

MARS INTERNATIONAL TEST REPORT

SCOPE OF WORK

FCC PART 15.247 CLASS II PERMISSIVE CHANGE – RADIO MODULE MODEL RN2903A, HOST MODEL C900 FL-TG

REPORT NUMBER

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EMISSIONS TEST REPORT

(COMPLIANCE TO TESTS PERFORMED)

Report Number: 104219975BOX-002

Project Number: G104219975

Report Issue Date: 02/10/2020

Model(s) Tested: RADIO MODULE MODEL RN2903A, HOST MODEL C900 FL-TG
(RADIO MODULE FCC ID: T9JRN2903)

Model(s) Partially Tested: None

Model(s) Not Tested but declared equivalent by the client: None

Standards: CFR47 FCC Part 15.247 Subpart C: 02/2020,
CFR47 FCC Part 15 Subpart B: 02/2020,
RSS-247 Issue 2 February 2017,
ICES-003 Issue 6 Published: January 2016 Updated: April 2017,
RSS-Gen Issue 5 April 2018 +Amendment 1 March 2019
(Class II Permissive Change – Addition of PCB Trace Antenna, see
Appendix for antenna specification)

Tested by:
Intertek Testing Services NA, Inc.
70 Codman Hill Road
Boxborough, MA 01719
USA

Client:
Mars International Inc.
60 Kingsbridge Road
Piscataway, NY 08854
USA

Report prepared by



Vathana Ven / EMC Staff Engineer

Report reviewed by



Kouma Sinn / EMC Staff Engineer

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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	--
8	Transmitter spurious emissions & Restricted Band CFR47 FCC Part 15 Subpart C: 02/2020, Section 15.247(d), 15.209(a), 15.205, RSS-247 Issue 2 February 2017	Pass
9	Digital Device and Receiver Radiated Spurious Emissions CFR47 FCC Part 15 Subpart B 15.109: 02/2020, ICES-003 Issue 6 Published: January 2016 Updated: April 2017 RSS-Gen Issue 5 April 2018 +Amendment 1 March 2019	Pass
10	AC Mains Conducted Emissions FCC 47CFR Part 15.107: 02/2020 ICES-003 Issue 6 Published: January 2016 Updated: April 2017 RSS-Gen Issue 5 April 2018 +Amendment 1 March 2019	Pass
11	Antenna Specification	--
12	Revision History	--

3 Client Information

This EUT was tested at the request of:

Client: Mars International Inc.
60 Kingsbridge Road
Piscataway, NY 08854
USA

Contact: David Salgueiro
Telephone: 908-233-0101 x42
Fax: None
Email: dsalgueiro@marsint.com

4 Description of Equipment Under Test and Variant Models

Manufacturer: Mars International Inc.
60 Kingsbridge Road
Piscataway, NY 08854
USA

Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Radio module	Mars International Inc.	RN2903A	Not labeled
Host	Mars International Inc.	C900 FL – TG	20-05-001

Receive Date:	02/06/2020
Received Condition:	Good
Type:	Production

Description of Equipment Under Test (provided by client)
The EUT is an

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
100-240 VAC	300 mA	60 Hz	1

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Transmit and Receive mode

Software used by the EUT:

No.	Descriptions of EUT Exercising
1	2.03 Application Provision Tool CVL

Radio/Receiver Characteristics	
Frequency Band(s)	902.3-927.5 MHz
Modulation Type(s)	FSK
Maximum Output Power	Not measured for Class II Permissive Change
Test Channels	Low Channel (903 MHz) Mid Channel (914.3 MHz) High Channel (927.5 MHz)
Occupied Bandwidth	Not measured for Class II Permissive Change
Frequency Hopper: Number of Hopping Channels	N/A
Frequency Hopper: Channel Dwell Time	N/A
Frequency Hopper: Max interval between two instances of use of the same channel	N/A
MIMO Information (# of Transmit and Receive antenna ports)	1
Equipment Type	Standalone
ETSI LBT/Adaptivity	Non-Adaptive
ETSI Adaptivity Type	N/A
ETSI Temperature Category (I, II, III)	N/A
ETSI Receiver Category (1, 2, 3)	3
Antenna Type and Gain	Patch Antenna, 5 dBi

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

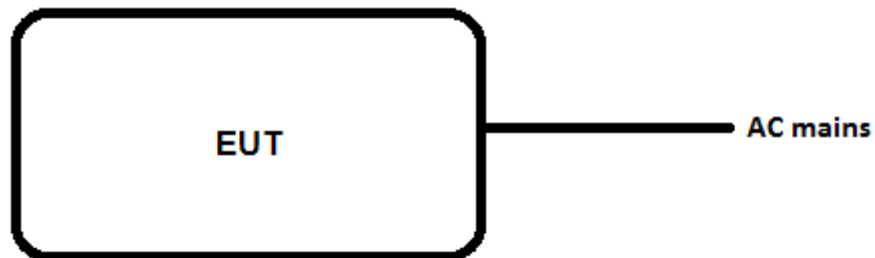
Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	Power cable	1.5	None	None	AC mains

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
PC	HP	8440p	CND12458Z0
AC adapter	AC ADAPTER	XH-UL0510-A1	Not labled

5.1 Method:

Configuration as required by Configuration as required by FCC Part 15 Subpart C 15.247: 02/2020, FCC Part 15 Subpart B: 02/2020, RSS 247 Issue 2: 02/2017, ICES 003 Issue 6: 01/2016 updated 06/2016, RSS-Gen Issue 5 April 2018 +Amendment 1 March 2019, ANSI C 63.10: 2013, and ANSI C 63.4: 2014.

5.2 EUT Block Diagram:



6 Transmitter spurious emissions & Restricted Band

6.1 Method

Tests are performed in accordance with ANSI C 63.10 and ANSI C 63.4.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	U _{CISPR}
Radiated Emissions, 10m	30-1000 MHz	4.6dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

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.

$$RA = 52.0 \text{ dB}\mu\text{V}$$

$$AF = 7.4 \text{ dB/m}$$

$$CF = 1.6 \text{ dB}$$

$$AG = 29.0 \text{ dB}$$

$$FS = 32 \text{ dB}\mu\text{V/m}$$

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:

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

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

Alternately, when BAT-EMC Emission Software is used, the "Level" includes all losses and gains and is compared directly in the "Margin" column to the "Limit". The "Correction" includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the "Level" column.

6.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DS40'	Temp, humidity, pressure gauge	Digi Sense	68000-49	181717625	11/13/2019	11/13/2020
145108'	EMI Test Receiver (20Hz - 40GHz)	Rohde & Schwarz	ESIB40	100209	06/06/2019	06/06/2020
145-410	Cables 145-420 145-421 145-422 145-406	Huber + Suhner	10m Track A Cables	multiple	07/22/2019	07/22/2020
PRE11'	50dB gain pre-amp	Pasternack	PRE11	PRE11	08/30/2019	08/30/2020
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	06/12/2019	06/12/2020
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/22/2019	07/22/2020
BONN001'	1-18GHz low noise pre-amp	Bonn	BLMA 0118-M	1811749	07/11/2019	07/11/2020
HORN3'	HORN ANTENNA	EMCO	3115	9610-4980	05/30/2019	05/30/2020
REA003'	1GHz High Pass Filter	Reactel, Inc	7HS-1G/10G-S11	06-1	02/25/2018	02/25/2020
FAIR001'	Tunable notch filter 500-1000MHz	Fairview Microwave	SBRF-0500-1000-01-N	DC 1651	04/26/2019	04/26/2020

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.17.0.3

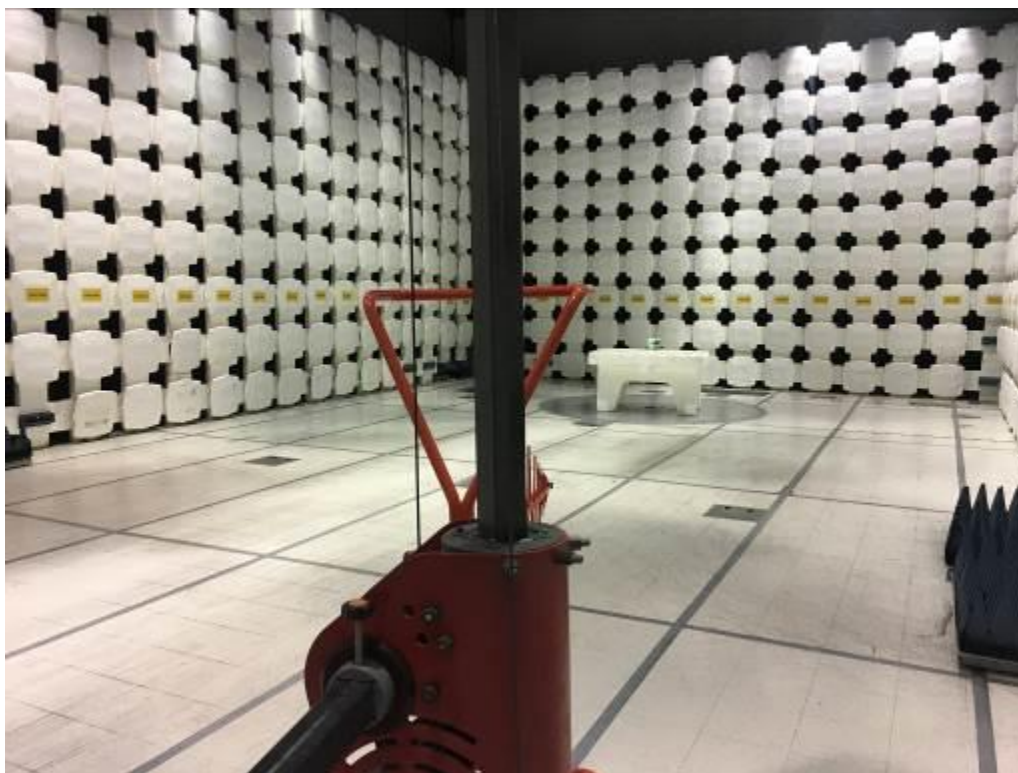
6.3 Results:

The sample tested was found to Comply.

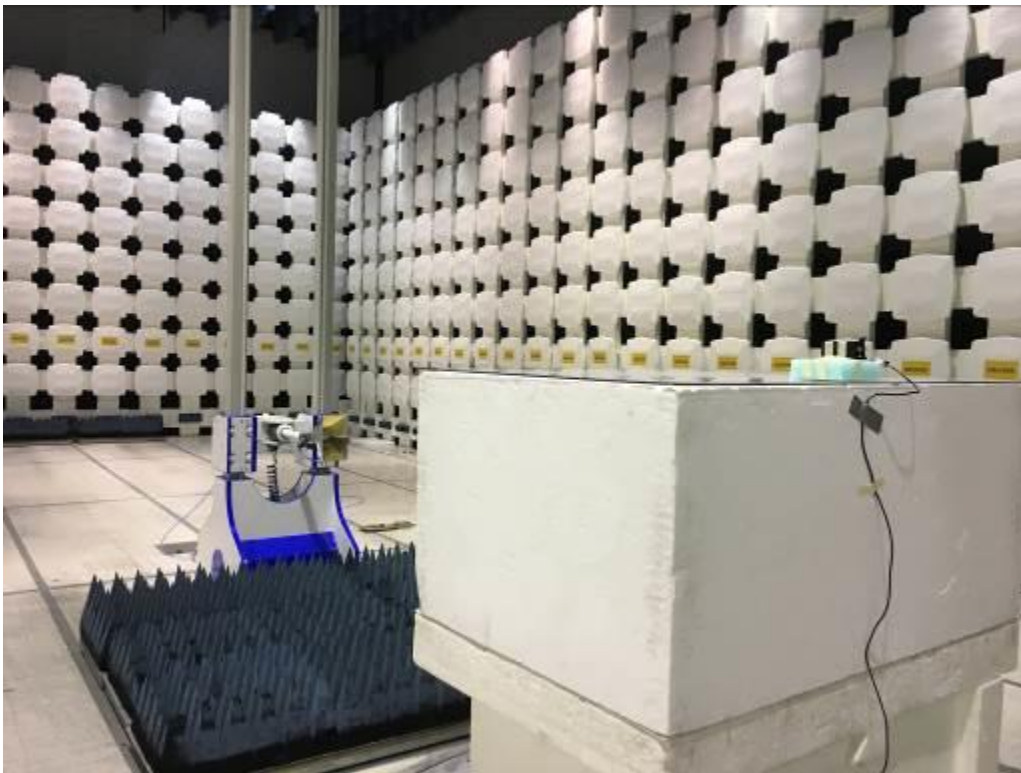
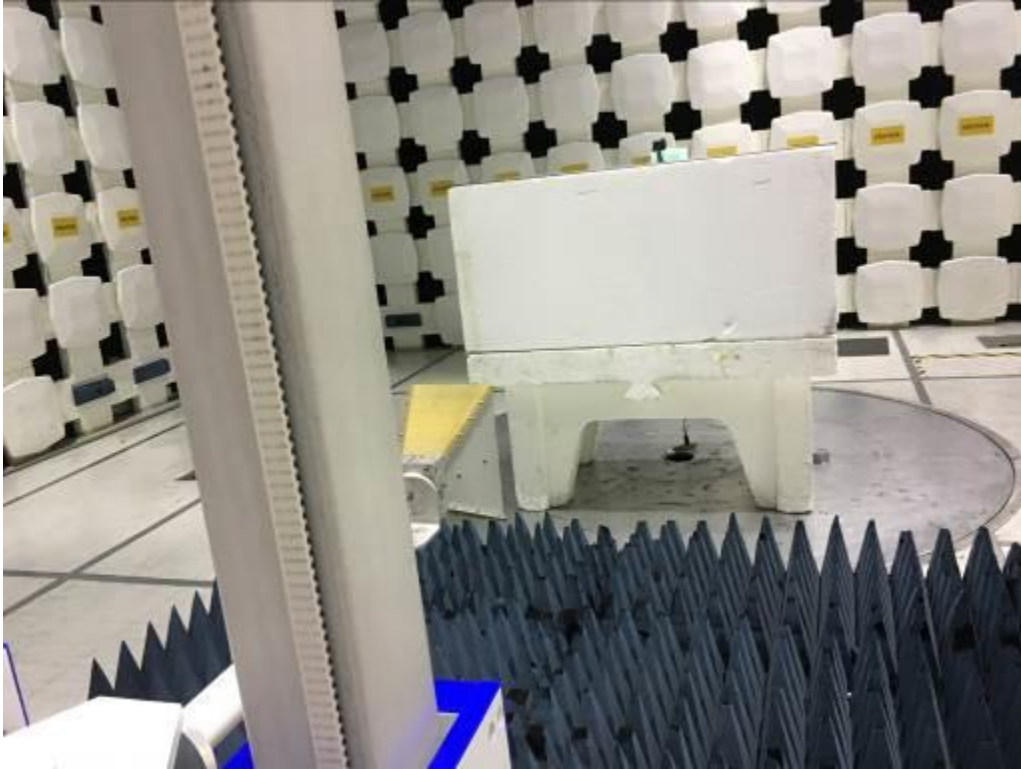
15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

