Excellence in Compliance Solutions

Certification Test Report

FCC ID: 2AELXM500
IC: 20120-M500

FCC Rule Part: 15.247
IC Radio Standards Specification: RSS-247

ACS Report Number: 15-3002.W06.1C

Manufacturer: SmallHD, LLC
Models: M501, M502

Test Begin Date: April 13, 2015
Test End Date: July 9, 2015

Report Issue Date: July 31, 2015

ANAB ACCREDITED ISO/IEC 17025 TESTING LABORATORY

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code AT-1921

This report must not be used by the client to claim product certification, approval, or endorsement by ANAB, ANSI, or any agency of the Federal Government.

Reviewed by:

M. R de Aranzeta

Mario de Aranzeta
Lab Manager Durham (RTP)
ACS Inc.

This report contains 20 pages

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1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification RSS-247 Certification.

1.2 Product Description

Cameratop monitor used for displaying captured images via HDMI or SDI input. Includes confidence tools for exposure, framing, and focus. 1920x1080p IPS LCD display in rubberized aluminum chassis with plastic front bezel and back battery plate.

Technical Information:

Detail	Description
Frequency Range	2402 to 2480 MHz
Number of Channels	3 advertising and 37 data
Modulation Format	GFSK (F1D)
Data Rates	To 1 Mbps
Number of Inputs/Outputs	1 RF output to an integral antenna
Operating Voltage	12 Vdc
Antenna Type / Gain	Ceramic chip 1.3 dBi Peak

Manufacturer Information:
SmallHD, LLC
118 MacKenan Drive
Cary, NC 27511

EUT Serial Numbers: N/A

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

The EUT is normally a battery operated handheld device, therefore, AC power line conducted emissions testing was not performed. There is a DC to DC adapter option for the device but again no AC mains capability.

The TX power was set to the highest power setting which is fixed in firmware and is not accessible by the customer and is also the highest power level possible by the radio IC manufacturer.

Several data rates were investigated and the worst case used for final testing.

Scrolling H's were sent from a Apple MacBook via the HDMI cable to the EUT.

The manufacturer provided test software to select the different individual channels and to select different data rates.

The Series 501 variant is a direct sub-set of the Series 502 monitor design. The same printed circuit board design is used in both the 501 and 502 variants. The physical differences between the two variants are that the 501 variant does not include:
1. The PCBA components to support the SDI video format, both input and output,
2. The external BNC connectors are eliminated.

The functional differences between the Series 501 variant and the Series 502 are that the 501 variant does not support:
1. SDI serial video input or output,
2. Video signal conversion from HDMI-to-SDI, or SDI-to-HDMI.

All other features and functions of the 501 are available in the 502 and were tested during 502 certification.

Since the product can be handheld both a X and Y orientation of the product was prescanned and the standup Y orientation was determined to be the worst case and used for all testing.

2 TEST FACILITIES

2.1 Location

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

Advanced Compliance Solutions
2320 Presidential Drive, Suite 101
Durham, NC 27703
Phone: (919) 381-4235

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by ANSI-ASQ National Accreditation Board under their ANAB program and has been issued certificate number AT-1921 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 18' x 28' x 18' shielded enclosure. The chamber is lined with Samwha Electronics Co. LTD Ferrite Absorber, model number SFA300 (HSN-1). The ferrite tile is 10cm x 10 cm and weighs approximately 1.4lbs. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber. On top of the ferrite tiles is DMAS HT-45 (Dutch Microwave Absorber Solutions) hybrid absorber on all walls except the wall behind the antenna mast which has a shorter DMAS HT-25 absorber.

The turntable is 1.50m in diameter and is located 150cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using short #6 copper wire. The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the turntable. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane.

