Electromagnetic Compatibility
Test Report

Test Report No: SED 031215 Rev.3
Issued on: February 25, 2016

Product Name
SE1000-ZB (SE ZB Module)
Model: AP1168

Tested According to
FCC 47 CFR, Part 15.247 &
IC Canada RSS -247 Issue 1

Tests Performed for
SolarEdge Technologies Ltd.
1 HaMada Street, Herzeliya 4673335, Israel
Tel: +972-9-9576620

QualiTech EMC Laboratory
30 Hasivim Street,P.O.Box 7500
Petah-Tikva, 4951169, Israel
Tel: +972-3-926 6994
Fax: +972-3-928 7490

ACCREDITED
Certificate 1633.01
Electrical Testing

Test Personnel

Tests Performed By: ----------

Dmitry Isaev

Report Prepared By: ----------

Bina Talkar

Report Approved By: ----------

Rami Nataf
EMC Lab. Manager
QualiTech EMC Laboratory

Test Report details:

Test commencement date: 15.11.2015

Test completion date: 22.02.2016

Customer's representative: Elad Moskovich

Issued on: 01.03.2016

Revision details:

Version	Date	Details/Reasons
Rev. 1	03.12.2015	-
Rev. 2	09.02.2016	Added Power Line Emissions measurements to the test report.
Rev. 3	23.02.2016	Retesting per TCB's request

Assessment information:

This report contains an assessment of the EUT against Electromagnetic Compatibility based upon tests carried out on the samples submitted. The results contained in this report relate only to the items tested. Manufactured products will not necessarily give identical results due to production and measurement tolerances. QualiTech, EMC Lab does not assume responsibility for any conclusion and generalization drawn from the test results with regards to other specimens or samples of type of the equipment represented by test item.

The EUT was set up and exercised using the configuration, modes of operation and arrangements defined in this report only.

Modifications:

Modifications made to the EUT

None

Modifications made to the Test Standard

None

Summary of Compliance Status

Test Spec. Clause	Test Case	Remarks
47 CFR §15.247 (a) (2) & RSS 247 ,section 5.4 (4)	DTS Bandwidth	Pass
47 CFR §15.247 (b) (3) (4) & RSS 247,section 5.2 (1)	Fundamental Emission Output Power	Pass
47 CFR §15.247 (e) & RSS 247,section 5.2 (2)	Maximum Power Spectral Density Level in the Fundamental Emission	Pass
47 CFR §15.247 (d) & RSS 247,section 5.5	Emissions in Non-Restricted Frequency Bands	Pass
47 CFR §15.247 (d), & §15.205, §15.209(a) & RSS-Gen Issue 4,section 8.11	Emissions in Restricted Frequency Bands	Pass
47 CFR §15.247 (d) &RSS 247 ,section 5.5	Band-edge Measurements	Pass
47 CFR §15.203 & RSS-Gen Issue 4	Antenna Connector Requirements	Pass
47 CFR §15.107/207, ICES-003 RSS-GEN section 7.2.3.2	Power Line Emissions measurements	Pass

Table of Contents

1. General

1.1. Referenced documents:

ANSI C63.4-2009	Limits and Methods of Measurement for Conducted and Radiated Emissions of Information Technology Equipment
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.2. Test Facility & Uncertainty of Measurement

Accreditation/ Registration reference:

- *A2LA Certificate Number: 1633.01*
- *IC Canada: Site# 4808A-1*

Test Facility description

The tests were performed at the EMC Laboratory, QualiTech Division, ECI Telecom

Address: 30, Hasivim St., Petah Tikva, Israel.
Tel: 972-3-926-6994

3m Anechoic Chamber:

Measurement distance	3m
Chamber dimensions	9.5m x 6.5m x 5.2m
Antenna height	1 - 4m
Shielding Effectiveness	Magnetic field ≥80dB at 15 kHz ≥90dB at 100 kHz Electric field >120dB from 1MHz to 1GHz >110dB from 1GHz to 10GHz
Absorbing material	Ferrite tiles on the walls and ceiling Emerson and Cuming absorbing material in selected positions on the walls
Normalized Site Attenuation measured at 5 positions	±3.9dB, 30MHz to 200MHz ±3dB, 200MHz to 1000MHz
Transmission Loss measured at 5 positions, at 1.5m height	±3dB, 1GHz to 18GHz

Uncertainty of Measurement:
The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report according to CISPR 16-4-2 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements ". Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Test Name	Test Method & Range	Uncertainty	
		Combined std. Uc(y)	Expanded U
Radiated Emission	30MHz÷230MHz, Horiz. polar. 30MHz÷230MHz, Ver. polar. 230MHz÷1000MHz, Horiz. polar. 230MHz÷1000MHz, Vert. polar.	[dB] 1.8 1.967 1.487 1.499	[dB] 3.6 3.934 2.973 2.998
Conducted Emission	9 kHz÷150 kHz 150 kHz÷30MHz	[dB] 1.378 1.095	[dB] 2.756 2.190
Radio frequency	Up to 18 GHz	$\pm 1*10^{-6}$	$< \pm 1*10^{-5}$
Total Conducted RF Power	Up to 18 GHz	±1.378 dB	< ±1.5dB
Conducted Power density	Up to 18 GHz	±1.378 dB	< ±3dB
Temperature	23.6 °C	±0.6°C	< ±2°C
Humidity	54.9%	±3.1%	< ±5%
DC Voltage	0-60 VDC	±0.3%	< ±3%

Note: QualiTech EMC labs expanded measurement instrumentation has less uncertainty than the industry norm and compliance is deemed to occur as no measured disturbance exceeds the disturbance limit.

Note: The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

1.3. Description of the EUT /test Item:

Product name: SE1000-ZB (SE ZB Module)

FCC ID: 2AGPT-SEZB

IC: 20916-SEZB

Frequency Band: 2405 MHz -2480 MHz

Modulation method: QPSK

Emission designator: 3M22G7D

Measured BW: 3216 kHz

Antenna Gain: 2.4 – 2.5 GHz 5dBi Super Mini Omni Directional Outdoor Antenna (N-Male), model OI-242505-M

1.4. Conducted RF Measurements:

The RF output of the transmitter under test was directly connected to the input of the Spectrum analyzer through a specialized antenna connector provided by the manufacturer, and an attenuator as specified. The external attenuator and cable loss were added to the reading. Worst-case results of the various modulation modes (where applicable) were reported.

For PSD, emission peak was zoomed within the pass band with spectrum analyzer's settings as reported (Sweep time=Span/3 kHz)

For Maximum Conducted Output Power an Average Power Meter was used.

For spurious emissions measurement, the spectrum from 9 kHz to 40 GHz was investigated with the transmitter set to the lowest, middle and highest channel frequencies.

For bandedge measurement allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section. Submit this plot.

Radiated Emissions Measurements in the restricted bands:

For radiated emissions, which fall in the restricted bands the spectrum from 1MHz to 25GHz was investigated following the guidelines in ANSI C63.4-2009, with the transmitter set to the lowest, middle and highest channel frequencies. Measurements were performed with peak detector and repeated averaged with VBW=10 Hz. Only Peak detection plots are presented. Worst-case results of the various modulation modes (where applicable) were reported.

1.5. Radiated Emission measurements:

Measurements were performed at a 3-meter measurement distance in the semi-anechoic chamber in order to evaluate the radiated electromagnetic interference characteristics of the EUT. The EUT was placed on a non-metallic table/support, 0.8m above the turntable, was configured, arranged and operated in a manner consistent with typical application and load conditions. The test program of exercising the equipment ensured that various parts of the EUT were exercised to permit detection of all EUT disturbances.
An appropriate antenna depending upon the frequency range, per ANSI C63.4-2009 clause 4.1.5 was used. While the turntable was being rotated, the height of the antenna was varied from 1 to 4m for the frequency range of 30MHz to 1GHz. The highest radiated emission was detected by manipulating the EUT through three axis(x,y,z) and system cables, a worst-case results are reported by max hold function
This process was repeated for both antenna polarizations. The spectrum up to 40 GHz was investigated for spurious emissions, using a band-reject filter where appropriate.
The amplitudes of worst-case emission were measured with the detector modes and resolution bandwidths over various frequency ranges according to the requirements of ANSI C63.4-2009 clause 4.2.

1.6. Worst Case Results:

In order to determine the worst case emissions for all modes/data rates/tests, all modes/data rates were investigated for each required test to determine which produces the worst- case data and then full testing was performed in that mode/data rate

2. Test Facility & Uncertainty of Measurement

2.1. Accreditation/ Registration reference:

- *A2LA Certificate Number: 1633.01*

2.2. Test Facility description

The tests were performed at the EMC Laboratory, QualiTech Division, ECI Telecom Group

Address: 30, Hasivim St., Petah Tikva, Israel.
Tel: 972-3-926-6994

Semi Anechoic Configuration:

Measurement distance	3m
Chamber dimensions	9.5m x 6.5m x 5.2m
Antenna height	1 - 4m
Shielding Effectiveness	Magnetic field ≥80dB at 15 kHz ≥90dB at 100 kHz Electric field >120dB from 1MHz to 1GHz >110dB from 1GHz to 10GHz
Absorbing material	Ferrite tiles on the walls and ceiling Emerson and Cuming absorbing material in selected positions on the walls
Normalized Site Attenuation measured at 5 positions	±3.9dB, 30MHz to 200MHz ±3dB, 200MHz to 1000MHz
Transmission Loss measured at 5 positions, at 1.5m height	±3dB, 1GHz to 18GHz

2.3. Uncertainty of Measurement:

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report according to CISPR 16-4-2 "Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements ". Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Test Name	Range	Expanded U lab Uncertainty	U CISPR Uncertainty
Radiated Emission	30MHz -200MHz, Horiz. Polar.	± 4.77 dB	±5.06
	30MHz - 200MHz, Ver. Polar.	± 4.90 dB	±5.17
	200MHz -1000MHz, Horiz. Polar.	± 4.96 dB	±5.34
	200MHz -1000MHz, Vert. Polar.	± 6.15 dB	±6.32
	1.0GHz - 6.0GHz	± 4.33 dB	±5.18
	6.0GHz -18.0GHz	± 4.75 dB	±5.48
Conducted Emission	9 kHz -150 kHz	± 3.47 dB	±3.83
	150 kHz -30MHz	± 3.18 dB	±3.44

Note: QualiTech EMC labs expanded measurement instrumentation has less uncertainty than the industry norm and compliance is deemed to occur as no measured disturbance exceeds the disturbance limit.

Note: The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

3. Report of Measurements and Examinations

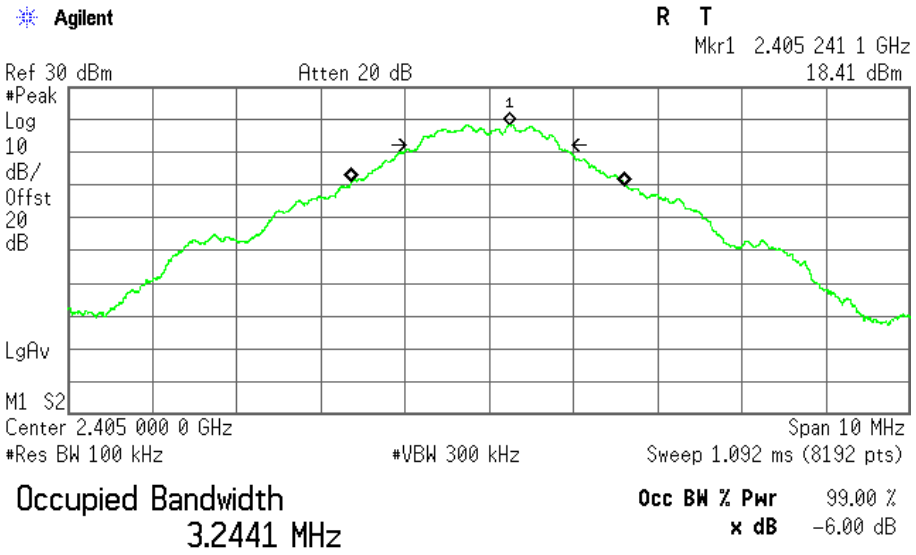
3.1. 6dB DTS Bandwidth

Reference document:	**47 CFR §15.247 (a)(2) & RSS 247 ,section 5.4 (4)**		
Test Requirements:	Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725–5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.		
Test setup:	See sec 2.1	Pass	
Method of testing:	KDB 558074 D01 v03r03, Sec.8.1 Conducted		
Operating conditions:	Under normal test conditions		
S.A. Settings:	RBW: 100 kHz, VBW: 3 MHz		
Environment conditions:	Ambient Temperature: 21°C	Relative Humidity: 48%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 3.1.1 – Plot 3.1.3	

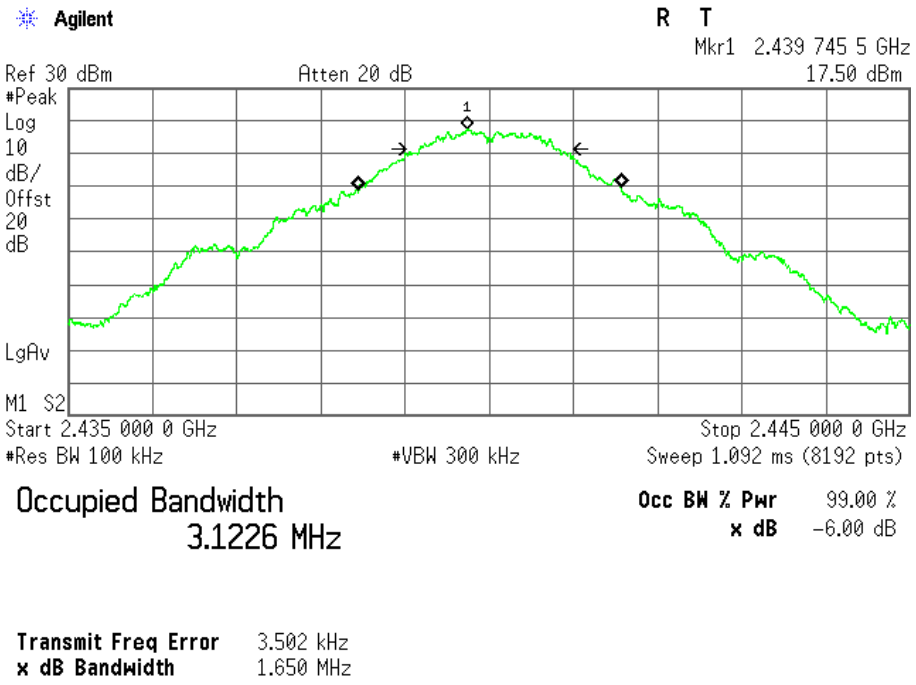
Test results:

Fundamental Frequency, [MHz]	6 dB DTS Bandwidth, [kHz]	Minimum Bandwidth, [kHz]	Pass/Fail
2405.0	1640.0	500.0	Pass
2440.0	1650.0	500.0	Pass
2480.0	1623.0	500.0	Pass

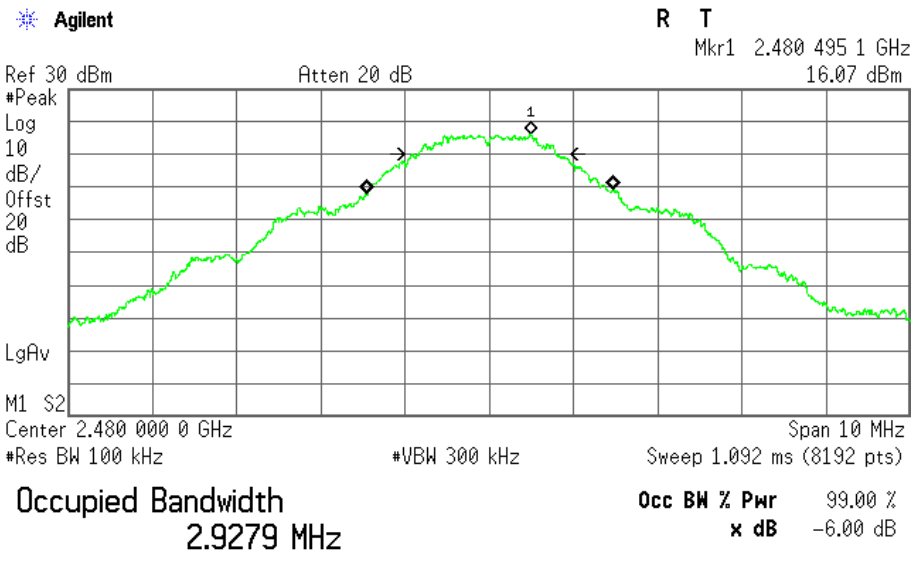
Plot 3.1.1: 6 dB DTS Bandwidth, Fc = 2405MHz



Plot 3.1.2: 6 dB DTS Bandwidth, Fc = 2440MHz



Plot 3.1.3: 6 dB DTS Bandwidth, Fc = 2480MHz



3.2. Fundamental Emission Output Power

Reference document:	**47 CFR §15.247 (b)(3)(4) & RSS 247,section 5.2 (1)**		
Test Requirements:	The maximum peak conducted output power of the intentional radiator for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands shall not exceed 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted (average) output power. The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.		
Test setup:	See sec 2.1	Pass	
Method of testing:	KDB 558074 D01 v03r03, Sec.9.1.2, PKPM1 Peak Power Meter Method		
Operating conditions:	Under normal test conditions		
Settings:	Triggered/signal-gated broadband power meter		
Environment conditions:	Ambient Temperature: 21°C	Relative Humidity:48 %	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	--	

Test Results:

