

## **Certification Test Report**

**FCC ID: 2AELXM700**

**IC: 20120-M700**

**FCC Rule Part: 15.247**

**IC Radio Standards Specification: RSS-247**

**ACS Report Number: 15-3046.W06.1C**

Manufacturer: SmallHD, LLC

Models: M701, M701L, M702, M702L

Test Begin Date: September 15, 2015

Test End Date: October 2, 2015

Report Issue Date: December 22, 2015



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:

A handwritten signature in black ink, appearing to read 'M. R. de Aranzeta'.

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

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**This report contains 22 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**

The SmallHD M700 and its variants (M702 Bright, M701 Bright, M702 Lite, M701 Lite) are camera-top monitors with 7-inch LCD panels used for displaying captured images via HDMI (all variants) or SDI input (M702 Bright, M702 Lite variants). The device includes a Bluetooth Low Energy radio. The device includes confidence tools for checking and correcting exposure, framing, and focus. The 7-Inch panel is a 1920x1200 IPS LCD display in an anodized aluminum chassis with plastic front bezel and plastic back battery plate.

Technical Information:

<b>Detail</b>	<b>Description</b>
Frequency Range	2402 to 2480 MHz
Number of Channels	40
Modulation Format	GFSK (F1D)
Data Rates	1 MBPS
Number of Inputs/Outputs	1 RF output to an integral antenna
Operating Voltage	6 to 8.4 Vdc
Antenna Type / Gain	Meandering PCB trace -7.8 dBi Peak

Manufacturer Information:

SmallHD, LLC  
118 MacKenan Drive  
Cary, NC 27511

EUT Serial Numbers: 702-0000065 and 702-000063

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

### **1.3 Test Methodology and Considerations**

All modes of operation, including all available data rates, were evaluated. The data presented in this report represents the worst case where applicable.

For radiated emissions, the EUT was evaluated in its normal orientation. This orientation is the landscape (wide screen) orientation.

The EUT is a battery operated handheld device, therefore, AC power line conducted emissions testing was not performed.

The power setting is fixed in the firmware and is not accessible by the end user.

A summary of the variants is in the table below:

Physical Difference	Functionality difference	Model Variant			
		702	701	701L	702L
PCBA components which support SDI video format input and output	SDI serial video input or output. Video signal conversion from HDMI-to-SDI, or SDI-to-HDMI	Yes	No	No	Yes
Two external BNC connectors for SDI input and output interfaces	SDI serial video input or output. Video signal conversion from HDMI-to-SDI, or SDI-to-HDMI	Yes	No	No	Yes
LCD panel pixel count 1080p (1920x1200 pixels) or 720p (1280x800 pixels)	Display resolution	1080p	1080p	720p	720p
PCBA components to support 1 or 2 DDR3 memory banks	Memory size	2	2	1	1
PCBA components for accelerometer sensor	Auto image rotation	Yes	Yes	No	No
PCBA components for Temperature sensor	PCB temperature sensing	Yes	Yes	No	No
PCBA components for Audio CODEC and headphone jack	Audio headset	Yes	Yes	No	No
PCBA components for USB (not supported for end-users)	Manufacturing verification tests	Yes	Yes	No	No

