



**FCC Part 15 Subpart C
Transmitter Certification Test Report –
Supporting Class II Permissive Change**

Direct Sequence Spread Spectrum Transmitter

ICL Report # 1201A

FCC ID: N82-KOHLER004

(Limited Modular Approval granted 8/19/2008)

Test Specification: FCC Rule Part: 15.247

Manufacturer: Kohler Company

Model Name/Number: DTV™ II Media Module, # K-638-K

Incorporating Roku PCB Media Module, # 1070734

Serial Numbers:

pcb-0294-05, revision 5,

WMMG1AC8I000270, WMMG1AB7F000197

Test Start Date: October 9, 2008

Test End Date: October 21, 2008

Report Issue Date: July 10, 2009

Test Result: Pass

Prepared By:

A handwritten signature in cursive script that reads 'Daniel L. Berg'.

**Daniel L. Berg
ICL Compliance Engineer**

Reviewed By:

A handwritten signature in cursive script that reads 'Ronald W. Zimmerman'.

**Ronald W. Zimmerman
ICL President and NCE**

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1.0 GENERAL

1.1 Purpose

The purpose of this report is to provide supporting information for a Class II Permissive Change to FCC ID: N82-KOHLER004 and demonstrate compliance with Part 15, Subpart C of the FCC’s Code of Federal Regulations with an additional host board, the DTV™II Media Module.

1.2 Product Description

1.2.1 General

The Kohler Media Module is one of the core components in the DTV™II showering system. The system allows a completely customizable showering experience. The Media Module coordinates information from up to two Digital User Interfaces and properly controls subcomponents such as the DTV™ Six-Port Thermostatic Valve for water control, the DTV Steamer, 250 watts of dimmable incandescent lighting, Internet radio or local MP3 selection from Servers (such as iTunes), and volume for up to four speakers. See the Kohler website (under showers- DTV™II) for more information. The Media Module has an input power range that may run on U.S. voltages of 120Vac or 230Vac 60Hz. Both were investigated to find worst case emissions.

1.2.2 Manufacturer Information

Kohler Company
444 Highland Dr.
Kohler, WI 53044

Contact: Jeff Mueller, Staff Engineer – Electronics, Tim Stessman, Sr. Project Analyst
Phone: (920) 457-4441 ext. 70237 (Jeff) and ext. 72122 (Tim)

1.2.3 Equipment Under Test and Peripheral Details

Each item in the EUT (Equipment Under Test) Setup was tagged and identified. See Figure 1 and Figure 2 for exact locations. The details for each item are listed below:

Item #	Description, Identifiers, and Part Numbers	Length
1	AC Input Power Cord for Media Module	36 ¼"
2	Incandescent Lighting Output, wired with typical Romex NM style house wiring, to light bulb fixtures in test stand. Four lighting fixtures populated with two incandescent bulbs rated at 200W and 50W, 240Vac (the maximum load).	~21.3'
3	DTV™ Six-Port Thermostatic Valve cable, 1068243, Steward 28A0593-0A2 near CSM.	30'
4	DTV II™ Digital Interface cable (for Primary User Interface), 1045251, 2706KSM (Ferrite already integrated and unlabeled).	30'
5	DTV II™ Auxiliary Digital Interface cable (for Secondary User Interface), 1045252, 4405KSM (Ferrite already integrated and unlabeled).	30'
6	Steamer communications cable, 1068289 (ferrite already integrated near CSM)	30'
7	Ethernet cable, 1069535, Steward 28A0593-0A2 snap-on ferrite.	30'
8	Speaker cable, 1068261, REV 0, EXCEL 197, Steward 28A0593-0A2 snap-on ferrite populated near Media Module.	25'
9	Speaker cable, 1068261, 4067. Steward 28A0593-0A2 snap-on ferrite populated near Media Module.	25'
10	Equipment Under Test: #1) DTV II™ Media Module (Equipment Under Test), Model# K-638-K... with Subcomponents:	n/a

Item #	Description, Identifiers, and Part Numbers	Length
10 (cont'd)	<p>a) Roku Wi-Fi Media Module Revision 3 Serial # WMMG1AC8I000270, Labeled "S00040828"</p> <p>b) V-INFINITY Switching Power Supply: Model: VPU-S200-24 Rev. F, 200W max, Input: AC 100-240Vac/2.8A 50/60Hz, Output: 24Vdc/8.3A, Serial Number 1043003107230000011.</p> <p>c) Printed Circuit Board Assembly (65.796 APP, 9-16-08), PCB-0194-05-R, Revision 5.</p> <p>#2) DTV II™ Media Module (Equipment Under Test), Model# K-638-K ... with Subcomponents:</p> <p>a) Roku Wi-Fi Media Module Revision 3, Serial # WMMG1AB7F000197, Labeled "FCC Test Board" (RF conducted) and Serial #S00040885, labeled "fcc test code" (RF radiated)</p> <p>b) V-INFINITY Switching Power Supply: Model: VPU-S200-24 Rev. F, 200W max, Input: AC 100-240Vac/2.8A 50/60Hz, Output: 24Vdc/8.3A, Serial Number 1043007107120000195.</p> <p>c) Printed Circuit Board Assembly (55.296 FCC 9-16-08), PCB-0194-05-R, Revision 5.</p> <p>#1 was configured for normal operation and #2 was configured for control of the wireless signal (channel selection, continuous transmit, gain, etc).</p>	n/a
11	DTV II™ Portrait Digital Interface, PLX074507486, Kohler# -1065899-1CP, Revision # - 1.0** (for use with Media Module K638 and K637). Secondary UI.	n/a
12	DTV™ Six-Port Thermostatic valve, K-682-K	n/a
13	AC Adapter, Class 2 Power Supply, 120-240Vac Input, 12Vdc/3.8A Output, for powering DTV™ Thermostatic valve. Also see Item#18. UL Listed and Tested to comply with FCC standard for home or office use.	30 7/8 "
14	Line-In Cable, 1068290 and Radio Shack RCA to 13.5mm stereo plug.	5'7"+ ~25'
15	Steamer simulator and DTV Steam Adapter, Version 3, with Temperature Sensor	25' sensor
16	Rio Cali MP3 (turned off) used for termination on MP3 input cable.	n/a
17	AC input cord for Steamer simulator and DTV Steam Adapter.	~5'
18	AC Adapter Input Cord for DTV Thermostatic Valve	13' 1/8"
19	DTV II™ Portrait Digital Interface, PLX074006796, Kohler# -1065899-1CP, Revision # - 1.0** (for use with Media Module K638 and K637). Secondary UI.	n/a
20 (not labeled)	SoundTile Speakers (quantity of two), K-8033, polkaudio, DB401, 4" Coaxial, 4SW RMS, 13SW Peak, 4 ohms	n/a

Table 1. List of Components Used in the EUT Configuration.

	Description, Identifiers, Part Numbers	Software Revision
1	Primary Digital Interface (Item#19 above)	1.00
2	Secondary Digital Interface (Item#11 above)	1.00
3	Six-Port Thermostatic Valve (Item#12 above)	6.10, 777.3
4	Media Module (Item#10 above) PCB APP and FCC versions	9-16-08
5	Roku on Media Module (Item#10 above) Configuration #1	2.7.85
6	Steamer	3.0

Table 2. Software Revision Levels Used in EUT Configuration.

