

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 C, paragraphs 15.207, 15.209 and 15.247

And

**Innovation, Science, and Economic Development Canada
Certification Per
IC RSS-Gen General Requirements for Radio Apparatus
And
RSS-247 Digital Transmission Systems (DTSS), Frequency Hopping Systems
(FHSS) and License-Exempt Local Area Network (LE-LAN) Devices**

For the

Centero LLC

Model: WCI TK FDAP

FCC ID: 2ANDP-WCITK

IC: 23069-WCITK

UST Project: 17-0329

Issue Date: November 2, 2017

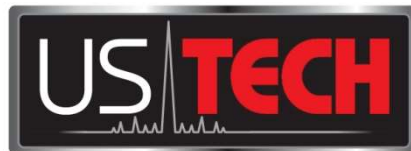
Total Pages in This Report: 52

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Page 1 of 52



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: Alan Ghasiani

Name: 

Title: Compliance Engineer – President

Date November 2, 2017



TESTING
NVLAP LAB CODE 200162-0

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FCC ID:
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Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

MEASUREMENT TECHNICAL REPORT

COMPANYS NAME: Centero LLC
MODEL: WCI TK FDAP
FCC ID: 2ANDP-WCITK
IC: 23069-WCITK
DATE: November 2, 2017

This report concerns (check one): Original grant ☒
Class II change

Equipment type: 2.4 GHz DTS 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

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US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

Table of Contents

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
1	General Information	7
1.1	Purpose of this Report	7
1.2	Characterization of Test Sample	7
1.3	Product Description	7
1.4	Configuration of Tested System	7
1.5	Test Facility	9
1.6	Related Submittals	9
	The EUT is subject to the following FCC authorizations:	9
2	Tests and Measurements	11
2.1	Test Equipment	11
2.2	Modifications to EUT Hardware	12
2.3	Number of Measurements for Intentional Radiators (15.31(m))	12
2.4	Frequency Range of Radiated Measurements (Part 15.33)	12
2.4.1	Intentional Radiator	12
2.4.2	Unintentional Radiator	13
2.5	Measurement Detector Function and Bandwidth (CFR 15.35)	13
2.5.1	Detector Function and Associated Bandwidth	13
2.5.2	Corresponding Peak and Average Requirements	13
2.5.3	Pulsed Transmitter Averaging (CFR 15.35(c))	13
2.6	EUT Antenna Requirements (CFR 15.203)	14
2.7	Restricted Bands of Operation (Part 15.205)	14
2.8	Intentional Radiator, Power Line Conducted Emissions (CFR 15.207)	14
2.9	Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 247 5.1 & 5.2)	15
2.10	Band Edge Measurements – (CFR 15.247 (d))	27
2.11	Six (6) dB Bandwidth per CFR 15.247(a)(2) and RSS Gen 6.6 (99%) Bandwidth	34
2.12	Maximum Peak Conducted Output Power (CFR 15.247 (b) (3))	38
2.13	Power Spectral Density (CFR 15.247(e))	42
2.14	Unintentional Radiator and Intentional Radiator Power Lines Conducted Emissions (CFR 15.107, 15.207)	45
2.15	Unintentional Radiator and Intentional Radiator, Radiated Emissions (CFR 15.109 and 15.209)	48
2.16	Measurement Uncertainty	52
2.16.1	Conducted Emissions Measurement Uncertainty	52
2.16.2	Radiated Emissions Measurement Uncertainty	52
3	Conclusions	52

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

List of Figures

<u>Figures</u>	<u>Title</u>	<u>Page</u>
Figure 1.	Block Diagram of Test Configuration	10
Figure 2.	Antenna Conducted Emissions Low Channel, 30 – 200 MHz.....	16
Figure 3.	Antenna Conducted Emissions Low Channel, 200 – 1000 MHz.....	17
Figure 4.	Antenna Conducted Emissions Low Channel, 1 GHz – 25 GHz.....	18
Figure 5.	Antenna Conducted Emissions Mid Channel, 30 – 200 MHz.....	19
Figure 6.	Antenna Conducted Emissions Mid Channel, 200 – 1000 MHz.....	20
Figure 7.	Antenna Conducted Emissions Mid Channel, 1 GHz – 25 GHz.....	21
Figure 8.	Antenna Conducted Emissions High Channel, 30 – 200 MHz	22
Figure 9.	Antenna Conducted Emissions High Channel, 200 – 1000 MHz	23
Figure 10.	Antenna Conducted Emissions High Channel, 1 GHz – 25 GHz	24
Figure 11.	Band Edge Compliance, Low Channel Delta - Peak.....	28
Figure 12.	Conducted Restricted Band Measurements 2.31 GHz to 2.39 GHz	29
Figure 13.	Radiated Restricted Band Measurements AVG, 2.31 GHz to 2.39 GHz. 30	
Figure 14.	Band Edge Compliance, High Channel Delta – Peak	31
Figure 15.	Conducted Restricted Band Measurements PK, 2.4835 GHz to 2.5 GHz	32
Figure 16.	Conducted Restricted Measurements AVG, 2.4835 GHz to 2.5 GHz	33
Figure 17.	Six (6) dB Bandwidth– Low Channel	35
Figure 18.	Six (6) dB Bandwidth – Mid Channel	36
Figure 19.	Six (6) dB Bandwidth – High Channel.....	37
Figure 20.	Peak Antenna Conducted Output Power, Low Channel	39
Figure 21.	Peak Antenna Conducted Output Power, Mid Channel	40
Figure 22.	Peak Antenna Conducted Output Power, High Channel	41
Figure 23.	Peak Power Spectral Density - Part 15.247 (e) - Low Channel	43
Figure 24.	Power Spectral Density - Part 15.247 (e) - Mid Channel	44
Figure 25.	Peak Power Spectral Density - Part 15.247 (e) - High Channel.....	45

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

List of Tables

<u>Table</u>	<u>Title</u>	<u>Page</u>
Table 1.	EUT and Peripherals.....	9
Table 2.	Test Instruments	11
Table 3.	Number of Test Frequencies for Intentional Radiators.....	12
Table 4.	Allowed Antenna(s).....	14
Table 5.	Peak Radiated Fundamental & Harmonic Emissions.....	25
Table 6.	Average Radiated Fundamental & Harmonic Emissions	26
Table 7.	6 dB Bandwidth and 99% Occupied Bandwidth	34
Table 8.	99% Occupied Bandwidth	34
Table 9.	Peak Antenna Conducted Output Power per Part 15.247 (b) (3)	38
Table 10.	Power Spectral Density for Low, Mid and High Bands.....	42
Table 11.	Transmitter Power Line Conducted Emissions Test Data, Part 15.107/15.207	47
Table 12.	Spurious Radiated Emissions 150 kHz-30MHz (CFR 15.209)	49
Table 13.	Unintentional Radiator, Peak Radiated Emissions (CFR 15.109/15.209), 30 MHz to 1000 MHz	50
Table 14.	Unintentional Radiator, Peak Radiated Emissions (CFR 15.109/15.209) 1 GHz to 25 GHz.....	51

List of Attachments

Agency Agreement
Application Forms
Letter of Confidentiality
Equipment Label(s)
Block Diagram(s)
Schematic(s)
Test Configuration Photographs
Internal Photographs
External Photographs
Theory of Operation
RF Exposure
User's Manual

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

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 247 and IC RSS 247 Issue 8.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on August 14, 2017 in good operating condition.

1.3 Product Description

The Equipment Under Test (EUT) is the Centero LLC model WCI TK FDAP. The EUT is an IEEE 802.15.4 and ISA 100.11a compliant wireless stack conformance test kit (STK) which allows the user to ensure a manufacturer's stack conforms to WCI's official ISA100 Wireless registration testing. The Wireless Compliance Institute (WCI) Field Device Access Point (FDAP) Back-Bone Router Stack Interoperability Test Kit defines test requirements and verifies the correct communication behavior of a wireless device as defined in the ISA100.11a standard. It is resourceful for troubleshooting, debugging, and regression testing of ISA100 Wireless stacks and products. The module allows certifying device conformance to the ISA100.11a standard, providing the basis for use of the ISA100 Wireless Compliant logo and registration.

The product incorporates two identical Honeywell radio modules for redundancy purposes. They do not transmit simultaneously. Both radios were evaluated to see which radio generated the worst case emissions; the results were negligible; therefore for all testing, Radio 1 was used. Radio 1 will always be the primary radio and the other radio, Radio 2, will only be used in the receive mode.

Modulation: Q-PSK
Data rate: 250 kbps
Operating frequency band: 2405-2475 MHz
Antenna: Omni Directional Antenna, +2.0 dBi Gain

1.4 Configuration of Tested System

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

The Test Sample was tested per *ANSI C63.10:2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices* for the intentional radiator aspect of the device and *ANSI C63.4:2014, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2014)* for the unintentional radiator aspect of the device as well as FCC subpart B and C of Part 15 and per FCC KDB Publication number 558074 v04 for Digital Transmission Systems Operating Under section 15.247.

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.

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

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. Its designation number is 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 15.247 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

EUT/PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC/ IC ID	CABLES P/D
EUT, Router with Radio Module (Centero LLC)	WCI TK FDAP	Engineering Sample	2ANDP-WCITK 23069-WCITK	1.5 m U D
Power Supply Adapter (XP Power)	VER12US1 20-JA	None	None	1.5 m U P
Laptop (Hewlett Packard)	Various	Various	Various	1.5 m U P
Antenna See antenna details	--	--	--	--

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

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

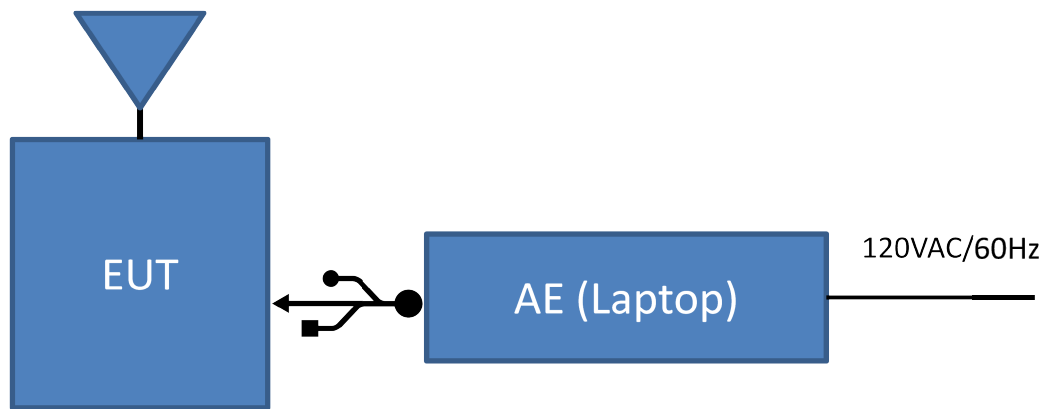


Figure 1. Block Diagram of Test Configuration

US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

FCC Part 15 Certification/ RSS 247
 2ANDP-WCITK
 23069-WCITK
 17-0329
 November 2, 2017
 Centero LLC
 WCI TK FDAP

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
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT- PACKARD	1937A02980	11/1/2017
PREAMP 1.0 GHz to 26.0 GHz	8449B	HEWLETT- PACKARD	3008A00480	10/26/2017
LOOP ANTENNA	SAS- 200/562	A. H. Systems	142	12/28/2017 2 yr extended
BICONICAL ANTENNA	3110B	EMCO	9307-1431	5/2/2019 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	5/1/2019 2 yr
HORN ANTENNA	3115	EMCO	9107-3723	9/22/2018 2 yr.
LISN x 2	8028-50- TS24-BNC	SOLAR ELECTRONICS	910494 & 910495	11/20/2017
CALCULATION PROGRAM	N/A	N/A	Ver. 6.0	N/A

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 2400 MHz to 2483.5 MHz, 3 test frequencies were used.

2.4 Frequency Range of Radiated Measurements (Part 15.33)

2.4.1 Intentional Radiator

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

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 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 following:

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 (CFR 15.35(c))

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: The manufacturer has a declared a Duty Cycle of 41% intended for normal operation; therefore where applicable (when using AVG detection) the duty cycle factor based on a 41% DC was applied.

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

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 module.

Table 4. Allowed Antenna(s)

REPORT REFERENCE	MANUFACTURER	TYPE OF ANTENNA	MODEL	GAIN dB _i	TYPE OF CONNECTOR
Antenna	Nearson	Omni Directional	S181Ah- 2450S	2.0	RP-SMA/ mmcx

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 cannot exceed the limits of 15.209. Radiated harmonics and other spurious are examined for this requirement see paragraph 2.1

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

Power line conducted emissions testing was performed to ensure that with the EUT in operation (exercising all transmitter functions), the complete system continues to meet the applicable requirements for CFR 15.207. These measurements were completed and are displayed along with the 15.107 power line test data in the sections below.

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

2.9 Intentional Radiator, Radiated Emissions (CFR 15.209, 15.247(d)) (IC RSS 247 5.1 & 5.2)

Radiated Spurious measurements: The EUT was placed into a continuous transmit mode of operation (>98% duty cycle) and tested per FCC Public Notice DA 00-705 and 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. A preliminary scan was performed on the EUT to find the 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 operate 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. The conducted spurious method as described below was used to investigate all other emissions emanating from the antenna port.