Fundamental Frequency, [MHz]	Fundamental Emission Output Power, [dBm]	Fundamental Emission Output Power, [mW]	Limit, [mW]	Margin, [mW]	Pass/Fail
2405.0	22.8	190.5	1000.0	-809.5	Pass
2440.0	22.3	170.0	1000.0	-830.0	Pass
2480.0	21.4	138.0	1000.0	-862.0	Pass

3.3. Maximum Power Spectral Density Level in the Fundamental Emissions

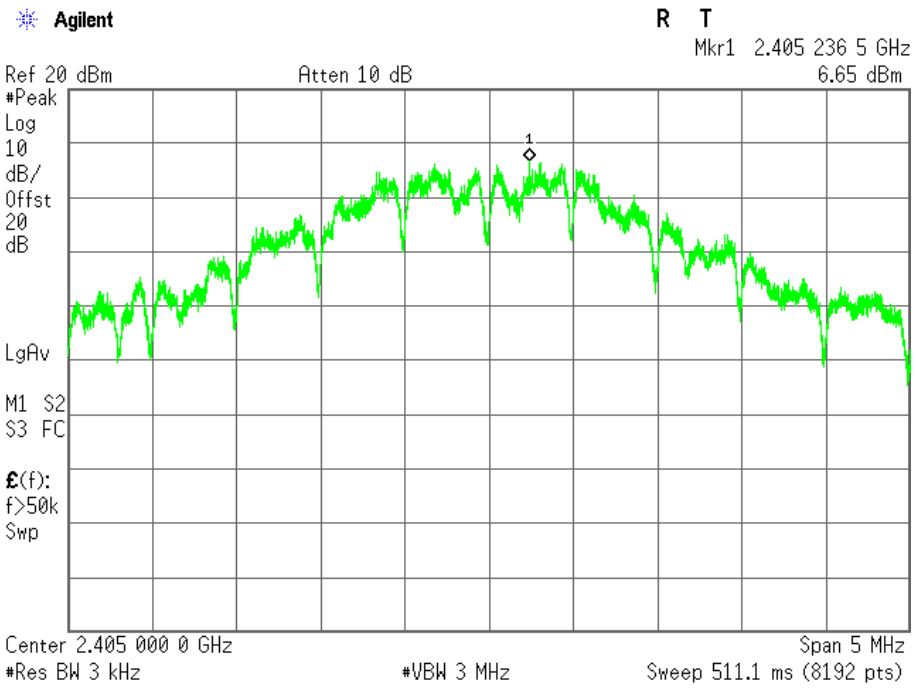
Reference document:	**47 CFR §15.247 (e) & RSS 247, section 5.2 (2)**		
Test Requirements:	For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.		
Test setup:	See sec 2.1	Pass	
Method of testing:	KDB 558074 D01 v03r03, Sec.10.2 Conducted, PKPSD method		
Operating conditions:	Under normal test conditions		
S.A. Settings:	RBW: 30 kHz, VBW: 3 MHz		
Environment conditions:	Ambient Temperature: 21 °C	Relative Humidity: 48%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 3.3.1 - Plot 3.3.3	

Test Results:

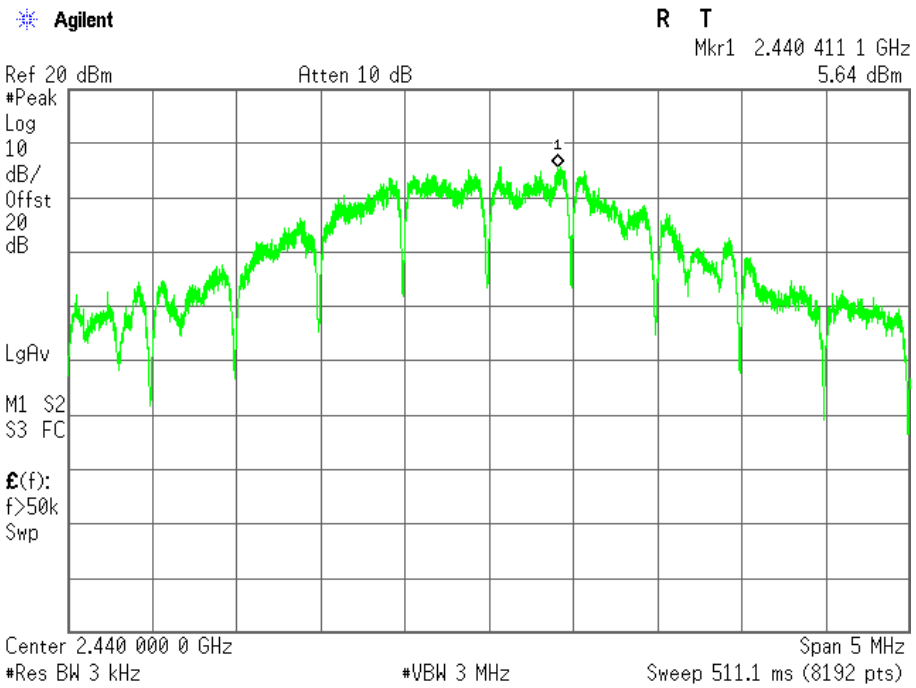
Fundamental Frequency, [MHz]	PSD Measured, [dBm/3kHz]	PSD Limit, [dBm/3kHz]	Margin, [dB]	Pass/Fail
2405.000	6.65	8.0	-1.35	Pass
2440.000	5.64	8.0	-2.36	Pass
2480.000	4.56	8.0	-3.44	Pass

*Margin = PSD Measured – PSD Limit

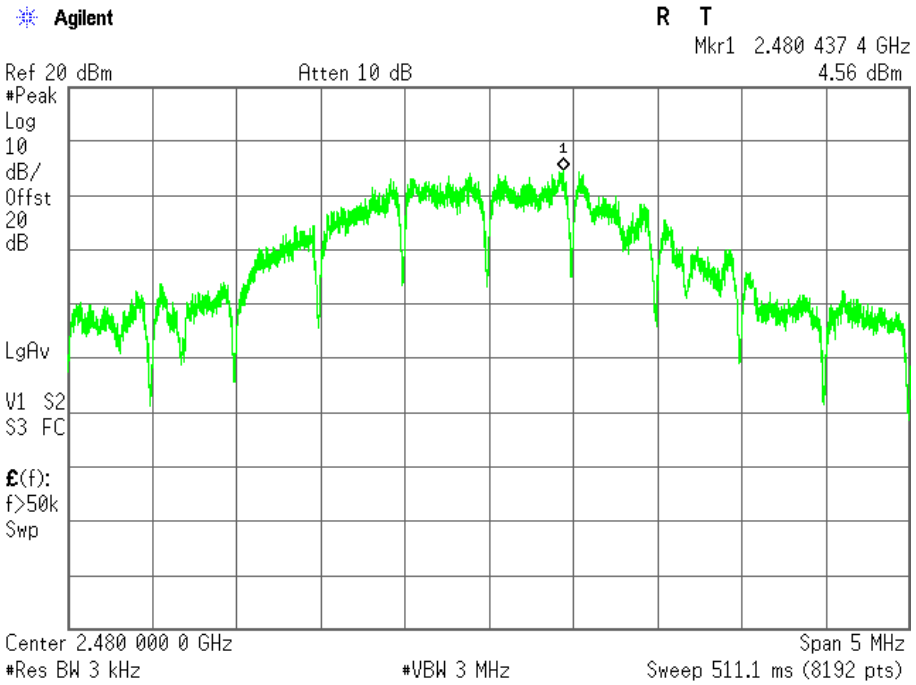
Plot 3.3.1 Maximum Power Spectral Density test results, Fc = 2405MHz



Plot 3.3.2 Maximum Power Spectral Density test results, Fc = 2440MHz



Plot 3.3.3 Maximum Power Spectral Density test results, Fc = 2480MHz



3.4. Emissions in Non-Restricted Frequency Bands

Reference document:	**47 CFR §15.247 (d) & RSS 247,section 5.5**		
Test Requirements:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (See §15.205(c)).		
Test setup:	See sec 2.1	**Pass**	
Method of testing:	KDB 558074 D01 v03r03 Sec.11.1, a) Conducted		
Operating conditions:	Under normal test conditions		
S.A. Settings:	RBW: 100 kHz, VBW:3 MHz		
Environment conditions:	Ambient Temperature: 21°C	Relative Humidity: 48%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 3.4.1- Plot 3.4.9	

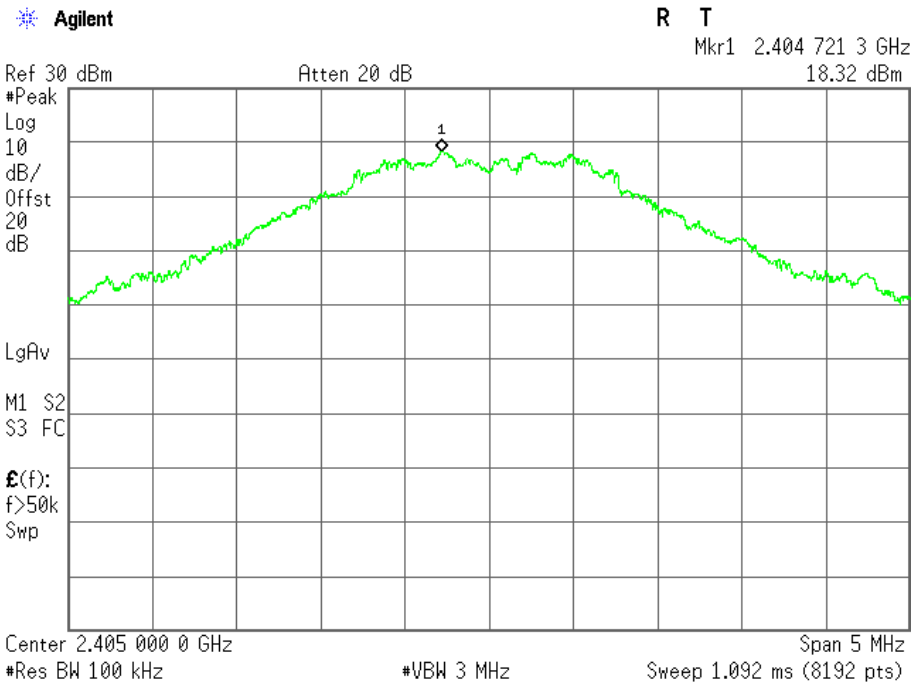
Test results:

Unwanted Emissions Measurements:

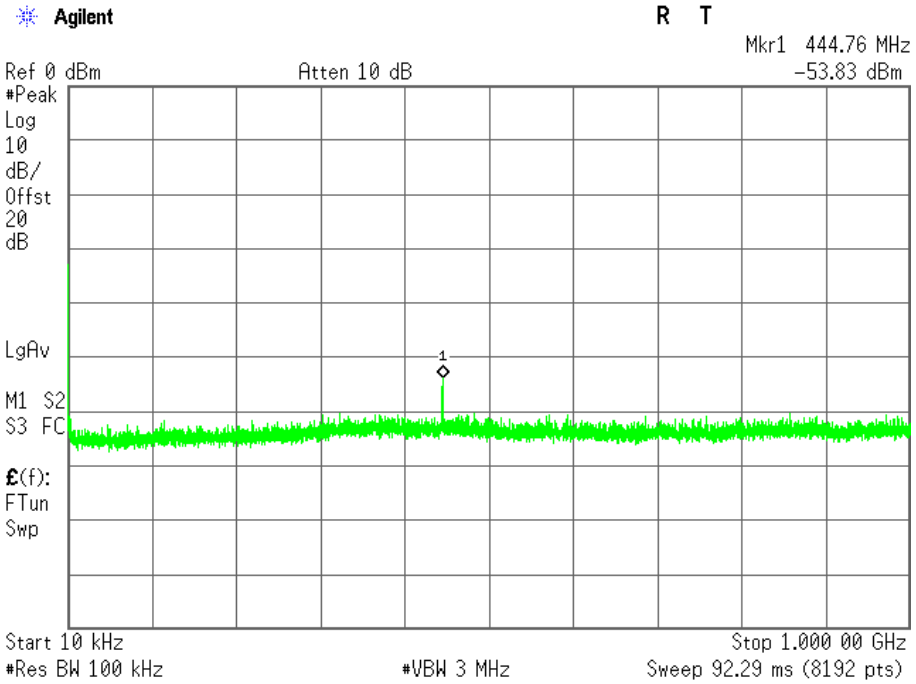
Fundamental Frequency, [MHz]	Fundamental Emission Reference Level, [dBm]	Unwanted Emissions Frequency, [MHz]	Unwanted Emissions Level, [dBm]	Attenuation Below Fundamental, [dB]	Minimum Attenuation Below Fundamental, [dB]	Margin*, [dB]	Pass/Fail
2405.0	18.3	444.760	-53.8	72.1	≥ 20.00	-52.1	Pass
		4812.000	-43.2	61.5		-41.5	
2440.0	17.4	478.820	-55.7	73.1	≥ 20.00	-53.1	Pass
		4882.300	-43.0	60.4		-40.4	
2480.0	16.8	518.740	-57.7	74.5	≥ 20.00	-54.5	Pass
		4958.500	-45.8	62.6		-42.6	

Margin = Minimum Attenuation below Fundamental - Attenuation below Fundamental

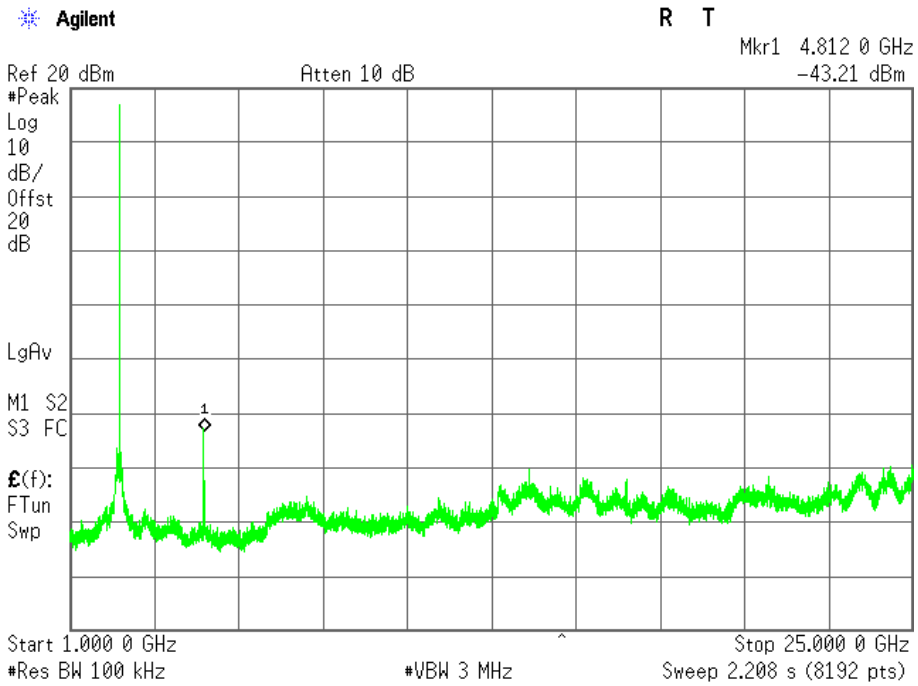
Plot 3.4.1 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results, Fundamental Emission Reference Level, Fc = 2405 MHz



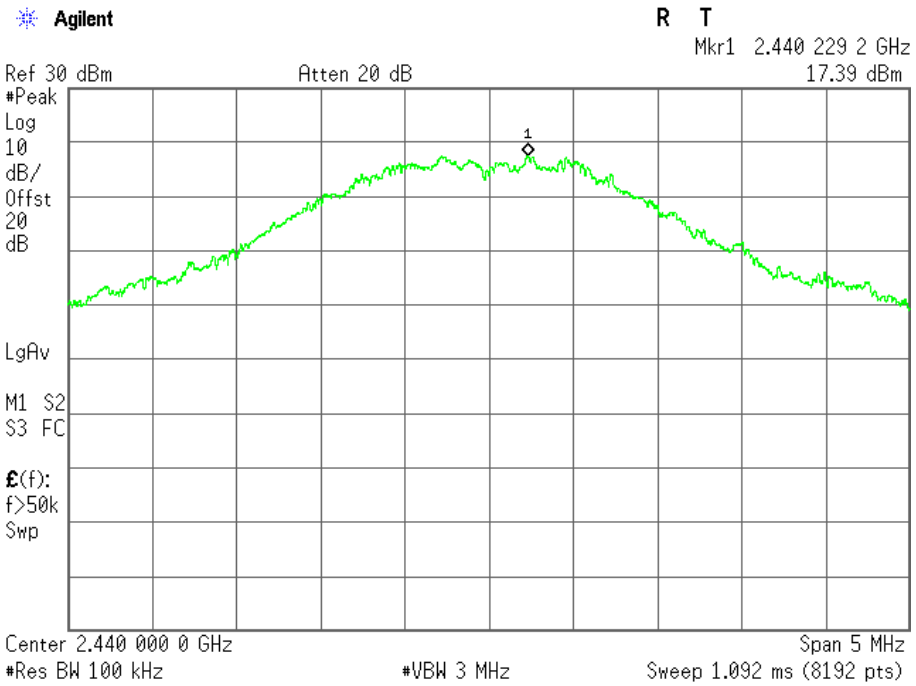
Plot 3.4.2 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results in 9 kHz – 1 GHz frequency range, Fc = 2405 MHz



