

EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 103097968BOX-024 **Project Number:** G103097968

Report Issue Date: 09/24/2017

Model(s) Tested: Mx Encoder Model(s) Partially Tested: None Model(s) Not Tested but declared equivalent by the client: None

> Standards: CFR47 FCC Part 15 Subpart C (15.247): 09/2017 CFR47 FCC Part 15 Subpart B: 09/2017

Tested by: Intertek Testing Services NA, Inc. 70 Codman Hill Road Boxborough, MA 01719 USA Client: Simbex 10 Water Street Suite 410 Lebanon, NH 03766 USA

Report prepared by Naga Suryadevara

Naga Suryadevara/EMC Project Engineer

Report reviewed by Kouma Sinn

A A

Kouma Sinn/Staff Engineer, EMC

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

Table of Contents

1	Introduction and Conclusion	}
2	Test Summary	}
3	Client Information4	ļ
4	Description of Equipment Under Test and Variant Models	ļ
5	System Setup and Method	5
6	Maximum Peak Power and Human RF exposure7	7
7	Occupied Bandwidth and 6dB Bandwidth11	I
8	Power Spectral Density	;
9	Conducted Spurious and Band Edge Emissions19)
10	Transmitter Spurious Emissions28	3
11	Digital Device Radiated Spurious Emissions46	;
12	Revision History	ļ

1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
3	Client Information	
4	Description of Equipment Under Test and Variant Models	
5	System Setup and Method	
6	Output Power and Human RF Exposure (CFR47 FCC Part 15 Subpart C (15.247): 09/2017)	Pass
7	Occupied (99%) and 6 dB Bandwidth (CFR47 FCC Part 15 Subpart C (15.247): 09/2017)	Pass
8	Power Spectral Density (CFR47 FCC Part 15 Subpart C (15.247): 09/2017)	Pass
9	Conducted Spurious and Band edge emissions (CFR47 FCC Part 15 Subpart C (15.247): 09/2017)	Pass
10	Transmitter Spurious Emissions (CFR47 FCC Part 15 Subpart C (15.247): 09/2017)	Pass
11	Digital Device Radiated Spurious Emissions (CFR47 FCC Part 15 Subpart B: 09/2017)	Pass
	AC Mains Conducted Emissions (CFR47 FCC Part 15 Subpart B: 09/2017)	N/A*
12	Revision History	

*Device is battery powered.

3 Client Information

This EUT was tested at the request of:

Client:	Simbex 10 Water Street Suite 410 Lebanon, NH 03766 USA		
Contact:	Spencer Brugger		
Telephone:	603-448-2367 x 395		
Fax:	None		
Email:	sbrugger@simbex.com		

4 Description of Equipment Under Test and Variant Models

Manufacturer:	Simbex
	10 Water Street Suite 410
	Lebanon, NH 03766
	USA

Equipment Under Test					
Description Manufacturer Model Number Serial Number					
Mx Encoder	Simbex	Mx	00217F15-01		

Receive Date:	06/14, 08/04/2017
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client) The EUT is an Mx Encoder

Equipment Under Test Power Configuration					
Rated Voltage Rated Current Rated Frequency Number of Phases					
3.6 VDC	1000 mAh	N/A	N/A		

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Tx mode on Low Mid and High channels
2	Rx mode

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	Not Provided

Radio/Receiver Characteristics			
Frequency Band(s)	2412-2462 MHz		
Modulation Type(s)	OFDM (802.11n)		
Data Rate	65 Mbps		
Maximum Output Power	19.42 dBm		
Test Channels	Low (2412 MHz), Mid (2437 MHz), High channels (2462 MHz)		
Occupied Bandwidth	18.30 MHz		
Frequency Hopper: Number of Hopping	N/A		
Channels			
Frequency Hopper: Channel Dwell Time	N/A		
Frequency Hopper: Max interval between	N/A		
two instances of use of the same channel			
MIMO Information (# of Transmit and	N/A		
Receive antenna ports)			
Equipment Type	Radio Module		
ETSI LBT/Adaptivity	N/A		
ETSI Adaptivity Type	N/A		
ETSI Temperature Category (I, II, III)	N/A		
ETSI Receiver Category (1, 2, 3)	N/A		
Antenna Type and Gain	Integral (1.9 dBi)		

Variant Models:

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

None

5 System Setup and Method

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
	None				

Support Equipment					
Description	Manufacturer	Model Number	Serial Number		
None					

5.1 Method:

Configuration as required by FCC Part 15 Subpart B: 2017, FCC Part 15 Subpart C: 2017, ANSI C63.4:2014 and ANSI C63.10.2013.

5.2 EUT Block Diagram:



Battery power

6 Maximum Peak Power and Human RF exposure

6.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247 and ANSI C63.10.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
ROS005'	ETSI Test System	Rhode & Schwartz	TS8997	N/A	09/15/2016	09/15/2017
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61A	05/10/2017	05/10/2018
CBLHF2012-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/08/2017	02/08/2018

Software Utilized:

Name	Manufacturer	Version
None		

6.3 Results:

The sample tested was found to Comply.

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt or 30 dBm.

Intertek

6.4 Plots/Data:



Date: 13.SEP.2017 16:58:30



Mid Channel (2462 MHz) Output Power = 17.89 dBm

Intertek

Date: 13.SEP.2017 10:55:12

Issued: 09/24/2017

Human RF Exposure

a) For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] $\cdot \left[\sqrt{f_{(GHz)}}\right] \le 3.0$ for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,³⁰ where

• f(GHz) is the RF channel transmit frequency in GHz

Maximum Output Power = 19.42 dBm @ 2437 MHz = 87.49 mW

Maximum duty cycle of the product during normal operation declared by the manufacturer = 0.02

Pavg = Peak Power*Duty Cycle = 87.49*0.02 = 1.74 mW

SAR = 0.53 < 3.0

Device meets SAR exclusion through calculation.

Test Personnel: Supervising/Reviewing	Naga Suryadevara N 5	Test Date:	09/13/2017
Engineer:	N/A		
Product Standard:	FCC Part 15 Subpart C	Limit Applied:	As specified in section 6.3
Input Voltage:	3.3 VDC		
Pretest Verification w/		Ambient Temperature:	22ºC
BB Source:	Yes – Signal generator	Relative Humidity:	44 %
		Atmospheric Pressure:	1003 mbars

Deviations, Additions, or Exclusions: None

7 Occupied Bandwidth and 6dB Bandwidth

7.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247 and ANSI C63.10.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

7.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
ROS005'	ETSI Test System	Rhode & Schwartz	TS8997	N/A	09/15/2016	09/15/2017
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61A	05/10/2017	05/10/2018
CBLHF2012-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/08/2017	02/08/2018

Software Utilized:

Name	Manufacturer	Version
None		

7.3 Results:

The sample tested was found to Comply.