Behind the turntable is a 2' x 6' x 1.5' deep shielded pit used for support equipment if necessary. The pit is equipped with 2 - 4" PVC chase from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

To comply with the requirements of the test methods given on page 4, RF absorbing foam was placed inside the chamber in a configuration that provided the best results. First, a 12ft X 12ft. patch of 10" tall absorber was placed on the floor between the turntable and the receiving antenna. This absorber meets the absorption requirements specified in ANSI C63.4:2009.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

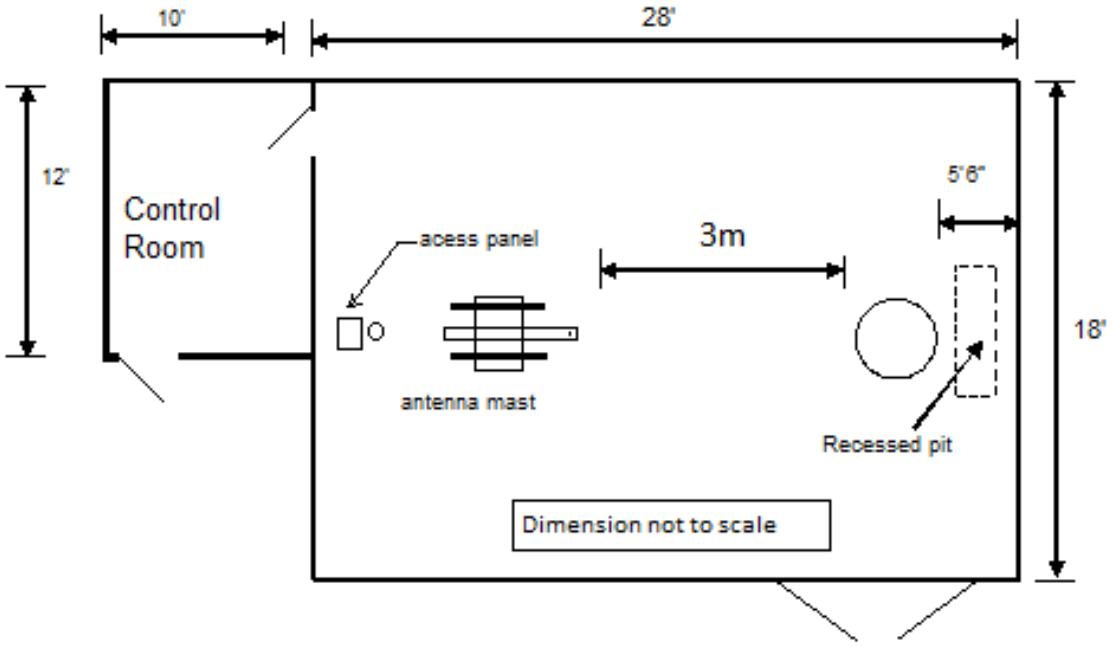

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 10' sheet galvanized steel horizontal ground reference plane (GRP) bonded every 6" to an 8' X 8' aluminum vertical ground plane.

A diagram of the room is shown below in figure 2.4-1:

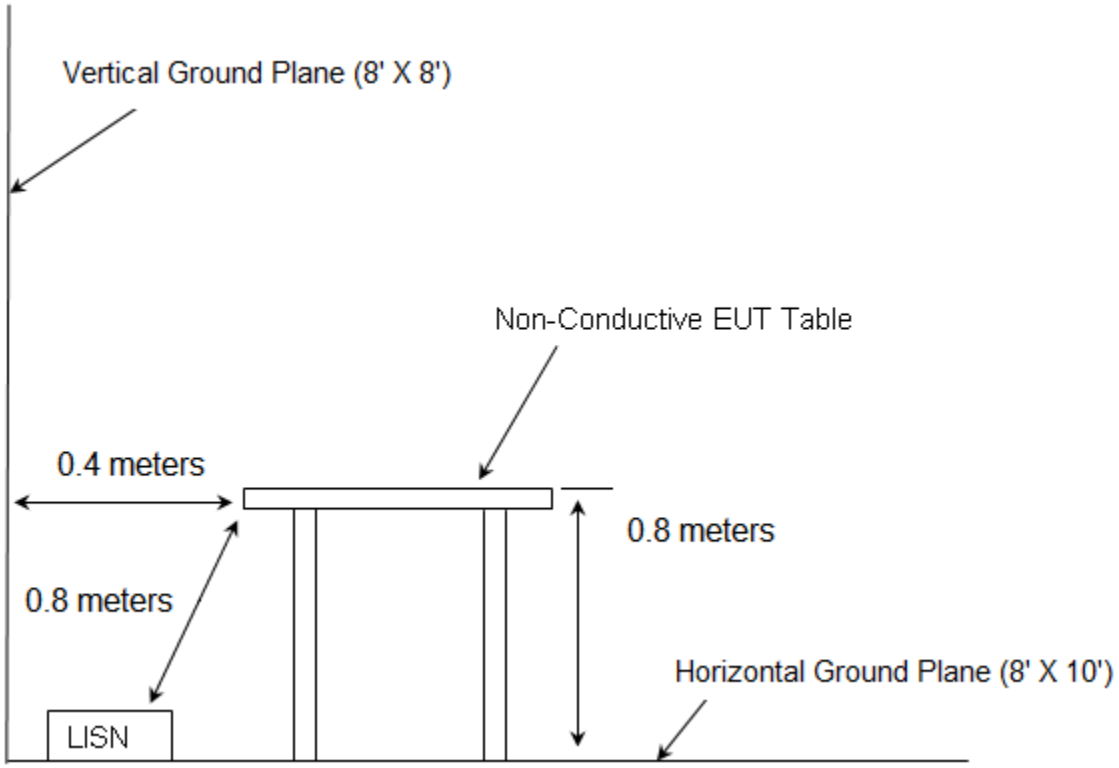

Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices *
- ANSI C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2015
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2015
- FCC KDB 558074 D01 DTS Meas Guidance v03r03 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, June 9, 2015
- Industry Canada Radio Standards Specification: RSS-247, Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 1, May 2015
- Industry Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, Nov 2014

* For Industry Canada reference only.

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
3002	Rohde & Schwarz	ESU40	Receiver	100346	7/25/2014	7/25/2015
3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	1/12/2015	1/12/2016
3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	1/12/2015	1/12/2016
3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antennas	2013120203	1/14/2015	1/14/2016
3057	Advanced Technical Materials	42-441-6/BR	Antennas	R110602	NCR	NCR
626	EMCO	3110B	Antennas	9411-1945	2/26/2014	2/26/2016
277	Emco	93146	Antennas	9904-5199	9/2/2014	9/2/2016
3006	Rohde & Schwarz	TS-PR18	Amplifiers	122006	7/24/2014	7/24/2015
3007	Rohde & Schwarz	TS-PR26	Amplifiers	100051	7/14/2014	7/14/2015
3054	Mountain View Cable	BMS-RG400-36.0-BMS	Cables	3054	1/12/2015	1/12/2016
3020	Rohde & Schwarz	SMB100A	Signal Generators	175943	7/24/2014	7/24/2015
3008	Rohde & Schwarz	NRP2	Meter	103131	1/15/2015	1/15/2016
3009	Rohde & Schwarz	NRP-Z81	Meter	102397	1/15/2015	1/15/2016
3046	Aeroflex Inmet	26AH-10	Attenuator	1443	1/15/2015	1/15/2016
3033	Hasco, Inc.	HLL142-S1-S1-36	Cables	1435	1/15/2015	1/15/2016
3034	Hasco, Inc.	HLL142-S1-S1-12	Cables	3076	1/18/2015	1/18/2016
3012	Rohde & Schwarz	EMC32-EB	Software	100731	1/19/2015	7/19/2016

NCR = No Calibration Required
Firmware Version: ESU40 is 4.73 SP1
Software Version: EMC32-B is 9.15

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	Monitor (EUT)	SmallHD, LLC	M501, M502	N/A
2	Power Supply DC	Sorenson	QRD 20-4	N/A
3	MacBook Pro	Apple	Retina	N/A
4	Power Adapter	Apple	Mag Safe 2	N/A

Notes:

1. Item 1 above was used to resistively terminate the SDI cable and was not powered.

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

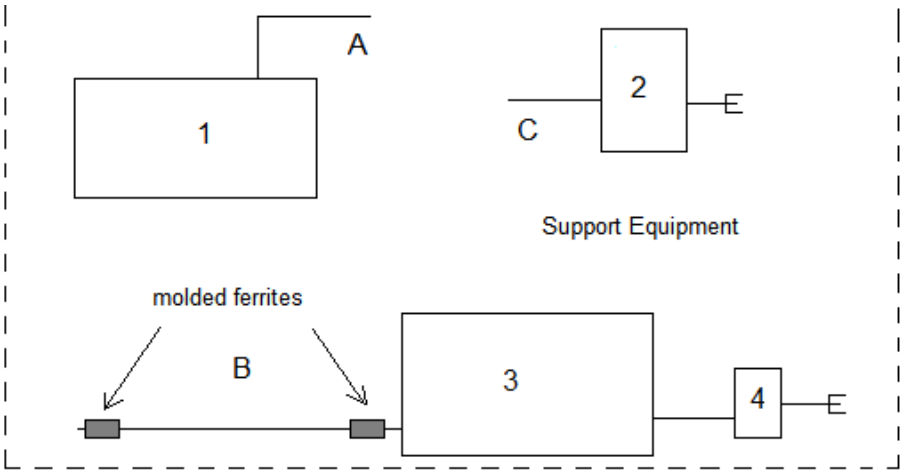

Figure 6-1: Test Setup Support Equipment Block Diagram

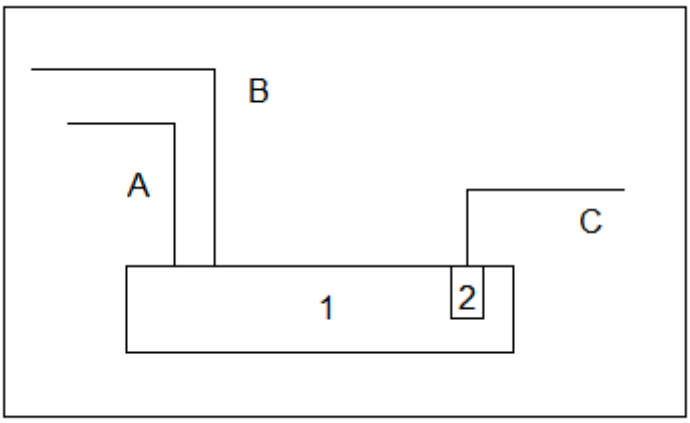

Figure 6-2: EUT Test Setup Block Diagram

Table 6-1: EUT Description

Item #	Type Device	Manufacturer or Responsible Party	Model/Part #	Serial #
1	Monitor (EUT)	SmallHD, LLC	M501, M502	N/A
2	Power Adapter (EUT)	SmallHD, LLC	PWR-ADP-DCA5	N/A

Table 6-2: Cable Description – Radiated Emissions

Cable #	Cable Type	Length	Shield	Termination
A	SDI Cable L5-CFB Same cable as item 2 in table 5.1	3.6 m	Yes	EUT to M502 monitor
B	HDMI Cable 3662	3.04 m	Yes	EUT to Apple MacBook Pro
C	DC Adapter cable	3.04m	No	Adapter to power supply

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC 15.203

The antenna is integral to the device and cannot be removed or replaced by the end user. The peak gain of the antenna is 1.3 dBi.

7.2 Power Line Conducted Emissions – FCC 15.207, IC: RSS-Gen 8.8

The EUT is a battery operated handheld device therefore AC power line conducted emissions testing was not performed. There is a DC to DC adapter option for the device but again no AC mains capability.

7.3 6dB / 99% Bandwidth – FCC 15.247(a)(2), IC: RSS-247 5.2(1)

7.3.1 Measurement Procedure

The 6dB bandwidth was measured in accordance with the FCC KDB 558074 D01 DTS Meas Guidance v03r03. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 3 times the RBW. The trace was set to max hold with a peak detector active. The marker-delta function of the spectrum analyzer was utilized to determine the 6 dB bandwidth of the emission.

The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The resolution bandwidth was set to 1% to 5% of the occupied bandwidth. The video bandwidth was set to 3 times the resolution bandwidth.

7.3.2 Measurement Results

Table 7.3.2-1: 6dB / 99% Bandwidth

Frequency [MHz]	6dB Bandwidth [MHz]	99% Bandwidth [MHz]
2402	0.569	1.050
2440	0.545	1.050
2480	0.505	1.034

