Electromagnetic Compatibility Test Report

Tests Performed on a DYNACO USA

Wireless Bottom Detector, Models ARF6838 (Receiver) and ARF6803 (Transmitter)

Radiometrics Document RP-7126

ACCREDITED
TESTING CERT #1495.01

Product Detail: FCC ID: A5Y6803 IC: 10163A-ARF6803E Equipment type: Momentarily Operated Transmitter and Receiver
Test Standards: US CFR Title 47, Chapter I, FCC Part 15 Subpart C FCC Part 15 CFR Title 47: 2012 Industry Canada RSS-210, Issue 8: 2010 as required for Category I Equipment This report concerns: Original Grant for Certification FCC Part 15.231

Tests Performed For:	*Test Facility:*
DYNACO USA 935 Campus Drive Mundlein, IL 60060	**Radiometrics Midwest Corporation** 12 East Devonwood Romeoville, IL 60446 (815) 293-0772

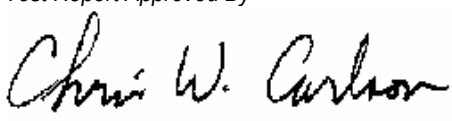
Test Date(s): (Month-Day-Year) September 30, 2011

Document RP-7126A Revisions:

Rev.	Issue Date	Affected Sections	Revised By
0	May 17, 2012		
1	June 5, 2012	All	Joseph Strzelecki
2	June 8, 2012	10.2.1	Joseph Strzelecki

Table of Contents

1 ADMINISTRATIVE DATA

Equipment Under Test: A DYNACO USA, Wireless Bottom Detector Model: ARF6803 and ARF6838 Serial Number: Sample A This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: (Month-Day-Year) 9-27-2011	*Test Date(s): (Month-Day-Year)* September 30, 2011
Test Report Written By: Joseph Strzelecki Senior EMC Engineer	*Test Witnessed By:* The tests were not witnessed by DYNACO USA
Radiometrics' Personnel Responsible for Test:  Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	*Test Report Approved By*  Chris W. Carlson Director of Engineering NARTE EMC-000921-NE

2 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a Wireless Bottom Detector, Models ARF6838 (Receiver) and ARF6803 (Transmitter), manufactured by DYNACO USA. The detailed test results are presented in a separate section. The following is a summary of the test results.

Emissions Tests Results

Environmental Phenomena	Frequency Range	Basic Standard	Test Result
RF Radiated Emissions	30-9000 MHz	RSS-210 & FCC Part 15	Pass
Conducted Emissions, AC Mains	0.15 - 30 MHz	RSS-210 & FCC Part 15	Pass
Occupied Bandwidth Test	Fundamental Freq.	RSS-210 & FCC Part 15	Pass

Note: The RSS-210 specification is not currently covered in Radiometrics' Scope of Accreditation. This is technically very similar to FCC, CFR 47 Part 15 which is on Radiometrics scope.

2.1 RF Exposure Compliance Requirements

Since the power output is 10 uW, the EUT meets the FCC requirement for RF exposure and it is exempt from RSS-102. There are no power level adjustments and the antenna is permanently attached. The detailed calculations for RF Exposure are presented in a separate document.

3 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a Wireless Bottom Detector, Models ARF6838 (Receiver) and ARF6803 (Transmitter), manufactured by DYNACO USA. The EUT was in good working condition during the tests, with no known defects.

3.1.1 FCC Section 15.203 & RSS-GEN Antenna Requirements

The antenna is permanently attached to the PCB via a trace on the circuit board. The antenna is internal to the EUT and it is not readily available to be modified by the end user. Therefore it meets the 15.203 Requirements.

3.2 Related Submittals

DYNACO USA is not submitting any other products simultaneously for equipment authorization related to the EUT.

4 TESTED SYSTEM DETAILS

4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations.

The receiver was supplied at 115 VAC, 60 Hz single-phase to an external linear power supply. The transmitter was supplied with a new battery.

The identification for all equipment, plus descriptions of all cables used in the tested system, are:

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	Open Loop Receiver	E	DYNACO USA	ARF6838	Sample A
2	Open Loop Transmitter	E	DYNACO USA	ARF6803	Sample A

* Type: E = EUT, P = Peripheral, S = Support Equipment; H = Host Computer

List of System Cables

QTY	Length (m)	Cable Description	Shielded?
1	1.0	24 VDC Cord from transformer to ARF6838	No
1	1.0	Antenna Cable to ARF6838	No
1	1.0	Unterminated, 3 wire, Relay Cable to ARF6838	No
1	1.0	Door Sensor wire to ARF6803	No

4.2 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

4.3 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

5 TEST SPECIFICATIONS AND RELATED DOCUMENTS

Document	Date	Title
FCC CFR Title 47	2012	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices
ANSI C63.4-2003	2003	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
IC RSS-210 Issue 8	2010	Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands) Category I Equipment
IC RSS-Gen Issue 3	2010	General Requirements and Information for the Certification of Radiocommunication Equipment (RSS-Gen)

The test procedures used are in accordance with the Industry Canada RSS-GEN and ANSI document C63.4-2003, "Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The specific procedures are described herein. Radiated testing was performed at an antenna to EUT distance of 3 meters. The antenna was raised and lowered from 1 to 4 meters.

