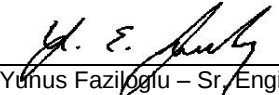




Test Report

CURTIS-STRAUS Curtis-Straus LLC, a wholly owned subsidiary of BV CPS

Report No	ES1533-2
Client	Novanta
Address	125 Middlesex Turnpike Bedford MA, 01730
Phone	617-499-4090
Items tested	M6e-A Module
FCC ID	QV5MERCURY6E-A
IC	5407A-MERCURY6EA
FRN	0008403743
Equipment Type	Part 15 Spread Spectrum Transmitter
Equipment Code	DSS
FCC/IC Rule Parts	CFR Title 47 FCC 15.247, ISED Canada RSS-247 Issue 2
Test Dates	Aug 6 to Sep 27, 2018
Results	As detailed within this report
Prepared by	 Zachary Johnson – EMC Engineer
Authorized by	 Yunus Faziloglu – Sr. Engineer
Issue Date	<u>11/27/2018</u>
Conditions of Issue	This Test Report is issued subject to the conditions stated in the 'Conditions of Testing' section on page 38 of this report.

Curtis-Straus LLC is accredited to ISO/IEC 17025 by A2LA for the specific scope of accreditation under Certificate Number 1627-01. This report may contain data which is not covered by the A2LA accreditation. See our scope of accreditation at the end of this test report. Any opinions or interpretations expressed in this report are outside the scope of our A2LA accreditation as A2LA only accredits testing.

Testing Cert. No. 1627-01



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One Distribution Center Circle, #1 • Littleton, MA • TEL (978) 486-8880 • FAX (978) 486-8828



page 1 of 39

Contents

Contents.....	2
Summary.....	3
Test Methodology.....	4
Product Tested - Configuration Documentation	5
Statement of Conformity	6
Test Results	7
20dB Bandwidth.....	7
99% Occupied Bandwidth	9
Channel Separation	11
Number of Channels	13
Dwell Time	14
Peak Output Power.....	16
Conducted Bandedges.....	23
Conducted Spurious	25
Radiated Spurious Emissions	28
AC side of DC supply Conducted Emissions.....	34
Measurement Uncertainty.....	37
Conditions Of Testing	38

Form Final Report REV 7-20-07 (DW)



Summary

This test report supports an application for certification of a transmitter operating pursuant to:
CFR Title 47 FCC 15.247, ISSED Canada RSS-247 Issue 2

M6e-A module is a frequency hopping transmitter that operates in the frequency range of
902.75-927.25MHz. It is powered by 5V DC.

Following antenna and cable configuration was supplied for testing,

Manufacturer	Model	Type	Gain	Cable Length	Notes
MTI Wireless	MT-242043 12"X12"	Circular	6dBil	12 ft	1
MTI Wireless	MT262024	Circular	4dBil	Not relevant	2

Note 1: Actual antenna that will be marketed with the device.

Note 2: Dummy antennas on ports 2, 3 and 4 in order to populate the ports for test purposes.

We found that the product met the above requirements with modifications as described on page
4 of this report. Test sample was received in good condition.

Release Control Record

Issue No.	Reason for change	Date Issued
1	Original Release	November 27, 2018



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Test Methodology

All the testing was performed according to the following rules/procedures/documents;
CFR Title 47 FCC 15.247, ISED Canada RSS-247 Issue 2, RSS-Gen Issue 5 and ANSI C63.10-2013.

Radiated emissions were maximized around 3 orthogonal planes. 4 Antennas were present to populate all ports, but only port 1 was active for testing. During normal operation only one port can be active at a time.

Conducted emissions testing at the antenna port was performed. Antenna cable provided by client was used during conducted antenna port testing.

After tests were completed, client performed the following modifications to the product:

- Tuning and matching component adjustments at the power amplifier
- Adjustments of the power supply voltage to that amplifier.

Client stated that, these changes were made to improve power supply efficiency. Specifically, following hardware changes were made.

L12 – Remove. Install TAIYO-YUDEN HK1005-4N7S, JADAK-PN IND-10010, 4.7 nH.
C27 – Remove. Install TAIYO-YUDEN UVK105CH3R9JW-F, JADAK-PN CAP-10030, 3.9pF.
C22 – Remove. Install TAIYO YUDEN UMK105CG8R2DV-F, JADAK-PN 060-0121-01, 8.2 pF.
C28 – Remove. Install Murata GJM1555C1H120GB01D, CAP-10031, 12 pF.
C173 – Nothing to remove. Install Murata GJM1555C1H120GB01D, CAP-10031, 12 pF.
L9 – Remove. Install Coilcraft 0402HP-2N0XJLW, JADAK-PN IND-10009, 2.0 nH, 2.1 Amp.
C29 – Remove. Install TAIYO-YUDEN UVK105CH3R9JW-F, JADAK-PN CAP-10030, 3.9 pF.
C35 – Nothing to remove. Install TAIYO-YUDEN UVK105CH3R9JW-F, JADAK-PN CAP-10030, 3.9 pF.
L8 – Remove. Install ROHM MCR01MZPJ000, JADAK-PN 050-0023-01, 0 ohm jumper.
R71 – Remove. Install Panasonic ERJ1GNF2492C, JADAK-PN 050-0302-01, 24.9Kohm.
R3 – Nothing to remove. Install Wurth 744 761 182C, JADAK-PN IND-10011, 82 NH.
C39 - Remove. Install TAIYO-YUDEN UVK105CH010BW-F, JADAK-PN, 060-0100-01, 1.0PF.

Per client's request only the following tests were repeated after modifications:

99% OBW, 20dB BW, Channel Separation, Peak Output Power, Conducted Bandedges and Conducted Spurious Emissions

The rest of the test results in this report represent the design before the described changes above.

3 channels were tested as follows:

Low channel = 902.75 MHz

Middle channel = 915.25 MHz

High channel = 927.25 MHz



Following bandwidths were used during radiated spurious and AC line conducted emissions tests

Frequency	RBW	VBW
150kHz – 30MHz	9kHz	30kHz
30MHz – 1GHz	120kHz	1MHz
1GHz – 10GHz	1MHz	3MHz

Product Tested - Configuration Documentation

EUT Configuration										
Work Order:	S1533									
Company:	Novanta (Formerly Thing Magic)									
Company Address:	125 Middlesex Turnpike									
	Bedford, MA, 01730									
Contact:	Harinath Reddy									
	MN			PN			SN			
EUT:	M6E-A									
EUT Description:	Transmitter Module									
EUT Max Frequency:	927.25 MHz									
EUT Min Frequency:	902.75 MHz									
Support Equipment	MN					SN				
HP laptop										
5V DC PSU										
Port Label	Port Type	# ports	# populated	cable type	shielded	ferrites	length (m)	in/out	under test	comment
Antenna	other	4	4	other	No	No		in	yes	
Software Operating Mode Description:										
EUT is monitored and operated through the Universal Reader Assistant program on the support computer.										
Performance Criteria:										
When EUT is powered on and "Reading" The Read/Count number should continue to increment on the monitoring page. Reading light at top of screen should remain green.										

Clock Frequencies	
frequencies (MHz)	927.25, 915.25, 902.75



Statement of Conformity

RSS-GEN	RSP-100	RSS 247	Part 15	Comments
6.4			15.15(b)	There are no controls accessible to the user that varies the output power to operate in violation of the regulatory requirements.
	3.1		15.19	The label is shown in the label exhibit.
	3.2		15.21	Information to the user is shown in the instruction manual exhibit.
			15.27	No special accessories are required for compliance.
3.2			15.31	The EUT was tested in accordance with the measurement standards in this section.
6.13.2			15.33	Frequency range was investigated according to this section, unless noted in specific rule section under which the equipment operates.
6.13.1			15.35	The EUT emissions were measured using the measurement detector and bandwidth specified in this section, unless noted in specific rule section under which the equipment operates.
6.8			15.203	The antenna for this device is an external antenna with 6dBi gain.
8.10			15.205 15.209	The fundamental is not in a Restricted band and the spurious and harmonic emissions in the Restricted bands comply with the general emission limits of 15.209 or RSS-Gen as applicable
8.8			15.207	The unit complies with the requirements of 15.207
			15.247	The unit complies with the requirements of 15.247
		RSS 247		The unit complies with the requirements of RSS-247
6.7				Occupied Bandwidth measurements were made.



Test Results

20dB Bandwidth

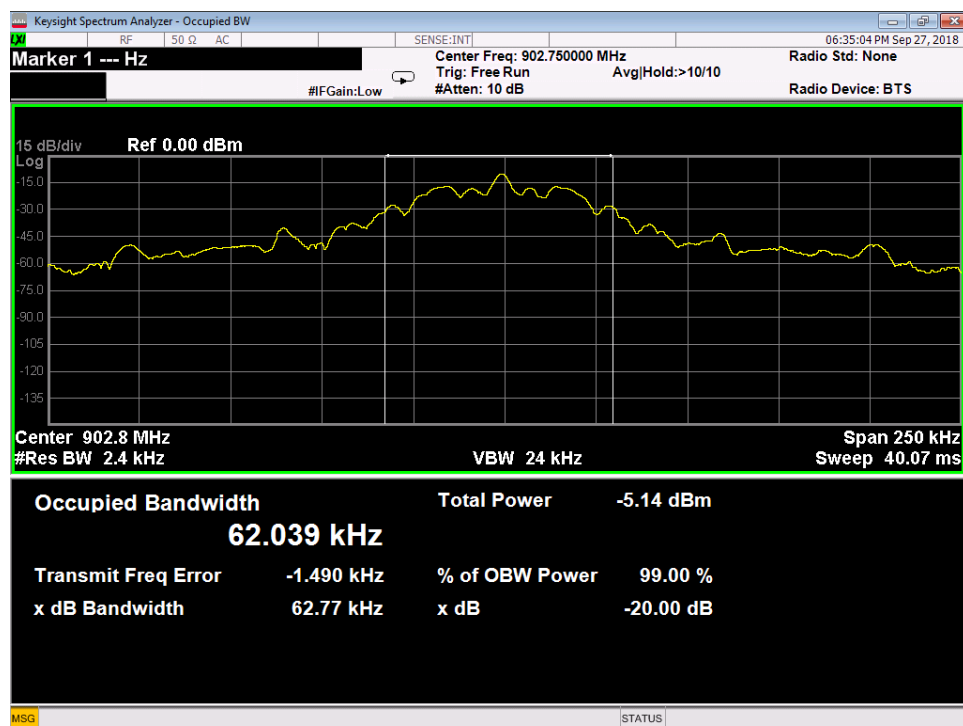
REQUIREMENT

15.247(a)(1)(i): The maximum allowed 20dB bandwidth of the hopping channel is 500kHz
 RSS-247 Issue 2 Section 5.1: The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

MEASUREMENTS / RESULTS

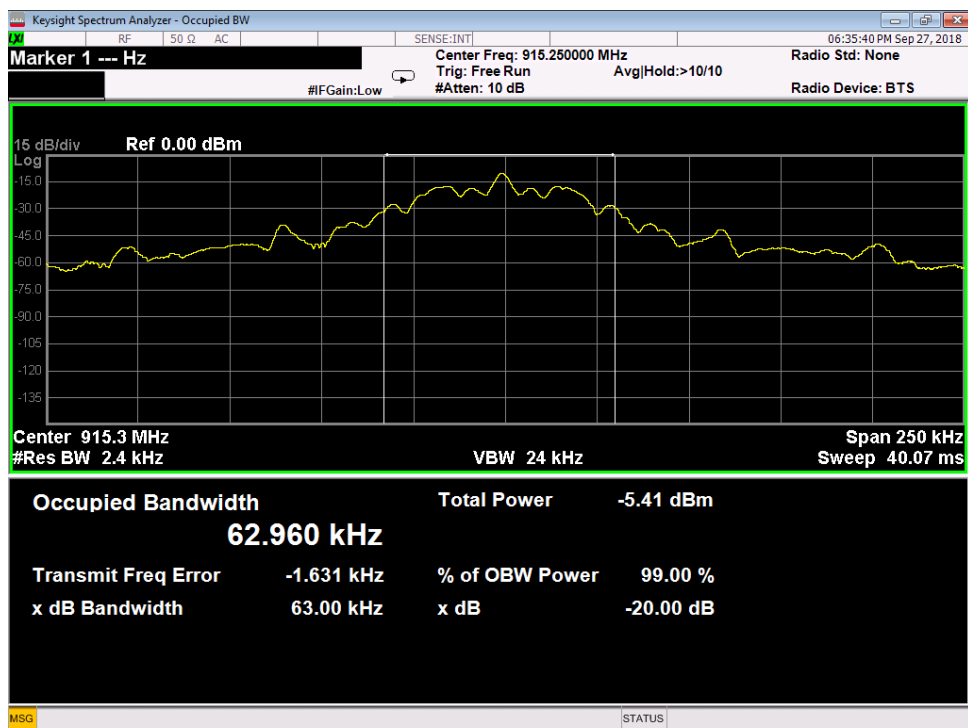
20dB Bandwidth					
Date: 9/27/2018		Company: Novanta			
Engineer: Zac Johnson		EUT: M6e-A			
Temp: 23.8°C		Humidity: 55%			
		Pressure: 1008mBar			
Frequency Range: 902.75-927.25 MHz		Measurement Type: Conducted			
Measurement Method: ANSI C63.10-2013					
Notes:					
Frequency Reading (MHz)	Reading (kHz)	20dB Bandwidth			
		Limit (kHz)	Result (Pass/Fail)		
		902.75	62.77	<500	Pass
		915.25	63.00	<500	Pass
		927.25	63.18	<500	Pass
Test Site: CEMI-5		Cable: 2288			
Analyzer: 1118473 SA		Attenuator: 2107 Pad			
Copyright Curtis-Straus LLC 2000					