Conducted Spurious measurements: The EUT was put into a continuous-transmit mode of operation and tested per ANSI C63.10:2013 for conducted out of band emissions emanating from the antenna port over the frequency range of 30 MHz to 25 GHz. A conducted scan was performed on the EUT to identify and record the spurious signals that were related to the transmitter to show that all spurious emissions were at least 20 dB below the fundamental frequency.

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

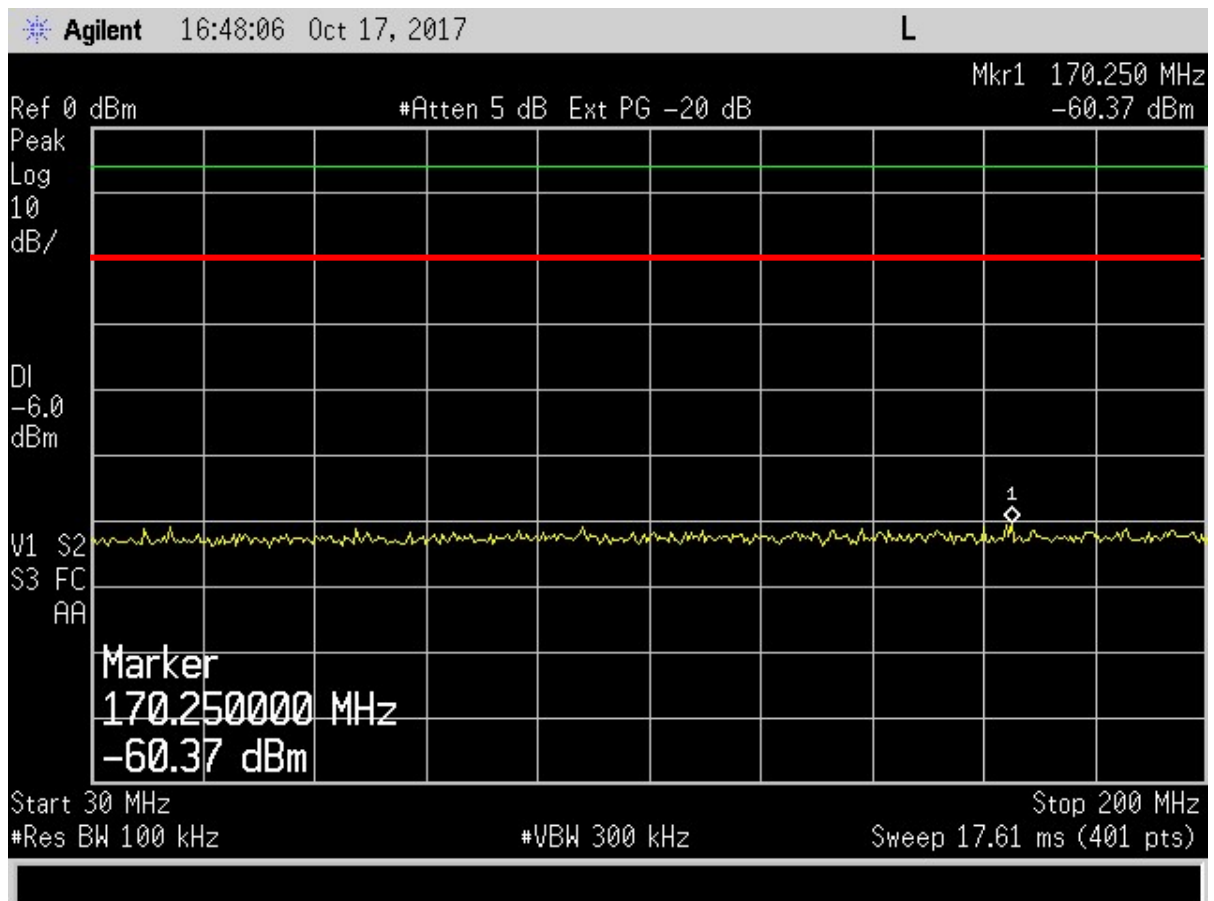


Figure 2. Antenna Conducted Emissions Low Channel, 30 – 200 MHz
RED Line= Limit line

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

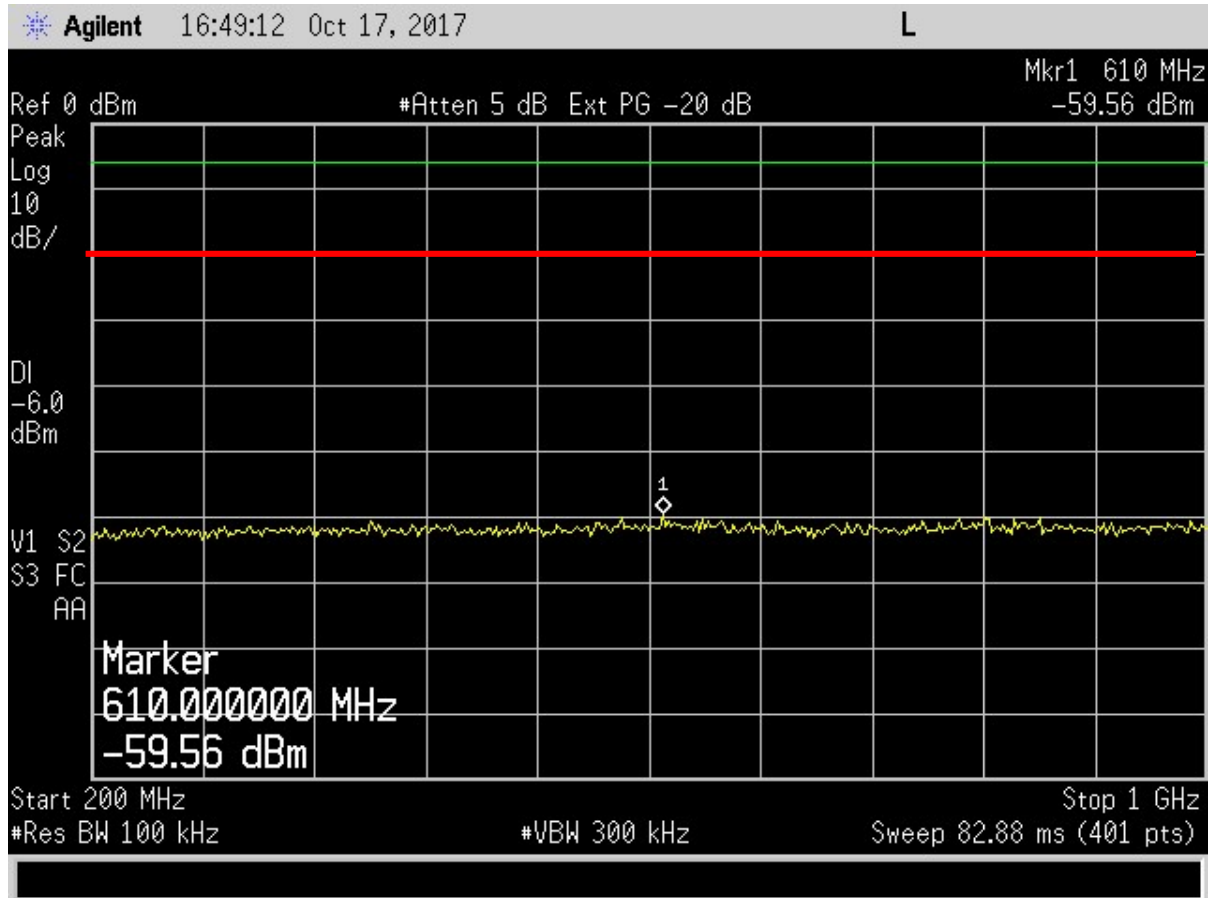


Figure 3. Antenna Conducted Emissions Low Channel, 200 – 1000 MHz
RED Line= Limit line

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

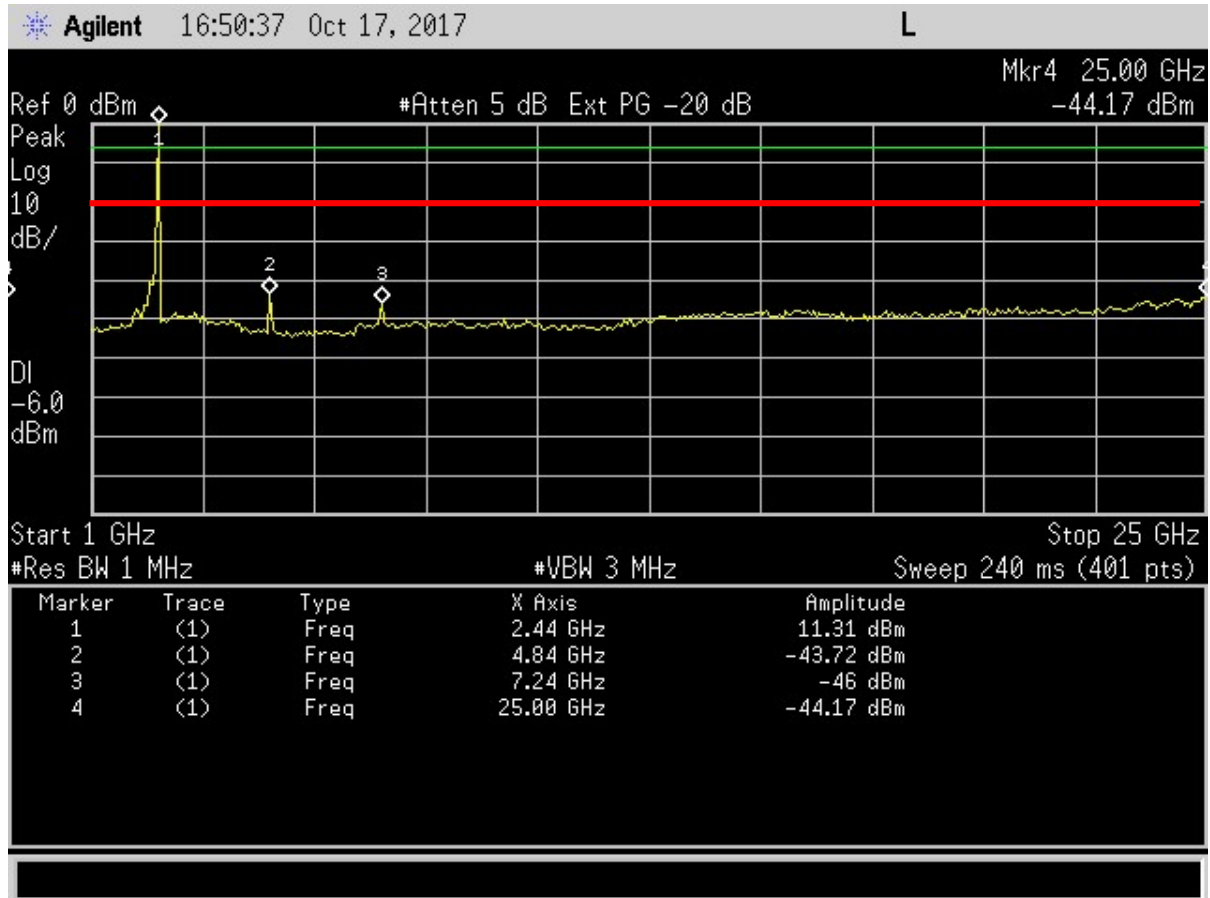


Figure 4. Antenna Conducted Emissions Low Channel, 1 GHz – 25 GHz
RED Line= Limit line

