

Johnson & Johnson Surgical Vision, Inc. **TEST REPORT**

SCOPE OF WORK

FCC §15.247 AND ISED RSS-247 TESTING – VERITAS VISION SYSTEM (CONSOLE)

REPORT NUMBER

104086841LAX-015

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September 01, 2020

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EMC TEST REPORT

(FULL COMPLIANCE)

Report Number: 104086841LAX-015

Project Number: G104086841

Original Report Issue Date: April 23, 2020

Revision Report Issue Date: September 01, 2020

Model(s) Tested: VRT680300

Standards: FCC CFR47 Part 15 Subpart C, January 2020

Intentional Radiator

§15.247, Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

ISED RSS-247 Issue 2, February 2017

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

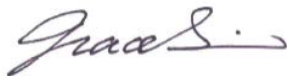
ISED RSS-Gen Issue 5, April 2018

General Requirements for Compliance of Radio Apparatus

Tested by:
Intertek
25791 Commercentre Drive
Lake Forest, CA 92630
USA

Client:
Johnson & Johnson Surgical Vision, Inc.
1700 East St., Andrew Place
Santa Ana, CA 92705
USA

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1 Introduction and Conclusion

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

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

2 Test Summary

Section	Test full name	Result
3	Client Information	-
4	Description of Equipment Under Test and Variant Models	-
5	System Setup and Method	-
6	DTS (6 dB) Bandwidth, 20 dB Bandwidth, and 99% Bandwidth (FCC §15.247(a)(2), ISED RSS-247 Issue 2 §5.2a; FCC §15.247(a)(1), ISED RSS-247 Issue 2 §5.1a; ISED RSS-Gen §6.7)	Compliant
7	Maximum Peak Conducted Output Power at Antenna Terminals (FCC §15.247(b), ISED RSS-247 Issue 2 §5.4)	Compliant
8	Maximum Power Spectral Density (FCC §15.247(e), ISED RSS-247 Issue 2 §5.2b)	Compliant
9	Conducted Spurious Emissions (FCC §15.247(d), ISED RSS-247 Issue 2 §5.5)	Compliant
10	Carrier Frequency Separation (FCC §15.247(a)(1), ISED RSS-247 Issue 2 §5.1b)	Compliant
11	Number of Hopping Frequencies (FCC §15.247(a)(1)(iii), ISED RSS-247 Issue 2 §5.1c)	Compliant
12	Average Time of Occupancy (Dwell Time) FCC §15.247(a)(1), ISED RSS-247 Issue 2 §5.1c)	Compliant
13	Radiated Spurious Emissions (FCC §15.247(d), §15.209, §15.205, ISED RSS-247 §5.5, ISED RSS-Gen §8.9)	Compliant
14	AC Mains Conducted Emissions (FCC §15.207, ISED RSS-Gen §8.8)	Compliant
15	Revision History	-

3 Client Information

This EUT was tested at the request of:

Client: Johnson & Johnson Surgical Vision, Inc.
 1700 East St., Andrew Place
 Santa Ana, CA 92705
 USA

Contact: Kathryn Lockwood
Telephone: 714 247 8677
Email: klockwoo@its.jnj.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: Johnson & Johnson Surgical Vision, Inc.
 1700 East St., Andrew Place
 Santa Ana, CA 92705
 USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Veritas Vision System (Console)	Johnson & Johnson Surgical Vision, Inc.	VRT680300	208940112

Receive Date:	01/28/2020	Test Started	01/28/2020
Received Condition:	Good	Test Ended	08/28/2020
Type:	Production		

Description of Equipment Under Test (provided by client)	
<p>The equipment under test is the console of the Veritas Vision System. The Veritas Vision System is a multi-functional tool for use in anterior segment surgery procedures. The console contains the following transmitters:</p> <ol style="list-style-type: none"> 1. Three (3) of Bluetooth Low Energy – Remote Control Receiver, ALP/Veritas Master Receiver, ALP/ Veritas Slave Receiver 2. Two (2) of Bluetooth 2.0 – ACP Master Receiver, ACP Slave Receiver 3. One (1) of certified Wi-Fi transmitter module (FCC ID: PPD-AR5B97, IC: 4104A-AR5B97) <p>All transmitters operate at 2.4 GHz.</p> <p>PCB serial numbers:</p> <p>Remote Control Receiver: 1938000036 (radiated), 1938000031 (conducted)</p> <p>ALP/Veritas Receiver: 1910000461 (radiated), 1803000147 (conducted, P2), 143800020 (conducted, P1)</p> <p>ACP Receiver (Rear Panel Connector PCBA): 1917000193</p>	

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
90-264 Vac	-	47-63Hz	1

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	<p>Test Mode – Bluetooth transmitters transmits continuously, with Wi-Fi configured as an access point.</p> <p>For the radiated spurious emissions and AC mains conducted emissions measurements, testing was performed on the following two worst-case configurations:</p> <ul style="list-style-type: none">a. Remote Control Receiver + ALP/Veritas Master Receiver + ALP/Veritas Slave Receiverb. Remote Control Receiver + ACP Master Receiver + ACP Slave Receiver

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	Under test mode, the EUT was programmed to transmit continuously during testing.

Radio/Receiver Characteristics (Bluetooth Low Energy)			
Frequency Band(s)	2402 MHz – 2480 MHz		
Type of transmission	Digital Transmission System (DTS)		
Modulation Type(s)	GFSK / 1Mbit/s		
Maximum Output Power	Remote Control Receiver:	0.4093 mW	
	ALP/Veritas Receiver:	0.31989 mW (P1)	0.33729mW(P2)
		Master Receiver	Slave Receiver
Test Channels	Remote Control Receiver:	2402 MHz,	2440 MHz, 2480 MHz
	ALP/Veritas Receiver:	2402 MHz,	2440 MHz, 2480 MHz
Occupied Bandwidth (99%)	Remote Control Receiver:	1068.58 kHz	
	ALP/Veritas Receiver:	1081.4 kHz (P1),	1072.5 kHz (P2),
		Master Receiver,	Slave Receiver
Number of Hopping Channels	40		
Equipment Type	Standalone		
Antenna Type and Gain*	Remote Control Receiver:	SMD antenna. Gains*: 2.0 dBi (2.38 GHz), 2.45 dBi (2.45 GHz), 2.0 dBi (2.6 GHz).	
	ALP/Veritas Mater Receiver:	SMD antennas. Peak Gain : 2.5 dBi.	
	ALP/Veritas Slave Receiver:	SMD antennas. Peak Gain : 2.5 dBi.	

* Antenna type(s) and gains were provided by the client. Intertek takes no responsibility for the accuracy of the values listed

Radio/Receiver Characteristics (Bluetooth 2.0)			
Frequency Band(s)	2402 MHz – 2480 MHz		
Type of transmission	Frequency Hopping Spread Spectrum		
Modulation Type(s)	GFSK		
Data Rate:	Up to 3Mbps (DH1, DH3, DH5)		
Maximum Output Power	ACP Receiver:	0.19011mW(J16)	0.20559(J17)
		Master Receiver	Slave Receiver
Test Channels	ACP Receiver:	2402 MHz	2441 MHz 2480 MHz
Occupied Bandwidth (99%)	ACP Receiver:	979.8 kHz (J16),	978.3 kHz (J17)
		Master Receiver	Slave Receiver
Frequency Hopper: Number of Hopping Channels	79		
Frequency Hopper: Channel Dwell Time	0.327 Second (J16), 0.285 Second (J17)		
Frequency Hopper: Max interval between two instances of use of the same channel	Not Applicable		
Equipment Type	Standalone		
Antenna Type and Gain*	ACP Mater Receiver:	Dipole antennas. Peak Gain: 2.2 dBi.	
	ACP Slave Receiver:	Dipole antennas. Peak Gain: 2.2 dBi.	

* Antenna type(s) and gains were provided by the client. Intertek takes no responsibility for the accuracy of the values listed

Variant Models:

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

- None

5 System Setup and Method

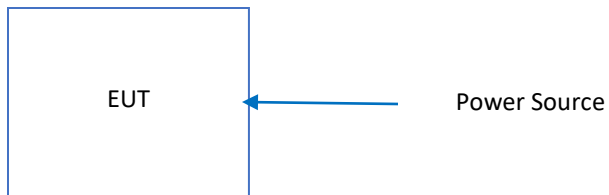
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	Power Cord	6	No	No	Yes

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
-	-	-	-

5.1 Method:

Configuration as required by ANSI C63.10-2013.

5.2 Test Setup Block Diagram:



6 DTS (6 dB) Bandwidth, 20 dB Bandwidth, and 99% Bandwidth

6.1 Requirement(s)

For systems using digital modulation techniques, the minimum DTS (6 dB) bandwidth shall be at least 500 kHz.

The 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

For frequency hopping systems operating in the 902-928 MHz band, the maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

For frequency hopping systems operating in the 5725-5850 MHz band, the maximum 20 dB bandwidth of the hopping channel is 1 MHz.

6.2 Method

- A. DTS (6 dB) Bandwidth. The procedure described in ANSI C63.10-2013 and FCC Publication *558074 D01 15.247 Meas Guidance v05r02*, April 2, 2019 was used to determine the DTS (6 dB) bandwidth. Section 8.2 was used.
 - a) Set RBW = 100 kHz.
 - b) Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
 - c) Detector = Peak.
 - d) Trace mode = max hold.
 - e) Sweep = auto couple.
 - f) Allow the trace to stabilize.
 - g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

- B. 20 dB Bandwidth. The procedure described in ANSI C63.10-2013 was used to determine the 20 dB bandwidth. Section 6.9.2 was used.

- C. 99% Bandwidth. The procedure described in ANSI C63.10-2013 was used to determine the 99% power bandwidth. Section 6.9.3 was used.

TEST SITE:

The test is performed in the wireless laboratory located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

6.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
1669	EMI Test Receiver	R&S	ESW44	101636	09/03/2019	09/03/2020
1412	Barometric Pressure/ Humidity/ Temperature Datalogger	EXTECH	SD700	Q769086	01/22/2020	01/22/2021

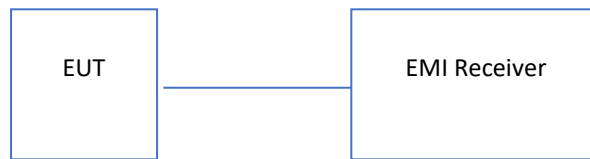
Software Utilized:

Name	Manufacturer	Version	Profile
N/A	N/A	N/A	N/A

6.4 Results:

The sample tested was found to Comply.

6.5 Setup Diagram:



6.6 Plots/Data:

Remote Control Receiver:

Frequency (MHz)	6 dB Bandwidth (kHz)	99% Bandwidth (kHz)
2402	728.93	1068.58
2440	760.52	1064.46
2480	737.73	1067.26

ALP/Veritas Receiver:

Frequency (MHz)	6 dB Bandwidth (kHz)		99% Bandwidth (kHz)	
	Port P1	Port P2	Port P1	Port P2
2402	695.3	767.2	1076.5	1068.9
2440	686.3	770.2	1081.4	1072.5
2480	686.3	767.2	1076.7	1068.0

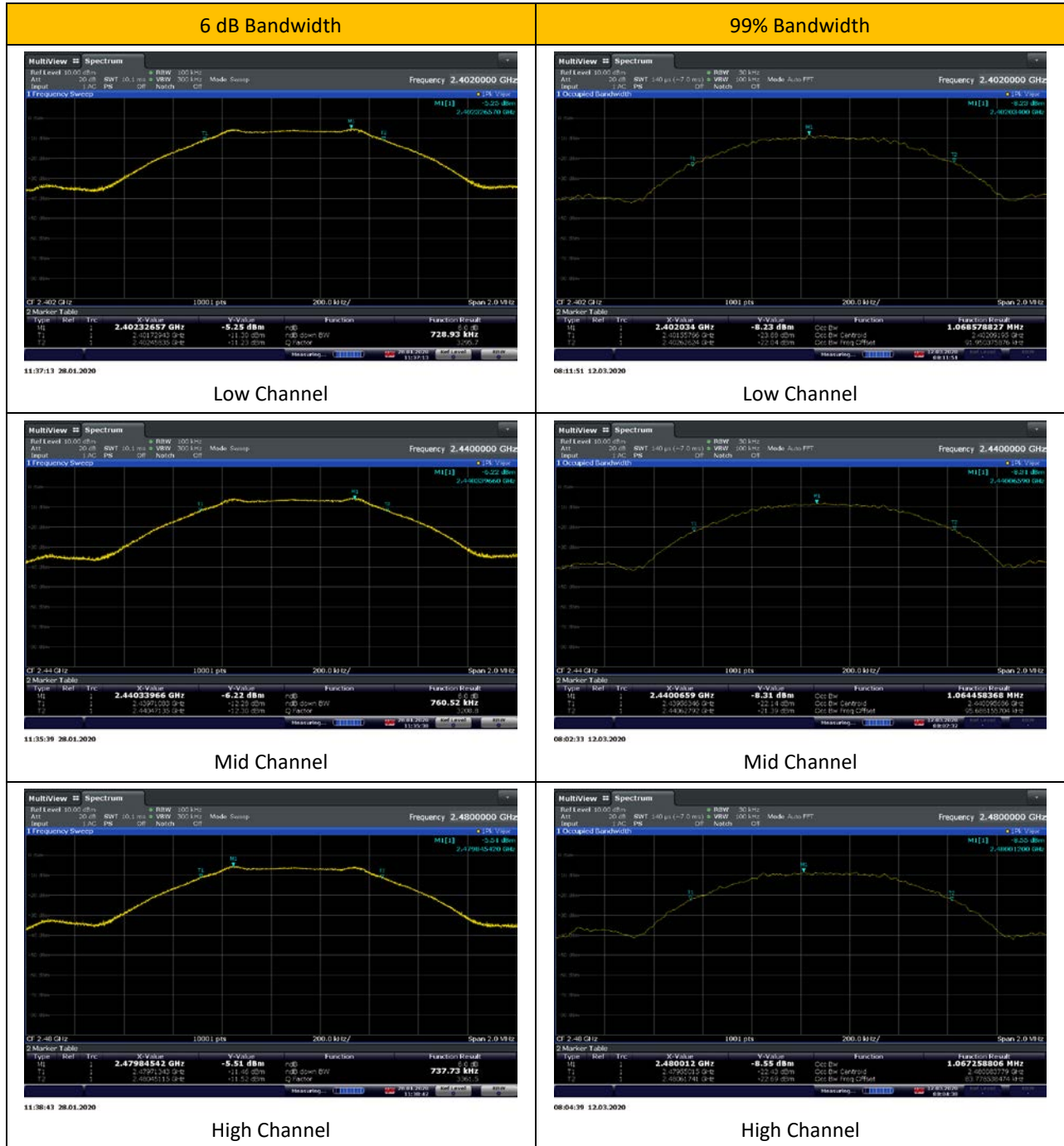
ACP Receiver:

Frequency (MHz)	Data Rate	20 dB Bandwidth (kHz)		99% Bandwidth (kHz)	
		Port J16	Port J17	Port J16	Port J17
2402	DH5	1049	1060	972.1	967.3
	DH3	1054	1070	975.4	971.4
	DH1	1054	1069	979.8	977.5
2441	DH5	1060	1060	969.1	968.0
	DH3	1060	1060	973.6	971.3
	DH1	1069	1064	974.5	976.7
2480	DH5	1070	1060	971.1	968.3
	DH3	1060	1060	975.8	970.8
	DH1	1069	1069	977.1	978.3

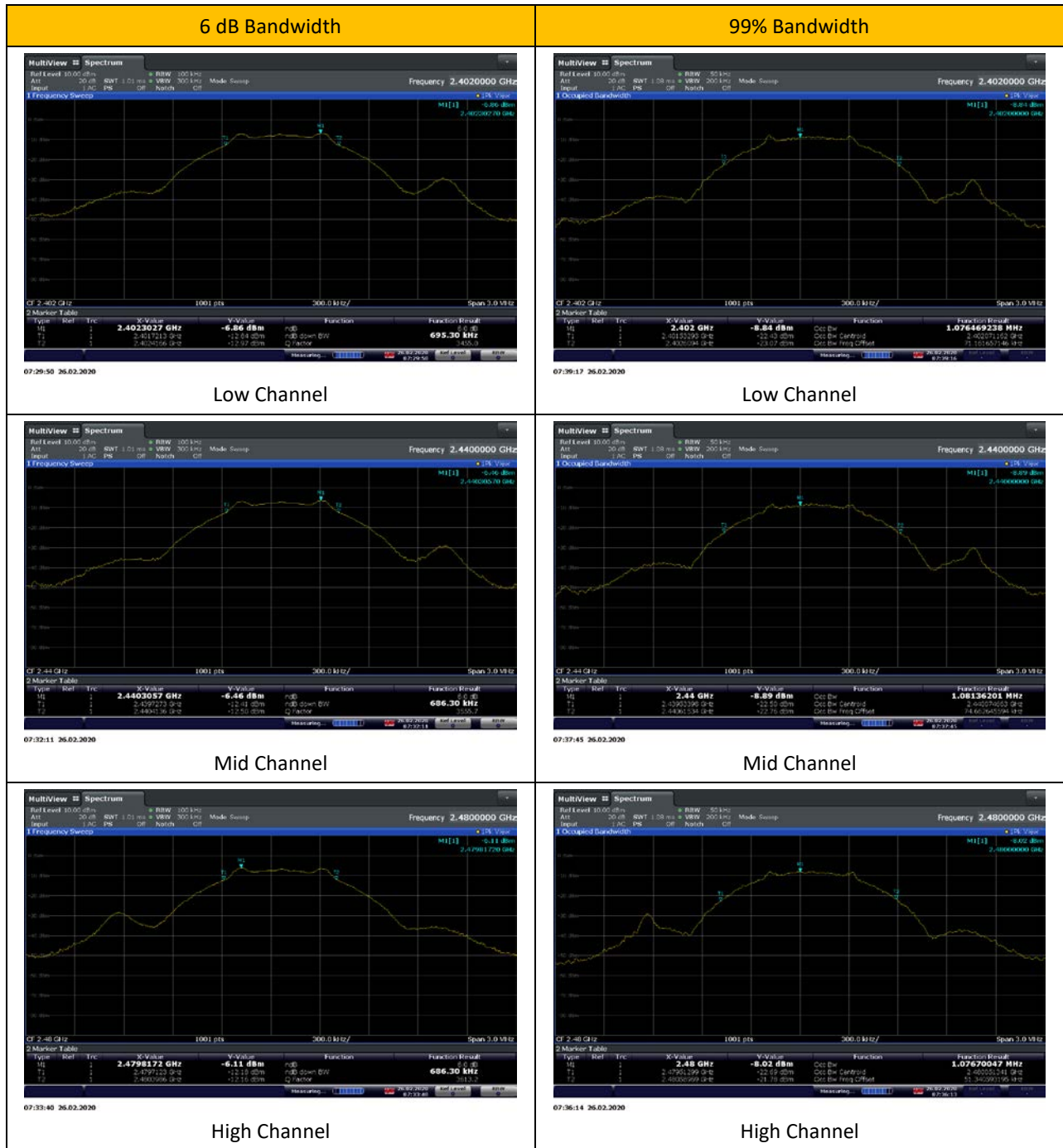
Note: The RF level in the plots is relative and is not the indication of RF output power.

6.6 Plots/Data: (Continued)

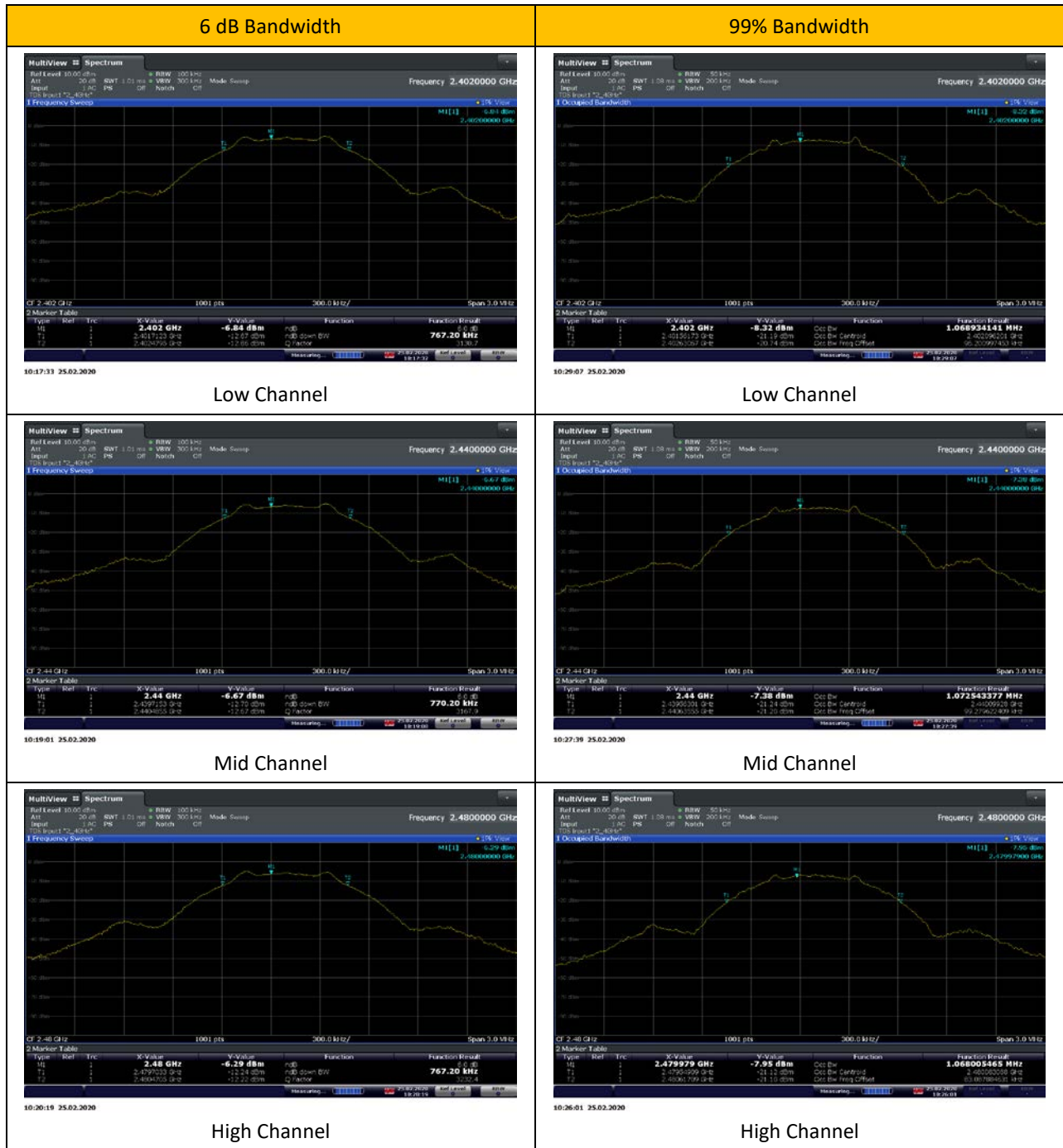
Remote Control Receiver:



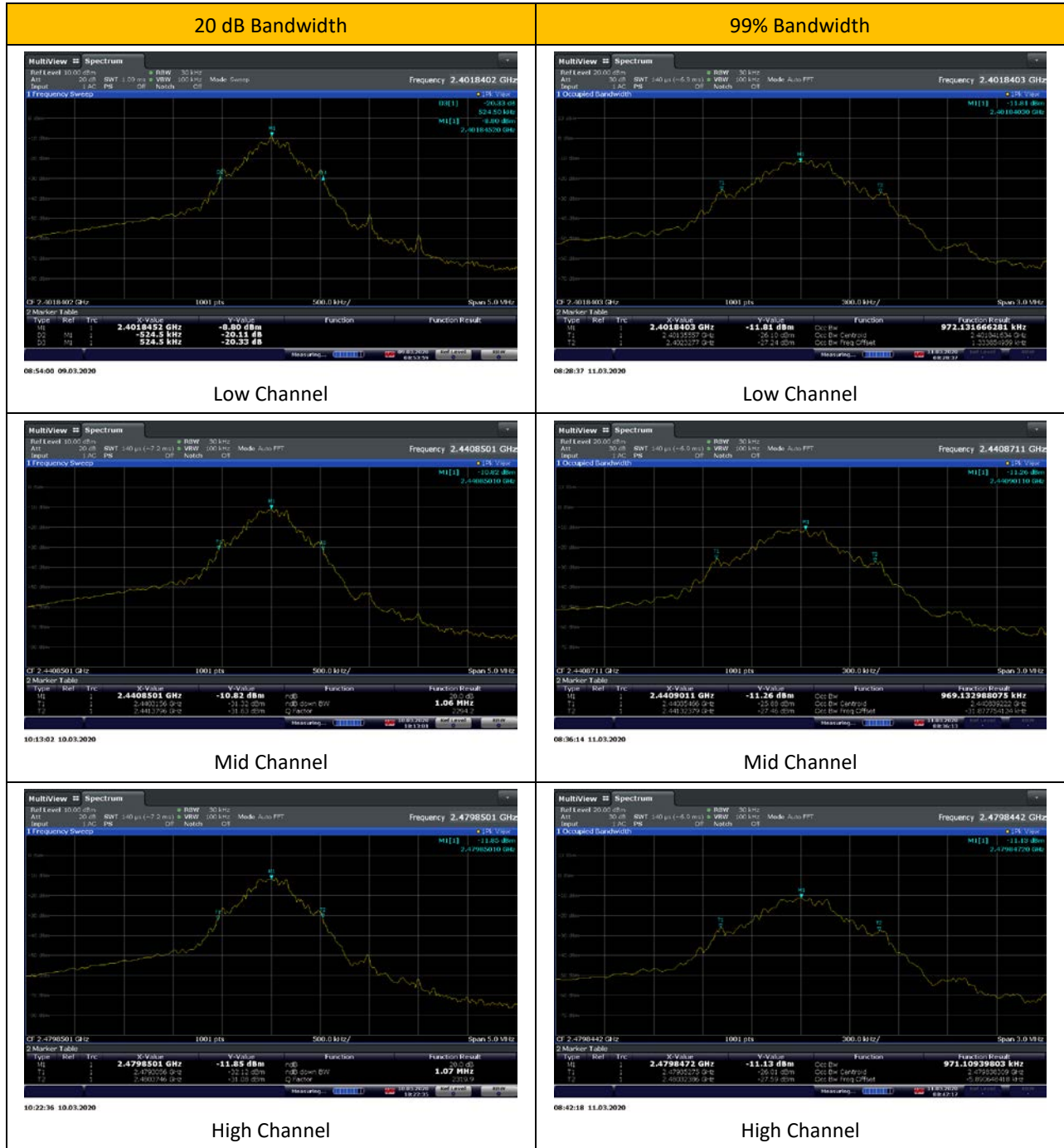
ALP/Veritas Receiver, Port P1:



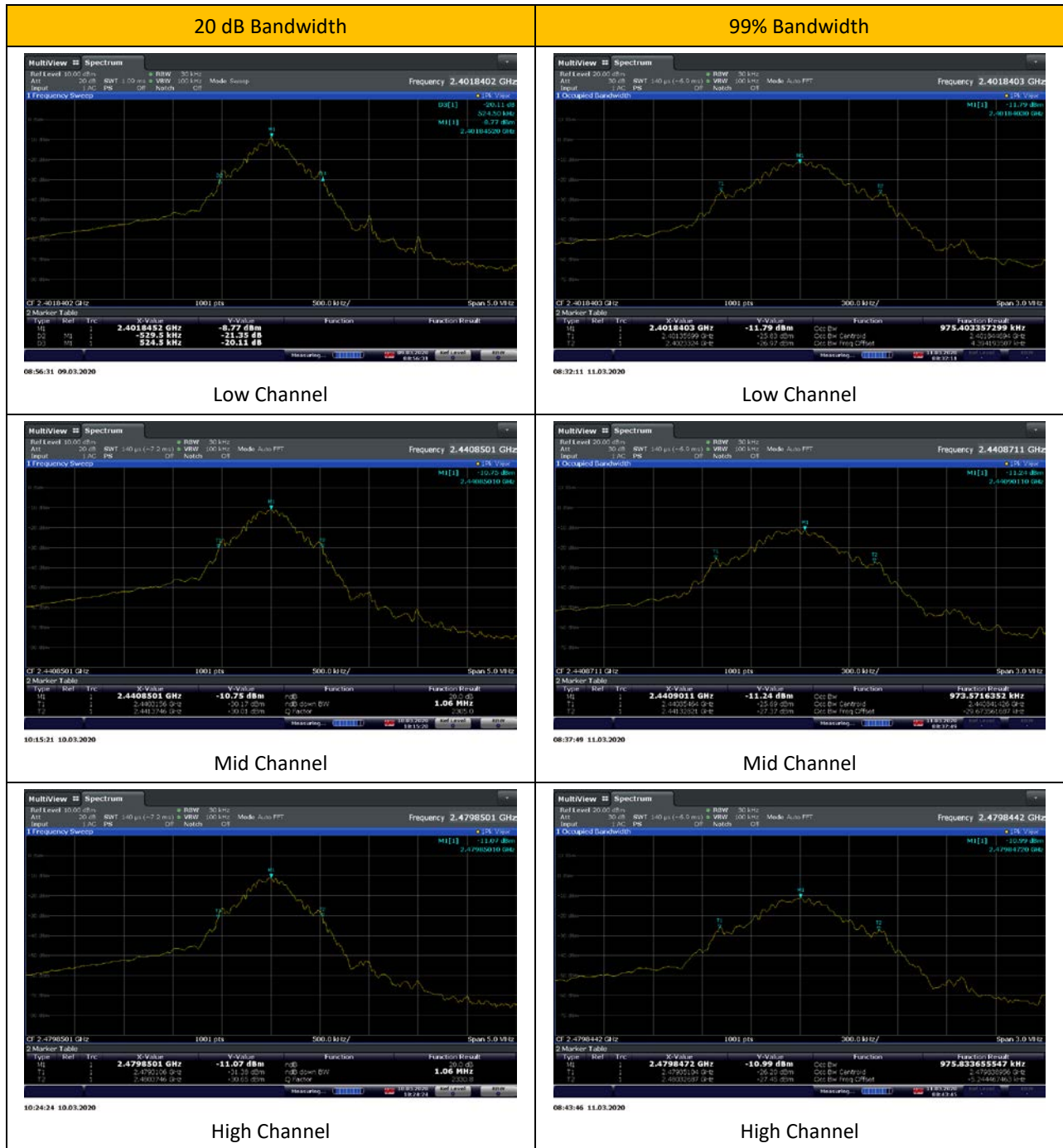
ALP/Veritas Receiver, Port P2:



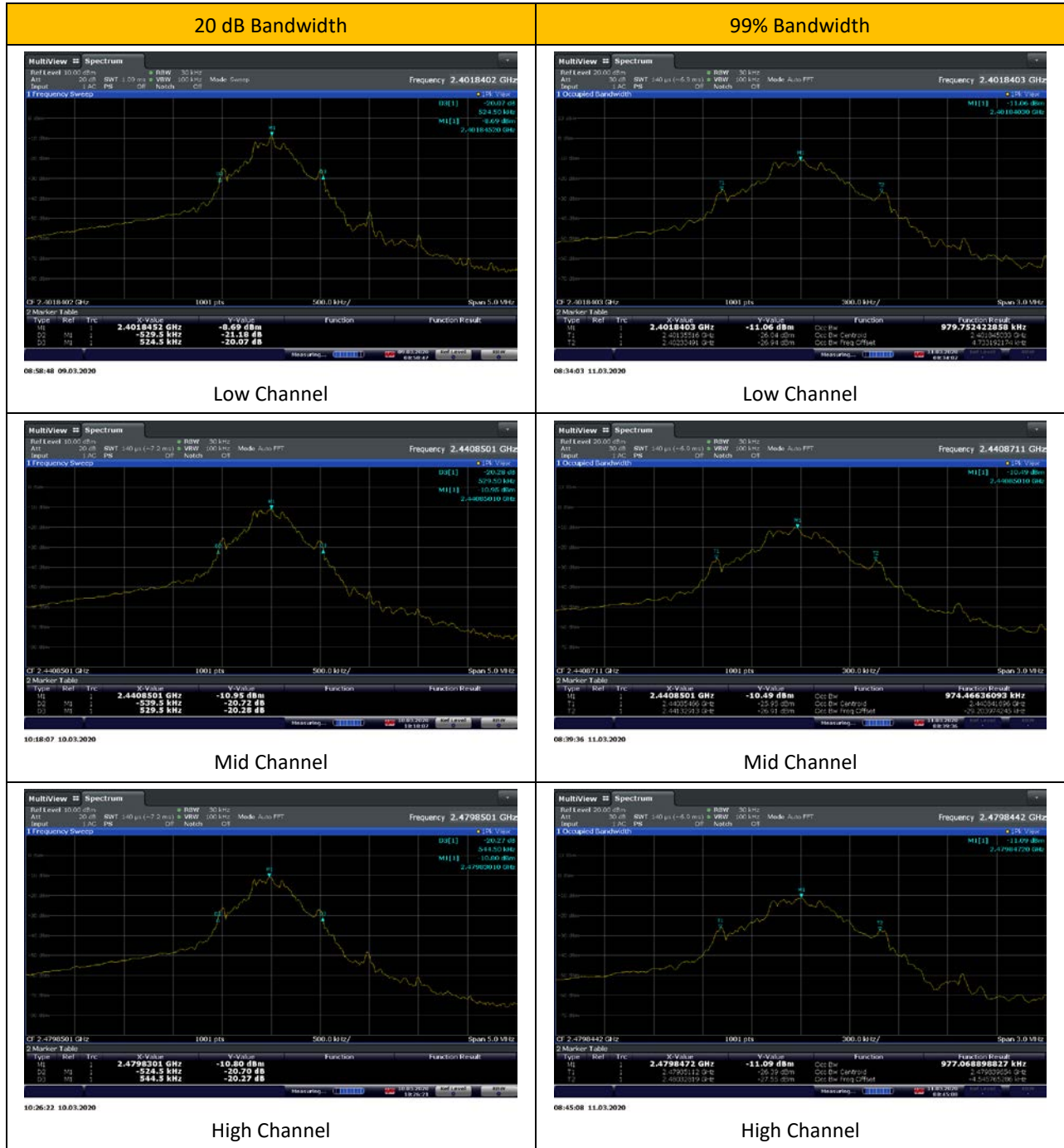
ACP Receiver, Port J16, DH5:



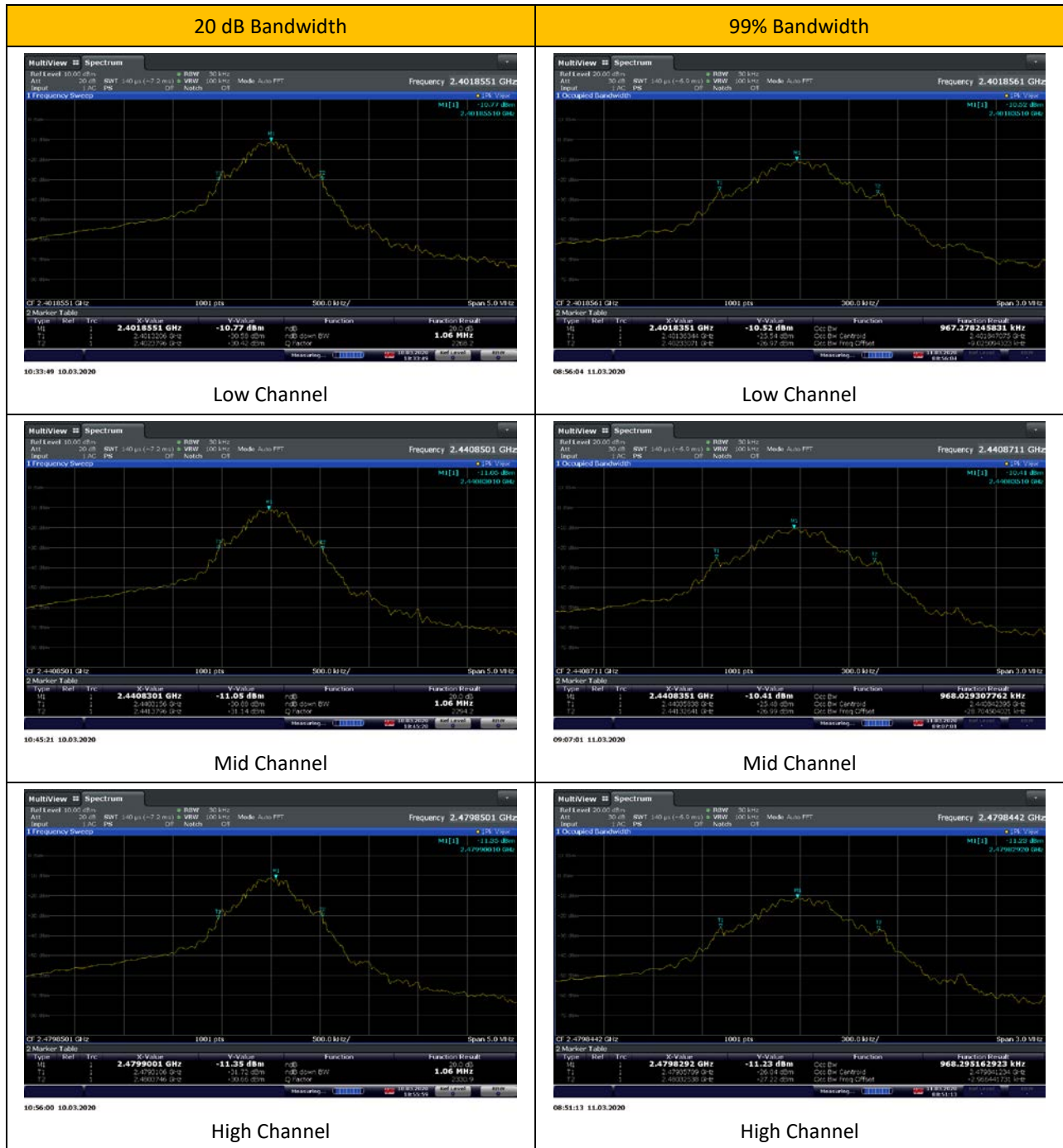
ACP Receiver, Port J16, DH3:



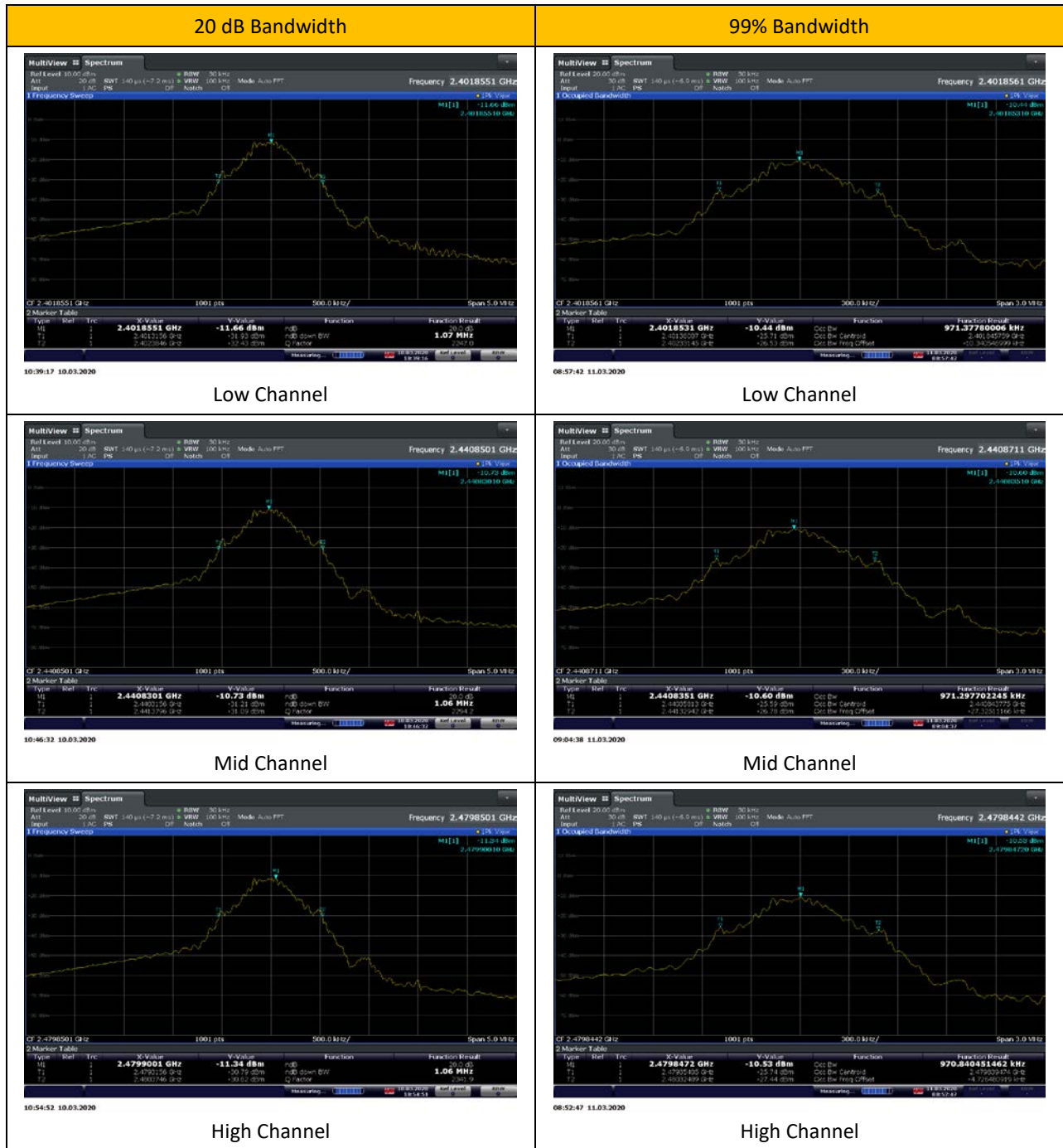
ACP Receiver, Port J16, DH1:



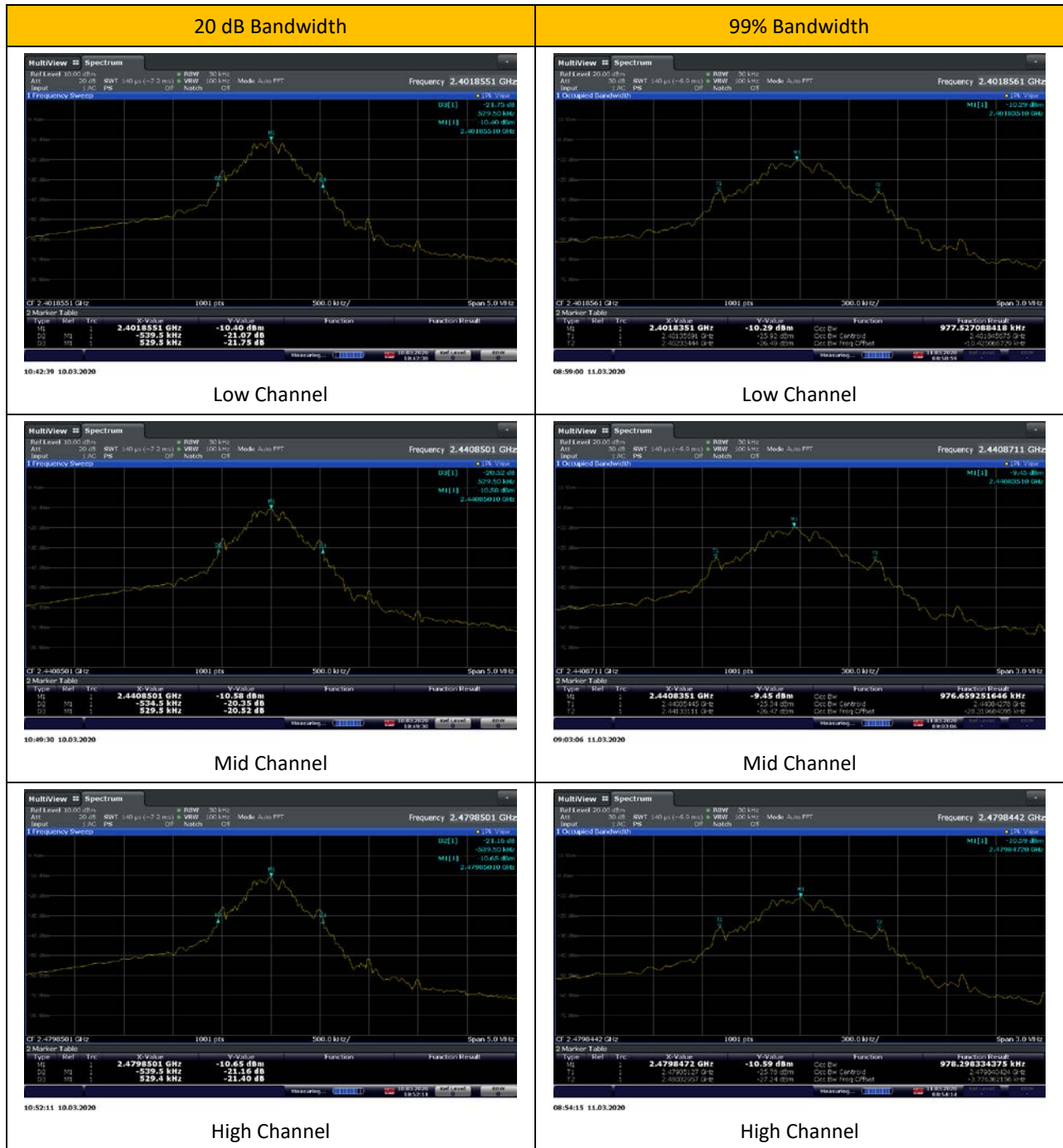
ACP Receiver, Port J17, DH5:



ACP Receiver, Port J17, DH3:



ACP Receiver, Port J17, DH1:



Test Personnel:	Grace Lin	Test Date:	01/28/2020, 02/25-26/2020, 03/10/2020, 03/11-12/2020
Product Standard:	FCC §15.247, ISED RSS-247	Limit Applied:	FCC §15.247, ISED RSS-247
Input Voltage:	120 Vac, 60 Hz	Ambient Temperature:	18.9 °C
Pretest Verification w/ BB Source:	N/A	Relative Humidity:	59.6 %
		Atmospheric Pressure:	992.9 mbars

Deviations, Additions, or Exclusions: None

7 Maximum Peak Conducted Output Power at Antenna Terminals

7.1 Requirement(s)

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt or 30 dBm. For antennas with gains greater than 6 dBi, transmitter output level must be decreased appropriately, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.2 Method

For digital transmission system, the procedure described in ANSI C63.10-2013 and FCC Publication 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019 was used. Specifically, Section 8.3.1.1 $RBW \geq DTS \text{ bandwidth}$ was utilized as the spectrum analyzer's resolution bandwidth was greater than the DTS bandwidth.

- a) Set the $RBW \geq DTS \text{ Bandwidth}$
- b) Set the $VBW \geq 3 \times RBW$
- c) Set the $\text{span} \geq 3 \times RBW$
- d) Sweep time = Auto couple
- e) Detector = Peak
- f) Trace mode = Max Hold
- g) Allow trace to fully stabilize
- h) Use peak marker function to determine the peak amplitude level.

For frequency hopping spread spectrum devices, the procedure described in ANSI C63.10-2013, specifically Section 7.8.5, was utilized.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

7.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
1669	EMI Test Receiver	R&S	ESW44	101636	09/03/2019	09/03/2020
1412	Barometric Pressure/ Humidity/ Temperature Datalogger	EXTECH	SD700	Q769086	01/22/2020	01/22/2021

Software Utilized:

Name	Manufacturer	Version	Profile
N/A	N/A	N/A	N/A

7.4 Results:

The sample tested was found to Comply.

7.5 Setup Diagram:



7.6 Plots/Data:

Remove Control Receiver:

Frequency (MHz)	Peak Conducted Output Power	
	dBm	mW
2402	-3.88	0.4093
2440	-3.95	0.4055
2480	-4.02	0.3963

ALP/Veritas Receiver:

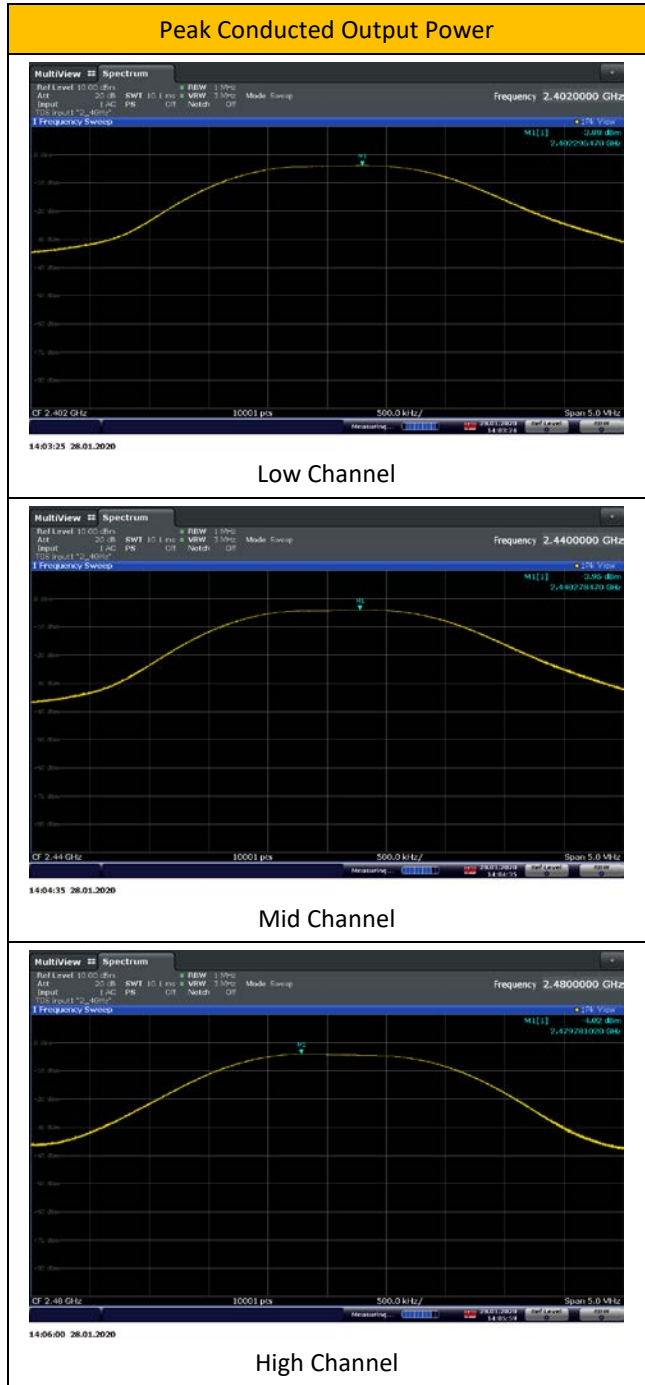
Frequency (MHz)	Peak Conducted Output Power			
	Port P1 (dBm)	Port P2 (dBm)	Port P1 (mW)	Port P2 (mW)
2402	-5.57	-5.13	0.27733	0.30690
2440	-5.26	-4.89	0.29785	0.32434
2480	-4.95	-4.72	0.31989	0.33729

ACP Receiver:

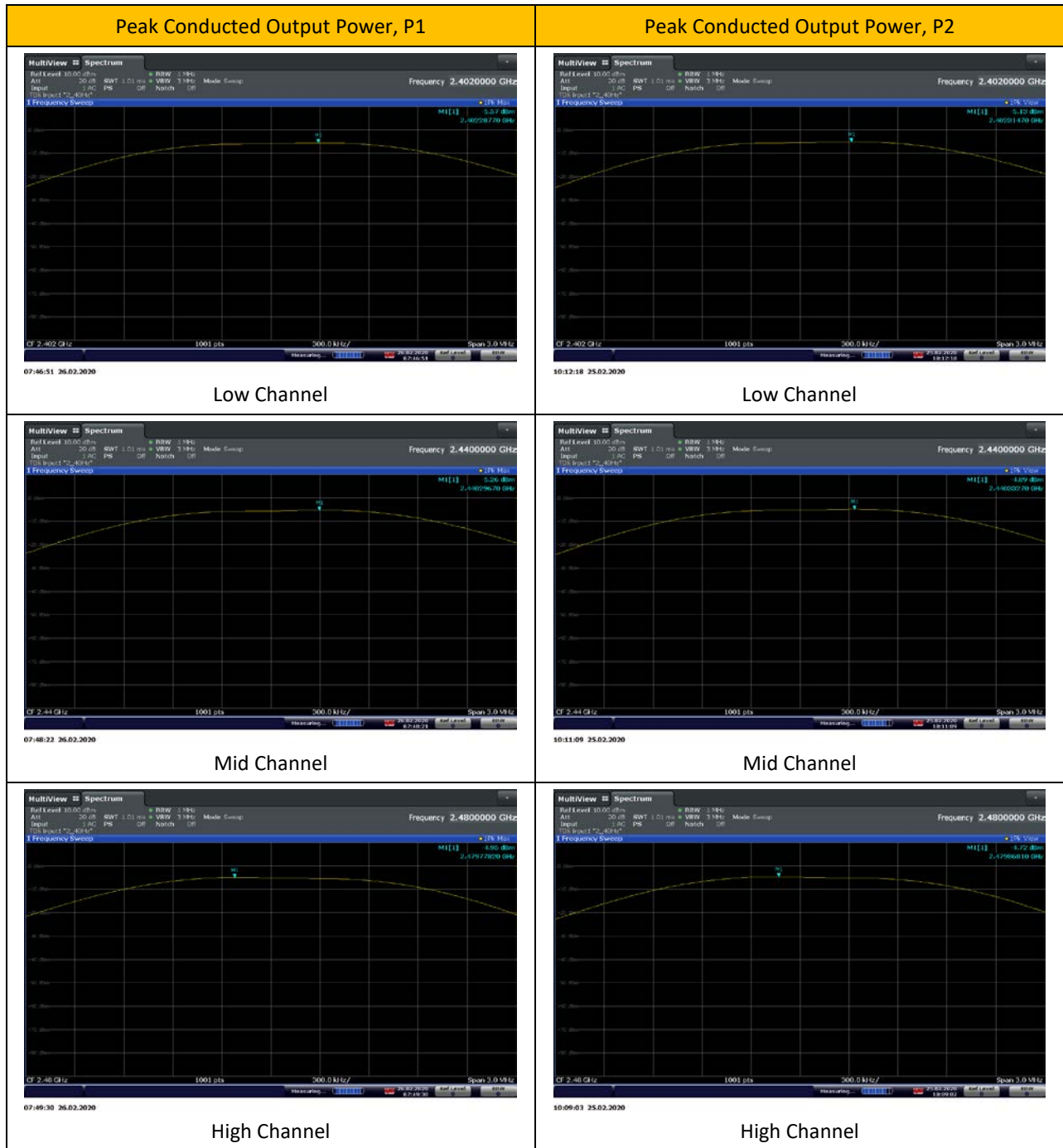
Frequency (MHz)	Data Rate	Peak Conducted Output Power			
		Port J16 (dBm)	Port J17 (dBm)	Port J16 (mW)	Port J17 (mW)
2402	DH5	-7.37	-7.09	0.18323	0.19543
	DH3	-7.35	-7.07	0.18408	0.19634
	DH1	-7.31	-7.00	0.18578	0.19953
2441	DH5	-7.25	-6.97	0.18836	0.20091
	DH3	-7.24	-6.96	0.18880	0.20137
	DH1	-7.21	-6.87	0.19011	0.20559
2480	DH5	-7.49	-7.26	0.17824	0.18793
	DH3	-7.43	-7.26	0.18072	0.18793
	DH1	-7.44	-7.19	0.18030	0.19099

