

# Emissions Test Report

EUT Name:Qolsys Zigbee Radio CardModel No.:QS-ZBCFR 47 Part 15.247: 2018 and RSS 247: 2017

Prepared for:

Qolsys Inc. 1900 The Alameda San Jose, CA 95126 U.S.A

Prepared by:

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Report/Issue Date:	May 31, 2019
Job #	234106671
Report Number:	31952400.001

# Revisions

Revision No.	Date	Reason for Change	Author
0	May 31, 2019	Original Document	BMJ

Note: Latest revision report will replace all previous reports.

# **Statement of Compliance**

Manufacturer:	Qolsys Inc.
	1900 The Alameda
	San Jose, CA 95126
Requester / Applicant:	Qolsys Inc.
Name of Equipment:	Qolsys Zigbee Radio Card
Model No.	QS-ZB
Type of Equipment:	Intentional Radiator
Application of Regulations:	CFR 47 Part 15.247: 2018 and RSS 247: 2017
Test Dates:	21st May, 2019 to May 30th 2019

Guidance Documents:

Emissions: ANSI C63.10-2013 CFR47 part 15.247:2018 and RSS247: 2017

Test Methods:

Emissions: ANSI C63.10-2013

The electromagnetic compatibility test and documented data described in this report has been performed and recorded by TUV Rheinland, in accordance with the standards and procedures listed herein. As the responsible authorized agent of the EMC laboratory, I hereby declare that the equipment described above has been shown to be compliant with the EMC requirements of the stated regulations and standards based on these results. If any special accessories and/or modifications were required for compliance, they are listed in the Executive Summary of this report.

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# **1** Executive Summary

# 1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR 47 Part 15.247: 2018 and RSS 247: 2017 based on the results of testing performed on 21st May, 2019 to May 30th 2019 on the Qolsys Zigbee Radio Card Model QS-ZB manufactured by Qolsys Inc.. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

# 1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report. The 2400 MHz to 2483.5 MHz frequency band is covered in this document.

# 1.3 Summary of Test Results

Table 1: Summary of Test Results

Test	Test Method ANSI C63.4	Worse Case (Measured)	Result
AC Power Conducted Emission	CFR47 15.207, RSS-GEN Sect.8.8	N/A – EUT is battery operated	N/A
DTS Bandwidth (6dB)	CFR47 15.247 (a)(2), RSS 247 Sect. 5.2(a)	1.7 MHz	Complied
Maximum Output Power	CFR47 15.247 (b), RSS 247 Sect. 5.4 (d)	11.0 dBm (peak)	Complied
Peak Power Spectral Density	CFR47 15.247 (e), RSS 247 Sect. 5.2	-4.35 dBm/3KHz	Complied
Out of Band Emissions	CFR47 15.247 (d), RSS 247 Sect.5.5	31 dB margin @ 2483.5 MHz	Complied
Transmit Radiated Spurious Emissions	CFR47 15.247 (d), RSS 247 Sect.5.5	44.8 dB @ 4819.3 MHz (Average)	Complied

# 1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

# 1.5 Equipment Modifications

None

#### 2 Laboratory Information

#### 2.1 Accreditations & Endorsements

#### 2.1.1 **US Federal Communications Commission**



TUV Rheinland of North America at 1279 Quarry Ln, Pleasanton, CA 94566 is recognized by the commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (US1131). The laboratory scope of accreditation includes: Title 47 CFR Parts 15, 18, and 90. The accreditation is updated every 3 years.

# 2.1.2 NIST / A2LA



TUV Rheinland of North America EMC test facilities are accredited by the American Association for Laboratory Accreditation (A2LA). The laboratories have been assessed and accredited by A2LA in accordance with ISO Standard 17025:2005 (Testing Certificate #3331.02). The Scope of Laboratory Accreditation includes emission and immunity

testing. The accreditations are updated annually.

#### Canada – Industry Canada 1.1.1



The Pleasanton 5-meter Semi-Anechoic Chamber, Registration No. 2932M-1, has been accepted by Industry Canada to perform testing to 3

and 5 meters based on the test procedures described in ANSI C63.4-2014. The Fremont 10-meter Semi-Anechoic Chamber, Registration No. 2932D-1, has been accepted by Industry Canada to perform testing to 3 and 10 meters based on the test procedures described in ANSI C63.4-2014.

#### 2.1.3 Acceptance by Mutual Recognition Arrangement



The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at 1279

Quarry Ln, Pleasanton, CA 94566 test results and test reports within the scope of the laboratory NIST / A2LA accreditation will be accepted by each member country.

# 2.2 Test Facilities

All of the test facilities are located at 1279 Quarry Lane, Pleasanton, California 94566, USA.

#### 2.2.1 Emission Test Facility

The Semi-Anechoic chamber and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 and 5 meters. The site is listed with the FCC and accredited by A2LA (Lab Code Testing Cert #3331.02). The 3/5-meter semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 meter semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 meter and 5 meters. A report detailing this site can be obtained from TUV Rheinland of North America.

#### 2.2.2 EMC Software - Pleasanton

Manufacturer	Name	Version	Test Type
Rohde & Schwarz	EMS32	10.40.10	Radiated Emissions
EMISoft	Vasona	5.0	Radiated Emissions

#### 2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1<sup>st</sup> Edition, 1995.

*The Combined Standard Uncertainty* is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities; it is equal to the positive square root of the sum of the variances or co-variances of these other quantities, weighted according to how the measurement result varies with changes in these quantities. The term *standard uncertainty* is the result of a measurement expressed as a standard deviation.

#### 2.3.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength  $(dB\mu V/m) = RAW - AMP + CBL + ACF$ 

Where:  $RAW = Measured level before correction (dB\mu V)$ 

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor-Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

25 dBuV/m + 17.5 dB - 20 dB + 1.0 dB = 23.5 dBuV/m

#### 2.3.2 Measurement Uncertainty

Per CISPR 16-4-2	Ulab	Ucispr
Radiated Disturbance @ 1	0 meters	
30 – 1,000 MHz	2.25 dB	4.51 dB
Radiated Disturbance @ 3	8 meters	
30 – 1,000 MHz	2.26 dB	4.52 dB
1 – 6 GHz	2.12 dB	4.25 dB
6 – 18 GHz	2.47 dB	4.93 dB
Conducted Disturbance @	Mains Terminals	
150 kHz – 30 MHz	1.09 dB	2.18 dB

Disturbance Power		
30 MHz – 300 MHz	3.92 dB	4.3 dB

#### **Measurement Uncertainty – Radio Testing**

The estimated combined standard uncertainty for frequency error measurements is $\pm$ 3.88 Hz
The estimated combined standard uncertainty for carrier power measurements is $\pm 0.7$ dB.
The estimated combined standard uncertainty for adjacent channel power measurements is $\pm$ 1.47 dB.
The estimated combined standard uncertainty for modulation frequency response measurements is $\pm 0.46$ dB.
The estimated combined standard uncertainty for transmitter conducted emission measurements is $\pm 2.06 \text{ dB}$

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

# 2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005. Equipment calibration records are kept on file at the test facility.