6.4 Setup Photographs:

Radiated Emissions Test Setup, 30-1000 MHz



Radiated Emissions Test Setup, Above 1 GHz



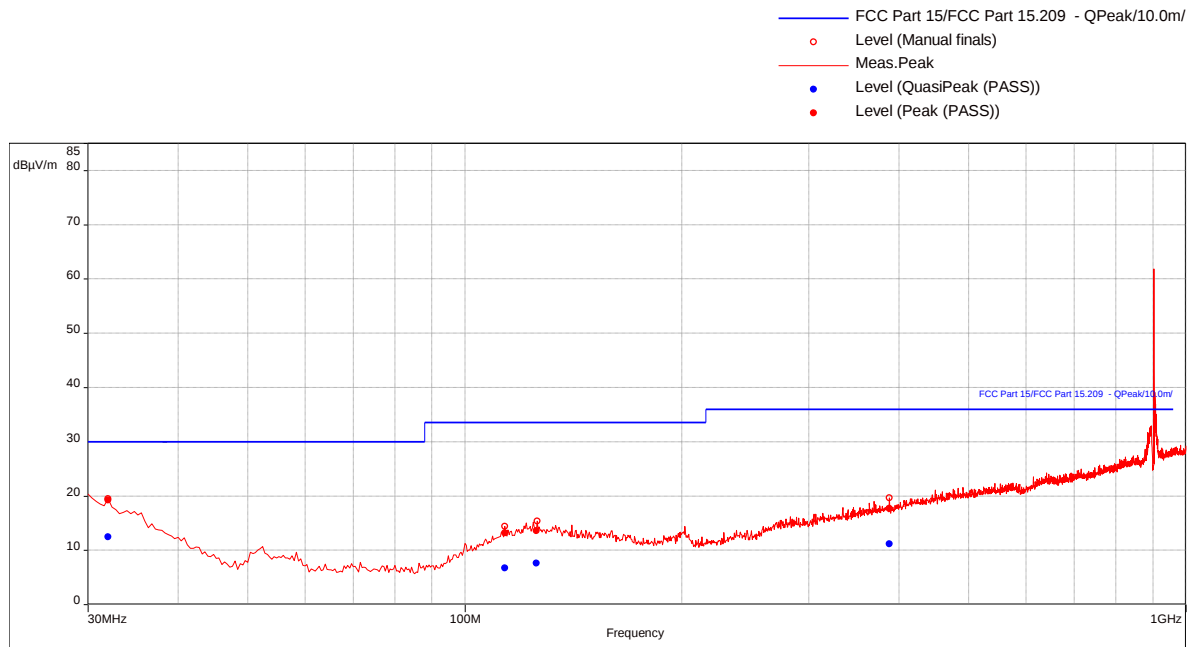
6.5 Plots/Data:

30-1000MHz, 120VAC Powered, Transmit @ Low Channel, EUT on X-axis

Test Information:

Date and Time	2/6/2020 6:35:21 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	993 mbar
Comments	RE 30-1000MHz_120VAC 60Hz Tx mode_Low CH_X-Axis

Graph:



Results:

QuasiPeak (PASS) (4)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
31.90526316	12.49	30.00	-17.51	135.00	3.58	Vertical	120000.00	-13.89
113.7894737	6.69	33.50	-26.81	39.00	1.84	Vertical	120000.00	-19.47
125.4631579	7.63	33.50	-25.87	122.00	1.01	Vertical	120000.00	-18.60
387.9684211	11.19	36.00	-24.81	85.00	1.75	Vertical	120000.00	-16.41

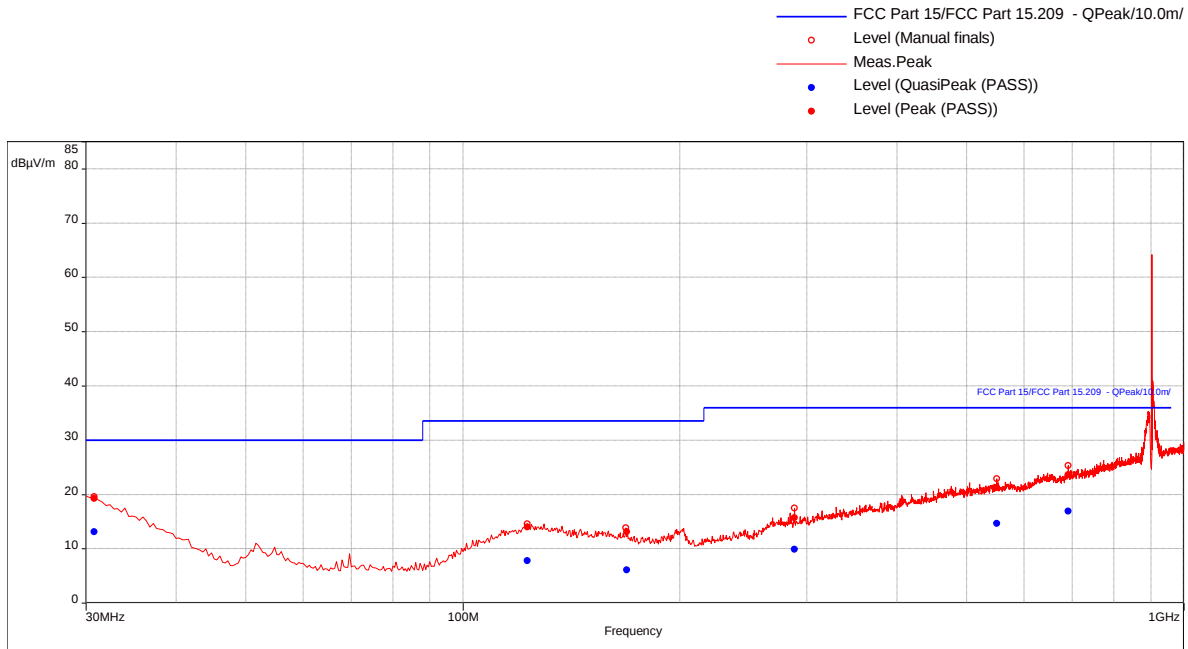
Note: The high peak is a fundamental emission, a filter was used to attenuate the signal.

30-1000MHz, 120VAC Powered, Transmit @ Low Channel, EUT on Y-axis

Test Information:

Date and Time	2/6/2020 5:50:03 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	993 mbar
Comments	RE 30-1000MHz 120VAC 60Hz Tx mode Low CH Y-Axis

Graph:



Results:

QuasiPeak (PASS) (6)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
30.95789474	13.13	30.00	-16.87	54.00	2.04	Horizontal	120000.00	-13.25
122.8631579	7.73	33.50	-25.77	314.00	1.68	Horizontal	120000.00	-18.65
168.8421053	6.07	33.50	-27.43	196.00	3.41	Horizontal	120000.00	-20.57
288.4947368	9.86	36.00	-26.14	231.00	1.65	Vertical	120000.00	-18.66
550.1263158	14.61	36.00	-21.39	195.00	2.62	Horizontal	120000.00	-12.62
690.9157895	16.91	36.00	-19.09	194.00	2.40	Horizontal	120000.00	-10.00

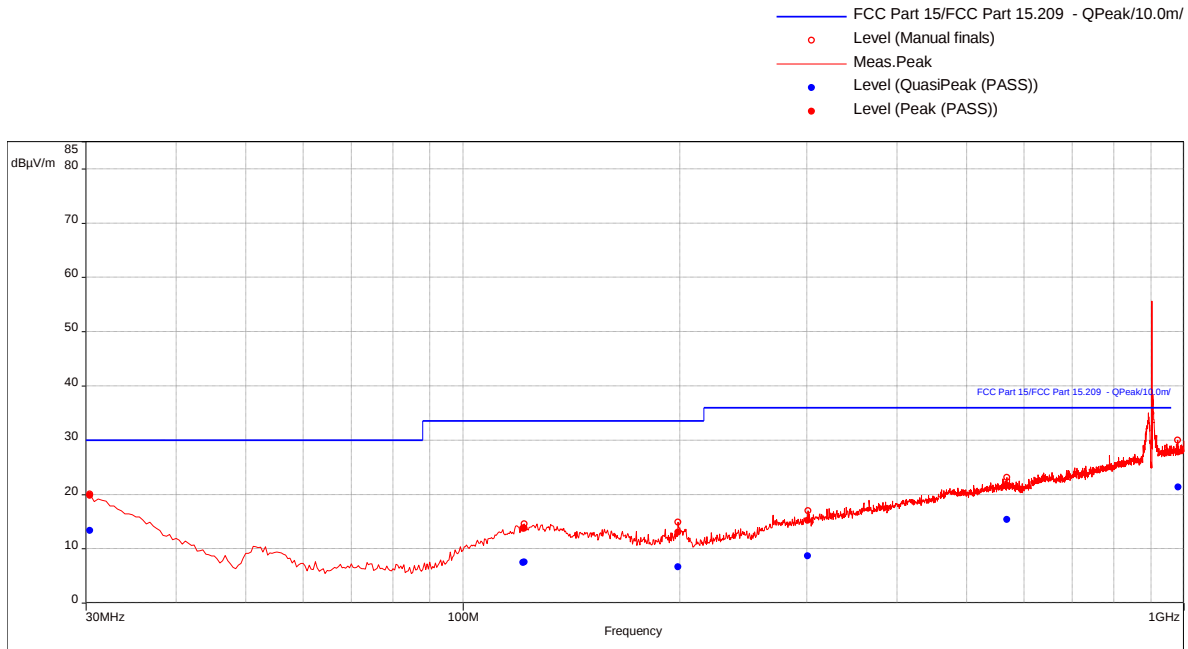
Note: The high peak is a fundamental emission, a filter was used to attenuate the signal.

30-1000MHz, 120VAC Powered, Transmit @ Low Channel, EUT on Z-axis

Test Information:

Date and Time	2/6/2020 4:58:07 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	993 mbar
Comments	RE 30-1000MHz 120VAC 60Hz Tx mode Low CH Z-Axis

Graph:



Results:

QuasiPeak (PASS) (7)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
30.49473684	13.36	30.00	-16.64	11.00	1.51	Horizontal	120000.00	-13.02
121.2842105	7.41	33.50	-26.09	24.00	3.74	Vertical	120000.00	-18.75
121.7894737	7.49	33.50	-26.01	304.00	3.38	Vertical	120000.00	-18.75
198.9894737	6.66	33.50	-26.84	210.00	1.09	Horizontal	120000.00	-19.78
300.6947368	8.66	36.00	-27.34	357.00	2.18	Horizontal	120000.00	-18.57
568.0315789	15.33	36.00	-20.67	342.00	2.96	Horizontal	120000.00	-12.08
981.4210526	21.38	36.00	-14.62	313.00	2.85	Vertical	120000.00	-5.07

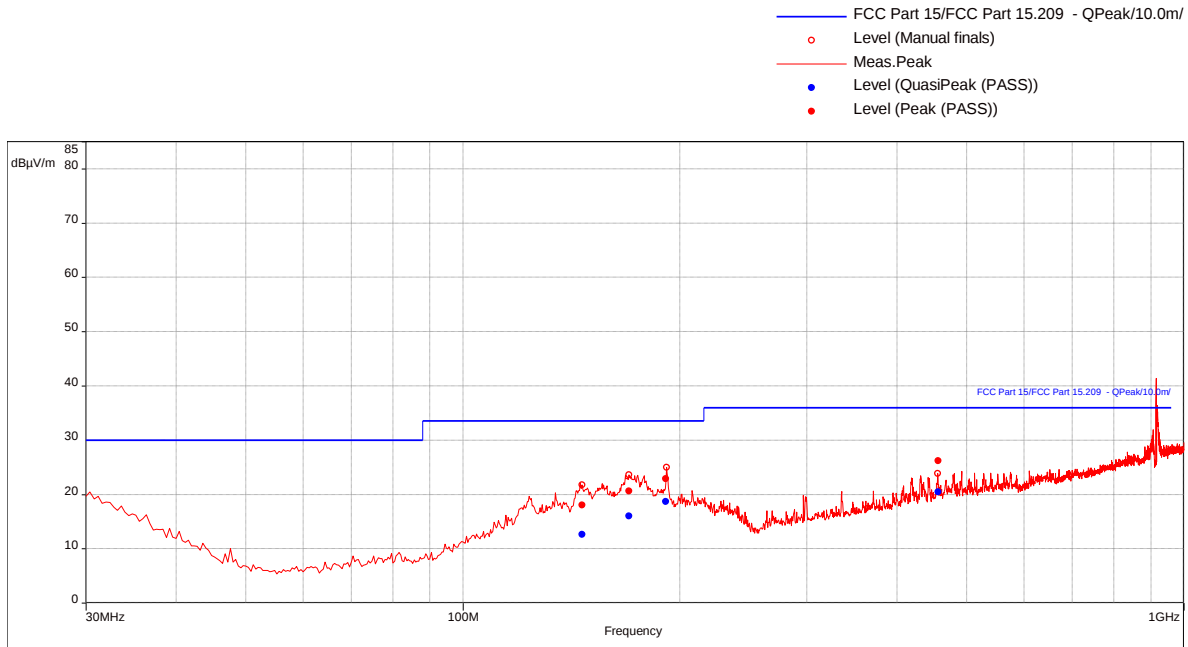
Note: The high peak is a fundamental emission, a filter was used to attenuate the signal.