## **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 an 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:

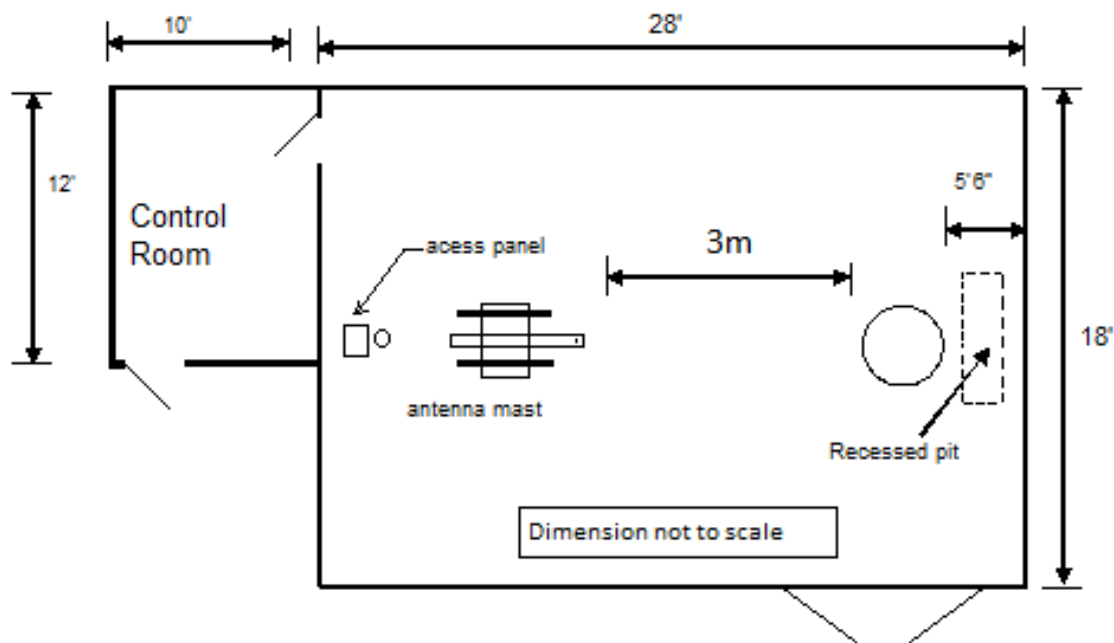


Figure 2.3-1: Semi-Anechoic Chamber Test Site

## 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:

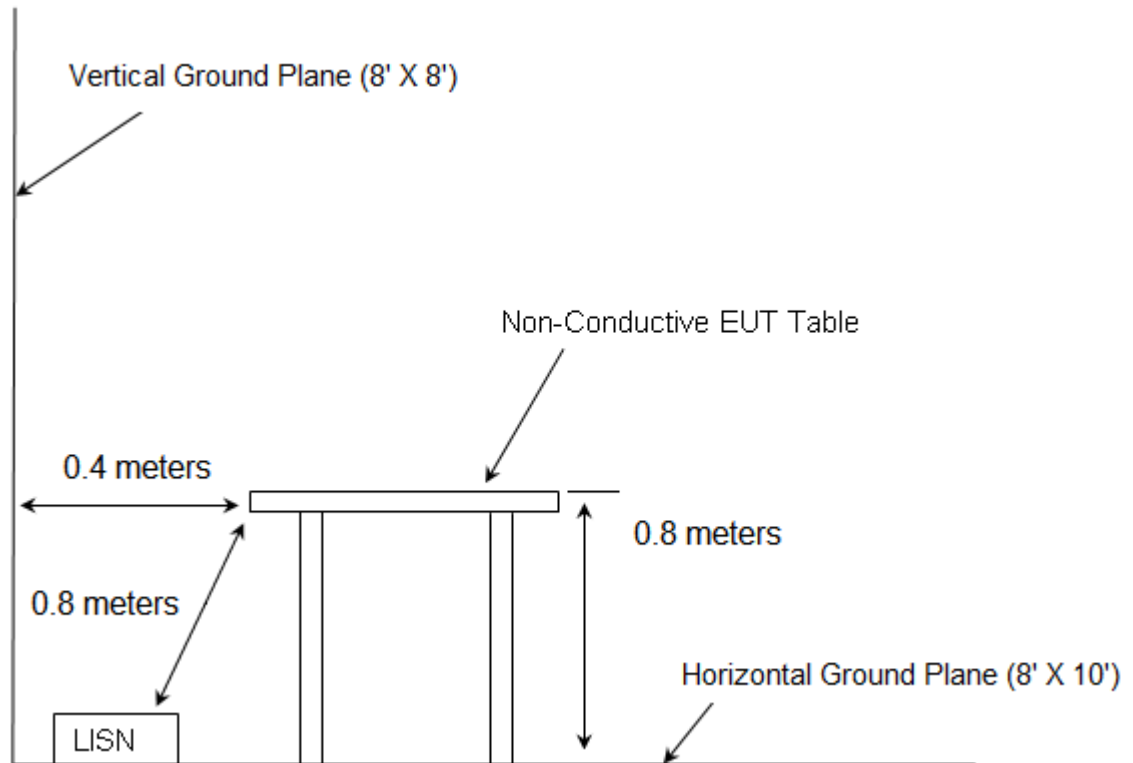


Figure 2.4-1: AC Mains Conducted EMI Site

## 3 APPLICABLE STANDARD REFERENCES

- ❖ ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of 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 License-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



#### 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	7/6/2015	7/6/2016
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	6/29/2015	6/29/2016
3007	Rohde & Schwarz	TS-PR26	Amplifiers	100051	6/29/2015	6/29/2016
3054	Mountain View Cable	BMS-RG400-36.0-BMS	Cables	3054	1/12/2015	1/12/2016
3020	Rohde & Schwarz	SMB100A	Signal Generators	175943	7/14/2015	7/14/2016
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

DMAS MT-25 RF absorber material was used on the floor for all final measurements above 1 GHz.