§15.247 (a) (2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Issued: 09/24/2017

7.4 Plots/Data:



Intertek

Date: 13.SEP.2017 13:10:19

Low Channel (2412 MHz) 6dB Bandwidth = 18.30 MHz



Date: 13.SEP.2017 13:11:16



Date: 13.SEP.2017 17:00:04



Mid Channel (2437 MHz) 6dB Bandwidth = 18.10 MHz

Date: 13.SEP.2017 17:01:19



High Channel (2462 MHz) Occupied Bandwidth = 17.86 MHz

Date: 13.SEP.2017 10:47:49





Date: 13.SEP.2017 10:45:48

		Intertek	
Report Number: 103	3097968BOX-024		Issued: 09/24/2017
Test Personnel	Naga Survadavara N.5	Test Date:	00/13/2017
Supervising/Reviewing	Naga Sulyadevala (4 S		03/13/2011
Engineer:	Ν/Δ		
Product Standard:	FCC Part 15 Subpart C	Limit Applied:	As specified in section 7.3
Input Voltage:	3.3 VDC		
Pretest Verification w/		Ambient Temperature:	22°C
Ambient Signals or BB Source:	Yes – Signal generator	Relative Humidity:	44 %
		Atmospheric Pressure:	1003 mbars

Deviations, Additions, or Exclusions: None

8 **Power Spectral Density**

8.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247 and ANSI C63.10.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
ROS005'	ETSI Test System	Rhode & Schwartz	TS8997	N/A	09/15/2016	09/15/2017
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61A	05/10/2017	05/10/2018
CBLHF2012-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/08/2017	02/08/2018

Software Utilized:

Name	Manufacturer	Version
None		

8.3 Results:

The sample tested was found to Comply.

§15.247 (e) For digitally modulated systems, 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.

8.4 Plots/Data:



Att	10 dB SWT	1.02 ms 🖷 VBW	300 kHz Mod	le Auto Sweep					
1 Frequenc	y Sweep								⊙2Pk Max
							M1	[2]	-1.86 dBn
20 dBm									2,4395020 GH
10 dBm									
0 dBm	-3.000 dBm			when have been been as	M1				
-10 dBm				Hat Managements of	lan Jera di Inalita Anast	4			
-20 dBm			- W			h.			
-30 dBm			nort			hy h			
			Manne			Why			
-40 dBm		AMM May May 100	(b ^{rad}				Www.WMhine		
-50 dBm	Mr. Why with My	ADVI:					wy.	Munundyna	4 Here the Joyly Marti
-60 dBm									
-70 dBm									
CF 2.437 G	Hz		1001 pt	S	8.	35 MHz/			Span 83.5 MHz

Date: 13.SEP.2017 16:59:26

Fighter of the second s	🕤 Spectrun	ı							
Ref Level 16.0 Att	0 dBm 26 dB SWT	● RE 1.02 ms ● VE	3W 100 kHz 3W 300 kHz Mod	le Auto Sweep					
1 Frequency S	weep								© 2Pk Max
								M1[2]	-5.57 dBr 2.4645040 GH
10 dBm									
0 dBm					M1				
				when higher when	when broken deed when				
-10 dBm				/					
					1				
-20 dBm			Í			1			
			J.			hu.			
-30 dBm			المار			hu,			
			had water			Mader			
-40 dBm	endehen warmente	Muderla Harth Mal	war war			May	mulumpature	Mush. rown or mel	munterview
alma-nd adno-A date	P0000- 0 ~	1							
-50 dBm									
-60 dBm									
-70 dBm									
oo daa									
-ou ubili			1001						
05 0 460 011			1001 p	ts	8.	36 MHZ/		5	pan 83.56 MH: 13.09.2017
CF 2.462 GHz			Instrumont u				measuring		10.40.01
CF 2.462 GHz	7 10:49:01		Instrument w	arning up		. ,			10/15/01
CF 2.462 GHz	7 10:49:01		Instrument w	winning up					
CF 2.462 GHz Date: 13.SEP.201	7 10:49:01		Instrument w	anning ap			t Deter	0/40/0047	101101
CF 2.462 GHz Date: 13.SEP.201 Test Pers	7 10:49:01	aga Suryad	devara N·5	unning op		Tes	t Date: _0	9/13/2017	
CF 2.462 GHz Date: 13.SEP.201 Test Pers ervising/Revi	7 10:49:01	aga Suryad	devara N·5			Tes	t Date: _0	9/13/2017	
CF 2.462 GHz Date: 13.SEP.201 Test Pers ervising/Revi Eng Where Appli	7 10:49:01 connel: <u>Na</u> iewing jineer: icable) N	aga Suryad	devara N·5			Tes	t Date: _ 09	9/13/2017	
CF 2.462 GHz Date: 13.SEP.201 Test Pers ervising/Revi Enc Where Appli Product Sta	7 10:49:01 connel: <u>N</u> iewing jineer: icable) <u>N</u> ndard: F(aga Suryad /A CC Part 15	devara N·5			Tes Limit A	t Date: <u>09</u> pplied: A	9/13/2017 s specified ir	section 8.3
CF 2.462 GHz Date: 13.SEP.201 Test Pers ervising/Revi Eng Where Appli Product Star Input Vo	7 10:49:01 connel: <u>N</u> iewing gineer: icable) <u>N</u> ndard: <u>F(</u> oltage: <u>3</u> .	aga Suryad /A CC Part 15 3 VDC	devara N·5			Tes Limit A	t Date: <u>05</u> pplied: <u>A</u>	9/13/2017 s specified ir	n section 8.3
CF 2.462 GHz Date: 13.SEP.201 Test Pers ervising/Revi Eng Where Appli Product Star Input Vo	7 10:49:01 connel: <u>N:</u> iewing gineer: icable) <u>N.</u> ndard: <u>F(</u> bltage: <u>3.</u>	aga Suryad /A CC Part 15 3 VDC	devara N·5			Tes Limit A	t Date: <u>05</u> pplied: <u>A</u>	9/13/2017 s specified in	n section 8.3
CF 2.462 GHz Date: 13.SEP.201 Test Pers ervising/Revi Eng Where Appli Product Star Input Vo test Verificat	T 10:49:01 connel: <u>N</u> iewing gineer: icable) <u>N</u> ndard: <u>F(</u> oltage: <u>3</u> .	aga Suryad /A CC Part 15 3 VDC	devara N-5		Amt	Tes Limit A	t Date: <u>09</u> pplied: <u>A</u>	9/13/2017 s specified in 2ºC	section 8.3
CF 2.462 GHz Date: 13.SEP.201 Test Pers ervising/Revi Eng Where Appli Product Star Input Vo test Verificat Ambient Sign	T 10:49:01 connel: <u>N</u> iewing gineer: icable) <u>N</u> ndard: <u>F(</u> oltage: <u>3</u> tion w/ nals or	aga Suryad /A CC Part 15 3 VDC	devara N·5		Amt	Tes Limit A sient Tempe	t Date: 09	9/13/2017 s specified in 2ºC	section 8.3
CF 2.462 GHz Date: 13.SEP.201 Test Pers ervising/Revi Eng Where Appli Product Sta Input Vo test Verificat Ambient Sigr BB S	T 10:49:01 connel: <u>N</u> iewing gineer: icable) <u>N</u> ndard: <u>F(</u> oltage: <u>3</u> tion w/ nals or ource: <u>Y(</u>	aga Suryad /A CC Part 15 3 VDC es – Signa	devara N·5		Amt	Tes Limit A vient Tempe Relative Hu	t Date: <u>09</u> pplied: <u>A</u> rature: <u>22</u> midity: <u>4</u>	9/13/2017 s specified in 2ºC	n section 8.3
CF 2.462 GHz Date: 13.SEP.201 Test Pers ervising/Revi Eng Where Appli Product Star Input Vo test Verificat Ambient Sigr BB S	7 10:49:01 connel: <u>N</u> iewing gineer: icable) <u>N</u> ndard: <u>F(</u> oltage: <u>3</u> . tion w/ nals or ource: <u>Y</u>	aga Suryad /A CC Part 15 3 VDC es – Signa	devara N·5		Amb	Tes Limit A vient Tempe Relative Hu	t Date: <u>09</u> pplied: <u>A</u> rature: <u>22</u> midity: <u>44</u>	9/13/2017 s specified in 2ºC 4 %	section 8.3

