Testing Tomorrow's Technology

Application

For

Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 15, Subpart B, paragraph 15.109, Subpart C, paragraphs 15.207, 15.209 and 15.249

And

IC Radio Standards Specification: RSS-210 Issue 9, Annex A 2.9

For the

Inventek Systems
Model: ISMRL78G1D

FCC ID: O7P-RL78
IC ID: 10147A-RL78

UST Project: 17-0165
Issue Date: February 15, 2018

Total Pages in This Report: 40

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

Testing Tomorrow's Technology

I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: George Yang

Name: 

Title: Laboratory Manager

Date February 15, 2018

TESTING
NVLAP LAB CODE 200162-0

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
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MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Inventek

MODEL: ISMRL78G1D-L31

FCC ID: O7P-RL78

IC ID: 10147A-RL78

DATE: February 15, 2018

This report concerns (check one): Original grant [X]
Class II change

Equipment type: 2402 – 2480 MHz Transmitter Module

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? Yes_____ No X

If yes, defer until: _____N/A_____
date
agrees to notify the Commission by N/A
date
of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

US Tech
3505 Francis Circle
Alpharetta, GA 30004
Phone Number: (770) 740-0717
Fax Number: (770) 740-1508

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1 General Information

1.1 Purpose of this Report

This report is prepared as a means of conveying test results and information concerning the suitability of this exact product for public distribution according to the FCC Rules and Regulations Part 15, Section 249 and IC Radio Standards Specification RSS-210 Issue, 8.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on May 24, 2017 in good operating condition.

1.3 Product Description

The Equipment Under Test (EUT) is the Inventek 2.4 GHz e-BLE SIP Module Model: ISMRL78G1D. The EUT is an embedded wireless Bluetooth low energy (BLE) connectivity device, based on the Renesas RL78/G1D microcomputer incorporating the RL78 CPU core and low power consumption RF transceiver supporting the Bluetooth ver.4.1 (Low Energy Single mode) specifications. The Inventek ISM78G1D offers a RL78 CPU core is a 3-stage pipeline CISC architecture with an integrated BLE Radio, etched antenna, and 256 KB ROM. The module provides a number of features and standard peripheral interfaces, enabling connection to an embedded design. The low cost, small foot print, 11mm x 13mm 31-Pin LGA package and ease of design-in make it ideal for a range of embedded applications. The module provides UART, I^2C.

Radio: Bluetooth v4.1 Spec. (Low Energy, Single mode)
Range: 2400-2500 MHz ISM Band
Modulation: GFSK
RF Output Power (EIRP): +0 dBm
Data Rate: Mbps (Max): 1 Mbps
Channels: 40

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.4:2014, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2014)*,and *ANSI C63.10.2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices*.

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs are provided in separate Appendices

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC under designation number US5301. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 9900A-1.

1.6 Related Submittals

The EUT is subject to the following FCC authorizations:

a) Certification under section 15.249 as a transmitter.
b) Verification under 15.101 as a digital device and receiver.

The Verification requirement shares many common report elements with the Certification report. Therefore, though this report is mostly intended to provide data for the Certification process, the Verification authorization report (part 15.107 and 15.109) for the EUT is included herein.

Table 1. EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/IC ID:	CABLES P/D
Inventek	ISMRL78G1D	Engineering Sample	FCC ID: O7P-RL78 IC ID: 10147A-RL78 (pending)	UD

U= Unshielded
S= Shielded
P= Power
D= Data

2 Tests and Measurements

2.1 Test Equipment

The table below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are indicated.

Table 2. Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	6/22/2018
SPECTRUM ANALYZER	N9342CN	AGILENT	SG05310114	7/21/2018
SPECTRUM ANALYZER	DSA815	RIGOL	DSA8A18030 0138	10/11/2018
LOOP ANTENNA	6502	EMCO	9810-3246	1/22/2020 2 yr.
BICONICAL ANTENNA	3110B	EMCO	9307-1431	10/23/2019 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	9/21/2018 2 yr
HORN ANTENNA	3115	EMCO	9107-3723	9/22/2018 2 yr
PRE-AMPLIFIER	8449B	HEWLETT-PACKARD	3008A00480	12/1/2018
PRE-AMPLIFIER	8477D	HEWLETT-PACKARD	1937A02980	3/7/2018
LISN	9247-50-TS-50N	SOLAR ELECTRONICS	955824 & 955826	2/28/2018

Note: The calibration interval of the above test instruments are 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 Modifications to EUT Hardware

No physical modifications were made by US Tech in order to bring the EUT into compliance with FCC Part 15, Subpart C Intentional Radiator Limits for the transmitter portion of the EUT or the Subpart B Unintentional Radiator Limits (Receiver and Digital Device) Requirements.

2.3 Number of Measurements for Intentional Radiators (15.31(m))

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in Table 3 below.

Table 3. Number of Test Frequencies for Intentional Radiators

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of Operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

Because the EUT operates at 2402 MHz to 2480 MHz, 3 test frequencies were used.

2.4 Frequency Range of Radiated Measurements (Part 15.33)

2.4.1 Intentional Radiator

The spectrum was investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10^{th} harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range tested was 30 MHz to 1000 MHz, or to 5 times the highest internal clock frequency.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35)

The radiated and conducted emissions limits shown herein are based on the parameters listed below.

2.5.1 Detector Function and Associated Bandwidth

On frequencies below 1000 MHz, the limits herein are based upon measurement equipment employing a CISPR Quasi-peak detector function and related measurement bandwidths (i.e. 9 kHz from 150 kHz to 30 MHz and 120 kHz from 30 MHz to 1000 MHz). Alternatively, measurements may be made with equipment employing a peak detector function as long as the same bandwidths specified for the Quasi-peak device are used.

2.5.2 Corresponding Peak and Average Requirements

Above 1000 MHz, radiated limits are based on measuring instrumentation employing an average detector function. When average radiated emissions are specified there is also a corresponding Peak requirement, as measured using a peak detector, of 20 dB greater than the average limit. For all measurements above 1000 MHz the Resolution Bandwidth shall be at least 1 MHz.

2.5.3 Pulsed Transmitter Averaging

When the radiated emissions limit is expressed as an average value, and the transmitter is pulsed, the measured field strength shall be determined by applying a Duty Cycle Correction Factor based upon dividing the total ON time during the first 100 ms period by 100 ms (or by the period if less than 100 ms). The duty cycle may be expressed logarithmically in dB.

NOTE: If the transmitter was programmed to transmit at >98% duty cycle, then, wherever applicable (where the detection mode was AVG), the duty cycle factor calculated will be applied.

2.6 EUT Antenna Requirements (CFR 15.203)

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 the provisions of this section. Only the antenna(s) listed in Table 4 will be used with this device.

Table 4. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB_i	TYPE OF CONNECTOR
Antenna	Inventek Systems	Etched	Etched	0.0	soldered

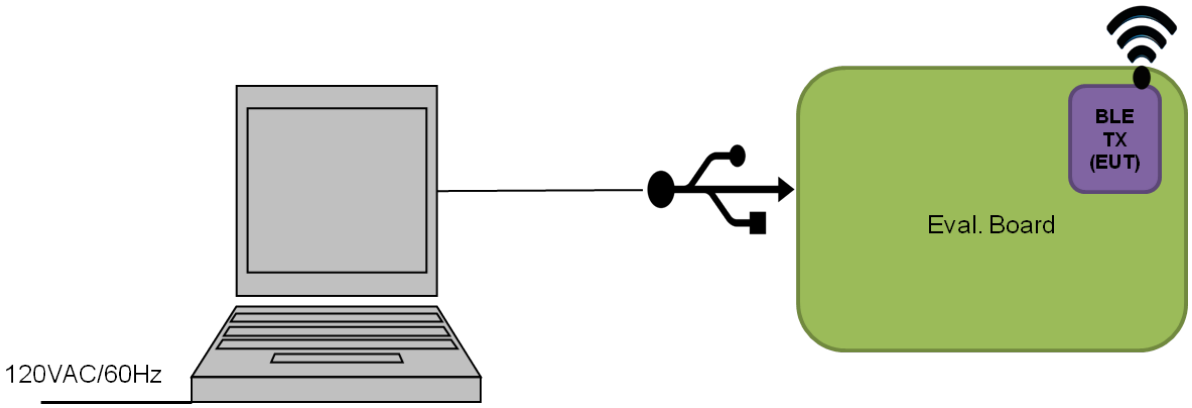


Figure 1. Block Diagram of Test Configuration

2.7 Restricted Bands of Operation (Part 15.205)

Only spurious emissions can fall in the frequency bands of CFR 15.205. The field strength of these spurious emissions cannot exceed the limits of 15.209. Radiated harmonics and other spurious emissions are examined for this requirement see paragraph 2.1

2.8 Pulsed Operation, Average value (CFR 15.35 (c))

The pulse train of the EUT did not exceed 0.1 seconds. Duty cycle plots are collected below to calculate the Duty Cycle factor to be employed in cases where the EUT was programmed to transmit at >98% Duty Cycle rate for testing purpose.

