

FCC & ISED Certification Test Report For the Owlet Baby Care Inc. Base Station

FCC ID: 2AIEP-OBS1B ISED: 21386-OBS1B

WLL JOB# 14578-01 Rev 1 August 31, 2016 Revised October 2, 2016

Prepared for:

Owlet Baby Care Inc. 32 W. Center Street. Suite 201 Provo, UT 84601

Prepared By:

Washington Laboratories, Ltd. 7560 Lindbergh Drive Gaithersburg, Maryland 20879



Testing Certificate AT-1448

FCC & ISED Certification Test Report For the Owlet Baby Care Inc. Base Station FCC ID: 2AIEP-OBS1B ISED: 21386-OBS1B

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epella

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Abstract

This report has been prepared on behalf of Owlet Baby Care Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Digital Transmission System (DTS) Transmitter under Part 15.247 (10/2014) of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy RSS-247 issue 1 of ISED. This Certification Test Report documents the test configuration and test results for the Owlet Baby Care Inc. Base Station.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The ISED OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Testing Certificate AT-1448 as an independent FCC test laboratory.

The Owlet Baby Care Inc. Base Station complies with the limits for a Digital Transmission System (DTS) Transmitter device under FCC Part 15.247 and ISED RSS-247.

Revision History	Description of Change	Date
Rev 0	Initial Release	August 31, 2016
Rev 1	Corrected low channel power level in table 8.	October 2, 2016

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1 Introduction

1.1 Compliance Statement

The Owlet Baby Care Inc. Base Station complies with the limits for a Digital Transmission System (DTS) Transmitter device under FCC Part 15.247 (10/2014) and ISED RSS-247 issue 1 May 2015.

The Base Station also contains a 2.4GHz 802.11b/g/n device that is certified under a separate report.

1.2 Test Scope

Tests for radiated emissions were performed. All measurements were performed in accordance with "C63.10 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices". The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:

TEMS Consulting Inc. 140 River Road Georgetown, TX, 78628

On Behalf of:

Owlet Baby Care Inc.
32 W. Center Street
Suite 201
Provo, UT 84601

Quotation Number:

69359A

1.4 Test Dates

Testing was performed on the following date(s): 8/3/2016 to 8/29/2016

1.5 Test and Support Personnel

Washington Laboratories, LTD Customer Representative James Ritter Stephen Berger

Abbreviations

Α	Ampere	
ac	alternating current	
AM	Amplitude Modulation	
Amps	Amperes	
b/s	bits per second	
BW	BandWidth	
CE	Conducted Emission	
cm	Centimeter	
CW	Continuous Wave	
dB	decibel	
dc	direct current	
EMI	Electromagnetic Interference	
EUT	Equipment Under Test	
FM	Frequency Modulation	
G	g iga – prefix for 10 ⁹ multiplier	
Hz	Hertz	
IF	Intermediate Frequency	
k	kilo – prefix for 10^3 multiplier	
LISN	Line Impedance Stabilization Network	
Μ	Mega – prefix for 10 ⁶ multiplier	
m	Meter	
μ	m icro – prefix for 10^{-6} multiplier	
NB	Narrowband	
QP	Quasi-Peak	
RE	Radiated Emissions	
RF	Radio Frequency	
rms	root-mean-square	
SN	Serial Number	
S/A	Spectrum Analyzer	
V	Volt	

2 Equipment Under Test

2.1 EUT Identification & Description

The base station receives sensor readings from the wearable sensor through the BT LE module and communicates them through its WiFi connection to the internet.

ITEM	DESCRIPTION
Manufacturer:	Owlet Baby Care Inc.
FCC ID:	2AIEP-OBS1B
ISED:	21386-OBS1B
Model Number:	OBS 1.1
Model Name:	Base Station
FCC Rule Parts:	§15.247
ISED:	RSS-247
Frequency Range:	2402-2480MHz
Maximum Output Power:	16.07mW (12.06dBm) conducted
Modulation:	GFSK
Occupied Bandwidth:	769.9kHz
Keying:	Automatic
Type of Information:	Data
Number of Channels:	40
Power Output Level	Fixed
Antenna	integral
Antenna Type	-2.13dBi trace antenna
Interface Cables:	None
Power Source & Voltage:	5V (USB) from 120VAC adaptor
Emission Designator	770KFXD
Highest TX Spurious	298.9/m @3m (4980MHz)
Highest RX Spurious	34.4uV/m @3m (39.4MHz)

Table 1: Device Summary

2.2 Test Configuration

4 devices were submitted for testing, 1 unit with the antenna replaced by a temporary antenna port and three with antennas for radiated testing. Each EUT was programmed to transmit at one of 3 frequencies (2402, 2440, & 2480MHz). All units were tested in a stand-alone configuration. All tests were performed in accordance with ANSI C63.10.The conducted unit was programmed at WLL for each frequency.

2.3 Testing Algorithm

The Base Station was programmed for DTS operation .The EUT was set to transmit PRBS packets continuously at the desired transmit frequency. Worst case emission levels are provided in the test results data.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The ISED OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

- ANSI C63.10:2013 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation
- RSS-Gen Issue 4 General Requirements for Compliance of Radio Apparatus
- RSS-247 issue 1 Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 (R2002) with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in

Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see

Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_{c} = \pm \sqrt{\frac{a^{2}}{div_{a}^{2}} + \frac{b^{2}}{div_{b}^{2}} + \frac{c^{2}}{div_{c}^{2}} + \dots}$$

Where u_c = standard uncertainty

a, b, c,.. = individual uncertainty elements

Divisor = 1.732 for rectangular distribution

Divisor = 2 for normal distribution

Divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

Where U	= expanded uncertainty
k	= coverage factor
	$k \le 2$ for 95% coverage (ANSI/NCSL Z540-2 Annex G)
uc	= standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is <u>not</u> used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in table 2 below.

Table 2: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Conducted Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	<u>+</u> 2.63 dB
Radiated Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	<u>+</u> 4.55 dB

Parameter	Uncertainty	Actual (+/-)	Unit
Radio Frequency	$\pm 1 \ge 10^{-7}$	8.64E-08	parts
RF Power conducted (up to 160 W)	±0.75 dB	0.3	dB
Conducted RF Power variations using a test fixture	±0.75 dB	0.3	dB
Transmitter transient frequency (frequency difference)	±250 Hz	160.7	Hz
Transmitter transient time	±20 %	9.2	%

3 Test Equipment

Table 3 shows a list of the test equipment used for measurements along with the calibration information.

Test Name: Conducted Antenna Port		Test Date:	8/26/2016
Asset #	Manufacturer/Model	Description	Cal. Due
823	AGILENT - N9010A	EXA SPECTRUM ANALYZER	9/30/2016

 Table 3: Test Equipment List

Test Name:	Radiated Emissions	Test Date:	8/25/2016
Asset #	Manufacturer/Model	Description	Cal. Due
823	AGILENT - N9010A	EXA SPECTRUM ANALYZER	9/30/2016
559	HP - 8447D	AMPLIFIER	9/30/2016
644	SUNOL SCIENCES CORPORATION - JB1 925-833-9936	BICONALOG ANTENNA	8/14/2017
627	AGILENT - 8449B	AMPLIFIER 1-26GHZ	9/30/2016
4	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	10/8/2016
281	ITC - 21A-3A1	WAVEGUIDE 4.51-10.0GHZ	10/22/2016
282	ITC - 21X-3A1	WAVEGUIDE 6.8-15GHZ	10/22/2016
453	AH SYSTEMS - PAM1840	PRE-AMPLIFIER 18GHZ-40 GHZ	9/30/2016
209	NARDA - V637	HORN STANDARD GAIN	CNR
210	NARDA - V638	HORN STANDARD GAIN	CNR
823	AGILENT - N9010A	EXA SPECTRUM ANALYZER	9/30/2016

Test Name:	Conducted Emissions Voltage	Test Date:	08/26/2016
Asset #	Manufacturer/Model	Description	Cal. Due
823	AGILENT - N9010A	EXA SPECTRUM ANALYZER	10/5/2016
124	SOLAR - 8012-50-R-24-BNC	LISN	10/15/2016
53	HP - 11947A	LIMITER TRANSIENT	3/1/2017

4 Test Summary

The Table Below shows the results of testing for compliance with a Digital Transmission System in accordance with FCC Part 15.247 10/2014 and RSS47 issue 1, 5/2015. Full results are shown in section 5.

TX Test Summary (Digital Transmission System (DTS))								
FCC Rule Part	FCC Rule Part IC Rule Part Description Result							
15.247(a) (2)	RSS-247 [5.2 (1)]	6dB Bandwidth	Pass					
15.247 (b)(3)	RSS-247 [5.4 (4)]	Transmit Output Power	Pas					
15.247 (e)	RSS-247 [5.2 (2)]	Power Spectral Density	Pass					
15.247 (d)	RSS-247 [5.5]	/Out-of-Band Emissions	Pass					
		(Band Edge @ 20dB below)						
15.205	RSS-Gen 7.2.2	General Field Strength	Pass					
15.209		Limits (Restricted Bands &						
		RE Limits)						
15.207	RSS-Gen [7.2.4]	AC Conducted Emissions	Pass					

Table 4: To	est Summary	Table
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5 Test Results

5.1 Occupied (DTS) Bandwidth:

Occupied bandwidth was performed by monitoring the output of the EUT antenna port with a spectrum analyzer corrected for any cable/attenuator losses.

For Direct Sequence Spread Spectrum Systems, FCC Part 15.247 requires the minimum 6 dB bandwidth be at least 500 kHz.