~ • • - ---

Deviations, Additions, or Exclusions: None

9 Conducted Spurious and Band Edge Emissions

9.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247 and ANSI C63.10.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

9.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
ROS005'	ETSI Test System	Rhode & Schwartz	TS8997	N/A	09/15/2016	09/15/2017
DAV004'	Weather Station	Davis Instruments	7400	PE80529A61A	05/10/2017	05/10/2018
CBLHF2012-2M-1'	2m 9kHz-40GHz Coaxial Cable - SET1	Huber & Suhner	SF102	252675001	02/08/2017	02/08/2018

Software Utilized:

Name	Manufacturer	Version
None		

9.3 Results:

The sample tested was found to Comply.

§15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.205(c)).

Issued: 09/24/2017

9.4 Plots/Data:



Intertek

Date: 13.SEP.2017 13:13:11



MultiView 8	Spectrum								
RefLevel 105 Att	5.00 dBµV 10 dB SW 1	■ RE T 1.02 ms ■ VE	3W 100 kHz SW 300 kHz M	ode Auto Sweep					
TDF									
1 Frequency Sv	weep						м	1[2]	O 2Pk Max 102 72 dBut
130 dBuV								ILZJ	2.4144730 GHz
120 dBµV									
110 dBµV									
	105 000 dBu								
اساليه العاليس مع	and what and be level a	had it is							
TOD OPHIAN OPHIAN	- Crowd Leo Are C.C.	1 CONTRACT							
		{							
90 dвµ∨	0								
		(
		<u> </u>							
- MI		V,							
10		\u							
70 dBμV			1						
			1100						
60 dBµV			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~						
			William	elen.	l				h a h uhr
				"Mumphulushard	hanglymallur	wanter why why prendy	Luganana	hunghillion	hand a
50 авру							<u> </u>		
40 dBµV									
			1001						0.4005.011
2.4 GHZ			1001 pt	s	8.	.35 MHZ/			2.4835 GHz
							Measuring 🔳		13:13:42

Date: 13.SEP.2017 13:13:42

 \square

Low Channel (2412 MHz) Conducted Spurious Emissions 2.4835 GHz – 10 GHz

Intertek

MultiView	B) Spectrum								
RefLevel 103 Att TDF	5.00 dBµV 10 dB SW	● RB T 75.2 ms ● VB	W 100 kHz W 300 kHz Mo	ode Auto Sweep					
1 Frequency S	weep								⊜2Pk Max
100 40-04							м	1[2]	58.06 dBµV
130 0800-									5121500 0112
120 dBµV									
110 dBµV									
	-105.000 dBµV								
100 dBµV									
90 dBuV									
80 dBµV									
70 dBµV									
60 dBµV									
M									
501dByv- nhrthwyryywr,n	gramman grand from	-	and the business of the second	nullprulowenderver	wanterparter	gether demonstration of the second	when when when we	Mahamman	international and the second
40 dBµV									
2.4835 GHz	1	1	1001 pt	S	75:	1.65 MHz/	1	1	10.0 GHz
][]						Measuring 【		13.09.2017 13:14:08

Date: 13.SEP.2017 13:14:08



MultiView	B Spectrum								
Ref Level 103	5.00 dBµV	• RB	N 100 kHz	de Auto Guiana					
TDF		150 ms - VBV	V SUURHZ NO	de Auto Sweep					
1 Frequency S	weep						MI	[2]	○ 2Pk Max 57 20 dBuy
130 dBµV								[2] 	24.6180 GHz
120 dBµV									
110 dBµV									
100 dBuV	105.000 dBµV								
100 0804									
90 dBµV									
80 dBµV									
70 dBµV									
60 dBu//									
		As the		يەر يەر	Mynaulikulo	white mentioned	what sail Alas and when the	white when we are	hurthan shill both is
50 dBUX	with when with the second	www.com. www.	holunnungenender	hand and a second se	Vo	1 - 0 - 7			[
40 dBµV									
10.0 GHz	1		1001 pt	6	1	.5 GHz/	1	1	25.0 GHz
							Measuring 【	••••	13.09.2017 13:14:33

Date: 13.SEP.2017 13:14:33



Intertek

Date: 13.SEP.2017 17:02:38





Date: 13.SEP.2017 17:03:10

Mid Channel (2437 MHz) Conducted Spurious Emissions 2.4835 GHz – 10 GHz

Intertek

MultiView	B Spectrum									
RefLevel 10 Att TDF	7.00 dBµV 10 dB SW	T 75.2 ms	 RBW 100 kHz VBW 300 kHz 	Mode Auto	Sweep					
1 Frequency S	Sweep									⊚2Pk Max
								м	1[2]	50.75 dBµV 7.87870 GHz
130 dBµV										
120 dBµV										
110 dBµV										
	107.000 dBµV									
100 dBuV										
100 0000										
90 dBµV										
80 dBµV										
70 dBµV										
60 dBuV										
μ.										
								M1		
SU OBDV	Muhuhulund when	werdennehan	how when the former	ulupromition	Jumbrum	uppy-unitable	mandanter	warden warden with	word March Willing	www.depuerent.ventra
40 dBuV										
2.4835 GHz			100	1 pts		751	.65 MHz/	1	I	10.0 GHz
	Y		100	* 1		701		Measuring		13.09.2017
L										17:03:39

Date: 13.SEP.2017 17:03:39



MultiView 🗄	Spectrum	1							\bigtriangledown
Ref Level 107	.00 dBµV	T 150 m	RBW 100 kHz						
TDF	IU UB SW	1 150 ms 🖷	VBW SOURH2 Mic	de Auto Sweep					
1 Frequency Sv	veep						MI	[2]	
							NT1	[2]	24.7680 GHz
130 dBµV									
120 dBµV									
110 dBµV									
1	107.000 dBµV								
100 dBµV									
90 dBuV									
80. dBu//									
00 000									
70 авру-									
60 dBµV									
		6. mi 1		bi u.	104 March	Managa da ya wakila akariwa	liles with as Alward	allower way wo	and the west have a we
5P. ABHN working MA	way was shown and the second	hun powershi	Had from the strategic between	How full working and some set of	10		weither the second	out out	
40 dBµV									
10.0 GHz		I	1001 pt	s	1	.5 GHz/	I	L	25.0 GHz
							Measuring 【		13.09.2017 17:04:06

