

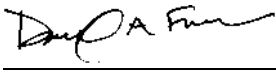


Engineering Solutions & Electromagnetic Compatibility Services

**Modular Approval Certification Application Report
FCC Part 15.249 & Industry Canada RSS-210**

Test Lab: Rhein Tech Laboratories, Inc. Tel: 703-689-0368 360 Herndon Parkway Fax: 703-689-2056 Suite 1400 www.rheintech.com Herndon, VA 20170 E-Mail: atcbinfo@rheintech.com		Applicant: Alarm.com Tel: 703-584-7319 8281 Greensboro Drive Suite 100 Tysons, VA 22102	
FCC ID	YL6-143620T	Test Report Date	September 21, 2016
IC	9111A-143620T	RTL Work Order #	2016169
Model	ADC-620T	RTL Quote #	QRTL16-169A
American National Standard Institute	ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
FCC Classification	DXT – Part 15 Low Power Transceiver		
FCC Rule Part(s)/ Guidance	15.249: Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz (10/01/2015)		
Industry Canada	RSS-210 Issue 9: Licence-Exempt Radio Apparatus: Category I Equipment		
Digital Interface Information	Digital Interface was found to be compliant		
Frequency Range (MHz)	Output Power (W)	Frequency Tolerance	Emission Designator
908.4	N/A	N/A	92K7F1D

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards. Furthermore, there was no deviation from, additions to, or exclusions from, the applicable parts of FCC Part 2, FCC Part 15, RSS-210, and ANSI C63.10.

Signature: 

Date: September 21, 2016

Typed/Printed Name: Desmond A. Fraser

Position: President

This report may not be reproduced, except in full, without the written approval of Rhein Tech Laboratories, Inc. and Alarm.com. The test results relate only to the item(s) tested.

These test(s) are accredited under Rhein Tech Laboratories, Inc. ISO/IEC 17025 accreditation issued by ANAB. Refer to certificate and scope of accreditation AT-1445.

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1 General Information

1.1 Scope

This is an original FCC and Industry Canada certification application request for modular approval.

Applicable Standards:

- FCC Part 15.249: Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5875 MHz, and 24.0-24.25 GHz
- Industry Canada RSS-210: Licence-Exempt Radio Apparatus: Category I Equipment

1.2 Description of EUT

Equipment Under Test	Multisensor Transceiver
Model	ADC-620T
Power Supply	3.9VDC
Modulation Type	DTS
Frequency Range	908.4 MHz
Antenna Type	Helical

1.3 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing.

1.4 Related Submittal(s)/Grant(s)

This is an original certification application for Modular Approval for Alarm.com Model ADC-620T, FCC ID: YL6-143620T, IC: 9111A-143620T.

1.5 Modifications

No modifications were made to the equipment during testing.

2 Test Information

2.1 Description of Test Modes

In accordance with FCC 15.31(m), and because the EUT utilizes an operating band greater than 10 MHz, the following frequencies were tested:

Table 2-1: Channels Tested

Frequency (MHz)
908.4

2.2 Exercising the EUT

The EUT was programmed for continuous transmission at 908.4 MHz. The EUT was tested in all three orthogonal planes in order to determine worst-case emissions. The carrier was also checked to verify that information was being transmitted.

2.3 Test Result Summary

Table 2-2: Test Result Summary

FCC Reference	IC Reference	Test	Pass/Fail or N/A
15.207	RSS-Gen Issue 4 8.8	AC Power Conducted Emissions	Pass
15.209	RSS-Gen Issue 4 8.9/8.10	Radiated Emissions	Pass
15.249(a)	RSS-210 Issue 9 B.10	Field Strength of Fundamental and Harmonics	Pass
N/A	RSS-Gen 6.6	99% Bandwidth	Pass

2.4 Test System Details

The test samples were received on August 22, 2016. The FCC identifiers for all applicable equipment, plus descriptions of all cables used in the tested system, are identified in the following table.

