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CERTIFICATION TEST REPORT

Report Number:	2013 01228790FCC
Project Number:	Q10236852
Nex Number:	228790
Applicant:	Residential Control Systems 11481 Sunrise Gold Circle Suite 1 Rancho Cordova, CA 95472
Equipment Under Test (EUT):	Communicating Thermostat
Model:	XR624
FCC ID: IC:	WIBTZW012 9374A-XR624
In Accordance With:	FCC Part 15 Subpart C, 15.249 IC RSS-210 Issue 8 December 2010 IC RSS-Gen Issue 3 December 2010
Tested By:	Nemko USA Inc. 2210 Faraday Avenue, Suite 150 Carlsbad, CA 92008
Authorized By:	 Alan Laudani, EMC/RF Test Engineer
Date:	MAR. 7, 2013
Total Number of Pages:	25

1 Applicant Affirmation

Michael Hoffman representing Residential Control Systems hereby affirms:

a) That he/she has reviewed and concurs that the test shown in this report are reflective of the operational characteristics of the device for which certification is sought;

b) That the device in this test report will be representative of production units;

c) That all changes (in hardware and software/firmware) to the subject device will be reviewed.

d) That any changes impacting the attributes, functionality or operational characteristics documented in this report will be communicated to the body responsible for approving (certifying) the subject equipment.

Michael Hoffman
Printed name of official

Signature of official

11481 Sunrise Gold Circle Suite 1
Rancho Cordova, CA 95472
Address

Date: MAR. 7, 2013

916-635-6784
Telephone number

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Email address of official

NOTE—This affirmation must be signed by the responsible party before it is submitted to a regulatory body for approval.

Section1: Summary of Test Results

General

All measurements are traceable to national standards

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 15; Subpart C and IC RSS-210. Radiated tests were conducted is accordance with ANSI C63.4-2003. Radiated emissions are made in a 10m semi-anechoic chamber. A description of the test facility is on file with the FCC and IC.

The assessment summary is as follows:

Apparatus Assessed:	Communicating Thermostat
Model:	XR624
Specification:	FCC Part 15 Subpart C, 15.249 IC RSS-210 Issue 8 December 2010
Date Received in Laboratory:	January 15, 2013
Compliance Status:	Complies
Exclusions:	None
Non-compliances:	None

1.1 Report Release History

REVISION	DATE	COMMENTS	
-	MAR. 7, 2013	Prepared By:	Alex Chang
-	MAR. 7, 2013	Initial Release:	Alan Laudani

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025.

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TESTED BY: Alex Chang Date: MAR. 7, 2013
Alex Chang, EMC Test Engineer

REVIEWED BY: Alan Laudani Date: MAR. 7, 2013
Alan Laudani, Test Report Verificator

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Section 2: Equipment Under Test

2.1 Product Identification

The Equipment Under Test was identified as follows:

DEVICE	MANUFACTURER MODEL # SERIAL #	POWER CABLE
EUT – Communicating Thermostat	Residential Control Systems Model: XR624 Serial #: Prototype 1	24VAC powered from external power supply
EUT – External Power Supply	Calrad Model: 45-764 Serial #: N/A	1.8m, unshielded, 20AWG, 2-wire, IEC connector

CONNECTION	I/O CABLE
EUT to external power supply	1m, unshielded, 24AWG, 2-wire cable
EUT to unterminated	(16) 2m, unshielded, 24AWG, simulate Thermostat connections

2.2 Theory of Operation

The XR624 is a Communicating Thermostat. It is a 24VAC powered from external power source operated vibration detector with a 908.42MHz transceiver that uses Z-Wave technology.

The EUT's performance during test was evaluated against the performance criterion specified by applicable test standards. Performance results are detailed in the test results section of this report.

2.3 Technical Specifications of the EUT

Manufacturer:	**Residential Control Systems**
Operating Frequency:	908.42MHz in the 902 – 928MHz Band
Number of Operating Frequencies:	1
Rated Field Strength:	47.3 mV/m
Modulation:	FSK
Antenna Type:	A small monopole antenna as a trace on the PCB assembly.
Antenna Connector:	None
Power Source:	24VAC from external power supply

Section 3: Test Conditions

3.1 Specifications

The apparatus was assessed against the following specifications:

FCC Part 15 Subpart C, 15.249
Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz and 24.0-24.25 GHz bands.