Date: 13.SEP.2017 17:04:05

High Channel (2462 MHz) Conducted Spurious Emissions 30 MHz – 2.4 GHz

Intertek

MultiView	B Spectrum								
Ref Level 74 Att TDF	.00 dBµV 10 dB SWT	● F 23.7 ms ● V	RBW 100 kHz /BW 300 kHz Mo	de Auto Sweep					
1 Frequency S	weep								⊖ 2Pk Max
110 dBµV								M1[2]	55.82 dBµV 2.34910 GHz
100 dBµV									
90 dBµV									
80 dBµV									
70 dBµV	-74.000 dBµV								
60 dBµV									.M1
50 dBµV					helmenteriteta	Henderhout	Her Monthean and	herewold here and a sport work	Hermond Martin
Yuuk _{uMu} ukuwaNdhi 40 dBµV	olden and the former	and a contraction of the second							
30 dBµV									
20 dBµV									
30.0 MHz				<u> </u> s	23	7.0 MHz/	1		2.4 GHz
	Y		1001 pt		20				13.09.2017
	Л						Measuring		10:58:16

Date: 13.SEP.2017 10:58:16



MultiView 🖽 Spectrum			
Ref Level 74.00 dBμV ■ RBW 100 kHz ■ NBW 200 kHz ■ NBW 200 kHz	<u>_</u>		
TDF	Sweep		
1 Frequency Sweep		141503	⊖ 2Pk Max
110 dBµV		MI[2]	2.4645230 GHz
		M1	
100 dBuV		the the second states of the s	
	/w/w/w	and a constant of the constant	
00 d0 4/		V I	
90 0600	}		
		L L	
80 dBµV	للمحي المح	՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝՝	
74.000 dBµV		- Hay	
70 dBµV	. borbager	1	M.,
	1. dut and		Mr.
60 dBµV			Welly Later 1
	where a start a		"White
30 Berren Margh - Adale - Angra and a second and a second and a second and the se			
40 dBµV			
30 dBuV			
20 UBHV			
2.4 GHz 1001 pts	8.35 MHz/		2.4835 GHz
		Measuring 🚺 🗰 🗰	13.09.2017 10:58:59

Date: 13.SEP.2017 10:58:59

High Channel (2462 MHz) Conducted Spurious Emissions 2.4835 GHz – 10 GHz

Intertek

MultiView	🖽 Spectrum								
Ref Level 74 Att TDF	10 dBµV 10 dB SWT	● RBV 75.2 ms ● VBV	₩ 100 kHz ₩ 300 kHz Moo	le Auto Sweep					
1 Frequency S	Sweep								O 2Pk Max
110 dBµV							M	1[2]	55.34 dBµV 2.58490 GHz
100 dBµV									
90 dBµV									
80 dBµV									
70 dBµV	-74.000 dBµV								
60 dBµV M1 50 dBµV			without the A		a Janio	A water and a first start of	الالمعاملة		Mar hallhang
40 dBµV	4 warning to the state of the s	putliprototion	handlande	white and the second of the se	hill water and a second		. Manund and	have the second	
30 dBµV									
20 dBµV									
2.4835 GHz		·	1001 pt	s	75	1.65 MHz/			10.0 GHz
							Measuring 📲		13.09.2017 10:59:41

Date: 13.SEP.2017 10:59:41



MultiView	🗐 Spectrum]							
Ref Level 74	.00 dBµV	RBW	100 kHz						
Att TDF	10 dB SWT	150 ms 🖷 VBW	300 kHz Mod	e Auto Sweep					
1 Frequency S	weep								⇔2Pk Max
110 dBuV							M1	[2]	57.68 dBµV
									24.7980 0112
100 In 11									
100 dBµv									
90 dBµV									
80 dBµV									
	-74.000 dBuV								
70 dBµV									
60.dBuV									M1
00 000									La partilla
FO JD.44		moundaylin			why Munumump	muniporteruitation	www.www.uhububububububububububububububububububu	mouthwallowalow	uppled approved by
Marin Marine Marine	www.www.	Will	Mutuber	orar post					
40 dBµV									
30 dBµV									
20 dBµV									
10.0 GHz	~		1001 pt	;	1	.5 GHz/			25.0 GHz
	JJ						Measuring 🔳		13.09.2017 11:00:16

Date: 13.SEP.2017 11:00:16

\bigtriangledown MultiView 😁 Spectrum BBW 100 kHz SWT 1.04 ms • VBW 300 kHz Mode Auto Sweep Ref Level 105.00 dBµV Att 10 dB Att 10 TDF TFrequency Sweep PPk Ma M2[2] 72.82 dBµ^t 2.4000000 GH 130 dBµ\ M1[2] 103.61 dBµ\ 2.4070150 GH 120 dBµ 110 dBµ\ .05.000 dBµ\ r.A.r. Λ Δ 100 dBµ 90 dBµV M 80 dBµV www. www 70 dBµV mm 60 dBµV 50 dBuV 40 dBµV-2.395 GHz 2.412 GHz 1001 pts 1.7 MHz/ 13.09.2017 13:15:25 Measuring...

Lower Band Edge Emissions

Date: 13.SEP.2017 13:15:25

MultiView 😁 Spectrum \bigtriangledown Ref Level 74.00 dBμV Att 10 dB TDF ● RBW 100 kHz SWT 1.01 ms ● VBW 300 kHz Mode Auto Sweep 1 Frequency Sweep 2Pk Max 55.11 dBµ' 2.4835000 GH M2[2] 110 dBuV M1[2] 101.63 dBµ 2.4645050 GH when have how how ADBY ABUR - MABUR www. 90 dBµ∿ h 80 dBµV 4.000 dBuV 70 dBµV 60 dBuV montrand 50 dBµV 40 dBu∿ 30 dBuV 20 dBuV 2.458 GHz 1001 pts 3.2 MHz/ 2.49 GHz 13.09.2017 11:04:04 Measuring... (.....) 🦇

Higher Band Edge Emissions

Date: 13.SEP.2017 11:04:04

		Intertek	
Report Number: 103	3097968BOX-024		Issued: 09/24/2017
Test Personnel	Naga Survadevara N-5	Test Date:	00/13/2017
Supervising/Reviewing	Naga Sulyadevala (4 S		03/13/2011
Engineer:	Ν/Δ		
Product Standard:	FCC Part 15 Subpart C	Limit Applied:	As specified in section 9.3
Input Voltage:	3.3 VDC		
Pretest Verification w/		Ambient Temperature:	22°C
Ambient Signals or BB Source:	Yes – Signal generator	Relative Humidity:	44 %
		Atmospheric Pressure:	1003 mbars

Deviations, Additions, or Exclusions: None

10 Transmitter Spurious Emissions

10.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, ANSI C63.10.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

	Frequency	Expanded Uncertainty	
Measurement	Range	(k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF +	CF - AG
Where	$FS = Field Strength in dB\mu V/m$
	RA = Receiver Amplitude (including preamplifier) in $dB\mu V$
	CF = Cable Attenuation Factor in dB
	AF = Antenna Factor in dB
	AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

 $\label{eq:result} \begin{array}{l} {\sf RA} = 52.0 \ {\sf dB}\mu {\sf V} \\ {\sf AF} = \ 7.4 \ {\sf dB}/{\sf m} \\ {\sf CF} = \ 1.6 \ {\sf dB} \\ {\sf AG} = 29.0 \ {\sf dB} \\ {\sf FS} = 32 \ {\sf dB}\mu {\sf V}/{\sf m} \end{array}$

To convert from $dB\mu V$ to μV or mV the following was used:

 $UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$ $NF = \text{Net Reading in } dB\mu\text{V}$

Example:

FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0 $UF = 10^{(32 \ dB\mu V / 20)} = 39.8 \ \mu V/m$

Alternately, when BAT-EMC Emission Software is used, the "Level" includes all losses and gains and is compared directly in the "Margin" column to the "Limit". The "Correction" includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the "Level" column.