	Description, Identifiers, Part Numbers	Length
1	Dell Laptop w/ AC adapter running iTunes 7.7.1.11 playing "Pink Noise at -20dBfs"	n/a
2	Wireless -G 2.4GHz Broadband Linksys Router, Model WRT54G V8, SN	n/a

	CDFG0G913122	
3	Ethernet cable connecting router and laptop.	~3'

Table 3. Support Equipment (for Wi-Fi)

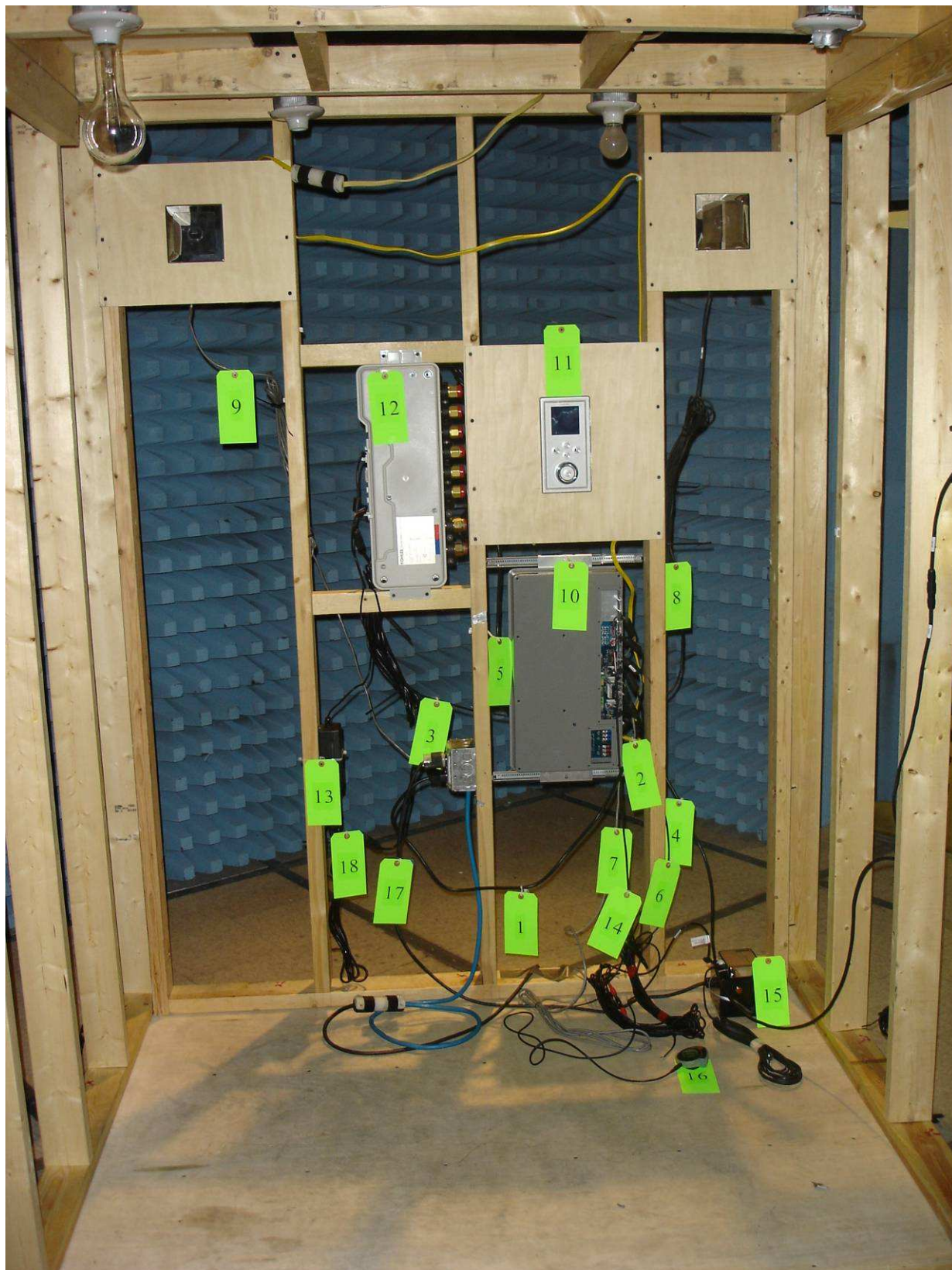


Figure 1. Kohler Media Module (EUT) and Associated Peripherals Setup (Radiated Emissions).



Figure 2. Side View of Peripheral (Digital Interface) Associated with Media Module (EUT) (Radiated Emissions)

2.0 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

International Compliance Laboratories, LLC
1057 Tullar Court
Neenah, WI 54904
Phone: (920) 720-5555
Fax: (920) 720-5556

2.2 Laboratory Accreditations/Recognitions/Certifications

The Semi-Anechoic Chamber Test Site and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada. In addition, ICL is compliant to ISO 17025 as certified by the American Association for Laboratory Accreditation (A2LA) under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 413232
Industry Canada Registration Number: 6602A
A2LA Certificate Number: 2599.01



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

INTERNATIONAL COMPLIANCE LABORATORIES, LLC
1057 Tullar Court
Neenah WI 54956
Ronald W. Zimmerman Phone: 920 720 5555

ELECTRICAL (EMC)

Valid to: April 30, 2010

Certificate Number: 2599.01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following electromagnetic compatibility and product safety tests:

Test Technology

Test Methods

Emissions

RF (Radiated and Conducted)

CFR 47, FCC Method Parts 15 and 18 using ANSI C63.4;
CISPR 11; EN 55011; CISPR 14-1; EN 55014-1; CISPR 14-2;
EN 55014-2; CISPR 15 ; EN 55015; CISPR 22; EN 55022;
CISPR 24; EN 55024; ICES-001, ICES-003

Harmonic Current Emissions
Voltage Fluctuations and Flicker

IEC 61000-3-2; EN 61000-3-2
EN 61000-3-3; EN 61000-3-3

Immunity

Electrostatic Discharge (ESD)

IEC 61000-4-2

Radiated RF

IEC 61000-4-3

Electrical Fast Transients (EFT) / Burst

IEC 61000-4-4

Electrical Surge

IEC 61000-4-5

Conducted RF

IEC 61000-4-6

Power Frequency and Magnetic Field

IEC 61000-4-8

Voltage Dip, Interruptions, and
Variations

IEC 61000-4-11

Generic and Product Specific EMC Standards

Generic Immunity Residential

IEC 61000-6-1; EN 61000-6-1

Generic Immunity Industrial

IEC 61000-6-2; EN 61000-6-2

Generic Emissions Residential

IEC 61000-6-3; EN 61000-6-3

Generic Emissions Industrial

IEC 61000-6-4; EN 61000-6-4

Laboratory Equipment

IEC 61326-1; EN 61326-1

Medical Equipment

IEC 60601-1-2:2001; IEC 60601-1-2

Information Technology Equipment

CISPR 24; EN 55024

Household Appliances and Similar

CISPR 14-2; EN 55014-2

Industry Canada Radio Tests

RSS-GEN; RSS-210

(A2LA Cert. No. 2599.01) Revised 06/29/2009

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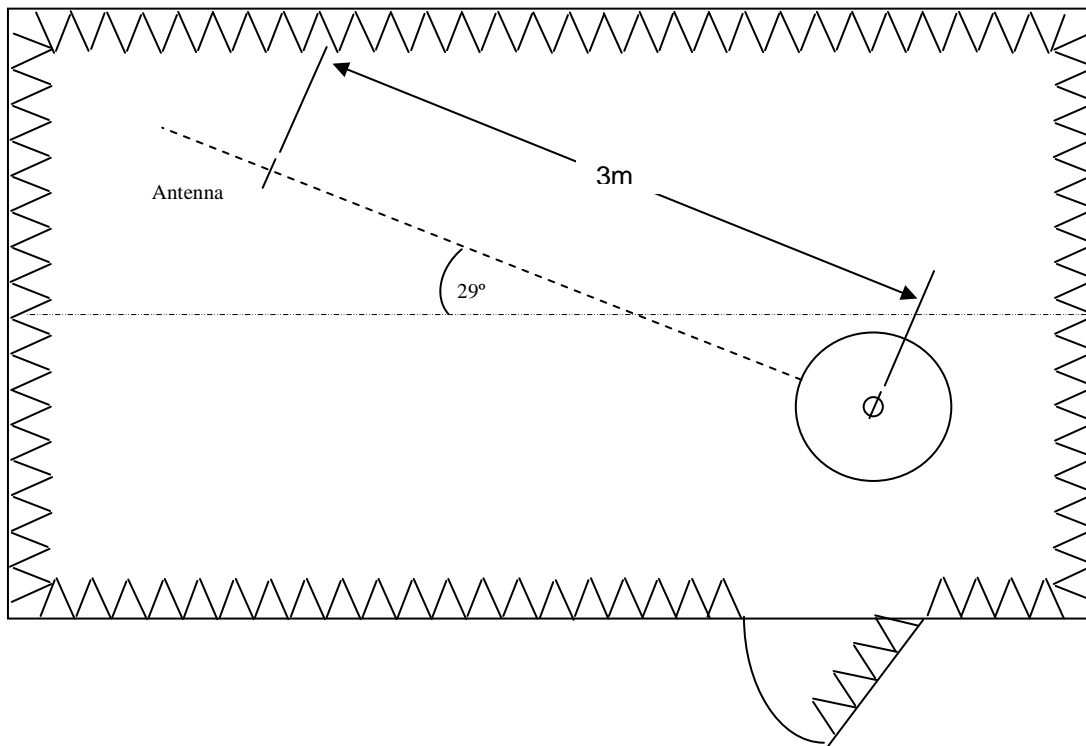
<u>Test Technology</u>	<u>Test Methods</u>
<i>ETSI Radio Tests</i>	
Emissions	EN 300 328
Immunity	EN 301 489-1; EN 301 489-17;
<i>Automotive Component EMC</i>	
Emissions	CISPR 25; SAE J1113-41
Bulk Current Injection (BCI)	SAE J1113-4
Electrostatic Discharge (ESD)	SAE J1113-13
Radiated RF Immunity	SAE J1113-21
<i>Harley Davidson Component EMC</i>	
Engineering Guideline EG-812-22614	
Radiated Emissions	EG-812-22614-401
Conducted Emissions	EG-812-22614-402
Bulk Current Injection (BCI)	EG-812-22614-405
Electrostatic Discharge (ESD)	EG-812-22614-407
<i>United Nations UNECE</i>	
Emissions and Immunity	E/ECE/324 Addendum 9: Regulation 10
<u>On the following products or types of products:</u> Light Industrial, Commercial, Residential, Heavy Industrial, Scientific, Medical, Portable Test and Measurement Equipment, Information Technology Equipment, Telecom, Automotive, and other Electrical and Electronic Equipment	
(A2LA Cert. No. 2599.01) Revised 06/29/2009	
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3.0 RADIATED EMISSIONS TEST SITE DESCRIPTION

