Excellence in Compliance Solutions

Certification Test Report

FCC ID: 2AHFM-BTCENMDB
IC: 21164-BTCENMDB

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

ACS Report Number: 15-3053.W06.1A

Manufacturer: Kaba Mas LLC
Model: Cencon MDB 30N

Test Begin Date: December 14, 2015
Test End Date: January 15, 2016

Report Issue Date: March 23, 2016

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:

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

This report contains 18 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 Cencon MDB is a Bluetooth LE device incorporated in the ATM Cash Vault Security System from Kaba Mas. The Cencon ATM Cash Vault Security System is designed to combat insider theft from ATMs through the combined use of lock hardware, systems software and Smart Keys™. Cencon offers total access control and accountability with its One Time Combination™ feature. The One Time Combination is dispatched from a central location and cannot be reused at a later date, thus eliminating temptation. This model of lock has been designed with a motorized deadbolt capable of moving with 30N of force while extending and retracting.

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	18Vdc
Antenna Type / Gain	Meandering trace antenna/ -1 dBi

Manufacturer Information:
Kaba Mas LLC
749 W. Short St.
Lexington, KY 40508

EUT Serial Numbers: CMSU000510202015

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

1.3 Test Methodology and Considerations

The test sample used for radiated emissions was also used for RF conducted emissions. After the radiated emissions tests were performed the client modified the same unit for RF conducted measurements by adding a temporary 50 ohm connector in place of the antenna.

Test firmware was placed in the test sample by the client that allowed selection of low, middle, and high channels.

The EUT was tested for radiated emissions in its normal orientation which is as installed per manufacturer instruction.

For power-line conducted and radiated emissions, the EUT was tested with a representative power supply.

All available data rates and modes of operation were evaluated. The data rate presented in this report represents the worst case.

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.

FCC Registered Test Site Number: 637011
ISED Test Site Registration Number: 20446

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:

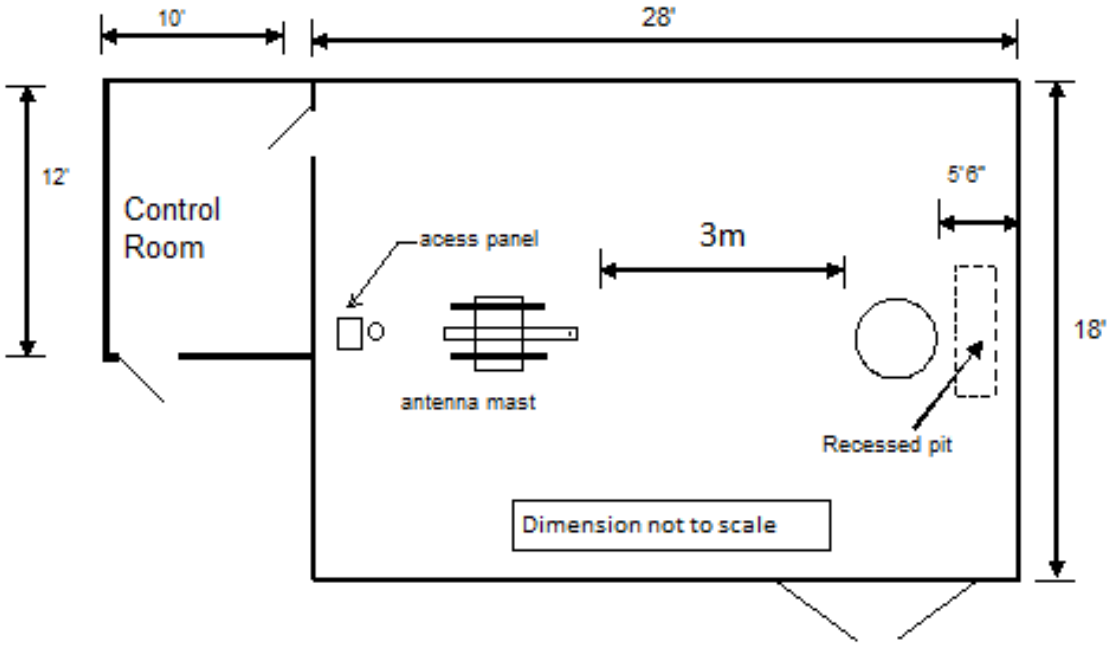

Figure 2.3-1: Semi-Anechoic Chamber Test Site

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:

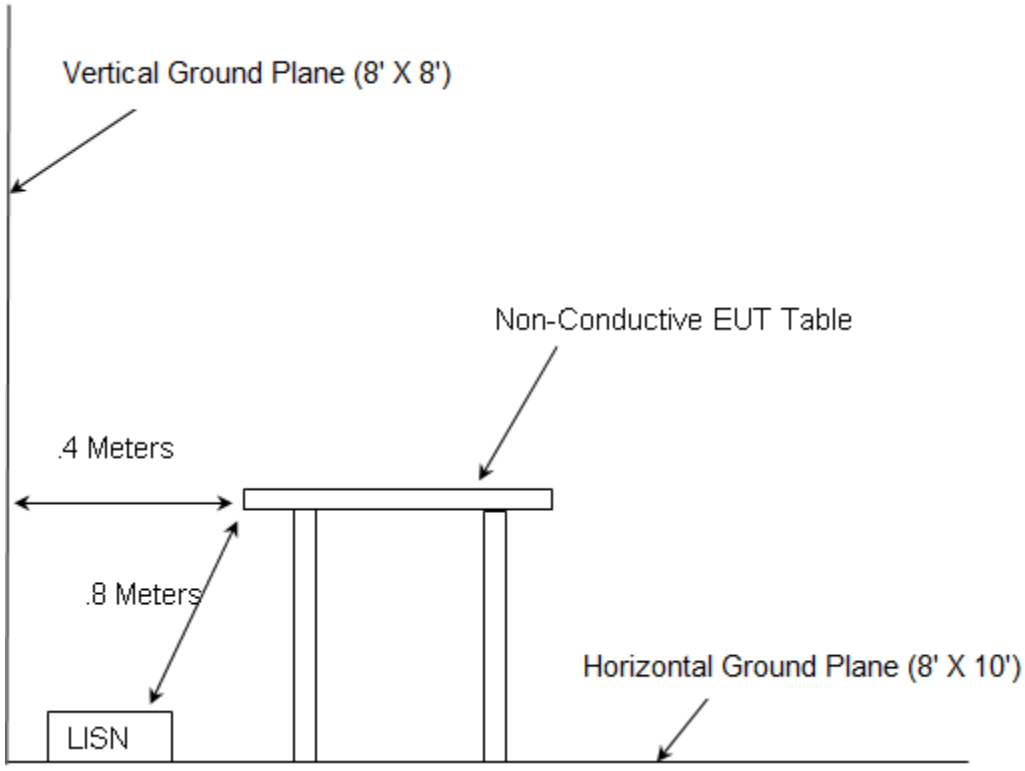

Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2014 - American National Standard for Methods of Measurement of Radio-Noise Emissions from low-voltage electrical and electronic equipment in the range of 9kHz to 40 GHz.
- 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, 2016
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2016
- FCC KDB 558074 D01 DTS Meas Guidance v03r04 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247, January 7, 2016
- 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
3038	Florida RF Labs	NMSE-290AW-60.0-NMSE	Cable Set	1448	12/22/2015	12/22/2016
3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	1/12/2015	1/12/2016
3039	Florida RF Labs	NMSE-290AW-396.0-NMSE	Cable Set	1447	12/22/2015	12/22/2016
3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antennas	2013120203	1/14/2015	1/14/2016
3016	Fei Teng Wireless Technology	HA-07M18G-NF	Antennas	2013120203	1/26/2016	1/26/2018
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
3034	Hasco, Inc.	HLL142-S1-S1-12	Cables	3076	1/18/2015	1/18/2016
3055	Rohde & Schwarz	3005	Cables	3055	1/16/2015	1/16/2016
3012	Rohde & Schwarz	EMC32-EB	Software	100731	1/19/2015	7/19/2016
3041	Aeroflex Inmet	18N10W-30	Attenuator	1447	1/18/2015	1/18/2016
3042	Aeroflex Inmet	18N10W-10	Attenuator	1444	1/18/2015	1/18/2016

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 SP4
Software Version: EMC32-B is 9.15

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	EUT	Kaba Mas LLC	Cencon MDB 30N	ACS # 12
2	Class 2 Power Supply	Triad	WDU18-1000	N/A

Notes:

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

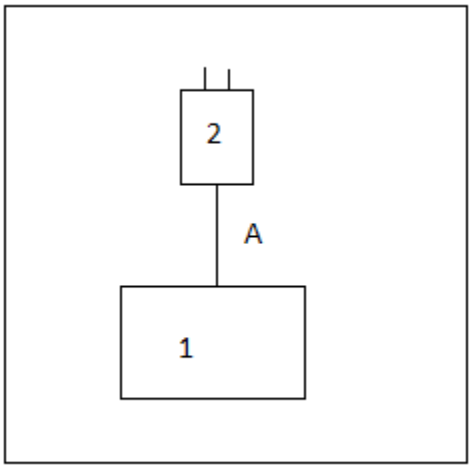

Figure 6-1: Test Setup Block Diagram

Table 6-1: Cable Description

Cable #	Cable Type	Length	Shield	Termination
A	Power Supply	1.8m	No	EUT to 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 -1.0 dBi.

