Electromagnetic Compatibility
Test Report

Test Report No: SLR 020714
Issued on: December 08, 2014

Product Name
Cubox (Stand-alone Board)

Tested According to
FCC 47 CFR, Part 15, Subparts C
IC RSS-210, Issue 8

Tests Performed for
Solid-run
3 Plane, Tafen Tower 24959
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Test Report details:

Test commencement date: 01.05.2014
Test completion date: 27.05.2014
Customer's Representative: Kossay Omary
Issued on: 08.12.2014

Revision details:

Version	Date	Details/Reasons
Rev. 1	02.07.2014	-
Rev. 2	09.12.2014	Added Power Line Emissions measurements to the test report, add calibration list table.

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 setup 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

Bluetooth

Test Spec. Clause	Test Case	Remarks
47 CFR §15.247 (a) (1),DA 00-705, RSS-210 section A8.1 (a)	20dB Bandwidth	Pass
47 CFR §15.247 (a) (1), DA 00-705, RSS-210 section A8.1 (b)	Carrier Frequency Separation	Pass
47 CFR §15.247 (a) (1)(iii), DA 00-705, RSS-210 section A8.1 (c)	Number of Hopping Channels	Pass
47 CFR §15.247 (a) (1) (iii), DA 00-705, RSS-210 section A8.1 (c)	Average Time of Occupancy (Dwell Time)	Pass
47 CFR §15.247 (b) (1), DA 00-705, RSS-210 section A8.1 (2)	Maximum Peak Output Power	Pass
47 CFR §15.247 (d), DA 00-705, RSS-210 Section A8.5	Band-edge compliance of RF Conducted Emission	Pass
47 CFR §15.247 (d), §15.209(a) & DA 00-705, RSS-210 Section A8.5	Radiated Spurious Emissions, Restricted Bands (2310-2390MHz, 2483.5-2500MHz)	Pass
47 CFR §15.247 (d), DA 00-705, RSS-210 Section A8.5	Spurious Emission - Conducted	Pass
47 CFR §15.247 (d) , §15.209(a) & DA 00-705, RSS-210 Section A8.5	Spurious Emissions - Radiated	Pass
47 CFR §15.407(b)(6) & §15.107/207, ICES-003 RSS-GEN section 7.2.3.2	Power Line Emissions measurements	Pass
47 CFR §15.203, RSS-Gen, Section 7.1.4	Antenna Connector Requirements	Pass

Table of Contents

1. General Description

Description of the EUT system/test Item:

The SolidRun SR-uSOM-MX6 is a high performance micro system on module that is based on the highly integrated Freescale i.MX6 family of products.

Product name: CuBox

Model: SR-uSOM-MX6

FCC ID: 2ACMW-MX6

IC ID: 12107A-MX6

Description:

Maximum Peak Output Power: 0.736 mW

Frequency range: 2400-2483.5 GHz

Type of Modulation:

Protocol	Modulation
Bluetooth	GFSK, QPSK, 8PSK

Antenna Specification:

Type: SRT-2.4G-PCB-8

Antenna Gain: 3dBi in the range 2.4 – 2.5 GHz

2. Method of Measurements

2.1. 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 carrier frequency separation, number of hopping frequencies, time of occupancy, 20dB BW, peak output power, band edge emissions, and spurious emissions were measured according the guidelines in DA 00-705.

For PSD, emission peak was zoomed within the pass band with spectrum analyzer's settings as reported (Sweep time=Span/3kHz). Transmitter outputs transmitting simultaneously were aggregated through a combiner.

For Maximum Conducted Output Power, the spectrum analyzer was set for free ran, and 100 traces were averaged in power averaging mode. The transmitter was continuously transmitting, at a duty cycle of about 99%, and power was integrated across a bandwidth of the 26dB EBW of the signal, using the spectrum analyzer's band power measurement function with band limits set equal to the EBW band edges. Alternatively, Peak Output Power was measured using a Peak Power Meter.

For spurious emissions measurement, the spectrum from 9 kHz to 25GHz was investigated with the transmitter set to the lowest, middle and highest channel frequencies.

2.2. Radiated Emissions Measurements in the restricted bands:

For radiated emissions, which fall in the restricted bands the spectrum from 30MHz to 25GHz was investigated following the guidelines in ANSI C63.4-2003, with the transmitter set to the lowest, middle and highest channel frequencies. Measurements were performed with peak detector and repeated averaged with VBW=10Hz. Only Peak detection plots are presented.

2.3. 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 C63.4-2003 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 system cables to the worst-case position. This process was repeated for both antenna polarizations. The spectrum up to 40GHz 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 C63.4-2003 clause 4.2.

2.4. Worst Case Results:

Worst case result is determined as the channel with the highest output power. Pre-scan has been conducted to determine the worst-case. Worst-case results of various modulation modes/data rates were determined as the modulation with the highest output power, and that was reported.

2.5. Power Line Emission measurements:

The EUT was placed on a non-conductive table/support 80 cm above the reference ground plane. The EUT was configured in accordance with ANSI C63.4-2003 using a 50μH/50 ohm LISN.

Compliance with the provisions was based on the measurements of the radio frequency voltage between each line and the ground at the power terminal.

The EUT was operated in receive mode and then with DSS, DTS and DSS transmitters operating alternately and the worst case results were presented.

3. Test Facility & Uncertainty of Measurement

3.1. Accreditation/ Registration reference:

- *A2LA Certificate Number: 1633.01*

3.2. Test Facility description

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

Address: 30, Hasivim St., Petah Tikva, Israel.
Tel: 972-3-926-8443

3m Anechoic Chamber:

The 3m-screened chamber is used in two configurations: the semi-anechoic configuration for Radiated Emission measurements and the full-anechoic configuration for Radiated Immunity tests.

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

Full-Anechoic Configuration:

Measurement distance	3m
Chamber dimensions	7m x 4m x 3m
Antenna height	1.55m at Horizontal & Vertical polarizations
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 and floor
Field Uniformity to EN61000-4-3	±3dB 80MHz to 18GHz

3.3. Uncertainty of Measurement:

Statement of the measurement uncertainty

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%.

4. Bluetooth: Report of Measurements and examinations

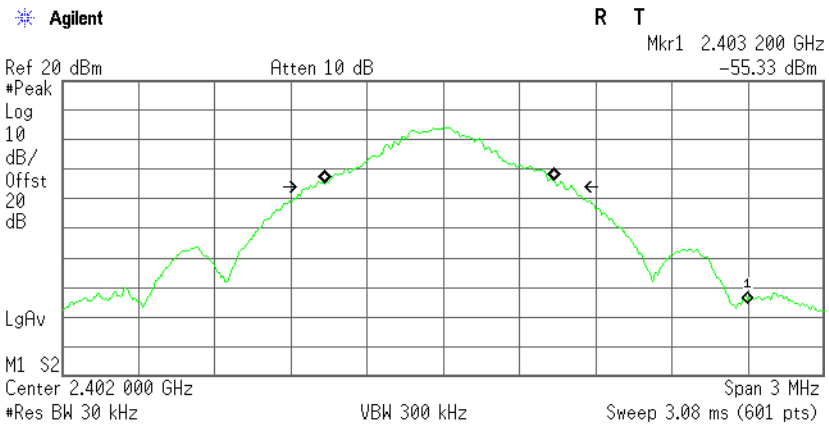
4.1. 20dB Bandwidth

Reference document:	47 CFR §15.247 (a) (1) & DA 00-705		
Test Requirements:	20dB Bandwidth of the hopping channel		
Test setup:	See Sec. 2.1	**Pass**	
Operating conditions:	Under normal test conditions		
Method of testing:	Conducted		
S.A. Settings:	RBW: 30kHz, VBW: 300kHz, Span: 3MHz		
Hopping function:	Disabled		
Environment conditions:	Ambient Temperature: 24.3 °C	Relative Humidity: 49.8%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.1.1 – 4.1.9	

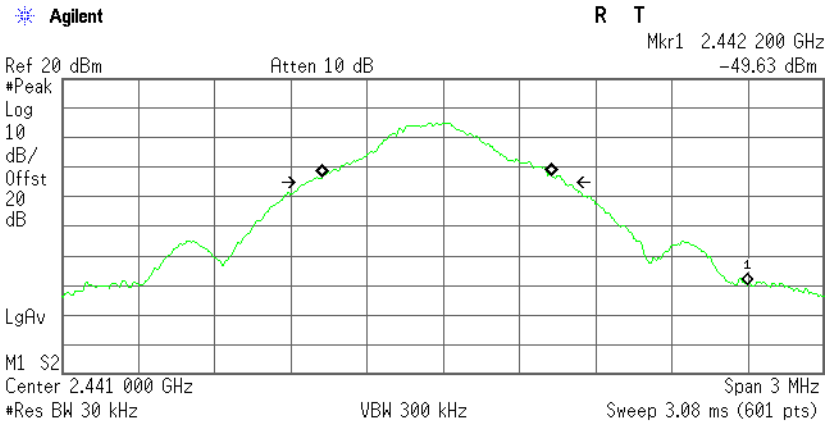
Test results:

Channel	Frequency, [MHz]	20dB BW, [kHz]	Notes
GFSK			
0	2402	1031	-
39	2441	1006	-
78	2480	1001	-
QPSK			
0	2402	1365	-
39	2441	1343	-
78	2480	1367	-
8PSK			
0	2402	1390	-
39	2441	1381	-
78	2480	1384	-

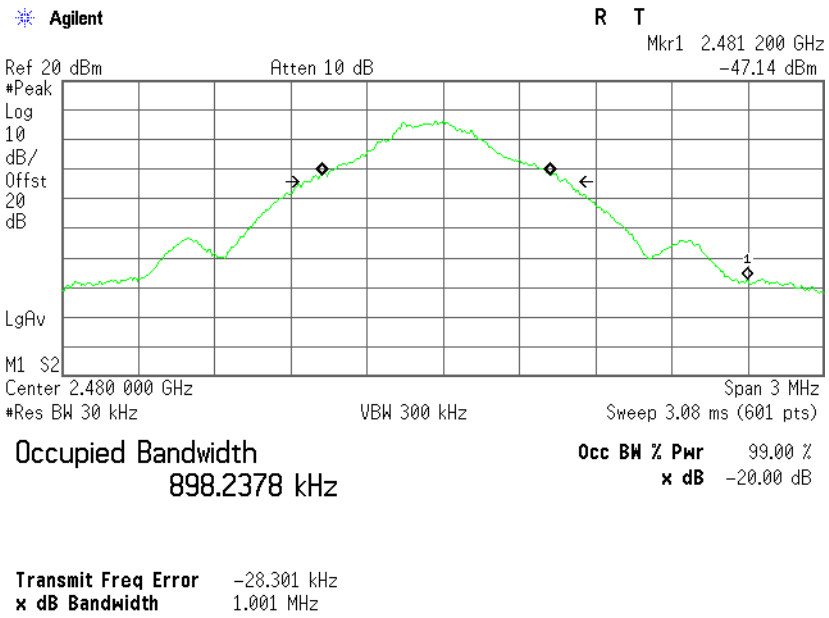
Plot 4.1.1 20dB bandwidth test results, GFSK, channel 0



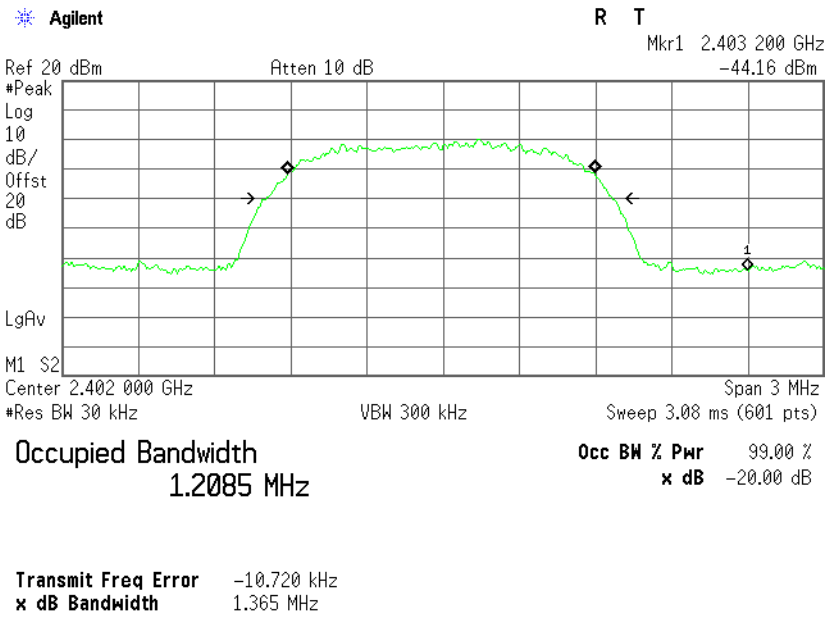
Plot 4.1.2 20dB bandwidth test results, GFSK, channel 39



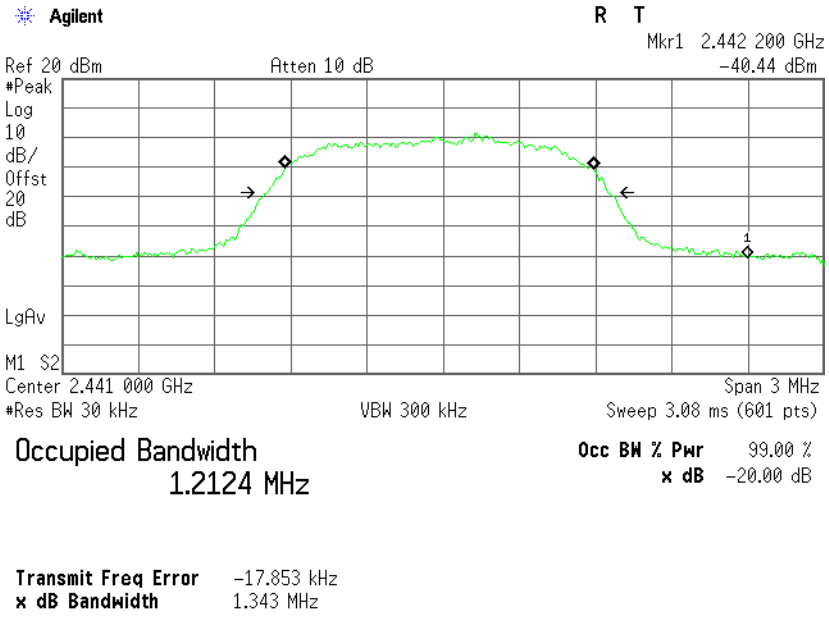
Plot 4.1.3 20dB bandwidth test results, GFSK, channel 78



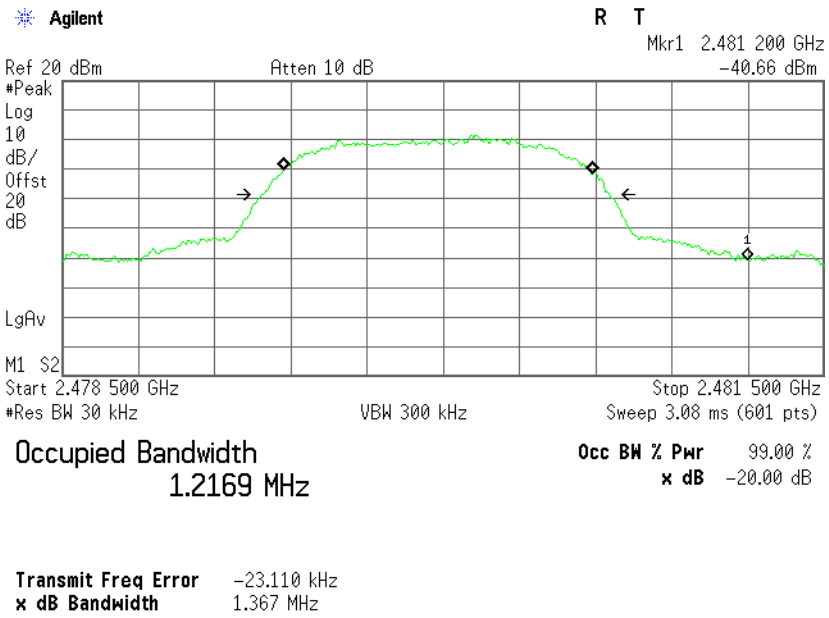
Plot 4.1.4 20dB bandwidth test results, QFSK, channel 0



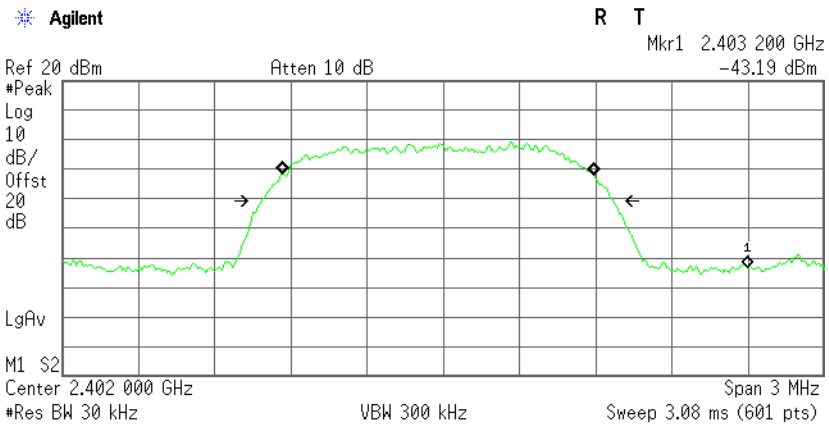
Plot 4.1.5 20dB bandwidth test results, QFSK, channel 39



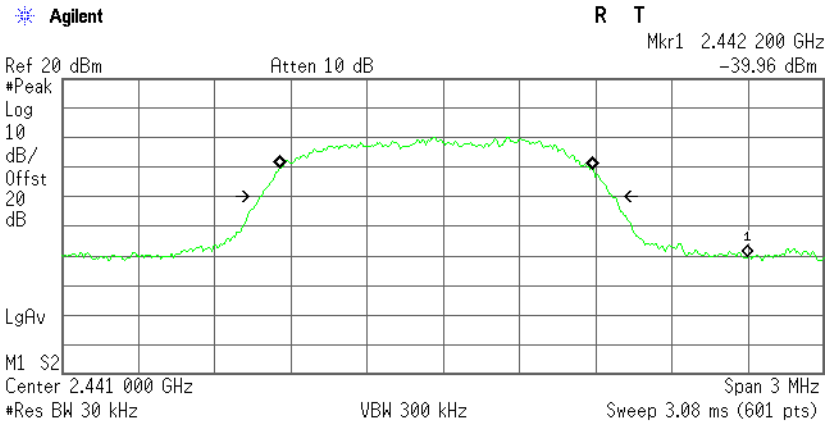
Plot 4.1.6 20dB bandwidth test results, QFSK, channel 78



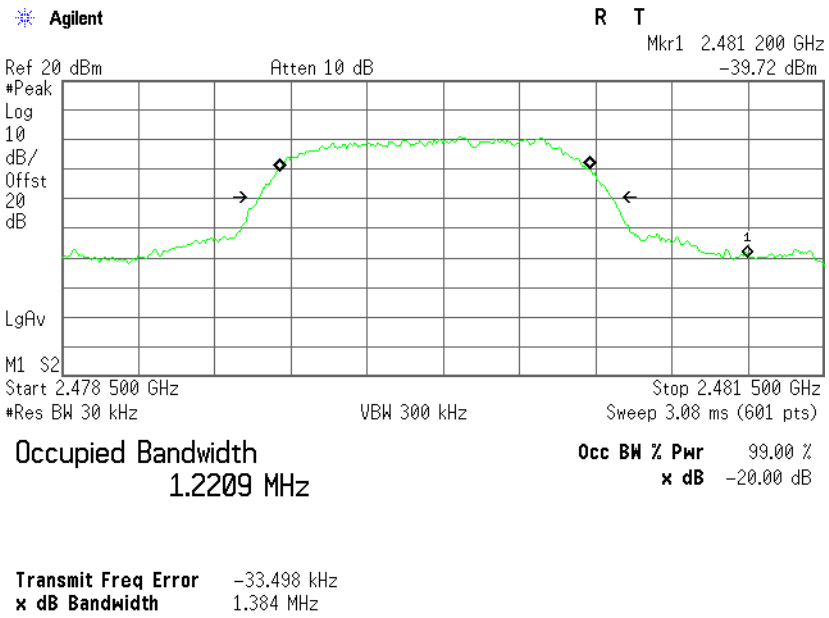
Plot 4.1.7 20dB bandwidth test results, 8PSK, channel 0



