Test Report

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

Report No	ES1533-3
Client	Novanta
Address	125 Middlesex Turnpike Bedford MA, 01730
Phone	617-499-4090
Items tested	M6e Module
FCC ID	QV5MERCURY6E
IC	5407A-MERCURY6E
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, 2018 to January 4, 2019
Results	As detailed within this report
Prepared by	Zachary Johnson – EMC Engineer
Authorized by	Yunus Fazilioglu – Sr. Engineer
Issue Date	1/8/2019
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.

Contents

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, ISED Canada RSS-247 Issue 2

M6e 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

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.

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.

On 1/4/2019, Peak Output Power measurements were repeated with recalibrated settings in order not to exceed the level listed in the original grant of equipment authorization. This was required to qualify for Class II Permissive Change. Since all other measurements were performed at slightly higher power producing calibration settings earlier, none of the previous measurements were repeated at the final recalibrated settings.

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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 (FormerlyThing Magic)		
Company Address:	125 Middlesex Turnpike		
	Bedford, MA, 01730		
Contact:	Harinath Reddy		
	MN	**PN**	**SN**
EUT:	M6E		
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

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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.

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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 **Work Order:** S1533
Engineer: Zac Johnson **EUT:** M6e **Operating Voltage/Frequency:** 5V DC
Temp: 23.8°C **Humidity:** 55% **Pressure:** 1008mBar

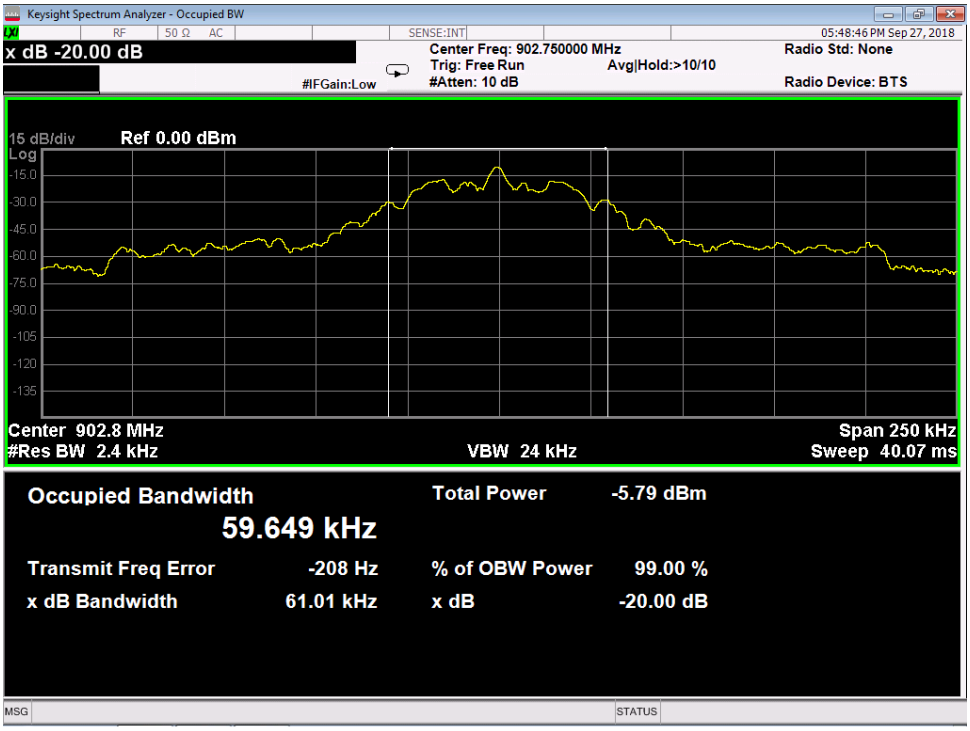
Frequency Range: 902.75-927.25 MHz **Measurement Type:** Conducted
Measurement Method: ANSI C63.10-2013

Notes:

Frequency Reading (MHz)	Reading (kHz)	20dB Bandwidth Limit (kHz)	20dB Bandwidth Result (Pass/Fail)
902.75	61.01	<500	Pass
915.25	62.10	<500	Pass
927.25	61.99	<500	Pass

Test Site: CEMI-5 **Cable:** 2288 **Attenuator:** 2107 Pad
Analyzer: 1118473 SA

PLOTS



902.75MHz Low Channel

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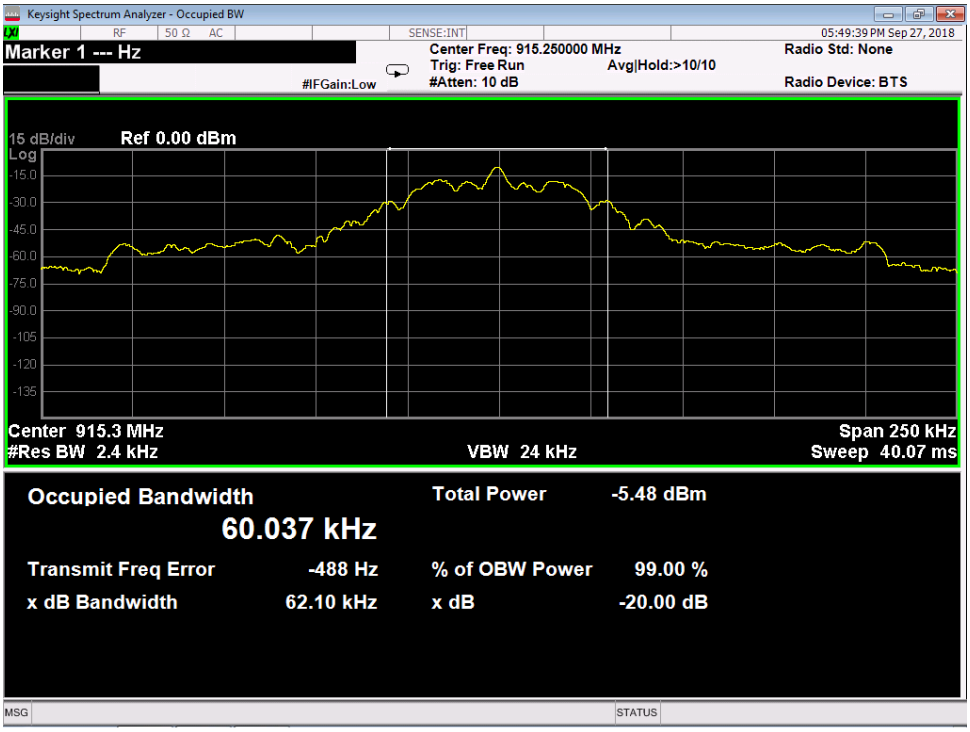
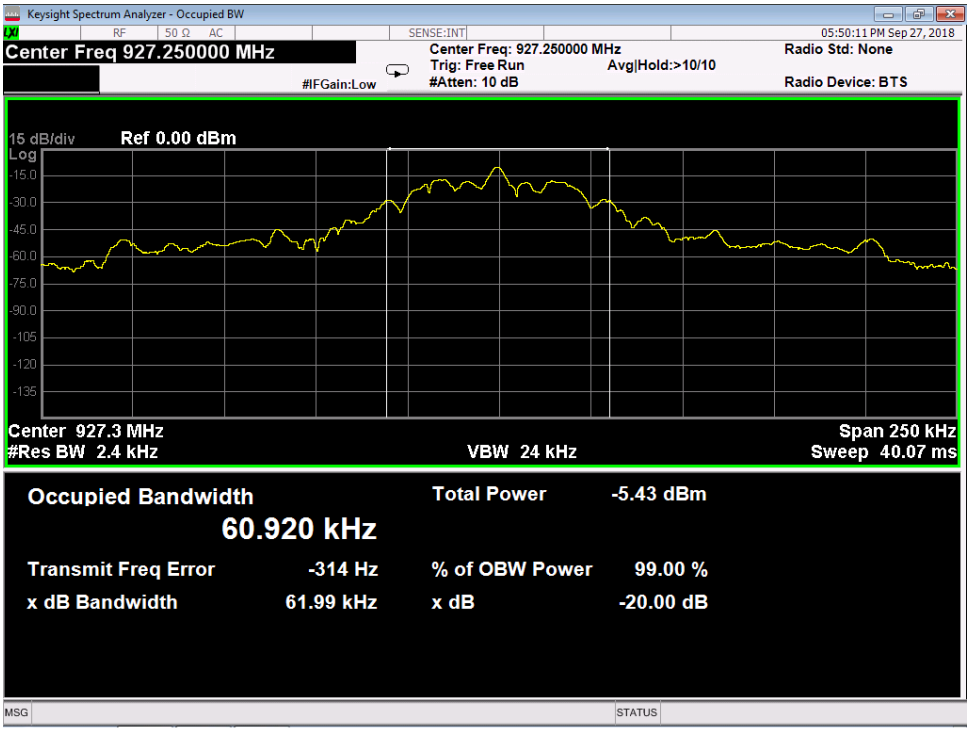


915.25MHz Mid Channel



927.25MHz High Channel

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99% OBW

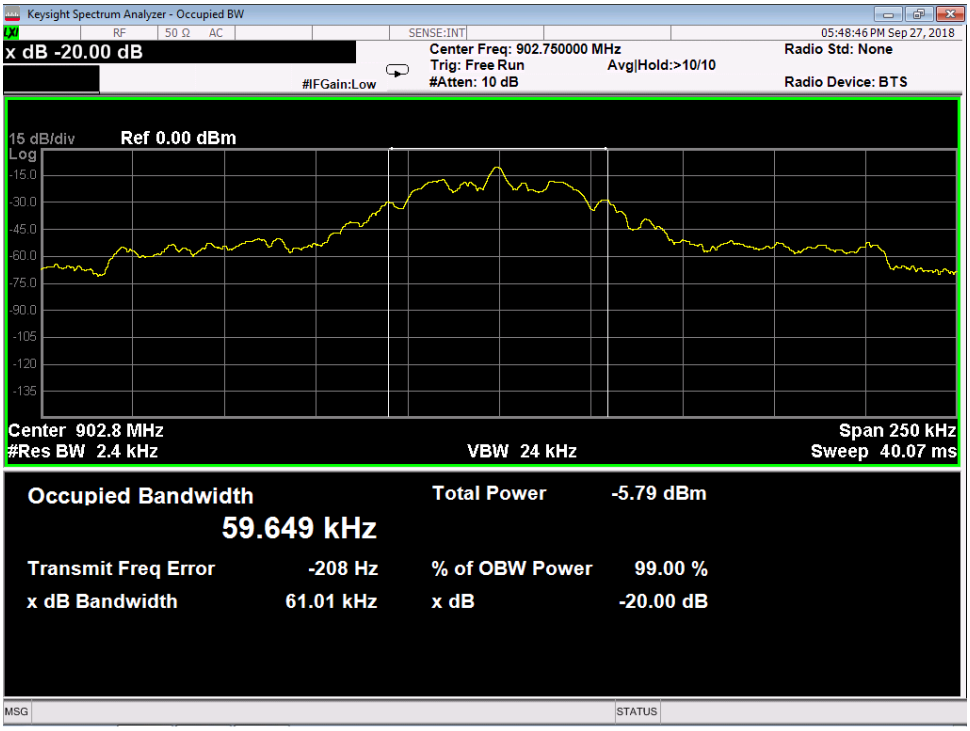
MEASUREMENTS / RESULTS

99% Occupied Bandwidth			
Date: 9/27/2018	**Company:** Novanta		**Work Order:** S1533
Engineer: Zac Johnson	**EUT:** M6e		**Operating Voltage/Frequency:** 5V DC
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	59.649
915.25	60.037
927.25	60.920

