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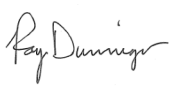
Report No.: 101818837CRT-001B

Test Report & Findings For:

ANENERGY EFFICIENCY COMPARISON MULTIPLE THERMOSTATS

Completed by:	Ray Dunnigan
Title:	Project Engineer
Signature:	

Completed by:	Alex Porter
Title:	Project Reviewer
Signature:	

THERMOSTAT ENERGY EFFICIENCY COMPARISON

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Objective:

*To determine through data collected and calculated in a controlled but "real world" test environment if **thermostat Sample A** saves energy while still maintaining the desired temperature set point as well as maintain indoor relative humidity at an acceptable level in direct comparison to **thermostat Sample B**.*

Parameters

The following parameters are controlled

Value	Description	Units	Method	MU
Temperature	Air Temperature	Deg F	Thermostat	+/- 0.8 C (Approx. 95 %, k=2)%
Power	Voltage and Amps	Watts	Power Meter	+/- 0.2 (Approx. 95 %, k=2)%
Frequency	Frequency	Hz	Household outlet	+/-0.24 Hz (Approx. 95 %, k=2)
Humidity	R/H	%	Thermostat	+/- 5.0 RH% (Approx. 95 %, k=2)

The following parameters are monitored

Value	Description	Units	Method	MU
Temperature	Air Temperature	Deg F	Sensor	+/- 0.8 C (Approx. 95 %, k=2)%
Power	Voltage and Amps	Watts	Data logger	+/- 0.2 (Approx. 95 %, k=2)%
Frequency	Frequency	Hz	Household outlet	+/-0.24 Hz (Approx. 95 %, k=2)
Humidity	R/H	%	Sensor	+/- 5.0 RH% (Approx. 95 %, k=2)

Sample Acquisition

Samples observed at test site:

Sample #	Description	Control Number	Witness Location	Date	Condition
Client provided	Programmable thermostat, data logger and environment sensors	See model and serial numbers in equipment list	SFH in Altamonte Springs, Florida	9/28/14	Good

Testable Hypothesis

The hypothesis as provided by our client:

"While operating the same HVAC system, the total energy (kWh) consumed by our thermostat will be significantly less than that of the energy consumed by the same HVAC system when controlled by the competing thermostat. Furthermore, our thermostat will provide the energy savings without compromising the desired temperature setting or relative humidity of the environment."

TECHNICAL STAFF:

Technical Staff

#	Staff Name	Area of Expertise
1	Ray Dunnigan	Proficient in witnessing test procedures per approved client protocol
2	Elwood Dodge	Proficient in witnessing test procedures per approved client protocol
3	Alex Porter	Qualified to review testing per approved client protocol

Note: Complete training records for staff are available upon request

CALIBRATED TEST EQUIPMENT:

Equipment list

#	Equipment Description	Manufacturer's Name / Model # / Serial #	Calibration Date	Calibration Due	Range Used
1	Energy Data Logger	eGauge EG3000, S/N 1406270085	9/14/14	9/14/15	0-100 A
2	Environment INDOOR Sensor	Thermotron SM-4S-SL, S/N 98:8B:AD:00:4D:B2	9/10/14	9/10/15	0-100ºF 0-100%rh
3	Environment OUTDOOR Sensor	Thermotron SM-4S-SL, S/N 98:8B:AD:00:1E:E7	9/10/14	9/10/15	0-100ºF 0-100%rh

EQUIPMENT UNDER TEST:

Equipment list

1	Thermostat Sample A	LHTS "REST" v 1.0 7-Day Programmable Thermostat	Thermostats were reviewed and programmed upon test commencement
2	Thermostat Sample B	Honeywell T-8011 7-Day Programmable Thermostat	Thermostats were reviewed and programmed upon test commencement

PROTOCOL & PROCEDURE DESCRIPTION

The test protocols and procedures for this study were client-defined and reviewed andapproved for use in the tests by Intertek engineers.