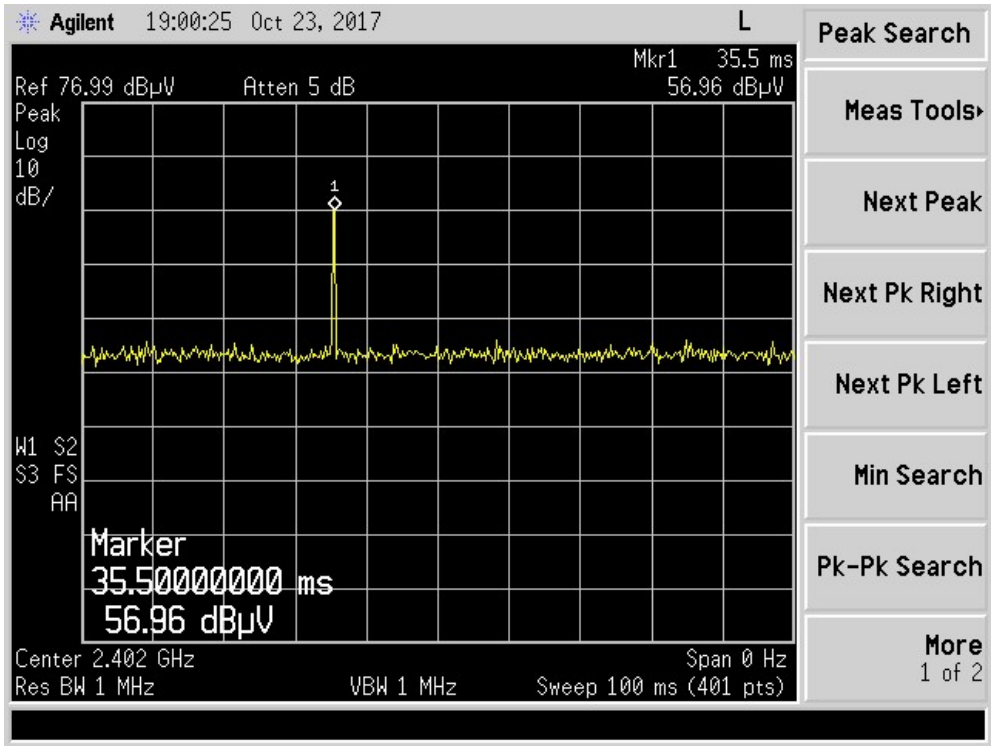


Figure 2. Pulse Train over 100 msec

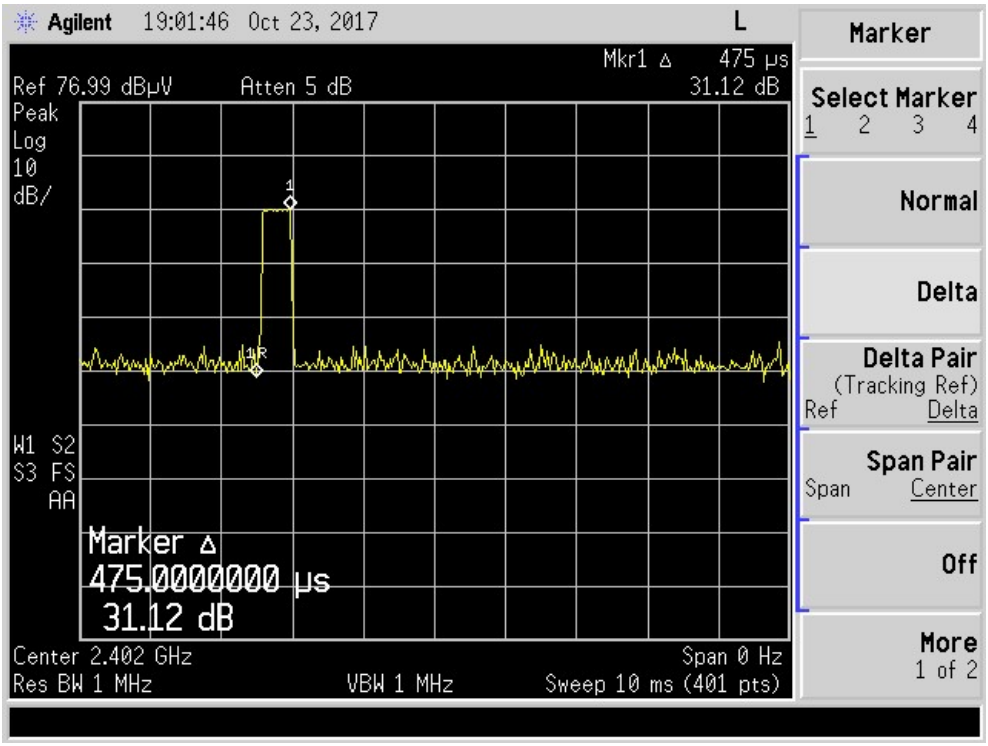


Figure 3. Pulse Width

The manufacturer claimed total duty cycle = 20 log (X/100 mS) =
20 log(0.475/100 mS)= -46.5 Numeric Duty Cycle
Duty Cycle factor = -20 dB

Since the Duty Cycle is less than -20 dB, only a -20 dB Duty Cycle correction factor will be applied in this test report.

2.9 Intentional Radiator, Power Line Conducted Emissions (CFR 15.207)

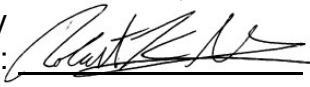
The EUT was evaluated for compliance to 15.207, Power line conducted emissions.

Table 5. Transmitter Power Line Conducted Emissions Test Data, Part 15.207

150KHz to 30 MHz						
Test: Power Line Conducted Emissions				**Client:** Inventek		
Project: 17-0165				**Model:** ISMRL78G1D		
Frequency (MHz)	**Test Data (dBuv)**	**LISN+CL-PA (dB)**	**Results (dBuV)**	**AVG Limits (dBuV)**	**Margin (dB)**	**Detector PK, QP, or AVG**
Phase						
0.1512	48.99	0.50	49.49	55.9	6.5	**QP**
0.6100	39.93	0.14	40.07	46.0	5.9	**PK**
1.2933	35.07	0.14	35.21	46.0	10.8	**QP**
9.7250	37.02	0.39	37.41	50.0	12.6	**PK**
11.9833	37.09	0.48	37.57	50.0	12.4	**PK**
20.2000	26.36	0.64	27.00	50.0	23.0	**PK**
Neutral						
0.1693	49.51	0.45	49.96	55.0	5.0	**QP**
0.6400	37.03	0.27	37.30	46.0	8.7	**QP**
1.8666	36.35	0.31	36.66	46.0	9.3	**PK**
8.8500	37.99	0.50	38.49	50.0	11.5	**PK**
15.4160	37.05	0.76	37.81	50.0	12.2	**PK**
23.6660	25.52	0.86	26.38	50.0	23.6	**PK**

Sample Calculation at: 0.1512 MHz

Magnitude of Measured Frequency	48.99	dBuV
+Antenna Factor + Cable Loss	0.50	dB
Corrected Result	49.49	dBuV/m

Test Date: October 25, 2017
Tested By
Signature:  Name: Robert K. Mills

2.10 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.249(a),(c)) (IC RSS 210, A2.9 (a))

Radiated Spurious measurements: the EUT was placed into a continuous transmit mode of operation transmitting at >98% duty cycle and tested per ANSI C63.10:2013. A preliminary scan was performed on the EUT to find signal frequencies that were caused by the transmitter part of the device. To obtain worse case results the EUT was tested in X, Y and Z axes or in the orientation of normal operation if the device is designed to operation in a fixed position.

Radiated measurements were then conducted between the frequency range of 9 KHz (or lowest frequency used/generated by the device) up to the tenth harmonic of the device (no greater than 40 GHz). In the band below 30 MHz a resolution bandwidth (RBW) of 9 kHz was used; emissions below 1 GHz were tested with a RBW of 120 KHz and emissions above 1 GHz were tested with a RBW of 1 MHz. All video bandwidth settings were at least three times the RBW value.

The EUT was investigated to CFR 15.209, General requirements for unwanted spurious emissions.

Table 6. Spurious Radiated Emissions Below 30 MHz

9 kHz to 30 MHz, 15.209 limits							
Test: Radiated Emissions				**Client:** Inventek			
Project: 17-0165				**Model:** ISMRL78G1D			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**QP Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
No emissions seen greater than 20 dB from the applicable limit.							

Sample Calculation: N/A

Test Date: February 7, 2018
Tested By

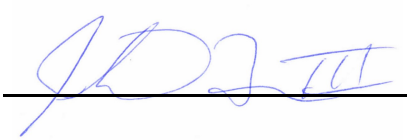
Signature:  Name: John Freeman

Table 7. Spurious Radiated Emissions (other than Fundamental & Harmonics)

Test: FCC Part 15, Paragraph 15.209, 15.249(a)					**Client:** Inventek			
Project: 17-0165					**Model:** ISMRL78G1D			
Frequency (MHz)	**Test Data (dBuV)**	**Factor (dB)**	**AF+CA -AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
65.28	40.08	0.0	-18.56	21.52	40.0	3m./VERT	18.5	**PK**
167.70	33.59	0.0	-14.18	19.41	43.5	3m./HORZ	24.1	**PK**
191.93	34.38	0.0	-12.47	21.91	43.5	3m./HORZ	21.6	**PK**
216.00	44.73	0.0	-14.64	30.09	43.5	3m./HORZ	13.4	**PK**
240.00	39.44	0.0	-14.13	25.31	46.0	3m./VERT	20.7	**PK**
386.00	41.12	0.0	-10.77	30.35	46.0	3m./VERT	15.7	**PK**

Notes:
1. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with the duty cycle programmed for >98% ON time in continuous transmit mode.
2. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at: 65.28 MHz

Magnitude of Measured Frequency	40.08	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	-18.56	dB/m
Duty Cycle Correction Factor	0.00	dB
Corrected Result	21.52	dBuV/m