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

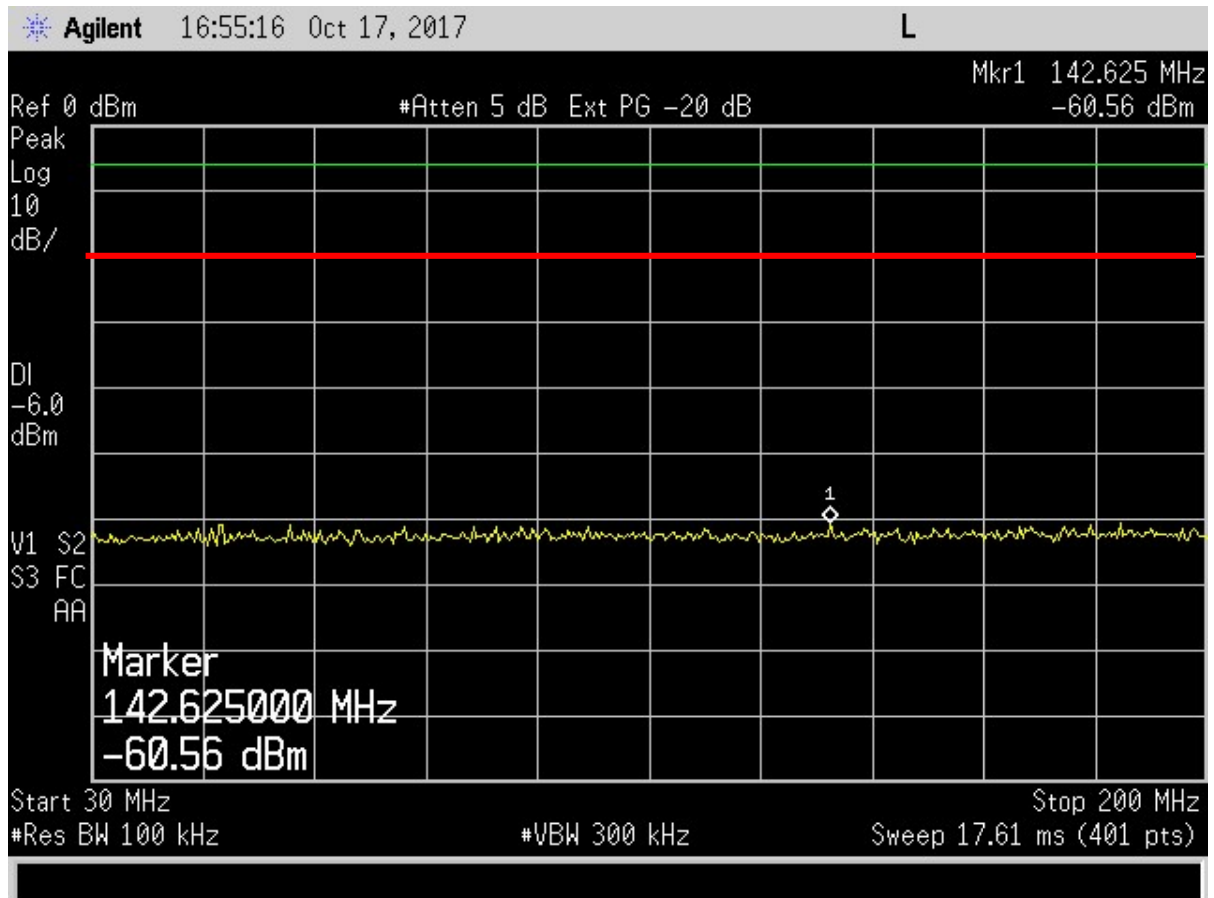


Figure 5. Antenna Conducted Emissions Mid Channel, 30 – 200 MHz
RED Line= Limit line

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

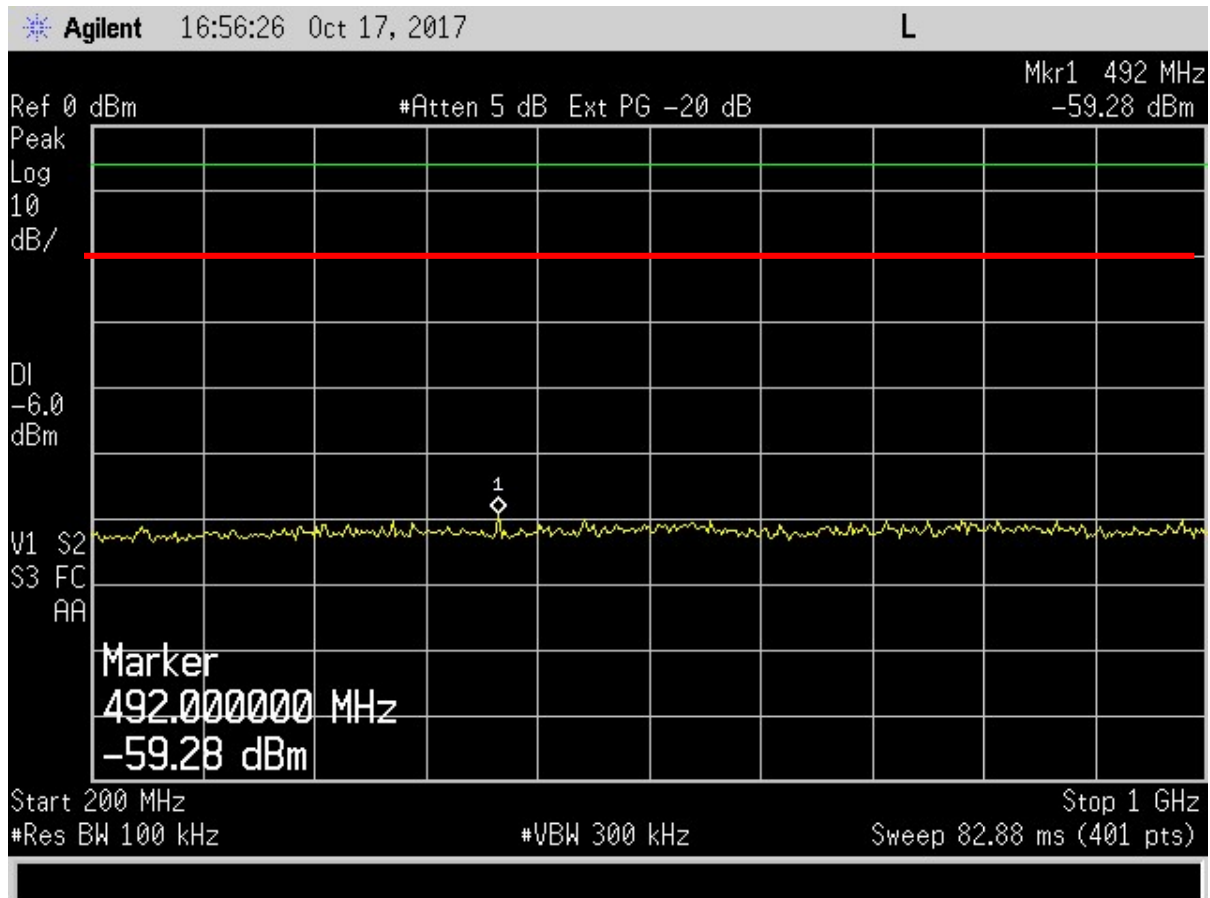


Figure 6. Antenna Conducted Emissions Mid Channel, 200 – 1000 MHz
RED Line= Limit line

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

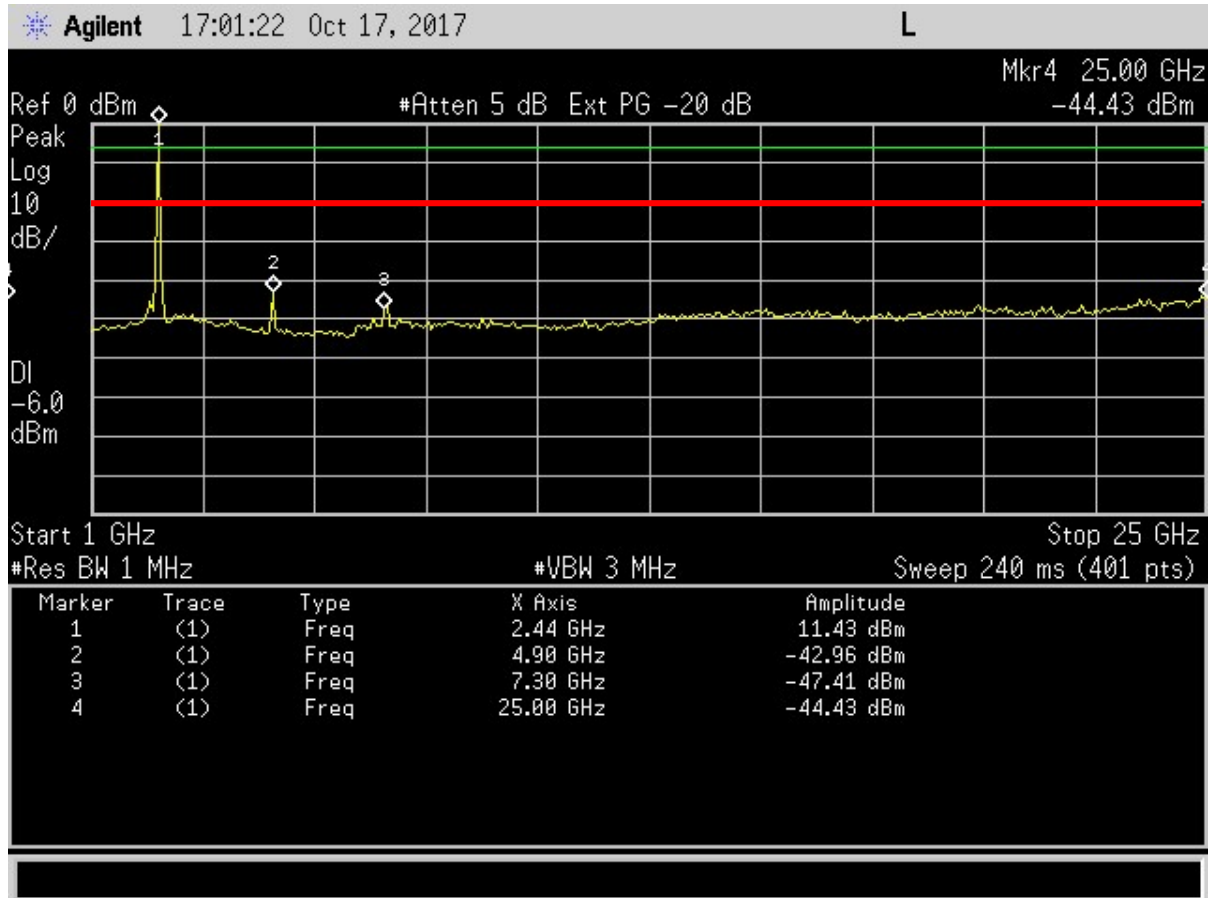


Figure 7. Antenna Conducted Emissions Mid Channel, 1 GHz – 25 GHz
RED Line= Limit line

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

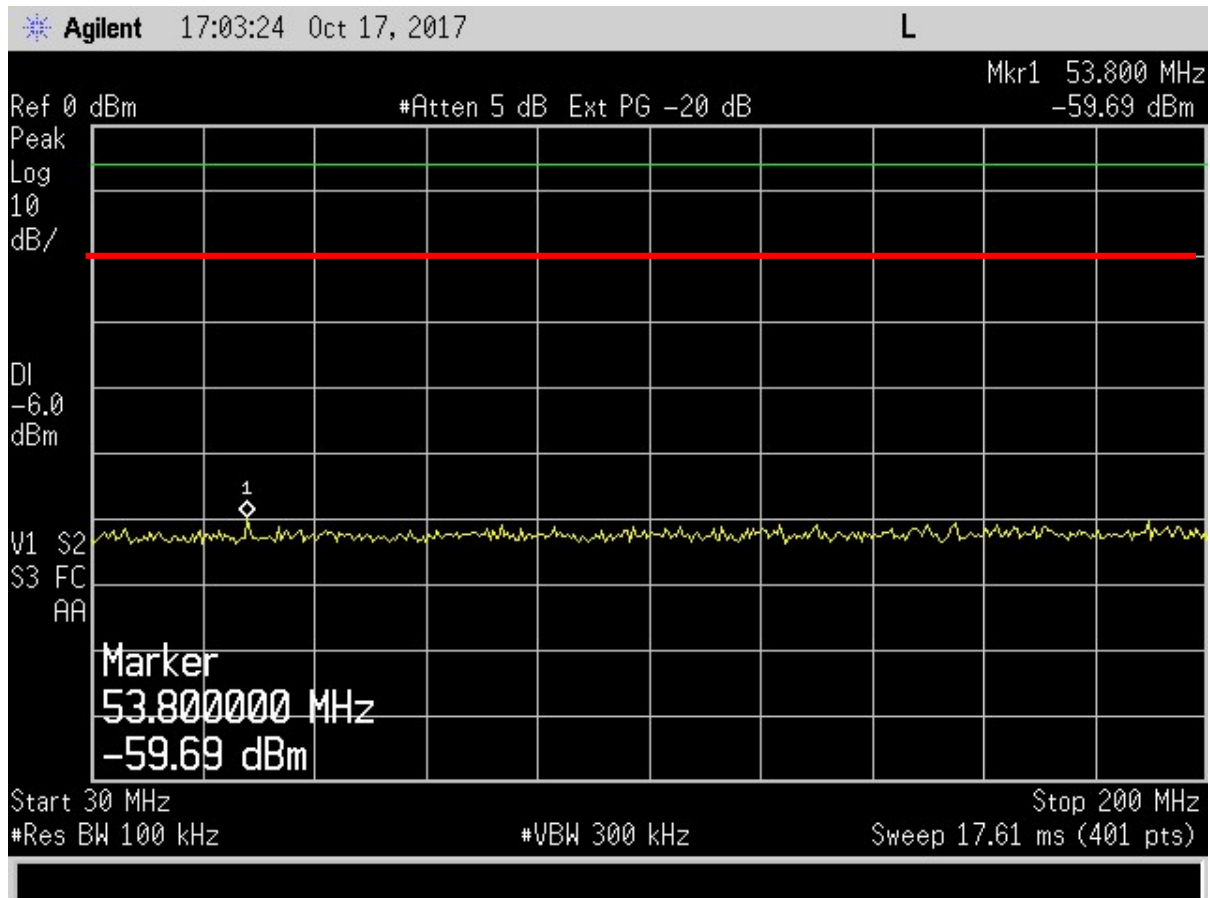


Figure 8. Antenna Conducted Emissions High Channel, 30 – 200 MHz
RED Line= Limit line

