Test Report # 317294 A

Equipment Under Test:	JCT BT 01
Test Date(s):	8/28/17 – 10/4/17
Prepared for:	Raffel Systems Attn: Edward Nowak N112 W14600 Mequon Rd. Germantown, WI 53022

Report Issued by: Shane Dock, EMC Engineer

Signature:

Date: 4/5/2018

Report Reviewed by: Adam Alger, Quality Systems Engineer

Signature:

Date: 11/03/2017

Report Constructed by: Shane Dock EMC Engineer

Signature:

Date: 3/13/2018

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Laird Technologies Test Services in Review

The Laird Technologies, Inc. laboratory located at W66 N220 Commerce Court Cedarburg, Wisconsin, 53012 USA is recognized through the following organizations:

TESTING CERT #1255.01

A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025: 2005 with Electrical (EMC) Scope
A2LA Certificate Number: 1255.01
Scope of accreditation includes all test methods listed herein, unless otherwise noted.

Federal Communications Commission (FCC) – USA

Accredited recognition of two 3 meter Semi-Anechoic Chambers

Accredited Test Firm Registration Number: 953492

Government of Canada

Innovation, Science and Economic Development Canada

ISED Site listing of two 3 meter Semi-Anechoic Chambers based on RSS-GEN – Issue 4
File Number: IC 3088A-2
File Number: IC 3088A-3

1 TEST REPORT SUMMARY

During **8/28/17 – 10/4/17** the Equipment Under Test (EUT), **JCT BT 01**, as provided by **Raffel Systems** was tested to the following requirements:

Requirement	Description	Specification	Method	Result
FCC: 15.247 (a)(2) IC: RSS-247 5.2 (1)	Digital Modulation System 6 dB bandwidth	500 kHz	FCC KDB 558074	Pass
FCC: 2.1049 IC: RSS-GEN 6.6	Occupied Bandwidth	Reported	ANSI C63.10	Pass
FCC: 15.247 (b)(3) IC: RSS-247 5.4 (4)	Maximum Conducted Output Power	30 dBm	FCC KDB 558074	Pass
FCC: 15.247 (e) IC: RSS-247 5.2 (2)	Digital Modulation System Power Spectral Density	8 dBm / 3 kHz	FCC KDB 558074	Pass
FCC: 15.247 (d) IC: RSS-247 5.5	RF Spurious Emissions at the Transmitter Antenna Terminal	20 dBc	FCC KDB 558074	Pass
FCC: 15.247 (d) IC: RSS-GEN 8.10	Spurious Radiated Emissions in Restricted Bands	FCC 15.209 RSS-GEN 8.9	ANSI C63.10	Pass
FCC: 2.1055 (d) IC: RSS-GEN 6.11	Frequency Stability	Reported	ANSI C63.10	Pass
FCC: 15.207 IC: RSS-GEN 8.8	AC Power Line Conducted Emissions	0.150-30 MHz	ANSI C63.10	Pass

Notice:

The results relate only to the item tested and described in this report. Any modifications made to the equipment under test after the specified test date(s) may invalidate the data herein.

If the resulting measurement margin is seen to be within the uncertainty value, as listed in this report, the possibility exists that this unit may not meet the required limit specification if subsequently tested.

2 CLIENT INFORMATION

Company Name	Raffel Systems
Contact Person	Edward Nowak
Address	N112 W14600 Mequon Rd. Germantown, WI 53022

2.1 Equipment Under Test (EUT) Information

The following information has been supplied by the client

Product Name	JCT BT 01
Model Number	JCTBT-01
Serial Number	Engineering Sample
FCC/IC ID	FCC ID: YZHJCTBT01 IC: 9314A-JCTBT01

2.2 Product Description

System is used to communicate with integrated cup holders in furniture with multiple power motion actuators. This module interfaces with a custom App giving the end user capability to control furniture functionality either via the cupholder interface or the App. The App may also provide additional functionality not present on the cup controls (for instance home position, memory functionality, massage, etc).

2.3 Modifications Incorporated for Compliance

None noted at time of test

2.4 Deviations and Exclusions from Test Specifications

None noted at time of test

2.5 Additional Information

EUT emissions peaked out in all orientations. Unit tested with USB port Occupied and with an output power of -18 as the set. Unit programmed via buttons on cupholder. Unit connected to sample motor.

2.6 Channel Plan

EUT emissions tested for Low Mid and High Channel.

Low – 2402 MHz

Mid – 2440 MHz

High – 2480 MHz

3 REFERENCES

Publication	Edition	Date
CFR 47 Part 15	-	2017
ANSI C63.10	-	2013
KDB 558074	V4	2017
RSS-247	2	2017
RSS GEN	4	2014

4 UNCERTAINTY SUMMARY

Using the guidance of the following publications the calculated measurement uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k = 2.

References	Version / Date
CISPR 16-4-1	Ed. 2 (2009-02)
CISPR 16-4-2	Ed. 2 (2011-06)
CISPR 32	Ed. 1 (2012-01)
ANSI C63.23	2012
A2LA P103	February 4, 2016
A2LA P103c	August 10, 2015
ETSI TR 100-028	V1.3.1 (2001-03)

Measurement Type	Configuration	Uncertainty ±
Radiated Emissions	Biconical Antenna	5.0 dB
Radiated Emissions	Log Periodic Antenna	5.3 dB
Radiated Emissions	Horn Antenna	4.7 dB
AC Line Conducted Emissions	Artificial Mains Network	3.4 dB
Telecom Conducted Emissions	Asymmetric Artificial Network	4.9 dB
Disturbance Power Emissions	Absorbing Clamp	4.1 dB
Radiated Immunity	3 Volts/meter	2.2 dB
Conducted Immunity	CDN/EM/BCI	2.4/3.5/3.4 dB
EFT Burst/Surge	Peak pulse voltage	164 volts
ESD Immunity	15 kV level	1377 Volts