5.1.1 Measurement Method:

Tests were performed as specified in ANSI C63.10 section 11.8 "DTS bandwidth" Option 1 (11.8.1).

Table 5: Occupied Bandwidth Spectrum Analyzer Settings

Resolution Bandwidth	Video Bandwidth
100kHz	1MHz

At full modulation, the occupied bandwidth was measured as shown in Figures 1-3.

Table 6 provides a summary of the Occupied Bandwidth Results.

Table 6: Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Low Channel: 2402MHz	679.8kHz	≥500kHz	Pass
Center Channel: 2440MHz	769.9kHz	≥500kHz	Pass
High Channel: 2480MHz	681.3kHz	<u>></u> 500kHz	Pass

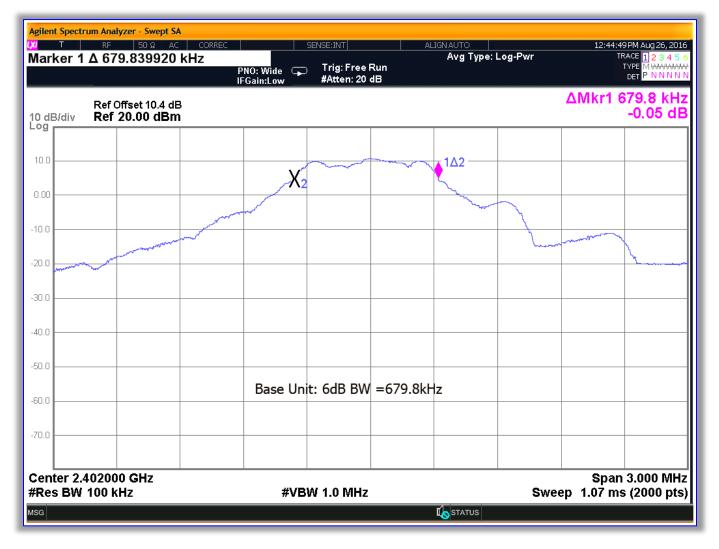


Figure 1: Occupied Bandwidth, Low Channel

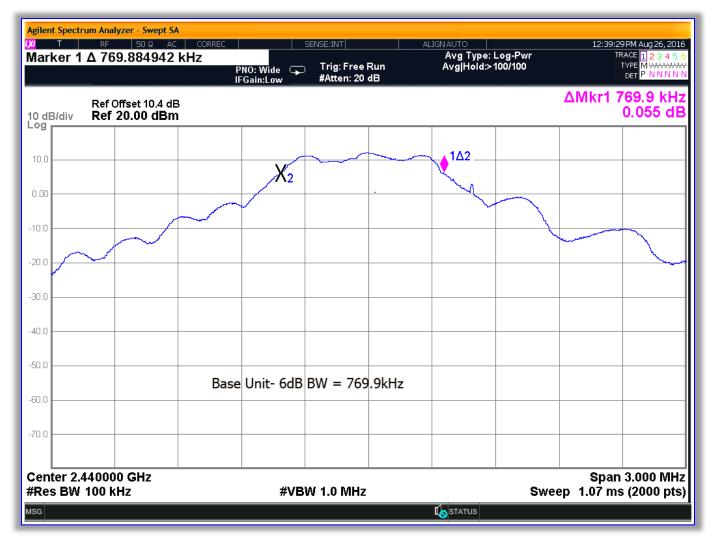


Figure 2: Occupied Bandwidth, Center Channel

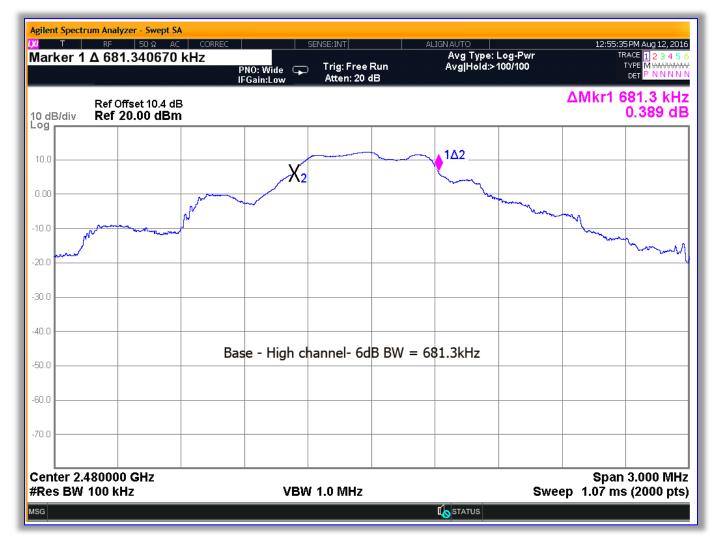


Figure 3: Occupied Bandwidth, High Channel

5.2 **RF Power Output:**

To measure the output power the unit was set to dwell on the low, high and middle channel. Testing was performed using the method from C63.10 section 11.9.1.1 "RBW \geq DTS bandwidth" at the antenna port as follows:

- a) Set the RBW \geq DTS bandwidth.
- b) Set VBW \geq [3 × RBW].
- c) Set span $\geq [3 \times RBW]$.
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level..

5.2.1 Measurement Method:

ANSI C63.10 section "11.9.1 Maximum peak conducted output power" subsection "11.9.1.1 RBW > DTS bandwidth"

 Table 7: Spectrum Analyzer Settings

Resolution Bandwidth	Video Bandwidth				
1MHz	3MHz				

Table 8: RF Power Output Summary

Frequency	Level	Limit	Pass/Fail
Low Channel: 2402MHz	10.67dBm	30dBm	Pass
Center Channel: 2440MHz	12.05dBm	30dBm	Pass
High Channel: 2480MHz	12.06dBm	30dBm	Pass

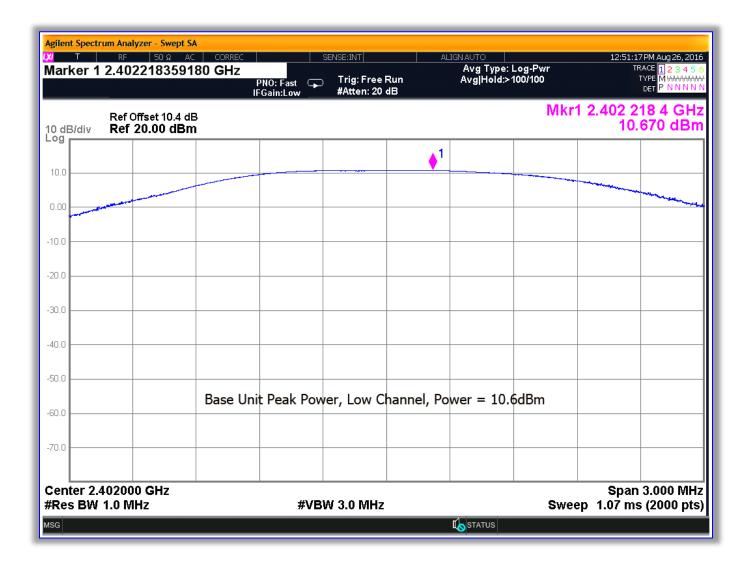


Figure 4: RF Peak Power, Low Channel

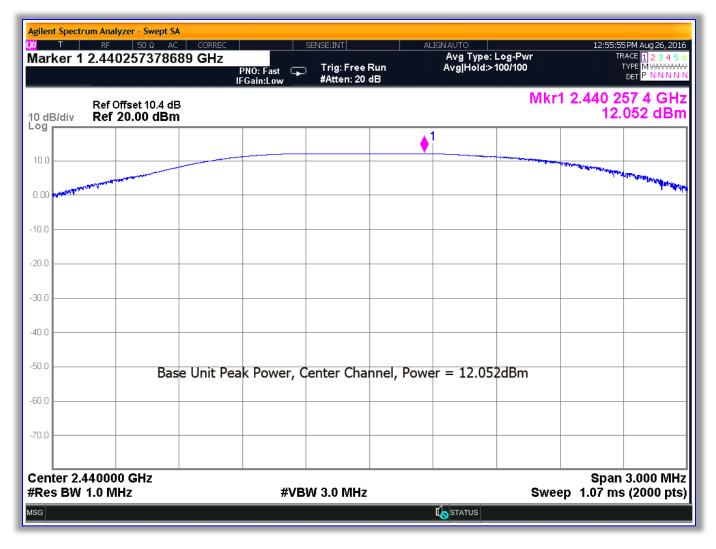


Figure 5: RF Peak Power, Center Channel

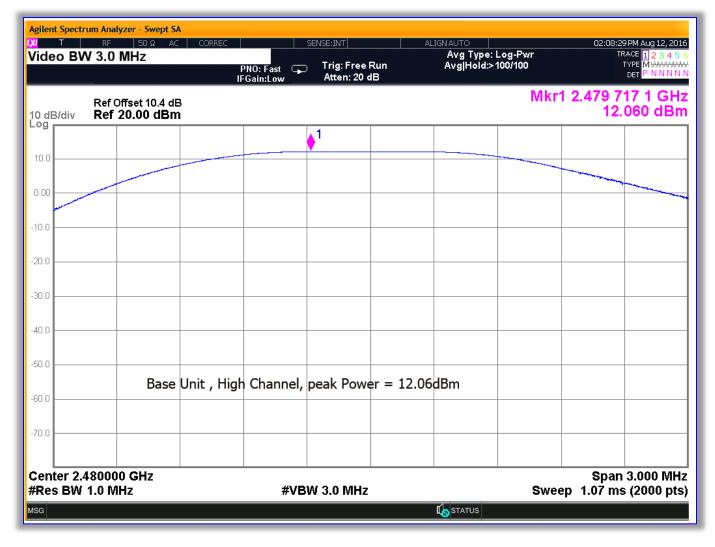


Figure 6: RF Peak Power, High Channel

5.3 **Power Spectral Density:**

Measurements for power spectral density were taken at the antenna port in accordance with ANSI C63.10. The spectrum analyzer was set to peak detect mode with a RBW of 3kHz ,VBW of 3MHz across a span 1.5x the DTS bandwidth using an auto sweep time.