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

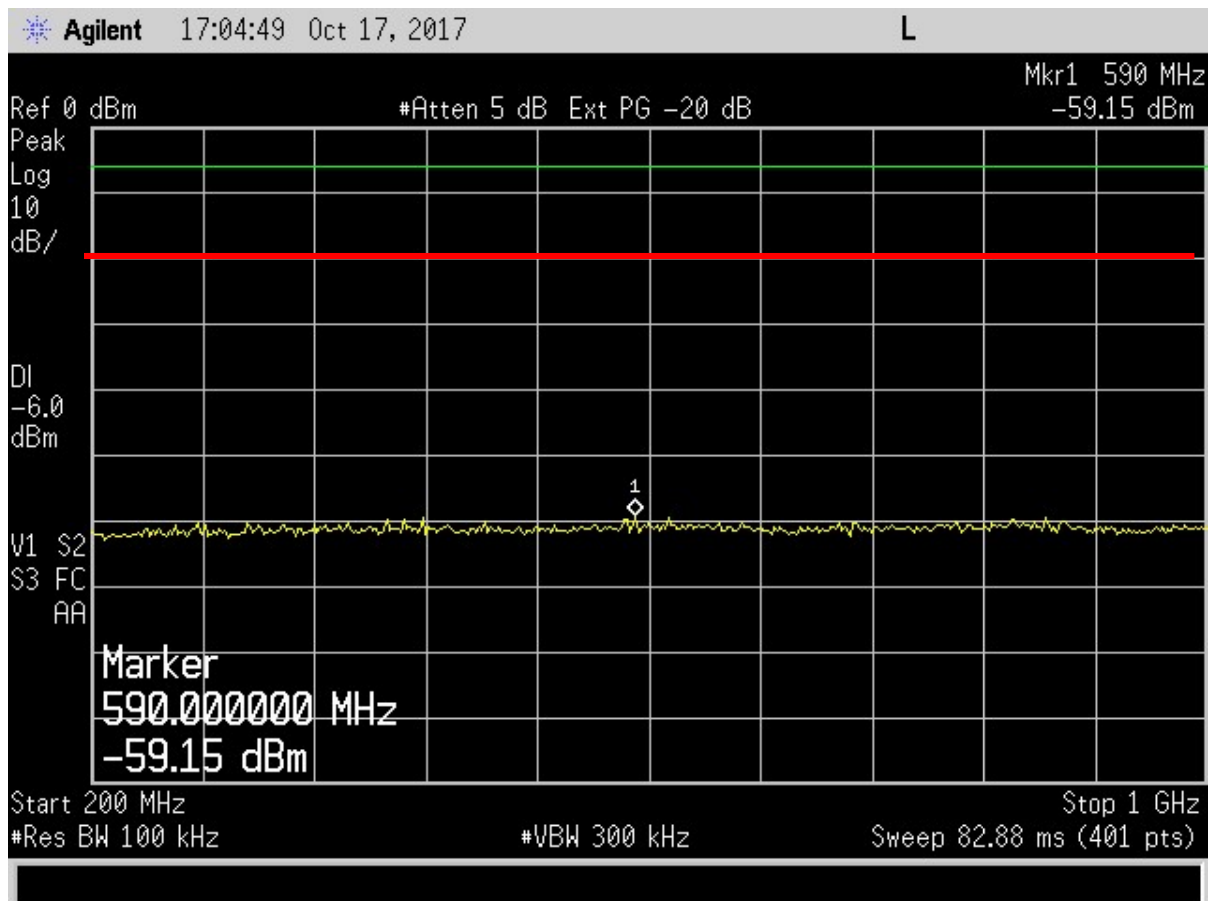


Figure 9. Antenna Conducted Emissions High Channel, 200 – 1000 MHz
RED Line= Limit line

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

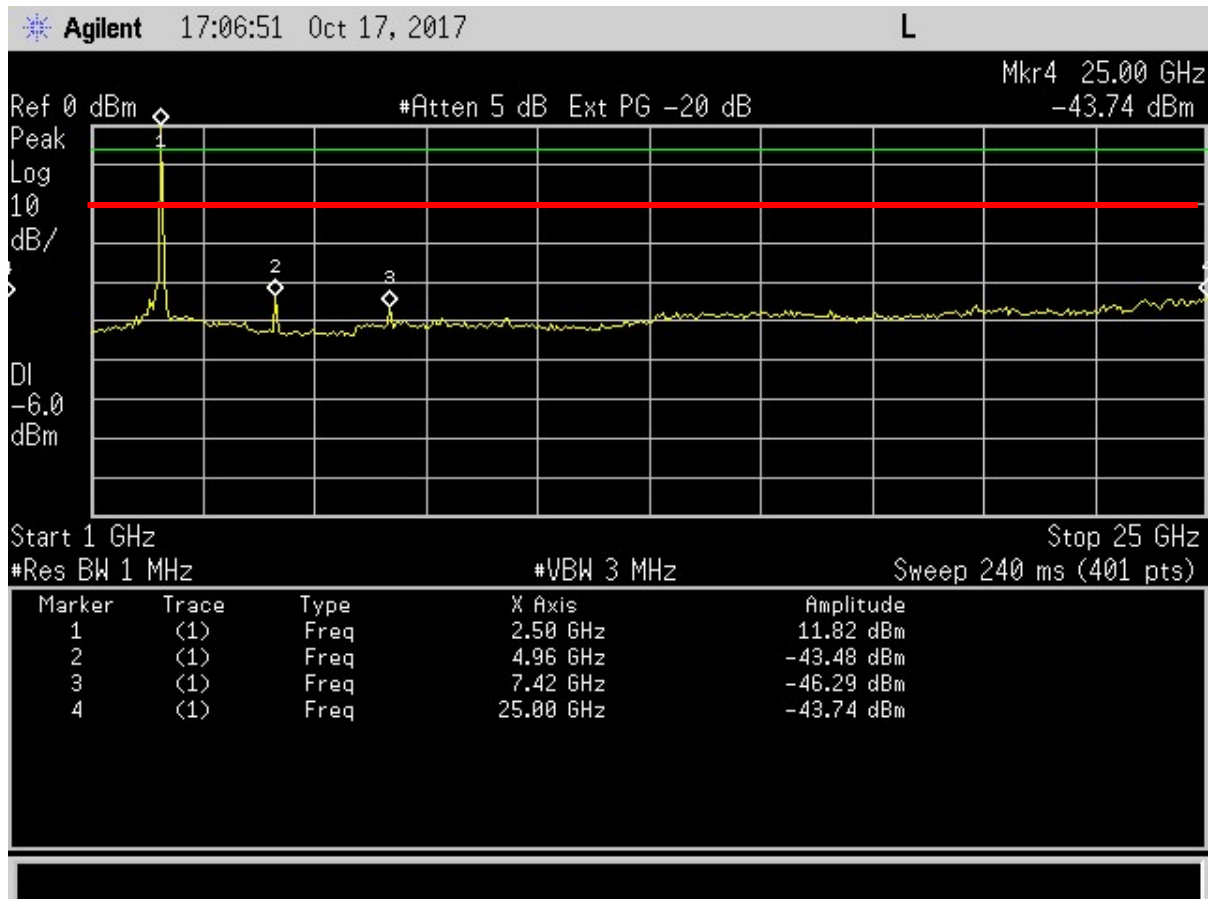


Figure 10. Antenna Conducted Emissions High Channel, 1 GHz – 25 GHz
RED Line= Limit line

US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

FCC Part 15 Certification/ RSS 247
 2ANDP-WCITK
 23069-WCITK
 17-0329
 November 2, 2017
 Centro LLC
 WCI TK FDAP

Table 5. Peak Radiated Fundamental & Harmonic Emissions

Test: FCC Part 15, Para 15.209, 15.247(d)					Client: Centro LLC			
Project: 17-0329					Model: WCI TK FDAP			
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 (Peak)								
2405.55	77.45	-	33.39	110.84	125.3	3.0m./VERT	14.4	PK
*4810.90	50.94	-	9.66	60.60	74.0	3.0m./VERT	13.4	PK
7213.65	54.84	-	21.00	75.84	90.8	3.0m./VERT	15.0	PK
9618.10	43.57	-	22.45	66.02	90.8	3.0m./VERT	24.8	PK
Mid Channel (Peak)								
2439.55	76.19	-	33.39	109.58	125.3	3.0m./VERT	15.7	PK
*4879.20	47.55	-	9.66	57.21	74.0	3.0m./VERT	16.8	PK
*7318.30	60.00	-9.50	21.32	71.82	74.0	3.0m./VERT	2.2	PK
9758.00	45.73	-	22.95	68.68	89.6	3.0m./VERT	20.9	PK
High Channel (Peak)								
2475.50	77.32	-	33.39	110.71	125.3	3.0m./VERT	14.5	PK
*4953.40	45.37	-	10.50	55.87	74.0	3.0m./VERT	18.1	PK
*7423.45	59.08	-9.50	21.45	71.03	74.0	3.0m./VERT	3.0	PK
9909.55	44.91	-	23.30	68.21	90.7	3.0m./VERT	22.5	PK

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 15.247
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.
4. For measurement performed at 1 meter test distance an extrapolation factor of -9.5 dB was applied to correct back to 3 meter.

Sample Calculation at: 2405.55 MHz

Magnitude of Measured Frequency	77.45	dBuV
+Additional Factor (filter + duty cycle)	0.00	dB
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	33.39	dB/m
Corrected Result	110.84	dBuV/m

Test Date: August 22, 2017

Tested By

Signature:  Name: Robert K Mills

Note: The transmitter was programmed to transmit at >98% during all testing.

US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

FCC Part 15 Certification/ RSS 247
 2ANDP-WCITK
 23069-WCITK
 17-0329
 November 2, 2017
 Centro LLC
 WCI TK FDAP

Table 6. Average Radiated Fundamental & Harmonic Emissions

Test: FCC Part 15, Para 15.209, 15.247(d)					Client: Centro LLC			
Project: 17-0329					Model: WCI TK FDAP			
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 (Average)								
2405.55	22.72	-	33.39	56.11	105.3	3.0m./VERT	49.1	AVG
4810.90	29.65	-	9.66	39.31	54.0	3.0m./VERT	14.7	AVG
7213.65	29.95	-	21.00	50.95	70.8	3.0m./VERT	19.9	AVG
9618.10	28.74	-	22.45	51.19	70.8	3.0m./VERT	19.7	AVG
Mid Channel (Average)								
2439.55	22.91	-	33.39	56.30	105.3	3.0m./VERT	48.9	AVG
4879.20	30.03	-	9.66	39.69	54.0	3.0m./VERT	14.3	AVG
7318.30	29.96	-9.50	21.32	41.78	54.0	3.0m./VERT	12.2	AVG
9758.00	29.28	-	22.95	52.23	69.6	3.0m./VERT	17.3	AVG
High Channel (Average)								
2475.50	24.96	-	33.39	58.35	105.3	3.0m./VERT	46.9	AVG
4953.40	29.45	-	10.50	39.95	54.0	3.0m./VERT	14.0	AVG
7423.45	29.14	-9.50	21.45	41.09	54.0	3.0m./VERT	12.9	AVG
9909.55	29.15	-	23.30	52.45	70.7	3.0m./VERT	18.3	AVG

1. (*) Falls within the restricted bands of CFR 15.205. Limits based on CFR15.209 & 15.247
2. No other signals detected within 20 dB of specification limit. Harmonics investigated up to the 10th harmonic
3. The EUT was placed in three orthogonal positions and the transmitter was in constant broadcast mode. The emissions were measured with the receive antenna in vertical and horizontal polarizations. The data listed in the above table was worst case.
4. For measurement performed at 1 meter test distance an extrapolation factor of -9.5 dB was applied to correct back to 3 meter.

Sample Calculation at: 2405.55 MHz

Magnitude of Measured Frequency	22.72	dBuV
+Additional Factor (filter + duty cycle)	0.00	dB
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	33.39	dB/m
Corrected Result	56.11	dBuV/m

Test Date: August 22, 2017

Tested By

Signature: 

Name: Robert K. Mills

Note: The transmitter was programmed to transmit at >98% during all testing.

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

2.10 Band Edge Measurements – (CFR 15.247 (d))

Band Edge measurements are made following the guidelines in ANSI C63.10:2013 with the EUT initially operating on the Lowest Channel and then operating on the Highest Channel within its band of operation. Antenna port conducted measurements are performed to demonstrate compliance with the requirement of 15.247(d) that all emissions outside of the band edges be attenuated by at least 20 dB 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 large enough (usually around 3 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. Conducted measurements are performed with RBW $\geq 1\%$ of the frequency span. In all cases, the VBW is set \geq RBW. See figure and calculations below for more detail. This measurement was performed with the EUT continuously transmitting on the low and high channels as well as in normal use mode.

