FCC Part 15 Subpart C Certification
372MHz Transmitter
(Includes Separate 372MHz Receiver Data)

Test Report

FCC ID: KJ8HAC010290842

FCC Rule Part: 15.231

ACS Report Number: 06-0050-15-231

Manufacturer: Wayne-Dalton Corp.
Trade name: Home Access Controller
Model: WDHA-12

Test Begin Date: February 6, 2006
Test End Date: February 27, 2006

Report Issue Date: March 29, 2006

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612

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This report contains 16 pages

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1.0 GENERAL

1.1 Purpose
The purpose of this report is to demonstrate compliance with Part 15.231, Subpart C of the FCC's Code of Federal Regulations.

1.2 Product Description

1.2.1 General
Automotive-based transmitters exist to activate garage door openers and similar devices. This technology is not compatible (hardware or software) with Z-Wave protocol. The Home Access Controller will function as a "bridge" between the Wayne-Dalton® Z-Wave Home Network System and automobile-based transmitters.

The Home Access Controller exchanges signals with the Z-Wave Home Network System over a radio frequency link. It also exchanges signals with the automotive transmitters over a 372MHz radio frequency link (different parameters than Z-Wave).

The Home Access Controller is made up of eight subsystems. These subsystems are…
- Battery
- Power Supply System
- Z-Wave ASIC (908.42MHz)
- Microcontroller
- **372MHz Transmitter**
- **372MHz Receiver**
- Housing
- User Interface

The purpose of this report is to demonstrate compliance of the 372MHz transmitter and receiver only. Other components of this composite device, such as the 908.42MHz Z-Wave transceiver, are covered under separate test reports.

1.2.2 Intended Use
The intended use of this device is in home automation environments.

1.2.3 Technical Specifications

Transmitter

Parameter	Min	Typical	Max	Units
Regulatory			FCC Part 15.231	
Frequency		372.0		MHz
Frequency Accuracy	± 100			kHz
Current Draw at 3.3V				mA
Temperature: Operating	0		70	°C
Temperature: Storage	0		70	°C

Receiver

Parameter	Min	Typical	Max	Units
Receive Frequency		372.0		MHz
Frequency Accuracy	± 100			kHz
Receive Sensitivity	-100			dBm
Receive Bandwidth		400		kHz
Current Draw at 3.3V		xxx		mA
Distance	300			Feet
Temperature: Operating	-40		85	°C
Temperature: Storage	-40		85	°C

2.0 TEST FACILITIES

2.1 Location

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

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment. In addition, ACS is compliant to ISO 17025 as certified by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 89450
Industry Canada Lab Code: IC 4175
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

NVLAP Lab Code: 200612

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm 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 3/4" stainless steel braided cable.

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 range. 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 during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases 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.