10.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV003'	Weather Station	Davis Instruments	7400	PE80529A39A	11/28/2016	11/28/2017
ETS001'	1-18GHz DRG Horn Antenna	ETS-Lindgren	3117	00143259	02/13/2017	02/13/2018
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2017	07/25/2018
145108'	EMI Test Receiver (20Hz - 40GHz)	Rohde & Schwarz	ESIB40	100209	05/23/2017	05/23/2018
PRE-10'	EMI Test Receiver (20Hz - 40GHz)	Rohde & Schwarz	ESIB40	100209	05/23/2017	05/23/2018
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	05/02/2017	05/02/2018
145-410'	Cables 145-420 145-421 145-422 145-406	Huber + Suhner	10m Track A Cables	multiple	07/25/2017	07/25/2018
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	06/03/2017	06/03/2018
REA004'	3GHz High Pass Filter	Reactel, Inc	7HSX-3G/18G-S11	06-1	02/17/2017	02/17/2018

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.16.0.69

10.3 Results:

The sample tested was found to Comply.

§15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.205(c)).

10.4 Setup Photographs:







18-25 GHz

10.5 Plots/Data:

Tx Low Channel, 30-1000 MHz

Test Information:

Date and Time	06/14/2017
Client and Project Number	Simbex_G103097968
Engineer	Vathana Ven
Temperature	26 deg C
Humidity	33%
Atmospheric Pressure	1003 mB
Comments	Battery power, Mx Encoder, 802.11n 20MHz, Lo Channel, Tx mode

Graph:



Results:

QuasiPeak	(PAS	S) (4)							
Frequency	SR	Level	Limit	Margin	Azimuth	Height	Pol.	Meas.	Correction
(MHz)		(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)		time (s)	(dB)
30.06	1	17.49	30.00	-12.51	110.00	1.34	Vertical	0.10	-12.52
33.24	1	14.96	30.00	-15.04	71.00	2.78	Vertical	0.10	-14.91
200.7	1	9.77	33.50	-23.73	129.00	2.35	Vertical	0.10	-19.53
711.6	1	17.12	36.00	-18.88	46.00	2.37	Vertical	0.10	-10.11

Scan 1-25 GHz, Tx mode, Low Channel, X-Axis

Test Information:

Date and Time	8/4/2017 5:26:38 PM
Client and Project Number	Simbex_G103097968
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	45%
Atmospheric Pressure	1004 mB
Comments	RE 3 to 13 GHz_Tx mode_Lo Channel_X-axis

Graph:



Note: Scans from 1-3 and 13-25 GHz were performed manually, no emissions were detected above the measuring equipment noise floor. High Pass Filter was used for frequency above 3 GHz scans.

Results:

Peak (PASS) (5)

Frequency	Level	Limit	Margin	Azimuth	Height	Pol.	RBW	Correction
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)			(dB)
3216.052632	51.34	74.00	-22.66	142.00	2.80	Vertical	1000000.00	6.44
4832.631579	46.00	74.00	-28.00	47.00	3.59	Vertical	1000000.00	9.20
7220.263158	49.58	74.00	-24.42	83.00	2.19	Vertical	1000000.00	11.99
9697.631579	50.99	74.00	-23.01	4.00	3.04	Vertical	1000000.00	13.13
12065.52632	56.26	74.00	-17.74	141.00	4.00	Horizontal	1000000.00	21.37

Average (PASS) (5)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW	Correction (dB)
3216.052632	38.03	54.00	-15.97	142.00	2.80	Vertical	100000.00	6.44
4832.631579	35.00	54.00	-19.00	47.00	3.59	Vertical	1000000.00	9.20
7220.263158	36.33	54.00	-17.67	83.00	2.19	Vertical	1000000.00	11.99
9697.631579	37.30	54.00	-16.70	4.00	3.04	Vertical	1000000.00	13.13
12065.52632	44.60	54.00	-9.40	141.00	4.00	Horizontal	1000000.00	21.37

Scan 1-25 GHz, Tx mode, Low Channel, Y-Axis

Test Information:

Date and Time	8/4/2017 6:07:00 PM
Client and Project Number	Simbex_G103097968
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	45%
Atmospheric Pressure	1004 mB
Comments	RE 3 to 13 GHz_Tx mode_Lo Channel_Y-axis

Graph:



Note: Scans from 1-3 and 13-25 GHz were performed manually, no emissions were detected above the measuring equipment noise floor. High Pass Filter was used for frequency above 3 GHz scans.

Results:

Peak (PASS) (6)							
Frequency	Level	Limit	Margin	Azimuth	Height	Pol.	RBW	Correction
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)			(dB)
3216.052632	51.86	74.00	-22.14	127.00	1.00	Vertical	1000000.00	6.44
4560	48.01	74.00	-25.99	181.00	1.95	Horizontal	1000000.00	10.00
4812.894737	45.98	74.00	-28.02	195.00	2.57	Vertical	1000000.00	9.19
7206.578947	49.57	74.00	-24.43	297.00	2.46	Vertical	1000000.00	11.98
9594.473684	49.78	74.00	-24.22	84.00	2.53	Horizontal	1000000.00	12.98
12154.73684	57.07	74.00	-16.93	18.00	2.92	Horizontal	1000000.00	21.51
Average (PASS	S) (6)							
Frequency	Level	Limit	Margin	Azimuth	Height	Pol.	RBW	Correction
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)			(dB)
3216.052632	38.65	54.00	-15.35	127.00	1.00	Vertical	1000000.00	6.44
4560	35.50	54.00	-18.50	181.00	1.95	Horizontal	1000000.00	10.00
4812.894737	33.45	54.00	-20.55	195.00	2.57	Vertical	1000000.00	9.19
7206.578947	36.15	54.00	-17.85	297.00	2.46	Vertical	1000000.00	11.98
9594.473684	37.06	54.00	-16.94	84.00	2.53	Horizontal	100000.00	12.98
12154.73684	45.03	54.00	-8.97	18.00	2.92	Horizontal	100000.00	21.51

Scan 1-25 GHz, Tx mode, Low Channel, Z-Axis

Test Information:

Date and Time	8/4/2017 6:41:44 PM
Client and Project Number	Simbex_G103097968
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	45%
Atmospheric Pressure	1004 mB
Comments	RE 3 to 13 GHz_Tx mode_Lo Channel_Z-axis

Graph:



Note: Scans from 1-3 and 13-25 GHz were performed manually, no emissions were detected above the measuring equipment noise floor. High Pass Filter was used for frequency above 3 GHz scans.