Comparison Testing of Thermostats for Energy Efficient Control of an HVAC System

All testing was performed in a fully furnished unoccupied single family home in Altamonte Springs, Florida.
During the course of the recorded & documented testing the house was secured from access with all doors and windows closed. The interior environment was maintained by a single HVAC system with two separate thermostats (Sample #A and Sample #B). Both were hard wired through a transfer/relay switch that maintained control of the HVAC system by only one of the thermostats at a time allowing no current to the idle thermostat.

Test Protocol #1
Test #1 was the "steady state" test in which each thermostat controlled and ran the system non-stop for a 48-hour period.
Each 48-hour test period was run at a set point of 65ºF for each thermostat respectively.
Sample # A thermostat was in operation for the first 48-hour test period, immediately followed by Sample # B for the next 48-hours.

Test Protocol #2
Test #2 was the 96-hour "programmed" test.
This test was implemented to simulate the real world of daily cycling on & off of the system via the homeowner's preferred temperature settings at different times of day.

The programmed test times & set points:

Wake: 7:00 am to 8:00 am @ 70 degrees F set point
Leave: 8:00 am to 4:00 pm @ 72 degrees F set point
Return: 4:00 pm to 11:00 pm @ 70 degrees F set point
Sleep: 11:00 pm to 7:00 am @ 72 degrees F set point

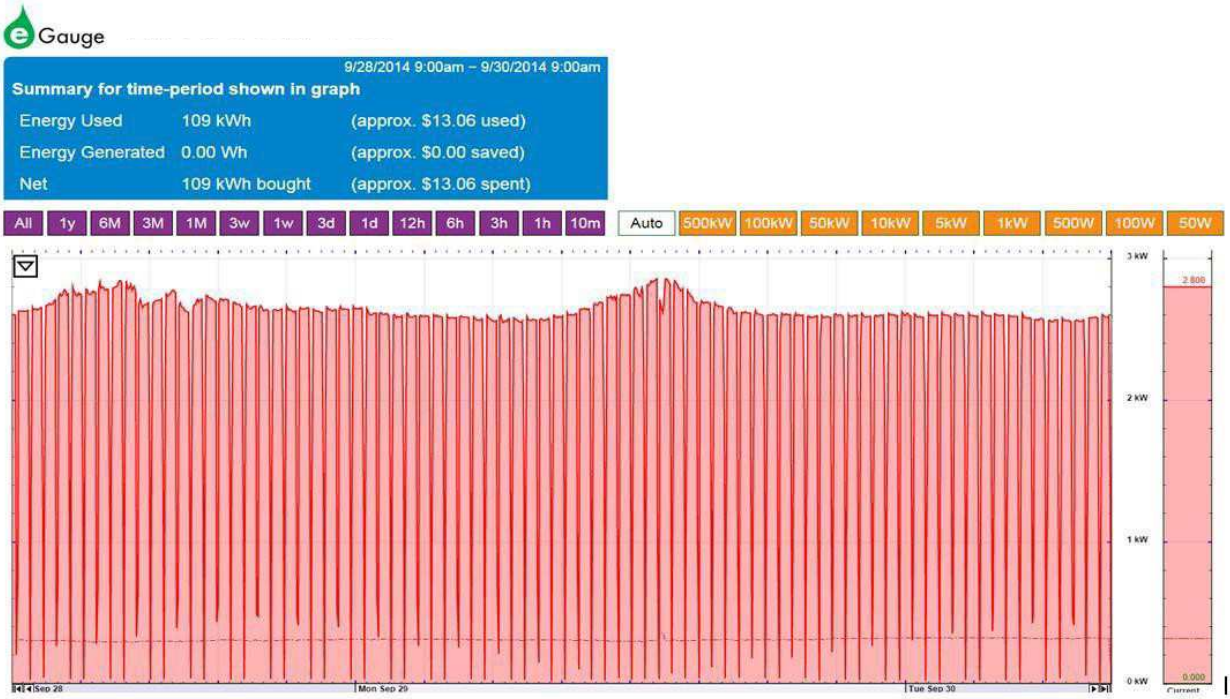
Tests commenced on: 9/28/2014
Tests concluded on: 10/15/2014

*** All aspects of the test site were inspected, audited and documented personally on site by the author of this report prior to the beginning of the study (See tech staff #1).