Table 2-3: Equipment Under Test

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
Transceiver (conducted port)	Alarm.com	ADC-620T	N/A	YL6-143620T	N/A	22120
Transceiver (radiated emissions)	Alarm.com	ADC-620T	N/A	YL6-143620T	N/A	22121

Table 2-4: Auxiliary Equipment

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
DC Supply	Hewlett Packard	6291A	1928A05365	N/A	Unshielded	90773

2.5 Configuration of Tested System

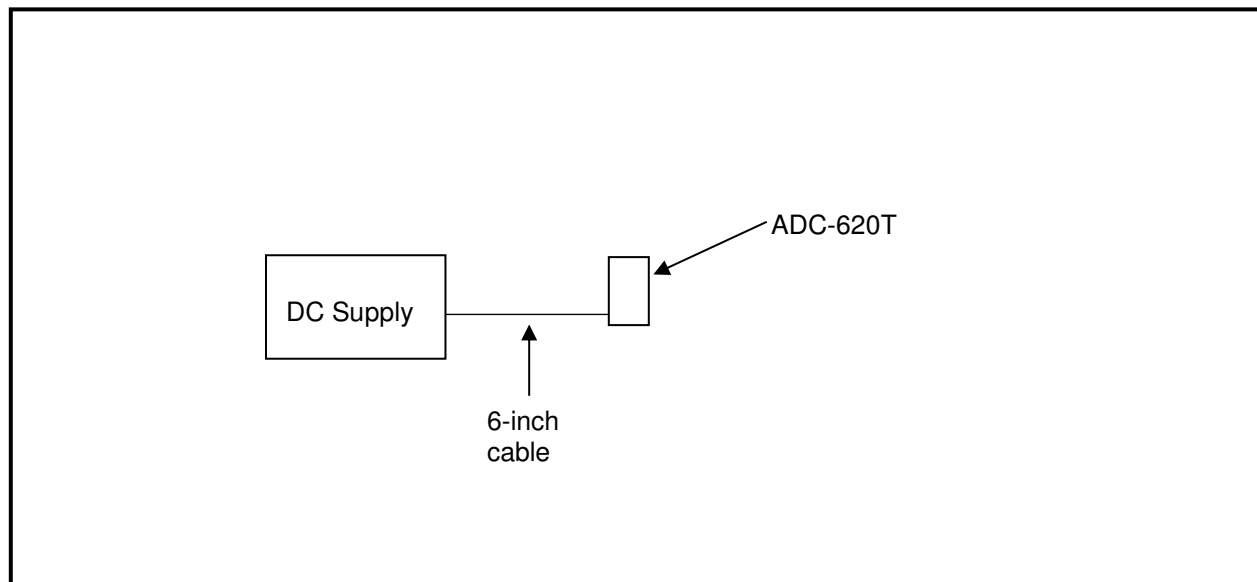


Figure 2-1: Configuration of System Under Test

3 Radiated Emissions – FCC 15.209, 15.249(a); RSS-210 B.10; RSS-Gen

3.1 Limits of Radiated Emissions Measurement

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009-0.490	2400/f (kHz)	300
0.490-1.705	2400/f (kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

As shown in 15.35(b), for frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any circumstances of modulation.

3.1.1 Radiated Emissions Measurement Test Procedure

Before final measurements of radiated emissions were made on the open-field three/ten meter range, the EUT was scanned indoors at one and three meter distances. This was done in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to ensure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three/ten-meter, open-field test site. The EUT was placed on a nonconductive turntable 0.8 m (< 1 GHz) / 1.5 m (> 1 GHz) above the ground plane. The spectrum was examined from 9 kHz to the 10th harmonic of the highest fundamental transmitter frequency (9.08 GHz).

