CERTIFICATION TEST REPORT

Report Number. : 12727679-E2V2

Applicant	:	WARMBOARD INC 8035 SOQUEL DR APTOS, CA 95003, U.S.A.
Model	:	WMC-01
FCC ID	:	2ASM7-WMC01
IC	:	24839-WMC01
EUT Description	:	MANIFOLD CONTROLLER WITH LORA WIRELESS COMMUNICATION
Test Standard(s)	:	FCC 47 CFR PART 15 SUBPART C ISED RSS-247 ISSUE 2 ISED RSS-GEN ISSUE 5

Date Of Issue:
April 09, 2019

Prepared by:
UL Verification Services Inc.
47173 Benicia Street
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NVLAP Lab code: 200065-0

REPORT REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
V1	4/5/2019	Initial Issue	--
V2	4/9/2019	Updated report to address TCB's question	Tina

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: WARMBOARD INC
8035 SOQUEL DR
APTOS, CA 95003, U.S.A.

EUT DESCRIPTION: MANIFOLD CONTROLLER WITH LORA WIRELESS COMMUNICATION

MODEL: WMC-01

SERIAL NUMBER: FCC-MC-HPDTeK-1

DATE TESTED: MARCH 20, 2019 TO MARCH 28, 2019

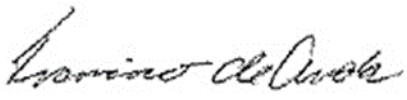
APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Complies
ISED RSS-247 Issue 2	Complies
ISED RSS-GEN Issue 5	Complies

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.

Approved & Released For
UL Verification Services Inc. By:



FRANCISCO DE ANDA
PROJECT LEAD
UL Verification Services Inc.

Prepared By:

ERIC YU
TEST ENGINEER
UL Verification Services Inc.

Reviewed By:

TINA CHU
SENIOR PROJECT ENGINEER
UL Verification Services Inc.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, ANSI C63.10-2013, KDB 558074 D01 15.247 Meas Guidance v05r02, RSS-GEN Issue 5 Amendment 1, and RSS-247 Issue 2.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street	47658 Kato Rd.
☐ Chamber A (ISED:2324B-1)	☐ Chamber D (ISED:22541-1)	☐ Chamber I (ISED: 2324A-5)
☐ Chamber B (ISED:2324B-2)	☐ Chamber E (ISED:22541-2)	☒ Chamber J (ISED: 2324A-6)
☐ Chamber C (ISED:2324B-3)	☐ Chamber F (ISED:22541-3)	☐ Chamber K (ISED: 2324A-1)
	☐ Chamber G (ISED:22541-4)	☐ Chamber L (ISED: 2324A-3)
	☐ Chamber H (ISED:22541-5)	

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0

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4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:
Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:
Final Voltage (dBuV) = Measured Voltage (dBuV) + Cable Loss (dB) + Limiter Factor (dB) + LISN Insertion Loss.
36.5 dBuV + 0 dB +10.1 dB+ 0 dB = 46.6 dBuV

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Worst Case Conducted Disturbance, 9KHz to 0.15 MHz	3.84 dB
Worst Case Conducted Disturbance, 0.15 to 30 MHz	3.65 dB
Worst Case Radiated Disturbance, 9KHz to 30 MHz	2.52 dB
Worst Case Radiated Disturbance, 30 to 1000 MHz	4.88 dB
Worst Case Radiated Disturbance, 1000 to 18000 MHz	4.24 dB
Worst Case Radiated Disturbance, 18000 to 26000 MHz	4.37 dB
Worst Case Radiated Disturbance, 26000 to 40000 MHz	5.17 dB

Uncertainty figures are valid to a confidence level of 95%.

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5. EQUIPMENT UNDER TEST

5.1. EUT DESCRIPTION

The EUT is a manifold controller with LoRa 915MHz wireless communication. It communicates with the Warmsource and Actuators to control the flow of heat to each zone. It is categorized as Digital Transmission System (DTS).

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
903 -927	LoRa	17.38	54.70

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a dipole Omni-directional antenna with a maximum gain of 3dBi.

5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing was Version 031819
The firmware installed in the EUT during testing was Version 031819

5.5. WORST-CASE CONFIGURATION AND MODE

Band edge and radiated emissions were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

The dipole antenna can only be operated in two different orientations. Therefore, the fundamental of the EUT was investigated in two orthogonal orientations X/Y, it was determined that Y- orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in Y- orientation.

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5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Description	Manufacturer	Model	Serial Number	FCC ID/DoC
Laptop	Sony	PCG-31113L	54042658 0003472	DoC
Laptop AC/DC adapter	Sony	VGP-AC19V32	148095531 0289840	DoC
Development Board	Warmboard	N/A	N/A	N/A

I/O CABLES (CONDUCTED TEST)

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length m	Remarks
1	AC	1	AC	Unshielded	1.5	AC Mains to AC/DC adapter
2	DC	1	DC	Unshielded	1.8	AC/DC adapter to laptop
3	USB	1	Serial ports	Shielded	0.5	Laptop to development board
4	Antenna	1	SMA	Unshielded	0.1	To spectrum analyzer
5	AC	1	3-prong	Unshielded	1.5	To EUT
6	Ribbon Cable	1	8 pins	Unshielded	0.15	development board to EUT

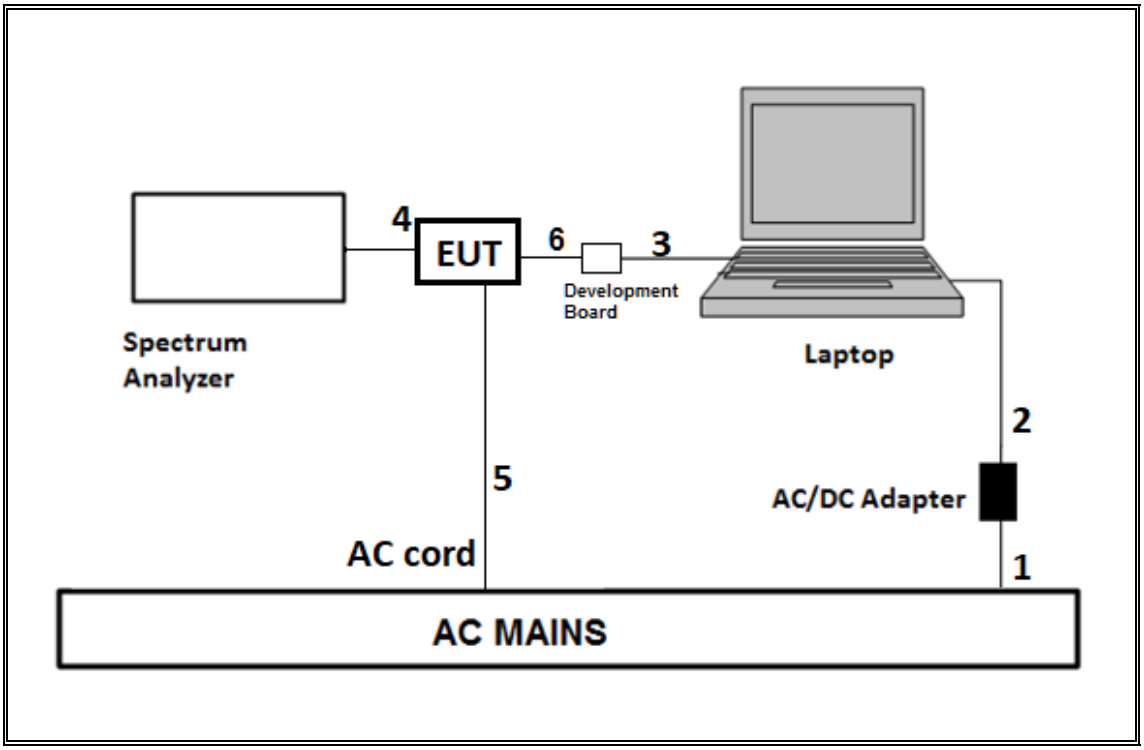
I/O CABLES (RADIATED TEST AND AC POWER LINE TEST)

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length m	Remarks
1	AC	1	3-prong	Unshielded	1.5	To EUT

TEST SETUP-CONDUCTED TEST

The EUT is AC powered. Test software exercised the EUT.

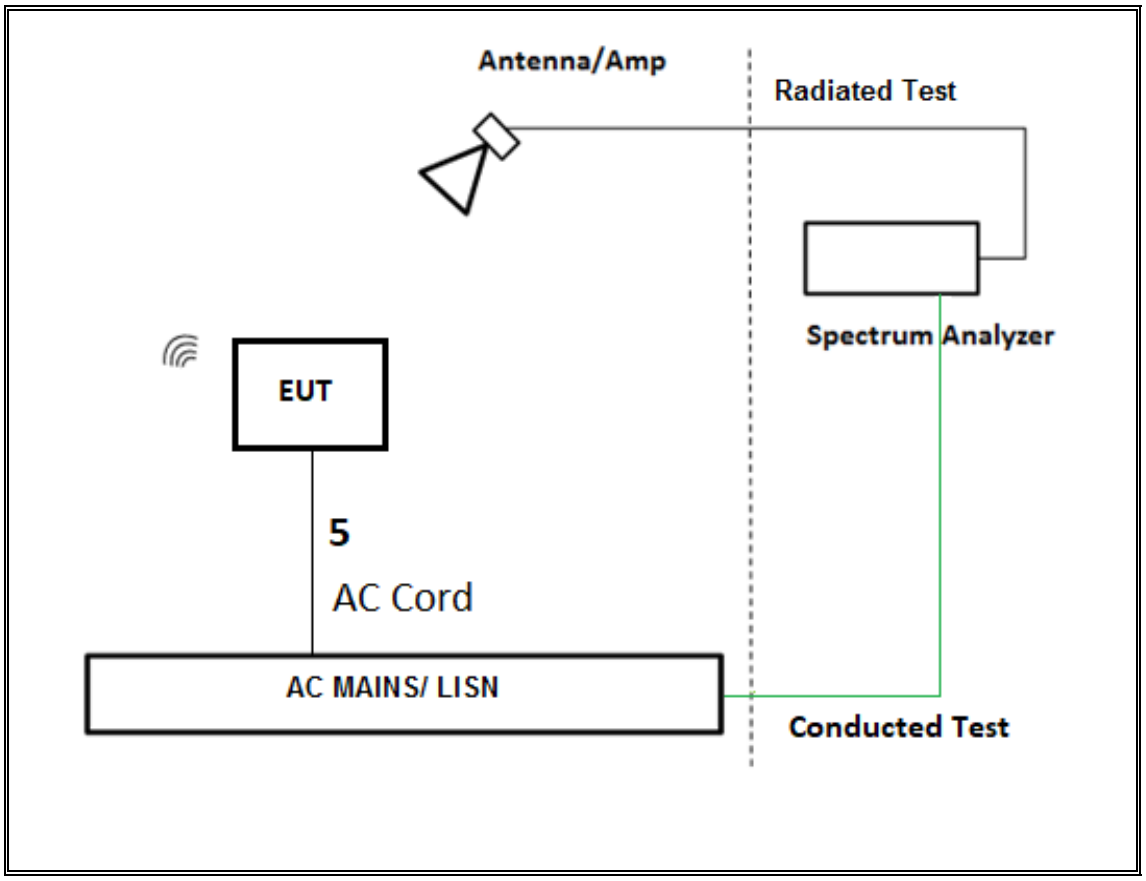
SETUP DIAGRAM



TEST SETUP- RADIATED TEST AND AC POWER LINE TEST

The EUT is AC powered. Test software exercised the EUT. Laptop was removed after test script was started.

SETUP DIAGRAM



6. MEASUREMENT METHOD

6 dB BW: ANSI C63.10 Subclause -11.8.1

Occupied BW (99%): ANSI C63.10-2013 Section 6.9.3

Output Power: ANSI C63.10 Subclause -11.9.1.3 Method PKPM1 Peak-reading power meter

Average Output Power:ANSI C63.10 Subclause -11.9.2.3.2 Method AVGPM-G (Measurement using a gated RF average-reading power meter)

PSD: ANSI C63.10 Subclause -11.10.2 Method PKPSD (peak PSD)

Radiated emissions non-restricted frequency bands: ANSI C63.10 Subclause -11.11

Radiated emissions restricted frequency bands: ANSI C63.10 Subclause -11.12.1

Conducted emissions in restricted frequency bands: ANSI C63.10 Subclause -11.12.2

Band-edge: ANSI C63.10 Subclause -11.13.3.4 Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction

AC Power Line Conducted Emissions: ANSI C63.10-2013, Section 6.2.

