

RF TEST REPORT

Applicant	Copeland Comfort Control LP
FCC ID	2A4JN-1F76U22Z
Product	Thermostat
Brand	Sensi
Model	1F76U-22ZB; 1F76U-22ZW
Report No.	R2409A1311-R2
Issue Date	December 11, 2024

Eurofins TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 15 (2023)**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

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Summary of Measurement Results

Number	Test Case	Clause in FCC rules	Verdict
1	Occupied Bandwidth (20dB)	15.215	PASS
2	Radiated Emissions	15.249, 15.209, 15.205;	PASS
3	AC Power Line Conducted Emissions	15.207;	PASS
Date of Testing: September 13, 2024 ~ October 9, 2024			
Date of Sample Received: September 10, 2024			
Note: PASS: The EUT complies with the essential requirements in the standard. FAIL: The EUT does not comply with the essential requirements in the standard. All indications of Pass/Fail in this report are opinions expressed by Eurofins TA Technology (Shanghai) Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only.			

1 Test Laboratory

1.1 Notes of the Test Report

This report shall not be reproduced in full or partial, without the written approval of **Eurofins TA Technology (Shanghai) Co., Ltd.** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above.

1.2. Test Facility

FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

Eurofins TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

A2LA (Certificate Number: 3857.01)

Eurofins TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

1.3 Testing Location

Company: Eurofins TA Technology (Shanghai) Co., Ltd.
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2 General Description of Equipment Under Test

2.1 Applicant and Manufacturer Information

Applicant	Copeland Comfort Control LP
Applicant address	8100 West Florissant Ave, St. Louis, United States of America
Manufacturer	Copeland Comfort Control LP
Manufacturer address	8100 West Florissant Ave, St. Louis, United States of America

2.2 General Information

EUT Description	
Model	1F76U-22ZB; 1F76U-22ZW
Lab internal SN	R2409A1311/S01
Hardware Version	0059 5453
Software Version	For Z-WAVE: MCU: 170-1737_V04_00_FCC_10dBm.hex Z-WAVE CHIP: 0170-1736_V05_00_FCC.hex
Power Supply	External power supply
Antenna Type	PCB Antenna
Test Mode(s)	z-wave
Tested Frequency Range(s)	908.4 MHz, 908.42 MHz, 916.00 MHz
Modulation Type	FSK, GFSK
Data rate	9.6 kbps, 40 kbps, 100 kbps
Note: The EUT is sent from the applicant to Eurofins TA and the information of the EUT is declared by the applicant.	

3 Applied Standards

According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

Test standards:

FCC CFR47 Part 15C (2023) Radio Frequency Devices

ANSI C63.10-2013

4 Test Configuration

Test Mode

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (X axis) and the worst case was recorded.

5 Test Case Results

5.1 Occupied Bandwidth

Ambient Condition

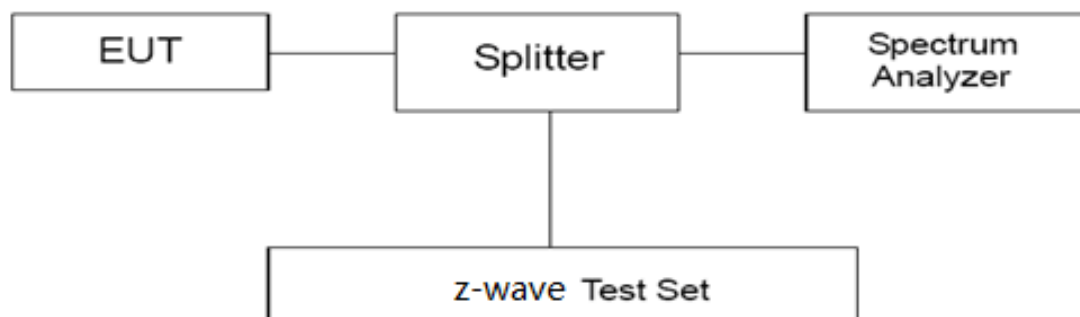
Temperature	Relative Humidity	Pressure
15°C ~ 35°C	20% ~ 80%	86 kPa ~ 106 kPa

Method of Measurement

Tests are performed in accordance with ANSI C63.10.

The 20 dB and 99% bandwidth of the fundamental frequency remain inside the band of operation of 902-928 MHz. The EUT was connected to the spectrum analyzer and z-wave test set via a power splitter with a known loss. The occupied bandwidth is measured using spectrum analyzer. RBW is set to 10 kHz and VBW is set to 30 kHz on spectrum analyzer.

Test Setup



Limits

No specific occupied bandwidth requirements in part 15.215(c).

Measurement Uncertainty

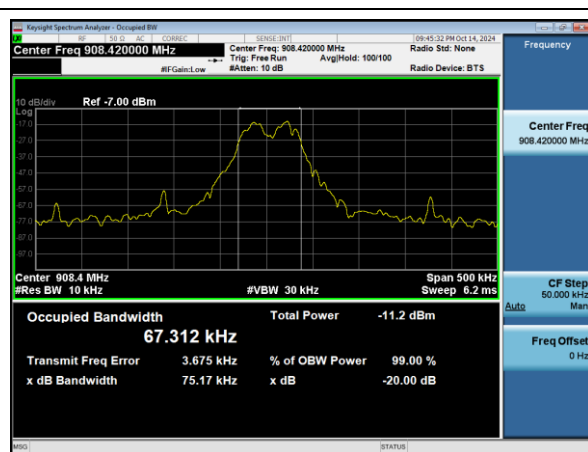
The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$. $U = 1.19$ dB

Test Results

Mode	Frequency (MHz)	Rate (kbit)	20dB Bandwidth(kHz)	99% Bandwidth(kHz)
z-wave	908.40	9.6	98.490	88.711
	908.42	40	75.170	67.312
	916	100	122.000	118.610



Carrier frequency (MHz): 908.40



Carrier frequency (MHz): 908.42



Carrier frequency (MHz): 916

5.2 Radiated Emissions

Ambient Condition

Temperature	Relative humidity	Pressure
15°C ~ 35°C	20% ~ 80%	86 kPa ~ 106 kPa

Method of Measurement

The test set-up was made in accordance to the general provisions of ANSI C63.10. The Equipment Under Test (EUT) was set up on a non-conductive table in the semi-anechoic chamber. The test was performed at the distance of 3 m between the EUT and the receiving antenna. The radiated emissions measurements were made in a typical installation configuration.

Sweep the whole frequency band through the range from 9 kHz to the 10th harmonic of the carrier, and the emissions less than 20 dB below the permissible value are reported.

During the test, below 30MHz, the center of the loop shall be 1 meters; above 30MHz, the height of receive antenna shall be moved from 1 to 4 meters, and the antenna shall be performed under horizontal and vertical polarization. The turntable shall be rotated from 0 to 360 degrees for detecting the maximum of radiated spurious signal level. The measurements shall be repeated with orthogonal polarization of the test antenna. The data of cable loss and antenna factor has been calibrated in full testing frequency range before the testing.

