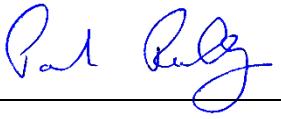


Test Report Num	25E11437-1b
Quotation	Q23-2408-2
Prepared For	Danu Sports Limited
Company Address	61-62 Fitzwilliam Lane, Dublin 2 , Ireland , D02 AK46
Contact	Oisin Lennon
Contact Phone	00353 86 6027606
Contact Email	olennon@danusports.com
Prepared By	Compliance Engineering Ireland
Test Lab Address	Clonross Lane, Derrockstown, Dunshaughlin, Co. Meath, Ireland
Tested By	Joy Dalayap
Test Report By	Michael Kirby
FCC Test Firm Registration	IE0002
Date	27 th May 2025
EUT Description	Smart sock movement analysis sensor
FCC ID	2BOSB-DANUV01
Authorised by	Paul Reilly
Authorised Signature:	

TEST SUMMARY

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

FCC 15.247 Section	RSS-247 Section	TEST PARAMETERS	Test Result
15.247 (a)2	RSS-247 5.2a	6dB bandwidth	Pass
15.247 (e)	RSS-247 5.2b	Power Spectral Density	Pass
15.247 (b)3	RSS-247 5.4d	Output power Conducted	Pass
15.247 (d)	RSS-247 5.5	Conducted Spurious Emissions	Pass
15.205 15.209	RSS Gen 8.9 RSS Gen 8.10	Radiated Spurious Emissions	Pass
	RSS Gen 6.7	99% bandwidth	Pass

RSS 247 Issue 3 Aug 2023
RSS-Gen Issue 5 Apr 2018 + Amd1 Mar 2019 + Amd2 Feb 2021

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

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1.0 EUT Description

FCC ID	2BOSB-DANUV01
Type:	Smart sock movement analysis sensor
Type of radio:	Stand-alone
Transmitter Type:	BLE
Operating Frequency Range(s):	2.402 GHz - 2.480GHz
Number of Channels:	40
Power configuration:	3.7v Battery.
Classification:	DTS
BLE Antenna Type :	Mini SMD antenna
BLE Antenna Gain Max:	1 dBi
Antenna Impedance:	50 ohms
Test Standards:	15.247 RSS-247
Test Methodology:	Measurements performed according to the procedures in ANSI C63.10-2013

The EUT was a battery powered sensor that transmits data over a custom BLE link. The device consisted of a sock with pressure sensors on the sole, connected to a pod which relays the sensor measurements to a mobile device via the BLE link

Software used to control the EUT

Test software (NUR RD tester version 2.0.5.2) from Nordic ID, running on a standard Windows laptop (Lenovo X250) was used control the EUT during test. This application is downloadable from Nordic ID for the purposes of testing the EUT radio interface.

The worst case results are reported here.

1.1 EUT Operation

Operating Conditions during Test:

It was necessary to power the EUT from a bench PSU (Kenwood PR36-3) for all conducted and radiated tests.

Conducted measurements were carried out on POD sample (Sample #001) where the antenna was replaced by cable and SMA (via snap-in connector which isolated the antenna).

Radiated measurement were performed with the POD sample #001 (standard antenna connection) installed in a sock.

The EUT was operated in test mode where the channel and modulation was set via USB connection from the EUT to a laptop.

Power setting in firmware was 4dB

Environmental conditions

	Temperature	Relative Humidity
Test	°C	%
Conducted Emissions	23.7	43
Radiated Emissions <1GHz	19	42
Radiated Emissions >1GHz	21.2	43

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 28th,29th Apr and 1st 2nd and 6th May 2025.

1.4 Description of Test modes

Channel List

Channel	Channel	Freq MHz
Low	1	2402
Mid	19	2440
High	39	2480

All tests were performed with the EUT on the low mid and high channels.

1.5 Description of Test methods

Tests were performed manually, and no special test software was used in the test equipment.

Preliminary tests were carried out and this report contains the worst-case results.

2 Emissions Measurements

2.1 Conducted Emissions Measurements

Radio Conducted measurements were carried out on the EUT as per section 1.1 above.

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

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 test 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 in the 1GHz-18GHz range 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, and by raising and lowering the test antenna from 1 to 4 metres.

Emissions above 18GHz were measured using a horn antenna located at 1 metre distance from the EUT in a fully anechoic chamber. The radiated emissions peaks where detected were maximised by configuring the EUT and by rotating the EUT and raising the test and antenna from 1 to 4 metres.

In this case the resolution bandwidth was 1MHz and video bandwidth was 3 MHz. 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)

A pre-scan was performed to determine the worst case EUT orientation for the radiated measurements.

All radiated tests were performed with the EUT in orientation O2 for Horizontal polarization measurements and with the EUT in orientation O1 for Vertical polarisation measurements.

Ref Appendix D for orientations.

3.0 Conducted emissions on the mains

Two pods (Sample #1 and Sample #2) were inserted into the dual charging cradle.

The cradle was powered from the mains through a LISN and an off the shelf mains to 5V DC adapter (Qualcomm model Q183) .

Limit as per 15.207

Detector	Frequency	Reading	Limit	Margin	Phase	Result
QP/ Ave	MHz	dB μ V	dB μ V	dB	L/N	P/F
Quasi-Peak	0.1523	34.78	65.94	-31.16	Live	Pass
Quasi-Peak	0.7035	30.66	56.00	-25.34	Live	Pass
Average	0.7103	22.85	46.00	-23.15	Live	Pass
Quasi-Peak	2.2290	23.51	56.00	-32.49	Live	Pass
Average	2.924	16.26	46.00	-29.74	Live	Pass
Average	9.746	16.93	50.00	-33.07	Live	Pass
Quasi-Peak	10.100	25.58	60.00	-34.42	Live	Pass

Margin (dB) = Reading (dB μ V) - Limit (dB μ V)

Calculation Example -31.16 = 34.78 - 65.94

Detector	Frequency	Reading	Limit	Margin	Phase	Result
QP/ Ave	MHz	dB μ V	dB μ V	dB	L/N	P/F
Quasi-Peak	0.1523	34.33	65.94	-31.61	Neutral	Pass
Quasi-Peak	0.7035	29.88	56.00	-26.12	Neutral	Pass
Average	0.7103	16.57	46.00	-29.43	Neutral	Pass
Quasi-Peak	2.2290	22.21	56.00	-33.79	Neutral	Pass
Average	2.924	11.78	46.00	-34.22	Neutral	Pass
Average	9.746	12.05	50.00	-37.95	Neutral	Pass
Quasi-Peak	10.100	25.26	60.00	-34.74	Neutral	Pass

Margin (dB) = Reading (dB μ V) - Limit (dB μ V)

Calculation Example -31.61 = 34.33 - 65.94

Result :- Pass.

4. Conducted Measurements

4.1 Bandwidth

4.1.1 6dB bandwidth

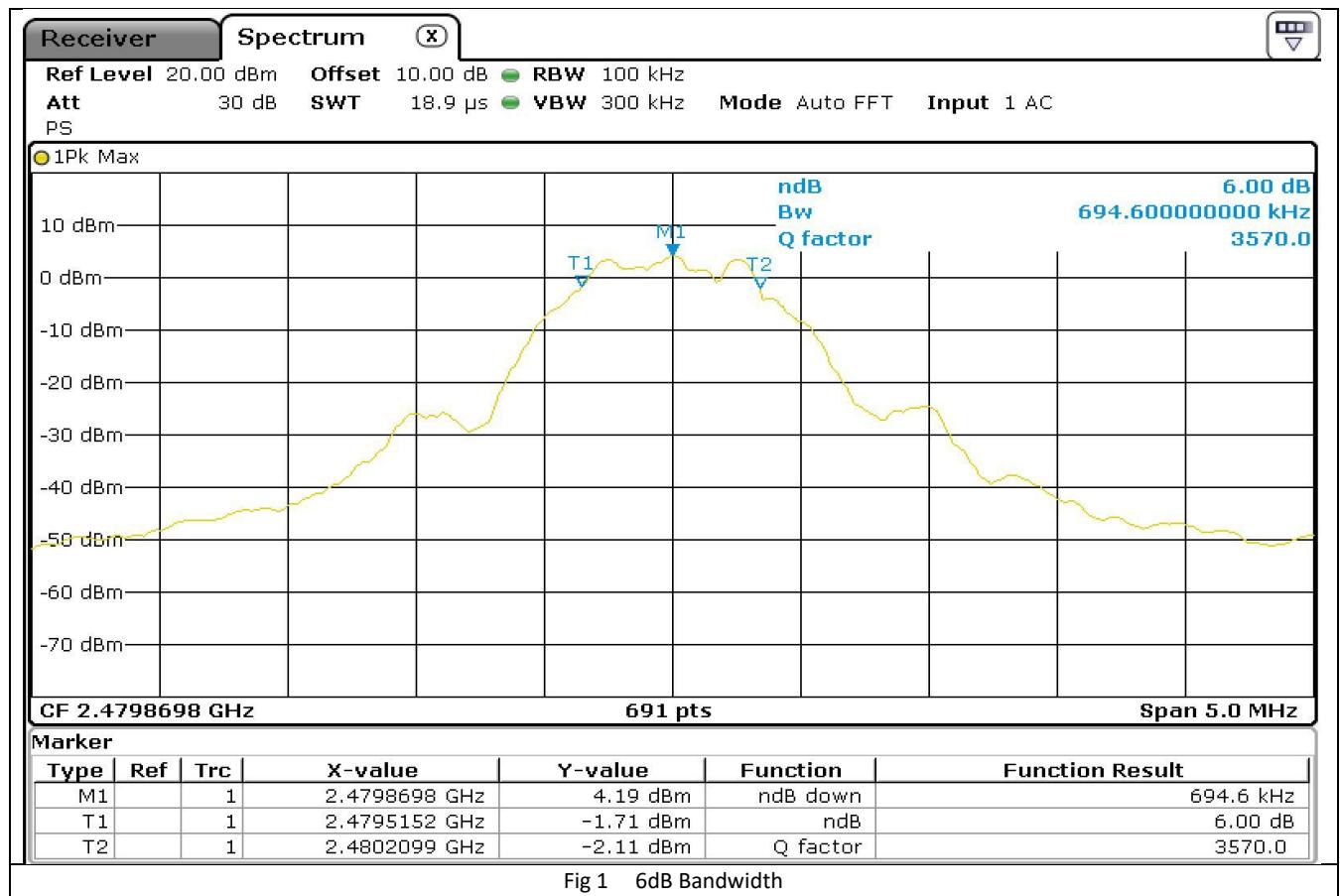
Test Method

As per Ansi 63.10 Section 11.8.2

Ansi63.10 Section 11.8.2 Option 2

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described in 11.8.1 (i.e., $\text{RBW} = 100 \text{ kHz}$, $\text{VBW} \geq 3 \times \text{RBW}$, and peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be $\geq 6 \text{ dB}$.

Limit for 6dB Bandwidth = 500KHz min



Frequency	6dB Bandwidth	Limit Min	Margin
MHz	kHz	kHz	kHz
2402	694.6	500	194.6
2440	694.6	500	194.6
2480	694.6	500	194.6

Result :- Pass

4.1.2 99% bandwidth

Test Method

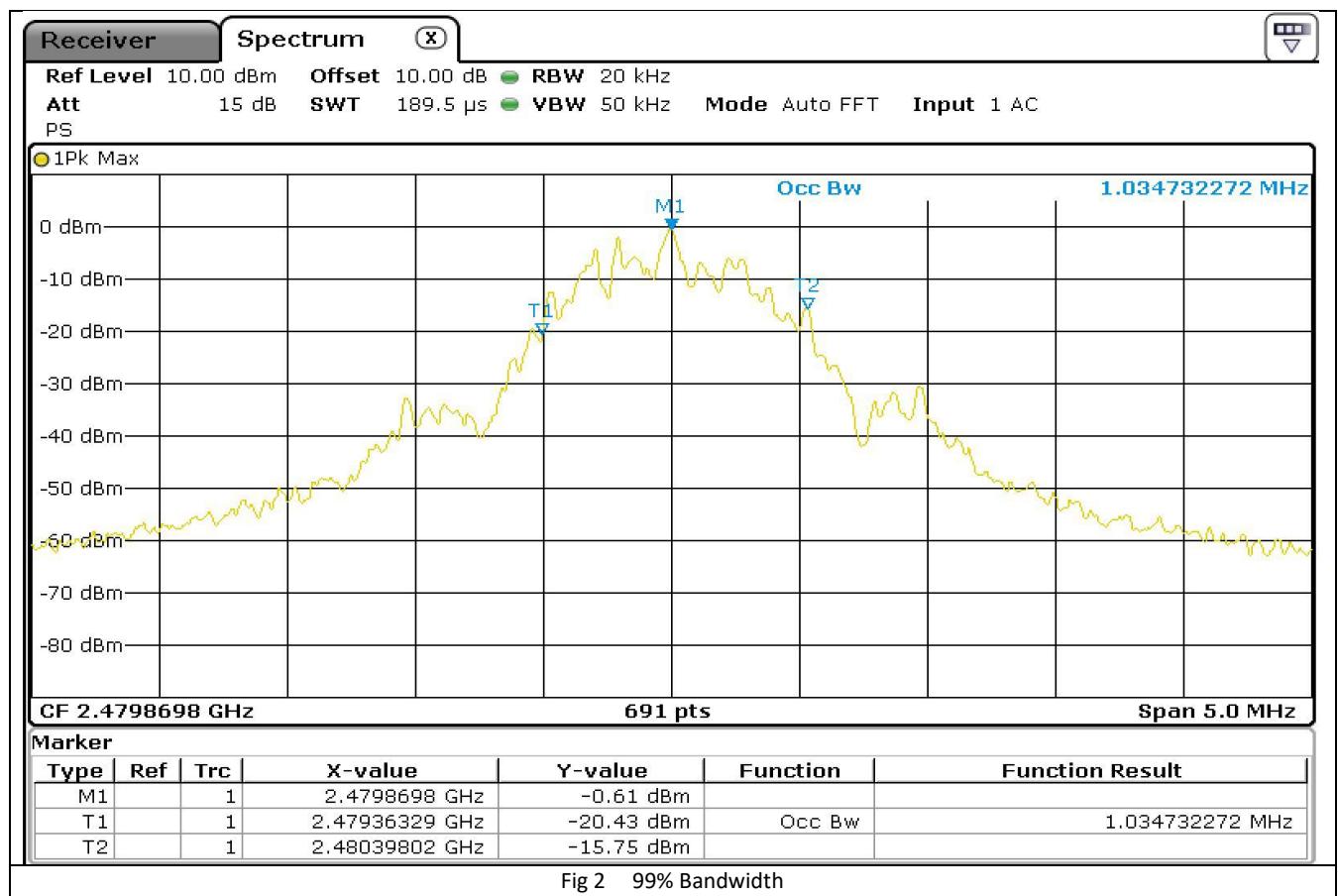
As per Ansi 63.10 Section 6.9.3

Ansi63.10 Section 6.9.3 Occupied bandwidth—power bandwidth (99%) measurement procedure

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

The following procedure shall be used for measuring 99% power bandwidth:

- a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.
- d) Step a) through step c) might require iteration to adjust within the specified range.
- e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
- f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
- g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
- h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).



Frequency	99% Bandwidth
MHz	MHz
2402	1.0347
2440	1.0347
2480	1.0347

Result :- Pass

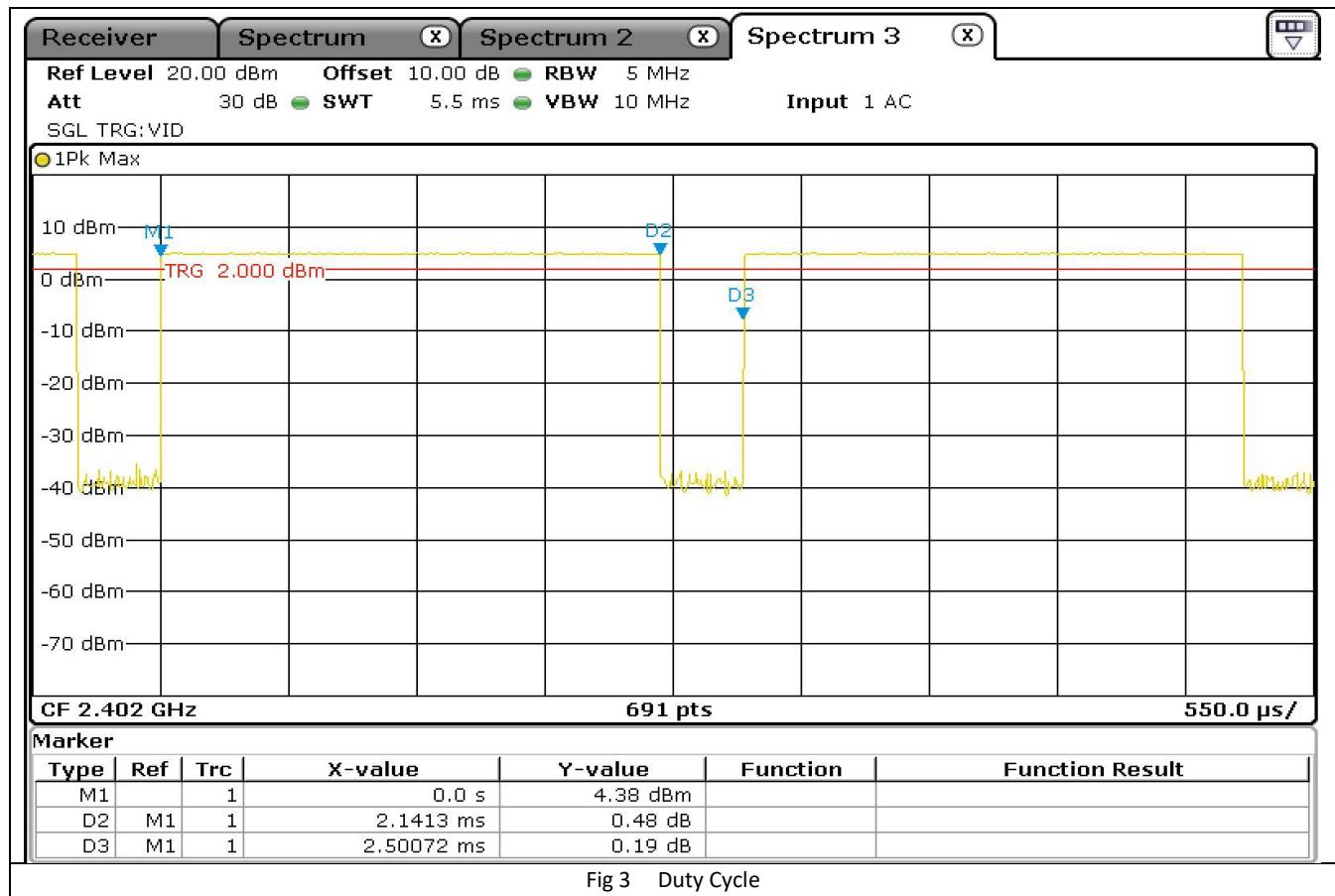
4.2 Duty Cycle

Test Method

As per Ansi 63.10 Section 11.6 zero span measurement method

Ansi63.10 Section 11.6 Duty cycle (D), transmission duration (T), and maximum power control level

Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be used to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data are being acquired (i.e., no transmitter OFF-time is to be considered).



Duty Cycle

Note the duty cycle results above shows how the sample operated during testing.
Duty cycle (d) =Ton/Tperiod = $2.1413/2.50072 = 85.65\%$

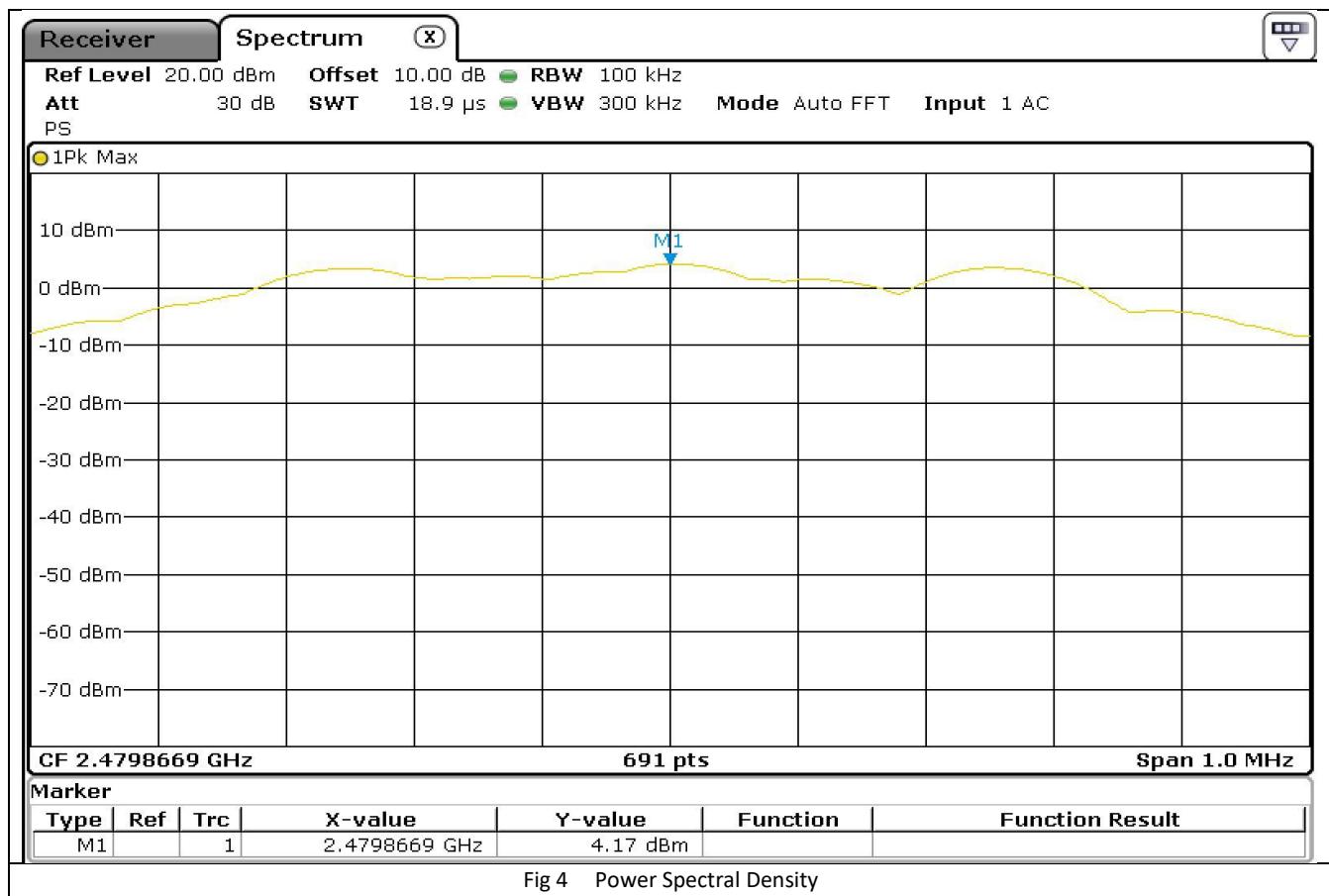
4.3 Power Spectral Density

Test Method
As per Ansi 63.10 Section 11.10.2

Ansi63.10 Section **Section 11.10.2 Method PKPSD (peak PSD)**

The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted (average) output power was used to determine compliance:

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set the VBW $\geq [3 \times \text{RBW}]$.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.