Radiated Spurious Emissions Below 30MHz: ANSI C63.10-2013 Section 6.4

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7. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST					
Description	**Manufacturer**	**Model**	**ID Num**	**Cal Due**	**Last Cal**
Power Meter, P-series single channel	Agilent (Keysight) Technologies	N1911A	T1262	1/31/2020	1/31/2019
Power Sensor, P - series, 50MHz to 18GHz, Wideband	Agilent (Keysight) Technologies	N1921A	T1223	2/25/2020	2/25/2019
Loop Antenna 30Hz-1MHz	Electro Metrics	EM-6871	PRE0179465	5/22/2019	5/22/2018
Loop Antenna 100KHz-30MHz	Electro Metrics	EM-6872	PRE0179467	5/22/2019	5/22/2018
Amplifier, 9KHz to 1GHz, 32dB	Sonoma Instrument	310	PRE0180174	5/31/2019	5/31/2018
Hybrid Antenna, 30MHz to 3GHz	SunAR rf motion	JB3	PRE0181575	8/1/2019	8/1/2018
Antenna, Horn 1-18GHz	AR	AMPL-ATH1G18	PRE0189055	4/20/2019	4/20/2018
Amplifier, 1 to 18GHz, 35dB	AMPLICAL	AMP1G18-35	T1571	7/30/2019	7/30/2018
EMI TEST RECEIVER	Rohde & Schwarz	ESW44	PRE0179372	5/4/2019	5/4/2018
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent (Keysight) Technologies	N9030A	T917	1/24/2020	1/24/2019
Filter, BRF 902 to 928MHz	MICRO-TRONICS	BRC50722	T1846	8/16/2019	8/16/2018
Filter, Highpass 1.2GHz	MICRO-TRONICS	HPM50108	PRE0182423	9/4/2019	9/4/2018
AC Line Conducted					
EMI Receiver	Rohde & Schwarz	ESR	T1436	2/14/2020	2/14/2019
LISN for Conducted Emissions CISPR-16	FCC INC.	FCC LISN 50/250	T1310	6/15/2019	6/15/2018
Test Software List					
Radiated Software	UL	UL EMC		Ver 9.5, Jan 11, 2019	
Antenna Port Software	UL	UL RF		Ver 9.4.1, Feb 19, 2019	
AC Line Conducted Software	UL	UL EMC		Ver 9.5, May 26, 2015	

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8. ANTENNA PORT TEST RESULTS

8.1. ON TIME AND DUTY CYCLE

LIMITS

None; for reporting purposes only.

PROCEDURE

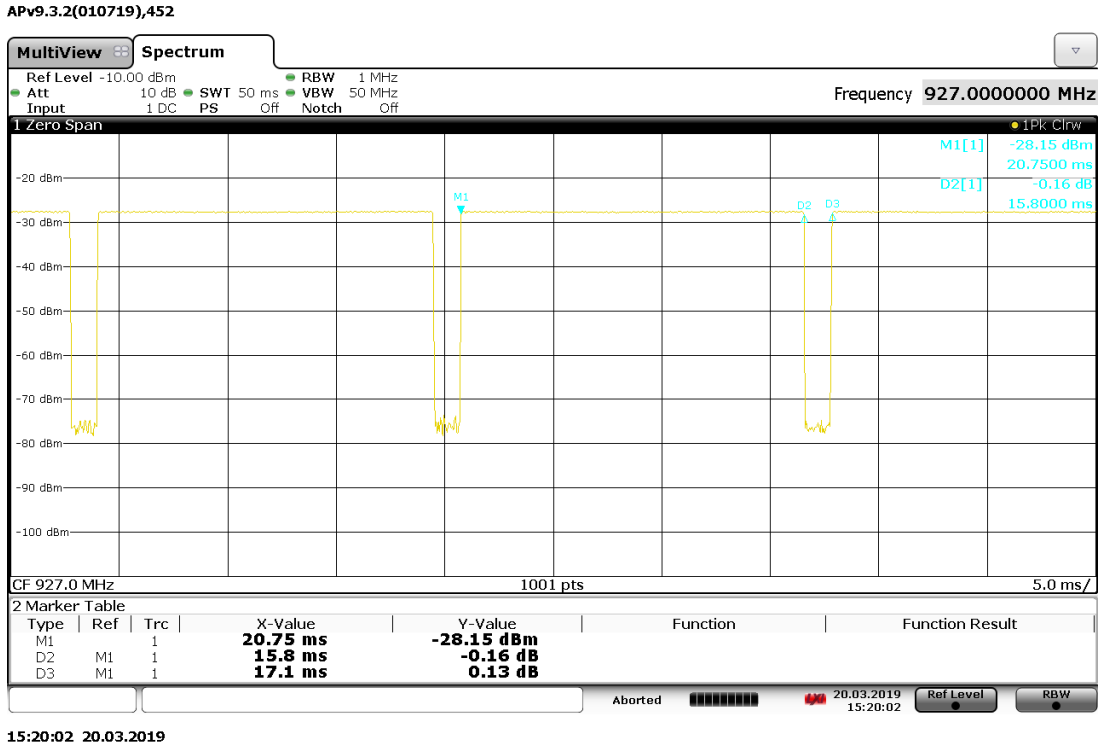
KDB 558074 Zero-Span Spectrum Analyzer Method.

RESULTS

Date:	3/20/2019
Test Engineer:	10649 JR

ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
LoRa	15.800	17.100	0.924	92.40%	0.34	0.063



DUTY CYCLE PLOTS

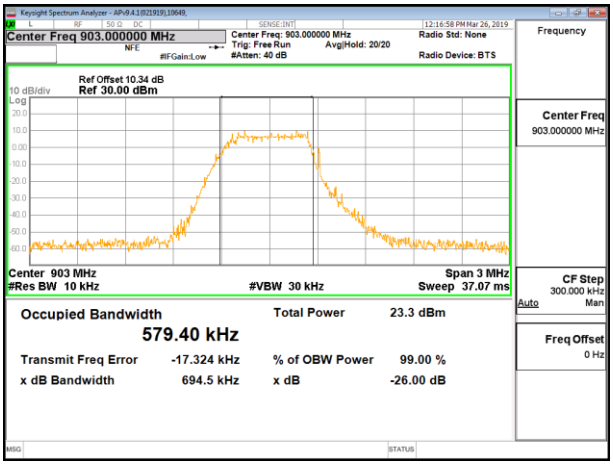
8.2. 99% BANDWIDTH

LIMITS

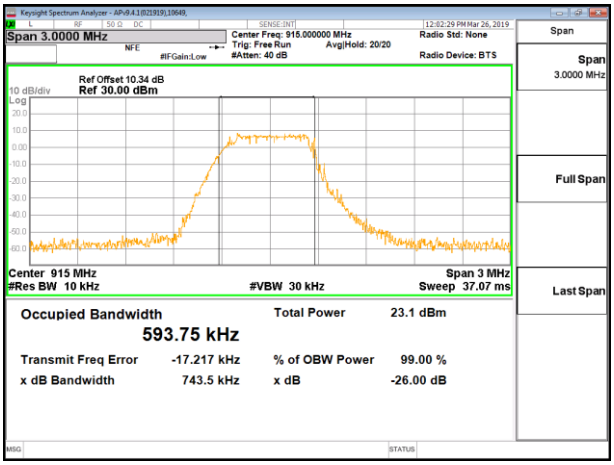
None; for reporting purposes only.

RESULTS

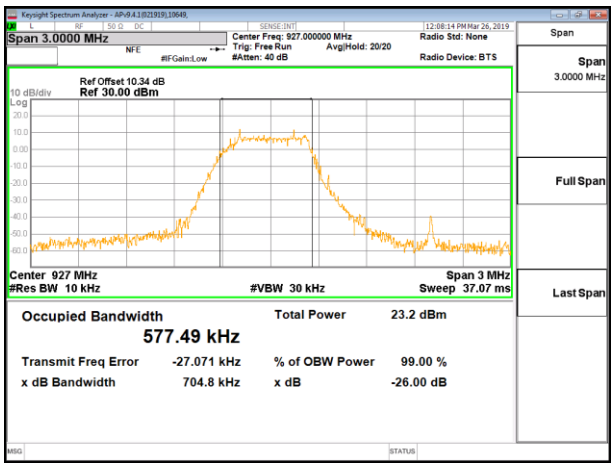
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	903	0.5794
Middle	915	0.5938
High	927	0.5775



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

8.3. 6 dB BANDWIDTH

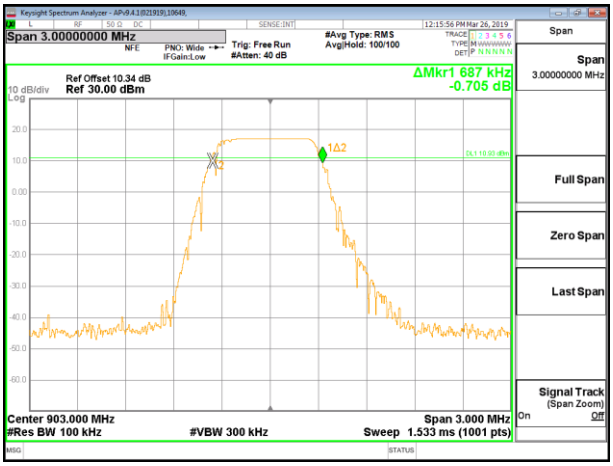
LIMITS

FCC §15.247 (a) (2)
RSS-247 5.2 (a)

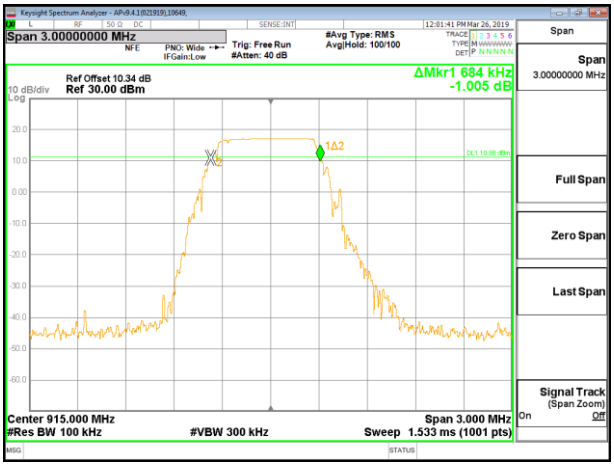
The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS

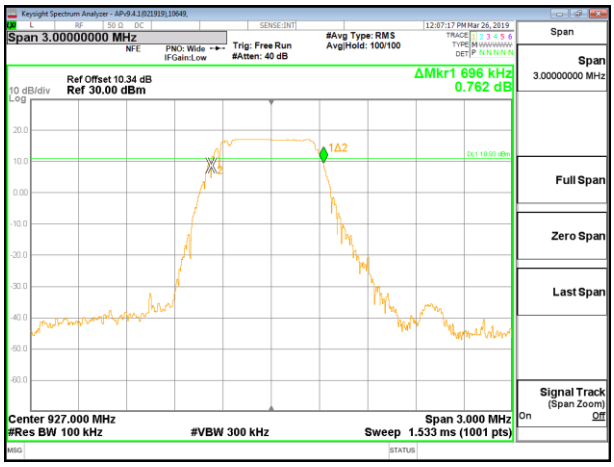
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	903	0.687	0.5
Middle	915	0.684	0.5
High	927	0.696	0.5



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

8.4. OUTPUT POWER

LIMITS

FCC §15.247 (b) (3)
RSS-247 5.4 (d)

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.34 dB (including 10 dB pad and 0.34 dB cable) was entered as an offset in the power meter to allow for a gated peak reading of power.

RESULTS

Tested By:	10649 JR
Date:	3/22/2019

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	903	17.38	30	-12.62
Middle	915	17.36	30	-12.64
High	927	17.35	30	-12.65

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8.5. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 10.34dB (including 10 dB pad and 0.34 dB cable) was entered as an offset in the power meter to allow for a gated average reading of power.