Set the spectrum analyzer in the following:

Below 1GHz (detector: Peak and Quasi-Peak)

RBW=100kHz / VBW=300kHz / Sweep=AUTO

Above 1GHz(detector: Peak):

(a) PEAK: RBW=1MHz VBW=3MHz/ Sweep=AUTO

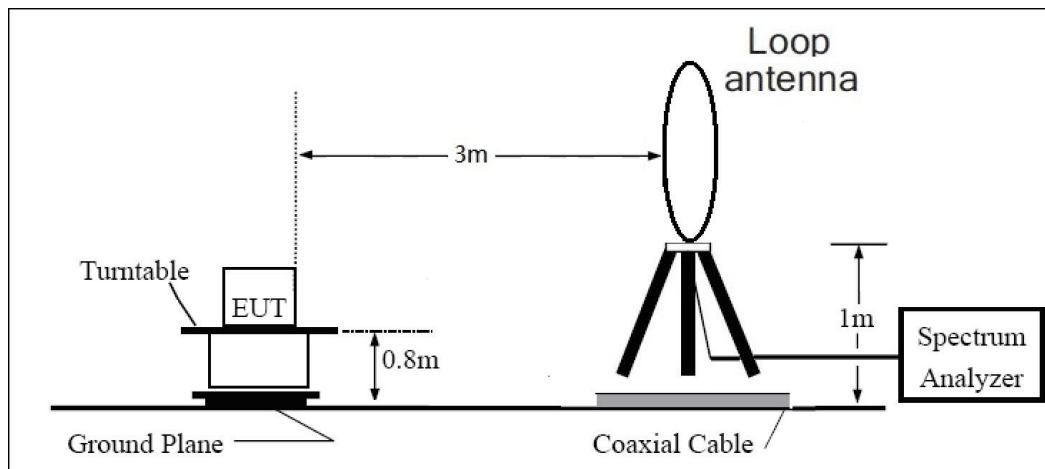
(b) AVERAGE: RBW=1MHz / VBW=3MHz / Sweep=AUTO

The radiated emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in stand-up position (Z axis) and the worst case was recorded. Then this mode was measured in the following mode: EUT with cradle and EUT without cradle. The worst emission was found in EUT with cradle mode and the worst case was recorded.

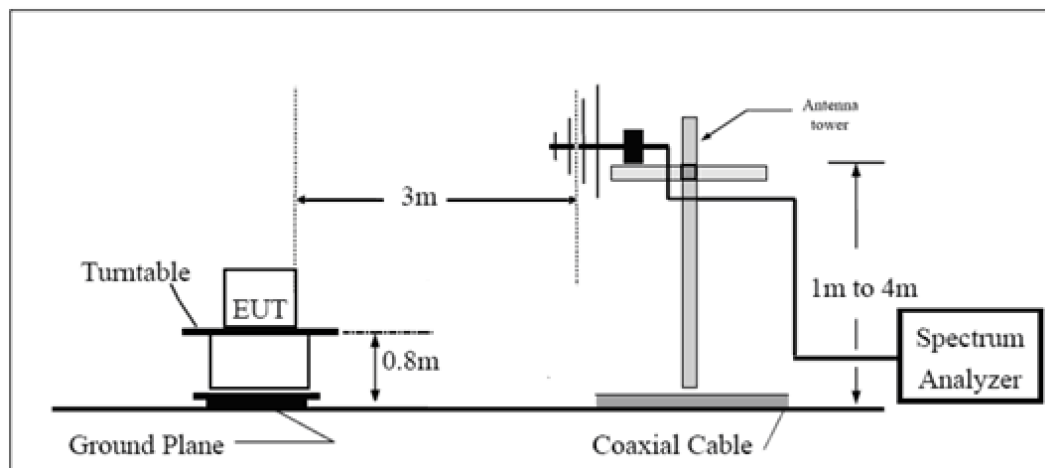
The test is in transmitting mode.

Test Setup

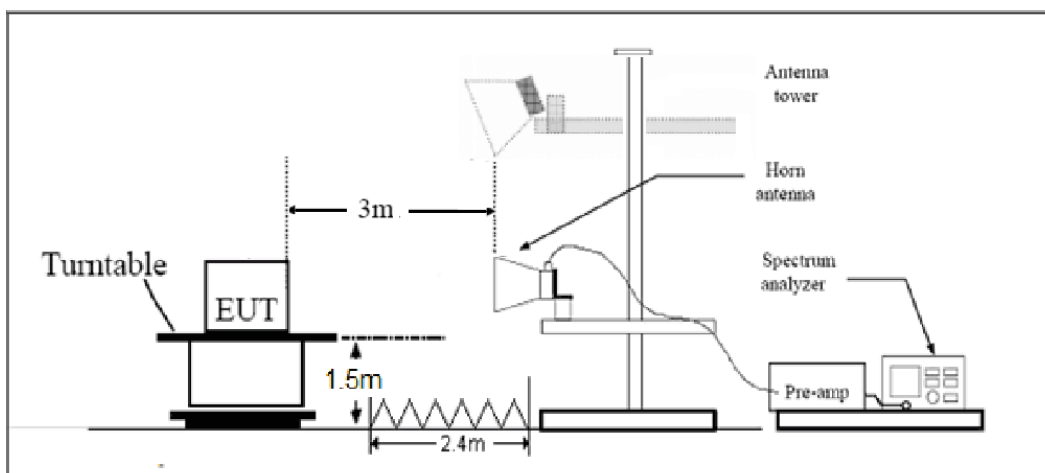
9KHz~ 30MHz



30MHz~ 1GHz



Above 1GHz



Note: Area side:2.4mX3.6m

Limits

Limit in restricted band (Part 15.209)

Frequency of emission (MHz)	Field strength($\mu\text{V/m}$)	Field strength($\text{dB}\mu\text{V/m}$)
0.009–0.490	2400/F(kHz)	/
0.490–1.705	24000/F(kHz)	/
1.705–30.0	30	/
30-88	100	40
88-216	150	43.5
216-960	200	46
Above960-1000	500	54

Spurious Radiated Emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(²)
13.36-13.41			

Limit in radiated emission measurement (Part 15.209)

Frequency of emission (MHz)	Field strength (dB μ V/m) @3m	
Above 1000	74 (peak)	54(average)

Limit in radiated emission measurement (Part 15.249)

Frequency of emission (MHz)	Field strength of fundamental @3m	
	(mV/m)	(dB μ V/m)
902-928 MHz fundamental	50	94(average) 114(peak)