Test Date: February 19, 2018
Tested By
Signature: _____ Name: John Freeman

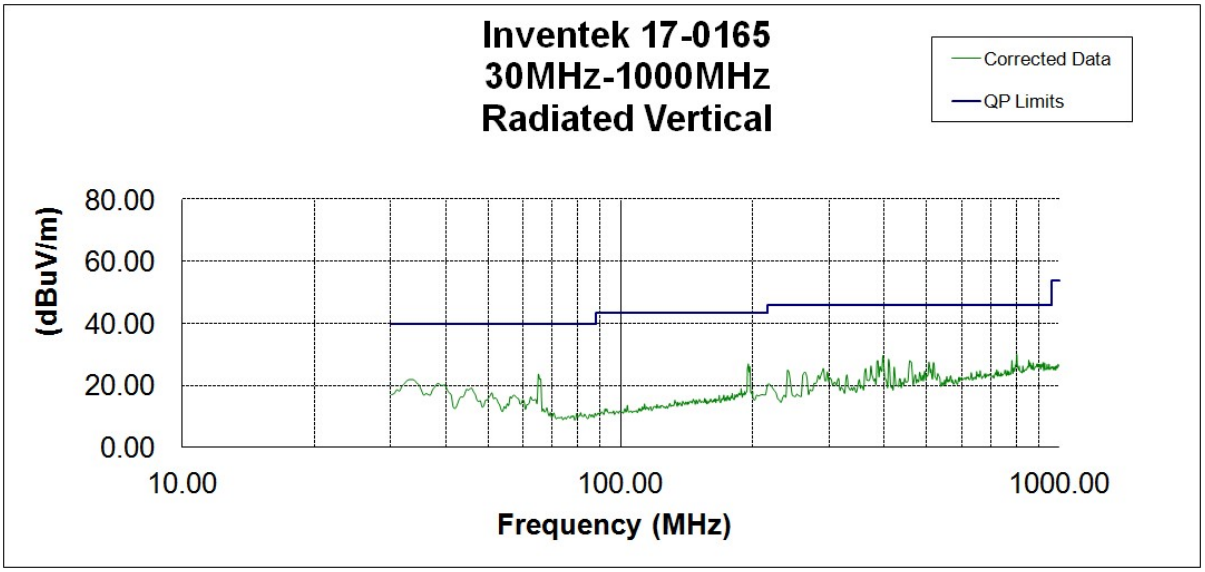


Figure 4. Radiated Emissions 30-1000 MHz, Vertical

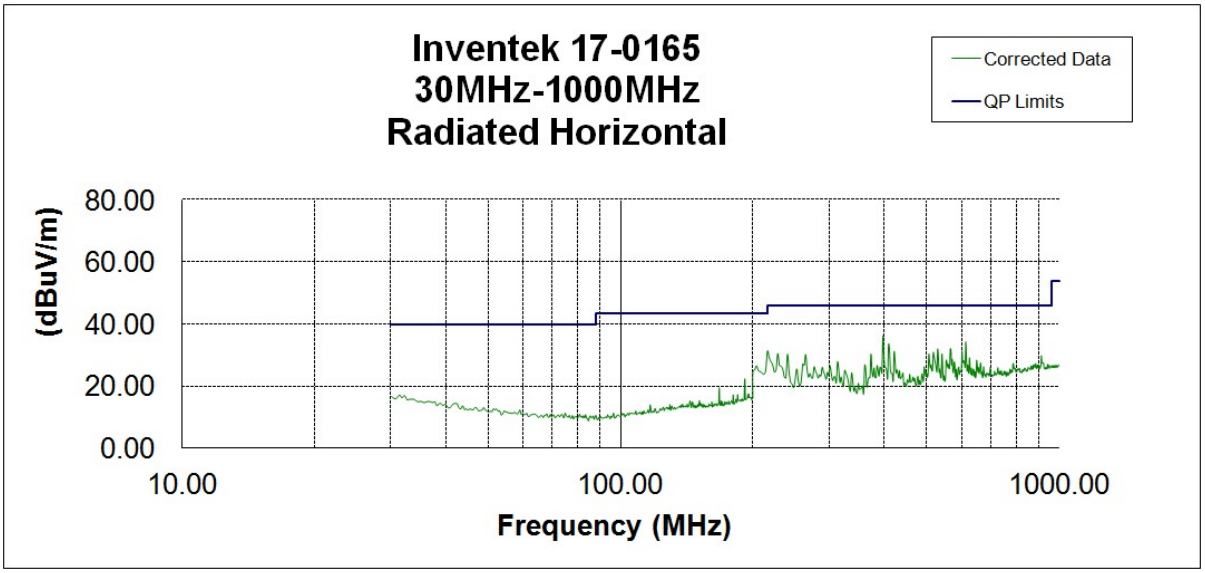


Figure 5. Radiated Emissions 30-1000 MHz, Horizontal

Table 8. Fundamental Emissions (Peak & AVG)

Test: FCC Part 15, Paragraph 15.209, 15.249(a)					**Client:** Inventek			
Project: 17-0165					**Model:** ISMRL78G1D			
Frequency (MHz)	**Test Data (dBuV)**	**Factor (dB)**	**AF+CA -AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
Low - Channel								
2402.10	57.42	0.0	31.91	89.33	114.0	3.0m./HORZ	24.7	**PK**
2402.10	57.42	-20.0	31.91	69.33	94.0	3.0m./HORZ	24.7	**AVG**
Mid – Channel								
2440.10	61.99	0.0	31.80	93.79	114.0	3.0m./HORZ	20.2	**PK**
2440.10	61.99	-20.0	31.80	73.79	94.0	3.0m./HORZ	20.2	**AVG**
High – Channel								
2480.05	58.64	0.0	31.95	90.59	114.0	3.0m./HORZ	23.4	**PK**
2480.05	58.64	-20.0	31.95	70.59	94.0	3.0m./HORZ	23.4	**AVG**

Notes:
1. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
2. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with the duty cycle programmed for >98% ON time in continuous transmit mode.
3. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at: 2402.00

Magnitude of Measured Frequency	57.42	dBuV
+Antenna Factor + Cable Loss - Amplifier Gain	31.91	dB/m
Corrected Result	89.33	dBuV/m

Test Date: February 13, 2018
Tested By
Signature: _____ Name: John Freeman

Table 9. Harmonics Emissions (Peak & AVG)

Test: FCC Part 15, Paragraph 15.209, 15.249(a)					**Client:** Inventek			
Project: 17-0165					**Model:** ISMRL78G1D			
Frequency (MHz)	**Test Data (dBuV)**	**Factor (dB)**	**AF+CA -AMP (dB/m)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector Mode**
Low - Channel								
4804.30	46.79	0.0	4.11	50.90	74.0	3.0m./HORZ	23.1	**PK**
4804.30	46.79	-20.0	4.11	30.90	54.0	3.0m./HORZ	23.1	**AVG**
Mid – Channel								
4880.10	48.63	0.0	3.42	52.05	74.0	3.0m./HORZ	22.0	**PK**
4880.10	48.63	-20.0	3.42	35.05	54.0	3.0m./HORZ	22.0	**AVG**
High – Channel								
4960.10	46.79	0.0	5.05	51.84	74.0	3.0m./HORZ	22.2	**PK**
4960.10	46.79	-20.0	5.05	31.84	54.0	3.0m./HORZ	22.2	**AVG**

Notes:
1. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
2. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode, with the duty cycle programmed for >98% ON time in continuous transmit mode.
3. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.

Sample Calculation at: 4804.30 MHz

Magnitude of Measured Frequency	46.79	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	4.11	dB/m
Duty Cycle Correction Factor	0.00	dB
Corrected Result	50.90	dBuV/m