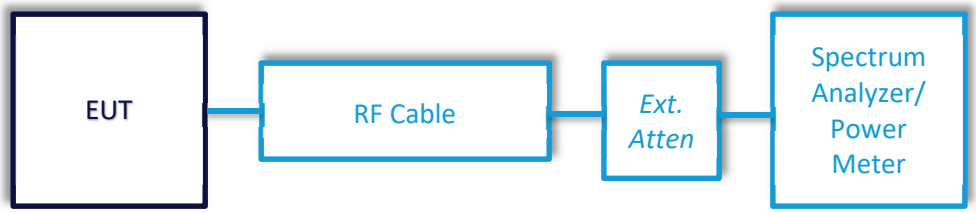
Parameter	ETSI U.C. ±	U.C. ±
Radio Frequency, from F0	$1x10^{-7}$	$0.55x10^{-7}$
Occupied Channel Bandwidth	5 %	2 %
RF conducted Power (Power Meter)	1.5 dB	1.2 dB
RF conducted emissions (Spectrum Analyzer)	3.0 dB	1.7 dB
All emissions, radiated	6.0 dB	5.3 dB
Temperature	1° C	0.65° C
Humidity	5 %	2.9 %
Supply voltages	3 %	1 %

5 TEST DATA

5.1 Antenna Port Conducted Emissions

Description of Measurement	The direct measurement of emissions at the antenna port of the EUT is achieved by use of a RF connection to a spectrum analyzer or power meter. The cable and attenuator factors are loaded into the analyzer or power meter allowing for direct measurement readings without the need for further corrections.
Example Calculations	Measurement (dBm) + Cable factor (dB) + External Attenuator (dB) = Corrected Reading (dBm) Margin (dB) = Limit (dBm) – Corrected Reading (dBm)

Block Diagram



5.1.1 Antenna Port Conducted Emissions – Bandwidth

Operator	Shane Dock
Test Date	9/20/17
Location	Conducted RF Measurement Area
Temp. / R.H.	70 degrees Fahrenheit / 53% RH
Requirement	OBW: FCC: 2.1049 IC: RSS-GEN 6.6 DTS BW: FCC: 15.247 (a)(2) IC: RSS-247 5.2 (1)
Method	ANSI C63.10 Section 6.9.2 FCC KDB 558074 D01 DTS Meas Guidance V04, Section 8

Limits:

6 dB BW (MHz)
> 500

Test Parameters

Frequency	2402, 2440, 2480 MHz

Tables

Channel	Low	Mid	High
6dB BW (kHz)	708.6	714.9	704.8
99% BW (kHz)	1060.7	1060.7	1059.8

Instrumentation

Laird
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Date : 29-Aug-2017 Test : Conducted RF Testing Job : C-2794

PE : Shane Dock Customer : Raffel Systems Quote : 317294

No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	EE 960087	44GHz EXA Spectrum Analyzer	Agilent	N9010A	MY 53400296	12/22/2016	12/22/2017	Active Calibration
2	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/26/2015	6/25/2017	Active Calibration

Plots

99% BW Low

6 dB BW Low

99% BW Mid

6 dB BW Mid

99% BW High

6 dB BW High

5.1.2 Antenna Port Conducted Emissions – Maximum Conducted Output Power

Operator	Shane Dock
Test Date	9/20/17
Location	Conducted RF Measurement Area
Temp. / R.H.	70 degrees Fahrenheit / 53% RH
Requirement	15.247 (b) (3)
Method	FCC KDB 558074 D01 DTS Meas Guidance V04, section 9.1.1

Limits:

Maximum Conducted Output Power (watts)	Maximum Conducted Output Power (dBm)
1	30

Test Parameters

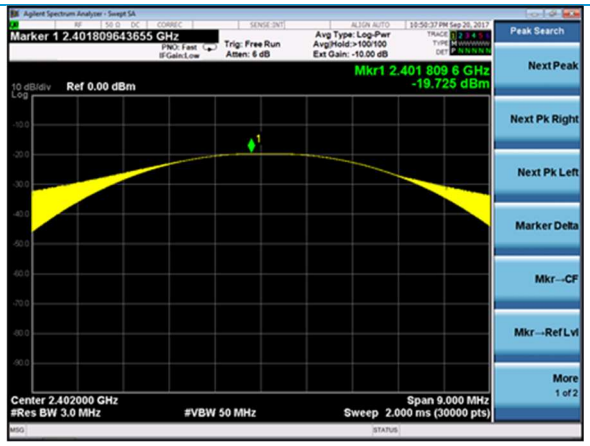
Frequency	2402, 2440, 2480 MHz
RBW	3 MHz

Table

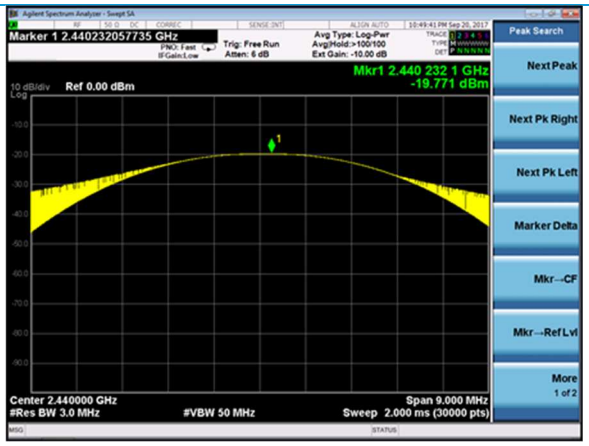
Channel	Low	Mid	High
Pout Conducted (dBm)	-19.725	-19.771	-19.898