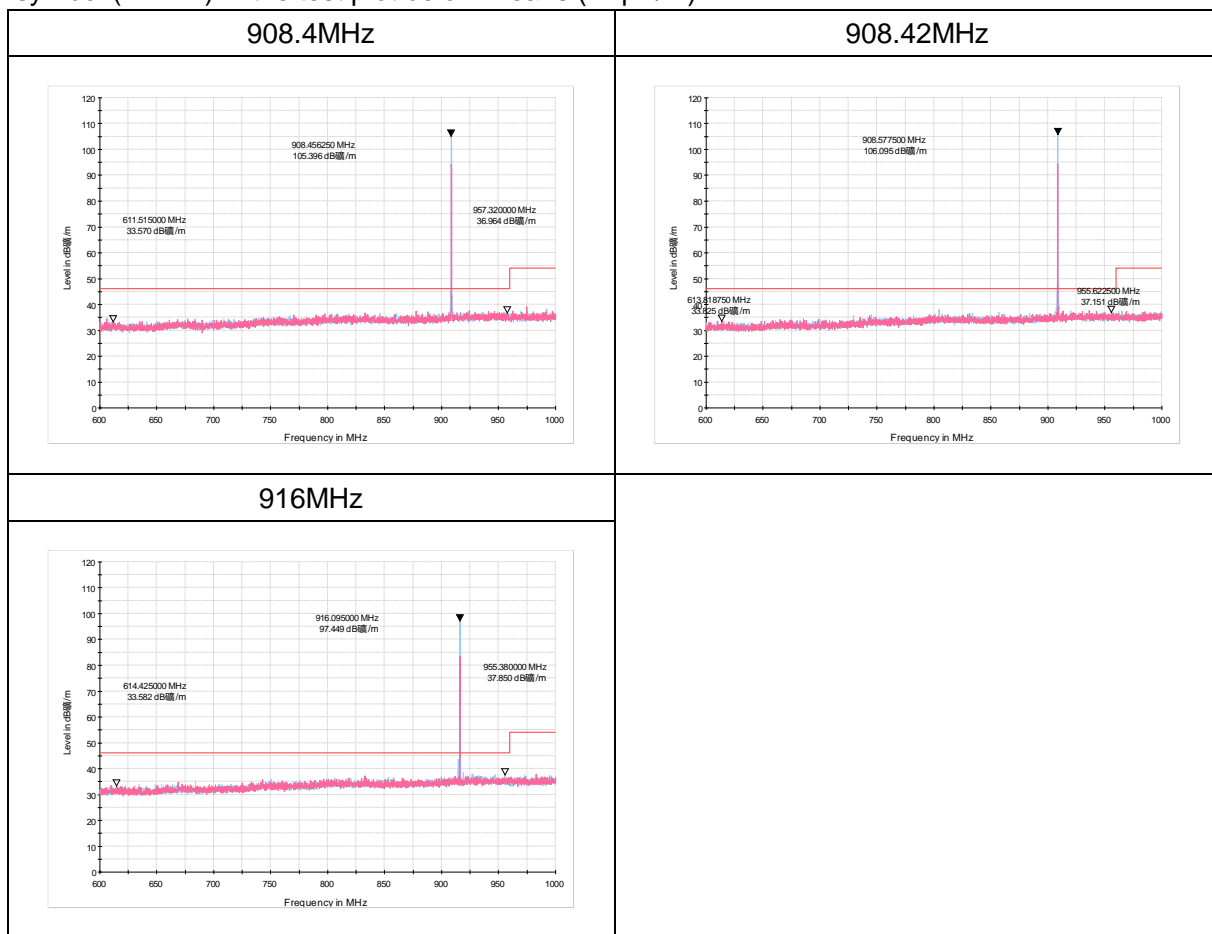
Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 1.96$.

Frequency	Uncertainty
9KHz-30MHz	3.55 dB
30MHz-200MHz	4.02 dB
200MHz-1GHz	3.28 dB
Above 1GHz	3.70 dB

Test Results:

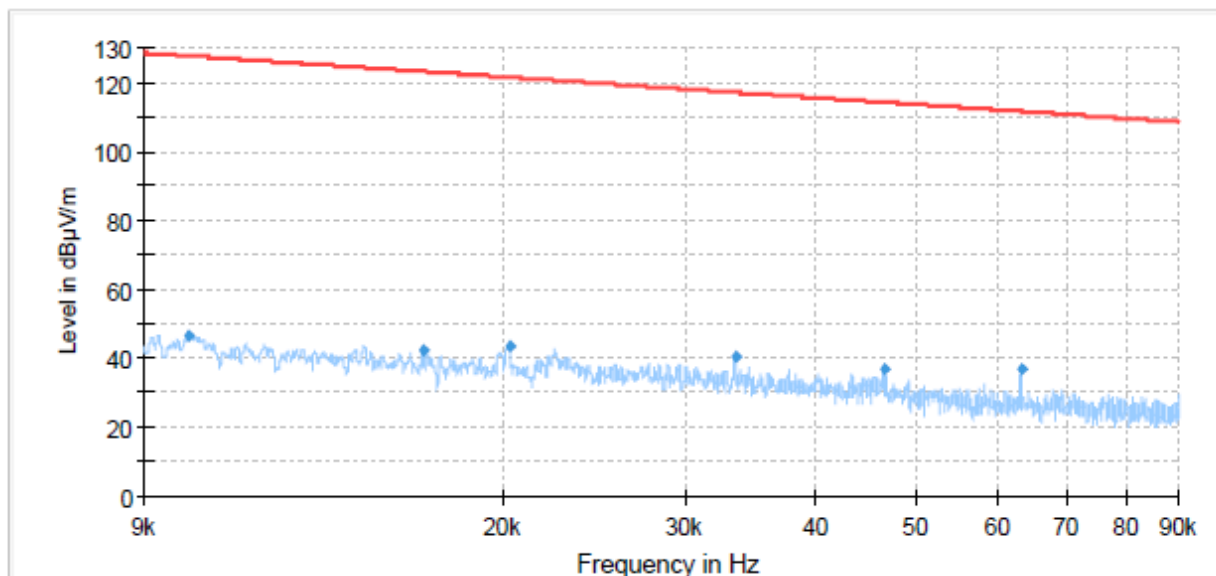
A symbol ($\text{dB}\mu\text{V/m}$) in the test plot below means (dB $\mu\text{V/m}$)



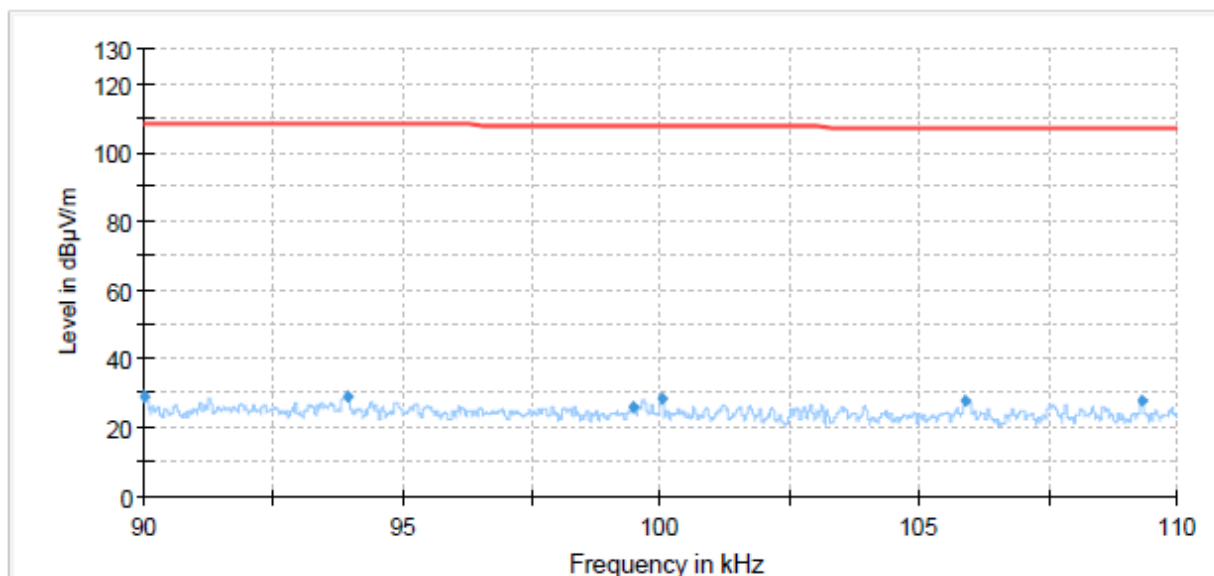
908.4MHz

During the test, the Radiates Emission from 9kHz to 30MHz was performed in all modes with all channels, **908.4MHz** are selected as the worst condition. The test data of the worst-case condition was recorded in this report.

