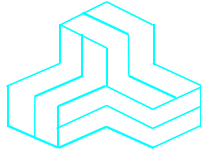


ENGINEERING TEST REPORT



Dimplex LVT
Model: CST-240
FCC ID: Z49-00008

Applicant:

Dimplex North America Limited
1367 Industrial Road
Cambridge, ON
N1R 7G8, CANADA
In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.249
Operating in the Frequency 2439.86 MHz

UltraTech's File No.: 17ETR122_FCC15249

This Test report is Issued under the Authority of
Tri M. Luu
Vice President of Engineering
UltraTech Group of Labs

Date: May 15, 2017

Report Prepared by: Santhosh Fernandez

Tested by: Mr. Hung Trinh

Issued Date: May 15, 2017

Test Dates: April 29-May 1, 2017

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by NVLAP or any agency of the US Government.*

UltraTech

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91038



1309



46390-2049



AT-1945



SL2-IN-E-
1119R



Korea
KCC-RRR
CA2049

TABLE OF CONTENTS

| | |
|---|-----------|
| EXHIBIT 1. INTRODUCTION | 1 |
| 1.1. SCOPE..... | 1 |
| 1.2. RELATED SUBMITTAL(S)/GRANT(S)..... | 1 |
| 1.3. NORMATIVE REFERENCES | 1 |
| EXHIBIT 2. PERFORMANCE ASSESSMENT | 2 |
| 2.1. CLIENT INFORMATION | 2 |
| 2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION | 2 |
| 2.3. EUT'S TECHNICAL SPECIFICATIONS | 3 |
| 2.4. LIST OF EUT'S PORTS | 3 |
| 2.5. ANCILLARY EQUIPMENT | 3 |
| EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS..... | 4 |
| 3.1. CLIMATE TEST CONDITIONS | 4 |
| 3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS | 4 |
| EXHIBIT 4. SUMMARY OF TEST RESULTS | 5 |
| 4.1. LOCATION OF TESTS | 5 |
| 4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS | 5 |
| 4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES | 5 |
| EXHIBIT 5. TEST DATA..... | 6 |
| 5.1. AC POWERLINE CONDUCTED EMISSIONS @ FCC PART 15, SUBPART B, PARA.15.107(A)..... | 6 |
| 5.2. OCCUPIED BANDWIDTH [§15.215(C)] | 10 |
| 5.3. FUNDAMENTAL FIELD STRENGTH AND HARMONIC EMISSIONS (RADIATED AT 3M) [47 CFR §§ 15.249(A), 15.209 & 15.205]..... | 12 |
| EXHIBIT 6. TEST EQUIPMENT LIST | 17 |
| EXHIBIT 7. MEASUREMENT UNCERTAINTY..... | 18 |
| 7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY (0.15-30 MHz)..... | 18 |
| 7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY | 18 |

EXHIBIT 1. INTRODUCTION

1.1. SCOPE

| | |
|--------------------------------------|---|
| Reference: | FCC Part 15, Subpart C, Section 15.249 |
| Title: | Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15 – Radio Frequency Devices |
| Purpose of Test: | Equipment Certification for Low Power Licensed-Exempt Transmitters operating in the Frequency Band 2400-2483.5 MHz. |
| Test Procedures: | <ul style="list-style-type: none"> ▪ ANSI C63.4 ▪ ANSI C63.10 |
| Environmental Classification: | <input checked="" type="checkbox"/> Commercial, industrial or business environment <input checked="" type="checkbox"/> Residential environment |

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None

1.3. NORMATIVE REFERENCES

| Publication | Year | Title |
|----------------------------|----------------------|---|
| 47 CFR Parts 0-19 | 2016 | Code of Federal Regulations (CFR), Title 47 – Telecommunication |
| ANSI C63.4 | 2014 | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz |
| ANSI C63.10 | 2013 | American National Standard for Testing Unlicensed Wireless Devices |
| CISPR 22 | 2008-09,Ed 6 | Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement |
| CISPR 16-1-1 +A1 +A2 | 2006 2006 2007 | Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus |
| CISPR 16-1-2 +A1 +A2 | 2003 2004 2006 | Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances |

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

| APPLICANT | |
|------------------------|---|
| Name: | Dimplex North America Limited |
| Address: | 1367 Industrial Road Cambridge Ontario Canada N1R 7G8 |
| Contact Person: | Mr. Nathan Hingston Ph: 519.650.3630 x 475 Fax: 519.650.3651 nhingston@dimplex.com |

| MANUFACTURER | |
|------------------------|---|
| Name: | Etratech Inc. |
| Address: | 1047 Cooke Blvd, Burlington Ontario Canada L7T4A8 |
| Contact Person: | Mr. Mike Renneboog Ph: 9056817544x285 Fax: 9056817606 mrenneboog@etrtech.com |