# **3** Product Information

# 3.1 Product Description

The Qolsys Zigbee Radio Card Model QS-ZB manufactured by Qolsys Inc. is a IEEE 802.15.4 ZigBee module. The module is intended to work within the 2.4GHz frequency band and utilizes a single antenna transceiver chain.

# 3.2 Equipment Configuration

A description of the equipment configuration is given in the Test Plan Section (Section 6). The EUT was tested as called for in the test standard and was configured and operated in a manner consistent with its intended use. The EUT was connected to rated power and allowed to reach intended operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of an EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce the worst case radiation for emissions testing.

# 3.3 Operating Mode

A description of the operation mode is given in the Test Plan Section (Section 6).

The final operating mode was selected to produce the worst case radiation for emissions testing.

# 3.4 Unique Antenna Connector

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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of CFR47 Parts 15.211, 15.213, 15.217, 15.219, or 15.221.

#### 3.4.1 Results

The Qolsys Zigbee Radio Card employs a single embedded chip antenna. An additional test sample with a temporary u.fl connector was supplied for the purpose of conducted testing

The antenna is utilized by the applicant as representative implementation for the certification of the module. The antenna is declared is inaccessible for the end user for later internal module integrations.

The antenna has a declared maximum gain of 1 dBi.

# 4 **Emissions**

Testing was performed in accordance with CFR 47 Part 15.247. These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Procedures described in section 8 of the standard were used.

# 4.1 Output Power Requirements

The maximum output power requirement is the maximum equivalent isotropic radiated power delivering at the transmitting antenna under specified conditions of measurements in the presence of modulation.

The maximum output power and harmonics shall not exceed CFR47 Part 15.247 (b)

*The maximum transmitted powers are:* 

Band 2400-2483.5 MHz: 1 W

# 4.1.1 Test Method

The ANSI C63.10-2013 Section 11.9.1.1. Conducted method was used to measure the channel power output. The preliminary investigation was not needed, as the ZigBee implementation runs only one modulation and one power setting. This test was conducted on 3 channels. The result are indicated in the following section.

Test Setup:



#### 4.1.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

<b>Table 2:</b> RF Output Power at the Antenna Port – Test Results – IEEE 802.15.4 - Zig
--

Test Condition	s: Conducted Measure	ement, Normal Temperat	ture					
Antenna Type:	Chip antenna	<b>Power Setti</b> FW default:	<b>ng:</b> Powerlevel 97; pov	wer: 104				
Max. Direction	al Gain: 1 dBi							
Signal State: M	Iodulated							
Ambient Temp.: 21° CRelative Humidity:35.8%								
	RF Output Power – IEEE 802.15.4 - ZigBee							
Voltage	Operating Channel (MHz)	Measured Peak Power [dBm]	Limit [dBm]	Margin [dB]				
	2405	11.0	30.0	19.0				
Nominal	2445	10.8	30.0	19.2				
	2480	10.8	30.0	19.2				
Note: All inser	tion loss corrections a	re accounted for in the n	neasurement plots.					

Frequency S	Sweep						⊖1Pk Ma
				M1		M1[1]	10.98 dB
dBm		-	 		 	2	40363970 0
lBm-							<u></u>
	1						
0.dBm							
J dBm							
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o ubiii							
0 dBm							
D dBm							
0 dBm							
D dBm							+
0 dBm							

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Figure 1 : Peak Output Power – IEEE 802.15.4 - ZIGBEE – 2405MHz



Figure 2 : Peak Output Power – IEEE 802.15.4 - ZIGBEE – 2445MHz

e <b>fLevel</b> 18.00 dBn tt 27 df	n Offset 0.6 3 SWT 2.0	0 dB = RBW 1 ms = VBW	3 MHz 10 MHz Mod	le Auto Sweep				
requency Sweep					M1		M1[1] 2	⊖1Pk Max 10.83 dBi .48052470 GH
dBm								
3m								
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dam								
dBm			2001 pt		1			Enop 10.0 Mil

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# 4.2 DTS Bandwidth (6dB)

The occupied bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

The minimum 6 dB bandwidth shall be at least 500 kHz.

# 4.2.1 Test Method

The conducted method was used to measure the occupied bandwidth and 6 dB bandwidth according to ANSI C63.10:2013 Section 6.9.3 and 11.8.1, respectively. The measurement was performed with modulation per CFR47 15.247(a) (2). Measurements were performed on 3 channels in each operating frequency range; 2400 MHz to 2483.5 MHz.

Test Setup:



#### 4.2.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

#### Table 3: Occupied Bandwidth – Test Results – IEEE 802.15.4 - ZigBee

Test Conditions: Conducted Measurement, Normal Temperature						
Antenna Type: whip antenna	<b>Power Setting:</b> FW default: Powerlevel 97; power: 104					
Signal State: Modulated						
Ambient Temp.: 21° C	<b>Relative Humidity:</b> 35.8%					

	Bandwidth for IEEE 802.15.4 - ZigBee									
Freq. (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Margin (MHz)							
2405	1.7	0.5	-1.2							
2445	1.7	0.5	-1.2							
2480	1.7	0.5	-1.2							



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Figure 4: 6dBc Bandwidth – IEEE 802.15.4 - ZIGBEE – 2405MHz



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MultiView HPe.WR	PSD	X PS.EF	(DB.99	(X) 0B.6c	BE_Low	BL.gh	DC	CSE	
Att 29 0	dB SWT	0.60 41.88 µs (~8.6	)dB <b>RBW</b> 10 ms) <b>■ VBW</b> 30	0 kHz 0 kHz <b>Mode</b> A	uto FFT				
1 Frequency Swee	p							M1[1] 2	01Rm Max 6.70 dBm 47948580 GHz
10 dBm			T1 ~	M1	m	T2			
0 dBm						V			
-10 dBm									
-20 dBm			/				m		
-30 dBm	$\sim$							<u> </u>	
-40 dBm	~								
-50 dBm									
-60 dBm									
-70 dBm									
CF 2.48 GHz			2001 pt	s	70	0.0 kHz/			Span 7.0 MHz
2 Marker Table Type   Ref   T M1 T1 T2	rc   1 <b>2.</b> 4	X-Value 1794858 GI 2.4791429 G		Y-Value 6.70 dBm 0.76 dBm	ndB ndB down	Function BW		Function R 6.0 <b>1.70 M</b> 1/15	esult dB Hz
12	1	2.4000451 0	16	5.07 ubm	QTACCOL		Measuring	C#1	21.05.2019

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Figure 6: 6dBc Bandwidth – IEEE 802.15.4 - ZIGBEE – 2480MHz

# 4.3 Peak Power Spectral Density

According to the CFR47 Part 15.247 (e) and RSS 247 Sect.5.2.2, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

#### 4.3.1 Test Method

The conducted method was used to measure the channel power output per ANSI C63.10-2013 Section 11.10.2. The measurement was performed with modulation per CFR47 Part 15.247 (e) and RSS 247 Sect.5.2.2.