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

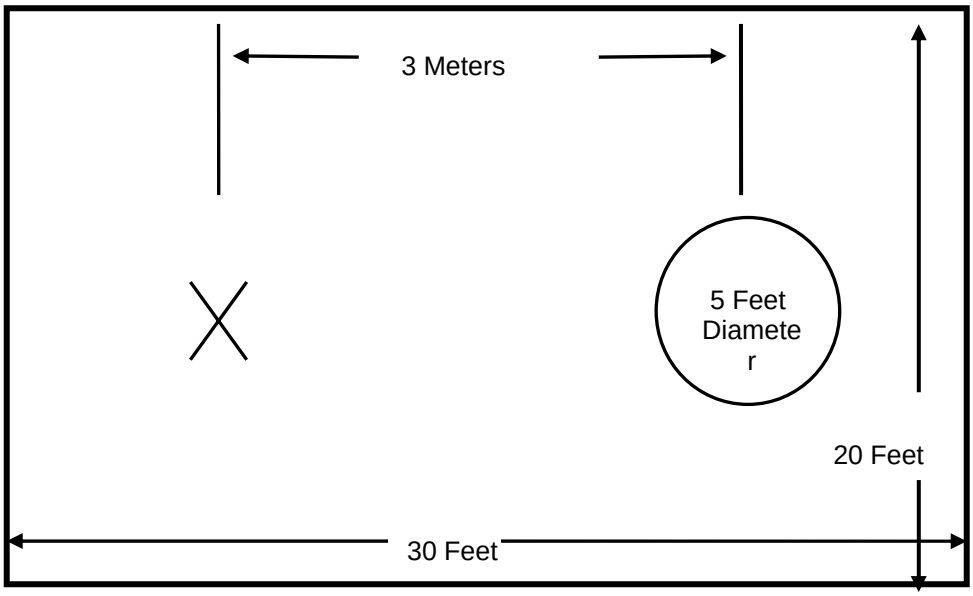

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. 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 during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room 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. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

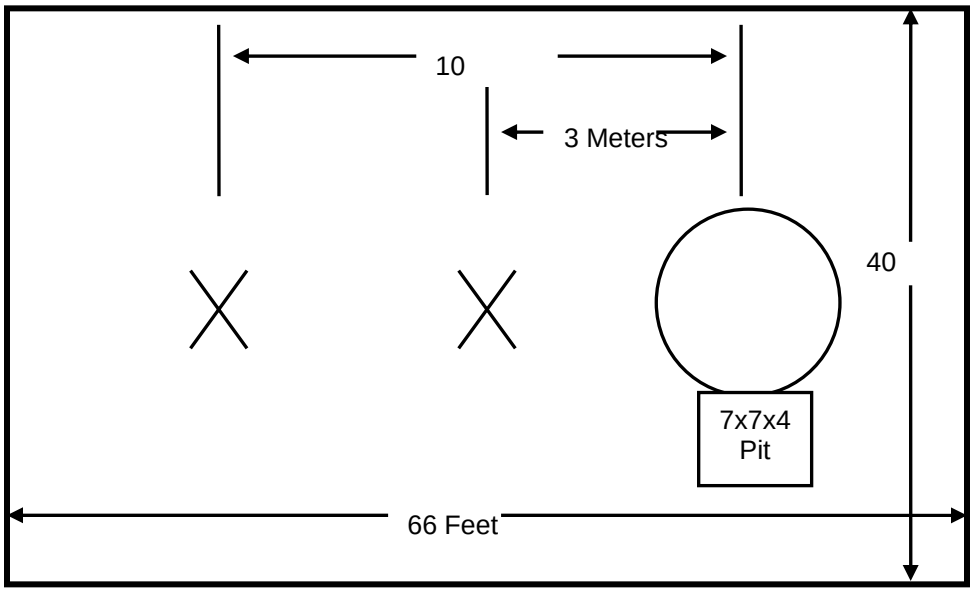

Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is a shielded room with the following dimensions:

- Height: 3.0 Meters
- Width: 3.6 Meters
- Length: 4.9 Meters

The room is manufactured by Rayproof Corporation and installed by Panashield, Inc. Earth ground is provided to the room via an 8' copper ground rod. Each panel of the room is connected electrically at intervals of 4".

Power to the room is filtered to prevent ambient noise from coupling to the EUT and measurement equipment. Filters are models 1B42-60P manufactured by Rayproof 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.