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

| | |
|---------------------------------------|--|
| Product Name: | Dimplex LVT |
| Model Name or Number: | CST-240 |
| Serial Number: | Test Sample |
| Type of Equipment: | Low Power Communication Device Transmitter |
| Input Power Supply: | 240Vac, 60Hz |
| Primary User Functions of EUT: | Thermostat control for heating application in residential environment. |

2.3. EUT'S TECHNICAL SPECIFICATIONS

| TRANSMITTER | |
|--|--|
| Equipment Type: | • Fixed |
| Intended Operating Environment: | ▪ Residential environment |
| Power Supply Requirement: | 240VAC 60Hz |
| RF Output Power Rating: | 107.98 dBµV/m Peak at 3m distance |
| Operating Frequency Range: | 2439.86 MHz |
| 20 dB Bandwidth: | 517.31 KHz |
| Modulation Type: | 2-GFSK, F1X |
| Antenna Connector Type: | Integral (Internal On board Antenna PCB Foil F-Type) |

| RECEIVER | |
|-----------------------------------|-------------|
| Power Supply Requirement: | 240VAC 60Hz |
| Operating Frequency Range: | 2439.86 MHz |
| Oscillator Frequency(ies): | 38.4MHz |

2.4. LIST OF EUT'S PORTS

| Port Number | EUT's Port Description | Number of Identical Ports | Connector Type | Cable Type (Specify minimum length and shielded/non-shielded) |
|-------------|------------------------|---------------------------|----------------|---|
| 1 | AC Power | 1 | Flying Leads | 9 Inches Non Shielded |
| 2 | Heater Output | 1 | Flying Leads | 9 Inches Non Shielded |

| List all EUT ports not connected during tests | Justification |
|---|---|
| Port 2, Heater Output | The state of this port is only ON or OFF. |

2.5. ANCILLARY EQUIPMENT

None

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

| | |
|---------------------|------------------|
| Temperature: | 21 to 23 °C |
| Humidity: | 45 to 58% |
| Pressure: | 102 kPa |
| Power Input Source: | 230 V AC , 60 Hz |

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

| | |
|----------------------------------|--|
| Operating Modes: | Single transmitted continuously for emissions measurements. |
| Special Test Software: | Special software provided by the Applicant to operate the EUT at each channel frequency continuously. |
| Special Hardware Used: | N/A |
| Transmitter Test Antenna: | The EUT is tested with the antenna fitted in a manner typical of normal intended use as integral antenna equipment as described with the test results. |

| Transmitter Test Signals | |
|---|-----------------------------------|
| Frequency Band(s): | 2439.86 MHz |
| Frequency(ies) Tested: | 2439.86 MHz |
| RF Power Output: (measured maximum output power at antenna terminals) | 107.98 dBµV/m Peak at 3m distance |
| Normal Test Modulation: | 2-GFSK |
| Modulating Signal Source: | Internal |

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).

Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with ANAB File No.: AT-1945.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

| FCC Section(s) | Test Requirements | Compliance (Yes/No) |
|---------------------------|--|---------------------|
| 15.203 | Antenna requirements | Yes |
| 15.207(a) | AC Power Line Conducted Emissions | Yes |
| 15.215(c) | 20 dB Bandwidth | Yes |
| 15.249(a), 15.209, 15.205 | Transmitter Radiated Emissions, Harmonic Emissions | Yes |

* The EUT complies with the requirement; it employs an integral antenna.

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None

EXHIBIT 5. TEST DATA

5.1. AC POWERLINE CONDUCTED Emissions @ FCC PART 15, SUBPART B, PARA.15.107(A)

5.1.1. Limits

The equipment shall meet the limits of the following table:

| Test Frequency Range (MHz) | CLASS B LIMITS | | Measuring Bandwidth |
|----------------------------|-------------------|-----------------|--|
| | Quasi-Peak (dBµV) | Average* (dBµV) | |
| 0.15 to 0.5 | 66 to 56* | 56 to 46* | RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 10 Hz for Average |
| 0.5 to 5 | 56 | 46 | RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 10 Hz for Average |
| 5 to 30 | 60 | 50 | RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 10 Hz for Average |

* Decreasing linearly with logarithm of frequency

5.1.2. Method of Measurements

Refer to Ultratech Test Procedures ULTR-P001-2004 & ANSI C63.4 for method of measurements.