Test Setup:



#### 4.3.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 4: Peak Power Spectral Density – Test Results – IEEE 802.15.4 - Zi
--

Test Conditions: Co	Fest Conditions:         Conducted Measurement, Normal Temperature							
Antenna Type: whip	o antenna	<b>Power Setting:</b> FW default: Powerlevel 97; power: 104						
Signal State: Modul	ated							
Ambient Temp.: 21	°C	<b>Relative Humidit</b>	<b>y:</b> 35.8%					
Peak Power Spectral Density – IEEE 802.15.4 - ZigBee								
Freq. (MHz)	Measured PSD [dBm/3kHz]	Limit [dBm/3kHz]	Margin [dB]					
2405	-4.35	8	12.35					
2445	-4.46	-4.46 8 12.46						
2480	-4.49 8 12.49							
Note: All insertion l	oss corrections are accounte	ed for in the measurement pl	lots.					



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Figure 7: Power Spectral Density – IEEE 802.15.4 - ZIGBEE – 2405 MHz



Figure 8: Power Spectral Density – IEEE 802.15.4 - ZIGBEE – 2445 MHz



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Figure 9: Power Spectral Density – IEEE 802.15.4 - ZIGBEE – 2480 MHz

# 4.4 Out of Band Emissions- Non-Restricted and Restricted Bands

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmitting mode; per requirement of CFR47 15.205, 15.209, 15.247(d).

# 4.4.1 Test Method

The conducted method and radiated method was used to measure the undesirable emission requirement for non-restricted bands. The radiated method was used to measure the undesirable emission requirement for non-restricted bands. The measurement was performed with modulation.

Duty Cycle Measurements were performed according to ANSI 63.10 Section 11.6. Measurements for emissions in nonrestricted frequency bands were performed according to ANSI 63.10-2013 sections 6.10.4 and 11.11.

The utilized test setup for radiated measurements is identical to the described setup for radiated spurious emissions.

# 4.4.2 Test Setup:



# 4.4.3 Duty Cycle

The duty cycle of the EUT while operating in each supported mode was measured. Applicable corrections have been applied to emissions measured while operating in modes with a duty cycle less than 98%. Application of the appropriate corrections are in accordance with ANSI 63.10 Section 11.

Mode	Continuous (>98%)	DC Constant?	On Time per period (ms)	Off Time per period (ms)	Period (ms)	Duty Cycle	Duty Cycle Correction Factor (dB)
ZigBee	YES	Yes	100	0	100	1	0









Zero Span	55 0D = <b>5</b> ₩1	10.2 <b>- A</b> B	11 J 1112				_	⊖1Pk Cln
) dam							M1[1]	10.70 dE
abiii								280.00 r
M1 X								
dBm								
dBm								
) dBm								
D dBm								
0 dBm								
) dBm								
D dBm								
) dBm								
n dBm								
2.48 GHz		•		100	l pts			1.0



# 4.4.4 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

# 4.4.5 Conducted Test results

**Table 5:** Out of Band Emissions including the Band-Edge – Test Results – IEEE 802.15.4 -ZigBee

Test Condition	s: Conducted Meas	urement, Nor	mal Temperature	e					
Antenna Type:	Chip antenna		Power Sett Power Setti FW default	t <b>ing:</b> ing: :: Powerlevel 9	7; power: 104	4			
Max. Direction	al Gain: 1 dBi				-				
Signal State: M	Iodulated								
Ambient Temp	<b>.::</b> 21° C		Relativ	ve Humidity:3	5.8%				
No	Non-Restricted Frequency Band Edge Emissions – IEEE 802.15.4 - ZigBee								
Operating Freq. (MHz)	Measured Freq. (MHz)	Measured (dBm)	100 kHz RBW Ref Power (dBm)	Limit (dBm)	Margin (dB)	Result			
2405	2400.0	-48.15	6.39	-13.61	-34.54	Pass			
2480	2483.5	-45.01	6.39	-13.61	-31.0	Pass			
	Non-Restricted Fr	equency Ban	d Emissions – I	EEE 802.15.4	- ZigBee				
2405	13535	-44.82	6.39	-13.61	-31.21	Pass			
2445	20218	-44.38	6.65	-13.35	-31.03	Pass			
2480	18797	-45.66	6.39	-13.61	-32.05	Pass			
Note: 1. The	e stated limits are 2	0dBc relative	to the max outp	ut measured w	ith 100kHz ba	andwidth			

# 4.4.6 Conducted Plots



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Figure 14: Reference Level – 100kHz RBW power – IEEE 802.15.4 - ZigBee – 2445 MHz



Figure 15: Reference Level – 100kHz RBW power – IEEE 802.15.4 - ZigBee – 2480 MHz







Figure 17: Upper Band Edge – IEEE 802.15.4 - ZIGBEE – 2480 MHz



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Figure 19: Conducted Emissions – IEEE 802.15.4 - ZIGBEE – 2445 MHz

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MultiView	Pe.WR	X PSE	PS.EF	(OB.99	OB.6c	BE_Low	BL.gh	DC	CSE	
Ref Lev Att	el 20.00 dir 29	Bm Offse dB SWT	t 0.60 dB = RBW 106 ms = VBW	/1MHz /3MHz Moo	e Auto Sweep					
Freque	ency Swee	ep								⊙1Pk Max
									M3[1]	-45.66 dBm
										18.79700 GHz
D dBm									M1[1]	-53.52 dBm
										4.92340 GHz
dBm										
10 dBm—					-					
	H1 -:	13.610 dBm —								
20 dBm—					-					
30 dBm—										
10 dfm-										
to upin-						M2		M3		والمرافقة فالقباش الر
					. Larman	A decision of the second	And the state of the	البالألذار لتعاليهم وترتب		
0 dBm—		Ţ	ى ئىلمىي بىر	المطوية البالي						
	الرانب ليتهيها			<b>.</b>						
50 dBm—										
70 dBm—										
	17			20001	nts	2	.65 GHz/			26.5 GHz
Marke	r Table			20001		L				2010 0112
Type	Ref	Trc	X-Value		Y-Value		Function		Function Re	esult
M1		1	4.9234 GH	z	-53.52 dBm					
M2 M3		1	13.5323 GH	Z	-46.24 dBm -45 66 dBm					
CIVI	11	1	101/97 011	6	-40100 UDIII					and 21.05.2010
								Measuring		11:07:12

11:07:12 21.05.2019

Figure 20: Conducted Emissions – IEEE 802.15.4 - ZIGBEE – 2480 MHz

# 4.4.7 Radiated Plots



Figure 21: Lower Band Edge (Radiated) - IEEE 802.15.4 - ZIGBEE - 2405 MHz - Peak detector



Figure 22: Lower Band Edge (Radiated) – IEEE 802.15.4 - ZIGBEE – 2405 MHz – Average Detector



Figure 23: Lower Band Edge (Radiated) - IEEE 802.15.4 - ZIGBEE - 2480 MHz - Peak detector



Figure 24: Lower Band Edge (Radiated) – IEEE 802.15.4 - ZIGBEE – 2480 MHz – Average Detector

# 4.5 Transmit Radiated Spurious Emissions

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmit mode; per requirement of CFR47 15.205, 15.209, 15.247(d).