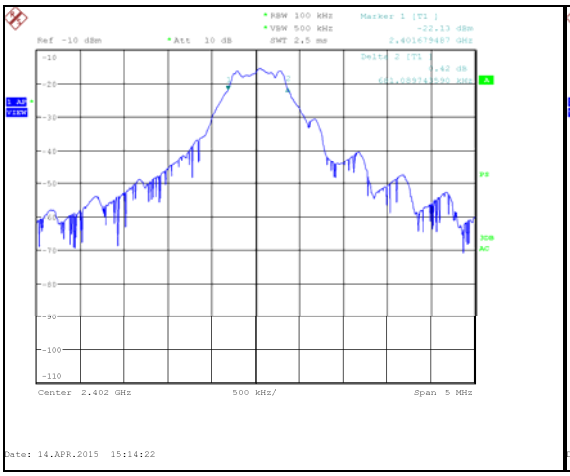

Figure 7.3.2-1: 6dB Bandwidth Low Channel

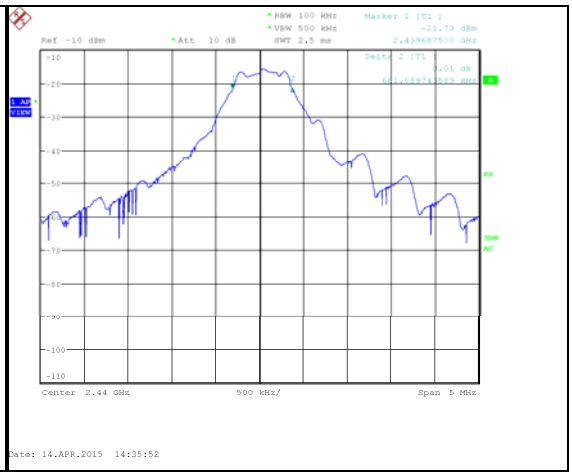

Figure 7.3.2-2: 6dB Bandwidth Mid Channel

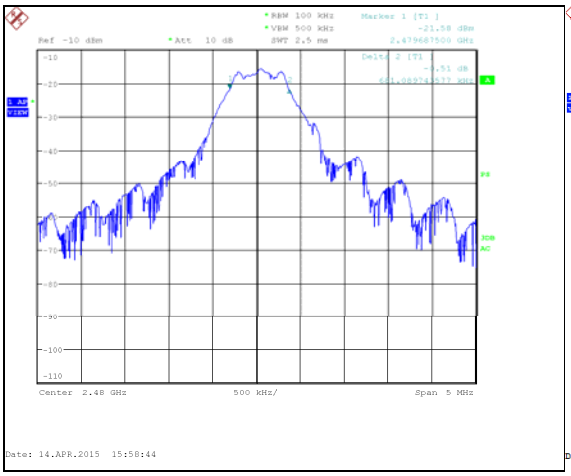

Figure 7.3.2-3: 6dB Bandwidth High Channel

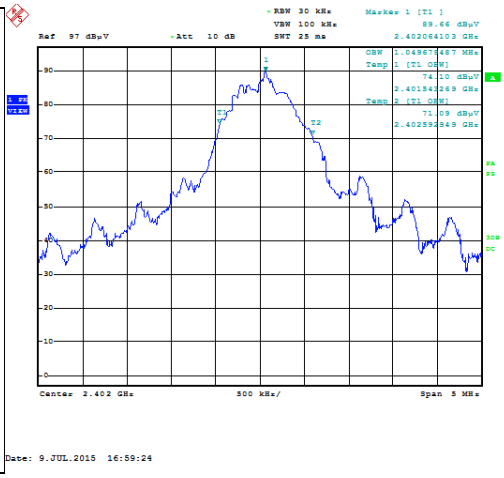

Figure 7.3.2-4: 99% Bandwidth Low Channel

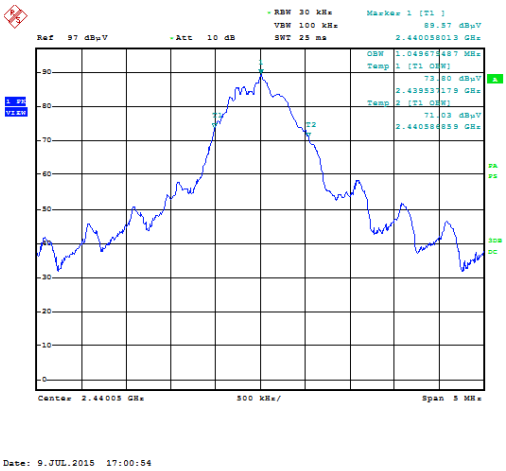

Figure 7.3.2-5: 99% Bandwidth Mid Channel

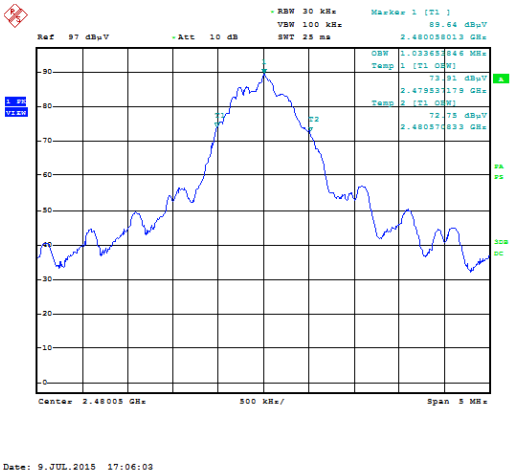

Figure 7.3.2-6: 99% Bandwidth High Channel

7.4 Fundamental Emission Output Power – FCC 15.247(b)(3), IC: RSS-247 5.4(4)

7.4.1 Measurement Procedure

The maximum peak conducted output power was measured in accordance with FCC KDB 558074 D01 DTS Measurement Guidance v03r03 utilizing the PKPM1 Peak power meter method. The RF output of the equipment under test was directly connected to the input of the peak power meter applying suitable attenuation.

7.4.2 Measurement Results

Table 7.4.2-1: Maximum Peak Conducted Output Power

Frequency (MHz)	Output Power (dBm)
2402	4
2440	3.6
2480	3

7.5 Emission Levels – FCC 15.247(d), 15.205, 15.209; IC RSS-247 5.5, RSS-Gen 8.9/8.10

7.5.1 Emissions into Non-restricted Frequency Bands

7.5.1.1 Measurement Procedure

The unwanted emissions into non-restricted bands were measured conducted in accordance with FCC KDB 558074 D01 DTS Measurement Guidance v03r03. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 300 kHz. Span was set to 1.5 times the DTS bandwidth. The trace was set to max hold with a peak detector active. The resulting spectrum analyzer peak level was used to determine the reference level with respect to the 20 dBc limit. The spectrum span was then adjusted for the measurement of spurious emissions from 30 MHz to 25GHz, 10 times the highest fundamental frequency. Additionally a prescan was performed from 9 kHz or the lowest frequency generated to 30 MHz.