PLOTS

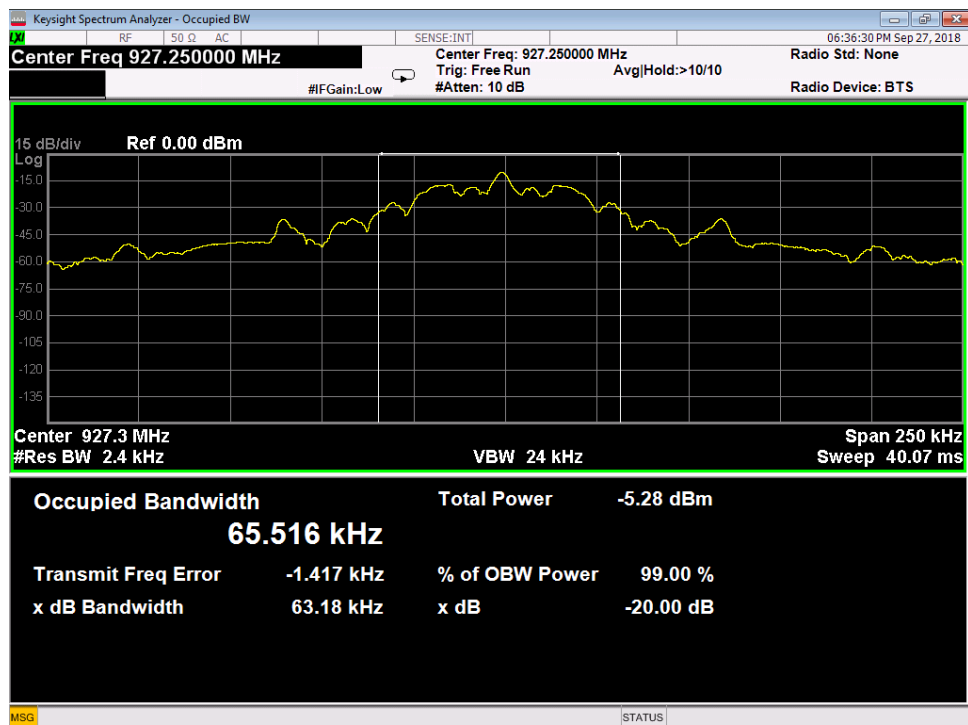


902.75MHz Low Channel





915.25MHz Mid Channel



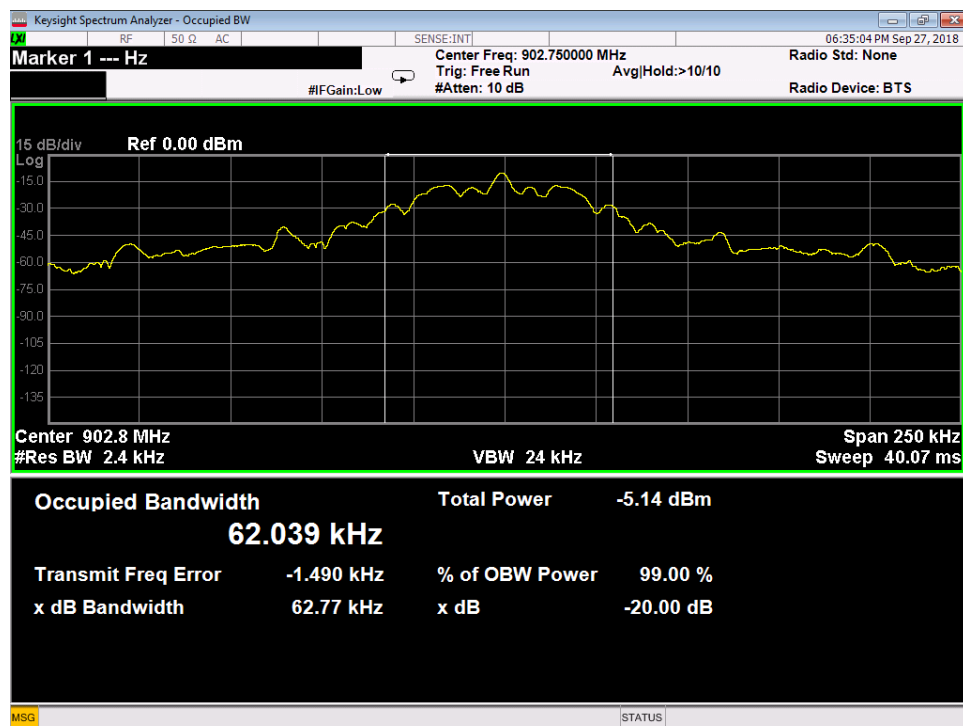
927.25MHz High Channel

99% Occupied Bandwidth

MEASUREMENTS / RESULTS

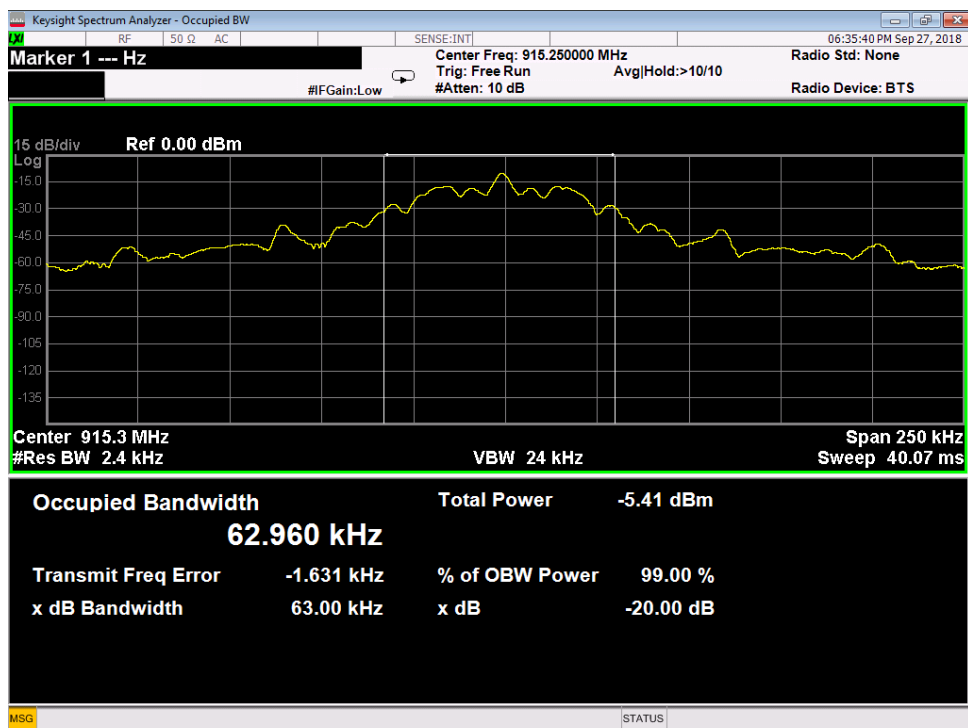
99% Occupied Bandwidth			
Date: 9/27/2018		Company: Novanta	
Engineer: Zac Johnson		EUT: M6e-A	
Temp: 23.8°C		Humidity: 55%	
		Pressure: 1008mBar	
Frequency Range: 902.75-927.25MHz		Measurement Type: Conducted	
		Measurement Method: RSS-Gen Issue 5 Section 6.7	
Notes:			
Frequency (MHz)	99% OBW (KHz)		
902.75	62.039		
915.25	62.960		
927.25	65.516		
Test Site: CEMI-05		Cable: 2288	
Analyzer: 1118473 SA		Attenuator: 2107 Pad	
Copyright Curtis-Straus LLC 2000			

PLOTS

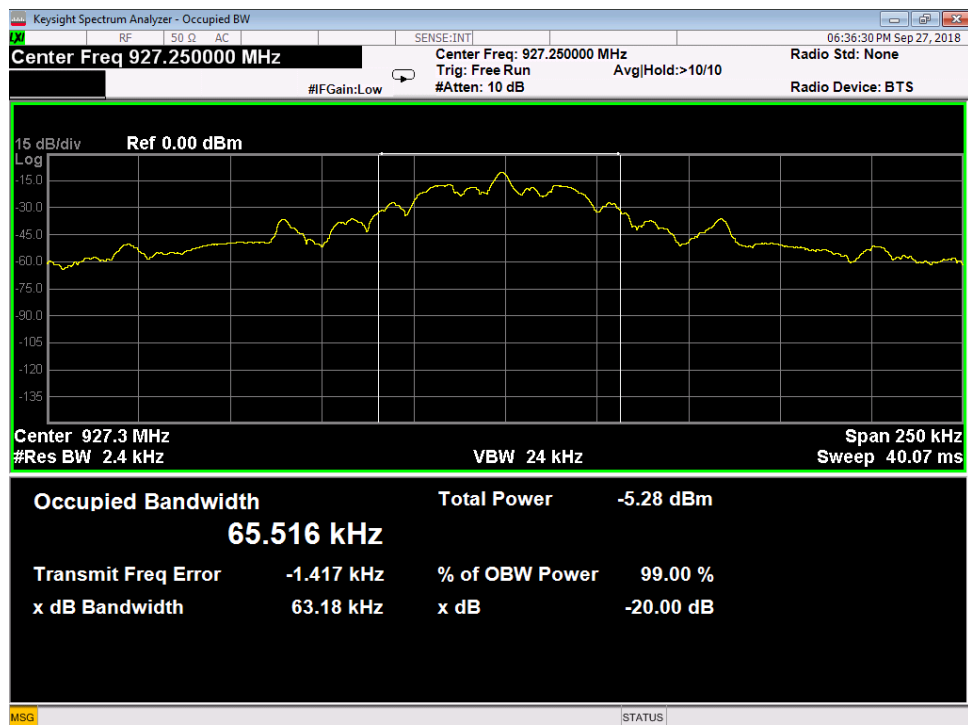


902.75MHz Low Channel





915.25MHz Mid Channel



927.25MHz High Channel

Channel Separation

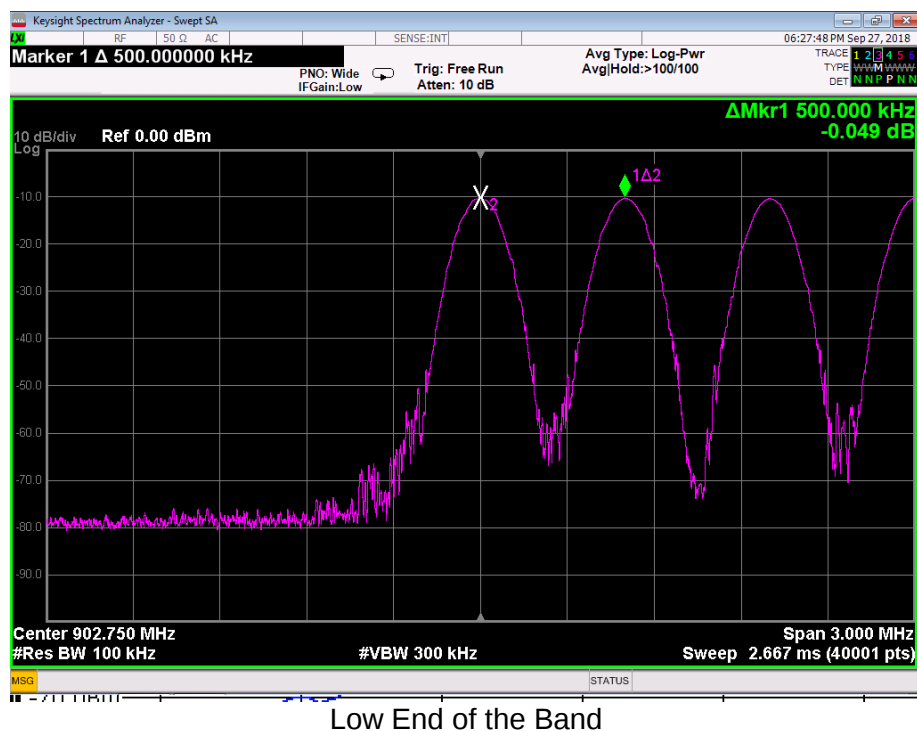
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

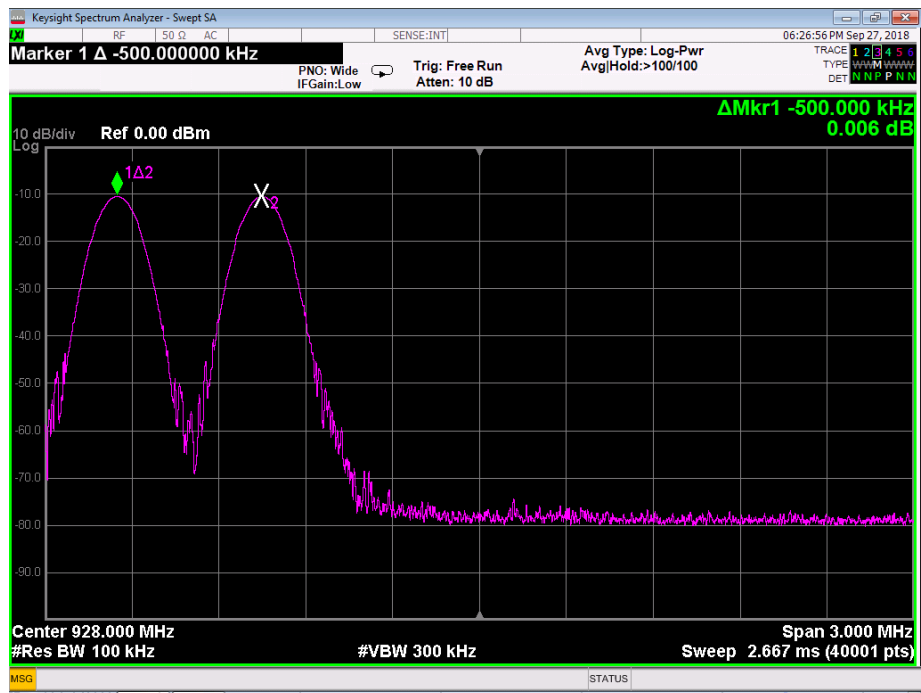
[15.247 (a) (1)]

MEASUREMENTS / RESULTS

Channels are spaced by 500kHz as seen in the following plots. This is higher than both 25kHz and the 20dB bandwidth of the product.

Plots





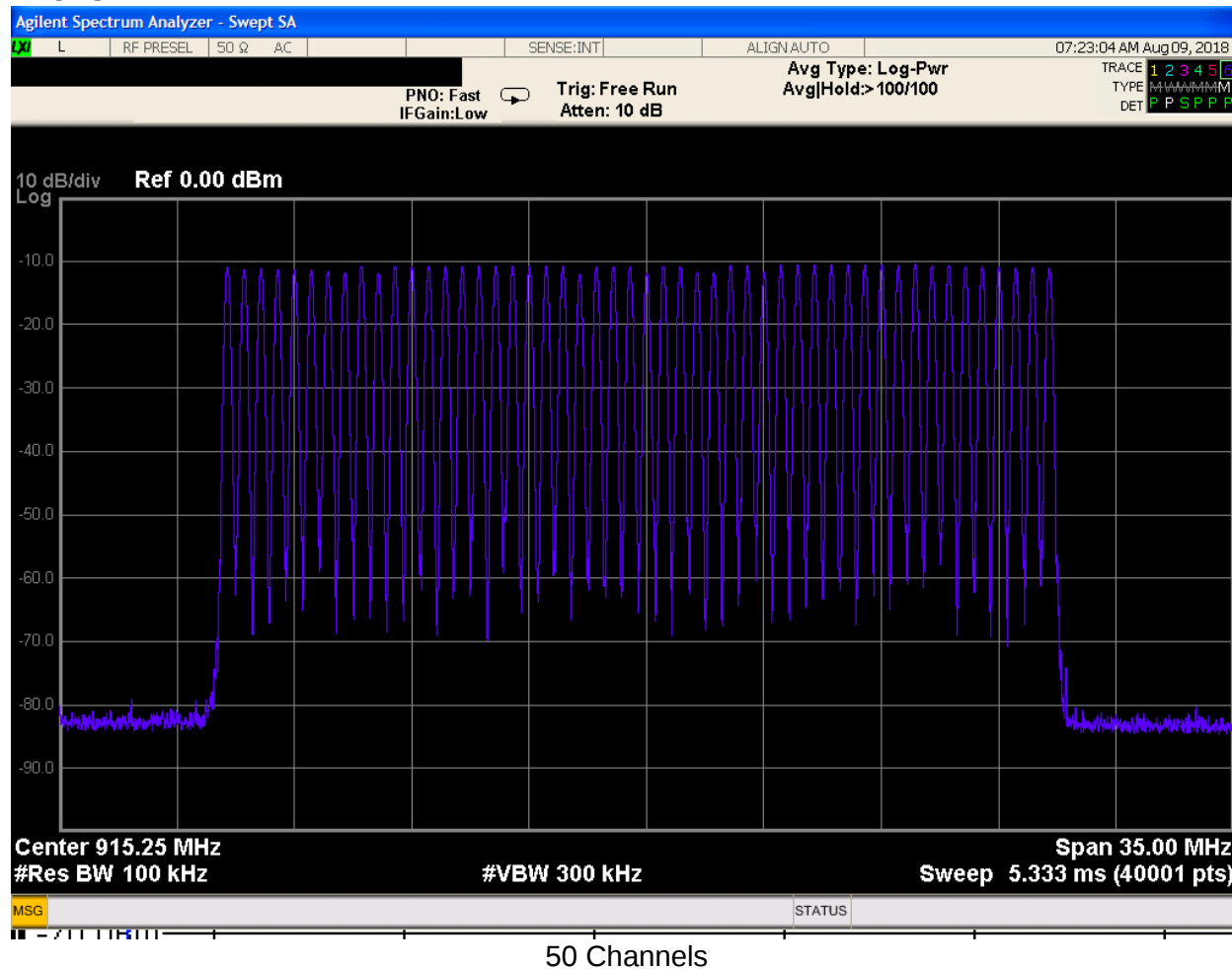
High End of the Band

Number of Channels

For frequency hopping systems operating in the 902-928MHz band: if the 20dB bandwidth of the hopping channel is less than 250kHz, the system shall use at least 50 hopping frequencies [15.247 (a) (1) (i)]