30-1000MHz, 120VAC Powered, Transmit @ Mid Channel, EUT on X-axis

Test Information:

Date and Time	2/6/2020 7:22:55 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	993 mbar
Comments	RE 30-1000MHz 120VAC 60Hz Tx mode_Mid CH_X-Axis

Graph:



Results:

QuasiPeak (PASS) (4)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
146.3368421	12.65	33.50	-20.85	25.00	3.67	Vertical	120000.00	-19.95
169.9684211	16.01	33.50	-17.49	344.00	1.52	Vertical	120000.00	-20.68
191.3473684	18.66	33.50	-14.84	320.00	1.00	Vertical	120000.00	-20.80
455.9789474	20.42	36.00	-15.58	328.00	2.32	Horizontal	120000.00	-14.33

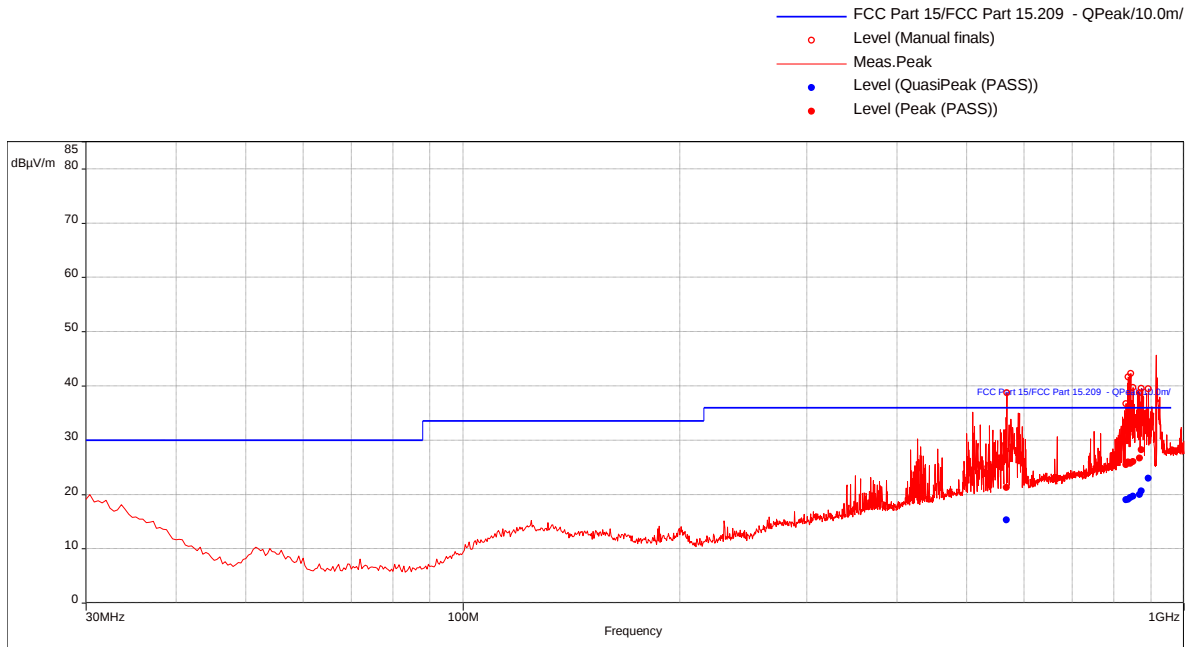
Note: The high peak is a fundamental emission, a filter was used to attenuate the signal.

30-1000MHz, 120VAC Powered, Transmit @ Mid Channel, EUT on Y-axis

Test Information:

Date and Time	2/6/2020 8:04:11 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	993 mbar
Comments	RE 30-1000MHz 120VAC 60Hz Tx mode_Mid CH_Y-Axis

Graph:



Results:

QuasiPeak (PASS) (8)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
567.6210526	15.27	36.00	-20.73	10.00	1.88	Horizontal	120000.00	-12.09
831.5684211	19.03	36.00	-16.97	201.00	1.89	Horizontal	120000.00	-7.41
837.6	19.08	36.00	-16.92	262.00	2.03	Horizontal	120000.00	-7.29
843.6526316	19.38	36.00	-16.62	342.00	1.81	Horizontal	120000.00	-7.13
850.9578947	19.61	36.00	-16.39	224.00	3.86	Horizontal	120000.00	-6.84
868.3894737	19.96	36.00	-16.04	40.00	1.36	Horizontal	120000.00	-6.89
873.2842105	20.62	36.00	-15.38	314.00	1.15	Horizontal	120000.00	-6.92
892.9789474	22.94	36.00	-13.06	25.00	2.98	Horizontal	120000.00	-6.60

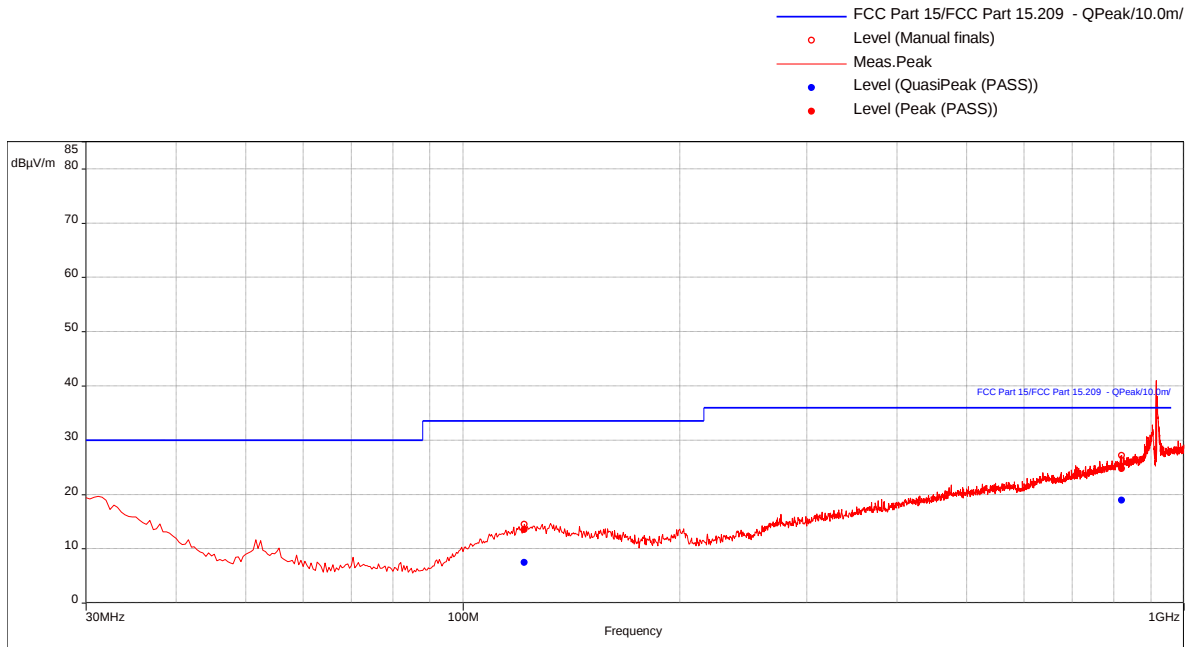
Note: The high peak is a fundamental emission, a filter was used to attenuate the signal.

30-1000MHz, 120VAC Powered, Transmit @ Mid Channel, EUT on Z-axis

Test Information:

Date and Time	2/6/2020 8:56:14 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	993 mbar
Comments	RE 30-1000MHz 120VAC 60Hz Tx mode_Mid CH_Z-Axis

Graph:



Results:

QuasiPeak (PASS) (2)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
121.6947368	7.41	33.50	-26.09	152.00	3.56	Horizontal	120000.00	-18.75
820.1263158	18.87	36.00	-17.13	305.00	3.15	Horizontal	120000.00	-7.64

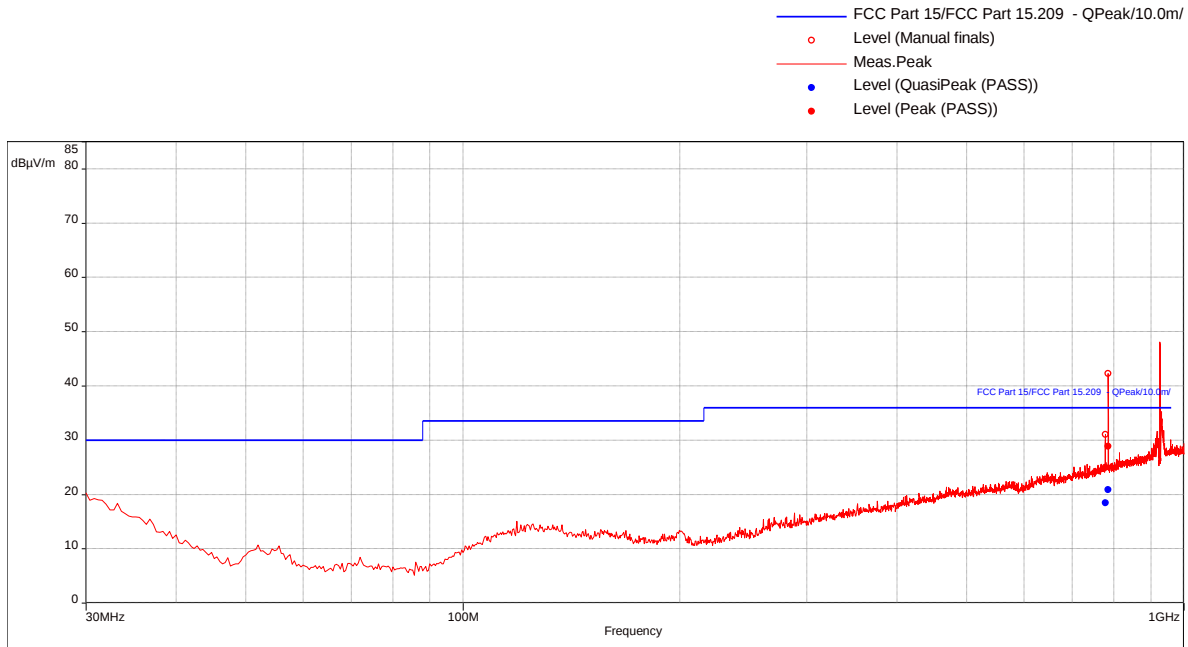
Note: The high peak is a fundamental emission, a filter was used to attenuate the signal.

30-1000MHz, 120VAC Powered, Transmit @ High Channel, EUT on X-axis

Test Information:

Date and Time	2/6/2020 9:41:47 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	993 mbar
Comments	RE 30-1000MHz 120VAC 60Hz Tx mode High CH X-Axis

Graph:



Results:

QuasiPeak (PASS) (2)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
778.0631579	18.42	36.00	-17.58	298.00	3.65	Vertical	120000.00	-8.36
785.5368421	20.89	36.00	-15.11	18.00	2.71	Vertical	120000.00	-8.30

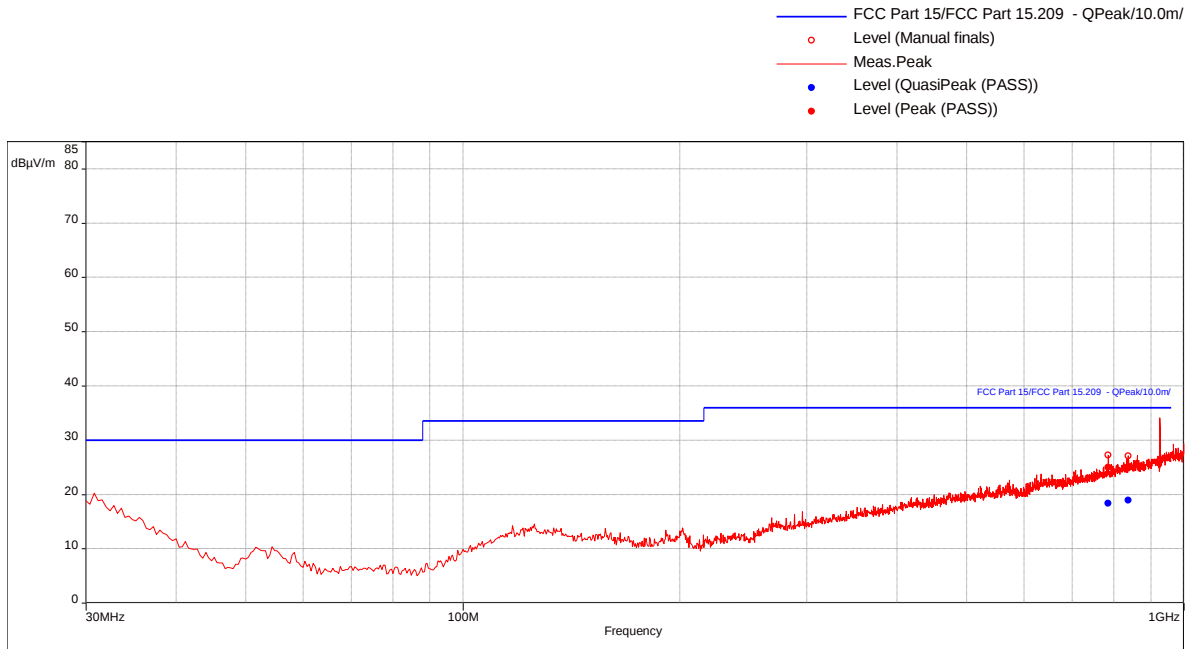
Note: The high peak is a fundamental emission, a filter was used to attenuate the signal.