Plot 4.1.8 20dB bandwidth test results, 8PSK, channel 39



Plot 4.1.9 20dB bandwidth test results, 8PSK, channel 78



4.2. Carrier Frequency Separation

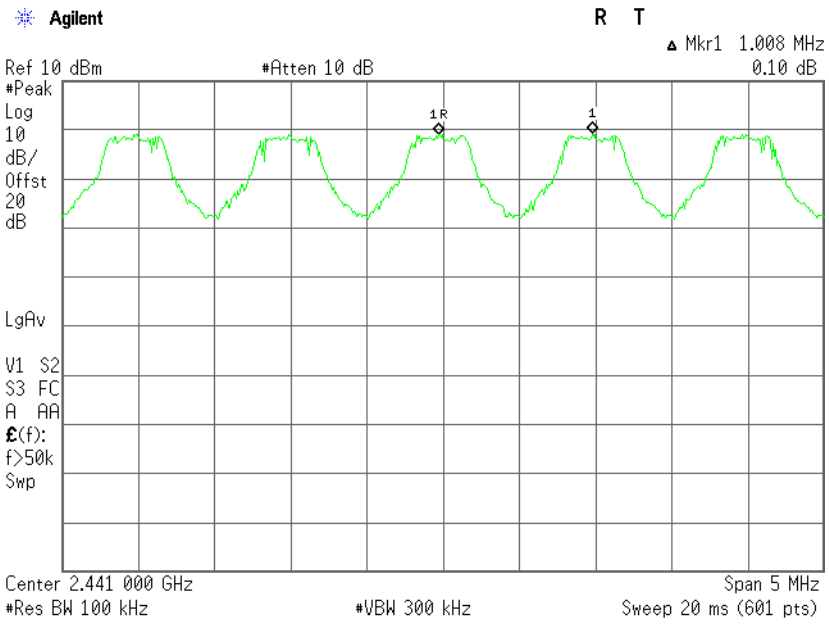
Reference document:	**47 CFR §15.247 (a) (1) & DA 00-705**		
Test Requirements:	In the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by a minimum of 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.		
Test setup:	See Sec. 2.1	**Pass**	
Operating conditions:	Under normal test conditions		
Method of testing:	Conducted		
S.A. Settings:	RBW: 100kHz, VBW: 300kHz		
Hopping function:	Enabled		
Environment conditions:	Ambient Temperature: 24.9°c	Relative Humidity: 50.1%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.2.1 – 4.2.3	

Test results:

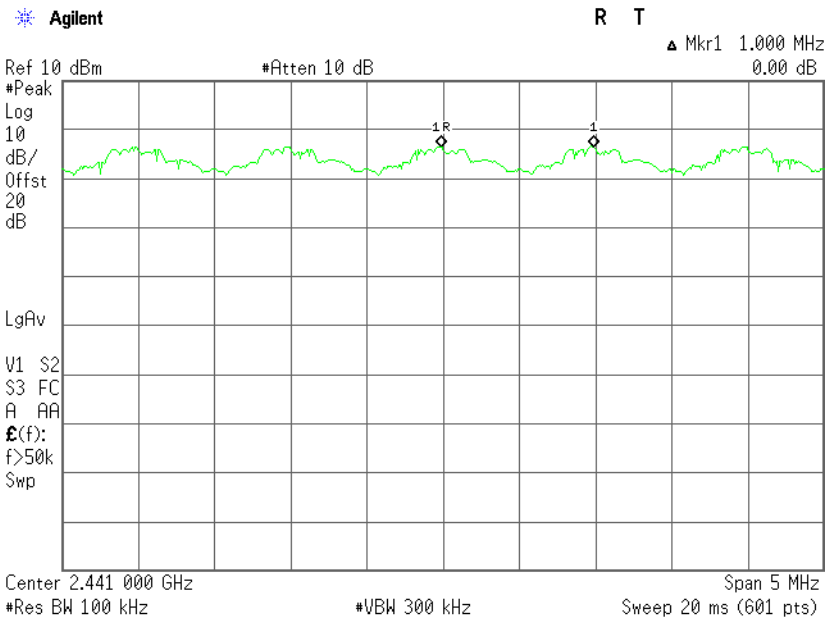
Type of Modulation	Frequency, MHz	20dB BW [kHz]	Measured Carrier separation [kHz]	Limit*, [kHz]	Result
GFSK	2441	1006.0	1008.0	≥666.7	Pass
QPSK	2441	1343.0	1000.0	≥895.3	Pass
8PSK	2441	1381.0	1000.0	≥920.7	Pass

*The limit is 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

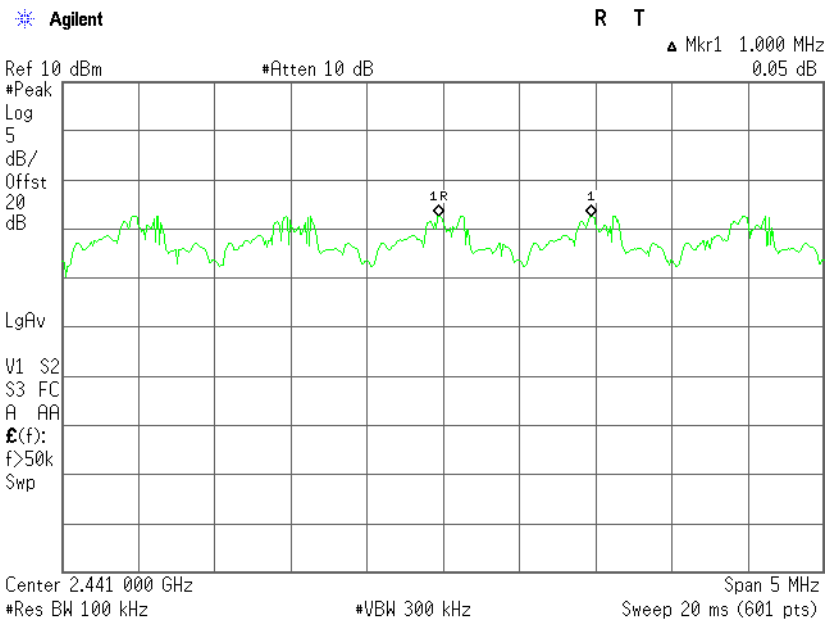
Plot 4.2.1 Carrier Frequency Separation test results, GFSK, channel 39



Plot 4.2.2 Carrier Frequency Separation test results, QPSK, channel 39



Plot 4.2.3 Carrier Frequency Separation test results, 8PSK, channel 39



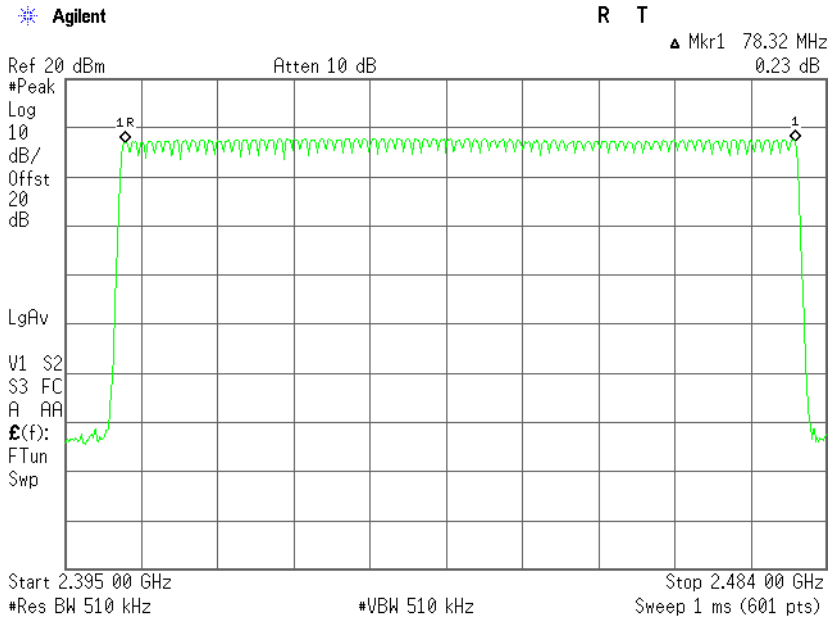
4.3. Number of Hopping Channels

Reference document:	**47 CFR §15.247 (a) (1)(iii) & DA 00-705**		
Test Requirements:	Hopping system shall use at least 15 non-overlapping channels.		
Test setup:	See Sec. 2.1	**Pass**	
Operating conditions:	Under normal test conditions		
Method of testing:	Conducted		
S.A. Settings:	RBW: 510kHz, VBW: 510kHz		
Hopping function:	Enabled		
Environment conditions:	Ambient Temperature: 24.9°C	Relative Humidity: 50.1%	Atmospheric Pressure: 1011.4 hPa
Test Result:	79 hopping channels	See Plot 4.3.1- 4.3.3	

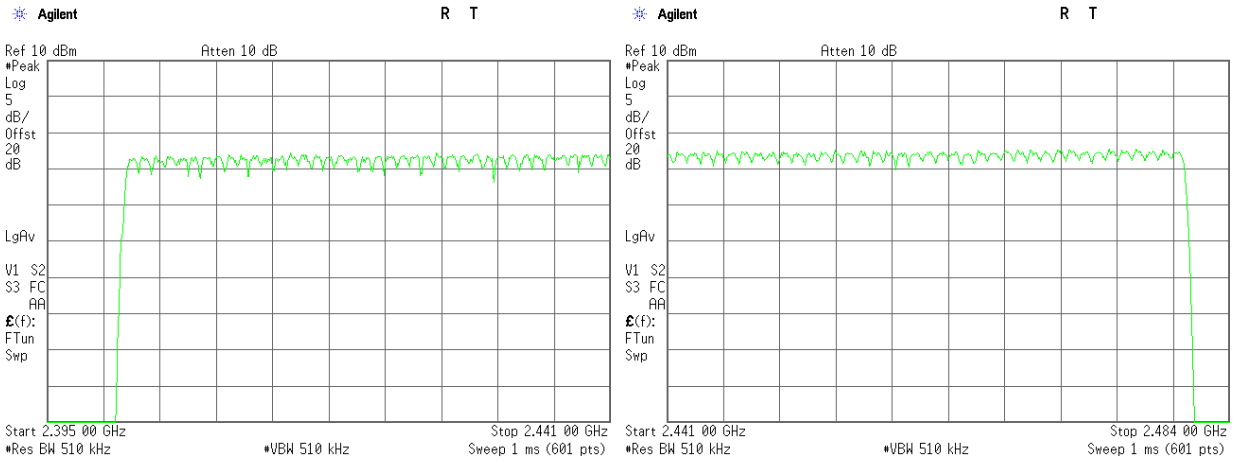
Test results:

Type of Modulation	Number of Hopping Channels	Limit	Result	Notes
GFSK	79	≥15	Pass	-
QPSK	79	≥15	Pass	-
8PSK	79	≥15	Pass	-

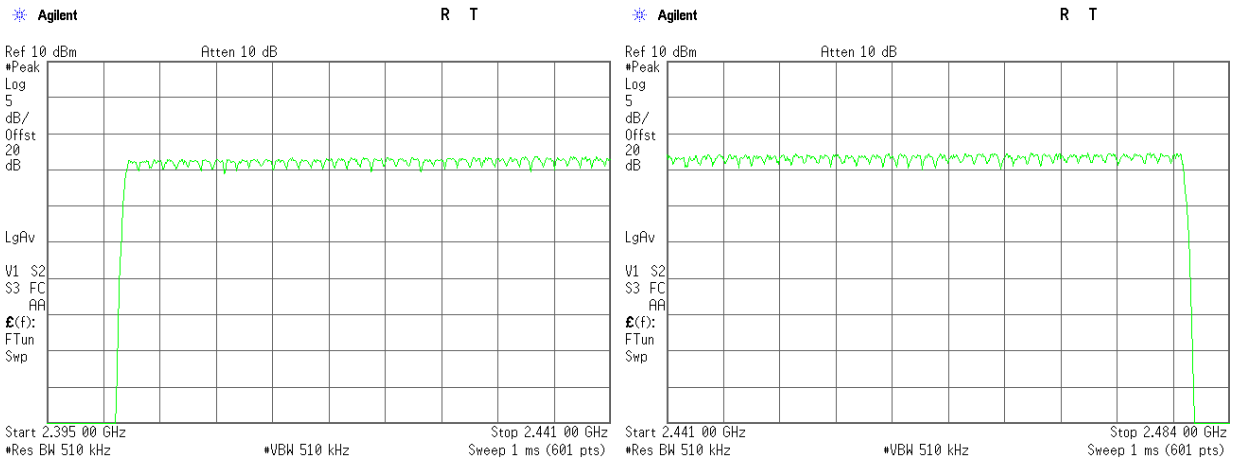
Plot 4.3.1 Number of Hopping Channels test results, GFSK



Plot 4.3.2 Number of Hopping Channels test results, QPSK, channel 39



Plot 4.3.3 Number of Hopping Channels test results, 8PSK, channel 39



4.4. Average Time of Occupancy (Dwell Time)

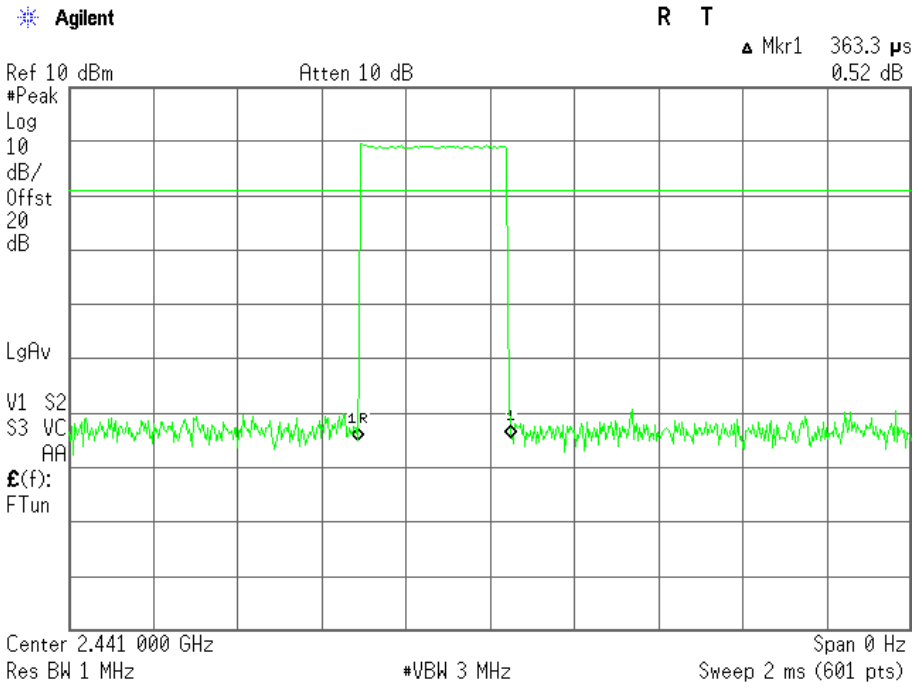
Reference document:	**47 CFR §15.247 (a) (1) (iii) & DA 00-705**		
Test Requirements:	The average time of occupancy on any channel shall not be greater than 400 ms within a period of 400 ms multiplied by the number of hopping channels employed.		
Test setup:	See Sec. 2.1	**Pass**	
Operating conditions:	Under normal test conditions		
Method of testing:	Conducted		
S.A. Settings:	RBW: 1MHz, VBW: 3MHz, Span:0 centered on hopping channel		
Hopping function:	Enabled		
Environment conditions:	Ambient Temperature: 24.9°C	Relative Humidity: 50.1%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.4.1– Plot 4.4.6	

Test results:

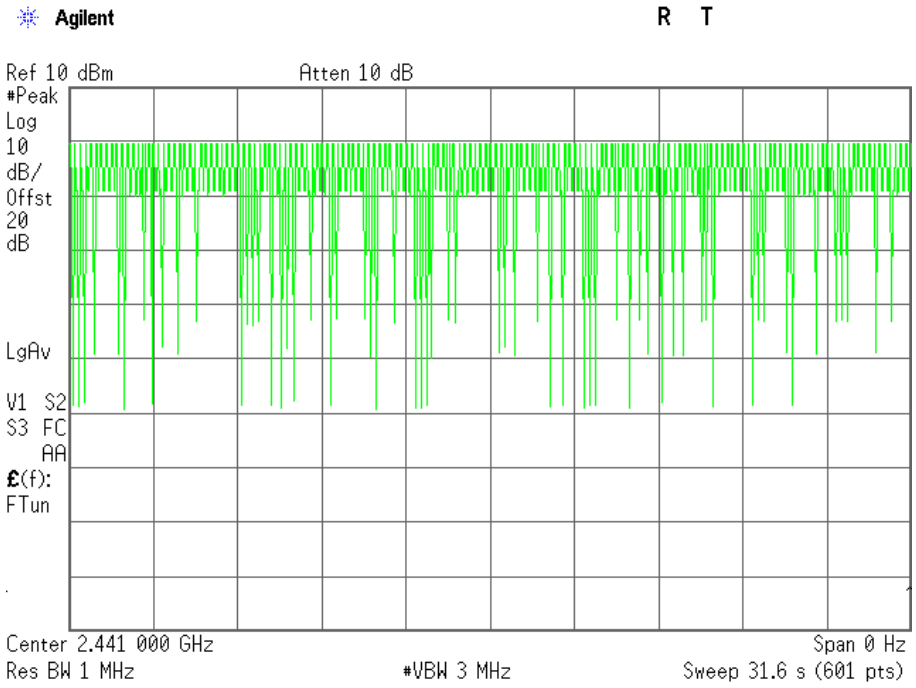
Type of Modulation	Frequency, MHz	Pulse length, msec	Hopping Rate, 1/s	Number of Hopping Channels	Period Time, s	Number of Hops in Period Time	Dwell time, ms*	Limit, [msec]	Pass/ Fail
GFSK(DH1)	2441.0	0.363	10.1	79	31.6	319.2	115.9	400.0	Pass
QPSK(DH1)	2441.0	0.407	10.1	79		319.2	129.2	400.0	Pass
8PSK(DH5)	2441.0	2.933	3.4	79		107.4	315.1	400.0	Pass

*Hopping Rate for 2 slots (DH1) = 1600/2/79 = 10.1 (1/s)
Hopping Rate for 6 slots (DH5) = 1600/6/79 = 3.4 (1/s)
Period Time = 0.4 s × Number of Hopping = 0.4 × 79 = 31.6 s
Number of Hops in Period Time = Hopping Rate × Period Time
Dwell Time = Pulse length × Number of Hops in Period time