7.5.1.2 Measurement Results

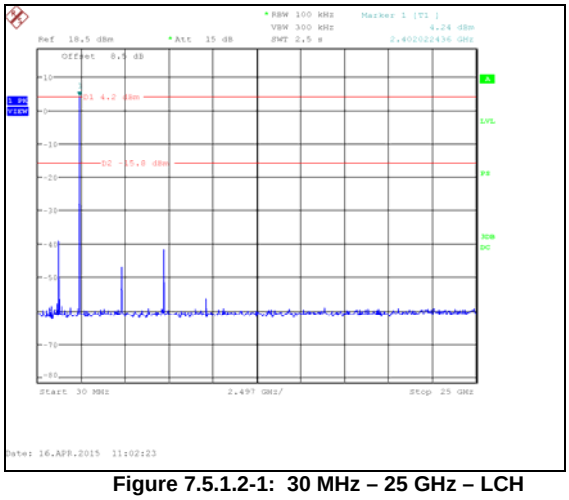

Figure 7.5.1.2-1: 30 MHz – 25 GHz – LCH

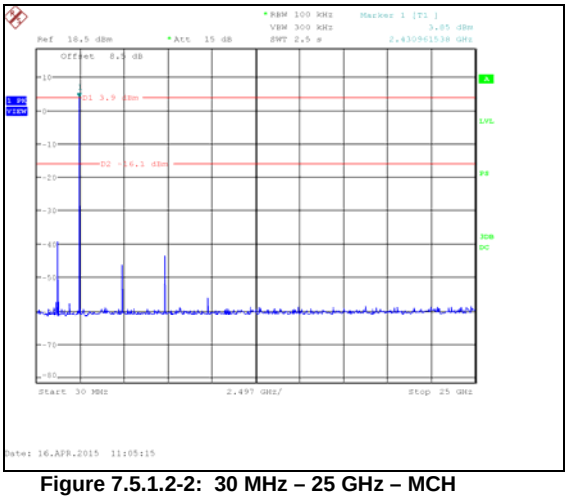

Figure 7.5.1.2-2: 30 MHz – 25 GHz – MCH

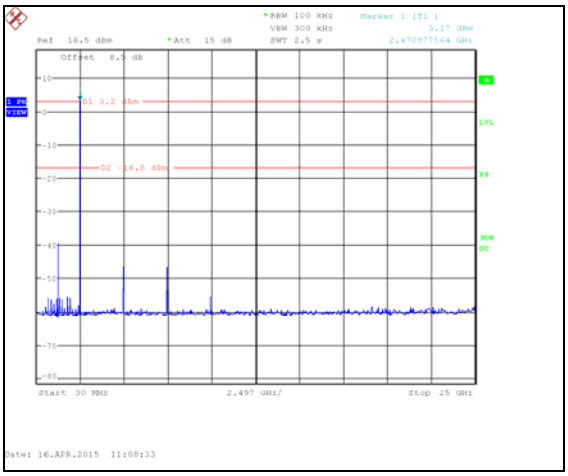

Figure 7.5.1.2-3: 30 MHz – 25 GHz – HCH

There were no significant emissions from 9 kHz or the lowest frequency generated to 30 MHz.

Band-edge compliance was determined using the conducted marker-delta method in which the radio frequency power that is produced by the EUT is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power.

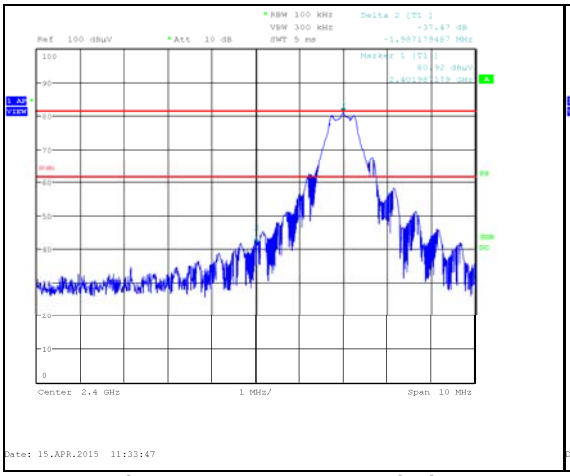

Figure 7.5.1.2-4: Lower Band-edge - LCH

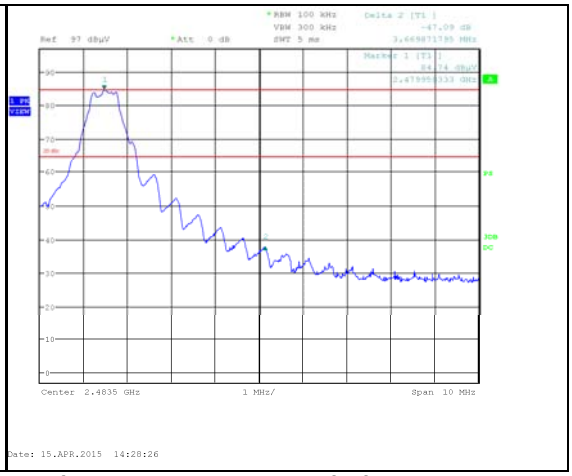

Figure 7.5.1.2-5: Upper Band-edge - HCH

7.5.2 Emissions into Restricted Frequency Bands

7.5.2.1 Measurement Procedure

The unwanted emissions into restricted bands were measured radiated over the frequency range of 30MHz to 25GHz, 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. For frequencies below 1000MHz, quasi-peak measurements were made using a RBW of 120 kHz and a VBW of 300 kHz. For frequencies above 1000MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz respectively.

Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209.

7.5.2.2 Duty Cycle Correction

The Duty Cycle Correction was not required.

7.5.2.3 Measurement Results

Table 7.5.2.3-1: Radiated Spurious Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
4804	44.30	35.30	H	5.44	49.74	40.74	74.0	54.0	24.3	13.3
4804	46.50	38.00	V	5.44	51.94	43.44	74.0	54.0	22.1	10.6
Mid Channel										
4880	42.40	32.80	H	5.32	47.72	38.12	74.0	54.0	26.3	15.9
4880	43.60	34.70	V	5.32	48.92	40.02	74.0	54.0	25.1	14.0
7320	43.70	32.20	H	9.81	53.51	42.01	74.0	54.0	20.5	12.0
7320	43.20	32.50	V	9.81	53.01	42.31	74.0	54.0	21.0	11.7
High Channel										
2483.50	40.35	---	V	-1.94	38.41	---	54.0	---	17.54	---
4960	41.00	30.00	H	5.19	46.19	35.19	74.0	54.0	27.8	18.8
4960	42.40	32.20	V	5.19	47.59	37.39	74.0	54.0	26.4	16.6
7440	39.20	27.00	V	10.20	49.40	37.20	74.0	54.0	24.6	16.8