6 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 2005 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the test methods listed herein. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la2.org).

The following is a list of shielded enclosures located in Romeoville, Illinois used during the tests:

Chamber A: Is an anechoic chamber that measures 24' L X 12' W X 12' H. The walls and ceiling are fully lined with ferrite absorber tiles. The floor has a 10' x 10' section of ferrite absorber tiles located in the center. Panashield of Rowayton, Connecticut manufactured the chamber. The enclosure is NAMAS certified.

Chamber E: Is a custom made anechoic chamber that measures 52' L X 30' W X 18' H. The walls and ceiling are fully lined with RF absorber. Pro-shield of Collinsville, Oklahoma manufactured the chamber.

Test Station F: Is an area that measures 10' D X 12' W X 10' H. The floor and back wall are metal shielded. This area is used for conducted emissions measurements.

A separate ten-foot long, brass plated, steel ground rod attached via a 6 inch copper braid grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

The FCC has accepted these sites as test site number US1065. The FCC test site Registration Number is 732175. Details of the site characteristics are on file with the Industry Canada as site number IC3124A-1.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

7 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

8 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification and the data contained herein was taken with calibrated test equipment. The results relate only to the EUT listed herein.

9 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
AMP-05	RMC/Celeritek	Pre-amplifier	MW110G	1001	1.0-12GHz	12 Mo.	01/19/11
AMP-22	Anritsu	Pre-amplifier	MH648A	M23969	0.1-1200MHz	12 Mo.	01/18/11
ANT-13	EMCO	Horn Antenna	3115	2502	1.0-18GHz	24 Mo.	11/18/10
ANT-44	Impossible Machine	Super Log Antenna	SL-20M2G	1002	20-2000MHz	24 Mo.	11/25/09
ANT-48	RMC	Std Gain Horn	HW2020	1001	18-26 GHz	12 Mo.	04/05/11
ANT-53	EMCO	Loop Antenna	6507	1453	1 kHz-30 MHz	24 Mo	11/04/09
HPF-01	Solar	High Pass Filter	7930-100	HPF-1	0.15-30MHz	24 Mo.	10/27/09
HPF-03	Mini-Circuits	High Pass Filter	VHP-39	HPF-03	3-10 GHz	24 Mo.	10/27/09
LSN-01	Electrometrics	50 uH LISN	FCC/VDE 50/2	1001	0.01-30MHz	24 Mo.	06/14/11
PRE-01	Hewlett Packard	Preselector	85685A	2510A00143	20 Hz-2GHz	12 Mo.	10/29/10
REC-01	Hewlett Packard	Spectrum Analyzer	8566A	2106A02115, 2209A01349	30Hz-22GHz	12 Mo.	10/29/10
REC-03	Anritsu	Spectrum Analyzer	MS2601B	MT94589	0.01-2200MHz	12 Mo.	03/18/11
REC-07	Anritsu	Spectrum Analyzer	MS2601A	MT53067	0.01-2200MHz	12 Mo.	01/21/11
THM-02	Fluke	Temp/Humid Meter	971	93490471	N/A	24 Mo.	04/01/10

Note: All calibrated equipment is subject to periodic checks.

10 TEST SECTIONS

10.1 AC Conducted Emissions

The tests and limits are in accordance with FCC section 15.207 and RSS Gen section 7.2.2.

A computer-controlled analyzer was used to perform the conducted emissions measurements. The frequency range was divided into 500 subranges equally spaced on a logarithmic scale. The computer recorded the peak of each subrange. This data was then plotted on semi-log graph paper generated by the computer and plotter. Adjusting the positions of the cables and orientation of the test system then maximizes the highest emissions.

Mains Conducted emission measurements were performed using a 50 Ohm/50 uH Line Impedance Stabilization Network (LISN) as the pick-up device. Measurements were repeated on both leads within the power cord. If the EUT power cord exceeded 80 cm in length, the excess length of the power cord was made into a 30 to 40 cm bundle near the center of the cord. The LISN was placed on the floor at the base of the test platform and electrically bonded to the ground plane.