Test Site: CEMI-5 **Cable:** 2288 **Attenuator:** 2107 Pad
Analyzer: 1118473 SA

PLOTS



902.75MHz Low Channel

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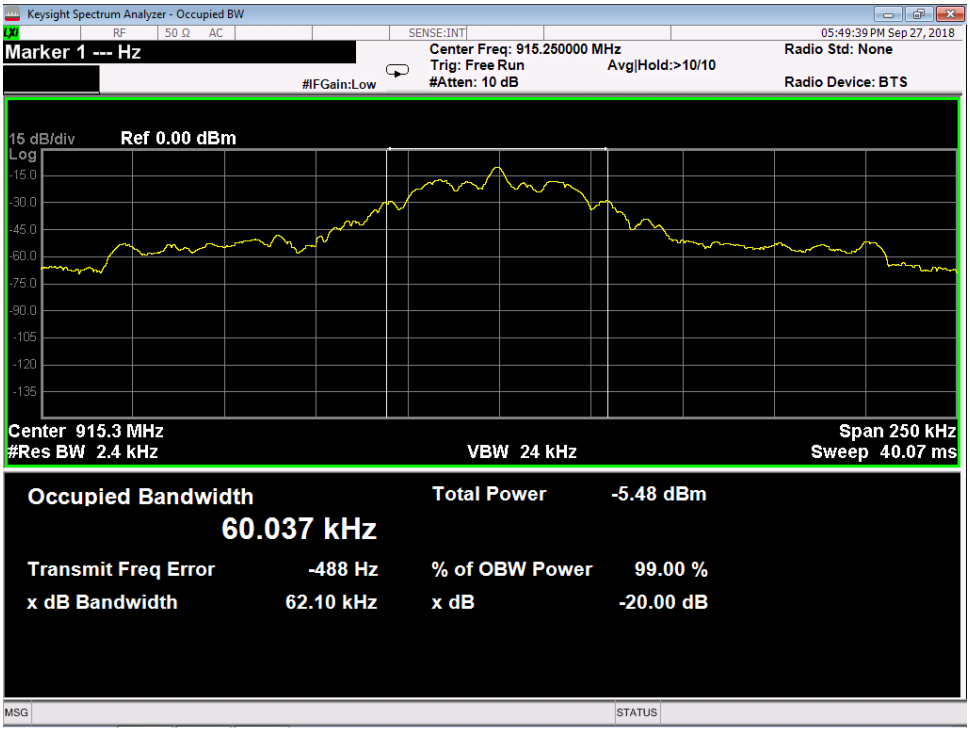
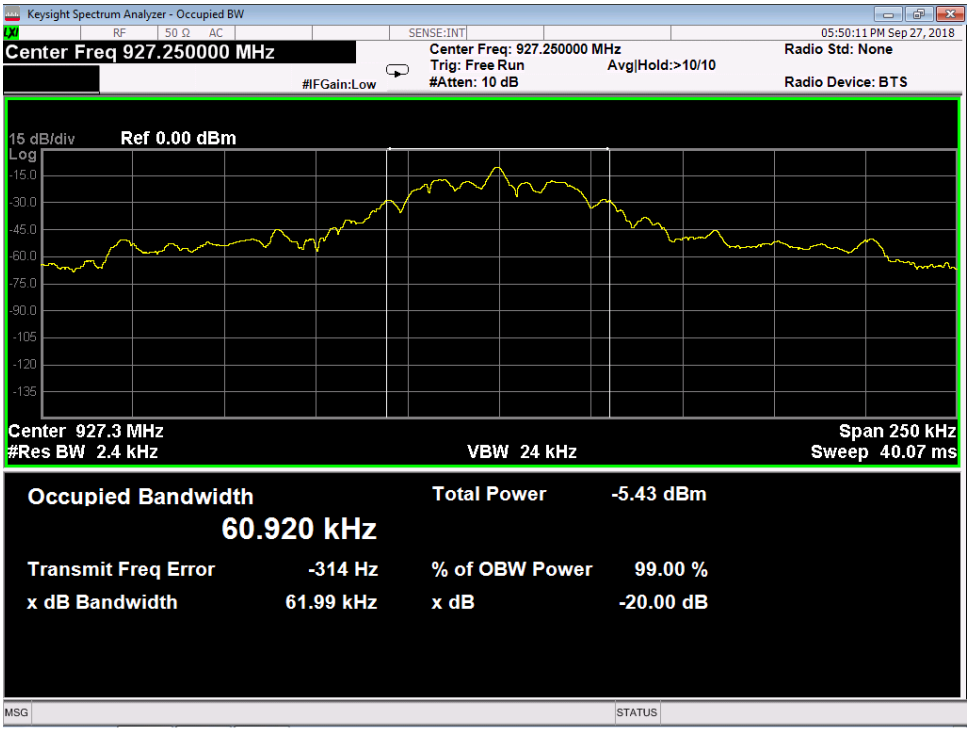


915.25MHz Mid Channel



927.25MHz High Channel

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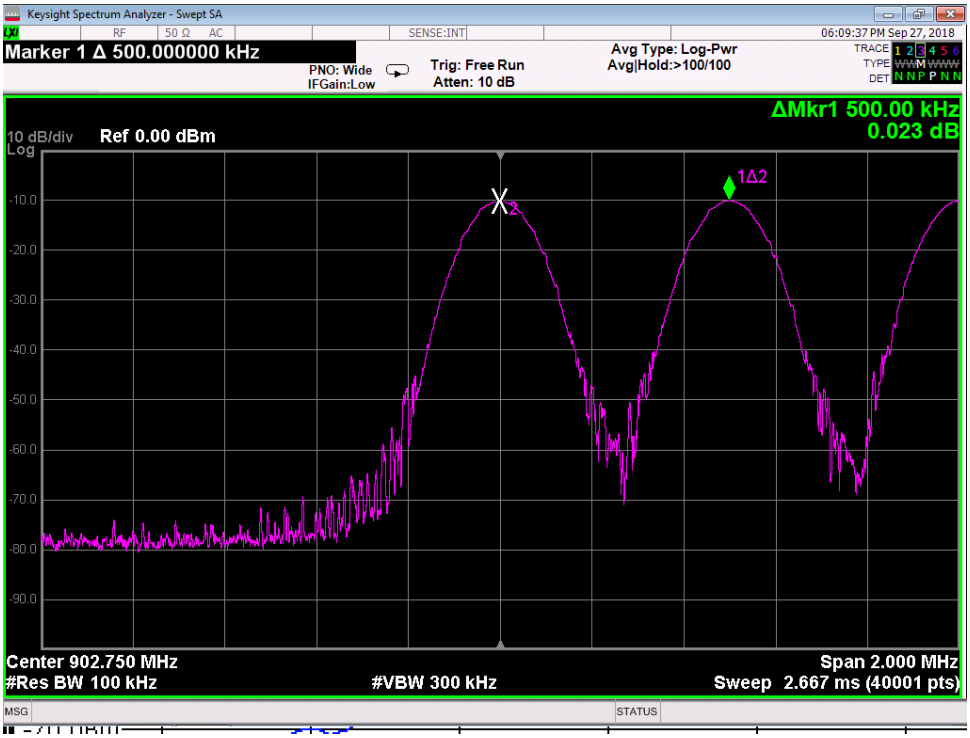
Channel Separation

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



Low End of the Band

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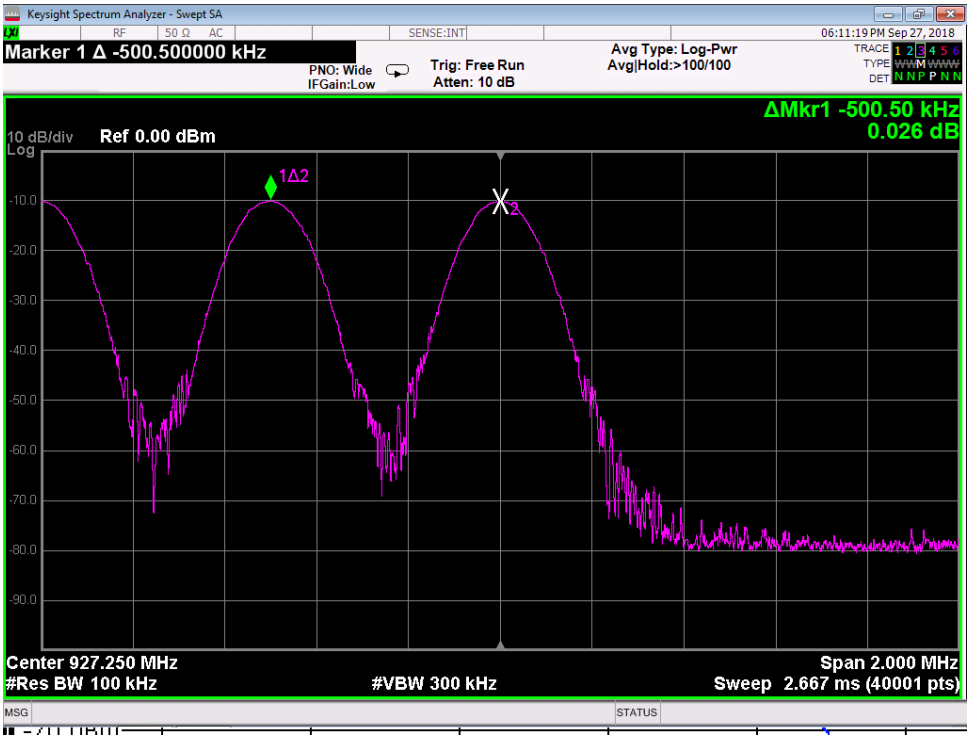