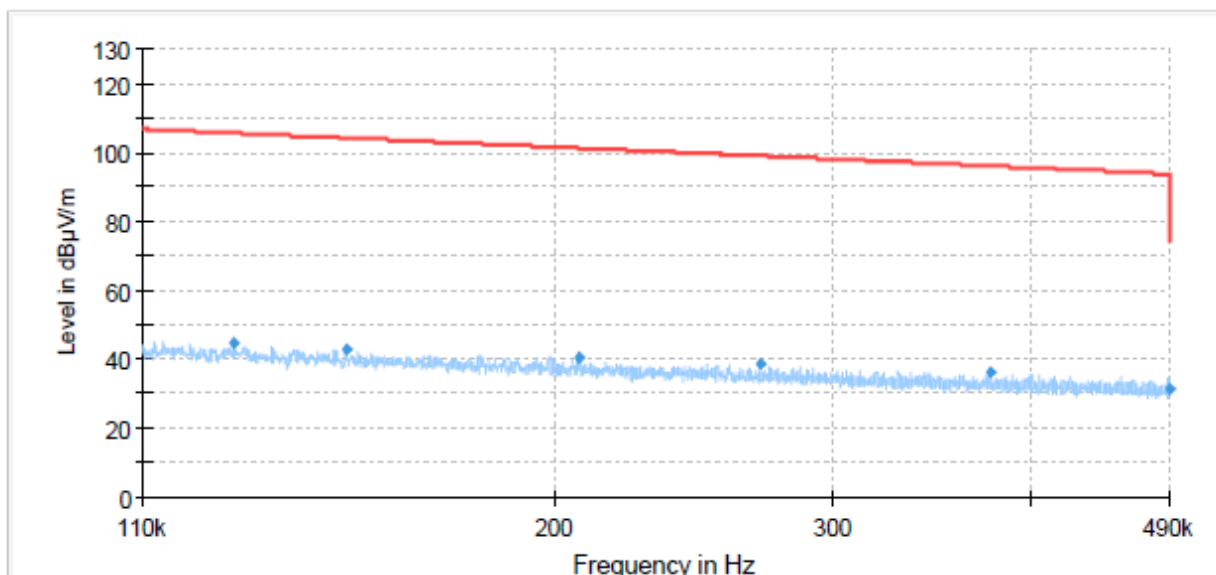
Continuous TX mode:



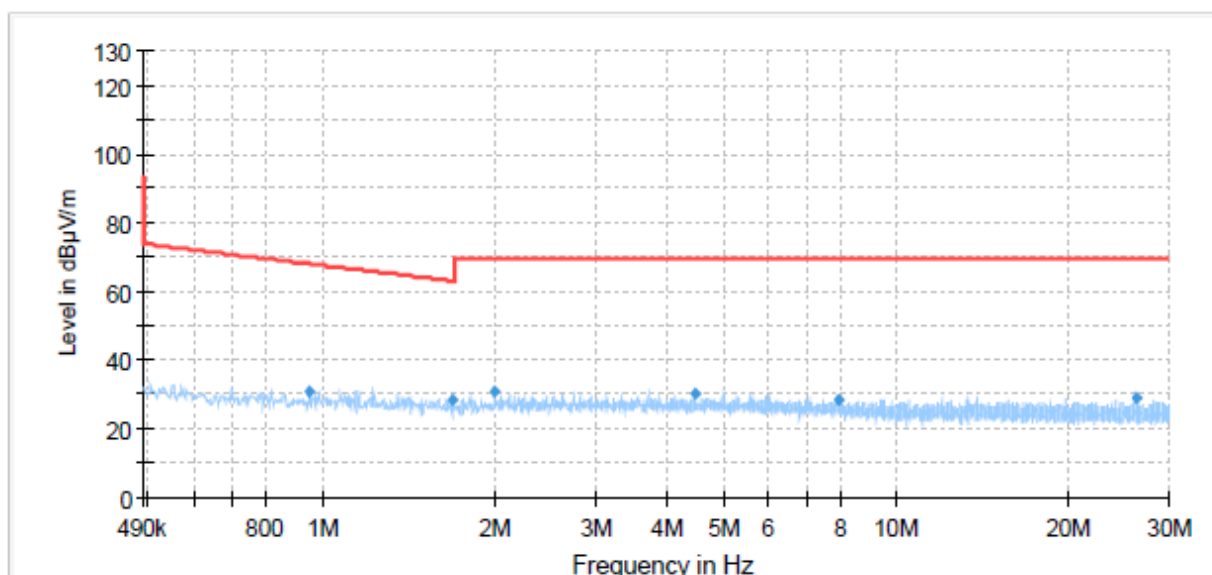
Radiates Emission from 9kHz to 90kHz



Radiates Emission from 90kHz to 110kHz

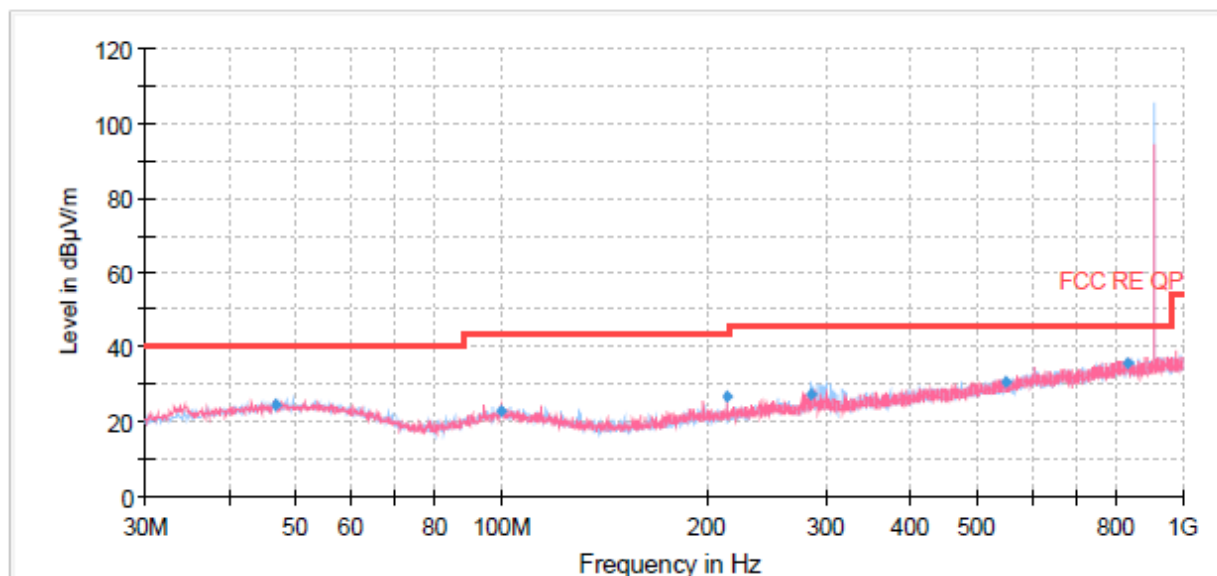


Radiates Emission from 110kHz to 490kHz



Radiates Emission from 490kHz to 30MHz

908.4MHz



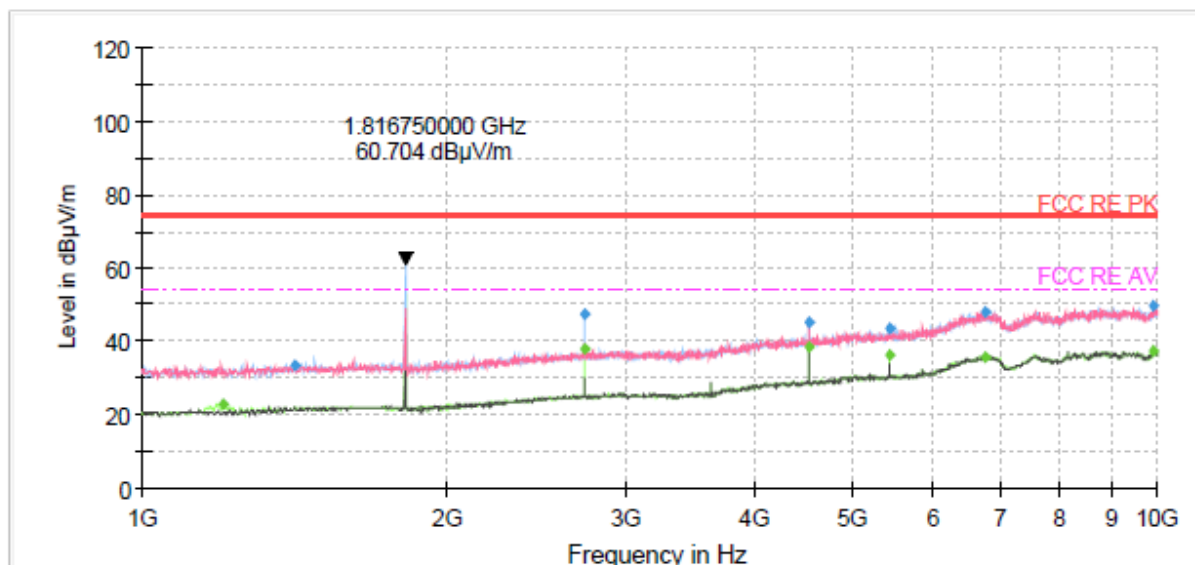
Note: The signal beyond the limit is carrier.

Radiates Emission from 30MHz to 1GHz

Frequency (MHz)	Quasi-Peak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Polarization	Azimuth (deg)	Correct Factor (dB)
46.72	24.54	40.00	15.46	117.0	V	282.00	20
100.02	23.10	43.50	20.40	209.0	H	215.00	19
214.49	26.90	43.50	16.60	215.0	V	26.00	18
285.33	27.08	46.00	18.92	100.0	H	260.00	21
551.21	30.76	46.00	15.24	211.0	H	231.00	26
832.36	35.91	46.00	10.09	100.0	V	87.00	30

Remark: 1. Correction Factor = Antenna factor + Insertion loss (cable loss + amplifier gain)

2. Margin = Limit – Quasi-Peak



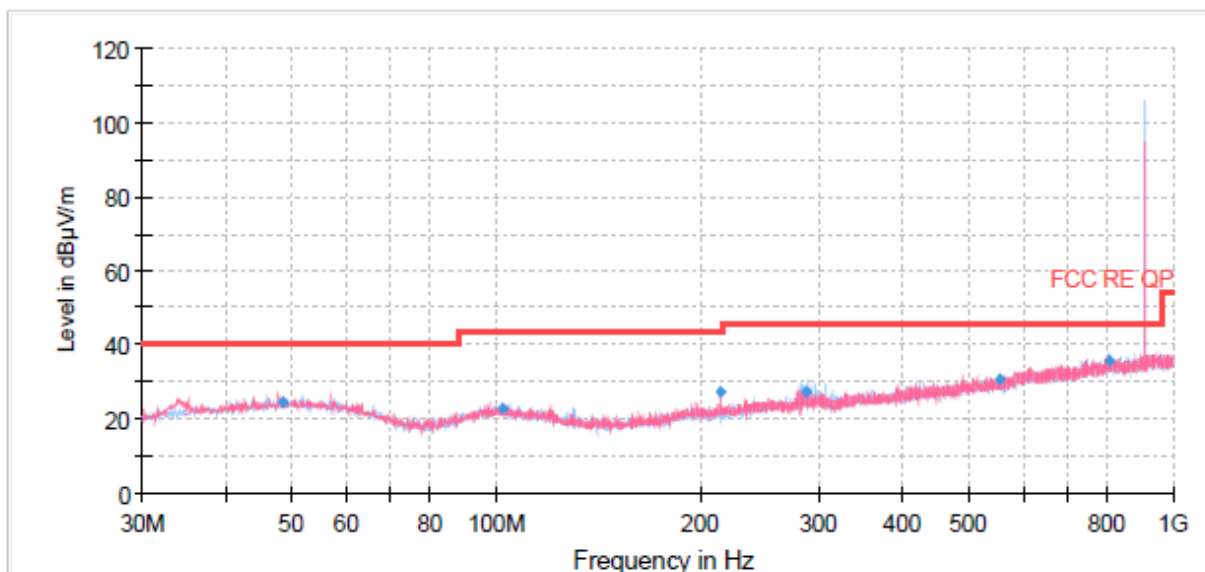
Note: The signal beyond the limit is Harmonic
Radiates Emission from 1GHz to 10GHz

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1202.50	---	23.10	54.00	30.90	500.00	100.0	H	32.00	-15
1416.25	33.57	---	74.00	40.43	500.00	100.0	V	357.00	-13
2723.50	---	38.20	54.00	15.80	500.00	200.0	H	319.00	-8
2725.75	47.66	---	74.00	26.34	500.00	200.0	H	294.00	-8
4541.50	45.27	---	74.00	28.73	500.00	100.0	V	114.00	-3
4541.50	---	38.77	54.00	15.23	500.00	100.0	V	114.00	-3
5450.50	43.63	---	74.00	30.37	500.00	200.0	H	178.00	-1
5450.50	---	36.25	54.00	17.75	500.00	200.0	H	178.00	-1
6775.75	---	35.92	54.00	18.08	500.00	200.0	H	146.00	4
6784.75	47.88	---	74.00	26.12	500.00	100.0	H	5.00	4
9923.50	49.53	---	74.00	24.47	500.00	100.0	V	243.00	7
9925.75	---	37.62	54.00	16.38	500.00	200.0	H	262.00	7

Remark: 1. Correction Factor = Antenna factor + Insertion loss (cable loss + amplifier gain)