US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

FCC Part 15 Certification/ RSS 247
 2ANDP-WCITK
 23069-WCITK
 17-0329
 November 2, 2017
 Centro LLC
 WCI TK FDAP

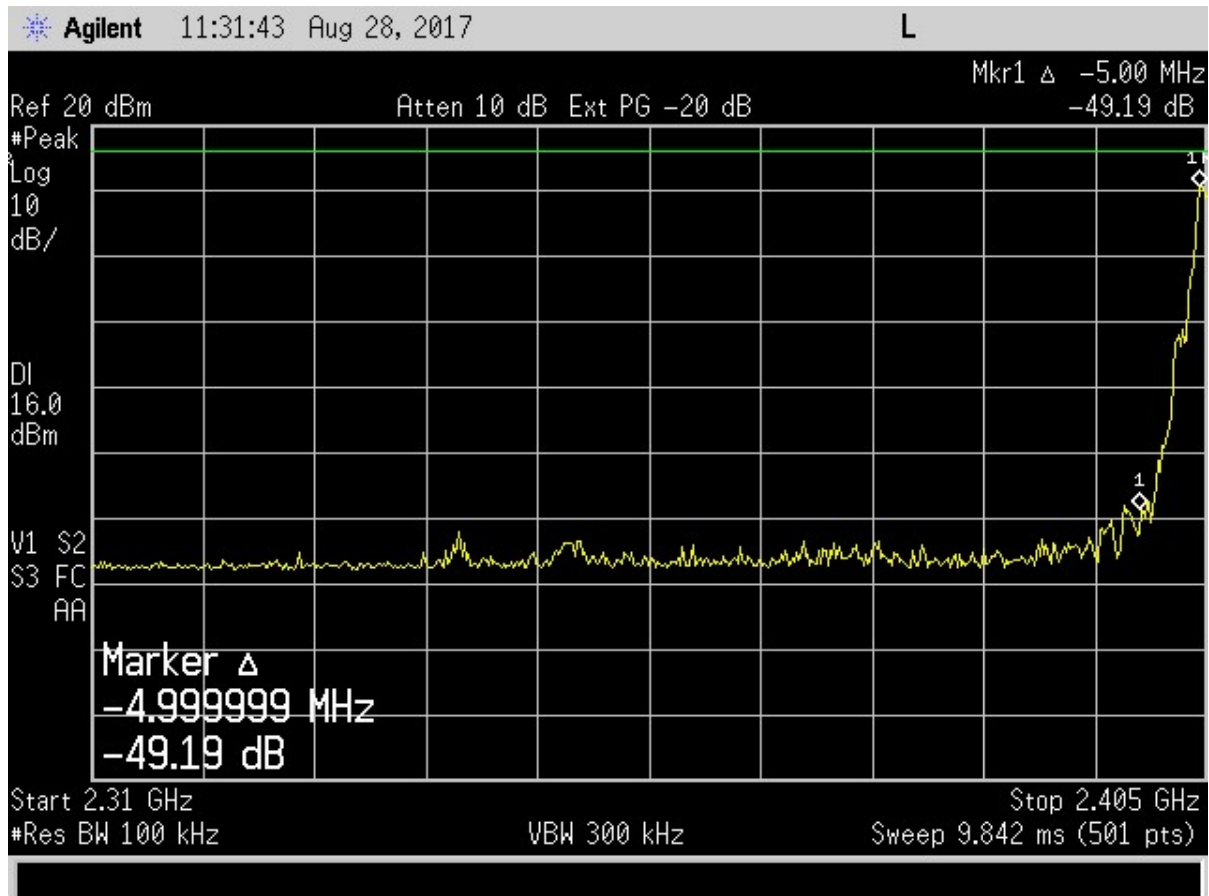


Figure 11. Band Edge Compliance, Low Channel Delta - Peak

Lower band edge must be 20 dB below the fundamental. An Average Measurement was not conducted since the peak measurement meets Average requirements.

Measured Result	49.19	dB
Band Edge Limit	20.00	dB
Band Edge Margin	29.19	dB

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

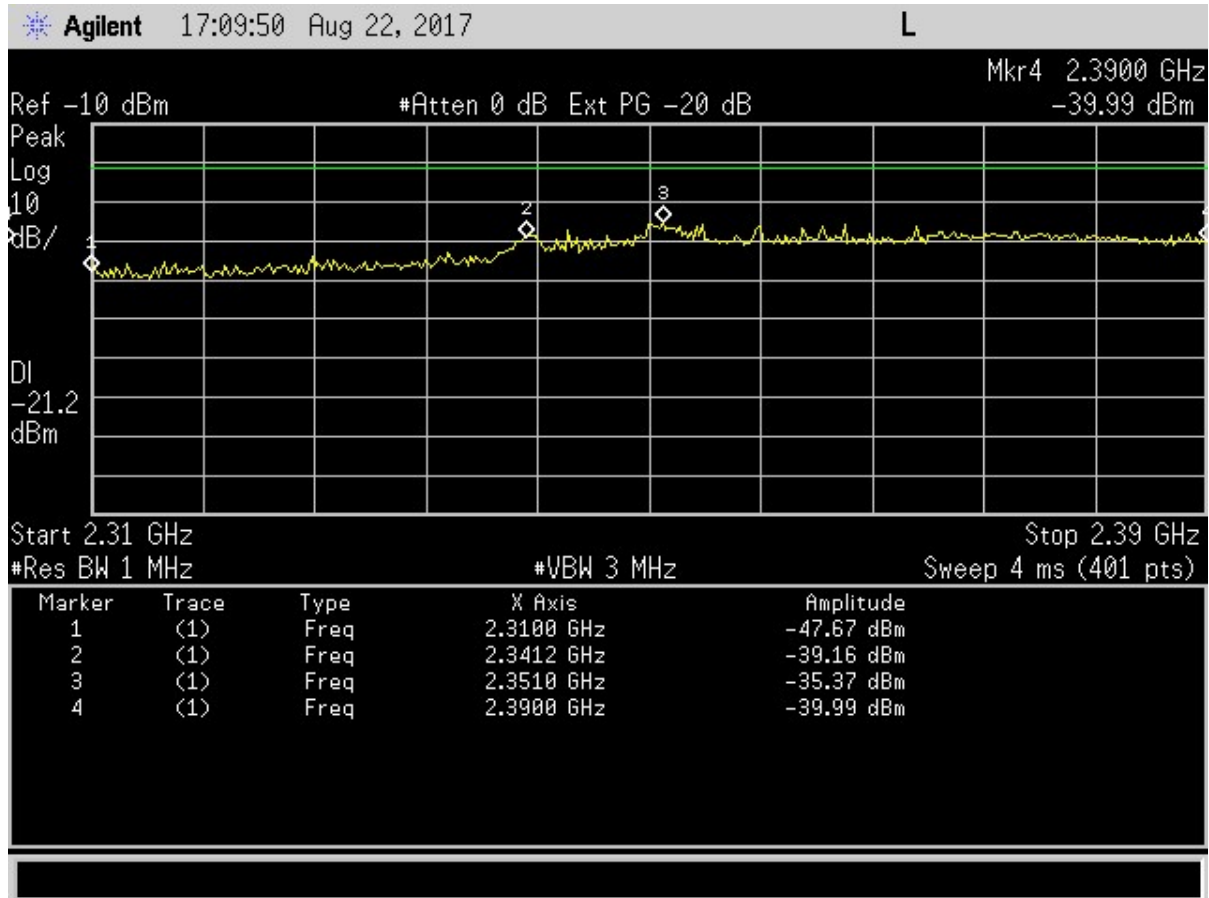


Figure 12. Conducted Restricted Band Measurements 2.31 GHz to 2.39 GHz

Calculation:

$E = \text{EIRP} - 20 \log(d) + 104.8$, where d is 3 meters

Limit PK = 74.0 dBuV/m

Frequency (MHz)	Test Data (dBm)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2310.00	-47.67	47.59	74.0	26.41
2341.20	-39.16	56.10	74.0	17.90
2351.00	-35.37	59.89	74.0	14.11
2390.00	-39.99	55.27	74.0	18.73

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

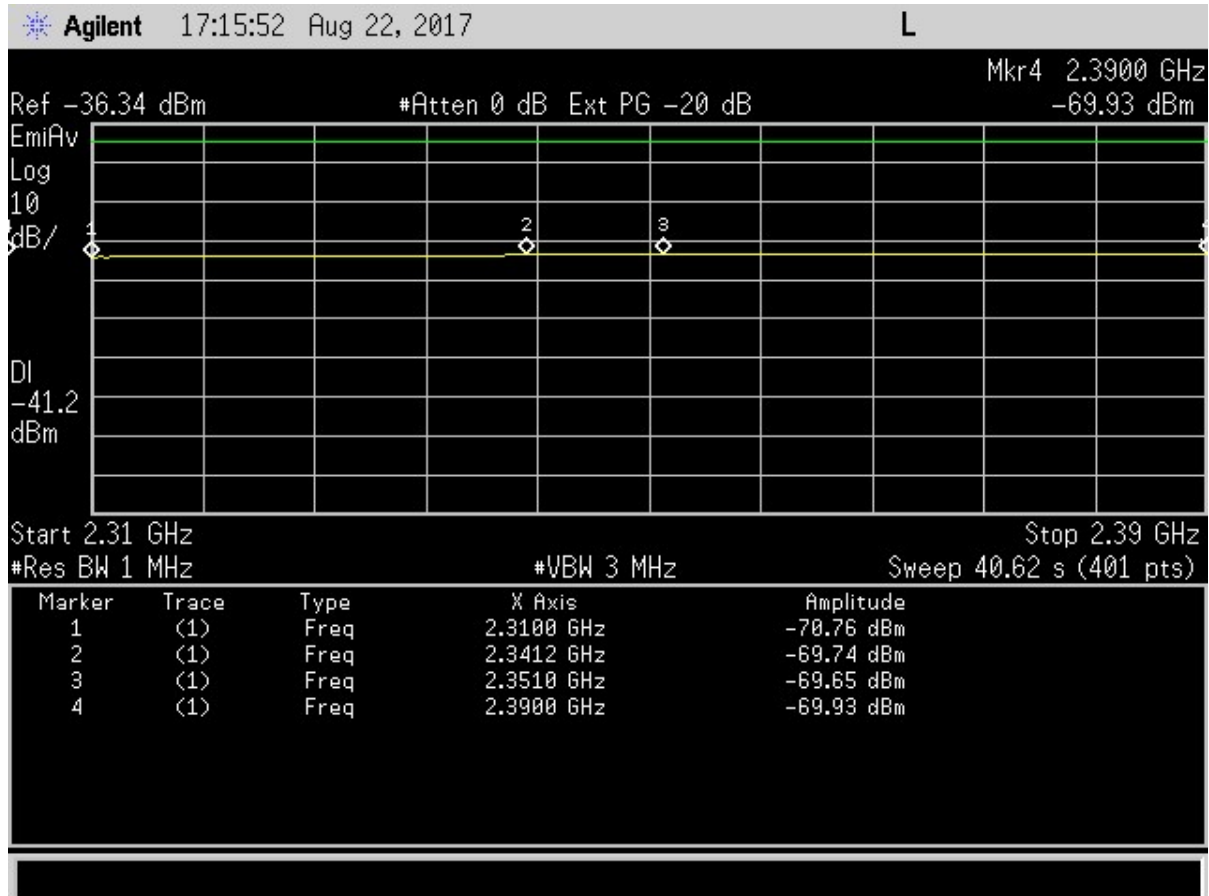


Figure 13. Radiated Restricted Band Measurements AVG, 2.31 GHz to 2.39 GHz

Calculation:

$E = \text{EIRP} - 20 \log(d) + 104.8$, where d is 3 meters

Limit PK = 54.0 dBuV/m

Frequency (MHz)	Test Data (dBm)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2310.00	-70.76	24.50	54.0	29.50
2341.20	-69.74	25.52	54.0	28.48
2351.00	-69.65	25.61	54.0	28.39
2390.00	-69.93	25.33	54.0	28.67

US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

FCC Part 15 Certification/ RSS 247
 2ANDP-WCITK
 23069-WCITK
 17-0329
 November 2, 2017
 Centro LLC
 WCI TK FDAP