High End of the Band

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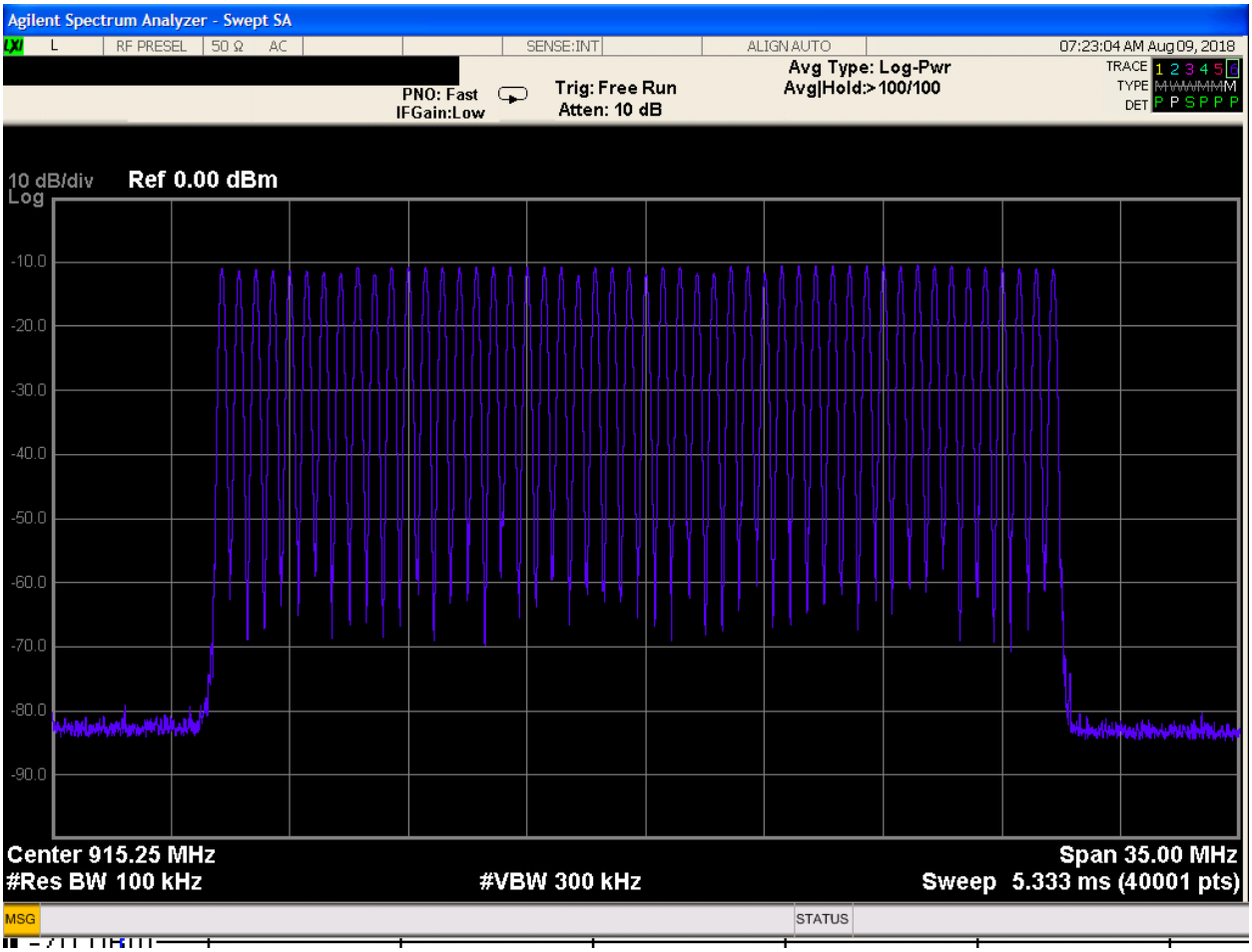
Number of Channels

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



50 Channels

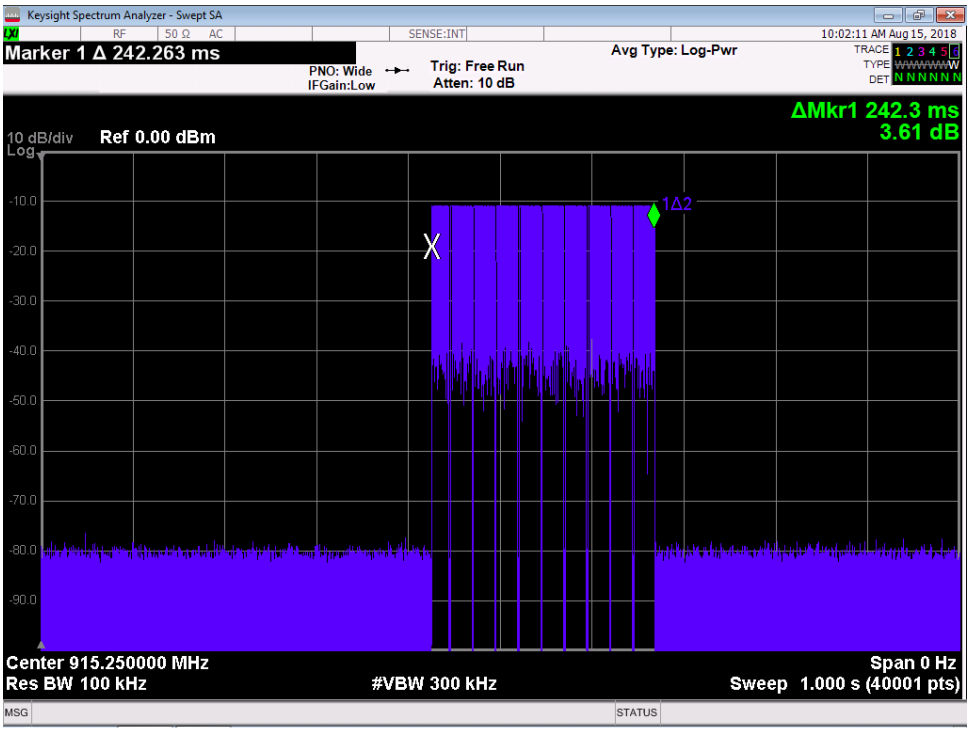
Dwell Time

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

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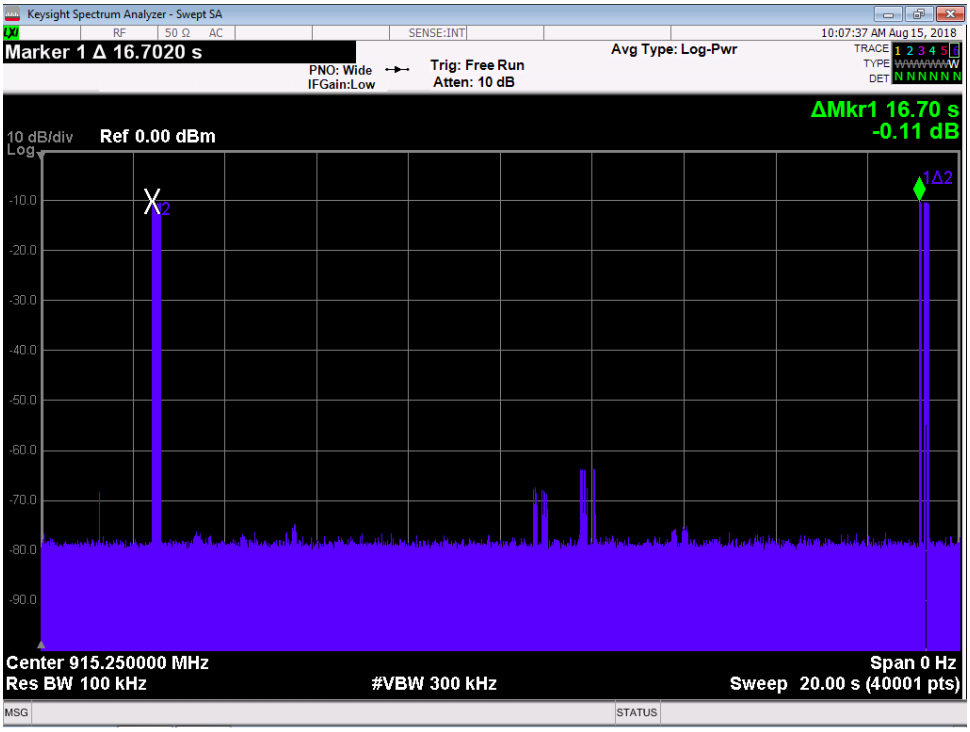

20 Seconds

*Dwell time in a 20sec period = (20s/16.70s)*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 30dBm.

Peak Output Power

Date: 1/4/2019 **Company:** Novanta **Work Order:** S1533
Engineer: AKZ **EUT:** M6e **Operating Voltage/Frequency:** 5V DC
Temp: 20°C **Humidity:** 32% **Pressure:** 1001mbar
Frequency Range: 902.75-927.25 MHz **Measurement Type:** Conducted
Measurement Method: ANSI C63.10-2013
Notes: Sample 1011, at 30.00dBm

Port Number	Frequency (MHz)	Peak Reading (dBm)	Cable Loss (dB)	Attenuator Loss (dB)	Peak Output Power (dBm)	Limit (dBm)	Margin (dB)	Result (Pass/Fail)
1.0	902.75	-10.420	0.20	40.0	29.780	30.0	-0.220	Pass
1.0	915.25	-10.420	0.20	40.0	29.780	30.0	-0.220	Pass
1.0	927.25	-10.304	0.20	40.0	29.896	30.0	-0.104	Pass
2.0	902.75	-10.319	0.20	40.0	29.881	30.0	-0.119	Pass
2.0	915.25	-10.320	0.20	40.0	29.880	30.0	-0.120	Pass
2.0	927.25	-10.405	0.20	40.0	29.795	30.0	-0.205	Pass
3.0	902.75	-10.390	0.20	40.0	29.810	30.0	-0.190	Pass
3.0	915.25	-10.424	0.20	40.0	29.776	30.0	-0.224	Pass
3.0	927.25	-10.406	0.20	40.0	29.794	30.0	-0.206	Pass
4.0	902.75	-10.340	0.20	40.0	29.860	30.0	-0.140	Pass
4.0	915.25	-10.320	0.20	40.0	29.880	30.0	-0.120	Pass
4.0	927.25	-10.310	0.20	40.0	29.890	30.0	-0.110	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)

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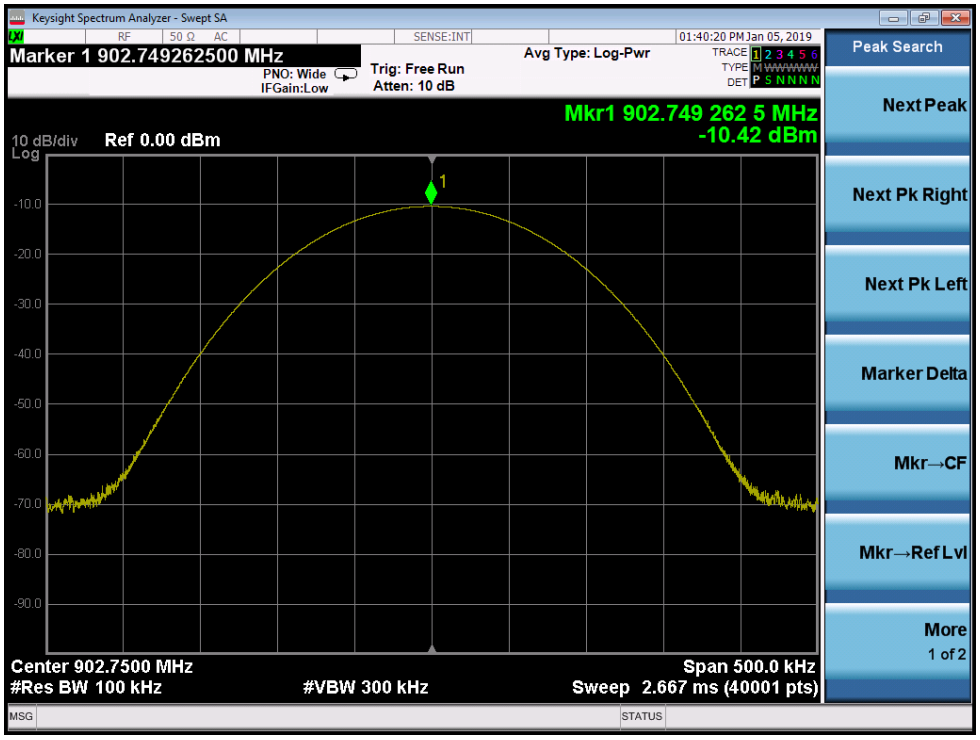
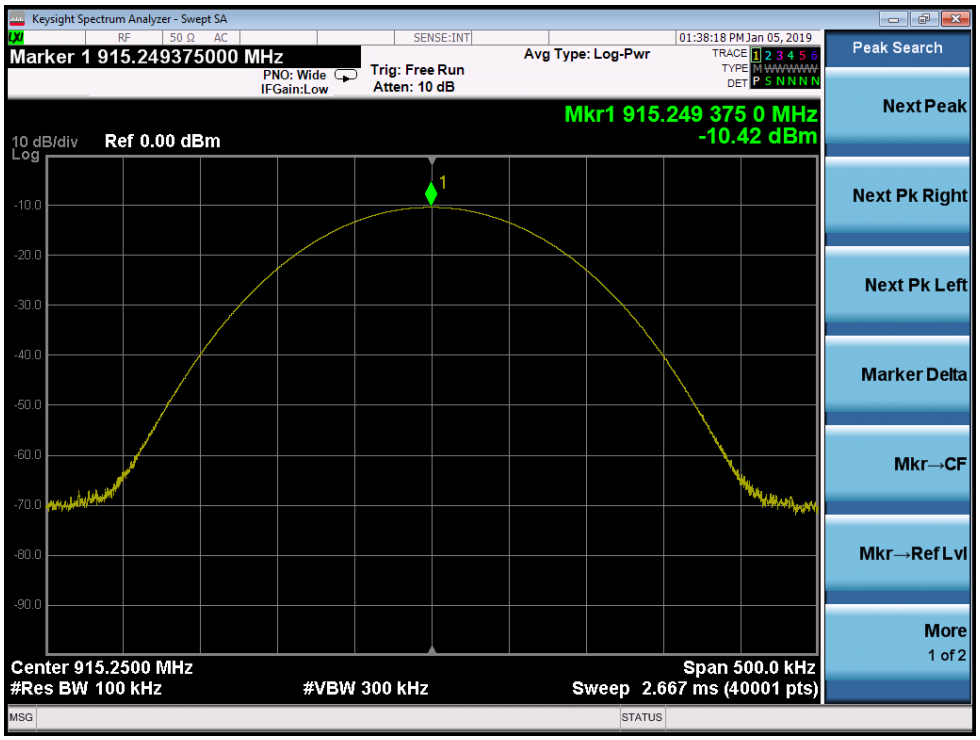
PLOTS