2. Margin = Limit –MAX Peak/ Average

908.42MHz



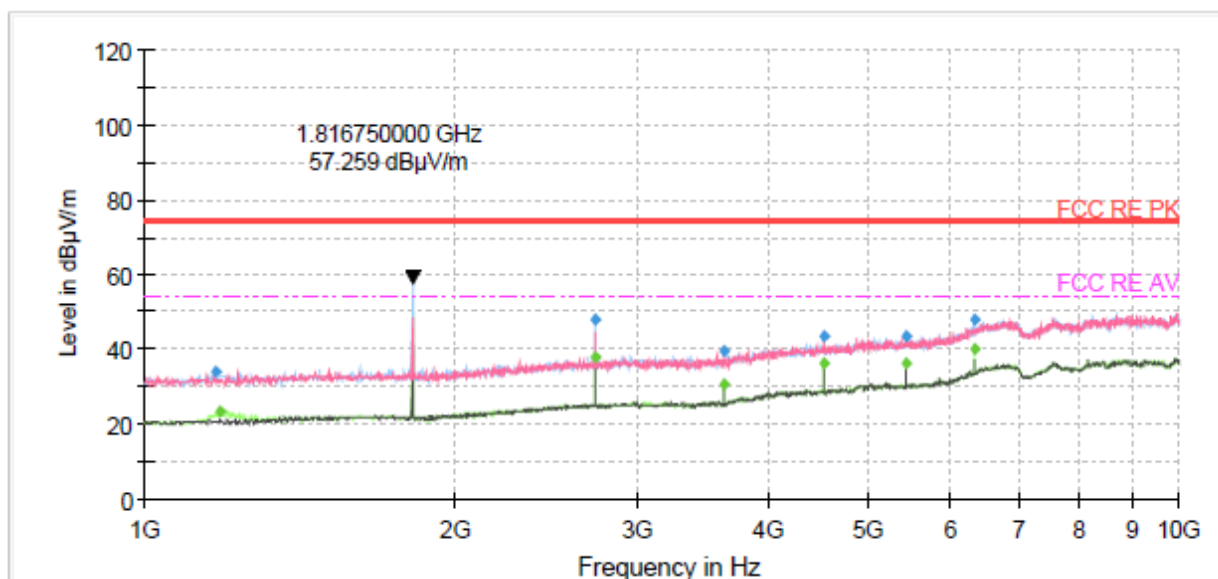
Note: The signal beyond the limit is carrier.

Radiates Emission from 30MHz to 1GHz

Frequency (MHz)	Quasi-Peak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Polarization	Azimuth (deg)	Correct Factor (dB)
48.58	24.66	40.00	15.34	110.0	V	135.00	20
102.02	22.89	43.50	20.61	114.0	V	22.00	19
214.51	27.49	43.50	16.01	209.0	V	334.00	18
287.96	27.25	46.00	18.75	107.0	H	247.00	21
551.99	30.69	46.00	15.31	123.0	H	124.00	26
803.69	35.64	46.00	10.36	100.0	H	276.00	30

Remark: 1. Correction Factor = Antenna factor + Insertion loss (cable loss + amplifier gain)

2. Margin = Limit – Quasi-Peak



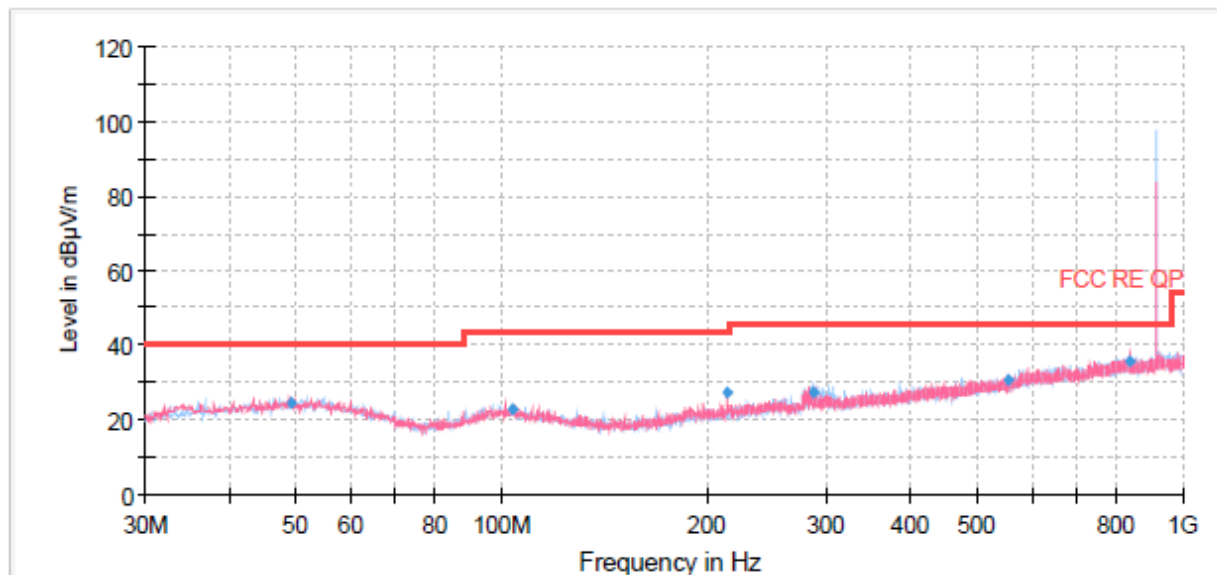
Note: The signal beyond the limit is Harmonic
Radiates Emission from 1GHz to 10GHz

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1168.75	33.77	---	74.00	40.23	500.00	100.0	H	72.00	-15
1184.50	---	23.34	54.00	30.66	500.00	100.0	H	86.00	-15
2723.50	---	38.19	54.00	15.81	500.00	100.0	H	291.00	-8
2723.50	48.02	---	74.00	25.98	500.00	100.0	H	291.00	-8
3632.50	---	30.76	54.00	23.24	500.00	200.0	V	228.00	-7
3632.50	39.54	---	74.00	34.46	500.00	100.0	V	231.00	-7
4541.50	43.64	---	74.00	30.36	500.00	100.0	H	317.00	-3
4541.50	---	36.32	54.00	17.68	500.00	200.0	V	285.00	-3
5450.50	43.43	---	74.00	30.57	500.00	100.0	H	8.00	-1
5450.50	---	36.51	54.00	17.49	500.00	100.0	H	8.00	-1
6359.50	---	39.99	54.00	14.01	500.00	100.0	H	124.00	2
6359.50	47.76	---	74.00	26.24	500.00	100.0	H	124.00	2

Remark: 1. Correction Factor = Antenna factor + Insertion loss (cable loss + amplifier gain)