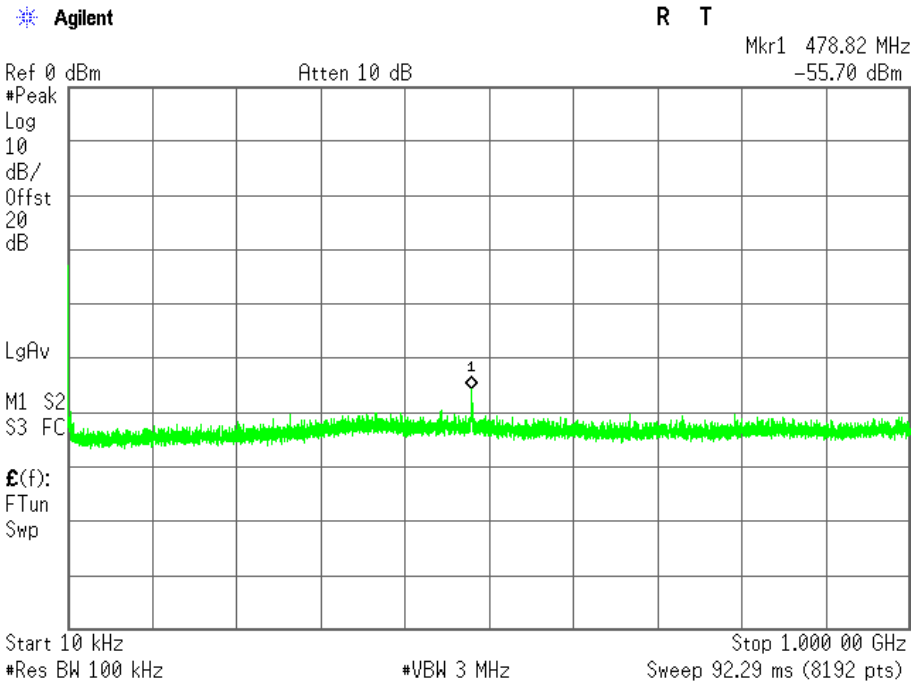
Plot 3.4.3 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results in 1 GHz – 25 GHz frequency range, Fc = 2405 MHz



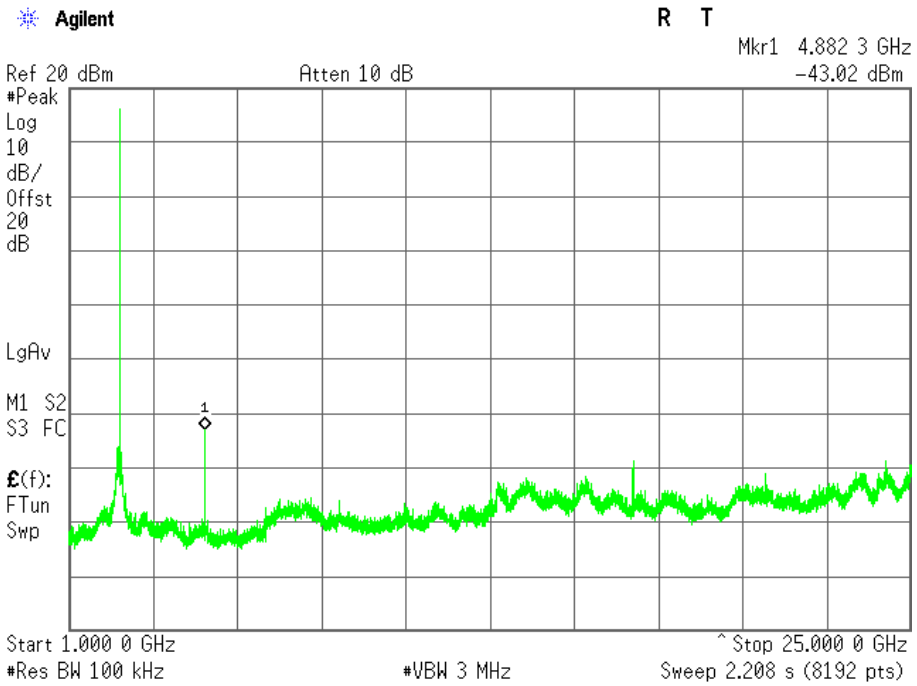
Plot 3.4.4 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results, Fundamental Emission Reference Level, Fc = 2440 MHz



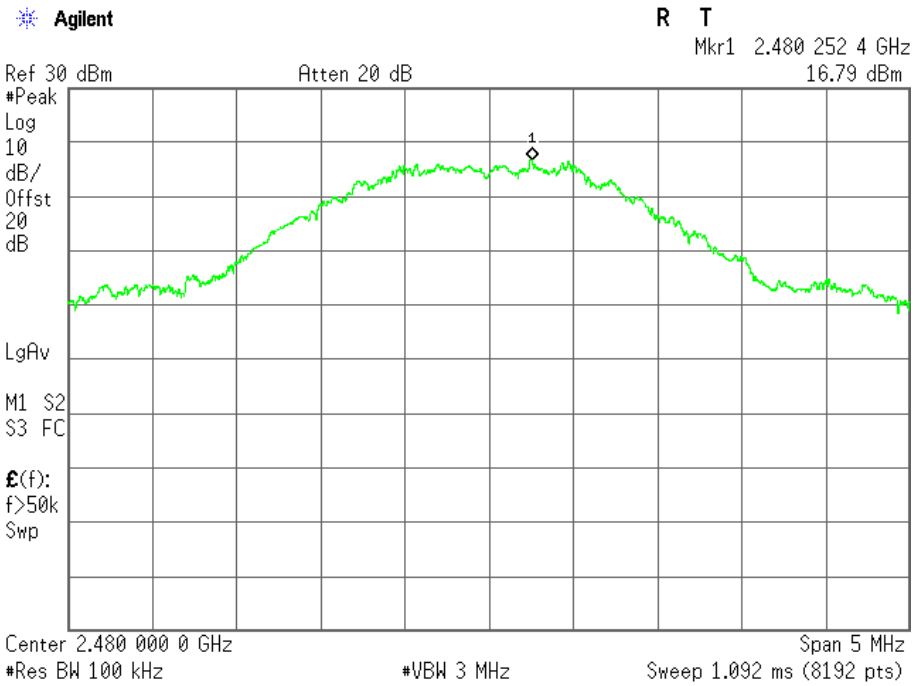
Plot 3.4.5 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results in 9 kHz – 1 GHz frequency range, Fc = 2440 MHz



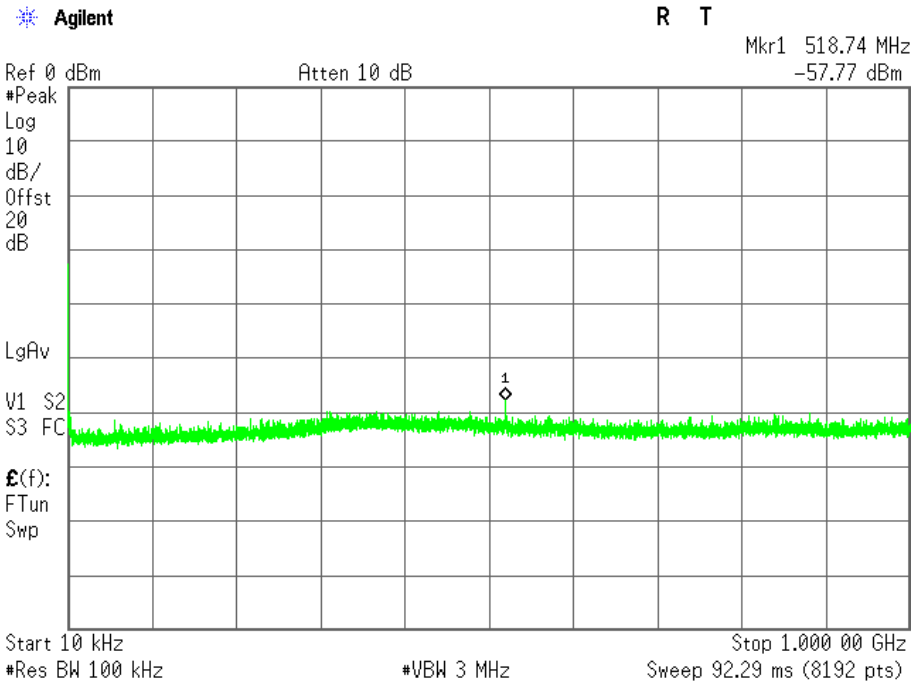
Plot 3.4.6 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results in 1 GHz – 25 GHz frequency range, Fc = 2440 MHz



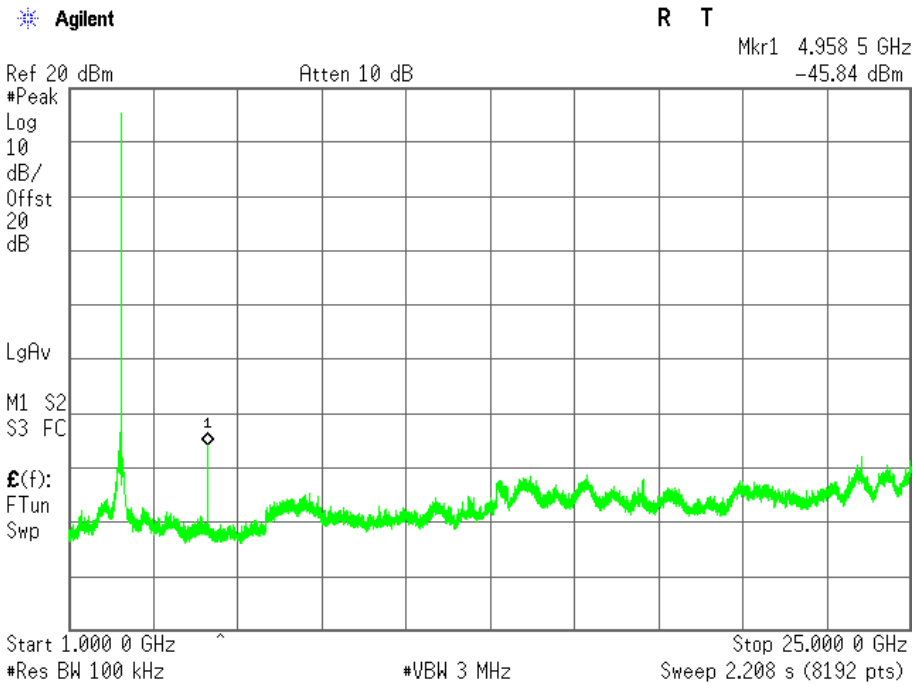
Plot 3.4.7 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results, Fundamental Emission Reference Level, Fc = 2480 MHz



Plot 3.4.8 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results in 9 kHz – 1 GHz frequency range, Fc = 2480 MHz



Plot 3.4.9 Unwanted Conducted Emissions into Non-Restricted Frequency Bands test results in 1 GHz – 25 GHz frequency range, Fc = 2480 MHz



3.5. Emissions in restricted frequency bands

Reference document:	**47 CFR §15.247 (d), & §15.205, & §15.209(a) RSS-Gen Issue 4, section 8.11**		
Test Requirements:	Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must comply with the radiated emissions limits specified in §15.209(a) (see §15.205(c)).		
Test setup:	See sec 2.2	Pass	
Method of testing:	KDB 558074 D01 v03r03, Sec.12.1 Radiated emission		
Operating conditions:	Under normal test conditions		
S.A. Settings:	According to KDB 558074 D01 v03r03		
Environment conditions:	Ambient Temperature: 22°C	Relative Humidity: 54%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 3.5.1 - Plot 3.5.36	

Limits:

30MHz to 1GHz frequency range:

Frequency [MHz]	QP Limit [dBµV /m] Class A	QP Limit [dBµV /m] Class B
30÷88	49.5	40.0
88÷216	54.0	43.5
216÷960	57.0	46.0
960÷1000	60.0	54.0

Above 1GHz frequency range:

Frequency [GHz]	AVR Limit [dBµV m] Class A	AVR Limit [dBµV /m] Class B
Above 1GHz	74	54

Test results:

Test results below 1GHz:

All measurements were done in horizontal and vertical polarizations; the results show the worst case.

Fundamental Frequency, MHz	Unwanted Emission Frequency, MHz	Antenna Polarization	QP Measured Emission, dBµV/m	Limit, dBµV/m	Delta, dB	Pass/Fail
2405	41.340	V	28.5	40.0	-11.5	Pass

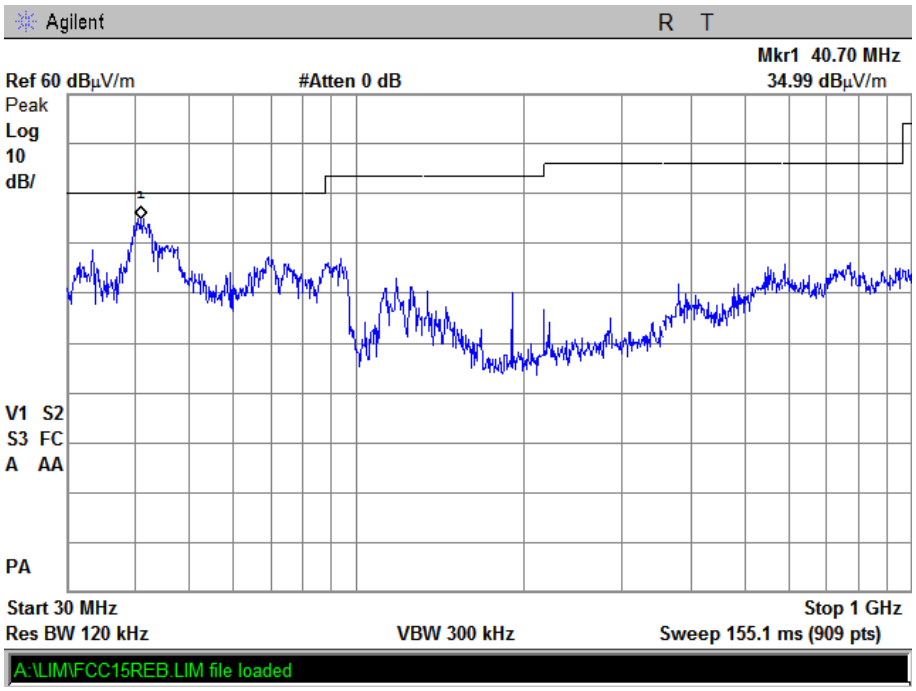
Test results above 1GHz:

All measurements were done in horizontal and vertical polarizations; the results show the worst case.

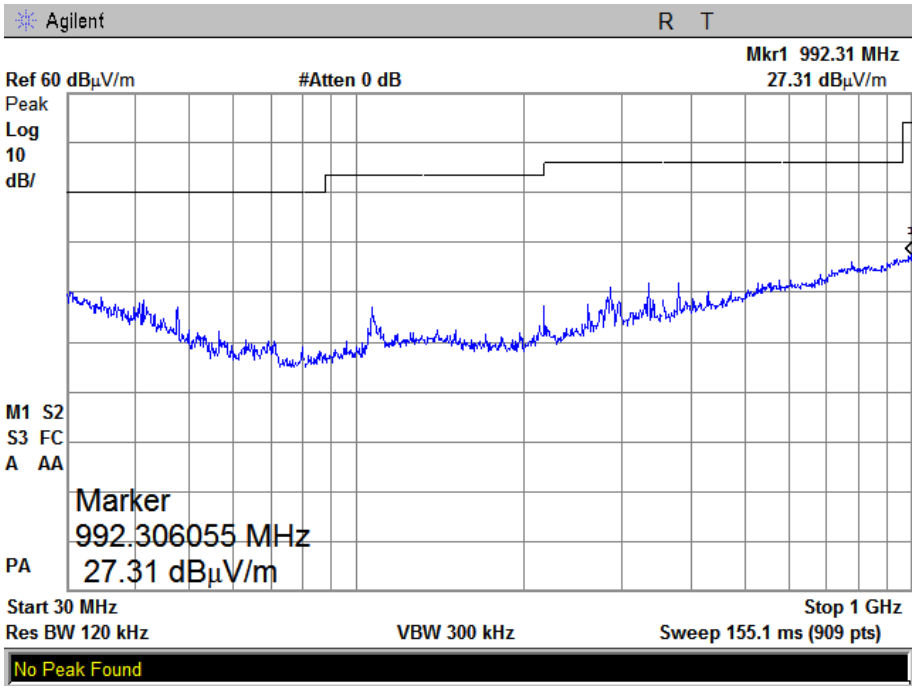
Fundamental Frequency, MHz	Unwanted Emission Frequency, MHz	Antenna Polarization	Measured Emission, dBµV/m		Limit, dBµV/m		Delta, dB		Pass/ Fail
			Peak	AVG	Peak	AVG	Peak	AVG	
2405	1393.000	V	31.5	23.5	74.0	54.0	-42.5	-30.5	Pass
	4809.000	V	57.4	50.2	74.0	54.0	-16.6	-3.8	Pass
2440	4879.000	V	56.5	48.9	74.0	54.0	-17.5	-5.1	Pass
	7321.000	V	54.1	41.8	74.0	54.0	-19.9	-12.2	Pass
	17080.700	H	65.8	53.2	74.0	54.0	-8.2	-0.8	Pass
2480	1520.050	V	28.9	20.1	74.0	54.0	-45.1	-33.9	Pass
	1759.825	H	39.2	31.1	74.0	54.0	-34.8	-22.9	Pass
	2079.125	V	40.3	33.0	74.0	54.0	-33.7	-21.0	Pass
	2524.00	H	45.1	33.2	74.0	54.0	-28.9	-20.8	Pass
	4960.975	V	50.5	42.3	74.0	54.0	-23.5	-11.7	Pass
	7441.300	V	51.7	41.5	74.0	54.0	-22.3	-12.5	Pass

Note: Spurious Emission [dBµV/m] = measured [dBµV] + Correction-factor [dB (1/m)]
Correction Factor = Antenna factor + Cable Loss