RESULTS

Tested By:	10649 JR
Date:	3/22/2019

Channel	Frequency (MHz)	AV power (dBm)
Low	903	17.24
Middle	915	17.23
High	927	17.22

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8.6. POWER SPECTRAL DENSITY

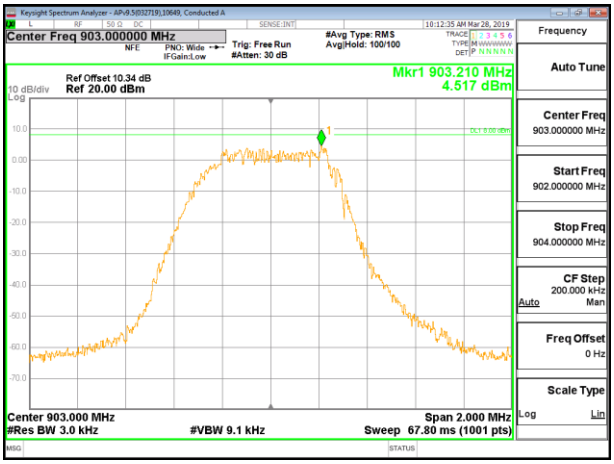
LIMITS

FCC §15.247 (e)
RSS-247 (5.2) (b)

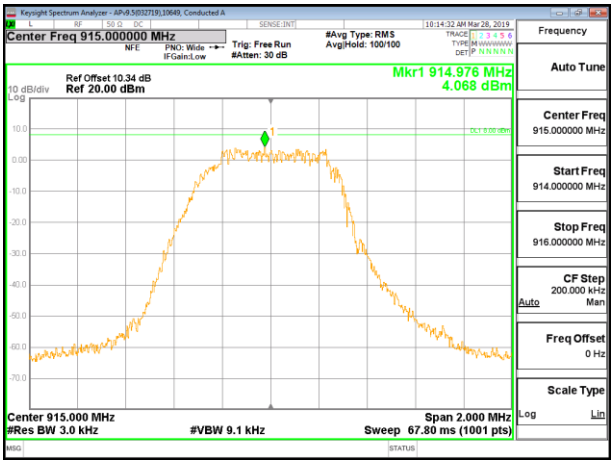
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS

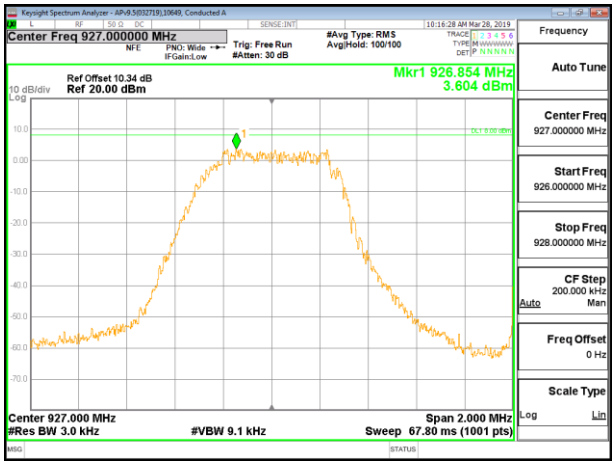
Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
Low	903	4.52	8	-3.48
Middle	915	4.07	8	-3.93
High	927	3.60	8	-4.40



LOW CHANNEL



MID CHANNEL



HIGH CHANNEL

8.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

RSS-247 5.5

Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

RESULTS

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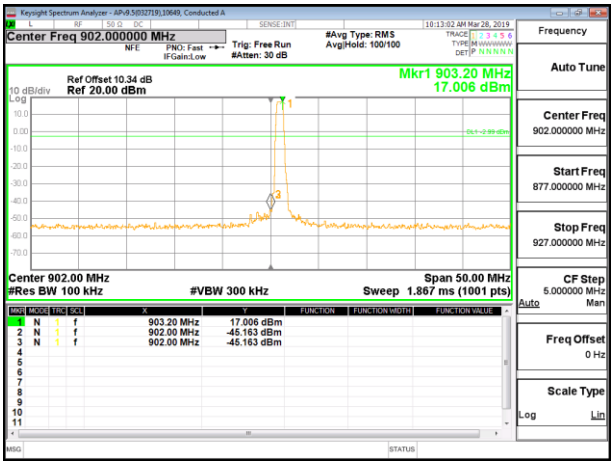
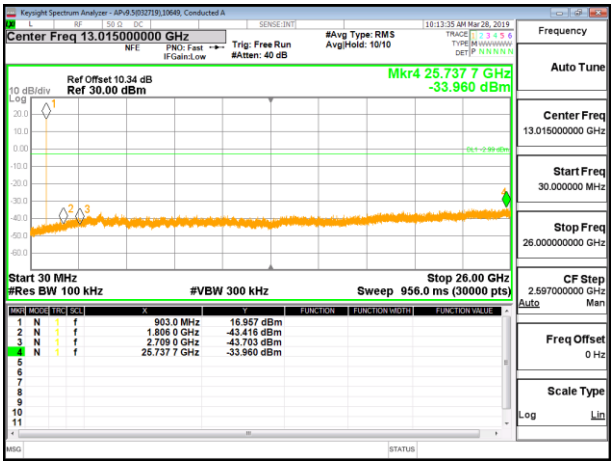
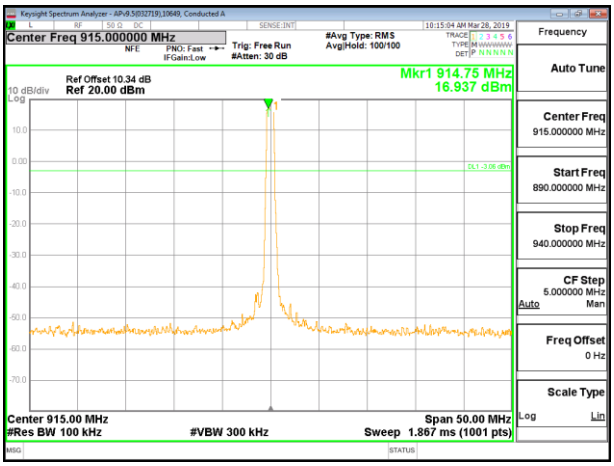


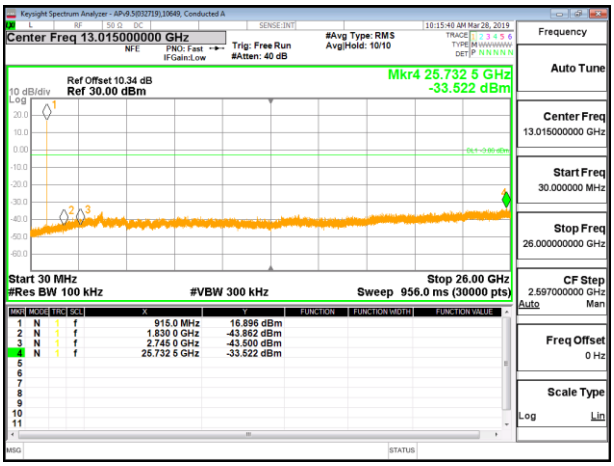
LOW CHANNEL BANDEDGE



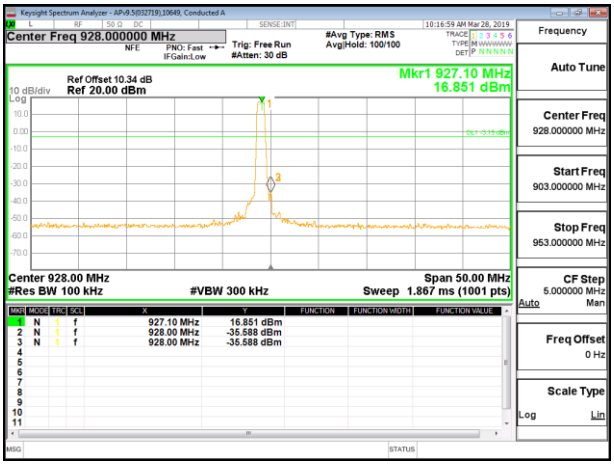
OUT-OF-BAND LOW CHANNEL



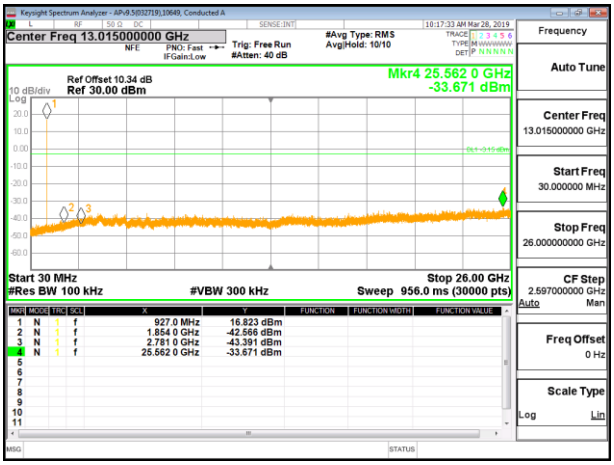
IN-BAND REFERENCE LEVEL



OUT-OF-BAND MID CHANNEL



HIGH CHANNEL BANDEDGE



OUT-OF-BAND HIGH CHANNEL

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9. RADIATED TEST RESULTS

9.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209
RSS-GEN, Section 8.9 and 8.10.

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
0.009-0.490	2400/F(kHz) @ 300 m	-
0.490-1.705	24000/F(kHz) @ 30 m	-
1.705 - 30	30 @ 30m	-
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 KHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements and as applicable for average measurements.

The spectrum from 1 GHz to 18 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band. Below 1GHz and above 18GHz emissions, the channel with the highest output power was tested.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.

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KDB 414788 Open Field Site(OFS) and Chamber Correlation Justification

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

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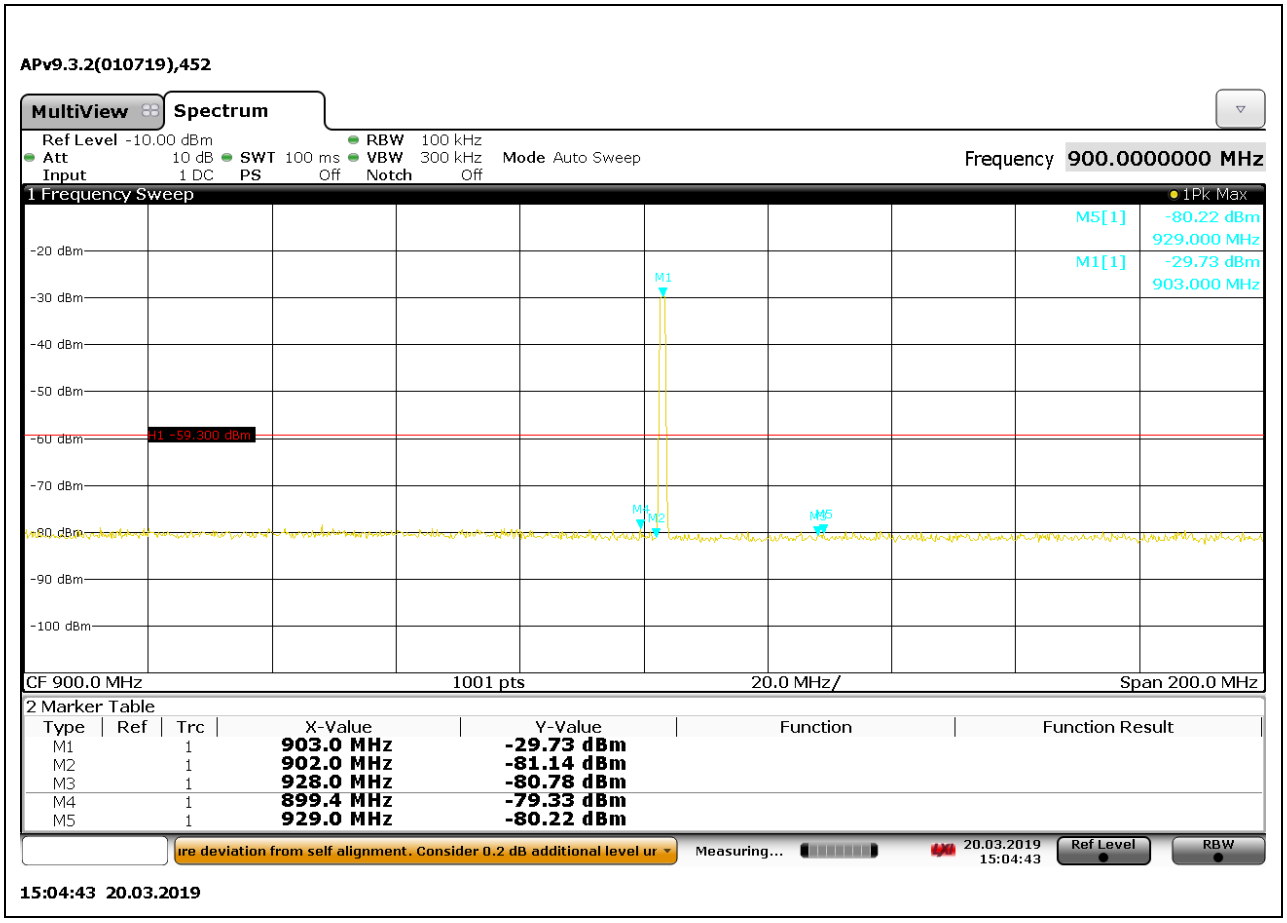
9.2. TRANSMITTER BELOW 1 GHz