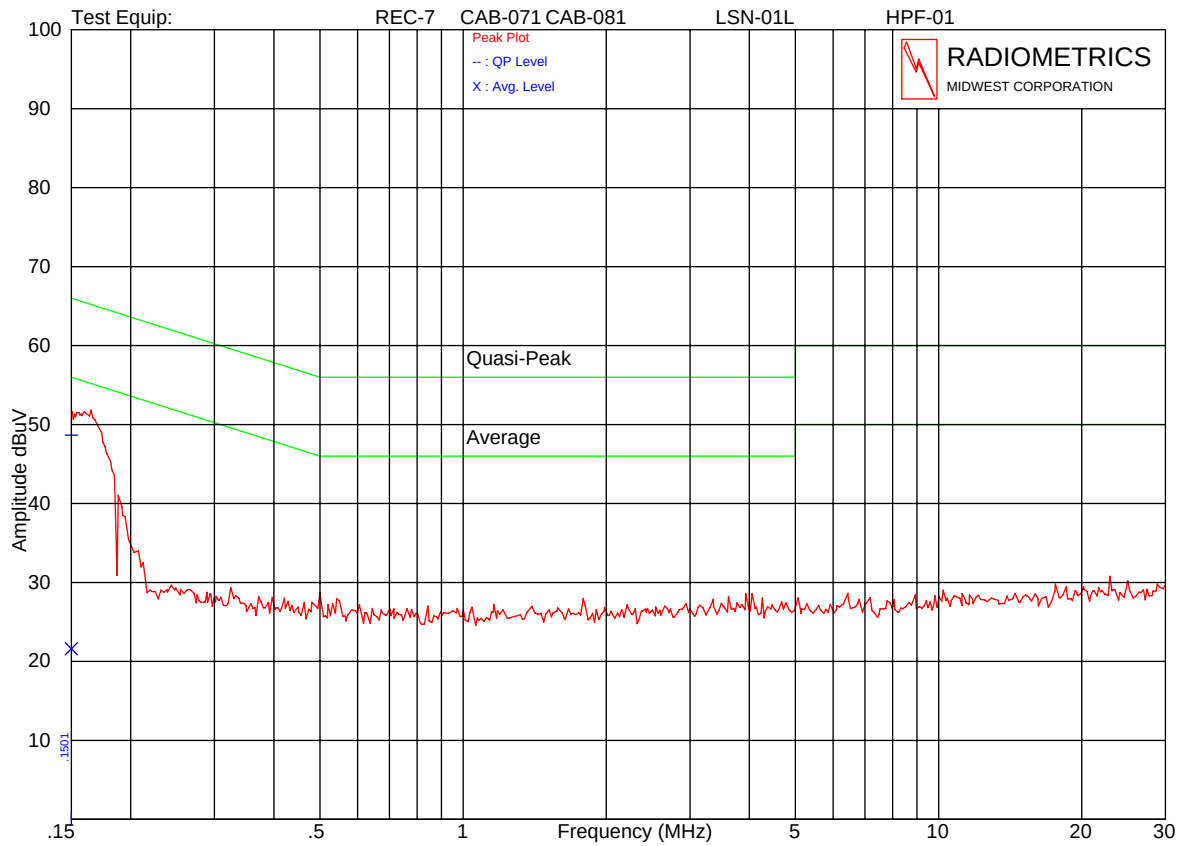
FCC Limits of Conducted Emissions at the AC Mains Ports