Worst Case Margin = 30.000 dBm – (-19.725 dBm) = 49.725 dB

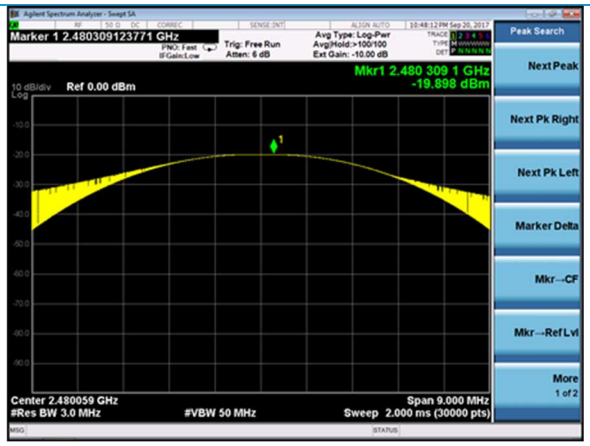
Plots



Low Channel Pout



Mid Channel Pout



High Channel Pout

5.1.3 Antenna Port Conducted Emissions – RF Spurious Emissions

Operator	Shane Dock
Test Date	9/20/17
Location	Conducted RF Measurement Area
Temp. / R.H.	70 degrees Fahrenheit / 53% RH
Requirement	15.247 (d)
Method	FCC KDB 558074 D01 DTS Meas Guidance V04, section 11

Limits:

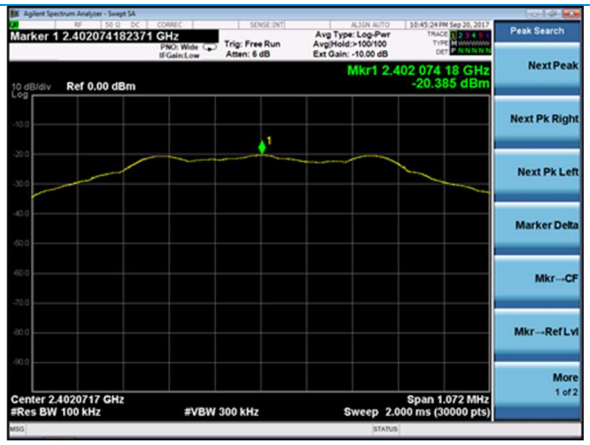
RF Spurious Limit
20 dBc

Test Parameters

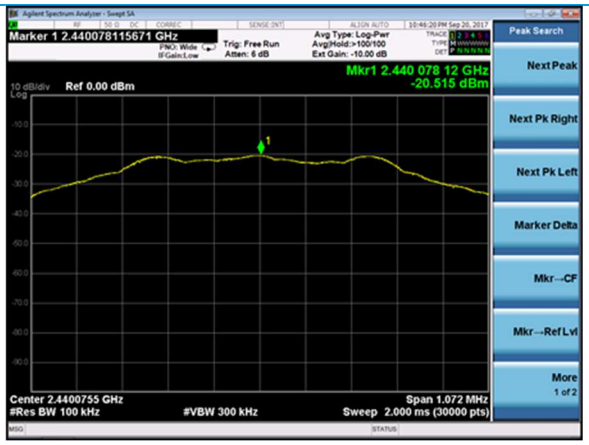
Frequency	30-25000 MHz
Settings	2402, 2440, 2480 MHz Channels
RBW	100k
VBW	300k
Trace	Max Hold
Detector	Peak
Note	All emissions are >10 dB below the limit.

Plots

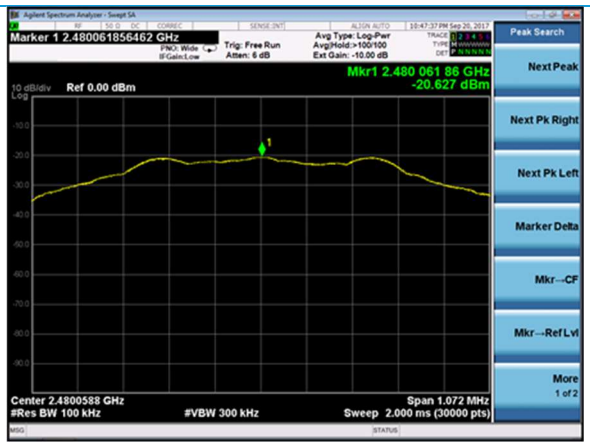
Reference Levels (Worst-Case Shown)