IC RSS-210 Issue 8 December 2010
Low-power Licence-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment. Annex 8 - Frequency Hopping and Digital Modulation Systems Operating in the Bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

IC RSS-Gen Issue 3 December 2010
General Requirements and Information for the Certification of Radio-communication Equipment

3.2 Test Environment

All tests were performed under the following environmental conditions:

Temperature range	25 °C
Humidity range	7%

3.3 Test Equipment

Nemko ID	Device	Manufacturer	Model	Serial Number	Cal Date	Cal Due Date
901	Preamp	Sonoma	310 N	130607	10/15/2012	10/15/2013
133	Antenna, loop	Electro-Metrics	ALR-25M	678	7/18/2011	7/18/2013
911	Spectrum Analyzer	Agilent	E4440A	US41421266	10/15/2012	10/15/2013
110	Antenna, LPA	Electrometrics	LPA-25	1217	4/1/2011	4/1/2013
128	Antenna, Bicon	EMCO	3104	2882	3/21/2011	3/21/2013
529	Antenna, DRWG	EMCO	3115	2505	10/31/2012	10/31/2014
Rental	Preamp	A.H. Systems	PAM-0118	321	01-10-2013	01-10-2014
E1018	9kHz to 7GHz Spectrum Analyzer	Rohde & Schwarz	FSP7	835363/0003	2/23/2012	2/23/2013
E1020	Two Line V-Network	Rohde & Schwarz	ENV216	101044	4/6/2012	4/6/2013
813	Multimeter	Fluke	111	78130060	10/13/2012	10/13/2013
E1035	Variac	Shanghai China	TDGC	NA	NCR	NCR

NA – not applicable, NCR – no calibration required.

Registrations of the 10m Semi-anechoic chamber is on file with the Federal Communications Commission and Industry Canada under Site Number 2040B-3.

Section 4: Observations

4.1 Modifications Performed During Assessment

No modifications were performed during assessment.

4.2 Record Of Technical Judgements

No technical judgements were made during the assessment.

4.3 EUT Parameters Affecting Compliance

The user of the apparatus could not alter parameters that would affect compliance.

4.4 Test Deleted

No Tests were deleted from this assessment.

4.5 Additional Observations

There were no additional observations made during this assessment.

4.6 Deviations From Laboratory Test Procedures

No deviations from Laboratory Test Procedure

Section 5: Results Summary

This section contains the following:

FCC Part 15 Subpart C: §15.249
IC RSS-210 Issue 8 December 2010 Annex A2.9
IC RSS-Gen Issue 3 December 2010

The column headed “Required” indicates whether the associated clauses were invoked for the apparatus under test. The following abbreviations are used:

N No: not applicable / not relevant
Y Yes: Mandatory i.e. the apparatus shall conform to these tests.
N/T Not Tested, mandatory but not assessed. (See section 4.4 Test deleted)

The results contained in this section are representative of the operation of the apparatus as originally submitted.

5.1 Test Results

Part 15C	Industry Canada	Test Description	Required	Result
15.207 (a)	RSS-Gen 7.2.4	Conducted Emission Limit	Y	Pass
15.215(c)	RSS-Gen 4.6.1	20dB & 99% Bandwidth	Y	Pass
15.249(a)(e)	RSS 210 A2.9	Maximum Field Strength	Y	Pass
15.249(a)	RSS 210 A2.9	Band-edge Compliance of RF Conducted Emissions	Y	Pass
15.249(a)(d)	RSS 210 A2.9	Spurious Radiated Emissions	Y	Pass
15.109(a)	RSS-Gen 4.10 & RSS-Gen 6.1	Receiver Spurious Emissions	Y	Pass

N* = *EUT only employ battery power for operation and doesn’t operate from the AC power lines or contain provisions for operation while connected to the AC power lines.*

N/T* = *EUT does not have a separate receive mode. Configured to transmit only.*

Appendix A: Test Results

Section 15.215(c) – Occupied Bandwidth

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

RSS-Gen Section 4.6.1 – Occupied Bandwidth

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual.

The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded.

The span between the two recorded frequencies is the occupied bandwidth.

Test Conditions:

Sample Number:	XR624	Temperature:	25°C
Date:	Jan. 15, 2013	Humidity:	7%
Modification State:	Transmit Modulated	Tester:	**Alex Chang**
		Laboratory:	Nemko

Test Results:

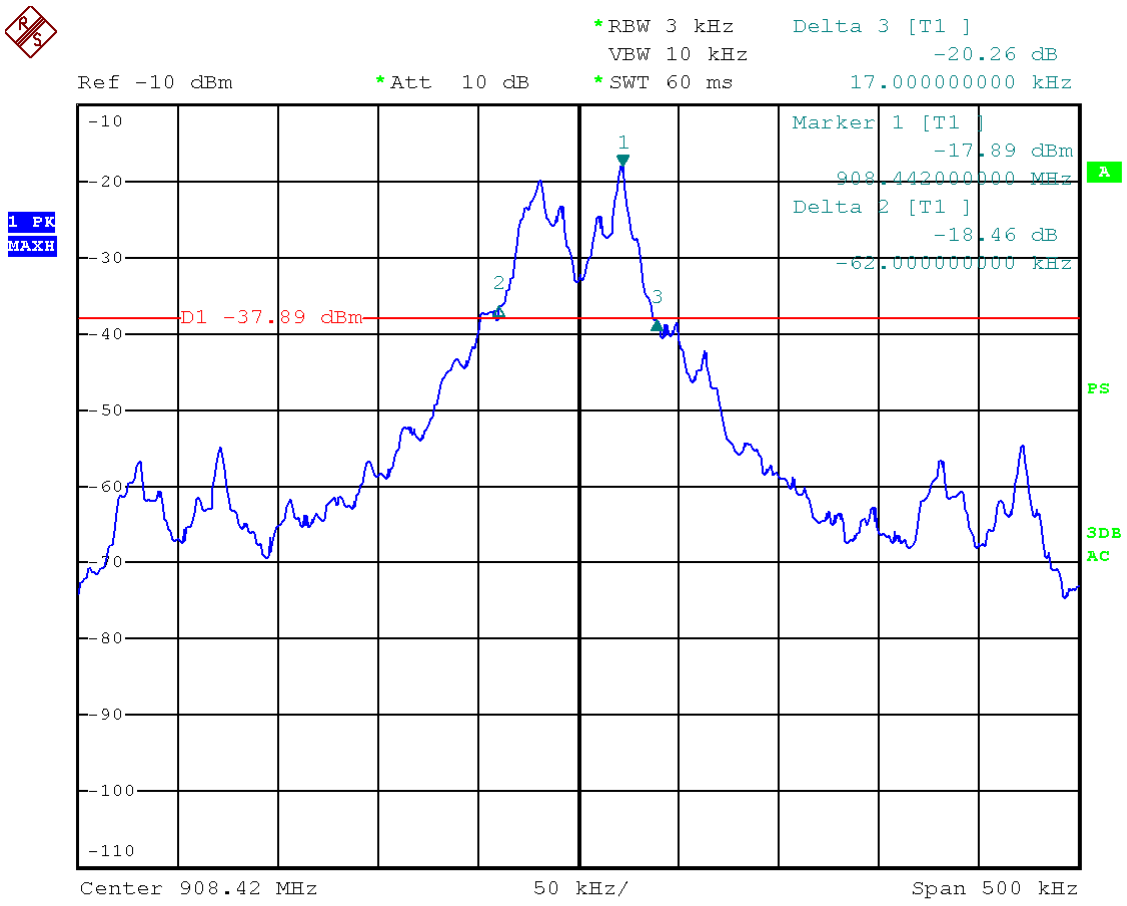
See attached plots

Additional Observations:

- Span is wide enough to capture the channel transmission
- RBW is 1% of the span or worst case

- VBW is 3X RBW
- Sweep is auto
- Detector is Peak
- Trace is Max Hold
- A peak output max hold reading was taken; a display line was drawn 20 dB lower than peak level. The 20 dB bandwidth was determined from where the channel output spectrum intersected the display line.
- Per Industry Canada requirement, another measurement was made using the built-in OBW measuring feature of the spectrum analyzer with power BW of 99%.
- Observed occupied BW is 0.079 MHz
- 908.42 MHz – 0.079/2 MHz = 908.380 MHz (within the frequency band)
- 908.42 MHz + 0.079/2 MHz = 908.460 MHz (within the frequency band)
- 99% BW = 95.0 kHz

20dB Occupied Bandwidth is 62 kHz
Delta 1-2 62.0 kHz, Delta 1-3 17 kHz, total 79 kHz.