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

7.2.1 Measurement Procedure

ANSI C63.4-2014 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150 kHz to 30 MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

7.2.2 Measurement Results

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.158000	---	14.24	55.53	41.29	2000.0	9.000	L1	OFF	9.5
0.158000	39.09	---	65.53	26.44	2000.0	9.000	L1	OFF	9.5
0.336000	---	12.74	49.09	36.35	2000.0	9.000	L1	OFF	9.5
0.336000	45.50	---	59.12	13.62	2000.0	9.000	L1	OFF	9.5
0.364000	---	15.98	48.45	32.47	2000.0	9.000	L1	OFF	9.6
0.364000	44.87	---	58.48	13.61	2000.0	9.000	L1	OFF	9.6
0.696000	---	6.09	46.00	39.91	2000.0	9.000	L1	OFF	9.6
0.696000	25.45	---	56.00	30.55	2000.0	9.000	L1	OFF	9.6
16.172000	---	0.54	50.00	49.46	2000.0	9.000	L1	OFF	10.0
16.172000	15.54	---	60.00	44.46	2000.0	9.000	L1	OFF	10.0
16.952000	---	5.03	50.00	44.97	2000.0	9.000	L1	OFF	10.0
16.952000	11.35	---	60.00	48.65	2000.0	9.000	L1	OFF	10.0

Table 7.2.2-1 Conducted EMI Results - Line 1

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.344000	---	16.26	48.90	32.64	2000.0	9.000	N	OFF	9.7
0.344000	35.46	---	58.93	23.47	2000.0	9.000	N	OFF	9.7
0.360000	---	19.20	48.54	29.34	2000.0	9.000	N	OFF	9.7
0.360000	36.88	---	58.57	21.69	2000.0	9.000	N	OFF	9.7
0.536000	---	16.36	46.00	29.64	2000.0	9.000	N	OFF	9.7
0.536000	41.48	---	56.00	14.52	2000.0	9.000	N	OFF	9.7
0.552000	---	15.74	46.00	30.26	2000.0	9.000	N	OFF	9.7
0.552000	40.60	---	56.00	15.40	2000.0	9.000	N	OFF	9.7
0.560000	---	13.26	46.00	32.74	2000.0	9.000	N	OFF	9.7
0.560000	29.26	---	56.00	26.74	2000.0	9.000	N	OFF	9.7
0.572000	---	11.46	46.00	34.54	2000.0	9.000	N	OFF	9.7
0.572000	39.60	---	56.00	16.40	2000.0	9.000	N	OFF	9.7

Table 7.2.2-2 Conducted EMI Results - Neutral

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 v03r04. 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 [kHz]	99% Bandwidth [kHz]
2402	512.8	871.4
2440	519.2	881.5
2480	516.0	881.2