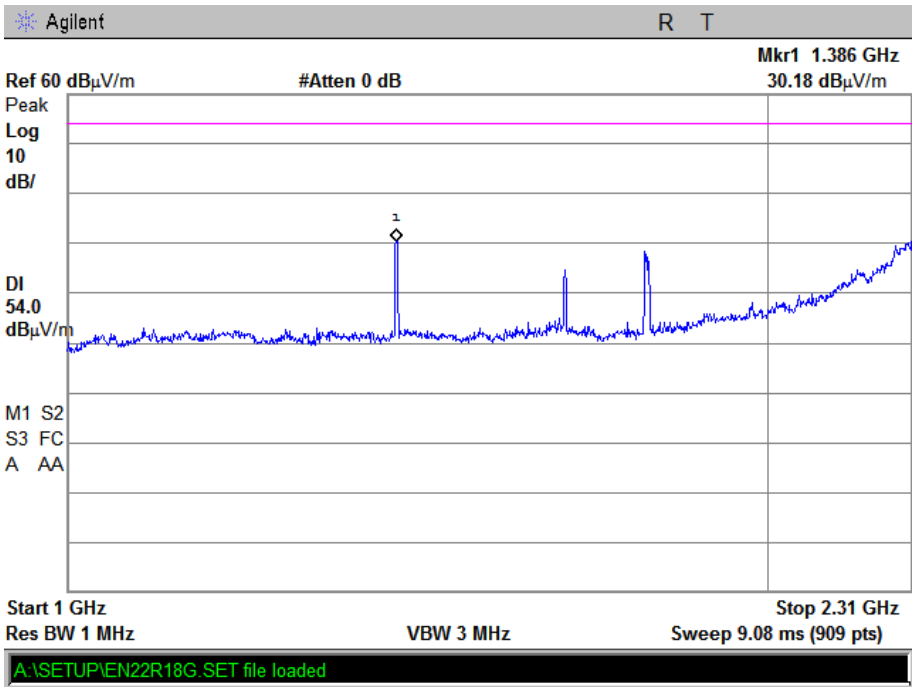
Plot 3.5.1 Emissions in restricted frequency bands test results, 30 MHz – 1 GHz range, Vertical polarization, Fc = 2405 MHz



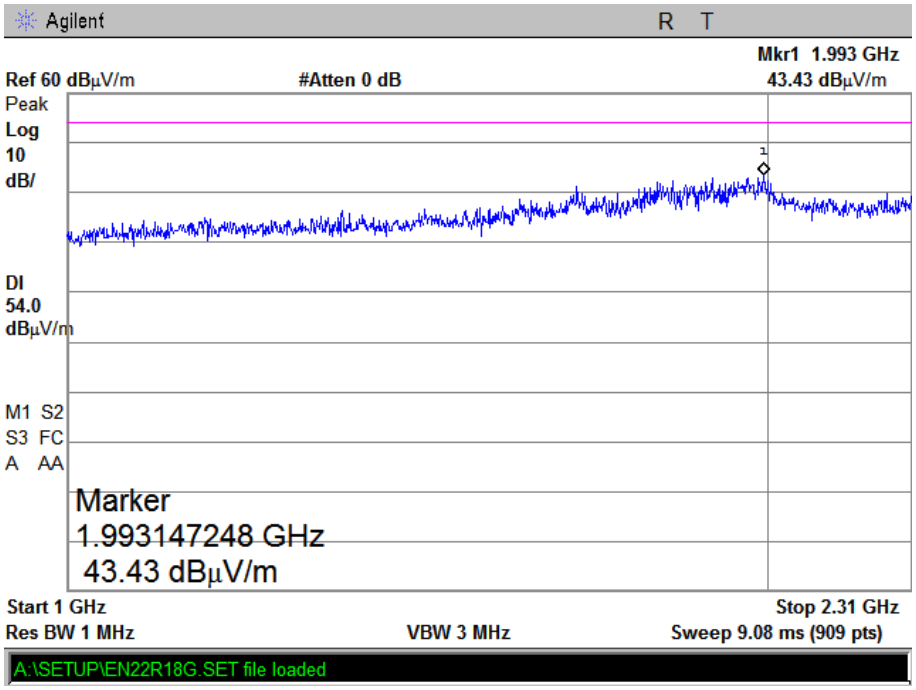
Plot 3.5.2 Emissions in restricted frequency bands test results, 30 MHz – 1 GHz range, Horizontal polarization, Fc = 2405 MHz



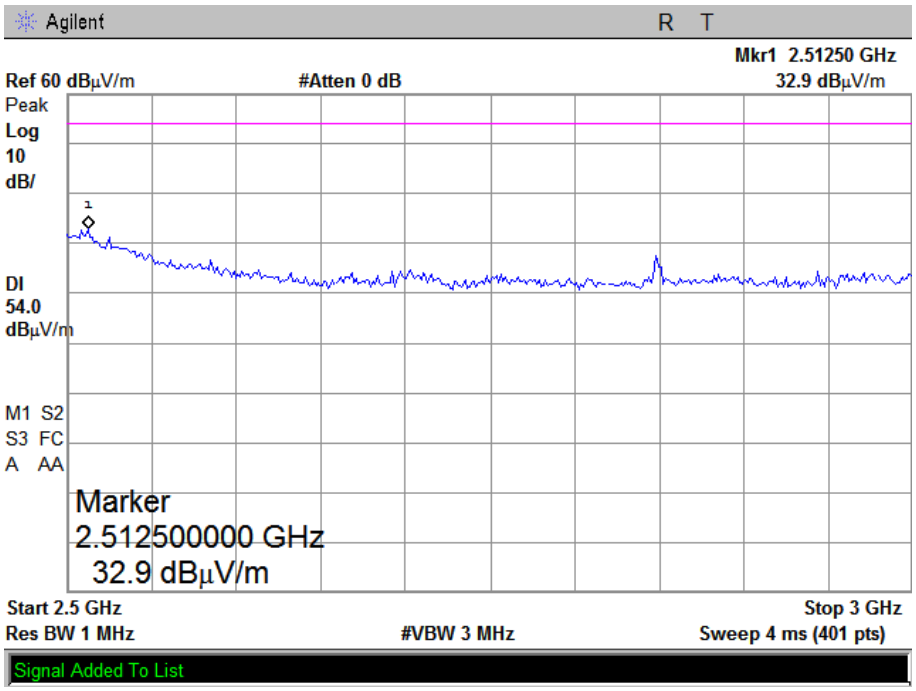
Plot 3.5.3 Emissions in restricted frequency bands test results, 1.0 – 2.31 GHz range, Vertical, Fc = 2405 MHz (w/o notch filter)



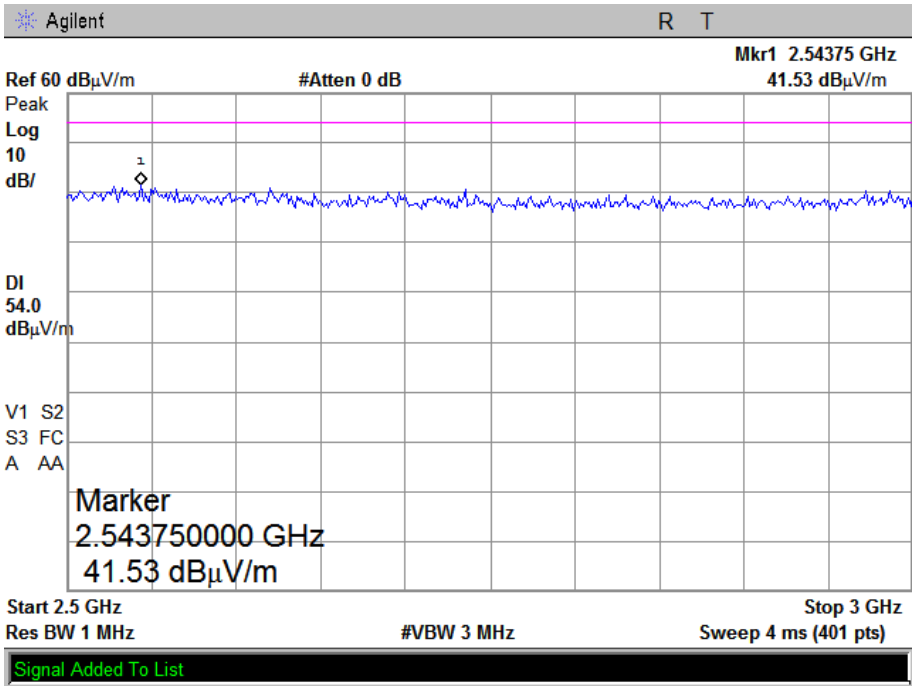
Plot 3.5.4 Emissions in restricted frequency bands test results, 1.0 – 2.31 GHz range, Horizontal, Fc = 2405 MHz (w/o notch filter)



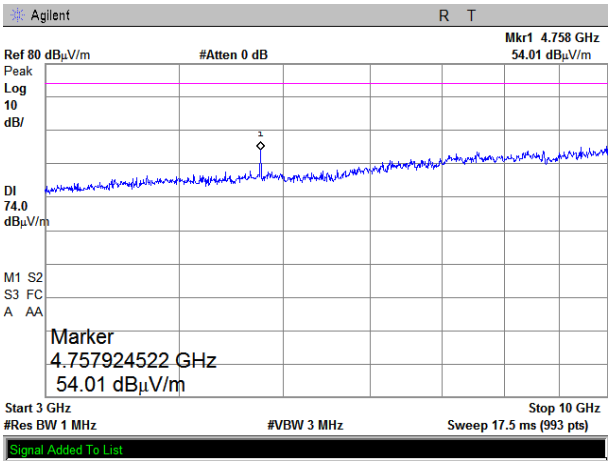
Plot 3.5.5 Emissions in restricted frequency bands test results, 2.5 – 3.0 GHz range, Vertical, Fc = 2405 MHz (w/o notch filter)



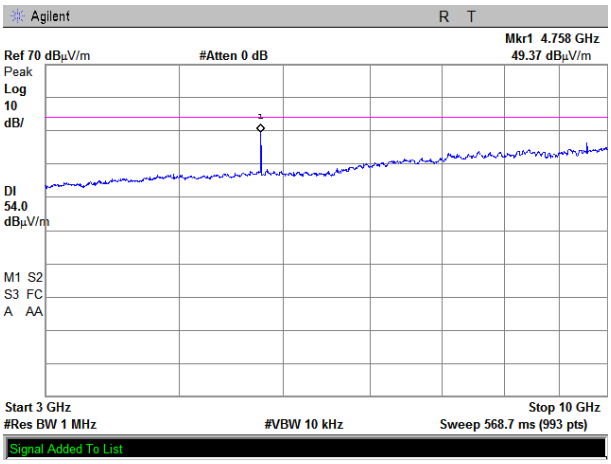
Plot 3.5.6 Emissions in restricted frequency bands test results, 2.5 – 3.0 GHz range, Horizontal, Fc = 2405 MHz (w/o notch filter)



Plot 3.5.7 Emissions in restricted frequency bands test results, 3 – 10 GHz range, Vertical, Fc = 2405 MHz (with notch filter)

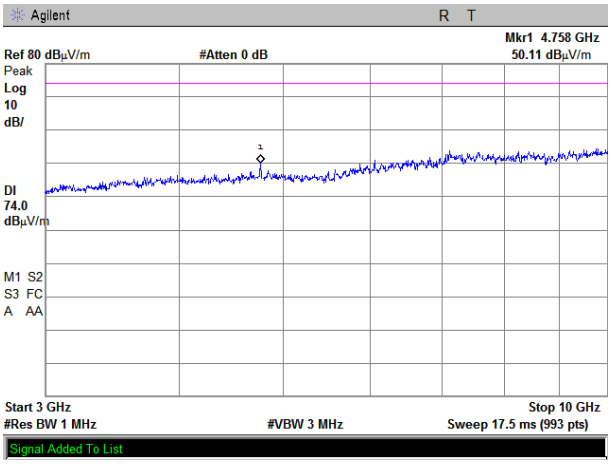


Peak

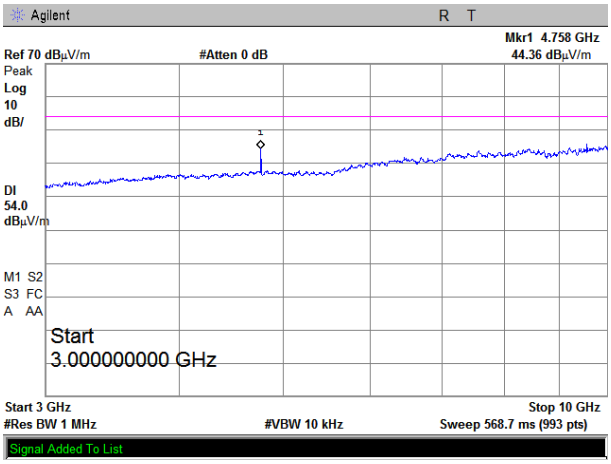


Average

Plot 3.5.8 Emissions in restricted frequency bands test results, 3 – 10 GHz range, Horizontal, Fc = 2405 MHz (with notch filter)

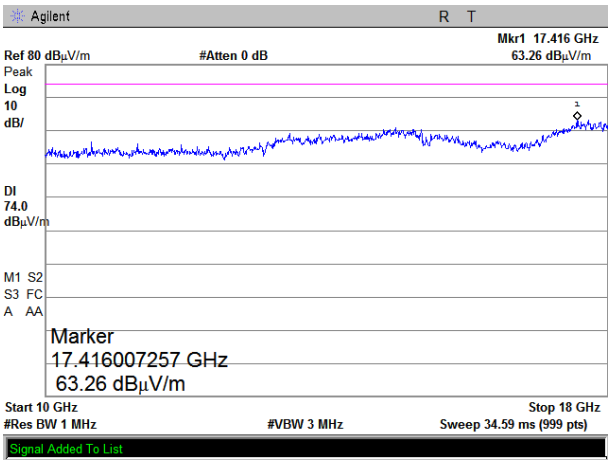


Peak

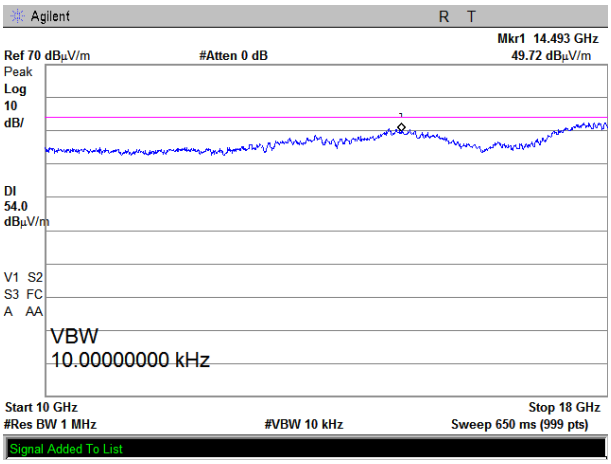


Average

Plot 3.5.9 Emissions in restricted frequency bands test results, 10 – 18 GHz range, Vertical, Fc = 2405 MHz (with notch filter)

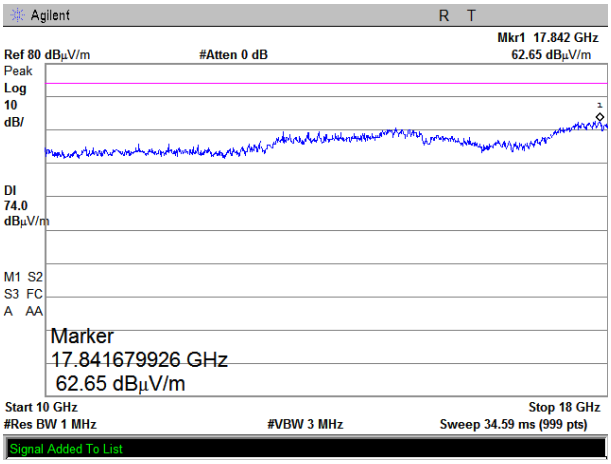


Peak

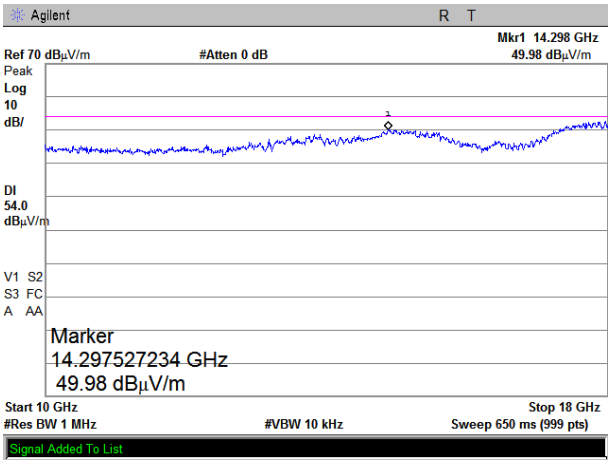


Average

Plot 3.5.10 Emissions in restricted frequency bands test results, 10 – 18 GHz range, Horizontal, Fc = 2405 MHz (with notch filter)