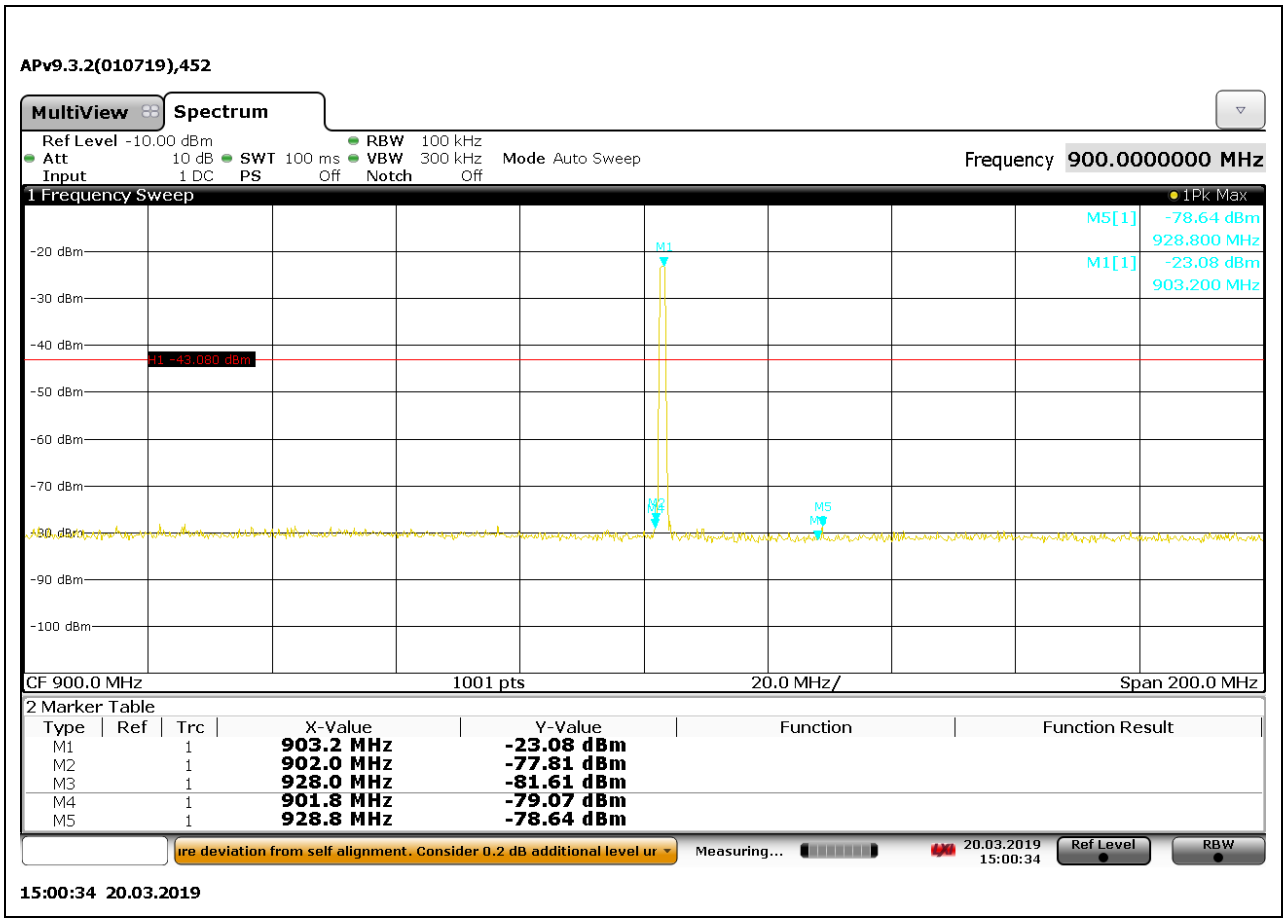
-20 dBc BANDEDGE WITHOUT NOTCH FILTER AND PRE-AMPLIFIER (LOW CHANNEL)

HORIZONTAL RESULT



Note: Testing done with Limit line at -30dBc, Represents worse-case as compared to -20dBc.

VERTICAL RESULT



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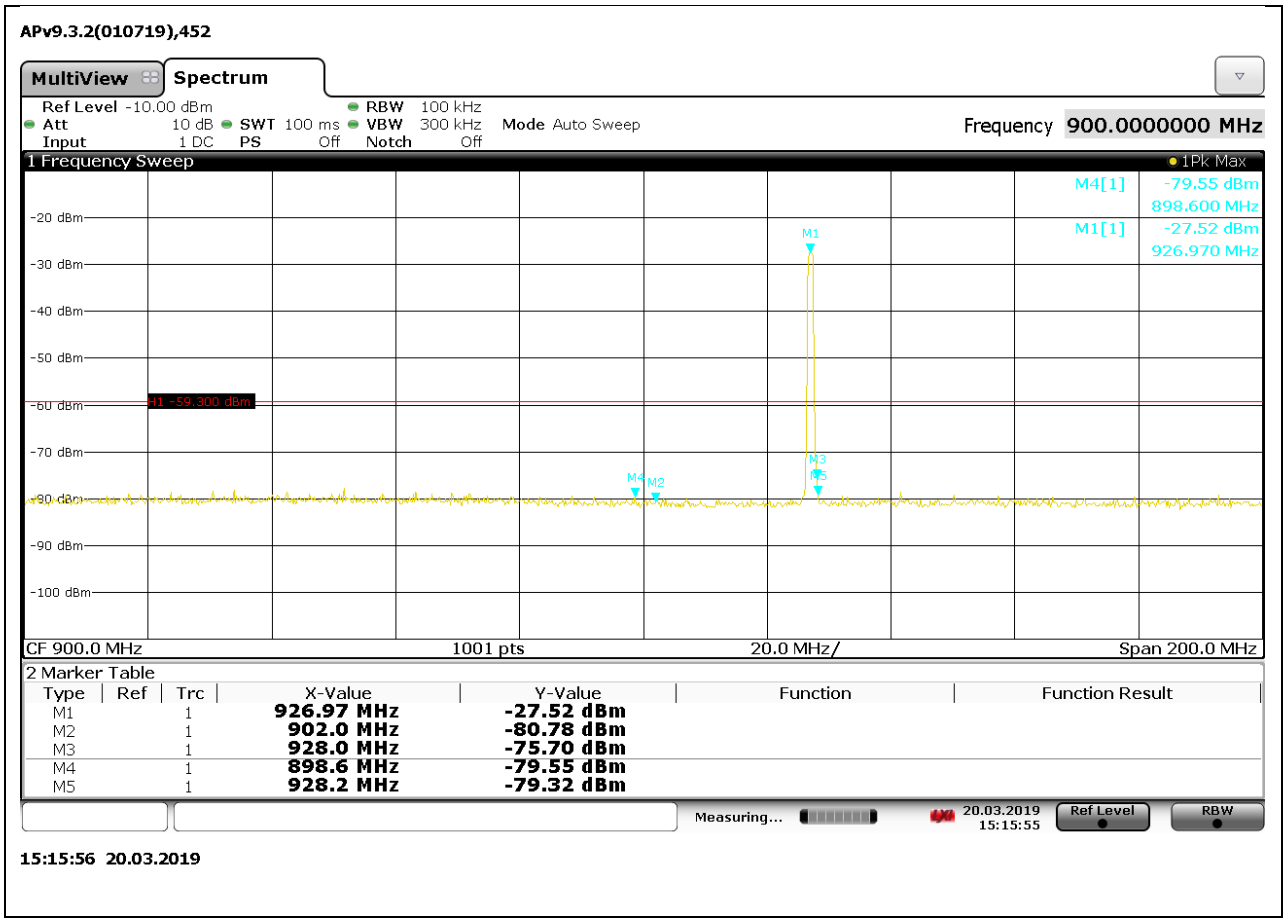
-20 dBc BANDEDGE WITHOUT NOTCH FILTER AND PRE-AMPLIFIER (HIGH CHANNEL)

HORIZONTAL RESULT



Note: Testing done with Limit line at -30dBc, Represents worse-case as compared to -20dBc.

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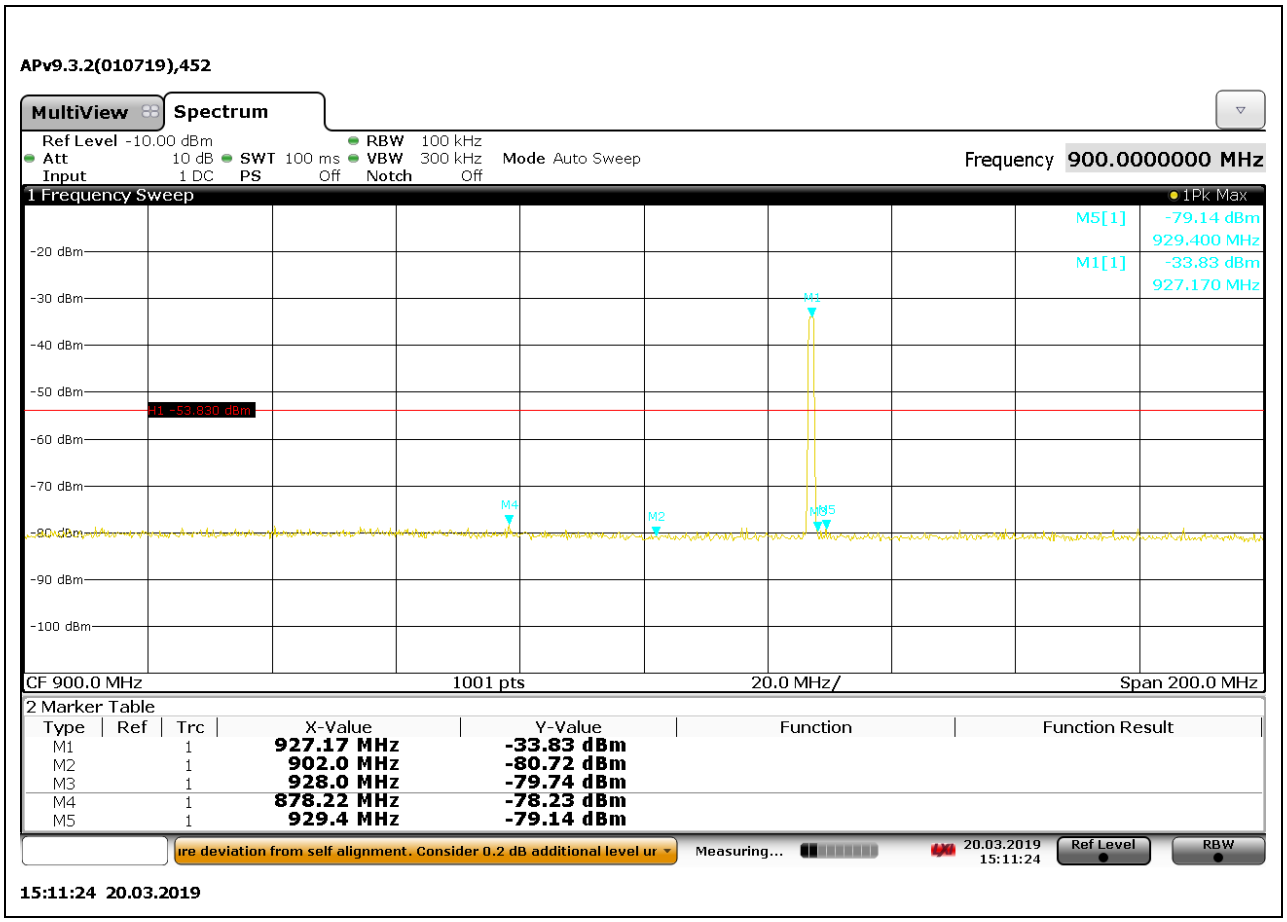
VERTICAL RESULT