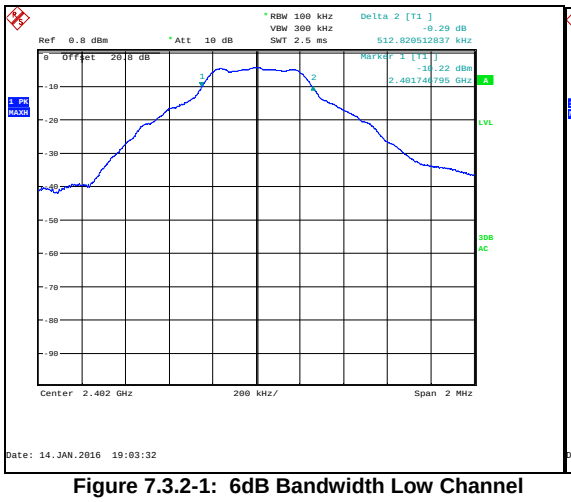

Figure 7.3.2-1: 6dB Bandwidth Low Channel

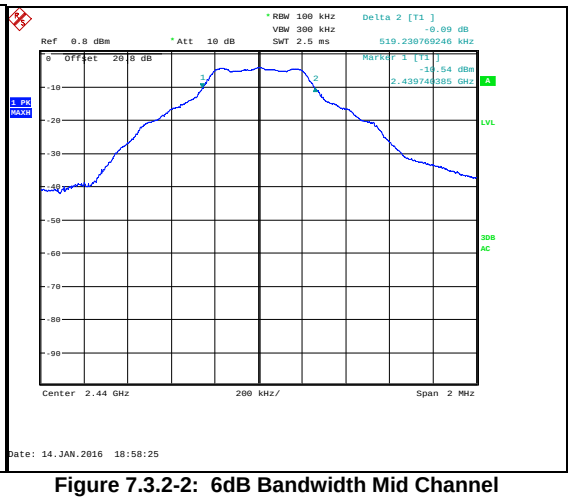

Figure 7.3.2-2: 6dB Bandwidth Mid Channel

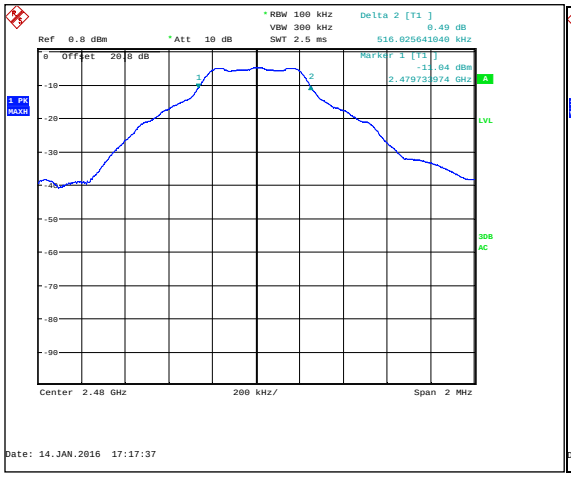

Figure 7.3.2-3: 6dB Bandwidth High Channel

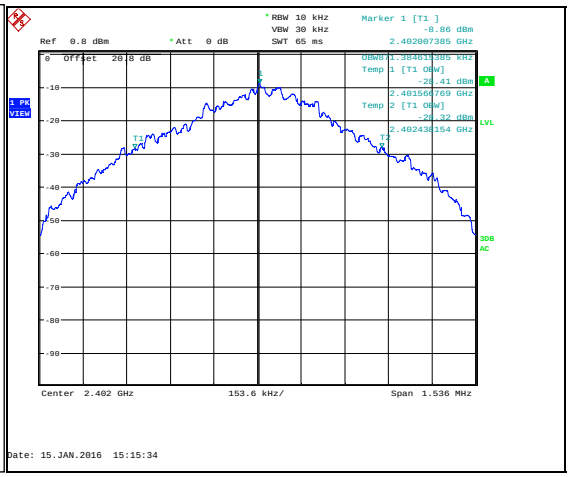

Figure 7.3.2-4: 99% Bandwidth Low Channel

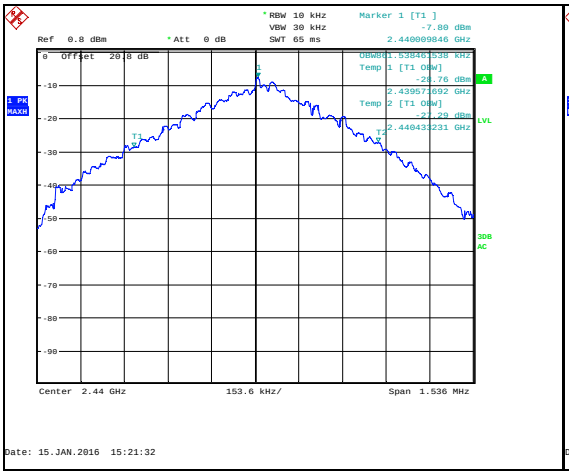

Figure 7.3.2-5: 99% Bandwidth Mid Channel

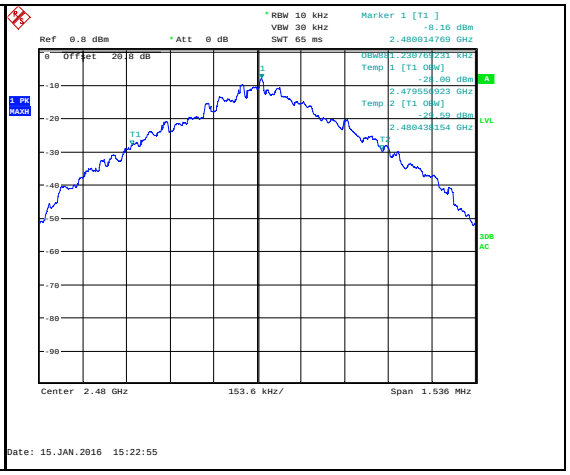

Figure 7.3.2-6: 99% Bandwidth High Channel

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

7.4.1 Measurement Procedure

The RF conducted output power was measured in accordance with FCC KDB 558074 D01 DTS Measurement Guidance v03r04 utilizing a spectrum analyzer using a peak detector and the