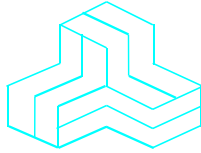


ENGINEERING TEST REPORT



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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AT-1945



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Korea
KCC-RRR
CA2049

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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:	▪ ANSI C63.4 ▪ ANSI C63.10
Environmental Classification:	☒ Commercial, industrial or business environment ☒ 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

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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.

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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 dB μ V/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 (dB μ V)	Average* (dB μ V)	
0.15 to 0.5	66 to 56*	56 to 46*	RBW = 9 kHz VBW $\geq$ 9 kHz for QP VBW = 10 Hz for Average
0.5 to 5	56	46	RBW = 9 kHz VBW $\geq$ 9 kHz for QP VBW = 10 Hz for Average
5 to 30	60	50	RBW = 9 kHz VBW $\geq$ 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 (dB μ V):

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:

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

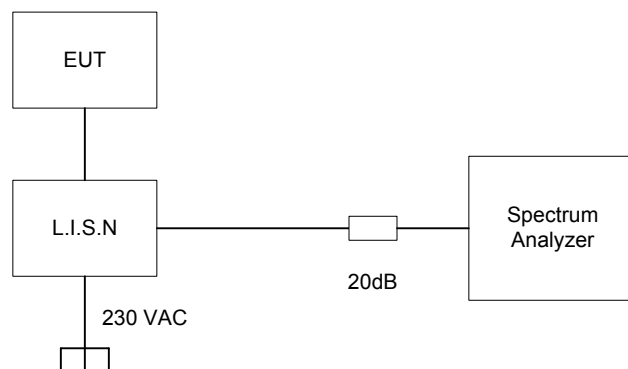
Where

RA	=	Receiver/Analyzer Reading in dB μ V
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