Frequency	Conducted Peak	Limit	Margin
MHz	dBm	dBm	dB
2402	4.79	8	3.21
2440	4.55	8	3.45
2480	4.17	8	3.83

Result :- Pass

4.4 Output power Conducted

4.4.1 Test Method

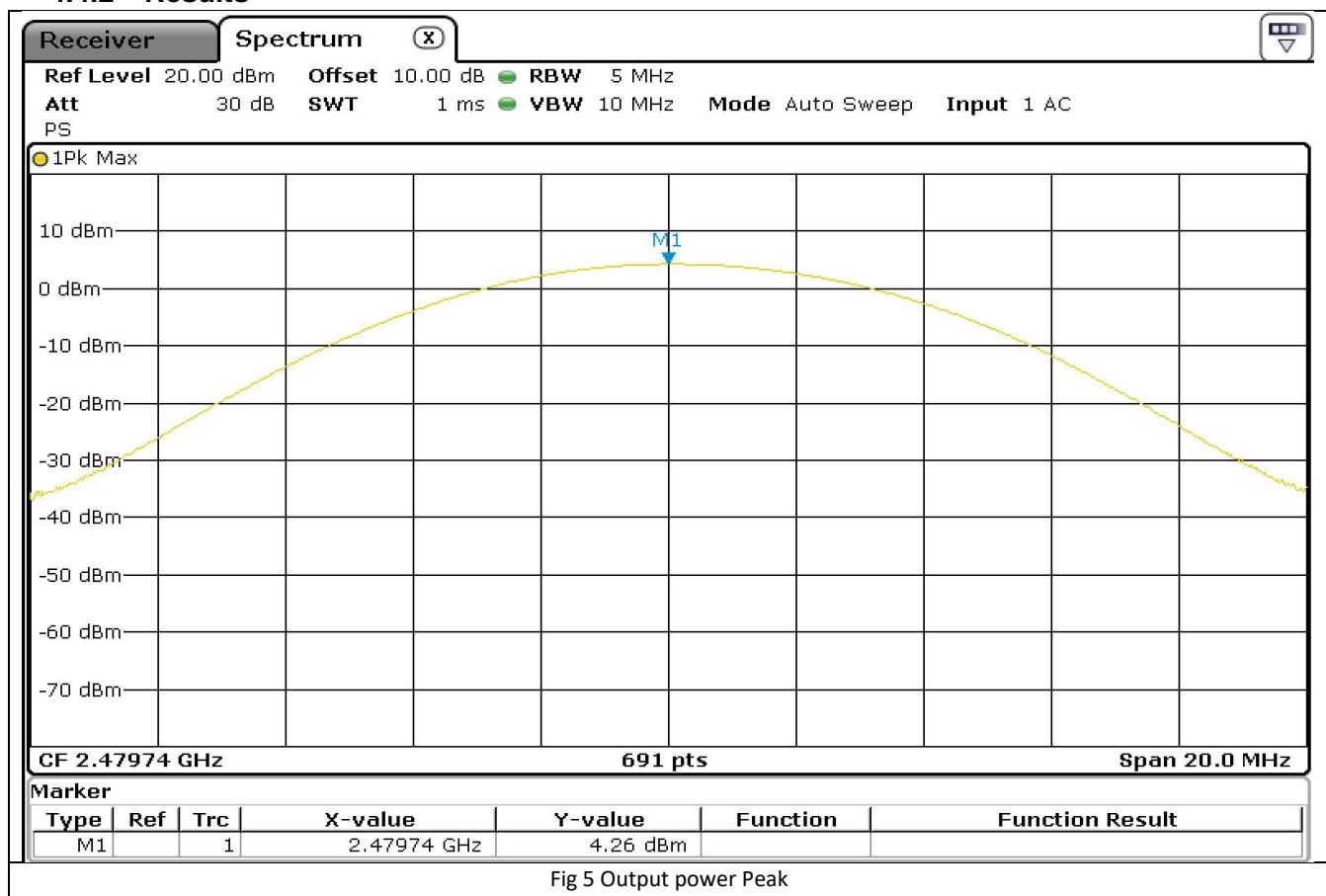
As per Ansi 63.10 Section 11.9.1.1

Ansi63.10 Section 11.9.1.1 RBW \geq DTS bandwidth

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

- a) Set the RBW \geq DTS bandwidth.
- b) Set VBW $\geq [3 \times \text{RBW}]$.
- c) Set span $\geq [3 \times \text{RBW}]$.
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

4.4.2 Results



Frequency	Measurement Conducted Peak	Limit	Margin
MHz	dBm	dBm	dB
2402	4.9	30	25.1
2440	4.63	30	25.37
2480	4.26	30	25.74

Result :- Pass

5. Spurious Emissions Measurements

5.1 Conducted Spurious Emissions

5.1.1 Test Method

As per Ansi63.10 Section 11.11.1 and 6.10.4

Ansi63.10 Section 11.11.1 General

Typical regulatory requirements specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions⁸⁹:

- a) If the maximum peak conducted output power procedure was used to determine compliance as described in 11.9.1, then the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc).

Ansi63.10 Section 6.10.4 Authorized-band band-edge measurements (relative method)

These procedures are applicable for determining compliance at authorized-band band-edges where the requirements are expressed as a value relative to the in-band signal level. Procedures for determining compliance with field strength limits at or close to the band-edges are given in 6.10.6 (see also Table A.2).

5.1.2 Results

Frequency	100KHz RBW	dBc Limit Min	Margin	Result
MHz	dBm	dB	dB	P/F
2402	4.53	20	-	-
4804	-57.66	20	67.26	Pass
7206	-62	20	71.6	Pass
9608	-64.37	20	73.97	Pass

Frequency	100KHz RBW	dBc Limit Min	Margin	Result
MHz	dBm	dB	dB	P/F
2440	4.41	20	-	-
4880	-57.62	20	67.22	Pass
7320	-61.23	20	70.83	Pass
9760	-63.44	20	73.04	Pass

Frequency	100KHz RBW	dBc Limit Min	Margin	Result
MHz	dBm	dB	dB	P/F
2480	4.31	20	-	-
4960	-63.75	20	73.35	Pass
7440	-61.09	20	70.69	Pass
9920	-64.98	20	74.58	Pass

Ref Appendix A for Scans

Result: - Pass

5.2 Radiated Spurious Emissions in Restricted bands

5.2.1 Test Method

As per Ansi63.10 Section 11.12.1 and 6.10.5

Ansi63.10 Section 11.12.1 Radiated emission measurements

Because the typical emission requirements are specified in terms of radiated field strength levels, measurements performed to determine compliance have traditionally relied on a radiated test configuration.⁹² Radiated measurements remain the principal method for determining compliance to the specified requirements; however antenna-port conducted measurements are also now acceptable to determine compliance (see 11.12.2 for details). When radiated measurements are utilized, test site requirements and procedures for maximizing and measuring radiated emissions that are described in 6.3, 6.5, and 6.6 shall be followed

6.10.5 Restricted-band band-edge measurements

These procedures are applicable for determining compliance at band edges of restricted bands.

6.10.5.1 Test setup

Restricted-band band-edge tests shall be performed as radiated measurements, on a test site meeting the specifications in 5.2 at the measurement distances specified in 5.3.⁵⁷

The instrumentation shall meet the requirements in 4.1.1 using the bandwidths and detectors specified in 4.1.4.2. Considering the requirements of 5.8, the antenna(s) shall be connected to the antenna ports. When performing radiated measurements, the measurement antenna(s) shall meet the specifications in 4.3. The EUT shall be connected to an antenna and operated at the highest power settings following procedures in 6.3, and the relevant procedure in 6.4, 6.5, or 6.6

As per Ansi 63.10 Section 11.12.2.5.2

5.2.2 Results Low Channel

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	dB μ V/m		V/H	dB	dB	dB	dB μ V/m	dB μ V/m	dB	P/F
4.804	45.8	O1	Vertical	33.1	39.3	7.8	47.4	54.0	26.6	Pass
12.010	42.5	O1	Vertical	39.2	37.3	10.9	55.3	54.0	18.7	Pass
4.804	49.1	O2	Horizontal	33.1	39.3	7.8	50.7	54.0	23.3	Pass
12.010	42.6	O2	Horizontal	39.2	37.3	10.9	55.4	54.0	18.6	Pass

Final Field Strength Peak (dB μ V/m) = Reading Peak (dB μ V/m) + Antenna Factor (dB) - Pre-amp Gain (dB) + Cable Loss (dB)
 Calculation Example $47.4 = 45.8 + 33.1 - 39.3 + 7.8$

Frequency	Reading Average	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain	Cable loss	Duty Cycle correction	Final Field Strength Average	Average Limit	Margin	Result
GHz	dB μ V/m		V/H	dB	dB	dB	dB	dB μ V/m	dB μ V/m	dB	P/F
12.0100	31.9	O1	Vertical	39.2	37.3	10.9	0.7	45.4	54.0	8.6	Pass
12.0100	31.9	O2	Horizontal	39.2	37.3	10.9	0.7	44.7	54.0	9.3	Pass

Final Field Strength Average (dB μ V/m) = Reading Average (dB μ V/m) + Antenna Factor (dB) - Pre-amp Gain (dB) + Cable Loss (dB) + Duty Cycle correction (dB)
 Calculation Example $45.4 = 31.9 + 39.2 - 37.3 + 10.9 + 0.7$

Result:- Pass

5.2.3 Results Mid Channel

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	dB μ V/m		V/H	dB	dB	dB	dB μ V/m	dB μ V/m	dB	P/F
4.880	46.7	O1	Vertical	33.2	39	7.8	48.7	54.0	25.3	Pass
7.320	46.0	O1	Vertical	36.4	40.6	10.1	51.9	54.0	22.1	Pass
12.200	43.7	O1	Vertical	39	36.8	10.8	56.7	54.0	17.3	Pass
4.880	50.0	O2	Horizontal	33.2	39	7.8	52.0	54.0	22.0	Pass
7.320	47.0	O2	Horizontal	36.4	40.6	10.1	52.9	54.0	21.1	Pass
12.200	43.2	O2	Horizontal	39	36.8	10.8	56.2	54.0	17.8	Pass

Final Field Strength Peak (dB μ V/m) = Reading Peak (dB μ V/m) + Antenna Factor (dB) - Pre-amp Gain (dB) + Cable Loss (dB)
 Calculation Example $48.7 = 46.7 + 33.2 - 39 + 7.8$

Frequency	Reading Average	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain	Cable loss	Duty Cycle correction	Final Field Strength Average	Average Limit	Margin	Result
GHz	dB μ V/m		V/H	dB	dB	dB	dB	dB μ V/m	dB μ V/m	dB	P/F
12.2000	32.8	O1	Vertical	39	36.8	10.8	0.7	46.4	54.0	7.5	Pass
12.2000	32.7	O2	Horizontal	39	36.8	10.8	0.7	45.7	54.0	8.3	Pass

Final Field Strength Average (dB μ V/m) = Reading Average (dB μ V/m) + Antenna Factor (dB) - Pre-amp Gain (dB) + Cable Loss (dB) + Duty Cycle correction (dB)

Calculation Example $46.4 = 32.8 + 39 - 36.8 + 10.8 + 0.7$

Result:- Pass

5.2.4 Results High Channel

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	dB μ V/m		V/H	dB	dB	dB	dB μ V/m	dB μ V/m	dB	P/F
4.960	48.4	O1	Vertical	33.5	39.2	8	50.7	54.0	23.3	Pass
7.440	46.0	O1	Vertical	36.6	40.8	10.4	52.2	54.0	21.8	Pass
12.400	42.9	O1	Vertical	39	37.1	11.3	56.1	54.0	17.9	Pass
4.960	47.8	O2	Horizontal	33.5	39.2	8	50.1	54.0	23.9	Pass
7.440	46.0	O2	Horizontal	36.6	40.8	10.4	52.2	54.0	21.8	Pass
12.400	41.9	O2	Horizontal	39	37.1	11.3	55.1	54.0	18.9	Pass

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

Calculation Example $50.7 = 48.4 + 33.5 - 39.2 + 8$

Frequency	Reading Average	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain	Cable loss	Duty Cycle correction	Final Field Strength Average	Average Limit	Margin	Result
GHz	dB μ V/m		V/H	dB	dB	dB	dB	dB μ V/m	dB μ V/m	dB	P/F
12.4000	31.8	O1	Vertical	39	37.1	11.3	0.7	45.6	54.0	8.3	Pass
12.4000	31.6	O2	Horizontal	39	37.1	11.3	0.7	44.8	54.0	9.2	Pass

Final Field Strength Average (dB μ V/m) = Reading Average (dB μ V/m) + Antenna Factor (dB) - Pre-amp Gain (dB) + Cable Loss (dB) + Duty Cycle correction (dB)

Calculation Example $50.7 = 48.4 + 33.5 - 39.2 + 8$

Result:- Pass

Average measurements not performed where the Final Peak level is below the Average limit of 54dB μ V/m.

5.3 Radiated Band Edge / Restricted band Measurements

11.13.3.2 Peak detection

When using a peak detector to measure unwanted emissions at or near the band edge (within 2 MHz of the authorized band), the following integration procedure can be used:

- a) Set instrument center frequency to the frequency of the emission to be measured (must be within 2 MHz of the authorized band edge).
- b) Set span to 2 MHz.
- c) RBW = 100 kHz.
- d) VBW $\geq [3 \times \text{RBW}]$.
- e) Detector = peak.
- f) Sweep time = auto.
- g) Trace mode = max hold.
- h) Allow sweep to continue until the trace stabilizes (required measurement time may increase for low-duty-cycle applications).
- i) Compute the power by integrating the spectrum over 1 MHz using the analyzer's band power measurement function with band limits set equal to the emission frequency (f_{emission}) ± 0.5 MHz. If the instrument does not have a band power function, then sum the amplitude levels (in power units) at 100 kHz intervals extending across the 1 MHz spectrum defined by $f_{\text{emission}} \pm 0.5$ MHz.

11.12.2.5.2 Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction

If continuous transmission of the EUT ($D \geq 98\%$) cannot be achieved and the duty cycle is constant (duty cycle variations are less than $\pm 2\%$), then the following procedure shall be used:

- a) The EUT shall be configured to operate at the maximum achievable duty cycle.
- b) Measure the duty cycle D of the transmitter output signal as described in 11.6.
- c) RBW = 1 MHz (unless otherwise specified).
- d) VBW $\geq [3 \times \text{RBW}]$.
- e) Detector = RMS (power averaging), if $[\text{span} / (\# \text{ of points in sweep})] \leq (\text{RBW} / 2)$. Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.
- f) Averaging type = power (i.e., rms):
 - 1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
 - 2) Some instruments require linear display mode to use linear voltage averaging. Log or dB averaging shall not be used.
- g) Sweep time = auto.
- h) Perform a trace average of at least 100 traces.
- i) A correction factor shall be added to the measurement results prior to comparing with the emission limit to compute the emission level that would have been measured had the test been performed at 100% duty cycle.

The correction factor is computed as follows:

- 1) If power averaging (rms) mode was used in step f), then the applicable correction factor is $[10 \log (1 / D)]$, where D is the duty cycle.
- 2) If linear voltage averaging mode was used in step f), then the applicable correction factor is $[20 \log (1 / D)]$, where D is the duty cycle.
- 3) If a specific emission is demonstrated to be continuous ($D \geq 98\%$) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that emission.

5.3.1 Result Radiated Restricted Band and band edge near 2.4 GHz band

From section 4.2

Duty cycle (d) = T_{on}/T_{period} = $2.1413/2.50072$ = 85.65%

Power averaging method used => Duty cycle correction factor = $10 \log (1/d)$ = 2.08 dB

Ref Appendix B for scans

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	dB μ V/m		V/H	dB	dB	dB	dB μ V/m	dB μ V/m	dB	P/F
2.344	23.2	O1	Vertical	28	0	4.7	55.9	54.0	18.1	Pass
2.390	20.9	O1	Vertical	28.4	0	4.8	54.1	54.0	19.9	Pass
2.344	22.9	O2	Horizontal	28	0	4.7	55.6	54.0	18.4	Pass
2.390	19.7	O2	Horizontal	28.4	0	4.8	52.9	54.0	21.1	Pass

Final Field Strength Peak (dB μ V/m) = Reading Peak (dB μ V/m) + Antenna Factor (dB) - Pre-amp Gain (dB) + Cable Loss (dB)
Calculation Example $55.9 = 23.2 + 28 - 0 + 4.7$

Frequency	Reading Average	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain	Cable loss	Duty Cycle correction	Final Field Strength Average	Average Limit	Margin	Result
GHz	dB μ V/m		V/H	dB	dB	dB	dB	dB μ V/m	dB μ V/m	dB	P/F
2.3455	15.8	O1	Vertical	28	0	4.7	0.7	49.1	54.0	4.8	Pass
2.3900	14.9	O1	Vertical	28.4	0	4.8	0.7	48.1	54.0	5.9	Pass
2.3472	13.2	O1	Vertical	28	0	4.7	0.7	45.9	54.0	8.1	Pass
2.3900	9.6	O2	Horizontal	28.4	0	4.8	0.7	42.8	54.0	11.2	Pass

Final Field Strength Average (dB μ V/m) = Reading Average (dB μ V/m) + Antenna Factor (dB) - Pre-amp Gain (dB) + Cable Loss (dB) + Duty Cycle correction (dB)
Calculation Example $49.1 = 15.8 + 28 - 0 + 4.7 + 0.7$

Frequency	Reading Peak dB μ V/m	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain dB	Cable loss dB	Final Field Strength Peak dB μ V/m	Average Limit +20dB	Margin for Peak v Average Limit +20dB	Result
GHz	dB μ V/m		V/H	dB	dB	dB	dB μ V/m	dB	dB	P/F
2.484	20.6	O1	Vertical	28.6	0	4.9	54.1	54.0	19.9	Pass
2.494	21.1	O1	Vertical	28.6	0	4.9	54.6	54.0	19.4	Pass
2.500	20.0	O2	Vertical	28.8	0	4.9	53.7	54.0	20.3	Pass
2.484	30.1	O2	Horizontal	28.6	0	4.9	63.6	54.0	10.4	Pass
2.499	30.8	O2	Horizontal	28.6	0	4.9	64.3	54.0	9.7	Pass
2.500	28.9	O2	Horizontal	28.8	0	4.9	62.6	54.0	11.4	Pass

Final Field Strength Peak (dB μ V/m) = Reading Peak (dB μ V/m) + Antenna Factor (dB) - Pre-amp Gain (dB) + Cable Loss (dB)
Calculation Example $54.1 = 20.6 + 28.6 - 0 + 4.9$

Frequency	Reading Average dB μ V/m	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain dB	Cable loss dB	Duty Cycle correction dB	Final Field Strength Average dB μ V/m	Average Limit dB μ V/m	Margin dB	Result
GHz	dB μ V/m		V/H	dB	dB	dB	dB	dB μ V/m	dB μ V/m	dB	P/F
2.4835	15.0	O1	Vertical	28.6	0	4.9	0.7	49.1	54.0	4.8	Pass
2.4867	14.6	O1	Vertical	28.6	0	4.9	0.7	48.1	54.0	5.9	Pass
2.500	10.2	O1	Vertical	28.8	0	4.9	0.7	43.9	54.0	10.1	Pass
2.4835	14.3	O2	Horizontal	28.6	0	4.9	0.7	47.8	54.0	6.2	Pass
2.4916	14.8	O2	Horizontal	28.6	0	4.9	0.7	48.3	54.0	5.7	Pass
2.500	13.2	O2	Horizontal	28.8	0	4.9	0.7	46.9	54.0	7.1	Pass