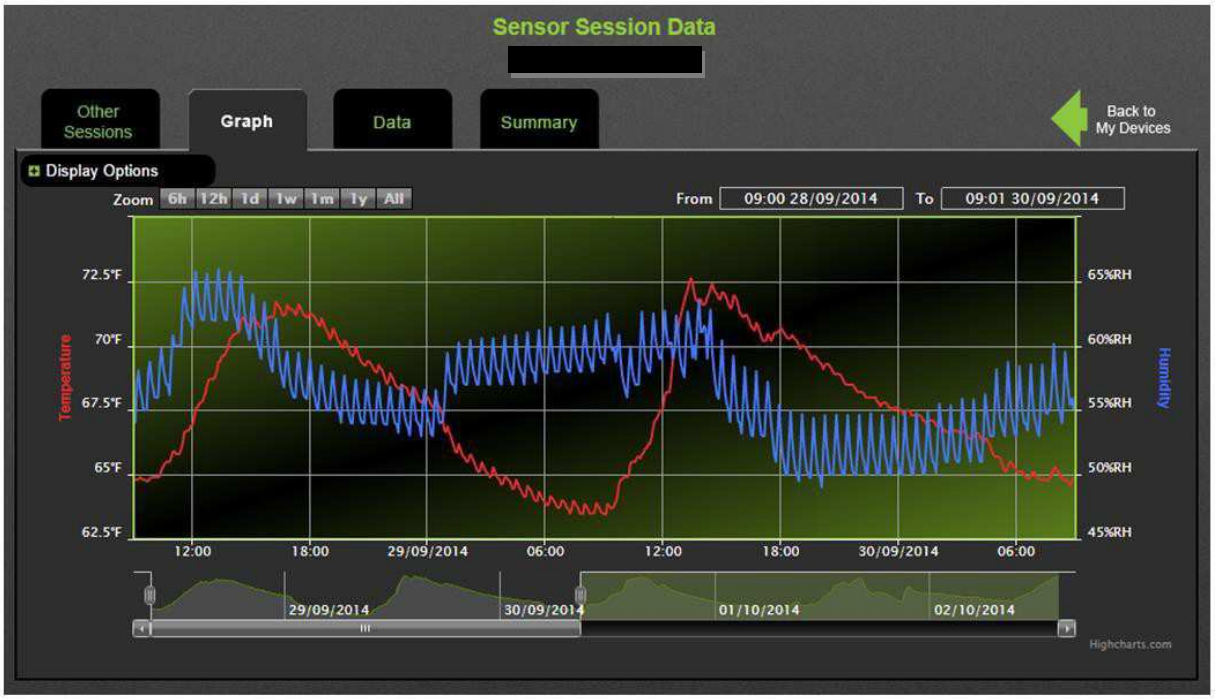
*** Both testing setup and all thermostat "switch-overs" were overseen, audited, and documented by an ETL engineer / field inspector (See tech staff #2).

*** The entire operation and test performance was monitored 24/7 by remote, secure internet access by ETL

48-Hour Test Data for Sample A:

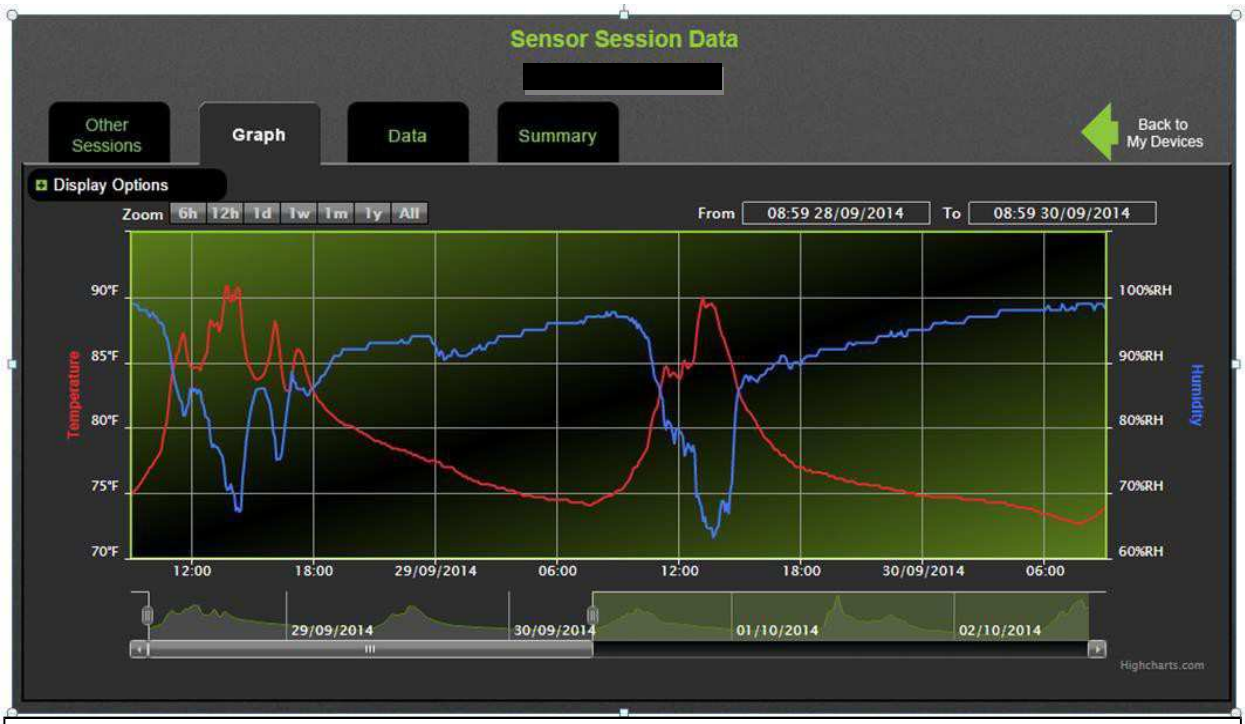


Power usage for Sample "A" test for 48 hours at 65 degree F set point



Indoor temperature and humidity data log for Sample "A" test during 48 hours at 65 degree F set point

48-Hour Test Data for Sample A:
(Continued)