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

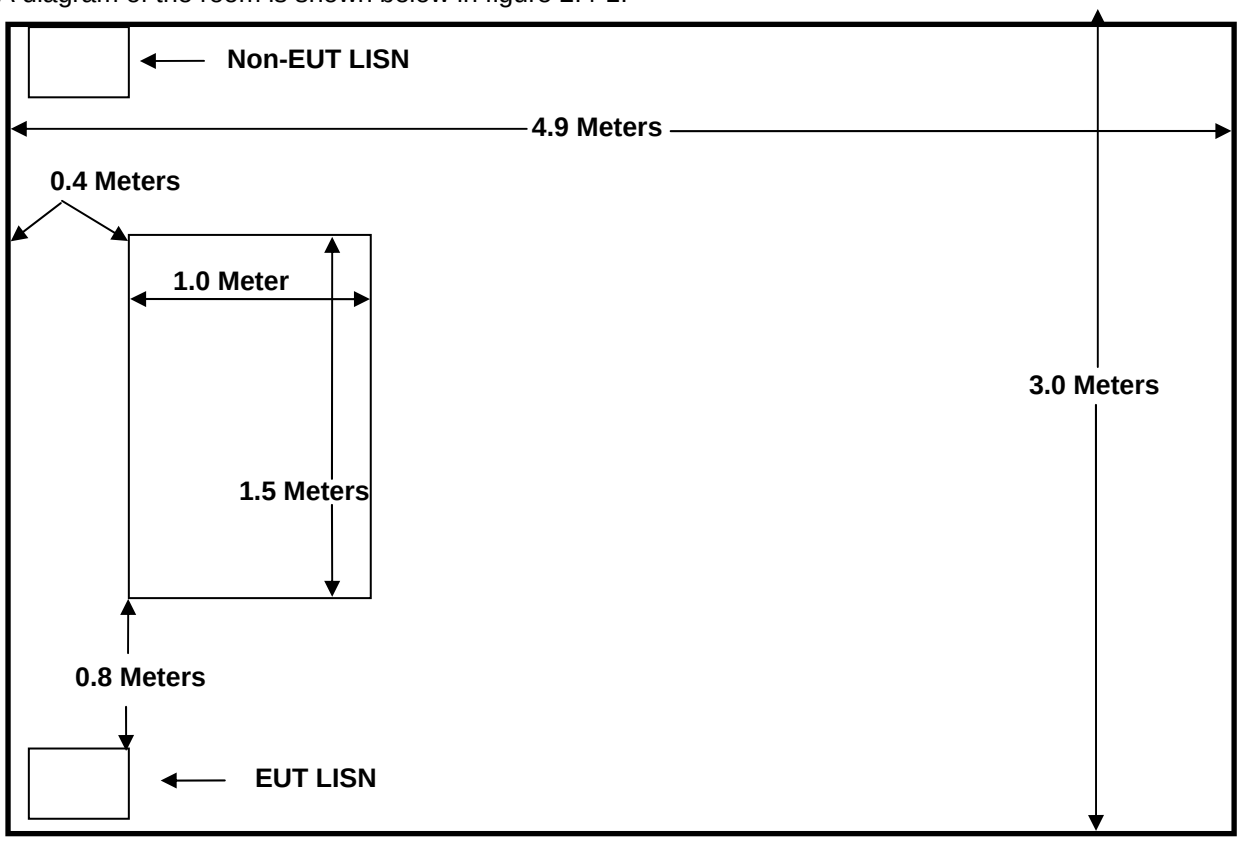

Figure 2.4-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

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

2 - US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators

4.0 LIST OF TEST EQUIPMENT

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

Table 4.0-1: Test Equipment

Equipment Calibration Information					
ACS#	**Mfg.**	**Eq. type**	**Model**	**S/N**	**Cal. Due**
☒ 25	Chase	Bi-Log Antenna	CBL6111	1043	5/23/06
☒ 041	ElectroMetrics	Bi-Con Antenna	BIA-25	2925	5/25/06
☒ 090	ElectroMetrics	LPA Antenna	LPA-25	1476	5/27/06
☒ 152	EMCO	LISN	3825/2	9111-1905	2/8/07
☒ 225	Andrew	OATS RF cable	Heliax	225	1/07/07
☒ 165	ACS	Conducted EMI Cable Set	RG8	165	3/07/07
☒ 22	Agilent	Pre-Amplifier	8449B	3008A00526	5/06/06
☒ 73	Agilent	Pre-Amplifier	8447D	272A05624	5/18/06
☒ 30	Spectrum Technologies	Horn Antenna	DRH-0118	970102	5/09/06
☒ 1	Rohde & Schwarz	Receiver Display	804.8932.52	833771/007	3/01/07
☒ 2	Rohde & Schwarz	ESMI Receiver	1032.5640.53	839587/003	3/01/07
☒ 3	Rohde & Schwarz	Receiver Display	804.8932.52	839379/011	11/02/06
☒ 4	Rohde & Schwarz	ESMI Receiver	1032.5640.53	833827/003	11/02/06
☒ ---	Agilent	Spectrum Analyzer	E7405A	US39110103	6/6/06
☒ 168	Hewlett Packard	Pulse Limiter	11947A	3107A02268	3/7/07
☒ 6	Harbour Industries	HF RF Cable	LL-335	00006	3/10/07
☒ 7	Harbour Industries	HF RF Cable	LL-335	00007	3/13/07
☒ 208	Harbour Industries	HF RF Cable	LL142	00208	6/24/06
☒ 167	ACS	Chamber EMI Cable Set	RG6	167	1/7/07
☒ 204	ACS	Chamber EMI RF cable	RG8	204	3/16/06
☒ 16	ACS	Conducted Emission Cable	Cable	16	6/6/06