Final Field Strength Average (dB μ V/m) = Reading Average (dB μ V/m) + Antenna Factor (dB) - Pre-amp Gain (dB) + Cable Loss (dB) + Duty Cycle correction (dB)
Calculation Example $49.1 = 15 + 28.6 - 0 + 4.9 + 0.7$

Result: - Pass

5.4 Radiated Power at fundamental

Frequency	Reading Peak	EUT Orientation	Antenna Polarity	Antenna Factor	Preamp Gain	Cable loss	Final Field Strength Peak	Transmitted Power	Limit	Margin	Result
GHz	dB μ V/m		V/H	dB	dB	dB	dB μ V/m	dBm	dBm	dB	P/F
2.402	65.3	O1	Vertical	28.6	0	4.8	98.7	3.5	36.0	32.5	Pass
2.402	65.0	O2	Horizontal	28.6	0	4.8	98.4	3.2	36.0	32.8	Pass
2.440	65.3	O1	Vertical	28.6	0	4.8	98.7	3.5	36.0	32.5	Pass
2.440	64.5	O2	Horizontal	28.6	0	4.8	97.9	2.7	36.0	33.3	Pass
2.480	62.1	O1	Vertical	28.6	0	4.9	95.6	0.4	36.0	35.6	Pass
2.480	61.9	O2	Horizontal	28.6	0	4.9	95.4	0.2	36.0	35.8	Pass

Final Field Strength Peak (dB μ V/m) =Reading Peak (dB μ V/m) + Antenna Factor (dB) - Pre-amp Gain (dB) + Cable Loss (dB)
Calculation Example 98.7 = 65.3 + 28.6 - 0 + 4.8

Transmitted power (dBm) =Final Field Strength Peak (dB μ V/m) -95.2 dB
Calculation Example 3.5 = 98.7 - 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

$$EIRP (dBm) = E_{3m} (dB\mu V/m) - 95.2$$

Result:- Pass

6 List of Test Equipment

Instrument	Manufacturer	Model	Serial Num	CEI Ref	Cal Date	Cal Interval Months
Microwave Preamplifier	Hewlett Packard	83017A	3123A00175	805	29-Jul-24	12
Spectrum Analyser 30Hz-40GHz	Rohde & Schwarz	FSP40	100053	850	09-Jan-25	36
Test Receiver 3.6GHz	Rohde & Schwarz	ESR	1316.3003k03-101625-s	869	23-May-23	36
Antenna Horn	EMCO	3115	2363	1100	21-Feb-23	36
Fully Anechoic Chamber	CEI	FAR 3M	906	906	29-Jul-22	36
Anechoic Chamber	CEI	SAR 10M	845	845	12-Sept-22	36
Antenna Biconical	EMCO		3110B	847	30-Oct-24	36
Antenna Log Periodic	Chase	UPA6108	1072	609	05-Nov-24	36
Antenna Horn Standard Gain 18-26.5GHz	A-Info	LB-42-25-C-KF	J2021091103028	877	02-Aug-24	12
Cable 20m				1213	29-Jul-24	12
Cable purple Ktype 1.8m				917	29-Jul-24	12
Cable HF Ktype 1.5m				705	29-Jul-24	12
LISN	Rohde & Schwarz	ESH3-Z5	825460/003	604	31-Oct-24	36
Antenna Loop	EMCO	6502	2233	1065	15-Dec-23	36

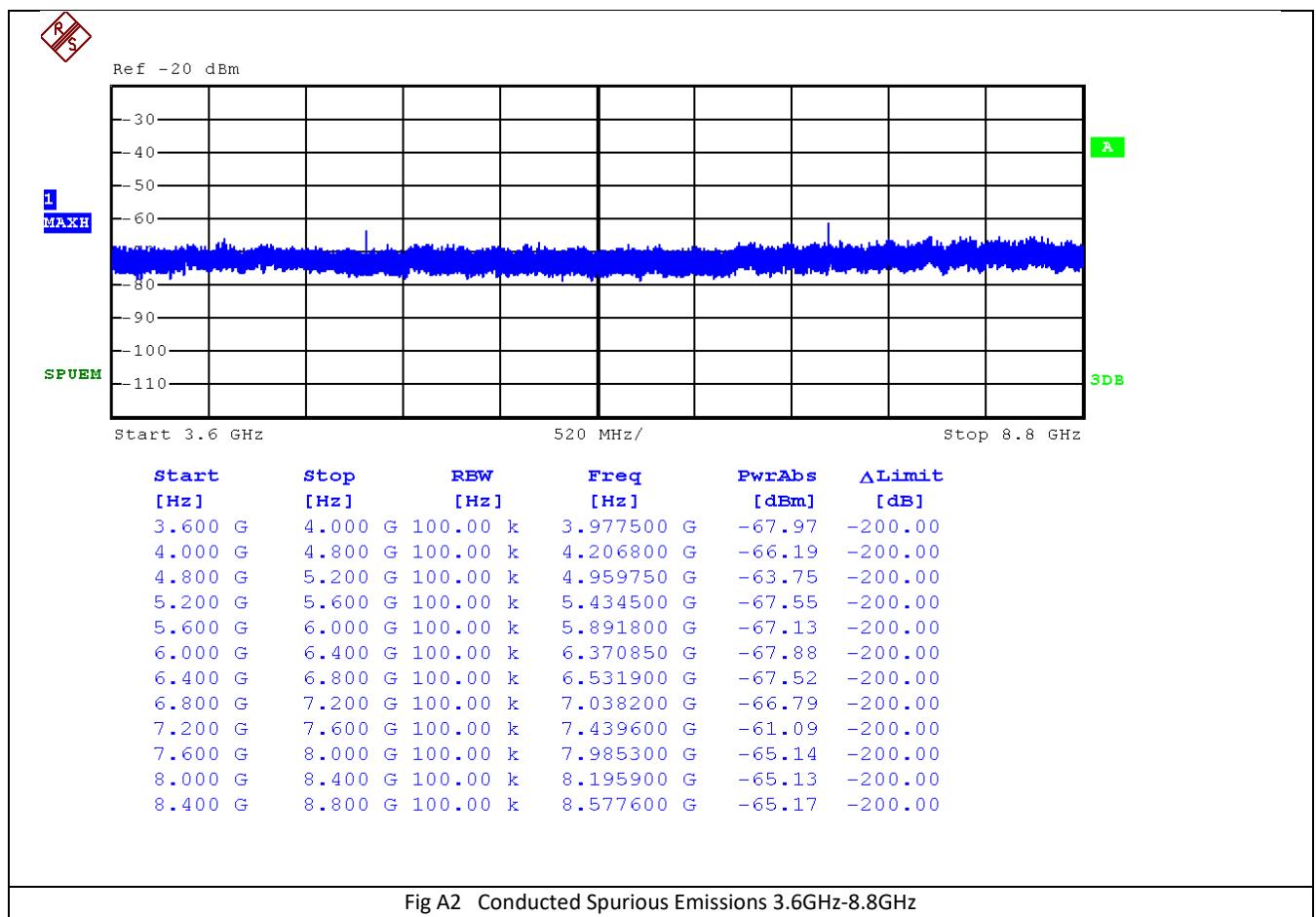
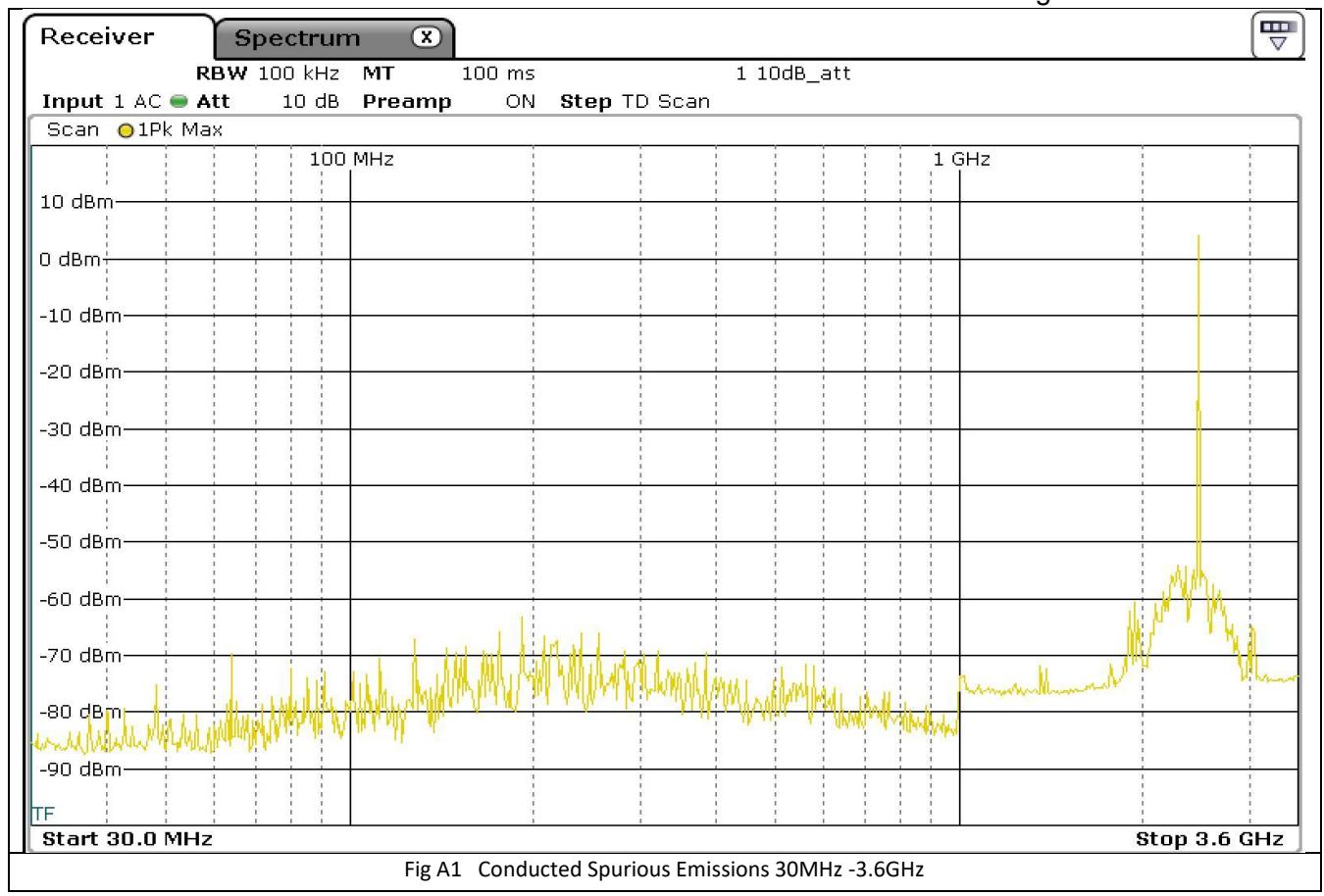
7 Measurement Uncertainties

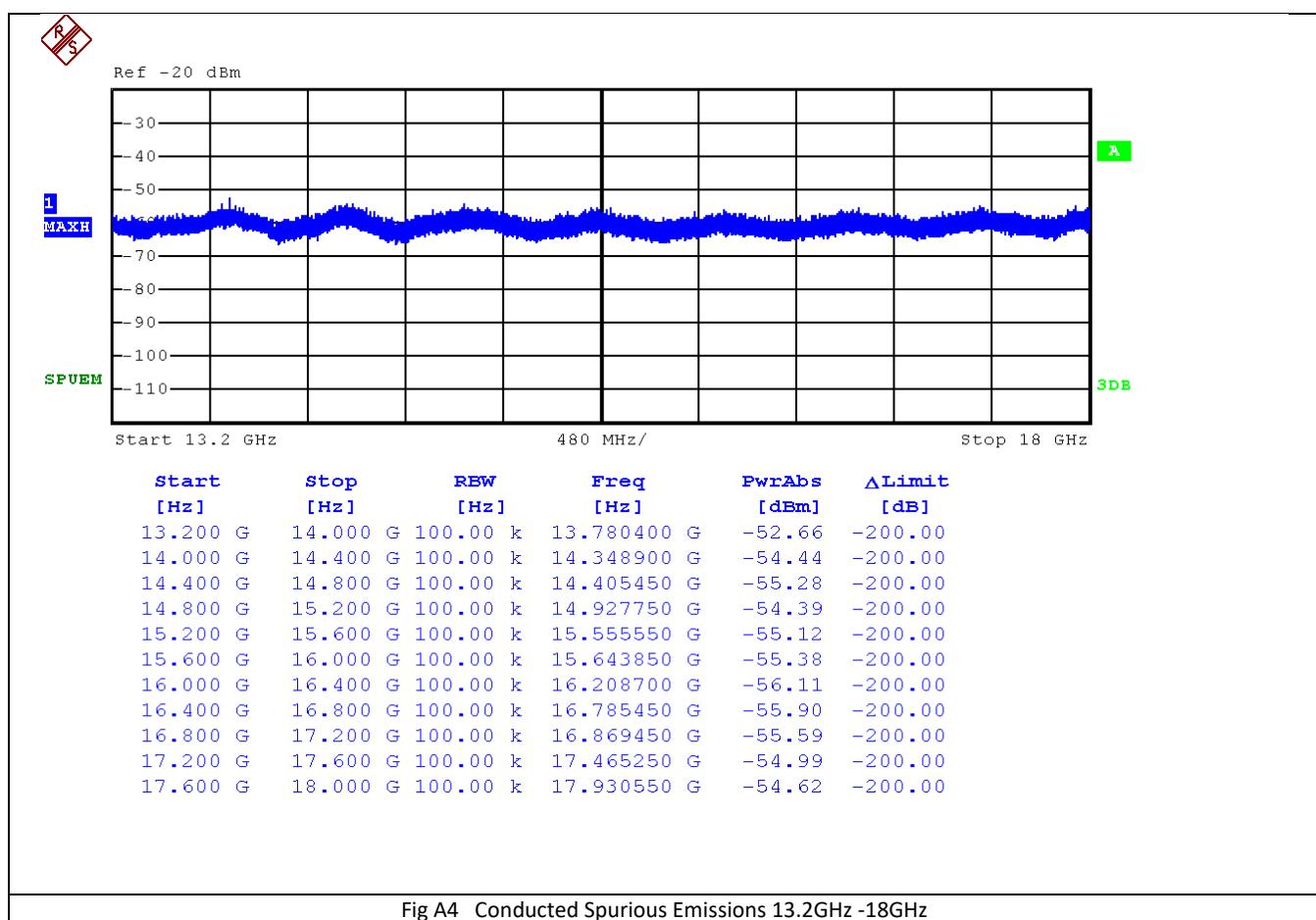
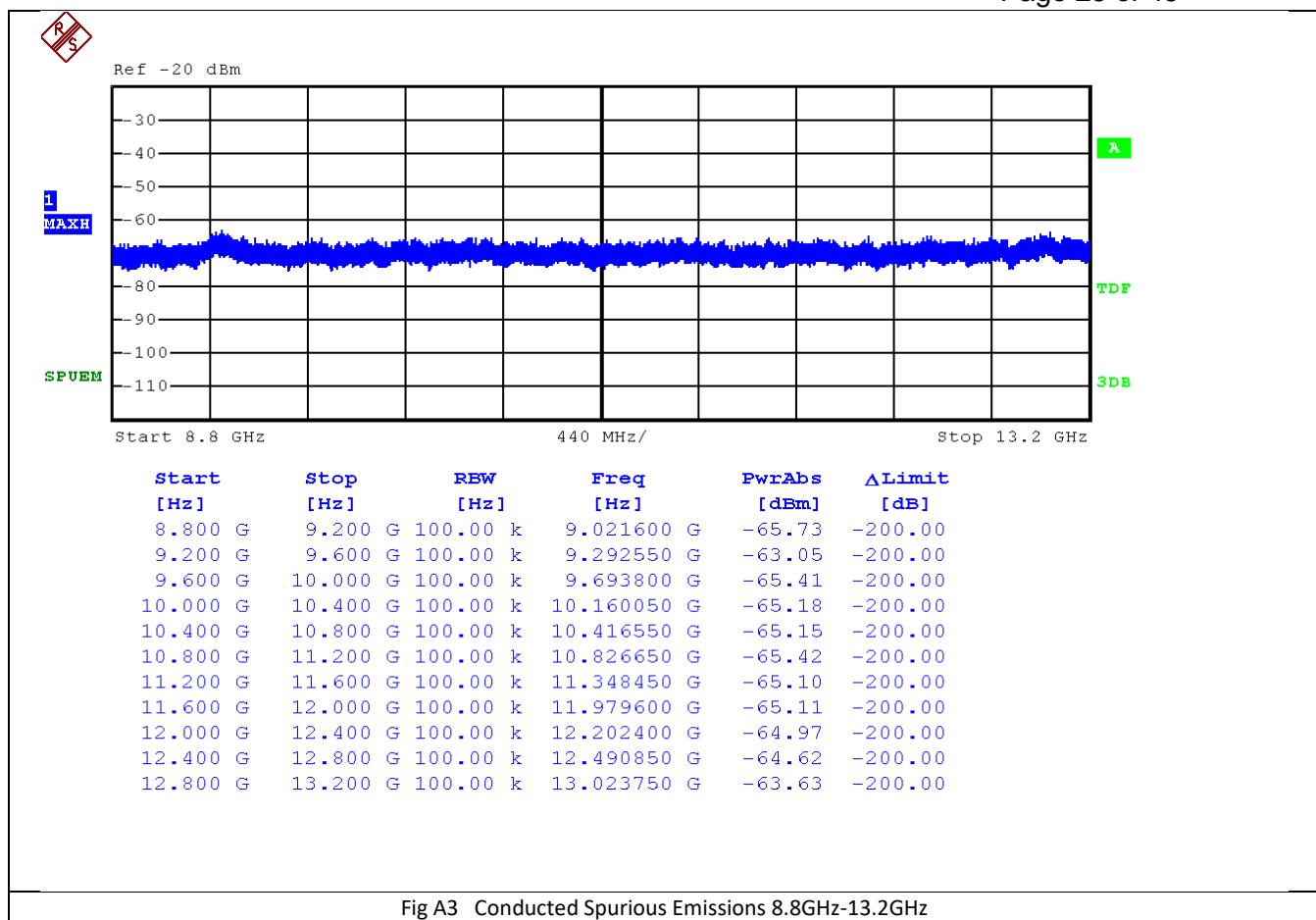
Measurement	Uncertainty
Radio Frequency	+/- 5×10^{-7}
Maximum Frequency Deviation	+/- 1.7 %
Conducted Emissions	+/- 1 dB
Radiated Emission 30MHz-100MHz	+/- 5.3 dB
Radiated Emission 100MHz-300MHz	+/- 4.7 dB
Radiated Emission 300MHz-1GHz	+/- 3.9 dB
Radiated Emission 1GHz-40GHz	+/- 3.8 dB
Modulation bandwidth	+/- 5×10^{-7}
Duty Cycle	+/- 5 %
Power supply	± 0.1 VDC
Temperature	± 0.2 °C
Frequency	± 0.01 ppm