Calculation of Conducted Emission Voltage (dBµV):

This is calculated by adding the L.I.S.N factor, Cable loss factor, and Attenuator factor to the measured reading. The basic equation with a sample calculation is as follows:

$$\text{Voltage (dB}\mu\text{V)} = \text{RA} + \text{AF} + \text{CF} + \text{LF}$$

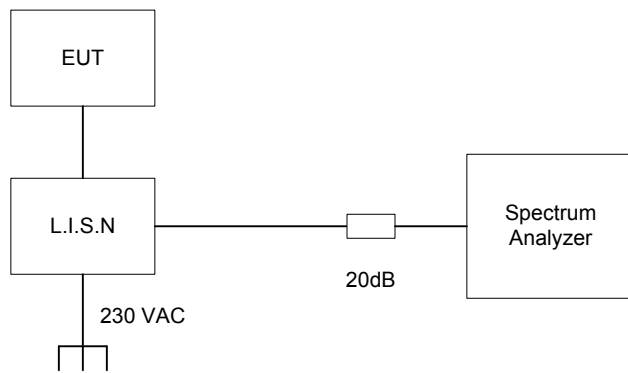
Where

- RA = Receiver/Analyzer Reading in dBµV
- AF = Attenuation Factor in dB
- CF = Cable loss Factor in dB
- LF = L.I.S.N Factor in dB

5.1.3. Test Instruments

Refer to Exhibit 6 for Test Instruments & Measurement Uncertainty

5.1.4. Test Arrangement

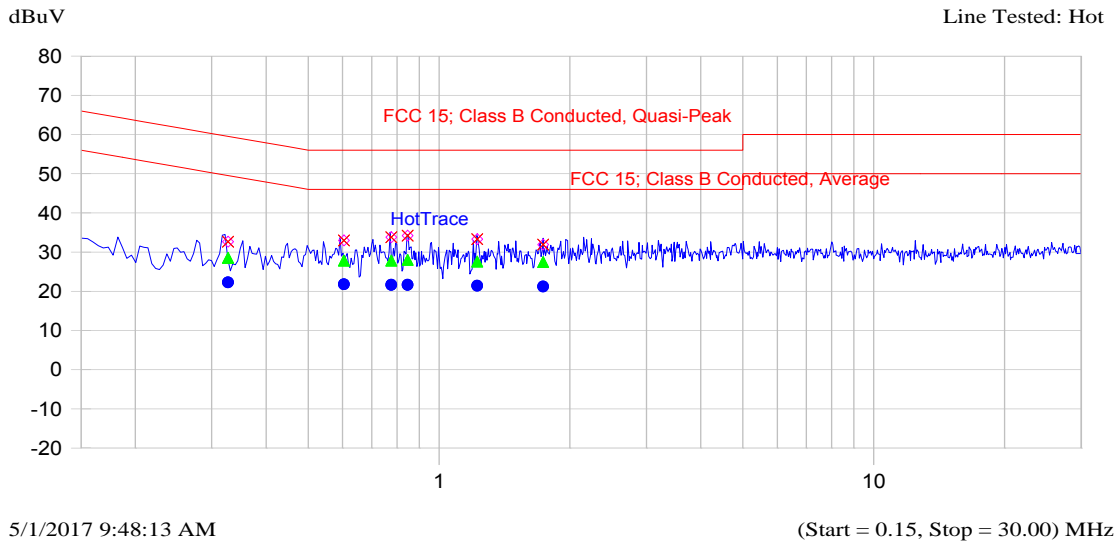


5.1.5. Test Results

The emissions were scanned from 150 kHz to 30 MHz at AC mains Terminal via a LISN, and all emissions less than 20 dB below the limits were recorded.

Hot Line

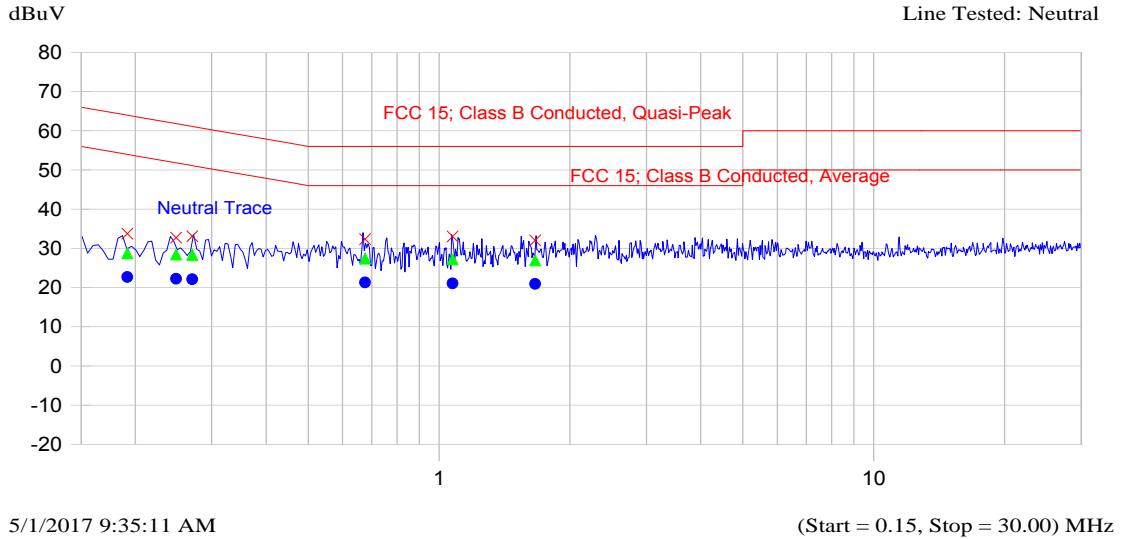
Description: Supply Voltage:230Vac
 Setup Name: FCC 15 Class B
 Customer Name: Etratech INC
 Project Number: ETR-122Q



