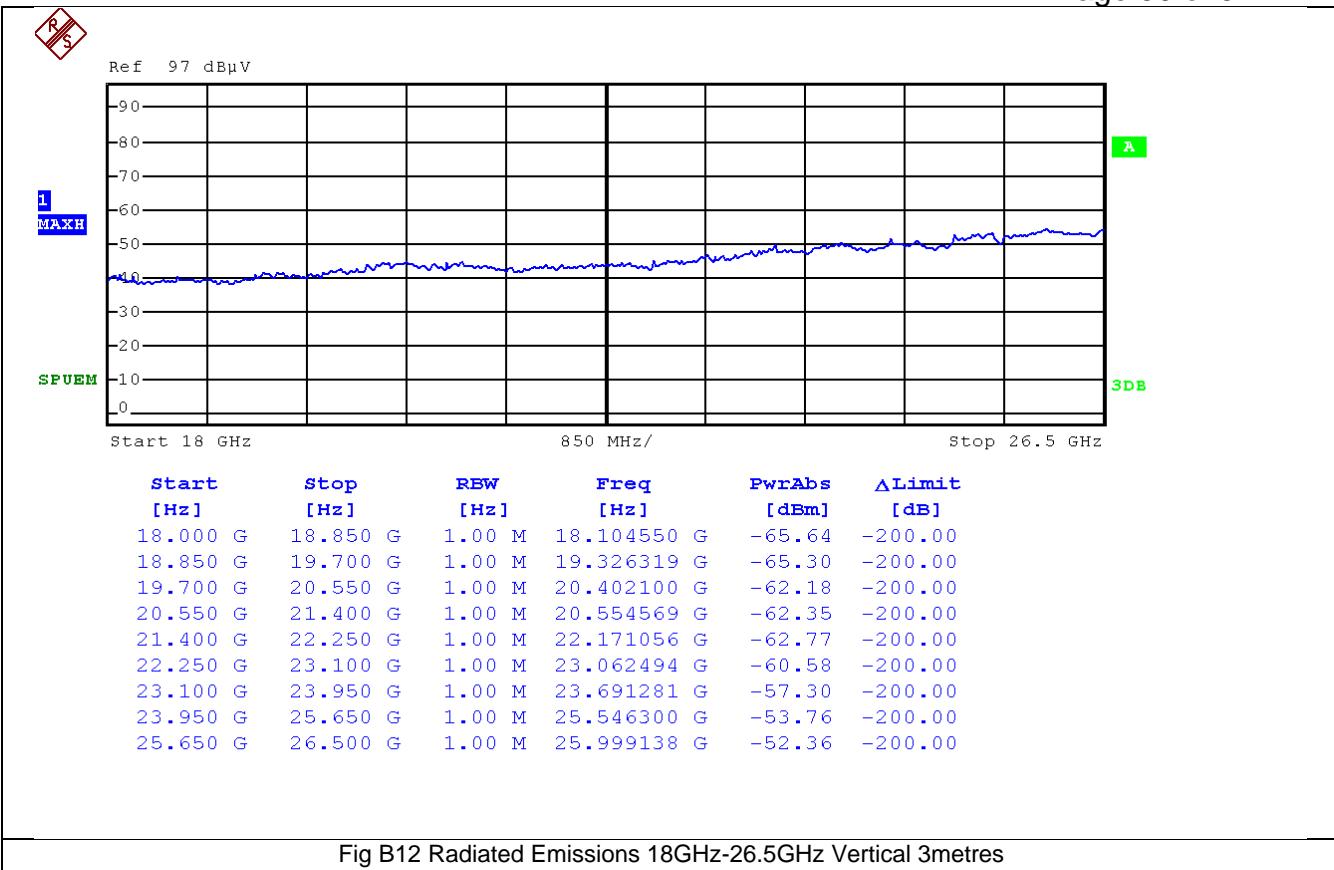
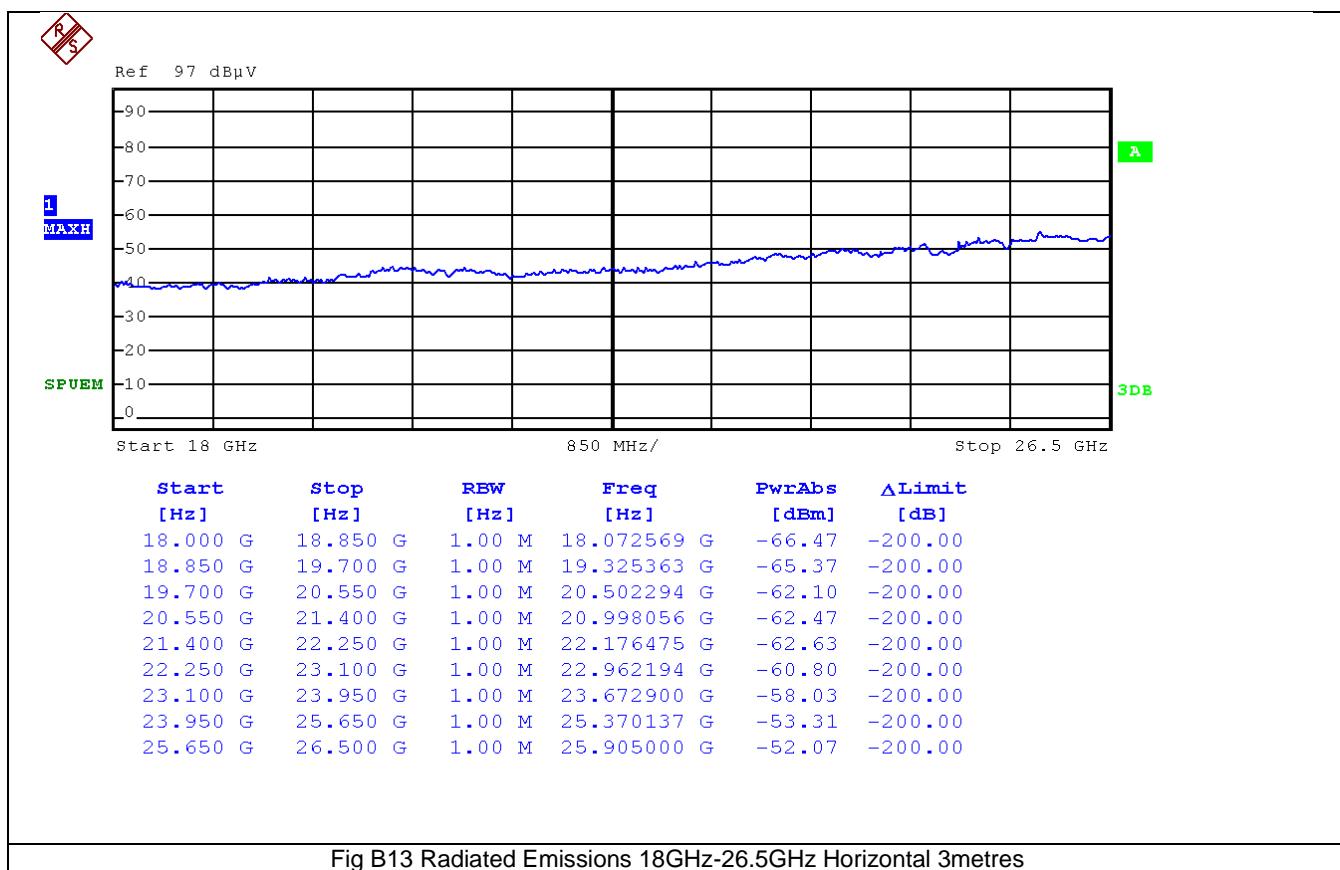


Fig B12 Radiated Emissions 18GHz-26.5GHz Vertical 3metres