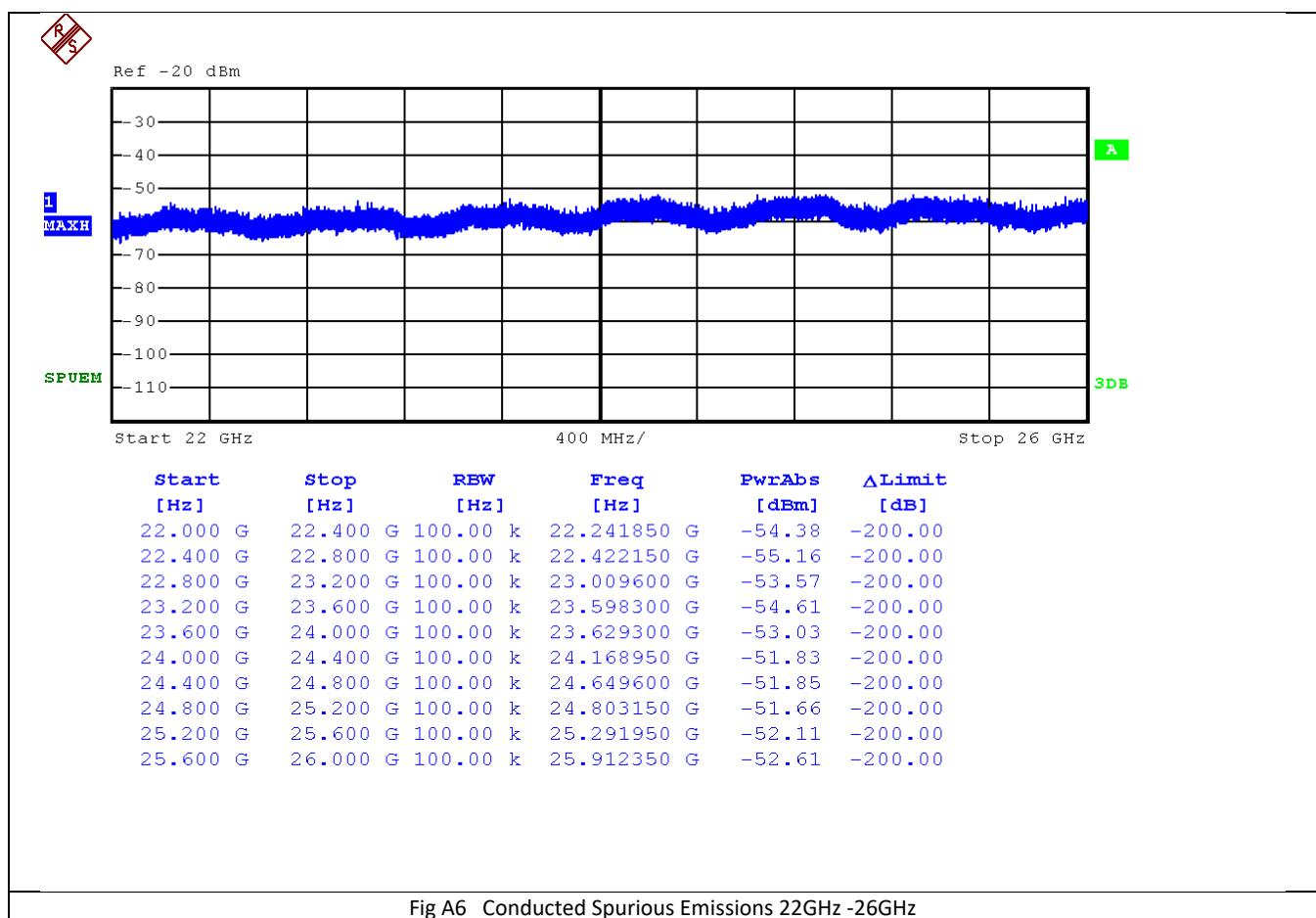
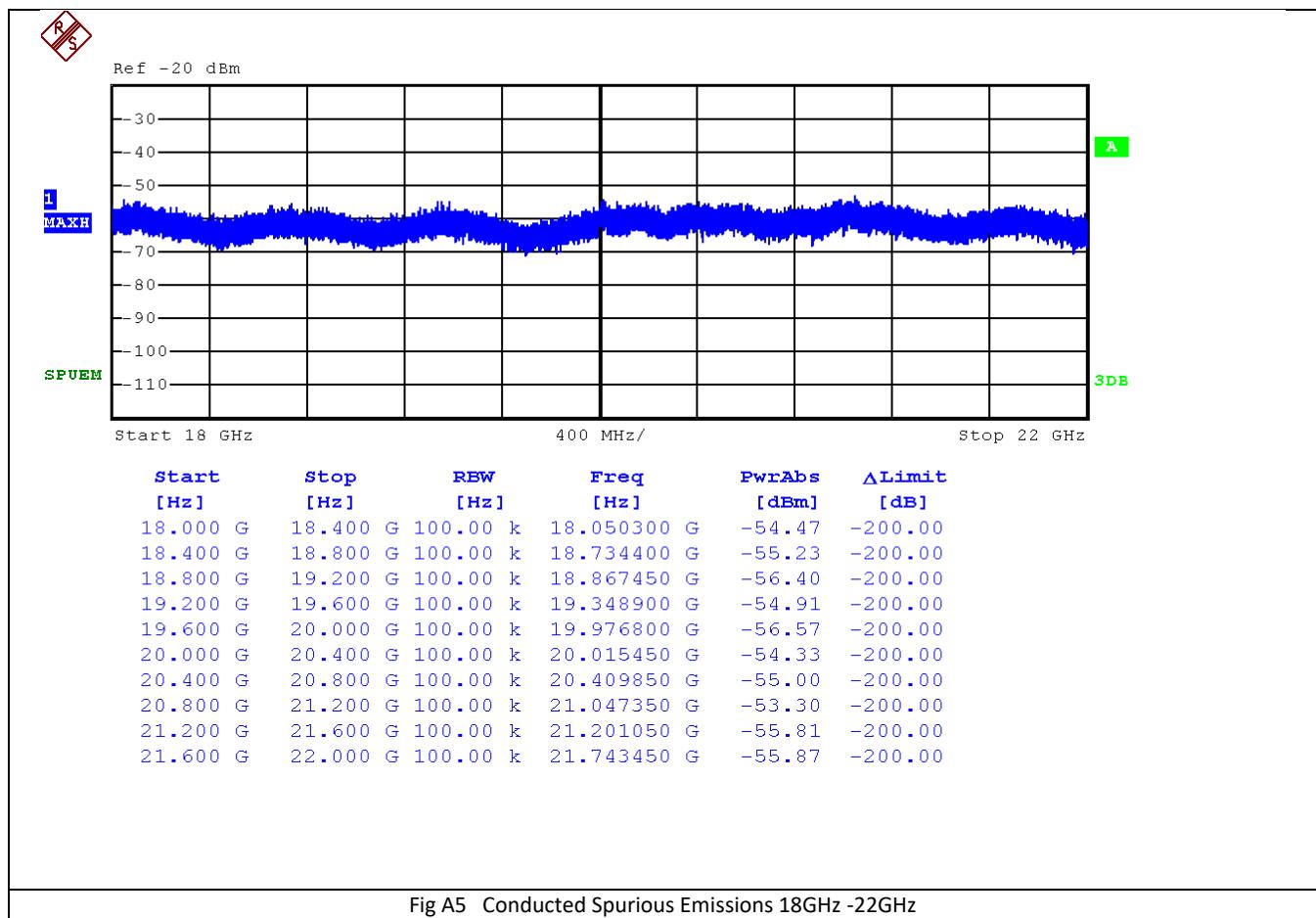
The measurement uncertainties stated were calculated with a $k=2$ for a confidence level of over 95% as per ETS TR100 028.

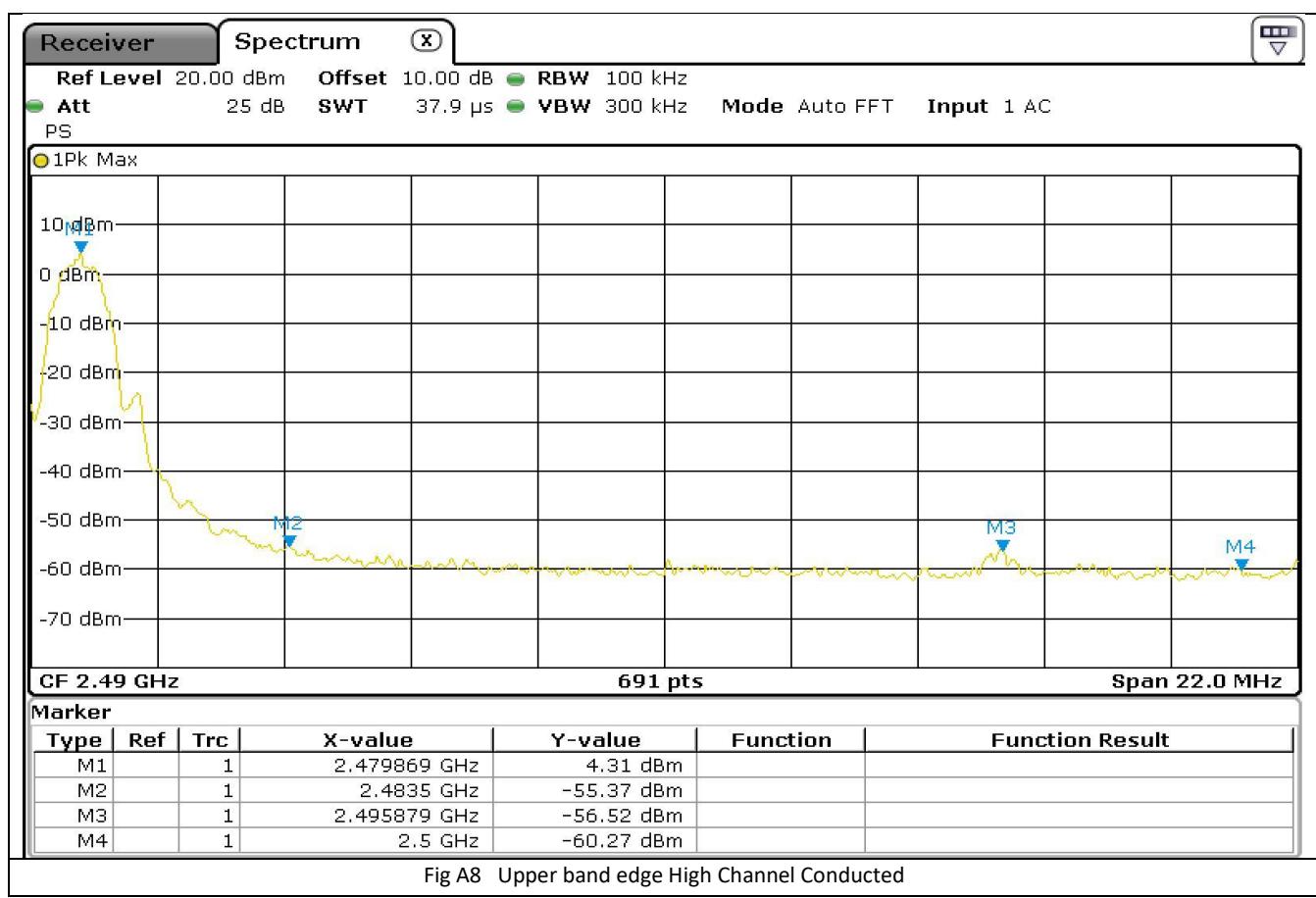
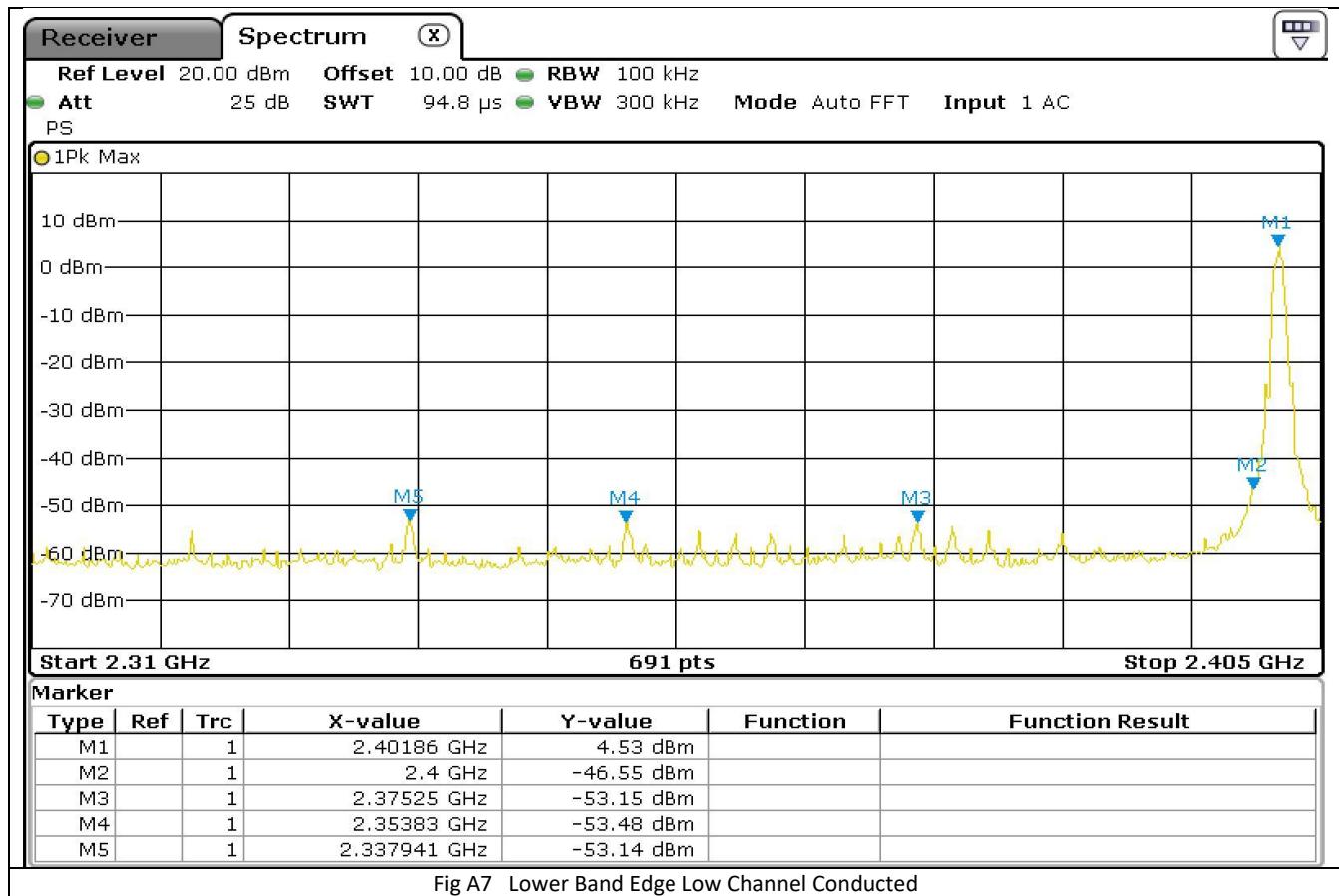
The test data can be compared directly to the specification limit to determine compliance, as the calculated measurement uncertainty meets the requirements of the applicable specification.

Appendix A Conducted Measurements on the Antenna Port

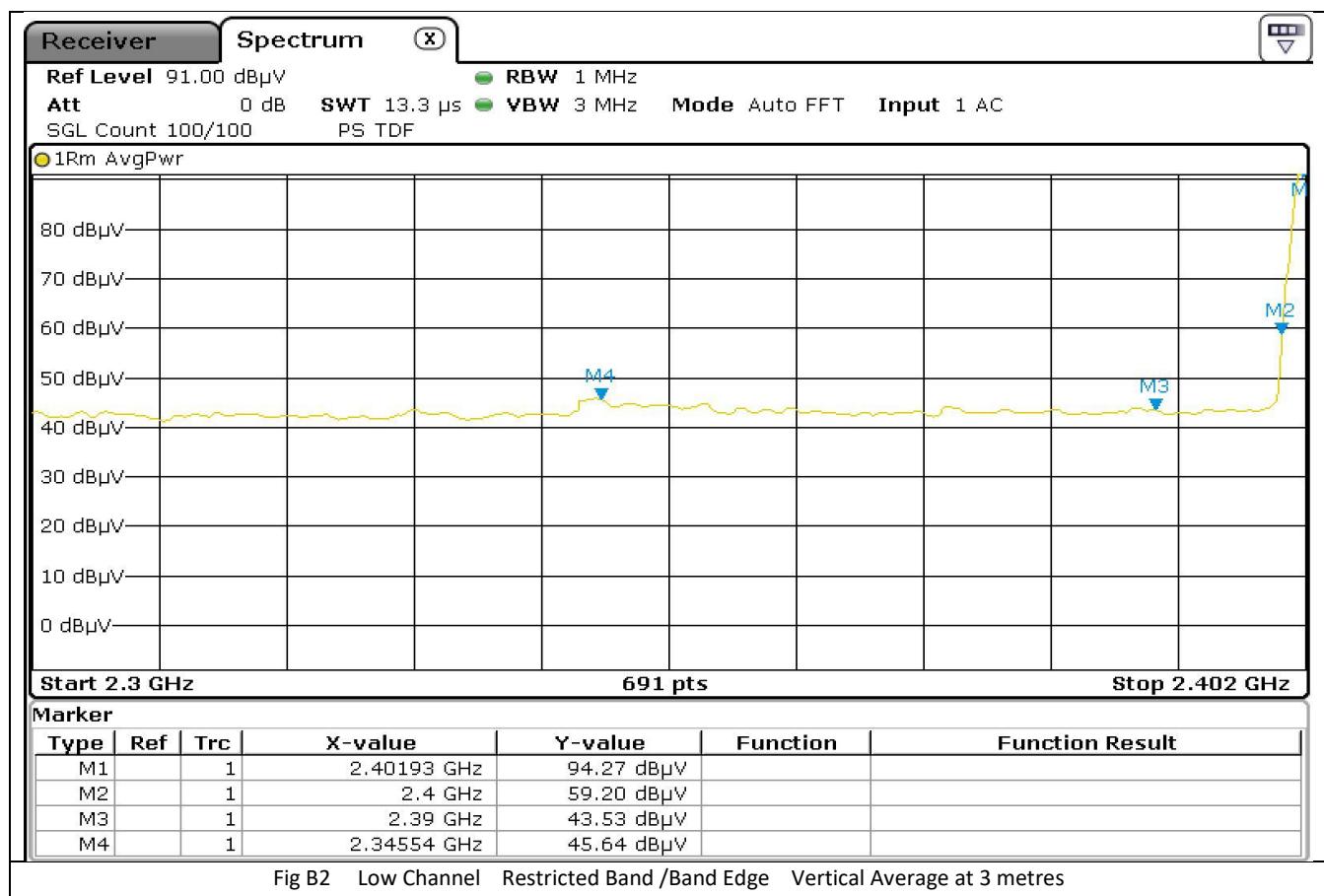
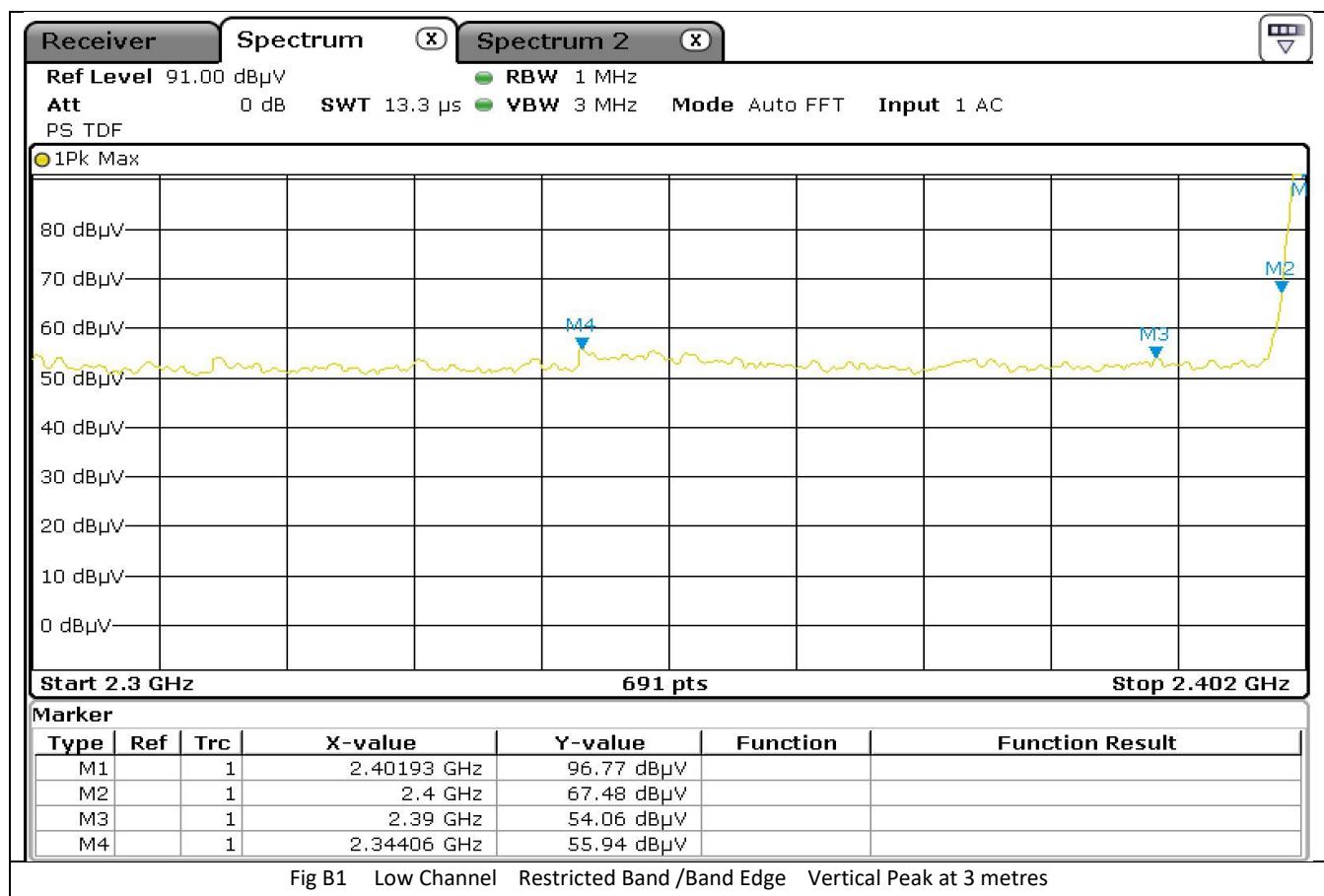