| Frequency MHz | Peak dBuV | QP dBuV | QP-QP Limit dB | Avg dBuV | Avg-Avg Limit dB | Trace Name |
|---------------|-----------|---------|----------------|----------|------------------|------------|
| 0.327 | 32.7 | 28.5 | -31.0 | 22.3 | -27.3 | HotTrace |
| 0.604 | 33.0 | 27.8 | -28.2 | 21.8 | -24.2 | HotTrace |
| 0.777 | 33.8 | 27.8 | -28.2 | 21.6 | -24.4 | HotTrace |
| 0.847 | 34.2 | 28.0 | -28.0 | 21.6 | -24.4 | HotTrace |
| 1.225 | 33.3 | 27.6 | -28.4 | 21.4 | -24.6 | HotTrace |
| 1.735 | 31.9 | 27.5 | -28.5 | 21.2 | -24.8 | HotTrace |

Neutral Line

Description: Supply Voltage:230Vac
 Setup Name: FCC 15 Class B
 Customer Name: Etratech INC
 Project Number: ETR-122Q



| Frequency MHz | Peak dBuV | QP dBuV | QP-QP Limit dB | Avg dBuV | Avg-Avg Limit dB | Trace Name |
|---------------|-----------|---------|----------------|----------|------------------|---------------|
| 0.192 | 33.7 | 28.8 | -35.2 | 22.7 | -31.3 | Neutral Trace |
| 0.248 | 32.7 | 28.5 | -33.4 | 22.3 | -29.6 | Neutral Trace |
| 0.270 | 33.1 | 28.3 | -32.8 | 22.1 | -29.0 | Neutral Trace |
| 0.676 | 32.3 | 27.4 | -28.6 | 21.3 | -24.7 | Neutral Trace |
| 1.074 | 33.0 | 27.2 | -28.8 | 21.0 | -25.0 | Neutral Trace |
| 1.664 | 32.0 | 26.9 | -29.1 | 20.9 | -25.1 | Neutral Trace |

5.2. OCCUPIED BANDWIDTH [§15.215(c)]

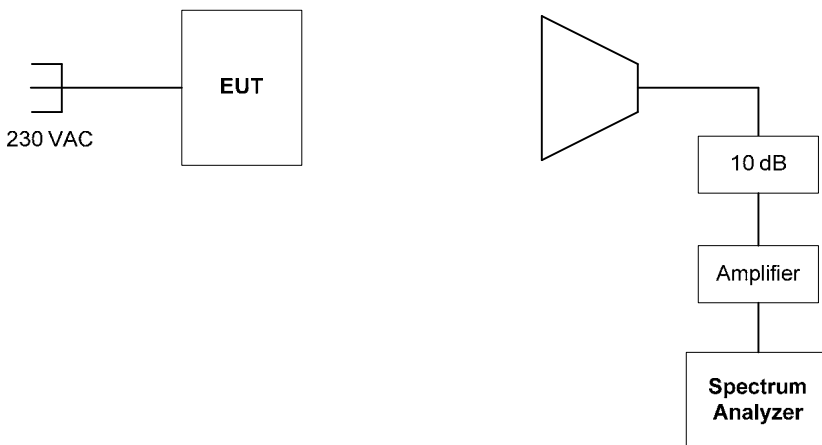
5.2.1. Limit(s)

The fundamental emission must be in the authorized bandwidth.