Port 1 Low



Port 1 Mid

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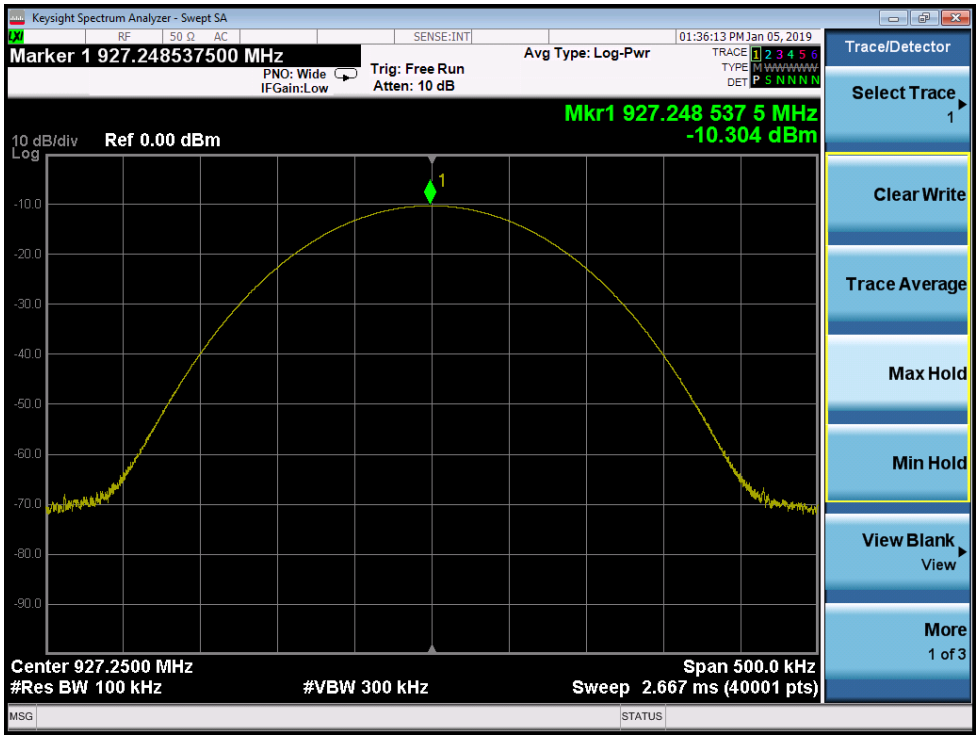
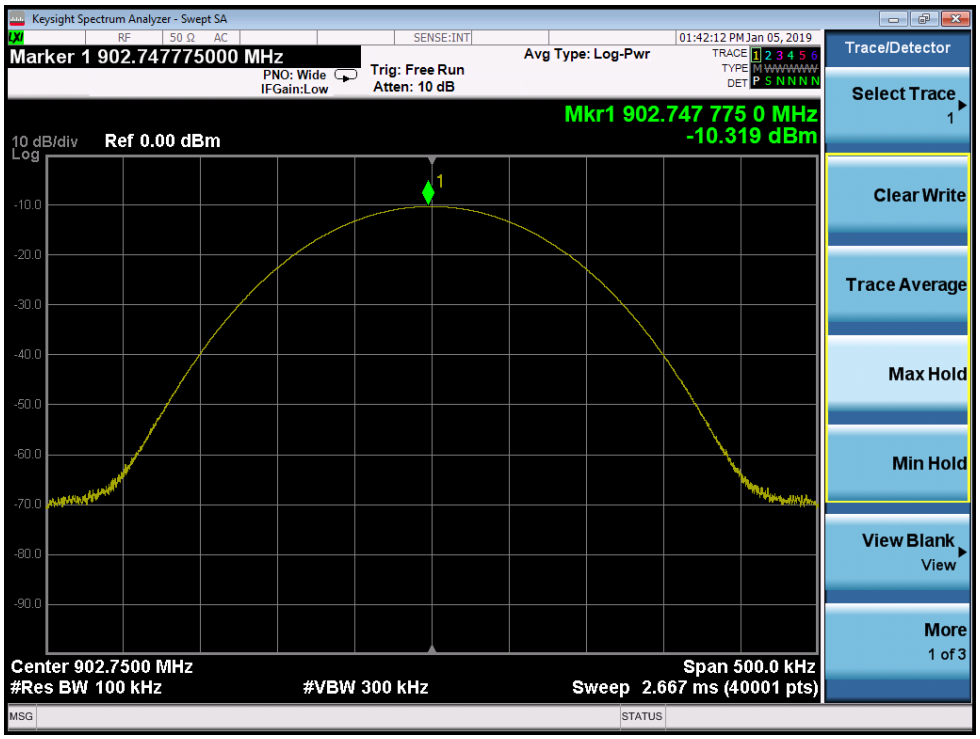


Port 1 High



Port 2 Low

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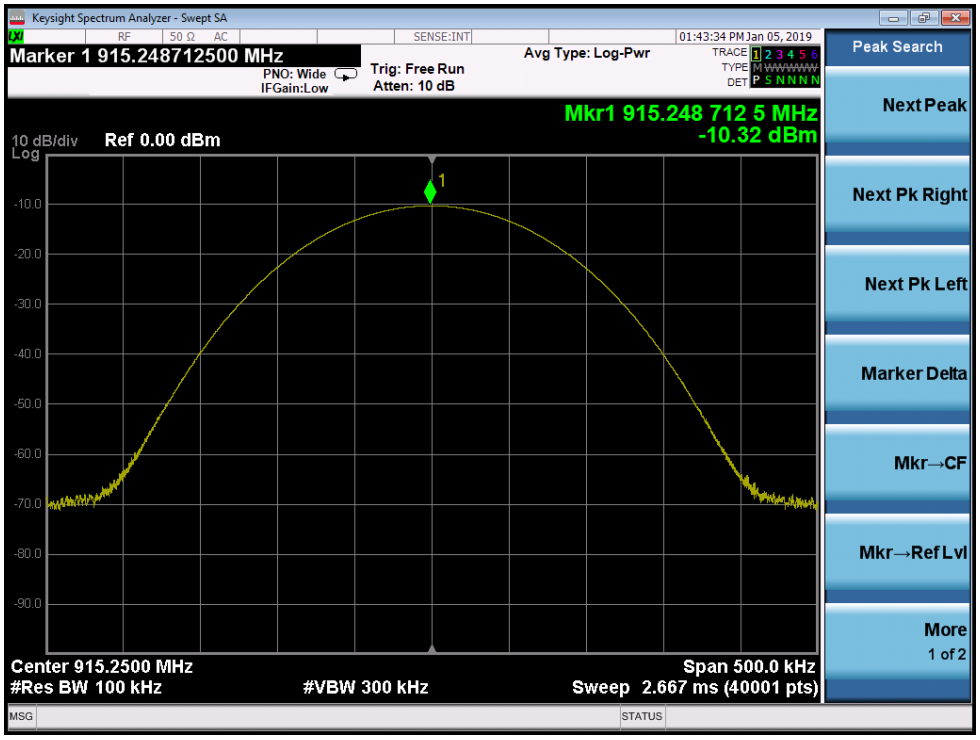
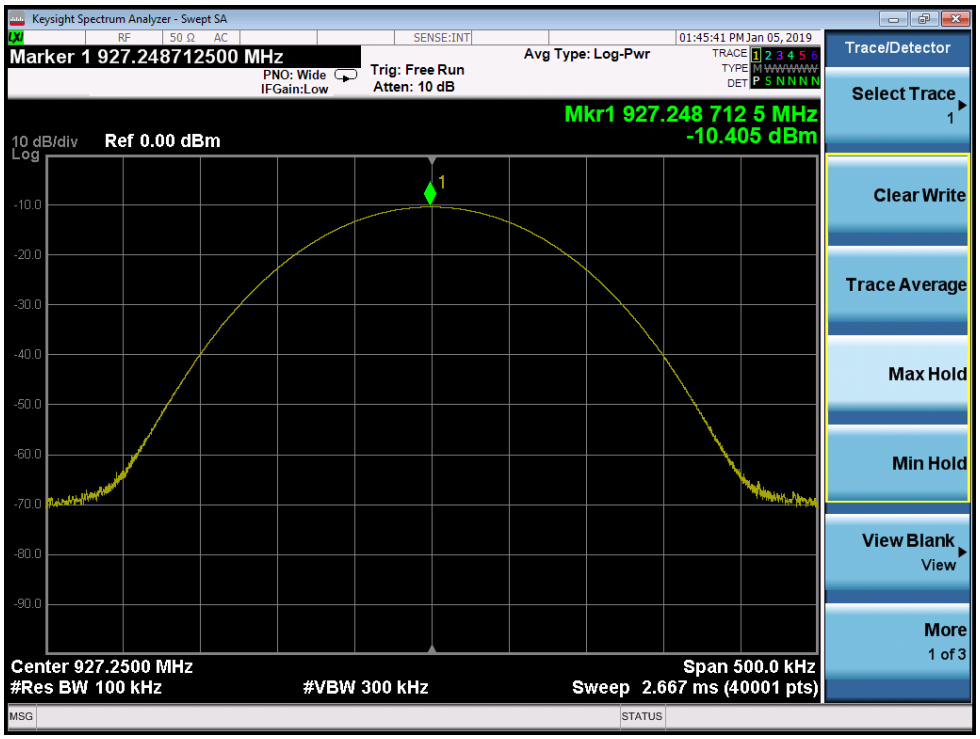