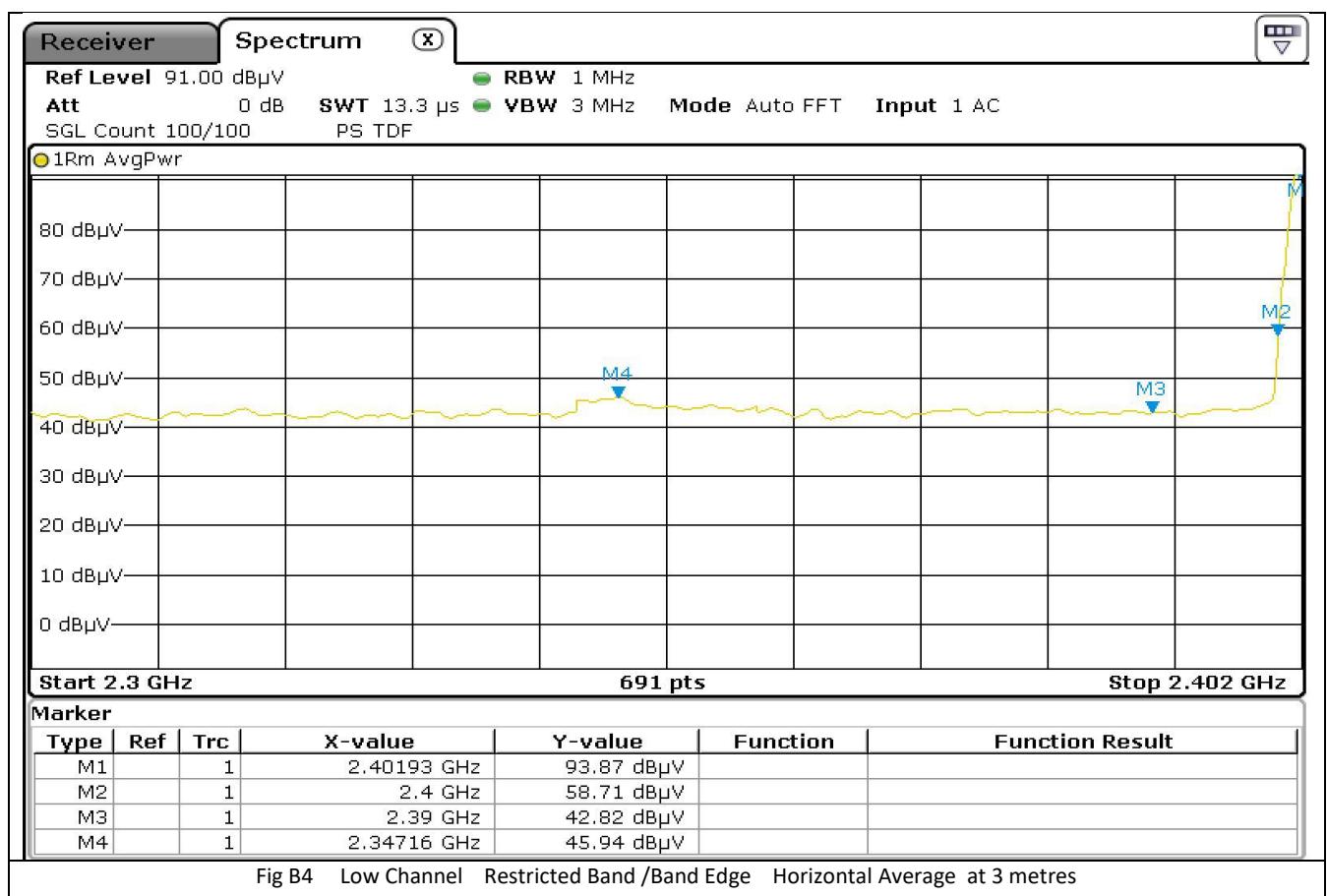
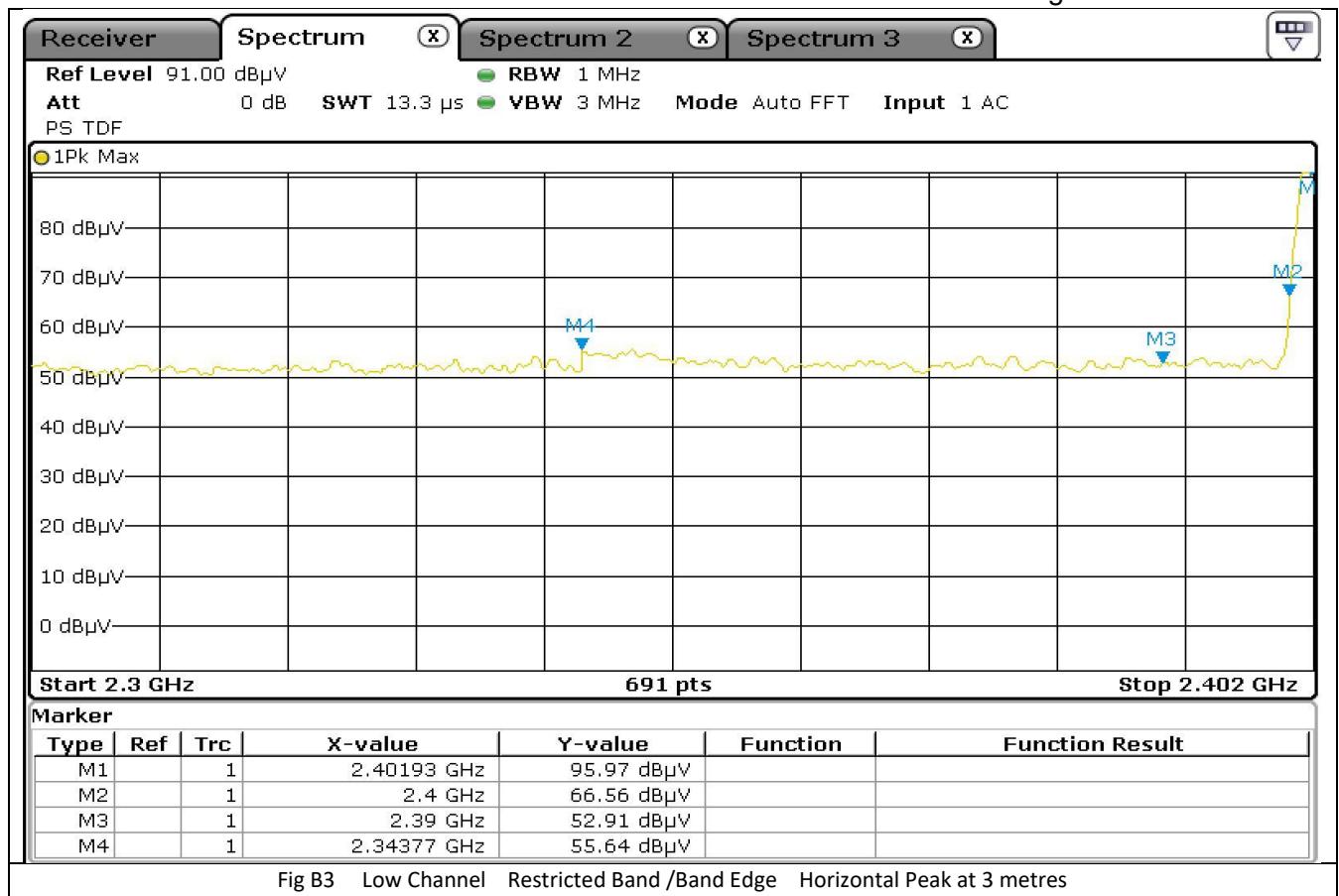


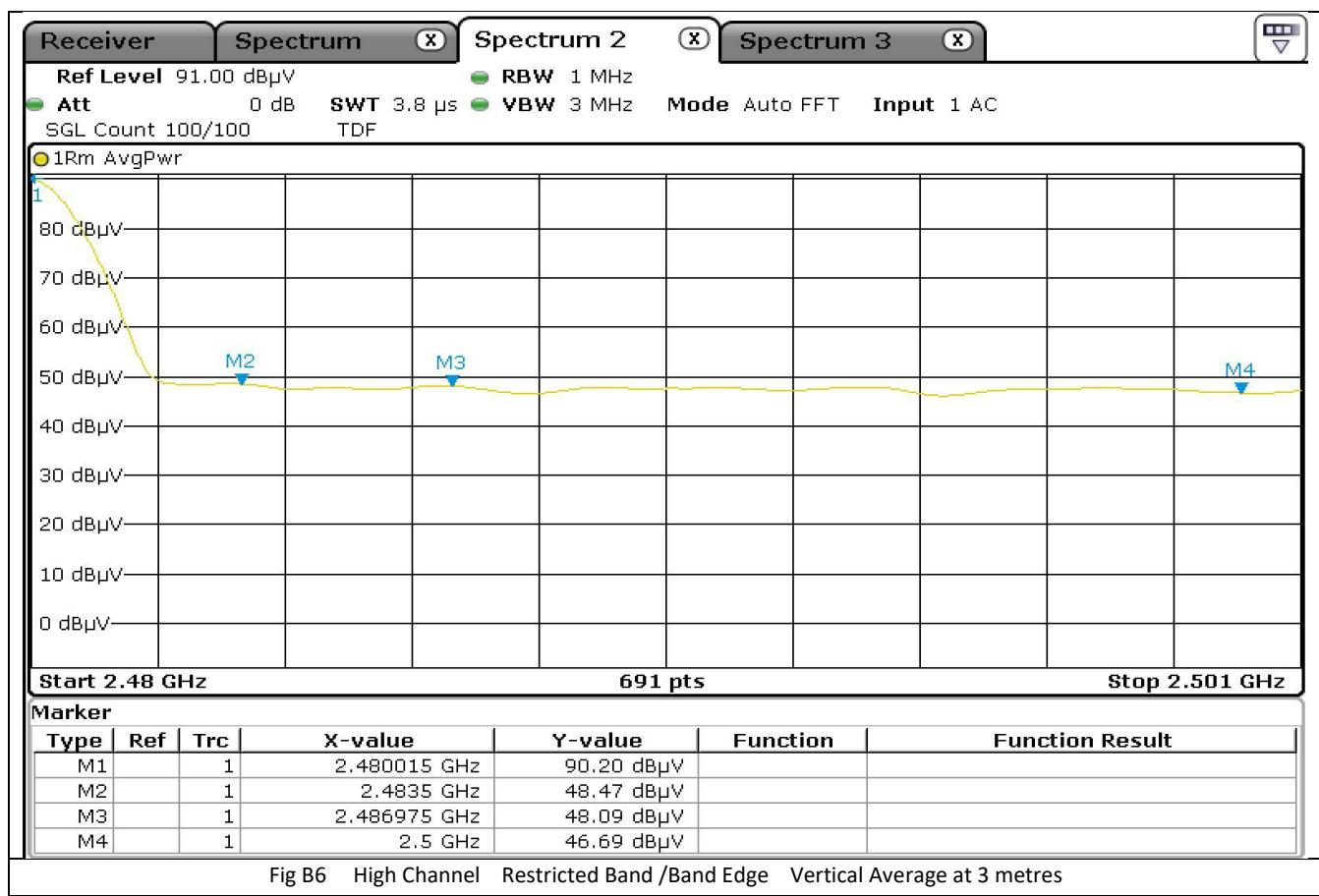
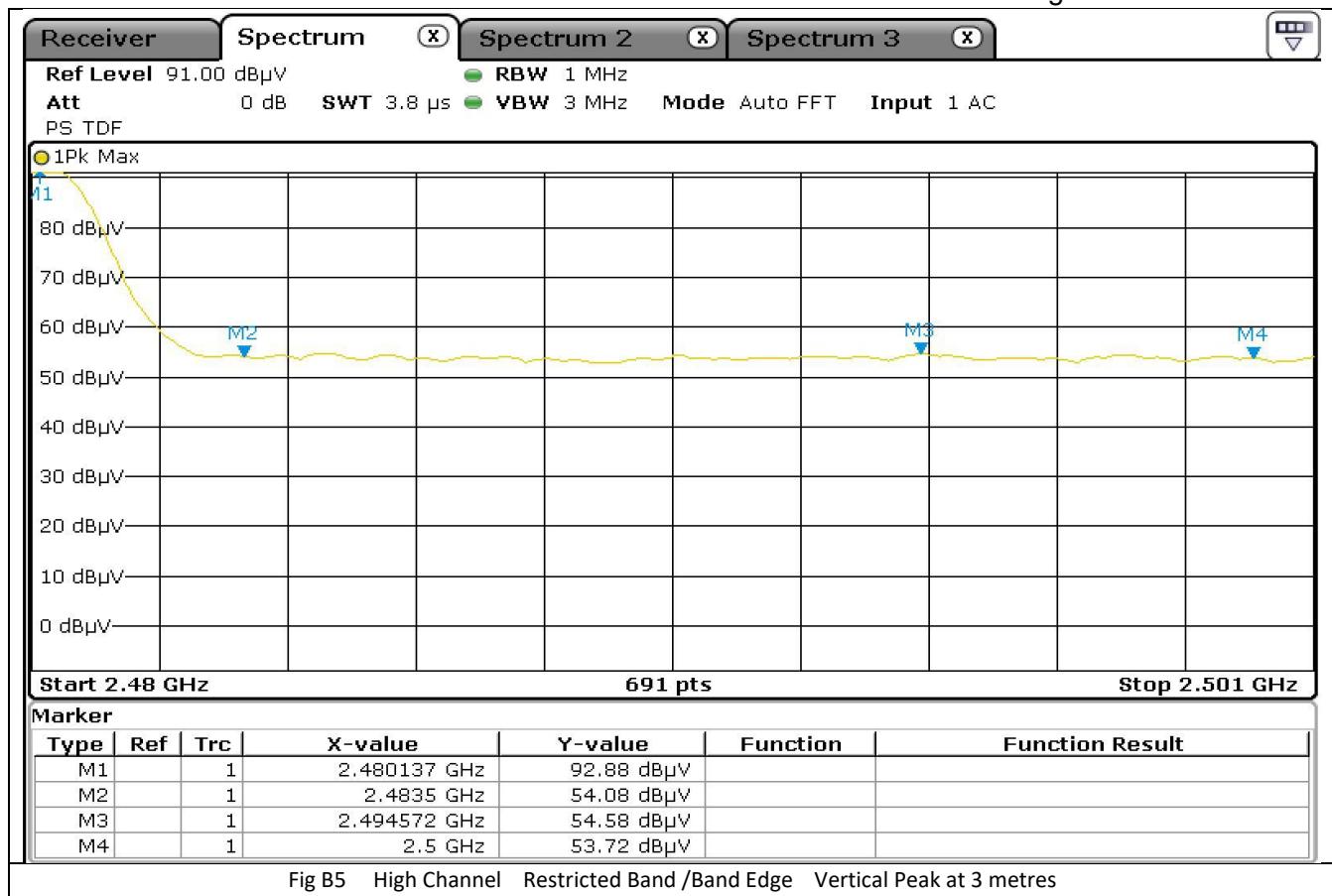


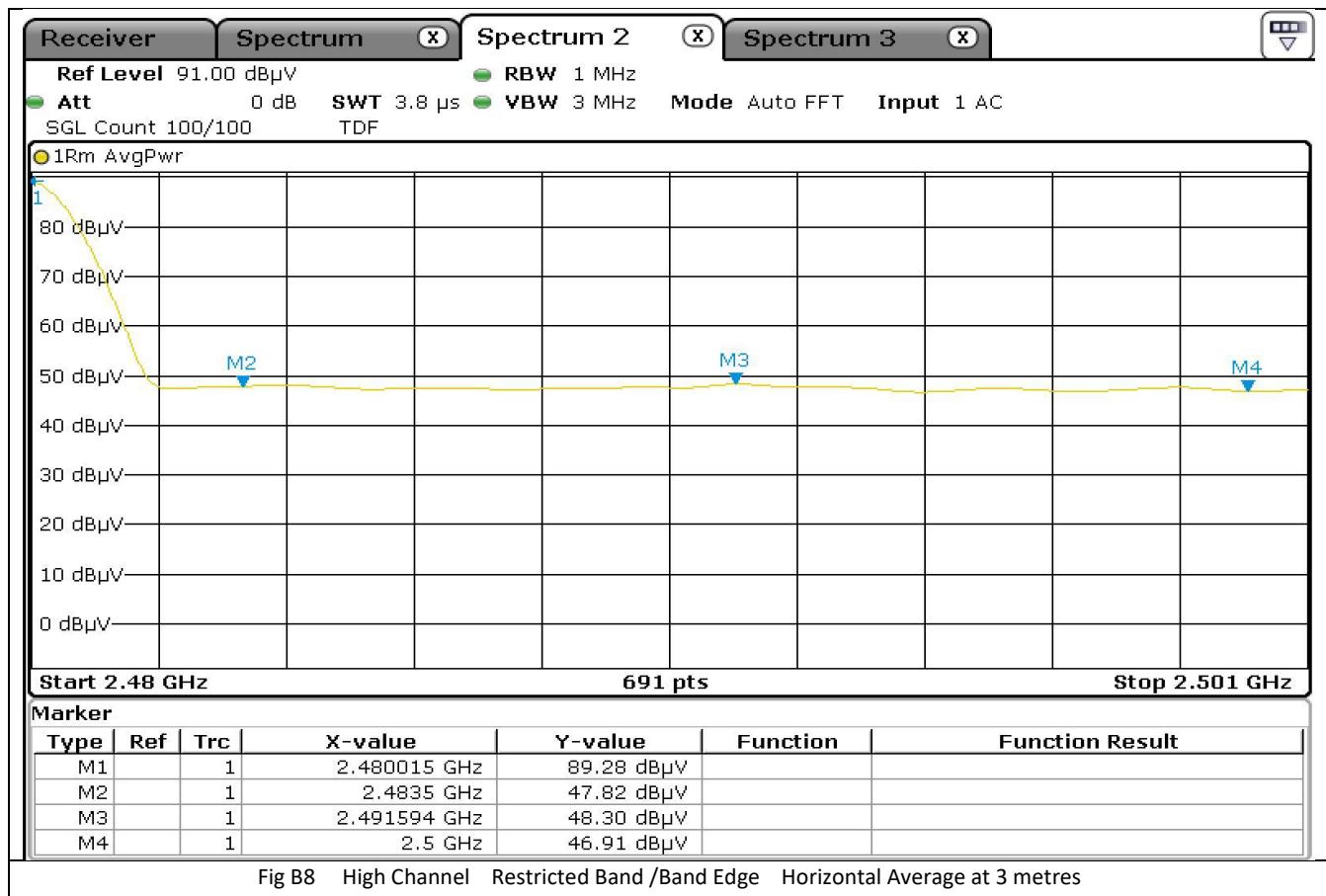
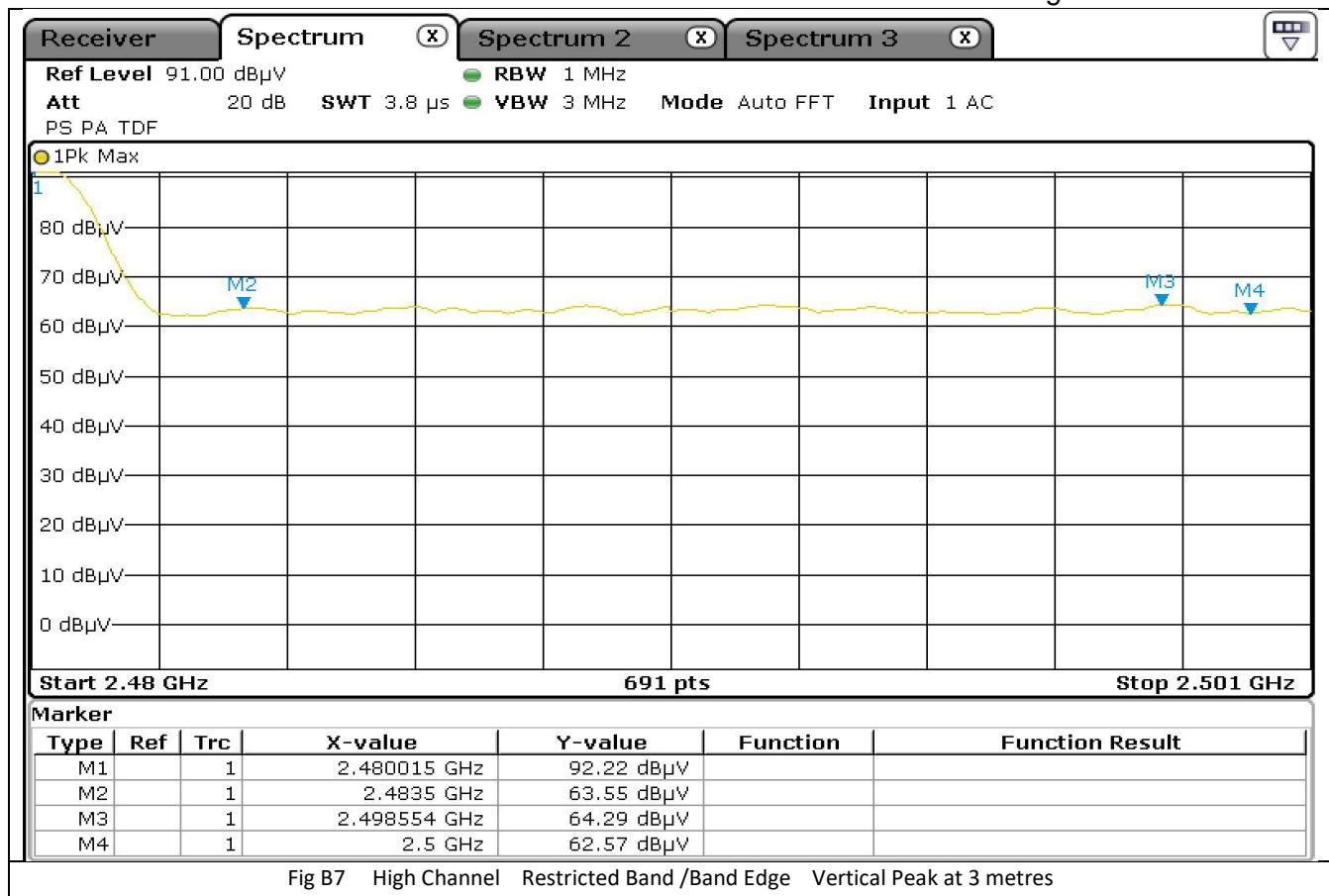