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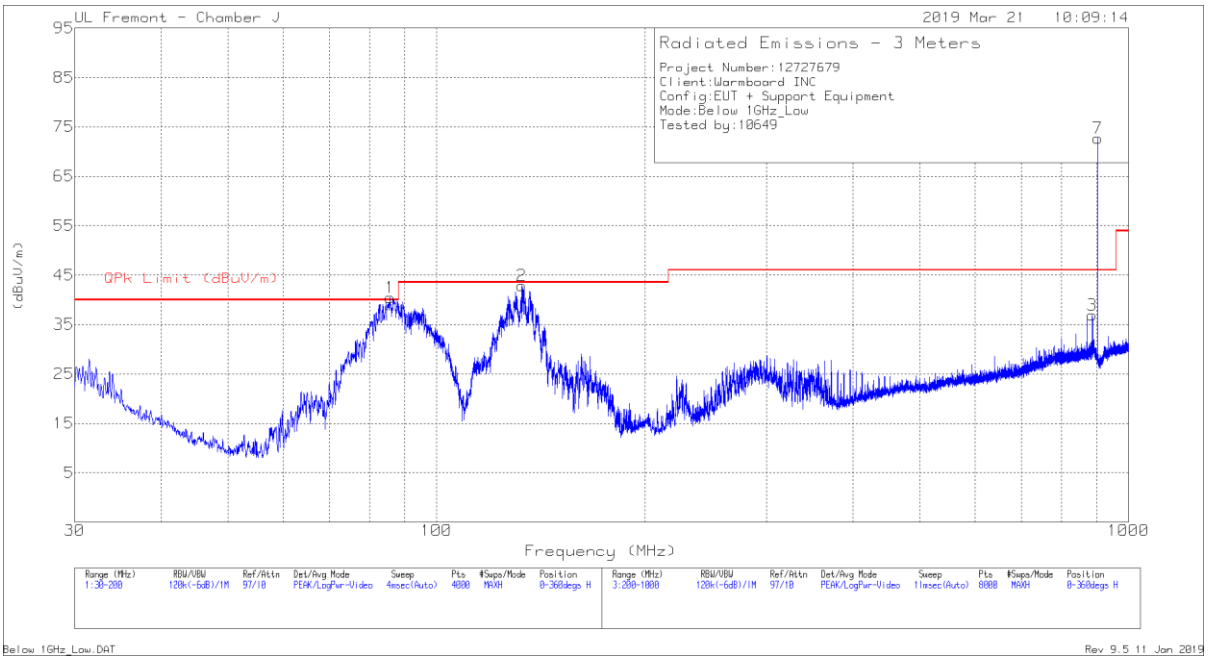
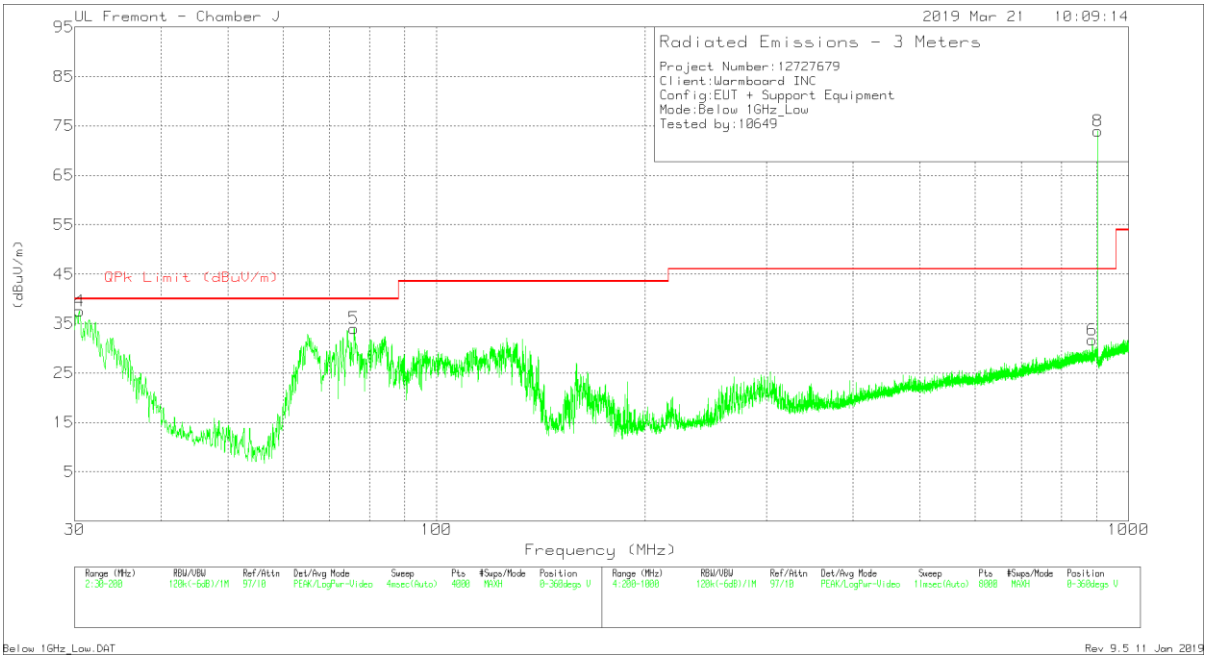
HARMONICS AND SPURIOUS EMISSIONS WITH A NOTCH FILTER

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181575 (dB/m)	Amp Cbl (dB)	Filter T1846 (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	85.6894	58.25	Pk	13.2	-31	0.5	40.95	40	0.95	0-360	199	H
	85.91	55.07	Qp	13.2	-31	0.5	37.77	40	-2.23	60	233	H
2	* 132.8766	54.21	Pk	19.4	-30.8	0.5	43.31	43.52	-0.21	0-360	199	H
	* 133.0852	49.85	Qp	19.4	-30.8	0.5	38.95	43.52	-4.57	77	235	H
4	30.4676	42.76	Pk	26.4	-31.6	0.5	38.06	40	-1.94	0-360	101	V
	30.2394	39.28	Qp	26.5	-31.6	0.5	34.68	40	-5.32	150	101	V
5	76.0394	51.34	Pk	13.8	-31.1	0.5	34.54	40	-5.46	0-360	101	V
	75.9632	45.93	Qp	13.8	-31.1	0.5	29.13	40	-10.87	132	102	V
3	886.8893	36.26	Pk	28.1	-27.5	0.5	37.36	46.02	-8.66	0-360	101	H
	887.025	33.45	Qp	28.1	-27.5	0.5	34.55	46.02	-11.47	36	164	H
6	886.8893	31.07	Pk	28.1	-27.5	0.5	32.17	46.02	-13.85	0-360	198	V
	886.954	27.14	Qp	28.1	-27.5	0.5	28.24	46.02	-17.78	350	149	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
Qp - Quasi-Peak detector

Note:
1. Marker 7 and 8 are fundamental signal of EUT.

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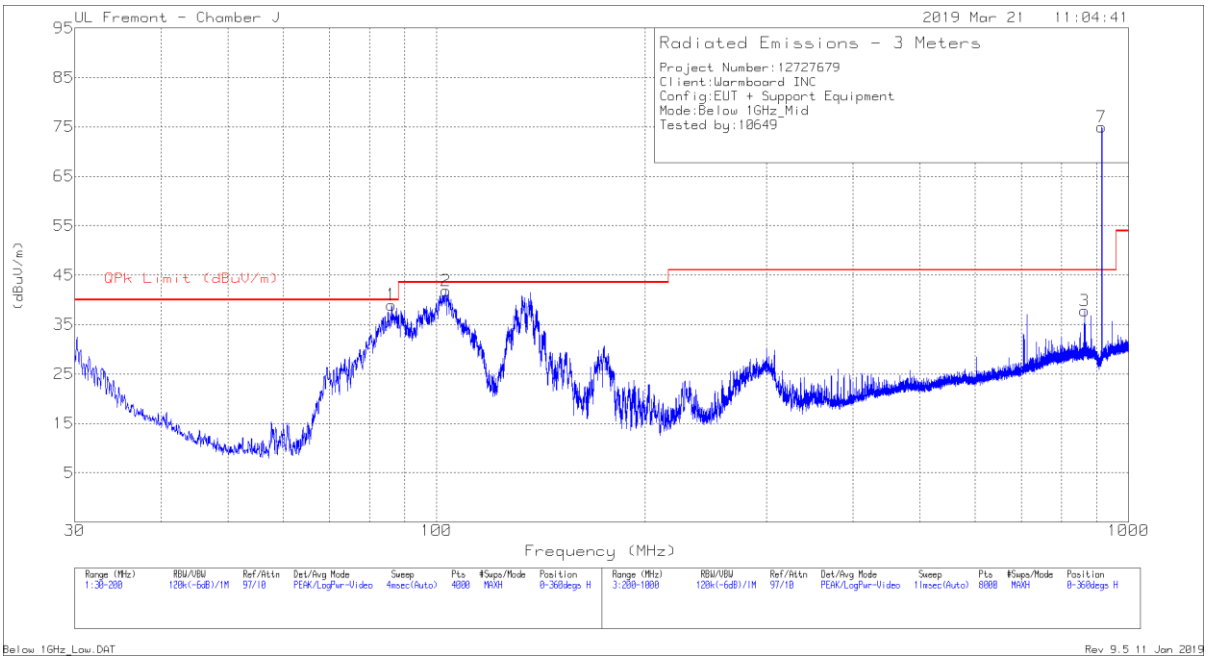
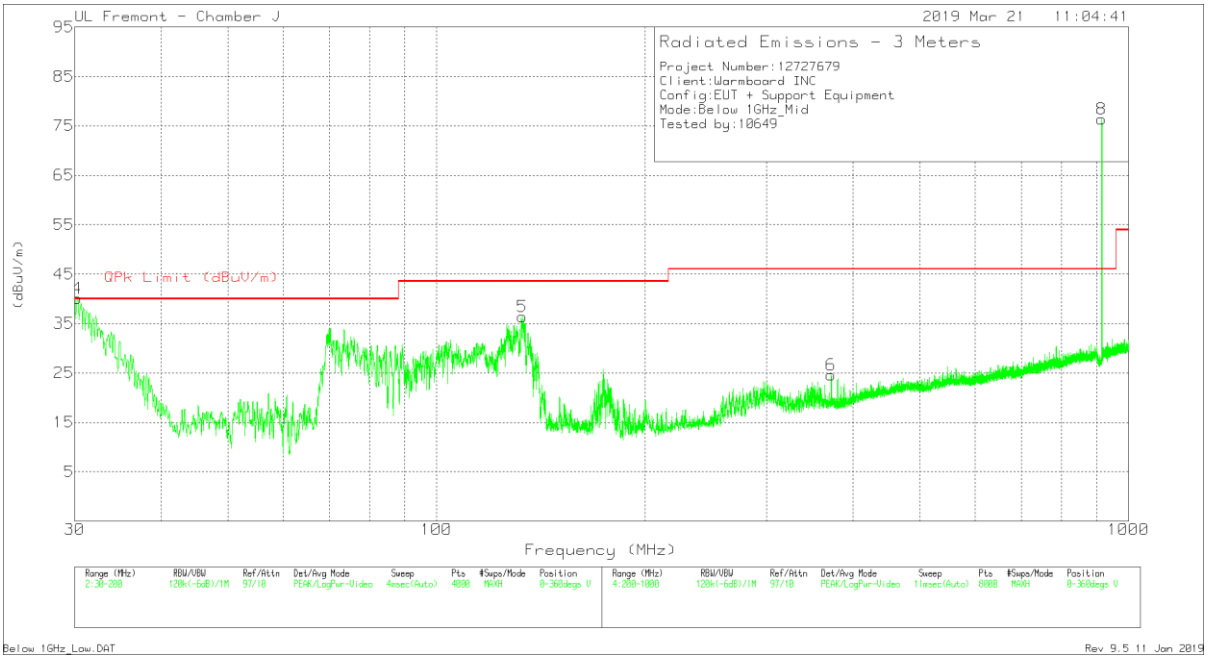
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181575 (dB/m)	Amp Cbl (dB)	Filter T1846 (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	86.157	56.79	Pk	13.2	-31	0.5	39.49	40	-0.51	0-360	298	H
	86.086	51.3	Qp	13.2	-31	0.5	34	40	-6	26	230	H
2	103.2465	55.4	Pk	17.3	-30.9	0.5	42.3	43.52	-1.22	0-360	298	H
	103.0931	51.52	Qp	17.2	-30.9	0.5	38.32	43.52	-5.2	213	296	H
4	30.2126	45.05	Pk	26.6	-31.6	0.5	40.55	40	0.55	0-360	101	V
	30.0965	38.48	Qp	26.6	-31.6	0.5	33.98	40	-6.02	175	104	V
5	* 132.9404	47.82	Pk	19.4	-30.8	0.5	36.92	43.52	-6.6	0-360	101	V
	* 133.1696	40.73	Qp	19.4	-30.8	0.5	29.83	43.52	-13.69	163	105	V
3	864.6864	37.62	Pk	27.8	-27.6	0.5	38.32	46.02	-7.7	0-360	398	H
	864.4572	22.4	Qp	27.8	-27.6	0.5	23.1	46.02	-22.92	30	166	H
6	372.0224	33.61	Pk	20.8	-29.8	0.5	25.11	46.02	-20.91	0-360	101	V
	372.1269	27.59	Qp	20.8	-29.8	0.5	19.09	46.02	-26.93	260	208	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
Qp - Quasi-Peak detector

Note:
1. Marker 7 and 8 are fundamental signal of EUT.