Port 2 Mid



Port 2 High

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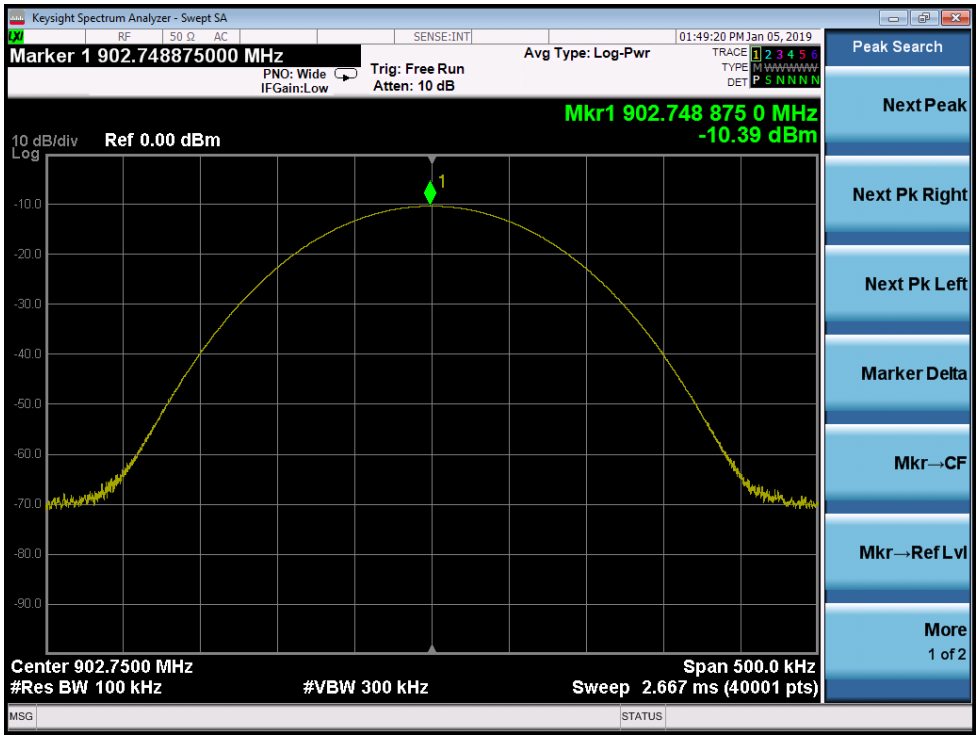
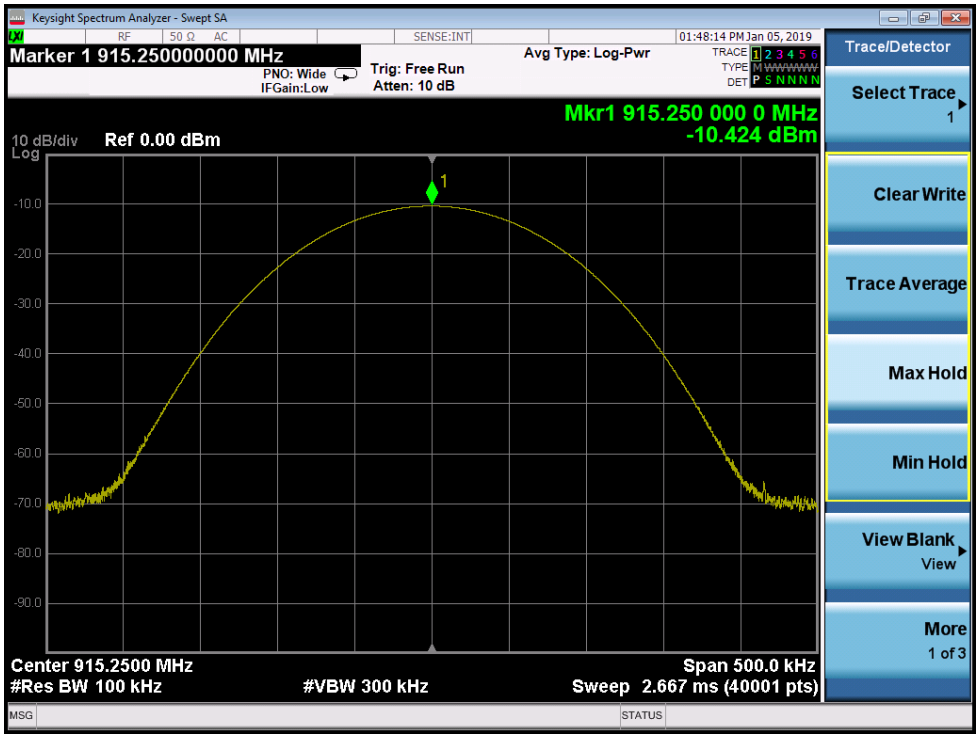


Port 3 Low



Port 3 Mid

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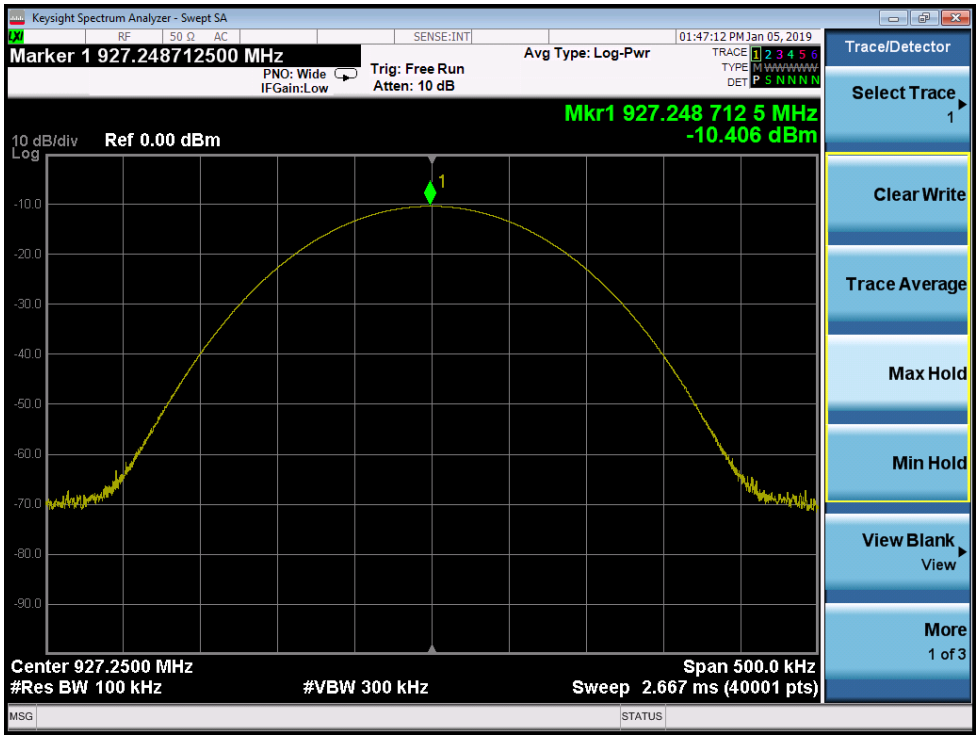

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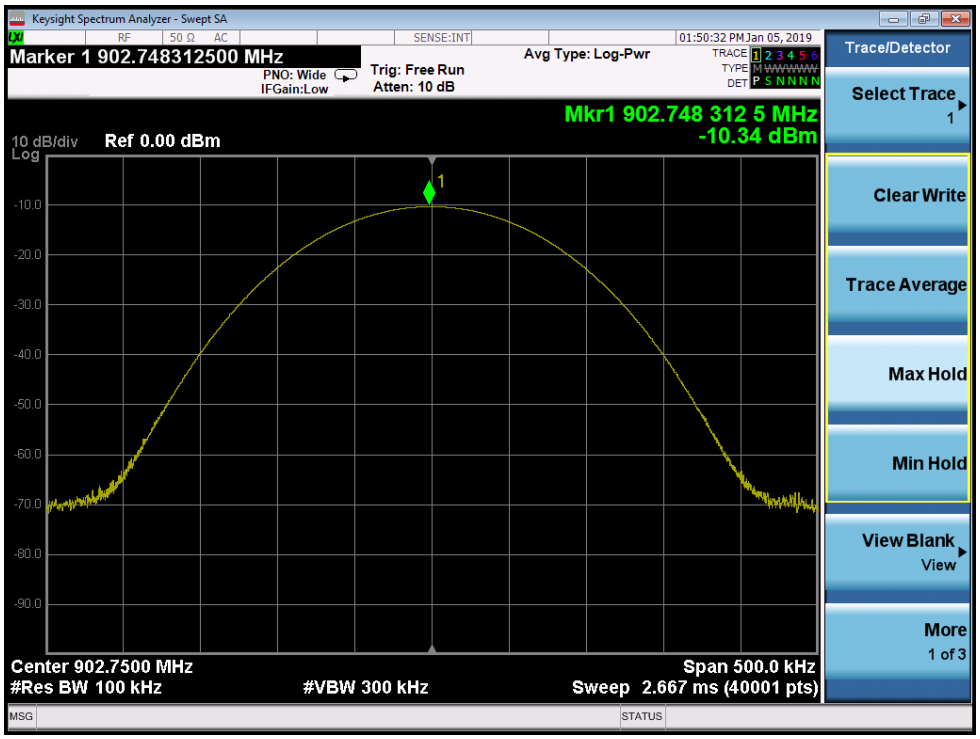