Results:

Peak (PASS) (7	7)							
Frequency	Level	Limit	Margin	Azimuth	Height	Pol.	RBW	Correction
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)			(dB)
3835	45.84	74.00	-28.16	69.00	2.28	Horizontal	1000000.00	7.45
4508.157895	47.85	74.00	-26.15	143.00	2.18	Vertical	1000000.00	10.12
4836.842105	45.60	74.00	-28.40	262.00	1.88	Horizontal	1000000.00	9.21
7237.631579	49.18	74.00	-24.82	341.00	1.84	Vertical	1000000.00	11.99
7780.789474	49.25	74.00	-24.75	291.00	3.37	Horizontal	1000000.00	11.79
9680	49.50	74.00	-24.50	210.00	3.08	Horizontal	1000000.00	13.11
12141.31579	57.34	74.00	-16.66	10.00	2.07	Horizontal	1000000.00	21.49
Average (PASS	S) (7)							
Frequency	Level	Limit	Margin	Azimuth	Height	Pol.	RBW	Correction
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)			(dB)
3835	32.31	54.00	-21.69	69.00	2.28	Horizontal	1000000.00	7.45
4508.157895	34.90	54.00	-19.10	143.00	2.18	Vertical	1000000.00	10.12
4836.842105	33.29	54.00	-20.71	262.00	1.88	Horizontal	1000000.00	9.21
7237.631579	36.07	54.00	-17.93	341.00	1.84	Vertical	1000000.00	11.99
7780.789474	36.31	54.00	-17.69	291.00	3.37	Horizontal	1000000.00	11.79
9680	37.37	54.00	-16.63	210.00	3.08	Horizontal	1000000.00	13.11
12141.31579	44.82	54.00	-9.18	10.00	2.07	Horizontal	100000.00	21.49

Scan 1-25 GHz, Tx mode, MId Channel, X-Axis

Test Information:

Date and Time	8/4/2017 8:30:32 PM
Client and Project Number	Simbex_G103097968
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	45%
Atmospheric Pressure	1004 mB
Comments	RE 3 to 13 GHz_Tx mode_Mid Channel_X-axis

Graph:



Note: Scans from 1-3 and 13-25 GHz were performed manually, no emissions were detected above the measuring equipment noise floor. High Pass Filter was used for frequency above 3 GHz scans.

Results:

Peak (PASS) (6	6)							
Frequency	Level	Limit	Margin	Azimuth	Height	Pol.	RBW	Correction
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)			(dB)
3291.052632	44.57	74.00	-29.43	179.00	3.41	Vertical	1000000.00	6.03
4891.842105	46.05	74.00	-27.95	26.00	3.16	Horizontal	1000000.00	9.26
7289.473684	49.46	74.00	-24.54	77.00	2.11	Horizontal	1000000.00	12.00
9765.263158	49.51	74.00	-24.49	0.00	3.77	Horizontal	1000000.00	13.37
12139.21053	57.48	74.00	-16.52	253.00	3.80	Vertical	1000000.00	21.49
12653.15789	59.02	74.00	-14.98	224.00	3.60	Vertical	1000000.00	23.32

Average (PASS) (6)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW	Correction (dB)
3291.052632	31.38	54.00	-22.62	179.00	3.41	Vertical	1000000.00	6.03
4891.842105	34.03	54.00	-19.97	26.00	3.16	Horizontal	1000000.00	9.26
7289.473684	36.25	54.00	-17.75	77.00	2.11	Horizontal	1000000.00	12.00
9765.263158	37.27	54.00	-16.73	0.00	3.77	Horizontal	1000000.00	13.37
12139.21053	44.41	54.00	-9.59	253.00	3.80	Vertical	1000000.00	21.49
12653.15789	45.81	54.00	-8.19	224.00	3.60	Vertical	100000.00	23.32

Scan 1-25 GHz, Tx mode, Mid Channel, Y-Axis

Intertek

Test Information:

Date and Time	8/4/2017 7:55:42 PM
Client and Project Number	Simbex_G103097968
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	45%
Atmospheric Pressure	1004 mB
Comments	RE 3 to 13 GHz_Tx mode_Mid Channel_Y-axis

Graph:



Note: Scans from 1-3 and 13-25 GHz were performed manually, no emissions were detected above the measuring equipment noise floor. High Pass Filter was used for frequency above 3 GHz scans.

Results:

Peak (PASS) (7	7)							
Frequency	Level	Limit	Margin	Azimuth	Height	Pol.	RBW	Correction
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)			(dB)
3249.473684	49.01	74.00	-24.99	47.00	1.22	Vertical	1000000.00	6.24
4515.526316	47.83	74.00	-26.17	32.00	1.53	Horizontal	1000000.00	10.11
4872.894737	48.31	74.00	-25.69	209.00	1.00	Vertical	1000000.00	9.24
7355.263158	48.96	74.00	-25.04	40.00	2.10	Vertical	1000000.00	11.89
9760.526316	50.14	74.00	-23.86	299.00	2.77	Horizontal	1000000.00	13.35
12230.26316	57.31	74.00	-16.69	76.00	2.85	Horizontal	1000000.00	21.61
12698.42105	59.07	74.00	-14.93	311.00	3.30	Vertical	1000000.00	23.37

Average (PASS) (7)

Frequency	Level	Limit	Margin	Azimuth	Height	Pol.	RBW	Correction
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)			(dB)
3249.473684	35.43	54.00	-18.57	47.00	1.22	Vertical	1000000.00	6.24
4515.526316	35.05	54.00	-18.95	32.00	1.53	Horizontal	1000000.00	10.11
4872.894737	33.76	54.00	-20.24	209.00	1.00	Vertical	1000000.00	9.24
7355.263158	35.97	54.00	-18.03	40.00	2.10	Vertical	1000000.00	11.89
9760.526316	37.15	54.00	-16.85	299.00	2.77	Horizontal	1000000.00	13.35
12230.26316	44.63	54.00	-9.37	76.00	2.85	Horizontal	100000.00	21.61
12698.42105	45.86	54.00	-8.14	311.00	3.30	Vertical	100000.00	23.37

Scan 1-25 GHz, Tx mode, Mid Channel, Z-Axis

Intertek

Test Information:

Date and Time	8/4/2017 7:17:43 PM
Client and Project Number	Simbex_G103097968
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	45%
Atmospheric Pressure	1004 mB
Comments	RE 3 to 13 GHz_Tx mode_Mid Channel_Z-axis

Graph:



Note: Scans from 1-3 and 13-25 GHz were performed manually, no emissions were detected above the measuring equipment noise floor. High Pass Filter was used for frequency above 3 GHz scans.