At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations. For frequencies between 30 and 1000 MHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. For emissions above 1000 MHz, emissions are measured using the average detector function with a minimum resolution bandwidth of 1 MHz. No video filter less than 10 times the resolution bandwidth was used. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

Table 3-1: Radiated Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900905	Rhein Tech Laboratories, Inc.	PR-1040	Amplifier (20 MHz - 2 GHz)	900905	9/11/16
900791	Chase	CBL6112	Antenna (30 MHz – 2 GHz)	2099	6/11/17
900913	Hewlett Packard	85462A	EMI Receiver RF Section (9 kHz - 6.5 GHz)	3325A00159	12/9/16
900914	Hewlett Packard	85460A	RF Filter Section (100 kHz - 6.5 GHz)	3330A00107	12/9/16
N/A	Rhein Tech Laboratories, Inc.	Automated Emission Tester	Emissions Testing Software	Rev. 14.0.2	N/A
900339	Hewlett Packard	85650A	Quasi-Peak Adapter	2521A00743	3/8/18
900930	Hewlett Packard	85662A	Spectrum Analyzer Display Section	3144A20839	4/21/17
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	4/21/17
900932	Rhein Tech Laboratories	8449B OPT H02	Amplifier (1 – 26.5 GHz)	3008A00505	9/11/16
900772	EMCO	3161-02	Horn	9804-1044	4/9/18
900321	EMCO	3161-03	Horn	9528-1020	4/9/18
900323	EMCO	3160-07	Horn	9605-1024	4/9/18

3.2 Radiated Emissions Test Results

Table 3-2: Radiated Emissions Test Data

Emission Frequency (MHz)	Peak Detector Level (dBuV/m) (1 MHz RBW/10 Hz VBW)	Site Correction Factor (dB/m)	Peak Corrected (dBuV/m)	QP Limit (dBuV/m)	Margin (dB)
908.42	70.5	23.3	93.8	94.0	-0.2

* testing performed at 3m

3.3 Radiated Emissions Harmonics/Spurious Test Data

Table 3-3: Radiated Emissions Harmonics/Spurious – 908.4 MHz – Peak

Emission Frequency (MHz)	Peak Detector (dBuV/m) (1 MHz RBW/VBW)	Site Correction Factor (dB/m)	Peak Corrected (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
1816.840	35.7	6.4	42.1	74.0	-31.9
2725.260	52.1	-15.3	36.8	74.0	-37.2
3633.680	52.1	-13.8	38.3	74.0	-35.7
4542.100	40.9	-7.4	33.5	74.0	-40.5
5450.520	35.5	-6.2	29.3	74.0	-44.7
6358.940	41.0	-4.6	36.4	74.0	-37.6
7267.390	46.3	-4.3	42.0	74.0	-32.0
8175.780	48.0	2.0	50.0	74.0	-24.0
9084.200	39.4	3.0	42.4	74.0	-31.6

Table 3-4: Radiated Emissions Harmonics/Spurious – 908.4 MHz - Average

Emission Frequency (MHz)	Average Detector (dBuV/m) (1 MHz RBW/ 10 Hz VBW)	Site Correction Factor (dB/m)	Average Corrected (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
1816.840	32.0	6.4	38.4	54.0	-15.6
2725.260	49.2	-15.3	33.9	54.0	-20.1
3633.680	46.2	-13.8	32.4	54.0	-21.6
4542.100	34.2	-7.4	26.8	54.0	-27.2
5450.520	25.9	-6.2	19.7	54.0	-34.3
6358.940	34.0	-4.6	29.4	54.0	-24.6
7267.360	38.8	-4.3	34.5	54.0	-19.5
8175.780	41.7	2.0	43.7	54.0	-10.3
9084.200	31.0	3.0	34.0	54.0	-20.0

Table 3-5: Radiated Emissions Test Data, Digital Unintentional Emissions

Temperature: 73°F						Humidity: 64%				
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/Fail
150.000	Qp	H	1	1.0	49.0	-19.0	30.0	43.5	-13.5	Pass
250.000	Qp	H	200	2.0	51.2	-15.7	35.5	46.0	-10.5	Pass
300.000	Qp	H	135	1.0	38.0	-14.4	23.6	46.0	-22.4	Pass
350.000	Qp	V	135	2.0	45.6	-12.6	33.0	46.0	-13.0	Pass
400.000	Qp	V	0	3.0	40.6	-10.6	30.0	46.0	-16.0	Pass
450.000	Qp	H	225	1.2	40.1	-9.1	31.0	46.0	-15.0	Pass

** testing performed at 3m*

Measurement uncertainty: Measurement uncertainties shown for these tests are expanded uncertainties expressed at 95% confidence level using a coverage factor $k = 2$. +4.0 dB / -2.65 dB

Test Personnel:

Jon Wilson		August 22 & 25, 2016
Test Engineer	Signature	Dates of Test

Note: Radiated emissions were investigated with the module collocated and transmitting simultaneously with the DTS transceiver submitted in this same application. No non-compliant emissions were found; per FCC guidance, no data is being reported.