Port 4 Low

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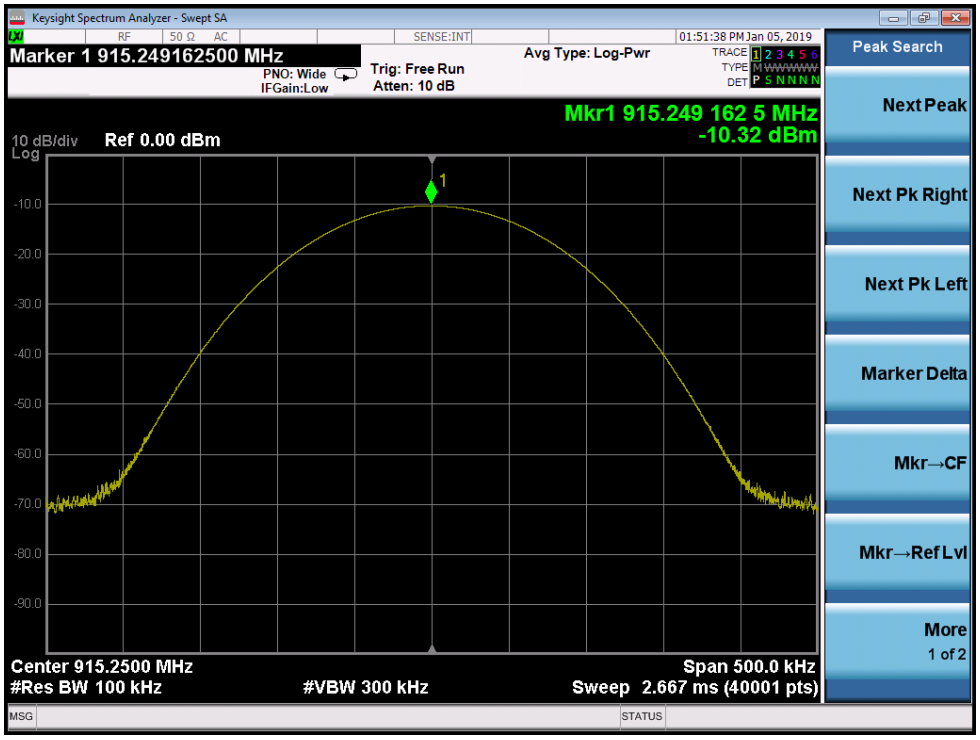
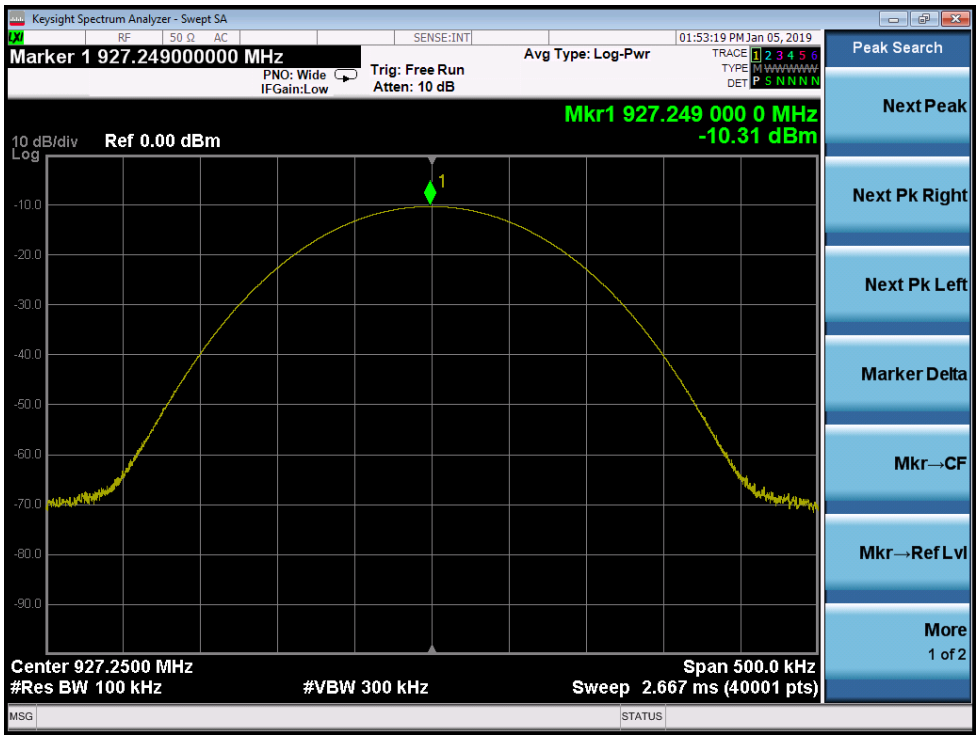


Port 4 Mid



Port 4 High

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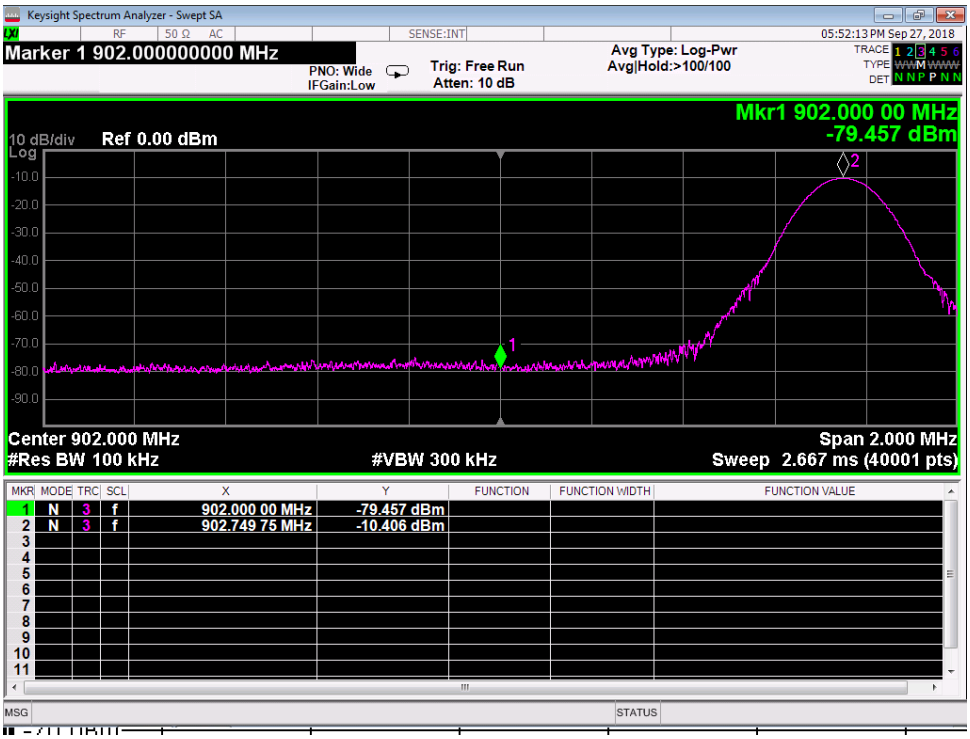
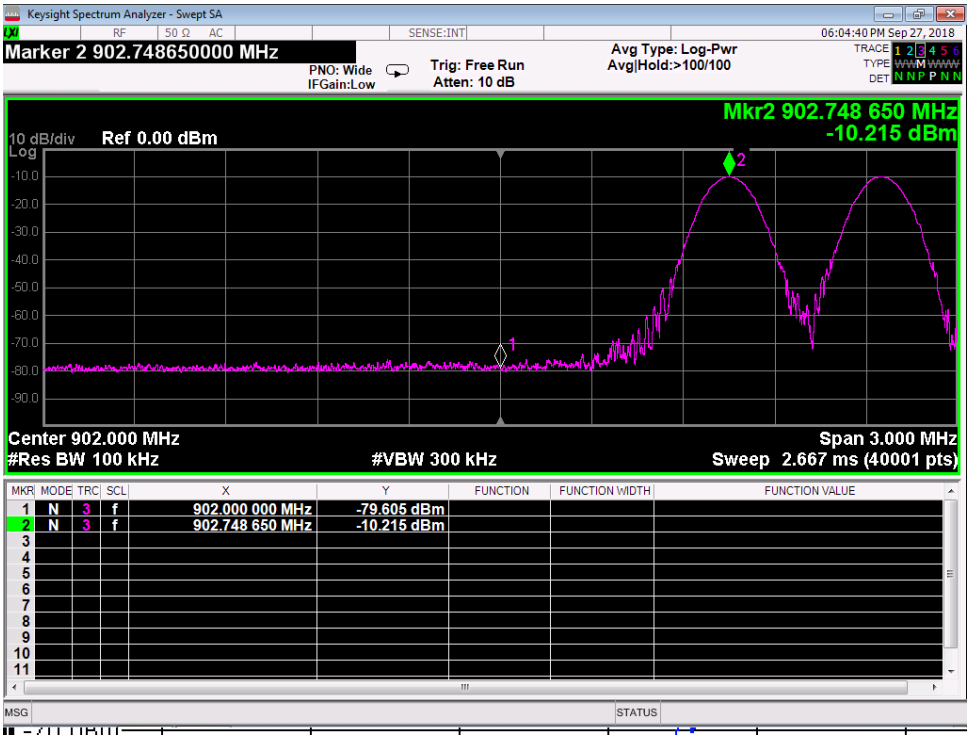
Conducted Bandedges

All band edges over 20dB from peak



Low Bandedge Non-hopping



Low Bandedge Hopping

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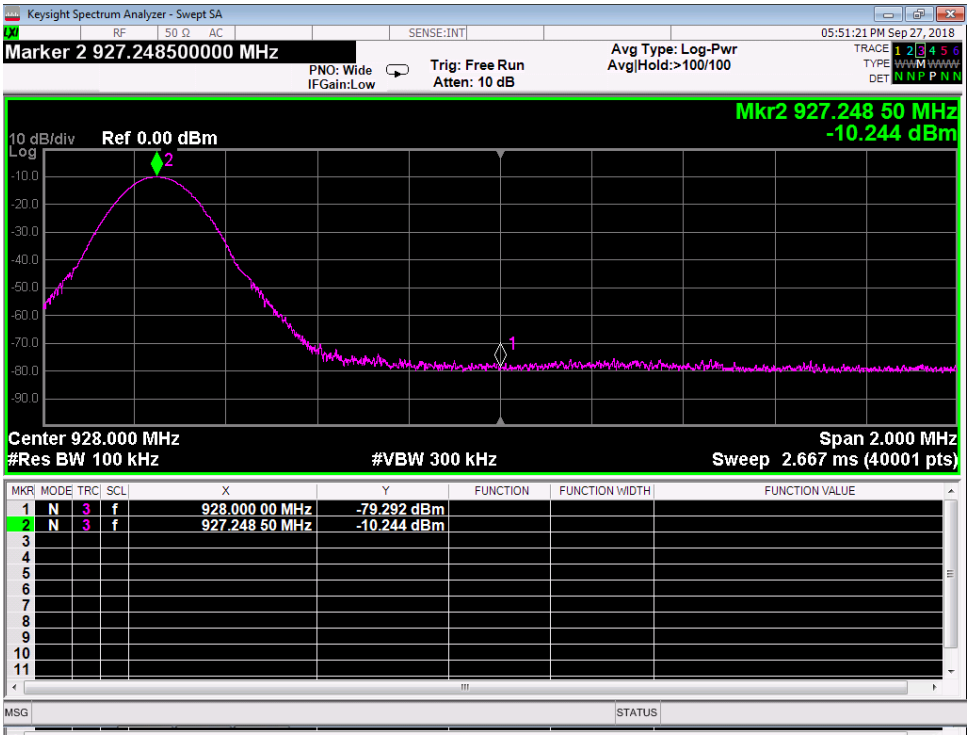
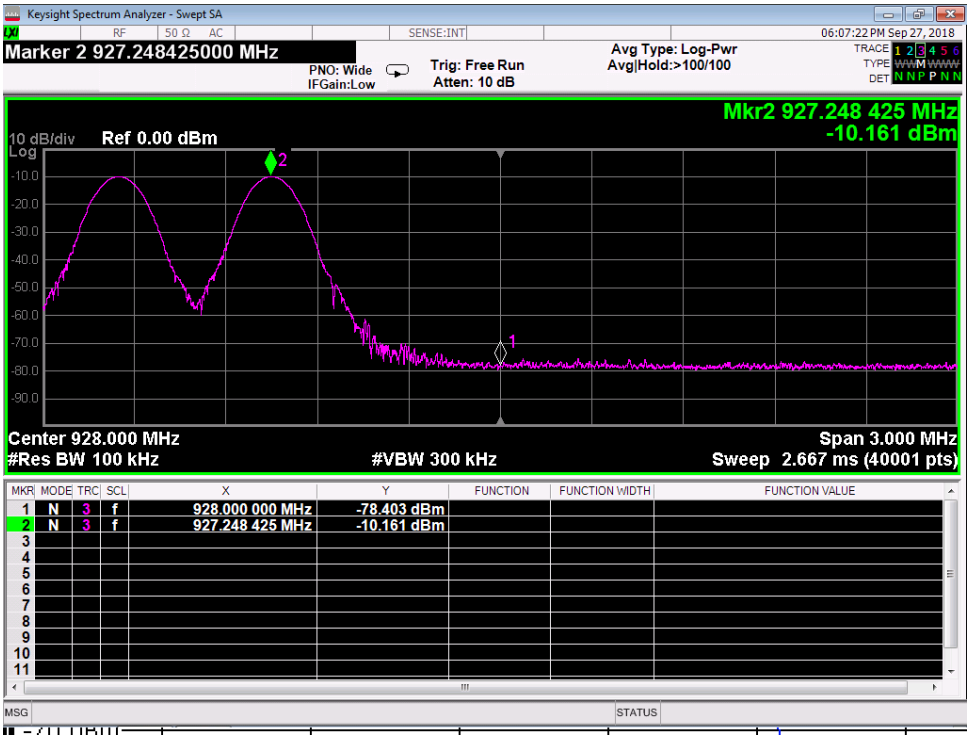