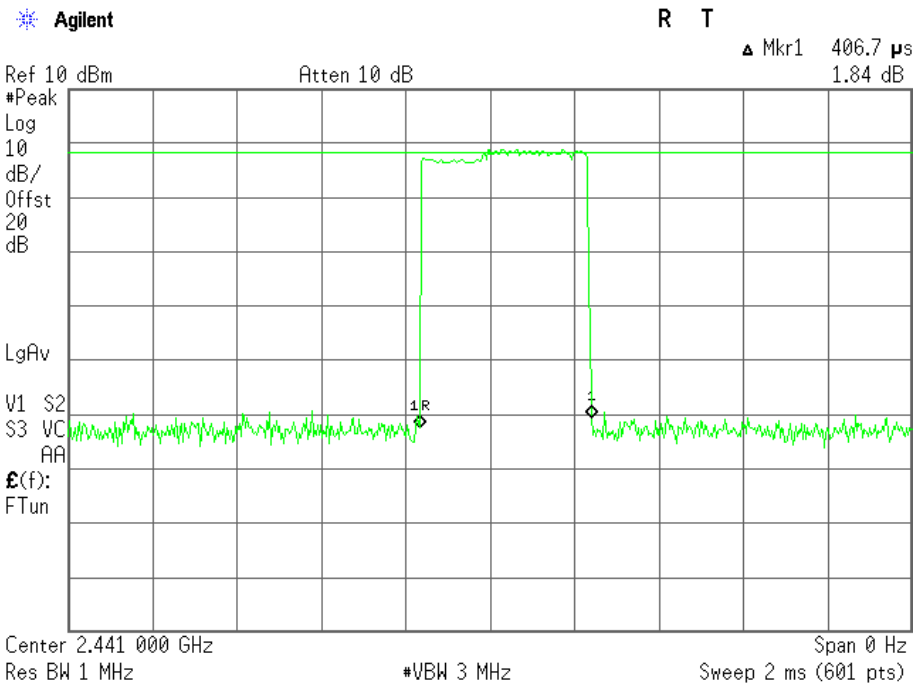
Plot 4.4.1 Average Time of Occupancy (Dwell Time) test results, Time slot length, GFSK, channel 39



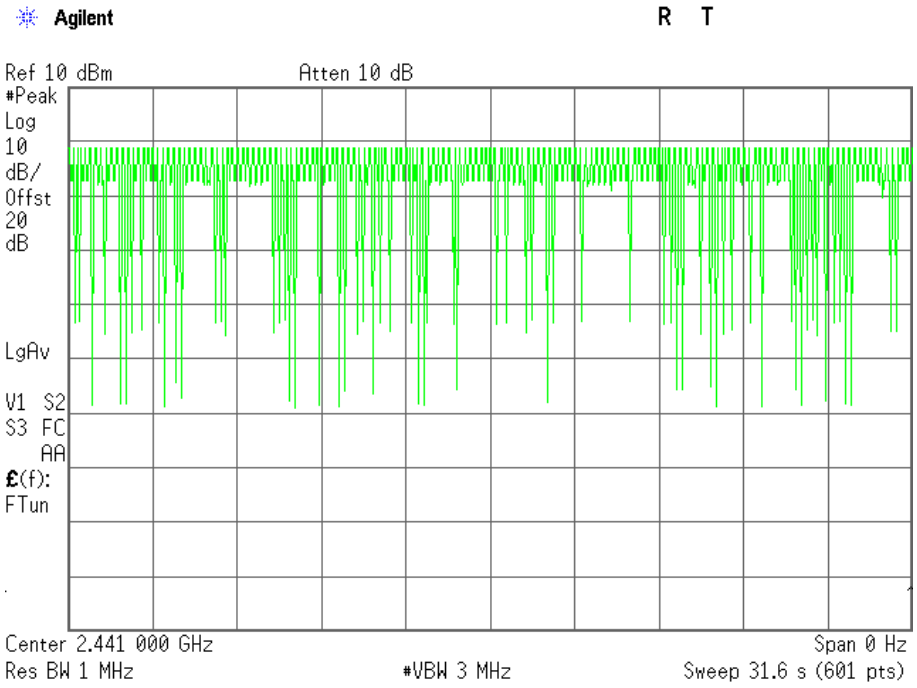
Plot 4.4.2 Average Time of Occupancy (Dwell Time) test results, Number of Slots in a Period, GFSK, channel 39



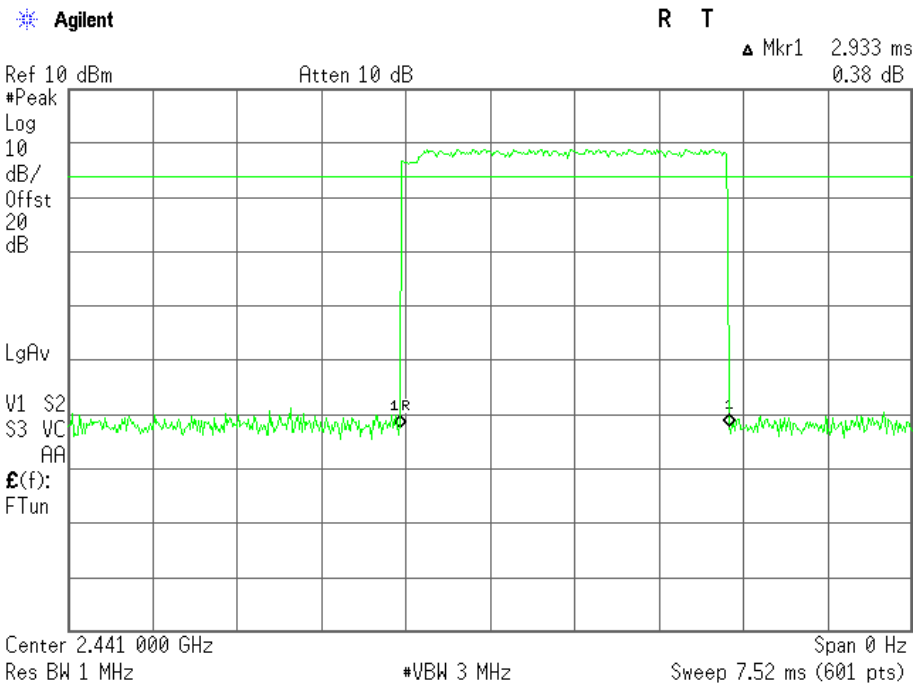
Plot 4.4.3 Average Time of Occupancy (Dwell Time) test results, Time slot length, QPSK, channel 39



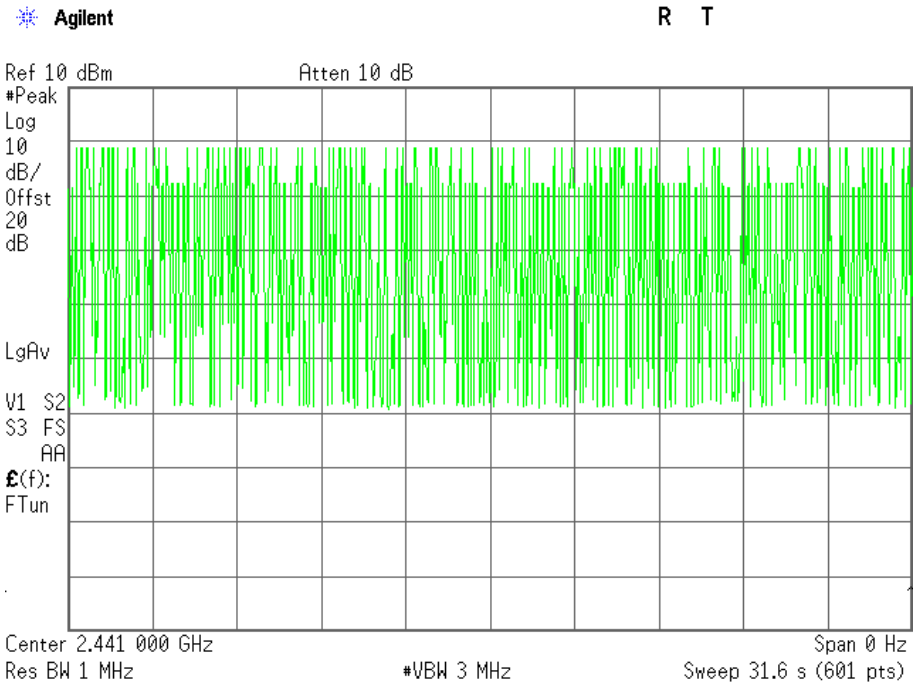
Plot 4.4.4 Average Time of Occupancy (Dwell Time) test results, Number of Slots in a Period, QPSK, channel 39



Plot 4.4.5 Average Time of Occupancy (Dwell Time) test results, Time slot length, 8PSK, channel 39



Plot 4.4.6 Average Time of Occupancy (Dwell Time) test results, Number of Slots in a Period, 8PSK, channel 39



4.5. Maximum Peak Output Power

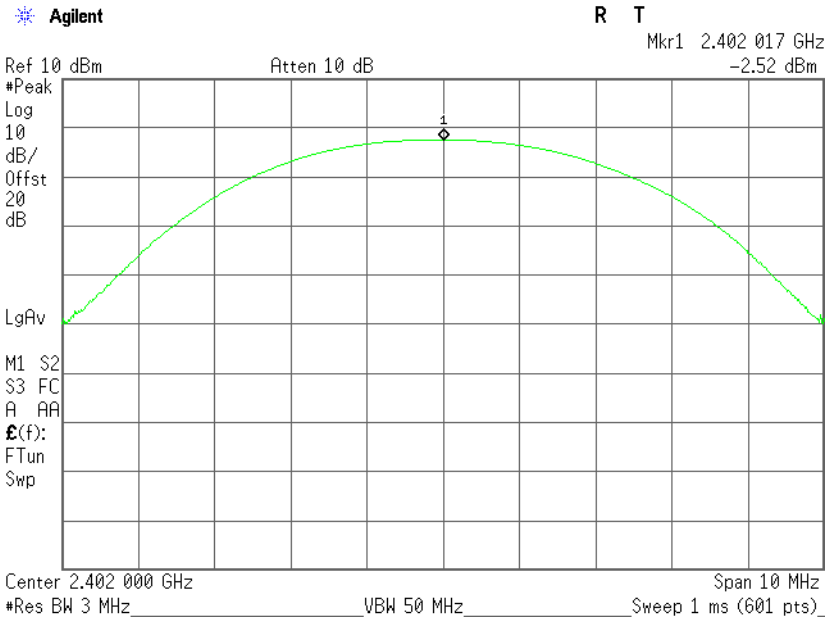
Reference document:	**47 CFR §15.247 (b) (1) & DA 00-705**		
Test Requirements:	The maximum peak output power shall not exceed 1Watt (30dBm)		
Test setup:	See Sec. 2.1	**Pass**	
Operating conditions:	Under normal test conditions		
Method of testing:	Conducted		
S.A. Settings:	RBW: 3MHz, VBW: 3MHz,		
Hopping function:	Disabled		
Environment conditions:	Ambient Temperature: 24.9°C	Relative Humidity: 50.1%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.5.1 – Plot 4.5.9	

Test results:

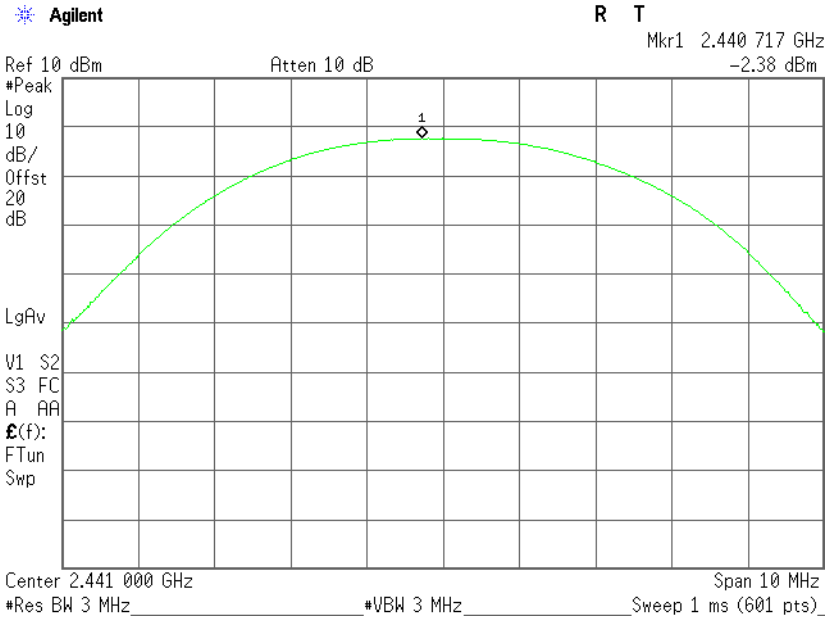
Type of Modulation	Channel	Frequency, [MHz]	Max. Peak Output power*, [dBm]	Limt, [dBm]	Delta, [dB]	Pass/Fail
GFSK	0	2.402	-2.52	30.00	-32.52	Pass
	39	2.441	-2.38	30.00	-32.38	Pass
	78	2.480	-2.00	30.00	-32.00	Pass
QPSK	0	2.402	-2.63	30.00	-32.63	Pass
	39	2.441	-2.36	30.00	-32.36	Pass
	78	2.480	-1.72	30.00	-31.72	Pass
8PSK	0	2.402	-2.40	30.00	-32.40	Pass
	39	2.441	-1.82	30.00	-31.82	Pass
	78	2.480	-1.33	30.00	-31.33	Pass

*Corrected for external attenuations & cable

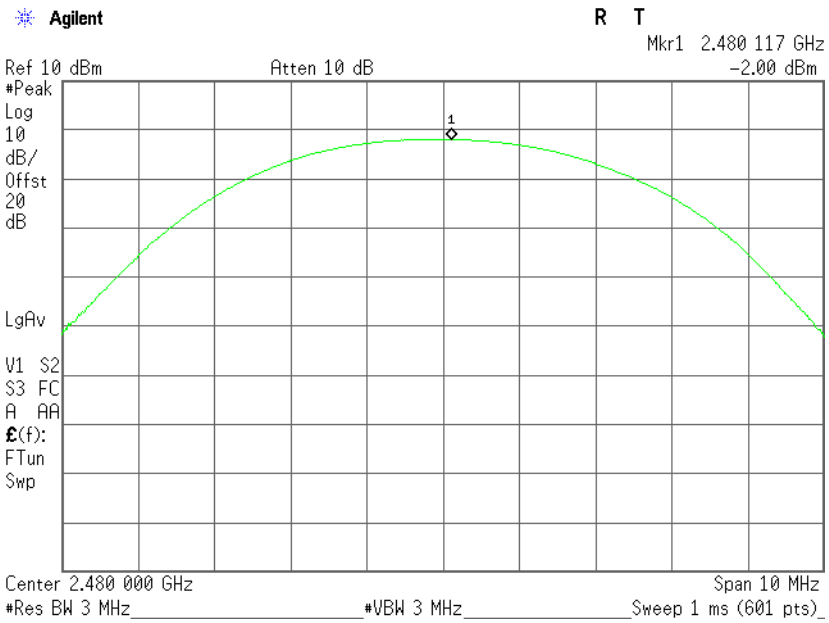
Plot 4.5.1 Maximum Peak Output Power test results, GFSK, channel 0



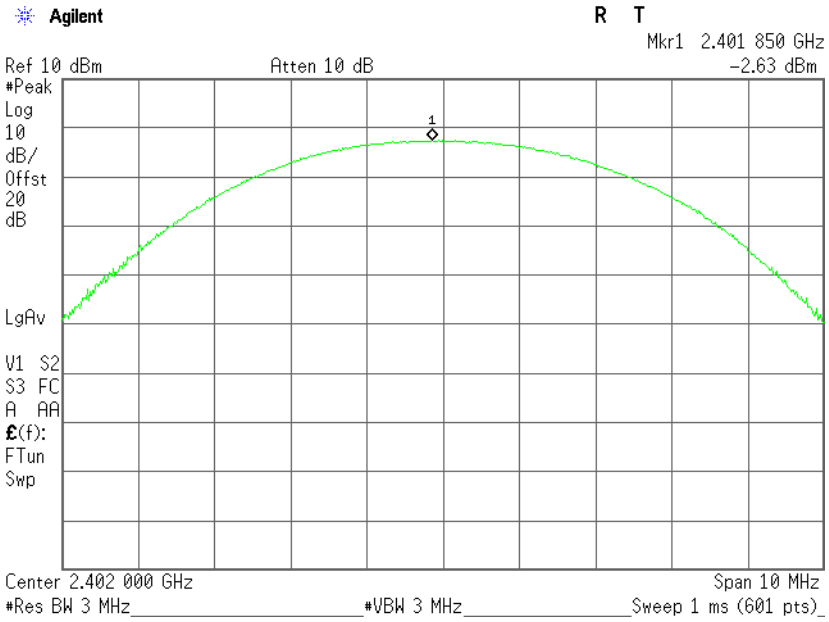
Plot 4.5.2 Maximum Peak Output Power test results, GFSK, channel 39



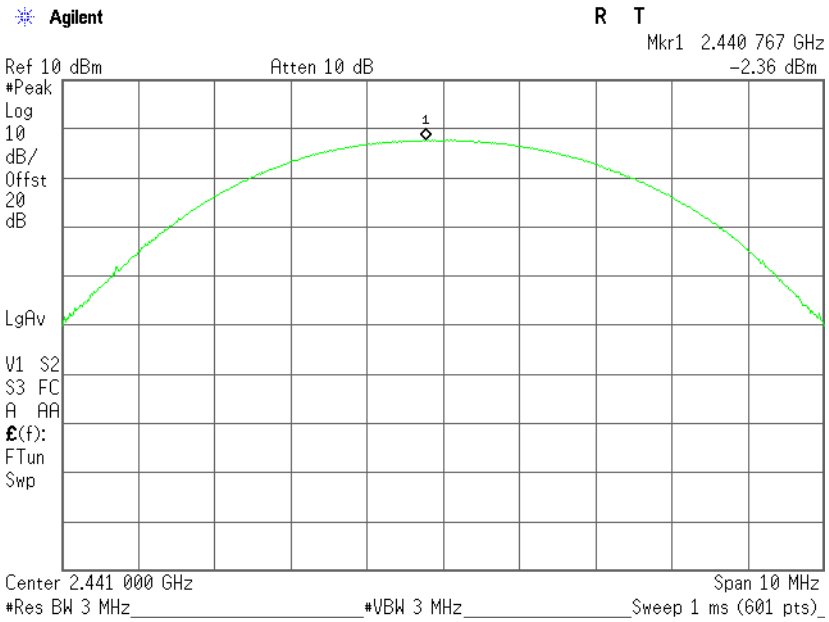
Plot 4.5.3 Maximum Peak Output Power test results, GFSK, channel 78



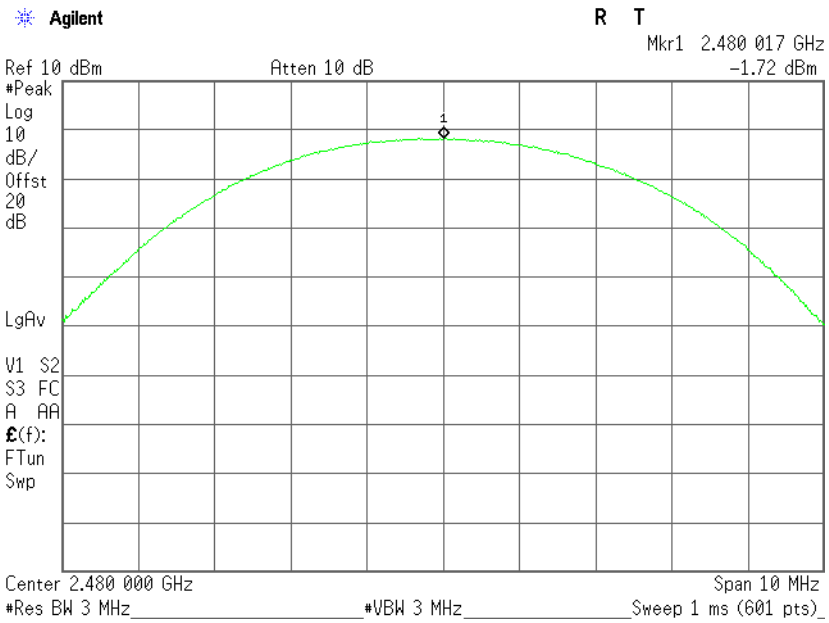
Plot 4.5.4 Maximum Peak Output Power test results, QPSK, channel 0