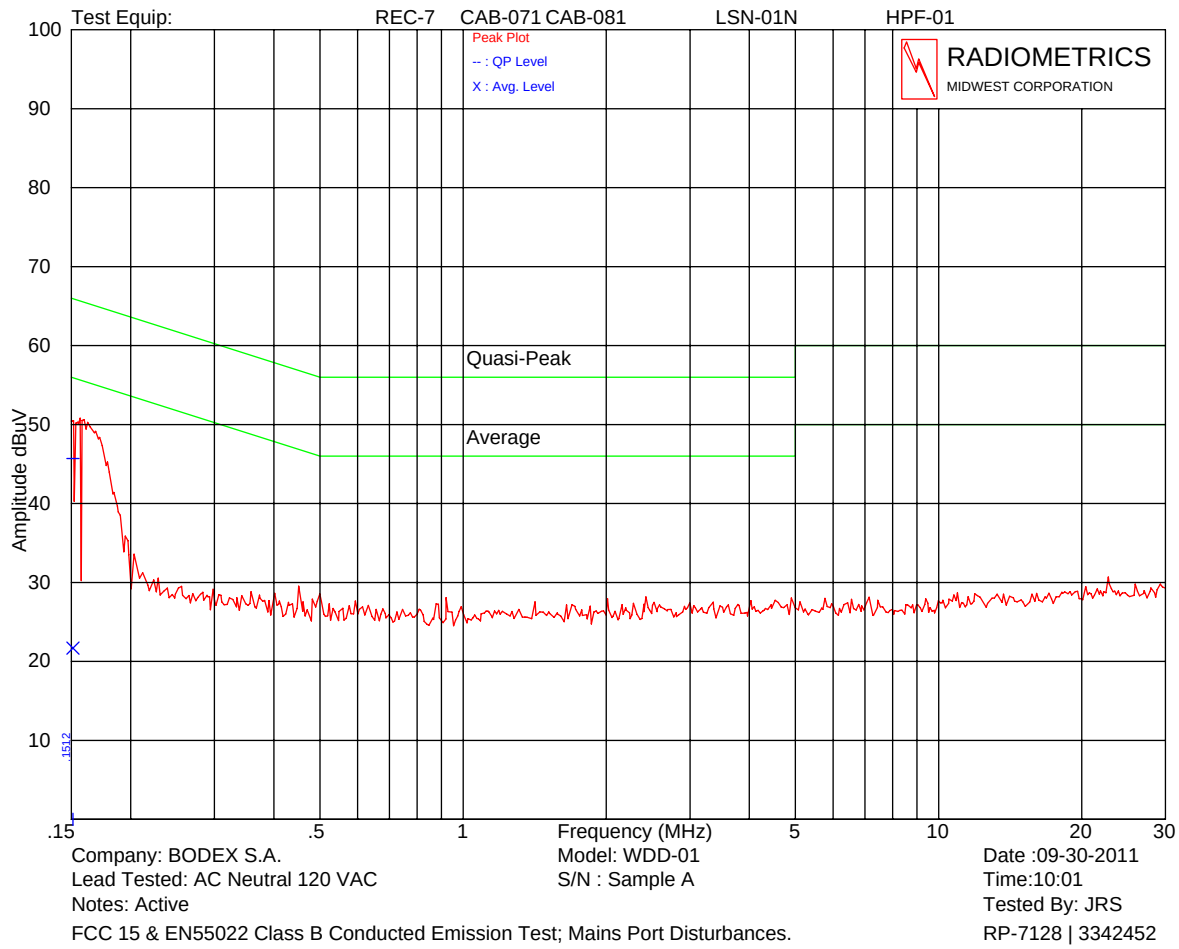
Frequency Range (MHz)	Class B Limits (dBuV)	
	Quasi-Peak	Average
0.150 - 0.50*	66 - 56	56 - 46
0.5 – 5.0	56	46
5.0 - 30	60	50
* The limit decreases linearly with the logarithm of the frequency in this range.		

The initial step in collecting conducted data is a peak detector scan and the plotting of the measurement range. Significant peaks are then marked as shown on the following table, and these signals are then measured with the quasi-peak detector. The following represents the worst case emissions from the power cord, after testing all modes of operation.

Test Date : September 30, 2011
The Amplitude is the final corrected value with cable and LISN Loss.

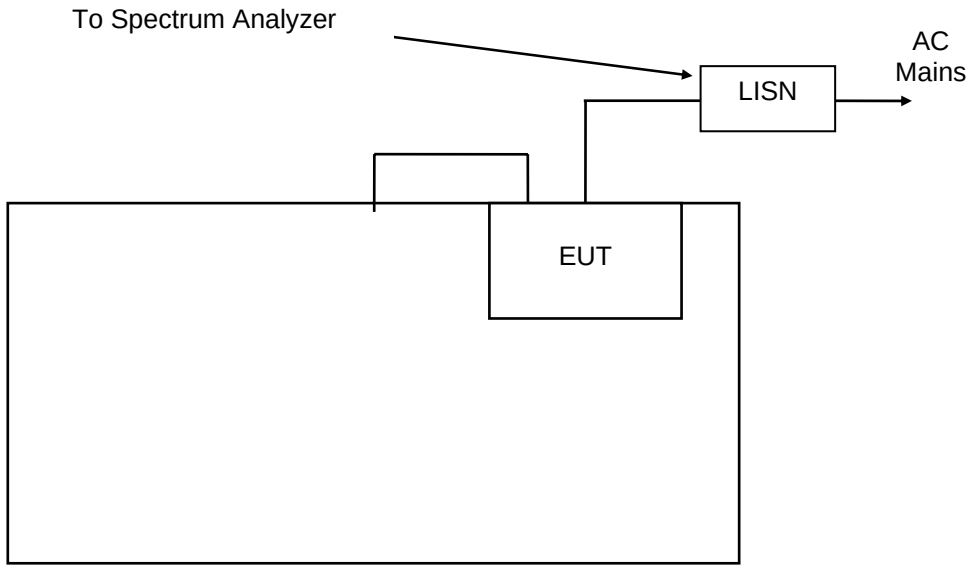
This test is only applicable to the Receiver.