30-1000MHz, 120VAC Powered, Transmit @ High Channel, EUT on Y-axis

Test Information:

Date and Time	2/6/2020 10:16:07 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	993 mbar
Comments	RE 30-1000MHz 120VAC 60Hz Tx mode High CH Y-Axis

Graph:



Results:

QuasiPeak (PASS) (2)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
785.1578947	18.31	36.00	-17.69	122.00	1.72	Vertical	120000.00	-8.27
836.6315789	18.95	36.00	-17.05	246.00	3.81	Vertical	120000.00	-7.29

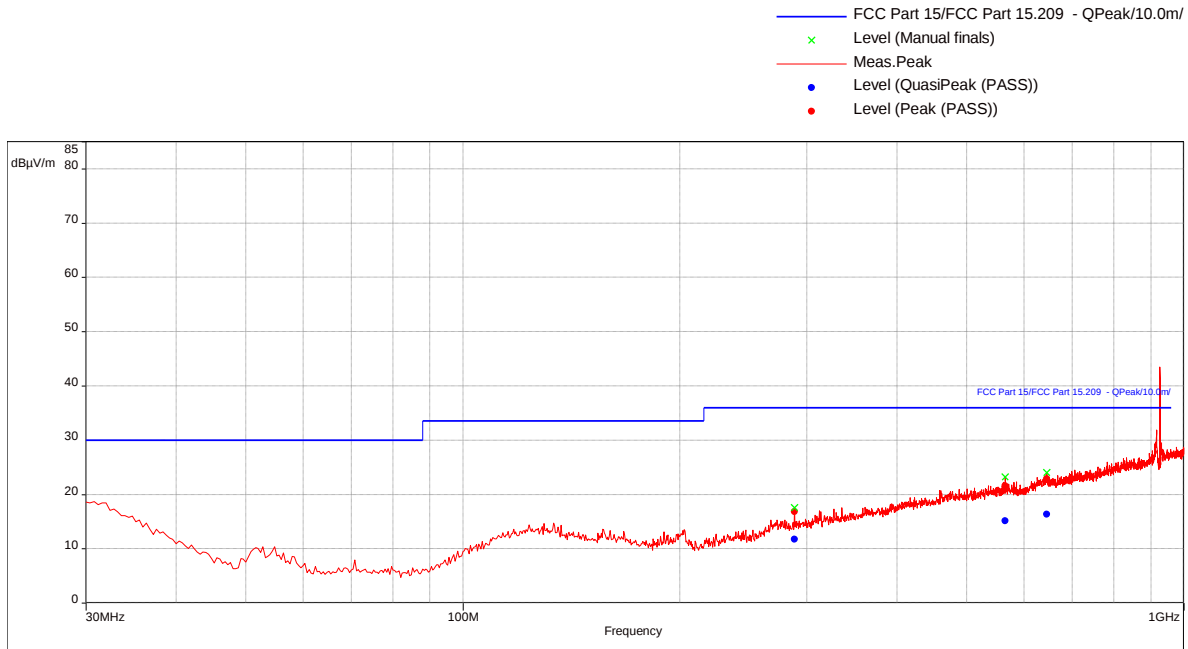
Note: The high peak is a fundamental emission, a filter was used to attenuate the signal.

30-1000MHz, 120VAC Powered, Transmit @ High Channel, EUT on Z-axis

Test Information:

Date and Time	2/6/2020 10:29:23 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	993 mbar
Comments	RE 30-1000MHz 120VAC 60Hz Tx mode_High CH_Z-Axis

Graph:



Results:

QuasiPeak (PASS) (3)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)
288.5578947	36.00	-24.25	91.00	1.73	Vertical	120000.00	-18.66
565.0736842	36.00	-20.90	0.00	2.34	Horizontal	120000.00	-12.19
645.3473684	36.00	-19.64	92.00	3.87	Vertical	120000.00	-10.42

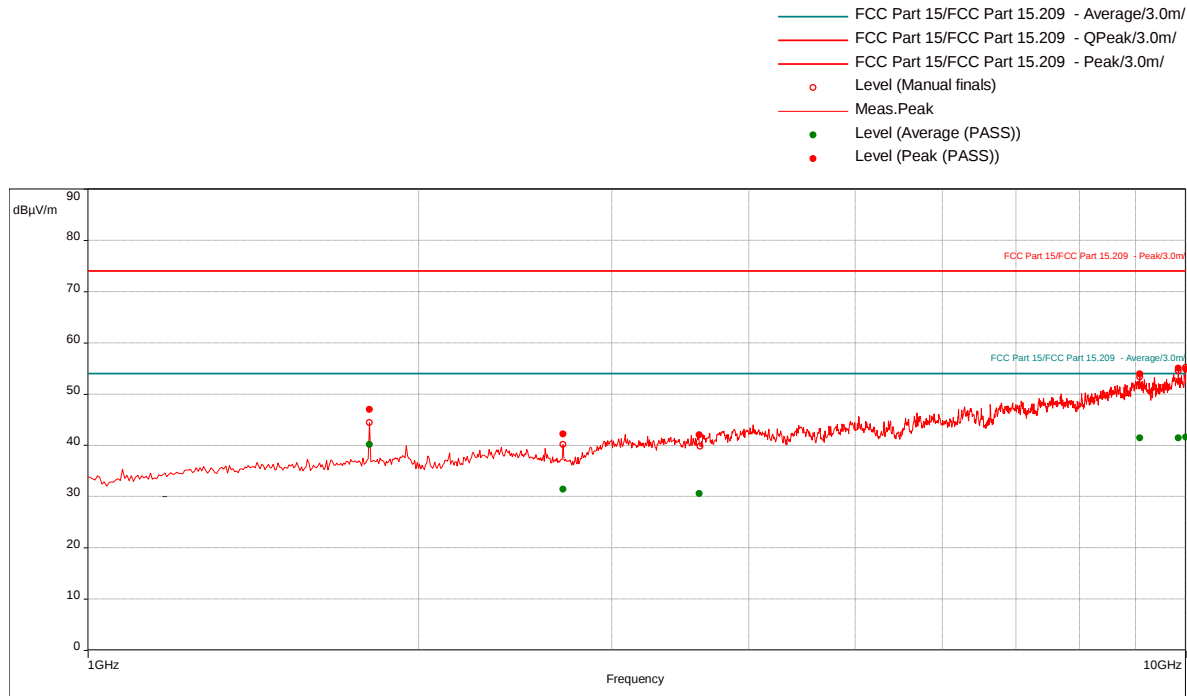
Note: The high peak is a fundamental emission, a filter was used to attenuate the signal.

1-10 GHz, 120VAC Powered, Transmit @ Low Channel, EUT on X-axis

Test Information:

Date and Time	2/7/2020 5:20:46 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	963 mbar
Comments	RE 1 to 10 GHz 120VAC 60Hz Tx mode Low CH X-Axis

Graph:



Results:

Peak (PASS) (6)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1806.052632	47.00	74.00	-27.00	32.00	1.55	Horizontal	1000000.00	-22.63
2708.421053	42.17	74.00	-31.83	40.00	1.50	Vertical	1000000.00	-19.15
3607.105263	42.03	74.00	-31.97	261.00	1.75	Horizontal	1000000.00	-15.34
9080.789474	53.88	74.00	-20.12	151.00	2.05	Vertical	1000000.00	-1.63
9844.210526	54.98	74.00	-19.02	77.00	2.65	Vertical	1000000.00	-0.01
9999.736842	54.86	74.00	-19.14	61.00	2.50	Vertical	1000000.00	0.46

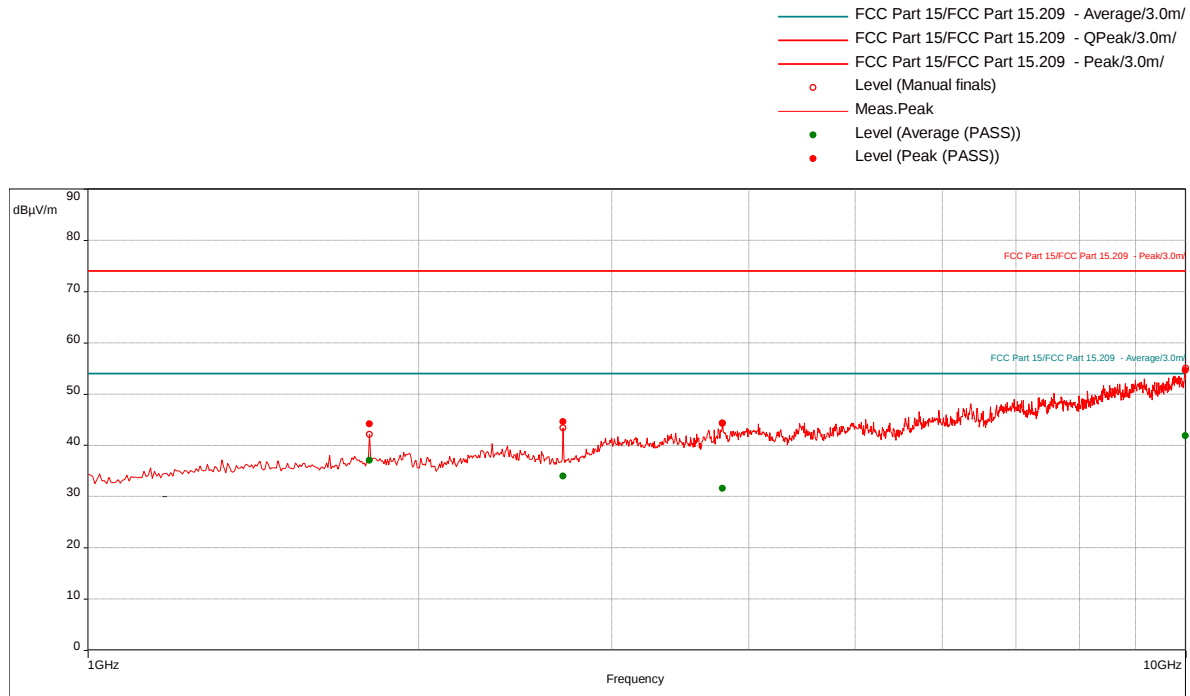
Average (PASS) (6)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1806.052632	40.14	54.00	-13.86	32.00	1.55	Horizontal	1000000.00	-22.63
2708.421053	31.43	54.00	-22.57	40.00	1.50	Vertical	1000000.00	-19.15
3607.105263	30.56	54.00	-23.44	261.00	1.75	Horizontal	1000000.00	-15.34
9080.789474	41.42	54.00	-12.58	151.00	2.05	Vertical	1000000.00	-1.63
9844.210526	41.45	54.00	-12.55	77.00	2.65	Vertical	1000000.00	-0.01
9999.736842	41.59	54.00	-12.41	61.00	2.50	Vertical	1000000.00	0.46

1-10 GHz, 120VAC Powered, Transmit @ Low Channel, EUT on Y-axis

Test Information:

Date and Time	2/7/2020 5:49:02 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	963 mbar
Comments	RE 1 to 10 GHz 120VAC 60Hz Tx mode Low CH Y-Axis

Graph:**Results:****Peak (PASS) (4)**

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1805.789474	44.18	74.00	-29.82	305.00	1.01	Horizontal	1000000.00	-22.63
2708.157895	44.61	74.00	-29.39	359.00	1.51	Horizontal	1000000.00	-19.15
3787.105263	44.32	74.00	-29.68	172.00	2.20	Horizontal	1000000.00	-13.92
9997.105263	54.57	74.00	-19.43	54.00	2.25	Horizontal	1000000.00	0.45

Average (PASS) (4)

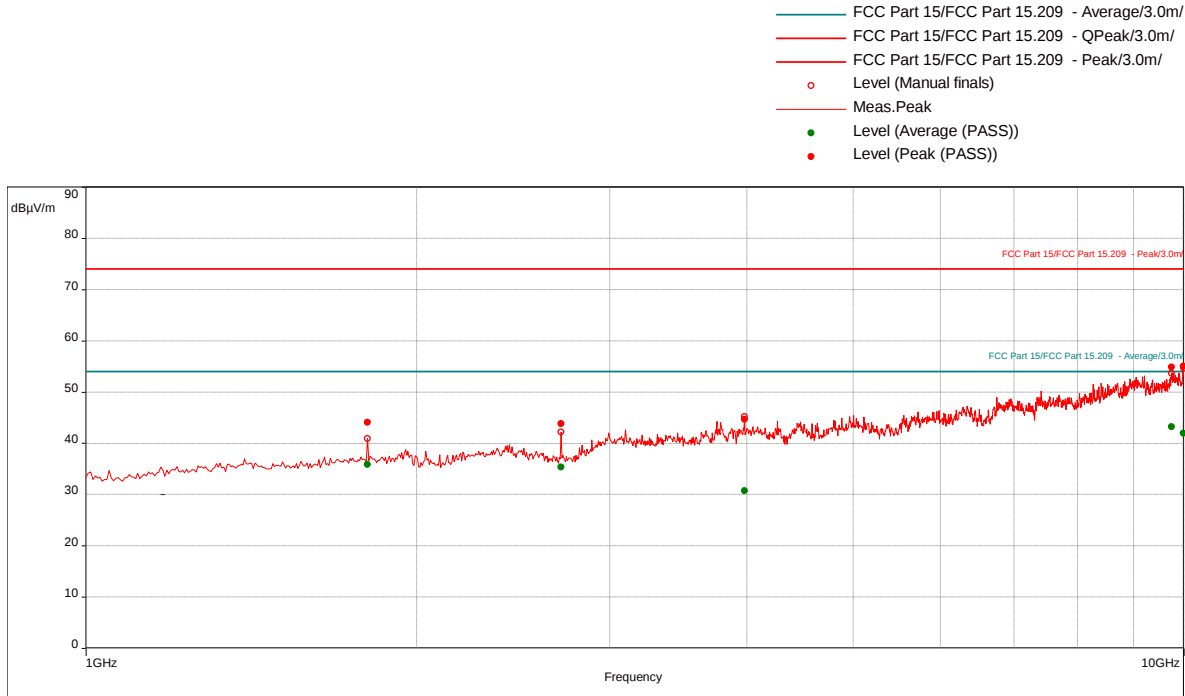
Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1805.789474	37.09	54.00	-16.91	305.00	1.01	Horizontal	1000000.00	-22.63
2708.157895	33.94	54.00	-20.06	359.00	1.51	Horizontal	1000000.00	-19.15
3787.105263	31.61	54.00	-22.39	172.00	2.20	Horizontal	1000000.00	-13.92
9997.105263	41.86	54.00	-12.14	54.00	2.25	Horizontal	1000000.00	0.45