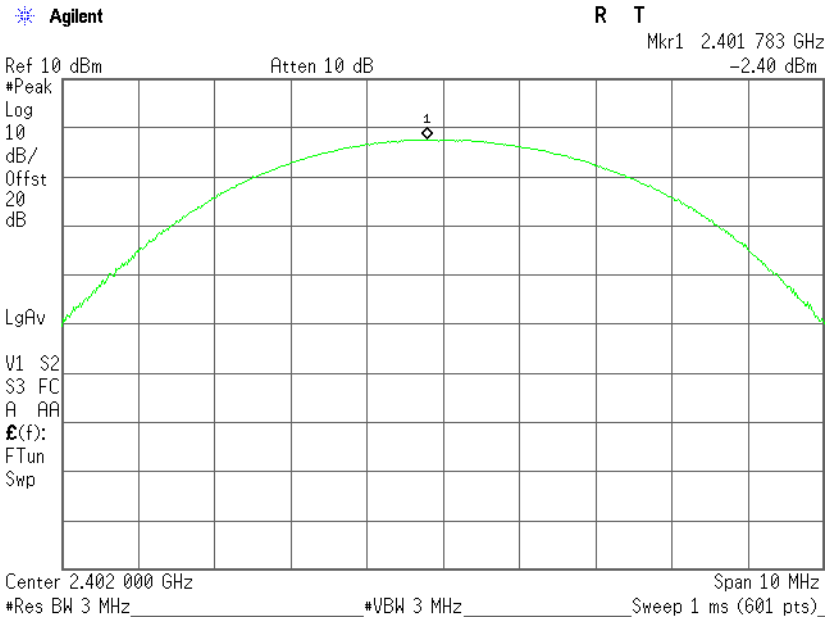
Plot 4.5.5 Maximum Peak Output Power test results, QPSK, channel 39



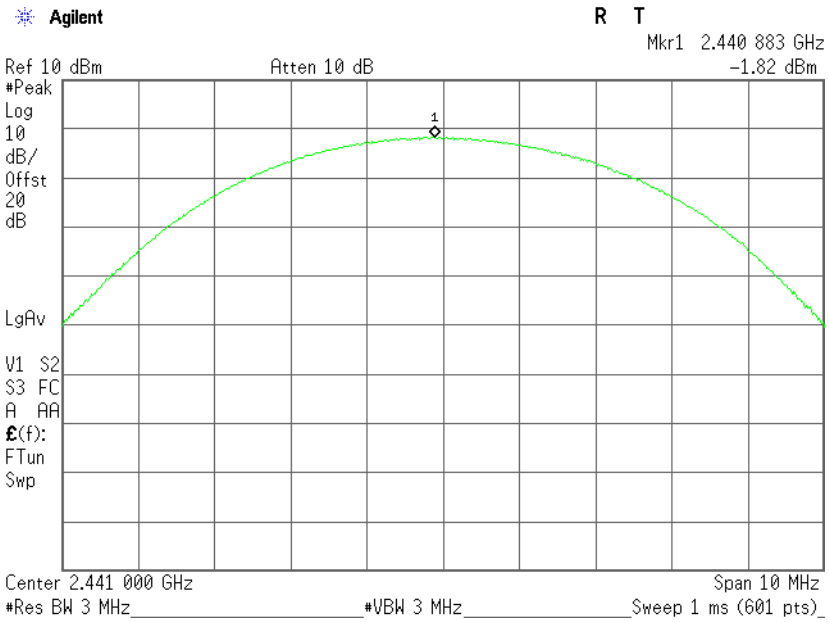
Plot 4.5.6 Maximum Peak Output Power test results, QPSK, channel 78



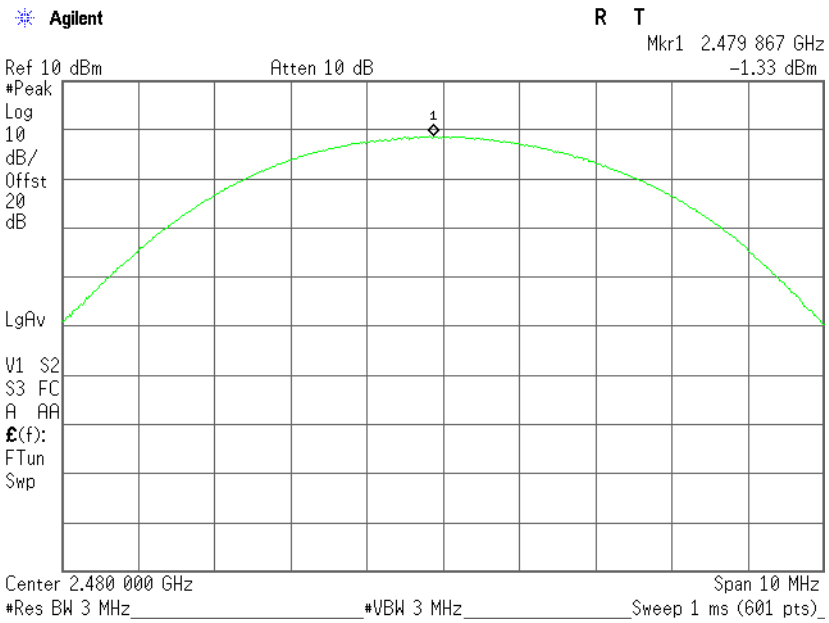
Plot 4.5.7 Maximum Peak Output Power test results, 8PSK, channel 0



Plot 4.5.8 Maximum Peak Output Power test results, 8PSK, channel 39



Plot 4.5.9 Maximum Peak Output Power test results, 8PSK, channel 78



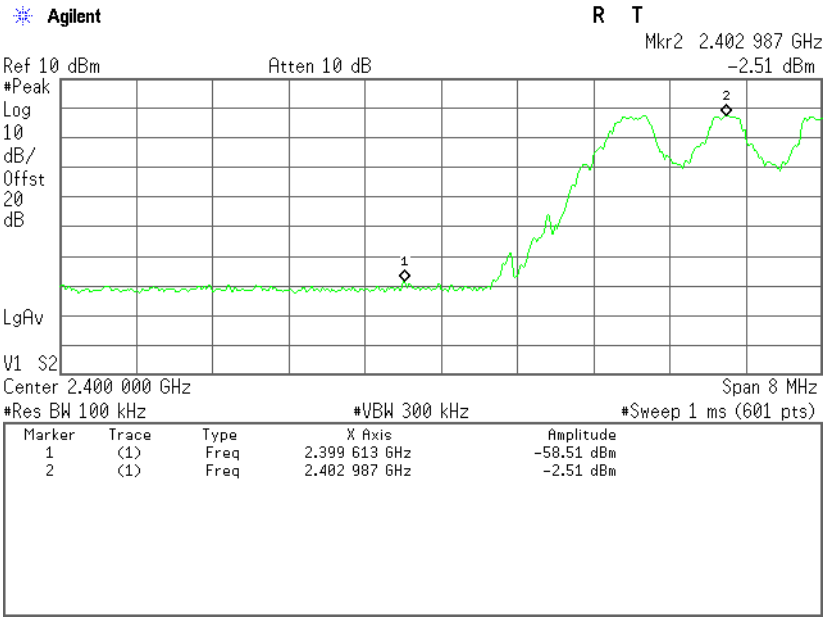
4.6. Band-edge compliance of RF Conducted Emission

Reference document:	**47 CFR §15.247 (d) & DA 00-705**		
Test Requirements and limit:	In any 100 kHz bandwidth outside the frequency band in which the digitally modulated 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 Section §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**	
Operating conditions:	Under normal test conditions		
Method of testing:	Conducted		
S.A. Settings:	RBW: 100kHz, VBW: 300kHz		
Hopping function:	Disabled/Enabled		
Environment conditions:	Ambient Temperature: 23.6°C	Relative Humidity: 49.1%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.6.1 – Plot 4.6.12	

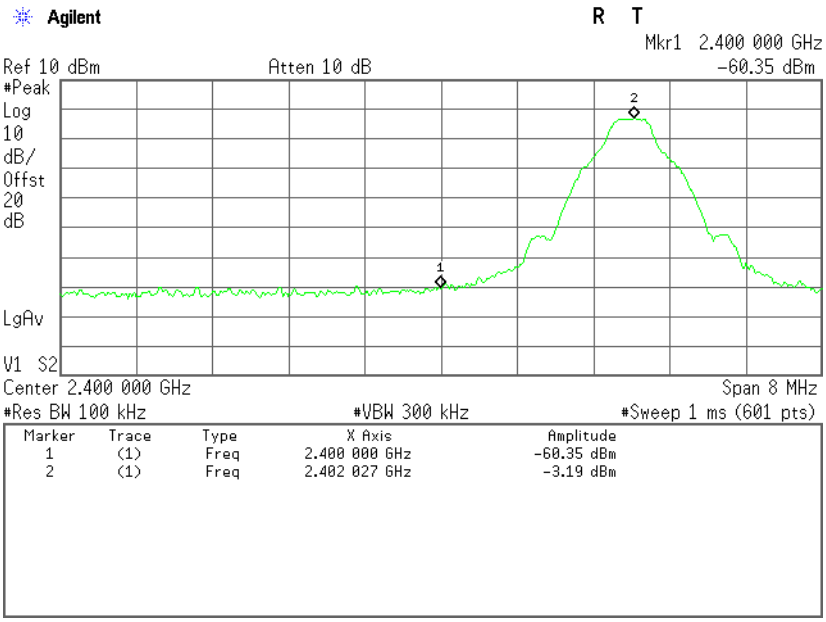
Test results

Type of Modulation	Mode	Channel	Measured emission, [dBc]	Limit, [dBc]	Result
GFSK	Hopping ON	0	-56.00	-20.00	Pass
		78	-57.91	-20.00	Pass
	Hopping OFF	0	-57.16	-20.00	Pass
		78	-57.93	-20.00	Pass
QPSK	Hopping ON	0	-55.00	-20.00	Pass
		78	-57.24	-20.00	Pass
	Hopping OFF	0	-47.13	-20.00	Pass
		78	-56.37	-20.00	Pass
8PSK	Hopping ON	0	-51.29	-20.00	Pass
		78	-54.75	-20.00	Pass
	Hopping OFF	0	-46.51	-20.00	Pass
		78	-53.32	-20.00	Pass

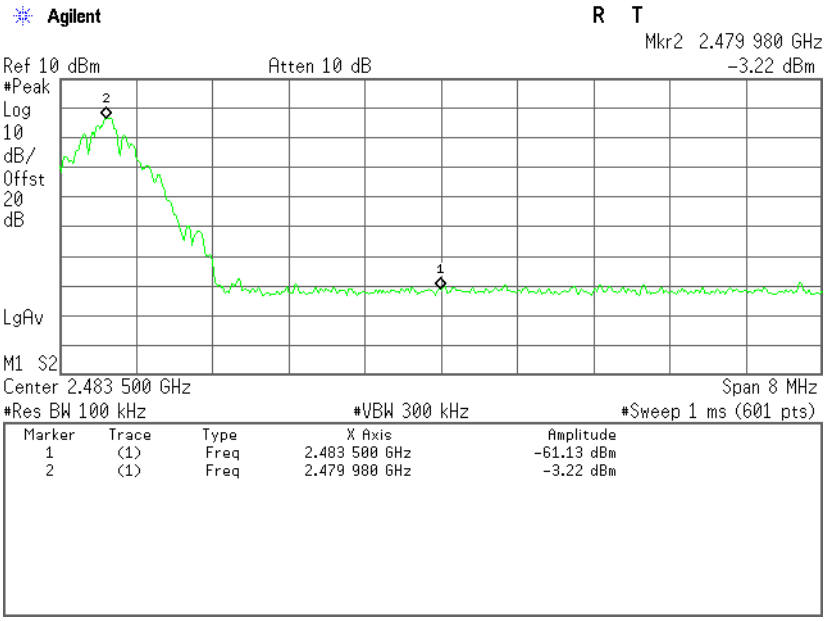
Plot 4.6.1 Band-edge test results, GFSK, channel 0, Hopping ON



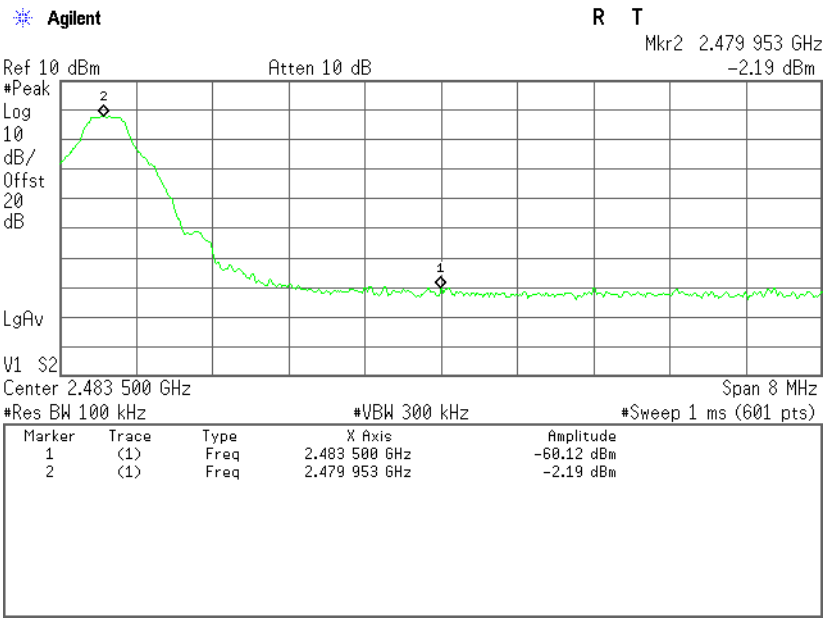
Plot 4.6.2 Band-edge test results, GFSK, channel 0, Hopping OFF



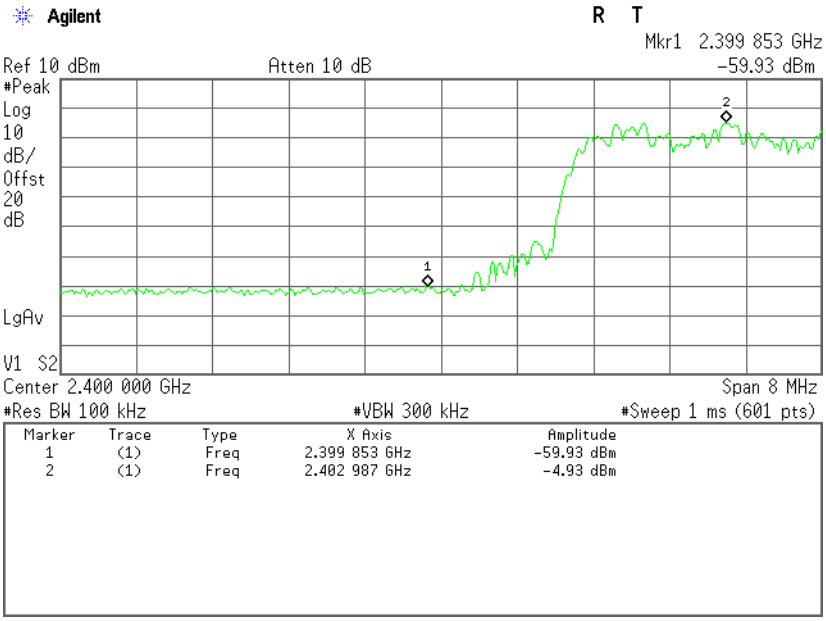
Plot 4.6.3 Band-edge test results, GFSK, channel 78, Hopping ON



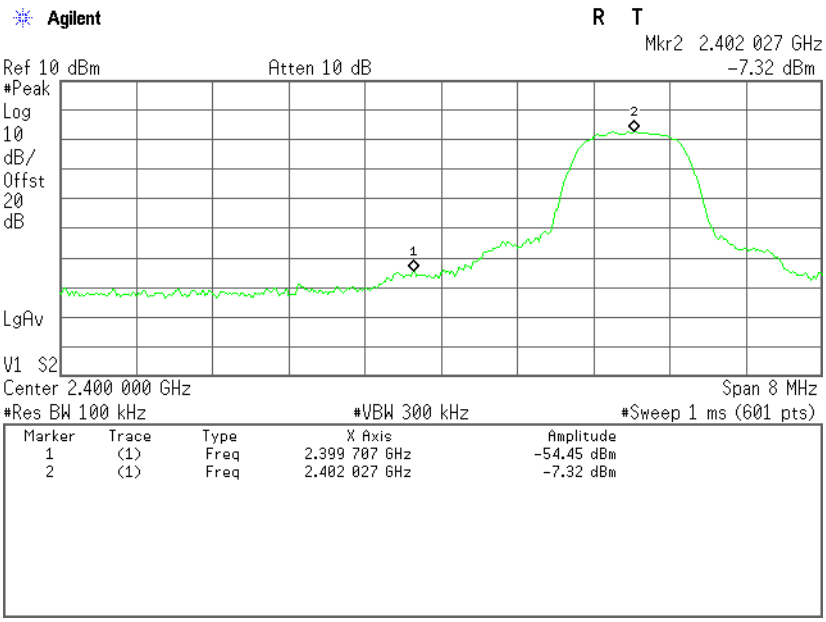
Plot 4.6.4 Band-edge test results, GFSK, channel 78, Hopping OFF



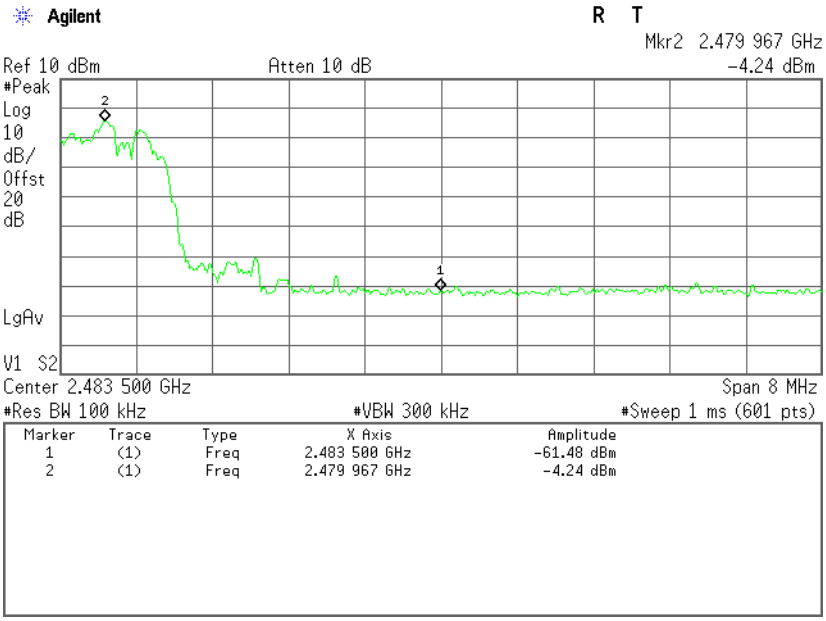
Plot 4.6.5 Band-edge test results, QPSK, channel 0, Hopping ON



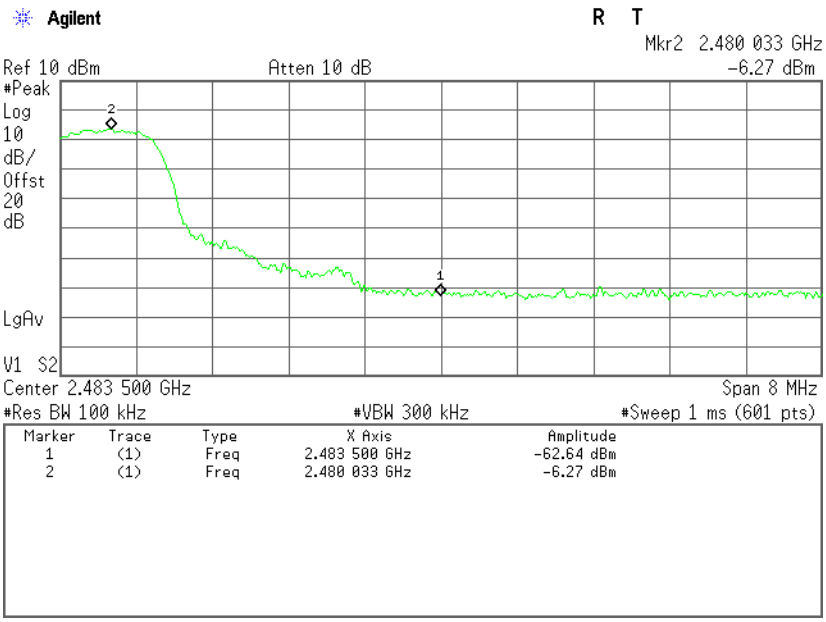
Plot 4.6.6 Band-edge test results, QPSK, channel 0, Hopping OFF