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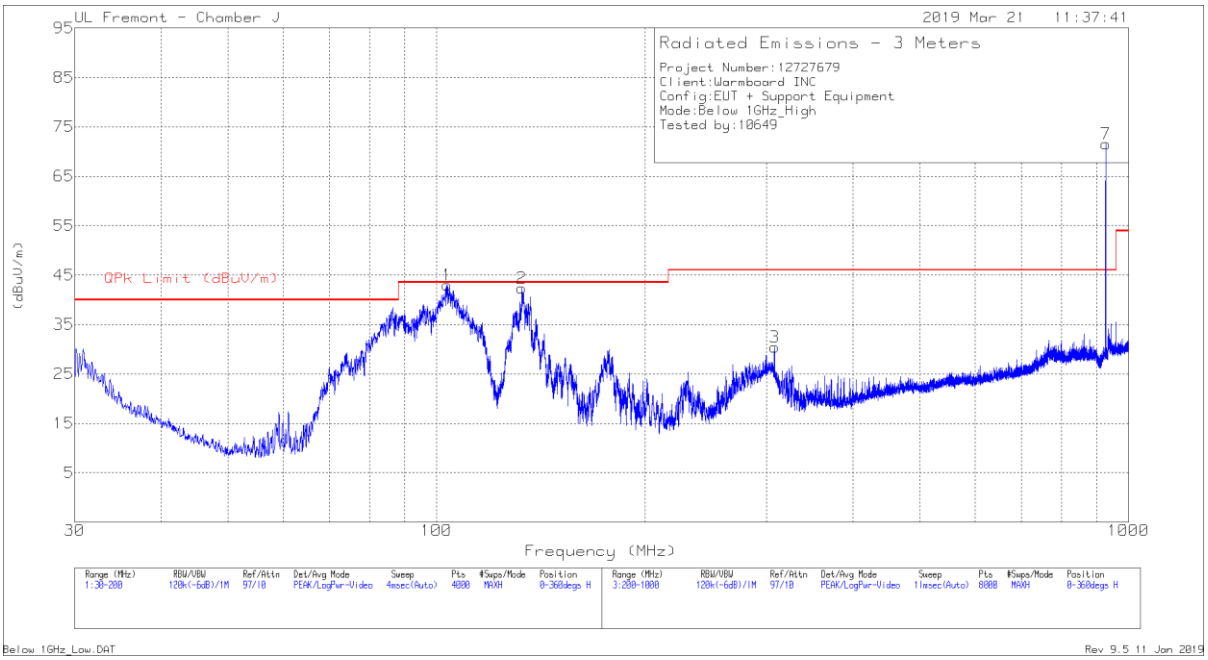
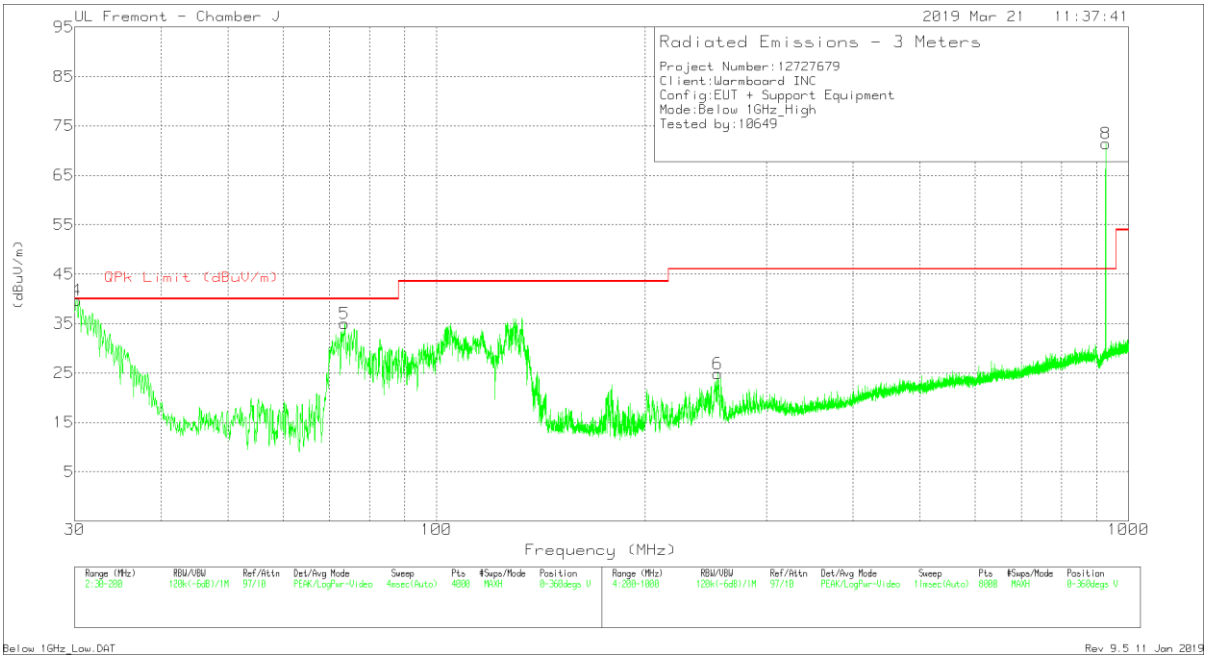
HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF PRE0181575 (dB/m)	Amp Cbl (dB)	Filter T1846 (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	103.7141	56.45	Pk	17.4	-30.9	0.5	43.45	43.52	-0.07	0-360	298	H
	103.542	38.25	Qp	17.4	-30.9	0.5	25.25	43.52	-18.27	174	160	H
2	* 132.8341	53.8	Pk	19.4	-30.8	0.5	42.9	43.52	-0.62	0-360	198	H
	* 133.0341	48.53	Qp	19.4	-30.8	0.5	37.63	43.52	-5.89	36	236	H
4	30.17	44.69	Pk	26.6	-31.6	0.5	40.19	40	0.19	0-360	101	V
	30.0604	43.55	Qp	26.7	-31.6	0.5	39.15	40	-0.85	177	101	V
5	* 73.6588	52.35	Pk	13.9	-31.2	0.5	35.55	40	-4.45	0-360	101	V
	* 73.8482	42.11	Qp	13.9	-31.1	0.5	25.41	40	-14.59	106	113	V
3	307.814	40.8	Pk	19.5	-29.9	0.5	30.9	46.02	-15.12	0-360	101	H
	307.8917	37.44	Qp	19.5	-29.9	0.5	27.54	46.02	-18.48	282	102	H
6	* 254.9071	37.41	Pk	17.5	-30.1	0.5	25.31	46.02	-20.71	0-360	101	V
	* 255.1392	23.31	Qp	17.5	-30.1	0.5	11.21	46.02	-34.81	90	139	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector
Qp - Quasi-Peak detector

Note:
1. Marker 7 and 8 are fundamental signal of EUT.

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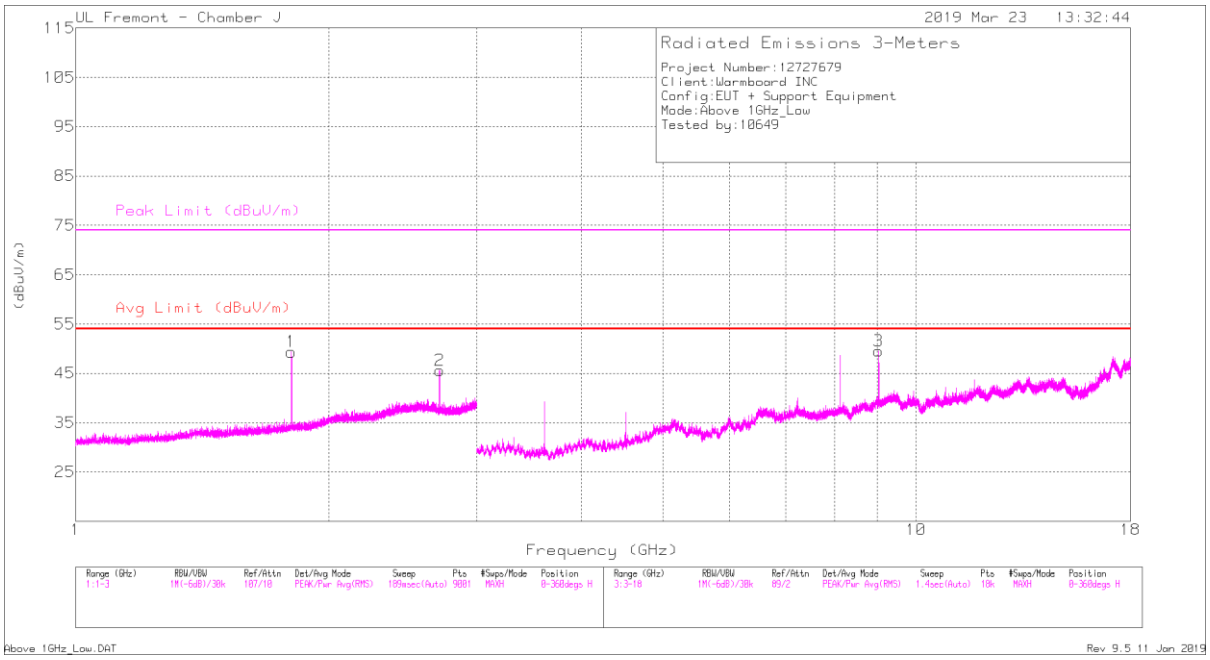
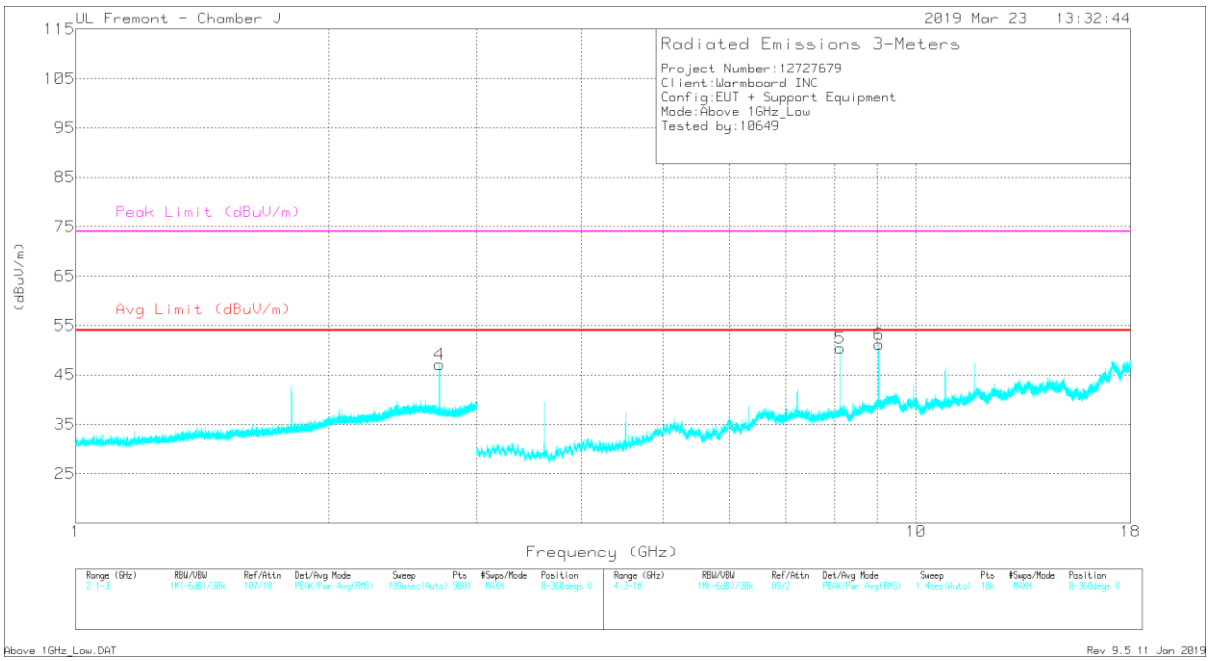
9.3. TRANSMITTER ABOVE 1 GHz

HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE018905 5 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	DC Corr (dB)	Filter PRE0182 423 (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.806	51.5	PK2	26.4	-26	0	1	52.9	-	-	-	-	300	368	H
2	* 2.709	46.25	PK2	29.6	-25.5	0	1	51.35	-	-	74	-22.65	65	108	H
	* 2.709	36.81	MAv1	29.6	-25.5	0.34	1	42.25	54	-11.75	-	-	65	108	H
3	* 9.032	39.15	PK2	38.9	-24.7	0	1	54.35	-	-	74	-19.65	195	294	H
	* 9.032	27.21	MAv1	38.9	-24.7	0.34	1	42.75	54	-11.25	-	-	195	294	H
4	* 2.709	48.35	PK2	29.6	-25.5	0	1	53.45	-	-	74	-20.55	147	279	V
	* 2.709	41.07	MAv1	29.6	-25.5	0.34	1	46.51	54	-7.49	-	-	147	279	V
5	* 8.126	41.15	PK2	37.9	-26.8	0	1	53.25	-	-	74	-20.75	310	112	V
	* 8.126	28.55	MAv1	37.9	-26.8	0.34	1	40.99	54	-13.01	-	-	310	112	V
6	* 9.031	38.9	PK2	38.9	-24.7	0	1	54.1	-	-	74	-19.9	316	104	V
	* 9.031	26.12	MAv1	38.9	-24.7	0.34	1	41.66	54	-12.34	-	-	316	104	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAv1 - KDB558074 Option 1 Maximum RMS Average