Appendix B Radiated tests for Band Edges /Restricted band

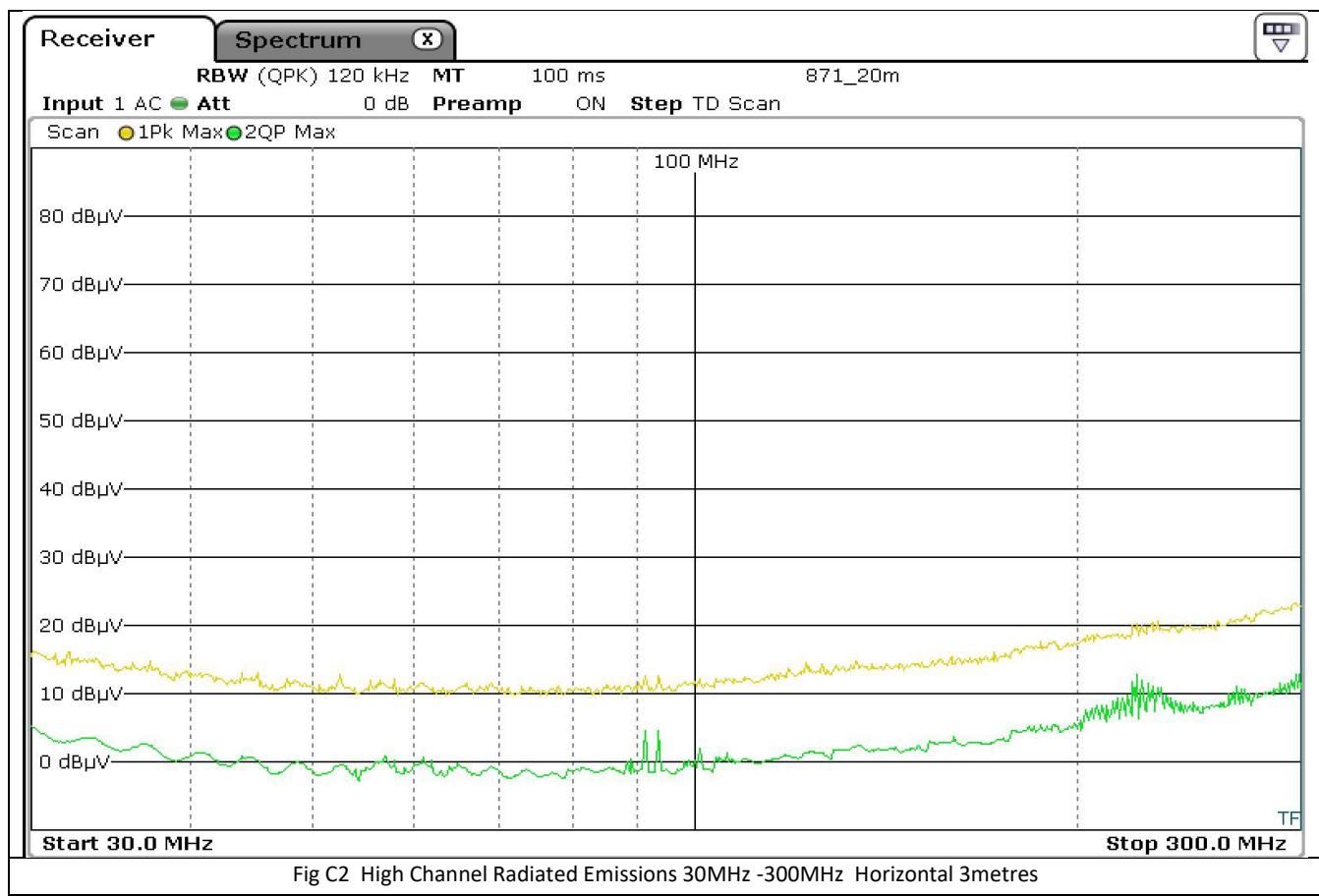
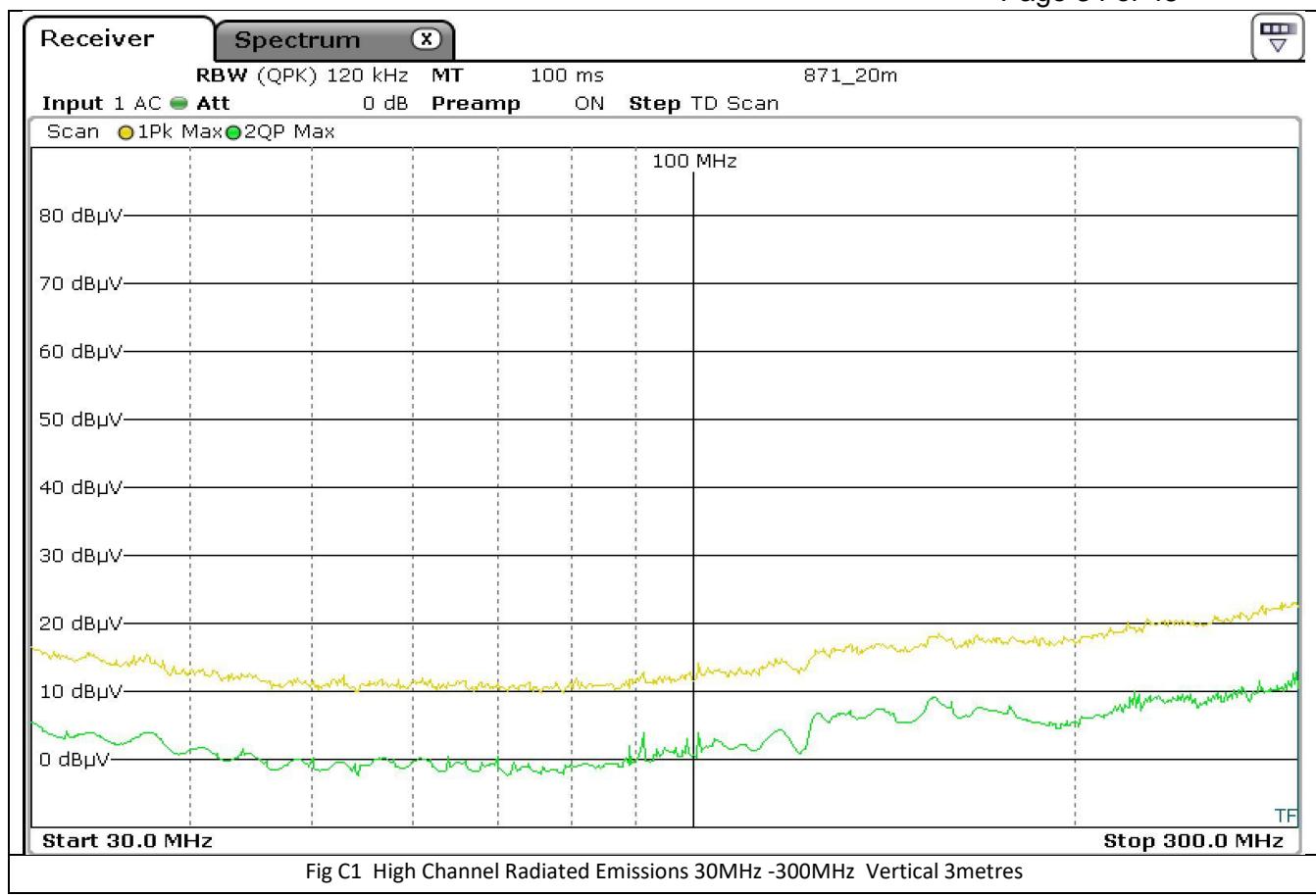


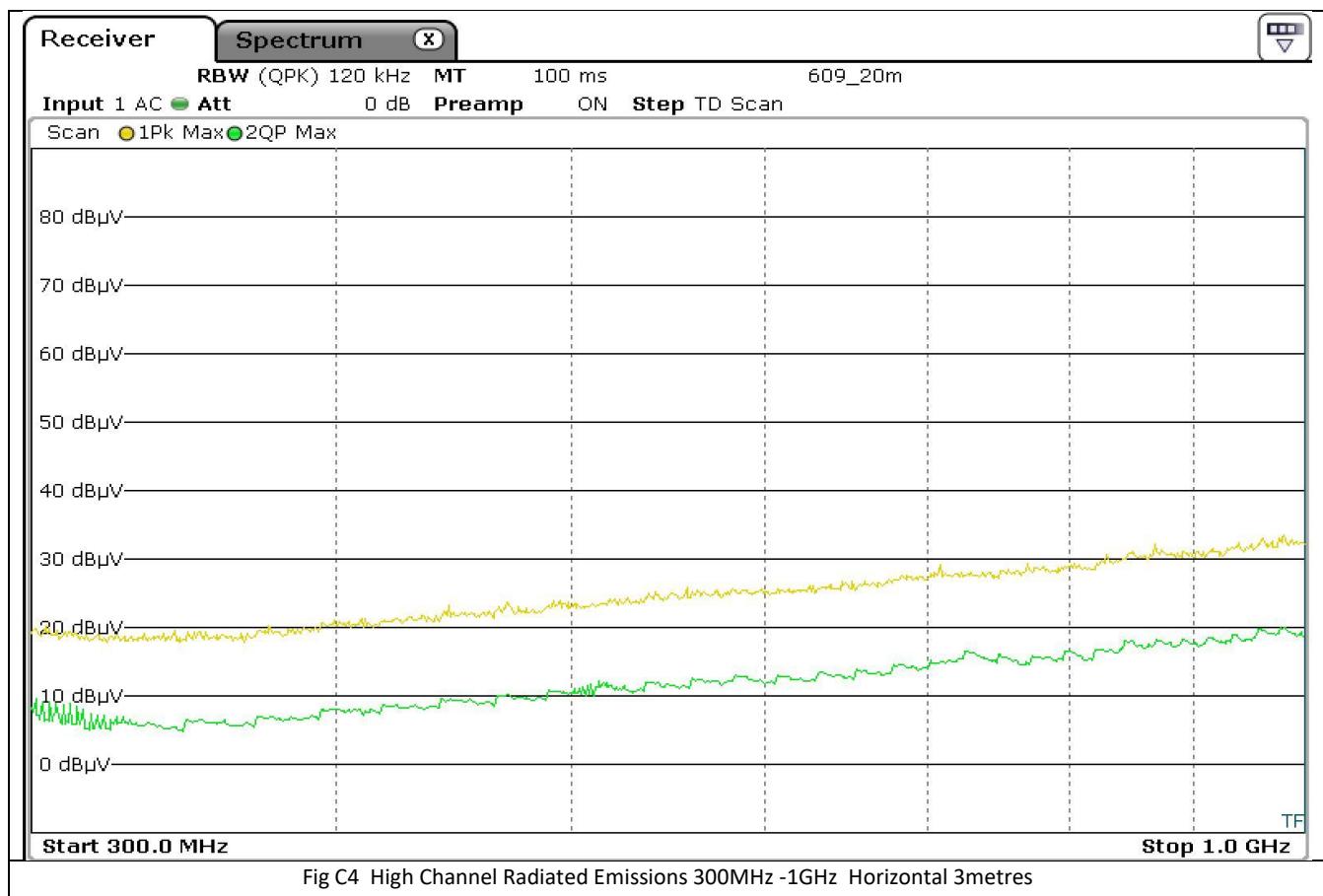
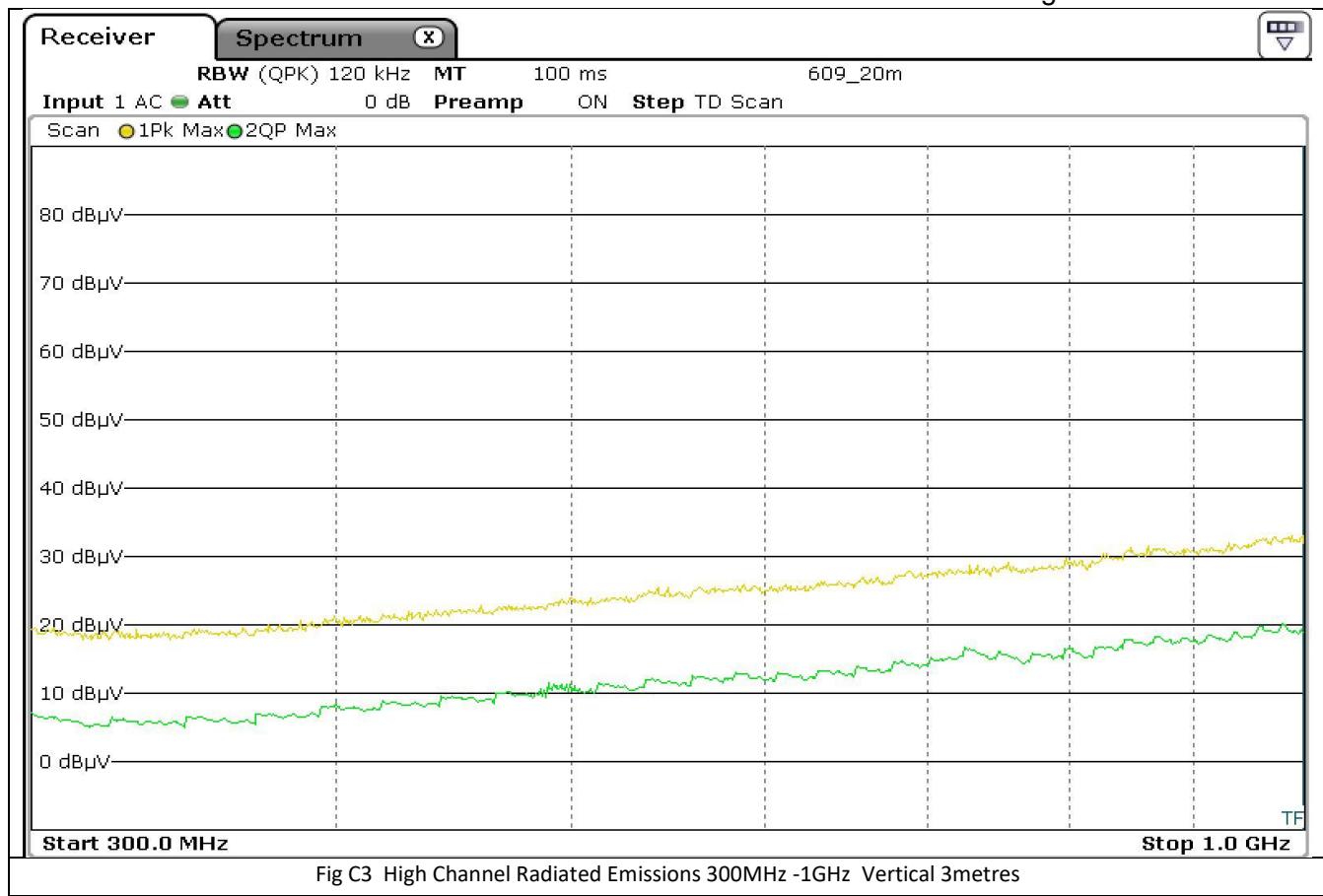


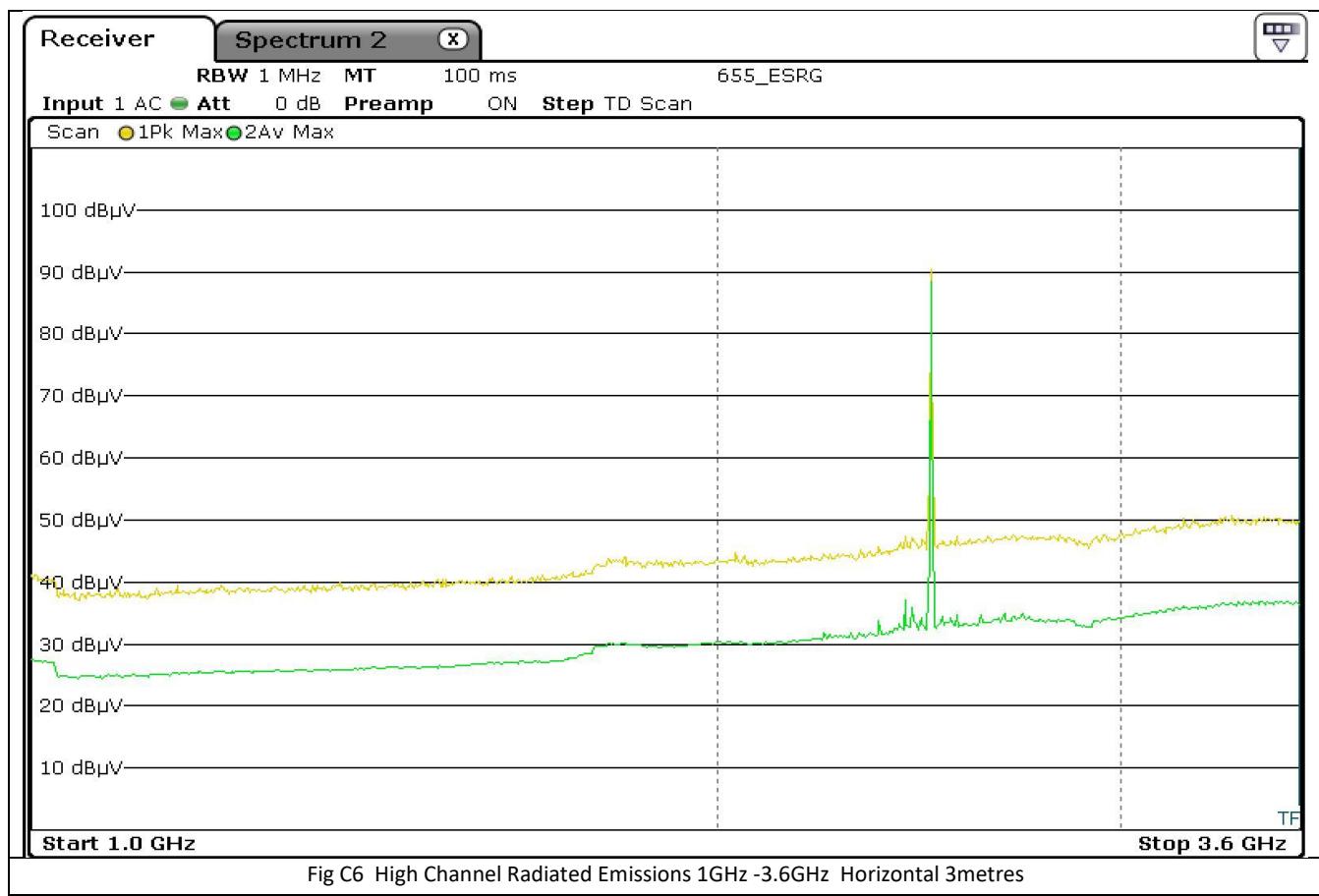
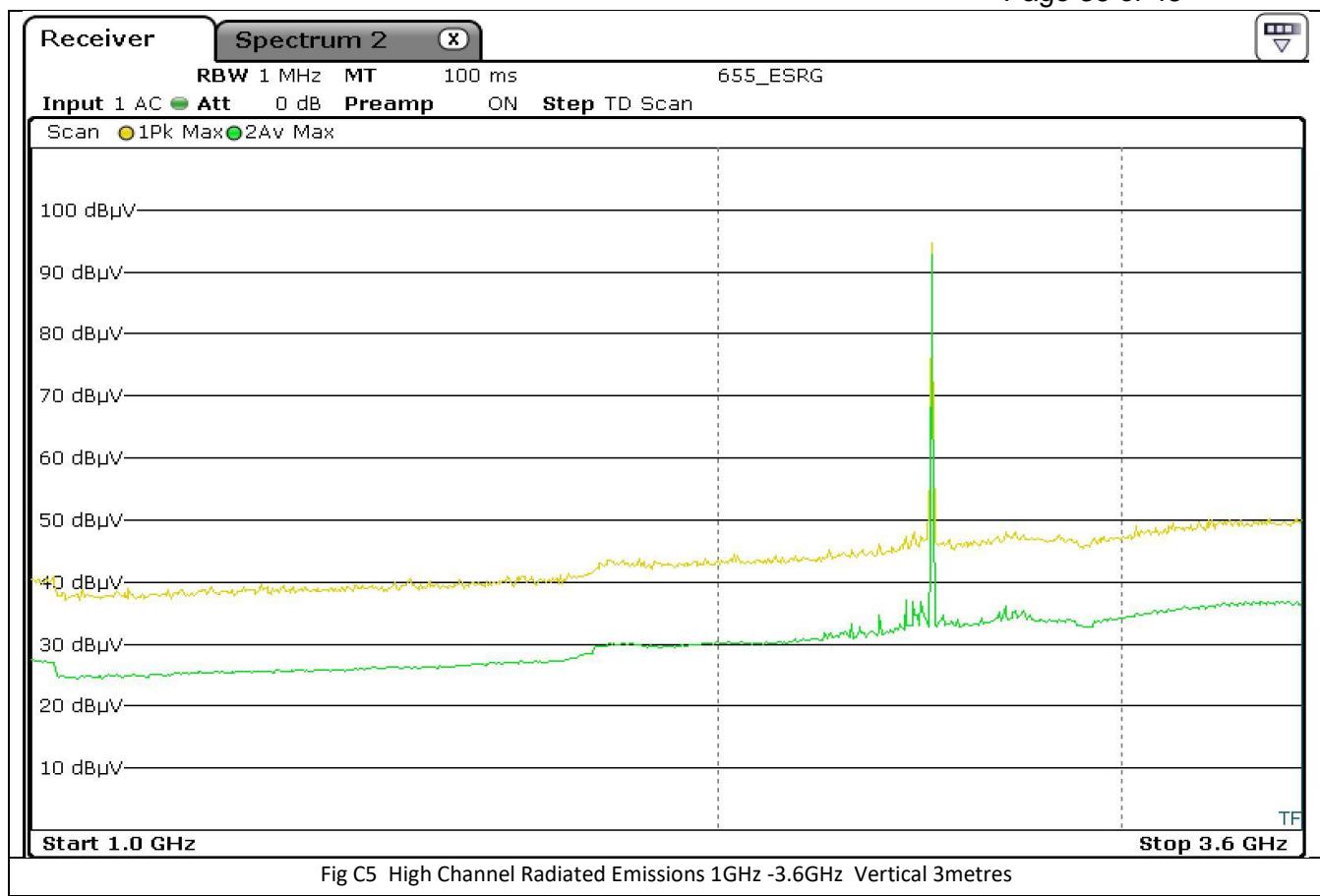