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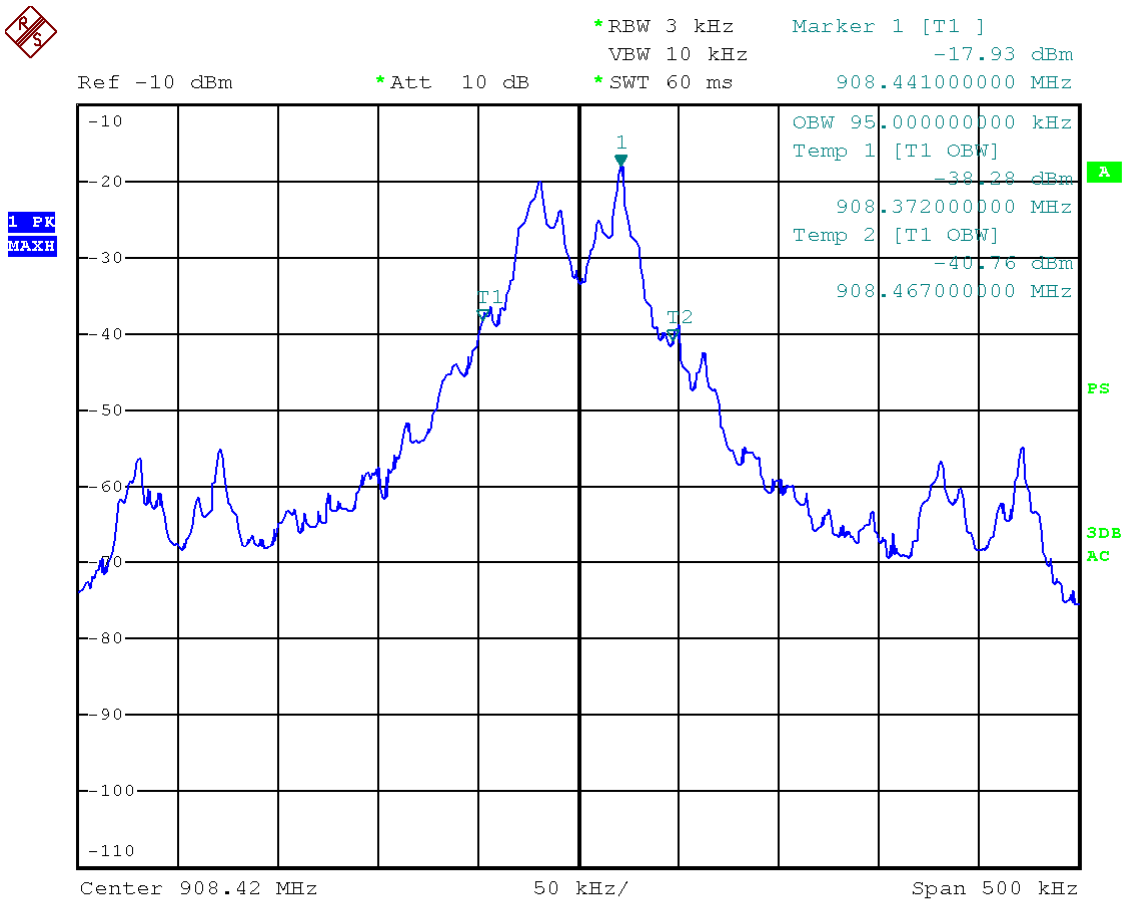
99% Occupied Bandwidth is 95.0 kHz



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Section 15.249(a) – Field Strength of Emissions

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	**50**	**500**
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

RSS-210 A2.9 – Field Strength of Emissions

This section provides standards for low-power devices that can be used for any application provided the following conditions are met:
(a) The field strengths measured at 3 metres shall not exceed the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (millivolts/meter)
902–928 MHz	50(Note 1)	0.5
2400–2483.5 MHz	50(Note 1)	0.5
5725–5875 MHz	50(Note 1)	0.5

Note 1: Equivalent to 0.75 mW e.i.r.p.

(b) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to Table 2 limits, whichever is the less stringent.

Section 4.4 of RSS-Gen (Pulsed Operation) does not apply to CISPR measurement for the band 902-928 MHz.

Test Conditions:

Sample Number:	XR624	Temperature:	25°C
Date:	Jan. 15, 2013 – Mar. 6, 2013	Humidity:	7%
Modification State:	Transmit Modulated	Tester:	**Alex Chang**
		Laboratory:	10m Chamber

Test Results: Quasi-Peak 93.5 dBuV/m @ 3m = 47.3 mV/m, Complies

See Table. EUT complies for fundamental power, band edges and spurious emission.

Additional Observations:

The spectrum was searched from 32 kHz (lowest internal clock) to the 10th Harmonic (10000 MHz).

The EUT was investigated with a variac that showed no output power differences when the line voltage was varied by +/- 15 % of nominal 120 Vac.

All measurements below 1 GHz were performed at 3m from 30 MHz to 1 GHz employing a CISPR quasi-peak detector, except for the radio's fundamental.

Peak measurements above 1 GHz were done utilizing RBW of 1 MHz and VBW of 3 MHz.