Note: The insertion loss was compensated for in the receiver

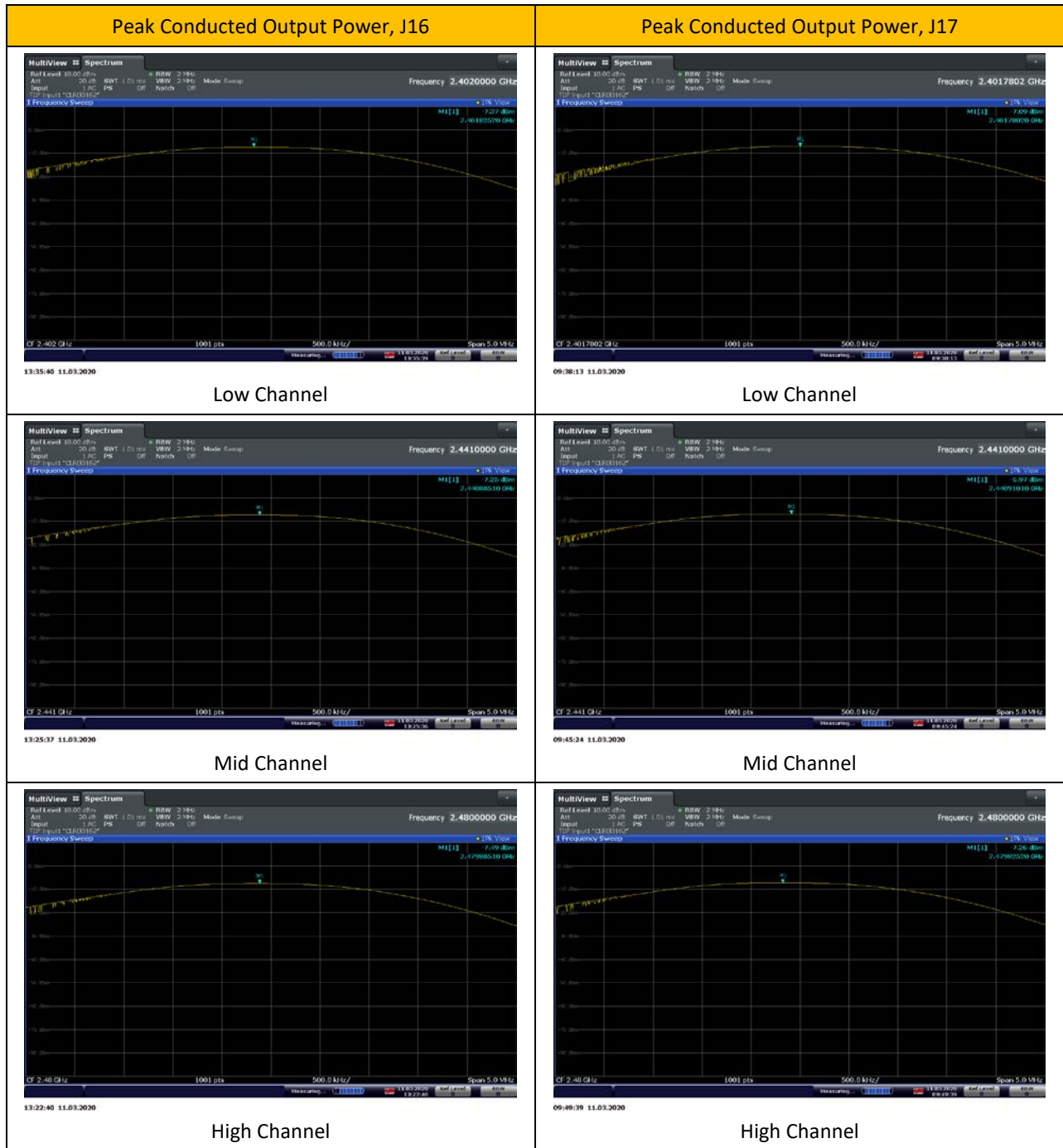
Remove Control Receiver:



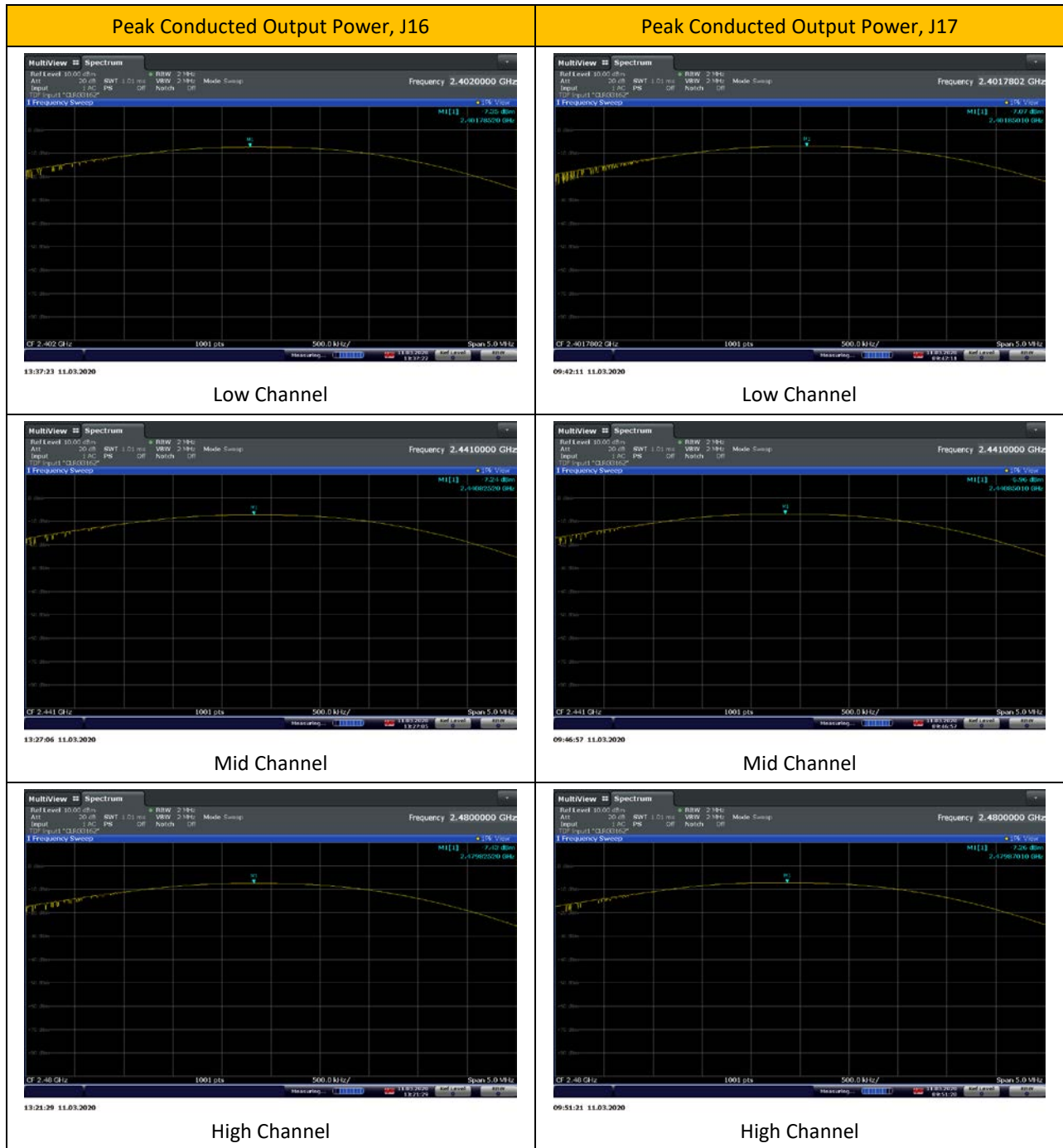
ALP/Veritas Receiver:



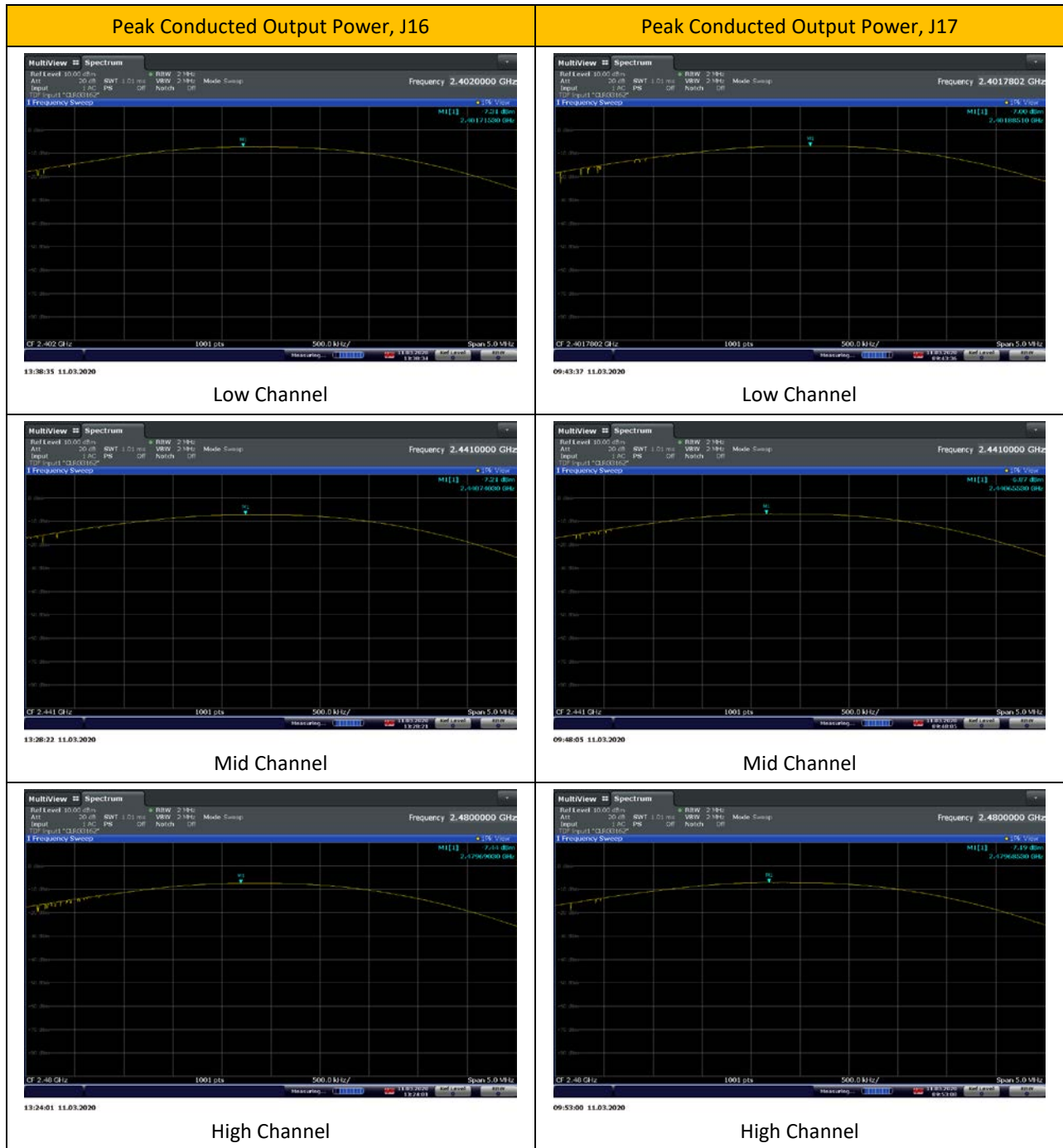
ACP Receiver, DH5:



ACP Receiver, DH3:



ACP Receiver, DH1:



Test Personnel:	Grace Lin	Test Date:	01/28/2020, 02/25-26/2020, 03/11/2020
Product Standard:	FCC §15.247, ISED RSS-247	Limit Applied:	FCC §15.247, ISED RSS-247
Input Voltage:	120 Vac, 60 Hz	Ambient Temperature:	25.3 °C
Pretest Verification w/ BB Source:	N/A	Relative Humidity:	49.9 %
		Atmospheric Pressure:	990.3 mbars

Deviations, Additions, or Exclusions: None

8 Maximum Power Spectral Density

8.1 Requirement(s)

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna should not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

8.2 Method

The procedure described in ANSI C63.10-2013 and FCC Publication 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019, specifically Section 8.4 DTS maximum power spectral density level in the fundamental emission was utilized.

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- d) Set the VBW $\geq 3 \times \text{RBW}$.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

8.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
1669	EMI Test Receiver	R&S	ESW44	101636	09/03/2019	09/03/2020
1412	Barometric Pressure/ Humidity/ Temperature Datalogger	EXTECH	SD700	Q769086	01/22/2020	01/22/2021

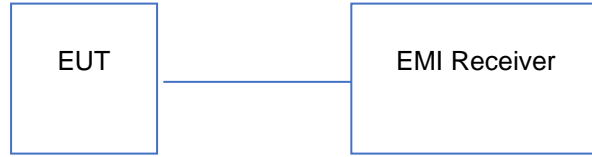
Software Utilized:

Name	Manufacturer	Version	Profile
N/A	N/A	N/A	N/A

8.4 Results:

The sample tested was found to Comply.

8.5 Setup Diagram:



8.6 Plots/Data:

Remove Control Receiver:

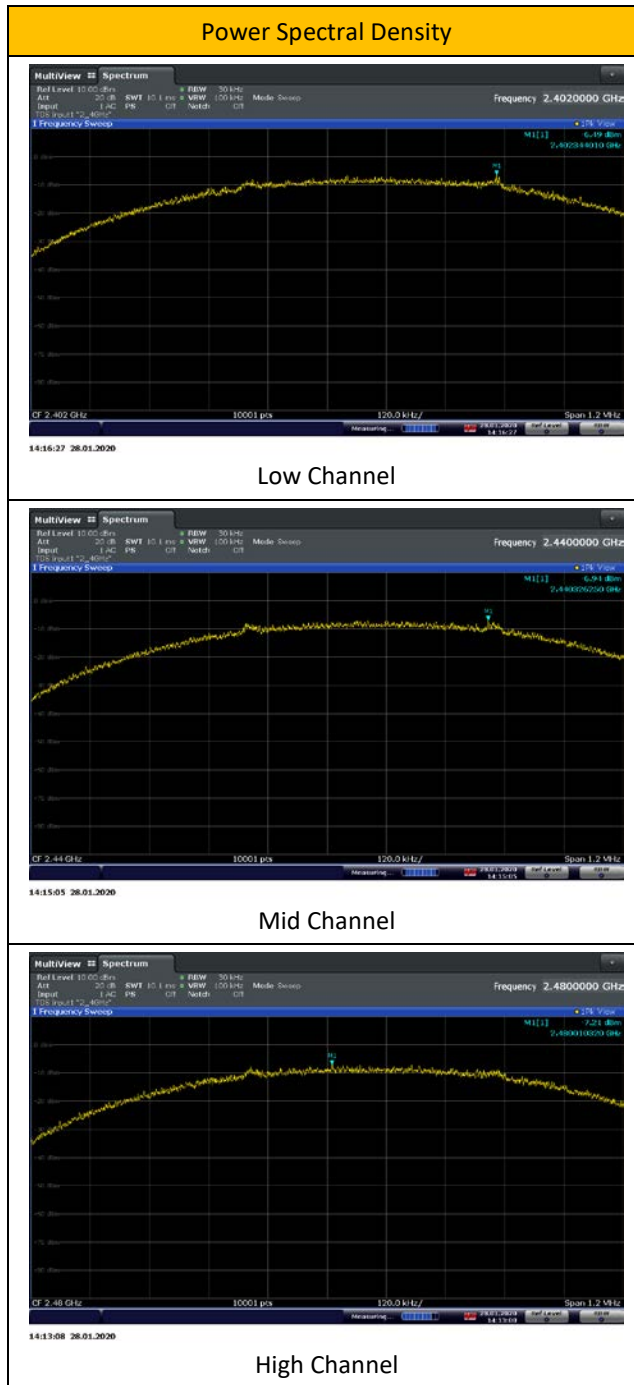
Frequency (MHz)	Power Spectrum Density (dBm)	Limit (dBm)
2402	-6.49	8
2440	-6.94	8
2480	-7.21	8

ALP/Veritas Receiver:

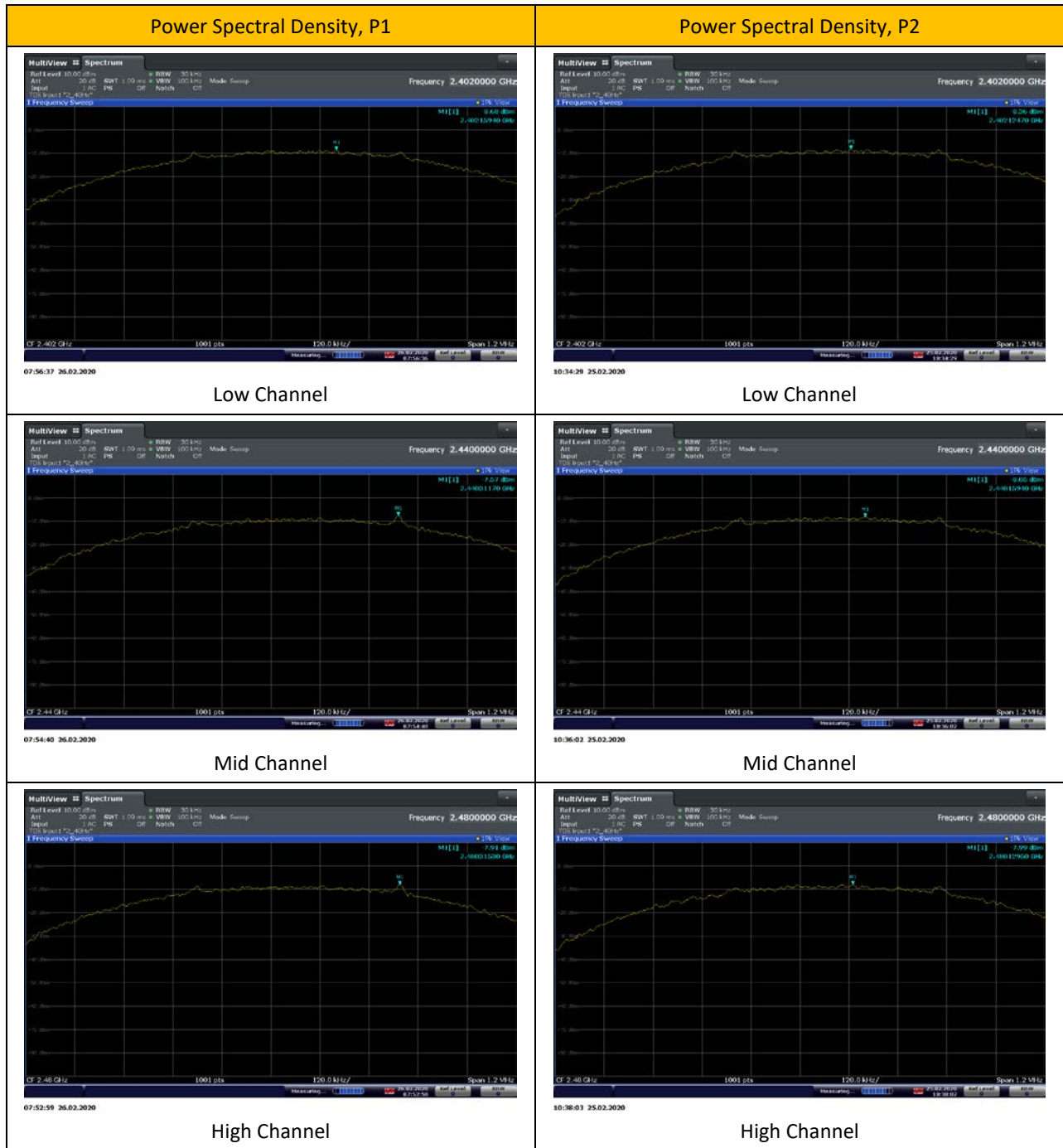
Frequency (MHz)	Power Spectrum Density (dBm)		Limit (dBm)
	Port P1	Port P2	
2402	-8.68	-8.36	8
2440	-7.57	-8.05	8
2480	-7.91	-7.99	8

Note: The insertion loss was compensated for in the receiver

Remove Control Receiver:



ALP/Veritas Receiver:



Note: The antenna port of the EUT connected directly to the input of the measuring EMI receiver.

Test Personnel: <u>Grace Lin</u>	Test Date: <u>01/28/2020, 02/25-26/2020</u>
Product Standard: <u>FCC §15.247, ISED RSS-247</u>	Limit Applied: <u>FCC §15.247, ISED RSS-247</u>
Input Voltage: <u>120 Vac, 60 Hz</u>	Ambient Temperature: <u>19.4 °C</u>
Pretest Verification w/ BB Source: <u>N/A</u>	Relative Humidity: <u>55 %</u>
	Atmospheric Pressure: <u>997.5 mbars</u>

Deviations, Additions, or Exclusions: None

9 Conducted Spurious Emissions

9.1 Requirement(s)

In any 100 kHz bandwidth outside the frequency band, the radio frequency power 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of the RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), shall comply with the radiated emission limits specified in § 15.209(a)

9.2 Method

The procedure described in ANSI C63.10-2013 and FCC Publication 558074 D01 15.247 Meas Guidance v05r02, April 2, 2019. Specifically, Section 8.5 DTS emissions in non-restricted frequency bands was utilized.

A spectrum analyzer was connected to the antenna port of the transmitter.

- a) Set the RBW = 100 kHz.
- b) Set the VBW $\geq 3 \times$ RBW.
- c) Detector = peak.
- d) Sweep time = auto couple.
- e) Trace mode = max hold.
- f) Allow trace to fully stabilize.
- g) Use the peak marker function to determine the maximum amplitude level.

The unwanted emissions were measured from 30 MHz to 25 GHz. Plots below are corrected for cable loss and then compared to the limits. The RF level in the plots is relative and is not the indication of RF output power.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

9.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
1669	EMI Test Receiver	R&S	ESW44	101636	09/03/2019	09/03/2020
1412	Barometric Pressure/ Humidity/ Temperature Datalogger	EXTECH	SD700	Q769086	01/22/2020	01/22/2021

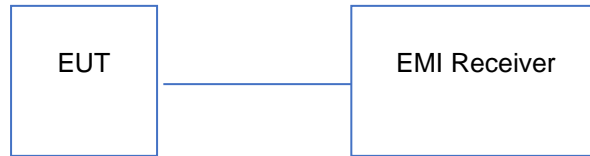
Software Utilized:

Name	Manufacturer	Version	Profile
-	-	-	-

9.4 Results:

The sample tested was found to Comply. All the emissions outside of the frequency band were at least 20 dB below the carrier power level.