5.3.1 Measurement Method:

ANSI C63.10 SECTION 11.10 "Maximum power spectral density level in the fundamental emission subsection 11.10.2 "Method PKPSD (peak PSD)"

The highest level detected across any 3 kHz band for continuous transmission was then recorded and compared to the limit 8dBm. The following table and plots give the results for power spectral density testing.

Frequency	Peak Level	Limit	Pass/Fail
Low Channel: 2402MHz	-3.38dBm	8dBm	Pass
Center Channel: 2440MHz	-2.01dBm	8dBm	Pass
High Channel: 2480MHz	0.32dBm	8dBm	Pass

Table 9: Power Spectral Density

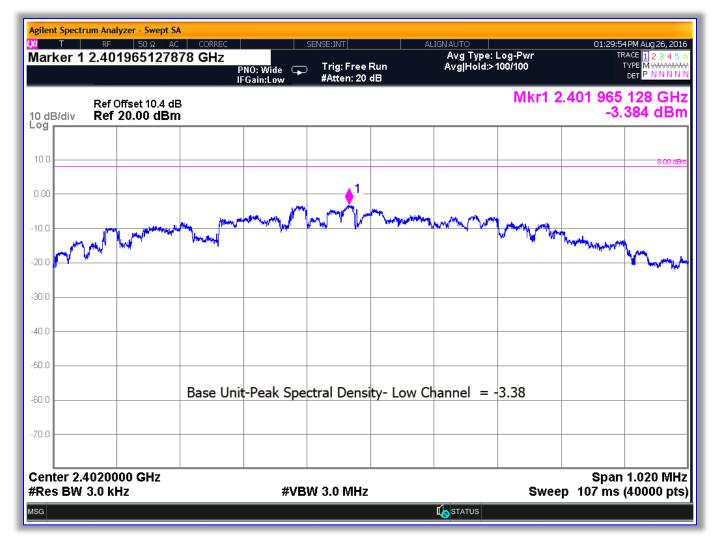


Figure 7: Power Spectral Density, Low Channel

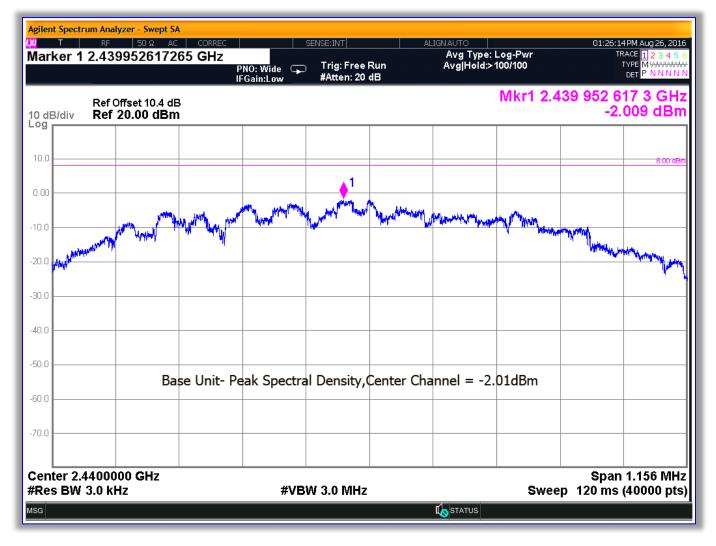


Figure 8: Power Spectral Density, Center Channel

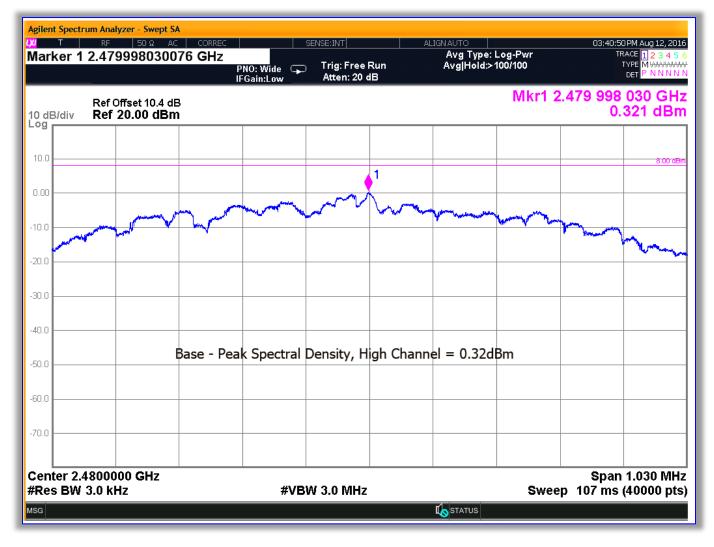


Figure 9: Power Spectral Density, High Channel

5.4 Conducted Spurious Emissions compliance

The EUT must comply with requirements for spurious emissions. Per §15.247(d) all spurious emissions in any 100 kHz bandwidth outside the frequency band in which the spread spectrum device is operating shall be attenuated 20 dB below the highest power level in a 100 kHz bandwidth within the band containing the highest level of the desired power.

Per ANSI C63.10 section 11.11 "Emissions in non-restricted frequency bands" this test may be performed in an antenna port conducted manner. The spectrum analyzer resolution bandwidth was set to 100 kHz and the video bandwidth was set to 300 kHz. The amplitude of the EUT carrier frequency was measured to determine the emissions limit (20 dB below the carrier frequency amplitude). The emissions outside of the allocated frequency band were then scanned from 30 MHz up to the tenth harmonic of the carrier. A peak detector was used for measurements.

As per ANSI C63.10 section 11.11.2 the high channel has the highest PSD and the limit for all channels was based on this level.

The following table shows the spurious emissions data.

5.4.1 Test Summary

The EUT complied with the requirements for spurious emissions at the antenna port.

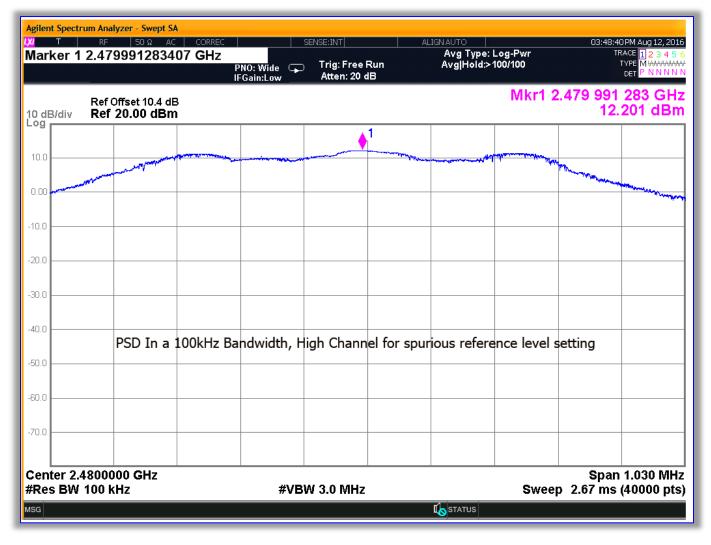


Figure 10: Highest PSD in a 100 kHz Channel (High channel)

Marker 1 994.883122078 MHz Avg Type: Log-Pwr Trace 1 2 3 4 Trig: Free Run AvglHold: 100/100 TYPE MWWWA	Agilent Spectrum Analyzer - Swept SA Ο// T RF 50 Ω AC CORREC SENSE:INT ALIGN AUTO D4:06:05 PM Aug 26, 2016											
PASS IPGG/Inst. Low #Atten: 20 dB Der P MAN 100 dB/div Ref Offset 10.4 dB Mkr1 994.883 MI -53.579 dB 10 dB/div Ref 20.00 dBm -53.579 dB 10.0 Image: state		ker 1 s			8 MHz		- · -		Avg Type: I	_og-Pwr	TR	RACE 1 2 3 4 5 6
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MSG STATUS	MSG								K STATUS			