max-hold function. The RBW was set ≥ DTS bandwidth. A RBW of 2 MHz was used, with VBW and SPAN set to be > RBW. The RF output of the equipment under test was connected to the input of the spectrum analyzer using suitable passive attenuation.

7.4.2 Measurement Results

Table 7.4.2-1: Maximum Peak Conducted Output Power

Frequency (MHz)	Output Power (dBm)
2402	-4.16
2440	-4.12
2480	-4.25

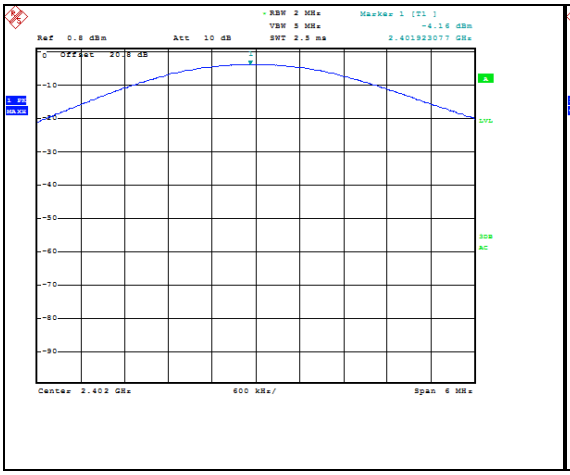

Figure 7.4.2-1: Output Power – Low Channel

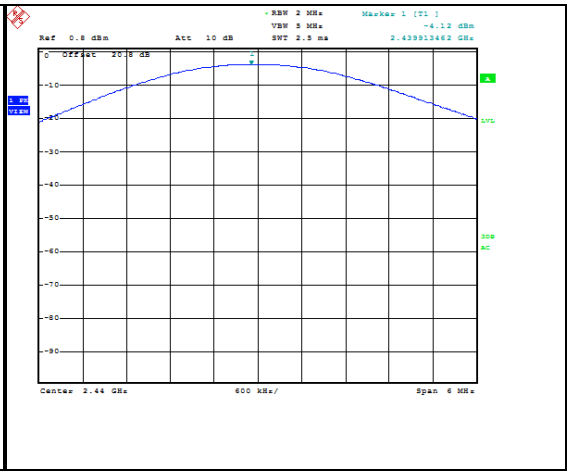

Figure 7.4.2-2: Output Power – Mid Channel

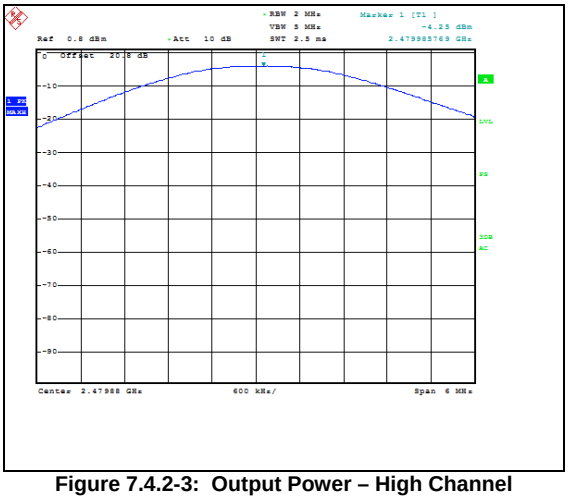

Figure 7.4.2-3: Output Power – High Channel

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 v03r04. 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