9.5 Setup Diagram:



9.6 Plots/Data:

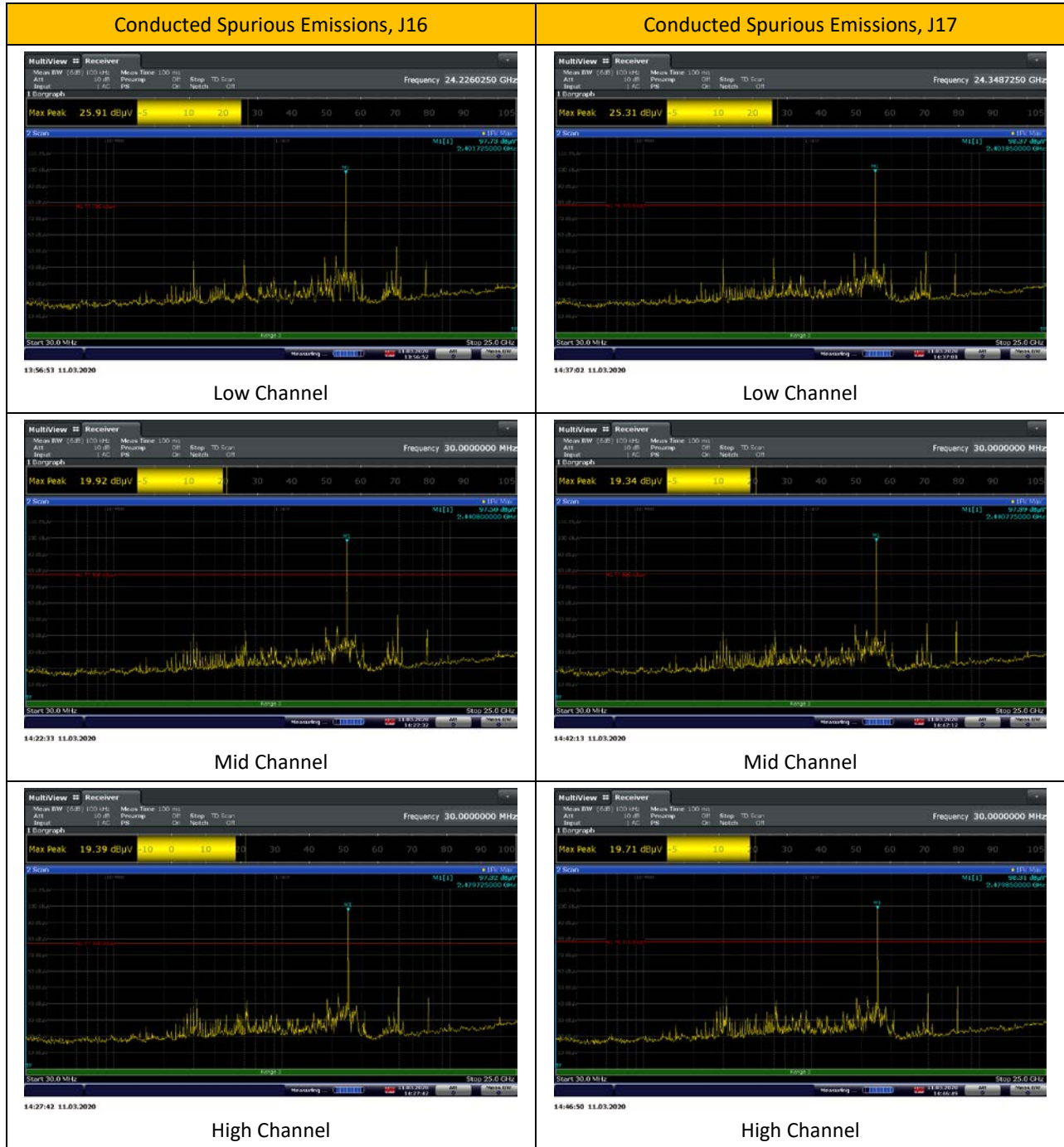
Remove Control Receiver:



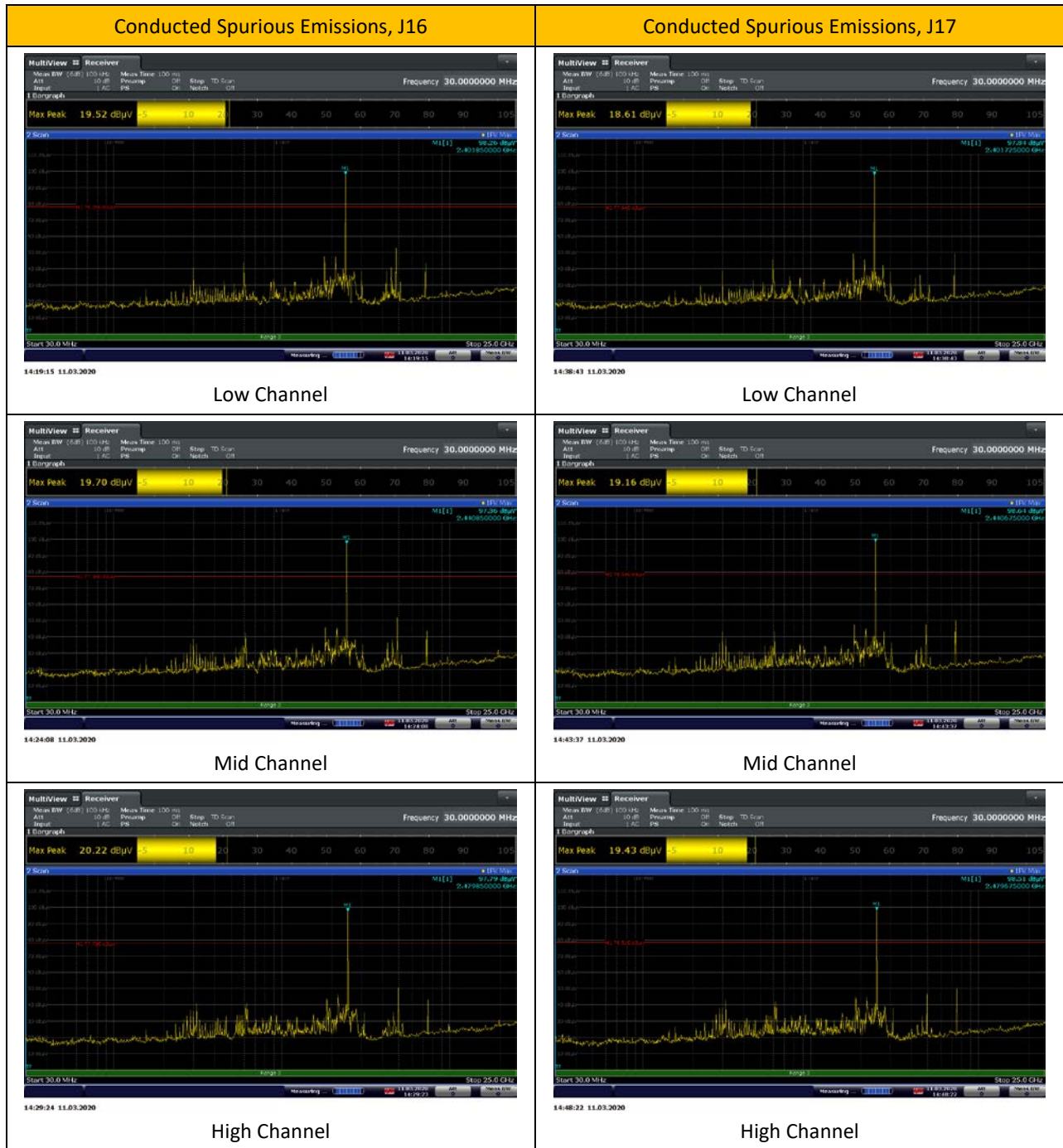
ALP/Veritas Receiver:



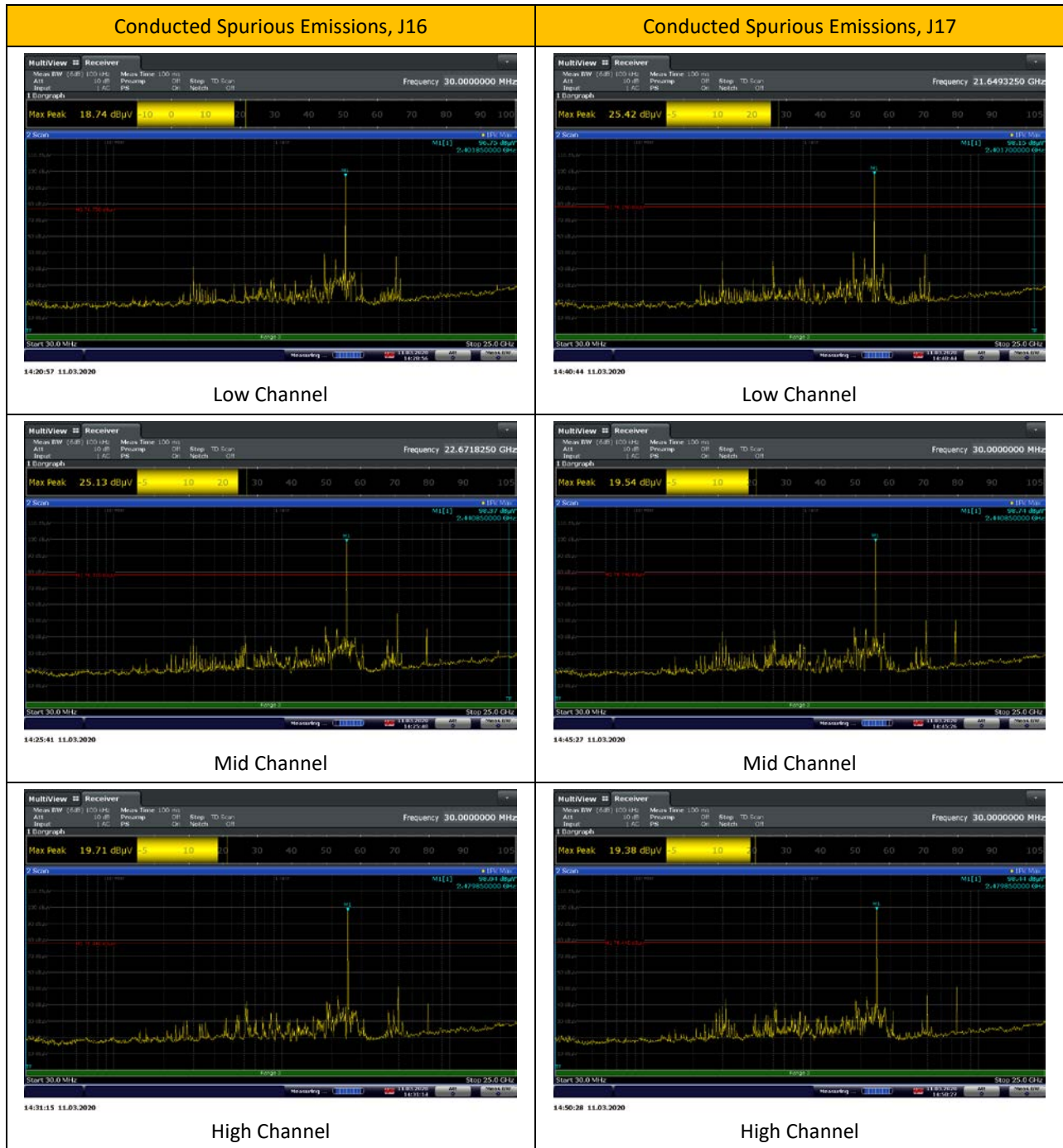
Conducted Spurious Emissions, ACP Receiver, DH5:



Conducted Spurious Emissions, ACP Receiver, DH3:



Conducted Spurious Emissions, ACP Receiver, DH1:

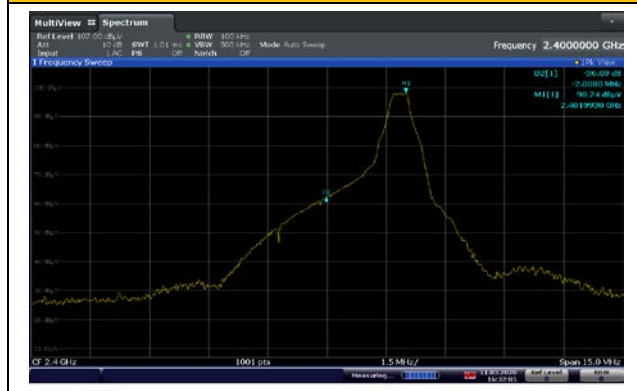


Conducted Spurious Emissions, Bandedge:

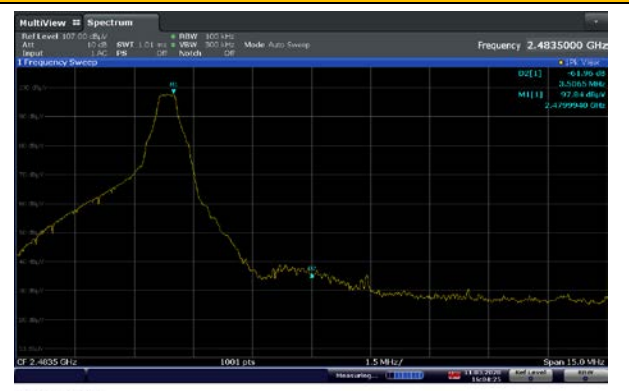


Conducted Spurious Emissions, Bandedge, ACP Receiver:

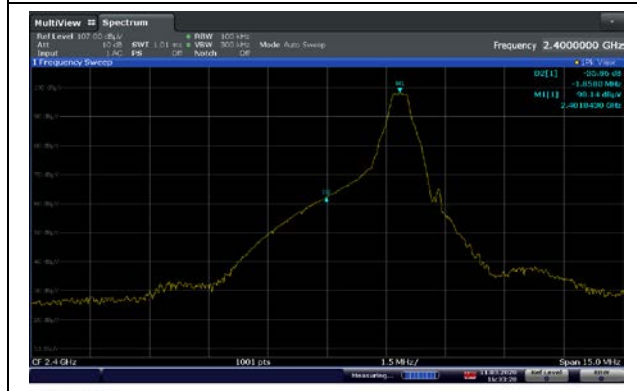
Conducted Spurious Emissions, ACP Receiver, J16, Hopping Off



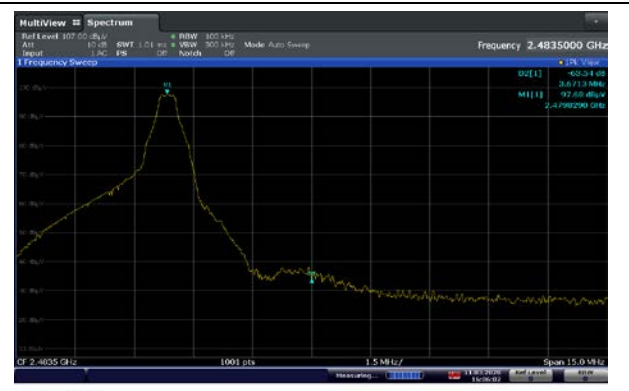
DH5, Low Channel



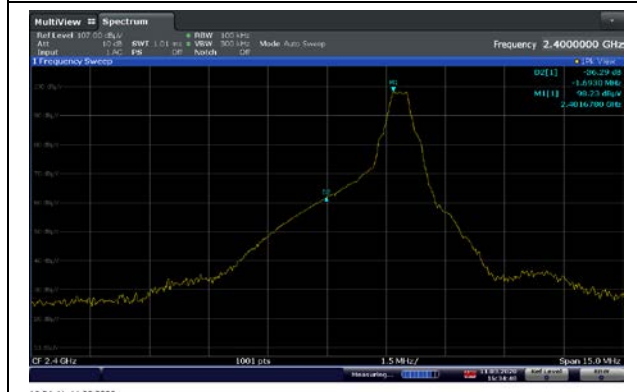
DH5, High Channel



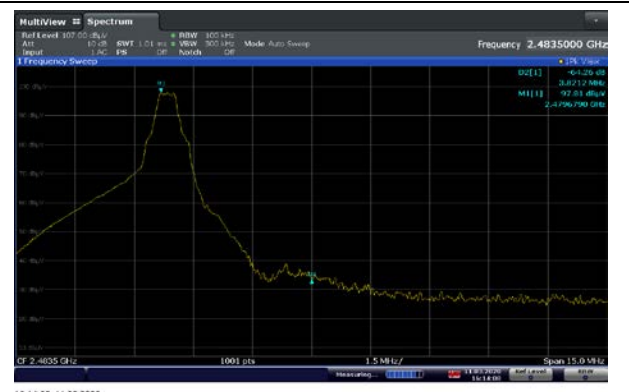
DH3, Low Channel



DH3, High Channel



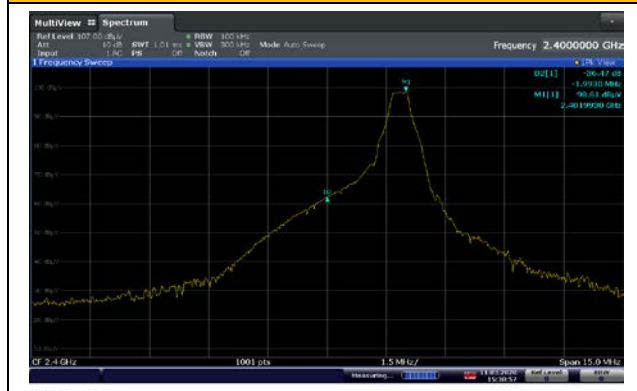
DH1, Low Channel



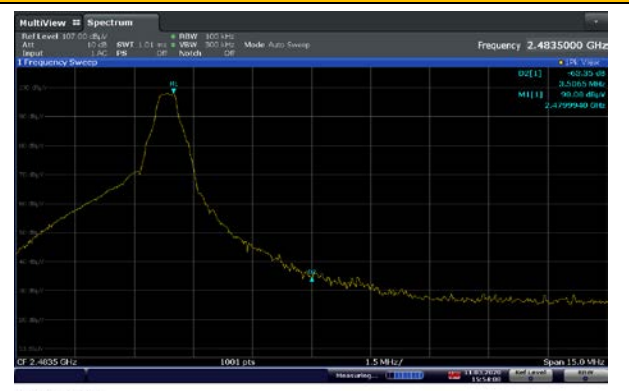
DH1, High Channel

Conducted Spurious Emissions, Bandedge, ACP:

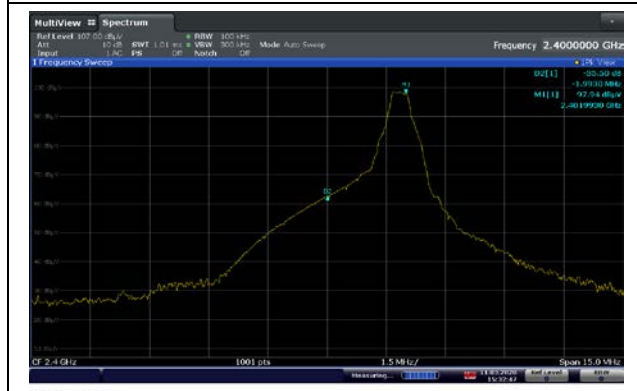
Conducted Spurious Emissions, ACP Receiver, J17, Hopping Off



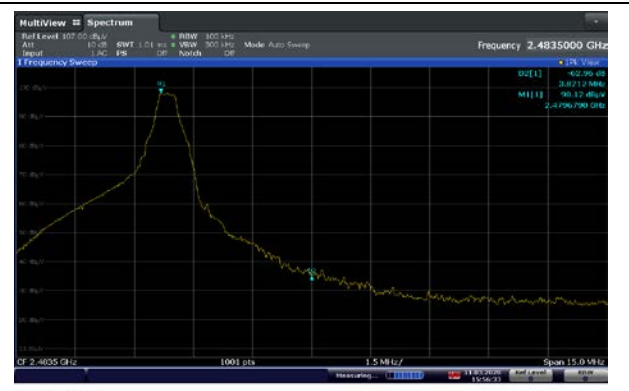
DH5, Low Channel



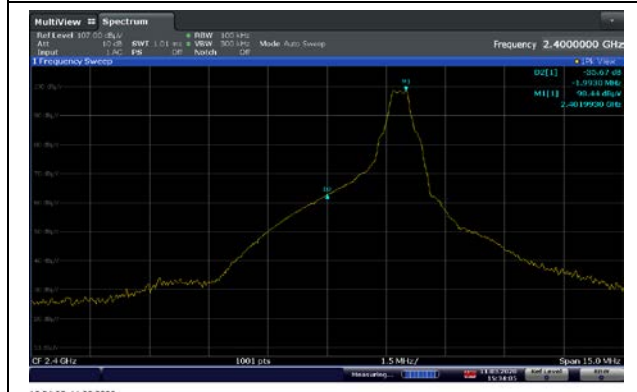
DH5, High Channel



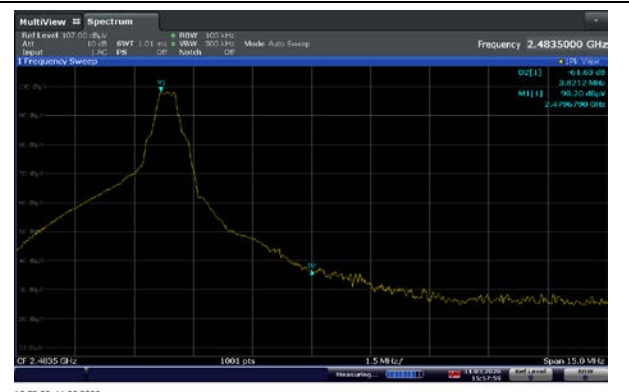
DH3, Low Channel



DH3, High Channel



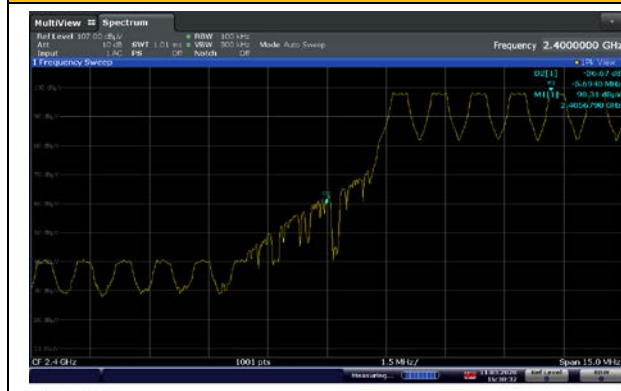
DH1, Low Channel



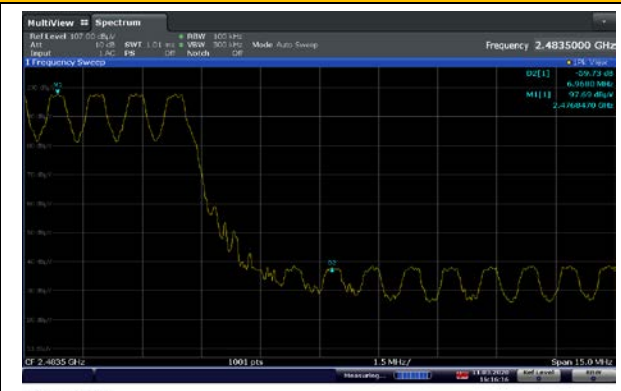
DH1, High Channel

Conducted Spurious Emissions, Bandedge, ACP Receiver:

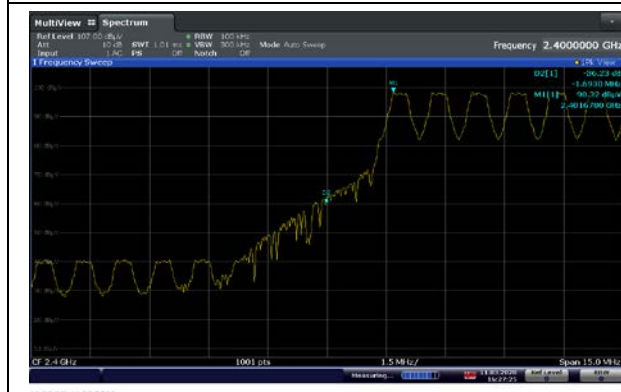
Conducted Spurious Emissions, ACP Receiver, J16, Hopping On



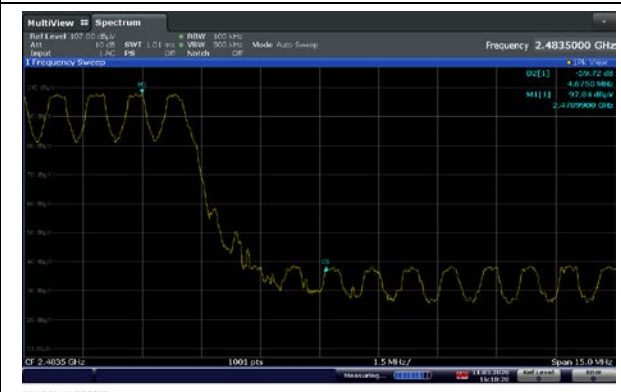
DH5, Low Channel



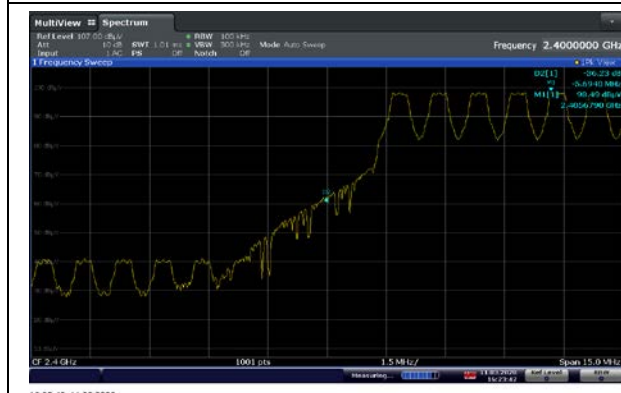
DH5, High Channel



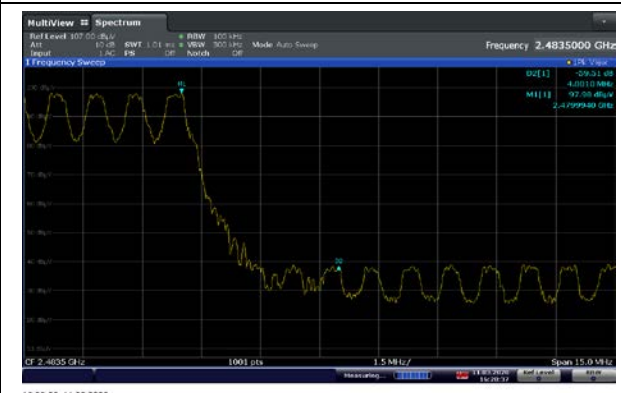
DH3, Low Channel



DH3, High Channel



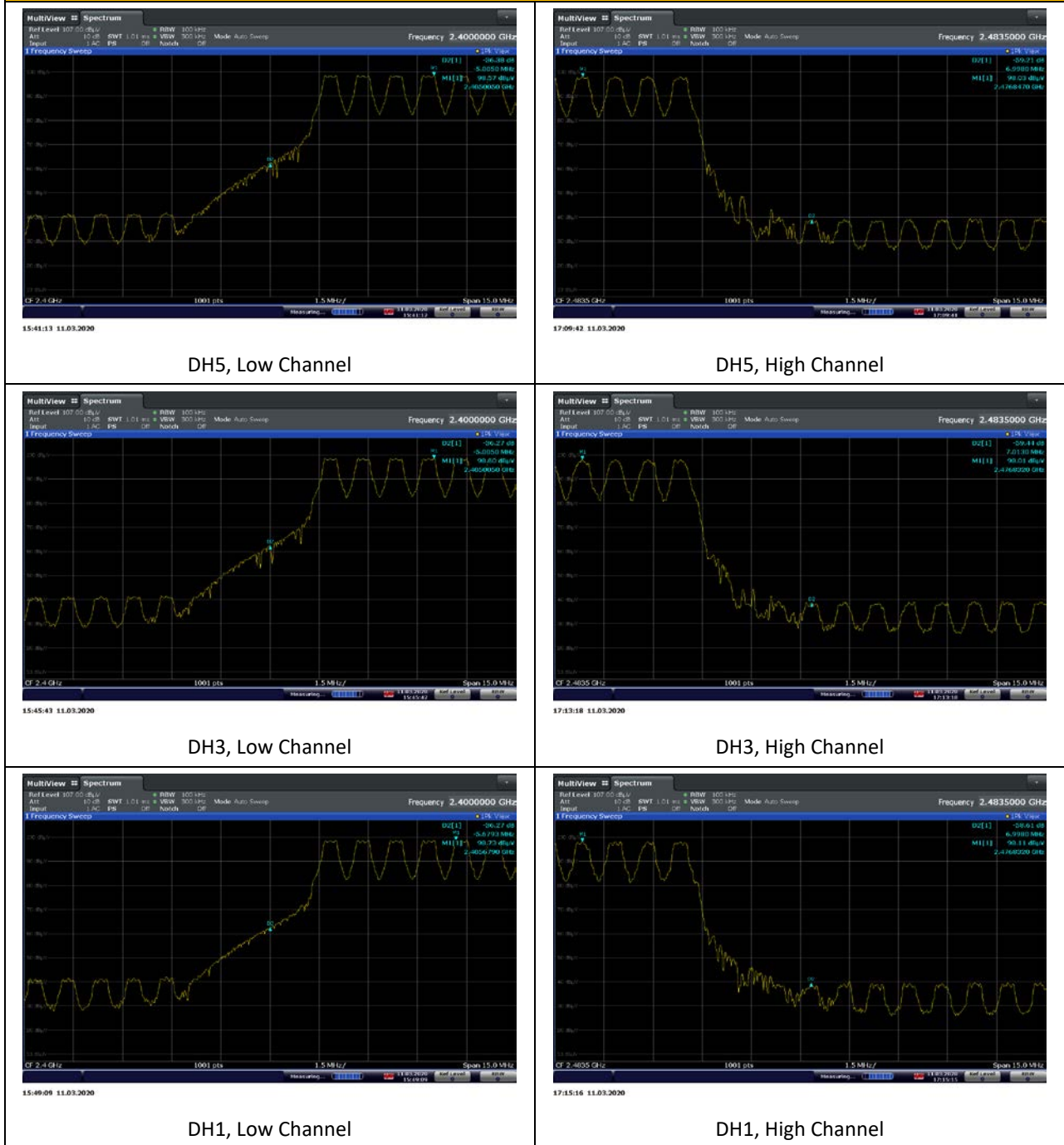
DH1, Low Channel



DH1, High Channel

Conducted Spurious Emissions, Bandedge, ACP Receiver:

Conducted Spurious Emissions, ACP Receiver, J17, Hopping On



Test Personnel: <u>Grace Lin</u>	Test Date: <u>01/28/2020, 02/25-26/2020, 03/11/2020</u>
Product Standard: <u>FCC §15.247, ISED RSS-247</u>	Limit Applied: <u>FCC §15.247, ISED RSS-247</u>
Input Voltage: <u>120 Vac, 60 Hz</u>	Ambient Temperature: <u>25.3 °C</u>
Pretest Verification w/ BB Source: <u>N/A</u>	Relative Humidity: <u>49.9 %</u>
	Atmospheric Pressure: <u>990.3 mbars</u>

Deviations, Additions, or Exclusions: None

10 Carrier Frequency Separation

10.1 Requirement(s)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

10.2 Method

The procedure described in ANSI C63.10-2013, specifically Section 7.8.2, was utilized.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

10.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
1669	EMI Test Receiver	R&S	ESW44	101636	09/03/2019	09/03/2020
1412	Barometric Pressure/ Humidity/ Temperature Datalogger	EXTECH	SD700	Q769086	01/22/2020	01/22/2021

Software Utilized:

Name	Manufacturer	Version	Profile
N/A	N/A	N/A	N/A

10.4 Results:

The sample tested was found to Comply.