# 4.5.1 Test Methodology

## 4.5.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emissions test procedure. The frequency range of interest was divided into sub-ranges. For each sub-range peak emission data was recorded and plotted while the turntable was rotated 360° in 90° steps and the measurement antenna was rotated in horizontal and vertical antenna polarization. For scan rage 9 kHz to 30 MHz, the measurement is executed with an active loop antenna in 0° and 90° orientation.

Preliminary emission profile testing was performed inside a semi-anechoic chamber. The EUT was placed on a non-conductive table 80 cm above the floor for emissions less than 1 GHz and 150cm above the floor for emissions greater than 1 GHz. The EUT was positioned as shown in the setup photographs. The measurement antenna was placed at a distance of 3m.

# 4.5.1.2 Final Test

Final testing was performed on an NSA compliant test site.

For each frequency measured in scan range 30 MHz to 25 GHz, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. Preliminary emissions within 10 dB of the limit were measured.

The final scans were performed on the worst EUT axis for three operating channels in the operating mode with the highest power.

#### 4.5.1.3 Deviations

None.

#### **Test Setup:**



Where h = 80cm for <1GHz and 150cm for >1GHz

#### 4.5.2 Transmitter Spurious Emission Limit

The spurious emissions of the transmitter shall not exceed the values in CFR47 Part 15.205, 15.209.

Field strength (microvolts/meter)	Measurement distance (meters)
2400/F(kHz)	300
24000/F(kHz)	30
30	30
100 **	3
150 **	3
200 **	3
500	3
	Field strength (microvolts/meter) 2400/F(kHz) 24000/F(kHz) 30 100 ** 150 ** 200 ** 500

All harmonics and spurious emission which are outside of the restricted band shall be 20dB below the in-band emission.

#### 4.5.3 Test Results

The final measurement data was taken under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and test plan.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

#### Radiated spurious emissions - FCC 15.247 Transmitter - 9kHz - 30 MHz:

I Name	Ooleve Ziahaa Radia C	ard Temp / Hum in	121° C / 36%rh
T Model	QS-7B	Line AC / Fred	N/A – Battery operated
T Config.	2405MHz	RBW / VBW	Setting: 9 kHz to 150 kHz: RBW = 200Hz, VBW = 1kHz 150 kHz to 30 MHz: RBW = 9kHz, VBW = 30kHz
Indard	CFR47 Part 15.247	Performed by	Abraham Avalos
tenna:	0 degree	Dist/Ant Used	3m/ Active Loop
//m 2.0	TUV Rheinland of North America		24 may 10 02:40 *
			[1] Vertical
			Qpk Lmt
0.0			Av Lmt
			+ Formal
0.0			
0			
. Munthen la			Cop Cop
The second secon		1	
and the second se	Marine Marine		
.0	A S A S A S A S A S A S A S A S A S A S	and the second with the second s	
			Meas Dist 3m
			Spec Dist 3m
			Frequency: MHz
0.01	Q.1	1.0	10.0 30.0
Qolsys			
Filename: c:\program files (x88)\emisoft	- vasona\results\Qolsys_CH11_9KHz-30MHz.emi		

Radiated Emissions – 9 kH	z – 30 MHz - Transmit at 240	05 MHz (Low Cha	nnel)
EUT Name	Qolsys Zigbee Radio Card	Temp / Hum in	21° C / 36%rh
EUT Model	QS-ZB	Line AC / Freq	N/A – Battery operated
EUT Config.	2405MHz	RBW / VBW	Setting: 9 kHz to 150 kHz: RBW = 200Hz, VBW = 1kHz 150 kHz to 30 MHz: RBW = 9kHz, VBW = 30kHz
Standard	CFR47 Part 15.247	Performed by	Abraham Avalos
Antenna:	90 degree	Dist/Ant Used	3m/ Active Loop



Radiated Emissions – 9 kH	Iz – 30 MHz - Transmit at 24	45 MHz (Mid Char	nnel)
EUT Name	Qolsys Zigbee Radio Card	Temp / Hum in	21° C / 36%rh
EUT Model	QS-ZB	Line AC / Freq	N/A – Battery operated
EUT Config.	2445MHz	RBW / VBW	Setting: 9 kHz to 150 kHz: RBW = 200Hz, VBW = 1kHz 150 kHz to 30 MHz: RBW = 9kHz, VBW = 30kHz
Standard	CFR47 Part 15.247	Performed by	Abraham Avalos
Antenna:	0 degree	Dist/Ant Used	3m/ Active Loop



Radiated Emissions – 9 kl	Hz – 30 MHz - Transmit at 24	45 MHz (Mid Char	nnel)
EUT Name	Qolsys Zigbee Radio Card	Temp / Hum in	21° C / 36%rh
EUT Model	QS-ZB	Line AC / Freq	N/A – Battery operated
EUT Config.	2445MHz	RBW / VBW	Setting: 9 kHz to 150 kHz: RBW = 200Hz, VBW = 1kHz 150 kHz to 30 MHz: RBW = 9kHz, VBW = 30kHz
Standard	CFR47 Part 15.247	Performed by	Abraham Avalos
Antenna:	90 degree	Dist/Ant Used	3m/ Active Loop



Radiated Emissions – 9 kHz	z – 30 MHz - Transmit at 248	30 MHz (High Cha	nnel)
EUT Name	Qolsys Zigbee Radio Card	Temp / Hum in	21° C / 36%rh
EUT Model	QS-ZB	Line AC / Freq	N/A – Battery operated
EUT Config.	2480MHz	RBW / VBW	Setting: 9 kHz to 150 kHz: RBW = 200Hz, VBW = 1kHz 150 kHz to 30 MHz: RBW = 9kHz, VBW = 30kHz
Standard	CFR47 Part 15.247	Performed by	Abraham Avalos
Antenna:	0 degree	Dist/Ant Used	3m/ Active Loop



Radiated Emissions – 9 kl	Hz – 30 MHz - Transmit at 24	80 MHz (High Cha	annel)
EUT Name	Qolsys Zigbee Radio Card	Temp / Hum in	21° C / 36%rh
EUT Model	QS-ZB	Line AC / Freq	N/A – Battery operated
EUT Config.	2480MHz	RBW / VBW	Setting: 9 kHz to 150 kHz: RBW = 200Hz, VBW = 1kHz 150 kHz to 30 MHz: RBW = 9kHz, VBW = 30kHz
Standard	CFR47 Part 15.247	Performed by	Abraham Avalos
Antenna:	90 degree	Dist/Ant Used	3m/ Active Loop