1-10 GHz, 120VAC Powered, Transmit @ Low Channel, EUT on Z-axis

Test Information:

Date and Time	2/7/2020 6:10:22 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	963 mbar
Comments	RE 1 to 10 GHz 120VAC 60Hz Tx mode Low CH Z-Axis

Graph:



Results:

Peak (PASS) (5)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1805.789474	44.06	74.00	-29.94	224.00	1.05	Vertical	1000000.00	-22.63
2708.684211	43.83	74.00	-30.17	32.00	1.10	Vertical	1000000.00	-19.15
3977.894737	44.70	74.00	-29.30	4.00	1.50	Horizontal	1000000.00	-13.41
9746.578947	54.81	74.00	-19.19	173.00	2.65	Vertical	1000000.00	-0.31
9996.842105	55.00	74.00	-19.00	91.00	3.64	Horizontal	1000000.00	0.45

Average (PASS) (5)

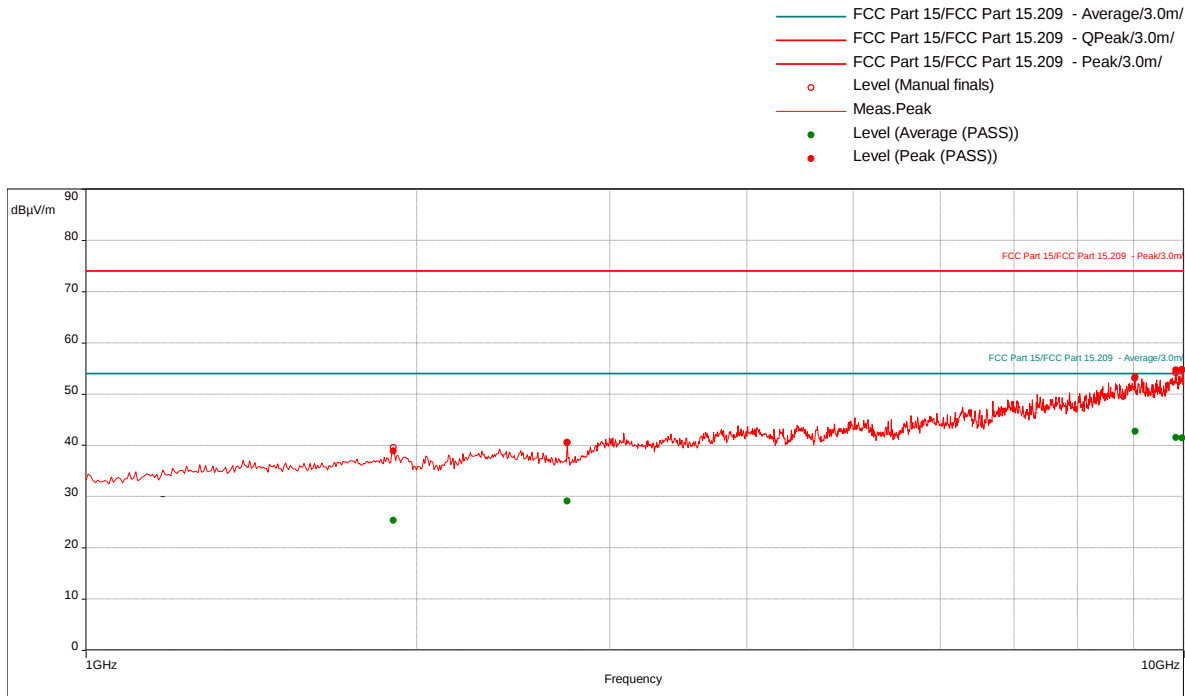
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1805.789474	35.86	54.00	-18.14	224.00	1.05	Vertical	1000000.00	-22.63
2708.684211	35.35	54.00	-18.65	32.00	1.10	Vertical	1000000.00	-19.15
3977.894737	30.74	54.00	-23.26	4.00	1.50	Horizontal	1000000.00	-13.41
9746.578947	43.18	54.00	-10.82	173.00	2.65	Vertical	1000000.00	-0.31
9996.842105	41.92	54.00	-12.08	91.00	3.64	Horizontal	1000000.00	0.45

1-10 GHz, 120VAC Powered, Transmit @ Mid Channel, EUT on X-axis

Test Information:

Date and Time	2/7/2020 7:26:20 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	963 mbar
Comments	RE 1 to 10 GHz 120VAC 60Hz Tx mode Mid CH X-Axis

Graph:



Results:

Peak (PASS) (5)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1903.684211	38.82	74.00	-35.18	84.00	2.75	Horizontal	1000000.00	-21.45
2744.473684	40.58	74.00	-33.42	329.00	3.10	Vertical	1000000.00	-19.13
9028.157895	53.33	74.00	-20.67	195.00	1.50	Horizontal	1000000.00	-1.65
9840.789474	54.68	74.00	-19.32	180.00	1.10	Vertical	1000000.00	-0.01
9965.263158	54.75	74.00	-19.25	17.00	3.15	Vertical	1000000.00	0.35

Average (PASS) (5)

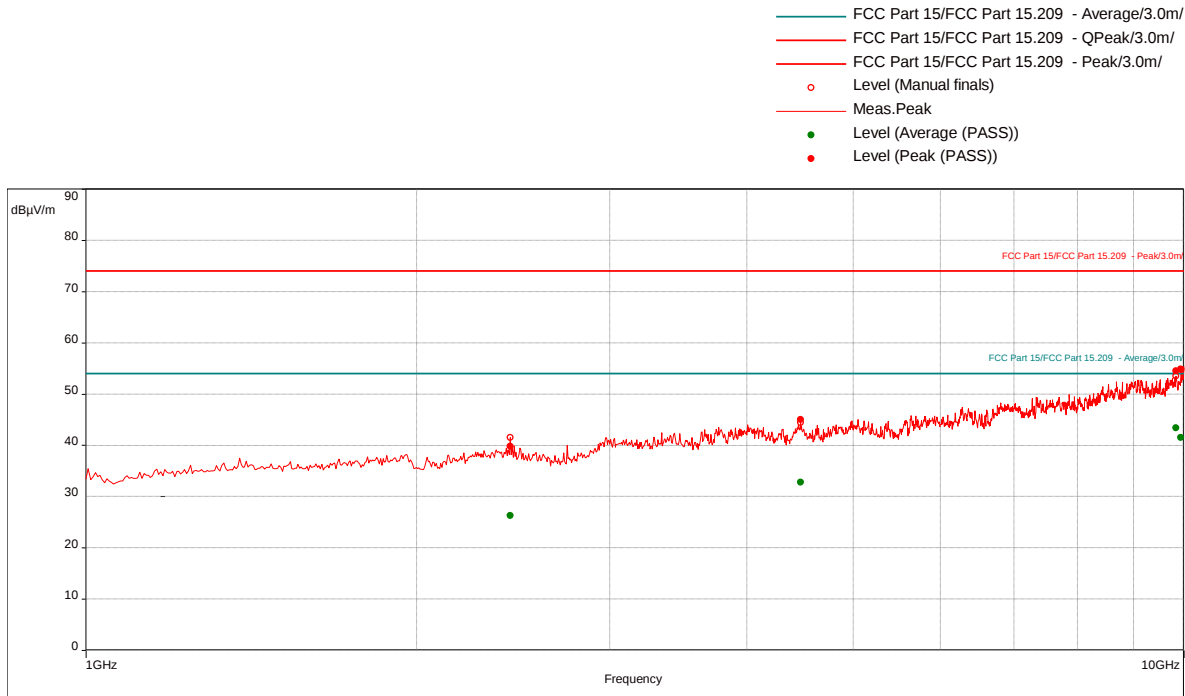
Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1903.684211	25.36	54.00	-28.64	84.00	2.75	Horizontal	1000000.00	-21.45
2744.473684	29.10	54.00	-24.90	329.00	3.10	Vertical	1000000.00	-19.13
9028.157895	42.73	54.00	-11.27	195.00	1.50	Horizontal	1000000.00	-1.65
9840.789474	41.53	54.00	-12.47	180.00	1.10	Vertical	1000000.00	-0.01
9965.263158	41.42	54.00	-12.58	17.00	3.15	Vertical	1000000.00	0.35

1-10 GHz, 120VAC Powered, Transmit @ Mid Channel, EUT on Y-axis

Test Information:

Date and Time	2/7/2020 7:04:17 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	963 mbar
Comments	RE 1 to 10 GHz 120VAC 60Hz Tx mode Mid CH Y-Axis

Graph:



Results:

Peak (PASS) (4)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
2433.684211	39.78	74.00	-34.22	291.00	3.15	Vertical	1000000.00	-19.72
4475.263158	45.01	74.00	-28.99	239.00	1.15	Vertical	1000000.00	-12.66
9839.210526	54.54	74.00	-19.46	54.00	1.00	Vertical	1000000.00	-0.02
9941.315789	54.82	74.00	-19.18	47.00	1.85	Horizontal	1000000.00	0.26

Average (PASS) (4)

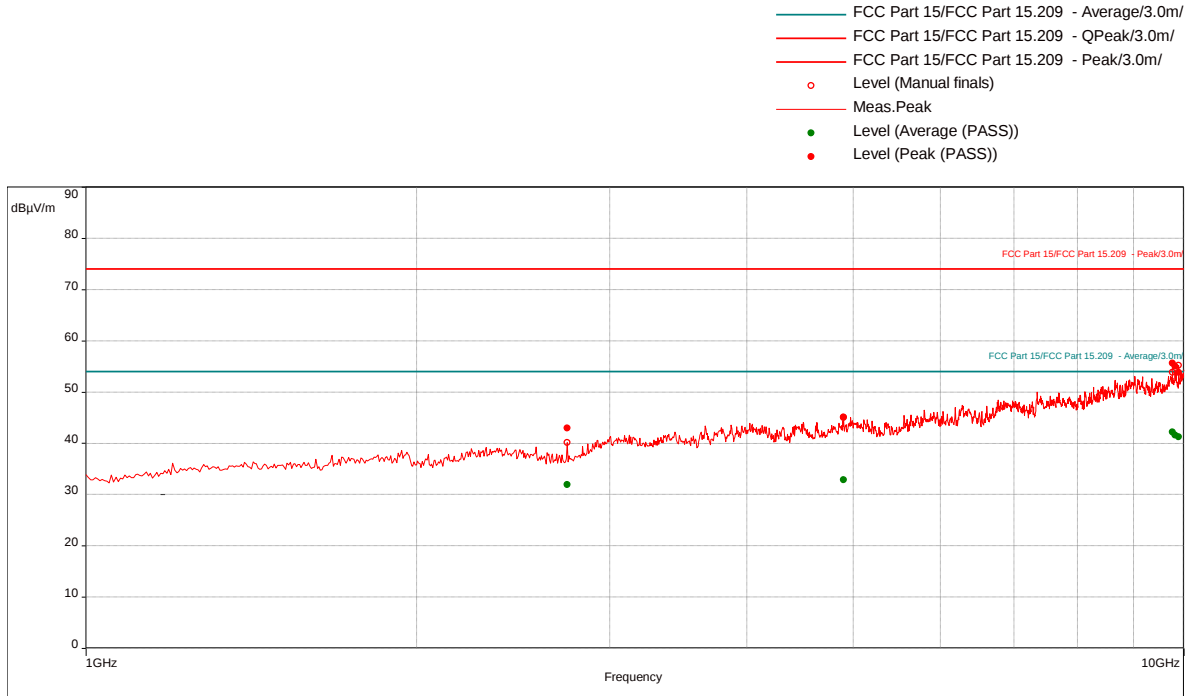
Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
2433.684211	26.28	54.00	-27.72	291.00	3.15	Vertical	1000000.00	-19.72
4475.263158	32.78	54.00	-21.22	239.00	1.15	Vertical	1000000.00	-12.66
9839.210526	43.34	54.00	-10.66	54.00	1.00	Vertical	1000000.00	-0.02
9941.315789	41.54	54.00	-12.46	47.00	1.85	Horizontal	1000000.00	0.26

1-10 GHz, 120VAC Powered, Transmit @ Mid Channel, EUT on Z-axis

Test Information:

Date and Time	2/7/2020 6:40:06 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	963 mbar
Comments	RE 1 to 10 GHz 120VAC 60Hz Tx mode Mid CH Z-Axis

Graph:



Results:

Peak (PASS) (5)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
2744.210526	42.91	74.00	-31.09	276.00	1.35	Horizontal	1000000.00	-19.13
4898.947368	45.00	74.00	-29.00	216.00	1.50	Horizontal	1000000.00	-10.90
9760.263158	55.64	74.00	-18.36	47.00	3.74	Vertical	1000000.00	-0.25
9815.526316	55.05	74.00	-18.95	62.00	1.80	Vertical	1000000.00	-0.07
9897.105263	53.82	74.00	-20.18	224.00	1.05	Vertical	1000000.00	0.11

Average (PASS) (5)