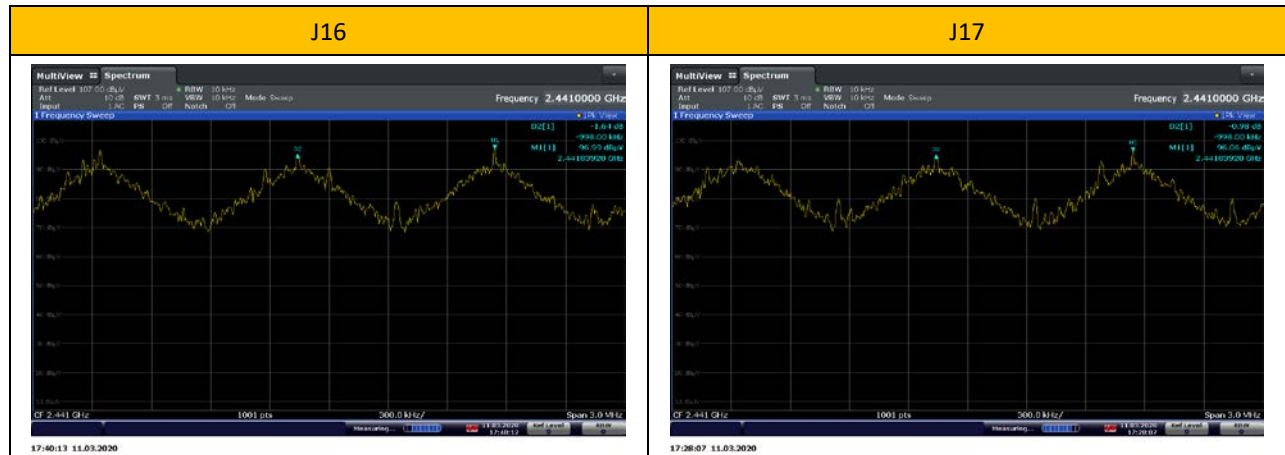
10.5 Setup Diagram:



10.6 Plots/Data:

ACP Receiver:

Carrier Frequency Separation (kHz)	
J16	J17
998	998



Note: The antenna port of the EUT connected directly to the input of the measuring EMI receiver.

Test Personnel: Grace Lin
 Product Standard: FCC §15.247, ISED RSS-247
 Input Voltage: 120 Vac, 60 Hz
 Pretest Verification w/
 BB Source: N/A

Test Date: 03/11/2020
 Limit Applied: FCC §15.247, ISED RSS-247
 Ambient Temperature: 25.3 °C
 Relative Humidity: 49.9 %
 Atmospheric Pressure: 990.3 mbars

Deviations, Additions, or Exclusions: None

11 Number of Hopping Frequencies

11.1 Requirement(s)

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies.

11.2 Method

The procedure described in ANSI C63.10-2013, specifically Section 7.8.3 was utilized.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

11.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
1669	EMI Test Receiver	R&S	ESW44	101636	09/03/2019	09/03/2020
1412	Barometric Pressure/ Humidity/ Temperature Datalogger	EXTECH	SD700	Q769086	01/22/2020	01/22/2021

Software Utilized:

Name	Manufacturer	Version	Profile
N/A	N/A	N/A	N/A

11.4 Results:

The sample tested was found to Comply.

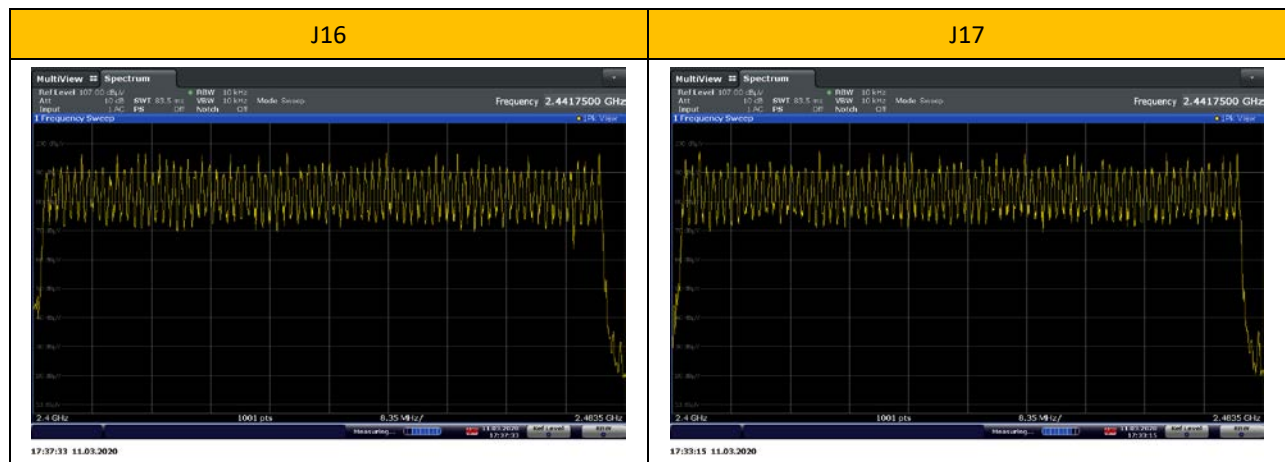
11.5 Setup Diagram:



11.6 Plots/Data:

ACP Receiver:

Number of Hopping Frequencies	
J16	J17
79	79



Note: The antenna port of the EUT connected directly to the input of the measuring EMI receiver.

Test Personnel: Grace Lin
 Product Standard: FCC §15.247, ISED RSS-247
 Input Voltage: 120 Vac, 60 Hz
 Pretest Verification w/
 BB Source: N/A

Test Date: 03/11/2020
 Limit Applied: FCC §15.247, ISED RSS-247
 Ambient Temperature: 25.3 °C
 Relative Humidity: 49.9 %
 Atmospheric Pressure: 990.3 mbars

Deviations, Additions, or Exclusions: None

12 Average Time of Occupancy (Dwell Time)

12.1 Requirement(s)

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

Frequency hopping systems in the 2400-2483.5 MHz band, the average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Frequency hopping systems operating in the 5725-5850 MHz band, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

12.2 Method

The procedure described in ANSI C63.10-2013, specifically Section 7.8.4 was utilized.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

12.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
00961	EMI Receiver	Rohde and Schwarz	ESU40	100172	03/09/2020	03/09/2021
01706	Barometric Pressure/ Humidity/ Temperature Datalogger	Omega Eng.	IBTHX-W	M19230374	07/16/2019	07/16/2020

Software Utilized:

Name	Manufacturer	Version	Profile
N/A	N/A	N/A	N/A

12.4 Results:

The sample tested was found to Comply.

12.5 Setup Diagram:



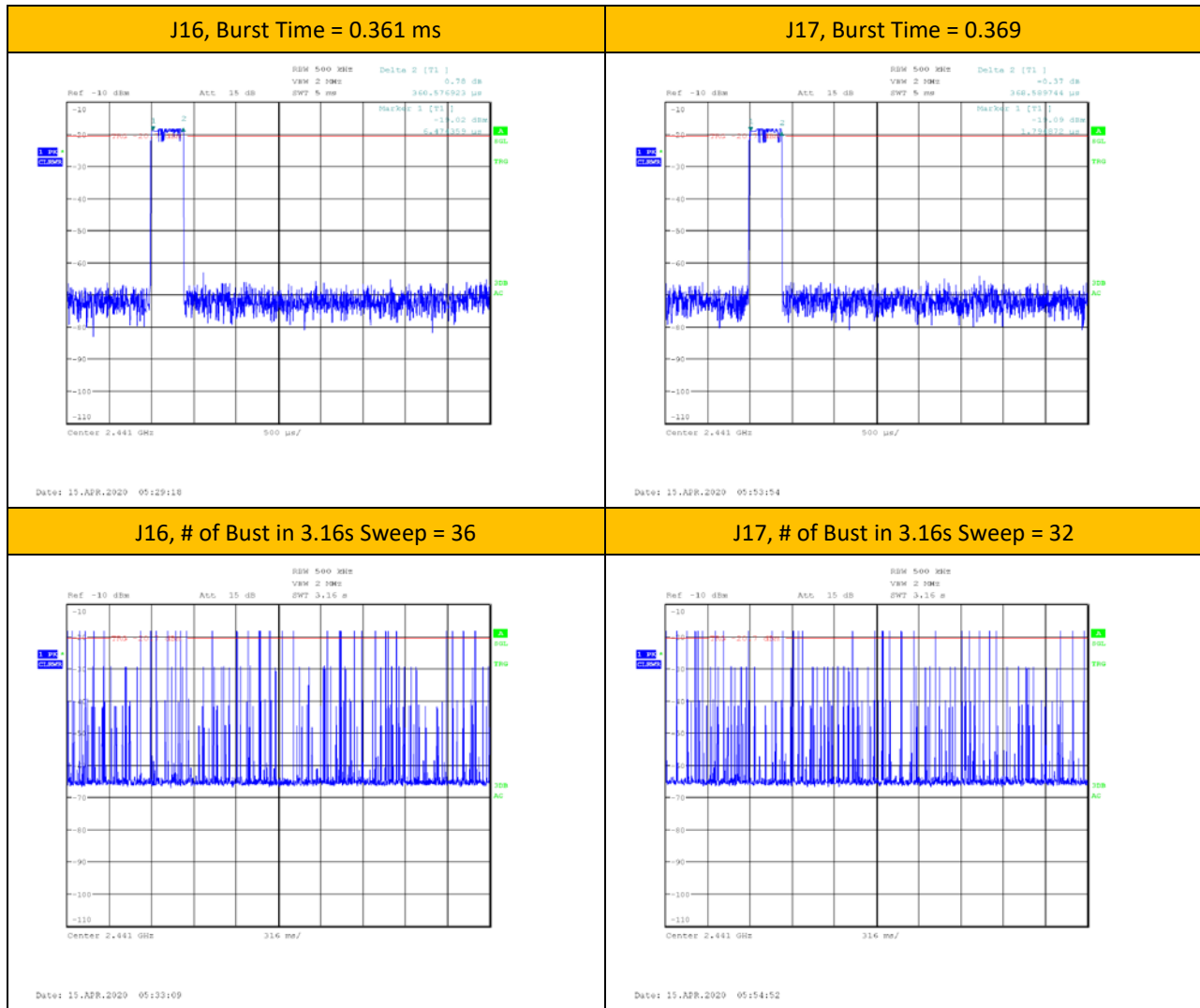
12.6 Plots/Data:

ACP Receiver: Measured at Port J16 & J17

Average Time of Occupancy DH1		
J16	J17	Limit
129.96 ms	118.08 ms	Less than 400 ms

J16: $0.361 \times 36 \times 10 = 129.96 \text{ ms}$

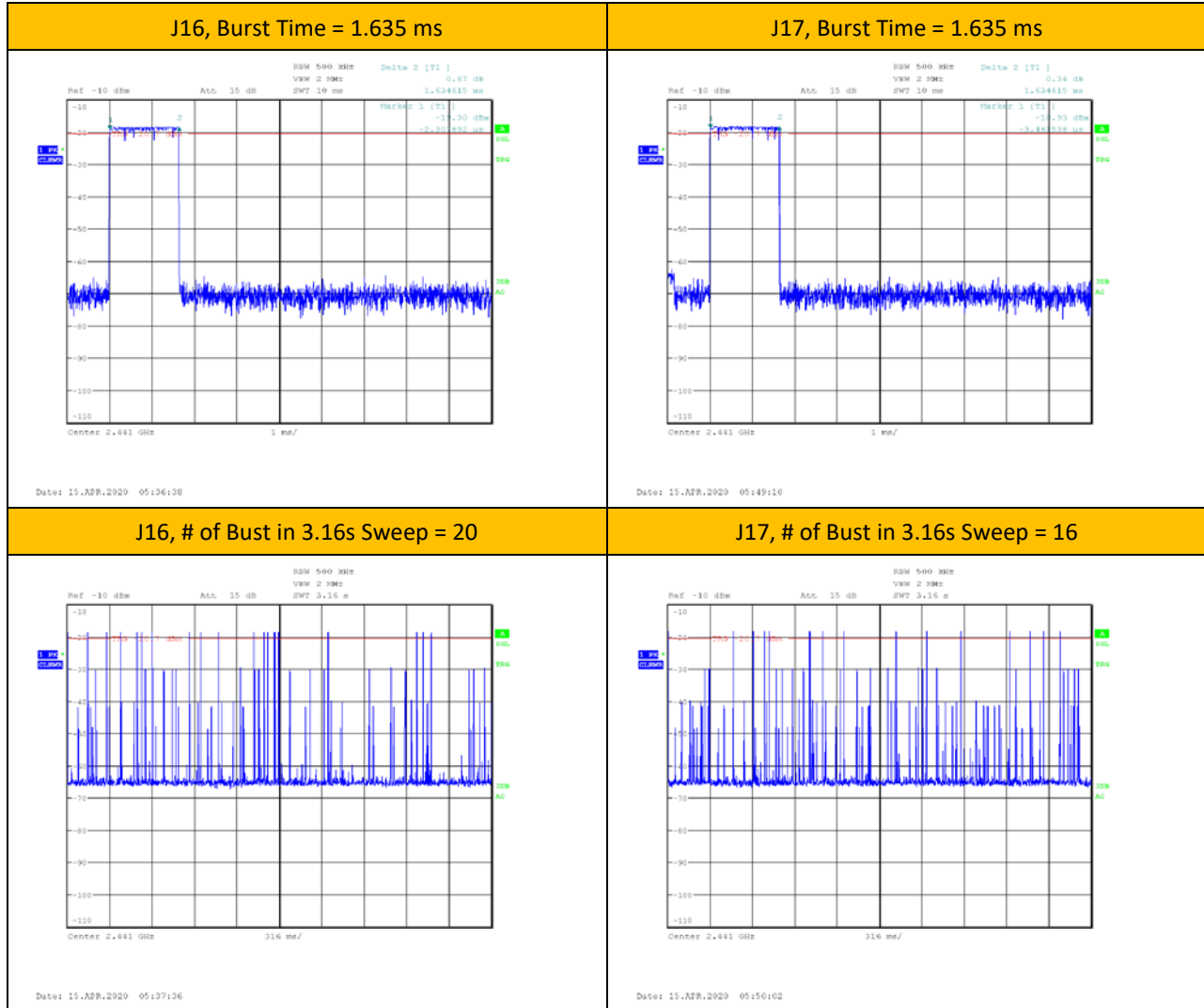
J17: $0.369 \times 32 \times 10 = 118.08 \text{ ms}$



Note: The antenna port of the EUT connected directly to the input of the measuring EMI receiver.

Average Time of Occupancy DH3		
J16	J17	Limit
327.00 ms	261.60 ms	Less than 400 ms

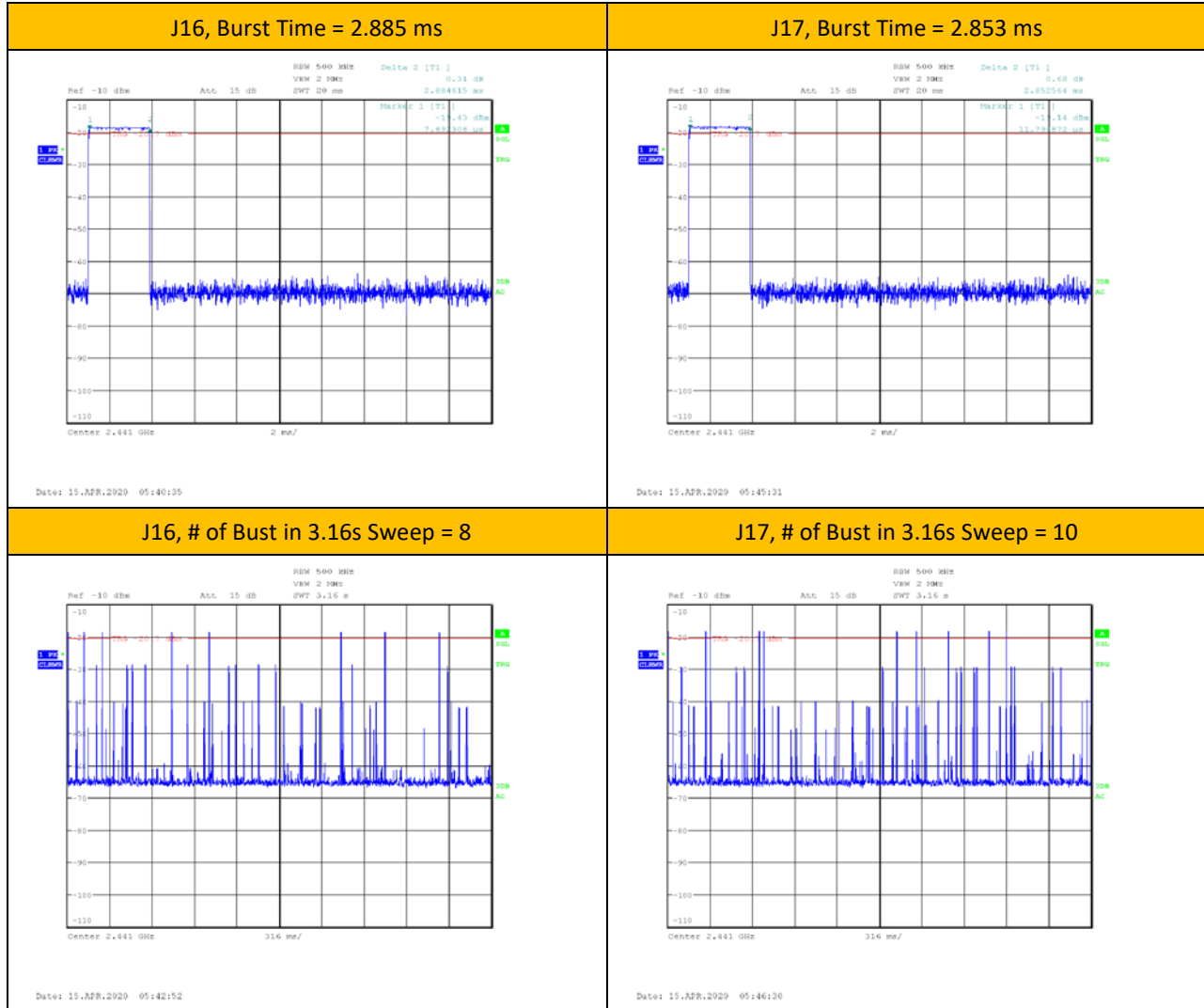
J16: $1.635 \times 20 \times 10 = 327.00 \text{ ms}$
 J17: $1.635 \times 16 \times 10 = 261.60 \text{ ms}$



Note: The antenna port of the EUT connected directly to the input of the measuring EMI receiver.

Average Time of Occupancy DH5		
J16	J17	Limit
230.80 ms	285.30 ms	Less than 400 ms

J16: $2.885 \times 8 \times 10 = 230.80 \text{ ms}$
 J17: $2.853 \times 10 \times 10 = 285.30 \text{ ms}$



Note: The antenna port of the EUT connected directly to the input of the measuring EMI receiver.

Test Personnel:	<u>Anderson Soungpanya</u>	Test Date:	<u>04/15/2020</u>
Product Standard:	<u>FCC §15.247, ISED RSS-247</u>	Limit Applied:	<u>FCC §15.247, ISED RSS-247</u>
Input Voltage:	<u>120 Vac, 60 Hz</u>	Ambient Temperature:	<u>21.3 °C</u>
Pretest Verification w/ BB Source:	<u>N/A</u>	Relative Humidity:	<u>51.2 %</u>
		Atmospheric Pressure:	<u>998.5 mbars</u>

Deviations, Additions, or Exclusions: None

13 Radiated Spurious Emissions

13.1 Requirement(s)

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), shall comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

In any 100 kHz bandwidth outside the frequency band, the radio frequency power 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of the RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

13.2 Method

EUT was configured to transmit continuously. Radiated emission measurements were performed from 9kHz to 25 GHz according to the procedure described in ANSI C64.10. Resolution bandwidth is 200 Hz for frequencies 9 kHz to 150 kHz, 9 kHz for frequencies 150 kHz to 30MHz, 120 kHz for frequencies 30 MHz to 1000 MHz and 1 MHz for frequencies above 1 GHz. Above 1 GHz, both Peak and Average measurements were performed. The Peak level of radiated emissions was measured with a peak detector. The Average level of radiated emissions was measured with an RMS detector with trace averaging.

The EUT is placed on a plastic turntable that is 80 cm in height for frequencies 9 kHz to 1000 MHz, 1.5 meters for frequency above 1000 MHz. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). During testing, all cables were manipulated to produce worst-case emissions. The signal is maximized through rotation. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at 3 meters for frequencies below 18 GHz. For frequencies above 18 GHz, preliminary scan is performed at 0.1 meter. Final measurement was performed at 1 meter for any emissions detected at 0.1 meter.

EUT was tested at three orientations. Data included is representative of the worst-case configuration (the configuration which resulted in the highest emission levels). Plots below are corrected for distance, cables, preamp, filters and antenna factors then compared to the limits.

Correlation measurements were performed below 30MHz between 10m ALSE and Open Field site according to FCC KDB 414788 D01 Radiated Test Site v01r01 section 2. All readings were within the acceptable tolerance.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucisp
Radiated Emissions, 3m	30-1000 MHz	4.3	6.3 dB
Radiated Emissions, 3m	1-18 GHz	4.7	5.2 dB
Radiated Emissions, 3m	18-26.5 GHz	4.5	-

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

Sample Calculation

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

$$FS = RA + AF + CF - AG$$

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

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

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

- RA = 52.0 dB μ V
- AF = 7.4 dB/m
- CF = 1.6 dB
- AG = 29.0 dB
- FS = 32 dB μ V/m

To convert from dB μ V to μ V or mV the following was used:

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

$$NF = \text{Net Reading in dB}\mu\text{V}$$

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$

$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

13.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
637	3m Semi-anechoic Chamber	Panashield	3 meter	25 331-D-Z	December 2018	December 2021
1669	EMI Test Receiver	R&S	ESW44	101636	09/03/2019	09/03/2020
1707	Bilog Antenna	sunAR	JB6	A110618	09/26/2019	09/26/2020
1576	Pre-amp	R&S	TS-PR1	102068	01/13/2020	01/13/2021
1515	Horn Antenna	ETS-Lindgren	3115	00161631	04/17/2019	04/17/2020
1556	Pre-amp	R&S	TS-PR18	102144	08/18/2019	08/18/2020
880	Horn Antenna	ETS-Lindgren	3116	00153521	04/19/2019	04/19/2020
1557	Pre-amp	R&S	TS-PR1840	100054	01/13/2020	01/13/2021
1517	Cable	R&S	TSPR-B7	101528	08/28/2019	08/28/2020
1518	Cable	R&S	TSPR-B7	101529	08/28/2019	08/28/2020
1412	Environmental Datalogger	EXTECH	SD700	Q769086	01/22/2020	01/22/2021
00961	EMI Receiver	Rohde and Schwarz	ESU40	100172	03/09/2020	03/09/2021
10775	Horn Antenna	ETS-Lindgren	3177-PB	1GVT 416044801-	10/17/2019	10/17/2020
01408	RF Cable	Megaphase	EMC1-K1K1-236	1GVT 416044801	11/11/2019	11/11/2020
00984	10m Semi-anechoic Chamber	Panashield	10 Meter Chamber	NA	09/11/2018	09/11/2021
01598	Loop Antenna	EMCO	6512	1029	10/22/2019	10/22/2020
00942	Pre-amp	Sonoma	310	293620	04/14/2020	04/14/2021
01345	RF Cable	TRU Corp.	TRU Core 300	30B0711-080	04/13/2020	04/13/2021
01619	RF Cable	TRU Corp.	TRU Core 300	30B1111-020	04/13/2020	04/13/2021
01619	RF Cable	TRU Corp.	TRU Core 300	30B1111-150	04/13/2020	04/13/2021

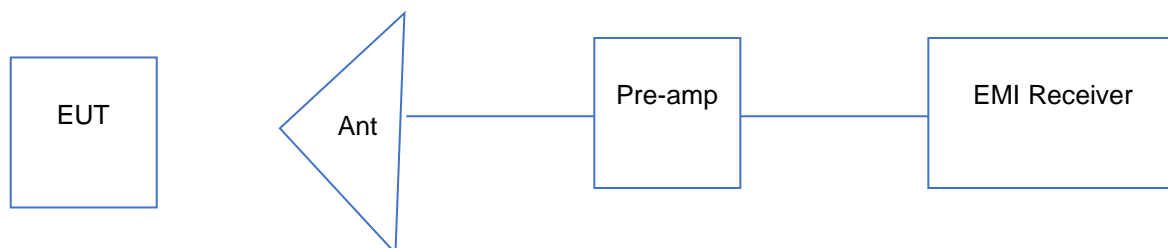
Software Utilized:

Name	Manufacturer	Version	Profile
BAT-EMC	Nexio	3.18.0.16	LAX Intertek Emissions Template 03-30-2018

13.4 Results:

The sample tested was found to Comply.