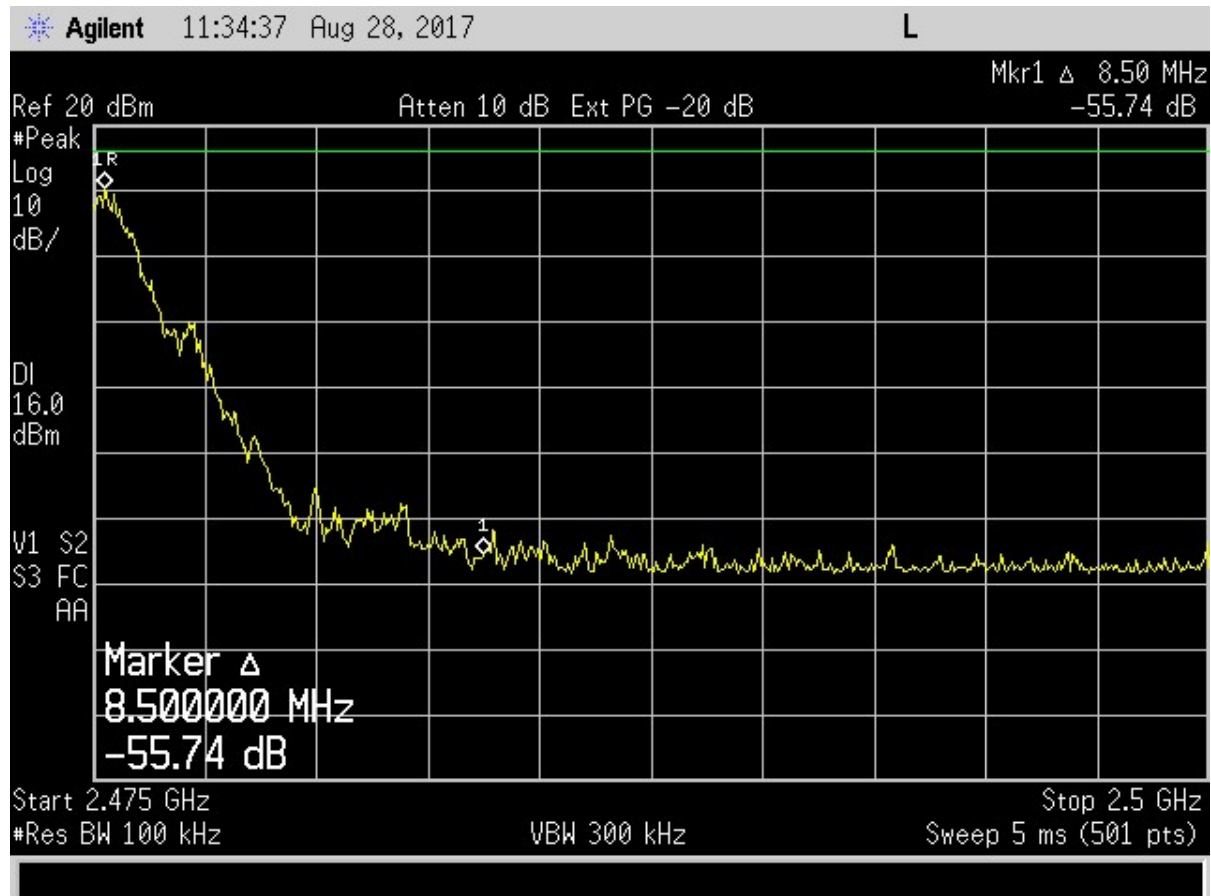


Figure 14. Band Edge Compliance, High Channel Delta – Peak

Lower band edge must be 20 dB below the fundamental. An Average Measurement was not conducted since the peak measurement meets Average requirements.

Measured Result	55.74	dB
Band Edge Limit	20.00	dB
Band Edge Margin	35.74	dB

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDP

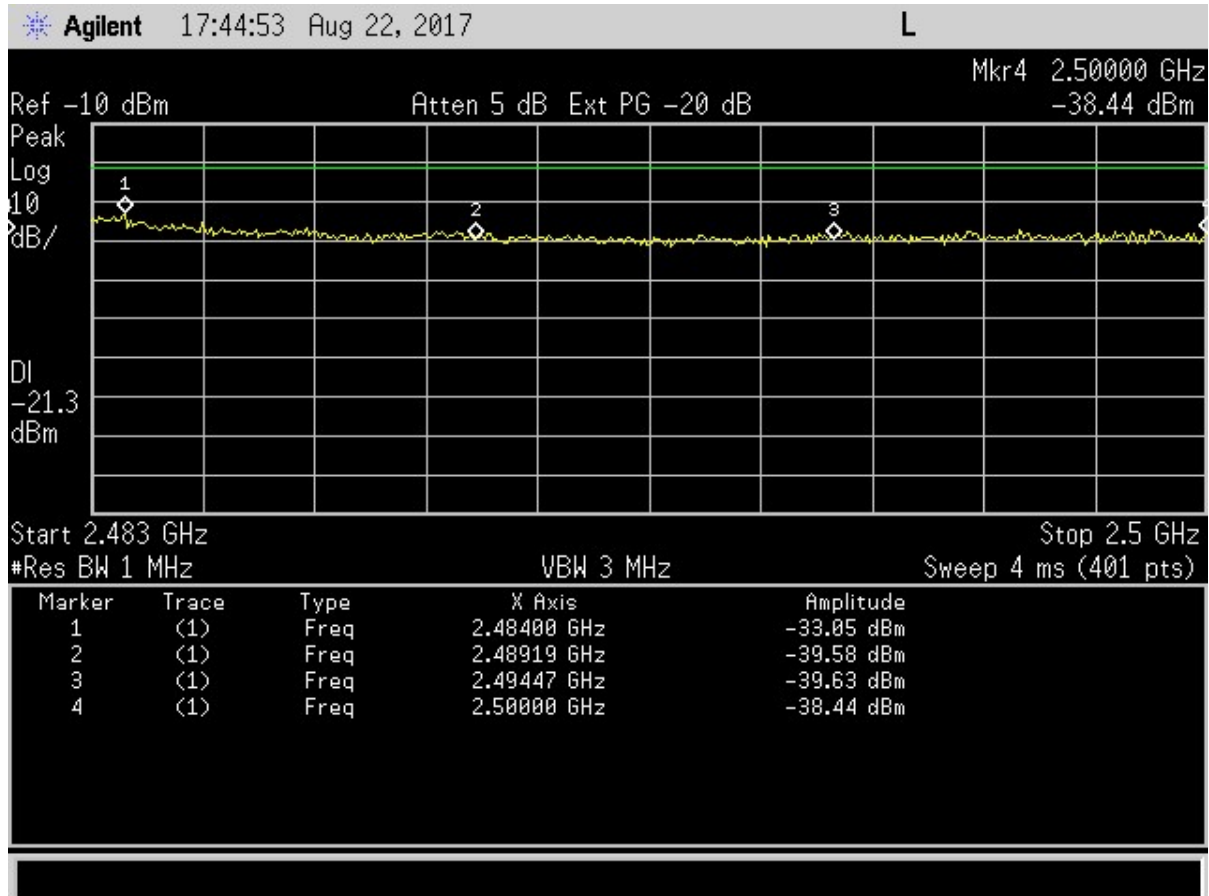


Figure 15. Conducted Restricted Band Measurements PK, 2.4835 GHz to 2.5 GHz

Calculation:

$E = \text{EIRP} - 20 \log(d) + 104.8$, where d is 3 meters

Limit PK = 74.0 dBuV/m

Frequency (MHz)	Test Data (dBm)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2484.00	-33.05	62.21	74.0	11.79
2489.19	-39.58	55.68	74.0	18.32
2494.47	-39.63	55.63	74.0	18.37
2500.00	-38.44	56.82	74.0	17.18

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

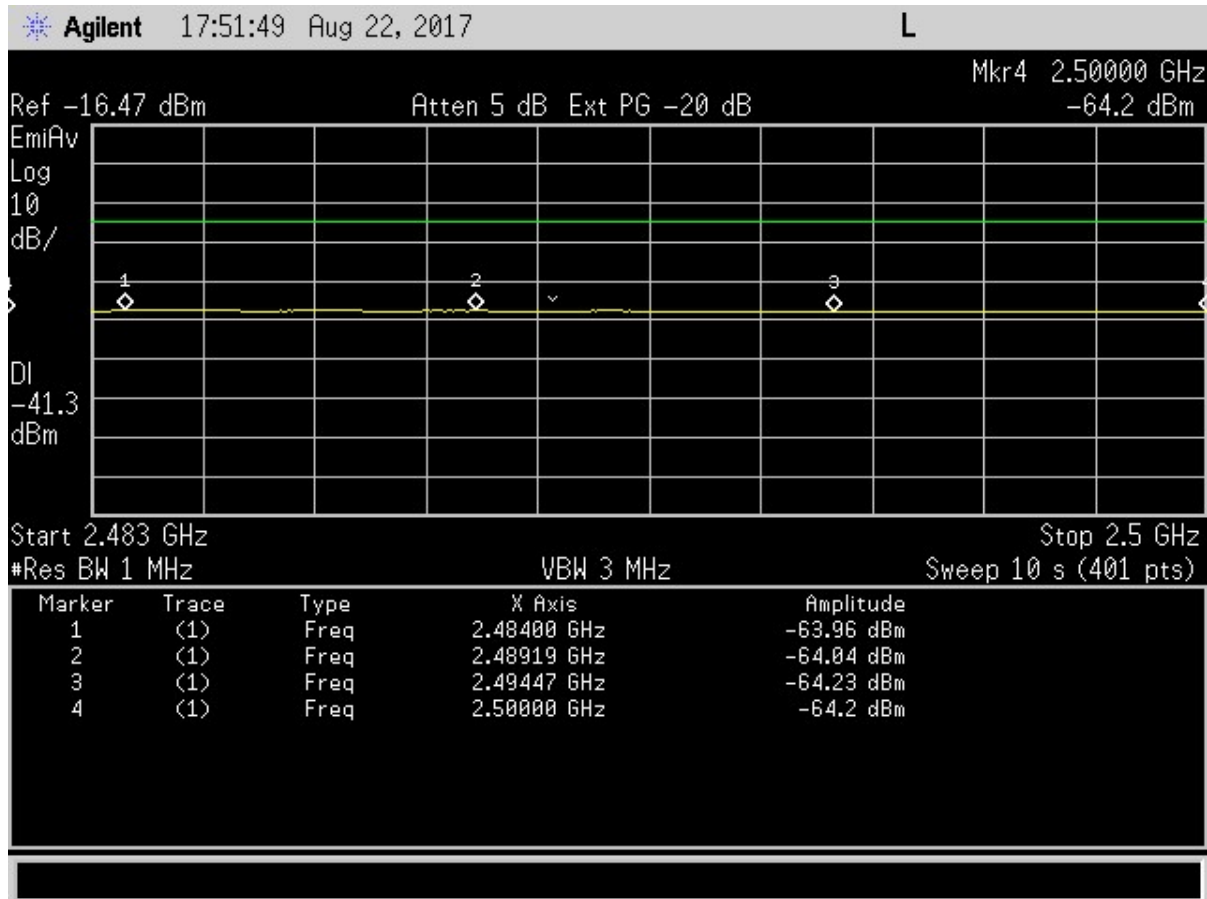


Figure 16. Conducted Restricted Measurements AVG, 2.4835 GHz to 2.5 GHz

Calculation:

$E = \text{EIRP} - 20 \log(d) + 104.8$, where d is 3 meters

Limit PK = 54.0 dBuV/m

Frequency (MHz)	Test Data (dBm)	Corrected Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2484.00	-63.96	31.30	54.0	22.70
2489.19	-64.04	31.22	54.0	22.78
2494.47	-64.23	31.03	54.0	22.97
2500.00	-64.20	31.06	54.0	22.94

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

2.11 Six (6) dB Bandwidth per CFR 15.247(a)(2) and RSS Gen 6.6 (99%) Bandwidth

The EUT antenna port was connected to a spectrum analyzer having a 50Ω input impedance. Measurements were performed following the guidelines of ANSI C63.10:2013.

Table 7. 6 dB Bandwidth and 99% Occupied Bandwidth

Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum FCC Bandwidth (MHz)
2405.00	1.579	0.5
2440.00	1.675	0.5
2475.00	1.580	0.5

Table 8. 99% Occupied Bandwidth

Frequency (MHz)	99% Occupied Bandwidth (MHz)	Comments
2405	3.6645	--
2440	3.2236	--
2475	3.3691	--

Test Date: August 19 & 21, 2017

Tested By

Signature: 