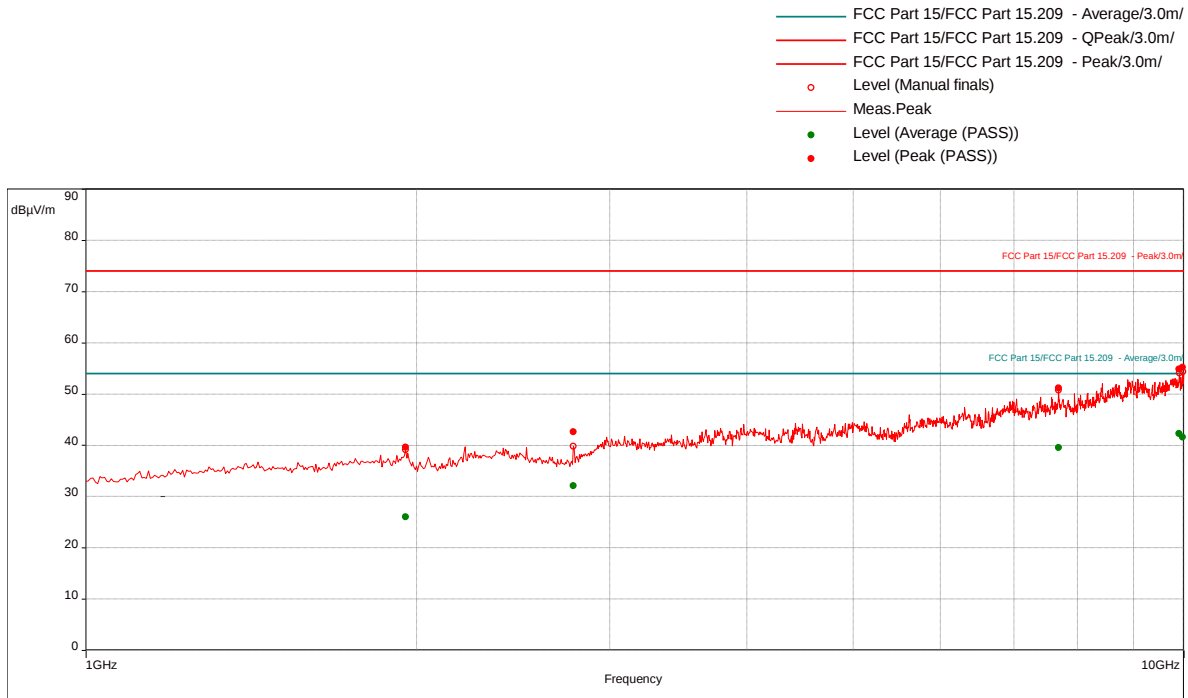
Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
2744.210526	31.91	54.00	-22.09	276.00	1.35	Horizontal	1000000.00	-19.13
4898.947368	32.88	54.00	-21.12	216.00	1.50	Horizontal	1000000.00	-10.90
9760.263158	42.14	54.00	-11.86	47.00	3.74	Vertical	1000000.00	-0.25
9815.526316	41.55	54.00	-12.45	62.00	1.80	Vertical	1000000.00	-0.07
9897.105263	41.24	54.00	-12.76	224.00	1.05	Vertical	1000000.00	0.11

1-10 GHz, 120VAC Powered, Transmit @ High Channel, EUT on X-axis

Test Information:

Date and Time	2/7/2020 7:57:35 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	963 mbar
Comments	RE 1 to 10 GHz 120VAC 60Hz Tx mode High CH X-Axis

Graph:



Results:

Peak (PASS) (5)

Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1952.894737	39.58	74.00	-34.42	356.00	2.85	Horizontal	1000000.00	-20.94
2780.263158	42.57	74.00	-31.43	11.00	1.20	Vertical	1000000.00	-19.04
7690.526316	51.12	74.00	-22.88	3.00	3.69	Horizontal	1000000.00	-5.04
9901.842105	54.81	74.00	-19.19	0.00	3.94	Vertical	1000000.00	0.12
9976.842105	55.22	74.00	-18.78	32.00	1.80	Vertical	1000000.00	0.38

Average (PASS) (5)

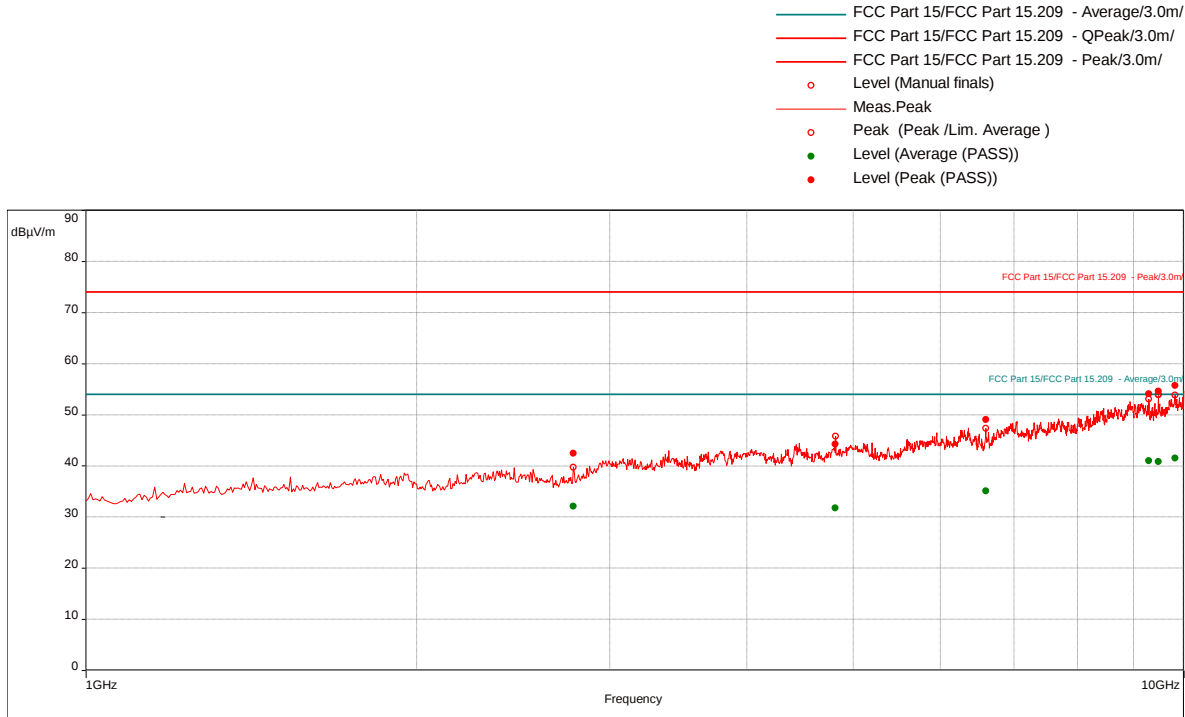
Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
1952.894737	26.00	54.00	-28.00	356.00	2.85	Horizontal	1000000.00	-20.94
2780.263158	32.13	54.00	-21.87	11.00	1.20	Vertical	1000000.00	-19.04
7690.526316	39.54	54.00	-14.46	3.00	3.69	Horizontal	1000000.00	-5.04
9901.842105	42.31	54.00	-11.69	0.00	3.94	Vertical	1000000.00	0.12
9976.842105	41.58	54.00	-12.42	32.00	1.80	Vertical	1000000.00	0.38

1-10 GHz, 120VAC Powered, Transmit @ High Channel, EUT on Y-axis

Test Information:

Date and Time	2/7/2020 8:22:15 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	963 mbar
Comments	RE 1 to 10 GHz 120VAC 60Hz Tx mode High CH Y-Axis

Graph:



Results:

Peak (PASS) (6)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
2780.526316	42.43	74.00	-31.57	268.00	1.20	Vertical	1000000.00	-19.04
4816.052632	44.25	74.00	-29.75	359.00	1.00	Vertical	1000000.00	-11.13
6600.263158	49.06	74.00	-24.94	54.00	1.75	Horizontal	1000000.00	-7.49
9293.421053	54.09	74.00	-19.91	336.00	2.35	Vertical	1000000.00	-1.29
9478.947368	54.60	74.00	-19.40	197.00	3.49	Vertical	1000000.00	-0.65
9816.578947	55.71	74.00	-18.29	320.00	3.49	Horizontal	1000000.00	-0.07

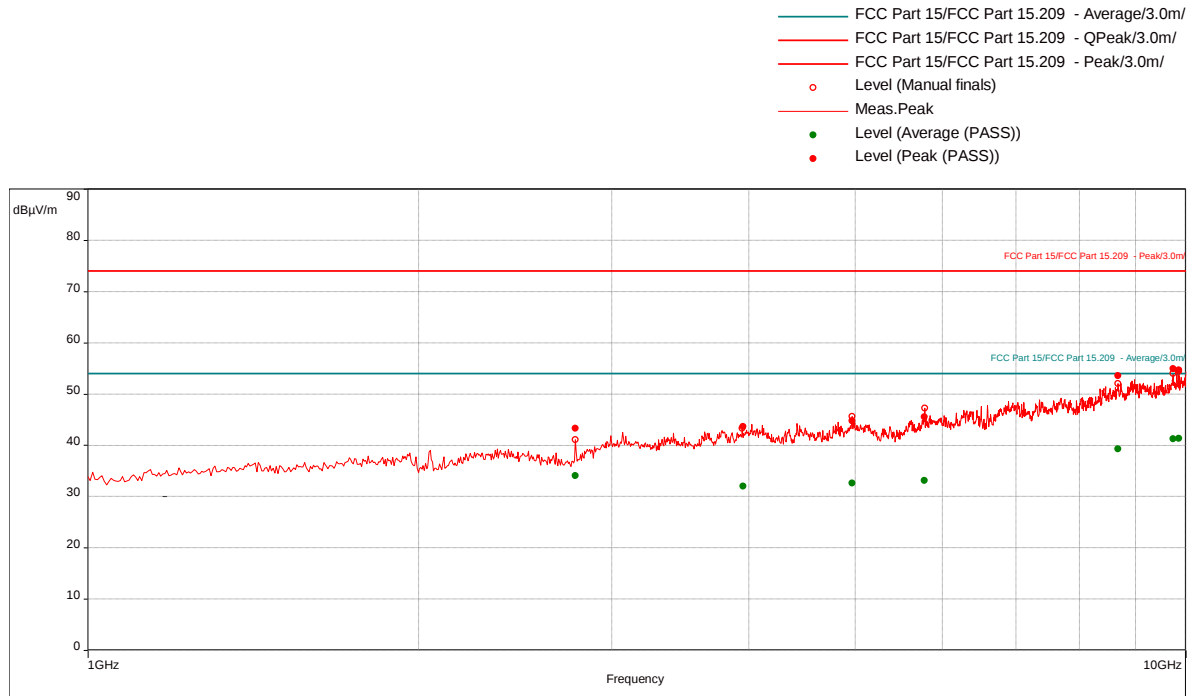
Average (PASS) (6)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
2780.526316	32.07	54.00	-21.93	268.00	1.20	Vertical	1000000.00	-19.04
4816.052632	31.77	54.00	-22.23	359.00	1.00	Vertical	1000000.00	-11.13
6600.263158	35.06	54.00	-18.94	54.00	1.75	Horizontal	1000000.00	-7.49
9293.421053	40.96	54.00	-13.04	336.00	2.35	Vertical	1000000.00	-1.29
9478.947368	40.84	54.00	-13.16	197.00	3.49	Vertical	1000000.00	-0.65
9816.578947	41.53	54.00	-12.47	320.00	3.49	Horizontal	1000000.00	-0.07

1-10 GHz, 120VAC Powered, Transmit @ High Channel, EUT on Z-axis

Test Information:

Date and Time	2/7/2020 8:50:38 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	963 mbar
Comments	RE 1 to 10 GHz 120VAC 60Hz Tx mode High CH Z-Axis

Graph:**Results:****Peak (PASS) (7)**

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
2780	43.27	74.00	-30.73	91.00	1.10	Horizontal	1000000.00	-19.04
3948.421053	43.62	74.00	-30.38	25.00	2.60	Horizontal	1000000.00	-13.46
4962.631579	44.72	74.00	-29.28	313.00	3.10	Horizontal	1000000.00	-10.79
5781.842105	45.51	74.00	-28.49	290.00	3.54	Horizontal	1000000.00	-8.61
8676.578947	53.58	74.00	-20.42	334.00	2.95	Vertical	1000000.00	-2.19
9735.789474	54.90	74.00	-19.10	217.00	2.85	Vertical	1000000.00	-0.35
9855.263158	54.71	74.00	-19.29	55.00	1.70	Vertical	1000000.00	0.02

Average (PASS) (7)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
2780	34.07	54.00	-19.93	91.00	1.10	Horizontal	1000000.00	-19.04
3948.421053	32.03	54.00	-21.97	25.00	2.60	Horizontal	1000000.00	-13.46
4962.631579	32.57	54.00	-21.43	313.00	3.10	Horizontal	1000000.00	-10.79
5781.842105	33.12	54.00	-20.88	290.00	3.54	Horizontal	1000000.00	-8.61
8676.578947	39.26	54.00	-14.74	334.00	2.95	Vertical	1000000.00	-2.19
9735.789474	41.23	54.00	-12.77	217.00	2.85	Vertical	1000000.00	-0.35
9855.263158	41.36	54.00	-12.64	55.00	1.70	Vertical	1000000.00	0.02

Test Personnel: Vathana Ven *VSV*
Supervising/Reviewing
Engineer:
(Where Applicable) N/A
Product Standard: CFR47 FCC Part 15.247
Input Voltage: RSS-247
120VAC 60Hz
Pretest Verification w/
Ambient Signals or
BB Source: BB Source

Test Date: 02/06/2020
02/07/2020

Limit Applied: See report section 6.3

Ambient Temperature: 23, 23 °C

Relative Humidity: 26, 26 %

Atmospheric Pressure: 993, 963 mbars

Deviations, Additions, or Exclusions: None

7 Digital Device and Receiver Radiated Spurious Emissions

7.1 Method

Tests are performed in accordance with ANSI C 63.4 and RSS-GEN.