Test Equip: REC-7 CAB-071 CAB-081 LSN-01L HPF-01
Peak Plot
-- : QP Level
X : Avg. Level
RADIOMETRICS
MIDWEST CORPORATION
Quasi-Peak
Average
Amplitude dBuV
100
90
80
70
60
50
40
30
20
10
.15
.5
1
5
10
20
30
Frequency (MHz)
Company: BODEX S.A.
Lead Tested: AC Hot 120 VAC
Notes: Active
Model: WDD-01
S/N : Sample A
Date :09-30-2011
Time:09:58
Tested By: JRS
FCC 15 & EN55022 Class B Conducted Emission Test; Mains Port Disturbances.
RP-7128 | 0554732



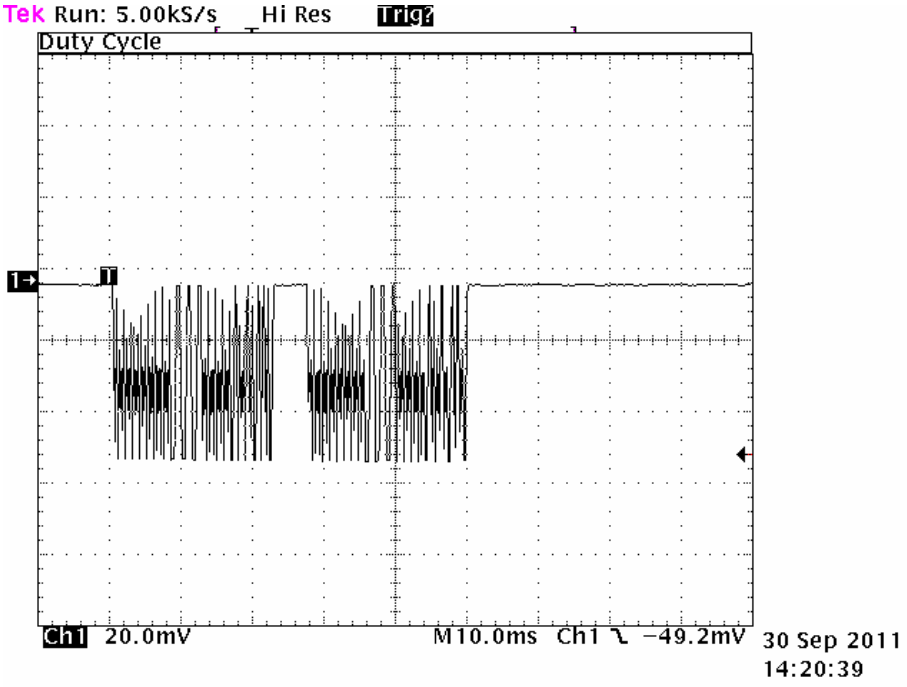
Judgment: Passed by at least 10 dB

Figure 1. Conducted Emissions Test Setup



Notes:
- LISN's at least 80 cm from EUT chassis
- Vertical conductive plane 40 cm from rear of table top
- EUT power cord bundled

10.2 Time of Occupancy (Dwell Time)



The pulse trains shown above are 22 mS. It could be up to 28.5 mS.

The Peak to average factor is calculated by the highest duty cycle over any 100mS transmission. The EUT has at most 2 pulse trains every 100 mSec. Each train is 28 mSeconds long with a 50% duty cycle within the pulse train. Therefore the maximum total on time for any 100 mSec time period is 28.5 mSec. The peak to average factor is 20*Log(22/100) = 10.9 dB.