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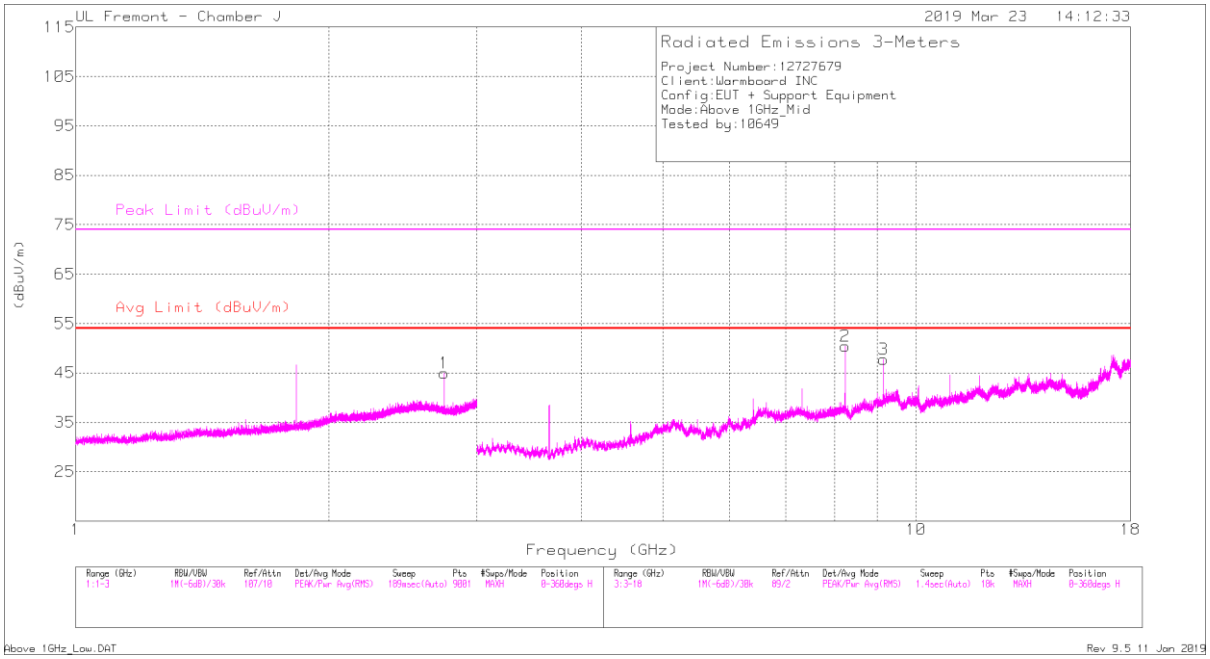
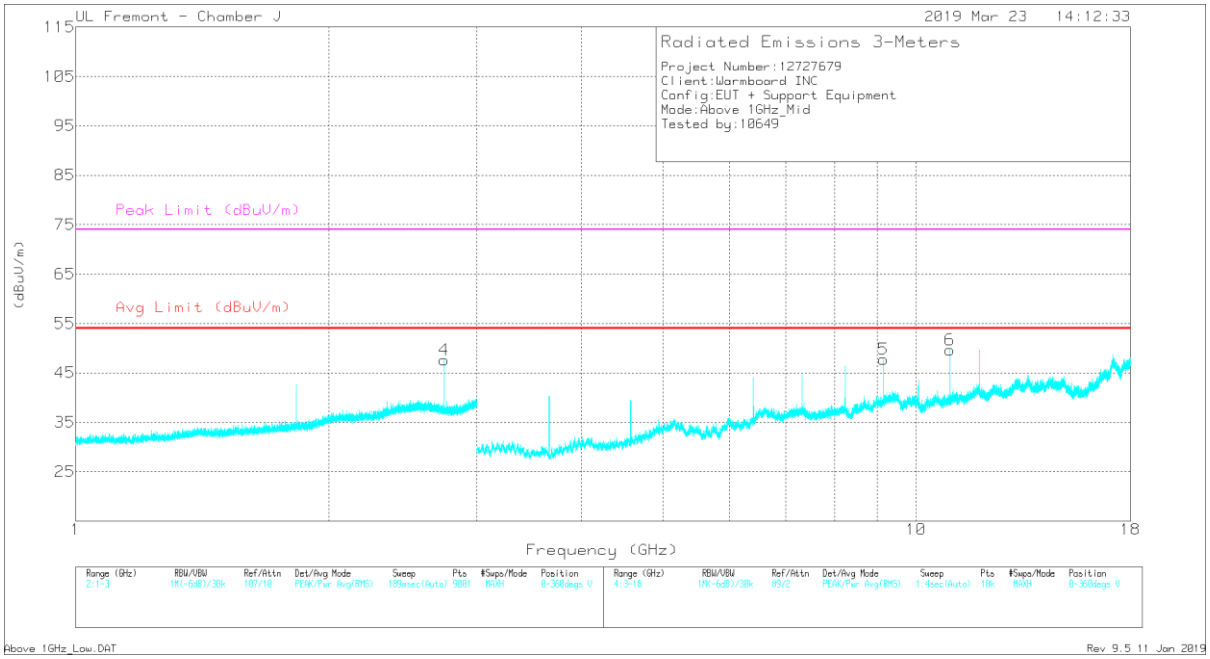
MID CHANNEL RESULTS



HORIZONTAL



VERTICAL

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RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189055 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	DC Corr (dB)	Filter PRE0182423 (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.745	45.18	PK2	29.4	-25.5	0	1	50.08	-	-	74	-23.92	75	120	H
	* 2.745	36.26	MAv1	29.4	-25.5	0.34	1	41.5	54	-12.5	-	-	75	120	H
4	* 2.745	46.16	PK2	29.4	-25.5	0	1	51.06	-	-	74	-22.94	32	103	V
	* 2.745	37.48	MAv1	29.4	-25.5	0.34	1	42.72	54	-11.28	-	-	32	103	V
2	* 8.235	40.86	PK2	38.4	-26.6	0	1	53.66	-	-	74	-20.34	347	111	H
	* 8.236	27.14	MAv1	38.4	-26.6	0.34	1	40.28	54	-13.72	-	-	347	111	H
3	* 9.15	38.34	PK2	39.5	-25.1	0	1	53.74	-	-	74	-20.26	195	307	H
	* 9.152	25.67	MAv1	39.5	-25.1	0.34	1	41.41	54	-12.59	-	-	195	307	H
5	* 9.149	38.16	PK2	39.5	-25.1	0	1	53.56	-	-	74	-20.44	325	104	V
	* 9.149	26.5	MAv1	39.5	-25.1	0.34	1	42.24	54	-11.76	-	-	325	104	V
6	* 10.978	37.75	PK2	39	-24.1	0	1	53.65	-	-	74	-20.35	214	107	V
	* 10.98	25.69	MAv1	39	-24.1	0.34	1	41.93	54	-12.07	-	-	214	107	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAv1 - KDB558074 Option 1 Maximum RMS Average

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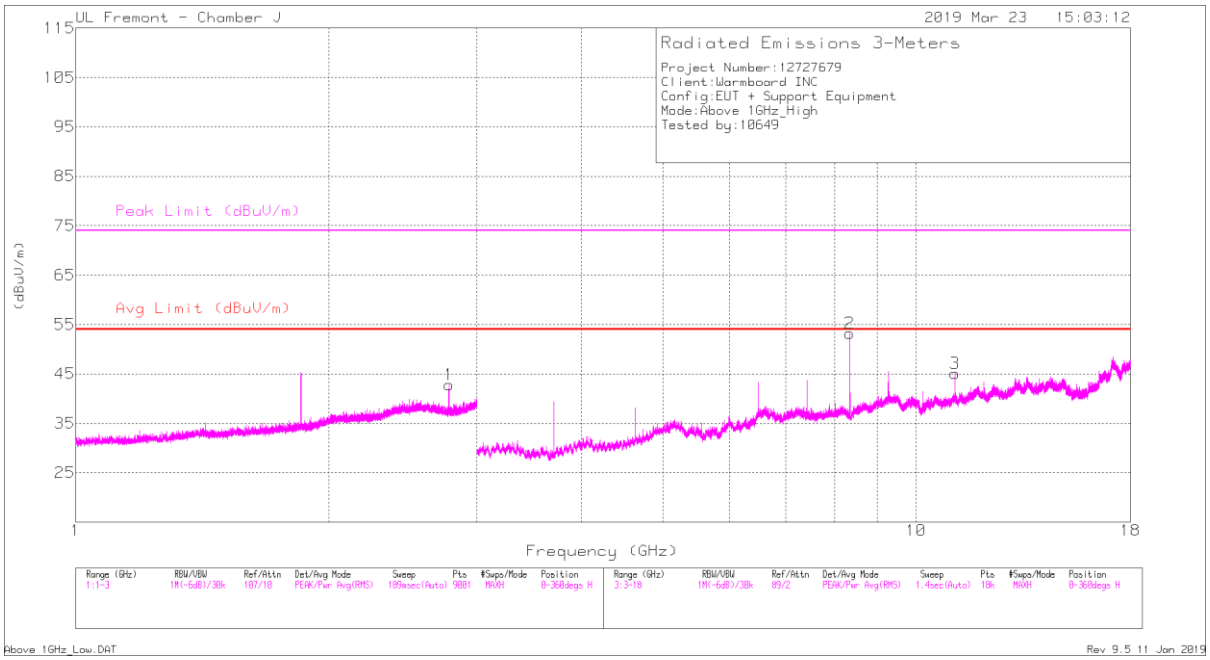
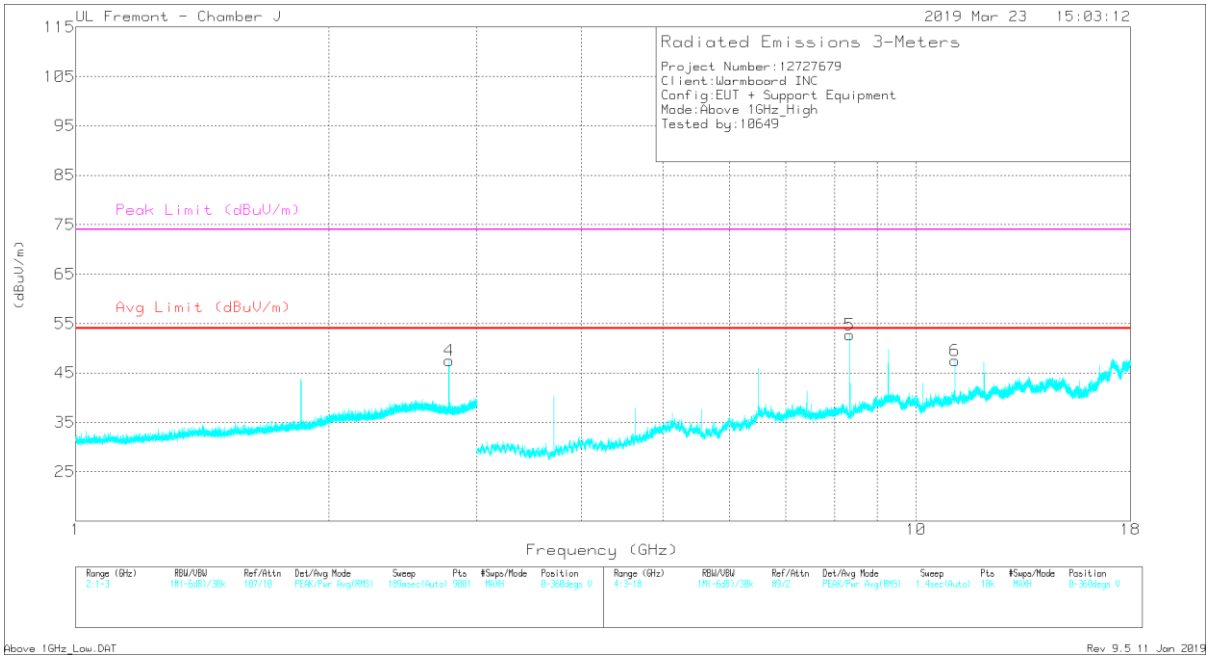
HIGH CHANNEL RESULTS



HORIZONTAL



VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF PRE0189 055 (dB/m)	Amp/Cbl/ Fltr/Pad (dB)	DC Corr (dB)	Filter PRE0182 423 (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.78	44.61	PK2	29.3	-25.5	0	1	49.41	-	-	74	-24.59	131	394	H
	* 2.781	36.04	MAv1	29.3	-25.5	0.34	1	41.18	54	-12.82	-	-	131	394	H
4	* 2.782	46.72	PK2	29.3	-25.5	0	1	51.52	-	-	74	-22.48	25	117	V
	* 2.781	38.18	MAv1	29.3	-25.5	0.34	1	43.32	54	-10.68	-	-	25	117	V
2	* 8.344	44.55	PK2	37.7	-26.5	0	1	56.75	-	-	74	-17.25	23	102	H
	* 8.342	31.25	MAv1	37.7	-26.5	0.34	1	43.79	54	-10.21	-	-	23	102	H
3	* 11.122	34.51	PK2	39.1	-23.3	0	1	51.31	-	-	74	-22.69	80	116	H
	* 11.125	23.65	MAv1	39.1	-23.3	0.34	1	40.79	54	-13.21	-	-	80	116	H
5	* 8.343	43.82	PK2	37.7	-26.5	0	1	56.02	-	-	74	-17.98	297	386	V
	* 8.344	31.14	MAv1	37.7	-26.5	0.34	1	43.68	54	-10.32	-	-	297	386	V
6	* 11.122	37.35	PK2	39.1	-23.2	0	1	54.25	-	-	74	-19.75	149	107	V
	* 11.124	25.13	MAv1	39.1	-23.3	0.34	1	42.27	54	-11.73	-	-	149	107	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
PK2 - KDB558074 Method: Maximum Peak
MAv1 - KDB558074 Option 1 Maximum RMS Average