#### Radiated spurious emissions - FCC 15.247 Transmitter - 30 MHz - 1 GHz:

Radia	ted Em	issions - 30	MHz– 1 GH	Iz Transmit a	at 2405 I	MHz (Lov	v Chanr	nel)			
EUT N	lame		Qolsys 2	Zigbee Radi	o Card	Temp / F	lum in		21° C	/ 36%၊	'n
EUT N	lodel		QS-ZB			Line AC	/ Freq		N/A –	Batter	y operated
EUT C	config.		2405MF	Iz - Horizont	al	RBW / V	BW		100K	Hz/ 300	)KHz
Stand	ard		CFR47	Part 15.247		Perform	ed by		Abrah	am Av	alos
						Dist/Ant	Used		3m/ J	B3	
Freq	uency	Level	Detector	Polarity	Heigh	nt Az	imuth	Limit	Ma	argin	Result
Μ	Hz	dBuV/m		H/V	cm		deg	dBuV/m	(	dB	
393	3.71	20.33	QP	Н	245		360	46.00	-2	5.67	Pass
450	0.01	19.94	QP	Н	183		252	46.00	-2	6.06	Pass
506	5.42	14.71	QP	Н	266		0	46.00	-3	1.29	Pass
618	3.69	27.82	QP	Н	117		316	46.00	-1	8.18	Pass
823	3.36	19.71	QP	Н	200		84	46.00	-2	6.29	Pass
998	3.72	22.00	QP	Н	105		196	54.00	-3	2.00	Pass
90.0 80.0 70.0 60.0 80.0 40.0											[1] Horizontal [2] Vertical Qpk Lmt Formal
20.0			رور رو الرور و الرور و الم	and the state of the second	والمالل فلتهم ومتعاجم	* 			+	Meas Dist 3m Spec Dist 3m	
10.0	Low	and a second second second		+						Frequency: MHz	
3	0.0	130.0 230.0	330.0	430.0 5	30.0	630.0	730.0	830.0 930.0	D 1000.	D	
	Qolsys										
	Filename: o:\pro	ogram files (x88)\emisoft - v	asona\results\Qolsys_FCC_1	5.247_CH11_30-1GHz.emi							
Note:	-										

EUT Name EUT Model EUT Config. Standard Iteration Standard Iteration MHz 30.56 1 45.97 1 393.94 1 465.72 1 599.97 1 994.34 2 000 000	Level D IBuV/ m 16.21 12.18 14.73 14.03 16.13 22.09	Qolsys Zi QS-ZB 2445 MH CFR47 P etector QP QP QP QP QP QP QP	igbee Radio z - Horizont Part 15.247 Polarity H/V V V H H H H H Rheinland of North Ame	Card         Ter           Lin         Lin           tal         RB           Per         Dis           Height         Cm           160         109           271         315           198         226	mp / Hum in he AC / Freq W / VBW rformed by st/Ant Used Azimuth deg 74 130 166 164 92 296	Limit dBuV/m 40.00 40.00 46.00 46.00 46.00 54.00	21° C / 36% N/A – Batter 100KHz/ 300 Abraham Av 3m/ JB3 Margin dB -23.79 -27.82 -31.27 -31.97 -29.87 -31.91	rh y operated DKHz alos Result Pass Pass Pass Pass Pass Pass Pass
EUT Model EUT Config. Standard I data MHz data 30.56 1 45.97 1 393.94 1 465.72 1 599.97 1 994.34 2 000 00000000000000000000000000000000	Level D IBuV/ m 16.21 12.18 14.73 14.03 16.13 22.09	QS-ZB 2445 MH CFR47 P etector QP QP QP QP QP QP QP QP	z - Horizont Part 15.247 Polarity H/V V V H H H H Kheinland of North Ame	Lin tal RB Pe Dis Height cm 160 109 271 315 198 226 erica	Ac / Freq W / VBW st/Ant Used Azimuth deg 74 130 166 164 92 296	Limit dBuV/m 40.00 40.00 46.00 46.00 46.00 54.00	N/A – Batter 100KHz/ 300 Abraham Av 3m/ JB3 Margin dB -23.79 -27.82 -31.27 -31.97 -29.87 -31.91	y operated DKHz alos Result Pass Pass Pass Pass Pass Pass Pass
EUT Config.           Standard           Standard           Image: standard standard           Image: standard	Level D IBUV/ m 16.21 12.18 14.73 14.03 16.13 22.09	2445 MH CFR47 P etector QP QP QP QP QP QP QP QP	z - Horizont Part 15.247 Polarity H/V V V H H H H V Rheinland of North Ame	RB           Pe           Dis           Height           cm           160           109           271           315           198           226	Azimuth       deg       74       130       166       164       92       296	Limit dBuV/m 40.00 40.00 46.00 46.00 46.00 54.00	100KHz/ 300 Abraham Av 3m/ JB3 Margin dB -23.79 -27.82 -31.27 -31.97 -29.87 -31.91	DKHz alos Result Pass Pass Pass Pass Pass Pass Pass
Standard         L           Frequency         L           MHz         dl           30.56         1           45.97         1           393.94         1           465.72         1           599.97         1           994.34         2           debu/m	Level D IBuV/ m 16.21 12.18 14.73 14.03 16.13 22.09	CFR47 P etector QP QP QP QP QP QP QP QP QP	Polarity Polarity H/V V V H H H H V Rheinland of North Ame	Pe           Dis           Height           cm           160           109           271           315           198           226	Azimuth           Azimuth           deg           74           130           166           164           92           296	Limit dBuV/m 40.00 40.00 46.00 46.00 46.00 54.00	Abraham Av 3m/ JB3 Margin dB -23.79 -27.82 -31.27 -31.97 -29.87 -31.91	Result Pass Pass Pass Pass Pass Pass Pass Pas
Frequency         L           MHz         dl           30.56         1           45.97         1           393.94         1           465.72         1           599.97         1           994.34         2           db//m         1000           800	Level D IBuV/ m 16.21 1 12.18 1 14.73 1 14.03 1 16.13 1 22.09 1	QP QP QP QP QP QP QP QP QP	Polarity H/V V H H H Kheinland of North Ame	Dis           Height           cm           160           109           271           315           198           226	At Used           Azimuth           deg           74           130           166           164           92           296	Limit dBuV/m 40.00 40.00 46.00 46.00 46.00 54.00	3m/ JB3 Margin dB -23.79 -27.82 -31.27 -31.97 -29.87 -31.91	Result Pass Pass Pass Pass Pass Pass
Frequency         L           MHz         di           30.56         1           45.97         1           393.94         1           465.72         1           599.97         1           994.34         2           detwim           100	Level D BuV/ m 16.21 1 12.18 1 14.03 1 14.03 2 16.13 2 22.09 1	QP QP QP QP QP QP QP QP QP UV F	Polarity H/V V H H H Kheinland of North Ame	Height cm 160 109 271 315 198 226 erica	Azimuth deg 74 130 166 164 92 296	Limit dBuV/m 40.00 40.00 46.00 46.00 46.00 54.00	Margin dB -23.79 -27.82 -31.27 -31.97 -29.87 -31.91	Result Pass Pass Pass Pass Pass Pass Pass
MHz         dl           30.56         1           45.97         1           393.94         1           465.72         1           599.97         1           994.34         2           detwine         1000           \$00	IBUV/ m 16.21 12.18 14.73 14.03 16.13 22.09	QP QP QP QP QP QP QP	H/V V H H H Kheinland of North Ame	cm 160 109 271 315 198 226 erica	deg       74       130       166       164       92       296	dBuV/m 40.00 40.00 46.00 46.00 54.00	dB -23.79 -27.82 -31.27 -31.97 -29.87 -31.91	Pass Pass Pass Pass Pass Pass
30.56 1 45.97 1 393.94 1 465.72 1 599.97 1 994.34 2 000 000 000	16.21       12.18       14.73       14.03       16.13       22.09	QP QP QP QP QP QP QP	V V H H H Kheinland of North Ame	160 109 271 315 198 226 erica	74 130 166 164 92 296	40.00 40.00 46.00 46.00 46.00 54.00	-23.79 -27.82 -31.27 -31.97 -29.87 -31.91	Pass Pass Pass Pass Pass Pass
45.97       1         393.94       1         465.72       1         599.97       1         994.34       2         dBuV/m       1000         \$200       0         800       0	12.18 14.73 14.03 16.13 22.09	QP QP QP QP QP TUV F	V H H V Rheinland of North Am	109 271 315 198 226 erica	130 166 164 92 296	40.00 46.00 46.00 46.00 54.00	-27.82 -31.27 -31.97 -29.87 -31.91	Pass Pass Pass Pass Pass
393.94     1       465.72     1       599.97     1       994.34     2       dBUV/m     2       1000     2       500     2	14.73 14.03 16.13 22.09	QP QP QP QP TUV F	H H H V Rheinland of North Ame	271 315 198 226 erica	166 164 92 296	46.00 46.00 46.00 54.00	-31.27 -31.97 -29.87 -31.91	Pass Pass Pass Pass
465.72 1 599.97 1 994.34 2 08VV/m 1000	14.03 16.13 22.09	QP QP QP TUV F	H H V Rheinland of North Ame	315 198 226 erica	164 92 296	46.00 46.00 54.00	-31.97 -29.87 -31.91	Pass Pass Pass
599.97 1 994.34 2 dBuV/m 1000	16.13	QP QP TUV F	H V Rheinland of North Ame	198 226 erica	92 296	46.00 54.00	-29.87 -31.91	Pass Pass
994.34 2 dBuV/m 1000 500	22.09	QP TUV R	V Rheinland of North Ame	226 erica	296	54.00	-31.91	Pass
48/JV/im 1000 5000 8000		TUV F	Rheinland of North Am	erica			20 may 10 22 02	
70.0							· · ·	(2) Verioal Opk Lmt Formal
200 100 200 300 Colsys	220.0	3300	+ + 4300 53		7300	800.0 930.0	Yee With American Ame	