5.2.2. Method of Measurements

ANSI C63.10

5.2.3. Test Arrangement

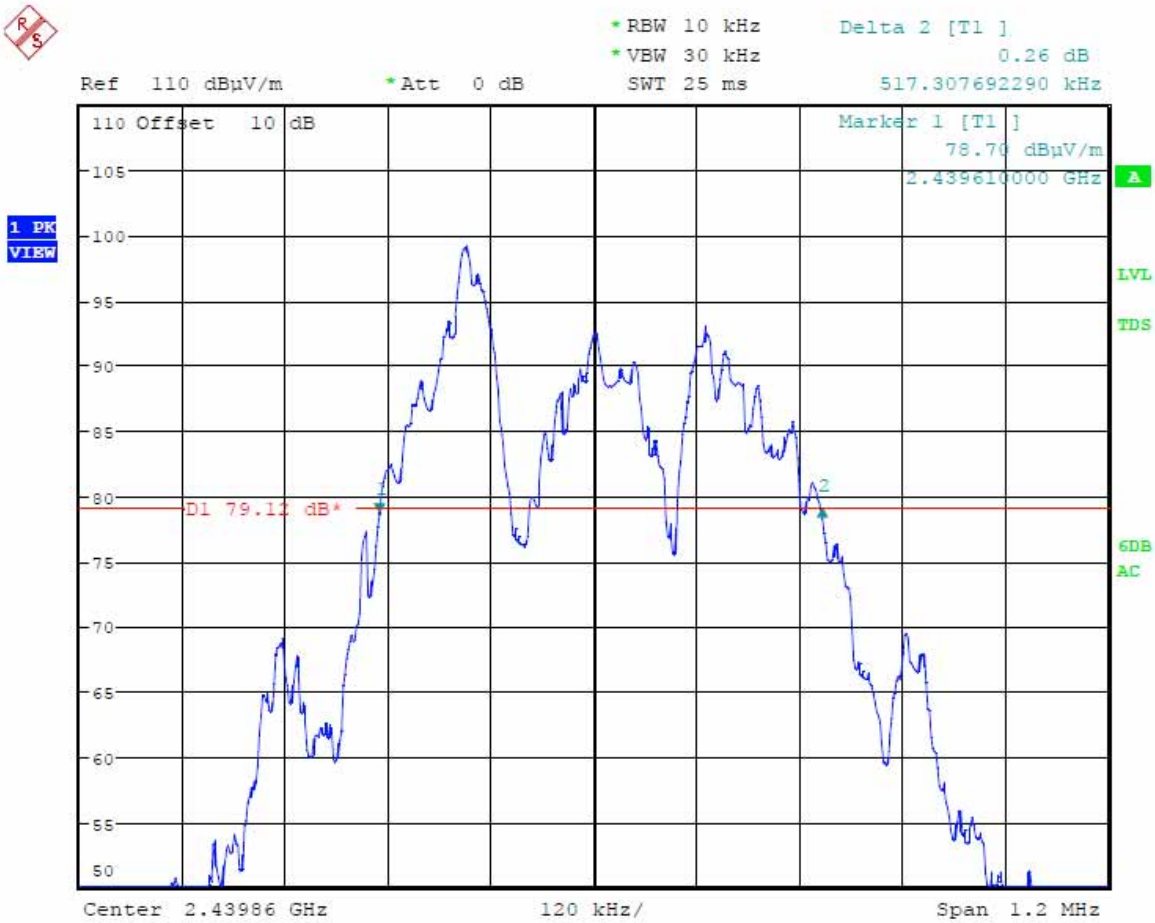


5.2.4. Test Data

| Frequency (MHz) | 20 dB Bandwidth (kHz) |
|-----------------|-----------------------|
| 2439.86 | 517.31 |

See the following plots for detailed measurements.

Plot 5.2.4.1. 20 dB Bandwidth, 2439.86 MHz



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File #: 17ETR122_FCC15249
May 15, 2017

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

5.3. FUNDAMENTAL FIELD STRENGTH AND HARMONIC EMISSIONS (RADIATED at 3m) [47 CFR §§ 15.249(a), 15.209 & 15.205]

5.3.1. Limit(s)

(a) The Field Strength of emissions from intentional radiators operated within 2400-2483.5 MHz band shall comply with the following:

| Fundamental Frequency | Field Strength of Fundamental (mV/m) | Field Strength of Harmonics (µV/m) |
|-----------------------|--------------------------------------|------------------------------------|
| 2439.86 MHz | 50 | 500 |

(c) Field strength limits specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

(e) As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

- The fundamental frequency shall not fall within any restricted frequency band specified in 15.205. All other emissions that fall in the restricted bands shall not exceed the general radiated emission limits specified in 15.209(a).

47 CFR 15.205 – Restricted Bands of Operation

| 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 |
| .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. | | | |

¹Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.

²Above 38.6

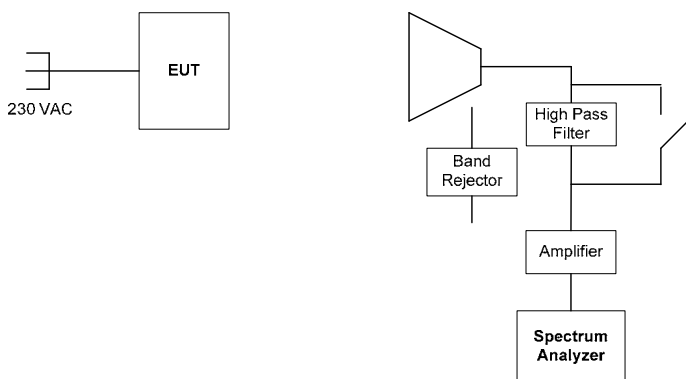
| 47 CFR 15.209(a) - Field Strength Limits within Restricted Frequency Bands | | |
|--|--|-------------------|
| Frequency (MHz) | Field Strength Limits ($\mu\text{V}/\text{m}$) | Distance (Meters) |
| 0.009 - 0.490 | 2,400 / F (KHz) | 300 |
| 0.490 - 1.705 | 24,000 / F (KHz) | 30 |
| 1.705 - 30.0 | 30 | 30 |
| 30 - 88 | 100 | 3 |
| 88 - 216 | 150 | 3 |
| 216 - 960 | 200 | 3 |
| Above 960 | 500 | 3 |