5.0 SUPPORT EQUIPMENT

Table 5-3: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number	FCC ID
The EUT was tested as a stand alone device and no support equipment was utilized.					

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

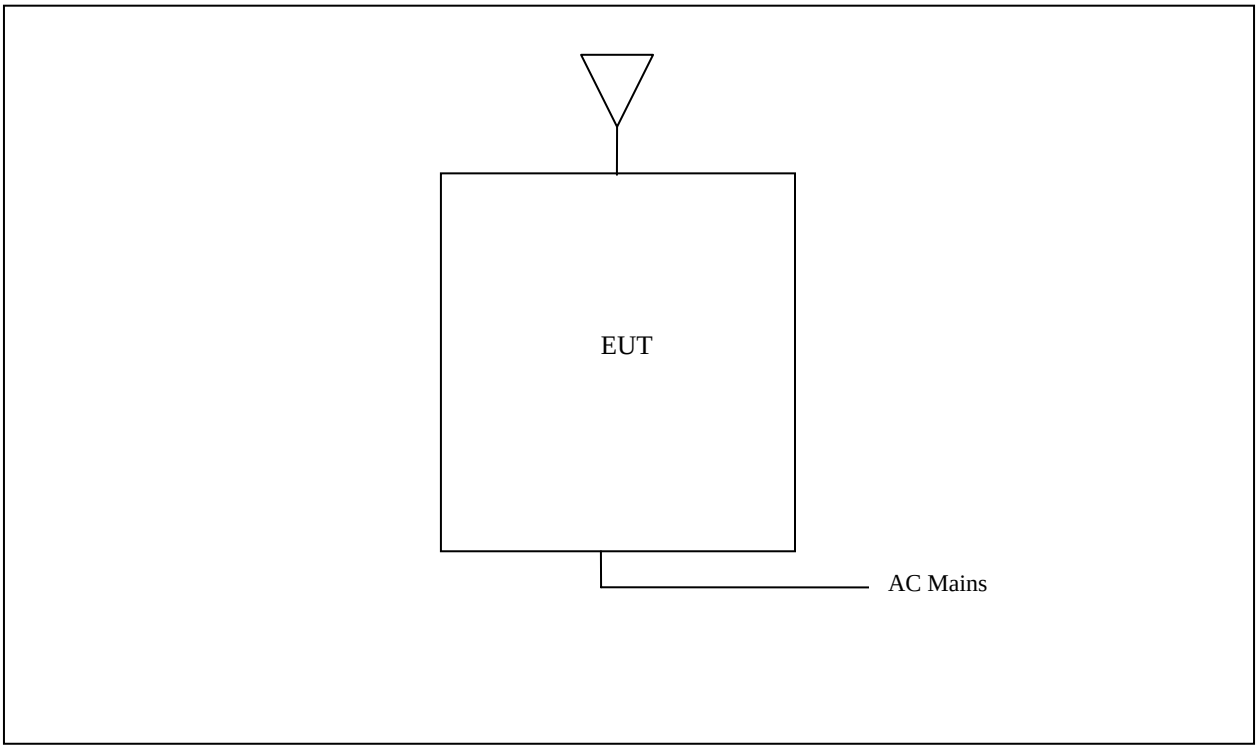

Figure 6.0-1: EUT Test Setup

7.0 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 Section 15.203

The EUT employs an integrated PCB antenna with gain of -12.85dBi typical.