Figure 11: Low Channel Conducted Spurious Plot 1

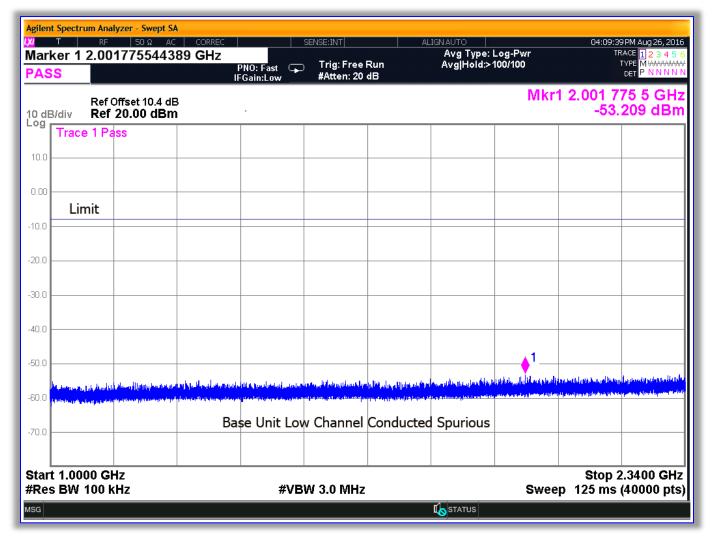


Figure 12: Low Channel Conducted Spurious Plot 2

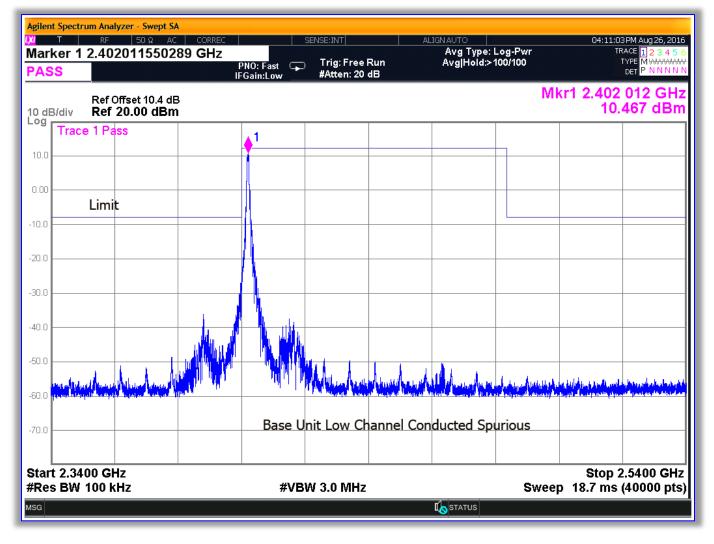


Figure 13: Low Channel Conducted Spurious Plot 3

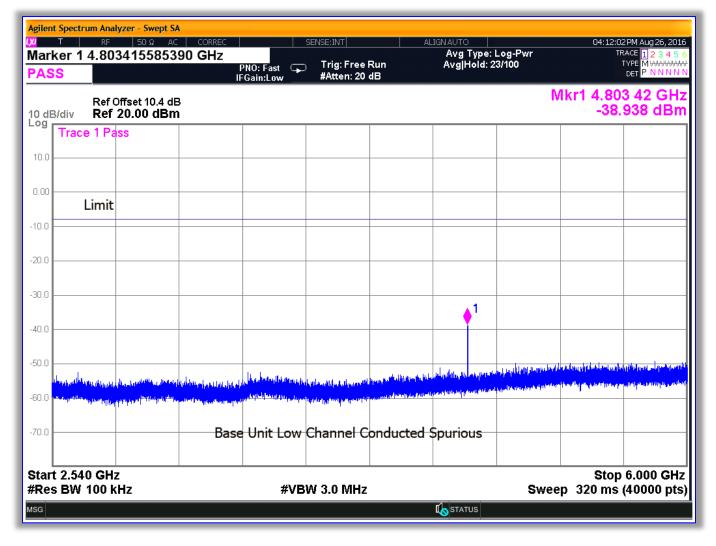


Figure 14: Low Channel Conducted Spurious Plot 4

Agilent Spectrum Analyzer - Swept SA Ο Odd Odd										
Mar	ker 1 6.7	99919998	000 GHz	PNO: Fast 🕞) Trig: Free	Run	Avg Type: I Avg Hold: 1	_og-Pwr 5/100	TR	ACE 1 2 3 4 5 6
PAS	is _		I	FGain:Low	#Atten: 20	dB			Miland C 7	
10 dE Log	B/div R e	f Offset 10.4 ef 20.00 dB								99 9 GHz 807 dBm
3	Trace 1	Pass								
10.0										
0.00										
	Limit	:								
-10.0										
-20.0										
-30.0										
-40.0										
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-70.0				Base Unit	Low Chan	nel Conduc	ted Spurio	us		
	Start 6.000 GHz Stop 10.000 GHz #Res BW 100 kHz #VBW 3.0 MHz Sweep 371 ms (40000 pts)									
MSG							I status			

Figure 15: Low Channel Conducted Spurious Plot 5

Agilent Spectrum Analyzer - Swept SA LXI T RF 50 Ω AC CORREC SENSE:INT ALIGN AUTO 04:13:53 PM Aug 26, 2016											
			04290107	253 GHz	PNO: Fast 🔾) Trig: Free	Run	Avg Type: Avg Hold: 1	Log-Pwr 6/100	TF	RACE 1 2 3 4 5 6
PAS	5				Gain:Low	#Atten: 20	dB			Alcud 42 C	
10 dE Log	3/div	Ref)ffset 10.4 dE 20.00 dBm							-48.	04 3 GHz 917 dBm
3	Trace	1 Pa	SS								
10.0											
0.00											
40.0	Lim	it									
-10.0											
-20.0											
-30.0											
-40.0											1
-50.0				للمقرير مراجع المراجع والالمراجع	. It is a date	rete de tau a tent d'adas e til.	فالاهلة الأدراء والدراد	la ah ah she ing a she ing a she a fa a ga	Additional and a state of the bill of the	مار و در ماداله از <mark>الارسان د</mark> ر ا	antificant set (that
-60.0	ing series in all series all b	an a	en en de la serie de la se	lahadi ka ya bay bay baya ya dani i nahari ka ya ti da mya da sa ya da sa	and the second	e sa kangini distrikani	participation participation (n and the second se	and the second	All the local terms of the party	ulf-Bestaulffegenties-Leates.p
-70.0				Base	Unit Low	Channel C	onducted	Spurious			
	Start 10.000 GHz Stop 14.000 GHz #Res BW 100 kHz #VBW 3.0 MHz Sweep 371 ms (40000 pts)										
MSG											

Figure 16: Low Channel Conducted Spurious Plot 6

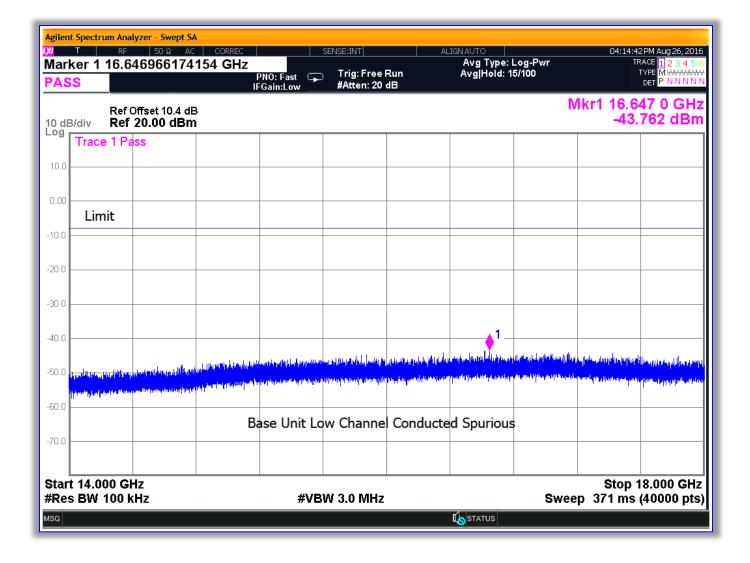


Figure 17: Low Channel Conducted Spurious Plot 7

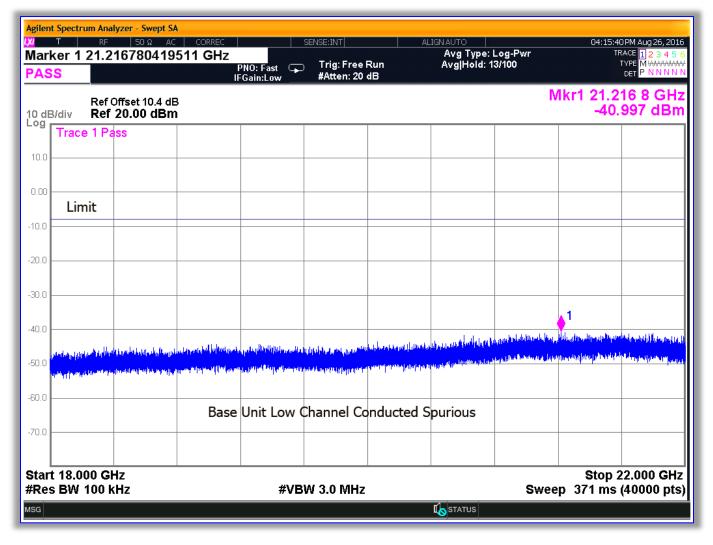


Figure 18: Low Channel Conducted Spurious Plot 8

T	RF 50 Ω AC	CORREC	9	SENSE:INT	AL	IGNAUTO			3PM Aug 26, 20
arker 1 ASS	24.8622215555		ast 🖵 Low	Trig: Free #Atten: 20		Avg Type: Avg Hold: 1	_og-Pwr 4/100		RACE 12345 TYPE MWWW DET PNNN
dB/div	Ref Offset 10.4 dB Ref 20.00 dBm						M	kr1 24.86 -37.	2 22 GH 844 dB
Trace	1 Pass								
0.0									
	Limit								
.0									
.0									. 1
.0							1		Linear and a build state
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.0 <mark>Uthillinetern</mark>	rdinka dinaka shuki pala (futan futan f	n i allandi parte di seri <mark>na da anti-</mark>	ataba ata pagt pitel ti	<mark>la kanthai kangkapapasa</mark>	digili dan Karatan (j.	<mark>leady of the state of the second s</mark>		and an investigated sector	
.0									
.0		Bas	se Unit	Low Chan	nel Condu	cted Spuri	ous		
.0									
art 22.00 les BW			#\/P\	N 3.0 MHz			Swoo	Stop 2 p 277 ms	25.000 GH
			#VD	W 3.0 WINZ			Swee		(40000 pi