MEASUREMENTS / RESULTS

PLOTS



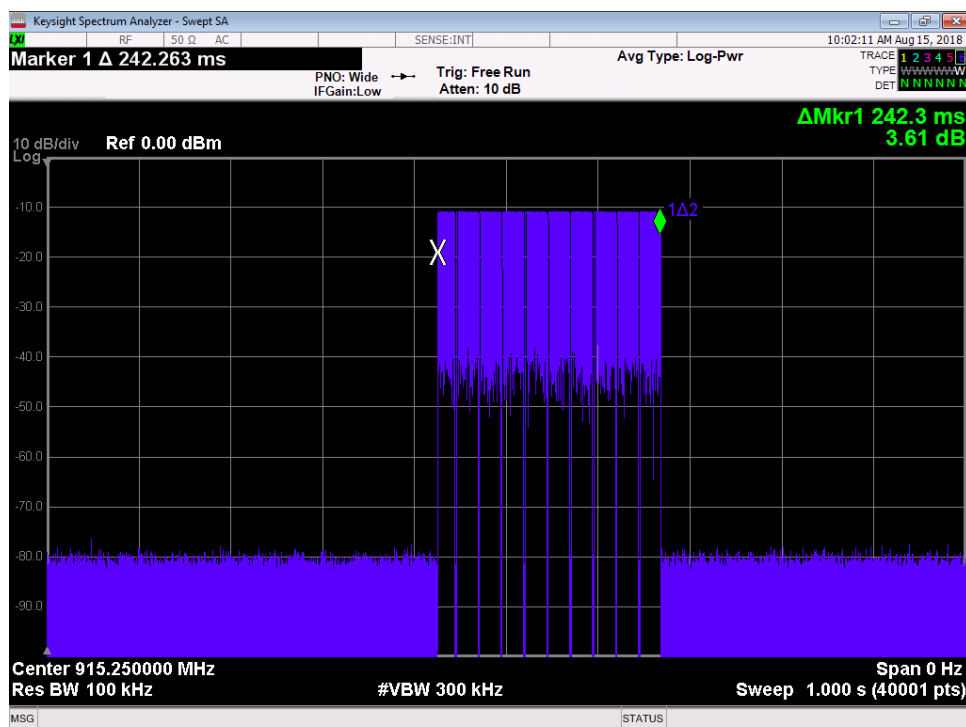
Dwell Time

For frequency hopping systems operating in the 902-928MHz band: if the 20dB bandwidth of the hopping channel is less than 250 kHz ...the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period;

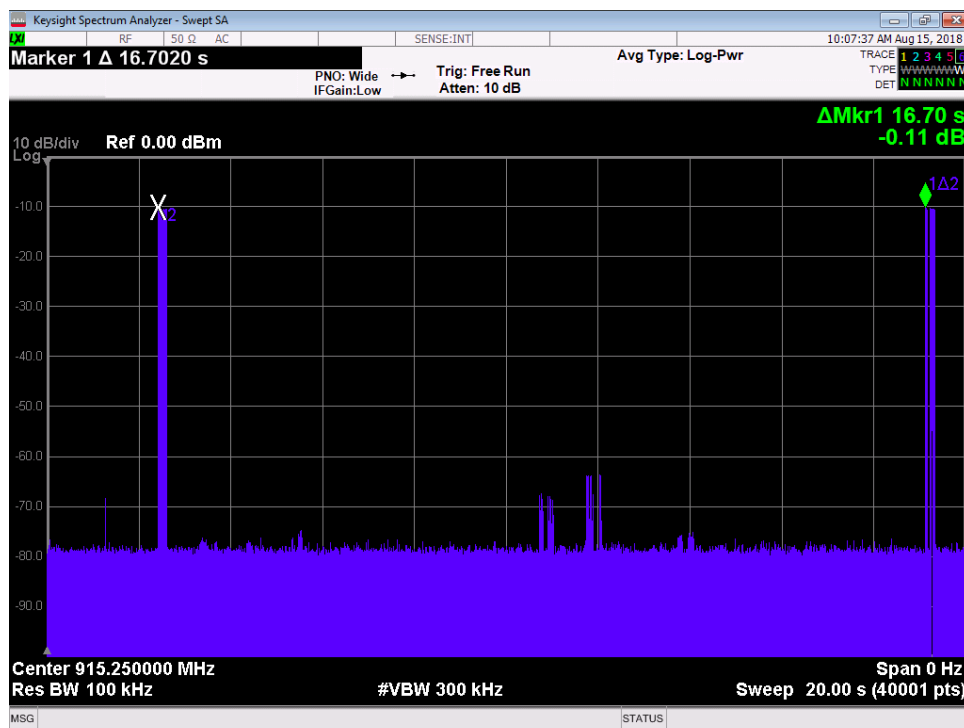
[15.247 (a) (1) (i)]

MEASUREMENTS / RESULTS

Plots



Single Hop = 242.3ms



20 Seconds

Dwell time in a 20sec period = $(20s/16.70s) \times 242.3ms = 290.2ms$. Limit (maximum) = 400ms

Peak Output Power

LIMIT

Conducted Output Power: 1 Watt [15.247(b) (2)]

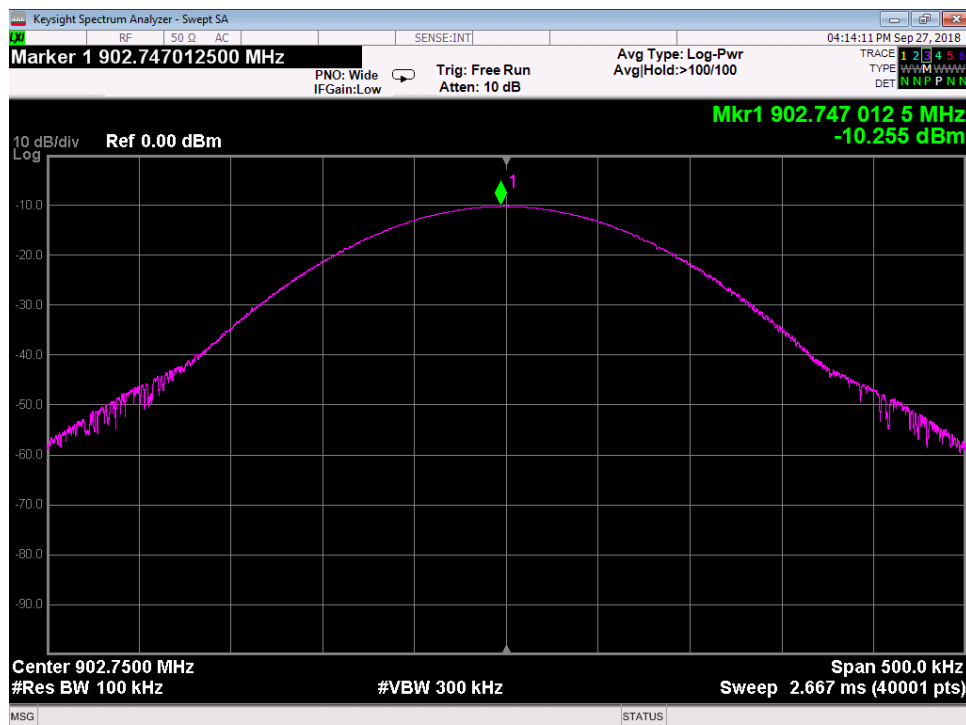
MEASUREMENTS / RESULTS

EUT power setting was 31.5dBm and measurements were taken at the end of the antenna cable supplied with the EUT. Therefore cable loss is 0dB in the following table.

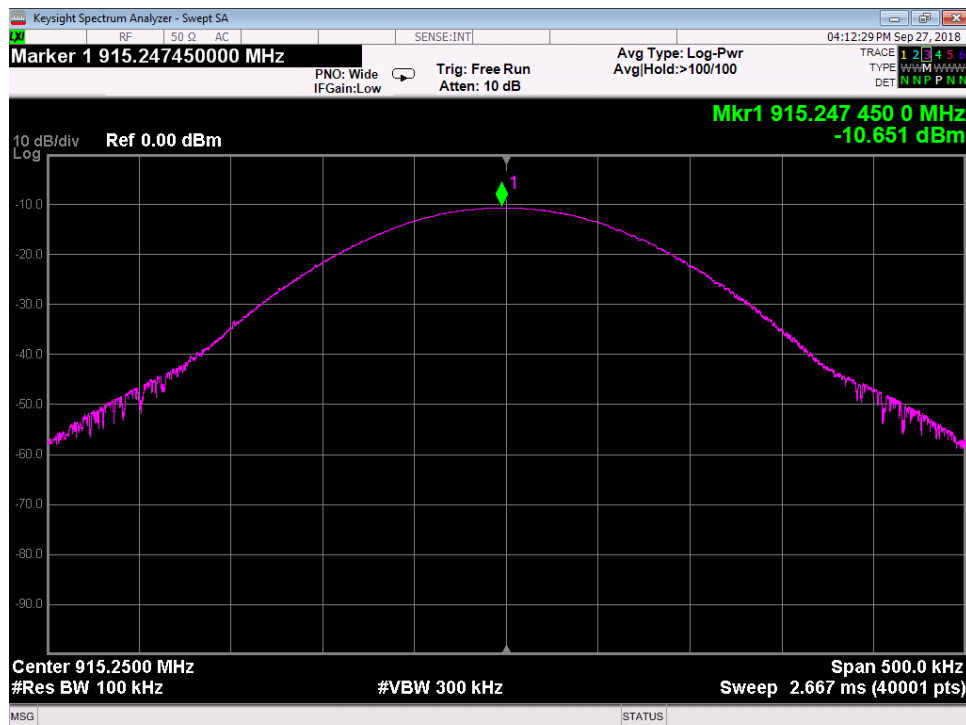
Peak Output Power								
Date: 9/27/2018			Company: Novanta			Work Order: S1533		
Engineer: Zac Johnson			EUT: M6e-A			Operating Voltage/Frequency: 5V DC		
Temp: 23.8°C			Humidity: 55%			Pressure: 1008mBar		
Frequency Range: 902.75-927.25 MHz				Measurement Type: Conducted				
Measurement Method: ANSI C63.10-2013								
Notes:								
Port Number	Frequency	Peak Reading	Cable Loss	Attenuator Loss	Peak Output Power	Limit	Margin	Result
	(MHz)	(dBm)	(dB)	(dB)	(dBm)	(dBm)	(dB)	(Pass/Fail)
1.0	902.75	-10.255	0.00	40.0	29.745	30.0	-0.255	Pass
1.0	915.25	-10.651	0.00	40.0	29.349	30.0	-0.651	Pass
1.0	927.25	-10.535	0.00	40.0	29.465	30.0	-0.535	Pass
2.0	902.75	-10.378	0.00	40.0	29.622	30.0	-0.378	Pass
2.0	915.25	-10.727	0.00	40.0	29.273	30.0	-0.727	Pass
2.0	927.25	-10.568	0.00	40.0	29.432	30.0	-0.568	Pass
3.0	902.75	-10.345	0.00	40.0	29.655	30.0	-0.345	Pass
3.0	915.25	-10.721	0.00	40.0	29.279	30.0	-0.721	Pass
3.0	927.25	-10.611	0.00	40.0	29.389	30.0	-0.611	Pass
4.0	902.75	-10.279	0.00	40.0	29.721	30.0	-0.279	Pass
4.0	915.25	-10.576	0.00	40.0	29.424	30.0	-0.576	Pass
4.0	927.25	-10.197	0.00	40.0	29.803	30.0	-0.197	Pass
Test Site: CEMI-5			Cable: 2288			Attenuator: 2107 Pad		
Analyzer: 1118473 SA								
Peak Output Power (dBm)= Peak Reading (dBm) + Cable Loss (dB) + Attenuator Loss (dB)								