NCR = No Calibration Required

Firmware Version: ESU40 is 4.73 SP1

Software Version: EMC32-B is 9.15

## 5 SUPPORT EQUIPMENT

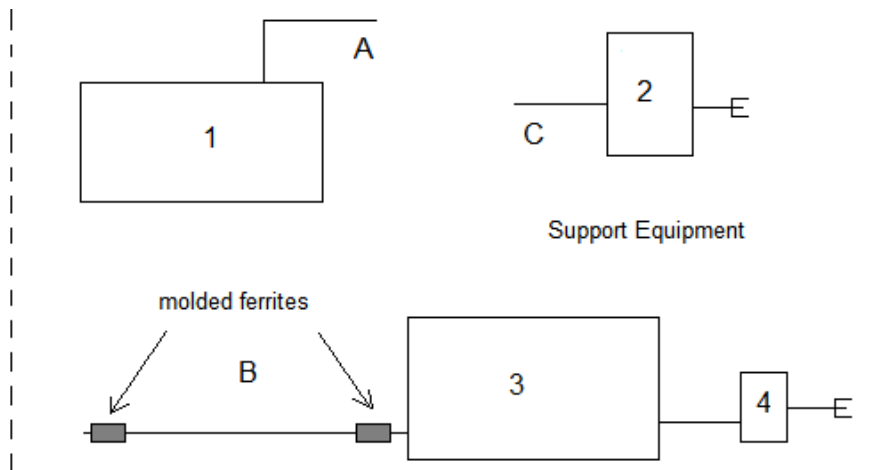


Figure 5-1: Test Setup Support Equipment Block Diagram

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	Monitor	SmallHD, LLC	M502	ACS # 32
2	Power Supply DC	Sorenson	QRD 20-4	ACS # 23
3	Laptop Computer	Lenovo Idea Pad Z710	20250	AB20732643
4	Power Adapter	Lenovo	ADL135NDC3A	ACS # 35

Table 5-2: Cable Description – Support Equipment

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

## 6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

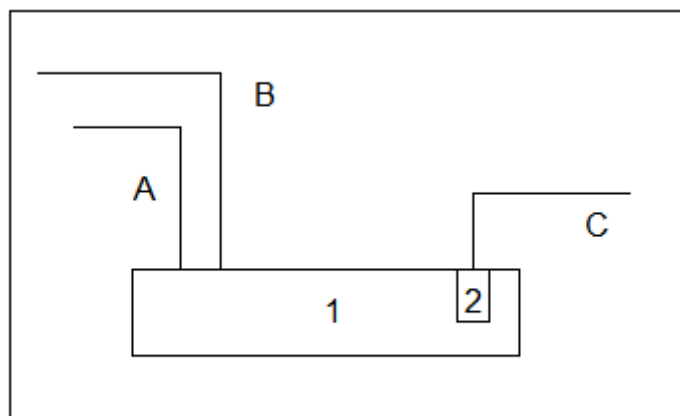


Figure 6-1: EUT Test Setup Block Diagram

Table 6-1: EUT Description

Item #	Type Device	Manufacturer or Responsible Party	Model/Part #	Serial #
1	Monitor (EUT)	SmallHD, LLC	M702	ACS # 30
2	Power Adapter (EUT)	SmallHD, LLC	PWR-ADP-DCA5	44

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 -7.8 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.