UT Name UT Model		Qolsys Z QS-ZB	Zigbee Radi	o Card Ter Lin	np / Hum in e AC / Freq w / VBW	min 21° C / 36%rh Freq N/A – Battery op W 100KHz/ 300KH		
Standard		CFR47	Part 15.247	Per	formed by		Abraham Avalos	
					t/Ant Used		3m/ JB3	
Frequency	Level	Detector	Polarity	Height	Azimuth	Limit	Margin	Result
MHz	dBuV/m		H/V	cm	deg	dBuV/m	dB	
30.00	16.86	QP	v	324	248	40.00	-23.14	Pass
43.10	11.66	QP	v	172	86	40.00	-28.35	Pass
393.73	21.44	QP	Н	113	324	46.00	-24.56	Pass
506.22	20.10	QP	Н	148	38	46.00	-25.91	Pass
803.95	19.65	QP	Н	309	136	46.00	-26.35	Pass
960.48	21.63	QP	V	243	0	54.00	-32.37	Pass
800 700 600 400 200								Qpk Lmt Formal
10.0					1990 - 19900 - 19900 - 19900 - 1990 - 1990 - 1990 - 1990 - 1990 - 1990 - 1990 -	*	Spec Dist 3m	

	me		Qolsys Zigbee Radio Card Temp / Hum in				21° C / 37%rł	า		
IT Mo	del		QS-ZB	Lir	ne A	C / Freq	N/A – Battery	operated		
IT Co	nfig.		2405MHz	RE	3W /	VBW	1 MHz/ 3 MHz			
andar	ď		CFR47 Part 15.24	<b>17 Ρε</b>	rfor	med by	Abraham Ava	alos		
				Di	st/A	nt Used	3m/ EMCO 3	115		
	11	0 <sub>1</sub>				V 2 40F	5000000 GHz			
	10	00				Fun	damental			
	Ę,	20								
	S⊓8 ∑n8						F(	<u>CC 15 Pk</u>		
	⊑ 6	i0				المقدينية المعالية المحالية ال	alesteration and an industry of the second	C 15 Avg		
	eve.	an fan maar lee ry stile 'n oeste de reek aan de kerkelen.	فتعيين فيتعاصب المعيا مانينية بيني بيريه ميلان فالتراسين وتقرر	As mineral option of the property of the state	Additional			$\nabla$		
-	4	₩07 1.000000000 Gł 37.190 dBµV/n	<b>⊣</b> z n	<u>1.750000000 (</u> 40.215 dBµV	3Hz ∕m		3.5000000 45.496 dB	0 GHz µV/m		
	2	1G				2G		3.5G		
				Frequer	ncy in	Hz				

#### Radiated spurious emissions - FCC 15.247 Transmitter - 1 GHz - 3.5 GHz:

T Nam	e	Qolsys Zigb	ee Radio Card Temp / Hum in	21° C / 37%rh						
T Mod	el	QS-ZB	Line AC / Freq	N/A – Battery operate 1 MHz/ 3 MHz						
T Con	fig.	2445MHz	RBW / VBW							
andard		CFR47 Part	15.247 Performed by	Abraham Avalos						
			Dist/Ant Used	3m/ EMCO 3115						
	110 <sub>T</sub>									
	100			V 103.004 dBµV/m						
	00-			Fundamental						
E.	30									
- À	80			FCC 15 Pk						
Щ	70									
<u>_</u>	60			a second s						
0	50	yer bennynde agente skingelyed en gedere die behende it hen fryser de see ster jaar het see skingelike ster se	en den sie werden an de lange begen in de keine eine werde de see maar die het in de staat die bester die see s	$\nabla$						
Ľ	40		$\nabla$							
	20	1.225000000 GHz	1.75000000 GHz	3 166000000 GHz						
	30	38.971 dBµV/m	40.144 dBµV/m	46.621 dBµV/m						
	20+		26	3 50						
	10	5 26 3.56								
			Frequency in Hz							
	– Pre	view Result 2-AVG P	review Result 1-PK+ * Critical_Freqs A	VG * Critical_Freqs PK+						