Test Date: February 13, 2018
Tested By
Signature: _____ Name: John Freeman

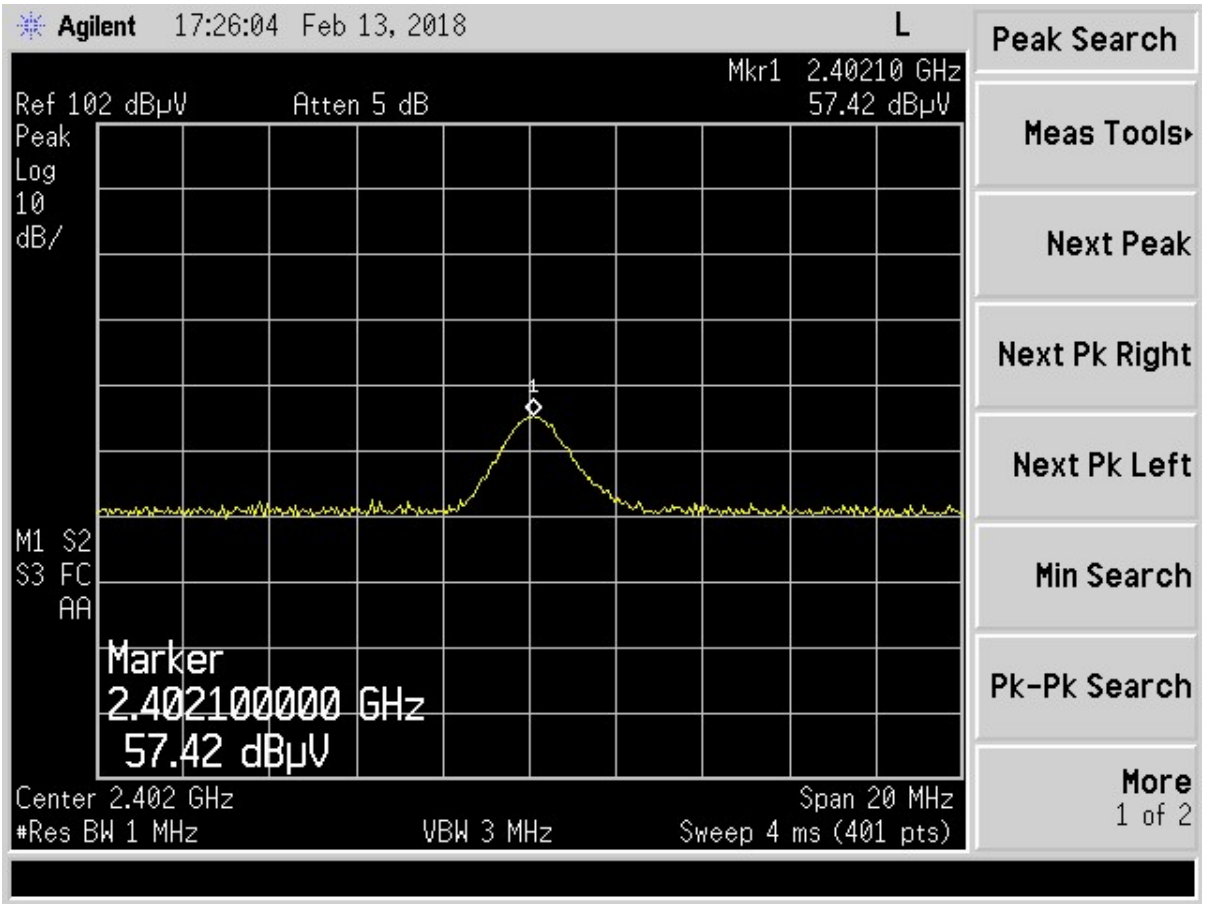


Figure 6. Low Channel Fundamental

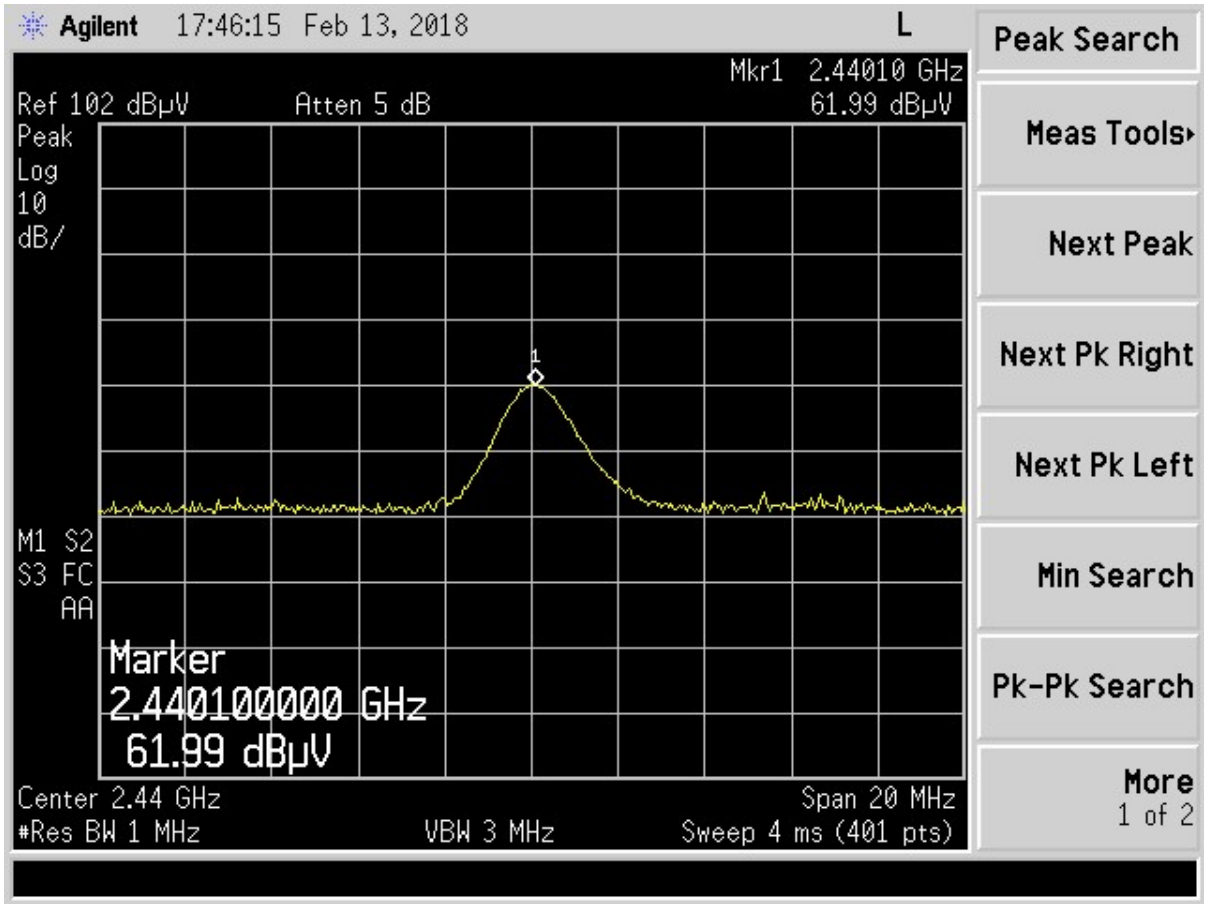


Figure 7. Mid Channel Fundamental

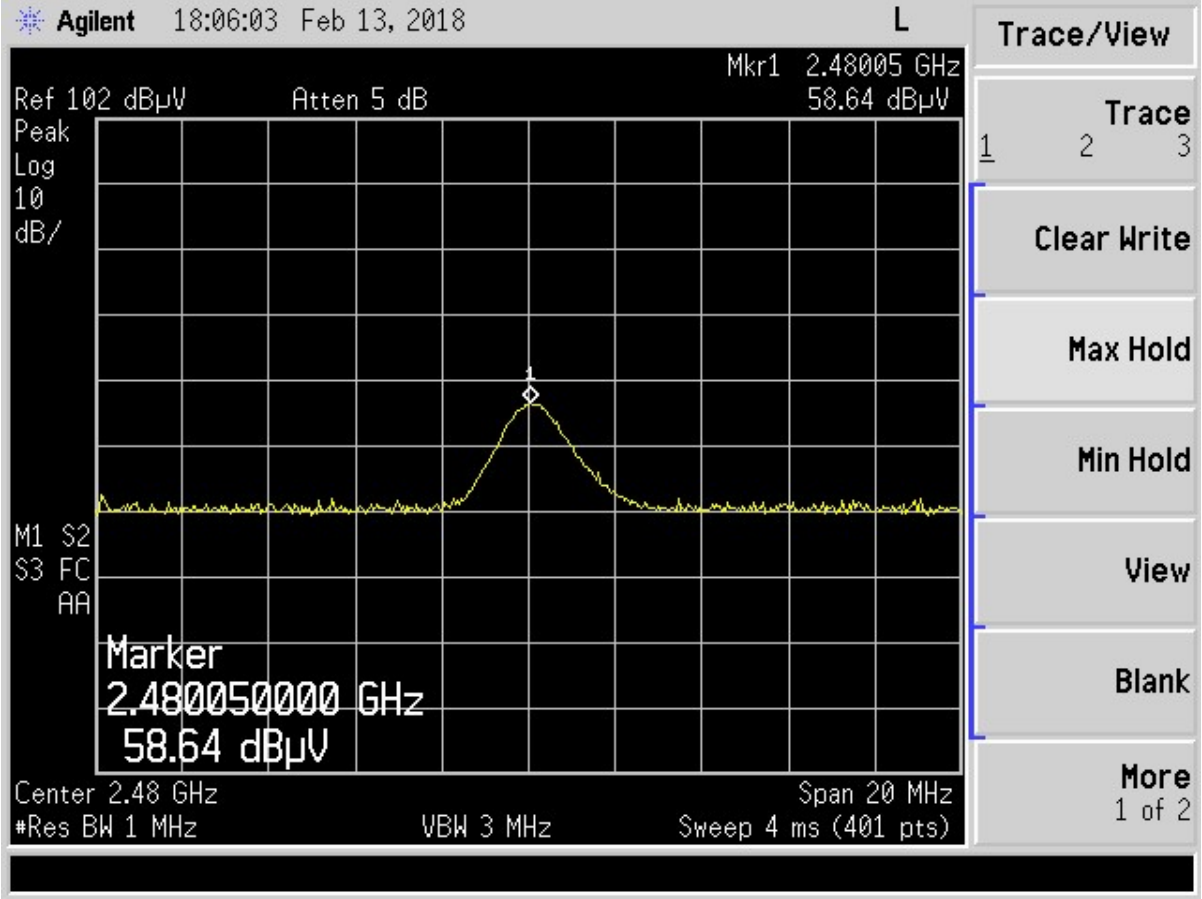


Figure 8. High Channel Fundamental

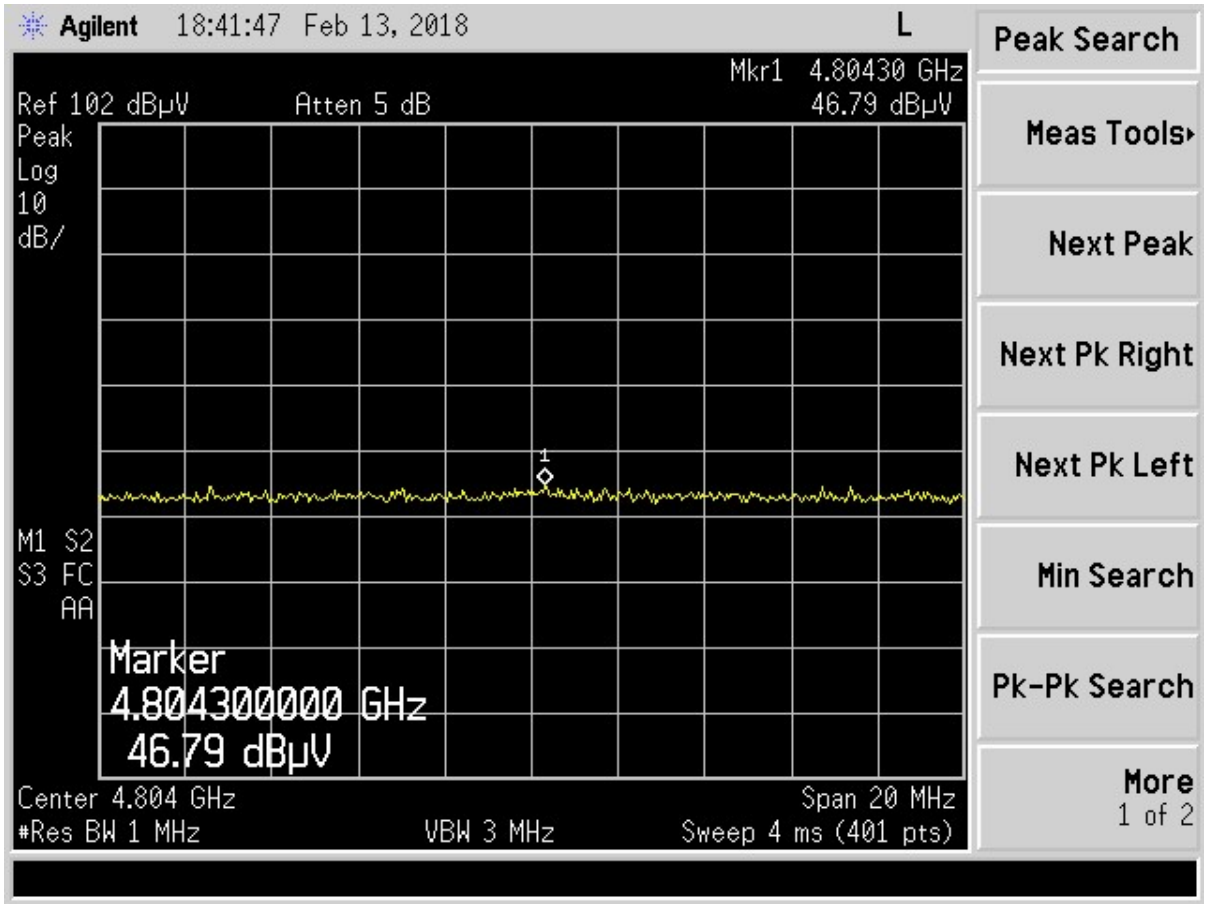


Figure 9. Low Channel Worst Case Harmonic

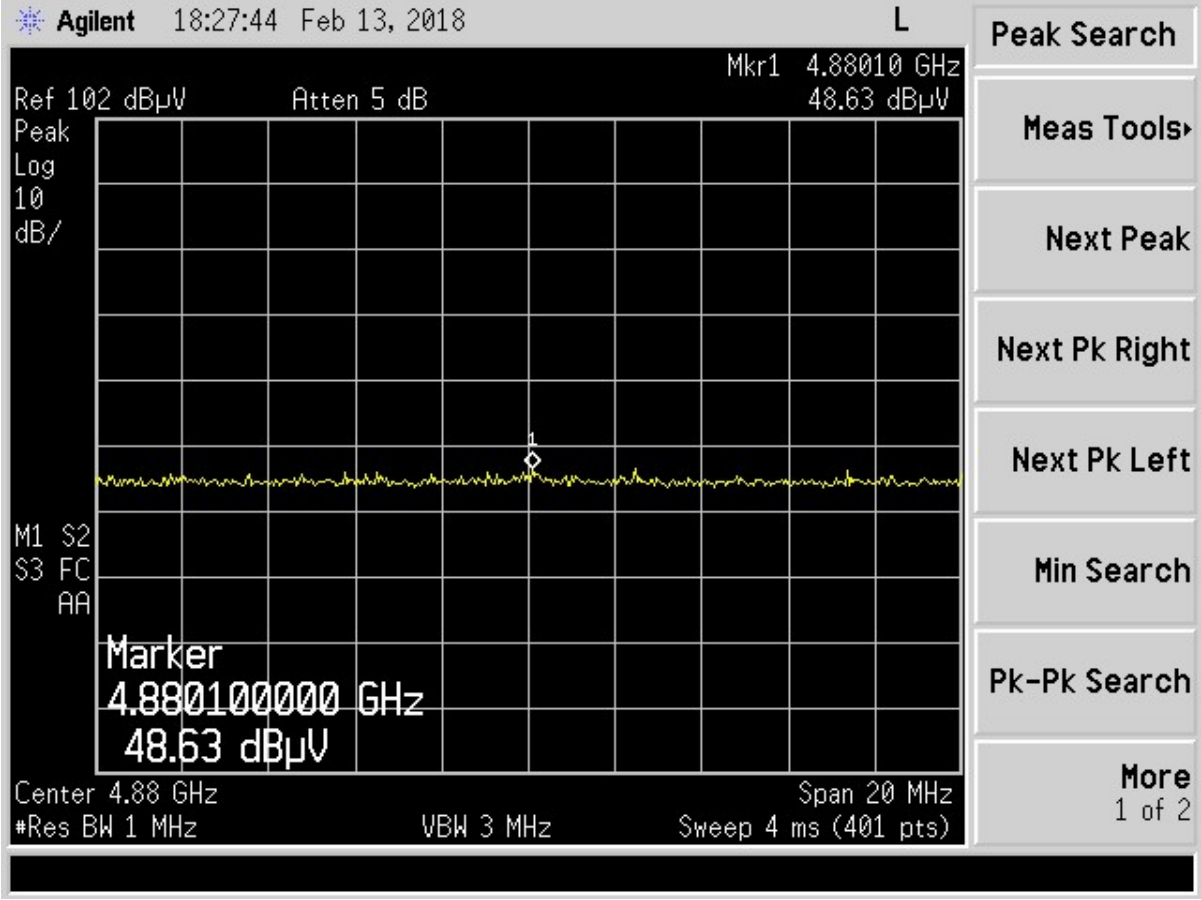


Figure 10. Mid Channel Worst Case Harmonic

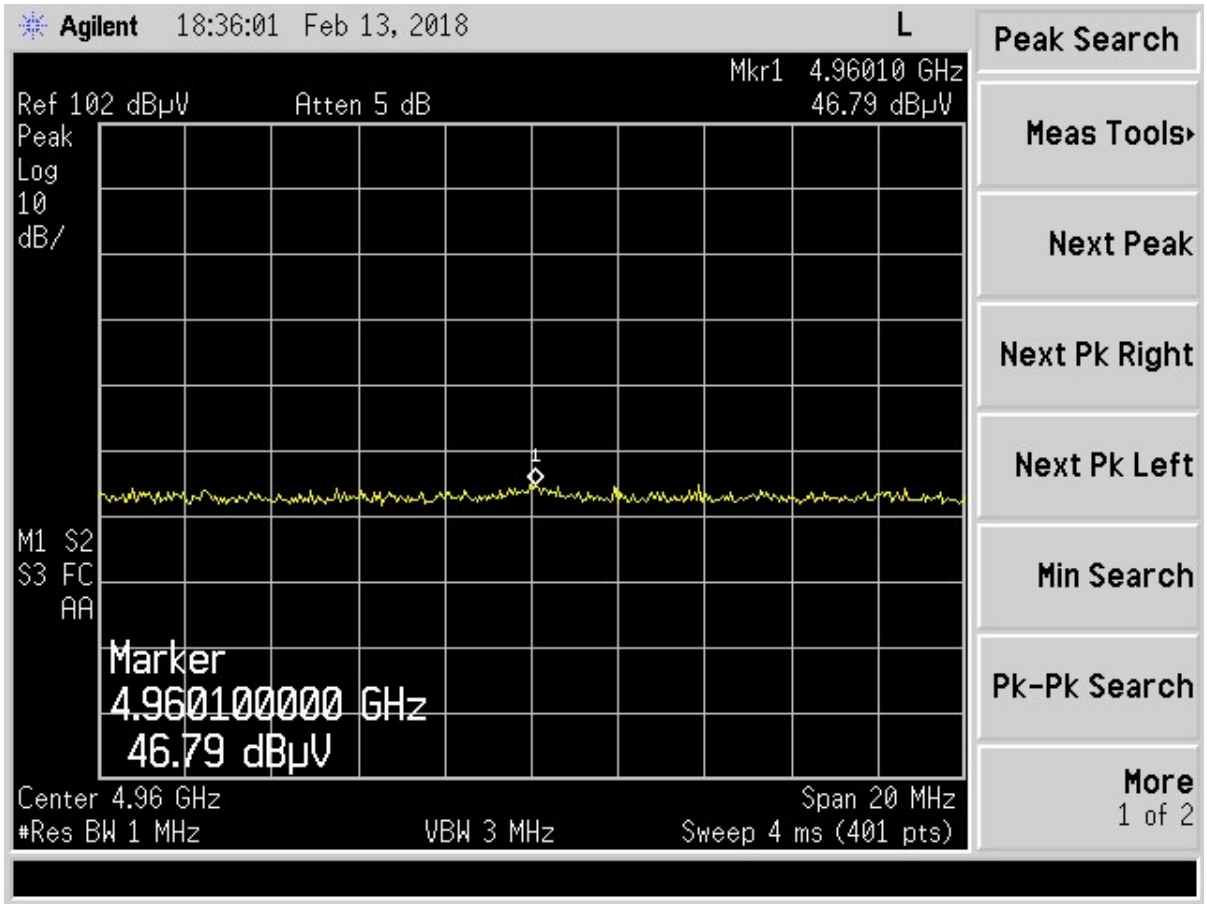


Figure 11. High Channel Worst Case Harmonic

2.11 Band Edge Measurements – (CFR 15.249 (d))

Band Edge measurements are made following the guidelines in FCC KDB Publication No. 558074 with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Radiated measurements are performed to demonstrate compliance with the requirement of 