### 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 ANSI C63.10: 2013 (11.8). The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to  $\geq 3$  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 [kHz]	99% Bandwidth [MHz]
2402	697.11	1.013
2440	689.10	1.026
2480	729.17	1.026

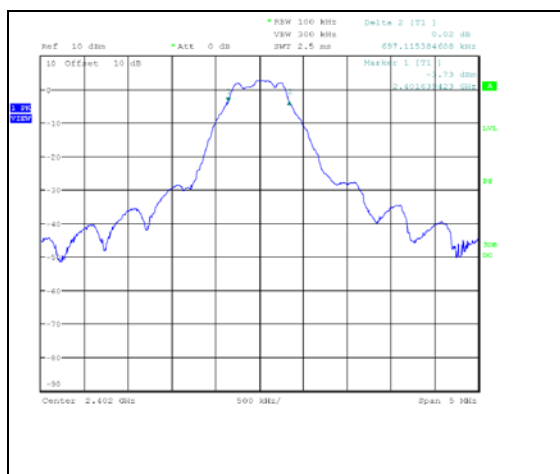


Figure 7.3.2-1: 6dB Bandwidth Low Channel

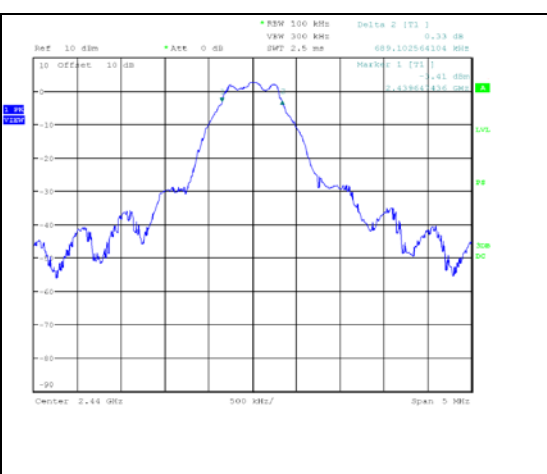


Figure 7.3.2-2: 6dB Bandwidth Mid Channel

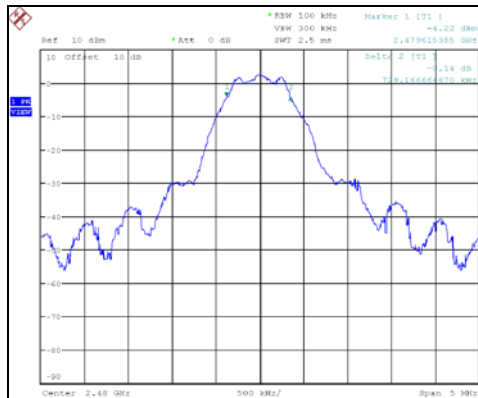


Figure 7.3.2-3: 6dB Bandwidth High Channel

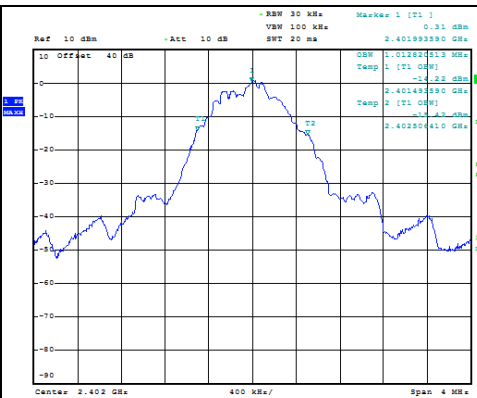


Figure 7.3.2-4: 99% Bandwidth Low Channel

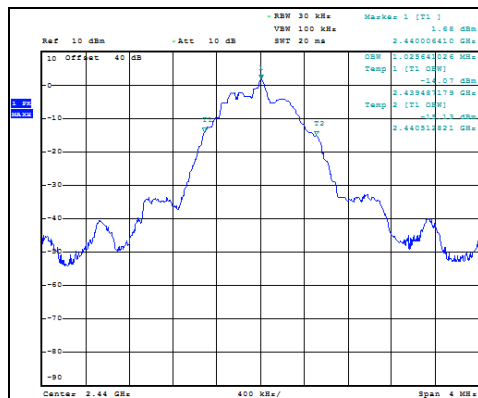


Figure 7.3.2-5: 99% Bandwidth Mid Channel

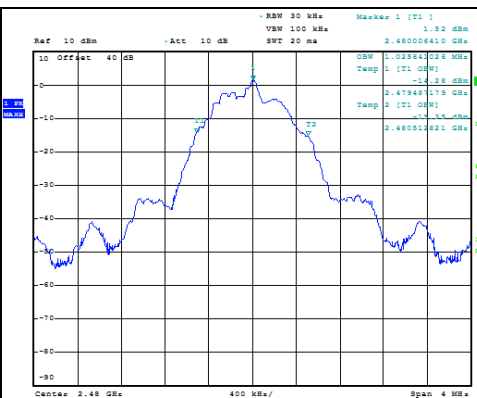


Figure 7.3.2-6: 99% Bandwidth High Channel

**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 ANSI C63.10: 2013 (11.9) 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**