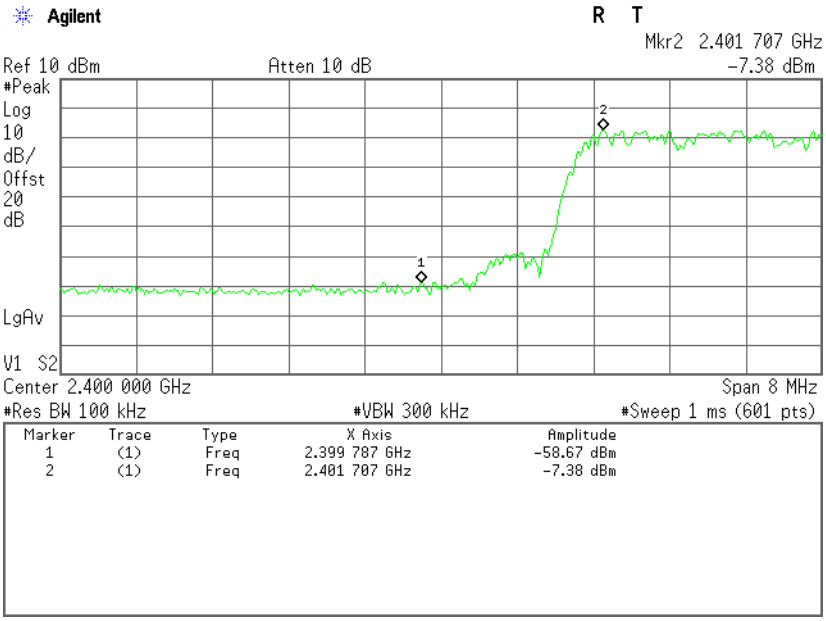
Plot 4.6.7 Band-edge test results, QPSK, channel 78, Hopping ON



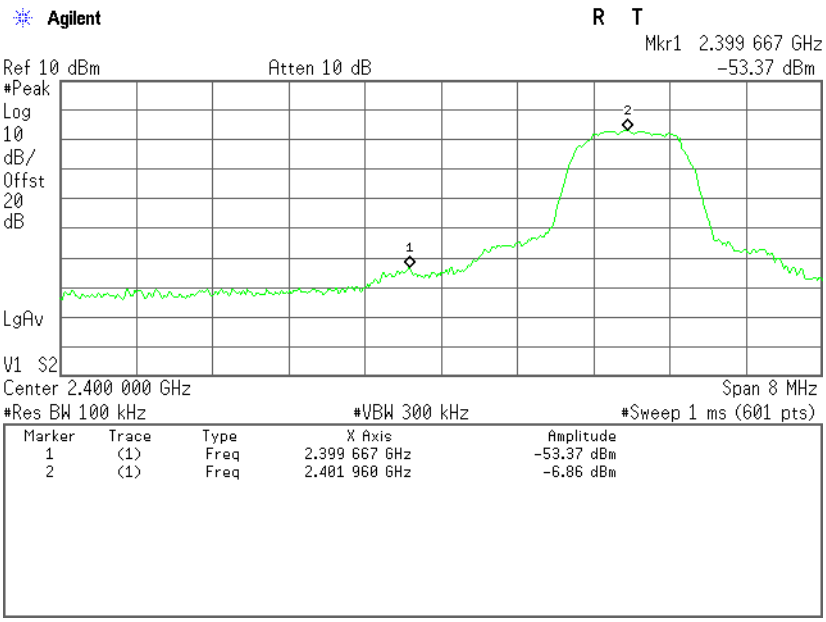
Plot 4.6.8 Band-edge test results, QPSK, channel 78, Hopping OFF



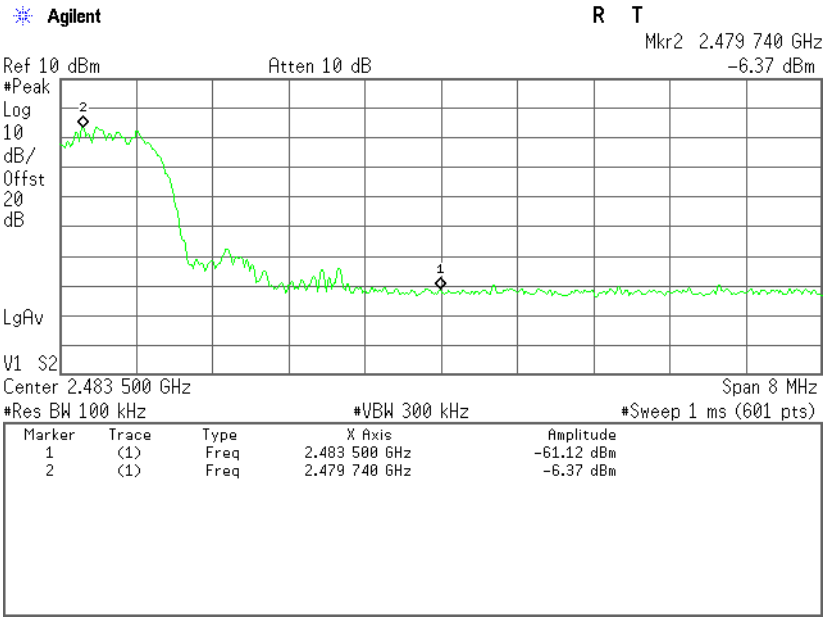
Plot 4.6.9 Band-edge test results, 8PSK, channel 0, Hopping ON



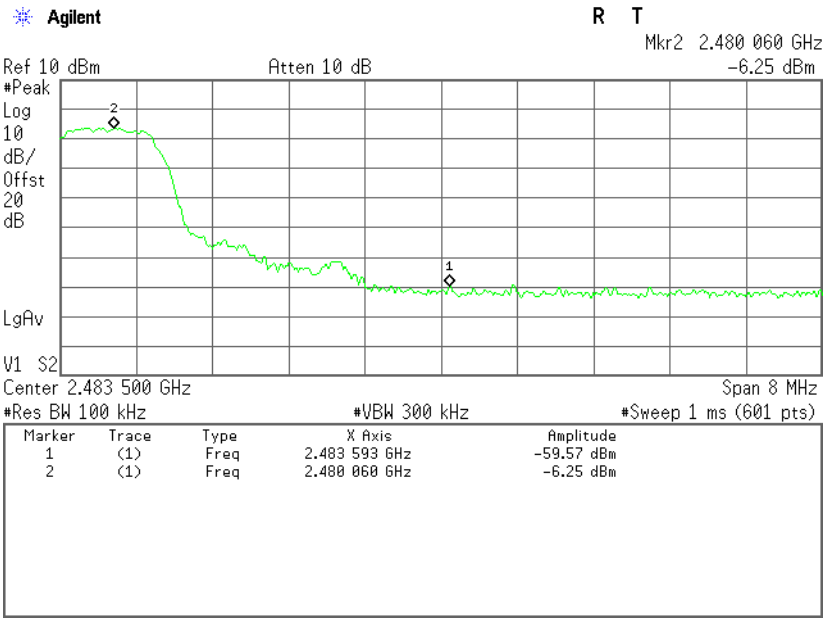
Plot 4.6.10 Band-edge test results, 8PSK, channel 0, Hopping OFF



Plot 4.6.11 Band-edge test results, 8PSK, channel 78, Hopping ON



Plot 4.6.12 Band-edge test results, 8PSK, channel 78, Hopping OFF



4.7. Spurious Emissions in Restricted Bands (2310-2390MHz, 2483.5-2500MHz) – Radiated Measurements

Reference document:	**47 CFR §15.247 (d) & §15.209(a) & DA 00-705**		
Test Requirements:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a) (See section 15.205(c).		
Test setup:	See Sec. 2.2	**Pass**	
Operating conditions:	Under normal test conditions		
Method of testing:	Radiated		
S.A. Settings:	RBW: 1MHz, VBW: 3MHz, 10Hz		
Hopping function:	Disabled/Enabled		
Environment conditions:	Ambient Temperature: 23.8°c	Relative Humidity: 51.6%	Atmospheric Pressure: hPa
Test Result:	See below	See Plot 4.7.1 – Plot 4.7.8	

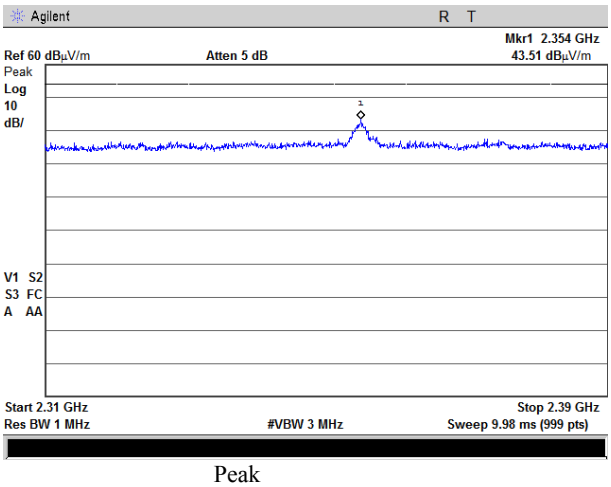
Test results (8PSK modulation as a worst case according to max output peak power):

All measurements were done in horizontal and vertical polarizations and 3orientation axis X,Y & Z; the results show the worst case.

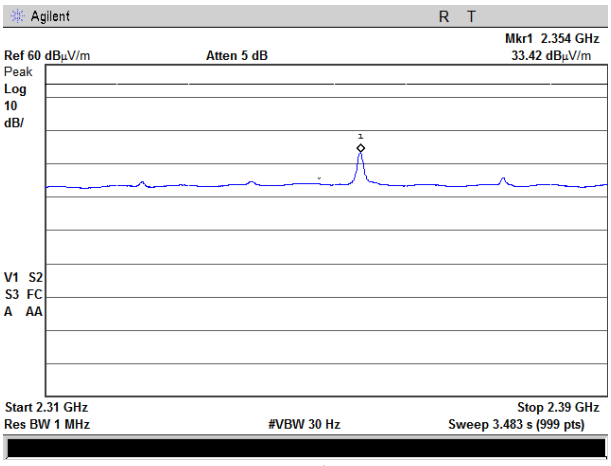
Frequency, MHz	Mode	Emission Frequency, MHz	Antenna Polarization	Detector type	Measured Emission, [dBµV/m]	Limit, [dBµV/m]	Delta, [dBµV/m]	Pass/ Fail
2402	Hopping OFF	2354.0	V	Peak	43.51	74.00	-30.49	Pass
		2354.0	V	Average	33.42	54.00	-20.58	Pass
	Hopping ON	2347.0	H	Peak	38.65	74.00	-35.35	Pass
		2375.0	H	Average	24.61	54.00	-29.39	Pass
2480	Hopping OFF	2493.0	H	Peak	43.02	74.00	-30.98	Pass
		2493.0	H	Average	30.35	54.00	-23.65	Pass
	Hopping ON	2493.0	V	Peak	44.02	74.00	-29.98	Pass
		2493.0	V	Average	35.86	54.00	-18.14	Pass

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

Plot 4.7.1 Spurious Emissions in Restricted Bands, Single mode, Fc = 2402MHz, Vertical Polarization, Hopping OFF

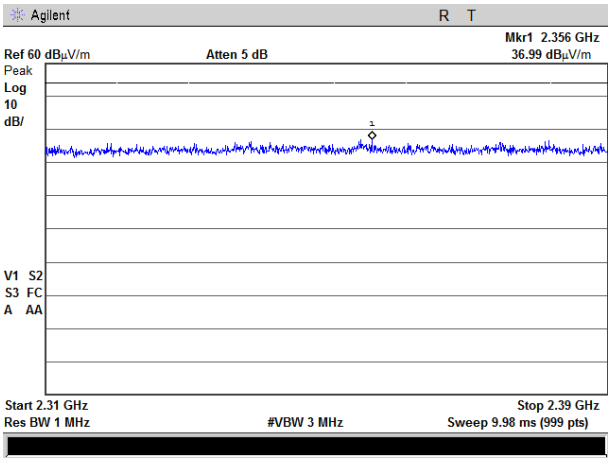


Peak

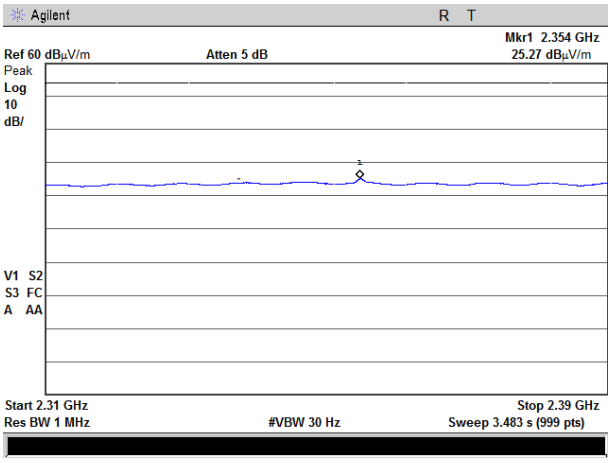


Average

Plot 4.7.2 Spurious Emissions in Restricted Bands, Single mode, Fc = 2402MHz, Horizontal Polarization, Hopping OFF

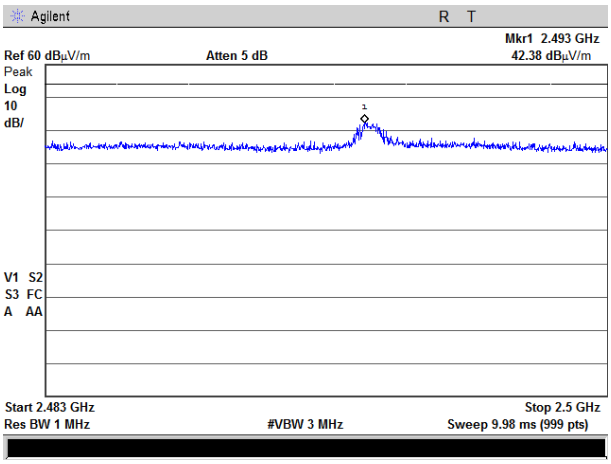


Peak

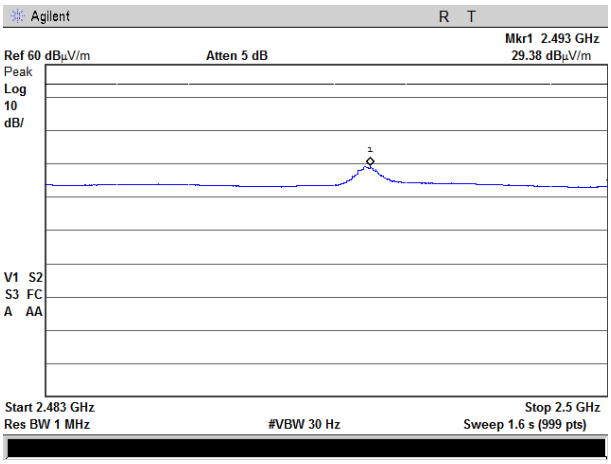


Average

Plot 4.7.3 Spurious Emissions in Restricted Bands, Single mode, Fc = 2480MHz, Vertical Polarization, Hopping OFF

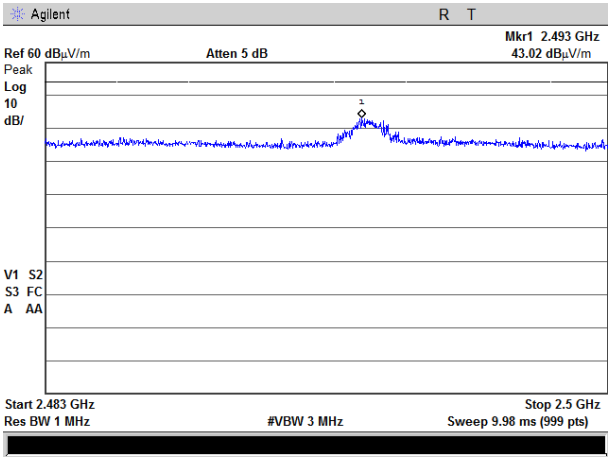


Peak

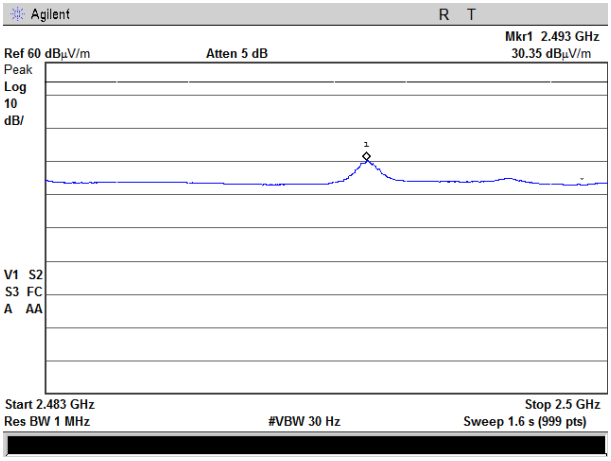


Average

Plot 4.7.4 Spurious Emissions in Restricted Bands, Single mode, Fc = 2480MHz, Horizontal Polarization, Hopping OFF

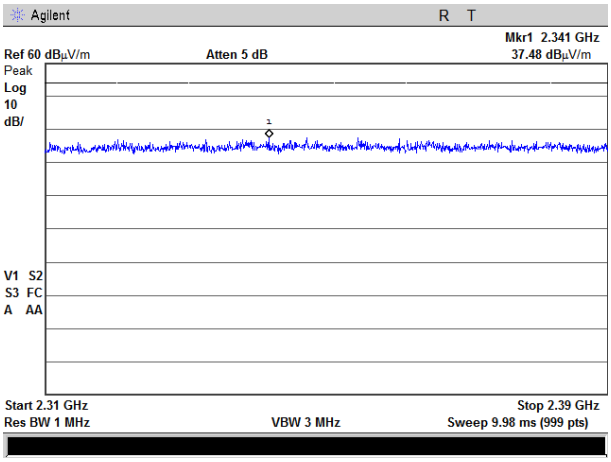


Peak

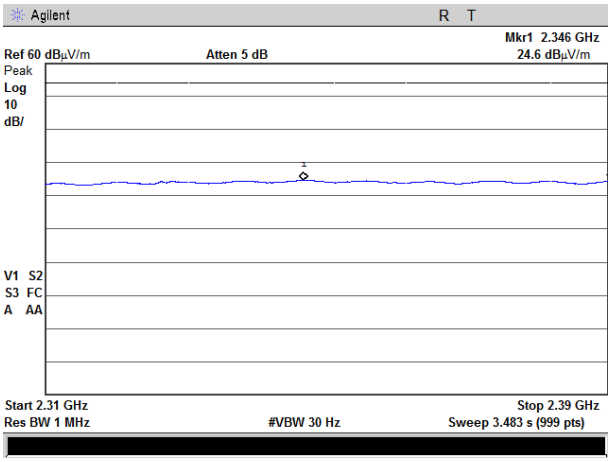


Average

Plot 4.7.5 Spurious Emissions in Restricted Bands, Fc = 2402MHz, Vertical Polarization, Hopping ON