2. Margin = Limit –MAX Peak/ Average

916MHz



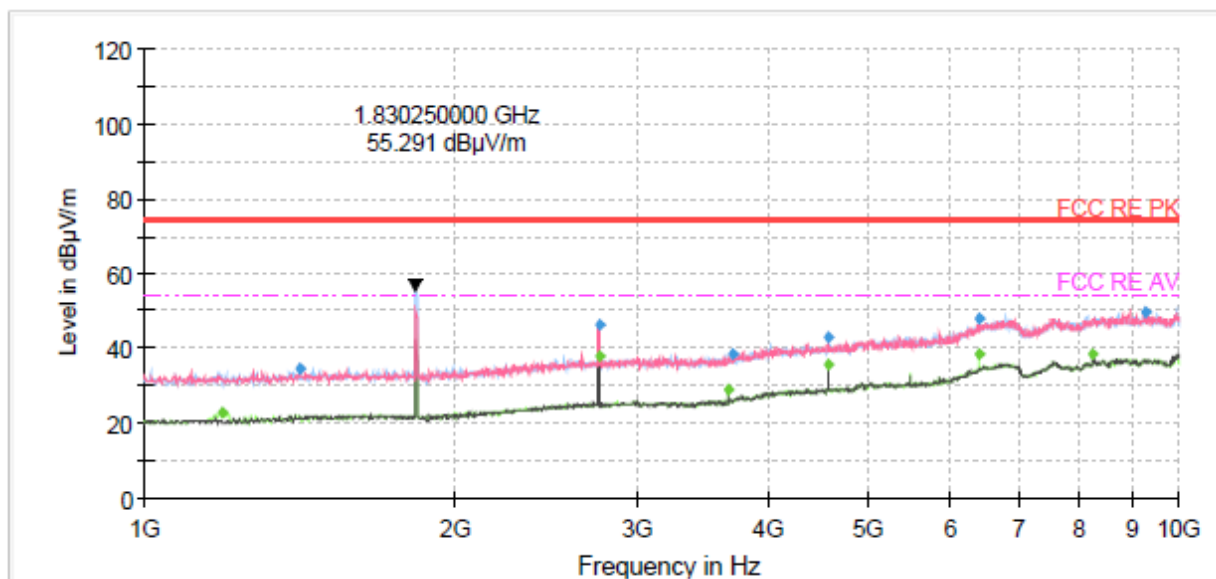
Note: The signal beyond the limit is carrier.

Radiates Emission from 30MHz to 1GHz

Frequency (MHz)	Quasi-Peak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Polarization	Azimuth (deg)	Correct Factor (dB)
49.20	24.71	40.00	15.29	222.0	V	203.00	20
104.10	22.71	43.50	20.79	102.0	H	92.00	18
214.51	27.49	43.50	16.01	210.0	V	318.00	18
286.64	27.59	46.00	18.41	105.0	H	249.00	21
554.69	30.69	46.00	15.31	101.0	V	138.00	26
832.94	35.88	46.00	10.12	194.0	V	146.00	30

Remark: 1. Correction Factor = Antenna factor + Insertion loss (cable loss + amplifier gain)

2. Margin = Limit – Quasi-Peak



Note: The signal beyond the limit is Harmonic
Radiates Emission from 1GHz to 10GHz

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1186.75	---	22.93	54.00	31.07	500.00	100.0	H	292.00	-15
1414.00	34.57	---	74.00	39.43	500.00	100.0	H	92.00	-13
3664.00	---	28.93	54.00	25.07	500.00	200.0	H	356.00	-12
3706.75	38.75	---	74.00	35.25	500.00	200.0	H	356.00	-12
2748.25	46.08	---	74.00	27.92	500.00	200.0	V	265.00	-8
2748.25	---	37.79	54.00	16.21	500.00	200.0	V	265.00	-8
4579.75	---	35.77	54.00	18.23	500.00	100.0	H	305.00	-3
4579.75	43.11	---	74.00	30.89	500.00	100.0	H	305.00	-3
6411.25	---	38.50	54.00	15.50	500.00	200.0	H	30.00	3
6411.25	48.00	---	74.00	26.00	500.00	200.0	H	30.00	3
8245.00	---	38.49	54.00	15.51	500.00	200.0	V	119.00	6
9298.00	49.92	---	74.00	24.08	500.00	200.0	V	184.00	7

Remark: 1. Correction Factor = Antenna factor + Insertion loss (cable loss + amplifier gain)

2. Margin = Limit –MAX Peak/ Average

5.3 Conducted Emissions

Ambient Condition

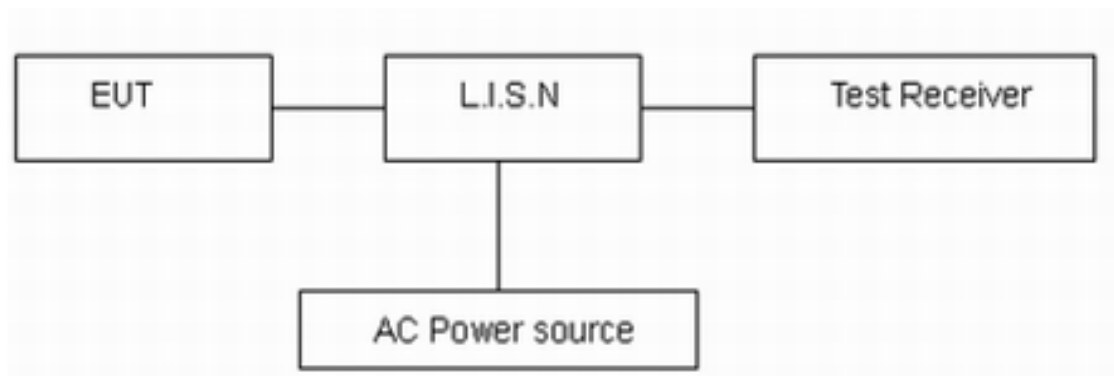
Temperature	Relative humidity	Pressure
15°C ~ 35°C	20% ~ 80%	86 kPa ~ 106 kPa

Method of Measurement

The EUT is placed on a non-metallic table of 80cm height above the horizontal metal reference ground plane. During the test, the EUT was operating in its typical mode. The test method is according to ANSI C63.10. Connect the AC power line of the EUT to the L.I.S.N. Use EMI receiver to detect the average and Quasi-peak value. RBW is set to 9 kHz, VBW is set to 30kHz. The measurement result should include both L line and N line.

The test is in transmitting mode.

Test Setup



Note: AC Power source is used to change the voltage from 220V/50Hz to 110V/60Hz.