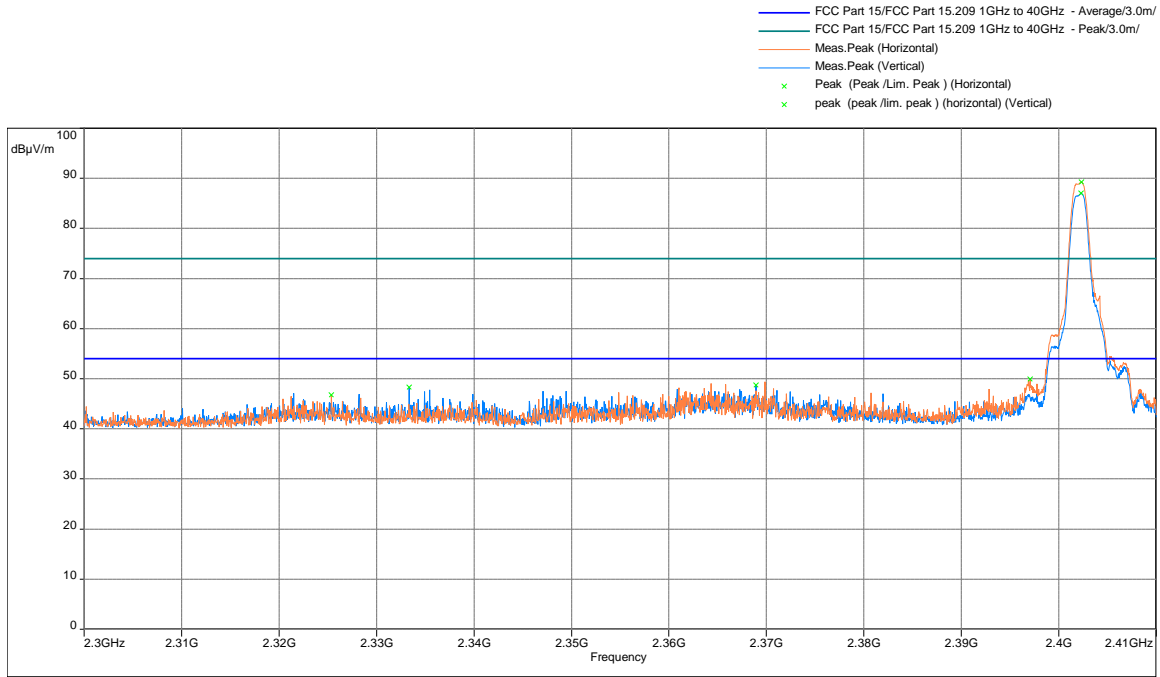
13.5 Setup Diagram:



13.6 Plots/Data:

Configuration: Remote Control Receiver

Radiated Band Edge, Low Channel, Peak Scan vs Peak and Avg Limits

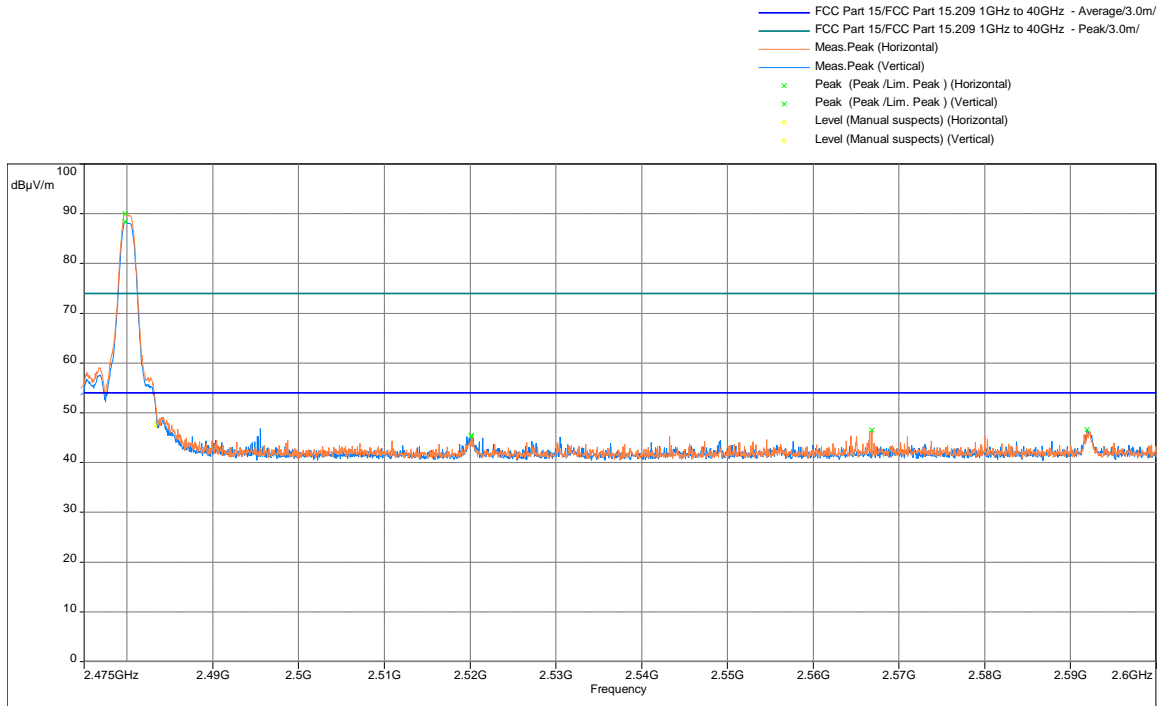


Model: ; Client: ; Comments: ; Test Date: 04/20/2020 08:22

Frequency (MHz)	Peak Level @ 3m (dBµV/m)	Avg Limit @3m (dBµV/m)	Margin dB	Height (m)	Angle (°)	Position	Correction (dB)
2369.84	49.39	54	-4.61	1.98	49	Horizontal	5.05
2390.00	41.18	54	-12.82	1.48	281	Horizontal	5.10
2368.95	48.76	54	-5.24	1.74	26	Vertical	5.04

Configuration: Remote Control Receiver

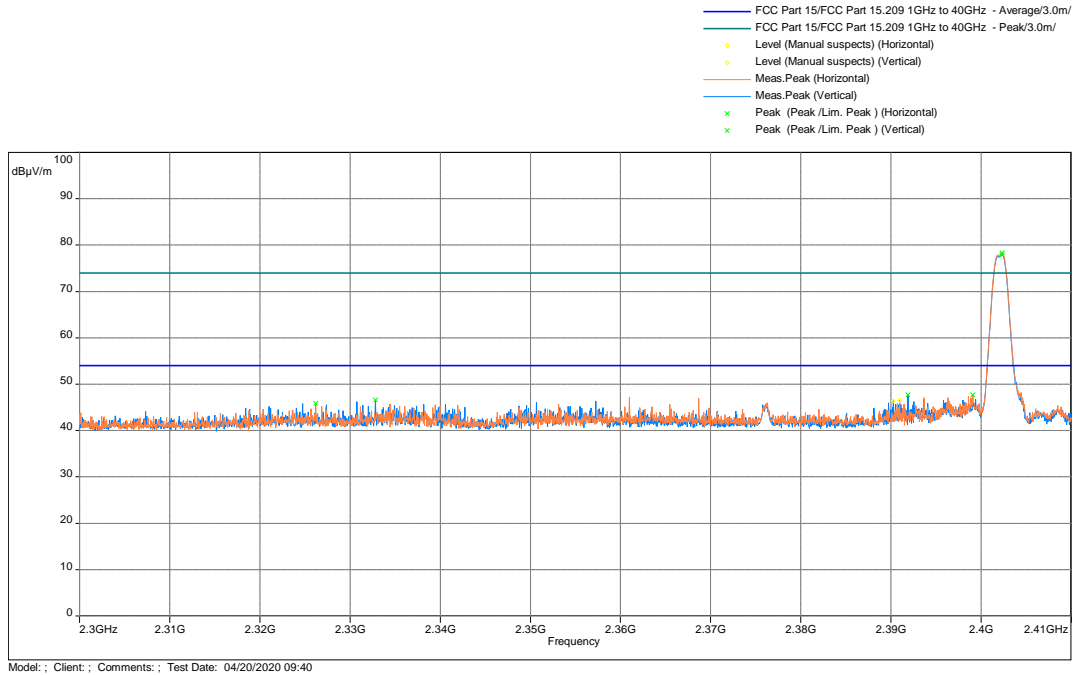
Radiated Band Edge, High Channel, Peak Scan vs Peak and Avg Limits



Frequency (MHz)	Peak Level @ 3m (dBµV/m)	Avg Limit @3m (dBµV/m)	Margin dB	Height (m)	Angle (°)	Position	Correction (dB)
2483.5	48.13	54	-5.87	1.08	243	Horizontal	5.2
2483.5	47.33	54	-6.67	2.47	243	Vertical	5.2

Configuration: ALP/Veritas Receiver

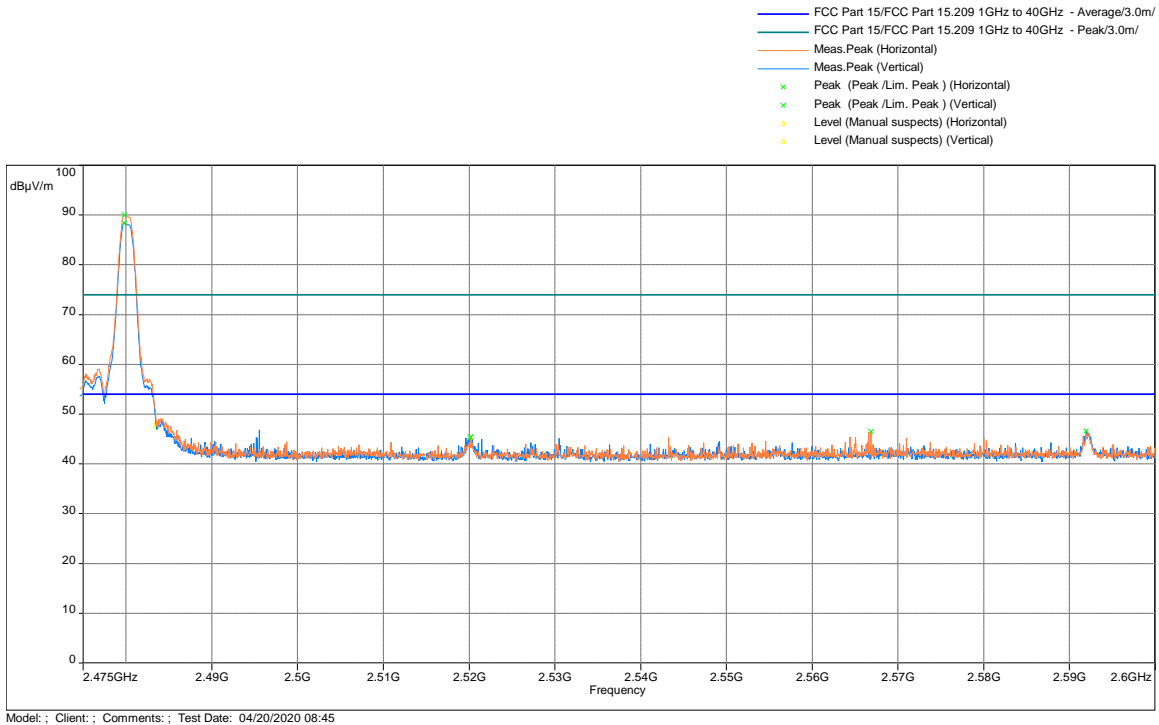
Radiated Band Edge, Low Channel, Peak Scan vs Peak and Avg Limits



Frequency (MHz)	Peak Level @ 3m (dBµV/m)	Avg Limit @3m (dBµV/m)	Margin dB	Height (m)	Angle (°)	Position	Correction (dB)
2390.00	46.63	54	-7.37	2.02	41	Horizontal	5.1
2390.00	46.46	54	-7.54	2.53	77	Vertical	5.1

Configuration: ALP/Veritas Receiver

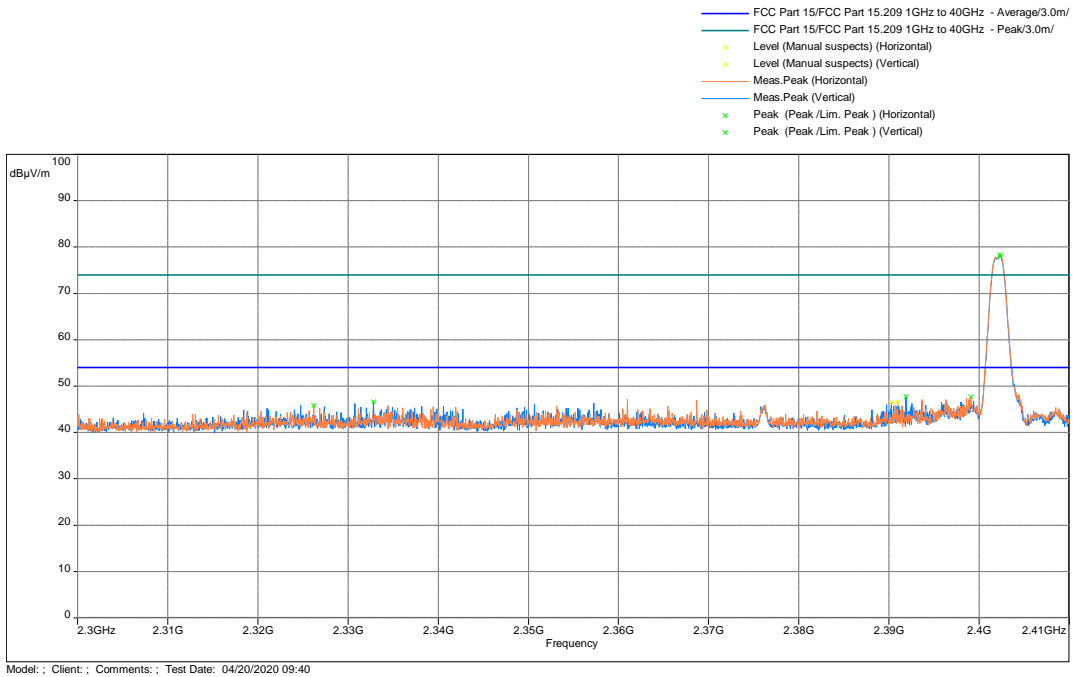
Radiated Band Edge, High Channel, Peak Scan vs Peak and Avg Limits



Frequency (MHz)	Peak Level @ 3m (dBµV/m)	Avg Limit @3m (dBµV/m)	Margin dB	Height (m)	Angle (°)	Position	Correction (dB)
2483.5	49.90	54	-4.10	2.44	79	Horizontal	5.2
2483.5	50.18	54	-3.82	1.91	140	Vertical	5.2

Configuration: ACP Receiver

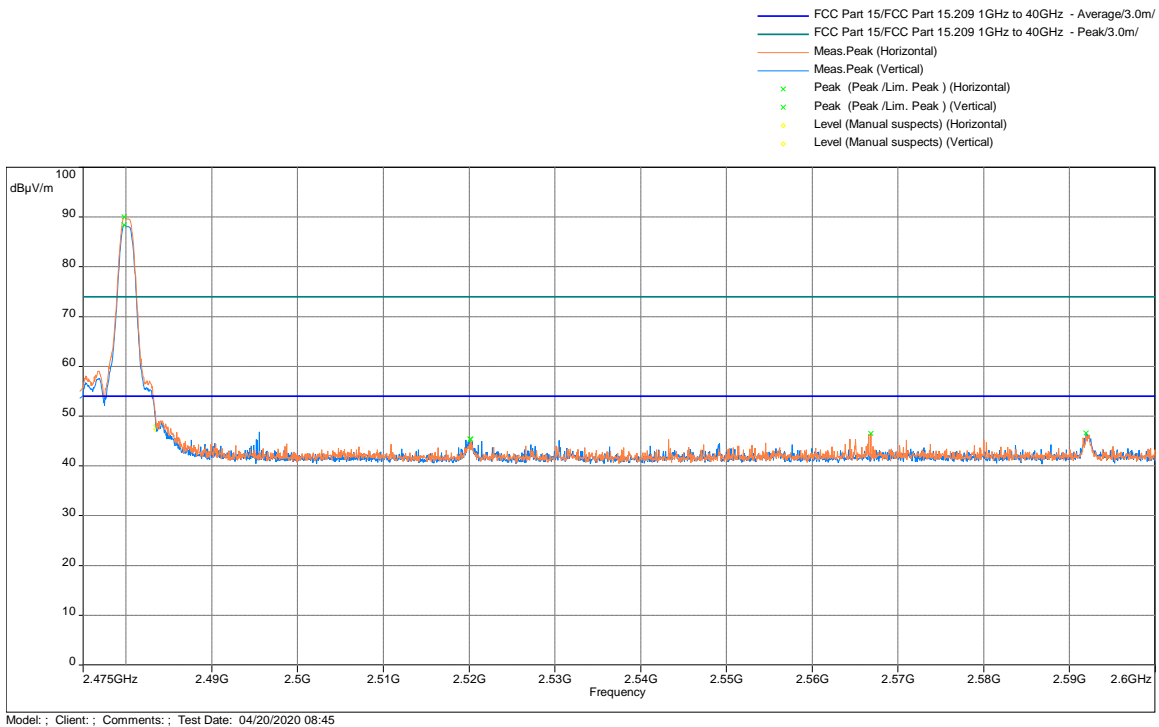
Radiated Band Edge, Low Channel, Peak Scan vs Peak and Avg Limits



Frequency (MHz)	Peak Level @ 3m (dBµV/m)	Avg Limit @3m (dBµV/m)	Margin dB	Height (m)	Angle (°)	Position	Correction (dB)
2390.00	44.92	54	-9.08	1.55	41	Horizontal	5.1
2390.00	45.71	54	-8.29	2.40	77	Vertical	5.1

Configuration: ACP Receiver

Radiated Band Edge, High Channel, Peak Scan vs Peak and Avg Limits

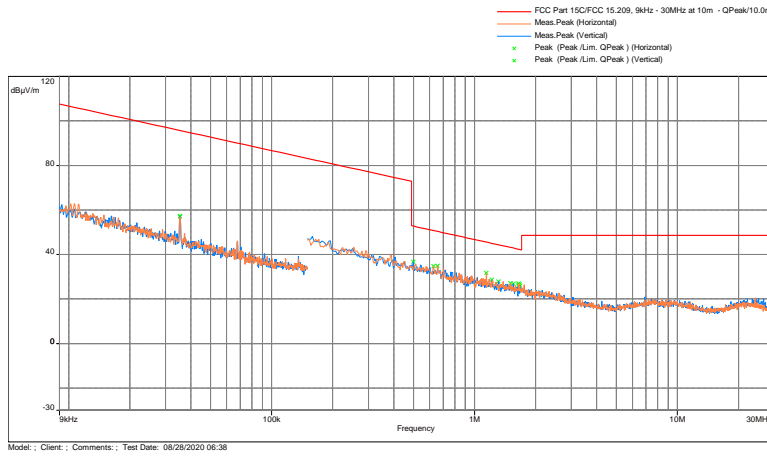


Frequency (MHz)	Peak Level @ 3m (dBµV/m)	Avg Limit @3m (dBµV/m)	Margin dB	Height (m)	Angle (°)	Position	Correction (dB)
2483.5	47.86	54	-6.14	2.63	83	Horizontal	5.2
2483.5	48.00	54	-6.0	2.49	89	Vertical	5.2

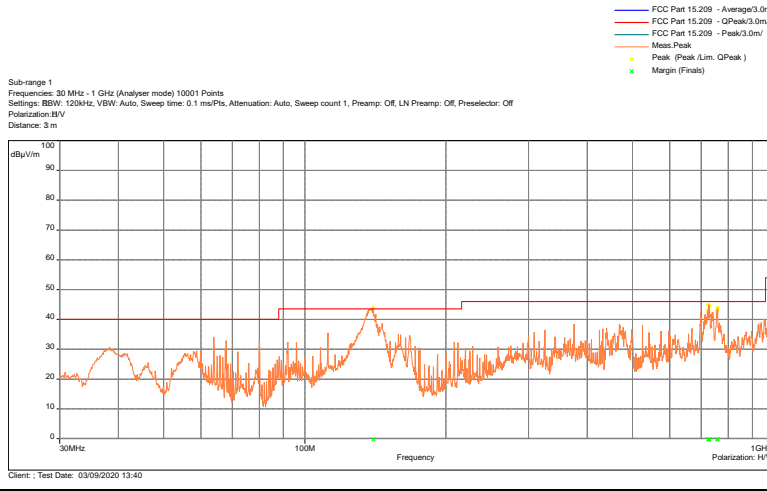
Configuration: ALP/Veritas Receiver + Remote Control Receiver

Radiated Spurious Emissions, 2402 MHz

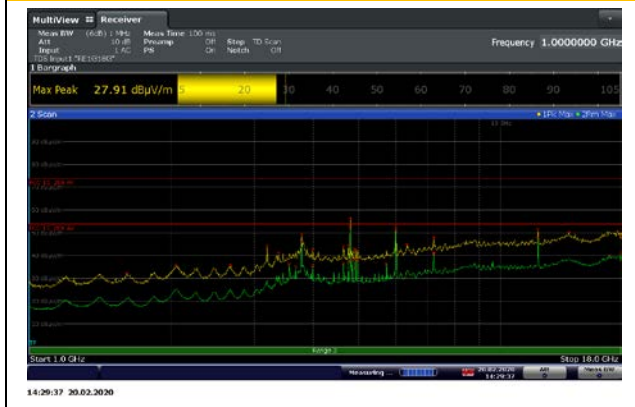
9 kHz – 30MHz, Peak Scan, Limit Line – QP



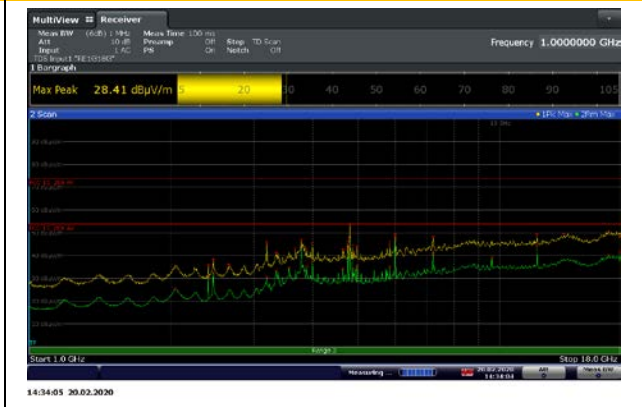
30 MHz - 1000 MHz, Peak Scan, Limit Line – QP



1- 18 GHz, Horizontal



1- 18 GHz, Vertical

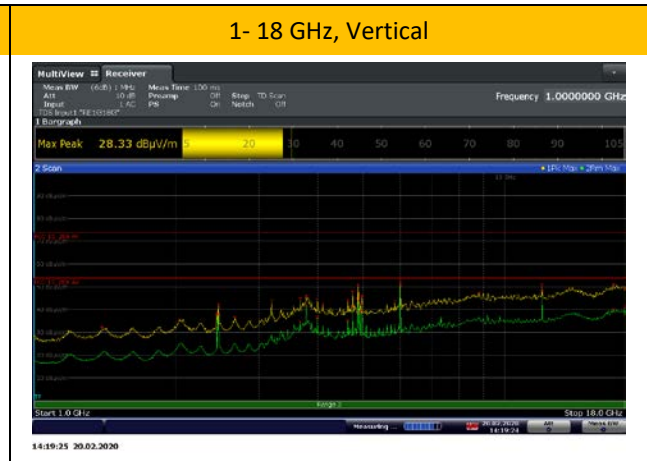
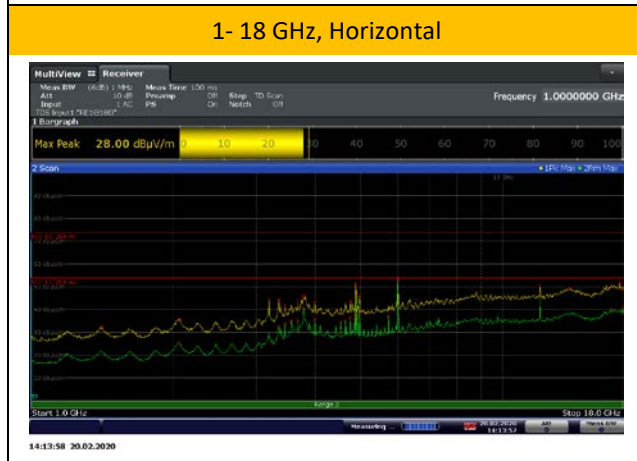
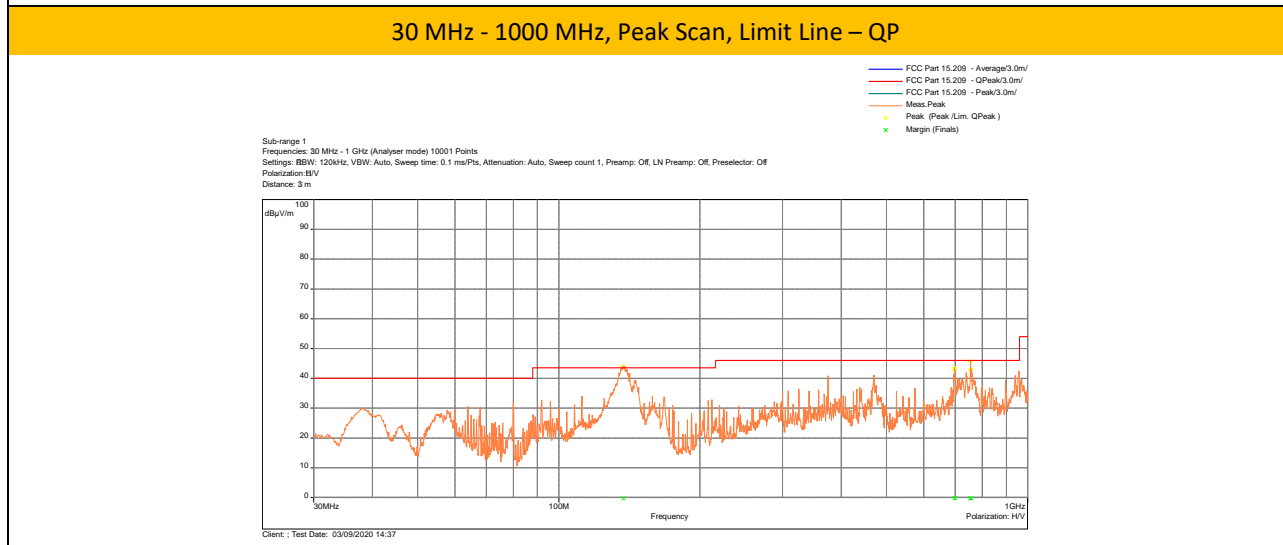
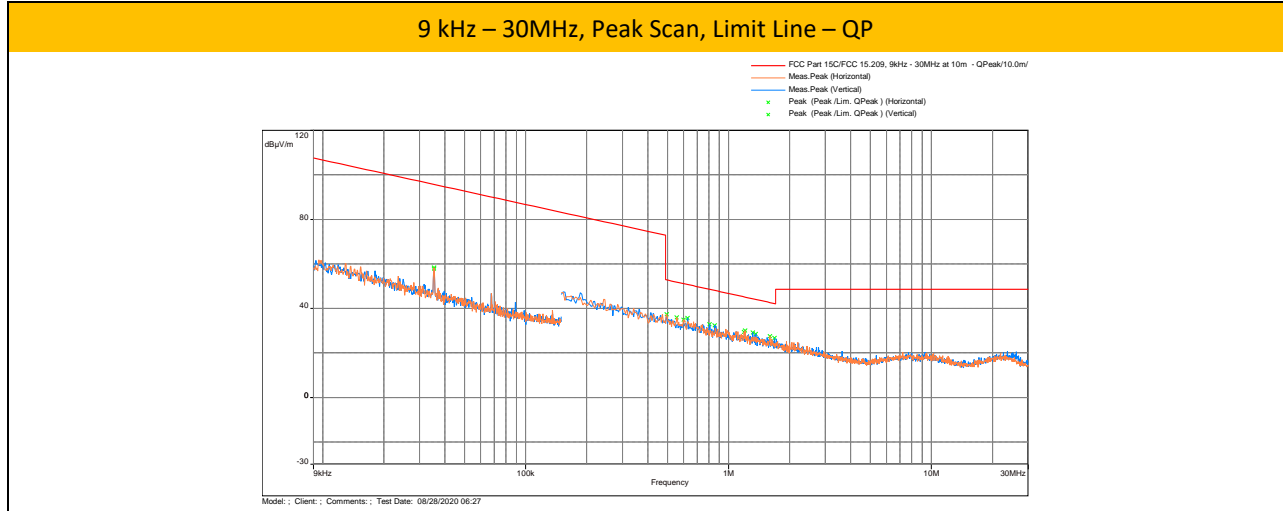


Note: Radiated spurious emissions measurements were performed from 9 kHz to 25 GHz.