10.2.1 Deactivation Time

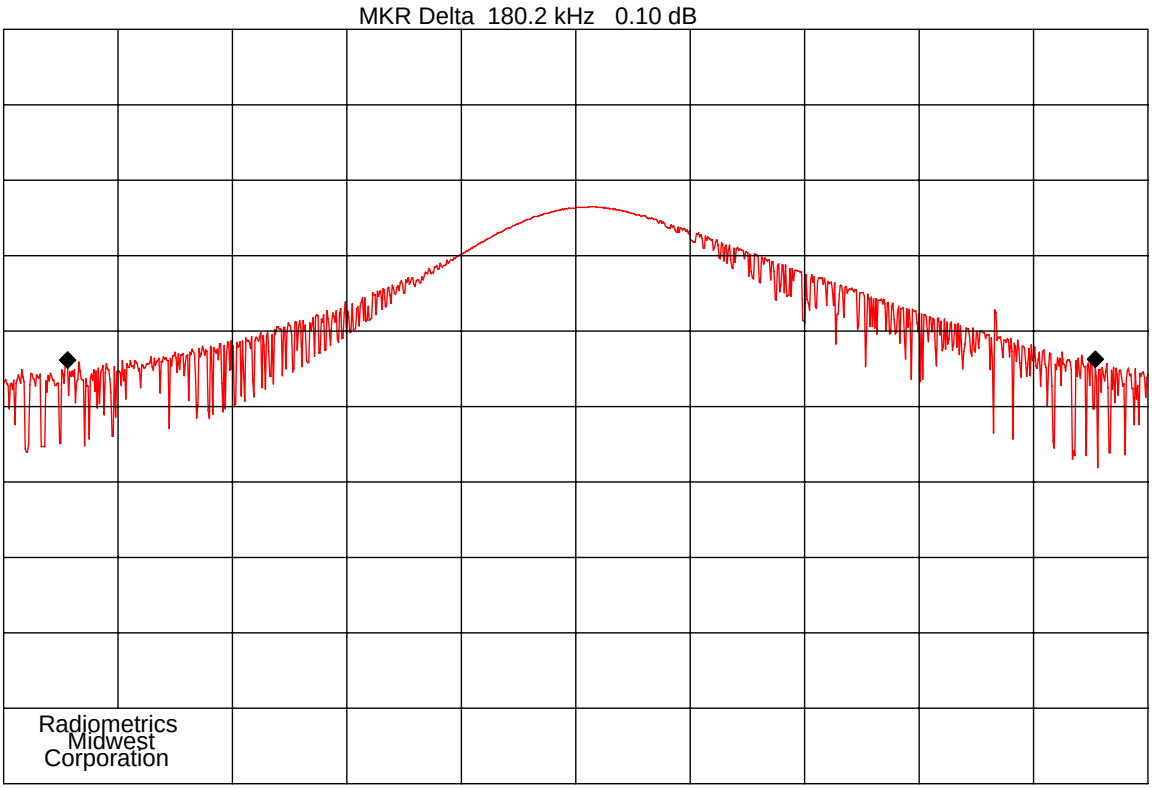
This device activates when only when an obstruction is detected. On each activation of the transmitter, the frame of “22ms” is sent 4 times. The OFF time between the repetitions is selected from the following values: 5ms, 30ms, 60ms, 90ms, 120ms, 150ms, 180ms et 240ms. Thus, the minimum off time between 2 pulse trains is 5ms and maximum 240ms. The worst case is 4 x 22ms + 3 x 240ms = 808 ms. Therefore, the transmitter automatically deactivates within the 5 second limit.

10.3 Occupied Bandwidth

The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The EUT was transmitting at its maximum data rate. The trace was allowed to stabilize.

The marker-to-peak function was set to the peak of the emission. Then the marker-delta function was used to measure 6 or 20 dB down one side of the emission. The marker-delta function was reset and then moved to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the bandwidth of the emission.

Channel	20 dB EBW kHz	Limit kHz
868.35	180	2170



10.4 Radiated RF Emissions

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. The radiated emission measurements were performed with a spectrum analyzer. The bandwidth used from 150 kHz to 30 MHz is 9 or 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. Above 1 GHz, a 1 MHz bandwidth is used. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists.

From 30 to 1000 MHz, an Anritsu spectrum analyzer was used. For tests from 1 to 9 GHz, an HP 8566 spectrum analyzer was used. For tests from 1 to 10 GHz, a high pass filter was used to reduce the fundamental emission. A harmonic mixer was used from 18 to 25 GHz. Figure 4 herein lists the details of the test equipment used during radiated emissions tests.

The EUT was rotated through three orthogonal axis as per 13.1.4.1 of ANSI C63.4 during the radiated tests.

Radiated emissions measurements were performed inside of an anechoic chamber at a test distance of 3 meters. The anechoic chamber is designated as Chamber E. This Chamber meets the Site Attenuation requirements of ANSI C63.4 and CISPR 16-1. Chamber E is located at 12 East Devonwood Ave. Romeoville, Illinois EMI test lab.

The entire frequency range from 30 to 9000 MHz was slowly scanned with particular attention paid to those frequency ranges which appeared high. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded. All measurements may be performed using either the peak, average or quasi-peak detector functions. If the peak detector data exceeds or is marginally close to the limits, the measurements are repeated using a quasi-peak detector or average function as required by the specification for final determination of compliance.

The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground.

10.4.1 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + CF - AG + PKA

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain
PKA = Peak to Average Factor (This is zero for non-average measurements)

The Peak to average factor is used when average measurements are required. It is calculated by the highest duty cycle in percent over any 100mS transmission. The factor in dB is 20 * Log(Duty cycle/100).