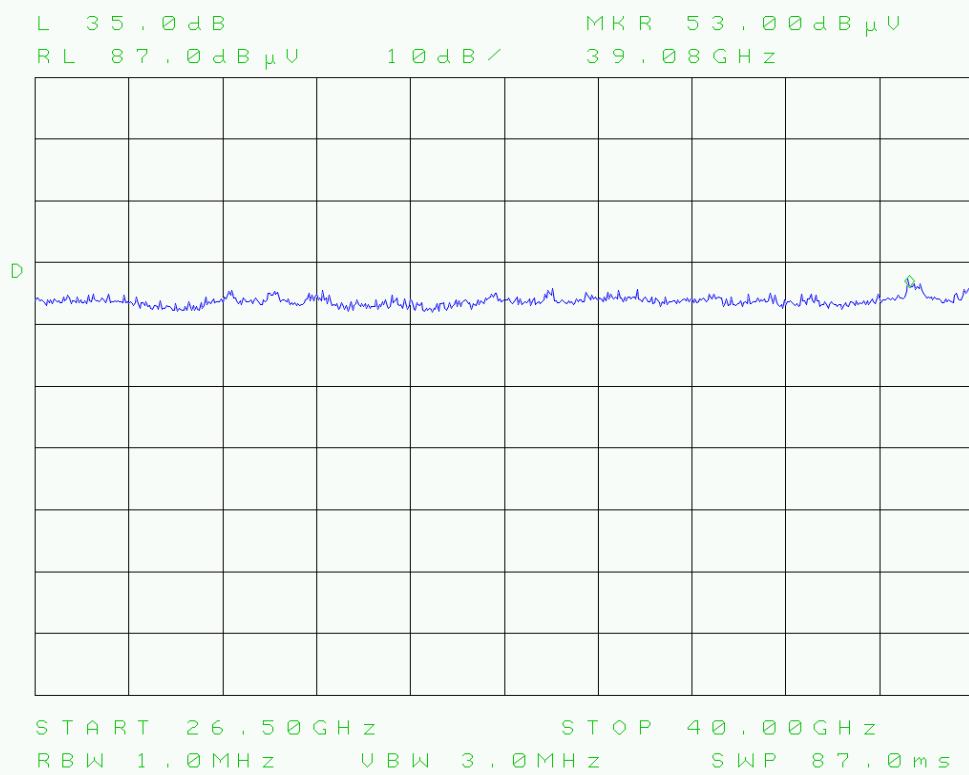


Fig B14 Radiated Emissions 26.5GHz-40GHz Vertical 1metre