3.1.1 Semi-Anechoic Chamber Test Site

The semi-anechoic chamber is a Series 81 EMC test chamber manufactured by ETS – Rayproof. This chamber was recently moved in 2006 to International Compliance Laboratories in Neenah, WI. The interior walls and ceiling are completely covered with 4" x 4" ferrite tiles and 16" absorber cones. The chamber is also equipped with a 1.2 meter flush mounted turntable. The test chamber's dimensions are 30ft. x 20ft. x 20ft. The test volume is 2.0-meter in diameter and 2 meters high and is centered on the turntable.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 3 below:



Power to the room is filtered to prevent ambient noise from coupling to the EUT and measurement equipment. Filters are models 07294/GFUL57915-1x100 (100 Amp 277/480Vac 50/60Hz) manufactured by Genisco Electronics Corporation.

The room is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

3.1.2 Conducted Emissions Test Site Description

The conducted emissions test site is an open area with two reference planes configured in the following way:

Reference Floor Plane constructed of galvanized steel measuring:

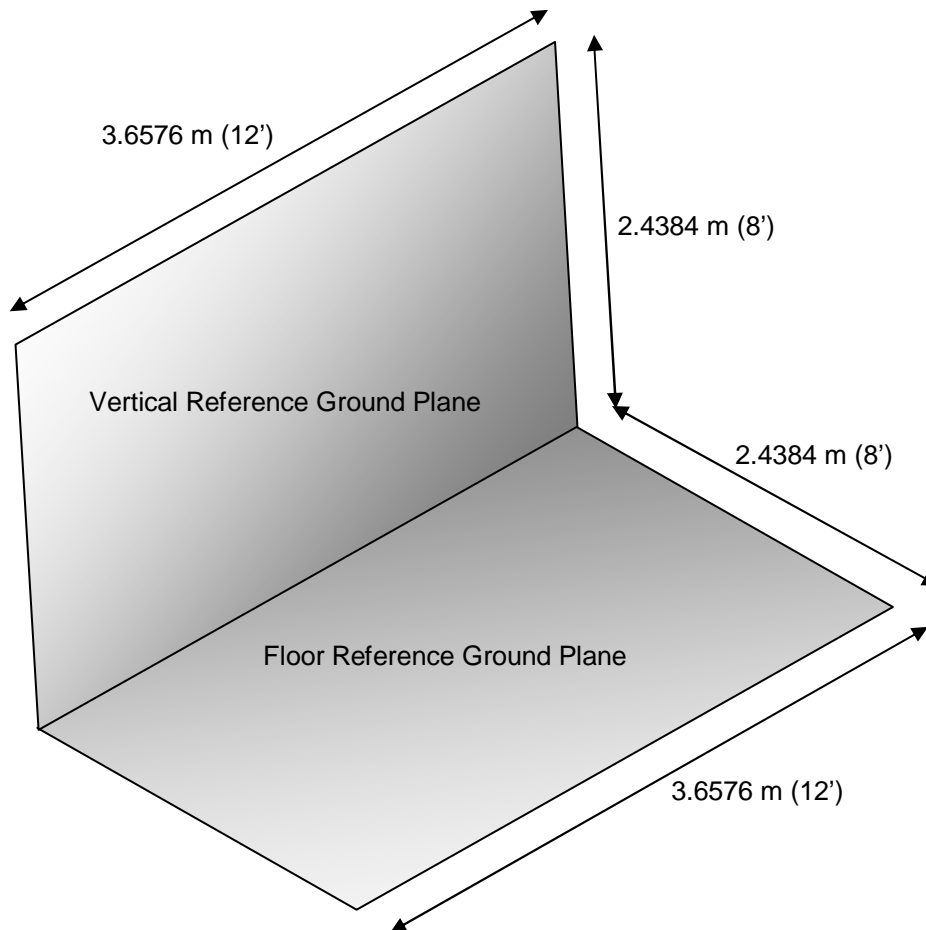
Width: 2.4384 meters (8')

Length: 3.6576 meters (12')

Vertical Reference Plane constructed of galvanized steel measuring:

Height: 2.4384 meters (8')

Length: 3.6576 meters (12')



The vertical and floor reference planes are bonded together with 2" width aluminum tape with a conductive adhesive. All joints were cleaned appropriately before they were joined.

The vertical reference plane is bonded to the building earthing system via fasteners. Additionally, these fasteners support the vertical reference plane against the wall by penetrating the building's steel construction. Electrical conduit nearby, also fastened to the same building steel construction, guaranteed a good earth connection.

4.0 APPLICABLE REFERENCE STANDARDS

The following standards were used:

ANSI C63.4-2003: *Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the 9 KHz to 40GHz*

US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: *Radio Frequency Devices, Intentional Radiators (July 10, 2008)*

FCC KDB Publication No. 558074 used for guidance. This publication references the document entitled, "*Measurement of Digital Transmission Systems Operating under Section 15.247 – March 23, 2005*"

LIST OF TEST EQUIPMENT

All test equipment used for regulatory testing is calibrated yearly or according to manufacturer's specifications.

Equipment List					
Manufacturer	Equipment Type	Model	Serial	Last Calibrated	Cal Interval
Hewlett Packard	EMI Test Receiver	8546A	3746A00414	4/2/2008	1 year
Hewlett Packard	Filter Section	85460A	3704A00360	4/2/2008	1 year
EMCO	Biconilog Antenna	3141	9706-1052	8/23/2008	2 years
EMCO	Horn Antenna	3115	6217	10/3/2008	2 years
COM Power	Horn Antenna	AH-826	081054	7/31/2008	1 year
Hewlett Packard	Pre-Amplifier, 1.0 – 26.5 GHz	8449B	3008A00151	11/25/2008	1 year
Hewlett Packard	Pre-Amplifier, 1.0 – 26.5 GHz	8449B	3008A02299	8/4/2008	2 years
Micro-Tronics	High-Pass Filter	HPM50111	041	Verified	n/a
Pasternack	Low Noise Amplifier, 2.0 -18.0 GHz	PE1524	0081	11/25/2008	1 year
HD Communications	Low Noise Amplifier, 18.0 - 26.5 GHz	HD26466	0004	11/25/2008	1 year
ETS-Rayproof	Absorber-Lined Shielded Enclosure	Series 81	n/a	9/25/2007	2 years
Rohde & Schwarz	EMI Test Receiver	ESI 26	863342/015	4/3/2008	1 year
Solar Electronics	LISN	8012-50-R-24 BNC	935436	1/4/2008	1 year
Solar Electronics	LISN	8028-50-R-24 BNC	968437	7/7/2007	n/a ^a
Solar Electronics	LISN	8028-50-R-24 BNC	980238	7/7/2007	n/a ^a
COM Power	Transient Limiter	LIT-930	711674	11/25/2008	1 year

Table 4. Test Equipment

^a Used for isolation of auxiliary equipment, not for measurement.

5.0 EQUIPMENT UNDER TEST SETUP

The connection diagram (Figure 4) below clarifies all Media Module connections with some modifications.