Results:

Peak (PASS) (7	7)							
Frequency	Level	Limit	Margin	Azimuth	Height	Pol.	RBW	Correction
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)			(dB)
3249.210526	47.51	74.00	-26.49	150.00	1.00	Vertical	1000000.00	6.24
4525	47.41	74.00	-26.59	357.00	1.38	Horizontal	1000000.00	10.08
4878.947368	46.43	74.00	-27.57	123.00	3.81	Horizontal	1000000.00	9.25
7310	49.57	74.00	-24.43	329.00	1.91	Horizontal	1000000.00	11.98
9747.894737	49.55	74.00	-24.45	180.00	1.25	Vertical	1000000.00	13.30
12272.89474	57.48	74.00	-16.52	150.00	3.89	Vertical	1000000.00	21.78
12663.15789	59.03	74.00	-14.97	187.00	3.74	Vertical	1000000.00	23.33

Average (PASS) (7)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW	Correction (dB)
3249.210526	34.14	54.00	-19.86	150.00	1.00	Vertical	1000000.00	6.24
4525	35.88	54.00	-18.12	357.00	1.38	Horizontal	1000000.00	10.08
4878.947368	33.50	54.00	-20.50	123.00	3.81	Horizontal	1000000.00	9.25
7310	36.32	54.00	-17.68	329.00	1.91	Horizontal	1000000.00	11.98
9747.894737	37.38	54.00	-16.62	180.00	1.25	Vertical	1000000.00	13.30
12272.89474	45.00	54.00	-9.00	150.00	3.89	Vertical	1000000.00	21.78
12663.15789	46.04	54.00	-7.96	187.00	3.74	Vertical	1000000.00	23.33

Scan 1-25 GHz, Tx mode, High Channel, X-Axis

Test Information:

Date and Time	8/4/2017 8:59:50 PM
Client and Project Number	Simbex_G103097968
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	45%
Atmospheric Pressure	1004 mB
Comments	RE 3 to 13 GHz_Tx mode_Hi Channel_X-axis

Graph:



Note: Scans from 1-3 and 13-25 GHz were performed manually, no emissions were detected above the measuring equipment noise floor. High Pass Filter was used for frequency above 3 GHz scans.

Results:

Peak (PASS) (5)							
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW	Correction (dB)
3277.368421	44.77	74.00	-29.23	85.00	2.18	Vertical	1000000.00	6.10
4805	45.57	74.00	-28.43	40.00	1.52	Vertical	1000000.00	9.18
7416.315789	49.15	74.00	-24.85	0.00	2.80	Vertical	1000000.00	11.83
9773.157895	49.92	74.00	-24.08	180.00	1.53	Vertical	1000000.00	13.40
12739.21053	59.55	74.00	-14.45	150.00	2.04	Horizontal	1000000.00	23.40

Average (PASS) (5)

Frequency	Level	Limit	Margin	Azimuth	Height	Pol.	RBW	Correction
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)			(dB)
3277.368421	31.52	54.00	-22.48	85.00	2.18	Vertical	1000000.00	6.10
4805	34.04	54.00	-19.96	40.00	1.52	Vertical	1000000.00	9.18
7416.315789	35.91	54.00	-18.09	0.00	2.80	Vertical	1000000.00	11.83
9773.157895	37.21	54.00	-16.79	180.00	1.53	Vertical	1000000.00	13.40
12739.21053	46.22	54.00	-7.78	150.00	2.04	Horizontal	100000.00	23.40

Scan 1-25 GHz, Tx mode, High Channel, Y-Axis

Test Information:

Date and Time	8/4/2017 9:26:51 PM
Client and Project Number	Simbex_G103097968
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	45%
Atmospheric Pressure	1004 mB
Comments	RE 3 to 13 GHz_Tx mode_Hi Channel_Y-axis

Graph:



Note: Scans from 1-3 and 13-25 GHz were performed manually, no emissions were detected above the measuring equipment noise floor. High Pass Filter was used for frequency above 3 GHz scans.

Results:

Peak (PASS) (7)							
Frequency	Level	Limit	Margin	Azimuth	Height	Pol.	RBW	Correction
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)			(dB)
3276.315789	44.38	74.00	-29.62	1.00	3.34	Vertical	1000000.00	6.11
4921.315789	48.38	74.00	-25.62	210.00	1.22	Vertical	1000000.00	9.31
6510.526316	49.23	74.00	-24.77	47.00	2.66	Horizontal	1000000.00	11.23
7394.210526	48.89	74.00	-25.11	237.00	1.65	Horizontal	1000000.00	11.82
9846.842105	49.78	74.00	-24.22	25.00	3.72	Horizontal	1000000.00	13.64
10393.94737	51.49	74.00	-22.51	291.00	2.08	Horizontal	1000000.00	15.50
12686.84211	59.06	74.00	-14.94	283.00	2.84	Horizontal	1000000.00	23.35

Average (PASS) (7)

Frequency	Level	Limit	Margin	Azimuth	Height	Pol.	RBW	Correction
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)			(dB)
3276.315789	31.53	54.00	-22.47	1.00	3.34	Vertical	1000000.00	6.11
4921.315789	34.33	54.00	-19.67	210.00	1.22	Vertical	1000000.00	9.31
6510.526316	36.33	54.00	-17.67	47.00	2.66	Horizontal	1000000.00	11.23
7394.210526	36.51	54.00	-17.49	237.00	1.65	Horizontal	1000000.00	11.82
9846.842105	37.35	54.00	-16.65	25.00	3.72	Horizontal	1000000.00	13.64
10393.94737	38.53	54.00	-15.47	291.00	2.08	Horizontal	1000000.00	15.50
12686.84211	46.27	54.00	-7.73	283.00	2.84	Horizontal	1000000.00	23.35

Scan 1-25 GHz, Tx mode, High Channel, Z-Axis

Test Information:

Date and Time	8/4/2017 9:58:23 PM
Client and Project Number	Simbex_G103097968
Engineer	Vathana Ven
Temperature	25 deg C
Humidity	45%
Atmospheric Pressure	1004 mB
Comments	RE 3 to 13 GHz_Tx mode_Hi Channel_Z-axis

Graph:



Note: Scans from 1-3 and 13-25 GHz were performed manually, no emissions were detected above the measuring equipment noise floor. High Pass Filter was used for frequency above 3 GHz scans.

Results:

Peak (PASS) (7	7)							
Frequency	Level	Limit	Margin	Azimuth	Height	Pol.	RBW	Correction
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)			(dB)
3827.631579	45.83	74.00	-28.17	283.00	2.48	Vertical	1000000.00	7.44
4916.052632	46.22	74.00	-27.78	165.00	1.70	Horizontal	1000000.00	9.30
7428.421053	48.76	74.00	-25.24	0.00	1.30	Horizontal	1000000.00	11.83
9920.789474	50.10	74.00	-23.90	173.00	2.87	Horizontal	1000000.00	13.84
10955.26316	53.40	74.00	-20.60	41.00	2.95	Vertical	1000000.00	17.42
12675.78947	59.32	74.00	-14.68	160.00	1.45	Vertical	1000000.00	23.34
12911.57895	58.64	74.00	-15.36	180.00	3.68	Vertical	1000000.00	23.91

Average (PASS) (7)

Frequency	Level	Limit	Margin	Azimuth	Height	Pol.	RBW	Correction
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)			(dB)
3827.631579	32.54	54.00	-21.46	283.00	2.48	Vertical	1000000.00	7.44
4916.052632	34.07	54.00	-19.93	165.00	1.70	Horizontal	1000000.00	9.30
7428.421053	35.92	54.00	-18.08	0.00	1.30	Horizontal	1000000.00	11.83
9920.789474	37.65	54.00	-16.35	173.00	2.87	Horizontal	1000000.00	13.84
10955.26316	40.54	54.00	-13.46	41.00	2.95	Vertical	1000000.00	17.42
12675.78947	46.05	54.00	-7.95	160.00	1.45	Vertical	1000000.00	23.34
12911.57895	46.19	54.00	-7.81	180.00	3.68	Vertical	1000000.00	23.91