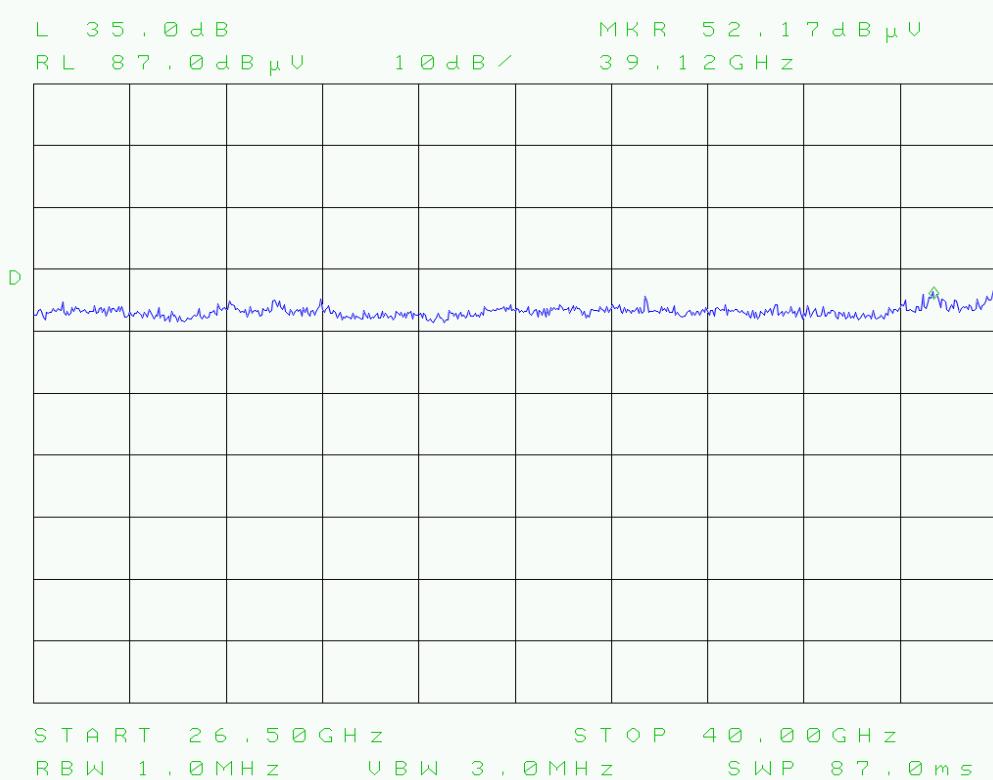


Fig B15 Radiated Emissions 26.5GHz-40GHz Horizontal 1metre

Appendix C: Conducted Emissions on the Mains