PLOTS

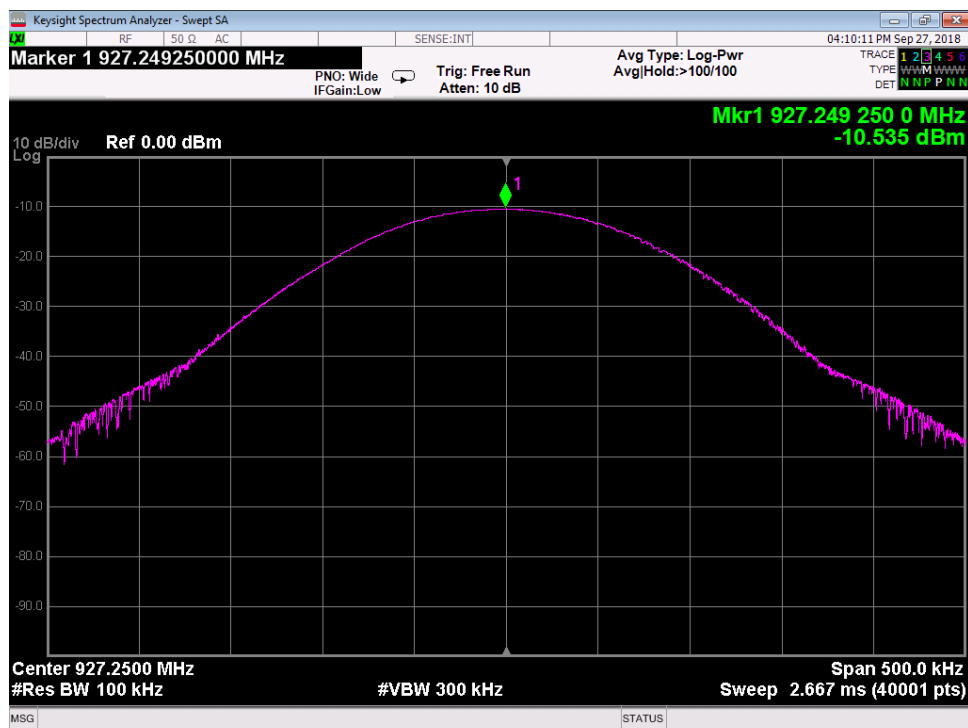


Port 1 Low

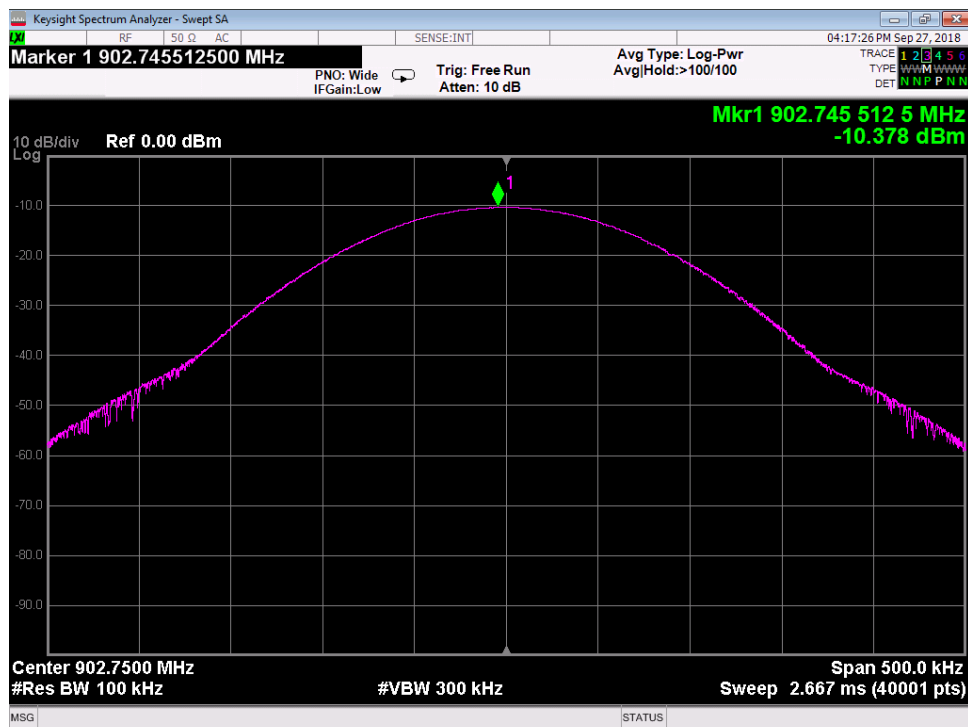


Port 1 Mid

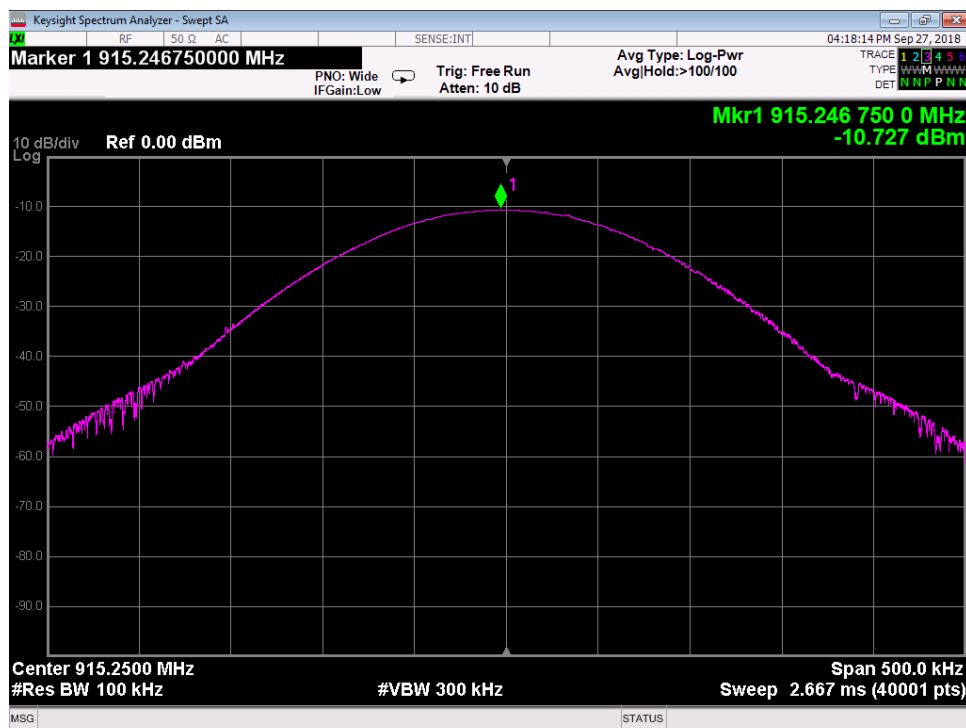




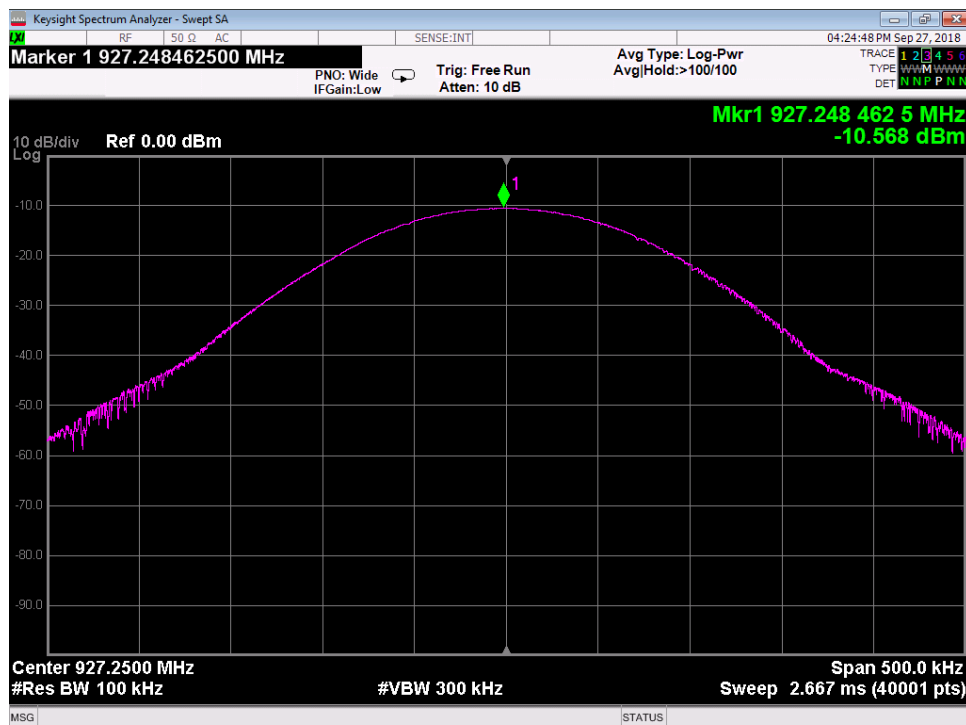
Port 1 High



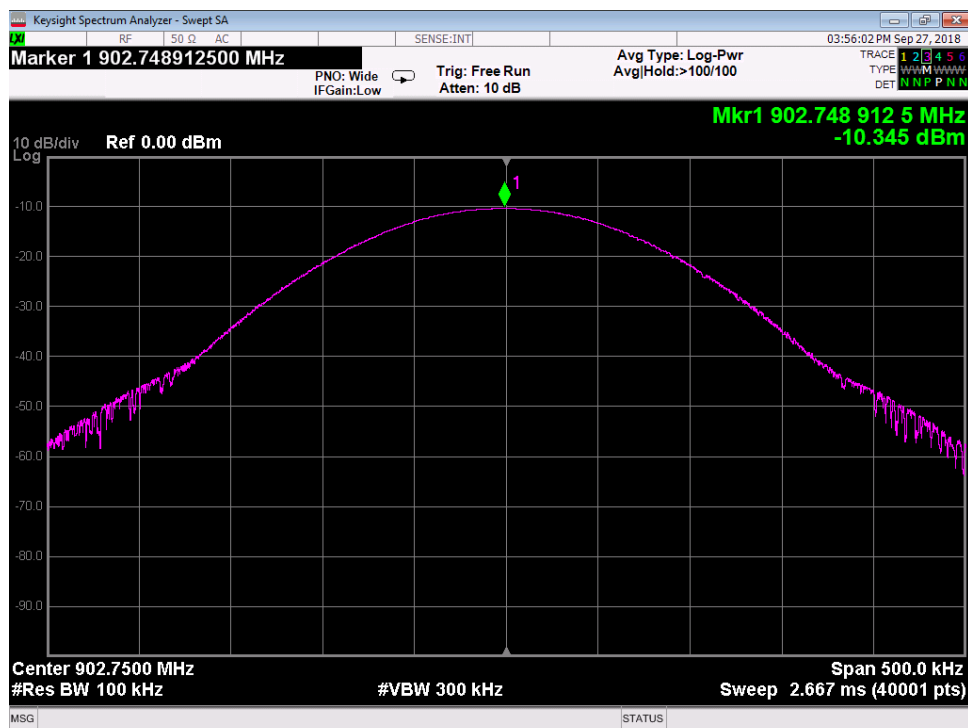
Port 2 Low



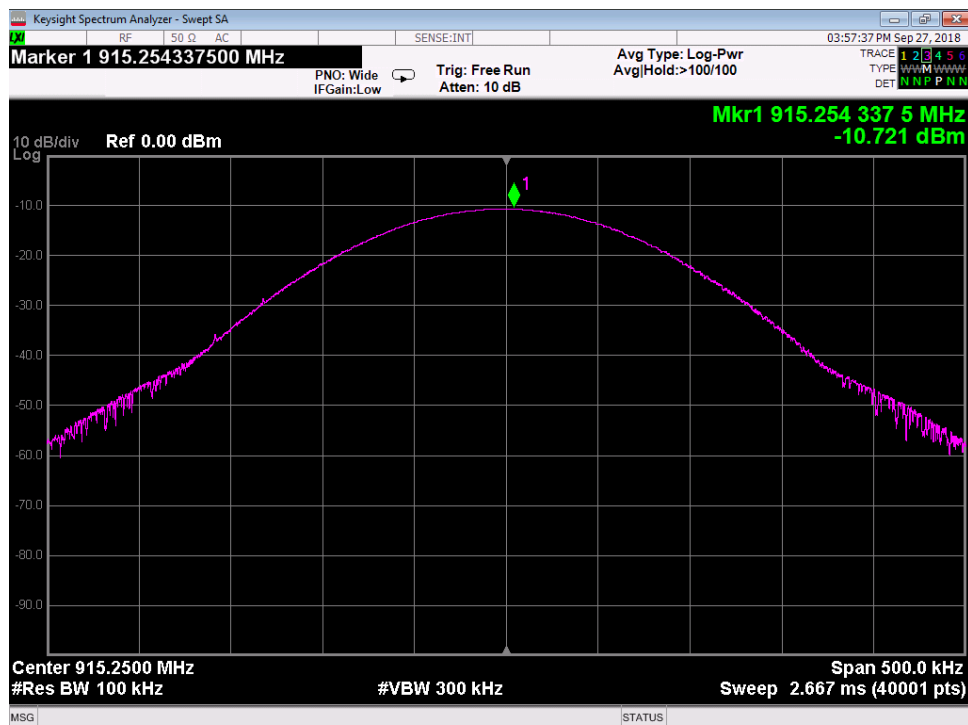
Port 2 Mid



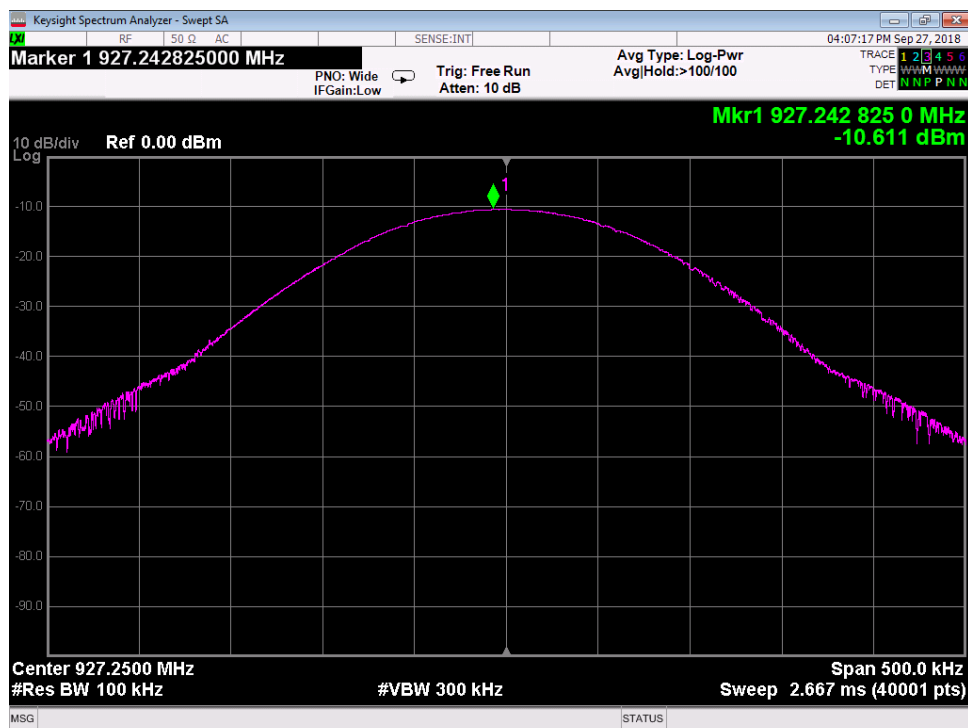
Port 2 High



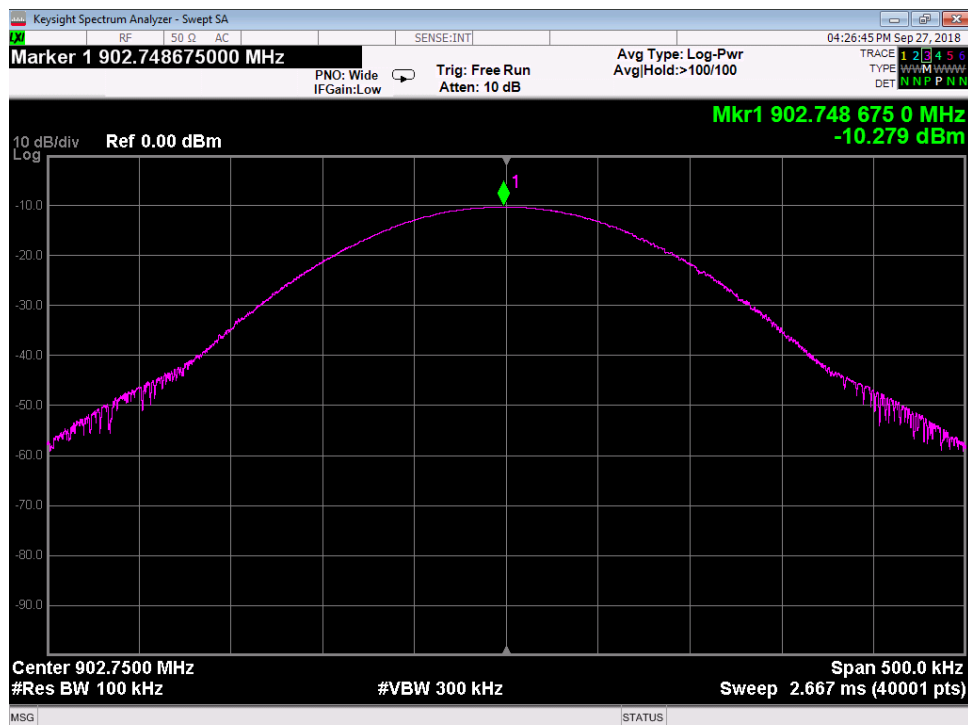
Port 3 Low



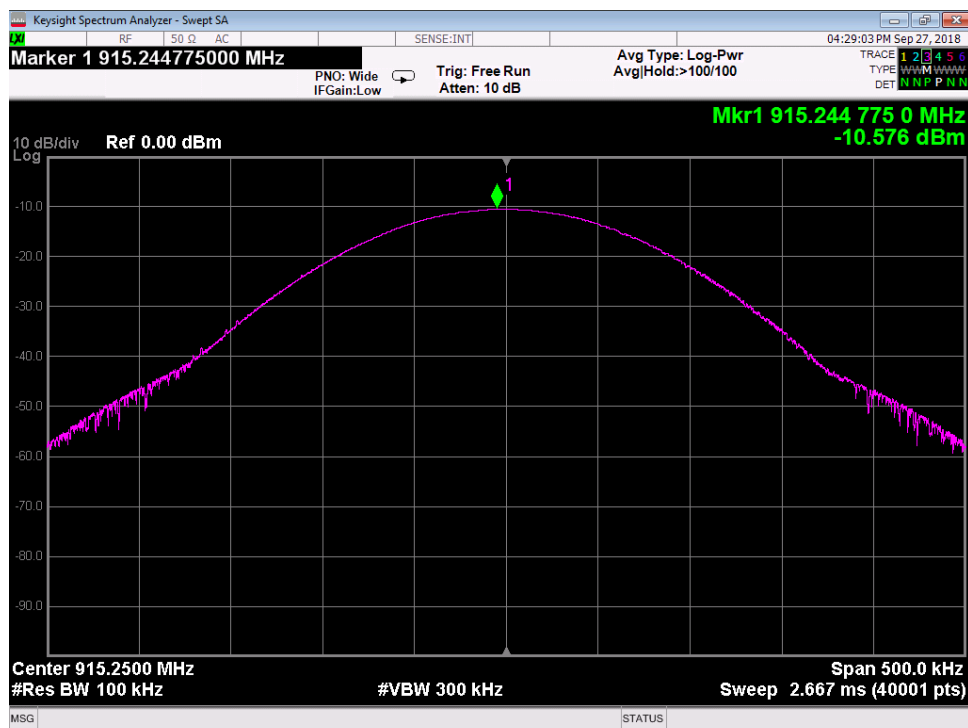
Port 3 Mid



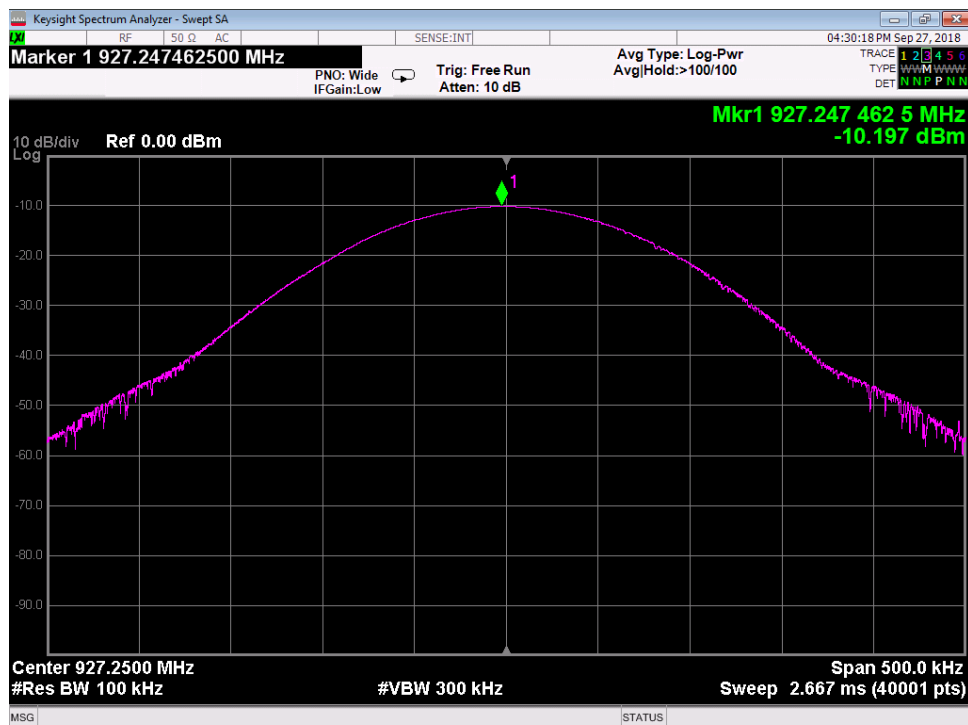
Port 3 High



Port 4 Low



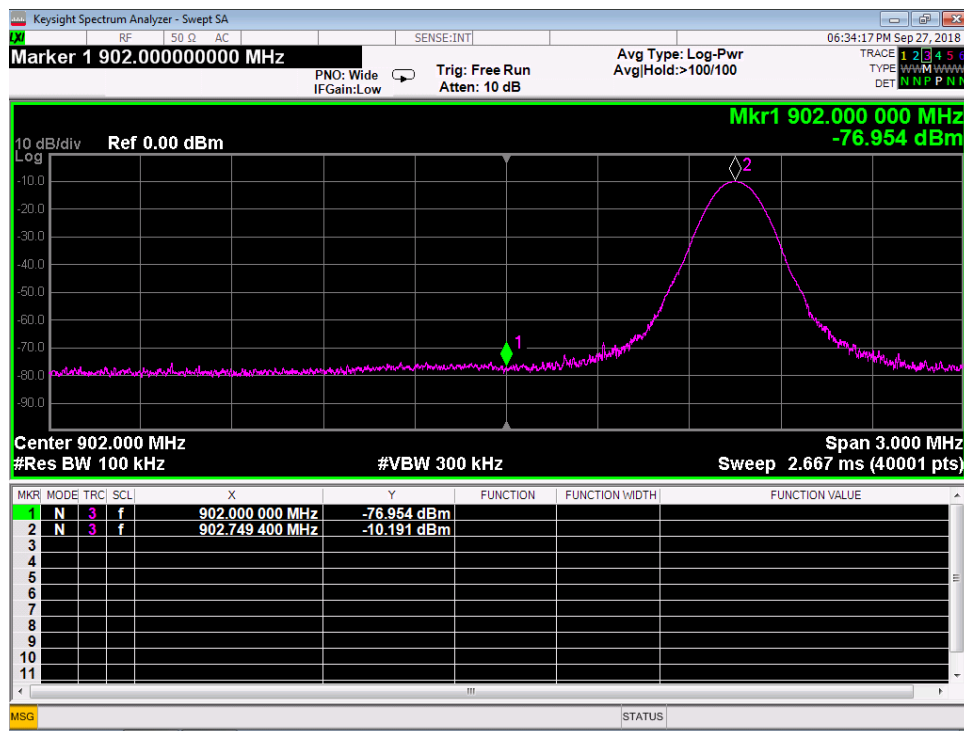
Port 4 Mid



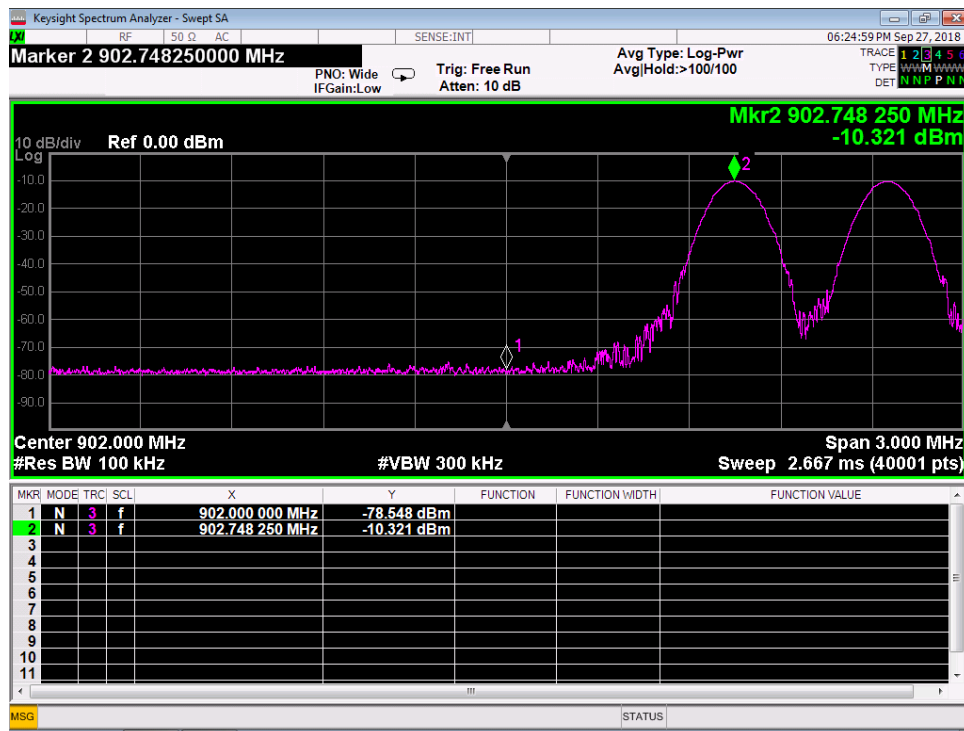
Port 4 High

Conducted Bandedges

All band edges over 20dB from peak

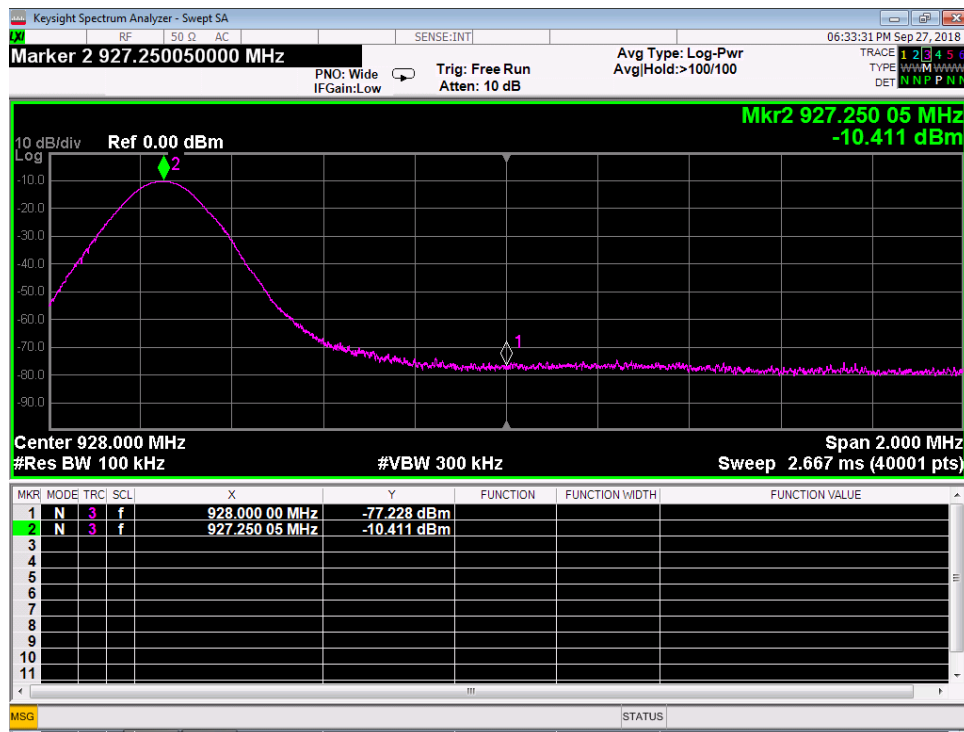


Low Bandedge Non-hopping

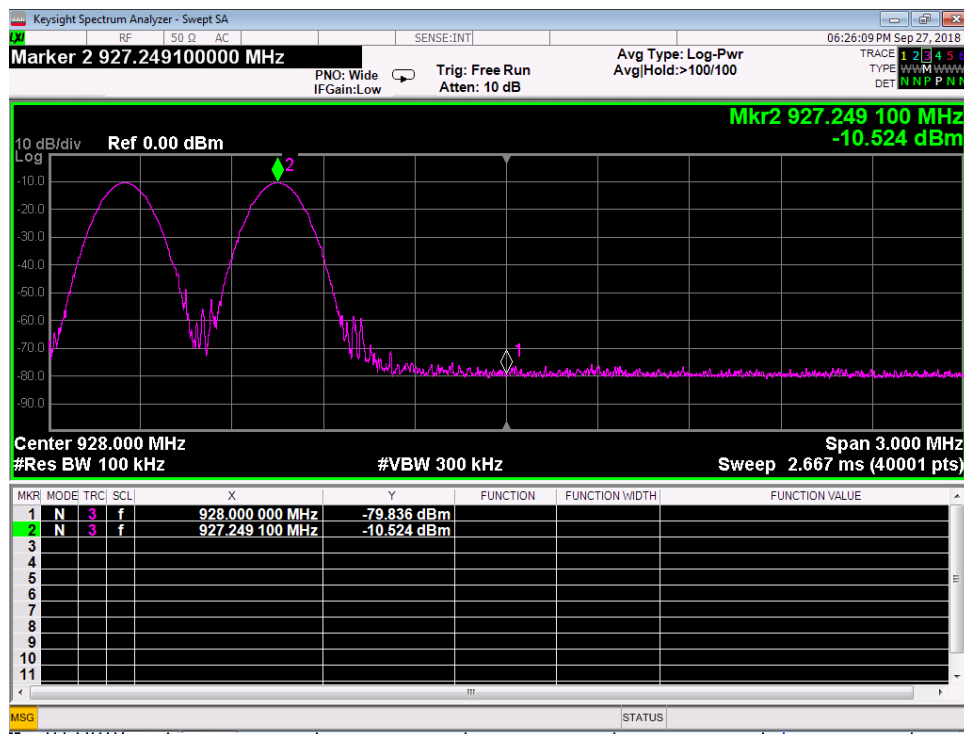


Low Bandedge Hopping





High Bandedge Non-hopping



High Bandedge Hopping

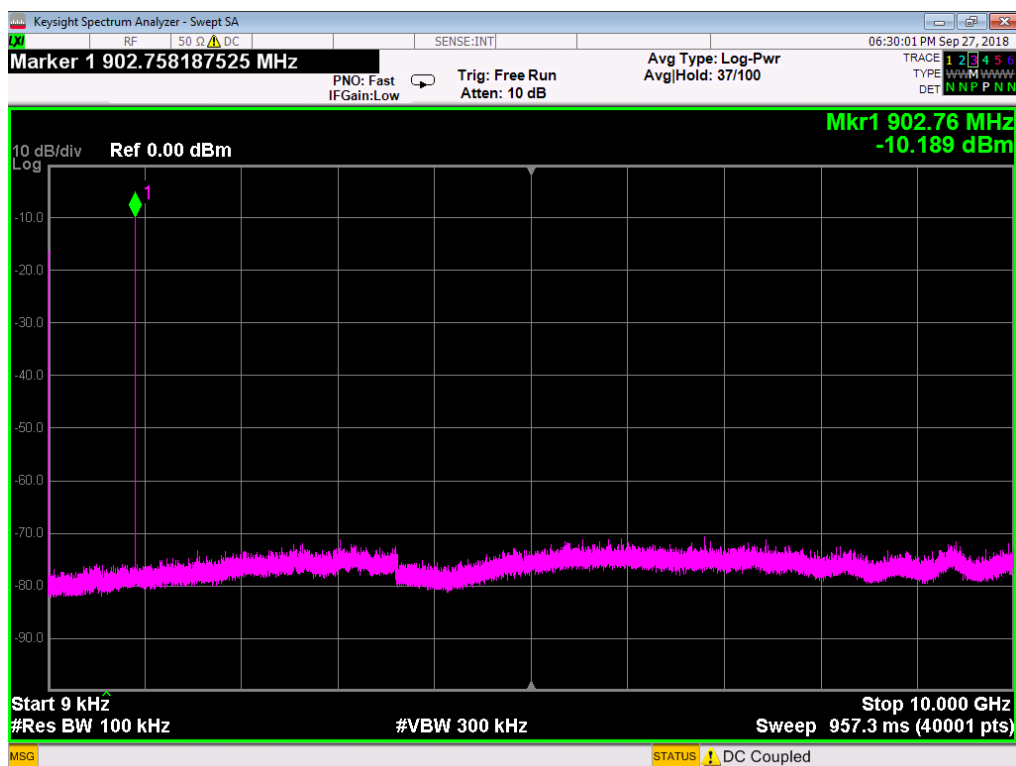


Conducted Spurious

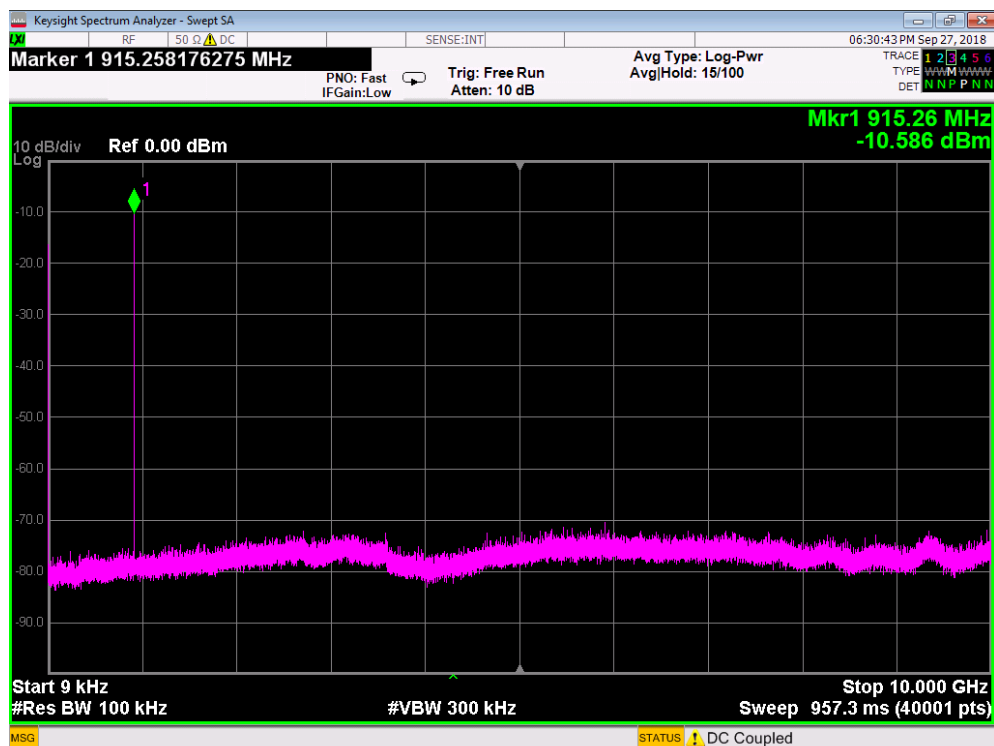
LIMITS

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.

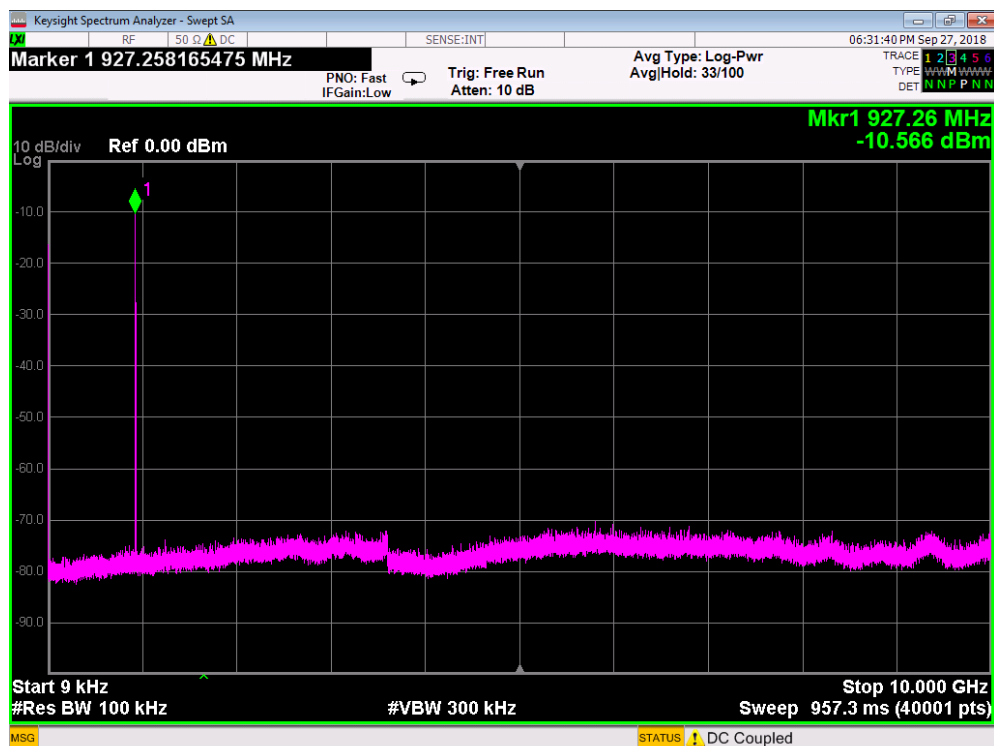
No emissions found within 20dB of its corresponding fundamental.



Low channel



Mid channel



High channel

Equipment used for the following tests:*20dB Bandwidth and 99% OBW**Channel Separation**Number of Hopping Channels**Dwell Time**Peak Output Power**Conducted Bandedges**Conducted Spurious Emissions*

Rev. 7/31/2018

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
2093 MXE EMI Receiver	20Hz-26.5GHz	N9038A	Agilent	MY51210181	2093	I	11/16/2018	11/16/2017
Preamps /Couplers Attenuators / Filters	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
API - 40dB 100W Attenuator	0.009-18GHz	48-40-34	API Weinschel	CG7990	2107	II	10/4/2018	10/4/2017
Cables	Range		Mfr			Cat	Calibration Due	Calibrated on
Asset #2289	9KHz-26.5GHz	FLC-1.5FT-SMSM+	Mini-Circuits	16021039		II	1/29/2019	1/29/2018

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.



Radiated Spurious Emissions

LIMITS

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

[15.247(d)]

MEASUREMENTS / RESULTS

Curtis Straus - a Bureau Veritas Company

Radiated Emissions Electric Field 3m Distance

Top Peaks Vertical 30-1000MHz

Operator: ZJ

Notes:

Low Channel

Work Order - S1533

EUT Power Input - 5V

Test Site - CH-2

Conditions - 23.7°C; 54%RH; 1002mBar

Data Taken at 02:24:17 PM, Monday, August 06, 2018

Frequency (MHz)	Peak Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Lim1: FCC_pt15_1 09_Class_B (dBμV/m)	Lim1 Margin (dB)	Lim1 Test Results (Pass/Fail)	Worst Margin Lim1 (dB)	Lim2: FCC_pt15_1 09_Class_B (dBμV/m)	Lim2 Margin (dB)	Lim2 Test Results (Pass/Fail)	Worst Margin Lim2 (dB)	Antenna Height (cm)	Turntable Azimuth (degrees)