High Bandedge Non-hopping



High Bandedge Hopping

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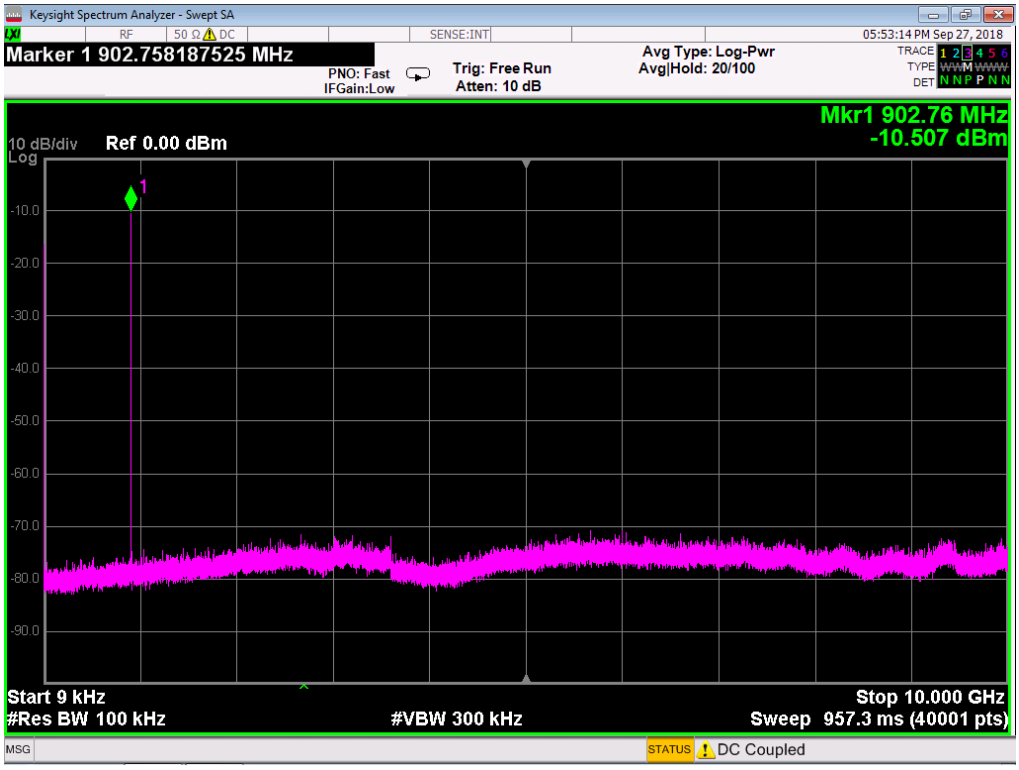
Conducted Spurious

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

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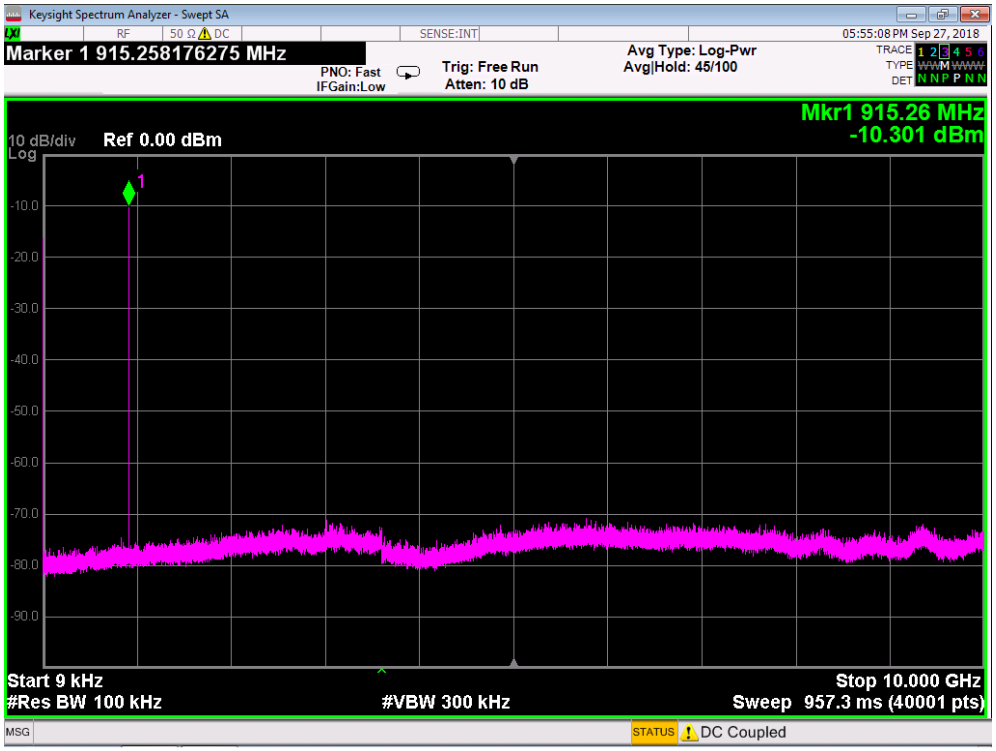
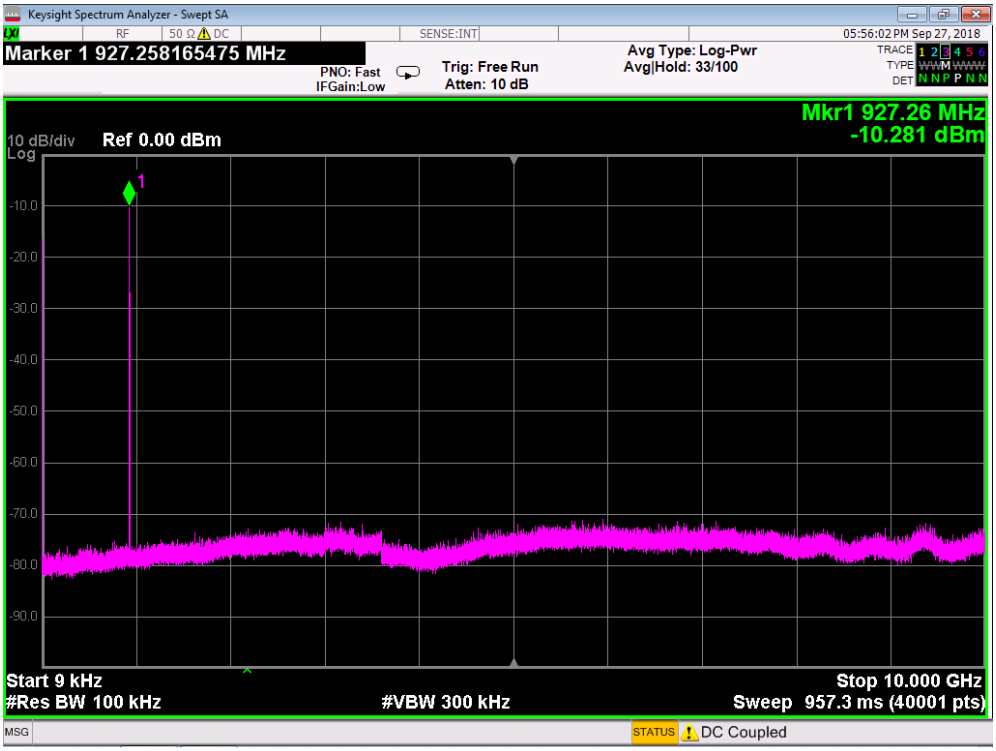


Mid channel



High channel

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Equipment used for the following tests:

20dB Bandwidth and 99% OBW
Channel Separation
Number of Hopping Channels
Dwell Time
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.

Equipment used for the following test:

Peak Output Power

Rev. 12/27/2018

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
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	10/9/2019	10/9/2018
Cables	**Range**		**Mfr**			**Cat**	**Calibration Due**	**Calibrated on**
Asset #2288	9KHz-26.5GHz	FLC-1.5FT-SMSM+	Mini-Circuits	16021029		II	1/29/2019	1/29/2018
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#2086		HTC-1	HDE		2086	II	3/23/2019	3/23/2018

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
30-1000MHz Vertical Data
Operator: Chris Bramley
Notes:
M6e
Low Channel - 902.75MHz
80cm Height
Data Taken at 09:23:08 PM, Tuesday, August 07, 2018

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

Frequency (MHz)	Raw QP Reading (dBµV)	Correction Factor (dB/m)	Adjusted QP Amplitude (dBµV/m)	Lim1: FCC_pt15_109_Class_B (dBµV/m)	Margin to Lim1 (dB)	Test Results Lim1 (Pass/Fail)	Worst Margin Lim1 (dB)	Lim2: FCC_pt15_109_Class_B (dBµV/m)	Margin to Lim2 (dB)	Test Results Lim2 (Pass/Fail)	Worst Margin Lim2 (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
33.193	36.1	-9	27.1	40	-12.9	PASS		40	-12.9	PASS		110	257
36.007	39.8	-11.2	28.6	40	-11.4	PASS		40	-11.4	PASS		118	97
38.046	43.5	-12.8	30.8	40	-9.2	PASS		40	-9.2	PASS		103	110
61.018	48.4	-20.7	27.7	40	-12.3	PASS		40	-12.3	PASS		107	295
72.042	52.7	-20.1	32.6	40	-7.4	PASS	-7.4	40	-7.4	PASS	-7.4	144	200
199.165	46.8	-14.5	32.3	43.5	-11.2	PASS		43.5	-11.2	PASS		116	126

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
30-1000MHz Horizontal Data
Operator: Chris Bramley
Notes:
M6e
Low Channel - 902.75MHz
80cm Height
Data Taken at 09:23:08 PM, Tuesday, August 07, 2018

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

Frequency (MHz)	Raw QP Reading (dBµV)	Correction Factor (dB/m)	Adjusted QP Amplitude (dBµV/m)	Lim1: FCC_pt15_109_Class_B (dbµV/m)	Margin to Lim1 (dB)	Test Results Lim1 (Pass/Fail)	Worst Margin Lim1 (dB)	Lim2: FCC_pt15_109_Class_B (dBµV/m)	Margin to Lim2 (dB)	Test Results Lim2 (Pass/Fail)	Worst Margin Lim2 (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
30	27.9	-6.4	21.5	40	-18.5	PASS		40	-18.5	PASS		216	250
71.992	47.9	-20.1	27.7	40	-12.3	PASS	-12.3	40	-12.3	PASS	-12.3	174	200
166.54	43.8	-15.6	28.2	43.5	-15.3	PASS		43.5	-15.3	PASS		136	250
180.002	45.6	-16.2	29.4	43.5	-14.1	PASS		43.5	-14.1	PASS		145	340
466.359	40.5	-9.1	31.4	46	-14.6	PASS		46	-14.6	PASS		146	198
532.077	31	-8.3	22.7	46	-23.4	PASS		46	-23.4	PASS		125	200

30-1000MHz Low Channel

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
30-1000MHz Vertical Data
Operator: Chris Bramley
Notes:
M6e
Mid Channel - 915.25MHz
80cm Height
Data Taken at 08:39:41 PM, Tuesday, August 07, 2018