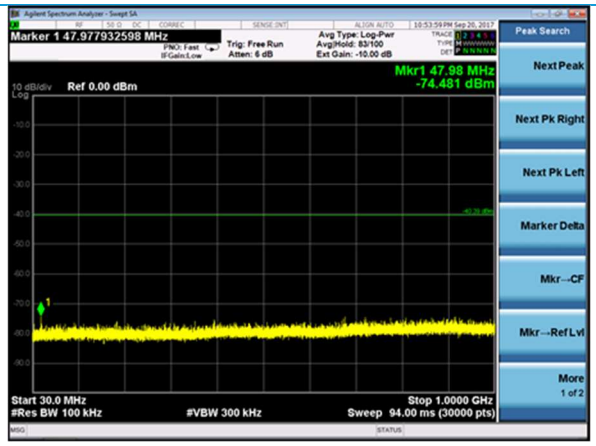
Low Channel



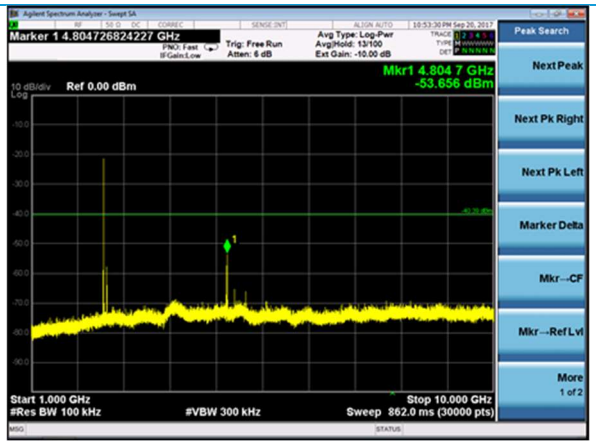
Mid Channel



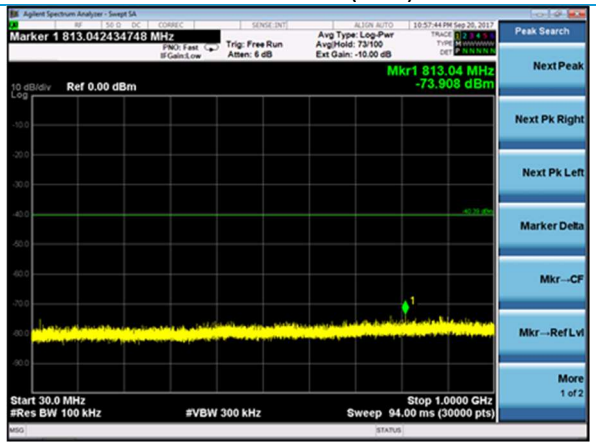
High Channels



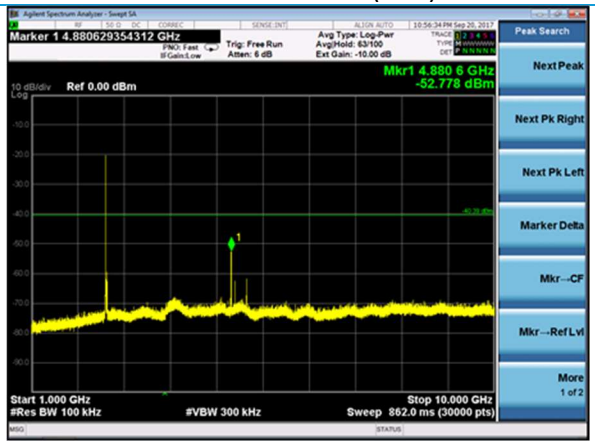
30-1000 MHz (Low)



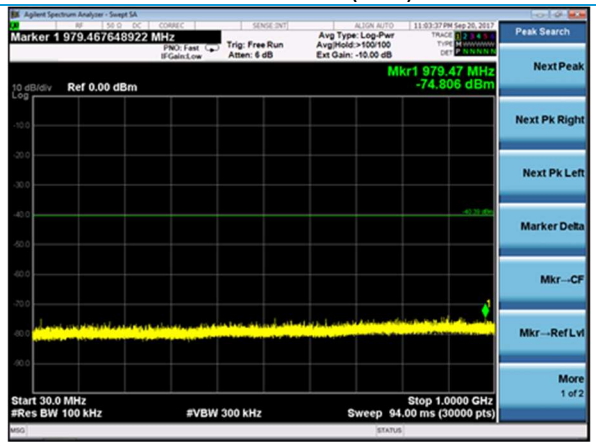
1000-10000 MHz (Low)



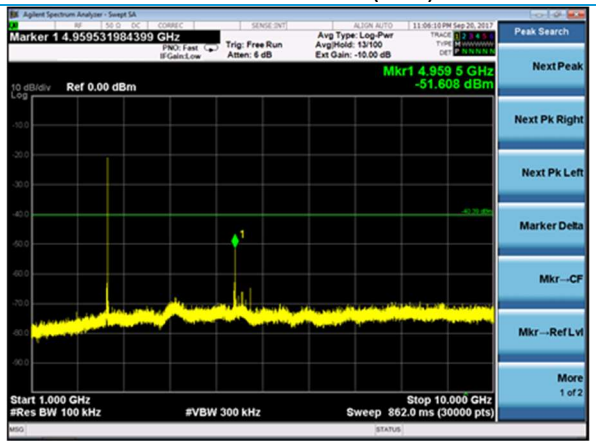
30-1000 MHz (Mid)



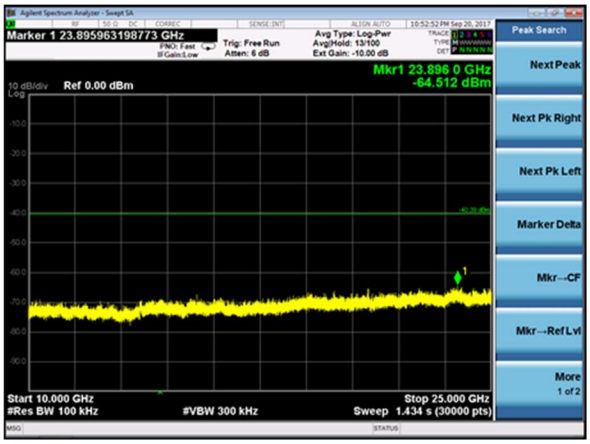
1000-10000 MHz (Mid)



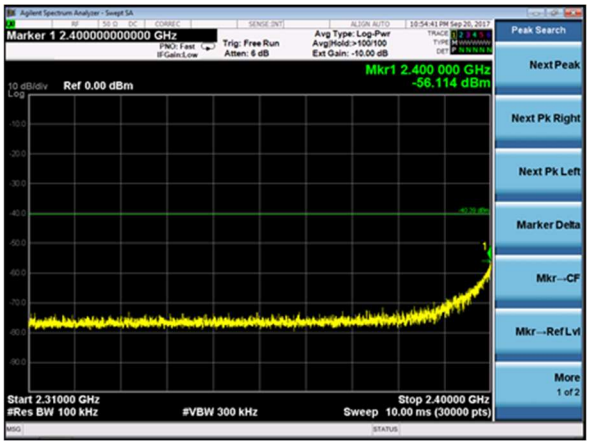
30-1000 MHz (High)



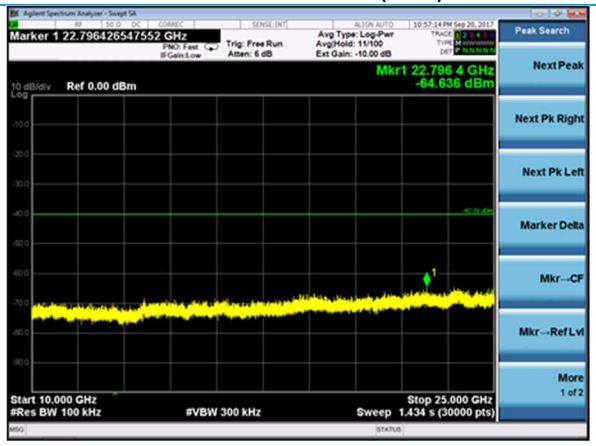
1000-10000 MHz (High)