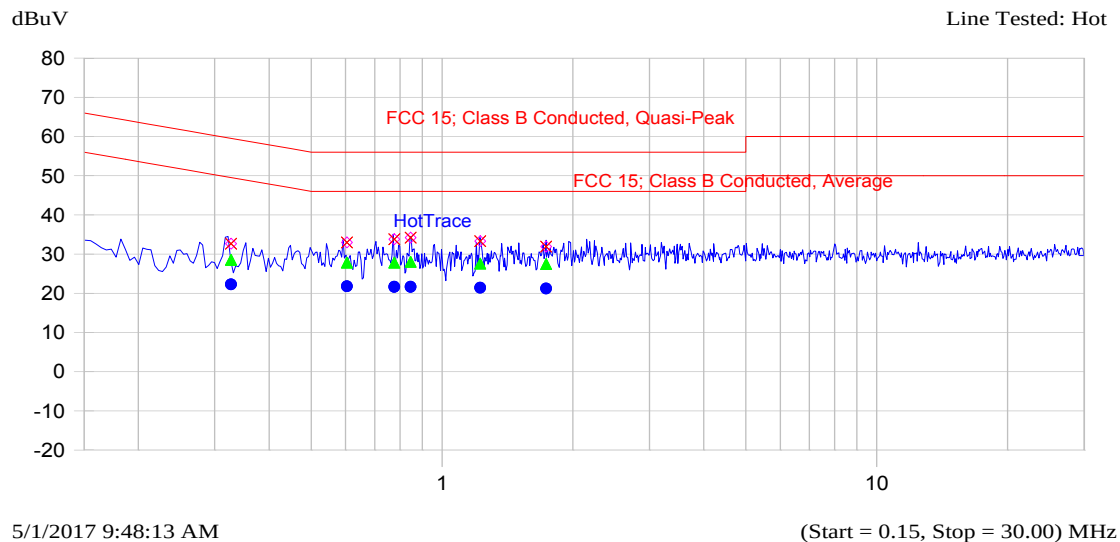


5.1.5. Test Results

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

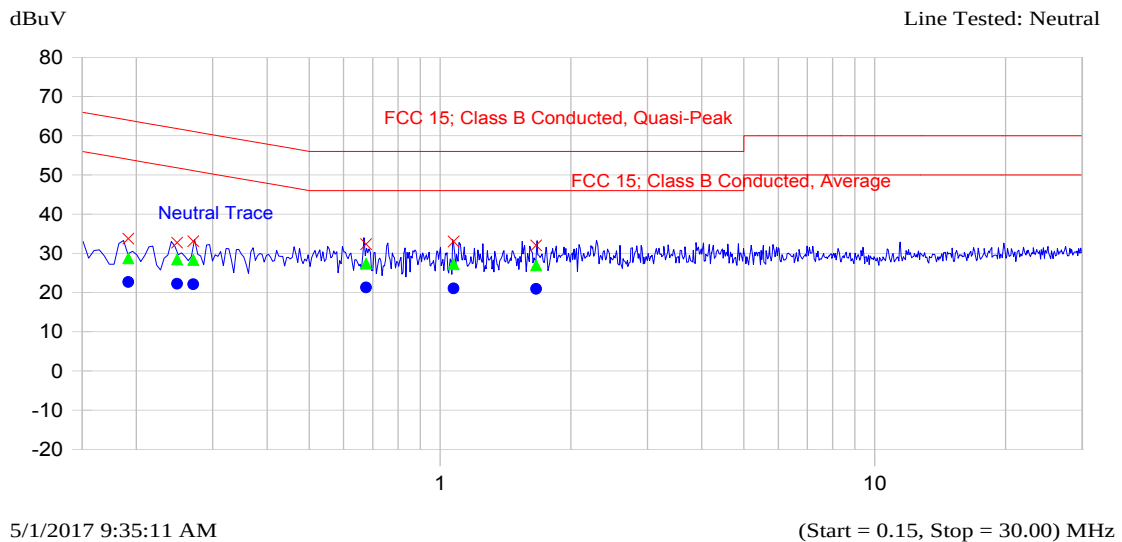
Description: Supply Voltage:230Vac
Setup Name: FCC 15 Class B
Customer Name: Etratech INC
Project Number: ETR-122Q



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

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5.2. OCCUPIED BANDWIDTH [§15.215(c)]

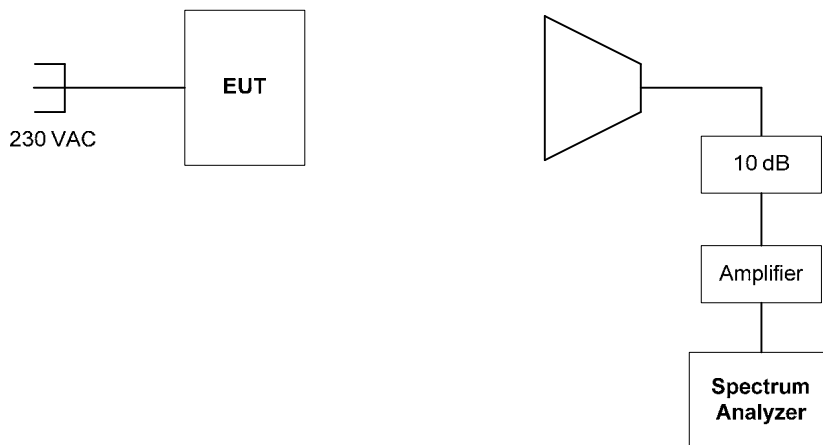
5.2.1. Limit(s)

The fundamental emission must be in the authorized bandwidth.