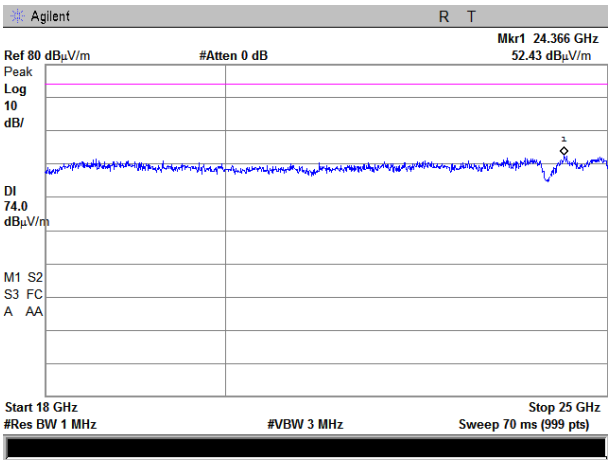


Peak

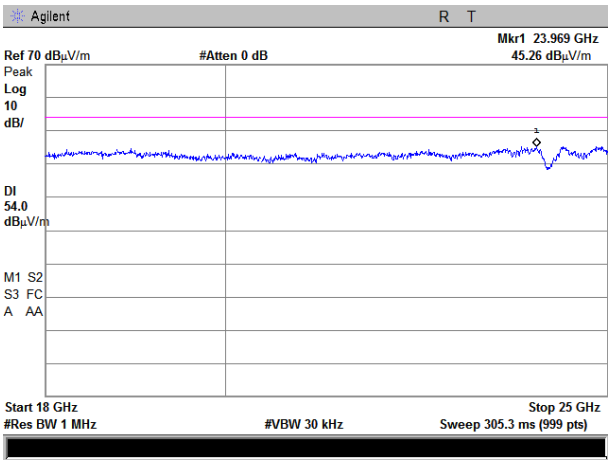


Average

Plot 3.5.11 Emissions in restricted frequency bands test results, 18 – 25 GHz range, Vertical, Fc = 2405 MHz (without notch filter)

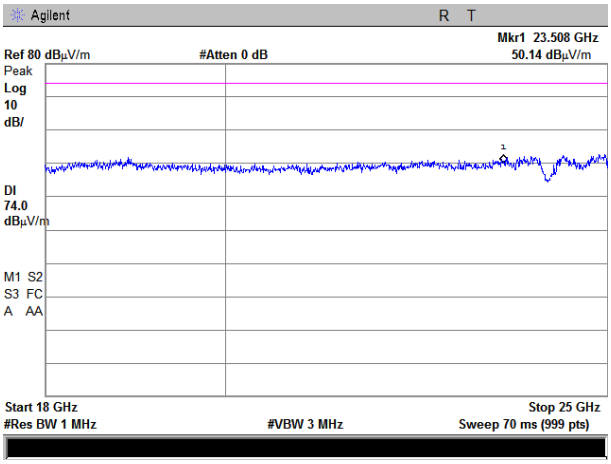


Peak

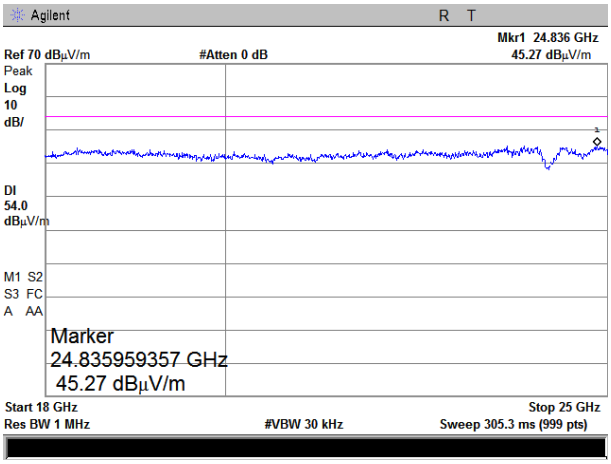


Average

Plot 3.5.12 Emissions in restricted frequency bands test results, 18 – 25 GHz range, Horizontal, Fc = 2405 MHz (without notch filter)

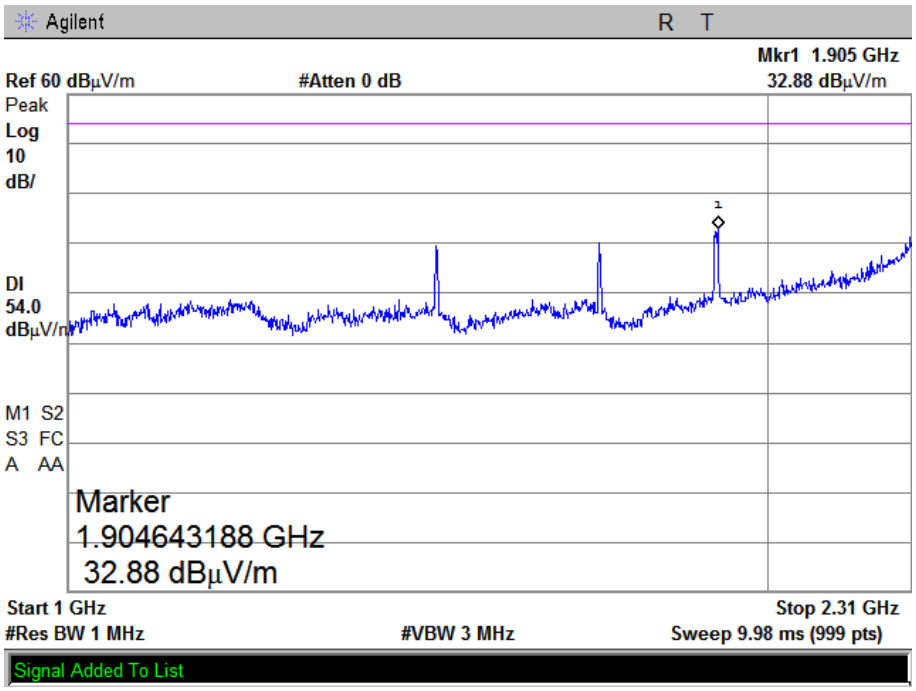


Peak

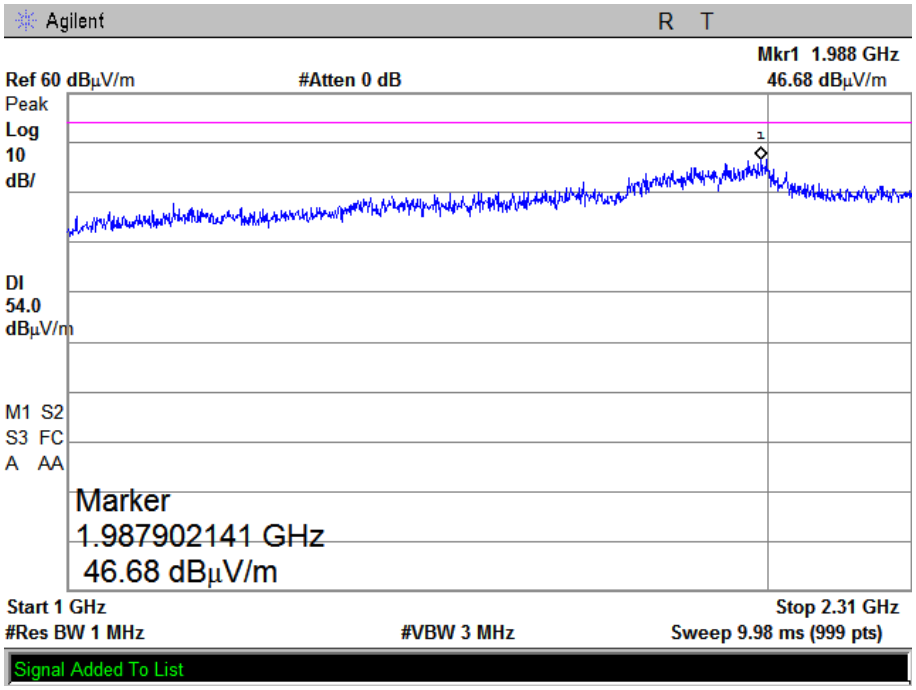


Average

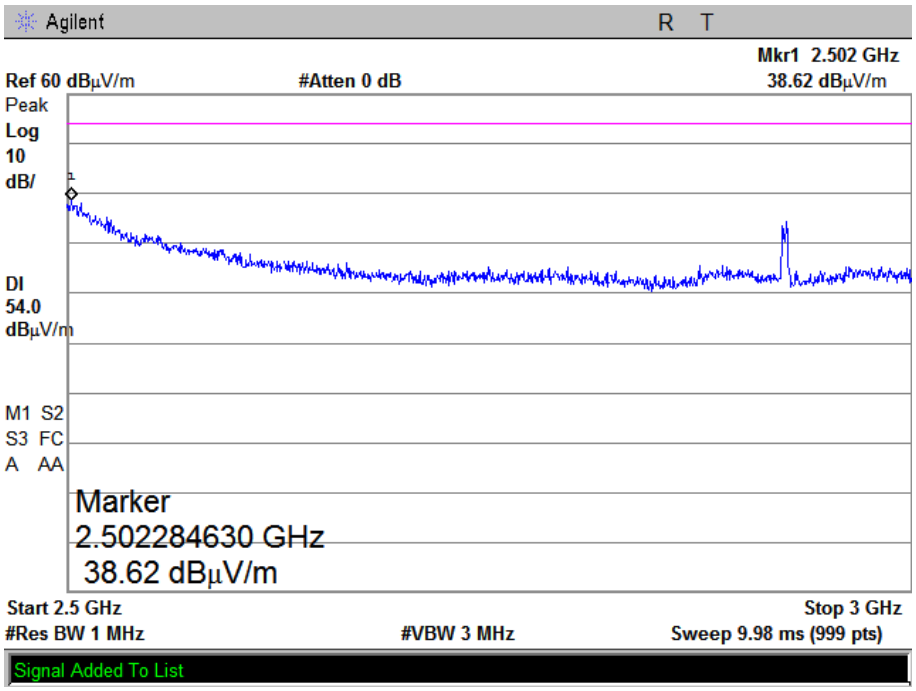
Plot 3.5.13 Emissions in restricted frequency bands test results, 1.0 – 2.31 GHz range, Vertical, Fc = 2440 MHz (w/o notch filter)



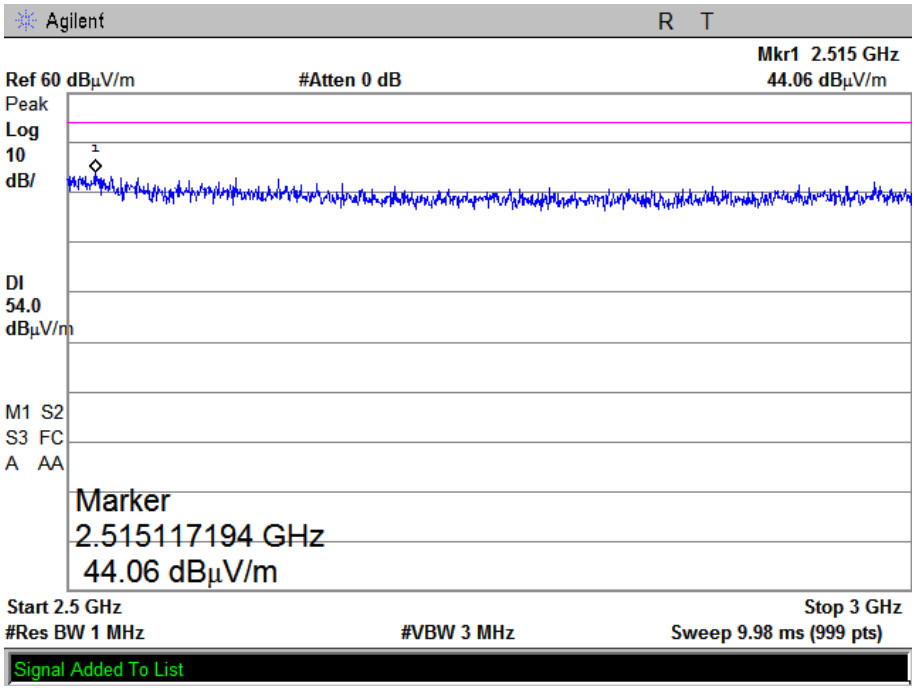
Plot 3.5.14 Emissions in restricted frequency bands test results, 1.0 – 2.31 GHz range, Horizontal, Fc = 2440 MHz (w/o notch filter)



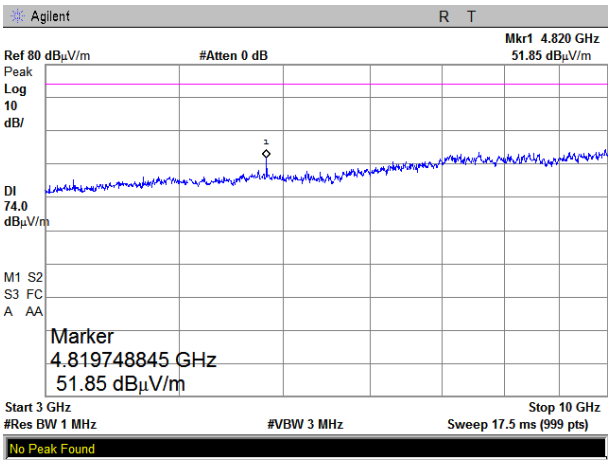
Plot 3.5.15 Emissions in restricted frequency bands test results, 2.5 – 3.0 GHz range, Vertical, Fc = 2440 MHz (w/o notch filter)



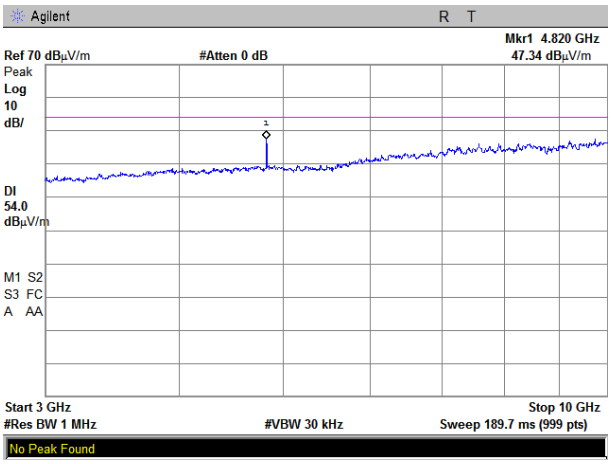
Plot 3.5.16 Emissions in restricted frequency bands test results, 2.5 – 3.0 GHz range, Horizontal, Fc = 2440 MHz (w/o notch filter)



Plot 3.5.17 Emissions in restricted frequency bands test results, 3 – 10 GHz range, Vertical, Fc = 2440 MHz (with notch filter)

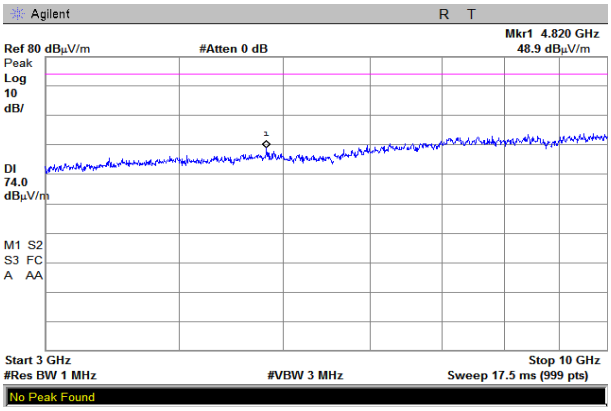


Peak

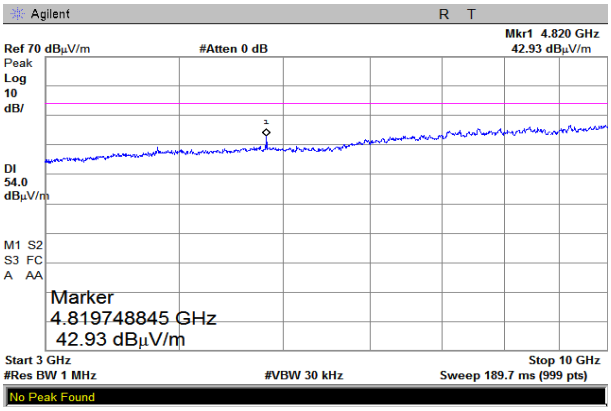


Average

Plot 3.5.18 Emissions in restricted frequency bands test results, 3 – 10 GHz range, Horizontal, Fc = 2440 MHz (with notch filter)

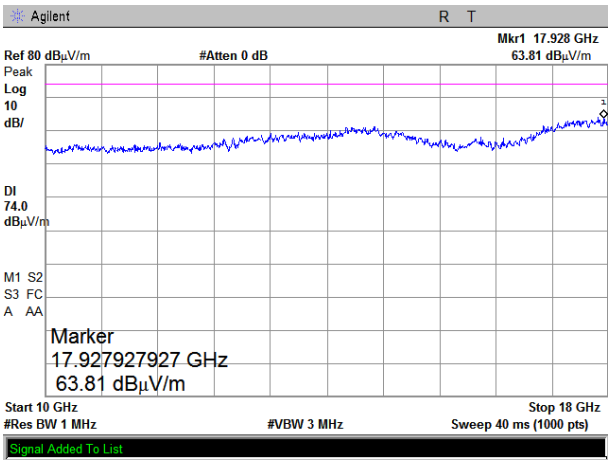


Peak

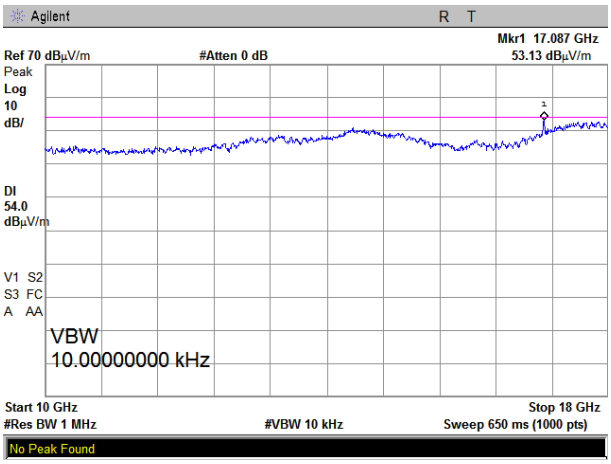


Average

Plot 3.5.19 Emissions in restricted frequency bands test results, 10 – 18 GHz range, Vertical, Fc = 2440 MHz (with notch filter)