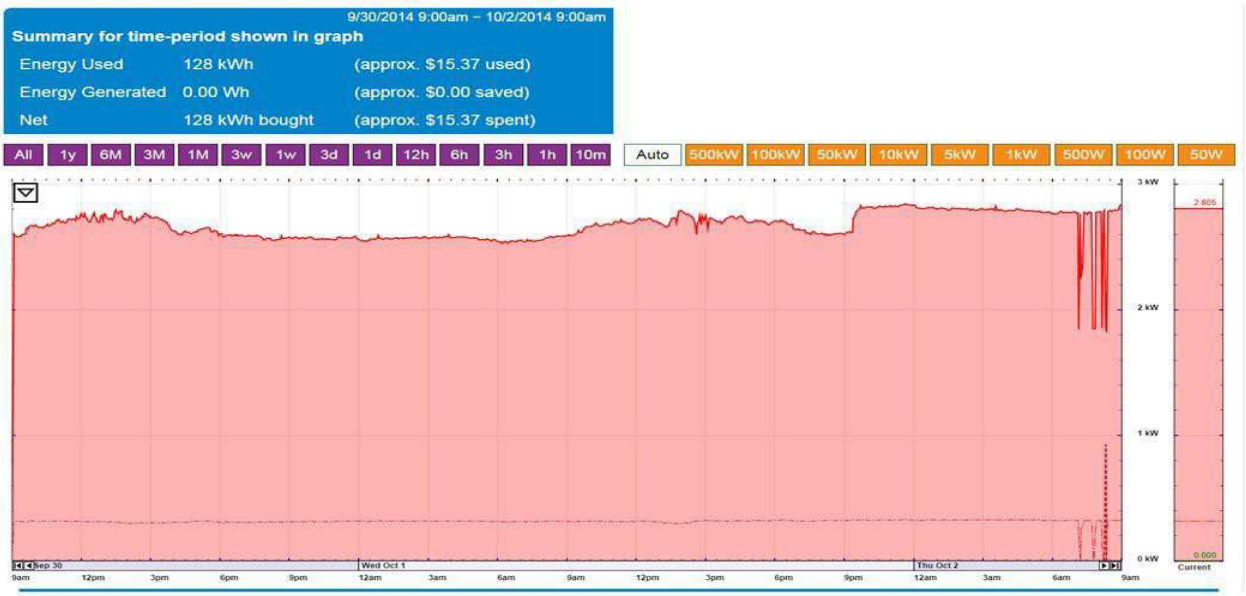


Outdoor temperature and humidity data log for Sample "A" test during 48 hours at 65 degree F set point

Thermostat Sample A
48-Hour Test Findings:

Total kWh utilized	=	109 kWh
Average Indoor Temperature	=	68 F
Average Indoor Relative Humidity	=	57 %
Average Outdoor Temperature	=	78 F
Average Outdoor Relative Humidity	=	91 %

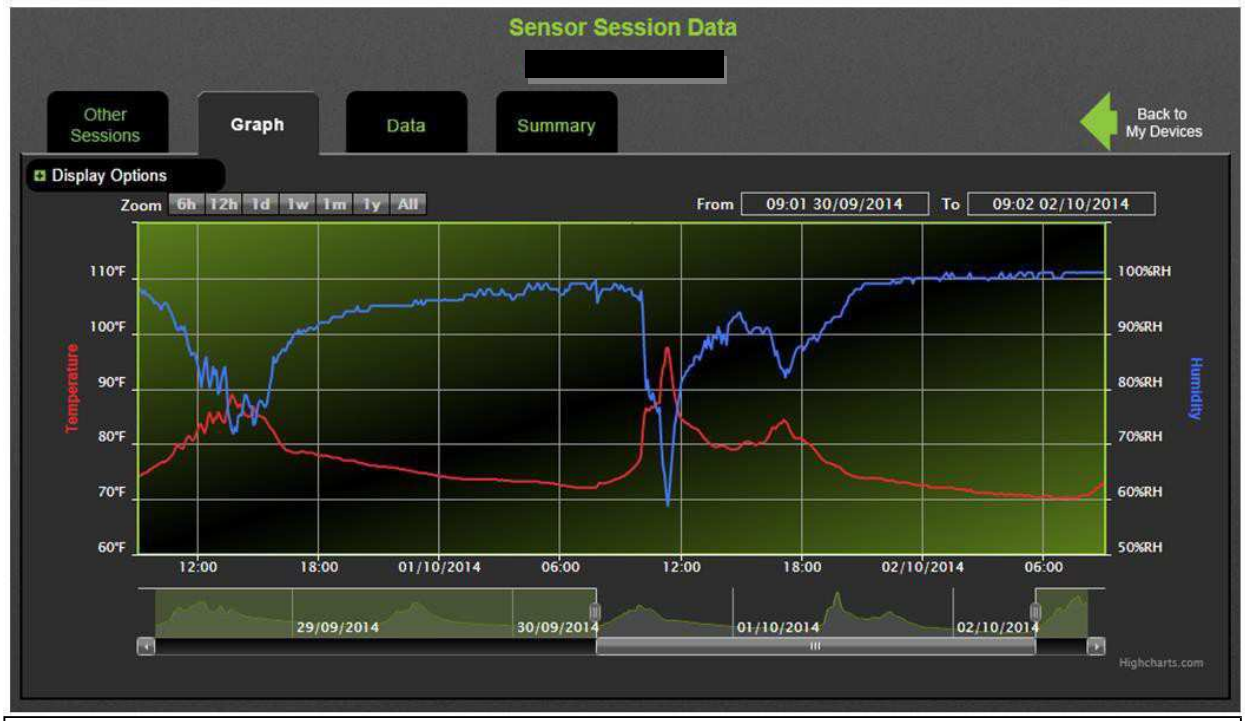
48-Hour Test Data for Sample B:



Power usage for Sample "B" test for 48 hours at 65 degree F set point

Indoor temperature and humidity data log for Sample "B" test during 48 hours at 65 degree F set point

48-Hour Test Data for Sample B:
(Continued)



Outdoor temperature and humidity data log for Sample "B" test during 48 hours at 65 degree F set point

Thermostat Sample B
48-Hour Test Findings:

Total kWh utilized	=	128 kWh
Average Indoor Temperature	=	68 F
Average Indoor Relative Humidity	=	54 %
Average Outdoor Temperature	=	77 F
Average Outdoor Relative Humidity	=	93%

48-Hour Steady State Test
Conclusion

After an audit of the data gathered from the 48-hour steady state tests, the following calculations were found to be accurate.