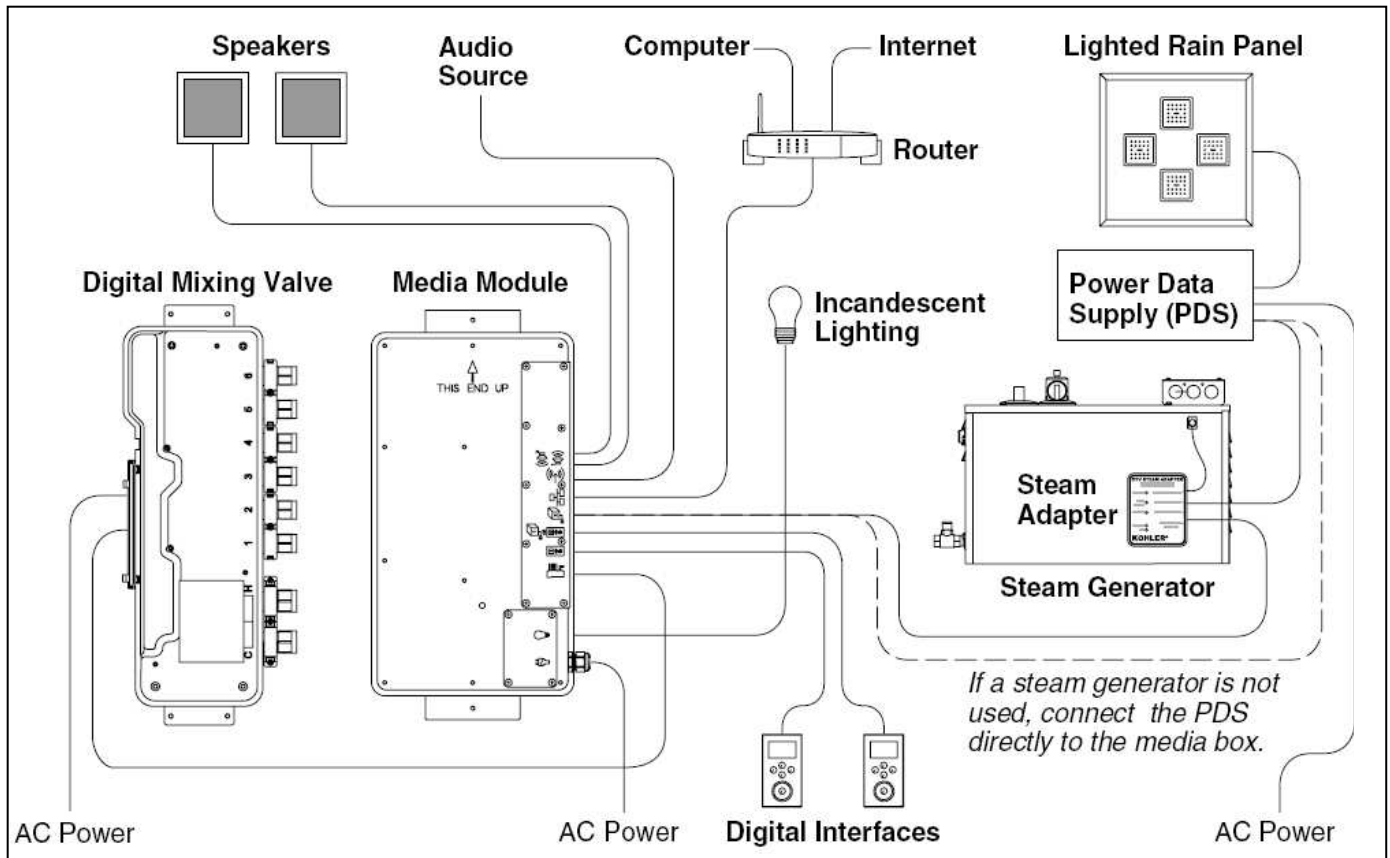


Figure 4. Connection Diagram of Media Module with Peripheral Devices

Please note the following changes to the diagram:

- 1) The Lighted Rain Panel and associated cabling were not present,
- 2) The Router connection to the Media Module was wireless and Ethernet was not used. The Ethernet needed to be unpopulated to activate wireless functionality.
- 3) A Steam Adapter with a simulated steam generator/power data supply was provided by Kohler.

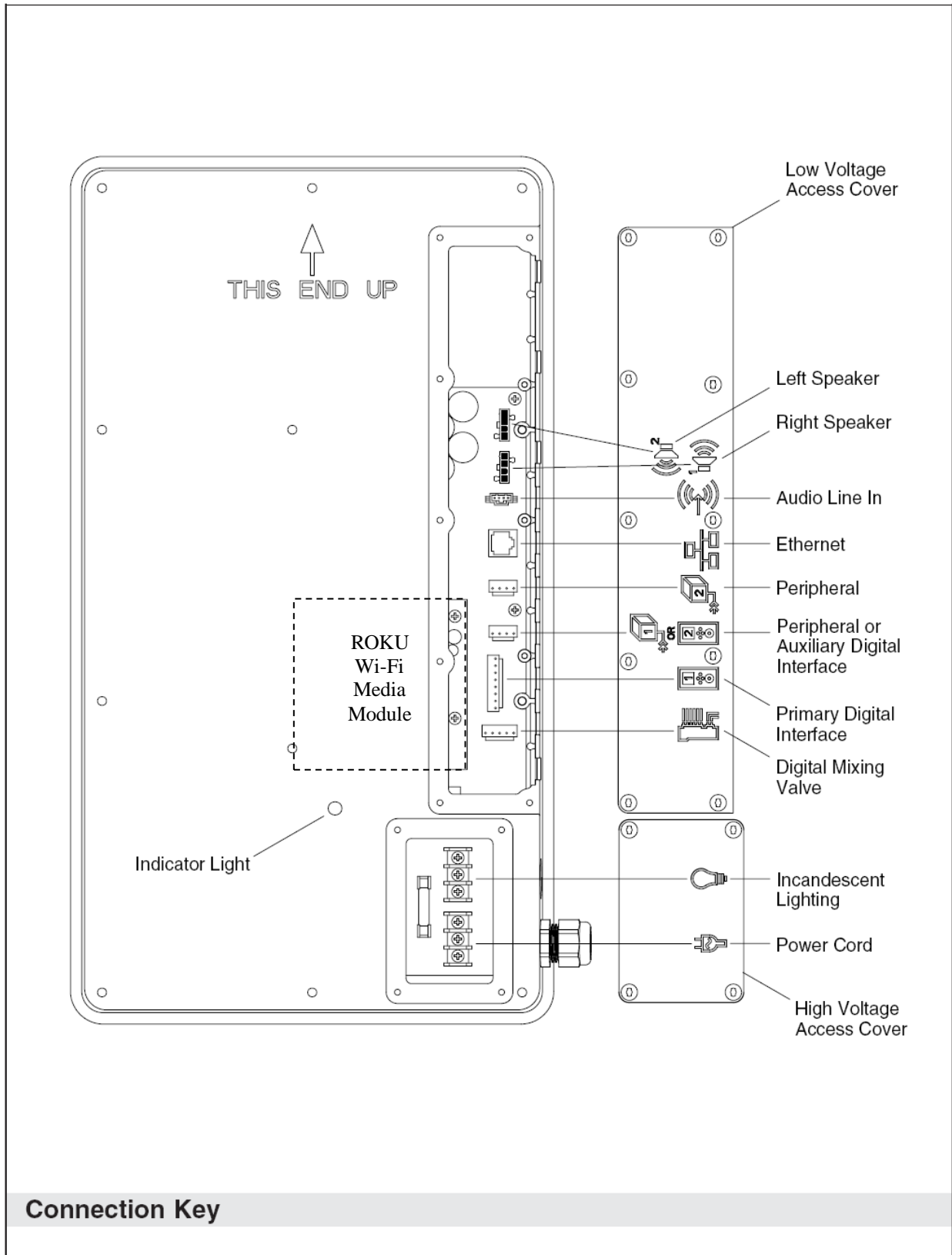


Figure 5. Diagram of Input/Output Ports for Media Module.

5.1 Radiated RF Emissions Setup

See Section 1.2.3. Figure 1 and Figure 2 depict the setup used during Radiated Emissions testing.

5.2 Power Line Conducted Emissions Setup



Figure 6. Overall Power Line Conducted Emissions Setup.