32.013	38	-1.6	36.4	40	-3.6	PASS		40	-3.6	PASS		150	0
40.015	40	-7.9	32.2	40	-7.8	PASS		40	-7.8	PASS		100	90
41.422	40.8	-9	31.9	40	-8.1	PASS		40	-8.1	PASS		100	90
44.017	42.8	-10.8	32	40	-8	PASS		40	-8	PASS		100	45
59.973	46.1	-14.6	31.5	40	-8.5	PASS		40	-8.5	PASS		100	270
72.001	51.9	-14.1	37.8	40	-2.2	PASS	-2.2	40	-2.2	PASS	-2.2	100	45

Curtis Straus - a Bureau Veritas Company

Radiated Emissions Electric Field 3m Distance

Top Peaks Horizontal 30-1000MHz

Operator: ZJ

Notes:

Low Channel

Work Order - S1533

EUT Power Input - 5V

Test Site - CH-2

Conditions - 23.7°C; 54%RH; 1002mBar

Data Taken at 02:24:17 PM, Monday, August 06, 2018

Frequency (MHz)	Peak Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Lim1: FCC_pt15_1 09_Class_B (dBμV/m)	Lim1 Margin (dB)	Lim1 Test Results (Pass/Fail)	Worst Margin Lim1 (dB)	Lim2: FCC_pt15_1 09_Class_B (dBμV/m)	Lim2 Margin (dB)	Lim2 Test Results (Pass/Fail)	Worst Margin Lim2 (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
32.013	33	-1.6	31.3	40	-8.7	PASS		40	-8.7	PASS		200	135
36.038	33.9	-5	28.9	40	-11.1	PASS		40	-11.1	PASS		200	0
63.998	42.9	-14.3	28.6	40	-11.4	PASS		40	-11.4	PASS		250	45
72.001	48.2	-14.1	34.1	40	-5.9	PASS	-5.9	40	-5.9	PASS	-5.9	250	135
114.972	46.3	-8.7	37.6	43.5	-5.9	PASS		43.5	-5.9	PASS		100	90
119.628	44.8	-8.3	36.4	43.5	-7.1	PASS		43.5	-7.1	PASS		150	90

30-1000MHz Low Channel



Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 3m Distance
 30-1000MHz Vertical Data
 Operator: ZJ
 Notes:
 Center Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.7°C; 54%RH; 1002mBar

Data Taken at 01:19:34 PM, Monday, August 06, 2018

Frequency (MHz)	Raw QP Reading (dBμV)	Correction Factor (dB/m)	Adjusted QP Amplitude (dBμV/m)	Lim1: FCC_pt15_1 09_Class_B (dBμV/m)	Margin to Lim1 (dB)	Test Results Lim1 (Pass/Fail)	Worst Margin Lim1 (dB)	Lim2: FCC_pt15_1 09_Class_B (dBμV/m)	Margin to Lim2 (dB)	Test Results Lim2 (Pass/Fail)	Worst Margin Lim2 (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
30.299	33.8	-0.3	33.5	40	-6.5	PASS		40	-6.5	PASS		168	265
31.672	38.5	-1.4	37.1	40	-2.9	PASS	-2.9	40	-2.9	PASS	-2.9	103	332
40.529	44.3	-8.3	36	40	-4	PASS		40	-4	PASS		103	67
50.248	43	-13.7	29.3	40	-10.7	PASS		40	-10.7	PASS		155	194

Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 3m Distance
 Top Peaks Horizontal 30-1000MHz
 Operator: ZJ
 Notes:
 Center Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.7°C; 54%RH; 1002mBar

Data Taken at 01:30:59 PM, Monday, August 06, 2018