Name: Robert K. Mills

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

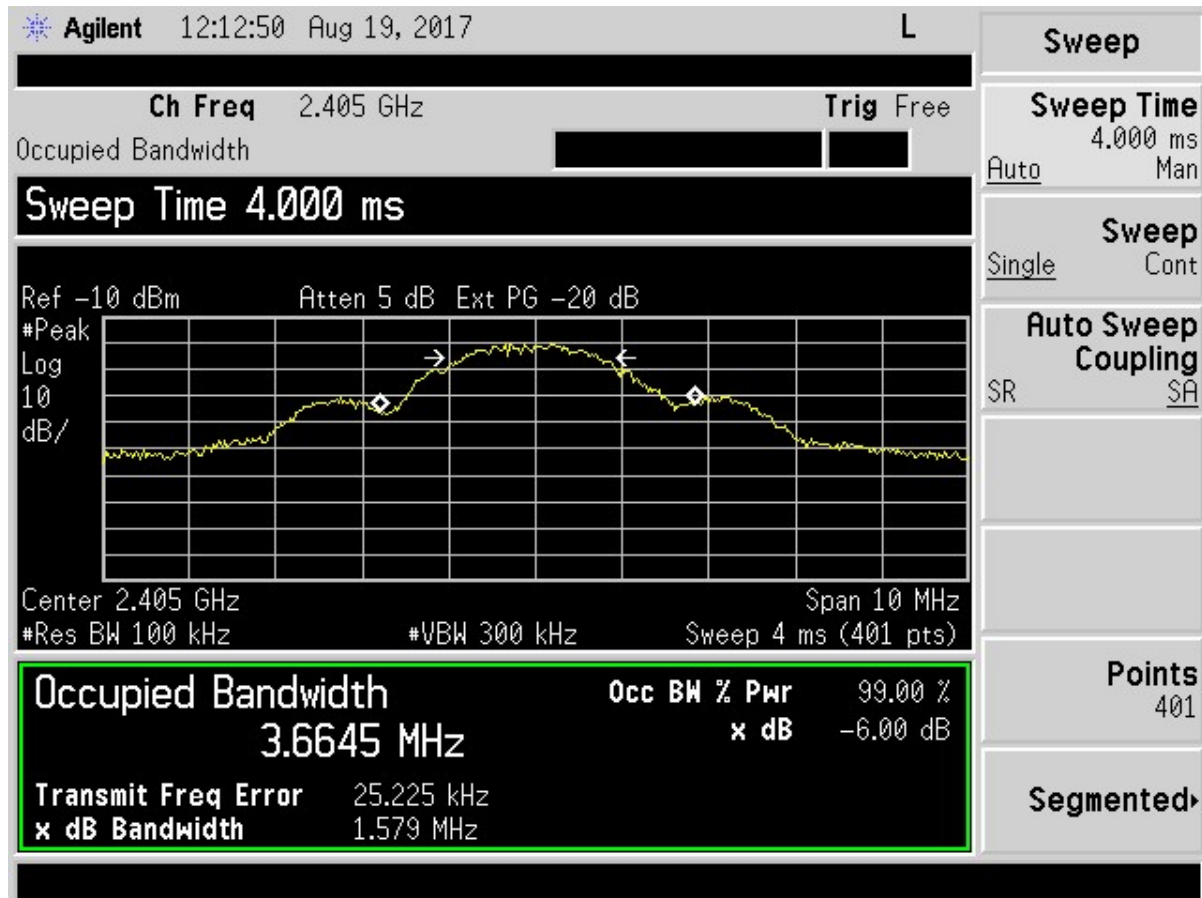


Figure 17. Six (6) dB Bandwidth– Low Channel

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

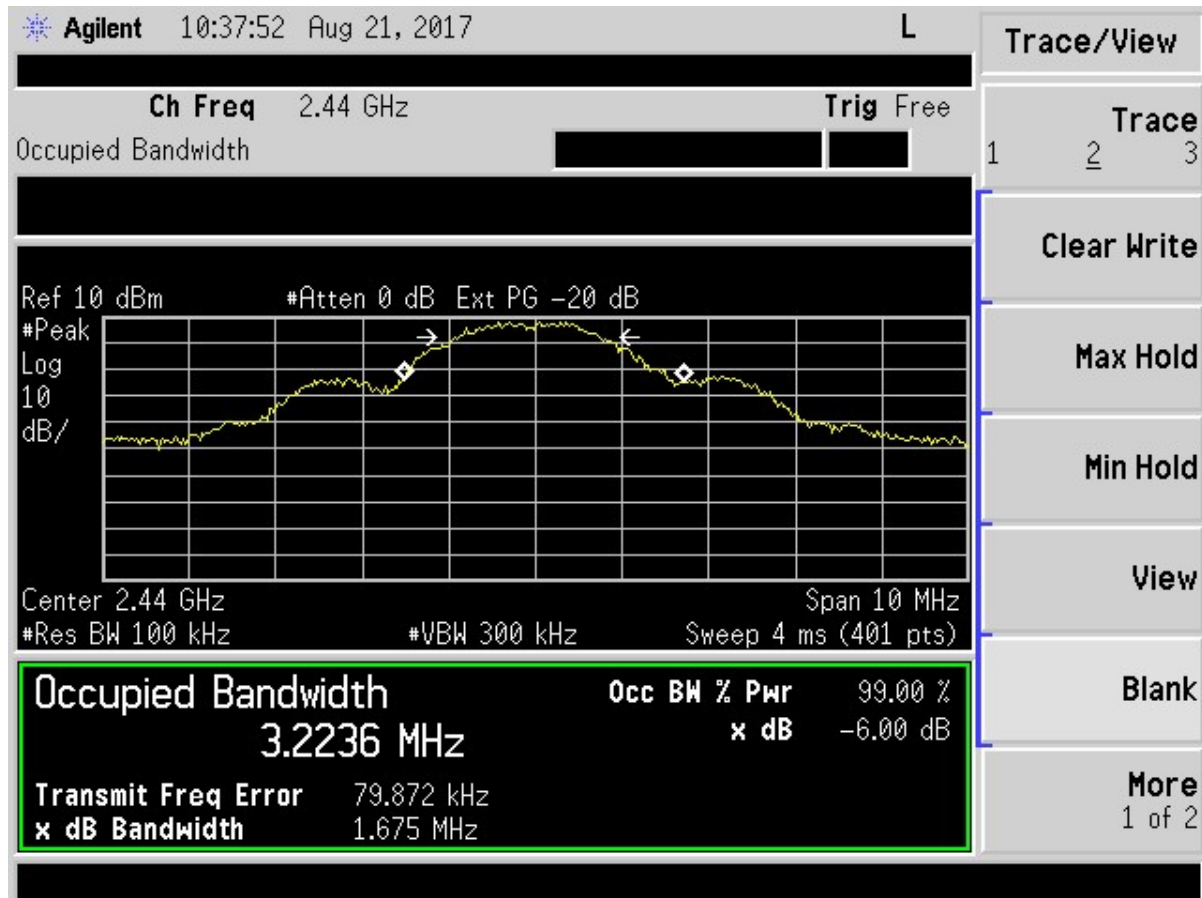


Figure 18. Six (6) dB Bandwidth – Mid Channel

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDP

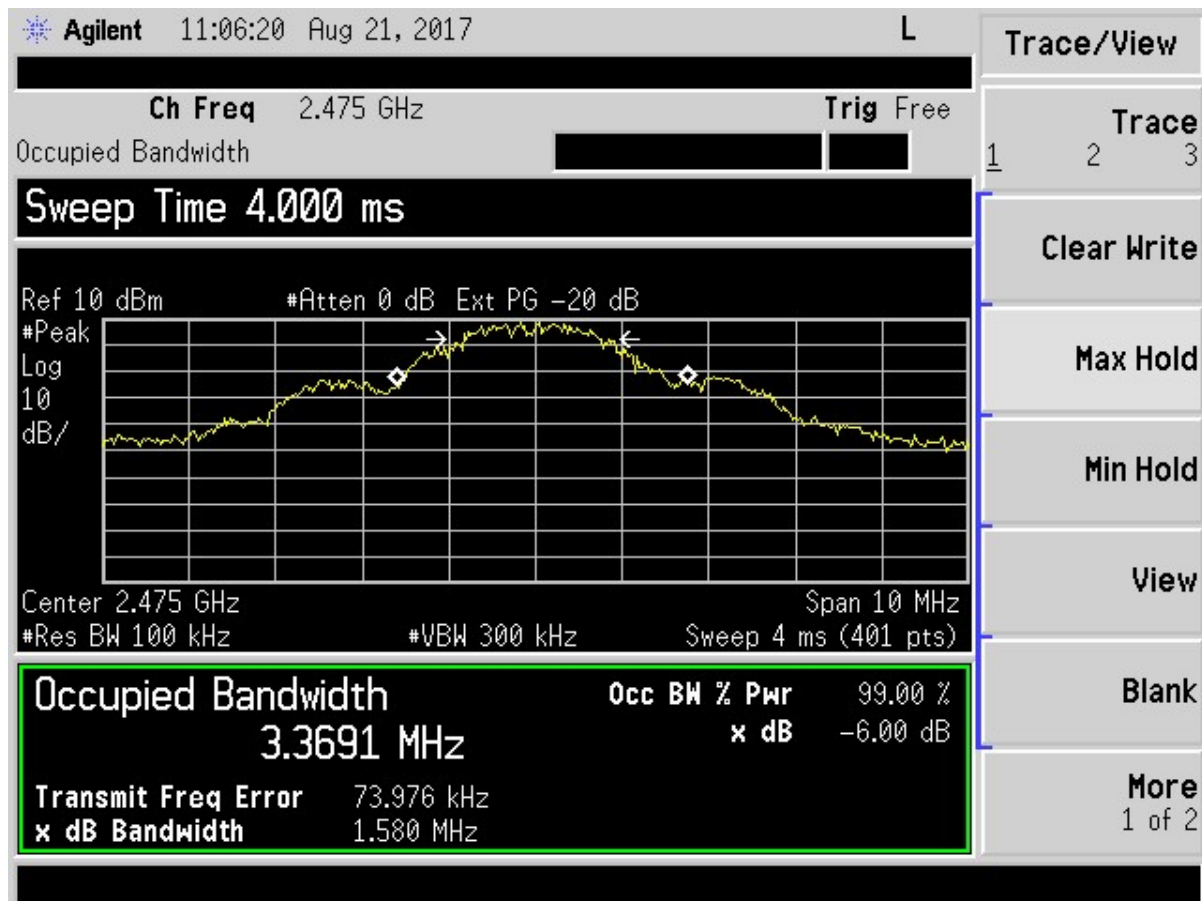


Figure 19. Six (6) dB Bandwidth – High Channel

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

2.12 Maximum Peak Conducted Output Power (CFR 15.247 (b) (3))

Peak power within the band 2400 MHz to 2483.5 MHz was measured per FCC KDB Publication 558074 v04 and ANSI C63.10:2013 as an Antenna Conducted test with a spectrum analyzer by connecting the spectrum analyzer directly, via a short RF cable, and attenuators to the antenna output terminals on the EUT. The spectrum analyzer was set for an impedance of 50 Ω with the RBW set greater than the 6 dB bandwidth of the EUT, and the VBW \geq RBW. Peak antenna conducted output power is tabulated in the table below.

Table 9. Peak Antenna Conducted Output Power per Part 15.247 (b) (3)

Frequency of Fundamental (MHz)	Measured Data dBm	Converted Data (mW)	FCC Limit (mW Maximum)
2405.00	14.74	29.51	1000
2440.00	14.80	30.20	1000
2475.00	15.20	33.11	1000

Test Date: August 22, 2017

Tested By

Signature: 