Figure 19: Low Channel Conducted Spurious Plot 9

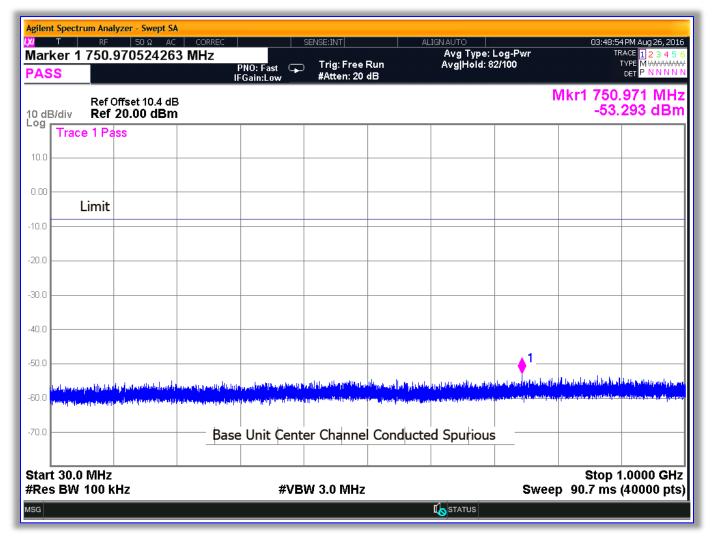


Figure 20: Center Channel Conducted Spurious Plot 1

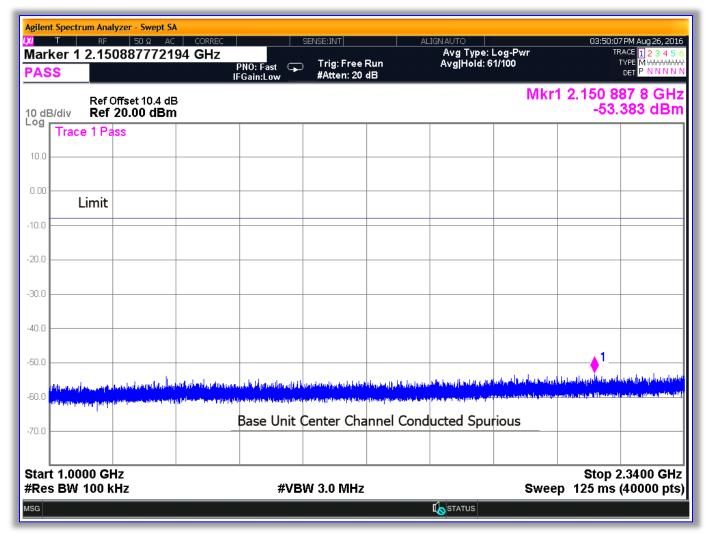


Figure 21: Center Channel Conducted Spurious Plot 2

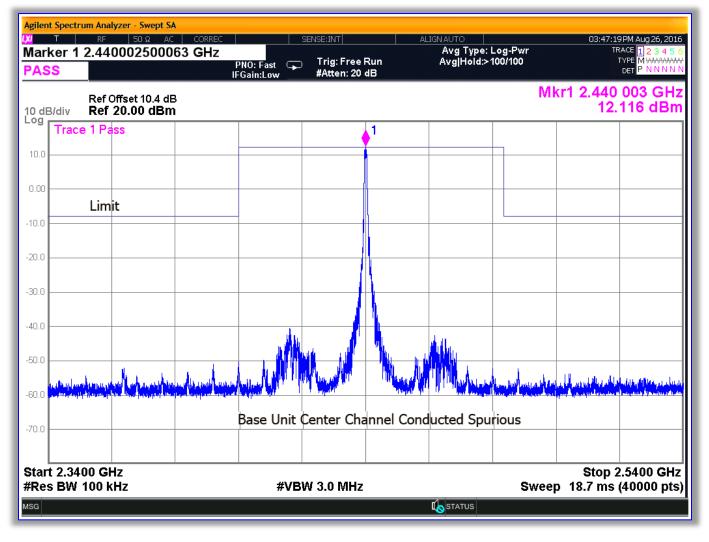


Figure 22: Center Channel Conducted Spurious Plot 3

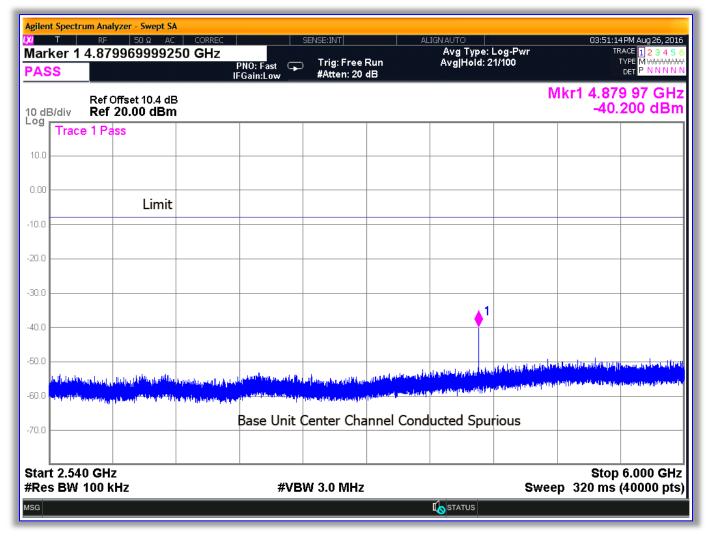


Figure 23: Center Channel Conducted Spurious Plot 4

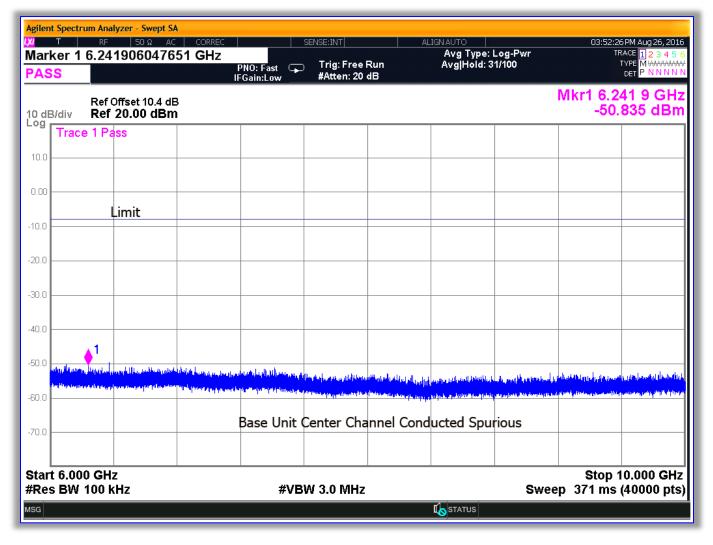


Figure 24: Center Channel Conducted Spurious Plot 5

Agilen	Agilent Spectrum Analyzer - Swept SA Official Sense: INT Align Auto O3:57:13 PM Aug 26, 2016 C/I T RF 50 Ω AC CORREC SENSE: INT ALIGN AUTO 03:57:13 PM Aug 26, 2016										
Mar			16690417	260 GHz	PNO: Fast			Avg Type: L Avg Hold: 2	.og-Pwr 5/100	TR	ACE 1 2 3 4 5 6
PAS	S			IF	Gain:Low	#Atten: 20					det <mark>PNNNN</mark>
10 dE Log	Ref Offset 10.4 dB Mkr1 13.616 7 GHz 10 dB/div Ref 20.00 dBm -48.636 dBm Log Trace 1 Pass -48.636 dBm										
10.0	Trace	1 Pa	SS								
0.00											
-10.0	Lin	nit									
-20.0											
-30.0											
-40.0											1
-50.0	ng bilita satati ki		and which a share a share where	التفرير بالفارية أترغم والقرارية	und plannourses about	n a da a calif di ta a di ta ta a ga ta a	the production of the local sector	an aphabatatistical publication of	ite providite policit, ite for a local	and the second states of the	lindense beken op otervelige Didektige des sterres og sterre
-60.0	and second s	entildetter.	agalalahahimaggatelega	en de la company de la comp	a <mark>dia kana dia kang kang kana kandi</mark> kati kati kati kati kati kati kati kati	<mark>, and an and a subsection of the sectors of the se</mark>	nderen server som	a na ana ana ana ana ana ana ana ana an	ومسخو حسل ويراور ويعاداتك	in _d alaran pilipada na kilangan In	
-70.0				Base	Unit Cent	er Channel	Conducted	d Spurious			
	t 10.00 s BW 1			·	#VE	W 3.0 MHz	·		Swee		4.000 GHz (40000 pts)
MSG								K STATUS			