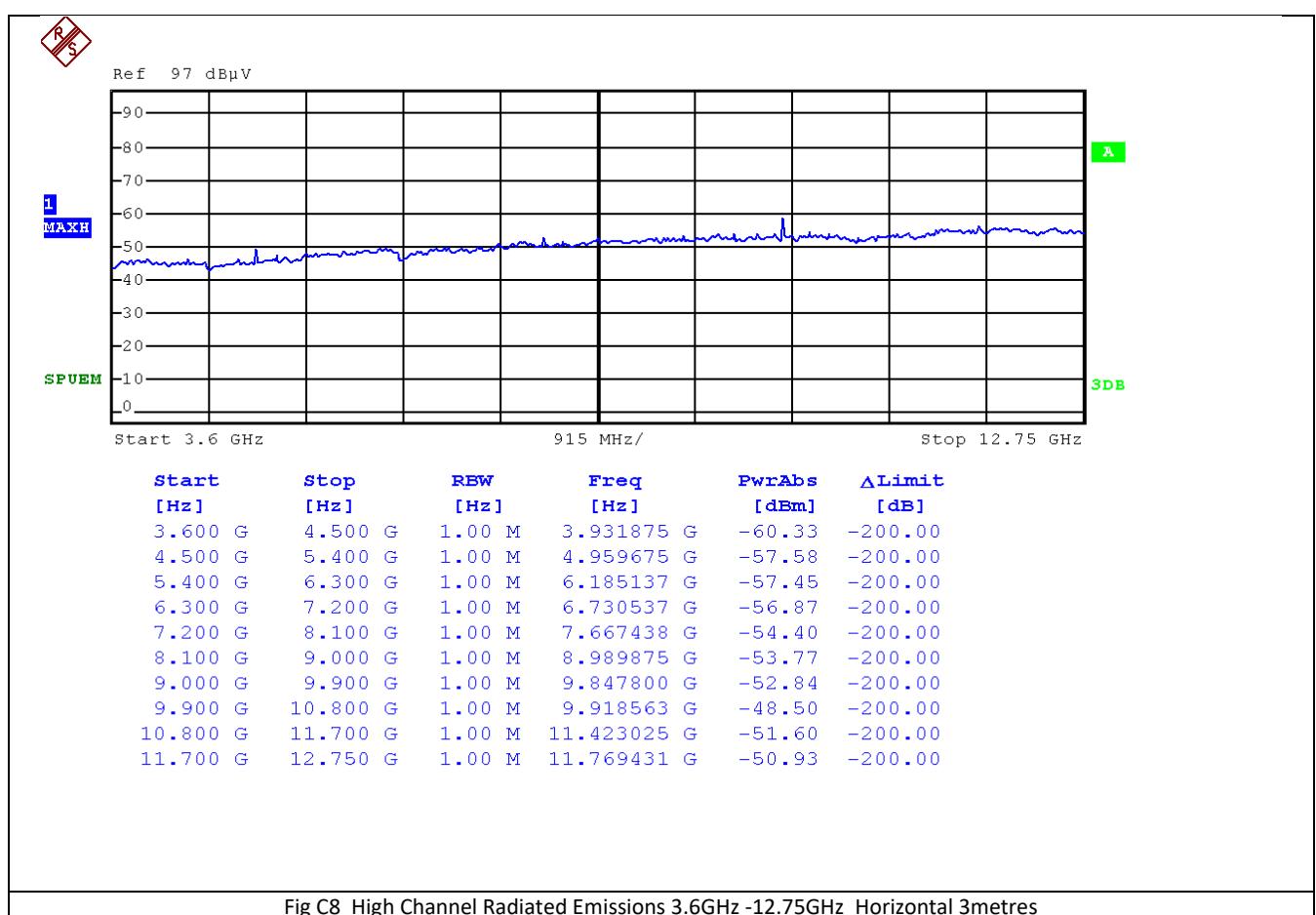
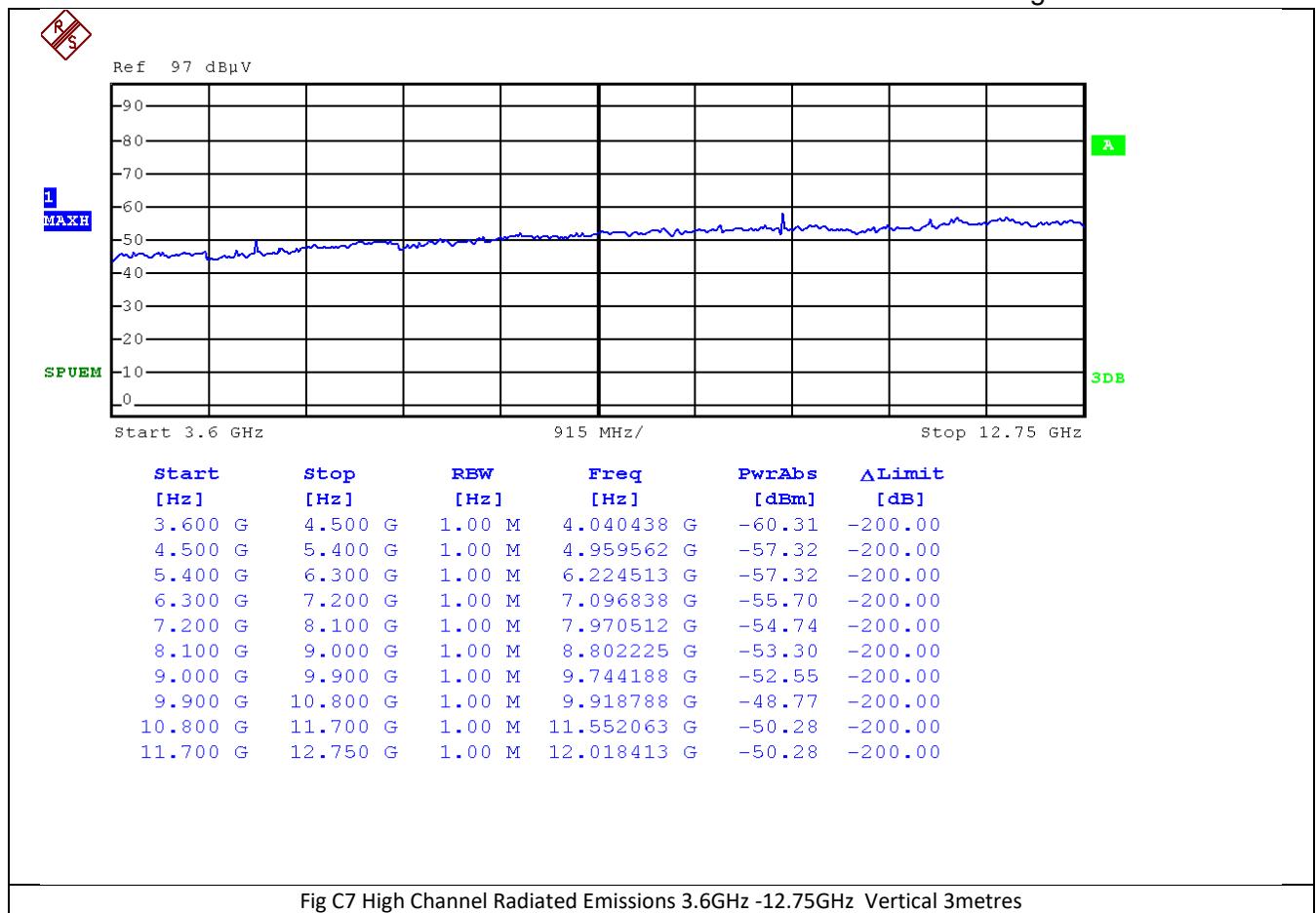


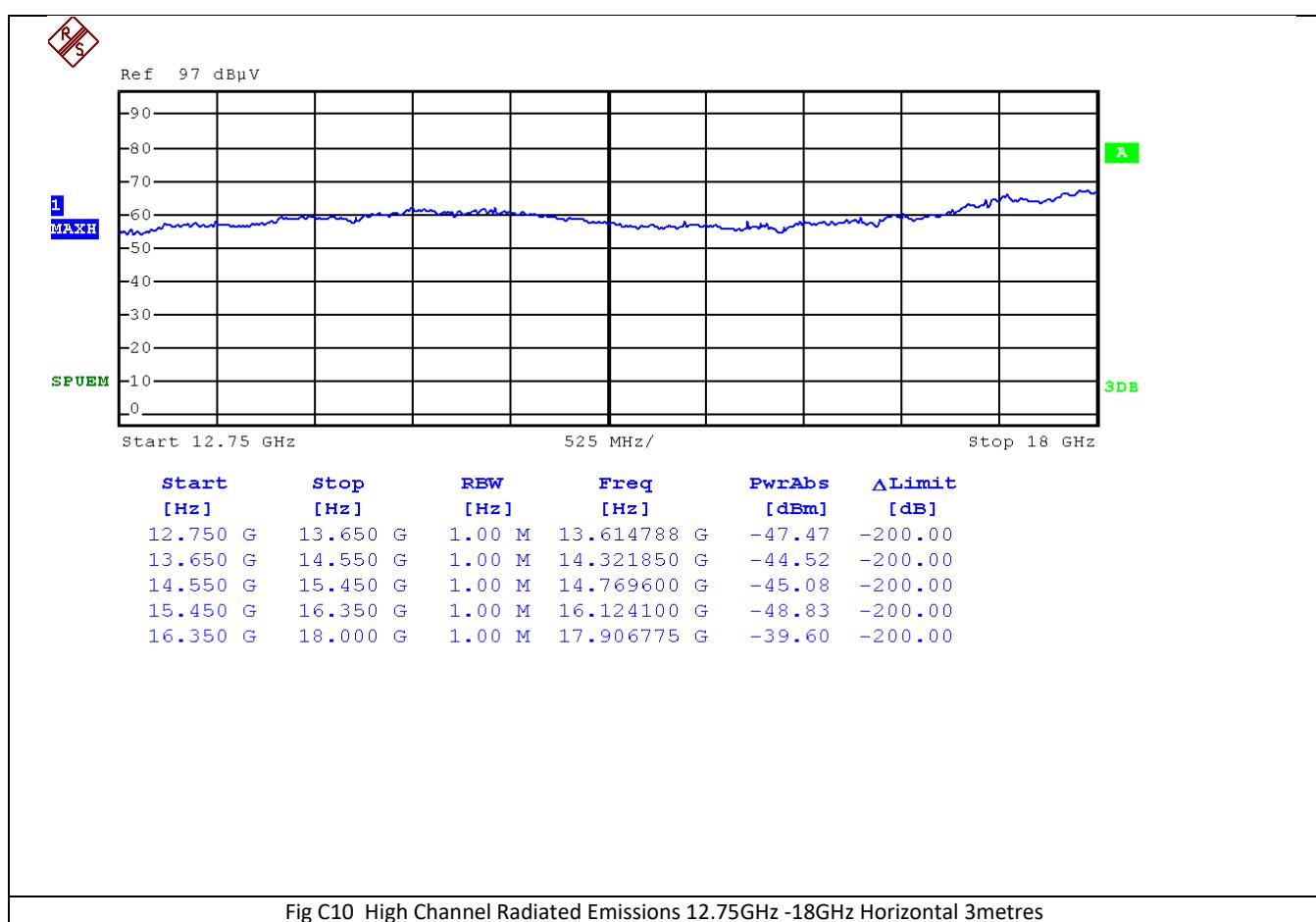
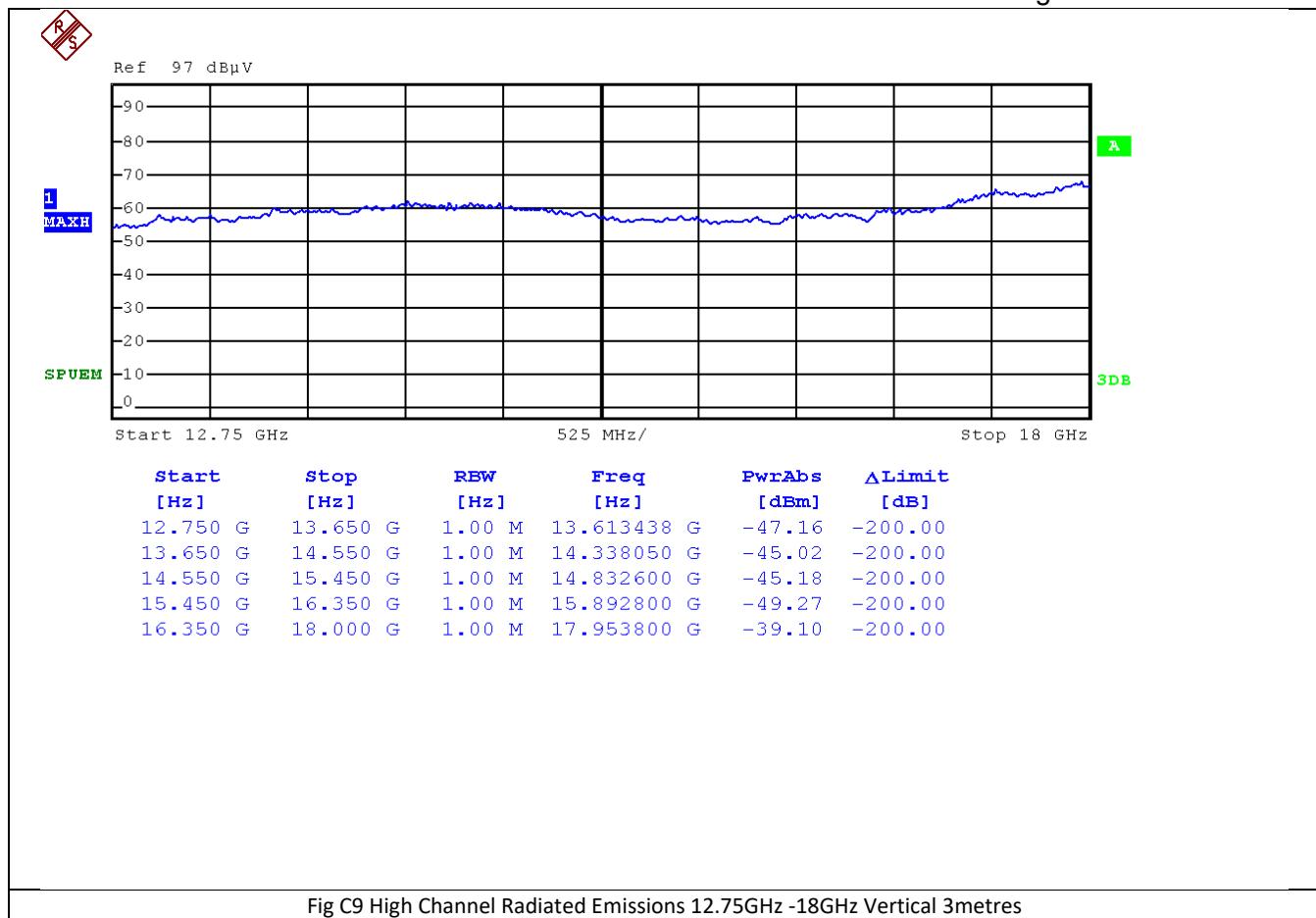
Appendix C Radiated Spurious Emissions

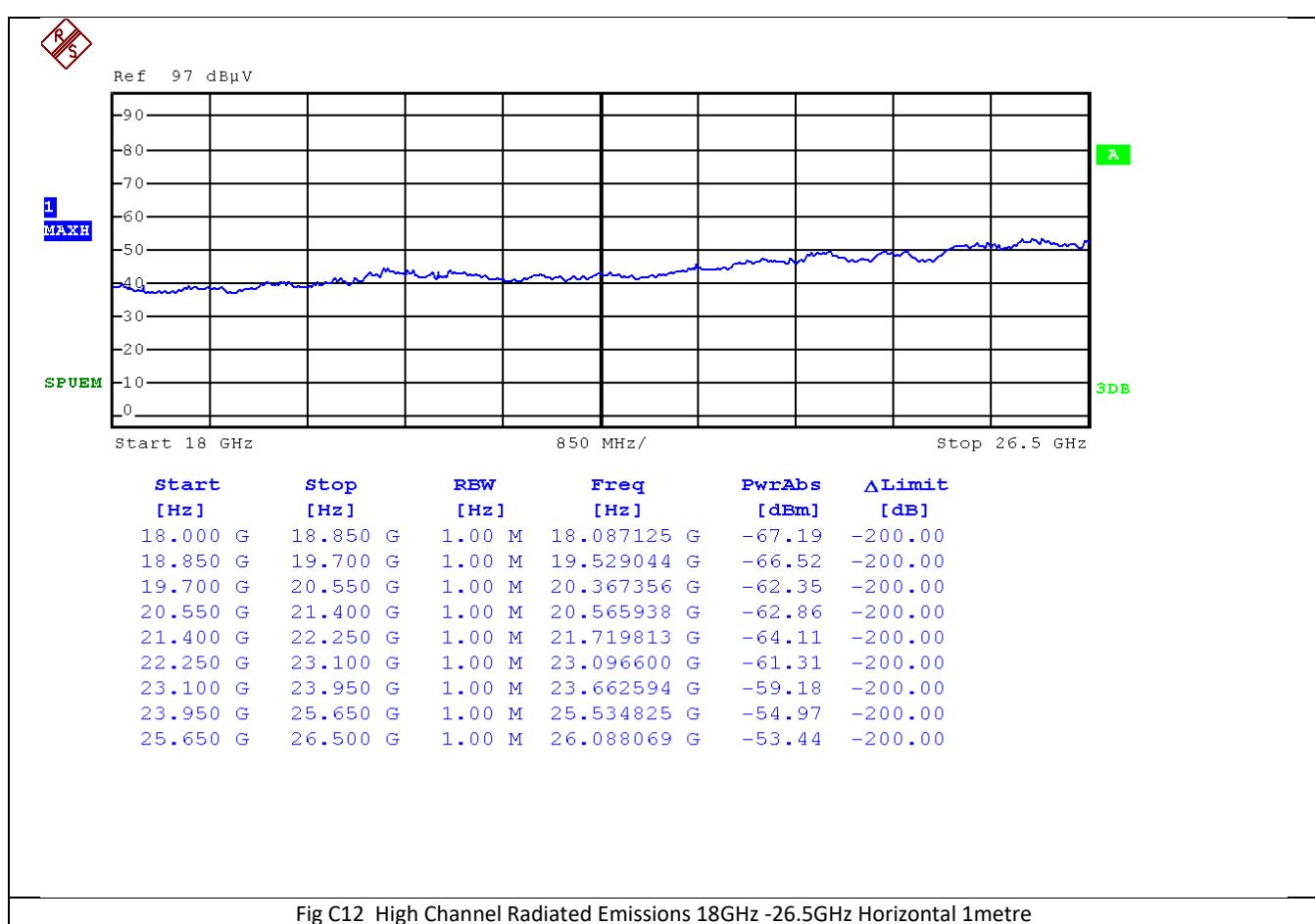
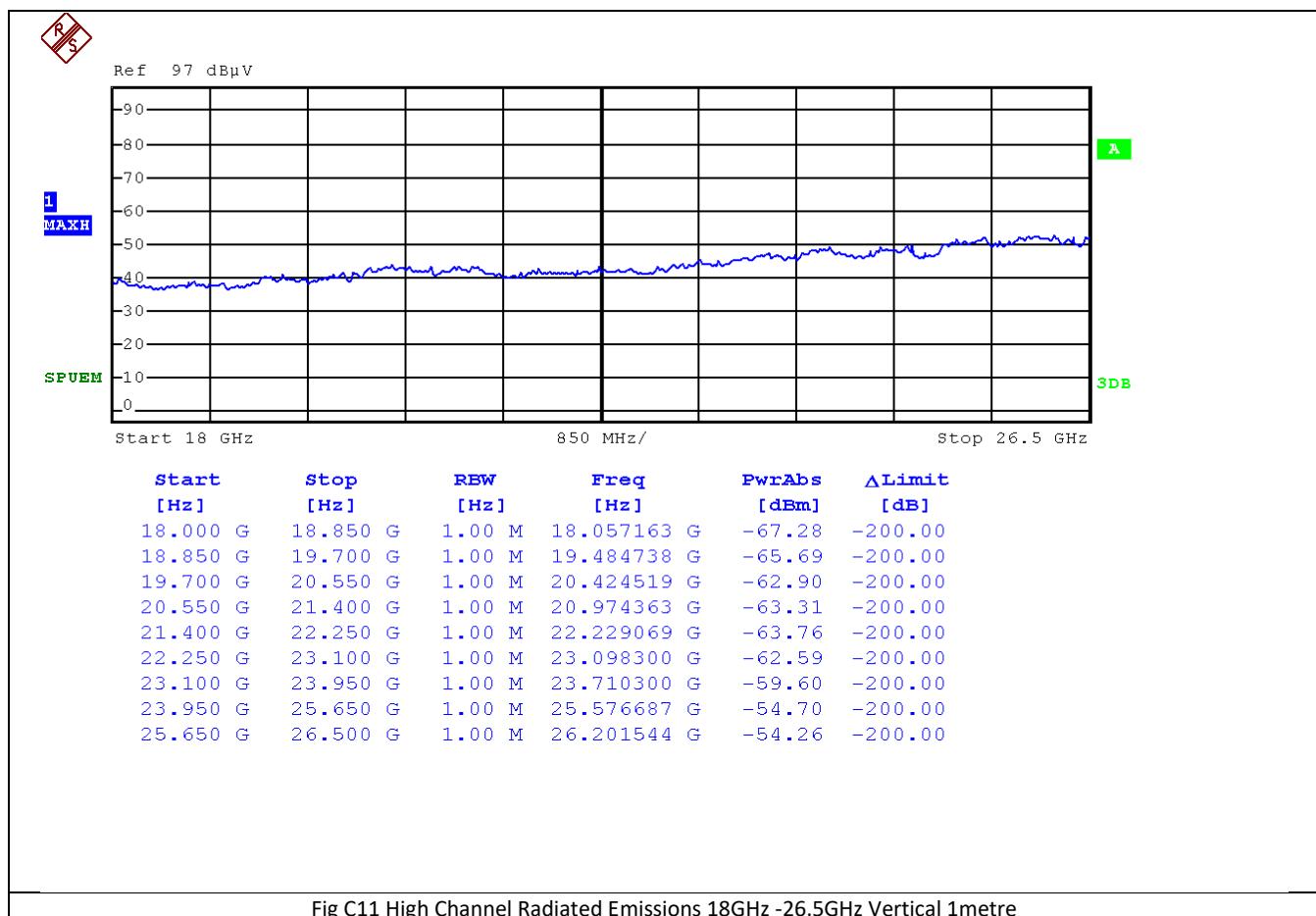