5.3.2. Method of Measurements

ANSI C63.10 and ANSI C63.4 for measurement methods.

5.3.3. Spurious Radiated Emissions

5.3.3.1. Test Arrangement



Remark(s):

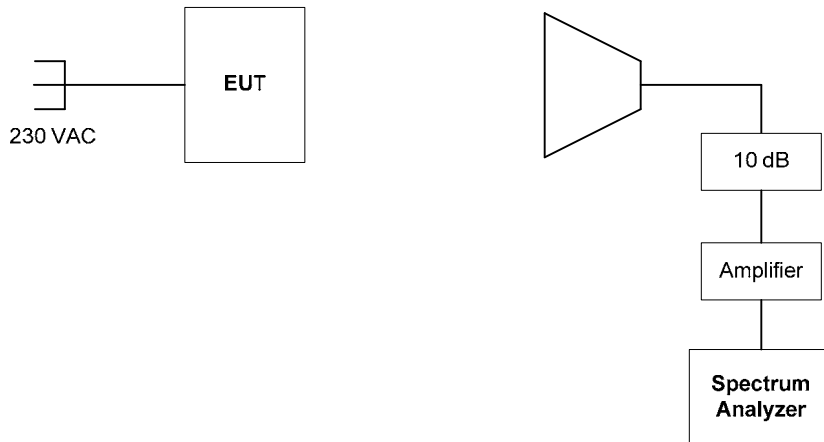
- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- EUT was tested in the actual use position as specified by the manufacturer @ 3m distance.
- The following test results are the worst-case measurements.

5.3.3.2. Test Data

| Fundamental Frequency: | | 2439.86 MHz | | | | | |
|--|------------------------|-----------------------|---------------------|---|-----------------------|-------------|-----------|
| Frequency Test Range: | | 30 MHz – 25 GHz | | | | | |
| Frequency (MHz) | RF Peak Level (dBµV/m) | RF Avg Level (dBµV/m) | Antenna Plane (H/V) | Limit of Fundamental / Harmonics AVG (dBµV/m) | Limit 15.209 (dBµV/m) | Margin (dB) | Pass/Fail |
| 2439.86 | 102.81 | 73.75 | V | 94.0 | -- | -20.25 | PASS |
| 2439.86 | 107.98 | 76.63 | H | 94.0 | -- | -17.37 | PASS |
| 4879.72 | 54.01 | 43.45 | V | 54.00 | 54.00 | -10.55 | PASS |
| 4879.72 | 54.66 | 38.25 | H | 54.00 | 54.00 | -15.75 | PASS |
| All other spurious emissions and harmonics are more than 20 dB below the applicable limit. | | | | | | | |