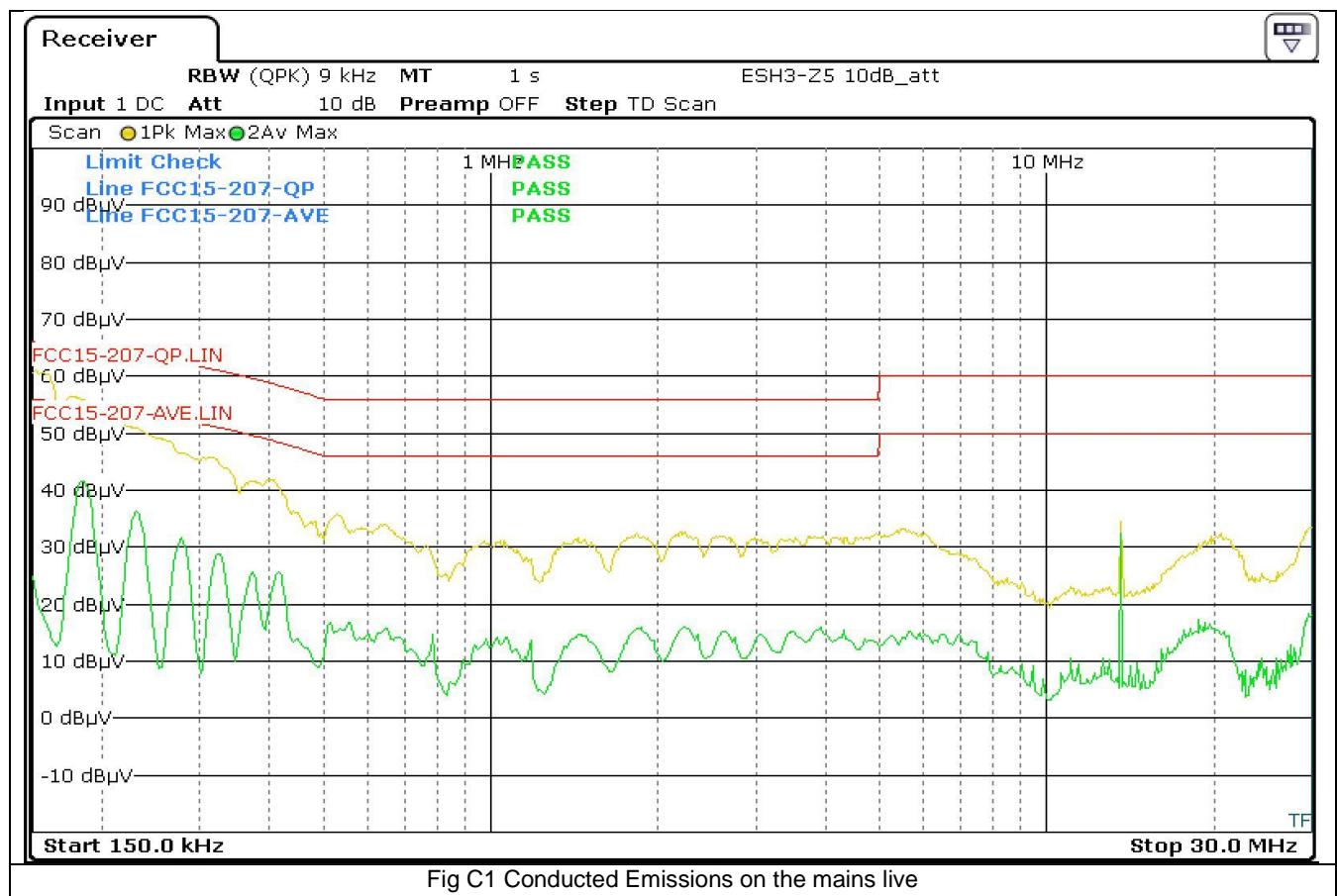


Fig C1 Conducted Emissions on the mains live

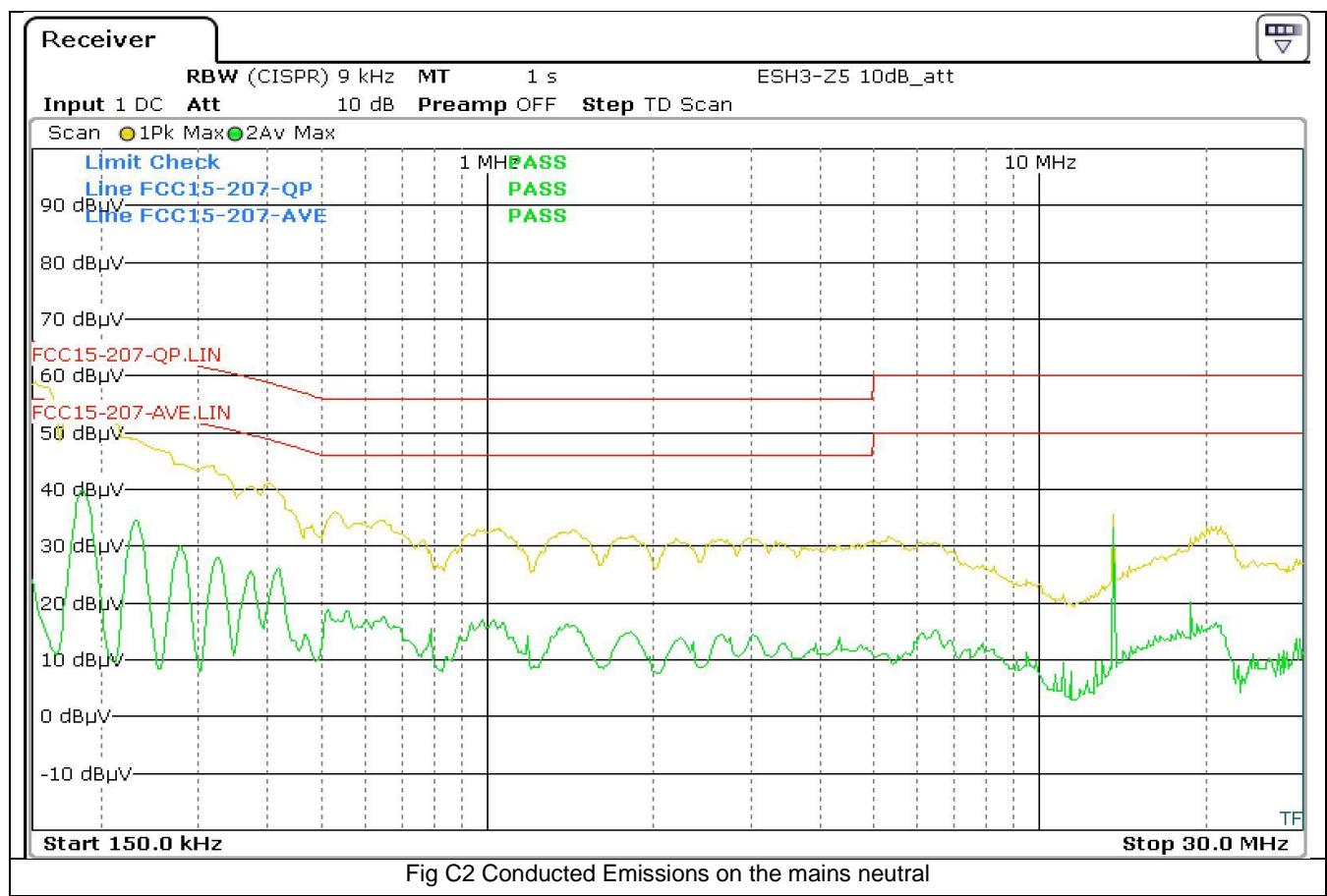