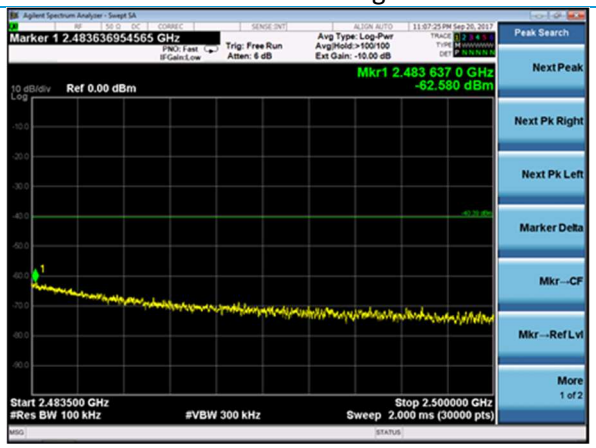
10000-25000 MHz (Low)



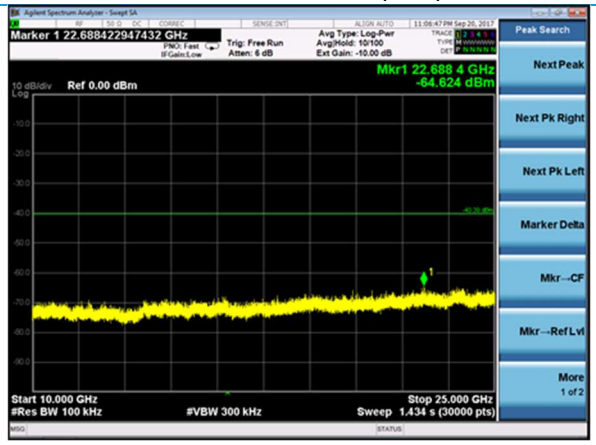
Lower Band Edge



10000-25000 MHz (Mid)



Upper Band Edge



10000-25000 MHz (High)

5.1.4 Antenna Port Conducted Emissions – Power Spectral Density

Operator	Shane Dock
Test Date	9/20/17
Location	Conducted RF Measurement Area
Temp. / R.H.	70 degrees Fahrenheit / 53% RH
Requirement	15.247 (e)
Method	FCC KDB 558074 D01 DTS Meas Guidance V04, Section 10.2

Limits:

PSD (dBm/3 kHz)
< 8

Test Parameters

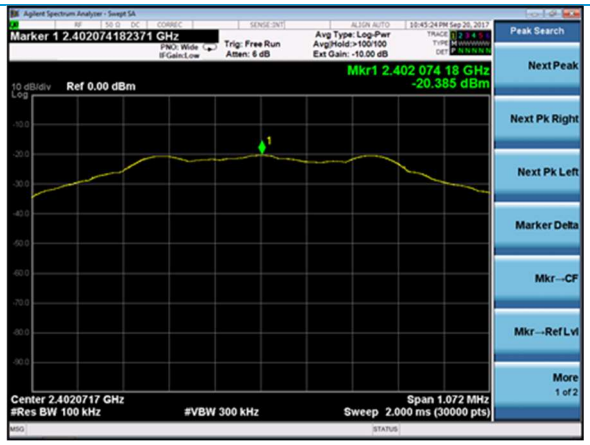
Frequency	2402, 2440, 2480 MHz
RBW	100kHz
VBW	300kHz
Trace	Max Hold
Detector	Peak

Table

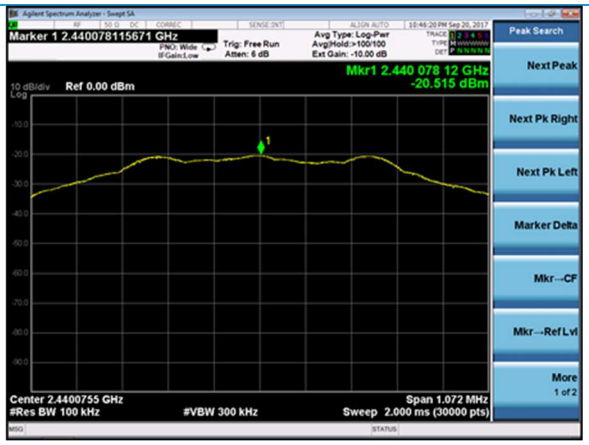
Channel	Low	Mid	High
PSD (dBm)	-20.385	-20.515	-20.627

Worst Case Margin = 8.000 dBm – (-20.385 dBm) = 28.385 dB

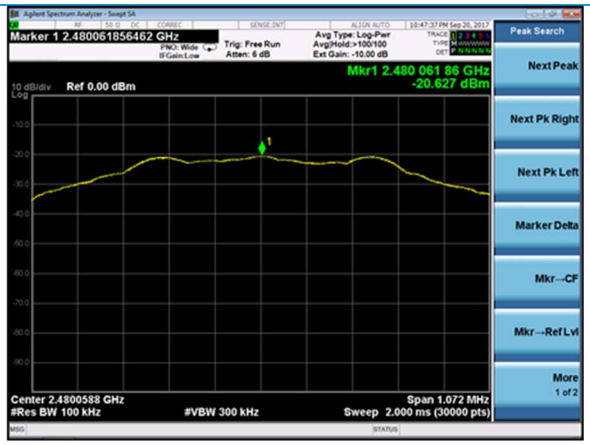
Plots



Low Channel



Mid Channel



High Channels

5.1.5 Antenna Port Conducted Emissions – Frequency Stability

Operator	Shane Dock
Test Date	10/4/17
Location	Conducted measurement area
Temp. / R.H.	71 degrees Fahrenheit / 56% RH
Requirement	FCC: 2.1055 (d) IC: RSS-GEN 6.11
Method	ANSI C63.10 Section 6.8

Test Parameters

Frequency	2402, 2440, 2480 MHz
Channels	Low, Mid, High
Frequencies (Nominal)	2402, 2440, 2480 Mhz
Voltages	102, 120, and 138 VAC (60 Hz)