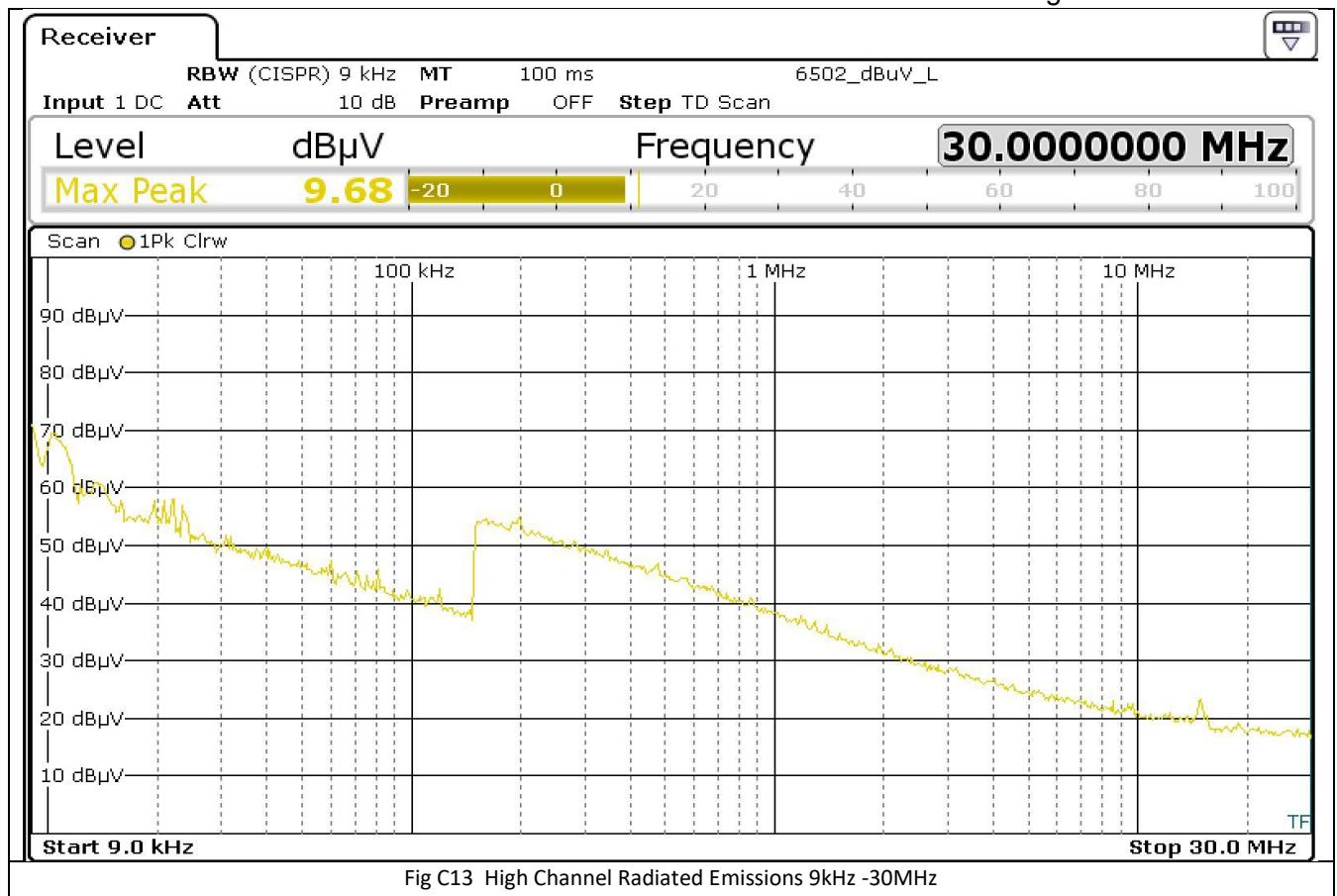


Fig C13 High Channel Radiated Emissions 9kHz -30MHz

Appendix D EUT Orientations for Radiated Emissions



Fig D1: EUT Orientation O1

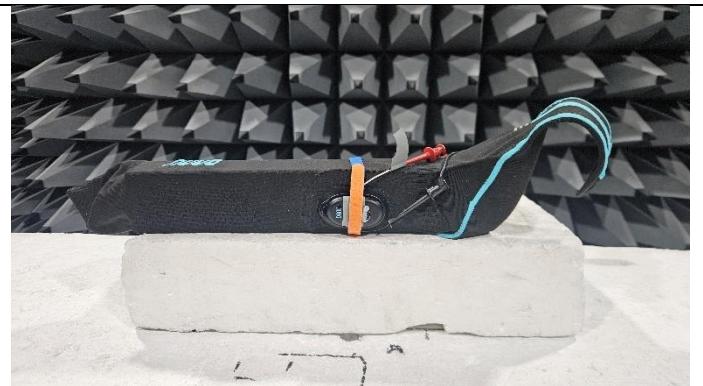


Fig D2: EUT Orientation O2

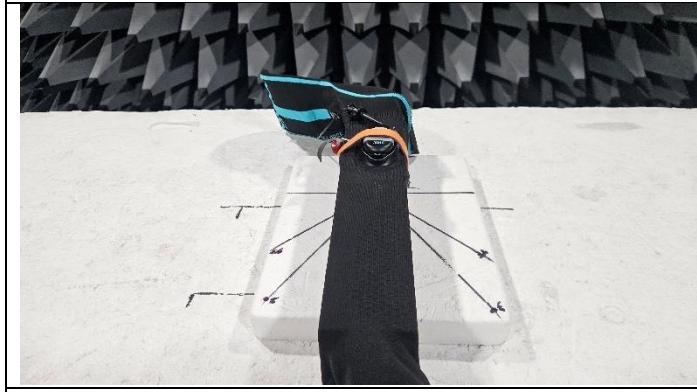


Fig D3: EUT Orientation O3

Appendix E Conducted Emissions on the mains

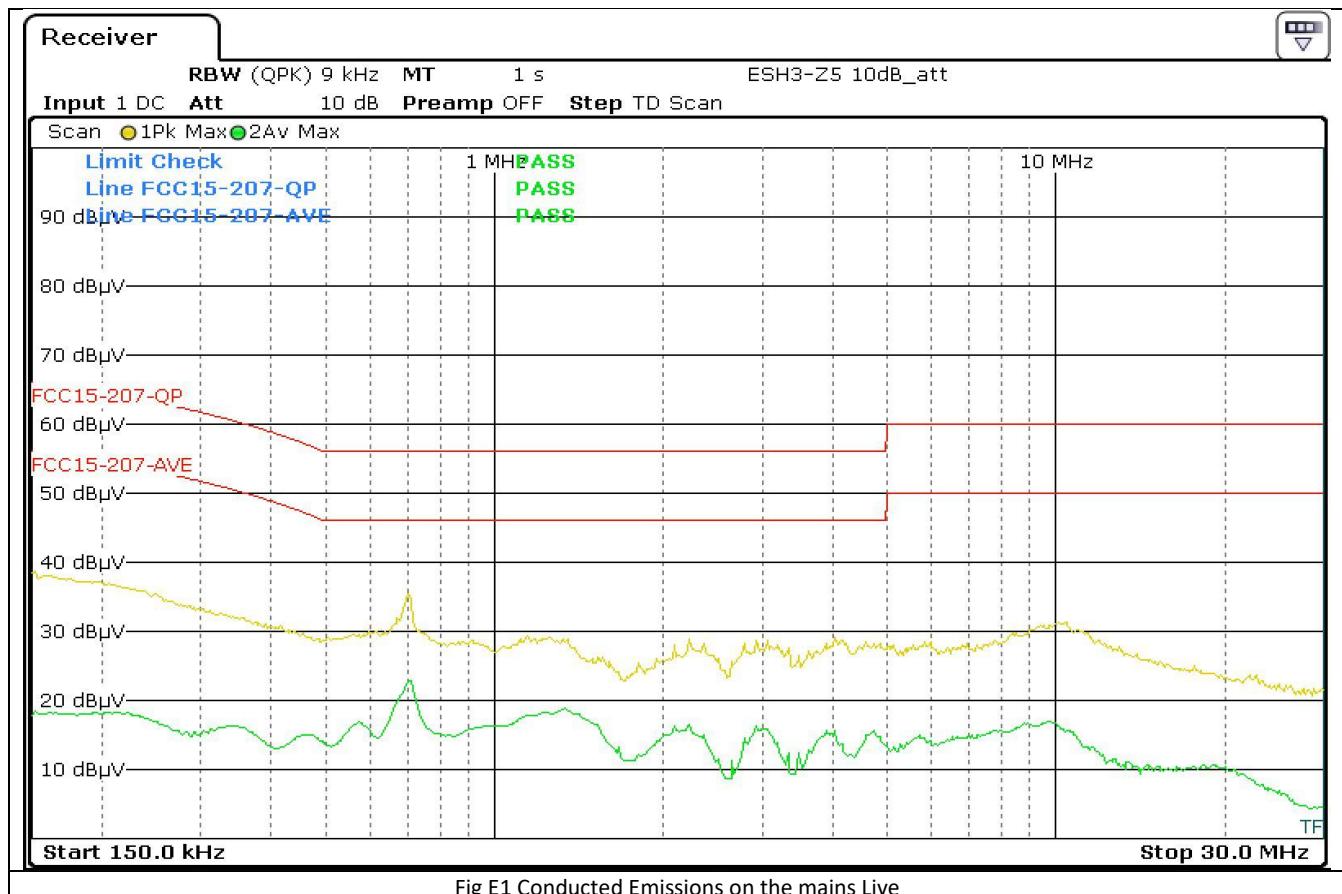


Fig E1 Conducted Emissions on the mains Live

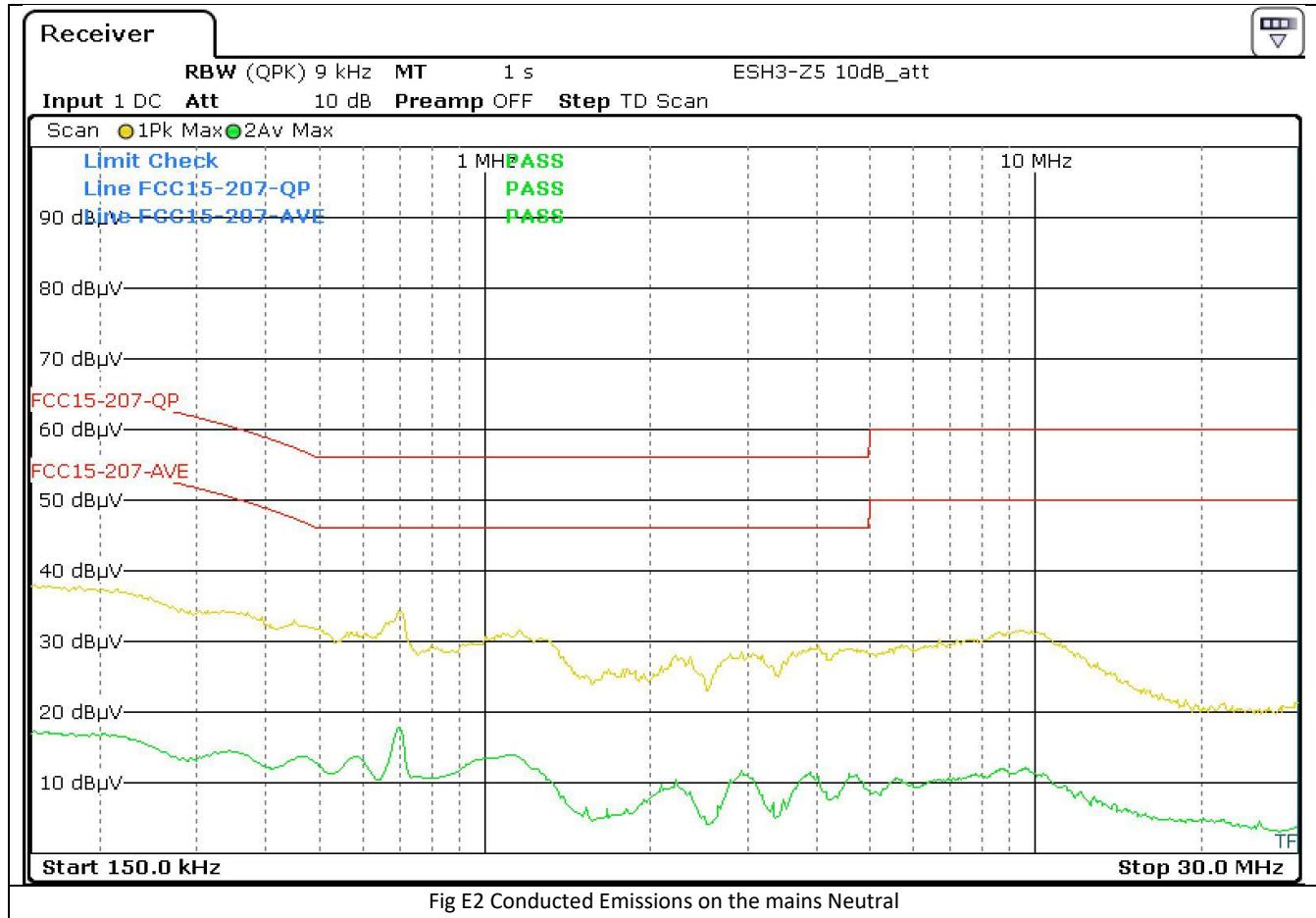
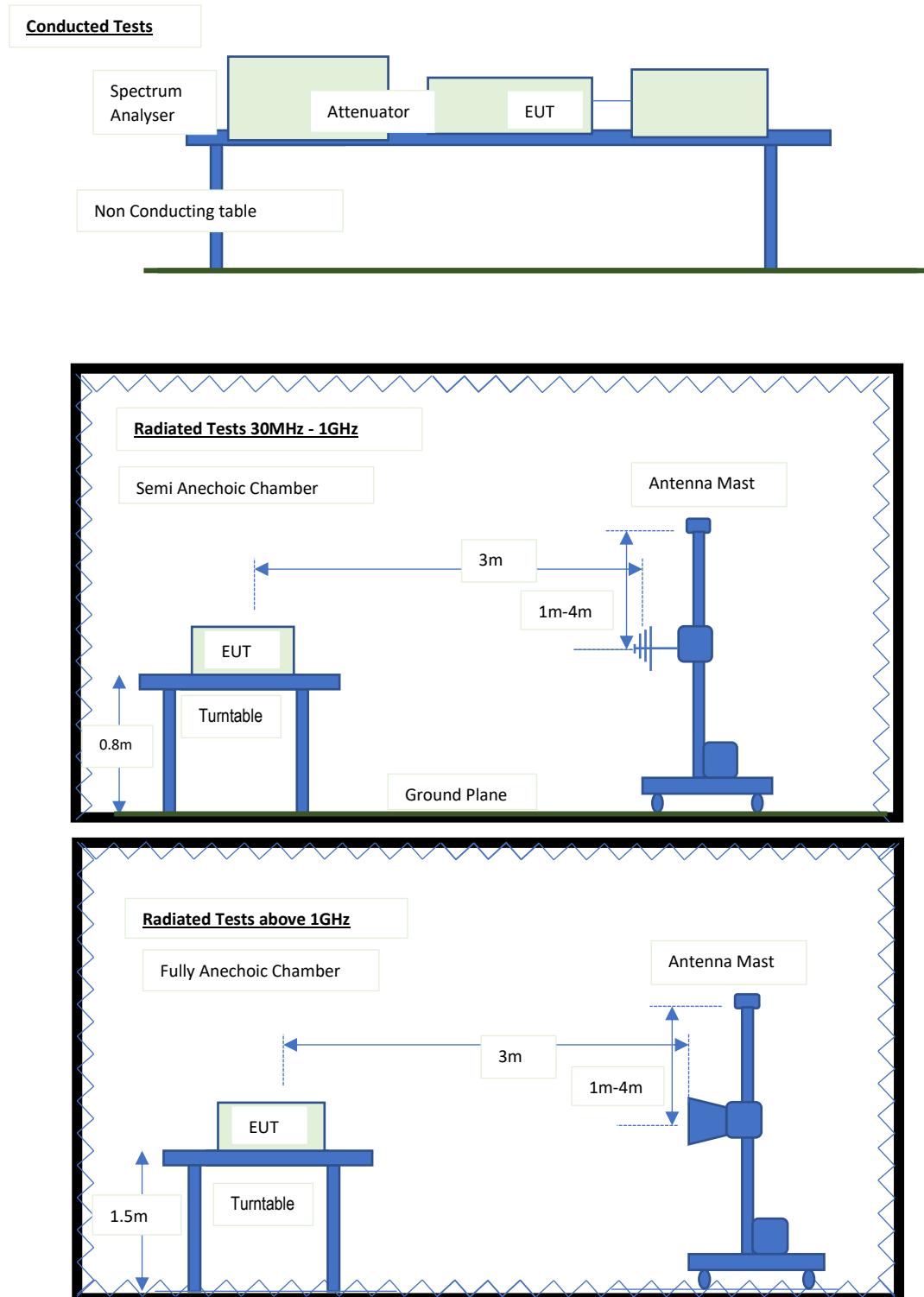
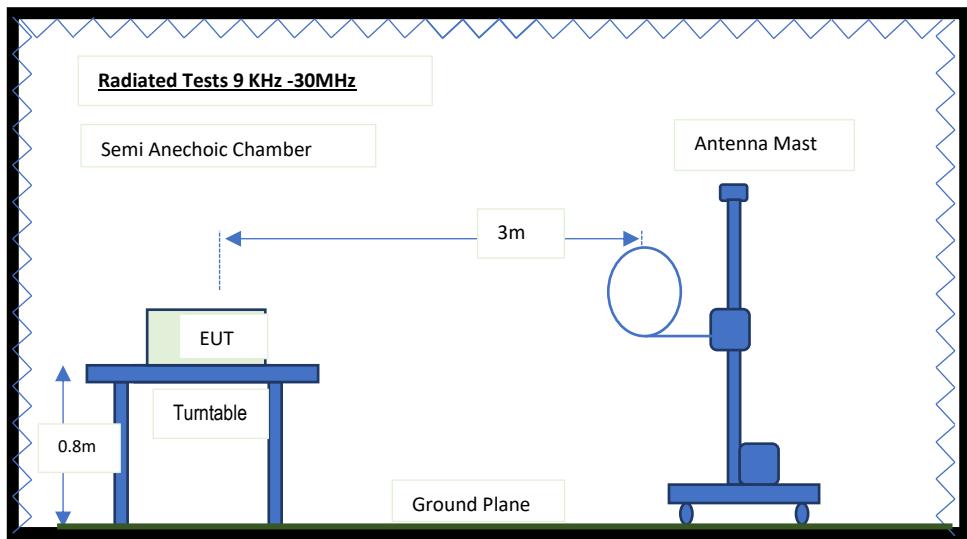


Fig E2 Conducted Emissions on the mains Neutral

Appendix F Block Diagrams of test set up





End of Report