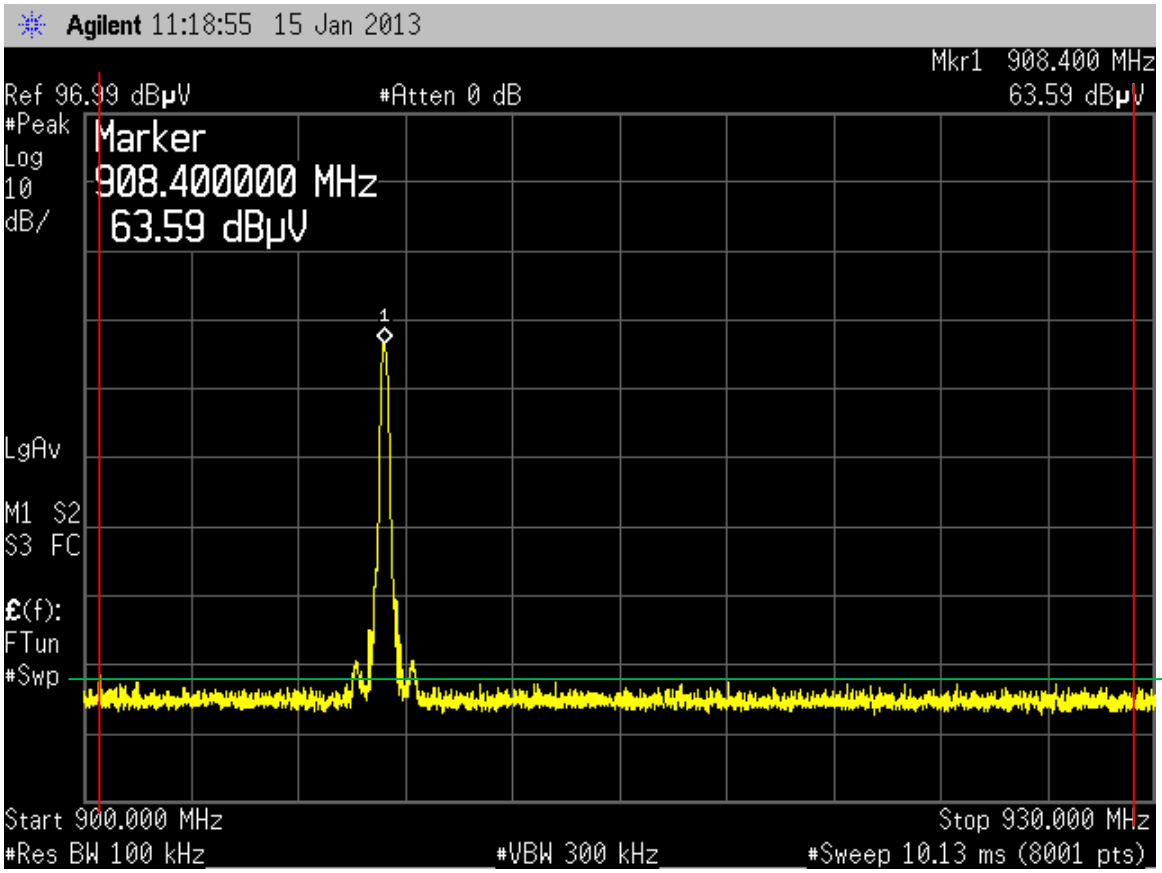
Average measurements above 1 GHz were done utilizing RBW of 1 MHz and VBW of 10 Hz as the duty cycle was 100%.

Measurements made in the semi-anechoic chamber, all measurements max hold after peaking for EUT rotation and antenna height from 1 to 4 meters.

Fundamental power was measured at 1 MHz RBW, 3 MHz VBW to ensure capture of entire emissions envelope. And the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. The peak field strength emission passes when measured at max hold RBW of 1 MHz with 3 MHz VBW.

The 908.42 MHz signal did not affect either the lower or upper band edge of 902 to 928 MHz. No other emissions found within 20 dB of the limits.

Plot shows range from 900 MHz to 930 MHz.



Red lines band: 902—928 MHz
Green line 50 dBc
Relative field strength plot

- All other emissions were found to be more than 20dB below the limit and have not been reported per FCC rule 15.31(o)."
- Average fundamental: Max Meter reading + Antenna Factor + Cable loss = Corrected Reading; 63.9 dBµV + 23.5 dB/m + 6.1 dB = 93.5 dBµV

Radiated Emissions Data

Job # :	Q10236852	Date :	3-6-2013	Page 1 of 1	
NEX#:	228790	Time :			
		Staff :			
Client Name :	Residential Control Systems			EUT Voltage :	24VAC
EUT Name :	Communicating Thermostat			EUT Frequency :	N/A
EUT Model # :	XR624			Phase:	N/A
EUT Serial # :	Prototype 1				
EUT Config. :	Transmitting - Modulation mode				
				Distance < 1000 MHz:	3 m
				Distance > 1000 MHz:	3 m
Specification :	FCC Part 15 Subpart C, 15.249				
Loop Ant. #:	133				
Bicon Ant.#:	128	Temp. (°C) :	25		
Log Ant.#:	110_3m	Humidity (%) :	7		
DRG Ant. #	529	Spec Analyzer #:	911		
Cable LF#:	SAC_10m	Analyzer Display #:	911		
Cable HF#:	WCC	Quasi-Peak Detector #:	911		
Preamp LF#:	901	Duty Cycle (%):	100.00		
Preamp HF#	1029				

Quasi-Peak	RBW:	120 kHz
	Video Bandwidth	300 kHz
Peak	RBW:	1 MHz
	Video Bandwidth	3 MHz
Average	RBW:	1 MHz
	Video Bandwidth	10 Hz

Measurements below 1 GHz are Quasi-Peak values, unless otherwise stated.
Measurements above 1 GHz are Average values, unless otherwise stated.