Frequency (MHz)	Peak Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Lim1: FCC_pt15_1 09_Class_B (dBμV/m)	Lim1 Margin (dB)	Lim1 Test Results (Pass/Fail)	Worst Margin Lim1 (dB)	Lim2: FCC_pt15_1 09_Class_B (dBμV/m)	Lim2 Margin (dB)	Lim2 Test Results (Pass/Fail)	Worst Margin Lim2 (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
31.14	31.9	-0.9	31	40	-9	PASS		40	-9	PASS		250	180
40.233	37.9	-8	29.8	40	-10.2	PASS		40	-10.2	PASS		250	0
175.112	37.2	-10	27.2	43.5	-16.3	PASS		43.5	-16.3	PASS		200	90
466.354	34.6	-3.5	31.1	46	-14.9	PASS		46	-14.9	PASS		150	135
777.652	39	2.1	41.1	46	-4.9	PASS	-4.9	46	-4.9	PASS	-4.9	200	45
786.357	38.6	2.1	40.7	46	-5.3	PASS		46	-5.3	PASS		150	45

30-1000MHz Mid Channel

Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 3m Distance
 30-1000MHz Vertical Data
 Operator: ZJ
 Notes:
 High Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.7°C; 54%RH; 1002mBar

Data Taken at 03:05:27 PM, Monday, August 06, 2018

Frequency (MHz)	Raw QP Reading (dBμV)	Correction Factor (dB/m)	Adjusted QP Amplitude (dBμV/m)	Lim1: FCC_pt15_1 09_Class_B (dBμV/m)	Margin to Lim1 (dB)	Test Results Lim1 (Pass/Fail)	Worst Margin Lim1 (dB)	Lim2: FCC_pt15_1 09_Class_B (dBμV/m)	Margin to Lim2 (dB)	Test Results Lim2 (Pass/Fail)	Worst Margin Lim2 (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
32.019	37.7	-1.6	36.1	40	-3.9	PASS	-3.9	40	-3.9	PASS	-3.9	109	25
777.848	26.8	2.1	28.9	46	-17.1	PASS		46	-17.1	PASS		207	307
781.037	23.2	2	25.2	46	-20.8	PASS		46	-20.8	PASS		199	317
782.109	23.2	2	25.2	46	-20.8	PASS		46	-20.8	PASS		125	115
782.643	23.1	2.1	25.2	46	-20.8	PASS		46	-20.8	PASS		140	85
784.527	23	2.1	25.2	46	-20.9	PASS		46	-20.9	PASS		131	115



Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 3m Distance
 Top Peaks Horizontal 30-1000MHz
 Operator: ZJ
 Notes:
 High Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.7°C; 54%RH; 1002mBar

Data Taken at 03:13:59 PM, Monday, August 06, 2018

Frequency (MHz)	Peak Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Lim1: FCC_pt15_109_Class_B (dBμV/m)	Lim1 Margin (dB)	Lim1 Test Results (Pass/Fail)	Worst Margin Lim1 (dB)	Lim2: FCC_pt15_109_Class_B (dBμV/m)	Lim2 Margin (dB)	Lim2 Test Results (Pass/Fail)	Worst Margin Lim2 (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
32.037	33.3	-1.7	31.7	40	-8.3	PASS		40	-8.3	PASS		200	135
35.965	33.3	-4.9	28.4	40	-11.6	PASS		40	-11.6	PASS		250	135
72.001	47.6	-14.1	33.5	40	-6.5	PASS	-6.5	40	-6.5	PASS	-6.5	200	270
95.984	43.2	-12.4	30.8	43.5	-12.8	PASS		43.5	-12.8	PASS		200	135
529.889	38.3	-2.7	35.5	46	-10.5	PASS		46	-10.5	PASS		150	45
700.852	32.9	0.4	33.3	46	-12.7	PASS		46	-12.7	PASS		250	135

30-1000MHz High Channel

Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 3m Distance
 1-6GHz Vertical Data
 Operator: ZJ
 Notes:
 Low Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.0°C; 48%RH; 1006mBar