Test Personnel:

Daniel W. Baltzell		August 26 - 30, 2016
Test Engineer	Signature	Dates of Test

4 AC Conducted Emissions - FCC 15.207; RSS-Gen 8.8: Conducted Limits

4.1 Site and Test Description

The power line conducted emissions measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was assembled on a wooden table 80 centimeters high. Power was fed to the EUT through a 50-ohm/50 microhenry Line Impedance Stabilization Network (LISN). The EUT LISN was fed power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT test peripherals. This peripheral LISN was also fed A.C. power. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the AC line through an isolation transformer. The 50-ohm output of the EUT LISN was connected to the spectrum analyzer input through a Solar 100 kHz high-pass filter. The filter is used to prevent overload of the spectrum analyzer from noise below 100 kHz. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable).

The analyzer's 6 dB bandwidth was set to 9 kHz. Video filter less than 10 times the resolution bandwidth is not used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, and by increasing the sweep time in order to obtain a calibrated measurement. The emission spectrum was scanned from 150 kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limits were measured and have been recorded.

4.2 Test Limits

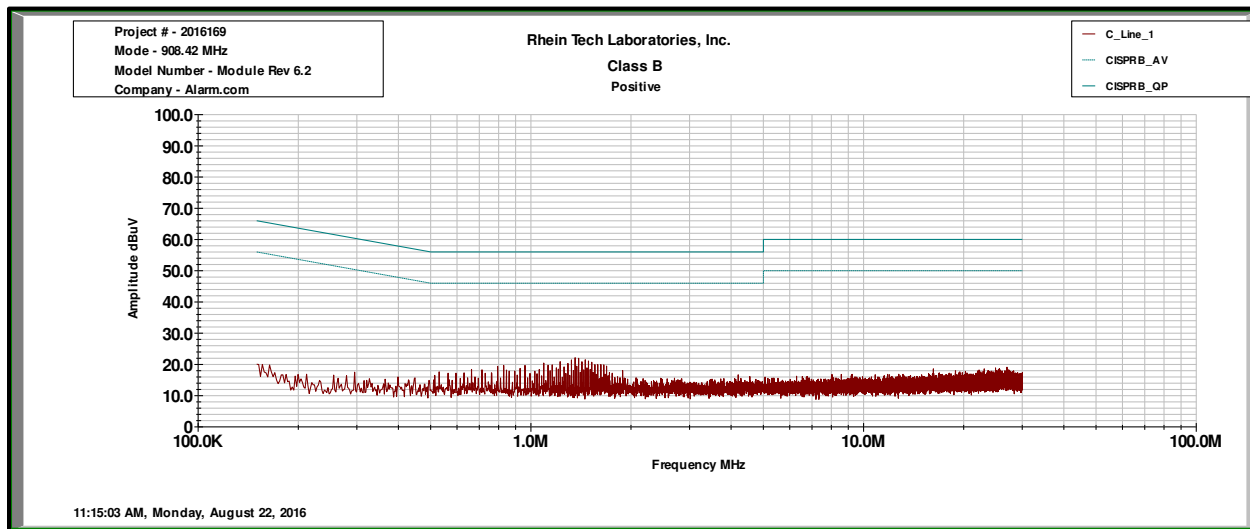
Line-Conducted Emissions		
Limit (dBμV)		
Frequency (MHz)	Quasi-Peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5.00	56	46
5.00 to 30.00	60	50