7.2 Power Line Conducted Emissions - FCC Section 15.207

7.2.1 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 calculation for the conducted emissions is as follows:

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

Measurements were made using a peak detector for comparison to the average limits. Results of the test are shown below in and Tables 7.2.2-1 through 7.2.2-4 and Figure 7.2.2-1 through 7.2.2-2.

7.2.2 Test Results

Table 7.2.2-1: Line 1 Conducted EMI Results (Quasi-Peak)

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.192	8.4	9.7	63.9	55.4	L1	FLO
0.360	2.9	9.7	58.7	55.8	L1	FLO
0.648	3.0	9.7	56.0	52.9	L1	FLO
1.320	3.0	9.7	56.0	52.9	L1	FLO
4.836	2.2	9.7	56.0	53.7	L1	FLO
16.776	1.8	9.3	60.0	58.1	L1	FLO
17.214	1.5	9.3	60.0	58.4	L1	FLO
17.256	1.8	9.3	60.0	58.1	L1	FLO
26.490	17.2	8.9	60.0	42.7	L1	FLO
27.216	17.0	8.9	60.0	42.9	L1	FLO

Table 7.2.2-2: Line 1 Conducted EMI Results (Average)

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.192	11.4	9.7	53.9	42.4	L1	FLO
0.360	7.4	9.7	48.7	41.2	L1	FLO
0.642	7.9	9.7	46.0	38.0	L1	FLO
1.308	7.0	9.7	46.0	38.9	L1	FLO
4.836	7.0	9.7	46.0	38.9	L1	FLO
16.650	6.4	9.3	50.0	43.6	L1	FLO
17.274	6.3	9.3	50.0	43.6	L1	FLO
17.310	6.4	9.3	50.0	43.5	L1	FLO
26.490	18.5	8.9	50.0	31.4	L1	FLO
27.168	18.8	8.9	50.0	31.1	L1	FLO

Table 7.2.2-3: Line 2 Conducted EMI Results (Quasi-Peak)

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.192	20.7	9.7	63.9	43.1	L2	FLO
0.642	13.7	9.7	56.0	42.2	L2	FLO
1.188	12.3	9.7	56.0	43.6	L2	FLO
1.458	12.0	9.7	56.0	43.9	L2	FLO
9.528	2.2	9.6	60.0	57.7	L2	FLO
10.002	6.0	9.5	60.0	53.9	L2	FLO
10.326	2.3	9.5	60.0	57.6	L2	FLO
11.316	2.2	9.5	60.0	57.7	L2	FLO
26.490	15.9	8.9	60.0	44.0	L2	FLO
27.798	15.2	8.8	60.0	44.7	L2	FLO

Table 7.2.2-4: Line 2 Conducted EMI Results(Average)

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.192	23.2	9.7	53.9	30.6	L2	FLO
0.642	16.1	9.7	46.0	29.9	L2	FLO
1.188	14.6	9.7	46.0	31.3	L2	FLO
1.458	14.5	9.7	46.0	31.5	L2	FLO
9.510	6.8	9.6	50.0	43.1	L2	FLO
10.002	9.7	9.5	50.0	40.3	L2	FLO
10.230	6.8	9.5	50.0	43.1	L2	FLO
11.358	6.8	9.5	50.0	43.1	L2	FLO
26.490	16.8	8.9	50.0	33.1	L2	FLO
27.798	17.1	8.8	50.0	32.8	L2	FLO