Energy Efficiency:

- For the duration of the 48-hour test, Sample A operated the HVAC system at a reduced energy burden of **-15%** over Sample B.

Indoor Temperature & RH:

- Sample # A indoor temperature averaged **-0.147** cooler than Sample # B.

- Sample # A relative humidity averaged **+2.98%** higher than Sample # B.

Outdoor Temperature & RH:

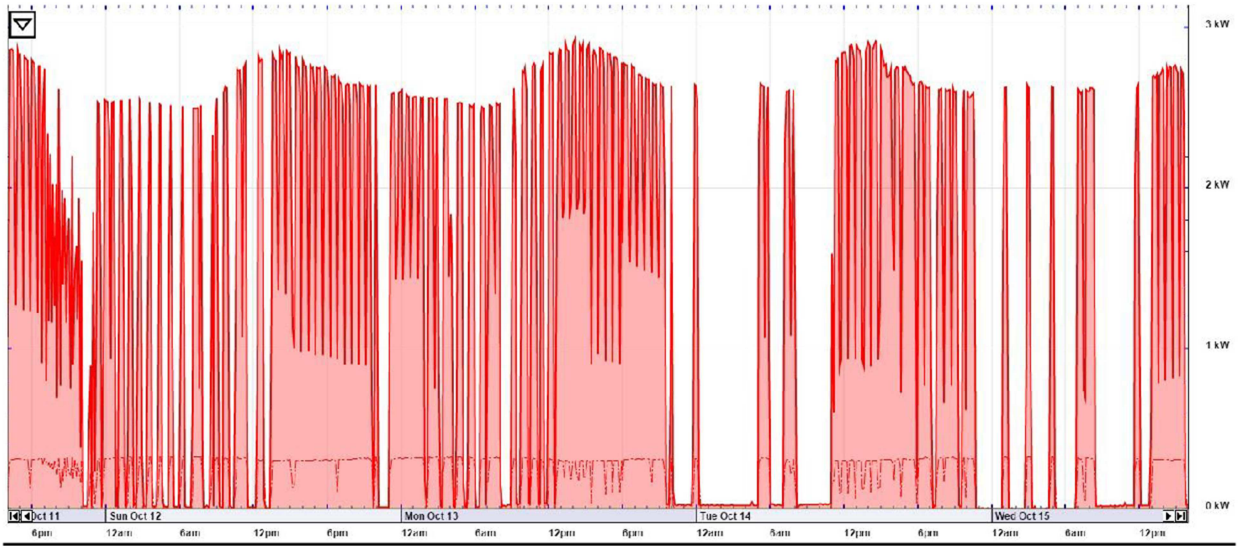
- Sample # A outdoor temperature averaged **+1.91** degrees warmer than Sample # B.

- Sample # A outdoor relative humidity averaged **-2.65 %** less than Sample # B.

CONCLUSION:

Sample A thermostat provided a significant reduction in overall energy burden with little to no adverse effect on the indoor environment regarding temperature and relative humidity.