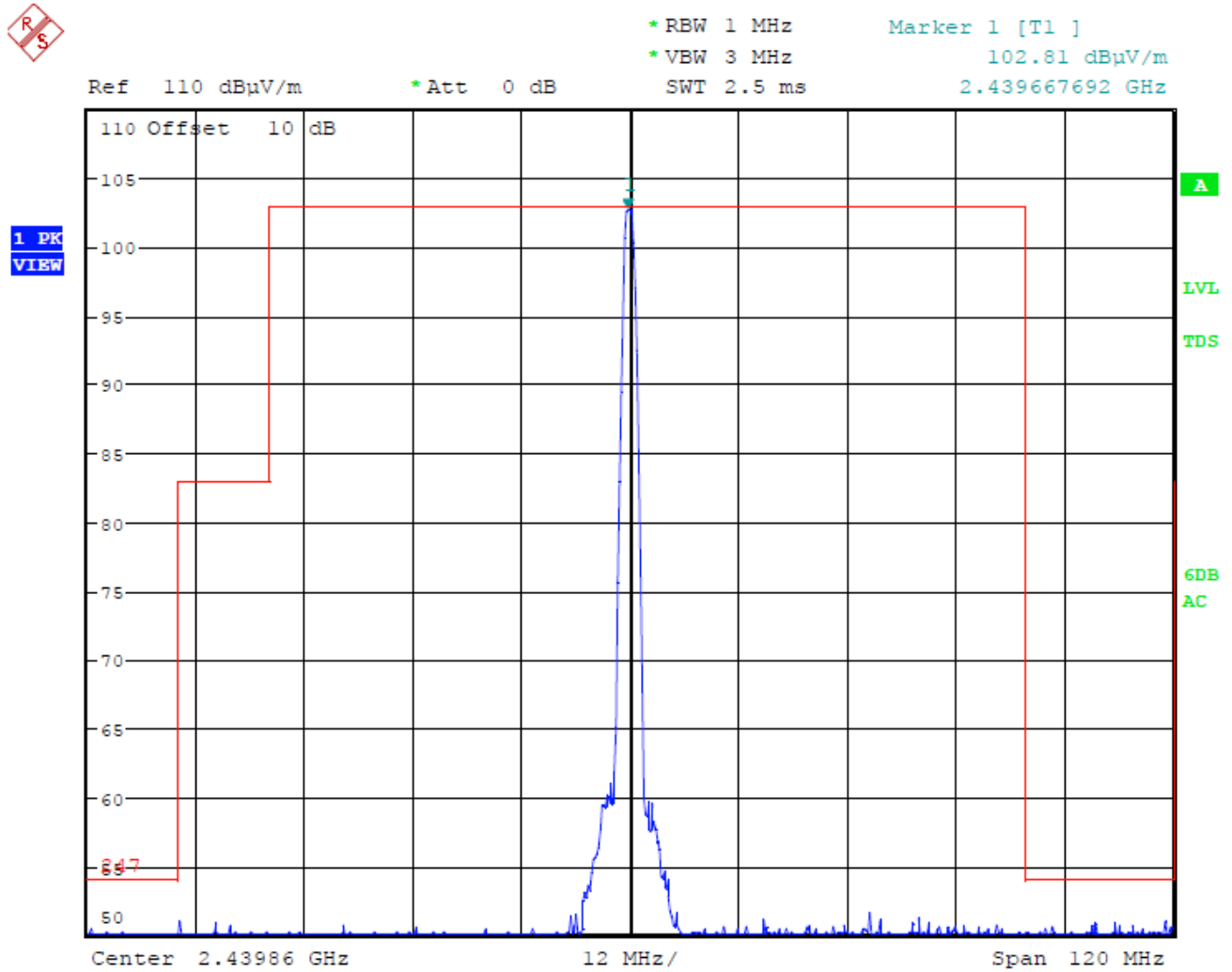
5.3.4. Band edge Emissions

5.3.4.1. Test Arrangement



5.3.4.2. Test Data

2439.86 MHz –Vertical Polarization



2439.86 MHz –Horizontal Polarization

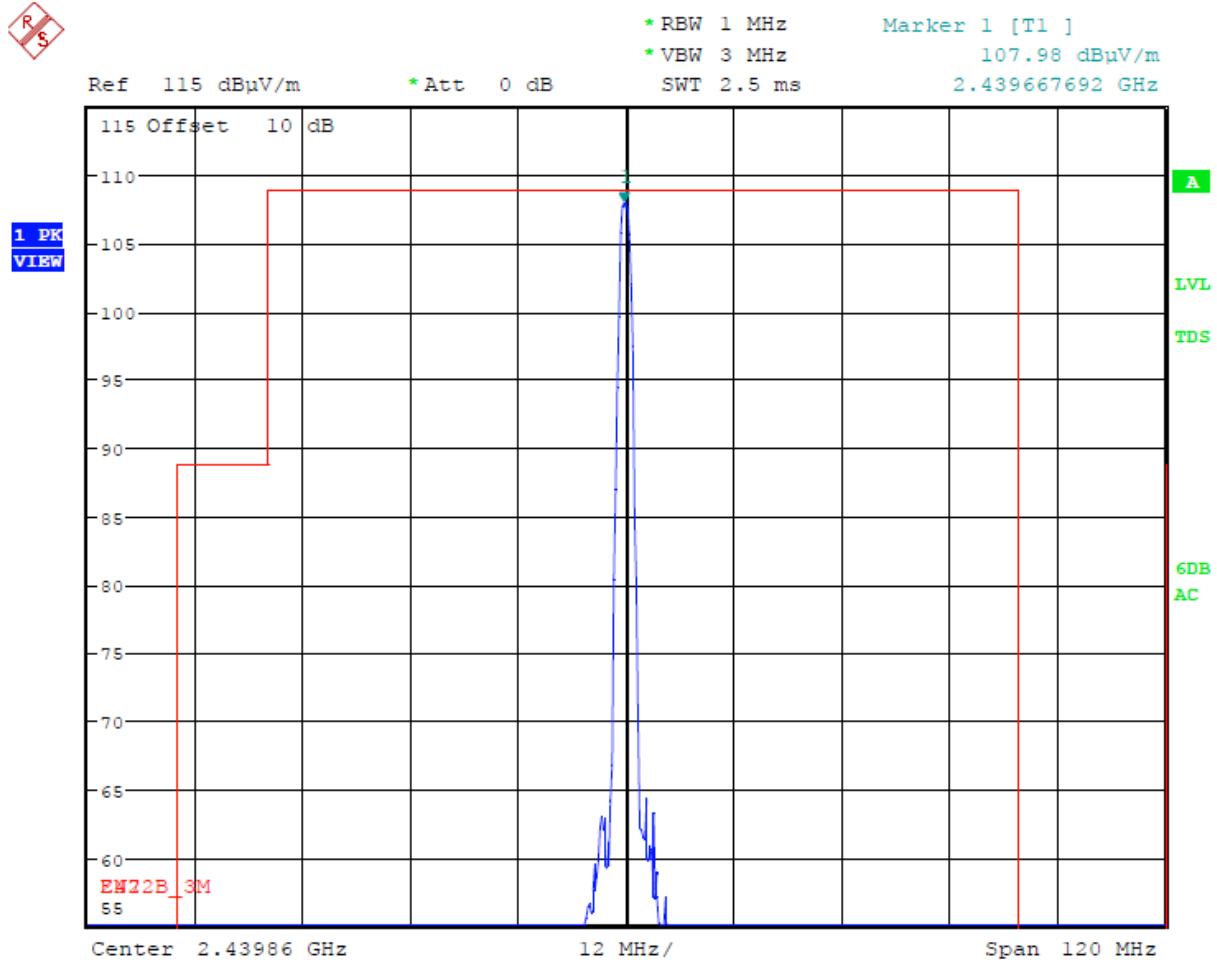


EXHIBIT 6. TEST EQUIPMENT LIST

| Test Instruments | Manufacturer | Model No. | Serial No. | Frequency Range | Cal. Due Date |
|--------------------|-----------------|--------------------|------------|---------------------------|---------------|
| Spectrum Analyzer | Hewlett Packard | HP 8593EM | 3710A00223 | 9 kHz–22 GHz | Oct 4, 2017 |
| Attenuator | Pasternack | PE7010-20 | 09 | DC–2 GHz | Mar 13, 2018 |
| LISN Used | EMCO | 3825/2 | 1531 | 10 kHz–100 MHz | Nov. 11, 2017 |
| Spectrum Analyzer | Rohde & Schwarz | ESU40 | 100037 | 20Hz–26.5 GHz | May 8, 2017 |
| Amplifier | Com-Power | PAM-0118A | 551052 | 0.5–18 GHz | Jul 13, 2017 |
| Horn Antenna | EMCO | 3115 | 9701-5061 | 1–18 GHz | Apr 24, 2018 |
| Horn Antenna | ETS-Lindgren | 3160-09 | 00118385 | 18 – 26.5 GHz | Oct 11, 2018 |
| Attenuator | Pasternack | PE7024-10 | 4 | DC–26.5 GHz | Cal on use |
| Biconilog Antenna | EMCO | 3142 | 9601-1005 | 26-2000 MHz | May 12, 2018 |
| Band Reject Filter | Micro-Tronics | BRM50701 | 105 | Cut off 2.4-2.4835 GHz | Cal on use |
| High Pass Filter | K & L | 11SH10-4000/T12000 | 4 | Cut off 2400 MHz | Cal on use |

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File #: 17ETR122_FCC15249