Intertek



Lower Band Edge Mx Encoder





Higher Band Edge Mx Encoder

Intertek

Report Number: 103097968BOX-024

	Ant.			Antenna	Cable	Pre-amp	Distance				
Detector	Pol.	Frequency	Reading	Factor	Loss	Factor	Factor	Net	Limit	Margin	Bandwidth
Туре	(V/H)	MHz	dB(uV)	dB(1/m)	dB	dB	dB	dB(uV/m)	dB(uV/m)	dB	
PK	Н	2483.500	29.02	32.24	5.18	0.00	3.52	62.92	74.00	-11.08	1/3 MHz
AVG	Н	2483.500	14.39	32.24	5.18	0.00	3.52	48.29	54.00	-5.71	1/3 MHz
Limit Dis	stance (m):	3									
Test Dis	stance (m):	2									

Test Personnel:	Vathana Ven	Test Date:	08/04/2017
(Where Applicable) Product Standard:	N/A FCC Part 15.247	Limit Applied:	Below Specified limits
Input Voltage:	Battery power		
Pretest Verification w/		Ambient Temperature:	25 °C
Ambient Signals or BB Source:	Yes	Relative Humidity:	45 %
		Atmospheric Pressure:	1004 mbars

Deviations, Additions, or Exclusions: None

11 Digital Device Radiated Spurious Emissions

11.1 Method

Tests are performed in accordance with CFR47 FCC Part 15.247, ANSI C63.10.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

	Frequency	Expanded Uncertainty	
Measurement	Range	(k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	4.6 dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF +	CF - AG
Where	$FS = Field Strength in dB\mu V/m$
	RA = Receiver Amplitude (including preamplifier) in $dB\mu V$
	CF = Cable Attenuation Factor in dB
	AF = Antenna Factor in dB
	AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

 $\label{eq:RA} \begin{array}{l} = 52.0 \ dB\mu V \\ AF = \ 7.4 \ dB/m \\ CF = \ 1.6 \ dB \\ AG = 29.0 \ dB \\ FS = 32 \ dB\mu V/m \end{array}$

To convert from $dB\mu V$ to μV or mV the following was used:

 $UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$ $NF = \text{Net Reading in } dB\mu\text{V}$

Example:

FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0 $UF = 10^{(32 \ dB\mu V / 20)} = 39.8 \ \mu V/m$

Alternately, when C5 Software is used, the "Level" includes all losses and gains and is compared directly in the "Margin" column to the "Limit". "AF" is the Antenna Factor; "PA+CL" are Preamp and Cable Loss. These are already accounted for in the "Level" column.

11.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV003'	Weather Station	Davis Instruments	7400	PE80529A39A	11/28/2016	11/28/2017
ETS001'	1-18GHz DRG Horn Antenna	ETS-Lindgren	3117	00143259	02/13/2017	02/13/2018
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/25/2017	07/25/2018
145108'	EMI Test Receiver (20Hz - 40GHz)	Rohde & Schwarz	ESIB40	100209	05/23/2017	05/23/2018
PRE-10'	EMI Test Receiver (20Hz - 40GHz)	Rohde & Schwarz	ESIB40	100209	05/23/2017	05/23/2018
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	05/02/2017	05/02/2018
145-410'	Cables 145-420 145-421 145-422 145-406	Huber + Suhner	10m Track A Cables	multiple	07/25/2017	07/25/2018
145014'	Preamplifier (1 GHz to 26.5 GHz)	Hewlett Packard	8449B	3008A00232	06/03/2017	06/03/2018
REA004'	3GHz High Pass Filter	Reactel, Inc	7HSX-3G/18G-S11	06-1	02/17/2017	02/17/2018

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.16.0.69

11.3 Results:

The sample tested was found to Comply.

11.4 Setup Photographs:





11.5 Plots/Data:

30-1000 MHz

Test Information:

Date and Time	06/14/2017
Client and Project Number	Simbex_G103097968
Engineer	Vathana Ven
Temperature	26 deg C
Humidity	33%
Atmospheric Pressure	1003 mB
Comments	Battery power, Mx Encoder, Rx mode

Graph:



Results:

QuasiPeak (PASS) (4)

Frequency	SR	Level	Limit	Margin	Azimuth	Height	Pol.	Meas.	Correction
(MHz)		(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)		time (s)	(dB)
31.5	1	16.28	30.00	-13.72	136.00	3.77	Vertical	0.10	-13.59
122.28	1	10.24	33.50	-23.26	47.00	3.00	Vertical	0.10	-19.00
288.54	1	14.64	36.00	-21.36	32.00	1.50	Vertical	0.10	-18.71
712.5	2	17.13	36.00	-18.87	143.00	3.68	Horizontal	0.10	-10.10

1-13 GHz

Test Information:

Date and Time	06/14/2017			
Client and Project Number	Simbex_G103097968			
Engineer	Vathana Ven			
Temperature	26 deg C			
Humidity	33%			
Atmospheric Pressure	1003 mB			
Comments	Battery power, Mx Encoder, Rx mode			

Graph:



Results:

Avg (PASS) (4)

Frequency	SR	Level	Limit	Margin	Azimuth	Height	Pol.	Meas.	Correction
(MHz)		(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)		time (s)	(dB)
2438	1	32.60	54.00	-21.40	278.00	4.00	Vertical	0.10	3.01
6748.5	1	40.57	54.00	-13.43	305.00	4.00	Vertical	0.10	11.74
12487.5	1	46.35	54.00	-7.65	0.00	4.00	Vertical	0.10	19.31
1323	2	31.11	54.00	-22.89	97.00	4.00	Horizontal	0.10	-1.76

Peak (PASS) (4)

Frequency	SR	Level	Limit	Margin	Azimuth	Height	Pol.	Meas.	Correction
(MHz)		(dBµV/m)	(dBµV/m)	(dB)	(°)	(m)		time (s)	(dB)
2438	1	52.80	74.00	-21.20	278.00	4.00	Vertical	0.10	3.01
6748.5	1	52.72	74.00	-21.28	305.00	4.00	Vertical	0.10	11.74
12487.5	1	57.77	74.00	-16.23	0.00	4.00	Vertical	0.10	19.31
1323	2	44.72	74.00	-29.28	97.00	4.00	Horizontal	0.10	-1.76

Report Number: 103097968BOX-024

Intertek

Test Personnel:	Vathana Ven	Test Date:	06/14/2017
Supervising/Reviewing			
(Where Applicable)	N/A		
Product Standard:	FCC Part 15 Subpart B	Limit Applied:	Class B
Input Voltage:	Battery power		
Pretest Verification w/		Ambient Temperature:	26 °C
Ambient Signals or			
BB Source:	Yes	Relative Humidity:	33 %
		Atmospheric Pressure:	1003 mbars

12 Revision History

Revision	Date	Report Number	Prepared	Reviewed	Notes
LEVEI			Бу	Ъу	
0	09/19/2017	103097968BOX-024	N.5	KPS	Original Issue
1	09/24/2017	103097968BOX-024	N-5	KPS 43	Revised Human RF Exposure