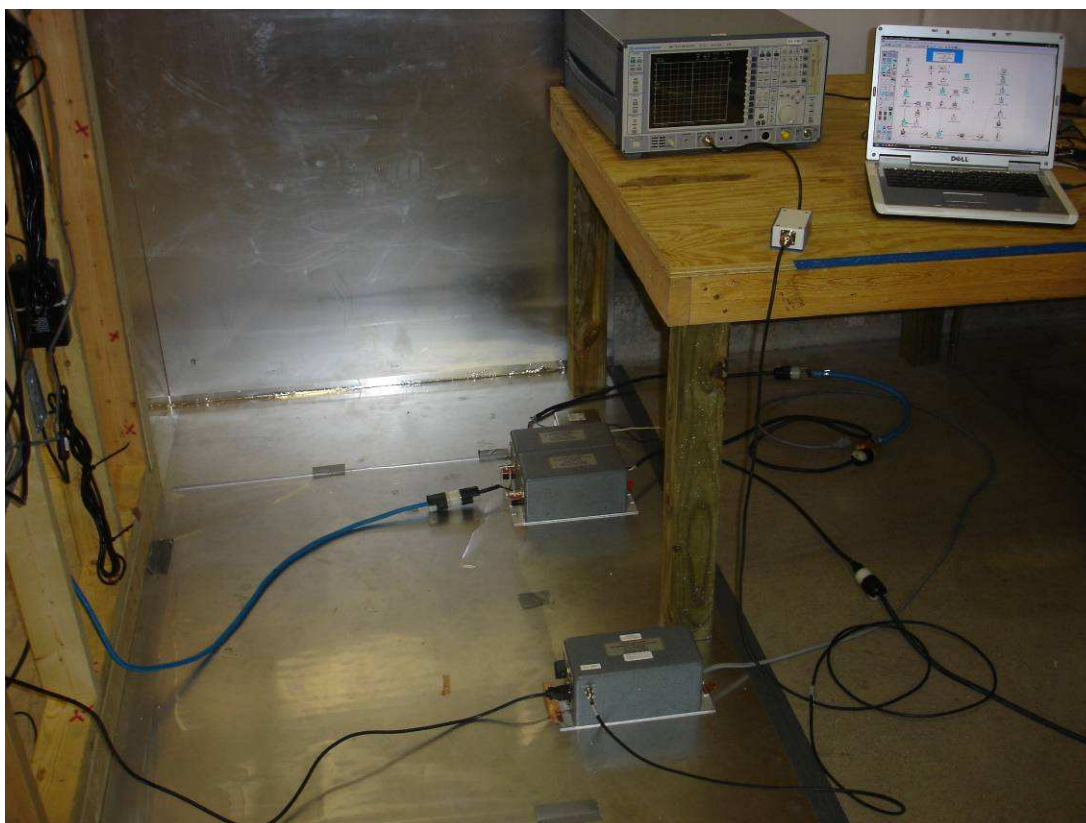


Figure 7. Measurement Section Close-up for Power Line Conducted Emissions Setup.

6.0 SUMMARY OF TESTS

Plots and tabular data are shown below. The data should support the TCB's decision to modify the grant of equipment authorization for the Limited Modular Approval of the Roku PCB Media Module and include the DTV™II Media Module (host).

6.1 Power Line Conducted Emissions – FCC Section 15.107 & 15.207

6.1.1 Test Methodology

Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz.

The EUT was tested in normal operation at 120Vac 60Hz with the following parameters configured: 1) Lights at 50% (populated with 250Watt capacity), 2) "Pink Noise at -20dbfs" mp3 file played from iTunes Server on nearby laptop (Wi-Fi used), 3) simulated steamer communicating and powered @ 218Vac 60Hz, 4) MP3 Player populated but not powered, 5) Ethernet cable left unpopulated to engage Wi-Fi, 6) Digital Thermostatic Valve communicating but valves not toggling. A similar mode was investigated with the module in receiver mode.

The laboratory environmental conditions were 19.4°C-21.0°C, 52%-55% R.H., and 101-102kPa.

The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss + Transient Limiter Loss
Margin (dB) = Applicable Limit - Corrected Reading

Results of the test are shown below in Table 5 through Table 6 and Figure 8 through Figure 9.

6.1.2 Test Results

ICL FCC & CISPR 22 Class B Conducted Emissions Line						
Operator: Daniel L. Berg Modes: RX, TX CE_FCC_and_CISPR22_CSM1_120Vac60Hz.TIL 09:39:32 AM, Wednesday, January 07, 2009						
Frequency (kHz)	QP Meas. (dBuV)	QP Limit (dBuV)	QP Margin (dB)	AVG Meas. (dBuV)	AVG Limit (dB)	AVG Margin (dB)
151.50	59.11	65.96	6.85	29.16	55.96	26.80
173.87	61.39	65.32	3.93	31.44	55.32	23.88
201.67	55.80	64.52	8.72	29.26	54.52	25.26
224.93	51.46	63.86	12.40	24.40	53.86	29.46
257.86	51.24	62.92	11.68	19.19	52.92	33.73
288.55	49.06	62.04	12.98	15.30	52.04	36.74
320.26	47.73	61.14	13.41	18.10	51.14	33.04
348.64	45.48	60.33	14.85	17.56	50.33	32.76
376.40	43.99	59.53	15.54	21.55	49.53	27.98
412.88	43.43	58.49	15.06	20.09	48.49	28.40
440.42	43.43	57.70	14.27	17.06	47.70	30.64
585.71	49.37	56.00	6.63	28.77	46.00	17.23

Table 5. Line Conducted EMI Results (Quasi-Peak and Average) @120Vac 60Hz

ICL FCC & CISPR 22 Class B Conducted Emissions Neutral						
Operator: Daniel L. Berg Modes: Rx, Tx CE_FCC_and_CISPR22_CSM1_120Vac60Hz.TIL 09:40:21 AM, Wednesday, January 07, 2009						
Frequency (kHz)	QP Meas. (dBuV)	QP Limit (dBuV)	QP Margin (dB)	AVG Meas. (dBuV)	AVG Limit (dB)	AVG Margin (dB)
151.50	58.73	65.96	7.23	27.63	55.96	28.33
175.60	59.38	65.27	5.88	31.58	55.27	23.69
197.68	56.78	64.64	7.86	33.06	54.64	21.58
227.22	52.05	63.79	11.74	23.05	53.79	30.75
255.15	50.83	63.00	12.16	18.61	53.00	34.39
281.73	47.00	62.24	15.24	17.28	52.24	34.96
321.57	47.20	61.10	13.90	17.28	51.10	33.82
348.64	45.51	60.33	14.81	18.05	50.33	32.27
374.81	44.02	59.58	15.56	18.33	49.58	31.24
396.95	41.33	58.94	17.61	21.39	48.94	27.55
406.41	43.19	58.67	15.48	18.56	48.67	30.12
440.13	42.95	57.71	14.76	20.47	47.71	27.24
591.76	47.11	56.00	8.90	24.46	46.00	21.54