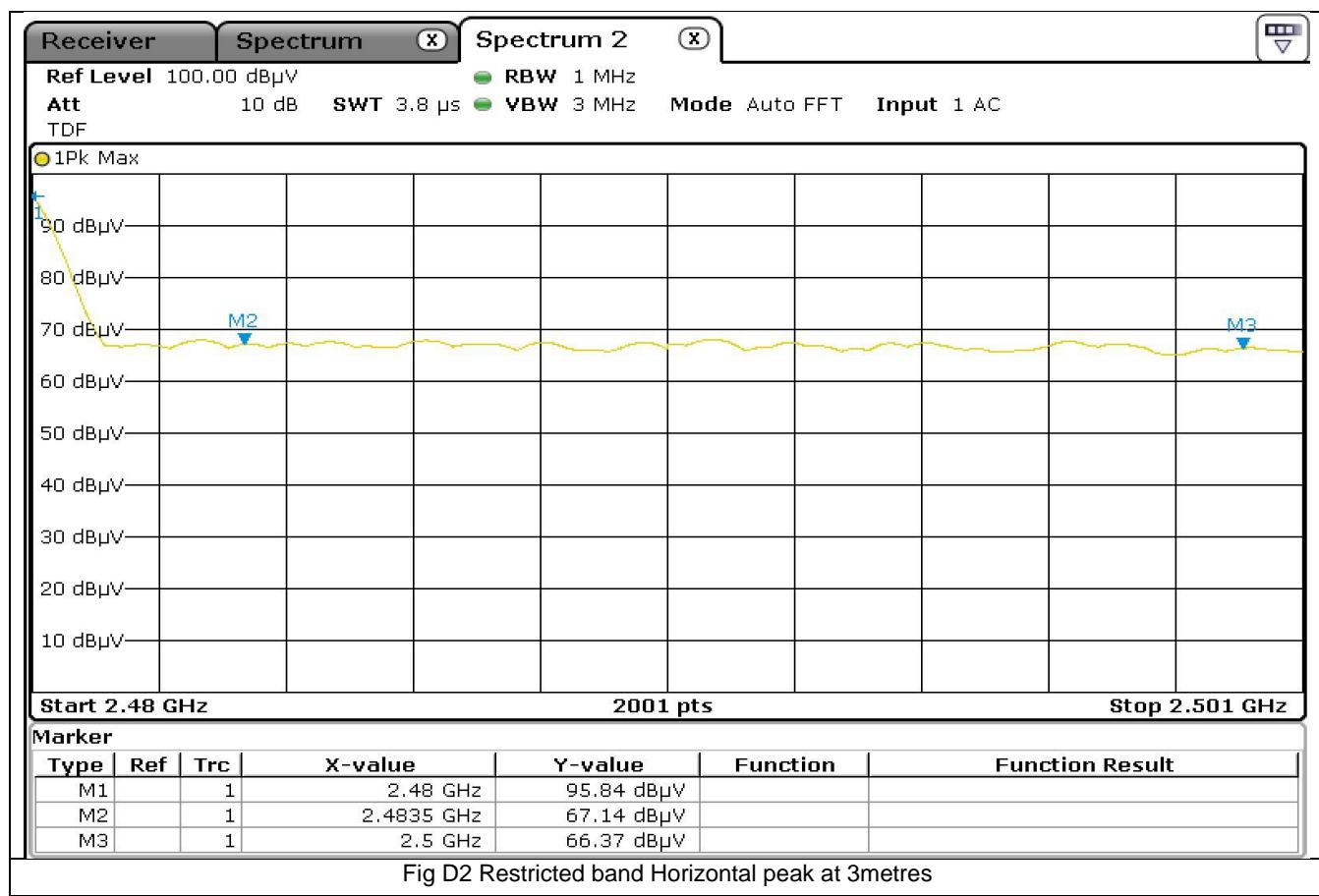
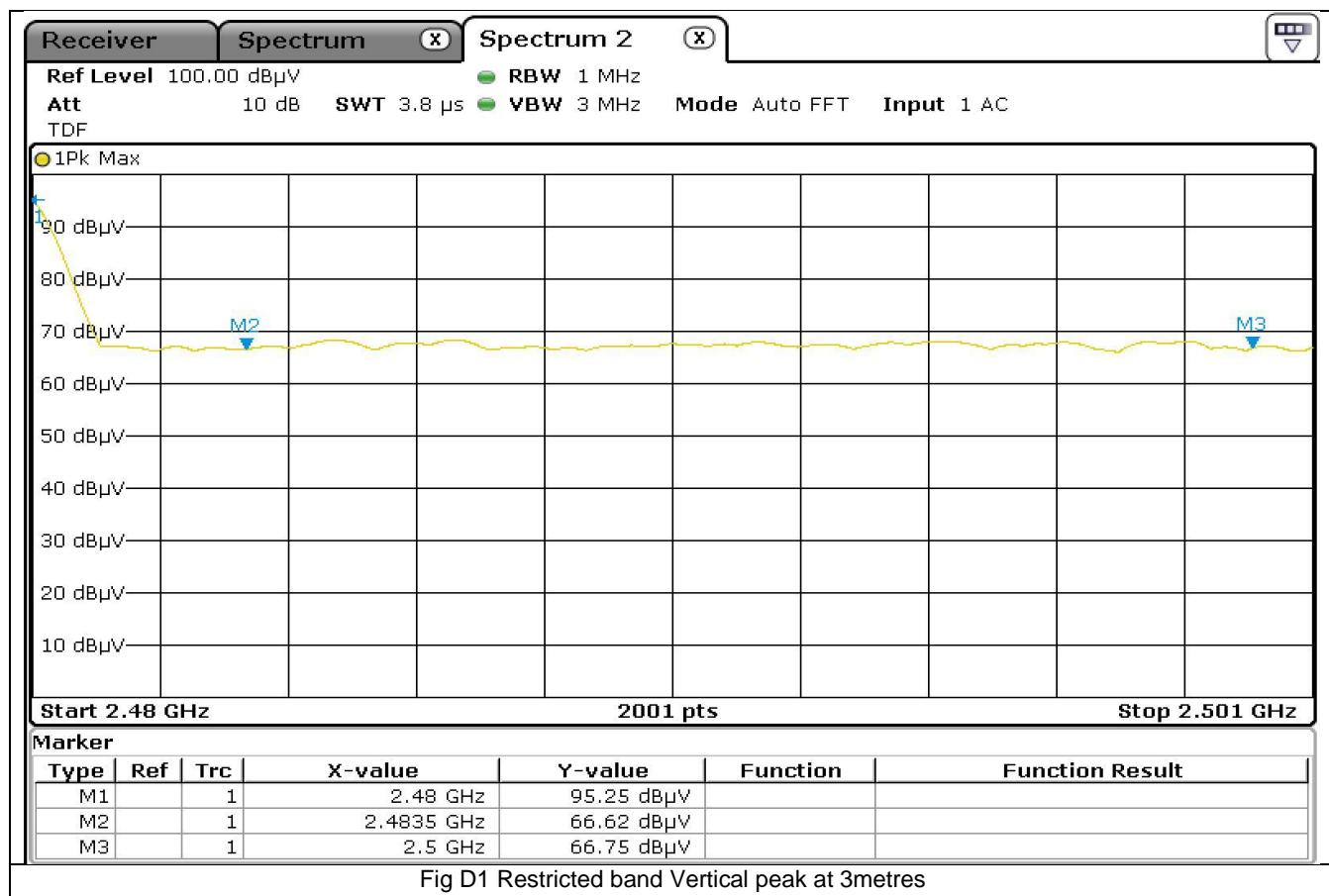
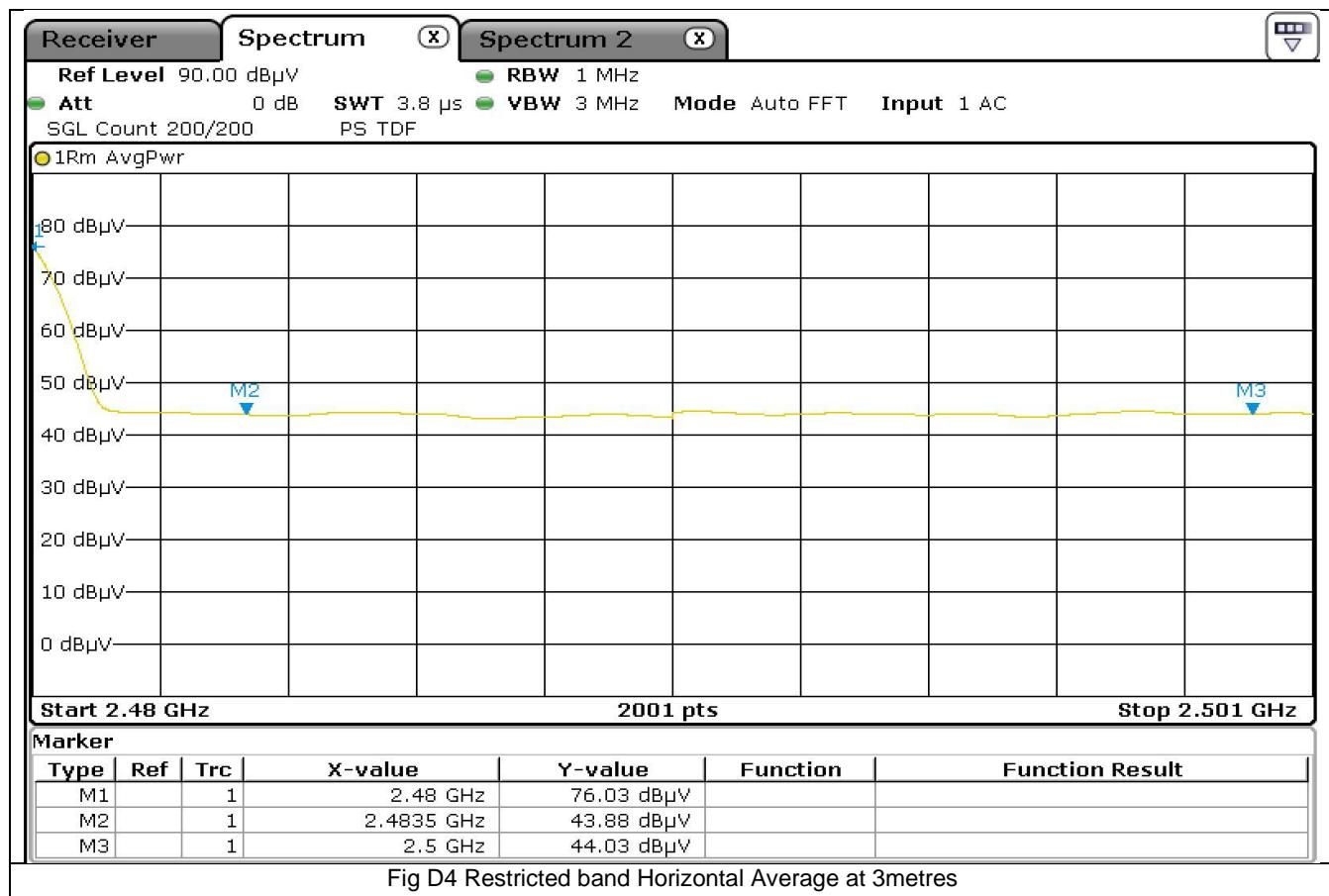