TEST SITE: 10m ALSE

The 10m ALSE is 13m (Length) x 21m (Depth) x 10m (Height) with the effective size in terms of space from the tips of the absorber is 12m (Length) x 20m (Depth) x 8.5m (Height). This chamber achieves broadband performance using a unique arrangement of hybrid and ferrite tile absorber. This chamber has a built in 3m diameter turntable (Embedded type). The metal structure of the table makes electrical connection around the entire circumference of the turntable to the ground plane with a metal brush type connection. The turntable is located on one end of the chamber and the antennas are mounted 3 and 10 meters away at the other end of the chamber on the adjustable an Antenna Mast. The antenna mast is a non-conductive bore sighted type with remote control of antenna height and polarization. The Antenna Mast and the turntable can be remotely controlled through the controller located in the adjacent Control room. A Styrofoam table 80 cm high is used for table-top equipment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucisp
Radiated Emissions, 10m	30-1000 MHz	4.6dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	5.3 dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.5 dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	5.2 dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	5.0 dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	5.0 dB	5.5 dB

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:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μ V
NF = Net Reading in dB μ V

Example:

$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$
 $UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$

Alternately, when BAT-EMC Emission Software is used, the "Level" includes all losses and gains and is compared directly in the "Margin" column to the "Limit". The "Correction" includes Antenna Factor, Preamp, and Cable Loss. These are already accounted for in the "Level" column.

7.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DS40'	Temp, humidity, pressure gauge	Digi Sense	68000-49	181717625	11/13/2019	11/13/2020
145108'	EMI Test Receiver (20Hz - 40GHz)	Rohde & Schwarz	ESIB40	100209	06/06/2019	06/06/2020
145-410	Cables 145-420 145-421 145-422 145-406	Huber + Suhner	10m Track A Cables	multiple	07/22/2019	07/22/2020
PRE11'	50dB gain pre-amp	Pasternack	PRE11	PRE11	08/30/2019	08/30/2020
145145'	Broadband Hybrid Antenna 30 MHz - 3 GHz	Sunol Sciences Corp.	JB3	A122313	06/12/2019	06/12/2020
145-416'	Cables 145-420 145-423 145-425 145-408	Huber + Suhner	3m Track B cables	multiple	07/22/2019	07/22/2020
BONN001'	1-18GHz low noise pre-amp	Bonn	BLMA 0118-M	1811749	07/11/2019	07/11/2020
HORN3'	HORN ANTENNA	EMCO	3115	9610-4980	05/30/2019	05/30/2020

Software Utilized:

Name	Manufacturer	Version
BAT-EMC	Nexio	3.17.0.3

7.3 Results:

The sample tested was found to Comply.

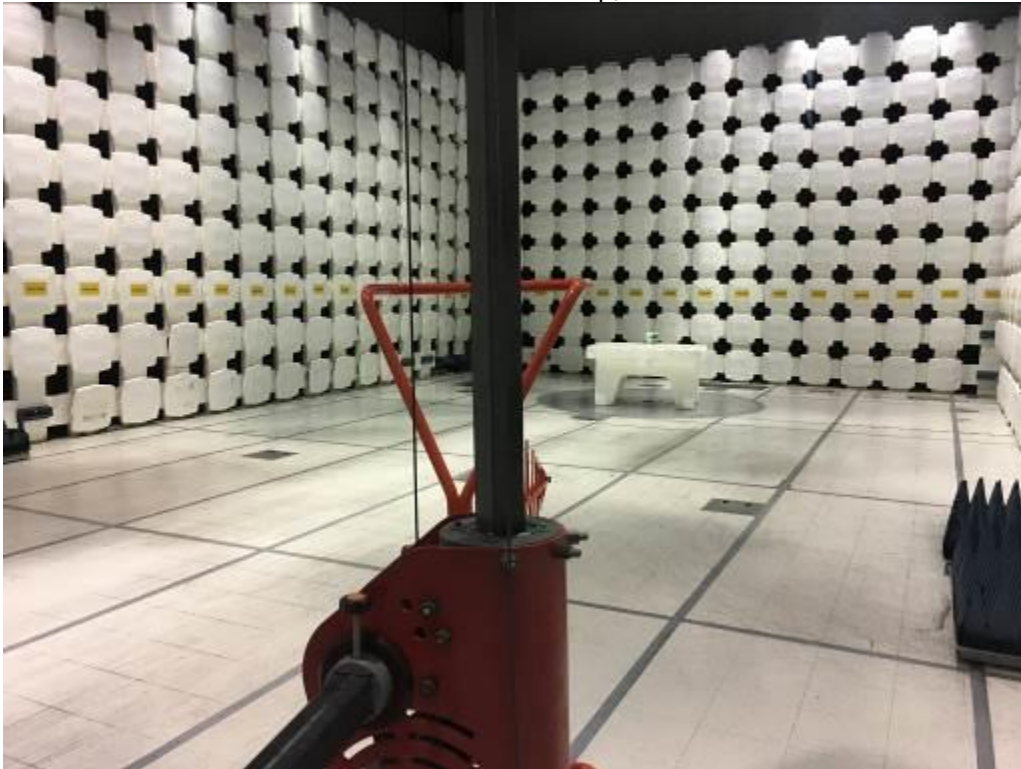
§15.109 Radiated emission limits.

The field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values.

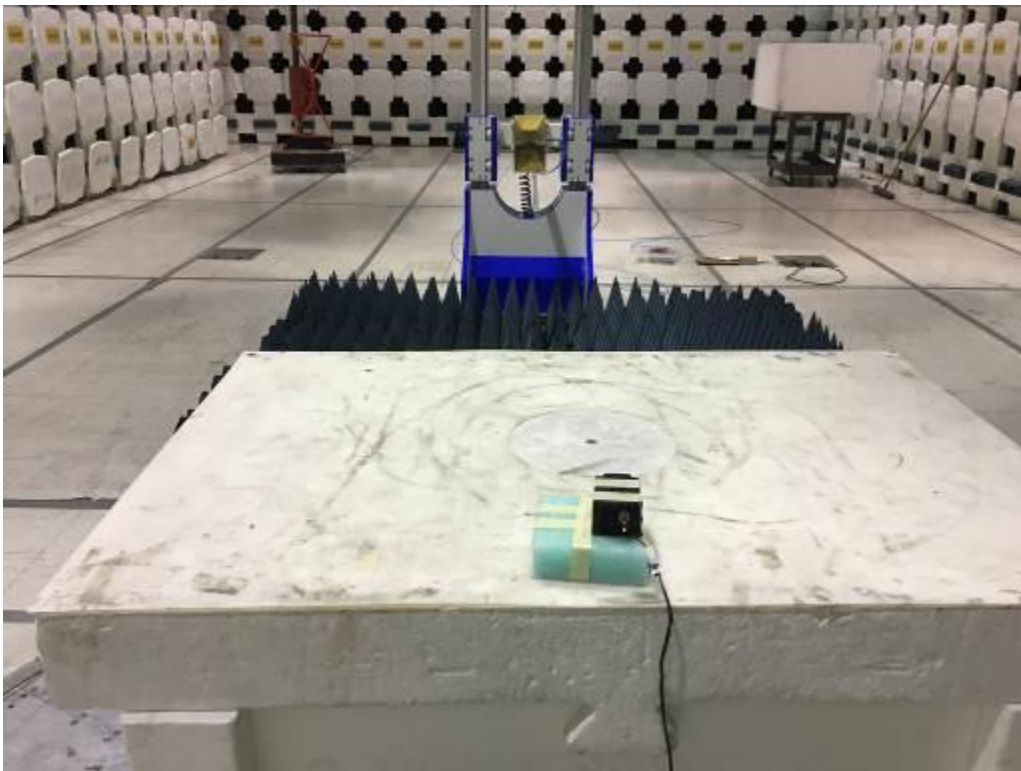
Frequency of emission (MHz)	Field strength (microvolts/meter)	Field strength (dBµV/m)
30-88	100	40.00
88-216	150	43.52
216-960	200	46.02
Above 960	500	54.00

7.4 Setup Photographs:

Radiated Emissions Test Setup, 30-1000 MHz



Radiated Emissions Test Setup, 1-10 GHz



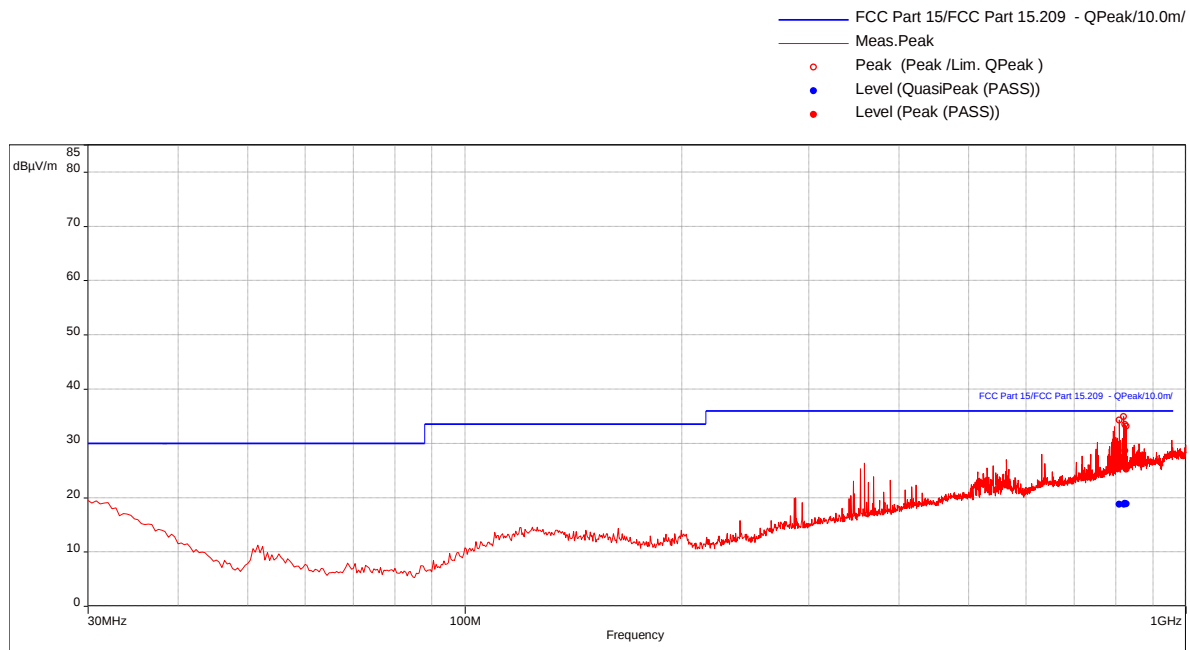
7.5 Plots/Data:

Radiated Emissions, 30-1000 MHz

Test Information:

Date and Time	2/6/2020 10:49:13 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	993 mbar
Comments	RE 30-1000MHz_120VAC 60Hz_Tx mode_Low CH_Rx/Idle mode

Graph:



Results:

QuasiPeak (PASS) (4)

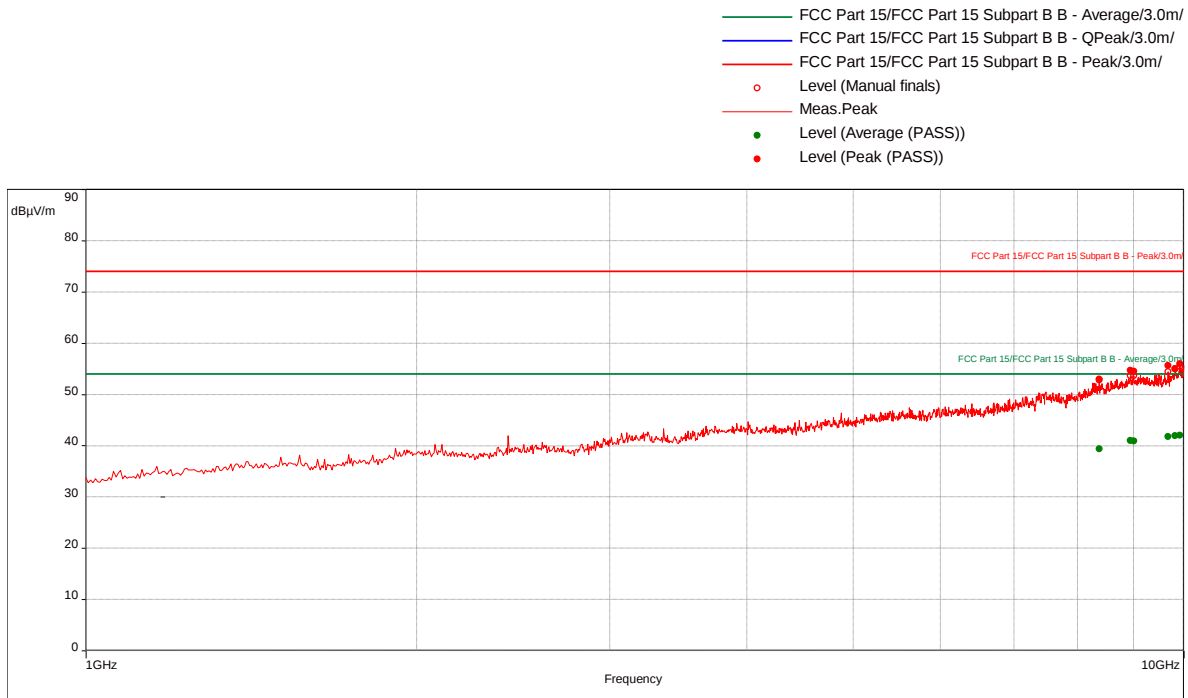
Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
808.2421053	18.73	36.00	-17.27	218.00	2.76	Vertical	120000.00	-7.85
820.7789474	18.74	36.00	-17.26	55.00	3.87	Vertical	120000.00	-7.63
823.4105263	18.94	36.00	-17.06	136.00	3.72	Vertical	120000.00	-7.50
827.3368421	18.85	36.00	-17.15	210.00	2.10	Vertical	120000.00	-7.45

Radiated Emissions, 1-10 GHz

Test Information:

Date and Time	2/7/2020 4:30:21 PM
Client and Project Number	Mars International G1044189103
Engineer	Vathana Ven
Temperature	23 deg C
Humidity	26%
Atmospheric Pressure	963 mbar
Comments	RE 1 to 10 GHz 120VAC 60Hz Rx/Idle mode

Graph:



Results:

Peak (PASS) (6)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
8374.736842	53.00	74.00	-21.00	83.00	3.89	Vertical	1000000.00	-3.29
8939.473684	54.71	74.00	-19.29	171.00	1.00	Horizontal	1000000.00	-1.71
9006.052632	54.50	74.00	-19.50	9.00	1.20	Vertical	1000000.00	-1.66
9672.631579	55.65	74.00	-18.35	128.00	1.00	Horizontal	1000000.00	-0.51
9816.052632	55.05	74.00	-18.95	359.00	1.00	Vertical	1000000.00	-0.07
9919.736842	55.95	74.00	-18.05	298.00	2.75	Horizontal	1000000.00	0.18

Average (PASS) (6)

Frequency (MHz)	Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Azimuth (°)	Height (m)	Pol.	RBW (Hz)	Correction (dB)
8374.736842	39.33	54.00	-14.67	83.00	3.89	Vertical	1000000.00	-3.29
8939.473684	40.99	54.00	-13.01	171.00	1.00	Horizontal	1000000.00	-1.71
9006.052632	40.93	54.00	-13.07	9.00	1.20	Vertical	1000000.00	-1.66
9672.631579	41.75	54.00	-12.25	128.00	1.00	Horizontal	1000000.00	-0.51
9816.052632	41.90	54.00	-12.10	359.00	1.00	Vertical	1000000.00	-0.07
9919.736842	42.02	54.00	-11.98	298.00	2.75	Horizontal	1000000.00	0.18

Test Personnel: Vathana Ven *VSV*
Supervising/Reviewing
Engineer:
(Where Applicable) N/A
Product Standard: FCC Part 15 Subpart B,
Input Voltage: ICES-003
120VAC 60Hz
Pretest Verification w/
Ambient Signals or
BB Source: BB Source

Test Date: 02/06/2020
02/07/2020

Limit Applied: See report section 7.3

Ambient Temperature: 23, 23 °C

Relative Humidity: 26, 26 %

Atmospheric Pressure: 993, 963 mbars

Deviations, Additions, or Exclusions: None

8 AC Mains Conducted Emissions

8.1 Method

Tests are performed in accordance with ANSI C63.4 and RSS-GEN.

TEST SITE: EMC Lab

The EMC Lab has one Semi-anechoic Chamber and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference ground-planes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	U _{CISPR}
AC Line Conducted Emissions	150 kHz - 30 MHz	1.2 dB	3.4dB
Telco Port Emissions	150 kHz - 30 MHz	2.8 dB	5.0dB

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:

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

NF = Net Reading in dB μ V

Example:

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

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

Alternately, when C5 Software is used, the "Level" includes all losses and gains and is compared directly in the "Margin" column to the "Limit". "TF" is the Transducer Factor; in this case LISN or ISN loss.

8.2 Test Equipment Used:

Asset	Description	Manufacturer	Model	Serial	Cal Date	Cal Due
DAV002'	Weather Station	Davis Instruments	7400	PE80519A93	06/13/2019	06/13/2020
LISN34'	LISN - CISPR16 Compliant 9kHz-30MHz	Com-Power	LI-215A	191956	04/17/2019	04/17/2020
CBLBNC2012-4'	50 Ohm Coaxial Cable	Pomona	RG58C/U	CBLBCN2012-4	05/07/2019	05/07/2020
DS27"	Attenuator, 20dB	Mini Circuits	20dB, 50 ohm	DS27	10/25/2019	10/25/2020
ROS002'	9kHz to 3GHz EMI Test Receiver	Rohde & Schwartz	ESCI 1166.5950K03	100067	06/12/2019	06/12/2020

Software Utilized:

Name	Manufacturer	Version
Compliance 5	Teseq	5.26.46.46

8.3 Results:

The sample tested was found to Comply.

8.4 Setup Photographs:



8.5 Plots/Data:

Transmit Mode

Test Information

Test Details

Test:

Project:

Test Notes:

Temperature:

Humidity:

Tested by:

Test Started:

User Entry

LISN - FCC15 Class B

Mars International

Transmit mode, 120VAC 60Hz

22C

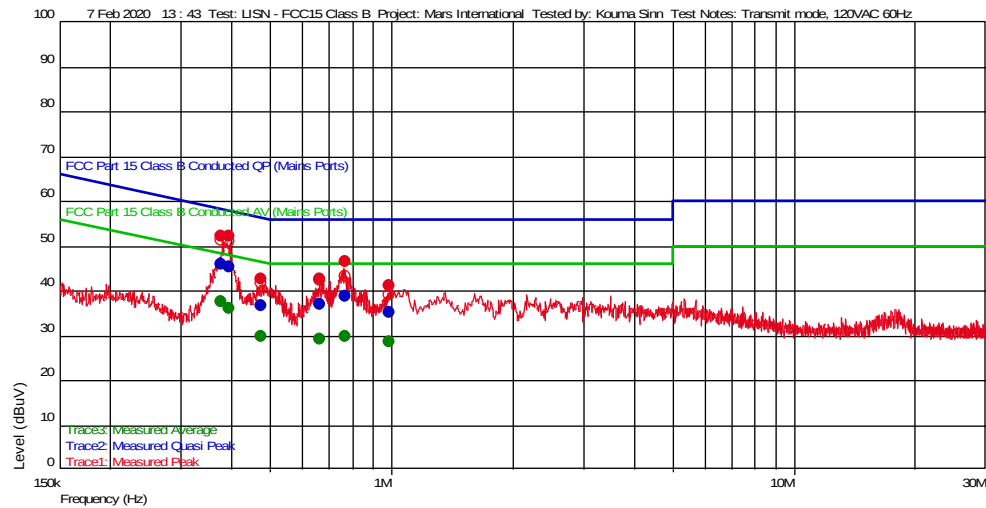
24%, 963mbar

Kouma Sinn

7 Feb 2020 13 : 43

Additional Information

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable

- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
990.65 k	35.14	0.040	20.189	56.000	-20.86	9 k		L1
477.25 k	36.59	0.044	20.131	56.387	-19.80	9 k		L1
668.5 k	36.79	0.040	20.154	56.000	-19.21	9 k		L1
770.5 k	38.59	0.040	20.165	56.000	-17.41	9 k		L1
395.65 k	45.14	0.047	20.118	57.944	-12.80	9 k		L1
380.35 k	45.78	0.047	20.116	58.272	-12.49	9 k		L1

Trace3: Measured Average

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
990.65 k	28.40	0.040	20.189	46.000	-17.60	9 k		L1
668.5 k	29.20	0.040	20.154	46.000	-16.80	9 k		L1
477.25 k	29.74	0.044	20.131	46.387	-16.65	9 k		L1
770.5 k	29.73	0.040	20.165	46.000	-16.27	9 k		L1
395.65 k	36.03	0.047	20.118	47.944	-11.91	9 k		L1
380.35 k	37.38	0.047	20.116	48.272	-10.89	9 k		L1

Receive Mode

Test Information

Test Details

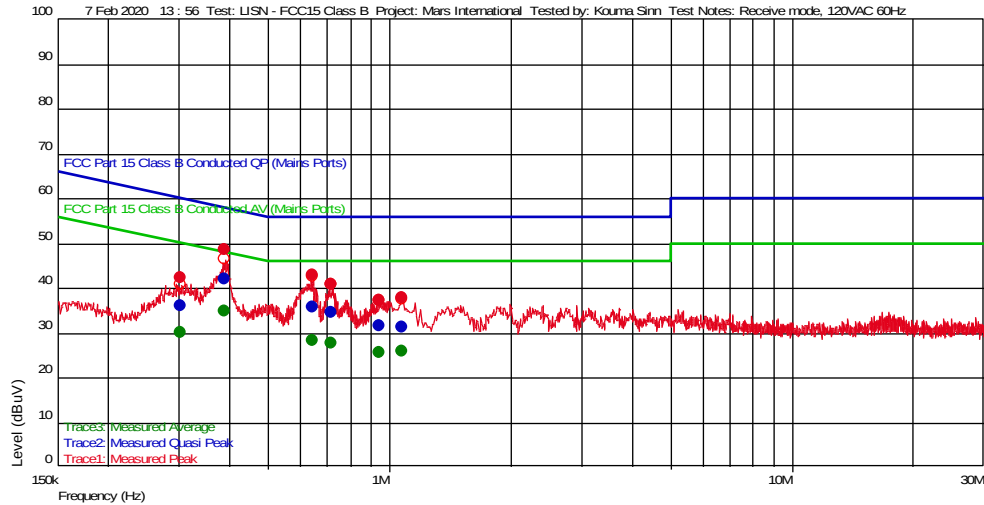
Test:
Project:
Test Notes:
Temperature:
Humidity:
Tested by:
Test Started:

User Entry

LISN - FCC15 Class B
Mars International
Receive mode, 120VAC 60Hz
22C
24%, 963mbar
Kouma Sinn
7 Feb 2020 13 : 56

Additional Information

Prescan Emission Graph



- Measured Peak Value
- Measured Quasi Peak Value
- Measured Average Value
- Maximum Value of Mast and Turntable

- Swept Peak Data
- Swept Quasi Peak Data
- Swept Average Data

Emissions Test Data

Trace2: Measured Quasi Peak

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
1.081 M	31.13	0.041	20.194	56.000	-24.87	9 k		L1
946.45 k	31.53	0.040	20.184	56.000	-24.47	9 k		L1
303.85 k	35.82	0.050	20.104	60.137	-24.31	9 k		L1
720.35 k	34.57	0.040	20.159	56.000	-21.43	9 k		L1
645.55 k	35.62	0.040	20.151	56.000	-20.38	9 k		L1
389.7 k	41.98	0.047	20.117	58.070	-16.09	9 k		L1

Trace3: Measured Average

Frequency(Hz)	Level(dBuV)	TF	PA+CL	Limit(dBuV)	Margin(dBuV)	RBW(Hz)	Comment	LINE
946.45 k	25.52	0.040	20.184	46.000	-20.48	9 k		L1
1.081 M	25.70	0.041	20.194	46.000	-20.30	9 k		L1
303.85 k	30.05	0.050	20.104	50.137	-20.08	9 k		L1
720.35 k	27.54	0.040	20.159	46.000	-18.46	9 k		L1
645.55 k	28.18	0.040	20.151	46.000	-17.82	9 k		L1
389.7 k	34.78	0.047	20.117	48.070	-13.29	9 k		L1

Test Personnel: Kouma Sinn *KPS*
Supervising/Reviewing
Engineer:
(Where Applicable) N/A
Product Standard: FCC Part 15 Subpart B
ICES-003
Input Voltage: 120VAC 60Hz
Pretest Verification w/
Ambient Signals or
BB Source: BB Source

Test Date: 02/07/2020
Limit Applied: All Class B
Ambient Temperature: 22 °C
Relative Humidity: 24 %
Atmospheric Pressure: 963 mbars

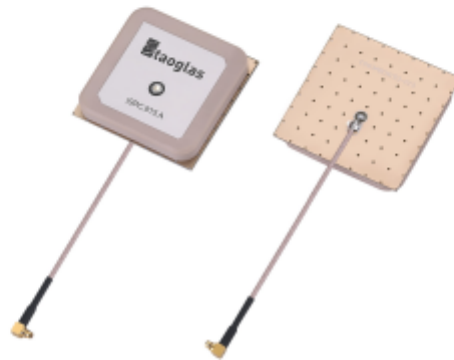
Deviations, Additions, or Exclusions: None

9 Appendix – Antenna Specification



SPECIFICATION

Part No.	ISPC.91A.09.0092E
Product Name	: 5dBi ISM Band 915MHz Embedded Ceramic Patch Antenna with Cable and Connector
Features	: High antenna efficiency 902MHz to 928MHz ISM Band 5dBi Peak (when placed on 30*30cm ground plane) 2dBi Peak Gain in free-space 47*47*6.5 mm (Ceramic Antenna) 49.5*49.5*7.5 mm (Antenna with EVB) RG178 92mm cable length MMCX male Right Angle Connector RoHS Compliant





1. Introduction

The 5dBi ISPC.91A embedded ceramic patch antenna with cable and connector is designed primarily for ISM band 915MHz compact fixed wireless applications where it can be mounted to a metal panel to function as ground underneath the antenna.

When placed on a reference 30cm square ground-plane, the antenna has excellent directional hemispherical radiation pattern up to 5dBi on the zenith, and an efficiency of 73%.

Even without a ground-plane underneath the antenna achieves 2dBi and an efficiency of 66% at 915MHz, with an omni-directional pattern.

Coming as standard with a RG178 cable and MMCX male right angle connector it is a great solution for the following typical applications

- RFID Readers
- Short range 915MHz mesh networks

Cable type, length and connector can be customized. Mechanical customization of the antenna can also be done for a minimum order quantity. Please contact your regional Taoglas office for more details.



2. Specifications

Electrical		
Measurement Environment	Free Space	On 30*30cm ground plane
Operation Frequency (MHz)	915MHz	
Peak Gain(dbi)	2	5
Efficiency (%)	66.51	73
Average Gain (dB)	-1.2	-1.2
Polarization	RHCP	
Impedance	50 Ohm	
Radiation Properties	Broadside Towards Zenith	
Max Input Power	5 W	
Mechanical		
Dimension (mm)	47.5*47.5*6.5	
Material	Ceramic	
Product Dimension (mm)	49.5*49.5*7.5	
Coaxial Cable	RG178	
Coaxial Length (mm)	92	
Connector	MMCX Male Right Angle	
Environmental		
Operation Temperature	-40°C to 85°C	
Storage Temperature	-40°C to 105°C	
Relative Humidity	40% to 95%	
RoHS Compliant	Yes	

10 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	02/10/2020	104219975BOX-002	VFV <i>VFV</i>	KPS <i>KPS</i>	Original Issue