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

Frequency (MHz)	Raw QP Reading (dBµV)	Correction Factor (dB/m)	Adjusted QP Amplitude (dBµV/m)	Lim1: FCC_pt15_109_Class_B (dBµV/m)	Margin to Lim1 (dB)	Test Results Lim1 (Pass/Fail)	Worst Margin Lim1 (dB)	Lim2: FCC_pt15_109_Class_B (dBµV/m)	Margin to Lim2 (dB)	Test Results Lim2 (Pass/Fail)	Worst Margin Lim2 (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
36.872	33.7	-11.9	21.8	40	-18.2	PASS		40	-18.2	PASS		125	70
38.072	42.3	-12.8	29.6	40	-10.4	PASS		40	-10.4	PASS		100	93
60.998	49	-20.7	28.4	40	-11.6	PASS		40	-11.6	PASS		105	301
71.977	55.5	-20.1	35.4	40	-4.6	PASS	-4.6	40	-4.6	PASS	-4.6	105	250
82.395	46.6	-20.6	26	40	-14	PASS		40	-14	PASS		125	139
199.139	46	-14.5	31.6	43.5	-12	PASS		43.5	-12	PASS		104	132

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
30-1000MHz Horizontal Data
Operator: Chris Bramley
Notes:
M6e
Mid Channel - 915.25MHz
80cm Height
Data Taken at 08:39:41 PM, Tuesday, August 07, 2018

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

Frequency (MHz)	Raw QP Reading (dBµV)	Correction Factor (dB/m)	Adjusted QP Amplitude (dBµV/m)	Lim1: FCC_pt15_109_Class_B (dbµV/m)	Margin to Lim1 (dB)	Test Results Lim1 (Pass/Fail)	Worst Margin Lim1 (dB)	Lim2: FCC_pt15_109_Class_B (dBµV/m)	Margin to Lim2 (dB)	Test Results Lim2 (Pass/Fail)	Worst Margin Lim2 (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
30.017	27.9	-6.4	21.5	40	-18.5	PASS		40	-18.5	PASS		100	17
72.036	46.8	-20.1	26.7	40	-13.3	PASS	-13.3	40	-13.3	PASS	-13.3	225	214
166.551	44.5	-15.6	28.9	43.5	-14.6	PASS		43.5	-14.6	PASS		175	295
179.989	46	-16.2	29.9	43.5	-13.7	PASS		43.5	-13.7	PASS		194	327
199.821	41.6	-14.5	27.1	43.5	-16.4	PASS		43.5	-16.4	PASS		125	222
466.306	37.8	-9.1	28.7	46	-17.3	PASS		46	-17.3	PASS		149	205

30-1000MHz Mid Channel

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
30-1000MHz Vertical Data
Operator: Chris Bramley
Notes:
M6e
High Channel - 927.75MHz
80cm Height
Data Taken at 10:12:57 PM, Tuesday, August 07, 2018

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

Frequency (MHz)	Raw QP Reading (dBµV)	Correction Factor (dB/m)	Adjusted QP Amplitude (dBµV/m)	Lim1: FCC_pt15_109_Class_B (dBµV/m)	Margin to Lim1 (dB)	Test Results Lim1 (Pass/Fail)	Worst Margin Lim1 (dB)	Lim2: FCC_pt15_109_Class_B (dBµV/m)	Margin to Lim2 (dB)	Test Results Lim2 (Pass/Fail)	Worst Margin Lim2 (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
36.958	35.1	-12	23.2	40	-16.8	PASS		40	-16.8	PASS		107	128
38.024	42.4	-12.8	29.6	40	-10.4	PASS		40	-10.4	PASS		125	70
57.986	45.5	-20.8	24.7	40	-15.3	PASS		40	-15.3	PASS		152	294
72.008	56.7	-20.1	36.6	40	-3.4	PASS	-3.4	40	-3.4	PASS	-3.4	105	250
73.222	49.6	-20.1	29.5	40	-10.5	PASS		40	-10.5	PASS		149	85
199.151	44.8	-14.5	30.3	43.5	-13.2	PASS		43.5	-13.2	PASS		109	69

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Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
30-1000MHz Horizontal Data
Operator: Chris Bramley
Notes:
M6e
High Channel - 927.75MHz
80cm Height
Data Taken at 10:12:57 PM, Tuesday, August 07, 2018

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

Frequency (MHz)	Raw QP Reading (dBµV)	Correction Factor (dB/m)	Adjusted QP Amplitude (dBµV/m)	Lim1: FCC_pt15_109_Class_B (dbµV/m)	Margin to Lim1 (dB)	Test Results Lim1 (Pass/Fail)	Worst Margin Lim1 (dB)	Lim2: FCC_pt15_109_Class_B (dBµV/m)	Margin to Lim2 (dB)	Test Results Lim2 (Pass/Fail)	Worst Margin Lim2 (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
30.449	27.9	-6.7	21.2	40	-18.8	PASS		40	-18.8	PASS		192	250
71.975	46.1	-20.1	26	40	-14	PASS		40	-14	PASS		275	233
166.508	44.4	-15.6	28.8	43.5	-14.7	PASS		43.5	-14.7	PASS		185	294
180.024	48.1	-16.2	31.9	43.5	-11.6	PASS	-11.6	43.5	-11.6	PASS	-11.6	225	326
199.813	40	-14.5	25.6	43.5	-18	PASS		43.5	-18	PASS		125	237
466.378	38.1	-9.1	29	46	-17	PASS		46	-17	PASS		142	295

30-1000MHz High Channel

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
1-6GHz Vertical Data
Operator: Chris Bramley
Notes:
M6e
Low Channel - 902.75MHz
1.5m Height
Data Taken at 05:35:02 PM, Tuesday, August 07, 2018

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

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)
1805.3	48.5	45.5	-2.2	46.3	74	-27.6	PASS		43.3	54	-10.7	PASS	-10.7	213	190
2708	45.6	39.6	0.6	46.2	74	-27.8	PASS		40.3	54	-13.7	PASS		225	202
3610.6	41.5	33.4	2.4	43.9	74	-30.1	PASS		35.7	54	-18.3	PASS		205	112
5919.7	40.5	31.1	7.1	47.7	74	-26.3	PASS	-26.3	38.2	54	-15.7	PASS		125	339

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
1-6GHz Horizontal Data
Operator: Chris Bramley
Notes:
M6e
Low Channel - 902.75MHz
1.5m Height
Data Taken at 05:56:00 PM, Tuesday, August 07, 2018

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

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)
1805.5	49.6	46.7	-2.2	47.4	74	-26.6	PASS		44.5	54	-9.5	PASS	-9.5	300	70
2707.8	43.1	38.3	0.6	43.8	74	-30.2	PASS		38.9	54	-15	PASS		179	5
3611.7	40.3	32	2.4	42.7	74	-31.3	PASS		34.3	54	-19.7	PASS		204	283
5923.2	40.7	31.1	7.1	47.8	74	-26.2	PASS	-26.2	38.3	54	-15.7	PASS		119	31

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 -M6E

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

Data Taken at 04:23:58 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)
1830.7	49.5	45.8	-2	47.5	74	-26.5	PASS		43.8	54	-10.1	PASS		100	142
2745.6	48.7	45.2	0.6	49.3	74	-24.6	PASS	-24.6	45.8	54	-8.2	PASS	-8.2	201	110
3661	46.1	40.8	2.8	48.9	74	-25	PASS		43.6	54	-10.4	PASS		100	284
5772.7	40.1	31.1	6.6	46.7	74	-27.3	PASS		37.6	54	-16.4	PASS		103	82

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
1-6GHz Horizontal Data
Operator: ZJ
Notes:
Mid Channel -M6E

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

Data Taken at 04:23:58 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 Average Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1830.5	51.1	49.2	-2	49.1	74	-24.9	PASS	-24.9	47.2	54	-6.8	PASS	-6.8	215	187
2745.7	47.6	43.3	0.6	48.2	74	-25.8	PASS		44	54	-10	PASS		198	275
3529.6	40.3	32.6	2.7	42.9	74	-31	PASS		35.3	54	-18.7	PASS		225	109
3661	45.5	39.7	2.8	48.3	74	-25.7	PASS		42.5	54	-11.5	PASS		125	209
5843.1	39.2	30.9	6.8	46.1	74	-27.9	PASS		37.8	54	-16.2	PASS		175	21

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 -M6E

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

Data Taken at 03:35:21 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)
1361.8	41.6	32.3	-3.7	37.9	74	-36.1	PASS		28.5	54	-25.5	PASS		222	176
3391.3	40.8	32.5	2.1	42.9	74	-31.1	PASS		34.6	54	-19.4	PASS		283	223
5710.8	40.5	31	6.4	46.8	74	-27.1	PASS	-27.1	37.4	54	-16.6	PASS	-16.6	225	202

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 3m Distance
1-6GHz Horizontal Data
Operator: ZJ
Notes:
High Channel -M6E

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

Data Taken at 03:35:21 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 Average Margin (dB)	Antenna Height (cm)	EUT Azimuth (degrees)
1854.6	46.8	41.9	-1.8	44.9	74	-29	PASS		40.1	54	-13.9	PASS		195	52
2781.8	47.5	42.9	0.6	48	74	-25.9	PASS	-25.9	43.5	54	-10.5	PASS	-10.5	275	312
3709.1	44.5	39	2.8	47.4	74	-26.6	PASS		41.8	54	-12.2	PASS		125	154
5930	40.2	30.8	7.1	47.3	74	-26.7	PASS		37.9	54	-16.1	PASS		175	300

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 -M6E

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

Data Taken at 01:53:18 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)
9922.2	39.7	30.4	11.1	50.8	83.5	-32.7	PASS	-32.7	41.5	63.5	-22	PASS	-22	100	11

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 1m Distance
6-18GHz Horizontal Data
Operator: ZJ
Notes:
Low Channel -M6E

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

Data Taken at 01:53:18 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)
9676.9	39.3	30.2	10.9	50.2	83.5	-33.3	PASS	-33.3	41.1	63.5	-22.4	PASS	-22.4	169	264

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 -M6E

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

Data Taken at 02:25:27 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)
9844.5	38.6	30.2	10.5	49.1	83.5	-34.4	PASS	-34.4	40.7	63.5	-22.8	PASS	-22.8	200	269

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 1m Distance
6-18GHz Horizontal Data
Operator: ZJ
Notes:
Mid Channel -M6E

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

Data Taken at 02:25:27 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)
9899.7	38.5	30.7	11	49.5	83.5	-34	PASS	-34	41.7	63.5	-21.8	PASS	-21.8	188	116

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 -M6E

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

Data Taken at 02:53:29 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)
8235.8	39.2	30.3	9.1	48.3	83.5	-35.2	PASS		39.4	63.5	-24.1	PASS		200	340
9977.9	38.9	30.5	11	49.9	83.5	-33.6	PASS	-33.6	41.5	63.5	-22	PASS	-22	127	138

Curtis Straus - a Bureau Veritas Company
Radiated Emissions Electric Field 1m Distance
6-18GHz Horizontal Data
Operator: ZJ
Notes:
High Channel -M6E

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

Data Taken at 02:53:29 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)
9930.8	39.2	30.3	11.1	50.3	83.5	-33.2	PASS	-33.2	41.4	63.5	-22.1	PASS	-22.1	163	76

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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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

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.

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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 CISPR	 5.6dB 4.6dB	 N/A 5.2dB (Ucispr)
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 CISPR	 3.9dB 3.6dB	 N/A 3.6dB (Ucispr)
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		

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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 were 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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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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