<b>Frequency (MHz)</b>	<b>Output Power (dBm)</b>	<b>Output Power Watts</b>
2402	3.3	0.0021
2440	3.16	0.0021
2480	3	0.002

## 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 ANSI C63.10: 2013 (11.11). 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  $\geq 300$  kHz. 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.

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.

#### 7.5.1.2 Measurement Results

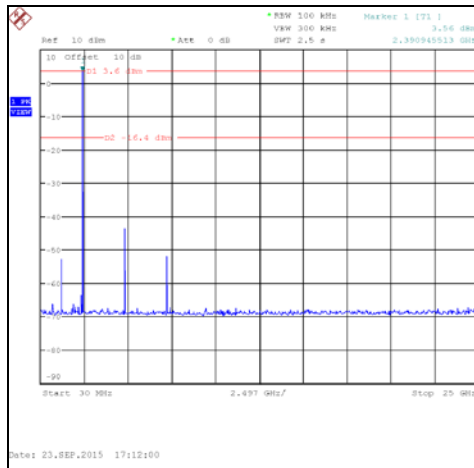


Figure 7.5.1.2-1: 30 MHz – 25 GHz – LCH

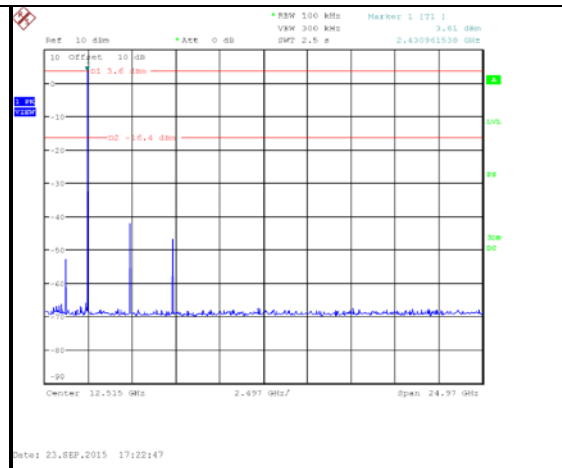


Figure 7.5.1.2-2: 30 MHz – 25 GHz – MCH

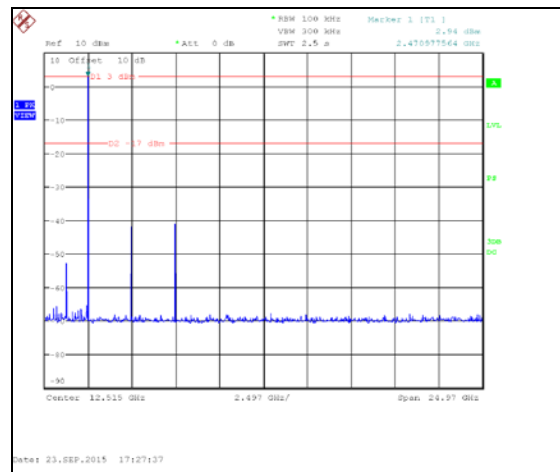


Figure 7.5.1.2-3: 30 MHz – 25 GHz – HCH



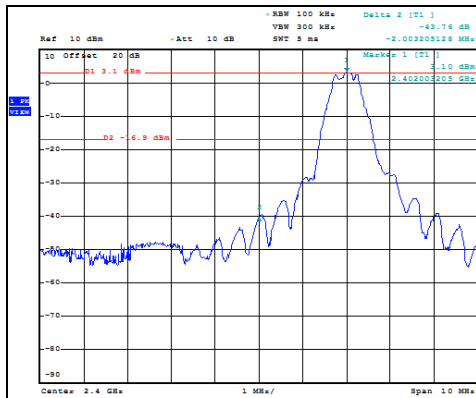


Figure 7.5.1.2-4: Lower Band-edge – LCH

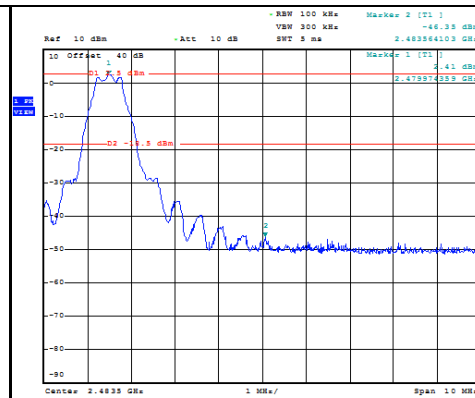


Figure 7.5.1.2-5: Upper Band-edge – HCH

## 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 1000 MHz, quasi-peak measurements were made using a RBW of 120 kHz and a VBW of 300 kHz. For frequencies above 1000 MHz, 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 – LCH**

Low Channel: 2402 MHz												
Measurement Distance: <input type="checkbox"/> 1 Meter <input checked="" type="checkbox"/> 3 Meter <input type="checkbox"/> 10 Meter												
Frequency (MHz)	Measured Level (dBuV)		Antenna Polarity (H/V)	Turntable Position (o)	Antenna Height (cm)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	Pk	Qpk/Av					Pk	Qpk/Av	Pk	Qpk/Av	Pk	Qpk/Av
4804	49.80	41.70	H	125	140	6.02	55.82	47.72	74.0	54.0	18.2	6.3
4804	48.00	35.10	V	127	125	6.02	54.02	41.12	74.0	54.0	20.0	12.9
1336	55.40	42.30	H	270	120	-5.39	50.01	36.91	74.0	54.0	24.0	17.1
1336	52.30	42.20	V	50	210	-5.39	46.91	36.81	74.0	54.0	27.1	17.2
2321.5	47.60	25.20	H	345	130	-2.38	45.22	22.82	74.0	54.0	28.8	31.2
2321.5	39.90	24.80	V	345	130	-2.38	37.52	22.42	74.0	54.0	36.5	31.6
2377.7	48.30	25.60	H	345	130	-2.21	46.09	23.39	74.0	54.0	27.9	30.6