Table 6. Neutral Conducted EMI Results (Quasi-Peak and Average) @120Vac 60Hz

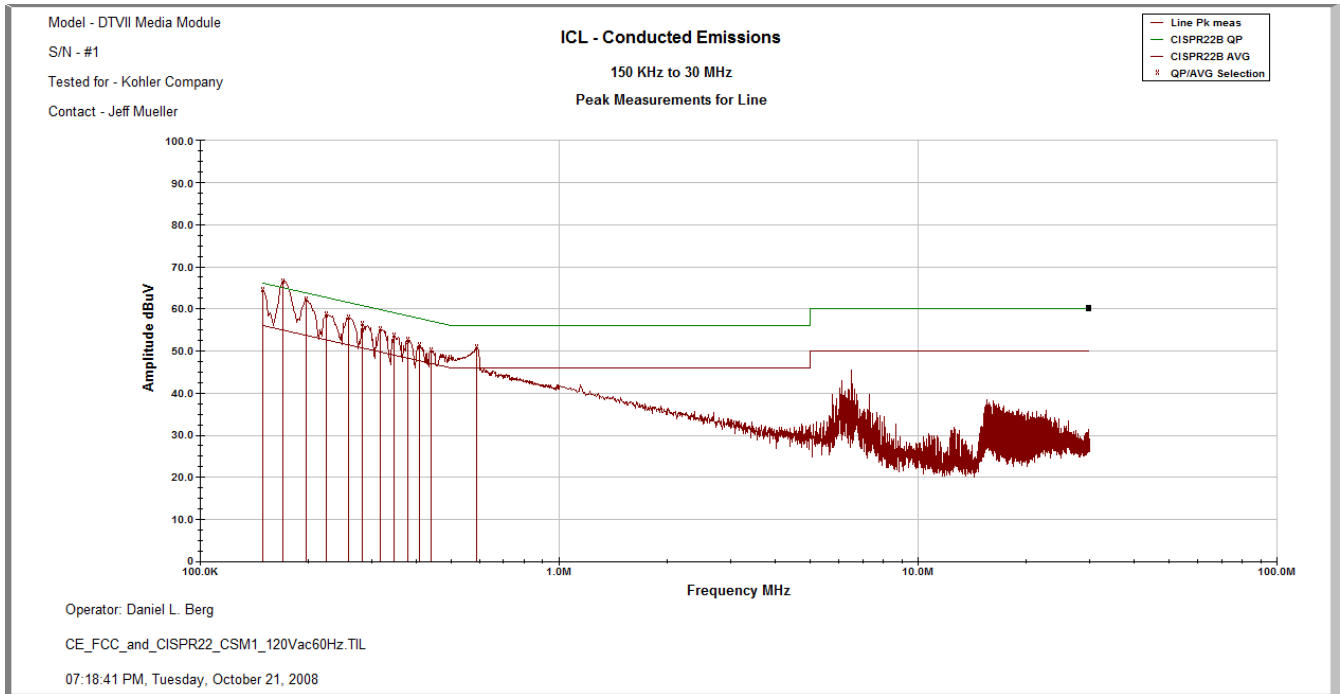


Figure 8. Conducted Emissions Graph – Line @120Vac 60Hz

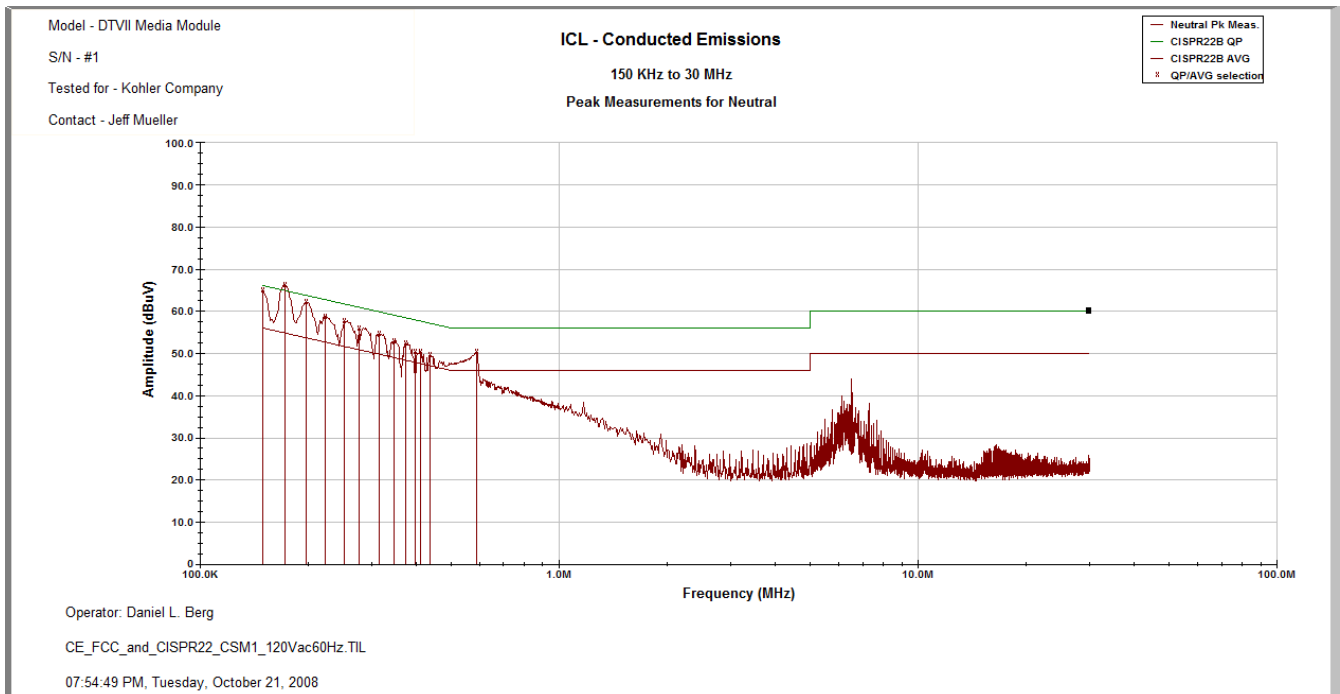


Figure 9. Conducted Emissions Graph – Neutral @120Vac 60Hz

6.1.3 Radiated Spurious Emissions (Restricted Bands) above 1GHz- FCC Section 15.205

6.1.3.1 Test Methodology

Radiated emissions tests were made over the frequency range of 1GHz to 26GHz, encompassing 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Peak and average detectors were used as needed. Peak measurements were made with RBW of 1MHz and VBW of 3 MHz. Average measurements (when applicable) were made with RBW of 1MHz and a VBW of 10Hz. Pulsed emissions subject to a limit requiring an average detector function were initially measured with a peak detector. This peak measurement was then corrected to a true average using the appropriate factor for emission duty cycle (per ANSI C63.4-2003 13.1.4.2). Exploratory measurements were conducted to ascertain worst case emissions as per procedures defined in ANSI C63.4-2003.

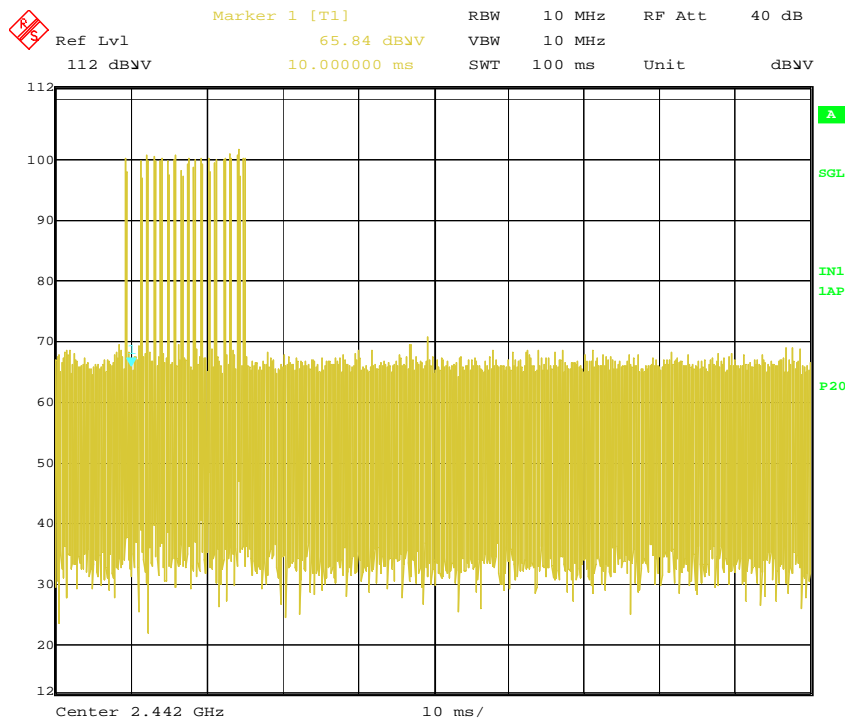
6.1.3.2 Duty Cycle Correction

For average limit comparisons in regard to pulsed radiated emissions, the peak measurement was reduced by a factor of -26.9dB to account for the duty cycle of the EUT. The duty cycle correction factor was determined using the formula below and methods detailed in ANSI C63.4 Appendix H.4 part j). The transmitter duty cycle was maximized as much as possible during normal operation and did not exceed 100ms. An oscilloscope was not used but the video trigger on the EMI Receiver was utilized.