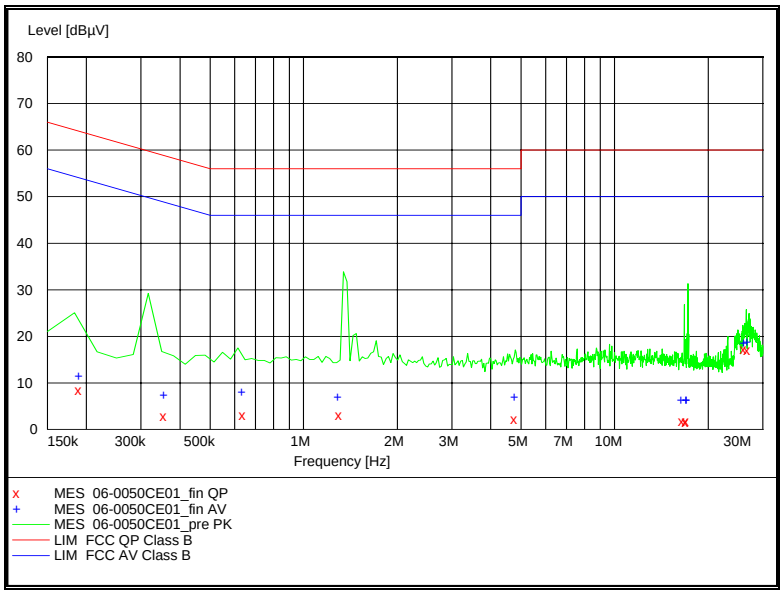

Figure 7.2.2-1: Conducted Emissions Graph – Line 1

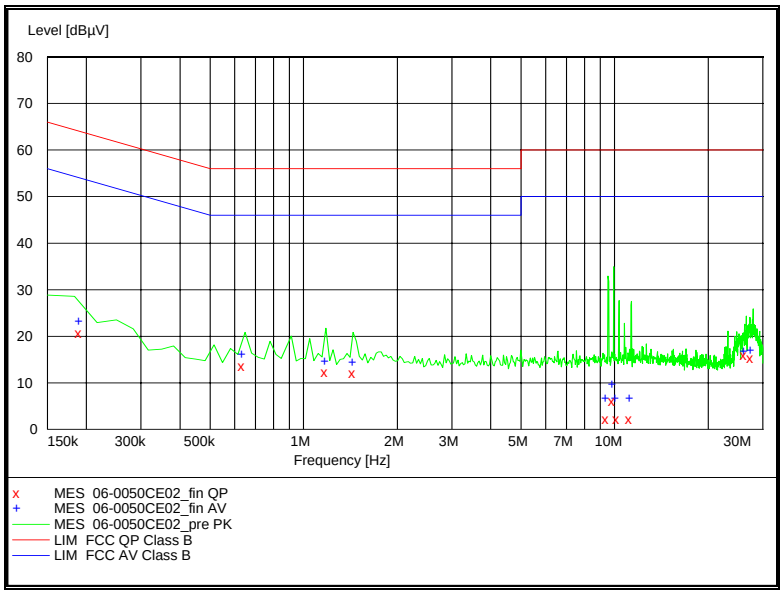

Figure 7.2.2-2: Conducted Emissions Graph – Line 2

7.3 Radiated Emissions - FCC Section 15.109(Unintentional Radiation)

7.3.1 Test Methodology

Radiated emissions tests were performed over the frequency range of 30MHz to 2 GHz. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test (EUT) and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. Radiated measurements were made with the Spectrum Analyzer's resolution bandwidth set to 120 KHz for measurements below 1000MHz. Average measurements are taken with the RBW and VBW were set to 1MHz and 10 Hz respectively for measurements above 1000MHz.