5.2.2. Method of Measurements

ANSI C63.10

5.2.3. Test Arrangement

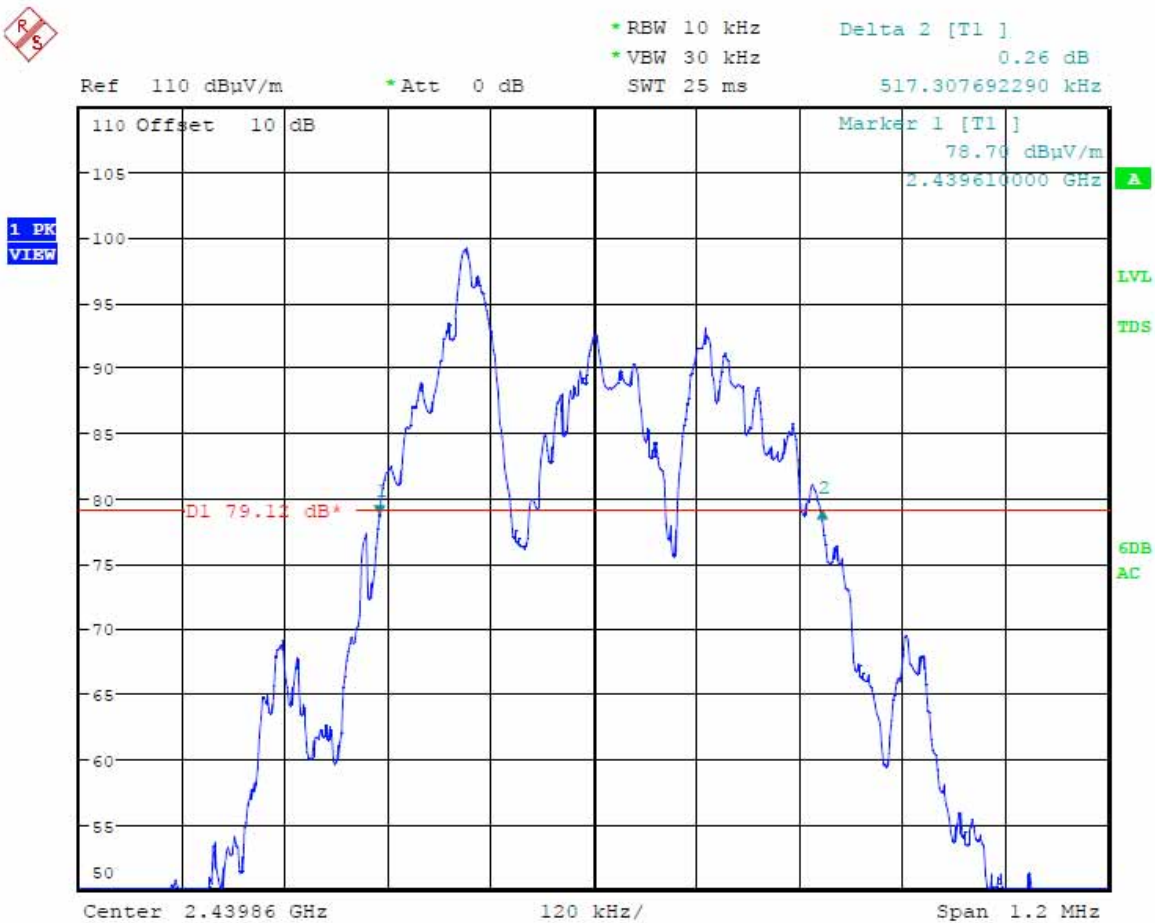


5.2.4. Test Data

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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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

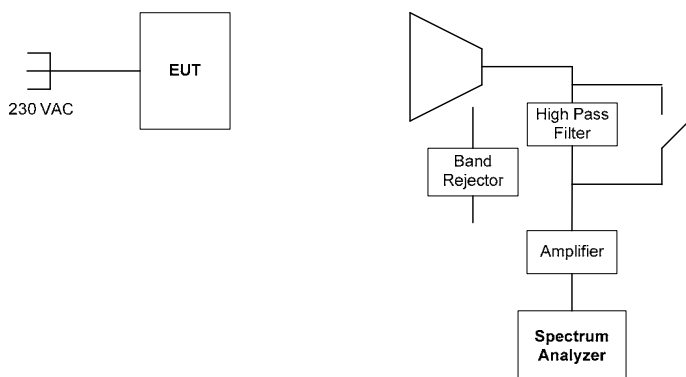
47 CFR 15.209(a) - Field Strength Limits within Restricted Frequency Bands		
Frequency (MHz)	Field Strength Limits ($\mu\text{V/m}$)	Distance (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / F (KHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

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):

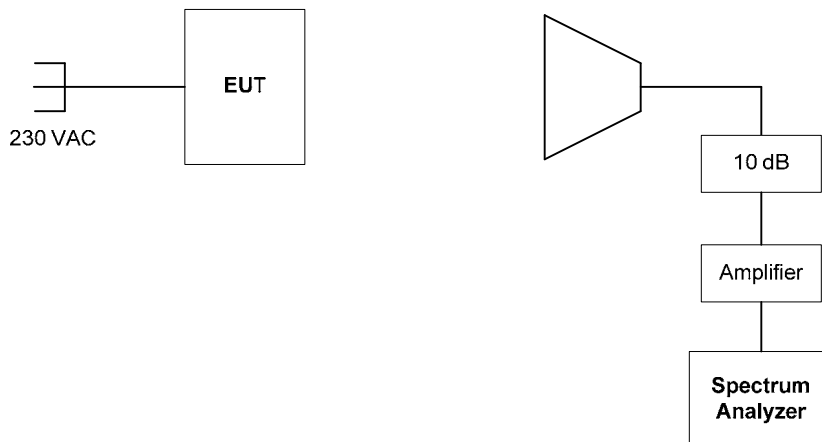
- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- EUT was tested in the actual use position as specified by the manufacturer @ 3m distance.
- The following test results are the worst-case measurements.