15.249(d) that all emissions outside of the band edges be attenuated by at least 50 dB or 15.209 limits, when compared to its highest in-band value (contained in a 100 kHz band).

To capture the band edge, set the Spectrum Analyzer frequency span to 2 MHz to capture the peak level of the emission operating on the channel closest to the band edge as well as any modulation products falling outside of the authorized band of operation. See figure and calculations following for more detail.

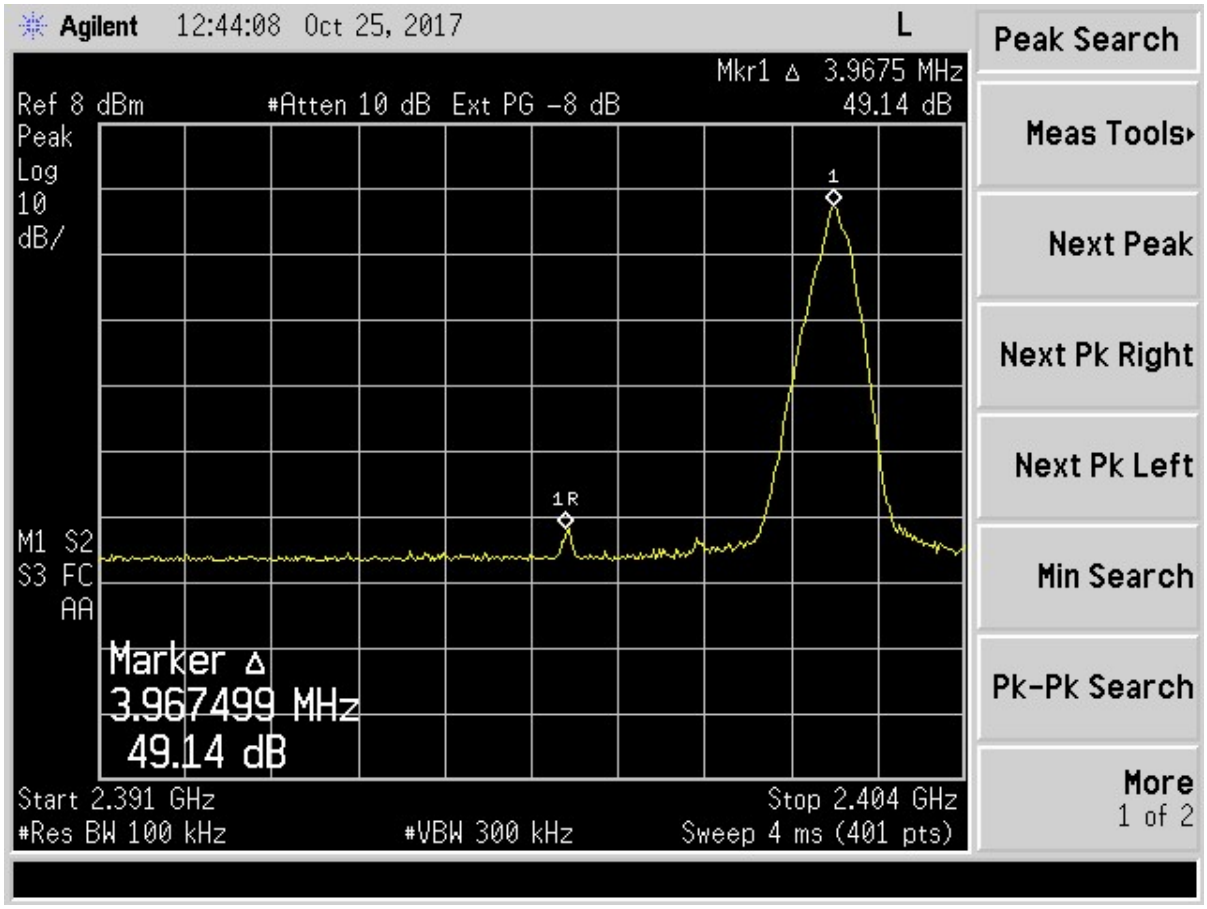


Figure 12. Band Edge Compliance, Low Channel Delta - Peak

Low Channel Corrected Measured Value from Table 7	81.52	dBuV
Low Channel Band Edge Delta from Figure 4	-49.14	dB
Calculated Result	32.38	dBuV/m
Band Edge Limit	54.00	dBuV/m
Calculated Result	32.38	dBuV/m
Band Edge Margin	21.62	dBuV/m

Peak value meets AVG limit.