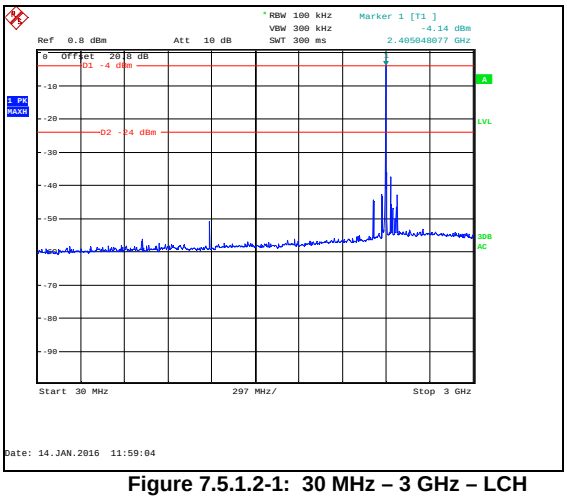

Figure 7.5.1.2-1: 30 MHz – 3 GHz – LCH

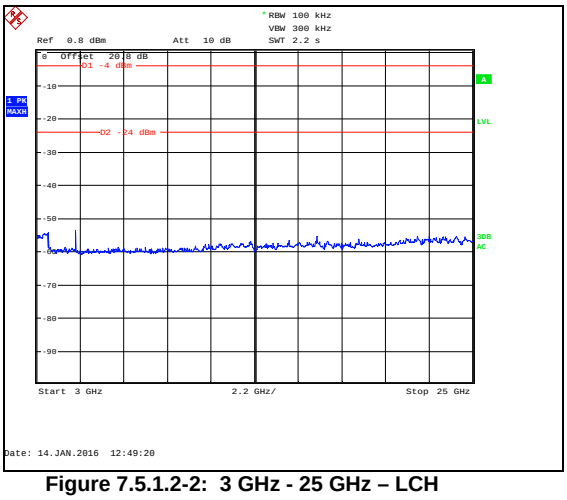

Figure 7.5.1.2-2: 3 GHz - 25 GHz – LCH

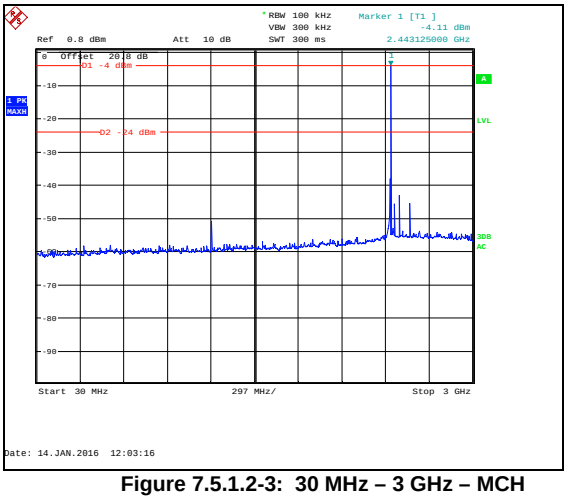

Figure 7.5.1.2-3: 30 MHz – 3 GHz – MCH

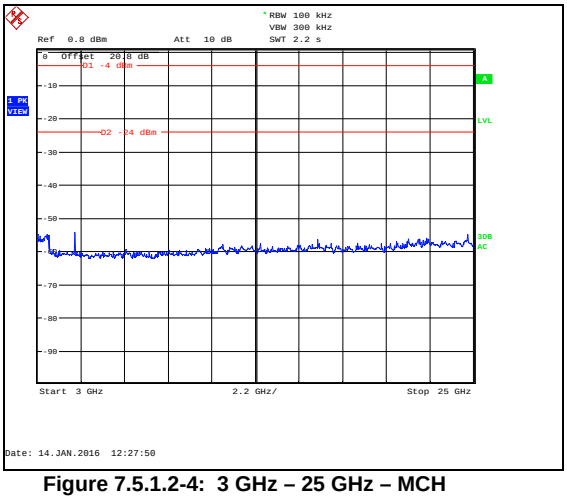

Figure 7.5.1.2-4: 3 GHz – 25 GHz – MCH

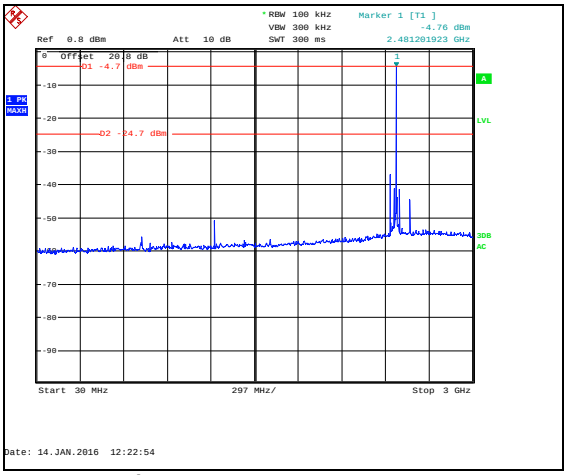

Figure 7.5.1.2-5: 30 MHz – 3 GHz – HCH

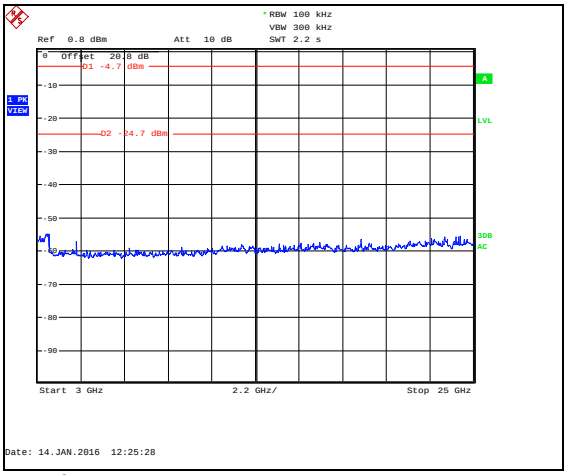

Figure 7.5.1.2-6: 3 GHz – 25 GHz - HCH

Band-edge conducted plots: 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.