7.3.2 Test Results

Results of the test are given below in Table 7.3.2-1:

Table 7.3-2-1: Radiated Emissions Tabulated Data

Frequency MHz	Level dBµV/m	Transducer dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Polarization (H/V)
464.720	34.5	-7.5	46.0	11.5	110	311	VERTICAL
479.440	29.5	-7.0	46.0	16.5	110	36	VERTICAL
494.240	32.7	-6.8	46.0	13.3	110	26	VERTICAL
508.960	36.7	-6.4	46.0	9.3	110	25	VERTICAL
523.760	37.9	-6.3	46.0	8.1	100	25	VERTICAL
538.480	38.4	-6.0	46.0	7.6	104	321	VERTICAL
553.200	36.8	-5.2	46.0	9.2	104	317	VERTICAL
568.000	37.6	-4.9	46.0	8.4	100	321	VERTICAL
582.720	34.3	-5.2	46.0	11.7	100	317	VERTICAL
641.760	27.4	-3.6	46.0	18.6	100	321	VERTICAL

* Note: All emissions above 641.760 MHz were attenuated at least 20 dB below the permissible limit.

7.4 FCC Section 15.231a (1) – Periodic Operation

7.4.1 Test Methodology

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter after 5 seconds of being released.

The transmitter was activated and evaluated using a spectrum analyzer at zero span. The moment at which the switch was released is indicated in the test results.

7.4.2 Test Results

The transmitter deactivated immediately after the switch was released. The results are shown in Figure 7.4.2-1.

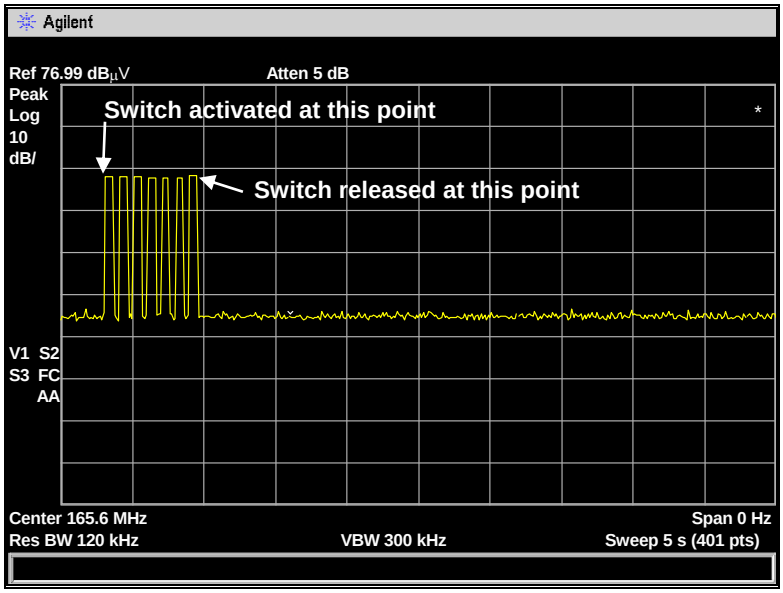

Figure 7.4.2-1

7.5 FCC Section 15.231c - Occupied Bandwidth

7.5.1 Test Methodology

For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

ANSI C63.4 Annex H was the guiding document for this evaluation. Radiated measurements were made with the Spectrum Analyzer's resolution bandwidth set to 120KHz.

7.5.2 Test Results

The 20dB bandwidth was measured as 413.75kHz. 0.25% of the center frequency 372MHz is equivalent to 930kHz. Therefore the 20dB bandwidth of the emission is less than 0.25% of the center frequency. The results are shown in Figure 7.5.2-1.