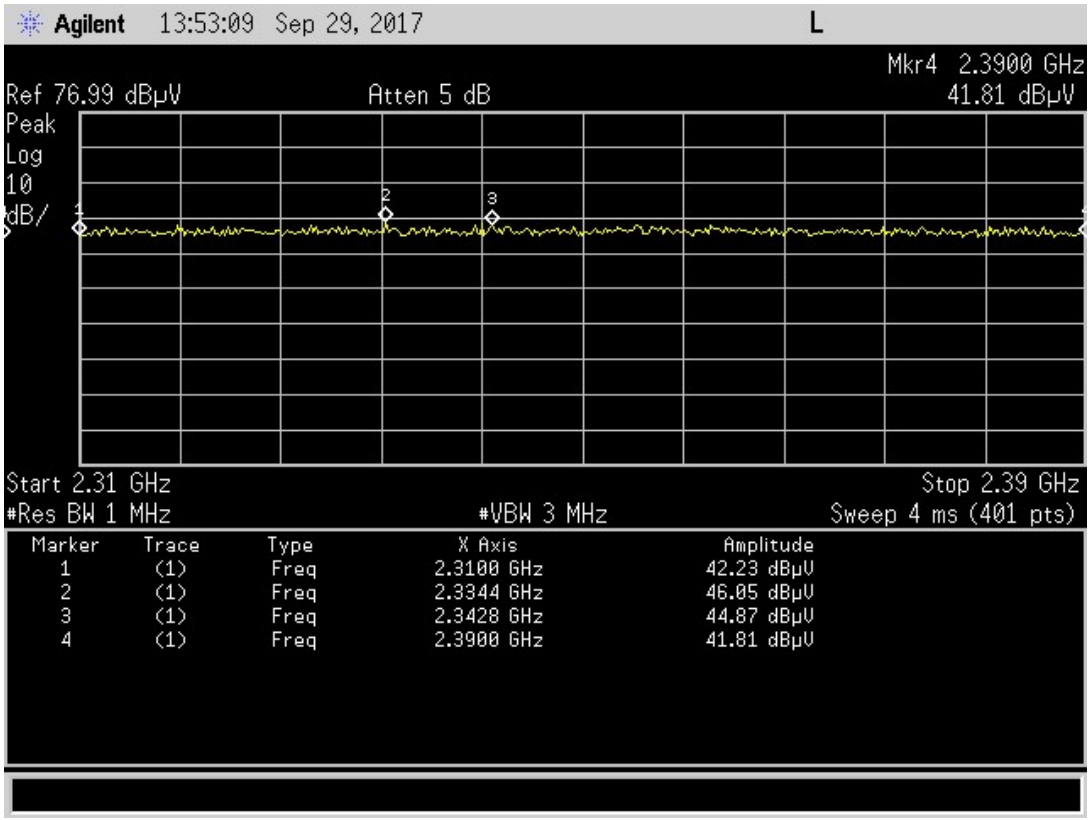


Figure 13. Radiated Restricted Band 2310 MHz to 2390 MHz, Peak

Table 10. Radiated Restricted Band 2310 MHz to 2390 MHz, Peak

2310 MHz to 2390 MHz Restricted Band Peak Measurements							
Test: Radiated Emissions				**Client:** Inventek			
Project: 17-0165				**Model:** ISMRL78G1D			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**PK Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
2310.00	42.23	-1.03	41.21	74.0	3.0m./HORZ	32.8	**PK**
2334.40	46.05	-1.03	45.03	74.0	3.0m./HORZ	29.0	**PK**
2342.80	44.87	-1.03	43.85	74.0	3.0m./HORZ	30.2	**PK**
2390.00	41.81	-1.03	40.79	74.0	3.0m./HORZ	33.2	**PK**

Test Date: September 29, 2017
Tested By
Signature: _____ Name: Robert K. Mills

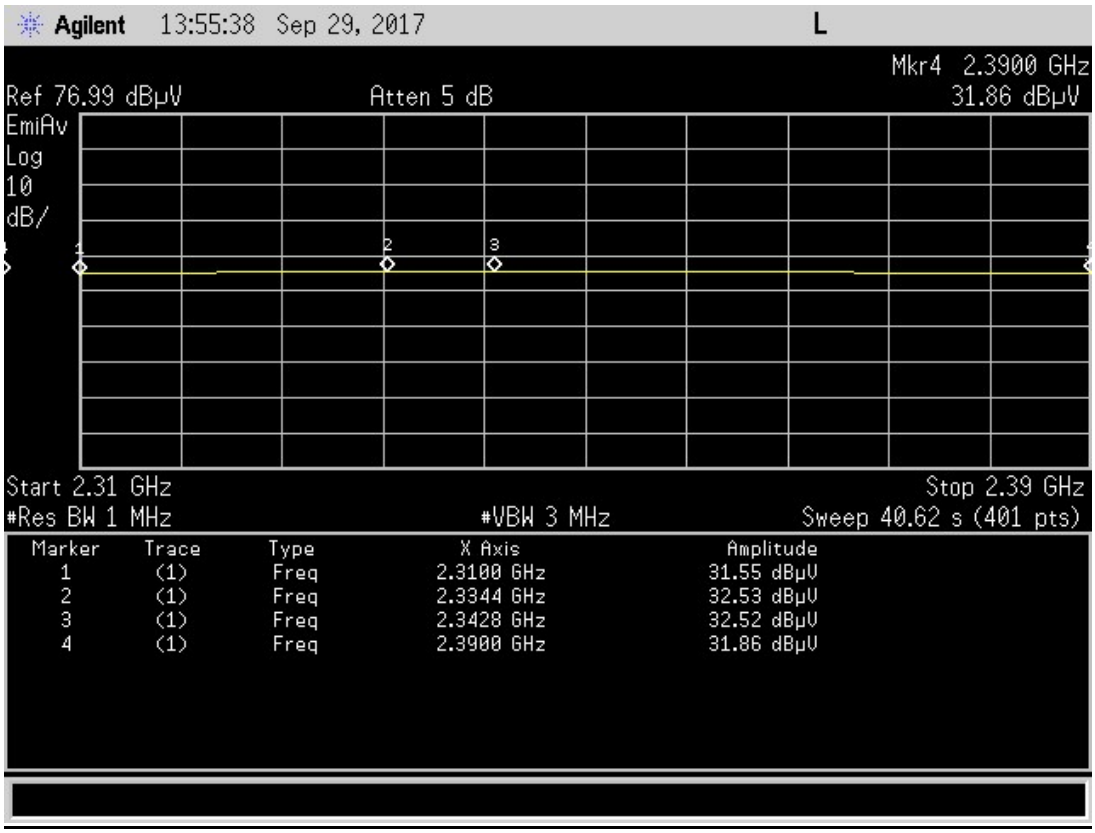


Figure 14. Radiated Restricted Band 2310 MHz to 2390 MHz Plot, Average

Table 11. Radiated Restricted Band 2310 MHz to 2390 MHz, Average

2310 MHz to 2390 MHz Restricted Band Peak Measurements								
Test: Radiated Emissions					**Client:** Inventek			
Project: 17-0165					**Model:** ISMRL78G1D			
Frequency (MHz)	**Test Data (dBuv)**	**Additional Factor (dB)**	**AF+CA-AMP+Duty Cycle (dB/m)**	**Results (dBuV/m)**	**AVG Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
2310.00	31.55	-	-1.03	30.53	54.0	3.0m./HORZ	23.5	**AVG**
2334.40	32.53	-	-1.03	31.51	54.0	3.0m./HORZ	22.5	**AVG**
2342.80	32.52	-	-1.03	31.50	54.0	3.0m./HORZ	22.5	**AVG**
2390.00	31.86	-	-1.03	30.84	54.0	3.0m./HORZ	23.2	**AVG**

Note: the EUT was programmed to transmit at >98% duty cycle, therefore the PK values were adjusted using the duty cycle factor of -20 dB.

Test Date: September 29, 2017
Tested By
Signature: Name: Robert K. Mills

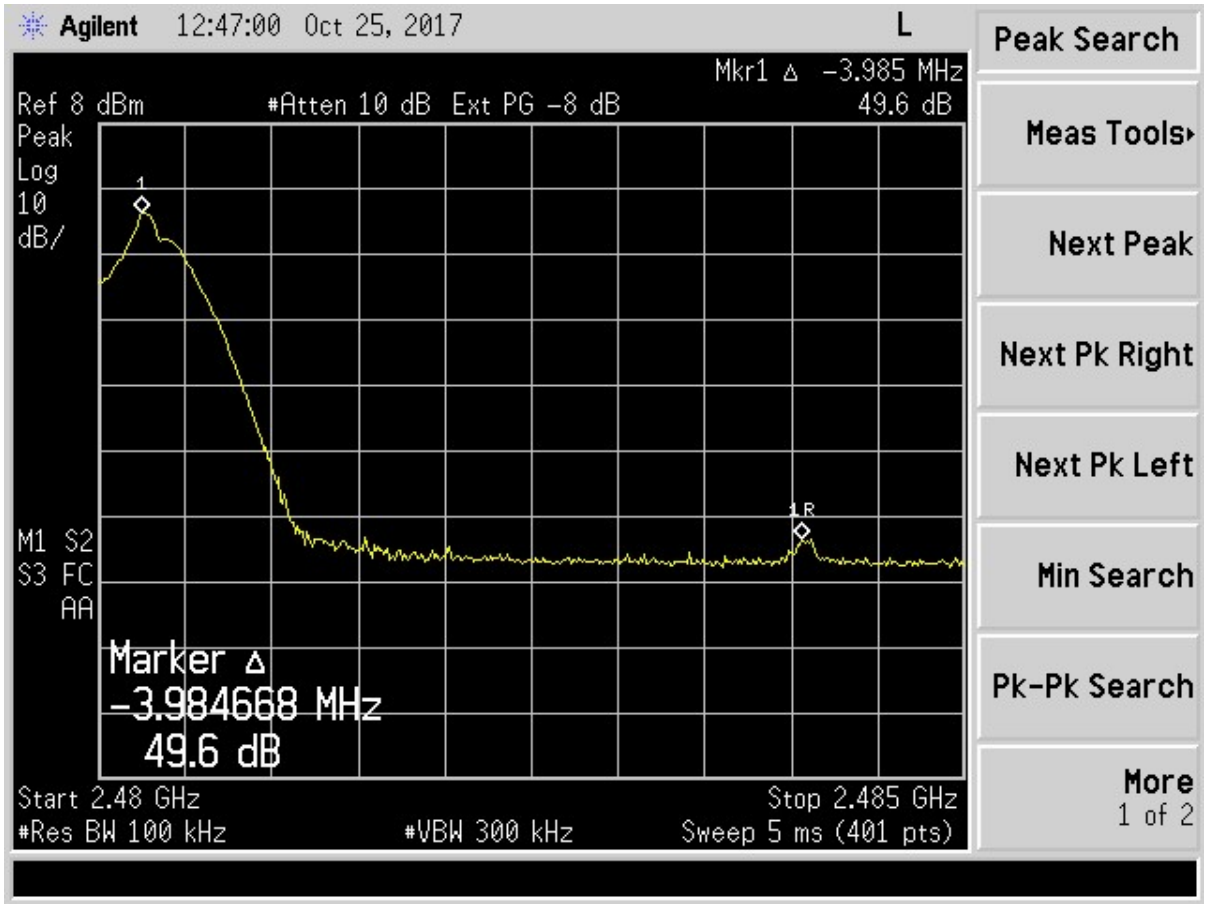


Figure 15. Band Edge Compliance, High Channel Delta – Peak

High Channel Corrected Measured Value from Table 8	92.16	dBuV
High Channel Band Edge Delta from Figure 6	-49.60	dB
Calculated Result	42.56	dBuV/m
Band Edge Limit	54.00	dBuV/m
Calculated Result	42.56	dBuV/m
Band Edge Margin	11.44	dBuV/m

Peak value meets AVG limit.