Name: Robert K. Mills

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP



Figure 20. Peak Antenna Conducted Output Power, Low Channel

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

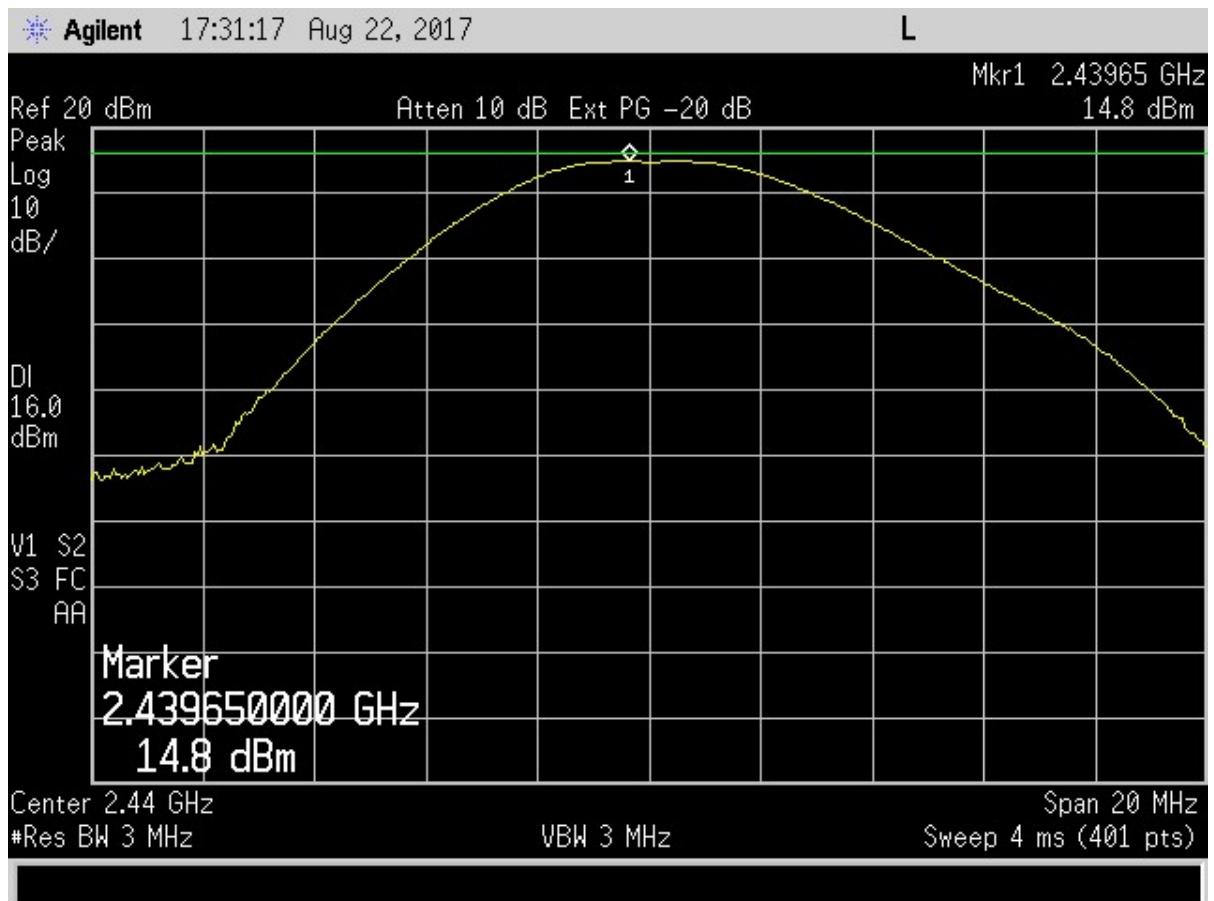


Figure 21. Peak Antenna Conducted Output Power, Mid Channel

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

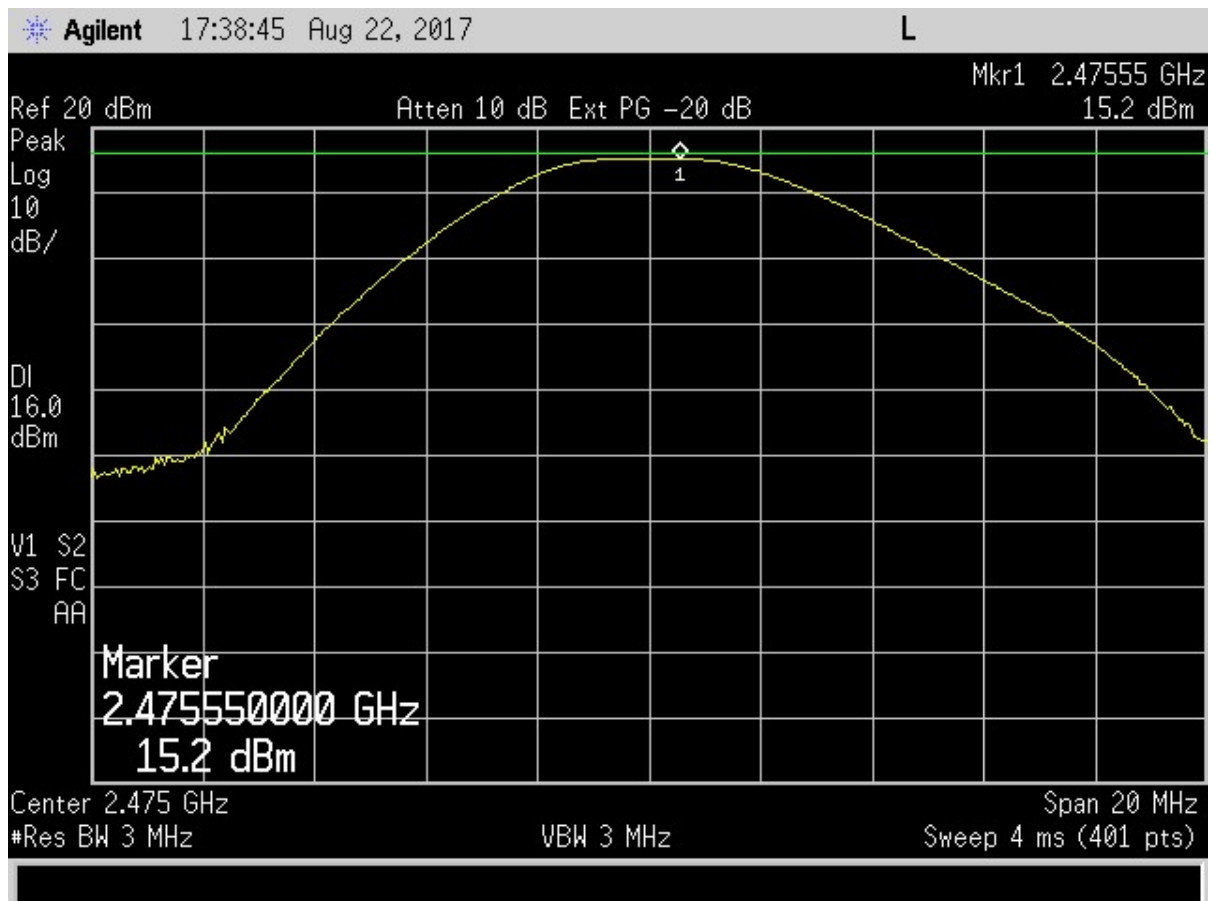


Figure 22. Peak Antenna Conducted Output Power, High Channel

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

2.13 Power Spectral Density (CFR 15.247(e))

The transmitter was placed into a continuous mode of operation at all applicable frequencies. The measurements were performed per the procedures of FCC KDB Procedure 558074 v04 and ANSI C63.10:2013. The RBW was set to 3 kHz and the Video Bandwidth was set to \geq RBW. The trace capture time was set to (Span/3 kHz).

In accordance with 15.247 (e), the power spectral density shall be no greater than +8 dBm per any 3 kHz band.

Results are shown in the table below and figures below. All are less than +8 dBm per 3 kHz band.

Table 10. Power Spectral Density for Low, Mid and High Bands

Frequency (MHz)	Results (dBm/3 kHz)	FCC Limit (dBm/3 kHz)
2405.00	6.84	8.0
2440.00	6.65	8.0
2475.00	7.43	8.0

Test Date: August 22, 2017

Tested By

Signature: 

Name: Robert K. Mills

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDP



Figure 23. Peak Power Spectral Density - Part 15.247 (e) - Low Channel

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP



Figure 24. Power Spectral Density - Part 15.247 (e) - Mid Channel

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP



Figure 25. Peak Power Spectral Density - Part 15.247 (e) - High Channel

2.14 Unintentional Radiator and Intentional Radiator Power Lines Conducted Emissions (CFR 15.107, 15.207)

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

The test data provided in this section is to support the Verification requirement for the digital apparatus. The power line conducted voltage measurements for Receiver and Digital Devices have been carried out in accordance with CFR 15.107 and ANSI C63.4:2014, Paragraph 7, with a spectrum analyzer connected to an LISN and the EUT placed into an idle condition or a continuous mode of receive (non-transmitting).

Additionally the power line conducted voltage emission measurements have been carried out in accordance with CFR 15.207, per ANSI C63.10:2013, Clause 6.2, with a spectrum analyzer connected to an LISN and the EUT placed into a continuous mode of transmission.

The worst-case results for conducted emissions were determined to be produced when the EUT was operating under continuous transmission. The worst case measurement was 1.3 dB from the applicable limit at 0.4108 MHz on the Phase line. All other emissions were at least 3.1 dB from the limit. Those results are given in the table below.

US Tech Test Report:
 FCC ID:
 IC:
 Test Report Number:
 Issue Date:
 Customer:
 Model:

FCC Part 15 Certification/ RSS 247
 2ANDP-WCITK
 23069-WCITK
 17-0329
 November 2, 2017
 Centero LLC
 WCI TK FDAP

Table 11. Transmitter Power Line Conducted Emissions Test Data, Part 15.107/15.207

150KHz to 30 MHz						
Test: Power Line Conducted Emissions				Client: Centero LLC		
Project: 17-0329				Model: WCI TK FDAP		
Frequency (MHz)	Test Data (dBuV)	LISN+CL-PA (dB)	Results (dBuV)	AVG Limits (dBuV)	Margin (dB)	Detector PK, QP, or AVG
120VAC/60 Hz Phase						
0.4108	46.15	0.17	46.32	47.6	1.3	QP
0.5000	39.59	0.15	39.74	46.0	6.3	PK
1.5200	31.35	0.15	31.50	46.0	14.5	QP
5.0417	29.14	0.24	29.38	50.0	20.6	QP
10.3167	23.00	0.41	23.41	50.0	26.6	QP
24.0333	32.15	0.73	32.88	50.0	17.1	PK
120VAC/60 Hz Neutral						
0.4248	43.94	0.31	44.25	47.4	3.1	QP
0.5508	36.90	0.29	37.19	46.0	8.8	PK
3.7733	30.24	0.36	30.60	46.0	15.4	QP
5.0417	29.97	0.39	30.36	50.0	19.6	QP
11.4667	32.57	0.58	33.15	50.0	16.9	PK
27.0000	27.62	0.95	28.57	50.0	21.4	PK

SAMPLE CALCULATION at: 0.41 MHz

Magnitude of Measured Frequency	46.15	dBuV
+LISN + Cable Loss+ Amplifier Gain	0.17	dB/m
Corrected Result	46.32	dBuV/m

Test Date: September 8, 2017

Tested By

Signature:  Name: Robert K. Mills

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

2.15 Unintentional Radiator and Intentional Radiator, Radiated Emissions (CFR 15.109 and 15.209)

The test data provided herein is to support the verification requirement for digital devices. Radiated emissions coming from the EUT in a non-transmit state per 15.109 were evaluated from 30 MHz to 12.5 GHz as well as radiated emissions coming for the EUT in a transmitting state per 15.209 and were investigated from 9 kHz or the lowest operating clock frequency to 25 GHz and tested as detailed in ANSI C63.10:2013, Clause 6.4-6.6. Data is presented in the table below. The data presented is with the EUT and all transmitters ON and transmitting. This is intended to satisfy the requirements for co-location transmitter testing.

Radiated emissions within the band of 9 kHz to 30 MHz were investigated using a calibrated Loop Antenna and per the requirements of ANSI C63.10:2013.

Measurements were made with the analyzer's resolution bandwidth set to 120 kHz for measurements made below 1 GHz and 1 MHz for measurements made above 1 GHz. The video bandwidth was set to three times the resolution bandwidth; 1 MHz RBW and 3 MHz VBW. The test data were maximized for magnitude by rotating the turn-table through 360 degrees and raising and lowering the receiving antenna between 1 to 4 meters in height as a part of the measurement procedure.

The worst-case radiated emission was 10.3 dB below the specification limit at 137.30 MHz. All other measured signals were at least 11.0 dB below the specification limit. The results are shown in the table below. These results are meant to show that this EUT's digital device portion has met the verification requirements for an unintentional radiator under CFR Part 15.109 as well as the intentional transmitter requirements of CFR Part 15.209.

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

Table 12. Spurious Radiated Emissions 150 kHz-30MHz (CFR 15.209)

Test By: RKM	Test: FCC Part 15.209			Client: Centero LLC			
	Project: 17-0329			Model: WCI TK FDAP			
Frequency (MHz)	Test Data (dBuV)	AF+CL-PA (dB)	Results (dBuV/m)	Limits (dBuV/m)	Distance / Polarization	Margin (dB)	DETECTOR PK / QP/AVG
All emissions were at least 20 dB from the applicable limit.							

SAMPLE CALCULATION: N/A

Test Date: August 22, 2017

Tested By

Signature:



Name: Robert K. Mills

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

Table 13. Unintentional Radiator, Peak Radiated Emissions (CFR 15.109/15.209), 30 MHz to 1000 MHz

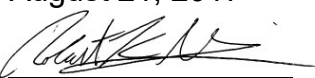
30 MHz to 1000 MHz								
Test: Radiated Emissions				Client: Centero LLC				
Project: 17-0329				Model: WCI TK FDAP				
Frequency (MHz)	Test Data (dBuV)	Additional Factor (dB)	AF+CA -AMP (dB/m)	Results (dBuV/m)	QP Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector PK, or QP
72.92	45.68	--	-18.23	27.45	40.0	3m./VERT	12.6	PK
111.00	47.85	--	-15.39	32.46	43.5	3m./VERT	11.0	PK
137.30	47.12	--	-13.87	33.25	43.5	3m./HORZ	10.3	PK
200.00	43.55	--	-14.95	28.60	43.5	3m./VERT	14.9	PK
200.04	45.12	--	-13.75	31.37	43.5	3m./HORZ	12.1	PK
257.90	48.08	--	-13.26	34.82	46.0	3m./HORZ	11.2	PK
610.00	39.24	--	-4.93	34.31	46.0	3m./HORZ	11.7	PK
610.00	39.73	--	-5.33	34.40	46.0	3m./VERT	11.6	PK

SAMPLE CALCULATION at: 72.92 MHz

Magnitude of Measured Frequency	45.68	dBuV
+Additional Factor (Distance Extrapolation)	0.0	dB
+Antenna Factor + Cable Loss+ Amplifier Gain – Duty Cycle	-18.23	dB/m
Corrected Result	27.45	dBuV/m

Test Date: August 21, 2017

Tested By

Signature:  Name: Robert K. Mills

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

Table 14. Unintentional Radiator, Peak Radiated Emissions (CFR 15.109/15.209) 1 GHz to 25 GHz

1 GHz to 25 GHz, Part 15.109/15.209 Limits							
Test: Radiated Emissions				Client: Centero LLC			
Project: 17-0329				Model: WCI TK FDAP			
Frequency (MHz)	Test Data (dBuv)	AF+CA-AMP (dB/m)	Results (dBuV/m)	AVG Limits (dBuV/m)	Antenna Distance/ Polarization	Margin (dB)	Detector PK, or AVG
Besides the emission reported in the sections above, all other emissions were at least 20 dB from the applicable limit.							

SAMPLE CALCULATION at: N/A

Test Date: August 22, 2017

Tested By

Signature:  Name: Robert K. Mills

US Tech Test Report:
FCC ID:
IC:
Test Report Number:
Issue Date:
Customer:
Model:

FCC Part 15 Certification/ RSS 247
2ANDP-WCITK
23069-WCITK
17-0329
November 2, 2017
Centero LLC
WCI TK FDAP

2.16 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%.

2.16.1 Conducted Emissions Measurement Uncertainty

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

2.16.2 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 ± 5.21 dB.

3 Conclusions

The data listed in this test report does not have sufficient margin to negate the effects of uncertainty, therefore the EUT conditionally meets and passes the requirements of the applicable standard when tested as presented in this test report.