Figure 25: Center Channel Conducted Spurious Plot 6

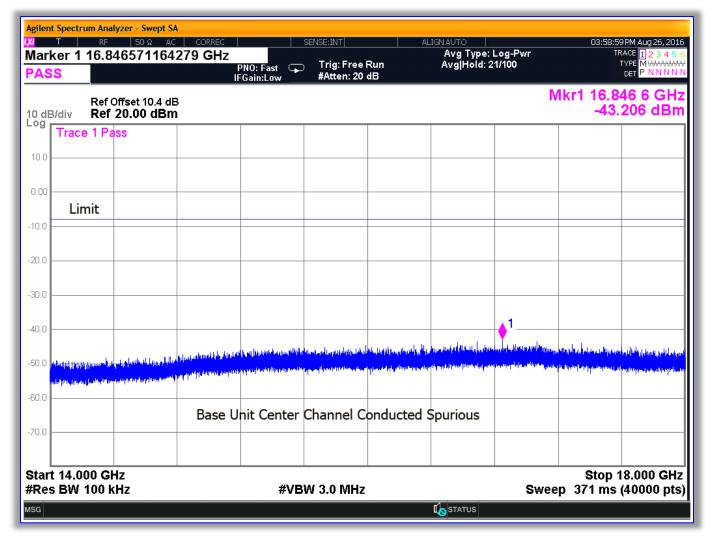


Figure 26: Center Channel Conducted Spurious Plot 7

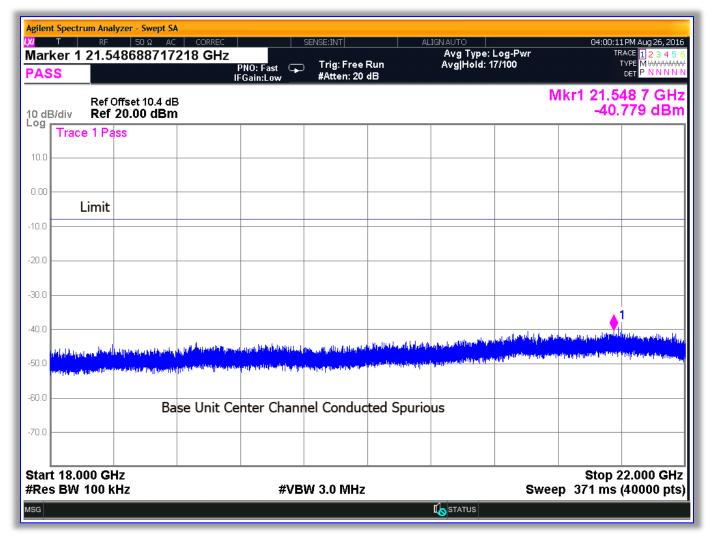


Figure 27: Center Channel Conducted Spurious Plot 8

Т	<mark>trum Analyzer - Sw</mark> RF 50 ຊ	AC CORREC		SENSE:INT	AL	.IGN AUTO			LO PM Aug 26, 20
arker ' <mark>ASS</mark>	1 24.978999	474987 GHz	PNO: Fast 😱 IFGain:Low	Trig: Free F #Atten: 20 d		Avg Type: Avg Hold: 2	_og-Pwr 1/100		RACE 12345 TYPE MWWWW DET PNNNN
dB/div	Ref Offset 10 Ref 20.00						M	kr1 24.97 -36.	'9 00 GH .972 dBi
Tra	ce 1 Pass								
0.0									
	imit								
1.0 <u> </u>	and the state of the second		والمرافق والمالي ومريا المرار	فالمردل مراد الملاطئة	Il and the state of the state of the	ALL DAY STREET	a a langaratikara k	and the second	a secondate to the way to be
	ale and a state of the state of	and the first state of the second state of the	in a second s	analy algerity and the p	undedi produjila je stanika	and the state of the second	elani), dias il mosfel	and a star star star star star star star st	and the second have
		the second s							
).0									
		B	ase Unit Ce	nter Chann	el Conduc	ted Spurio	us		
).0									
	000 GHz						-		25.000 GH
_	/ 100 kHz		#VB	W 3.0 MHz		_	Swe	ep 277 ms	(40000 pt
ŝ						I STATUS			

Figure 28: Center Channel Conducted Spurious Plot 9

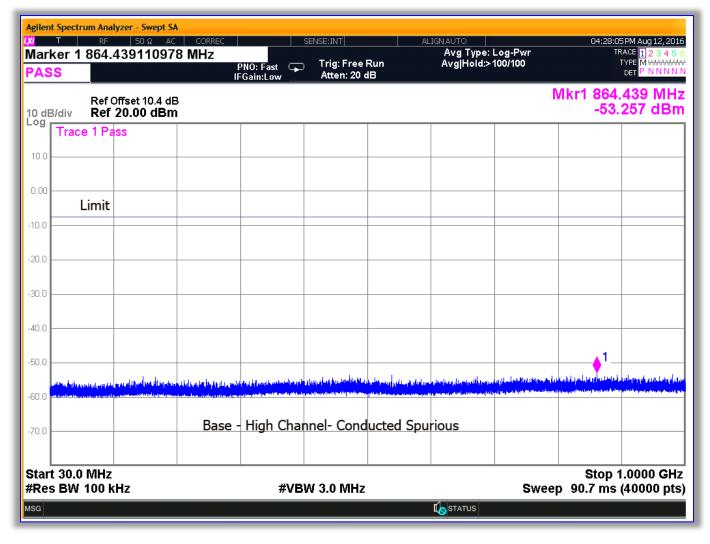


Figure 29: High Channel Conducted Spurious Plot 1

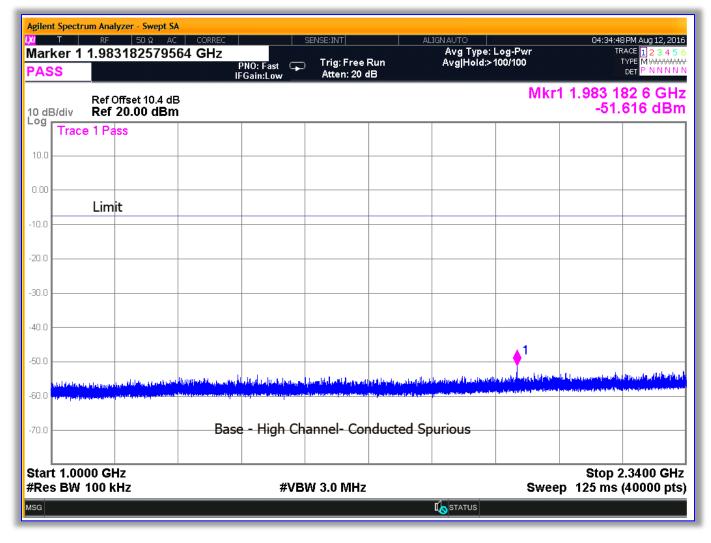


Figure 30: High Channel Conducted Spurious Plot 2

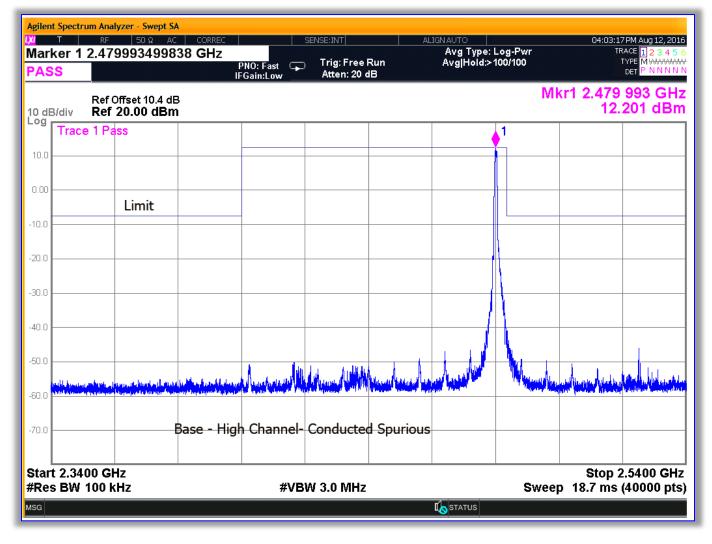


Figure 31: High Channel Conducted Spurious Plot 3

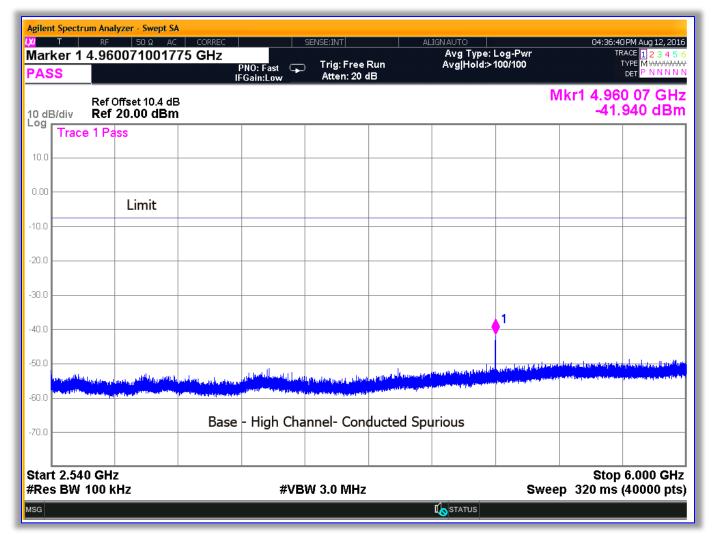


Figure 32: High Channel Conducted Spurious Plot 4

Agilent Spectrum Analyzer - Swept SA			
[™] T RF 50 Ω AC CORREC Marker 1 6.628715717893 GHz PASS	PNO: Fast Trig: Free IFGain:Low Atten: 20		04:38:26 PM Aug 12, 2016 Log-Pwr TRACE 1 2 3 4 5 6 51/100 TYPE MWWWWW DET P N N N N N
Ref Offset 10.4 dB 10 dB/div Ref 20.00 dBm			Mkr1 6.628 7 GHz -49.080 dBm
10.0 Trace 1 Pass			
0.00			
-10.0			
-20.0			
-30.0			
-60.0	and the stand of the former for the departed of the former formed a state of the present Annual state of the state of the former of Annual state of the former of the form		ly his come a plany day way half had no shifting and had no and had no and had no share at the normalization of the share
-70.0	Base - High Channel-	Conducted Spurious	
Start 6.000 GHz #Res BW 100 kHz	#VBW 3.0 MH	z	Stop 10.000 GHz Sweep 371 ms (40000 pts)
MSG		I STATUS	