IT Nam	e	Qolsys Zigb	ee Radio Card Ten	ip / Hum in	21° C / 37%rh		
IT Mod	el	QS-ZB	Line	e AC / Freq	N/A – Battery operat		
IT Con	fig.	2480 MHz	RB	V / VBW	1 MHz/ 3 MHz		
andard		CFR47 Part	t 15.247 Per	ormed by	Abraham Avalos	6	
			Dist	/Ant Used	3m/ EMCO 3115	5	
	110-						
	100			7	7 2.480000000 GHz		
	100				99.725 dBµV/m		
	90-				Fundamental		
	80-				FCC 15 (	QP-Pk	
BL	70						
	60				E00-48	Δ <i>u</i> α.	
a	50	an an in a superior and a superior the set of the set of the set of the set of the superior design of the superior	ter en se her an se start better men an en gen an star men en start an der der start an beseter beseter beseter			<u> </u>	
e	50				V		
	40	1 25700000 GHz			3.145500000 G	Hz	
	30-	39.357 dBuV/m			46.540 dBµV/i	<b>n</b> }	
	20-						
	10	G		2G		3.5G	
			Frequenc	/ in Hz			
	— Pi	review Result 2-AVG	review Result 1-PK+ *	Critical Frees AVG	* Critical Frees F	РК+	
	— E(		CC 15 Avg	Final Docult DK+	♦ Final Desult AV	ic i	

#### Radiated spurious emissions - FCC 15.247 Transmitter - 3.5 GHz - 18 GHz:

Ra	diated Emiss	ions - 3.5	– 18 GH	z Transı	mit at 240	)5MHz					
EUT	Г Name		Qolsys	Zigbee	Radio Ca	ard Ten	np / Hum in		21	° C / 36%rh	1
EUT	۲ Model		QS-ZE	3		Line	e AC / Freq		N/A	A – Battery	operated
EUT	Γ Config.		2405N	1Hz		RB\	N/VBW		1 N	/Hz/ 3 MHz	7
Sta	ndard		CFR47 Part 15.247				formed by		Ab	raham Ava	los
							t/Ant Used		3m	/EMCO311	15
F	inal_Result										
	Frequency (MHz)	MaxPe	Avera	Limit (dBuV/	Margin (dB)	Meas. Time	Bandwidth	Height (cm)	Pol	Azimuth	Elevation (deg)
	(	(dBµV/	(dBµV/	m)	(0.27	(ms)	(1112)	(0.1.)		(uog)	(uog)
E	4808.90666	7	45.29	54.00	8.71	500.0	1000.000	126.0	v	128.0	0.0
	4811.00000	0	41.30	54.00	12.70	500.0	1000.000	381.0	V	125.0	0.0
	4811.14333	3 52.93		74.00	21.07	500.0	1000.000	100.0	V	145.0	0.0
	4811.34666	7 54.31		74.00	19.69	500.0	1000.000	107.0	V	148.0	0.0
$\vdash$	14227.47666		39.36	54.00	14.64	500.0	1000.000	400.0	V	164.0	339.0
$\vdash$	17871 89666	7 33.95	42 58	54.00	20.00	500.0	1000.000	230.0 338.0	V	114.0	211.0
	65 60 55 55 10 10 10 10 10 10 10 10 10 10 10 10 10		4_811 54.3 *	346667 ( 111 dBµV	3Hz m			MM		17.7932000 53.947 di FC	000 GHz BµV/m 8 15 A 2
	35+		<b>X</b>				LANNA.		w	what	f
	30	<b>A A A</b>	h	m	mm	$\mathcal{N}^{\mathcal{N}\mathcal{N}}$	<b>~</b> ~~	M/14.23 39.	324166 236 dB	67 GHz <mark>↓</mark> µV/m	NV.
	25		×								
	20									17.8719	16667 GHz
	15									42.489	) dBµV/m
	10 3.5G	i	5G		6 7	1 1 7 8	9 10	G			18G
	Prev * Critic Final	iew Result cal_Freqs P I_Result PK	2-AVG /K+ (+	•	Previe FCC Final	Prequer ew Result 15 QP-Pk Result A	t 1-PK+ c – VG	*	Critical FCC 1	L_Freqs AV0 5 Avg	6





IT Name						Qolsys Z	Zigbee	e Radio	Card	Temp / Hum in				21°	21° C / 37%rh			
JT N	lode				(	QS-ZB				Line AC / Freq				N/A	N/A - Battery operate			
JT Config.				2	2405MHz				RBW	/ VBW	1		1 M	1 MHz/ 3 MHz				
and	ard				(	CFR47 F	Part 1	5.247		Perfo	rmed	by		Abra	aham A	Avalos		
										Dist/A	nt Us	ed		1m ·	– AHA	-840		
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				авни	· · · ·													
		201	8 15	5	10	10.5	20	20.5	21	21.5	22	22.5	23	23.5	2/	2/1.5	 25	
			0 10		13	13.5	20	20.5	<u>-</u>	21.0	22	22.0	20	20.0	24	27.J	20	
									F	requenc	y							
		- F	<sup>2</sup> review R	esult 2-	AVG		Prev	iew Result	1-PK+	*	Critica	al Freqs A	/G	*	Critical	Fregs PK	(+	
-		- F	FCC 15 Q	P-Pk			- FCC	15 Ava		٠	Final	Result PK+		•	Final F	esult AVG		

#### Radiated spurious emissions - FCC 15.247 Transmitter - 18 GHz - 25 GHz:

JT Nam	e				Qolsys	Zigbee	e Radio	Card	Temp	/ Hun	n in		21°	C / 37	%rh		
JT Mod	el				QS-ZB				Line AC / Freq				N/A	N/A – Battery operated			
JT Con	fig.				2445MHz				RBW /	/ VBW			1 M	Hz/ 3 I	ИНz		
andard				(	CFR47	Part 1	5.247		Perfo	rmed	by		Abra	aham <i>i</i>	Avalos		
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Ľ	301	8.000 - 39.64	00000 14 dBu\	GHz //m			20.746625 39.680 (	5000 GHz dBµV/m				23	.5606250 39.462 dE	00 GHz µV/m			
	20- 1	8	18.5	19	19.5	20	20.5	21	21.5	22	22.5	23	23.5	24	24.5	 25	
								F	requenc	y							
	- F	Preview	Result	2-AVG		Prev	iew Result	1-PK+	*	Critica Final	I_Freqs A	VG	*	Critica Final F	Freqs Pk	(+	

JT N	Name Qo					Qolsys Zigbee Radio Card				Temp / Hum in				21°	21° C / 37%rh				
ЈТ М	ode	el				QS-ZB				Line AC / Freq				N/A	N/A - Battery operated				
ЈТ С	T Config.					2480MHz				RBW	/ VBW	1		1 M	Hz/ 3 I	ИНz			
anda	ndard				CF	R47 F	Part 1	5.247		Perfo	med	by		Abra	aham /	Avalos			
											Dist/A	nt Us	ed		1m ·	– AHA	-840		
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		20		-uop															
		18	1	8.5	19		19.5	20	20.5	21	21.5	22	22.5	23	23.5	24	24.5	25	
										-	requenc	u.							
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		Pre	view F	Result	2-AV(	3		Prev	iew Result	1-PK+	*	Critica	al_Freqs A	VG	*	Critica	_Freqs Pk	(+	
		- FC	C 15 (	QP-Pk				FCC	15 Avg		•	Final_	Result PK+	÷	•	Final_F	Result AVG		

# 4.6 AC Conducted Emissions

Testing was performed in accordance with ANSI C63.4: 2014. These test methods are listed under the laboratory's A2LA Scope of Accreditation.