Data Taken at 10:30:02 AM, Tuesday, August 07, 2018

Frequency (MHz)	Raw Peak Reading (dBμV)	Raw Avg Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBμV/m)	Peak Margin (dB)	Peak Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBμV/m)	Av Lim: FCC_pt15_109_ClassB_AVG (dBμV/m)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1325.2	41.8	32.4	-3.4	38.4	74	-35.6	PASS		29	54	-25	PASS		300	233
1805.2	46.7	42.6	-2.2	44.5	74	-29.4	PASS		40.4	54	-13.6	PASS		307	205
2708.2	49.3	45.8	0.6	49.9	74	-24	PASS	-24	46.4	54	-7.6	PASS	-7.6	201	202
3521.9	41.6	32.5	2.7	44.3	74	-29.6	PASS		35.3	54	-18.7	PASS		213	208
4991.9	41.4	31.2	4.5	45.9	74	-28.1	PASS		35.7	54	-18.3	PASS		215	290
5980.5	39.5	30.9	6.9	46.4	74	-27.6	PASS		37.7	54	-16.2	PASS		300	342

Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 3m Distance
 1-6GHz Horizontal Data
 Operator: ZJ
 Notes:
 Low Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.0°C; 48%RH; 1006mBar

Data Taken at 10:30:02 AM, Tuesday, August 07, 2018

Frequency (MHz)	Raw Peak Reading (dBμV)	Raw Avg Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBμV/m)	Peak Margin (dB)	Peak Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBμV/m)	Av Lim: FCC_pt15_109_ClassB_AVG (dBμV/m)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Average Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1289	41.5	32.3	-3.4	38.1	74	-35.9	PASS		28.9	54	-25.1	PASS		209	26
1805.7	47.4	43.7	-2.2	45.2	74	-28.8	PASS		41.5	54	-12.4	PASS		300	1
2708.2	48.3	42.9	0.6	48.9	74	-25	PASS	-25	43.5	54	-10.4	PASS	-10.4	399	33
3567.4	39.5	32.4	2.5	42	74	-32	PASS		34.9	54	-19.1	PASS		125	178
5786.2	40.1	30.9	6.6	46.7	74	-27.3	PASS		37.5	54	-16.5	PASS		300	177

1-6GHz Low Channel



Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 3m Distance
 1-6GHz Vertical Data
 Operator: ZJ
 Notes:
 Mid Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.7°C; 54%RH; 1002mBar

Data Taken at 11:41:15 AM, Tuesday, August 07, 2018

Frequency (MHz)	Raw Peak Reading (dBμV)	Raw Avg Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBμV/m)	Peak Margin (dB)	Peak Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBμV/m)	Av Lim: FCC_pt15_109_ClassB_AVG (dBμV/m)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1247.8	40.9	32.4	-3.8	37.1	74	-36.9	PASS		28.5	54	-25.5	PASS		300	176
2745.7	48.8	43.8	0.6	49.4	74	-24.6	PASS	-24.6	44.5	54	-9.5	PASS	-9.5	228	208
3509.5	41.7	32.6	2.7	44.4	74	-29.6	PASS		35.3	54	-18.7	PASS		291	112
5968.2	42.4	31	6.9	49.4	74	-24.6	PASS		38	54	-16	PASS		225	279

Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 3m Distance
 1-6GHz Horizontal Data
 Operator: ZJ
 Notes:
 Mid Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.7°C; 54%RH; 1002mBar

Data Taken at 11:41:15 AM, Tuesday, August 07, 2018

Frequency (MHz)	Raw Peak Reading (dBμV)	Raw Avg Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBμV/m)	Peak Margin (dB)	Peak Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBμV/m)	Av Lim: FCC_pt15_109_ClassB_AVG (dBμV/m)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Average Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1830.7	46	43	-2	43.9	74	-30	PASS		41	54	-13	PASS		387	279
2745.7	47.4	43.1	0.6	48.1	74	-25.9	PASS	-25.9	43.7	54	-10.3	PASS	-10.3	292	295

1-6GHz Mid Channel

Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 3m Distance
 1-6GHz Vertical Data
 Operator: ZJ
 Notes:
 High Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.7°C; 54%RH; 1002mBar

Data Taken at 11:46:11 AM, Tuesday, August 07, 2018

Frequency (MHz)	Raw Peak Reading (dBμV)	Raw Avg Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBμV/m)	Peak Margin (dB)	Peak Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBμV/m)	Av Lim: FCC_pt15_109_ClassB_AVG (dBμV/m)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1326.1	40.6	32.3	-3.4	37.2	74	-36.8	PASS		28.9	54	-25.1	PASS		275	102
2781.6	45.9	39.8	0.6	46.5	74	-27.5	PASS		40.4	54	-13.6	PASS	-13.6	134	134
3461.1	42.1	32.5	2.3	44.5	74	-29.5	PASS		34.8	54	-19.1	PASS		300	0
5931.2	40.1	31	7.1	47.2	74	-26.8	PASS	-26.8	38.1	54	-15.8	PASS		299	10

Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 3m Distance
 1-6GHz Horizontal Data
 Operator: ZJ
 Notes:
 High Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.7°C; 54%RH; 1002mBar

Data Taken at 11:46:11 AM, Tuesday, August 07, 2018

Frequency (MHz)	Raw Peak Reading (dBμV)	Raw Avg Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Pk Lim: FCC_pt15_109_ClassB_Peak (dBμV/m)	Peak Margin (dB)	Peak Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBμV/m)	Av Lim: FCC_pt15_109_ClassB_AVG (dBμV/m)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Average Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1324.5	41.7	32.4	-3.4	38.3	74	-35.7	PASS		29	54	-25	PASS		275	181
2781.7	49.5	45.8	0.6	50.1	74	-23.9	PASS	-23.9	46.4	54	-7.6	PASS	-7.6	300	115
3543.8	40.2	32.5	2.6	42.8	74	-31.1	PASS		35.1	54	-18.8	PASS		275	75
5933.1	40.7	31	7.1	47.8	74	-26.2	PASS		38.1	54	-15.9	PASS		275	263

1-6GHz High Channel



Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 1m Distance
 6-18GHz Vertical Data
 Operator: ZJ
 Notes:
 Low Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.0°C; 48%RH; 1006mBar

Data Taken at 11:03:46 AM, Tuesday, August 07, 2018

Frequency (MHz)	Raw Peak Reading (dBμV)	Raw Avg Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Pk Lim: FCC_pt15_109_ClassB _Peak (dBμV/m)	Peak Margin (dB)	Peak Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBμV/m)	Av Lim: FCC_pt15_109_C lassB_AVG (dBμV/m)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
9941	40.1	30.3	11.1	51.2	83.5	-32.3	PASS	-32.3	41.4	63.5	-22.1	PASS	-22.1	200	176

Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 1m Distance
 6-18GHz Horizontal Data
 Operator: ZJ
 Notes:
 Low Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.0°C; 48%RH; 1006mBar

Data Taken at 11:03:46 AM, Tuesday, August 07, 2018

Frequency (MHz)	Raw Peak Reading (dBμV)	Raw Avg Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Pk Lim: FCC_pt15_109_ ClassB_Peak (dBμV/m)	Peak Margin (dB)	Peak Test Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBμV/m)	Av Lim: FCC_pt15_109_C lassB_AVG (dBμV/m)	Avg Margin (dB)	Avg Test Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
9948.7	39.2	30.4	11	50.2	83.5	-33.3	PASS	-33.3	41.4	63.5	-22.1	PASS	-22.1	175	225

6-10GHz Low Channel

Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 1m Distance
 6-18GHz Vertical Data
 Operator: ZJ
 Notes:
 Mid Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.0°C; 48%RH; 1006mBar

Data Taken at 11:32:46 AM, Tuesday, August 07, 2018

Frequency (MHz)	Raw Peak Reading (dBμV)	Raw Avg Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Pk Lim: FCC_pt15_109_ClassB _Peak (dBμV/m)	Peak Margin (dB)	Peak Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBμV/m)	Av Lim: FCC_pt15_109_ClassB _AVG (dBμV/m)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
9934.6	39.9	30.3	11.1	51	83.5	-32.5	PASS	-32.5	41.4	63.5	-22.1	PASS	-22.1	200	40

Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 1m Distance
 6-18GHz Horizontal Data
 Operator: ZJ
 Notes:
 Mid Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.0°C; 48%RH; 1006mBar

Data Taken at 11:32:46 AM, Tuesday, August 07, 2018

Frequency (MHz)	Raw Peak Reading (dBμV)	Raw Avg Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Pk Lim: FCC_pt15_109_Clas sB_Peak (dBμV/m)	Peak Margin (dB)	Peak Test Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBμV/m)	Av Lim: FCC_pt15_109_ ClassB_AVG (dBμV/m)	Avg Margin (dB)	Avg Test Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
9992.8	39.6	30.5	11.1	50.7	83.5	-32.8	PASS	-32.8	41.6	63.5	-21.9	PASS	-21.9	125	247

6-10GHz Mid Channel



Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 1m Distance
 6-18GHz Vertical Data
 Operator: ZJ
 Notes:
 High Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.0°C; 48%RH; 1006mBar

Data Taken at 01:03:17 PM, Tuesday, August 07, 2018

Frequency (MHz)	Raw Peak Reading (dBμV)	Raw Avg Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Pk Lim: FCC_pt15_109_ClassB _Peak (dBμV/m)	Peak Margin (dB)	Peak Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBμV/m)	Av Lim: FCC_pt15_109_ClassB _AVG (dBμV/m)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
9715.1	39.1	30.9	11	50.1	83.5	-33.4	PASS	-33.4	41.9	63.5	-21.6	PASS	-21.6	300	29

Curtis Straus - a Bureau Veritas Company
 Radiated Emissions Electric Field 1m Distance
 6-18GHz Horizontal Data
 Operator: ZJ
 Notes:
 High Channel

Work Order - S1533
 EUT Power Input - 5V
 Test Site - CH-2
 Conditions - 23.0°C; 48%RH; 1006mBar

Data Taken at 01:03:17 PM, Tuesday, August 07, 2018

Frequency (MHz)	Raw Peak Reading (dBμV)	Raw Avg Reading (dBμV)	Correction Factor (dB/m)	Adjusted Peak Amplitude (dBμV/m)	Pk Lim: FCC_pt15_109_ClassB _Peak (dBμV/m)	Peak Margin (dB)	Peak Test Results (Pass/Fail)	Worst Peak Margin (dB)	Adjusted Avg Amplitude (dBμV/m)	Av Lim: FCC_pt15_109_ClassB _AVG (dBμV/m)	Avg Margin (dB)	Avg Test Results (Pass/Fail)	Worst Avg Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
9732.6	41.3	30.7	10.9	52.2	83.5	-31.3	PASS	-31.3	41.6	63.5	-21.9	PASS	-21.9	300	0

6-10GHz High Channel

Rev. 7/31/2018

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
2093 MXE EMI Receiver	20Hz-26.5GHz	N9038A	Agilent	MY51210181	2093	I	11/16/2018	11/16/2017
Radiated Emissions Sites	FCC Code	IC Code	VCCI Code	Range	Asset	Cat	Calibration Due	Calibrated on
EMI Chamber 2	719150	2762A-7	A-0015	30-1000MHz	1686	I	12/21/2018	12/21/2016
EMI Chamber 2	719150	2762A-7	A-0015	1-18GHz	1686	I	12/21/2018	12/21/2016
Preamps /Couplers Attenuators / Filters	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
2443 PA	9KHz-6GHz	BBV9744	SCWARZBECK	63	2443	I	2/5/2019	2/5/2018
2111 HF Preamp	0.5-18GHz	PAM-118A	COM-POWER	551063	2111	II	11/19/2018	11/19/2017
2114 HPF	0.009-18000MHz	HPM50108	Micro-Tronics	G250	2114	II	11/8/2018	11/8/2017
2130 BRF	9KHz-10GHz	BRM18770	Micro-Tronics	1	2130	II	1/10/2019	1/10/2018
Antennas	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
Red-White Bilog	30-2000MHz	JB1	Sunol	A091604-1	1105	I	8/21/2019	8/21/2017
Blue Horn	1-18GHz	3117	ETS	157647	1861	I	2/14/2019	2/14/2017
Meteorological Meters/Chambers		MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
Weather Clock (Pressure Only)		BA928	Oregon Scientific	C3166-1	831	I	5/15/2020	5/15/2018
TH A#2080		HTC-1	HDE		2080	II	3/22/2019	3/22/2018
Cables	Range		Mfr			Cat	Calibration Due	Calibrated on
Asset #2051	9kHz - 18GHz		Florida RF			II	3/7/2019	3/7/2018
Asset #2054	9kHz - 18GHz		Florida RF			II	10/31/2018	10/31/2017
Asset #2468	9KHz-18GHz		MegaPhase			II	10/29/2018	10/29/2017

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.



AC side of DC supply Conducted Emissions

LIMITS

AC line conducted emissions must comply with the conducted emission limits specified in Section 15.207.

Data Tables:

Curtis Straus - a Bureau Veritas Company

Conducted Emissions per CISPR 16-2-1

Quasi-peak Detector Data

Notes:

EUT Line tested: AC side of DC 120VAC/60Hz; Neutral

Hopping mode: NA (31.5 dBm)

Work Order # - S1533

EUT Power Input - 120VAC/ 60Hz

Test Site - CEMI-1

Conditions: - 23.2°C; 45%RH; 1007mBar

Test Engineer - Fatou Faye

Witnessed by - N/A

Data Taken at 09:04:42 PM, Friday, August 10, 2018

Frequency (MHz)	Raw QP Reading (dBμV)	Correction Factor (dB)	Adjusted QP Amplitude (dBμV)	QP Lim: Mains_FCC&CISPR_QP_Class_B (dBμV)	Margin to QP Limit (dB)	QP Limit Results (Pass/Fail)	Worst Margin (QP Limit) (dB)
0.163	18.397	20.8	39.2	65.3	-26.2	PASS	
0.299	11.933	20.8	32.7	60.3	-27.6	PASS	
12	16.466	21	37.4	60	-22.6	PASS	
16.001	24.64	21	45.7	60	-14.3	PASS	-14.3
16.253	13.902	21	34.9	60	-25.1	PASS	
24.001	17.399	21.1	38.5	60	-21.5	PASS	

Curtis Straus - a Bureau Veritas Company

Conducted Emissions per CISPR 16-2-1, CISPR Average Detector

Final Average Detector Data

Notes:

EUT Line tested: AC side of DC 120VAC/60Hz; Neutral

Hopping mode: NA (31.5 dBm)

Work Order # - S1533

EUT Power Input - 120VAC/ 60Hz

Test Site - CEMI-1

Conditions: - 23.2°C; 45%RH; 1007mBar

Test Engineer - Fatou Faye

Witnessed by - N/A

Data Taken at 09:12:56 PM, Friday, August 10, 2018

Frequency (MHz)	Raw Avg Reading (dBμV)	Correction Factor (dB)	Adjusted Avg Amplitude (dBμV)	Av Lim: Mains_FCC&CISPR_Avg_Class_B (dBμV)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Avg Margin (dB)
12.001	14.6	21	35.5	50	-14.5	PASS	
16	23.9	21	44.9	50	-5.1	PASS	-5.1
16.252	5.7	21	26.8	50	-23.2	PASS	
16.399	3.1	21	24.2	50	-25.8	PASS	
20.001	10.6	21.1	31.6	50	-18.4	PASS	
24.001	15	21.1	36.1	50	-13.9	PASS	

CEMI - Neutral



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page 34 of 39



Curtis Straus - a Bureau Veritas Company

Conducted Emissions per CISPR 16-2-1

Quasi-peak Detector Data

Notes:

EUT Line tested: AC side of DC 120VAC/60Hz; Phase

Hopping mode: NA (31.5 dBm)