13.6 Plots/Data: (Continued)

Configuration: ALP/Veritas Receiver + Remote Control Receiver

Radiated Spurious Emissions, 2440 MHz

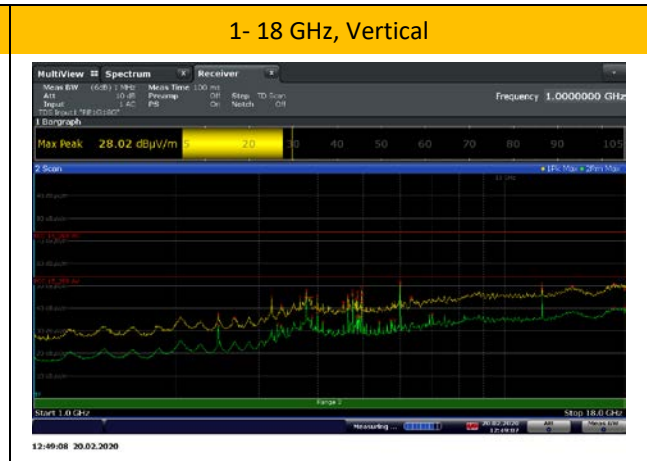
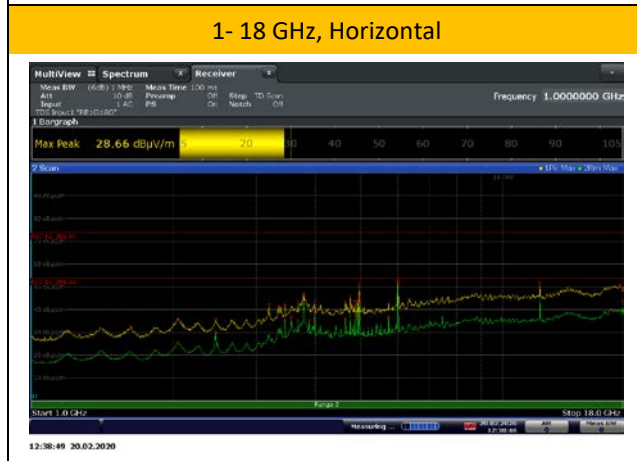
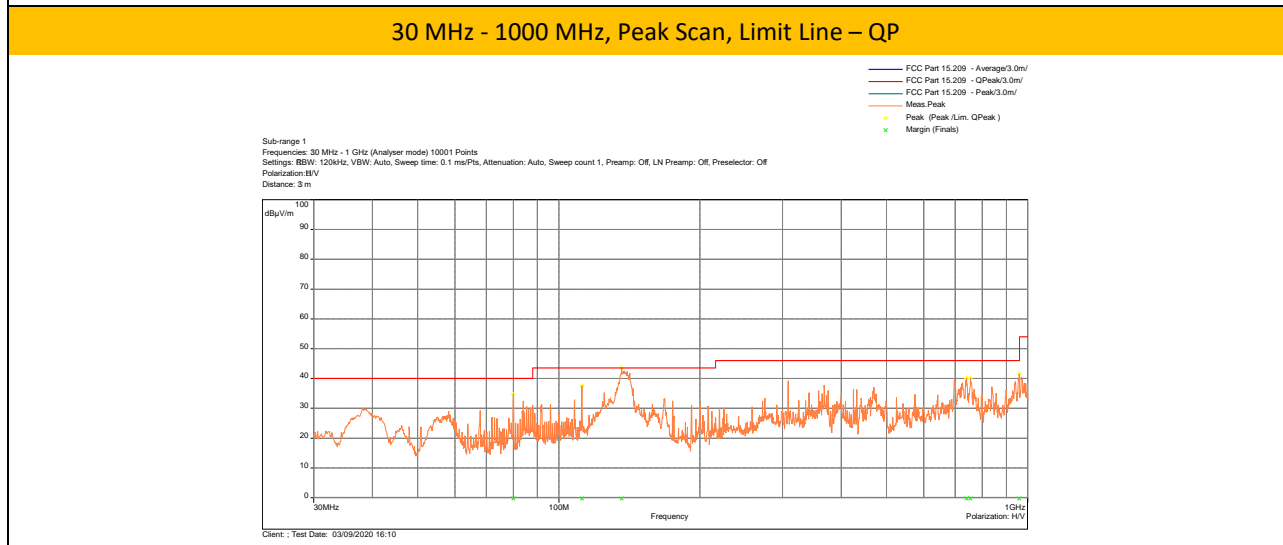
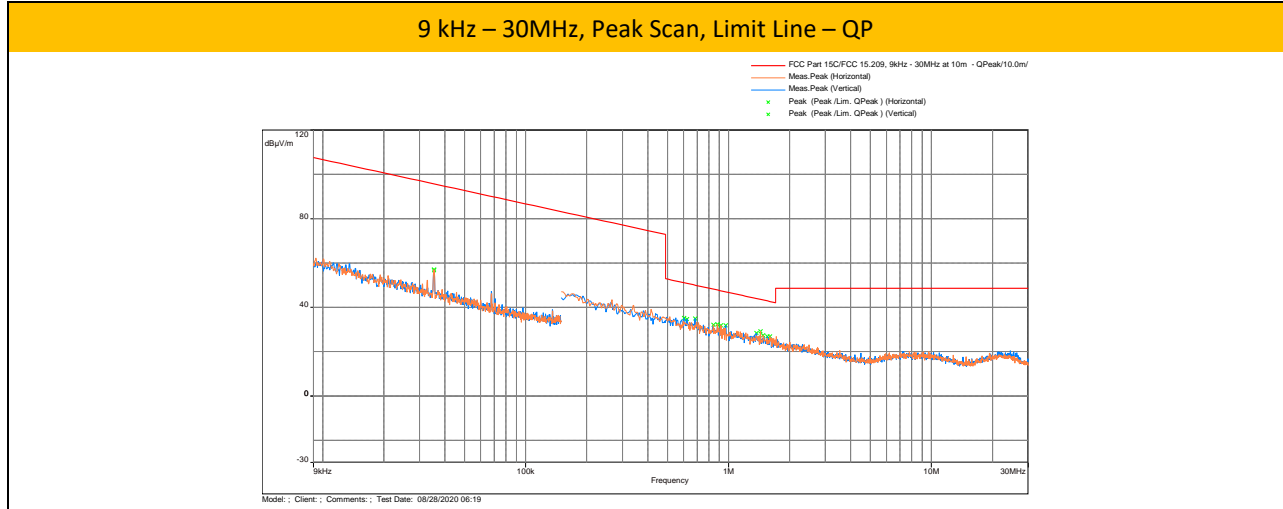


Note: Radiated spurious emissions measurements were performed from 9 kHz to 25 GHz.

13.6 Plots/Data: (Continued)

Configuration: ALP/Veritas Receiver + Remote Control Receiver

Radiated Spurious Emissions, 2480 MHz

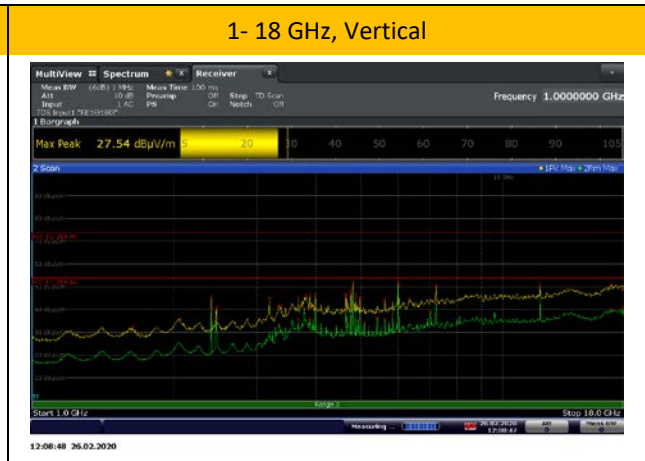
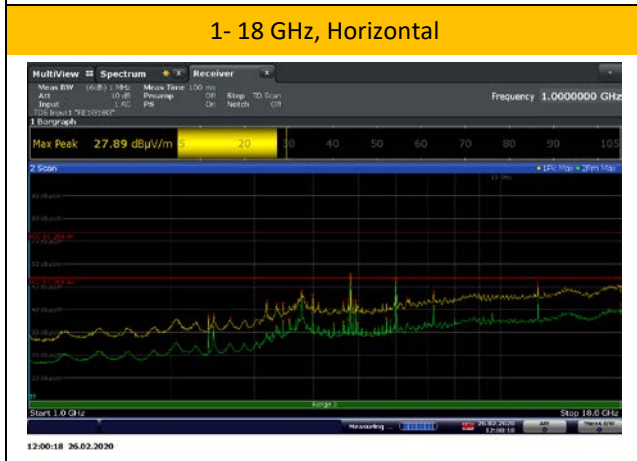
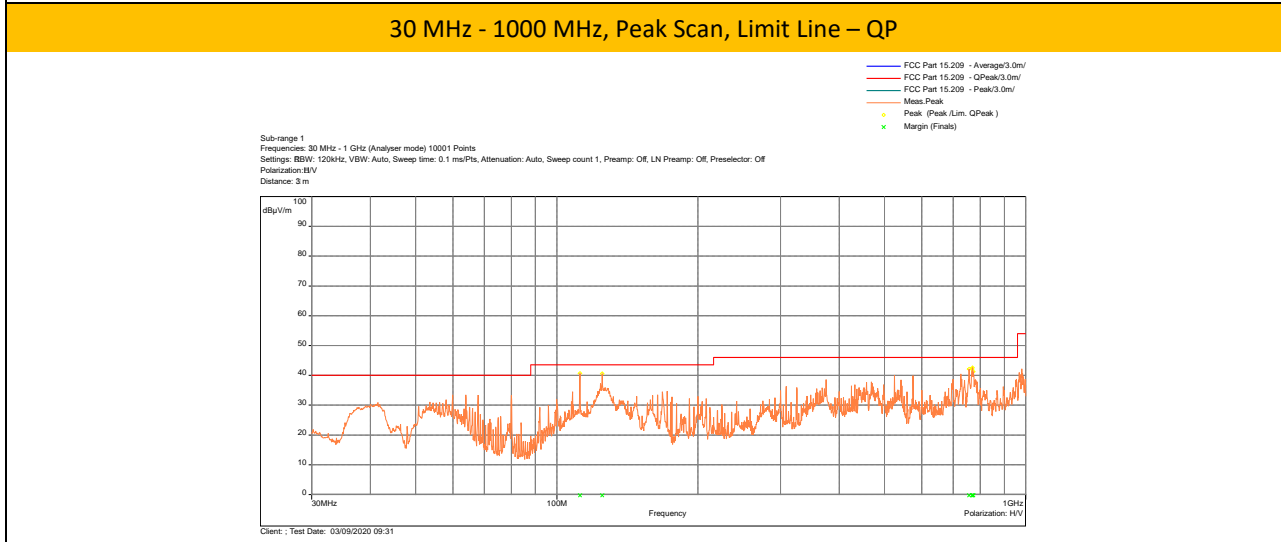
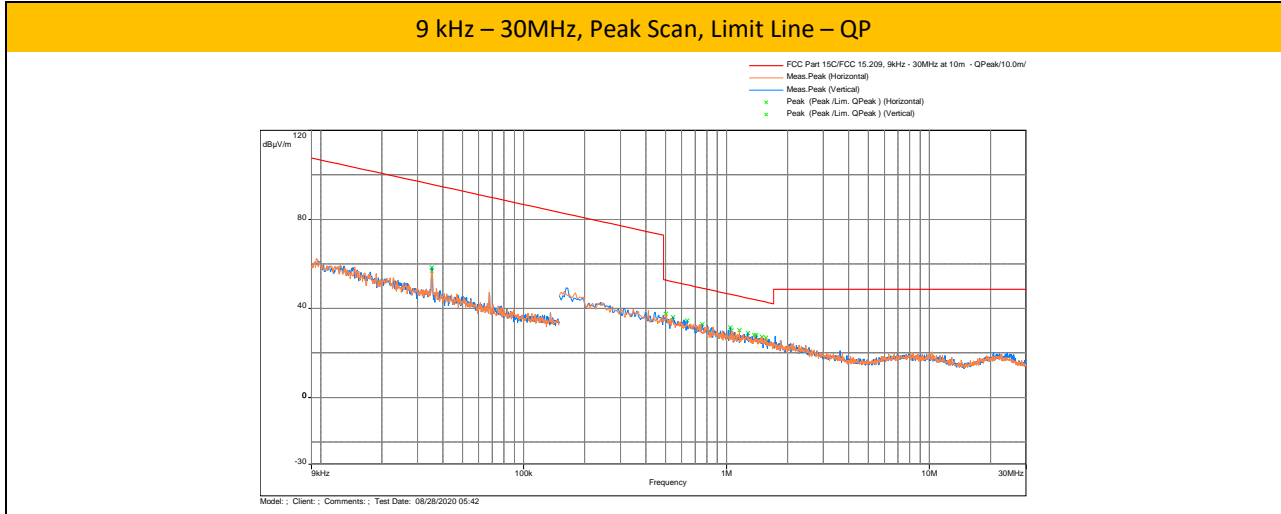


Note: Radiated spurious emissions measurements were performed from 9 kHz to 25 GHz.

13.6 Plots/Data: (Continued)

Configuration: ACP Receiver + Remote Control Receiver

Radiated Spurious Emissions, 2402 MHz

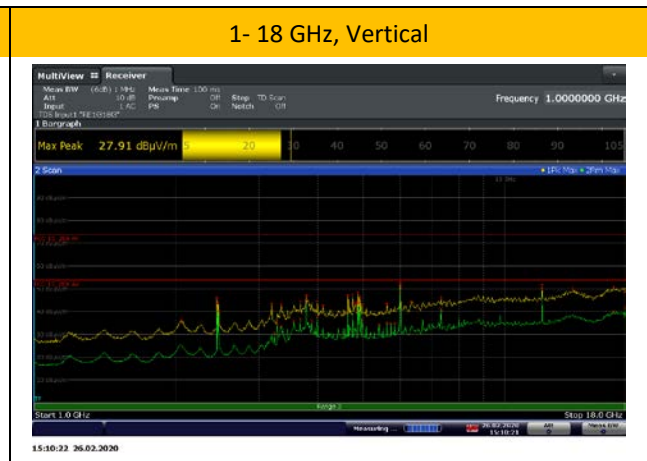
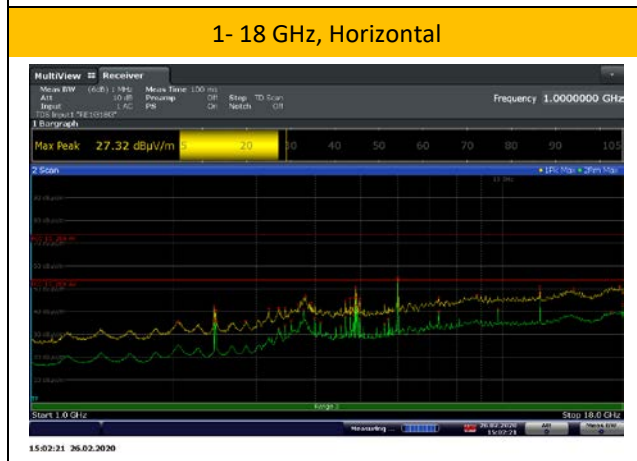
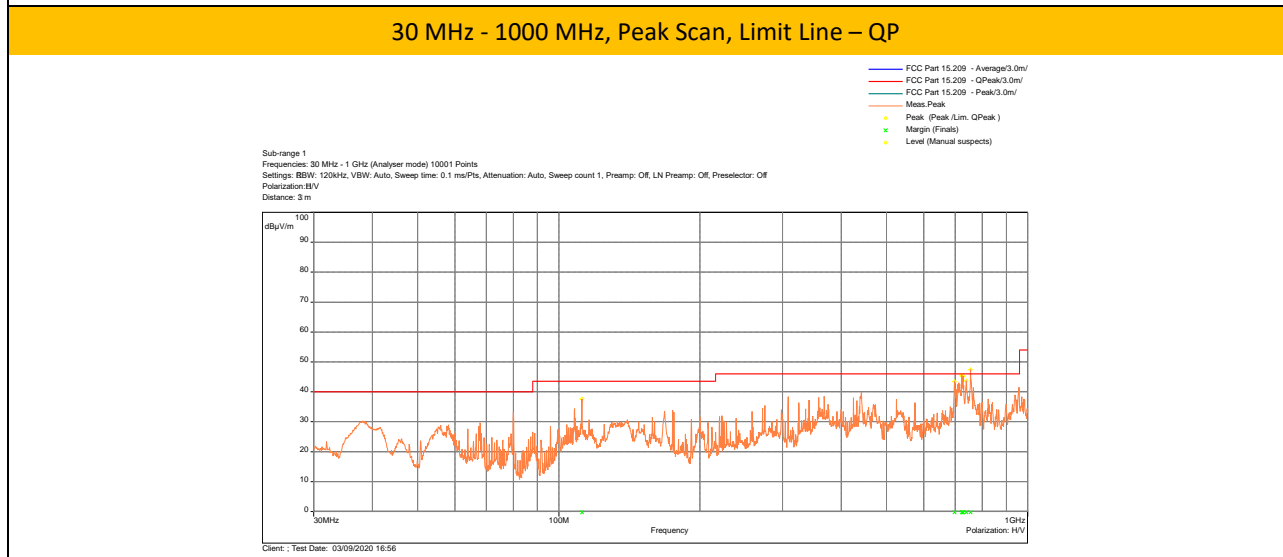
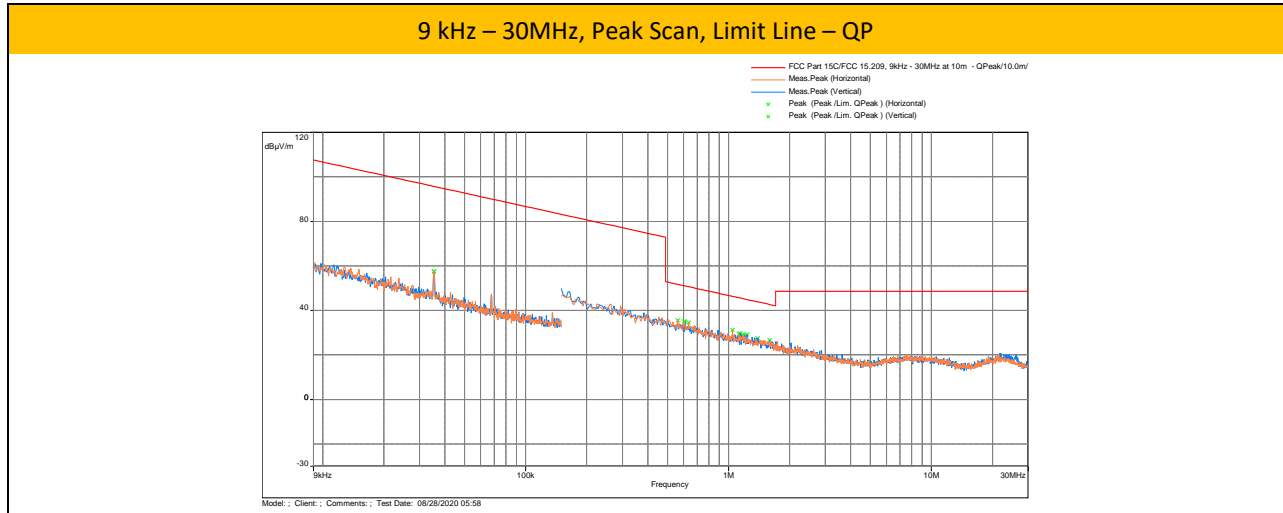


Note: Radiated spurious emissions measurements were performed from 9 kHz to 25 GHz.

13.6 Plots/Data: (Continued)

Configuration: ACP Receiver + Remote Control Receiver

Radiated Spurious Emissions, 2440 (Remote Control) and 2441 (ACP) MHz

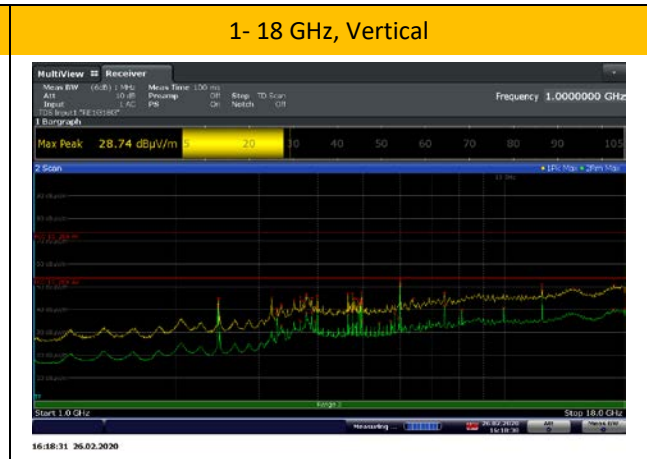
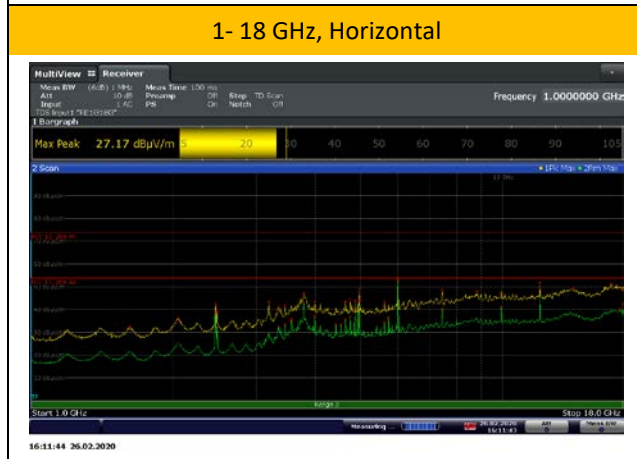
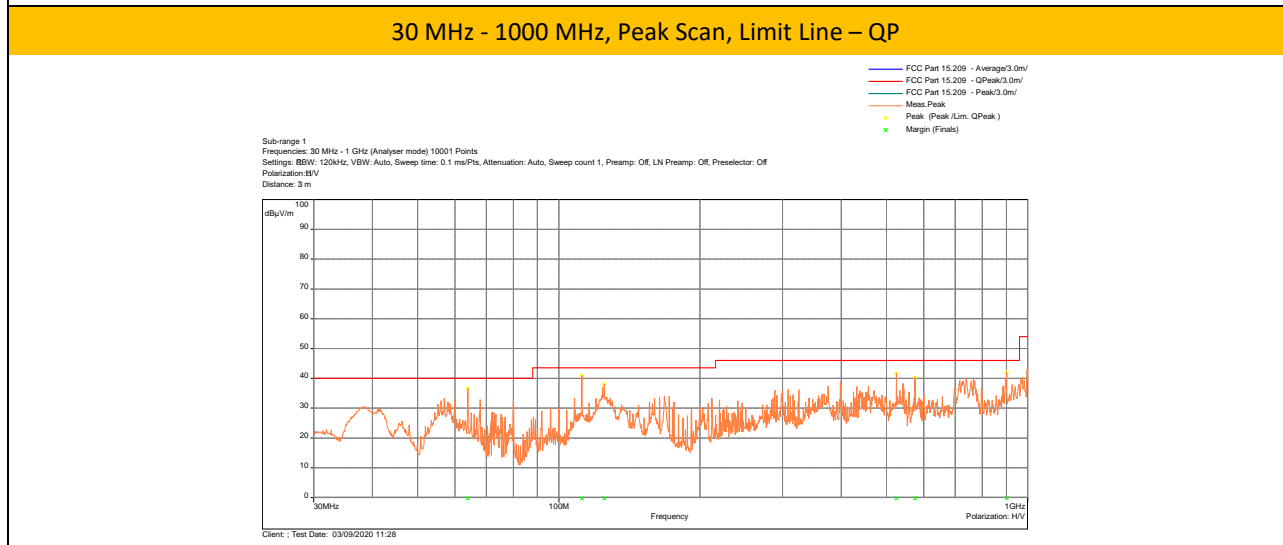
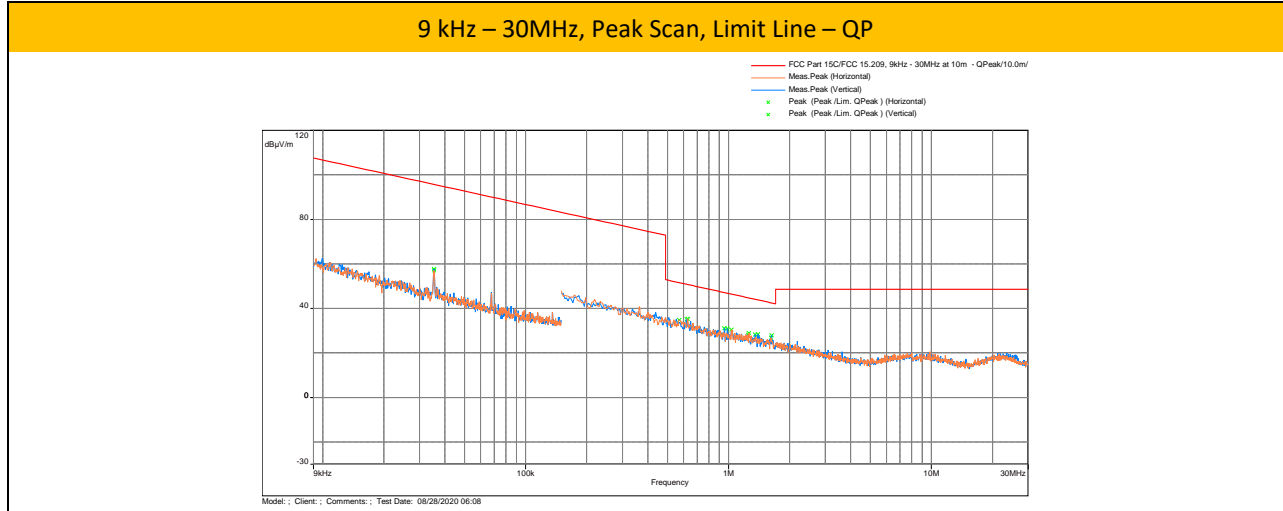


Note: Radiated spurious emissions measurements were performed from 9 kHz to 25 GHz.

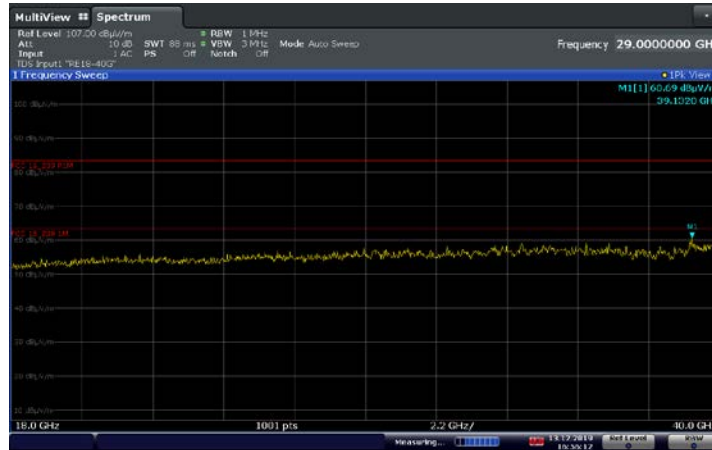
13.6 Plots/Data: (Continued)

Configuration: ACP Receiver + Remote Control Receiver

Radiated Spurious Emissions, 2480 MHz



Note: Radiated spurious emissions measurements were performed from 9 kHz to 25 GHz.