10.4.2 Transmitter Radiated Emissions Test Results

Manufacturer	DYNACO USA	Specification	FCC Part 15.231 & RSS-210
Model	ARF6803	Test Date	09/30/2011
Serial Number	Sample A	Test Distance	3 Meters

Specification	FCC Part 15 Subpart C & RSS-210
Abbreviations	P = peak; Q = QP Pol = Antenna Polarization; V = Vertical; H = Horizontal; For Antenna Type Bi-Log = (ANT-44); Horn = (ANT-13)

This table includes Emissions below 1 GHz except for fundamental.

Freq. MHz	Meter Reading dBuV	Antenna Factor dB	Antenna Pol/ Type	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
63.6	30.2P	9.5	V/44	-28.5	11.2	40.0	28.8
96.0	34.7P	8.7	V/44	-28.2	15.2	43.5	28.3
120.0	32.2P	14.4	V/44	-28.2	18.4	43.5	25.1
133.2	29.9P	12.8	V/44	-28.2	14.5	43.5	29.0
350.6	38.8P	14.9	V/44	-27.8	25.9	46.0	20.1
839.2	30.4P	21.9	V/44	-26.2	26.1	46.0	19.9
33.2	32.3P	16.2	H/44	-28.7	19.8	40.0	20.2
93.6	31.0P	8.3	H/44	-28.2	11.1	43.5	32.4
120.0	30.3P	14.4	H/44	-28.2	16.5	43.5	27.0

942.4	24.2P	22.4	H/44	-25.5	21.1	46.0	24.9

Transmitter emissions from 860 MHz to 9 GHz

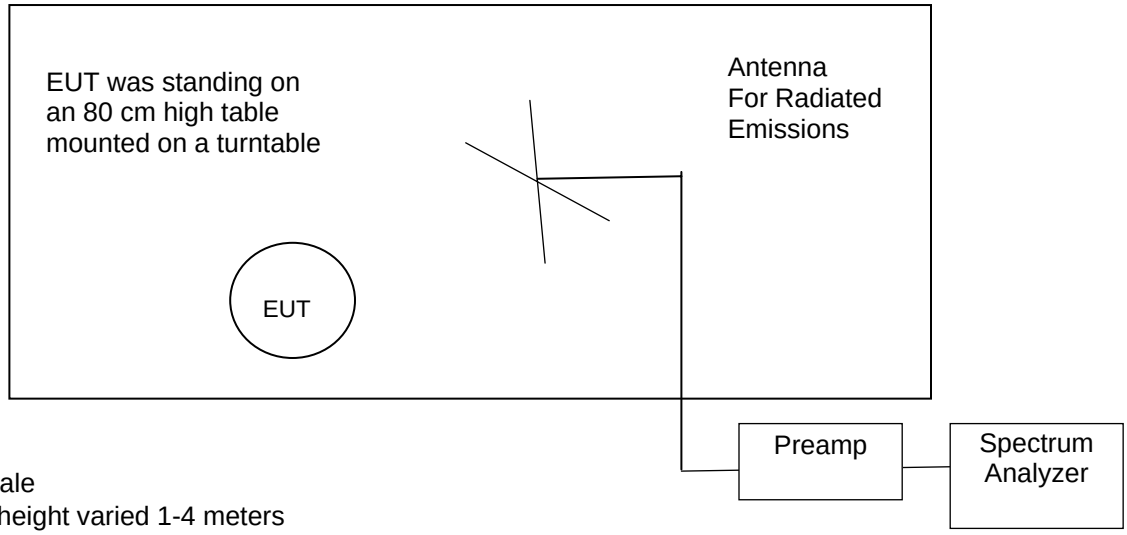
		Spectrum Analyzer					EUT					Margin
hrm	Tx	Readings				Corr.	Emission	Tot. FS		Limit		Under
		Vertical Pol		Horizontal Polarization		Fact.	Freq MHz	dBuV/m		dBuV/m		Limit
#	Freq	Peak	Ave	Peak	Ave	dB	MHz	Peak	Ave	Peak	Ave	dB
1	868.3	61.0	50.1	64.2	53.3	23.5	868.3	87.7	76.8	101.9	81.9	5.1
2	868.3	48.6	37.7	50.3	39.4	0.7	1736.6	51.0	40.1	81.9	61.9	21.8
3	868.3	48.4	37.5	52.3	41.4	4.1	2604.9	56.4	45.5	81.9	61.9	16.4
4	868.3	36.2	25.3	35.7	24.8	7.2	3473.2	43.4	32.5	81.9	61.9	29.4
5	868.3	34.9	24.0	34.1	23.2	9.6	4341.5	44.5	33.6	74.0	54.0	20.4
6	868.3	35.7	24.8	33.4	22.5	11.4	5209.8	47.1	36.2	81.9	61.9	25.7
7	868.3	34.5	23.6	34.5	23.6	12.8	6078.1	47.3	36.4	81.9	61.9	25.5
8	868.3	33.8	22.9	34.9	24.0	15.0	6946.4	49.9	39.0	81.9	61.9	22.9
9	868.3	33.2	22.3	34.4	23.5	16.8	7814.7	51.2	40.3	81.9	61.9	21.6
10	868.3	33.0	22.1	33.9	23.0	20.0	8683.0	53.9	43.0	81.9	61.9	18.9
Column numbers (see below for explanations)												
1	2	3	4	5	6	7	8	9	10	11	12	13