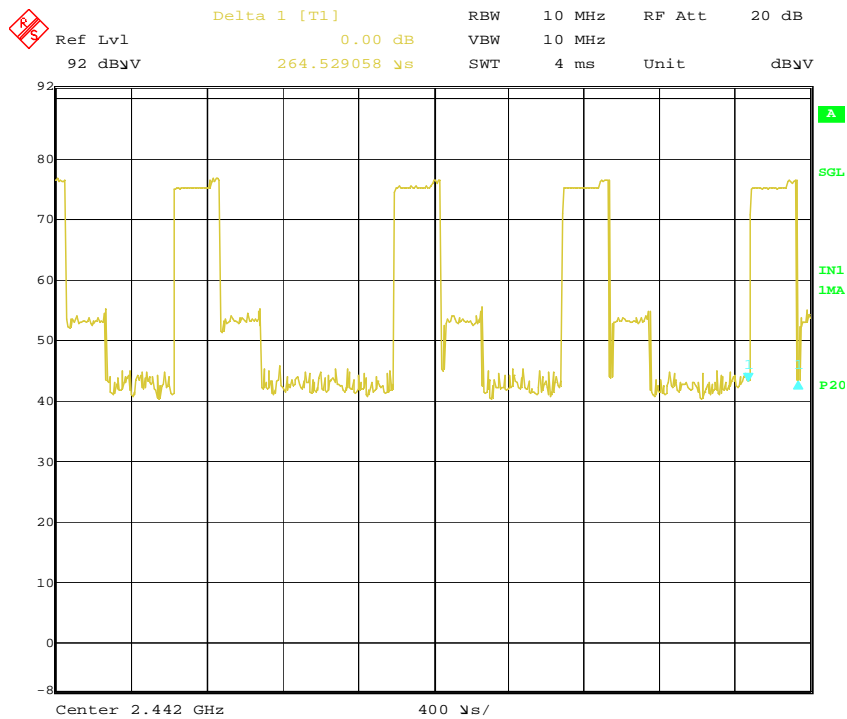
The duty cycle correction formula with measured data is as follows:

$$20 \times \text{Log} \left(\frac{\text{NumberOfPulses} \times \text{PulseWidth}(ms)}{100ms} \right) = 20 \times \text{Log} \left(\frac{17 \times 0.265ms}{100ms} \right) = -26.9dB$$

Plots supporting the calculation above are included below in Figure 10 and Figure 11.



Date: 14.OCT.2008 13:04:25
Figure 10. Duty Cycle Correction Data – Worse Case Number of Pulses



Date: 14.OCT.2008 16:36:21
Figure 11. Duty Cycle Correction Data – Worse Case Pulse Width (μs)

6.1.3.3 Test Results

Using the procedures set forth in the FCC publication “New Guidance on Measurements for Digital Transmission Systems in Section 15.247”, radiated spurious emissions found in the band of 1GHz to 26GHz are reported in Table 7 through Table 9. Each emission found to be in a restricted band as defined by section 15.205, was compared to the radiated emission limits as defined in section 15.209. The highest spurious emissions not in a restricted band are also detailed below. Worst-case band-edge and fundamental measurements are also included.

Freq. (GHz)	Level (dBuV)	Antenna Polarity (H/V)	Correction Factors (dB)		Corrected Level (dBuV/m)		Limit 15.209(a) (dBuV/m)		Margin(dB)		Restricted Band? (Y/N)
			Pk	Av	Pk	Av	Pk	Av	Pk	Av	
2.3824 ^{ab}	57.94	H	1.76	-25.14	59.70	32.80	74	54	14.30	21.20	Y
2.3860 ^{ab}	60.61	V	1.78	-25.12	62.39	35.49	74	54	11.61	18.51	Y
4.8257 ^a	108.66	H	-46.21	-73.11	62.45	35.55	74	54	11.55	18.45	Y
7.2365 ^a	98.84	H	-39.33	-66.24	59.50	32.60	^c	^c	^c	^c	N
9.6473 ^a	91.60	H	-36.08	-62.98	55.52	28.62	^c	^c	^c	^c	N
4.8297 ^a	108.98	V	-46.19	-73.09	62.79	35.89	74	54	11.21	18.11	Y
9.6472 ^a	94.74	V	-36.08	-62.97	58.67	31.77	^c	^c	^c	^c	N
14.4729 ^a	89.89	V	-23.43	-50.33	66.46	39.56	74	54	7.54	14.44	Y

Table 7. Radiated Spurious Emissions Channel 1 (2.412 GHz).

Freq. (GHz)	Level (dBuV)	Antenna Polarity (H/V)	Correction Factors (dB)		Corrected Level (dBuV/m)		Limit 15.209(a) (dBuV/m)		Margin(dB)		Restricted Band? (Y/N)
			Pk	Av	Pk	Av	Pk	Av	Pk	Av	
4.8737 ^a	108.98	H	-46.00	-72.90	62.98	36.08	74	54	11.02	17.92	Y
7.3106 ^a	96.04	H	-39.06	-65.97	56.97	30.07	74	54	17.03	23.93	Y
9.7495 ^a	90.54	H	-35.91	-62.80	54.64	27.74	^c	^c	^c	^c	N
4.8697 ^a	109.09	V	-46.02	-72.92	63.07	36.17	74	54	10.93	17.83	Y
9.7495 ^a	90.60	V	-35.91	-62.81	54.69	27.79	^c	^c	^c	^c	N
14.6212 ^a	85.52	V	-23.82	-50.72	61.70	34.80	^c	^c	^c	^c	N

Table 8. Radiated Spurious Emissions Channel 6 (2.437 GHz).

^a Harmonic of Fundamental and Pulsed Emission - Duty Cycle Correction Applies.

^b Worst case emission found in restricted band.

^c The transmitter complies with conducted power limits in bands outside operational frequencies (20dB < max peak power). Radiated measurements then are not applicable to 15.209(a) radiated limits in non-restricted bands. Spurious Emissions are reported however, in accordance with ANSI C63.4 Appendix H.4(n).

Freq. (GHz)	Level (dBuV)	Antenna Polarity (H/V)	Correction Factors (dB)		Corrected Level (dBuV/m)		Limit 15.209(a) (dBuV/m)		Margin(dB)		Restricted Band? (Y/N)
			Pk	Av	Pk	Av	Pk	Av	Pk	Av	
2.4843 ^{ab}	65.70	H	2.15	-24.75	67.85	40.95	74	54	6.15	13.05	Y
2.3860 ^{ab}	62.94	V	2.17	-24.73	65.11	38.21	74	54	8.89	15.79	Y
4.9259 ^a	108.76	H	-45.78	-72.68	62.98	36.08	74	54	11.02	17.92	Y
9.8497 ^a	90.60	H	-35.71	-62.61	54.89	27.99	c	c	c	c	N
4.9218 ^a	109.06	V	-45.80	-72.70	63.26	36.36	74	54	10.74	17.64	Y
9.8477 ^a	90.94	V	-35.72	-62.62	55.22	28.32	c	c	c	c	N
14.7715 ^a	80.00	V	-24.15	-51.05	55.85	28.95	c	c	c	c	N

Table 9. Radiated Spurious Emissions Channel 11 (2.462 GHz).

6.1.3.4 Sample Calculation:

$$R_c = R_u + CF_T$$

Where:

R_c = Corrected Level

R_u = Uncorrected Reading

CF_T = Total Correction Factor (AF+CA+AG+HFA)+DC(for Pulsed Emissions Harmonics Only)

AF = Antenna Factor

CA = Cable Attenuation

AG = Amplifier Gain

HFA = High-Pass Filter Attenuation

DC = Duty Cycle Correction Factor

Example Calculation: Peak

$$\text{Corrected Level } (R_c) = 109.02 (R_u) - 46.23 (CF_T) = 62.79 \text{ dBuV/m}$$

$$CF_T = 33.71 (AF) + -24.58 (CA) + -55.67(AG) + 0.31(HFA) = -46.23$$

$$\text{Margin: } 74\text{dBuV/m} - 62.79 \text{ dBuV/m} = 11.21 \text{ dB}$$

Example Calculation: Average (for pulsed harmonic of fundamental)

$$\text{Corrected Level: } 109.02 (R_u) - 73.13 (DC) = 35.89\text{dBuV/m}$$

$$CF_T = 33.71 (AF) + -24.58 (CA) + -55.67(AG) + 0.31(HFA) + -26.9\text{dB} (DC) = -73.13$$

$$\text{Margin: } 54\text{dBuV/m} - 35.89\text{dBuV/m} = 18.11 \text{ dB}$$

6.1.4 Radiated Spurious Emissions (Restricted Bands) below 1GHz- FCC Section 15.205

6.1.4.1 Test Methodology

Radiated emissions tests were made over the frequency range of 30MHz to 1GHz.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Peak and Quasi-peak measurements were made using a resolution bandwidth RBW of 120kHz and a video bandwidth VBW of 300kHz. Exploratory measurements were conducted to ascertain worst case emissions as per procedures defined in ANSI C63.4-2003.

6.1.4.2 Test Results

Using the procedures set forth in the ANSI C63.4-2003, radiated spurious emissions found in the band of 30MHz to 1GHz are reported in Table 10. Plots of the spectrum are shown in Figure 12 and Figure 13. Each emission found to be in a restricted band as defined by section 15.205, was compared to the radiated emission limits as defined in section 15.209. In evaluation of Channels 1, 6, and 11, Channel 6 had the “worst” or highest radiated emissions. All worst-case spurious emissions not in a restricted band are also detailed below.