Limits

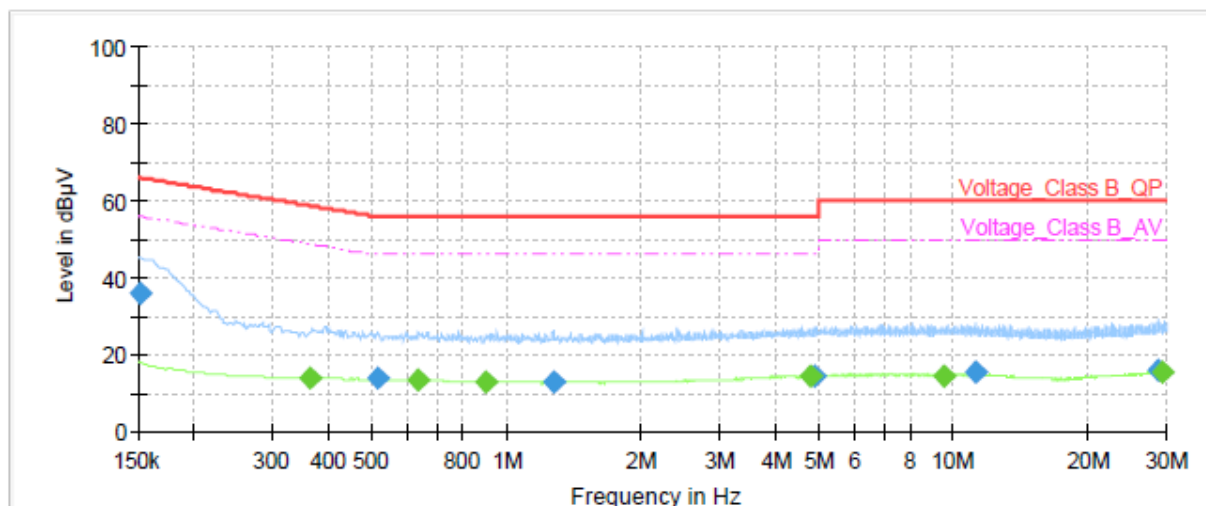
Frequency (MHz)	Conducted Limits(dBμV)	
	Quasi-peak	Average
0.15 - 0.5	66 to 56 *	56 to 46*
0.5 - 5	56	46
5 - 30	60	50
*: Decreases with the logarithm of the frequency.		

Measurement Uncertainty

The assessed measurement uncertainty to ensure 95% confidence level for the normal distribution is with the coverage factor $k = 2$. $U = 1.19$ dB

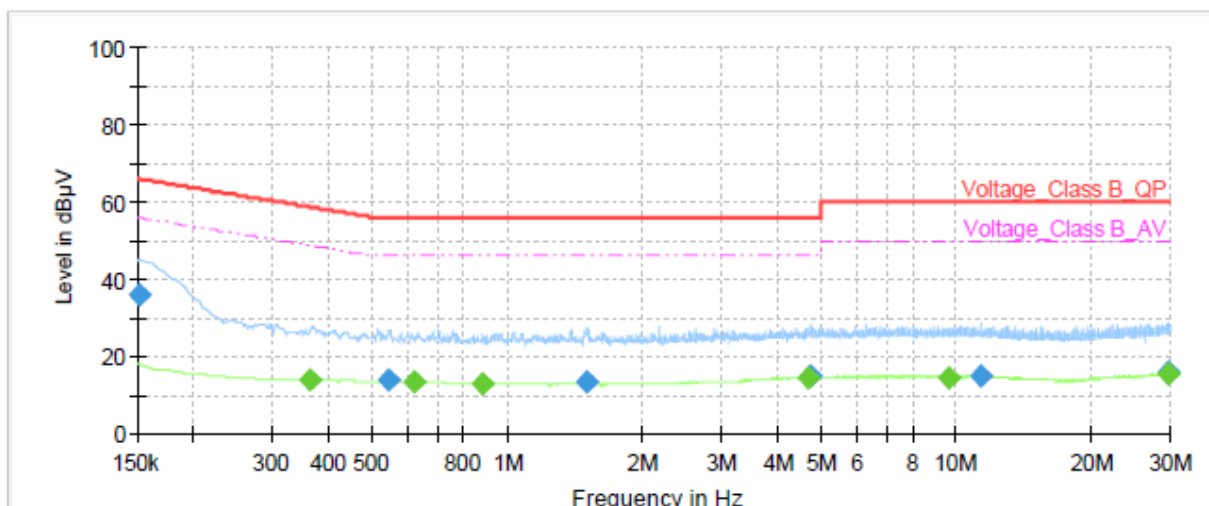
Test Results:

Following plots, Blue trace uses the peak detection and Green trace uses the average detection. During the test, the Conducted Emission was performed in all channels, 908.4MHz are selected as the worst condition. The test data of the worst-case condition was recorded in this report.



Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.15	36.10	---	65.88	29.77	1000.0	9.000	L1	ON	21.0
0.36	---	13.78	48.69	34.91	1000.0	9.000	L1	ON	21.0
0.52	13.83	---	56.00	42.17	1000.0	9.000	L1	ON	20.8
0.64	---	13.23	46.00	32.77	1000.0	9.000	L1	ON	20.7
0.90	---	12.90	46.00	33.10	1000.0	9.000	L1	ON	20.3
1.27	13.06	---	56.00	42.94	1000.0	9.000	L1	ON	20.0
4.77	---	14.11	46.00	31.89	1000.0	9.000	L1	ON	19.5
4.87	14.55	---	56.00	41.45	1000.0	9.000	L1	ON	19.5
9.54	---	14.51	50.00	35.49	1000.0	9.000	L1	ON	19.5
11.26	15.39	---	60.00	44.61	1000.0	9.000	L1	ON	19.5
28.64	15.92	---	60.00	44.08	1000.0	9.000	L1	ON	19.7
29.40	---	15.50	50.00	34.50	1000.0	9.000	L1	ON	19.7

L line Conducted Emission from 150 kHz to 30 MHz



Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.15	36.12	---	65.88	29.76	1000.0	9.000	N	ON	21.0
0.36	---	13.74	48.69	34.95	1000.0	9.000	N	ON	21.0
0.55	13.96	---	56.00	42.04	1000.0	9.000	N	ON	20.8
0.62	---	13.24	46.00	32.76	1000.0	9.000	N	ON	20.7
0.88	---	12.73	46.00	33.27	1000.0	9.000	N	ON	20.3
1.51	13.19	---	56.00	42.81	1000.0	9.000	N	ON	19.9
4.69	---	14.15	46.00	31.85	1000.0	9.000	N	ON	19.5
4.75	14.78	---	56.00	41.22	1000.0	9.000	N	ON	19.5
9.60	---	14.54	50.00	35.46	1000.0	9.000	N	ON	19.6
11.37	14.91	---	60.00	45.09	1000.0	9.000	N	ON	19.6
29.58	15.92	---	60.00	44.08	1000.0	9.000	N	ON	19.7
29.73	---	15.51	50.00	34.49	1000.0	9.000	N	ON	19.7

N line Conducted Emission from 150 kHz to 30 MHz

6 Main Test Instruments

Name of Equipment	Manufacturer	Type/Model	Serial Number	Calibration Date	Expiration Time
Radiated Emission					
EMI Test Receiver	R&S	ESCI3	100948	2024-05-07	2025-05-06
Signal Analyzer	R&S	FSV40	101298	2024-05-07	2025-05-06
Loop Antenna	SCHWARZBECK	FMZB1519	1519-047	2023-04-16	2026-04-15
TRILOG Broadband Antenna	SCHWARZBECK	VULB 9163	01111	2022-10-25	2025-10-24
Horn Antenna	SCHWARZBECK	BBHA 9120D	430	2024-07-18	2027-07-17
Amplifier	MWPA.CN	MWLA-010200G 40	YQ2103039B01	2024-05-07	2025-05-06
Software	R&S	EMC32	9.26.01	/	/
Conducted Emission					
Artificial main network	R&S	ENV216	102191	2022-12-10	2024-12-09
EMI Test Receiver	R&S	ESR	101667	2024-05-07	2025-05-06
Software	R&S	EMC32	10.35.10	/	/

ANNEX A: The EUT Appearance

The EUT Appearance are submitted separately.

ANNEX B: Test Setup Photos

The Test Setup Photos are submitted separately.

***** END OF REPORT *****