18-40 GHz Noise Floor with reference to limits at 0.1m and 1 m

13.6 Plots/Data: (Continued)**Configuration: ALP/Veritas Receiver + Remote Control Receiver**

Radiated spurious emissions, 30 MHz – 1 GHz, 2402 MHz:

Frequency (MHz)	QP FS (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Ant. Height (m)	Turntable Angle (°)	Ant. Pol.	Correction (dB)
138.25	40.91	43.5	-2.59	2.05	278.25	H	-11.56
139.90	40.05	43.5	-3.45	1.89	271.00	H	-11.60
724.62	34.50	46	-11.50	2.08	238.25	H	-2.81
725.59	31.16	46	-14.84	1.48	257.25	H	-2.81
729.08	34.66	46	-11.34	2.24	236.50	V	-2.81
757.11	32.39	46	-13.61	2.91	259.75	H	-2.40

Configuration: ALP/Veritas Receiver + Remote Control Receiver

Radiated spurious emissions, 30 MHz – 1 GHz, 2440 MHz:

Frequency (MHz)	QP FS (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Ant. Height (m)	Turntable Angle (°)	Ant. Pol.	Correction (dB)
137.19	42.03	43.5	-1.47	1.36	290.50	H	-11.54
698.43	35.23	46	-10.77	1.00	250.75	V	-3.24
699.01	35.10	46	-10.90	2.02	247.00	V	-3.24
754.49	32.39	46	-13.61	1.98	193.25	H	-2.40
755.46	33.61	46	-12.39	1.09	139.50	H	-2.39
757.40	34.09	46	-11.91	2.03	213.75	H	-2.40

Configuration: ALP/Veritas Receiver + Remote Control Receiver

Radiated spurious emissions, 30 MHz – 1 GHz, 2480 MHz:

Frequency (MHz)	QP FS (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Ant. Height (m)	Turntable Angle (°)	Ant. Pol.	Correction (dB)
79.96	31.75	40	-8.25	2.55	127.25	H	-17.59
111.97	36.42	43.5	-7.08	1.55	288.25	H	-12.28
136.02	42.20	43.5	-1.30	2.14	280.00	H	-11.54
740.23	26.58	46	-19.42	2.05	279.25	V	-2.58
755.37	29.93	46	-16.07	1.27	64.75	V	-2.39
958.97	29.24	46	-16.76	2.19	133.00	V	0.95

Configuration: ALP/Veritas Receiver + Remote Control Receiver

Radiated spurious emissions, above 1 GHz:

Antenna Polarization	Frequency (MHz)	Channel Freq. (MHz)	Final Field Strength (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Turtable Degree	Antenna Height (cm)	Detector
H	2390	2402	54.48	74.00	-19.52	275.75	123.00	PK
H	2390	2402	39.00	54.00	-15.00	275.75	123.00	RMS
H	4804	2402	55.19	74.00	-18.81	246.25	118.00	PK
H	4804	2402	50.03	54.00	-3.97	246.25	118.00	RMS
H	4880	2440	53.36	74.00	-20.64	242.25	161.00	PK
H	4880	2440	47.86	54.00	-6.14	242.25	161.00	RMS
H	7320	2440	49.50	74.00	-24.50	228.50	175.00	PK
H	7320	2440	40.07	54.00	-13.93	228.50	175.00	RMS
V	7320	2440	49.18	74.00	-24.82	328.75	176.00	PK
V	7320	2440	40.95	54.00	-13.05	328.75	176.00	RMS
V	2483.5	2480	58.57	74.00	-15.43	327.00	251.00	PK
V	2483.5	2480	50.33	54.00	-3.67	327.00	251.00	RMS
H	4960	2480	52.42	74.00	-21.58	276.00	104.00	PK
H	4960	2480	46.82	54.00	-7.18	276.00	104.00	RMS
H	5999.9241	2480	54.34	74.00	-19.66	129.25	110.00	PK
H	5999.9241	2480	52.07	54.00	-1.93	129.25	110.00	RMS
H	7440	2480	49.13	74.00	-24.87	301.50	257.00	PK
H	7440	2480	39.27	54.00	-14.73	301.50	257.00	RMS
V	7440	2480	48.78	74.00	-25.22	220.75	190.00	PK
V	7440	2480	39.95	54.00	-14.05	220.75	190.00	RMS
H	11999.844	2480	53.09	74.00	-20.91	134.00	181.00	PK
H	11999.844	2480	48.09	54.00	-5.91	134.00	181.00	RMS

Note: Radiated spurious emissions measurements were performed from 30 MHz to 25 GHz.

Configuration: ACP Receiver + Remote Control Receiver

Radiated spurious emissions, 30 MHz – 1 GHz, 2402 MHz:

Frequency (MHz)	QP FS (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Ant. Height (m)	Turntable Angle (°)	Ant. Pol.	Correction (dB)
111.97	38.13	43.5	-5.37	2.86	180.75	V	-12.28
124.96	39.15	43.5	-4.35	1.44	315.50	H	-11.49
757.02	30.19	46	-15.81	2.50	260.75	H	-2.40
769.33	35.99	46	-10.01	1.51	218.00	H	-2.38
769.92	29.66	46	-16.34	2.55	284.00	H	-2.39
773.51	30.81	46	-15.19	1.02	279.00	H	-2.28

Configuration: ACP Receiver + Remote Control Receiver

Radiated spurious emissions, 30 MHz – 1 GHz, 2440/2441 MHz:

Frequency (MHz)	Peak (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Ant. Height (m)	Turntable Angle (°)	Ant. Pol.	Correction (dB)
111.97	35.45	43.5	-8.05	3.14	20.00	V	-12.28
697.65	27.80	46	-18.20	2.50	68.75	V	-3.24
722.87	35.37	46	-10.63	1.11	100.50	V	-2.80
725.78	37.29	46	-8.71	1.51	101.50	V	-2.81
727.82	37.61	46	-8.39	1.51	86.75	V	-2.81
739.56	34.85	46	-11.15	2.19	74.75	V	-2.58

Configuration: ACP Receiver + Remote Control Receiver

Radiated spurious emissions, 30 MHz – 1 GHz, 2480 MHz:

Frequency (MHz)	QP FS (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)	Ant. Height (m)	Turntable Angle (°)	Ant. Pol.	Correction (dB)
63.95	30.02	40	-9.98	1.54	298.50	V	-17.79
111.97	39.94	43.5	-3.56	1.81	290.00	H	-12.28
124.96	35.19	43.5	-8.31	3.49	135.00	V	-11.49
524.99	39.82	46	-6.18	1.06	172.75	H	-5.50
575.04	38.07	46	-7.93	1.02	179.25	H	-4.70
902.03	20.63	46	-25.37	3.60	86.00	V	0.31

Configuration: ACP Receiver + Remote Control Receiver

Radiated spurious emissions, above 1 GHz:

Antenna Polarization	Frequency (MHz)	Channel Freq. (MHz)	Final Field Strength (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Turtable Degree	Antenna Height (cm)	Detector
H	2390	2402	59.85	74.00	-14.15	313.75	358.00	PK
H	2390	2402	41.25	54.00	-12.75	313.75	358.00	RMS
H	4804	2402	54.52	74.00	-19.48	298.50	210.00	PK
H	4804	2402	52.99	54.00	-1.01	298.50	210.00	RMS
H	4880	2440	51.37	74.00	-22.63	280.75	100.00	PK
H	4880	2440	49.80	54.00	-4.20	280.75	100.00	RMS
H	4882	2441	48.59	74.00	-25.41	301.50	177.00	PK
H	4882	2441	45.95	54.00	-8.05	301.50	177.00	RMS
H	7320	2440	46.37	74.00	-27.63	301.25	224.00	PK
H	7320	2440	39.06	54.00	-14.94	301.25	224.00	RMS
V	7320	2440	47.47	74.00	-26.53	238.75	180.00	PK
V	7320	2440	43.41	54.00	-10.59	238.75	180.00	RMS
H	2483.5	2480	53.91	74.00	-20.09	321.75	376.00	PK
H	2483.5	2480	50.26	54.00	-3.74	321.75	376.00	RMS
H	4960	2480	50.98	74.00	-23.02	316.00	134.00	PK
H	4960	2480	49.35	54.00	-4.65	316.00	134.00	RMS
H	5999.9	2480	54.68	74.00	-19.32	54.00	304.00	PK
H	5999.9	2480	52.88	54.00	-1.12	54.00	304.00	RMS
H	7440	2480	51.82	74.00	-22.18	273.25	157.00	PK
H	7440	2480	49.77	54.00	-4.23	273.25	157.00	RMS
H	11999.8	2480	53.99	74.00	-20.01	171.50	312.00	PK
H	11999.8	2480	51.68	54.00	-2.32	171.50	312.00	RMS

Test Personnel: <u>Grace Lin / Anderson Soungpanya</u> Product Standard: <u>FCC §15.247, ISED RSS-247</u> Input Voltage: <u>120 Vac, 60 Hz</u> Pretest Verification w/ BB Source: <u>Yes</u>	Test Date: <u>01/28/2020, 02/19-21/2020, 02/26-27/2020, 03/09/2020, 4/20/2020 & 08/28/2020</u> Limit Applied: <u>FCC §15.209, RSS-Gen §8.9</u> Ambient Temperature: <u>19.7 °C</u> Relative Humidity: <u>35.3 %</u> Atmospheric Pressure: <u>997.5 mbars</u>
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Deviations, Additions, or Exclusions: None

14 AC Mains Conducted Emissions

14.1 Performance Criterion

Frequency Band MHz	Conducted Limit dB(μ V)	
	Quasi-Peak	Average
0.15-0.50	66 to 56 *	56 to 46 *
0.50-5.00	56	46
5.00-30.00	60	50

*Note: *Decreases linearly with the logarithm of the frequency
At the transition frequency the lower limit applies.*

14.2 Method

Tests are performed in accordance with ANSI C63.4-2014.

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Floor standing EUT are placed on a horizontal metal ground plane and isolated from the ground plane by resting on an insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.4.

TEST SITE:

The test is performed in the 3 meter semi-anechoic chamber located at 25791 Commercentre Drive, Lake Forest, California 92630 USA. This test facility meets the requirements of CISPR 16-1-4 and has been accredited by A2LA. IC test site registration number is 2042T.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucisp
AC Line Conducted Emissions	150 kHz - 30 MHz	2.1 dB	3.4dB

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

Sample Calculations

The following is how net line-conducted readings were determined:

$$NF = RF + LF + CF + AF$$

Where NF = Net Reading in dB μ V

RF = Reading from receiver in dB μ V

LF = LISN or ISN Correction Factor in dB

CF = Cable Correction Factor in dB

AF = Attenuator Loss Factor in dB

To convert from dB μ V to μ V or mV the following was used:

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

NF = Net Reading in dB μ V

Example:

$$NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 \text{ dB}\mu\text{V}$$

$$UF = 10^{(49.1 \text{ dB}\mu\text{V} / 20)} = 285.1 \mu\text{V/m}$$

14.3 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
00984	10m Semi-anechoic Chamber	Panashield	10 Meter Chamber	NA	09/11/2018	09/11/2021
01607	EMI Test Receiver	R&S	ESR7	101369	10/23/2020	10/23/2020
00522	LISN	FCC	FCC-LISN-50-50-M-H	2012	12/12/2019	12/12/2020
01330	RF Cable	TRU Corporation	TRU CORE 300	ITS 01330	05/09/2019	05/09/2020
01465	RF Cable	TRU Corporation	TRU CORE 300	ITS 01465	08/27/2019	08/27/2020
01470	RF Cable	TRU Corporation	TRU CORE 300	ITS 01470	08/27/2019	08/27/2020
01715	Transient Limiter	COM-POWER	LIT-930A	22020032	11/11/2019	11/11/2020
01706	Barometric Pressure/ Humidity/ Temperature Datalogger	Omega Eng.	IBTHX-W	M19230374	07/16/2019	07/16/2020

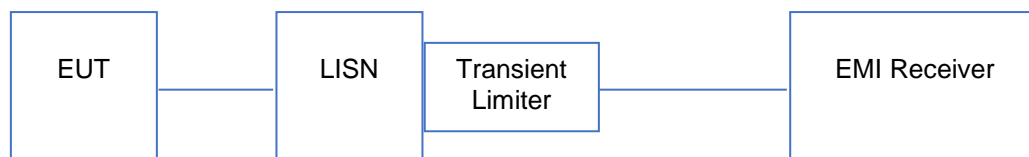
Software Utilized:

Name	Manufacturer	Version	Profile
BAT-EMC	Nexio	3.18.0.23	-

14.4 Results:

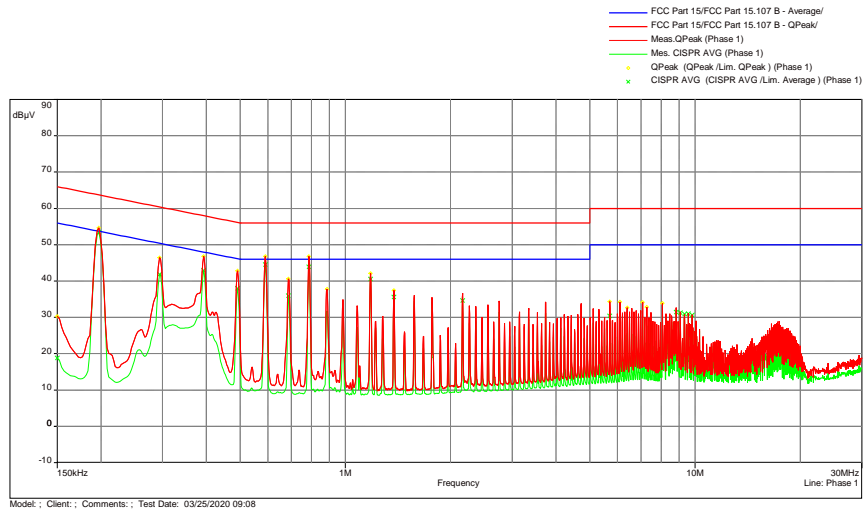
The sample tested was found to Comply.

14.5 Test Setup Diagram:

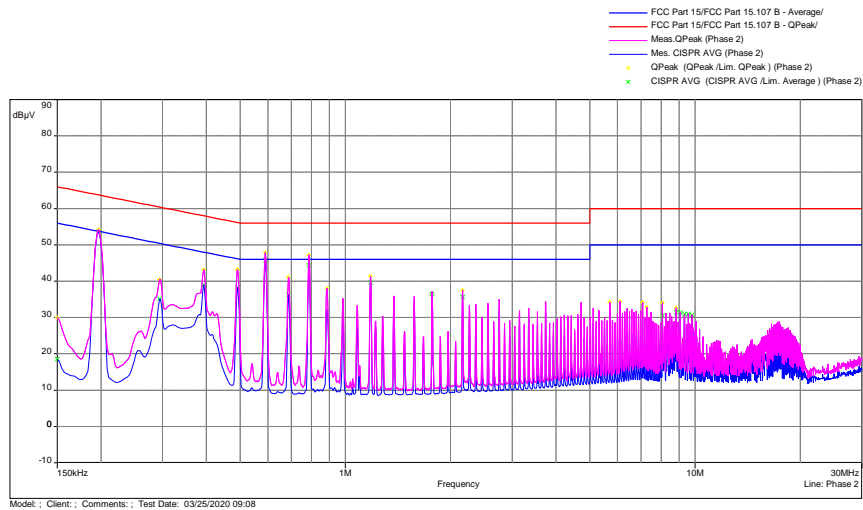


14.6 Plots/Data:

Line 1, ALP/Veritas Receiver + Remote Control Receiver:



Line 2, ALP/Veritas Receiver + Remote Control Receiver:



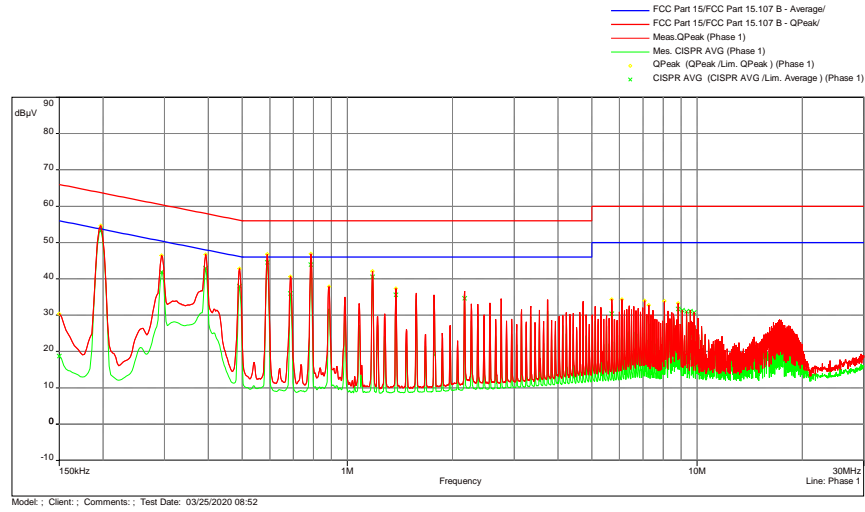
Quasi-Peak Table

Frequency (MHz)	QPeak (dB μ V)	Lim. QPeak (dB μ V)	QPeak-Lim (dB)	Comment	Correction (dB)
0.150	30.30	66.00	-35.70	Phase 1	10.71
0.150	30.06	66.00	-35.94	Phase 2	10.71
0.197	54.68	63.73	-9.05	Phase 1	10.67
0.197	54.27	63.73	-9.46	Phase 2	10.67
0.294	46.45	60.41	-13.96	Phase 1	10.63
0.294	40.51	60.41	-19.90	Phase 2	10.63
0.393	46.77	58.00	-11.23	Phase 1	10.63
0.393	43.21	58.00	-14.79	Phase 2	10.63
0.492	43.26	56.13	-12.87	Phase 2	10.63
0.492	42.86	56.13	-13.27	Phase 1	10.63
0.591	47.89	56.00	-8.11	Phase 2	10.62
0.591	46.80	56.00	-9.20	Phase 1	10.62
0.688	40.58	56.00	-15.42	Phase 1	10.62
0.688	41.12	56.00	-14.88	Phase 2	10.62
0.787	46.84	56.00	-9.16	Phase 1	10.62
0.787	47.24	56.00	-8.76	Phase 2	10.62
0.886	38.05	56.00	-17.95	Phase 2	10.62
0.886	37.80	56.00	-18.20	Phase 1	10.62
1.181	41.40	56.00	-14.60	Phase 2	10.65
1.181	42.09	56.00	-13.91	Phase 1	10.65
1.376	37.41	56.00	-18.59	Phase 1	10.66
2.164	37.57	56.00	-18.43	Phase 2	10.70
5.705	34.37	60.00	-25.63	Phase 1	10.89
5.705	34.31	60.00	-25.69	Phase 2	10.89
6.099	34.46	60.00	-25.54	Phase 2	10.91
6.099	34.27	60.00	-25.73	Phase 1	10.91
6.394	32.65	60.00	-27.35	Phase 1	10.92
7.082	34.14	60.00	-25.86	Phase 1	10.95
7.082	34.19	60.00	-25.81	Phase 2	10.95
7.278	32.86	60.00	-27.14	Phase 1	10.96
7.278	32.87	60.00	-27.13	Phase 2	10.96
8.066	34.07	60.00	-25.93	Phase 2	10.99
8.066	33.90	60.00	-26.10	Phase 1	10.99
8.828	32.64	60.00	-27.36	Phase 2	11.02

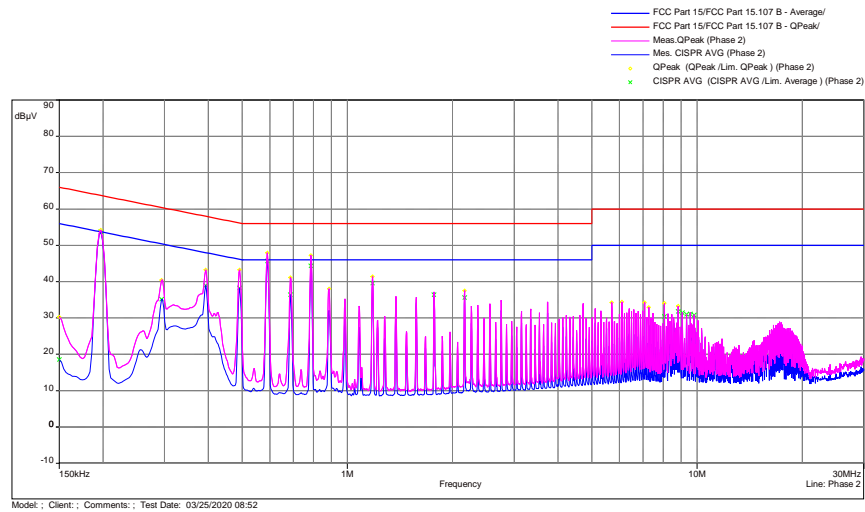
Average Table

Frequency (MHz)	Ave (dB μ V)	Lim. Ave (dB μ V)	Ave-Lim (dB)	Comment	Correction (dB)
0.150	18.78	56.00	-37.22	Phase 1	10.71
0.150	18.58	56.00	-37.42	Phase 2	10.71
0.197	53.44	53.73	-0.28	Phase 1	10.67
0.197	53.70	53.73	-0.03	Phase 2	10.67
0.294	41.85	50.41	-8.56	Phase 1	10.63
0.294	35.12	50.41	-15.29	Phase 2	10.63
0.393	42.93	48.00	-5.07	Phase 1	10.63
0.393	38.93	48.00	-9.07	Phase 2	10.63
0.492	38.25	46.13	-7.89	Phase 2	10.63
0.492	37.96	46.13	-8.17	Phase 1	10.63
0.591	45.63	46.00	-0.37	Phase 2	10.62
0.591	44.50	46.00	-1.50	Phase 1	10.62
0.688	35.94	46.00	-10.06	Phase 1	10.62
0.688	36.34	46.00	-9.66	Phase 2	10.62
0.787	43.88	46.00	-2.12	Phase 1	10.62
0.787	44.29	46.00	-1.71	Phase 2	10.62
1.181	39.53	46.00	-6.47	Phase 2	10.65
1.181	40.52	46.00	-5.48	Phase 1	10.65
1.376	35.58	46.00	-10.42	Phase 1	10.66
1.770	36.42	46.00	-9.58	Phase 2	10.68
2.164	34.58	46.00	-11.42	Phase 1	10.70
2.164	35.61	46.00	-10.39	Phase 2	10.70
5.705	30.34	50.00	-19.66	Phase 1	10.89
8.066	30.43	50.00	-19.57	Phase 2	10.99
8.828	31.48	50.00	-18.52	Phase 2	11.02
8.828	31.48	50.00	-18.52	Phase 1	11.02
9.074	31.31	50.00	-18.69	Phase 2	11.02
9.074	31.28	50.00	-18.72	Phase 1	11.02
9.319	30.90	50.00	-19.10	Phase 1	11.03
9.319	30.92	50.00	-19.08	Phase 2	11.03
9.564	30.98	50.00	-19.02	Phase 1	11.05
9.564	30.99	50.00	-19.01	Phase 2	11.05
9.809	30.63	50.00	-19.37	Phase 2	11.05
9.809	30.63	50.00	-19.37	Phase 1	11.05

Line 1, ACP Receiver+ Remote Control Receiver:



Line 2, ACP Receiver+ Remote Control Receiver:



Quasi-Peak Table

Frequency (MHz)	QPeak (dB μ V)	Lim. QPeak (dB μ V)	QPeak-Lim (dB)	Comment	Correction (dB)
0.150	30.35	66.00	-35.65	Phase 1	10.71
0.150	30.29	66.00	-35.71	Phase 2	10.71
0.197	54.67	63.73	-9.05	Phase 1	10.67
0.197	54.26	63.73	-9.46	Phase 2	10.67
0.294	46.41	60.41	-14.00	Phase 1	10.63
0.294	40.49	60.41	-19.92	Phase 2	10.63
0.393	46.72	58.00	-11.28	Phase 1	10.63
0.393	43.24	58.00	-14.76	Phase 2	10.63
0.492	43.27	56.13	-12.86	Phase 2	10.63
0.492	42.87	56.13	-13.26	Phase 1	10.63
0.591	47.93	56.00	-8.07	Phase 2	10.62
0.591	46.84	56.00	-9.16	Phase 1	10.62
0.688	40.60	56.00	-15.40	Phase 1	10.62
0.688	41.11	56.00	-14.89	Phase 2	10.62
0.787	46.86	56.00	-9.14	Phase 1	10.62
0.787	47.23	56.00	-8.77	Phase 2	10.62
0.886	38.07	56.00	-17.93	Phase 2	10.62
0.886	37.85	56.00	-18.15	Phase 1	10.62
1.181	42.13	56.00	-13.87	Phase 1	10.65
1.181	41.43	56.00	-14.57	Phase 2	10.65
1.376	37.38	56.00	-18.62	Phase 1	10.66
2.164	37.57	56.00	-18.43	Phase 2	10.70
5.705	34.30	60.00	-25.70	Phase 2	10.89
5.705	34.36	60.00	-25.64	Phase 1	10.89
6.099	34.45	60.00	-25.55	Phase 2	10.91
6.099	34.38	60.00	-25.62	Phase 1	10.91
7.082	34.29	60.00	-25.71	Phase 2	10.95
7.082	33.98	60.00	-26.02	Phase 1	10.95
7.278	32.78	60.00	-27.22	Phase 1	10.96
7.278	32.94	60.00	-27.06	Phase 2	10.96
8.066	33.89	60.00	-26.11	Phase 1	10.99
8.066	34.06	60.00	-25.94	Phase 2	10.99
8.833	33.32	60.00	-26.68	Phase 2	11.02
8.833	33.26	60.00	-26.74	Phase 1	11.02

Average Table

Frequency (MHz)	Ave (dB μ V)	Lim. Ave (dB μ V)	Ave-Lim (dB)	Comment	Correction (dB)
0.150	18.75	56.00	-37.25	Phase 1	10.71
0.150	18.56	56.00	-37.44	Phase 2	10.71
0.197	53.45	53.73	-0.28	Phase 1	10.67
0.197	53.70	53.73	-0.03	Phase 2	10.67
0.294	41.88	50.41	-8.53	Phase 1	10.63
0.294	35.14	50.41	-15.27	Phase 2	10.63
0.393	42.93	48.00	-5.07	Phase 1	10.63
0.393	38.96	48.00	-9.04	Phase 2	10.63
0.492	38.22	46.13	-7.91	Phase 2	10.63
0.492	37.98	46.13	-8.16	Phase 1	10.63
0.591	45.67	46.00	-0.33	Phase 2	10.62
0.591	44.52	46.00	-1.48	Phase 1	10.62
0.688	35.99	46.00	-10.01	Phase 1	10.62
0.688	36.37	46.00	-9.63	Phase 2	10.62
0.787	43.89	46.00	-2.11	Phase 1	10.62
0.787	44.33	46.00	-1.67	Phase 2	10.62
1.181	39.52	46.00	-6.48	Phase 2	10.65
1.181	40.53	46.00	-5.47	Phase 1	10.65
1.376	35.56	46.00	-10.44	Phase 1	10.66
1.770	36.42	46.00	-9.58	Phase 2	10.68
2.164	34.59	46.00	-11.41	Phase 1	10.70
2.164	35.62	46.00	-10.38	Phase 2	10.70
5.705	30.38	50.00	-19.62	Phase 1	10.89
8.066	30.38	50.00	-19.62	Phase 2	10.99
8.833	31.75	50.00	-18.25	Phase 2	11.02
8.833	31.74	50.00	-18.26	Phase 1	11.02
9.078	31.42	50.00	-18.58	Phase 2	11.02
9.078	31.38	50.00	-18.62	Phase 1	11.02
9.323	30.96	50.00	-19.04	Phase 1	11.03
9.323	31.00	50.00	-19.00	Phase 2	11.03
9.569	31.06	50.00	-18.94	Phase 1	11.05
9.569	31.09	50.00	-18.91	Phase 2	11.05
9.814	30.83	50.00	-19.17	Phase 2	11.05
9.814	30.73	50.00	-19.27	Phase 1	11.05

Test Personnel:	<u>Anderson Soungpanya</u>	Test Date:	<u>March 25, 2020</u>
Product Standard:	<u>FCC §15.247, ISED RSS-247</u>	Limit Applied:	<u>FCC §15.207</u>
Input Voltage:	<u>120 Vac, 60 Hz</u>	Ambient Temperature:	<u>21.9 °C</u>
Pretest Verification w/ BB Source:	<u>N/A</u>	Relative Humidity:	<u>38.9 %</u>
		Atmospheric Pressure:	<u>1019.7 mbars</u>

15 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	04/23/2020	104086841LAX-015	GL/AS	KV	Initial Issue
1	09/01/2020	104086841LAX-015	AS	KV	Updated section 13 with below 30MHz radiated emissions test data