2377.7	47.60	25.40	V	345	130	-2.21	45.39	23.19	74.0	54.0	28.6	30.8

**Table 7.5.2.3-2: Radiated Spurious Emissions Tabulated Data - MCH**

Mid Channel: 2440 MHz												
Measurement Distance: <input type="checkbox"/> 1 Meter <input checked="" type="checkbox"/> 3 Meter <input type="checkbox"/> 10 Meter												
Frequency (MHz)	Measured Level (dBuV)		Antenna Polarity (H/V)	Turntable Position (o)	Antenna Height (cm)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	Pk	Qpk/Av					Pk	Qpk/Av	Pk	Qpk/Av	Pk	Qpk/Av
4880	48.60	40.50	H	125	140	5.97	54.57	46.47	74.0	54.0	19.4	7.5
4880	48.10	31.70	V	127	125	5.97	54.07	37.67	74.0	54.0	19.9	16.3
7320	42.90	30.70	H	125	140	9.26	52.16	39.96	74.0	54.0	21.8	14.0
7320	39.40	25.20	V	125	125	9.26	48.66	34.46	74.0	54.0	25.3	19.5
1336.5	58.40	48.00	H	270	120	-5.39	53.01	42.61	74.0	54.0	21.0	11.4
1336.5	57.50	49.10	V	50	210	-5.39	52.11	43.71	74.0	54.0	21.9	10.3

Table 7.5.2.3-3: Radiated Spurious Emissions Tabulated Data - HCH

High Channel: 2480 MHz												
Measurement Distance:												
<input type="checkbox"/> 1 Meter <input checked="" type="checkbox"/> 3 Meter <input type="checkbox"/> 10 Meter												
Frequency (MHz)	Measured Level (dBuV)		Antenna Polarity (H/V)	Turntable Position (o)	Antenna Height (cm)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	Pk	Qpk/Av					Pk	Qpk/Av	Pk	Qpk/Av	Pk	Qpk/Av
4960	49.50	39.70	H	130	190	5.91	55.41	45.61	74.0	54.0	18.6	8.4
4960	49.10	34.00	V	195	155	5.91	55.01	39.91	74.0	54.0	19.0	14.1
7440	43.20	31.10	H	130	125	9.60	52.80	40.70	74.0	54.0	21.2	13.3
7440	38.80	24.70	V	190	195	9.60	48.40	34.30	74.0	54.0	25.6	19.7
1336.5	54.50	44.90	H	90	250	-5.39	49.11	39.51	74.0	54.0	24.9	14.5
1336.5	53.50	44.40	V	135	150	-5.39	48.11	39.01	74.0	54.0	25.9	15.0
2483.5	42.70	25.30	H	255	130	-1.89	40.81	23.41	74.0	54.0	33.2	30.6
2483.5	43.10	25.50	V	330	100	-1.89	41.21	23.61	74.0	54.0	32.8	30.4