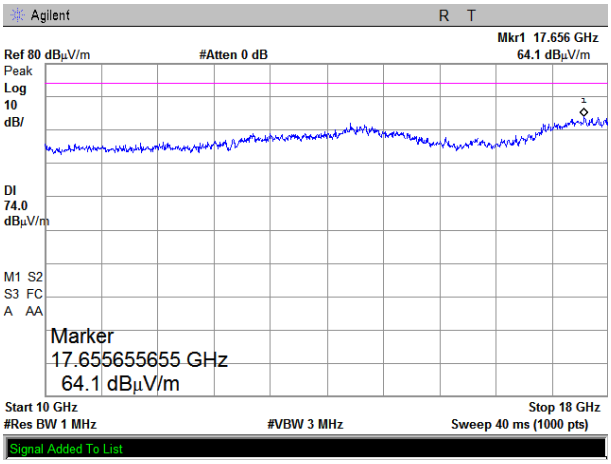


Peak

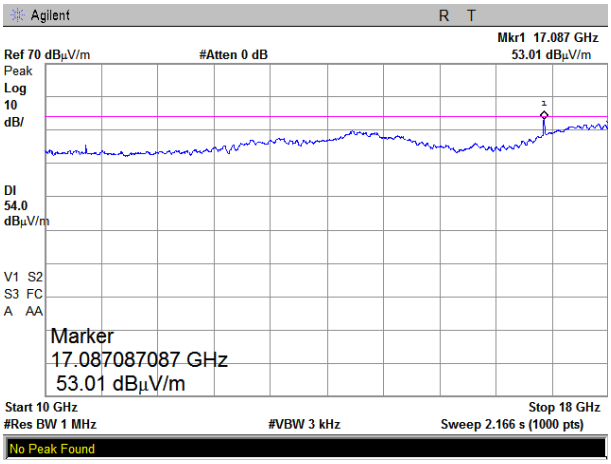


Average

Plot 3.5.20 Emissions in restricted frequency bands test results, 10 – 18 GHz range, Horizontal, Fc = 2440 MHz (with notch filter)

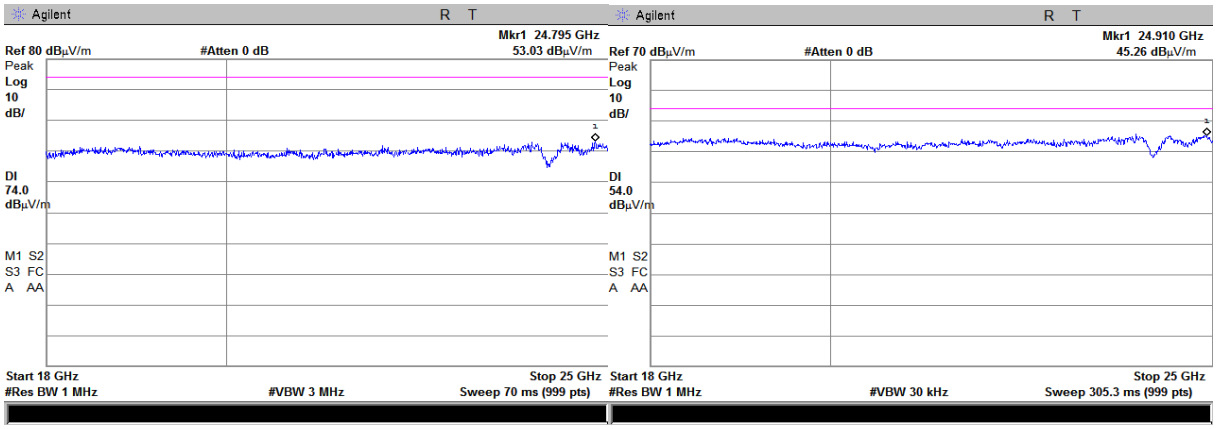


Peak

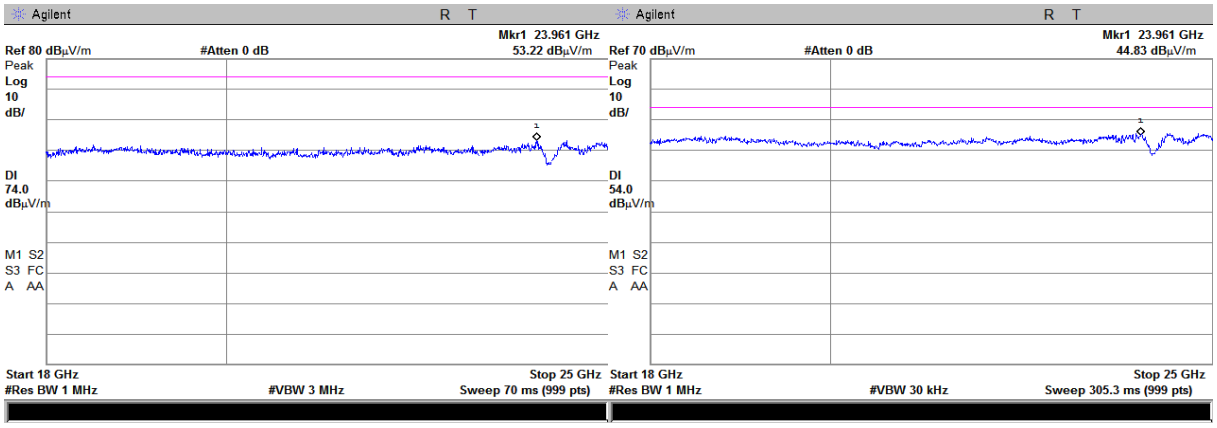


Average

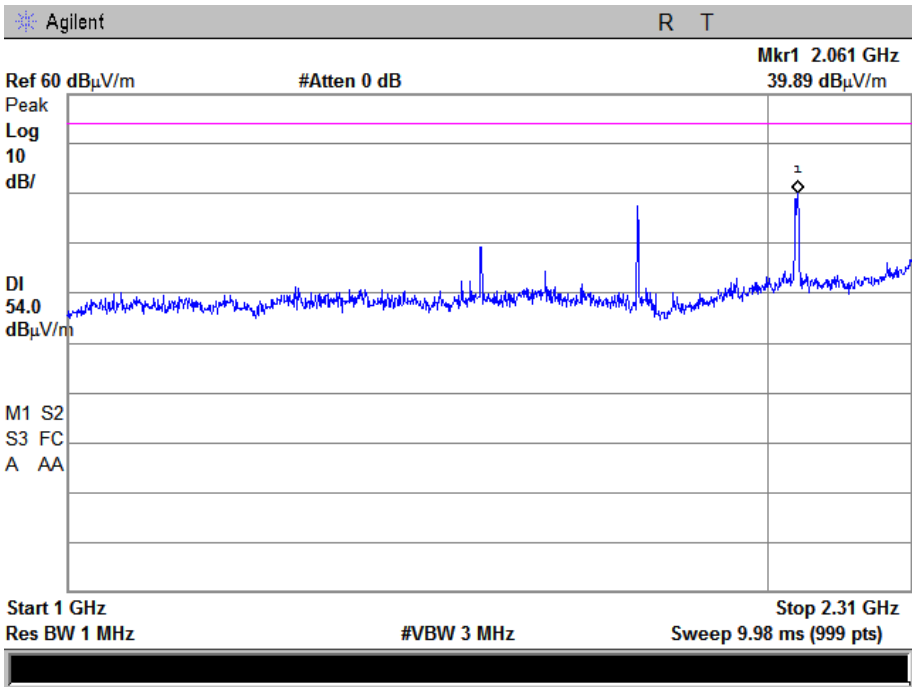
Plot 3.5.21 Emissions in restricted frequency bands test results, 18 – 25 GHz range, Vertical, Fc = 2440 MHz (without notch filter)



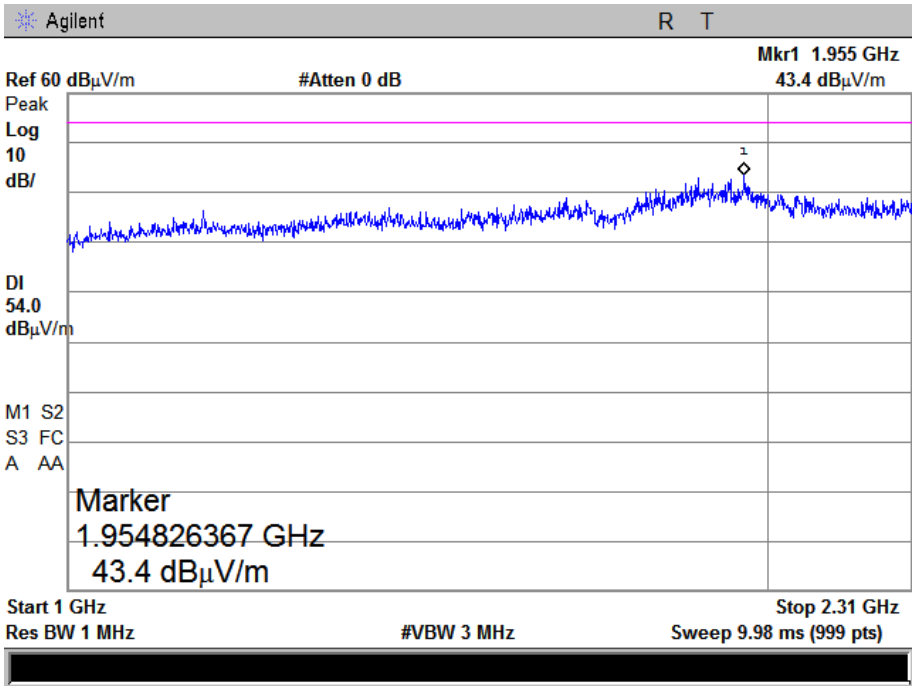
Plot 3.5.22 Emissions in restricted frequency bands test results, 18 – 25 GHz range, Horizontal, Fc = 2440 MHz (without notch filter)



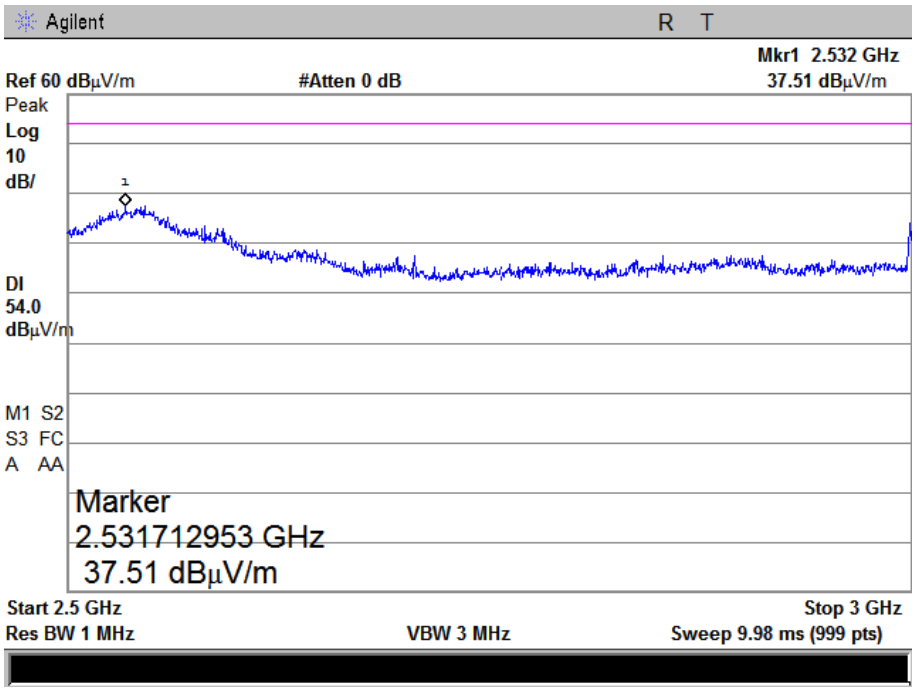
Plot 3.5.23 Emissions in restricted frequency bands test results, 1.0 – 2.31 GHz range, Vertical, Fc = 2480 MHz (w/o notch filter)



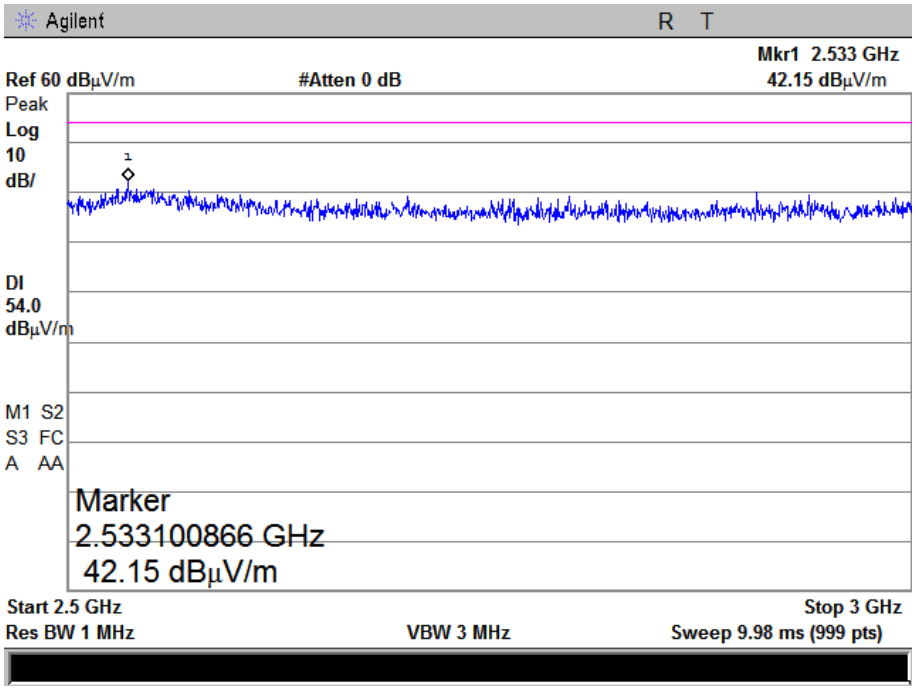
Plot 3.5.24 Emissions in restricted frequency bands test results, 1.0 – 2.31 GHz range, Horizontal, Fc = 2480 MHz (w/o notch filter)



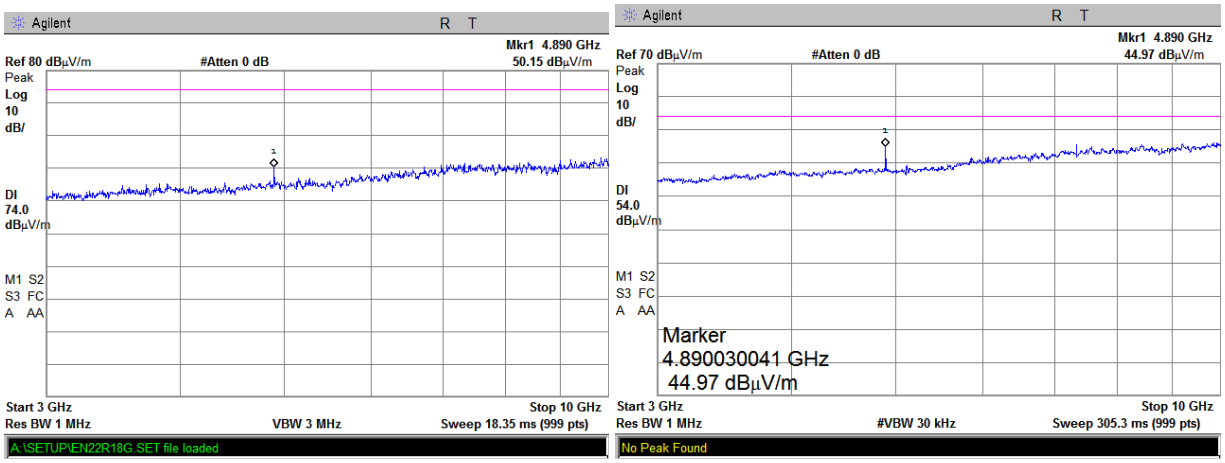
Plot 3.5.25 Emissions in restricted frequency bands test results, 2.5 – 3.0 GHz range, Vertical, Fc = 2480 MHz (w/o notch filter)



Plot 3.5.26 Emissions in restricted frequency bands test results, 2.5 – 3.0 GHz range, Horizontal, Fc = 2480 MHz (w/o notch filter)

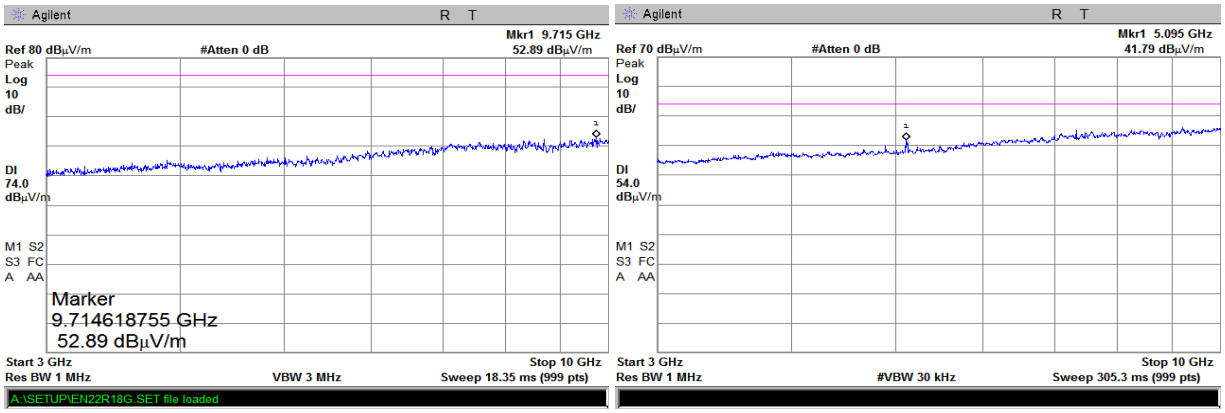


Plot 3.5.27 Emissions in restricted frequency bands test results, 3 – 10 GHz range, Vertical, Fc = 2480 MHz (with notch filter)