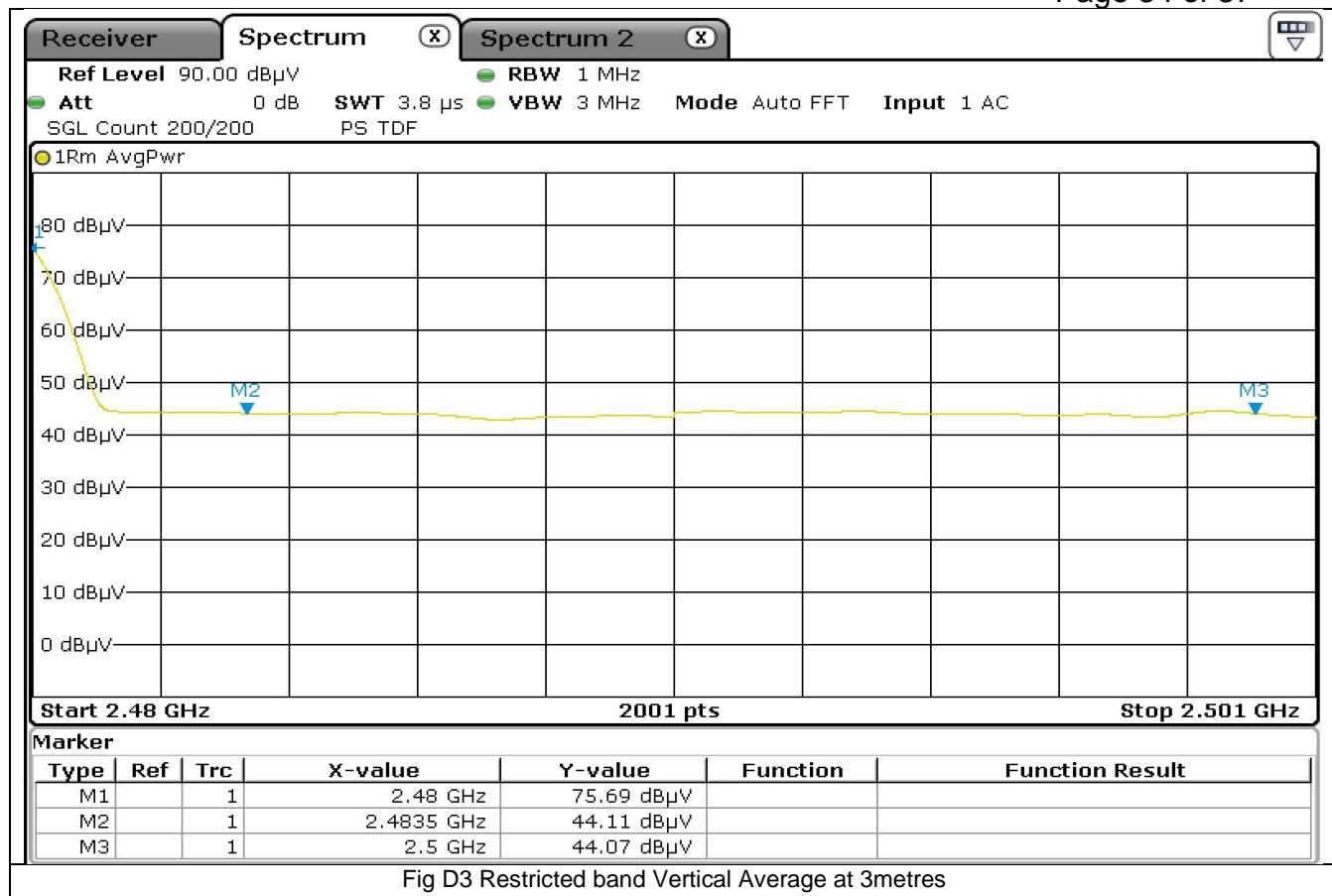
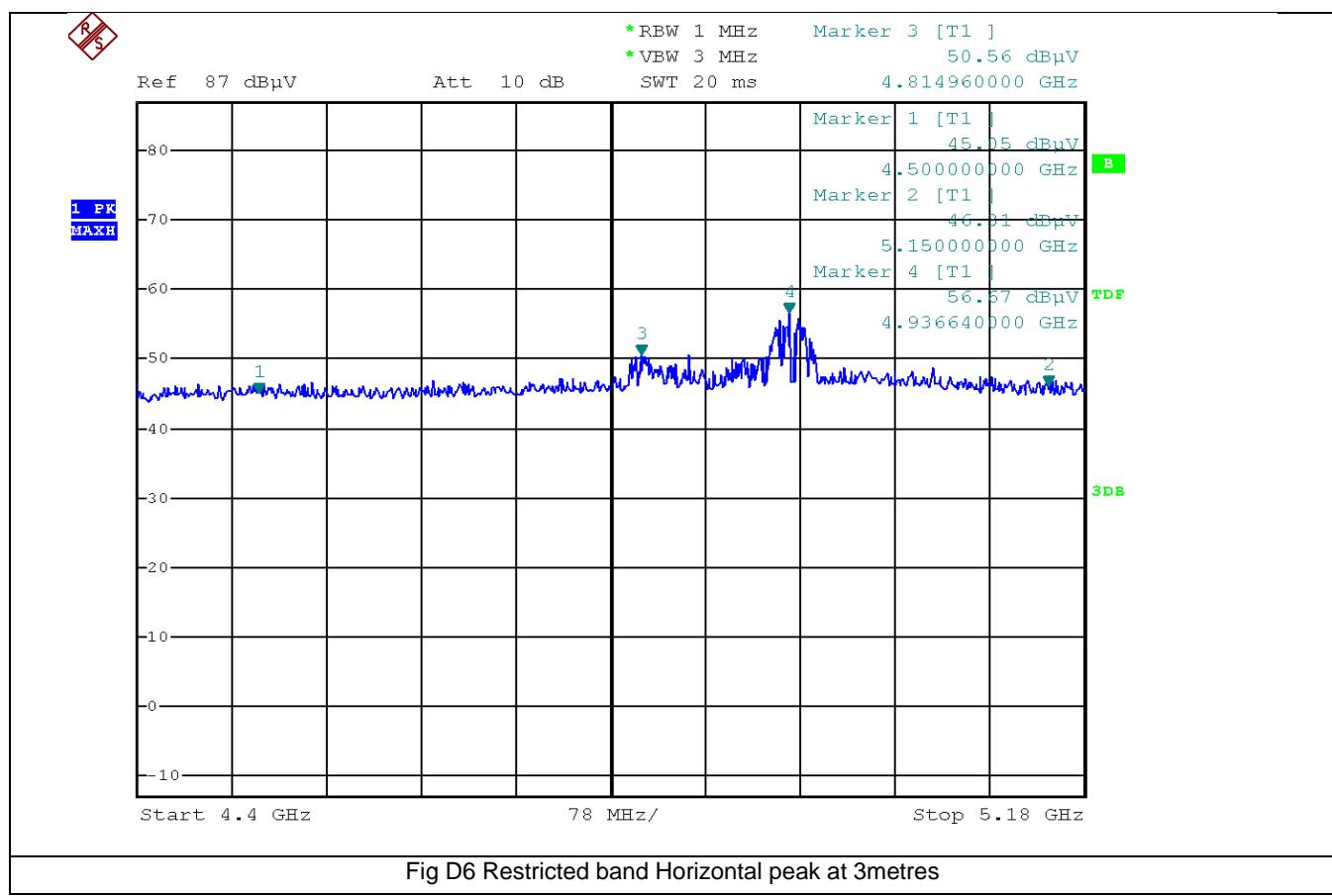
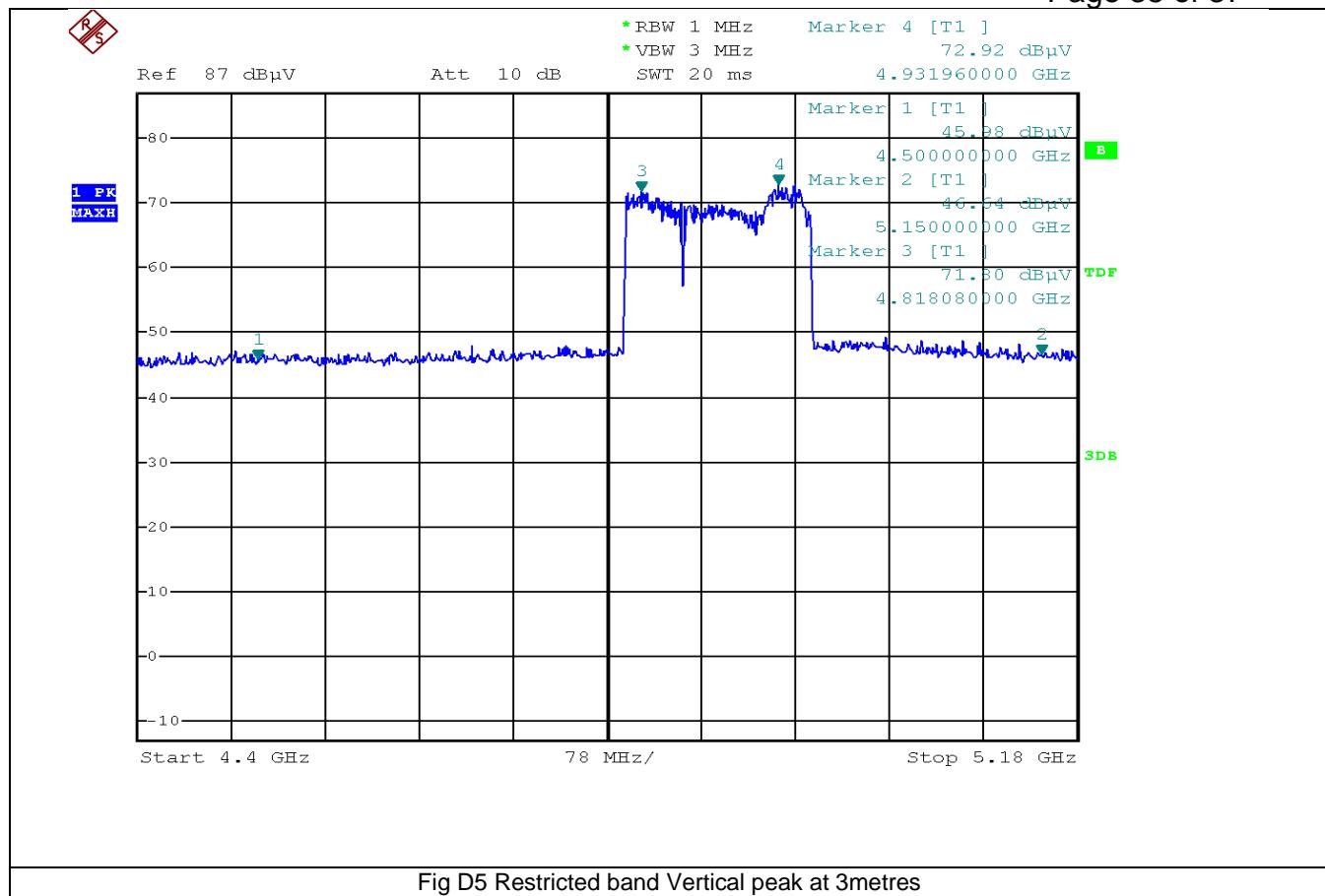