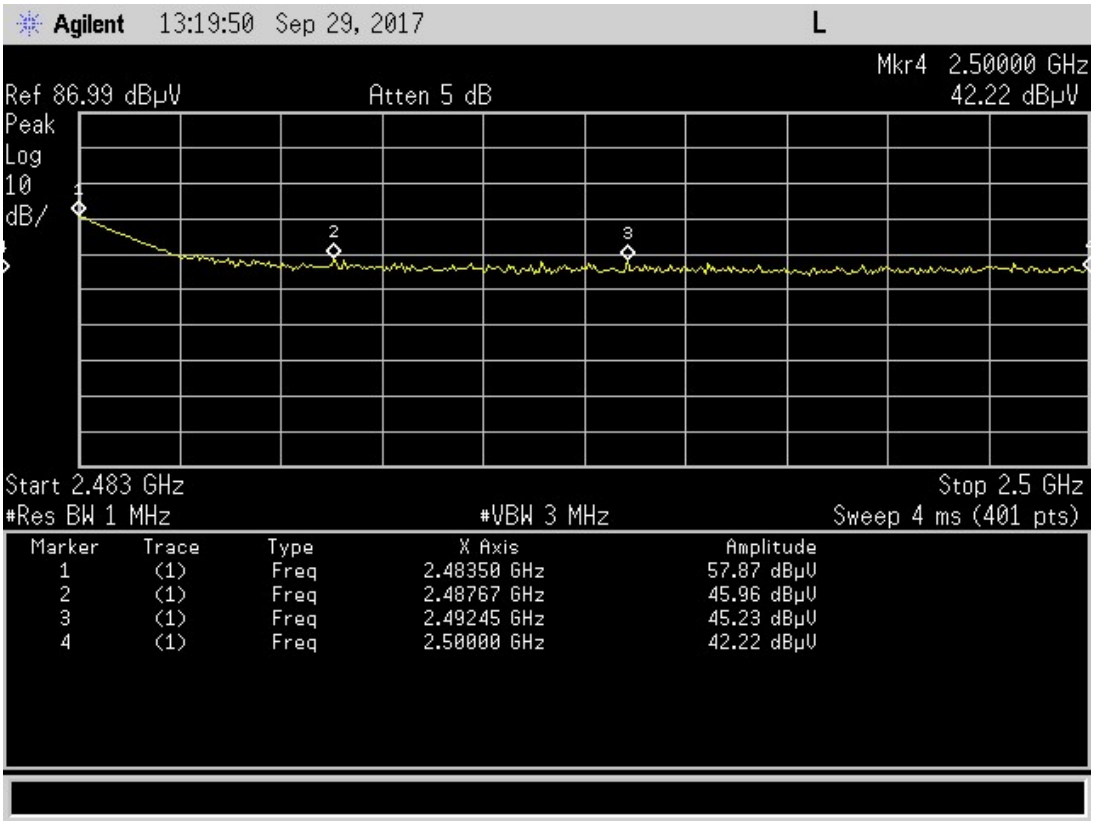


Figure 16. Radiated Restricted Band 2483.5 MHz to 2500 MHz, Peak

Table 12. Radiated Restricted Band 2483.5 MHz to 2500 MHz, Peak

2483.5 MHz to 2500 MHz Restricted Band Peak Measurements							
Test: Radiated Emissions				**Client:** Inventek			
Project: 17-0165				**Model:** ISMRL78G1D			
Frequency (MHz)	**Test Data (dBuv)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**PK Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
2483.50	57.87	-0.86	57.01	74.0	3.0m./HORZ	17.0	**PK**
2487.67	45.96	-0.86	45.10	74.0	3.0m./HORZ	28.9	**PK**
2492.45	45.23	-0.86	44.37	74.0	3.0m./HORZ	29.6	**PK**
2500.00	42.22	0.13	42.35	74.0	3.0m./HORZ	31.7	**PK**

Test Date: September 29, 2017
Tested By
Signature: _____ Name: Robert K. Mills

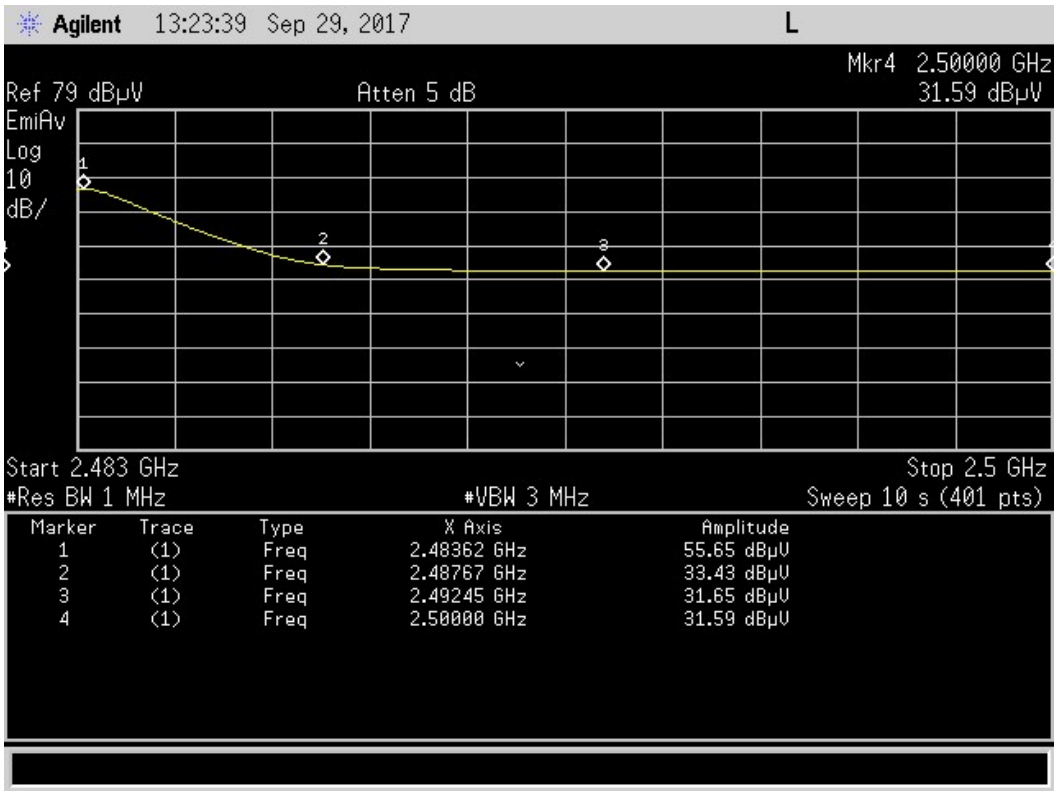


Figure 17. Radiated Restricted Band 2483.5 MHz to 2500 MHz, Average

Table 13. Radiated Restricted Band 2483.5 MHz to 2500 MHz, Average

2483.5 MHz to 2500 MHz Restricted Band Average Measurements								
Test: Radiated Emissions					**Client:** Inventek			
Project: 17-0165					**Model:** ISMRL78G1D			
Frequency (MHz)	**Test Data (dBuv)**	**Additional Factor (dB)**	**AF+CA-AMP+Duty Cycle (dB/m)**	**Results (dBuV/m)**	**AVG Limits (dBuV/m)**	**Antenna Distance/ Polarization**	**Margin (dB)**	**Detector PK, or AVG**
2483.62	55.65	-20.00	-0.86	34.79	54.0	3.0m./HORZ	19.2	**AVG**
2487.67	33.43		-0.86	32.57	54.0	3.0m./HORZ	21.4	**AVG**
2492.45	31.65		-0.86	30.79	54.0	3.0m./HORZ	23.2	**AVG**
2500.00	31.59		0.13	31.72	54.0	3.0m./HORZ	22.3	**AVG**

Note: the EUT was programmed to transmit at >98% duty cycle, therefore the PK values were adjusted using the duty cycle factor of -20 dB.

Test Date: September 29, 2017
Tested By
Signature: _____ Name: Robert K. Mills

2.12 99% Occupied Bandwidth (Part 2.1049)

These measurements were performed while the EUT was in a constant transmit mode. A method similar to the marker delta method was used to capture the points. The RBW was set to approximately 1/100 of the manufacturers claimed RBW and with the VBW ≥ RBW. The results of this test are given in Table 12 and Figures 10-12.