Figure 33: High Channel Conducted Spurious Plot 5

Agilen	nt Spectru	<mark>ım Analyzer</mark> RF	<mark>- Swept SA</mark> 50 Ω AC	CORREC		SENSE:INT		ALIGNAUTO		04:40:2	27 PM Aug 12, 2016
Mar PAS				774 GHz	PNO: Fast G			Aug Type: Avg Hold:			RACE 1 2 3 4 5 6 TYPE MWWWWW DET P N N N N N
10 dE	B/div		et 10.4 dE 00 dBm							Mkr1 13.6 -49	38 2 GHz 485 dBm
Log	Trace	1 Pass									
10.0											
0.00	Lin	nit									
-10.0											
-20.0							<u> </u>				
-30.0							<u> </u>				
-40.0											
-50.0											↓ ¹
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-60.0	L Alfaton de la co	a non die 19 mil 19 mil 19 mil 19 mil	and and a standard of the								
-70.0				De	ise - riigh			ted Spurious			
Star	L)0 GHz								Stop	14.000 GHz
#Re		100 kHz			#VI	BW 3.0 MHz			Swe	ep 371 ms	
MSG											

Figure 34: High Channel Conducted Spurious Plot 6

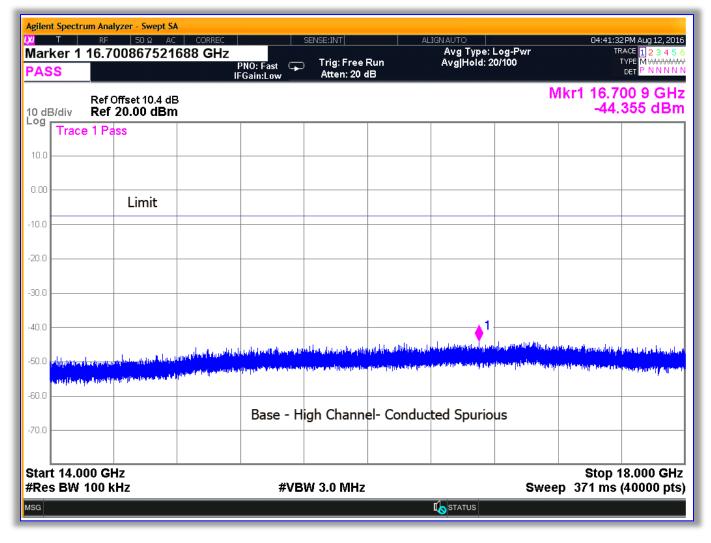


Figure 35: High Channel Conducted Spurious Plot 7

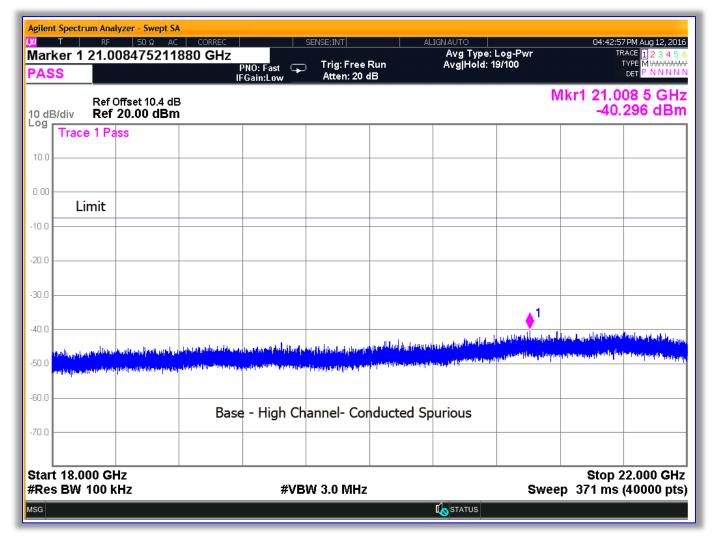


Figure 36: High Channel Conducted Spurious Plot 8

и т		Ω AC CORREC		SENSE:INT	AL	IGN AUTO			6 PM Aug 12, 20
larke ASS	er 1 24.972474	F	'NO: Fast 🕞 Gain:Low	Trig: Free I Atten: 20 d		Avg Type: I Avg Hold:>1	_og-Pwr I00/100		RACE 12345 TYPE MWWW DET PNNN
0 dB/c	Ref Offset 1 div Ref 20.00						М	kr1 24.97 -38.	2 47 GH 590 dBi
۳F	Trace 1 Pass								
10.0 —									
1.00	Limit								
0.0									
0.0									
0.0									
0.0				a sana dana sa saka sa saka sa sa si kila sa siki	l de la Marine discon de la cont	a ha hada data	a line da ata da	a hand the set of standard	
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io.o —									
io.o 🗕									
0.0		Base - High	Channel-	Conducted	Spurious				
°0.0									
	22.000 GHz					1		Stop :	25.000 GH
Res	BW 100 kHz		#VB	W 3.0 MHz			Swee	ep 277 ms	(40000 pt
SG						I STATUS			

Figure 37: High Channel Conducted Spurious Plot 9



Figure 38: Lower Band Edge Low Channel

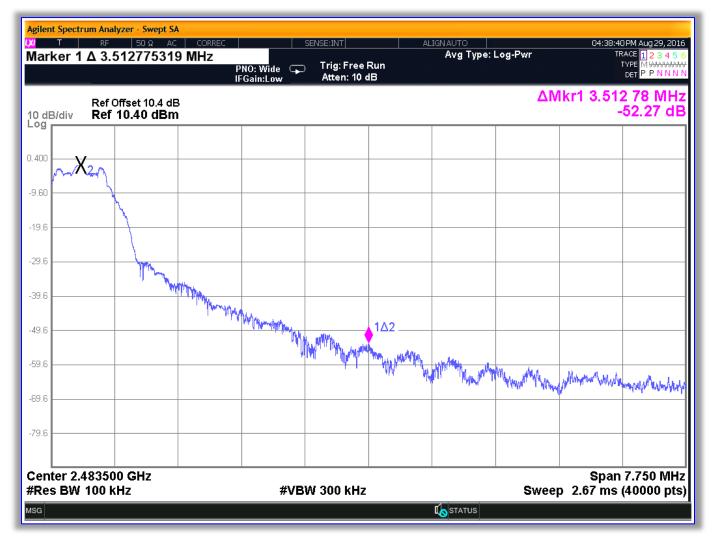


Figure 39: Upper Band Edge High Channel

5.5 Radiated Spurious Emissions:

The EUT must comply with the requirements for radiated spurious emissions that fall within the restricted bands. These emissions must meet the limits specified in §15.209 and §15.35(b) for peak measurements.

5.5.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. Both the horizontal and vertical field components were measured.

The EUT was tested in 3 orthogonals with the worst case readings reported.

Above 1GHz the EUT was placed on a 1.5meter table with RF absorber material between the EUT and Receive antenna.

The emissions were measured using the following resolution bandwidths:

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	100kHz	1MHz
>1000 MHz	1 MHz	3MHz

Table 10: Spectrum Analyzer Settings

Average measurements above 1GHz were made with the Spectrum analyzer set to RMS Average. Correction factors were then applied and the resulting value was compared to the limit.

The EUT was scanned up to 25GHz.

5.5.1.1 Duty Cycle Corrections

A duty cycle correction of 3.2dB was added to the RMS average readings to compensate for the on time of the EUT in accordance with C63.10 section 11.13.3.4.

The measured duty cycle = (Time on)/(Time on and Time off)=291.2us/625.1us=0.47 (47%)

Correction Calculation = 10*Log (1/(duty cycle) = 10*Log (1/0.47) = 3.2dBm



Figure 40: Duty Cycle Calculation

5.5.2 Test Summary

The EUT complied with the requirements for radiated spurious emissions.