Table 4-1: Conducted Emissions Test Equipment

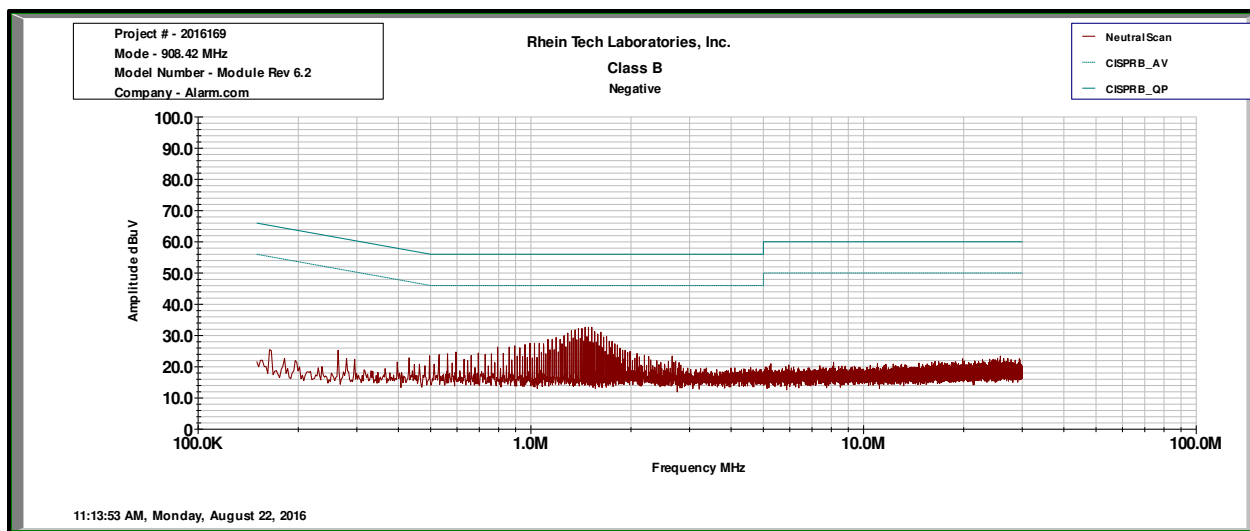
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900339	Hewlett Packard	85650A	Quasi-Peak Adapter	2521A00743	3/8/18
900930	Hewlett Packard	85662A	Spectrum Analyzer Display Section	3144A20839	4/21/17
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	4/21/17
901083	AFJ International	LS16/110VAC	16A LISN	16010020080	3/11/17
N/A	Quantum Change	Tile!	Test Software	4.0.A.8	N/A

4.3 Conducted Emissions Test Data

Plot 4-1: Conducted Emissions Transmit - +3.9VDC



Plot 4-2: Conducted Emissions Transmit – VDC Return



Measurement uncertainty: Measurement uncertainties shown for these tests are expanded uncertainties expressed at 95% confidence level using a coverage factor $k = 2$. ± 3.6 dB

Test Personnel:

Jon Wilson
 Test Engineer


 Signature

August 22, 2016
 Date of Test

5 99% Bandwidth – IC RSS-Gen 6.6

5.1 99% Bandwidth Test Procedure

The 99% bandwidth per RSS-Gen were measured using a 50-ohm spectrum analyzer. The modulated carrier was adjusted on the analyzer so that it was displayed entirely on the spectrum analyzer. The sweep time was auto and allowed through several sweeps with the max hold function used in peak detector mode. The table below contains the bandwidth measurement results.

Table 5-1: 99% Bandwidth Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901583	Agilent Technologies	EXA N9010A	Spectrum Analyzer (10 Hz – 26.5 GHz)	ATO-7568 SER MY51250846	4/21/17

5.2 99% Bandwidth Test Data

Table 5-2: 99% Bandwidth Test Data

99% bandwidths	
Frequency (MHz)	Bandwidth (kHz)
908.4	92.7

5.3 99% Bandwidth Plots

Plot 5-1: 99% Bandwidth; 908.4 MHz



Test Personnel:

Jon Wilson
 Test Engineer

Jon Wilson
 Signature

August 24, 2016
 Date of Test

6 Conclusion

The data in this measurement report shows that the EUT as tested, Alarm.com Model: ADC-620T, FCC ID: YL6-143620T, IC: 9111A-143620T, complies with the applicable requirements of Parts 2 and 15 of the FCC Rules and Regulations, and IC RSS-210 and RSS-Gen. and qualifies for Modular Approval.