Table 14. 20 dB Bandwidth and 99% Occupied Bandwidth

Frequency (MHz)	20 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
2402	1.262	1.073
2442	1.268	1.085
2480	1.248	1.061

Test Date: May 25, 2017
Tested By

Signature:  Name: Robert K. Mills

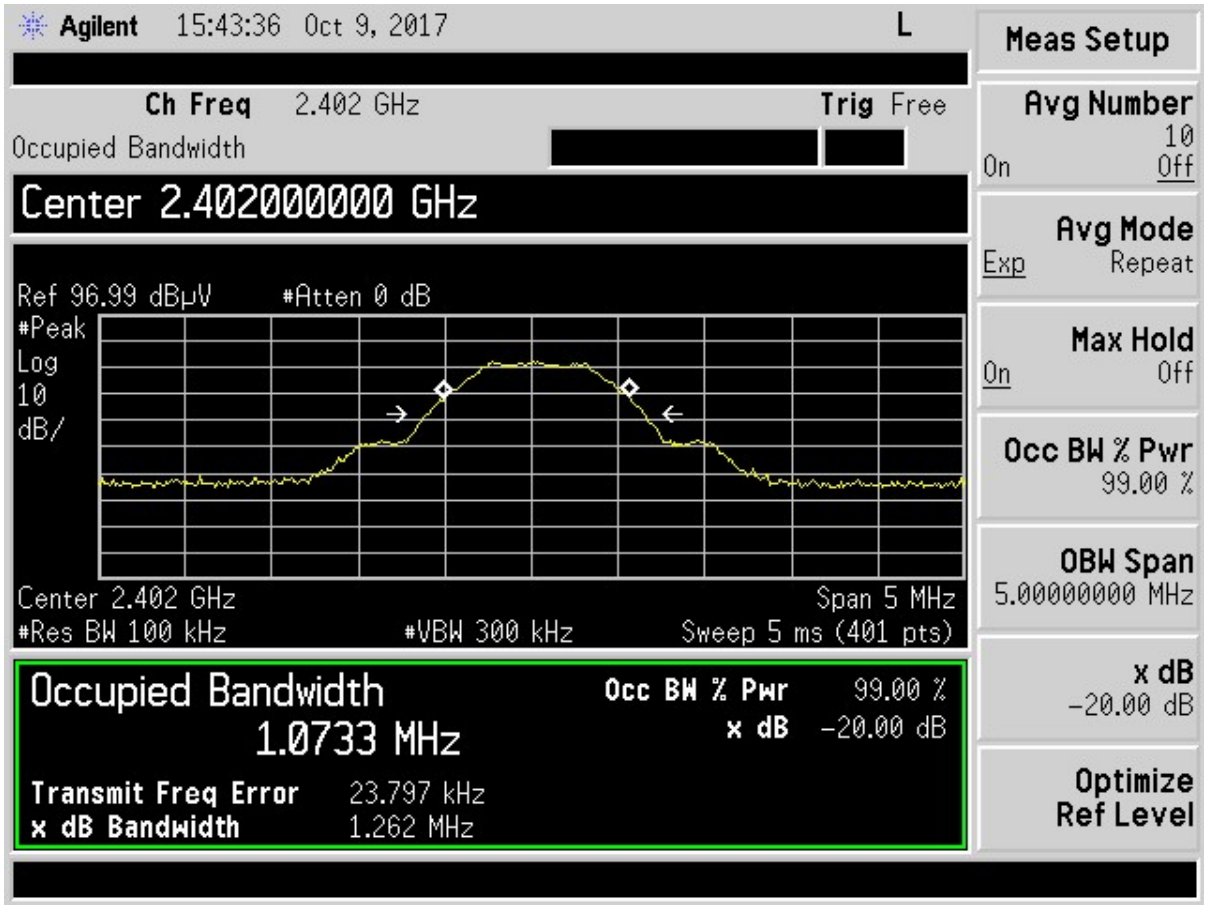


Figure 18. 99% Occupied Bandwidth – Low Channel

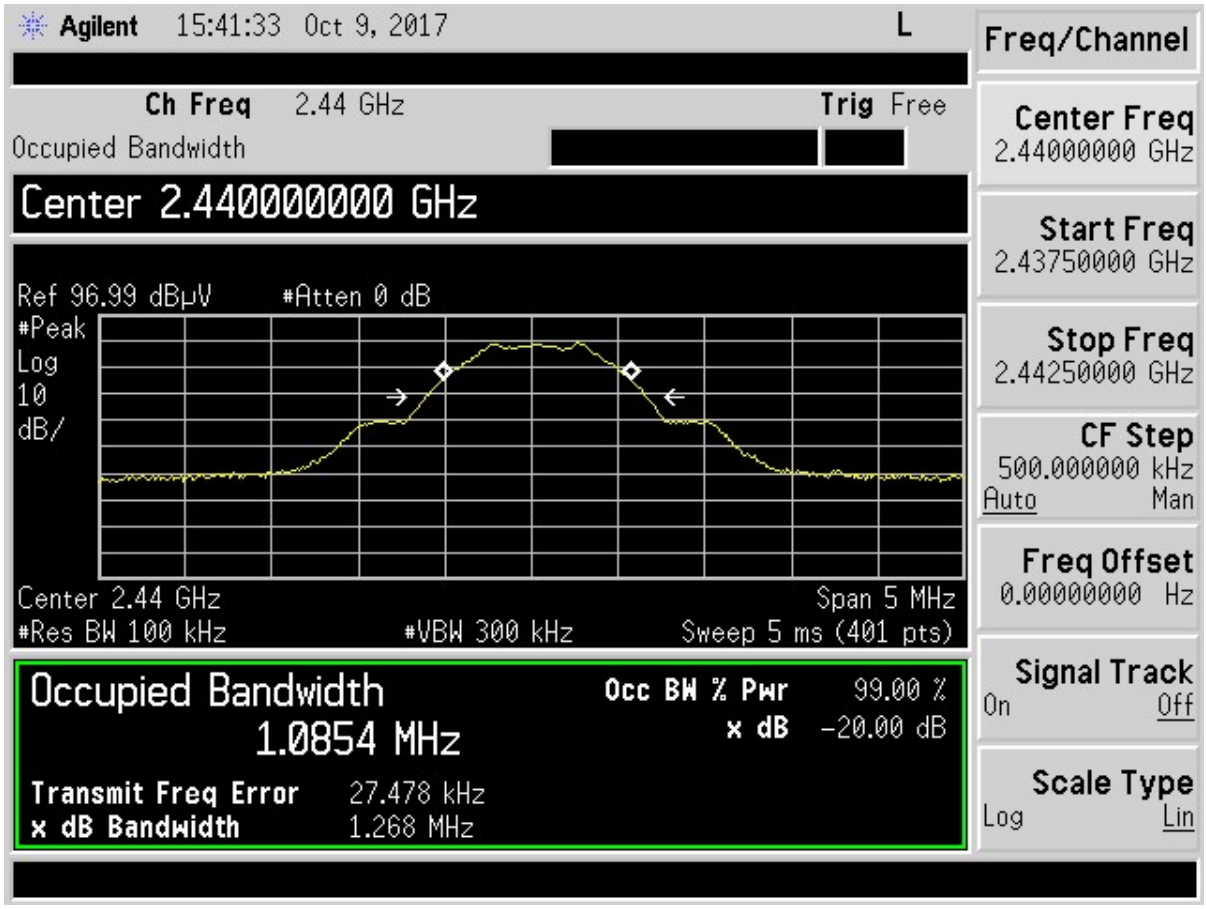


Figure 19. 99% Occupied Bandwidth – Mid Channel

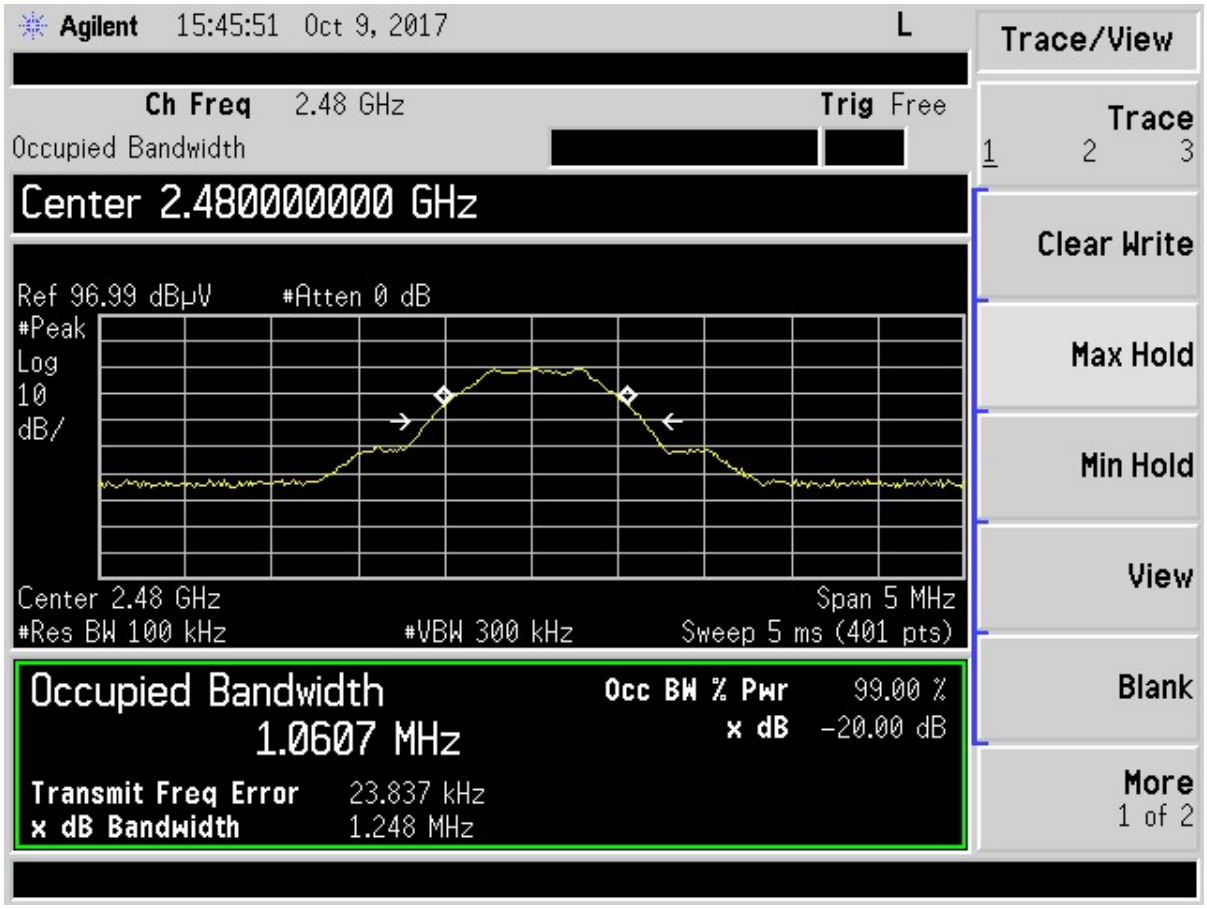


Figure 20. 99% Occupied Bandwidth – High Channel

2.13 Measurement Uncertainty

The measurement uncertainties given were calculated using the method detailed in CISPR 16-4-2:2011. A coverage factor of k=2 was used to give a level of confidence of approximately 95%.

2.13.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ± 2.78 dB.

2.13.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ± 5.39 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ± 5.18 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ± 5.21dB.

3 Conclusions

The EUT is deemed to meet the requirements of the test standards cited herein when tested in the configuration detailed in this test report.