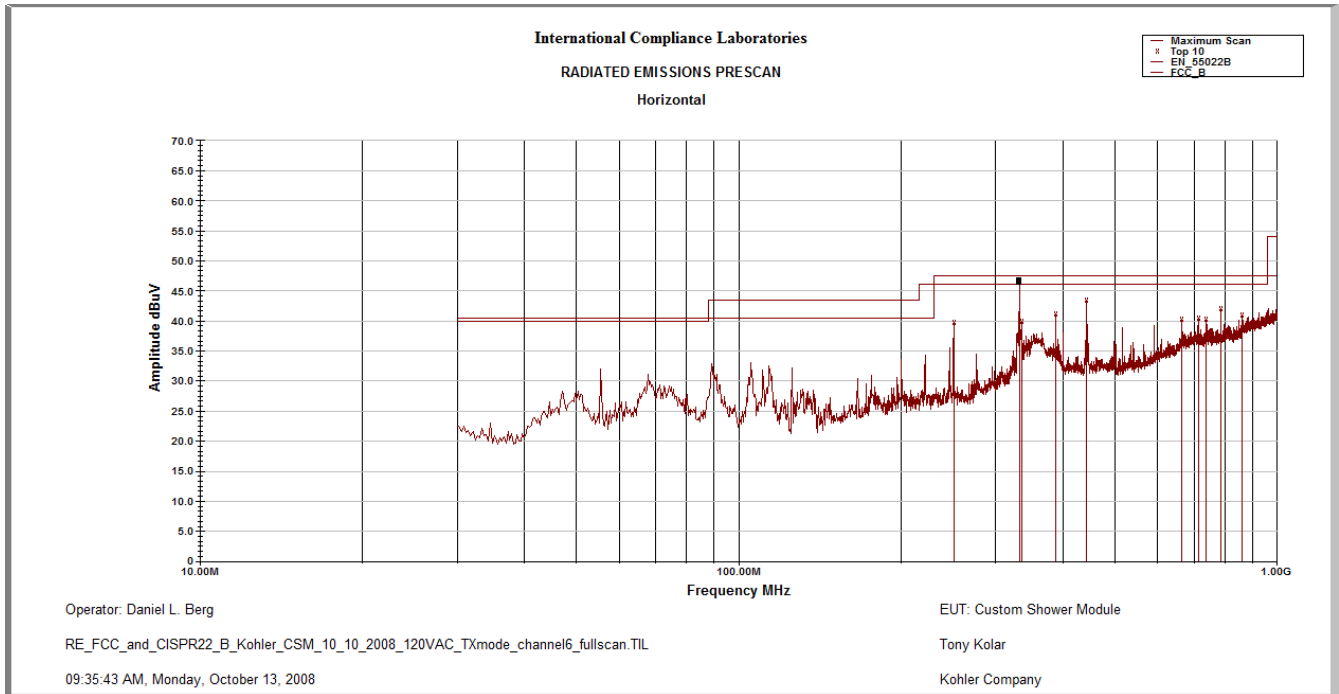


Figure 12. Radiated Emissions 30MHz-1GHz. Horizontal Antenna Polarization. Channel 6.

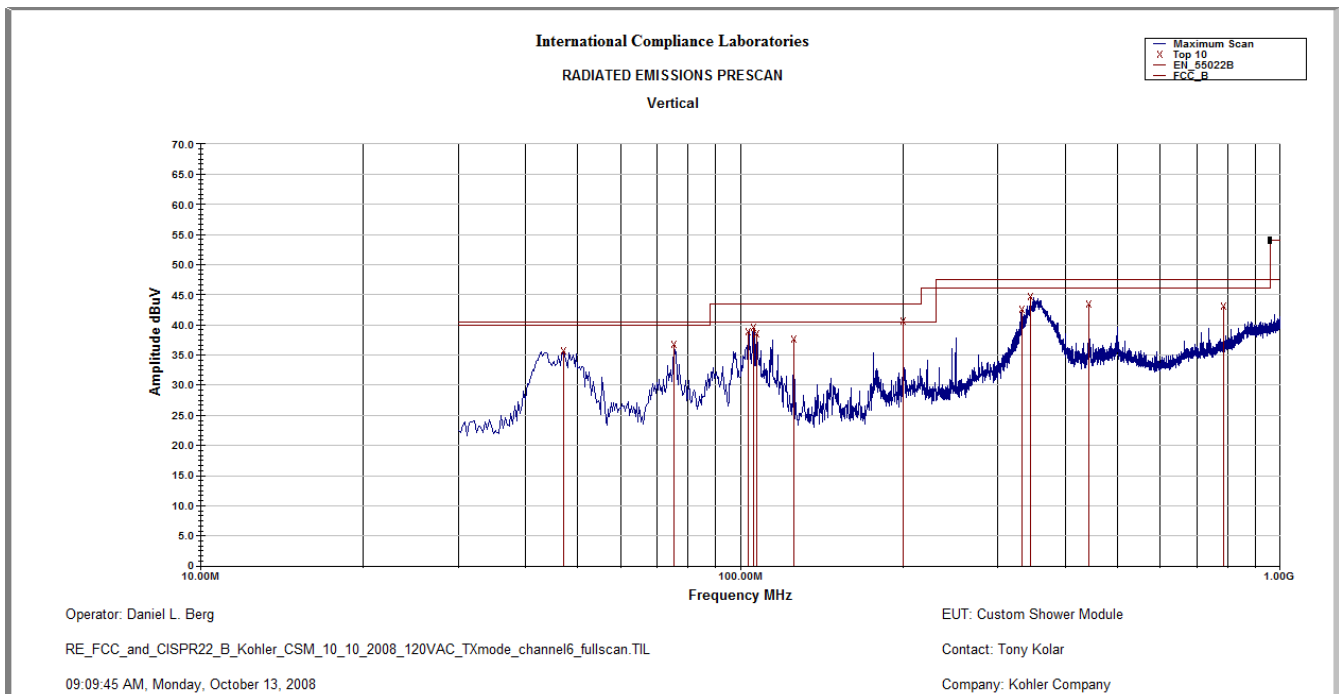


Figure 13. Radiated Emissions 30MHz-1GHz. Vertical Antenna Polarization. Channel 6.

Freq. (MHz)	Level (dBuV)	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)	Limit 15.209(a) (dBuV/m)	Margin (dB)	Restricted Band? (Y/N)
			QP	QP	QP		
249.99	24.85	H	14.21	39.06	46.02	6.96	Y
331.79	27.82	H	17.49	45.31	46.02	0.71	Y
334.98	19.15	H	17.59	36.74	46.02	9.28	Y
387.09	19.93	H	18.74	38.67	46.02*	7.35**	N
442.36	22.43	H	19.58	42.01	46.02*	4.01**	N
663.53	11.94	H	24.77	36.71	46.02*	9.31**	N
712.63	5.38	H	25.70	31.08	46.02*	14.94**	N
737.27	11.73	H	25.49	37.22	46.02*	8.80**	N
786.40	13.54	H	26.16	39.70	46.02*	6.32**	N
860.11	8.32	H	27.03	35.35	46.02*	10.67**	N
47.03	23.66	V	6.63	30.29	40.00*	69.71	N
75.20	20.54	V	9.58	30.12	40.00	9.88	Y
103.03	20.85	V	10.07	30.92	43.52*	12.60**	N
105.02	26.43	V	9.84	36.27	43.52*	7.25**	N
106.68	22.66	V	9.64	32.30	43.52*	11.22**	N
124.99	27.62	V	8.56	36.18	43.52	7.34	Y
199.99	27.17	V	11.99	39.16	43.52*	4.36**	N
331.8	20.85	V	16.93	37.78	46.02	8.24	Y
343.97	23.70	V	17.32	41.02	46.02*	5.00**	N
442.36	22.53	V	19.59	42.12	46.02*	3.90**	N
786.41	14.84	V	25.58	40.42	46.02*	5.60**	N

* Unintentional radiator limit for digital devices (15.109).

** Margin to unintentional radiator limit.

Table 10. Quasi-Peak Data for Spurious Radiated Emissions Below 1GHz.

7.0 CONCLUSION

It was found that the Roku PCB Media Module installed in the Kohler DTV II™ Media Module host, Model# K-638-K, **meets** the emission requirements (both conducted and radiated) of the FCC CFR47, Part 15, Subpart C, Section 15.247 for operating within the 2400-2483.5 MHz Band.