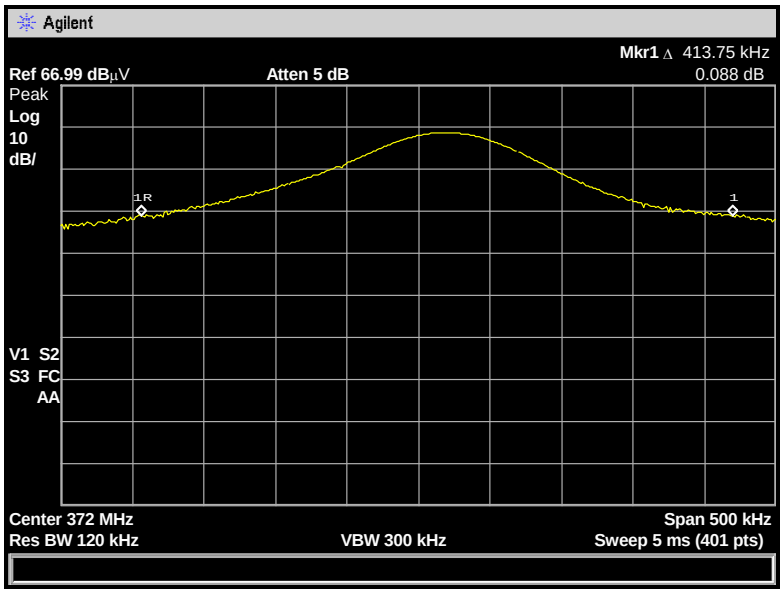

Figure 7.5.2-1

7.6 FCC Section 15.231 (b) – Field Strength of Emissions

7.6.1 Test Methodology

Radiated emissions tests were made over the frequency range of 30MHz to 4GHz, 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. Radiated measurements were made with the Spectrum Analyzer's resolution bandwidth set to 120KHz for measurements below 1000MHz and 1MHz for measurements above 1000MHz. All measurements were made using a peak detector and reduced by the duty cycle correction factor to be applied to the average limits according to 15.35. The provisions of Part 15.205 were also demonstrated were appropriate.

The EUT was modified to operate continuously for this test.

7.6.2 Duty Cycle Correction Factor

For average radiated measurements, the measured level was reduced by a factor 10.45dB to account for the duty cycle of the EUT. The duty cycle was determined to be 30.0% within a 100ms period. The duty cycle correction factor is determined using the formula: 20log (0.300) = -10.45dB. Further justification of the duty cycle can be found in the Theory of Operation contained in this filing.

7.6.3 Test Results

The results for the fundamental and spurious emissions are shown in Table 7.6.3-1

Table 7.6.3-1 - Field Strength of Emissions

Frequency (MHz)	Level (dBuV)	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
				pk	avg	pk	avg	pk	avg
Fundamental Frequency									
372	55.80	H	18.11	73.91	63.46	98.5	78.5	24.59	15.05
372	67.68	V	18.19	85.87	75.42	98.5	78.5	12.63	3.09
Spurious Emissions									
744	55.19	H	-2.14	53.05	42.59	78.5	58.5	25.45	15.91
744	54.84	V	-2.14	52.70	42.24	78.5	58.5	25.80	16.26
1116	52.77	H	-6.99	45.78	35.32	74.0	54.0	28.20	18.66
1116	52.19	V	-6.99	45.20	34.74	74.0	54.0	28.78	19.24
1488	54.32	H	-4.24	50.08	39.63	74.0	54.0	23.90	14.35
1488	51.14	V	-4.24	46.90	36.45	74.0	54.0	27.08	17.53
1860	51.77	H	-1.68	50.09	39.63	78.5	58.5	28.41	18.87
1860	50.82	V	-1.68	49.14	38.68	78.5	58.5	29.36	19.82
2232	53.12	H	0.34	53.46	43.01	74.0	54.0	20.52	10.97
2232	48.94	V	0.34	49.28	38.83	74.0	54.0	24.70	15.15

7.6.4 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

*Amplifier gain was not included in determining the correction factor for the fundamental emission measurement.

Example Calculation: Peak
Corrected Level: 55.19 -2.14 = 53.05 dBuV
Margin: 78.5dBuV – 58.41 dBuV = 25.45 dB

Example Calculation: Average
Corrected Level: 55.19 -2.14 – 10.46= 42.59 dBuV
Margin: 58.5dBuV – 42.59 dBuV = 15.91 dB

8.0 CONCLUSION

In the opinion of ACS, Inc. the Home Access Controller model WDHA-12, manufactured by Wayne-Dalton Corp., meets the requirements of FCC Part 15.231 subpart C.