 May 15, 2017

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

7.1. Line Conducted Emission Measurement Uncertainty (0.15-30 MHz)

| | Line Conducted Emission Measurement Uncertainty (9 kHz – 30 MHz): | Measured | Limit |
|----------|---|------------|-----------|
| u_c | Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$ | ± 1.44 | ± 1.8 |
| U | Expanded uncertainty U: $U = 2u_c(y)$ | ± 2.89 | ± 3.6 |

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

| | Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz): | Measured (dB) | Limit (dB) |
|----------|---|---------------|------------|
| u_c | Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$ | ± 2.39 | ± 2.6 |
| U | Expanded uncertainty U: $U = 2u_c(y)$ | ± 4.79 | ± 5.2 |

| | Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz): | Measured (dB) | Limit (dB) |
|----------|---|---------------|------------|
| u_c | Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$ | ± 2.39 | ± 2.6 |
| U | Expanded uncertainty U: $U = 2u_c(y)$ | ± 4.78 | ± 5.2 |

| | Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz): | Measured (dB) | Limit (dB) |
|----------|--|---------------|---------------------|
| u_c | Combined standard uncertainty: $u_c(y) = \sqrt{\sum_{i=1}^m u_i^2(y)}$ | ± 1.87 | Under consideration |
| U | Expanded uncertainty U: $U = 2u_c(y)$ | ± 3.75 | Under consideration |