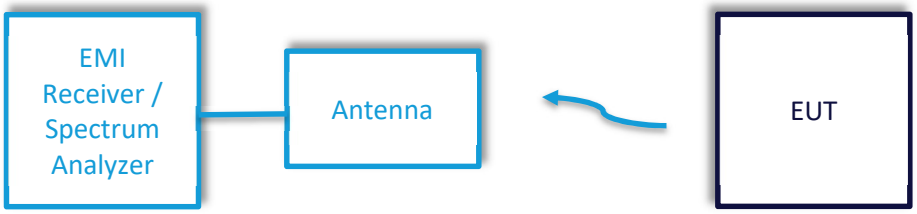
Table (Values below listed in Hz at the given voltages)

Channel	102 VAC	120 VAC	138 VAC	Deviation (Hz)
Low	2402070400	2402070400	2402070400	0
Mid	2440071100	2440071200	2440071200	100
High	2480072500	2480072500	2480072500	0

5.2 Radiated Emissions

Description of Measurement	The frequency spectrum is investigated for intentional and / or unintentional signals emanating from the EUT by use of a standardized test site and measurement antenna. The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed allowing the data to be gathered and reported as corrected values. The maximum emissions from the EUT are determined by turn-table azimuth rotation (360°) and scanning of the measurement antenna. Maximized levels are noted at degree values of azimuth, measurement antenna height, and measurement antenna polarity.
Example Calculations	Measurement (dBµV) + Cable factor (dB) + Other (dB) + Antenna Factor (dB/m) = Corrected Reading (dBµV/m) Margin (dB) = Limit (dBµV/m) - Corrected Reading (dBµV/m) Example at 4000 MHz: Reading = 40 dBµV + 3.4 dB + 0.9 dB + 6.5 dB/m = 50.8 dBµV/m Average Limit = 20 log (500) = 54 dBµV/m Margin = 54 dBµV/m - 50.8 dBµV/m = 3.2 dB

Block Diagram



5.2.1 Radiated Emissions

Operator	Shane Dock
Test Date	8/28/17 – 9/14/17
Location	Chamber 5, Chamber 3
Temp. / R.H.	69 degrees Fahrenheit / 55% RH
Requirement	FCC: 15.247 (d) IC: RSS-GEN 8.10
Method	ANSI C63.10 Sections 6.5 and 6.6

Limits:

	30-88 MHz	88-216 MHz	216 – 960 MHz	960+ MHz
Field Strength (µV/m)	100	150	200	500
Field Strength (dBµV/m)	40.0	43.5	46.0	54.0

Test Parameters

Frequency	30-25000
Distance	3M
Settings	Unit tested at Low, Mid, High Channels
Settings	RBW = 120kHz, VBW 1.2 MHz (<1 GHz) RBW = 1 MHz, VBW = 3 MHZ (>1 GHz)
Notes	Measurements taken in restricted bands. For measurements above 1 GHz, antenna used with a tilt gear to keep EUT within the cone of radiation. Absorbers were also added to the floor of the chamber while measuring emissions above 1 GHz. Emissions under 1 GHz are not a function of Tx Mode. Unit tested with customer-provided ferrite.
Example Calculation	Limit (dBµV) = 20* Log[Limit (µV)] 40 = 20* log (100) Raw Data + Antenna Factor + Cable Factor = Reported Data 19.77 dBµV + 12.50 dB/m + 0.93 dB = 38.80 dBµV/m

Instrumentation

Laird
Smart Technology. Delivered.

Date : 29-Aug-2017 Test : Spurious Emissions Job : C-2794

PE : Shane Dock Customer : Raffel Systems Quote : 317294

No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	AA 960158	Double Ridge Horn Antenna	ETS Lindgren	3117	109300	4/12/2017	4/12/2018	Active Calibration
2	EE 960159	Low Noise Amplifier	Mini-Circuits	ZVA-213X-S+	462101702	4/12/2017	4/12/2018	Active Calibration
3	AA 960171	Cable - low loss 6m	A.H. Systems, Inc	SAC-26G-6	386	3/31/2016	11/21/2017	Active Verification
4	EE 960085	EMI Receiver	Agilent	N9038A	MY51210148	5/12/2017	5/12/2018	Active Calibration
5	AA 960174	Small Horn Antenna	ETS Lindgren	3116C-PA	00206880	5/1/2017	5/1/2018	Active Calibration
6	AA 960128	Biconical Antenna	ETS Lindgren	3110B	00062899	4/13/2017	4/13/2018	Active Calibration
7	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	4/17/2017	4/17/2018	Active Calibration
8	AA 960153	High Pass Filter 2.4 GHz	KWM	HPF-L-14186	7272-04	5/2/2017	5/2/2018	Active Calibration

Table

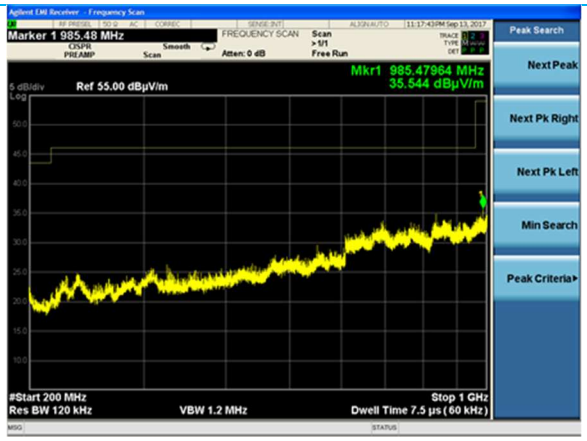
Frequency (MHz)	Channel	EUT orientation	Antenna Polarity	Height (cm)	Azimuth (degree)	Peak Reading (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Avg Margin (dB)
4960.00	High	Flat	Horiz	181.42	188.00	52.3	74.0	21.7	47.7	54.0	6.3
4880.00	Mid	Flat	Horiz	184.85	186.75	50.8	74.0	23.2	46.4	54.0	7.6
4804.00	Low	Flat	Horiz	174.61	149.75	50.5	74.0	23.5	45.6	54.0	8.4