Meas. Freq. (MHz)	Meter Reading **Vertical**	Meter Reading **Horizontal**	Det.	EUT Side DEG	Ant. Height cm	Max. Reading (dBµV)	Corrected Reading (dBµV)	Spec. limit (dBµV)	CR/SL Diff. (dB)	Pass Fail	Comment
908.420	61.1	63.9	Q	347	100	63.9	93.5	94.0	-0.5	Pass	
1816.840	50.2	51.3	P	153	184	51.3	50.3	74.0	-23.7	Pass	
1816.840	44.4	44.7	A	153	184	44.7	43.6	54.0	-10.3	Pass	
2725.260	47.9	51.1	P	180	137	51.1	53.3	74.0	-20.7	Pass	
2725.260	39.1	43.9	A	180	137	43.9	46.1	54.0	-7.8	Pass	
3633.680	47.7	46.8	P	212	100	47.7	52.8	74.0	-21.2	Pass	
3633.680	40.3	38.8	A	212	100	40.3	45.3	54.0	-8.7	Pass	

Section 15.249 (d) – Spurious Emissions Outside of the band

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

RSS-210 A2.9 – Spurious Emissions Outside of the band

(b) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to Table 2 limits, whichever is the less stringent.

Section 4.4 of RSS-Gen (Pulsed Operation) does not apply to CISPR measurement for the band 902-928 MHz.

Test Conditions:

Sample Number:	XR624	Temperature:	25°C
Date:	Jan. 15, 2013	Humidity:	7%
Modification State:	Transmit Modulated	Tester:	**Alex Chang**
		Laboratory:	10m Chamber

Test Results: See data previous page.

Additional Observations:

- All measurements below 1 GHz were performed at 3m employing a CISPR quasi-peak detector.

- Peak measurements above 1 GHz utilize a RBW of 1 MHz and a VBW of 3 MHz

- The Spectrum was searched from 32 kHz (lowest oscillator source) to 10 GHz (10x highest operating frequency).

- There were no emissions found other than the fundamental and the second thru fourth harmonics (Section 15.249(a)).

- All other emissions were found to be more than 20dB below the limit and have not been reported per FCC rule 15.31(o)."

RSS-Gen 4.10 – Receiver Spurious Emissions

6.1 Radiated Limits
Radiated spurious emission measurements shall be performed with the receiver antenna connected to the receiver antenna terminals.

Table 2: Radiated Limits of Receiver Spurious Emissions

Frequency (MHz)	Field Strength (microvolts/m at 3 meters)*
30-88	100
88-216	150
216-960	200
Above 960	500

*Measurements for compliance with limits in the above table may be performed at distances other than 3 metres, in accordance with Section 7.2.7.

Test Conditions:

Sample Number:	XR624	Temperature:	25°C
Date:	Jan. 15, 2013	Humidity:	7%
Modification State:	Transmit Modulated	Tester:	Alex Chang
		Laboratory:	10m Chamber

Additional Observations:

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is higher, to at least 3 times the highest tunable or local oscillator frequency, whichever is higher, without exceeding 40 GHz.

For emissions below 1000 MHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector function properly adjusted for factors such as pulse desensitization as required, with an equal or greater measurement bandwidth relative to the applicable CISPR quasi-peak bandwidth.
Above 1000 MHz, measurements shall be performed using an average detector with a minimum resolution bandwidth of 1 MHz.

- All measurements below 1 GHz were performed at 3m employing a CISPR quasi-peak detector.
- Emissions were searched from 32 kHz to 1000 MHz
- All other emissions were found to be more than 20dB below the limit and have not been reported per FCC rule 15.31(o)."

Test Results: No emissions found.

Power Line Conducted Emissions

15.207(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
.5–5	5	46
5–30	60	50

*Decreases with the logarithm of the frequency.

Test Conditions:

Sample Number:	XR624	Temperature:	25°C
Date:	Jan. 15, 2013	Humidity:	7%
Modification State:	Transmit Modulated, Receive	Tester:	**Alex Chang**
		Laboratory:	Nemko SR2