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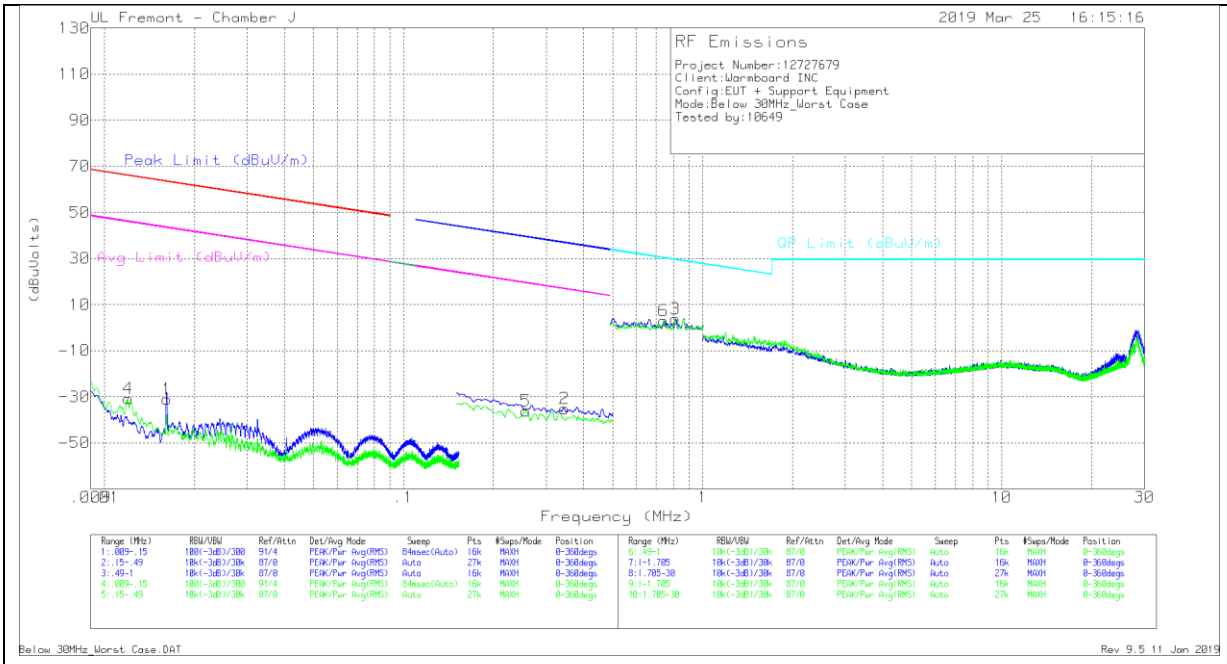
9.4. WORST CASE BELOW 30MHz

SPURIOUS EMISSIONS BELOW 30 MHz (WORST-CASE CONFIGURATION)



ANTENNA- TWO ORIENTATIONS FACE ON/FACE OFF

Below 30MHz Data

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/Cbl (dB)	Dist Corr 300m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Avg Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
1	.0162	17.91	Pk	59.5	-28.5	-80	-31.09	63.39	-94.48	43.39	-74.48	-	-	-	-	0-360
2	.34485	17.13	Pk	56.3	-28.6	-80	-35.17	-	-	-	-	36.86	-72.03	16.86	-52.03	0-360
4	.01199	17.65	Pk	60	-28.5	-80	-30.85	66.01	-96.86	46.01	-76.86	-	-	-	-	0-360
5	.25593	16.09	Pk	56.3	-28.6	-80	-36.21	-	-	-	-	39.45	-75.66	19.45	-55.66	0-360

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (ACF)	Amp/Cbl (dB)	Dist Corr 30m (dB) 40Log	Corrected Reading (dBuVolts)	QP Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)
3	.81072	15.95	Pk	56.3	-28.5	-40	3.75	29.44	-25.69	0-360
6	.73885	15.28	Pk	56.3	-28.5	-40	3.08	30.24	-27.16	0-360

Pk - Peak detector

10. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 8.8

Frequency of Emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.10.

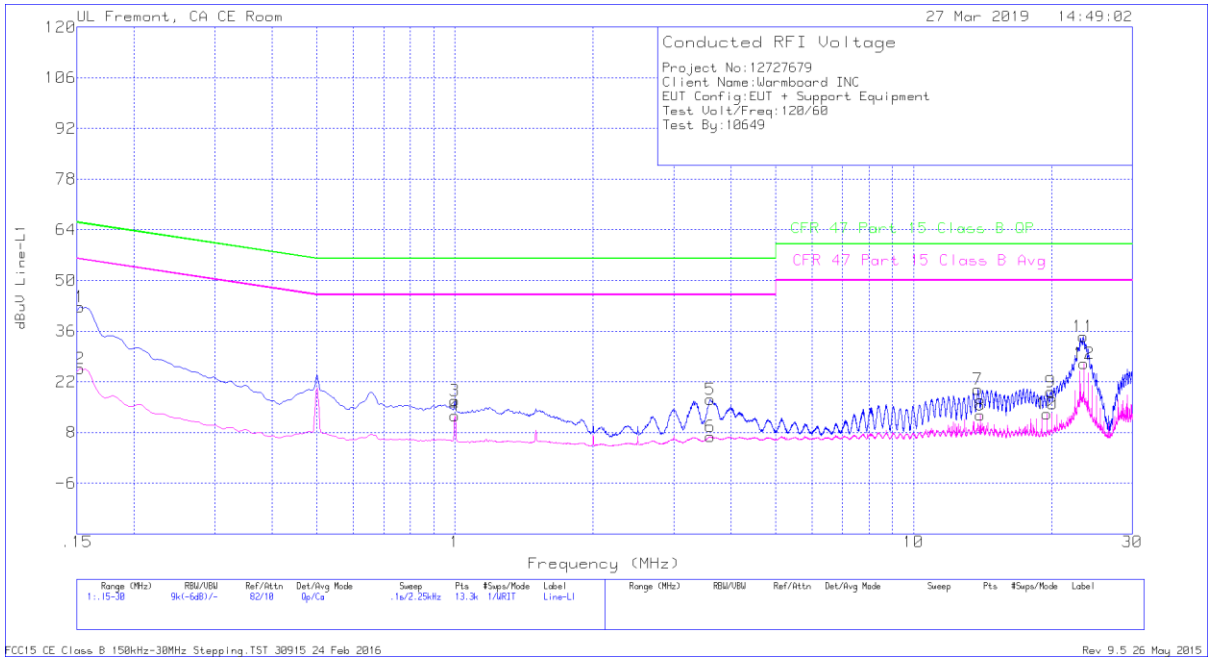
The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

UL VERIFICATION SERVICES INC.
47173 Benicia Street, Fremont, CA 94538; USA TEL:(510) 319-4000 FAX:(510) 661-0888

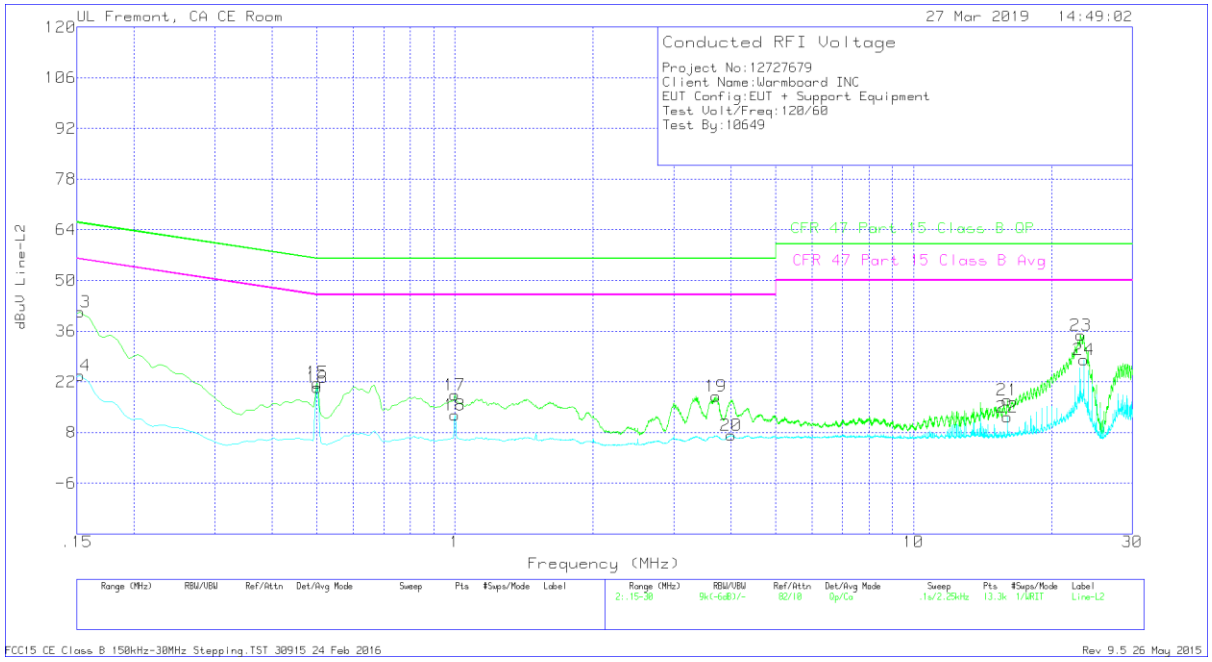
LINE 1 RESULTS



Range 1: Line-L1 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L1	LC Cables C1&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
1	.15225	32.53	Qp	.1	0	10.1	42.73	65.88	-23.15	-	-
2	.15225	15.43	Ca	.1	0	10.1	25.63	-	-	55.88	-30.25
3	1.0005	6.59	Qp	0	.1	10.1	16.79	56	-39.21	-	-
4	1.0005	2.49	Ca	0	.1	10.1	12.69	-	-	46	-33.31
5	3.606	6.97	Qp	0	.1	10.1	17.17	56	-38.83	-	-
6	3.60825	-3.37	Ca	0	.1	10.1	6.83	-	-	46	-39.17
7	13.82775	9.34	Qp	.1	.3	10.2	19.94	60	-40.06	-	-
8	13.9695	2.22	Ca	.1	.3	10.2	12.82	-	-	50	-37.18
9	19.88475	8.51	Qp	.1	.3	10.3	19.21	60	-40.79	-	-
10	19.5225	2.44	Ca	.1	.3	10.3	13.14	-	-	50	-36.86
11	23.43525	23.7	Qp	.1	.3	10.4	34.5	60	-25.5	-	-
12	23.52525	16.27	Ca	.1	.3	10.4	27.07	-	-	50	-22.93

Qp - Quasi-Peak detector
Ca - CISPR average detection

LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz											
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	LISN L2	LC Cables C2&C3	Limiter (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	QP Margin (dB)	CFR 47 Part 15 Class B Avg	Av(CISPR)Margin (dB)
13	.15225	31.13	Qp	.1	0	10.1	41.33	65.88	-24.55	-	-
14	.15225	13.59	Ca	.1	0	10.1	23.79	-	-	55.88	-32.09
15	.501	11.65	Qp	0	0	10.1	21.75	56	-34.25	-	-
16	.501	10.28	Ca	0	0	10.1	20.38	-	-	46	-25.62
17	1.0005	8.22	Qp	0	.1	10.1	18.42	56	-37.58	-	-
18	1.0005	2.55	Ca	0	.1	10.1	12.75	-	-	46	-33.25
19	3.7095	7.77	Qp	0	.1	10.1	17.97	56	-38.03	-	-
20	4.00538	-3.01	Ca	0	.1	10.1	7.19	-	-	46	-38.81
21	15.999	6.23	Qp	.1	.3	10.3	16.93	60	-43.07	-	-
22	15.999	1.52	Ca	.1	.3	10.3	12.22	-	-	50	-37.78
23	23.13375	24.15	Qp	.1	.3	10.4	34.95	60	-25.05	-	-
24	23.5275	17.24	Ca	.1	.3	10.4	28.04	-	-	50	-21.96

Qp - Quasi-Peak detector
Ca - CISPR average detection