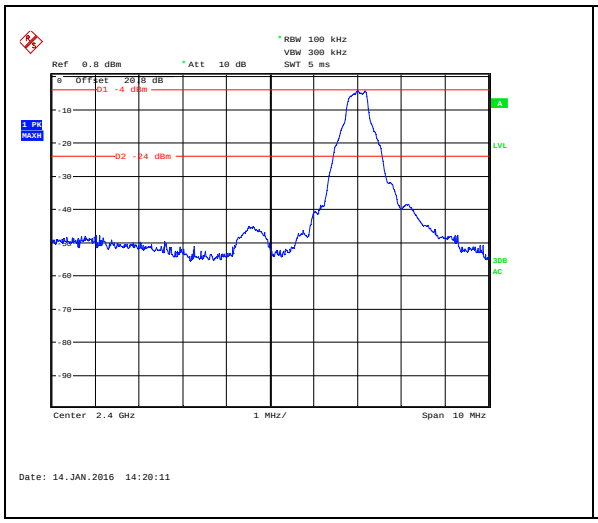

Figure 7.5.1.2-7: Lower Band-edge - LCH

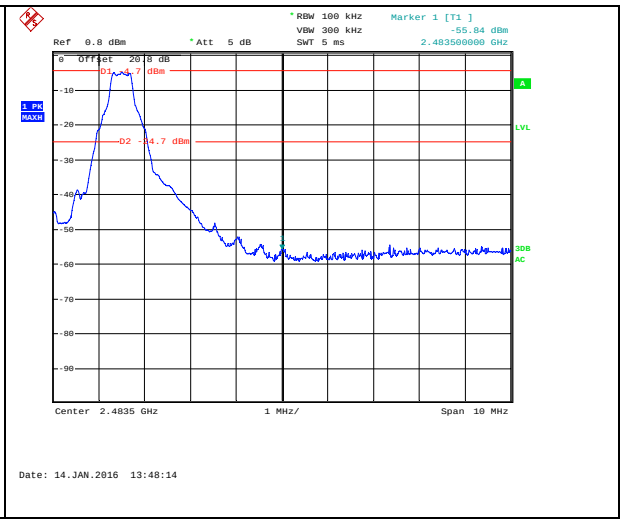

Figure 7.5.1.2-8: Upper Band-edge - HCH

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

For average radiated measurements, using a 3.33% duty cycle, the measured level was reduced by a factor 29.55dB. The duty cycle correction factor is determined using the formula: 20log (3.33/100) = - 29.55dB.

A detailed analysis of the duty cycle timing is provided in the Theory of Operation accompanying the application for certification.