7.5.2.4 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation: Peak

Corrected Level: 44.30 + 5.44 = 49.74dBuV/m
Margin: 74dBuV/m – 49.74dBuV/m = 24.3dB

Example Calculation: Average

Corrected Level: 35.30 + 5.44 - 0 = 40.74dBuV
Margin: 54dBuV – 40.74dBuV = 13.3dB

7.6 Power Spectral Density in the Fundamental Emission – FCC 15.247(e) IC: RSS-247 5.2(2)

7.6.1 Measurement Procedure

The power spectral density was measured in accordance with the FCC KDB 558074 D01 DTS Meas Guidance v03r03 utilizing the PKPSD (peak PSD) method. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 3 kHz. The Video Bandwidth (VBW) was set to 10 kHz. Span was set to 1.5 times the DTS bandwidth. The trace was set to max hold with a peak detector active.

7.6.2 Measurement Results

Table 7.6.2-1: Peak Power Spectral Density

Frequency (MHz)	PSD Level (dBm)
2402	-9.80
2440	-11.02
2480	-11.96

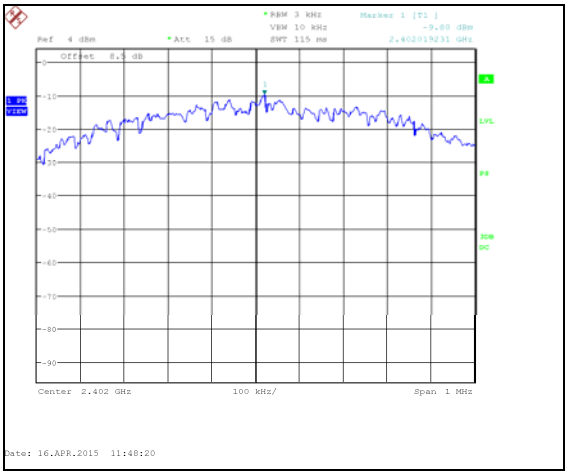

Figure 7.6.2-1: PSD Plot –LCH

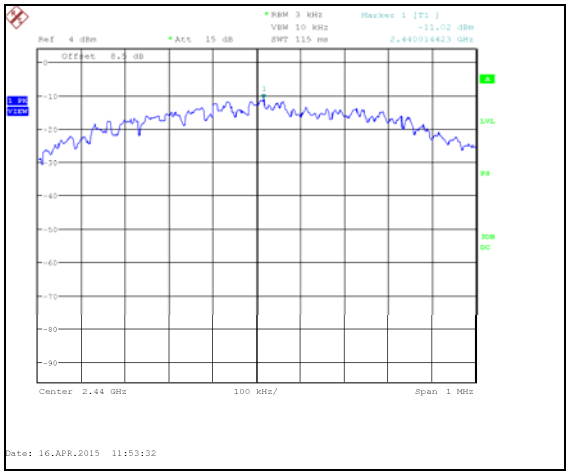

Figure 7.6.2-2: PSD Plot – MCH

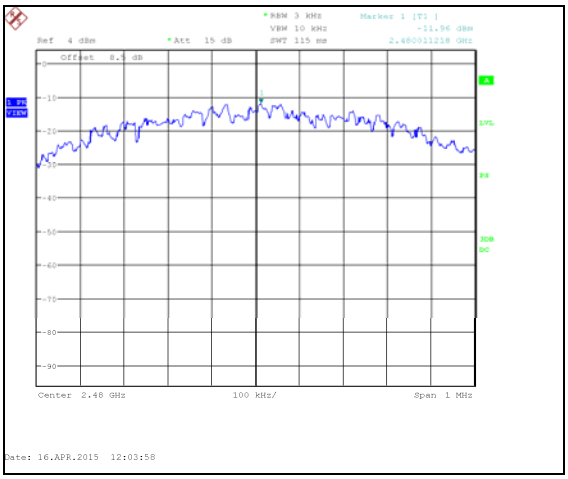

Figure 7.6.2-3: PSD Plot – HCH

8 CONCLUSION

In the opinion of ACS, Inc. the M501, M502, manufactured by SmallHD, LLC meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-247.

END REPORT