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.							

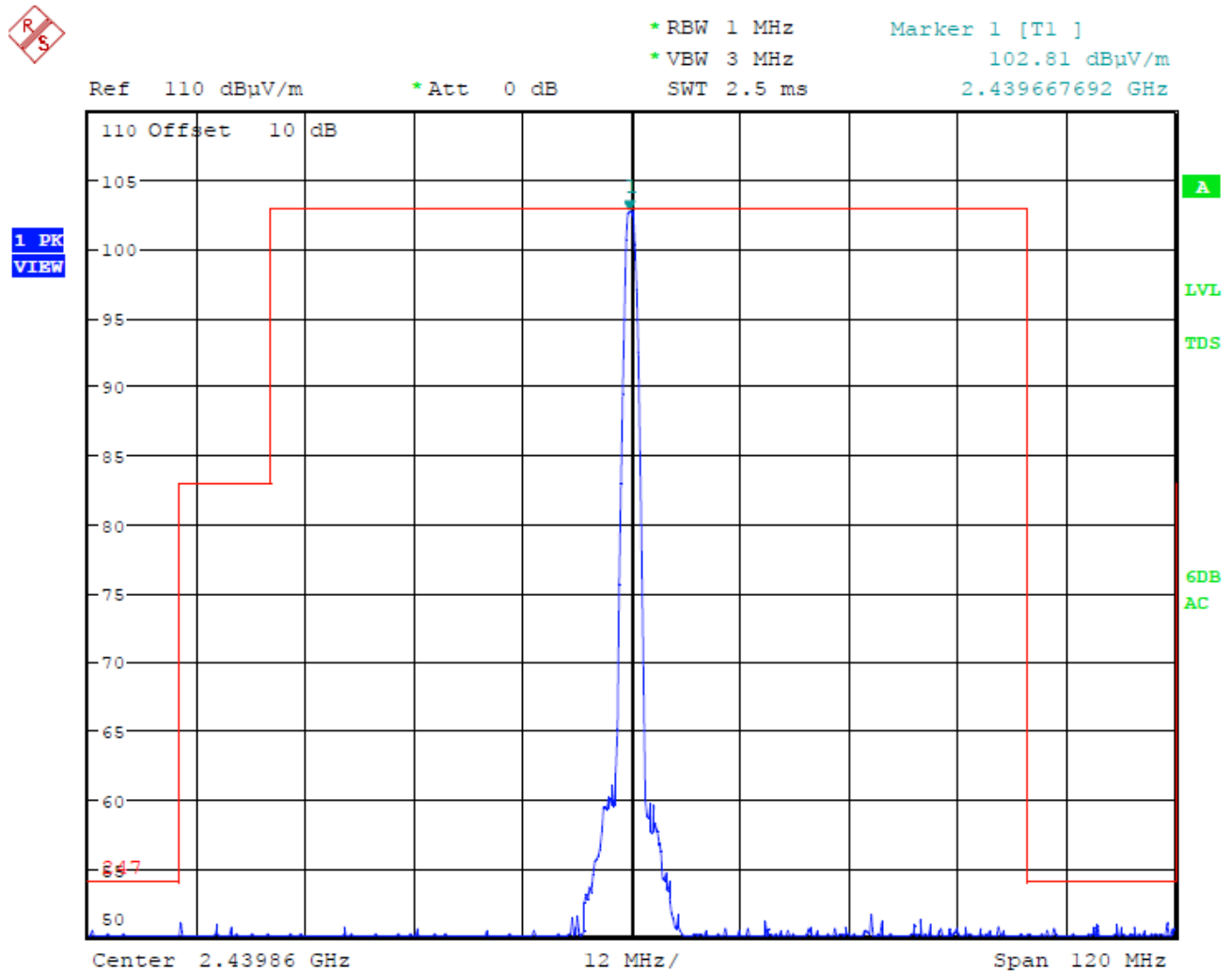
5.3.4. Band edge Emissions

5.3.4.1. Test Arrangement



5.3.4.2. Test Data

2439.86 MHz –Vertical Polarization



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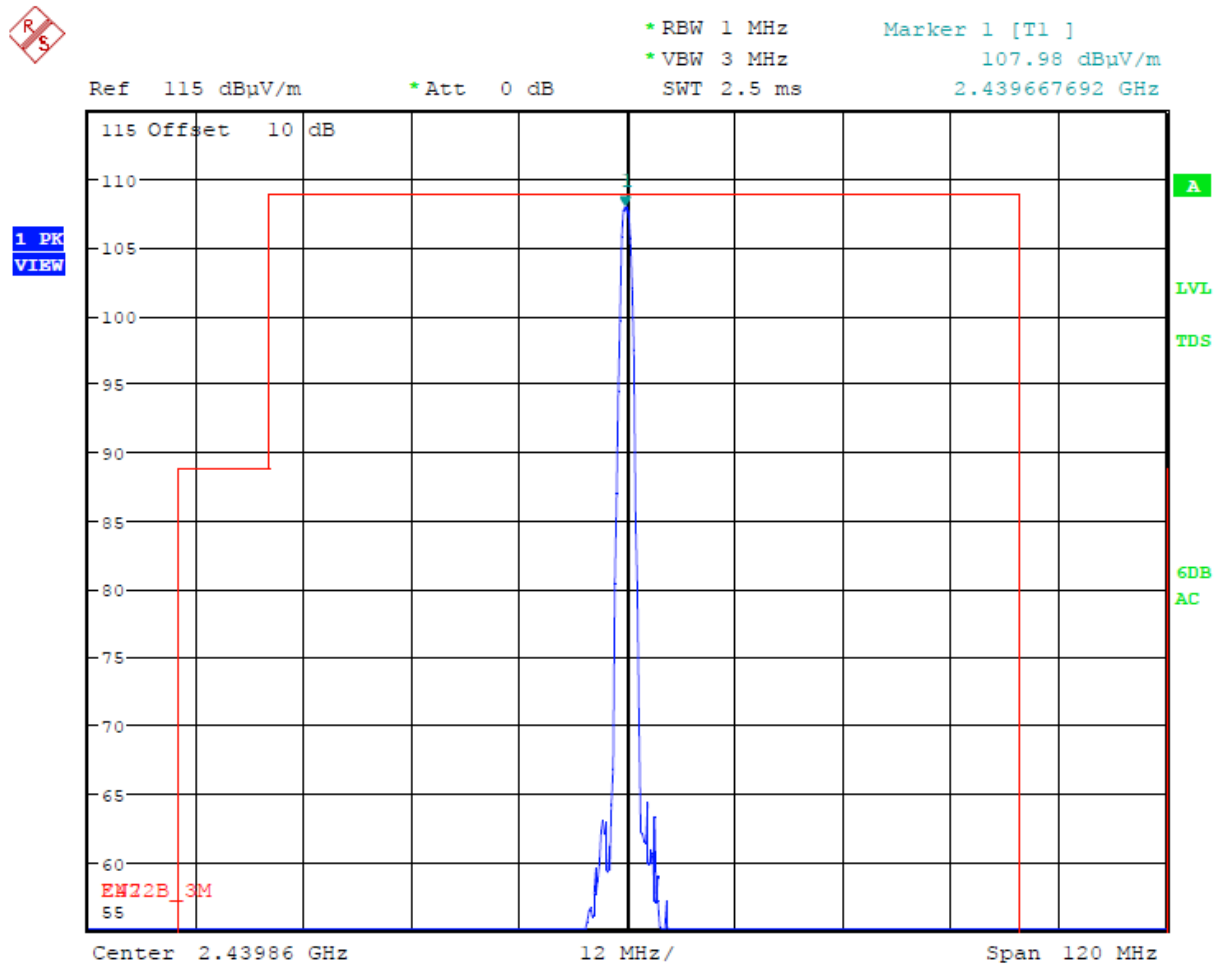
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2439.86 MHz –Horizontal Polarization



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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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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

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