**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 (dBuV)
$R_C$	=	Corrected Level (dBuV/m)
AF	=	Antenna Factor (dB/m)
CA	=	Cable Attenuation (dB)
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

**Example Calculation: Peak**

Corrected Level:  $49.80 + 6.02 = 55.82\text{dBuV/m}$

Margin:  $74\text{dBuV/m} - 55.82\text{dBuV/m} = 18.2\text{dB}$

**Example Calculation: Average**

Corrected Level:  $41.70 + 6.02 - 0 = 47.72\text{dBuV/m}$

Margin:  $54\text{dBuV} - 47.72\text{dBuV} = 6.3\text{dB}$

## 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 ANSI C63.10: 2013 (11.10) 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	-10.07
2440	-10.25
2480	-10.27

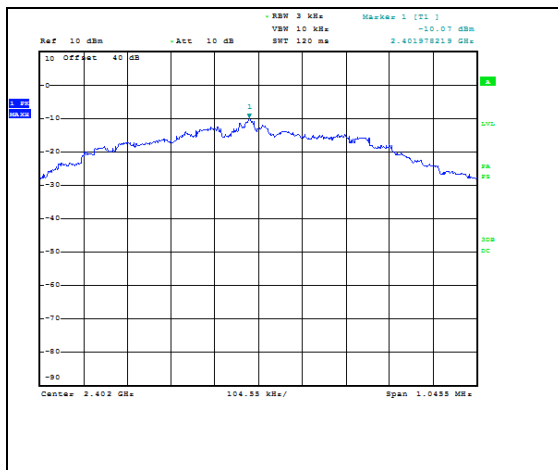


Figure 7.6.2-1: PSD Plot –LCH

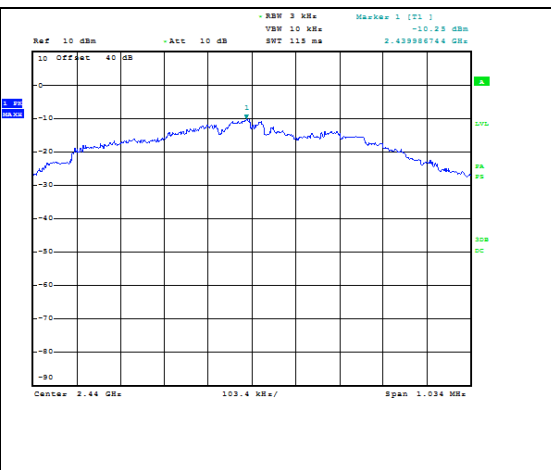


Figure 7.6.2-2: PSD Plot – MCH

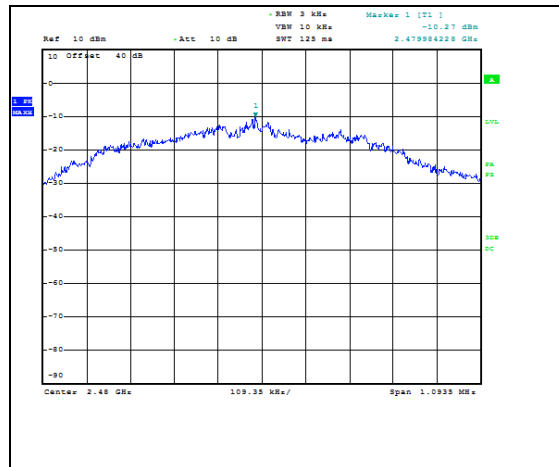


Figure 7.6.2-3: PSD Plot – HCH

## **8 CONCLUSION**

In the opinion of ACS, Inc. the M701, M701L, M702, M702L, manufactured by SmallHD, LLC meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-247.

# **END REPORT**