Table 11: Radiated Emission Test Data (all Channels)(Restricted Bands)

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Duty Cycle Correction (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
37.80	V	0.00	1.00	33.97	-8.2	0.0	19.4	100.0	-14.3
114.30	V	90.00	1.30	36.34	-9.8	0.0	21.1	150.0	-17.0
255.04	V	270.00	1.92	32.02	-11.3	0.0	10.8	200.0	-25.3
38.17	Н	45.00	4.00	28.67	-8.5	0.0	10.2	100.0	-19.8
114.43	Н	90.00	3.60	32.85	-9.8	0.0	14.1	150.0	-20.5
264.45	Н	190.00	2.90	32.87	-10.3	0.0	13.4	200.0	-23.5

Table 12: Radiated Emission	Test Data, Low Channel
-----------------------------	------------------------

Low Channel @ 2402MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Duty Cycle Correction (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2402.00	V	190.00	3.60	99.86	-1.5	0.0	82622.8	NA	NA	Fundamental-pk
2390.00	V	190.00	3.60	49.54	-1.5	0.0	252.8	5000.0	-25.9	pk
2390.00	V	190.00	3.60	38.75	-1.5	3.2	105.6	500.0	-13.5	Ave
4804.00	V	270.00	4.00	46.11	3.2	0.0	290.8	5000.0	-24.7	pk
4804.00	V	27.00	4.00	38.00	3.2	3.2	165.2	500.0	-9.6	Ave
12010.00	V	0.00	3.60	37.90	14.1	0.0	398.2	5000.0	-22.0	nlı
12010.00	V	0.00	3.60	26.48	14.1	3.2	154.6	500.0	-10.2	pk Ava
12010.00	V	0.00	5.00	20.48	14.1	5.2	134.0	500.0	-10.2	Ave
2402.00	TT	100.00	2.51	101.20	1.5	0.0	006166	NT A	NT A	
2402.00	Н	180.00	3.51	101.39	-1.5	0.0	98616.6	NA	NA	Fundamental-pk
2390.00	Н	180.00	3.51	47.89	-1.5	0.0	209.1	5000.0	-27.6	pk
2390.00	Н	180.00	3.51	38.83	-1.5	3.2	106.5	500.0	-13.4	Ave
4804.00	Н	10.00	3.66	48.59	3.2	0.0	386.9	5000.0	-22.2	pk
4804.00	Н	10.00	3.66	39.52	3.2	3.2	196.8	500.0	-8.1	Ave
12010.00	Н	90.00	4.00	36.69	14.1	0.0	346.4	5000.0	-23.2	pk
12010.00	Н	90.00	4.00	25.80	14.1	3.2	142.9	500.0	-10.9	Ave

Table 13: Radiated Emission Test Data, Center Channel

Center Channel @ 2440 MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Duty Cycle Correction (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2440.00	V	60.00	3.40	102.20	-1.5	0.0	108445.8	NA	NA	Fundamental-pk
4880.00	V	45.00	3.80	49.99	4.5	0.0	531.0	5000.0	-19.5	pk
4880.00	V	45.00	3.80	41.80	4.5	3.2	298.9	500.0	-4.5	Ave
7320.00	V	90.00	3.40	45.30	11.3	0.0	674.2	5000.0	-17.4	pk
7320.00	V	90.00	3.40	33.83	11.3	3.2	260.3	500.0	-5.7	Ave
12200.00	V	10.00	3.80	40.50	14.6	0.0	571.6	5000.0	-18.8	pk
12200.00	V	10.00	3.80	29.50	14.6	3.2	232.8	500.0	-6.6	Ave
2440.00	Н	60.00	3.40	102.06	-1.5	0.0	106736.5	NA	NA	Fundamental-pk
4880.00	Н	90.00	3.15	48.50	4.5	0.0	447.3	5000.0	-21.0	pk
4880.00	H	90.00	3.15	48.30 39.70	4.5	3.2	234.7	500.0	-6.6	-
4880.00	п	90.00	5.15	39.70	4.3	5.2	234.7	300.0	-0.0	Ave
7320.00	Н	90.00	3.15	45.12	11.3	0.0	660.9	5000.0	-17.6	pk
7320.00	Н	90.00	3.15	34.00	11.3	3.2	265.5	500.0	-5.5	Ave
			_							
12200.00	Н	190.00	3.20	41.20	14.6	0.0	619.5	5000.0	-18.1	pk
12200.00	Н	190.00	3.20	30.10	14.6	3.2	249.5	500.0	-6.0	Ave

Table 14: Radiated Emission Test Data, High Channel

High Channel @ 2480MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Duty Cycle Correction (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)	Comments
2480.00	V	90.00	3.80	102.50	-1.5	0.0	112515.0	NA	NA	Fundamental-pk
2402.50	**	00.00	2.00	50.00					160	
2483.50	V	90.00	3.80	59.20	-1.5	0.0	769.7	5000.0	-16.3	pk
2483.50	V	90.00	3.80	42.10	-1.5	3.2	155.3	500.0	-10.2	Ave
4960.00	v	90.00	4.00	48.21	3.2	0.0	373.7	5000.0	-22.5	pk
4960.00	V	90.00	4.00	40.39	3.2	3.2	219.7	500.0	-7.1	Ave
7440.00	V	45.00	3.63	42.00	10.8	0.0	437.9	5000.0	21.2	, nlt
7440.00	V V	45.00	3.63	29.62	10.8	3.2	152.2	500.0	-21.2	pk Ave
7440.00	v	43.00	3.03	29.02	10.8	5.2	132.2	500.0	-10.5	Ave
12400.00	V	45.00	3.90	40.44	15.1	0.0	594.8	5000.0	-18.5	pk
12400.00	V	45.00	3.90	28.83	15.1	3.2	226.0	500.0	-6.9	Ave
2480.00	Н	0.00	2.80	100.66	-1.5	0.0	91014.5	NA	NA	Fundamental-pk
2483.50	Н	0.00	2.80	58.37	-1.5	0.0	699.5	5000.0	-17.1	pk
2483.50	H	0.00	2.80	41.02	-1.5	3.2	137.2	500.0	-11.2	Ave
10(0.00		0.00	1.00	10.04	2.2	0.0	266.5	5000.0	22.7	
4960.00	H	0.00	4.00	48.04	3.2	0.0	366.5	5000.0	-22.7	pk
4960.00	Н	0.00	4.00	39.26	3.2	3.2	192.9	500.0	-8.3	Ave
7440.00	Н	10.00	3.58	43.02	10.8	0.0	492.2	5000.0	-20.1	pk
7440.00	Н	10.00	3.58	30.60	10.8	3.2	170.4	500.0	-9.4	Ave
12400.00	Н	90.00	4.00	38.30	15.1	0.0	464.9	5000.0	20.6	nk
12400.00	н Н	90.00	4.00	26.78	15.1	3.2	464.9	5000.0 500.0	-20.6 -8.9	pk Ave
12400.00	п	90.00	4.00	20.78	13.1	3.2	1/8.3	500.0	-0.9	Ave

5.6 Co-Located Transmitters Attestation

The Base Station device (EUT) was scanned in a radiated fashion with both the Wi-Fi 802.11b/g/n transmitter and the onboard 2.4GHz DTS device simultaneously transmitting. During this radiated emissions scan no spurious emissions over the FCC class 'B' limits or intermodulation products were noted. The unit was scanned up to 25GHz (10 harmonic)

5.7 Conducted AC Mains Emissions

5.7.1 Requirements

Test Arrangement: Table Top

Compliance Standard: FCC Part 15 (10/2014), Class B

FCC Compliance Limits							
Frequency	Quasi-peak	Average					
0.15-0.5MHz	66 to 56dBµV	56 to 46dBµV					
0.5 to 5MHz	56dBµV	46dBµV					
0.5-30MHz	60dBµV	50dBµV					

5.7.2 Test Procedure

The requirements of FCC Part 15 and RSS-Gen call for the EUT to be placed on an 80 cm high 1 X 1.5 m non-conductive table above a ground plane. Power to the EUT was provided through a Solar Corporation 50 Ω /50 μ H Line Impedance Stabilization Network bonded to a 3 X 2 meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power was supplied to the peripherals through a second LISN. The peripherals were placed on the table in accordance with ANSI C63.4. Power and data cables were moved about to obtain maximum emissions.

The 50 Ω output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 150 kHz to 30 MHz were measured. The detector function was set to quasi-peak, peak, or average as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth. For average measurements the post-detector filter was set to 10 Hz.

At frequencies where quasi-peak or peak measurements comply with the average limit, no average measurements need be performed.

5.7.3 Test Data

The EUT complied with the Class B Conducted Emissions requirements. Table 6 provides the test results for phase and neutral line power line conducted emissions.

5.7.4 Conducted Data Reduction and Reporting

At frequencies where quasi-peak or peak measurements comply with the average limit, no average measurements need be performed. The Conducted emissions level to be compared to the FCC limit is calculated as shown in the following example.

Example:

Spectrum Analyzer Voltage: VdBµV

LISN Correction Factor: LISN dB

Cable Correction Factor: CF dB

Electric Field: $EdB\mu V = V dB\mu V + LISN dB + CF dB$

Table 15: Conducted Emission Test Data

Tested though AC/USB adaptor PHIHONG Model PSA05A-050QL6

NEUTRAL

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.508	33.1	29.0	10.2	0.2	43.5	39.4	56.0	46.0	-12.5	-6.6
1.160	32.5	27.4	10.3	0.2	42.9	37.8	56.0	46.0	-13.1	-8.2
0.850	21.6	15.9	10.3	0.1	31.9	26.3	56.0	46.0	-24.1	-19.7
1.412	19.9	13.7	10.2	0.2	30.3	24.1	56.0	46.0	-25.7	-21.9
5.222	20.8	11.8	10.7	0.1	31.6	22.6	60.0	50.0	-28.4	-27.4
8.200	19.4	10.6	11.0	0.3	30.7	21.9	60.0	50.0	-29.3	-28.1

Phase

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.520	29.8	25.2	10.2	0.4	40.4	35.8	56.0	46.0	-15.6	-10.2
1.160	31.8	26.8	10.3	0.1	42.2	37.2	56.0	46.0	-13.8	-8.8
0.890	19.8	13.2	10.3	0.1	30.2	23.6	56.0	46.0	-25.8	-22.4
1.381	20.1	13.5	10.2	0.2	30.5	23.9	56.0	46.0	-25.5	-22.1
6.280	19.2	9.9	10.9	0.1	30.1	20.8	60.0	50.0	-29.9	-29.2
7.500	18.9	11.1	11.0	0.1	30.0	22.2	60.0	50.0	-30.0	-27.8