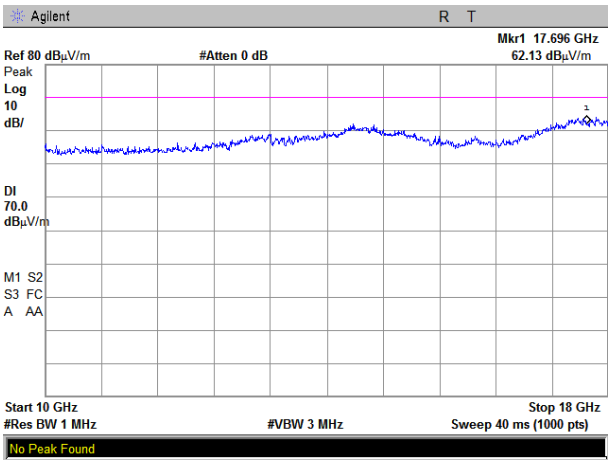
Peak Average

Plot 3.5.28 Emissions in restricted frequency bands test results, 3 – 10 GHz range, Horizontal, Fc = 2480 MHz (with notch filter)

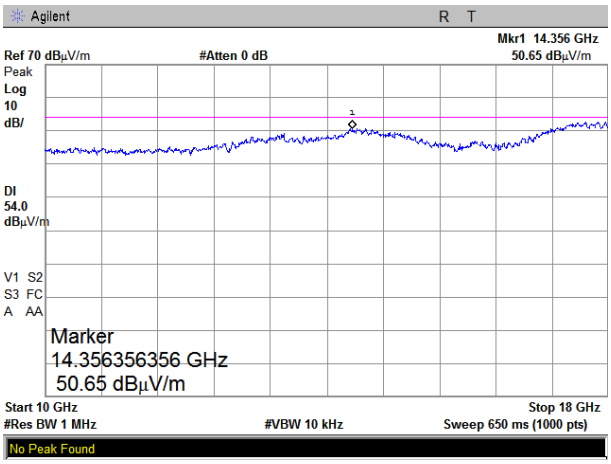


Peak Average

Plot 3.5.29 Emissions in restricted frequency bands test results, 10 – 18 GHz range, Vertical, Fc = 2480 MHz (with notch filter)

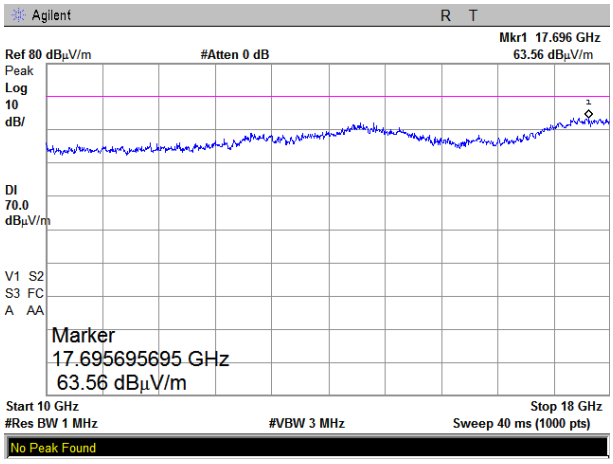


Peak

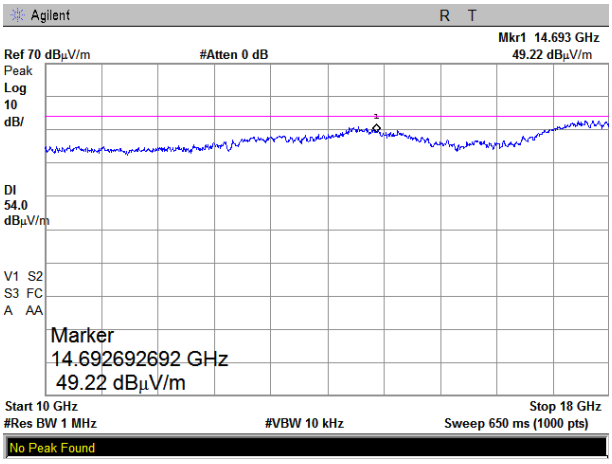


Average

Plot 3.5.30 Emissions in restricted frequency bands test results, 10 – 18 GHz range, Horizontal, Fc = 2480 MHz (with notch filter)

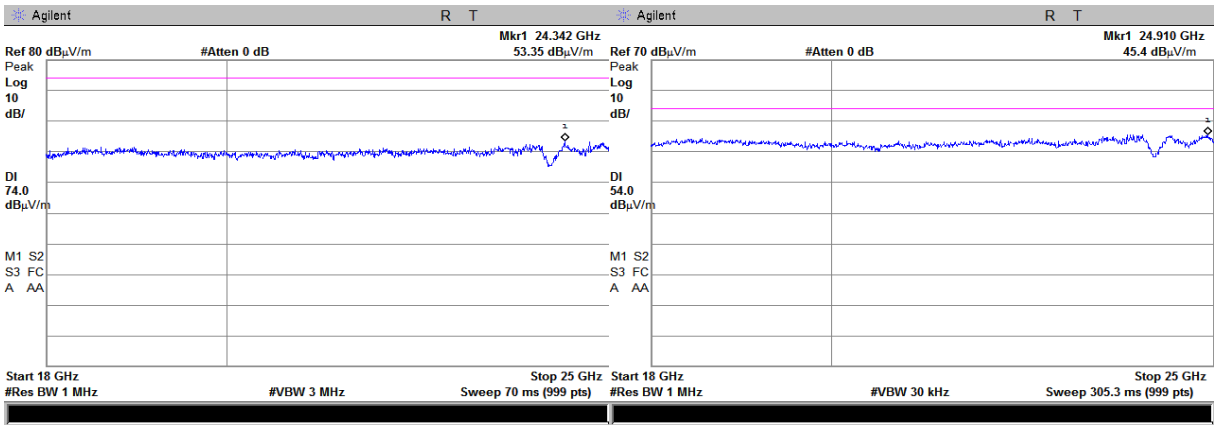


Peak



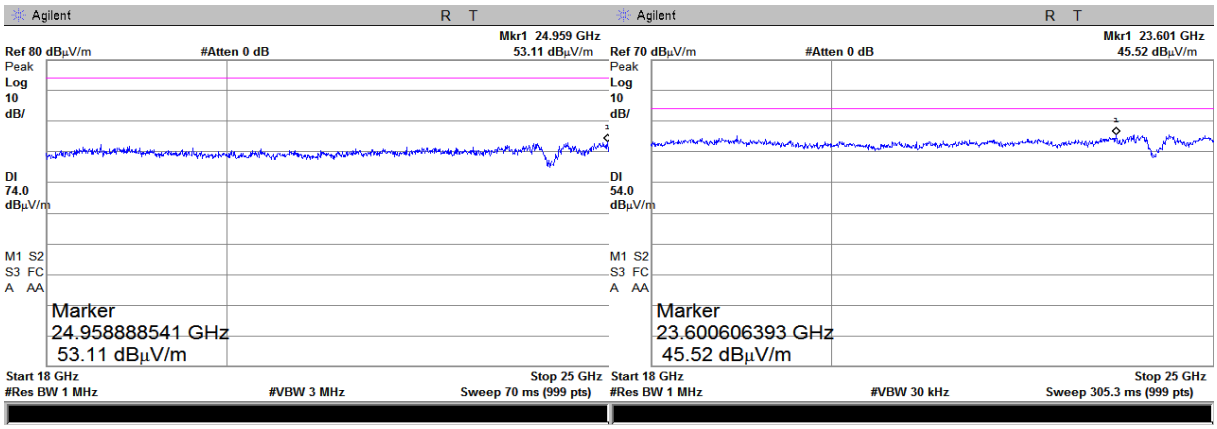
Average

Plot 3.5.31 Emissions in restricted frequency bands test results, 18 – 25 GHz range, Vertical, Fc = 2480 MHz (without notch filter)



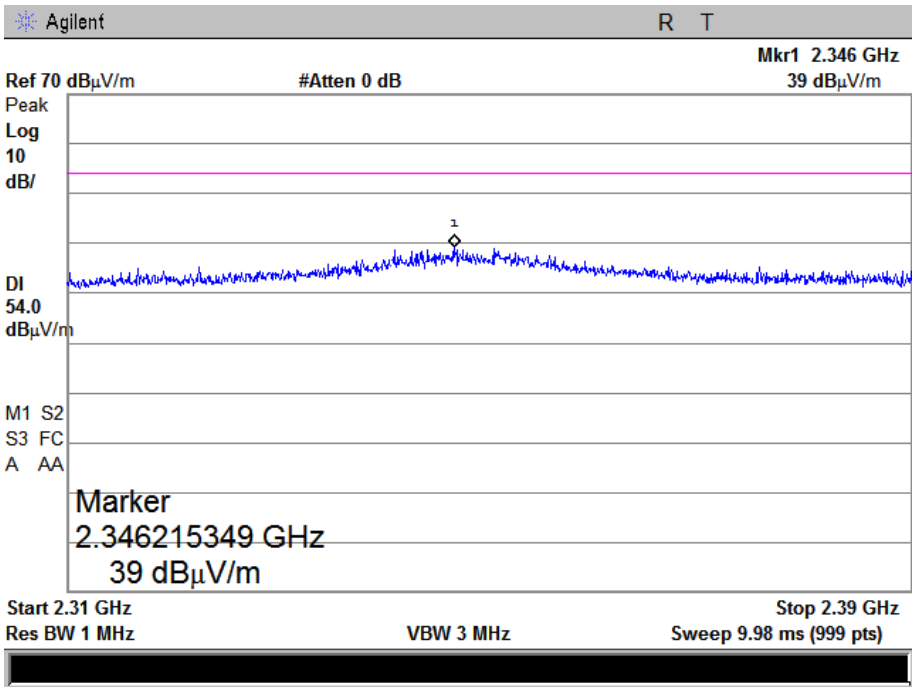
Peak Average

Plot 3.5.32 Emissions in restricted frequency bands test results, 18 – 25 GHz range, Horizontal, Fc = 2480 MHz (without notch filter)

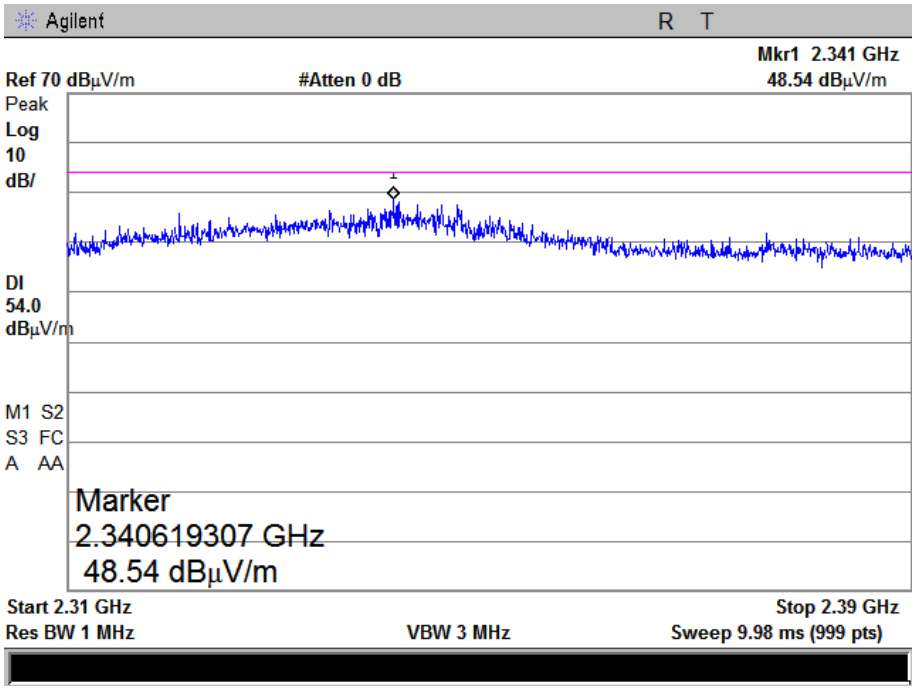


Peak Average

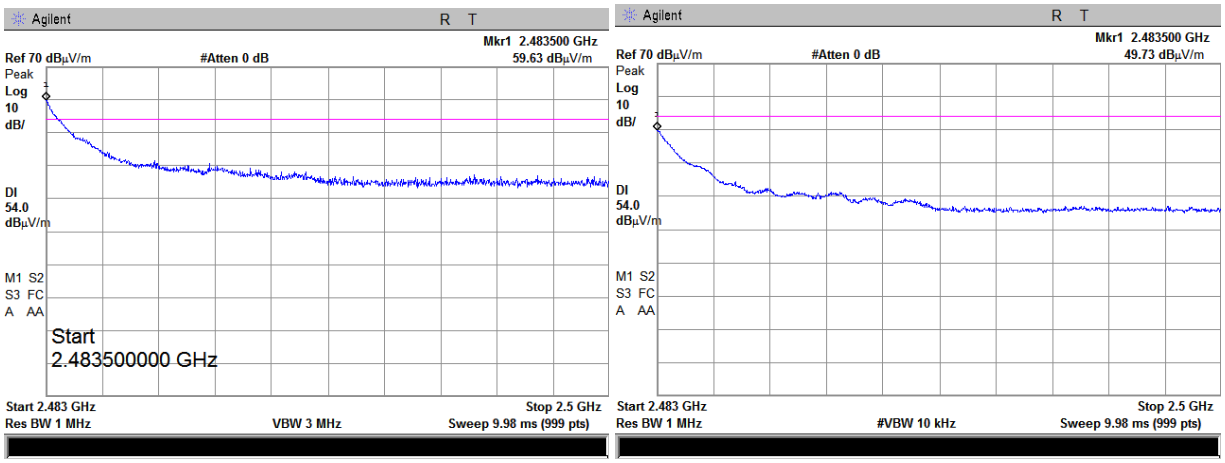
Plot 3.5.33 Emissions in restricted frequency bands test results, 2310 – 2390 MHz band, Vertical polarization, Fc = 2405 MHz



Plot 3.5.34 Emissions in restricted frequency bands test results, 2310 – 2390 MHz band, Horizontal polarization, Fc = 2405 MHz

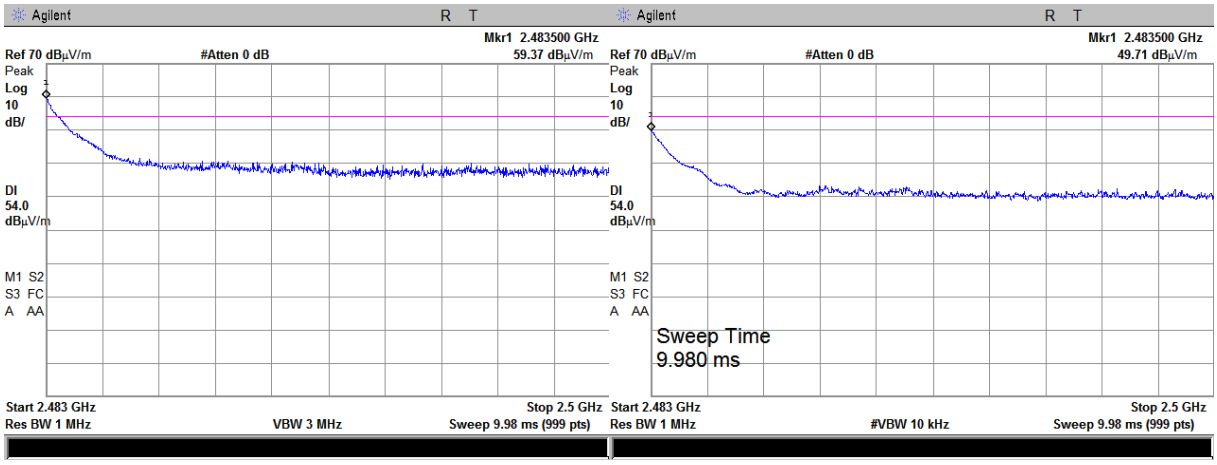


Plot 3.5.35 Emissions in restricted frequency bands test results, 2483.5 – 2500 MHz band, Vertical polarization, Fc = 2480 MHz



Peak Average

Plot 3.5.36 Emissions in restricted frequency bands test results, 2483.5 – 2500 MHz band, Horizontal polarization, Fc = 2480 MHz