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	56.30	53.60	H	6.68	62.98	30.73	74.0	54.0	11.0	23.3
4804	57.20	54.60	V	6.68	63.88	31.73	74.0	54.0	10.1	22.3
2378.4	58.00	29.50	H	-2.21	55.79	-2.26	74.0	54.0	18.2	56.3
2378.4	60.60	30.10	V	-2.21	58.39	-1.66	74.0	54.0	15.6	55.7
Middle Channel										
4880	52.60	49.00	H	6.64	59.24	26.09	74.0	54.0	14.8	27.9
4880	53.00	49.50	V	6.64	59.64	26.59	74.0	54.0	14.4	27.4
7320	47.60	35.60	H	9.69	57.29	15.74	74.0	54.0	16.7	38.3
7320	47.30	35.10	V	9.69	56.99	15.24	74.0	54.0	17.0	38.8
High Channel										
4960	54.10	51.40	H	5.91	60.01	27.76	74.0	54.0	14.0	26.2
4960	53.90	51.50	V	5.91	59.81	27.86	74.0	54.0	14.2	26.1
7440	50.10	43.60	H	9.60	59.70	23.65	74.0	54.0	14.3	30.4
7440	49.70	42.90	V	9.60	59.30	22.95	74.0	54.0	14.7	31.1
2483.5	47.70	28.10	H	-1.89	45.81	-3.34	74.0	54.0	28.2	57.3
2483.5	49.90	29.20	V	-1.89	48.01	-2.24	74.0	54.0	26.0	56.2

The peak to average ratio is higher in the at the upper bandedge and adjacent restricted band as the content is mostly noise.

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: 56.30 + 6.68 = 62.98dBuV/m
Margin: 74dBuV/m – 63dBuV/m = 11dB

Example Calculation: Average

Corrected Level: 53.6 + 6.68 - 29.55 = 30.73dBuV
Margin: 54dBuV – 30.73dBuV = 23.3dB

7.6 Power Spectral Density – 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 v03r04 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	-16.07
2440	-12.74
2480	-14.35

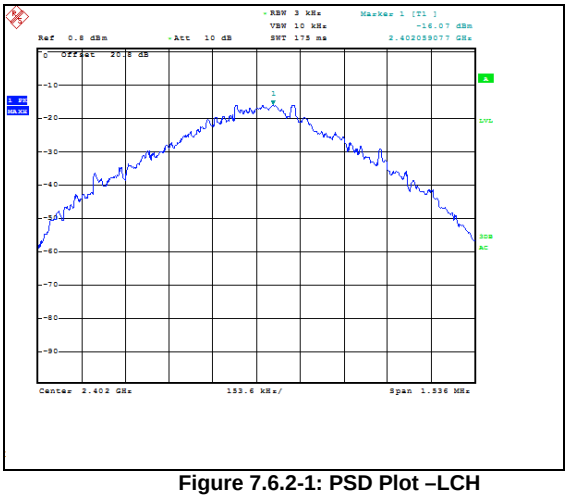

Figure 7.6.2-1: PSD Plot –LCH

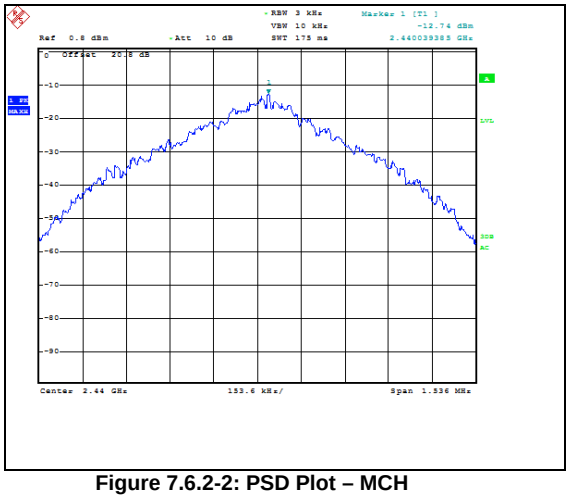

Figure 7.6.2-2: PSD Plot – MCH

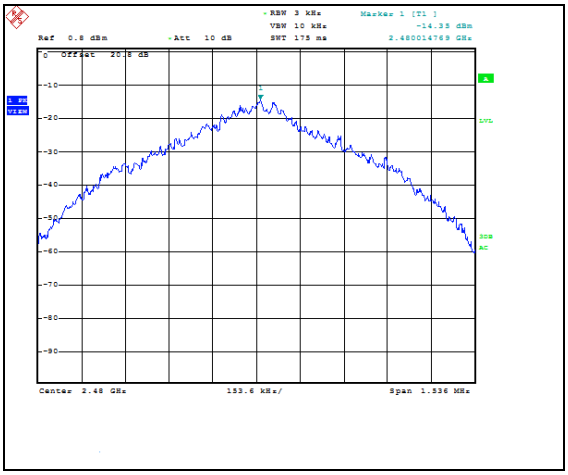

Figure 7.6.2-3: PSD Plot – HCH

8 CONCLUSION

In the opinion of ACS, Inc. the Cencon MDB 30N, manufactured by Kaba Mas LLC meets the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-247.

END REPORT