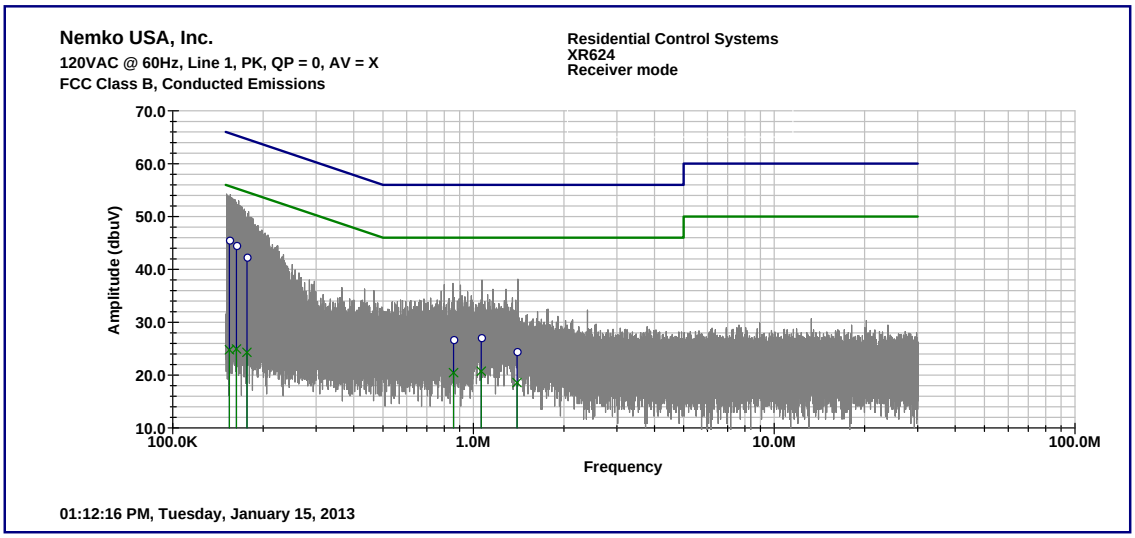
Test Results: EUT complies

See attached plots

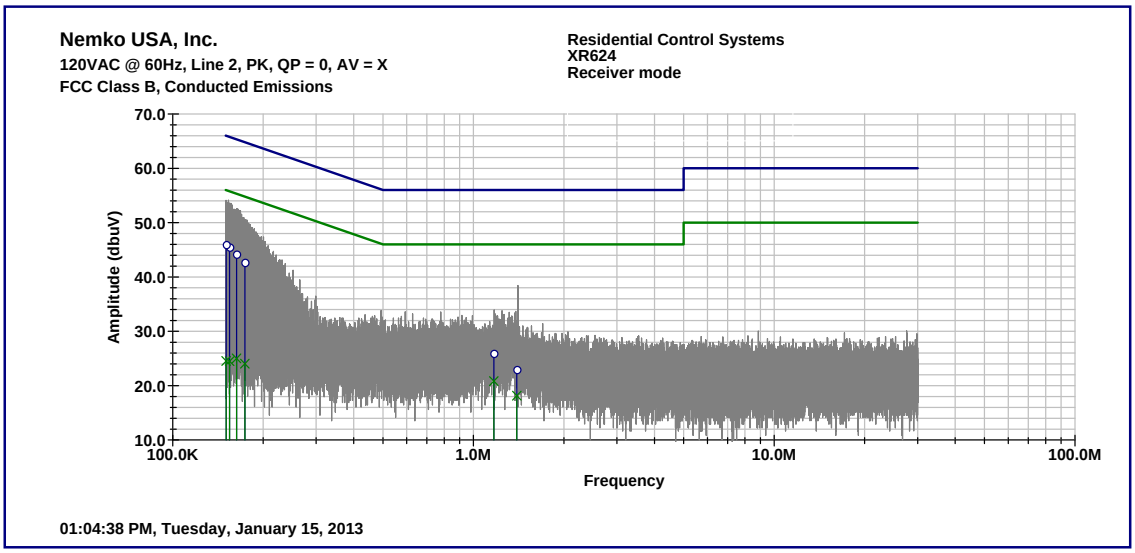
Additional Observations:

- EUT was tested using the following modes: Low channel, Mid channel, High channel and Receive Test Mode.
- EUT was tested using a representative power supply.
- Green limit line is Average limit and blue limit line is Quasi-peak limit.
- o represents final quasi peak measurements while x represent final average measurements.
- Instrumentation settings are 9kHz RBW/30kHz VBW for Average measurements and 100kHz RBW/100kHz VBW for Quasi-Peak measurements.