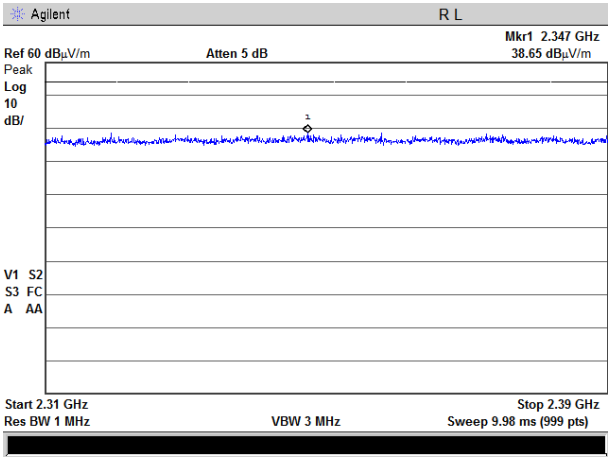


Peak

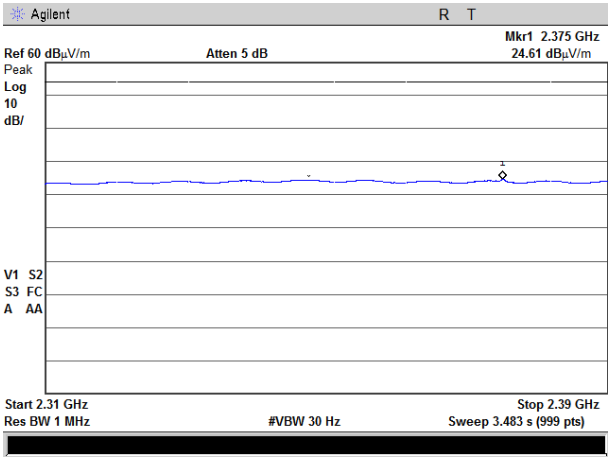


Average

Plot 4.7.6 Spurious Emissions in Restricted Bands, Fc = 2402MHz, Horizontal Polarization, Hopping ON

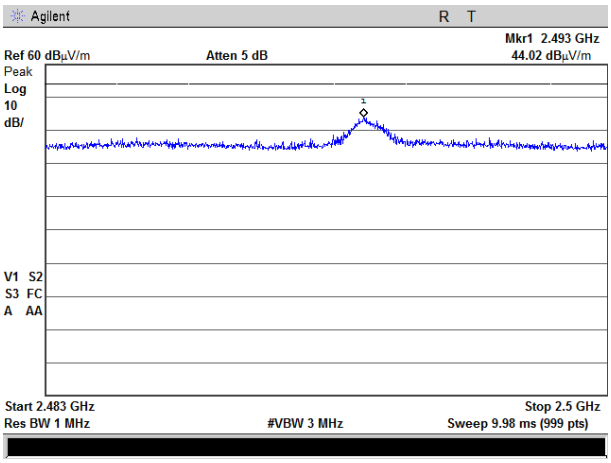


Peak

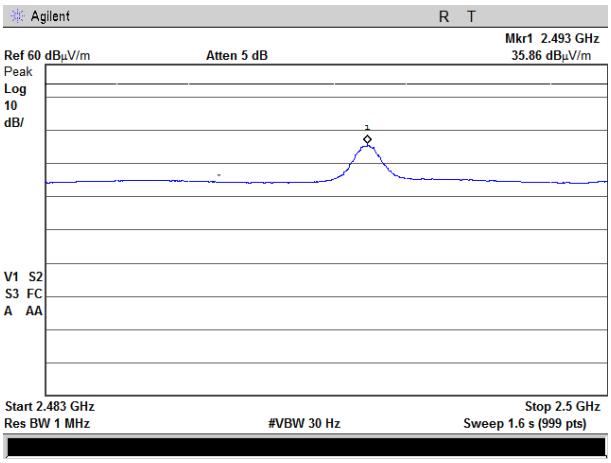


Average

Plot 4.7.7 Spurious Emissions in Restricted Bands, Fc = 2480MHz, Vertical Polarization, Hopping ON

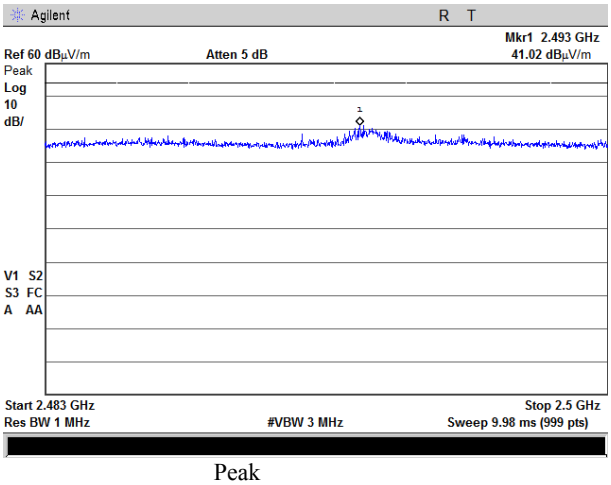


Peak

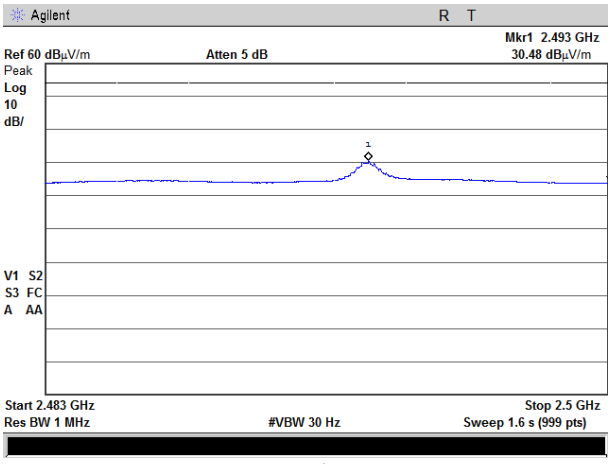


Average

Plot 4.7.8 Spurious Emissions in Restricted Bands, Fc = 2480MHz, Horizontal Polarization, Hopping ON



Peak



Average

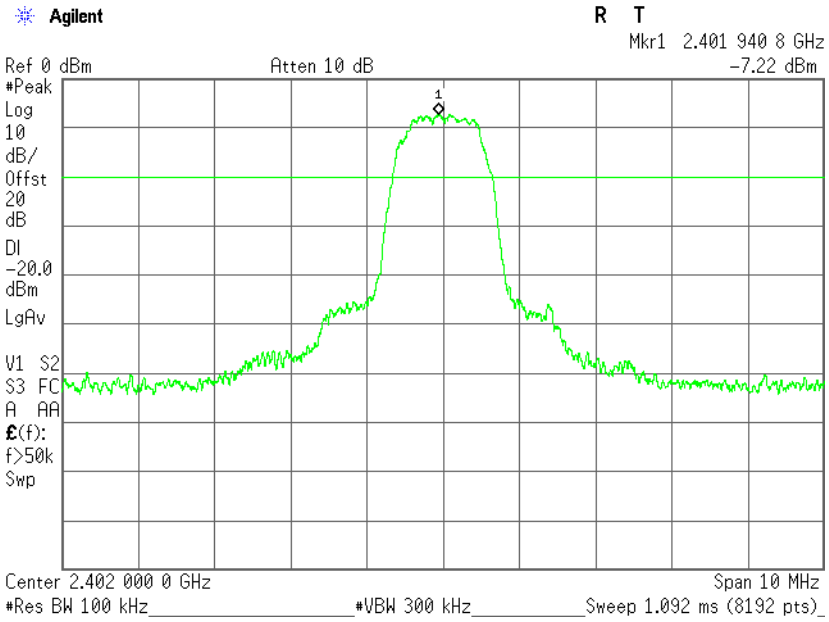
4.8. Spurious Emission- Conducted Measurements

Reference document:	**47 CFR §15.247 (d) & DA 00-705**		
Test Requirements:	In any 100 kHz bandwidth outside the frequency band at least 20 dB below the highest level of the desired power.		
Test setup:	See Sec. 2.1	**Pass**	
Operating conditions:	Under normal test conditions		
Method of testing:	Conducted		
S.A. Settings:	RBW: 100kHz, VBW: 300kHz		
Hopping function:	Disabled (lowest, middle, and highest channels to be investigated)		
Environment conditions:	Ambient Temperature: 23.6°C	Relative Humidity: 49.1%	Atmospheric Pressure: 1011.4 hPa
Test Result:	See below	See Plot 4.8.1 – Plot 4.8.7	

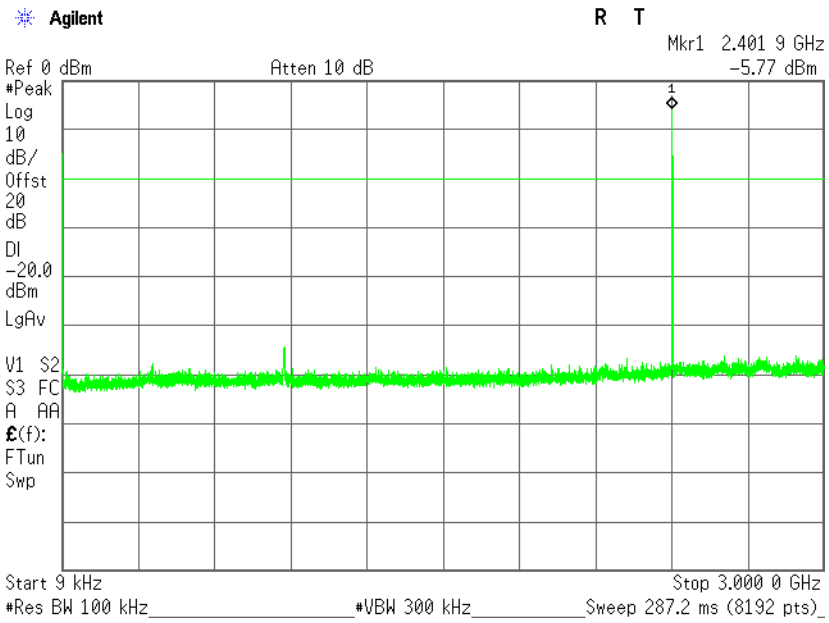
Test results (8PSK modulation as a worst case according to max output peak power):

Frequency, [MHz]	Channel	Emission Frequency, [MHz]	Emission Level, [dBµV]	Limit, dBc	Pass/Fail
2402.0	0	All emissions are at least 20dB below the Limit, noise level -50.54		-20.0	Pass
2437.0	39	All emissions are at least 20dB below the Limit, noise level -49.18		-20.0	Pass
2480.0	78	All emissions are at least 20dB below the Limit, noise level -50.81		-20.0	Pass

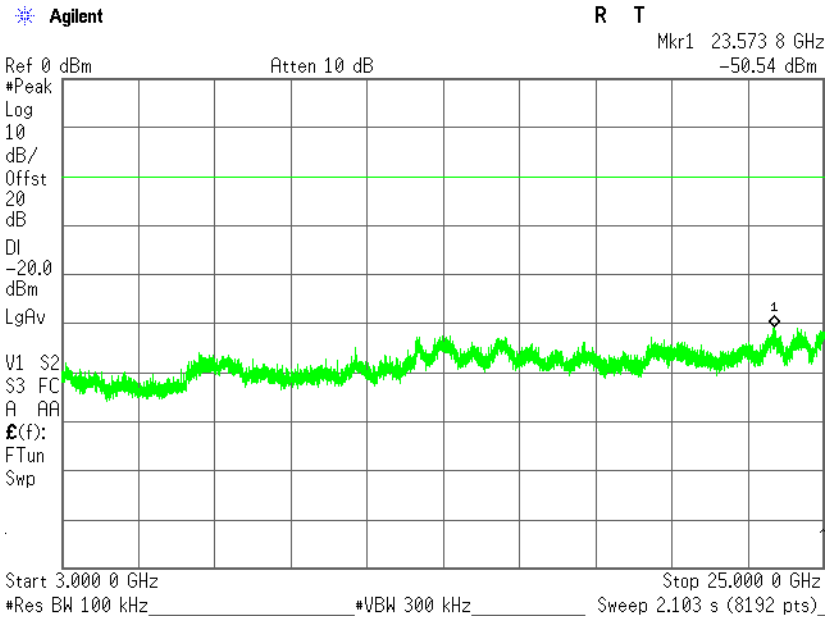
Plot 4.8.1 Band-edge test results, 8PSK, channel 0, reference level



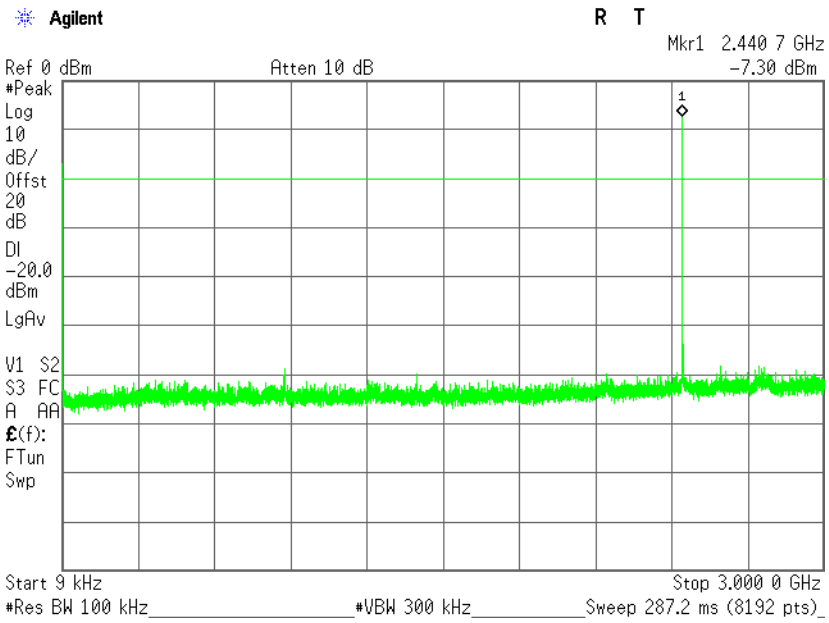
Plot 4.8.2 Band-edge test results, 8PSK, channel 0, 9 kHz – 3 GHz range



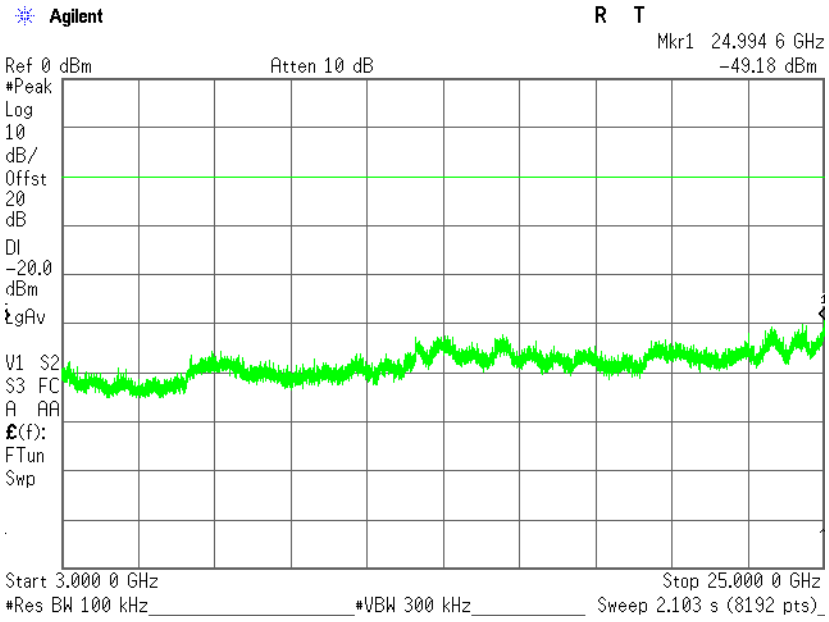
Plot 4.8.3 Band-edge test results, 8PSK, channel 0, 3 GHz – 25 GHz range



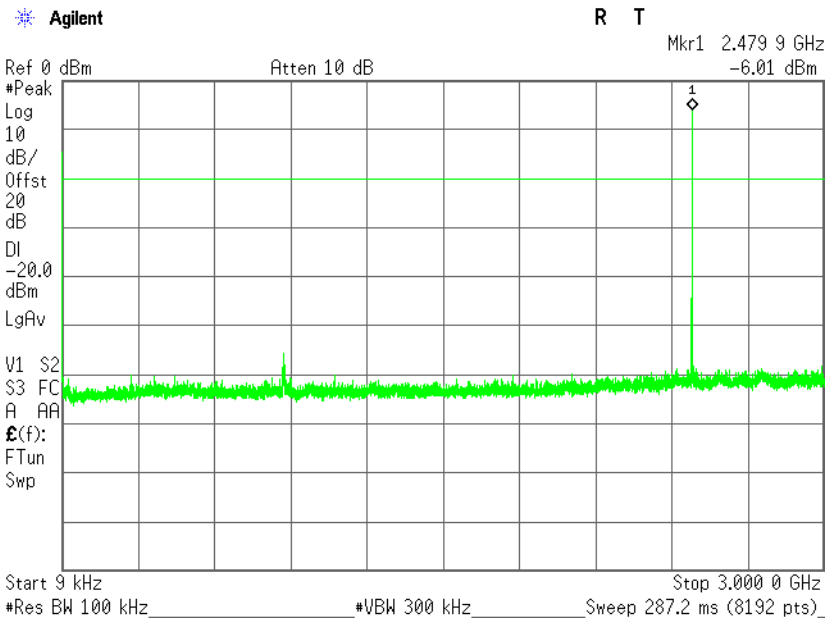
Plot 4.8.4 Band-edge test results, 8PSK, channel 39, 9 kHz – 3 GHz range



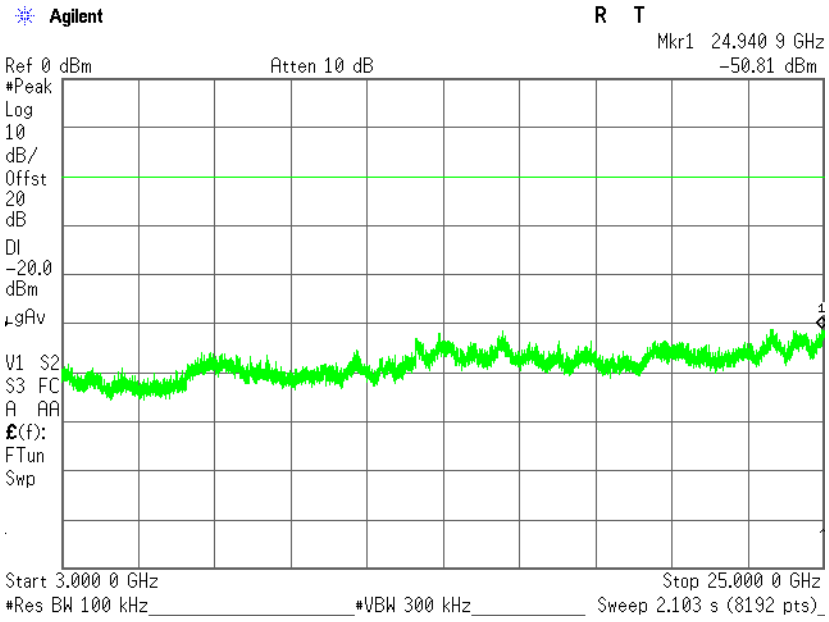
Plot 4.8.5 Band-edge test results, 8PSK, channel 39, 3 GHz – 25 GHz range



Plot 4.8.6 Band-edge test results, 8PSK, channel 78, 9 kHz – 3 GHz range



Plot 4.8.7 Band-edge test results, 8PSK, channel 78, 3 GHz – 25 GHz range



4.9. Spurious Emissions – Radiated Measurements

Reference document:	**47 CFR §15.247 (d) & §15.209(a) & DA 00-705**		
Test Requirements:	The emissions from an intentional radiator shall not exceed the field strength levels specified in §15.209(a).		
Test setup:	See Sec. 2.2	**Pass**	
Operating conditions:	Under normal test conditions		
Method of testing:	Radiated		
S.A. Settings:	f >1GHz: Peak: RBW= 1MHz, VBW= 3MHz, Average: VBW= 10 Hz f<1GHz: RBW: 120kHz,VBW**:** 300kHz		
Hopping function:	Disabled (lowest, middle, and highest channels to be investigated)		
Environment conditions:	Ambient Temperature: °C	Relative Humidity: %	Atmospheric Pressure: hPa
Test Result:	See below	Plots 4.9.1 – Plot 4.8.17	

All measurements were done in horizontal and vertical polarizations and 3 orientation axis X,Y & Z; the results show the worst case.