Frequency (MHz)	Channel	EUT orientation	Antenna Polarity	Height (cm)	Azimuth (degree)	Peak Reading (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)
2385.09	Low	Horiz	Vert	203.00	96.50	47.4	74.0	26.6
2483.61	High	Horiz	Vert	203.00	96.50	48.9	74.0	25.1

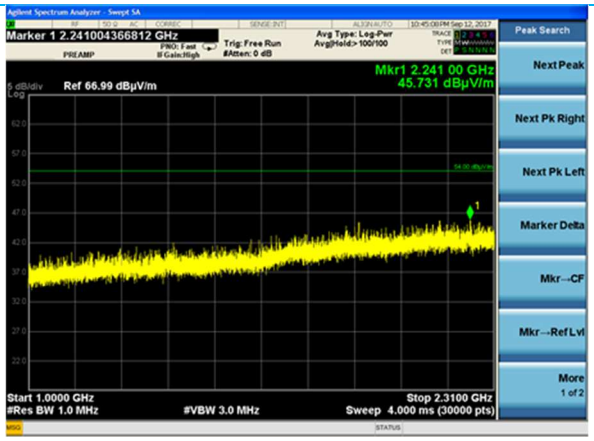
Frequency (MHz)	Channel	EUT orientation	Antenna Polarity	Height (cm)	Azimuth (degree)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Avg Margin (dB)
2376.77	Low	Horiz	Vert	203.00	96.50	34.9	54.0	19.1
2485.52	High	Horiz	Vert	203.00	96.50	35.0	54.0	19.0

Plots (Worst-Case Shown)

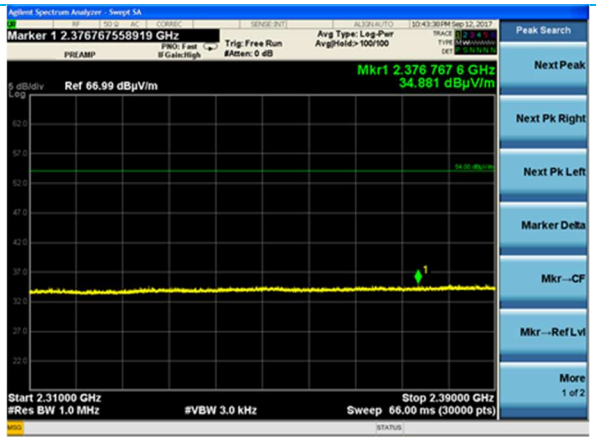
30 – 200 MHz



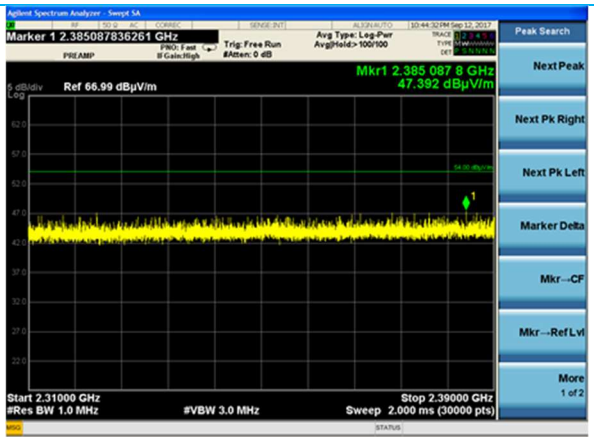
200 – 1000 MHz



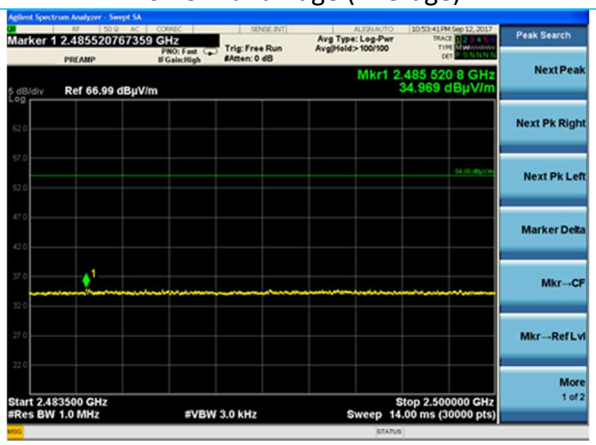
1 – 2.31 GHz



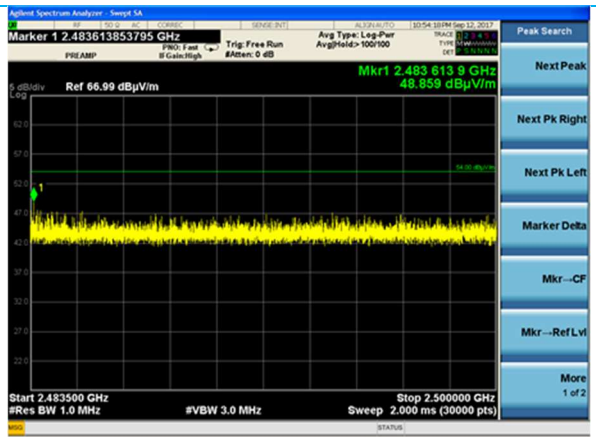
Lower Band Edge (Average)



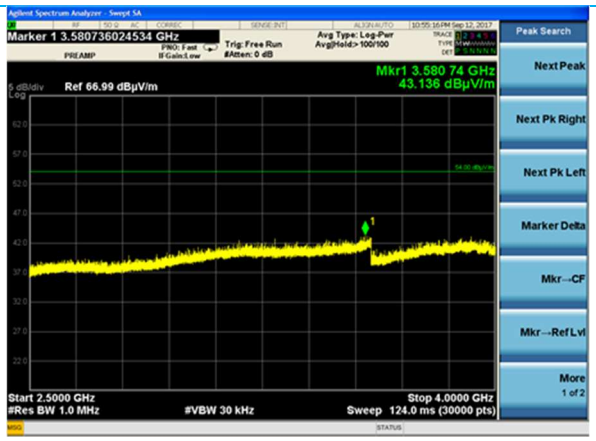
Lower Band Edge (Peak)