Receive Mode

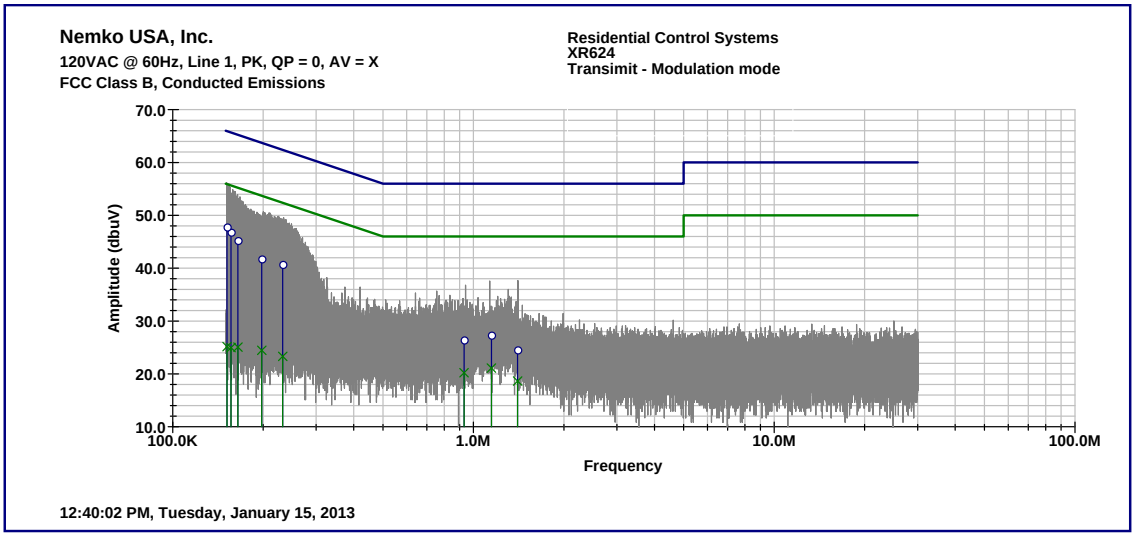


Frequency	Measured		Limit		Margin	
(kHz)	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
150.594	46.0	24.5	66.0	56.0	-20.0	-31.5
154.671	45.5	24.5	65.7	55.7	-20.2	-31.2
163.035	44.2	25.0	65.3	55.3	-21.1	-30.3
173.719	42.7	24.0	64.8	54.8	-22.1	-30.8
1168.560	26.0	20.8	56.0	46.0	-30.0	-25.2
1393.860	23.0	18.2	56.0	46.0	-33.0	-27.8

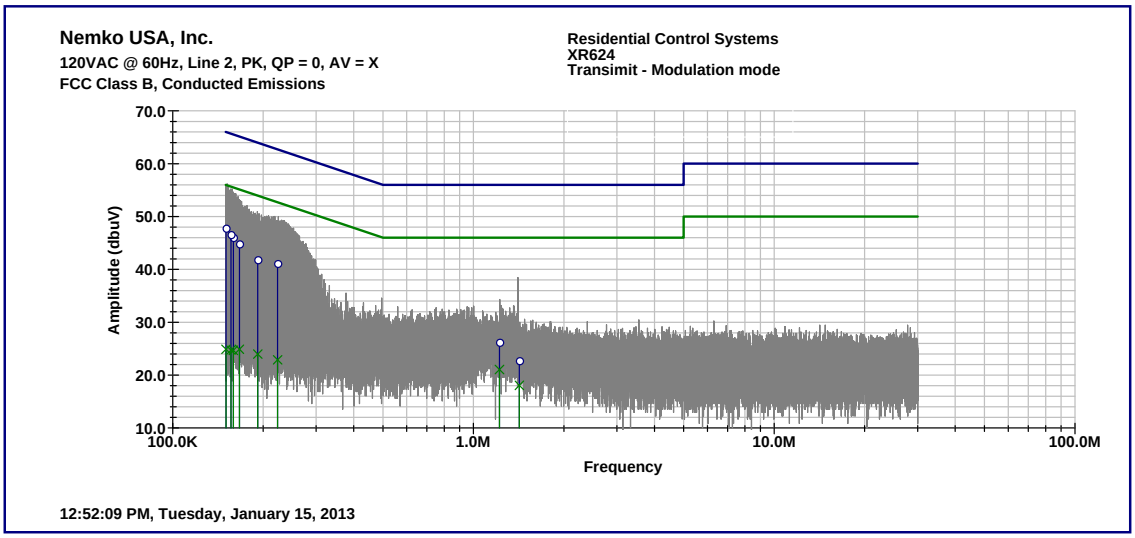


Frequency	Measured		Limit		Margin	
(kHz)	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
150.594	46.0	24.5	66.0	56.0	-20.0	-31.5
154.671	45.5	24.5	65.7	55.7	-20.2	-31.2
163.035	44.2	25.0	65.3	55.3	-21.1	-30.3
173.719	42.7	24.0	64.8	54.8	-22.1	-30.8
1168.560	26.0	20.8	56.0	46.0	-30.0	-25.2
1393.860	23.0	18.2	56.0	46.0	-33.0	-27.8

Transmit Mode



Frequency	Measured		Limit		Margin	
(kHz)	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
151.651	47.8	25.1	65.9	55.9	-18.1	-30.8
156.388	46.8	25.0	65.7	55.7	-18.9	-30.7
164.822	45.2	25.1	65.2	55.2	-20.0	-30.1
197.829	41.8	24.5	63.7	53.7	-21.9	-29.2
232.272	40.7	23.3	62.4	52.4	-21.7	-29.1
930.769	26.4	20.2	56.0	46.0	-29.6	-25.8
1147.900	27.3	21.1	56.0	46.0	-28.7	-24.9
1402.790	24.5	18.6	56.0	46.0	-31.5	-27.4



Frequency	Measured		Limit		Margin	
(kHz)	Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
150.381	47.8	24.9	66.0	56.0	-18.2	-31.1
156.190	46.6	24.7	65.7	55.7	-19.1	-31.0
159.099	46.0	24.7	65.5	55.5	-19.5	-30.8
166.782	44.8	24.9	65.1	55.1	-20.3	-30.2
191.773	41.8	24.0	64.0	54.0	-22.2	-30.0
223.243	41.1	22.9	62.7	52.7	-21.6	-29.8
1220.300	26.2	21.0	56.0	46.0	-29.8	-25.0
1421.130	22.7	18.1	56.0	46.0	-33.3	-27.9