Test results below 1GHz:

Emission Frequency, [MHz]	Detector Type	Antenna Polarization,	Emission Level, [dBµV/m]	Limit, [dBµV/m]	Delta, [dB]	Pass/Fail
250.000	QP	H	45.41	46.00	-0.59	Pass
288.000	QP	H	45.35	46.00	-0.65	Pass
375.000	QP	H	40.44	46.00	-5.56	Pass
412.500	QP	H	42.45	46.00	-3.55	Pass
445.500	QP	H	45.33	46.00	-0.67	Pass
478.500	QP	H	45.57	46.00	-0.43	Pass

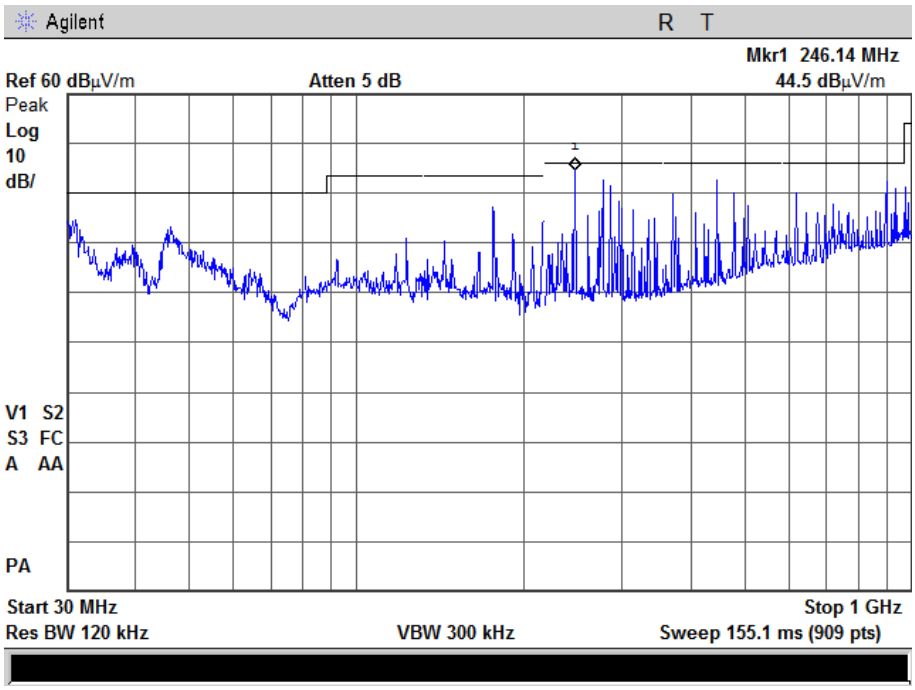
Test results above 1GHz:

Emission Frequency, [MHz]	Detector Type	Antenna Polarization	Emission Level, [dBµV/m]	Limit, [dBµV/m]	Delta, [dB]	Pass/Fail
Lowest Frequency, 2402 MHz						
All emissions are at least 20dB below the Limit,noise level peak-63.77 dBµV/m, AVG- 52.67 dBµV/m						Pass
Middle Frequency, 2437 MHz,						
Maximum emission level- 1.933 GHz,AVG 39.5 dBµV/m						Pass
Highest Frequency, 2480 MHz						
Maximum emission level- 1.933 GHz,AVG 39.8 dBµV/m						Pass

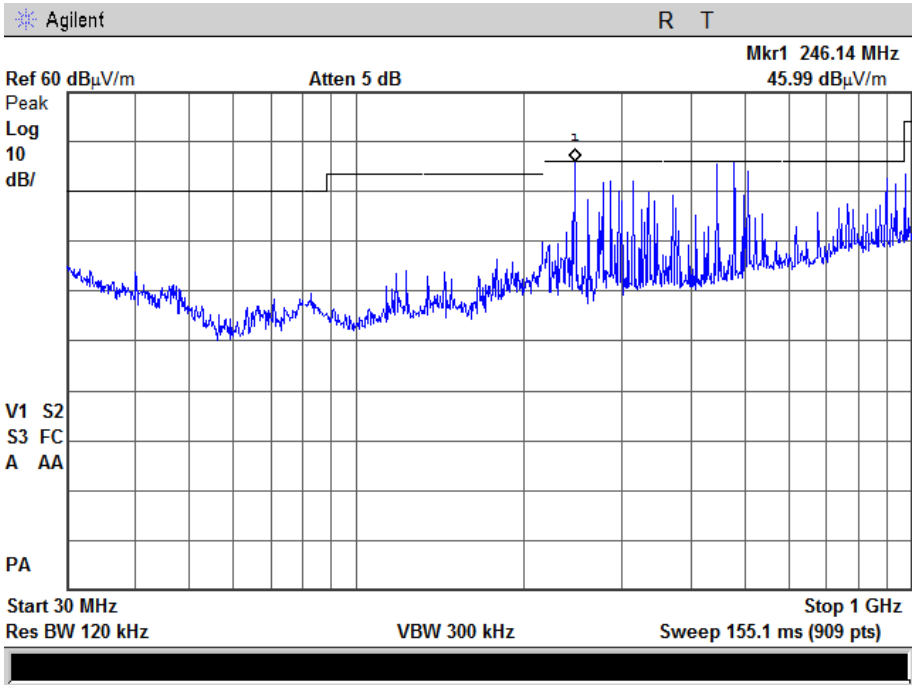
Note: Emission Level [dBµV/m] = Measured Emission [dBµV] + Correction-factor [dB (1/m)]

Correction Factor = Antenna factor + Cable Loss + Filter I/L

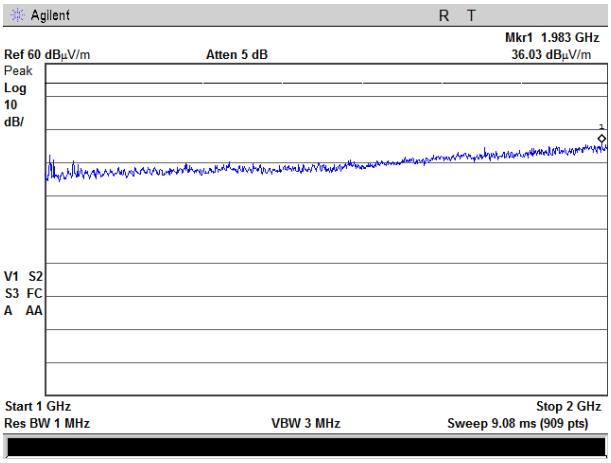
Plot 4.9.1 Radiated Spurious Emission in 30 MHz – 1 GHz range, Worst case for all modes and all frequencies, Vertical



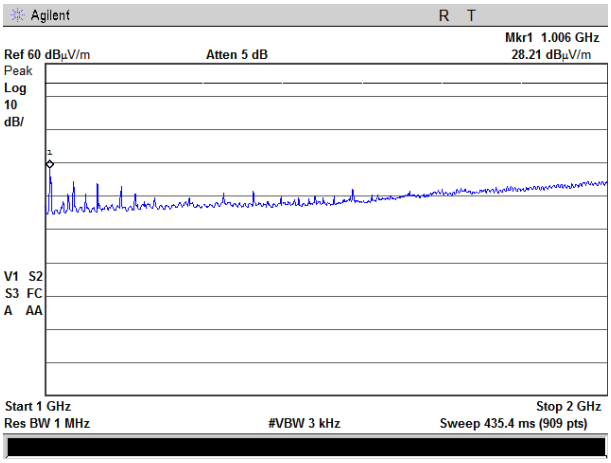
Plot 4.9.2 Radiated Spurious Emission in 30 MHz – 1 GHz range, Worst case for all modes and all frequencies, Horizontal



Plot 4.9.3 Radiated Spurious Emission in 1 – 2 GHz range, Fc = 2402 MHz, Horizontal & Vertical

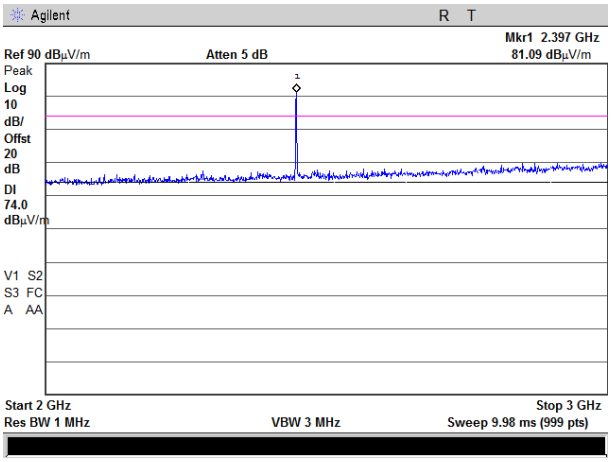


Peak

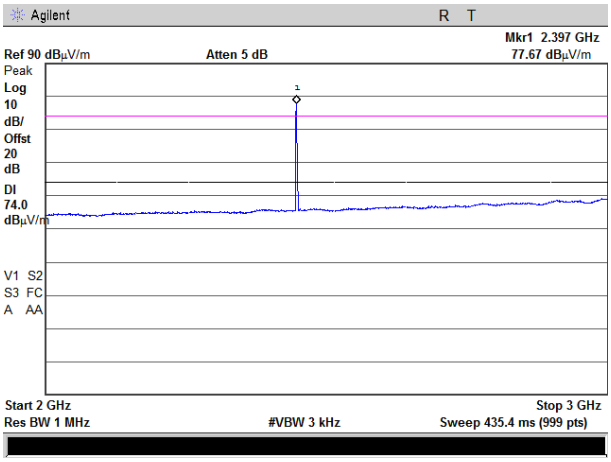


Average

Plot 4.9.4 Radiated Spurious Emission in 2 – 3 GHz range, Fc = 2402 MHz, Horizontal & Vertical

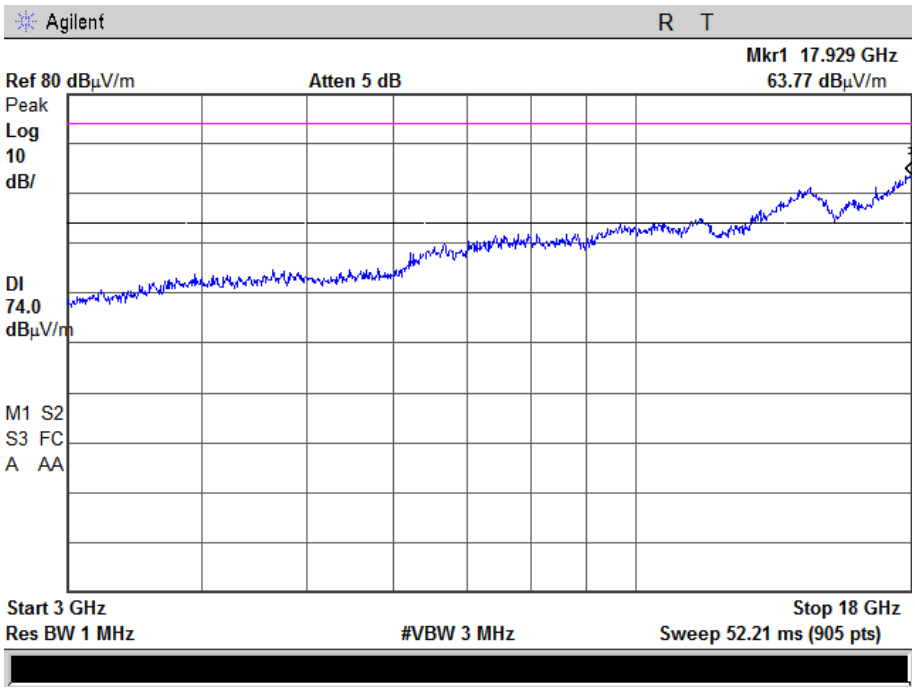


Peak

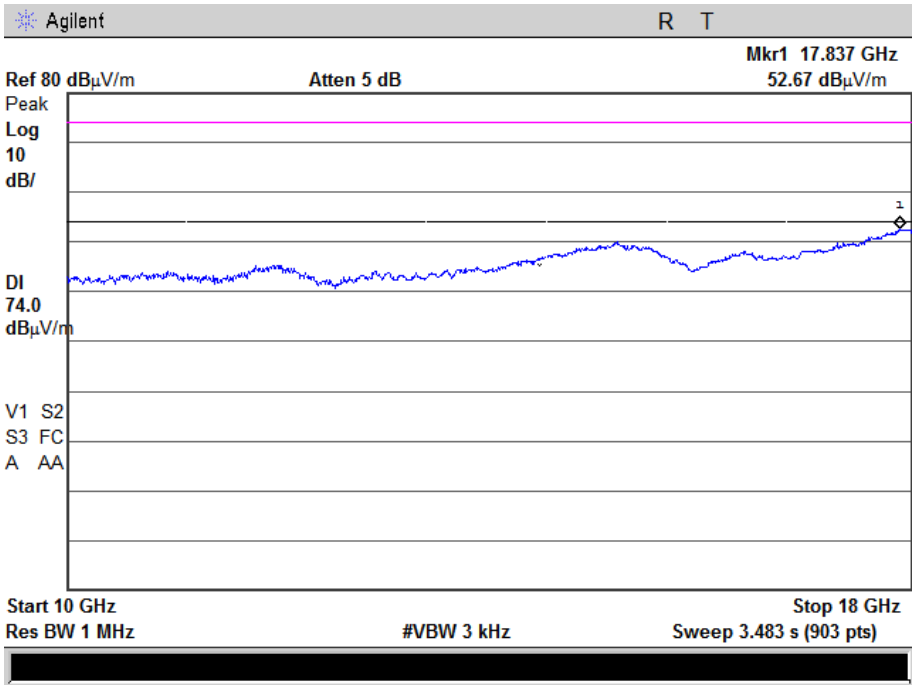


Average

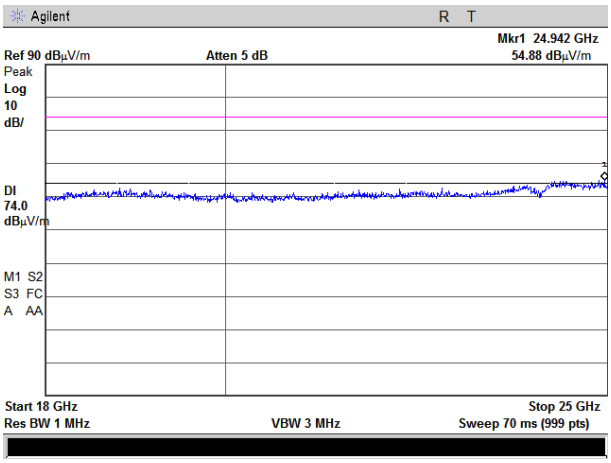
Plot 4.9.5 Radiated Spurious Emission in 3 – 18 GHz range, Fc = 2402 MHz, Horizontal & Vertical, Peak



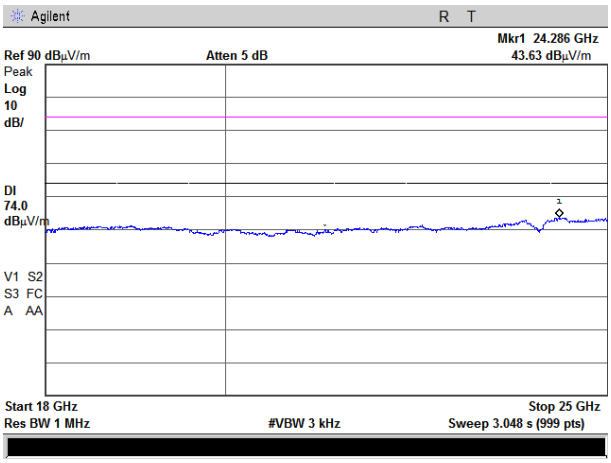
Plot 4.9.6 Radiated Spurious Emission in 10 – 18 GHz range, Fc = 2402 MHz, Horizontal & Vertical, Average



Plot 4.9.7 Radiated Spurious Emission in 18 – 25 GHz range, Fc = 2402 MHz, Horizontal & Vertical

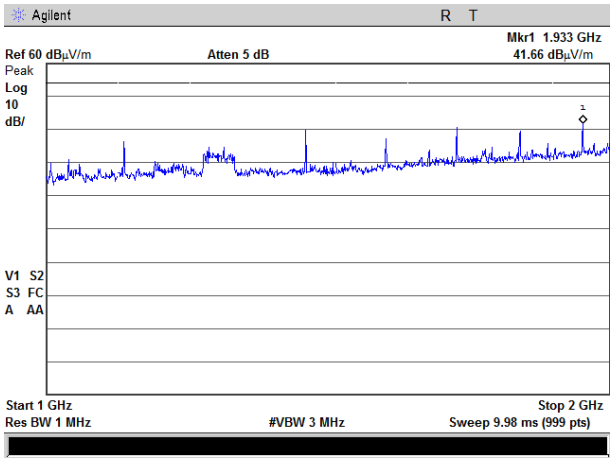


Peak

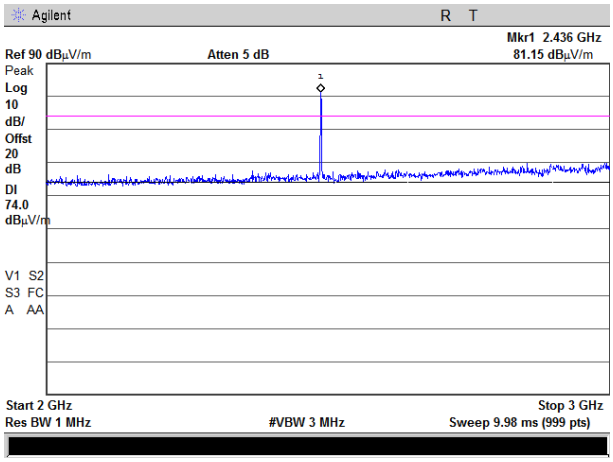


Average

Plot 4.9.8 Radiated Spurious Emission in 1 – 2 GHz range, Fc = 2437 MHz, Horizontal & Vertical

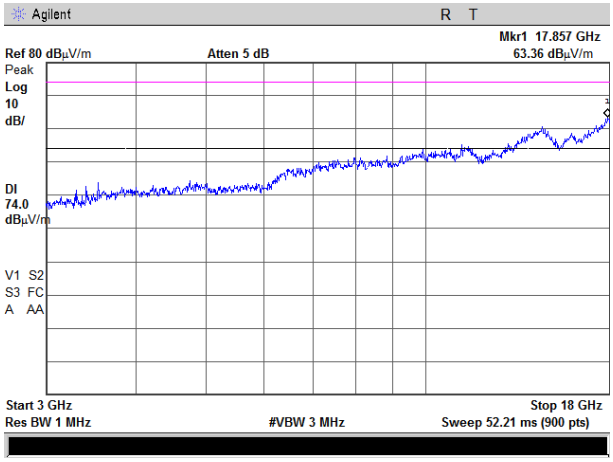


Plot 4.9.9 Radiated Spurious Emission in 2 – 3 GHz range, Fc = 2437 MHz, Horizontal & Vertical