Work Order # - S1533

EUT Power Input - 120VAC/ 60Hz

Test Site - CEMI-1

Conditions: - 23.2°C; 45%RH; 1007mBar

Test Engineer - Fatou Faye

Witnessed by - N/A

Data Taken at 08:54:06 PM, Friday, August 10, 2018

Frequency (MHz)	Raw QP Reading (dBμV)	Correction Factor (dB)	Adjusted QP Amplitude (dBμV)	QP Lim: Mains_FCC&CISPR_QP_Class_B (dBμV)	Margin to QP Limit (dB)	QP Limit Results (Pass/Fail)	Worst Margin (QP Limit) (dB)
0.152	19.418	20.7	40.1	65.9	-25.8	PASS	
0.198	16.09	20.8	36.8	63.7	-26.9	PASS	
6.078	10.962	20.8	31.8	60	-28.2	PASS	
12	16.157	20.9	37	60	-23	PASS	
16.001	24.16	20.9	45.1	60	-14.9	PASS	-14.9
24.002	17.485	21	38.5	60	-21.5	PASS	

Curtis Straus - a Bureau Veritas Company

Conducted Emissions per CISPR 16-2-1, CISPR Average Detector

Final Average Detector Data

Notes:

EUT Line tested: AC side of DC 120VAC/60Hz; Phase

Hopping mode: NA (31.5 dBm)

Work Order # - S1533

EUT Power Input - 120VAC/ 60Hz

Test Site - CEMI-1

Conditions: - 23.2°C; 45%RH; 1007mBar

Test Engineer - Fatou Faye

Witnessed by - N/A

Data Taken at 08:54:06 PM, Friday, August 10, 2018

Frequency (MHz)	Raw Avg Reading (dBμV)	Correction Factor (dB)	Adjusted Avg Amplitude (dBμV)	Av Lim: Mains_FCC&CISPR_Avg_Class_B (dBμV)	Avg Margin (dB)	Avg Results (Pass/Fail)	Worst Avg Margin (dB)
12.001	14.5	20.9	35.4	50	-14.6	PASS	
16.001	22.5	20.9	43.5	50	-6.5	PASS	-6.5
16.25	4.1	20.9	25	50	-25	PASS	
16.404	2.5	20.9	23.4	50	-26.6	PASS	
20	10.4	21	31.4	50	-18.6	PASS	
24.001	15.1	21	36.1	50	-13.9	PASS	

CEMI – Phase



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page 35 of 39



Rev. 7/31/2018

Spectrum Analyzers / Receivers /Preselectors	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
Rental EXA Signal Analyzer(1118473)	9KHz-26.5GHz	N9010A-526;N	AT	MY51170076	1118473	I	6/19/2019	6/19/2018
LISNs/Measurement Probes	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
LISN Asset 1791	9KHz-30MHz	NNLK 8121	Schwarzbeck	NNLK 8121-603	1791	I	6/20/2019	6/20/2018
Conducted Test Sites (Mains / Telco)	FCC Code		VCCI Code			Cat	Calibration Due	Calibrated on
CEMI 6	719150		A-0015			III	NA	N/A
Meteorological Meters/Chambers		MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
Weather Clock (Pressure Only)		BA928	Oregon Scientific	C3166-1	831	I	5/15/2020	5/15/2018
TH A#2077		HTC-1	HDE		2077	II	3/22/2019	3/22/2018
Cables	Range		Mfr			Cat	Calibration Due	Calibrated on
CEMI-18	9kHz - 2GHz		C-S			II	11/4/2018	11/4/2017
Attenuators	Range	MN	Mfr	SN	Asset	Cat	Calibration Due	Calibrated on
20dB Attenuator-64	9kHz-2GHz			N/A		II	11/6/2018	11/8/2017

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.



Measurement Uncertainty

The listed uncertainties are the worst case uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Expanded Uncertainty k=2	Maximum allowable uncertainty
Radiated Emissions (30-1000MHz)		
NIST	5.6dB	N/A
CISPR	4.6dB	5.2dB (Ucisprr)
Radiated Emissions (1-26.5GHz)	4.6dB	N/A
Radiated Emissions (above 26.5GHz)	4.9dB	N/A
Magnetic Radiated Emissions	5.6dB	N/A
Conducted Emissions		
NIST	3.9dB	N/A
CISPR	3.6dB	3.6dB (Ucisprr)
Telco Conducted Emissions (Current)	2.9dB	N/A
Telco Conducted Emissions (Voltage)	4.4dB	N/A
Electrostatic Discharge	11.5%	N/A
Radiated RF Immunity (Uniform Field)	1.6dB	N/A
Electrical Fast Transients	23.1%	N/A
Surge	23.1%	N/A
Conducted RF Immunity	3dB	N/A
Magnetic Immunity	12.8%	N/A
Dips and Interrupts	2.3V	N/A
Harmonics	3.5%	N/A
Flicker	3.5%	N/A
Radio frequency (@ 2.4GHz)	3.23×10^{-8}	1×10^{-7}
RF power, conducted	0.40dB	0.75dB
Maximum frequency deviation:		
• Within 300Hz and 6kHz of audio frequency / Within 6kHz and 25kHz of audio frequency	3.4% 0.3dB	5% 3dB
Adjacent channel power	1.9dB	3dB
Conducted spurious emission of transmitter, valid up to 12.75GHz	2.39dB	3dB
Conducted emission of receivers	1.3dB	3dB
Radiated emission of transmitter, valid up to 26.5GHz	3.9dB	6dB
Radiated emission of transmitter, valid up to 80GHz	3.3dB	6dB
Radiated emission of receiver, valid up to 26.5GHz	3.9dB	6dB
Radiated emission of receiver, valid up to 80GHz	3.3dB	6dB
Humidity	2.37%	5%
Temperature	0.7°C	1.0°C
Time	4.1%	10%
RF Power Density, Conducted	0.4dB	3dB
DC and low frequency voltages	1.3%	3%
Voltage (AC, <10kHz)	1.3%	2%
Voltage (DC)	0.62%	1%
The above reflects a 95% confidence level		



Conditions Of Testing

[Bureau Veritas Consumer Products Services, Inc., a Massachusetts corporation], and/or its affiliates (collectively, the "Company") will conduct, at the request of the Submitter ("Client"), the tests specified on the submitted Test Request Form or equivalent in accordance with, and subject to, the following terms and conditions (collectively, "Conditions"):

1. All orders for tests are subject to acceptance by the Company, and no order will constitute a binding commitment of the Company unless and until such order is accepted by it, as evidenced by the issuance of a written report ("Test Report") by the Company. The Test Report is issued solely by the Company, is intended for the exclusive use of Client and shall not be published, used for advertising purposes, copied or replicated for distribution to any other person or entity or otherwise publicly disclosed without the prior written consent of the Company. By submitting a request for services to the Company, Client consents to the disclosure to accreditation bodies of those records of Client relevant to the accreditation body's assessment of the Company's competence and compliance with relevant accreditation criteria. The Company shall not be liable for any loss or damage whatsoever resulting from the failure of the Company to provide its services within any time period for completion estimated by the Company. If Client anticipates using the Test Report in any legal proceeding, arbitration, dispute resolution forum or other proceeding, it shall so notify the Company prior to submitting the Test Report in such proceeding. The Company has no obligation to provide a fact or expert witness at such proceeding unless the Company agrees in advance to do so for a separate and additional fee.
2. The Test Report will set forth the findings of the Company solely with respect to the test samples identified therein. Unless specifically and expressly indicated in the Test Report, the results set forth in such Test Report are not intended to be indicative or representative of the quality or characteristics of the lot from which a test sample is taken, and Client shall not rely upon the Test Report as being so indicative or representative of the lot or of the tested product in general. The Test Report will reflect the findings of the Company at the time of testing only, and the Company shall have no obligation to update the Test Report after its issuance. The Test Report will set forth the results of the tests performed by the Company based upon the written information provided to the Company. The Test Report will be based solely on the samples and written information submitted to the Company by Client, and the Company shall not be obligated to conduct any independent investigation or inquiry with respect thereto.
3. The Company may, in its sole discretion, destroy samples which have been furnished to the Company for testing and which have not been destroyed in the course of testing. The Company may delegate the performance of all or a portion of the services contemplated hereunder to an affiliate, agent or subcontractor of the Company, and Client consents to such delegation.
4. These Conditions and the Test Report represent the entire understanding of the parties hereto with respect to the subject matter hereof and of the Test Report, and no modification, variance or extrapolation with respect thereto shall be permitted without the prior written consent of the Company.
5. The names, service marks, trademarks and copyrights of the Company and its affiliates, including the names "BUREAU VERITAS," "BUREAU VERITAS CONSUMER PRODUCTS SERVICES," "BVCPS," "MTL," "ACTS," "MTL-ACTS" and "CURTIS-STRAUS" (collectively, the "Marks") are and shall remain the sole property of the Company or its affiliates and shall not be used by Client except solely to the extent that Client obtains the prior written approval of the Company and then only in the manner prescribed by the Company. Client shall not contest the validity of the Marks or take any action that might impair the value or goodwill associated with the Marks or the image or reputation of the Company or its affiliates.
6. Payment in full shall be due 30 days after the date of invoice. Interest shall be due on overdue amounts from the due date until paid at an interest rate of 1.5% per month or, if less, the maximum rate permitted by law. The Company reserves the right, at any time and from time to time, to revoke any credit extended to Client. Client shall reimburse the Company for any costs it incurs in collecting past due amounts, including court costs and fees and expenses of attorneys and collection agencies. The Test Report may not be used or relied upon by Client if and for so long as Client fails to pay when due any invoice issued by the Company or any affiliate of it to Client or any affiliate or subsidiary of Client together with interest and penalties, if any, accrued thereon.
7. The Company disclaims any and all responsibility or liability arising out of or in connection with e-mail transmissions of such information.
8. Client understands and agrees that the Company is neither an insurer nor a guarantor, that the Company does not take the place of Client or any designer, manufacturer, agent, buyer, distributor or transportation or shipping company, and that the Company disclaims all liability in such capacities. Client further understands that if it seeks assurance against loss or damage, it should obtain appropriate insurance.
9. Client agrees that the Company, by providing the services, does not take the place of Client nor any third party, nor does the Company release them from any of their obligations, nor does the Company otherwise assume, abridge, abrogate or undertake to discharge any duty of any third party to Client or any duty of Client or any third party to any other third party, and Client will not release any third party from its obligations and duties with respect to the tested goods.
10. Client shall, on a timely basis, (a) provide adequate instructions to the Company in order to enable the Company to perform properly its services, (b) provide, or cause Client's suppliers and contractors to provide, the Company with all documents necessary to enable the Company to perform its services, (c) furnish the Company with all relevant information regarding Client's intended use and purposes of the tested goods, (d) advise the Company of essential dates and deadlines relevant to the tested goods and (e) fully exercise all rights and remedies available to Client against third parties in respect of the tested goods.
11. The Company shall undertake due care and ordinary skill in the performance of its services to Client, and the Company shall accept responsibility only where such skill has not been exercised and, even in such event, only to the extent of the limitation of liability set forth herein.
12. If Client desires to assert a claim arising from or relating to (i) the performance, purported performance or non-performance of any services by the Company or (ii) the sale, resale, manufacture, distribution or use of any tested goods, it must submit that claim to the Company in a writing that sets forth with particularity the basis for such claim within 60 days from discovery of the potential claim and not more than six months after the date of issuance of the Test Report to Client. Client waives any and all such claims



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page 38 of 39



including, without limitation, claims that the Test Report is inaccurate, incomplete or misleading or that additional or different testing is required, unless and then only to the extent that Client submits a written claim to the Company within both such time periods.

13. CLIENT SHALL, EXCEPT TO THE EXTENT OF COMPANY'S LIABILITY TO CLIENT HEREUNDER (WHICH IN NO EVENT SHALL EXCEED THE LIMITATION OF LIABILITY HEREIN), HOLD HARMLESS AND INDEMNIFY THE COMPANY, ITS AFFILIATES AND THEIR RESPECTIVE DIRECTORS, OFFICERS, EMPLOYEES, AGENTS AND SUBCONTRACTORS AGAINST ALL ACTUAL OR ALLEGED THIRD PARTY CLAIMS FOR LOSS, DAMAGE OR EXPENSE OF WHATSOEVER NATURE AND HOWSOEVER ARISING FROM OR RELATING TO (i) THE PERFORMANCE, PURPORTED PERFORMANCE OR NON-PERFORMANCE OF ANY SERVICES BY THE COMPANY OR (ii) THE SALE, RESALE, MANUFACTURE, DISTRIBUTION OR USE OF ANY TESTED GOODS.

14. EXCEPT AS MAY OTHERWISE BE EXPRESSLY AGREED TO IN WRITING BY THE COMPANY AND NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN OR IN ANY TEST REPORT, NO WARRANTY OR GUARANTEE, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, IS MADE.

15. (A) IN NO EVENT WHATSOEVER SHALL THE COMPANY BE LIABLE FOR ANY CONSEQUENTIAL, SPECIAL, INCIDENTAL, EXEMPLARY OR PUNITIVE DAMAGES IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE TEST REPORT OR THE SERVICES PROVIDED BY THE COMPANY HEREUNDER, INCLUDING WITHOUT LIMITATION LOSS OF OR DAMAGE TO PROPERTY; LOSS OF INCOME, PROFIT OR USE; OR ANY CLAIMS OR DEMANDS MADE AGAINST CLIENT OR ANY OTHER PERSON BY ANY THIRD PARTY IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE SERVICES PROVIDED BY THE COMPANY HEREUNDER.

(B) NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN, AND IN RECOGNITION OF THE RELATIVE RISKS AND BENEFITS TO CLIENT AND THE COMPANY ASSOCIATED WITH THE TESTING SERVICES CONTEMPLATED HEREBY, THE RISKS HAVE BEEN ALLOCATED SUCH THAT UNDER NO CIRCUMSTANCES WHATSOEVER SHALL THE LIABILITY OF THE COMPANY TO CLIENT OR ANY THIRD PARTY IN RESPECT OF ANY CLAIM FOR LOSS, DAMAGE OR EXPENSE, OF WHATSOEVER NATURE OR MAGNITUDE, AND HOWSOEVER ARISING, EXCEED AN AMOUNT EQUAL TO FIVE (5) TIMES THE AMOUNT OF THE FEES PAID TO THE COMPANY FOR THE SPECIFIC SERVICES WHICH GAVE RISE TO SUCH CLAIM OR U.S.\$10,000, WHICHEVER IS THE LESSER AMOUNT.

16. The Company shall not be liable for any loss or damage resulting from any delay or failure in performance of its obligations hereunder resulting directly or indirectly from any event of force majeure or any event outside the control of the Company. If any such event occurs, the Company may immediately cancel or suspend its performance hereunder without incurring any liability whatsoever to Client.

17. Company's services, including these Conditions, shall be governed by, and construed in accordance with, the local laws of the country where the Company performs the tests or, in the case of tests performed in the United States of America, the laws of Massachusetts without regard to conflicts of laws principles. If any aspect(s) of these Conditions is found to be illegal or unenforceable, the validity, legality and enforceability of all remaining aspects of these Conditions shall not in any way be affected or impaired thereby. Any proceeding related to the subject matter hereof shall be brought, if at all, in the courts of the country where the Company performs the tests or, in the case of tests performed in the United States of America, in the courts of Massachusetts. Client waives the right to interpose any counterclaim or setoffs of any nature in any litigation arising hereunder.

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