This test measures RF emissions emanating from the EUT's AC input port, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

The AC conducted emissions of equipment under test shall not exceed the values in CFR47 Part 15.207.

# 4.6.1 Test Methodology

A test program that controls instrumentation and data logging was used to automate the AC Power Line Conducted emission test procedure. The frequency range of interest was divided into subranges such as to yield a frequency resolution of 9 kHz. Each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a set of  $50\mu$ H /  $50\Omega$  LISNs.

Testing is performed in Lab 5. The setup photographs clearly identify which site was used. The vertical ground plane used in the semi-anechoic chamber is a 2m x 2m solid aluminum frame and panel, and it is bonded to the horizontal ground plane.

In the case of tabletop equipment, the EUT is placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane and 40cm from a vertical ground reference plane. The rear of the EUT was positioned flush with the backside of the table and directly over the LISNs. The power and I/O cables were routed over the edge of the table and bundled approximately 40cm from the ground plane. Support equipment was powered from a separate LISN.

# 4.6.1.1 Deviations

There were no deviations from this test methodology.

# 4.6.2 Test Results

Not Applicable, the EUT is battery operated via a development board.

# 5 Test Equipment List

# 5.1 Equipment List

Note: Equipment is characterized before use.

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal mm/dd/yy yy	Next Cal mm/dd/yy yy								
Spectrum Analyzer	Rohde & Schwarz	FSW67	104088	06/11/2018	06/11/2019								
EMI Receiver	Rohde & Schwarz	ESIB40	5000- 3090823415	09/20/2018	09/20/2019								
Bilog Antenna	Sunol Sciences	JB3	A102606	08/01/2018	08/01/2020								
Horn Antenna	EMCO	3115	9211-3969	05/16/2017	05/16/2019* (08/16/2019) (s. Note 1)								
Amplifier	Sonoma	310N	185616	01/16/2019	01/16/2020								
Active loop antenna	Emco	6502	00062531	06/08/2018	06/08/2019								
Maturo Control Unit	Maturo	SCU	246/205712 16	N	/A								
Maturo EUT Positioner	Maturo	TD1.5-10kg	087/205712 16	N	/A								
Amplifier	Miteq	AMF-7D-01001800-30- 10p-L	2074297	N/A (Se	ee Note)								
DC Block	Mini-Circuits	UNAT-1+	VUU837010 27	N/A (Se	e Note)								
3.5 GHz High Pass Filter	Hewlett Packard	84300-80038	820004	N/A (Se	e Note)								
Note: No calibration rec Note 1: Equipment und	quired. Path loss corre er laboratory designat	ction characterized internal. ed extended calibration cyc	le of 3 month ext	ension	Note: No calibration required. Path loss correction characterized internal. Note 1: Equipment under laboratory designated extended calibration cycle of 3 month extension								

#### **EMC** Test Plan 6

# 6.1 Introduction

This section provides a description of the Equipment Under Test (EUT), configurations, operating conditions, and performance acceptance criteria. It is an overview of information provided by the manufacturer so that the test laboratory may perform the requested testing.

# 6.2 Customer

	Table 6: Customer Information
Company Name	Qolsys Inc.
Address	1900 The Alameda
City, State, Zip	San Jose, CA 95126
Country	USA
Applicant name	Walt Wallach
E-mail	Walt.Wallach@qolsys.com
Phone	+1 855-476-5797

#### Equipment Under Test (EUT) 6.3

The information provided in the following table should be listed as it should appear in the final report. For those products that have only a model name, list the model number as non-applicable and vice-versa.

	Table 7 – EUT Designation
Product Name	Qolsys Zigbee Radio Card
Model Number	QS-ZB
Product Description	The Qolsys Zigbee Radio Card Model QS-ZB is a radio module utilizing an IEEE 802.15.4 radio based on communication ZigBee technology.

Table 7 FUT Designation

# 6.4 Product Specifications

 Table 8: EUT Specifications

	EUT Specification							
Operating Voltage	N/A – Host PCB powered							
Number of Antenna Feeds	Transmit: 1 Receive: 1							
Product Marketing Name (PMN)	Qolsys Zigbee Radio Card							
FW Version	6.4.1							
HW Version	X1							
Radio Evaluated	IEEE 802.15.4 - ZigBee							
Transmit Frequency Band	2400-2483.5MHz							
Max. Power Output for Technology	10.98 dBm (Measured peak, Conducted)							
Antenna Gain	1 dBi							
Antenna Type	Internal embedded chip antenna							
Modulation Type	O-QPSK							
Type of Equipment	□ Table Top □ Wall-mount □ Floor standing cabinet ☑ Other: Module							

#### Table 9: Antenna Information

Number	Antenna Type	Description	Max Gain (dBi)
1	Internal	Embedded chip antenna	1

#### **able 10:** Interface Specifications

Interface Type	Cabled with what type of cable?	Is the cable shielded?	Maximum potential length of the cable?	Metallic (M), Coax (C), Fiber (F), or Not Applicable?
USB	USB	No	3m	Not Applicable
Note: USB cable Removed after co	connected to auxiliary ho onfiguration before radiate	ost. ed testing.		

# Table 11: Support Equipment

Equipment	Manufacturer	Model	Used for
Laptop	Lenovo	T480 Thinkpad	EUT configuration via Putty serial\USB interface connection for module operational mode configuration.
Host Auxiliary IQ Panel 2	Qolsys Inc.	QS-IQPANEL2 FW Version: 2.3.0 HW Version: REV H	Host device for EUT - Module
Note: None.			

#### Table 12: Description of Sample used for Testing

Device	Serial	<b>RF</b> Connection	Comment	
Qolsys Zigbee Radio Card	N/A	Temporary u.fl	Conducted testing	
Qolsys Zigbee Radio Card	N/A	Intended embedded chip antenna	Radiated testing	

#### Table 13: Accessory Equipment

Equipment	Manufacturer	Model	Serial	Comment
-	-	-	-	-

#### 1.1.1 Block Diagram



IQ Panel 2 Host

Vertical Orientation

# 6.5 EUT Configuration:

The EUT's 802.15.4 radio was stimulated for continuous modulated transmission on all applicable channels via terminal command sets.

# 6.6 Testing Notes:

Following example configuration indicates the utilized commands:

- busybox microcom -s 115200 /dev/ttyHSL4
- rx 0
- config2p4GHz802154
- setDebugMode 1
- freqOverride 2405000000
- setDebugMode 0
- SetTxStream 1

The Firmware implemented power configuration is not changed from the supplied FW default: Powerlevel 97; power: 104 configuration, which is declared by the manufacturer as representative for the final implementation.

# **END OF REPORT**