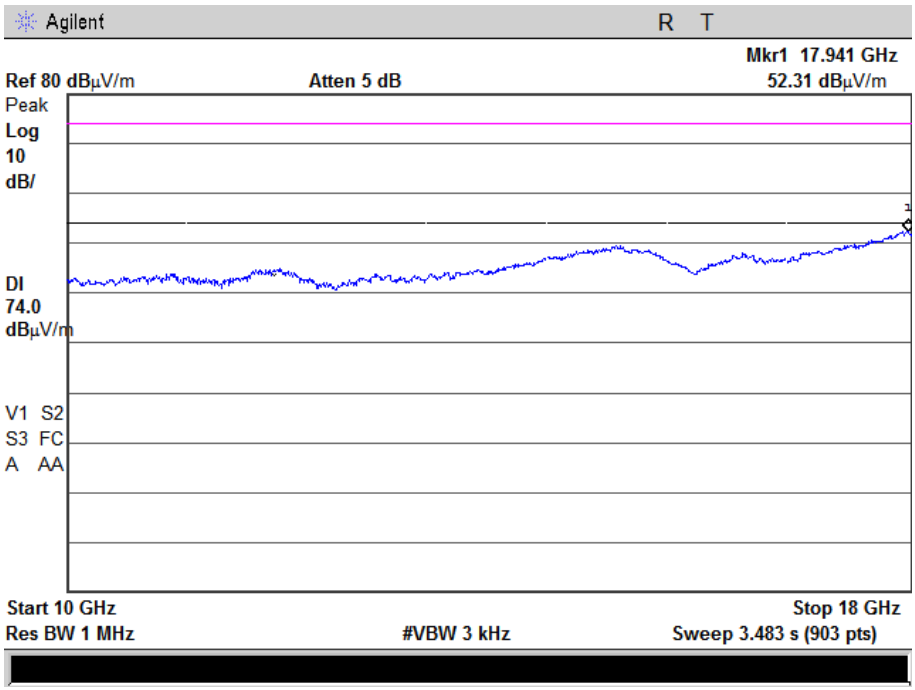


Plot 4.9.10 Radiated Spurious Emission in 3 – 18 GHz range, Fc = 2437 MHz,

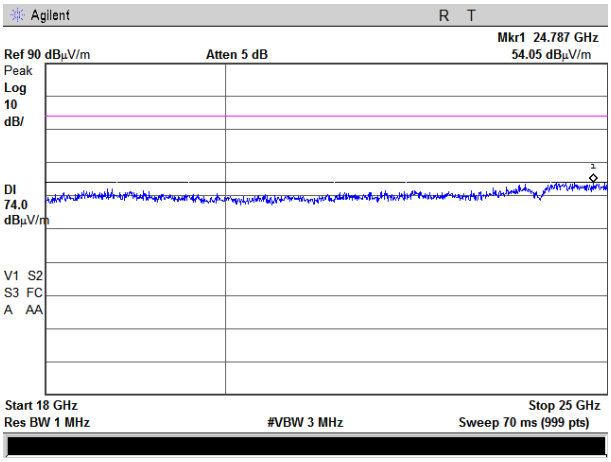
Horizontal & Vertical, Peak



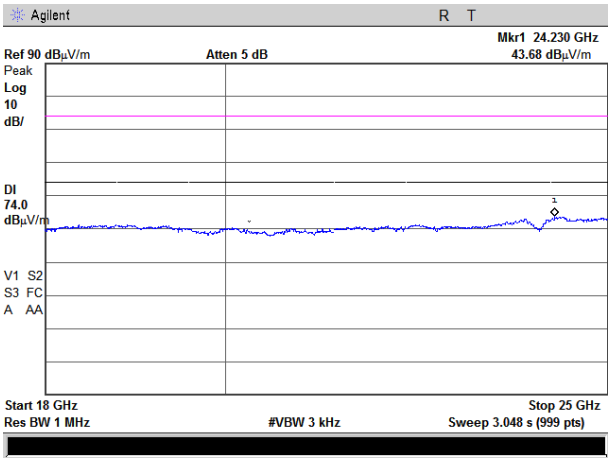
Plot 4.9.11 Radiated Spurious Emission in 10 – 18 GHz range, Fc = 2437 MHz, Horizontal & Vertical, Average



Plot 4.9.12 Radiated Spurious Emission in 18 – 25 GHz range, Fc = 2437 MHz, Horizontal & Vertical

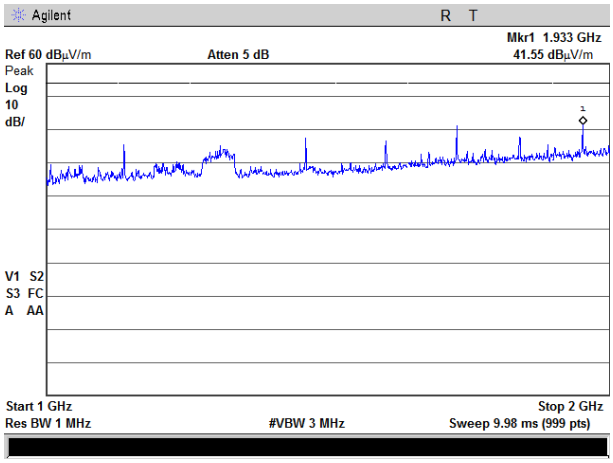


Peak

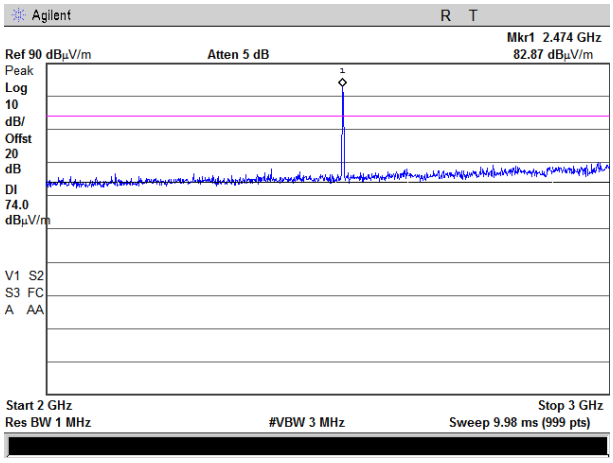


Average

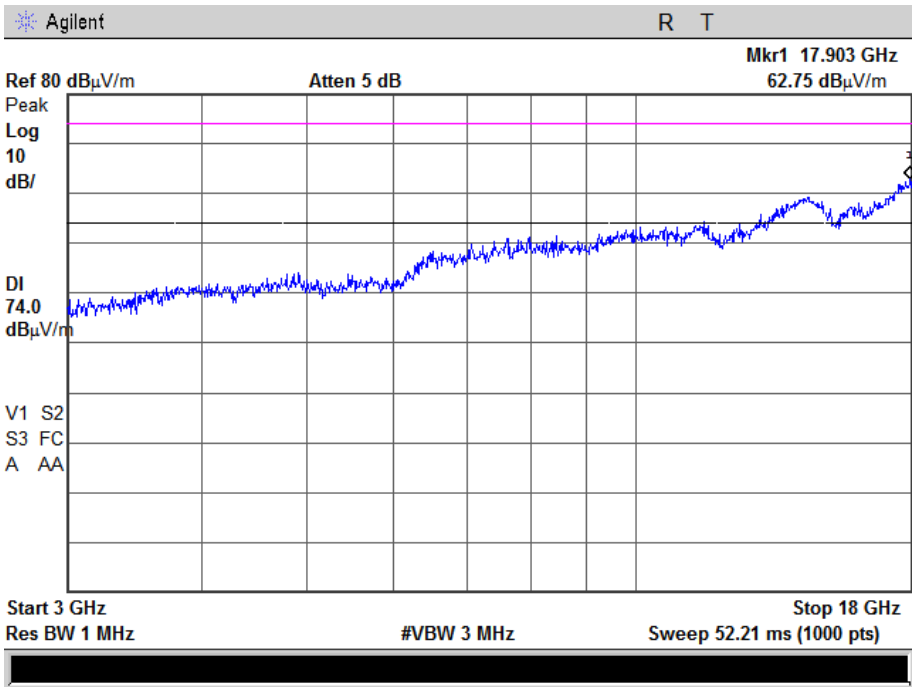
Plot 4.9.13 Radiated Spurious Emission in 1 – 2 GHz range, Fc = 2480 MHz, Horizontal & Vertical,



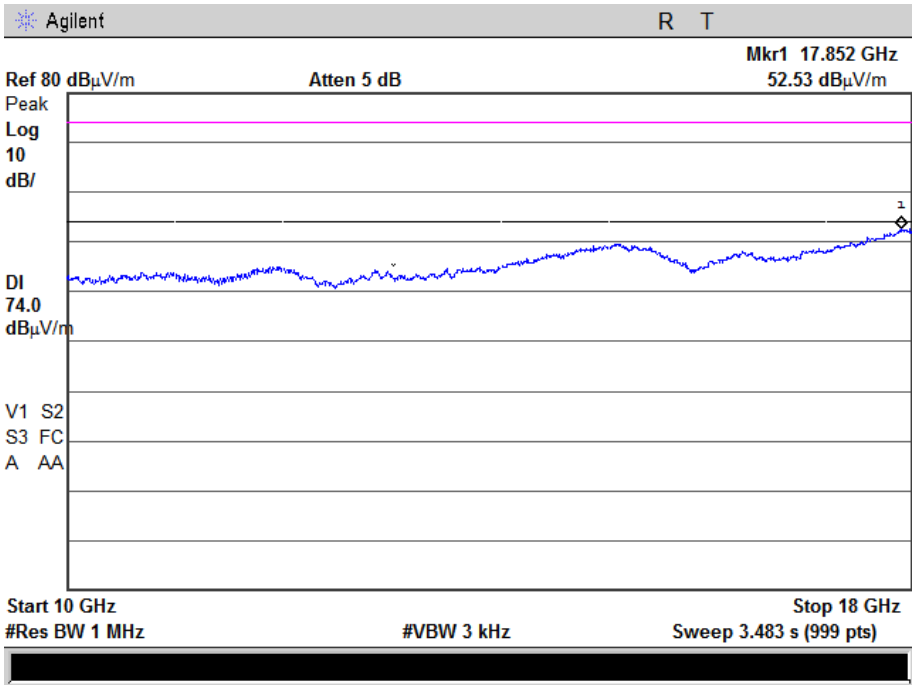
Plot 4.9.14 Radiated Spurious Emission in 2 – 3 GHz range, Fc = 2480 MHz, Horizontal & Vertical,



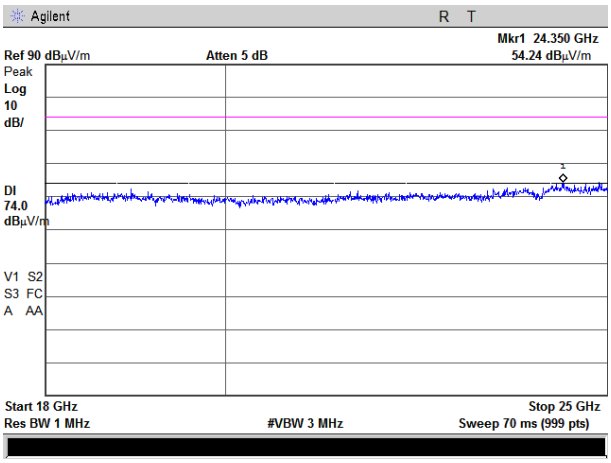
Plot 4.9.15 Radiated Spurious Emission in 3 – 18 GHz range, Fc = 2480 MHz, Horizontal & Vertical, Peak



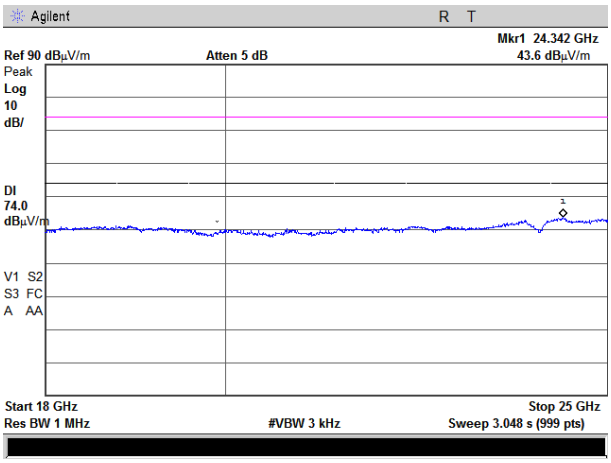
Plot 4.9.16 Radiated Spurious Emission in 10 – 18 GHz range, Fc = 2480 MHz, Horizontal & Vertical, Average



Plot 4.9.17 Radiated Spurious Emission in 18 – 25 GHz range, Fc = 2480 MHz, Horizontal & Vertical



Peak



Average

4.10. 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 4.10.1 - Plot 4.10.2	

Test Results:
Worst case results of unintentional emissions and emissions while NII, DTS and BT transmitters are operating alternately, measured at the charger 110VAC port.

"Phase" Lead

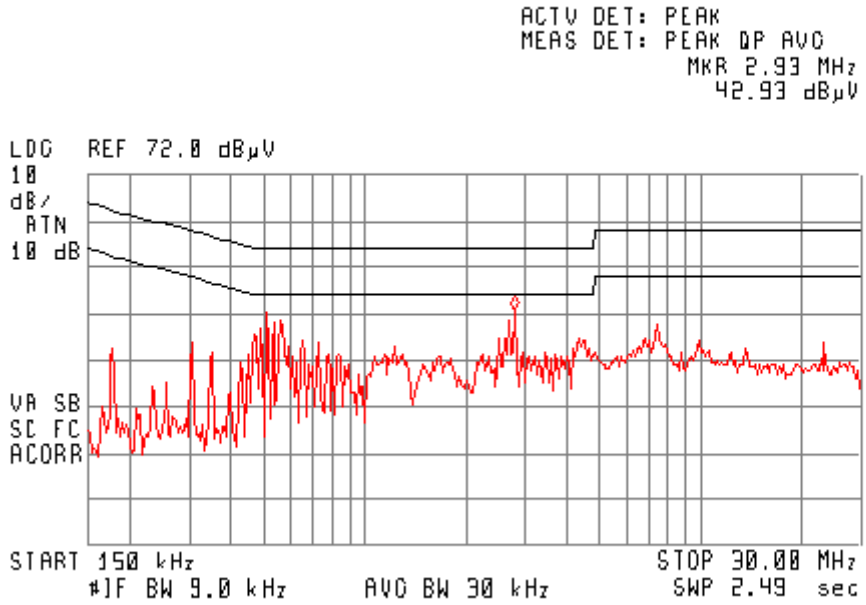
Frequency [MHz]	Measured Result [dBµV]		Limit [dBµV]		Margin [dB]		Pass/Fail
	QP	AVR	QP	AVR	QP	AVR	
0.54076	41.8	28.5	56.00	46.00	-14.20	-17.50	**Pass**
0.178424	39.9	26.5	64.56	54.56	-24.66	-28.06	**Pass**
2.827791	41.2	34	56.00	46.00	-14.80	-12.00	**Pass**
7.427423	36.9	25.8	60.00	50.00	-23.10	-24.20	**Pass**
7.270178	35.8	26.6	60.00	50.00	-24.20	-23.40	**Pass**
9.467	28.1	20	60.00	50.00	-31.90	-30.00	**Pass**

"Neutral" Lead

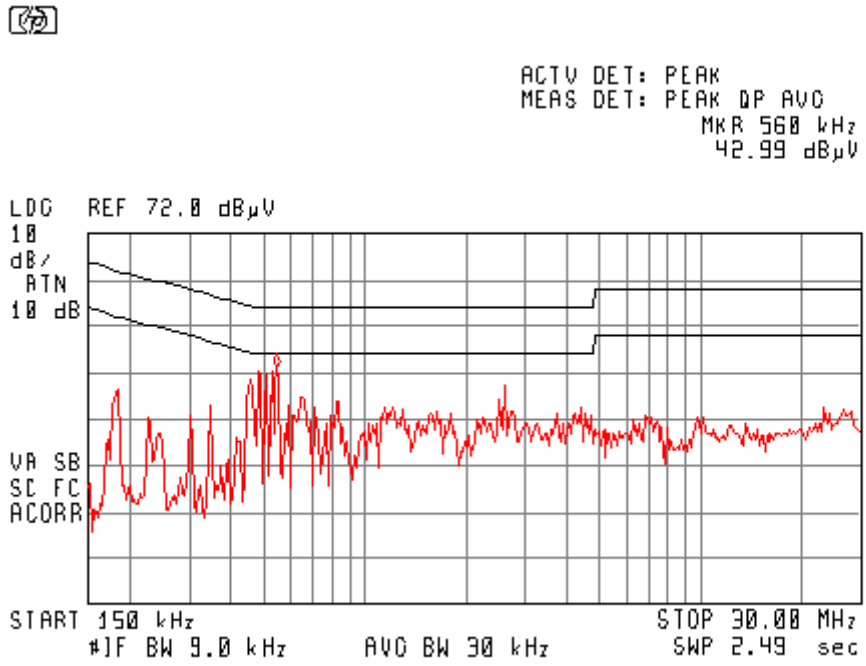
Frequency [MHz]	Measured Result [dBµV]		Limit [dBµV]		Margin [dB]		Pass/Fail
	QP	AVR	QP	AVR	QP	AVR	
0.533668	42.1	28.8	56.00	46.00	-13.90	-17.20	**Pass**
0.881005	33.4	21.9	56.00	46.00	-22.60	-24.10	**Pass**
0.90528	33.9	21.6	56.00	46.00	-22.10	-24.40	**Pass**
0.312132	35.6	24.9	59.91	49.91	-24.31	-25.01	**Pass**
2.759011	41	32.9	56.00	46.00	-15.00	-13.10	**Pass**
1.283	32.8	21.5	56.00	46.00	-23.20	-24.50	**Pass**

Measured at the charger 110VAC port

Plot 4.10.1: Phase Lead



Plot 4.10.2: Neutral Lead



4.11. Antenna Connector Requirements

Reference document:	**47 CFR §15.203**	
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.	
Verdict	An integral antenna	Comply

Appendix A: List of test equipment used

Manufacturer	Model	Description	Serial No.	Cal Due
HP	8546A	EMI Receiver (6.5GHz)	3710A00392	29/12/2015
A.R.A	DRG 118/A	Dual Ridged Guide Ant.1-18 GHz	17188	23/05/2015
Schwarzbeck	VUSLP9111	Log-Periodic 200 – 1000 MHz	9111184	20/05/2015
Agilent	N1911A	Power Meter	MY45100784	25/05/2015
Miteq	AMF-5F-18002650-30-10P	Low-Noise Amplifier 18 - 26.5 GHz	945372	07/07/2015
Agilent	E4446A	Spectrum Analyzer 3Hz-44GHz	MY46180602	13/11/2016
Schwarzbeck	BBHA9170214	Horn Antenna 15-40 GHz	BBHA9170214	03/05/2015
AMP	7D-010180-30-10P-GW	LNA Amplifier 1 GHz to 18 GHz	618653	05/05/2015
K&L	3TNF-800/1000-0.2-N/N	Tunable Bandreject Filter	336	14/01/2016
K&L	5TNF-1700/2000-0.1-N/N	Tunable Bandreject Filter	212	14/01/2016
Micro-Tronics	BRM50702-05	Notch Filter	1	14/01/2016
WAINWRIGHT	WHK1.2/15G-10EF	Highpass Filter, 1.2 , 15 GHz	3	14/01/2016
WAINWRIGHT	WHK2.4/18G-10EF	Highpass Filter, 2.4 , 18 GHz	1	14/01/2016
WAINWRIGHT	WHKX7.0/18G-8SS	Highpass Filter, 7 , 18 GHz	12	14/01/2016
HP	8546A	EMI Receiver (6.5GHz)	3710A00392	29/12/2015
A.R.A	DRG 118/A	Dual Ridged Guide Ant.1-18 GHz	17188	23/05/2015
Schwarzbeck	VUSLP9111	Log-Periodic 200 – 1000 MHz	9111184	20/05/2015
Agilent	N1911A	Power Meter	MY45100784	25/05/2015
Miteq	AMF-5F-18002650-30-10P	Low-Noise Amplifier 18 - 26.5 GHz	945372	07/07/2015
Agilent	E4446A	Spectrum Analyzer 3Hz-44GHz	MY46180602	13/11/2016
Schwarzbeck	BBHA9170214	Horn Antenna 15-40 GHz	BBHA9170214	03/05/2015
AMP	7D-010180-30-10P-GW	LNA Amplifier 1 GHz to 18 GHz	618653	05/05/2015
K&L	3TNF-800/1000-0.2-N/N	Tunable Bandreject Filter	336	14/01/2016
K&L	5TNF-1700/2000-0.1-N/N	Tunable Bandreject Filter	212	14/01/2016
Micro-Tronics	BRM50702-05	Notch Filter	1	14/01/2016
WAINWRIGHT	WHK1.2/15G-10EF	Highpass Filter, 1.2 , 15 GHz	3	14/01/2016
WAINWRIGHT	WHK2.4/18G-10EF	Highpass Filter, 2.4 , 18 GHz	1	14/01/2016
WAINWRIGHT	WHKX7.0/18G-8SS	Highpass Filter, 7 , 18 GHz	12	14/01/2016
HP	8546A	EMI Receiver (6.5GHz)	3710A00392	29/12/2015

Appendix B: 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