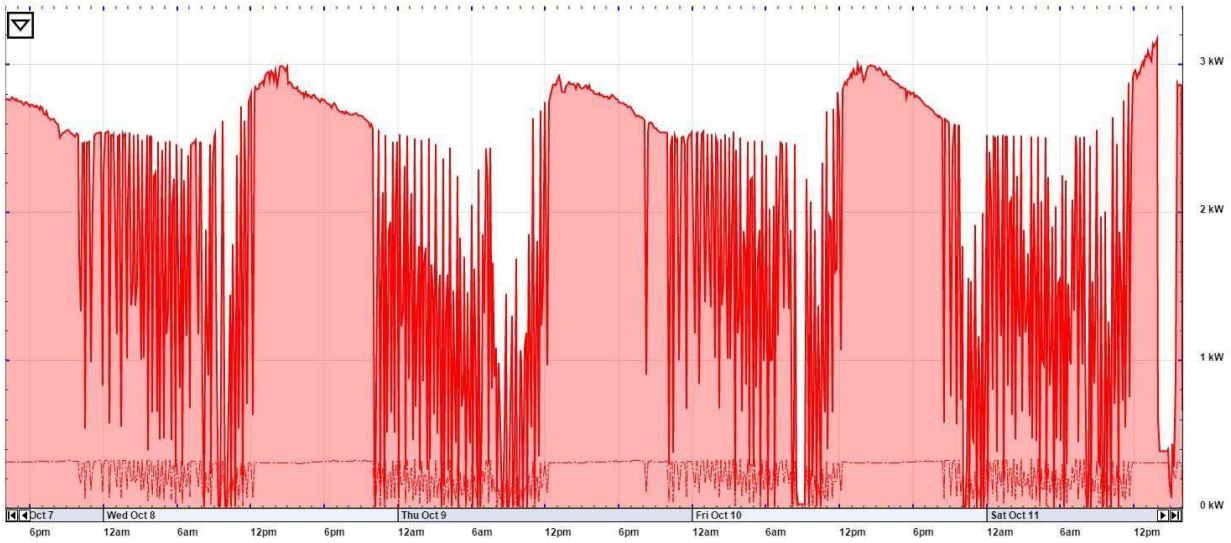
96-Hour “Programmed” Test Data for Sample A



Thermostat Sample A
96-Hour “Programmed” Test Findings

Total kWh utilized	=	152 kWh
Average Indoor Temperature	=	72 F
Average Indoor Relative Humidity	=	54% RH
Average Outdoor Temperature	=	78 F
Average Outdoor Relative Humidity	=	79% RH

96-Hour “Programmed” Test Data for Sample B



Thermostat Sample B
96-Hour “Programmed” Test Findings

Total kWh utilized	=	208 kWh
Average Indoor Temperature	=	71 F
Average Indoor Relative Humidity	=	51% RH
Average Outdoor Temperature	=	77 F
Average Outdoor Relative Humidity	=	74% RH

96-Hour “Programmed” Test
Conclusion

After an audit of the data gathered from the 96-hour programmed tests, the following calculations were found to be accurate.

Energy Burden:

- For the duration of the 96-hour programmed test, Sample A operated the HVAC system at a reduced energy burden of **-27%** over Sample B.

Indoor Temperature & RH:

- Sample # A outdoor temperature averaged **+1.38** warmer than Sample B.

- Sample # A relative humidity averaged **+2.67%** higher than Sample B.

Outdoor Temperature & RH:

- Sample A outdoor temperature averaged **-0.1**3 degrees cooler than Sample B.

- Sample A outdoor relative humidity averaged **+5 %** more than Sample B.

CONCLUSION:

Sample A thermostat provided a significant reduction in overall energy burden with little to no adverse effect on the indoor environment regarding temperature and relative humidity.

Summary:

"Based on the data collected, the client's Hypothesis is accepted."

The test data collected, reviewed and calculated during this study clearly identifies that thermostat Sample A provided a significant reduction in overall energy burden when compared to the same data collected for thermostat Sample B.

- **-15%** kWh for the Steady State Test
- **- 27%** kWh for the Programmed Test
- For an average of **-21%** reduced kWh burden for both protocols

Furthermore, the savings provided above caused little to no adverse effect on the indoor climate focusing mainly on relative humidity which recorded an average increase of less than 3% for both tests conducted while the HVAC system was controlled by thermostat Sample A.

Calculation of MU:

Given the test equipment utilized, the “real world” condition of the test environment, as well as other contributing factors, Intertek has assigned an MU of **± 5.2% @ 95% confidence** to our findings for this study.

These results were based upon and calculated utilizing ***The NIST Reference on Constants, Units and Uncertainty***.