Column #1. hrm = Harmonic
Column #2. Frequency of Transmitter.
Column #3. Uncorrected readings from the spectrum analyzer Vertical Polarization
Column #4. Average Reading based on peak reading reduced by the Duty cycle correction
Column #5. Uncorrected readings from the spectrum analyzer Horizontal Polarization
Column #6. Average Reading based on peak reading reduced by the Duty cycle correction
Column #7. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor
Column #8. Frequency of Tested Emission
Column #9. Highest peak field strength at listed frequency.
Column #10. Highest Average field strength at listed frequency.
Column #11. Peak Limit.
Column #12. Average Limit.
Column #13. The margin (last column) is the worst case margin under the peak or average limits for that row.

Judgment: Passed by 5.1 dB

Figure 2. Drawing of Radiated Emissions Setup

Chamber E, anechoic



Notes:
- Not to Scale
- Antenna height varied 1-4 meters
- Distance from antenna to tested system is 3 meters
- AC cords not shown. They are connected to AC outlet with low-pass filter on turntable

Frequency Range	Receive Antenna	Pre-Amplifier	Spectrum Analyzer
0.01 to 30 MHz	ANT-53	None	REC-03
30 to 1000 MHz	ANT-44	AMP-33	REC-03
1 to 10 GHz	ANT-13	AMP-05	REC-01

10.5 Unintentional Emissions (Receiver)

Manufacturer	DYNACO USA	Specification	FCC Part 15.207 & RSS-210
Model	ARF6838	Test Date	07/20/2011
Serial Number	A	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; P = peak; Q = QP		
Notes	Corr. Factors = Cable Loss – Preamp Gain – Duty Cycle Factor + HP Filter Loss		
Configuration	Receive mode		

Freq. MHz	Meter Reading dBuV	Dect. Type	Antenna		Corr. Factors dB	Field Strength dBuV/m		Margin Under Limit dB
			Factor dB	Pol/ ID#		EUT	Limit	
33.2	33.9	P	16.2	H/44	-28.7	21.4	40.0	18.6
96.0	30.4	P	8.7	H/44	-28.2	10.9	43.5	32.6
120.0	29.4	P	14.4	H/44	-28.2	15.6	43.5	27.9
216.0	28.7	P	11.2	H/44	-27.9	12.0	46.0	34.0
286.2	29.4	P	12.7	H/44	-27.8	14.3	46.0	31.7
295.8	29.1	P	12.8	H/44	-27.8	14.1	46.0	31.9
378.2	28.5	P	14.7	H/44	-27.9	15.3	46.0	30.7
390.1	29.1	Q	15.1	H/44	-27.9	16.3	46.0	29.7
390.2	34.7	P	15.1	H/44	-27.9	21.9	46.0	24.1
399.8	28.1	P	15.7	H/44	-27.9	15.9	46.0	30.1
34.8	29.4	P	16.1	V/44	-28.7	16.8	40.0	23.2
63.2	29.5	P	9.6	V/44	-28.5	10.6	40.0	29.4
82.4	30.1	P	7.1	V/44	-28.3	8.9	40.0	31.1
93.6	34.8	P	8.3	V/44	-28.2	14.9	43.5	28.6
96.0	34.7	P	8.7	V/44	-28.2	15.2	43.5	28.3
120.0	35.0	P	14.4	V/44	-28.2	21.2	43.5	22.3
133.2	31.4	P	12.8	V/44	-28.2	16.0	43.5	27.5
170.8	29.0	P	9.5	V/44	-28.1	10.4	43.5	33.1
221.6	28.9	P	11.5	V/44	-27.9	12.5	46.0	33.5
254.6	30.9	P	13.0	V/44	-27.9	16.0	46.0	30.0
403.8	28.6	P	15.9	V/44	-27.8	16.7	46.0	29.3
763.0	26.0	P	20.5	V/44	-26.8	19.7	46.0	26.3