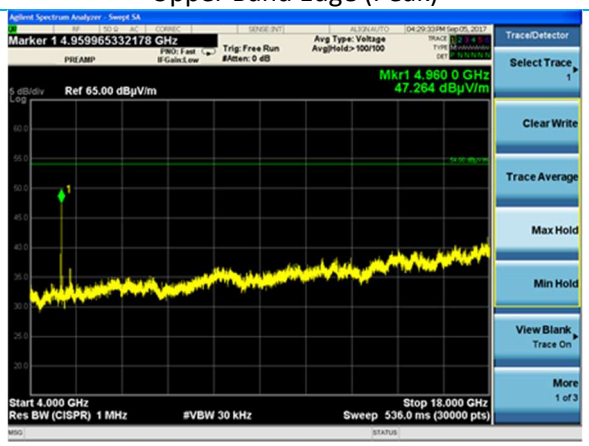
Upper Band Edge (Average)



Upper Band Edge (Peak)



2.5 – 4 GHz



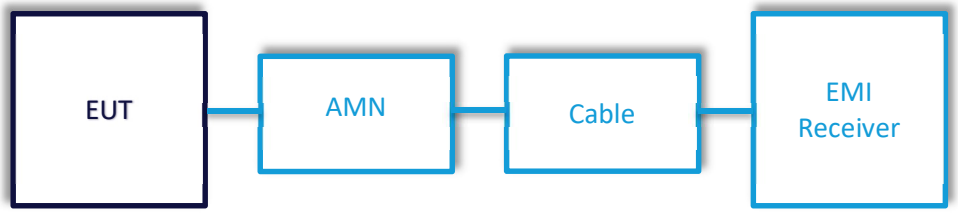
4 – 18 GHz

18 – 25 GHz

5.3 AC Mains Conducted Emissions

Description of Measurement	A line impedance stabilization network (LISN) or artificial mains network (AMN) allows the emissions of the power supply conductors to be measured while isolating the EUT from the supply mains. The AMN, cable, and other necessary measurement system correction factors are loaded onto the EMI receiver when the measurements are performed. The data is gathered and reported as the corrected values. Maximum emissions are determined with a peak max hold trace then measurements at a selection of the highest points are made with quasi-peak and average detectors. Results are recorded and compared to limit for each line. (e.g. line and neutral)
Example Calculations	Measurement (dBµV) + Cable factor (dB) + Other (dB) = Corrected Reading (dBµV) Margin (dB) = Limit (dBµV) - Corrected Reading (dBµV)

Block Diagram



5.3.1 AC Mains Conducted Emissions

Operator	Jon Dilley
QA	Adam Alger
Test Date	9/15/17
Location	EMC Lab
Temp. / R.H.	70 degrees F / 60% RH
Requirement	FCC: 15.207 IC: RSS-GEN 8.8
Method	ANSI C63.10 Section 6.2

Limits:

Frequency of Emission (MHz)	Quasi-Peak Limit (dBuV)	Average Limit (dBuV)
0.15 - 0.50	66 to 56	56 to 46
0.5 – 5	56	46
5-30	60	50

Test Parameters

Frequency	0.15 – 30 MHz
Settings	RBW 9 kHz
Settings	VBW 90 kHz
EUT Power	120V 60 Hz

Instrumentation

Laird
Smart Technology. Delivered.

Date : 29-Aug-2017 Test : Conducted Emissions Job : C-2794

PE : Shane Dock Customer : Raffel Systems Quote : 317294

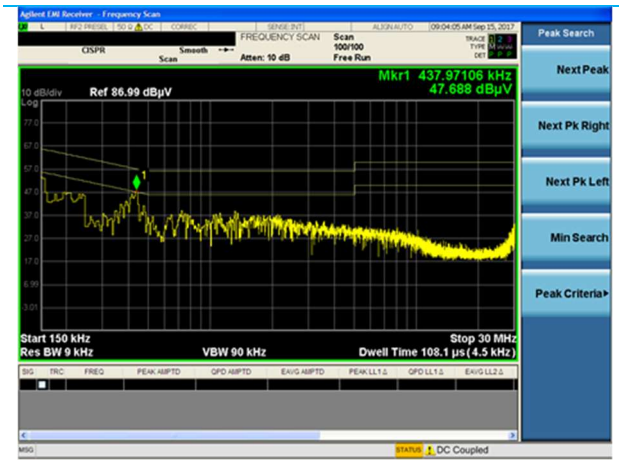
No.	Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due Date	Equipment Status
1	EE 960088	EMI Receiver	Agilent	N9038A	MY51210138	3/2/2017	3/2/2018	Active Calibration
2	EE 960162	LISN	COM-POWER	LI-215A	191969	8/28/2017	8/28/2018	Active Calibration

Tested By: Quality Assurance:

Table

Mode	Line	Frequency (MHz)	Q-Peak Reading (dBµV)	Q-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)
Tx	L1	0.438	41.8	57.1	15.3	24.3	47.1	22.8
Tx	L1	0.726	41.7	56.0	14.3	24.4	46.0	21.6
Tx	L1	29.955	41.8	60.0	18.2	24.3	50.0	25.7
Tx	L2	0.429	42.4	57.3	14.8	24.7	47.3	22.6
Tx	L2	0.739	42.4	56.0	13.6	24.7	46.0	21.3
Tx	L2	29.618	42.4	60.0	17.6	24.7	50.0	25.3

Plots



Line 1

Line 2

6 REVISION HISTORY

Version	Date	Notes	Person
V0	10/16/17	First Draft	Shane Dock
V1	10/26/17	Updated Draft	Shane Dock
V2	3/13/18	Final Draft	Shane Dock
V3	3/28/18	Updated Draft	Shane Dock
V4	4/5/18	Instrumentation Correction	Shane Dock

END OF REPORT