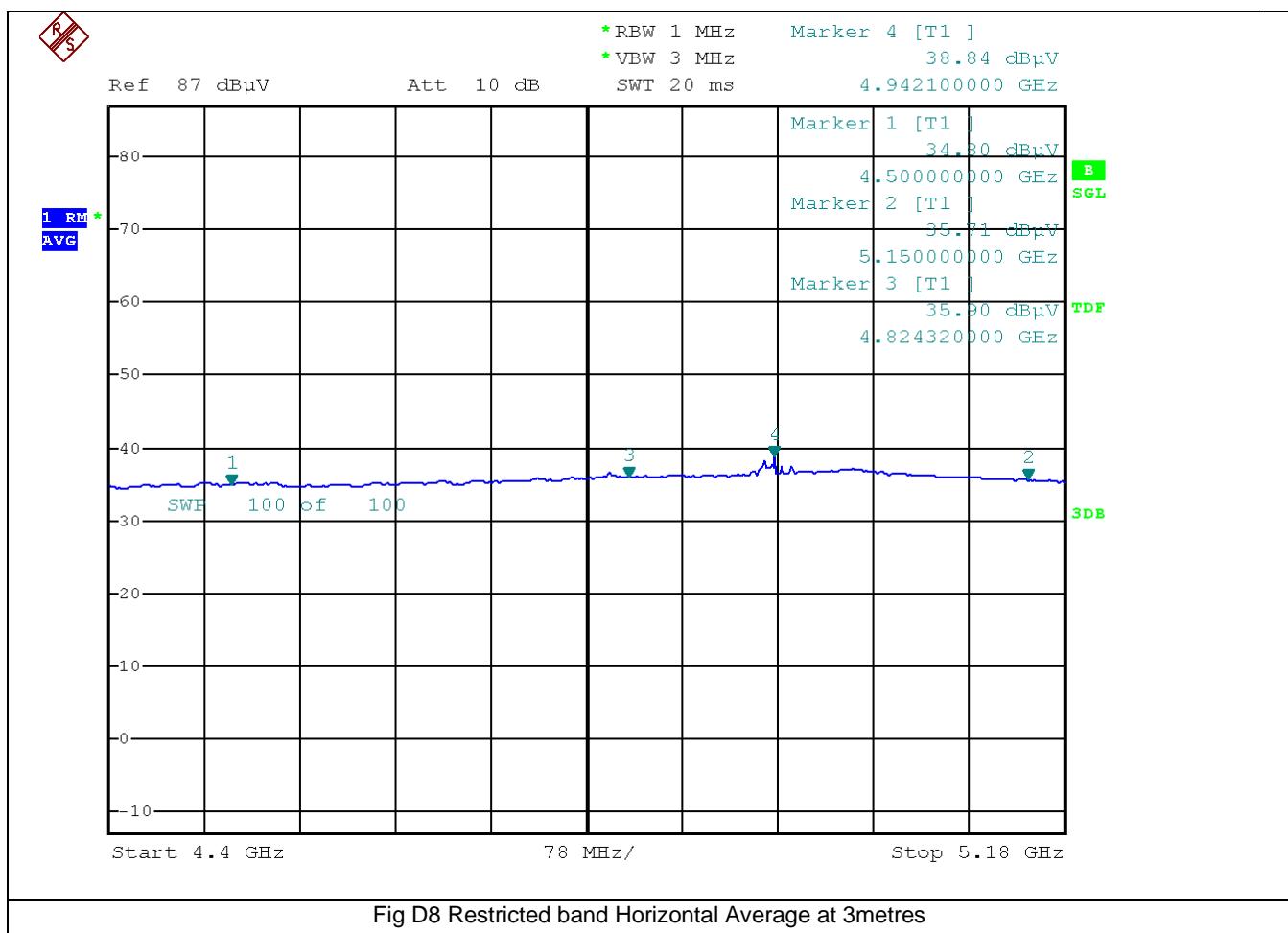
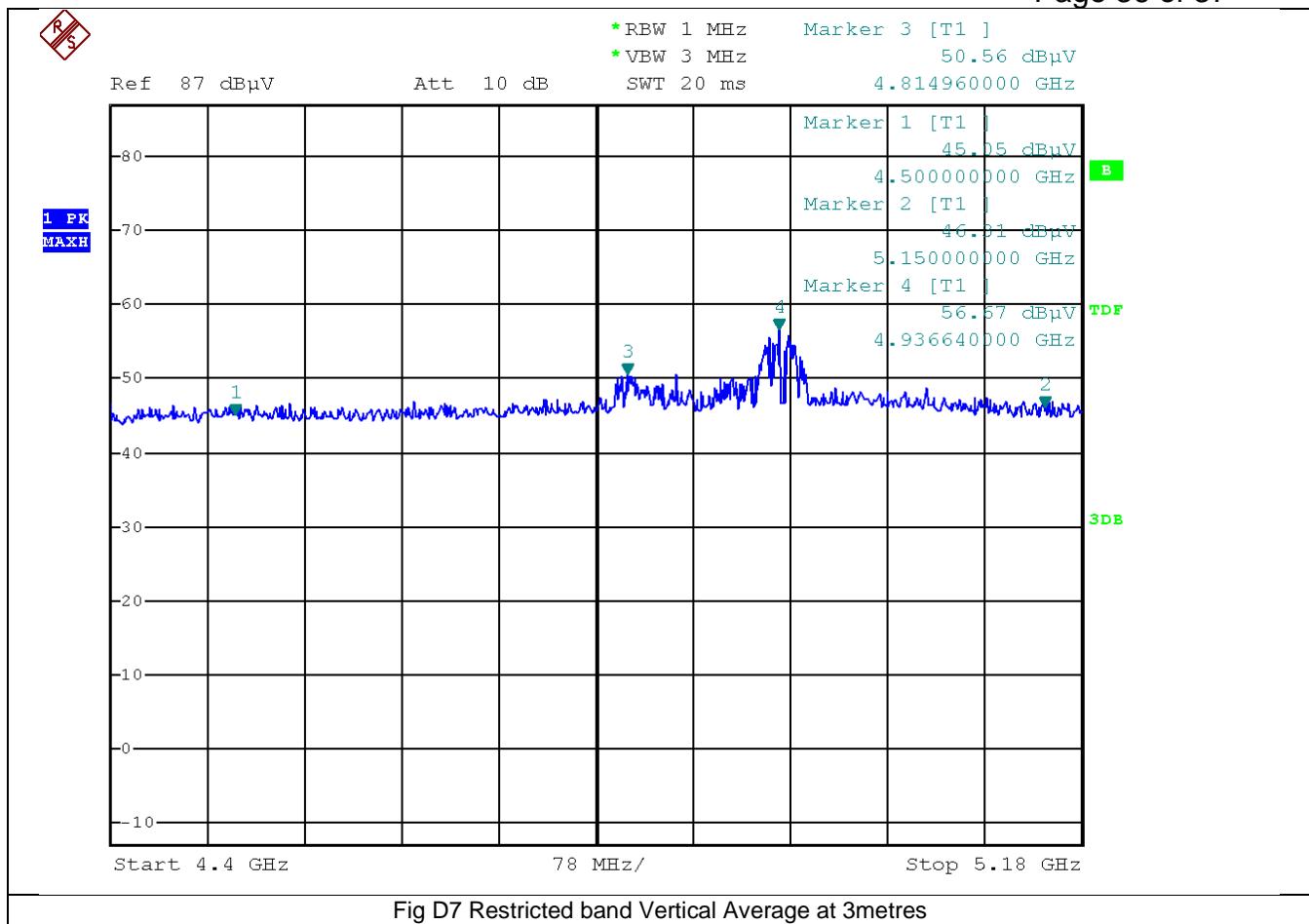
Fig C2 Conducted Emissions on the mains neutral

Appendix D: Restricted bands









Ref 24E10359-2a Part 2 of 2 for appendices D-F

End of Part 1 of report