Peak Average

3.6. Band edge measurements

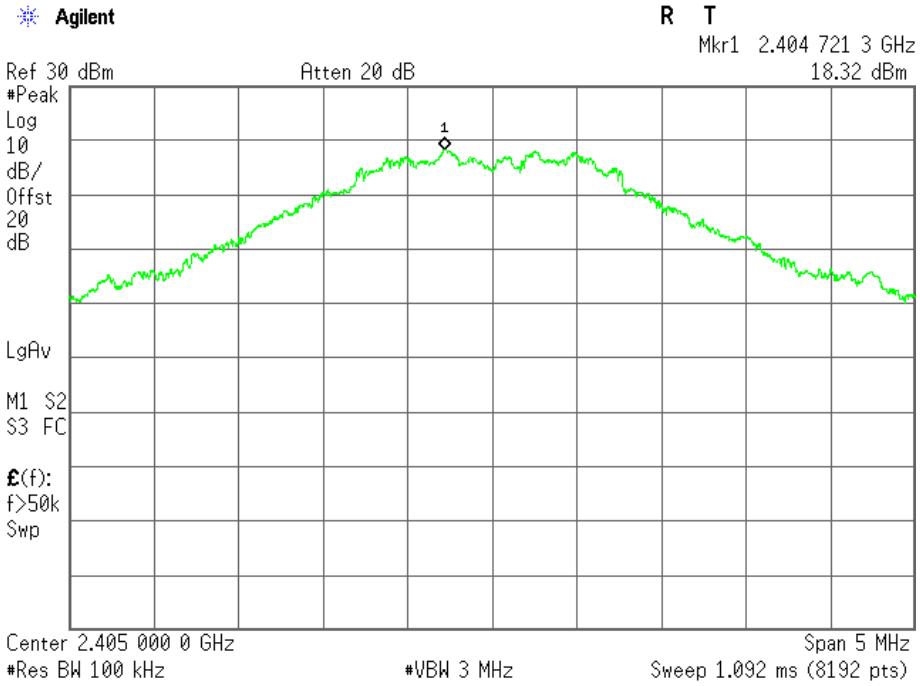
Reference document:	**47 CFR §15.247 (d) &RSS 247, section 5.5**		
Test Requirements:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30dB instead of 20dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (See §15.205(c)).		
Test setup:	See sec 2.2	Pass	
Method of testing:	KDB 558074 D01 v03r03, Sec.13.3.1 Conducted		
Operating conditions:	Under normal test conditions		
S.A. Settings:	RBW: 100 kHz, VBW: ≥3×RBW		
Environment conditions:	Ambient Temperature: 21°C	Relative Humidity: 48%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 3.6.1 - Plot 3.6.4	

Test results:

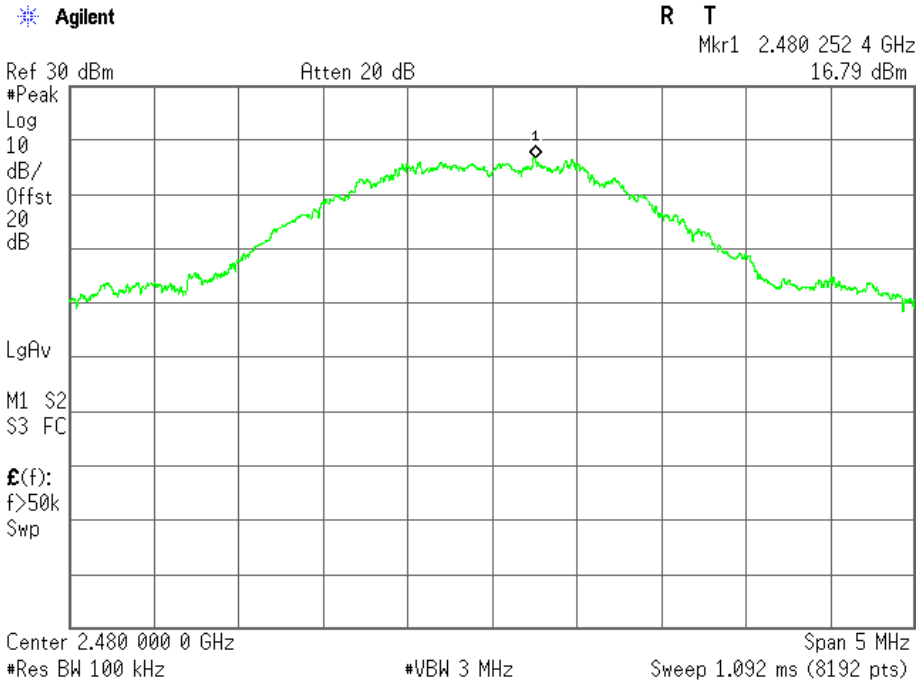
Fundamental Frequency, [MHz]	Fundamental Emission Reference Level, [dBm]	Measured Average Power, [dBm]	Duty Cycle Correction Factor	Calculated Average Power, [dBm]	Attenuation Below Fundamental, [dB]	Minimum Attenuation Below Fundamental, [dB]	Margin, [dB]	Pass/ Fail
2405.000	18.3	-38.9	0*	---	57.2	20.0	-37.2	Pass
2480.000	16.8	-29.2	0*	---	46.0	20.0	-26.0	Pass

*Duty Cycle Correction Factor = 10log(1/X), X is a transmit duty cycle
Test was performed with continuous transmitting at full power

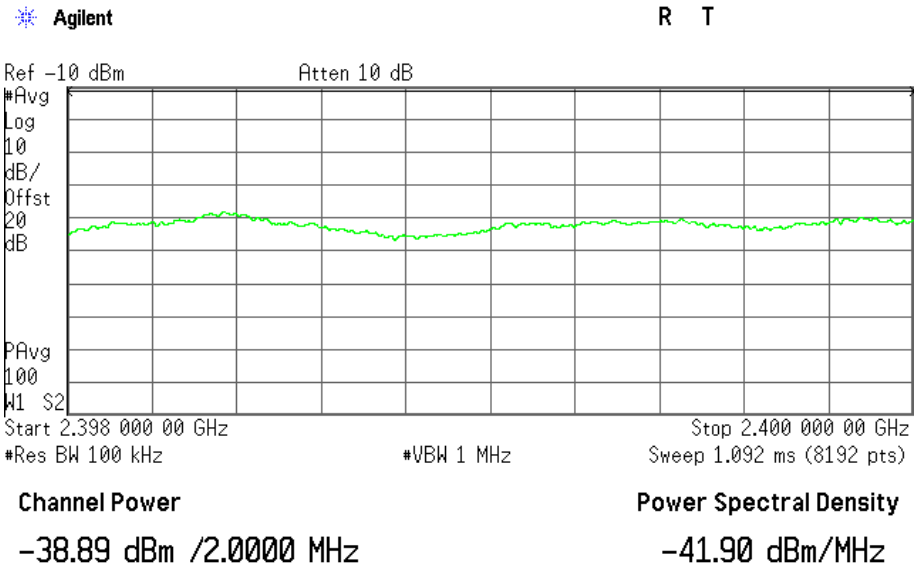
Plot 3.6.1 Band-Edge test results, Fundamental Emission Reference Level, Fc = 2405 MHz



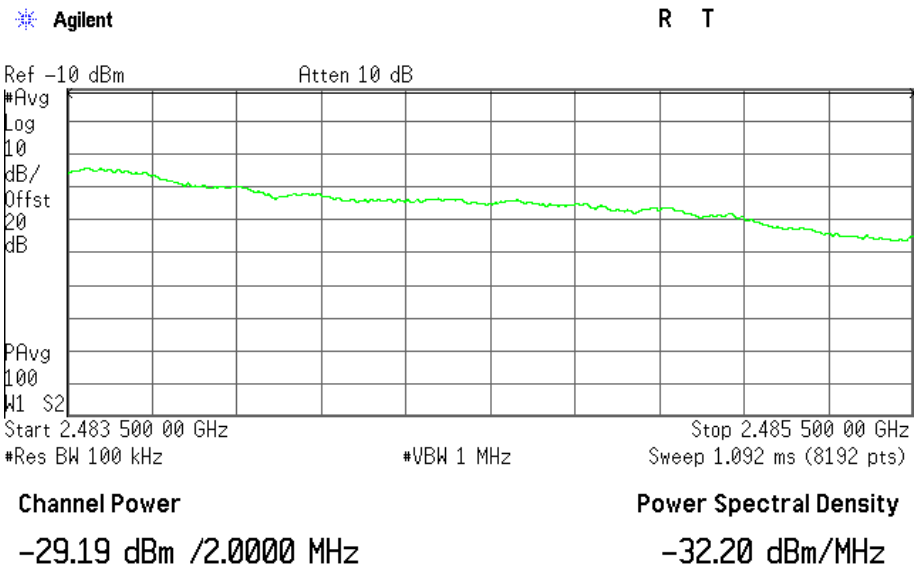
Plot 3.6.2 Band-Edge test results, Fundamental Emission Reference Level, Fc = 2480 MHz



Plot 3.6.3 Band-Edge test results, Fc = 2405 MHz



Plot 3.6.4 Band-Edge test results, Fc = 2480 MHz



3.7. Antenna Connector Requirements

Reference document:	**47 CFR §15.203 & RSS-Gen Issue 4**	
Test Requirements:	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall 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 provisions of this section.	
Test Result:	The EUT contains SMA reverse polarity (male) antenna connector.	

3.8. Power Line Emissions measurements

Reference document:	**47 CFR §15.107/207**		
Test Requirements:	The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in §15.107. The emissions from an intentional radiator shall not exceed the field strength levels specified in §15.207. Any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in Sec.15.207.		
Test setup:	See Sec. 2.5	**Pass**	
Operating conditions:	Under normal test conditions		
Method of testing:	Conducted Emissions		
S.A. Settings:	f <30MHz: RBW: 9kHz, VBW:30kHz		
Radio device:	Idle		
Environment conditions:	Ambient Temperature: 23.2°c	Relative Humidity: 48.1%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 3.8.1 - Plot 3.8.2	

Test Results:
Worst case results of unintentional emissions and emissions while the ZigBee transmitter is operating alternately, measured at the charger 110VAC port.

"Phase" Lead

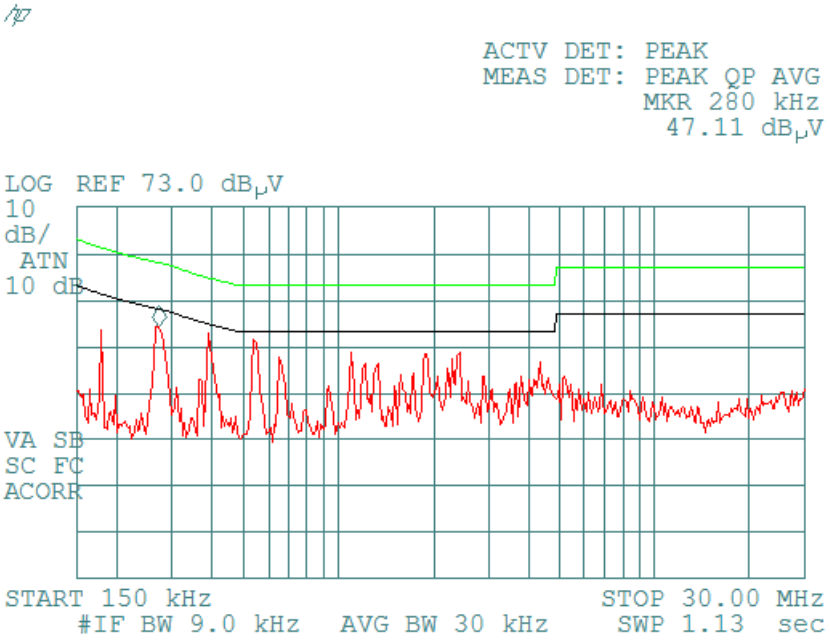
Frequency [MHz]	Measured Result [dBµV]		Limit [dBµV]		Margin [dB]		Pass/Fail
	QP	AVR	QP	AVR	QP	AVR	
0.188675	38.1	20.2	64.09	54.09	-25.99	-33.89	**Pass**
0.407945	35.6	29.6	57.69	47.69	-22.09	-18.09	**Pass**
0.551515	42.3	24.1	56.00	46.00	-13.70	-21.90	**Pass**
2.50447	35.5	27.3	56.00	46.00	-20.50	-18.70	**Pass**
1.10857	39.5	29.4	56.00	46.00	-16.50	-16.60	**Pass**
0.2782	46.2	37.9	60.87	50.87	-14.67	-12.97	**Pass**

"Neutral" Lead

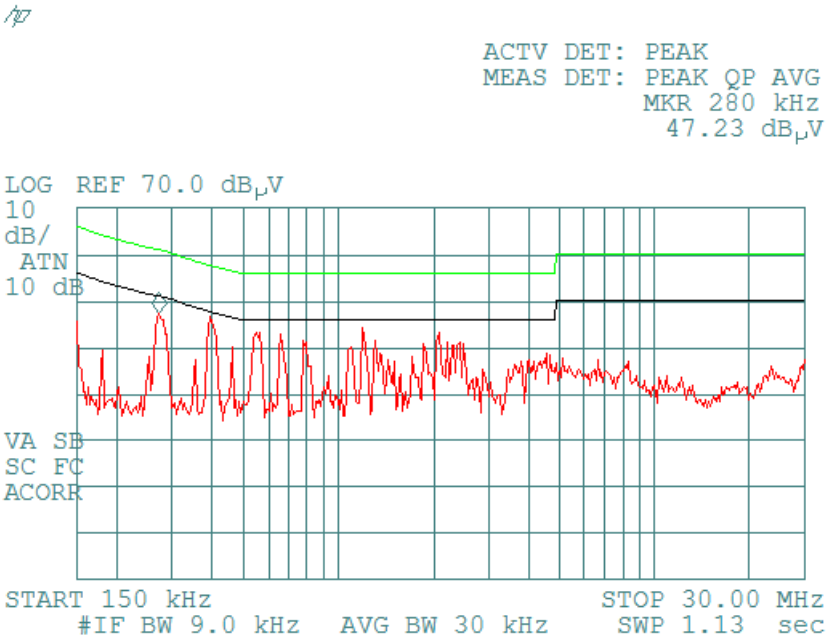
Frequency [MHz]	Measured Result [dBµV]		Limit [dBµV]		Margin [dB]		Pass/Fail
	QP	AVR	QP	AVR	QP	AVR	
0.275521	45.8	37.1	60.95	50.95	-15.15	-13.85	**Pass**
0.414618	45.8	39.4	57.56	47.56	-11.76	-8.16	**Pass**
1.244643	40.7	32.2	56.00	46.00	-15.30	-13.80	**Pass**
0.55484	45	39.1	56.00	46.00	-11.00	-6.90	**Pass**
2.070198	39.1	28.3	56.00	46.00	-16.90	-17.70	**Pass**
0.69129	41.4	33.3	56.00	46.00	-14.60	-12.70	**Pass**

Measured at the charger 110VAC port

Plot 3.8.1: Phase Lead



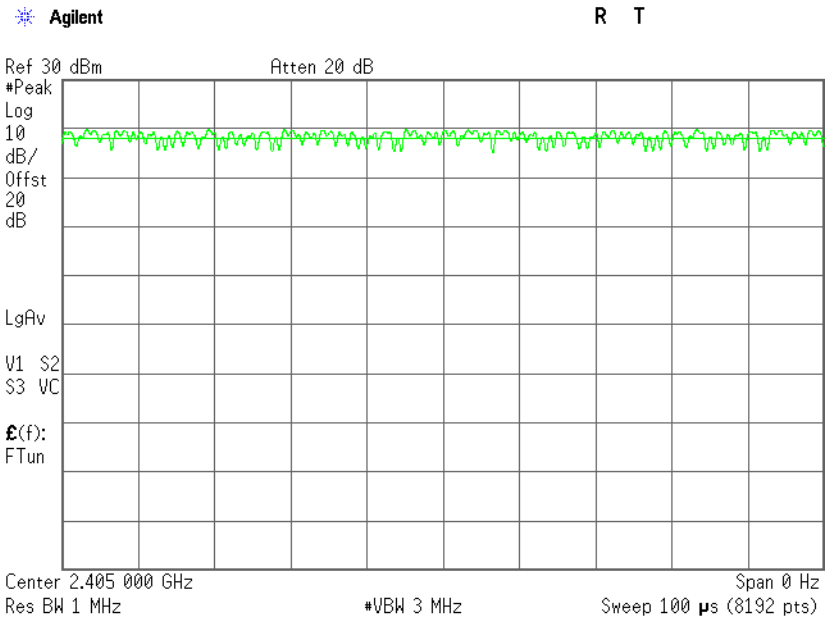
Plot 3.8.2: Neutral Lead



4. Appendix

Appendix A: Duty cycle

100% duty cycle used throughout the tests



Appendix B: List of test equipment used

Equipment	Manufacturer	Model No.	Serial No.	Calibration Due Date
Antenna BiLog	Teseq	CBL 6141B	34119	16/07/2018
Antenna Double Ridge Guide Horn	A.R.A	DRG-118/A	17188	06/03/2016
Antenna Horn	Schwarzbeck	BBHA 9170	BBHA9170214	06/03/2016
CISPR16 EMI Receiver	HP	8546A	3710A00392	09/02/2017
EMC Analyzer 100Hz – 26.5GHz	Agilent	E7405A	US41160436	02.06.2016
LNA 1 GHz to 18 GHz	Miteq	7D-010180-30-10P-GW	618653	05/03/2016
LNA 18 GHz to 26.5 GHz	Miteq	AMF-5F-18002650-30-10P	945372	07/03/2016
LNA 26.5GHz to 40GHz	Spacek Labs	SLKa-35-4	2M10	07/03/2016
Power Meter	Agilent	N1911A	MY45100784	15/01/2016
Spectrum Analyzer 3Hz-44GHz	Agilent	E4446A	MY46180602	13/11/2016
Wideband Power Sensor	Agilent	N1921A	MY45241242	15/01/2016

Appendix C: Accreditation Certificate

ilac-MRA

American Association for Laboratory Accreditation

Accredited Laboratory

A2LA has accredited

QUALITECH

Petach-Tikva, Israel

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 16th day of October 2014.

President & CEO
For the Accreditation Council
Certificate Number 1633.01
Valid to June 30, 2016

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

End of the Test Report